Level 1

Essentials of Paint and Painting Technology
There are many types of spray finishing application equipment. A wide range of manufacturers provide and endless supply of pumps, guns, hoses, and accessories. We classify spray equipment by atomizes the paint, and there are 4 basic types:

1. airless spray;
2. conventional air spray;
3. HVLP, and
4. air-assist airless.

**Airless**

Paint flows from a central supply through a high pressure pump (1000 psi to 3000 psi). This high pressure fluid goes through a fluid line to a spray gun. The high pressure fluid is expelled out the front of the gun through a small orifice or tip. As the fluid escapes into the atmosphere it expands and forms a spray pattern of small droplets (atomization). The production rate of airless is quite high as well as the transfer efficiency can be as high as 75%.

The Advantages of Airless Spray

Reduced Overspray and Fog: This is the number one advantage of airless spray. As stated, more than 75% of the paint gets to and remains on the surface. This high transfer efficiency saves on paint costs and brings a significant reduction in emissions.

Increased Production: Uniform thickness and greater penetration increases the speed of application. High flow rates coupled with large airless tips dramatically allow the worker to make fewer passes to apply the required mil thickness.

Handles Viscous Materials: Paints and coatings that have a naturally high viscosity can be sprayed with no thinning or very little thinning. Solvent use is lowered, so emissions are too.

Disadvantages of Airless Spray

Coarse Atomization: Compared to air spray, airless atomization is somewhat coarser. Coating should be able to flow out well to even out the atomized droplets once they hit the surface. Fine finishing tips and heated systems help to improve atomization.

Safety: Because of the extremely high pressure created (1000 psi to 3000 psi) with airless atomization, there is a danger of injection injuries. The pumps, lines, and guns must be manufactured to withstand these pressures. The guns themselves must be manufactured with trigger guards, trigger lock, and tip guards. The painter must also have complete safety training before using the equipment.

Expensive: The pumps, lines, guns, and accessories are designed to handle and produce extremely high fluid pressures. For this reason the equipment has to be well made and strong. Typical airless systems are more expensive than air spray systems, and the maintenance costs are higher, too.

**Gun Controls:** An airless gun is full on/full off. When the trigger is pulled, the gun is wide open and the full amount of paint is being expelled. This characteristic can be a disadvantage when spraying intricate parts or shapes. "Feathering" of the trigger (see note below) is not possible. Speed of motion will dictate how much paint...
IMPORTANT NOTES - APPLICATION

Introduction
- Information and knowledge covering the basic types of application equipment for Paints and Finishes.

There are three main methods of application:
- Brush - Oldest method of application. Slow in comparison to other methods but with good transfer efficiency.
- Rollers - A fast production tool with high transfer efficiency. This method of application produces a stipple texture.
- Spray - Spray painting can be achieved in many ways but the end result is small droplets of paint formed into a pattern and applied to a surface.

Brushes
- A brush is a collection of bristles attached to a handle by means of a plastic setting compound.
- Chinese Hogs Hair (Pure Bristle) is the most common animal hair used. The tip of the hair flags or split to produce a fine tip for application. Suitable for oil and alkyd paints but suitable for water-based products.
- Synthetic (Polyester/ Nylon) is an attempt to copy the pure bristle hairs. These filaments do not react with water so they are well suited when using water-based finishes.

Brush types may be classified into five categories:
- Wall brushes
- Sash and Trim brushes
- Enameling and Varnish Brushes
- Stucco and Masonry brushes
- Specialty Brushes

Application Methods and Procedures
- Always use thinned, strained coating
- Use the right size and type of brush
- Plan the work
- Work out of a container 1/4 to 1/3 full
- Use full brush strokes
- Feather out the final strokes
- Always keep a wet edge
- Control the tack up time of the coating
- Avoid over-brushing.
STUDY QUESTIONS : APPLICATION

1. Identify three main methods of coating application.
   1. 
   2. 
   3. 

2. How would you determine what type of application method to use for a particular product or coating?

3. What type of brush bristle would you recommend when using an alkyd slow dry enamel?

4. Synthetic bristles are suitable in what type of paint/coating?

5. Sash and trim brushes are used to paint trim work and are extensively used to ______ before rolling a surface.

6. What is an advantage of a radiator brush over a standard type brush?

7. Identify the four main parts to complete a roller painting outfit.
   1. 
   2. 
   3. 
   4. 

8. Identify the material that is most commonly used to make the roller fabric?

9. Briefly explain what "back rolling" is in both roller and spray applications.

10. Airless spraying uses very high pressures. What is the pressure range of a typical Airless system? ___________ psi.
Level 2 - ASM
DESCRIPTION OF THE SUBSTRATE

**Dimensional lumber** is a term used for lumber that is finished, planed and cut to standardized width and depth specified in inches. Examples of common sizes are 2"x4", 2"x6", and 4"x4", specified separately from the width and depth. It is thus possible to find 2"x4"s that are four, eight, or twelve feet in length. In the United States the standard lengths of lumber range from 8'92-1/2" inches, 164-1/2" inches, and 116-1/2" inches.

