



UNDERSTANDING: INSPECTION CERTIFICATES





WHAT'S IN A TEST CERTIFICATE?

Inspection Certificates are essential quality control documents for many materials of construction in general and stainless steels in particular. In this e-Book we review the information that these certificates may contain.



INTRODUCTION

The information contained in Inspection Certificates (aka Material / Mill / Test Certificates) may vary considerably depending on the nature of the product and level of risk associated with its use.

Inspection Certificates aim to provide assurance that the product supplied or on offer meets specific standards and the user's requirements in particular. EN 10204:2004¹ is the generally used guideline for inspection documents and Type 3.1 Certificates are the most common and are issued by a manufacturer declaring that the products are in accordance with a standard and the order's requirements. Type 3.2 Certificates are compiled by making use of an inspection authority that is independent of the producer of the metal.

Implicit in the statement to the right is the fact that the document must be traceable to the product it covers and its process of manufacture. In principle it should be possible to trace a stainless flange forged and machined in South Africa back to the raw material used to make the billet which in turn was produced elsewhere in the world. The boundaries for the 3 categories of information, provenance, quality and performance, may be blurred but they remain a useful guide to understanding the content of certificates.

Whilst EN10204 is the guideline for Inspection Certificates the information that these documents contain may be viewed under the 3 headings and this is illustrated with reference to Fig 1, an inspection certificate for plate*. The content of the equivalent documents for pipe, bar, forgings and other product forms will differ. The word "origin" will be used in preference to "provenance" in this e-Book

*Material certification is the ID of a particular material heat and production batch. It indicates its **provenance**, its **quality** and can offer an insight into **material performance** under real life service conditions.*

CLARA MOYANO²

*This is an edited version of the original and is intended solely for educational purposes in this e-book.

Fig. 1

INSPECTION CERTIFICATE EN 10204-3.1

Sales Order No.
9000049327

Production mill
NAME OF PLANT

Certificate No.
131703
Date
21 Apr 2022

Revision
00
Delivery No.
8000130086

CUSTOMER ORDER NO.
PO04887 / MPO20039

Sold to		Product Stainless Steel Hot Rolled Plate, Slit edge, Forta DX 2205		Grade 1.4462 UNS S31803 UNS S32205	
Ship to EMV Africa (Pty) Ltd Kyalami Park 2 Brands Hatch Close JOHANNESBURG 1685 SOUTH AFRICA		Requirements ASME SA-240/SA-240M BPVC.II.A-2021 ASTM A240/A240M - 20a EN 10028-7:2016 EN 10088-4:2009 ASME SA-480/SA-480M BPVC.II.A-2021 ASTM A480/A480M - 20a EN ISO 9444-2:2010			
Mark of manufacturer UNIQUE TO THE MILL		Process E+AOD		Inspector's Stamp UNIQUE TO INSPECTOR	
Sales order Item	Dimensions	Quantity (pcs)	Weight	Heat No.	Lot No.
20	10,00 X 1500,0 X 6000 mm	1	699 kg	521062	1
Identification No. of Product			Customer's Material No.		
521062-1					

Chemical Composition

Heat No.	Country of Melt	C %	Si %	Mn %	P %	S %	Cr %	Ni %	Mo %	N %
521062	Sweden	0,014	0,41	1,32	0,026	0,001	22,4	5,7	3,1	0,17

Test Results (1=Beginning, 2=Middle, 3=End, T=Transverse, L=Longitudinal, D=Diagonal, RT=Room temperature)

