UNDERWATER SUB SEA CONNECTORS

TESTING PROCEDURE

QUALIFICATION AND ACCEPTANCE

IFREMER TESTING SPECIFICATION

OF SUBMARINE ENGINEERING N° 31 SE19 B

(English version)
### UPDATING

<table>
<thead>
<tr>
<th>Id.</th>
<th>Date</th>
<th>Modified pages</th>
<th>Description of updating</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>9/06/95</td>
<td>-</td>
<td>Creation of the document</td>
</tr>
<tr>
<td>A</td>
<td>09/95</td>
<td>All</td>
<td>International agreement</td>
</tr>
<tr>
<td>B</td>
<td>24/09/95</td>
<td>Pages 1 and 8</td>
<td>Control file in the request for testing</td>
</tr>
</tbody>
</table>
CONTENTS

1 - CONCERN

2 - SCOPE OF APPLICATION

3 - REFERENCES

4 - DEFINITIONS

5 - QUALIFICATION TESTS

5.1 - Concerned connectors

5.2 - Qualification testing program

5.2.1 - Sequence of tests
5.2.2 - Non destructive testing
5.2.3 - Voltage rating
5.2.4 - Insulation resistance
5.2.5 - Contact resistance
5.2.6 - Climatic, mechanical and other environmental tests
5.2.7 - Withstanding of service pressure announced by the manufacturer
5.2.8 - Pressure cycling
5.2.9 - Creep tests
5.2.10 - Connection cycles

6 - ACCEPTANCE TESTS

6.1 - Concerned connectors

6.2 - Program of acceptance test

6.2.1 - Withstanding of service pressure announced by the manufacturer
6.2.2 - Pressure cycling
6.2.3 - Voltage rating
6.2.4 - Insulation resistance
6.2.5 - Non destructive testing

7 - REPORTING CERTIFICATE
1 - CONCERN

The document describes the minimum procedure for qualification or acceptance tests of any connecting system used in oceanography.

For underwater activities, the electrical links between water resistant containers and between containers of immersed systems are requiring watertight and water-resistant penetration. They must be submitted to a different qualification from the remaining equipment.

The acceptance of the equipment with its connectors must be undertaken at least according to the document "MILIEU MARIN - INSTRUMENTATION OCEANOGRAPHIQUE - GUIDE D'ESSAI EN ENVIRONNEMENT".

Various materials are used for the connectors. In the state of experience at IFREMER, this global document is recommended. It might be modified to take into account special ageing phenomenon when they are quantified.

2 - SCOPE OF APPLICATION

The document is mainly intended for:

* designers and manufacturers of connecting equipment,
* equipment developers using connectors,
* operators of trials and persons who prescribe trials,
* end users and operators of the equipments on board oceanographic vessels.

The optical performances of electro-optic connectors are qualified and accepted according to specific methods, the connectors must nevertheless cope with this document for their mechanical and electrical characteristics.

For submarines with human occupancy, the qualification and acceptance are performed according to tests prescribed by the Safety Commission.

3 - REFERENCES

3.1 - Règlement pour la classification des engins sous-marins - BUREAU VERITAS - 17 bis, place des Reflets - Cedex 44 - 92077 PARIS LA DEFENSE.

3.2 - Guide d'essais en environnement des matériels océanographiques - IFREMER/SHOM.

3.3 - Dossier connectique et câblage - Service Technique Commun -IFREMER/GENAVIR - STC/DB/VA 93-075.

4 - DEFINITIONS

Ps : Maximum service pressure of the connectors
Ts : Minimum service temperature
Pe : Testing pressure in hyperbaric tank
Te : Testing temperature in hyperbaric tank

Pressure - depth relation

While buyers and users are inclined to speak in terms of maximum depth of use, designers and testing responsibilities preferably use the pressure.

