# APPROVAL OF MANUFACTURER CERTIFICATE

Certificate No:
**AMMM000002N**
Revision No:
**20**

## This is to certify:

**That**

## Jiangsu Shagang Group Co., Ltd

**Jinfeng Town, 215 625 Zhangjiagang, Jiangsu, China**

is an approved manufacturer of
**Steelmaking and Rolled Steel Products**

in accordance with
**DNV rules for classification – Ships**
**DNV-OS-B101 – Metallic materials**
**DNV-OS-E304 – Offshore mooring steel wire ropes, Edition July 2023**
**DNV class programme – DNV-CP-0242 Semi-finished steel products**
**DNV class programme – DNV-CP-0243 Rolled steel products – non stainless steel**
**DNV class programme – DNV-CP-0256 Offshore mooring steel wire ropes and sockets**

and the following particulars:

| | |
|---|---|
| **Application area** | **Normal strength steel**<br>**High strength steel**<br>**Extra high strength steels**<br>**Z-grade steels (plates with through thickness properties)**<br>**BCA steels (steels with brittle crack arresting properties)**<br>**Steels for boiler and pressure vessels**<br>**Steel for low temperature service**<br>**Steel wire rods for offshore mooring wire ropes**<br>**Semi-finished products** |
| **Product** | **Slabs, Plates, Steel wire rods** |
| **Steelmaking** | **BOC or EAF, continuous casting** |
| **Deoxidation** | **Killed** |
| **Fine grain elements** | **See particulars of the approval** |
| **Delivery conditions** | **See particulars of the approval** |
| **Max. thickness/diam.** | **See particulars of the approval** |
| **Remarks** | **See particulars of the approval** |

Manufacturer(s) approved by this certificate is/are accepted to deliver according to DNV GL, DNV and GL rules. Materials to be applied to DNV classed object shall fulfill the material requirements in the applicable DNV class rules.

Issued at **Hamburg** on **2023-11-09**

This Certificate is valid until **2024-12-31**.
DNV local unit: **Jiangyin NB & CMC**

Approval Engineer: **Torben Schälicke**

for **DNV**

Digitally Signed By: Wildhagen, Christian
Location: DNV Hamburg, Germany
Signing Date: 23.11.2023, on behalf of

**Thorsten Lohmann**
**Head of Section**

## Particulars of the approval

**Semis for rolling stock: Slabs**

| Grade | Steelmaking[1)] | Fine grain elements | Max. thickness [mm] |
|---|---|---|---|
| NV A, NV B, NV D, NV E | BOC, CC | Al, Nb, V or Ti either singly or in any combination | Not applicable |
| NV A32, NV A36, NV A40, NV D32, NV D36, NV D40, NV E32, NV E36, NV E40, NV F32, NV F36, NV F40 | BOC, CC | | |
| NV AO620, NV AO690, NV DO620, NV DO690, NV EO620, NV EO690 | BOC, LF, RH, CC | Al+Nb+Ti | |

**Steel wire rods for offshore mooring wire ropes [3)]**

| Grade | Steelmaking[1)] | Heat treatment condition[2)] | Diameter range [mm] |
|---|---|---|---|
| Carbon | BOC, CC | AR | 5.5 – 14 mm |

**Final products: Steel Plates**

**Normal strength steel**

| Grade | Steelmaking[1)] | Fine grain elements | Heat treatment condition[2)] | Max. thickness [mm] | Z-quality |
|---|---|---|---|---|---|
| NV A, NV B | BOC, CC | Al | AR | 40 | - |
| NV A, NV B | BOC, CC | Al+Ti | NR | 60 | Z35 |
| | | | N | 100 | Z35 |
| NV D | BOC, CC | Al or Al+Ti | AR | 35 | Z35 |
| NV E | BOC, CC | Al | TM | 40 | - |
| NV D, NV E | BOC, CC | Al+Nb+Ti | TM | 60 | Z35 |
| | | | N | 100 | Z35 |
| NV A, NV B, NV D, NV E | BOC, LF, RH, CC | Al+Nb+Ti | TM | 100 | Z35 |

**High strength steel**

| Grade | Steelmaking[1)] | Fine grain elements | Heat treatment condition[2)] | Max. thickness [mm] | Z-quality |
|---|---|---|---|---|---|
| NV A32, NV A36, NV D32, NV D36, NV E32, NV E36, NV F32, NV F36 | BOC, CC | Al+Nb or Al+Nb+Ti | TM | 60 | Z35 |
| NV A32, NV D32, NV E32, NV F32 | BOC, LF, RH, CC | Al+Nb+V+Ti | N | 100 | Z35 |

