TITLE: **Installation & Operation Manual for Modular Connectorized Distribution Unit - MCDU**

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Contents

1.0 Introduction

This installation and operation manual covers Teledyne Oil & Gas, Inc. MCDU assemblies. If required, the MCDU outline and interface details will be provided from drawings referenced on the assembly drawing. Since the MCDU is a custom unit, some interface dimensions may vary however utilization of standard components and connectors are included as part of this unique assembly.

Refer to the following operations manual(s) for information about the associated connector(s):

- Nautilus Connector Installation and Operations Manual – **DN 10368-1**
- Wet-Mate Hybrid Connector Installation and Operations Manual – **DN 10272-1**

2.0 Unpacking

The MCDU is supplied as an integral assembly with loose components bagged and tagged for identification. The loose components are primarily for the installation of the MCDU into the host structure. Great care must be taken while unpacking the MCDU to prevent damage to the connectors and accompanying hardware. The MCDU is packaged to prevent movement during transit. In some specific designs, the MCDU is positioned within the accompanying landing base frame and secured. The MCDU including the landing base frame are packaged together to ensure the individual components arrive together and without damage. The following check list should be used as guidance during unpacking of the assemblies.

2.1 Check list

2.1.1 Upon opening the shipping container, check to see if the contents appear to have been disturbed.

2.1.2 Inspect the packing material that the MCDU and connectors are lying on for the presence of excess silicone oil.

NOTE: A small amount of silicone oil may be present from filling the hybrid connectors just prior to shipment. This is normal.

2.1.3 Taking care not to damage any optical fiber pigtails that may be present, remove the MCDU assemblies from the packing crate.

NOTE: Do not pick-up the MCDU by the mounted connectors. Lift the MCDU at the end plates, lifting eyes, or the “T” handle if present. Lifting at the end plates will require two people. DO NOT try and remove the assembly without the support of additional help or by the use of a lift crane.

2.1.4 Verify there is no damage to the fiber pigtails if present.

2.1.5 Inspect the MCDU and related connector assemblies for any signs of damage.

2.1.6 Refer to the relative connector installation and operations manual for further instructions regarding the inspection of the type of connectors.

3.0 Installation

The installation of the MCDU is based upon the type of assembly. The *retrievable* MCDU is usually accompanied by a landing base frame. The *fixed mount* MCDU includes the necessary brackets and related mounting bolts necessary for installation. The landing base frame associated with the retrievable option is secured to the host structure with the MCDU independent of the frame. The retrievable option may not include the mounting bolts necessary to secure the landing base frame to the structure. In this case, the customer has opted to provide the necessary hardware.

NOTE: Where the mounting of the MCDU is carried out by those other than Teledyne Oil & Gas, Inc. the responsibility for that work lies with the customer or his subcontractor. The following information is provided for guidance only.

3.1 Retrievable MCDU

For those applications, we recommend that the MCDU landing base frame be secured prior to the installation of the MCDU assembly.

3.1.1 MCDU

3.1.1.1 The retrievable MCDU is supplied with a lift “T” handle or similar option to be used as the intervention point by the ROV. At no time should the MCDU be lifted by the connectors.

3.1.1.2 Usually the MCDU manifold weldment is made from titanium for the retrievable option. Ensure the manifold is placed in a safe zone when separated from the landing base. This will reduce the likelihood of potential damage.

3.1.1.3 Ensure the connectors are protected by the use of the protective caps provided during shipment/handling. These caps are for shipping/handling purposes and should be removed prior to deployment or for testing.

3.1.2 Landing Base Frame

3.1.2.1 The landing base frame has been designed to capture the MCDU and retain in position in the deployed state. Depending upon the design and the requirements, the frame may include a positive detent assembly used in the prevention of separation between the MCDU and the frame.

3.1.2.2 The installation of the frame requires positioning within the host structure and secured through the use of either customer or Teledyne Oil & Gas supplied hardware.

3.1.2.3 If the frame has been epoxy coated, it is important to minimize movement to prevent damage to the coated surfaces. If movement is necessary, provide a protective layer of a material that will prevent damage to the epoxy surface during placement.

NOTE: Loctite 425 is strongly recommended on plastic components or when plastic components are adjacent to fasteners. Thread-locking fluid and primer specified for metallic components can cause stress cracking if used on certain plastics.

