

PED- Pressure Equipment Directive 97/23/EC

- European Approval for Materials -

This data sheet has been raised in accordance with the requirements of Article 11 of the Pressure Equipment Directive (97/23/EC). The material described within is not included in a standard which has been harmonised to the afore mentioned directive.

EAM-0526-43-4:2004/05

Submitted by: **Notified Body 0526**

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EAM – 0526- 43/4 - Rev 4 - EN

Date: 25 May 04

Designation	EAM - NiCr15Fe
Type of material	Nickel-chromium-Iron alloy – Seamless Tubes.

1	Material Designation	1.1 Classification: EAM-0526-43-4:2004/05 1.2 Name: NiCr15Fe 1.3 Material Ref. No.: 2.4816 1.4 UNS Ref. No.: N06600 1.5 ISO / TR 15608:2000 Group 45																
2	Standards to which consideration and or reference has been given.	<p>This EAM incorporates by dated reference provisions from other publications. These references are cited in the text and in the following list. Subsequent amendments to, or revisions of any of these publications apply to this EAM only when incorporated in an amendment or revision to this EAM.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">2.1 VdTÜV 305 – 03/1999 (origin)</td> <td style="width: 50%;">2.8 EN 10234:1994</td> </tr> <tr> <td>2.2 EN 10002-1:2001</td> <td>2.9 EN 10236:1994</td> </tr> <tr> <td>2.3 EN 10002-5:1992</td> <td>2.10 EN 10237:1994</td> </tr> <tr> <td>2.4 EN 10045-1:1990</td> <td>2.11 EN 10246-2:2000</td> </tr> <tr> <td>2.5 EN 10204:1991</td> <td>2.12 EN 10246-6:2000</td> </tr> <tr> <td>2.6 EN ISO 6506-1:1999</td> <td>2.13 EN 10246-7:1996</td> </tr> <tr> <td>2.7 EN 10233:1994</td> <td>2.14 EN 10246-17:2000</td> </tr> <tr> <td></td> <td>2.15 EN 473:2000</td> </tr> </table>	2.1 VdTÜV 305 – 03/1999 (origin)	2.8 EN 10234:1994	2.2 EN 10002-1:2001	2.9 EN 10236:1994	2.3 EN 10002-5:1992	2.10 EN 10237:1994	2.4 EN 10045-1:1990	2.11 EN 10246-2:2000	2.5 EN 10204:1991	2.12 EN 10246-6:2000	2.6 EN ISO 6506-1:1999	2.13 EN 10246-7:1996	2.7 EN 10233:1994	2.14 EN 10246-17:2000		2.15 EN 473:2000
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	2.15 EN 473:2000																	

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3	Limiting Dimensions	Form	Dimensions										
			Thickness (mm)				Diameter (mm)						
		Seamless Tubes	Up to and including 25 mm				Up to and including 170 mm						
4	Melting Method	4.1 Electric Arc Process 4.2 Induction Furnace Process 4.3 Possibly material produced under vacuum, remelting, decarburisation using oxygen and/or argon (AOD process)											
5	Production Method / Delivery Condition	5.1 Hot Rolled 5.2 Cold Rolled 5.3 Extruded } Soft annealing or solution annealing (see section 10) The products shall be free from surface and internal defects which might impair their usability.											
6	Application Temp.	6.1 -10 °C to 450 °C 6.2 The material is also suitable for use below -10 °C. For such cases; impact energy values and verification procedures shall be agreed at the time of order.											
7	Chemical Composition	% Composition by Weight											
			Ni	C	Si	Mn	S	P	Fe	Cu	Cr		
		Heat	Minimum	72.00	-	-	-	-	-	6.0	-	14.00	
		Heat	Maximum		0.08	0.50	1.00	0.010	0.010	10.0	0.50	17.00	
		Product	Minimum	71.55	-	-	-	-	-	5.8	-	13.80	
		Product	Maximum	-	0.09	0.55	1.05	0.013	0.013	10.2	0.53	17.20	
A maximum of 1 % Co is allowed and counted as nickel													
8	Mechanical and Technological requirements	8.1 Tensile Properties at Room Temperature (20 °C)											
		Heat treatment		Rp0.2 min N/mm ²		Rm N/mm ²		A min (%) (both 5d and 5.65√So)					
		Soft annealing		200		550 to 750		30					
		Solution annealing		180		500 to 700		35					
	Verification Test Direction		8.2 Transverse (see section 9)										
	Tensile Properties		8.3 Minimum proof and tensile strength values at Elevated Temperature ¹⁾										
			Temperature (°C)		100	200	300	400	450				
			Requirement N/mm ²										
			Rp0.2 Rm	Soft annealing		180	165	155	150	145			
						520	500	485	480	475			
Rp0.2 Rm			Solution annealing		170	160	150	150	145				
	480	460			445	440	435						
¹⁾ For design calculations no interpolation between stated values is permitted (unless the design code explicitly provides for it). The values at the higher temperature shall be used. These property values are taken from VdTUV 305 – 03/1999.													

