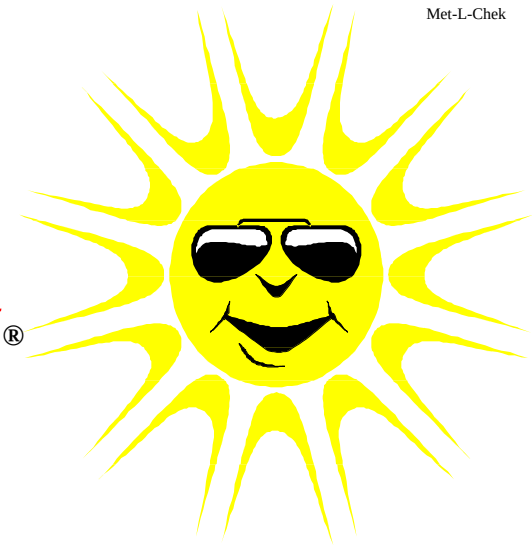
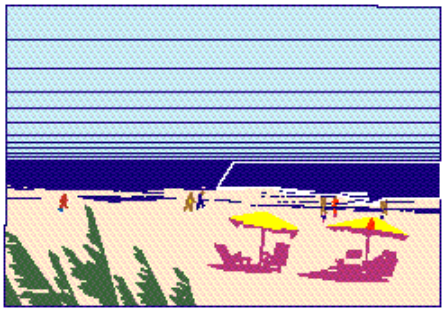
The Summertime Penetrant Professor from Met-L-Chek®

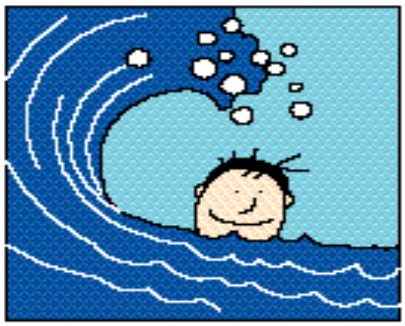


Water Content

ASTM E-1417, and perhaps other specifications, require the periodic analysis of used water washable penetrant for water content. The analysis is to be performed by using either the method of ASTM D-95 or the Karl Fischer method described in Annex A1 of ASTM E-1417. We recently received the question of whether the results were in volume percent or in weight percent. The answers to this are found in the specification documents. TheAnnex A1 calculation (paragraph A1.5) is made by dividing the weight of the titrant used by the weight of the sample, thus giving the weight percentage of water. The weight of the titrant is calculated in the final equation by multiplying the volume of titrant used by a factor that converts the volume into weight. This "titer" constant is provided with the titrant. The equation is as follows:

Weight % water = 100 X volume of titrant X titer value, in grams per ml, divided by the weight of the sample. The ASTM D-95 method calculates either weight percent or volume percent, depending upon whether the sample was taken by weight or by volume.





Water Pre-rinse

ASTM E-1417 states (Paragraph 7.3.4.2) that "Hydrophilic post emulsifiable penetrant shall be removed with a water Pre-rinse, application of the hydrophilic emulsifier and then a post-rinse." There is an unanswered question as to whether this applies equally to both immersion in the emulsifier and to emulsifier that is sprayed on. The answer may be found in the ASNT Penetrant Handbook, where it points out that the water Pre-rinse is for the purpose of limiting the amount of penetrant that is washed from the part into the emulsifier, thus extending the useful life of the emulsifier bath. When the emulsifier is sprayed onto the part, it is not reused, and so there is no equivalent rationale for using a Pre-rinse

MORE ABOUT EMULSIFIER

In our last issue, we pointed out that some auditors now require that the user make his or her own concentration chart for our E-58D hydrophilic emulsifier. The apparent reasoning behind this is that there is no guarantee that the refractometer used by Met-L-Chek and the refractometer in the user's possession will give the same results. So let's discuss how to make a chart that will be useful.

First, it is relevant to understand that the relationship between the refractometer reading and the E-58D

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concentration is a linear one. This means that if you have one point for the concentration and its associated refractometer reading, you can draw a straight line from the zero point on the graph paper through the measured point, and you will have what is needed. While this is true, it poses a couple of practical problems. The first one of these is that if a hand held refractometer is used, it is sometimes difficult to get an exact reading with it, because the scale divisions are in increments of 0.2, and the dividing line that marks the scale is sometimes a bit fuzzy. In practice, this is not a problem, because the effect is very small, but it can become a problem during an audit. That leads us to the second practical problem, which is that of an audit. Auditors have varying degrees of technical education, and it is possible that an auditor does not understand that the relationship is linear, in which case he or she may want to see a graph with more than one measured point on it. And, as pointed out above, if the graph has been made with a single reference point, the auditor may ask that the point be defended as accurate.

So we will discuss how to make a useful graph that can be defended if necessary. What is needed is a container that will hold an exact amount of liquid. A kitchen measuring cup will not do. We suggest a volumetric pipette of 20 ml size. With this, you can measure exactly 20 ml of a liquid. You will also need a container that will hold perhaps 600 ml of liquid.

Now, using the pipette, measure exactly 20 ml of E-58D into the 600 ml container. Now, using the same pipette, and without cleaning it, measure into the same 600 ml container, 40 ml of water. This will require two 20 ml portions. Mix the liquids thoroughly, and the result is 60 ml of E-58D at a concentration of 1/3, or 33.333%. Now take a reading with the refractometer and record it. Next, add one more 20 ml portion of water to the mixture, and mix it thoroughly. Now the mixture is one part E-58D and three parts water, or 25% exactly. Take a refractometer reading and record it. Add one more 20 ml portions of water, and mix. The result is one part of E-58D and four parts of water, or 20% exactly. Record the refractometer reading for this. You can continue this process as long as you wish, recording the refractometer readings and the concentration each time, but when you get to a 10% solution it is probably sufficient. You can use the following chart as a guide.