		EN ISO 6892-1 / ASTM A370 (RT)				ASTM E10 / EN ISO 6506-1		EN ISO 148-1	
Identification No. of Product	Sample ID	RP0.2 MPa	RM MPa	A5 %	A50 %	HARDNESS HBW		IMPACT VALUE 1 J 20°C /68 °F	
	Minimum	460	700	25	25				
	Maximum		950			293			
521062-1	1 T 799659	654	829	35	36	264		144	
521062-1	3 T 799660	662	828	33	34	266		114	
		EN ISO 148-1				PMI			
Identification No. of Product	Sample ID	IMPACT VALUE 2 J 20°C /68 °F	IMPACT VALUE 3 J 20°C /68 °F	IMPACT VALUE MEAN J 20°C /68 °F	PMI				
	Minimum			75					
	Maximum								
521062-1	1 T 799659	127	132	134	OK				
521062-1	3 T 799660	106	96	105	OK				

Country of Origin:

Solution annealed at 1070 °C/1958 °F. Rapidly cooled with water and air.

Certified acc. to PED 2014/68/EU by TÜV NORD, notified body, Reg-No. 0045

DOPS acc. to CPR available on the web page by steel number

Charpy impact test (V-notch) subsize specimen 10x7.5 mm

Marking, visual and dimensional inspection: Approved

Mill Name Business Area Operations Tel: Regoffice: Regno: V.A.T no:	This material is found to comply with order requirements AUTHORIZED INSPECTOR SIGNATURE AND EMAIL ADDRESS
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ORIGIN

Origin, encompasses the manufacturing mill and its contact details, intermediary's details, country of origin, product description, dimensions and ordering information, and heat/lot /batch number.

In combination this data allows for traceability. It should be possible to link a batch of production material with an individual component and their properties should correlate.

Some users may require that producers record further information relating to the origin of the raw materials used. This may be to cover socio-economic objectives (eg: no raw material from conflict areas; sustainability) and health and safety objectives (eg: raw material to be free of mercury and radio-active contamination). The latter often appears on inspection certificates whilst the former is more commonly a separate declaration.

Sales Order No.
9000049327

CUSTOMER ORDER NO.
PO04887 / MPO20039

Product
Stainless Steel Hot Rolled Plate, Slit edge, Forta DX 2205

Grade
1.4462
UNS S31803
UNS S32205

Finish
1D

Requirements
240/SA-240M BPVC.II.A-2021
20M - 20a

Manufacturer
UNIQUE TO THE MILL

Process
E+AOD

Sales order Item	Dimensions	Quantity
20	10,00 X 1500,0 X 6000 mm	1

Chemical Composition

Heat No.	Country of Melt	C %	Si %
521062	Sweden	0,014	0,41

Test Results (1=Beginning, 2=Middle, 3=End, T=Transverse, L=Longitudinal)

EN ISO 6892-1 / ASTM A370 (RT)

Specification No. of Product	Sample ID	RP0.2 MPa
	Minimum	460
	Maximum	

QUALITY

It is common practice to use industry recognised specifications to set the basic quality requirements for the material and in South Africa these are the ASTM, ASME, EN, and ISO standards as shown in Fig 1.

Its beyond the scope of this review to explain the need for and the relationship between the various standards.

Over and above this statement, standards make extensive reference to agreement by supplier and customer and hence the tests conducted, and data recorded may vary in line with this. Furthermore, the content of the equivalent documents for pipe, bar, forgings and other product forms will be in line with their applicable specifications.

ASTM standards are developed voluntarily and used voluntarily. They become legally binding only when a government body references them in regulations or when they are cited in a contract. Any item that is produced and marked as conforming to an ASTM standard must meet all applicable requirements of that standard.

FOREWARD, ANNUAL BOOK OF ASTM STANDARDS³

Manufacturer		Process	
UNIQUE TO THE MILL		E+AOD	
Sales Order Item	Dimensions	Quantity	
20	10,00 X 1500,0 X 6000 mm	1	
Chemical Composition			
Heat No. 521062	Country of Melt Sweden	C % 0,014	Si % 0,41
Test Results (1=Beginning, 2=Middle, 3=End, T=Transverse, L=Longitudinal)			
Classification No. of Product		Sample ID	
		RP0.2 MPa	
Minimum		460	
Maximum			
EN ISO 6892-1 / ASTM A370 (RT)			
Product		Grade	
Stainless Steel Hot Rolled Plate, Slit edge, Forta DX 2205		1.4462 UNS S31803 UNS S32205	
Finish			
1D			
Requirements			
ASME SA-240/SA-240M BPVC.II.A-2021 ASTM A240/A240M - 20a EN 10028-7:2016 EN 10088-4:2009			
ASME SA-480/SA-480M BPVC.II.A-2021 ASTM A480/A480M - 20a ISO 9444-2:2010			

