SIEMENS energy

DigiTRON

Installation, Operations and Maintenance Manual

IOM-001 Rev 16

DigiTRON EFL's, Jumpers and Harness Assemblies
Protection, Storage, Shipment, Unpacking, Deployment and Maintenance Instructions

siemens-energy.com

DigiTRON EFL's, Jumpers and Harness Assemblies Protection, Storage, Shipment, Unpacking, Deployment and Maintenance Instructions

Thank you for purchasing a Siemens Energy Subsea product. The information contained in this document is an overview including the protection, storage, shipment, unpacking, deployment and maintenance for DigiTRON connector product range.

IMPORTANT

READ CAREFULLY BEFORE USE

KEEP FOR FUTURE REFERENCE

Rev	Compiled by	Date	Approved by	Issue Date	Page(s) Affected/Remarks
16	R Wyatt	17/03/2023	JP Smith	17/03/2023	Sections affected: 2.2, 6.1, 6.2, 6.4, 7.7, 8.2, 9.6 9.9, 9.10. Information added or changed: temperature limits for storage 50°C air temp. Outdoor storage of wooden crates. Bend radius gauge and protection from crate edges. Checks for test connectors, incl gauge for bent pins. Inspection for corrosion, damage to front seals added. Cleaning with IPA added. Visibility of lipseal indicator from side view. Figure 21 updated to include cold shrink.
15	L.Belcher	04/08/2022	R Wyatt	04/08/2022	Section 7.4 Non-Standard Bracket added.
14	R Wyatt	27/06/2022	R Wyatt	27/06/2022	Siemens Energy front and back cover pages added
13	R Wyatt	10/06/2022	R Wyatt	10/06/2022	Sections updated: 2.2 2.4 2.5 3.3.6 5.1 5.2 5.3 6.3 6.4.1 6.4.2 6.4.3 7.4 7.6 9.4.2
12	R Wyatt	09/11/2020	R Wyatt	09/11/2020	Section1, list of IOMs updated
11	R Wyatt	24/09/2020	Eric Chaize	24/09/2020	Updated onto new IOM template with product safety advice clearly identified. DigiTRONe and DigiTRON3 added. Subsea cable specification added Section on Caps and Dummies added. Alternative test connector added (from IOM-001-CAM, so this IOM can be obsoleted).
10	J.Pridmore	11/06/19	R.Mandal	11/06/19	Section 12 updated for vertically mounted junction boxes
9	J.Pridmore	19/03/19	R.Mandal	19/03/19	Section added for installation of junction boxes
8	J.Pridmore	09/11/18	JP.Smith	09/11/18	“Power off” max. de-mate speed increased to 1 m/s
7	M.Bell	07.03.16	N.Atkinson	07.03.16	Section 11 Split floating flange assembly added, references to Aquatron amended to Siemens Energy Pressure Balanced Oil Filled Hose
6	P.Westwell	28.05.15	B.Leach	28.05.15	Misalignment tolerances updated, Extended storage added, Section 5 updated
5	P.Westwell	11.7.14	B.Leach	11.7.14	Various spelling and grammar corrections
4	P.Westwell	29.4.14	B.Leach	29.4.14	New cover design and complete document reformat.
3	P.Westwell	31.11.13	B.Leach	31.11.13	Section 7 updated, Section 16 added, general updates. Full reformat and new cover
2	P.Westwell	31.11.13	B.Leach	31.11.13	Re-format, various text amendments, pictures of packaging added, pg 11 images changed
1	P.Westwell		B.Leach		First issue

Contents

Tables

Illustrations

1 PRODUCTS COVERED BY THIS MANUAL

This manual includes information on DigiTRON product range of electrical flying leads (EFL), jumper and sensor harnesses, including connectors that are part thereof, their electrical and mechanical specification.

Also this manual provides details of installing the DigiTRON product range of connectors that are fitted as part of an oil filled hose or cable assembly. These may involve the installation of a flange mounted fixed connector or sensor.

The DigiTRON product range includes the following products:

DigiTRON**+**

DigiTRON**e**

DigiTRON**3**

Installation, Operation and Maintenance manuals for other DigiTRON products not covered by this document can be found on Siemens Energy Subsea website www.siemens-energy.com /search Subsea, as listed in Table 1.

Instructions for sensors are not covered by this manual. The sensor manufacturer should be contacted for their relevant installation, operation and maintenance manual. For Siemens sensor products use the manuals listed in Table 1.

If a non-Siemens connector is fitted as part of the EFL or harness then the manufacturer of that product should be contacted for the IOM manual.

DOC. No.	PRODUCT
IOM-002	DigiTRON electrical single connectors
IOM-003	Obsoleted, replaced by IOM-002.
IOM-004	Not used
IOM-005	Retrievable Electrical Distribution unit (REDU), 2nd generation
IOM-006	Retrievable Electrical Distribution unit (REDU), 1st generation
IOM-007	Disconnectable junction boxes type TC3A-107 and similar Electrical Distribution Units (EDUs).
IOM-008	DigiTRON**f** fiber optic flying leads and harness assemblies
IOM-009	DigiTRON**f** fiber optic single connectors
00003075	Subsea PT/TT sensors
00007464	Differential Pressure sensors SDP-6 / SDP-8

Table 1 List of other Installation, Operation and Maintenance manuals related to DigiTRON product range

2 BASIC INFORMATION & QUICK REFERENCE

2.1 Product overview

DigiTRON connectors, electric flying leads (EFLs), jumpers and harness assemblies intended use is to provide low voltage and communications links between pieces of electrical equipment that are submerged in water, e.g. subsea.

The DigiTRON range of connectors have been developed for long term reliable communications and low voltage power control system applications associated with offshore installations. The underwater mateable capacity of these connectors is achieved using pressure compensated electrical inserts employing the CE principle.

An EFL is completely independent of other equipment and is fitted with ROV or Diver installable connectors at each end. All EFL's are oil filled pressure compensated hose or suitable subsea cable assemblies and are supplied as complete finished product from the factory. All EFL's should be retrievable and when installed should not cross-over each other.

Some illustrations are shown in section 2.7 to help identify an EFL and jumper (harness).

Table 2 below identifies each product type in the DigiTRON product range.

The products look very similar, so it is important to note the identifier for each product type.

Product range	Description	Visual identifier	Typical part number (etched on the connector)
DigiTRON**+**	4, 7, and 12 pins Voltage rating 1kV pin-ground 2kV pin-pin	White-coloured cone* or disc on ROV connectors. No visual identifier on Stab or Diver type connectors	BROV-…….. BRSP- ……. BSTA- ..... BSSP- ……. BDIV- …….. BDSP- …….
DigiTRON**e**	12 pins only. As DigiTRON+, but with 4 or 8 of the pins wired with ethernet cable**.	White-coloured cone* or disc on ROV connectors. No visual identifier on Stab or Diver type connectors	EROV-…….. ERSP- ……. ESTA- ..... ESSP- ……. EDIV- …….. EDSP- …….
DigiTRON**3**	4 pin only. Voltage rating 1.8kV pin-ground / 3.6kV pin-pin	Blue-coloured cone* or disc on ROV connectors. Blue-coloured sleeve on Stab and Diver type connectors	D3RV- …… D3ST- ……. D3DV- ……

* Occasionally different coloured cones may be fitted, as specified by the customer, e.g. red, green, yellow. In this case also check the part number to identify the product range

** Wiring diagram on the drawing will show how the product is wired. Contact Siemens Technical Support for this information connectortechnicalsupport.gb@siemens-energy.com .

Table 2 DigiTRON product range identification

2.2 Product specification and certification

Basic specifications relating to all products covered by this manual are below in Table 3. Additional specifications can be found in section 5.

Design Life:	30 years in subsea environment
Rated voltage	DigiTRON**+** 1,000Vac pin-ground, 2,000Vac pin-pin DigiTRON**e** Ethernet lines 50Vdc, other lines as DigiTRON**+** DigiTRON3 1,800Vac pin-ground, 3,600Vac pin-pin
Rated current	In water: 4-way 35-40A 7-way 22-32A 12-way 20-28A In air: 4-way 18A 7-way 14A 12-way 11A (Excludes ethernet lines)
Over-current	100A for 5 seconds, no more than 2 per hour
Rated number of operations	1000 (750dry/250wet) mate / de-mate cycles (Power off)
Water depth	4,000 m (13,123ft)
Storage temperature	-40°C +70°C (-40°F +158°F) (upper limit is surface temperature of the product and includes solar gain from bright sunlight) Recommended maximum ambient air temperature +50°C (122°F).
Operational temp	Subsea: -5°C +60°C (+23°F +140°F). In air: -20°C +50°C (-4°F +122°F)
Product Certification:	

Standard	Description
EU Directive 2001/95/EC	General Product Safety
EU Directive 2014/35/EU	Low Voltage Directive
IEC 61984	Connectors - Safety requirements and tests
API-17F	Standard for Subsea Production Control Systems

Note: Self-certified via in-house testing.

Table 3 DigiTRON product specification and certification

2.3 Contact details and feedback

For additional information or questions regards the products visit the Siemens Energy Subsea website https://www.siemens-energy.com /search Subsea, or contact the following

Department	E-mail address
Product Safety Officer	subsea.connectors.productsafety.gb@siemens-energy.com
Technical Support	connectortechnicalsupport.gb@siemens-energy.com
Service (Site Team)	susultlcmsupport.gb@siemens-energy.com
Sales	connectorsales.gb@siemens-energy.com

Table 4 DigiTRON product contact details

Any information, records, or Health and Safety feedback that needs to be detailed can be recorded in section 10 of this document and sent to the relevant department in Table 4

2.4 Product advice label

The following product advice label is supplied with all Siemens Energy Subsea products.

Figure 1 Product advice label

2.5 Product marking

Siemens Energy Subsea DigiTRON products are marked with the Siemens Energy part number and unique serial number. Also, the voltage, temperature and water depth ratings are indicated. Marking locations are typically on the metal bodies of the connectors. Refer to Figure 2.

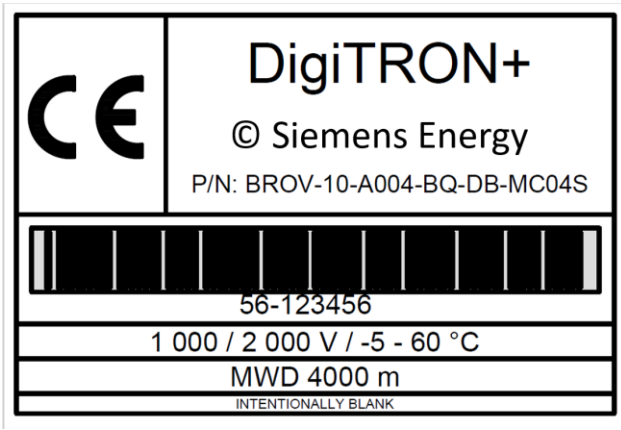

Figure 2 Product marking on DigiTRON product

Harnesses are also marked with the Siemens Energy Subsea unique serial number. Labels are typically black text on a yellow background underneath a clear protective wrap and are typically located at each end of the harness and centrally. Often client's own information is added to these labels.

2.6 CE and UKCA label/marking

The CE label/marking where applicable shows that the products comply with the requirements of the applicable directives as follows:

- 2014/35/EU – Low Voltage Directive

The UKCA label/marking where applicable shows that the products comply with the requirements of the applicable directives as follows:

- Electrical Equipment (Safety) Regulations 2016

Declaration of Conformity will be supplied with the goods.

