

## EUROPEAN ASSESSMENT DOCUMENT

EAD 200022-00-0302

May 2015

# THERMO-MECHANICALLY ROLLED LONG STEEL PRODUCTS MADE OF WELDABLE FINE GRAIN STRUCTURAL STEEL OF SPECIAL STEEL GRADES

The reference title and language for this EAD is English. The applicable rules of copyright refer to the document elaborated in and published by EOTA.

This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

## Contents

<b>1</b>	<b>Scope of the EAD</b> .....	<b>4</b>
1.1	Description of the construction product	4
1.2	Information on the intended use(s) of the construction product	5
1.2.1	Intended use .....	5
1.2.2	Working life/Durability.....	5
<b>2</b>	<b>Essential characteristics and relevant assessment methods and criteria</b> .....	<b>6</b>
2.1	Essential characteristics of the product	6
2.2	Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product	6
2.2.1	Chemical composition of the steel .....	6
2.2.2	Yield strength, tensile strength and elongation at fracture .....	7
2.2.3	Impact properties of the steel.....	7
2.2.4	Weldability of the steel .....	8
2.2.5	Load bearing capacity of fillet welds.....	8
2.2.6	Reaction to fire.....	9
<b>3</b>	<b>ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE</b> .....	<b>10</b>
3.1	System of assessment and verification of constancy of performance to be applied	10
3.2	Tasks of the manufacturer	10
3.3	Tasks of the notified body	11
<b>4</b>	<b>Reference documents</b> .....	<b>12</b>

# 1 SCOPE OF THE EAD

## 1.1 Description of the construction product

The products are uncoated thermo-mechanically hot-rolled long steel products with maximum flange thickness 150 mm made of weldable fine grain steel. The steel grades are similar to the structural steel grades S355M/ML and S460M/ML according to EN 10025-4:2004 (listed in Table 1).

The product is not fully covered by the following harmonised technical specification: EN 10025-4:2004

Due to the manufacturing process of special quenching and self-tempering (QST) the steel grades deviate from EN 10025-4:2004 as follows:

- For thicknesses larger than 15 mm the minimum yield strengths  $R_{eH}$  and the ultimate strengths  $R_m$  are greater than those specified in EN 10025-4:2004.
- The chemical analysis differs from the analysis specified in EN 10025-4:2004. This results in a lower carbon equivalent than specified in EN 10025-4:2004 for S355M/ML and S460M/ML.

This EAD comprises structural components made of the products mentioned above as well.

**Table 1 Comparison of steel grades**

Steel grade according this EAD	Comparable steel grade according EN 10025-4	
	Designation according EN 10027-1:2005	Designation according EN 10027-2:1992
A	S355M	1.8823
B	S460M	1.8827
C	S355ML	1.8834
D	S460ML	1.8838

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary. Thus, the use, maintenance, repair is not required during the intended working life; the thermo-mechanically hot-rolled long steel products made of weldable fine grain structural steel can be dismantled and recycled, but are normally not intended for re-use.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals, notably in accordance with the provisions of EN 1090-2:2008+A1:2011.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

## **1.2 Information on the intended use(s) of the construction product**

### **1.2.1 Intended use**

The thermo-mechanically hot-rolled long steel products made of weldable fine grain structural steel are intended for use in welded, bolted or riveted structures.

### **1.2.2 Working life/Durability**

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the thermo-mechanically rolled long steel products made of weldable fine grain structural steel of special steel grades for the intended use of 100 years when installed in the works (provided that the thermo-mechanically rolled long steel products made of weldable fine grain structural steel of special steel grades are subject to appropriate installation). These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works<sup>1</sup>.

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

---

<sup>1</sup> The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than the working life referred to above.

## 2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

### 2.1 Essential characteristics of the product

Table 2 shows how the performance of thermo-mechanically hot-rolled long steel products made of weldable fine grain structural steel is assessed in relation to the essential characteristics.