3.1.2.4 Depending upon the bolt size, the use of an approved thread locking fluid similar to Loctite 293 for Metallic parts or Loctite 425 for any Plastic parts should be included as part of the assembly process. Apply a small amount of thread lock to each fastener prior to installation and tightening. Refer to table 1 for a list of suggested torque values to be used in accordance with a particular fastener thread size.

3.1.2.5 Once secured, install the MCDU into the landing base and check for ease of installation. The MCDU should slide smoothly into position through the use of guide strips mounted within the frame. Once installed, engage the optional detent assembly to ensure the device operates as intended and prevents the MCDU from removal.

3.1.2.6 It is recommended that the MCDU be removed from the landing base and installed to complete one additional trial cycle. This trial fit check should be completed prior to final preparations for deployment.

3.1.2.7 The frame has been supplied with a ground strap and mounting screw. (Figure 1) Ensure the ground strap tab is secured to an unpainted surface of the host structure to provide connectivity to the CP system. Tighten the screw to the torque value per table 1.

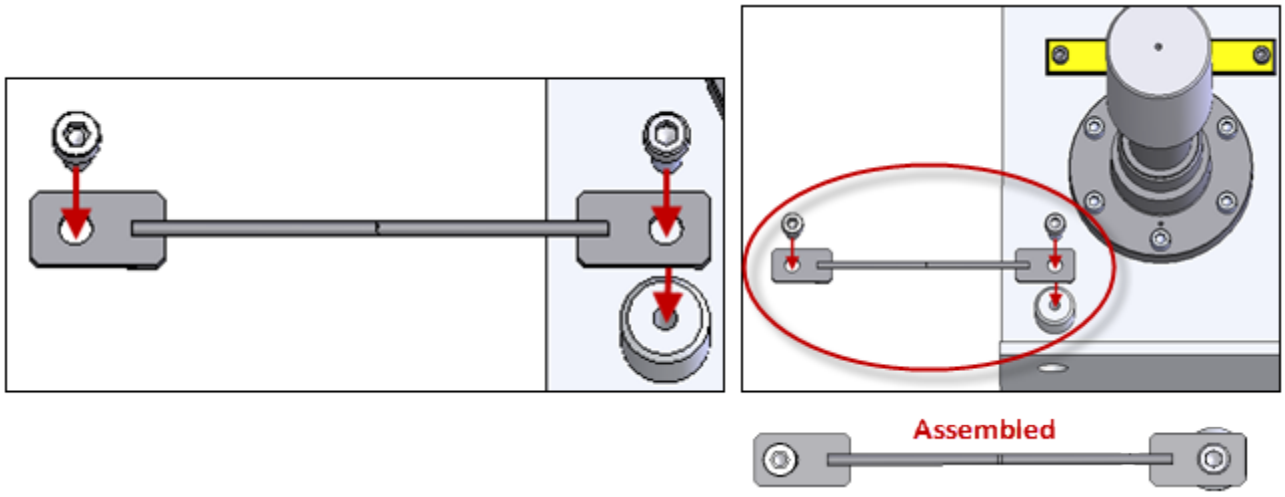


Figure 1

3.1.2.8 If the MCDU is equipped with a ground strap and the landing frame is equipped with the corresponding ground point, the MCDU ground strap must be attached to the landing frame ground point pre deployment and unhooked prior to retrieval of the MCDU.

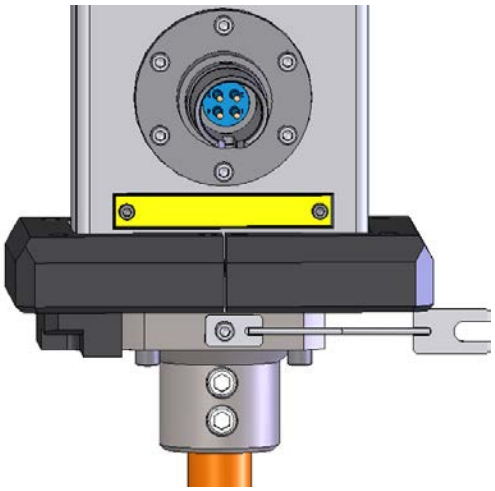


Figure 2

3.2 **Fixed Mount MCDU**

For those applications, we recommend that the required outline dimensions be verified on the host structure in accordance with the interface drawing prior to the installation of the MCDU assembly.

