2011

Technology Mission on Technical Textiles

Compendium on Centres of Excellence

सत्यमेव जयते

Ministry of Textiles
Government of India

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आनन्द शर्मा, सांसद
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MESSAGE

The textiles industry has played a vital role in nation building. Government of India has proactively supported and encouraged potential upcoming areas in this sector. With a view to posit India as a global leader in the realm of Technical Textiles, Government of India has adopted a multi-pronged interventional strategy of heavy infrastructure investments to increase global competitiveness and enhance the skill base of the industry.

Realising the importance of this sector, Government of India has announced the Technology Misison on Technical Textiles for a period of five years with a fund outlay of Rs. 200 crores. An important facet of this Mission is the creation and promotion of indigenous Centres of Excellence (CoE) of international standards to facilitate informed awareness and sustained capacity building of the industrial human resource relating to technical textiles. In addition to the existing CoEs, four new CoEs are being set up for Non Wovens, Composites, Indutech and Sportech with the object of training over a lakh people in the next few years. With a proposed allocation of Rs. 900 crores in the twelth five year plan, the developments in this sector will definitely be worth watching.

It is very heartening to know that a compendium focusing exclusively on the activities of the various Centres of Excellence is being published. I am positive, this compendium will prove to be a useful data bank for the various stakeholders and will go a long way in establishing a continuous, multi dimensional dialogue with our domestic and international partners, enriching our mental landscapes.

Anand Sharma

ANAND SHARMA

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Message

It gives me great pleasure to learn that a Compendium on the Centers of Excellence on Technical Textiles is being published to provide a comprehensive overview on the important activities initiated by the various nodal agencies appointed by the Central Government in this field. With an objective of shaping Indian Industry as a strategic player in these emerging sectors, these Centers of Excellence established under the Technology Mission for Technical Textiles are undertaking a wide gambit of activities to enable comprehensive support to the industry. The Central Government has provided significant funding to ensure that these Centers of Excellence can provide cutting-edge services in these sectors.

I am confident that the Compendium will be a valuable resource to all stake holders as they pursue innovation and shape products for the future.

(Panabaaka Lakshmi)

Place: New Delhi
Dated: August 11th, 2011.

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सचिव
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Message

Technical Textiles is the emerging area for investment in India. The potential of technical textiles in India is still untapped. Technical textiles represents a multi-disciplinary field with numerous end use applications. The production of different items of technical textiles industry has been slowly but steadily increasing in the country. The field of technical textiles is a fast emerging area and Sub-Group on technical textiles has projected a growth rate of 20% in 12th five year plan. The Govt. has taken many steps in a structured manner for growth and development of technical textiles.

Under the scheme for Growth and Development of Technical Textiles, four Centres of Excellence were established in the field of Protective textiles, Geotextiles, Agrotextiles and Medical Textiles. These Centres of Excellence are equipped with latest testing facilities with national/international accreditation, Information centre, Prototype development facilities, Facilities for training etc. Besides this, a baseline survey on technical textiles was done and more than 60 awareness programmes were carried out across the country.

Govt. has recently launched the Technology Mission on Technical Textiles (TMTT) with a fund outlay of Rs. 200 crore. The aim of TMTT is to address issues like lack of basic infrastructure in terms of testing facilities, lack of market development support, skilled manpower, lack of R & D, absence of regulatory measures, absence of specifications and standards for technical textiles etc. Under the Technology Mission on Technical Textiles, four more centres of excellence in the area of Composite, Non-Wovens, Indutech and Sportech are under establishment.

It gives me immense pleasure that NITRA, with support of the Ministry of Textiles is bringing out a compendium of facilities available in the Centres of Excellence. This compendium provides a status update on the available facilities, as also the activities being undertaken by the various CoEs and the initiatives planned over the next few years.

This publication is an effort to facilitate easy access to information in this field and is recognition of the need to shape a proactive communication with the industry. I am hopeful the information provided here will enable the Industry at large to better connect with the CoEs and held shape provide the requisite thrust to these emerging fields.

(Rita Menon)

Place: New Delhi

Dated: August 16th, 2011

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1. Introduction

In 2007, Prime Minister Dr. Manmohan Singh announced the Technology Mission on Technical Textiles under the XI Five Year Plan. The mission has been established to address the "major constraints for improving production and consumption of technical textiles".

In 2008-09, four Centres of Excellence (COEs) were set up to catalyze industry support and build capacity in the area of Geotech (geo textiles used in civil engineering applications), Protech (personal and property protective clothing), Meditech (medical textiles) and Agrotech (specialized agriculture use). Each of these COEs was setup with an initial outlay of Rs 11 crores from the Central Government.

In 2010 a fund outlay of Rs 200 crores was announced to support the Mission for a period of five years (till 2014-15). As part of this, four new COEs have been announced: two COEs to focus on Indutech (industrial textiles) and Sportech (sports related); and two COEs to build national expertise in processes based on Nonwovens and Composites.

This compendium lists out the activities being undertaken by the COEs[1] and also provides insight into the additional initiatives planned at these centres.

About Technical Textiles

Technical textiles are defined as textile materials and products used primarily for their technical performance and functional properties rather than their aesthetic or decorative characteristics. Other terms used for defining technical textiles include industrial textiles, functional textiles, performance textiles, engineering textiles, smart textiles and hi-tech textiles.

Technical textiles are used individually or as a component/part of another product to enhance its functional properties. The examples of technical textiles used individually to satisfy specific functions are fire retardant fabric for uniforms of firemen, coated fabric as awnings, airbags, carpets etc. The examples of technical textiles as a component or part of another product are tyre cord fabrics in tyres, interlining in shirt collars, webbings in seat belts, etc. Technical textiles are also used as accessories in processes to manufacture other products like filter fabric in chemical and food industries or paper maker felt in paper mills.

Technical textiles sector is a knowledge based research oriented industry and has been slowly but steadily gaining ground due to functional requirements viz. facets such as health and safety, cost effectiveness, durability, high strength, light weight, versatility, customization, user friendliness, eco friendliness, logistical convenience etc.

[1]The Sportech COE is yet to be identified and hence only status of 7 COEs is presented

Different kinds of Technical Textiles

Agrotech

Agrotech includes technical textile products used in agriculture, horticulture (incl. floriculture), fisheries and forestry.

Examples of Agrotech technical textiles include shade-nets, mulch-mats, crop-covers, anti-hail nets and bird protection nets, fishing nets, etc.

Agrotech consumption in India is estimated at Rs 487 crore. Fishing nets constitute over 90% of the Agrotech technical textiles.

Buildtech

Buildtech segment comprises of textiles or composite materials used in the construction of permanent and temporary buildings as well as structures.

The products covered under Buildtech include architectural membranes, hoardings and signages, cotton canvas tarpaulins, HDPE tarpaulins, awnings and canopies, scaffolding nets, floor & wall coverings, etc.

Domestic consumption of buildtech has been estimated at Rs 1,726 crore. Consumption of HDPE tarpaulins is estimated at Rs 650 crore, accounting for around 40% of the total segment.

Clothtech

Clothtech segment of technical textiles mainly comprises of textile components used for specific functional applications in garments and shoes. These components are largely hidden e.g. interlinings in shirts, sewing threads, shoe laces, labels, hook and loop fasteners (Velcro), etc. Fabrics like umbrella cloth are also classified under the Clothtech segment.

Clothtech consumption is estimated at Rs 6,570 crore. Sewing threads alone account for around 60% of the technical textiles consumption under Clothtech followed by labels with around 19% share.

Geotech

Geotech segment comprises of products used in Geotechnical applications pertaining to soil, rock, earth etc. Application areas include Civil Engineering (roads and pavements, slope stabilization and embankment protection, tunnels, rail-track bed stabilization, ground stabilization and drainage, etc.), Marine Engineering (soil erosion control and embankment protection, breakwaters) and Environmental Engineering (landfills and waste management).

Current Geotextiles Market in India (Imports and domestic production) is around Rs 272 Crore, comprising imports of an estimated Rs 105 Crore and domestic production of around Rs 167 Crore.

Hometech

Hometech segment comprises textiles used in the domestic environment-interior decoration and furniture, carpeting, protection against the sun, cushion materials, fireproofing, floor and wall coverings, textile reinforced structures/fittings, filter products for vacuum cleaners.

Examples include mattress and pillow components, fiberfil, carpet backing cloth, stuff toys, blinds, HVAC filters, filter cloth for vacuum cleaners, nonwoven wipes, mosquito nets, etc.

Consumption under Hometech is estimated at around Rs 3,200 crore. Fiberfil and pillow and mattress components together constitute over 50% of the technical textile usage.

Indutech

Indutech includes textile products used in the manufacturing sector such as conveyor belts (TT component), drive belts (TT component), decatising cloth, bolting cloth, AGM glass battery separators, coated abrasives (TT component), ropes and cordages, composites (technical textiles component), paper making fabrics, filtration products, etc.

Technical textiles consumption under Indutech in India is estimated at around Rs 2,326 crore. Printed circuit boards, AGM battery separators and other applications of fibre glass constitute around one-third of the technical textiles usage.

Meditech

Meditech products include textile materials used in hygiene, health and personal care as well as surgical applications. The products covered include baby diapers, incontinence diapers, sanitary napkin, surgical sutures, disposables, surgical dressing, artificial implants, etc.

Meditech consumption is estimated at Rs 1,514 crore. Surgical dressing alone accounts for over 50% of the total.

Mobiltech

Mobiltech is used in the construction of automobiles, railways, ships, aircraft and space craft. The Mobiltech products can be broadly classified into two categories-visible components and concealed components. The visible components include seat upholstery, carpets, seat belts, headliners, airbags, etc. The concealed components include Noise Vibration and Harness (NVH) components, tyre cords, liners, etc.

Technical textiles consumption under Mobiltech is estimated at Rs 3,158 crore. Nylon tyre cord accounts for over 60% of the total technical textile consumption in the segment followed by seat upholstery / fabric with a share of around 13%. Insulation felts.

Oekotech

Oekotech or Ecotech segment refers to use of technical textiles in Environmental Engineering. The primary segment in this is landfill waste management which refers to the use of Geosynthetic products to secure landfills against leakage of municipal or hazardous waste. Other areas include secondary protection in chemical/oil industries.

The current market size of Oekotech segment is estimated at Rs 68 Crore. The market is expected to grow based on spends on municipal waste disposal in accordance with Municipal Solid Wastes (Management & Handling) Rules, 2000, as well as greater awareness and government activity on Hazardous Waste in accordance with Supreme Court Guidelines.

Packtech

Packtech includes several flexible packaging materials used for industrial, agricultural, consumer and other goods. It ranges from synthetic bags used for industrial packaging to jute sacks used for packing food grains. Other packtech applications include: Polyolefin woven sacks, FIBC, Leno bags, wrapping fabric, jute hessian and sacks (including Food grade jute bags), soft luggage products, tea-bags, etc.

Packtech consumption is estimated at Rs 14,067 crore. Woven sacks (excluding FIBC) account for around 50% of the technical textiles consumption under Packtech followed by Jute hessian and sacks with around 30% share.

Protech

Protech are used in the manufacture of various protective clothing for personnel working in hazardous environment. The protective clothing includes garments and related paraphernalia for protection from harmful chemical environment, extreme temperature environments, low visibility, ballistic protection, bullet-proof jackets, fire retardant apparels/ furnishings, radiation protection textile, high visibility clothing, industrial gloves, high altitude clothing, etc.

Indian Defence Forces with a total strength of around 1.5 million individuals comprising the army, navy and air force, is one of the largest consumers of protective textiles.

Sportech

Sportech comprises products used in sports and leisure such as shoes, sports equipment, flying and sailing sports, climbing, angling, cycling, winter and summer sports and indoor sports.

The technical textiles usage in the Sportech segment is valued at Rs 2,632 crore in 2007-08. Domestic consumption of sports footwear components is valued at Rs 2,250 crore, accounting for around 85% of the total segment consumption. It is expected to grow at around 11% y-o-y over the next five years. Sport composites include inflatable balls (footballs, volleyball, basketballs, etc), cricket protective equipments and boxing equipments.

The world market for technical textiles was estimated to be around 19.68 million tonnes with a value of approx Rs 50,000 crores (US$ 107 billion) during 2005 and the drivers for future growth of this industry are expected to be Asian countries like China and India.

In the global scenario, Mobiltech, Indutech and Sportech are predominant segments which collectively constitute about 56 percent of total global consumption of technical textiles.

While overall this industry is import intensive, some of the products are also exported - most of these are commodity products like tarpaulin, jute carpet backing, stuffed toys, surgical dressing, sutures, sports composites, etc. With increase in indigenous production, there is excellent potential for export of technical textiles particularly in the SAARC countries, where this industry is not well developed and depends on import to meet their domestic demand.

About Technology Mission on Technical Textiles

The Technology Mission on Technical Textiles (TMTT) is composed of two mini-missions and the components under each are outlined below:

Overview of Mini-Mission I

The creation and expansion of the COEs is being undertaken under the aegis of Mini-mission I. The mission document outlines the essential features to be created at the Centres of Excellence and the same are summarized below:

1. Facilities for testing and evaluation of products in identified segments of technical textiles with national/ international accreditation and collaboration with foreign institutes/ laboratories. The testing facilities shall cater to the requirement of testing the final product as also the fibre, yarn, fabrics and other elements that go into the final product. The goal is to ensure that the COEs are duly accredited by NABL and other reputed international institutes so that their test results are accepted in the international market.

2. Resource centre with IT infrastructure that provides knowledge and information on the technical textiles. Each COE shall maintain and develop information related to material, books, specifications, directives, etc.
3. Facilities for indigenous development of prototypes. Pilot plant facilities are being created for development of prototypes / technology which shall be transferred to the industry after standardization and optimization of the production process.
4. Facilities for training of core personnel and regular training of personnel from the technical textile industry. COEs will impart training to textile technologists, academicians, scientists, etc. from TRAs, institutes and industry to develop a set of core training professionals.
5. Knowledge sharing with stakeholders and end users such as farmers, civil engineers, architects, medical practitioners, government agencies, etc.
6. Incubation centres where each of the COEs will provide necessary facilities to entrepreneurs for testing new ideas and technologies.
7. Support BIS in setting up standards that are at par with global level. This is especially critical given that technical textiles are functional in nature and yet Indian standards and specifications are not available for most technical textile products.

The Centres of Excellence covered under Mini-mission I include 6 product-focused COEs and 2 process focused COEs.

Product Focused Centres of Excellence

Agrotech	Lead: Synthetic & Art Silk Mills Research Association (SASMIRA), Mumbai Partners: Man-made Textile Research Association (MANTRA), Surat Navsari Agriculture University, Navsari Knowledge partner: Indian Institute of Technology (IIT), Delhi
Geotech	Lead: Bombay Textile Research Association (BTRA) , Mumbai Partner: Ahmedabad Textile Industry's Research Association (ATIRA), Ahmedabad
Indutech *	PSG College of Technology, Coimbatore
Meditech	Lead: South India Textile Research Association (SITRA), Coimbatore Partner: AC College of Technology, Chennai
Protech	Lead: Northern India Textile Research Association (NITRA), Ghaziabad Partner: Indian Institute of Technology (IIT), Delhi
Sportech	To be announced

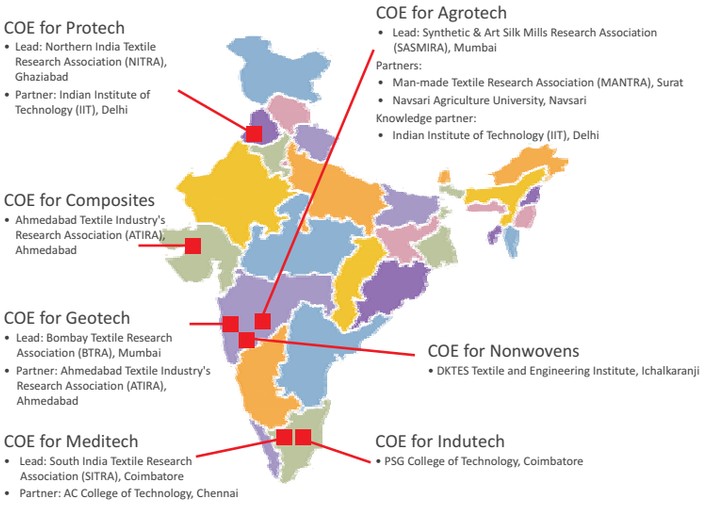
Process Focused Centres of Excellence

Composites*	Ahmedabad Textile Industry's Research Association (ATIRA), Ahmedabad
Nonwovens*	D.K.T.E. Society's Textile & Engineering Institute, Ichalkaranji

*Recently launched COEs

For each of the 4 existing COEs, fund support to the tune of Rs. 25 crores has been allocated (Rs. 11 crores has already been provided prior to the launch of the TMTT). The balance Rs. 14 crores is currently under disbursement to further augment the capacity of these COEs.

For each of the recently launched COEs, Rs. 25 crores is being provided (Rs. 20 crores for capital equipments for lab, pilot plant, prototype development, etc. Rs. 2 crores for developing training facilities, etc. and Rs. 3 crores towards recurring expenditure for appointment of consultants/scientists/technologists for an initial period of 3 years).



Overview of Mini-Mission II

Mini-Mission-II (with a total outlay of Rs. 44 crores) primarily focuses on the market development activities for promotion of technical textiles in the domestic and export markets. The mission aims to:

1. Generate 30 business start-up projects. Rs. 3 crore fund allocation has been made to support entrepreneurial investment in this field.
2. Organize 52 workshops. A Rs. 5 crore fund allocation has been made to support this effort.
3. Catalyze social compliance through standardization of regulatory measures. Some of the technical textile products require mandatory prescriptions for their use. Through Mini-mission II, consultants will be engaged to identify the needed regulatory changes required along with international best practices as also to define the strategy to facilitate such changes in rules and regulation. A Rs. 5 crore fund allocation has been made to support this effort.
4. Provide market development support through 30 buyer-seller meetings. The aim is to support bulk and/or institutional transactions nationally as well as internationally. Nationally, technical textiles are predominantly consumed by institutional consumers like defence, railways, NHAI, etc. In its report on the Baseline Survey of Technical Textile Industry, ICRA Management Consultancy Services (IMaCS) has estimated the current consumption of technical textiles from defence, hospital and railways to be around Rs. 1570 crores. A Rs. 15 crore fund allocation has been made to support this activity.
5. Support 50 manufacturing units for export assistance. A Rs. 5 crore allocation has been made to support this activity.

6. Support 20 contract research projects through IITs, TRAs and Textile institutes. Given that technical textiles is a high technology area where most of the material is imported, there is a need to promote indigenous development, for which R&D is a pre-requisite. A Rs. 11 crore allocation has been made to support this effort.

Enterprises wishing to engage in the above areas and work with the COEs can learn more about the operational mechanics and requirements in the Technology Mission on Technical Textiles 2010-11 to 2014-15. A soft copy of these documents is available on the site for Technical Textiles being run by the Office of the Textile Commissioner, Government of India: http://technotex.gov.in/.

2. Snapshot of COEs

In this section a snapshot of key objectives and updates on the activities of the various COEs is provided. Comprehensive information on each of the COEs is provided separately in subsequent sections.

COE on Agrotech

The Centre of Excellence for Agrotextiles has been assigned to The Synthetic and Art Silk Mills' Research Association (SASMIRA) as the lead partner duly supported by other agencies viz., The Man-made Textiles Research Association (MANTRA), Surat and Navsari Agricultural University (NAU), Navsari.

The SASMIRA laboratory for Centre of Excellence Agrotextiles is accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with the international standard ISO/IEC 17025-2005 for physical and chemical evaluation of textiles. In addition, MANTRA is in the process of acquiring NABL Accreditation under the guidance of the Textile Committee, Mumbai.

The centre assists the manufacturers in development of standard agro-textile products and users in adopting the agro-textile products in the most scientific way. This is facilitated through specific training workshops, online training and field demonstrations. Customized courses are conducted to address the specific needs of the industry.

List of standards and specifications formulated at the Agrotech COE

1. Glossary of Agrotextiles-finalized and accepted by BIS. Under publication
2. Specification for 50 % shade nets for horticulture applications-finalized and accepted by BIS. Under publication
3. Specification for woven ground covers-finalized; being sent to BIS for acceptance
4. Specification for 75 % shade nets for horticulture applications-finalized; being sent to BIS for acceptance
5. Specification for 90 % shade nets for horticulture applications-finalized; being sent to BIS for acceptance

Additional details are in Section 3.

COE on Geotextiles

The Centre of Excellence on Geotech was launched in 2008 with Bombay Textile Research Association (BTRA) as the lead partner duly supported by Ahmedabad Textile Industry's Research Association (ATIRA).

Major Technical Textile Testing Equipment Installed at the COEs

- Agrotextile light shading percentage tester
- Air permeability Tester
- Air Permeability Tester (WIRA)
- Apparent Opening Size Analyzer
- ATLAS Weather -o-meter
- Atomic Absorption Spectrophotometer (AAS)
- Ball Burst Tester
- Banana fibre extractor
- Brush Pilling Tester (SDL-ATLAS)
- BTRA Thickness Tester
- Bundesmann Water repellency Tester
- Bursting strength tester
- Carbon Black Content Analyser
- Carbon Black Dispersion Tester
- Carle Zeiss microscope
- CBR puncture test with accessories
- Cold Impact Chamber
- Compression tester
- Computer Colour Matching System (reflective & transmission)
- Cone Drop Tester
- Constant Tension Transport (CTT)
- Contact Heat Tester
- Convective heat Tester
- Creep Tester
- CSI Abrasion Tester
- Deterioration of Smoke Visibility Tester
- Differential Scanning Calorimeter (DSC)
- Digital Bursting StrengthTester
- Digital Density Balance
- Digital Platform Scale
- Direct Shear Box : For Friction Properties Analysis
- Dynamic Fatigue Tester
- Dynamic Impact Tester
- Electronic crock meter
- Electrostatic tester
- Endurance Test for Hook & Loop Fastener
- ESCR
- Film Thickness Tester
- Flammability tester
- Flushability Tester for Non-Woven Products
- Fogging Tester
- Fourier Transform Infra-red Spectroscopy (FTIR)
- Gas Chromatography and Mass Spectrum Detector (GC-MS)
- Gas/Vapor Permeameter
- Global UV 200
- Gravimetric Absorption Test System (GATS)
- High Performance Liquid Chromatography (HPLC)
- High Performance Thin Layer Chromatography (HPTLC)
- High pressure air-permeability tester
- High Visibility clothing testing equipment
- Hirox Advanced 3 D Video Microscope
- Horizontal Flammability Tester
- Humidity and temperature control Chamber
- Hydrostatic pressure head tester
- ICI Mace Snag Tester SDL-ATLAS
- Inclined Automatic Flammability Tester
- Index Puncture Test Apparatus (mechanical)
- Index Puncture Test Apparatus (Pneumatic)
- Instron make UTM, 50 KN
- Instrument for Run test
- Lab. Coating Machine
- Limited Oxygen Index Tester
- Liquid Absorbency Tester & Liquid Absorbency Kit
- Liquid Barrier Test System
- Liquid Wicking Rate Tester Kit
- Lister AC & Wet Back
- Low Stress Property Kawabata KES Auto System
- Martindale Abrasion Cum Pilling tester (SDL)
- Mechanical pre-treatment device for metalized material
- Melt Flow Index Tester
- Mettler Balance
- Microbial resistance tester
- Microscope & Microtome (Zeiss)
- Microwave Digestion Unit
- Moisture analyzer
- Moisture Balance
- Moisture Management Tester
- Molten metal splash Tester
- Particle Size Analyser
- Peel Bond Tester
- Pneumatic press (with cutting dies)
- Polarised Microscope
- Porometer
- Profile Projector
- Pull Out Tester
- Puncher tester
- QUV spray tester
- Radiant Heat transmission tester
- Rapid oil extraction apparatus
- Reciprocating Movement of Slider under Load Tester for Zippers
- Resistance to Heat under Load Tester for Zipper
- Rotary crock meter
- SDL Thickness Tester
- Seam Fatigue Tester
- Shear Tester
- Sieve Shaker
- Spray Tester-Water Repellency
- Surface Resistance Tester (Rothschild static Voltmeter)
- Sweating Guarded Hot Plate
- T.G.A. Instrument
- Taber abrasion tester
- Tear strength Tester (Textest)
- Temperature Chamber for Ball Burst Tester
- Tensile Testing Machine
- Tension creep
- Thermal Conductivity Tester
- Thermal insulation tester TIV
- Thermal Oxidation Tester
- Thermolabo-Thermal Property Measuring Instrument
- Thickness Gauge
- Torsion Balance
- Toxicity Tester
- Universal Tensile Testing M/C (SDL)
- Universal wear tester
- Uster Tensorapid -4
- UV Weatherometer
- UV-Visible Spectrophotometer
- Vertical and horizontal flame chamber
- Vertical Flammability Tester
- Vibrodyne
- Vibroscope & Vibrodyne (Lenzing)
- Vibrotex (Lenzing)
- Washing and dry cleaning cylinder
- Water Cooled Xenon Tester
- Water permeability in the plane of the geosynthetic (with load)
- Water Permeability Perpendicular to the plane of the geosynthetic (without load, falling head)
- Water Permeability Tester
- Water Permeability: perpendicular to the plane of the geosynthetic (with load)
- Water Vapour Transmission Rate Tester
- Weatherometer
- Wet Barrier Tester
- Wind blocking percentage tester
- Wyzenbeek Abrasion tester

The above list does not include testing equipment proposed to be bought by the COEs; details on the same are mentioned in the sections on the individual COEs.

In the past two decades, many applications of geo-synthetics have proved their value in civil engineering projects. This new class of material has added an entirely new dimension to the world of geotechnical engineering. Geosynthetic materials like Geotextiles, Geogrids, Geonets, Geocell, and Geomembranes are used in various civil engineering activities.

