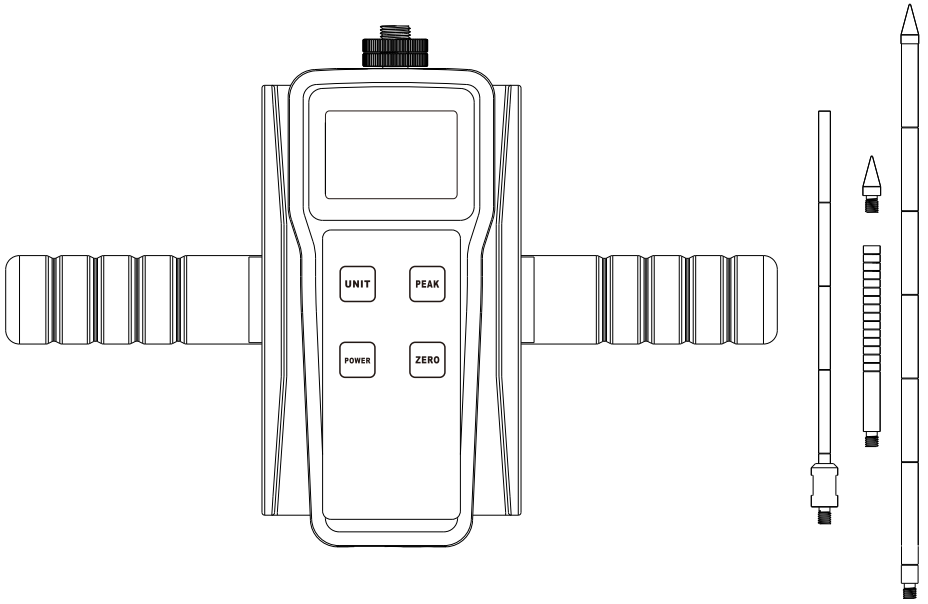
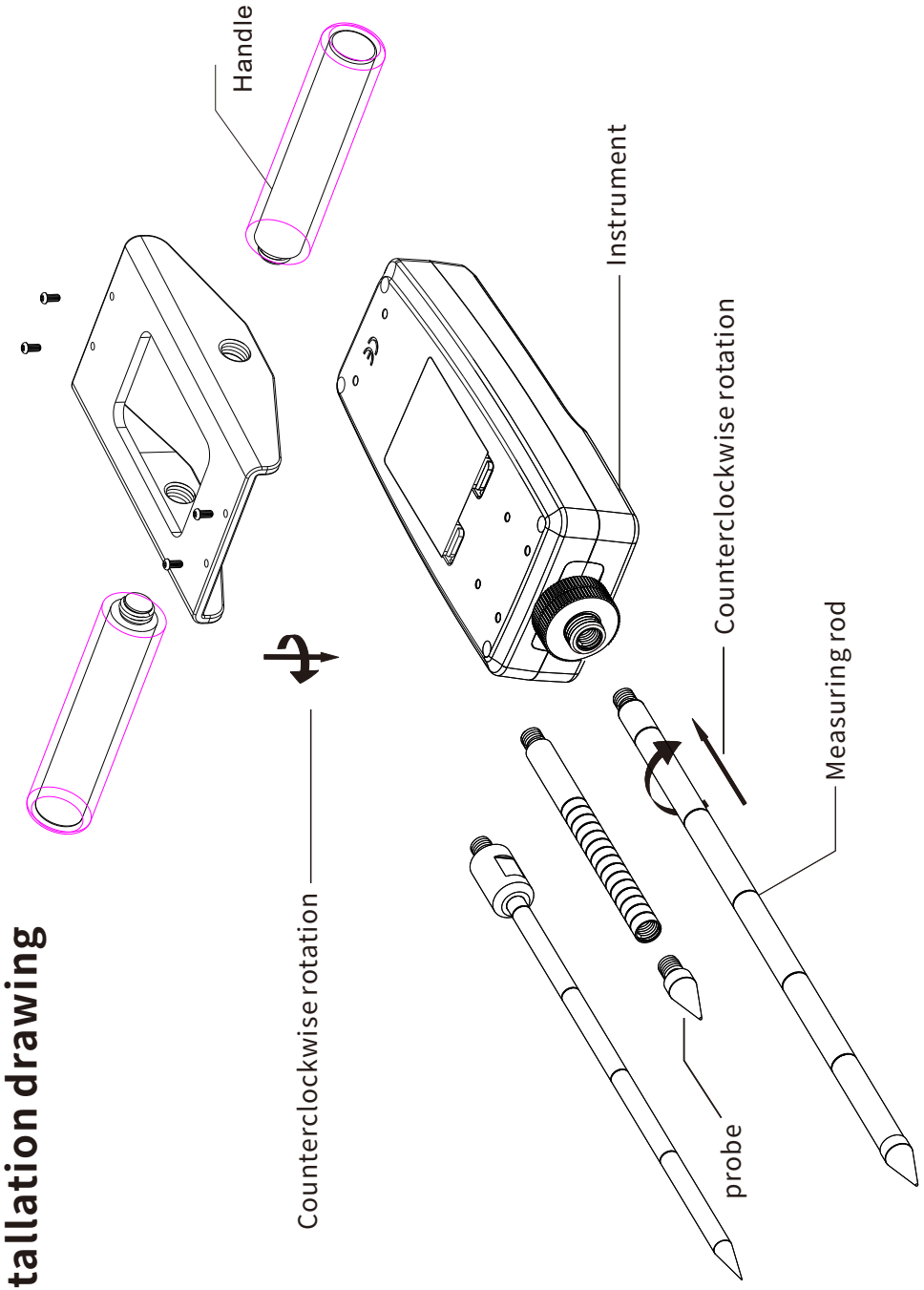
SOIL LOAD PENETROMETER
&
GROUND BEARING CAPACITY DETECTOR
FM-204DJ