3.2.1 MCDU

3.2.1.1 The fixed mount MCDU is supplied with the necessary mounting hardware to secure into position within the host structure. At no time should the MCDU be lifted by the connectors.

3.2.1.2 Usually the MCDU manifold weldment is made from stainless steel and may include epoxy coating. Ensure the manifold is placed in a safe zone prior to installation. This will reduce the likelihood of potential damage to the painted surfaces.

3.2.1.3 Ensure the connectors are protected by the use of the protective caps provided during shipment/handling. These caps are for shipping/handling purposes and should be removed prior to deployment or for testing.

NOTE: Loctite 425 is strongly recommended on plastic components or when plastic components are adjacent to fasteners. Thread-locking fluid and primer specified for metallic components can cause stress cracking if used on certain plastics.

3.2.1.4 Depending upon the bolt size, the use of an approved thread locking fluid similar to Loctite 293 for Metallic parts or Loctite 425 for any Plastic parts should be included as part of the assembly process. Apply a small amount of thread lock to each fastener prior to installation and tightening. Refer to table 1 for a list of suggested torque values to be used in accordance with a particular fastener thread size.

3.2.1.5 The MCDU may have been supplied with a ground strap and mounting screw if the MCDU housing is stainless steel. Ensure the ground strap tab is secured to an unpainted surface of the host structure to provide connectivity to the CP system. Tighten the screw to the torque value per table 1.

3.2.1.6 If MCDU housing is titanium, do not connect to CP system with a ground strap. Instead use the provided isolation components to ensure MCDU is isolated from CP system. See **Figure 3** for example of isolation components. The fasteners, however, must be connected to CP system since they are stainless. It is therefore recommended to check the fasteners for connection to CP system after assembly process is complete.