The Centre of Excellence for Geotech at BTRA has been established to undertake the following:

- To create awareness for the use of geosynthetic products and to facilitate the evaluation and development of geosynthetics
- To encourage the entrepreneurs to develop geosynthetics indigenously by providing know how and developing samples at BTRA pilot plant

BTRA has setup a new Geotech Laboratory with all testing facilities to test Geotextiles, Geomembranes, Geocomposites, Gabions, Geosynthetic Clay Liner, Geogrids, Prefabricated Vertical Drain etc. BTRA is also strengthening its information resources on Geotech by procuring various books and international test methods such as ASTM, INDA, EDANA, ISO, etc. The Geotech laboratory at BTRA is accredited per the following:

- GAI-LAP Accreditation of Geosynthetics Institute, USA
- ISO/IEC-17025:2005

R&D projects undertaken/under progress in the field at Geotech COE are:

1. Development of geotextile (natural & synthetic fibres) for various clients (completed).
2. Development of filters for various clients (completed).
3. Design & development of creep rupture tester as per ASTM D 5262 (under progress).
4. Development of protective nonwoven (completed).
5. Development of woven geotextile (under progress).

Additional details are in Section 4.

COE on Meditech

The Centre of Excellence on Medical Textiles is being led by SITRA. The first phase of the COE implementation also saw involvement from the AC College of Technology, Chennai.

SITRA has formulated standards for the following Meditech related products:

1. Disposable surgical gowns
2. Disposable surgical drape
3. Disposable surgical face mask
4. Cellulose wadding
5. Vapor permeable water proof plastic wound dressings
6. Non-woven gauze bandage
7. Paraffin gauze dressings
8. Knitted viscose primary dressings
9. Perforated film absorbent dressings

In addition, the following prototypes have been developed by SITRA:

1. Woven surgical gowns treated with nano finishes
2. Hernia mesh
3. Heart valve fabric
4. Functional spacer fabrics for medical inlays in orthopaedic shoes
5. Woven arterial prosthetic graft
6. Clinical heart patch
7. Bandages using bamboo fibres
8. Ankle support

Additional details are in section 5.

COE on Protech

The Centre of Excellence for Protective Textiles is led by NITRA. The first phase of the COE implementation also saw involvement from the Indian Institute of Technology, New Delhi.

NITRA has successfully completed the following projects on Technical Textiles:

1. Development of fire resistant equipment
2. Development of industrial fabrics
3. Protective clothing from jute
4. Development of antimicrobial fabric
5. Development of UV resistant fabric
6. Garments for protection against pesticides

Additionally, the following products have been developed at NITRA:

1. NYCO fabric for Paramilitary and Military combat uniforms
2. Personal protective fabric using X-static and crabyon fibres
3. Functional fabric to provide bacterial and ultraviolet protection to the skin (bamboo)
4. Extra soft knitted fabric for inner wear / kids wear by using 'High Performance Modal Fibre'

With respect to prototypes, the following instruments have been indigenously developed and successfully commercialised:

1. Smoke Visibility Tester
   - This instrument is developed as per UIC 564-2 Appendix 15 and is used to determine the effect of smoke generated on visibility.
2. Fire Resistance Tester
   - This instrument is developed as per UIC 564-2 and is used to determine the effect of fire on various materials.
3. Flammability Tester
   - This instrument is developed as per BS 5438 and is used to determine the effect of fire on textile materials in vertical mode.

NITRA has submitted a draft white paper on 'Formulation of Regulations in respect of Safety Industrial work-wear (Heat and Flame)' to the Government of India suggesting to amend 16 industrial acts to ensure workers' safety while working in high risk environment.

Additional details are in Section 6.

COE on Composites

Ahmedabad Textile Industry's Research Association (ATIRA) has been designated as the Center of Excellence on Composites.

ATIRA's stated objective is to create a COE for development of advanced composites through newer and innovative processes in order to achieve weight reduction, high mechanical properties and cost competitiveness. Furthermore the goal is to enhance the knowledge base in composites through research, development and training.

The following projects are being undertaken at ATIRA:

- Construction related design as well as environmental design parameters for both Woven and Non-Woven Geo-Synthetics
- Development of Nano-Fibre based textiles
- Spinning of fire retardant fibre blends on cotton system
- Development of fire retardant textiles

In addition to the COE for Composites, ATIRA is also establishing COEs for Geo-Textiles and Nano web Technology with the support of the Gujarat State Government.

Additional details on the Composite COE are provided in Section 7.

COE on Indutech

PSG College of Technology has been designated to house the recently announced Centre of Excellence on Industrial Textiles. The COE on Indutech was sanctioned in March 2011 and the setting up of infrastructure facilities is currently underway.

The following projects are in progress related to Industrial Textiles:

- Development of Natural fiber nonwovens for acoustic applications
- Development of Jute/Wool blend nonwovens
- Development of natural fibre nonwovens for application as car interiors for noise control
- Bamboo blended nonwovens for automobile interiors
- Utilisation of chicken feathers for the development of nonwovens and value added products
- Development of natural fibre nonwovens for application as car interiors
- Production of a hydrophobic oleophilic kapok nonwoven fabric for its potential application
- Analysis of Natural Nonwoven Geo Textiles used in erosion control
- Design & development of nonwoven products using recycled fibres
- Nonwoven textiles as Health Care products
- Development of odour free antimicrobial hospital linens
- Production and properties of Nonwovens using comber noils
- Design and development of Home Textiles using nonwoven fabrics

Additional details on the plans for the Indutech COE are presented in Section 8.

COE on Non-wovens

The D.K.T.E. Society's Textile & Engineering Institute based in Ichalkaranji houses the COE on Nonwovens. This COE has been established recently.

The Centre is still being set-up and DKTE will be building upon the following R&D activities that are in progress / have been completed:

- Geo-Textiles in Nonwoven Application in Paved Road & Unpaved Road
- Nonwoven needle punched polypropylene fabric
- Endless Fabric Belt For Weighing machine
- Industrial Fabric for Military
- Development of Filter Fabric for Vacuum Cleaner
- 1000D Geotextile fabric
- 20 x 30 Peroxide bleached fabric for medical textiles
- Development of needle punched nonwoven fabric products from banana fibre
- Coir nonwoven with cement composites
- Novel application of Kapok fibre nonwoven for recovery of oil spill
- Development of Nanometal Oxide coated cotton fabrics with improved UV protection.
- Development of antibacterial and conductive fabrics using Nano-ZnO.
- Investigating the modification of textiles using plasma
- Development of flame retardant fabrics for school children

For details on the equipment being procured by D.K.T.E. Society's Textile & Engineering Institute as well as other aspects of the COE, please refer to Section 9.

Status of Established COEs

Blank

3. COE on Agrotech

Lead: Synthetic and Art Silk Mills' Research Association (SASMIRA)

Background And Information Of Parent Organization(s)

The Centre of Excellence for Agrotextiles has been assigned to The Synthetic and Art Silk Mills' Research Association (SASMIRA) as the lead agency duly supported by other agencies viz., The Man-made Textiles Research Association (MANTRA), Surat and Navsari Agricultural University (NAU), Navsari. The establishment and functioning of this centre has been initiated under the MOU signed on 25th August, 2008 with the Office of the Textile Commissioner.

Synthetic and Art Silk Mills' Research Association (SASMIRA)

Conceived after independence, SASMIRA, a co-operative endeavor in textile research, has become a reality through joint efforts of numerous institutions and dedicated individuals. At that time silk and art silk industry was composed of large number of small units and the industry pioneers mooted the proposal for creating a co-operative research organization. This proposal was supported by the Council of Scientific and Industrial Research (CSIR) and other Government agencies and led to the establishment of Silk and Art Silk Mills' Research Association, since rechristened as SASMIRA. SASMIRA completed its fifty years of existence and industrial excellence in 2000, coinciding with the new millennium.

SASMIRA is engaged in multifarious activities with the prime objective of rendering scientific and technical assistance to the textile industry and allied sectors. Various activities undertaken by SASMIRA are summarized below:

1. Research & Development
2. Human Resource Development
3. Testing and Evaluation of textiles and allied substrates
4. Technical services and consultancy
5. Instrumentation
6. Publication
7. Powerloom Service Centres, Bhiwandi

SASMIRA has been designated as the lead agency for Centre of Excellence for Agrotextiles in the country. On this front, the institute has established facilities for demonstration, testing and evaluation, training of manpower and information sourcing on agrotextiles.

Man-Made Textile Research Association, MANTRA, Surat

MANTRA, established in 1981, is one of the eight national level Textiles Research Associations (TRAs) and one of the leading TRAs in man-made fibres, linked to the Ministry of Textiles, Government of India, and recognized as SIRO by the Department of Scientific & Industrial Research, Ministry of Science & Technology, Government of India. MANTRA is registered under Bombay Public Trust Act, 1950, and Societies Registration Act, 1860.

Besides R&D, environmental audit, energy audit, consultancy and HRD activities, MANTRA also undertakes testing and technical services. MANTRA has a full-fledged modernized physical testing laboratory, chemical testing laboratory, eco-laboratory, environmental affairs laboratory, analytical testing laboratory and energy audit laboratory. MANTRA is equipped with state-of-the art testing facilities and offers testing of fibres, yarns, fabrics, dyes and chemicals, eco parameters, water and waste water, air, thermic oil, coal, etc.

Navsari Agricultural University, NAU, Navsari

Navsari campus was started with establishment of N.M. College of Agriculture way back in 1965. The campus gained the status of a separate agricultural university on May 1, 2004. The headquarters of Navsari Agricultural University is at Navsari - the University's 13 research stations work in the area of soil and water management, biotechnology, plant protection, Agro techniques, post harvest technology and food quality research with respect to various crops viz., cotton, paddy, sugarcane, sorghum, pigeon pea, black gram, niger, smaller millets, fruit crops (mango, sapota and banana), etc.

The University has three major activities namely Teaching (offering UG and PG degree including Ph.D in various subjects under three faculties i.e. Agriculture, Horticulture and Forestry and PG degree in Agri. Business Management), Research and Extension Education.

Infrastructure and Facilities

Testing Instruments at the COE

The established testing facility under Centre of Excellence is nationally and internationally accredited and is available to manufacturers and users of agrotextile products. This helps the users and manufacturers to ascertain the product quality and specifications.

The list of testing equipments added under the Centre of Excellence at SASMIRA, Mumbai is provided below:

Equipment	Purpose
Differential Scanning Calorimeter (DSC)	To determine melting point, glass transition temp (Tg) and weight loss at different temperatures
Polarised Microscope	Identification of fibres and fabrics based on analytical as well as quantitative study of fiber (longitudinally as well as cross-sectional) and fabric
High pressure air-permeability tester	To measure the air-permeability of different textile fabrics
Tension creep	To determine the creep behaviour of agrotextile fabrics
Computer Colour Matching System (reflective & transmission)	Color value of colored textiles
Fourier Transformation Infra Red Spectrophotometer	Chemical identification of the basic material used for various Agrotextile products
CBR puncture test with accessories	Tensile strength testing of fabric with soil in CBR mode
Thermal insulation tester TIV	To determine thermal conductivity of different textile
Agrotextile light shading percentage tester	To determine light transmission percentage through Agrotextiles
Microbial resistance tester	Determine the resistance of Agrotextiles to microbes
Electrostatic tester	To determine the static charge
QUV spray tester	To determine the weatherability of Agrotextile fabrics
Vibrodyne	To determine the fibre denier and strength
Film Thickness Tester	For coated technical textiles
Shear Tester	To determine the shear force on textiles
Taber abrasion tester	Abrasion resistance of Agrotextiles
Torsion Balance	Weighing Range
Weather-o-meter	To determine light fastness and weathering performance of coloured textiles
Thermal Oxidation Tester	To determine the oxidative degradation of Agrotextiles
Wind blocking percentage tester	To determine the wind breaking percentage

The list of testing equipments added under the Centre of Excellence at MANTRA, Surat is as follows:

S.No.	Equipment
1.	Vibrodyne
2.	Shear Tester
3.	Water Vapour Transmission Tester
4.	Cold Crack Tester
5.	Light Fastness and Weathering Testing Instrument
6.	Pullout Resistance in Soil
7.	Taber Abrasion Tester

Images of Testing Equipments at the COE

Differential Scanning Calorimeter (DSC)

CBR Puncture Test with Accessories

Thermal Insulation Tester TIV

Polarised Microscope

Fourier Transformation Infra Red Spectrophotometer

Agrotextile Light Shading Percentage Tester

High Pressure Air-Permeability Tester

Computer Colour Matching System (reflective & transmission)

Microbial Resistance Tester

Tension Creep

QUV Spray Tester

Electrostatic Tester

Test Parameters

The SASMIRA laboratory for Centre of Excellence on Agrotextiles is accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with the international standard ISO/IEC 17025-2005 for physical and chemical evaluation of textiles. Although, NABL accreditation has recognition by world laboratories, American accreditation has also been undertaken for the COE on Agrotextiles to facilitate exports of these products to USA. This has been achieved through international accreditation for the COE laboratory by the American Association for Laboratory Accreditation (A2LA), USA for physical, chemical and microbiological testing of textiles and allied substrates.

The testing laboratories have been recognized by international accreditation agencies and national accreditation agencies for 125 and 48 test parameters respectively.

MANTRA is in the process of acquiring NABL Accreditation under the guidance of the Textile Committee, Mumbai.

Scope of Mechanical Test Parameters

	Mechanical Test Parameter	Test Method (s)	Testing Charges (excludes taxes) in Rs.
1.	Mass or weight per square metre of fabric	ASTM D 3776 ISO 7211-6 IS 1964	100
2.	Threads/unit length	ASTM D 3775 ISO 7211-2 IS 1963	125
3.	Yarn count	ASTM D 1059 ISO 7211-5 IS 3442	150
4.	Thickness	ASTM D 1777 IS 7702	125
5.	Stiffness	ASTM D 1388 Option A	200
6.	Tensile strength	ASTM D 5035 ISO 13934-1 IS 1969	350/500
7.	Grab strength	ASTM D 5034 ISO 13934-2 IS 1969	400
8.	Tear strength (woven) (Non-woven)	ASTM D 2261 ISO 13937-2 ASTM D 5733	350/500
9.	Air permeability	ASTM D 737 ISO 9237	350
10.	Puncture Resistance Index CBR Puncture	ASTM D 4833 ASTM D 6241 ISO 12236	500
11.	Bursting strength and bursting distension of fabrics: diaphragm method	ASTM D 3786 ISO 13938-2 IS 1966	250
12.	Martindale abrasion	ASTM D 4966 ISO 12947-1	400 for 10000 rubs
13.	Textiles-yarn-Determination of Breaking load and elongation at break of single strand	ASTM D 2256 IS 1670	325
14.	Determination of Length of woven fabrics	ASTM D 3773 ISO 22198 IS 1954	100
15.	Width of Fabric	ASTM D 3774 ISO 22198 IS 1954	100
16.	Determination of Linear density of yarns spun on cotton system	ASTM D 1907 ISO 2060 IS 1315 IS 7703 Part-1	200

	Mechanical Test Parameter	Test Method (s)	Testing Charges (excludes taxes) in Rs.
17.	Twist in yarn	ASTM D 1422 ISO 7211-4 ASTM D 1423 IS 832	200
18.	Linear density of textile fibres	ASTM D 1577	250
19.	Tensile strength of fibre	ASTM D 3822 ISO 5079	500
20.	Water permeability	ASTM D 4491 ISO 11058	500
21.	Taber abrasion	ASTM D 3884	750
22.	Trapezoid tear strength	ASTM D 4533	500
23.	Breaking strength by wide width method	ASTM D 4595 ISO 10319	1000
24.	Thermal resistance	ASTM D 1518	400
25.	Grab strength	ASTM D 4632	400
26.	Apparent opening size	ASTM D 4751	500
27.	Seam strength	ASTM D 1683 ISO 13935-2	500
28.	Seam slippage	ASTM 1683 ISO 13936-1	500
29.	Grab strength for Nonwovens	ISO 9073-18	400
30.	Air permeability for Nonwovens	ISO 9073-15	350

Scope of Chemical Tests

	Mechanical Test Parameter	Test Method (s)	Testing Charges (excludes taxes) in Rs.
1.	Moisture content	ASTM D 2654	200
2.	Fiber analysis : qualitative	AATCC-20 IS 667	200
3.	Fiber analysis : quantitative	AATCC-20 A ISO 1833 IS 2006 IS 1819 IS 2005 IS 3416	500
4.	Flammability	ASTM D 1230 ISO 6941:2003	300
5.	Whiteness of textiles	AATCC 110 AATCC 173	500
6.	Color fastness to artificial light	AATCC 16 Option 3 ISO 105 B02 IS 2454	700
7.	Color fastness to water	AATCC 107 ISO 105 E01 IS 767	200
8.	Color fastness to sea water	AATCC 106 ISO 105 E02 IS 690	250

Mechanical Test Parameter	Test Method (s)	Testing Charges (excludes taxes) in Rs.
9. Color fastness to perspiration	AATCC 15 ISO 105 E04 IS 971	300
10. Color fastness to crocking / rubbing	AATCC 8 ISO 105 X12 (E) IS 766	150
11. Determination of pH value of aqueous extract of textile materials	AATCC 81 ISO 3071 IS 1390	200
12. Determination of skew change of fabric and garment	AATCC 179	400
13. Color fastness to laundering	AATCC 61 ISO 6330 IS 687 IS 3361 IS 764 IS 765 IS 3417	400
14. Color fastness to heat (hot pressing)	AATCC 133 IS 4636	200
15. CMC calculation of small color difference for acceptability	AATCC 173	500
16. Hydrostatic pressure test	AATCC 127 Option 2	300
17 Water repellency : spray test	AATCC 22 IS 390	250
18 Antifungal activity of textiles	AATCC 30, Part 3	1200
19 Antibacterial finishes on textile materials	AATCC 100	1400
20 Antibacterial activity assessment-parallel streak method	AATCC 147	700
21 Accelerated UV exposure	ASTM D 4355 ASTM G 154 AATCC 169	20000 (500 hrs)
22 Color fastness to washing with soap or soap and soda	ISO 105 C 01, 02, 03, C 04, C05	250 each 300 400
23. Shower test Bundesmann	ISO 9865	300
24 Spirallity for knitted garment	ISO 16322, Part 1 and Part 2	500
25 Color Fastness to dry cleaning	ISO 105 DO1	300
26 Absorbency of Textiles	AATCC 79	200

Incubation Center

In order to catalyze new product development and production and marketing activities of agrotextile products, the COE on Agrotech also has set up an incubation centre. The Agrotech COE is engaging with various stakeholders from the industry to generate suggestions on product development ideas and also areas of potential collaboration on product innovation. This will ensure proper utilisation of COE facility and support the working trials and various shop floor trials.

The following is the list of machines procured under the Centre of Excellence to support the incubation efforts:

i) Dornier Rapier PTS 2/16, 190 cm: For development of woven agrotextile products, even leno structures can be woven
ii) Raschel Warp Knitting Machine, RS 4N, E12, 170 inches: For development of protective nets
iii) DILO Needle punched nonwoven line, 700 mm: For development of nonwoven agrotextile products
iv) Mathis laboratory coating machine: For development of coated agrotextile products

Select images of the incubation centre equipment

Raschel Warp Knitting Machine, RS 4N, E12, 170”

DILO Needle punched nonwoven line, 700 mm

Dornier Rapier PTS 2/16, 190 cm

Agrotech Products

FISHING NETS

Composition:

- Nylon mono-filament, multi-filament or HDPE

Construction:

- Warp knitted

Advantages:

- Helps in fishing and in fish farming

SHADE NETS

Composition:

- Polyethylene tape yarns or mono-filaments

Construction:

- Warp knitted

Advantages:

- Low weight
- Acts like a sunscreen
- Protection against strong wind

MULCH MATS

Composition:

- Jute, polypropylene, polyethylene

Construction:

- Woven, non-woven

Advantages:

- Weed control around newly planted trees and shrubs
- Photo-degradable
- Cost effective

HARVEST NETS

Composition:

- Polyethylene mono-filaments

Construction:

- Warp knitted

Advantages:

- Perfect collecting fruits which fall off the tree when they are ripe.
- Simplifies and rationalizes the harvesting process

BIRD PROTECTION NET

Composition:

- Polyethylene tape yarns or mono-filament yarns

Construction:

- Warp knitted

Advantages:

- To protect the fruits eaten by birds
- Light weight
- Durable and strong

ANTI INSECT NETS

Composition:

- HDPE mono-filaments

Construction:

- Warp knitted advantages

Advantages:

- Insect net blocks the penetration of insects into the crop environment
- Reduces the use of pesticides, saving labor, time and money for the grower

CROP COVERS

Composition:

- Polypropylene

Construction:

- Woven, non-woven

Advantages:

- Low wind sensitivity
- No excess water retention on the fabric surface
- UV stabilized
- Extremely strong
- Long lasting

List of Companies Engaged in Manufacturing of Agrotech Products

	Name	Location	Products
1.	Gujarat Fisheries unit	Ahmedabad, Gujarat	Fishing Net and fishline cargo nets, twine, etc.
2.	Ruparel Plastics	Mahuva , Gujarat	Fishing nets, cargo nets, twine, etc.
3.	Makharia Netting	Dahod, Gujarat	Fishing net and fishline
4.	J.K. Industries	Rajkot, Gujarat	Fishing net and fishline
5.	Globe Cast	Umbergaon	Fishing net and fishline
6.	Chain Synthetics (P) Ltd.	Porbandar, Gujarat	Fishing net and fishline
7.	Jayshree Marine nets	Nani Daman	Fishing net and fishline
8.	Khetan Twist Net(P) Ltd.	Mumbai	Fishing net and fishline
9.	Fisheries (P) Ltd.	Bardoli, Gujarat	Fishing net and fishline
10.	Amar Polyfilms	Porbander, Gujarat	Fishing net and fishline
11.	Tuflex India (www.tuflex.net)	Vadodara, Gujarat	Agroshade Net
12.	Agrotech	Anand, Gujarat	Agroshade Net
13.	Technofabrics	Udhna, Gujarat	Agriculture Net
14.	Rishi Packer	Silvassa	Crop Protection Net
15.	ARD Polymer	Silvassa	Crop Protection Net
16.	Unimin	Silvassa	Shade Net/fabrics
17.	Fiberweb India Ltd	Silvassa	Woven and nonwoven crop covers
18.	Malmo Exim	Mumbai	Shading nets, mulch mats
19.	Kwality nets	Mumbai	Shading nets
20.	Netlon	Baruch	Shading nets
21.	Mysore Nandi Tarpaulins Mfg. Co.	Secunderabad, Andhra Pradesh	Agricultural shade nets
22.	Planet Plastics	Nagpur, Maharashtra	Shade net and anti bird net
23.	KT Exports (I) Pvt. Ltd	Mumbai, Maharashtra	Shade nets such as agriculture nets, windbreaker nets, bird nets, weed control - non woven, geolay and frost cover
24.	Ever Green Industries	Coimbatore, Tamil Nadu	Shade net
25.	Affy Export India Pvt. Ltd.	Ghaziabad, Uttar Pradesh	Nets, shade nets, agriculture net, scaffolding nettings, silt fence, woven fabric and ground Covers.

	Name	Location	Products
26.	CTM Technical Textiles Limited	Ahmedabad, Gujarat	Agro shading nets
27.	Sree Durga Industries	Coimbatore, Tamil Nadu	Shade nets
28.	Creative Plastics	Mumbai, Maharshtra	Shading net, insect net, bulb sleeves
29.	Bhindarwala Traders	Mumbai, Maharshtra	Anti-bird nets, safety nets, shading nets, throwing fishing nets, nylon fishing twine, nylon fishing line
30.	Neo Sack Limited	Pithampur, Madhya Pradesh	HDPE/ PP woven sacks, raschel bags, bags with tie-string, shade nets and other allied Products
31.	Phuar Agrotech	Delhi Cantonment, Delhi	Shade net, insect net and irrigation Components
32.	Ratna Fiber Industries	Bangalore, Karnataka	Insect proof nets, window mesh, "UV Stabilized" agro shade net, anti-virus nets
33.	India Plastic Associates	Vadodara, Gujarat	Garden fencing and shading net
34.	Premier Tarpaulins	Coimbatore Tamil Nadu	Tarpaulins, shade nets, pond liners, chilly drying mats
35.	Bokaria Meshes and wires	Chennai, Tamil Nadu	Plastic shade nets, light weight nylon shade nets, colored shade nets, window screen shade nets and nylon shade nets
36.	Br Agri Factors	Daman	Shade nets and monofilament nets
37.	Essen metals & alloys	Pune, Maharashtra	Shade Net, Shade Net Ropes, Insect Nets
38.	Reach netting Solutions Pvt. Ltd.	New Delhi	Shade nets, bird protection nets, Monofilament nets
39.	Shree Siddhivinayak Polyhouse	Pune, Maharashtra	Fabricator natural ventilated greenhouse, poly house, tunnel type shade nets.
40.	Super Paulin	Coimbatore, Tamil Nadu	Shade nets
41.	Gulati Canvas	Delhi	Shade nets, Canvas
42.	Lepakshi Tarpaulin Industries	Hyderabad, Andhra Pradesh	Agriculture Shade nets
43.	Bharat Tarpaulin Co.	Bangaluru, Karnataka	Shade nets, tarpaulins
44.	Flora Agrotech	Vapi Gujarat	Shade nets, monofilament nets
45.	Indonet Plastic Industries	Vadodara, Gujarat	Shade nets,
46.	Neelgiri Tarpaulin Co.	Salem, Tamil Nadu	Shade nets, tarpaulins, Poultry shed
47.	R. R. Polynets	Valsad, Gujarat	Shade nets, insect nets, bird protection net, pond liners
48.	Agro-tech	Anand, Gujarat	Shade nets, vermicompost bed, poultry Shed nets
49.	Betala Canvas Co.	Chennai, Tamil Nadu	Shade nets, Tarpaulins
50.	Rajdeep Agri Products ltd.	Delhi	Shade nets
51.	Hind Fab	Ahmedabad, Gujarat	Shade nets, Packing sacks, Tarpaulins
52.	Creative Polymers	Halol, Gujarat	Shade nets, Horti pots
53.	Rajvi Plastotech Pvt. Ltd.	Vapi, Gujarat	Shade nets
54.	Fortune Agro nets	Vapi, Gujarat	Shade nets, poly sacks
55.	Hari Om Polysacks	Vapi, Gujarat	Shade nets, polysacks
56.	Venkatesh Agro shde nets	Vapi, Gujarat	Shade nets
57.	J. B. Packaging	Ahmedabad, Gujarat	Shade nets, insect nets
58.	Balaji Polynets	Vapi, Gujarat	Shade nets

Information Center

The COE has also established an Information Centre to facilitate dissemination of information through sample exhibits, awareness programmes, e-library, video conferencing and publication of books and papers and technical know-how literature to the manufacturers and users of agrotextile products. List of books, journals and standards procured under the Centre of Excellence on Agrotech is indicated below.