Installation drawing

I. Product Overview

Universal type penetrometer and filling compactness detector, detector or the foundation bearing capacity is used to detect dry density of backfill soil and uniformity, can save to replace sand ring cutting irrigation irrigation water in the construction site inspect the filled soil bedding face, a full range of quality and reduce the workload of geotechnical tests, shorten the construction period, it is suitable for layering construction units, roller compaction test, It is also suitable for quality inspection and supervision company sampling inspection of any layer, but also suitable for colleges and universities to teach and learn to do geotechnical experiments, it has no radioactive nuclear pollution, low price, small volume, easy to carry on site.

The product has been included in the international standard in 1982, and has been widely used in engineering construction in the United States, Japan, Russia and other countries. It has also been included in the foundation design code, foundation treatment technology code and foundation construction quality acceptance code. At present, it has been widely used in civil and industrial construction, highway, railway, road and bridge, municipal drainage, pipeline line, water conservancy, dam construction, dike, irrigation canal, reservoir construction, airport runway engineering. In the past, it took at least 8 hours to take a set of ring knives for three times of combustion, and the results were far behind the progress of the project, which had no guiding significance for the on-site construction at that time. When the inspection indicators are found to be unqualified or problematic, the site filling has already covered two or three layers of soil. The maximum 15-20 minutes for a group of tests with the penetration method is efficient, fast and productive. Because of its detection depth of 30 cm, but also extended to 1.5 m, so it can timely find soft weakness and hidden trouble at the bottom, to ensure the quality of construction.

