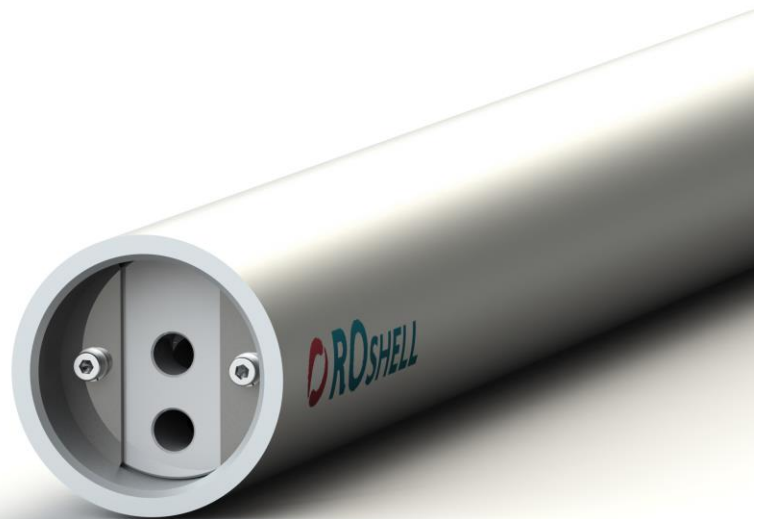


ROShell 4" END PORT PRESSURE VESSEL

RS40E SERIES

USER MANUAL



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TABLE OF CONTENTS

| | |
|--|----|
| 1. Versions and Revisions | 3 |
| 2. General information..... | 4 |
| 3. Safety precautions..... | 5 |
| 4. Installation notes..... | 6 |
| 5. Modifications..... | 7 |
| 6. Technical data | 9 |
| 7. Construction | 10 |
| 8. Technical service | 12 |
| 8.1. Instruction for assembling vessels 4" | 12 |
| 8.2. Instruction for opening vessels 4" | 12 |
| 8.3. Head disassembling/assembling..... | 12 |
| 8.3.1. Head disassembling..... | 12 |
| 8.3.2. Head reassembling..... | 13 |
| 8.4. Vessel cleaning and inspection | 13 |
| 8.5. Loading/replacing membrane elements..... | 13 |
| 8.5.1. Steps to unload membrane..... | 13 |
| 8.5.2. Installation of head assembly at downstream end..... | 14 |
| 8.5.3. Load membrane elements from upstream end of the vessel..... | 14 |
| 8.5.4. Installation of head assembly at upstream end..... | 15 |
| 9. Troubleshooting | 16 |
| 10. Transportation and storage | 17 |
| 10.1. Vessel Handling Precautions | 17 |
| 10.2. Storage Requirements | 17 |
| 11. Limited warranty | 18 |

| Revision | Date | Notes | Page |
|----------|--------------|-------|---------|
| 01 | 2015 January | | 2 of 19 |

1. Versions and Revisions

Revision 1 – 2015 January.

| Revision | Date | Notes | Page |
|----------|--------------|-------|---------|
| 01 | 2015 January | | 3 of 19 |

2. General information

ROShell 4" End Port RS40E Series is a fiberglass pressure vessels designed for the continuous, long-term use as housing for reverse osmosis membrane elements.

The RS40E Series designed to accommodate from 1 to 5 membranes at length 40" in one vessel.

The vessel body produced by a continuous filament winding process and the pipes connections are located on the end assembly parts.

ROShell vessels for reverse osmosis membranes are designed for pressure of up to 1200 psi (82 bar).

Testing of ROShell vessels conforms to all industrial standards, assuring superior technical parameters.

ROShell quality is guaranteed by computer-controlled automatic equipment and high-qualified staff. Production quality control is maintained in accordance with ISO 9001 requirements.

| Revision | Date | Notes | Page |
|----------|--------------|-------|---------|
| 01 | 2015 January | | 4 of 19 |

3. Safety precautions

- ROShell® pressure vessels are designed for high pressure operations. Improper installation, operation service or maintenance may cause severe damage to property, physical injury or death.
- Inspect end closures regularly; replace components that have deteriorated and correct causes of corrosion.
- Regularly inspect the system to verify that head locking components are properly placed and secured. Replace any faulty component.
- It is recommend that only a qualified mechanic, experienced in servicing high-pressure hydraulic systems, should assemble or disassemble vessel.
- Provide overpressure protection in the system safety devices.
- Do not use corroded parts. They may cause difficulties in removing some components.
- Do not operate vessel at temperature over 120°F and do not operate vessel at pressures in excess of specific rating.
- Do not service any component until you verify that vessels and piping are fully depressurized.
- Do not pressurize vessels without element in place, unless permeate ports are plugged properly.
- Do not tolerate leaks or allow end closures to be routinely wetted in any way.

| Revision | Date | Notes | Page |
|----------|--------------|-------|---------|
| 01 | 2015 January | | 5 of 19 |

4. Installation notes

Carefully study the vessel engineering drawings for key dimensions and technical requirements.

