SpecTRON Evolution
Medium & High Power
Electrical Connector Systems

Siemens Subsea introduces its SpecTRON (Subsea Power Electrical Connector) range of Medium and High Power Electrical Connector Systems for the Oil & Gas industry.

Product History

Since 1979 Siemens Subsea Connectors has been involved in subsea applications for the Oil & Gas industry. Initially, most electrical equipment placed on the sea bed was relatively low power, i.e. control systems and instrumentation. The company’s involvement in high power connectors started with a development programme initiated in 1988 (Project SPEED). This led to the design, manufacture and test of the world’s first subsea mateable connector pair rated to 11kV 400Amps. Development of these connector ranges continued and became our standard SpecTRON 10 connector which is commonly used for Multi Phase Pumping (MPP) projects.

1994 saw a significant turning point in oil production history when Petrobras, in partnership with Siemens Subsea Connectors, installed the world’s first subsea Electrical Submersible Pump (ESP) system complete with wet mate connectors to power the downhole pump. Since that time, ESPs for subsea wells have become an accepted solution and the SpecTRON 5 system is seen as the industry standard with an unprecedented subsea proven track record.

Since 1994 the amount of subsea equipment requiring high voltage (HV) and high current (HC) has increased significantly. In response Siemens Subsea have developed the most extensive range of HV power connectors in the industry. Through the years of development, Siemens Subsea have delivered world firsts on many new connector developments and subsea applications. As the market for subsea ‘medium to high power connectors’ increases Siemens Subsea will continue to develop the enabling technologies needed to satisfy the requirements of the subsea Oil & Gas industry.

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SpecTRON

Connector Range Design Features
- The connector design is based on the proven Controlled Environment (CE) principle used in all Siemens Subsea connectors (see diagram below)
- Incorporates true dual redundancy sealing allowing continuous operation with the primary seal breached (flooded front end and / or flooded cable termination gland)
- Incorporates compensated elements to eliminate differential pressure across seals
- Qualified for HV breakdown greater than 6Uo

CE Principle - Sequence of Operations

1. Receptacle & Plug prior to mating
2. Receptacle pin engages with shuttle pin of plug assembly
3. Receptacle pin enters first oil chamber of the primary diaphragm and pushes back the shuttle pin
4. Receptacle pin enters secondary diaphragm and makes full contact with plug contact pin

Leading through innovation – delivering world firsts

- 1988: World's first 11kV subsea connector deployed
- 1994: World's first subsea ESP connector system for Petrobras
- 1995: World's first field-wide ESP development for AMOCO
- 2002: Awarded the E&P Meritorious award for engineering innovation for high power subsea wet mate connector
- 2005: World's deepest subsea pumping application (1680 metres water depth) for BP
SpecTRON Global Experience

World map indicates sample cross section of SpecTRON projects.

MTBF (Mean Time Before Failure)
For SpecTRON product range MTBF: 5,422,440 hours

1. Papa Terra SpecTRON 8
2. Bicudo SpecTRON 5
3. Lufeng SpecTRON 5
4. Topacio SpecTRON 2
5. Laggan Tormore SpecTRON 5
6. Agard SpecTRON 5 & 10
7. Lihua SpecTRON 5
8. Ormen Lange SpecTRON 5
9. Sin Badejo SpecTRON 5
10. Vincent SpecTRON 10

World's first combined ESP (Electrical Submersible Pump) & MPP (Multi-Phase Pump) development:
- 2006

World's first commercial subsea separation system:
- 2009

Launch of enhanced SpecTRON 10 HV power connector:
- 2011

Awarded world's first subsea gas compression project:
- 2011

Tronic become part of Siemens Subsea marking a new era of product development:
- 2012
SpecTRON Evolution

The SpecTRON Evolution has arrived with the next generation of SpecTRON connectors featuring industry leading engineering and reliability manufactured in our world class facilities.

**Industry-Leading Engineering**
- Industry-leading Research and Development facilities
- Industry-leading HV electrical and HP pressure testing facilities
- Industry-leading design and analysis
- Industry-leading experience

**Research and Development**
Our purpose built Research and Development facility has a dedicated engineering team devoted to developing the SpecTRON range of connectors.
SpecTRON Product Range Development

Reliability
- Reliability through design and experience
- Reliability through world-class production facilities
- Reliability through materials and manufacturing process
- Reliability and risk management through upfront simulation and experience

SpecTRON Product Development
At Siemens Subsea Connectors we are continually reviewing our market’s requirements and improving our product range to meet new and evolving demands for higher voltage and higher pressure requirements. Our growing team of highly qualified and experienced engineers, with a large test department at their disposal, are always available to respond to your product development needs.

Members of the SpecTRON team in the assembly and test bay area.
Siemens Subsea Connectors medium and high power SpecTRON subsea electrical connectors are usually used in the type of systems shown. Please contact our Technical Department to discuss your specific requirements.

**ESP SYSTEMS**

Electrical Submersible Pump (ESP) systems have 2 distinct power requirements; 5kV and 8kV. The higher powered 8kV systems address the requirement for deeper water applications.