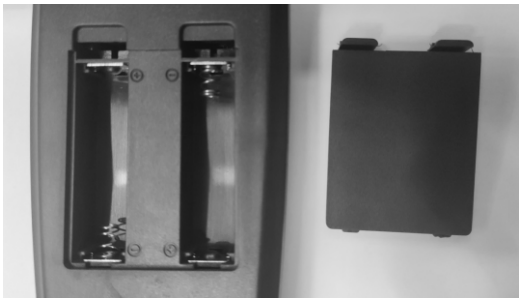
Universal type penetro meter is based on the geotechnical experiment: the penetration of soil and the dry density of soil, the relationship between the relationship between the penetration and water content of soil and the relationship between soil water volume and compactness, through a lot of penetration and ring cutting parallel contrast test And establish the regression equation, the rate of penetration resistance between the dry density and the related data sheet. By measuring the penetration resistance and looking up the table, the dry density can be quickly obtained, and then the compaction coefficient can be quickly calculated. Two, main technical parameters

2. main technical parameters

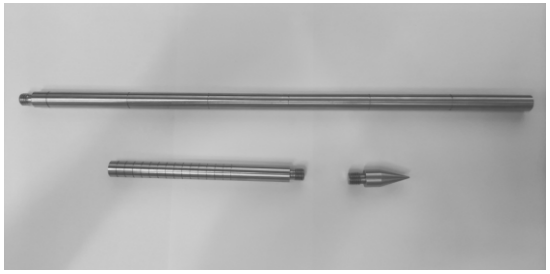
Measuring range: 0kg-100kg (0N-1000N)
Test depth: 0cm-30cm
Material tested: all kinds of backfill soil, clay, sand and mixed soil after rolling
Application environment: highway, railway, reservoir, dike, dam and civil building, etc
Test results: filling resistance, relative density, compaction coefficient and foundation bearing capacity
Power: 2 AA batteries(6 V dc matching)
Weight (excluding battery): instrument 415 g, handle 295 g, probe rod 380 g.
Test accuracy:≤0.25%
Shutdown mode: Close automatically or manually shut down 10 minutes

3. instrument assembly

(I) Battery installation: 2 AA batteries are required for the use of the instrument. Open the back cover, the box is marked with "+" and "-" poles, and assemble the battery according to the polarity marked.



If not used for a long time, you need to take out the battery to avoid damage to the instrument.
(2) mounting the probe rod: assemble the probe rod to the lower part of the instrument. There are three kinds of probe rod in the instrument box, ϕ7mm*240mm, ϕ10*120mm and ϕ10mm*320mm. The two ϕ 10 rods share one probe.



When ϕ 7 probe rod is connected to the main engine, a corresponding joint is required.

Connect the probe rod to the main engine before testing. Users according to different needs, choose different probe rod. Check between the probe and the probe before use, the screw thread buckle between the probe and the host shaft must be tightened, not loose, lest the probe twisted deformation or broken.
(3) Adjust the protection nut: before measuring, screw the two protection nuts at the bottom of the host to the middle, do not touch the protection sleeve. When the instrument is not in use, keep the protective nut close to the protective sheath to protect the force measuring elements

Similarly, when P is any number =725N, plug in ③ to get,

$$\lambda_{\text{Any number}} = \frac{725}{730} = 0.993$$

Conclusion: Firstly, the maximum P value under the maximum Rd state is calculated, and then an arbitrary value is obtained as long as the construction site is selected at any point. By substituting equation ③, λ arbitrary of the corresponding compaction system at this point can be obtained.

Appendix 4-compaction coefficient calculation method

1. According to the known Rd_{MAX} and Rd_{Design}, the pressure coefficient λ design is calculated

①

$$\lambda_{\text{Any number}}\frac{\mathrm{Rd}_{\text{Design}}}{\mathrm{Rd}_{\text{MAX}}}=\frac{1.58}{1.63}=0.97$$

2. Calculate the maximum P in Rdmax state:

②

Equation: $$\frac{P_{\text{MAX}}}{P_{\text{design}}}=\frac{\lambda_{\text{MAX}}}{\lambda_{\text{Design}}}$$

Substitute the specific parameters into:

$$\frac{P_{\text{MAX}}}{709}=\frac{1}{0.97}$$

Equation: $$P_{\text{MAX}}=\frac{1}{0.97}*709=730(\mathrm{N})$$

3.Three, arbitrary calculation of λ :

