

به نام خدا



مرکز دانلود رایگان
مهندسی متالورژی و مواد

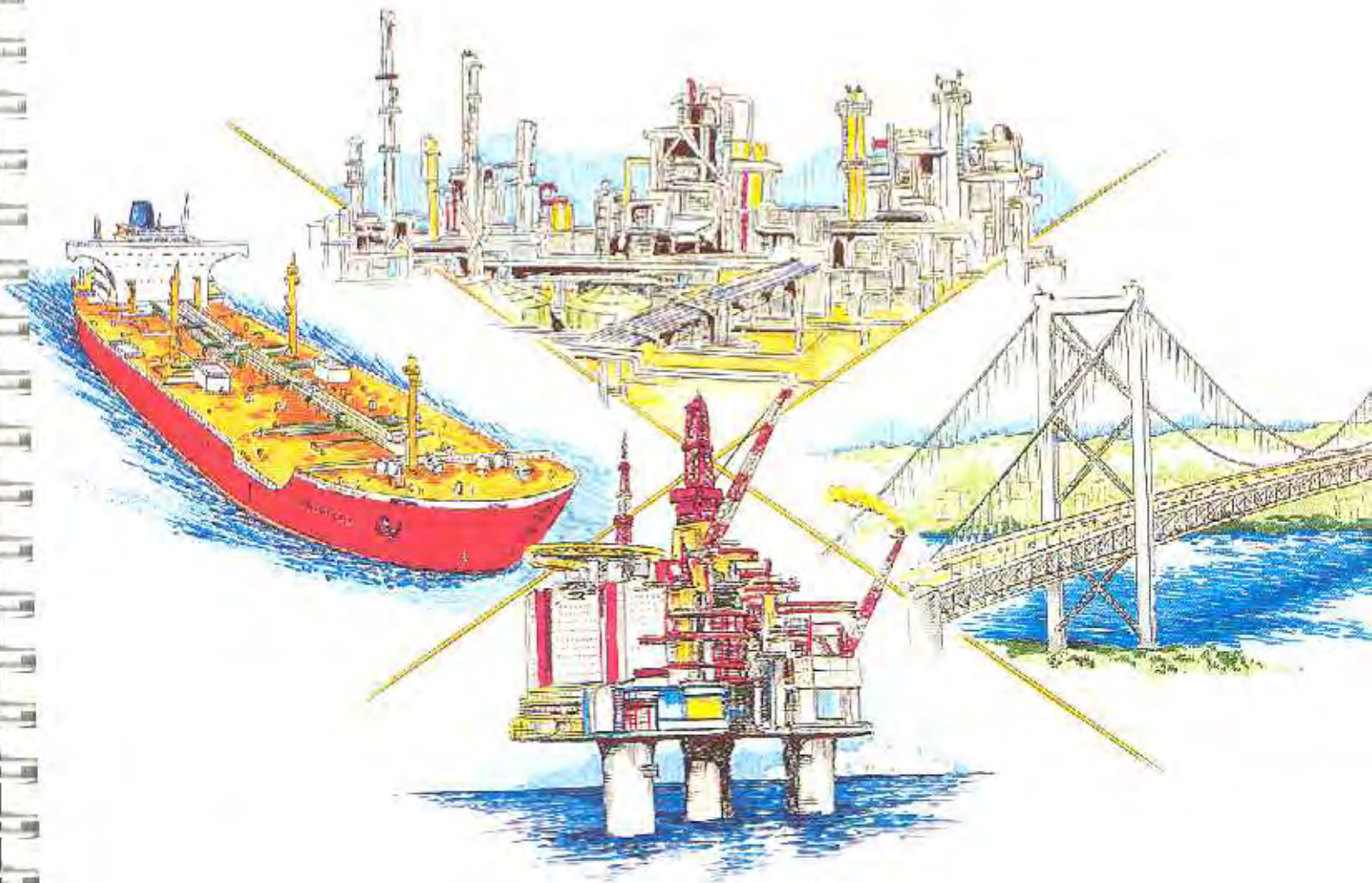
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Application Handbook

Welding Procedure Specifications



Preface

The ESAB Application Handbook is a collection of welding procedure specifications and actual test results. It is aimed to serve as a guidance when questions concerning selection of suitable welding parameters and other conditions are discussed in connection with ESAB consumables. This collection covers the most common welding processes with examples taken from several different application areas e.g. the offshore and shipbuilding industry.

Each welding procedure specification, WPS, is based on experience from actual welding procedure tests carried out either by customers at their premises or by ourselves in our welding laboratories.

It is obvious that a collection like this not by far can cover all situations of interest but still we are convinced the ESAB Application Handbook can be of great interest for many welding applications.

It must always be remembered that any WPS used as an actual job document must be based on the users experience and on own procedure qualification tests.

Business Area Consumables
Esab AB
GÖTEBORG, Sweden

APPLICATION HANDBOOK

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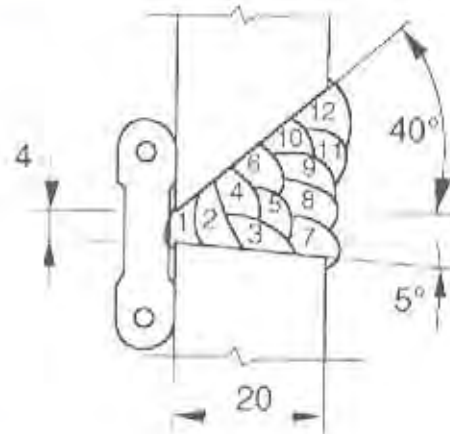
OK Femax 38.65

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK Femax 38.65 ϕ 3.25 and 4.0 mm
 Classification : AWS A5SFA 5.1: E 7028

Joint preparation and bead sequence

Material spec. : DH36
 Plate thickness : 20 mm
 Welding position : 2G
 Current/polarity : AC+
 Root treatment : NA
 Restrained : No
 Preheat temp.C° : RT
 Interpass temp.C° : Max 300
 PWHT : NA
 Remarks : NA
 Backing : OK Backing 2124006000



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	3.25	125-154	26	165	2.0-2.5
2-4	4.0	196-236	31	330	1.4-1.7
5	4.0	168-217	33	330	1.3-1.7
6	4.0	189-244	34	330	1.5-1.9
7	4.0	188-226	32	330	1.2-1.4
8-9	4.0	170-229	32	330	1.0-1.7
10-12	3.25	137-174	29	330	1.0-1.2

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.0 hour

Consumption of consumables : OK Femax 38.65 ϕ 3.25 = 1.3 kg
 OK Femax 38.65 ϕ 4.0 = 2.5 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	55	39	30	41
	Fusion line	70	60	56	62
	Fusion line +3 mm	114	93	103	103

Hardness test

Chemical analyses, weld metal/ base material, %

Remarks

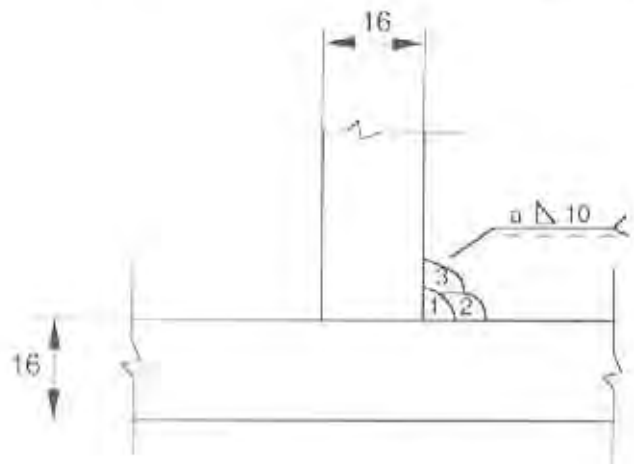
OK Femax 38.85

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK Femax 38.85 ϕ 5.0 mm
 Classification : AWS A/SFA 5.1: E 7028

Material spec. : D36
 Plate thickness : 16 mm
 Welding position : 2F
 Current/polarity : AC
 Root treatment : NA
 Restrained : No
 Preheat temp.C° : RT
 Interpass temp.C° : Max 300
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	5.0	272	40	425	2.6
2	5.0	272	40	547	2.0
3	5.0	248	40	420	2.4

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.2 hour

Consumption of consumables : OK Femax 38.85 ϕ 5.0 = 1.4 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld
MPa	of fraction	MPa	MPa	%	%	metal	SR	mm
						C°		

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule

Hardness test HV10

Location of travers	Side 1 (continius plate)
HAZ :	247-239-254-247-239-243-239-239-233-236-239-251-243
Weld metal :	247-239-254-247-239-243-239-239-233-236-239-251-243
HAZ :	270-236-209-199-181-181
Parent metal:	176

Chemical analyses, weld metal/ base material,%

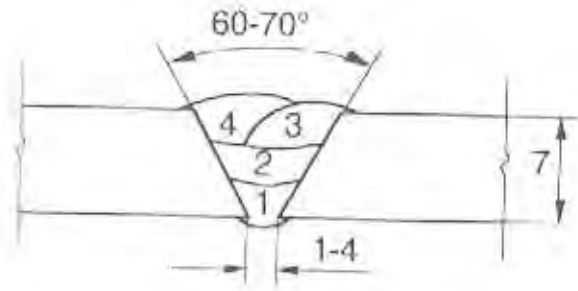
Remarks

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 48.00 ϕ 2 and 3,25 mm
 Classification : AWS A/SFA 5.1; E 7018

Material spec. : A 106 Gr B
 Pipe : 7 mm
 Welding position : 6G
 Current/polarity : DC+
 Root treatment : NA
 Restrained : No
 Preheat temp.C° : Min 50
 Interpass temp.C° : Max 200
 PWHT : 605 \pm 20 °C
 Holding time: 60min
 Rise: 200°C/hour
 Fall: 150°C/hour

Joint preparation and bead sequence



Remarks : NA

Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1-2	2.0	65-75	22	55	
3-4	2.5	80-85	22	100	1.0-1.1

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.9 hour
 Consumption of consumables : OK 48.00 ϕ 2.0 = 0.5 kg
 OK 48.00 ϕ 2.5 0 = 0.5kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	
514	Base metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule

Hardness test HV10

Location of travers	Face A	FaceB
HAZ :	187	187
Weld metal :	199	196
HAZ :	184	181
Parent metal: :	160	

Chemical analyses, weld metal/ base material, %

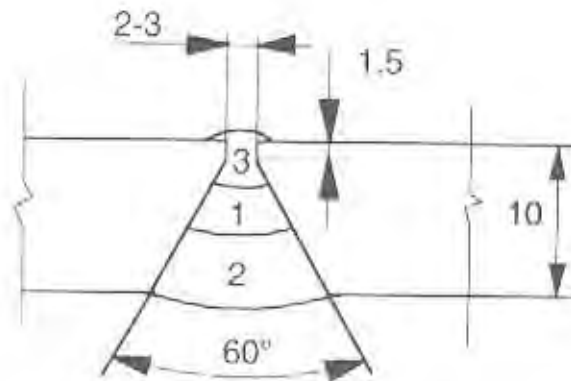
Remarks

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 48.00 ϕ 2,5 and 3,25 mm
 Classification : AWS A/SFA 5.1: E 7018

Material spec. : SS 1412
 Pipe : 10 mm
 Welding position : 3G
 Current/polarity : DC+
 Root treatment : NA
 Restrained : No
 Preheat temp.C° : Min RT
 Interpass temp.C° : Max 350
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	2.5	70	22	70	2.0
2	3.25	130	23	150	2.0
3	2.5	85	22	70	2.4

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.85 hour
 Consumption of consumables : OK 48.00 ϕ 2.5 = 0.7 kg
 OK 48.00 ϕ 3.25 = 0.3 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	
430	Base metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule

Hardness test HV10

Location of tracers	Face A	Face B
HAZ	143-148-152-167	143-145-160-162-168
Weld metal	175-190-185-180	199-197
HAZ	164-162-152-151	180-158-156-150-135

Chemical analyses, weld metal/ base material, %

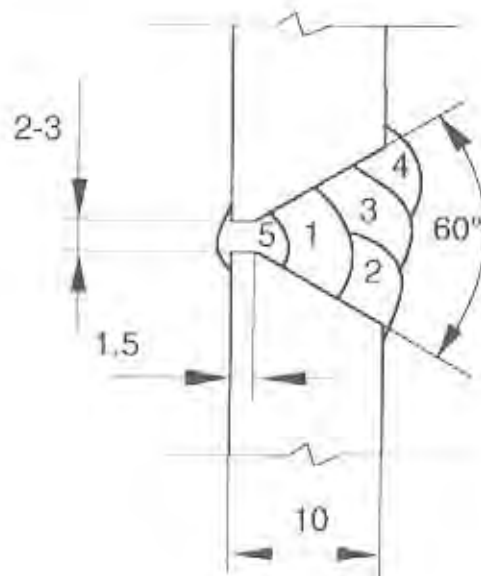
Remarks

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 48.00 ϕ 3.25 and 4.0 mm
 Classification : AWS A/SFA 5.1: E 7018

Material spec. : SS 1412
 Plate thickness : 10mm
 Welding position : 2G
 Current/polarity : DC+
 Root treatment : Grinding
 Restrained : No
 Preheat temp.C° : 10
 Interpass temp.C° : Max 350
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1-3	4.0	175	24	285	1.4
4	3.25	140	23	375	0.8
5	4.0	175	24	285	1.4

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.44 hour
 Consumption of consumables : OK 48.00 ϕ 3.25 = 0.2 kg
 OK 48.00 ϕ 4.0 = 0.8 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location of fraction	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa		MPa	MPa	%	%	C°	SR	mm
447	Base metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule

Hardness test HV10

Location of travers	Face A	Face B
HAZ :	161-158-167-188-182	216-204-187-155-155
Weld metal :	171-180-219-219	206-199
HAZ :	145-138-165-177-188	197-169-169-156-157

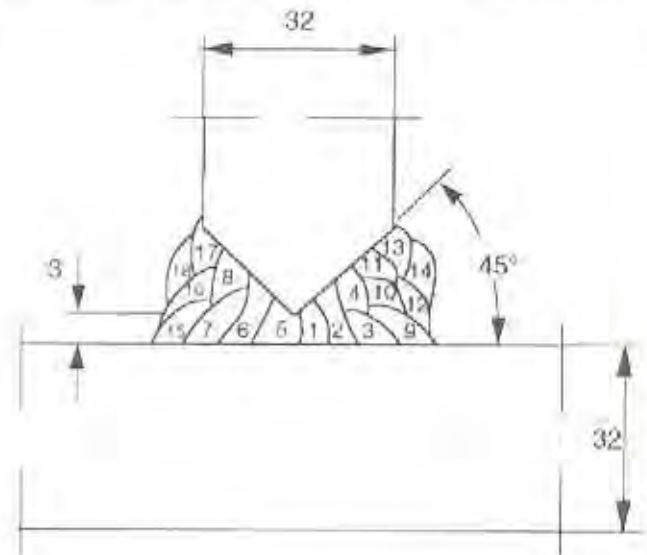
Chemical analyses, weld metal/ base material,%

Remarks

Welding Procedure Specification

Welding process	: SMAW (111)
Welding consumable	: OK 48.08 ϕ 3.25, 4.0, 5.0 mm
Classification	: AWS A/SFA 5.5: E 7018-G
Material spec.	: NVE 36
Plate thickness	: 32 mm
Welding position	: 2G
Current/polarity	: DC(+)
Root treatment	: Grinding
Restrained	: No
Preheat temp.C ^o	: Min 100
Interpass temp.C ^o	: Max 250
PWHT	: NA
Remarks	: NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1-5	3.25	143	22	130	2.0
2-3	4.0	180	22	280	1.3
4	4.0	195	22	235	1.7
6-8	4.0	185	22	186	2.0
9,12,16	5.0	250	23	298	1.7
10	5.0	245	23	185	2.6
11,15	5.0	255	23	244	2.0
13	4.0	160	22	380	0.9
14,17,18	4.0	175	22	305	1.1

Welding economy (Data for welding 1m length of the joint)

Arc time	: 2.1 hour
Consumption of consumables	: OK 48.08 ϕ 3.25 = 0.8 kg
	OK 48.08 ϕ 4.0 = 3.0 kg
	OK 48.08 ϕ 5.0 = 2.0 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	62	80	77	70
	Fusion line	52	58	54	55
	Fusion line + 2mm	75	34	77	62
	Fusion line +5mm	56	65	51	57

Hardness test HV10

Location of travers	1st side	2nd side
HAZ	264-309-236-229	220-309-350-254-236
Weld metal	206-206-181-193-187	236-236-220-229-220
HAZ	193-220-206-240-213	309-274-254-236-206

Chemical analyses, base material, %

C	Mn	Si	Cr	Ni	Mo	Nb	V	Al	P	S
.15	1.26	.46	.05	.78	.010	.027	.0020	.03	.010	.006

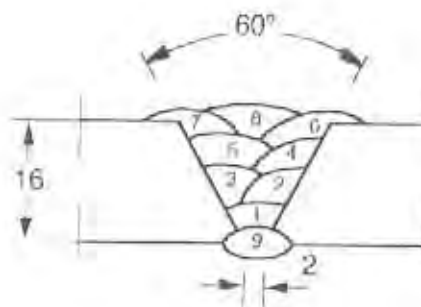
Remarks

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 48.08 ϕ 3.25, 4.0, 5.0 mm
 Classification : AWS A/SFA 5.5; E7018-G

Material spec. : Raex 385P
 Plate thickness : 16mm
 Welding position : 1G
 Current/polarity : DC(+)
 Root treatment : Grinding
 Restrained : No
 Preheat temp.C° : Min 5
 Interpass temp.C° : Max 250
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input k/mm
1	3.25	130	22	210	1.2
2-3	4.0	190	22	230	1.6
4-8	5.0	250	23	313	1.6
9	4.0	190	22	326	1.2

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.85 hour

Consumption of consumables : OK 48.08 ϕ 3.25 = 0.3kg
 OK 48.08 ϕ 4.0 = 0.9 kg
 OK 48.08 ϕ 5.0 = 1.7 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	
552	Base metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	87	109	100	99
-50	Weld metal centre line	63	95	69	76

Hardness test

Chemical analyses, base material, %

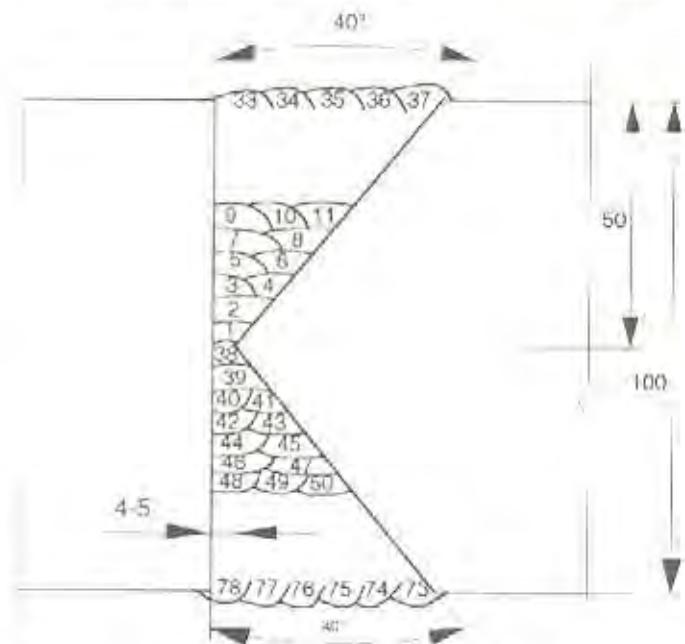
Remarks

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 48.08 ϕ 3.25, 4.0 mm
 Classification : AWS A/SFA 5.5: E 7018-G

Material spec. : Nippon 420 Gr 1
 Plate thickness : 100 mm
 Welding position : 3G
 Current/polarity : AC
 Root treatment : Grinding
 Restrained : Yes
 Preheat temp. C° : Min 75
 Interpass temp. C° : Max 110
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	3.25	100	21	88	2.1
2	3.25	125	22	84	2.8
3	4.0	156	23	203	1.5
4-26	4.0	156	23	115-155	2.1-2.8
27-28	4.0	156	23	190-200	1.6-1.7
29-38	4.0	152-158	23	130-175	1.8-2.5
39-41	4.0	156-170	23-25	120-140	2.3-3.2
42-70	4.0	165-170	23-24	130-165	2.1-2.9
71	4.0	165	23	180	1.9
72-78	4.0	165	23	130-155	2.2-2.6

Welding economy (Data for welding 1m length of the joint)

Arc time : 13.4 hour
 Consumption of consumables : OK 48.08 ϕ 3.25 = 1.0 kg
 OK 48.08 ϕ 4.0 = 30 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location of fraction	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa		MPa	MPa	%	%	C°	SR	mm
577	Base metal	555	620	22	72	-10	AW	0.31

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	93	69	79	80
	Fusion line	148	95	188	144
	Fusion line +2 mm	252	174	188	205
	Fusion line +5 mm	200	186	52	146
	Weld root	104	92	99	98