| | | | | | |
|---|---|---|---|---|---|
| NV A32, NV D32 | BOC, CC | Al+Ti | NR | 40 | Z35 |
| NV A36, NV D36 | | Al+Nb+Ti | | | |
| NV A32, NV A36 | BOC, CC | Al+Nb+Ti | AR | 30 | - |
| NV A32, NV D32 | BOC, LF, RH, CC | Al+Ti | NR+ACC | 40 | Z35 |
| NV A36, NV D36 | BOC, LF, RH, CC | Al+Nb+Ti | NR+ACC | 40 | Z35 |
| NV A32, NV D32, NV E32, NV A36, NV D36, NV E36 | BOC, CC | Al+Nb+V+Ti | TM | 50 | Z35 |
| NV A40, NV D40, NV E40, NV F40 | BOC, CC | Al+Nb+Ti or Al+Nb+V+Ti | TM | 60 | Z35 |
| NV A36, NV D36, NV E36, NV F36, NV A40, NV D40, NV E40, NV F40 | BOC, LF, RH, CC | Al+Nb+V+Ti | N | 100 | Z35 |
| NV A27S, NV D27S, NV E27S | BOC, LF, RH, CC | Al+Nb+Ti | TM | 100 | Z35 |
| NV A32, NV A36, NV D32, NV D36, NV E32, NV E36 | | | | | |
| NV A40, NV D40, NV E40 | | | | | |

**Extra high strength steel**

| Grade | Steelmaking[1)] | Fine grain elements | Heat treatment condition[2)] | Max. thickness [mm] | Z-quality |
|---|---|---|---|---|---|
| NV A47, NV D47, NV E47 | BOC, LF, RH, CC | Al+Nb+V+Ti | TM | 80 | Z35 |
| NV AO690, NV DO690, NV EO690 [5)] | BOC, LF, RH, CC | Al+Nb+V+Ti | QT | 83 | Z35 |
| NV A690, NV D690, NV E690 [5)] | BOC, LF, RH, CC | Al+Nb+V+Ti | QT | 83 | Z35 |

**Rolled steels for boiler and pressure vessels**

| Grade | Steelmaking[1)] | Fine grain elements | Heat treatment condition[2)] | Max. thickness [mm] | Z-quality |
|---|---|---|---|---|---|
| NV 360-0N, NV 360-1FN, NV 410-0N, NV 410-1FN, NV 460-0N | BOC, CC | Al+Ti | NR | 40 | Z35 |
| NV 490-0N, NV 490-1FN | BOC, CC | Al+Nb+Ti | NR | 40 | Z35 |

**Steel for low temperature service**

| Grade | Steelmaking[1)] | Fine grain elements | Heat treatment condition[2)] | Max. thickness [mm] | Z-quality |
|---|---|---|---|---|---|
| NV 360-2FN, NV 2-2, NV 2-3, NV 2-4, NV 2-4L | BOC, CC | Al+Nb+Ti | TM | 40 | Z35 |
| NV 4-2, NV 4-3, NV 4-4, NV 4-4L | BOC, CC | Al+Nb+Ti | TM | 60 [4)] | Z35 |
| NV 4-2, NV 4-3, NV 4-4, NV 4-4L | BOC, CC | Al+Nb+Ti | NT | 60 [4)] | Z35 |
| NV 0.5Ni/b | BOC, CC | Al+Nb+Ti | NT | 60 [4)] | Z35 |
| 13MnNi6-3 | BOC, CC | Al+Nb+Ti | NT | 60 | Z35 |
| P355M, P355ML1, P355ML2 | BOC, CC | Al+Nb+Ti | TM | 40 | Z35 |
| P420M, P420ML1, P420ML2 | BOC, CC | Al+Nb+V+Ti | TM | 40 | Z35 |
| NV 5Ni/a, NV 9Ni/a | BOC, CC | Al | QT | 50 | Z35 |

**Brittle Crack Arrest BCA Steel**

| Grade | Steelmaking[1)] | Fine grain elements | Heat treatment condition[2)] | Max. thickness [mm] | Z-quality |
|---|---|---|---|---|---|
| NV A36BCA1, NV D36BCA1, NV E36BCA1, NV A40BCA1, NV D40BCA1, NV E40BCA1 [6)] | BOC, LF, RH, CC | Al+Nb+V+Ti | TM+AcC | 85 | Z35 |