Vessels must be installed correctly to ensure safe use and long service life.

Make sure that the vessel is horizontally installed on support saddles.

Straps should be tightened enough to hold the vessel onto the support pads, but never so tightly as to restrict expansion.

Vessel should not support any other system components.

Ensure enough space is reserved around the two ends of the vessel for installation and removal of the membrane elements.

The piping system must be connected to the ports using flexible connectors (victaulics or others) in order to allow relative movement of the vessels and the piping system.

Inspect if all components are in place.

Inspect if all components in as-new condition, clean and free of damage or corrosion.

Inspect if retaining ring is fully seated in the retaining ring groove.

Read and follow the membrane manufacturer installation instructions along with this manual.

| Revision | Date | Notes | Page |
|----------|--------------|-------|---------|
| 01 | 2015 January | | 6 of 19 |

5. Modifications

RS40E series modifications:

RS 40 X . XXX . E X

| | | | | | | | |
|--|--|--|--|--|--|--|---|
| | | | | | | | |
| | | | | | | | Color |
| | | | | | | | B - Blue |
| | | | | | | | W - White |
| | | | | | | | C - Custom |
| | | | | | | | Side-Port Diameter |
| | | | | | | | _ - Empty for End-Port |
| | | | | | | | Side-Port Quantity |
| | | | | | | | _ - Empty for End-Port |
| | | | | | | | Type of Port |
| | | | | | | | E - End-Port |
| | | | | | | | Pressure |
| | | | | | | | 300 - 300 Psi |
| | | | | | | | 450 - 450 Psi |
| | | | | | | | 600 - 600 Psi |
| | | | | | | | 1000 - 1000 Psi |
| | | | | | | | 1200 - 1200 Psi |
| | | | | | | | Quantity of Standard Elements (40" Membrane) |
| | | | | | | | 1 - 1 |
| | | | | | | | 2 - 2 |
| | | | | | | | ... - ... |
| | | | | | | | 5 - 5 |
| | | | | | | | Membrane Diameter |
| | | | | | | | 40 - 4" |

Example

4" end port vessel for three standard elements, 300 Psi, color blue:

RS403.300.EB

RS40E Series modifications:

| Model | Pressure, Psi | D, mm |
|--------------|----------------------|--------------|
| RS40n.300.E | 300 | 117 |
| RS40n.450.E | 450 | 117 |
| RS40n.600.E | 600 | 120 |
| RS40n.1000.E | 1000 | 125 |
| RS40n.1200.E | 1200 | 125 |

| Membrane | Shell length, mm |
|-----------------|-------------------------|
| 40"x1 | 1205 |
| 40"x2 | 2221 |
| 40"x3 | 3237 |
| 40"x4 | 4253 |
| 40"x5 | 5269 |

6. Technical data

ROShell RS40E Series pressure vessels are designed to provide safe operation over a long service life if properly installed, operated, and maintained. The operating conditions:

Drawing Number: 40.00.00

RS40n.300.E Design Pressure: 300 Psi/20,7 Bar

RS40n.450.E Design Pressure: 450 Psi/31 Bar

RS40n.600.E Design Pressure: 600 Psi/41 Bar

RS40n.1000.E Design Pressure: 1000 Psi/68 Bar

RS40n.1200.E Design Pressure: 1200 Psi/82 Bar

Min. Operating Temp: 14°F / -10°C

Max. Operating Temp: 120°F / 49°C

Factory Test Pressure: Standard: 1.5x Design Pressure
ASME: 1.1x Design Pressure

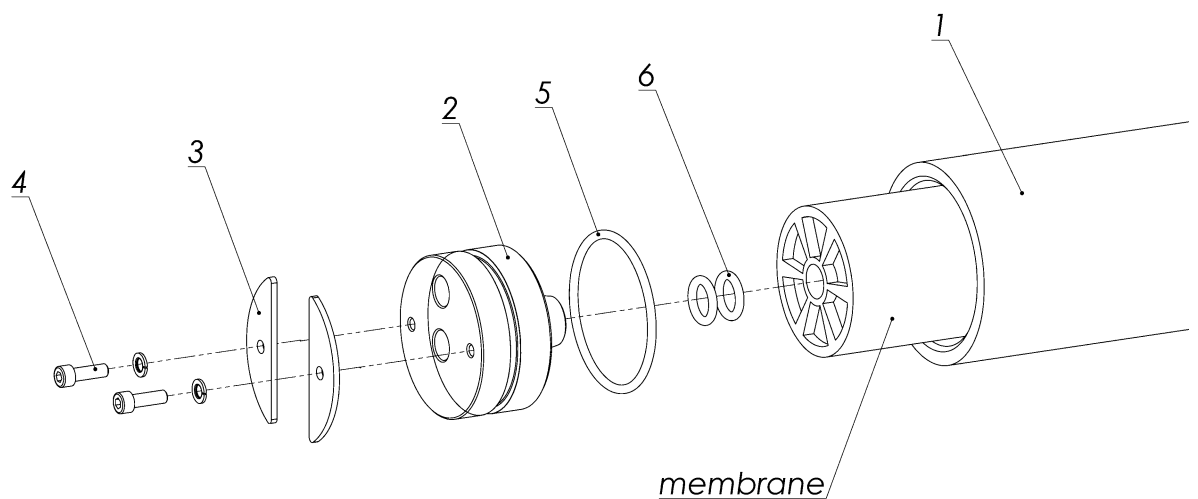
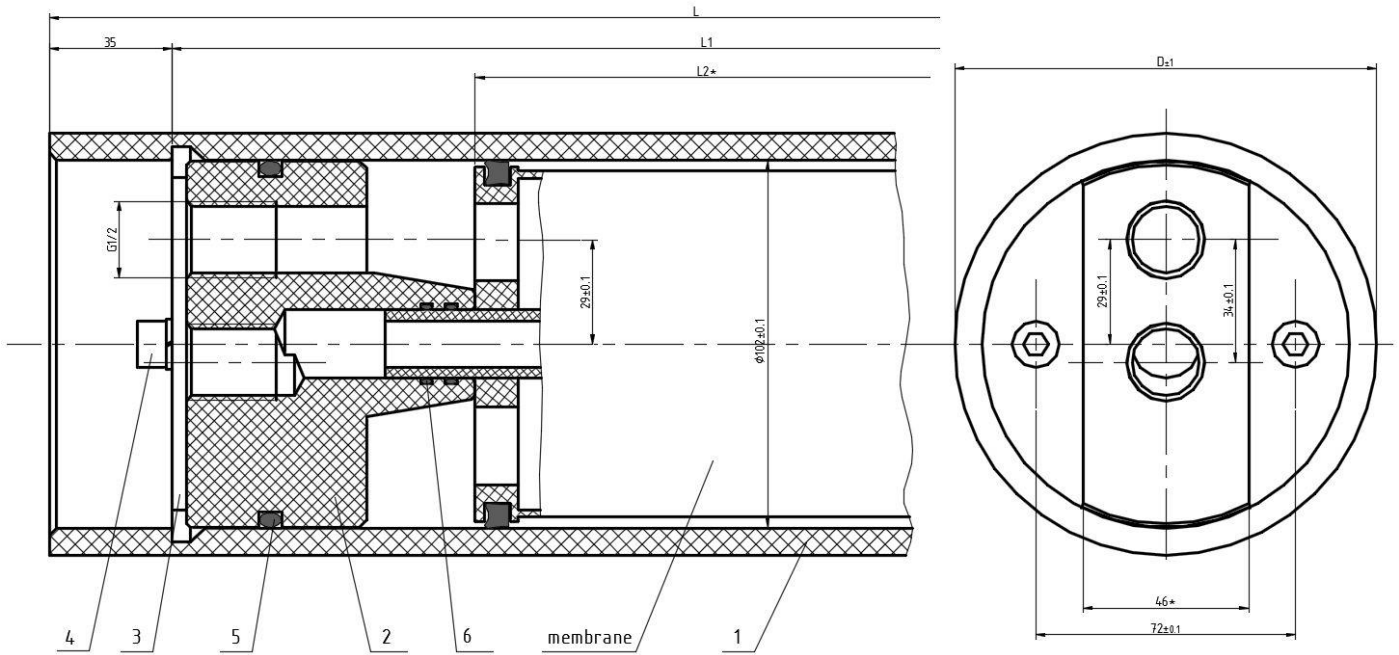
Permeate internal pressure: not to exceed 125 PSI (8.6bar) at temperature 120° F (49 °C). Do not operate the vessel permeate port over 125PSI.