2.7 Product examples

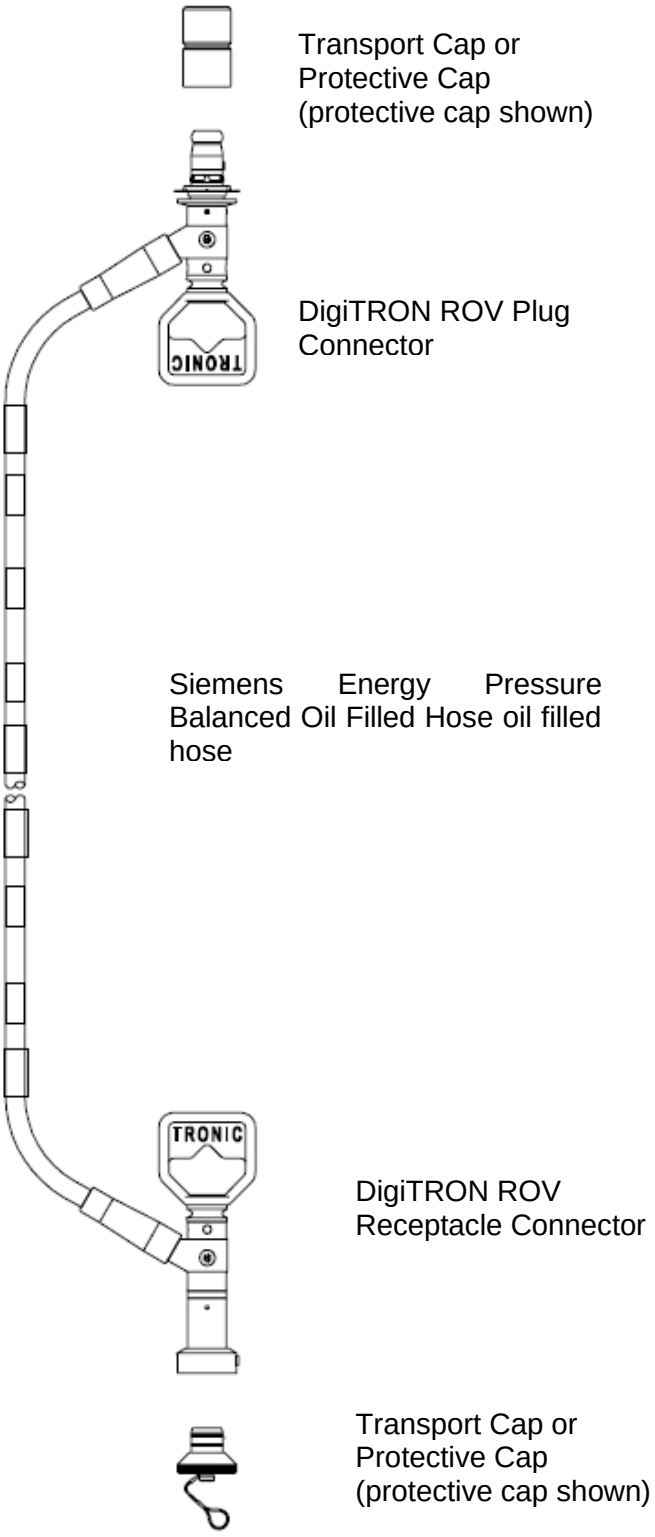

Figure 3 Typical EFL (Electric Flying Lead)

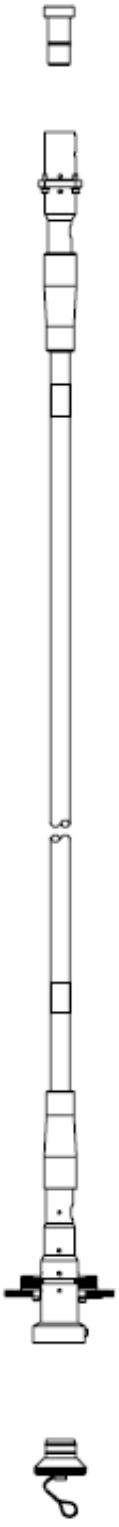

Figure 4 Typical jumper (harness) assembly

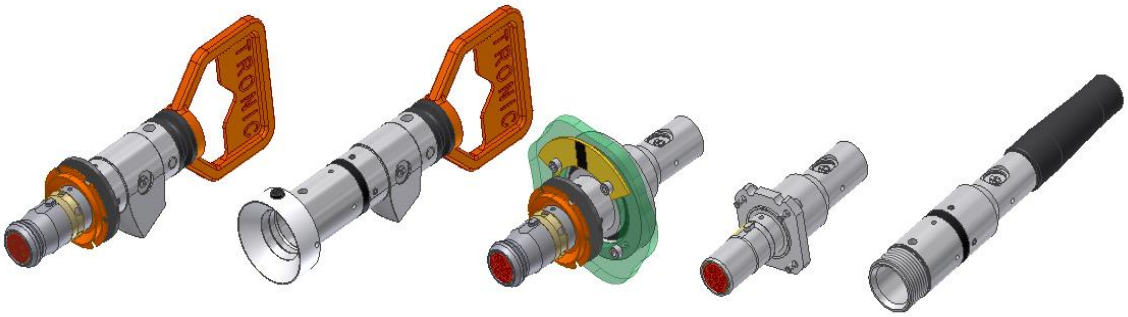

Figure 5 Examples of DigiTRON oil hose connectors

Figure 6 Examples of flying lead and harnesses.

3 PRODUCT SAFETY

Siemens Energy Subsea recommends the termination of all equipment shall only be undertaken by trained, suitably qualified and experienced personnel (SQEP) i.e. competent person.

Following installation, commissioning or deployment of product, if you have any feedback please complete and return the Customer Comments/Feedback form (Section 10). Please e-mail completed form to the Product Safety Officer at subsea.connectors.productsafety.gb@siemens-energy.com

3.1 Action-related warnings

Classification of action-related warnings

The action related warnings are classified in accordance with the severity of the possible danger using the following warning signs and signal words:

Warning symbols and signal words

	**Danger!** Imminent danger to life or risk of severe personal injury
	**Danger!** Risk of death from electric shock
	**Warning.** Risk of minor personal injury
	**Caution.** Risk of material or environmental damage

3.2 Intended use

The product is intended as a Low Voltage electrical connection system for subsea use

There is a risk of injury or death to the user or others, or of damage to the product and other property in the event of improper use or use for which it is not intended.

Intended use includes the following:

- observance of the installation and operating instructions included for the product and any other system components.
- compliance with all inspection and maintenance conditions listed in the instructions.
- use of all recommended tooling appropriate for specific tasks.
- all activities to be undertaken by a competent person (see 3.3.1 for definition).

Any other use that is not specified in this document or covered in installation and operating instructions, or beyond that specified in this document shall be considered improper use.

	**Danger!** Risk of imminent danger to life or risk of severe personal injury. Sudden release of stored pressure. DigiTRON products are not intended for use as a penetration for fixed top-side or land-based pressure vessels. They are not designed to comply with the requirements of the Pressure Equipment Directive (2014/68/EU). They are intended for integration into subsea equipment only. All pressure testing of DigiTRON product must be undertaken by a competent person.

	**Caution.** Risk of material or environmental damage, improper use of any kind is prohibited.

3.3 General safety information

3.3.1 Installation by competent persons only

The installation, inspection, maintenance and repair of the product shall be undertaken by trained, suitably qualified and experienced personnel (SQEP) i.e. competent person, to carry out a specified activity. Installation, inspection, maintenance and repair of products by untrained and deemed non-competent persons could invalidate the product warranty.

For further information contact Siemens Energy Lifecycle Management (Site Team) susultlcmsupport.gb@siemens-energy.com

3.3.2 Personal protective equipment (PPE)

Personal Protective Equipment (PPE) is legally defined as 'all equipment (including clothing affording protection against the weather) which is intended to be worn or held by a person at work and which protects the user against one or more risks to their health or safety'.

In the hierarchy of risk control, PPE is considered to rank lowest and represent the option of last resort. PPE is only appropriate where the hazard in question cannot be totally removed or controlled in such a way that harm is unlikely (for example by isolating the hazard or reducing the risk at source to an acceptable level).

All company personnel and operators should wear appropriate Personal Protective Equipment (PPE) defined as a result of relevant risk assessments in accordance with the Personal Protective Equipment (PPE) Regulations.

Wear appropriate PPE according to the product safety advice given in this document

3.3.3 Danger caused by improper operation and foreseeable misuse

Improper operation and foreseeable misuse may present a danger to you and others and cause material damage. Carefully read the enclosed instructions and all other applicable documents, particularly the "Safety" section and the warnings.

	**Danger!** Risk of death from electric shock if shuttle pins (on the plug connector) are depressed e.g. with a screwdriver when plug is live (foreseeable misuse). - Testing activities must only be carried out by a competent person. - Correct test connector shall always be fitted for electrical testing.
	**Danger!** Risk of imminent danger to life, risk of severe personal injury caused by a shuttle pin projectile due to damage caused to shuttle pins e.g. with a screwdriver (foreseeable misuse). - Maintenance and testing activities must only be carried out by a competent person. - Correct tools must always be used.

3.3.4 Risk of death due to electrocution

	**Danger!** Risk of death from electric shock due to exposed live pins, e.g. factory or top-side system test and unmated receptacle is energised. - Never energise a receptacle connector when not mated to a plug. - Ensure all test procedures are followed. - Communication channels and protocols are observed.
	**Danger!** Risk of death from electric shock due to unscreened cables. - Do not touch electrical wires while energised. Ensure all test procedures are followed.
	**Danger!** Risk of death from electric shock from any exposed conductors due to stored electrical energy, e.g. capacitance of cable or elsewhere in the system. - Ground all electrical conductors after testing and do not touch conductors until electrical system is fully discharged. Ensure all procedures are followed.
	**Danger!** Risk of death from electric shock, if product is terminated incorrectly e.g. loose conductor touching metal body or terminated to metal body in error. - Installation/termination activities must be carried out by a competent person. - Always electrically ground metal bodies prior to electrically energising a connector. - Never hand-hold the product when live.
	**Danger!** Risk of death from electric shock or severe personal injury through burning from de-mating live conductors by hand. - Do not demate the product while live - Do not hand-hold the product while live - Ensure all procedures are followed for mating/de-mating connectors.

3.3.5 Risk of injury and material damage due to testing, maintenance and repairs carried out incorrectly or not at all

The oil-filled hoses and connectors are non-serviceable by the user. In case of suspected faults with the product (refer to section 8.2), do not use the product and contact Siemens Energy Technical Support or Siemens Energy Product Safety for advice. Never attempt to carry out maintenance work or repairs on the product yourself.

	**Danger!** Risk of death from electric shock if user dismantles / incorrectly re-assembles / incorrectly terminates product (foreseeable misuse). - There are no parts of the product that require maintenance or inspection. The product should not be disassembled. - Termination of electrical wires to the product must only be carried out by a competent person.
	**Danger!** Risk of death from electric shock from improper use of test connector (foreseeable misuse). In particular, removal of the rubber termination sleeves placed over the joint between the cable and the test connector is prohibited, as this will expose live parts to the user. - Never disassemble a test connector
	**Danger!** Risk of imminent danger to life, risk of severe personal injury caused by released pressure and or projectile due to incorrectly installed pressure retaining product, (e.g.bulk-

	head connector or penetrator) during system pressure test, or the rated differential pressure of the product is exceeded - Ensure all product assembly and testing activities are completed by competent persons. - Do not exceed the maximum differential pressure rating of the product installed. - Individual products have different differential pressure ratings, refer to the specific product datasheet or contact Siemens Energy Technical Support
	**Warning !** Risk of minor personal injury from high temperature of the product due to ohmic heating in short-circuit condition or high over-currents. - In the event of a high over-current, allow the connectors to cool before touching. - Ensure all testing of products both factory and deployed in-field have been completed by competent persons.
	**Danger!** Risk of severe personal eye injury due to pressurised oil squirting out of damaged hose or removal of fill/vent screw. - Ensure all testing of products both factory and deployed in-field have been completed by competent persons.
	**Warning.** Risk of eye/bodily injury caused by released pressure during product disassembly, in the event of retrieval from subsea with a fault that causes depth pressure to be trapped inside the product. - Ensure all product disassembly activities are completed by competent persons in accordance with relevant procedures and using relevant personal protective equipment (PPE).
	**Warning.** Risk of bodily injury caused by pressure retaining parts becoming projectile due to user over-pressurising the system, e.g. during Site Installation Test (SIT). - Ensure all product SIT activities are completed by competent persons in accordance with relevant procedures.

3.3.6 Risk of injury and material damage due to manual handling

Manual handling, lifting and carrying are known to be one of the largest contributors to occupational ill-health. Ensure mechanical handling aids are used wherever possible to avoid manual handling. Where manual handling is considered appropriate for the task, safe lifting guidelines must be followed, e.g. adopt correct posture, consider team lifting, employ safe lifting technique, etc. Only competent persons are permitted to perform tasks without supervision, if in doubt ask.