QUALITY

Some explanatory comments relating to the **Quality** category of inspection certificate data with reference to Fig 1 are:

- Many products may have two standards which are used to define their quality. For plate these are ASTM A240 and ASTM A480. The former, details the chemical composition for the grade and its basic mechanical properties whilst the latter "covers a group of general requirements that, unless otherwise specified in the purchase order.... shall apply to rolled plate."
- Inspection certificates may contain the limits recorded in the specification for ease of use by the reader. For the composition, Fig 1 does not reproduce these limits but it does do so for the mechanical property tests.
- The methodology for the mechanical tests is cross referenced by other standards and the location of the test pieces is referenced to facilitate reproducibility and comparison.
- Information relating to the manufacture of the plate appears at several points in the inspection certificate.

- Product description states Hot Rolled Plate.
- "Finish 1D" is intended as an indicator of appearance but it is in fact also a descriptor of the production route.
- Process Field indicates the melting and refining processes used.
- "Solution annealedetc" defines the final heat treatment step and often supporting documentation in the form of furnace recorder print outs may be requested in an order.

- Charpy Impact Testing (ref Fig 1) is listed as a Supplementary Requirement of ASTM A240.
- Its noteworthy that ASTM A480 caters for the "repair of surface defects of plate by welding unless prohibited by other specifications or purchase order requirements". As a result, Inspection Certificates may include a statement regarding this.

- There are several non-destructive tests which may be commonly stipulated and will be reported in Inspection Certificates and these are:

- Hydrostatic testing of tubular products
- Ultrasonic testing of plate, bar or forgings.
- Eddy current testing
- Radiography
- Dye penetrant and magnetic particle testing

- Corrosion resistance is a primary property of the metals of interest and is a reflection of their QUALITY. Corrosion test results may only be recorded on inspection certificates if they are a requirement of the standard / order. This is handled in greater detail as a separate topic on page 9.

	Minimum	Maximum
62-1	1 T 799659	127
21062-1	3 T 799660	106

Country of Origin:

Solution annealed at 1070 °C/1958 °F. Rapidly cooled with wa

Certified acc. to PED 2014/68/EU by TÜV NORD, notified body

DOPS acc. to CPR available on the web page by steel number

Charpy impact test (V-notch) subsize specimen 10x7.5 mm

Marking, visual and dimensional inspection: Approved

Mill Name
Business Area
Locations

This material is found to comply with requirements

AUTHORIZED

PERFORMANCE

Performance Information may be viewed as going beyond the requirements of composition and the basic mechanical properties in the standards.

This category of information arises when specialised processing and testing is required in order to:

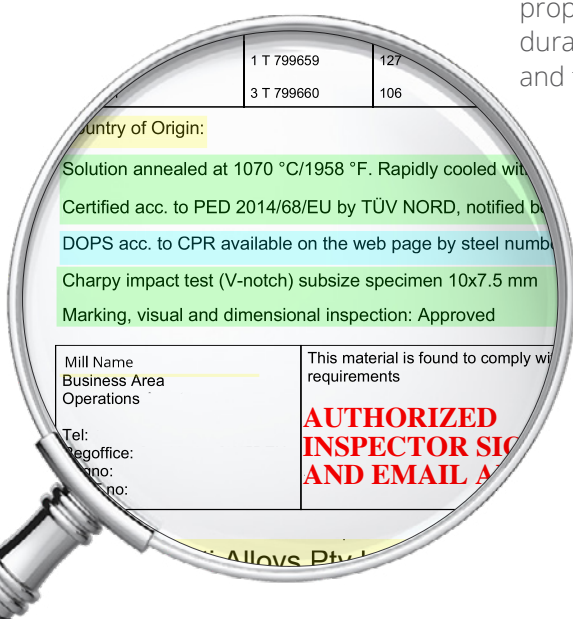
- verify the suitability of the material for a specific application or -
- preclude certain known risks arising from fabrication or during service
- to comply with industry or customer specific requirements.