**Table 2 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics**

No	Essential characteristic <i>(where relevant with footnote*)</i>	Assessment method	Type of expression of product performance <i>(level, class, description)</i>
<b>Basic Works Requirement 1: Mechanical resistance and stability</b>			
1	Chemical composition	2.2.1	Level(pass/fail)
2	Yield strength	2.2.2	Level( $R_{eH}$ [MPa])
3	Tensile strength		Level( $R_m$ [MPa])
4	Elongation at fracture		Level( $L_0$ [%])
5	Impact toughness value	2.2.3	Level( $K_v$ [J])
6	Weldability	2.2.4	Level(CEV [%])
7	Load bearing capacity of fillet welds	2.2.5	Level( $\beta_w$ )
<b>Basic Works Requirement 2: Safety in case of fire</b>			
8	Reaction to fire	2.2.6	Class (A1) according to EN 13501-1:2007

### 2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

Characterisation of products to be assessed shall be done in accordance with available specifications, notably for the following:

Materials according to EN 10025-4 with deviations according to following tables 3, 4 and 5.

This EAD contains provisions on how to declare certain performance characteristics. These provisions only apply if the manufacturer wishes to declare a performance for the relevant product characteristic.

#### 2.2.1 Chemical composition of the steel

The chemical analysis shall be carried out in accordance with EN 10025-4:2004, clause 8.3.3 and 9.1. The test method shall be in accordance with EN 10025-4:2004, clause 10.1. Option 29 does not apply.

The chemical analysis shall meet the level of characteristics of table 3.

**Table 3 Chemical analysis of the weldable fine grain steel grade A (similar to S355M), grade B (similar to S460M), grade C (similar to S355ML) and grade D (similar to S460ML)**

Steel grade	Percent by weight														Carbon equivalent CEV <sup>2)</sup>	
	C ≤	Si ≤	Mn ≤	P ≤	S ≤	N ≤	Al <sup>1)</sup> ≥	Mo <sup>3)</sup> ≤	Cr <sup>3)</sup> ≤	Ni ≤	Nb ≤	Cu <sup>3)</sup> ≤	V ≤	Ti ≤	t ≤ 63 mm	63 mm < t ≤ 125 mm
A	0,12	0,50	1,60	0,035	0,030	0,015	0,020	0,20	0,30	0,30	0,05	0,55	0,10	0,05	0,39	0,39
B	0,12	0,60	1,70	0,035	0,030	0,025	0,020	0,20	0,30	0,70	0,05	0,55	0,12	0,05	0,41	0,43
C	0,12	0,50	1,60	0,030	0,025	0,015	0,020	0,20	0,30	0,30	0,05	0,55	0,10	0,05	0,39	-
D	0,12	0,60	1,70	0,030	0,025	0,025	0,020	0,20	0,30	0,70	0,05	0,55	0,12	0,05	0,41	-
4)	+0,02	+0,05	-0,05 +0,10	+0,005	+0,005	+0,002	-0,005	+0,03	+0,05	+0,05	+0,01	+0,05	+0,02	+0,01	+0,02	+0,02

<sup>1)</sup> If sufficient other N-binding elements are present the minimum Al content does not apply

<sup>2)</sup>  $CEV = C + Mn / 6 + (Cr + Mo + V) / 5 + (Ni + Cu) / 15$

<sup>3)</sup>  $\Sigma (Cr + Cu + Mo) < 0,60 \%$

<sup>4)</sup> acceptable deviations of product analyses from limit values of ladle analyses

## 2.2.2 Yield strength, tensile strength and elongation at fracture

Location and orientation including preparation of samples and test pieces shall be in accordance with EN 10025-1:2004 and EN 10025-4:2004. The test method shall be in accordance with EN 10025-1:2004, clause 10.2.1 and EN 10025-4:2004.

The determined values of the yield strength, the ultimate strength and the elongation shall meet the level s of characteristics of Table 4.

