

BENCHMARK ENGINEERING

PERTH SAND PENETROMETER

User Guide



THE BEST CHOICE FOR THE MOST EXPERIENCED
ENGINEERS, BUILDERS AND EXCAVATORS

179 Mulgool road, Malaga WA - 6090

Ph: 08 9248 8884

@: info@penetrometers.com.au

www.benchmarkeng.com.au

Perth Sand Penetrometer - User Guide by Elson Abraham

Copyright © 2021 Benchmark Engineering Pty Ltd, Perth

All Rights Reserved.

All information within this document was true and correct at time of publishing. Benchmark Engineering is not liable for any failure of this device due to improper use and/or handling.

Second edition, October 2021

Cover Design by Elson Abraham

Printed in Western Australia.

Author: Elson Abraham

Product Development Engineer

Benchmark Engineering Pty Ltd, Perth

179 Mulgul Road, Malaga WA - 6090

www.benchmarkeng.com.au

TABLE OF CONTENTS

TABLE OF CONTENTS	2
1.INTRODUCTION	3
2.SAFETY NOTICE.....	4
3.DESCRPTION OF DEVICE.....	5
3.1.PERTH SAND PENETROMETER (PSP)	5
4.HARDWARE.....	6
4.1.HAMMER.....	6
4.2.UPPER SHAFT	6
4.3.ANVIL	6
4.4.LOWER SHAFT	6
4.5.PSP TIP.....	6
5.TEST PROCEDURE	7
6.MAINTENANCE.....	9
7.GUARANTEEE	9
8.REFERENCES	9

1. INTRODUCTION

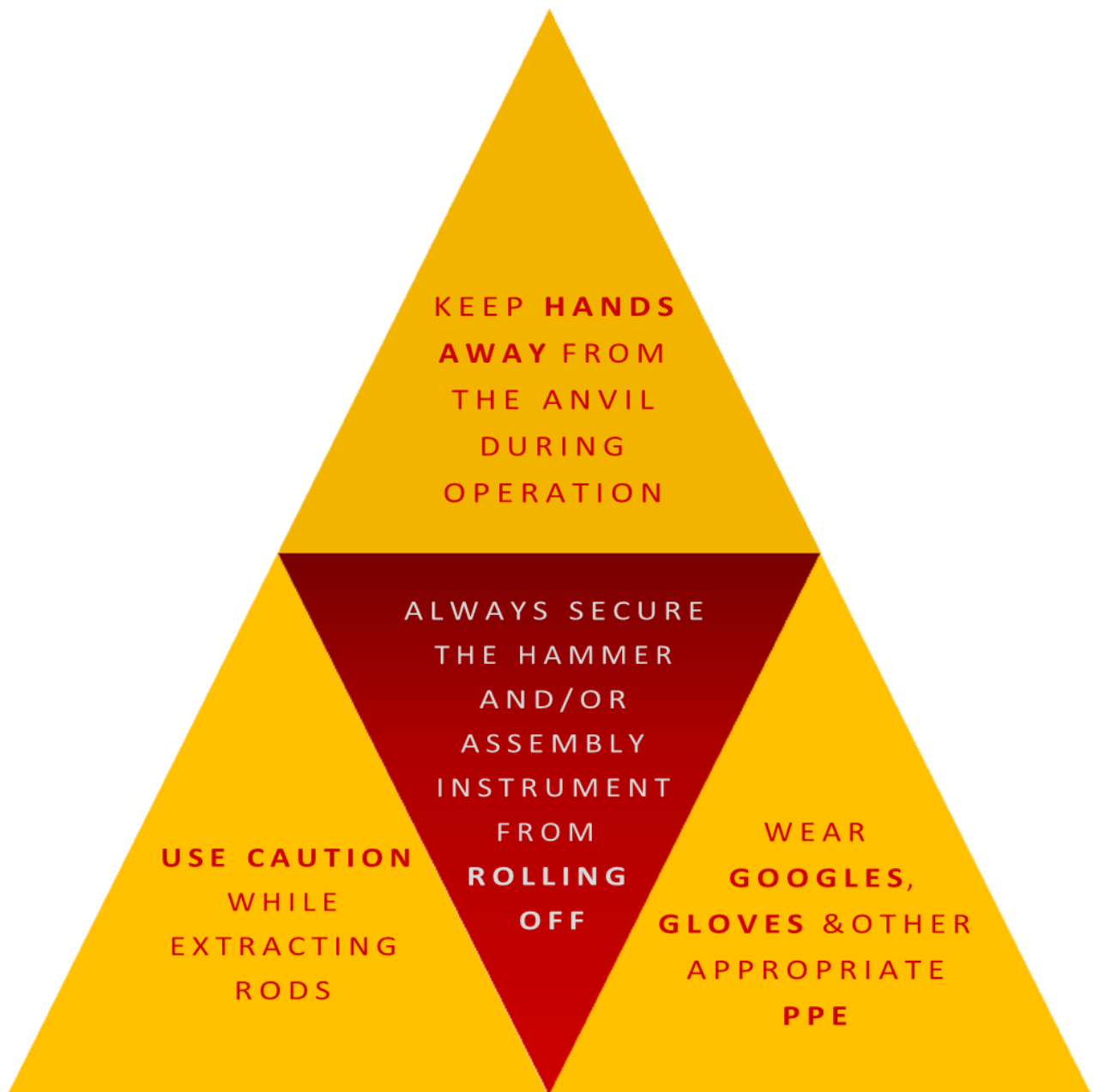
Benchmark Engineering has an excellent reputation for manufacturing high-precision, high-quality machined products. From 2009-2011, the Benchmark Perth Sand penetrometer was developed in collaboration with local and national geotechnical engineering firms. It is designed and manufactured in Western Australia with the finest standards of precision, accuracy, and reliability. We are confident that our penetrometers are tough, strong, and long-lasting.

