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Thin Layer Nuclear Density Gauge Performance Test Results

Troxler Electronic Laboratories, Inc. is the only manufacturer of a true thin layer density gauge. Troxler Models 4640 and 3450 both feature the patented technology to measure the density of thin layer asphalt and concrete overlays from 2.5 to 10 cm (1 to 4 inches) without influence from the underlying material. This testing method determines density through the backscatter method. Photons from the source are scattered through the material being tested. Two sets of photon detectors are present in the gauge base to read those photons scattered back toward the gauge from differing depths. The difference in the depth of material measured by each system, factory calibration, and the mathematical models allow the thin layer gauges to determine the density of the top layer of asphalt.

The state of Virginia has devised a specification to determine that a nuclear density gauge is a true thin layer gauge. The test procedure for this specification is called, "Virginia Test Method for Thin-Lift Nuclear Density Gauge Performance Requirements" designation: VTM-81. The equipment necessary to perform this test includes:
2 base blocks (each 22"L x 14"W x 8"D minimum); one with density between 100 – 120 PCF density and the other with density between 155 – 170 PCF density
4 thin layer metal plates; two Aluminum (22"L x 14"W x 1.25"D and 22"L x 14"W x 2"D) and two Magnesium (22"L x 14"W x 1.25"D and 22"L x 14"W x 2"D)

The procedure for this test involves placing each of the thin layer plates on each of the base blocks, placing the gauge upon the plate, taking four readings and finding the average of the four. The instructions for this test are as follows:

Place the 1.25" Aluminum plate on top of one of the base blocks. Check to make sure that it is resting squarely and does not rock. Set the nuclear gauge on the 1.25" Aluminum plate. Check to see that it does not rock. Set the gauge thickness to match the plate thickness (for thin layer gauges). Take four one-minute readings and record them and their average on the attached form. Repeat this process using the same 1.25" Aluminum plate placed on the other base block. The following steps require that this procedure be repeated with each of the other thin layer plates. The results of the density of the same plate tested on the different base blocks should not vary if tested with a true thin layer gauge due to the fact that the underlying material density does not influence the reading. Therefore, limits are set by this test to determine how much the two tests may vary.

This report will give the results obtained when following this test procedure using a Troxler Model 3440 gauge, Model 3450 gauge and Model 4640 gauge. The Model 3440 gauge does not offer a thin layer mode and therefore was used in the backscatter position in asphalt mode. The Model 3450 was used in thin layer mode, and the 4640 (a thin layer only gauge) was also used in this mode. The test results shown below prove that the standard surface moisture/density gauge, does not pass the criteria of a thin layer gauge and that the readings are greatly influenced by the underlying material density. The Model 4640 and Model 3450 in thin layer mode easily fall within the limits stated by this test. These two density gauges pass the test of a true thin layer density gauge, proving that the underlying material density does not influence the readings of the thin layer gauges.

Model 3440 BACKSCATTER MODE serial # 19177

1.25" MG on MG base	1.25" MG on AL base	1.25" AL on MG base	1.25" AL on AL base
108.575pcf	125.525	137.35	159.75
difference 16.95 pcf		difference 22.4 pcf	
FAIL	*limit +/-3.3 pcf*	***FAIL***	*limit +/-2.4 pcf*
2.00" MG on MG base	**2.00" MG on AL base**	**2.00" AL on MG base**	**2.00" AL on AL base**
109.725pcf	117.325	150	160.625
difference 7.6 pcf		difference 10.625 pcf	
FAIL	*limit +/-2.3pcf*	***FAIL***	*limit +/-1.6pcf*

Model 3450 THIN LAYER MODE serial # 110

1.25" MG on MG base	1.25" MG on AL base	1.25" AL on MG base	1.25" AL on AL base
111.075pcf	111.375	161.775	160.45
difference 0.3 pcf		difference 1.325 pcf	
PASS	*limit +/-3.3 pcf*	***PASS***	*limit +/-2.4 pcf*
2.00" MG on MG base	**2.00" MG on AL base**	**2.00" AL on MG base**	**2.00" AL on AL base**
110.875pcf	110.3	161.025	160.85
difference 0.575 pcf		difference 0.175 pcf	
PASS	*limit +/-2.3pcf*	***PASS***	*limit +/-1.6pcf*

Model 4640 THIN LAYER GAUGE serial #1256

1.25" MG on MG base	1.25" MG on AL base	1.25" AL on MG base	1.25" AL on AL base
109.35pcf	109.975	161.025	159.75
difference 0.625 pcf		difference 1.275 pcf	
PASS	*limit +/-3.3 pcf*	***PASS***	*limit +/-2.4 pcf*
2.00" MG on MG base	**2.00" MG on AL base**	**2.00" AL on MG base**	**2.00" AL on AL base**
110.1pcf	108.725	160.575	159.925
difference 1.375 pcf		difference 0.65 pcf	
PASS	*limit +/-2.3pcf*	***PASS***	*limit +/-1.6pcf*

The shaded areas show the difference between two tests taken on the same thin layer plate on different bases having varying densities.

MG base= 110 pcf
AL base= 160 pcf

Model Serial #

1.25" MG on MG base	**1.25" MG on AL base**	**1.25" AL on MG base**	**1.25" AL on AL base**
difference	**pcf**	**difference**	**pcf**
Pass / fail	*limit +/-3.3 pcf*	**Pass / fail**	*limit +/-2.4 pcf*
2.00" MG on MG base	**2.00" MG on AL base**	**2.00" AL on MG base**	**2.00" AL on AL base**
difference	**pcf**	**difference**	**pcf**
Pass / fail	*limit +/2.3 pcf*	**Pass / fail**	*limit +/-1.6 pcf*