# MARINE PAINTING GUIDE INDEX




PPG Protective & Marine Coatings
*We Know...*

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# MARINE PAINTING GUIDE – WHAT ARE COATINGS?

For ease of understanding, it's common nowadays to distinguish between the type of liquid-applied materials by the functions of which each is formulated and designed.

Typically, the following three general classifications are used.

**1. Paint-**

A liquid, film-forming material, usually oil, alkyd, acrylic, or water based latex in composition, which is designed primarily to beautify through the use of color. It is generally used in a non-corrosive environment free of aggressive chemicals.

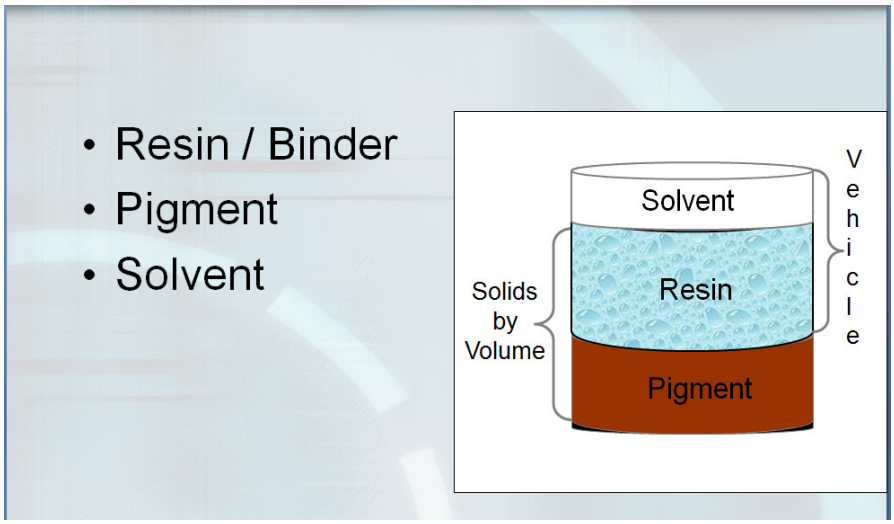
**2. Coating**

A film-forming material, either liquid or non-liquid, used to protect a material or substrate in a hostile environment from deterioration for a period of time. (This is also referred to as a "protective coating" oftentimes.)

**3. Lining**

A film-forming material, either liquid or non-liquid, that is applied to a substrate in an immersion condition such as a tank interior or a pipeline interior to protect the substrate and to protect the material being stored from contamination.

The components of most protective coatings are a resin/binder, pigment and solvent. Their descriptions and an image representing the relationship are below.




The resin, also known as a "binder", functions as the glue of the coating, adhering to the surface, providing chemical resistance and holding the coating together. Most coatings are named after their resin system (e.g. acrylic, alkyd, epoxy, polyurethane).

# MARINE PAINTING GUIDE – WHAT ARE COATINGS?

Pigments are defined as a discrete particulate solid, and they decrease permeability, provide color, inhibit rust, reinforce film, provide abrasion resistance and can increase UV inhibition.

The solvent reduces viscosity and assists in application.

Pigments, solvents and additives play an important role in the formulation of coatings, but coatings are usually classified according to the primary type of resin used in the coating. It is the resin that is responsible for the primary characteristics of the coating.

There is no perfect coating resin that will perform in all environments or do all that is asked of a coating. For instance, an inorganic zinc coating offers outstanding corrosion resistance on steel, but is susceptible to acidic or alkaline chemical attack. An epoxy coating offers additional corrosion resistance and chemical resistance, but is susceptible to chalking erosion, yellowing, and loss of gloss due to UV radiation. A polyurethane coating has excellent resistance to weathering and UV radiation, but generally has limited corrosion and chemical resistance.

Sometimes a “systems” approach, consisting of a properly selected primer, intermediate, and topcoat provides the best answer to the requirements of a particular exposure environment.

The systems approach can involve selecting three different generic types of coatings from the same manufacturer (such as the commonly used IOZ primer, epoxy intermediate, and polyurethane topcoat), or in other situations, all the coats may be based on the same or similar resin compositions. The selection of a three coat system for specific applications can provide enhanced durability and performance. A description of each system and its functions are below:

**Primer coat:**
A primer should meet most, if not all, of the following requirements.

- Good adhesion to the surface to be protected when the surface has been cleaned or prepared according to the specification.
- Provide a satisfactory bonding surface for the next coat.
- Possess the ability to retard the spread of corrosion from discontinuities such as pinholes, holidays, or breaks in the coating film.
- Contain enough chemical and weather resistance by itself to protect the surface for a time period in excess of that anticipated before application of the next coating in the system.