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ml E-58D	ml H2O	Total vol.	Conc.	Refractometer Reading
20	40	60	33.3	
20	60	80	25.0	
20	80	100	20.0	
20	100	120	16.6	
20	120	140	14.2	
20	140	160	12.5	
20	160	180	11.1	
20	180	200	10.0	

When all of the readings have been taken, place the points on a graph and connect the dots, using a ruler. We have made this exercise in our laboratory, and the results are shown below. Remember that these points were developed using our refractometer. Your results will be either identical or very similar, depending upon your refractometer.

ml E-58D	ml H2O	Total vol.	Conc.	Refractometer Reading
20	40	60	33.3	24.0
20	60	80	25.0	18.2
20	80	100	20.0	14.6
20	100	120	16.6	12.0
20	120	140	14.2	10.5
20	140	160	12.5	9.0
20	160	180	11.1	8.0
20	180	200	10.0	7.4

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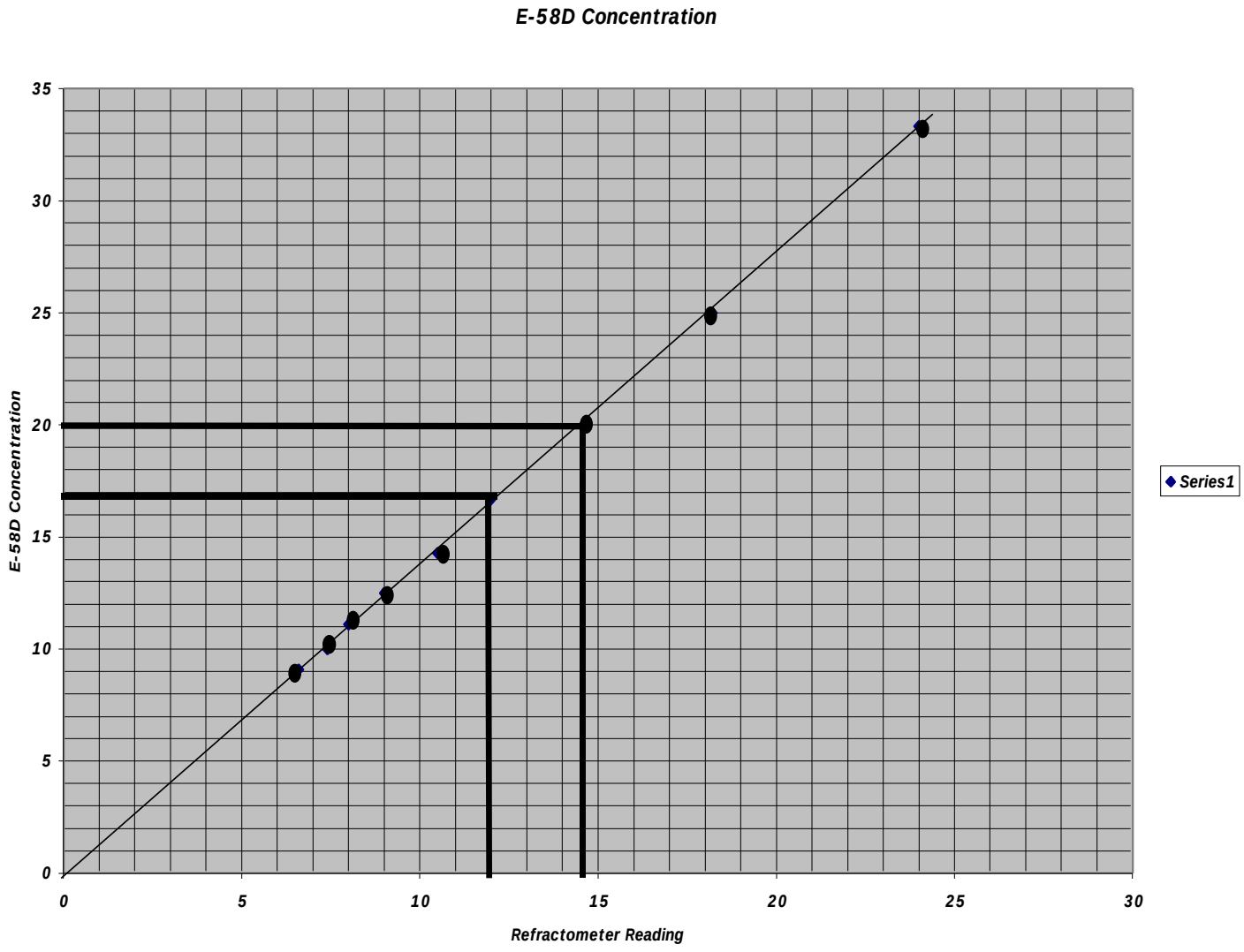

Note that these particular points do not exactly lie on a straight line. This is because of the difficulty in reading a hand held refractometer exactly. If we had used an electronic refractometer, the graph would have been more accurate. One can also derive an equation for this line, and for the line illustrated, the equation is as follows:

E-58D concentration equals 1.376 times the refractometer reading.

For a 20% solution, the refractometer reading should be 20/1.376, or 14.53. Note that the actual reading was 14.6, which is a minor difference. For a 17% solution, the refractometer reading should be 17/1.376, or 12.35.