

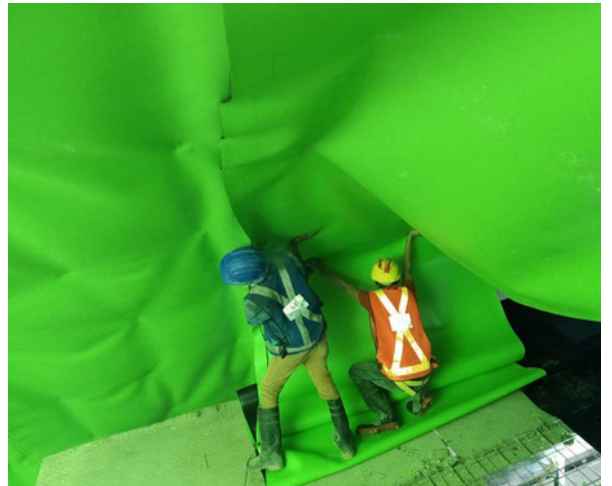


# DL MILLAR AND COMPANY LIMITED

Established since 1929

**COMPLETE WATERPROOFING**

**T U R N K E Y   S O L U T I O N S**



# DL MILLAR AND COMPANY LIMITED

Established since 1929, we are pleased to introduce ourselves as a reputed manufacturer for various infrastructure projects and have been serving various Govt Departments and private projects to meet their requirements for a variety of works. Under our brand name Dr. Millars, we are supplying PVC Geo –membranes, High Voltage Insulating mats, Promatt & PPE Kits & Coveralls. Dr. Millars PVC Geo –membranes are used for Tunnel Waterproofing. These PVC sheets are normally of 1.5 MM & 2.00 MM, produced in India as per a special formulation provided by our technical experts which meet the latest RVNL, IRCON, NHA1 & are also as per BIS (IS:15909:2020) specifications.

The Geomembrane is produced by modern calendaring lines along with a well equipped laboratory meeting at the testing requirements of BIS, RDSO and RITES etc. which are international standards. The special features of PVC Geomembrane are that it conforms to uneven ground surface. enhancing life & can be easily repaired. This is most suitable product for tunnels as the PVC membranes have excellent flexibility & elongation which will not fail in case of earthquakes. The PVC Geomembrane installed by us meet all standard quality parameters and can be a safe economical option for water proofing applications.

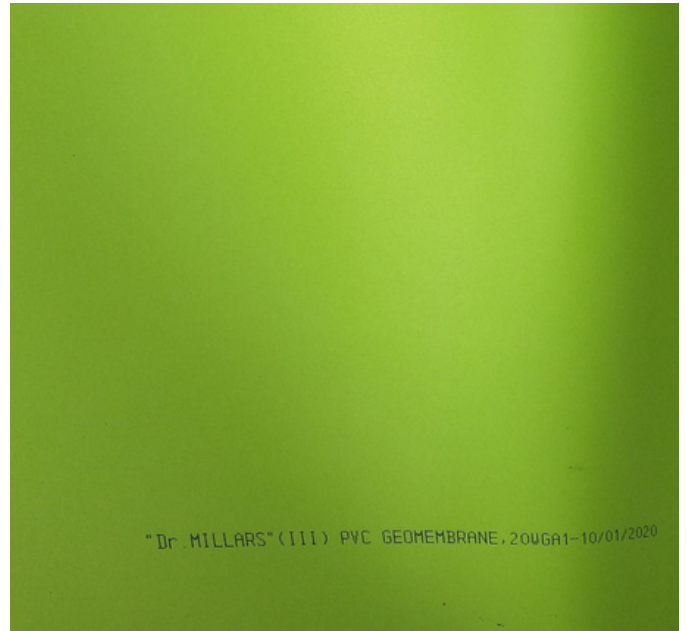
Dr.Millars" brand PVC Geomembrane used for water proofing/ seepage control of concrete structures, Building roofs, foundations, Basements, tunnels, underpasses and sealing of expansion joints and for lining of reservoirs, water bodies, canals etc. for seepage control.

We Provide turnkey based projects i.e. Supply & Installation of PVC Geomembrane. We have complete range of Water Proofing Product.

About Dr. Millars Waterproofing membranes:

"Dr.Millars" PVC Geomembrane is 100% Indian under Make in India program meets the specification as per international standards (ASTM & EN) as well as IS: 15909:2010 (BIS specification for PVC Geomembrane lining).





## SALIENT FEATURES

- Products are 100% made in India under the prestigious "Make in India" program which replaces 100% imported products & dependency on foreign companies.
- Possibility to produce & supply PVC membranes for tailor made specifications of large infra projects.
- Quick & on time delivery as goods are produced by a reputed PVC processing factory located near New Delhi under the supervision of Dr. Millar's engineers.
- Geo Textiles for tailor made requirement is got produced from OEM manufacturers & all installation accessories is sourced from reputed & approved suppliers along with test certificates.
- Test reports from reputed labs like M/s. Spectro Labs conforming to all properties meeting international ASTM & DIN Standards.



# AREAS OF APPLICATION

Use of PVC Geomembrane for these applications is an accepted standard worldwide. The special features of PVC Geomembrane are that it conforms to uneven ground surface enhancing life & can be easily repaired

This is most suitable product for tunnels as the PVC membranes have excellent flexibility & elongation which will not fail even in case of mild earthquakes. The PVC Geomembrane supplied by us meet to all standard quality parameters and can be a safe and economical option for water proofing applications.

- Water Proofing of Building Roofs and Foundations, Underground Concrete Structures like Basement Foundations etc.
- Waste Containment for Industrial Effluents & Solid Waste Management to prevent contamination of Ground Water Aquifer.
- Landfill Capping to prevent fluid flow into the land fill and to trap and properly vent the gases.
- Lining of Canals for Imigation/Agricultural Purpose and many more.
- Lining of Lakes/Reservoirs/Water Bodies for 100% Seepage Control including aquaculture reservoirs for Fish Farming.



The PVC Geomembrane supplied by us meet to all standard quality parameters and can be a safe and economical option for water proofing applications



Use of PVC Geomembrane for these applications is an accepted standard worldwide.