Hardness test HV5

Location of tracers	Face A	Face B
Parent metal :	188-183-188	186-192-195
HAZ :	188-190-197-199	202-216-225-227
Weld metal :	202-195-192-199-204-182	197-192-186-175-182-197
HAZ :	214-197-182-178	212-208-201-197
Parent metal :	178-183-190	190-185-185

Chemical analyses, weld metal/ base material,%

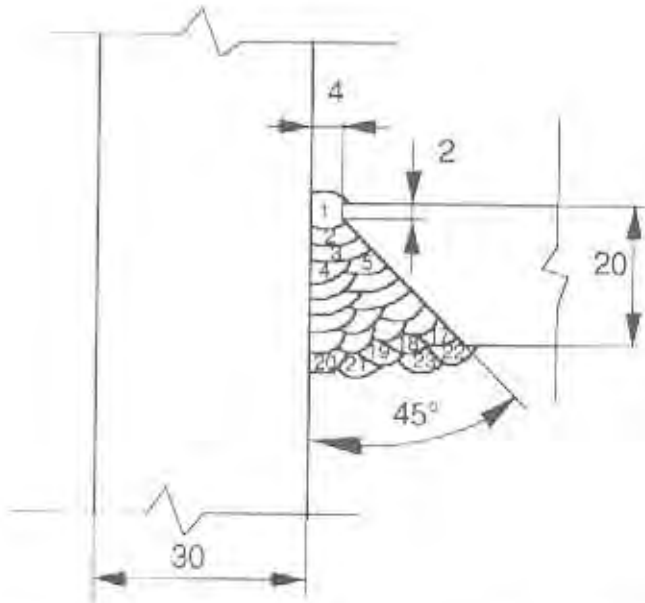
Remarks

OK 53.35

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 53.35 ϕ 3.20, 4.0 mm
 Classification : AWS A/SFA 5.1: E 7048
 Material spec. : HS 420 Gr 1
 Plate thickness : 30/20 mm
 Welding position : 3G down
 Current/polarity : DC+
 Root treatment : No
 Restrained : No
 Preheat temp.C° : Min 50
 Interpass temp.C° : Max 200
 PWHT : NA
 Remarks : NA

Joint preparation and bead



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	3.20	140-141	24	90	2.3-2.5
2	4.0	185-186	24	210	1.5-1.6
3-8	4.0	207-208	25-27	200	1.7-1.8
9-23	4.0	220-222	25-27	470	0.7-0.9

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.4 hour
 Consumption of consumables : OK 53.35 ϕ 3.20 = 0.5kg
 OK 53.35 ϕ 4.0 = 3.8kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location of fraction	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa		MPa	MPa	%	%	C°	SR	mm
		462	557	26	76			

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	151	159	145	152
	Fusion line	165	181	178	176
	Fusion line +2 mm	41	101	178	106
	Fusion line +5 mm	299	299	299	299

Location of travers	Side 1	Side 2
Parent metal :	179-176-176	177-178-180
HAZ :	174-193-198-228-283-297	185-185-197-201-206-210-206
Weld metal :	203-182-168-182-203-198	171-170-172
HAZ :	212-213-199-199	237-238-233-202-197-186
Parent metal :	201-201-194	186-179-181

Chemical analyses, weld metal/ base material, %

Remarks

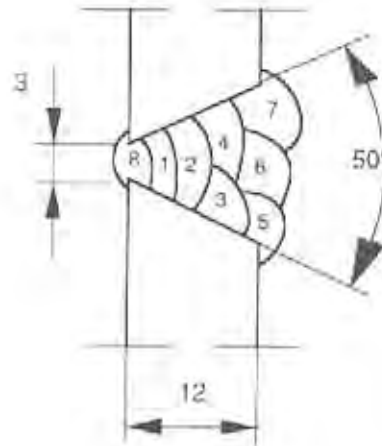
OK 73.68

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 73.68 ϕ 3.25, 4.0 mm
 Classification : AWS A/SFA 5.5: E 8018-C1

Material spec. : OX 602E
 Plate thickness : 12 mm
 Welding position : 2G
 Current/polarity : DC+
 Root treatment : Grinding
 Restrained : No
 Preheat temp.C° : Min 14
 Interpass temp.C° : Max 250
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	3.25	115	22	125	1.7
2-8	4.0	175	23	278	1.4

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.0 hour

Consumption of consumables : OK 73.68 ϕ 3.25 = 0.4 kg
 OK 73.68 ϕ 4.0 = 1.9 kg

p111-004

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm
661	Weld metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	108	92	89	96
	Fusion line	122	37	103	87
	Fusion line + 2mm	137	102	145	128
	Fusion line +5mm	166	170	190	175

Hardness test HV5

Location of travers	Face A	Face B
Parent metal:	237-228-226-221	218-226-212-187
HAZ :	194-191-207-235-250	181-195-222-260-298-2
Weld metal :	234-228-222-227-227	241-240-245
HAZ :	257-241-208-202	298-283-243-205-188
Parent metal:	214-224-224-221	172-183-191-211

Chemical analyses, weld metal/ base material %

Remarks

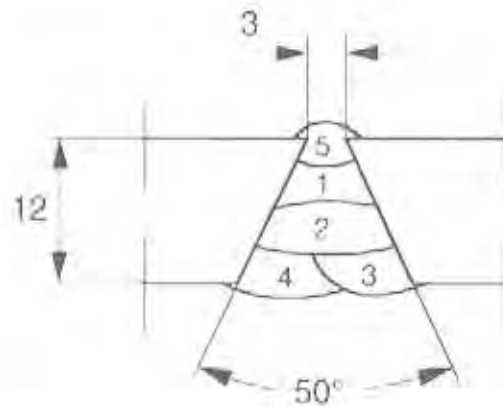
OK 73.68

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 73.68 ϕ 3.25 mm
 Classification : AWS A/SFA 5.5: E 8018-C1

Material spec. : OX602E
 Plate thickness : 12mm
 Welding position : 3G
 Current/polarity : DC+
 Root treatment : Grinding
 Restrained : No
 Preheat temp.C° : RT
 Interpass temp.C° : Max 250
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/m
1	3.25	100	21	83	2.1
2-5	3.25	115	22	139	1.8

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.3 hour

Consumption of consumables : OK 73.68 ϕ 3.25 = 2.0 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	
662	Weld metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	73	122	100	98
	Fusion line	70	77	56	68
	Fusion line + 2mm	127	155	153	145
	Fusion line + 5mm	206	257	158	207

Hardness test HV5

Location of travers	Side 1	Side 2
Parent metal :	224-220-225-222	213-211-205-186I
HAZ :	200-202-213-220-240-245	197-205-214-240-255
Weld metal :	240-217-208-224	226-240-239-232
HAZ :	248-241-218-202-192-194	262-233-232-207-197-190
Parent metal :	220-224-218-221	178-192-211-212

Chemical analyses, weld metal/ base material %

Remarks

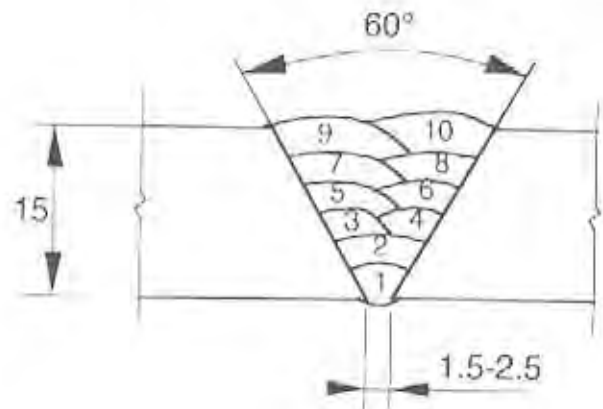
OK 74.70

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 74.70 ϕ 4.0 mm
 Classification : AWS A/SFA 5.5: E 8016-D3

Material spec. : EH 36
 Plate thickness : 15 mm
 Welding position : 1G
 Current/polarity : DC+
 Root treatment : NA
 Restrained : No
 Preheat temp.C° : Min RT
 Interpass temp.C° : Max 250
 PWHT : NA
 Remarks : Root pass performed with OK 53.70 ϕ 3.25

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	3.25	96	22	330	0.4
2-10	4.0	160	24	330	1.0

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.9 hour
 Consumption of consumables : OK 53.70 ϕ 3.25 = 0.1 kg
 OK 74.70 ϕ 4.0 = 1.8 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of	MPa	MPa	%	%	C°	SR	mm
fraction								
		518	650	32	73			

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-60	Weld metal centre line	51	49	52	51
-20		97	94	104	98

Hardness test

Chemical analyses, weld metal/ base material %

Remarks

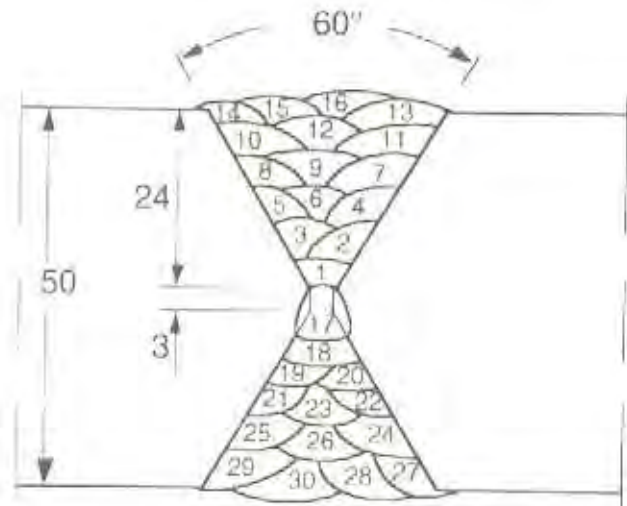
OK 74.78

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 74.78 ϕ 4.0 and 5.0 mm
 Classification : AWS A/SFA 5.5: E9018-D1

Material spec. : JIS G3115-88
 Plate thickness : 50 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Root treatment : Grinding
 Restrained : Strong backs
 Preheat temp. C° : Min 150
 Interpass temp. C° : Max 175
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1-12	5.0	270	24	380	1.6
13-16	4.0	200	23	270	1.6
17-26	5.0	270	24	330	2.0
27-30	4.0	200	23	240	1.9

Welding economy (Data for welding 1m length of the joint)

Arc time : 2.5 hour
 Consumption of consumables : OK 74.78 ϕ 4.0 = 2.4 kg
 OK 74.78 ϕ 5.0 = 6.5 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm
661	Base metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-20	Weld metal centre line	68	103	89	87
	Fusion line	86	76	112	91
	Fusion line + 2mm	53	220	64	112
	Fusion line +5mm	266	288	268	274

Hardness test

Chemical analyses, base material %

Remarks

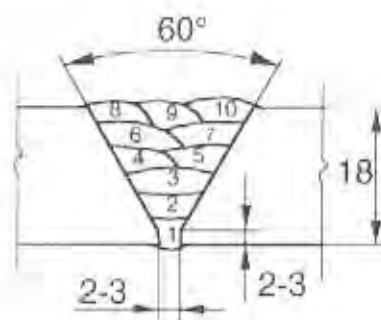
OK 76.18

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 76.18 ϕ 2.0 and 3.25 mm
 Classification : AWS A/SFA 5.1: E 8018-B2L

Material spec. : A 335 P11
 Pipe : 18 mm
 Welding position : 6G
 Current/polarity : DC+
 Root treatment : NA
 Restrained : No
 Preheat temp.C" : Min 150
 Interpass temp.C" : Max 350
 PWHT : 700 °C / 1h
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1-3	2.0	55-65	23	65	0.8-0.9
4-10	3.25	95-105	24	168	1.1-1.2

Welding economy (Data for welding 1m length of the joint)

Arc time : 2.04 hour

Consumption of consumables : OK 76.18 ϕ 2.0 = 0.6 kg
 OK 76.18 ϕ 3.25 = 1.9 kg

p111-009

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	
506	Base metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule

Hardness test HV10

Root pass	206
Filler pass	236
Parent metal	151

Chemical analyses, weld metal/ base material %

Remarks

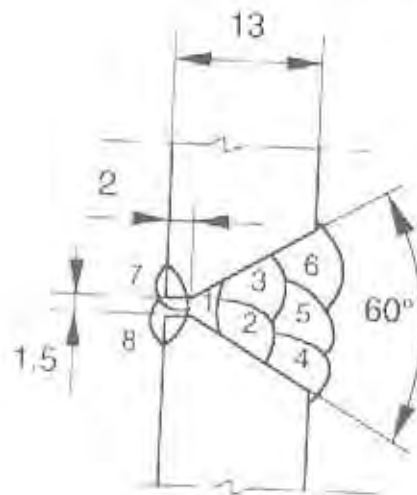
OK 61.30

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 61.30 ϕ 2.5 and 3.25 mm
 Classification : AWS A/SFA 5.4: E 308L-17

Material spec. : 2333
 Plate thickness : 13mm
 Welding position : 2G
 Current/polarity : DC+
 Root treatment : Grinding
 Restrained : No
 Preheat temp.C° : RT
 Interpass temp.C° : Max 200
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	2.5	75	29	150	0.5
2-8	3.25	100	30	200	0.8

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.7 hour

Consumption of consumables : OK 61.30 ϕ 2.5 = 0.12 kg
 OK 61.30 ϕ 3.25 = 1.2 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm
638	Weld metal							

Charpy V-notch impact values Size of specimens 8x10 mm

Temp. C°	Notch location	1st J/cm ²	2nd J/cm ²	3rd J/cm ²	Av. J/cm ²
-196	Weld metal centre line	63	68	78	70

Hardness test

Chemical analyses, weld metal/ base material %

Remarks

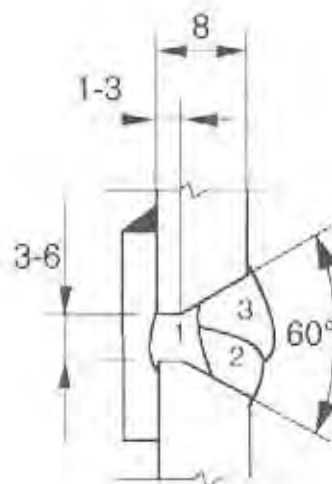
OK 61.30

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 61.30 ϕ 3.25 and 4.0 mm
 Classification : AWS A/SFA 5.4: E 308L-17

Material spec. : SS 2333
 Plate thickness : 8 mm
 Welding position : 2G
 Current/polarity : DC+
 Root treatment : NA
 Restrained : No
 Preheat temp.C° : RT
 Interpass temp.C° : Max 200
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	3.25	100	30	150	1.1
2-3	4.0	150	30	175	1.5

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.34 hour

Consumption of consumables : OK 61.30 ϕ 3.25 = 0.25 kg
 OK 61.30 ϕ 4.0 = 0.6 kg

p111-015



Mechanical test results

Tensile test

Reduced section Rm MPa	Location of fraction	All weld tensile test				CTOD Temp C°	AW SR	δ max weld metal mm
		R _{eL} MPa	Rm MPa	A %	Z %			
616	Weld metal							

Charpy V-notch impact values		Size of specimens 8x6.4 mm			
Temp. C°	Notch location	1st J/cm ²	2nd J/cm ²	3rd J/cm ²	Av. J/cm ²
-196	Weld metal centre line	49	53	49	50

Hardness test

Chemical analyses, weld metal/ base material %

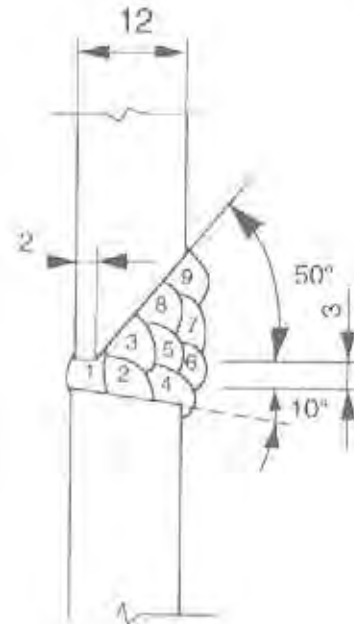
Remarks

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 67.53 ϕ 3.25 and 4.0 mm

Material spec. : 2205
 Plate thickness : 12 mm
 Welding position : 2G
 Current/polarity : DC+
 Root treatment : NA
 Restrained : No
 Preheat temp.C^o : RT
 Interpass temp.C^o : Max 150
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	3.25	61-81	23-24	140	0.6-0.8
2	3.25	100-105	23-32	142	0.9-1.3
3	3.25	100-105	24-30	200	0.7-0.9
4	4.0	123-127	23-28	255	0.7-0.9
5	4.0	120-127	22-32	241	0.7-0.9
6	4.0	120-127	22-31	255	0.6-1.0
7	4.0	123-127	23-28	246	0.7-0.9
8	4.0	123-127	22-31	260	0.7-0.9
9	4.0	112-128	23-24	200	0.8-1.1

Welding economy (Data for welding 1m length of the joint)

Arc time: 0.9 hour

Consumption of consumables: OK 67.53 ϕ 3.25 = 0.7 kg
 OK 67.53 ϕ 4.0 = 1.3 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-20	Weld metal centre line	39	40	38	39
	Fusion line	36	33	29	33
	Fusion line +2 mm	76	76	79	77
	Fusion line +5 mm	106	92	93	97

Hardness test

Chemical analyses, weld metal/ base material, %

Remarks

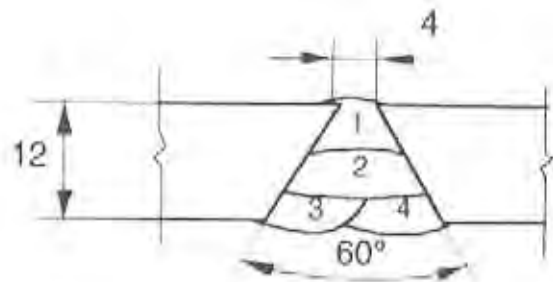
OK 67.53

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 67.53 ϕ 3.25 mm

Material spec. : 2205
 Plate thickness : 12 mm
 Welding position : 3G
 Current/polarity : DC(+)
 Root treatment : NA
 Restrained : No
 Preheat temp.C° : RT
 Interpass temp.C° : Max 150
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	3.25	60-63	25-27	80	1.7-1.9
2	3.25	85-107	26-27	67	2.4-2.5
3	3.25	86-90	25-26	78	1.8-1.9
4	3.25	85-90	25-27	58	2.1-2.4

Welding economy (Data for welding 1m length of the joint)

Arc time: 1.2 hour

Consumption of consumables: OK 67.53 ϕ 3.25 = 2.0 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-20	Weld metal centre line	57	68	60	
	Fusion line	78	76	79	78
	Fusion line +2 mm	87	71	77	78
	Fusion line +5 mm	98	91	89	91

Hardness test

Chemical analyses, weld metal/ base material %

Remarks

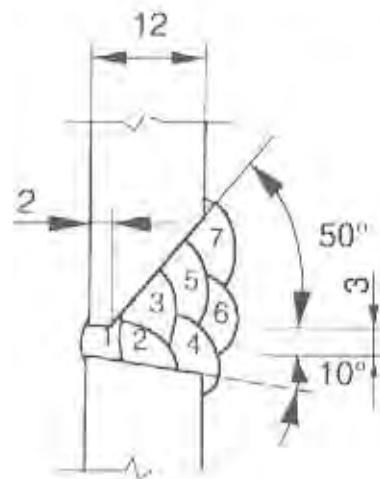
OK 67.55

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 67.55 ϕ 3.25, 4.0 mm
 Classification : AWS A/SFA 5.4: E2209-15

Material spec. : 2205
 Plate thickness : 12 mm
 Welding position : 2G
 Current/polarity : DC(+)
 Root treatment : NA
 Restrained : No
 Preheat temp.C° : RT
 Interpass temp.C° : Max 150
 PWHT : NA
 Remarks : NA

Joint preparation and bead



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	3.25	82-86	21-24	200	0.6-0.7
2	3.25	99-102	21-25	170	0.9-1.1
3	3.25	98-102	21-26	120	1.2-1.6
4	4.0	128-137	22-25	200	1.0-1.2
5	4.0	128-134	22-27	200	1.0-1.3
6	4.0	127-134	23-28	140	1.5-2.0
7	4.0	118-123	21-24	350	0.5-0.6

Welding economy (Data for welding 1m length of the joint)

Arc time: 0.84 hour

Consumption of consumables: OK 67.55 ϕ 3.25 = 0.7 kg
 OK 67.55 ϕ 4.0 = 1.1 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{p0.2}	Rm	A5	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm
		650	800	25	50			

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule

Hardness test

Chemical analyses, base material %

Remarks

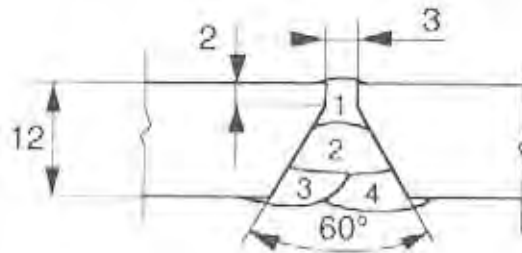
OK 67.55

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 67.55 ϕ 3.25 and 4.0 mm
 Classification : AWS A/SFA 5.4: E2209-15

