INTRODUCTION

In the past 25 years many applications of *geosynthetics* have proved their value in civil engineering projects and this new class of material has added entirely a new dimension to the world of geotechnical engineering. Geosynthetic materials like *Geotextiles*, *Geogrids*, *Geonets*, *Geocell*, and *Geomembranes* are used in various civil engineering activities especially in highway engineering to facilitate construction, ensure better performance of the structure and reduce maintenance.

To know the performance of these products, performance evaluation is to be done & to meet the requirements, quality has to be maintained.

* NEED FOR TESTING
* NABL Accreditation
* GEO-TECHNICAL PRODUCTS
* GEO-TEXTILE TESTING
* VARIOUS TESTS &
TEST STANDARDS

NEED FOR TESTING

Products are tested for the following reasons.

* Quality assurance and control
* Setting and maintaining performance standards
* Investigation of complaints
* Product developments and research
* **Testing can be classified into two categories,**
  1. Quality testing 2. Performance assessments

1. Quality Testing

Individual characteristics are measured against required specification.

e.g.**Constructional details of woven geotextile**

* Fabric mass, density and thickness
* Threads per inch
* Type of weave
* Cloth cover factor
* Other physical properties

e.g.**Constructional details of Geogrid**

* Aperture Size
* Density
* Melt flow index & other physical properties

2. Performance Assessments

Prediction of behaviour of Product in use conditions.

Factors affecting the Quality of Testing

- ***Variation in the material***
- ***Variation caused by the test method***
- ***Environment***
- ***Type of instrument & its accessories***
- ***Conditions of testing such as speed, pressure and duration***

QUALITY ASSURANCE

- What is QUALITY ?
- Quality is a quantifiable attribute based on product performance, satisfies the customer and meets the requirements or specifications.
- Quality of design, conformance, application and customer service.
- Quality control is the process of maintaining the current standards & product quality by the regular inspection carried out on limited no.of items. The results are recorded on control charts and monitoring the sample means & ranges to give warning of the process moving out of control.

- What is Quality Assurance ?
- The system by which one can give assurance of quality of products, process, testing, design/development, installation & servicing and assessment. The system consists of guide lines. Quality management system (ISO 9000).
- ISO 9000 is the guide line for quality control i.e totality of features and characteristics of product or service that bear on the ability to satisfy stated or implied needs.

The standard is not directly concerned with the actual properties or design of product but with gaureenting that the product is always manufactured in the same way, to the same specifications, that no substandard raw material used in the production and that any rejects do not find their way into the output. The concerns of the standard are really with good organizational practice and it involves complete documentation of the whole process together with internal and external checks to ensure that everything is being run according to these written instructions.

QUALITY ASSURANCE OF TESTING

SKILLED & EXPERIENCED TESTING STAFF

CALIBRATED EQUIPPMENTS

NABL ACCREDITED & ISO 17025 CERTIFIED LAB

btra

Testing staff having skill in sample preparation, handling of test equipments, knowledge of quality system and test standards. Experience in testing of similar products & various tests will have better influence on quality of testing. The staffs are trained time to time for various tests, quality control systems and interpretation of results.

Calibration of test equipments is done periodically (every year).

Quality audit is carried out by NABL every year.

The Laboratory implements new or revised test standards.

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The system consists of following areas.

- Enquiries and orders
- Purchased material or services
- Inspection & testing
- Calibration of test equipment
- Organizational structure
- Quality audit
- Training
- Monitoring the production
- Assessing the final product
- Investigation of faulty material
- Product development & research

Accreditation

Laboratory accreditation is a procedure by which an authoritative body gives formal recognition of technical competence for specific tests/ measurements, based on third party assessment and following national /international standards

WTO recognises that non acceptance of test results and measurement data is a Technical Barrier to Trade.

Global sourcing of components calls for equivalence of measurement, which can be facilitated by a chain of accredited calibration laboratories.