Dimensional lumber is what’s used to make glue-lam beams, decks, and some of the other wood constructions we’ll discuss in subsequent sections. It’s used for siding, columns, beams, joists, etc.

Softwoods such as cedar, pine, spruce and fir are commonly used as dimension lumber. These woods can be delivered to the job site unfinished or factory primed. The types of wood used in finish grades of softwoods, such as cedars, pines, fir and spruce. Wood used for siding and fence boards is available in smooth to rough textures of various widths, thicknesses and types.

**What to look for**

Unfinished lumber should be stored in a dry area. The wood will easily pick up moisture and subsequently swell. Wood that has been stored outside without protection should have a moist finishing work is attempted.

Most paint failures on new wood construction can be attributed to the use of ‘green’ or uncured wood that releases sap, partially solidified resin, or water after being painted. Pine and fir sap or pitch trapped in knots and deep pockets within the wood board. These can sometimes appear after painting and cause the paint film to lift. When sap or pitch moisture is excreted, pressurized and cause failure through blistering, splitting, cracking and staming. This is more frequently a problem if a coating with low permeability is used, such as a gloss alkyd.

On knots and areas where sap has been removed from the surface, vinyl-based knot sealers can be used to seal surfaces and minimize or prevent further sap release.

**Factory Primed Surfaces**

Factory primed wood can present a problem because often, the primer chosen by the factory cannot be relied upon to properly seal the wood surface. The wood supplier must provide carton using the specified surface preparation and primer. If this cannot be confirmed, the primer may have to be removed and an appropriate primer re-applied, especially for exterior applications. Extremely susceptible to expansion and contraction from temperature/moisture intrusion, making proper adhesion of the primer too critical to compromise.

**Avoiding Problems with Moisture**

Exterior wood must be well protected from water intrusion, as this often leads to swelling, cracking and cupping in the wood and blistering, peeling and cracking in the coating. End sealing used to reduce water intrusion in horizontally and vertically placed wood. "Back Priming" refers to the practice of priming the entire wood component including the back and edges. All edges ‘back primed’ prior to installation, for interior applications, all wood surfaces that may come in contact with moist areas must be back primed before installation.

To seal areas often left unpainted (such as the contact point at the rail), fence boards are best coated on all sides, edges, and ends before attaching to the fence. Cedar siding applied bel must be sealed by back priming. Water contacting the masonry or stucco surface can pick up alkali salts, accelerating the extraction of soluble tannins from the wood, and leading to yellow discoloration.

It is not possible to guarantee long term coating protection if the backs of the wood surfaces cannot be primed.

**Coating Failures on Dimension Lumber**
MPI PAINT SYSTEMS

Exterior and Interior Systems Options

When you click on the link for the systems another browser will open with the specific systems. You can safely close this browser at any time without leaving the training site. Once in the system choice is highlighted. This is the best gloss level to use in most circumstances.

6.2 Dimension Lumber

Options for Exterior Systems

Options for Interior Systems
SURFACE PREPARATION AND PAINT APPLICATION

Since water and poor preparation work are generally the main sources for coating adhesion failures, it must again be emphasized how important it is to keep moisture out of the substrate, work.

Proper surface preparation on dimension lumber should include the protocols discussed in the previous section, including:

- All surfaces must be free of dust, dirt, oil, grease, silicone, wax, and other foreign matter.
- On softwoods such as pine and fir, all sap and pitch must be removed. All pitch pockets and sap-affected areas must be sealed with an appropriate sealer.
- If a paint system is specified, all light knots should be sealed with an appropriate knot sealer. If a semi-transparent stain system is, knots should be left unsealed appear patchy. Loose knots should be removed and filled with an appropriate caulk compound.
- If a clear finish or semi-transparent stain is to be applied, all discolorations such as water stains, scuff marks, pencil marks, etc. must be removed from the surface. Sand before, and between coats, with a fine grade of sandpaper to maintain a smooth surface, and lack rag surfaces to remove all sanding debris.
- Nail holes, cracks, joints and miters shall be filled with an appropriate filler or caulking compound level with the surrounding surfaces after application of the prl

If the surface to be coated is newly installed pressure treated lumber, always refer to the lumber manufacturer's instructions for how to paint it. And contrary to our admonitions against pre previous section, aging or weathering in exposure to UV light will actually be required to break down the glaze on the surface.