The penetration test has a long history of use in geotechnical engineering. We only manufacture penetrometers that are compliant with all relevant Australian Standards. Many engineers and professionals have used Benchmark penetrometers in the field and found them to be high-performing, durable, and resistant to wear. We supply a wide variety of configurations with Penetrometer kits. Please see our website or contact us for more information.



Figure 1: Benchmark Engineering building 2021

2. SAFETY NOTICE



- Please strictly adhere to the instrument's guidelines for usage, care, and handling safely. The manufacturer cannot be held responsible for damages caused by inappropriate use of the product.
- Do not tamper or modify the device for any reason.
- During transportation or storage, ensure the hammer is supported enough to reduce bending of the penetrometer rod. We recommend using the carry case for transporting.

3. DESCRIPTION OF DEVICE

The Penetrometer is a simple hand-held device that can be used to measure the strength and density of soil. At Benchmark Engineering, we produce mainly 2 types of penetrometers. The Perth Sand Penetrometer (PSP) is described in detail in Australian Standard AS 1289.6.3.3. The physical layout of PSP is summarized in this section and illustrated in Figure 1.

3.1. Perth Sand Penetrometer (PSP)

The PSP made up of a 9kg sliding weight that provides a defined amount of energy by falling down a 600mm height into an anvil block. This energy is used to drive a 16mm steel rod with a blunt end into the ground. The steel rod is usually scribed in 50mm increments up to the length of the rod. The device's gross mass is less than 20kg, making it quite portable. The weight is lifted and released by hand, with some care necessary to ensure that:

- the weight is hoisted through the whole 600mm height,
- there is no impact on the upper stop at the top of the lift, and
- the weight is released cleanly and allowed to freefall without interference.

In order to extend the depth of testing, more rods can be attached after the hammer has been driven. A standard PSP can be tested to a depth of 1050mm.

NB: Depths tested greater than 450mm are outside the scope of the method. Friction will significantly affect the accuracy of the result beyond 450mm deep.