# TUNNEL WATERPROOFING

## WHY GEOMEMBRANE IS RECOMMENDED ?

D.L.Millars & Company Ltd. Supplier a complete range of PVC Geomembranes in response to a wide variety of applications. Experience has shown that PVC-Geomembrane is most suitable for waterproofing of tunnels due to its excellent mechanical properties and its durability in accordance with the expected lifetime of the applicable area.

In addition, this geomembrane can be laminated with a geotextile of polypropylene (up to 700 g/m<sup>2</sup>) for bonded applications.

The waterproofing system with PVC-Geomembrane, Dr. Millars offers maximum security against differential settlements, and risk of perforation due to concrete reinforcement.

In addition, in the event of any damage occurred to the geomembrane, it offers the possibility to achieve a system to repair any leaking, with no perforation of the concrete shell.

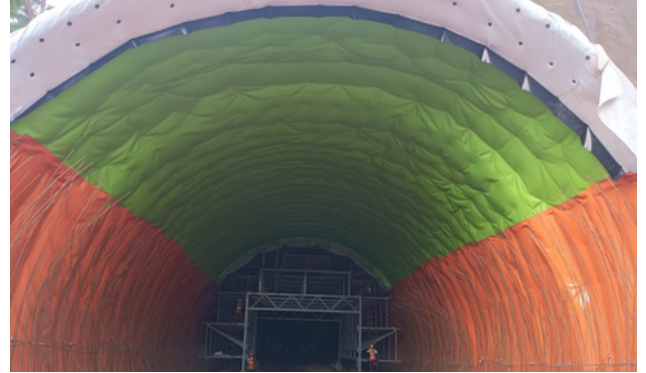


# DR MILLARS" PVC GEOMEMBRANE INSTALLATION PHOTOGRAPHS



## RVNL PROJECT

Berkhera-Budhni section of Bhopal Itarsi 3rd Line



## RVNL PROJECT

Bhanupali-Bilaspur-Beri New Rail-line, Punjab/H.P.



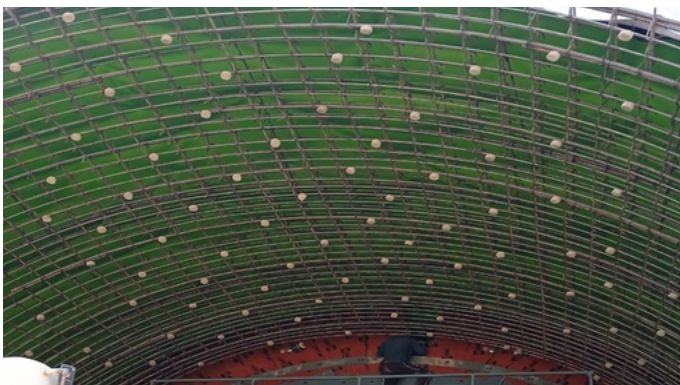
## KONKAN RAILWAY PROJECT

Katra-Banihal section of Udhampur-Sri Nagar- Baramulla Rail-line T-5, Reasi Jammu Through Max Infa Limited



## KONKAN RAILWAY PROJECT

Katra-Banihal section of Udhampur-Sri Nagar- Baramulla Rail-line, T-13 Through Vensar Construction Company Limited



## RVNL PROJECT

Berkhera-Budhni section of Bhopal Itarsi 3rd Line T-5 Through Max Infra Limited

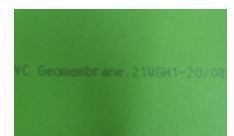
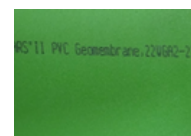
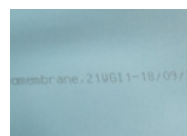


## RVNL PROJECT

Berkhera-Budhni section of Bhopal Itarsi 3rd Line Through Max Infra Limited

## COMPARATIVE SPECIFICATIONS OF “DR MILLARS” 2.0 MM PVC GEOMEMBRANE

Sl. No.	Properties	Unit	Test Method	DLM1	DLM2	DLM3
1	Thickness	mm	EN 1849-2	2.0, ±10%	≥2.0	2.0, -0/+10%
2	Specific Weight	Kg/m <sup>2</sup>	EN 1849-2			2.6 ± 5%
3	Tensile Strength	N/mm <sup>2</sup>	EN ISO 527-3	15 ±2	≥15	
			EN 12311-2			L: ≥17 T: ≥17
4	Elongation at failure	%	EN ISO 527-3	L:250, -10% T:250, -10%	L: ≥280 T: ≥280	
			EN 12311-2			L: ≥300 T: ≥300
5	Tear Strength	KN/m	EN ISO 34	≥40		
			DIN 53363		≥80	
6	Tear propagation strength	N	EN 12310-2			≥100
7	Behavior during perforation test Height of fall without perforation	mm	DIN 16726	≥ 1100	≥ 1100	No perforation at 1100 mm height of fall
8	Cold folding resistance	°C	EN 495-5	No cracks at -20°C	No cracks at -20°C	No cracks at -35°C
9	Hydrostatic pressure resistance		EN 1928-B			Waterproof at 5 bar for 24 hours
10	Dimensional Stability after accelerated ageing (6h/800C)	%	EN ISO 1107-2	≤2%	≤2%	≤2%
11	Change of dimensioning after heating at 70 OC for 2 hours		EN 1110			Stable
12	Root resistance		EN 14416	Resistant	Resistant	Resistant
13	Resistance to acid and alkaline at 28 days		DIN 16726			20 % maximum elongation
14	Resistance of welded seam shear resistance	N/mm <sup>2</sup>	EN 12317-2	Root resistance	Root resistance	≥13.5 Break out of the joint
15	Resistant to static puncturing (24h/20kg)	Kg	EN 12730-B	Root resistance	Root resistance	≥ 20
16	Behaviour in fire		B2 ON B 3800/1 SIA 280 DIN 4102 EN ISO 11925	B2 IV.2 B2 Class E	Root resistance	Class E





# ADVANTAGES OF PVC GEOMEMBRANE

There are distinct advantages that set PVC apart from the REST.....

PVC is the only material that can be engineered to adapt and perform according to Usage and Environments of extreme nature i.e. from the tropics to the desert and to the mountains.

In case of breach, the system can be repaired very fast by unskilled workmen without special equipments etc.

PVC remains elastic through its elongation. The minimum elongation at break for 0.76 mm is 380% for this reason PVC conforms to subgrade soil better.