**Intermediate coat:**
An intermediate coat may be required in a system to provide one or more of the following properties.

- Increased film thickness of the system.
- A uniform bond between the primer and topcoat.
- A superior barrier with respect to aggressive chemicals in the environment.

# MARINE PAINTING GUIDE – WHAT ARE COATINGS?

**Finish coat:**
Finish coats are the initial barriers to the environment, but are also the surfaces that are seen by management and the public. There are situations where the barrier to the environment will primarily be a function of the primer coat or intermediate coat, while the finish coat serves to provide a pleasing appearance, or a non-skid effect, or another specialized purpose. But obviously, the chemical resistance of the finish coat must be sufficient to ensure it remains intact in the service environment.

# MARINE PAINTING GUIDE – DEFINITIONS

The product data sheets are designed to provide useful and important information. To get maximum benefit from the data sheets, PPG recommends reading the following descriptions of the terms used in the specification data section.

**Coating Type**

Generic description of the coating. Specific information on the components of the coating are considered proprietary and therefore are not provided.

**Color**

Specific colors and their catalog numbers (ordering numbers) are listed. Finish coatings are referred to the color card for color selection and specific ordering numbers. In many cases, special colors not listed can be ordered, but may require a delay in delivery for manufacture and/or formulation, and may have a minimum volume requirement.

**Packaging**

Many products are supplied in two - component kits. The entire contents of each component container must be mixed together to insure the proper component ratio is obtained.

**Component Ratio**

The component ratio indicates the proper mixing ratio, by volume, of each component in a kit.

**Flash Point**

The flashpoint of a material is the lowest temperature at which the vapor in the headspace above the specimen ignites when an ignition source is applied.

**Thinner**

The thinner recommended by PPG for a specific paint will not adversely affect the performance of the paint. If any other thinner is used, the quality or performance of the paint may be altered or a hazard may be created. PPG cannot assume responsibility when non - specified thinners are used.

**Pot Life**

When the components of a two - component paint are mixed, a chemical reaction is initiated. The paint has to be applied before the reactive ingredients solidify, or otherwise can no longer be applied. The period of time at which the paint can applied is the pot life. The pot life is a function of temperature. Warming paint will shorten the pot life. Paint should be kept at moderate temperatures if at all possible

# MARINE PAINTING GUIDE – DEFINITIONS

**Induction Time**

After the components of a two - component paint are mixed, a period of time must be allowed to insure the chemical reaction has initiated. The induction time varies with each paint and also is a function of temperature. At lower temperatures, longer induction times are required and conversely, induction times should be shortened for warm paint.

**Shelf Life**

Most paints are stable in their unopened cans for a long period of time. If, however, the paint is stored where containers are exposed to the weather or at extreme temperatures, the shelf life can be adversely affected. The shelf life noted on the data sheet assumes the paint is stored under proper conditions.

**VOC**
(Volatile Organic Compound)

For the majority of cases, the VOC in paints are the solvent. Many air pollution regulations require the VOC to be listed on the data sheet. The VOC is listed in pounds per gallon of solvent as well as grams per liter. These quantities are based on test procedures defined in EPA Method 24. If EPA Method 24 is not noted, the determination was made by theoretical calculation.

**Temperature Resistance**

At some elevated temperature, paint films will degrade and break down. The temperature resistance listed indicates the upper limit for that specific paint under dry heat conditions. For specific information under wet or immersion conditions, consult your PPG representative.

**Volume Solids**

One of three methods will be utilized to report volume solids. Wet/Dry is used mainly for inorganic zinc coatings; calculated for 100% solids coatings; and the modified ASTM method for the majority of our coatings. We believe the method chosen in each case will most accurately represent the actual results in the field when determining wet versus dry measurements of film thickness and consumption requirements. Each data sheet will indicate not only the volume solids but the method used to determine that number. Listed below is a description of the three methods used.

| | |
|---|---|
| **Wet/Dry** | Percentage based on the ratio of the applied wet film thickness of a coating to the resultant dry film thickness. |
| **Calculated** | Calculation based on the actual ingredients in the formulation |
| **ASTM D2697** (modified) | Standard test method that determines the physical volume of an applied coating after seven days at 77°F (25°C). |

# MARINE PAINTING GUIDE – DEFINITIONS

## Time - Temperature

Many of the product data sheets have a Time - Temperature Drying Curve which provides the drying times at various temperatures at a specific film thickness. There are two drying degrees noted, dry-to-recoat time and dry-hard time. PPG uses the ASTM Method D1640 to make these determinations. The descriptions read as follows:

**Dry-to-recoat** - A film is considered dry for recoating when a second coat or specified topcoat can be applied without the development of any film irregularities, such as lifting or loss of adhesion of the first coat, and the drying time of the second coat does not exceed the maximum specified ( if any ) for the first coat.