Accreditation is considered as the first essential step for facilitating mutual acceptance of test results and measurement data.

Benefits of Accreditation

- Increased confidence in Testing/ Calibration Reports issued by the laboratory.
  Better control of laboratory operations and feedback to laboratories as to whether they have sound Quality Assurance System and are technically competent.
  Users of accredited laboratories enjoy greater access for their products, in both domestic and international markets.
  Customers can search and identify the laboratories accredited by NABL for their specific requirements from the NABL.
- Savings in terms of time and money due to reduction or elimination of the need for re-testing of products.

GEO-TECHNICAL PRODUCTS:

GEOTEXTILES
GEONETS
GEOGRIDS
GEOMEMBRANES
GEOCOMPOSITES
Geosynthetic Clay Liner (GCL)
Turf Reinforcement Mats (TRM)
GEOFOAMS
Rigid Cellular Polystyrene Geofoam
Expanded Polystyrene (EPS) Geofoam
DRAINS
Geocomposite Pavement Panel Drains
Vertical Strip Drains
Prefabricated Vertical Drains (PVD)
Erosion Control Blankets (ECB)
Alternative Daily Covers (ADC)
Prefabricated Bituminous Geomembranes (PBGM)

GEO-TECHNICAL PRODUCTS:

GEOTEXTILE : A flexible, permeable fabric used with foundation, soil, rock, earth, or other geotechnical engineering related material as an integral part of a man made project, structure, or system.

GEONET: A netlike polymeric material formed from intersecting ribs integrally joined at the junctions used for drainage with foundation, soil, rock, earth or any other geotechnical-related material.

GEOGRID: An open grid structure of polymeric material used primarily for tensile reinforcement.

GEOMEMBRANE : An essentially impermeable membrane.

GEOCOMPOSITE : A manufactured material using geotextiles, geogrids and/or geomembranes in laminated or composite form.

GEOCELL: A three-dimensional structure filled with soil, thereby forming a mattress for increased stability when used with loose or compressible soils.

Geosynthetic Clay Liner : Factory-manufactured hydraulic barriers consisting of a layer of bentonite clay or other very low permeability material supported by geotextiles and/or geomembranes and mechanically held together by needling, stitching or chemical adhesive.

- **Turf Reinforcement Mats (TRM) :** cost effective and environmentally friendly alternative to hard armor erosion protection solutions such as concrete and riprap. UV and chemical resistant synthetic polyolefins are manufactured to create a flexible three-dimensional matrix. Seed and soil are held in place within the matrix. As the vegetation matures, roots and stems inter-twine with the matrix, creating a "Biotechnical Composite" that is permanently anchored to the soil greatly enhancing the turfs' ability to withstand high shear stresses and flow velocities.
- **GEOFOAMS** :
- Rigid Cellular Polystyrene Geofoam: block or planar rigid cellular foam polymeric material used in geotechnical engineering applications
- Expanded Polystyrene (EPS) Geofoam : EPS geofoam is a lightweight, rigid foam plastic that is approximately 100 times lighter than most soil and at least 20 to 30 times lighter than other lightweight fill alternatives
- **DRAINS**
- Geocomposite Pavement Panel Drains
- Vertical Strip Drains
- Prefabricated Vertical Drains (PVD): A geotextiles constructed from specially conditioned geotextile fabrics and plastic cores used for consolidation of soil & ground improvement
- **Erosion Control Blankets (ECB) :** A temporary protective blanket laid on top of bare soil vulnerable to erosion, commonly made of mulch, wood fibre or synthetics.
- **Alternative Daily Covers (ADC):** A cover material other than earthen material placed on the surface of the active face of a municipal solid waste landfill at the end of each operating day to control vectors, fires, odors, blowing litter, and scavenging.
- **Prefabricated Bituminous Geomembranes (PBGM) :** A geotextile impregnated & coated with bituminous binder.