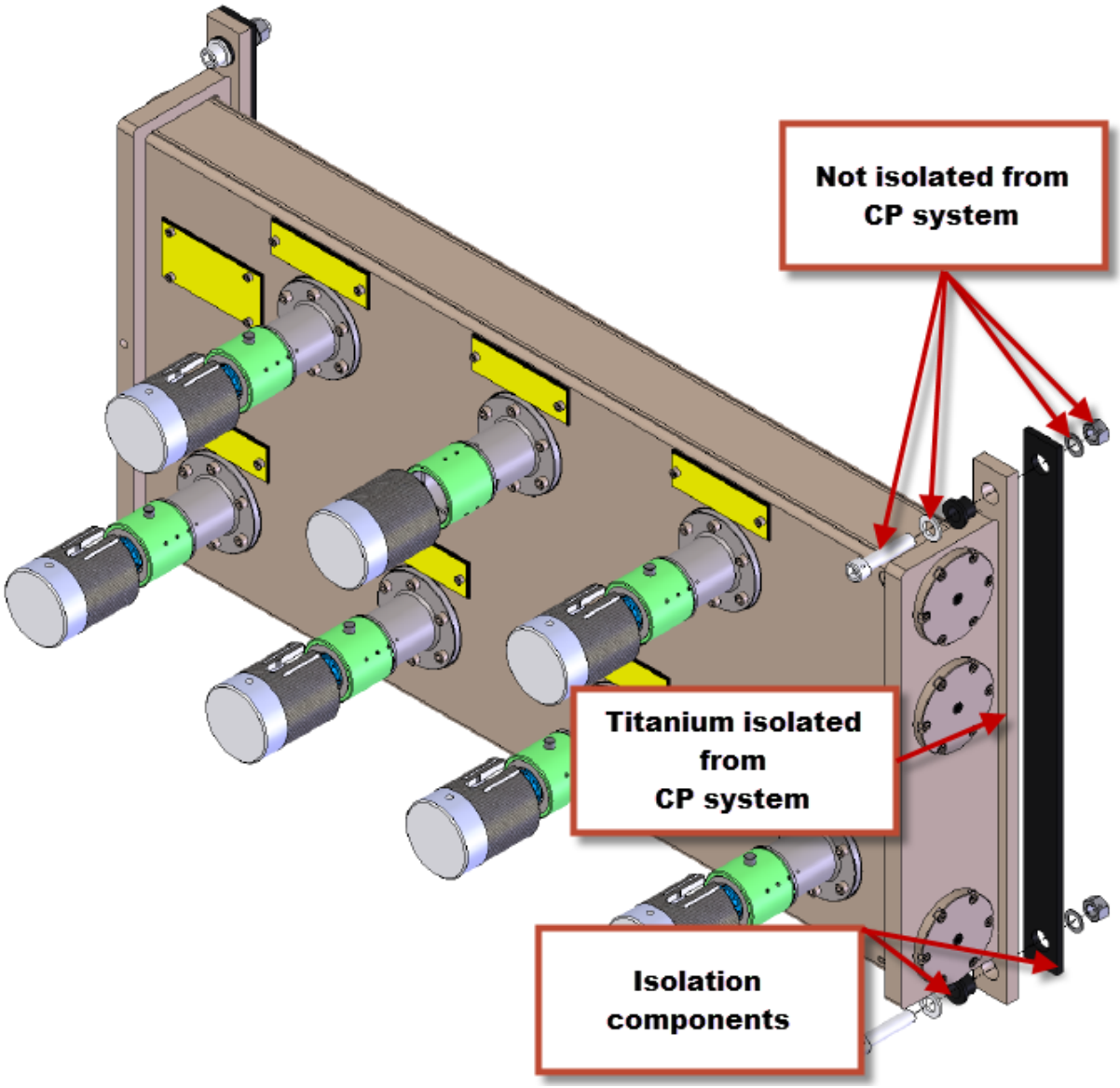


Figure 3

Fastener Size	**Torque (in-lbs ±10%)** (hex head & socket head cap screws)
10-32	17
¼-20	35
¼-28	40
5/16-18	72
5/16-24	80
3/8-16	128
3/8-24	144
M12 X 1.75	270
½-13	240
½-20	272
5/8-11	336
5/8-18	395

Table 1

Fastener Torque Suggestions for Standard Materials

3.3 **ROV Guidelines – Retrievable MCDU Assembly**

3.3.1 There are no features located on the MCDU landing base frame that can provide ROV docking. The docking of the ROV must occur on the host structure.

3.3.2 If the landing base design includes the use of a detent assembly, the ROV will be required to "unlock" the assembly prior to removal of the MCDU.

3.3.3 The horizontal "T" handle will need to rotate clockwise 90^{o} in order to "unlock" the detent. Grab the "T" handle and rotate clockwise until the handle is on a vertical position. At this point the handle will not rotate further based on the fixed hard stop of the assembly.

3.3.4 Pull the "T" handle in the vertical position until maximum distant is reached against a hard stop feature of the assembly. The detent is now in the unlocked position and the MCDU is ready for retrieval.

3.3.5 Grab the vertical "T" or similar handle design located at the top of the MCDU assembly and begin to lift the assembly from the landing base frame.

3.3.6 Installing the MCDU assembly into the landing base frame will be similar to the retrieval steps.

3.3.7 Install the retrievable MCDU assembly into the landing base frame by using the frame features to guide the manifold into position. The large funneled entry of

the frame can be used to align the manifold to the entry opening of the frame.

3.3.8 Once aligned at the frame opening, the MCDU manifold will further align and slide against the plastic runners mounted within the frame. The MCDU should be lowered until the manifold is completely positioned within the frame and bottoms against the hard stop.

3.3.9 If equipped with a detent assembly, the ROV must grab the "T" handle and push forward until it reaches the hard stop feature. Rotate the "T" handle counterclockwise 90^{o} in order to "lock" the detent into position.

3.3.10 The MCDU is secured and unable to be removed from the landing base frame.

3.4 ROV Mating Guidelines – Connectors Positioned in Horizontal Connection

NOTE: The following guidelines with respect to ROV intervention of the connectors can be reviewed in greater detail in each installation manual for the particular type of connector.

3.4.1 Use the ROV manipulator jaw to grasp the flying lead handle squarely. Adjust the arm so that the connector is held as close to horizontal as possible. The alignment keyway in the ROV connector should be aligned with the key on the bulkhead connector located on the MCDU assembly.

3.4.2 Position the manipulator jaw and the connector such that the camera is in line with the centerline of the axis of the connector.

NOTE: Positioning the camera off axis to the ROV connector increases the potential for damaging due to misalignment.

3.4.3 Once the conical lead-in on the ROV flying connector has engaged the outer bushing on the bulkhead connector located on the MCDU and proper alignment is confirmed, mate the connectors by applying linear motion and along the axis of the connectors.