Books

	Title of book	Publisher	Author	Year of Publication
1.	Properties & Performance of Natural Fibre	Woodhead Publishing	K. Pickering	2008
2.	Fabric Testing	Woodhead Publishing	J Hu	2008
3.	2-D Fibrous Assemblies	Woodhead Publishing	J Hu	2008
4.	Structure & Mechanics of Textile Fibre Assembly	Woodhead Publishing	P Schwartz	2011
5.	Indian ManMade Fibre Industry	CARE research		2010
6.	Coloration Technology (2009)	SDC		2009
7.	Monthly Periodical on textile Featuring Research in TT (2009)			2009
8.	Textile research Journal; (2009)	SAGE		2009

List of Standards

- BS EN 471:2003 + AI 2007
- BS EN ISO 6941:2003
- BS 3356:1990 Incorporating Amendment No. 1
- BS 3321:1986
- BS : 2782-10 Method 1006:1978
- BS:3090:1978 Incorporating Amendment No.1
- BS 3181-1:1987
- BS 3183: 1968
- BS 3271:1970 Incorporating amendment No. 1
- BS 4569: 1983
- BS: 1771-2 : 1990
- BS 3424-21:1993
- BS EN 29073-3 :1992, ISO 9073-3:1989, Incorporating Amendment No. 1
- BS EN ISO 105-AD6: 1997
- BS EN ISO 105- B04:1997
- BS EN 29865:1993, ISO:9865:1991
- BS EN ISO:10319:1996, ISO 10319:1993
- BS EN ISO 105-C08:2002 + AI:2008
- BS EN ISO 105-C10 2007
- BS EN ISO 105-C07:2001
- BS EN ISO 6330:2001
- BS EN 20811:1992, ISO 811: 1981 Incorporating Amendment No.1
- BS EN 22313:1992, ISO 2313:1972
- BS EN 24920:1992, ISO 4920:1981
- BS EN ISO 9864:2005
- BS ISO 7211:3, 1984
- BS ISO 7211-4, 1964
- BS ISO 7211-5:1984
- BS EN ISO 3175-3:2003
- BS EN ISO 9237:1995
- BS EN 199586:2008
- BS ISO 4880:1997
- BS EN ISO 6940:2004
- BS EN ISO 5470-2: 2003 Incorporating corrigendum No.1
- BS EN ISO 5470-2; 1999
- BS 3424-36; 1993
- BS 1932-2:1989 Incorporating amendment No.1
- BS 2471:2005
- BS 4554: 1970
- BS 1903: 1981
- BS 1781: 1981
- BS 5066: March 1974 UDC 677: 017 633 2
- BS EN 12447: 2001
- BS EN 13392: 2005
- BS EN 1103: 2005
- BS EN 1102: 1996
- BS EN 13562: 2000
- BS EN 13738: 2004 Incorporating corrigendum No.1
- BS EN 20105 - No.1: 1995, ISO 105-No.1 1993
- BS EN ISO 12127: 1998
- BS EN ISO 105- B01: 1999
- BS EN ISO 105 - B02: 1999 Incorporating corrigendum Nos. 1 & 2 & Amendment 1
- BS EN ISO 105- B03: 1997
- BS 7342: 1990, ISO 8498:1989
- BS 5742: 1989
- BS 8475: 2006
- BS 7343: 1990, ISO 8499: 1990
- BS EN 530: 1995 Incorporating Amendment no. 1
- BS EN 1624: 1999
- BS 7552-1: 1992, ISO 9866-1: 1991
- BS 3424- 13: 1999
- BS 3408: 1992 Incorporating Amendment No.1

List of Standards

- BS EN ISO 105-B06:2004, Incorporating Amendment No.1 to BS ISO 105 BO6:1998
- BS EN ISO 16663-1:2003 Incorporating Corrigendum No.1
- BS EN ISO 16663-1:2003 Incorporating Corrigendum No.1
- BS EN ISO 11058:1999
- BS EN ISO 105-C09:2003 Incorporating amendments No.1
- BS 5438:1989 Incorporating amendment No.1 and 2
- BS EN ISO 105-B08:1999
- BS EN ISO 105-B05:1996
- BS EN 29073-1:1992, ISO 9073-1:1989 Incorporating Amendment No.1
- BS EN 1897:2001 Incorporating corrigendum No.1
- BS EN 12224-2000
- BS EN ISO 105-E06:2006
- BS EN 13895:2003
- BS EN ISO 105-AO4:1999
- BS EN ISO 105:405:1997
- BS 5523:1997, ISO 3572 1976
- BS EN 13772:2003
- BS EN 13844:2002
- BS EN 20105-AD2:1995, ISO 105-A02:1993
- BS EN ISO 5084:1997
- BS 3424: Part 14: 1985
- BS EN 12225: 2000
- BS EN ISO 105-C06: 1997 Incorporating Technical corrigendum No.1
- BS 4029: 1978
- BS EN ISO 105-AO1: 1996 Incorporating Amendment - No.1
- BS EN ISO 3175: 1998
- BS 4674: 1971 Incorporating Amendment No.1
- BS EN ISO 105-E-11: 1997
- BS EN ISO 105- E10: 1997
- BS EN 1049-2: 1994
- BS 3424 20: 1987
- BS 3424-19: 1989
- BS 3424- 18: 1986
- BS 3424- 17: 1987
- BS EN ISO 3175- 2: 1998
- BS 3424- 34: 1992
- BS 3424: 31 1990
- BS 3424: 25: 1993
- BS 3424- 24: 1990
- BS EN ISO 1973: 1996
- BS 7837: 1996
- BS EN ISO 2060: 1995
- BS EN ISO 105- E09, 1997 Incorporating Technical corrigendum No. 1
- BS EN ISO 105- E08; 1997
- BS EN ISO 105- E07: 1997, Incorporating Technical corrigendum No.1
- BS EN ISO 105- C12: 2006
- BS EN ISO 105- E01: 1996 Incorporating Technical corrigendum No.1
- BS 3424- 16: 1995
- BS 3404: 1992 Incorporating Amendment No.1
- BS 3424- 0:2000
- BS 3424-12: 1996, ISO 1419: 1995 Incorporating Amendment Nos 1 & 2
- BS 3424- 8: 1983 Incorporating Amendment No. 2
- BS 2782- 7: Method Y21 A: 1988
- BS 8459: 2005 Incorporating corrigendum No.1
- BS EN 1773: 1997
- BS 3424- 5: 1982
- BS 3424- 38: 1998
- BS EN ISO 3071: 2006
- BS EN 20105- A03: 1995, ISO 105-A03: 1993
- BS 1771-1: 1989
- BS 2043: 1968
- BS 2610: 1978 Incorporating Amendment No.1
- BS EN ISO 2061:1996
- BS EN ISO 105-ED5:2006
- BS EN ISO 105-E04:2009
- BS EN ISO 105-E03:1997
- BS EN ISO 105-E02:1996 Incorporating technical corrigendum No.1
- BS-3424-26:1990
- BS EN ISO 105-X11:1996
- BS EN ISO 105-D01:1995, IS0 105-D01:1993
- BS EN ISO 105:D02:1996
- BS EN ISO 1101: 1996 Incorporating Amendment No.1

Technical Manpower

SASMIRA, Mumbai		
1.	Mr. U. K. Gangopadhyay	Textiles & Technical Textiles
2.	Dr M R Mathur	Textile Polymers and Chemistry
3.	Dr. K. Tandon	Marketing and Project implementation
4.	Mr. A. Oak	Marketing and Project implementation
5.	Mr. H. Soni	Marketing and Project implementation
6.	Mrs. A. S. Sudam	Textile testing and technical textiles
7.	Mr. S. Saini	Development of Textiles
8.	Mrs Manisha Hira	R & D in Technical textiles
9.	Dr R Ramakrishnan	Polymer Chemistry
10.	Mr. R. P. Singh	Fibre Science and Technical Textiles
11.	Ms. S. N. Shinde	Biotechnology
12.	Mr. P.R.Survase	Textiles and Technical Textiles
13.	Ms Purnima Chauhan	Textile Chemistry
14.	Shri J S Sawant	Textile Chemistry and training
15.	Shri A C Bhuta	Testing and evaluation
16.	Shri V D Naik	Testing and evaluation
17.	Ms A A Desai	Testing and evaluation
18.	Shri A S Patil	Testing and evaluation
19.	Shri H S Pandit	Testing and evaluation
20.	Shri A R Talekar	Testing and evaluation
21.	Shri N T Mistry	Testing and evaluation
22.	Shri P G Kochrekar	Testing and evaluation
23.	Shri D M Jani	Testing and evaluation
24.	Ms A T Jhaveri	Testing and evaluation
25.	Ms K A Hallur	Testing and evaluation
26.	Ms L V Mhatre	Testing and evaluation
27.	Shri R.K.Kulkarni	Testing and evaluation
28.	Shri A. R. Venkatramanan	Agrotextile product and field applications
MANTRA, Surat		
1.	Dr. S. K. Basu	Textiles and Technical Textiles
2.	Dr. Hima D. Joshi	Textile Chemistry
3.	M. G. Patel	Textile Chemistry
4.	B. S. Pancholi	Textiles
5.	M. G. Parikh	Textile testing
6.	A. M. Choksi	Textile chemistry
7.	A. D. Chauhan	Textile Testing
8.	D. M. Prajapati	Textile Testing
9.	S. R. Upadhyay	Textile Testing
10.	D. V. Kantharia	Textile Testing
11.	J. K. Patel	Textile Testing
12.	K. N. Jadhav	Textile Testing
NAU, Navsari		
1.	Dr. A. R. Pathak	Application of Agrotextile products and
2.	Dr. R. G. Patil	field application
3.	Er. E. M. Solia	
4.	Dr. S.G. Patil	

List of Standards Formulated

1. Glossary of Agrotextiles finalized and accepted by BIS. Under publication
2. Specification for 50% shade nets for horticulture applications - finalized and accepted by BIS. Under publication
3. Specification for woven ground covers-finalized; being sent to BIS for acceptance
4. Specification for 75% shade nets for horticulture applications-finalized; being sent to BIS for acceptance
5. Specification for 90% shade nets for horticulture applications-finalized; being sent to BIS for acceptance

List of Manuals Prepared

1. A concept paper of Agrotextile with special focus on Protective Agrotextiles
2. A concept paper on Agrotextiles in Hindi and Marathi languages for local publicity
3. A 25 minute film on Agrotech COE 'Samruddhi ki disha mein' has been prepared in English as well as popular regional languages Hindi, Marathi and Tamil highlighting
    i. COE activities and facilities created
    ii. Potential products and application areas of Agrotextile
    iii. Success stories of few manufacturers and users
4. A short 5 min. film highlighting the usage and benefits of key Agrotextile products has also been prepared.

R&D Projects on Agrotech Undertaken/Under Progress

SASMIRA

1. Development of reflective agrotextiles for Sun Management
2. Development of specialty fabric for water conservation and soil erosion control used in horticulture application
3. Development of durable, breathable and barrier work wear fabrics for agrotextile applications
4. Development of PET/ nanoclay nanocomposite for barrier packaging
5. Evaluating compatibility & establishing methodology for simultaneous functional finishes for textile
6. Standardisation of norms for agricultural shade net
7. Dyeing of polypropylene using nanotechnology
8. Development of Super absorbent polymer mats for horticulture applications
9. Establishing correlation on UV Stability of Technical Textiles under different exposure conditions
10. Development of Electrically Conductive PET/CNT Nanocomposite Film

MANTRA

1. Development of multilayer fabrics for sportswear (in progress)
2. Smart fabrics/garment products with smart colours for security labeling
3. Development of innovative fabrics from PTT yarn and to set processing parameters for them

Training Programmes Offered

The centre assists the manufacturers in development of standard agrotextile products and users in adopting the agrotextile products in the most scientific way. This is facilitated through specific training workshops, online training and field demonstrations. In addition, customised courses are developed to address the specific needs of the industry. The following section depicts the various training modules being conducted by the COE on Agrotech.

I. Short Term Courses in Technical Textiles

Short Term Course	Content
1. Orientation course in Agrotextiles Duration : 1 week Batch size : 20 Course fee : Rs 500	I. Introduction to Agrotextiles ii. Classification of Agrotextiles iii. Composition and construction of Agrotextiles iv. Manufacturing of Agrotextiles v. Testing and evaluation of Agrotextiles vi. Market scenario of Agrotextiles
2. Testing and evaluation of technical textiles Duration : 1 week Batch size : 20 Course fee : Rs 1,000 Qualification : Graduation in Science/ Diploma or Degree in Textiles	i. Introduction & classification of Technical Textiles ii. Functional Requirements of Technical Textiles iii. Principles of Testing and Evaluation iv. Introduction to various test standards v. Standard Test methods for evaluating Technical Textiles vi. Testing and evaluation of Technical Textiles
3. Crash course in Testing and evaluation of technical textiles (Customised) **(Theory & Practical Demonstration)** Duration : 3 days Batch size : 5 max. Course fee : Rs 5,000 Qualification : Graduation in Science/ Diploma or Degree in Textiles	i. What, Why and How of Technical Textile Testing (Specific areas) ii. Introduction to various test standards iii. Standard Test methods for evaluating Technical Textiles(Specific areas) iv. Testing and evaluation of Technical Textiles (Specific areas) v. Practical Demonstration of Test Procedures (Specific areas)
4. Entrepreneurship in Agrotextiles Duration : 1 week Batch size : 20 Course fee : Rs 5,000	i. Introduction to Agrotextiles ii. Classification of Agrotextiles iii. Composition and construction of Agrotextiles iv. Manufacturing of Agrotextiles v. Testing and evaluation of Agrotextiles vi. Market research in Agrotextiles vii. Product development strategy viii. Product Pricing ix. Government Schemes and Fiscal Policies x. Business Promotion for Agrotextiles

II. Certificate Courses

Certificate Course	Topics Covered
Certificate course in Technical Textiles Duration : 6 months Batch : 25 Course Fees : Rs 25,000 Qualification : Graduation in Science/Diploma or Degree in Textiles	i. Introduction to Technical Textiles ii. Raw Material fibre / yarn etc. iii. Manufacturing of fibre / yarn iv. Polymer spinning v. Conventional & special spinning processes vi. Weaving vii. Non wovens viii. Knitting / braiding, with special focus on nets ix. Special finishes for Technical Textiles Various segments of technical textiles, specialisation in Agrotextile/ composites/ coated textiles x. Testing & Evaluation xi. International Bodies for testing and Certification xii. Practicals in Testing and Evaluation xiii. Entrepreneurship in Technical Textiles xiv. Elements of marketing xv. Marketing Strategies xvi. Manufacturers in India xvii. Exim Policies

II. Certificate Courses

Certificate Course	Topics Covered
Certificate course in Agrotextiles Duration: 3 months Batch : 25 Course Fees : Rs 25,000 Qualification : Graduation in Science/ Diploma or Degree in Textiles	i. Introduction to Agrotextiles ii. Raw Material fibre / yarn for Agrotextiles iii. Manufacturing Process for Agrotextile products iv. Finishing and Making up of Agrotextiles v. Testing & Evaluation of Agrotextiles vi. International Bodies for testing and Certification vii. Practicals in Testing and Evaluation viii. Entrepreneurship in Agrotextiles ix. Elements of marketing x. Marketing Strategies xi. Exim Policies

Awareness Programmes Conducted

Agriculture is the backbone of Indian economy. However due to industrialization and urbanization the availability of cultivable land is reducing. In order to feed the growing population, it is essential to get the best yield from the available cultivable land. Protective Agrotextiles enable protected cultivation and thus help improve the yield. The Centre of Excellence has an important mission of popularizing Agrotextiles. With this aim, several awareness programmes have been conducted till date and the same are listed below:

Agrotextile Seminars (SASMIRA)

1. 1st October 2008 Mumbai (Introductory, 200 participants)
2. 6th February 2009 Nagpur (200 participants)
3. 25th August 2009 Navsari (250 participants)
4. 5th March 2010 Targhadia, Rajkot (200 participants)
5. 22nd March 2010 Vijayawada (180 participants)
6. 28th October, 2010 Jalandhar (250 participants)
7. 16th December, 2010 Pune (200 participants)
8. 20th January 2011 One Day seminar on Protective Agrotextiles: Advantages and Future Prospects, Ichalkaranji, Kolhapur (250 participants)
9. 7th June 2011 - One Day seminar on Protective Agrotextiles: Advantages and Future Prospects, Coimbatore (200 participants)

Agrotextile Seminars (MANTRA)

1. 8th October, 2009 International Seminar on coating and laminating including Agrotextile applications, Surat
2. 14th Dec., 2009 Half day Seminar on New Polyester Fibre, Surat
3. 8th January, 2010 Industry Innovations for sustainability and growth, Ahmedabad
4. 20th February, 2010 A destiny for investment in technical textiles in India with respect to Agrotextiles, Meditech and Coating and Laminated Textiles
5. 25th March, 2010 One day Conference on Technical Textiles, Indore
6. 30- 31st July, 2010 Two day Conference on Texellence '10, Ahmedabad
7. 23rd Dec., 2010 - International Seminar on Technical Textile: An emerging opportunity for growth, Surat

SASMIRA participated in agro-show KISAN 2010 organized by Kisan Forum Pvt. Ltd. at Pune during December 15 -19, 2010. To create awareness among the masses about the Agrotextile products and its uses, variety of Agrotextile products like shade-net, mulch mat, anti-hail nets etc. were displayed to the visitors. Almost 40,000 people visited SASMIRA's stall (approximately 8000 people per day) during the five day program. During the program, the team interacted with many farmers, consultants and industry people about various Agrotextile products, their uses, development techniques and quality testing.

Foreign Collaboration details

SASMIRA

1. American Association for Laboratory Accreditation, A2LA, USA for accredited testing services
2. Industrial Fabrics Association International, IFAI, USA for marketing and entrepreneurship in technical textiles. Also participation in seminars and exhibitions across the world
3. International Jute Study Group, IJSG, for development of Agrotextile product from natural fibres
4. Colorado State University for research and development in Technical Textiles.

MANTRA has collaborated with the De Monfort University, UK for R&D and technical information exchange.

Agrotech Prototypes to be developed

Today, a large share of market is dominated by fishing nets under the domain of Agrotextiles. The product is standardized and defined under Indian specifications. However, no norms and standards are available for the other large gamut of protective agrotextile products specifically shade nets, crop covers, ground covers, harvesting nets, insect nets and hail protection nets. Since the users are currently unaware about the substantial advantages of these products, the main activity of COE on Agrotextiles is creating awareness about the different products of Agrotextiles and their benefits. Also, the Centre of Excellence plays a significant role in testing, evaluation and establishment of standards for these products. Though there are few entrepreneurs in the field of agrotextiles in India, the entire gamut of products under agrotextiles are currently not being manufactured in India. Another important factor is that most of the entrepreneurs are small time players; no single manufacturer has the infrastructure facility and know-how to produce all the products. Hence, the Centre of Excellence can play a significant role in assisting the manufacturers of agrotextile products in development of new products suitable for usage by the Indian cultivators. The COE is well positioned to showcase new technology and process for development of the various agrotextile products to the manufacturers and entrepreneurs. The technology and processes can be suitably adopted in the industry after studying the market acceptability of the developed product prototypes.

A few of the envisaged prototype developments are:

1. Artificial soil from polymer fibre balls can be used as substitute for soil for plantation
2. Ground cover fabrics with screening for sunlight management
3. Knitted hoses for storing and transporting water near to plant roots for irrigation
4. Super Absorbent Polymer mats for water management during cultivation
5. Water retention nets using super absorbent polymer resin coating on the textile structure

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Eru Char Raasta,
Navsari

4. COE on Geotech

Lead: Bombay Textile Research Association (BTRA)

Background and Information of Parent Organization(s)

The Centre of Excellence on Geotech was launched in 2008 with Bombay Textile Research Association (BTRA) as the lead partner duly supported by Ahmedabad Textile Industry's Research Association (ATIRA).

BTRA

The Bombay Textile Research Association (BTRA) was set up in the year 1954 as an autonomous Co-operative Research Association. BTRA was the third in the series of Co-operative Textile Research Institutes set up in the aftermath of Indian Independence with a view to carry out research and other scientific work for textile and allied industries. The aim of the organisation is to provide day-to-day technological inputs to the industry and support the s & technological objectives set at the national level.

Geotech COE at BTRA is focused on the following areas:

- Testing of geo-textiles
- Testing of industrial filters
- Testing of coated textiles
- Testing of hygienic products (Medical Textiles)
- Evaluation of high loft wadding
- Product development through spun lace system (especially for products made from cellulosic fibre)

In the past two decades, many applications of geosynthetics have proved their value in civil engineering projects. 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.

The Centre of Excellence for Geotech at BTRA has been established to undertake the following:

- To create awareness for the use of geosynthetic products and to facilitate the evaluation and development of geosynthetics
- To encourage the entrepreneurs to develop geosynthetics indigenously by providing know how and developing samples at BTRA pilot plant

Apart from testing & development, BTRA provides training to users / entrepreneurs in Geotech as well as in other fields of technical textiles. Also consultancy including DPR preparation, is provided to entrepreneurs to support establishment of new manufacturing facilities for geosynthetics.

BTRA has setup a new Geotech Laboratory with all testing facilities to test Geotextiles, Geomembranes, Geocomposites, Gabions, Geosynthetic Clay Liner, Geogrids, Prefabricated Vertical Drain etc. BTRA is also strengthening its information resources on Geotech by procuring various books and international test methods such as ASTM, INDA, EDANA, ISO, etc. This Geotech laboratory is accredited per the following:

- GAI-LAP Accreditation of Geosynthetics Institute, USA
- ISO/IEC-17025:2005

Infrastructure Facilities

Testing Instruments

Testing Equipment Installed at BTRA

	Name of Equipment	Model/Type/Year of Make	Range & Accuracy
1.	Universal Testing Machine	H300KU Tinius Olsen 2008	300KN 1%
2.	Peel Bond Tester	1kN Tinius Olsen 2008	1 KN 1%
3.	Melt Flow Indexer	AC type Stop watch LSW-72 International Equipments	Temp. up to 400°C + 0.1°C
4.	ESCR	Controller -VT 4826 International Equipments	Temp. 100 °C±0.1°C
5.	Carbon Black Content Tester	Controller -VT 4826 International Equipments	Temp.up to1000°C Rotameter 2.0 LPM
6.	Porometer	Quantchrome 3Gz USA	1 to 500 microns ± 0.01 micron
7.	Particle Size Analyser	Malvern Master Sizer 2000	0.02 to 2000 microns ± 0.01 micron
8.	Water Vapour Transmission Rate Tester	TextTest FX 3150 Gravitest	Air flow +0.01m/sec Weight +0.1mg Humidity + 0.1 % Temp +0.1°C
9.	CBR Puncture Test Apparatus	Aimil	Max. Stroke 150mm
10.	Index Puncture Test Apparatus (Pneumatic)	Tinius Olsen	Max. Stroke 50mm
11.	Air Permeability Tester	Qualitest-Frazier	Up to 500 LMP
12.	Thermal Conductivity Tester	Laser Comp	Product up to 25 mm max
13.	Pneumatic Press (with cutting dies)	Pneumatic Dumbell Cutter	Capacity 1 Ton
14.	UV Weatherometer	Q-Sun	--
15.	Profile Projector	Sipcon / SVI-IMG MSU 3D	30x to 200x
16.	Hydrostatic Pressure Head Tester	Mesdan	Water head up to 100cm
17.	Upgradation of DSC	HP	Up to 1000°C
18.	Instron	4206	50kN ± 1%
19.	Cone Drop Tester	BTRA	2 to 50 mm ± 2 mm
20.	BTRA Thickness Tester	BTRA	10 mm, 0.01 mm
21.	Water Permeability Tester	BTRA	Flow rate 1 to 30 LPM ± 0.1 LPM WH up to 100 mm
22.	Digital Density Balance	ER200A Afcoset	up to 100 g ± 0.0001 g
23.	Digital Bursting StrengthTester	Qualitest QC115D	Up to 60kg/cm^2 ± 0.1kg/cm^2
24.	SDL Thickness Tester	SDL Carpet thickness gauge	Thick 0 to 25 mm ± 0.01mm Pressure 2 to 200kPa
25.	Index Puncture Test Apparatus (mechanical)	BTRA	Max. stroke 50mm
26.	Digital Platform Scale	CS 100 CITIZEN	Up to 100 kg ± 20 g
27.	Sieve Shaker		

Testing Equipment to be Procured at BTRA

1.	Stress Cracking Resistance Tester	WIRA	
2.	Pyramid Puncture Tester	Tinius Olsen	Capacity 5 Ton

Geotech COE Equipment Installed at ATIRA

1. Instron make UTM, 50 KN
2. ATLAS Weather-o-meter
3. Mettler Balance
4. Pull out Test Device
5. Thickness Gauge
6. Global UV Test System

Images: Geotech COE Equipment at BTRA


Bursting Strength Tester


Carbon Black Content Tester


Cone Drop Tester

Density Tester


ESCR


Martindale Abrasion Tester


Melt Flow Indexer


Particle Size Analyser


Peel Bond Tester

Pneumatic Press

UTM (Universal Testing Machine)

Profile Projector

Thickness Testers

Thermal Conductivity Tester

Porometer

UV Weather-o-meter

Sizing Machine

X-Ray Diffraction

Geotech Test Parameters Supported and Corresponding Cost

The BTRA testing lab is accredited by GRI, USA as well as by NABL.