Local regulations for mechanically-aided lifting operations and lifting equipment must be adhered to, e.g. ‘LOLER’ in the UK.

	**Warning.** Risk of musculoskeletal injury from hand-mating or de-mating connectors. - Referring to the mate / demate forces specified herein, ensure suitable manual handling precautions are taken. - Ensure all product testing activities are completed by competent persons in accordance with relevant procedures.
	**Warning.** Risk of musculoskeletal injury from manual handling of heavy products, e.g. harnesses or sensor assemblies. Refer to shipping information or product datasheet for weights of the product. - Ensure mechanical handling aids are used wherever possible to avoid manual handling. - Where manual handling is considered appropriate for the task, safe lifting guidelines must be followed, e.g. adopt correct posture, consider team lifting, employ safe lifting technique, etc. - Only competent persons are permitted to perform tasks without supervision, if in doubt ask.
	**Warning.** Risk of bodily injury from heavy product falling during lift with machinery. Local regulations for mechanically-aided lifting operations and lifting equipment must be adhered to, e.g. 'LOLER' in the UK.
	**Warning.** Risk of minor personal injury to persons with sensitivities to silicone or mineral based oils. - There is a small risk that oil could leak from the product if faulty. Wear appropriate hand protection when handling products or mineral or synthetic based oils in case oils leak from the connector due to a fault.
	**Warning.** Risk of minor personal injury and material damage due to slips, trips and falls. - Good housekeeping avoids slips, trips and falls, keep all work areas clean and tidy.

3.4 Related documents

Installers shall carryout a full site risk assessment and put into place all necessary steps and procedures to comply with applicable area, regional, national or international health and safety legislation, e.g. The Health and Safety at Work Act (HASAWA) in the United Kingdom (UK) and ensure safety of themselves and others regarding manual handling and working at height requirements.

During the product installation (and any subsequent work) it will be necessary to employ caution. All installers and operatives involved from unloading the product until it is deployed in its final installed location must exercise a full duty of care for themselves and others regarding safety. When lifting and handling this product, operatives should employ assistance if required. In certain situations, it may be necessary to use mechanical handling aids. Take care to avoid trip hazards, slippery or wet surfaces.

Employers and installers should refer to the Health and Safety Executive (HSE) web site in the UK for full advice and manual handling assessment charts (MAC) tool.

In addition, where no specific instructions are given then reference shall be made, but not restricted to, where applicable, British Standards and codes of practice such as the following:

- The Health and Safety at Work Act.
- COSHH Control of substances hazardous to health.
- BS 7671 Requirements for electrical installations. IEE Wiring Regulations.
- The Electricity at Work Regulations.

It is the operator's and installers responsibility to comply with current Company, area, regional, national or international health and safety legislation.

3.5 Control of substances hazardous to health (COSHH)

Hazardous substances, Control of substances hazardous to health (COSHH) Assessments regards to materials such as elastomers and oils, etc. used in DigiTRON products are available on request from the Product Safety Officer at subsea.connectors.productsafety.gb@siemens-energy.com

4 ABBREVIATIONS

A	Ampere
ac	Alternating Current
Assy	Assembly
API	American Petroleum Institute
AWG	American Wire Gauge
BOM	Bill of Material
°C	Degree Celsius
°F	Degree Fahrenheit
CE	Community European
Comms	Communication Signal
COSHH	Control of substances hazardous to health
CP	Cathodic Protection
dc	Direct Current
DWG	Drawing
EFL	Electrical Flying Leads
EMF	Electrical Magnetic Field
EMI	Electromagnetic Interference
FAT	Factory Acceptance Test
IR	Insulation Resistance
ISO	International Organization for Standardization
ITP	Inspection Test Plan
LTC	Long Term Cover
M	Metres
Max.	Maximum
Min.	Minimum
No.	Number
PPE	Personal Protective Equipment
ROV	Remotely Operated Vehicle
SI	Standard International
SIT	Site Installation Test
SRT	Site Received Test
SST	Stainless Steel
TBD	To Be Defined
TSP	Twisted Screened Pair
UNS	Unified Numbering System for Metals and Alloys
V	Volt

5 SPECIFICATIONS

The following is a basic specification for DigiTRON products. Actual product may vary. Please refer to product specific data sheet(s), contact Siemens Energy Technical Support connectortechnicalsupport.gb@siemens-energy.com for more detailed information.

General specification of the product is listed in section 2.2. Additional specifications are as follows.

5.1 Connector Specification

	ROV operated		Stab-plate		Diver operated	
Misalignment Type	4 & 7-way	12-way	4 & 7-way	12-way	4 & 7-way	12-way
Rotational (0º)	±15º	±15º	±1.6º	±1.6º	n/a	n/a
Radial	±20mm (0.787”)	±20mm (0.787”)	±1mm (0.039”)	±1mm (0.039”)	n/a	n/a
Angular	±20º	±20º	±0.7º	±0.7º	n/a	n/a
Mate force	<300N (67 lb)	<500N (112 lb)	<300N (67 lb)	<500N (112 lb)	Integral clamp ring	
Demate force	240 – 360N (54 – 81 lb)	480-800N (108 - 179lb)	0	0	0	0
Overload withstand						
Axial load	9800N (2,198 lb)	9800N (2,198 lb)	9800N (2,198 lb)	9800N (2,198 lb)	n/a	n/a
Bending load	500Nm (369 lbf.ft)	500Nm (369 lbf.ft)	n/a	n/a	n/a	n/a
Torsion load	500Nm (369 lbf.ft)	500Nm (369 lbf.ft)	n/a	n/a	n/a	n/a
Maximum mate / de-mate speeds	1 m/s (3.3 ft/s)	1 m/s (3.3 ft/s)	1 m/s (3.3 ft/s)	1 m/s (3.3 ft/s)	1 m/s (3.3 ft/s)	1 m/s (3.3 ft/s)
Deployment rate	350m/min (1149ft/min)	350m/min (1149ft/min)	350m/min (1149ft/min)	350m/min (1149ft/min)	350m/min (1149ft/min)	350m/min (1149ft/min)
Limit of exposure of male pins to seawater 28 days cumulative over lifetime						

Table 5 DigiTRON connector specification

Caution. Risk of material damage. Maximum cumulative exposure of the male pins to seawater is 28 days to prevent corrosion of the pins. If the connectors are to be left unmated, in seawater, for any length of time Subsea Environment Cap or Dummy Plug must be fitted to protect the pin contacts in the receptacle connectors. Over exposure will increase the risk of corrosion damage or marine growth on the contact surfaces of the

	receptacle contact pins. This could lead to damage to the seals and insulation within the plug socket contacts. Plug connectors do not require full dummy connectors for protection. Siemens Energy Subsea advise the fitting of acetal caps to protect plugs against marine growth. It is good practice to always fit the protective cap when a connector is unmated topside prior to deployment to provide mechanical protection.
⚠	**Caution.** Risk of material damage. Unmated receptacles (exposed male pins) should never be electrically energised subsea (even a small residual voltage e.g. 1 Volt). This can very quickly corrode the pins, cause detrimental chemical reactions locally in the seawater, and even cause complete electrical failure of the product.

5.2 Siemens Energy *AquaTRON* pressure-balanced oil-filled hose specification

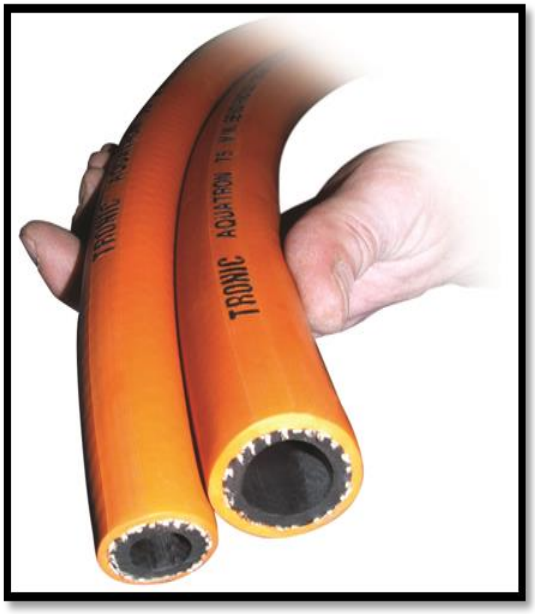

Figure 7 AquaTRON hose, size 50 (1/2" bore), and size 75 (3/4" bore)

	size 50, ½" bore	size 75, ¾" bore
Min bend radius (static and dynamic)	125mm (4.9")	180mm (7.1")
Maximum tensile load in service	2,500N (561 lb)	2,500N (561 lb)
Tensile load to failure	5,000N (1,121 lb)	5,000N (1,121 lb)
Maximum twisting	180° per 5m (16.4ft) length	180° per 5m (16.4ft) length
Mass (air)	0.66kg/m (0.44lb/ft)	1.04kg/m (0.69lb/ft)
Mass (water)	0.14kg/m (0.09lb/ft)	0.24kg/m (0.16lb/ft)
Max water depth	4,000m (13,123ft)	4,000m (13,123ft)
Oil fill pressure	15 bar (218 psi)	15 bar (218 psi)
Deployment rate	350 m/min (1148 ft/min)	350 m/min (1148 ft/min)

Table 6 AquaTRON oil-filled hose specification

5.3 Siemens Energy Subsea Cable Specification

	4-way	7-way	12-way
Part Number	75-004-TR	75-007-TR	75-012-TR
Voltage rating	600 / 1,000Vac	600/ 1,000Vac	600 / 1,000Vac
Min bend radius static / dynamic	182mm / 273mm (7.2” / 10.7”)	200mm / 300mm (7.9” / 11.8”)	300mm / 400mm (11.8” / 15.7”)
Maximum axial load	1,000N (224 lb)	1,000N (224 lb)	1,000N (224 lb)
Mass (air)	3.71 kg/m (2.47 lb/ft)	3.99 kg/m (2.66 lb/ft)	5.65 kg/m (3.77 lb/ft)
Mass (water)	1.05 kg/m (0.70 lb/ft)	1.32 kg/m (0.88 lb/ft)	1.64 kg/m (1.09 lb/ft)
Max water depth	3,000m (9,843ft)	3,000m (9,843ft)	3,000m (9,843ft)
Resistance	13.3 Ohm/km 4.05 Ohm/1,000ft	13.3 Ohm/km 4.05 Ohm/1,000ft	13.3 Ohm/km 4.05 Ohm/1,000ft
Conductor	1.5mm^2 (0.0023in^2)	1.5mm^2 (0.0023in^2)	1.5mm^2 (0.0023in^2)
Deployment rate	350 m/min (1148 ft/min)	350 m/min (1148 ft/min)	350 m/min (1148 ft/min)

Table 7 DigiTRON subsea cable specification

Figure 8 Siemens Energy subsea cable

Axial loads on terminated glanded connectors should be kept to a minimum unless the connector has been specifically designed to take such a load. The maximum applied loads will depend on the cable type and the gland internals (Contact Siemens Energy Subsea Technical Department for advice).

6 PREPARING PRODUCT FOR USE OR STORAGE

6.1 Product protection and packaging

Siemens Energy Subsea electrical connectors are manufactured primarily from materials such as 316L stainless steel and Super Duplex stainless steel, and as such are designed to withstand harsh saliferous environments. However, the connector inserts and exposed parts are susceptible to mechanical damage if not protected. Transport caps or Acetal protective caps must be fitted to all Siemens Energy Subsea connectors before transport.

	**Caution.** Risk of material damage. Transport caps or protection caps must always be fitted to an unmated connector during transport, and should remain in place while topside before deployment

Products may be stored in their original packing crates or boxes indefinitely.

Wooden packaging crates supplied with Siemens Energy products are not weatherproof.
As a guide, outdoor storage should be limited to 3 months with protection from direct sunlight and wet weather. Actual duration will depend on the environmental conditions, e.g. in temperate dry conditions more than 3 months may be acceptable, in inclement conditions or use offshore it may be less than 3 months. It is recommended to inspect the crates periodically during outdoor storage to assess their suitability to protect the products from the external environment and to withstand handling.