**Dry-hard** - With the end of the thumb resting on the test film and the forefinger supporting the test panel, exert a maximum downward pressure ( Without twisting ) of the thumb on the film. Lightly polish the contacted area with a soft cloth. The film shall be considered dry-hard when any mark left by the thumb is completely removed by the polishing operation.

**The graph**, because of limited space available on the data sheet, only covers a temperature range of 20°F-80°F (7°C- 27°C) . Many of our products will cure below 20°F (7°C) and of course can be applied above 80°F (27°C) . The slope of the curve can be projected to provide an estimate of curing time beyond this range. If specific curing times are required beyond 80°F (27°C) or below 20°F or at film thickness other than noted on the graph, consult your PPG representative.

## Surface Profile

The product data sheet details a suitable surface profile for those products which are applied over metal surfaces. This profile description applies to new metal. Grit blasting of old, rusty or pitted steel will result in a much greater surface profile depth. In all cases, film thickness recommendations made should be measured from the high points of the profile. When estimating the normal paint loses beyond the theoretical spreading rate, the surface profile depth should be an important consideration.

# MARINE PAINTING GUIDE

## SURFACE PREPARTION-

### Steel Structures Painting Council Standard Description

Often, the surface preparation of steel for painting requires a three step process: 1) initial pre-cleaning to remove grease, oil, dirt, and other surface contaminants; 2) cleaning with hand/ power tools, pressurized water, chemicals, or abrasive blasting; 3) creation or verification of the specified anchor pattern profile. The life of a coating depends as much on the degree and quality of surface preparation as on the selected coating system, because most coating failures can be attributed to inadequate surface preparation or lack of coating adhesion. Surface preparation, therefore, should receive thorough consideration.

**SSPC-SP 1 Solvent Cleaning** - A method for removing all visible oil, grease, soil, drawing and cutting compounds and other soluble contaminants from steel surfaces. It is intended that solvent cleaning be used prior to the application of paint and in conjunction with surface preparation methods specified for the removal of rust, mill scale, or paint.

**SSPC-SP 2 (St 2) Hand Tool Cleaning** - A method of preparing steel surfaces by the use of non-power hand tools. Hand tool cleaning removes all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter. It is not intended that this process remove adherent mill scale, rust, and paint. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.

**SSPC-SP 3 (St 3) Power Tool Cleaning** - A method of preparing steel surfaces by the use of power assisted hand tools. Power tool cleaning removes all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter. It is not intended that this process remove adherent mill scale, rust, and paint. Mill scale, rust, and paint are considered adherent if they can not be removed by lifting with a dull putty knife.

**SSPC-SP 5/NACE No. 1 (Sa 3) White Metal Blast Cleaning** - A white metal blast cleaned surface, when viewed without magnification shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter.

**SSPC-SP 6/NACE No. 3 (Sa 2) Commercial Blast Cleaning** - A commercial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter, except for staining. Random staining shall be limited to no more than 33 percent of each unit area of surface and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.

**SSPC-SP 7/NACE No. 4 (Sa 1) Brush - Off Blast Cleaning** - A brush-off blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose coating. Tightly adherent mill scale, rust, and coating may remain on the surface. Mill scale, rust, and coating are considered tightly adherent if they cannot be removed by lifting with a dull putty knife after abrasive blast cleaning has been performed. The entire surface shall be subjected to the abrasive blast. The remaining mill scale, rust, or coating shall be tight. Flecks of the underlying steel need not be exposed whenever the original substrate consists of intact coating.

**SSPC - SP 10/NACE No. 2 (Sa 2½) Near - White Blast Cleaning** - A near-white metal blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter,

except for staining. Random staining shall be limited to no more than 5 percent of each unit area of surface and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, stains of previously applied coating.

**SSPC - SP 11**
**Power Tool Cleaning to Bare Metal** -

Metallic surfaces which are prepared according to this specification, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted. When painting is specified, the surface shall be roughened to a degree suitable for the specified paint system. The surface profile shall not be less than 1mil (25 micrometers).