Fig 1 references only one such performance criterion. A Declaration of Performance (DOP) which is a document that may be required by the construction industry. It overlaps with the Inspection Certificate but includes comment on material properties such as weldability, durability, fracture toughness and formability.

Corrosion phenomena are often the focus of **Performance** related requirements and if not already part of the manufacturers program specific tests may be requested to minimise the risks of in-service failure from stress corrosion cracking, pitting or intergranular corrosion.

The processing of duplex stainless steels is not difficult but it differs from that of austenitic stainless steels and thus extra metallographic work for this family of alloys, notably ferrite counts and austenite spacing, may be required.

The offshore oil and gas industry is one example where an added level of detail may be required for materials that they use. So called "NORSOK" standards may be called for and the compliance of product with these may be stated on Inspection Certificates. Similarly, and more commonly pressure vessel design codes required that the metals used comply with their requirements and ASME standards may be cited in this regard.



CORROSION TESTING

Corrosion tests conducted on stainless steel may, conveniently, be categorised by the terms **delivery tests** and **acceptance tests**⁴ and as appropriate the results of these are included in inspection reports.

Delivery corrosion tests are intended to ensure that the material supplied has the properties expected for this grade. One of the tests also serves as a verification of the correct heat treatment of the material. Since incorrect annealing of stainless steels may result in the formation of intergranular precipitates, corrosion tests appropriate to the grade are used to ensure that this is not the case.

Tests to establish the sensitivity to pitting and crevice corrosion are also used selectively as delivery tests to ensure that grades intended for seawater service and similar can perform. These tests are a direct indication of inherent corrosion resistance.

Acceptance corrosion testing requires an extended test program to screen the suitability of various metals for a specific application but similarly in order to define the parameters of a corrosion test method that will expose the metals to a realistic duty.

Thus, for example, the offshore, pollution control and automotive industries have corrosion tests that aid in the selection of materials of construction.

Thus, by extension, purchase orders may require that a batch of metal be tested in accordance with a more application – focussed corrosion test and the results recorded on the inspection report.



CONCLUSION

The amount of information contained in Inspection Certificates may vary greatly and a vague level of detail should be regarded with suspicion.

However, some manufacturers may conduct extensive tests but may not issue the results in the inspection certificate unless this is specifically required but record the data as part of their own process control.

It is not uncommon for intermediaries in the supply chain to issue Inspection Certificates although they are not in any way manufacturing or processing the material. To do so they are required to have suitably trained personnel and an audited quality system. In addition, there needs to be a reference to the fact that the data in their Inspection Certificate is an accurate reproduction of that in the manufacturers document which they have on file.

As EMVAfrica our focus has been to develop and operate an Inspection Certificate system that is efficient, ensures traceability for the range of products we supply and suppliers we draw from and that remains effective over a wide range of stock levels.

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THE SOURCES CONSULTED IN THE PREPARATION OF THIS REVIEW ARE:

1. EN10204 Metallic products – Types of inspection documents.
2. The Importance of Material Certification, Claire Moyano, 2020 Parker Hannifin Manufacturing Ltd
3. ASTM SANDARD VOL 01.03 2009 Steel – Plate, Sheet, Strip, Wire; Stainless Steel Bar.
ASTM SANDARD VOL 01.01 2007 Steel – Piping, Tubing. Fittings
4. Corrosion Handbook, Tenth Edition, 2009. Outokumpu

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