Siemens Subsea Connectors supply the full connection system from the Umbilical Termination Unit fitted to the umbilical cable, the infield jumper taking the power to the Tree Cap, through the Tree, and finishing at the Tubing Hanger Receptacle.

We supply both single feed-through and dual feed-through systems.

**SpecTRON 5 (5kV(U))** and **SpecTRON 8 (8.7kV(U))** subsea electrical connectors meet the requirements for ESP systems.

**MUDLINE PUMPING SYSTEMS**

Siemens Subsea Connectors deliver **SpecTRON 10 (10kV(U))** subsea electrical connector systems designed for the power requirement of Multi Phase Pumps (MPPs), Single Phase Pumps (SPPs) and Gas Compressors.

**SUBSEA POWER DISTRIBUTION**

MPPs (Multi Phase Pumps), SPPs (Single Phase Pumps) and Gas Compressors often require the power to be transferred through a subsea transformer. To accommodate this requirement we have a **SpecTRON 60** (60kV(U)) penetrator to interface with the high power umbilical.

We also have a modular **SpecTRON MUTU 5, 8 & 10** for power distribution to Electrical Submersible Pumps, Mudline Pumping and Gas Compressor Systems.

**FLOWLINE SYSTEMS**

Siemens Subsea Connectors deliver **SpecTRON 2 (2kV(U))** and **SpecTRON 15 (14kV(U))** subsea electrical connectors to facilitate the provision of power from the FPSO or platform to the flowline. The **SpecTRON 15** normally feeds into a transformer from which the **SpecTRON 2** takes the power to the heating system.
Flowline Heating System
MPP (Multi-Phase Pump) or Gas Compressor
Transformer UTU (Umbilical Termination Unit)

Semi-Submersible Platform
FPSO

FLOWLINE HEATING SYSTEMS

SUBSEA POWER DISTRIBUTION
Pages 18 & 19
MUDLINE PUMPING SYSTEMS
Pages 14 & 15

POWER SOURCE

SpecTRON 60 (Long Step Out) SpecTRON
SpecTRON 10 SpecTRON
SpecTRON 15 SpecTRON
SpecTRON 2 SpecTRON
SpecTRON 5 SpecTRON
SpecTRON 8 SpecTRON

5 kV (U) 200A ESP power feedthrough system connectors
8.7 kV (U) 220A ESP power feedthrough system connectors
2 10
5 15
8 60

UTU (Umbilical Termination Unit) Transformer MPP (Multi-Phase Pump) SPP (Single-Phase Pump) or Gas Compressor Transformer Flowline Heating System

SpecTRON 2 2 kV (U) 1000A pipeline heating system connectors
SpecTRON 5 5 kV (U) 200A ESP power feedthrough system connectors
SpecTRON 8 8.7 kV (U) 220A ESP power feedthrough system connectors
SpecTRON 10 10kV (U) 450A connectors for use on MPP (Multi-Phase Pumping) systems
SpecTRON 15 14kV (U) 200A dry mate connectors for use on power distribution systems
SpecTRON 60 60kV (U) 630A power distribution penetrator
SpecTRON 5
5kV (U) 200A Connector Systems

Electrical Submersible Pumps (ESPs) have been used since the early 1990s to enhance oil recovery from deepwater and marginal wells. Siemens Subsea Connectors, has been heavily involved in providing ESP connection systems since those pioneering days and Siemens Subsea Connectors 5kV 200A (SpecTRON 5) connectors are now seen as the industry standard with deployments worldwide.

The connection system is a 3-phase, 2.9/5(5.8)kV system qualified to a water depth of 1330m (200 bar test). Wet mate connectors can be configured as ROV, Diver or Stab Plate mated. The penetrator and tubing hanger receptacle are designed to API standards and differential pressure rated to 260 bar (520 bar test). The most recent addition to this range is a penetrator with either an API or SPO flange rated to 345 bar (517 bar test). For use on subsea transformers, circuit breakers, power distribution units and condensate pumps.

An ESP power feedthrough system typically comprises an Umbilical Termination Unit to splice the umbilical power cores to flexible leads which then terminate into a Wet Mate Receptacle. A ‘flying’ jumper links the umbilical to the Xmas tree. A penetrator in the tree cap provides a pressure retaining feedthrough to a wet mateable tree cap plug, which mates with a wet mateable receptacle in the tubing hanger. The tubing hanger receptacle is pressure retaining and engineered to withstand the hostile environment of aggressive chemicals at high temperature.

The tubing hanger receptacle is terminated to downhole motor cable which ultimately connects to the pump.

Suitable Applications:

- Low voltage / high current supply to mudline processes, ESP systems, long step out control systems
- ESP systems
- Long step out control systems
- Subsea gas compression systems (transformers and pumps)

*Based on connectors deployed to date
SpecTRON 5
5kV (U) 200A Connector Systems

ESP Power Feedthrough Systems

Electrical Submersible Pumps (ESPs) are used to boost well pressure and enhance oil recovery. Power to the ESP is provided through a series of electrical jumpers and subsea inter-connections. The inter-connections are made up of wet mateable electrical connectors and penetrators. These allow power to pass from the umbilical through the subsea tree to the ESP. They provide both a pressure retaining capability at the tree cap and tubing hanger and a wet mate / demate function at the umbilical and tubing hanger.

