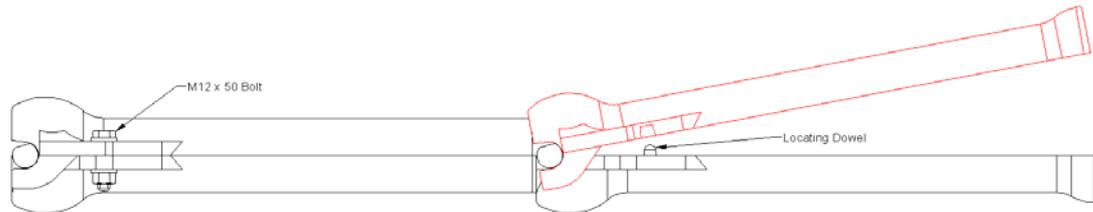




UTS 55mm Articulated Pipe Design and Test Specification 2015

1 General Description

Spheroidal Graphite (SG, also known as Nodular and Ductile) Cast Iron split-pipe for the physical protection and submerged stability of submarine cables. Designed for each section (or piece, or half) to connect and interlock by hook and pin arrangement and articulate by ball and socket connection, each pair resulting in half meter installed length for ease of handling and installation by divers underwater or on the deck of installation vessels and with associated cable plant.



2 Manufacture Standards – Material Grade

Manufactured to comply with International Standard ISO 1083 third edition 2004-07-15 for Spheroidal Graphite Cast Irons – Classification; which determines the method of evaluation of the mechanical properties from machined test pieces. And to comply with the designation ISO1983/JS/400-15, which shall be tested in accordance with the process detailed in the standard to verify that test pieces meet or exceed the following mechanical properties and chemical composition:

Tensile Strength minimum (Rm)	400 N/mm² (or MPa)
Proof Stress/Yield point minimum 0.2% (R_{p0.2})	250 N/mm² (or MPa)
Elongation minimum (A)	15%
Micro-Structure: Graphite Nodular V + VI >80%; Predominantly Ferritic; < 5% free carbides	
Carbon (C)	3% to 4%
Silicon (Si)	2% to 4%
Sulphur (S)	0.02% maximum
Phosphorus (P)	0.05% maximum
Manganese (Mn)	0.5% maximum
Copper (Cu)	0.15% maximum
Magnesium (Mg)	0.06% maximum

2 Batch Material Testing and Certification

Quality Control Testing shall be undertaken and published by the foundry in the form of a material certificate detailing a metallurgical control report for samples taken as a minimum for each batch or melt, and shall detail the following information as a minimum:

- Supplier name; date; part number; casting ID; material specification/grade
- Mechanical Characteristics/Properties
- Metallurgical and Micro-Structure
- Chemical Composition Analysis



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3 Product Design Technical Information

3.1 Technical Specification

Installed length minimum ¹	495 mm
Installed length maximum ²	510 mm
Nominal Wall thickness	9 mm
Minimum wall thickness ³	8.5 mm
Weight in air minimum	17.6 kg/m
Internal bore minimum	55 mm
External Diameter maximum ⁴	165 mm (across hook and pin)
Assembled minimum bend radius ⁵	2 m
Assembled maximum bend radius ⁶	4 m

Notes: 1. measured compressed by hand only so slack in ball and socket removed to minimum.
2. measured in tension by hand only so slack in ball and socket removed to maximum.
3. over 95% of surface area but not less than 8mm over remaining 5% of area.
4. radius measured using shaft centre as datum.
5. laid on edge, hook and pin in vertical orientation, tension by hand only.
6. laid flat with hook and pin in normal flat/horizontal orientation, tension by hand only.

3.2 Assembly and Fixings

Each piece (i.e. section or half) of each pair to be identical and interchangeable with others. Either side of each piece adjacent to either side of the socket webs plates shall be formed to accommodate a pair of locating dowels/pegs ether side to limit lateral movement and similarly a pair of A4 Stainless Steel (316 grade) Hexagonal M12 x 50mm fixing sets (typically Hexagon full nut and bolt, one flat form A and one spring/split/coil washer). The fixing webs shall each not exceed maximum 16mm and minimum 10mm in thickness.

