

TYPE APPROVAL CERTIFICATE

This is to certify:**That the Plastic Pipes, Fibre Reinforced Thermosetting**

with type designation(s)

Wavistrong EST/CST and Wavistrong FR3 EST/CST

Issued to

**Future Pipe Industries B.V.
Hardenberg, Overijssel, Netherlands**

is found to comply with

Det Norske Veritas' Rules for Classification of Ships**Det Norske Veritas' Offshore Standards****Det Norske Veritas' Type Approval Programme 1-501.1, 2011, Fibre Reinforced Thermosetting Plastic Pipes****IMO Resolution A.753(18). Guidelines for the Application of Plastic Pipes on Ships****Application :****For installation in accordance with DNV GL Rules/Standards and Manufacturer's Specification.****The piping system is conductive, for installation in gas hazardous areas. The piping system is approved to Fire Endurance L3 in accordance with IMO Resolution A.753(18) and to Low Flame Spread in accordance with ASTM D635.****Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV GL.**This Certificate is valid until **2018-06-30**.Issued at **Høvik** on **2015-10-12**DNV GL local station: **Rotterdam**Approval Engineer: **Gisle Hersvik**for **DNV GL**

**Martin Strande
Head of Section**

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid. The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

Job Id: **262.1-006336-3**
Certificate No: **TAK000003V**

Product description

Wavistrong EST/CST and Wavistrong FR3 EST/CST Pipes and Fittings for marine applications.

- Wavistrong FR3 is standard Wavistrong EST/CST with an additional fire resistant barrier on the outside.
- In accordance with Future Pipe Industries' System Specification 01/01 and 01/03 ES System: REP 373/Rev01/0199 and REP 374/Rev01/0199.

Pipes:

Wavistrong CB/CS													
EST - IMO [bar]	Minimum reinforced wall thickness in mm, excl. liner.												
	25	40	50	65	80	100	125	150	200	250	300	350	400
8 - 6	-	-	-	-	-	-	-	-	-	-	-	2.8	3.2
12.5 - 10	-	-	-	-	-	-	-	-	-	2.5	3.0	3.5	4.0
16 - 12	-	-	-	-	-	-	-	-	2.5	3.2	3.8	4.4	5.1
20 - 16	-	-	-	-	-	-	-	2.4	3.3	4.1	4.9	5.7	6.5
25 - 20	-	-	-	-	-	2.4	2.6	3.1	4.1	5.1	6.1	7.1	8.2
32 - 25	1.8	1.8	1.8	2.4	2.4	2.6	3.2	3.8	5.1	6.4	7.7	-	-

Wavistrong TB/TS, FB/FS*, Laminate																
EST = IMO [bar]	Minimum reinforced wall thickness in mm, excl. liner															
	25	40	50	65	80	100	125	150	200	250	300	350	400	450	500	600
8	-	-	-	-	-	-	-	-	-	-	-	2.8	3.2	3.6	4.0	4.8
12.5	-	-	-	-	-	-	-	-	-	2.5	3.0	3.5	4.0	4.5	5.1	6.1
16	-	-	-	-	-	-	-	-	2.5	3.2	3.8	4.4	5.1	5.7	6.3	7.6
20	-	-	-	-	-	-	-	2.4	3.3	4.1	4.9	5.7	6.5	7.3	8.1	9.8
25	-	-	-	-	-	2.4	2.6	3.1	4.1	5.1	6.1	7.1	8.2	9.2	10.2	12.2
32	1.8	1.8	1.8	2.4	2.4	2.6	3.2	3.8	5.1	6.4	7.7	9.0	10.3	-	-	-

* FB/FS joint is available for DN ≥ 50mm

Wavistrong FB/FS, Laminate				
EST - IMO [bar]	Minimum reinforced wall thickness in mm, excl. liner			
	700	750	800	
8 - 7.5	5.6	6.0	6.5	
12.5 - 11.8	7.1	7.6	8.1	
16 - 15	8.9	9.5	10.1	
20 - 19	11.4	12.2	13.0	

Wavistrong FB/FS, Laminate				
EST - IMO [bar]	Minimum reinforced wall thickness in mm, excl. liner			
	900	1000	1100	1200
8 - 7	7.3	8.1	8.9	9.7
12.5 - 11	9.1	10.1	11.1	12.1

EST: electrical non-conductive, standard application, tensile resistant

CST: electrical conductive, standard application, tensile resistant

The number after *EST/CST* represents nominal pressure.