NOTE: If the ROV connector is not aligned with the bulkhead connector, attempt again to re-align the connectors before mating. If the stab is made with very slight misalignment (+/- 5° tilt), the connector handle is compliant enough to allow the connectors to mate without damage. However, excessive angular misalignment (greater than +/- 5°) can cause severe damage to the connectors.

3.4.4 Positive thrust should be maintained until the locking arms (latch fingers) on the ROV flying connector are witnessed as flush with respect to the side of the ROV connector shell.

3.4.5 Ensure that latch fingers are flush with respect to ROV connector shell.

3.5 ROV Connector Mating Guidelines – Connectors Positioned in Vertical Connection

NOTE: The following guidelines with respect to ROV intervention of the connectors can be reviewed in greater detail in each installation manual for the particular type of connector.

3.5.1 Use ROV manipulator jaw to grasp the plastic handle on the ROV flying connector.

3.5.2 Position the manipulator jaw and connector such that the camera is in line with the centerline axis of the connector.

NOTE: Positioning the camera off axis to the ROV connector increases the potential for damaging due to misalignment.

3.5.3 Use the ROV manipulator jaw to gently set the ROV flying connector onto the bulkhead connector so that the acceptance cone in the ROV flying connector guides down onto the bulkhead connector bushing.

NOTE: If the ROV connector is not aligned with the bulkhead connector, attempt again to realign the connectors before mating. If the stab is made with very slight misalignment (+/- 5° tilt), the connector handle is compliant enough to allow the connectors to mate without damage. However, excessive angular misalignment (greater than +/- 5 °) can cause severe damage to the connectors.

3.5.4 Release the manipulator jaw from the connector handle.

3.5.5 Turn the manipulator jaw on its side and gently press down on the top of the handle until the locking arms (latch fingers) on the ROV connector are witnessed as flush with respect to the side of the ROV connector shell.

3.5.6 Ensure that latch fingers are flush with respect to ROV connector shell.

3.6 ROV De-mating Guidelines – Connectors Positioned in Horizontal Disconnection

NOTE: The following guidelines with respect to ROV intervention of the connectors can be reviewed in greater detail in each installation manual for the particular type of connector.

3.6.1 Position the manipulator jaw and connector such that the camera is in line with the centerline axis of the connector.

NOTE: Positioning the camera off axis to the ROV connector increases the potential for damaging due to misalignment.

3.6.2 Stabilize the ROV sub then close the manipulator jaw on the flying connector plastic handle.

3.6.3 Apply linear and steady motion to disconnect the flying lead.

3.6.4 Inspect the connector faces.

3.7 ROV De-mating Guidelines – Connectors Positioned in Vertical Disconnection

NOTE: The following guidelines with respect to ROV intervention of the connectors can be reviewed in greater detail in each installation manual for the particular type of connector.

3.7.1 Position the manipulator jaw and connector such that the camera is in line with the centerline axis of the connector.

NOTE: Positioning the camera off axis to the ROV connector increases the potential for damaging due to misalignment.

3.7.2 Stabilize the ROV sub.

3.7.3 Extend and open the ROV manipulator jaw.

3.7.4 Position the open manipulator jaw squarely under the connector handle.

3.7.5 Raise the manipulator arm vertically to raise the connector slightly off the bulkhead receptacle.

3.7.6 Close the manipulator jaw on the handle to avoid dropping the connector.

3.7.7 Inspect the connector faces.

4.0 General Notes of Caution

The Teledyne Oil and Gas MCDU and related connectors are unlike any other connectors with which you may be familiar and they require special handling to function properly. Failure to follow correct procedures, as outlined below, will most likely cause **severe** damage.

4.1 **Never** exceed the connector specifications.

4.2 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 Oil & Gas, Inc. for further guidance.

4.3 Do not permit exposure of the connectors to petroleum-based fluids or lubricants, or other aggressive fluids that adversely affect natural rubbers.

4.4 Do not permit prolonged exposure to sunlight. Always fit a temporary or permanent protective cap when any connectors are left unmated.

4.5 Simple tests, such as continuity, for example, can only be done on fully mated connectors with conductor pigtails or other exposed cable ends. Probing or visual inspection on either connector half should be avoided.

4.6 **Never** attempt to actuate the connector's seals using anything but a mating connector.

4.7 **Never** attempt to insert anything into any of the ports of the connector shells.

