Instruction Manual

STANDARD DIGITAL PENETROMER

Product Code

H-5237 & H-5237.5F

Do not attempt to operate this equipment before reading

and comprehending the manual in all its parts

Users

MACHINE MANUFACTURERS | DRAUGHTSMEN | OPERATORS | MAINTENANCE WORKERS | ANY OTHERS

REV.	DESCRIPTION	MANAGED	APPROVED	PRODUCT CODE	PAGES	ISSUE DATE
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GENERAL INDEX

Chapter 1 GENERAL INFORMATION

1.01 WARNINGS

The manufacturer does not accept any responsibility for direct or indirect damage to people, things or animals and use of the appliance in different conditions from those foreseen.
The manufacturer reserves the right to make changes to the documentary information or to the appliance without advance notice.
Check the machine responds to the standards in force in the state in which it has been installed.
All operations necessary for maintaining machine efficiency before and throughout use are the operator's responsibility
Carefully read the entire manual before operating the machine.
It is vital to know the information and limitations contained in this manual for correct machine use by the operator.
Interventions are only permitted if the operator is accordingly competent and trained.
The operator must be knowledgeable about machine operations and mechanisms.
The purchaser must ensure that operators are trained and aware of all the information and clarifications in the supplied documentation.
Even with such certainty the operator or user must be informed and therefore aware of potential risks when operating the machine.
Safety, reliability and optimum performance is guaranteed when using original parts.
Any tampering or modifying of the appliance (electrical, mechanical or other) which has not been previously authorised in writing by the manufacturer is considered abusive and disclaims the constructor from any responsibility for any resulting damage.
All necessary operations to maintain the efficiency of the machine before and throughout use are the responsibility of the user.

1.02 WARNING AND DANGER INDICATIONS - SIGNS

The machine has been designed and constructed according to the current norms and consequently with mechanical and electrical safety devices designed to protect the operator or user from possible physical damage. Residual risks during use or in some intervention procedures on the device are however present. Such risks can be reduced by carefully following manual procedures, using the suggested individual protection devices and respecting the legal and safety norms in force.
This manual includes "Warning" and "Danger" indications in relevant chapters. These indications are shown with the words "Danger" or "Warning" in bold font and uppercase to make them highly visible.

	**WARNING**	indicates that machine damage could be caused should indications be ignored.
	**DANGER**	indicates that machine damage and/or injury to the worker could be caused should indications be ignored.

"**DANGEROUS ZONE**" indicates any zone inside or in the proximity of the appliance in which a person is exposed to the risk of injury or damage to health.

1.03 AIM OF THE INSTRUCTIONS MANUAL

This manual has been edited with the aim of providing all machine operators with all the necessary information on installation, use and maintenance from production to scrapping in as comprehensive and clear manner as possible.
All the procedures useful for any foreseeable emergency situations have been listed by the manufacturer and can be verified during use.
Operators, for whom this manual has been written, due to their competence must give instructions or operate the machine themselves.
The instructions manual must be carefully consulted by laboratory or site safety managers, equipment operators and any internal and external maintenance workers.
The manual is integral to the product and refers to this appliance only.
The manual must be safeguarded and always kept near the equipment so that it can be easily consulted whenever necessary.
IMPORTANT: The manual does not substitute the experience and technical training of the worker but must be considered a guide for carrying out its functions.
Furthermore all the norms and rules the operator should be aware of or consult for correct use of the machine and/or test performance can be found in the manual.
This responsibility is entrusted to the installer and Laboratory or Site Manager where the machine is installed.
The Constructor is available to provide further information.

1.04 MODIFICATIONS AND ENCLOSURES OF THE INSTRUCTIONS MANUAL

This manual reflects the state at the time of the launch of the machine on its market. If any modifications, improvements or adjustments have been made since machine supply the Manufacturer does not have to intervene on the marketed machine and will not consider the machine or the manual deficient or inadequate.

1.05 CONSTRUCTOR IDENTIFICATION

MATEST SPA
Via Delle Industrie, 25
24048 Treviolo
(Bergamo) Italy
Tel +39 0352055011
Fax +39 0352055055
Email : matest@matest.com
Internet : www.matest.com

1.06 MACHINE IDENTIFICATION DATA

MODEL : B056-01 KIT / S165-01 KIT

PRODUCTION DATA: vedi dichiarazione CE

INSTRUCTIONS MANUAL CODE: B056-01KIT.M01.IT.02

1.07 USAGE

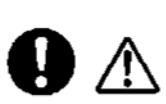
B056-01KIT

This equipment is used to determine a precise value of the consistency of a bituminous sample.
During the test the specimen is vertically penetrated by a standard needle under fixed conditions of load, time and temperature.