 NB: 1 N/mm² =1 MPa

8	Other Properties	8.4 Minimum Impact Properties (Charpy ISO – V) EN 10045-1						
		At Room Temperature (20 °C) Longitudinal direction: KV = 160 Joules Transverse direction : KV = 120 Joules						
		8.5 Hardness Brinell HB - EN ISO 6506-1						
		Solution annealing: 185 HB max Soft annealing: 195 HB max						
		8.6 Modulus of Elasticity (kN/mm ²)						
		Temperature (°C)	20	100	200	300	400	500
		E-Modulus	214	209	205	200	194	187
		8.7 Technological Requirements						
		Outside Diameter D (mm)	Wall Thickness T (mm)					
			T < 2	2 ≤ T ≤ 16		16 < T ≤ 25		
		D ≤ 18	Flattening test	Flattening test ¹⁾		-		
		18 < D ≤ 150	Flattening test	Ring Expanding test ¹⁾		Flattening test		
		150 < D ≤ 220	-	Ring Tensile test		Ring Tensile test		
		1) The test may, at the discretion of the manufacturer, be replaced by a drift expanding test or ring tensile test.						
		<p>Flattening test: specimens shall be flattened until the distance between the platens "H" is achieved using</p> $H = \frac{(1+c)T}{c + \frac{T}{D}}$ <p style="text-align: right;">Where T = wall thickness (mm) D = outside diameter (mm) c = constant: 0.1</p> <p>Ring expanding test specimens shall be expanded until fracture occurs. The fracture shall be of a clean ductile nature. If a 40 % expansion is reached the test may be discontinued.</p> <p>Drift expanding test: The diameter of the specimen shall be increased by 30 % and when examined shall show no signs of cracking without the use of magnifying aids.</p> <p>Ring tensile test: Specimens shall have a clean ductile fracture.</p> <p>Flattening and expanding tests shall show no visible cracks when examined without the use of magnifying aids.</p>						

9	Testing	9.1 Type of Inspection and Test		
		Test / Inspection	Frequency	Reference
		Heat Analysis	One per heat	Section 7
		Product Analysis	One per heat (If required and agreed at the time of order by the Purchaser).	Section 7
		Positive Material identification	All Items	Section 7
		9.2 Tensile Test at Room Temperature (20 °C)		
		Product form	Frequency	Reference
		All	One Longitudinal test per heat, heat treatment lot and size for every 100 tubes or part thereof.	Section 8.1 and EN 10002-1
		9.3 Elevated Temperature Tensile Tests		
		Product Form	Frequency	Reference
		All product forms with operating temperatures ≥ 100 °C	One test per heat from the product with the largest thickness.	Section 8.3 and EN 10002-5
		9.4 Impact Testing		
		Impact energy is checked according to section 8.4 for all products except for diameter or thickness ≤ 20 mm for which the verification is carried out only if required when specified by the Purchaser at the time of order.		Reference
		The values stated in section 8.4 shall be the minimum average of 3 specimens, with only one individual specimen value allowed up to a maximum of 30 % lower.		Section 8.4 and EN 10045-1
		9.5 Hardness Test		
		Product Form	Frequency	Reference
		All	All Mechanical Test Samples / Coupons (If required and agreed at the time of order by the Purchaser).	Section 8.5
		9.6 Leak Test		
		Test Method	Frequency	Reference
		Hydraulic pressure test with water at 80 bar ¹⁾ , duration 5 sec. minimum. Alternatively Eddy Current Testing may be employed.	All Tubes	EN 10246-2
		Test Method	Frequency	Reference
		<p>1) Pressures greater than 80 bar may be used, where agreed. However under no circumstances shall the test pressure be such as to result in the stress exceeding the Rp0.2 or Rp1.0 proof strength</p> <p style="text-align: center;">Using: $P=20 \times (S \times T)/D$</p> <p>Where</p> <p>P = Test pressure in bar S = 86 % of the minimum specified Rp0.2 proof strength in N/mm² (Reference the formula from DIN 2413 with a 1.1 safety factor) T = Minimum wall thickness in mm D = Outside diameter in mm.</p>		

