



# **Wynnum STP Manufacturers Data Report and O&M**

**Contract No: C1314-20  
Evoqua Ref: 1515-000002-MDR-001**



| ISSUE | DESCRIPTION | ISSUED BY | DATE      | APPROVED BY | DATE       |
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|       |             |           |           |             |            |



## TABLE OF CONTENTS

| SECTION  | SUB-SECTION | DESCRIPTION                                   |
|----------|-------------|---|
|          |             | <b>Introduction</b>                           |
|          |             | <b>RO - Membrane</b>                          |
| <b>A</b> |             | <b>Inspection Reports</b>                     |
|          | A-1         | Inspection and Test Plans                     |
| <b>B</b> |             | <b>Certificates</b>                           |
|          | B-1         | Dow - Certificate                             |
|          |             | <b>UF - Membrane</b>                          |
| <b>C</b> |             | <b>Inspection Reports</b>                     |
|          | C-1         | Inspection and Test Plans                     |
| <b>D</b> |             | <b>Certificates</b>                           |
|          | D-1         | Membrane - Data Sheets                        |
|          | D-2         | Installation Map                              |
|          | D-3         | Certificates                                  |
|          |             | <b>Wynnum STP</b>                             |
| <b>E</b> |             | <b>Reports</b>                                |
|          | E-1         | QUU Wynnum Membrane Replacement Report        |
|          | E-2         | RO Autopsy Report                             |
|          | E-3         | UF Membrane Autopsy Report                    |
| <b>F</b> |             | <b>Miscellaneous</b>                          |
|          | F-1         | Protec Pressure Vessel Drawing and Data Sheet |



# 1 Introduction

Wynnum Water Reclamation MF/RO Plant was commissioned and put into operation from early 2008.

Plant produces high purity water from clarified secondary effluent. It does this by combining Memcor's CP system with Reverse Osmosis. The product water from the reclamation plant is sent to the Caltex Oil Refinery to be used as process water.

Secondary effluent is pumped from the waste water treatment plant to two balance tanks. These tanks contain a recirculation pump to prevent sedimentation at the bottom of the tank. The MF feed pump takes water from either of the two balance tanks and directs it into a common feed manifold for the Memcor CP Units. Upstream of the CP Units is a Mono Chloramine dosing point (2-5 mg/L) and two MF Pre-Screens.

The feed pumps are controlled by a VSD which is controlled by a PID control loop to maintain a pressure set-point in the feed manifold. The filtration flow rate in each MF Unit is controlled by a Flow Control Valve (FCV-92x-01) which is controlled by a PID control loop that uses the instantaneous filtration flow rate as a set-point. The filtrate produced from each CP Unit is combined in a common filtrate manifold, is pH adjusted (with Sulphuric Acid) and fed into the RO Feed Tank.

The Wynnum Memcor CP System consists of two MEMCOR® CP Units with 90 L20V membranes and is designed to produce 7.1 MLD of filtrate. Each Unit has a block with 15 banks of 6 modules which is equivalent to 90 modules. Each Unit has all the required valves and ancillary equipment required to perform a Backwash, PDT, Sonic Test, Drain down, Maintenance Clean and CIP.

The backwash waste from each Unit drained into a waste pit, which is then pumped back to the head of the Wynnum Waste Water treatment plant. The CIP waste from each unit is drained into a Neutralisation Pit, where it is neutralised and slowly transferred into the Waste Pit.


It was decided to replace L20V module with L20N and OR membrane to maintain the performance of tertiary water treatment system. Evoqua Water Technologies carried site work and re-commissioned both RO& MF system in March 2015 upon modules being replaced. This document details module factory QA certificate, as well as data report, retired membrane autopsy results and ITPs.



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## **RO – Membrane Replacement**

### **A-1 Inspection and Test Plan**

| INSPECTION AND TEST PLAN   |   |  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
|--|---|--|------------------------------------|---|-----------------|---|-----|-------------|--------------------------------|--|-----|-------------|--------------------|
| <br>Evoqua Water Technologies Pty Ltd<br>A.B.N. 52 165 060 168<br>160 Herring Rd.,<br>Macquarie Park NSW 2113<br>Ph: 1300 661 809                                   |   | PROJECT: Replacement of MF,RO Membranes & Misc Works at Luggage Point and Wynnum Sewage Treatment Plants                   |                                    |   |                 | LEGEND:<br>W = Witness A= Approve<br>V = Visual Check<br>R = Review<br>H = Hold<br>S = Surveillance Point |     |             |                                | SHEET 1<br>DOCUMENT NUMBER 151100002-ITP-001 |     |             |                    |
|  |   | COMPONENT/PROCESS: Membrane Replacement  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| CONTRACT NO:   |   | C1314-20   |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| EWT REFERENCE:   |   | 1515-000002  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| NOTES:<br>1. CLIENT TO ADVISE HOLD/WITNESS POINT PRIOR TO START.<br>2. ACCEPTANCE OUTCOME COLUMN TO BE INITIALED BY INSPECTOR FOLLOWING COMPLETION OF EACH ACTIVITY.<br>3. RELEVANT EWT AND CLIENT SPEC'S TO BE READ IN CONJUNCTION WITH THIS I.T.P. |   |  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| DATE   |   | DESCRIPTION  |                                    | PREPARED  |                 | APPROVED  |     | Revision    |                                |  |     |             |                    |
| 11/02/2015   |   | First Revision   |                                    | AJ  |                 | EA  |     | 0           |                                |  |     |             |                    |
| No   | INSPECTION ACTIVITY                           | INSPECTION PROCEDURE   | APPLICABLE STANDARD, SPEC, DRAWING | ACCEPTANCE CRITERIA                               | INSPECTION TYPE |   |     |             | INSPECTION APPROVAL / SIGN OFF |  |     |             | REMARKS            |
|  |   |  |                                    |   | End User        | Client  | EWT | Subcontract | End User                       | Client                                       | EWT | Subcontract |                    |
| <b>1 Good Receiveal</b>  |   |  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| 1.1  | Specification                                 | Review Specification and Scope of Works  | Contract C1314-20                  | Scope of works defined                            |                 |   | R   |             |                                |  | MS  |             |                    |
| 1.2  | Place Order for RO and UF Membranes           | Order membranes. Check Order confirmation  | Relevant Purchase Order            | Orders as per scope of works                      |                 |   |     |             |                                |  | MS  |             |                    |
| 1.3  | Receive RO Membranes                          | Check delivery for any visible faults or damage. Check against order   | Relevant Purchase Order            | Membranes in good condition and as per order      |                 |   | V   |             |                                |  | MS  |             |                    |
| 1.4  | Receive MF Membranes                          | Check delivery for any visible faults or damage. Check against order. Check temperature log and shock switches if relevant | Relevant Purchase Order            | Membranes in good condition and as per order      |                 |   | V   |             |                                |  | MS  |             |                    |
| <b>2 UF Membrane Change</b>  |   |  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| 2.1  | Collect MF Performance Data                   | Data to be provided to EWT from SCADA logs and manual logs   | per QUU Standard                   | Data in useable format                            |                 |   | R   |             |                                |  | MS  |             |                    |
| 2.2  | Perform CIP on MF Membranes                   | Clean UF membranes directly prior to removal   | MF Unit Standard Operation         | Verification of CIP                               |                 |   | S   |             |                                |  | MS  |             |                    |
| 2.4  | Remove MF Modules (Keep 2 for Autopsy)        | Remove and Dispose of UF Membranes   | MGS00omm01_05                      | Modules Removed                                   |                 |   | S   |             |                                |  | MS  |             |                    |
| 2.5  | Replace MF Modules                            | Replace Modules as per installation guide  | MGS00omm01_05                      | Modules replaced as per Memcor installation guide |                 |   | S   |             |                                |  | MS  |             |                    |
| 2.7  | Run MF Check PDT and other critical processes | Recommission UF Units  | MF Unit Standard Operation         | UF Operating to expected parameters               |                 |   | W   |             |                                |  | MS  |             | PDT 0.19 & PDT 0.2 |
| <b>3 RO Membrane Change</b>  |   |  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| 3.1  | Collect RO Performance Data                   | Data to be provided to EWT from SCADA logs and manual logs   | per QUU Standard                   | Data in useable format                            |                 |   | R   |             |                                |  | MS  |             |                    |
| 3.2  | Perform CIP on RO Membranes                   | Clean UF membranes directly prior to removal   | RO Unit Operation                  | Verification of CIP                               |                 |   | W   |             |                                |  | MS  |             |                    |
| 3.4  | Remove RO Modules                             | Remove and Dispose of UF Membranes   | Filmtec Data Sheet BW 30 400FR     | Modules Removed                                   |                 |   | S   |             |                                |  | MS  |             |                    |
| 3.5  | Replace RO Modules                            | Replace Modules  | Filmtec Data Sheet BW 30 400FR     | Modules replaced as per Memcor installation guide |                 |   | S   |             |                                |  | MS  |             |                    |
| 3.7  | Restart RO                                    | Restart RO and check pressure drop and permeate conductivity   | RO Unit Operation                  | UF Operating to expected parameters               |                 |   | W   |             |                                |  | MS  |             |                    |
| <b>4 Disposal</b>  |   |  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| 4.1  | Dispose of all membranes in approved landfill | Disposal off site to be by licenced contractor   |                                    |   |                 |   | S   |             |                                |  | MS  |             |                    |
| 4.2  | Receive goods disposal confirmation           | Receive document confirming proper disposal  |                                    | Document Received                                 |                 |   | S   |             |                                |  | MS  |             | N/A                |



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## **RO – Membrane Replacement**

### **B-1 DOW Certificates**



Dow Water & Process Solutions  
5400 Dewey Hill Rd.  
Edina, Minnesota 55439-2085  
USA

Telephone: 952-897-4200  
Fax: 952-838-3999 (Administration)  
Fax: 952-835-4996 (Customer Service)

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## CERTIFICATE OF CONFORMANCE

**CUSTOMER** : DOW CHEMICAL (AUSTRALIA) PTY  
**CUSTOMER PO** :  
**DELIVERY #** : 803609861  
**SAP ORDER #** : 4000855437  
**TOTAL SHIPPED QTY** : 336  
**MODEL** : BW30FR-400  
**GMID** : 202684  
**SHIP DATE** : 12/9/2014 10:59:09 PM  
**COUNTRY OF ORIGIN** : USA

### NORMALIZED TEST CONDITIONS:

FEED COMPOSITION : NaCl  
FEED CONCENTRATION (ppm) : 2000  
FEED CONDUCTIVITY (umhos) : 3865  
TEMPERATURE (C) : 25  
APPLIED PRESSURE (PSI) : 225

### SPECIFICATIONS:

FLOW LIMITS (GPD) MIN : 9,775.0  
MAX : 14,375.0  
MINIMUM % REJECTION : 99

The products listed below meet the specifications requirements:

Released By:

| Serial Number: | Serial Number: | Serial Number: | Serial Number: | Serial Number: | Serial Number: | Serial Number: | Serial Number: | Serial Number: |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| F7885988       | F9468883       | F9468885       | F9468896       | F9468898       | F9468967       | F9468976       | F9468985       | F9468987       |
| F9469053       | F9469064       | F9469076       | F9469078       | F9469145       | F9469167       | F9469174       | F9469177       | F9469220       |
| F9469222       | F9469223       | F9469266       | F9515125       | F9515131       | F9515136       | F9515138       | F9515142       | F9515143       |
| F9515145       | F9515146       | F9515147       | F9515148       | F9515149       | F9515150       | F9515151       | F9515152       | F9515153       |
| F9515155       | F9515157       | F9515159       | F9515160       | F9515161       | F9515162       | F9515163       | F9515164       | F9515165       |
| F9515166       | F9515167       | F9515168       | F9515169       | F9515170       | F9515171       | F9515173       | F9515174       | F9515177       |
| F9515178       | F9515179       | F9515182       | F9515193       | F9515194       | F9515195       | F9515197       | F9515198       | F9516086       |





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|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| F9516141       | F9516150       | F9516152       | F9516315       | F9516362       | F9516452       | F9516464       | F9516472       | F9516508       |
| F9516514       | F9516522       | F9516528       | F9516534       | F9516538       | F9516541       | F9516542       | F9516603       | F9516664       |
| F9516673       | F9516678       | F9516679       | F9516689       | F9516744       | F9516752       | F9516755       | F9516757       | F9516758       |
| F9516766       | F9516851       | F9516855       | F9516865       | F9516869       | F9516904       | F9516907       | F9516939       | F9516956       |
| F9517003       | F9517028       | F9517043       | F9517046       | F9517089       | F9517112       | F9517120       | F9517123       | F9517198       |
| F9517221       | F9517223       | F9517225       | F9517314       | F9517339       | F9517352       | F9517355       | F9517363       | F9517420       |
| F9517422       | F9517428       | F9517505       | F9521942       | F9521947       | F9521949       | F9521968       | F9522200       | F9522204       |
| F9522229       | F9522241       | F9522289       | F9522291       | F9522326       | F9522396       | F9522488       | F9522490       | F9522501       |



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|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| F9522503       | F9522688       | F9522691       | F9522695       | F9522709       | F9522796       | F9522798       | F9522800       | F9522802       |
| F9523042       | F9523056       | F9523061       | F9523064       | F9523140       | F9523147       | F9523150       | F9523151       | F9523235       |
| F9523237       | F9523239       | F9523932       | F9524107       | F9524282       | F9524286       | F9524296       | F9524305       | F9524736       |
| F9524741       | F9524758       | F9524772       | F9524817       | F9524821       | F9524822       | F9524845       | F9524929       | F9525062       |
| F9525074       | F9607101       | F9607102       | F9607106       | F9607109       | F9607186       | F9607192       | F9607194       | F9607195       |
| F9607271       | F9607275       | F9607276       | F9607283       | F9607363       | F9607364       | F9607365       | F9607374       | F9607447       |
| F9607448       | F9607449       | F9607457       | F9607546       | F9607547       | F9607548       | F9607549       | F9607630       | F9607633       |
| F9607634       | F9607635       | F9607721       | F9607722       | F9607723       | F9607724       | F9637138       | F9637147       | F9637158       |



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|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| F9637160       | F9637195       | F9637218       | F9637222       | F9637226       | F9637282       | F9637559       | F9637569       | F9637573       |
| F9637578       | F9637642       | F9637657       | F9637658       | F9637664       | F9637707       | F9637735       | F9637736       | F9637748       |
| F9637749       | F9637822       | F9637825       | F9637852       | F9637855       | F9637920       | F9637924       | F9637930       | F9637941       |
| F9637992       | F9638022       | F9638023       | F9638024       | F9638094       | F9638098       | F9638113       | F9638114       | F9638189       |
| F9638193       | F9638197       | F9638199       | F9638268       | F9638286       | F9638288       | F9638291       | F9638369       | F9638370       |
| F9638372       | F9638374       | F9638468       | F9638469       | F9638479       | F9638522       | F9638552       | F9638567       | F9638574       |
| F9638618       | F9638629       | F9638640       | F9638643       | F9638646       | F9638652       | F9638681       | F9638733       | F9638738       |
| F9638740       | F9638744       | F9638822       | F9638823       | F9638825       | F9638829       | F9638874       | F9638878       | F9638908       |



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| F9638941       | F9638946       | F9638947       | F9638949       | F9638951       | F9638970       | F9638974       | F9638976       | F9639032       |
| F9639082       | F9639109       | F9639115       | F9639117       | F9639174       | F9639179       | F9639201       | F9639203       | F9639213       |
| F9639216       | F9639281       | F9639286       | F9639347       | F9639349       | F9639375       | F9639376       | F9702102       | F9702103       |
| F9702105       | F9702106       | F9702186       | F9702189       | F9702200       | F9702201       | F9702272       | F9702276       | F9702278       |
| F9702288       | F9764326       | F9764340       | F9764342       | F9764344       | F9764420       | F9764421       | F9764422       | F9764426       |
| F9764510       | F9764520       | F9764521       | F9764523       | F9764695       | F9764699       | F9764701       | F9764703       | F9764757       |
| F9764771       | F9764798       | F9764803       |                |                |                |                |                |                |



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## **UF – Membrane Replacement**

### **C-1 Inspection and Test Plan**

| INSPECTION AND TEST PLAN   |   |  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
|--|---|--|------------------------------------|---|-----------------|---|-----|-------------|--------------------------------|--|-----|-------------|--------------------|
| <br>Evoqua Water Technologies Pty Ltd<br>A.B.N. 52 165 060 168<br>160 Herring Rd,<br>Macquarie Park NSW 2113<br>Ph: 1300 661 809                                    |   | PROJECT: Replacement of MF,RO Membranes & Misc Works at Luggage Point and Wynnum Sewage Treatment Plants                   |                                    |   |                 | LEGEND:<br>W = Witness A= Approve<br>V = Visual Check<br>R = Review<br>H = Hold<br>S = Surveillance Point |     |             |                                | SHEET 1<br>DOCUMENT NUMBER 1511.000002-ITP-001 |     |             |                    |
|  |   | COMPONENT/PROCESS: Membrane Replacement  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| CONTRACT NO:   |   | C1314-20   |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| EWT REFERENCE:   |   | 1515-000002  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| NOTES:<br>1. CLIENT TO ADVISE HOLD/WITNESS POINT PRIOR TO START.<br>2. ACCEPTANCE OUTCOME COLUMN TO BE INITIALED BY INSPECTOR FOLLOWING COMPLETION OF EACH ACTIVITY.<br>3. RELEVANT EWT AND CLIENT SPEC'S TO BE READ IN CONJUNCTION WITH THIS I.T.P. |   |  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| DATE   |   | DESCRIPTION  |                                    | PREPARED  |                 | APPROVED  |     | Revision    |                                |  |     |             |                    |
| 11/02/2015   |   | First Revision   |                                    | AJ  |                 | EA  |     | 0           |                                |  |     |             |                    |
| No   | INSPECTION ACTIVITY                           | INSPECTION PROCEDURE   | APPLICABLE STANDARD, SPEC, DRAWING | ACCEPTANCE CRITERIA                               | INSPECTION TYPE |   |     |             | INSPECTION APPROVAL / SIGN OFF |  |     |             | REMARKS            |
|  |   |  |                                    |   | End User        | Client  | EWT | Subcontract | End User                       | Client   | EWT | Subcontract |                    |
| <b>1 Good Receipt</b>  |   |  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| 1.1  | Specification                                 | Review Specification and Scope of Works  | Contract C1314-20                  | Scope of works defined                            |                 |   | R   |             |                                |  | MS  |             |                    |
| 1.2  | Place Order for RO and UF Membranes           | Order membranes. Check Order confirmation  | Relevant Purchase Order            | Orders as per scope of works                      |                 |   |     |             |                                |  | MS  |             |                    |
| 1.3  | Receive RO Membranes                          | Check delivery for any visible faults or damage. Check against order   | Relevant Purchase Order            | Membranes in good condition and as per order      |                 |   | V   |             |                                |  | MS  |             |                    |
| 1.4  | Receive MF Membranes                          | Check delivery for any visible faults or damage. Check against order. Check temperature log and shock switches if relevant | Relevant Purchase Order            | Membranes in good condition and as per order      |                 |   | V   |             |                                |  | MS  |             |                    |
| <b>2 UF Membrane Change</b>  |   |  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| 2.1  | Collect MF Performance Data                   | Data to be provided to EWT from SCADA logs and manual logs   | per QUU Standard                   | Data in useable format                            |                 |   | R   |             |                                |  | MS  |             |                    |
| 2.2  | Perform CIP on MF Membranes                   | Clean UF membranes directly prior to removal   | MF Unit Standard Operation         | Verification of CIP                               |                 |   | S   |             |                                |  | MS  |             |                    |
| 2.4  | Remove MF Modules (Keep 2 for Autopsy)        | Remove and Dispose of UF Membranes   | MGS00omm01_05                      | Modules Removed                                   |                 |   | S   |             |                                |  | MS  |             |                    |
| 2.5  | Replace MF Modules                            | Replace Modules as per installation guide  | MGS00omm01_05                      | Modules replaced as per Memcor installation guide |                 |   | S   |             |                                |  | MS  |             |                    |
| 2.7  | Run MF Check PDT and other critical processes | Recommission UF Units  | MF Unit Standard Operation         | UF Operating to expected parameters               |                 |   | W   |             |                                |  | MS  |             | PDT 0.19 & PDT 0.2 |
| <b>3 RO Membrane Change</b>  |   |  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| 3.1  | Collect RO Performance Data                   | Data to be provided to EWT from SCADA logs and manual logs   | per QUU Standard                   | Data in useable format                            |                 |   | R   |             |                                |  | MS  |             |                    |
| 3.2  | Perform CIP on RO Membranes                   | Clean UF membranes directly prior to removal   | RO Unit Operation                  | Verification of CIP                               |                 |   | W   |             |                                |  | MS  |             |                    |
| 3.4  | Remove RO Modules                             | Remove and Dispose of UF Membranes   | Filmtec Data Sheet BW 30 400FR     | Modules Removed                                   |                 |   | S   |             |                                |  | MS  |             |                    |
| 3.5  | Replace RO Modules                            | Replace Modules  | Filmtec Data Sheet BW 30 400FR     | Modules replaced as per Memcor installation guide |                 |   | S   |             |                                |  | MS  |             |                    |
| 3.7  | Restart RO                                    | Restart RO and check pressure drop and permeate conductivity   | RO Unit Operation                  | UF Operating to expected parameters               |                 |   | W   |             |                                |  | MS  |             |                    |
| <b>4 Disposal</b>  |   |  |                                    |   |                 |   |     |             |                                |  |     |             |                    |
| 4.1  | Dispose of all membranes in approved landfill | Disposal off site to be by licenced contractor   |                                    |   |                 |   | S   |             |                                |  | MS  |             |                    |
| 4.2  | Receive goods disposal confirmation           | Receive document confirming proper disposal  |                                    | Document Received                                 |                 |   | S   |             |                                |  | MS  |             | N/A                |



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## **UF – Membrane Replacement**

### **D-1 Membrane Data Sheet**



## MEMCOR® L20N MEMBRANE FILTRATION MODULE SPECIFICATION

### L20N MODULE SPECIFICATIONS

| Parameter                         | Details                                     |
|-----------------------------------|---|
| Module Operating Process          | Pressurized Ultrafiltration                 |
| Typical Applications              | General Applications                        |
| Membrane Type                     | Hollow Fiber                                |
| Filtration Flow Direction         | Outside to Inside                           |
| Backwash Type                     | Air Scour with Liquid Backwash              |
| Membrane Material                 | PVDF (Polyvinylidene Fluoride)              |
| Other Wetted Module Components    | Polyurethane, Polyethylene, Polyamide, EPDM |
| Nominal Membrane Pore Size        | 0.04 $\mu\text{m}$                          |
| Nominal Membrane Area             | 34.8 m <sup>2</sup> / 375 ft <sup>2</sup>   |
| Nominal Module Length (Overall)   | 1800 mm / 70.9 in                           |
| Nominal Module Diameter (Overall) | 119 mm / 4.7 in                             |
| Approximate Module Mass           | 12.0 kg / 26 lb                             |





## L20N MODULE OPERATING SPECIFICATIONS

| Parameter   | Details  |
|---|--|
| Operating Temperature Range   | > 0 to 35 °C / > 32 to 95 °F<br>(Must not be exposed to freezing conditions)   |
| Temperature Range for Transportation and Storage                        | Preferred range 5 to 25 °C / 41 to 77 °F<br>Allowable range > 0 to 35 °C / > 32 to 95 °F<br>(shipment/storage in a temperature controlled container (or reefer) at 20 °C / 68 °F recommended).<br>Modules must not be exposed to freezing conditions and must remain moist at all times. |
| Typical Feed pH Range   | 6.0 – 9.0 pH <sup>Note i</sup>   |
| Allowable pH Range for Cleaning   | 2.0 – 10.0 pH typical <sup>Note ii</sup>   |
| Typical Maximum Recommended Trans-Membrane Pressure (TMP) in Filtration | 140 kPa / 20 psi <sup>Note iii</sup>   |
| Maximum Allowable TMP at any time                                       | ± 150 kPa / ± 22 psi @ ≤ 30 °C / 86 °F<br>± 120 kPa / ± 17 psi @ > 30 °C / 86 °F   |
| Maximum Module Housing Operating Pressure                               | 500 kPa / 75 psi   |
| Typical chlorine concentration during cleaning (MW or CIP)              | 50 – 200 mg/L @ 25 °C / 50 – 200 ppm @ 77 °F <sup>Note iv</sup>  |
| Maximum chlorine concentration during cleaning                          | 1000 mg/L @ 25 °C / 1000 ppm @ 77 °F <sup>Note iv</sup>  |
| Maximum total exposure to chlorine during cleaning                      | 500,000 mg.h/L @ 25 °C / 500,000 ppm.h @ 77 °F <sup>Note iv</sup>  |
| Maximum separate exposure to chlorine in feed or during storage         | < 1 mg/L average, < 5 mg/L maximum, pH > 6.5 @ 25 °C<br>< 1 ppm average, < 5 ppm maximum, pH > 6.5 @ 77 °F<br>100,000 mg.h/L @ 25 °C / 100,000 ppm.h @ 77 °F <sup>Note iv</sup>  |
| Maximum separate exposure to chloramines in feed or during storage      | < 2.5 mg/L average, < 5 mg/L maximum, pH > 6.5 @ 25 °C<br>< 2.5 ppm average, < 5 ppm maximum, pH > 6.5 @ 77 °F<br>150,000 mg.h/L @ 25 °C / 150,000 ppm.h @ 77 °F <sup>Note iv</sup>  |

## Notes:

- Exposure to chlorine or chloramines is not recommended in feeds below 6.5 pH.
- Occasional brief exposure during chlorine cleans to pH 10.5 is acceptable.
- Maximum recommended filtration TMP for a particular application is usually feed dependent. The actual recommended value may vary from the value shown.
- Please consult Evoqua Water Technologies for additional guidance on exposure limits and for operation at different temperatures.

