	Specification	Technology
---	----------------------	-------------------

Title: **Strategic Boiler Tubes Order Specification** Unique Identifier: **474-10206**

Alternative Reference Number: **N/A**

Area of Applicability: **Engineering**

Documentation Type: **Specification**

Revision: **1**

APPROVED FOR AUTHORISATION



TECHNOLOGY ENGINEERING

DOCUMENT CENTRE ☎ X4962

Total Pages: **14**

Next Review Date: **N/A**

Disclosure Classification: **CONTROLLED DISCLOSURE**

Compiled by



F. Nganke
Engineer

Date: 05/06/2014

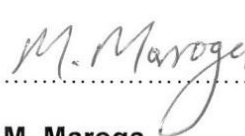
Reviewed by



S. Karthikeyan
Boiler Specialist

Date: 05/06/2014

Approved by



M. Maroga
Boiler Pressure Parts Manager

Date: 05/06/2014

CONTENTS

	Page
1. INTRODUCTION	3
2. SUPPORTING CLAUSES	3
2.1 SCOPE	3
2.1.1 Purpose	3
2.1.2 Applicability	3
2.2 NORMATIVE/INFORMATIVE REFERENCES	3
2.2.1 Normative	3
2.2.2 Informative	4
2.3 DEFINITIONS	4
2.3.1 Disclosure Classification	4
2.4 ABBREVIATIONS	4
3. TECHNICAL REQUIREMENTS	4
3.1 MATERIALS	4
3.2 REQUIREMENTS TO THE SUPPLIER	5
3.3 MARKING	5
3.4 PROCESS AND MANUFACTURING / SURFACE CONDITIONING	5
3.4.1 Steel Making Process	5
3.4.2 Heat Treatment	5
3.5 CHEMICAL COMPOSITION	6
3.5.1 Restrictions for the following materials are stated below:	6
3.5.2 The following requirements shall be maintained and reported on the material certificates:	6
3.6 PROTECTION AGAINST CORROSION	7
3.7 INSPECTIONS, TESTS AND CERTIFICATES	7
3.8 DELIVERY	7
4. REVISIONS	7
APPENDIX A : SCHEDULE OF BOILER TUBES	8

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

1. INTRODUCTION

The purpose of this document is to provide technical specification for the purchase of boiler tubes for the 13 coal-fired power stations. This document does not cover the tender technical evaluation criteria and is solely based on the current design information obtained from all stations.

2. SUPPORTING CLAUSES

2.1 SCOPE

Technical requirements for seamless austenitic, martensitic and ferritic steel tubes for the use on "Water-tube boilers in accordance to BS EN 12952 and ASME I. Seamless tubes with dimensions and steel grades are to be supplied as per attached schedule (APPENDIX A).

Applicable Codes and standards

For BS EN material

- EN 10216-2, 3, 4 and 5
- VdTÜV WB511 (03.2009), – X10CrMoVNb9-1
- VdTÜV WB547 (06.2003) – DMV 347 HFG only

For ASME Material

- ASTM A178/A178M
- ASTM A192/A192M
- ASTM A209/A209M
- ASTM A210/A210M
- ASTM A213/A213M
- ASTM A335/A335M

2.1.1 Purpose

The purpose of this document is to provide technical specification for the purchase of boiler tubes.

2.1.2 Applicability

This document shall apply to Group Technology and Generation.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

- [1] ISO 9001 Quality Management Systems.
- [2] BS EN 12952
- [3] EN 10216-2, 3, 4 and 5
- [4] VdTÜV WB511 (03.2009), – X10CrMoVNb9-1
- [5] VdTÜV WB547 (06.2003) – DMV 347 HFG only

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

- [6] ASME I and II
- [7] ASTM A178/A178M
- [8] ASTM A192/A192M
- [9] ASTM A209/A209M
- [10] ASTM A210/A210M
- [11] ASTM A213/A213M
- [12] ASTM A335/A335M