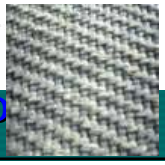
GEOTECHNICAL PRODUCTS

- GEOTEXTILE



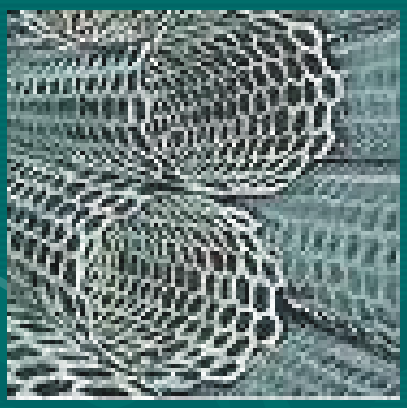


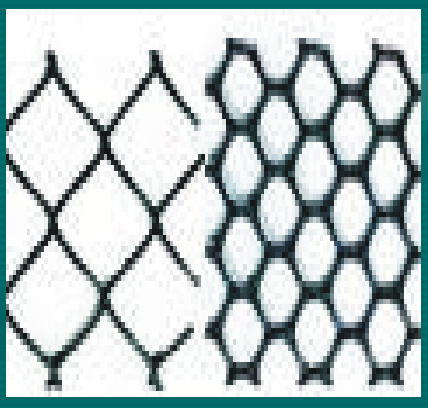

Woven Geotextile as reinforcement for embankment at Tuticorin Port



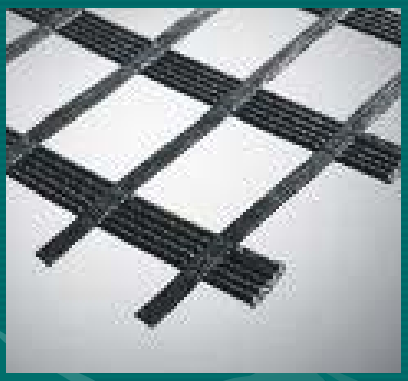
GEOTEXTILE IN USE FOR ROAD

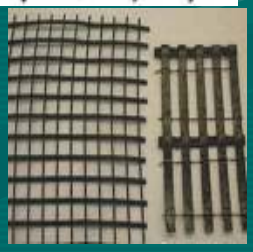
GEONET



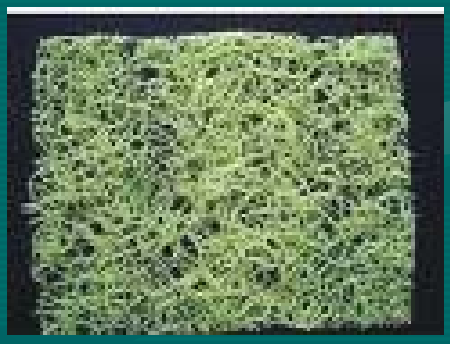


GEOGRID

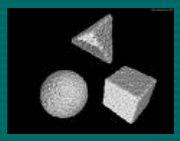


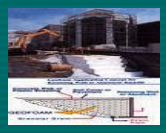


GEOMAT



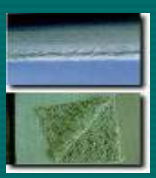
- GEOFOAM



- GEOCOMPOSITE


- GEOSYNTHETIC CLAY LINER

- PREFABRICATED VERTICAL DRAIN




- TURF REINFORCEMENT MAT

- EROSION CONTROL BLANKET

- GEOCELL

- ALTERNATE DAILY COVERS

TESTING SERVICES AT BTRA

Geomembranes

- Peel and Shear
- Thickness
- Density
- Melt Flow Index
- Carbon Black Content
- Tear & Puncture Resistance
- Tensile Properties

Geogrids

- Aperture Size
- Density
- Melt Flow Index
- Carbon Black Content & Dispersion
- Rib & Junction Strength
- Wide Width

Geonets and Geocomposites

- Mass per Unit Area
- Thickness
- Density
- Melt Flow Index
- Carbon Black Content
- Transmissivity
- Compression Behavior
- CBR Puncture

