

APPROVAL OF MANUFACTURER CERTIFICATE

This is to certify:

That
Jiangsu Shagang Group Co., Ltd
Zhangjiagang, Jiangsu,
China

is an approved manufacturer of
Steelmaking and Rolled Steel Products

in accordance with
DNV GL rules for classification – Ships
DNV GL offshore standards

and the following particulars:

Application area	Normal strength steel High strength steel Extra high strength steel Z-grade steels (plates with through thickness properties) BCA steels (steels with brittle crack arresting properties) Steels for boiler and pressure vessels Steel for low temperature service
Product	Slabs, Plates
Manufacturing method	Basic oxygen converter or electric ARC furnace, Continuous casting
Deoxidation	Killed
Fine grain elements	See particulars of the approval
Delivery condition	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 GL classed object shall fulfill the material requirements in the applicable DNV GL class rules.

Issued at **Hamburg** on **2019-03-29**

for **DNV GL**

This Certificate is valid until **2021-12-31**.

DNV GL local station: **Jiangyin**

Approval Engineer: **Christian Wildhagen**

Thorsten Lohmann
Head of Section



Job Id: **263.11-009619-1**
 Certificate No: **AMMM000002N**
 Revision No: **8**

Particulars of the approval

Semis for rolling stock: Slabs

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

Final products: Steel Plates

Normal Strength Steels					
Grade	Steelmaking ¹⁾	Fine grain elements	Delivery condition ²⁾	Max. thickness (mm)	Z-quality
VL A, VL B	BOC, CC	Al	AR	40	-
VL A, VL B	BOC, CC	Al+Ti	NR	60	Z35
			N	100	Z35
VL D	BOC, CC	Al or Al+Ti	AR	35	Z35
VL E	BOC, CC	Al	TM	40	-
VL D, VL E	BOC, CC	Al+Nb+Ti	TM	60	Z35
			N	100	Z35

High Strength Steels					
Grade	Steelmaking ¹⁾	Fine grain elements	Delivery condition ²⁾	Max. thickness (mm)	Z-quality
VL A32, VL A36, VL D32, VL D36, VL E32, VL E36, VL F32, VL F36	BOC, CC	Al+Nb or Al+Nb+Ti	TM	60	Z35
VL A32, VL D32, VL E32, VL F32	BOC, LF, RH, CC	Al+Nb+V+Ti	N	100	Z35
VL A32, VL D32	BOC, CC	Al+Ti	NR	40	Z35
VL A36, VL D36		Al+Nb+Ti			
VL A32, VL A36	BOC, CC	Al+Nb+Ti	AR	30	-
VL A40, VL D40, VL E40, VL F40	BOC, CC	Al+Nb+Ti or Al+Nb+V+Ti	TM	60	Z35

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Grade	Steelmaking ¹⁾	Fine grain elements	Delivery condition ²⁾	Max. thickness (mm)	Z-quality
VL A36, VL D36, VL E36, VL F36, VL A40, VL D40, VL E40, VL F40	BOC, LF, RH, CC	Al+Nb+V+Ti	N	100	Z35

Extra High Strength Steels					
Grade	Steelmaking ¹⁾	Fine grain elements	Delivery condition ²⁾	Max. thickness (mm)	Z-quality
VL AO420, VL AO460, VL AO500, VL AO550, VL AO620, VL DO420, VL DO460, VL DO500, VL DO550, VL DO620, VL EO420, VL EO460, VL EO500, VL EO550, VL EO620	BOC, LF, RH; CC	Al+Nb+Ti	QT	100	Z35
VL A420, VL A460 VL D420, VL D460 VL E420, VL E460 ⁵⁾	BOC, LF, RH; CC	Al+Nb+V+Ti	TM	80	Z35
VL AO690, VL DO690, VL EO690 ³⁾⁴⁾	BOC, LF, RH; CC	Al+Nb+Ti	QT	85	Z35
VL AO620, VL DO620, VL EO620, VL AO690, VL DO690, VL EO690 ⁶⁾	EAF, IC	Al+Nb+V+Ti	QT	181	Z35
VL A420, VL A460, VL D420, VL D460, VL E420, VL E460, VL F420, VL F460, VL A500, VL O550, VL D500, VL D550, VL E500, VL E550, VL F500, VL F550	BOC, LF, RH; CC	Al+Nb+V+Ti	TM	60	Z35

Boiler and Pressure Vessel Steels					
Grade	Steelmaking ¹⁾	Fine grain elements	Delivery condition ²⁾	Max. thickness (mm)	Z-quality
VL 360-0N, VL 360-1FN, VL 410-0N, VL 410-1FN, VL 460-0N	BOC, CC	Al+Ti	NR	40	Z35
VL 490-0N, VL 490-1FN	BOC, CC	Al+Nb+Ti	NR	40	Z35

