

EPA INFORMATION *Bulletin*



TESTING OF WASTE COMPACTION DENSITY IN LANDFILLS

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General

A review commissioned jointly by EPA, the Recycling and Resource Recovery Council and the Waste Management Council in 1994 indicated that average waste compaction densities at landfills exceeded **1 tonne per cubic metre**. This review involved both collection of waste compaction density data from landfill operators and a testing program conducted at eight landfills in Melbourne and Geelong. The testing involved:

- measuring the airspace filled during the construction of a weekly cell while recording the weight and category of waste deposited; and
- excavating and weighing a portion of material from a cell.

The review revealed that high waste compaction densities may result from either high equipment performance or the high density of the waste material itself.

The method approved by the Authority for estimating the landfill levy where the weight of waste is not known, requires the use of a volume to weight conversion factor (previously set by the Authority at 0.55 tonnes per cubic metre). Following the 1994 compaction review, the Authority has determined that, from 1 July 1995, the factor will be **1 tonne per cubic metre**, and will apply to all premises relying on volume based estimates where the operator

has not established the actual compaction density being achieved. Testing to determine the compaction density being achieved must be in accordance with the method contained in this publication and undertaken by a company having a quality system complying with ISO 9000 series.

Purpose

This publication provides details on the test method to be used to determine the average waste compaction density (volume to weight conversion factor) of a schedule two premises (landfill). Details are also provided on the supporting technical information required to be submitted with any request to the Authority to use a conversion factor other than 1 tonne per cubic metre for calculating the landfill levy.

Test Method

Overview. At least three holes are to be excavated from a cell. The extracted material is to be weighed. The volume of each hole is to be measured by sand replacement, where the volume of sand is to be determined from its weight and density. The depth of cover material is to be measured by direct measurement.

Cell Excavation. Test holes are to be excavated in at least three locations in a weekly cell, where the cell has been constructed in the previous six months under normal operating conditions. The

cell is to have been constructed with waste that is typical for the premises, and this is to be supported by gate records.

The holes are to be excavated to the base of the landfill cell (approximately 2 metres). The material extracted is to be placed in a truck (or other suitable receptacle) that has been pre-weighed. The volume of the excavated hole should be a minimum of 6 cubic metres. The test locations must be determined in consultation with the operator of the site and EPA representatives.

Waste Composition. The relative proportions of the different waste types in the test cell are to be estimated from gate records.

Measurement of Excavation. The dimensions of the hole (width, breadth and depth) are to be measured prior to backfilling. The average depth of cover is to be determined from measurements taken at the sides of the excavation.

Weighing. The excavated material is to be weighed over a weighbridge.

Backfilling. Following excavation and measurement of the dimensions of each hole, a material of high loose density (ie. sand) is to be placed into the void. The weight of material placed is to be determined by weighbridge. The volume of the void is to be estimated from the density and weight of material placed. The density of the material is to be determined using a recognised method (ie. nuclear density gauge).

Backfilling is an accurate method for determining the volume of an excavated hole.

Record Keeping. The attached Data Collection Sheets are to be completed by an authorised representative of the company undertaking the tests.

Calculation of Waste Density. For each excavation, the waste density is to be calculated by estimating the weight and volume of the layer of cover, and subtracting these from the weight and volume of the excavated material determined by weighbridge and backfill. The volume of cover is to be estimated by multiplying the measured average depth(s) of cover by the measured width and length of the excavated hole. The weight of cover is to be estimated by assuming a cover density of 2 tonnes per cubic metre. The average waste density can then be calculated following the steps contained on Data Collection Sheet No. 2.

The average waste density for the premises (volume to weight conversion factor) is the average of the waste densities of the three holes.

Certification. At the completion of testing an authorised representative of the company undertaking the testing is to endorse the Data Recording Sheets in the space provided.

Requests to Vary the Volume to Waste Conversion Factor for Calculating the Landfill Levy

Requests to use a volume to waste conversion factor other than 1 tonne per cubic metre for calculating the landfill levy must be lodged with the Authority within two weeks of test results being available and must include the completed Data Collection Sheets. The figure will only be valid for two levy periods.