Products tested at BTRA include the following:

- Geomembrane
- Geogrid
- Geocell
- Geotextile
- Geocomposite
- Geodrain
- Geosynthetic Clay Liner
- Geostrap
- Gabions
- Prefabricated Vertical Drain
- Geonet
- And others

	Test Parameters	ASTM	ISO	IS	BS EN	Minimum Quantity	Cost of Test (Rs)
1.	AOS	D 4751		14294		2 M^2	600
2.	Abrasion	D 4886		14714		0.5 M^2	4000
3.	Bursting strength	D 3786				0.5 M^2	350
4.	CBR puncture	D 6241	12236			2 M^2	1250
5.	Carbon black content	D 1603				1 sq.ft	1200
6.	Cone drop		13433	13162-4	918	2 M^2	400
7.	Density	D 792				1 sq.ft	500
8.	ESCR	D 1693				1 sq.ft	1200
9.	Grab strength	D 4632	13934-2			1 M^2	1000
10.	Index puncture	D 4833				0.75 M^2	1200
11.	Mass	D 5261	9864	14716		0.5 M^2	500
12.	Melt flow index	D 1238				10 gm	900
13.	Pore size	D 6767				0.5 M^2	1250
14.	Rope strength			7071-4	1140	6 M	900
15.	Seam strength	D 4884	10321	15060		2 M^2	1500
16.	Tear strength of geomembrane	D 1004				0.5 M^2	1200
17.	Tensile strength 50mm strip	D 5035	13934-1	1969		0.5 M^2	900
18.	Tensile strength of geogrid-single rib	D 6637 A				3 M^2	1000
19.	Tensile strength of geogrid-multi rib	D 6637 B				3 M^2	2000
20.	Tensile strength of geomembrane	D 6693				0.5 M^2	1200
21.	Thickness	D 5199	9863-2	13162-3		0.5 M^2	250
22.	Trapezoid tear strength	D 4533		14293		1 M^2	1000
23.	UV stabilsation	D 4355		13162-2	12225	1 M^2	80/hr
24.	Water permeability	D 4491	11058	14324	6906-3	0.75 M^2	900
25.	2% secant modulus of geomembrane	D 5323				0.5 M^2	1200
26.	Metal gabion(size, thickness, tensile)	D 975				1 piece	1700
27.	Wide width of geotextile	D 4595	10319	13162-5		2 M^2	1500
28.	Wide width of geomembrane	D 4885				2 M^2	1500
29.	Pyramid puncture resistance	D 5494				2 M^2	2000
30.	Thermal conductivity			3144		1 M^2	2000

Incubation Centre

The following equipment is available at the incubation centre to support innovation and the development of new products and processes :

1. Nonwoven pilot plant
   - Needle punching & Hydro entanglement nonwoven (for geotextiles & others) for width 500mm
2. Plasma processing plant
   - For product development using plasma technology
   - Woven geotextiles
   - Max. width 500 mm
3. Sample Loom : CCI (Dobby) computer operated with mini sizing & warping
   - Machine and drawing-in machine
   - Any design with different coloured yarns is possible
   - Its fast & economical process to develop woven geotextiles
   - Various types of fibres can be processed

Needle Loom

Water Vapour Transmission Rate Tester (Warping Machine)

Plasma Processing Unit

Information Center

Books & CDs Procured

- Coated textiles - principles & applications
- ASTM-STP1190
- ASTM-STP1379
- Ullmann's fibres [vol. 1 & 2]
- High performance fibres
- Military textiles
- 3D fibre reinforced polymer composites
- Friction in textile materials
- Composites forming technologies
- Guide specifications for geotextiles in separate applications
- Worldwide outlook for the nonwovens industry [2007-2012] / india nonwovens outlook [2007-2012] - trends, forecasts & business strategies
- World markets for technical textiles to 2012 & strategies of leading technical textile companies
- Bridging the gap between technical textiles and fashion
- 3-D fibrous assemblies, biologically inspired textiles, structure and mechanics of textile fibre assemblies, tribology of natural fibre polymer composites
- Textile advances in the automotive industry, physical properties of textile fibres
- Properties and performance of natural fibre composites, engineering textiles
- Developments in Smart Fabrics
- Developments in Nonwovens for Personal Care
- Developments in Nonwovens for Wipes
- Developments in Nonwovens for Filtration
- Technical Textiles: Technology, Development & Applications
- Airlaid Pulp Nonwoven Primer
- Elementary Nonwovens Training DVD
- Filtration Technology Handbook
- Hydroentangled Technology Primer
- Needlepunch Nonwoven Primer
- Nonwoven Fabric Sampler & Technology Reference
- Principles of Nonwovens
- Nonwovens! What Are They DVD
- The Nonwoven Fabrics Handbook
- Spunbonded and Melt Blown Technology Handbook
- Technical Textiles Markets 5th Symposium CD ROM
- Technical Textiles Markets 4th Symposium CD ROM
- Buyers Guide for 2010
- Designing with Geosynthetics - (Hard bound book 2005 - 5th Edition), Designing with Geosynthetics Solutions Manual 2005 - 5th Edition
- GRI Standards (currently numbering 45)
- Status and Use of AASHTO M288 Geotextile Specifications
- Survey of Landfill Liner and Cover, Regulations Part 1 USA Status
- Survey of Landfill Liner and Cover, Regulations Part II Worldwide Status
- Geosynthetics in Infrastructure Remediation
- Field Performance of Geosynthetics
- Field Installation of Geosynthetics
- Lessons Learned from Case Histories
- Geosynthetics in the Future
- Bioreactors, GCLs and SRWs
- Peak/Residual, RECMs and Installation
- Probability, LFs, Poor Backfill
- MSW Properties, GT Tubes
- Geosynthetics R & D - “In-Progress”
- Koerner Symposium Proceedings
- CD-LF-K , B-Fill in Walls, Heap Leach Pads, etc.
- CD-Combating Terrorism & Natural Disasters
- CD-Agriculture & Aqua-culture
- CD-It's All in the Details
- Needle punch Conference Proceedings 2004, 2006 & 2009
- Link with India Conference Proceedings, 2007
- INTC Conference Proceedings 2004 to 2009
- Vision Conference Proceedings 2005 to 2009
- World of Wipes Conference Proceedings 2007 & 2008
- Non-woven Research Academy, 2005 To 2008
- International Non-wovens Symposium, 2006, 2007 & 2009
- Middle East Non-wovens Symposium, 2009 & 2007
- FILTREX Conference, 2004, 2006 & 2008
- OUTLOOK Conference, 2005 to 2008
- Filtrex Asia 2010
- International Non-wovens Symposium 2010
- Non-wovens Structures for Absorption of Body Fluids
- Non-wovens Booklet
- 2009 GEO conference proceedings CD
- 6th ICG proceedings Vol. 1 & 2
- Advanced landfill liner system
- Geosynthetics: How to buy, design and build retaining walls
- FHWA Manual Geosynthetic design and construction guidelines
- 2010 state of the industry report
- Advances in Geosynthetic Clay Liner Technology: 2nd Symposium [STP1456]
- Testing and Performance of Geosynthetics in Subsurface Drainage [STP1390]
- Testing and Acceptance Criteria for Geosynthetic Clay Liners [STP1308]
- Geostatistics for Environmental and Geotechnical Applications [STP1283]
- Recent Developments in Geotextile Filters & Prefabricated Drainage Geocomposites [STP1281]
- Dynamic Geotechnical Testing II [STP1213]
- Geotechnical Engineering of Ocean Waste Disposal [STP1087]
- Geosynthetic Testing for Waste Containment Applications [STP1081]
- Geotechnics of Waste Fills Theory and Practice [STP1070]
- Geotextile Testing and the Design Engineer [STP952]
- Composite Materials: Testing and Design (13th Vol) [STP 1242]
- Geosynthetics in civil and environmental engineering
- Introduction to Non-wovens
- Non-wovens: theory, process, performance and testing
- Technical needs: Non-wovens for medical/surgical and consumer uses
- Geosynthetics Asia 1997
- Geotextiles, Geomembranes and related products [vol. 1, 2, 3]
- Geotextiles in filtration & drainage
- Filtration conference [2003, 2005, 2006, 2008]
- IDEA [2004, 2007] Proceedings
- Geotechnical aspects of landfill design and construction
- Final covers for solid waste landfills and abandoned dumps
- Waste containment facilities
- Hitech fibrous materials
- Construction and geotechnical methods in foundation engineering
- Construction and geotechnical engineering using synthetic fabrics
- Durability and aging of geosynthetics
- Geosynthetic resins, formulations and manufacturing
- Soft soil stabilization using geosynthetics
- Video 'Geosynthetics in Transportation Applications'
- Video 'Geosynthetics in Reinforced Soil Structures'
- Video 'Geosynthetics in Landfills'
- CD Geosynthetics and environmental engineering
- CD Retaining Structures with Geosynthetics
- Durability of geotextiles

Standards Procured

- AASHTO M 288
- ASTM-C1338:2000
- ASTM-D2020:1992(03)
- ASTM-D2574:2006
- ASTM-D3273:2000(05)
- ASTM-D5590-2000(05)
- ASTM-E1428:1999(04)
- ASTM-E2180:2007
- ASTM-E96/96M:2005
- BS DD CEN/TS [14416, 14417, 14418]
- DIN EN [12226, 12447, 13719, 13738, 14030, 14150, 14196, 14414, 14415, 14574, 14575, 14576]
- DIN HANDBOOK 385
- DIN-EN-1644-1:1997
- DIN-EN-1644-2:2000
- DIN-V53160-1:2002
- ISO/TS 13434:2008
- ISO-10318:2005
- ISO-10319:2008
- ISO-10320:1999
- ISO-10321:2008
- ISO-10722:2007
- ISO-12236:2006
- ISO-12957-1:2005
- ISO-12957-2:2005
- ISO-12958:1999
- ISO-13426-1:2003
- ISO-13426-2:2005
- ISO-13427:1998
- ISO-13428:2005
- ISO-13433:2006
- ISO-13437:1998
- ISO-13935-2:1999
- ISO-25619-1-2008
- ISO-25619-2-2008
- ISO-3071:2005
- ISO-3759:2007
- ISO-4920:1981
- ISO-5978:1990
- ISO-6330:2000
- ISO-9863-2:1996

Journals Subscribed

1. Future Materials
2. Geosynthetics International
3. Geotechnical Testing Journal
4. Geotextiles And Geomembranes
5. International Dyer
6. Journal Of The Textile Institute
7. Textile Progress
8. Smart Textiles And Nanotechnology
9. Technical Textile International
10. Technical Textile Markets
11. Technical Textiles
12. Textile Research Journal
13. World Textiles

Technical Manpower

1.	Dr. A. N. Desai	Ph.D in Nonwoven Field of specialization: Nonwoven & technical textiles Experience: 31 years
2.	Mr. Venkatrayan	M.Sc. Field of specialization: Consultancy in Lab Accreditation, Total Quality Management, Lead Assessor for NABL Audit. Over 35 years experience in all aspects of textile testing and certification/accreditation & quality management.
3.	Mr. V.K.Patil	LTM , VJTI Field of specialization: Nonwoven & technical textiles, development of products, Development of test equipments, consultancy in Nonwoven etc . Experience: 31 years
4.	Mr. Amol Shivdas	M.Tech (Geotechnical Engineering) IIT Guwahati. M.Tech project: Performance improvement of railway ballasted track using geocell reinforcement.
5.	Mr. Rajit Menon	B.Sc (Chemistry) Experience: 19 years in testing of technical textiles
6.	Ms. Kanchaan K. Vaichalkar	B.Tech (Textile Technology) Testing of Geosynthetics

List of Standards and Specifications Formulated

Specifications Finalized

1. Specifications of geosynthetics for highways
   - Geotextile for reinforcement applications
   - Geotextile for separation purpose
   - Geotextile for filtration purpose
   - Geotextile for drainage applications
2. Specifications of PVC geomembrane (IS 15909) for water proofing lining purpose for use in canal, ponds, reservoirs, industrial effluents & roofing
3. Specifications for coir bhoovastra (IS 15869)

Specifications Under Preparation

Draft Standard Prepared

a. Specifications for geogrid used as soil reinforcement in mechanically stabilized earth(MSE) retaining structures
b. Specifications for geogrid used as reinforcement of base and sub-base layers in pavement structures
c. Specifications for geotextile used in pavement overlays
d. Specifications for geotextile used as protection (or cushioning) material

Revision of Standards

a. Jute geotextile-part 1 for strengthening of sub grade in road (IS 14715)
b. Part 2 for control of bank erosion in rivers & waterways (IS 14715)

Drafts Proposed

a. Specifications for geotextile used in sub-surface drainage application
b. Specifications for geotextile for permanent erosion control in hard armor system
c. Specifications for geotextile used in sub-grade separation in pavement structures
d. Specifications for geotextile used in sub-grade stabilization in pavement structures

Test Standards Finalized

1. Determination of water permeability normal to the plane, without load
2. Determination of the characteristics opening size
3. Determination of water flow capacity in their plane
4. Static (CBR) puncture resistance
5. Apparent opening size by wet sieving

Test Standards Under Review

1. Test method for the determination of the filtration behaviour of geotextiles under turbulent water flow conditions
2. Geotextiles and Geotextile-related products- Determination of water permeability characteristics normal to the plane, under load

R&D Projects on Technical Textiles Undertaken/Under Progress

- Development of geotextile (natural & synthetic fibres) for various clients (completed)
- Development of Filters for various clients (completed)
- Design & development of creep rupture tester as per ASTM D 5262 (under progress)
- Development of protective non-woven (completed)
- Development of woven geotextile (under progress)

Training Programmes Offered

Training covering the following topics on non-wovens/woven and composite fabrics is provided by the COE:

- Raw material used for non-woven
- Different web forming technologies
- Various methods of non-woven finishing
- International test methods used for various technical textiles (non-woven, woven and composite)
- Some applications of technical textiles

Foreign Collaboration Details

Collaborated with foreign Institutes / organisations

- FITI (Testing Laboratory GRI, USA accredited), South Korea
- GRI (Geosynthetic Research Institute), USA

In addition, BTRA is a member of IGS (International Geosynthetic Society), USA; EDANA, Europe and INDA, USA.

Type of Technical Consultancy Provided/Offered

The Geotech COE provides the following specialized consulting services:

- Development of Nonwoven Geotextiles
- Development of Nonwoven composite canal liner

Contact details

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The Bombay Textile Research Association
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E-mail: btra@vsnl.com, geotechbtra@gmail.com
Phone: +91-22-25002652

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5. COE on Meditech

Lead: South India Textile Research Association (SITRA)

Background and Information of Parent Organization(s)

The Centre of Excellence on Medical Textiles is led by the South India Textile Research Association (SITRA). The first phase of the COE implementation also saw involvement from the AC College of Technology, Chennai.

South India Textile Research Association (SITRA)

SITRA was established in the year 1956 by the textile industry with support from the Ministry of Textiles, Government of India. SITRA is governed by Council of Administration consisting of members from the textile industry, representatives from Ministry of Textiles, Government of India, representatives from Government of Tamil Nadu, scientists from reputed institutions and Directors of other Textile Research Associations.

The total membership of SITRA now stands at about 280, covering about 330 units. This includes 11 mills from 8 foreign countries namely Sri Lanka, Malaysia, Nepal, Thailand, Iran, Nigeria, Bangladesh and Indonesia. SITRA's services are also utilised by about 77 small units under the technical service card holder's category. Further SITRA offers services through 7 power loom service centers, one textile service center, 4 CAD centers, one jute promotion center and one sample collection center.

AC College of Technology, Anna University, Chennai

AC College of Technology has been at the forefront of textile education in the country since 1945 and was the first institute to offer degree programmes in textile technology. It offers undergraduate, post graduate and research programmes in the areas of spinning, weaving and technical textiles.

Infrastructure Facilities

The COE is equipped with the following equipment to support the industry's needs:

Testing Instruments

	Name of the Instrument	Make	Model	Description
1.	Lister AC & Wet Back	Lenzing Instrument	-	To determine liquid strike through & wetback of the non-woven
2.	Upgraded Instron	Instron	Model 6021 with 5500 R	To test the tensile properties of all kinds of Meditech products
3.	Sweating Guarded Hot Plate	SDL Atlas	M259B	To determine Thermal resistance, Water-vapour resistance, Water-vapour transmission, Water-vapour permeability index of Meditech products
4.	Hydrostatic Head Tester	Textest Instruments	FX 3000 (Hydro tester III)	To test the water resistance of all types of fabrics, including those treated with water resistant or water repellent finish
5.	Vertical Flammability Tester	SDL Atlas	M233M	Used for determining the ignitability of material
6.	Gas Chromatography and Mass Spectrum Detector (GC-MS)	Thermo Scientific	DSQ II (SR.No: MS 220-6340)	Used for analyzing banned aryl amine, pesticides, phthalates, alkyl phenol ethoxylates (APEO), Pentachlorophenol (PCP), Organic metallic Tin (OMT), etc.

	Name of the Instrument	Make	Model	Description
7.	Atomic Absorption Spectrophotometer (AAS)	SHIMADSU	AA-7000	Atomic absorption along with atomic emission using either flame or electro thermal atomization is widely used for analysis arsenic; selenium, mercury, tin, lead, nickel, chromium, etc can be quantified in ppm/ppb levels
8.	High Performance Liquid Chromatography (HPLC)	Waters	C2695	Mainly used for separation technique both for volatile and non-volatile samples, quantifying the banned compounds i.e. Aryl amines, disperse dyes, pentachlorophenol etc.
9.	UV-Visible Spectrophotometer	GBC	UV/VIS 918	To determine the drug release in the wound dressings
10.	Liquid Absorbency Tester & Liquid Absorbency Kit	WIRA instruments	SR.No: G102/10	To determine the sinking time & water holding capacity of the Meditech products
11.	Instrument for Run test	WIRA Instruments	SR.No: G103/10	The Run-off tester is used to measure the quantity of test liquid (simulated urine) which runs down a Nonwoven test piece
12.	Wet Barrier Tester	WIRA	G103/10	The test uses an inverted mason jar to assess the ability of a sample to withstand water, penetration by applying a constant head of liquid over a period of time
13.	Liquid Wicking Rate	WIRA Instruments	G103/10	To determine the liquid transport in all kinds of fabric
14.	Flushability Tester for Non-Woven Products	Lenzing Instruments Flush 100	Flush 100	To access the rate and extent of disintegration of a test material by turbulent water in a rotating tube
15.	Fourier Transform Infra-red Spectroscopy (FTIR)	Thermo Scientific	Nicolet IS 10	To determine the functional groups present in the materials
16.	Microwave Digestion	Milestone Unit	SR.No: 132122	Microwave sample preparation has become the benchmark technology in digesting samples for AAS, AES, ICP, and ICP-MS
17.	High Performance Thin Layer Chromatography (HPTLC)	CAMAG	027.6200	Useful for the analysis of banned amines and other chemicals present in the Meditech products

Lister AC &Wet Back

Upgraded Instron

Sweating Guarded Hot Plate

Hydrostatic Head tester

Vertical Flammability Tester

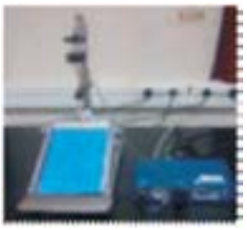
Gas Chromatography and Mass Spectrum Detector (GC-MS)

Atomic Absorption Spectrophotometer (AAS)

High Performance Liquid Chromatography (HPLC)

UV-Visible Spectrophotometer

Liquid Absorbency Tester & Liquid Absorbency Kit



Instrument for Run test

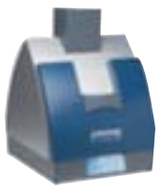
Wet Barrier Tester

Liquid Wicking Rate Tester Kit

Flushability Tester for Non-Woven Products

Fourier Transform Infra-red Spectroscopy (FTIR)

Microwave Digestion Unit



High Performance Thin Layer Chromatography (HPTLC)

Test Parameters

The laboratory is fully geared to undertake the following tests:

Test Name	International Standards Applied	Sample Size Required	Testing Charges in (Rs.)
Hydrostatic resistance	AATCC 127	½ square Metre cloth	300
Bacterial filtration efficiency	ASTM F 2101	½ Metre cloth	1000
Thermal resistance	ISO 11092	1 square Metre cloth	2000
Water-vapour resistance	ISO 11092	1 square Metre cloth	2000
Water-vapour permeability	ISO 11092	1 square Metre cloth	1000
Liquid strike through time	EDANA 150.5 & ISO 9073 - 13	½ square Metre cloth	450
Wet back	EDANA 151.2 & ISO 9073 - 8	½ square Metre cloth	200
Run-off test	ISO 9073 - 11	½ square Metre cloth	400
Flushability	-	½ square Metre cloth	500
Knot strength	-	-	400
Threads/unit length	ASTM 3775	½ square Metre cloth with selvedge	125
Yarn count	ASTM D 1059	½ square Metre cloth	150
GSM	ASTM D 3776/ IS 1964	½ square Metre cloth	190
Tear strength	ASTM D 1424	½ square Metre cloth	150
Tensile Strength	ASTM D 5035	½ square Metre cloth	150
Thickness	ASTM D 1777	½ square Metre cloth	50
Stiffness	ASTM D 4032/BS 3356	½ square Metre cloth	150
Pilling	IS 10971	½ square Metre cloth	150
Co-efficient of drape woven	BS 5058	½ square Metre cloth	150
Air permeability	ASTM D 737	½ square Metre	150
Bursting strength	IS 1966	½ square Metre cloth	100
Antibacterial activity assessment (Qualitative)	AATCC 147	½ Metre cloth	1000
Antibacterial activity assessment (Quantitative)	AATCC 100	½ Metre cloth	1400
Antifungal evaluation, qualitative	AATCC 30, Part III	½ Metre cloth	1250
Soil burial test	AATCC 30, Part I	½ Metre cloth	3000
Aerobic bioburden	-	½ Metre cloth	1000
Fungal bioburden	-	½ Metre cloth	1000
Spore bioburden	-	½ Metre cloth	1000
Total colony unit	APHA 9215B	½ Metre cloth	800
Most probable number of E.Coli	IS 1622	½ Metre cloth	800
E.Coli (Isolation)	IS 5887 (PI)	½ Metre cloth	700
E.Coli (Enumeration)	IS 5887 (PI)	½ Metre cloth	1000
Light	AATCC 16/IS 686/IS 2454/BS 1006	½ Metre cloth	400
Rubbing	IS 766/AATCC 8/AATCC 165	½ Metre cloth	125
Washing	AATCC 61/IS 687/IS 3361/IS 764/IS 765/IS 3417/IS 984	½ Metre cloth	150
Perspiration	IS 790/AATCC 15	½ Metre cloth	150
Water repellency	AATCC- 22	½ Metre cloth	125
Water soluble substances	IS 3456/AATCC 97	½ Metre cloth	150
Presence of surfactants	-	½ Metre cloth	150
Residual total dissolved solids	-	½ Metre cloth	300
Sulphate content	IS 4203	½ Metre cloth	300
Ash content	IS 199	½ Metre cloth	200
Presence of fluorescence		½ Metre cloth	100
Absorbency	IS 2369/AATCC 79/IS 14579	½ Metre cloth	125
Wicking rate	-	½ Metre cloth	300
Ether soluble substances	IS 4390	½ Metre cloth	400

Incubation Center

Incubation activities have just been initiated and prospective entrepreneurs are being identified.

Illustrative Meditech Products

	Product Name	Description	End Use	Manufacturers
1.	Absorbent cotton/wool I.P.	100% bleached cotton.	Suitable for cleaning and swabbing wounds. Applications of medicaments to wounds. Economical and convenient for Clinic, Dental, Nursing home and Hospital.	The Ramaraju Surgical Cotton Mills Ltd. Rajapalayam, Tamilnadu, India. Alluvion Cotton Processing Factory, UK.
2.	Absorbent lint I.P.	100% Cotton woven, One side brushed.	Used in general surgeries.	Disha Surgicals (P) Ltd, Meerut , India. Global Veterinary Products, Australia.
3.	Ankle binder	Knitted fabric.	Adjusts and fits the ankle firmly. Stretched knitted material allows for targeted compression and support to sprained ankles.	Gel O Kare, Lucknow, India. Anping County XuDa Hardware Wire Mesh Co., Ltd., China.
4.	Anti embolism stocking	80% Nylon and 20% Elastane Knitted fabric.	Immobile patients. Pre, intra, post operative bed ridden patients.	Web cot, Aluva, Kerala. Manifattura Calze Ci-Zeta Srl, Italy.
5.	Arm sling pouch (adjustable)	Cotton fabric with Nylon straps.	Effective support to the left/right arm during recuperation from fracture, sprain, strain or surgery.	Viccos Ortho Aids, Delhi. Fortuna International Ltd., UK.
6.	Baby soft dry care (Diaper)	PP spun bond, Wood pulp with SAP, PE spun bond.	Absorbs urine very fast and retains it.	Huggies, India. Pamper, UK.
7.	Bamboo Bandage	100% Bamboo, Plain Weave.	Used as Wound Dressing.	Developed by SITRA.
8.	Barbed bi-directional surgical sutures	Polydioxanone monofilament & Monocryl monofilament barbed sutures.	Biomaterial for wound closure and tissue approximation. *In Vitro* Tendon Repair. *In Vivo* Wound Closure.	Developed by SITRA.
9.	Compression stockinet	Cotton and Synthetic Knitted.	Used in orthopaedics & others.	Shashi International, Kanpur, India. Anji Yuandong Medical Products Co., Ltd. China.