An ESP is a device which has a hermetically sealed motor close-coupled to the pump body; the whole assembly is submerged in the fluid to be pumped. Submersible pumps are used to provide an efficient form of "artificial lift" able to operate across a broad range of flow rates and depths.

Siemens Subsea Connectors supply the full connection system from the Umbilical Termination Unit fitted to the umbilical cable, the infield jumper taking the power to the Tree Cap, through the Tree, and finishing at the Tubing Hanger Receptacle. We supply both single feed-through and dual feed-through systems.

<table>
<thead>
<tr>
<th>SpecTRON 5 Wet Mate Connectors 5kV (U) 200A</th>
<th>SpecTRON 5 Penetrator 5kV (U) 200A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Contacts</td>
<td>3</td>
</tr>
<tr>
<td>Voltage Uo/U(Um)</td>
<td>2.9/5 (5.8) kV</td>
</tr>
<tr>
<td>Voltage Frequency</td>
<td>1-200Hz</td>
</tr>
<tr>
<td>Maximum Current (Dependent on ambient temperature &amp; supply frequency)</td>
<td>200A</td>
</tr>
<tr>
<td>Water Depth Rating</td>
<td>3000 metres (9843 feet)</td>
</tr>
<tr>
<td>Differential Pressure Rating (Inboard pressure high)</td>
<td>345 bar (520 bar test)</td>
</tr>
<tr>
<td>Working Temperature Range</td>
<td>-4°C to 40°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-40°C to 70°C</td>
</tr>
</tbody>
</table>

Note: For the full specification please refer to pages 18 & 19.
SpecTRON 8
8kV (U) 220A Connector Systems

SpecTRON 8 is the latest addition to the Siemens Subsea Connectors, range of medium and high power connector systems.

The design and development of this range of connectors is based on the knowledge and experience that we have gained from the extensive deployment of SpecTRON connectors throughout the Oil & Gas industry. At the same time we have taken the opportunity to incorporate the latest developments in technology. This new product range provides the industry with increased power capacity, particularly for ESP systems, whilst maintaining the high degree of reliability inherent in the SpecTRON product range.

SpecTRON 8 satisfies a similar need to the SpecTRON 5, but has been developed to meet the increasing power demand for ESPs to extract the heavy oils in deep and ultra-deep water (typically offshore Brazil). SpecTRON 8 provides a complete connection system from the umbilical through to the pump/tubing hanger; comprising Umbilical Termination Unit, ROV wet mate-able connectors, penetrator, plug and tubing hanger receptacle. They provide pressure retaining capability at both the tree cap and tubing hanger, and a wet mate / de-mate function at the umbilical and tubing hanger.

Suitable Applications:
ESP systems and Renewables.

Projects delivered: 2
MTBF: 205,000 hours*
Qualified to Specification: Petrobras
Technology Readiness Level (TRL): 7 - Proven Technology
*Based on connectors deployed to date
## SpecTRON 8

### 8kV (U) 220A Connector Systems

### Table: SpecTRON 8 Connector Specifications

<table>
<thead>
<tr>
<th>SpecTRON 8 Wet Mate Connectors 8kV (U) 220A*</th>
<th>SpecTRON 8 Penetrator 8kV (U) 220A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Contacts</strong></td>
<td>3</td>
</tr>
<tr>
<td><strong>Voltage Uo/U(Um)</strong></td>
<td>5 / 8.7 (10) kV</td>
</tr>
<tr>
<td><strong>Voltage Frequency</strong></td>
<td>1-200Hz</td>
</tr>
<tr>
<td><strong>Maximum Current</strong></td>
<td>&lt;br&gt;355A (45°C, 50Hz) &lt;br&gt;220A*  &lt;br&gt;(91°F, 50Hz THR only) &lt;br&gt; &amp; 90°C, 50Hz for Tree Cap Plug only</td>
</tr>
<tr>
<td><strong>Water Depth Rating</strong></td>
<td>3000 metres (9843 feet)</td>
</tr>
<tr>
<td><strong>Differential Pressure Rating</strong></td>
<td>Tubing Hanger Receptacle 345 bar (517 bar test)</td>
</tr>
<tr>
<td><strong>Working Temperature Range</strong></td>
<td>4°C to 40°C (ROV) &lt;br&gt; 4°C to 110°C (THR) &lt;br&gt; 4°C to 90°C (TCP)</td>
</tr>
<tr>
<td><strong>Storage Temperature Range</strong></td>
<td>-30°C to 60°C</td>
</tr>
</tbody>
</table>

*Note: For the full specification please refer to pages 18 & 19.*

*220A current rating is representative of ESP applications and is dependent on ambient temperature and supply frequency.*
SpecTRON 10
10kV (U) 450A Connector Systems

Multi Phase and Single Phase Pumping

SpecTRON 10 connectors are typically used for Multi-Phase Pumping (MPP) and Single-Phase Pumping (SPP) applications, also called booster pumps or mudline pumps. The MPP or SPP is situated on the sea bed and is joined to the pipeline, boosting flow from the well to top-side. The pumps increase oil recovery and can be specified for new field developments, or for existing fields to extend their life.