③

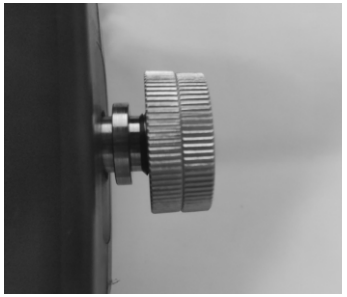
Equation:$$\lambda_{\text{Any number}}\frac{\mathrm{P}_{\text{any number}}}{\mathrm{P}_{\text{MAX}}}$$

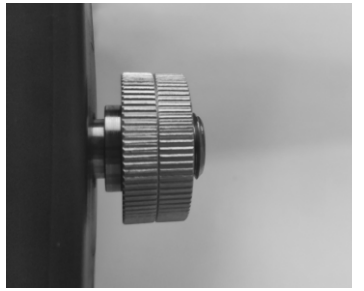
When the measured P is arbitrary =700 (N). Substitute in ③ to compute an arbitrary value of λ,

$$\lambda_{\text{Any number}}\frac{700}{730}=0.959$$

Similarly, when P is equal to 715 (N). ① Substitute in ③ and calculate an arbitrary value of λ,

$$\lambda_{\text{Any number}}\frac{715}{730}=0.979$$





measurement **protect**

4.Instrument startup

After the battery is installed or the AC POWER is switched on, press the power button to turn it on.

(1) Shutdown of the instrument

(2) Manual shutdown In the startup state, press and hold the POWER button (POWER) largeAlmost 2 seconds, when "OFF" appears on the display, release the key and shut down the instrument.

(3) Automatic shutdown The instrument automatically shuts down after 10 minutes of no key operation.

5. penetration resistance P measurement

(1) Install the probe rod, screw the two protection nuts at the lower part of the main engine to the middle, do not get the protection sleeve.

(two) open the switch on the right of the screen, the screen displays an initial value.

(three) Suspend the instrument and press the [Clear] key to adjust the display value to 0. Reset only need to boot reset once can be.

(4) Drill a hole of suitable depth at the measuring point. For example, if you need to measure penetration resistance at a depth of 30cm, drill a hole at a depth of 20cm. The purpose of drilling is to save the operator the effort to drill the probe to a specified depth.

(5) Insert the probe of the instrument into the depth to be measured. Penetration speed should be uniform, down ward The force should be smooth and continuous, generally inserted into 10 cm, it takes 10-15 seconds, not too fast, do not Use the force. Don't slow down. Do it in one go. One man in, one man in When the instrument is about to penetrate to the specified depth, press the [PEAK] key. When inserted into the specified At depth, the value shown by the instrument is multiplied by 10, which is the penetration resistance. After recording the data, press again Press the [PEAK] key to release the maximum value, so that you can press [PEAK] the next time to record the maximum value Great value.

6. Obtaining Rd of relative dry density

(1) Penetration resistance is obtained according to the measurement of penetration resistance P.

(2) According to the soil quality, check the corresponding dry density data table (see Appendix 1- Dry density data for details)

According to the penetration resistance, the relative dry density Rd was obtained. The dry density data table is only of reference value for some special soils. The dry density data table was drawn by a large number of parallel contrast tests of penetration and ring knife method. If you have any questions or concerns, you can draw the dry density data table by comparing with the ring knife method according to the actual soil quality. (See Appendix 2- Calculation method of relative dry density values and Appendix 3- Calibration Method)

7. calculation of compacting coefficient λ

(I) According to the previous step, find the relative dry density dry density Rd.

(2) The relative dry density value divided by the current maximum dry density value of soil, is the required compaction coefficient. (See Appendix 4- Calculation method of compaction coefficient)

8. calculation of foundation bearing capacity

(1) According to the relative dry density value Rd, the relative dry density value Rd was found. (2) Rd multiplied by 100, the value obtained is the foundation bearing capacity, the unit is kPa. If you want to do it in kilograms per square meter, you just multiply it by 100.

9. Storage after measurement

(1) Tighten the protection nut close to the protective sleeve to protect the force measuring original inside the instrument.

(2) The probe rod from the instrument up and down, clean and save.