Material spec. : 2205
 Plate thickness : 12 mm
 Welding position : 3G
 Current/polarity : DC(+)
 Root treatment : NA
 Restrained : No
 Preheat temp.C" : RT
 Interpass temp.C" : Max 150
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	3.25	72-78	23	73	1.9-2.1
2-4	4.0	107-113	23	95	2.1-2.2

Welding economy (Data for welding 1m length of the joint)

Arc time: 0.90 hour

Consumption of consumables: OK 67.55 ϕ 3.25 = 0.5 kg

OK 67.55 ϕ 4.0 = 1.1 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-20	Weld metal centre line	60	53	49	54

Hardness test

Chemical analyses, weld metal/ base material %

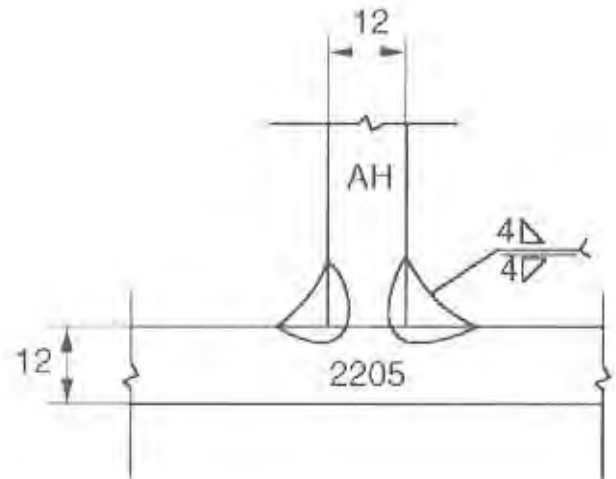
Remarks

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 67.72 700xø5.0 mm
 Classification : AWS A/SFA 5.4: E309 Mo-26

Material spec. : 2205
 Plate thickness : 12 mm
 Welding position : 2F
 Current/polarity : AC
 Root treatment : NA
 Restrained : No
 Preheat temp.C° : RT
 Interpass temp.C° : NA
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ø mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	5.0	230-240	37	650	2.3-2.5
2	5.0	250-260	37	650	2.3-2.5

Welding economy (Data for welding 1m length of the joint)

Arc time: 9 minutes

Consumption of consumables: OK 67.72 700x ø5. = 0.9 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{p0.2} MPa	Rm MPa	A5 %	Z %	Temp C°	AW SR	
		520	680	35	50			

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule

Hardness test

Chemical analyses, weld metal/ base material %

Remarks

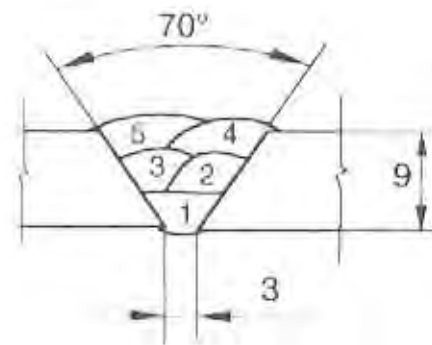
OK 68.53

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 68.53 ϕ 2.5 and 3.25 mm

Joint preparation and bead sequence

Material spec. : Zeron 100
 Pipe : ϕ 170x8.7mm
 Welding position : 1G
 Current/polarity : DC(-)
 Shielding gas : Ar (12litre/min)
 Root treatment : NA
 Restrained : No
 Preheat temp.C° : RT
 Interpass temp.C° : Max 100
 PWHT : NA
 Remarks : Root pass performed with
 OK Tigrod 16.88 ϕ 2.4 mm



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	2.4	120-140	21-23	-	1.1-1.2 (TIG)
2-3	2.5	66-74	21-23	70	0.9-1.0
4-5	3.25	85-95	21-23	100	1.1-1.4

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.0 hour
 Consumption of consumables : OK Tigrod 16.88 ϕ 2.4 = 0.1kg
 OK 68.53 ϕ 2.5 = 0.4 kg
 OK 68.53 ϕ 3.25 = 0.6 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-20	Weld metal centre line	50	51	29	43
-40	Weld metal centre line	33	23	24	27

Hardness test

Chemical analyses, weld metal/ base material %

	C	Mn	Si	Cr	Ni	Mo	W	Cu	N	O
BM=	.026	.67	.12	25.0	7.26	3.92	.09	.17	.22	.008
WR=	.021	.56	.26	25.4	8.37	3.92	.20	.30	.21	.009

Remarks

Ferrite content
Weld topp= FN 52

Weld centre line= FN 48

Weld root= FN 50

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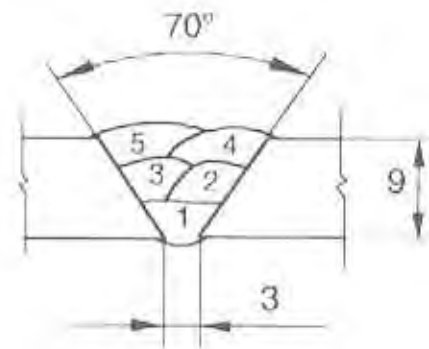
OK 68.55

Welding Procedure Specification

Welding process : SMAW (111)
 Welding consumable : OK 68.55 ϕ 2.5 and 3.25 mm

Joint preparation and bead sequence

Material spec. : Zeron 100
 Pipe : ϕ 170x8.7mm
 Welding position : 1G
 Current/polarity : DC(-)
 Shielding gas : Ar (12litre/min)
 Root treatment : NA
 Restrained : No
 Preheat temp.C° : RT
 Interpass temp.C° : Max 100
 PWHT : NA
 Remarks : Root pass performed with
 OK Tigrod 16.88 ϕ 2.4 mm



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	2.4	120-140	12-13	50 mm/min)	1.7-2.2 (TIG)
2-3	2.5	66-74	21-23	70	0.9-1.0
4-5	3.25	85-95	21-23	100	1.1-1.4

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.0 hour

Consumption of consumables : OK Tigrod 16.88 ϕ 2.4 = 0.1 kg
 OK 68.55 ϕ 2.5 = 0.4 kg
 OK 68.55 ϕ 3.25 = 0.6 kg

P111 019

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD	AW SR	δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°		
		700	900	28				

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-20	Weld metal centre line	62	57	55	58
-40	Weld metal centre line	50	44	44	46

Hardness test

Chemical analyses, base material and weld metal %

	C	Mn	Si	Cr	Ni	Mo	W	Cu	N	O
BM=	0.26	0.67	0.12	25.0	7.26	3.92	0.57	0.57	0.22	.008
WR=	0.22	0.55	0.26	25.3	8.44	3.92	0.20	0.30	.018	.005

Remarks

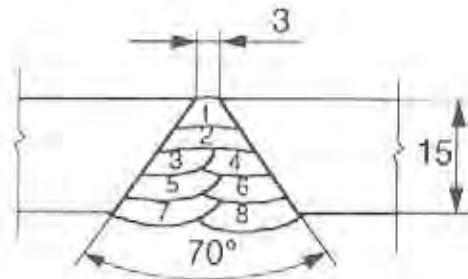
Ferrite content:

Weld top= FN 49 Weld centre line= FN 49 Weld root= FN 55

OK 92.55

Welding Procedure Specification

Welding process	: SMAW (111)	
Welding consumable	: OK 92.55 ϕ 3.25 mm	
Classification	: AWS A/SFA 5.11: E NiCrMo-6	
Material spec.	: SA 533-1(9% Ni)	Joint preparation and bead sequence
Plate thickness	: 15mm	
Welding position	: 3G	
Current/polarity	: AC	
Root treatment	: NA	
Restrained	: No	
Preheat temp.C°	: 20	
Interpass temp.C°	: Max 100	
PWHT	: NA	
Remarks	: NA	



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	ROL mm	Heat input kJ/mm
1	3.25	71-81	23-25	140-160	0.6-0.9
2	3.25	110-120	22-24	170-190	0.8-1.1
3-8	3.25	100-110	22-24	180-200	0.7-0.9

Welding economy (Data for welding 1m length of the joint)

Arc time: 1.2 hour

Consumption of consumables: OK 92.55 ϕ 3.25 =1.9 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ weld metal mm
715	Base metal	433	723	56	54	-170	AW	0.46-0.51-0.45

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-196	Weld metal centre line	114	106	98	106
	Fusion line	148	164	156	156
	Fusion line +2 mm	288	244	230	254
	Fusion line +5 mm	246	239	243	243

Lateral expansion (mm)

Temp. C°	Notch location	1st mm	2nd mm	3rd mm	Av. mm
-196	Weld metal centre line	1.8	1.7	1.3	1.6
	Fusion line 1.5	1.6	1.5	1.5	1.5
	Fusion line +2 mm	2.0	1.9	1.9	1.9
	Fusion line + 5 mm	2.4	2.2	2.2	2.3

Hardness test HV10

Lokation of travers	Top side	Root side
Base metal :	270-270-270	254-254-254
HAZ :	258-260-294-272-283-287	268-274-272-285-285
Weld metal :	297-322-317	281-274-274-268
HAZ :	317-317-339-297-281-256-251	260-266-268-270
Base metal :	256-256-256	256-254-254

Chemical analyses, weld metal/ base material %

Remarks

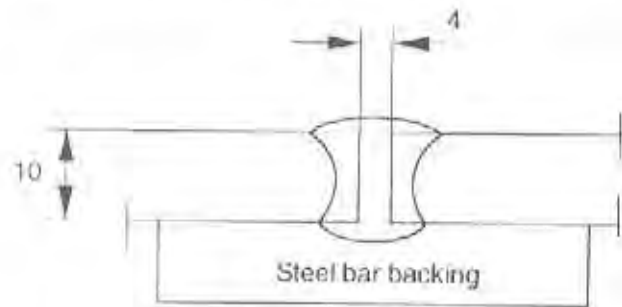
OK Autrod 12.10

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable
 Wire : OK Autrod 12.10 ϕ 5.0 mm
 Flux : OK Flux 10.70
 Classification : AWS A/SFA 5.17: F7A4-EL12

Material spec. : OX 522D
 Plate thickness : 10 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp. temp. C° : NA
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	900	34	37	3.0

Welding economy (Data for welding 1m length of the joint)

Arc time : 2 min.

Consumption of consumables :

Wire : OK Autrod 12.10 ϕ 5.0 = 0.3 kg

Flux : OK Flux 10.70 = 0.4 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	
589	Base metal							

Charpy V-notch impact values. Specimen size 10x5 mm

Temp. C°	Notch location	Min value Joule	Max value Joule	Average Joule
-20	Weld metal centre line	42	45	43
	Fusion line	38	54	46
	Fusion line + 1mm	40	51	45
	Fusion line +3mm	63	69	66
	Fusion line + 5 mm	60	63	61
	Fusion line + 7 mm	63	68	65
	Base metal	64	66	65

Hardness test HV5 max 237 in HAZ

Chemical analyses, base material, %

C	Si	Mn	P	S	V	Ti	Nb	Al	N
.15	.44	1.46	.012	.018	-	-	.019	.025	.005

Remarks

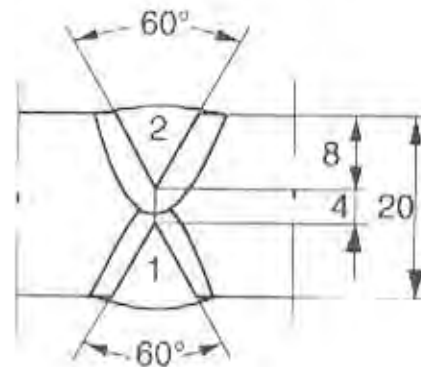
OK Autrod 12.10

Welding process : SAW (121)
 Welding consumable
 Wire : OK Autrod 12.10 ϕ 5 mm
 Flux : OK Flux 10.70
 Classification : AWS A/SFA 5.17: F7A4-EL12

Welding Procedure Specification

Material spec. : OX 522
 Plate thickness : 20 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 25 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 5
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	750	34	31	3.0
2	900	36	37	3.2

Welding economy (Data for welding 1m length of the joint)

Arc time : 3.6 minutes

Consumption of consumables :

Wire : OK Autrod 12.10 ϕ 5.0 = 0.6 kg

Flux : OK Flux 10.70 = 0.8 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD	AW SR	δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°		
628	Base metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-20	Weld metal centre line	Min 39			40
	Fusion line	Min 50			100
	Fusion line + 1mm	Min 60			120
	Fusion line + 3mm	Min 105			138

Hardness test HV10

Max 260

Chemical analyses, base material, %

C	Mn	Si	Nb	Al	P	S
.150	1.48	.44	.04	.07	.020	.020

Remarks

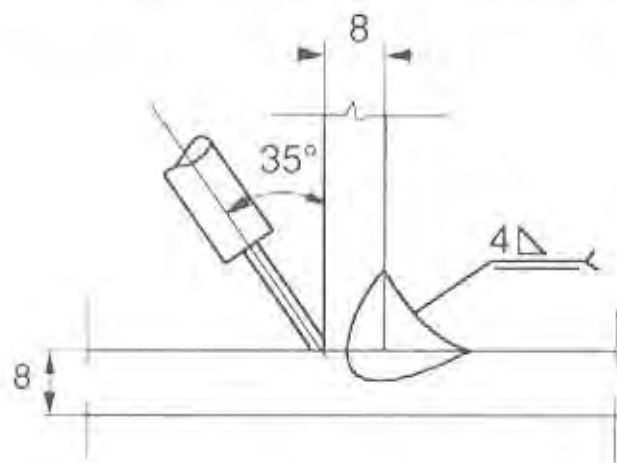
OK Tubrod 15.00S

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Tubrod 15.00S ϕ 3.0 mm
 Flux : OK Flux 10.71

Material spec. : AH36
 Plate thickness : 8 mm
 Welding position : 2F
 Current/polarity : DC(+)
 Stick out : 25 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp. temp. C° : NA
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	650	32	51	1.5

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.2 minutes
 Consumption of consumables :
 Wire : OK Tubrod 15.00S ϕ 3.0 = 0.30 kg
 Flux : OK Flux 10.71 = 0.20 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
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Hardness test HV10

Location of travers

Base metal : 193
HAZ : 217

Weld metal : 238-233-228-229
HAZ : 229
Base metal : 196

Chemical analyses, base material, %

Remarks

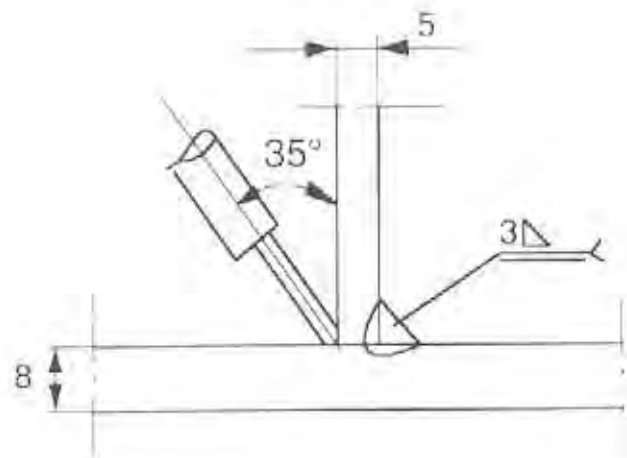
OK Tubrod 15.00S

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Tubrod 15.00S ϕ 3.0 mm
 Flux : OK Flux 10.71

Material spec. : AH36
 Plate thickness : 5/8 mm
 Welding position : 2F
 Current/polarity : DC(+)
 Stick out : 25 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp. temp. C° : NA
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	600	32	60	1.2

Welding economy (Data for welding 1m length of the joint)

Arc time : 1 minute.

Consumption of consumables :

Wire : OK Tubrod 15.00S ϕ 3.0 = 0.20 kg
 Flux : OK Flux 10.71 = 0.15 kg

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Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule

Hardness test HV10

Location of travers

Base metal : 187
HAZ : 236

Weld metal : 247-249-244-239-231

HAZ : 216
Base metal : 181

Chemical analyses, base material, %

Remarks

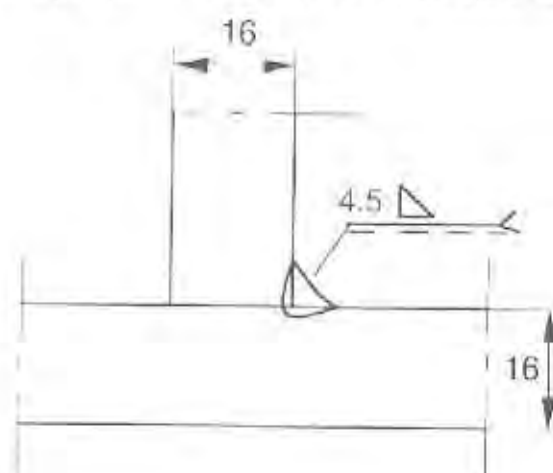
OK Autrod 12.10

Welding Procedure Specification

Welding process : SAW Twin arc (121)
 Welding consumable
 Wire : OK Autrod 12.10 2x ϕ 2.0 mm
 Flux : OK Flux 10.81
 Classification : AWS A/SFA 5.17: F7AZ-EL12

Material spec. : NVD 36
 Plate thickness : 16 mm
 Welding position : 2F
 Current/polarity : DC(+)
 Stick out : 20 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp. temp. C° : NA
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat Input kJ/mm
1	650	32	48	1.6

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.3 minutes

Consumption of consumables

Wire : OK Autrod 12.10 2x ϕ 2.0 = 0.2 kg
 Flux : OK Flux 10.81 = 0.2 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
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Hardness test HV10

Location of travers	Side 1
HAZ :	176-181-178-204-224-243
Weld metal :	224-220-217-220-230-236-233-236-236-239-230
HAZ :	270-283-217-193-174-176-170
Base metal :	165

Chemical analyses, weld metal/ base material, %

Remarks

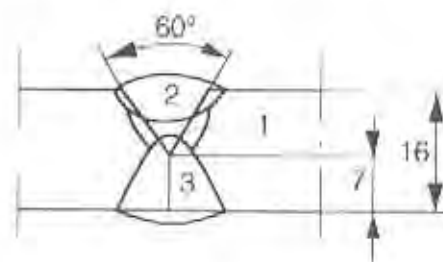
OK Autrod 12.22

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 12.22 ϕ 4 mm
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5.17: F7A8-EM12K

Material spec. : NVD 36
 Plate thickness : 16 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 35 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	570	35	36	2.0
2	590	36	36	2.1
3	660	36	36	2.4

Welding economy (Data for welding 1m length of the joint)

Arc time : 4.8 minutes

Consumption of consumables :

Wire : OK Autrod 12.22 ϕ 4.0 = 0.6 kg

Flux : OK Flux 10.62 = 0.7 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	
557	Base metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-20	Weld metal centre line	54	81	146	94
	Fusion line	60	57	62	60
	Fusion line + 1mm	45	47	43	45
	Fusion line +3mm	52	56	52	53

Hardness test HV10

Location of travers:	Top side	Root region
HAZ :	160-174-176-199-214-212	170-176-181-185-206-209
Weld metal :	206-209-204-209-212-209	204-201-199-201-199-206
HAZ :	220-214-220-217-206-193	212-206-191-181-176-170

Chemical analyses, base material, %

Remarks

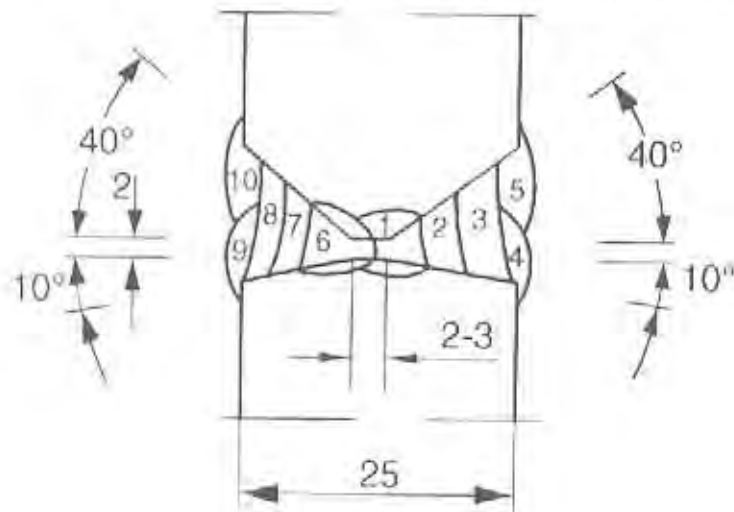
OK Autrod 12.24

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 12.24 ϕ 2.5 mm
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5.23: F8A6-EA2-A2

Material spec. : OX 600E
 Plate thickness : 25 mm
 Welding position : 2G
 Current/polarity : DC(+)
 Stick out : 30 mm
 Root treatment : Grinding
 Restrained : No
 Preheat temp. C° : Min 10
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1-5	380	26	28	1.3
6-10	380	26	34	1.0

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.33 hour

Consumption of consumables :