SpecTRON 10 connectors have a nominal voltage rating of 6/10(12)kV, in accordance with the IEC voltage class system. This makes them suitable for 3-phase system voltages up to 12kV (Um).

Maximum current throughput is up to 520A, depending on the temperature and pressure inside the pump motor. This means the connectors can provide power to pump motors rated to 9MW (12,000 hp), or to 5MW (6,700 hp) for systems requiring Category C operation.

SpecTRON 10 has been qualified to 450 bar test (4500 metres) for use in deepwater to 3000 metres (which is currently the world’s deepest MPP project).

Suitable Applications: MPP and SPP systems and gas compressors.

Projects delivered: 18
MTBF: 10,200,000 hours*
Qualified to Specification: TDO153
Technology Readiness Level (TRL): 7 - Proven Technology

*Based on connectors deployed to date
SpecTRON 10
10kV (U) 450A Connector Systems

Compliantly Mounted Right Angled Plug (PCE-A74)
Compliantly Mounted Dummy Plug (PCE-L10)
Fixed Mounted In-line Receptacle (PCE-B62)
Fixed Mounted Parking Receptacle (PCE-M19)
Fixed Mounted In-Line Penetrator (TC1A-263)
Fixed Mounted In-Line SPO Flange Penetrator (TC1A-270)
Compliantly Mounted low voltage Dummy Plug (PCE-L13*)
Compliantly Mounted Parking Plug (PCE-L11)

Termination options: Right angle & in-line Penetrator Termination Kit

Diver Mate Option - Wet Mate Plug Connector

All connector part numbers are from the SpecTRON 10 Mk II product range. Items marked * are in development.

Note: For the full specification please refer to pages 18 & 19.
SpecTRON MUTU 5, 8 & 10
(Modular Umbilical Termination Unit)

New development ‘Modular’ UTU which is more compact with no external compensator. Less project-specific engineering and qualification. Used as basis for HV controls UTU (Laggan & Tormore - Quad core from umbilical, 2-off cable pairs out to SpecTRON 5).

Typical MUTU harness assembly example
(3 x Single Phase + SpecTRON 8 Main Housing Internal Compensator + 3 x AquatRON 2” + 3 x 16mm + SpecTRON 8 ROV Receptacle)

SpecTRON MUTU 3D Modular Map

<table>
<thead>
<tr>
<th>SpecTRON 5 MUTU 2.9/5kV (5.8kV) 150A</th>
<th>SpecTRON 8 MUTU 5/8kV (10kV) 350A</th>
<th>SpecTRON 10 MUTU 6/10kV (12kV) 630A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Phases</td>
<td>3 x Single or Triad</td>
<td>3 x Single or Triad</td>
</tr>
<tr>
<td>Voltage Uo/U(Um)</td>
<td>2.9/5 (5.8) kV</td>
<td>5/8.7 (10) kV</td>
</tr>
<tr>
<td>Voltage Frequency</td>
<td>1-200Hz</td>
<td>1-200Hz</td>
</tr>
<tr>
<td>Maximum Current Rating</td>
<td>250A @ 4˚C, 50Hz</td>
<td>350A @ 20˚C, 50Hz</td>
</tr>
<tr>
<td>Water Depth Rating</td>
<td>3000 metres (9843 feet)</td>
<td>3000 metres (9843 feet)</td>
</tr>
<tr>
<td>External Test Pressure Rating</td>
<td>450 bar</td>
<td>450 bar</td>
</tr>
<tr>
<td>Working Temperature Range</td>
<td>-5˚ to 30˚C</td>
<td>-5˚ to 30˚C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-30˚C to 60˚C</td>
<td>-30˚C to 60˚C</td>
</tr>
</tbody>
</table>

Note: For the full specification please refer to page 20
SpecTRON 60
Penetrator 60kV (U) 650A

Siemens Subsea Connectors has achieved yet another first in technological development with the creation of the SpecTRON 60 penetrator, a vital enabling technology for high voltage subsea electrical distribution systems, with the capacity to operate in water depths up to 2000 metres. SpecTRON 60 was developed to meet the ever-growing demand for connectivity between higher voltage umbilical cables and subsea transformers, making it possible to achieve longer step-out distances and higher power loads required by projects such as subsea gas compression.

What makes SpecTRON 60 unique is the sealing and barrier philosophy developed for the penetrator. The design not only meets the requirements of TD0153, which allows insulation to be the second barrier to sea-water, but surpasses it. Having an additional sea water barrier prevents water treeing in the insulation. This is a specific feature of the SpecTRON 60 design to ensure that the insulation system is never exposed even if the primary sea water barrier is breached.

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60kV Penetrator
Development Team

60kV Penetrator under thermal cycle test.

Environmental Spec

Working Temperature Range
0˚ to 30˚C

Storage Temperature Range
-25˚C to 60˚C

Mechanical Spec

Differential Pressure Rating
10 bar

Water Depth Rating
2000 metres (6562 feet)

Note: For the full specification please refer to pages 18 & 19.