Be very careful if fitting additional screws, nails or staples to the crate, such that they do not protrude on the inside of the crates. This can very easily damage the hoses within.

Connectors can be shipped singularly or in multiples. Care should be taken to protect the connector(s) with 'Instapack', bubble wrap or similar wrapping materials to avoid surface damage during transit. If large numbers are shipped in one consignment suitably reinforced transport box will be necessary to withstand the weight. See Figure 9 and Figure 10.

Figure 9 Acceptable packaging for shipment

Figure 10 Unacceptable packaging and storage

Bulkhead type connectors with exposed tailing wires should be packed and shipped in a suitably sized box to allow adequate space for the tailing wires without bending or kinking.

Connectors are designed to withstand vibration that occurs during transportation and to withstand being dropped from a height of 1m (3.3 ft) whilst in packaging.

If the connectors are assembled onto hoses or cables, these must be suitably coiled and secured with tape to prevent uncoiling during transit. Respect the minimum bend radius (refer to section 5.2 and 5.3). A minimum band radius gauge can be used when re-packing assemblies into a crate, Figure 11, 3d model available from Siemens Energy, which can be used to a 3d print the gauge.

Figure 11 Minimum bend radius gauges

6.2 Unpacking

Remove wrapping material taking care to inspect for any surface damage or items that may have become separated from the connector, such as ‘O' seals. Do not use a knife to cut the wrapping material, as this may cause damage to any elastomeric parts of the connector. Do not remove protective caps until connectors are ready for installation

On removal of hose assemblies from packing crates, do not allow the hoses to drag over the edges of the crate. If necessary, cover the edge of the crate with something non-abrasive to protect the hose, and take care to respect the minimum bend radius of the hose.

6.3 Lifting of harnesses and EFLs

Avoid lifting hose and cable assemblies (EFLs, harnesses) by the connector. The recommended practice to manoeuvre assemblies in or out of shipping crates and deployment baskets is to lift the entire assembly equally.

It is recommended to neatly coil into a circle or figure-of-eight (respecting bend radius of hose, sections 5.2 and 5.3)

Slings should then be used at minimum 3 equidistant places around the circle (or more if the hose is coiled in a large diameter) to prevent the hose from kinking, plus additional point at the cross-over for a figure-of-eight layup. Ensure the slings are placed beneath the bottom coil and capture all the coils up to the uppermost coil (Figure 12).

If there is heavy equipment terminated to the hose (e.g. sensor or other instrument, or large junction boxes) weighing >5kg then additional appropriate securing and/or slinging should be employed.

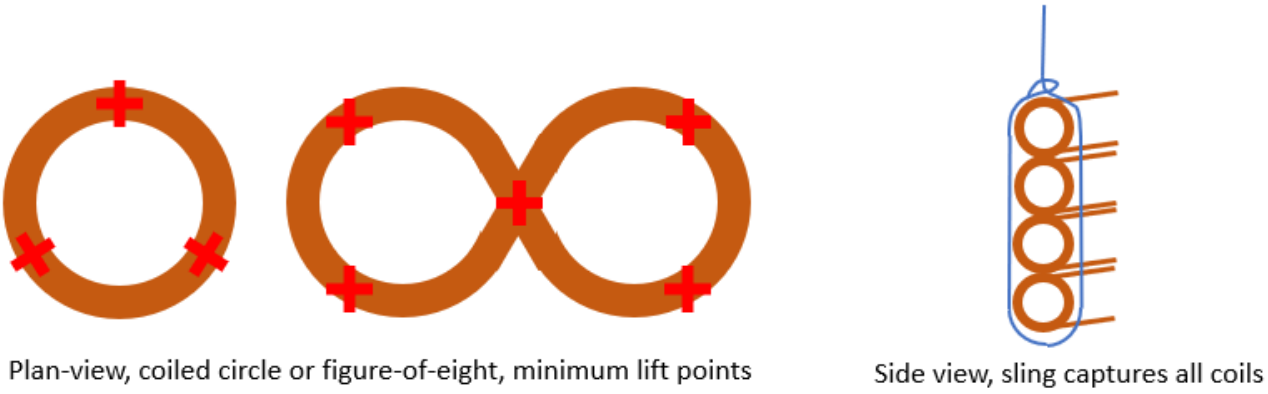

Figure 12 Illustration of strapping points for lifting hose assemblies

6.4 Storage, protection and end of life

Connectors are sensitive to environments where grit and dirt are present. All connectors come supplied with a transport cap. It is recommended to leave the caps on whenever possible. The caps must be removed before subsea deployment.

Connector may be fitted with a black-colour plastic Protective Cap (Figure 26), which is available to purchase separately (customer preference). These caps provide a higher degree of mechanical protection to the connector than the transport caps.

Refer to section 9.4 for details on the types of caps and dummy connectors available for protection during storage.

⚠	**Caution.** Risk of material damage. If storage is carried out in saline conditions, e.g. on a ship's deck or hold, then a Subsea Environment Cap or Dummy Plug connector should be used to protect the receptacle pins from corrosion.

Connectors and hose / cable assemblies must be stored in a clean dry area and be protected by bubble wrap or similar.

It is recommended to store products in their original packaging (e.g. wooded crates or boxes, noting outdoor storage of crates per section 6.1).

Carbon steel must not be present in the storage of the products, to avoid contamination of the stainless steel products.

If product has been recovered from subsea use, it should be cleaned before storage. Clean only with fresh water or 50% citric acid solution. If 50% citric acid wash is not performed, as a minimum, wash with clean water to remove any salt water on the products.

6.4.1 Short term storage

Storage where temperature and humidity are not controlled should be limited to 4 weeks Storage temperature range: -40°C to +50°C air temperature (-40 to 122°F). Storage humidity below 75%. Maximum skin temperature of the product should not exceed 70°C (158°F), including solar gain due to exposure to sunlight radiation.

6.4.2 Long term storage

These recommendations apply to products both prior to and after assembly to other equipment (e.g. XT, manifolds, SCM).

Ambient air temperature should be between -40°C and +50°C (-40 to 122°F). Storage humidity below 75%. Very moist or very dry conditions should be avoided. The equipment should be protected from strong sunlight and strong artificial light with a high ultraviolet content.

Maximum skin temperature of the product should not exceed 70°C (158°F), including solar gain due to exposure to sunlight radiation.

After 5 years storage it is recommended to perform a visual examination and electrical tests to confirm the product is still fit for purpose and within specification. Check for any oil-leaks or obvious signs of damage to the connectors (refer to section 8). Refer to 'Site Receiving Test' document SRT-002 (available on the Siemens-Energy/subsea website) for electrical test requirements.

For product already assembled onto other equipment, the test regime of that piece of equipment shall take precedence over the SRT document, e.g. IR tests may not be allowable; function test may applicable.

Beyond 5 years storage, re-inspection and test is recommended every 2 years and before the product is put into service.

For products stored at air temperatures continually above 25°C it is recommended to perform re-inspection and test every 12 months.

	**Caution.** Skin temperature must not exceed 70°C (158°F). Suitable protection must be used to ensure maximum storage temperature is not exceeded.
	**Caution.** Risk of material damage. Connectors should not be allowed to encounter solvents, oil, grease or other semi-solid materials.

If glanded connectors are to be stored bolted into their interfaces prior to cable termination, ensure the cable entry point into the gland is covered to prevent dirt and water ingress.

6.4.3 Siemens Energy pressure balanced oil filled hose storage

Recommend hose and junction box assemblies be stored in original packing crates. If not, protected from direct sunlight or strong artificial light with tarpaulin sheet or equivalent.

Maximum initial storage period: 2 years stored in accordance with ISO 2230 (pressurised), and noting the storage requirements in section 6.4.2 . After this perform visual checks and electrical

tests. Refer to 'Site Receiving Test' document SRT-001 (available on the Siemens-Energy/subsea website) for electrical test requirements.:

Pressurised hose assemblies must be visibly inspected for:

- Permanent distortions, such as creases or flats
- Mechanical damage, such as cuts, tears, abraded areas or delaminated plies
- Surface cracking
- Changes in surface condition, such as hardening, softness or tackiness.

If insulation resistance has fallen below specification, changing the oil in the hose can be performed by Siemens Energy. Contact Siemens Energy for site service or product return for oil change.

After the inspection and test is completed, the assembly can be stored for a further 2 years, rolling program. For products stored at air temperatures continually above 25°C it is recommended to perform re-inspection and test every 12 months.

6.4.4 Cable storage

Storage temperature range: -40°C to +50°C ambient air temperature. (-40 to 122°F)

Storage humidity: 0% to 85% R.H.

Siemens Energy cable (ref. section 5.3) is designed for long life in hazardous environments but for extended storage periods we recommend dry storage, under cover and out of direct sunlight. For non-Siemens Energy cables, please refer to original cable manufacturer instructions.

6.4.5 Long term storage of elastomers

For the recommended storage of elastomeric components e.g. termination sleeves and cable boots, please refer to Siemens Energy Subsea Document MH006 – Procedure for Storage and Handling of Elastomeric Materials, available from Siemens Energy Technical Support.

6.4.6 Repackaging to prevent damage in transport

In the event of a requirement to return any product back to the manufacturer (Siemens Energy Subsea Connectors), it is recommended that the transport cap, protective cap, or suitable dust cap is fitted to the connector(s) and care should be taken to protect the connector(s) with bubble wrap or similar non-fibrous wrapping materials to avoid any surface damage. Do not use cloths, especially any contaminated with oil, grease or other substances.

Use the original packaging supplied with the product wherever possible.

If there are multiple connectors to be returned, it is recommended that a suitably reinforced box be used to withstand the weight and allow shipping in one consignment. Contact Siemens Energy Technical Support connectortechnicalsupport.gb@siemens-energy.com to discuss details of typical boxes.

Carbon steel must not be present in the storage of the products, to avoid contamination of the stainless steel products.

6.4.7 Disposal and recycling

Safe disposal or recycling of waste packaging and/or end of life product is recommended by correctly observing and complying with area, regional, national or international environmental legislation where applicable.

To return waste packaging and/or end of life product to the manufacturer, contact the Product Safety Officer at subsea.connectors.productsafety.gb@siemens-energy.com .

7 INSTALLATION AND ASSEMBLY

If in doubt contact Siemens Energy Technical Support connectortechnicalsupport.gb@siemens-energy.com for more detailed information.

Caution. Risk of material damage. All sealing surfaces interfacing to DigiTRON connectors shall be inlayed with Inconel 625 or similar corrosion resistant alloy, with no additional protection required. This is to prevent localised pitting corrosion of the interface

7.1 Pre-installation checks for EFL's

- Check hose tagging information is correct according to drawing/tag schedule.
- Ensure Flying Lead has passed Site Received Test (refer to Siemens Energy document SRT-001, available on Siemens Energy Subsea website).
- Make sure prior to installation a final visual inspection of the Flying Lead is completed.
- No part of the connectors should be dismantled prior to or during deployment, apart from the removal of protective caps and installation of split flanges, since there are no user serviceable parts inside.
- Any defects need to be recorded on the form in section 10 of this document and where possible take photos of any issues that need to be recorded and inform Siemens Energy Technical Department.

7.2 Cathodic protection

ROV Connectors are manufactured in super duplex stainless steel and are designed to operate isolated from the CP (Cathodic Protection) system. Such connectors are supplied with all hardware needed to isolate the connector from the structure to which it will be mounted.

ROV connectors that do get connected to the CP system will not be immediately damaged, but there is an increased risk of hydrogen embrittlement of the metal (possible cracking under high mechanical stresses), and increased rate of calcareous deposits on the product (which may cause problems demating the connectors).

Stainless steel 316L (UNS S31603) diver and stab mate connectors must be connected to the CP (Cathodic Protection) system at all times.

Do not fit 'bracelet' anodes around hose or cable as part of CP protection. These can easily damage the hose or cable as the anodes corrode.

7.3 Installation of harnesses with flanged connectors and / or junction boxes

Tooling required

- ¼ inch drive torque wrench 0-25 Nm (18.4 lbf.ft) – with 3mm and 5mm Allan key drive
- Flat blade screwdriver
- Loctite 243

If cable ties are used to secure harnesses to structures, leave loose on the hose. Do not compress.

