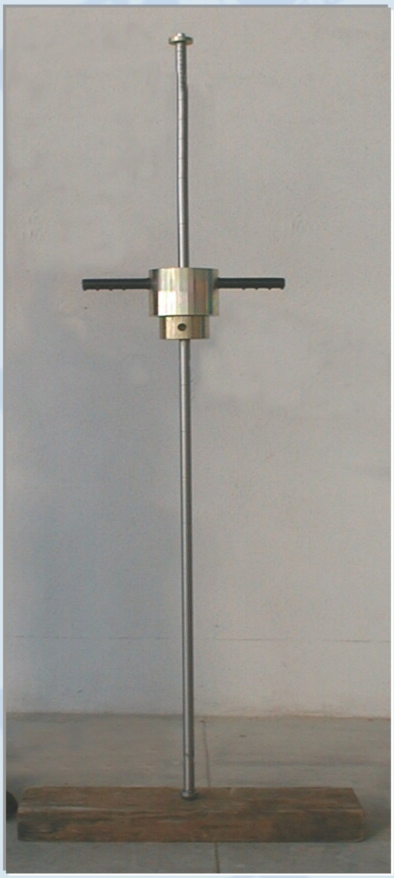
PAGANI GEOTECHNICAL EQUIPMENT

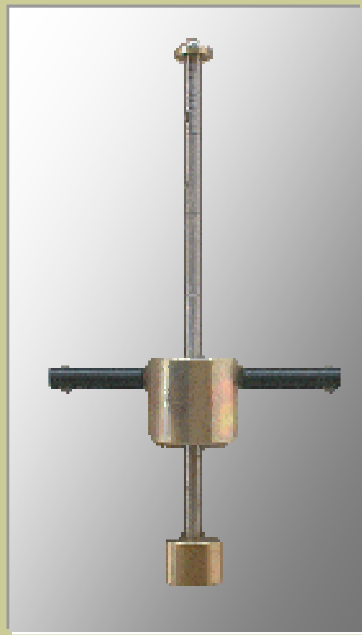
THE IN-SITU TESTING WORLD

DP Manual



Models:

DP	Dynamic DPL



ROD EXTRACTOR

ROD EXTRACTOR

DPL Datas

Hammer weight	Fall height	∅ Rods	Cone
10 [kg]	500 [mm]	22 [mm]	10 [cm^2] - 90°

PAGANI GEOTECHNICAL EQUIPMENT

Sede Legale:
Loc. Santimento, 44
29010 Calendasco (PC)
ITALIA

Produzione:
Loc. Campogrande
29010 Calendasco (PC)
ITALIA

E-mail: e.pagani@tin.it

PAGANI *Geotechnical Equipment s.r.l.*

PAGANI Penetrometer mod. DPM 30-20

Only for DPML dynamic tests

Penetration System

Drop hammer weight (Kg)	Free fall height (mm)	Special steel rods	Cone tip
30 kg	200 mm	Ø 20 mm Length1000 mm Weight 2,4 kg	Ø 35,6 mm B 60° A 10 cm^2

Available versions

Electric motor	Gasoline engine
	

PAGANI *Geotechnical Equipment s.r.l.*

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Data above are subject to be changed without any previous notice.

PAGANI *Geotechnical Equipment s.r.l.*

PAGANI Penetrometer mod. TG 30-20

AVAILABLE VERSIONS

DPL

DPML

DPM

DIMENSIONS AND WEIGHT

	DPML/DPM	DPL
Height [mm]	1000	1000
Length [mm]	1900	1900
Width [mm]	1000	1000
Weight [kg]	350	330

TECHNICAL FEATURES

Engine	Type	Patrol; 1 cyl.; 45°
	Power [HP (kW) - giri]	6 (4.5) - 3600
	Cooling system	Air
Driving	On wheels with hydrostatic transmission	4 x 4
	Speed (km/h)	0 ÷ 2.5
	Gradience	20%
Hydraulic pumps	Nr. of pumps	1
	Max operative pression (bar)	150
Outriggers	Nr.	4
	Type	Manual

DATI DP

	Hammer weight (kg)	Free fall height (mm)	Rods Ø (mm)	Cone cm^2— °
DPML	30	200	20 / 22	10— 60
DPM	30	500	32	10— 90

