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TITLE: Installation & Operation Manual for Nautilus Connectors

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1.0 Introduction

This Installation and Operation Manual covers Nautilus plug, receptacle, and penetrator connectors. The connector's outline and interface details are provided on the assembly drawing.

NOTE: This is a generic manual covering all Nautilus connectors. Any project specific instructions, such as field-installable terminations, will be dealt with in a separate document.

NOTE: For Nautilus High Power Connectors, please refer to **D/N 63860** (ODN-342-23).

2.0 Installation

In general, Nautilus connectors are simple and straightforward to install, usually without the need for special tools. However, the following sections should be read to prevent damage to connectors.

NOTE: Where cable termination work and mounting are carried out by those other than Teledyne ODI, then the responsibility for that work lies with the customer or his subcontractor, and the following information is provided for guidance only.

2.1 Solder Pots

Both plug and socket are provided with gold plated solder pots for cable connection. Standard solder pots can accommodate wire sizes up to 14 AWG (2.5 mm²) and up to 10 AWG (6 mm²) using solder bucket adaptors. Termination should be performed per a commercially recognized soldering standard such as IPC/E1A J-STD-001C.

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2.2 Boot Seals

If rubber “mechanical” boot seals are employed, then both wire jacket and boot seal nipple should be cleaned with a warm, 50% distilled water/alcohol solution (verify wire jacket is compatible with alcohol), dried, and then lightly lubricated with dielectric silicone lubricant (e.g., Dow Corning, DC-4). Take care to ensure the wire is cut cleanly and that no sharp edges or stray wires are sticking out that may damage the boot seals during installation. It is recommended that the integrity of seals be verified using standard Insulation Resistance practices.

NOTE: If other cleaning agents or solvents are to be used, contact Teledyne ODI for confirmation of their compatibility with the plastic and rubber parts of the connector.

2.3 O-Rings

Both the plug and receptacle are supplied with all o-rings required for sealing the connector onto its mounting. Normally, these are Nitrile o-rings and their compatibility with the contained fluid (if any) should be confirmed. The o-rings are supplied in a clean separate bag. Prior to fitment, ensure that the o-ring grooves in the connector are clean. Ensure that the o-rings are clean, and lightly lubricate the o-rings with silicone lubricant and install in grooves.

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2.4 General Notes of Caution

Do **not**, under any circumstances, insert anything into the Nautilus receptacle except the Nautilus plug. Insertion of foreign objects such as electrical test probes will most likely damage the seals or break the stoppers. Similarly, probing the pins in the Nautilus plug could result in cracking of the pin insulation.

These Nautilus connectors are designed to withstand differential pressure across them only when the pressure is applied from the connector face normally exposed to the sea. Application of differential pressure in excess of 150 psi from the solder pots side of Nautilus connectors will result in irreparable damage to the connector. For purposes of designing pressure balanced oil-filled systems (PBOF), pressure on the solder pots side of these connectors should not exceed the ambient exterior pressure applied to the connector's open face by more than 150 psi.

Great care should be taken not to drop these connectors. Their solder pots are vulnerable to mechanical damage prior to termination.

Connectors should not be handled by their pigtails. This may cause damage to the solder joints resulting in electrical failure.

Live Connection and Disconnection - These connectors are **NOT** designed to be connected or disconnected while power is applied to the electrical circuits. **Severe** damage (including connector failure) can occur if this is done. In the event that live connection may occur or has occurred, please contact Teledyne ODI for further guidance.

Subsea Storage of Unmated Connector - The connectors should not be left unmated subsea for a cumulative period of greater than two weeks due to corrosion and marine growth.

Connectors should never be left unmated with power applied to exposed pins. Connectors left unmated for more than 2 weeks should be cleaned and inspected. Upon re-deployment it may remain for another 2-week period. Plug connectors should never be left unmated subsea if there is a possibility that the circuits may become energized, this will most certainly result in damage. In the event unmated connectors are to be stored subsea, contact Teledyne ODI, Inc. for the appropriate protective covers.