Electrical Spec

Number of Contacts
1

Voltage U0/U(Um)
36/60 (72.5) kV

Voltage Frequency
1-200Hz

Maximum Current
Dependent on ambient temperature & supply frequency

630A

SpecTRON 60
Penetrator 60kV (U) 650A
## SpecTRON Generic Data Sheet

### Wet & Dry Mate Connectors

#### Electrical Specification

<table>
<thead>
<tr>
<th></th>
<th>SpecTRON 5 5kV (U) 200A</th>
<th>SpecTRON 8 8kV (U) 220A</th>
<th>SpecTRON 10 10kV (U) 630A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Contacts</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Voltage Uo/U(Um)</td>
<td>2.9/5 (5.8) kV</td>
<td>5 / 8.7 (10) kV</td>
<td>6/10 (12) kV</td>
</tr>
<tr>
<td>Voltage Frequency</td>
<td>0-100Hz</td>
<td>1-200Hz</td>
<td>1-200Hz</td>
</tr>
<tr>
<td>Maximum Current</td>
<td>200A</td>
<td>335A (at 25°C, 10kHz)</td>
<td>630A</td>
</tr>
<tr>
<td>Maximum Test Voltage</td>
<td>10.1kV rms</td>
<td>20kV rms</td>
<td>24kV rms</td>
</tr>
<tr>
<td>Minimum Breakdown Voltage</td>
<td>&gt;25kV rms</td>
<td>&gt;30kV rms</td>
<td>&gt;36kV rms</td>
</tr>
</tbody>
</table>

#### Mechanical Specification

<table>
<thead>
<tr>
<th></th>
<th>SpecTRON 5 5kV (U) 200A</th>
<th>SpecTRON 8 8kV (U) 220A</th>
<th>SpecTRON 10 10kV (U) 630A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Depth Rating</td>
<td>1330 metres (4364 feet)</td>
<td>3000 metres (9843 feet)</td>
<td>3000 metres (9843 feet)</td>
</tr>
<tr>
<td>Submerged Design Life</td>
<td>25 Years</td>
<td>25 Years (10 years TH Receptacle)</td>
<td>30 Years</td>
</tr>
<tr>
<td>Connection Method</td>
<td>ROV, Tubing Hanger, Diver &amp; Tree Cap</td>
<td>ROV, Tubing Hanger &amp; Tree Cap</td>
<td>Stab / ROV &amp; Diver</td>
</tr>
<tr>
<td>Mate / Demate Forces</td>
<td>&lt;640 Newtons</td>
<td>&lt;750 Newtons</td>
<td>2kN per phase</td>
</tr>
<tr>
<td>Differential Pressure Rating</td>
<td>Tubing Hanger Receptacle only 260 bar (520 bar test)</td>
<td>Tubing Hanger Receptacle only 345 bar (517 bar test)</td>
<td>Receptacle only: 130 bar (200 bar test)</td>
</tr>
<tr>
<td>Weight (in air) approx.</td>
<td>ROV Recept: 13kg ROV Plug: 15kg TH Conns: 10kg</td>
<td>Tubing Hanger Receptacle: 27kg Others: &lt;20kg</td>
<td>Receptacle: 33kg Plug: 30.5kg</td>
</tr>
<tr>
<td>Weight (in water) approx.</td>
<td>ROV Recept: 10kg ROV Plug: 12kg TH Conns: 7kg</td>
<td>Tubing Hanger Receptacle: &lt;2.2kg Others: &lt;1.7kg</td>
<td>Receptacle: 29kg Plug: 26.5kg</td>
</tr>
<tr>
<td>Connector Body Material</td>
<td>Super Duplex</td>
<td>316L Stainless Steel or Super Duplex</td>
<td>316L Stainless Steel or Super Duplex</td>
</tr>
</tbody>
</table>

#### Environmental Specification

<table>
<thead>
<tr>
<th></th>
<th>SpecTRON 5 5kV (U) 200A</th>
<th>SpecTRON 8 8kV (U) 220A</th>
<th>SpecTRON 10 10kV (U) 630A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Temperature Range</td>
<td>-4°C to 40°C TH Conns: 200A at ambient of 80°C</td>
<td>4°C to 40°C ROV 4°C to 110°C THR 4°C to 90°C TCP</td>
<td>-5°C to 20°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-40°C to 70°C</td>
<td>-30°C to 60°C</td>
<td>-40°C to 70°C</td>
</tr>
<tr>
<td>Cathodic Protection Required</td>
<td>No</td>
<td>Yes (for 316L SS Conns)</td>
<td>No (for Super Duplex Conns)</td>
</tr>
</tbody>
</table>

Wet & Dry Mate Connectors

SpecTRON Generic Data Sheet
- Wet & Dry Mate Connectors

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New SpecTRON Oct 2014 - 09/04/2015 11:07 Page 18
# SpecTRON Generic Data Sheet - Penetrators