30 mil PVC Geomembrane is equivalent to 60 mil HDPE Geomembrane. While the thickness of PVC Geomembrane is half that of HDPE Geomembrane the tensile strength is only 18% less than the HDPE Geomembrane.

PVC Geomembrane is amorphous material & is not subject to environmental stress cracking, whereas HDPE Geomembranes are crystalline structure in Nature. Stress cracking of a car windshield. A minuscule stone chip can create a shattering effect.

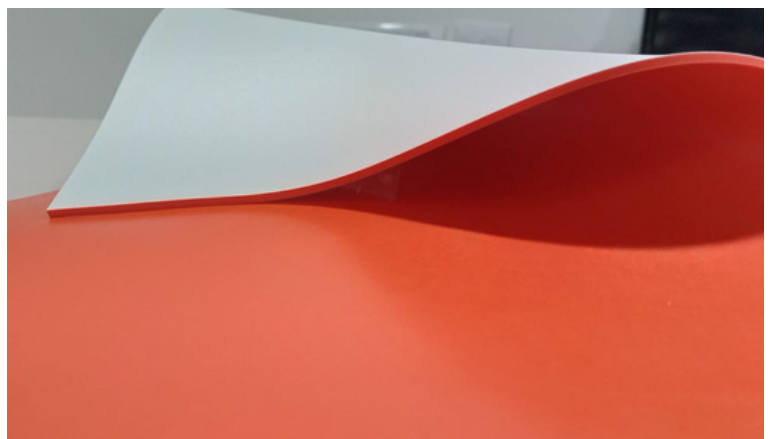
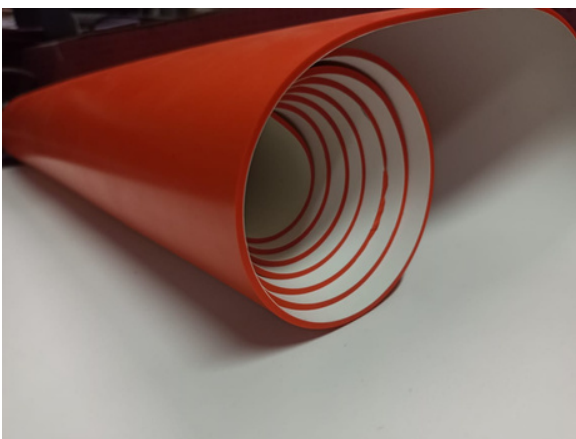
High Flexibility & Elongation till the balance in favour of PVC.

PVC has excellent chemical resistance to most of the chemicals, acids & alkalies



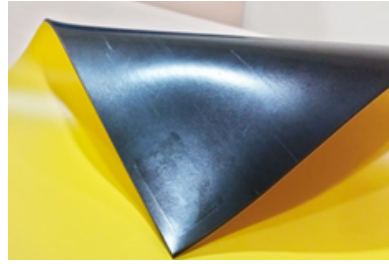
# INTRODUCTION ABOUT BIS 15909:2020

- Bureau of Indian Standard brought out standard IS 15909 in 2010 for PVC Geomembrane for use as a lining material with a max thickness upto 1.5 mm.
- This specifications were revised in the year 2015 (first revision) by adding specifications of 2.0 mm thickness.
- In the year 2020 it was further revised (second revision), by incorporating Category-A & Category-B. For both categories they advised light coloured membranes to avoid using recycled PVC into the product.
- **Category A** for thickness up to 1.5 mm, for use in canals, ponds, reservoirs for seepage control, for lining of landfills, hazardous waste management, solid waste management and industrial effluent for waste containments and for water proofing of basement, roof/terrace.
- **Category B** for thickness 2.0 mm, 2.5 mm & 3.0 mm, PVC Geomembrane for unexposed application for use in large underground civil structures, basement, road underpasses, waterproofing of rail/road tunnels, bunkers, dams and other mega civil structures.
- Until recently PVC Geomembranes were being imported into India for waterproofing of Rail & Road tunnels, basements, bunkers, Naval & Defence projects, Metro Rail ducts etc.
- The European specifications suggested use of black layer membrane with a color signal layer on the top. Membranes with black color base can easily be produced using recycled material which help reduce costs but since product performance is desired for 50-100 years, quality can not be compromised.
- BIS has prepared the specifications accordingly by plugging all loop holes as the new standards ensures use of only virgin raw material by avoiding use of black and dark colors. BIS has also enhanced the specifications for better quality and longer life as per Indian conditions.



**PVC GEOMEMBRANE AS PER BIS SPECIFICATIONS IS15909:2020 CATEGORY-B**

## SALIENT FEATURES OF BIS SPECIFICATIONS (1/7)



AS PER INTERNATIONAL SPECIFICATION

AS PER BIS SPECIFICATIONS  
IS : 15909:2020 CATEGORY B



International Specification	BIS Specifications IS : 15909:2020 Category B	Advantages of BIS specs over International specs
Geomembrane for tunnels and basement works with signal layer (twin colours)-yellow/Black.	Shall be made from virgin raw material –twin colour with white signal layer, The bottom layer of the membrane shall preferably be in light orange colour. Any dark colour like black, blue, grey and brown etc. shall not be used for manufacturing of bottom layer so as to avoid use of recycled material.	Since BIS specs ensure use of virgin grade raw materials only, it will ensure consistency in quality in the entire batch. Use of recycled materials lead to a non homogeneous formulation leading to quality variation thereby increasing chances of failure over long periods of time.

## SALIENT FEATURES OF BIS SPECIFICATIONS (2/7)

International Specification	BIS Specifications IS : 15909:2020 Category B	Advantages of BIS specs over International specs
Nil But actual thickness of signal layer is approx 0.8 mm	$\leq 0.20$ mm	During installation or during the welding of joints, membranes can get damaged due puncturing by sharp objects or due to burning during welding of joints. If signal layer is thicker, as is presently in the case of low quality products, even if the membrane has got damaged, it will not be visible which is a very important parameter. BIS has enhanced the specification by determining the thickness of the Signal Layer to a max of 0.20mm.

