

CHAPTER 8

COMPARATIVE PAINTING COSTS

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Since the purpose of protective coatings is primarily economic, no practical treatise on painting structural steel is complete without a discussion of comparative costs.

The specifier must have access to basic information and procedures identifying candidate systems that are suitable in the specific environment, costing each, making a selection and justifying the choice.

Because there is considerable literature on coatings' cost evaluation, this chapter deals primarily with hypothetical practical examples of alternative costs. Assumptions regarding paint life are very conservative and apply mainly to severe environments. Values for interest rates, labor, materials, salaries, overhead, energy, etc. have been assumed to make illustration possible. In some examples the time-value of money is neglected with the tacit assumption that interest rate is currently balanced by inflation rate. Maintenance examples are based, whenever possible, on new but sound industry practice, such as repainting when SSPC-Vis 2 Rustgrade 7 or 8 is reached or when 10-15% repainting is required. Cost factors in surface preparation are reviewed in a separate chapter.

Cost data represent the authors' best estimate for 1992-93, and are intended only to illustrate methods of comparing alternatives. Prices and costs in specific areas should be secured from local paint suppliers and contractors.

Subjects covered in this chapter include Elements of Field Painting Costs (Sline); Cost Factors in Coating Selection (Brevoort); and Types of Contracts (Oechsle).

I. ELEMENTS OF FIELD PAINTING COSTS

When selecting paint or a protective coating system, a study of comparative costs of the systems is usually made. Typical choices involve generic types of coating, number of coats, shop or field coating and surface preparation methods.

The cost of labor, equipment and material is constantly changing. A coating system considered too expensive today may become economically attractive if material costs rise faster than labor, or if a technological improvement reduces the required labor. The number of circumstances to consider are too great to list individually. Coating steel involves the condition of steel, geographic location, accessibility, size of the project, specifications and other factors.

One preferred method for evaluating and selecting a coating system is to secure a detailed analysis and cost estimate from an experienced coatings estimator such as a

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painting contractor or applicator. In this manner, specifics of the particular job can be dealt with, and the estimate reflects all aspects that might otherwise be missed.

The cost of each alternate should be considered on a total project rather than a per square foot basis for several reasons. First, the magnitude of the work can be recognized and reflected in the cost estimate. Secondly, certain aspects of the work are better evaluated on a whole project basis. Different surfaces probably have different costs per square foot (structural steel, tanks, piping, valves, etc.). Certain elements of the estimate such as productive labor operations (abrasive blasting, coating application, etc.) lend themselves to a square footage basis for production rates. Support operations and equipment generally are expressed in terms of productive labor requirements (e.g., one pot tender for every two "productive" workers during the abrasive blasting and priming operation). And finally, some operations are most appropriately expressed in terms of the total project, such as move-in and move-out, rigging, and similar operations.

A. ELEMENTS OF COSTS

1. Labor

Labor should be figured on a person-hour or person-day basis for the project based upon the operations performed. Typically, these include cleaning, abrasive blasting, application of each coat of paint, pot tending (for abrasive blasting), helping rigging, removing spent abrasive and supervising. Productive operations are calculated on the basis of labor production rates applied to each surface area classification involved. Classifications might include large structural shapes, small structural shapes, miscellaneous steel (handrails, ladders, etc.), piping, valves, equipment, vessels and so forth.

Following is a description of typical labor support categories:

a. Pot Tender — Assists abrasive blasting operators to adjust abrasive blasting pots, refill pots and frequently assists priming operations. The ratio of pot tenders to blasters depends on equipment involved and labor restrictions. A single tender should be able to handle at least two pots. When bulk abrasive is used, pot tending is much less time consuming; frequently, the crew foreman doubles as pot tender.

b. Abrasive Handlers — Handle spent abrasive, when required. Most frequently abrasive handlers are used to remove the abrasive from inside a vessel or from the immediate work area; sometimes, the abrasive must be hauled to a remote dump site. Abrasive removal is normally figured on a pounds per hour or tons per day basis. The rate is determined by the distance the abrasive has to be moved, the obstacles in the way, and the equipment.

c. Helpers — Number varies with the requirements of the project. Helpers may be used to mix paints and assist in moving rigging; spray painters frequently take care of these operations when working on the ground but not when working off staging. The need and degree of use of helpers should be evaluated on a case by case basis.

d. Riggers — Deployment, placement and removal of equipment enabling workers to gain access to surfaces to be cleaned and coated. This normally includes hanging suspension scaffolding and cages, erecting scaffolding, etc. The most efficient rigging method should be evaluated for each case; it is frequently dependent upon the operations to be performed (i.e., abrasive blasting versus hand or power tool cleaning).

e. Supervisors — Field supervision. This is normally figured based on the number of crew days and supervisors required. A single supervisor seldom has more than 8 to 10 workers. A working foreman may be employed on crews of up to about 6 persons.