The information provided in this literature contains merely general descriptions or characteristics of performance which in actual case of use do not always apply as described or which may change as a result of further development of the products.

An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of the contract. Additional operating information, storage instructions and warranty terms may apply. Please contact Evoqua Water Technologies for more information.

## Evoqua Water Technologies Membrane Systems Pty Ltd

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Australia

Tel: +61 (0)2 4577-6800

Fax: +61 (0)2 4577-0078

Email: [memcorasia.au@evoqua.com](mailto:memcorasia.au@evoqua.com)

Internet: <http://www.evoqua.com>



---

## **UF – Membrane Replacement**

### **D-2 Installation Map**

# Module Mapping

Version 1.0.13

(This sheet is part of the design of this interface, please do not modify or delete it)

Wynnum WRP  
(SiteID:201200)

6x15

6x15

## Operations

|                                      |   |
|--------------------------------------|---|
| Select a Module Operation ....       | ▼ |
| Select an Unit Operation ....        | ▼ |
| Select a Find or Show Operation .... | ▼ |

## Block ID: Unit1\_32024

Columns: 6 Rows: 15

|    | A        | B        | C        | D        | E        | F        |
|----|----------|----------|----------|----------|----------|----------|
| 1  | WSF1891E | WSF1913G | WSF1833E | WRF1D543 | WSF11213 | WRF19841 |
| 2  | WNEBE32H | WSF1844O | WRF1874A | WRF1B11C | WMF1A62A | WRF1D424 |
| 3  | WMF1854R | WRF1A61- | WSF1843Z | WSF1113Y | WRF1B13R | WSF1743S |
| 4  | WRF18835 | WSF18923 | WRF1831X | WSF1B124 | WSF1A118 | WRF1A12V |
| 5  | WSF1882J | WSF1881U | WMF18531 | WRF1133- | WRF1982N | WSF1823U |
| 6  | WRF1881R | WPECV834 | WSF19145 | WMF1951U | WRF1764J | WSF1982Q |
| 7  | WRF1843W | WRF1832M | WSF19111 | WSF1B22P | WRF1A71K | WRF1D41F |
| 8  | WRF1861M | WRF18340 | WRF1833B | WPECVA4Z | WRF1B121 | WSF1B243 |
| 9  | WRF1A62P | WSF1912R | WRF19142 | WMF1A63- | WRF1A73Z | WSF1B11F |
| 10 | WSF1744H | WSF1884Y | WRF18426 | WRF1D52P | WSF1B14J | WMF1931P |
| 11 | WRF1B23B | WMF1843H | WRF1873L | WRF1D43U | WSF1B23E | WSF1741D |
| 12 | WPECV82F | WRF1872W | WSF18838 | WMF17235 | WRF1D51- | WRF11449 |
| 13 | WRF1A729 | WRF1D44J | WRF1B22M | WMF1734F | WMF1952J | WRF1981Y |
| 14 | WRF1A74O | WSF17422 | WSF1B21- | WRF1B14G | WMF1811D | WRF1823R |
| 15 | WSF1A12Y | WRF1D53E | WRF1B21X | WMF1722G | WMF1954Y | WRF1A115 |

# Module Mapping

Version 1.0.13

(This sheet is part of the design of this interface, please do not modify or delete it)

Wynnum WRP  
(SiteID:201200)

6x15

6x15

## Operations

|                                      |   |
|--------------------------------------|---|
| Select a Module Operation ....       | ▼ |
| Select an Unit Operation ....        | ▼ |
| Select a Find or Show Operation .... | ▼ |

## Block ID: Unit2\_32025

Columns: 6 Rows: 15

|    | A        | B        | C        | D        | E        | F        |
|----|----------|----------|----------|----------|----------|----------|
| 1  | WSE4724A | WPE46320 | WNEAJ41K | WRF16242 | WMF1A510 | WSF1A53X |
| 2  | WMEAJ12H | WNEAJ43Z | WSE47216 | WRF17539 | WRF1A42K | WRF1A44Z |
| 3  | WREAH631 | WPE4633Q | WNEAJ44O | WRF1611E | WRF1A439 | WRF16123 |
| 4  | WSF1824J | WRF1821C | WSE4722W | WSF1922B | WSF1752N | WRF1763U |
| 5  | WSF19810 | WSF1A14C | WSE4723L | WRF1761F | WSF1761I | WRF18716 |
| 6  | WSF1A13N | WRF1983C | WPE4634F | WSF17627 | WMF1733Q | WSF1924Q |
| 7  | WSF19844 | WRF1A13K | WRF1A41V | WRF17624 | WSF1A527 | WRF1862B |
| 8  | WSF18224 | WMF1A52Q | WMF1721R | WSF1A817 | WRF1882G | WPECV84U |
| 9  | WRF18221 | WSF1A51I | WSF1763X | WRF19228 | WSF1A731 | WSF1753C |
| 10 | WRF1743P | WRF1752K | WRF1432V | WSF1894I | WSF1841K | WMF1852C |
| 11 | WRF1824G | WSF1764M | WMF1731B | WMF1A544 | WPECVA1V | WMF1851N |
| 12 | WSF1A84B | WRF1741A | WSF1A82X | WRF1924N | WSF1874D | WRF1A63E |
| 13 | WRF1744E | WSF1751Y | WSF1A71N | WSF1893T | WPECVA2K | WRF1A643 |
| 14 | WSF1A72C | WMF1A53F | WSF1A54M | WSF18429 | WRF1884V | WSF1872Z |
| 15 | WMF18446 | WSF1A74R | WSF19230 | WRF1864Q | WPECV81Q | WRF1844L |



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## **UF – Membrane Replacement**

### **D-3 Certificates**

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*1515-000002-QUU Wynnum STP RO and UF Membrane Replacement*

**eVOQUA**  
WATER TECHNOLOGIES

**EWT Membrane Systems Pty Ltd**  
**Memcor Products**  
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Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WSF1891E** Serial No. **856249** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      |  |                               |                                |
|----------------------|--|-------------------------------|--------------------------------|
| Integrity Test (DAF) | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/> | Tested By <b>Chirayu Mehta</b> |
| Flow Test            | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Date <b>27/01/2015</b>         |
| Visual Check         | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Crate ID <b>F1R4</b>           |
| Size and Length      | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      |                                |

Form QA 104 Issue 11

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WMF1854R** Serial No. **856359** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      |  |                               |                                |
|----------------------|--|-------------------------------|--------------------------------|
| Integrity Test (DAF) | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/> | Tested By <b>Marvin Romero</b> |
| Flow Test            | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Date <b>28/01/2015</b>         |
| Visual Check         | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Crate ID <b>F1R4</b>           |
| Size and Length      | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      |                                |

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WNEBE32H** Serial No. **846887** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      |  |                               |                                |
|----------------------|--|-------------------------------|--------------------------------|
| Integrity Test (DAF) | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/> | Tested By <b>Chirayu Mehta</b> |
| Flow Test            | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Date <b>27/01/2015</b>         |
| Visual Check         | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Crate ID <b>F1R4</b>           |
| Size and Length      | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      |                                |

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WRF18835** Serial No. **856323** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      |  |                               |                                |
|----------------------|--|-------------------------------|--------------------------------|
| Integrity Test (DAF) | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/> | Tested By <b>Marvin Romero</b> |
| Flow Test            | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Date <b>28/01/2015</b>         |
| Visual Check         | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Crate ID <b>F1R4</b>           |
| Size and Length      | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      |                                |

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WSF1882J** Serial No.: **856277** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Marvin Romero**  
Visual Check ☒ Date: **28/01/2015**  
Size and Length ☒ Crate ID: **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WRF1843W** Serial No.: **856207** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Chirayu Mehta**  
Visual Check ☒ Date: **27/01/2015**  
Size and Length ☐ Crate ID: **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WRF1881R** Serial No.: **856370** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Marvin Romero**  
Visual Check ☒ Date: **28/01/2015**  
Size and Length ☒ Crate ID: **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WRF1861M** Serial No.: **856279** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Chirayu Mehta**  
Visual Check ☒ Date: **27/01/2015**  
Size and Length ☐ Crate ID: **F1R4**


Form QA 104 Issue 11

1471

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**



Module ID **WRF1A62P** Serial No. **856332** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |


Tested By **Chirayu Mehta** Date **27/01/2015** Crate ID **F1R4**

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**



Module ID **WRF1B23B** Serial No. **857230** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |


Tested By **Robert Finch** Date **02/02/2015** Crate ID **F1S3**

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WATER TECHNOLOGIES

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**



Module ID **WSF1744H** Serial No. **857271** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |


Tested By **Robert Finch** Date **02/02/2015** Crate ID **F1S3**

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**



Module ID **WPECV82F** Serial No. **856193** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Chirayu Mehta** Date **27/01/2015** Crate ID **F1R4**

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WATER TECHNOLOGIES

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**EWT Membrane Systems Pty Ltd**  
**Memcor Products**  
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South Windsor NSW  
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Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module ID** WRF1A729 **Serial No.** 857270 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Robert Finch **Date** 02/02/2015 **Crate ID** F1S3

Form QA 104 Issue 11

**eVOQUA**  
WATER TECHNOLOGIES

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**EWT Membrane Systems Pty Ltd**  
**Memcor Products**  
A.B.N 36 166 784 694  
15 Blackman Crescent  
South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module ID** WSF1A12Y **Serial No.** 856494 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Chirayu Mehta **Date** 28/01/2015 **Crate ID** F1S3

Form QA 104 Issue 11

**eVOQUA**  
WATER TECHNOLOGIES

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**EWT Membrane Systems Pty Ltd**  
**Memcor Products**  
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15 Blackman Crescent  
South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module ID** WRF1A740 **Serial No.** 857284 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Robert Finch **Date** 02/02/2015 **Crate ID** F1S3

Form QA 104 Issue 11

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WATER TECHNOLOGIES

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**EWT Membrane Systems Pty Ltd**  
**Memcor Products**  
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15 Blackman Crescent  
South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module ID** WSF1913G **Serial No.** 856248 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Chirayu Mehta **Date** 27/01/2015 **Crate ID** F1R4

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WRF1A61-** Serial No.: **856333** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Chirayu Mehta**  
Visual Check ☒ Date: **27/01/2015**  
Size and Length ☒ Crate ID: **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WSF1881U** Serial No.: **856283** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Chirayu Mehta**  
Visual Check ☒ Date: **27/01/2015**  
Size and Length ☒ Crate ID: **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WSF18440** Serial No.: **856227** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Chirayu Mehta**  
Visual Check ☒ Date: **27/01/2015**  
Size and Length ☒ Crate ID: **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WSF18923** Serial No.: **856252** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Chirayu Mehta**  
Visual Check ☒ Date: **27/01/2015**  
Size and Length ☒ Crate ID: **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WPECV834 **Serial No.** 856185 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Chirayu Mehta **Date** 27/01/2015 **Crate ID** F1R4

Form QA 104 Issue 11

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF18340 **Serial No.** 856202 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Chirayu Mehta **Date** 27/01/2015 **Crate ID** F1R4

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1832M **Serial No.** 856241 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Marvin Romero **Date** 28/01/2015 **Crate ID** F1R4

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF1912R **Serial No.** 856259 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Marvin Romero **Date** 28/01/2015 **Crate ID** F1R4

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Fax: 61 (02) 4577 0002

Module ID: WMF1843H  
Serial No.: 856300  
Part No.: 120408  
Type: L20N  
Batch No.: 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

Tested By: Chirayu Mehta  
Date: 27/01/2015  
Crate ID: F1R4

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Fax: 61 (02) 4577 0002

Module Test Certificate  
Polyvinylidene fluoride Membrane

Module ID: WMF1843H  
Serial No.: 856300  
Part No.: 120408  
Type: L20N  
Batch No.: 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☐ Fail  
Flow Test ☒ ☐  
Visual Check ☒ ☐  
Size and Length ☒ ☐

Tested By: Chirayu Mehta  
Date: 27/01/2015  
Crate ID: F1R4

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Fax: 61 (02) 4577 0002

Module ID: WRF1D44J  
Serial No.: 857396  
Part No.: 120408  
Type: L20N  
Batch No.: 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

Tested By: Chirayu Mehta  
Date: 27/01/2015  
Crate ID: F1R4

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Fax: 61 (02) 4577 0002

Module Test Certificate  
Polyvinylidene fluoride Membrane

Module ID: WRF1D44J  
Serial No.: 857396  
Part No.: 120408  
Type: L20N  
Batch No.: 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☐ Fail  
Flow Test ☒ ☐  
Visual Check ☒ ☐  
Size and Length ☒ ☐

Tested By: Robert Finch  
Date: 02/02/2015  
Crate ID: F1S3

Form QA 104 Issue 11



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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF17422 **Serial No.** 857239 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Robert Finch**  
Date **02/02/2015**  
Crate ID **F1S3**

Form QA 104 Issue 11

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**Memcor Products**  
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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WMF18531 **Serial No.** 856357 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Chirayu Mehta**  
Date **27/01/2015**  
Crate ID **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1D53E **Serial No.** 857405 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Robert Finch**  
Date **02/02/2015**  
Crate ID **F1S3**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF19145 **Serial No.** 856254 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Chirayu Mehta**  
Date **27/01/2015**  
Crate ID **F1R4**

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MFI



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Module Test Certificate

Polyvinylidene fluoride Membrane



Module ID **WSF1833E** Serial No. **856196** Part No. **120408** Type **L20N** Batch No. **1467436**

Lubricate O-Rings with Supplied Silicone Grease Only

Pass ☒ Fail ☐  
Integrity Test (DAF) ☒ ☐  
Flow Test ☒ ☐  
Visual Check ☒ ☐  
Size and Length ☒ ☐

Tested By **Chirayu Mehta**  
Date **27/01/2015**  
Crate ID **F1R4**

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Module Test Certificate

Polyvinylidene fluoride Membrane



Module ID **WRF1874A** Serial No. **856261** Part No. **120408** Type **L20N** Batch No. **1467436**

Lubricate O-Rings with Supplied Silicone Grease Only

Pass ☒ Fail ☐  
Integrity Test (DAF) ☒ ☐  
Flow Test ☒ ☐  
Visual Check ☒ ☐  
Size and Length ☒ ☐

Tested By **Chirayu Mehta**  
Date **27/01/2015**  
Crate ID **F1R4**

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Module Test Certificate

Polyvinylidene fluoride Membrane



Module ID **WSF1843Z** Serial No. **856200** Part No. **120408** Type **L20N** Batch No. **1467436**

Lubricate O-Rings with Supplied Silicone Grease Only

Pass ☒ Fail ☐  
Integrity Test (DAF) ☒ ☐  
Flow Test ☒ ☐  
Visual Check ☒ ☐  
Size and Length ☒ ☐

Tested By **Chirayu Mehta**  
Date **27/01/2015**  
Crate ID **F1R4**

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Module Test Certificate

Polyvinylidene fluoride Membrane



Module ID **WRF1831X** Serial No. **856226** Part No. **120408** Type **L20N** Batch No. **1467436**

Lubricate O-Rings with Supplied Silicone Grease Only

Pass ☒ Fail ☐  
Integrity Test (DAF) ☒ ☐  
Flow Test ☒ ☐  
Visual Check ☒ ☐  
Size and Length ☒ ☐

Tested By **Chirayu Mehta**  
Date **27/01/2015**  
Crate ID **F1R4**

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WATER TECHNOLOGIES

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1833B **Serial No.** 856240 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Chirayu Mehta**  
Visual Check ☒ Date **27/01/2015**  
Size and Length ☒ Crate ID **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF18426 **Serial No.** 856204 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Chirayu Mehta**  
Visual Check ☒ Date **27/01/2015**  
Size and Length ☒ Crate ID **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF19111 **Serial No.** 856253 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Chirayu Mehta**  
Visual Check ☒ Date **27/01/2015**  
Size and Length ☒ Crate ID **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF19142 **Serial No.** 856198 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Chirayu Mehta**  
Visual Check ☒ Date **27/01/2015**  
Size and Length ☒ Crate ID **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

*C11*

Module ID **WRF1873L** Serial No. **856251** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Chirayu Mehta** Date **27/01/2015** Crate ID **F1R4**

Form QA 104 Issue 11

**eVOQUA**  
WATER TECHNOLOGIES

**EWT Membrane Systems Pty Ltd**  
**Memcor Products**  
A.B.N 36 166 784 694  
15 Blackman Crescent  
South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

*C13*

Module ID **WRF1B22M** Serial No. **857269** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Robert Finch** Date **02/02/2015** Crate ID **F1S3**

Form QA 104 Issue 11

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

*C12*

Module ID **WSF18838** Serial No. **856245** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Chirayu Mehta** Date **27/01/2015** Crate ID **F1R4**

Form QA 104 Issue 11

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

*C14*

Module ID **WSF1B21-** Serial No. **857316** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Robert Finch** Date **02/02/2015** Crate ID **F1S3**

Form QA 104 Issue 11



**MF1**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1B21X **Serial No.** 857232 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Robert Finch **Date** 02/02/2015 **Crate ID** F1S3

Form QA 104 Issue 11

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1B11C **Serial No.** 857294 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Robert Finch **Date** 02/02/2015 **Crate ID** F1S3

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1D543 **Serial No.** 857371 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Robert Finch **Date** 02/02/2015 **Crate ID** F1S3

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF1113Y **Serial No.** 856152 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Robert Finch **Date** 02/02/2015 **Crate ID** F1S3

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WSF1B124** Serial No. **857306** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Robert Finch**  
Visual Check ☒ Date **02/02/2015**  
Size and Length ☒ Crate ID **F1S3**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WMF1951U** Serial No. **856507** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Robert Finch**  
Visual Check ☒ Date **02/02/2015**  
Size and Length ☒ Crate ID **F1S3**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WRF1133-** Serial No. **857354** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Robert Finch**  
Visual Check ☒ Date **02/02/2015**  
Size and Length ☒ Crate ID **F1S3**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WSF1B22P** Serial No. **857286** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Robert Finch**  
Visual Check ☒ Date **02/02/2015**  
Size and Length ☒ Crate ID **F1S3**


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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane** *D9*



Module ID **WMF1A63-** Serial No. **857240** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |


Tested By **Robert Finch** Date **02/02/2015** Crate ID **F1S3**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane** *D11*



Module ID **WRF1D43U** Serial No. **857397** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |


Tested By **Robert Finch** Date **02/02/2015** Crate ID **F1S3**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane** *D8*



Module ID **WPECVA4Z** Serial No. **856338** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |


Tested By **Robert Finch** Date **02/02/2015** Crate ID **F1S3**

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Australia 2756  
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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane** *D10*



Module ID **WRF1D52P** Serial No. **857369** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Robert Finch** Date **02/02/2015** Crate ID **F1S3**

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WATER TECHNOLOGIES

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Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WMF1734F**  
Serial No.: **856396**  
Part No.: **120408**  
Type: **L20N**  
Batch No.: **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☐ Fail  
Flow Test ☒ ☐  
Visual Check ☒ ☐  
Size and Length ☒ ☐

Tested By: **Robert Finch**  
Date: **02/02/2015**  
Crate ID: **F1S3**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WMF1722G**  
Serial No.: **857243**  
Part No.: **120408**  
Type: **L20N**  
Batch No.: **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☐ Fail  
Flow Test ☒ ☐  
Visual Check ☒ ☐  
Size and Length ☒ ☐

Tested By: **Nathan Refalo**  
Date: **02/02/2015**  
Crate ID: **F1S3**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WMF17235**  
Serial No.: **857228**  
Part No.: **120408**  
Type: **L20N**  
Batch No.: **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☐ Fail  
Flow Test ☒ ☐  
Visual Check ☒ ☐  
Size and Length ☒ ☐

Tested By: **Robert Finch**  
Date: **02/02/2015**  
Crate ID: **F1S3**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WRF1B14G**  
Serial No.: **857296**  
Part No.: **120408**  
Type: **L20N**  
Batch No.: **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☐ Fail  
Flow Test ☒ ☐  
Visual Check ☒ ☐  
Size and Length ☒ ☐

Tested By: **Nathan Refalo**  
Date: **02/02/2015**  
Crate ID: **F1S3**

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Module Test Certificate

Polyvinylidene fluoride Membrane



|                 |               |               |             |                |
|-----------------|---------------|---------------|-------------|----------------|
| Module ID       | Serial No.    | Part No.      | Type        | Batch No.      |
| <b>WSF11213</b> | <b>855934</b> | <b>120408</b> | <b>L20N</b> | <b>1467438</b> |

Lubricate O-Rings with Supplied Silicone Grease Only

|                      |                                     |                          |                      |
|----------------------|-------------------------------------|--------------------------|----------------------|
| Integrity Test (DAF) | Pass                                | Fail                     | Tested By            |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>Chirayu Mehta</b> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Date                 |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>28/01/2015</b>    |
|                      |                                     |                          | Crate ID             |
|                      |                                     |                          | <b>F1S3</b>          |

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Module Test Certificate

Polyvinylidene fluoride Membrane



|                 |               |               |             |                |
|-----------------|---------------|---------------|-------------|----------------|
| Module ID       | Serial No.    | Part No.      | Type        | Batch No.      |
| <b>WMF1A62A</b> | <b>857288</b> | <b>120408</b> | <b>L20N</b> | <b>1467438</b> |

Lubricate O-Rings with Supplied Silicone Grease Only

|                      |                                     |                          |                     |
|----------------------|-------------------------------------|--------------------------|---------------------|
| Integrity Test (DAF) | Pass                                | Fail                     | Tested By           |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>Robert Finch</b> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Date                |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>02/02/2015</b>   |
|                      |                                     |                          | Crate ID            |
|                      |                                     |                          | <b>F1S3</b>         |

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Module Test Certificate

Polyvinylidene fluoride Membrane



|                 |               |               |             |                |
|-----------------|---------------|---------------|-------------|----------------|
| Module ID       | Serial No.    | Part No.      | Type        | Batch No.      |
| <b>WRF1B13R</b> | <b>857281</b> | <b>120408</b> | <b>L20N</b> | <b>1467438</b> |

Lubricate O-Rings with Supplied Silicone Grease Only

|                      |                                     |                          |                     |
|----------------------|-------------------------------------|--------------------------|---------------------|
| Integrity Test (DAF) | Pass                                | Fail                     | Tested By           |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>Robert Finch</b> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Date                |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>02/02/2015</b>   |
|                      |                                     |                          | Crate ID            |
|                      |                                     |                          | <b>F1S3</b>         |

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Module Test Certificate

Polyvinylidene fluoride Membrane



|                 |               |               |             |                |
|-----------------|---------------|---------------|-------------|----------------|
| Module ID       | Serial No.    | Part No.      | Type        | Batch No.      |
| <b>WSF1A118</b> | <b>856496</b> | <b>120408</b> | <b>L20N</b> | <b>1467438</b> |

Lubricate O-Rings with Supplied Silicone Grease Only

|                      |                                     |                          |                      |
|----------------------|-------------------------------------|--------------------------|----------------------|
| Integrity Test (DAF) | Pass                                | Fail                     | Tested By            |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>Chirayu Mehta</b> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Date                 |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>28/01/2015</b>    |
|                      |                                     |                          | Crate ID             |
|                      |                                     |                          | <b>F1S3</b>          |

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**MF1**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1982N  
**Serial No.** 856485  
**Part No.** 120408  
**Type** L20N  
**Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** Pass ☒ Fail ☐  
**Flow Test** ☒ ☐  
**Visual Check** ☒ ☐  
**Size and Length** ☒ ☐

**Tested By** Chirayu Mehta  
**Date** 28/01/2015  
**Crate ID** F1S3

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1A71K  
**Serial No.** 857293  
**Part No.** 120408  
**Type** L20N  
**Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** Pass ☒ Fail ☐  
**Flow Test** ☒ ☐  
**Visual Check** ☒ ☐  
**Size and Length** ☒ ☐