(3) Remove the battery from the instrument to avoid battery leakage and damage to the instrument.

10. Fault analysis

(I) After the battery is installed and the switch is turned on, the screen of the instrument does not display:

First, make sure the battery is installed correctly. Second, replace the battery and try it. Third, please contact the dealer or manufacturer to solve the problem.

(2) Unstable multiple measurement data:

The data is unstable for many times, which may be caused by insufficient battery power supply. Please try a new battery.

When the relevant data table of the local area is established, and there is no time, no condition to calibrate or do parallel comparison test, this simple judgment method can be used to stipulate: roll four times, then use this instrument for on-site inspection, and record the reading P value of the instrument is higher than or equal to 700N, that is, the dry density is qualified: for example, (750N, 810N) are qualified. If less than 700N is not qualified, must be rolled again - again test. When the water content changes, such as the filler composition changes or changing the material field, a set of ring knife recalibration and its corresponding standard penetration P value should be made. In the above calibration tests, at least three groups of the same soil must be made before curves can be. drawn and regular data tables can be summarized, and regression equations can be established.

Attached table: Times of rolling: four times. Soil classification: cohesive soil, 10cm probe penetration.

Diameter: 10mm. Number of ring knives: 5 groups.

Experimental results loci	one	two	three	four	five	six	seven	eight	average
Ring knife test results Hd	165								
Penetration test	680	695	700	695	715	705	800	390	701
water content WO	18%								

$$Rd_{\text{Any number}} = \frac{720}{709} \times 1.58 = 1.60$$

Measured $\mathbf{P}_{\text{Any number}}$=725N Substitute into equation ② to obtain:

$$Rd_{\text{Any number}} = \frac{725}{709} \times 1.58 = 1.61$$

Conclusion: P design can be calculated as long as Rd design and P design are known. In the case of Rd design and P design, the corresponding dry capacity value can be obtained as long as P is measured at any point on site and substituted into the above formula. Rd is arbitrary, and so on.

Appendix 3- Measurement method

(1) If the conditions permit, the unit shall conduct parallel contrast test by itself with ring knife and penetrometer. The method is to peel off 1/3 of the surface layer and the remaining 1/3 of the bottom layer after rolling three to five times, and test the 1/3 to 2/3 of the middle layer.

(2) Take 3 to 5 ring knives from the position 2/3 deep in the detection layer. When the dry density reaches the qualified requirements, write down the dry density and water content and fill in the attached table as the standard value of ring knives.

(3) At the same time, draw a circle with a radius of about 30cm as the center of the ring knife. Take 7 to 8 points on the circumference to conduct penetration test, and the penetration depth should be consistent with the depth of the ring knife at 1/3 of the cushion* Select between 2/3, eliminate the points with large deviation, and take the average value of the other points as the standard penetration value corresponding to the ring knife.

(4) When the standard penetration resistance value is determined, the penetrometer can be used instead of the ring knife method to enter the construction site to inspect the filling quality in a wide area and in all directions. When the water content is controlled, when the test result is greater than or equal to the standard penetration resistance value, it is considered that the rolling is closed; when the test result is lower than the standard penetration resistance value, it is considered that the dry density is low, and the rolling is continued if it is unqualified. Fill in the results of the parallel tests in the attached table below:

Note: soil classification (cohesive soil, sandy soil, mixed soil, etc.), bedding thickness, rolling times, penetration depth and probe diameter should be indicated in the attached table. Design requirements dry density and maximum dry density. Examples of songhua River embankment construction are listed below:

Dam embankment filling soil composition: just clay. Rolling times: four times. Take a group of ring knives as: 5 soil samples. Experimental results: Rd= 1.65, Wo=18%, the compactness was confirmed to be qualified. At the same time, let the 30cm penetrometer enter the field for the test. Dig out 10cm of the surface and 10cm of the bottom at the same position of the ring cutter, select 10-15 cm of the middle layer for the penetration depth, read the penetration resistance value, and then take seven to eight points of penetration around the ring cutter. The test results of the eight points are:

①P_{20}=680N ②P_{20}=700N ③P_{20}=710N ④P_{20}=695N

11.Question and answer for user operation

(I) Must the depth of the test point taken from 7 to 8 o 'clock of the penometer be consistent?