**Table 4 Mechanical properties of the long steel products at ambient temperature**

Steel grade	Part thickness t [mm]	Mechanical properties		
		Upper yield strength ReH [MPa]	Tensile strength Rm [MPa]	Elongation at fracture $L_0 = 5,65 \cdot \sqrt{S_0}$ [%]
A (similar to S355M)	≤ 150	355	470 to 630	22
B (similar to S460M)	≤ 100	460	540 to 720	17
	100 < t ≤ 150	450		
C (similar to S355ML)	≤ 125	355	470 to 630	22
D (similar to S460ML)	≤ 125	460	540 to 720	17

## 2.2.3 Impact properties of the steel

Location and orientation of samples and test specimen shall be in accordance with EN 10025-4:2004, clause 9.2.

The impact properties shall be determined according to EN 10025-4:2004, clause 7.3.2. The determined values of the impact toughness shall meet the levels of characteristics of the values given in Table 5.

**Table 5 Minimum value of impact energy for longitudinal specimen**

Steel grade	Minimum value of impact energy [J] at test temperature [C°]			
	-50	-40	-30	-20

A (similar to S355M)	---	---	---	40
B (similar to S460M)				
C (similar to S355ML)	27	31	40	47
D (similar to S460ML)				

#### 2.2.4 Weldability of the steel

The chemical analysis shall be performed in accordance with 2.2.1.1.

The carbon equivalent value CEV shall be determined according to EN 10025-1:2004. CEV shall meet the level of characteristic given in Table 3.

#### 2.2.5 Load bearing capacity of fillet welds

The load bearing capacity shall be calculated according to EN 1993-1-8:2005 + AC:2009 using the factor  $\beta_w$  for the steel grades S355M/ML or S460M/ML according to EN 1993-1-8:2005 + AC:2009, Table 4.1 or using a factor  $\beta_w$  determined by tension tests according to 2.2.5.2 and 2.2.5.3.

The factor  $\beta_w$  for a certain application range may be determined by component tests. The application range (e.g. the welding process, welding parameters, the filler metal) shall be clearly specified. A test matrix for the considered application range shall at least comprise:

- a) Lap joints with longitudinal fillet welds (see Figure A) with at least
  - 2 different ratios of weld length  $l$  to the throat thickness  $a$ , where one of these ratios  $l/a$  shall at least be equal to 100
  - 2 different throat thicknesses  $a$  within the application range.
- b) Cruciform joints with fillet welds (see Figure B) with at least 2 different throat thicknesses  $a$  within the application range.

If the application ranges comprises single layer and multi layer welds, both single layer and multi layer welds shall be tested. The welds shall be fabricated with a filler metal, which is approved for the thermo-mechanically hot-rolled steel according to EN 14532-1:2004. The nominal yield strength of the filler metal shall at least match the yield strength of the thermo-mechanically hot-rolled steel. The mechanical properties of the filler metal used for the test welds shall be determined by tensile tests with specimen according to EN 14532-1:2004.