**Tested By** Robert Finch  
**Date** 02/02/2015  
**Crate ID** F1S3

**Form QA 104 Issue 11**

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**EWT Membrane Systems Pty Ltd**  
**Memcor Products**  
A.B.N 36 166 784 694  
15 Blackman Crescent  
South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1764J  
**Serial No.** 856399  
**Part No.** 120408  
**Type** L20N  
**Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** Pass ☒ Fail ☐  
**Flow Test** ☒ ☐  
**Visual Check** ☒ ☐  
**Size and Length** ☒ ☐

**Tested By** Chirayu Mehta  
**Date** 28/01/2015  
**Crate ID** F1S3

**Form QA 104 Issue 11**

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1B121  
**Serial No.** 857305  
**Part No.** 120408  
**Type** L20N  
**Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** Pass ☒ Fail ☐  
**Flow Test** ☒ ☐  
**Visual Check** ☒ ☐  
**Size and Length** ☒ ☐

**Tested By** Robert Finch  
**Date** 02/02/2015  
**Crate ID** F1S3

**Form QA 104 Issue 11**



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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

Module ID: **WSF1B14J** Serial No.: **856504** Part No.: **120408** Type: **L20N** Batch No.: **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Robert Finch** Date: **02/02/2015**  
Visual Check ☒ Date ID: **F1S3**  
Size and Length ☒ Crate ID: **F1S3**

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

Module ID: **WRF1D51-** Serial No.: **857370** Part No.: **120408** Type: **L20N** Batch No.: **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Robert Finch** Date: **02/02/2015**  
Visual Check ☒ Date ID: **F1S3**  
Size and Length ☒ Crate ID: **F1S3**

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

Module ID: **WRF1A73Z** Serial No.: **857272** Part No.: **120408** Type: **L20N** Batch No.: **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Robert Finch** Date: **02/02/2015**  
Visual Check ☒ Date ID: **F1S3**  
Size and Length ☒ Crate ID: **F1S3**

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

Module ID: **WSF1B23E** Serial No.: **857295** Part No.: **120408** Type: **L20N** Batch No.: **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Robert Finch** Date: **02/02/2015**  
Visual Check ☒ Date ID: **F1S3**  
Size and Length ☒ Crate ID: **F1S3**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WMF1952J** Serial No. **856505** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Nathan Refalo**  
Visual Check ☒ Date **02/02/2015**  
Size and Length ☒ Crate ID **F1S3**

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WMF1954Y** Serial No. **856506** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Nathan Refalo**  
Visual Check ☒ Date **02/02/2015**  
Size and Length ☒ Crate ID **F1S3**

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WMF1811D** Serial No. **856103** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Chirayu Mehta**  
Visual Check ☒ Date **28/01/2015**  
Size and Length ☒ Crate ID **F1S3**

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WRF19841** Serial No. **856487** Part No. **120408** Type **L20N** Batch No. **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Chirayu Mehta**  
Visual Check ☒ Date **28/01/2015**  
Size and Length ☒ Crate ID **F1S3**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1D424 **Serial No.** 857395 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Robert Finch **Date** 02/02/2015 **Crate ID** F1S3

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1A12V **Serial No.** 856495 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Chirayu Mehta **Date** 28/01/2015 **Crate ID** F1S3

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF1743S **Serial No.** 857250 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Robert Finch **Date** 02/02/2015 **Crate ID** F1S3

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF1823U **Serial No.** 856476 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Chirayu Mehta **Date** 28/01/2015 **Crate ID** F1S3

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF1982Q **Serial No.** 856477 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Chirayu Mehta** Date **28/01/2015** Crate ID **F1S3**

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Australia 2756  
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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF1B243 **Serial No.** 857249 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Robert Finch** Date **02/02/2015** Crate ID **F1S3**

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1D41F **Serial No.** 857394 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Robert Finch** Date **02/02/2015** Crate ID **F1S3**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF1B11F **Serial No.** 857283 **Part No.** 120408 **Type** L20N **Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Robert Finch** Date **02/02/2015** Crate ID **F1S3**

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Module Test Certificate  
Polyvinylidene fluoride Membrane

Module ID: **WMF1931P** Serial No.: **857320** Part No.: **120408** Type: **L20N** Batch No.: **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By: **Robert Finch** Date: **02/02/2015**  
Crate ID: **F1S3**

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Module Test Certificate  
Polyvinylidene fluoride Membrane

Module ID: **WRF11449** Serial No.: **857344** Part No.: **120408** Type: **L20N** Batch No.: **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By: **Robert Finch** Date: **02/02/2015**  
Crate ID: **F1S3**

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Module Test Certificate  
Polyvinylidene fluoride Membrane

Module ID: **WSF1741D** Serial No.: **857317** Part No.: **120408** Type: **L20N** Batch No.: **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By: **Robert Finch** Date: **02/02/2015**  
Crate ID: **F1S3**

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Module Test Certificate  
Polyvinylidene fluoride Membrane

Module ID: **WRF1981Y** Serial No.: **856488** Part No.: **120408** Type: **L20N** Batch No.: **1467438**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By: **Chirayu Mehta** Date: **28/01/2015**  
Crate ID: **F1S3**

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**EWt Membrane Systems Pty Ltd**  
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**Module ID** WRF1A115  
**Serial No.** 856493  
**Part No.** 120408  
**Type** L20N  
**Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** ☒ Pass ☐ Fail  
**Flow Test** ☒ ☐  
**Visual Check** ☒ ☐  
**Size and Length** ☒ ☐

**Tested By** Chirayu Mehta  
**Date** 28/01/2015  
**Crate ID** F1S3

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**EWt Membrane Systems Pty Ltd**  
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**Module ID** WRF1823R  
**Serial No.** 856483  
**Part No.** 120408  
**Type** L20N  
**Batch No.** 1467438

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** ☒ Pass ☐ Fail  
**Flow Test** ☒ ☐  
**Visual Check** ☒ ☐  
**Size and Length** ☒ ☐

**Tested By** Chirayu Mehta  
**Date** 28/01/2015  
**Crate ID** F1S3

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSE4724A **Serial No.** 816694 **Part No.** 120408 **Type** L20N **Batch No.** 1417340

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Greg Horrigan **Date** 19/06/2014 **Crate ID** E6J2

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WREAH631 **Serial No.** 841794 **Part No.** 120408 **Type** L20N **Batch No.** 1451673

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Marvin Romero **Date** 05/11/2014 **Crate ID** EB44

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WMEA12H **Serial No.** 841871 **Part No.** 120408 **Type** L20N **Batch No.** 1451673

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Marvin Romero **Date** 05/11/2014 **Crate ID** EB44

Form QA 104 Issue 11

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**EWT Membrane Systems Pty Ltd**  
**Memcor Products**  
A.B.N 36 166 784 694  
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South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF1824J **Serial No.** 856475 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Chirayu Mehta **Date** 28/01/2015 **Crate ID** F1S1

Form QA 104 Issue 11



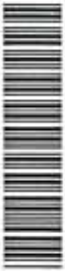
MT-2

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Australia 2756  
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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**AS**



Module ID **WSF19810** Serial No. **856484** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Chirayu Mehta**  
Date **28/01/2015**  
Crate ID **F1S1**

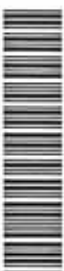
Form QA 104 Issue 11

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Australia 2756  
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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**A7**



Module ID **WSF19844** Serial No. **856478** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Chirayu Mehta**  
Date **28/01/2015**  
Crate ID **F1S1**

Form QA 104 Issue 11

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**A6**



Module ID **WSF1A13N** Serial No. **856504** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Chirayu Mehta**  
Date **28/01/2015**  
Crate ID **F1S1**


Form QA 104 Issue 11

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**A8**



Module ID **WSF18224** Serial No. **856463** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Chirayu Mehta**  
Date **28/01/2015**  
Crate ID **F1S1**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1743P **Serial No.** 856407 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ **Pass** ☒ **Fail** ☐  
Flow Test ☒ **Tested By** Marvin Romero  
Visual Check ☒ **Date** 28/01/2015  
Size and Length ☒ **Crate ID** F1S1

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF1A84B **Serial No.** 856426 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ **Pass** ☒ **Fail** ☐  
Flow Test ☒ **Tested By** Marvin Romero  
Visual Check ☒ **Date** 28/01/2015  
Size and Length ☒ **Crate ID** F1S1

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF18221 **Serial No.** 856466 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ **Pass** ☒ **Fail** ☐  
Flow Test ☒ **Tested By** Chirayu Mehta  
Visual Check ☒ **Date** 28/01/2015  
Size and Length ☒ **Crate ID** F1S1

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1824G **Serial No.** 856460 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ **Pass** ☒ **Fail** ☐  
Flow Test ☒ **Tested By** Marvin Romero  
Visual Check ☒ **Date** 28/01/2015  
Size and Length ☒ **Crate ID** F1S1

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11F2

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WRF1744E** Serial No. **856402** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Marvin Romero** Date **28/01/2015** Crate ID **F1S1**

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WMF18446** Serial No. **856247** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Marvin Romero** Date **28/01/2015** Crate ID **F1S1**

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WSF1A72C** Serial No. **856375** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Marvin Romero** Date **28/01/2015** Crate ID **F1S1**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID **WPE46320** Serial No. **816697** Part No. **120408** Type **L20N** Batch No. **1417340**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Greg Horrigan** Date **19/06/2014** Crate ID **E6J2**

Form QA 104 Issue 11

**MT2**

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Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**B<sub>2</sub>**

Module ID **WNEAJ43Z** Serial No. **841864** Part No. **120408** Type **L2ON** Batch No. **1451673**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Marvin Romero**  
Visual Check ☒ Date **05/11/2014**  
Size and Length ☒ Crate ID **EB44**

Form QA 104 Issue 11

**evoQUA**  
WATER TECHNOLOGIES

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A.B.N 36 166 784 694  
15 Blackman Crescent  
South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**B<sub>4</sub>**

Module ID **WRF1821C** Serial No. **856467** Part No. **120408** Type **L2ON** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Chirayu Mehta**  
Visual Check ☒ Date **28/01/2015**  
Size and Length ☒ Crate ID **F1S1**

Form QA 104 Issue 11

**evoQUA**  
WATER TECHNOLOGIES

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15 Blackman Crescent  
South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**B<sub>3</sub>**

Module ID **WPE4633Q** Serial No. **816698** Part No. **120408** Type **L2ON** Batch No. **1417339**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Greg Horrigan**  
Visual Check ☒ Date **19/06/2014**  
Size and Length ☒ Crate ID **E6G1**

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Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**B<sub>5</sub>**

Module ID **WSF1A14C** Serial No. **856474** Part No. **120408** Type **L2ON** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By **Chirayu Mehta**  
Visual Check ☒ Date **28/01/2015**  
Size and Length ☒ Crate ID **F1S1**

Form QA 104 Issue 11




*MF2*

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**Module Test Certificate**  
*B6*  
**Polyvinylidene fluoride Membrane**



Module ID **WRF1983C** Serial No. **856486** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**


|                      |  |                               |                                |
|----------------------|--|-------------------------------|--------------------------------|
| Integrity Test (DAF) | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/> | Tested By <b>Chirayu Mehta</b> |
| Flow Test            | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Date <b>28/01/2015</b>         |
| Visual Check         | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Crate ID <b>F1S1</b>           |
| Size and Length      | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      |                                |

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**Module Test Certificate**  
*B8*  
**Polyvinylidene fluoride Membrane**



Module ID **WMF1A52Q** Serial No. **856435** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**


|                      |  |                               |                                |
|----------------------|--|-------------------------------|--------------------------------|
| Integrity Test (DAF) | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/> | Tested By <b>Chirayu Mehta</b> |
| Flow Test            | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Date <b>28/01/2015</b>         |
| Visual Check         | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Crate ID <b>F1S1</b>           |
| Size and Length      | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      |                                |

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**Module Test Certificate**  
*B7*  
**Polyvinylidene fluoride Membrane**



Module ID **WRF1A13K** Serial No. **856473** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**


|                      |  |                               |                                |
|----------------------|--|-------------------------------|--------------------------------|
| Integrity Test (DAF) | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/> | Tested By <b>Chirayu Mehta</b> |
| Flow Test            | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Date <b>28/01/2015</b>         |
| Visual Check         | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Crate ID <b>F1S1</b>           |
| Size and Length      | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      |                                |

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**Module Test Certificate**  
*B9*  
**Polyvinylidene fluoride Membrane**



Module ID **WSF1A51I** Serial No. **856376** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      |  |                               |                                |
|----------------------|--|-------------------------------|--------------------------------|
| Integrity Test (DAF) | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/> | Tested By <b>Marvin Romero</b> |
| Flow Test            | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Date <b>28/01/2015</b>         |
| Visual Check         | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Crate ID <b>F1S1</b>           |
| Size and Length      | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      |                                |

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**Module ID** **Serial No.** **Part No.** **Type** **Batch No.**  
**WSF1764M** **856404** **120408** **L20N** **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** **Pass** **Fail** **Tested By** **Date** **Crate ID**  
☒ ☐ **Marvin Romero**  
**Flow Test** ☒ ☐ **28/01/2015**  
**Visual Check** ☒ ☐ **F1S1**  
**Size and Length** ☒ ☐

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**Module ID** **Serial No.** **Part No.** **Type** **Batch No.**  
**WSF1751Y** **856394** **120408** **L20N** **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** **Pass** **Fail** **Tested By** **Date** **Crate ID**  
☒ ☐ **Marvin Romero**  
**Flow Test** ☒ ☐ **28/01/2015**  
**Visual Check** ☒ ☐ **F1S1**  
**Size and Length** ☒ ☐

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**Module ID** **Serial No.** **Part No.** **Type** **Batch No.**  
**WRF1752K** **856406** **120408** **L20N** **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** **Pass** **Fail** **Tested By** **Date** **Crate ID**  
☒ ☐ **Marvin Romero**  
**Flow Test** ☒ ☐ **28/01/2015**  
**Visual Check** ☒ ☐ **F1S1**  
**Size and Length** ☒ ☐

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Australia 2756  
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Fax: 61 (02) 4577 0002

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**Module ID** **Serial No.** **Part No.** **Type** **Batch No.**  
**WRF1741A** **856405** **120408** **L20N** **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** **Pass** **Fail** **Tested By** **Date** **Crate ID**  
☒ ☐ **Marvin Romero**  
**Flow Test** ☒ ☐ **28/01/2015**  
**Visual Check** ☒ ☐ **F1S1**  
**Size and Length** ☒ ☐

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**EWT Membrane Systems Pty Ltd**  
**Memcor Products**  
A.B.N 36 166 784 694  
15 Blackman Crescent  
South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

Module ID: **WSF1A74R** Serial No.: **856369** Part No.: **120408** Type: **L20N** Batch No.: **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Tested By: **Marvin Romero**  
Flow Test ☒ Fail ☐ Date: **28/01/2015**  
Visual Check ☒ Crate ID: **F1S1**  
Size and Length ☒

Form QA 104 Issue 11

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Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

Module ID: **WSE47216** Serial No.: **816695** Part No.: **120408** Type: **L20N** Batch No.: **1417340**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Tested By: **Greg Horrigan**  
Flow Test ☒ Fail ☐ Date: **19/06/2014**  
Visual Check ☒ Crate ID: **E6J2**  
Size and Length ☒

Form QA 104 Issue 11

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

Module ID: **WMF1A53F** Serial No.: **856382** Part No.: **120408** Type: **L20N** Batch No.: **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Tested By: **Marvin Romero**  
Flow Test ☒ Fail ☐ Date: **28/01/2015**  
Visual Check ☒ Crate ID: **F1S1**  
Size and Length ☒

Form QA 104 Issue 11

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

Module ID: **WNEAJ41K** Serial No.: **841870** Part No.: **120408** Type: **L20N** Batch No.: **1451673**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Tested By: **Marvin Romero**  
Flow Test ☒ Fail ☐ Date: **05/11/2014**  
Visual Check ☒ Crate ID: **EB44**  
Size and Length ☒

Form QA 104 Issue 11

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WNEAJ440** Serial No.: **841861** Part No.: **120408** Type: **L20N** Batch No.: **1451673**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     | Tested By            | Date              | Crate ID    |
|----------------------|-------------------------------------|--------------------------|----------------------|-------------------|-------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>Marvin Romero</b> | <b>05/11/2014</b> | <b>EB44</b> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                      |                   |             |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                      |                   |             |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                      |                   |             |

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**evoQUA**  
WATER TECHNOLOGIES

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WSE4723L** Serial No.: **816688** Part No.: **120408** Type: **L20N** Batch No.: **1417340**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     | Tested By            | Date              | Crate ID    |
|----------------------|-------------------------------------|--------------------------|----------------------|-------------------|-------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>Greg Horrigan</b> | <b>19/06/2014</b> | <b>E6J2</b> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                      |                   |             |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                      |                   |             |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                      |                   |             |

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WATER TECHNOLOGIES

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Australia 2756  
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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WSE4722W** Serial No.: **816689** Part No.: **120408** Type: **L20N** Batch No.: **1417340**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     | Tested By            | Date              | Crate ID    |
|----------------------|-------------------------------------|--------------------------|----------------------|-------------------|-------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>Greg Horrigan</b> | <b>19/06/2014</b> | <b>E6J2</b> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                      |                   |             |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                      |                   |             |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                      |                   |             |

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WATER TECHNOLOGIES

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Australia 2756  
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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WPE4634F** Serial No.: **816699** Part No.: **120408** Type: **L20N** Batch No.: **1417340**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     | Tested By            | Date              | Crate ID    |
|----------------------|-------------------------------------|--------------------------|----------------------|-------------------|-------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>Greg Horrigan</b> | <b>19/06/2014</b> | <b>E6J2</b> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                      |                   |             |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                      |                   |             |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                      |                   |             |

Form QA 104 Issue 11



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Australia 2756  
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Fax: 61 (02) 4577 0002

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**Module ID** **Serial No.** **Part No.** **Type** **Batch No.**  
**WMF1721R** **856408** **120408** **L20N** **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Marvin Romero**  
Date **28/01/2015**  
Crate ID **F1S1**

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Fax: 61 (02) 4577 0002

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**Module ID** **Serial No.** **Part No.** **Type** **Batch No.**  
**WRF1432V** **855480** **120408** **L20N** **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Marvin Romero**  
Date **28/01/2015**  
Crate ID **F1S1**

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Fax: 61 (02) 4577 0002

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**Module ID** **Serial No.** **Part No.** **Type** **Batch No.**  
**WRF1A41V** **856433** **120408** **L20N** **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Marvin Romero**  
Date **28/01/2015**  
Crate ID **F1S1**

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**Module ID** **Serial No.** **Part No.** **Type** **Batch No.**  
**WSF1763X** **856410** **120408** **L20N** **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Marvin Romero**  
Date **28/01/2015**  
Crate ID **F1S1**

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane** *C12*



Module ID **WSF1A82X** Serial No. **856418** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      |  |                               |                                |
|----------------------|--|-------------------------------|--------------------------------|
| Integrity Test (DAF) | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/> | Tested By <b>Marvin Romero</b> |
| Flow Test            | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Date <b>28/01/2015</b>         |
| Visual Check         | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Crate ID <b>F1S1</b>           |
| Size and Length      | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      |                                |


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**Module Test Certificate**

**Polyvinylidene fluoride Membrane** *C14*



Module ID **WSF1A54M** Serial No. **856383** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      |  |                               |                                |
|----------------------|--|-------------------------------|--------------------------------|
| Integrity Test (DAF) | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/> | Tested By <b>Marvin Romero</b> |
| Flow Test            | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Date <b>28/01/2015</b>         |
| Visual Check         | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Crate ID <b>F1S1</b>           |
| Size and Length      | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      |                                |


Form QA 104 Issue 11

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane** *C11*



Module ID **WMF1731B** Serial No. **856400** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      |  |                               |                                |
|----------------------|--|-------------------------------|--------------------------------|
| Integrity Test (DAF) | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/> | Tested By <b>Marvin Romero</b> |
| Flow Test            | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Date <b>28/01/2015</b>         |
| Visual Check         | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Crate ID <b>F1S1</b>           |
| Size and Length      | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      |                                |

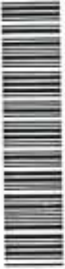
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**Module Test Certificate**

**Polyvinylidene fluoride Membrane** *C13*



Module ID **WSF1A71N** Serial No. **856374** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      |  |                               |                                |
|----------------------|--|-------------------------------|--------------------------------|
| Integrity Test (DAF) | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/> | Tested By <b>Marvin Romero</b> |
| Flow Test            | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Date <b>28/01/2015</b>         |
| Visual Check         | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      | Crate ID <b>F1S1</b>           |
| Size and Length      | <input checked="" type="checkbox"/>      | <input type="checkbox"/>      |                                |

Form QA 104 Issue 11

**MT2**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF19230 **Serial No.** 856341 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Marvin Romero **Date** 28/01/2015 **Crate ID** F1S1

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF17539 **Serial No.** 856403 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Chirayu Mehta **Date** 28/01/2015 **Crate ID** F1S1

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WATER TECHNOLOGIES

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF16242 **Serial No.** 856459 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Chirayu Mehta **Date** 28/01/2015 **Crate ID** F1S1

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WATER TECHNOLOGIES

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1611E **Serial No.** 856462 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Chirayu Mehta **Date** 28/01/2015 **Crate ID** F1S1

Form QA 104 Issue 11



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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**



Module ID **WRF1761F** Serial No. **856412** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ ☒ ☒ ☒  
Visual Check ☒ ☒ ☒ ☒  
Size and Length ☒ ☒ ☒ ☒

Tested By **Marvin Romero**  
Date **28/01/2015**  
Crate ID **F1S1**

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WATER TECHNOLOGIES

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Australia 2756  
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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**



Module ID **WRF17624** Serial No. **856401** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ ☒ ☒ ☒  
Visual Check ☒ ☒ ☒ ☒  
Size and Length ☒ ☒ ☒ ☒

Tested By **Marvin Romero**  
Date **28/01/2015**  
Crate ID **F1S1**

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WATER TECHNOLOGIES

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South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**



Module ID **WSF1922B** Serial No. **856350** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ ☒ ☒ ☒  
Visual Check ☒ ☒ ☒ ☒  
Size and Length ☒ ☒ ☒ ☒

Tested By **Marvin Romero**  
Date **28/01/2015**  
Crate ID **F1S1**

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Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**



Module ID **WSF17627** Serial No. **856420** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ ☒ ☒ ☒  
Visual Check ☒ ☒ ☒ ☒  
Size and Length ☒ ☒ ☒ ☒

Tested By **Marvin Romero**  
Date **28/01/2015**  
Crate ID **F1S1**

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Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**Module ID** WSF1A817 **Serial No.** 856417 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** ☒ **Pass** ☒ **Fail** ☐  
**Flow Test** ☒ **Tested By** Marvin Romero  
**Visual Check** ☒ **Date** 28/01/2015  
**Size and Length** ☒ **Crate ID** F1S1

Form QA 104 Issue 11

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Fax: 61 (02) 4577 0002

**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**Module ID** WSF1894I **Serial No.** 856276 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** ☒ **Pass** ☒ **Fail** ☐  
**Flow Test** ☒ **Tested By** Chirayu Mehta  
**Visual Check** ☒ **Date** 27/01/2015  
**Size and Length** ☒ **Crate ID** F1R4

Form QA 104 Issue

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**Module ID** WRF19228 **Serial No.** 856349 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** ☒ **Pass** ☒ **Fail** ☐  
**Flow Test** ☒ **Tested By** Marvin Romero  
**Visual Check** ☒ **Date** 28/01/2015  
**Size and Length** ☒ **Crate ID** F1R4

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**Module Test Certificate**

**Polyvinylidene fluoride Membrane**

**Module ID** WMF1A544 **Serial No.** 856384 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

**Integrity Test (DAF)** ☒ **Pass** ☒ **Fail** ☐  
**Flow Test** ☒ **Tested By** Marvin Romero  
**Visual Check** ☒ **Date** 28/01/2015  
**Size and Length** ☒ **Crate ID** F1R4

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1924N **Serial No.** 856199 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

| Pass                                | Fail                     |
|-------------------------------------|--------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Integrity Test (DAF)** **Tested By** Marvin Romero  
**Flow Test** **Date** 28/01/2015  
**Visual Check** **Crate ID** F1R4  
**Size and Length**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF18429 **Serial No.** 856224 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

| Pass                                | Fail                     |
|-------------------------------------|--------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Integrity Test (DAF)** **Tested By** Marvin Romero  
**Flow Test** **Date** 28/01/2015  
**Visual Check** **Crate ID** F1R4  
**Size and Length**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WSF1893T **Serial No.** 856244 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

| Pass                                | Fail                     |
|-------------------------------------|--------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Integrity Test (DAF)** **Tested By** Chirayu Mehta  
**Flow Test** **Date** 27/01/2015  
**Visual Check** **Crate ID** F1R4  
**Size and Length**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1864Q **Serial No.** 856280 **Part No.** 120408 **Type** L20N **Batch No.** 1467436

