Underwater Wet-Welding Trials

Surface Quality Class "A" Wet Welding
to
AWS D3.6M: 2010

Topic

Examination and Testing of
Barracuda Gold Electrodes
(Evaluation of mechanical & weld quality properties)
In accordance with
AWS D3.6M: 2010
Class A
(Comparable properties and testing requirements with above water welding)

by
George Maroudas
(Marex Overseas Contractors)

Examination and Certification conducted

by

General Applications of Technology &
Science Testing Laboratories

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PASS ☒ FAIL ☐

DECEMBER 2012

Contents

Introduction

Underwater wet welding has been employed for many years now, with varying degrees of success; from excellent to very poor, since the early 1900. The success of underwater wet welding has in part been due to a number of interacting factors. Perhaps first and foremost are improvements in training, together with improvements in electrode development, better understood welding techniques as well as improved steel manufacturing, which provides for steels having improved properties and lower carbon equivalent values. However, most class societies still regard wet welding as a 'temporary' repair methodology.

Previous studies [1-6] have shown that underwater wet welding can, with correct training and appropriate skill, produce AWS D3.6M class 'B' quality wet welds, but until now no published reports have shown that class 'A' weld quality has been achieved for welding in the wet.

The purpose of this investigation was to identify if underwater wet-welding could now be performed, using the electrode Barracuda Gold, to deliver weld metal quality in accordance with AWS D3.6M: 2010 Class 'A', therefore moving this process out of temporary to permanent repair methodologies.

Under the AWS D3.6M underwater welding specification Class 'A' welds are intended to be suitable for applications and design stresses that are comparable to their conventional surface welding counterparts, by virtue of specifying comparable properties and testing requirements.

For the purposes of these trails, welding was conducted at -3M water depth in a freshwater training tank. Water temperature was $7C^0$ and visibility was good. All welding was performed by Mr. George Maroudas of Marex.

Barracuda Gold is an underwater C/Mn welding electrode, with added nickel, manufactured by Speciality Welds Ltd. Although no standard/specification exists for any underwater welding electrode, the nearest equivalent may be taken from BSEN ISO 2560: 2009 for covered welding electrodes. The nearest code being E4221NiRR (AWS A5.1, E7014); the specification of which is detailed on table 1

Chemistry:

Element	C	Mn	Si	Ni	P	S
Min	0.06	0.45	0.40	0.25		
Max	0.09	0.60	0.50	0.35	0.025	0.020

Table 1

Brief History (personal)

During my career, especially in the regions around Greece and the waters of the Balkans and North Africa, I have met many Engineers looking for permanent underwater welding repairs for steel structures. All of them, without exception, had little confidence in underwater wet welding qualities.

As an experienced Welder-diver with many years exposure to wet welding, I was determined to provide evidence that wet welding can provide for high quality permanent repairs. However, it was very clear from the start that if I wanted to achieve this result, then it was essential that a quality wet welding electrode was used. Therefore, I undertook a number of early performance trails to select the best commercially available wet welding electrode. Following these trails, my final decision was for Barracuda Gold.

As a former student of the Weldcraft-Pro™ underwater welding course and having had the opportunity to meet David Keats (author), his enthusiasm, knowledge and professional commitment to strive and always do better, inspired me to the same ends. I therefore, undertook these trails to demonstrate that not only can high quality wet welding be achieved underwater, but also to show the quality of the Barracuda Gold welding electrode to produce high quality weld metal that meets permanent repair quality.

With a determination to succeed, I hope this report demonstrates the achievable quality possible from wet welding and that such achievements prove of value to industry.

P.S.: Dedicated to my family..

George A. Maroudas

Acknowledgements

I would like to express my personal thanks and gratitude to Mr. D. Keats of Specialty Welds Ltd for his kind assistance and enthusiasm shown throughout these trials, without whom this task would have been much more difficult.

I would also like to offer my sincere appreciation and gratitude to Mr. George Fyrigos of GATS Ltd, whose knowledge and expertise proved most valuable.