Wire : OK Autrod 12.24 ϕ 2.5 = 1.5 kg

Flux : OK10.62 = 1.0 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	88	75	103	89
	Fusion line	75	74	67	72
	HAZ	70	64	65	66

Hardness test

Chemical analyses, base material, %

Remarks

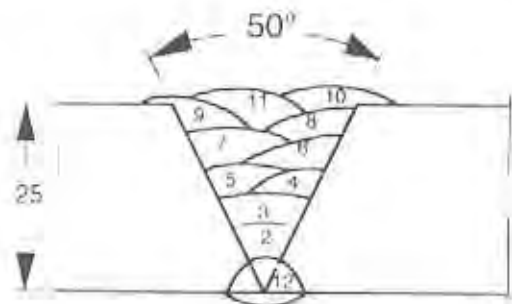
OK Autrod 12.32

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 12.32 ϕ 4.0mm
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5.23: F7A8-EG-G

Material spec. : EH36
 Plate thickness : 25 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm, 15 mm (root run)
 Shielding gas : 80Ar+20CO₂ (root run)
 Root treatment : Grinding
 Restrained : Yes
 Preheat temp. C° : Min 10
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : Root run performed with
 OK Tubrod 14.00 ϕ 1.2 mm

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	180	25	7.2	2.3
2	500	26	30	1.6
3	600	28	30	1.7
4-9	600	30	30	2.2
10-11	600	30	42	1.5
12	600	30	30	2.2

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.49 hour

Consumption of consumables :

Wire : OK Tubrod 14.00 ϕ 1.2 = 0.3 kg

OK Autrod 12.32 ϕ 4.0 = 2.4 kg

Flux : OK Flux 10.62 = 2.0 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	
		534	612	25.4	73			

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	129	126	134	130
	Fusion line	32	32	31	32
	Fusion line + 2mm	49	40	41	43

Hardness test

Chemical analyses, weld material, %

C	Si	Mn	P	S	Cr, Ni	Mo	V	Nb	Cu
.085	.37	1.59	.014	.005	.03	.01	.006	.005	.06

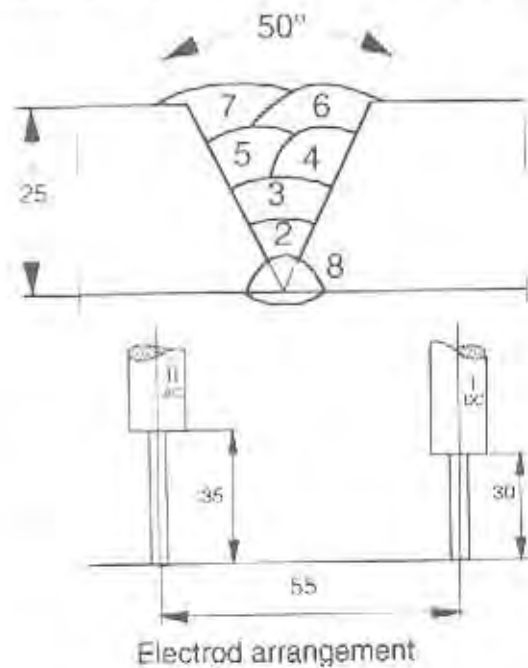
Remarks

OK Autrod 12.32

Welding Procedure Specification

Welding process : SAW Tandem(121)
 Welding consumable :
 Wire : OK Autrod 12.32 2x ϕ 4.0 mm
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5.23: F7A8-EG-G

Joint preparation and bead sequence



Material spec. : EH36
 Plate thickness : 25 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm, 15mm(root run)
 Shielding gas : 80Ar+20CO₂(root run)
 Root treatment : Grinding
 Restrained : NA
 Preheat temp. C° : Min 10
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : Root run performed with
 OK Tubrod 14.00 ϕ 1.2 mm

Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	180	25	7.2	2.3
2	500	26	30	1.6 Singel
3-7	1) 600 2) 600	28 DC(+) 32 AC	30	4.3 Tandem
8	600	30	30	2.2 Singel

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.40 hour
 Consumption of consumables :
 Wire : OK Tubrod 14.00 ϕ 1,2 = 0.3 kg
 OK Autrod 12.32 ϕ 4,0 = 2.3 kg
 Flux : OK Flux 10.62 = 2.0 kg

p121-024

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	
		577	643	25.4	73			

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	98	115	115	109
	Fusion line	35	39	36	37
	Fusion line + 2mm	24	28	28	27

Hardness test

Chemical analyses, weld material, %

C	Si	Mn	P	S	Cr	Ni	Mo	V	Nb	Cu	Al	Ti
.09	.32	1.49	.014	.005	.03	.03	.21	.006	.002	.08	.015	.002

Remarks

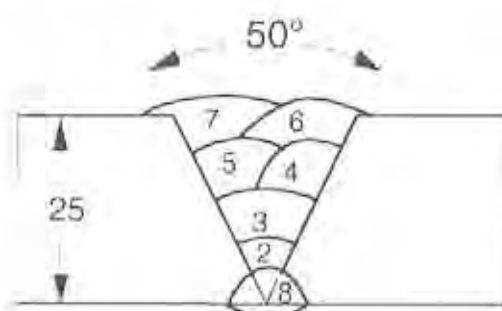
OK Autrod 12.32

Welding Procedure Specification

Welding process : SAW MP (121)
 Welding consumable
 Wire : OK Autrod 12.32 ϕ 4.0 mm
 Flux : OK Flux 10.62
 Metal powder : OK Grain 21.85

Material spec. : EH36
 Plate thickness : 25 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm, 15mm (root run)
 Shielding gas : 80Ar+20CO₂(root run)
 Root treatment : Grinding
 Restrained : NA
 Preheat temp. C° : Min 10
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : Root pass performed with
 OK Tubrod 14.00 ϕ 1.2 mm

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	180	25	7.2	2.3
2	600	30	30	1.3
3	600	32	30	1.3
4	600	32	24	1.7
5-6	600	32	30	1.3
7	600	32	30	2.3
8	600	30	30	2.2

Pass No 2-6 iron powder OK Grain 21.85 is added by 70-80 g/min. This is considered in the heat input calculation.

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.42 hour
 Consumption of consumables
 Wire: OK Tubrod 14.00 ϕ 1.2 = 0.4 kg
 OK Autrod 12.32 ϕ 4.0 = 1.7 kg
 Flux: OK Flux 10.62 = 1.6 kg
 Metal powder: OK Grain 21.85 = 0.8 kg

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Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	
		512	587	27	73			

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	155	157	162	158

Hardness test

Chemical analyses, weld material,%

C	Si	Mn	P	S	Cr	Ni	Mo	V	Nb	Cu	Al	Ti
.076	.28	1.39	.014	.005	.02	.02	.01	.006	.001	.05	.013	.002

Remarks

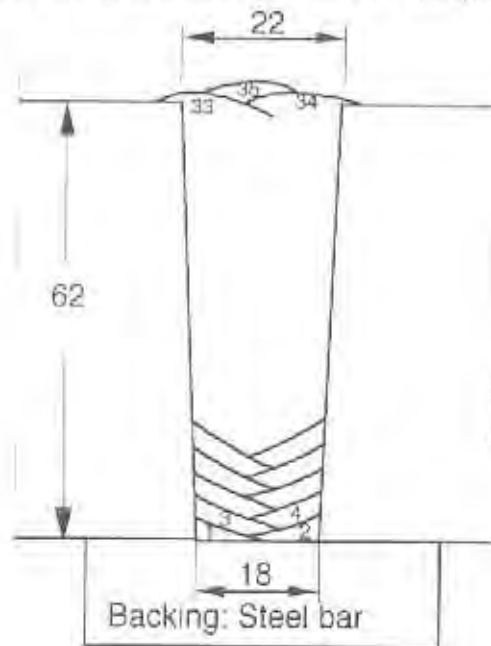
OK Autrod 12.32

Welding Procedure Specification

Welding process : SAW NG (121)
 Welding consumable :
 Wire : OK Autrod 12.32 ϕ 4.0
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5.23: F7A8-EG-G

Material spec. : BS 4360-Gr 50E
 Plate thickness : 62 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 40 mm
 Root treatment : NA
 Restrained : Strong backs
 Preheat temp. C° : Min 150
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1-15	550	28	24	2.3
16-18	575	28	24	2.4
19-29	575	28	27	2.1
30-34	575	28	30	1.9
35	575	28	29	2.0

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.4 hour

Consumption of consumables :

Wire : OK Autrod 12.32 4.0 = 8.5 kg

Flux : OK Flux 10.62 = 6.3 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm
	Base metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Top weld metal centre line	158	83	124	122
	Middle weld metal centre line	92	88	92	91
	Root weldmetal centre line	126	142	79	116
	Root fusion line	170	155	201	175

Hardness test HV10

Chemical analyses, base material,%

Remarks

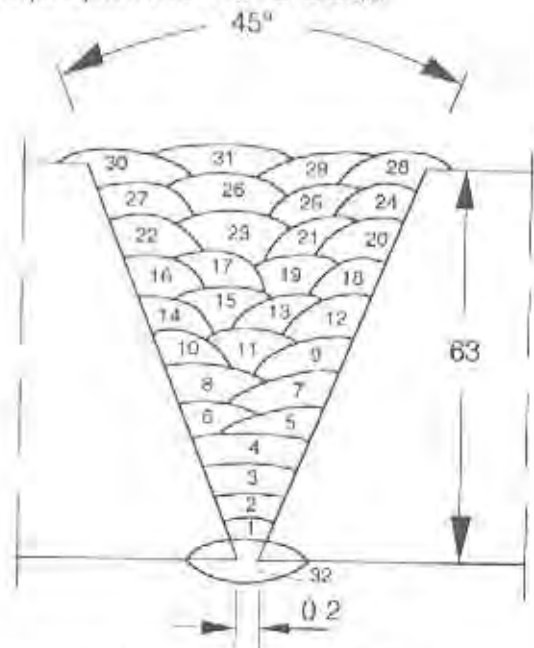
OK Autrod 12.32

Welding Procedure Specification

Welding process : SAW MP (121)
 Welding consumable :
 Wire : OK Autrod 12.32 ϕ 4.0 mm
 Flux : OK Flux 10.62
 Metal powder : OK Grain 21.85

Material spec. : BS 4360-Gr 50D
 Plate thickness : 63 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 15 mm (MAG)
 40 mm (SAW)
 Shielding gas : 95Ar+5O₂
 Root treatment : Grinding
 Restrained : Strong backs
 Preheat temp. C° : Min 100
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : Root pass performed with
 OK Autrod 12.51 ϕ 1.2mm

Joint preparation and bead



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	250	30	12	2.3
2	480	29	26	1.9
3	560	32	26	2.5
4-27	640	34	27	1.6
28-31	550	34	26	2.6
32	640	33	26	3.0

Pass NO 4-27 iron powder OK Grain 21.85 added by 100 g/min. This is considered in the heat input calculation.

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.3 hour

Consumption of consumables :

Wire : OK 12.51 ϕ 1.2 = 0.2 kg
 OK Autrod 12.34 ϕ 4.0 = 7.9 kg
 Flux : OK Flux 10.62 = 16.6 kg
 Metal powder : OK Grain 21.85 = 7.7 kg

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Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm
		545	485	27		-10	AW	0.88-0.90-0.89

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-25	Cap, weld metal centre line	136	139	162	146
-40	Cap, weld metal centre line	65	134	125	108
-25	Root, weld metal centre line	96	90	97	94
-40	Root, weld metal centre line	74	66	82	74

Hardness test HV10

Max 252 in HAZ

Chemical analyses, base material, %

Remarks

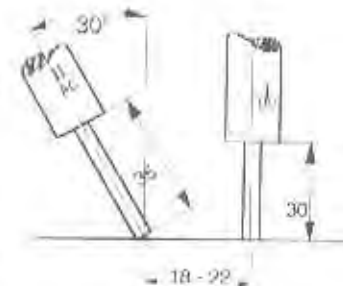
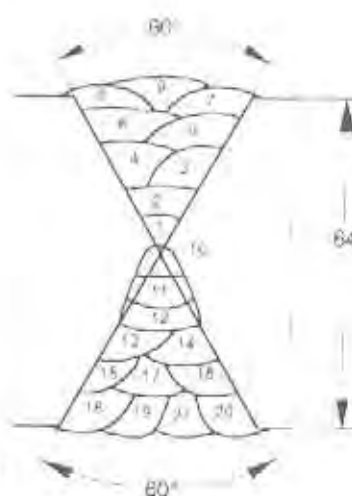
OK Autrod 12.32

Welding Procedure Specification

Welding process : SAW Tandem (121)
 Welding consumable
 Wire : OK Autrod 12.32 ϕ 4.0mm
 Flux : OK Flux 10.62
 Classification : AWS A/FSA 5.17: F7A8-EH12K

Material spec. : St 52-3N
 Plate thickness : 64 mm
 Welding position : 1G
 Current/polarity : MAG DC(+)
 El. No.1 DC(+)
 El. No. 2 AC
 Stick out : MAG=15 mm
 El. No. 1= 30mm
 El. No. 2= 35 mm
 Shielding gas : 80Ar+20CO₂
 Root treatment : Arc gouging /
 Grinding
 Restrained : Strong backs
 Preheat temp. C° : Min 15
 Interp. temp. C° : Max 150
 PWHT : NA
 Remarks : Root run performed by OK Autrod
 12.51 ϕ 1.2 mm

Joint preparation and bead sequence



Electrode arrangement

Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	250	30	12	2.3 (MAG)
2-9 (1)	600	30		
(2)	600	33	45	3.1
10-21(1)	600	30		
(2)	600	30	45	3.1

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.0 hour

Consumption of consumables :

Wire : OK Autrod 12.51 ϕ 1.0 = 0.35 kg

OK Autrod 12.32 ϕ 4.0 = 8.8 kg

Flux : OK Flux 10.62 = 7.9 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	
576 (cap)	Base metal					-10	AW	0.35-0.42-0.29
573 (root)	Base metal					-7	AW	0.62-0.45-0.38

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line				59
	Fusion line				41
	Fusion line + 2mm				87
	Fusion line +5mm				36
-40	Root Weld metal centre line				109
	Fusion line				175

Hardness test

Chemical analyses, base material, %

Remarks

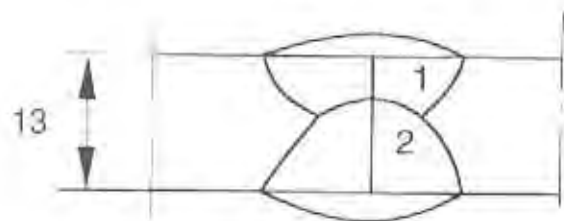
OK Autrod 12.34

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable
 Wire : OK Autrod 12.34 ϕ 5.0 mm
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5.23: F8A8-EA 4-A4

Material spec. : NVD36
 Plate thickness : 13 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 35mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	625	32	34	2.1
2	750	32	34	2.5

Welding economy (Data for welding 1m length of the joint)

Arc time : 4 minutes

Consumption of consumables :

Wire : OK Autrod 12.34 ϕ 5.0 = 0.5 kg

Flux : OK Flux 10.62 = 0.5 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm
529	Base metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-20	Weld metal centre line	43	40	41	41
	Fusion line	29	45	34	36
	Fusion line + 2mm	57	32	54	48
	Fusion line +5mm	48	52	52	51

Hardness test HV10

	Weld top	Root region
HAZ :	160-170-165-181-199-199	165-170-170-193-199-199
Weld metal:	228-228-228-206-228-206	199-199-206-206-213-220
HAZ :	199-199-170-160-160	220-220-228-213-170-160

Chemical analyses, base material, %

Remarks

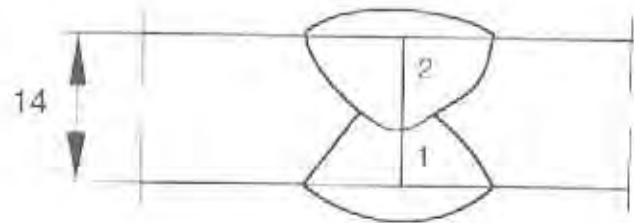
OK Autrod 12.34

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 12.34 ϕ 5.0 mm
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5.23: F8A8-EA 4-A4

Material spec. : NVE36
 Plate thickness : 14 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 35 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	700	36	36	2.5
2	900	36	36	3.2

Welding economy (Data for welding 1m length of the joint)

Arc time : 4 minutes

Consumption of consumables :

Wire : OK Autrod 12.34 ϕ 5.0 = 0.5 kg

Flux : OK Flux10.62 = 0.7 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location of fraction	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa		MPa	MPa	%	%	C°	SR	mm
530	Base metal							

Charpy V-notch impact values

Temp.	Notch location	1st	2nd	3rd	Av.
C°		Joule	Joule	Joule	Joule
-40	Weld metal centre line	61	70	71	67
	Fusion line	34	28	37	33
	Fusion line + 2mm	28	49	49	42
	Fusion line + 5mm	93	44	28	55

Hardness test HV5

Location of travers

HAZ	:	210-210-205-230-230
Weld metal	:	235-235-240-240-230
HAZ	:	220-195

Chemical analyses, weld metal%

C	Mn	Si	P	S	Mo	Nb	Al
0.12	1.39	0.35	0.015	0.013	0.15	0.017	0.020

Remarks

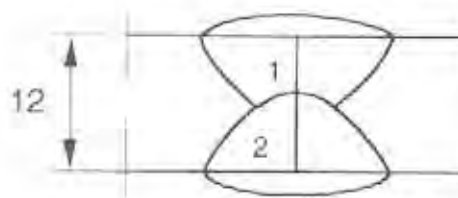
OK Autrod 13.27

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 13.27 ϕ 4.0 mm
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5.23: F8A10-ENi2-Ni2

Material spec. : OX 602E
 Plate thickness : 12 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 15
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	675	29	40	1.8
2	675	29	40	1.8

Welding economy (Data for welding 1m length of the joint)

Arc time : 3 minutes

Consumption of consumables :

Wire : OK Autrod 13.27 ϕ 4.0 = 0.5 kg

Flux : OK Flux 10.62 = 0.4 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm
668	Weld metal							

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-40	Weld metal centre line	37	38	29	35
	Fusion line	57	77	78	71
	Fusion line + 2mm	151	142	146	146
	Fusion line +5mm	209	178	222	203

Hardness test HV5

Location of travers	Face A	Face B
Base metal :	225-225-225	225-222-221
HAZ :	217-190-217	200-185-212
Weld metal :	221-222-223	222-223-220
HAZ :	217-204-186	223-206-186
Base metal :	216-220-222	216-222-223

Chemical analyses, base material, %

Remarks

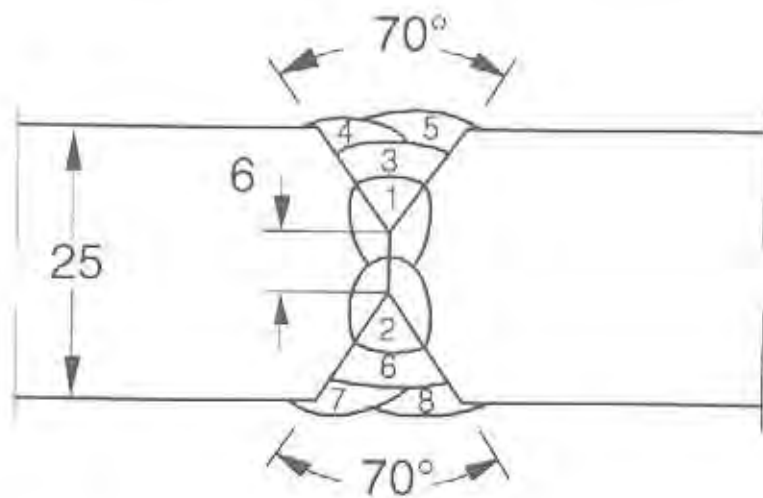
OK Autrod 13.27

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 13.27 ϕ 4.0 mm
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5.23; F8A10-ENi2-Ni2

Material spec. : OX 602E
 Plate thickness : 25 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 21
 Interp. temp. C° : Max 100
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1-2	675	28	30	2.3
3-8	675	30	36	2.0

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.23 hour

Consumption of consumables :

Wire : OK Autrod 13.27 ϕ 4.0 = 2.1 kg

Flux : OK Flux 10.62 = 1.8 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location of fraction	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa		MPa	MPa	%	%	C°	SR	mm
690	Base metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	60	86	70	72
	Fusion line	110	80	75	88
	Fusion line + 2mm	61	74	80	72
	Fusion line +5mm	95	110	114	106

Hardness test HV5

Location of tracers	Face A	Face B
Base metal :	223-221-216-212-218	225-221-223-229-232
HAZ :	214-209-232-329-321	210-204-229-280-283
Weld metal :	262-252-254-237-252	244-237-234-241-237
HAZ :	310-329-358-341-277	289-306-325-310-262
Base metal :	225-227-229-223	221-221-221-227-221