**Lubricate O-Rings with Supplied Silicone Grease Only**

| Pass                                | Fail                     |
|-------------------------------------|--------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Integrity Test (DAF)** **Tested By** Chirayu Mehta  
**Flow Test** **Date** 27/01/2015  
**Visual Check** **Crate ID** F1R4  
**Size and Length**


Form QA 104 Issue 11

1172

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**



Module ID **WMF1A510** Serial No. **856436** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

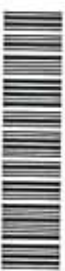
Tested By **Chirayu Mehta**  
Date **28/01/2015**  
Crate ID **F1S1**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**



Module ID **WRF1A439** Serial No. **856428** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |


Tested By **Marvin Romero**  
Date **28/01/2015**  
Crate ID **F1S1**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**



Module ID **WRF1A42K** Serial No. **856434** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |


Tested By **Chirayu Mehta**  
Date **28/01/2015**  
Crate ID **F1S1**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**



Module ID **WSF1752N** Serial No. **856411** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Marvin Romero**  
Date **28/01/2015**  
Crate ID **F1S1**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WMF1733Q** Serial No.: **856409** Part No.: **120408** Type: **L20N** Batch No.: **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Marvin Romero**  
Visual Check ☒ Date: **28/01/2015**  
Size and Length ☒ Crate ID: **F1S1**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WRF1882G** Serial No.: **856371** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Marvin Romero**  
Visual Check ☒ Date: **28/01/2015**  
Size and Length ☒ Crate ID: **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WSF17611** Serial No.: **856397** Part No.: **120408** Type: **L20N** Batch No.: **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Marvin Romero**  
Visual Check ☒ Date: **28/01/2015**  
Size and Length ☒ Crate ID: **F1S1**

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WSF1A527** Serial No.: **856373** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

Integrity Test (DAF) ☒ Pass ☒ Fail ☐  
Flow Test ☒ Tested By: **Marvin Romero**  
Visual Check ☒ Date: **28/01/2015**  
Size and Length ☒ Crate ID: **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WSF1A731** Serial No.: **856372** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By: **Marvin Romero** Date: **28/01/2015**  
Crate ID: **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WPECVA1V** Serial No.: **856331** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By: **Chirayu Mehta** Date: **27/01/2015**  
Crate ID: **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WSF1841K** Serial No.: **856225** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By: **Marvin Romero** Date: **28/01/2015**  
Crate ID: **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

Module ID: **WSF1874D** Serial No.: **856351** Part No.: **120408** Type: **L20N** Batch No.: **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By: **Marvin Romero** Date: **28/01/2015**  
Crate ID: **F1R4**

Form QA 104 Issue 11




**MF2**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane** **E-13**



Module ID **WPECVA2K** Serial No. **856334** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      |                                     |      |                                     |      |                          |
|----------------------|-------------------------------------|------|-------------------------------------|------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | Pass | <input checked="" type="checkbox"/> | Fail | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> |      | <input type="checkbox"/>            |      | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> |      | <input type="checkbox"/>            |      | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> |      | <input type="checkbox"/>            |      | <input type="checkbox"/> |


Tested By **Marvin Romero** Date **28/01/2015** Crate ID **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane** **E-15**



Module ID **WPECV81Q** Serial No. **856339** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      |                                     |      |                                     |      |                          |
|----------------------|-------------------------------------|------|-------------------------------------|------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | Pass | <input checked="" type="checkbox"/> | Fail | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> |      | <input type="checkbox"/>            |      | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> |      | <input type="checkbox"/>            |      | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> |      | <input type="checkbox"/>            |      | <input type="checkbox"/> |

Tested By **Marvin Romero** Date **28/01/2015** Crate ID **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane** **E-14**



Module ID **WRF1884V** Serial No. **856324** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      |                                     |      |                                     |      |                          |
|----------------------|-------------------------------------|------|-------------------------------------|------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | Pass | <input checked="" type="checkbox"/> | Fail | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> |      | <input type="checkbox"/>            |      | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> |      | <input type="checkbox"/>            |      | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> |      | <input type="checkbox"/>            |      | <input type="checkbox"/> |


Tested By **Marvin Romero** Date **28/01/2015** Crate ID **F1R4**

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane** **F1**



Module ID **WSF1A53X** Serial No. **856381** Part No. **120408** Type **L20N** Batch No. **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      |                                     |      |                                     |      |                          |
|----------------------|-------------------------------------|------|-------------------------------------|------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | Pass | <input checked="" type="checkbox"/> | Fail | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> |      | <input type="checkbox"/>            |      | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> |      | <input type="checkbox"/>            |      | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> |      | <input type="checkbox"/>            |      | <input type="checkbox"/> |

Tested By **Marvin Romero** Date **28/01/2015** Crate ID **F1S1**

Form QA 104 Issue 11

147F2

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**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1A44Z **Serial No.** 856427 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Chirayu Mehta  
**Date** 28/01/2015  
**Crate ID** F1S1

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Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF1763U **Serial No.** 856393 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Marvin Romero  
**Date** 28/01/2015  
**Crate ID** F1S1

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**Memcor Products**  
A.B.N 36 166 784 694  
15 Blackman Crescent  
South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF16123 **Serial No.** 856461 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Chirayu Mehta  
**Date** 28/01/2015  
**Crate ID** F1S1

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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** WRF18716 **Serial No.** 856352 **Part No.** 120408 **Type** L20N **Batch No.** 1467437

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

**Tested By** Marvin Romero  
**Date** 28/01/2015  
**Crate ID** F1S1

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MF2

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Australia 2756  
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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** **WSF1924Q** **Serial No.** **856340** **Part No.** **120408** **Type** **L20N** **Batch No.** **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     | Tested By     | Date       | Crate ID |
|----------------------|-------------------------------------|--------------------------|---------------|------------|----------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Marvin Romero | 28/01/2015 | F1S1     |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |            |          |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |            |          |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |            |          |

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Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** **WPECV84U** **Serial No.** **856192** **Part No.** **120408** **Type** **L20N** **Batch No.** **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     | Tested By     | Date       | Crate ID |
|----------------------|-------------------------------------|--------------------------|---------------|------------|----------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Marvin Romero | 28/01/2015 | F1S1     |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |            |          |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |            |          |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |            |          |

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South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** **WRF1862B** **Serial No.** **856282** **Part No.** **120408** **Type** **L20N** **Batch No.** **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     | Tested By     | Date       | Crate ID |
|----------------------|-------------------------------------|--------------------------|---------------|------------|----------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Marvin Romero | 28/01/2015 | F1S1     |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |            |          |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |            |          |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |            |          |

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Australia 2756  
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Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**

**Module ID** **WSF1753C** **Serial No.** **856419** **Part No.** **120408** **Type** **L20N** **Batch No.** **1467437**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     | Tested By     | Date       | Crate ID |
|----------------------|-------------------------------------|--------------------------|---------------|------------|----------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Marvin Romero | 28/01/2015 | F1S1     |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |            |          |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |            |          |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |            |          |

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*MF2*

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15 Blackman Crescent  
South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**



Module ID **WMF1852C** Serial No. **856358** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |


Tested By **Marvin Romero** Date **28/01/2015** Crate ID **F1R4**

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South Windsor NSW  
Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**



Module ID **WRF1A63E** Serial No. **856321** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Chirayu Mehta** Date **27/01/2015** Crate ID **F1R4**

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Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**



Module ID **WMF1851N** Serial No. **856360** Part No. **120408** Type **L20N** Batch No. **1467436**

**Lubricate O-Rings with Supplied Silicone Grease Only**

|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |


Tested By **Marvin Romero** Date **28/01/2015** Crate ID **F1R4**

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Australia 2756  
Tel: 61 (02) 4577 0001  
Fax: 61 (02) 4577 0002

**Module Test Certificate**  
**Polyvinylidene fluoride Membrane**



Module ID **WRF1A643** Serial No. **856322** Part No. **120408** Type **L20N** Batch No. **1467436**




**Lubricate O-Rings with Supplied Silicone Grease Only**




|                      | Pass                                | Fail                     |
|----------------------|-------------------------------------|--------------------------|
| Integrity Test (DAF) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Flow Test            | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Visual Check         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Size and Length      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Tested By **Chirayu Mehta** Date **27/01/2015** Crate ID **F1R4**

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MF2

|   |  |  |                                |
|---|--|--|--------------------------------|
|  |  | <b>EWT Membrane Systems Pty Ltd</b><br><b>Memcor Products</b><br>A.B.N 36 166 784 694<br>15 Blackman Crescent<br>South Windsor NSW<br>Australia 2756<br>Tel: 61 (02) 4577 0001<br>Fax: 61 (02) 4577 0002 |                                |
| <b>Module Test Certificate</b><br><b>Polyvinylidenefluoride Membrane</b>            |  | <b>Module Test Certificate</b><br><b>Polyvinylidenefluoride Membrane</b>   |                                |
|  |  |    |                                |
| Module ID   | Serial No.                               | Part No.   | Batch No.                      |
| WSF1872Z  | 856278                                   | 120408   | L20N 1467436                   |
| <b>Lubricate O-Rings with Supplied Silicone Grease Only</b>                         |  |  |                                |
| Integrity Test (DAF)  | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/>  | Tested By <b>Chirayu Mehta</b> |
| Flow Test   | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/>  | Date <b>27/01/2015</b>         |
| Visual Check  | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/>  | Crate ID <b>F1R4</b>           |
| Size and Length   | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/>  |                                |
| Form QA 104 Issue 11  |  |  |                                |

|  |  |  |                                |
|--|--|--|--------------------------------|
|  |  | <b>EWT Membrane Systems Pty Ltd</b><br><b>Memcor Products</b><br>A.B.N 36 166 784 694<br>15 Blackman Crescent<br>South Windsor NSW<br>Australia 2756<br>Tel: 61 (02) 4577 0001<br>Fax: 61 (02) 4577 0002 |                                |
| <b>Module Test Certificate</b><br><b>Polyvinylidenefluoride Membrane</b>           |  | <b>Module Test Certificate</b><br><b>Polyvinylidenefluoride Membrane</b>   |                                |
|  |  |    |                                |
| Module ID  | Serial No.                               | Part No.   | Batch No.                      |
| WRF1844L   | 856205                                   | 120408   | L20N 1467436                   |
| <b>Lubricate O-Rings with Supplied Silicone Grease Only</b>                        |  |  |                                |
| Integrity Test (DAF)   | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/>  | Tested By <b>Chirayu Mehta</b> |
| Flow Test  | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/>  | Date <b>27/01/2015</b>         |
| Visual Check   | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/>  | Crate ID <b>F1R4</b>           |
| Size and Length  | Pass <input checked="" type="checkbox"/> | Fail <input type="checkbox"/>  |                                |
| Form QA 104 Issue 11   |  |  |                                |



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## **Wynnum STP**

### **E-1 QUU Wynnum Membrane Replacement Report**





# QUU WYNNUM MEMBRANE REPLACEMENT REPORT

**18<sup>th</sup> May 2015**

**Contract No: C1314-20**

**Evoqua Water Technologies Pty Ltd**  
160 Herring Road,  
Macquarie Park, NSW, 2113, Australia

A.B.N: 52 165 060 168  
[www.evoqua.com.au](http://www.evoqua.com.au)

## 1 EXECUTIVE SUMMARY

The MF and RO membranes were replaced at Wynnum STP. The membranes had been in operation for 7 years, and an examination of the performance data and the membranes themselves found no evidence of damage other than typical ageing.

In order to increase MF filtration time between CIPs a trial of increased ration of dual CIPs could be conducted. PDT records should also be kept and regular MF maintenance performed if Pressure Decay Rates begin to increase.

## 2 INTRODUCTION

EWT attended site at QUU Wynnum from the 2<sup>nd</sup> to the 15<sup>th</sup> of March 2015 to replace the MF and RO membrane modules in the tertiary treatment plant. This report details what was noted during this change out, the results of the Membrane Autopsy and recommendations for operation of the plant.

The water treatment plant has been in operation since March 2008, meaning that both the RO and MF membrane module are around 7 years old. This is at or above the design lifetime for both RO, indicating the plant has been operated well.

## 3 REMOVAL NOTES

### 3.1 MF Modules

The MF modules removed were in relatively good condition given their age. A small amount of black substance was visible at the top and bottom of the module. A number of the pots had swelled slightly making removal difficult. A fine sand like grit was apparent around the module housing threads and O-rings. All O-rings showed signs of deterioration due to chloramine exposure.

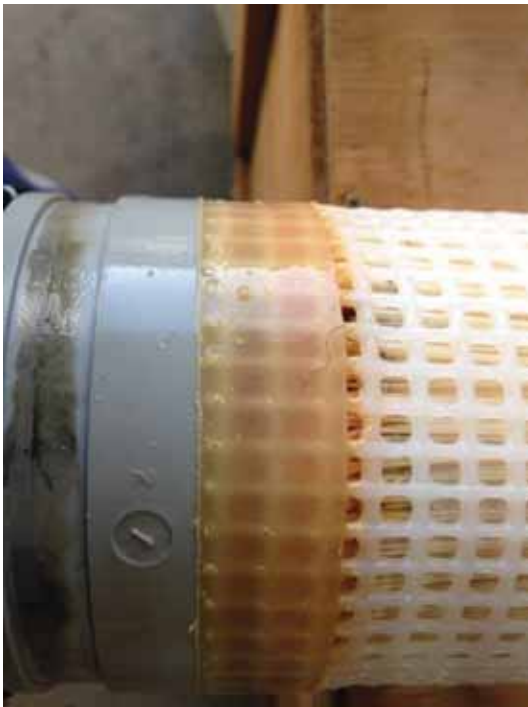


Figure 1 MF Membrane Condition



Figure 2 MF O-Ring Degradation

### 3.2 RO Modules

The feed spacer of the first membrane for both Stage 1 and Stage 2 was fouled with a large amount of particulate matter, both rust and plastic. A large metal tool bit (potentially a thread tapping bit) was found in the feed spacer of RO2 Vessel 1A. However, due to the large space in the feed cavity there was no indication that the fouling was causing any significant issues.



Figure 3 First Membrane Feed spacer fouling



Figure 4 Installation tool found in pressure tube.

The second stage membranes on both skids were noticeably dirtier, likely due to the fact that the second stage isn't cleaned as often as the first stage. The membrane fouling also increased along each vessel indicating a less adequate CIP flow distribution in the tail end modules.

## 4 PERFORMANCE SUMMARY

### 4.1 MF System

The MF system has been operating for 7 years and was showing signs of age prior to membrane replacement. The MF system has been run with high TMPs which can increase the wear and tear on the membrane module.

CIP frequency had increased, with filtration time between CIPs decreasing to as low as 1-2 days in some cases. It was noted that dual CIPs tended to give longer filtration intervals until another CIP was required. Given the increased effectiveness of the dual CIP, it may be worthwhile attempting a trial on 1 MF unit of increasing the ration of dual CIPs from the current ratio of 4:1 chlorine to acid to 2:1 or a similar ratio. It should be noted that any increase in filtration interval between CIPs will need to be evaluated against the increased costs of the dual CIP.



In addition the resistance of the units was quite high however once the membranes were replaced the resistance dropped to expected levels. The level of resistance build up was consistent with aged membranes in a waste water treatment plant.

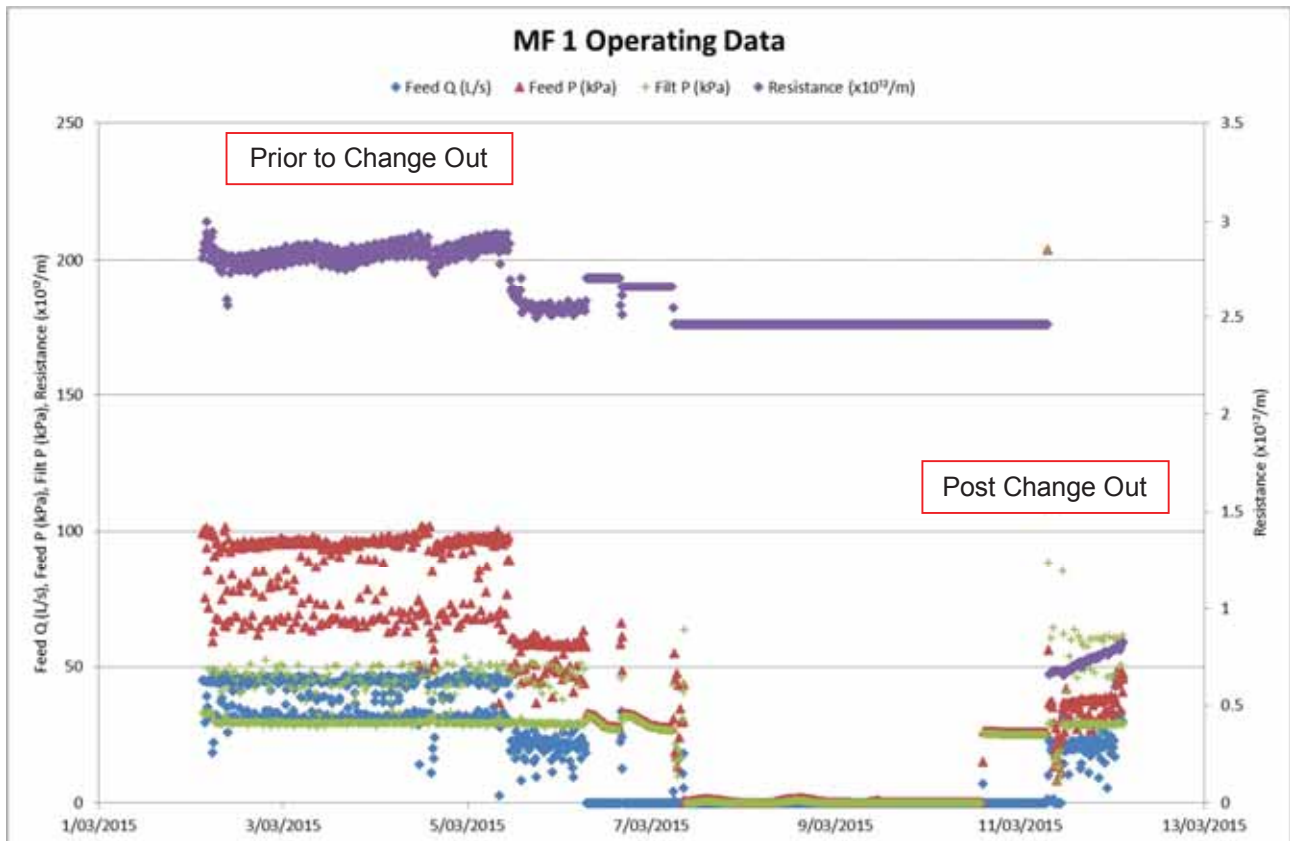


Figure 5: MF 1 Operating Data

Figure 5 and Figure 6 show the MF operation before and after membrane change out. It can be seen that Resistance dropped from the high levels seen prior to change out.

The PDT results for the MF plant indicated a loss of membrane integrity. Historical progression of PDT data was not available during membrane replacement. As the membranes ages individual fibres can become damaged. Integrity can be restored by undertaking pinning of the membrane module. It is important that regular maintenance including pinning of the MF system is undertaken. EWT are able to offer scheduled or occasional MF maintenance under a service agreement.

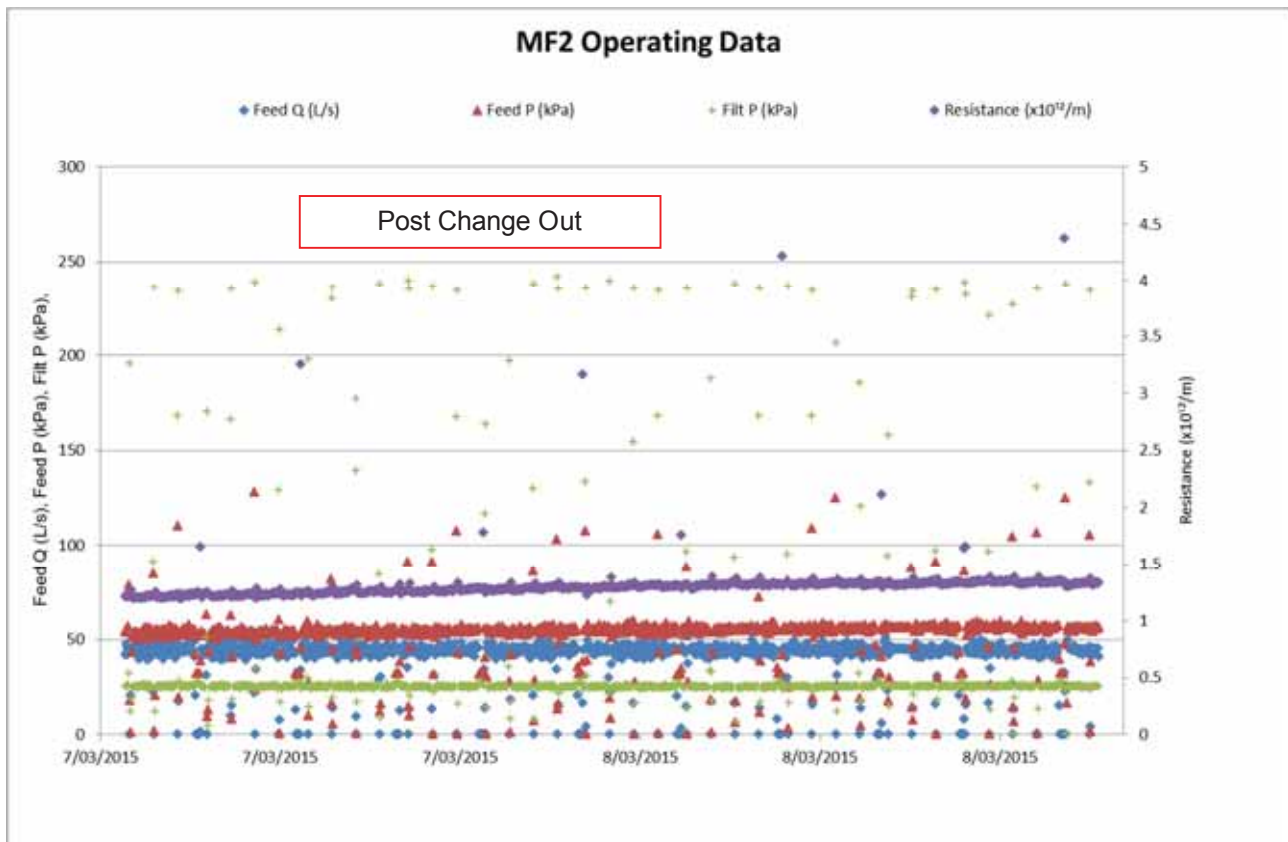


Figure 6: MF2 Operating Data

## 4.2 RO System

The RO System operating data was examined. The normalised permeate flow was relatively stable for the majority of the operating life of the plant. The normalised permeate flow gives an indication of membrane fouling and the resistance to flow. It was noted that data received for the two RO racks was very similar.