4.8 Avoid any damage to the exposed rubber parts on the connector's mating faces.

4.9 Be extremely careful not to sharply bend the optical fibers as applicable, which are particularly vulnerable at the point where they exit the MCDU. Fiber breakage resulting in the permanent loss of the affected circuit would result.

4.10 The high mating and de-mating forces can make hand mating difficult. This is particularly true for ROV mateable versions. Care should be taken to ensure that excessive force is not used to mate or de-mate the connector and that the maximum mating/de-mating speed is not exceeded. The mating/de-mating motion should be smooth and steady. If access to the connectors makes controlled mating and de-mating difficult, then Teledyne Oil and Gas, Inc. should be contacted to provide either on site assistance or for consultation on a mating and de-mating fixture tailored to the specific application and the access limitations.

4.11 Like all of Teledyne Oil & Gas standard ROV connectors, ROV versions of the connector should be mated and de-mated using the attached handle only. 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.

4.12 Do not coil the hose more than 1/2 turn within 3 feet of connector/penetrator termination shell. Excessive coiling of the hose in close proximity to the termination shell could lead to fiber and wire management issues inside of the termination shell.

4.13 Ensure the vent ports located on the end plates of the MCDU are not blocked after installation. Blocking of the vent ports will result in damage to the internal bladders of the assembly. The retrievable option automatically provides clear access to the ports by design.

5.0 Operation

The following lists the capabilities of the MCDU assembly. These should not be exceeded. Refer to the relative operations manual of the connector used in the MCDU for additional operating capabilities.

- Operational Temperature: -5°C (+32°F) to +40°C (+104°F) (seawater)
- Storage Temperature: -20°C (-4°F) to + 60°C (+140°F)
- Operational Pressure: 4,500 psi (3,000 m depth) up to 10,000 psi (7,000 m depth)

NOTE: If an application is outside of this range, contact Teledyne Oil & Gas Engineering.

NOTE: +60°C Maximum allowable product storage temperature including ambient, solar, and internal contributions.