The link between the two values can be established through the following formula:

\[ P = 0.101 H + 0.5 \times 10^{-6} H^2 \]

with \( P \) : Pressure in bar (\( 1 \) bar = \( 10^5 \) Pa)
and \( H \) : Depth in metre

This approached formula, sufficient for the purpose of this specification, provides the following relation:
5 - QUALIFICATION TESTS

5.1 - Concerned connectors

Every newly developed underwater connector and connectors which have not been completely qualified by their manufacturer might be concerned.

A connector is defined by:

- the number and dimension of contacts,
- its geometry,
- its materials,
- its manufacturing process.

A qualification must be undertaken each time a modification has been done on these characteristics.

According to the prescription of the manufacturer, the qualification tests may be performed mated or unmated (open face). One must nevertheless note that when a fluid penetrates in a cable, the external pressure may establish inside a mated connector. The tests with open face connectors are consequently necessary for the receptacles of penetrations involving safety.

Two connectors are tested for each qualification.

5.2 - Qualification testing program

5.2.1 - Sequence of tests

1) Non destructive testing of materials.
2) Voltage rating.
3) Insulation resistance.
4) Contact resistance.
5) Climatic, mechanical tests and other environmental tests.
6) Pressure tests.
7) Cyclic tests.
8) Creep tests.
9) Voltage rating.
10) Insulation resistance.
11) Non destructive testing of materials.
12) Connection cycles.

5.2.2 - Non destructive testing

According to the materials, one uses ultrasonic or X-ray investigations, it is checked that defaults and flaws detectable by these methods are not present.

Decision: no qualification.

5.2.3 - Voltage rating

This test is performed according to the French standard NF C 93422 § 3.2.1.

Duration of application: 1 minute.

Value of electrical tension: (2U + 1000) volts (U is the maximum tension in service).

Application point: between neighbouring contacts, between shells or bulkheads and the nearest contacts.
Decision: no holes, nor gas emission, nor cracking may occur.

5.2.4 - Insulation resistance

This test is performed according to the French standard NF C 93422 § 3.2.2, without pressure, the connecting equipment is alone in the air, male part and female part.

The measurement is done under a continuous electrical tension of 500 V (or characteristics of the manufacturer ± 15%).

Duration of the application: 1 minute.

Points of application: the same as for the voltage rating.

Decision: the insulation resistance must be larger than $5 \times 10^3 \, \Omega$ without pressure.

5.2.5 - Contact resistance

This test is performed according to the French standard NF C 93 433 § 3.2.4.

The test is done without pressure.

The measurement is made in DC:

- under an electrical current of 50 mA,
- under an electrical current I, I being the maximum service intensity per contact.

The test is made on every contact or at least on six contacts evenly distributed on the connector.

The resistance must be less than 15 mΩ or the characteristic announced by the manufacturer for a contact (between internal and external plug).

5.2.6 - Climatic, mechanical and other environmental tests

The connector is mounted on a small test container. A type E2 program from the document "MILIEU MARIN - INSTRUMENTATION OCEANOGRAPHIQUE - GUIDE D’ESSAIS EN ENVIRONNEMENT" excepted the electrical and hydrostatic pressure test, is applied to the connector.

Depending on the design of the equipments intended to bear the connector, other tests must be undertaken to ascertain the compliance with the "life profile". For instance, it must be checked that the connector is compatible with oil used to fill up the cables.

5.2.7 - Withstanding of service pressure announced by the manufacturer

The connector is mounted on the small test container. The design of this container must be agreed by the manufacturer or correspond to its requirements.

The fluid of the hyperbaric chamber is maintained at a trial temperature $T_e$ corresponding to the minimum service temperature $T_s$ required and announced by the manufacturer (in general, $T_e = T_s = 2°C$ for a 6000 m connector).

The pressure raising is performed at a speed of 12 bar/min (± 2 bar/min) to a trial pressure $P_e = 1.5 \, P_s$.

The duration of the step at $P_e$ and $T_e$ is 24 h.

The pressure is diminished to reach the atmospheric temperature at a speed of 12 bar/min (± 2 bar/min).