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The In-Situ Testing World

Field Inspection
Vane Tester VT12

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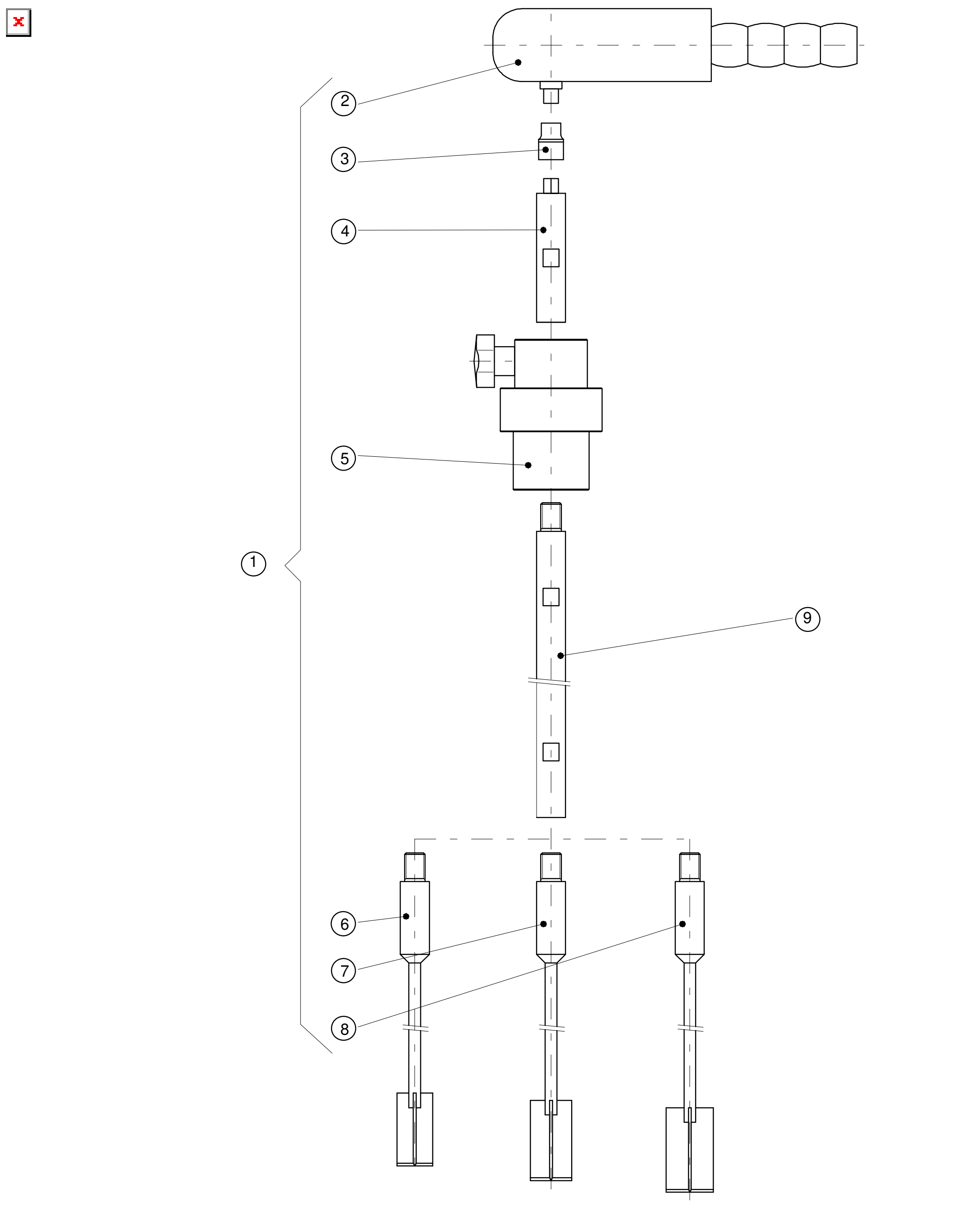
1. *Equipment*