The allowable water PH range: 3-10 under normal operating conditions and 2-12 if the vessel is periodically cleaned.

| Revision | Date | Notes | Page |
|----------|--------------|-------|---------|
| 01 | 2015 January | | 9 of 19 |

7. Construction

RoShell 4" PRESSURE VESSEL End Port assembly



| Revision | Date | Notes | Page |
|----------|--------------|-------|----------|
| 01 | 2015 January | | 10 of 19 |

| Nr. | Part Number | Description | Ref | Q-ty | Material |
|-----|--------------|--------------------------------|-----|------|----------|
| 1 | 40.01.00 | Pressure Shell 40 | 1 | 1 | GRE |
| 2 | 40.04.00 | Internal Plate 4" | 2 | 2 | POM |
| 3 | 40.06.00 | Locking Crescent 4" | 3 | 4 | SS316 |
| 4 | DIN912 M8-25 | Screw M8-25 with spring washer | 4 | 4 | A2 SS |
| 5 | 06-534-8969 | O-ring 89.69x5.34 | 5 | 2 | EPDM |
| 6 | 06-250-1800 | O-ring 18.00x2.50 | 6 | 4 | EPDM |
| 7 | 2714 | IFO-115 (saddle) | | 2 | |

PRESSURE VESSEL DIMENSIONS:

| Memb. Q-ty | 40"x1 | 40"x2 | 40"x3 | 40"x4 | 40"x5 |
|------------|-------|-------|-------|-------|-------|
| L | 1205 | 2221 | 3237 | 4253 | 5269 |
| L1 | 1135 | 2151 | 3167 | 4183 | 5199 |
| L2 | 964 | 1928 | 2892 | 3856 | 4872 |

| Revision | Date | Notes | Page |
|----------|--------------|-------|----------|
| 01 | 2015 January | | 11 of 19 |

8. Technical service

8.1. Instruction for assembling vessels 4"

Check all the components of vessel visually before assembling it. The components must not have a visible damage, which may have an effect during the operation (chips in the places for rubber rings, thread breakage in threaded connections, dents on the internal surface and rents of concentrate channel or cracked rubber rings).

1. Inspect vessel (pos. 1) for a mechanical damage in the inner surface.
2. During the installation lubricate all rubber rings with silicone oil (111 Compound Molykote).
3. Take the internal plate (pos. 2) and in the permeate channel insert the rubber O-rings (pos.6).
4. Put the O-ring (pos.5) around the internal plate (pos. 2).
5. Insert assembled plate (pos. 2) into the vessel (pos. 1). Lubricate seating surface of the vessel with silicone grease.
6. Secure with two locking crescents (pos. 3), and fix with two bolts M8-25 (pos. 4)

The same sequence for assembling the second end of vessel.

8.2. Instruction for opening vessels 4"

1. Shut off all sources of pressure and relieve pressure from the vessel
2. Disconnect all pipes from ports connecting the vessel's heads with the manifolds.
3. Inspect the vessel at each end for corrosion which may interfere with head assembly removal. If corrosion is evident, proceed as follows:
 - Clean any rusts with a small wire brush
 - Flush away loosened rusts with clean water.
 - Open vessel.
4. Before removing the assembled construction (head) from the vessel, unscrew screws M8 (pos.4), remove the locking crescents (pos. 3).
5. Gently tap the assembled construction with a rubber mallet.
6. Thread a ½" NPT male threaded piece of PVC or similar material pipe into one of channels grasp. Pull head straight out. A sharp forceful tug may be required to start head assembly moving.
7. If the head seal remains in the vessel bore, it should be removed at this time.

8.3. Head disassembling/assembling

8.3.1. Head disassembling

| Revision | Date | Notes | Page |
|----------|--------------|-------|----------|
| 01 | 2015 January | | 12 of 19 |

Inspection: Make sure all pressure has been relieved from the vessel, following system manufacturer’s recommendations. Make sure that the head is removed from the vessel according to “Instruction for opening vessels”.

- Remove the O-ring(s) from the internal plate.

8.3.2. Head reassembling

- Lubricate the O-ring and seat it into the groove located on the outside diameter of the internal plate.