7.3.1 Stab-plate connectors

Figure 13 Typical stab-plate connectors

For stab plate connectors, there are 4 types of flange designs available:

- Solid Fixed
- Solid Floating
- Split Fixed
- Split Floating

Refer to Figure 14 for mounting detail.

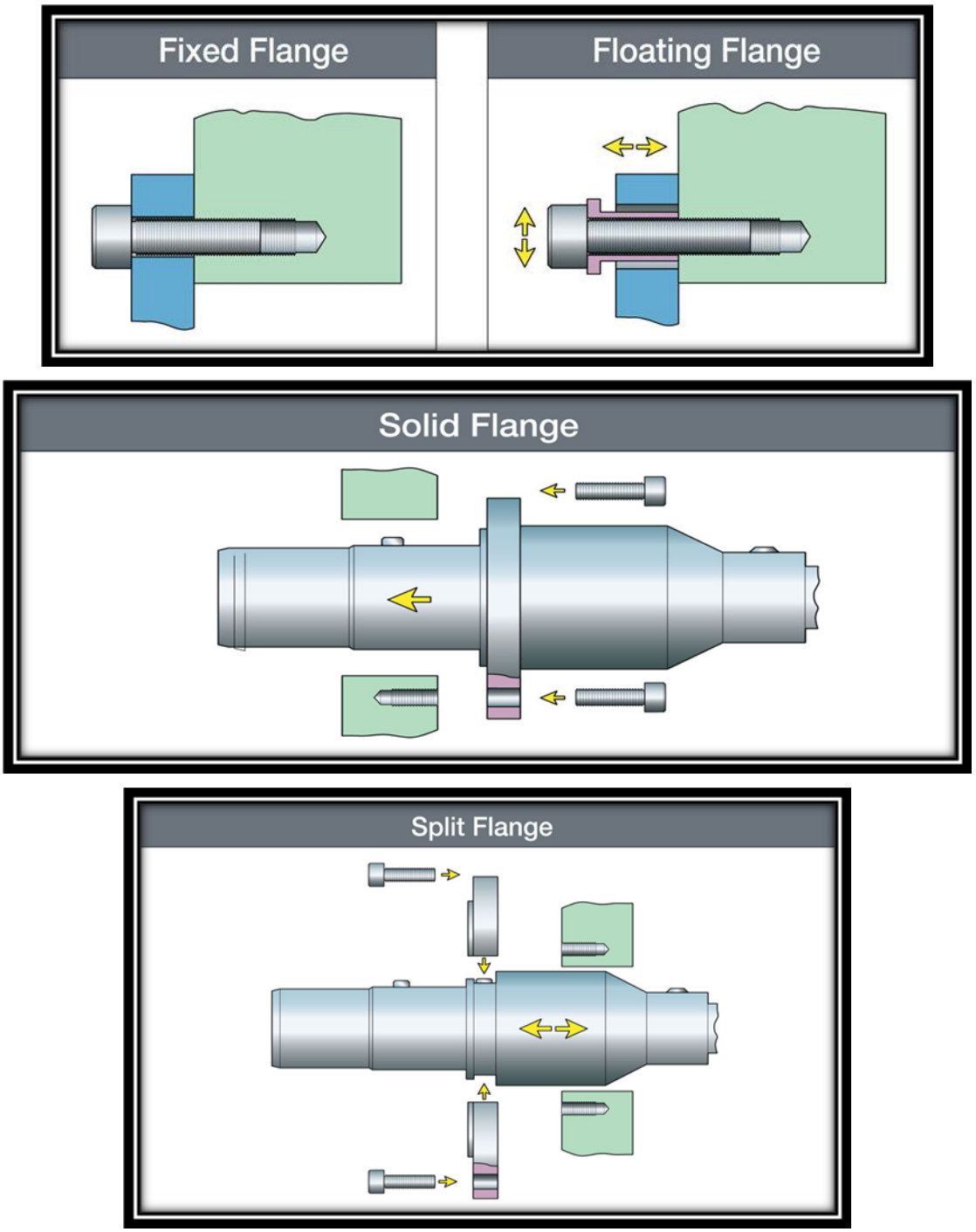

Figure 14 Flange styles for stab-plate connectors

- **Solid Fixed flanges**

  The Solid Fixed flange is non-removable and will be supplied pre-assembled as part of the connector. Fasteners are supplied loose with the connector.

Mounting instructions

Apply a spot of Loctite 243 to the threads of the cap head screws. Fix the connector to the stab plate (metal to metal flange contact) using the cap head screws as shown in Figure 11. Torque to 10-12Nm (7.38 – 8.85 lbf.ft)

- **Solid Floating flanges**

  The Solid Floating flange is non-removable and will be supplied pre-assembled as part of the connector. Fasteners and spacers are supplied loose with the connector.

  Mounting instructions

  The spacers should be mounted in the orientation shown in Figure 11 “Floating Flange” detail.

  Place the spacers on the M6 fasteners, apply a spot of Loctite 243 to the threads of the cap head screws and position through the flange into the interface. Fix the connector to the stab plate (metal to metal flange contact) as shown in Figure 14. Torque to 10-12Nm (7.38 – 8.85 lbf.ft).

- **Split Fixed flanges**

  The Split Fixed flange is removable and is supplied loose with the connector. Fasteners, grub screw and dowels are also supplied loose with the connector.

  Mounting instructions

  To mount the flange on the connector, first, pass the connector through the interface hole, the two halves of the flange should be brought together around the connector front end. Make sure that the lip around the through hole is facing forwards toward the connector front end and the key is in-line with the keyway in the flange.

  To secure the two halves together, Insert the 2-off location dowels into the holes in the flange and press fit until flush with the face of the flange.

  A M6 grub screw is supplied for tightening the flange to the connector body. Apply Loctite 243, screw into the M6 tapped hole on the bottom face of the flange and tighten to 3.5 Nm (2.58 lbf.ft).

  Apply a spot of Loctite 243 to the threads of the cap head screws. Fix the connector to the stab plate (metal to metal flange contact) using the cap head screws as shown in Figure 11. Torque to 10-12Nm (7.38 – 8.85 lbf.ft).

- **Split Floating Flanges**

  The Split Floating flange is removable and is supplied loose with the connector. Fasteners, grub screw, dowels and spacers are also supplied loose with the connector.

  Mounting instructions

  To mount the flange on the connector, first, pass the connector through the interface hole, the two halves of the flange should be brought together around the connector font end. Make sure that the lip around the through hole is facing forwards toward the connector front end and the key is in-line with the keyway in the flange.

  To secure the two halves together, Insert the 2-off location dowels into the holes in the flange and press fit until flush with the face of the flange.

  A M6 grub screw is supplied for tightening the flange to the connector body. Apply Loctite 243, screw into the M6 tapped hole on the bottom face of the flange and tighten to 3.5 Nm (2.58 lbf.ft).

The spacers should be mounted in the orientation shown in Figure 14 “Floating Flange” detail.

Place the spacers on the M6 fasteners, apply a spot of Loctite 243 to the threads of the cap head screws and position through the flange into the interface. Fix the connector to the stab plate (metal to metal flange contact) as shown in Figure 14. Torque to 10-12Nm (7.38 – 8.85 lbf.ft)

	• **Note - Floating Flanges** Floating Flanges have larger fixing holes in the flange, and a steel top hat washer under the screw head. The larger hole means that if an attempt were made to fit the connector without the top hats, the screw head would pass straight through the hole, indicating that something was missing.

7.3.2 ROV connectors

Refer to Figure 15 for a typical flange-mounted ROV connector.

Remove M6 mounting screws and orientation disc, pass the front of the connector through the interface, install 4 off M6 mounting screws and orientation disc, secure screws with a spot of Loctite 243 on the threads and torque to 10-12 Nm (7.38 – 8.85 lbf.ft):

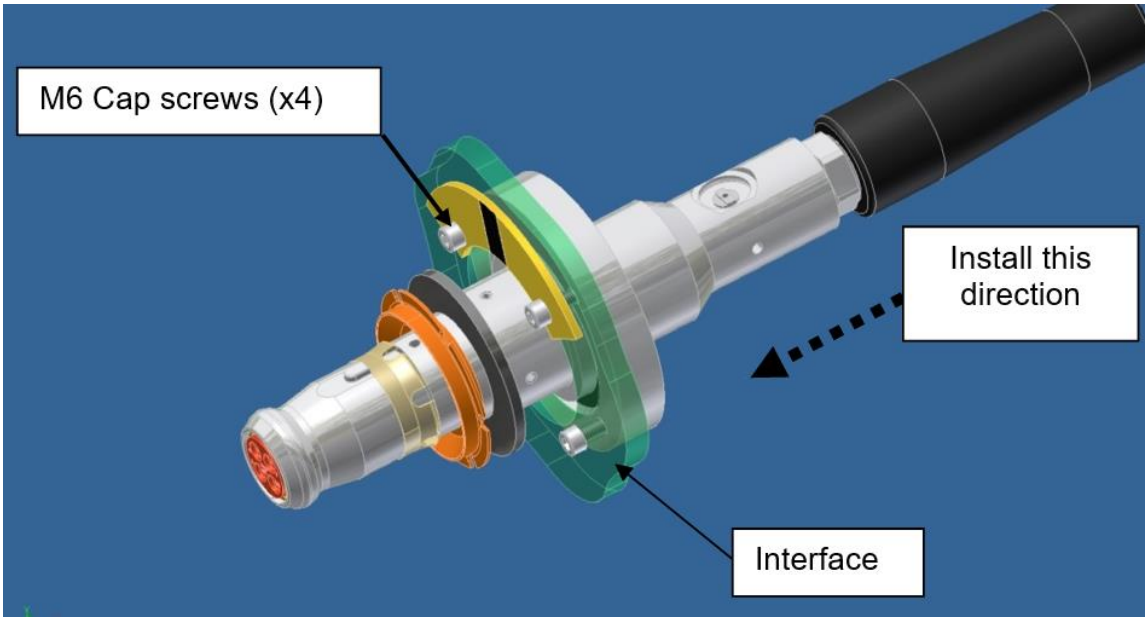

Figure 15 Installation of compliant flange-mount ROV plug

For mounting ROV receptacles (male pins) an extra ring is required, to keep the connector captive in the event that the rubber mount is lost. This is supplied with the connector and should be fitted along with the alignment disc, in the orientation shown in Figure 16 and Figure 17.

NOTE:

The alignment cone on the receptacle may require removal in order to install the connector, and re-fitting once installed. Ensure correct orientation to the internal key-way.