**SSPC-SP 12/NACE No. 5**
**Surface Preparation and Cleaning of Metals by Waterjetting Prior to Coating**

**Waterjetting (WJ):** Use of standard jetting water discharged from a nozzle at pressures of 70 MPa (10,000 psig) or greater to prepare a surface for coating or inspection. Waterjetting uses a pressurized stream of water with a velocity that is greater than 340 m/s (1,100 ft/s) when exiting the orifice. Waterjetting does not produce an etch or profile of the magnitude currently recognized by the coatings industry. Rather, it exposes the original abrasive-blasted surface profile if one exists.
**Water Cleaning (WC):** Use of pressurized water discharged from a nozzle to remove unwanted matter from a surface.
**Standard Jetting Water:** Water of sufficient purity and quality that it does not impose additional contaminants on the surface being cleaned and does not contain sediments or other impurities that are destructive to the proper functioning of waterjetting equipment.
**Low-Pressure Water Cleaning (LP WC)**: Water cleaning performed at pressures less than 34MPa (5,000 psig). This is also called “power washing” or “pressure washing.”
**High-Pressure Water Cleaning (HP WC):** Water cleaning performed at pressures from 34 to 70 MPa (5,000 to 10,000 psig).
**High-Pressure Waterjetting (HP WJ):** Waterjetting performed at pressures from 70 to 210 MPa (10,000 to 30,000 psig).
**Ultrahigh-Pressure Waterjetting (UHP WJ):** Waterjetting performed at pressures above 210 MPa (30,000 psig).
**Nonvisible Contamination (NV):** Nonvisible contamination is the presence of organic matter, such as very thin films of oil and grease, and/or soluble ionic materials such as chlorides, ferrous salts, and sulfates that remain on the substrate after cleaning.
**Visible Surface Cleanliness (VC):** Visible surface cleanliness is the visible condition of the substrate,

**SSPC-SP 12/NACE No. 5**
**Surface Preparation and Cleaning of Metals by Waterjetting Prior to Coating**

**Visual Surface Preparation Definitions**
**WJ-1** surface shall be free of all previously existing visible rust, coatings, mill scale, and foreign matter and have a matte metal finish.
**WJ-2** surface shall be cleaned to a matte finish with at least 95% of the surface area free of all previously existing visible residues and the

remaining 5% containing only randomly dispersed stains of rust, coatings, and foreign matter.
**WJ-3** shall be cleaned to a matte finish with at least two-thirds of the surface free of all visible residues (except mill scale), and the remaining one-third containing only randomly dispersed stains of previously existing rust, coatings, and foreign matter.
**WJ-4** shall have all loose rust, loose mill scale, and loose coatings uniformly removed.

**Flash Rusted Surface Definitions**
**No Flash Rust** A steel surface which, when viewed without magnification,exhibits no visible flash rust.
**Light (L)** A surface which, when viewed without magnification, exhibits small quantities of a yellow-brown rust layer through which the steel substrate may be observed. The rust or discoloration may be evenly distributed or present in patches, but it is tightly adherent and not easily removed by lightly wiping with a cloth.
**Moderate (M)** A surface which, when viewed without magnification, exhibits a layer of yellow-brown rust that obscures the original steel surface. The rust layer may be evenly distributed or present in patches, but it is reasonably well adherent and leaves light marks on a cloth that is lightly wiped over the surface.
**Heavy (H)** A surface which, when viewed without magnification, exhibits a layer of heavy red-brown rust that hides the initial surface condition completely. The rust may be evenly distributed or present in patches, but the rust is loosely adherent, easily comes off, and leaves significant marks on a cloth that is lightly wiped over the surface.

**Nonvisual Surface Preparation Definitions**
**NV -1** shall be free of all detectable levels of contaminants as determined using available field test equipment with sensitivity approximating laboratory test equipment. For purposes of this standard, contaminants are water-soluble chlorides, iron-soluble salts, and sulfates.
**NV-2** shall have less than 7µg/cm$_2$ chloride contaminants, less than 10µg/cm$_2$ of soluble ferrous ion levels, and less than 17µg/cm$_2$ of sulfate contaminants as verified by field or laboratory analysis using reliable, reproducible test equipment.
**NV-3** shall have less than 50µg/cm$_2$ chloride and sulfate contaminants as verified by field or laboratory analysis using reliable, reproducible test equipment.

