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# ICPC Recommendation

## Recommendation No. 12

### Mechanical Testing of Submarine Telecommunications Cables

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**Note:** The presence of a Suffix letter after the Issue number indicates inclusion of updated peripheral information that does not change the wording of this Recommendation.

## Contact for Enquiries and Proposed Changes

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## 1. INTRODUCTION

The purpose of this Recommendation is to facilitate a consistent approach to the mechanical testing of a submarine cable during its design stage. Such testing is essential to ensure that:

- the cable can be safely and economically installed.
- the lifetime and reliability performance of the cable system can be achieved.
- the cable can be recovered and repaired in the event of a failure.

## 2. RECOMMENDATION

ITU –T G976 (ref 1) section 7.2 “Tests on the Optical Fibre Submarine Cable” is an internationally recognised standard which details the test methods applicable to submarine cables. It is recommended that these methods be specified as a minimum requirement for all cable purchases.

However, in order to ensure that a cable is correctly specified for the performance envelope required for the proposed system, it is recommended that the test levels specified are varied from those detailed in ITU-T G976 as detailed in the table below:

Section	ITU-T G976 Heading	ITU Level	ICPC Recommendation
7.2.1.1	Manufactured Cable Loss.	Satisfy system power budget	Satisfy system power budget
7.2.1.2	Cable Fibre Strain.	Cable design limits	Cable design limits
7.2.1.3	Temperature Stability	Designed temp range	Designed temp range
7.2.1.4	Hydraulic Pressure Resistance	Design depth	Design depth
7.2.2.1	Tensile Test with Twist Restrained.	NTTS	3 cycles to NTTS with 1hour hold on final to take account of deployment, recovery and redeployment
7.2.2.2	Tensile Test with Torque Minimised.	Design depth deployment tension	3 cycles to NTTS with 1hour hold on final to take account of deployment, recovery and redeployment
7.2.2.3	Tensile Test to Failure.	Cable Breaking Load (CBL)	CBL plus Fibre Break Load (FBL) if different

7.2.2.4	Mechanical Fatigue Test.	No tension or sheave diameter stated. No of cycles to simulate expected repair time and sea state	Not required as covered by 7.2.2.5
7.2.2.5	Sheave Test.	30 to 50 cycles at maximum deployment load, followed by 3 cycles at maximum recovery tension	50 cycles at NOTS followed by 3 cycles at NTTS to establish cable can take loads experienced under operational conditions
7.2.3.1	Crush Test	1 hour with force of 10m of cable or that provided by shipboard machinery whichever is greater	24hrs, 10KN for LW, 15KN for Sa, 30KN for DA and 40KN for RA
7.2.3.2	Impact Resistance.	50mm diameter 2kg from 1m for LW	50mm, 1m 2Kg for LW, 4Kg for SA, 8Kg for DA and 12Kg for RA
7.2.3.3	Flexure Resistance.	50 flexures at room temp, low temp and high temp 2m sheave.	50 flexures at room temp, low temp and high temp 2m sheave.
7.2.4.1	Water ingress Limitation.	14 days design spec.	For design depth less than 1km, A water pressure equivalent to 250m of water applied suddenly to an open cable end shall result in penetration of less than 250m after 14 days  For a design depth greater than 1km, a water pressure equivalent to the maximum design depth applied suddenly to an open cable end shall result in less than $10^{-4} \sqrt{(P.t)}$ metres where P is the water pressure in pascals and t is the time in seconds.
7.2.4.2	Corrosion Test	Sea water at 50° C for 18 months	Sea water at 50° C for 18 months
7.2.4.3	High Voltage Test.	$VT^k$ where V is the service voltage, T is the test duration and k is a constant	$VT^k$
7.2.4.4	Insulation Integrity Test.	Voltage level based upon operational requirements	Voltage level based upon operational requirements

7.2.5.1	Cable Inter-Layer Adhesion Test.	150 to 250mm cable sample, level of force required to cause movement evaluated	150 to 250mm cable sample, level of force required to cause movement evaluated
7.2.5.2	Cable Stopper Test.	90 minutes at tensions simulating max design depth deployment	90 minutes at NTTS plus a safety margin
7.2.5.3	Tests with Installed Equipment	Tensions simulating maximum design depth deployment	Test To NTTS plus a safety margin

The main differences proposed to the recommended test levels is the use of the Nominal Transient Tensile Strength (NTTS) and Nominal Operating Tensile Strength (NOTS) of the cable to set load limits for some tests. The value of these can either be set by the cable manufacturer or by the purchaser, based upon the performance envelope required for the particular installation.

In addition to the tests specified above, it is recommended that purchasers request suppliers to carry out impact tests under the same conditions stated in ITU G976 section 7.2.3.2 but on a sample that is optically and electrically monitored until the cable is seen to suffer either an electrical or optical fault. The test should be repeated on three different cable samples and the average energy declared. This test will allow different cable types to be rated against each other, but will not be able to guarantee any level of survivability. (Ref 2)

### 3. DEFINITIONS

The following words, acronyms and abbreviations are referred to in this document.

Term	Definition
NTTS	Nominal Transient Tensile Strength: The maximum short-term tension that can be applied to the cable during an at-sea recovery operation over a cumulative period of approximately one hour without significantly reducing the system performance, lifetime and reliability. NTTS represents the maximum transient or unexpected tension that may be applied to the cable, and is normally limited to a percentage of the CBL from a mechanical safety point of view.
NOTS	Nominal Operating Tensile Strength: The maximum average operational tension which the cable can support for the period required for marine operations (typically 48 hours) without significantly reducing the system performance, lifetime and reliability. NOTS represents the maximum average operational tension during installation or repair.
CBL	Cable Breaking Load: The minimum guaranteed breaking strength of the cable, with ends fixed, taking into account material and dimensional tolerances of the cable components.
FBL	Fibre-Breaking cable Load: The load which, when applied longitudinally to the cable with fixed ends, results in an instantaneous fibre break.

Term	Definition
LW	Lightweight Cable: Cable suitable for laying, recovery and operation where no special protection is required.
SA	Single Armoured cable: A cable with a single layer of protective armour.
DA	Double Armoured cable: A cable with a double layer of protective armour.
RA	Rock Armoured cable: A cable with a multiple layer of protective armour (usually two), the outer layer being wound with a small pitch.

#### 4. REFERENCES

Document No	Title
1	ITU G976, Test Methods Applicable to Optical Fibre Submarine Cable Systems. International Telecoms Union.
2	ITU G972, Definition of Terms Relevant to Optical Fibre Submarine Cable Systems. International Telecoms Union.
3	T Taylor and A Levins, Cable Robustness. Proceeding of Suboptic 2004, Paper Th B1.3