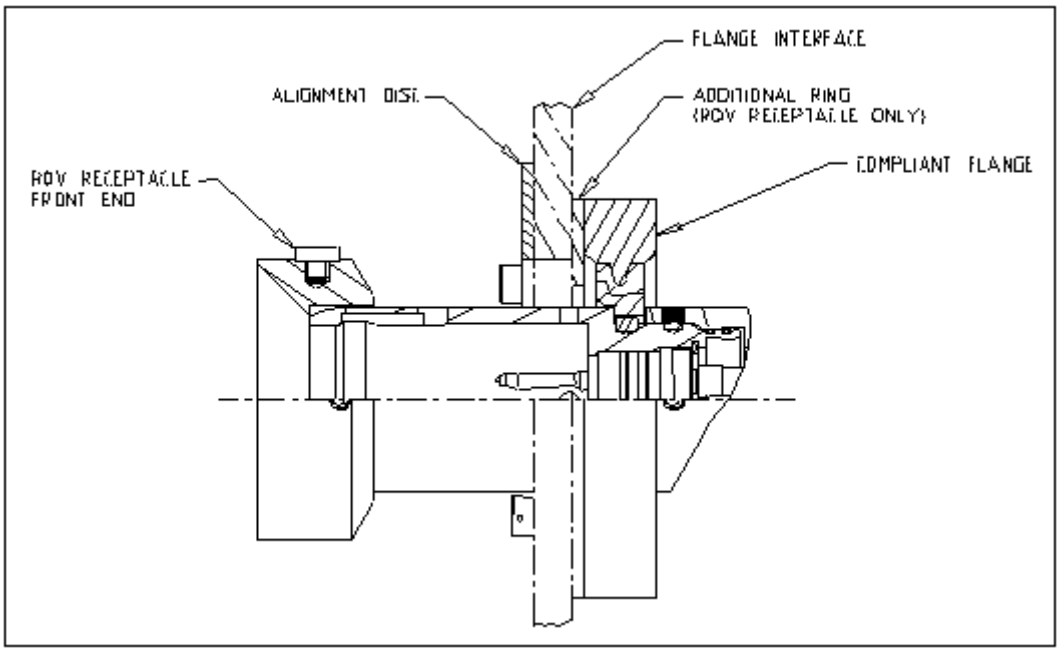

Figure 16 Sectional view to show installation and parts of compliant flange-mount connector

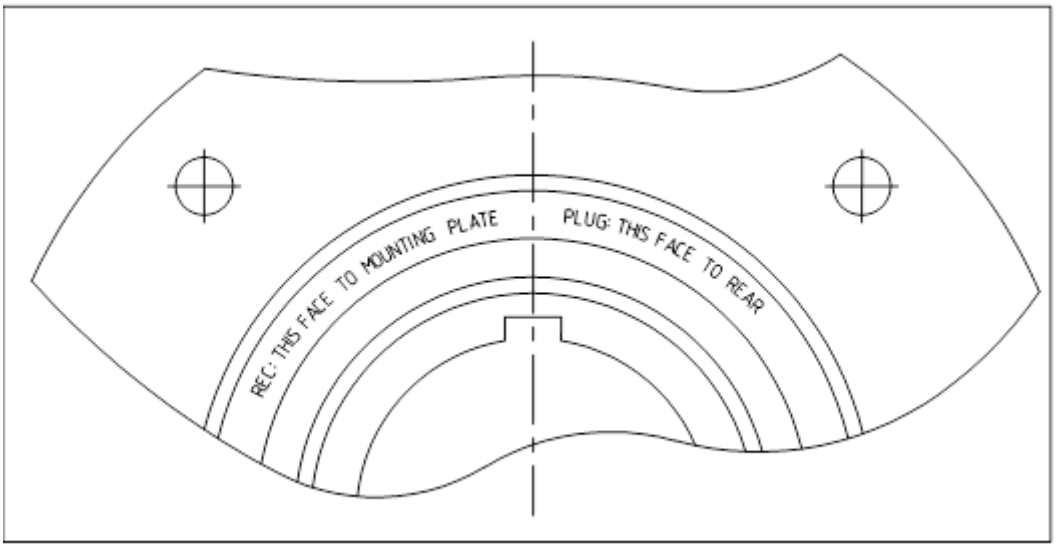

Figure 17 View to show ROV compliant mount flange text (note orientation of flange is different plug to receptacle)

7.3.3 Diver operated connectors

Flange mounted diver operated connector have a fixed flange that will be supplied pre-assembled as part of the connector. Fasteners are supplied loose with the connector.

Mounting instructions

Apply a spot of Loctite 243 to the threads of the cap head screws. Fix the connector to the mounting position (metal to metal flange contact) using the cap head screws. Torque to 10-12Nm (7.38 – 8.85 lbf.ft).

7.4 Installation of AquaTRON junction box and mounting brackets

Referring to Figure 18, the junction box is designed to be mounted and deployed in a horizontal position. If the junction box is to be mounted vertically, the hose will need to be supported on either side of the junction box to maintain the minimum bend radius.

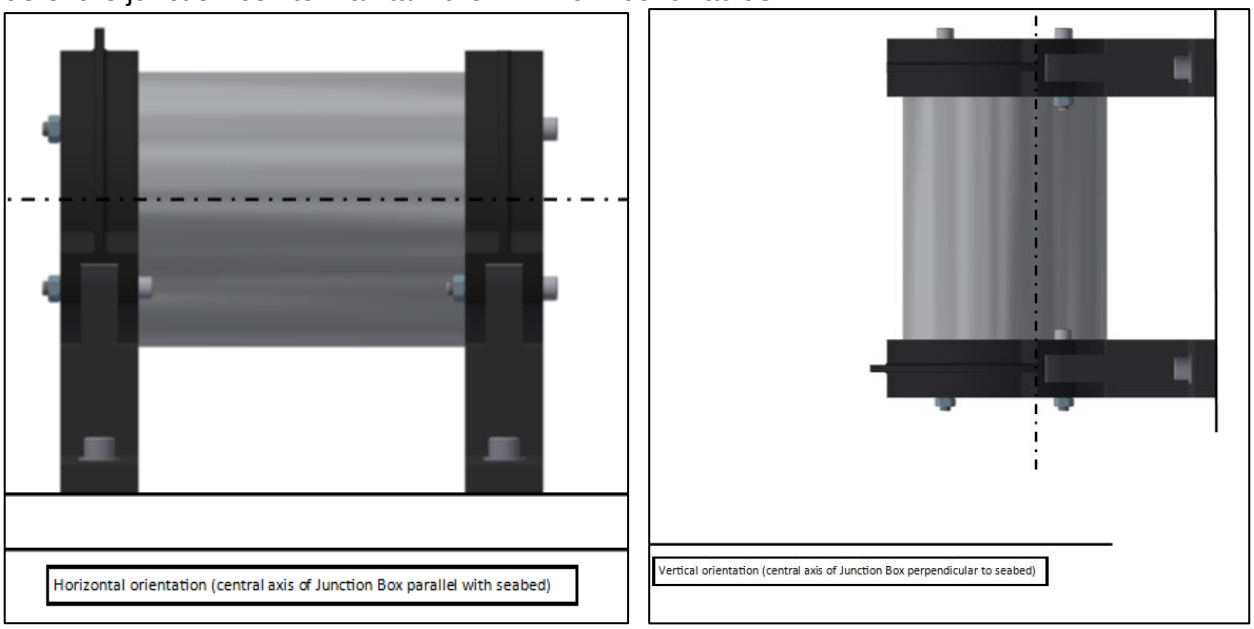

Figure 18 Junction box mounting horizontal (left) and vertical (right)

It is critical the brackets for the junction box are installed as identified on Siemens Energy drawing T33073, available from Siemens Energy Technical Support

Drill interface holes as required for installation as per drawing T33073
.
Apply a spot of Loctite 243 to the threads of the cap head screws. Fix the junction box to the structure with 4x M8 screws, torque to 10-12Nm (7.38 – 8.85 lbf.ft)

In the event that the brackets are supplied separate to the junction box body, these will need to be assembled and installed. If applicable: assemble brackets to the body taking into account the anti-rotation peg, which is to be situated on the underside of the unit and locates into a recess in the body. Fit 1-off black nitrile strip to each bracket on the opposite side to the anti-rotation peg. Tighten the M6 fasteners to 3.5Nm (2.58 lbf.ft) to complete the bracket installation. See Figure 19 and Figure 20.

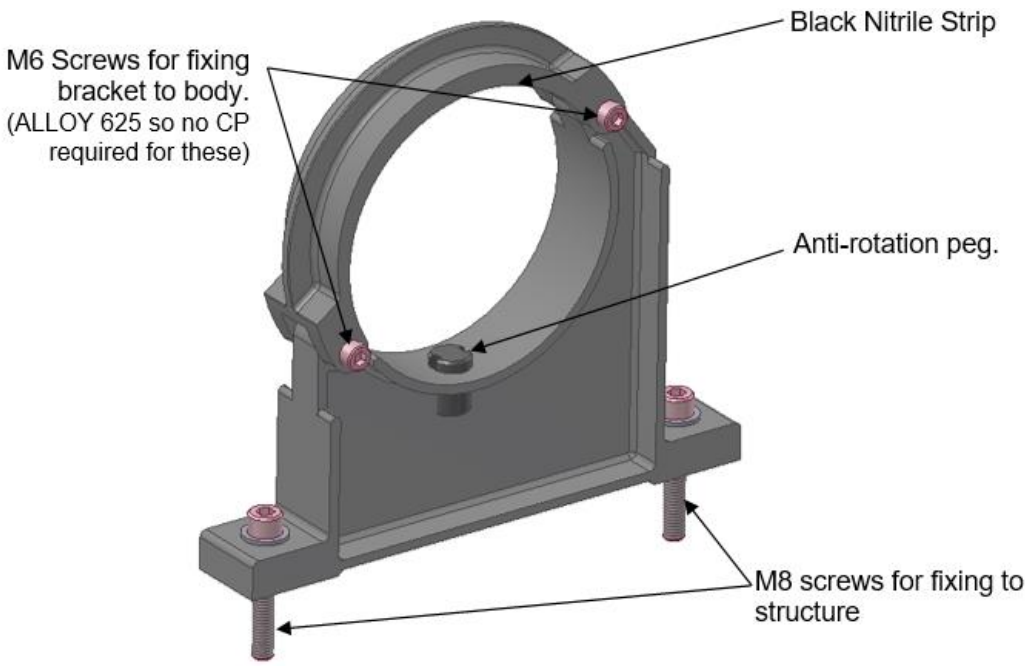

Figure 19 Junction box mounting bracket assembly

Ensure mounting brackets are secure and the junction box is orientated correctly. This completes the installation of the junction box.

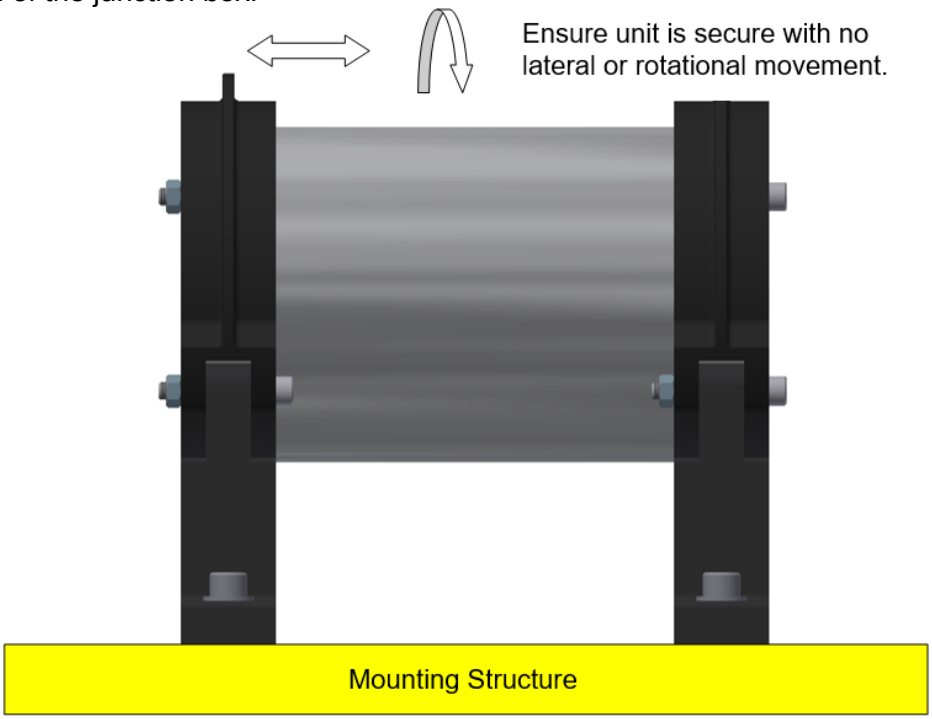

Figure 20 Junction box correctly installed on structure

Non-Standard Junction Boxes, Splices & Glanded configurations.