Geosynthetic Clay Liners

- Bentonite Mass per Unit Area
- Swell Index & Fluid Loss
- Internal Shear
- Index Flux or Permeability

Geotextiles

- Mass per Unit Area
- Thickness
- Grab Strength
- Trapezoidal Tear
- Puncture Resistance
- Permittivity
- Apparent Opening Size (AOS)
- CBR Puncture

Interface Friction by Direct Shear

- Geosynthetic to Geosynthetic
- Geosynthetic to Soils
- Geosynthetic to GCL's
- Soil

Common Tests of Geotxtile

- ***Mass : gms per meter square***
- ***Thickness at specified pressure***
- ***Tensile strength : Strip / Grab / Wide Width***
- ***Tear Strength : Trapezoid***
- ***Water Permeability : Vertical / Horizontal***
- ***Apparent Opening Size : Sieving method***
- ***Puncture Resistance : CBR / Index / Cone***

STANDARD TEST METHODS FOR GEOTEXTILES / GEOSYNTHETICS

Sr.No.	TEST PARAMETERS	ASTM	ISO
1	Apparent Opening Size	D 4751	12956
2	Mass per unit area	D 5261	9864
3	CBR Puncture Resistance	D 6241	12236
4	Index Puncture Resistance	D 4833	
5	Grab breaking load & elongation	D 4632	13934
6	Trapezoid Tearing Strength	D 4533	13434
7	Tensile Properties of Geotextiles by the Wide-Width Strip Method	D 4595	10319
8	Nominal Thickness of Geosynthetics	D 5199	9863-1
9	Water Permeability by Permittivity	D 4491	11058
10	Hydraulic Transmissivity of a Geosynthetic Using a Constant Head	D 4716	12958

STANDARD TEST METHODS FOR GEOTEXTILES / GEOSYNTHETICS

Sr.No.	TEST PARAMETERS	ASTM	ISO
11	Dynamic peroration by Cone Drop		13433
12	Biological Clogging of Geotextiles	D 1987	
13	Bursting Strength-Hydraulic	D 3886	
14	,, ,, - Ball	D 3887	
15	Tensile Properties of Geogrids by the Single or Multi-RibTensile Method	D 6637	13426
16	Strength of Sewn or Thermally Bonded Seams of Geotextiles	D 4884	10321 13426
17	Deterioration of Geotextile by Exposure to Light, Moisture & Heat	D 4355	
18	Microbiological degradation		12961

STANDARD TEST METHODS FOR GEOTEXTILES / GEOSYNTHETICS

Sr.No.	TEST PARAMETERS	ASTM	ISO
19	Interface Friction between Soil & Geotextile by Direct Shear Method	D 5321	12957
20	Bond Strength (Ply Adhesion) of Geocomposites	D 7005	
21	Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry	D 5885	11357
22	Effect of Temperature on stability of Geotextile	D 4594	
23	Permittivity of Geotextiles Under Load	D 5493	
24	Ply Adhesion Strength of Reinforced Geomembranes	D 6636	

STANDARD TEST METHODS FOR GEOTEXTILES / GEOSYNTHETICS

Sr.No	TEST PARAMETERS	ASTM	ISO
25	Filtering Efficiency and Flow Rate of a Geotextile for Silt Fence Application Using Site-Specific Soil	D 5141	
26	Pyramid Puncture Resistance of Unprotected and Protected Geomembranes	D 5494	
27	Soil-Geotextile System Clogging Potential by the Gradient Ratio	D 5101	
28	Determination of tensile creep and creep rupture behaviour	D 5262	13431
29	Determining the resistance to Oxidation		13438
30	Chemical Resistance of Geosynthetics / Geotextile to Liquids	D 5322 D 6389	
31	Strip Tensile Properties of Reinforced Geomembranes	D 7003	