S165-01KIT
This equipment is used for determining the content of water at which a ground passes from the plastic to the liquid state by means of the penetration of a cone that freely falls into the specimen.

This appliance is for the exclusive use which it has been conceived for.
Any other use is considered improper and therefore negligent.
Machine use is allowed only in places free from danger of explosion or fire.
During operation check for conditions of danger.
immediately stop the machine should it be working irregularly, and consult the authorised dealer's Sales Service department.
It is the Client's responsibility to verify at the time of installation and use that no conditions of use arise which are different to those indicated.
Refer to the Constructor when in doubt.

1.08 OPERATORS



DANGER WARNING

The use, transportation, installation, maintenance, demolition and disposal of the appliance are only permitted to "QUALIFIED PERSONNEL".
This manual is exclusively aimed at "QUALIFIED PERSONNEL" and contains the necessary information for machine use.

QUALIFIED PERSONNEL" means people who, due to their training, experience and education, as well as knowledge of the relevant standards, limitations and measures, have been authorised by the "PLANT SAFETY MANAGER" to carry out any necessary activity and are able to recognise and avoid any possible danger.

The manufacturer recommends that the instructions, procedures and recommendations in this manual and the work safety legislation in force be scrupulously adhered to, even with the use of appropriate protection devices (whether individual or part of the machine).
Knowledge and respect of the instructions, safety warnings and danger in this manual are all necessary for installation, operation, management and machine maintenance with a minimal risk.
The "PLANT SAFETY MANAGER" has the following responsibilities and duties:

- To know the machine functions, its commands, safety and protection devices, possible dangers of use and all the information in this manual in detail. This knowledge can only be gleaned from detailed reading of this manual.

- To know the safety legislation in force in detail in order to operate the machine

- To recognise the “QUALIFIED PERSONNEL” for transportation, handling, installation, use, maintenance, disposal, etc.

- Correctly train and educate the “QUALIFIED PERSONNEL” before allowing them access to the machine. The personnel must also be exhaustively trained with regards to the machine’s protection devices.

- Ensure the machine’s safety devices are not tampered with or removed and are checked on a daily basis. Provide the operator appropriate individual protection devices according to the laws in force.

- The constructor is available for clarification, assistance and training and declines all responsibility for damage to things or people resulting from improper, incorrect and negligent use by untrained personnel.

1.09 STORAGE

WARNING	The appliance must be stored and conserved in the original packaging and in a closed environment, protected from atmospheric agents with a minimum temperature of -15C°, and a maximum of +60C° and a maximum humidity of 70%.

1.10 TRANSPORTATION AND MOVEMENT

WARNING	In order to avoid irreparable machine damage, move with care, do not overturn, protect from rain, do not stack, protect the packaging and its contents from bumps and sources of heat.

During transportation and movement it is important to avoid bumps, overloading with other packages, exposure to freezing or heating atmospheric agents, or any other potentially harmful condition to the device, things or people. Machine transportation and movement must be entrusted to Qualified Personnel who can ensure correct movement.

WARNING DANGER	Do not transport or move the product should it be impossible to respect the conditions on the packaging or there be any doubts. Request information from the constructor

1.11 PACKAGING REMOVAL

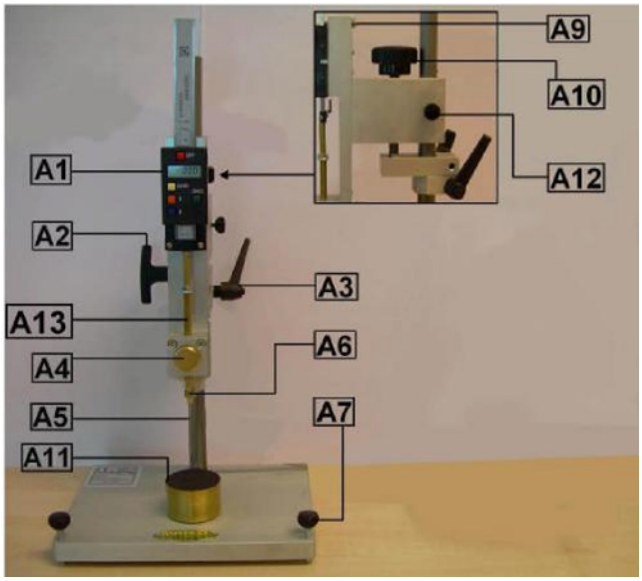
After removing the packaging check the machine is complete and that there are no visibly damaged parts. DO NOT USE THE MACHINE and referto the constructor when in doubt.