REF. POS.	PART. N. CODICE	Q.TY Q.TA'	DENOMINAZIONE	DESCRIPTION	NOTE
9	000561	A.R.	ASTA	ROD	ø20x1000
8	001332	1	. PALETTA	. VANE	60x30
7	001031	1	. PALETTA	. VANE	50x25
6	001030	1	. PALETTA	. VANE	38x19
5	001406	1	. CENTRATORE	. ROD DRIVER	
4	001028	1	. CAPPELLOTTO	. DRIVE CAP	
3	001029	1	. CHIAVE A BUSSOLA	. NUT SOCKET	
2	001015	1	. CHIAVE TORSIOMETRICA	. TORQUE WRENCH	
1	001407	1	GRUPPO VANE TEST	VANE TEST SET	

DA DIS.1271

A.R.: A RICHIESTA
ON DEMAND

DENOMINAZIONE/DESCRIPTION: VANE TEST GROUP	DIS/DRW: 1726	FOGLIO/SHEET: 1/1	PAGANI Geotechnical Equipment
SERIE VANE TEST		DATA/DATE: 06.04.01	

2. *Aim and test description*

This test enables the direct measurement of the undrained shear resistance of saturated cohesive soils.

It can be carried out either in the field, on the wall or at the bottom of an excavation, or even in a laboratory on a confined specimen.

The test consists of forcing into the soil a vane equipped with four orthogonal blades and then rotating until the soil failure. Maximum torque value must be measured and recorded.

Afterwards the remoulding shear resistance of the soil can be measured rotating the vane for several turns.

The vanes have a rectangular shape (**Fig. 1**) and a height double their diameter, according to the recommendation included in the EUROCODE 7 (1977) and ASTM Standard Code (D 2573); in the latter one also vanes having a tapered end are allowed.

The above mentioned codes prescribe that the rotation must be carried out at a rate of 0.1- 0.2 degrees/sec., that is (6 –12 degrees/min).

Over the blades of the vane, a thin enlarging ring can be applied so that the main part of the resistance due to the soil friction along the tract of the rod inserted into the soil does not affect the measures.

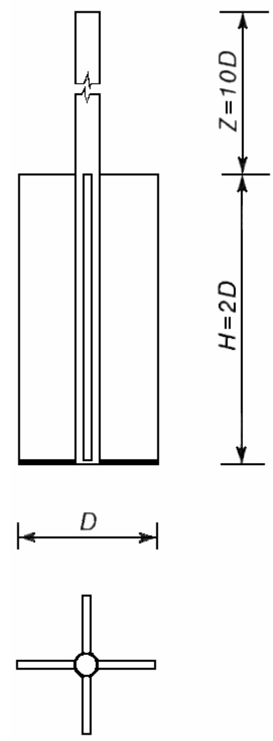


Fig. 1

Tests can be also carried out at the bottom of a borehole; in this case the vane must penetrate at least five times the hole diameter into the soil below the bottom of the hole to be sure that undisturbed soil will be tested (ASTM D 2573).

Test is carried out as follows:

- Push the rod supporting the vane to the estimated test depth.
- Rotate the vane from the surface at the prescribed rate, using the relevant torque wrench.
- Measure the maximum torque required to reach the soil failure.
- Go on rotating regularly the vane for at least 3 complete turns measuring and recording the residual torque.

To carry out deep vane tests with the Pagani Geotechnical Equipment static or dynamic penetrometers the following procedure (see **Fig. 2**) is suggested:

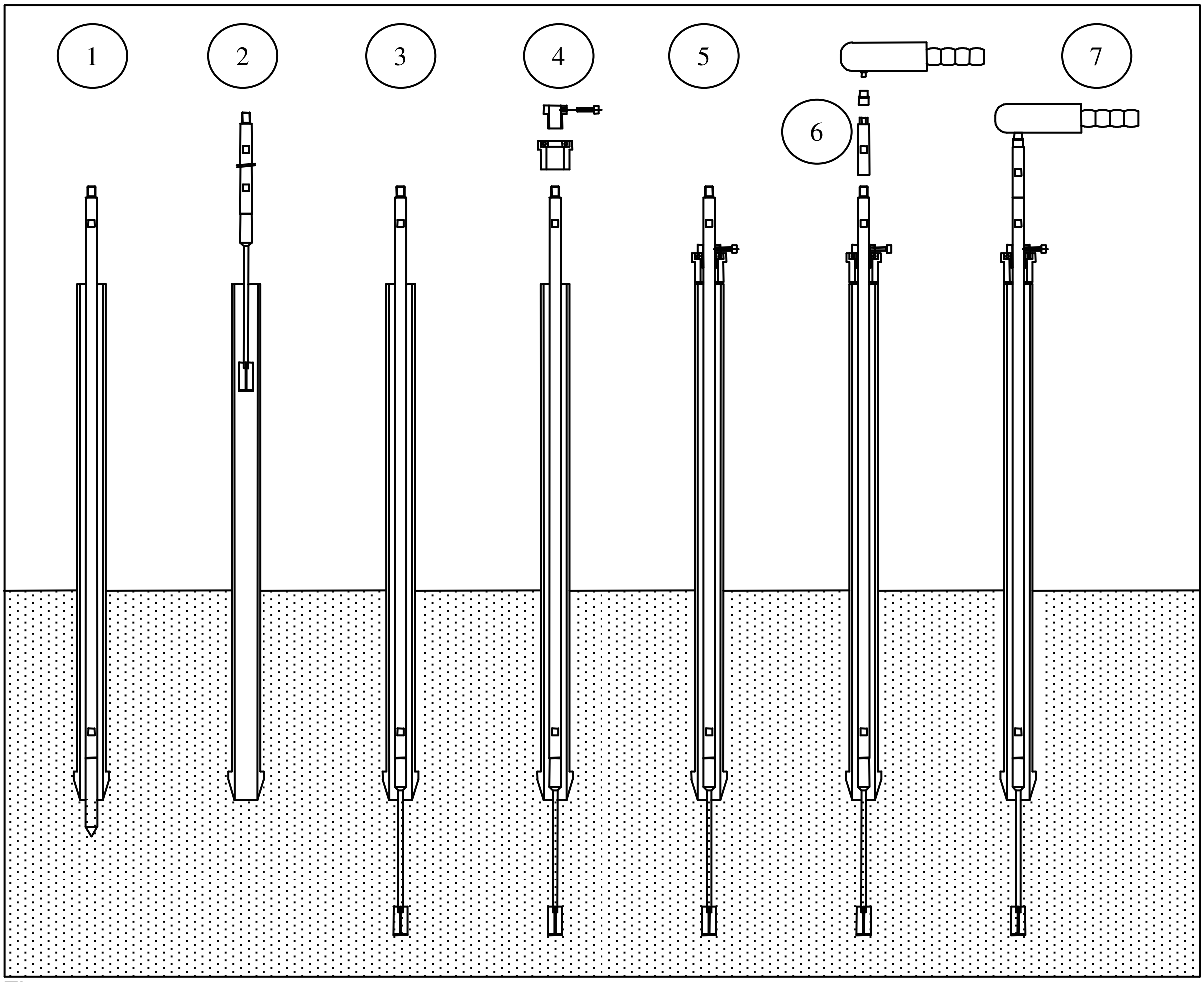


Fig. 2

1. Perform a static test (CPT-CPTU) up to the depth close to where the vane test has to be carried out; the related steel casing shall be inserted after the penetration of each rod.
2. Withdraw only rods and tip, leaving the casing in place.
3. Lower the vane joined to the relevant rods and force it below the hole bottom to reach the undisturbed soil.
4. Set the thrust bearing among rod and casing. Set the centered sleeve to support the extension rods.
5. Lock the screw to fasten extension rods to supporting sleeve.
6. Apply the torque wrench.
7. Carry out the test.

Vanes which can be used together with the different types of casing tubes are the following:

Model of Penetrometer Pagani Geotechnical Equipment	Inner / outer Diameter of the casing tubes	Usable vane	
		Size	Code
DPM 30 *TG 30 / 20*	*20 / 33 mm*	*38x19*	*001032*
TG 63 / 100 *TG 63 / 200* *TG 73 / 200*	*32 / 48 mm*	*60x30* *50x25* *38x19*	*001030* *001031* *001032*

3. Calculation of the undrained shear resistance

Undrained shear resistance at failure ($S_{u(FV)}$) is calculated by the maximum torque required to cut the soil included into the cylinder obtained rotating the vane blades.