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Cathodic Protection of Connectors – Teledyne ODI generally manufactures its connectors from titanium which does not require cathodic protection. However, Teledyne ODI does manufacture connectors from various other materials including Stainless Steels. These other materials do require cathodic protection in the subsea environment to prevent corrosion. It is the customer’s responsibility to provide cathodic protection to the connectors as required by the materials.

Galvanic Isolation – Teledyne ODI manufactures its connectors from various materials. Most notably, the ROV connectors are manufactured from titanium. Teledyne ODI can provide isolation adapters for all of its connectors should the mounting structure be made from a dissimilar material. Please contact Teledyne ODI for connector materials and isolation adapters to prevent galvanic corrosion.

Storage of Assemblies – Nautilus assemblies were designed for subsea use and when storing connectors it is optimal to store them in an environment similar to subsea conditions. Maximum life will be obtained from Nautilus if it is stored in a cold, dark location. Exposure to UV sources should be limited as much as possible. Exposure to chemicals (including Ozone) must be limited. It is strongly recommended that chemical exposure is not allowed during storage (Including Ozone). If there is concern that Nautilus connectors may be exposed to chemicals during storage, contact ODI for additional guidance. Additionally, if the assemblies remain unused after 2 years of storage, it is strongly recommended that they be returned to Teledyne ODI for evaluation. If in doubt, contact Teledyne ODI for further information and guidance.

Chemical Exposure – Do Not expose Nautilus to chemicals including the following: (beyond trace concentrations) hydrocarbons, xylene, Brayco SV/A, Carnation Mineral Oil, Hydrolubric 120-B, or Midel 7131. Exposure to these chemicals has a detrimental effect on the insulating materials and can damage the product. Limited exposure (time) and low concentrations can be tolerated in some instances. If a connector has been exposed to any of these chemicals, or requires exposure to these chemicals please contact Teledyne ODI for further guidance.

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Plastic Protective Caps – Plastic protective caps are available for all connectors to provide mechanical, and sometimes electrical, protection of the connectors. These plastic caps were designed for subsea operation and should be stored in a similar manner to the Nautilus product (as described above). Plastic caps have the further requirement of being fully mated to their respective connector to function correctly. Should a cap not be fully mated, damage to the connector, as well as damage to the plastic cap could occur. Teledyne ODI has seen instances where, when plastic protective caps are not fully mated, the latch fingers which retain the cap can change shape and permanently damage the connector. This can be avoided by ensuring the Protective Cap is fully mated (subsea or during storage).

Plastic protective caps do not require any materials to aid in their functionality. **DO NOT** fill the protective caps with any type of viscous fluid in an attempt to further protect the connectors. Teledyne ODI has seen instances where this type of process has caused damaged to the Nautilus connectors.

Handling of ROV Connectors – Teledyne ODI ROV connectors employ metallic latch fingers to perform the mating/de-mating function for the connectors. These metallic fingers are actuated by a slide shell which slides over the outside of the connector and provides a mounting point for the orange ROV handle. This slide shell may be activated by other methods, including (but not limited to) dropping the connector and impacting the front of the connector. This will force the connector slide to the actuated position fully engaging the latch fingers. In this instance it is possible to damage these latch fingers with excessive loading, or impact energy. To prevent damage, take great care not to over actuate the slide shell/latch fingers during surface handling.

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3.0 Operation

Nautilus connectors require no special instructions regarding their operation. The following lists the capabilities of the Nautilus connector. These should not be exceeded.

3.1 Standard Nautilus Specification

Characteristics:	These connectors are intended for general subsea use. They are wet-mateable at the surface and at depth.
Pressure Rating:	Pressure balanced - 10 kpsi Differential Pressure - Contact Teledyne ODI for rating of connector in question.
Current Rating:	30 AMP/circuit
Breakdown Voltage:	> 15,000 volts AC or DC
Electrical Insulation Resistance:	≥ 10 gigaohms between circuits and to seawater @1,000 VDC
Electrical Contact Resistance:	≤0.2 Ohms/circuit (Light Current (mA))
Operating Temperature:	-2° C to +50° C
Storage Temperature:	-20° C to +60° C (-25° C possible with reduced safety factor)
Mating Cycle Lifetime:	>1,000 mate cycles
Design Life	25 years In subsea environment

NOTE: The above refer to the Nautilus connectors' qualified capabilities and not to the Factory Acceptance Tests actually carried out on the delivered connectors. Refer to test procedure for details of the delivered connectors tested parameters.