	Product Name	Description	End Use	Manufacturers
10.	Cotton crepe bandage B.P	100% Cotton, Woven.	General Surgical, Orthopaedic and sports injuries. Extremely convenient as a pressure dressing and for skin grafts. Can be used for sprains, aches dislocation, painful joints, veins, cramps, skin injuries to tendons and muscles. Very useful as a light compression bandage for muscular support.	Dynamic Techno Medicals (P) Ltd, Aluva, Kerala. KOB Medical Textiles, TN, India. Fortuna International Ltd, UK.
11.	Disposable surgical face mask	SMS PP Nonwoven.	To protect from blood borne pathogens.	Thea-Tex, Maharashtra, India. Bosung Industrial Co., Ltd. South Korea.
12.	Elastic abdominal binder	Nylon with Elastomer.	Support the weakened abdominal wall post delivery.	Antro Care Enterprises, Chennai, India. Biomedical Horizons, Inc., USA.
13.	Elastic tubular bandage B.P	Cotton with Elastomer, Knitted.	Muscular pain, sprain, strain and swelling.	Dr. Sabharwals Mfg. Labs Limited, Kanpur, India. JetNet Corporation, USA.
14.	Elastic tubular fabric for knee support & ankle support	Heat resistant rubber and High quality yarn.	Provides firm support for weak ankle and helps to prevent and treat stress injuries. Used in sports.	Vespas Orthotics Industries, Haryana, India Champ, Pune, India Yanmao, China.
15.	Elbow Support	100% Cotton Knitted.	Provides support and compression to the elbow and surroundings. Release pain, reduces swelling.	Champ, Pune, India. Yechun, China.
16.	Heart patch (knitted fabric)	100% Polyester, Warp Knitted.	To rectify ventricular septal defect.	Developed by SITRA.
17.	Heart valve fabrics	100% Polyester, Warp Knitted.	Covering fabric for heart valve.	
18.	Hernia mesh	PP warp knitted structure.	Quite strong and effectively repair hernias Completely.	

	Product Name	Description	End Use	Manufacturers
19.	Insoles/Liners for Diabetic Shoes	3-D spacer fabric.	Reduces the Risk of lesions on the lower extremities of foot. Pressure release & soft bedding of the foot.	
20.	Leno gauze	100% cotton Leno weave.	Wound dressing application.	Kulkarni Weaving Mills Pvt. Ltd., India. Nantong Flexitex Co., Ltd., China.
21.	Lumbar sacral support	Sewn with unique combination of virgin elastic, durable fabric material with foam and soft cotton inner lining.	Back pain, postural muscle imbalance in the Spine. Post discetomy syndrome. Slight joint loosening in the lumbar Spine.	Antro Care Enteprices, Chennai, India. HK siwei medical instrument Co.,Ltd., Taiwan.
22.	Poly glycolide violet sutures	100% Polyglycolide Acid-Braided & Coated.	Implantable surgical sutures.	Sutures India Private Limited, India. Dynek (P) Ltd, Australia.
23.	Prosthetic bifurcated vascular graft	100% Polyester, Tubular Woven Fabric.	Replacement of cardio vascular system.	Developed by SITRA.
24.	Ribbed cotton stockinette B.P	Tubular rib knitted. 100% cotton	As sterilisable stockinette for surgical incisions. As stump socks for amputees wearing prosthesis.	Shashi International, Kanpur, India. Anji Yuandong Medical Products Co., Ltd., China.
25.	Soft cervical collar	High density PU foam, cotton stockinet covering.	Cures cervical spondylolysis, neck sprain/stiff neck.	Viccos Ortho Aids, Delhi. HK siwei medical instrument Co.,Ltd., Hong Kong.
26.	Surgical gown fabric treated with Nano antimicrobial finish	100% cotton	Surgical gown worn by surgeons.	Developed by SITRA
27.	Surgical gown fabric treated with Nano liquid repellent finish	100% cotton	Surgical gown worn by surgeons.	Developed by SITRA
28.	Sutures	Nylon, Braided structure.	Closure for wounds.	Arasan phosphates (P) Ltd, TN, India. STARMEDIX, USA.
29.	Tennis elbow support	Cotton, PE, Nylon, PP and Ethafoam PU.	Preventive or non surgical care.	Samson Scientifics and surgical, Indore, India. F3 Sports Inc., USA.
30.	Varicose vein stoking	Woven by circular looms, Nylon and Spandex Yarn. Gives four way stretching,	Controlled compression to the legs to squeeze away abnormal back flow of blood	Samson scientific and surgical, Indore, India. Yiwu Yinhong Healthy&Sports Article Co., Ltd., China.
31.	Wrist splint	Made of strong and porous, high quality elastic.	To maintain wrist in functional position. Resting splint for arthritis.	Dynamic Technomedicals (P) Ltd, Aluva, Kerala. Jiangsu Reak Healthy Articles Co., Ltd., China.

 Absorbent cotton / wool I.P.	 Absorbent lint I.P.	 Ankle binder
 Anti embolism stocking	 Arm sling pouch (adjustable)	 Baby soft dry care (Diaper)
 Bamboo bandage	 Barbed bi-directional surgical sutures	 Compression stockinet
 Cotton crepe bandage B.P	 Disposable surgical face mask	 Elastic abdominal binder
 Elastic tubular bandage B.P	 Elastic tubular fabric for knee support & ankle support	 Elbow support
 Heart patch (knitted fabric)	 Heart valve fabrics	 Hernia mesh

Insoles/liners for diabetic shoes

Leno gauze

Lumbar sacral support

Poly glycolide violet sutures

Prosthetic bifurcated vascular graft

Ribbed cotton stockinette B.P

Soft cervical collar

Surgical gown fabric treated with Nano antimicrobial finish

Surgical gown fabric treated with Nano liquid repellent finish

Sutures

Tennis elbow support

Varicose vein stoking

Wrist splint

Information Center

The COE on Meditech at SITRA has a comprehensive repository of books, publications, journals and relevant standards. An overview of these resources is provided below.

Books and Publications

1.	Medical Textiles. Proceedings of the International Conference 24 & 25 August 1999 Bolton, UK. Edited by Prof. Subhash Anand Woodhead Publishing Limited, England. 2001. vii, 237p.
2.	Medical Textiles and Biomaterials for Healthcare. Edited by Prof.S.C.Anand, Prof.J.F.Kennedy, Dr.M.Miraftab and Dr.S.Rajendran. Woodhead Publishing Limited, England. 2006. xi, 508p.
3.	Smart Textiles for Medicine and Healthcare: Materials, Systems and Applications. Edited by L.Van Langenhove. Woodhead Publishing Limited, England. 2007. xiii, 312p.
4.	Biologically Inspired Textiles. Edited by A.Abbott and M.Ellison Woodhead Publishing Limited, England. 2008. xxi, 219p
5.	Clothing Biosensory Engineering. Edited by Y.Li and A.S.W.Wong Woodhead Publishing Limited, England. 2006. xv, 391p.
6.	Biomechanical Engineering of Textiles and Clothing. Edited by Y.Li and X-Q.Dal Woodhead Publishing Limited, England. 2006. xvi, 412p
7.	Biomedical Polymers Edited by Mike Jenkins Woodhead Publishing Limited, England. 2007. ix, 224p.
8.	Handbook of Technical Textiles. Edited by A.R.Horrocks and S.C.Anand Woodhead Publishing Limited, England. 2000. xvi, 559p.
9.	Handbook of Industrial Textiles (Wellington series). Edited by Sabit Adanur, Technomic Publishing Company, U.S.A. 1995. xx,832p.
10.	Textiles for Protection. Edited by Richard A.Scott, Woodhead Publishing Limited, England. 2005. xxx, 754p.
11.	Natural Fibers, Biopolymers, and Biocomposites. Edited by Amar K.Mohanty, M.Misra and L.T.Drzal, Taylor & Francis, USA. 2005. 875p.
12.	Biomaterials, Artificial Organs and Tissue Engineering. Edited by L.L.Hench and J.R.Johnes. Woodhead Publishing Limited, England. 2005. xii, 284p.
13.	Natural Based Polymers for Biomedical Applications. Edited Rui L.Reis et al, Woodhead Publishing Limited, England. 2008. xxv, 802p.
14.	Smart Materials. Edited by Mel Schwartz, CRC Press, USA. 2009.
15.	Military Textiles. Edited by Eugene Wilusz, Woodhead Publishing Limited, England. 2008. xxii, 362p.
16.	Handbook of Nonwovens. Edited by S.J.Russell, Woodhead Publishing Limited, England. 2007. xiii, 530p
17.	Nanofibers and Nanotechnology in Textiles. Edited by P.J.Brown and K.Stevens Woodhead Publishing Limited, England. 2007. xvi, 528p.
18.	Advances in Fire Retardant Materials. Edited by A.R.Horrocks and D.Price, Woodhead Publishing Limited, England. 2008. xvi, 616p.
19.	Medtex 2007 Conference Programme. The University of Bolton, Bolton, UK. 2007.
20.	Nonwoven. by Madhavamoorthi, Mahajan Publishers Pvt Ltd, Ahmedabad. 2005. 342p.
21.	Annual Book of ASTM Standards 2007: Volume 11.03 Occupational Health and Safety, Protective Clothing. ASTM International, USA. 2007. XVII, 487P.
22.	Seminar on Medical Textiles Opportunities & Applications Office of the Textile Commissioner, Mumbai. 2008.
23.	Processing of Reusable Surgical Textiles for use in Health Care Facilities. Association for the Advancement of Medical Instrumentation, USA. 2000.
24.	Seminar on Woven and Knitted Technical Textiles- Resume of Papers. SITRA, Coimbatore. 2008.
25.	Plasma Technologies for Textiles. Edited by R.Shishoo Woodhead Publishing Limited, England. 2007. xxx, 322p.
26.	Ecotextiles: The Way Forward for Sustainable Development in Textiles. Edited by Miraftab and Horrocks. Woodhead Publishing Limited, England. 2007. x, 221p.

27.	Use of Natural Polysaccharides in Medical Textile Applications by Fouda University of Duisburg-Essen, Egypt. 2005. 121p.
28.	Introduction to Medical Microbiology by R.Ananthanarayan Orient Longman, Hyderabad. 1984. 207p.
29.	Medical Microbiology - Volume 1 Microbial Infections by J.P.Duguid et al ELBS, Hong Kong. 1978. 666p.
30.	Medical Physics by Cameron and Skofronick John Wiley & Sons, New York. 1978. 615p.
31.	Advances in nano science & nanotechnology by Dr. Ashutosh Sharma et al. , National Institute of Science
32.	Communication and Information Resources, July 2004, 284p.
33.	Handbook of Nonwoven filter media by Mr. Irvin M. Hutter, Elsiver Ltd, 2007, 473p.
34.	Intelligent Textiles and Clothing by H.R. Mattila, Wood head Publishing Ltd, 2006, 506p.
35.	Joint Replacement Technology by A. Revell, Woodhead Publishing Ltd, 2008, 675p.
36.	Applications of Nonwoven in Technical Textiles by R.A. Chapman, Woodhead Publishing Ltd, 2010, 212p.
37.	Technical Textiles Yarns Industrial and Medical Application by R. Allagirusamy and A. Dass, Woodhead Publishing Ltd, 2010, 612p.
38.	Medical and Health Care Textiles by S.C. Anand et al., Woodhead Publishing Ltd, 2010, 529p.
39.	Compression Garments for Enhanced Performance, Textile Intelligence Ltd., UK. 2008 IV, 16p.
40.	Industry Technology Roadmapping of Nonwoven Medical Textiles by Asad Amir North Carolina State University, USA. 2006. 133p.

List of Journals

1. Medical Textiles Published by International News Letter, U.K.
2. Future Material
3. Asian Technical Textiles
4. Technical Textiles International

List of Standards

1. ASTM Volume 11.03 consisting Standards of Medical/Protective Textiles.
2. ISO 10993-15 Standards.
3. Australian Standards AS 3789 10 Standards

Technical Manpower

	Name	Qualification	Experience (Years)
1.	Dr. Prakash Vasudevan (Head)	PhD	20
2.	Mr. R.Krishnan	M.E	30
3.	Mr. Kumaravel	B.E	25
4.	Mr. S.Sounderraj	M.Tech (Textile Technology)	13
5.	Mr. T.Sureshram	M.Tech (Textile Technology)	7
6.	Mr. A.Jothivelmurugan	M.Tech (Textile Technology)	4
7.	Mr. P.Sundramoorthy	M.Tech (Textile Technology)	1
8.	Mr. A.Thambidurai	M.Tech (Textile Technology)	-
9.	Mr. P.Senthilkumar	B.Tech (Textile Technology)	9
10.	Mr. V.J.Rajendren	D.T.T	31
11.	Mr. P.Subramaniam	B.Sc (Chem)	30
12.	Mr. S.Shanmuganandan	B.Sc(Phy)	20
13.	Mr. D.Ranganathan	M.Sc (Chem)	15
14.	Mr. G.Santhanakrishnan	B.Tech (Textile Technology)	12
15.	Mr. C.Sathishkumar	M.Sc (Chem)	5
16.	Ms. B.Renuka	M.Sc (Chem)	4
17.	Ms. K.Nandhini	M.Sc M.Phil (Microbiology)	-

List of Standards Formulated

SITRA has formulated the standards for the following Meditech related products:

1. Disposable surgical gowns
2. Disposable surgical drape
3. Disposable surgical face mask
4. Cellulose wadding
5. Vapor permeable water proof plastic wound dressings
6. Non-woven gauze bandage
7. Paraffin gauze dressings
8. Knitted viscose primary dressings
9. Perforated film absorbent dressings

List of Manuals Prepared

The COE on Meditech has produced manuals covering a vast array of subjects relevant to the field of Medical textiles.

1. The scope of medical textiles in India
2. Basic quality requirements for meditech products
3. Nonwovens: Technology & Machinery
4. Training workshop on medical textiles with special emphasis on products & devices for bandaging and pressure garments
5. Meditech products produced using existing machinery setup
6. Functional finishes for medical textiles
7. Textile composites for technical textiles
8. Production and application of wound care products for chronic and acute wound
9. Manufacturing of Meditech products using advanced technique
10. Opportunities and challenges for fibrous products in medical and hygiene sector

R&D Projects on Technical Textiles Undertaken/Under Progress

	R & D Project Title	Status of the Projects
1.	Development of functional spacer fabrics for medical inlays in orthopaedic shoes	Completed
2.	Breathability of woven surgical gowns treated with nano Finishes	Completed
3.	Cut-resistance technical fabrics using spectra filament yarns	Completed
4.	Design and development of Hernia mesh	Completed
5.	Woven arterial prosthetic graft	Completed
6.	Bandages using bamboo fibres	Completed
7.	Clinical heart patch	Completed
8.	Development of specialty 3 D compression bandages for Lymphedema	Ongoing
9.	Design and fabrication of an instrument to assess the barrier properties of operation theatre surgical apparels with specific reference to blood and other body fluids	Ongoing
10.	Development of spun laced non-woven wound dressings using bamboo Fibres	Ongoing
11.	Development of barbed, bi-directional surgical sutures	Ongoing
12.	Controlled drug release on Chitosan-coated cotton gauze	Ongoing
13.	Development of special wound care dressing made of PVA / Chitosan and PVA/Silver nitrate nano membrane	Ongoing
14.	Development of bifurcated vascular graft	Ongoing
15.	Compression bandage pressure measurement systems	Ongoing
16.	Development of rotator cuff repair devices for shoulder re-construction	Ongoing

Training Programmes Offered

Following are the list of training programmes offered by the Meditech COE at SITRA:

1. The scope of Medical textiles in India
2. Basic quality requirements for Meditech Products
3. Nonwovens: Technology & Machinery
4. Training workshop on Medical textiles with special emphasis on products & devices for bandaging and pressure garments
5. Meditech products produced using existing machinery setup
6. Functional finishes for Medical textiles
7. Textile composites for technical textiles
8. Production and application of wound care products for chronic and acute wound
9. Manufacturing of Meditech products using advanced technique
10. Opportunities and challenges for fibrous products in Medical and hygiene sector

Foreign Collaboration Details

SITRA has executed an MoU on 25th January, 2010 with the University of Bolton, UK. The MoU is valid for 2 years, and covers research in healthcare and medical textiles.

Details of Prototypes Developed

The following prototypes have been developed by SITRA:

1. Woven surgical gowns treated with nano finishes
2. Hernia mesh
3. Heart valve fabric
4. Functional spacer fabrics for medical inlays in orthopaedic shoes
5. Woven arterial prosthetic graft
6. Clinical heart patch
7. Bandages using bamboo fibres
8. Ankle support

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<tr>
<td> 
Woven surgical gowns treated with Nano finishes</td>
<td> 
Woven surgical gowns treated with Nano finishes</td>
<td> 
Hernia mesh</td>
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Heart valve fabric</td>
<td> 
Orthopaedic shoes</td>
<td> 
Woven arterial prosthetic graft</td>
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Clinical heart patch</td>
<td> 
Bandages using bamboo fibres</td>
<td> 
Ankle support</td>
</tr>
</table>

Type of Technical Consultancy Provided/Offered

Client Name and Address	Manufacturing Items	Services Offered by SITRA
1. KOB Medical Textiles, Perumpalli, Semmipalayam Village, Trichy Road, Palladam-641 662. Phone: (04255) 277833 Fax No.(04255) 277836 E-mail: nvi@kobmt.com	Medical Bandages	Waste generation analysis and reduction and fixation of norms for waste for various types of bandages
2. Dynamic Techno Medicals Pvt. Ltd., Post Box No.45, Asokapuram, Aluva, Kerala-683 101. Phone: (0484) 2837788, 2837970 Fax No .(0484) 2837688 E-mail: dynamicortho@sify.com	Medical Stockings, Bandages, etc.	Consultancy offered for product development in bandages
3 Sidd Life Sciences P. Ltd., Plot No.4, NH-7, M.M.DA Industrial Estate, Maraimalai Nagar-603 209. Tamil Nadu	Membrane Oxygenator	Development of fabric winding machine for membrane oxygenator
4. T.T.K. Healthcare Ltd., Plot A-28, Kinfra Apparel Park, St. Xavier's College Post, Thumba, Trivandrum-695 586. Fax : (0471) 2707004 E-mail: heartvalve@ttkhealthcare.com	Vascular Grafts, Heart Valve, etc.	1) Development of clinical heart patch fabric 2) Development of heart valve fabric 3) Development of Prosthetic vascular grafts
5. Eucare Pharmaceuticals Private Limited, Plot No.AC-25B, Sidco Industrial Estate, Thirumudivakkam, Chennai-600 044. md_eucare@yahoo.co.in Fax No.(44) 2478 2516 E-mail: eucare@vsnl.com	Development of Oxidised Cellulosic Fabrics for Haemostatic Purpose	1) Development of Haemostatic fabric using cotton and rayon 2) Development of nylon 66 fabric for medical application
6. Comfort Meditex (I) Pvt. Ltd., 2/949-B, Rupika Garden, Mahalakshmi Nagar (East), Goundampalayam Road, Palladam 641 664, Tirupur District. Phone 04255 251846, 256097 Fax 04255 256098	Bandages, Crepe Bandages, Elastic Bandages, Compression Bandages etc. for Medical Application	Testing, product analysis and re-engineering of bandages for medical

Other services and support offered by Meditech COE at SITRA

A range of services and support programmes are provided, an illustrative list is presented below:

- Inter-Mill Study of Productivity
- Managerial Training Programmes
- Quality Audit
- Energy Audit
- Maintenance Audit
- Functional Programmes
- Quality Management
- Apparel Costing
- Calibration Services
- Software Development
- Training Programmes for Shop Floor Workers
- Effluent Characteristic Study and Advice on the Treatment Plants

Contact Details

Dr. Prakash Vasudevan
Joint Director and Head, Center of Excellence in Medical Textiles, SITRA
13/37, Avinashi Road, Coimbatore Aerodrome Post, Coimbatore - 641 014, Tamil Nadu, India.
Email: sitraindia@dataone.in
Phone: +91-422-2574367-9, 6544188, 4215333

6.COE on Protech

Lead: Northern India Textile Research Association (NITRA)

Background and Information of Parent Organization(s)

The Centre of Excellence for Protective Textiles is led by NITRA. The first phase of the COE implementation also saw involvement from the Indian Institute of Technology, New Delhi.

Northern India Textile Research Association (NITRA)

NITRA is one of the four textile research associations established in the year 1975 with the objective to carry out scientific research in the field of textiles as well as to promote and foster scientific research studies for the extension of knowledge related to or connected with textile industry. NITRA is linked to the Ministry of Textiles and recognized by the Department of Scientific and Industrial Research for providing services to centralized as well as decentralized sectors.

NITRA is rendering services to the centralized sector through various R&D projects, consultancies, training programmes and publications. These services span across areas such as energy audit, manpower studies, pollution control, machine and design development, designing of effluent treatment plants and software development. Besides, NITRA helps the industry in solving their operational problems. NITRA is also rendering services to the decentralized sector through eight (8) Powerloom Service Centers established by the Ministry of Textiles, Govt. of India in the Northern Region under the administrative control of Director, NITRA.

Indian Institute of Technology (IIT), Delhi

IIT Delhi was created as centre of excellence for higher training, research and development in science, engineering and technology in India. Established as College of Engineering in 1961, the Institute was later declared an institution of National Importance under the 'Institutes of Technology (Amendment) Act, 1963' and was renamed as the 'Indian Institute of Technology, Delhi'.

The Textile Technology department at IIT Delhi enjoys a special status in the country and has the distinction of being the only Department of Textile Technology amongst the IITs. The department aims to achieve excellence in education in Textile Technology through continuous up gradation of textile syllabi, conducting fundamental research in established and emerging technologies as well as applied/developmental research by closely interacting with the industry and thus provides highly competent technical manpower to the industry, R&D organisations and academic institutes.

Infrastructure Facilities

Testing Instruments Installed at NITRA

	Equipment	Purpose
1.	Flammability tester	This instrument is useful to test work wear as per national and International for vertical oriented samples standards.
2.	Limited oxygen index tester	This instrument is used to test flame retardant behavior of fabric under varying oxygen and nitrogen concentrations.
3.	Contact heat tester	This instrument is used to determine to test the protective textile material against contact heat.
4.	Washing and dry cleaning cylinder	This instrument is used to determine the effect of washing and dry cleaning on protective clothing for flame resistance properties.

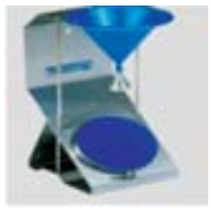
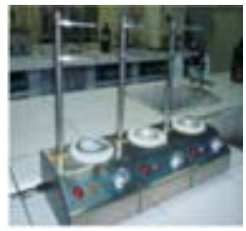
	Equipment	Purpose
5.	Moisture analyzer	This instrument is used to determine moisture content in the textiles.
6.	Mechanical pre-treatment device	The effectiveness of metalized coatings in reflecting radiant heat can be for metalized material drastically reduced by the effect of wear. In this instrument protective textiles are pretreated mechanically to simulate wear.
7.	Rapid oil extraction apparatus	This instrument is used to determine quantity of spin finish oil in the textile materials.
8.	Bundesmann water repellency tester	This instrument is used to determine the resistance to the passage of simulated rain by fabrics being rubbed and rotated.
9.	Rotary crock meter	This is used to determine wet or dry rubbing fastness properties of printed fabric.
10.	Humidity and temperature control chamber	This is used to condition textile material before performing tests.
11.	Inclined automatic	To determine the burning characteristics of textiles under controlled Flammability Tester conditions, when the textile material is in inclined (45°) stage.
12.	Molten metal splash tester	This instrument is used to assess the resistance of materials used in protective clothing to molten metal splash.
13.	Vertical flammability tester	This instrument is used to measure the vertical flame spread for children sleepwear, fabrics and other textile materials.
14.	Horizontal flammability tester	To determine the comparative burn rates and burn resistance of textiles.
15.	Radiant heat transmission tester	This instrument is used to compare the heat transmission on exposure of radiant heat through materials used in protective clothing. By this instrument heat transmission index is measured.
16.	Convective heat tester	This instrument is used to compare the heat transmission on exposure of flame through materials used in protective clothing. By this instrument heat transmission index is measured.
17.	Moisture management tester	This instrument is used to measure liquid moisture management properties of knitted, woven and non-woven textile fabrics.
18.	Fogging tester	This instrument is used to determine fogging characteristics of automotive interior trim of textiles, plastic or leather.
19.	Hydrostatic head tester	This is used to determine the resistance of fabric to water penetration under pressure while firmly clamped in the test rig of standard area, by means of dynamic test method and static test method.
20.	Spray tester-water repellency	To determine the surface wetting resistance of fabric.
21.	Water cooled xenon tester	This instrument is used to determine weathering effect on textile and plastic material.
22.	High visibility clothing	These instruments are used to determine the high visibility clothing (Retro testing equipment reflective and background material).
23.	Electronic crock meter	This is used to determine the colour fastness of textile materials to dry or wet rubbing.
24.	Vibroscope & vibrodyne (Lenzing)	Vibroscope : To determine fineness of manufactured fibres. Vibrodyne : To determine fibre tensile properties viz breaking strength , tenacity, Elongation , Modulus etc.
25.	Vibrotex (Lenzing)	To determine crimp stability of manufactured fibres.
26.	Microscope & Microtome (Zeiss)	For microscopic studies.