**SSPC-SP 14/NACE No. 8**

**Industrial Blast Cleaning** - when viewed without magnification surfaces shall be free of all visible oil, grease, dust, and dirt. Traces of tightly adherent mil scale, rust and coating residues are permitted to remain on 10% of each unit area of the surface if they are evenly distributed. The traces of mill scale, rust, and coating shall be considered tightly adherent if they cannot be lifted with a dull putty knife. Shadows, streaks, and discolorations caused by stains of rust, stains of mill scale, and stains of previously applied coating maybe resent on the remainder of the surface.

**SSPC-SP 15**
**Commercial Grade**
**Power Tool Cleaning-**

A commercial grade power tool cleaned steel surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, rust, coating, oxides, mill scale, corrosion products, and other foreign matter, except as noted below:

Random staining shall be limited to no more than 33 percent of each unit area of surface as defined below. Staining may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coating. Slight residues of rust and paint may also be left in the bottoms of pits if the original surface is pitted.

Unit area for determining staining shall be approximately 6400 $mm^2$ (9 $in^2$) (i.e., a square 80 x 80 mm [3 x 3 inches]).

This standard covers the requirements for power tool cleaning to provide a commercial grade power tool cleaned steel surface, and to retain or produce a minimum 25 micrometer (1.0 mil) surface profile.

A commercial grade power tool cleaned steel surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, rust, coating, oxides, mill scale, corrosion products, and other foreign matter, except as noted.

Random staining shall be limited to no more than 33 percent of each unit area of surface as defined. Staining may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coating. Slight residues of rust and paint may also be left in the bottoms of pits if the original surface is pitted.

# MARINE PAINTING GUIDE
APPLICATION

## APPLICATION
The most important single aspect of a successful coating system lies in the application process. This process includes proper specification, proper surface preparation, proper application, proper inspection and proper dry/cure schedule.

## KEYS TO SUCCESSFUL APPLICATION
In order to be successful, the coating process must pay strict attention and adhere to the following criteria:

### PROPER SURFACE PREPARATIONS
The importance of surface preparation to the success of a coating system cannot be over emphasized.
See Surface Preparation.

### ENVIRONMENTAL CONDITIONS
Proper environmental conditions are just as crucial to a successful project outcome as proper surface preparation. The primary factors related to coating application and curing are obviously temperature and humidity. One generally accepted industry standard is for the surface temperature to be at least 5 $^{o}$F above the dew point temperature. The dew point temperature is based on the air temperature and the relative humidity. In general, higher temperatures and lower humidity promote fast drying and curing.

Other important environmental controls include barriers to wind during application, ensuring clean, dry fresh air intake, and restriction of combustion sources (for both safety reasons and to prevent carbon dioxide, which can contribute to development of amine blush).

## APPLICATION TECHNIQUES AND EQUIPMENT

**Brushing** - This is one of the simplest of methods, but is very valuable for small projects or for applications where the coating must be "worked in" to difficult to reach areas. Brushing has a low productivity rate and is normally reserved for small applications. Brushing can produce a rough finish with many coatings due to poor flow and leveling properties. Brushing does not require a skilled applicator. For solvent based products, a high quality natural bristle brush is best.

**Rolling -** Rolling has a relatively high production rate and requires a minimal amount of skill. Rolling leaves a "stipple" texture in the film to varying degrees. Varying nap lengths on roller colors are available to accommodate several coating viscosities. Lower nap rollers produce a finer finish.

**Air Spray or Conventional Spray** - Conventional spray is accomplished when the coating is placed in a pressurized pot and atomized by compressed air injected through the fluid stream at the spray gun. Conventional spray offers the applicator a high degree of control over the finish. The conventional spray application has a high loss factor due to a relatively poor transfer efficiency.

**Airless Spray** – Airless spray is probably the most common application method employed with our coatings. The fluid stream is atomized hydraulically through high fluid pressures as the material is driven through a small orifice (spray tip) by a positive displacement pumps. Airless spray pumps are rated based on their compression ratio of incoming compressed air pressure to pressure delivered at the outlet. For example, a 33:1 pump would potentially deliver 3,300 psi when a 100 psi air pressure source is connected directly to the pump. Airless spray guns have only a fluid line and area therefore much easier on the user for large operations. The gun-to-surface distance is much greater with airless spray equipment. The production rate is extremely high with airless spray equipment. There is a moderate loss factor, but the transfer efficiency is generally higher than that of conventional spray. A commonly used modification of an airless spray operation is an a*ir –assisted airless spray.* This gives an enhanced level of atomization for a finer finish with potentially less pressure applied at the pump.

**HVLP (High Volume Low Pressure)** - HVLP guns are specialized spray guns that require lower than normal pressures due to the flow design in the gun internals. HVLP guns can be fed by airless

pumps or by pressure pots.