2.2.2 Informative

N/A

2.3 DEFINITIONS

Definition	Description
N/A	

2.3.1 Disclosure Classification

Public Domain: Published in any public forum without constraints (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
ASME	American Society of Mechanical Engineers
CSEF	Creep Strength Enhanced Ferritic Steels
Hv	Hardness value
PED	Pressure Equipment Directive
SANS	South African National Standard
VPI	Vapour Phased Inhibitor

3. TECHNICAL REQUIREMENTS

3.1 MATERIALS

BS EN Materials

Material	Material no.	Delivery Conditions	Specification
P235 GH	1.0345	EN 10216-2	EN 10216-2
P265 GH	1.0425		
16Mo3	1.5415		
10CrMo9-10	1.7380		
13CrMo4-5	1.7335		
X10CrMoVNb9-1	1.4903		
X20CrMoV11-1	1.4922	EN 10216-5	EN 10216-5
X6CrNiMo17-13-2	1.4918		

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

ASME Materials

Material	Specification
SA-178-C	SA-178/SA-178M
SA-192 Gr.CD	SA-192/SA-192M
SA-209 Gr.T1 CD	SA-209/SA-209M
SA-209-T1	SA-209/SA-209M
SA-210 Gr A-1 CD	SA-210/SA-210M
SA-210-A1	SA-210/SA-210M
SA-210-C	SA-210/SA-210M
SA-213 Gr T11 CD	SA-213/SA-213M
SA-213 Gr.T22 CD	SA-213/SA-213M
SA-213 Gr.TP-304H	SA-213/SA-213M
SA-213 Gr.TP-347H	SA-213/SA-213M
SA-335 Gr.T11	SA-335/SA-335M

3.2 REQUIREMENTS TO THE SUPPLIER

The manufacturer has a certified quality management system in accordance with EN 764-5, clause 4.

3.3 MARKING

Standard and clear legible marking (stencil painting) shall be applied on the outer surfaces along the lengths of the tubes at both ends of each tube. Third party (if applicable) marking shall be included. The mandatory marking in accordance with EN 10216-2, clause 12.1 on the tube shall be done for all tube sizes. All tubes shall have permanent markings by using low stress metal stamp, for tubes with Outer Diameter less than 177.8 mm needle marking is permitted.

3.4 PROCESS AND MANUFACTURING / SURFACE CONDITIONING

3.4.1 Steel Making Process

Material shall be manufactured under controlled melting processes (as a minimum, electric arc process with vacuum degassing, argon bubbling, inductive stirring, bottom pouring and appropriate after-treatment) to ensure that clean steel which is also “free” of inclusions is delivered to the tube manufacturing plant. Raw material and scrap control by foundries shall demonstrate low contamination levels of trace and dangerous (poisonous and radioactive) elements. Only fully killed steels will be acceptable.

For Austenitic Stainless Steels, only Argon-Oxygen-Decarburisation (AOD) or Vacuum-Oxygen-Decarburisation (VOD) processes are allowed.

3.4.2 Heat Treatment

The following requirements shall apply:

- The calibration status of the furnace, temperature sensors (thermocouples) and monitoring instrumentation loops shall be verified before heat treatment commences.
- The control thermocouple shall maintain the target temperature within 2°C (+/- 1°C)
- The horizontal, vertical and diagonal temperature differentials of the furnace shall be less than 20°C (+/- 10°C) over the areas where the tubes will be positioned during heat treatment. This shall be

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

demonstrated by placing at least 1 calibrated thermocouple block per furnace control area distributed over the entire loading area and to include the extremes. The plan to show how this was or will be achieved shall be supplied and agreed prior to manufacturing, and the results to prove that it was achieved shall be included in the furnace calibration certificates. Thermocouples shall be used for the austenitizing, hardening, tempering, and solution annealing heat treatments.