## SALIENT FEATURES OF BIS SPECIFICATIONS (3/7)

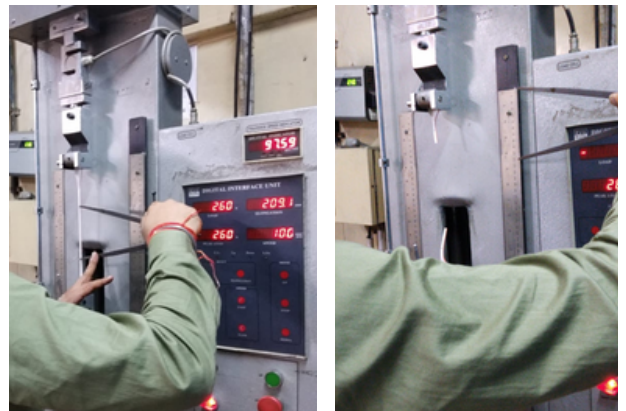
### SPECIFIC GRAVITY



International Specification	BIS Specifications IS : 15909:2020 Category B	Advantages of BIS specs over International specs
NIL	1.30 ± 0.03	Specific gravity has been mentioned for improved compliance. Lower specific gravity is a better-quality membrane

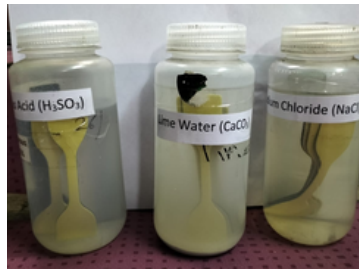
## SALIENT FEATURES OF BIS SPECIFICATIONS (4/7)

### ELONGATION PROPERTY



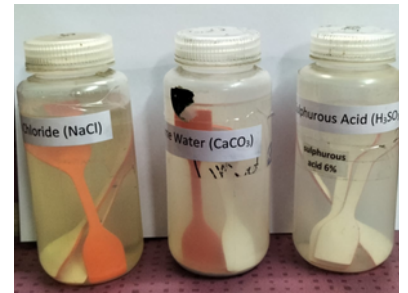
PROPERTIES	UNIT	BIS Specifications IS : 15909:2020 Category B	Advantages of BIS specs over International specs
Elongation at failure M T	%	≥ 300 ≥ 300	Elongation Property of IS Specification is improved. This will ensure better resistance against punctures.

## SALIENT FEATURES OF BIS SPECIFICATIONS (5/7)



AS PER INTERNATIONAL SPECIFICATION

AS PER BIS SPECIFICATIONS  
IS : 15909:2020 CATEGORY B



PROPERTIES	International Specification	BIS Specifications IS : 15909:2020 Category B	Advantages of BIS specs over International specs
Behavior after storage in aqueous solution, resistance to acid and alkali after 28 days	20% maximum variation in elongation	Change in tensile and elongation shall be within $\pm 10\%$ of the original value	Ageing property of IS specification is improved. It indicates better durability/life.

## SALIENT FEATURES OF BIS SPECIFICATIONS (6/7)



AS PER INTERNATIONAL SPECIFICATION



AS PER BIS SPECIFICATIONS  
IS : 15909:2020 CATEGORY B



PROPERTIES	International Specification	BIS Specifications IS : 15909:2020 Category B	Advantages of BIS specs over International specs
Strength of welded seam shear resistance	$\geq 13.5$ N/mm <sup>2</sup> break out of the joint	$\geq 1050$ N/50 mm	Specifications have been improved for better performance of welded joints.

## SALIENT FEATURES OF BIS SPECIFICATIONS (7/7)



**VERTICAL RATE OF BURNING**

**HORIZONTAL RATE OF BURNING**

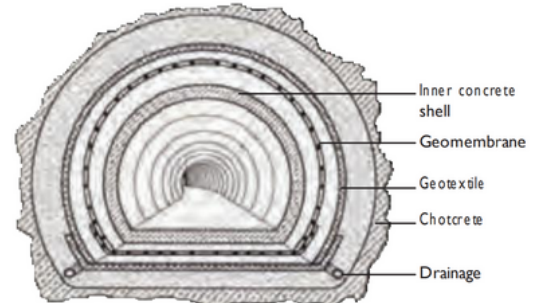


PROPERTIES	International Specification	BIS Specifications IS : 15909:2020 Category B	Advantages of BIS specs over International specs
Fire reaction	Class E	-	
Flammability Test, Horizontal & Vertical rate of Burning	-	$\leq 100$ mm/min	Flammability test as per tests facility available in India has been adopted.

# INSTALLATION PROCEDURE TO INSTALL MEMBRANES IN TUNNELS

## 1. SURFACE PREPARATION

- The surface is cleaned with removing all the construction materials.
- Surface is made free from debris, dirt, standing water etc.
- Surface should be free from any potholes or depressions.
- Surface should have minimal undulations; undulations should be eliminated that are greater than B- 305 mm deep within any L-1525 mm linear distance



## 2. GEOTEXTILE FIXING

Geotextile/Dimple board is fixed on the clean surface by nailing the pvc roundles



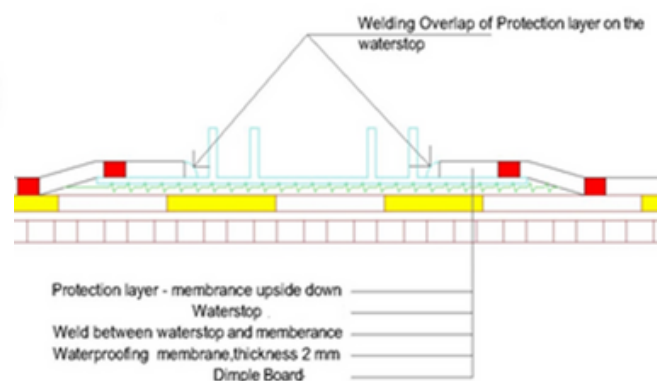
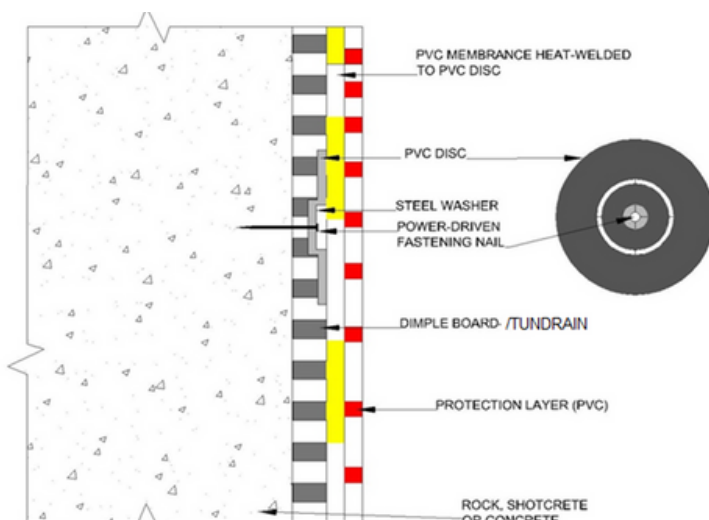
## 3. FIXING OF PVC WATERPROOFING MEMBRANE

