

**Title: Delta MS-20 Membrane**

**Determination of Carbon Dioxide  
Gas Permeability**

**Certificate of Test Number: 19024**

**Customer's Name & Address:**

DELTA Membrane Systems Ltd  
Delta House, Merlin Way,  
North Weald,  
Epping,  
Essex  
CM16 6HR

Our Ref: N950/TR0006

VTC Job No: 3SQ0 – 1.345.01

Your Ref: P.O. #012689 dated 07-Aug-13

Date: 20 January 2014

Date samples received: 03 September 2013

Samples received from: Client

Sample No: 148545 – 148546

Written by: .....  
D Thompson (position: Engineer)

Authorised by: .....  
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## 1. INTRODUCTION

This certificate of test describes the Carbon Dioxide gas permeability testing carried out at the request of Delta Membrane Systems Ltd on 14 January 2014 at VINCI Technology Centre (VTC), Leighton Buzzard.

The test was carried out in accordance with In-House Test Procedure TP950/05/13569 Issue 1 and "Rilem Report 12, Performance Criteria for Concrete Durability, E & FN Spon, London, UK pp 226 – 230".

## 2. SAMPLE DESCRIPTION

Technology Centre received 2no. A4 sized sheets of Delta MS-20 membrane. One sheet of Delta MS-20 membrane, Plain (TC Ref 148545) and one sheet of Delta MS-20 membrane, Jointed (TC Ref 148546). The membranes were given unique TC sample numbers for reference purposes only.

## 3. TEST PROCEDURE

An approximately 95mm diameter sized specimen was cut from each sheet (the jointed membrane incorporated the joint within the test area), and was sealed in a circular steel rig such that both faces were exposed. Carbon Dioxide gas at approximately 23kPa above atmospheric pressure was passed over one face of the membrane, and any gas flow passing through the sample was determined via a gas bubble-meter.

## 4. TEST RESULTS

The results for the testing are contained in Table 1 below.

### CARBON DIOXIDE GAS PERMEABILITY RESULTS

Table 1

Client Reference	TC Ref	Specimen Thickness (m)	Exposed Area (m <sup>2</sup> )	CO <sub>2</sub> Gas Permeability (K <sub>gas</sub> ) (m/s)
Delta MS-20 Membrane (Plain)	148545	8.000 x10 <sup>-4</sup>	6.783 x10 <sup>-3</sup>	7.92 x10 <sup>-11</sup>
Delta MS-20 Membrane (Jointed)	148546	2.188 x10 <sup>-3*</sup>	5.803 x10 <sup>-3</sup>	8.68 x10 <sup>-10</sup>

Date of test: 14 January 2014

\* Thickness based upon average of 4no. readings : two on unjointed & two on jointed areas.

## 5. SPECIFICATION

The permeability specification for non-geological barriers is as follows:

For inert waste: K<sub>gas</sub> <1.00 x10<sup>-7</sup> m/s.

Taken from Council Directive 193/31/EC dated 04/1999.

END OF CERTIFICATE