Figure 2: Benchmark Perth Sand Penetrometer

4. HARDWARE

4.1. Hammer

The 9kg hammer is manually lifted to the bottom of the stopper in the upper shaft, and then dropped on the anvil to transmit energy to the lower shaft to penetrate dirt.

4.2. Upper Shaft

The upper shaft is a 16mm diameter steel shaft on which the hammer slides. The length of upper shaft allows the hammer to drop a distance of 600mm.

4.3. Anvil

The Anvil is the hammer's lower stopping mechanism. It also serves as a link between the top and lower shafts. This enables disassembly, which decreases the size of the instrument for transport. *

4.4. Lower Shaft

The lower shaft is a 16mm diameter steel shaft, approximately 1m long and marked in 50mm increment for recording the penetration.

4.5. PSP Tip

The PSP tip measures 16mm in diameter and 50mm in length. More information is available on the Benchmark website.

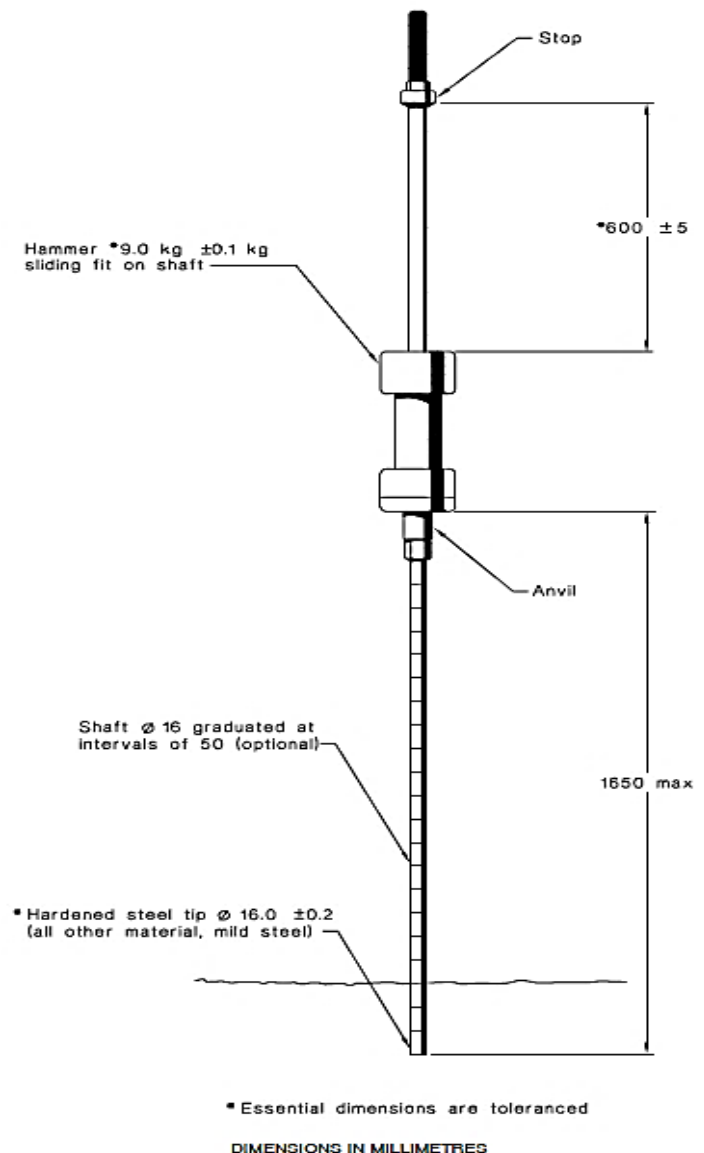


Figure 3: Perth Sand Penetrometer (Australian Standard AS 1289.6.3.3)

*Applies to 2-piece models only.