PVC waterproofing membrane is welded to the pvc roundles by fusion

- For the seam welding between two waterproofing membranes, Hot Air welding / Double wedge welding is used with an overlap of approx. 100 mm.
- The same system is followed for the Protection membrane.
- To compartmentalize the system, water bars are welded on the WP membrane.
- Welding should be done by TUV SUD certified welder with reference to the DVS codes.



## 4. Sample Assembly with protection membrane



# APPROVAL LETTER RECEIVED FROM VARIOUS PROJECTS

**कोंकण रेलवे कॉर्पोरेशन लिमिटेड**  
**Konkan Railway Corporation Limited**  
 (एनईएल सीएल वी ३१३३) (A Government of India Undertaking)  
 www.konkanrailways.com

No. KR/POJAKIAGE-PATEL (JV)/Tunnel T2/102 Date: 24.02.2020  
 Mr. Prasad / Mr. Ravi / Mr. Shree / Mr. ...

M/s AGE-Patel (JV)  
 USBRL TUNNEL - T2 PROJECT,  
 Village & P. O. Bhuga, Tehsil-Raasi  
 District - Raas (JMK) 182311  
 E-mail - usbr-2@pateleng.com

(Kind Attn: Shakeel Chauhan, Project Manager)

Sub: Construction of Tunnel T-2 (between Km 33.212 to Km 38.375 approx.) on Kattrabhal Section of Udhampur-Srinagar-Baramulla New BG Railway Line Project (Package T-2)  
 - Approval of Vendors.

Ref: (1) C.A. No. IRCON/JMK CELL/JAT/4/1014K-BT-2/327/1017 dtd 14.05.2016.  
 (2) KRCL Letter No. KR/POJAKIAGE-PATEL (JV)/Tunnel T2/47 dtd 21.02.2019  
 (3) KRCL Letter No. KR/POJAKIAGE-PATEL (JV)/Tunnel T2/60 dtd 22.05.2019  
 (4) KRCL Letter No. KR/POJAKIAGE-PATEL (JV)/Tunnel T2/85 dtd 01.06.2019  
 (5) KRCL Letter No. KR/POJAKIAGE-PATEL (JV)/Tunnel T2/89 dtd 18.06.2019  
 (6) KRCL Letter No. KR/POJAKIAGE-PATEL (JV)/Tunnel T2/92 dtd 12.12.2019

M/s APJV has submitted the vendors profile tabulated below for approval of KRCL. The details of construction materials are tabulated as under:

S.no	Material Description	Source	Remarks
1	Hydrophilic Water stopper seal	Manuli Techno rubber	
2	Geotextile 700 GSM	Vivendera Textile	
3	Water Proofing Membrane - 2mm	MYK Amement	
4	Water Proofing Membrane - 2mm	DR Millers	
5	SQA - 50mm Dia	Sup Anchor	
6	Swedish Rock Bolt - 50mm Dia	Argentum	
7	Steel Fiber	Shewata	
8	River Sand	Karshan - Raasi	
9	Geotextile 700 GSM	Manas Geotextile	
10	Water Proofing Membrane - 2mm	Chayati	

The samples of the material were sent to approved laboratory for third party testing vide ref (2) to (6) above. Based on the test reports received from testing laboratory, which are found satisfactory in all parameters, the approval is hereby accorded for vendors for supply of corresponding construction materials as mentioned above.

Please note that this approval has been accorded on the condition of maintaining of quality of product intact. In case of any negative feedback and deterioration in quality, this approval will stand cancelled automatically. Mandatory checks for ensuring the quality will also be done.

3/24/2020

**Segmental Consulting & Infrastructure Advisory (P) Ltd**  
 SOWIL Limited  
 Office: Segmental Consulting & Infrastructure Advisory (P) Ltd, 204, Bangalore, PD - 996, Taluka-Wal, District-Satara, Maharashtra - 422017  
 E-Mail: SOG@SOWIL.com

Project: CONSULTANCY SERVICES FOR AUTHORITY'S ENGINEER FOR SUPERVISION OF CONSTRUCTION OF NEW TWIN TUBE 4-LANE TUNNEL AT KHAMBATKI GHAT SECTION OF NH-4 AND ITS APPROACHES FROM EXISTING KM. 771.730 TO EXISTING KM. 782.000 IN THE STATE OF MAHARASHTRA UNDER NHDP PHASE-V ON EPC MODE.  
 SCIA/REG/2009/PC/1885/SOWIL/CON/14/5220M/109P/C12085

Date: 09/02/2022

To,  
 The Project Manager,  
 Gayatri-Crescent (JV)  
 GF2, Indraprast Building,  
 Balaji Nagar, Near Spandan Hospital,  
 Khandala-412802

(Kind Attention: Mr. Arvind Kulkarni - Project Manager)

Subject: Credentials of D.L MILLARS & COMPANY Ltd - Manufacturer for Water Proofing Membrane to be used in Tunnel.

Ref: 1. GAYATRI - CRESCENT (JV): PIU: Khambatk/2021-22/660, Dated: 02/02/2022

Dear Sir,

With reference to subject mentioned above & reference no. (1), EPC contractor has submitted the Credentials of D.L MILLARS & COMPANY Ltd - Manufacturer of Water Proofing Membrane to be used in Tunnel has been reviewed by Authority Engineers it found in order, hence accorded for Provisional Approval.

However, an inspection of manufacturing unit as well as ongoing project site is required to be arranged in the representation of AE to ascertain available facilities for quality testing of Water Proofing Membrane in accordance to the requirement of relevant codes & MoRTH specification of sampling for third party testing at NABL certified laboratory & final approval shall be accorded after reviewing the third party test results.