Since 1970 GATS Ltd. has been solely occupied with the inspection of materials, trials, measurements and the supervision of technical work (mechanical engineering) with a view to improving the quality of the work. For the service of its clients, GATS Ltd. runs two laboratories, one in Athens and the other in Thessaloniki, both of which are fully equipped and staffed by competent technicians and scientists who have been trained on the specific subjects required, both in Greece and abroad. GATS Ltd. Company has worked for a number of years in various foreign countries, as Iraq, S. Arabia, Libya etc. GATS Ltd has received the certificate of approval for **ISO 9002** from Bureau Veritas Quality International Ltd. (BVQI) since 1991 for Inspections, Destructive and Non Destructive Testing and Thermal Heat Treatment. And the accreditation certificate for **ISO 17025** and **EN 45004** from the Hellenic Accreditation Council (ESYD). Scope of accreditation for:

- ISO 17025: -Nondestructive and Mechanical testing
- EN 45004: -Welding process
- Periodic and intermediate inspection of vehicles used in the transportation of dangerous goods by road (ADR)

Furthermore GATS Ltd is a recognized third party organization for the approval of permanent joining procedures and personnel under Annex I, 3.1.2 of the Pressure Equipment Directive 97/23/EC.

Comments

From the evidence supported in this report, utilising careful control for welding operations and attention to detail, the evidence from the NDT and destructive examination and testing **has shown that class A wet welds has been achieved**.

During these trails the only piece of equipment that was used, which may have differed from other trails, was the way in which each weld pass was cleaned during welding. This was carried out using a cleaning system which operates with the principles of cavitation.

BARRACUDA

WELDING TRIALS

GROOVE (BUTT) WELD SAMPLES

CONDUCTED DECEMBER 2012

FOR

MAREX
OVERSEAS CONTRACTORS

AS WELDED

BY

GEORGE A. MAROUDAS

Speciality Welds — Experts to the Welding Industry

MAREX OVERSEAS CONTRACTORS

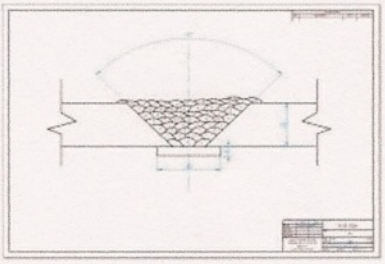
Weldcraft Pro

preliminary **WELDING PROCEDURE SPECIFICATION** (pWPS)

Date:	Tuesday, Dec18, 2012
Welding Specification:	AWS D3.6M-2010-CLASS A
Manufacturer/Client:	Marex U.C.
pWPS:	#8
Welder's Name:	**Maroudas, George**

Weld Test Details	
Welding Process:	MMA/SMAW (111)
Plate or Pipe:	Plate
Material Thickness:	20mm
Parent Metal Group:	S355J2+N
Type of Joint:	Groove Weld with Backing
Method of Preparation:	Point Welded
Test Dimensions:	400X320X20
Welding Position:	1G
Filler Material:	Barracuda Gold, 3.2mm
Electrode Type:	E 422 (AWS 7014)
Waterproof Coating:	Special Formula Acrylic Lac
Storage of Electrodes:	Use directly from box
Method of Trans/tation:	Wet Quiver
Total Immersion Time:	60 min. max.
Cleaning Method:	CavitCleaner
Joint Fit-up Tolerance:	10mm

Pass	Ampers	Volts	ROL (mm/min)
1-8	*160-170A*	*29-31V*	*220-230 KJ*
9-45	*170-180A*	*29-31V*	*210-220 KJ*
46-54	*160-170A*	*29-31V*	*220-230 KJ*



Date of Exam:	18 December 2012
Location:	Aharnai
Test House:	G.A.T.S. Lab

Welding Parameters	
Polarity:	DCSP (-)
Techniques Used:	Drag & Step Back
Visibility & Depth:	Good @ test depth (3m)
Water Type & State:	
Machine Model:	Telwin Inverter

Type of Test	Results
Visual:	PASS
Radiography:	PASS
MPI:	N/A
Macro:	N/A
Fracture:	N/A
Bend:	N/A
Tensile:	PASS