- Pieces shall be packed and separated to avoid non-uniform heating and cooling rates (especially during austenitizing, hardening and tempering of CSEF steels) and associated non-uniform material properties.
- For X10CrMoVNb9-1, the following limits shall be adhered to:
 - Austenitizing shall be done at 1060°C. The minimum temperature on any component should be 1050°C and the maximum 1080°C. Once the full thickness reaches the desired temperature, soaking shall be carried out for at least 10 minutes at this temperature. After Austenitizing, the hardening process requires cooling to temperatures <80°C reached by the entire thickness of the product. Tempering shall be done at 760°C observing strict control between limits of 750°C - 770°C. Soaking starts once the full thickness reaches the desired temperature. Temper temperature and soaking time (which shall be reported) shall be chosen to provide the required hardness limits (215HV – 260HV). Cooling shall be in air after tempering. Upper and lower limits specified shall not be exceeded on any occasions even including measurement tolerances. Impact properties specified in VdTÜV datasheet 511/2 06.2001 shall be achieved for acceptance.

3.5 CHEMICAL COMPOSITION

3.5.1 Restrictions for the following materials are stated below:

- X20CrMoV11-1
- X10CrMoVNb9-1
- X12CrCoWMoVNb 12-2-2 (VM12-SHC)
- 7CrWVMoNb9-6 (T23)
- 7CrMoVTiB10-10 (T24)

Cu < 0.250%

Sn < 0.010%.

P ≤ 0,020; S ≤ 0,010; As ≤ 0,010; Sb ≤ 0,003; and As + Sn + Sb + Pb < 0.01

3.5.2 The following requirements shall be maintained and reported on the material certificates:

- For: X10CrMoVNb9-1:
 - N 0,035 – 0,060; N/Al > 4; Ni ≤ 0,20 and to control delta ferrite:
 - $(Cr + 6Si + 4Mo + 1,5W + 11V + 5Nb + 9Ti + 12Al) - (40C + 30N + 4Ni + 2Mn + 1Cu) < 12$
- For: X20CrMoV11-1:
 - Ni ≤ 0,40 and to control delta ferrite:
 - $(Cr + 6Si + 4Mo + 1,5W + 11V + 5Nb + 9Ti + 12Al) - (40C + 30N + 4Ni + 2Mn + 1Cu) < 12$

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

3.6 PROTECTION AGAINST CORROSION

All tubes shall be dry, free of corrosion, and a temporary protective coating shall be applied on each tube to protect it for long term storage in outside atmospheric conditions (open storage). Tube ends shall be covered with tight fitting end caps and desiccant bags or suitable inhibitor shall be placed in the inside of each tube to protect it for long term storage in atmosphere (outside storage). The manufacturer shall supply details of the coating and desiccant /inhibitor that will be applied for approval by Eskom.

Naval transport: Outer surface protection according to manufacturer's recommendations, inside protection by use of suitable kind of VPI powder.

3.7 INSPECTIONS, TESTS AND CERTIFICATES

- The leak-tightness test shall be by Electromagnetic testing for all ferritic steel tubes and Eddy current testing according to EN ISO 10893-1 for austenitic stainless steel.
- The manufacturer has to verify the Proof strength $R_{p0.2}$ at an elevated temperature of 400 ° C for all materials.
- The material manufacturer certificate in accordance to PED 97/23/EC shall be issued for approval for all the materials prior to manufacturing, in case this certificate is not available, EN 10204:3.2 certification shall be supplied.

3.8 DELIVERY

3.8.1 Upon completion, technical data books shall be supplied containing as a minimum:

- Signed quality control plans.
- Steel making processes and foundry material certificate
- Certificates according to EN 10204 (3.1, 3.2) including detailed results for all destructive and non-destructive testing, tensile curves, additional testing, proof test at elevated temperature, etc.
- Heat treatment charts (austenitizing and tempering) and or detail explanation of the heat treatment processes with ramp rates, quench media, holding times and temperatures.
- Surface finish and protection applied.
- All concessions correspondence if applicable.