In the same group of tests on the same measured surface, the test depth must be consistent, for example, when h=10 cm, all measuring points must penetrate 10 cm to read the results.

(2) when is the reading accurate?

When the probe is inserted to a standard depth, the instantaneous peak, the maximum, should be read. The method of reading is: the operator should always keep constant pressure, the recorder should pay attention to observe the insertion depth do not interfere with the operator, when the standard depth boundary is reached, when the soil surface just pressed into the boundary moment, immediately press the button to read the maximum value. If you can't grasp the keys, you can also do not press the keys. Direct observation of the instantaneous peak when the line is pressed. The method is to place your finger on a predetermined standard depth limit, keep your eye on the reading display, and read the instantaneous peak as soon as the soil touches your finger.

(3) What should be paid attention to when detecting the bottom compactness?

It is necessary to calculate the thickness of the interface of each two cushion layers, and avoid detection on the interface, because the high density here is not representative. For example, the first layer is 30cm thick, and the soil is drilled 10cm deep clockwise with a wooden drill with a diameter of 30cm, and then the soil is pulled out counterclockwise. The section from 10cm to 20cm is the best detection layer. When detecting the second layer, attention should be paid to the bottom of the first layer at 20cm-30cm and the top layer at 30-40cm. Also can not test, but also to peel off, with wood drill clockwise to 40 cm and then counterclockwise to pull out the soil, from 40 cm to 50 cm is the second layer of effective detection layer, remember to peel off 1/3 of each cushion layer, leaving 1/3 of the bottom layer, the measured layer in the middle 2/3, and then check a layer, and so on.

12. matters needing attention

(1) To determine the bearing capacity of the foundation at the same depth and at different points on the same working surface, take a point at an interval of 0.5 meters, and take seven to eight measuring points in total, and the penetration depth of each point should be consistent.

(2) to measure the bearing capacity of the different depth, can match with a diameter of 2.5 cm~ 3.0 cm woodworking drill, clockwise, counterclockwise to soil exits, drill a layer of a layer, drilled down another layer, the measured through part of the disturbed soil come back, then a layer of operation in order to detect time, anyhow to grasp a principle, be measured surface and by measuring point must be no disturbance of the earth, Disturb a layer, drill off - - layer, drill off a layer of disturbed soil out and then check down, it is best to keep the same depth of each layer of detection, in order to accurately evaluate the uniformity and change of soil. For example: to select a point in a site, in order to understand the ground endurance of each layer between 0 and 1.5 meters in this hole, take a wooden drill with a diameter of 3cm first, drill into 10cm depth and then pull out the topsoil in reverse. Then the host connection probe is inserted into the hole 10cm, the data is recorded and then drilled down 10cm, the disturbed soil part of the soil out of the test, the instrument is inserted down 10cm. The insertion depth can be calculated by observing the rod scale from the ground.

(4) Remove the probe rod after each use, wipe the rod, butter it, and wrap it in plastic paper to prevent rust. The threaded part of the rear cover of the battery case should also be coated with a little butter to prevent rust.

(5) The interval of a period of time is not used, the battery can be withdrawn, so as not to be affected by moisture leakage.

13. Error analysis

(I) When the water content of dike soil is greatly different, the data of penetration resistance will be affected, such as soil

When the water content increases, the penetration resistance decreases. When the water content decreases, the penetration resistance increases. The best solution to reduce the error is to follow up the test immediately after rolling, because the field air drying and sun exposure after rolling will lose a lot of water every hour, directly affecting the accuracy of the dry density value. In actual operation, there are many factors that affect the compacting uniformity of the penetrometer, such as filling

The composition of the material of cohesive soil, sand soil, mixed soil mixing uniformity), porosity, hole hole, aggregate content, slope, water content change and the degree of compaction, near the center of the operating experience of the author, and will directly influence the resistance value, which requires engineering technical personnel in practice through the penetrometer contrast test with cutting ring, Master the water content identification method of soil, all kinds of soil discrimination method and other means, constantly summarize experience, constantly explore, master rules, overcome shortcomings, perfect the actual application technology of the penetration instrument.