Mating surfaces free of flash and flat with maximum bowing or arching of 1mm permissible.

3.3 Casting and ID

Finish shall be "as-cast" and free of significant surface defects; pitting not to exceed depth 1.5mm, length 30mm; Shrinkage porosity must not be excessive. Each piece (i.e. section or half) to have an ID cast on the external or internal face that uniquely and directly correlates with the material certification raised for that casting batch/melt for traceability. The ID shall be alpha-numeric characters minimum 5mm high and 1mm proud of the main casting.

4 Mechanical Acceptance Testing and Certification

The product must pass the following tests to verify design and manufacture integrity. The pipe shall not be bolted for tension and bend testing but is permissible for impact and crush testing.

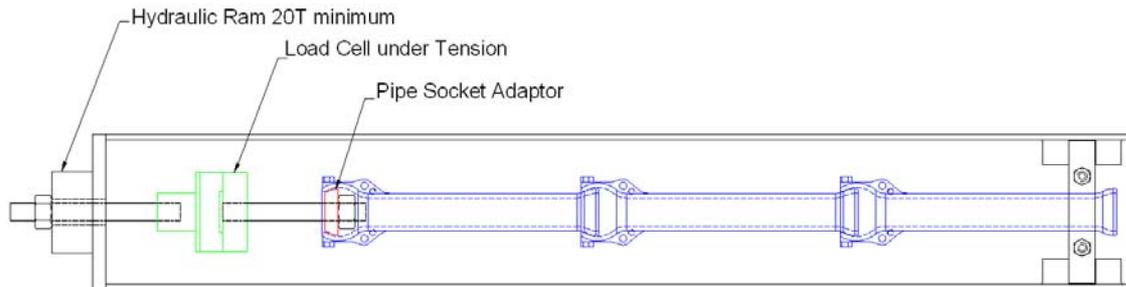


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4.1 Tension

Three pipe pairs shall be assembled to form a length of 1.5m. The assembly shall be subjected to an increasing tension of up to 15 tonnes. This tension shall be held for a minimum of 5 minutes.

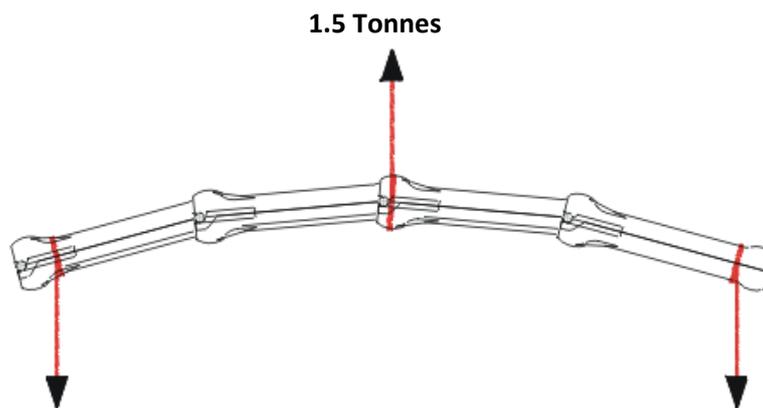
Example Tension Test Setup



Pass Criteria - no fracture of any casting or an elongation over 1.5m of more than 0.5% (7.5mm)

4.2 Bend Test

Four pipe pairs shall be assembled in horizontal orientation and connected by three suitable strops attached in 'choke' formation. Each of the two end strops shall be wrapped around each end of the assembly as close to the outer knuckle as possible. The third strop shall be attached (in choke) to the central knuckle of the assembly. Each end strop shall then be attached to 750kg test weights. The central strop shall be attached to a calibrated tension measuring device and lifting equipment.



Using lift equipment the assembly shall be raised by the central strop until the pipe assembly suspends both test weights or indicates 1.5 Tonnes on the central calibrated load cell.