For 'factory-primed' material, the manufacturer/supplier shall provide certification that the specified surface preparation and priming has been performed utilizing the appropriate MPI appro
IMPORTANT NOTES

DESCRIPTION OF THE SUBSTRATE

Dimensional lumber is a term used for lumber that is finished planed and cut to standardized width and depth specified in inches.

Softwoods such as cedar, pine, spruce, and fir are commonly used as dimension lumber.

Unfinished lumber should be stored in a dry area.

Most paint failures on new wood construction can be attributed to the use of “green” or uncured wood that releases sap, partially solidified resin, or water after being painted.

Factory primed wood can present a problem because, often, the primer chosen by the factory cannot be relied upon to properly seal the wood surface.

End sealing and back priming are two methods used to reduce water intrusion in horizontally and vertically placed wood.

Cedar siding applied below masonry or stucco wall surfaces must be sealed by back priming.

CHOOSING A PAINT SYSTEMS

For exterior applications, using a primer can also facilitate recoating with minimal surface preparation after the surface has weathered.

Alkyd and oil-based stain-resistant primers, are also recommended to block water contact and reduce stain bleeding on wood species prone to exudative and tannin bleeding, such as cedars.

Rough surfaced wood is often coated with filler finishes; a flat finish assists in improving the uniformity of slightly rough surfaces.

Fire-resistant coatings are available as both pigmented or clear penetrating finishes that show moderate exterior or interior durability.

The coating type should be selected based on the particular fire rating required for the application.

Systems for exterior service: The alkyd primer and creates a uniform surface for the latex finish coat and reduces the probability of extractive staining from colored wood.

Two-component aliphatic polyurethane clears such as MPI #75 are durable clear finishes with excellent resistance to chemicals, solvents, abrasion, and UV light.

Caution: all stains tend to lap do not stain in the direct sun or on a hot surface, and use two coats on badly weathered or new wood.

SURFACE PREPARATION AND PAINT APPLICATION

On softwoods, such as pine & fir, all sap and pitch must be removed and the areas sealed with an appropriate sealer.

If a clear finish is to be applied, all discolorations must be removed from the surface.

Nail holes, cracks, etc. must be filled with an appropriate filler or caulk.

If the lumber is pressure treated always refer to the lumber manufacturer’s instructions.
STUDY Q & A - QUESTIONS

1. Dimension lumber is what’s used to make blank, decks, siding, columns, beams, blank, fencing, etc.

2. Pine & fir species often contain blank or blank trapped in knots and deep pockets within the wood board.

3. Exterior wood surfaces are extremely susceptible to expansion and contraction form temperature/moisture intrusion, making proper blank of the primer to blank.

4. blank refers to the practice of priming the entire wood component including the back and edges.

5. blank primers are designed for wood surfaces where penetration into the wood fiber is required for optimum adhesion.

6. blank and blank finishes reduce dirt and dust accumulation and are more cleanable, but accentuate surface roughness so are better suited for smooth surfaces.

7. “Fire retardant” paints may be blank, which means that when subjected to heat or flames, they form a char like material that insulates the combustible substratum.

8. Both intumescent and non-intumescent paints are rated and tested by the blank for flame spread and smoke development.

9. Exterior wood stains are blank types manufactured as solid color.

10. Using an alkyd stain over a previously stained surface can lead to blank (the non-uniform appearance of a coating evidenced by noticeable variations in the

11. Stain effects may vary by blank, so it’s always recommended to do a sample brush-out.

12. The premium multicolor system uses a blank coating as the last coat to improve the abrasion, detergent and dirt-resistance in moderate traffic areas.

13. blank stains have a low level of pigmentation that enhances the wood grain and texture, giving a natural appearance.
Level 2 - RSM
DESCRIPTION OF THE SUBSTRATE

Block Manufacture and Design

Concrete blocks, or Concrete Masonry Units (CMU’s) have been used more in recent years for exterior walls on large, low-rise warehouse and commercial construction. The process of mixing cement, gravel, sand and water into a paste and pouring it into molds that uses vibration and pressure to form a rectangular block, typically measuring 8” x 8” x 16.” After it’s removal undergoes an accelerated curing process at an elevated temperature that evaporates the water and binds the cement, sand, and gravel together into a hardened block. The block is then cut over a 14-30 day period before being shipped to the distributor or construction site.