The general formula, referred to rectangular vanes having height (H) and diameter (D), is:

$$S_{u(FV)} = T / ((\pi D^3/2)\,(H/D + a/2)) \qquad (1)$$

where:

T = maximum applied torque (deducted any friction).

a = factor depending by the assumed shear stress distribution at the ends of the cylinder obtained rotating the vane blades and amounting to 2/3 for uniform shear stress.

For rectangular vanes having H/D = 2, equation (1) is reduced to:

$$Su(FV) = 6T / 7\pi D^3 = 0.273T / D^3 \qquad (2)$$

The remoulded shear strength value is calculated using the above mentioned formula (2) introducing the value of the torque, free from any friction, measured after some vane rotation turns, that is when the soil offers a fast constant resistance.

Fig. 3

By using the provided vanes having a ratio H/D=2 and values of the diameter equal to 30, 25 e 19 mm respectively, as well as the equipped torque wrench (model ADS12D - **Fig. 3**) with end scale amounting to 12 Nm, the measuring intervals are the following:

Vane 60 x 30mm: **to 1 Nm displayed, corresponds 10.11 kN/m^2** of shear resistance Su; (end scale 121.26 kN/m^2)

Vane 50 x 25mm **to 1 Nm displayed, corresponds 17.46 kN/m^2** of shear resistance Su; (end scale 209.54 kN/m^2)

Vane 38 x 19mm **to 1 Nm displayed, corresponds 39.78 kN/m^2** of shear resistance Su; (end scale 477.34 kN/m^2)

The torque wrench key is calibrated by the manufacturer also supplying the relevant certificate; the maximum difference between the value of the measured stress and the actual one is 4%.

4. Soil sensitivity

Sensitivity "S_t" of a saturated cohesive soil is defined by the ratio between the maximum (peak) undrained shear resistance and the residual one.
Sensitivity is therefore an index of the contribution to the shear resistance due to the structure and to the intergranular links of the deposit.

5. Valuation of results

Vane test can supply a reasonable valuation of the undrained shear resistance of saturated clayey deposits, as to stability analyses in terms of total stresses. Hard clays and the heavy preconsolidated ones having a preconsolidation degree (OCR) greater than 6 can be considered as an exception.
It is recommended to adjust the measured value multiplaying it by a correction coefficient obtained from **Fig. 4** (Aas and al., 1986). This chart is based upon later verifications, which have been carried out on a quite large number of actual cases of embankments and excavations failures occurred in sites geotechnically well recorded.
This chart takes into consideration the (indirect) influence of the plasticity index PI. A distinction bewteen normalconsolitated (NC) and overconsolidated (OC) clays is instead required.
Authors confirm it can be applied to both type of controls, excavations and embankments, but they suggest a careful automatic application when the surface failure is shallow. Anyway, they suggest to apply a correction factor value μ =1 when the ratio between the measured shear resistance ($S_{u(FV)}$) and the effective vertical stress (σ') is less than 0.2.

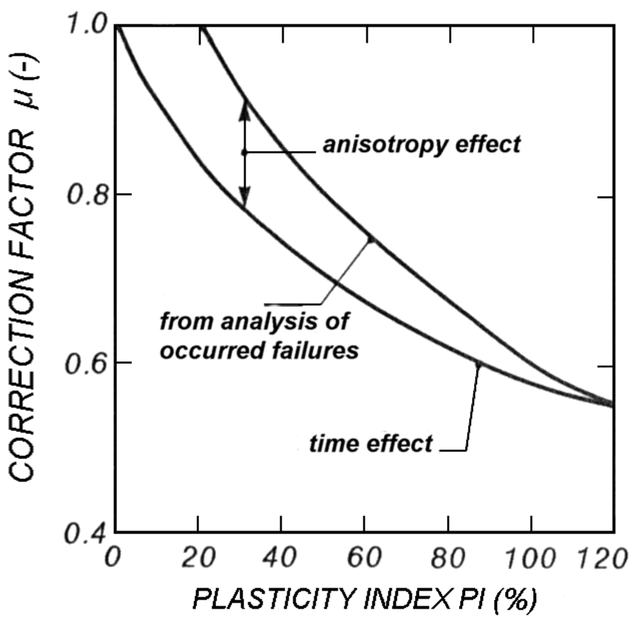


Fig. 4

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