5. TEST PROCEDURE

The Perth Sand Penetrometer (PSP) test is a relatively quick field test to determine the penetration resistance of Perth soil. The density of soil is measured to evaluate its strength and ability to resist settlements. The compactive effort and moisture content are the two most essential factors in ensuring optimum density. By compacting the soil at or near optimal moisture content, you create the ideal conditions for any kind of compactible soil to sustain these strength properties. The following procedure is based on AS 1289.6.3.3.

NOTE: Before initiating this test, the whereabouts of probable subsurface utilities such as **gas, water, and electricity** should be identified.

Preparation of site: Unearth to the level to be tested. Remove any material, such as crushed rock or gravel, that will be too difficult to penetrate with the penetrometer or that may cause damage to the instrument. Tests are not to be performed on material that has particles greater than 2mm in size or material that is cohesive. Check if the drop height is 600mm.

- ❖ Record the depth from the surface level to the top surface of the layer to be tested, approximated to the closest 10mm.
- ❖ Then, penetrate the tip of the PSP to 150mm by tapping the hammer on the anvil while holding the penetrometer vertically with its hardened tip on the layer to be tested. This is called "Seating".
- ❖ Raise the hammer to the stop and let it drop freely onto the anvil. Count how many drops it takes to drive the penetrometer 300 mm (total penetration 450 mm) into the soil.
- ❖ Material type, moisture condition and location of ground water should be recorded.
- ❖ Use Table 1 to record the data.

(Australian Standard AS 1289.6.3.3)

NOTE: Selection of the appropriate correlation is a matter of professional judgment.

Calculations: The penetration resistance (N_p) is computed by calculating the number of strikes required to achieve a further penetration of 300 mm after the first 150 mm penetration. Interpretation of density data is via field or laboratory based analysis and professional judgement is required.

NOTE: Stop the test when eight strikes create a penetration of less than 20mm to avoid damage to the instrument.

Table 1: PSP Data Sheet

PSP DATA SHEET			
Project:		Date:	
Location:		Personnel:	
Depth of commencing the test:		Weather condition:	
Depth below ground level (mm)	No. of Blows (blows/300mm)	Depth below ground level (mm)	No. of Blows (blows/300mm)
0-150mm	Seating	0-150mm	Seating
150-450mm		150-450mm	
450 – 750mm		450 – 750mm	
750 – 1050mm		750 – 1050mm	
Note: PSP correlations only valid to 450 mm depth			

Table 2: Density Correlation HB 160-2006 (Australian Standard AS 1726-1993)

Density	Very Loose (VL)	Loose (L)	Medium Dense (MD)	Dense (D)	Very Dense (VD)
No. of Blows	≤ 2	2 – 6	6 – 8	8 – 15	> 15

6. MAINTENANCE

- Testing with the Benchmark penetrometer causes wear on the metal parts that make up the device.
- Periodic examinations of the Benchmark penetrometer for fatigue or damage are suggested in order to guarantee optimal service life.
- We will repair or replace any worn or broken parts with original Benchmark penetrometer parts.
- Prior to each test, the drive rod and hardened point should be thoroughly cleaned. Maintaining the drive rod's cleanliness and oil lubrication is essential.

We offer a one-year guarantee and have spare parts readily available for you in our workshop. Our dedicated team is committed to providing you with exceptional customer and after-sales service.

7. GUARANTEE

We offer a one-year guarantee on our PSP's. We have spare parts readily available for you in our workshop.

Our dedicated team is committed to providing you with exceptional customer and after-sales service.

8. REFERENCES

Australian Standard. (1997). Soil strength and consolidation tests—Determination of the penetration resistance of a soil—9 kg dynamic cone penetrometer test. *Methods of testing soils for engineering purposes.*, 1289.6.3.2.

Australian Standard AS 1289.6.3.3. (1997). Soil strength and consolidation tests—Determination of the penetration resistance of a soil—Perth sand penetrometer test. *Methods of testing soils for engineering.*

Australian Standard AS 1726-1993. (1981). Geotechnical site investigations. *Standards Association of Australia.*