## Electrical Specification

<table>
<thead>
<tr>
<th></th>
<th>SpecTRON 5 5kV (U) 200A (API Flange)</th>
<th>SpecTRON 5 5kV (U) 200A (Spool Mount)</th>
<th>SpecTRON 8 8kV (U) 220A</th>
<th>SpecTRON 10 10kV (U) 450A</th>
<th>SpecTRON 60 60kV (U) 650A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Contacts</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Voltage Uo/U(Um)</td>
<td>2.9 / 5 (5.8)kV</td>
<td>2.9 / 5 (5.8)kV</td>
<td>5 / 8.7 (10)kV</td>
<td>6 / 10 (12)kV</td>
<td>36 / 60 (72.5)kV</td>
</tr>
<tr>
<td>Voltage Frequency</td>
<td>1-200Hz</td>
<td>1-200Hz</td>
<td>1-200Hz</td>
<td>1-200Hz</td>
<td>5-200Hz</td>
</tr>
<tr>
<td>Maximum Current</td>
<td>200A</td>
<td>200A</td>
<td>335A</td>
<td>330-520A</td>
<td>630A</td>
</tr>
<tr>
<td>Maximum Test Voltage</td>
<td>10.1kV rms</td>
<td>10.1kV rms</td>
<td>20kV rms</td>
<td>24kV rms</td>
<td>144kV rms</td>
</tr>
<tr>
<td>Minimum Breakdown Voltage</td>
<td>&gt;25kV rms</td>
<td>&gt;25kV rms</td>
<td>&gt;30kV rms</td>
<td>&gt;36kV rms</td>
<td>&gt;200kV rms</td>
</tr>
</tbody>
</table>

## Mechanical Specification

<table>
<thead>
<tr>
<th></th>
<th>SpecTRON 5 5kV (U) 200A (API Flange)</th>
<th>SpecTRON 5 5kV (U) 200A (Spool Mount)</th>
<th>SpecTRON 8 8kV (U) 220A</th>
<th>SpecTRON 10 10kV (U) 450A</th>
<th>SpecTRON 60 60kV (U) 650A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Depth Rating</td>
<td>3000 metres (9843 feet)</td>
<td>3000 metres (9843 feet)</td>
<td>3000 metres (9843 feet)</td>
<td>3000 metres (9843 feet)</td>
<td>2000 metres (6563 feet)</td>
</tr>
<tr>
<td>Submerged Design Life</td>
<td>25 years</td>
<td>25 years</td>
<td>25 years</td>
<td>30 years</td>
<td>25 years</td>
</tr>
<tr>
<td>Connection Method</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Differential Pressure Rating (Outboard pressure high)</td>
<td>300 bar (450 bar test)</td>
<td>300 bar (450 bar test)</td>
<td>300 bar (450 bar test)</td>
<td>300 bar (450 bar test)</td>
<td>N/A</td>
</tr>
<tr>
<td>Differential Pressure Rating (Inboard pressure high)</td>
<td>345 bar (520 bar test)</td>
<td>345 bar (520 bar test)</td>
<td>345 bar (520 bar test)</td>
<td>345 bar (520 bar test)</td>
<td>10 bar</td>
</tr>
<tr>
<td>Weight (in air) approx.</td>
<td>26kg</td>
<td>10kg</td>
<td>12kg</td>
<td>30kg</td>
<td>132kg</td>
</tr>
<tr>
<td>Weight (in water) approx.</td>
<td>22kg</td>
<td>7kg</td>
<td>9kg</td>
<td>28kg</td>
<td>95kg</td>
</tr>
<tr>
<td>Connector Body Material</td>
<td>Super Duplex</td>
<td>Super Duplex</td>
<td>Super Duplex</td>
<td>316L Stainless Steel or Super Duplex</td>
<td>316L Stainless Steel or Super Duplex</td>
</tr>
</tbody>
</table>

## Environmental Specification

<table>
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<tr>
<th></th>
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<th>SpecTRON 8 8kV (U) 220A</th>
<th>SpecTRON 10 10kV (U) 450A</th>
<th>SpecTRON 60 60kV (U) 650A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Temperature Range</td>
<td>Inboard: Oil @ 40˚C max. Outboard: Water @ -4˚C to 20˚C</td>
<td>-4˚C to 40˚C</td>
<td>4˚C to 90˚C</td>
<td>Inboard: Oil @ 60˚C max. Outboard: Water @ -5˚C to 20˚C</td>
<td>0˚ to 30˚C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-40˚C to 70˚C</td>
<td>-40˚C to 70˚C</td>
<td>-30˚C to 60˚C</td>
<td>-40˚C to 70˚C</td>
<td>-25˚C to 60˚C</td>
</tr>
<tr>
<td>Cathodic Protection Required</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes for 316L No for Super Duplex</td>
<td>Yes for 316L No for Super Duplex</td>
</tr>
</tbody>
</table>
### SpecTRON Oct 2014 - 09/04/2015 11:07 Page 20

SpecTRON Generic Data Sheet

**MUTU (Modular Umbilical Termination Unit)**

#### Entry Specification

<table>
<thead>
<tr>
<th></th>
<th>SpecTRON 5 2.9(5.8kV)</th>
<th>SpecTRON 8 5 / 8.7kV (10kV)</th>
<th>SpecTRON 10 6/10kV (12kV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umbilical Entry Configuration</td>
<td>1 x Triad (To Be Developed) or 3 x Single Power Core</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Umbilical Triad Cable Size Range</td>
<td>To Be Developed</td>
<td>To Be Developed</td>
<td>To Be Developed</td>
</tr>
<tr>
<td>Umbilical Power Core Outer Diameter Size Range</td>
<td>19mm - 49mm</td>
<td>19mm - 49mm</td>
<td>19mm - 49mm</td>
</tr>
<tr>
<td>Umbilical Power Core Semi-Conductor Diameter Size-range</td>
<td>15mm - 40mm</td>
<td>15mm - 40mm</td>
<td>15mm - 40mm</td>
</tr>
</tbody>
</table>