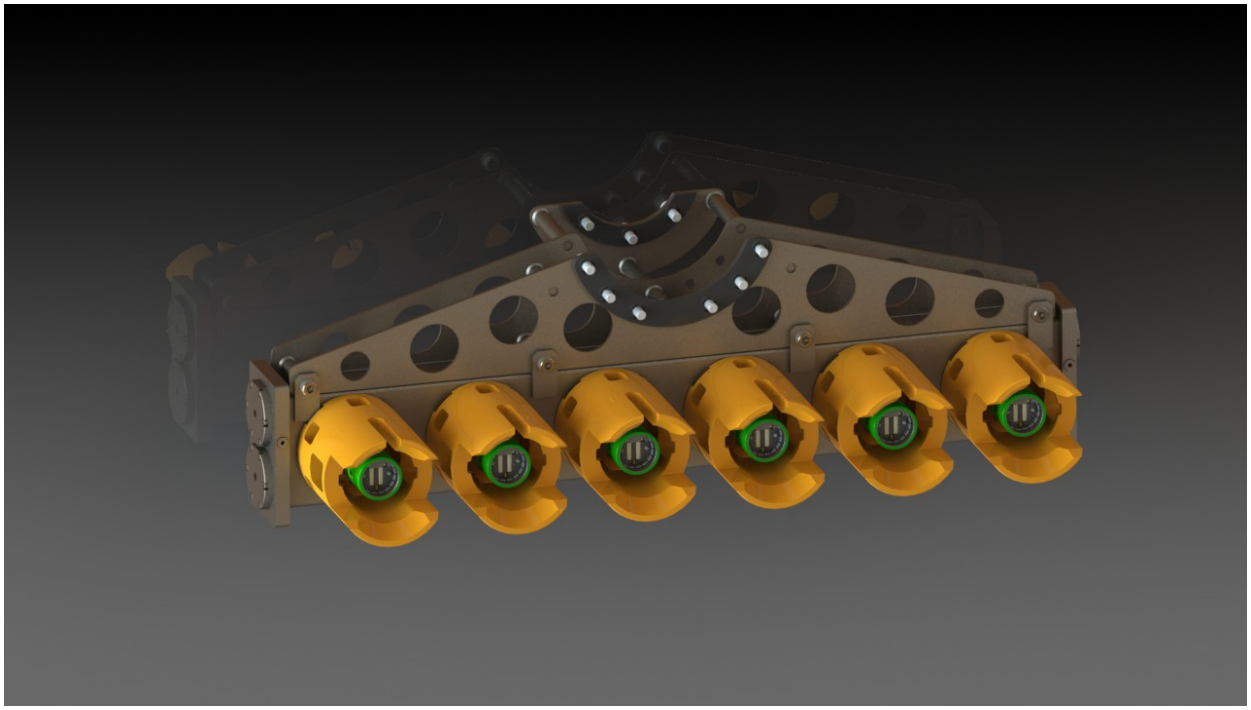
6.0 Storage

6.1 **Short-term Storage (up to 1 year)**
The connectors should be stored in clean, dry conditions and protected from exposure to sources of UV or ozone. Preferably, they should remain in their original shipping containers with shipping/protective caps in place.

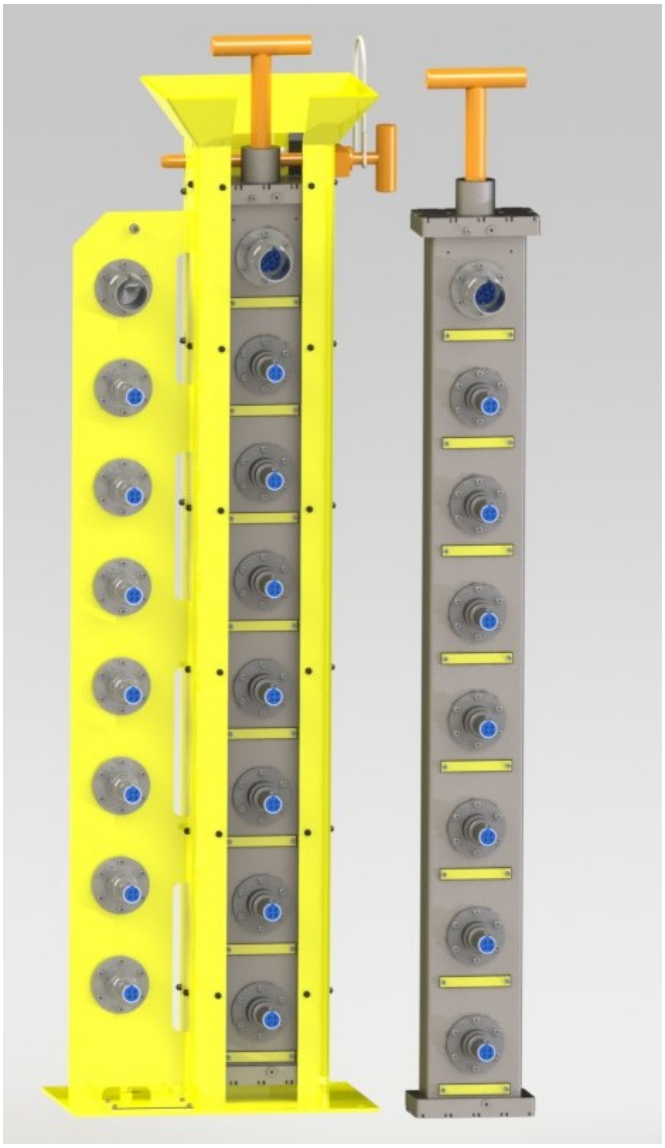
6.2 **Long-term Storage (greater than 1 year)**
The same storage conditions should be observed as specified in 6.1 above.
Additionally, if the connectors remain unused after 2 years of storage, it is strongly recommended that they be returned to Teledyne Oil & Gas, Inc. for evaluation. If in doubt, contact Teledyne Oil & Gas, Inc. for further information and guidance.

APPENDIX A: FIGURES

Fixed Mounted MCDU



Retrievable MCDU (without landing base)



Retrievable MCDU with Landing Base Frame

Revision History

Revision	CO #	Revised By	Summary of Changes	Release Date
E	33537	K. Hanecki	Changed the email address on cover page	8/6/14
D	32825	M. Hemby	Added Figure 3, step 3.2.1.6, and notes before steps 3.1.2.4 and 3.2.1.4. Clarified steps 3.1.1.3, 3.2.1.3, and 3.2.1.5. Added M12 to Table 1.	5/28/14
C	30527	S. Jackson	Added Figures 1 and 2; added step 3.1.2.8.	9/17/13