Chemical analyses, base material, %

Remarks

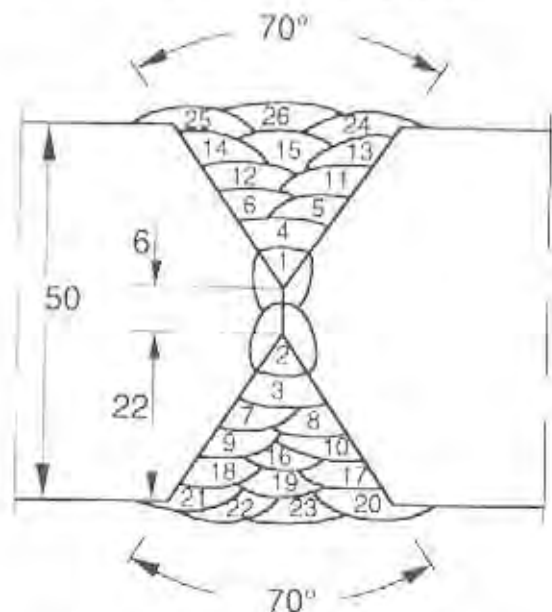
OK Autrod 13.27

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 13.27 ϕ 4.0 mm
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5.23: F8A10-ENi2-Ni2

Material spec. : OX 602E
 Plate thickness : 50 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C" : Min 15
 Interp. temp. C" : Max 100
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1-2	650-700	28	30	2.2-2.3
3-26	650-700	30	36	2.0-2.1

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.73 hour

Consumption of consumables :

Wire : OK Autrod 13.27 ϕ 4.0 = 6.6 kg

Flux : OK Flux 10.62 = 5.6 kg

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Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location of fraction	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa		MPa	MPa	%	%	C°	SR	mm
681	Weld metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	116	126	126	123
	Fusion line	80	68	80	76
	Fusion line + 2mm	132	118	112	121
	Fusion line +5mm	90	80	95	88

Hardness test HV5

Location of travers	Face A	Face B
Base metal :	265-262-271-265-244	260-260-262-268-271
HAZ :	239-252-303-336-371	212-225-260-325-345
Weld metal :	269-257-265-260-268	246-257-241-260-254
HAZ :	358-349-345-353-296	257-260-306-310-299
Base metal :	262-268-274-271-268	249-262-260-262-257

Chemical analyses, base material, %

Remarks

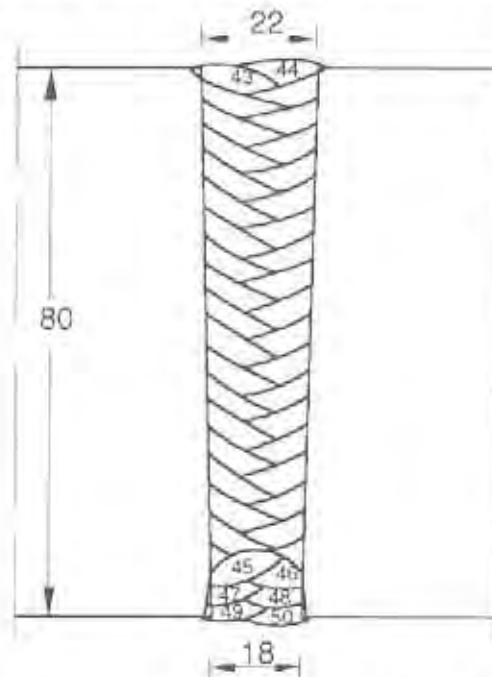
OK Autrod 13.27

Welding Procedure Specification

Welding process : SAW NG (121)
 Welding consumable :
 Wire : OK Autrod 13.27 ϕ 3.0 mm
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5.23: F8A10-ENi2-Ni2

Joint preparation and bead sequence

Material spec. : OX 602E
 Plate thickness : 80 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm
 Root treatment : Grinding
 Restrained : Strong backs
 Preheat temp. C° : Min 100
 Interp. temp. C° : Max 190
 PWHT : NA
 Remarks : NA



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1-2	435	27	27	1.6
3-44	465	27	27	1.7
45-51	465	27	27	1.7

Welding economy (Data for welding 1 m length of the joint)

Arc time : 1.9 hour

Consumption of consumables :

Wire : OK Autrod 13.27 ϕ 3.0 = 13 kg

Flux : OK Flux 10.62 = 9 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR AW	δ max weld metal mm
680	Weld metal					-10		1.18, 1.04, 1.08

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld cap, centre line	90	112	109	104
	Fusion line	69	82	55	69
	Fusion line + 2mm	94	116	108	106
	Fusion line +5mm	101	75	122	99
-40	Weld root, centre line	96	113	118	109
	Fusion line	110	67	120	99
	Fusion line +2 mm	155	158	153	155
	Fusion line +5 mm	126	134	116	125

Hardness test HV10

Location of travers	Cap, 1mm below surface	Root, 1 mm below surface
HAZ :	272-274-290-272-283-285	287-270-224-290-279-276
Weld metal :	272-220-206-225-213-232	225-225-232-232-233-243
HAZ :	270-297-297-240-237-222	255-290-285-247-227-242

Chemical analyses, base material, %

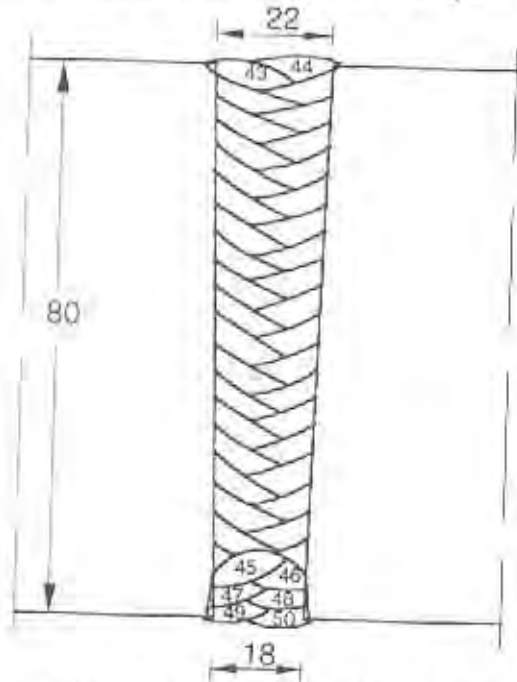
Remarks

OK Autrod 13.27

Welding Procedure Specification

- Welding process : SAW NG (121)
 Welding consumable :
 Wire : OK Autrod 13.27 ϕ 3.0 mm
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5.23: F8P10-ENi2-Ni2
- Material spec. : OX 602E
 Plate thickness : 80 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm
 Root treatment : Grinding
 Restrained : Strong backs
 Preheat temp. C° : Min 100
 Interp. temp. C° : Max 190
 PWHT : 600°C, 4 h
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1-2	435	27	27	1.6
3-44	465	27	27	1.7
45-51	465	27	27	1.7

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.9 hour

Consumption of consumables :

Wire : OK Autrod 13.27 ϕ 3.0 = 13 kg
 Flux : OK Flux 10.62 = 9 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm
655	Weld metal					-10	SR	1.05, 1.02, 1.01

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.	
C°	location	Joule	Joule	Joule	Joule	
-40	Weld cap, centre line	96	113	118	109	113
	Fusion line		110	67	120	99
	Fusion line + 2mm		155	158	153	155
	Fusion line +5mm		126	134	116	125

Hardness test HV10

Location of travers	Cap, 1mm below surface	Root, 1 mm below surface
HAZ :	213-198-245-259-270-283	232-294-216-247-254-253
Weld metal :	230-224-206-215-213-219	219-213-220-222-220-228
HAZ :	266-264-245-205-198-243	272-266-225-209-197-243

Chemical analyses, base material, %

Remarks

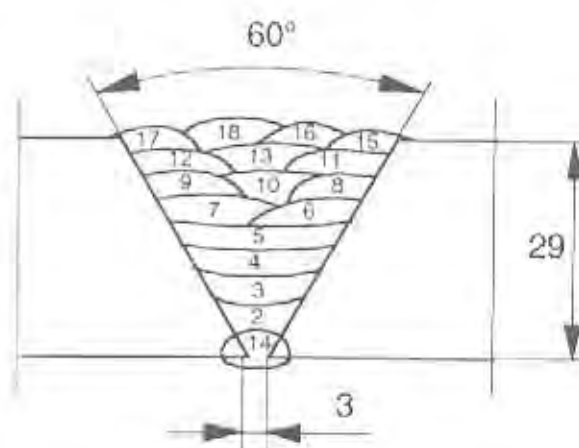
OK Autrod 13.43

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 13.43 ϕ 4.0 mm
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5,23: F11A8-EG-G

Joint preparation and bead sequence

Material spec. : OX812EM
 Plate thickness : 29 mm
 Welding position : 1G
 Current/polarity : DC(+), (DC-)¹
 Stick out : 30 mm, (20 mm)¹
 Shielding gas : 80Ar+20CO₂ (root runs)
 Root treatment : Gouged and grinded
 Restrained : No
 Preheat temp. C° : Min 130
 Interp. temp. C° : Max 200
 PWHT : NA
 Remarks : 1) Root runs 1-3 performed by OK Tubrod



14.03 ϕ 1.2 mm

Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	140-160	19 (DC-)	8.4	1.1-1.3
2-3	165-185	24 (DC-)	13	1.1-1.3
4-13	570-630	30 (DC+)	21	2.9-3.2
14	570-630	30 (DC+)	24	2.6-2.8
15-18	570-630	30 (DC+)	21	2.9-3.2

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.0 hour
 Consumption of consumables :
 Wire : OK Autrod 13.43 ϕ 4.0 = 5.4 kg
 Flux : OK Flux 10.62 = 4.7 kg
 Cored Wire : OK Tubrod 14.03 ϕ 1.2 = 0.8 kg

p121-003

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location of fraction	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa		MPa	MPa	%	%	C°	SR	mm
787	Base metal	856	922	17				

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	95	96	81	91
	Fusion line	66	75	66	69
	Fusion line +3 mm	109	111	103	108

Hardness test HV10

Location of travers	Top side 1	Root
HAZ :	358-371-358	265-265-265
Weld metal :	362-336-353	303-325-277
HAZ :	310-362-367	293-280-257
Parent metal :	265	

Chemical analyses, weld metal/ base material, %

Remarks

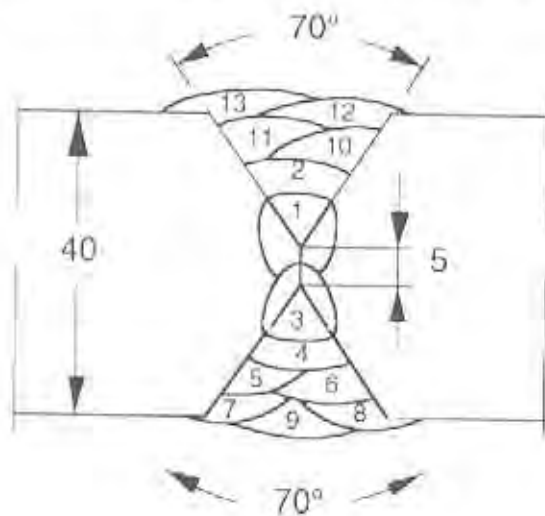
OK Autrod 13.43

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 13.43 ϕ 4.0 mm
 Flux : OK Flux 10.62
 Classification : AWS A/FSA 5.23: F11A8-EG-G

Material spec. : OX 812EM
 Plate thickness : 40 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm
 Root treatment : Grinding
 Restrained : No
 Preheat temp. C° : Min 75
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	600	30	30	2.2
2	800	30	30	2.9
3	800	30	36	2.4
4-9	800	30	30	2.9
10-13	800	30	30	2.9

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.43 hour

Consumption of consumables :

Wire : OK Autrod 13.43 ϕ 4.0 = 3.9 kg

Flux : OK Flux 10.62 = 3.3 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	71	84	76	77
	Fusion line	63	54	48	55
	Fusion line + 2mm	46	67	72	62
	Fusion line +5mm	95	118	137	117

Hardness test

Chemical analyses, base material, %

C	Mn	Si	Cr	Ni	Mo	V	B	P	S
.11	.89	.27	--	--	.40	--	.002	.016	.004

Remarks

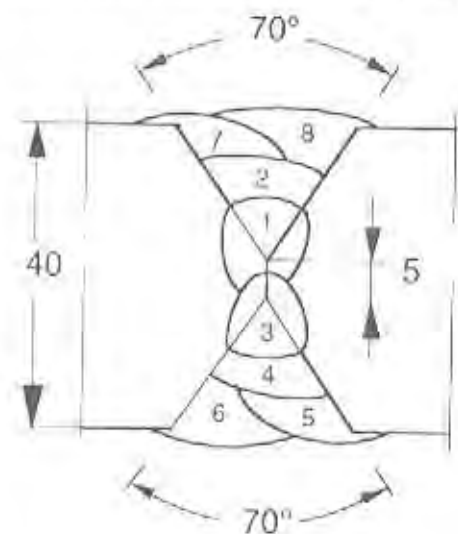
OK Autrod 13.43

Welding Procedure Specification

Welding process : MP SAW (121)
 Welding consumable
 Wire : OK Autrod 13.43 ϕ 4.0 mm
 Flux : OK Flux 10.62
 Metal powder : OK Grain 21.87

Material spec. : OX 812EM
 Plate thickness : 40 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : Metal powder is added to each pass by 8 kg/h. This is considered in the heat in put calculation.

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	750	31	36	1.2
2	750	36	36	1.4
3	800	28	36	1.2
4-6	750	36	36	1.4
7-8	750	36	36	1.4

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.3 hour

Consumption of consumables :

Wire : OK Autrod 13.43 ϕ 4.0 = 2.0 kg
 Flux : OK Flux 10.62 = 2.0 kg
 Metal powder : OK Grain 21.87 = 1.7 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-40	Weld metal centre line	66	61	52	60
	Fusion line	93	98	97	96
	Fusion line + 2mm	81	81	86	83
	Fusion line +5mm	95	89	89	91

Hardness test

Chemical analyses, base material,%

C	Mn	Si	Mo	B	P	S
0.11	0.89	0.27	0.40	0.002	0.016	0.004

Remarks

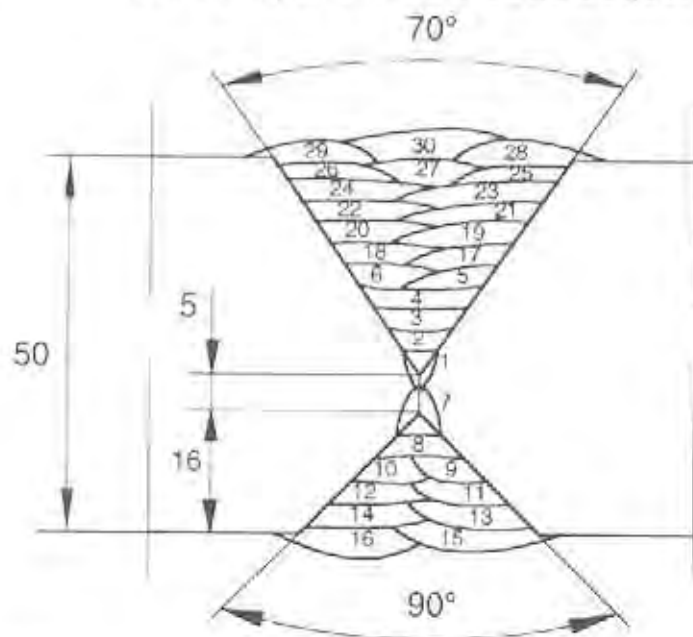
OK Autrod 13.43

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 13.43 ϕ 4.0 mm
 Flux : OK Flux 10.62
 Classification : AWS A/SFA 5.23: F11A8-EG-G

Material spec. : OX 812EM
 Plate thickness : 50 mm
 Welding position : 1G
 Current/polarity : DC (+)
 Stick out : 30 mm
 Root treatment : No
 Restrained : No
 Preheat temp. C° : Min 150
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/min	Heat input kJ/mm
1	660-740	30	0.60	1.8-2.4
2-6	620-680	30	0.50	2.1-2.6
7	740-810	28	0.50	2.4-2.8
8-30	620-680	30	0.50	2.1-2.6

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.0 hour
 Consumption of consumables
 Wire : OK Autrod 13.43 ϕ 4.0 = 7.4 kg
 Flux : OK Flux 10.62 = 6.3 kg

Mechanical test results



Tensile test

Reduced section Rm MPa	Location of fraction	All weld tensile test				CTOD Temp C°	AW SR	δ max weld metal mm
		R _{eL} MPa	Rm MPa	A %	Z %			
795	Base metal	717	803	20	70			

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-20	Weld metal centre line	90	106	88	95
	Fusion line	162	130	158	150
	Fusion line +3 mm	191	171	183	182
-51	Weld metal centre line	52	54	42	49
	Fusion line	97	101	97	98
	Fusion line + 3 mm	72	87	110	90

Hardness test HV5

Location of travers	Top side 1	Root	Top side 2
HAZ	: 362-396-391	313	391-371-353
Weld metal	: 286-299-289	286	283-274-277
HAZ	: 391-386-353	306	280-286-303
Parent metal	: 299	254	289

Chemical analyses, weld metal/ base material, %

Remarks

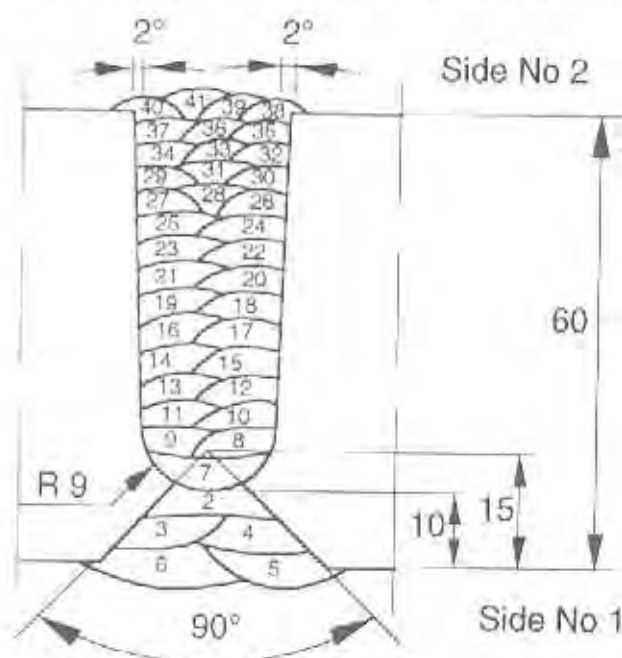
OK Autrod 13.43

Welding Procedure Specification

Welding process : SAW NG (121)
 Welding consumable :
 Wire : OK Autrod 13.43 ϕ 4 mm
 Flux : OK Flux 10.62
 Classification : AWS A/FSA 5.23:F11A8-EG-G

Material spec : OX 812EM
 Plate thickness : 60 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm
 Root treatment : Machined
 Restrained : No
 Preheat temp. C° : Min 150
 Interp. temp. C° : Max 250
 PWHT : NA
 Remarks : NG-groove machined when side No 1 is welded.