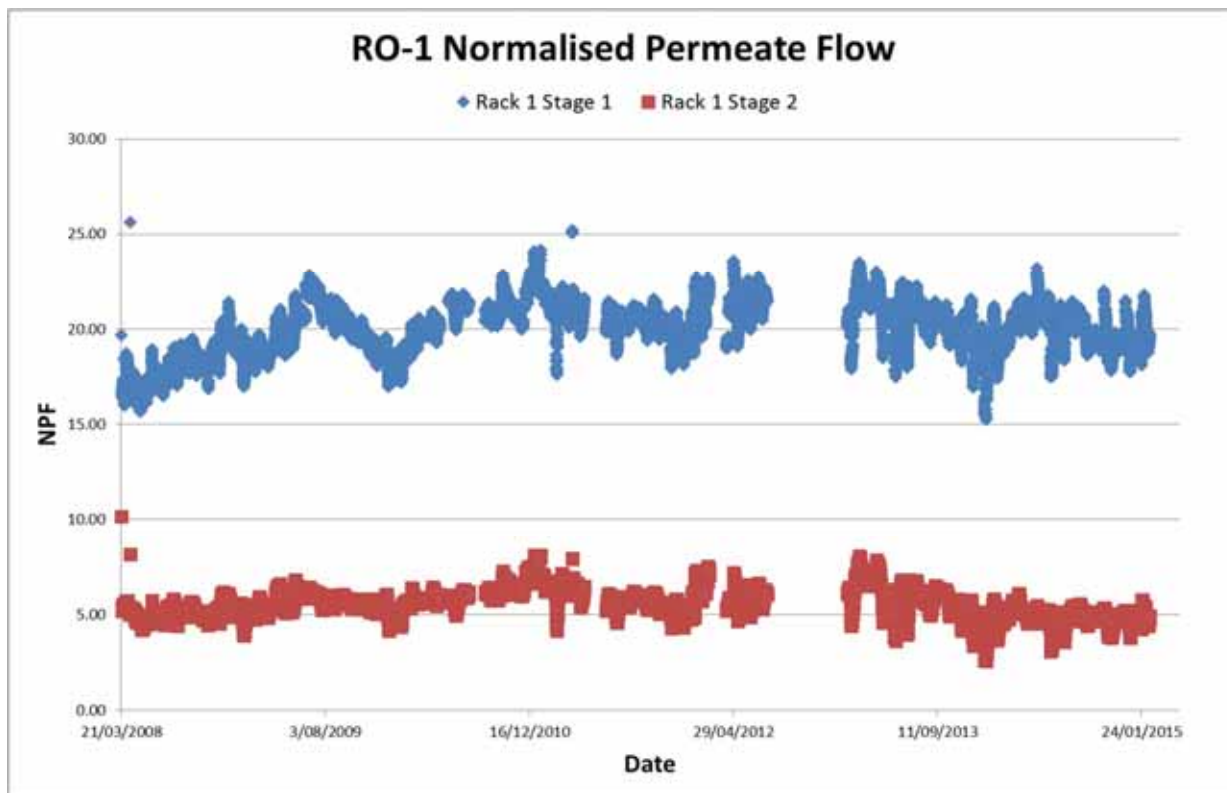


Figure 7: RO-1 Normalised Permeate Flow

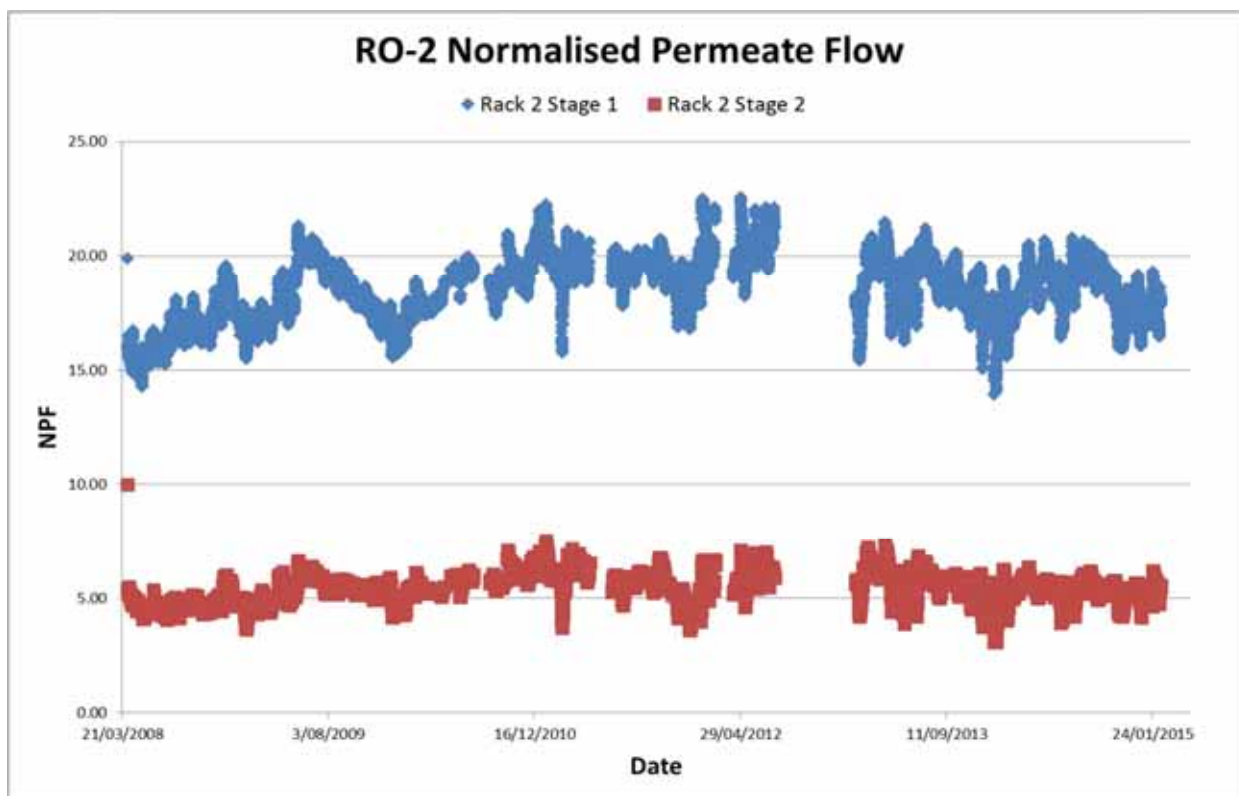


Figure 8: RO-2 Normalised Permeate Flow



The normalised salt passage was also examined. The normalised salt passage can be seen to increase slowly over time. There rate of salt passage increased towards the end of the membrane life, however this is not abnormal based on aging of the membrane.

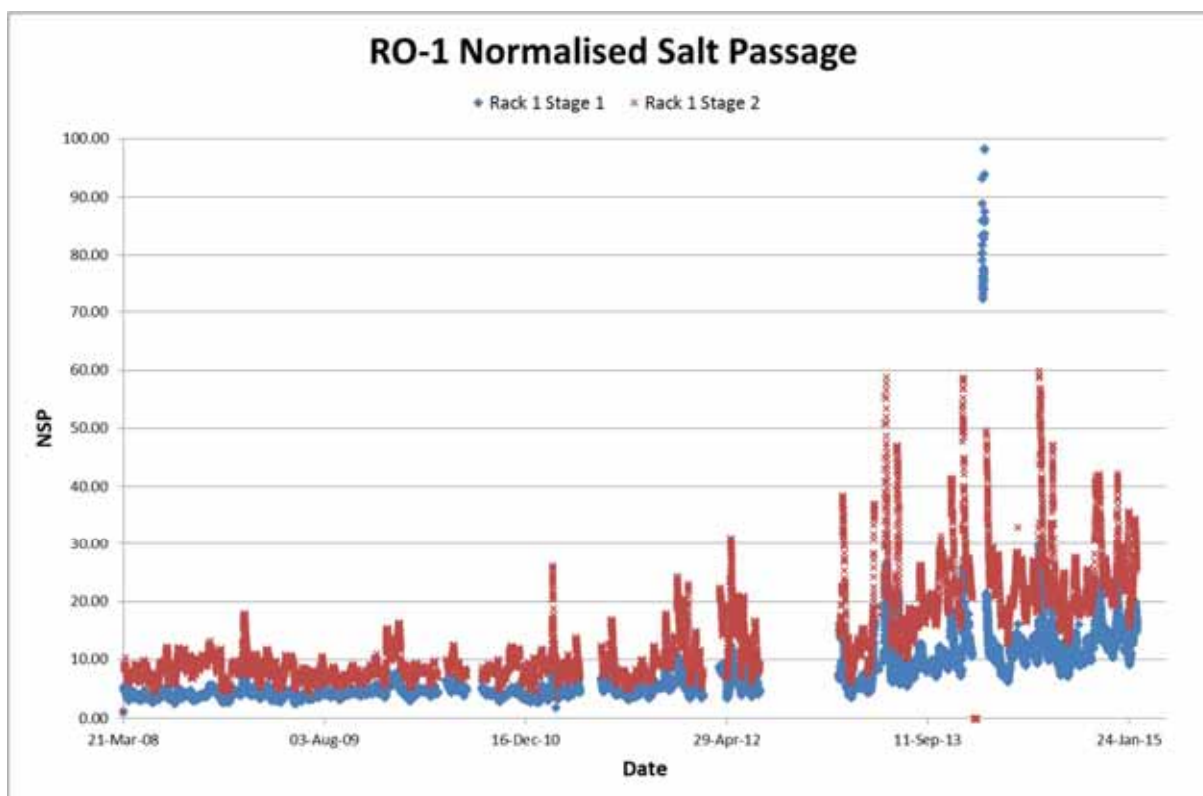


Figure 9: RO-1 Normalised Salt Passage

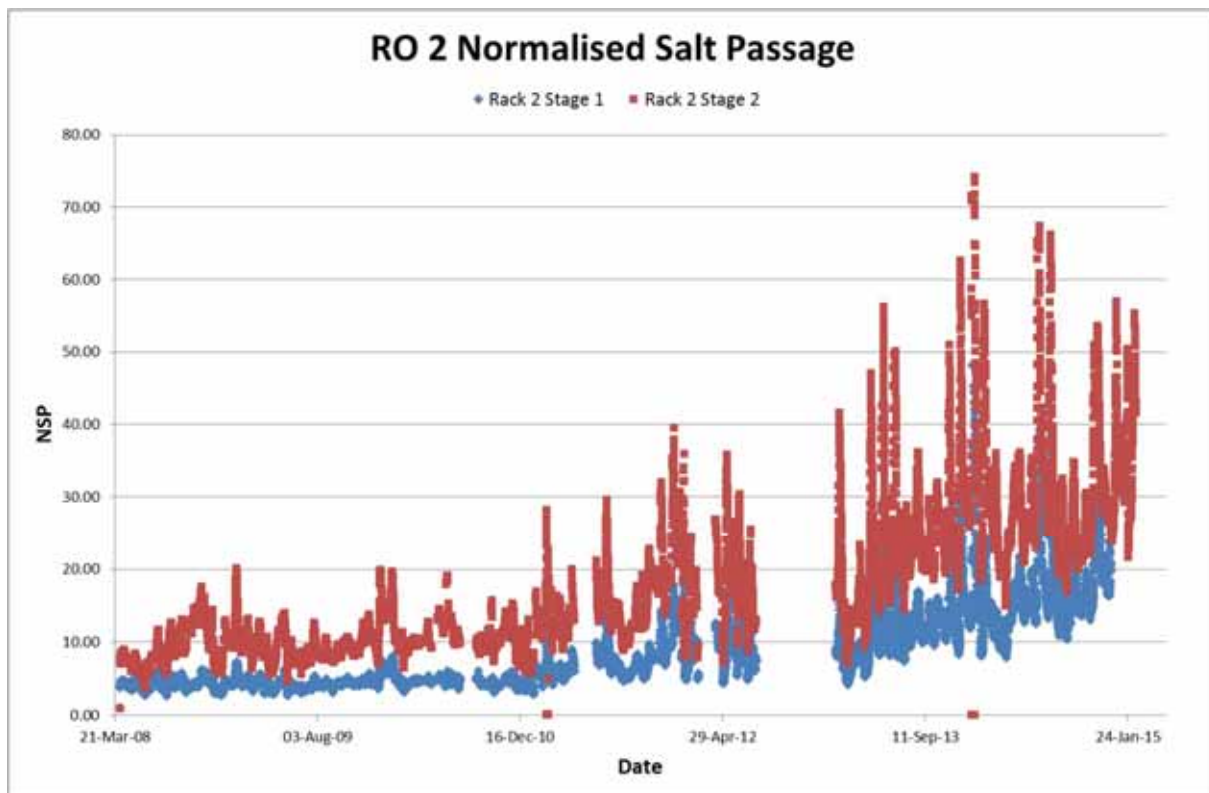


Figure 10: RO-2 Normalised Salt Passage

## 5 MEMBRANE AUTOPSIES

The RO and MF autopsies are attached to this report. The MF Autopsy found that the membranes were generally in good condition with a slight swelling of the pots but the fibres clean and in good condition. The performance and fouling were found to be typical of an aged membrane.

The RO autopsy found evidence of biofouling in the RO module but no physical damage. Given that pressure drops and NPF remained stable, there was no indication that the fouling is out of control. The autopsy found no evidence of oxidative damage to the membranes and concluded that the salt passage increase was typical of membrane ageing.



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## **Wynnum STP**

### **E-2 RO Autopsy Report**

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*1515-000002-QUU Wynnum STP RO and UF Membrane Replacement*





## Reverse Osmosis Membrane Autopsy Report



Evoqua Water Technologies



**29<sup>th</sup> April 2015**

Job Number: FS15179



## DOCUMENT CONTROL

### EVOQUA WATER TECHNOLOGIES: AUTOPSY REPORT FOR REVERSE OSMOSIS MEMBRANES

|                     |                                   |
|---------------------|-----------------------------------|
| <b>Prepared For</b> | Evoqua Water Technologies Pty Ltd |
| <b>Prepared By</b>  | Wastewater Futures Pty Ltd        |

|  |  |
|--|--|
| <b>Membrane Futures</b><br>Unit 6, 120 Bluestone Circuit<br>Seventeen Mile Rocks 4073<br>Queensland Australia<br><br>Tel: +61 7 3715 8168<br>Fax: +61 7 3715 8170<br><br>ABN 93 085 246 699<br><br>www.membranefutures.com | <b>Document:</b> Evoqua_-_Apr15<br><br><b>Job Number:</b> FS15179<br><br><b>Project Manager:</b> Jason Dwyer                               |
|  | <b>Client:</b> Evoqua Water Technologies Pty Ltd<br><br><b>Client Contact:</b> Edina Aganovic<br>Edina.aganovic@evoqua.com<br>0447 319 146 |

|  |
|--|
| <b>Title:</b> Evoqua Water Technologies: Autopsy Report for RO Membranes |
| <b>Contributors:</b> Julien Reungoat, David Reynolds & Jason Dwyer       |
| <b>Synopsis:</b> Standard Autopsy  |

#### Revision History

| Revision No | Date Issued | Checked By |           | Issued By |            |
|-------------|-------------|------------|-----------|-----------|------------|
| Version 1   | 29/04/2015  | JND        | 29/4/2015 | JR        | 29/04/2015 |
| Version 2   | 05/05/2015  |            |           | JR        | 05/05/2015 |

## EXECUTIVE SUMMARY

Membrane Futures received two reverse osmosis (RO) elements from Evoqua Water Technologies for autopsy. The elements were from Wynnum advanced water treatment plant that treats tertiary effluent from a municipal wastewater treatment plant. The elements were both brackish water Dow BW30-400/34i-FR from Stage 1 – Lead (S1L) and Stage 2 – Tail (S2T) positions. The reason for autopsy was that the elements were at the end of their life and in the process of being replaced because of increased salt passage. The membranes were seven years old. The aim of the autopsy was to perform a health check and identify possible cause(s) of increased salt passage.

| Parameter                       | Methods   | Results   |
|---------------------------------|---|---|
| Performance and integrity       | Vacuum decay test<br>Visual inspection<br>Fujiwara test | <u>S1L</u> . No sign of physical damage. No sign of high differential pressure. No sign of delamination. No sign of chemical oxidation. Connector O-ring degraded.  |
|                                 |   | <u>S2T</u> . No sign of physical damage. No sign of high differential pressure. No sign of delamination. No sign of chemical oxidation.   |
| Fouling levels and distribution | Visual inspection<br>Loss on ignition                   | <u>S1L</u> . Brown deposit visible on surface, higher concentration towards the lead end, also caught in spacer mesh. Easy to scrape off, sludge like substance, contains large amount of small particles. Amount of solids was 4,230 mg/m <sup>2</sup> at the lead (89% organics/11% inorganics) and 1,573 mg/m <sup>2</sup> at the tail (88% organics/12% inorganics). This was a significant to high level of fouling. |
|                                 |   | <u>S2T</u> . Brown deposit visible on surface with darker patches. Some caught in spacer mesh. Thick brown sludge easily removed when scraped off. Amount of solids was 1,032 mg/m <sup>2</sup> at the lead (85% organics/15% inorganics) and 682 mg/m <sup>2</sup> at the tail (82% organics/18% inorganics). This was a significant level of fouling.   |
| Nature of inorganic fouling     | SEM-EDS   | <u>S1L</u> . Low magnification showed an apparently clean surface but high magnification revealed the presence of diatoms.  |
|                                 |   | <u>S2T</u> . Low magnification showed an apparently clean surface but high magnification revealed the presence of diatoms at the lead, the tail sample was clean.   |

There was no obvious damage to the element or to the membrane surface that would explain the increased salt passage. There was a medium to high amount of fouling on both elements. The amount decreased in the direction of the flow. More than 80 % of the solids mass was organic matter, the level of inorganic fouling was low except at the lead of the Stage 1 – Lead element. Given that the plant treats tertiary effluent from a wastewater treatment plant, it was reasonable to assume that the organic matter presence was due to biofouling. Biofouling typically leads to increased differential pressure and sometime to a drop in flux but it does not usually affect salt





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rejection. The SEM-EDS analysis showed the presence of diatoms on the membrane. Diatoms have a hard cell wall made of silica that could lead to abrasion of the membrane surface. The increase in salt passage had been gradual over the years so it was not due to a single event. Membrane Futures opinion is that the increase in salt passage was caused by membrane ageing and possibly abrasion caused by the diatoms.

The diatoms were approximately 10  $\mu\text{m}$  in size and should be removed by ultrafiltration. Membrane Futures recommends reviewing the pre-treatment of the plant. The high pH CIP appeared to have kept biofouling development under control. If possible, cleaning in the reverse direction of the flow is preferable as it prevents pushing the fouling material further in the process.




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## TABLE OF CONTENTS

|  |    |
|--|----|
| Document Control.....  | 2  |
| Executive Summary .....  | 3  |
| Table of Contents.....   | 5  |
| Figures and Tables .....   | 6  |
| 1.0 Background .....   | 7  |
| 2.0 Results .....  | 10 |
| 2.1 Vacuum Decay Test.....   | 10 |
| 2.2 Visual Inspection.....   | 10 |
| 2.3 Sampling Regime .....  | 21 |
| 2.4 Loss on Ignition (LOI).....  | 22 |
| 2.5 Scanning Electron Microscopy – Energy Dispersive X-ray Spectroscopy (SEM-EDS) .... | 23 |
| 2.6 Fujiwara Analysis .....  | 27 |
| 3.0 Conclusions.....   | 29 |
| Appendix.....  | 30 |
| A.1 Vacuum Decay Test.....   | 30 |
| A.2 Visual Inspection.....   | 30 |
| A.3 Loss on Ignition (LOI).....  | 30 |
| A.4 Scanning Electron Microscopy – Energy Dispersive X-ray Spectroscopy (SEM-EDS) .... | 30 |
| A.5 Fujiwara Test .....  | 31 |



## FIGURES AND TABLES

|           |   |    |
|-----------|---|----|
| Figure 1  | RO elements received for autopsy.....                           | 7  |
| Figure 2  | Normalised permeate flow and salt passage (SP).....             | 8  |
| Figure 3  | Vacuum decay test results.....                                  | 10 |
| Figure 4  | External inspection of the Stage 1 – Lead element.....          | 12 |
| Figure 5  | Internal inspection of Stage 1 – Lead element.....              | 14 |
| Figure 6  | Stereomicroscope inspection of Stage 1 – Lead element.....      | 15 |
| Figure 7  | External inspection of the Stage 2 – Tail element.....          | 17 |
| Figure 8  | Internal inspection of Stage 2 – Tail element.....              | 19 |
| Figure 9  | Stereomicroscope inspection of Stage 2 – Tail element.....      | 21 |
| Figure 10 | Average fouling levels.....                                     | 23 |
| Figure 11 | SEM images and EDS analysis of Stage 1 – Lead, lead sample..... | 24 |
| Figure 12 | SEM images and EDS analysis of Stage 1 – Lead, tail sample..... | 25 |
| Figure 13 | SEM images and EDS analysis of Stage 2 – Tail, lead sample..... | 26 |
| Figure 14 | SEM images and EDS analysis of Stage 2 – Tail, tail sample..... | 27 |
| Figure 15 | Fujiwara results.....   | 28 |
| Table 1   | Sampling regime.....  | 21 |
| Table 2   | Results of solids content on the membranes.....                 | 22 |





## 1.0 BACKGROUND

Membrane Futures received two reverse osmosis (RO) elements from Evoqua Water Technologies (Figure 1) for autopsy. The elements were from the Wynnum advanced water treatment plant. The elements were both brackish water Dow BW30-400/34i-FR from:

- Stage 1, vessel D5, lead position: #F2743304
- Stage 2, vessel D5, tail position: #F2743272

The reason for autopsy was that the elements were at the end of their life and in the process of being replaced because of increased salt passage (Figure 2). The membranes were seven years old. The aim of the autopsy was to perform a health check and identify possible cause(s) of increased salt passage.

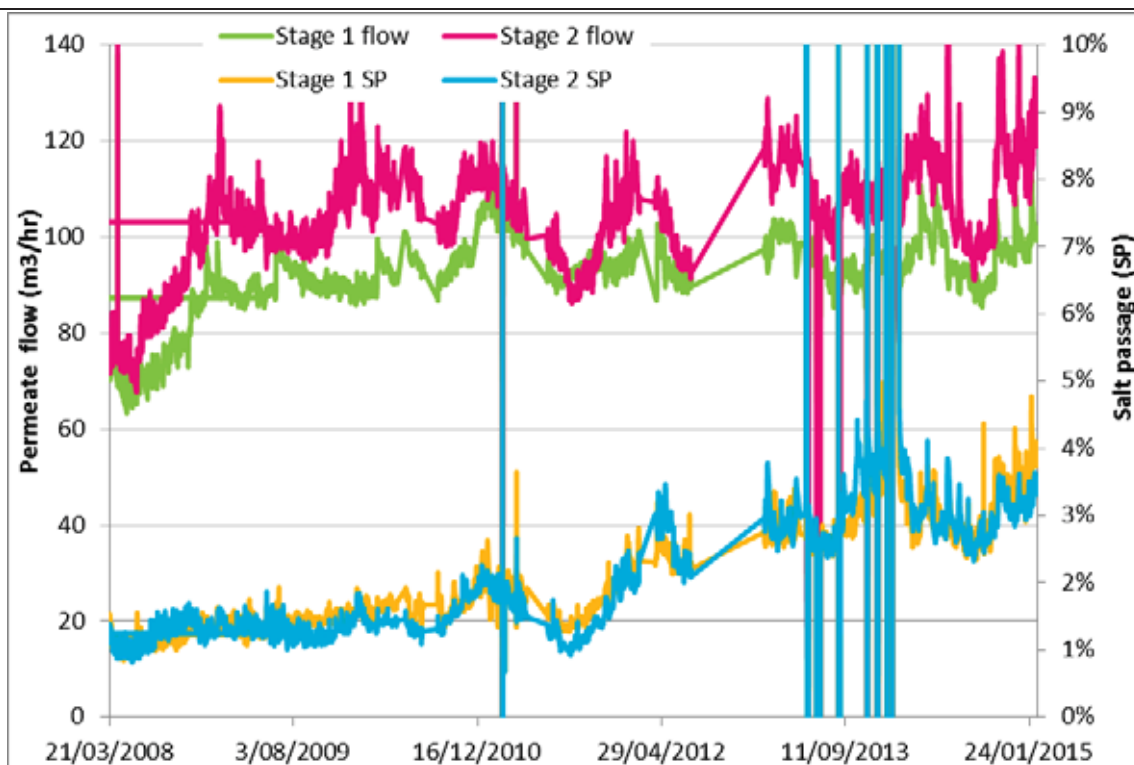


(a) Stage 1 – Lead #F2743304

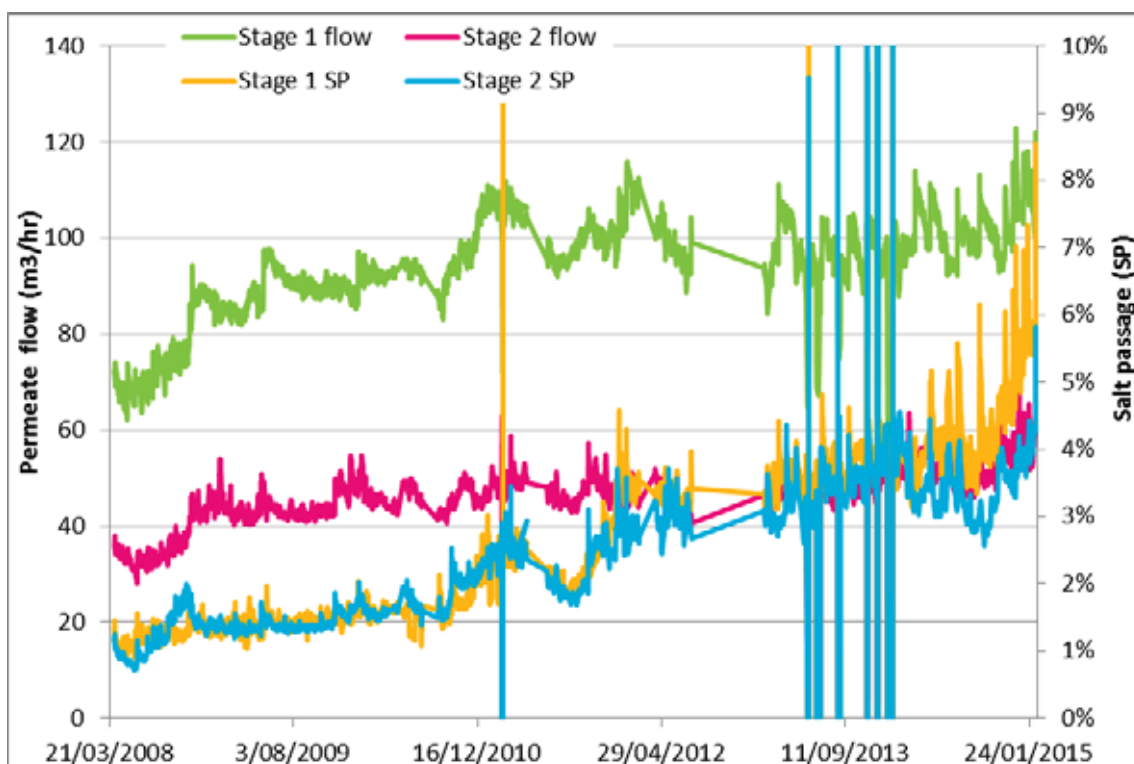


(b) Stage 2 – Tail #F2743272

**Figure 1** RO elements received for autopsy.



(a) Train 1



(b) Train 2

**Figure 2** Normalised permeate flow and salt passage (SP).



The Wynnum advanced water treatment plant treats tertiary effluent from a municipal wastewater treatment plant. The RO feed water had a conductivity between 1,600 and 2,000  $\mu\text{S}/\text{cm}$ , pH was in the 6.5 to 7.0 range, turbidity was 0.05, SDI was below 2.5 and temperature varied between 25 and 28°C. The RO treatment had two trains with two stages. There were 16 vessels in the first stage and 8 vessels in the second stage. There were seven 8 inch elements in each pressure vessel. The feed flow was 140  $\text{m}^3/\text{hr}$  per train and the permeate flow was 100  $\text{m}^3/\text{hr}$ . The target recovery was 75%. The feed pressure was 900 kPa and the concentrate pressure was 600 kPa. The permeate pressure was 260 kPa in the first stage to balance the flow and 30 kPa in the second stage. The pre-treatment before the RO consisted of:

- Chloramination (1.5-1.7 ppm total chlorine, free chlorine < 0.05 ppm)
- Pressurised ultrafiltration

Cleaning in place (CIP) was performed based on a pressure drop in the normalised data. The frequency of cleaning approached monthly at the end of the life of the membranes. The CIP was performed with an acid solution only, no caustic cleaning was performed.