DANGER	The components used for packaging (plastic bags, polystyrene, nails, screws, wood, etc) must be kept out of reach of children, as they are sources of danger. These components should be placed in the appropriate containers.

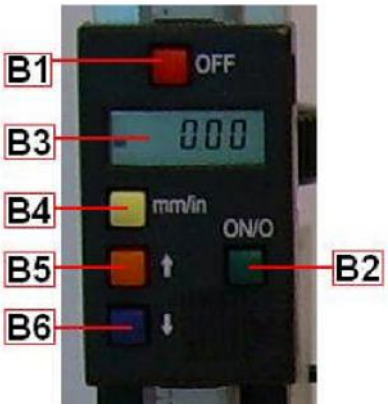
WARNING	In order to avoid bumps and overturn adopt the normal and logical precautions. Before disposing of the packaging check all machine components such as accessories, utensils, instructions, documents etc have been removed.

Chapter 2 TECHNICAL CHARACTERISTICS

2.01 GENERAL MACHINE DESCRIPTION



ELECTRONIC METER



- **A1 -ELECTRONIC METER:** Measures penetration of the needle or the cone in the sample.
- **A2 - CLAMP :** Holds the penetrometer in place after positioning the needle or the cone in the intended place.
- **A3 -CLAMP:** Holds the clamp in place which determines the correct height of the penetrometer for the test to be carried out.
- **A4 - BUTTON:** When the button is pressed the penetration needle or penetration cone will free fall.
- **A5- PENETRATION NEEDLE OR CONE B056-01 KIT: penetration needle S165-01 KIT: penetration cone**
- **A6 - TIGHTENING SCREW** Holds the needle or cone in the penetration beam.
- **A7 - KNOBS:** Level out the instrument.
- **A10 - KNOB:** Micrometer height regulation of the penetration needle or cone relative to the sample.
- **A11 - CONTAINER:** Contains the sample to be tested.
- **A12 - KNOB :** After regulating needle or cone height the tightening screw fixes the penetrometer to the stand, avoiding that it loosens.
- **A13 - PENETRATION BEAM**: the beam containing the penetration needle or the penetration cone where the penetration measurement of the needle or cone in the sample takes place.
- **B1 - OFF BUTTON :** Press this button to switch the electronic meter off (A1).
- **B2 - ON BUTTON :** Press this button to switch the electronic meter on (A1); this button can be also used to reset to zero the value shown on the LCD display regardless of its position.
- **B3 - LCD DISPLAY**
- **B4 - MM/INCHES SWITCHING BUTTON:** Press this button to switch the scale form mm to inches or otherwise
- **B5/B6 - PRE SETTING BUTTONS :** Press and keep on pressing the buttons B5 (for negative values) or B6 (for positive values) to pre-select the height value. The display will start showing the increasing or decreasing value by increasing the speed progressively.

2.02 DIMENSION AND WEIGHT

LENGTH	200 mm
WIDTH	260 mm
HEIGHT	500 mm

Chapter 3 GENERAL SAFETY STANDARDS

3.01 GENERAL STANDARDS

To ensure the safety of machine operators:

- Any tampering with the appliance not pre-emptively authorised by the manufacturer exempts the manufacturer from any responsibility for damage caused by or to it.
- The removal or tampering with safety devices entails a violation of the safety standards.
- Machine use is only allowed in areas where there is no risk of explosions or fires.
- Only the original fittings can be used. The use of unoriginal fittings exonerates the manufacturer from all responsibility.
- Check the appliance is in ideal working conditions and that its parts are not worn or faulty before Carry out all necessary maintenance
- Do not wear loose clothing, ties, chains or anything else which could become caught in the frame or other moving parts of the appliance.
- Be aware of the danger of electrical shocks from direct or indirect contact due to unforeseen electrical faults.
- Do not subject the appliance to violent impact.
- Do not expose the appliance to fire, welding sparks or extreme temperatures.
- Do not bring the appliance into contact with corrosive substances.
- Do not wash the appliance with jets of water.
- Check the workspace around the machine is clear from potentially dangerous objects.
- The machine operator must wear appropriate work clothing such as protective glasses, gloves and mask in order to avoid damage from, for example, harmful dust projection. Wear a lower back support when lifting heavy parts. There should be no hanging objects such as bracelets or otherwise, long hair should be protected with relevant precautions, shoes must be appropriate for the type of operation to be carried out.

