AGREEMENT

Number:	V-DK-008
Titel:	**Use of the nickel-chrome-iron alloy NiCr15Fe**
Signatories:	VDEh FDBR Vd-TÜV VGB
Publication Date:	January 2018

Agreement on Steam Boilers 008
2018-01

between

FDBR FDBR e.V. Fachverband Anlagenbau, Düsseldorf

VDEh Stahlinstitut VDEh, Düsseldorf

VdTÜV Verband der TÜV e.V., Berlin

VGB VGB PowerTech e.V., Essen

on the

Use of the nickel-chrome-iron alloy NiCr15Fe

Preamble

This agreement is intended to supplement the pertinent rules and regulations. It is a collection of experience made, recommendations and, where required, a concretization of the rules and regulations, which, to the best of our knowledge, reflects the state-of-the-art at its date of publication. This agreement aims at ensuring the operational safety of steam boiler plants and their components.

No liability will be taken for the correctness of the contents of this agreement. Patents and other protective rights shall be clarified under the responsibility of the user.

The associations having participated in the establishment of this guideline will appreciate the support and further development of its contents through other national and international associations/institutions.

This agreement is intended to supplement VdTÜV-Werkstoffblatt 305 and provide guidelines for the use of the heat-resisting alloy NiCr15Fe (Material no. 2.4816, Alloy 600/Alloy 600H) which will especially be used for the fabrication of

- welded-on nozzles for attachment of spray attemperators and retaining bolts
- branches for thermal sleeves and
- thermowells for temperature and analysis measuring points

in boiler construction at temperatures ranging from – 10 °C to 600 °C

Contents

1 Scope

This agreement applies to rolled and forged bars with diameters ranging from 17 mm to 60 mm as well as for plates with thicknesses up to and including 55 mm made of the nickel-chrome-iron alloy NiCr15Fe to VdTÜV-Werkstoffblatt 305 to be used in the fabrication of the above mentioned components in boiler construction at temperatures ranging from – 10 °C to 600 °C

In addition to VdTÜV-Werkstoffblatt 305 the following stipulations apply:

2 Material

2.1 Chemical composition

The carbon content determined by ladle analysis shall be at least 0.05%.

2.2 The tensile test values at elevated temperatures shall conform to DIN EN ISO 6892-2.

For the proof stress $R_{p0.2}$ at elevated temperatures the following minimum values apply independently of the heat treatment condition:

Test temperature [°C]	**$R_{p0.2}$ [MPa] minimum**
500	140
500	132

2.3 Long-term elevated temperature strength

The following guide values for the long-term elevated temperature strength apply in dependence of the heat treatment condition:

Long-term elevated temperature strength values for 100,000h				
Test temperature ϑ [°C]	**Heat treatment condition**			
	Solution annealed		**Soft annealed**	
	$R_{p0.1}$, 100,000 h, ϑ [MPa]	**R_m, 100,000 h, ϑ [MPa]**	**$R_{p0.1}$, 100,000 h, ϑ [MPa]**	**R_m, 100,000 h, ϑ [MPa]**
450	196	322	180	248
460	180	300	167	236
470	166	274	153	220
480	156	255	142	208
490	144	234	132	196
500	128	216	124	184
510	120	201	113	174
520	114	183	104	163
530	105	168	95	152

540	96	155	86	140
550	88	142	79	129
560	81	129	73	118
570	74	118	67	110
580	69	108	62	102
590	63	99	57	96
600	58	91	52	89
Source: VDM Metals, tabular values only valid for plates and bars				

The manufacturer shall submit documents on creep rupture tests performed on materials fabricated by him in the heat-treatment condition governing the delivery. The documents shall suffice to prove that guide values of the 100,000 h creep rupture strength are representative for the material delivered, with the values not being less than the aforementioned guide values.

3 Test requirements

For bars, a deep-etch test shall be performed on both ends at each random length. For plates, this test may be substituted by other suitable test methods (e.g. ultrasonic testing). The performance of the deep-etch test and the acceptance criteria shall be agreed with the manufacturer.

For plates, ultrasonic testing shall be performed. The performance of ultrasonic testing and the acceptance criteria shall be agreed with the manufacturer.

In addition to the mechanical tests to VdTÜV-Werkstoffblatt 305, a tensile test to comply with the limits of VdTÜV-Werkstoffblatt 305 shall be performed to prove the $R_{p0.2}$ proof stress at 500°C and 550 °C.

4 Prove of quality characteristics

4.1 For the products, inspection certificate 3.2 to DIN EN 10204 shall be established by the inspection agency. The inspection certificate shall be confirmed by the authorized inspector and the manufacturer's authorized inspection representative.

4.2 The manufacturer shall confirm the

- steel-making process
- result of the ladle analysis
- result of mechanical testing
- result of the deep-etch test
- result of the material identity check
- result of non-destructive testing (if required)
- heat treatment condition
- heat treatment parameters
- conformance of the delivery with the requirements of this agreement.

5 Design strength values

The following design values are to be considered:

- within the range of time-independent design strength values, the minimum values of $R_{p0.2}$ proof stress to VdTÜV-Werkstoffblatt 305 as well as the values additionally required by this agreement.

- within the range of time-dependent design strength values, the guide values for long-term elevated temperature strength given by this agreement.

The design shall consider the safety factors to DIN EN 12952-3 or AD-Merkblatt B 0 and in case of time-dependent design strength values to AD-Merkblatt 2000 S 6.

6 Literature

AD 2000-Merkblatt B 0	Design of Pressure Vessels (German version)
AD 2000-Merkblatt S 6	Creep Stress for Steels (German version)
VdTÜV-Werkstoffblatt 305	Nickel-Chrome-Iron Alloy NiCr15Fe material No. 2.4816; Strips, Plates, Seamless Tubes, Forgings, Bars (in German only)
DIN EN 10204	Metallic Products. Types of Inspection Documents (German version)
DIN EN 12953-3	Water-Tube Boilers and Auxiliary Installations. Part 3: Design and Calculation of Pressure Parts (German version)
DIN EN ISO 6892-2	Metallic Materials. Tensile Testing. Part 2: Method of Test at Elevated Temperature (German version)

7 Former agreements and effective date

This agreement replaces the Agreement on Steam Boilers 451/94/2 and shall apply immediately to new products.

Düsseldorf, 9th January 2018
FDBR e. V. Fachverband Anlagenbau
Signed: Dr. Maaß

Essen, 3rd January 2018
VGB PowerTech e.V.
Signed: Christensen

Berlin, 1st February 2018
VdTÜV Verband der Technischen Überwachungs-Vereine e.V.
Signed: Dr. Bühler

Düsseldorf, 28th January 2018
Stahlinstitut VDEh.
Signed: Dr. Dahlmann