Specifications describing concrete block compressive strength and water absorption are described in ASTM standards C66, C146, C90, and C120, and CSA A466 1.

There are a large variety of block types and shapes manufactured. Smooth sided blocks are generally known as ‘standard’ and scored, split face, fluted, etc. are referred to as ‘profiled.’ D colored pigments can be added to the mixture to achieve custom colors.

The concrete mixture and proportions of ingredients dictate the density, strength, and porosity of the surface. Semi lightweight and lightweight blocks substitute lightweight aggregates such as these have much lower density than the standard types. While the lighter weight block may offer advantages from a general construction perspective, the lower density and high porosity for easier ingress of water and the problems/issues that come with it. Also, the density of block will also have a significant effect on coating consumption. The more porous lightweight block the amount of block filler to produce a “filled” surface. All these factors can ultimately affect which coating system we choose.

Regardless of the type or shape, concrete block has a very porous surface and usually requires a block filler as the primer to create a surface suitable for the application of most coatings.

CMU Construction

CMU offers advantages over other types of concrete construction. Till-up, for example, creates a wall that is 4” thick. Concrete Masonry Unit (blocks) constructed buildings are typically constructed as rectangular blocks stacked on top of one another with a mortar mix made up of cement, sand, additives, and water acting as the glue that holds them in place — a method also referred to as “flying blocks” are added to achieve the desired height of the building. Concrete block walls are typically 8” thick and more energy efficient than till-up. If desired, insulation material may be blocked, and some kind of finishing system and insulation may be added on the inside wall which may or may not incorporate an air barrier membrane.

Likely Causes for Coating Failure

MOISTURE ISSUES

If the right coating products are specified and applied properly, coatings on concrete block can provide a long lasting finish. However, both liquid water and water vapor within the block must be controlled; or premature failure can occur. Issues with moisture will evidence themselves in the form of efflorescence; blistering and/or peeling of the paint film; or stains on both the exterior and interior surfaces. Moisture can infiltrate including vapor drive, defects in construction, or from the outside.

Vapor Drive

Moisture vapor naturally travels through walls to achieve balance, and there are a number of conditions that increase vapor drive from one side to the other. One is the porosity of the wall. For example, under the right conditions and especially if the wall is not insulated, a difference in relative humidity (usually higher humidity inside and lower humidity outside) can cause air to fall beneath the dew point while vapor inside inside the block, causing water vapor to condense and wet the interior of the block.

Temperature differences will also drive moisture vapor from inside to outside and vice versa. Moisture vapor naturally moves from the warm side of a wall to the cold side. Which side is warmer?
MPI REPAINT SYSTEMS

Exterior and Interior Systems Options

4.2 Concrete Masonry Units

Options for Exterior Systems

Options for Interior Systems
SURFACE PREPARATION FOR CMU AND BRICK

If the current coatings are intact overall and an overcoat is all that's necessary, preparation protocols for CMU are similar to those used for concrete. Preparation of the different types of CMU (fluted) differ as follows: if grooves in scored blocks are bridged or filled in, they must be cleaned out by grinding with hand or power tools or whatever mechanical means are required, and if primer, if needed. With split face, scored, and fluted CMU, hand tooling during preparation may be necessary due to the unevenness of the blocks.

However, with buildings constructed from brick or CMU, there is a limit to how many times a wall can be refurbished simply by power washing and/or roughening the surface and applying the new coating(s). The concerns discussed in the opening section (incompatibility of the existing coating with the desired repair material, or the existing coating being too poorly adhered to support the new coating), CMU, and masonry surfaces pose the additional consideration that adding another coat to what's already there may reduce the permeability of the system to the point that moisture v

In these cases, some or all of the existing coating needs to be removed with proper surface preparation practices. And full removal of failing coatings on CMU or brick surfaces can add sig maintenance planning.

Shortcomings of Surface Prep Standards

As we discussed in the section on Concrete, there are industry standards describing methods of surface preparation for concrete and masonry surfaces — however, most of the standards rather than painted CMU or brick.