STANDARD TEST METHODS FOR GEOTEXTILES / GEOSYNTHETICS

Sr.No.	TEST PARAMETERS	ASTM	ISO
32	Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics	D 5596	11420
33	Hydraulic Transmissivity of a Geosynthetic by Radial Flow	D 6574	
34	Pore Size Characteristics of Geotextiles by Capillary Flow Test	D 6767	
35	Grab Tensile Properties of Reinforced Geomembranes	D 7004	
36	Determining Geonet Breaking Force	D 7179	
37	Abrasion Resistance of Geotextiles (Sand Paper/Sliding Block Method)	D 4886	13427
38	Tensile Creep & Creep rupture behaviour of geo-textile		13431

Wide Width Tensile Strength
ASTM D 4595

Index Puncture Resistance (ASTM D 4833):

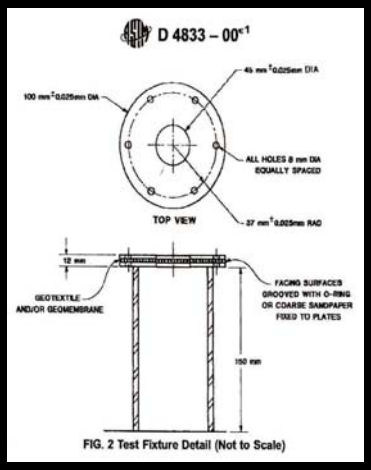
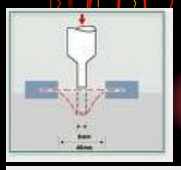


FIG. 2 Test Fixture Detail (Not to Scale)



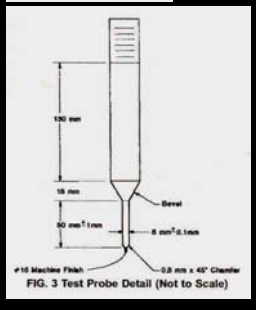
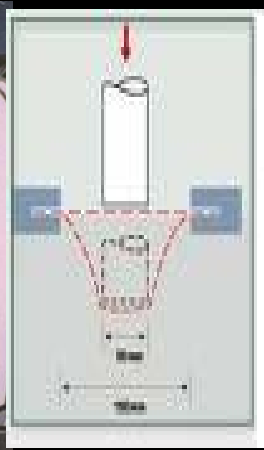
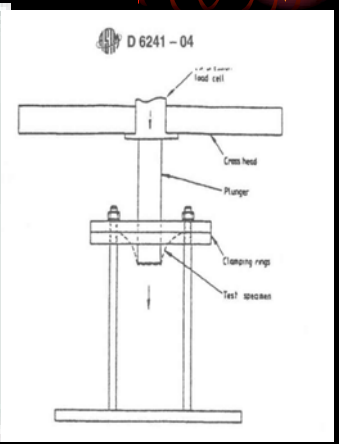


FIG. 3 Test Probe Detail (Not to Scale)

CBR (static) puncture resistance ASTM D 6241 / ISO 12236





Trapezoid Tear Strength

Of Geotextile

(ASTM D 4533)

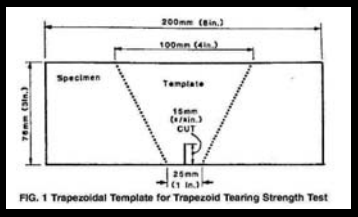


FIG. 1 Trapezoidal Template for Trapezoid Tearing Strength Test

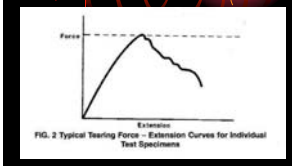
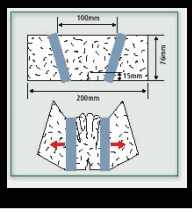
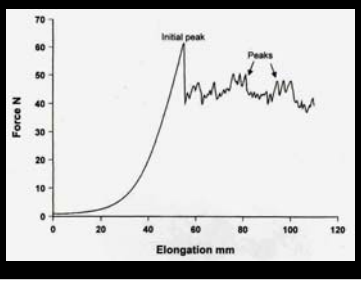
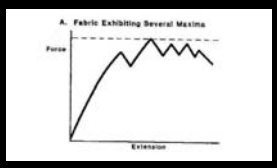


