Quantity Item Value
6 Post hole diggers ............................................................. 8.00
1 Scythe ................................................................................. 1.50
2 Lumber hooks ..................................................................... 3.00
1200 Pounds nails ............................................................... 40.00
1 Tarpaulin ............................................................................. 12.00
4 Paint brushes (old) .......................................................... 1.00
2 30-ft. extension ladders .................................................. 10.00
1 Paint machine .................................................................... 31.00
35 Gallons linseed oil ......................................................... 30.00
225 Gallons bridge paint ..................................................... 450.00

Total value ................................................................. $2,749.55

SPECIFICATIONS FOR BRIDGE PAINT

By P. D. Meisenhelder, Engineer of Tests, Indiana State
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Specifications for bridge paint, broadly speaking, are for the
same purpose as any specification which we deal with in con­
struction work: that is, they set forth a detailed description
of the material which is desired by one party and which the
second party agrees to furnish. It is assumed of course that
the first party who has prepared the specification has selected
and described a material of the type which will satisfactorily
accomplish what he desires. To prepare such a specification
for paint is usually a difficult task, probably because of our
limited knowledge of the subject.

The first manufacture of mixed paints is credited as being
essentially an American enterprise. The first small packages
of mixed paint were marketed about 1865. Since that time
very marked progress has been made in the study of paint and
paint materials and in the knowledge accumulated about them.
Nevertheless, paint making and to some extent painting is an
art as much as or more than a science. It should not be under­
stood from this that science does not have its place in the
manufacture of paint, for it most certainly does and the paint
industry today employs some of the leading scientific men of
this country. It is through their efforts and study that rapid
progress is being made and it may be that we can some day
consider the specifying and manufacturing of paint as being
strictly scientific. However, we are still in the stage where
an efficient paint cannot be invented or compounded merely
by theoretical reasoning. We must be guided largely by our
own or others' experience to prescribe a paint which may
safely be expected to serve our purpose satisfactorily.

Paint as defined by the American Society for Testing Mate-
rials, in their standard definition of terms relating to paint
specifications, is "a mixture of pigment with vehicle, intended
to be spread in thin coats for decoration or protection, or
both". In this definition we have two terms which are so
commonly used in connection with paints that it is also desir-
able to define them. The terms to which I refer are pigment
and vehicle. Pigment is defined by the same reference given
for paint as "the fine solid particles used in the preparation
of paint, and substantially insoluble in the vehicle". It is fur-
ther explained under this definition that "asphaltic materials
are not pigments except when they contain substances sub-
stantially insoluble in the vehicle in which they are used"
Vehicle is defined as "the liquid portion of a paint." Here any-
thing that is dissolved in the liquid portion of a paint is a
part of the vehicle. Formerly it was the practice for paint-
ers to purchase all the ingredients of the paint—that is, the
dry pigment, tinting materials, oils, and dryers—and mix
them themselves. For various reasons this practice has been
almost entirely discontinued.

Classes of Paint for Steel

At present, paint used on steel structures falls into two
classes, either a ready mixed paint or paint which is mixed
on the job, using pigment previously ground in oil, more com-
monly referred to as prepared paste. Specifications for these
two types necessarily differ somewhat in form though both
are sometimes clearly an outgrowth of the old method: that
is, the specification will require a certain number of pounds
of pigment to be used with a given number of gallons of
vehicle. Such a specification may or may not be practicable,
depending upon the manner in which the inspection work is
to be handled.

Regardless of the type of paint to be specified there are two
or three features that should always be covered by the specifi-
cations. As has already been stated, paint is a mixture of
pigment and vehicle; therefore the first logical thing is to set
out the amount of each, or their relation to each other; sec-
ond, if, as is generally the case, the pigment or vehicle (or both) is composed of more than one ingredient, to state the quantity or relation of each ingredient; third, to describe and identify the quality of each ingredient. These three steps, though they appear simple and logical, are all too frequently confused or disregarded in paint specifications and this confusion many times results in disagreements, disputes, and generally ends with the use of an inferior paint.

With this outline of procedure in mind let us consider separately the two types of paint already mentioned, that is, the ready mixed paint and paint mixed on the job from prepared paste. For the latter it should be stated that with a given number of pounds of the prepared paste shall be mixed a certain volume of oil and a specified amount of thinner and drier. Then there should appear a description of the paste setting forth the character of the pigment in it and the amount of oil with which it is ground. Likewise there should be a description of the oil, of the drier, and of the thinner.