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/min	Heat input kJ/mm
1-6	650	30	0.6	1.95
7-29	650	30	0.6	1.95
30-37	550	29	0.6	1.60
38-41	550	29	0.7	1.40

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.2 hours
 Consumption of consumables
 Wire : OK Autrod 13.43 ϕ 4.0 = 8.8 kg
 Flux : OK Flux 10.62 = 7.5 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm
797	Base metal	741	787	20	62			

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-20	Weld metal centre line	100	102	100	101
	Fusion line	118	138	66	107
	Fusion line +3 mm	131	96	186	138
-51	Weld metal	64	64	64	64
	Fusion line	75	71	50	65
	Fusion line + 3 mm	33 ¹	176	172	127

Note 1: Retested. Average= 176 Joule

Hardness test HV 5

Location of travers	Top side 1	Top side 2
HAZ	345-345-313	367-371-371
Weld metal	268-274-280	310-317-303
HAZ	345-371-341	386-386-401
Parent metal	277	

Chemical analyses, weld metal/ base material, %

Remarks

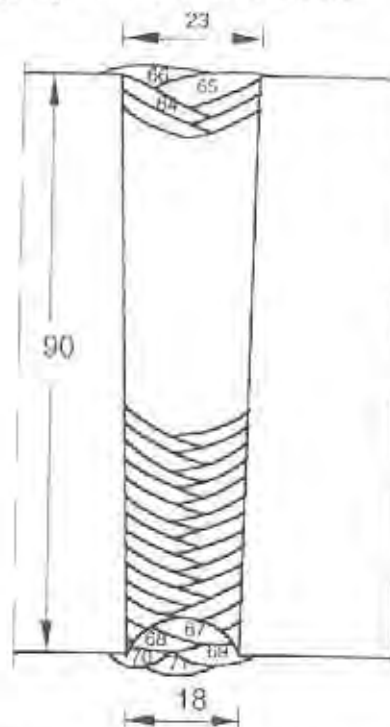
OK Autrod 13.43

Welding Procedure Specification

Welding process : SAW NG (121)
 Welding consumable :
 Wire : OK Autrod 13.43 ϕ 3.0 mm
 Flux : OK Flux 10.62
 Classification : AWS A/FSA 5.23: F11A8-EG-G

Material spec. : A517 GrF-Cr modif.
 Plate thickness : 90 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm
 Root treatment : Grinding
 Restrained : Strong backs
 Preheat temp. C° : Min 150
 Interp. temp. C° : Max 200
 PWHT : NA
 Remarks : NA

Joint preparation and bead



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1-2	425	28	24	1.8
3-64	475	28	24	2.0
65-66	475	30	24	2.1
67-71	475	30	24	2.1

Welding economy (Data for welding 1m length of the joint)

Arc time : 3.0 hour

Consumption of consumables :

Wire : OK Autrod 13.43 ϕ 3.0 = 18.9 kg

Flux : OK Flux 10.62 = 14.3 kg

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Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm
842	Weld metal							

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-40	Cap, weld metal centre line	81	81	74	79
	Fusion line	74	59	62	65
	Fusion line + 2mm	154	151	169	158
	Fusion line +5mm	142	158	160	153
-40	Root, weld metal centre line	68	69	71	69
	Fusion line	97	93	61	84
	Fusion line + 2 mm	115	115	112	114
	Fusion line + 5 mm	161	143	165	156

Hardness test HV10

Location of travers	Cap	Root
HAZ	: 243-292-322-378-350-363	254-279-327-385-383-387
Weld metal	: 287-297-285-283-266-274	317-287-283-287-274-287
Haz	: 301-363-383-339-287-274	363-357-354-297-279-254

Chemical analyses, base material,%

C	Mn	Si	Cr	Ni	Mo	Cu	V	B	P	S
.13	1.08	.37	.51	1.2	.45	.18	.04	.003	.005	.004

Remarks

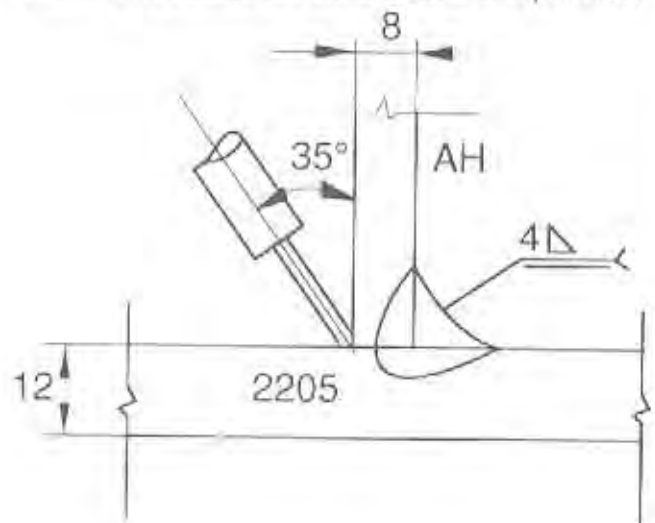
OK Autrod 16.53

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable
 Wire : OK Autrod 16.53 ϕ 3.0 mm
 Flux : OK Flux 10.93

Material spec. : 2205-AH
 Plate thickness : 12/8 mm
 Welding position : 2F
 Current/polarity : DC(+)
 Stick out : 30 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : RT
 Interp. temp. C° : NA
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	480-520	29-33	36	1.4-1.7

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.8 minutes

Consumption of consumables :

Wire : OK Autrod 16.53 ϕ 3.0 = 0.20 kg

Flux : OK Flux 10.93 = 0.10 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule

Hardness test

Chemical analyses, weld metal/ base material,%

Remarks

Ferite content

Weld metal FN: 6.3, 7.7, 9.5, 8.5, 7.9
 FN 8 average

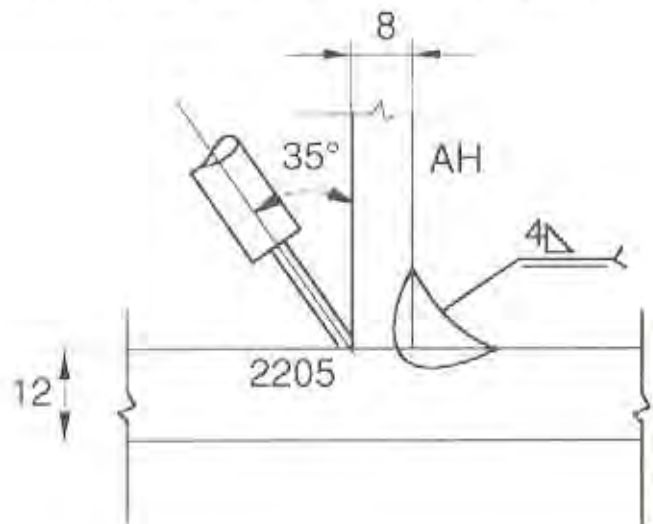
OK Autrod 16.53

Welding Procedure Specification

Welding process : SAW Twin arc (121)
 Welding consumable :
 Wire : OK Autrod 16.53 2x ϕ 2.0
 Flux : OK Flux 10.93

Material spec. : 2205-AH
 Plate thickness : 12/8 mm
 Welding position : 2F
 Current/polarity : DC(+)
 Stick out : 25 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : RT
 Interp. temp. C° : NA
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat Input kJ/mm
1	540-570	29-33	42	1.4-1.6

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.5 minutes
 Consumption of consumables :
 Wire : OK Autrod 16.53 2x ϕ 2.0 = 0.14 kg
 Flux : OK Flux 10.93 = 0.10 kg

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Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C"	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C"	location	Joule	Joule	Joule	Joule

Hardness test

Chemical analyses, weld metal/ base material, %

Remarks

Ferrite content

Weld metal FN: 17.5, 16.0, 17.4, 16.6, 17.5
 FN 17 average

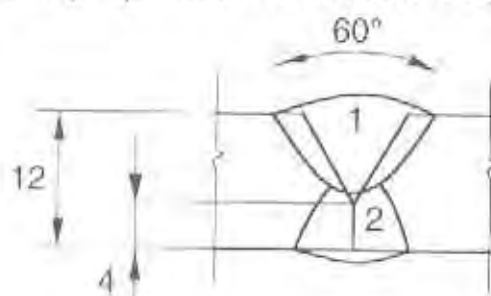
OK Autrod 16.86

Welding Procedure Specification

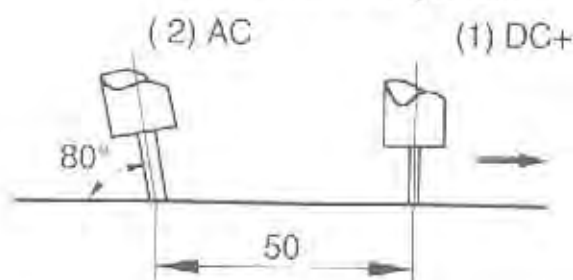
Welding process : SAW Tandem (121)
 Welding consumable :
 Wire : OK Autrod 16.86 ϕ 2x3.2 mm
 Flux : OK Flux 10.93

Material spec. : 2205
 Plate thickness : 12 mm
 Welding position : 1G
 Current/polarity : (1) DC(+), (2) AC
 Stick out : 25-35 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : NA
 Interp. temp. C° : Max 150°C
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Electrode arrangement



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
(1)	480-520	30 DC+		
1 (2)	500-550	40 AC	45	2.8-3.0
2	520-580	33 DC+	45	1.4-1.5

Welding economy (Data for welding 1m length of the joint)

Arc time : 4 minutes

Consumption of consumables :

Wire: OK Autrod 16.86 ϕ 3.2 = 0.3 kg

Flux: OK Flux 10.93 = 0.3 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-20	Weld metal centre line	113	98	94	102

Hardness test

Chemical analyses, weld metal/ base material, %

Remarks

Ferrite content

Weld metal FN: 76.2, 74.5, 77.7, 79.4, 76.3, 58.2, 59.1, 60.5, 61.6, 63.9
 FN 69 average

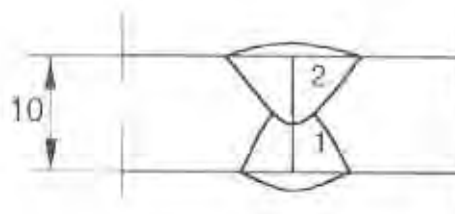
OK Autrod 16.86

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 16.86 ϕ 4.0 mm
 Flux : OK Flux 10.93

Material spec. : 2205
 Plate thickness : 10 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 30 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp. temp. C° : Max 150
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	622	29	39	1.7
2	700	29	39	1.9

Welding economy (Data for welding 1m length of the joint)

Arc time : 3 min.

Consumption of consumables :

Wire : OK Autrod 16.86 ϕ 4.0 = 0.5 kg

Flux : OK Flux 10.93 = 0.25 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm
815	Base metal							

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-20	Weld metal centre line	117	85	95	99
	Fusion line + 2 mm	178	188	175	180

Hardness test

Chemical analyses, weld material, %

	C	Mn	Si	Cr	Ni	Mo	Cu	O	N
Top	.017	1.37	.52	22.10	6.62	2.96	.15	.03	.16
Root	.026	1.35	.55	21.86	6.74	3.05	.15	.15	.16

Remarks

Ferrite content Weld metal=FN 65

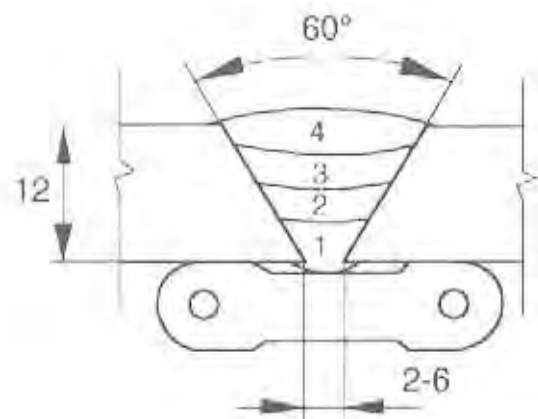
OK Autrod 16.86

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 16.86 ϕ 3.2 mm
 Flux : OK Flux 10.93

Material spec. : 2205
 Plate thickness : 12 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 25-30 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : RT
 Interp. temp. C° : Max 150
 PWHT : NA
 Remarks : Root pass performed by
 OK Tubrod 14.27 ϕ 1.2 mm
 Shielding gas : 80Ar+ 20CO₂
 Backing : OK 2124006000

Joint preparation and bead sequence



Welding parameters

Pass No	Wire dia. mm	Current A	Arc voltage volt	Stick out mm	Speed m/h	Heat input kJ/mm
1	1.2	180-200	24-26	15	7.8	2.0-2.4
2	3.2	290-310	29	30	30	1.0-1.1
3	3.2	450-500	32	25	30	1.6-1.7
4	3.2	550-600	33	25	30	2.2-2.4

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.23 hrs

Consumption of consumables :

Wire : OK Autrod 16.86 ϕ 3.2 = 0.6 kg
 Flux : OK Flux 10.93 = 0.4 kg
 Cored wire : OK Tubrod 14.27 ϕ 1.2 = 0.6 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-20	Weld metal centre line	111	111	110	111
	Fusion line	235	251	215	234
	Fusion line +2 mm	292	299	242	278

Hardness test

Chemical analyses, weld metal/ base material, %

Remarks

Ferrite content

Weld metal, top: 55.7, 54.9, 59.4, 55.6, 57.7, 53.5, 55.5, 53.9, 50.8, 49.8

FN 55 average

Weld metal, root: 42.9, 43.8, 41.6

FN 43 average

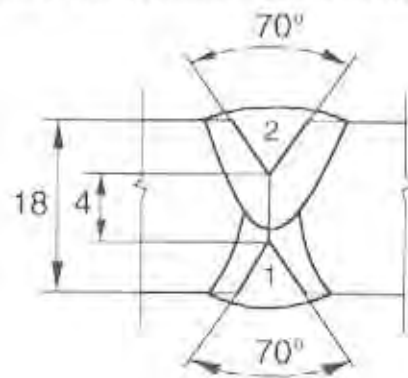
OK Autrod 16.86

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 16.86 ϕ 3.2 mm
 Flux : OK Flux 10.93

Material spec. : 2205
 Plate thickness : 18 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 25-30 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : RT
 Interp. temp. C° : Max 150
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	570-630	33	30	2.3-2.5
2	620-680	33	30	2.5-2.7

Welding economy (Data for welding 1m length of the joint)

Arc time : 4 minutes

Consumption of consumables :

Wire : OK Autrod 16.86 ϕ 3.2 = 0.6 kg

Flux : OK Flux 10.93 = 0.4 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-20	Weld metal centre line	166	130	170	155

Hardness test

Chemical analyses, weld metal/ base material, %

Remarks

Ferrite content

Weld metal: 57.9, 56.0, 59.5, 72.8, 72.5, 64.9, 63.3, 64.0, 65.5, 65.4
FN 64 average

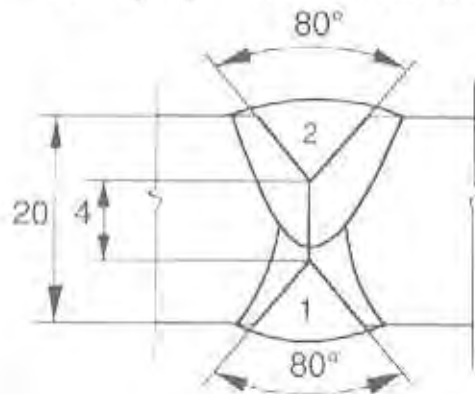
OK Autrod 16.86

Welding Procedure Specification

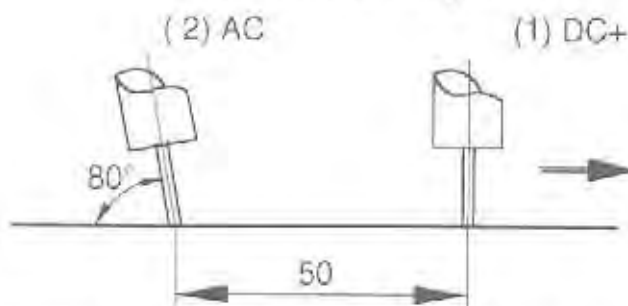
Welding process : SAW (121) Tandem
 Welding consumable :
 Wire : OK Autrod 16.86 ϕ 2x3.2 mm
 Flux : OK Flux 10.93

Material spec. : 2205
 Plate thickness : 20 mm
 Welding position : 1G
 Current/polarity : DC(+)/AC
 Stick out : 30 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C^o : RT
 Interp. temp. C^o : Max 150
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Electrode arrangement



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
(1)	550-600	33 DC		
1 (2)	490-510	40 AC	45	3.0-3.2
(1)	690-710	34 DC+		
2 (2)	490-510	40 AC	45	3.4-3.6

Welding economy (Data for welding 1m length of the joint)

Arc time : 5 minutes

Consumption of consumables :

Wire : OK Autrod 16.86 ϕ 2.3 = 0.7 kg

Flux : OK Flux 10.93 = 0.6 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-20	Weld metal centre line	70	96	145	104

Hardness test

Chemical analyses, weld metal/ base material, %

Remarks

Ferrite content

Weld metal FN: 62.8, 65.9, 57.7, 66.2, 63.0, 68.9, 66.1, 66.8, 73.6, 73.0
 FN 66 average

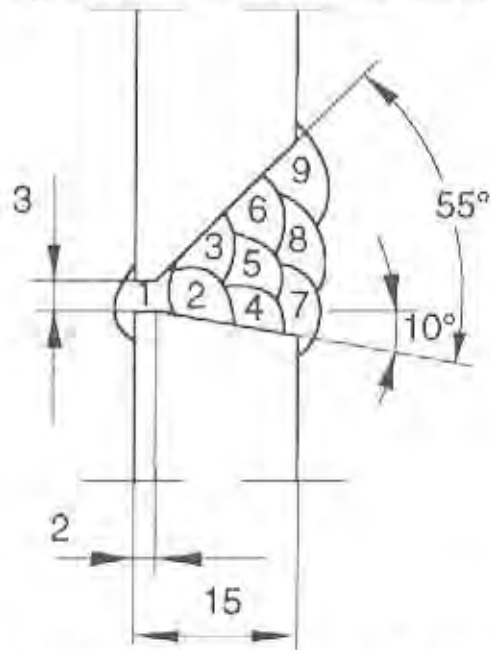
OK Autrod 19.82

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 19.82 ϕ 1.6 mm
 Flux : OK Flux 10.16
 Classification : AWS A/SFA 5.14: ER Ni Cr Mo-3

Welding Procedure Specification

Material spec. : SA 553-1(9% Ni)
 Plate thickness : 15 mm
 Welding position : 2G
 Current/polarity : DC(-)
 Stick out : 25 mm
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 20
 Interp. temp. C° : Max 150
 PWHT : NA
 Remarks : Root pass performed
 by SMAW with
 OK 92.55 ϕ 3.25 mm

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1	110-120	21	200 mm	0.7-0.8
2-5	270-290	28-31	31-35	0.8-1.0
6	240-260	28-31	31-35	0.7-0.9
7	270-290	30-34	29-32	0.9-1.2
8	240-260	30-34	31-35	0.7-0.9
9	260-290	30-34	31-35	0.8-1.0

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.36 hour

Consumption of consumables :

Electrode : OK 92.55 ϕ 3.25 = 0.3 kg
 Wire : OK Autrod 19.82 ϕ 1.6 = 1.0 kg
 Flux : OK Flux 10.16 = 0.6 kg

p121-028

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location of fraction	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa		MPa	MPa	%	%	°C	SR	mm
701	Weld metal	418	698	44	54	-170	AW	WM=0.644,0.658,0.564 HAZ=0.595,0.529,0.594

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-196	Weld metal centre line	126	111	126	121
	Fusion line	92	120	118	110
	Fusion line + 2mm	354	146	354	285
	Fusion line +5mm	182	187	196	188

Hardness test HV10

Location of travers	Face	mid-thickn	Root
HAZ :	228-230-254-254	220-227-225-203	251-264-272-276
Weld metal :	240-237-237	217-224-228	227-209-209
HAZ :	230-304-297-270	227-242-238-222	330-333-256-232
Base metal :	230-230-230	224-220-224	233-230-228

Chemical analyses, base material, %

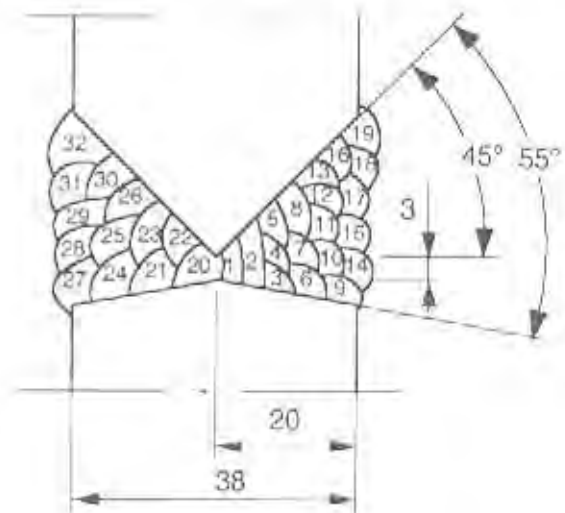
OK Autrod 19.82

Welding Procedure Specification

Welding process : SAW (121)
 Welding consumable :
 Wire : OK Autrod 19.82 ϕ 1.6 mm
 Flux : OK Flux 10.16

Material spec. : SA 553-1 (9% Ni)
 Plate thickness : 38 mm
 Welding position : 2G
 Current/polarity : DC(-), AC (root runs)
 Stick out : 25mm
 Root treatment : Grinding
 Restrained : No
 Preheat temp. C° : Min 20
 Interp. temp. C° : Max 150
 PWHT : NA
 Remarks : Root passes welded
 by OK 92.55 ϕ 3.25

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage Volt	Speed m/h	Heat input kJ/mm
1-2	75-85	22-24	ROL 140-160 mm	0.6-0.9
3-12	270-290	30-34	31-35	0.8-1.1
13-19	240-260	30-34	29-32	0.8-1.1
20-25	240-260	30-34	31-35	0.8-1.0
26-32	240-260	30-34	28-31	0.8-1.1

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.5 hour
 Consumption of consumables :
 Stick electrode : OK 92.55 ϕ 3.25 = 0.6 kg
 Wire : OK Autrod 19.82 ϕ 1.6 = 4.2 kg
 Flux : OK Flux 10.16 = 2.4 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm WM=0.72-0.42-0.46 HAZ=0.55-0.48-0.32
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR AW	
699	Base metal					-170		

Charpy V-notch impact values

Temp C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-196	Weld metal centre line	127	121	118	122
	Fusion line	126	110	103	113
	Fusion line + 2mm	252	304	288	281
	Fusion line +5mm	186	182	180	183

Hardness test HV10

Location of travers	Side 1	Root area	Side 2
HAZ	342-333-304	254-251-339	330-327-330
Weld metal	193-181-183	245-272-260	217-217-213
HAZ	345	294-306-249	322
Base metal	238-237-237	242-242-242	233-233-233