DURING USE

When operating check there are no conditions of danger. Immediately stop the machine when it is functioning irregularly. Contact the authorised Sales Service department.

- For the operator's safety do not touch any part of the appliance when testing and use the appropriate individual protection devices in order to keep the operator safe.

3.02 MACHINE SAFETY DEVICES AND PROTECTION

DEFINITION: Protections are all the safety measures that consist of the use of specific technical means (repairs, safety devices) to protect people from dangers which cannot be limited reasonably in design.

⚠	**DANGER**	Tampering with the protections or any appliance modification could cause risks to users or other exposed people. The manufacturer does not assume any responsibility for direct or in direct damage to people, things or animals following tampering with the protections.

Chapter 4 INSTALLATION INSTRUCTIONS

4.01 LOCATION

The equipment must be placed in an ideal position and environment for the use it has been conceived for (laboratory use and protected from atmospheric agents) and that the machine is placed by a qualified operator.

ALLOWED TEMPERATURE:	from +5°C to +40°C
ALLOWED RELATIVE HUMIDITY:	from 30% to 70%
MAXIMUM HEIGHT OVER SEA LEVEL:	1000 m

GENERAL ADVICE

- The machine must be installed in an area which allows ease of access to all parts so that maintenance may be carried out.
- Unauthorised people and objects which could be potential sources of danger must not be permitted in the area surrounding the machine.

Do not position the equipment near instruments or appliances which could produce vibrations.

4.02 TRANSPORTATION AND MOVEMENT

These instructions are applicable to the machine assemblers.
Ensure the equipment is correctly supported at the lifting point and that the machine does not slip.
Do not remain in direct line with the application of force and do not allow personnel where there are loads that cannot be adequately supported by mechanical means.

Chapter 5 IN FUNCTION - USE

DANGER WARNING

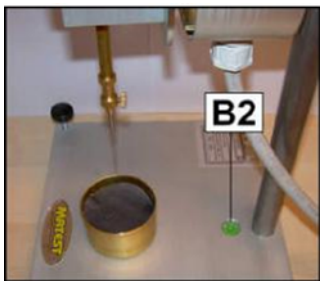
Before setting the machine in motion it is essential that the Operator and Safety Manager have read the Instructions Manual and understood all parts of the machine and activities linked to it (Risks, Dangers, Functionality, Operation, Protections, Commands, etc.)

5.01 MACHINE CALIBRATION – METERS - INDICATORS

The machine is checked in the factory, using sample equipment periodically checked by officially recognised institutes. These checks cannot guarantee that the machine, meters and indicators will provide accurate values and results conforming to the standards in force in the countries the machine has been installed and used in.
Normally such norms envisage calibration check after every movement. In order to obtain correct values and results it is therefore VITAL that the operator, once the machine has been installed and set up and before official tests, has an officially recognised body check the machine characteristics, its calibration and results/values reliability. The manufacturer is exempt from all responsibility in the case of direct and indirect damage from use of the machine without officially approval by the relevant bodies.

5.02 BASE SPIRIT LEVEL REGULATION

Before carrying out the test it is important that the base is placed horizontally.
Regulate with the **A7** knobs and check the position in the **B2** spirit level.