3.2 ROV Mate Nautilus Connectors

ROV connectors should be mated and de-mated using only the attached handle. The mate is a simple push to connect and the de-mate is a simple pull to disconnect, both via the handle. Any attempt to disconnect by pulling on other parts of the connector (including the hose or cable termination) will likely result in permanent damage to the connector. The following lists the capabilities of the ROV Mate Nautilus Connector. These should not be exceeded.

3.3 ROV Mate Nautilus Specification

|| Minimum Connector Mating Force Required for Successful Mate ($\pm 10\%$): ||

4-WAY	6-WAY 7-WAY	8-WAY 9-WAY	12-WAY
35 lb 16 kgf	55 lb 25 kgf	62 lb 28 kgf	84 lb 38 kgf

ROV Handle De-mating Force: 35 – 55 lb (16 – 25 kgf)

Connector Mated Breakaway Force: >300 lb (136 kgf) applied via hose or termination shell

ROV Mating Indication: Visual Latch Finger Engagement (See Photos 1 & 2)

Maximum Allowable Axial Force During Mating: Approximately 450 lb (204 kgf), depending on connector configuration



Photo 1: ROV Connectors showing ROV Latch Fingers in the closed position



Photo 2: ROV Connectors showing ROV Latch Fingers in the open position

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3.4 Maintenance

Nautilus connectors require no periodic maintenance and are maintenance-free for their intended life subsea. If damage occurs to the connector, then the entire connector must be returned to Teledyne ODI for repair or replacement.

General Connector Cleaning

If it becomes necessary, Nautilus connectors can be cleaned following the instructions below:

NOTE: Do not disassemble connectors. General cleaning instructions are intended for light to moderately soiled connectors. If a connector exhibits reduced performance and extreme soiling is suspected, return the connector to Teledyne ODI for repair or replacement.

3.4.1 Nautilus plugs: Plugs can be cleaned with a warm 50% distilled water/alcohol solution. This includes the pins, shell, and most boot seals. Some rubber compounds display reduced electrical performance after exposure of alcohol; please contact Teledyne ODI prior to cleaning boot seals to verify materials. If the boot seals are cleaned with Alcohol and insulation resistance is lost, the boots must be replaced to recover the insulation value. An alternate cleaning solution of Alconox may be used which will not affect the performance of the boot seals. Rinse the connector thoroughly with the solution followed by a clean water rinse. If performance does not improve, clean a second time using a soft, natural bristle brush.

NOTE: Use caution when cleaning pins, side-loading will result in cracked pins.

3.4.2 Nautilus receptacles: Receptacles can be cleaned by rinsing with clean water. Do not clean receptacles with alcohol, the Alconox solution cleaner may be used on receptacles.

NOTE: Never insert anything into the receptacle since this may introduce contamination into the connector or cause internal damage.

Never inject connectors with any type of fluid or attempt to clean connectors with any fluid not stated above. For specific questions, contact Teledyne ODI.

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Removal of Marine Growth and Calcareous Deposits

- 3.4.3 To remove calcite growth from the Nautilus connectors, a solution of 50% by volume of Citric Acid and water is recommended. All Seawater exposed elastomeric materials in the connectors have been fully tested against Citric Acid and are compatible for duration of 1 hour. After soaking, rinse thoroughly with fresh water to remove traces of the Citric Acid solution. Use of a low pressure water jet is acceptable, but the jet should not be directed onto the white stoppers at the front of the receptacle or into the radial vent holes as this could result in a risk of water being forced through the primary seals.