**MIXING AND THINNING**

Regardless of the application method, most coatings will require mixing and thinning prior to application. Careful attention should be paid to storage of the material prior to use. Material temperatures should be within the limits set forth in the product data sheets.

For multiple component products, the components should be mixed at the appropriate mixing ratios. Mixing partial kits of material is highly discouraged. Each component should be mixed individually to ensure a uniform mixture with good off-bottom mixing. The thinner of the two components should be poured into the thicker of the two components under good agitation. Care should be taken so as not to over mix the material and whip air into the mixture.

The appropriate amount of thinner should be added based on the data sheet instructions. Thinning levels will vary depending on the actual application equipment and environmental conditions.

If an induction time is called for it should be strictly adhered to. If epoxies which require an induction time do not receive the proper induction, they can be vulnerable to develop and amine blush after application. After induction, the material should be briefly mixed again prior to use.

## FILM THICKNESS

An adequate film thickness is essential for the success of any coating system. Under-application will generally result in premature failure. However, the old adage of “the more paint, the better” can be equally dangerous. The over-application of coatings can lead either to solvent entrapment and subsequent loss of adhesion, cracking or to splitting of primer coats. With the majority of coatings, the limits of acceptable dry film thickness allow for reasonable practical variation, but the specified film thickness should always be the target during application.

The actual dry film thickness recommended for a particular surface will depend on the type of coating system being used and the nature of the surface. Recommended dry film thicknesses for individual products are given on the product data sheets.

## CURING CONDITIONS

The job is not over until the coating system is properly cured. After application, it is important that the applied coating have good ventilation and the proper temperatures for curing. This is especially crucial for tank lining operations. Tanks and enclosed spaces should have forced ventilation throughout the cure-to-service period. Coating should be protected from mechanical damage, chemical exposure, moisture, and temperature extremes until it is cured to the point of resistance to each of these. Most coatings can be force cured with special conditions applied. Force curing can result in a color drift at times.

## SAFETY CONSIDERATIONS

Always carefully read and completely follow the safety procedures and instructions recommended by manufacturers of surface preparation devices, application equipment, media or products and the job site safety measures.

Prior to use, obtain and consult the Material Safety Data Sheet for products being used concerning health and safety information. Read and follow all precautionary notices on the Material Safety Data Sheet and container label. If you do not fully understand these warnings and instructions or if you cannot strictly comply with them, do not use this product. Proper ventilation and protective measures must be provided during application and drying to keep solvent vapor concentrations within safe limits and to protect against toxic or oxygen deficient hazards. Actual safety measures are dependant on application methods and work environment. These are general statements to alert you to the importance of specific warnings and instructions on individual products.

# MARINE PAINTING GUIDE
# THEORETICAL SPREADING RATE/ COVERAGE

## Theoretical Spreading Rate / Coverage

The Theoretical spreading rate or coverage of a coating is a function of the volume solids. The volume solids is the percentage of the coating consisting of binder and pigments which remain on the substrate, forming the final paint film after the volatile components or solvents evaporate. In the U.S. measurements, one U.S. gallon of paint with 100% solids by volume will cover 1,604 square feet of surface area at a dry film thickness of 1 mil. The theoretical coverage of any coating can be calculated from the following formula, *knowing the solids by volume (SBV) and the dry film thickness.*

*(**DFT) desired**:*

$$\frac{1604}{\text{DFT (mils)}} \quad X \quad \text{SBV} \quad = \quad \text{Theoretical Coverage}$$

**Examples:**
65% solids by volume coating applied at 5.0 mils dry film thickness

$$\frac{1604}{5} \quad X \quad (0.65) \quad = \quad 208.52 \text{ square feet per gallon}$$

In metric measurement, one liter of paint with 100% solids by volume will cover 1,000 square meters of surface area at a dry film thickness of 1 micron. To calculate the theoretical coverage of a coating in metric units, utilize the following formula:

$$\frac{1000}{\text{DFT (microns)}} \quad X \quad \text{SBV} \quad = \quad \text{Theoretical coverage}$$

**Example:**
65% solids by volume coating applied at 125 microns dry film thickness

$$\frac{1000}{125} \quad X \quad (0.65) \quad = \quad 5.2 \text{ square meters per liter}$$

# MARINE PAINTING GUIDE
## THEORETICAL SPREADING RATE/ COVERAGE

### Practical Spreading Rate/Coverage

The theoretical formulas above assume that all of the coatings (except solvents) are uniformly applied to the substrate with no over spray or application loss. The theoretical coverage is used in calculating cost comparisons between coatings systems and suppliers and establishes a factual starting point from which the practical spreading rate/coverage can be estimated. The practical coverage makes allowances for application losses and is more reliable indicator of what will be experienced in the field. Application losses are affected by many factors, including wind, application technique, application equipment and type/profile of the substrate to be coated. Loss factors will vary depending on the specific situation.