8.4. Vessel cleaning and inspection

When the head have been removed, perform a visual inspection of the vessel head and fittings, to locate any signs of corrosion or salt concentrations. If corrosion or salt concentrations are found, follow the following steps:

- Use a small wire brush to loosen any large deposits.
- Put the components in a soapy water and wash their surfaces until all corrosion is removed.
- Rinse components with clear water.
- Blow components dry with compressed air.
- Examine components for damage that may affect structural strength or sealing properties.
- Clean the inner groove of the vessel by removing the residue or corrosions with a mild soap solution and then flush with clean water.

Inspect vessel, if there are scratches on the inner surface of the vessel up to 20 cm depth, grind the area carefully with sand paper until it is smooth.

8.5. Loading/replacing membrane elements

Membrane elements must be loaded at the feed (upstream) end of the vessel, and unloaded through the concentrated (downstream) side of the vessel. Always remove and install elements in the direction of feed flow.

Make a matching list for the removed membrane and the vessel to avoid possible disorder during membrane loading.

8.5.1. Steps to unload membrane

Inspection

- Verify all pressure has been relieved from the vessel, following system manufacturer’s recommendations.
- Ensure the vessel is opened according to **instruction for opening vessels**.

| Revision | Date | Notes | Page |
|----------|--------------|-------|----------|
| 01 | 2015 January | | 13 of 19 |

Disassemble membrane components

- Remove the adapter from the membranes on both sides of the vessel.

Unload the membrane

- Clean off any lubricant residue or salt build up from the inside diameter at both ends of the vessel.
- Remove the membrane out of the vessel according to the membrane manufacturer requirements.

8.5.2. Installation of head assembly at downstream end

1. Apply a layer of Lubricant on the O-ring. Insert a head assembly into vessel. Do not rotate head assembly after insertion into vessel as this may cause head seal to become detached.
2. Hold head assembly square to axis of shell and slide it straight in until a slight resistance is felt.
3. Using both hands, firmly push head in as far as it will go (a sharp, forceful thrust may be necessary to push head seal into vessel bore.) When head is in correct position, insert ring and locking Kit Segment and screw bolts.

8.5.3. Load membrane elements from upstream end of the vessel

1. Inspect the membrane element surface to find any imperfections that could scratch the vessel bore element loading. If a defect is found, which cannot be easily corrected contact the element manufacturer.
2. Using an approximate 50% mixture of glycerin in water, lubricate the inside of the vessel. This may best be accomplished using a suitably sized swab soaked in the mixture. This procedure will ease membrane element loading and reduce chance of scratching the vessel bore.
3. Load the membrane from the feed end of the vessel; ensure that the membrane is properly orientated. If there are more than one membrane to be loaded into the vessel, do not push the first membrane into the vessel completely but reserve around 200mm to facilitate the connection of the next membrane.
4. Inspect and make sure the membrane interconnector is clean and intact. Apply a thin layer of glycerin onto the interconnector seals without excessive amount; otherwise the membrane may get contaminated. Install the interconnector into the loaded membrane.
5. Install and connect the next membrane with the loaded one with the interconnector.
6. Load all membrane elements in the same way. Push all the membranes into the vessel until the adaptor at the concentration end is inserted into the center hole of the first membrane and the membrane face is pushed against the thrust ring.

| Revision | Date | Notes | Page |
|----------|--------------|-------|----------|
| 01 | 2015 January | | 14 of 19 |

8.5.4. Installation of head assembly at upstream end

1. Apply a layer of Lubricant on the O-ring. Insert a head assembly into vessel. Do not rotate head assembly after insertion into vessel as this may cause head seal to become detached.
2. Hold head assembly square to axis of shell and slide it straight in until a slight resistance is felt.
3. Using both hands, firmly push head in as far as it will go (a sharp, forceful thrust may be necessary to push head seal into vessel bore.) When head is in correct position, insert ring and locking Kit Segment and screw bolts.

| Revision | Date | Notes | Page |
|----------|--------------|-------|----------|
| 01 | 2015 January | | 15 of 19 |

9. Troubleshooting

1. If locking kit segment's screw is too tight to thread out, proceed as follows:
 - Apply penetrating fluid (such as WD-40 similar) onto the locking kit segment and gently tap it with a mallet until the screw can be threaded off. Please take care not to contaminate the membrane elements.

2. If there is leakage, the possibilities can be:
 - Deteriorated head seals after running for over 2 years
 - Seals are deformed due to the pH of the medium
 - Seals are deformed due to the high temperature of the medium
 - Seals are damaged due to improper installation
 Proceed as follows:
 - Check the temperature, and pH of the medium.
 - Replace the seals.