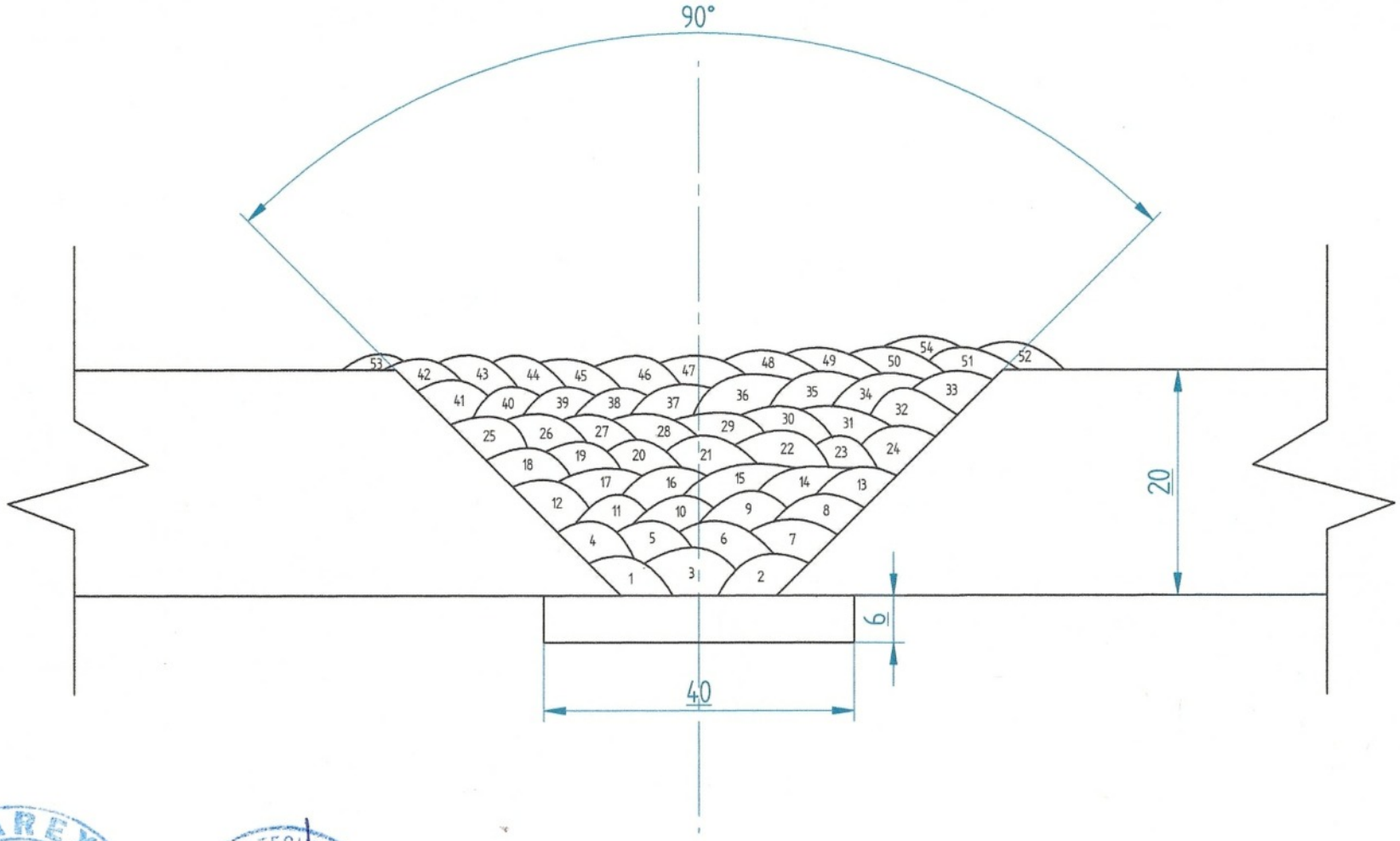
Author of pWPS	Witnessing Body
George Maroudas	Ilias Pouleas (G.A.T.S.)