ENVIRONMENT PROTECTION AUTHORITY

LANDFILL COMPACTION DENSITY TESTING: Data Collection Sheets
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Testing is to be in accordance with the method contained in EPA Information Bulletin 455 "Testing of Waste Compaction Density in Landfills", and undertaken by a company having a quality system complying with ISO 9000 series.

These sheets are to be completed by an authorised representative of the company undertaking the tests.

Name of Landfill:	Test Date:
Licensee:	Compaction Equipment:
Licence No.:	Ground Conditions:
Location:	Weather conditions:
Operator:	

Estimate of Waste Proportions Deposited in the Test Cell (from gate records)

Waste Type (including cover)	Quantity through gate (cubic metres)
.....
.....
.....
.....
.....
.....
.....
.....
TOTAL

Excavation and Backfilling of Test Holes

<u>Excavation & Backfilling</u>	<u>Hole 1</u>	<u>Hole 2</u>	<u>Hole 3</u>
Hole Area (a_h) (square metres) - <i>from direct measurement</i>			
Hole depth (d_h) (metres) - <i>from direct measurement</i>			
Cover depth (d_c) (metres) - <i>from direct measurement</i>			
Excavation weight (W_h) (tonnes) - <i>from weighbridge</i>			
Density of backfill material (ρ_f) (tonnes per cubic metre) - <i>measured</i>			
Weight of backfill material (W_f) (tonnes) - <i>from weighbridge</i>			
Volume of hole ($V_h = W_f / \rho_f$) (cubic metres) - <i>from backfill</i>			
Density of waste and cover ($\rho_h = W_h / V_h$) (tonnes per cubic metre)			

Waste Density (ρ_w) Calculation

For each test hole, the waste density, in tonnes per cubic metre, is to be calculated by following steps (1) through to (5) where:

- V_h = volume of hole (cubic metres) - *from backfill*
- a_h = hole area (square metres) - *from direct measurement*
- d_c = cover depth (metres) - *from direct measurement*
- W_h = excavation weight (tonnes) - *from weighbridge*
- ρ_c = density of cover material, **assumed to be 2 tonnes per cubic metre**
- V_c = volume of cover = $a_h \times d_c$ (cubic metres)
- W_c = weight of cover = $\rho_c \times V_c = 2 \times V_c$ (tonnes)
- W_w = weight of waste = $W_h - W_c$ (tonnes)
- ρ_w = density of waste

HOLE 1

Derived values
$V_h =$
$a_h =$
$d_c =$
$W_h =$

Calculations
(1) $V_c = a_h \times d_c =$
(2) $V_w = V_h - V_c =$
(3) $W_c = \rho_c \times V_c = 2 \times V_c =$
(4) $W_w = W_h - W_c =$
(5) ρ_w (hole1) = $W_w/V_w =$

HOLE 2

Derived values
$V_h =$
$a_h =$
$d_c =$
$W_h =$

Calculations
(1) $V_c = a_h \times d_c =$
(2) $V_w = V_h - V_c =$
(3) $W_c = \rho_c \times V_c = 2 \times V_c =$
(4) $W_w = W_h - W_c =$
(5) ρ_w (hole2) = $W_w/V_w =$

HOLE 3

Derived values
$V_h =$
$a_h =$
$d_c =$
$W_h =$

Calculations
(1) $V_c = a_h \times d_c =$
(2) $V_w = V_h - V_c =$
(3) $W_c = \rho_c \times V_c = 2 \times V_c =$
(4) $W_w = W_h - W_c =$
(5) ρ_w (hole3) = $W_w/V_w =$

Average Waste Density (ρ_w) = $(\rho_w \text{ (hole1)} + \rho_w \text{ (hole2)} + \rho_w \text{ (hole3)})/3$

Average Waste Density (ρ_w) = tonnes per cubic metre

Certification by authorised representative of company conducting tests. The details recorded on these sheets are true and correct and have been determined by test in accordance with the method contained in EPA Information Bulletin 445 "Testing of Waste Compaction Density in Landfills".

Signature

Date

Name

Company