3.8.2 The tubes shall be delivered as per the schedule (Appendix A) to random lengths of not less than 6m and not greater than 12m.

4. REVISIONS

Date	Rev.	Compiler	Remarks
June 2014	0.1	F. Nganke	Draft Document
June 2014	1	F. Nganke	Final Document for Authorisation and Publication

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

APPENDIX A: SCHEDULE OF BOILER TUBES

Item no	Material Code	Design Material	Outside Diameter (mm)	Wall Thickness (mm)
1	EN 10216-2	P235 GH	44.5	4.5
2	EN 10216-2	P235 GH	48.3	3.6
3	EN 10216-2	P235 GH	48.3	4.5
4	EN 10216-2	P235 GH	48.3	6.3
5	EN 10216-2	P235 GH	51	3.6
6	EN 10216-2	P235 GH	51	4.5
8	EN 10216-2	P235 GH	51	5
9	EN 10216-2	P235 GH	51	5.6
10	EN 10216-2	P235 GH	51	6.3
11	EN 10216-2	P235 GH	51	7.1
12	EN 10216-2	P235 GH	51	8
13	EN 10216-2	P235 GH	54	5.6
14	EN 10216-2	P235 GH	54	6.3
15	EN 10216-2	P235 GH	54	7.1
16	EN 10216-2	P235 GH	57	4
17	EN 10216-2	P235 GH	57	5.6
18	EN 10216-2	P235 GH	60.3	3.6
19	EN 10216-2	P235 GH	63.5	4.5
20	EN 10216-2	P235 GH	63.5	5
21	EN 10216-2	P235 GH	63.5	5.6
22	EN 10216-2	P235 GH	73	5
23	EN 10216-2	P235 GH	76.1	8
24	EN 10216-2	P265 GH	38	4.5
25	EN 10216-2	P265 GH	44.5	8
26	EN 10216-2	P265 GH	48.3	4.5
27	EN 10216-2	P265 GH	48.3	8
28	EN 10216-2	P265 GH	51	4.5
29	EN 10216-2	P265 GH	51	5
30	EN 10216-2	P265 GH	51	5.6
31	EN 10216-2	P265 GH	51	6.3
32	EN 10216-2	P265 GH	51	7.1
33	EN 10216-2	P265 GH	51	8
34	EN 10216-2	P265 GH	57	5
35	EN 10216-2	P265 GH	57	6.3
36	EN 10216-2	P265 GH	63.5	4.5
37	EN 10216-2	P265 GH	63.5	5.6
38	EN 10216-2	P265 GH	63.5	6.3
39	EN 10216-2	P265 GH	63.5	7.1

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

Item no	Material Code	Design Material	Outside Diameter (mm)	Wall Thickness (mm)
40	EN 10216-2	P265 GH	63.5	8
41	EN 10216-2	P265 GH	76.1	5.6
42	EN 10216-2	P265 GH	76.1	6.3
43	EN 10216-2	P265 GH	76.1	7.1
44	EN 10216-2	P265 GH	76.1	8
45	EN 10216-2	P265 GH	88.9	10
46	EN 10216-2	16Mo3	26.9	3.6
47	EN 10216-2	16Mo3	26.9	5
48	EN 10216-2	16Mo3	26.9	5.6
49	EN 10216-2	16Mo3	30	6.3
50	EN 10216-2	16Mo3	31.8	4
51	EN 10216-2	16Mo3	31.8	5.6
52	EN 10216-2	16Mo3	33.7	3.6
53	EN 10216-2	16Mo3	33.7	4
54	EN 10216-2	16Mo3	33.7	4.5
55	EN 10216-2	16Mo3	33.7	6.3
56	EN 10216-2	16Mo3	38	4
57	EN 10216-2	16Mo3	38	4.5
58	EN 10216-2	16Mo3	38	5
59	EN 10216-2	16Mo3	38	5.6
60	EN 10216-2	16Mo3	38	6.3
61	EN 10216-2	16Mo3	42.4	6.3
62	EN 10216-2	16Mo3	44.5	4.5
63	EN 10216-2	16Mo3	44.5	5
64	EN 10216-2	16Mo3	44.5	5.6
65	EN 10216-2	16Mo3	44.5	6.3
66	EN 10216-2	16Mo3	44.5	8
67	EN 10216-2	16Mo3	48.3	3.6
68	EN 10216-2	16Mo3	48.3	6.3
69	EN 10216-2	16Mo3	51	3.6
70	EN 10216-2	16Mo3	51	4
71	EN 10216-2	16Mo3	51	4.5
72	EN 10216-2	16Mo3	51	5
73	EN 10216-2	16Mo3	51	5.6
74	EN 10216-2	16Mo3	51	6.3
75	EN 10216-2	16Mo3	57	3.6
76	EN 10216-2	16Mo3	57	6.3
77	EN 10216-2	16Mo3	57	7.1
78	EN 10216-2	16Mo3	63.5	7.1
79	EN 10216-2	16Mo3	63.5	8