Please note that material shall be procured for project after the inspection & reviewing the third party test results conducted at NABL certified laboratory.

This is for information & necessary action.

For Segmental Consulting & Infrastructure Advisory Pvt. Ltd.  
 In Joint Venture with  
 SOWIL Limited

Rajesh Kumar  
 Team Leader cum Sr. Tunnel Expert

Cc.  
 1. The Project Director, NHAI, PIU Pune for Information.  
 2. Project Coordinator Segmental Consulting & Infrastructure Advisory Pvt. Ltd- for Information.

**YOKSEL PROJE**  
 09 July 2022

No. YPH-1857-PMC-GDN-2205

To,  
 Mr. Yashpal Singh Rathore, Project Manager  
 M/s Navayuga Engineering Company Ltd.  
 RVNL Camp, Package-5 Village & Post: Maletha,  
 Dist: Tehri Garhwal, Uttarakhand - 249161

Contract: CONSTRUCTION OF SINGLE BG TUNNEL T-9 (2800 m), T-10 (4140 m) WITH PARALLEL ESCAPE TUNNEL, STATION YARD AT SRINAGAR AND MALETHA, MINOR BRIDGES AND OTHER ANCILLARY WORKS IN BETWEEN CH: 63+460 km TO 73+018 km UNDER PACKAGE - 5 IN CONNECTION WITH NEW SINGLE BROAD-GAUGE RAIL LINK BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN THE STATE OF UTTARAKHAND, INDIA.

Subject: Approval for PVC Water Proofing Membrane and Non-Woven Geotextile (D L Millar and Company Ltd.)-Reg.

Reference: (1) C.A. No. RVNL / RKSH-KNPG/Tender/Tunnels/PK-5/CA-45 dated 18.10.2019  
 (2) Contractor Letter No. NEC/RVNL/PACKAGE-5/22-23/758 of dated 17.06.2022

Dear Sir,

With above mentioned reference Contractor had submitted the Technical Specification and Credential of "D L Millar and Company Ltd." for Engineer's review and initiating the procurement process with following reference documents and Samples,

1. Technical Specification.  
 2. MITC reports.  
 3. Samples as listed hereafter:  
 A) Membrane: One square meter of each type membrane (3 Nos.)  
 B) Protective felt: One square meter of each type of felt (3 Nos.)  
 C) Welded splice: One meter of welded membrane splice for each type of membrane (3 Nos.)

Engineer has reviewed the submitted technical specification and Credential of D L Millar and Company Ltd. as per C 2.1 and C 2.2 of Bill Quantities and in conformance with Sub clause 4.2.5. Annexure A of Work's requirement and found to be meeting the requirements.

Therefore, the above-mentioned products are hereby Provisionally Approved for construction with the condition that below mentioned points must be completed:

1) Manufacturer Test Certificates (MITC) are required for each LOT.  
 2) Before using, third party test to be conducted at NABL approved Laboratory for joint Sample collected at site.  
 3) The test result should satisfy with Contract Agreement and relevant codal provisions.  
 4) Shop drawing showing treatment of projections, connections to water stops, connection to waterproofing of structures in open cut, local reinforcement etc.

YOKSEL PROJE (Lead Partner)  
 IET (JV Partner)

701 to 754, 77Floor, Vigneshwara, Subhash Road 1, Gurgaon-122009/INDIA  
 www.yokselproje.com

**AECOM** designed & delivered

AECOM India Pvt. Ltd.  
 91 124 483 2100 IN  
 91 124 483 2108 IN  
 5F, Infocity Tower C,  
 DLF Cyber City, Phase II,  
 Gurgaon 122 002  
 India  
 www.aecom.com  
 CIN: U74120MH2005BFTC028183

Ref No: AECOM/GEO/RVNL/PMC/RKSH-KNPG/PKG-7A/MAX-HES/JV/1745 Date: 30.09.2022

M/s Max-HES (JV)  
 Plot No. 319 & 320,  
 4th Floor East Avenue Building,  
 Ayyappa Society, Madhapur,  
 Hyderabad - 500081,  
 E-mail- tenders@maxinfra.in

(Kind Attention: Mr. Vinay Khetarpal, Authorized Signatory)

Subject: CONSTRUCTION OF TUNNELS & BRIDGES WORKS FROM CHAINAGE 83+899 to 91+228 UNDER PACKAGE-7A IN CONNECTION WITH NEW BG LINE BETWEEN RISHIKESH AND KARANPRAYAG (125KM) IN STATE OF UTTARAKHAND, INDIA.

Reg: Reply of submission of third-party test report of make - M/s D L Millar and Company Ltd.

Ref: (i) CA No. RVNL/RKSH-KNPG/Tender/Tunnels/PK-7A/51 Dated: 26.08.2020  
 (ii) Contractor Letter: MAX-HES (JV)/RVNL/Tunnels/RKSH-KNPG/PKG-7A/2021-22/752, Dated 17.04.2021  
 (iii) Our Letter No: AECOM/GEO/RVNL/PMC/RKSH-KNPG/PKG-7A/MAX-HES/JV/571, Date:20.04.2021  
 (iv) Contractor Letter: MAX-HES (JV)/RVNL/Tunnels/RKSH-KNPG/PKG-7A/2021-22/1622, Dated 24.03.2022  
 (v) Our Letter No: AECOM/GEO/RVNL/PMC/RKSH-KNPG/PKG-7A/MAX-HES/JV/1589, Date:08.07.2022  
 (vi) Contractor Letter: MAX-HES (JV)/RVNL/Tunnels/RKSH-KNPG/PKG-7A/2021-22/1982, Dated 30.07.2022  
 (vii) Our Letter No: AECOM/GEO/RVNL/PMC/RKSH-KNPG/PKG-7A/MAX-HES/JV/1644, Date:02.08.2022  
 (viii) Contractor Letter: MAX-HES (JV)/RVNL/Tunnels/RKSH-KNPG/PKG-7A/2021-22/1994, Dated 03.08.2022  
 (ix) Our Letter No: AECOM/GEO/RVNL/PMC/RKSH-KNPG/PKG-7A/MAX-HES/JV/1654, Date:04.08.2022  
 (x) Contractor Letter: MAX-HES (JV)/RVNL/Tunnels/RKSH-KNPG/PKG-7A/2021-22/2057, Dated 30.08.2022