Brackets for non-standard assemblies are supplied loose. These should be fitted to the assembly as indicated by the GA or datasheet using the lever arm and securing. See Figure 21

Figure 21 Loose Bracket with Lever Arm

2 types of brackets

- Size 10 – M6x30 long
- Size 20 – M8x30 long

Apply a spot of Loctite 243 to the threads of the cap head screws. Fix the assembly with the brackets to the structure with the following torque to 10-12Nm (7.38 – 8.85 lbf.ft)

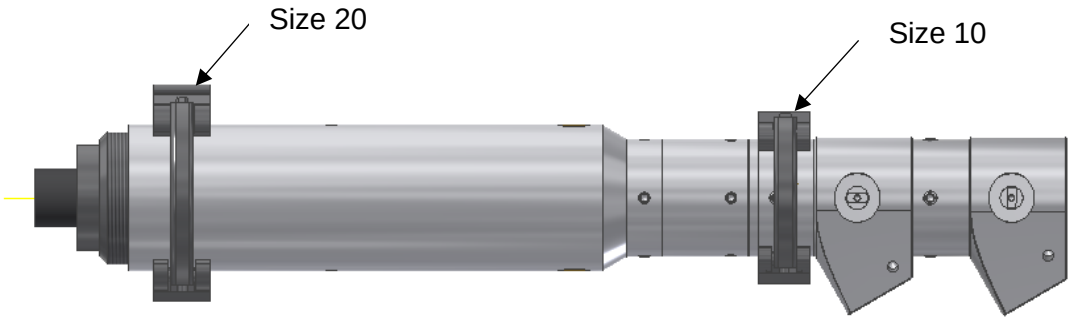

Figure 22 Junction box brackets correctly installed

7.5 Sensor assemblies

Sensor installation is specific to each sensor and assembly instructions are to be provided by the sensor manufacturer. Refer to Table 1 for Siemens sensors.

7.6 Product mounted within umbilical termination assemblies (UTA)

This section applies to product such as glanded connectors, cable-to-hose cross-over units, and Advanced Cable Termination (ACT) units that are terminated to the umbilical and mounted inside the UTA.

These products should be securely mounted to the UTA structure using the fastenings supplied with the product, or suitable alternatives. Umbilical cables should be routed inside the UTA such that no undue strain is applied where the cable enters the product.

The cable should be clamped onto a cable tray or similar before entering the product, such that any movement of the cable in the UTA (planned or otherwise e.g. shock load) does not transmit strain to the product. It is recommended to position a cable clamp circa 200mm prior to the cable entry to the product and coaxially to ensure a straight run of cable up to the product.

7.7 TESTING OF EFL'S

For testing of products in a dry environment (topside) The appropriate test connector must always be used to make electrical contact during testing.

For testing EFL's in a wet environment, a standard subsea connector must be used. Siemens connectors should not be used as pressure barrier in a pressure vessel, they are not intended for this use.

If present, guide pins must never be removed from test connectors as this can lead to damage and will invalidate the connector warranty.

Under no circumstances should a non-Siemens Energy test connector be used. This is certain to damage the product.

	**Danger!** Risk of imminent danger to life or risk of severe personal injury. Sudden release of stored pressure. DigiTRON products are not intended for use as a penetration for fixed top-side or land-based pressure vessels. They are not designed to comply with the requirements of the Pressure Equipment Directive (2014/68/EU). They are intended for integration into subsea equipment only. All pressure testing of DigiTRON product must be undertaken by a competent person.
	**Danger!** Risk of death from electric shock from a damaged test connector - Never hold a test connector while electrically energised - Do not use a test connector is it appears damaged in any way.
	**Danger!** Risk of death from electric shock from improper use of test connector. Never disassemble test connectors. In particular, removal of the rubber termination sleeves placed over the joint between the cable and the test connector is prohibited, as this will expose live parts to the user. - Never disassemble a test connector
	**Caution.** Risk of material damage. The appropriate test connector must always be used to make electrical contact during testing. Under no circumstances should a foreign object (such as a screwdriver, test probe or crocodile clip) be used as a test connection as this could damage the seals and insulation. Such actions will invalidate the product warranty.
	**Caution**. Risk of material damage. Test connectors should never be used in water. There is a high change of damage to the test connector and also to the connector under test.

- Below are some images of standard dry (topside) Siemens Energy test connectors.

Figure 23 Dry (Topside) Test connectors, ROV, Diver and Stab-plate type

Alternatively, a standard subsea connector (e.g. Figure 24) tailed with cable can be used as a test connector. Siemens can provide such connectors tailed with appropriate cables (Siemens recommendation), or untailed.

Cable tails require soldering into the solder cups on the rear of the connector. Each termination must be protected by a termination sleeve supplied with the connector.

Only a Suitably Qualified and Experienced Person (SQEP) should install the cable tails, e.g. person trained by Siemens Energy.
Siemens Energy installation procedure should be used.

Figure 24 Example of standard subsea connector (shown untailed)

All test connectors should be periodically inspected and cleaned (refer to section 9.6). Electrical integrity should be checked by performing an Insulation Resistance and Contact Resistance test.

Check that there is no debris or dirt on the test connector; this can be transferred to the connector under test, especially male pins and front face of the plug connector. It is good practice to inspect the test connector before every use.

Check that pins are not bent, and the gold-plated tips of the pins are in good condition.
A gauge can be used to check straightness of the pins; 3d model supplied by Siemens Energy, which can be used to a 3d print the gauge. See Figure 25.

Figure 25 Gauges for checking straightness of receptable pins (ROV type shown)

8 USER INFORMATION DURING NORMAL OPERATION AND FAULT CONDITIONS

8.1 Visible/audible signals

There are no visible or audible signals from the product during use that identify particular operations to the user.

The product should be silent during operation and its appearance should not change.

8.2 Normal and faulty/dangerous operation

Do not operate the product if there appears to be a fault. If in doubt contact Siemens Energy Technical Support. Below are some indications of a product fault.

- Any loose items such as metal bodies, fasteners, other fixings
- Any oil leak is present, either from the connector or from the oil-filled hoses or junction boxes.
- Bent pins
- Damage to the rubber seals on the front-face of the plug especially around the seals such as tears or nicks. Small nicks away from the front seals are acceptable.
- Blackening or darkening of the rubber seals on the front face of the plug.
- Any signs of electrical activity on the exterior of the products, such as burning on the front face of the plug or burning of the male pins.
- Green-coloured corrosion on the male pins.
- Damaged insulation on any cables.
- Loose or faulty electrical joint between cables and connector.
- Any noise coming from the product.

8.3 Troubleshooting

If there is any problem with the product failing to operate correctly, please contact Siemens Energy for advice. Do not dismantle the product in any way.:

Department	E-mail address
Product Safety Officer	subsea.connectors.productsafety.gb@siemens-energy.com
Technical Support	connectortechnicalsupport.gb@siemens-energy.com
Service (Site Team)	susultlcmsupport.gb@siemens-energy.com

Table 8 Troubleshooting product contact details

9 PRODUCT OPERATION AND MAINTENANCE

9.1 Safety precautions

Before use, read section 3 on product safety advice.

9.2 Product maintenance and servicing

DigiTRON products require zero maintenance for their 30 year subsea lifetime and up to 250 subsea mate and demate cycles.

There are no user serviceable parts in the connectors, EFLs, jumpers or harnesses. Disassembly of the product should not be attempted. If there are any problems developed with the product then the user should contact Siemens Energy Technical Support for advice

9.3 Subsea protection of receptacle contact pins

	**Caution.** Risk of material damage, corrosion of the exposed male pin in the receptacle connector. 28 days is the maximum cumulative allowable exposure of unprotected receptacle pins to seawater over the lifetime of the connector **Always immediately fit a Subsea Environment Cap or Dummy Plug to the receptacle in order to protect the pins from corrosion.**
	**Caution.** Risk of material damage. Under no circumstances must the contact pins in the receptacle connector be exposed to seawater with power on. If this situation does occur the electrical connector could be destroyed (depending on electrical energy available). At a minimum, the contact surfaces of the pins will very rapidly degrade by electrolytic action. If these damaged pins are subsequently mated into a socket insert there is a **very high risk** of damage to the insulation and seals within the plug connector.
	**Caution**. Risk of material damage. It is important to isolate and earth prior to disconnect in order to remove any stray charges in the system. If left, this can induce corrosion on the exposed pins once the plug is removed.

9.4 Product protection; caps and dummy connectors

There are five types of caps and dummy connectors available to protect the product in use. The following gives the use case for each type.

9.4.1 Topside caps

- Transport cap: Supplied with the connector to protect it against damage during transport (Figure 26)
- Protective cap: Provides greater degree of mechanical protection to the connector than the transport cap. Recommended for when connectors are exposed to higher risk of damage outside of transportation Figure 26

Topside caps can simply be pushed on or removed by hand

Topside caps should not be deployed subsea.

⚠	**Caution.** Risk of material damage. If storage is carried out in saline conditions, e.g. on a ship's deck or hold, then a Subsea Environment Cap or Dummy Plug connector should be used to protect the receptacle pins from corrosion.

Figure 26 ROV-type Transport Caps (left) and Protective Caps

9.4.2 Subsea caps

- Subsea Protective Caps: Provides mechanical protection to the plug or receptacle connector (Figure 27). It is a **non-electrical** cap. The cap for the plug connector (female sockets, oil-filled) can be used for long-term mechanical protection. The cap for the receptacle (exposed male pins) **does not** protect the exposed male pins in the receptacle from corrosion. It should only be used for very short-term subsea use, e.g. the cap is removed within a few days after deployment and the flying lead connected to receptacle (noting that the 28 days maximum in section 9.3)
- Subsea Environment Cap: Provides mechanical protection to the receptacle connector (male pins) **including** corrosion protection of the exposed pins. This is a **non-electrica**l cap. To be used where the receptacle connector will be left un-mated for any length of time. Subsea Environment Caps can be identified by their red-coloured disc and labelled 'zero volts' (Figure 28 and Figure 30).
- Dummy Connectors. Provides mechanical and electrical protection to the plug or receptacle, **including** corrosion protection of the exposed pins in the receptacle (Figure 29). These are connectors have full electrical rating. They can be configured at time of order to be open-circuit or looped with wire or resistors (labelled as shown in Figure 30). These connectors should be used everywhere the system will be electrically energised or for electrical testing.

In locations where marine growth activity is prevalent, it is advised to fit a dummy receptacle connector to the plug for enhanced protection. A time limit when dummy connectors should be used cannot be given, as the type and rate of marine growth activity varies enormously for each circumstance and location. The end user is best placed to know the risk associated with marine growth for the particular location and circumstances. If other options are required please contact Siemens Technical.

Figure 27 ROV-type Subsea Caps

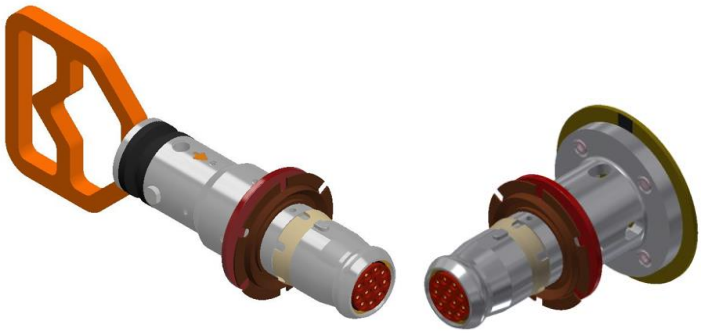

Figure 28 ROV-type Subsea Environment Caps (red-coloured disc)

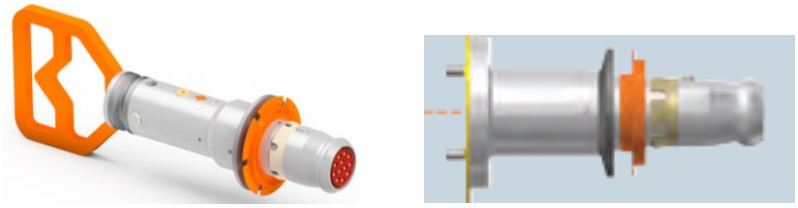

Figure 29 ROV-type Dummy Connectors, flying and flanged types (black-coloured disk).

Figure 30 Example label on connectors ('LOOPED' or 'RESISTORS' or 'ZERO VOLTS')

9.5 Live Mate / De-mate

The connectors are not designed to be mated or demated while electrically energised. Depending on the type of electrical load, the following advice should be followed.

	**Danger!** Risk of death from electric shock due to exposed live pins, e.g. factory or top-side system test and unmated receptacle is energised. - Ensure all test procedures are followed. - Communication channels and protocols are observed.
	**Caution**. Risk of material damage. The maximum number of live mate / de-mate operations under any of these conditions is ONE only. There is a high risk of damage to both plug and receptacle connector that would render it unusable.

Resistive loads

Mating the connectors should not lead to any damage to the sealing mechanisms within the plugs.