#### Exit Specification

<table>
<thead>
<tr>
<th></th>
<th>SpecTRON 5 2.9(5.8kV)</th>
<th>SpecTRON 8 5 / 8.7kV (10kV)</th>
<th>SpecTRON 10 6/10kV (12kV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Exit Hoses</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Exit Hose Size</td>
<td>1 5/8 Gorilla or 2&quot; Aquatron</td>
<td>2&quot; Aquatron</td>
<td>1 5/8 Gorilla or 2&quot; Aquatron</td>
</tr>
<tr>
<td>Number of Exit Cables</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Exit Cable Type</td>
<td>Siwokul (Unscreened)</td>
<td>Siwokul (Unscreened)</td>
<td>Feletoflex (Screened)</td>
</tr>
<tr>
<td>Exit Cable Size</td>
<td>16mm²</td>
<td>35mm²</td>
<td>70mm² or 150mm²</td>
</tr>
<tr>
<td>Exit Cable Voltage Rating</td>
<td>6.6/7.2kV</td>
<td>13.8/15kV</td>
<td>6/10kV</td>
</tr>
</tbody>
</table>

#### Mechanical Specification

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<tr>
<th></th>
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<th>SpecTRON 8 5 / 8.7kV (10kV)</th>
<th>SpecTRON 10 6/10kV (12kV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing Material</td>
<td>316L Stainless Steel (UNS S31603) or Super Duplex (UNS S32550/UNS S32760)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum number of seawater barriers</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Compensation Method</td>
<td>Internal Diaphragm</td>
<td>Internal Diaphragm</td>
<td>Internal Diaphragm</td>
</tr>
<tr>
<td>Weight in Air (excluding umbilical / harness) 3 x Single Phase</td>
<td>86kg (3 X Single Phase)</td>
<td>86kg (3 X Single Phase)</td>
<td>To Be Developed</td>
</tr>
<tr>
<td>Weight in Air (excluding umbilical / harness) Triad</td>
<td>To Be Developed</td>
<td>To Be Developed</td>
<td>To Be Developed</td>
</tr>
<tr>
<td>Weight in Water (excluding umbilical / harness) 3 x Single Phase</td>
<td>59kg (3 X Single Phase)</td>
<td>To Be Developed</td>
<td>To Be Developed</td>
</tr>
<tr>
<td>Weight in Water (excluding umbilical / harness) Triad</td>
<td>To Be Developed</td>
<td>To Be Developed</td>
<td>To Be Developed</td>
</tr>
</tbody>
</table>

#### Electrical Specification

<table>
<thead>
<tr>
<th></th>
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<th>SpecTRON 10 6/10kV (12kV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Phases</td>
<td>3 x Single or Triad</td>
<td>3 x Single or Triad</td>
<td>3 x Single or Triad</td>
</tr>
<tr>
<td>Voltage Rating: Uo/Um</td>
<td>2.9/5(5.8kV)</td>
<td>5/8.7(10kV)</td>
<td>6/10(12kV)</td>
</tr>
<tr>
<td>Maximum Current Rating</td>
<td>200A (@4°C, 50Hz)</td>
<td>350A (@4°C, 50Hz)</td>
<td>630A (@10°C, 50Hz)</td>
</tr>
<tr>
<td>Frequency</td>
<td>1-200Hz</td>
<td>1-200Hz</td>
<td>1-200Hz</td>
</tr>
<tr>
<td>HVAC Test Voltage - Qualification (4Uo)</td>
<td>11.6kV</td>
<td>20kV</td>
<td>24kV</td>
</tr>
<tr>
<td>HVAC Test Voltage - Routine (≥2.5Uo)</td>
<td>7.25kV</td>
<td>12.5kV</td>
<td>15kV</td>
</tr>
<tr>
<td>Breakdown Voltage (&gt;6Uo)</td>
<td>&gt;17.4kV</td>
<td>&gt;30kV</td>
<td>&gt;36kV</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>&gt;10 G</td>
<td>&gt;10 G</td>
<td>&gt;10 G</td>
</tr>
<tr>
<td>Partial Discharge</td>
<td>&lt;10pC @ 5.8kV (Um)</td>
<td>&lt;10pC @ 8.7kV (1.73Um)</td>
<td>&lt;10pC @ 10.4kV (1.73Um)</td>
</tr>
<tr>
<td>Contact Resistance</td>
<td>&lt;0.1 m</td>
<td>&lt;0.1 m</td>
<td>&lt;0.1 m</td>
</tr>
<tr>
<td>Voltage Impulse Withstand</td>
<td>60kV (3.6/6(7.2kV) level)</td>
<td>75kV (6/10(12kV) Level)</td>
<td>75kV (6/10(12kV) Level)</td>
</tr>
</tbody>
</table>