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

Item no	Material Code	Design Material	Outside Diameter (mm)	Wall Thickness (mm)
80	EN 10216-2	16Mo3	63.5	16
81	EN 10216-2	16Mo3	73	10
82	EN 10216-2	16Mo3	76.1	8.8
83	EN 10216-2	16Mo3	88.9	11
84	EN 10216-2	16Mo3	88.9	22.2
85	EN 10216-2	16Mo3	108	16
86	EN 10216-2	16Mo3	127	25
87	EN 10216-2	10CrMo9-10	31.8	4.5
88	EN 10216-2	10CrMo9-10	31.8	5
89	EN 10216-2	10 CrMo9-10	31.8	6.3
90	EN 10216-2	10CrMo9-10	31.8	7.1
91	EN 10216-2	10 CrMo9-10	33.7	5
92	EN 10216-2	10CrMo9-10	33.7	5.6
93	EN 10216-2	10 CrMo9-10	33.7	6.3
94	EN 10216-2	10CrMo9-10	38	4.5
95	EN 10216-2	10CrMo9-10	42.4	10
96	EN 10216-2	10CrMo9-10	44.5	3.6
97	EN 10216-2	10CrMo9-10	44.5	4
98	EN 10216-2	10CrMo9-10	44.5	6.3
99	EN 10216-2	10CrMo9-10	44.5	7.1
100	EN 10216-2	10CrMo9-10	44.5	8
101	EN 10216-2	10CrMo9-10	44.5	8.8
102	EN 10216-2	10CrMo9-10	48.3	3.6
103	EN 10216-2	10CrMo9-10	48.3	4.5
104	EN 10216-2	10CrMo9-10	48.3	5
105	EN 10216-2	10CrMo9-10	51	3.6
106	EN 10216-2	10CrMo9-10	51	5.6
107	EN 10216-2	10CrMo9-10	51	6.3
108	EN 10216-2	10 CrMo9-10	51	8.8
109	EN 10216-2	10CrMo9-10	54	5.6
110	EN 10216-2	10CrMo9-10	54	7.1
111	EN 10216-2	10CrMo9-10	57	4
112	EN 10216-2	10CrMo9-10	57	4.5
113	EN 10216-2	10 CrMo9-10	57	5
114	EN 10216-2	10 CrMo9-10	57	5.6
115	EN 10216-2	10CrMo9-10	57	6.3
116	EN 10216-2	10CrMo9-10	57	7.1
117	EN 10216-2	10CrMo9-10	57	8.8
118	EN 10216-2	10CrMo9-10	57	10