The speed of de-mating should be between 40mm/s to 60mm/s (1.6 – 2.4”/s). Following this de-mating procedure, testing should be carried out on the connector to establish if any damage has occurred. Under no circumstances shall connectors be partially mated with power on.

Capacitive loads

Mating with power on will lead to an in-rush current. The magnitude of this in-rush current will depend on the capacitance of the circuit. It is very important that the in-rush current is no more than 100A for 5 seconds.

Inductive loads

Mating the connectors should not lead to any damage to the sealing mechanisms within the inserts. De-mating **must not be attempted** as there is a risk of high back EMF’s which will cause damage to the seals and insulation within the inserts.

9.6 Inspection and cleaning of connector products

All connector products should be thoroughly inspected before use, refer to section 8.2 for faults to look for.

Connectors can be safely cleaned using Isopropyl Alcohol (IPA) and lint-free cloth, but do not soak the product in IPA. Allow time for IPA to evaporate before mating the connector together. Be careful not to leave any cloth fibres on the front-face of the plug or on the receptacle pins. Other cleaning fluids should not be used as they may not be compatible with the rubbers or plastics used in the product.

Under no circumstances should a foreign object be used to depress the shuttle pins of the plug connector.

9.7 Removal of marine growth and calcareous deposits

To remove calcareous deposits from Siemens Energy Subsea connectors, a solution of 50% Citric Acid is recommended. All seawater exposed elastomeric materials in Siemens Energy Subsea connectors have been fully tested against 50% Citric Acid and are compatible for a duration of 1 hour. In addition, the thermoplastic materials have a good resistance to citric acid.

	**Warning.** Risk of minor personal injury to persons with sensitivities to a solution of 50% Citric Acid, should wear appropriate hand and eye protection when handling.
	**Caution.** Risk of material damage. Other acid cleaners, such as 50% Acetic Acid, should not be used as they may cause deterioration of the elastomeric materials.
	**Caution.** Risk of material damage. Chiselling and abrasive methods are not recommended. Use of a water jet is acceptable, but the jet should not be directed into the shuttle pins at the front of the plug as this could result in a risk of water being forced through the primary seals.

9.8 Testing of product

Refer to section 7.7 for test connector advice.

Document SRT-001 defines electrical tests to perform to check performance of the product, available on Siemens Energy/subsea website.

9.9 Checks before mating the product

Transport and topside protection caps must be removed before subsea deployment

Before mating, the receptacle connector (male pins) should be checked for debris and damage. The connectors have been designed to accommodate sand and silt contamination; however large pieces of debris should be removed. Use a water jet if subsea, but do not direct the water jet at the front face (seals) of the plug connector

Inspect the receptacle pins for any signs of damage, such as bent pins, blackening due to electrical faults, or corrosion of the pins (green colour), corrosion of metal parts or others items listed in section 8.2.

Check the front face of the plug to see that all the shuttle pins are correctly protruding through the front seals, and are not stuck behind the front seals. If stuck behind the front seals, it is still acceptable to mate the connectors. If possible to do so, a slow speed demate of the connectors should rectify any stuck shuttle pins. Contact Siemens Energy for further advice is needed.

If evidence of such faults exists, do not use the connector. Please contact Siemens Energy Technical Support for advice.

9.10 ROV connectors mating and de-mating

9.10.1 ROV connector alignment and mating

Refer to Figure 31 for images of alignment marks and mating

- DigiTRON connectors have been designed to self-align during mating.
- The connectors must be roughly aligned using the alignment marks on the plug body, flange and receptacle cone.
- The mounting of the ROV handle has sufficient compliance to accommodate fine adjustments during the final approach prior to connector engagement.
- Ensure correct orientation of the alignment disc
- It is important that the ROV compliant flange is orientated correctly.
- Observe the text on the flange and orientate accordingly.

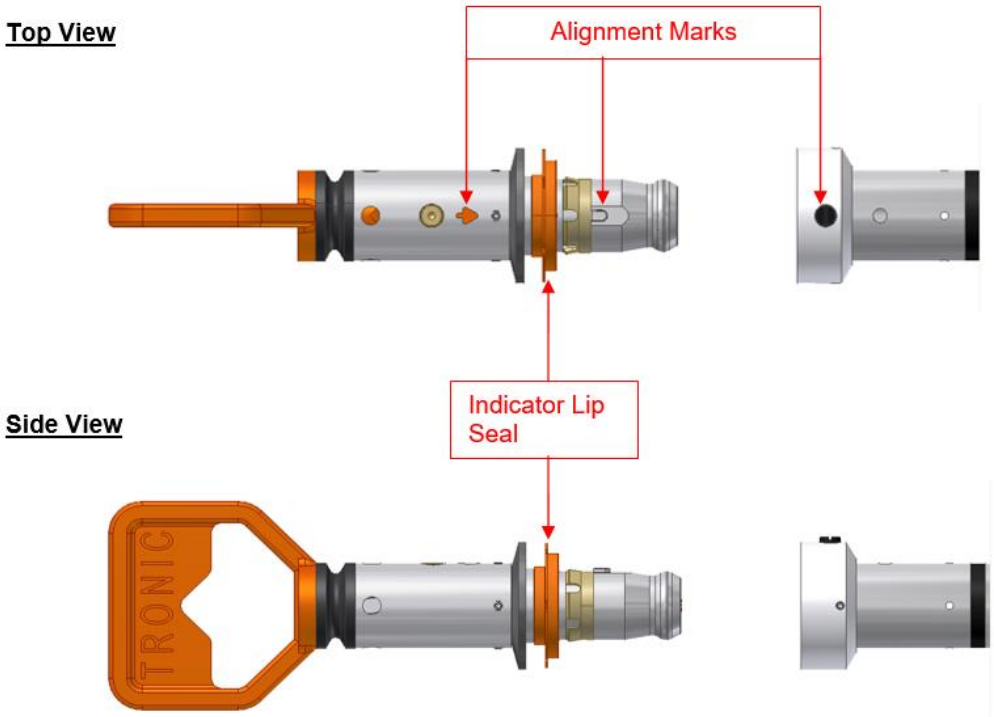

Figure 31 Alignment marks and lip seal mating indicator

- When the connector is fully mated, the lip seal will not be visible from the ROV camera first-person view, i.e. view from behind the connector. A thin orange-colour line approx. 2mm may be visible from side-on view.
- If the lip seal can still be seen from the first-person view, remove and retry making connection by following the procedure again.
- If connectors can't be mated both the plug and receptacle need to be inspected for any mis-alignment damage or debris that is preventing connection.
- If any damage has occurred please contact Siemens Energy Technical Support for advice.

9.10.2 ROV connector maximum misalignment values and mating forces

Refer to section 5.1

9.10.3 ROV connector de-mating

De-mating is achieved by a straight pull on the ROV handle, sufficient to release the latching mechanism.

Force required is detailed under the mechanical forces in section 5.1

For topside use, e.g. during system testing, there is a hand operated ROV de-mate tool available to make connector de-mate by hand easier and safe. It is recommended that this tool should always be used topside. Part number BQ-30090-00. See Figure 32

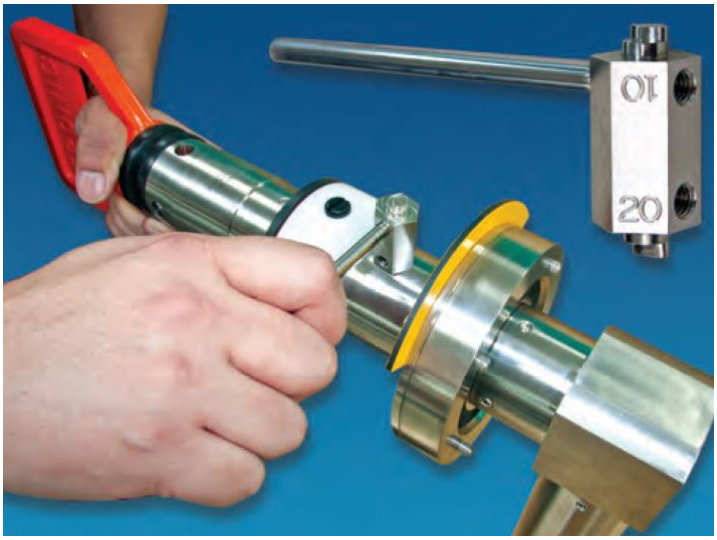

Figure 32 ROV de-mate tool, part number BQ-30090-00

⚠	**Warning.** Risk of musculoskeletal injury from hand-mating or de-mating connectors. - Referring to the mate / demate forces specified herein, ensure suitable manual handling precautions are taken and the topside demate tool is used - Ensure all product testing activities are completed by competent persons in accordance with relevant procedures.

When an EFL is de-mated and returned to the surface please inspect, store and protect as detailed in section 5.5.

9.11 Stab-plate connectors mating and de-mating

9.11.1 Stab-plate connector mating and demating

Stab-plate connector do not have any latching mechanism. The connectors are mated together by the force of the stab-plate. There is no special operation needed to demate the connector, simply the stab-plate is withdrawn and the connectors separate.

Only the alignment of the key and the maximum misalignment values need to be adhered to, refer to section 5.1.

9.11.2 Partial disconnection and interrupted connection

Partial disconnection with the contact pin remaining between the primary and secondary diaphragms is not recommended, as there is a risk of damaging the insulation. If it is necessary to operate the connectors partially mated, the connectors should be separated by 8.6 – 9.2mm (0.340 - 0.360”) from the nominal, mated, stab distance. In this condition the level of insulation between the contact pin and socket contact is reduced and the connector is relying on the primary seals within the plug. There is also an increased risk of insulation break down at voltages above 500V.

Interrupted connection (i.e. Partial mate to full de-mate) can be carried out without any adverse effect to connectors, as long as the power is off.

9.12 Diver operated connectors mating and de-mating

9.12.1 Diver operated connector mating and de-mating

The clamp ring should be rotated clockwise by hand until tight. The connectors are designed to remain clamped together with only firm hand tightness on the clamp ring. If a clamping torque is used, this MUST NOT exceed 20Nm (15 lbf.ft). A 2-3” C-spanner can be used for this operation.

De-mating is simply a reverse of this process.

9.12.2 Diver operated connector maximum misalignment values

These connectors have been designed to self-align during mating. All that is required is to ensure that the alignment pin on the plug connector is engaged in the alignment groove within the receptacle connector before screwing the clamp ring up.

9.12.3 Diver operated connector post mating checks

Full engagement of the connectors can be checked through the viewing hole in the clamp ring. If the connectors are fully mated, then no gap should be visible between the plug and receptacle, refer to Figure 33.

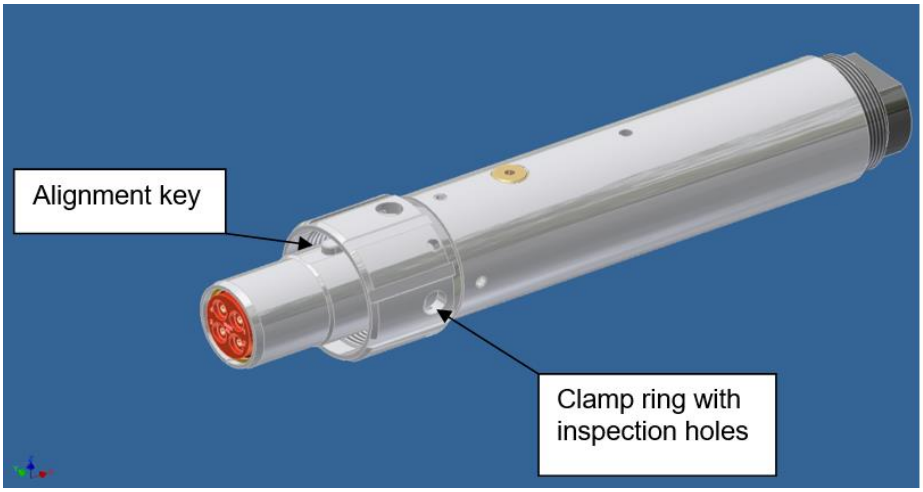

Figure 33 Diver operated connector mating features

10 CUSTOMER COMMENTS/FEEDBACK

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Siemens Energy Global GmbH & Co. KG
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