Once the person-hours for each labor operation are determined, the labor cost can be determined by multiplying the person-hours by the hourly rate for each classification of worker. The person-hour rate is the labor cost plus an overhead fee. Labor cost is the sum of wages, fringe benefits, travel pay and subsistence. Companies differ in how they handle fees on labor and the other components of the total system cost. One method is to apply only payroll taxes, insurance, small tools and expendables to the labor cost; labor cost is then accumulated with equipment and material cost and profit and overhead is applied to all of it as a group. Some firms consider payroll taxes and insurance as part of labor cost instead of fees, but the difference in methods is not significant for the purpose of comparison. There is normally a difference in wages paid to skilled and unskilled labor. Blasters and painters receive more than helpers. Many unions require premiums for wages on such items as abrasive blasting and spray painting, working with epoxies and other exotic materials, working more than fifty feet in the air and so forth. Supervision normally receives the highest hourly rate.

2. Equipment

Equipment required for individual jobs varies with type of job, size and configuration of the structures, type of surface preparation, type of paint or coating, etc. Following is a description of typical operations and the equipment required.

a. Abrasive Blasting and Priming — Compressed air for the abrasive blasting is determined by the nozzle size and other factors, figuring 350-450 CFM per nozzle for atypical job. Blast pots, hoses, nozzles and helmets (with appropriate air lines and filters) need also to be figured. Spray equipment for priming would be figured as indicated below; since a large source of compressed air would already be available, additional compressed air would not be needed for spraying primer after abrasive blasting.

b. Conventional Spraying — Spray pots are figured as required; the larger pots can handle two spray guns. If compressed air is not otherwise available, a small compressor may be needed.

c. Airless Spraying — Airless pumps are figured as required. Production sized units can normally handle two guns unless the material is highly viscous or other circumstances warrant. A power source (electrical or compressed air) needs to be used for the pump.

d. General — All jobs need a pickup or larger trucks to haul workers, equipment, and materials. Additionally, the project may require rigging cages, lifts, scaffolds, or similar items. Offices, change rooms, storage rooms, sanitary facilities, etc., may also be required.

The cost of equipment is figured on the number of days each piece of equipment is used at reasonable rental rate. Even if the firm owns all of the equipment, it should recognize and allow for recovering the investment in that equipment. Items costing at least several hundred dollars are normally considered rental equipment.

Supplies associated with rental equipment are either allowed for in the rental rates or are themselves rental items. Included in this category are hoses, nozzles, guns, abrasive blasting helmets, fuel, and so forth. Local rental firms or published sources such as the *Rental Rate Blue Book* can be used to determine rental rates. Rental rates are normally based upon continuous charge during the possession of the equipment with 5-day, 40-hour weeks. The renter normally furnishes fuel and the operator.

3. Materials

a. Abrasives — The cost is figured by applying a consumption rate to the number of abrasive blasting person-hours or person-days figured. For abrasives such as sand, slag, and many mineral

abrasives, one-quarter to one-half ton is used per hour. The higher consumption rates would be expected on large jobs with continuous operating bulk equipment. The cost of abrasives can vary so greatly that the cost of the entire coating system can more than double if changing from one of the lesser expensive when the abrasive is not recycled. Delivery costs of abrasive can also be a major cost factor in remote locations. When estimating costs, the abrasive supplier should be contacted for a price to avoid serious errors in the total system cost.

b. Paint and/or Protective Coatings — The quantity of each paint or coating is determined by dividing the surface area to be covered with that material by the practical coverage. The practical coverage is the theoretical coverage less a loss factor, typically 20-30%. The quantity of solvents required for thinning and clean up should be figured, typically this is about 20-30% of the quantity figured for paint. The quantity of each material is multiplied by the cost per unit and taxes and freight charges added in, for the total paint cost.

4. Cost Summary

The costs individually calculated for labor, equipment and materials are added together and a fee for overhead and profit applied to give a total system cost. When considering alternatives to be undertaken by the same firm, the amount of the fee for overhead and profit is not important to determine relative costs. On the other hand, if an owner is considering alternatives involving work by different vendors or himself and a vendor, differences in fees by the different organizations might be significant.