FIG. 2 Typical Tearing Force – Extension Curves for Individual Test Specimens

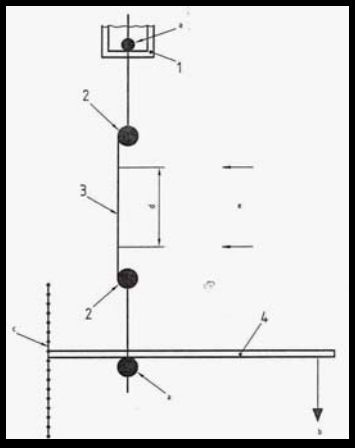


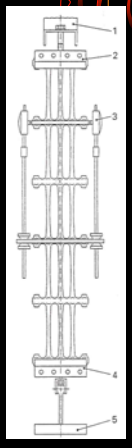




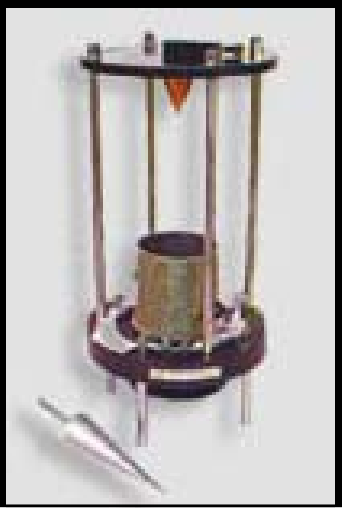
CREEP & RUPTURE BEHAVIOUR Of Geotextile

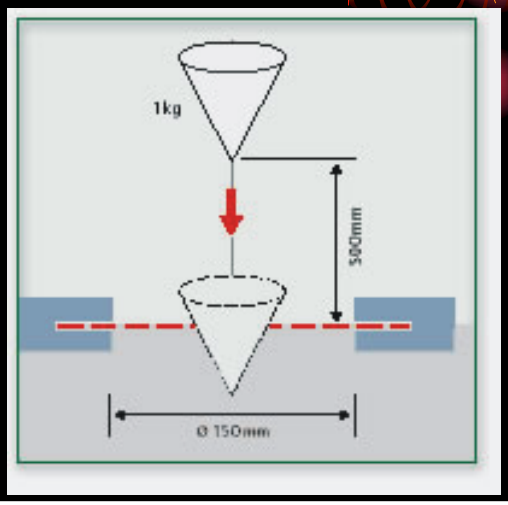
ASTM D 5262



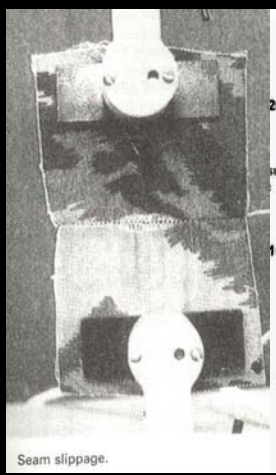


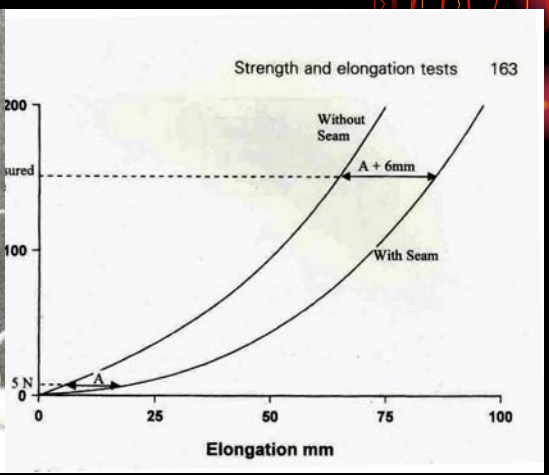
Cone Drop Test
(EN 918, ISO 13433)