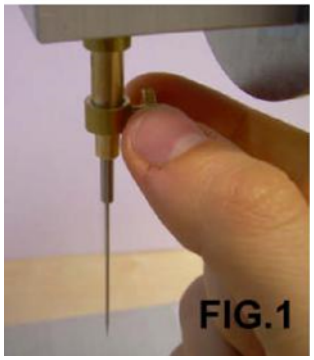


5.03 EQUIPPING – SAMPLE POSITIONING

Put the additional weight, to be chosen from the range supplied with the equipment, on the upper part of the penetration beam the fit additional weight for the execution of the test among those furnished in endowment with the tool
The following calibrated weights are supplied:

- B056-01 KIT: n°1 weight 50g + n°1 weight 100g
- S165-01 KIT: n°1 weight 20g

Raise the position of the beam of the **A1** meter until the end.
Press **A4** and raise the **A13** penetration beam until it hits the penetrometer and release the button in order to old the beam.
Insert the needle or the cone **A5** into the penetration beam **A13** and lock it by means of the tightening screw **A6.**
Ensure the **A2** clamp is tightened.
Open the knob on the **A3** clamp and position it at such a height so the penetration needle or cone is positioned 3-4 mm above the hypothetical surface of the sample.
After doing so close the knob firmly
and do not open it for the rest of the test.



Open the knob on the **A2** clamp and gradually move the penetrometer until it rests under the **A3** clamp. Turn the penetrometer so that it corresponds to the point of the needle, with the centre of the instrument base.
Tighten the **A2** clamp. Throughout the test it is possible to loosen it every time the needle or cone needs to be moved laterally, without altering its height.
Position the **A11** container which has already been filled with the sample to be tested on the base of the penetrometer, more or less centred with the tip of the **A5** penetration needle**.**
Consult the UNI- EN1426 standard for the correct procedure in order to fill the **A11** container.

Regulate the remaining height of the needle or cone so that the tip is skimming the surface of the sample. Turn the **A10** knob to regulate it.
Slowly lower the beam of the electronic meter so that its lower end is in contact with the upper spherical point of the **A13** penetration beam**.**
Tighten the **A12** knob; reset the numerical value on the electronic meter.

5.04 SWITCHING THE APPLIANCE ON

Press the **A4** key to start penetration.

5.05 TEST START UP

Before using the appliance regularly check it is working correctly by carrying out at least one complete empty cycle according to the previous instructions.
Should there be any problem consult the chapter “DIAGNOSTICS”.
If the instructions in this manual do not provide the solution to the problem, contact Sales Assistance.

5.06 PRACTICAL USAGE EXAMPLE

Here follows an “example procedure” for an inexperienced operator to carry out a complete test. The experience of the operator will enable him to optimise use of the equipment according to his needs.
Consult the UNI EN1426 standard before starting the test.

1. Regulation of the base position – See the chapter :**REGULATION OF THE LEVEL OF THE BASE**
2. Equip and prepare the instrument – See the chapter : **SETTING UP – SAMPLE POSITIONING**
3. Push the button **A4** and keep on pushing it for at least 5 seconds. This is the necessary time to allow the penetration into the specimen.
4. After 5 seconds the position reached by the needle or the cone is automatically blocked and the penetration can now be measured; gently push the beam of the electronic meter down until it in contact with the upper spherical end of the penetration beam **A13**.
5. Record the value shown.

Chapter 6 MAINTENANCE

6.01 ORDINARY MAINTENANCE

 **DANGER WARNING**	Do not perform maintenance – interventions on the machine which have not been quoted and described in this instructions manual without first contacting the manufacturer. Periodically clean all machine parts and oil the unpainted parts in order to preserve the machine and its efficiency. Avoid the use of solvents which damage paint and parts in synthetic material.

6.02 EXTRAORDINARY MAINTENANCE

For extraordinary maintenance operations refer directly to the Manufacturer.

6.03 AUTHORISED MAINTENANCE CENTRES

For information on the nearest authorised help centre it is essential to contact the manufacturer.

Chapter 7 GUIDE TO RECOGNISING DAMAGE AND ANOMALIES

This chapter presents and discusses all the simple problems which could occur during machine use.
The appropriately qualified, professional personnel must carry out all the maintenance procedures, check and control, as well as all the repair operations on parts of the machine or the electrical system.
Contact Technical Sales Assistance for any other problem not listed on the previous table or should the malfunctioning persist after the intervention of the operator in accordance with the previously mentioned courses of action.

PROBLEM	POSSIBLE CAUSE	REMEDY
The electronic meter won't switch on or show the values correctly	Meter failure or power battery flat	Contact Technical Assistance.

Chapter 8 SPARE PARTS

WARNING DANGER

Only original spare parts can be used.
Use of unoriginal spare parts exempts the manufacturer from all responsibility.
Procedures for substitution of spare parts will be provided by the manufacturer along with the part. For spare parts contact the manufacturer's Sales Service department.