	Equipment	Purpose
27.	Uster tester-5	To determine yarn unevenness , imperfections & hairiness.
28.	Uster tensorapid -4	For tensile properties of yarn / Thread viz breaking force, tenacity, elongation, modulus etc.
29.	Constant Tension Transport (CTT)	To determine frictional properties of yarn Lawson- Hemphill.
30.	Universal Tensile Testing M/C (SDL)	To determine tensile properties of yarn / fabric and also used for seam strength, puncture strength , peel / bond strength , constant load elongation and tear strength etc.
31.	Martindale abrasion cum pilling tester (SDL)	To determine abrasion & pilling properties of fabric / garments.
32.	CSI abrasion tester	To determine wear properties of fabric and garment.
33.	Wyzenbeek abrasion tester (Oscillatory abrasion Tester) SDL-ATLAS	To determine abrasion resistance property of textiles.
34.	ICI mace snag tester SDL-ATLAS	To determine snagging resistance property of fabric /garments.
35.	Tear strength tester (Textest)	To determine tear strength of fabric / garments (Elmendorf Tear).
36.	Surface resistance tester (Rothschild static Voltmeter)	To determine antistatic properties of textiles.
37.	Brush pilling tester (SDL-ATLAS)	To determine fuzz & pilling propensity of textiles.
38.	Air permeability tester (WIRA)	To determine air permeability of fabric / garments.
39.	Toxicity Tester	To determine toxicity of various materials.
40.	D.S.C. Instrument	To determine thermal properties of polymers.
41.	T.G.A. Instrument	To determine thermal properties of polymers.
42.	Universal Tensile Machine	To determine tensile properties of materials.
43.	Seam Fatigue Tester	To determine the effect of cycles on seam.
44.	Resistance to heat under load tester for zipper	To determine the effect of heat and load on zippers.
45.	Reciprocating movement of slider under load tester for zippers	To determine the effect of zippers movement under load.
46.	Endurance test for hook & loop fastener	To determine the usability of hook & loop fastener.
47.	Deterioration of smoke visibility tester	To determine the effect of smoke generated on visibility.

Testing Equipment Installed at IIT, Delhi

1. Sweating Guarded Hot Plate
2. Dynamic Impact Tester
3. Ball Burst Tester
4. Low Stress Property Kawabata KES Auto System
5. High Visibility Clothing Testing Equipment
6. Thermolab -Thermal Property Measuring Instrument
7. Liquid Barrier Test System
8. Dynamic Fatigue Tester
9. Hirox Advanced 3 D Video Microscope
10. Moisture Balance
11. Temperature Chamber for Ball Burst Tester
12. Gravimetric Absorption Test System (GATS)
13. Gas/Vapor Permeameter

Images: Testing Equipment at the COE

 Electronic Crock Meter	 High Visibility Clothing Testing Equipment	 High Visibility Clothing Testing Equipment
 Water Cooled Xenon Tester	 Spray Tester-Water Repellency	 Hydrostatic Head Tester
 Fogging Tester	 Moisture Management Tester	 Convective Heat Tester
 Radiant Heat Transmission Tester	 Horizontal Flammability Tester	 Vertical Flammability Tester
 Molten Metal Splash Tester	 Inclined Automatic Flammability Tester	 Humidity And Temperature Control Chamber
 Rotary Crock Meter	 Bundesmann Water Repellency Tester	 Rapid Oil Extraction Apparatus

Images: Testing Equipment at the COE

 Mechanical Pre-treatment Device For Metalized Material	 Moisture Analyzer	 Washing And Dry Cleaning Cylinder
 Water Cooled Xenon Tester	 Limited Oxygen Index Tester	 Flammability Tester For Vertical Oriented Samples
 Vibroscope & Vibrodyne (Lenzing)	 Vibrotex (Lenzing)	 Microscope (Zeiss)
 Uster Tester-5	 Constant Tension Transport (CTT) Lawson- Hemphill	 Universal Tensile Testing M/c (SDL)
 Martindale Abrasion Cum Pilling Tester (SDL)	 CSI Abrasion Tester	 Wyzenbeek Abrasion Tester (Oscillatory Abrasion Tester) SDL-ATLAS
 ICI Mace Snag Tester SDL-ATLAS	 Tear Strength Tester (Textest)	 Surface Resistance Tester (Rothschild Static Voltmeter)

Images: Testing Equipment at the COE


Brush Pilling Tester (SDL-ATLAS)


Air Permeability Tester (WIRA)


Toxicity Tester


D.S.C. Instrument


T.G.A. Instrument


Universal Tensile Machine


Seam Fatigue Tester


Resistance to Heat under Load Tester for Zipper


Reciprocating Movement of Slider under Load Tester for Zippers


Endurance Test for Hook & Loop Fastener


Microtome (Zeiss)


Deterioration of Smoke Visibility Tester


Sweating Guarded Hotplate


Ball Burst Tester

Parameters that can be tested at the Protech COE*

Heat and Flame Resistance Tests

Personal Protective Clothing	
Ease of ignition of vertically oriented specimen	BS EN ISO 6940
Flame spread properties of vertically oriented specimen	BS EN ISO 6941, DIN EN ISO 6941, BS EN 1103
Night wear clothing	BS 5438, BS 5722

*For test charges and other details, visit **www.nitratextile.org**

45° inclined specimen	16FR 1610, ASTM D 1230, NFPA 702
Vertical flammability test	IS:11871, BS 3119, NFPA 1971
Horizontal flammability test	IS:15061, ASTM D 4804
Limited flame spread test	ISO 15025, BS 5438:1976 test 1, test 2 and test 3, IS:15758 (part-4)
Convective heat test	ISO 9151, IS:15758 (part-1)
Radiant heat test	ISO 6942
Molten metal splash test	ISO 9185
Contact heat test	ISO 12127
Impact of spatter test	ISO 14181 (for zippers)
Upholsteries	
Ignitability of vertically oriented specimen	BS EN 1101, IS:15612, IS:15741
Flame spread vertically	BS EN 1102, NFPA 701
Smoldering cigarette test	IS: 15727
Automotive fabrics	
Horizontal test	FMVSS 302, DIN 75200
Railways	
Limiting oxygen index	IS:13501, ISO 4589-2
Smoke visibility test	UIC 564-20R appendix 15
Toxicity Index	NCD 1409
Fire resistance test	UIC 564 OR
Floor coverings	
Methanamine tablet test	BS 6307, IS: 12722
Hot metal nut test	BS 4790
Vertically oriented	IS: 15764

Colour Fastness And Weathering Effect

Colour fastness to light	IS 2454, ISO 105 B02, B 03, B04, AATCC-16
Colour fastness to laundering	IS 105-C10, C06, AATCC 61
Colour fastness to rubbing	IS 766, ISO 105-X12, AATCC-8
Colour fastness to perspiration	IS 971, ISO 105 E04, AATCC 15

Water Resistance

Bundesmann/shower test	IS 392
Cone test	IS 7941
Spray test	IS 390, AATCC 22, ISO 4920
Hydrostatic pressure head test	IS 7016 (Part-VII), AATCC 79, ASTM D 4772
Water vapour transmission test	ASTM E 96

Mechanical Testing on Fabric/Garments

Tensile strength	IS :1969
-Cut strip method	ASTM D 5034
-Wide width method	ASTM D 5035
-Ravelled strip method	ASTM D 4355
-Grab method	ASTM D 4595
	ISO 5081
	ISO 10319
Tear strength	IS : 6489
-Falling pendulum method	ASTM D 1424
-Single tongue tear	ASTM D 2261
-Double tongue tear	ASTM D 4533
-Trapezoidal tear method	ASTM D 5587
	ISO 9290

Bursting Strength -Ball Bursting Method -Diaphragm Bursting Method	IS: 1966 ASTM D 3787 ASTM D 3786
Abrasion Resistance -Martindale Abrasion -Flax & Flat Abrasion -Wyzenbeek Abrasion	IS : 12673 ASTM D 3885 ASTM D3886 ASTM D 4966 ASTM D 4157
Puncture Strength Test -Falling Cone Method -CBR Puncture Method	ASTM D 4833 ASTM D 6261 ASTM D 6241
Seam Strength Test & Seam Slippage Test	ASTM D 1683 ASTM D 434 ISO 13935-1 &2 ISO 13936 -1&2
Snag Resistance Test	ASTM D 3939
Fabric Stretch & Growth	ASTM D 6614 ASTM D 5278 ASTM D 3107; 2594
Stiffness & Flexural Rigidity	IS 6490 ASTM D 1388 BS 3356
Constant Load Elongation & permanent set	ASTM D 6614
Bond / Adhesion strength / Peel Strength / Shear strength	ASTM D 2724 ASTM D 3936 ASTM D 3135 ISO 4637

Mechanical Testing on Yarn/Thread

Yarn / Thread Strength Loop strength & Knot strength	ASTM D 2256 IS :1671
Yarn / Thread Elongation	ASTM D 2256 IS :1671
Yarn Un-evenness & Imperfections	ASTM D 1425 ISO 16549
Yarn Twist	ASTM D 1422/1423 IS 832
Yarn / Thread Shrinkage due to exposure to boiling water or dry heat	ASTM D 204 ASTM D 4974 ASTM D 2259
Thread Diameter	ASTM D 204
Yarn on yarn abrasion (Dry & Wet)	ASTM D 6611
Yarn to Yarn & Yarn to metal friction	ASTM D 3108 ASTM D 3412

Mechanical Tests On Fibre Properties

Microscopic study on fibre structure -Longitudinal / Cross sectional structure	
Fibre length	ASTM D 5103 IS 10014 Part 1
Fibre Fineness	ASTM D 1577 IS 10014 Part 2 BISFA
Fibre Strength, Elongation and Modulus	ASTM D 3822 ISO 5079 DIN 53816

Fibre Crimp & crimp stability	ASTM D 3937
Fibre Shrinkage -Bundle Test -Single Fibre Test	ASTM D 2102-07 ASTM D 5104
Fibre Diameter	-
Breaking Tenacity of manufactured fibres in loop & knot configuration	ASTM D 3217

Additional Tests

Toxicity Test	NCD 1409
Zipper Test	IS 14181, IS 3148, IS 9748 and BS 3084
Endurance Test for Hook & Loop Fastener	IS 8156
Seam Fatigue Test	JASO M 403, HES D 6511, SES N 3298 & 3294 and NES M 7081
D.S.C. & T.G.A.	ASTM D 3418 and ASTM D 6370
Crease Flex Test	HES D 6511 and SES N 3298
Tensile Properties	IS 7016, IS 1969, ASTM D 638
Deterioration of Smoke Visibility Test	UIC 564-2 Appendix-15
Thermal Insulation	Thermal Conductivity Apparatus
Ultra Violet Protection factor	AATCC 183 and AS/NZS 4399
Peel Strength	IS 7016, IS 8156 and IS 1259
Ignitibility Test (includes Cigarette, Butane Gas, Wooden Crib Test)	BS 5852
Fire Resistance Test	UIC 564-2
Zipper(Slide Fastener)	
Remeshability of Fastener	IS 14181
Fold Over Security of Textile Chain	IS 14181
Resistance to Abrasion under Load Cycles	IS 14181
Security of Attachment of Bottom Stop	IS 14181
Security of Attachment of Puller to Slider	IS 14181
Security of Attachment of Top Stop	IS 14181
Security of Inter-Locking of Textile Chain to Lateral Load	IS 14181
Security of Slider Lock Holding	IS 14181
Chain Crosswise Strength	IS 14181
Security of Attachment of Retainer to Longitudinal Load	IS 14181
Security of Attachment of Retainer to Lateral Load	IS 14181
Resistance to Heat under Load	IS 14181
Reciprocating Movement of Slider under Load	IS 14181

Incubation Center

The equipment that textile enterprises can leverage at the incubation centre for the Protech COE are indicated below:

Spinning Equipment

Blow Room	LR - 1993
Carding Machine	LR - 1981, C-1/2
Draw Frame	LR - 1981, DO-2S
Speed Frame	LR - 1981, GS
Ring Frame	LR - 1981, DJ - 5
Friction Spinning Machine	Fehrer - AG, 1998, DREF-III
Ginning Machine	Bajaj - 1994
Double Roller Gin	Mark - I
Two For One Twister (Trytex-2011)	Lab Model
Rotor Spinning Machine (Trytex-2011)	Lab Model

Images: Testing Equipment at the COE

Blow Room: LR – 1993

Carding Machine: LR - 1981 C-1/2

Ginning Machine Double Roller Gin: Bajaj – 1994 Mark - I

Draw Frame: LR – 1981 DO-2S

Speed Frame: LR – 1981 GS

Two For One Twister (Trytex-2011): Lab Model

Ring Frame: LR – 1981 DJ – 5

Friction Spinning Machine: Fehrer – AG, 1998 DREF-III

Rotor Spinning Machine (Trytex-2011): Lab Model

Weaving Equipment

Rapier (Double) Weaving machine	Challenger
Automatic Loom	Ruti CA1NT
Terry Towel Loom	Cimmco
Sample Warping Machine	CCI
Sample Sizing Machine	CCI
Sample Loom	CCI
Hand Loom with Dobby	
Hand Loom with Jacquard	

 Rapier (Double) Weaving Machine: Challenger	 Automatic Loom: Ruti CA1NT
 Terry Towel Loom: Cimmco	 Sample Warping Machine: CCI
 Sample Sizing Machine: CCI	 Sample Loom: CCI
 Hand Loom with Dobby	 Hand Loom with Jacquard

Knitting Equipment

1. Interlock Knitting Machine
2. Knitability Tester
3. Flat Knitting Machine

 Flat Knitting Machine	 Knitability Tester	 Interlock Knitting Machine

Additional Equipment At The Incubation Centre

	Equipment	Purpose
1.	Name: Single Needle 2-Thread Straight Lock Stitch Machine Make: Brother Model: SL 1010-3	The machine is used for all general application of joining and topstitching, mainly woven fabrics.
2.	Name: Button Hole Machine Make: Brother Model: HE-800A-2	The Button Hole Machine is used to create various types of Button Holes in various garments like Men's Shirts, T-shirts, and Ladies Tops etc.
3.	Name: Bartack Machine Make: Brother Model: KE-430D-02	The machine is used to reinforce certain areas of the garment which are subjected to excess stress due to repeated usage, such as pocket openings, bottom of fly opening, buttonholes etc.
4.	Name: Single Thread Chain stitch blind hem Machine Make: Brother Model: JC-9330-0	The machine is used to stitch bottom hems of Formal Trousers, Skirts etc.
5.	Name: Flatlock Machine Make: Brother Model: JC-9330-0	This machine is mainly used for knits. It is widely used for the applications like stitching undergarments both men and women, cover-stitching t-shirts.
6.	Name: Button Stitch Machine Make: Brother Model: BE-438D	The machine is used to attach various types of buttons to the garments like shirt, trousers, tops etc.
7.	Name: Fusing Machine Make: HASHIMA Model: HP-400CS	The machine is used to fix various types of interlinings to provide extra stiffness to the garments.
8.	Name: Single Needle Lockstitch Straight Buttonholing Machine Make: JUKI Model: LBH-781	The machine is capable of sewing heavy weight materials such as bulky knits with maximum lift of work clamp up to 12mm to make high quality button holes in Men's' Shirt, Blouses, Working wear, ladies wear etc.
9.	Name: 6 Thread Overlock Machine Make: JUKI Model: MO-6700	The machine makes safety stitch which is used in run stitching, gathering in knits and woven garments, swimsuit construction etc.
10.	Name: Twin Needle Feed of the Arm double chain stitcher Make: Brother Model: DA-9270-A	The machine is used in joining side seam, jeans inseam, balloon stitching etc.
11.	Name: 4 thread overlock machine Make: JUKI Model: MO-6700	It is used in seaming (over edging) knits and woven.
12.	Name: Single needle direct drive straight lock stitcher with thread trimmer Make: BROTHER Model: S-7200A-303	Used in all application of single needle lock stitching like run stitch/topstitch with ease of stitch length /pattern selection, automatic backtack, under bed thread trimmer etc.
13.	Name: High Speed single needle lockstitch machine with UBT Make: BROTHER Model: SL-737-403	Used in all application of single needle lock stitching like run stitch/topstitch with ease of stitch length /pattern selection, automatic backtack, under bed thread trimmer etc.
14.	Name: LECTRA CAD Plotter Make: LECTRA Model: ALYS-30	It is used to print marker, patterns etc. when connected with CAD Software
15.	Name: GERRBER Digitizer Make: GTCO Cacomp Model: SG63648	It is used to digitize paper patterns, which can be further used in CAD Software for pattern grading, marker making etc.
16.	Name: TUMBLE DRYER Make: RAMSONS	It is used to dry clothes after hydro extraction process in a heated rotating drum.

	Equipment	Purpose
17.	Name: Textile Processing Machine Make: RAMSONS Model: RHTP-15	It is a type of tunnel washing with rotating basket where detergent mixed with hot water is sprayed for effective cleaning of clothes.
18.	Name: Hydro Extractor Make: RAMSONS Model: RDD	It is used to extract water with minimum energy requirement through centrifuge principle. The wet material is placed in the extractor, which has a wall of perforated metal, generally stainless steel. The internal drum rotates at high speed thus throwing out the water contained in it.
19.	Name: Stain buster (Stain Removing Work Station) Make: RAMSONS Model: CL-4	It is used to remove stains with the help of cold spotting guns & dual steam cum air gun. Body designed to stand all types of chemical spray makes it more effective for wide range of chemical applications.
20.	Name: Shirt Folding Table Make: RAMSONS Model: R-516	It is used to fold formal shirt with minimal time and effort.
21.	Name: Thread Sucking M/c Make: RAMSONS	It is used to suck loose threads, dust from a garment with the application of required air pressure.
22.	Name: Computerized Embroidery m/c with standard accessories Make: DEFU Model: DF1H9061500	It is a six head Computerized Embroidery m/c used to create embroidery design on fabric/garment with the help of a computer head in which required design floppy is loaded.

Images: Additional Equipment at Incubation Centre

Single Needle 2-Thread Straight Lock Stitch Machine

Button Hole Machine

Bartack Machine

Single Thread

Flatlock Machine

Button Stitch Machine

Fusing Machine

Single Needle Lockstitch Straight Buttonholing Machine

6 Thread Overlock Machine

Images: Additional Equipment at Incubation Centre

Twin Needle Feed of the
Arm Double Chain Stitcher

4 Thread Overlock Machine

Button Stitch Machine

High Speed Single Needle
Lockstitch Machine with UBT

LECTRA CAD Plotter

GERRBER Digitizer

Tumble Dryer

Textile Processing Machine

RDD

Stain Buster
(stain Removing Work Station)

Shirt Folding Table

Thread Sucking M/c

Computerized Embroidery m/c
with Standard Accessories

Details of Products Developed by COE

Antimicrobial Baby T Shirt
(Knitted, Cotton Crabyon 85/15, 30 Ne)

Antimicrobial Baby T Shirt (Knitted,
Cotton Crabyon 70/30, 30 Ne)

Antimicrobial Baby T Shirt (Knitted,
Cotton Silver Coated Nylon 95/05, 30 Ne)

Antimicrobial Baby T Shirt (Knitted,
Cotton Silver Coated Nylon 90/10, 30 Ne)

Antimicrobial Polo T Shirt
(Knitted, Cotton Crabyon 85/15, 30 Ne)

Antimicrobial Polo T Shirt
(Knitted, Cotton Crabyon 70/30, 30 Ne)

Antimicrobial Polo T Shirt (Knitted,
Cotton Silver coated Nylon 95/05, 30 Ne)

Antimicrobial Polo T Shirt (Knitted,
Cotton Silver coated Nylon 90/10, 30 Ne)

Kidswear
(Knitted, Cotton 100%, 30 Ne)

Kidswear
(Knitted, Modal Cotton 35/65, 30 Ne)

Kidswear
(Knitted, Modal 100%, 30 Ne)

Kidswear
(Knitted, Modal Cotton 50/50, 30 Ne)

Man's Undergarment
(100% Bamboo, 30 Ne)

Lady's Undergarment
(100% Bamboo, 40 Ne)

Man's T Shirt
(100% Bamboo, 30 Ne)

Lady's T Shirt
(100% Bamboo, 40 Ne)

Combat Uniform
(Nylon 66 Cotton, 50/50)

Information Center at the Protech COE

The books and data sources available at the Protech COE are listed below.

Books

1.	Handbook of Non-woven
2.	Non-woven textiles
3.	Military textiles
4.	Advances in fire retardant materials
5.	Textile in sports
6.	Handbook of technical textiles
7.	Polymer Data Handbook
8.	Thermal and Moisture Transport in fibrous material
9.	Eco textiles: the way forward
10.	Intelligent textiles of clothing
11.	Fabric Testing
12.	Engineering Textiles
13.	Smart textiles for medicine and healthcare
14.	Medical Textiles and Bio Material for Health Care
15.	Protective Clothing
16.	Wearable Electronics & Photonics
17.	Identification of Fibres
18.	Smart Cloths and Wearable Technology
19.	Ullmann's Fibres
20.	Design & Manufacturing of Textile Composites
21.	Smart Textiles Coatings and Laminates
22.	Advance in Yarn Spinning Technology
23.	Advances in Textile Biotechnology
24.	Textiles for Cold weather Apparel
25.	Handbook of Textile fibre Structure : Fundamentals and Manufactured Polymer Fibres (Volume I)
26.	Handbook of Textile fibre Structure: Natural, Regenerated, Inorganic and Specialist Fibres (Volume II)
27.	Interior Textiles : Design and Development
28.	Colour Measurement : Principals, Advances and Industrial Applications
29.	Advanced Textiles for wound Care
30.	Modelling and Predicting Textile Behaviour
31.	Sustainable Textiles : Life Cycle and Environmental Impact
32.	Textiles, Polymers and Composites for Buildings

Standards

1.	ASTM Vol. 11.03
2.	ASTM Vol. 04.13
3.	ASTM Vol. 11.03
4.	ASTM Vol. 04.13
5.	ASTM Vol. 07.01 & 07.02
6.	AATCC manual
7.	ISO 12402 - 1 : 2005
8.	ISO 12402 - 2 : 2006
9.	ISO 12402 - 3 : 2006
10.	ISO 12402 - 4 : 2006
11.	ISO 12402 - 5 : 2006
12.	ISO 12402 - 6 : 2006
13.	ISO 12402 - 7 : 2006
14.	ISO 12402 - 8 : 2006
15.	ISO 12402 - 9 : 2006
16.	ISO 12402 -10 : 2006
17.	ASTM Vol. 07.01 & 07.02

Technical Manpower

	Name	Qualification	Experience (yrs)
1.	Dr. J. V. Rao	B. Tech., M.Tech., Ph.D.	40
2.	Dr. A. V. Agrawal	M. Text, Ph.D., F.I.E., F.I.V.	21
3.	Dr. M. S. Parmar	M.Sc., Ph.D.	18
4.	Dr. Surender Kumar	M.Sc., Ph.D.	25
5.	Dr. A. A. Ansari	M.Sc., M.Phil., Ph.D.	17
6.	Dr. B. K. Sharma	M.Sc., M.Tech., Ph.D.	19
7.	Abhijit Pal	B.Sc. (Text. Tech), MS (by research), F.I.E., F.I.V.	25
8.	N. N. Sharma	B. Text. (Tech.), MS (by research)	34
9.	R. K. Gaur	B.Text., M.Tech. Dip. in TQM & ISO 9000	28
10.	U. C. Sharma	AMIE (Textile Engg.), MS (by research), M.I.E., F.I.V.	28
11.	R. S. Yadav	B.Tech. (Text.), MS (by research), MIE	21
12.	Vivek Agarwal	B.Tech. (Text. Tech), MS (by research), PGDBM	16
13.	Sanjeev Shukla	B.Text., M.Tech. (Text. Tech.), PGDBM	17
14.	Neeraj Aggarwal	B.Text., MS (by research)	18
15.	A. K. Singh	B.Text.(Tech.)	31
16.	A.K. Pandey	B.Text. (Text. Tech.)	31
17.	A. K. Aggarwal	M.Sc.	33
18.	M. K. Bansal	Dip. in Text. Tech., MBA	20
19.	Neha Kapil	M.Sc.(Textile & Clothing)	7
20.	Shweta Saxena	M.Sc.(Textile & Clothing)	7
21.	M.M. Tiwari	B.Sc., Dip. in Text. Tech.	29
22.	Maheshwar Singh	B.Sc., Dip. in Text. Chem.	27
23.	C.B. Chourasia	B.E. (Civil), M. Tech. (Civil)	20
24.	Vikas Sharma	B.E. (Mech.), Adv. Dip. in Maint. Mgmt. & Condition Monitoring	11
25.	Sanjeev Saxena	B. Tech.	15
26.	Partha Basu	B.Com., PG Dip. in Advt. & Mktg.	21
27.	Krishan Kr. Dewan	BHM, PGDBM	11
28.	R. K. Sharma	B.Sc.	27

List of Standards Formulated

Following standards have been formulated / reviewed at the Protech COE and communicated to BIS for acceptance:

1. Protective clothing for fire fighters
2. Textiles-resistance to ignition of mattresses, diwans and bed bases
3. Nylon life jacket with expandable polyethylene foam, buckle and whistle plastic
4. Nylon-cotton blended combat uniform cloth

In addition, specifications for the following items have been specifically prepared for the Indian Navy, CRPF (CoBRA) and other armed forces:

Technical Specifications Prepared by Nitra for Indian Navy

<table>
<tr>
<td rowspan="2"> 
Unarmed Combat dress
for Marine Commandoes</td>
<td> 
Cap FS Blue</td>
<td> 
T Shirt</td>
</tr>
<tr>
<td> 
Shorts</td>
<td> 
Socks</td>
</tr>
</table>