GEORGE A. MAROUDAS
HSE DIVER [illegible]/38466/98
MAREX UNDERWATER CONTRACTORS

GENERAL APPLIED TECHNOLOGY & SCIENCE — GATS

MAREX UNDERWATER CONTRACTORS

REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED



MAREX UNDERWATER CONTRACTORS

INSTITUTE OF TECHNOLOGY & SCIENCE • GENERAL APPLICATIONS

	NAME	DATE
DRAWN	George Mar	01/28/13
CHECKED		
ENG APPR		
MGR APPR		

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MILLIMETERS
ANGLES ±X.X°
2 PL ±X.XX 3 PL ±X.XXX

Solid Edge

TITLE

SIZE: A2 | DWG NO | REV

FILE NAME: Multipass Weld Class Adft

SCALE: | WEIGHT: | SHEET 1 OF 1

Fig 1: Test piece prepared prior to welding, general view.

Fig 2: Test sample before welding, showing prep detail.

ΓΕΤΕ
GATS

General Applications of Technology and Science Testing Laboratories

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Tel: (2310) 781 747, Fax: (2310) 783 439
E-mail: info_the@gatsndt.gr

RADIOGRAPHIC TEST REPORT- RT

G3/NDTR1 (10/08/2006)

Report N°:	A/12/080 RT: 006	Page N°:	1/1	Sample Received Date (if applicable):	10.12.12	Contract N°	- - -
Client - Address:	MAREX U.C			Test Location:	GATS. LAB. ATH		
Contractor:	MAREX U.C			Project:	--		
Item:	PLATE			Material:	S355J2+N		
Test According To:	AWS D3.6M :2010 CLAUSE 6 PART III			Accep. Standard According To:	AWS D3.6M :2010 CLAUSE 7 PART III		
Rad. source:	Ir.192	Activity (Ci):	14,51	Source size (mm):	2.0 x 1.4	Heat Treat:	- - -
Film:	KODAK (D4)	Density:	2-4	Screens (mm):	0,027	F.F.D. (mm):	500
Development	Automatic / ~~Manual~~	Time: / Temperature :	5' / 20° C	I.Q.I.	Standard: ASME / Location: FS or SS	Exp. Techn.	SWSI/DWSI/DWDI
X-ray:		KV:		mA:		Time:	

Diam.	Item	Joint N°	Zone	Welder	Thick. (mm)	I.Q.I%	Faults	Conclusion A.	Conclusion N.A	Remarks
-	PLATE	W01	A - B	01	6,0			A	-	TEST SPECIMEN BEFORE WELDING INSPECTION OF BACKING STRIP

Aa:	Gas Pores	C:	Incomplete Fusion	Eb:	Transverse Cracks
Ab:	Worm Holes	D:	Incomplete Penetration	F:	Undercut
Ba:	Slag Inclusions	Tr:	Excess Penetration	Kv:	Linear Misalignment
Bb:	Slag Lines	Ea:	Longitudinal Cracks	Ru:	Root Concavity
Ti:	Tungsten Inclusions				

FF:	Film Defect
Rx:	Reshoot
A.:	Accepted
N.A.:	Not Accepted

Report Approved By:	Issue Date:	Report Made By:	Test Made By:
		MOREANU ALEXANDRU LEVEL II RT-PT-UT-MT-VT	MOREANU ALEXANDRU LEVEL II RT-PT-UT-MT-VT
			Date: 11.12.2012

Certificate of Approval N°: 42158/B.V.Q.I.

Page 1

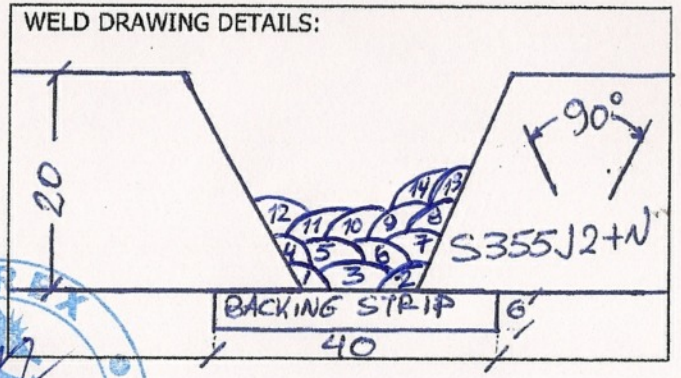
UNDERWATER WET-WELDING RECORD SHEET

PROJECT NAME/CODE: TESTING BARRACUDA ELECTRODE GOLD 3.2mm UNDER AWS.D3.6M-2010 CLASS A OF WELDS.