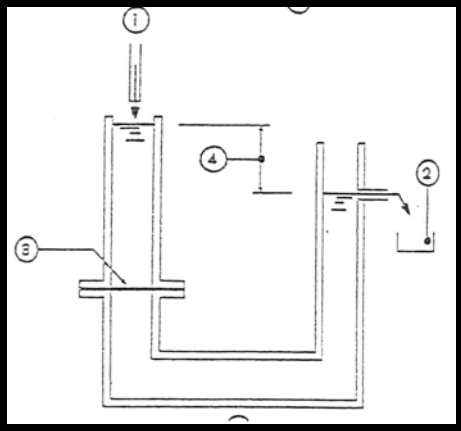


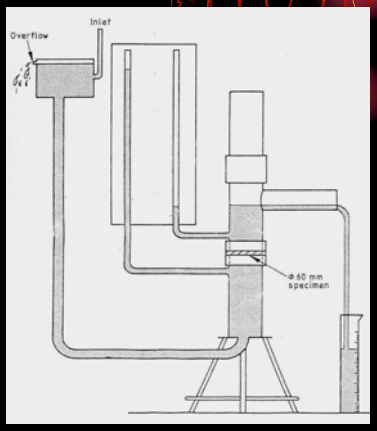
SEAM STRENGTH
Of Geotextile
ASTM D 4884


Seam slippage.



Water permeability by permittivity method (ASTM D 4491)



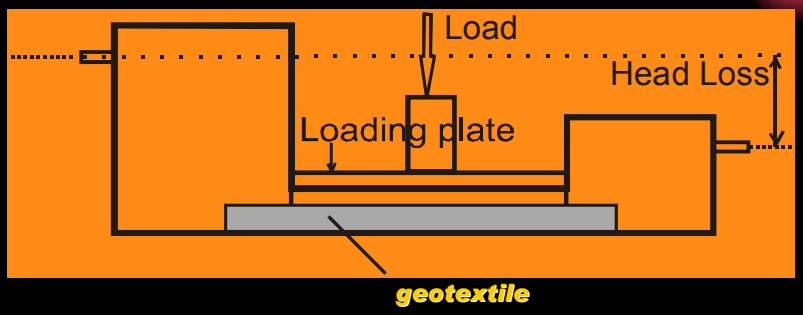


In-plane Permeability (Hydraulic Transmissivity):

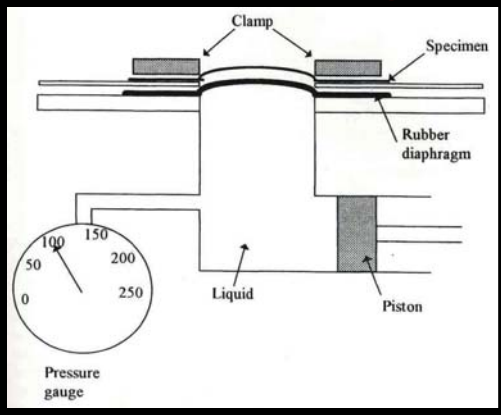
Of Geotextile

ASTM D 4716

DIscharge Capacity



Bursting Strength (Mullen / Hydraulic) ASTM D 3786



Where to test

- In Accredited Laboratories Like BTRA
- Benefits of testing in accredited Labs :
- User is confident about the test report issued by accredited laboratory & sure that the same results will be obtained if tested in any other accredited laboratory within specified limits.
- Users of accredited laboratory enjoy greater access for their products in both domestic as well as international market.
- Savings in terms of time & money due to reduction or elimination of the need for re-testing of products

NON-WOVEN PLANT- NEEDLE PUNCHING WITH HOT AIR BONDING AND THERMAL CALENDERING