Certificate No:
TAP00002R1

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Metallic Expansion Joints

with type designation(s)
NES-HHI-EJ-A1960549326, NES-HHI-EJ-A1960521287, NES-HHI-EJ-A196052190A, NES-HHI-EJ-A1960549447, NES-HHI-EJ-A1960521537

Issued to
NES Inc
Gimhae-si, Gyeongsangnam-do, Korea, Republic of

is found to comply with
DNV rules for classification – Ships Pt.4 Ch.6 Piping systems
DNV rules for classification – Ships Pt.6 Ch.2 Sec.5 Gas fuelled ship installations – Gas fuelled LNG

Application :

Product(s) approved by this certificate is/are accepted for installation on vessels classed by DNV.

Type:	Temperature range:	Max. working press.:	Sizes:
NES-HHI-EJ-A1960549326	-15 °C to 60°C	16 bar	Ø76.3/ Ø114.3/Ø151.2
NES-HHI-EJ-A1960521287	-15 °C to 60°C	16 bar	Ø114.3/Ø151.2
NES-HHI-EJ-A196052190A	-15 °C to 60°C	16 bar	Ø76.3/ Ø114.3/Ø151.2
NES-HHI-EJ-A1960549447	-15 °C to 60°C	16 bar	Ø76.3/ Ø114.3/Ø151.2
NES-HHI-EJ-A1960521537	-15 °C to 60°C	16 bar	Ø76.3/ Ø114.3/Ø151.2

Issued at **Høvik** on **2023-11-17**
This Certificate is valid until **2028-11-14**.
DNV local unit: **AK Admin Support**

Approval Engineer: **Sarah Miller**

for **DNV**

Zeinab Sharifi
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.

LEGAL DISCLAIMER: Unless otherwise stated in the applicable contract with the holder of this document, or following from mandatory law, the liability of DNV AS, its parent companies and their subsidiaries as well as their officers, directors and employees ("DNV") arising from or in connection with the services rendered for the purpose of the issuance of this document or reliance thereon, whether in contract or in tort (including negligence), shall be limited to direct losses and under any circumstance be limited to 300,000 USD.

Product description

Seven types of double walled metallic expansion bellows with collar and flange, designed according to EJMA 10th edition:

Bellow type	**Single bellows**			
Designation	A196052190A	A1960549447	A1960549326	A1960521537
Size	Ø76.3	Ø76.3	Ø76.3	Ø76.3
Design Pressure (bar)	16	16	16	16
Number of plies	3	3	3	3
Thickness of each ply	0.4	0.4	0.4	0.4
Number of convolutions	3	3	3	3
Conv. Height (mm)	11	11	11	11
Conv. Pitch (mm)	11	11	11	11
Axial Movement (mm)	±0.5	±0.5	±0.5	±0.5
Lateral Movement (mm)	0	0	0	0
Angular movement	0	0	0	0

Type	**Double walled compensator, gas type bellows**				
	Inner /Outer				
Bellow type	**Universal**				
Designation	A1960521287	A196052190A	A1960549447	A1960549326	A1960521537
Size	Ø114.3/Ø151.2	Ø114.3/Ø151.2	Ø114.3/Ø151.2	Ø114.3/Ø151.2	Ø114.3/Ø151.2
Design Pressure (bar)	16 bar	16 bar	16 bar	16 bar	16 bar
Number of plies	3/3	3/3	3/3	3/3	3/3
Thickness of each ply	0.5/0.6	0.5/0.6	0.5/0.6	0.5/0.6	0.5/0.6
Number of convolutions	5+5/4+4	4+4/3+3	4+4/3+3	10+10/8+8	10+10/8+8
Conv. Height (mm)	8/13	8/13	8/13	8/13	8/13
Conv. Pitch (mm)	15/18	15/18	15/18	15/18	15/18
Axial Movement (mm)	±3.5	±1	±1	±1	±1
Lateral Movement (mm)	±3.5	±1.5	±1.5	±1.5	±1.5
Angular movement	0	0	0	0	0

Material:

Bellow: SUS316L
Flange. SUS316L
Collar: SUS316L
Pipe: SUS316L

Application/Limitation

Expansion bellows covered by this certificate are found to be in compliance with the given design standard and may be installed in Natural gas systems (inner bellow) and air applications (outer bellow).

All expansion bellows covered by this approval are approved for 8000 life cycle.

For application in gas piping systems on combustion engines in addition to the thermal expansion life cycle calculation the endurance against high frequency cycle is to be documented by EJMA lifetime calculation confirming fatigue life > 10^7 cycles. See DNV-RU-SHIP Pt.4 Ch.3 Sec.1 [10.2.8.6].

Materials and material protection chosen for the specific system shall be suitable for the intended medium and environmental conditions. Bellows of austenitic stainless steel shall not be used in direct contact with seawater.

Welding shall fulfil requirements in DNV-RU-SHIP Pt.2 Ch.4.

The installation shall be done according to type approval holder's procedures.

Flow velocities in each bellow shall be limited as specified in EJMA 10th edition Table 4.10-1 when there is no sleeve installed.

Production test:

Each expansion bellow shall be subjected to minimum hydrostatic test pressure equal to 1.5 times internal design pressure in the presence of a DNV surveyor.

Type Approval documentation

DRW no. A1960521287 rev.A
DRW no. A196052190A rev.A
DRW no. A1960549447 rev.A
DRW no. A1960549326 rev.C
DRW no. A1960521537 rev.A
Calculations dated 18-10-2022
Visual inspection Report No. NES-LR-HHI-VI-01 issued on 2022-02-24(5 pages), if applicable
Dimension Check Sheet issued on 2022-03-04(5 pages), if applicable
Prototype Test Report(Form No. QP-205-04(Rev.0) for bellows issued on 2022-03-04(5 pages)
Prototype Test Report(Form No. QP-205-04(Rev.0) for gas main piping assembly with bellows issued on 2022-03-04(4 pages)

Certification

Material of bellows shall have material certificates in accordance with DNV-RU-SHIP Ship Pt.6 Ch.2 Sec.5 table 4. All materials delivered with NV or works certificate shall be made at works approved by the Society (AoM).

Cargo expansion bellows for liquefied gas tankers covered by this certificate shall be delivered with a product certificates issued by the society in accordance with DNV-RU-SHIP Pt.5 Ch.7 Sec.1 table7.

Tests carried out

Burst test – Hydraulic Test - cyclic loading test (thermal movement)- Fatigue test (ship deformation)

Marking of product

For traceability to this type approval, the compensators are to be marked with:

- Manufacturer’s trade mark
- Type designation (as stated in the submitted drawings)
- Size
- Maximum working pressure
- Temperature range

Periodical assessment

For retention of the Type Approval, a DNV Surveyor shall perform periodical assessment after two years (+/- 90 days) and after 3.5 years (+/- 90 days) to verify that the conditions for the approval are complied with. Reference is made to DNV-CP-0338.