## 2.0 RESULTS

### 2.1 Vacuum Decay Test

The vacuum decay test was used to determine the physical integrity of the reverse osmosis elements and the membrane. A vacuum of 700 mbar was applied on the permeate side and the vacuum decay was monitored over time (Figure 3). A decay of more than 100 mbar in the first minute is a sign of physical damage. Both elements passed the test. The vacuum loss in Stage 1 – Lead was 87 mbar after one minute while it was only 8 mbar for Stage 2 – Tail element.

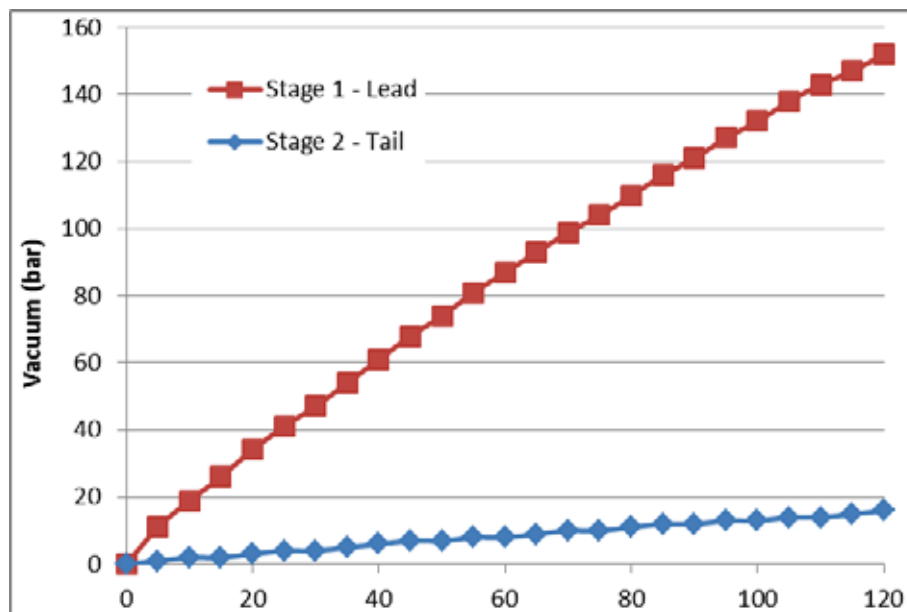


Figure 3 Vacuum decay test results.

### 2.2 Visual Inspection

Each element was drained and weighed before it was opened. When the element was opened the sheets were labelled consecutively. All the sheets were inspected, the pictures below show typical observations.

#### Stage 1 – Lead

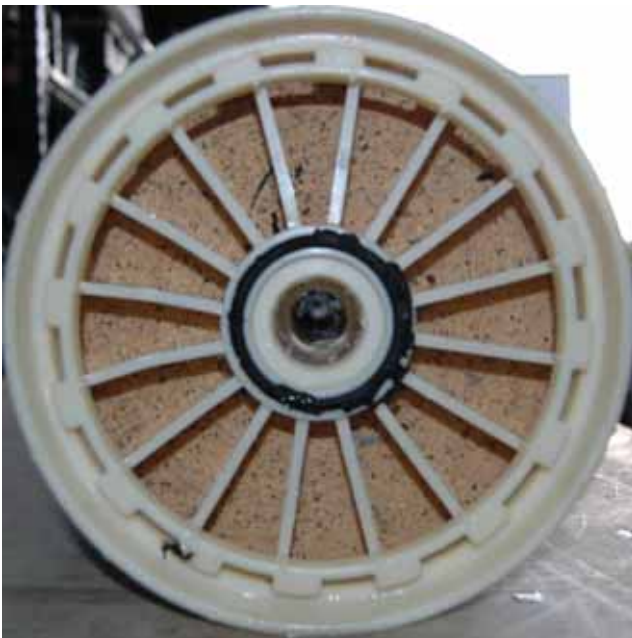
The fiberglass casing had a brown discoloration but was otherwise clean and in good condition (Figure 4a). Some of the arms of the lead anti-telescoping device were bent (Figure 4b). This could be due to high differential pressure or could have happened during loading or unloading of the element. There was a lot of debris on the lead coil (Figure 4d-e). The particles were of different sizes, ranging from less than a millimetre to over one centimetre. The particles were of various colours, mostly black or grey but also brown and blue. The permeate O-ring was heavily degraded



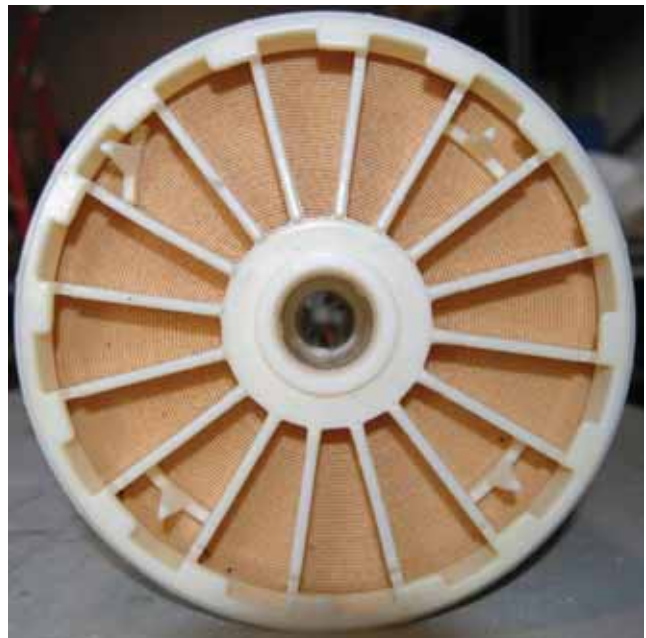
and some of the particles on the coil seemed to have come from it (Figure 4 f). The tail anti-telescoping device was in good condition except for a spike that was broken (Figure 4 c). This probably happened during loading or unloading of the element. The tail coil was clean, there were only a few black particles. The brine seal was attached to the module. It was in good condition and there was no deposit in the channel (Figure 4 g).



(a) external casing



(b) lead anti-telescoping device and coil



(c) tail anti-telescoping device and coil



(d) debris on lead coil



(e) debris on lead coil

*(f) permeate O-ring**(g) brine seal***Figure 4** External inspection of the Stage 1 – Lead element.

The fiberglass and outer tape were removed from the element and the membrane sheets unwound. The surface of the sheets was covered with a brown residue (Figure 5a-b). The amount of residue was higher at the lead. There were also some black particles towards the lead end (Figure 5c). There was a strip of black staining along a dozen of the sheets (Figure 5d). The affected sheets were all next to each other and the stain location changed gradually from the external edge toward the permeate tube. This suggested that it could be due to the element being stored lying for a long period of time in or out of the pressure vessel. Some of the deposit was caught in the spacer mesh (Figure 5e). The glue lines were in good conditions. When the surface was wiped with a cloth or scraped with a glass slide, a large amount of light brown thick deposit was removed (Figure 5f-g).





*(a) surface overview*



*(b) deposit in middle of sheet*



*(c) deposit and black particles at lead end*

*(d) patch of black discoloration**(e) spacer mesh**(f) deposit removed when wiped with a cloth**(g) deposit removed when scraped with a glass slide***Figure 5** Internal inspection of Stage 1 – Lead element.

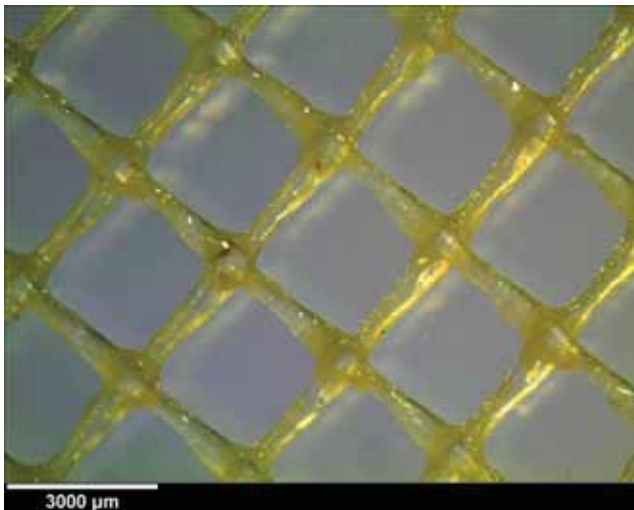
The membrane surface, the spacer mesh and the deposit removed with the glass slide were observed under a stereomicroscope. The deposit on the membrane surface was concentrated along the spacer mesh lines (Figure 6a-b). The deposit was caught in the spacer mesh, in particular around the intersections (Figure 6c-d). This can block the flow of the water and lead to high differential pressure across the element. The deposit removed with the glass slide contained a lot of small particles (Figure 6e-f).



(a) membrane surface x10



(b) membrane surface x50



(c) spacer mesh x10



(d) spacer mesh x50



(e) deposit removed with glass slide x10



(f) deposit removed with glass slide x50

**Figure 6** Stereomicroscope inspection of Stage 1 – Lead element.



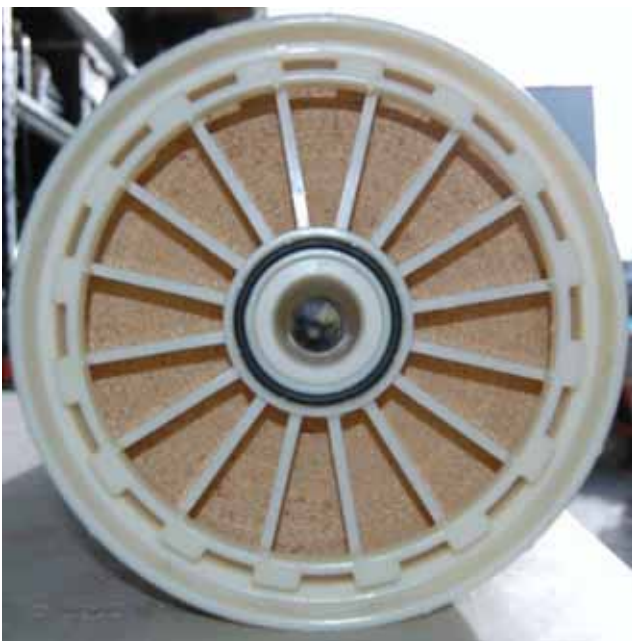
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## Stage 2 – Tail

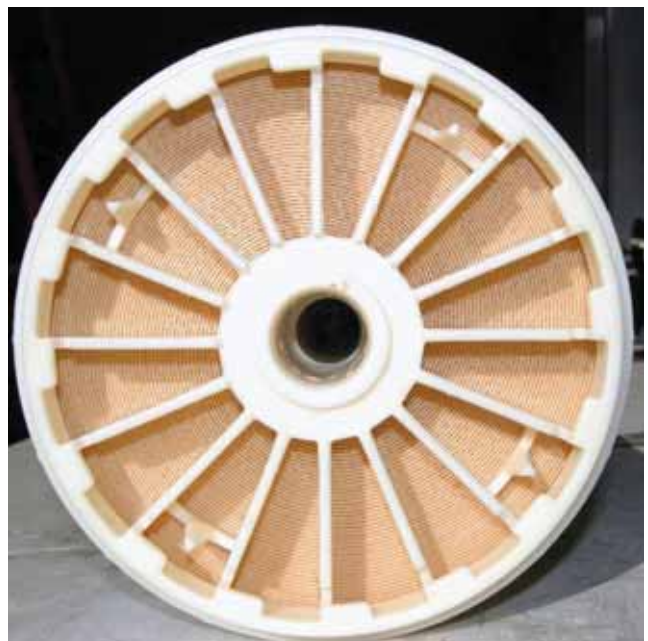
The fiberglass casing was clean and in good condition (Figure 7 a). The anti-telescoping devices were in good condition (Figure 7 b-c). There were some brown deposits on the lead coil but the amount was not concerning (Figure 7 d). The tail coil was clean. The brine seal was attached to the module (Figure 7 e). It was in good condition and there was no deposit in the channel. There was no external sign of high differential pressure.



*(a) external casing*



*(b) lead anti-telescoping device and coil*



*(c) tail anti-telescoping device and coil*

*(d) brown deposit on lead coil**(e) brine seal***Figure 7** External inspection of the Stage 2 – Tail element.

The fiberglass and outer tape were removed from the element and the membrane sheets unwound. The surface of the membrane was covered with a brown deposit (Figure 8a-c). There were isolated patches of thicker dark brown deposits (Figure 8d). In this location corresponded some deposit caught in the spacer mesh (Figure 8e). The glue lines were in good condition. When the surface was wiped with a cloth or scraped with a glass slide, a thick dark brown residue was removed (Figure 8f-g).



*(a) surface overview*



*(b) deposit at lead end*



*(c) deposit on middle of sheet*



*(d) patches of dark brown deposit**(e) deposit caught in spacer mesh**(f) deposit removed when wiped with a white cloth**(g) deposit removed when scraped with a glass slide***Figure 8** Internal inspection of Stage 2 – Tail element.

The surface of the membrane, the spacer mesh and the deposit removed with the glass slide were observed under a stereomicroscope. The deposit on the membrane was more concentrated along the spacer mesh lines (Figure 9a-b). There were indentations in the surface, probably caused by the spacer mesh, however the surface of the membrane did not appear to be damaged. The dark brown deposits had a granular appearance (Figure 9c-d). The deposit caught in the spacer mesh was mostly around the intersections (Figure 9e-f). The deposit removed with the glass slide was similar to the Stage 1 – Lead element but with less particles (Figure 9g-h).



(a) membrane surface x10



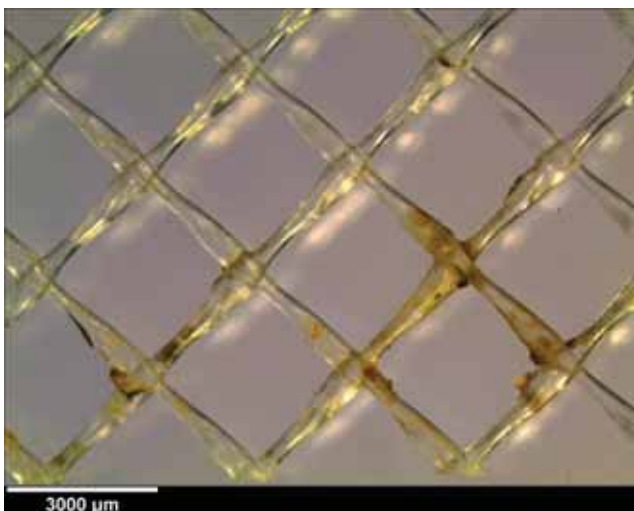
(b) membrane surface x50



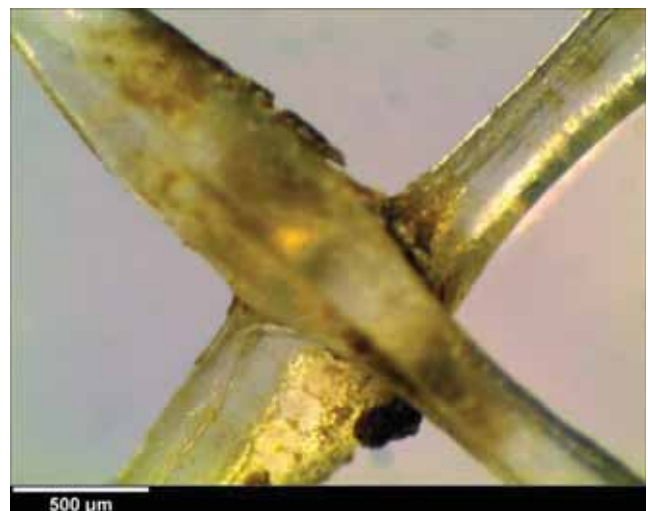
(c) dark brown patch x10



(d) dark brown patch x50



(e) spacer mesh x10



(f) spacer mesh x50



(g) deposit removed with glass slide x10



(h) deposit removed with glass slide x50

**Figure 9** Stereomicroscope inspection of Stage 2 – Tail element.

## 2.3 Sampling Regime

Samples were taken at the lead and tail from various sheets throughout the elements. Samples were always taken at the very edge of the glue lines. A summary of the location of the samples taken for analysis is provided (Table 1). The elements each had 25 sheets.

**Table 1** Sampling regime.

| Element        | Location   | LOI | SEM | Fujiwara |
|----------------|------------|-----|-----|----------|
| Stage 1 – Lead | Lead 1/2   | X   | X   | X        |
|                | Tail 1/2   | X   | X   | X        |
|                | Lead 19/20 | X   |     |          |
|                | Tail 19/20 | X   |     |          |
| Stage 2 – Tail | Lead 1/2   | X   | X   | X        |
|                | Tail 1/2   | X   | X   | X        |
|                | Lead 19/20 | X   |     |          |
|                | Tail 19/20 | X   |     |          |

Samples were prepared using different methods. The sample preparation for each of the analyses used is described:

LOI: Samples 10x15 cm were placed into ultrapure water.

SEM-EDS: Samples were mounted on plates and analysed at the surface.

Fujiwara: Samples 2x2 cm were taken and tested.





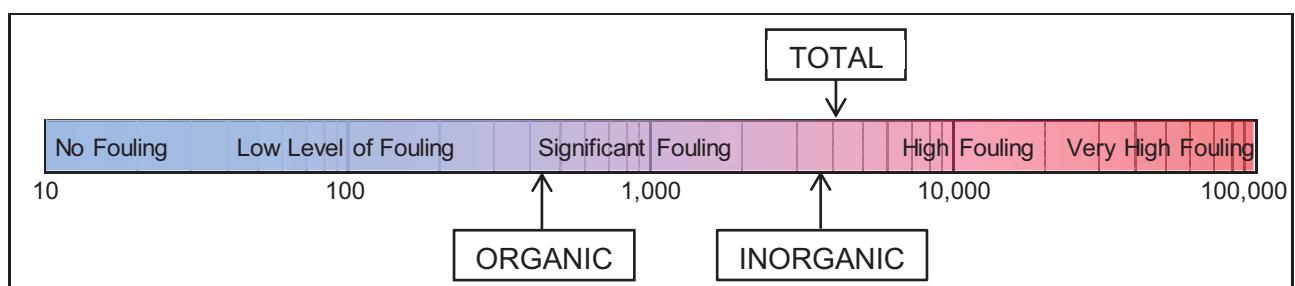
## 2.4 Loss on Ignition (LOI)

LOI, TOC and total ICP-AES analysis was performed on samples from each of the elements. Analysis was performed on two lead and two tail locations from each of the elements. LOI was performed on the foulant mass that could be wiped off the membrane surface. TOC and ICP-AES analysis was completed on the foulant mass that was able to dissolve into a 5% w/w nitric acid solution. The average results are provided individually for each location (Table 2). The elements were also placed on an indicative fouling level scale (Figure 10).

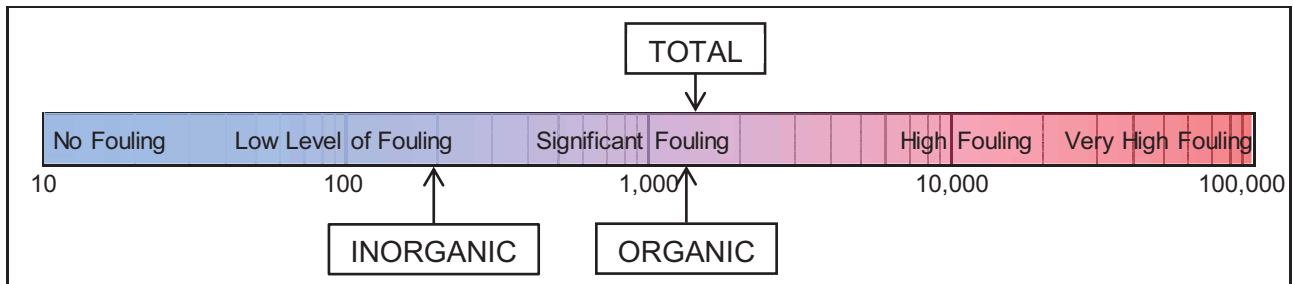
There was a significant to high amount of fouling on the Stage 1 – Lead element. The amount of fouling was almost three times higher at the lead compared to the tail. The proportions of volatile and fixed solids were the same at the lead and tail. The volatile solids accounted for nearly 90%, indicating that the foulant was mainly organic matter. It is typical for the amount of organic fouling to decrease in the direction of the flow. The total amount of fouling on the Stage 2 – Tail element was lower than on the Stage 1 – Lead element, but it was still significant. The amount also decreased in the direction of the flow. Similarly to the Stage 1 element, volatile solids accounted for a large part of the solids, more than 80%.