**Brittle Crack Arrest BCA Steel and COD Steel**

| Grade | Steelmaking[1)] | Fine grain elements | Heat treatment condition[2)] | Max. thickness [mm] | Z-quality |
|---|---|---|---|---|---|
| NV A40BCA1COD, NV A40BCA2COD, NV D40BCA1COD, NV D40BCA2COD, NV E40BCA1COD, NV E40BCA2COD 10) | BOC, LF, RH, CC | Al+Nb+Ti | TM+AcC | 100 | Z35 |
| NV A47BCA1, NV D47BCA1, NV E47BCA1 7)8)9)) | BOC, LF, RH, CC | Al+Nb+V+Ti | TM | 80 | Z35 |
| NV A47COD, NV D47COD, NV E47COD 7)8)9)) | BOC, LF, RH, CC | Al+Nb+V+Ti | TM | 80 | Z35 |
| NV A47BCA1COD, NV D47BCA1COD, NV E47BCA1COD 7)8)9)) | BOC, LF, RH, CC | Al+Nb+V+Ti | TM | 80 | Z35 |
| NV A47BCA1COD, NV A47BCA2COD, NV D47BCA1COD, NV D47BCA2COD, NV E47BCA1COD, NV E47BCA2COD 11) | BOC, LF, RH, CC | Al+Nb+Ti | TM+AcC | 100 | Z35 |

**Steels for high heat input welding - high strength steel**

| Grade | Steelmaking[1)] | Fine grain elements | Heat treatment condition[2)] | Max. thickness [mm] | Z-quality |
|---|---|---|---|---|---|
| NV A32-W700, NV D32-W700, NV E32-W700 *)l) | BOC, LF, RH, CC | Ti | TM | 80 | Z35 |
| NV A36-W700, NV D36-W700, NV E36-W700 *)l) | BOC, LF, RH, CC | Ti | TM | 80 | Z35 |
| NV A40-W700, NV D40-W700, NV E40-W700 *)l) | BOC, LF, RH, CC | Ti | TM | 80 | Z35 |

*) the following applies:

- W700 was qualified on plate thickness t = 80 mm and t = 40 mm
- application of steels for high heat input welding is subject to case-by-case design approval
- WPQT is required for each yard/construction site according to RU-SHIP Pt.2 Ch.4 Sec.5.; the exception given in RU-SHIP Pt.2 Ch.4 Sec.5 [6.2.2] d) is not applicable
- chemical composition and $C_{eq}$ shall be as per agreed manufacturer specification (refer to the original certificate in red print)
- further details which shall be adhered to for production testing are stated on the original certificate in red print.

[l)] Approval for grades NV A32W to NV E40W, incl. Z35 grades, as follows:

- Manufacturing shall be in accordance with the parameters as specified in "Process scheme for max. 80mm hull structural steel for high hear input welding", Doc.-No. 20220112001 Rev.02 ddt. 06.07.2022
- The manufacturer shall support DNV in recommending yard/construction site to perform additional Charpy V-testing at t/2 at -20°C for WPQT; notch positions WM, FL, FL+1, FL+2, FL+5, FL+10.

**Steel plates produced from 3500 mm Medium Plate Workshop of Steel Plate Mill**

**Normal strength steel**

| Grade | Steelmaking[1)] | Fine grain elements | Heat treatment condition[2)] | Max. thickness [mm] | Z-quality |
|---|---|---|---|---|---|
| NV A, NV B | BOC, LF, CC | Al | AR | 40 | Z35 |
| NV A, NV B, NV D | BOC, LF, CC | Al | NR | 40 | Z35 |
| NV E | BOC, LF, RH, CC | Al+Nb+Ti | TM | 40 | Z35 |

**High strength steel**

| Grade | Steelmaking[1)] | Fine grain elements | Heat treatment condition[2)] | Max. thickness [mm] | Z-quality |
|---|---|---|---|---|---|
| NV A32, NV D32 | BOC, LF, RH, CC | Al+Ti | NR | 40 | Z35 |
| NV A32, NV D32 | BOC, LF, RH, CC | Al+Nb+Ti | TM | 40 | Z35 |
| NV A36, NV D36 | BOC, LF, RH, CC | Al+Nb+Ti | NR | 40 | Z35 |
| NV A36, NV D36 | BOC, LF, RH, CC | Al+Nb+Ti | TM | 40 | Z35 |
| NV A32, NV D32 | BOC, LF, RH, CC | Al+Ti | NR+ACC | 40 | Z35 |
| NV A36, NV D36 | BOC, LF, RH, CC | Al+Nb+Ti | NR+ACC | 40 | Z35 |

Remarks:

1) BOC: Basic Oxygen Converter
EAF: Electric arc furnace
LF: Ladle Furnace
RH: Ruhrstahl Heraeus
CC: Continuous Casting.

2) AR: As Rolled
NR: Normalising Rolling
N: Normalising
TM: Thermo-Mechanical rolling
QT: Quenched and Tempered
ACC: Accelerated Cooling Process

3) Steel wire rods intended for offshore mooring ropes produced according to ISO 16120

4) Test temperature for 40 < t ≤ 50 mm in acc. with IACS W1, for 50 < t ≤ 60 mm lowest at -75 ℃ (acc. case-by-case approval)

5) Maximum welding heat input is 3.8 kJ/mm.

6) The production shall be in accordance with the manufacturer's specification: "Test report of high strength crack arrest steel EH40CAS steel plates''. September 12, 2015

7) The production shall be in accordance with the manufacturer's specification: "Test report of high strength crack arrest steel GL-E47 EXP steel plates''. December 29, 2014.