9	Testing	9.7 Non-destructive Tests					
		Test		Frequency		Reference	
		Ultrasonic Test ^{2) 3)}		All Tubes		EN 473 or equivalent EN 10246-6, 7 or 17	
		2) The ultrasonic test shall be performed in accordance with EN 10246-7 (longitudinal imperfections), and the acceptance criteria shall be Level U2 subcategory C. This test may be dispensed with where the tube is being used inside a pressure vessel (internal tubes). The order shall specify whether internal use is intended.					
		3) Ultrasonic testing for transverse or laminar imperfections, if required, shall be agreed at the time of order.					
		9.8 Visual Inspection					
		Product Form		Frequency		Reference	
		All		All items		(1)	
		9.9 Dimensional Inspection					
		Product Form		Frequency		Reference	
		All		All items		(1)	
		1) 100 % inspection of all products by the Material Manufacturer. Dimensional tolerances for all product forms shall be agreed between the Material Manufacturer and Purchaser at the time of order.					
		9.10 Technological tests					
		Test		Frequency		Reference	
Flattening Test		1 test piece from 1 end of each tube or factory length		Section 8.7 and EN 10233 EN 10234 EN 10236 EN 10237			
Ring Tensile Test							
Drift Expanding Test							
Ring Expanding Test							
10	Heat Treatment	Method	Temperature (°C)	Thickness (mm)	Holding Time (min)	Cooling	
		Soft annealing	920 to 1000	≤ 10	5 to 15	Water, air or inert gas	
				> 10 to ≤ 25	30		
		Solution annealing	1080 to 1150	≤ 10	5 to 20		
				> 10 to ≤ 25	30 to 60		
		11	Joining	11.1 Welding			
<p>This material has, historically, proven suitable for fusion welding by all recognised processes including: the MMA (111) welding process with coated electrodes using the appropriate filler material, e.g. material No. 2.4805* (S-NiCr 15 FeNb) and material No. 2.4807* (S-NiCr 15 FeMn) and also the processes TIG (141) and MIG (131) using the appropriate filler material, e.g. material No. 2.4806 (S-NiCr 20 Nb) and material No. 2.4803* (S-NiCr 15 FeTi).</p> <p>The use of submerged arc welding is not recommended.</p> <p>Information supplied by the consumable manufacturer on the filler wires suitability must be considered, especially with regard to sulphur sensitivity and both low and elevated temperature properties.</p> <p>The material does not normally require preheat neither post-welded heat treatment.</p> <p>Consultation with the material manufacturer's technical department is recommended when choosing a filler wire or welding process.</p>							
		* Werkstoffnummer					

12	Forming	12.1 Hot and Cold forming		
		This material is suitable for both hot and cold forming subject to the following provisions:		
		Hot forming temperature (°C)	Ratio of deformation (%)	Type of forming
		1230 to 1030	≥ 5	Rolling, bending
		1030 to 900	< 5	For all
<p>A new heat treatment according to 10 is needed after a hot forming.</p> <p>A new heat treatment according to 10 is needed where cold forming deformation exceeds 5 %.</p> <p>The material is sensitive to sulphur above 400 °C, therefore the surface should be carefully cleaned before any welding or heat treatment.</p> <p>It is important that furnace atmospheres for processing are sulphur free. The furnace atmosphere should be either mildly reducing or neutral. If the atmosphere cannot be maintained as sulphur free then it should be mildly oxidising. Alternating between oxidising and reducing should be avoided.</p>				
13	Marking	<p>Material shall be marked with the following information:</p> <ul style="list-style-type: none"> 1 - Manufacturers Identification Mark 2 - Heat/Melt Number 3 - Test or Manufacturing Batch Number 4 - Material Grade 5 - EAM Reference No. <p>Markings shall normally be by permanent marking.</p>		
14	Inspection documents	14.1 Document type		
		<p>1) Material manufacturers shall supply documentation affirming compliance with this EAM.</p> <p>This documentation shall normally be in the form of an inspection certificate in accordance with EN 10204 3.1.B.</p> <p><u>Note:</u> Where a material manufacturer has an appropriate quality assurance system, certified by a competent body, established within the community and having undergone a specific assessment for materials, certificates issued by the manufacturer are presumed to certify conformity with the requirements of section 4.3 of Annex I of the PED.</p> <p>2) If an inspection document in accordance with EN 10204 3.1.C or 3.2 is specified, the purchaser shall notify the manufacturer of the name and address of the organisation or person who is to carry out the inspection and produce the inspection document. In the case of the inspection report 3.2 it shall be agreed which party shall issue the certificate.</p> <p><u>Note:</u> The affirmation of the compliance of the delivery with this EAM is not a mandatory requirement of EN 10204. Such affirmation – as it is required by PED, 97/23/EC, in Annex I 4.3 first paragraph – can be added into the text of the inspection certificate, when it is signed by the manufacturer. It could also be provided in a separate document. In the case the inspection certificate is signed by a third party, the affirmation shall be contained in a document which is (also) signed by the manufacturer.</p>		

		<p>14.2 Content of inspection documents</p> <ol style="list-style-type: none">1) Details of the manufacturer2) Details of the purchaser3) Description, quantity and dimensions of each Product4) Purchasing conditions5) Heat Analysis6) Product Analysis (if required)7) Results from mechanical verification tests8) applied Heat treatment9) Results from other required Tests (e.g. PMI)10) Marking and identification11) Affirmation of compliance with this EAM12) Declaration of the Status of the Manufacturers Quality System (including the name of the competent body having certified the Quality System, if applicable).
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