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

Item no	Material Code	Design Material	Outside Diameter (mm)	Wall Thickness (mm)
119	EN 10216-2	10CrMo9-10	57	11
120	EN 10216-2	10CrMo9-10	60.3	4
121	EN 10216-2	10CrMo9-10	63.5	4
122	EN 10216-2	10CrMo9-10	63.5	4.5
123	EN 10216-2	10CrMo9-10	63.5	5.6
124	EN 10216-2	10CrMo9-10	63.5	6.3
125	EN 10216-2	10CrMo9-10	63.5	7.1
126	EN 10216-2	10CrMo9-10	63.5	8
127	EN 10216-2	10CrMo9-10	63.5	8.8
128	EN 10216-2	10CrMo9-10	63.5	10
129	EN 10216-2	10CrMo9-10	63.5	11
130	EN 10216-2	10CrMo9-10	63.5	12.5
131	EN 10216-2	10CrMo9-10	70	4.5
132	EN 10216-2	10CrMo9-10	70	5
133	EN 10216-2	10CrMo9-10	70	6.3
134	EN 10216-2	10CrMo9-10	70	7.1
135	EN 10216-2	13CrMo4-5	31.8	3.6
136	EN 10216-2	13CrMo4-5	31.8	4
137	EN 10216-2	13CrMo4-5	33.7	3.6
138	EN 10216-2	13CrMo4-5	33.7	4
139	EN 10216-2	13CrMo4-5	33.7	4.5
140	EN 10216-2	13CrMo4-5	38	3.6
141	EN 10216-2	13CrMo4-5	38	4
142	EN 10216-2	13CrMo4-5	44.5	3.6
143	EN 10216-2	13CrMo4-5	44.5	4.5
144	EN 10216-2	13CrMo4-5	44.5	5
145	EN 10216-2	13CrMo4-5	44.5	5.6
146	EN 10216-2	13CrMo4-5	44.5	6.3
147	EN 10216-2	13CrMo4-5	44.5	8
148	EN 10216-2	13CrMo4-5	48.3	4
149	EN 10216-2	13CrMo4-5	48.3	4.5
150	EN 10216-2	13CrMo4-5	48.3	5.6
151	EN 10216-2	13CrMo4-5	48.3	7.1
152	EN 10216-2	13CrMo4-5	48.3	8
153	EN 10216-2	13CrMo4-5	51	3.6
154	EN 10216-2	13CrMo4-5	51	5
155	EN 10216-2	13CrMo4-5	51	6.3
156	EN 10216-2	13CrMo4-5	51	7.1
157	EN 10216-2	13CrMo4-5	51	8

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

Item no	Material Code	Design Material	Outside Diameter (mm)	Wall Thickness (mm)
158	EN 10216-2	13CrMo4-5	51	8.8
159	EN 10216-2	13CrMo4-5	54	4.5
160	EN 10216-2	13CrMo4-5	54	5
161	EN 10216-2	13CrMo4-5	54	5.6
162	EN 10216-2	13CrMo4-5	54	6.3
163	EN 10216-2	13CrMo4-5	54	8.8
164	EN 10216-2	13CrMo4-5	57	3.6
165	EN 10216-2	13CrMo4-5	57	4
166	EN 10216-2	13CrMo4-5	57	5
167	EN 10216-2	13CrMo4-5	57	5.6
168	EN 10216-2	13CrMo4-5	57	6.3
169	EN 10216-2	13CrMo4-5	57	7.1
170	EN 10216-2	13CrMo4-5	57	8
171	EN 10216-2	13CrMo4-5	57	8.8
172	EN 10216-2	13CrMo4-5	63.5	3.6
173	EN 10216-2	13CrMo4-5	63.5	4
174	EN 10216-2	13CrMo4-5	63.5	5
175	EN 10216-2	13CrMo4-5	63.5	5.6
176	EN 10216-2	13CrMo4-5	63.5	7.1
177	EN 10216-2	13CrMo4-5	63.5	8
178	EN 10216-2	13CrMo4-5	70	7.1
179	EN 10216-2	X10CrMoVNb9-1	70	4.5
180	EN 10216-2	X10CrMoVNb9-1	70	5
181	EN 10216-2	X20CrMoV11-1	38	4
182	EN 10216-2	X20CrMoV11-1	38	4.5
183	EN 10216-2	X20CrMoV11-1	38	5
184	EN 10216-2	X20CrMoV11-1	38	5.6
185	EN 10216-2	X20CrMoV11-1	38	6.3
186	EN 10216-2	X20CrMoV11-1	44.5	6.3
187	EN 10216-2	X20CrMoV11-1	44.5	8
188	EN 10216-2	X20CrMoV11-1	51	3.6
189	EN 10216-5	X6CrNiMo17-13-2	57	5
190	EN 10216-5	X6CrNiMo17-13-2	57	6.3
191	EN 10216-5	X6CrNiMo17-13-2	57	10
192	EN 10216-5	X6CrNiMo17-13-2	63.5	6.3
193	EN 10216-5	X6CrNiMo17-13-2	63.5	7.1