The water tightness of the container is controlled after trial.

5.2.8 - Pressure cycling

The fluid of the hyperbaric chamber is at ambient temperature.

1000 cycles with upper and lower step of 5 min are made; the upper pressure is equal to $P_s$.

The pressure increases and decreases are performed at a speed of 100 bar/min maximum.

The water tightness of the container is controlled after the test.
5.2.9 - Creep tests

The connector is mounted on the small test container.

The fluid of the test tank is at ambient temperature.

The increase of pressure is performed at a speed of 12 bar/min ± 2 bar/min, up to the pressure Ps.

The pressure is held at Ps during 500 h.

The decrease in pressure is done at a speed of 12 bar/min ± 2 bar/min.

5.2.10 - Connection cycles

500 cycles of connection and disconnection are done manually.

6 - ACCEPTANCE TESTS

6.1 - Concerned connectors

Connectors certified similar to those qualified. All the parameters must be similar.

6.2 - Program of acceptance test

6.2.1 - Withstanding of service pressure announced by the manufacturer

The connector is mounted on the small test container. The design of this container must be agreed by the manufacturer or correspond to its requirements.

The fluid of the hyperbaric chamber is maintained at a trial temperature Te corresponding to the minimum service temperature Ts required and announced by the manufacturer (in general, Te = Ts = 2°C for a 6000 m connector).

The pressure raising is performed at a speed of 12 bar/min (± 2 bar/min) to a trial pressure Pe = 1.5 Ps.

The duration of the step at Pe and Te is 24 h.

The pressure is diminished to reach the atmospheric temperature at a speed of 12 bar/min (± 2 bar/min).

The water tightness of the container is controlled after trial.

6.2.2 - Pressure cycling

The fluid of the hyperbaric chamber is at ambient temperature.

10 cycles with upper and lower step of 5 min are made ; the upper pressure is equal to Ps.

The pressure increases and decreases are performed at a speed of 100 bar/min maximum.

The water tightness of the container is controlled after the test.

6.2.3 - Voltage rating

This test is performed according to the French Standard NF C 93422 § 3.2.1.

Duration of application : 1 minute.

Value of electrical tension : (2U + 1000) volts (U is the maximum tension in service).

Application point :
between neighbouring contacts,
between shells or bulkheads and the nearest contacts.

Decision : no holes, nor gases emission, nor crackling may occur.

6.2.4 - Insulation resistance

This test is performed according to the French standard NF C 93422 § 3.2.2, without pressure the connecting equipment is alone in the air, male part and female part.

The measurement is done under a continuous electrical tension of 500 V (or characteristics of the manufacturer ± 15 %).
Duration of application: 1 minute.

Points of application: the same as for the voltage rating.

Decision: the insulation resistance must be larger than $5 \times 10^3 \, \text{M} \Omega$ without pressure.

**6.2.5 - Non destructive testing**

According to the materials, one uses ultrasonic or X-Ray investigations. It is checked that defaults and flaws detectable by these methods are not present.

Decision: If defaults are present, the acceptance is not obtained.

**7 - REPORTING CERTIFICATE**

The certificate is delivered if all the tests have been satisfactory and if no loss of water tightness have been noticed. It says whether it is a qualification certificate or an acceptance certificate.

It mentions:

- The testing laboratory.
- The date of the test.
- The registering number of the test.
- The origin of the demand (name and company of the person who prescribes).
- The references of the connectors given with the demand of test:
  - name and address of the manufacturer and its resale agent,
  - type and series number, number of contacts,
  - the operating conditions (mounting, dismounting, special tools,...),
  - guaranteed service pressure,
  - the control file of the manufacturer.
- The test means used.
- The reference to this testing procedure (qualification and acceptance).
- The results of electrical and environment tests.
- The proof pressure.
- The proof temperature.
- The measurements of pressure as function of time.
- The reports of non destructive testing.
- The possible defaults noticed.