**Table 2** Results of solids content on the membranes.

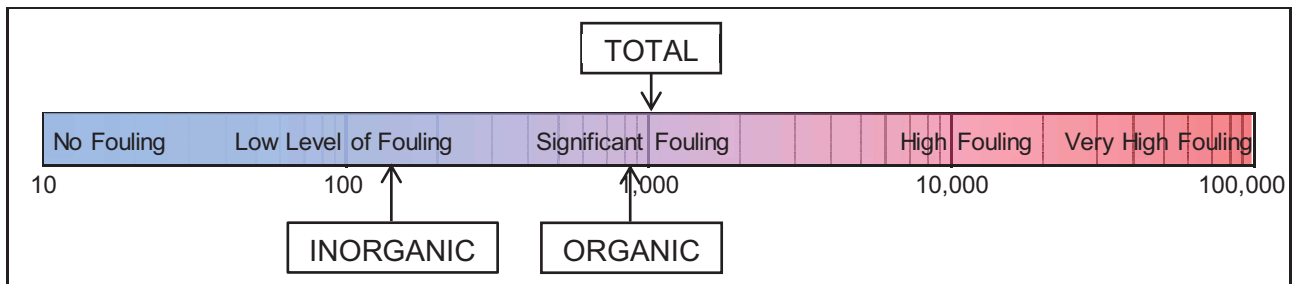
| Element        |      | Total Solids                          | Volatile Solids | Fixed Solids |
|----------------|------|---------------------------------------|-----------------|--------------|
|                |      | mg/m <sup>2</sup> (% of Total Solids) |                 |              |
| Stage 1 – Lead | Lead | 4,230±797                             | 3,777±758 (89%) | 453±39 (11%) |
|                | Tail | 1,573±91                              | 1,382±121 (88%) | 192±29 (12%) |
| Stage 2 – Tail | Lead | 1,032±88                              | 878±101 (85%)   | 153±13 (15%) |
|                | Tail | 682±167                               | 562±160 (82%)   | 120±7 (18%)  |



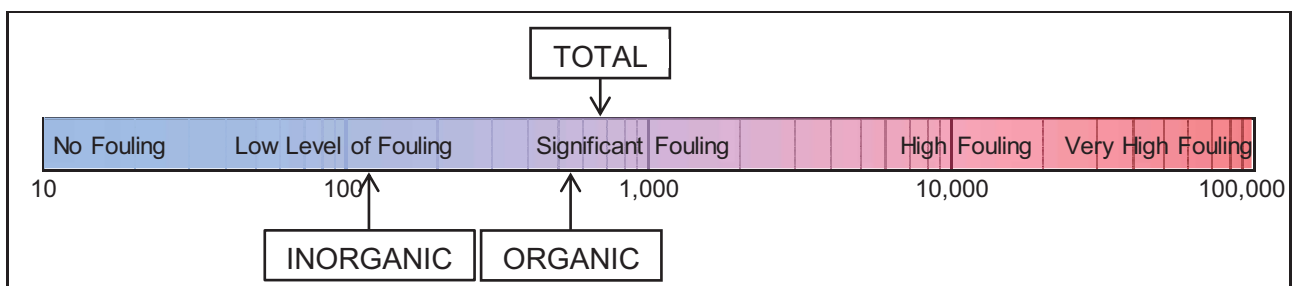
(a) Stage 1 – Lead, lead sample



(b) Stage 1 – Lead, tail sample



(c) Stage 2 – Tail, lead sample



(d) Stage 2 – Tail, tail sample

**Figure 10** Average fouling levels.

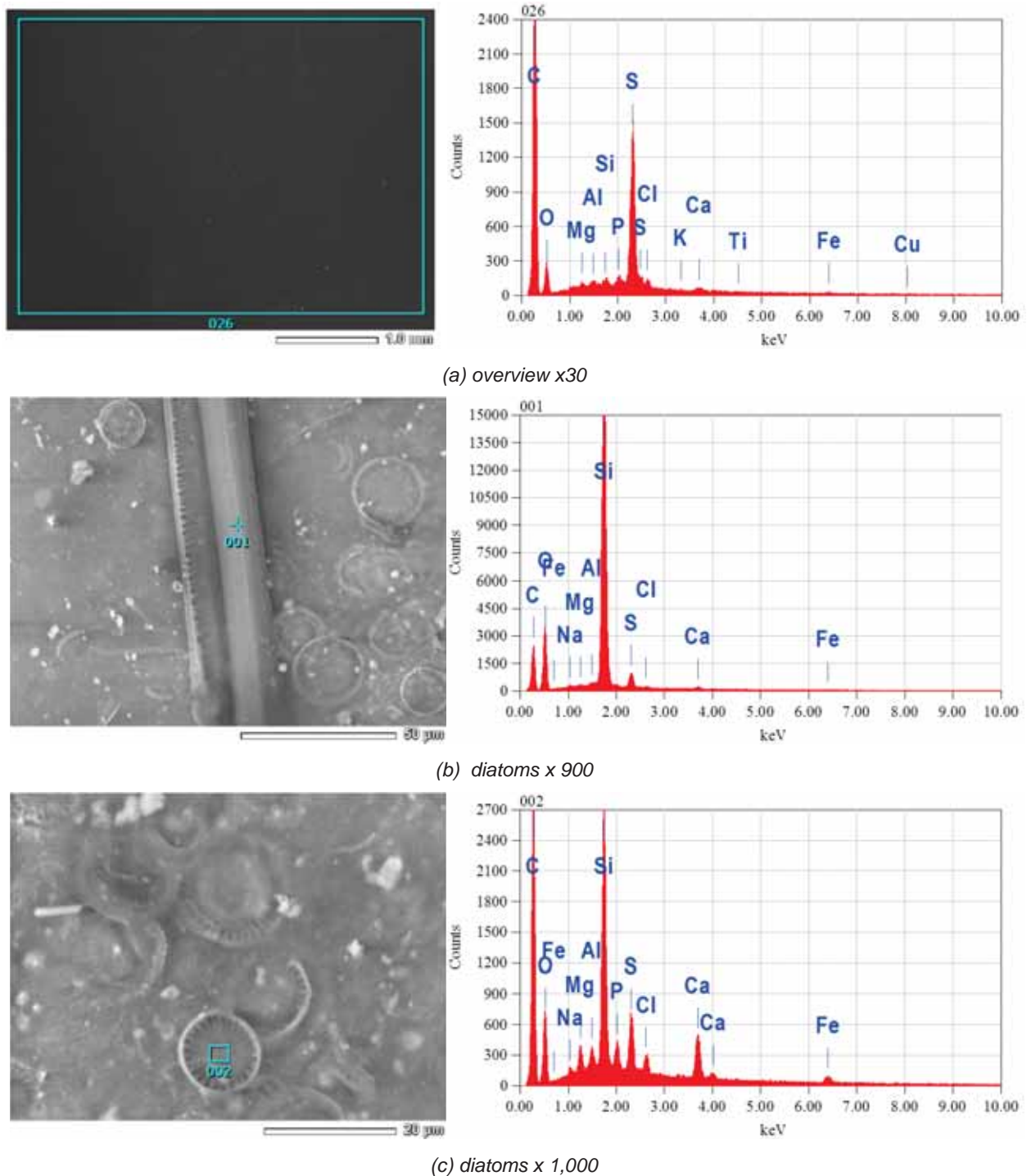
## 2.5 Scanning Electron Microscopy – Energy Dispersive X-ray Spectroscopy (SEM-EDS)

SEM and EDS analysis was performed on samples from the lead and tail of each of the elements to confirm the LOI and ICP-AES findings and better characterise the deposits. First, SEM images were taken of the surface of representative samples at low magnification (x 30) to give an overview of the area. In these images, high atomic number elements correspond to more intensely white regions. EDS analysis was completed on the entire visible surface on these images. The membrane material produces large peaks of carbon, oxygen and sulfur. Then, high magnification images were taken of the deposits that were found and EDS analysis performed to better characterise them.



## Stage 1 – Lead

The overview image of the lead sample showed that the surface was mainly free of deposits (Figure 11a). The EDS analysis showed significant peaks for the membrane material only. However, high magnification images and EDS analysis showed the presence of diatoms on the surface (Figure 11b-c). Diatoms are unicellular algae enclosed in a silica wall.

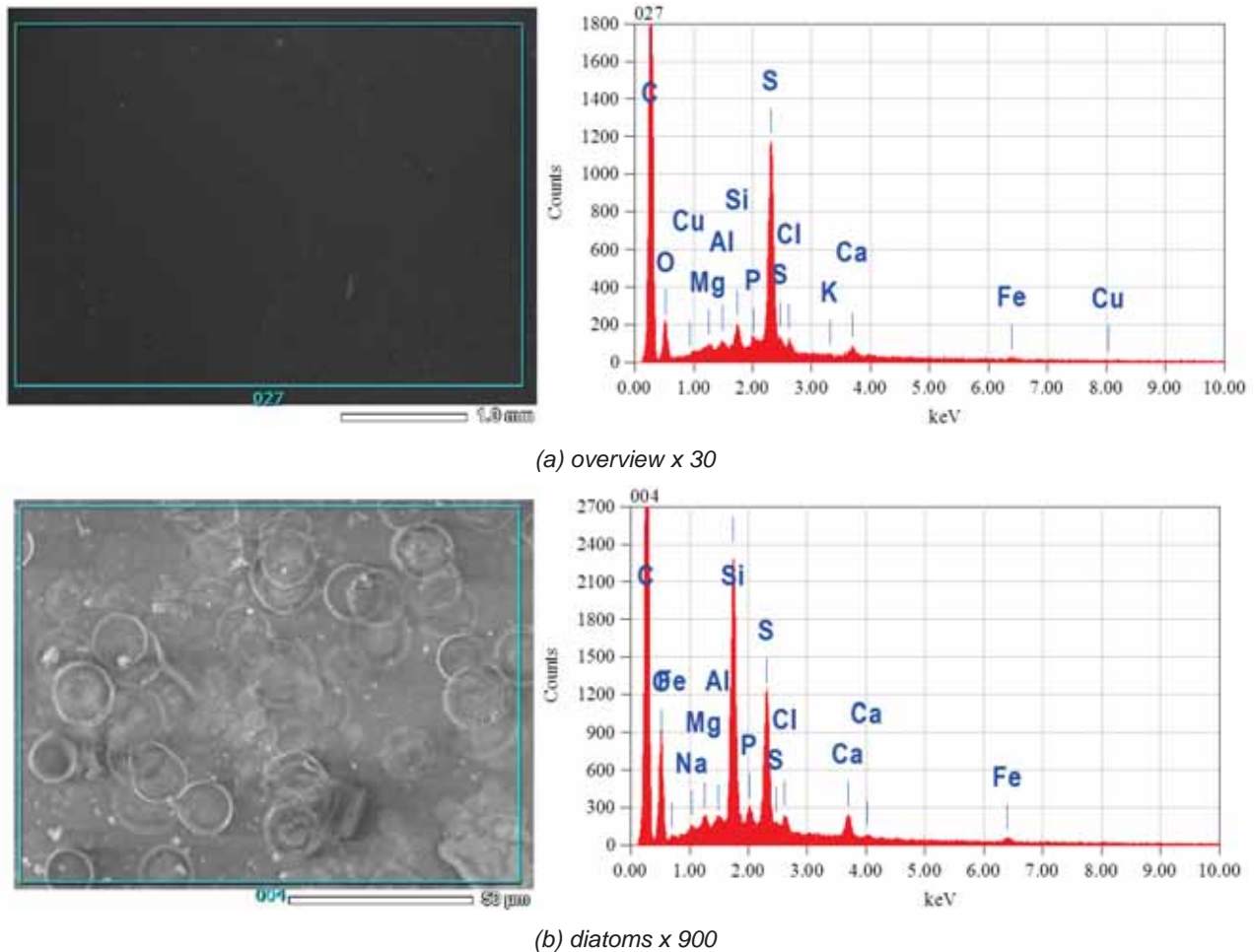


**Figure 11** SEM images and EDS analysis of Stage 1 – Lead, lead sample.





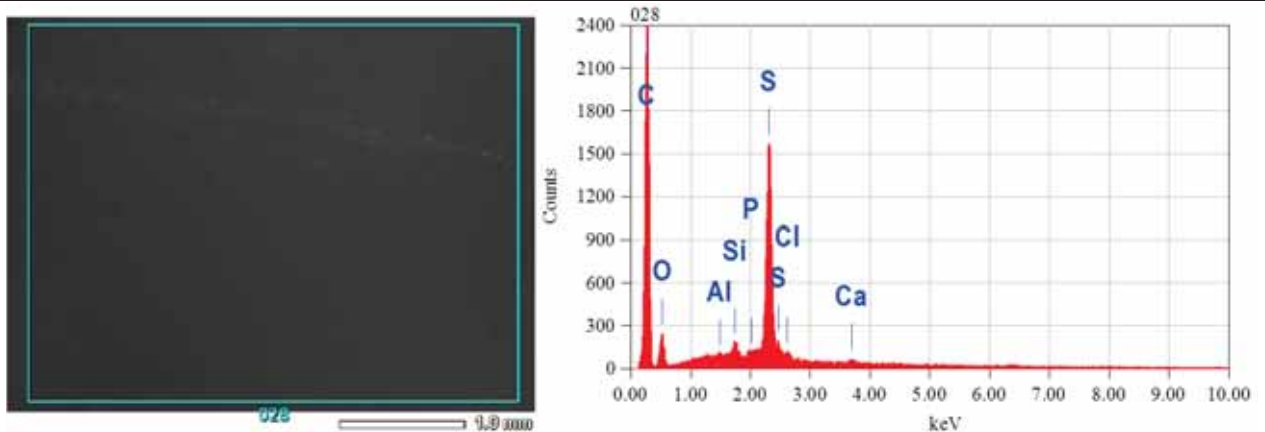
The overview image of the tail sample showed that the surface was mainly free of deposits (Figure 12a). The EDS analysis showed significant peaks for the membrane material and a small peak for silica. Similarly to the lead sample, high magnification images and EDS analysis showed the presence of diatoms on the surface (Figure 12b).



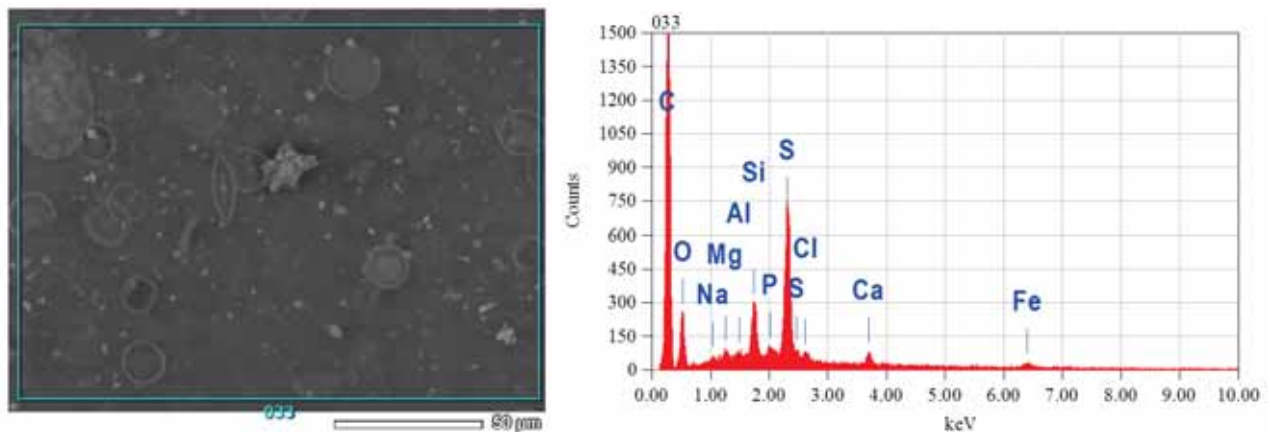
**Figure 12** SEM images and EDS analysis of Stage 1 – Lead, tail sample.

### Stage 2 – Tail

The overview image of the lead sample showed a surface free of deposits (Figure 13a). The EDS analysis showed significant peaks for the membrane material only. High magnification images and EDS analysis showed the presence of diatoms (Figure 13b).



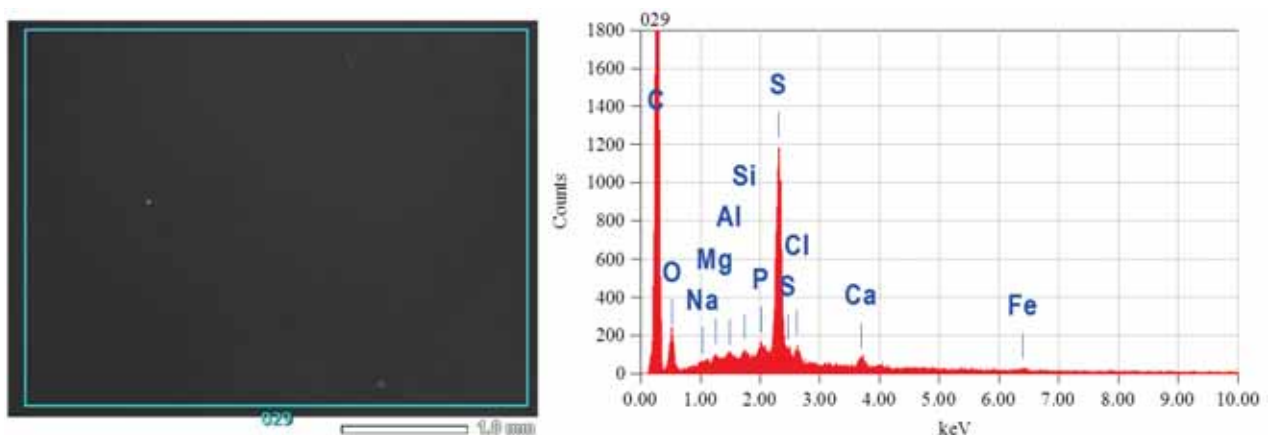
(a) overview x 30



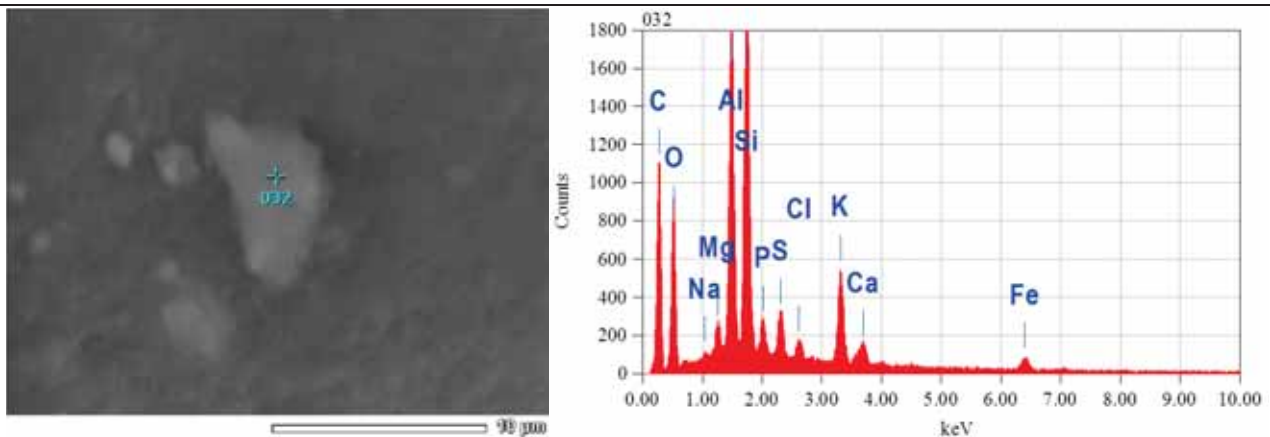
(b) diatoms x 700

**Figure 13** SEM images and EDS analysis of Stage 2 – Tail, lead sample.

The overview image of the tail sample was similar to the lead sample, the surface appeared free of deposits (Figure 14a). The high magnification images and EDS analysis did not find diatoms but a small aluminium silicate particle was present (Figure 14b).



(a) overview x 30



(b) aluminium silicate particle x 5,000

**Figure 14** SEM images and EDS analysis of Stage 2 – Tail, tail sample.

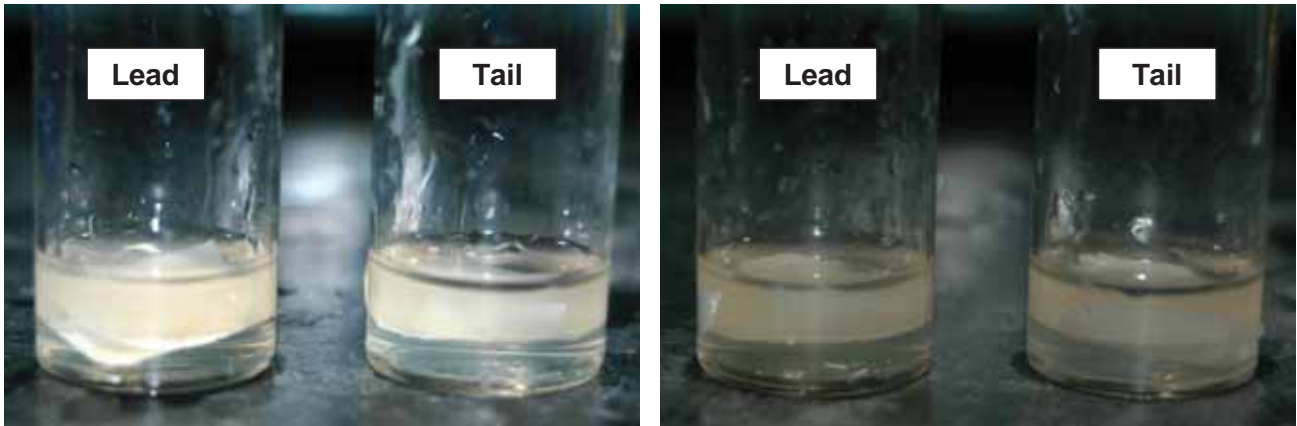
## 2.6 Fujiwara Analysis

Fujiwara analysis was conducted on lead and tail samples from each element. A positive control was also included (Figure 15 a). A positive result is identified by the formation of a pink colour in the test tube. Both elements had negative results (Figure 15 b-c). A negative result does not guarantee that there has not been any oxidative damage as the Fujiwara test is not sensitive in the early stages of oxidation.



(a) Positive control





(a) Stage 1 – Lead

(b) Stage 2 – Tail

**Figure 15**

*Fujiwara results.*

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### 3.0 CONCLUSIONS

There was no obvious damage to the element or to the membrane surface that would explain the increased salt passage. There was a medium to high amount of fouling on both elements. The amount decreased in the direction of the flow. More than 80 % of the solids mass was organic matter, the level of inorganic fouling was low except at the lead of the Stage 1 – Lead element. Given that the plant treats tertiary effluent from a wastewater treatment plant, it was reasonable to assume that the organic matter presence was due to biofouling. Biofouling typically leads to increased differential pressure and sometime to a drop in flux but it does not usually affect salt rejection. The SEM-EDS analysis showed the presence of diatoms on the membrane. Diatoms have a hard cell wall made of silica that could lead to abrasion of the membrane surface. The increase in salt passage had been gradual over the years so it was not due to a single event. Membrane Futures opinion is that the increase in salt passage was caused by membrane ageing and possibly abrasion caused by the diatoms.

The diatoms were approximately 10 µm in size and should be removed by ultrafiltration. Membrane Futures recommends reviewing the pre-treatment of the plant. The high pH CIP appeared to have kept biofouling development under control. If possible, cleaning in the reverse direction of the flow is preferable as it prevents pushing the fouling material further in the process.



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## APPENDIX

Outlined below is a brief description of the autopsy tasks and how they were undertaken.

### A.1 Vacuum Decay Test

The vacuum decay test was used to determine the physical integrity of the reverse osmosis elements and the membrane. A vacuum of 700 mbar was applied on the permeate side and the vacuum decay was monitored over time. A decay of more than 100 mbar in the first minute is a sign of physical damage.

### A.2 Visual Inspection

The feed and tail ends of the spiral wound modules were closely examined and foreign material sampled for relevant analysis. Careful examination was made for signs of high-pressure events. The membrane module fiberglass skin was cut open and removed. The internal membrane sheets were unwound and each side of the individual membrane sleeves examined. Documentation of any visual fouling was made, as well as any evidence of high-pressure events (tears or rupturing of glue lines). Dissection of representative sections of the membrane surface was performed, including the sampling of all visually obvious fouled surfaces. Magnified images of very small ruptures were taken, if present.

### A.3 Loss on Ignition (LOI)

The LOI test measures the degree of volatile and incombustible solids on the membrane surface. Samples of fibres or flat sheet membrane were placed into water and agitated very gently to remove surface fouling. The membrane was removed from the solution and the solution was evaporated at 110 °C and weighed. The remaining material was then ignited at 550 °C and weighed again.

### A.4 Scanning Electron Microscopy – Energy Dispersive X-ray Spectroscopy (SEM-EDS)

SEM produces highly magnified images of the surface of the membranes and the fouling materials. The three dimensional nature of SEM allows for identification of the surface and of the fouling material structures. EDS uses electron beams to excite the atoms of the membrane and the fouling materials. X-rays emitted are examined to decipher information about the elements present at the membrane surface.





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## A.5 Fujiwara Test

The Fujiwara test is a qualitative indicator of damage caused by halide oxidation of the membrane polyamide surface. It is commonly used to indicate oxidation caused by chlorine to polyamide thin-film membranes. Small coupons of membrane were immersed in a solution containing pyridine and sodium hydroxide and heated. The formation of a pink colour indicates oxidative damage.

However, the Fujiwara test is not sensitive enough to detect early damage caused by halide oxidants. As a result, the absence of pink colour formation does not necessarily guarantee that damage has not occurred. Membrane Futures can perform additional tests to determine if the organic fouling has a biological origin.



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## **Wynnum STP**

### **E-3 UF Membrane Autopsy Report**

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*1515-000002-QUU Wynnum STP RO and UF Membrane Replacement*



## WYNNUM WATER RECLAMATION PLANT MEMCOR® CP SYSTEM

### EVOQUA WATER TECHNOLOGIES MEMBRANE MODULE AUTOPSY REPORT

15th May 2015

#### **Evoqua Water Technologies Pty Ltd**

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South Windsor NSW 2756 AUSTRALIA  
Reference: 1515-000002trp01\_01\_Wynnum Autopsy Report  
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Printed: 19 May 2015





## **Contents**

|            |   |          |
|------------|---|----------|
| <b>1</b>   | <b>INTRODUCTION</b>                                   | <b>3</b> |
| <b>2</b>   | <b>SUMMARY &amp; RECOMMENDATIONS</b>                  | <b>3</b> |
| <b>3</b>   | <b>AUTOPSY RESULTS</b>                                | <b>4</b> |
| <b>3.1</b> | OBSERVATIONS  | 4        |
| <b>3.2</b> | TENSILE RESULTS                                       | 5        |
| <b>3.3</b> | EDS (ENERGY DISPERSIVE (X-RAY) SPECTROSCOPY) ANALYSIS | 6        |
|            | <b>APPENDIX – REFERENCE INFORMATION</b>               | <b>8</b> |



## **1 Introduction**

The Wynnum Memcor® CP System consists of two MEMCOR® CP Units with 90 L20V membranes and is designed to produce 7.1 MLD of filtrate. The system has been in operation since May 2008.