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

Item no	Material Code	Design Material	Outside Diameter (mm)	Wall Thickness (mm)
1	SA-178	SA-178-C	50.8	5.08
2	SA-178	SA-178-C	50.8	5.59
3	SA-178	SA-178-C	54	5.59
4	SA-178	SA-178-C	63.5	6.5
5	SA-192	SA-192 Gr.CD	63.5	3.43
6	SA-192	SA-192 Gr.CD	63.5	3.78
7	SA-209	SA-209 Gr.T1 CD	47.6	5.03
8	SA-209	SA-209 Gr.T1 CD	63.5	3.38
9	SA-209	SA-209 Gr.T1 CD	63.5	3.78
10	SA-209	SA-209-T1	54	5.59
11	SA-210	SA-210 Gr A-1 CD	47.6	5.08
12	SA-210	SA-210 Gr A-1 CD	47.6	6.1
13	SA-210	SA-210 Gr A-1 CD	47.6	7.11
14	SA-210	SA-210-A1	50.8	5.59
15	SA-210	SA-210-A1	54	5.59
16	SA-210	SA-210-A1	57.2	9.14
17	SA-210	SA-210-A1	63.5	6.6
18	SA-210	SA-210-A1 (rifled)	47.6	7.11
19	SA-210	SA-210-A1 (rifled)	50.8	5.59
20	SA-210	SA-210-C (rifled)	50.8	5.08
21	SA-210	SA-210-C (rifled)	63.5	9.66
22	SA-213	SA-213 Gr T11 CD	47.6	5.03
23	SA-213	SA-213 Gr T11 CD	47.6	5.72
24	SA-213	SA-213 Gr.T11 CD	47.6	6.1
25	SA-213	SA-213 Gr.T11 CD	63.5	3.78
26	SA-213	SA-213 Gr.T11 CD	63.5	8.59
27	SA-213	SA-213-T11	63	7.14
28	SA-213	SA-213 Gr.T22 CD	47.6	7.16
29	SA-213	SA-213 Gr.T22 CD	47.6	8.13
30	SA-213	SA-213 Gr.T22 CD	47.6	9.14
31	SA-213	SA-213 Gr.T22 CD	47.6	10.03
32	SA-213	SA-213 Gr.T22 CD	47.6	10.8
33	SA-213	SA-213 Gr.T22 CD	63.5	5.03
34	SA-213	SA-213 Gr.T22 CD	63.5	13.59
35	SA-213	SA-213 Gr.T22 CD	76.2	6.1

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

Item no	Material Code	Design Material	Outside Diameter (mm)	Wall Thickness (mm)
36	SA-213	SA-213 Gr.TP-304H	63.5	3.38
37	SA-213	SA-213 Gr.TP-347H	47.6	4.83
38	SA-213	SA-213 Gr.TP-347H	47.6	5.08
39	SA-213	SA-213 Gr.TP-347H	47.6	6.1
40	SA-213	SA-213 Gr.TP-347H	63.5	6.6
41	SA-335	SA-335 Gr.T11	50.8	9.4

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.