SUGGESTED SPARE PART: PENETRATION ROD A13

Chapter 9 INACTIVITY

Ensure all machine parts are in safe working order before operating it again should the machine be inactive for a long period of time. When in doubt contact the Manufacturer.

Chapter 10 DECOMMISSIONING THE MACHINE

Should it be decided that the machine is to be no longer used, proceed as follows:

- Disconnect the electrical supply network by removing the connecting cable therefore making it unusable.
- Make the potential sources of danger harmless, such as sharp or protruding parts.
- Dismantle the machine; divide it into similar parts and dispose of according to the standards in force.

Recycling notice for the disposal of electrical and electronical devices

This symbol, shown on the device or on the package and/or the documentation, suggests that the device should not be disposed together with other home garbage at the end of its life cycle.
To avoid further environment, or health-care damage, caused by the unsuitable disposal of garbage, the user should separate this device from other different types of garbage and recycle it in responsibly to avoid the reuse of material resources. Users must take care at the disposal of the equipment by taking it to the nearest recycling site for appropriate recycling treatment for electrical and electronical devices. Gathering and
Recycling deplete devices allow the preservation of natural resources and grant them the adequate treatment by respecting health and environment.
For further information on your local recycling site please contact your local council or city waste treatment department. The developer, as producer of electrical and electronical devices, will provide to finance the recycling and treatment services for deplete devices that will come back through these recycling sites, according to the local statement.

Atterberg Limits Testing

Atterberg Limits testing is widely used in the design stage of construction to ensure that the soils being used exhibit the proper consistency to support structures even as their moisture levels change. Soils for engineering use are often classified based on properties relative to foundation support or how they might perform under pavements and in earthworks. In the early 1900s, the Swedish chemist Albert Atterberg developed a classification system and method with which these states of consistency could be determined. His methods were later defined by Arthur Casagrande. The method is based on the determination of the water content at distinct transitions between different states of soil consistency. These transitions are defined as shrinkage limit, plastic limit, and liquid limit, and collectively are referred to as Atterberg limits. The liquid limit and plastic limit tests are the most commonly used of the Atterberg limits tests. The values for these limits are dependent on various soil parameters (e.g., particle size, specific surface area of the particles that are able to attract water molecules).

Geotechnical classification systems are designed to make it easy to equate field observations to estimates of engineering properties. As moisture content of a fine-grained, clay-like soil increases, it goes through four distinct states of consistency: solid, semi-solid, plastic, and liquid. Each stage is defined by significant changes in strength, consistency and behavior. As a hard, rigid solid in the dry state, fine grained soil becomes a crumbly (friable) semisolid when certain moisture content, or shrinkage limit, is reached. This soil will also begin to swell as shrinkage limit is exceeded. Increasing the water content beyond the soil's plastic limit will transform it into a plastic mass, which causes additional swelling. The soil will remain in this plastic state until its liquid limit is exceeded, which causes it to transform into a viscous liquid that flows when jarred. These limits can be determined with the three tests that make up the Atterberg limits tests. They are Shrinkage limit, Plastic limit and Liquid limit.

Knowledge of these values helps in foundation design of structures and to predict behavior of soils in fills and embankments. The values derived from Atterberg limit tests can contribute to estimates of shear strength, permeability, settlement and the identification of potentially expansive soils.

The Atterberg limits for different types of fine-grained soils can vary greatly. For example, Illite exhibits a shrinkage limit of 15% to 17% depending on particle sizes, while its plastic limit is typically 24% to 52%, and its liquid limit is typically 30% to 110%. Kaolinite exhibits a shrinkage limit of 25% to 29% depending on particle sizes, while its plastic limit is typically 30% to 40%, and its liquid limit is typically 35% to 72%.

A common way to describe expansive soils is through plasticity index values. The plasticity index refers to the range of plastic properties a soil exhibits at varying levels of water content. The plasticity index is essentially the difference between liquid limit and plastic limit values. Clay loam has a plasticity index of 10-20% and is referred to as a medium plastic soil. Silty clay has a plasticity index of 20-35% and is considered a highly plastic soil. Very high plasticity soils have a plasticity index of over 35% and contain a predominance of clay.

Liquid Limit

The liquid limit (ASTM D4318) is defined as the water content at which the behavior of a clayey soil changes from plastic to liquid. However, the transition from plastic to liquid behavior is gradual over a range of water contents, and the shear strength of the soil is not actually zero at the liquid limit. The precise definition of the liquid limit is based on standard test procedures described below.