In the case of ready mixed paint there are two forms of specifications that are sometimes used. Some men are distinctly in favor of one, some equally in favor of the other. Either can be successfully used under certain conditions. In one form a certain number of pounds of pigment, or number of pounds of each ingredient of the pigment, is required to be ground in a certain number of gallons of oil. There is further specified the amount of drier and thinner that shall be added and then a description of the character of each ingredient for both pigment and vehicle. This sort of specification is essentially a mixing formula to be followed by the manufacturer. It may be satisfactory if the buyer can have a representative present during the manufacturing process.

The other form is to state the percentages (by weight) of pigment and vehicle in the finished paint, the percentages of each ingredient in the pigment and in the vehicle followed by a definition of the quality of each ingredient. This is undoubtedly the better form to be used if it is desired to perform tests on the paint that is delivered.

This last specification form is usually written in one of two ways. It is not practical to expect a sample of paint from a single container that has been packed from a large batch as manufactured to have always an exact percentage of each ingredient. There are several things which may cause slight
differences. Therefore, it is customary to list maximum and minimum percentages allowed or to state a definite percentage with a certain allowable percentage variation from that figure. The same object may be accomplished with either form.

Mention might be made at this time of some of the advantages and disadvantages of ready mixed paint and that mixed on the job from prepared paste. A ready mixed paint is generally considered the more convenient, and in a great many instances a better paint may result from having the pigment ground in the vehicle. On the other hand, unless rigid inspection is maintained, adulterants may be substituted for some of the ingredients or there may be a deficiency in the quantity of pigment in the paint. If paint is mixed on the job by using prepared paste, the process is somewhat more tedious but the inspector can readily check the proportions of pigment and vehicle used and there may not be as great a likelihood of substitution when the ingredients are purchased separately. However, it is not possible to obtain all forms and combinations of pigment in paste form.

At no place in this paper have definite figures or amounts been mentioned because the quantity of pigment that can successfully be used in a paint varies widely with the type of pigment. The relation or percentages of pigment and vehicle used in one paint should not be arbitrarily transferred for another using a different pigment. As previously stated, we must be guided by experience in many problems in connection with paint.

**Information on Specifications**

The question is often asked, What can be used as a guide in specifying the quality of various paint materials? The Bureau of Standards of the U. S. Department of Commerce has prepared a number of master specifications for supplies purchased by the government. These include a variety of paints and paint materials. A list of these master specifications and the specifications themselves can be obtained at very small cost from the Superintendent of Documents at Washington, D. C. The American Society for Testing Materials, whose standard specifications and methods of tests are very widely used throughout the country, have also prepared specifications for many of the more generally used paint materials. In addition they have prepared a list of definitions of and terms ap-
plying to paints, from which a quotation was made earlier in this paper. Separate specifications or a book containing all of their standards may be purchased from their office at 1315 Spruce St., Philadelphia, Pennsylvania. The standard specification of various State Highway Departments may also be advantageously used when preparing paint specifications.

Though possibly not properly a part of a discussion of paint specifications, there is sometimes an attempt or gesture at describing paint that should be mentioned. Under the heading "paint" in the specification for a project, there may be a statement that "the paint shall be such and such a brand" or that "the paint shall be the best grade manufactured by so and so's company". Apparently as a sort of after thought there may be added "or its equal". Such statements should not be used as specifications. Usually they are an attempt to favor some particular dealer; but, granting that such is not the case and that the specification writer is conscientious and honest, how are you to know the kind of paint you may get? The formula and the quality of a brand may be changed at the will of the manufacturer. Also, suppose a competitor offered to supply the paint and you had to decide whether or not it was the "equal" of that named. How can you determine that any material is equal to another if you have no specific or definite standard for the first?

SPECIFICATIONS AND INSPECTION

By G. P. Springer, Assistant Professor of Civil Engineering, Purdue University

Specifications should be written for every part of every contract, regardless of how small the unit of the work may be, for only with proper specifications, carefully written, may the contractor fully understand each item proposed for the construction operation. From the specifications a bidder arrives at the nature and amount of work which he will be expected to perform, if he is the fortunate winner of the award. From the wording of the specifications, the contractor will draw his conclusions as to the fairness of the parties who drew the specifications, how well the engineer knows the details of the work contemplated, and what kind of treatment may be ex-