8) Aim analysis for elements which are determining for BCA property (small scale testing):

**0.48 ≤% Ni.**

Alternatively, in case obtained analysis results in: % Ni < 0.48, then the BCA property shall be verified by large scale test (ESSO or double tension test).

9)

a) Production testing has to be performed as follows (see reports dated Sept 2020 in NPS job 263.11-009619-5):

Once per motherplate with Pellini tests (ASTM E208 specimen), two successful tests (=specimens) for the following positions:

For NV E40 BCA1:

- surface: no break at -60°C (NDTT ≤ -65°C) (type P-1)
- t/2: no break at -35°C (NDTT ≤ -40°C) (type P-3)
- side section: no break at -40°C (NDTT ≤ -45°C) (type P-2)

For NV E47 BCA1 and NV E47 BCA1COD:

- surface: no break at -60°C (NDTT ≤ -65°C) (type P-1)
- t/2: no break at -30°C (NDTT ≤ -35°C) (type P-3)
- side section: no break at -35°C (NDTT ≤ -40°C) (type P-2)

b) The approval does not cover NV E40BCACOD or NV E40COD, among others because the tested CTOD specimens did not fulfil the conditions concerning dimensions and notch positioning. Especially for notch position in CGHAZ validation by assessment of microstructure which contributes to CGHAZ (with macrograph + evaluation) has to be submitted.

10) Particulars for grades NV E40 BCA2COD (including all corresponding grades with A, D, BCA1, BCA2, COD) with max. plate thickness t = 100 mm as follows:

a) Manufacturing process as per "Appendix 1: The steelmaking process, macrostructure, and original process records" submitted for NPS job 263.11-009619-6 (file marked with "2022 06", completed Oct 2022).

Aim analysis for elements which are determining for BCA and COD properties are:

% Ni ≥ 0.74;

% Mn ≥ 1.50;

% C ≤ 0.060;

% Cr ≤ 0.19;

Ceq ≤ 0.42

b) As per the "Proposal of small scale test in lieu of the large scale double tension test" (in "The test report of high strength crack arrest steel plates at VL E40BCA1 and EH40BCA2 grades" dated June 2022 and "F0-04 Test Report EH40BCA Pt3 DNV-rev") production testing shall be performed once per motherplate with Pellini tests (ASTM E208 specimen types) as follows:

For BCA1 grades:

- surface: no break at -60°C (NDTT ≤ -65°C) (type P-3) or
  surface: no break at -70°C (NDTT ≤ -75°C) (type P-1)
- t/2: no break at -30°C (NDTT ≤ -45°C) (type P-3)
- side section: no break at -35°C (NDTT ≤ -50°C) (type P-3)

For BCA2 grades:

- surface: no break at -60°C (NDTT ≤ -65°C) (type P-3) or
  surface: no break at -70°C (NDTT ≤ -75°C) (type P-1)
- t/2: no break at -40°C (NDTT ≤ -45°C) (type P-3)

- side section: no break at -45°C (NDTT ≤ -50°C) (type P-3)

The appropriate test results must be indicated on each relevant inspection document.

11) Particulars for grades NV E47 BCA2COD (including all corresponding grades with A, D, BCA1, BCA2, COD) with max. plate thickness t = 100 mm as follows:

c) Manufacturing process as per "Appendix 1: The steelmaking process, macrostructure, and original process records" submitted for NPS job 263.11-009619-6 (file marked with "2022 06", completed Oct 2022).

Aim analysis for elements which are determining for BCA and COD properties are:

% Ni ≥ 0.90;

% Mn ≥ 1.60;

% C ≤ 0.050;

% Cr ≤ 0.18;

Ceq ≤ 0.45

d) As per the "Proposal of small scale test in lieu of the large scale double tension test" (in "The test report of high strength crack arrest steel plates at VL E47BCA1 and EH47BCA2 grades" dated June 2022 and "F7-04 Test Report EH47BCA Pt3 DNV-rev") production testing shall be performed once per motherplate with Pellini tests (ASTM E208 specimen types) as follows:

For BCA1 grades:

- surface: no break at -65°C (NDTT ≤ -70°C) (type P-3 or type P-1)
- t/2: no break at -30°C (NDTT ≤ -35°C) (type P-3)
- t/4: no break at -35°C (NDTT ≤ -40°C) (type P-3)

For BCA2 grades:

- surface: no break at -65°C (NDTT ≤ -70°C) (type P-3 or type P-1)
- t/2: no break at -45°C (NDTT ≤ -50°C) (type P-3)
- t/4: no break at -55°C (NDTT ≤ -60°C) (type P-3)

The appropriate test results must be indicated on each relevant inspection document.

--- (end of document) ---