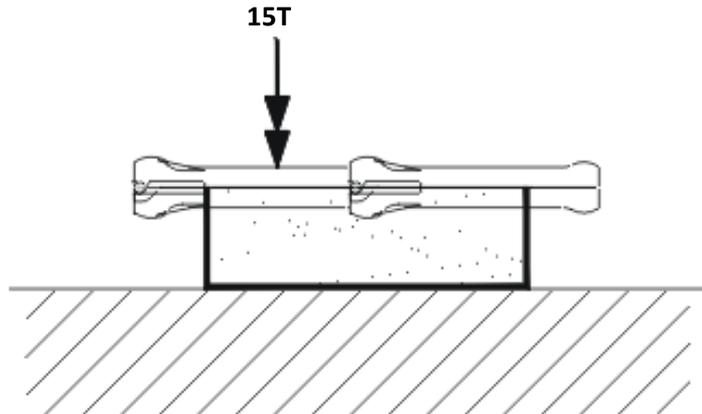
Pass criteria: 1.5 Tonnes lifting force maintained for 5 minutes without failure.



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4.3 Crush Test Procedure

Two pairs of pipes shall be assembled into an interlocked 1m length, laid in the horizontal orientation on to a pre-fabricated tray level filled with sand and the assembly half buried with the split line horizontal and level with the sand. The assembly shall be aligned so that the centre of a circular hydraulic compression ram of diameter 100mm is central in both planes to one pair, i.e. centre of pipe laterally and directly over apex.

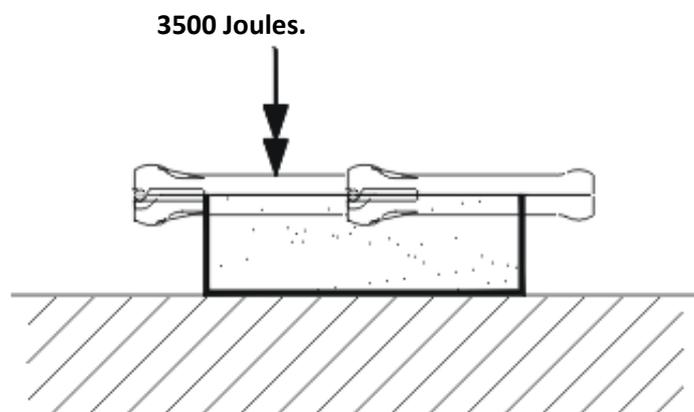


Using calibrated compression equipment the hydraulic ram shall progressively apply a force of 15 Tonnes. When the test load has been achieved the pipe shall be allowed to deform whilst under load for 5 minutes.

Pass criteria: Pipe deformation does not reduce the bore of the pipe less than 46mm diameter.

4.4 Impact Test Procedure

Two pairs of pipes shall be assembled into an interlocked 1m length, laid in the horizontal orientation on to a pre-fabricated tray level filled with sand and the assembly half buried with the split line horizontal and level with the sand. The assembly shall be aligned such that the end of a drop weight iron bar with flat surface 25mm wide is rigged to impact perpendicular to the pipe at the centre of the one enclosed pair in both planes, i.e. centre of pipe laterally and directly over apex.



The assembly shall be impacted once with a weight in free-fall from height to achieve 3500 Joules.

Pass Criteria: Pipe deformation does not reduce the bore of the pipe less than 46mm diameter.



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6 Packing Specification

Articulated Pipe will be clipped together in pairs and packed in palletised wooden boxes containing an installed length of 25m and will include inside 12 fixings sets as detailed in 3.2 above. The box will be constructed in such a manner to securely contain the pipe and be suitable for stacking, storing handling and shipping multiple times. The box will be treated to ISPM15 standard (International Standards for Phytosanitary Measures – Regulation of Wood Packing Material in International Trade). The ISPM stamp is to be seen on two faces of the packing box and certificate of conformance to be supplied from each supplier. The box when packed will be secured with 6 bands, two around each of the sides and ends and two horizontally, or shrink wrapped, as a minimum. The box shall have a palletised base that can be accessed and lifted from any side by a fork-lift.

Box dimensions 95cm long x 84cm wide x 78cm high; gross weight approx. 490kg



Typical Box with Security Bands and ISPM15 Stamp