B. AN EXAMPLE

Consider cleaning and painting the exterior shell of a new 200 foot diameter × 48 foot high storage tank. The calculated square footage is 30,159. If the first alternate is a near white blast (SSPC-SP 10), 3 dry mils of inorganic zinc and 5 dry mils of polyamide epoxy, the system cost could be estimated as follows:

TABLE 1: Summary of Assumed Costs for Example of Storage Tank Coating

NOTE: The following 1992-93 data and cost calculations are presented as examples only and are not intended for use on actual jobs. Costs vary by location, job, and time. Secure estimates locally on the specific job involved.

Assumed Labor Costs:	MIN	MAX	USE
Journeyman wage	\$15.00/hour	\$22.50/hour	\$19.00/hour
Foreman wage	\$17.50/hour	\$25.00/hour	\$21.00/hour
Fringe benefits	\$ 4.00/hour	\$ 7.50/hour	\$ 5.50/hour
Assumed equipment costs (fueled):			
750 CFM Compressor	\$180.00/day		
Four-nozzle blast pot with all hose, hoods, nozzles, etc.	\$100.00/day		
Airless spray rig with hose and 2 guns	\$ 35.00/day		
Spider	\$ 30.00/day		
Pickup truck	\$ 30.00/day		
Assumed abrasive cost:	\$60.00/ton delivered		
Assumed coatings cost:			
Inorganic zinc — \$35/gallon — theoretical coverage 300 sq. ft./gal. @ 3 mils			
Polyamide epoxy — \$18/gallon — theoretical coverage 160 sq. ft./gal. @ 5 mils			
Thinner for both — \$8/gallon			
Assumed internal company costs			
Taxes and insurance	60% of wages		
Tax			
• Social Security			
• Federal Unemployment tax			
• State Unemployment tax			
• Liability			
• Workers Compensation			
Overhead and profit	35% of total labor, equipment and material		

Summary of Assumed Costs for Example of Storage Tank Coating (Cont'd)

Assumed production rates:

Blast @ 100 sq. ft./hr.	302 worker hours
Prime @ 300 sq. ft./hr.	101 worker hours
Finish @ 500 sq. ft./hr.	60 worker hours
Rig (from experience)	16 worker hours
Foreman (working) 1:4	120 worker hours
TOTAL	= 599 worker hours

Pot tender and helper were not figured separately because with this small crew the foreman could fulfill those functions.

The labor cost would be as follows:

Journeyman 479 @ \$19	\$9,101
Foreman 120 @ \$21	\$2,520
Fringes 599 @ \$5.50	\$3,295
	Subtotal = \$14,916
Taxes & Insurance @ 60% (Wages only)	= \$ 6,973
	TOTAL LABOR = \$21,889

After blasting and priming is completed, the large compressors could be exchanged for smaller compressors, but since the finish coating will be done in such a short period of time, this is impractical. With a 5-person crew working 8-hour days, the job will be done in 15 working days: Therefore, the equipment is:

750 CFM Compressors	2 units x 15 days @ \$ 180	= \$ 5,400
Blast pot	15 days @ \$ 100	= \$ 1,500
Airless spraying rig	2 units x 15 days @ \$ 35	= \$ 1,050
Spider	4 units x 15 days @ \$ 30	= \$ 1,800
Pickup truck	15 days @ \$ 30	= \$ 450
	TOTAL EQUIPMENT	= \$10,200

Materials cost:

Abrasive — ½ ton per worker hour	302 x ½ @ \$60	= \$ 9,060
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Coating	Theoretical Coverage	(25% loss) Practical Coverage	Gallons Required	Price	Cost
Zinc-rich	300	225	134	\$35	\$ 4,690
Epoxy	160	120	251	\$18	\$ 4,518
Thinner — 385 gallons x 20%			= 77	\$ 8	\$ 616
			Total coatings	=	\$ 9,824
			Abrasive from above	=	\$ 9,060
			Subtotal	=	\$18,884
			Sales tax 5%	=	\$ 944
			TOTAL MATERIALS	=	\$19,828

Price Summary

Labor	\$21,889
Equipment	\$10,200
Material	\$19,828
	Subtotal
Overhead & Profit @ 35%	\$51,917
	\$18,171
	TOTAL COST = \$70,088

*Labor rates for the Northeast

If the system were being compared to a system of commercial blast (SSPC-SP 6) and three 2.5 mil coats of alkyd, the calculations could result in a price of, say, \$40,000. The second alternate would be less for the following reasons:

Abrasive blasting to a commercial blast is faster than to a near white. Spraying alkyd is slightly easier and faster per coat than either inorganic zinc or epoxy, plus the millage is lower per coat. The fact that this is a three-coat rather than a two-coat system would be substantially washed out by the increased production rates. Less time

would be required for abrasive blasting equipment and less abrasive would be used. The cost of the coating materials in the second alternate is less also.

