

Determining the Force or Pressure to Use for T.A.P. (Bulk) Density with the GeoPyc 1360

To measure bulk density, the GeoPyc® 1360 consolidates the sample within a cylindrical chamber until a specific force is achieved. A measurement is taken at that point, and subtracted from blank (empty chamber) data stored in the GeoPyc to yield the sample's bulk volume. This volume and the sample's weight are used to calculate bulk density. When you begin a bulk density analysis with the GeoPyc 1360, you must enter the force with which you wish the sample to be consolidated at the time the measurement is taken.

The GeoPyc allows you to use either force (in Newtons) or pressure (in Newtons/cm²) as your unit for measuring consolidation of the sample. In this application note, pressure is used, but all information is applicable when force is used.

A wide range of pressures can be used. If a small pressure is entered, the sample may simply be consolidated loosely. If a great pressure is used, the sample may be thoroughly consolidated, eliminating much of the void space among the particles or granules. Still further consolidation may cause individual sample particles to collapse, shatter, or be distorted, especially if the sample is fragile or soft.

In some instances, the purpose of the experiment may be to observe the sample's performance and quantify its density under a range of pressures. For example, such a study might be useful in packaging and shipping bulk granular products.

In many cases, though, the purpose of the experiment is to determine the sample's bulk density, as compared to historical product data obtained using the older "tap" density method*.

In such cases, it is necessary to enter the level of pressure that corresponds to the degree of sample compaction at which the "tap" density was measured. Tap density instruments do compact the sample to a specific degree, but —unlike the GeoPyc— they may not provide any way to quantify that degree.

*ASTM Standard Test Method B 527-81, Tap Density of Powders of Refractory Metals and Compounds by Tap-Pak Volumeter.

To discover what GeoPyc consolidation pressure corresponds with the degree of compaction typically obtained by the other method, you must conduct a brief series of tests on your sample, using a range of pressures. The pressure that yields data corresponding to your “tap” results should be used for subsequent tests with this sample material.

GeoPyc T.A.P.[™] density data typically replicate tap data at consolidation forces of 1 to 3 N/cm² (plunger cross-section). Therefore, it is recommended that you perform a series of tests using pressures in this range if your sole interest is in replicating tap data. To assist operators who have selected Newtons as the unit for consolidation force, Table 1 converts this range to equivalent values in Newtons for each chamber.

Because the GeoPyc enables you to control precisely the pressure used to consolidate the sample, you always know the exact degree of consolidation achieved when the measurement is taken.

Table 1. Recommended Force or Pressure for Emulating Tap Density

Internal Chamber Diameter (mm)	Recommended Pressure Range for Emulating Tap Density (N/cm²)	Recommended Force Range for Emulating Tap Density (Newtons)
12.7*	<i>*These chambers are not recommended for emulating tap density. They are very useful, however, for assessing sample compaction at higher pressures.</i>	
19.1*		
25.4	1 to 3	5 to 15
38.1	1 to 3	11 to 33
50.8	1 to 3	20 to 60