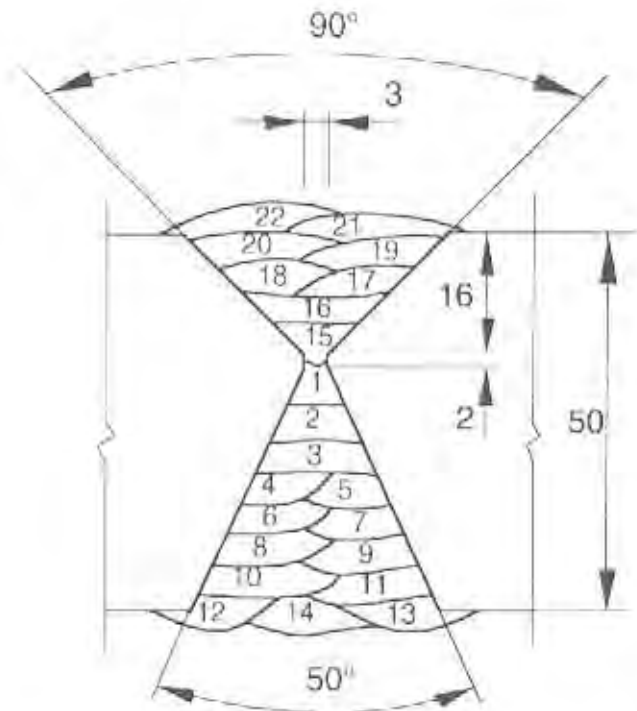
Chemical analyses, weld metal/ base material, %

Remarks

OK Autrod 13.13

Welding Procedure Specification

Welding process	: MAG (135)	
Welding consumable	: OK Autrod 13.13 ϕ 1.2 mm	
Classification	: AWS A/SFA 5.28: ER100S-G	
Material spec.	: OX 812EM	Joint preparation and bead sequence
Plate thickness	: 50 mm	
Welding position	: 3G	
Current/polarity	: DC (+)	
Stick out	: 19 mm	
Shielding gas	: 95%Ar+5%CO ₂	
Root treatment	: Grinding	
Restrained	: No	
Preheat temp. C°	: Min 150	
Interp. temp. C°	: Max 250	
PWHT	: NA	
Remarks	: NA	



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1-13	135-145	26-28	90	2.3-2.7
14-15	135-145	26-28	100	2.1-2.4
16	135-145	26-28	90	2.3-2.4
17-18	135-145	26-28	100	2.1-2.4
19-22	135-145	26-28	90	2.3-2.4

Welding economy (Data for welding 1m length of the joint)

Arc time	: 4.0 hour
Consumption of consumables	
Wire	: OK Autrod 13.13 ϕ 1,2 = 8,0 kg

p.135-001

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	°C	SR	mm
795	Base metal	681	796	22	68			

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
°C	location	Joule	Joule	Joule	Joule
-20	Weld metal centre line	68	70	84	74
	Fusion line	94	103	90	96
	Fusion line +3 mm	187	188	194	190
-51	Weld metal	30	27	40	32
	Fusion line	82	56	54	64
	Fusion line + 3 mm	174	172	159	168

Hardness test HV 5

Location of travers	Top side 1	Root	Top side 2
HAZ	358-381-362	286	396-396-391
Weld metal	283-280-274	299	306-299-293
HAZ	376-381-386	349	396-407-386
Parent metal	280-296		286-286

Chemical analyses, weld metal/ base material, %

Remarks

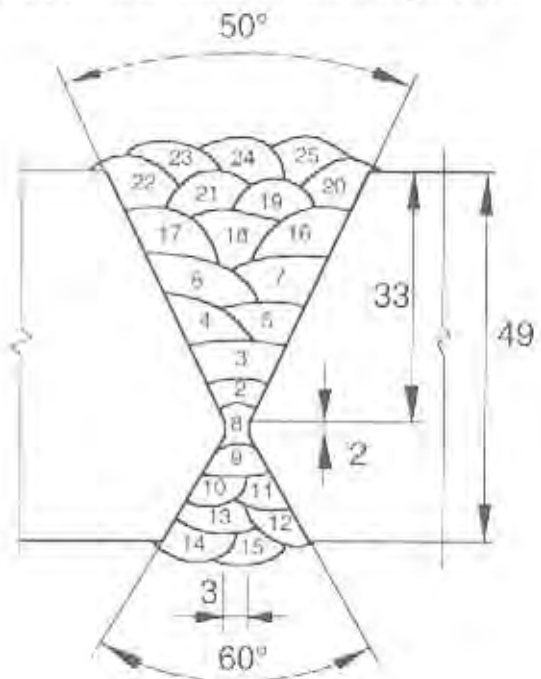
OK Tubrod 14.03

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 14.03 ϕ 1.2 mm
 Classification : AWS A/SFA 5.29: E81TG-A1

Material spec : OX 812EM
 Plate thickness : 49 mm
 Welding position : 3G
 Current/polarity : DC(-)
 Stick out : 15-20 mm
 Shielding gas : 80%Ar+20%CO₂
 Root treatment : Grinding
 Restrained : No
 Preheat temp. C° : Min120
 Interp. temp. C° : Max 200
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	120	18	100	1.3
2-25	160	21	160	1.3

Welding economy (Data for welding 1m length of the joint)

Arc time : 2.7 hour
 Consumption of consumables
 Cored wire : OK Tubrod 14.03 ϕ 1.2 = 6.0 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm
760	Base metal	799	858	17				

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-40	Weld metal centre line	55	56	54	55
	Fusion line	103	65	67	78
	Fusion line +3 mm	220	171	216	202

Hardness test HV10

Location of tracers	Top side 1	Top side 2
HAZ	274-376-376	336-376-396
Weld metal	299-293-310	310-286-277
HAZ	376-391-280	381-386-386
Parent metal:	260	

Chemical analyses, weld metal/ base material, %

Remarks

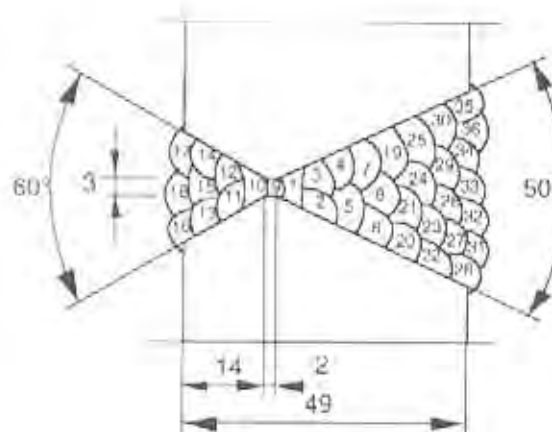
OK Tubrod 14.03

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 14.03 ϕ 1.2 mm
 Classification : AWS A/SFA 5.29: E81TG-A1

Material spec. : OX812EM
 Plate thickness : 49 mm
 Welding position : 2G
 Current/polarity : DC(-)
 Stick out : 15-20 mm
 Shielding gas : 80%Ar+20%CO₂
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 120
 Interp. temp. C° : Max 200
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	170-180	24	200	1.2-1.3
2-36	170-180	24	250	1.0-1.1

Welding economy (Data for welding 1m length of the joint)

Arc time : 2.4 hour
 Consumption of consumables
 Cored wire : OK Autrod 14.03 ϕ 1.2 = 6.5 kg

g136-005

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm
765	Base metal	794	837	16				

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	53	53	56	54
	Fusion line	72	91	58	74
	Fusion line +3 mm	212	204	221	212

Hardness test HV10

Location of travers	Top side 1	Top side 2
HAZ	: 353-376-376	376-381-362
Weld metal	: 303-313-293	329-317-310
HAZ	: 396-381-396	386-391-386
Parent metal	: 257	

Chemical analyses, weld metal/ base material, %

Remarks

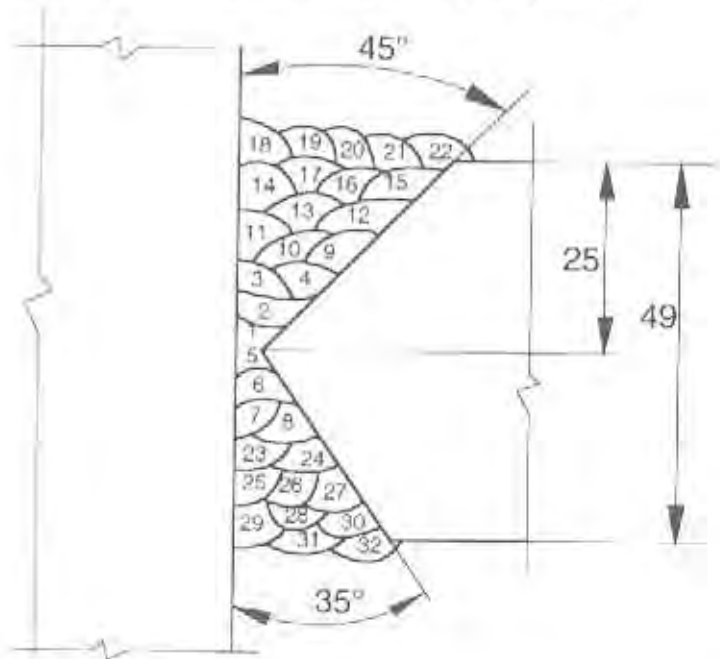
OK Tubrod 14.03

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 14.03 ϕ 1.2 mm
 Classification : AWS A/SFA 5.29: E81TG-A1

Material spec. : OX 812EM
 Plate thickness : 49 mm
 Welding position : 3G
 Current/polarity : DC(-)
 Stick out : 15-20 mm
 Shielding gas : 80%Ar+20%CO₂
 Root treatment : Grinding
 Restrained : No
 Preheat temp. C° : Min 150
 Interp. temp. C° : Max 200
 PWHT : -NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	150-170	23	200	1.0-1.2
2-32	170-185	24	240	1.0-1.1

Welding economy (Data for welding 1m length of the joint)

Arc time : 2.3 hour
 Consumption of consumables
 Cored wire : OK Tubrod 14.03 ϕ 1.2 = 6.0 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm
		789	836	17				

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	55	53	54	54
	Fusion line	95	94	92	94
	Fusion line +3 mm	177	160	168	168

Hardness test HV10

Location of travers	Top side 1	Top side 2
HAZ :	293-386-412	293-386-412
Weld metal :	313-271-303	313-303-293
HAZ :	401-296-271	386-407-303
Parent metal:	251	

Chemical analyses, weld metal/ base material, %

Remarks

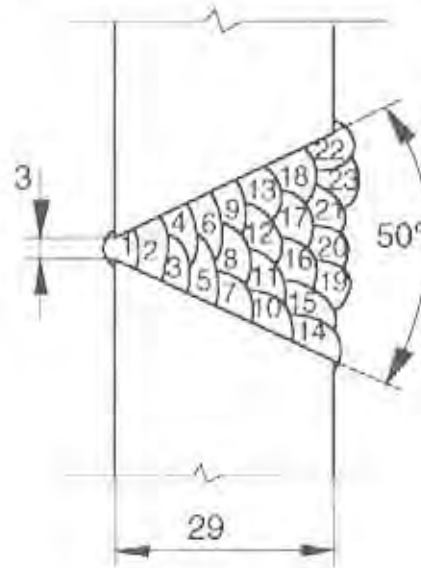
OK Tubrod 14.03

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 14.03 ϕ 1.2 mm
 Classification : AWS A/FSFA 5.29; E81TG-A1

Material spec. : OX812EM
 Plate thickness : 29 mm
 Welding position : 2G
 Current/polarity : DC(-)
 Stick out : 15-20 mm
 Shielding gas : 80%Ar+20%CO₂
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 100
 Interp. temp. C° : Max 200
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	135-150	18	160	0.9-1.0
2-23	165-185	24	250	1.0-1.1

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.6 hour
 Consumption of consumables
 Cored wire : OK Tubrod 14.03 ϕ 1.2 = 4.2 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location of fraction	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa		MPa	MPa	%	%	C°	SR	mm
787	Base metal	803	839	19				

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	60	58	57	58
	Fusion line	80	94	107	94
	Fusion line +3 mm	200	220	219	213

Hardness test HV10

Location of travers	Top	Root
HAZ :	283-313-381	299-268-274
Weld metal :	325-277-310	268-286-274
HAZ :	407-396-313	274-271-293
Parent metal:	265	

Chemical analyses, weld metal/ base material, %

Remarks

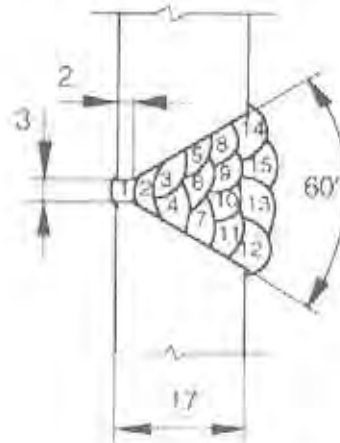
OK Tubrod 14.03

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 14.03 ϕ 1.2 mm
 Classification : AWS A/SFA 5.29: E81TG-A1

Material spec. : OX 812EM
 Welding position : 2G
 Plate thickness : 17 mm
 Current/polarity : DC(-)
 Stick out : 15-20 mm
 Shielding gas : 80%Ar+20%CO₂
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 80
 Interp. temp. C° : Max 200
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	110-120	18	160	0.7-0.8
2-15	165-185	24	250	1.0-1.1

Welding economy (Data for welding 1m length of the joint)

Arc time : 1.1 hour
 Consumption of consumables
 Cored wire : OK Tubrod 14.03 ϕ 1.2 = 2.7 kg

p106-002

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	
803	Base metal	811	861	18				

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-40	Weld metal centre line	60	64	66	63
	Fusion line	146	100	154	133
	Fusion line +3 mm	206	196	187	196

Hardness test HV10

Location of travers	Top	Root
HAZ :	362-391-381	280-286-268
Weld metal :	341-262-310	277-274-286
HAZ :	371-371-381	271-277-303
Parent metal:	257	

Chemical analyses, weld metal/ base material, %

Remarks

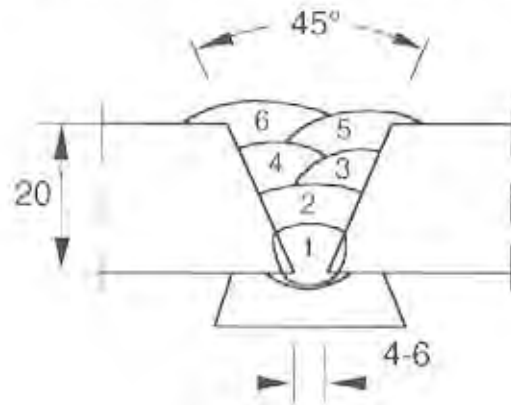
OK Tubrod 15.00

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 15.00 ϕ 1.2 mm
 Classification : AWS A/SFA 5.20: E71 T-5

Joint preparation and bead sequence

Material spec : DH36
 Plate thickness : 20 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 15-20 mm
 Shielding gas : 80% Ar+20% CO₂
 Shielding gas flow : 18 l/min
 Root treatment : NA
 Restrained : No
 Preheat temp. C^o : Min 10
 Interp.temp. C^o : Max 250
 PWHT : NA
 Remarks : NA
 Backing : OK Backing 2124087000



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1-2	170-190	23-25	200	1.2-1.4
3-6	280-320	25-27	290	1.5-1.8

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.40 hour
 Consumption of consumables
 Cored wire : OK Tubrod 15.00 ϕ 1.2 = 2.1 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-20	Weld metal centre line	50	60	66	59
	Fusion line	102	118	122	114
	Fusion line +3mm	170	165	145	160

Hardness test

Chemical analyses, base material, %

Remarks

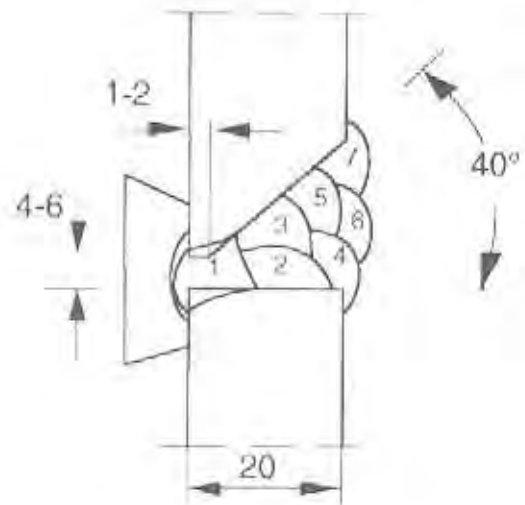
OK Tubrod 15.00

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 15.00 ϕ 1.2 mm
 Classification : AWS A/SFA 5.20; E 71 T-5

Joint preparation and bead sequence

Material spec. : DH36
 Plate thickness : 20 mm
 Welding position : 2G
 Current/polarity : DC(+)
 Stick out : 15-20 mm
 Shielding gas : 80% Ar+20% CO₂
 Shielding gas flow : 18 l/min.
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp.temp. C° : Max 250
 PWHT : NA
 Remarks : NA
 Backing : OK Backing 2124087000



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	170-190	23-25	200	1.2-1.4
2-7	190-210	25-27	240	1.2-1.4

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.5 hour
 Consumption of consumables
 Cored wire : OK Tubrod 15.00 ϕ 1.2 = 1.6 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
-20	Weld metal centre line	123	107	104	111
	Fusion line	135	149	146	143
	Fusion line +3mm	173	137	162	157

Hardness test

Chemical analyses, base material, %

Remarks

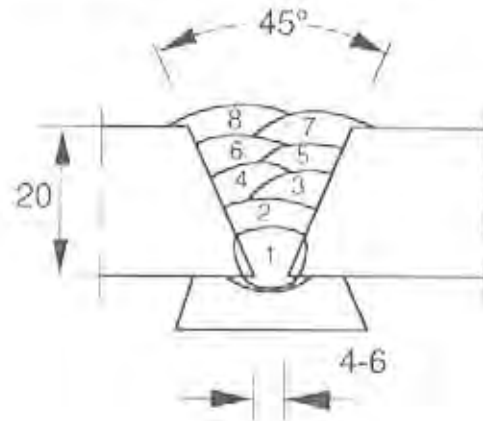
OK Tubrod 15.25

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 15.25 ϕ 1.2 mm

Joint preparation and bead sequence

Material spec. : DH36
 Plate thickness : 20 mm
 Welding position : 1G
 Current/polarity : DC(-)
 Stick out : 15-20 mm
 Shielding gas : 80% Ar+20% CO₂
 Shielding gas flow : 18 l/min.
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp.temp. C° : Max 250
 PWHT : NA
 Remarks : NA
 Backing : OK Backing 2124087000



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1-2	170-190	23-25	140	1.7-2.0
3-8	240-260	25-27	200	1.8-2.1

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.74 hour
 Consumption of consumables
 Cored wire : OK Tubrod 15.25 ϕ 1.2 = 2.3 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-60	Weld metal centre line	86	67	27	60
-40	Fusion line	61	149	94	101
	Fusion line +3mm	79	41	37	52

Hardness test

Chemical analyses, base material, %

Remarks

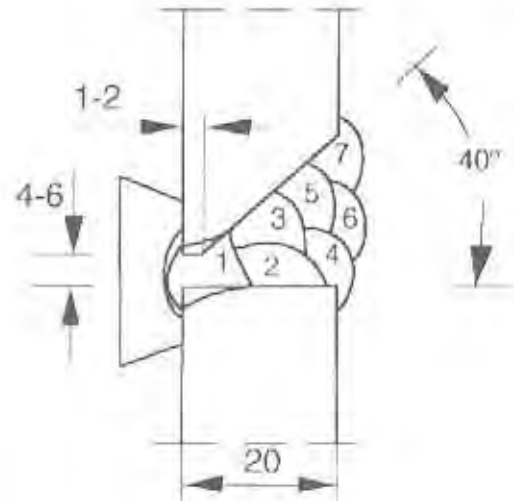
OK Tubrod 15.25

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 15.25 ϕ 1.2 mm

Material spec. : DH36
 Plate thickness : 20 mm
 Welding position : 2G
 Current/polarity : DC(-)
 Stick out : 15-20 mm
 Shielding gas : 80% Ar+20% CO₂
 Shielding gas flow : 18 l/min.
 Root treatment : NA
 Restrained : No
 Preheat temp. C" : Min 10
 Interp.temp. C" : Max 250
 PWHT : NA
 Remarks : NA
 Backing : OK Backing 2124087000

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	170-190	23-25	200	1.2-1.4
2-7	190-210	25-27	240	1.2-1.4

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.5 hour
 Consumption of consumables : OK Tubrod 15.25 ϕ 1.2 = 1.6 kg
 Cored wire

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-60	Weld metal centre line	60	72	39	57
	Fusion line	47	37	44	43
	Fusion line +3mm	117	136	157	137