Technical Specifications Prepared by Nitra for CRPF (CoBRA)

<table>
<tr>
<td> 
NYCO Uniform</td>
<td> 
Life Jacket</td>
<td> 
Multi Purpose Light Weight Load Bearing Frame With Carrier Facilities and Convertibility As Stretcher</td>
</tr>
<tr>
<td> 
Durable Combat Sack</td>
<td> 
Water Proof Multipurpose Rain Poncho With Convertibility as Bivouac</td>
<td> 
Pouches</td>
</tr>
<tr>
<td> 
Anti-mosquito Veil</td>
<td> 
Jungle Hat</td>
<td> 
Balaclava with Convertible Properties as Cap Comforter, Face Mask and Cold Weather Muffler</td>
</tr>
<tr>
<td> 
Tactical 3 Point Sling</td>
<td> 
Special Operation Rope</td>
<td> 
Nylon Belt</td>
</tr>
</table>

Technical Specifications Prepared for other Agencies

1. National Disaster Response Force, Ministry of Home Affairs: Development of colour specification of uniform
2. RPSF: Development of colour specification of uniform
3. DBEL: Development of test method of dope dyed material

R&D Projects on Technical Textiles Undertaken/Under Progress

NITRA has successfully completed the following projects on Technical Textiles:

1. Development of fire resistant equipment
2. Development of industrial fabrics
3. Protective clothing from jute
4. Development of antimicrobial fabric
5. Development of UV resistant fabric
6. Work-wear for protection against pesticides

Following products have been developed:

1. NYCO fabric for Paramilitary and Military combat uniforms
2. Personal protective textile using novel fibre
3. Functional fabric to provide bacterial & ultraviolet protection to the skin (bamboo)
4. Extra soft knitted fabric for inner wear/kids wear by using 'High Performance Modal Fibre'

Training Programmes Offered

Supervisory Level Programs on Protective Textile

1. Heat resistant fabrics
2. Fire resistant fabrics
3. Fabrics for Extreme cold
4. Bullet Proof fabrics
5. Fabric for UV radiation protection
6. Fabric for Nuclear radiation protection
7. Fabric for Biological Protection
8. Fabric for Electromagnetic radiation protection
9. Fabric for Reduced Visibility Protection
10. Fabric for Chemical Protection
11. Cut resistant fabric
12. High-Visibility fabric

Programs For Laboratory Technician & Quality Controller

1. Testing & evaluation of Heat resistant fabrics
2. Testing & evaluation of Fire resistant fabrics
3. Testing & evaluation of Extreme cold fabrics
4. Testing & evaluation of Bullet Proof fabrics
5. Testing & evaluation of fabric for UV radiation protection
6. Testing & evaluation of fabric for Nuclear radiation protection
7. Testing & evaluation of fabric for Biological Protection
8. Testing & evaluation of fabric for Electromagnetic radiation protection
9. Testing & evaluation of fabric for Reduced Visibility Protection
10. Testing & evaluation of fabric for Chemical Protection
11. Testing & evaluation of Hi-Visibility fabric
12. Testing & evaluation of Cut resistant fabric
13. Tester-Fibre -length, Strength, elongation, fineness, crimp, etc.
14. Tester-Yarn Count, Strength, elongation, Twist, Evenness, etc.
15. Tester-Fabric structure, Strength, dimensions, abrasion, pilling, etc.
16. Tester-Blend Analysis

Operator Level Programs

1. Coating machine operator
2. Needle punching adhesive based non-woven machine operator
3. Sewing machine operator for heavy duty fabrics
4. Multilayer Industrial fabrics weaver
5. High speed knitting machine operator

Foreign Collaboration Details

NITRA has entered into an agreement with University of Bolton, U.K. to conduct collaborative research in the area of Protective Textiles. The areas earmarked in the agreement are:

- Cooperate and exchange research findings for mutual benefits.
- Provide facilities for quality testing at respective institutions for research purpose.
- Support and engage in research dissemination activities such as journal publications and conference presentations in the areas of Protech.
- Support each other for staff deputation and training in the area of Protective Textiles.
- Deputation of experts and scientists for guidance in research work on mutually agreed terms.

Details of Prototypes Developed

Following instruments have been developed by NITRA:

1. Smoke Visibility Tester
   - This instrument is developed as per UIC 564-2 Appendix 15 and is used to determine the effect of smoke generated on visibility.
2. Fire Resistance Tester
   - This instrument is developed as per UIC 564-2 and is used to determine the effect of fire on various materials.
3. Flammability Tester
   - This instrument is developed as per BS 5438 and is used to determine the effect of fire on textile materials in vertical mode.

Type of Technical Consultancy Provided/Offered

The Protech COE also provides support in the following areas:

- Quality Management
- Process House Study
- Computer Aided Textile Designing
- Defect Analysis
- Product Development and its Evaluation
- Package Design Consultancy on Recovery or Treatment for Textile Effluent
- Air Quality Monitoring (Stack & Ambient)
- Pilot Plant Study for Specific Design relating to Paper & Beverage Industries
- Performance Evaluation of Textile Export House
- Electrical Energy & Safety Audit
- Thermal Energy Audit
- Thermal Insulation Audit
- Power Quality Audit
- Environmental Audits
- Air Pollution Abatement
- E.T.P Operator's Training
- Assessment of Workers Turnover & Absenteeism
- Training System Audit
- D.G. Audit
- Automation & Modification
- Steam Trap Maintenance Audit
- Humidification Audit
- Industrial Furnace Audit
- Environmental Surveys/ Rapid EIA
- Laboratory as well as pilot plant scale R & D studies on typical effluents
- Testing (analysis) of Effluent & Water Samples

List of Companies Engaged in Manufacturing of Protective Textiles

List of Indian Manufacturers

	Name	Country	Website
1.	Adigear International	India	www.adigear.com
2.	Alok Industries	India	www.alokind.com
3.	Alps Industries Ltd.	India	www.alpsindustries.com
4.	Arvind Ltd.	India	www.arvindmills.com
5.	Baswara syntax Ltd.	India	www.banswarasyntex.com
6.	Delkon Textiles Pvt. Ltd.	India	www.delkontextiles.com
7.	Jaya Shree Textiles	India	www.jayashree-iril.com
8.	JCT Ltd.	India	www.jct.co.in
9.	Kusumgar	India	www.kusumgar.com
10.	Mafatlal Industries Ltd.	India	www.mafatlals.com
11.	Reliance Industries Ltd.	India	www.ril.com
12.	RSWM	India	www.lnjbhilwara.com
13.	Shree Lakshmi Cotsyn Ltd.	India	www.shrilakshmi.in
14.	Superior Fabrics	India	www.superiorfabrics.in
15.	Surya Processors (P) Ltd.	India	www.suryatextiles.com
16.	Tarasafe International Pvt. Ltd.	India	www.tarasafe.in

List of International Manufacturers

	Name	Country	Website
1.	3 M	USA	www.3m.com/scotchlite
2.	Ames Europe	Netherlands	www.ames-europe.com
3.	Andropol	Poland	www.andropol.com.pl
4.	Argar Technology	Italy	www.argartechnology.com
5.	Baltex	UK	www.baltex.co.uk
6.	Bel Maille	France	www.belmaille.com
7.	Blucher	Germany	www.bluecher.com
8.	Boos	Germany	www.boos-textil.de
9.	British Millerain	UK	www.britishmillerain.com
10.	Burce	Turkey	www.burce.com.tr
11.	C.F. Weber	Germany	www.cfweber.de
12.	Carrington Career & Workwear	UK	www.carrington.uk.com
13.	Concordia Textiles	Belgium	www.concordiatextiles.com
14.	Dupont Safety & Protection	USA	www.personalprotection.dupont.com
15.	Engtex	Sweden	www.engtex.se
16.	Eschler	Switzerland	www.eschler.com
17.	Europrotect	France	www.europrotect.fr
18.	Everest Textile	Taiwan	www.everest.com.tw
19.	FOV	Sweden	www.fov.se
20.	Frohn	Germany	www.frohn-textil.de
21.	Gehring Textiles	USA	www.gehringtextiles.com
22.	Gelvenor Textiles	South Africa	www.geltex.co.za

	Name	Country	Website
23.	Glen Raven	USA	www.glenraven.com
24.	GTT	China	www.guobatex.com
25.	Guardiantex	Germany	www.guardiantex.com
26.	Hainsworth	UK	www.hainsworth.co.uk
27.	HDM/SuperFabric	USA	www.superfabric.com
28.	Ibena Protect	Germany	www.protect.ibena.de
29.	IBQ Fabrics	Spain	www.ibqfabrics.com
30.	JB Broadley	UK	www.jbbroadley.co.uk
31.	KAP	Germany	www.kap.de
32.	Kermel	France	www.kermel.com
33.	Klopman	Germany	www.klopman.com
34.	Kolon FM	South Korea	www.kolonfm.com
35.	Komatsu Seiren	Japan	www.komatsuseiren.co.jp
36.	Lauffenmuhle	Germany	www.lauffenmuehle.com
37.	Marina Textil S.L.	Spain	www.marinatextil.net
38.	Mectex	Italy	www.mectex.com
39.	Monotex/Shin Heung	South Korea	www.monotex.co.kr
40.	Noiret	France	www.groupe-noiret.com
41.	Norafin	Switzerland	www.norafin.com
42.	Oztek Textile	Turkey	www.oztektekstil.com.tr
43.	Performance Global Solutions	France	www.solutions-globales.com
44.	Polartec	USA	www.polartec.com
45.	Pro-Belting	Germany	www.pro-belting.com
46.	Safety Components International	USA	www.safetycomponents.com
47.	Savex Protection Textiles	China	www.savex-textile.com
48.	Schoeller Textil	Switzerland	www.schoeller-works.com
49.	Sioen Industries	Belgium	www.sioen.com
50.	Sympatex	Germany	www.sympatex.com
51.	Tencate Protective Fabrics	Netherlands	www.tencateprotectivefabrics.com
52.	Textil Santanderina	Spain	www.textilsantanderina.com
53.	Thai Taffeta	Thailand	www.thai-taffeta.com
54.	Toray Industries	Japan	www.toray.com
55.	Utexbel	Belgium	www.utexbel.com
56.	Verseidag Ballistic Protection	Germany	www.verseidagprotection.de

Contact Details

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Director
Northern India Textile Research Association,
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E-mail: mail@nitratextile.org
Phone: +91-120-2783334

Status of Newly Announced COEs

Blank

7.COE on Composites

Lead: Ahmedabad Textile Industry's Research Association (ATIRA)

Background and Information of Parent Organization(s)

Ahmedabad Textile Industry's Research Association (ATIRA) has been designated as the Center of Excellence on Composites. ATIRA's stated objective is to create a Centre of Excellence (COE) for development of advanced composites through newer and innovative processes in order to achieve weight reduction, high mechanical properties and cost competitiveness. Furthermore the goal is to enhance the knowledge base in composites through research, development and training.

Ahmedabad Textile Industry Research Association (ATIRA)

ATIRA is an autonomous non-profit association for textile research. ATIRA was established at the initiative of Dr. Vikram Sarabhai and Shri Kasturbhai Lalbhai in 1947 with the support of the textile industry of Ahmedabad. It started in 1949 after due recognition by the Council of Scientific and Industrial Research, Ministry of Science and Technology, Government of India. Later it was linked to the Ministry of Textiles.

ATIRA membership is voluntary and consists of 150 units spread all over India and abroad: comprising units engaged in ginning, spinning, weaving, process houses, composite textile units, manufacturers of fibres, dyes, chemicals, instruments, equipments and machinery.

The scientific and technological activities of ATIRA include:

- Process optimization for improved processed control leading to better quality, cost reduction and export promotion
- Development of new products, processes and design of new instruments, equipments and machinery with emphasis on industry/user collaboration/sponsorship as far as possible
- Supportive studies in areas of environmental pollution, management, human relations and policy aspects

Infrastructure Facilities

Testing Instruments

The following test instruments are available at the COE in ATIRA:

Apparent Opening Size Analyzer

Thickness Gauge

Water Permeability: Perpendicular to the plane of the geosynthetic (without load, falling head)

Tensile Testing Machine

Water Permeability: Perpendicular to the plane of the geosynthetic (with load)

Water Permeability: In the plane of the geosynthetic (with load)

 Carbon Black Dispersion Tester	 Melt Flow Index Tester	 Carbon Black Content Analyser
 Cold Impact Chamber	 Global UV 200	 ATLAS Weather-o-meter
 Creep Testing	 Pull Out Tester	 Direct Shear Box : For Friction Properties Analysis

Test Parameters

Index Testing Parameters

- Fabric Weight (GSM) ISO 9863-1& 2
- Fabric Thickness ISO 9864
- Grab Tensile Strength : (ASTM D 4632, IS 1969, ISO 13934-2)
- Width Tensile Strength (BS EN ISO 10319, ASTM D 4595)
- Trapezoidal Tear Strength (ASTM D 4533)
- Pyramid Puncture (ASTM D 5494)
- Index Puncture (ASTM D 4833)
- CBR Puncture (ASTM D 6241, ISO 12236)
- Bursting Strength (ASTM D 3786,BS EN ISO 13938-1,ISO 13938-1)
- Dynamic Cone Drop Apparatus (ISO 13433)
- UV Resistance (% Retained @ 500hrs) ASTM D 4355
- System for Measuring Resistance to Weathering (DIN EN 12224)
- Apparent Opening Size (AOS)- ISO 12956
- Porometer for Pore Size Analysis
- Falling Head Water Permeability (EN ISO 11058 and ASTM D4491-99a)
- Constant Head Water Permeability (ISO 11058)
- In-Plane Permittivity (ISO 12958)
- Protection Efficiency (ISO 13428)
- Carbon Black Content Analyzer
- Carbon Black Dispersion Analyzer
- Melt Flow Index Tester

Performance Testing

- Shear Box-Friction Properties ISO 12957-1 & 2
- Pull out Tester-For Geogrid material testing for Abrasion damage simulation
- Creep Test Apparatus (ISO 13431)-The test is carried out over a long period of time. The specimens are loaded with a constant static force, in constant ambient conditions of temperature and humidity. The elongation of the specimen is recorded continuously or is measured at specific time intervals. The load is maintained for a period of 1000 hrs. If the specimen fails before 1000 hrs., the time to rupture is recorded.
- Damage during Installation: ISO 17022

Friction Behavior Of Geosynthetics In Soil

- Test Method: ISO 12957
- Test Equipment: Shear Box

Information Centre

The COE Information Centre has a comprehensive repository of books, journals and standards to enable knowledge dissemination in the field.

Books

The list of books available at the COE Information Centre is indicated below:

	Title	Author
1.	Environmental impact of textiles : Production, processes and protection	SLATER (K.)
2.	Structure and mechanics of textile fibre assemblies	SCHWARTZ (P.) ed.
3.	Textile advances in the automotive industry	SHISHOO (R.) ed.
4.	Fabric testing	JINLIAN (H. U.) ed.
5.	Geosynthetics in civil engineering	SARSBY (R. W.) ed.
6.	Physical properties of textile fibres	MORTON (W. E.) & HEARLE (W. S.)
7.	Handbook of non-woven filter media	HUTTEN (I. M.)
8.	Succeeding like success : The affluent consumers of Asia	WONG (Y. N.)
9.	Quest for global dominance : Transforming global presence into global competitive advantage	GUPTA (A. K.), GOVINDARAJAN (V.) & WANG (H.)
10.	Annual book of ASTM standards 2008 : Section 4, construction, Volume 04.13 Geosynthetics	ASTM International
11.	Brainstorming session on technological innovations in textiles, 30th April 2004 : Proceedings	Office of the Textile Commissioner, Mumbai
12.	Bio-mechanical engineering of textiles and clothing	LI (Y.) & DAI (X. Q.) eds.
13.	Medical textiles and biomaterials for healthcare	ANAND (S.), KENNEDY (J. F.) , MIRAFTAB (M.) & RAJENDRAN (S.) eds.
14.	3-D fibrous assemblies : Properties, applications and modelling of three-dimensional textile structures	JINLIAN (H. U.)
15.	Physical properties of polymers handbook	MARK (J. E.)
16.	Coated textiles : Principles and applications	SEN (A. K.)
17.	Recycling in textiles	WANG (Y.) ed.
18.	Designing with geosynthetics	KOERNER (R. M.)
19.	Handbook of technical textiles	HORROCKS (A. R.) & ANAND (S. C.) eds.
20.	Smart fibres, fabrics and clothing	TAO (X.) ed.
21.	Yarn texturing technology	HEARLE (J. W. S.), HOLLICK (L.) & WILSON (D. K.)
22.	Recent advances in textile composites (Proceedings of the 9th International conference on textile composites) : TEXCOMP9, October 13-15, 2008	ADVANI (S. G.) & GILLESPIE (J. W.) eds.

	Title	Author
23.	Cotton : Science and technology	GORDON (S.) & HSIEN (Y. L.) eds.
24.	Engineering textiles : Integrating the design and manufacture of textile products	MOGAHZY (Y. E. EI)
25.	Handbook of weaving	ADANUR (S.)
26.	Modern textile characterization methods	RAHEEL (M.) ed.
27.	Ullmann's fibers 1 : Fiber classes, production and characterization	ULLMANN
28.	Ullmann's fibers 2 : Textile and dyeing technologies, high performance and optical fibers	ULLMANN
29.	Advances in apparel production	FAIRHURST (C.) ed.
30.	Materials in sports equipment : Volume 2	SUBIC (A.) ed.
31.	Intelligent textiles and clothing	MATTILA (H. R.) ed.
32.	Fire retardant materials	HORROCKS (A. R.) & PRICE (D.) eds.
33.	3-D textile reinforcements in composite materials	MIRAVETE (A.) ed.
34.	Textile in automotive engineering	FUNG (W.) & HARDCASTLE (M.)
35.	3D fibre reinforced polymer composites	TONG (L.), MOURITZ (A. P.) & BANNISTER (M. K)
36.	Smart clothes and wearable technology	McCANN (J.) & BRYSON (D.) eds.
37.	High speed spinning of polyester and its blends with viscose : A practical guide	NANAL (S. Y.) & GARDE (A. R.)
38.	Chemical finishing of textiles	SCHINDLER (W. D.) & HAUSER (P. J.)
39.	Composite solutions thermosets and thermoplastics	REYNE (M.) ed.
40.	Composite materials in construction and civil engineering	JEC Group
41.	JEC 2009 forum proceedings : Biomaterials forum 26th March 2009, Paris	JEC Composites, Paris
42.	Strength & life of composites	TSAI (S. W.) ed.
43.	JEC 2009 forum proceedings : Wind energy forum, 24th March 2009, Paris	JEC Composites, Paris
44.	JEC 2009 forum proceedings : Civil engineering forum, 25th March 2009, Paris	JEC Composites, Paris
45.	JEC 2009 forum proceedings : Rail and road transportation forum, 25th March 2009, Paris	JEC Composites, Paris
46.	JEC 2009 forum proceedings : Aeronautics forum, 15th October, 2009, Singapore	JEC Composites, Singapore
47.	JEC 2009 forum proceedings : Wind energy forum, 15th October 2009, Singapore	JEC Composites, Singapore
48.	JEC 2009 forum proceedings : Automotive & mass transportation, 16th October 2009, Singapore	JEC Composites, Singapore
49.	JEC 2009 forum proceedings : Construction civil engineering, 16th October 2009, Singapore	JEC Composites, Singapore
50.	Main dynamics of the Asia-Pacific composite industry	
51.	Composite materials in the aeronautics industry	
52.	Composite materials in the marine industry	
53.	Composites materials in automotive	
54.	Aeronautics forum proceeding	JEC Asia 2008
55.	Automotive & mass transportation forum proceeding	JEC Asia 2008
56.	Construction & civil engineering forum proceeding	JEC Asia 2008
57.	Annual book of ASTM standards 2009 : Section 7, Volume 07.01, Textiles (i) : D 76 - D4391	ASTM International
58.	Annual book of ASTM standards 2009 : Section 7, Volume 07.02, Textiles (ii) : D 4393 - Latest	ASTM International

	Title	Author
59.	Engineering apparel fabrics and garments	FAN (J.) & HUNTER (L.)
60.	Humidification and ventilation management in textile industry	PURUSHOTHAMA (B.)
61.	Quality characterisation of apparel	DAS (S.)
62.	Aircraft textiles : Interior fabrics and air cabin fashion 25 supplier profiles	FISHER (G.)
63.	Performance apparel market issue no. 29 (TISPAM)	
64.	Design and manufacture of textile composites	LONG (A. C.) ed.
65.	Composite forming technologies	LONG (A. C.) ed.
66.	Seven macro trends in the textiles and apparel industry : Management briefing	International News Services
67.	Automotive textiles : The changing landscape for tier 1 and tier 2 suppliers : 40 Company profiles	WILSON (A.)
68.	Surface modification of textiles	WEI (Q.) ed.
69.	Sustainable textiles : Life cycle and environmental impact	BLACKBURN (R. S.) ed.
70.	Chemicals technology in the coloration of textiles : Volume 1	KARMAKAR (S. R.)
71.	Anthology of speciality chemicals for textiles	SIVARAMAKRISHNAN (C. N.)
72.	Colour technology : Tools, techniques & applications	GUPTE (V. C.)
73.	Profiles in analysis of chemicals	DESAI (N. F.)
74.	Advance in fire retardant materials	HORROCKS (A. R.) & PRICE (D.) eds.
75.	Textiles for cold weather apparel	WILLIAMS (J. T.) ed.
76.	Automation of polymer composites manufacturing	MAFELD (A.) ed.
77.	World wide composites industry : Structure, trends and innovation	JEC Composite, Paris
78.	Application of non-wovens in technical textiles	CHAPMAN (R.A.) ed.
79.	Smart textile coating and laminates	SMITH (W.C.) ed.

Journals

The following journals are available at the COE on Composites at ATIRA:

- Textile Research Journal 2009
- Journal of the Textile Institute 2009
- Textile Progress 2009
- AATCC Review 2009
- Asian Textile Journal 2009
- Coloration Technology 2009
- Chemical Fibers International 2009
- Mellian International 2009
- Indian Journal of Fiber and Textile Research Journal 2009
- Journal of Industrial Textiles 2009
- Technical Textile International 2009
- Textile Industry of India 2009
- Textile Trends 2009
- Textile World 2009
- Textile Asia 2009
- Journal of the Indian Society for Cotton Improvement 2009
- Modern Textile Journal 2009
- Asian Textile Business 2009
- Indian Textile Journal (April 2009 to March 2010)
- Textile Month (April 2009 to March 2010)
- International Dyer (July 2009 to June 2010)
- Press Clippings Textile Industry (July 2009 to June 2010)
- Textile Horizons (July 2009 to June 2010)
- Textile Industry & Trade Journal (July 2009 to June 2010)
- Geotechnical Testing Journal 2010
- Journal of Industrial Textiles 2010
- Textile Research Journal 2010
- Journal of the Textile Institute 2010
- Textile Progress 2010
- Indian Textile Journal 2010
- Textile Month 2010
- Coloration Technology 2010
- Indian Journal of Fiber and Textile Research 2010
- Technical Textile International 2010
- Textile World 2010
- Textile Asia 2010
- AATCC Review 2010
- Textile Trends 2010
- Textile Industry of India 2010
- Asian Textile Journal 2010
- International Dyer July 2010 to June 2011
- Textile Horizons July 2010 to June 2011
- Asian Textile Business 2010
- Chemical Fibres International 2010
- Journal of the Indian Society for Cotton Improvement 2010
- Melliand International 2010
- Modern Textile Journal 2010
- Textile Industry and Trade Journal July 2010 to June 2011
- Press Clipping : Textile Industry July 2010 to June 2011

Standards

The following standards can be perused at the COE:

1. BS EN 1149-1 : 2006 Protective clothing - electrostatic properties Part 1 : Test method for measurement of surface resistivity
2. BS EN 1149-2 : 1997 Protective clothing - electrostatic properties Part 2 : Test method for measurement of the electrical resistance through a material (vertical resistance)
3. BS EN 1149-3 : 2004 Protective clothing - electrostatic properties - Part 3 : Test methods for measurement of charge decay
4. BS EN 1149-5 : 2008 Protective clothing -electrostatic properties - Part 5 : Material performance and design requirements
5. ISO set of - TC 38/SC1, TC 38/SC2, TC 38/SC 24, TC 38, TC 221 & TC 94/SC 13 on CD-ROM
6. BS EN 1150 : 1999 Protective clothing - visibility clothing for non professional use test methods and requirements
7. BS EN ISO 7854 : 1997, BS 3424-9 : 1996 - Rubber or plastics -coated fabrics determination of resistance to damage by flexing
8. BS EN 348 : 1992 Protective clothing determination of behaviour of materials on impact of small splashes of molten metal
9. BS EN ISO 9185 : 2007 Protective clothing - Assessment of resistance of materials to molten metal splash
10. DIN EN ISO 17070 : 2007 Leather chemical tests determination of pentachlorophenol content (ISO 17070 : 2006) English version of DIN ISO 17070 : 2007-01
11. ISO/IS 19036 : 2006 Microbiology of food and animal feeding stuffs - Guidelines for the estimation of measurement uncertainity for quantitative determinations
12. IS 15612 Pt. 1 : 2005 Textiles - Burning behaviour of curtains and drapes Part 1 Classification scheme
13. IS 15612 Pt. 2 : 2006 Textiles - Burning behaviour of curtains and drapes Part 2 Measurement of flame spread of vertically oriented specimens with large ignition source
14. IS 15612 Pt. 3 : 2005 Textiles - Burning behaviour of curtains and drapes Part 3 Method for determining the ignitability of vertically oriented specimens (small flame)
15. IS 15612 Pt. 4 : 2005 Textiles - Burning behaviour of curtains and drapes Part 4 Method for determining the flame spread of vertically oriented specimens
16. BS 5438 : 1989 Methods of test for flammability of textile fabrics when subjected to a small igniting flame applied to the face or bottom edge of vertically oriented specimens
17. IS Standards
18. IS 15758 Pt. 4 : 2000, ISO 15025 : 2000 Textiles Protective clothing
19. IS 15061 : 2002 Automotive vehicles flammability requirements
20. BS EN 659 : 2003 + A1 : 2008 Protective gloves for firefighters
21. ISO 11613 : 1999 Protective clothing for firefighters - Laboratory test methods and performance requirements
22. IS 12467 Pt. 1: 2006 Textiles - Assessment of the ignitability of upholstered furniture Part 1 Ignition source: Smouldering cigarette
23. IS 12467 Pt. 2: 2006 Textiles - Assessment of the ignitability of upholstered furniture Part 2 Ignition source: Match flame equivalent
24. IS 13501 : 1992 Textiles - Determination of flammability by oxygen index
25. IS 15589 : 2005 ISO 6940 : 2004 Textile fabrics - Burning behaviour determination of ease of ignition of vertically oriented specimens
26. IS 15590 :2005 ISO 6941 : 2003 Textile fabrics - Burning behaviour measurement of flame spread properties of vertically oriented specimens
27. IS 15727 Pt. 1 : 2007 ISO 12952 - 1 : 1998 Textiles - Burning behaviour of bedding items Part 1 General test methods for the ignitability by a smouldering cigarette
28. IS 15727 Pt. 2 : 2007 ISO 12952 - 2 : 1998 Textiles - Burning behaviour of bedding items Part 2 Specific test methods for the ignitability by a smouldering cigarette
29. IS 15727 Pt. 3 : 2007 ISO 12952 - 3 : 1998 Textiles - Burning behaviour of bedding items Part 3 General test methods for the ignitability by a small open flame