Also, the standards do not describe definitively the degree of cleanliness beyond stating that a sound concrete surface free of flaws, dust, efflorescence, and incompatible curing compounds are required. Standards that may be referenced (along with their potential shortcomings for use with CMU and clay masonry surfaces) include:

SSPC-SP11/NACE No. 6, Surface Preparation of Concrete

Many of the methods described within (abrasive blasting, shot-blasting, wet blasting) can remove existing coatings but may significantly roughen or damage block or brick and mortar joints.

SSPC-SP12/NACE No. 4, Surface Preparation and Cleaning of Metals by Water Jetting Prior to Recoating

Wet methods will remove poorly adhered coating, allow intact coating to remain, or completely remove existing coating if higher pressures and dwell times are used. While these methods of metal surfaces, some roughening will occur. And while methods described in the standard are suitable for use on concrete and masonry surfaces, the acceptance criteria described for each metallic substrate.

ASTM D4259, Standard Practice for Abrading Concrete

This practice addresses methods for removing coatings and roughening the surface but many of the methods described can damage the substrate.

ICRI Guidelines No. 310.2-1997 (formerly No. 03732), Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

We described this in detail in the preceding “Concrete” section. Some of the methods described are suitable for removing coatings from CMU and brick (abrasive blasting, scarifying, needle abrasive). Most suitable methods such as high and ultra-high-pressure water jetting are also covered, as well as low pressure water cleaner to remove loose coating. Methods described that will not remove coatings or are not suitable for CMU or brick include detergent scrubbing, acid etching, grinding, shotblasting, sandblasting, flame blast...
IMPORTANT NOTES - CONCRETE MASONRY UNITS

DESCRIPTION OF THE SUBSTRATE

- Concrete masonry units (CMU's) are sometimes referred to as concrete block, cement block, cinder block or light-weight block.
- The block face can be smooth, split face or scored.
- The blocks are cured from 14 – 30 days before they are shipped to a construction site.
- The blocks come in various shapes & sizes as well as various weights and densities.
- Regardless of the type or shape, new concrete blocks have a very porous surface that usually requires a block-filler as a primer.

ASSESSMENT & DSD LEVELS

Likely causes of coating failures on concrete masonry units:

- Moisture issues
- Moisture vapor – caused by humidity or temperature differences
- Construction issues – defective gutters, flashing, roofing, etc.
- Design and environment issues
- Too much paint – non-breathable systems
- Issues with clear coatings

Surface defects and flaws:

- Efflorescence – this is the highly alkaline white powdery substance that results when block & mortar joints are exposed to moisture or water infiltration over time.
- Mold & mildew – also caused by moisture. This must be removed prior to applying a repaint coating.

DSD 0 – ideal surface: a color or gloss change may be preferred
DSD 1 – slightly deteriorated coating on concrete masonry units
DSD 2 – moderately deteriorated coating on concrete masonry units
DSD 3 – severely deteriorated coating on concrete masonry units
DSD 4 – substrate damage to the concrete masonry units

COATING PRODUCTS & SYSTEMS

Considerations for choosing a coating:

- Location
- Type of block used
- Breathability of the existing coating and the new repaint system

Block Profile – smooth, split-faced, fluted, etc.
STUDY Q & A - QUESTIONS

Questions - Concrete Masonry Units

1. Concrete masonry units are sometimes referred to as _______ block, cement block, _______ block or lightweight block.

2. Concrete masonry units can be smooth, _______ fluted, ribbed or scored.

3. The _______ of the block will have a significant effect on coating consumption.

4. Moisture vapor naturally moves from areas of _______ concentration to areas of _______ concentration.

5. Other sources of moisture in the CMUs include: water intrusion from wind-driven rain through pinholes; _______ caused by the building settling; and defective _______.

6. When choosing a repainting system, the _______ of the existing coating(s) must be considered.

7. _______ systems are very good for aggressive environments.

8. In an interior situation, when a latex system has been specified, a/an _______ primer should be used on areas that have been prepared back to bare CMU surface.

9. Choosing the method of surface preparation for CMUs is dependent upon surface _______, defects and the _______ of DSD.

10. A pH level between ___ and ___ is acceptable for concrete masonry units.

System Review Questions - Concrete Masonry Units

1. What MPI # would you use if the system required is REX 4.2C G3 (for a topcoat)?

2. What MPI # would you use if the system required is REX 4.2A G5 (for a topcoat)?

3. What MPI # would you use as an intermediate coat if the system required is RIN 4.2E?

4. What MPI # would you use if the system required is RIN 4.2L G3?