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Low Temperature Service Steels					
Grade	Steel-making ¹⁾	Fine grain elements	Delivery condition ²⁾	Max. thickness (mm)	Z-quality
VL 360-2FN, VL 2-2, VL 2-3, VL 2-4, VL 2-4L ⁶⁾	BOC, CC	Al+Nb+Ti	TM	40	Z35
VL 4-2, VL 4-3, VL 4-4, VL 4-4L ⁷⁾	BOC, CC	Al+Nb+Ti	TM	40	Z35
P355M, P355ML1, P355ML2 ⁷⁾	BOC, CC	Al+Nb+Ti	TM	40	Z35
P420M, P420ML1, P420ML2 ⁸⁾	BOC, CC	Al+Nb+V+Ti	TM	40	Z35

Hull Structural Steels for container ships

Brittle Crack Arrest Steel ($K_{Ic} \geq 6000\text{N/mm}^{1.5}$ at -10°C).

Extra High Strength Steels:					
Grade	Steelmaking ¹⁾	Fine grain elements	Delivery condition ²⁾	Max. Thickness (mm)	Z-quality
VL A36BCA, VL D36BCA, VL E36BCA, VL A40BCA, VL D40BCA, VL E40BCA ¹⁰⁾	BOC, LF, RH, CC	Al+Nb+V+Ti	TM+AcC	85	Z35

Brittle Crack Arrest Steel ($K_{Ic} \geq 6000\text{N/mm}^{1.5}$ at -10°C) including CTOD test.

Extra High Strength Steels:					
Grade	Steelmaking ¹⁾	Fine grain elements	Delivery condition ²⁾	Max. Thickness (mm)	Z-quality
VL A47BCA, VL D47BCA, VL E47BCA ¹¹⁾¹²⁾¹³⁾	BOC, LF, RH, CC	Al+Nb+V+Ti	TM	80	Z35
VL A47COD, VL D47COD, VL E47COD ¹¹⁾¹²⁾	BOC, LF, RH, CC	Al+Nb+V+Ti	TM	80	Z35
VL A47BCACOD, VL D47BCACOD, VL E47BCACOD ¹¹⁾¹²⁾¹³⁾	BOC, LF, RH, CC	Al+Nb+V+Ti	TM	80	Z35

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

Normal Strength Steels					
Grade	Steelmaking ¹⁾	Fine grain elements	Delivery condition ²⁾	Max. thickness (mm)	Z-quality
VL A, VL B	BOC, LF, CC	Al	AR	40	Z35
VL A, VL B, VL D	BOC, LF, CC	Al	NR	40	Z35
VL E	BOC, LF, RH, CC	Al+Nb+Ti	TM	40	Z35
High Strength Steels					
Grade	Steelmaking ¹⁾	Fine grain elements	Delivery condition ²⁾	Max. thickness (mm)	Z-quality
VL A32, VL D32	BOC, LF, RH, CC	Al+Ti	NR	40	Z35
VL A32, VL D32	BOC, LF, RH, CC	Al+Nb+Ti	TM	40	Z35
VL A36, VL D36	BOC, LF, RH, CC	Al+Nb+Ti	NR	40	Z35
VL A36, VL D36	BOC, LF, RH, CC	Al+Nb+Ti	TM	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
- 3) Maximum welding heat input is 3.8 kJ/mm.
- 4) Approval limits (in wt%) for intentionally added elements: 0.15 - 0.40% Cr, 0.20 - 0.55% Ni, for all the grades.
- 5) Carbon content and C_{eq} of steel (in wt%) tested during the approval: 0.06% C & 0.42% C_{eq}
- 6) Approved chemistry for intentionally added elements: 0.98% Cr, 1.97%Ni, 0.54% Mo
- 7) % Ni ≥ 0.10
- 8) % Ni ≥ 0.15
- 9) % Ni ≥ 0.18
- 10) 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
- 11) 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.
- 12) 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).
- 13) Production testing:
A relationship between large scale testing and representative small scale testing – with sufficient evidence - has not been proposed yet to DNV GL for approval.
Therefore, for production testing presently successful large scale tests – witnessed by DNV GL Surveyor – have to be performed as follows:
a) Once per heat, on the largest plate thickness.
In order to enable proposal for relationship between large scale and small scale testing, in addition to the already performed tests at least the following items are required:
b) On the same plate as per a): Pellini tests in order to determine the transition temperature for position SS, t/4 and t/2. The tests have to be witnessed by DNV GL Surveyor.

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- c) On the same plate as per a): microstructure evaluation (micrographs 100:1 and 500:1) for the same positions as above.
- d) It is considered that for determination of the above relationship the tests as per a), b) and c) have to be performed on at least two additional heats.
- e) The approval does not cover VL E40BCACOD or VL 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.