30. IS 15727 Pt. 4 : 2007 ISO 12952 - 4 : 1998 Textiles - Burning behaviour of bedding items Part 4 Specific test methods for the ignitability by a small open flame
31. IS 15741 : 2007 Textiles - Resistance to ignition of curtains and drapes - specification
32. IS 15742 : 2007 Textiles - Requirements for clothing made of limited flame spread materials and material assemblies affording protection against heat and flame - specification
33. IS 15748 : 2007 Textiles - Protective clothing for industrial workers exposed to heat (Excluding firefighters' and welders' clothing)
34. IS 15758 Pt 1 : 2007 ISO 9151 : 1995 Textiles - Protective clothing Part 1 Method of determining of heat transmission on exposure to flame
35. IS 15758 Pt. 2 : 2007 ISO 6942 : 2002Textiles - Protective clothing Part 2 Assessment of material assemblies when exposed to source of radiant heat
36. IS 15758 Pt. 5 : 2007 ISO 15025 : 2000 Textiles - Protective clothing Part 5 Assessment of resistance of materials to molten metal splash
37. IS 15764 : 2008 Textiles - Determination of burning behaviour of textile floor coverings
38. IS 15768 : 2008Textiles - Resistance to ignition of upholstered composites used for non-domestic furniture - specification
39. IS 15781 : 2008 Textiles - Method for determination of flammability of blankets
40. IS 15782 : 2008 Textiles - Method for determining deterioration of visibility due to smoke released on comustion of materials
41. IS 6489 : 1993 Textiles - Woven fabrics - Determination of tear resistance by falling pendulum method
42. IS/ISO 105 - C10 : 2006 Textiles - Tests for colour fastness Part C10 colour fastness to washing with soap or soap and soda
43. IS 7903 : 2005 Textiles - Tarpaulines made from high density polyethylene woven fabric - Specification
44. NFPA 1977 Standard on Protective Clothing and Equipment for Wildland fire fighting 2005 Edition
45. NFPA 1975 Standard on Station/work Uniforms for emergency services 2009 Edition
46. NFPA 1971 Standard on Protective Ensembles for structural fire fighting and proximity fire fighting 2007 Edition
47. NFPA 2112 Standard on flame resistant garments for protection of industrial personnel against flash fire 2007 Edition
48. NFPA 1992 Standard on Liquid splash protective ensembles and clothing for hazardous materials emergencies 2005 Edition
49. DIN EN 13034 - 2009 Protective clothing against liquid chemicals - performance requirements for chemical protective clothing offering limited protective performance against liquid chemicals (type 6 and Type PB [6] equipment)(includes amendment A1:2009) English version of DIN EN 13034: 2009-08
50. ASTM D 751 : 2006 Standard test methods for coated fabrics
51. ASTM D 1603 - 06 Standard test method for carbon black content in olefin plastics
52. ASTM D 297 - 1993 (Reapproved - 2006) Standard test methods for rubber products - Chemical analysis
53. ASTM SEC 11 VOL. 11.03 : 2010 Water and environmental technology : Atmospheric analysis; occupational health and safety; protective
54. ASTM E96 / E96M - 05 Standard Test Methods for Water Vapor Transmission of Materials

Technical Manpower

1.	Dr. S. Rahman	M.Sc., Ph. D. Resin Chemistry, Nano Composites
2.	Ms. Seema Patel	B.E., M.E. (Textiles), Testing & Quality Assurance of Technical Textiles
3.	Mr. Suresh Saini	B.E. (Chemical), PGDPE (CIPET)
4.	Mr. Suketa Tyagi	B.E (Chemical), M.Tech. (Plastic Technology)
5.	Mr. Anup V. Devane	B.Text. (Textile Technology), Weaving expert (Technical Textiles)
6.	Mr. Amit Shah	B.E. (Textiles), Weaving expert (Technical Textiles)
7.	Mr. Amit Sehgal	B.Text. (Textile Engineering), Weaving expert (Technical Textiles)

R&D Projects on Technical Textiles Undertaken/Under Progress

The following projects are being undertaken at ATIRA:

- Construction related design as well as environmental design parameters for both woven and non-woven geo-synthetics
- Development of nano-fibre based textiles
- Spinning of fire retardant fibre blends on cotton system
- Development of fire retardant textiles

Training Programmes Offered

Composites Manufacturing Process (Duration 1 Month)

Foreign Collaboration Details

- ITA Aachen, Germany
- Karlsruhe Institute of Technology (KIT), Germany
- Fraunhofer ICT, Karlsruhe Germany
- Bremen Institute of Technology
- Northwest Composite Centre, Manchester, UK

Contact Details

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8.COE on Indutech

Lead: PSG College of Technology

Background and Information of Parent Organization(s)

PSG College of Technology houses the recently announced Centre of Excellence on Industrial Textiles. The COE on Indutech was sanctioned in March 2011 and the setting up of infrastructure facilities is currently underway.

PSG College of Technology

PSG College of Technology is an institution of academic excellence, founded in 1951 by PSG & Sons' Charities Trust. The emphasis of the Trust started with vocational education & production oriented industrial training. Presently, PSGCT boasts student strength of around 7000 along with 450 faculty members, with 130 doctoral qualifications.

In addition to the Centre of Excellence on Indutech, the college also has the following additional centres of excellence:

- Centre for Robotics
- TIFAC-CORE in Product Design
- Center for Supply Chain Management
- PSG Agilent Center for Advanced RF Design
- Virtual Reality Centre
- Engineering Design Laboratory
- Festo Pneumatic Centre
- Laser Centre
- Education Technology Centre
- Metal Testing and Research Centre
- Thin Film Centre
- CAD/CAM Centre,
- Virtual Instrumentation Centre
- VLSI Design Centre
- Product Development Centre
- PSG LAPP Center in Cable Technology
- PSG - L & T Center in LV Switchgear
- Audio Processing Centre
- Centre for Technology Management

Infrastructure Facilities

Testing Instruments

The following instruments are proposed to be procured to facilitate the objectives of the COE:

	Name of the Equipment	Description- Quality Parameters Tested	Make
1.	Zwick Z100	Tensile strength	Zwick Roell, Germany
2.	Permetest	Dry heat & water vapour permeability	Sensora Instruments, Czech Republic
3.	LISTER	Liquid strike through time tester for coverstocks and absorbing materials	Ms. Lenzing Instruments, GmbH & Co. KG, Austria
4.	Automatic Processor Tensiometer	Absorption/ wetting behaviour of powder and fibre sample	M/s. Kruss GmbH, Germany
5.	Ge-Te-Flow	To test water permeability of non-woven, geotextiles, industrial textiles	MS. Lenzing Instruments, GmbH & Co. KG, Austria
6.	Impedence Tube	To measure sound absorption coefficients and impedance	Bruel & Kjaer
7.	Wrap Reel	Preparing leas to determine count and leas strength of the yarns	
8.	Stiffness Tester	Used to measure stiffness of fabrics. Results are expressed in bending length (to calculate flexural rigidity) and bending modulus of fabrics	SDL

	Name of the Equipment	Description- Quality Parameters Tested	Make
9.	Crease Recovery Tester	Rapid determination of crease resistance of fabrics	
10.	Launderometer	Evaluation of colour - fastness to washing of the dyed and printed textiles	SDL
11.	Abrasion Resistance Tester (Taber/ Martindale) & Pilling	To determine the abrasion and pilling resistance of all kinds of textile structures	SDL
12.	Spray rating Tester	Measuring the water-repellent efficiency of finishes applied to the fabric	SDL
13.	Electronic Crockmeter	To determine the color fastness of textiles to dry or wet rubbing	SDL
14.	Flammability Tester	To test the flammability characteristics	SDL
15.	Friction Tester for non-woven Fabrics	The fabric friction tester determines the static and kinetic co-efficient of friction for non-woven fabrics.	WIRA, UK
16.	Elmendrof Tearing Tester	Elmendorf type tearing strength tester is used to determine the tearing strength of fabrics, plastic films or other similar materials	SDL
17.	Bursting Strength Tester	To determine the bursting strength and distension at burst of woven, knitted and non-woven fabrics	SDL
18.	Softness Tester	To test the softness of the leather and textile material like coated fabrics with SPC software	SDL
19.	Liquid Absorptive Capacity Tester	To measure the absorption capacity of non-woven	WIRA
20.	Air Permeability Tester	To analyze the permeability of a textiles	WIRA
21.	Hydrostatic Head Tester	Water proofness of medium and heavy weight fabrics	WIRA
22.	FTIR Spectrometer	Surface chemistry	Thermo scientific, USA

Information Center

The Information Center at COE on Indutech is procuring the following books and standards to enable information access to the industry stakeholders:

Books

	Woodhead Publishing	
1.	Textiles in Automotive Engineering	W. Fung, Collins and Aikman Automotive Fabrics and J M Hardcastle, Consultant, UK
2.	Application of Non-wovens in Technical Textiles	Edited by R Chapman, Consultant, UK
3.	Handbook of Non-wovens	Edited by S. Russell, University of Leeds, UK
4.	Smart Textile Coatings and Laminates	Edited by W. C. Smith, Industrial Textile Associates, USA
5.	Handbook of Natural Textile Fibres	Edited by R. Kozlowski, Institute of Natural Fibres (INF), Poland
6.	Bast and other Plant Fibres	Edited by R. R. Franck, Consultant, UK
7.	Regenerated Cellulose Fibres	Edited by C. Woodings, Consultant, UK

Woodhead Publishing		
8.	Handbook of Textile Fibres: Natural Fibre	J Gordon Cook
9.	Fibrous and Composite Material for Civil Engineering Applications	Edited by R Fangueiro, University of Minho, Portugal
10.	Modification of Fibres for Technical Applications	S Mukhopadhyay, Indian Institute of Technology Delhi, India
11.	Composites Forming Technologies	Edited by A C Long, University of Nottingham, UK
12.	Handbook of Technical Textiles	Edited by A R Horrocks and S C Anand, University of Bolton, UK
13.	Automotive Textiles	S Mukhopadhyay and J F Partridge
14.	Textile Terms and Definitions	M J Denton and P N Daniels
15.	Advanced Textiles for Wound Care	Edited by S Rajendran, University of Bolton, UK
Elsevier Publications		
1.	Handbook of Non-woven Filter Media	Irwin M. Hutten, Filtration Consultant, Perry, GA, USA
2.	Absorbent Technology	P.K. Chatterjee, Nutech International Co., B.S. Gupta, North Carolina State University, Raleigh.
CRC Press		
1.	Wellington Sears Handbook of Industrial Textiles	Sabit Adanur, Auburn University. Edited by Xiaoming Tao
2.	Advanced Technical Textile Product	Edited by R. Alagirusamy; A. Das
3.	Technical Textile Yarns	Edited by Rose A. Ryntz; Philip V. Yaneff, E.I. Dupont Canada
4.	Coating of Polymers and Plastics	Ajax, Ontario, Canada
5.	Coating Technology Handbook	Edited by Arthur A. Tracton, BRIDGEWATER, NEW JERSEY
Textile Institute Publications		
1.	Absorbent Incontinence Products	Cusick, G.E. and Hopkins, T.
2.	Thermal Bonding of Non-woven Fabrics	Dharmadhikary, R.K., Gilmore, T.F., Davis, H.A., and Batra, S.K.
3.	Developments in Non-woven Fabrics	Purdy, A.T.
4.	Industrial Applications of Textiles	Bajaj, P. and Sengupta, A.K.
Wiley Publications		
1.	Industrial Applications of Natural Fibres	Edited by Jörg Müssig, Christian Stevens
2.	Non-woven Fabrics Raw Materials, Applications, Testing Processes	Edited by Wilhelm Albrecht, Hilmar Fuchs and Walter Kittelmann
EDANA Publication		
1.	Standard Test Methods for Non-woven Industry	

Standards

ASTM Standards
1. Standard test methods for determining average grain size
2. ASTM Volume 07.01 Textiles (I): D76 D4391
3. ASTM Volume 07.02 Textiles (II): D4393
B S Standards
1. Test methods for non-wovens. Determination of resistance to penetration by water (hydrostatic pressure)
INDA Standards
1. Harmonized test methods for the non-wovens & related industries
2. Standard test methods for the non-wovens and related industries
3. Individual non-woven standard test methods
4. Principles of non-wovens

R&D Projects on Technical Textiles Undertaken/Under Progress

The following projects on Industrial Textiles are currently underway at the COE:

- Development of natural fiber non-wovens for acoustic applications
- Development of jute/wool blend non-wovens
- Development of natural fibre non-wovens for application as car interiors for noise control
- Bamboo blended non-wovens for automobile interiors
- Utilisation of chicken feathers for the development of non-wovens and value added products
- Development of natural fibre non-wovens for application as car interiors
- Production of an hydrophobic oleophilic kapok non-woven fabric for its potential application
- Analysis of natural non-woven geotextiles used in erosion control.
- Design & development of non-woven products using recycled fibres
- Non-woven textiles as health care products
- Development of odour free antimicrobial hospital linens
- Production and properties of non-wovens using comber noils
- Design and development of home textiles using non-woven fabrics

Training Programmes Offered

1. One day workshop on “Industrial Technical Textiles-Products, Applications and Testing”, on 17th August, 2011.
   Areas covered:
   - Needle punched non-woven products, their production and application
   - Spun bonded and chemical bonded non-woven products, their production and application
   - Technology Mission on Technical Textiles and Government support
   - Industrial textiles testing and methods (yarns, ropes, cordages and coated fabrics-tensile strength)
   - Surface chemistry analysis of textile products
2. A national conference on 'Industrial Textiles- Products, Applications and Prospects INDUTECH 2012' is planned to be organised in January, 2012.

Foreign Collaboration details

PSG Tech's COE on Indutech is in the process of executing MOUs with two leading international institutions regarding technical consultancy. The institutions are:

1. University of Bolton, UK; and
2. Technical University of Liberec, Czech Republic

Indutech Prototypes to be developed

The incubation centre for Indutech COE will support the innovators to access funds and technical know-how for the development of prototypes and also support them during the establishment of production facilities.

Indutech COE will also actively engage in training of students, faculty members of academic institutions and technicians from the industry to create awareness and knowledge about the technical textiles field as a whole. Short term courses shall be offered round the year to suit the requirements of the industry.

Contact Details

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9.COE on Nonwovens

Lead: DKTE Society's Textile & Engineering Institute (DKTE)

Background and Information of Parent Organization(s)

DKTE

The D.K.T.E. Society's Textile & Engineering Institute was founded in 1982. It is based in Ichalkaranji (popularly known as 'Manchester of Maharashtra') which is one of the prominent hubs of the decentralized textile segment. The Institute has 8 departments, 175 full time academic staff and 2960 full time students.

The Institute is engaged in a wide array of activities as summarized below:

- Academic
- Research and Development Activity
- Consultancy (Trouble shooting, Turn key projects, Project appraisal)
- Training for Industry (Management, Technical man power, Machine Technician and Operators)
- Testing Facilities
- Seminars/ Workshops and Conferences (Dissemination of Technical knowledge and information)
- Training and Placement for Students
- Co-curricular activities for Students (Paper presentation contests, Project Contests, Quiz Contest etc.)
- Entrepreneurial Development Activity and Business Incubation

Infrastructure Facilities

Testing Instruments

The COE on Nonwovens will procure the following testing instruments:

	Instruments		Instruments
1.	Water Permeability Tester	15.	Direct Shear Apparatus
2.	Pore size Analyser	16.	Fibre Orientation Web Measurement
3.	Air Permeability	17.	Universal Tensile Tester
4.	Liquid-Strike-Through-Time and Wetback Property of Nonwoven	18.	Water Repellency Tester
5.	Digital Bursting Strength Tester	19.	Vibroscope
6.	Water Transmission Tester	20.	Digital Thickness Tester
7.	Hydrostatic Head Tester	21.	Digital Pneumatic Stiffness Tester
8.	Digital Tearing Strength Tester	22.	Fibre Crimp Tester
9.	Softness Tester	23.	Spin Finish Extractor
10.	Microscope With Microtome	24.	Conditioning Chamber
11.	Water Vapour Permeability Tester	25.	UV Accelerated Weathering Tester
12.	GSM Tester	26.	Abrasion Tester Martindale / Universal
13.	LOI Tester	27.	Electrical Resistivity Tester
14.	Thermal Conductivity Tester	28.	Microbiological Resistivity

In addition to the above, the Institute already has the following technical textile testing instruments:

1. Lab coating machine
2. Bursting strength tester
3. Vertical and horizontal flame chamber
4. Instron tester
5. Compression testing
6. Puncher tester
7. Ball bursting
8. Banana fibre extractor
9. Carle Zeiss microscope
10. Universal wear tester

Incubation Center

The Nonwoven COE incubation centre proposes to procure the following equipment to assist the industry development efforts:

	Name of the Machinery/Equipment
1.	Needle Punched Nonwoven
2.	Spun lace
3.	Melt blown
4.	Spunbond
5.	Coating & Lamination machine
6.	Foam padder and Stenter
7.	Calendaring machine
8.	Fibre retrieving machine
9.	Industrial stitching machine
10.	Fabric inspection machine
11.	Slitter rewinder Machine
12.	Fusing machine
13.	Moulding

Information Center

The COE is equipped with the following literature and aligned resources.

List of Books with the Institute

	Name of books	Year of publication	Name of the publisher
1.	Handbook of Nonwovens by S.J. Russell	2007	
2.	Non-woven Textiles by L.C. Wadsworth	1999	Carolina Academic Press, North Carolina
3.	Handbook of Nonwoven Filter Media	2007	
4.	Nonwoven Textiles	1999	Woodhead Publication
5.	Medical Textiles 96	1997	
6.	Textiles in Sports	2005	Woodhead Publication
7.	Military Textiles	2008	
8.	Textiles for Protection	2005	Woodhead Publication
9.	Nonwoven Textiles by L.C. Wadsworth	1999	
10.	Wellington Sears Handbook of Industrial Textiles by Sabit Adnur	1995	Technommic Publicaton Co., USA
11.	Hand Book of Technical Textiles by A. R. Horoocks	2008	
12.	Automotive Textiles by Textile Progress Vol. 29 by S. K. Mukhopadhyay	2003	The Textile Institute Manchester, UK
13.	Coated & Laminated Fabrics : 2000 & Beyond by AATCC	1998	
14.	Coated Textiles by A. K. Sen	2008	Technommic Publicaton Co.,USA
15.	Coated Textiles, Principles & applications by A. K. Sen	2008	
16.	Composites Forming Technologies by A.C. Long	2005	Woodhead Publication,UK

	Name of books	Year of publication	Name of the publisher
17.	Composites materials: Engineering & Science by F. L. Matthews & R. D. Rawlings	1999	Woodhead Publication
18.	Fibre Reinforced Composites by P. K. Mallick	1993	Marcel Dekker,Inc,New York
19.	Textiles in automotive engineering by W. Fung & M. Hardcastle	2001	The Textile Institute, Manchester
20.	Military Textiles by E. Wilusz	2008	Woodhead Publication, England
21.	Textiles for Protection by R.A. Scott	2005	Woodhead Publication Ltd. & Textile Institute
22.	Smart Textiles : Coatings & Laminates	2010	Woodhead Publication
23.	Materials in Sports Equipment	2003	Woodhead Publication
24.	Surface modification of Textiles	2009	Woodhead Publication
25.	Smart Textile Coating and Laminates	2010	Woodhead Publication
26.	Handbook of Advance material testing	2003	Dekker
27.	Intelligent Textile and clothing edited by H. R. Mattila	2006	Woodhead Publication, England
28.	3-D Textile Reinforcements in composite materials by A. Miravate	1999	Woodhead Publication, Cambridge
29.	Nanofibres & Nanotechnology in Textiles by P.J. Brown & K. Stevens	2007	Woodhead Publishing Limited,Anand
30.	New Fibres by T. Hongu & G.O. Phillips	1997	Woodhead Publication, England
31.	New Millennium Fibres by G.O. Phillips & M. Takigami	2005	Woodhead Publication, UK
32.	Smart Fibres, Fabrics and Clothing edited by Xiaoming Tao	2001	Woodhead Publishing Ltd. England
33.	Medical Textiles & Biomaterial for Healthcare by S.C. Anand, M.M. Traftab, S. Rajendra	2006	Woodhead Publication
34.	Plasma Technology for Textiles by Roshan Shishoo	2007	Woodhead Publishing Limited, England, CRC Press
35.	Medical Textile & Bio-materials for health care	2006	Woodhead Publication
36.	Nano Fibres and Nanotechnology in textiles	2007	Woodhead Publication
37.	Handbook of Nonwoven Filter Media	2007	Elsevier
38.	Nonwoven Textiles	1999	Woodhead Publication
39.	Medical Textiles 96	1997	Woodhead Publication
40.	Textiles in Sports	2005	Woodhead Publication
41.	Military Textiles	2008	Woodhead Publication
42.	Textiles for Protection	2005	Woodhead Publication

Technical Manpower

1.	Dr. S. B. Vhanbatte	I/C Director
2.	Mr. S. S. Aparaj	Testing/ Training Officer
3.	Reshma Ramanna	Jr. Scientist

R&D Projects on Technical Textiles Undertaken/Under Progress

- Geotextiles in Nonwoven application in paved road and unpaved road: non-woven needle punched polypropylene fabric - Ichalkaranji Nagarpalika, Ichalkaranji.
- Endless fabric belt for weighing machine - Tetra Pak, Nickrom, Pune
- Industrial fabric for military - Sunil Industries, Mumbai
- Development of filter fabric for vacuum cleaner- Modi Hoovers Ltd., New Delhi
- 1000d geotextile fabric-Marex Geogrids, Pune
- 20 x 30 peroxide bleached fabric for medical textiles-Sultanpure Textile Mills, Ichalkaranji (Johnson & Johnson, Mumbai)
- Development of needle punched Nonwoven fabric products from banana fibre
- Coir Nonwoven with cement composites
- Novel application of kapok fibre Nonwoven for recovery of oil spill
- Development of Nanometal oxide coated cotton fabrics with improved UV protection
- Development of antibacterial and conductive fabrics using nano-ZnO
- Investigating the modification of textile using plasma
- Development of flame retardant fabrics for school children along with Kumarguru College of Technology, Coimbatore

Training Programmes Offered

- Various aspects of Technical Textiles, May 5, 2009 to May 7, 2009
- Weaving of Technical Textiles, June 8, 2009 to July 22, 2009
- Weaving of Filter fabrics-Costing & Marketing for Entrepreneurs in and around Ichalkaranji, September 20, 2009

Foreign Collaboration Details

Industry Collaborations

- Dogetech, Taiwan
- Xerolla AG, Switzerland
- Pinter, Spain
- SEDO, TREEPOINT, Germany
- Zinser Saurer, Switzerland

University Collaborations

- Eastern Michigan University, USA
- School of Textile Technology, Indonesia
- Busitema University,Uganda
- Copperbelt University, Zambia
- Kenyatta University, Kenya
- NC State University, USA
- UCLA Extension, USA
- Troy University, USA
- DeVry University, USA

Details of Prototypes Developed

Development of an instrument for measurement of acoustic characteristic of fabrics

Knowledge and Industry Partners

DKTE has associated with the following organizations for the COE on Nonwovens:

Knowledge Partners

1. Eastern Michigan University, USA
2. Texas Tech University, USA
3. Association of Nonwoven Fabrics Industry (INDA), USA
4. NWTEXNET Ltd., UK

Industry Partners

1. SVM Nonwovens Pvt. Ltd., Hyderabad
2. Ruby Surgical & Allied Products Pvt. Ltd., Jalgaon
3. Reliance Industries Limited, Patalganga, Maharashtra
4. Deegee Cotsyn Pvt. Ltd., Amravati
5. Anjani Nonwovens, Kolkata
6. Sri Bhagirath Textile Ltd., Nagpur
7. Suvin Advisors Pvt. Ltd., Thane
8. SVG Fashions Limited, Daman
9. Ujwal Texprints, Sangli
10. Mahlo GmbH and Co. KG, Germany
11. Zenith Fibres Pvt. Ltd., Baroda
12. Obeetee Textile Pvt. Ltd., Mirzapur

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