The second alternate at \$40,000 is lower in initial cost; but is it the most economical in the long run? Perhaps not. The analysis must be continued: What is the ultimate service life of each alternate (i.e., how long before the system fails and has to be blasted off)? What maintenance costs will be entailed during the service life and when will they be incurred?

This example leads into the other portions of this chapter which deal with identification of candidate paint systems, expected service life, and economic evaluation and justification.

The analysis of coating alternatives begins with the determination of cost using either currently available, specifically applicable cost data or a detailed cost estimate. The maintenance cost and projected service life must also be considered, weighing the value of monetary expenditure over time.

II. COST FACTORS IN COATING SELECTION

Identifying and justifying acceptable paint and protective coating systems for a given environment is difficult, and often neglected. If the project is a new plant, specifications often call for hand (SSPC-SP 2) or power-tool (SSPC-SP 3) cleaning, a shop primer and one or two topcoats of alkyd applied at the jobsite. Sometimes an old specification from a previous job is simply pulled from the file, renamed, and used on the current job without consideration of whether or not it is acceptable in the new environment.

Frequently, the coatings engineer is nonexclusive and has other areas of responsibility. Paint and coating selection cost estimates and justification for new construction or maintenance can be a confusing and difficult task for the nonexclusive coatings engineer. It need not be.

The purpose of this cost guide is to help coating engineers understand basic cost elements, show how to calculate approximate applied costs and outline procedures for arriving at an intelligent coating selection based on fact with supportable detail. Use of the guide can help clarify coating selection and increase effectiveness.

It must be emphasized that this cost guide is just that — *A GUIDE*. It is not intended as an infallible or absolute cost source. It is not meant for use in calculating actual job costs, nor as a tool for negotiating with contractors and fabricators.

The cost guide gives the specifier a simplified means of calculating total applied costs based on current material, cleaning and application costs. The cost information has been supplied by representative U.S. applicators and paint suppliers. The base cost produced by the guide is for structural steel on the ground at the jobsite, with costs for jobsite touchup if shop priming is considered. Percentage factors also are included to convert base costs to in-place costs.

The cost guide gives nonexclusive specifying engineers a method to help them identify candidate systems for a given environment. It establishes a procedure for calculating approximate applied costs and for estimating expected service life and cost per year for each proposed system. The use of the guide facilitates comparison, selection and justification of a suitable system.

A. PRELIMINARY COST ISSUES

Some common questions, factors and influences that the specifying engineer will encounter are discussed on the following pages.

1. *Why Attempt Cost Calculations?*

We live in a world of costs, numbers and "justification". Decisions on most matters and materials are made on the basis of cost savings and economics. To make good selections — and have them accepted by management — the specifying engineer must include a sound economic analysis.

2. *Why Paint At All?*

Unfortunately, without a protective coating, steel rusts and corrodes at varying rates depending on environment and/or climate. An alternative to painting is to specify thicker steel to compensate for corrosion loss. Assuming a twenty-year plant life, if the corrosion rate of the steel in a particular environment is above 2 mils per year, painting is less expensive than increasing steel thickness.⁽⁷⁾

Aesthetics, too, are an important reason to paint. Any structure simply looks better painted. While some people discount painting for appearance, it is, in fact, an important consideration in most cases.

3. *Importance of Initial Painting*

Once a structure is in operation, it is sometimes impractical, if not impossible, to blast clean, spray or to get sufficient "down time" to do an adequate maintenance painting job. In most cases, the original painting is the only time in the life of the structure when the job can be done effectively and economically. Therefore, the initial coating selection is of critical importance. The alternative is costly and/or ineffective maintenance for the life of the structure.

4. *Design For Total Structure Life*

Whether for new construction or maintenance the coatings engineer should consider the total cost and number of paintings required for the design or total life of the structure. If the design life is three years, a coating system should be selected that will last only that long. However, if the design life is 20 years, a long-life system requiring a minimum number of maintenance paintings make sense. See below, "Required Life (Design Life)" for more details.