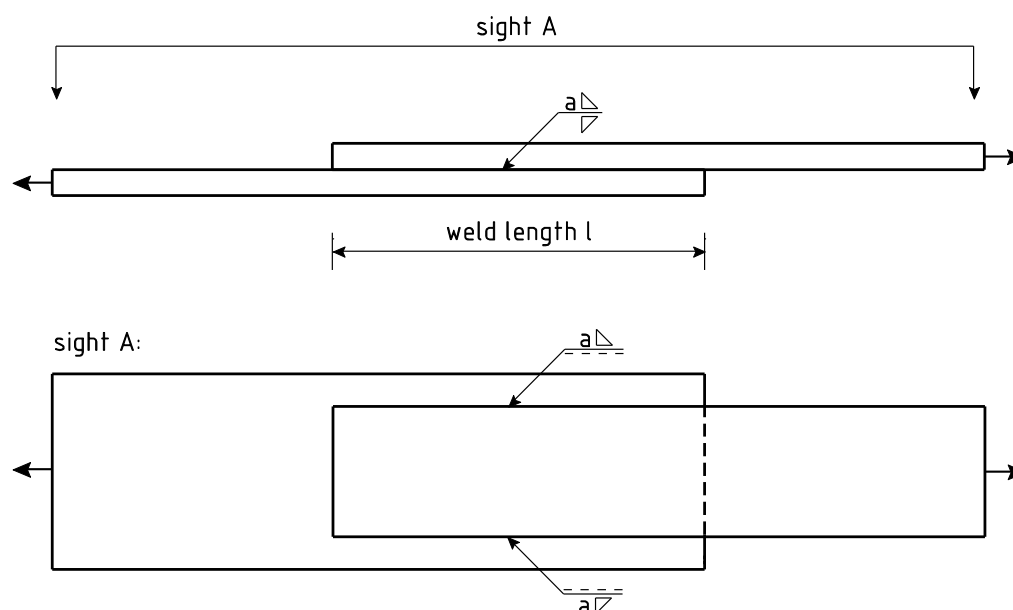




Figure A. Lap joint with fillet welds

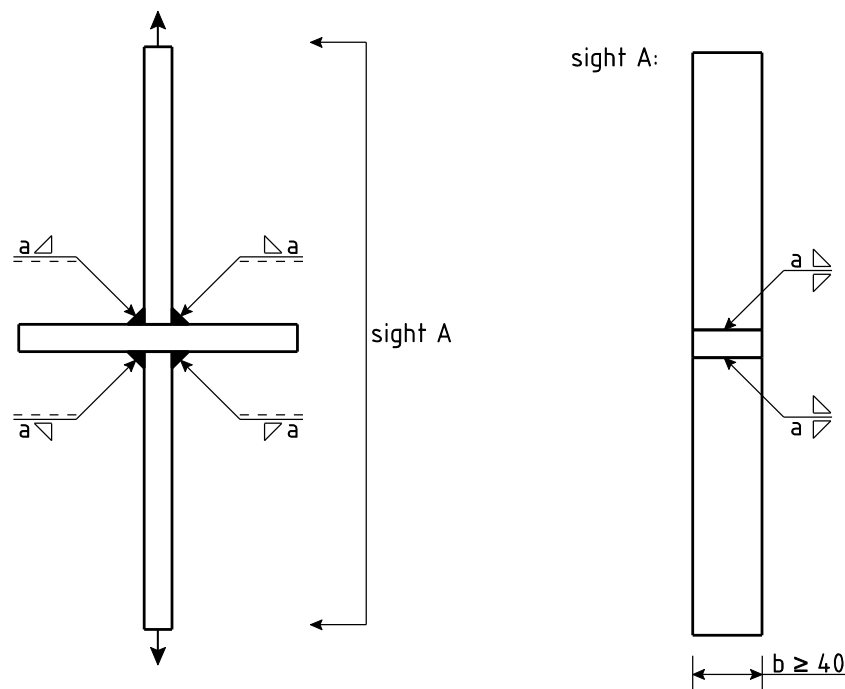
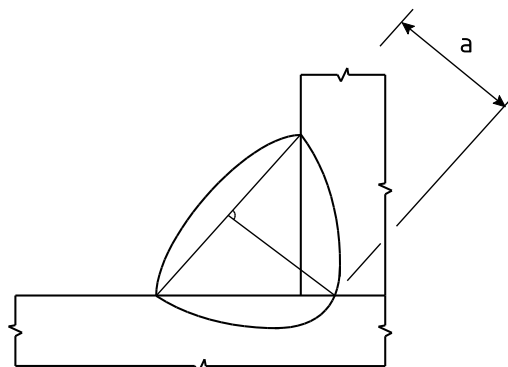


Figure B Cruciform joint with fillet welds

All tests shall be evaluated according to Annex D.7 of EN 1990:2002+A1:2005/AC:2010. The measured load bearing capacities of the fillet welds shall be multiplied with the ratio of the minimum tensile strength of a filler metal which is approved for the application range according the EN 14532-1:2004 and the measured tensile strength of the weld metal used for the test welds.