Fittings:

Elbows, Tees (equal and un-equal), Laterals (45°), Reducers (eccentric and concentric), Flanges, Saddles, Couplers and Adaptors.

Joining methods:

Lamination Joint, Adhesive Joint (CB/CS), Adhesive Joint (TB/TS), Rubber Seal (Lock) Joint (FB/FS)

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Manufactured by

Future Pipe Industries b.v., J.C. Kellerlaan 3, P.O. Box 255, 7770 AG Hardenberg, The Netherlands

DNV GL local office: Rotterdam

Future Pipe Industries (L.L.C.), P.O. Box 29205, Abu Dhabi, United Arab Emirates

DNV GL local office: Abu Dhabi

PT – Future Pipe Industries, Jl. Raya Serang Km.30, Kelurahan Gembong Dan Cangkudu, Kecamatan Balaraja, Tangerang 15610, Indonesia

DNV GL local office: Singapore

Future Pipe Industries (S.A.E.), 6th of October City – 5th Industrial Area, Block 48, Cairo, Egypt

DNV GL local office: Alexandria

Responsibility

The Company (stated on the front page of this Certificate) takes the responsibility that both design and production are in compliance with Rules, Standards and/or Regulations listed on page 1 of this certificate.

Application/Limitation

Approved only for installation of piping systems onboard ships which will not be exposed to vacuum inside the pipes and not exposed to external pressure outside the pipes.

For installation in accordance with DNV GL Rules/Standards and Manufacturer's Specification.

The EST piping system is non-conductive, not for installation in gas hazardous areas.
The CST piping system is electrical conductive.

The standard Wavistrong piping system is approved to Fire Endurance L3 in accordance with IMO Resolution A.753(18) for diameters ≥ 150 mm.

Wavistrong FR EST/ESN piping system with 3 mm fire resistance barrier is approved to Fire Endurance L3 in accordance with IMO Resolution A.753(18).

The standard Wavistrong piping system is tested to have Low Flame Spread characteristics in accordance with ASTM D635 (horizontal burning rate 0 mm/s) (accepted as an alternative to IMO Resolution A.653(16)).

For compliance with IMO Resolution A.653(16), Low Flame Spread characteristics, the standard Wavistrong EST/CST piping shall be reinforced with an additional outside fire barrier of at least 5 mm thickness.

The piping system Wavistrong FR is successfully tested for jet fire resistance, using fire protection barrier as per FPI's instructions.

Maximum continuous service temperature is +110°C.

For the chemical resistance of the Wavistrong piping system to specific chemicals, please refer to the Manufacturer's Chemical Resistance List.

Type Approval documentation

Tests carried out

Type Testing carried out in accordance with **Type Approval documentation**, ref. DNV's Type Approval Programme No. 1-501.1 (2011) Fibre Reinforced Thermosetting Plastic Pipes.

Marking of product

The product is to be marked with:

- *manufacturer's name*
- *manufacturing plant*
- *type designation*
- *pressure rating*
- *nominal pressure*
- *dimensions*
- *production date.*

The marking is to be carried out in such a way that it is visible, legible and indelible. The marking of product is to enable traceability to the DNV GL Type Approval Certificate.

Periodical assessment

The scope of the Periodical Assessment is to verify that the conditions stipulated for the Type Approval is complied with and that no alterations are made to the product design or choice of materials.

Periodical Assessment to be performed after two (2) years (Certificate Retention) and at renewal after four (4) years (Certificate Renewal).

The main elements of the Periodical Assessment are to:

- Ensure that **Type Approval documentation** is available.
- Review design, materials, production process, and performance with respect to possible changes, in order to ensure compliance with **Type Approval documentation** and/or referenced material specifications.
- Ensure traceability between manufacturer's product marking and the DNV GL Type Approval Certificate.

END OF CERTIFICATE