Hardness test

Chemical analyses, base material, %

Remarks

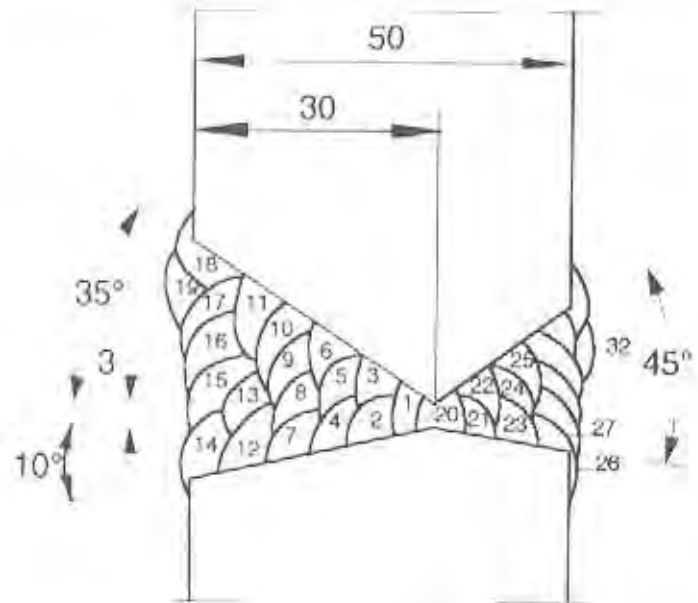
OK Tubrod 15.26

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 15.26 ϕ 1.6 mm

Material spec. : HY 80
 Plate thickness : 50 mm
 Welding position : 2G
 Current/polarity : DC(-)
 Stick out : 20 mm
 Shielding gas : 80% Ar+20% CO₂
 Shielding gas flow : 18 l/min.
 Root treatment : Backgouged and grinded
 Restrained : Strong backs
 Preheat temp. C° : Min 120
 Interp.temp. C° : Max 150
 PWHT : NA
 Remarks : Root pass performed with OK 78.04 ϕ 3.2

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	120	22	ROL=150 mm	1.5
2-12	300	27	265	1.8
13	230	27	265	1.4
14-18	300	27	265	1.8
19	230	27	265	1.4
20-25	300	27	265	1.8
26	230	27	265	1.4
27-31	300	27	265	1.8
32	230	27	265	1.4

Welding economy (Data for welding 1m length of the joint)

Arc time : 2.1 hour
 Consumption of consumables
 Cored wire : OK Tubrod 15.26 ϕ 1.2 = 8 kg
 OK 78.04 ϕ 3.2 = 0.3 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm
		640	719	20				

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-50	Weld metal centre line	116	128	122	121

Hardness test

Chemical analyses, weld material,%

C	Si	Mn	P	S	Cr	Mo	Ni	Cu
.08	.42	1.50	.013	.016	.16	.06	1.9	.02

Remarks

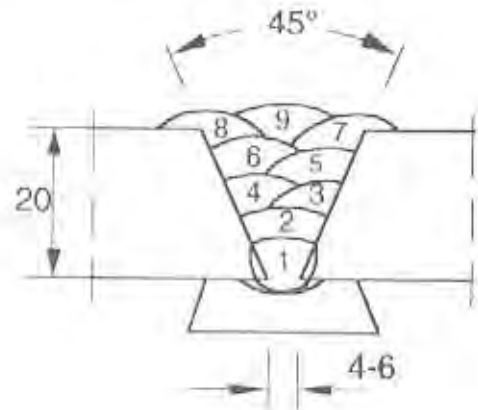
OK Tubrod 15.14

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 15.14 ϕ 1.2 mm
 Classification : AWS A/SFA 5.20: E 71T-1

Joint preparation and bead sequence

Material spec. : DH36
 Plate thickness : 20 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 15-20 mm
 Shielding gas : 80% Ar+20% CO₂
 Shielding gas flow : 18 l/min.
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp.temp. C° : Max 250
 PWHT : NA
 Remarks : NA
 Backing : OK Backing 2124087000



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	190-210	25-27	250	1.1-1.4
2-9	280-300	28-32	330	1.4-1.7

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.5 hour
 Consumption of consumables
 Cored wire : OK Tubrod 15.14 ϕ 1.2 = 2.4 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-20	Weld metal centre line	106	125	111	114
	Fusion line	122	73	63	86
	Fusion line +3mm	202	160	151	171

Hardness test

Chemical analyses, base material, %

Remarks

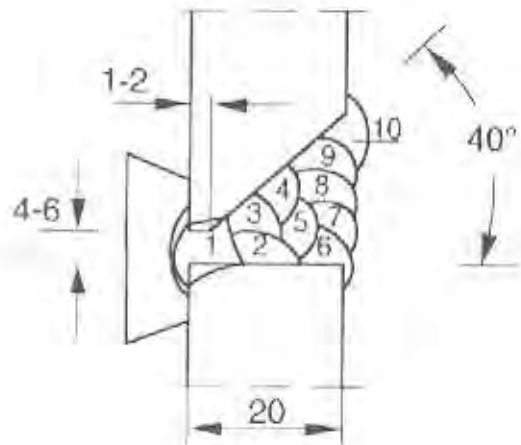
OK Tubrod 15.14

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 15.14 ϕ 1.2 mm
 Classification : AWS A/SFA 5.20: E71T-1

Joint preparation and bead sequence

Material spec. : DH36
 Plate thickness : 20 mm
 Welding position : 2G
 Current/polarity : DC(+)
 Stick out : 15-20 mm
 Shielding gas : 80% Ar+20% CO₂
 Shielding gas flow : 18 l/min.
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp.temp. C° : Max 250
 PWHT : NA
 Remarks : NA
 Backing : OK Backing 2124087000



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	190-210	25-27	190	1.5-1.8
2-10	190-210	25-27	280	1.0-1.2

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.61 hour
 Consumption of consumables
 Cored wire : OK Tubrod 15.14 ϕ 1.2 = 1.9kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-20	Weld metal centre line	78	125	61	88
	Fusion line	105	148	112	122
	Fusion line +3mm	199	179	183	187

Hardness test

Chemical analyses, base material, %

Remarks

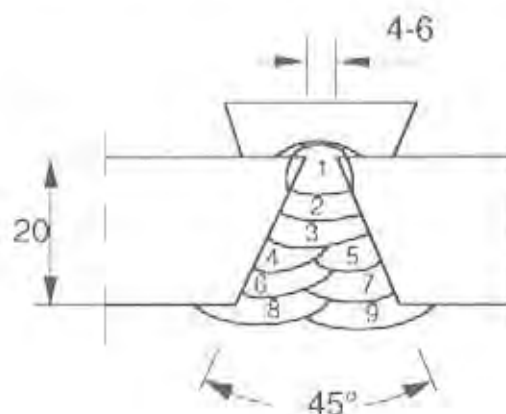
OK Tubrod 15.14

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 15.14 ϕ 1.2 mm
 Classification : AWS A/SFA 5.20: E71T-1

Joint preparation and bead sequence

Material spec. : DH36
 Plate thickness : 20 mm
 Welding position : 3G
 Current/polarity : DC(+)
 Stick out : 15-20 mm
 Shielding gas : 80% Ar+20% CO₂
 Shielding gas flow : 18 l/min.
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp.temp. C° : Max 250
 PWHT : NA
 Remarks : NA
 Backing : OK Backing 2124087000



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	190-210	25-27	200	1.4-1.7
2-9	190-210	25-27	210	1.3-1.6

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.72 hour
 Consumption of consumables
 Cored wire : OK Tubrod 15.14 ϕ 1.2 = 2.3 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-20	Weld metal centre line	77	42	80	66
	Fusion line	74	85	122	94
	Fusion line +3mm	161	164	159	161

Hardness test

Chemical analyses, base material, %

Remarks

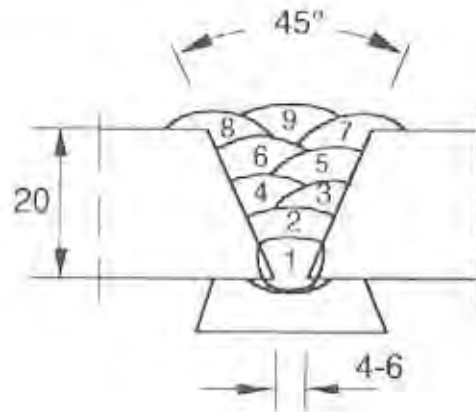
OK Tubrod 15.17

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 15.17 ϕ 1.2 mm
 Classification : AWS A/SFA 5.29: E81 T1-Ni 1

Joint preparation and bead sequence

Material spec. : DH36
 Plate thickness : 20 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 15-20 mm
 Shielding gas : 80% Ar+20% CO₂
 Shielding gas flow : 18 l/min.
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp.temp. C° : Max 250
 PWHT : NA
 Remarks : NA
 Backing : OK Backing 2124087000



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	190-210	25-27	250	1.1-1.4
2-9	280-300	28-32	330	1.4-1.7

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.5 hour
 Consumption of consumables
 Cored wire : OK Tubrod 15.17 ϕ 1,2 = 2.4 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location of fraction	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa		MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch location	1st	2nd	3rd	Av.
C°		Joule	Joule	Joule	Joule
-40	Weld metal centre line	115	76	92	94
	Fusion line	86	73	46	68
	Fusion line +3mm	32	34	51	39

Hardness test

Chemical analyses, base material, %

Remarks

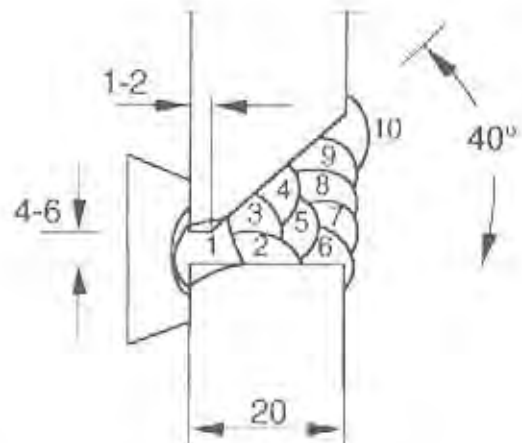
OK Tubrod 15.17

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 15.17 ϕ 1.2 mm
 Classification : AWS A/SFA 5.29: E81T1-Ni

Joint preparation and bead sequence

Material spec. : DH36
 Plate thickness : 20 mm
 Welding position : 2G
 Current/polarity : DC(+)
 Stick out : 15-20 mm
 Shielding gas : 80% Ar+20% CO₂
 Shielding gas flow : 18 l/min.
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp.temp. C° : Max 250
 PWHT : NA
 Remarks : NA
 Backing : OK Backing 2124087000



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	190-210	25-27	200	1.4-1.7
2-10	190-210	25-27	280	1.0-1.2

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.62 hour
 Consumption of consumables :
 Cored wire : OK Tubrod 15.17 ϕ 1.2 mm = 1.9 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-40	Fusion line	83	133	97	104
	Fusion line +3 mm	63	97	65	75
	Weld metal centre line	106	107	117	110

Hardness test

Chemical analyses, base material, %

Remarks

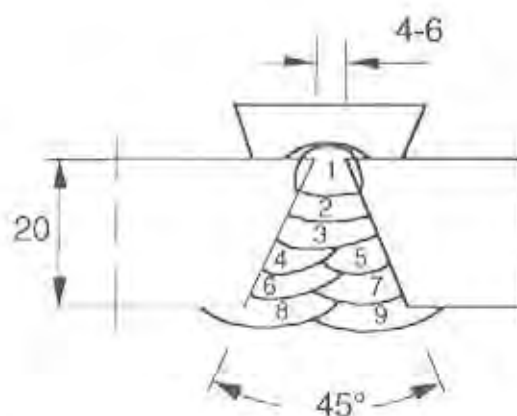
OK Tubrod 15.17

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 15.17 ϕ 1.2 mm
 Classification : AWS A/SFA 5.29: E81T-Ni-1

Joint preparation and bead sequence

Material spec. : DH36
 Plate thickness : 20 mm
 Welding position : 3G
 Current/polarity : DC(+)
 Stick out : 15-20 mm
 Shielding gas : 80% Ar+20% CO₂
 Shielding gas flow : 18 l/min.
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp.temp. C° : Max 250
 PWHT : NA
 Remarks : NA
 Backing : OK Backing 2124087000



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	190-210	25-27	200	1.4-1.7
2-9	190-210	25-27	210	1.3-1.6

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.72 hour
 Consumption of consumables
 Cored wire : OK Tubrod15.17 ϕ 1.2 = 2.3 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-40	Weld metal centre line	58	65	49	57
	Fusion line	93	120	65	93
	Fusion line +3mm	125	126	130	127

Hardness test

Chemical analyses, base material, %

Remarks

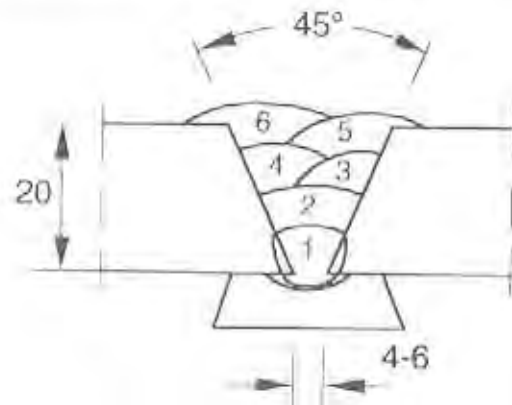
OK Tubrod 15.18

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 15.18 ϕ 1.2 mm
 Classification : AWS A/SFA 5.20: E70T-1

Joint preparation and bead sequence

Material spec. : DH36
 Plate thickness : 20 mm
 Welding position : 1G
 Current/polarity : DC(+)
 Stick out : 15-20 mm
 Shielding gas : 80% Ar+20% CO₂
 Shielding gas flow : 18 l/min.
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : Min 10
 Interp.temp. C° : Max 250
 PWHT : NA
 Remarks : NA
 Backing : OK Backing 2124087000



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	170-190	23-25	150	1.6-1.9
2-6	300-340	28-30	280	1.8-2.2

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.3 hour
 Consumption of consumables
 Cored wire : OK Tubrod 15.18 ϕ 1.2 = 2.1 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-20	Weld metal centre line	27	29	37	31
	Fusion line	61	56	65	61
	Fusion line +3mm	195	170	183	183

Hardness test

Chemical analyses, base material, %

Remarks

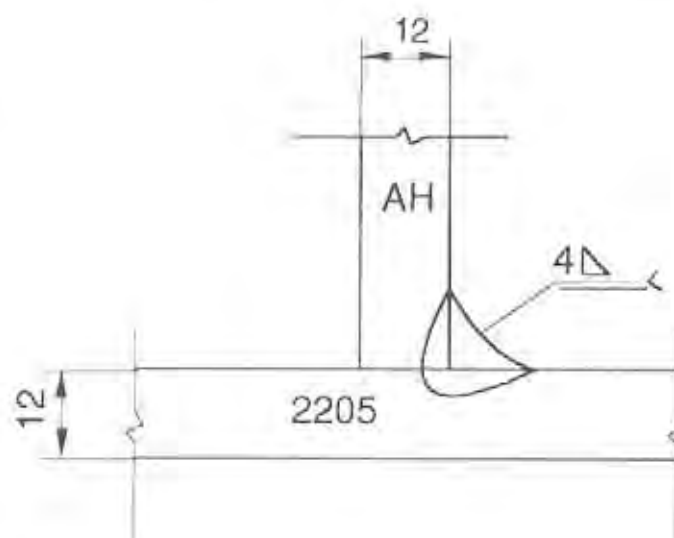
OK Tubrod 14.27

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 14.27 ϕ 1.2 mm

Material spec. : 2205
 Plate thickness : 12 mm
 Welding position : 3F
 Current/polarity : DC(+)
 Stick out : 15 mm
 Shielding gas : 80%Ar+20%CO₂
 Shielding gas flow : 18 l/min.
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : RT
 Interp.temp. C° : NA
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	145-155	22-23	200	1.0-1.1

Welding economy (Data for welding 1m length of the joint)

Arc time : 5 minutes
 Consumption of consumables
 Cored wire : OK Tubrod 14.27 ϕ 1.2 mm =0.22 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		δ max weld metal mm
Rm MPa	Location of fraction	R _{p0.2} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	

Charpy V-notch impact values

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
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Hardness test

Chemical analyses, weld metal/ base material, %

Remarks

Ferrite content

Weld metal FN: 67,68,64
FN 66 average

d136-011

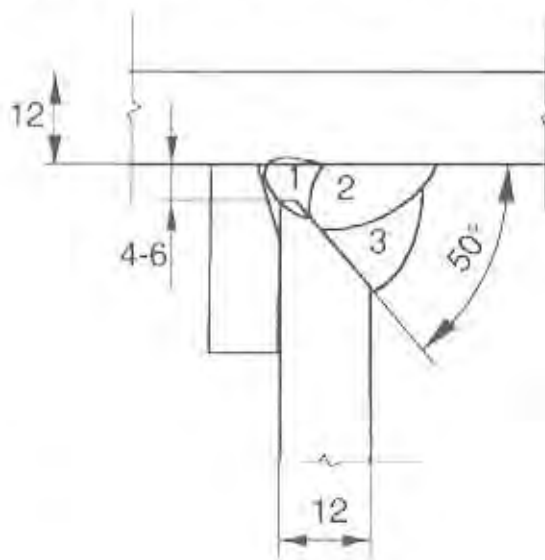
OK Tubrod 14.27

Welding Procedure Specification

Welding process : FCAW (136)
 Welding consumable : OK Tubrod 14.27 ϕ 1.2 mm

Joint preparation and bead sequence

Material spec. : 2205
 Plate thickness : 12 mm
 Welding position : 3G
 Current/polarity : DC(+)
 Stick out : 15 mm
 Shielding gas : 80Ar+20CO₂
 Shielding gas flow : 18l/min.
 Root treatment : NA
 Restrained : No
 Preheat temp. C° : RT
 Interp.temp. C° : Max 150
 PWHT : NA
 Remarks : Backing OK 2124085000



Welding parameters

Pass No	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1-3	140-160	22-24	150	1.2-1.5

Welding economy (Data for welding 1m length of the joint)

Arc time : 0.33 hour
 Consumption of consumables
 Cored wire : OK Tubrod 14.27 ϕ 1.2 = 1.0 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm MPa	Location of fraction	R _{eL} MPa	Rm MPa	A %	Z %	Temp C°	AW SR	δ max weld metal mm

Temp. C°	Notch location	1st Joule	2nd Joule	3rd Joule	Av. Joule
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Hardness test

Chemical analyses, weld metal/ base material, %

Remarks

Ferrite content

Weld metal FN: 57.7, 48.8, 50.9, 54.5, 52.7, 47.5, 52.5, 47.6, 50.9, 51.5
 FN 51 average

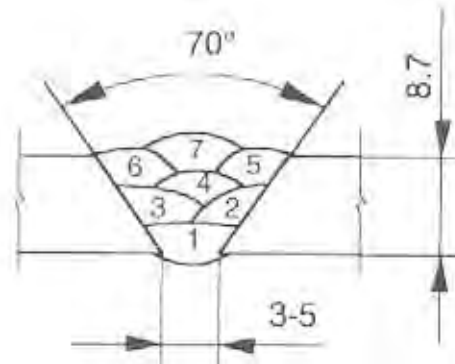
OK Tigrod 16.88

Welding Procedure Specification

Welding process : TIG (141)
 Welding consumable : OK Tigrod 16.88 ϕ 2.4 mm

Material spec. : Zeron 100
 Pipe : ϕ 170x8.7mm
 Welding position : 1G
 Current/polarity : DC-
 Shielding gas : Ar (15 litre/min)
 Root treatment : NA
 Restrained : No
 Preheat temp.C° : RT
 Interpass temp.C° : Max 150
 PWHT : NA
 Remarks : NA

Joint preparation and bead sequence



Welding parameters

Pass No	Electrode ϕ mm	Current A	Arc voltage V	Speed mm/min	Heat input kJ/mm
1	2.4	120-140	12-13	50	1.7-2.2
2	2.4	120-140	12-13	70	1.3-1.6
3-7	2.4	120-140	12-13	50	1.7-2.2

Welding economy (Data for welding 1m length of the joint)

Arc time : 2.2 hour

Consumption of consumables : OK Tigrod 16.88 ϕ 2.4 = 0.8 kg

Mechanical test results



Tensile test

Reduced section		All weld tensile test				CTOD		
Rm	Location	R _{eL}	Rm	A	Z	Temp	AW	δ max weld metal
MPa	of fraction	MPa	MPa	%	%	C°	SR	mm

Charpy V-notch impact values

Temp.	Notch	1st	2nd	3rd	Av.
C°	location	Joule	Joule	Joule	Joule
-20	Weld metal centre line	89	90	71	83
-40	Weld metal centre line	51	86	73	70

Hardness test

Chemical analyses, weld metal/ base material,%

	C	Si	Mn	Cr	Ni	Mo	W	Cu	O
BM=	.18	.14	.66	24.8	7.32	3.64	.64	.66	.008
WM=	.026	.14	.42	24.8	9.22	3.96	.66	.11	-
WR=	.034	.03	.49	24.7	8.71	3.89	.20	.28	.001

Remarks

Ferrite content

BM= FN 74

WMCL= FN 62

WMT= FN 75

WR= FN 66



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