The practical coverage/spreading rate of a coating is calculated as follows:

| | | | |
|---|---|---|---|
| Theoretical coverage | X (1-Loss factor) | = | Practical coverage |

**Example:**

Theoretical coverage of 200 square feet per gallon at recommended dry film thickness
Loss factor of 30%

| | | | |
|---|---|---|---|
| 200 sq. ft. /gal | X (1-0.30) | = | 140 square feet/gallon |

### Paint Consumption

In order to estimate the total number of gallons necessary for a specific job, it is necessary to know the total area to be painted. Theoretical and/or practical paint consumption estimates can then be calculated using the following formulas:

$$\frac{\text{Total Area (ft.}^2\text{ or m}^2\text{)}}{\text{Theoretical Coverage (ft.}^2\text{/gal or m}^2\text{/l)}} = \text{Theoretical Consumption (Gal or L)}$$

or

$$\frac{\text{Total Area (ft.}^2\text{or m}^2\text{)}}{\text{Practical Coverage (ft.}^2\text{/gal or m}^2\text{/l)}} = \text{Practical Consumption (Gal or L)}$$

# MARINE PAINTING GUIDE-
SAFETY

## Safety Precautions

INTRODUCTION

These notes concern health and safety requirements, industrial hygiene and potential hazards involved in handling paint and thinners. They are not intended to be exhaustive and do not cover all eventualities during the application and storage of paint. PPG emphasizes the importance of the safe use of paint, and has provided tools to address potential hazards. Material Safety Data Sheets on all products are available on request.

FIRE AND EXPLOSION

The majority of paints contain flammable organic solvents. When a paint container is opened, solvent vapors are released. The lower explosive limit (LEL) is defined as the percentage of solvent vapor in the air which is the point where an explosion will occur if the air and solvent mixture is ignited with a spark. If the LEL is never reached, no explosion can occur.

Information on LELs can be found in Material & Safety Datasheets.

The flash point is the lowest temperature at which a liquid gives off sufficient vapor to form a flammable mixture in contact with air:- If the flash point of the paint is lower than or close to the temperature of the air there is a very considerable risk of explosion and fire. - If the flash point exceeds the air temperature then there is no risk of explosion but there is still a risk of fire.

Therefore, no open flames, cigarettes, matches or other sources of ignition should be allowed near an area where paint is being applied or stored. Precautions should also be taken to avoid sparks from electrical equipment or by use of sparking tools. If a fire involving paint does occur:-

- Do not extinguish with water, as paint solvents float on water, and this helps to spread fire.
- Use a dry chemical, foam or $CO_2$ extinguisher.
- Protect yourself from the smoke and vapors with breathing apparatus/supplied air.

SPILLED PAINT

If paint is spilled the following precautions should be taken:

- Eliminate all potential ignition sources.
- Ventilate the area to remove the vapors.
- Wear appropriate Personal Protective Equipment (PPE).
- Do not walk into the spill
- Mop up all spilled paint with absorbent material, ensuring that all materials used to mop up the paint are disposed of in closed metal containers.
- Arrange for proper disposal of all waste materials.

# MARINE PAINTING GUIDE-
## SAFETY

SKIN AND EYE CONTACT

It is recommended that the following precautions should be taken to prevent paint coming into contact with the skin and eyes:

• Select sensible working clothes, that cover as much of the body as possible.
• Always wear gloves and eye protection.
See Material Safety Data Sheet for details on relevant PPE.
• Do not touch your mouth or eyes with your gloves.
• Read and observe precautionary notices on paint containers.
• Eyes are particularly sensitive, so if you are splashed in the eyes, by paint or thinners, flood them immediately with fresh water for at least 15 minutes and seek medical advice immediately.
• If paint should splash on your skin, remove it with soap and water.
NEVER USE SOLVENT.
• Remember to wash hands and rinse mouth after working with paint.
• Despite these precautions paint can still come into contact with the skin or eyes (e.g. spray mist, excessive splashing), so a non-greasy barrier cream is recommended for all exposed skin.

Remember the objective is to avoid skin contact. If your clothes become soaked in paint, change them immediately and thoroughly wash the affected garments with suitable detergent and water.