The modules were replaced in March 2015 after almost 7 years in service. Considering typical membrane module life is 5 to 7 years, the CP units must have been operated and maintained well.

One module, WK78654D (382036), was returned to Evoqua for a general autopsy. The autopsy findings will be discussed in this report.

## **2 Summary & Recommendations**

The module was found to be visually clean with no gross solids fouling. The cleanness of the membrane fibres were confirmed by EDS analysis with only trace amount of inorganics detected.

Slight degradation of polyurethane of the pots and O-rings from exposure to chlorine were observed whilst other module components including nylon potting sleeves and module screen showed no apparent degradation.

Tensile tests performed on the fibres sampled from the module returned up to 25% loss in break extension compared to initial QC results. This indicates that mechanically the fibres are in good condition.

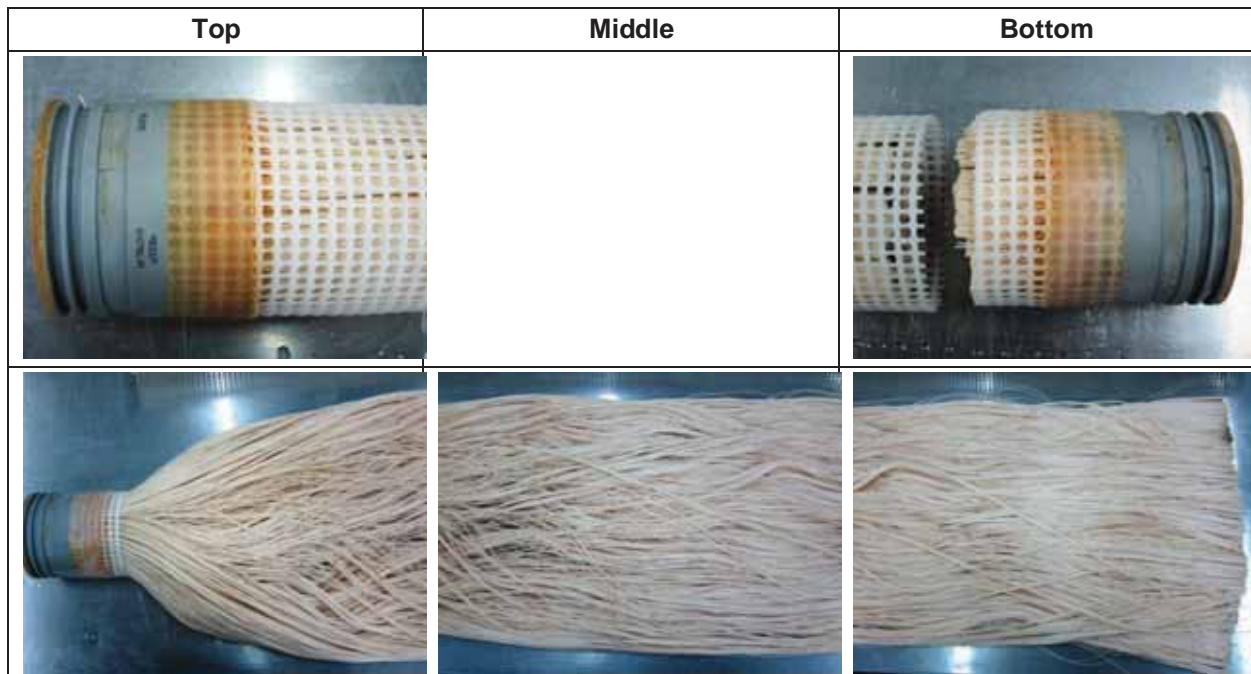
Although the membrane module was still in good mechanical condition, based on the operator feedback and recent CIP history, it was concluded that the modules at Wynnum Water Reclamation Plant were exhibiting typical symptoms of ageing such as increase in fouling rate and increase in CIP frequency.

### 3 Autopsy Results

#### 3.1 Observations

| Serial No | Winder ID | Comments  |
|-----------|-----------|---|
| 382036    | WK78654D  | <ul style="list-style-type: none"> <li>The module as received in Autopsy had its bottom pot cut off (to facilitate removal from the centre tube as the polyurethane of the pots had swelled slightly).</li> <li>The combined weight of the two pieces was 10.1 kg which is in the range of new wetted un-used L20V module.</li> <li>The polyurethane of the pots had slightly swelled and acquired a matt / cloudy surface finish. This degradation is typically caused by oxidation from exposure to chlorine over the lifetime of the membrane.</li> <li>Similarly, the module O-rings also had acquired a slight matt surface finish due to oxidation.</li> <li>Other module components including nylon potting sleeves and module screen showed no apparent degradation.</li> <li>On removal of the protective module screen the membrane fibres looked visually very clean except for some minor black stain internal to the fibre bundle near the bottom pot.</li> <li>Screen indents were not seen. This implies that the module had never experienced gross solids fouling (i.e. excellent screening of solids in the feed water).</li> </ul> |

**FIGURE 1: IMAGES OF THE MODULE 382036 BEFORE AND AFTER THE MODULE SCREEN IS REMOVED**





**FIGURE 2: IMAGE OF BLACK STAIN INSIDE MEMBRANE FIBRE BUNDLE NEAR THE BOTTOM POT**

### 3.2 Tensile Results

12 fibres from the outside of the bundle and 12 from the inside of the bundle were sampled from the module, dried at room temperature overnight and tensile tested across the fibre. The averaged results are tabled below.

**TABLE 1: RESULTS OF TENSILE TESTS**

| <b>Fibre Tensile Results</b>                                   | <b>Initial (QC data)</b> | <b>Final<br/>outside of bundle</b> | <b>Final<br/>centre of bundle</b> |
|--|--------------------------|------------------------------------|-----------------------------------|
| <b>Force at Break (N)</b>                                      | 1.79                     | 1.84 ± 0.04                        | 1.80 ± 0.04                       |
| <b>Yield Extension (%)</b>                                     | 5.67                     | 5.21 ± 0.12                        | 4.95 ± 0.23                       |
| <b>Young's Modulus (MPa)</b>                                   | 92 ± 4                   | 106 ± 5.35                         | 118 ± 11.42                       |
| <b>Break Extension (%)</b>                                     | 131 ± 7                  | 107 ± 7.15                         | 98 ± 9.04                         |
| <b>Drop in Break Extension<br/>relative to initial results</b> | -                        | 18 %                               | 25 %                              |

There has been a noticeable drop in break extensions of up to 25 %, but this would not be unexpected for a module that is over seven years old.

### 3.3 EDS (Energy Dispersive (X-Ray) Spectroscopy) Analysis

EDS analysis allows a qualitative analyses of elemental inorganic material on the membrane surface. EDS was performed on two random fibre samples, one from the inside and the other from the outside of the membrane fibre bundle. The results are shown in the table below.

**TABLE 2: RESULTS OF EDS ANALYSIS**

| Sample                    | Atomic Weight % <small>see note</small> |      |      |      |     |     |     |      |     |
|---------------------------|---|------|------|------|-----|-----|-----|------|-----|
|                           | C                                       | O    | F    | Al   | Si  | Ca  | Fe  | N    | Na  |
| Inside Middle Location 1  | 65.7                                    | -    | 33.7 | 0.03 | 0.3 | -   | -   | -    | -   |
| Inside Middle Location 2  | 59.6                                    | 19.9 | 19.6 | -    | -   | 1.0 | -   | -    | -   |
| Inside Middle Location 3  | 64.2                                    | -    | 35.8 | -    | -   | -   | -   | -    | -   |
| Inside Middle Location 4  | 62.6                                    | 2.3  | 38.9 | -    | -   | -   | -   | -    | -   |
| Inside Bottom Location 1  | 52.8                                    | 15.7 | 11.7 | -    | -   | -   | -   | 18.6 | 1.2 |
| Inside Bottom Location 2  | 61.6                                    | 1.3  | 37.1 | -    | -   | -   | -   | -    | -   |
| Inside Bottom Location 3  | 64.7                                    | -    | 35.3 | -    | -   | -   | -   | -    | -   |
| Inside Bottom Location 4  | 61.1                                    | -    | 34.2 | -    | -   | -   | 0.9 | -    | -   |
| Outside Top Location 1    | 44.6                                    | 6.4  | 49.0 | -    | -   | -   | -   | -    | -   |
| Outside Top Location 2    | 52.9                                    | 11.5 | 30.6 | -    | -   | 4.9 | -   | -    | -   |
| Outside Top Location 3    | 55.9                                    | 9.5  | 34.6 | -    | -   | -   | -   | -    | -   |
| Outside Top Location 4    | 63.6                                    | 2.9  | 33.5 | -    | -   | -   | -   | -    | -   |
| Outside Middle Location 1 | 49.4                                    | -    | 50.6 | -    | -   | -   | -   | -    | -   |
| Outside Middle Location 2 | 64.3                                    | -    | 35.7 | -    | -   | -   | -   | -    | -   |
| Outside Middle Location 3 | 61.6                                    | -    | 38.4 | -    | -   | -   | -   | -    | -   |
| Outside Middle Location 4 | 61.9                                    | 3.5  | 34.6 | -    | -   | -   | -   | -    | -   |

**Note** EDS analysis is performed on a very small section of the surface of the fibre, therefore the results given above may not be indicative of the entire membrane bundle.



EDS analyses showed the samples to be relatively clean. The Carbon and Fluorine are representative of the membrane formulation and the inorganics detected can be regarded as trace only.





## Appendix – Reference Information

|   |   |
|---|---|
| <b>Module Serial No</b>   | 382036  |
| <b>Module ID:</b>   | WK78654D  |
| <b>Unit Type:</b>   | 90L20V (32024)  |
| <b>Location:</b>  | B4 Initial, C7 Final                                      |
| <b>Installation Date:</b>   | 17/09/2007 (factory), 8/01/2008 (site)                    |
| <b>Removal Date:</b>  | 11/03/2015  |
| <b>CMF Running Time (Hrs)</b>   | Not Known   |
| <b>Pre-Screening:</b>   | 500 µm AMIAD Screen                                       |
| <b>Feedstream:</b>  | Secondary Sewage  |
| <b>Cleaning Regime (CIP) Used:</b>  | CIP every 2 days<br>Acid CIP after every 3 Hypochlorite   |
| <b>Was the module removed immediately after CIP? What was the CIP performed immediately before the module was removed</b> | No, "not for a while"<br>Hypochlorite                     |
| <b>Warranty Claim:</b>  | No  |
| <b>Memlog Connected:</b>  | N/A   |
| <b>Pressure Decay Result:</b>   | 45 kPa/min  |
| <b>Temperature:</b>   | 28° C   |
| <b>Flow Rate:</b>   | Not Known   |
| <b>Backwash Interval (min):</b>   | 35  |
| <b>TMP(measured prior to cleaning) kPa:</b>   | 80 kPa  |
| <b>Other Notes:</b>   | Scouring air flow is not readable due to instrument issue |



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## Miscellaneous

### F-1 Protec Pressure Vessel Drawing and Data Sheet

## Protec Pressure Vessels PRO-8-450-SP

### PRO-8-450-SP



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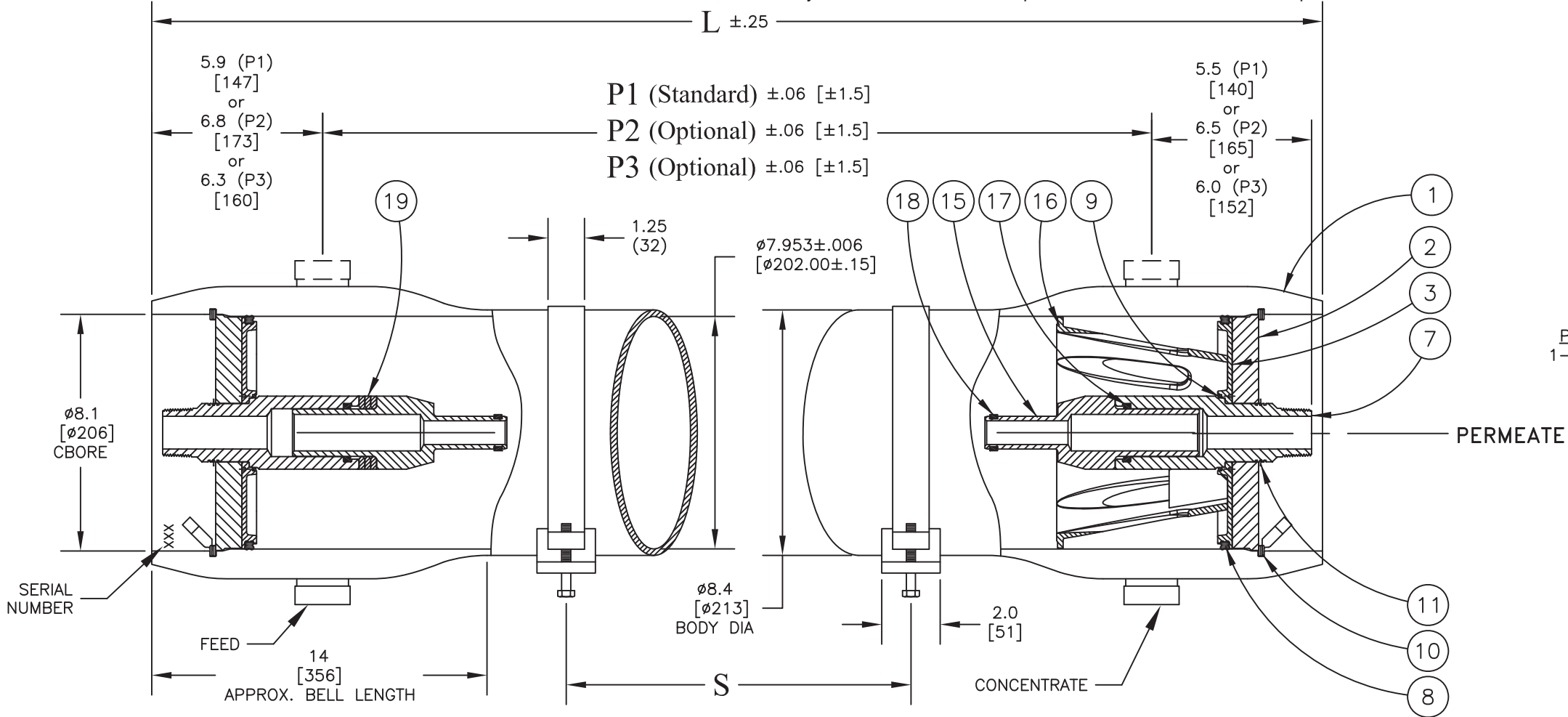
The PROTEC Model PRO-8-450-SP is designed for continuous use as housing for membrane filtration elements to purify typical brackish waters at any positive pressure up to 450 PSI.

What separates this SP model from the traditional side port is the addition of the 3 " port designed specifically for systems using multiple port technology.

The PRO-8-450-SP will accommodate any make of eight-inch nominal diameter spiral-wound element as well as many hollow fiber elements. The element interface hardware for the specified element is supplied with the vessel.

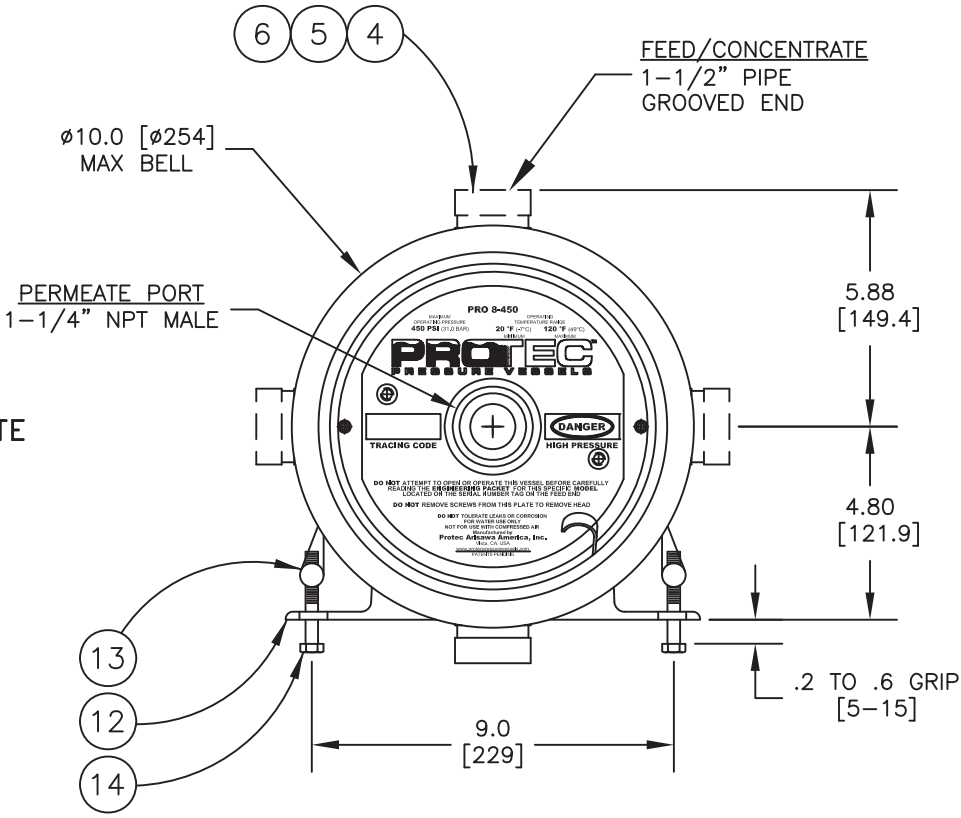
The Model PRO-8-450-SP has been designed to meet the standards of the American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code, Section X. At an additional cost, vessels can be inspected during fabrication by an ASME Authorized Inspector and Code stamped.

|                         |          |                                      |                     |
|-------------------------|----------|--------------------------------------|---------------------|
| Design Pressure         | 450 PSI  | Operating pH Range                   | 3-11                |
| Minimum Operating Temp. | 20°F     | Cleaning pH Range (less than 30 min) | 2-12                |
| Maximum Operating Temp. | 120°F    |                                      |                     |
| Factory Test Pressure   | 495 PSI  | Application                          | Typ. Brackish Water |
| Burst Pressure          | 2700 PSI |                                      |                     |



Design Pressure = 450 PSI @ 120 °F  
Min. Design Temperature = 20 °F @ 450 PSI  
Hydrotest Pressure = 495 PSI

**450 PSI**  
SIDE PORT



NOTE: STANDARD PARTS ARE SHOWN FOR REFERENCE ONLY  
CHECK ORIGINAL ORDER FOR ORDERING SPARE PARTS

| Shell Length Code | L<br>inch<br>(mm)  | P1<br>Standard<br>inch<br>(mm) | P2<br>Optional<br>inch<br>(mm) | P3<br>Optional<br>inch<br>(mm) | S<br>Span<br>in (mm) | Empty Weight<br>lb<br>(kg) |
|-------------------|--------------------|--------------------------------|--------------------------------|--------------------------------|----------------------|----------------------------|
| -1                | 58.7<br>(1490.98)  | 47<br>(1193.80)                | 45<br>(1143.00)                | 46<br>[1168.40]                | 1 @ 28<br>(711.20)   | 76<br>(35)                 |
| -1.5              | 78.7<br>(1998.98)  | 67<br>(1701.80)                | 65<br>(1651.00)                | 66<br>[1676.40]                | 1 @ 42<br>(1066.80)  | 88<br>(40)                 |
| -2                | 98.7<br>(2506.98)  | 87<br>(2209.80)                | 85<br>(2159.00)                | 86<br>[2184.40]                | 1 @ 56<br>(1422.40)  | 99<br>(45)                 |
| -3                | 138.7<br>(3522.98) | 127<br>(3225.80)               | 125<br>(3175.00)               | 126<br>[3200.40]               | 1 @ 80<br>(2032.00)  | 122<br>(55)                |
| -4                | 178.7<br>(4538.98) | 167<br>(4241.80)               | 165<br>(4191.00)               | 166<br>[4216.40]               | 2 @ 64<br>[1625.60]  | 145<br>(66)                |
| -5                | 218.7<br>(5554.98) | 207<br>(5257.80)               | 205<br>(5207.00)               | 206<br>[5232.40]               | 2 @ 78<br>[1981.20]  | 168<br>(76)                |
| -6                | 258.7<br>(6570.98) | 247<br>(6273.80)               | 245<br>(6223.00)               | 246<br>[6248.40]               | 2 @ 92<br>[2336.80]  | 191<br>(87)                |
| -7                | 298.7<br>(7586.98) | 287<br>(7289.80)               | 285<br>(7239.00)               | 286<br>[7264.40]               | 2 @ 106<br>[2692.40] | 214<br>(97)                |
| -7.5              | 318.7<br>(8094.98) | 307<br>(7797.80)               | 305<br>(7747.00)               | 306<br>[7772.40]               | 2 @ 114<br>[2895.60] | 226<br>(103)               |
| -8                | 338.7<br>(8602.98) | 327<br>(8305.80)               | 325<br>(8255.00)               | 326<br>[8280.40]               | 2 @ 120<br>[3048.00] | 237<br>(108)               |

| ITEM | QTY | P/N       | DESCRIPTION                           | MATERIAL                           |
|------|-----|-----------|---------------------------------------|------------------------------------|
| 1    | 1   | 4080020   | Shell                                 | Filament Wound, Epoxy FRP          |
| 2    | 2   | 4080030   | Bearing Plate                         | 6061-T6 Aluminum, SB-221, Anodized |
| 3    | 2   | 4080177-3 | Sealing Plate                         | Noryl GFN2                         |
| 4    | 2   | 4080250   | Feed/Concentrate Port, 1-1/2", "D"    | Stainless Steel, 316, SA-312       |
| 5    | 4   | 6121187   | Retaining Ring, F/C Port, 1-1/2", "D" | Stainless Steel, 316, SA-479       |
| 6    | 2   | 6184604-N | O-Ring Seal, F/C Port, 1-1/2", "D"    | Ethylene Propylene                 |
| 7    | 2   | 4080309   | Permeate Port                         | Noryl GFN2                         |
| 8    | 2   | 6100442MK | Head Seal                             | Ethylene Propylene                 |
| 9    | 2   | 6110229-N | Permeate Port Seal                    | Ethylene Propylene                 |
| 10   | 2   | 4080320   | Retaining Ring w/ Finger Pull         | Stainless Steel, 316, SA-479       |
| 11   | 2   | 6121200   | Retaining Ring, Permeate Port         | Stainless Steel, 316               |
| 12   | 2*  | 4080174   | Support Saddle                        | Thermoplastic Rubber               |
| 13   | 2   | 4080137   | Strap Assembly                        | Stainless Steel, 316L              |
| 14   | 4   | 6150001   | Strap Screw                           | Stainless Steel, 18-8              |
| 15   | 2   | A/R       | Adapter                               | Thermoplastic                      |
| 16   | 1   | 4080165-1 | Thrust Cone                           | PVC Thermoplastic                  |
| 17   | 2   | 6110326-N | Adapter Seal                          | Ethylene Propylene                 |
| 18   | A/R | A/R       | PWT Seal                              | Ethylene Propylene                 |
| 19   | 3   | 4080062-4 | Shim, Adapter                         | Noryl GFN2                         |

\*3 each with shell lengths -4 and longer.

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**NOTES:**  
DIMENSIONS IN INCHES (MM APPROX.)  
FOR REFERENCE ONLY, NOT FOR CONSTRUCTION UNLESS CERTIFIED  
SHIMMING OF THE SADDLES MAY BE REQUIRED  
CENTER VESSEL ON 2 OR 3 SUPPORTS AT SPAN(S) "S".  
INCORRECT MANIFOLDING WILL CAUSE SEVERE LOCAL STRESS AROUND PORT AND MAY RESULT IN LEAKS AND PREMATURE FAILURE. TAKE EVERY PRECAUTION LISTED IN THE ENGINEERING PACKET OR USERS MANUAL.  
INTERNAL PERMEATE PRESSURE MUST NOT EXCEED 125 PSI.  
ASME SECTION X, 2010  
RP CODE STAMP OPTIONAL  
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



**PRO 8-450-SP**

|                           |       |                    |                   |          |
|---------------------------|-------|--------------------|-------------------|----------|
| APPROVED<br>AP<br>12/1/00 | ECO   | REVISED<br>4/28/11 | DRAWING<br>101003 | REV<br>U |
| CHECKED<br>AP<br>12/1/00  | 10119 |                    |                   |          |
| DRAWN<br>AP<br>12/1/00    |       |                    |                   |          |