

Racing Surfaces Testing Laboratory

2 Summer St.
Orono, ME 04473
207.866.1046



LABORATORY TEST METHOD FOR BULK DENSITY AND MAXIMUM BULK DENSITY DETERMINATION OF RACING SURFACE SOIL MATERIALS USING A SMALL MOLD (Diaz-Zorita 2001, ASTM D698)

Note:

This procedure applies to dirt only. All material must be completely free from wax and other synthetic materials. See the "Wax Separation" and "Rubber & Fiber Separation" procedures.

1) Obtain at least 1600 g of **oven** dried material. Refer to the Moisture Removal and Determination Procedure for details.



2) Weigh the empty **sample pan** and **spoon** to ± 0.1 g and record the weight on the data sheet under "weight of pan + spoon."



3) Add approximately 200g of the oven dried material from step 1. Record the weight of the pan, spoon, and material on the data sheet under "Weight of pan + spoon + dry material."

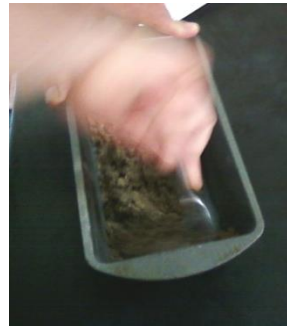


4) Add enough **distilled water** to the sample using a spray bottle to obtain the desired moisture content (remember water content is $(W_{\text{Water}}/W_{\text{Dry Soil}})$). When filled

out, the data sheet shows the amount of water to be added under "Amount of water added" and the total weight of the pan, spoon, sample, and water to be added under "Weight of water + material + pan + spoon."



5) Mix the material very thoroughly to ensure that the moisture content is even throughout the material.



6) Weigh the **base** and **bottom half** of the **proctor** ($V_{\text{small}}=2.4264E-3 \text{ ft}^3$) to ± 0.01 g. Record the weight on the data sheet under "Weight of mold".

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7) Attach the **top half of the proctor**. Fill the proctor with sample, taking care not to compact it.



8) Clean the **5.5 pound hammer** with a paper towel. Compact the sample using a 5.5 pound hammer using 5 blows at the full height of 12 inches. If the hammer bounces off the material when it hits it, try to prevent the hammer from hitting the sample a second time.



9) If any water leaks out of the sample at any time during compaction, the results from that test are not good, and it will be difficult to get good results at that moisture content.



10) Remove the top half of the proctor and scrape off excess material until the material inside the bottom half of the proctor is even with the top rim of the bottom half of the proctor. Do not reuse this material or any other compacted material. All previously compacted material should be labeled with its sample identifier and "after bulk density." If the surface of the material is below the top rim of the bottom half of the mold, remove all material, clean the proctor, and repeat steps 2 through 5.



11) Weigh the bottom part of the proctor and the sample to $\pm 0.01\text{g}$. Record this weight on the data sheet under "Weight of the mold and the wet material."



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12) Weigh a clean, empty small **sample tin** (or **250 mL beaker** if drying sample in the **microwave oven**) to $\pm 0.01g$ and record the weight under "weight of container." Label the tin or beaker with the sample identifier and the moisture content being tested.



13) Place the entire sample from the bottom half of the proctor into the sample tin (or beaker). Weigh the wet sample to $\pm 0.01g$, record the weight under "weight of container + wet material", and place the tin into the oven (or microwave oven). Work quickly because water is being lost as time progresses.



14) Clean any material stuck to the proctor. This may be done with a brush, a damp paper towel, or in the sink.



15) Repeat steps 2 through 9, increasing the moisture content each time until all the desired moisture contents have been tested.

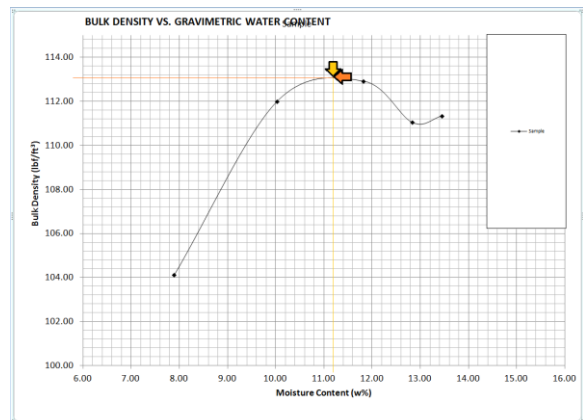
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Moisture Content (%)	Wt. of Container (g)	Wt. of Container + Wet Material (g)	Wt. of Container + Dry Material (g)	Wt. of Water (g)	Wt. of Solids (g)
2.55	11.485	24.239	25.377	2.892	13.885
4.20	11.485	24.239	25.377	2.892	13.885
5.85	11.485	24.239	25.377	2.892	13.885
7.50	11.485	24.239	25.377	2.892	13.885
9.15	11.485	24.239	25.377	2.892	13.885
10.80	11.485	24.239	25.377	2.892	13.885
12.45	11.485	24.239	25.377	2.892	13.885
14.10	11.485	24.239	25.377	2.892	13.885
15.75	11.485	24.239	25.377	2.892	13.885
17.40	11.485	24.239	25.377	2.892	13.885

16) Obtain all dry material weights the following day (or after drying in the microwave oven) and record them in the data sheet.



17) Find the maximum bulk density and the moisture content at which it is reached from the graph of bulk density vs. gravimetric water content (found on the tab 'curve (w%)' in the datasheet). It may be necessary to change the axes to see the peak more clearly.



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ABC_12345-A	
Sample	
Tested Moisture (w%)	▶
Moisture Tested (v%)	0.00
Max. Bulk Density (lb/ft ³)	▶

Revision No.	Date	Revision By	Description
1.0	19-Feb-2010	Wenjin Luo	Created and issued procedure
1.1	26-Dec-2011	Molly Segee	Added step to find maximum bulk density from graph
1.2	24-Apr-2012	Molly Segee	Clarified instructions
1.3	23-Jan-2013	C Mahaffey	Updated Vsmall from 3.0733E-3 ft ³ to corrected 2.4264E-3 ft ³
1.4	06-June-2013	Molly Segee	Do not reuse compacted material, updated for new datasheet
1.5	24-Jun-2013	Molly Segee	Mix material very thoroughly before test, do not use results if water leaks from mold during compaction.
1.6	26-Jan-2014	Hilary Babbitt	Updated lab address