Dear Sir,

The Engineer is in receipt of the contractor's letter dated August 30, 2022, regarding the submission of third-party test reports for water proofing membrane 2 mm and geotextile 500 GSM. We have reviewed the awaited results of the resistance to acidic and alkaline solutions and the resistance against acids and alkaline solutions third party test report and

Site Office: - The Engineer, RVNL Office, (Behind Rudratok Hotel), Village - Khanika, Dist - Rudrapur, Uttarakhand, Pin -246171

Page 1 of 2



# THIRD PARTY TEST REPORT FOR "DR MILLARS" BRAND PVC GEOMEMBRANE

**PIONEER TESTING LABORATORY**  
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 Email: pioneertestinglab@gmail.com  
 Web: www.pioneertestinglaboratory.com

F.No. F(01) 7.8

### TEST-REPORT

Report No. :- PTL/GEN/04793  
 Letter Ref. No. :- PMC/BPL/BKA-BNI/MAX/178, Dt:- 31/07/2021  
 Date of Receipt :- 05/08/2021  
 Period of Testing :- 06/08/2021 - 28/08/2021  
 Date of Report :- 28/08/2021

Issued to: M/S AECOM India Pvt Ltd, PMC Office, BKA-BNI 3<sup>rd</sup> Line Project, New Toll Plaza, Hosangbad Road, Near Shalimar Hotel, Obodilaganj, Diso-Raisen M.P. India-464993

Sample Description:- PVC Waterproofing Membrane (2.00mm thick) \*Source:- Dr. Millar\*

Name of Work:- Construction of five tunnels/ Cut & Cover with Ballast less track in connection with 3<sup>rd</sup> Bhopal Division of West Central Railway in Sehore and Raisen Districts of Madhya Pradesh State, India 3<sup>rd</sup> Line Between Barkhara-Budli (26.5km)  
 (CA No. RVNL/Bhopal/BKA-BNI(Tunnel) Date:-27.02.2019)  
 Ref-Vide M/s Max Letter's No. MLR/RVNL/Tunnels/Bhopal/2020-21/424, dtd 31.07.2021  
 Name of Agency :- M/s Max Infra Pvt. Ltd. Sample ID:-Max/PVC/Mem/05/364 / Max/PVC/Mem/05/364, Welded

S. No.	Test	Units	Test Method	Result	Requirement As per customer	Conformity
1.	Thickness	mm	DIN 53370	2.04	2 Min.	Yes
2.	Tensile Strength	N/mm <sup>2</sup>	DIN 53455			
	a. Longitudinal direction			20.11	15 Min.	Yes
	b. Transverse direction			17.20	15 Min.	Yes
3.	Elongation at Break	%	DIN 53455			
	a. Longitudinal direction			356	250 Min.	Yes
	b. Transverse direction			379	250 Min.	Yes
4.	Compressive Strength at 20% Strain (10mm cube)	N/mm <sup>2</sup>	DIN 53454	8.15	2.5 Min.	Yes
5.	Tear Propagation Strength	N/mm	DIN 53363		100 Min.	
	a. Longitudinal direction			125.57		Yes
	b. Transverse direction			115.02		Yes
6.	Strength of Welded Seam	N/50 mm	DIN 16726	1175.2	-	-
7.	Dimensional Stability after accelerating ageing	%	DIN 16726	0.06	±2 Max.	Yes
8.	Material Characteristics during and After storage at 80 °C		DIN 16726			
	General Appearance			No Blisters	No Blisters	Yes
	Dimensional Stability			0.09	±3% Max.	Yes
	a. Longitudinal direction			0.07	±3% Max.	Yes
	b. Transverse direction					
	Variation of Tensile			+2.4	+10% Max.	Yes
	a. Longitudinal direction			+3.1	+10% Max.	Yes
	b. Transverse direction					

Lab Incharge: [Signature] Authorised Signatory: Director C. N. MISHRA

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 (2) Total liability of our Lab is limited to the invoiced amount.  
 (3) Samples will be destroyed after 90 days from the date of test report unless otherwise specified.  
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 Date of Report :- 28/08/2021

Issued to: M/S AECOM India Pvt Ltd, PMC Office, BKA-BNI 3<sup>rd</sup> Line Project, New Toll Plaza, Hosangbad Road, Near Shalimar Hotel, Obodilaganj, Diso-Raisen M.P. India-464993

Sample Description:- PVC Waterproofing Membrane (2.00mm thick) \*Source:- Dr. Millar\*

S. No.	Test	Units	Test Method	Result	Requirement As per customer	Conformity
	Variation of Elongation at Failure		DIN 16726			
	a. Longitudinal direction			+4.7	-10% Max.	Yes
	b. Transverse direction			+4.4	-10% Max.	Yes
	Folding at a temperature of 20°C			No fissures	No fissures	Yes
9.	Water Absorption	%	DIN 53495	0.06	1 Max.	Yes
10.	Behaviour after storage in acid and/ or alkaline solutions		DIN 16726			
	Variation of Tensile			Awaited	±20% Max.	-
	a. Longitudinal direction			Awaited	±20% Max.	-
	b. Transverse direction			Awaited	±20% Max.	-
	Variation of Elongation at Failure			Awaited	±20% Max.	-
	a. Longitudinal direction			Awaited	±20% Max.	-
	b. Transverse direction			Awaited	±20% Max.	-
	Folding at a temperature of 20°C			Awaited	No fissures	-
11.	Shear Strength of Splice with bitumen	N/50 mm	DIN 16726	138	100/50 mm	Yes
12.	Behaviour During Perforation Test	mm	DIN 50014	No perforation observed	No perforation 750mm height of fall	Yes

Lab Incharge: [Signature] Authorised Signatory: Director C. N. MISHRA

\*Test Witness By Mr. S. Modi (TCE/PMC), Atul Nigam (PMC), Anm Jat (Sr. QC, Max infra) & Vikash (Dr. Miller)  
 \*\*End of Report\*\*

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F.No. F(01) 5.10

### TEST-REPORT

Report No. :- TC718119100001537P  
 Letter Ref. No. :- KR/PTD/K&K/AGE-PATEL/JVY, Tazel T2/65, Dt:- 01/06/2019  
 Date of Receipt:- 03/06/2019  
 Date of Report:- 10/06/2019