3. Body damage of the vessel, the possibilities can be:
 - During transportation.
 - During installation.

4. If damage is serious, replace the vessel.

| Revision | Date | Notes | Page |
|----------|--------------|-------|----------|
| 01 | 2015 January | | 16 of 19 |

10. Transportation and storage

10.1. Vessel Handling Precautions

- **DO NOT** drop vessel or allow it to hit hard on the ground or against other objects.
- Use padding to protect the vessels during handling to prevent damage.
- **DO NOT** Scratch or damage to the inner surface of the vessel.
- **DO NOT** lift the vessel from the Feed/Concentrate ports or permeate ports.
- **DO NOT** impose excessive external force on the vessel.
- **DO NOT** climb on the vessel.
- Damaged vessel must not be used.

10.2. Storage Requirements

- Vessel storage area shall be well leveled, clean and dry.
- Vessels shall not be stored outdoors. Long term exposure to outdoor environment would accelerate aging of FRP and also discoloring and peeling of paint. Vessels placed outdoors for a short period of time shall be covered with oilcloth.
- Make a list of product and spare parts before storage.
- Store vessels in their original packaging.
- Vessel storage area shall be far away from heat source.
- Store in a safe area to keep the vessel from shaking or falling.
- Height: not exceeding 3 packing units. Do not stack any other articles on top of vessels.

| Revision | Date | Notes | Page |
|----------|--------------|-------|----------|
| 01 | 2015 January | | 17 of 19 |

11. Limited warranty

The warranty obligations of Nowadays Technologies are limited to the terms set forth below:

What is Covered:

ROShell vessel (Product) and parts (Parts) are warranted to the original owner to be free of defects in material and/or workmanship under normal use for a period of five (5) year from date of Invoice.

What is Not Covered:

This warranty does not cover:

- defects resulting from improper or unreasonable use or maintenance;
- defects not reported to Nowadays Technologies within the above described warranty period;
- failure to follow operating instructions;
- damage caused by acts of nature or problems resulting from abuse, misuse, negligence or accident;
- unauthorized alteration or modification or attempted repair of Product or Parts;
- damages caused by inadequate packing or shipping procedures;
- Normal wear of replaceable components, including elastomeric Seals, Spacers etc. These parts require maintenance as part of a yearly service schedule.
- Products purchased from unauthorized dealers.
- What Nowadays Technologies will do:
- During the warranty period, Nowadays Technologies will, at its sole option, issue a credit in the amount of the original purchase price of the product, or repair or replace any defective parts within a reasonable period of time.

How to Obtain a Remedy under this Limited Warranty:

If the buyer discovers within this period a failure of the product to conform to specifications, or a defect in material or Workmanship, the buyer must promptly notify Nowadays Technologies in writing. In no event may that notification be received by Nowadays Technologies more than 30 days after the end of the warranty period. Any goods that the buyer believes to be defective are to be returned to Nowadays Technologies factory for examination. However, upon request of the buyer, Nowadays Technologies may, at its discretion, agree to examine the goods in the field. If, upon examination by Nowadays Technologies, any goods sold under this agreement or purchase order do fail to conform to Product specifications, or prove to be defective in material or workmanship, Nowadays Technologies will supply an identical or substantially similar part F.O.B., Nowadays Technologies factory; or Nowadays Technologies, at its option, will repair such part or give credit to the buyer for the original cost of such goods.

Other conditions:

| Revision | Date | Notes | Page |
|----------|--------------|-------|----------|
| 01 | 2015 January | | 18 of 19 |

THE PROVISIONS OF THIS LIMITED WARRANTY ARE IN LIEU OF ANY OTHER WARRANTY, WHETHER EXPRESSED OR IMPLIED, WRITTEN OR ORAL, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. NOWADAYS TECHNOLOGIES MAXIMUM LIABILITY SHALL NOT EXCEED THE ACTUAL PURCHASE PRICE PAID FOR THE PRODUCT.

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Disclaimers:

No dealer or other person has any authority to make any warranties or representations concerning Nowadays Technologies or its Products. Accordingly, Nowadays Technologies is not responsible for any such warranties or representations.

Other legal rights:

This limited warranty gives you specific legal rights, and you also may have other rights that vary from state to state or country to country. Some places do not allow limitations on implied warranties or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

| Revision | Date | Notes | Page |
|----------|--------------|-------|----------|
| 01 | 2015 January | | 19 of 19 |