

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-0526-28:2004/07

Submitted by: **Notified Body 0526**

CETIM - BP. 80067 - 52 avenue Félix Louat
F-60304 SENLIS CEDEX – France.
Tel. +33.344673479 Fax. +33.344673427
e-mail chaieb.jarboui@cetim.fr

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Designation

EAM-NiMo16Cr16Ti

Type of material

Nickel-chromium- Molybdenum alloy – Flat products

1	Material Designation	1.1	Classification:	0526-28:2004/07
		1.2	Name:	NiMo16Cr16Ti
		1.3	Material Ref. No.:	2.4610 (Werkstoffnummer)
		1.4	UNS Ref. No.:	N10455
		1.5	ISO/TR 15608:2000	Group 43
		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> <p>2.1 VdTÜV 424 – 09/2002 (Origin) modified to reflect the actual material deliveries. 2.2 EN 10002-1:2001 2.3 EN 10002-5:1992 2.4 EN 10045-1:1990 2.5 EN 10204:1991 2.6 EN ISO 6506-1:1999 2.7 EN 910:1996 2.8 SEP 1877-II:1994</p>

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3	Limiting Dimensions	Form	Dimensions											
		Flat products	Thickness (mm)							Diameter (mm)				
			Up to and including 65 mm							-				
4	Melting Method	4.1 Electric Arc Process and vacuum or argon process												
		4.2 Induction Furnace Process and vacuum or argon process												
5	Production Method / Delivery Condition	5.1 Hot Rolled										} Solution annealing (see section 10)		
		5.2 Cold Rolled												
		The products shall be free from surface and internal defects which might impair their usability.												
6	Application Temperatures	6.1 -196 °C to 400 °C												
		6.2 The material is suitable for use down to -196 °C. For use below -10 °C, impact energy values and verification procedures shall be agreed at the time of ordering.												
7	Chemical Composition	% Composition by Weight												
			Ni	Cr	Fe	C	Mn	Si	Mo	P*	S*	Co	Ti	
		Ladle and Product	Minimum	Bal.	14.50	-	-	-	-	14.00	-	-	-	-
			Maximum		17.50	3.00	0.009	1.00	0.050	17.00	0.010	0.005	2.00	0.70
		* modified to reflect the actual material deliveries.												
8	Mechanical and Technological requirements	8.1 Tensile Properties at Room Temperature (RT)												
		Rp0.2 min (N/mm ²)			Rp1.0 min (N/mm ²)				Rm (N/mm ²)	A min (%) (both 5d and 5.65√So)				
		e ≤ 5	5 < e ≤ 20	20 < e ≤ 65	e ≤ 5	5 < e ≤ 20	20 < e ≤ 65	700 - 900	40					
		305	300	280	340	330	315							
		8.2 Transverse (see section 9).												
	Tensile Properties	8.3 Minimum proof strength values at Elevated Temperature (°C) ¹⁾												
		Thickness (mm)	100		200		300		400					
			Requirement N/mm ²											
		Rp1.0	e ≤ 5	315		285		270		260				
			5 < e ≤ 20	305		280		255		240				
			20 < e ≤ 65	295		275		255		240				
		Rp0.2	e ≤ 5	285		255		245		225				
			5 < e ≤ 20	270		245		220		205				
20 < e ≤ 65	260		235		215		205							
		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 VdTÜV 424 - 09/2002.												

 N.B. 1 N/mm² = 1 MPa

8	Other Properties	8.4 Minimum Impact Properties, Transverse direction (Charpy ISO - V) EN 10045-1					
		<ul style="list-style-type: none"> ▪ at RT: KVmin = 96 Joules ▪ at -196 °C: KVmin = 80 Joules 					
		8.5 Hardness Brinell - EN ISO 6506-1					
		HB: 320 max					
		8.6 Modulus of Elasticity (kN/mm ²)					
		Temperature (°C)	20	100	200	300	400
		E-Modulus	211	207	202	195	188
		8.7 Intergranular corrosion properties SEP 1877 method II.					
9	Testing	9.1 Type of Inspection and Test					
		Test / Inspection	Frequency			Reference	
		Cast Analysis	One per cast			Section 7	
		Product Analysis	One per cast (if required and agreed at the time of ordering by the purchaser).			Section 7	
		Positive Material identification	All Items			Section 7	
		9.2 Tensile Test at RT					
		Product form	Frequency			Reference	
		Plate < 10 mm	1 Transverse test per cast, per heat treatment lot, per size, per 10 plates minimum or part thereof.			Section 8.1 and EN 10002-1	
		Plate ≥ 10 mm	1 Transverse test per plate.				
		Coil Strip ≤ 4 mm	1 Transverse test at each end of the coil, longitudinal for coil width < 200 mm.				
		9.3 Elevated Temperature Tensile Tests					
		Product Form	Frequency			Reference	
		All product forms with operating temperatures > 50 °C	One test per cast from the product with the largest thickness.			Section 8.3 and EN 10002-5	