Issued to: Dy. Chief Engineer/R&T/Kanur, Konkan Railway Corporation Ltd., Jyotipuram - Road, Goanagar, Reasi - 182311, (J&K)

Sample Description:- PVC Waterproofing Membrane 2mm thick (Green & Black) (Source:- Dr. Millar)

Name of Work:- Construction of Tunnel T2, (Between km 33.212 to 38.375 approx) on Katra-Banhal Section of Udhampur-Srinagar-Baramulla New BG Railway Line Project (Package T2)

Ref:- (1) CA No. IRCON/J&K CELL/JAT/14/1014/K-B/T-2/227/1017 dated 14/05/2016  
 (2) M/s AGE-Patel (JV) letter no. 100/350/USBR/L-T2/APJV-KD/813 dtd 01.06.2019

Name of Agency:- M/s AGE Patel (JV)

S. No.	Test	Units	Test Method	Result	Requirement Specified Value Tunnel T2 K B Section/USBR/L Project	Conformity
1.	Thickness	mm	EN 1894-2	2.05	≥ 2	Yes
2.	Tensile Strength	N/mm <sup>2</sup>	EN 12311-2			
	a. Longitudinal direction			19.17	> 17	Yes
	b. Transverse direction			17.36	> 17	Yes
3.	Elongation at Break	%	EN 12311-2			
	a. Longitudinal direction			325	≥ 300	Yes
	b. Transverse direction			321	≥ 300	Yes
4.	Tear Strength	N/mm	EN 12310-2			
	a. Longitudinal direction			181	≥ 100	Yes
	b. Transverse direction			181	≥ 100	Yes
5.	Peneture Static Test	KN	EN ISO 12236	2.8	≥ 2.5	Yes
6.	Water Tightness at 0.5 N/mm <sup>2</sup> , 24 hours	N/mm <sup>2</sup>		No Leakage	Water tight	Yes
7.	Change in Dimension at heating at 70 °C for 24 hours	°C	EN 1110	No Change	Stable	Yes
8.	Cold Bending at -35 °C	°C	EN 495-5	No Crack	≥ 35	Yes
9.	Resistance of Joints	N/mm <sup>2</sup>	EN 12317-2	11.2	≥ 10.5	Yes
10.	Resistance to acidic and alkaline at 28 days	%	DIN 16726	Awaited	20 Max.	-

Lab Incharge: [Signature] Authorised Signatory: Director C. N. MISHRA

\*\*End of Report\*\*

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F.No. F(01) (5.10)

### TEST-REPORT

Report No. :- 190603GEN00001417  
 Date of Report :- 18/06/2019  
 Your Ref No. :- KR/PTD/K&K/AGE-PATEL (JVY) Tunnel T2/64 Dt:- 01/06/2019  
 Date of Receipt:- 03/06/2019

Issued to: Dy. Chief Engineer/R&T/Kanur, Konkan Railway Corporation Ltd., Jyotipuram-Road, Goanagar, Reasi-182311 (J&K)

Sample Description :- 1-Water Proofing Membrane 2mm Thick

Name of Work :- Construction of Tunnel T2 (between km 33.212 to 38.375 approx) on Katra- Banhal Section of Udhampur-Srinagar-Baramulla New BG Railway Line Project (Package T2)

Ref. No. :- (1) CA No. IRCON/J&K Cell/ JAT/14/1014/K-B/T-2/227/1017 dated 14/05/2016  
 (2) M/s AGE Patel (JV) letter no. 100/350/USBR/L-T2/APJV-KD/813 dated 01/06/2019

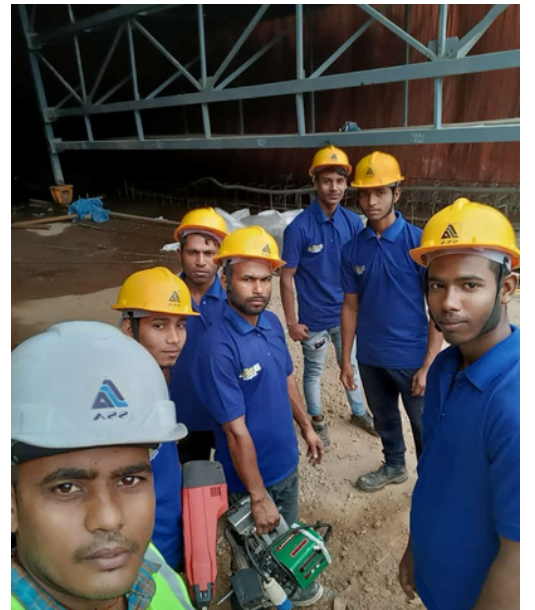
Name of Agency :- M/S AGE-Patel (JV)  
 Source :- DR Millars.

S. No.	Test	Units	Test Method	Results	Requirement Party Specified Value	Conformity
1.	Thickness	mm	EN 1894-2	2.10	≥ 2.0	Yes
2.	Tensile Strength	N/mm <sup>2</sup>	EN 12311-2			
(i)	Longitudinal direction			19.33	> 17.0	Yes
(ii)	Transverse direction			17.45	≥ 300	Yes
3.	Elongation at break	%	EN 12311-2			
(i)	Longitudinal direction			326.0	≥ 300	Yes
(ii)	Transverse direction			317.0	≥ 300	Yes
4.	Resistance to Tear	N/mm	EN 12310-2			
(i)	Longitudinal direction			212.0	≥ 100	Yes
(ii)	Transverse direction			196.0	≥ 100	Yes
5.	Peneture Static Test	KN	EM/ISO-12236	2.72	≥ 2.5	Yes
6.	Water Tightness (24 hrs at 0.5 N/mm <sup>2</sup> )	N/mm <sup>2</sup>	EN 1982	No Leakage Observed	Water Tight	Yes
7.	Change of Dimension (After heating at 70°C for 2 Hrs.)	°C	EN 1110	No any change in dimension	Stable	Yes
8.	Cold bending	0°C	EN 495-5	More than -35	≥ -35	Yes
9.	Resistance to acidic and alkaline for elongation (at 28 days)	%	DIN 16726	Awaited	20.0 Max	-
10.	Resistance of Joints	N/mm <sup>2</sup>	EN 12317-2	12.1	≥ 10.5	Yes

Lab Incharge: [Signature] Authorised Signatory: B. N. JHA Quality Manager

\*\*End of Report\*\*

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