The original liquid limit test developed by Atterberg involved mixing a pat of clay in a round-bottomed porcelain bowl of 10–12cm diameter. A groove was cut through the pat of clay with a spatula, and the bowl was then struck many times against the palm of one hand. Casagrande subsequently standardized the apparatus and the procedure to make the measurement more repeatable.

Soil is placed into the metal cup portion of a liquid limit device and a groove is cut down its center with a standardized tool of 2mm (0.079") width. The cup is repeatedly dropped 10mm onto a hard rubber base at a rate of 120 blows per minute, during which the groove closes up gradually as a result of the impact. The number of blows for the groove to close is recorded.

The moisture content at which it takes 25 drops of the cup to cause the groove to close over a distance of 12.7mm (0.50") is defined as the liquid limit. The test is normally run at several moisture contents, and the moisture content which requires 25 blows to close the groove is interpolated from the test results. The test method also allows running the test at one moisture content where 20 to 30 blows are required to close the groove; then a correction factor is applied to obtain the liquid limit from the moisture content.

Another method for measuring the liquid limit is the fall cone test, also called the cone penetrometer test. It is based on the measurement of penetration into the soil of a standardized cone of specific mass. Although the Casagrande test is widely used across North America, the fall cone test is much more prevalent in Europe.

Plastic Limit

Water content at the change from a plastic to a semisolid state is known as the plastic limit. The plastic limit test (ASTM D4318) is done by rolling out a small thread of soil on a flat, non-porous surface. If the soil is at a moisture content where its behavior is plastic, the thread will retain its shape down to a very narrow diameter. As the moisture content falls due to evaporation, the thread will begin to break apart at larger diameters. The sample can then be re-molded and the test re-peated. The plastic limit is defined as the moisture content where the thread breaks apart at a diameter of 3.2mm (about 0.125"). A soil is considered non-plastic if a thread cannot be rolled out down to 3.2 mm at any moisture possible.

Shrinkage Limit

The shrinkage limit (ASTM D4943) is defined as the point where the water content of the soil will not result in any more volume reduction. This test is much less commonly used than the liquid and plastic limit tests. Humboldt offers the H-4254 Shrinkage Limit Set for performing this test.

ASTM D4318

Related Standards: C702, D75, D420, D653, D1241, D2216, D2487, D3282, D3740, D4542, D4753, D6026, E11, E177, E691, AASHTO T89, T90

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Qty.	Model	Description
1	Choose one: H-4234 H-4235	 ASTM liquid limit test set, includes: H-4230, manual, liquid limit machine w/o counter, mixing dish, spatula, graduated cylinder and moisture cans ASTM liquid limit test set, H-4228, manual, liquid limit machine with counter, mixing dish, spatula, graduated cylinder, and moisture cans

or

1	Choose one: H-4230 H-4228 H-4226 H-4226.5F	 ASTM liquid limit machine ASTM liquid limit machine with counter ASTM liquid limit machine, motorized, 120V 60Hz ASTM liquid limit machine, motorized, 220V 50/60Hz
1	H-4253	ASTM plastic limit set, plastic limit plate, mixing dish, spatula, graduated cylinder and moisture cans

1	H-4233	Resiliency tester, for testing base every 90 days
1	H-4222D	Durometer, for testing hardness of base

Accessories/*Options*

1	H-4229	ASTM grooving tool, Metal
1	H-4229P	ASTM grooving tool, Plastic
1	H-4232	AASHTO liquid limit metal grooving tool
1	H-4262	Plastic limit roller and 50 sheets of paper for surface
1	Choose one: HB-5315A HB-5315A.4F	 Ohaus adventurer balance, 1520g x 0.01g, 120V 60Hz Ohaus adventurer balance, 1520g x 0.01g, 220V 50/60Hz
1	H-4926	Aluminum moisture boxes 2" (51mm) dia. x 7/8" (22mm) Height
1	Choose one: H-30145 H-30145.4F	 Laboratory bench oven, 7.0 cu. ft. (198 L) cap., 115V 60Hz Laboratory bench oven, 7.0 cu. ft. (198 L) cap., 230V 50/60Hz


H-4234


H-4230 H-4228 H-4226


H-4229P


H-4253


H-4229


H-4232


H-4262


HB-5315A


H-30145

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