9	Testing	9.4 Impact Testing			
		Verification of impact properties is only required when specified by the purchaser at the time of ordering.			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		Section 8.5
		9.6 Corrosion test			
		Product Form	Frequency		Reference
		All	First finished worked product made from the relevant cast		Section 8.7
		9.7 Visual Inspection ¹⁾			
		Product Form	Frequency		Reference
		All	All items		
		9.8 Dimensional Inspection ¹⁾			
		Product Form	Frequency		Reference
All	All items				
¹⁾ 100 % inspection of all products by the manufacturer. Dimensional tolerances for all product forms shall be agreed between the manufacturer and purchaser at the time of ordering.					
10	Heat Treatment	Method	Temperature (°C)	Holding Time (min)	Cooling
		Solution Annealing	1050 to 1080	5 to 60 depending of thickness	Water For product thickness up to 1.5 mm, rapid air cooling should be acceptable
11	Joining	11.1 Welding			
		This material has, historically, proven suitable for fusion welding by the TIG (141) and MIG (131) welding process using the appropriate filler material, e.g. No. 2.4611* (Type NiMo16Cr16Ti) and 2.4839* (Typ NiCr20Mo15). The MMA (111) welding process with coated electrodes using the appropriate filler material, e.g. material No. 2.4612* (Type NiMo15Cr15Ti) and 2.4657* (Typ NiMo19Cr15) may also be applied, but it is important to consult material manufacturer and other interested parties to insure that appropriate precaution are implemented.			
		The use of submerged arc welding for this alloy is not recommended.			
		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.			
		The material does not normally require preheat neither post-welded heat treatment.			
		Welding operations, however, must be carried out at a temperature of more than 5 °C. The temperature between passes must be keep relatively low i.e. less than 100 °C.			
		Where cold forming exceeds 15 %, solution annealing shall be performed prior to welding.			
		Consultation with the material manufacturer's technical department is recommended when choosing a filler wire or welding process.			
		* Werkstoffnummer			

		<p>11.2 Bend properties on welded joint: (on production test coupon)</p> <p>Bending test at room temperature on welded joint shall be carried out on mandrel with diameter, $D = 3.a$ (a: specimen thickness) according to EN 910;</p> <p>Bending angle: 180°.</p>
12	Forming	12.1 Hot and Cold forming
		<p>This material is suitable for both hot and cold forming subject to the following provisions:</p> <ol style="list-style-type: none"> 1) Hot forming shall occur at between 1080°C to 900°C followed by solution annealing (see section 10). 2) Where cold forming deformation exceeds 15 % a solution annealing shall be performed (see section 10). 3) The material is sensitive to sulphur above 400°C, therefore the surface should be carefully cleaned before heating: hot forming, welding or heat treatment. 4) It is important that furnace atmospheres for processing are sulphur free.
13	Marking	<p>Material shall be marked with the following information:</p> <ol style="list-style-type: none"> 1) Manufacturers Identification Mark 2) Cast/Melt Number 3) Test or Manufacturing Batch Number 4) Material Grade 5) EAM Reference No. <p>Markings shall normally be by permanent ink marking or vibro-etching.</p>
14	Inspection documents	14.1 Document type
		<ol style="list-style-type: none"> 1) Material manufacturers shall supply documentation affirming compliance with this EAM. This documentation shall normally be in the form of an inspection certificate in accordance with EN 10204 - 3.1.B. <i>Note: 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.</i> 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. <i>Note: 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.</i>

14	Inspection documents	<p data-bbox="400 230 1532 286">14.2 Content of inspection documents</p> <ol data-bbox="400 286 1532 1079" style="list-style-type: none"><li data-bbox="400 286 1532 342">1) Details of the manufacturer<li data-bbox="400 342 1532 398">2) Details of the purchaser (if required)<li data-bbox="400 398 1532 454">3) Description and dimensions of the Product<li data-bbox="400 454 1532 510">4) Supply conditions<li data-bbox="400 510 1532 566">5) Ladle Analysis<li data-bbox="400 566 1532 622">6) Product Analysis (if required)<li data-bbox="400 622 1532 678">7) Results from mechanical verification tests<li data-bbox="400 678 1532 734">8) Heat treatment applied<li data-bbox="400 734 1532 790">9) Results from other applicable Tests (e.g. PMI)<li data-bbox="400 790 1532 846">10) Marking and identification<li data-bbox="400 846 1532 902">11) Affirmation of compliance with this EAM<li data-bbox="400 902 1532 1079">12) 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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