(2) The reading value suddenly increases or decreases in the penetration process: the penetration resistance value will be significantly higher or lower in the case of compaction hard block, edge block hole, root and bark crack during the construction site operation. It can prompt the operator to analyze the cause in time, find out the soft weakness and abnormal point of the bottom layer, and timely find loopholes to eliminate the hidden dangers of the project. The characteristics and uniqueness of the penetrometer just make up for the limitation of local sampling of the ring knife. The penetrometer can pick and fill points randomly, anytime and anywhere, which is very flexible and not limited by time and place.

(3) When the dry capacity is qualified in the ring knife experiment, but the penetration value of each point is low in the perpenter experiment, the reasons should be analyzed: first, whether the sand content of the soil is high or not will directly affect the dry capacity value; Second, the moisture content of the soil is large, and the penetration value is low. At this time, it can be dried by air and then rolled again after half a day, and the penetration value is increased.

Appendix 2- Calculation of relative dry density values

Given that the maximum dry capacity Rd_{MAX}=1.63 and the design requirement Rd_{Design}=1.58, $Rd_{Any\ number}$ value of any measured point is required to be calculated. First, a set of ring knives are taken to measure $Rd_{measured}$= 1.56, and the penetration value $P_{measured}$=700N is measured at the same point.

(1) Equation:

① $$\frac{P_{design}}{P_{measured}} = \frac{R\,d_{Design}}{Rd_{measured}}$$

Substituting the above parameters into formula 1, we can get:

$$\frac{P_{design}}{100} = \frac{1.58}{1.56}$$

Solve the equation: $P_{design} = \frac{1.58}{1.56} \times 700 = 709(N)$

(2) When the measured $P_{Any\ numbe}$=715 (N), $Rd_{Any\ numbe}$ can be calculated according to the following formula.

② Equation: $$\frac{R\,d_{Any\ numbe}}{R\,d_{Design}} = \frac{P_{any\ numbe}}{P_{design}}$$

Substitute the specific parameters into equation ② and get:

$$\frac{Rd_{Any\ numbe}}{1.58} = \frac{715}{709}$$

Solve the equation: $Rd_{Design} = \frac{715}{709} \times 1.58 = 1.59$

When the measured $P_{Any\ numbe}$ =720N, equation ② is also substituted into:

Dry density data sheet　　Northwest yard offers suitable silt fine sand

P	300	330	350	380	400	410	430	440
Rd	1. 35	1. 38	1. 40	1. 46	1. 49	1. 50	1. 51	1. 52
P	450	470	490	500	520	540	550	570
Rd	1. 53	1. 54	1. 55	1. 56	1. 57	1. 58	1. 59	1. 60
P	590	610	630	650	660	670	690	700
Rd	1. 61	1. 62	1. 63	1. 64	1. 65	1. 66	1. 68	1. 70
P	720	730	750	780	800	850	870	900
Rd	1. 72	1. 74	1. 76	1. 78	1. 80	1. 83	1. 85	1. 86

Penetration depth 8cm~20cm probe ϕ10mm　　Water content is 3%~8%

P penetration resistance value in the table (N)　　Rd= relative dry density value

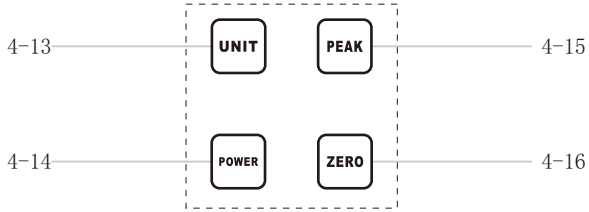
Dry density data sheet　　North China garden provides suitable silty loam