INHALATION

The inhalation of solvent vapors, paint vapors and dust must be avoided. Please follow the precautions listed.

• Ensure that ventilation is available to remove solvent vapors.
• Check Material Safety Data Sheet for appropriate respiratory protection.
• If spaces are difficult to ventilate efficiently wear a NIOSH-approved supplied air respirator.
• Spaces may require monitoring for LEL and exposure levels.
• Think about where the vapors are being ventilated. They could affect other people in adjacent spaces.

<u>Remember solvent vapors are heavier than air, they push breathable air upwards. They can flow down drains and ventilation ducts.</u>

• If dizziness, drunkenness or headaches are experienced this could indicate you are being affected by solvent vapors. Move into fresh air and do not return until the ventilation has improved.
• If breathing vapors results in the collapse of a painter, medical attention should be sought immediately.
• Never enter a space where vapors have or could have accumulated without breathing apparatus.

# MARINE PAINTING GUIDE-
## SAFETY

| | |
|---|---|
| INHALATION OF SPRAY MISTS | • The mist of paint particles created when spraying should not be inhaled.<br>• In well ventilated spaces a dust cartridge respirator can filter out these particles of paint effectively. Cartridges can be product specific, careful selection is required. (Replace the cartridge regularly, following a regular schedule).<br>• If ventilation is poor an airfed hood or mask is essential, if any doubt whatsoever exists wear an airfed hood/mask.<br>• Never filter spray mists through rags wrapped over the mouth, as the rags can get soaked and allow paint to come into direct contact with the mouth. Rags are also rather inefficient filters. |
| INGESTION | Food and drink should not be consumed, stored or prepared in areas where paint is stored or being applied. In the case of accidental ingestion, medical attention should be obtained at once. |
| MATERIAL SAFETY DATA SHEETS AND CONTAINER LABELS | Prior to use, obtain and consult the Material Safety Data Sheet for products being used concerning health and safety information. Read and follow all precautionary notices on the Material Safety Data Sheet and container label. If you do not fully understand these warnings and instructions or if you can not strictly comply with them, do not use this product. Proper ventilation and protective measures must be provided during application and drying to keep solvent vapor concentrations within safe limits and to protect against toxic or oxygen deficient hazards. Take precautions to avoid skin and eye contact (i.e. gloves, goggles, face, mask, barrier creams etc.) Actual safety measures are dependent on application methods and work environment. |

# MARINE PAINTING GUIDE – THINNERS

The great majority of paints and coatings listed in this guide were designed to be applied without thinning. There are circumstances, however, where some thinning is required, such as application during colder temperatures or with certain types of application equipment. Each Product Data Sheet lists the correct thinner and the limits of thinning. PPG cannot accept any responsibility for the use of unauthorized thinners.

Listed below are the thinners supplied by PPG, their product numbers and flash points. The Product Data Sheet must be consulted before thinning any PPG product. It should be noted that some products in our line do not require thinning for application, but may require a thinner for clean-up. This information can be found on the Product Data Sheets.

| Product | Description | Flash Point (US*) | Flash Point (Europe*) |
|---|---|---|---|
| T-10 | Thinner | 80°F (27°C) | 25°C (77°F ) |
| Amercoat 8 | Thinner | 20°F (-7°C) | |
| Amercoat 9HF | Thinner/Cleaner | | 26°C (79°F) |
| Amercoat 12 | Cleaner, SCAQMD Rule 1171 | 2°F (-17°C) | 24°C (75°F ) |
| Amercoat 13 | Thinner/Cleaner | | 12°C (54°F ) |
| Amercoat 15 | Thinner/Cleaner | 106°F (41°C) | 41°C (106°F ) |
| Amercoat 65 | Thinner | 78°F (26°C) | 24°C (75°F ) |
| Amercoat 101 | Thinner | 145°F (63°C) | |
| Amercoat 104 | Water-based Cleaner | 230°F (110°C) | |
| Amercoat 900 | Thinner | | -5°C (23°F ) |
| Amercoat 902 | Thinner | | 43°C (109°F ) |
| Amercoat 903 | Thinner | | 78°C (172°F ) |
| Amercoat 911 | Thinner | 76°F (24°C) | 27°C (81°F ) |
| Amercoat 920 | Thinner | | 42°C (108°F ) |
| Amercoat 923 | Thinner | 102°F (39°C) | |
| Amercoat 924 | Thinner | 140°F (60°C) | |
| Amercoat 927 | Thinner | 60°F (16°C) | |
| Amercoat 930 | Thinner | 214°F (101°C) | 101°C (214°F |