The evaluation procedure should be performed with regard to the factor  $\beta_w$  of EN 1993-1-8:2005 + AC:2009 by using the directional design method for calculating the load bearing capacity of fillet welds. The evaluation of the test results shall be done using the measured throat thickness  $a$  including penetration according to Figure C.

Figure C. Definition of throat thickness  $a$  for test evaluation

## 2.2.6 Reaction to fire

The thermo-mechanically hot-rolled long steel products made of weldable fine grain structural steel are considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire, in accordance with the provisions of EC decision 96/603/EC (as amended) without the need for testing on the basis of it fulfilling the conditions set out in that Decision and its intended use being covered by that Decision.

### 3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

#### 3.1 System of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: Decision 1998/214/EC

The system is: **2+**

#### 3.2 Tasks of the manufacturer

The corner stones of the actions to be undertaken by the manufacturer of the thermo-mechanically hot-rolled long steel products made of weldable fine grain structural steel in the process of assessment and verification of constancy of performance are laid down in Table 6.

**Table 6 Control plan for the manufacturer; corner stones**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
<b>Factory production control (FPC)</b> [including testing of samples taken at the factory in accordance with a prescribed test plan]					
1	Chemical composition (Weldability)	2.2.1	Results have to be assessed by Table 3	1	Every cast
2	Yield strength Tensile strength Elongation at fracture	2.2.2	Results have to be assessed by Table 4	3	
3	Impact strength	2.2.3	Results have to be assessed by Table 5	3	

<sup>1)</sup> A supplementary testing of the product shall be carried out on the every range and every grade and quality being placed on the market taken from any of the 3 casts used for the other tests.

### 3.3 Tasks of the notified body

The corner stones of the actions to be undertaken by the notified body in the procedure of verification of constancy of performance for the thermo-mechanically hot-rolled long steel products made of weldable fine grain structural steel are laid down in Table 7.

**Table 7 Control plan for the notified body; corner stones**

No	Subject/type of control (product, raw/constituent material, component - indicating characteristic concerned)	Test or control method  (refer to 2.2 or 3.4)	Criteria, if any	Minimum number of samples	Minimum frequency of control
<b>Initial inspection of the manufacturing plant and of factory production control</b> (for systems 1+, 1 and 2+ only)					
1	Chemical composition	2.2.1		5	Heat
2	Yield strength Tensile strength Elongation at fracture	2.2.2		6	Heat
3	Impact strength	2.2.3		6 sets	Heat
<b>Continuous surveillance, assessment and evaluation of factory production control</b> (for systems 1+, 1 and 2+ only)					
4	Surveillance and assessment of factory production control				Once a year
5	Surveillance of the testing facilities of the manufacturer				Once a year

## 4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment is of relevance.

EOTA TR 034	General BWR 3 Checklist for EADs/ETAs - Dangerous substances in construction products
EN 1090-2:2008+A1:2011	Execution of steel structures and aluminium structures – Part 2: Technical requirements for the execution of steel structures
EN 1990:2002 +A1:2005/AC:2010	Basis of structural design
EN 1993	Eurocode 3: Design of steel structures
EN 10025-1:2004	Hot rolled products of structural steels – Part 1: General technical delivery conditions
EN 10025-4:2004	Hot rolled products of structural steels – Part 4: Technical delivery conditions for thermo-mechanical rolled weldable fine grain structural steels
EN 13501-1:2007+A1:2009	Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests
EN 1993-1-8:2005 + AC:2009	Eurocode 3: Design of steel structures - Part 1-8: Design of joints