P	140	150	180	200	230	250	280	300
Rd	1. 42	1. 45	1. 47	1. 50	1. 53	1. 55	1. 57	1. 58
P	330	350	380	400	430	450	470	500
Rd	1. 60	1. 61	1. 63	1. 64	1. 65	1. 66	1. 67	1. 68
P	530	550	580	600	630	650	690	740
Rd	1. 69	1. 70	1. 71	1. 72	1. 73	1. 74	1. 75	1. 76
P	780	820	830	860				
Rd	1. 77	1. 78	1. 79	1. 80				

Penetration depth 8cm~20cm probe ϕ10mm　　Water content is 20%~27%

P penetration resistance value in the table (N)　　Rd= relative dry density value

14. Operation buttons



Operation buttons

4-13 (UNIT)

It is a unit conversion key for unit conversion operations.

4-14 (POWER)

It is the power switch, the return key in data browsing mode, and the action key to call up automatic shutdown Settings.

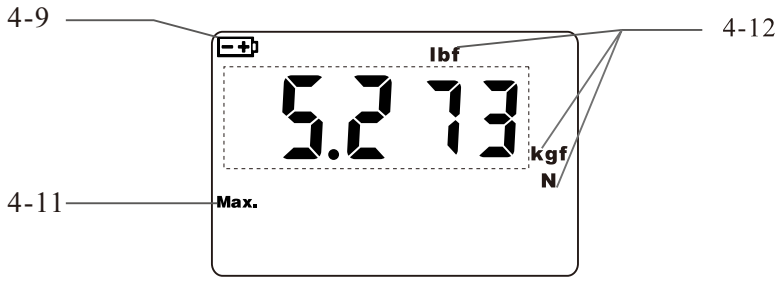
4-15 (PEAK)

It is a switch button between peak holding mode and real-time measurement mode.

4-16 (ZERO)

Instrument zero operation button.

15. Display function description



Screen display

4-9 Battery indicator " "

If the battery voltage is too low, " " appears in the upper left corner of the screen, indicating that the battery voltage is insufficient and the battery needs to be replaced.

4-10 Peak indicator MAX.

When MAX. Is displayed, it indicates the peak holding mode, and the screen displays the peak value. If MAX. Does not appear, it indicates the real-time measurement mode, and the value displayed on the screen changes with the load.

4-11 Units of measurement

Indicates the current measurement unit, including KGF, N, and LBF. Only one of these units is displayed.

Appendix 1- Dry density data table

Dry density data sheet Northeast courtyard offers suitable clay soil

P	145	150	170	200	230	250	280	320
Rd	1. 40	1. 42	1. 44	1. 46	1. 48	1. 50	1. 52	1. 54
P	350	380	400	430	450	480	500	540
Rd	1. 55	1. 56	1. 57	1. 58	1. 59	1. 60	1. 61	1. 62
P	560	580	600	630	650	700	750	800
Rd	1. 63	1. 64	1. 65	1. 66	1. 67	1. 68	1. 69	1. 70
P	820	830	840	850	860	880	900	
Rd	1. 74	1. 72	1. 73	1. 74	1. 76	1. 78	1. 80	

Penetration depth 8cm~20cm probe ϕ10mm Water content is 18%~26%

P penetration resistance value in the table (N) Rd= relative dry density value

Dry density data sheet South Central institute provides suitable clay

P	140	150	180	200	230	250	280	300
Rd	1. 42	1. 45	1. 47	1. 50	1. 53	1. 55	1. 57	1. 58
P	330	350	380	400	430	450	470	500
Rd	1. 60	1. 61	1. 63	1. 64	1. 65	1. 66	1. 67	1. 68
P	530	550	580	600	630	650	690	740
Rd	1. 69	1. 70	1. 71	1. 72	1. 73	1. 74	1. 75	1. 76
P	780	820	830	860				
Rd	1. 77	1. 78	1. 79	1. 80				

Penetration depth 8cm~20cm probe ϕ10mm Water content is 15%~21%

P penetration resistance value in the table (N) Rd= relative dry density value