To be cost-effective the immediate painting must be evaluated from both a short-term, immediate economic viewpoint as well as the long-term, total-structure-life viewpoint.

5. Why Blast?

Hand (SSPC-SP 2) or power-tool (SSPC-SP 3) cleaning does not remove mill scale. In severe environments, mill scale pops off in one to three years and takes the coatings with it. Blast cleaning is the most practical and effective means of cleaning the surface. It removes mill scale and creates an anchor pattern, which is essential for good paint adhesion. While commonly considered more expensive than hand or power-tool cleaning, shop blasting can cost less, since it lengthens the service life and reduces the cost per year.

6. Field vs. Shop Blasting and Priming

On new construction, shop blasting is considered to be about half the cost of field blasting. This means that where a minimum of 250 tons of steel is involved, shop blasting can be done for less than the cost of hand and/or power-tool cleaning in the field. See Table 5 and 6 for direct comparisons. This assumes the fabricator has centrifugal wheel-blasting equipment.

More important than the cost, shop blasting and priming allows and justifies application of a suitable protective coating system at the one time in the life of the plant when the job can be done effectively and economically. Application is easier on the ground, spray loss is reduced and personal safety enhanced. Job-site conflicts, scheduling difficulties and comprised applications common on most construction projects are greatly reduced or eliminated.

Selection of abrasion-resistant primers, such as inorganic zincs, plus use of wood dunnage for shipping, should be included to reduce in-transit damage and job-site touch up.

7. More Than One Coat In the Shop?

Painting can be controlled better in the fabricator's shop than at the job-site. Theoretically, the entire system or primer and intermediate coat can be applied in the shop. When it is impractical to apply coatings in the field, such as an expansion of an operating facility in a highly corrosive environment, total shop application is desirable.

Before the decision is made to apply totally or partially in the shop, it should be recognized that many steel fabricators have limited capability to hold steel for extended periods. Some shops are not enclosed or heated. Frequently, a maximum of only 24 hours can be tolerated by the fabricator for blasting, painting and loading.

If applying totally or partially in the shop, be certain the steel fabricator selected can effectively shop apply all coats. Make sure the coating system selected will dry and cure adequately

within the period the fabricator can accept, and that the coating manufacturer is in agreement. On a practical basis, touch-up the final coat after all repairs and welding are completed.

8. Galvanizing vs. Zinc-Rich Coatings

Galvanizing and zinc-rich coatings, with their galvanic action, have revolutionized steel protection. Galvanizing with 1½ ounces of zinc per square foot is equivalent in thickness to 2.5 mills dry of a zinc-rich coating. From a protection standpoint, they are about the same. Galvanizing via a "bath" treatment is more easily applied to small parts, gratings, etc. However, facilities are not always close to the job, and vat size can be a limitation. Heat resistance is somewhat *below* the melting point of zinc (750°F-399°C).

Compared with galvanizing, zinc-rich coatings are more easily applied to existing structures in place. They tend to weather better in marine and coastal environments, and accept top coats more readily^(5,6). They are less expensive on large structural members, and inorganic zincs have heat resistance somewhat *above* the melting point of zinc (750°F-399°C).

On a cost basis, the break point is approximately 275 ft.²/ton. Galvanize if the area is greater; coat with zinc-rich if it is less.

9. Cost Per Square Foot vs. Per Ton or Total Job Basis

It is impractical, and generally unnecessary, for the specifying engineer to attempt a take-off and total job estimate. *For system comparison and selection*, cost per square foot can be estimated through use of this cost guide in sufficient accuracy for an intelligent decision.

To convert to typical painting cost per ton size, multiply cost per square foot by 250. For large structural members, use 100-250 ft.²/ton; for medium 200-300 ft.²/ton; for light structural, 300-400 ft.²/ton; and trusses 350-500 ft.²/ton.

10. Delay Topcoating?

Many new construction projects run over budget, and it is not uncommon for construction managers to search for items that can be delayed until after start-up when maintenance dollars are used instead of capital dollars. U.S. tax classifies maintenance painting as a deductible expense; and, thus, a delay in topcoating could represent a reduced cost. To the uninformed construction manager, topcoat application might appear to be a good candidate for this.

If top coating is selected for delaying, "midstream" after the specification has been written and priming has been accomplished, and if the primer does not protect adequately for the extended period or in the environment, a major problem can result. The specifying engineer must be