#### Environmental Specification

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<th>SpecTRON 10 6/10kV (12kV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Depth Rating</td>
<td>3000m (9843 feet)</td>
<td>3000m (9843 feet)</td>
<td>3000m (9843 feet)</td>
</tr>
<tr>
<td>External Test Pressure</td>
<td>450 bar</td>
<td>450 bar</td>
<td>450 bar</td>
</tr>
<tr>
<td>Working Temperature</td>
<td>-5°C to 30°C</td>
<td>-5°C to 30°C</td>
<td>-5°C to 30°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-30°C to 60°C</td>
<td>-30°C to 60°C</td>
<td>-30°C to 60°C</td>
</tr>
<tr>
<td>Design Life</td>
<td>25 years</td>
<td>25 years</td>
<td>25 years</td>
</tr>
<tr>
<td>Deployment / Retrieval Rate</td>
<td>20 bar / min</td>
<td>20 bar / min</td>
<td>20 bar / min</td>
</tr>
</tbody>
</table>
Life Cycle Management

Installation, Commissioning, Refurbishment, Field Service and After Care for the entire design life of all our products and systems

Siemens Subsea Services - Life Cycle Management
Subsea Services - Life Cycle Management

Siemens Subsea Services - Life Cycle Management group provides a range of post-sales support. We have an extensive field service team of qualified and fully trained UK installation engineers along with teams based in Brazil, USA, Norway and Malaysia, whose expertise is utilised around the world, supporting our customers at both onshore and offshore locations.

**Our Life Cycle Management Services**
- Connector installation and test
- Offshore deployment support
- Spares and inventory management
- Investigation support
- Condition reports / inspections
- Umbilical test
- Test connector hire
- Paperless documentation system available to complement hard copy project records

**Global Capabilities**
Our UK based service team has extensive experience of installing the full range of connectors at onshore and offshore locations around the world. Additionally, we provide growing and dedicated in-country support utilising locally based personnel. This not only provides focused in-country resource but also offers indigenous workforces where ‘local content’ is required. In country support is available in the UK, Europe, USA, Brazil, West Africa and Malaysia.

**Capabilities**
- Termination, installation and test of the complete connector range
- 24 hour access to inventory for spares and emergency scenarios
- Priority Service Response mobilisation within 24 - 48 hours
- Fully equipped vehicles and installation containers for large ‘on site’ project requirements
- On-site system interrogation and applications advice
- 24 hour 7 days a week telephone emergency response service
- Installations assured by warranty
- Paperless documentation system available to complement hard copy project records
Siemens Subsea Locations and Address details

Siemens Subsea General email address: subsea.energy@siemens.com

United Kingdom
- ULLVERSTON -
  **SUBSEA CONNECTORS**
  Siemens Plc
  Subsea Excellence Centre
  Ulverston, Cumbria LA12 9EE
  Phone: +44 1229 586 604
  Fax: +44 1229 586 604
  E-Mail: connectorsales.gb@siemens.com

- ABERDEEN -
  Siemens Plc. Oil & Gas
  Unit D2 Abbotswell Road West Tullos
  Aberdeen,
  AB12 3AD
  Phone: +44 0 1224 238800
  Fax: +44 0 1224 238801

Norway
- OSLO -
  Siemens AS
  Østre Aker vei 88
  N-0596 Oslo
  Postadresse:
  Postboks 1 Alnabru
  N-0613 Oslo
  Phone: +47 22 63 30 00
  Fax: +47 22 63 38 05

- STAVANGER -
  Siemens AS
  Gamle Forus vei 1
  N-4033 Stavanger
  Postadresse:
  Postboks 8036 Forus,
  4068 Stavanger
  Phone: +47 51 82 70 70
  Fax: +47 51 82 70 30

- TRONDHEIM -
  **SUBSEA SYSTEMS**
  Siemens AS
  Bratsbergveien 5
  N-7037 Trondheim
  Postadresse:
  N-7493 Trondheim
  Phone: +47 73 95 90 00
  Fax: +47 73 95 90 70

- KONGSBerg -
  **SUBSEA DISTRIBUTION**
  Siemens AS
  Kirkegårdsveien 45
  N-3616 Kongsberg
  Postadresse:
  P.O. Box 375
  N-3604 Kongsberg
  Phone: +47 22 63 30 00
  Fax: +47 32 28 61 11

- ROMOLO -
  **SUBSEA SENSORS**
  Siemens AS
  Ternetangen 65
  N-5420 Rubbestadneset
  Phone: +47 22 63 30 00
  Fax: +47 53 42 86 01

United States of America
- HOUSTON -
  Siemens Inc
  10730 Telge Road,
  Houston, TX 77095
  Phone: +1 281 856 4400

Brazil
- RIO DE JANEIRO -
  Siemens Ltda.
  Rua Geraldo Martins,
  54 - Sobroloja,
  Santa Rosa, Niterói, RJ,
  CEP 24220-380
  Phone: +55 21 3445 8000

Malaysia
- JOHOR -
  41 Jalan Mega 1/6,
  Taman Perindustrian Nusa Cemerlang,
  81550 Gelang Patah, Johor
  Phone: +60 7556 3330
  Fax: +60 7556 3321

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