DATE: 13.12.2012
MATERIAL TYPE: S335J2+N
THICKNESS: 20mm
JOINT TYPE: GROOVE WELD WITH BACKING STRIP.
WELDING POSITION: FLAT PA (1G)
ELECTRODE SIZE / TYPE: BARRACUDA GOLD 3.2mm
WELDING DIRECTION: AWAY FROM EARTH.
WELDING SPECIFICATION: AWS.D3.6M:2010-CLASS A.
CABLE SIZE / LOCATION: 50mm²
CLEANING METHOD: CAVITCLEANER
WHITNESSING: MR. ILIAS POULEAS
CLASS: G.A.T.S. LTD
WELDERS NAME: GEORGE MAROUDAS
COMPANY: MAREX U.C.
OPERATOR'S NAME: VAVVAKOUSIS. NEKTARIOS
COMPANY: MAREX U.C.

Pass No	Technique	Earth Location	Amps	Volts	Duration sec.	Length mm	ROL (mm/sec)	ARC ENERGY (KJ/mm)
1	DRAG	AWAY	165	30	110	430		1,27
2	〃	〃	165	30	104	〃		1,20
3	〃	〃	165	30	112	〃		1,29
4	〃	〃	165	30	113	〃		1,30
5	〃	〃	165	30	113	〃		1,30
6	〃	〃	165	30	111	〃		1,28
7	〃	〃	165	30	114	〃		1,31
8	〃	〃	165	30	109	〃		1,25
9	STEP BACK	〃	177	30	121	〃		1,49
10	〃	〃	177	30	119	〃		1,47
11	〃	〃	177	30	115	〃		1,42
12	〃	〃	177	30	122	〃		1,51
13	〃	〃	177	30	120	〃		1,48
14	〃	〃	177	30	124	〃		1,53

WELD DRAWING DETAILS:



First Welding Seam end on No: —
Second Welding Seam end on No: —
Third Welding Seam end on No: —

Welder's Signature:
Operator's Signature:
Class Stamp & Signature:

GEORGE A. MAROUDAS
HSE DIVER SS/38466/98
MAREX UNDERWATER CONTRACTORS

MAREX UNDERWATER CONTRACTORS

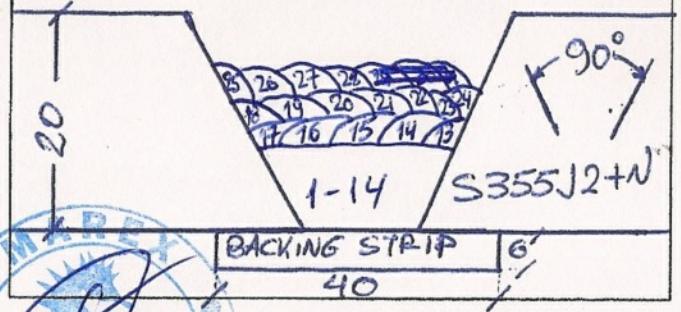
GATS GENERAL APPLICATIONS OF TECHNOLOGY & SCIENCE

UNDERWATER WET-WELDING RECORD SHEET

PROJECT NAME/CODE: TESTING BARRACUDA ELECTRODE GOLD 3.2mm UNDER AWS.D3.6M-2010 CLASS A OF WELDS.

DATE: 13.12.2012
MATERIAL TYPE: S335J2+N
THICKNESS: 20mm
JOINT TYPE: GROOVE WELD WITH BACKING STRIP.
WELDING POSITION: FLAT PA (1G)
ELECTRODE SIZE / TYPE: BARRACUDA GOLD 3.2mm
WELDING DIRECTION: AWAY FROM EARTH.
WELDING SPECIFICATION: AWS.D3.6M:2010-CLASSA.
CABLE SIZE / LOCATION: 50mm²
CLEANING METHOD: CAVITCLEANER
WHITNESSING: MR. ILIAS POULEAS
CLASS: G.A.T.S. LTD
WELDERS NAME: GEORGE MAROUDAS
COMPANY: MAREX U.C.
OPERATOR'S NAME: VAVVAKOUSIS. NEKTARIOS
COMPANY: MAREX U.C.

WELD DRAWING DETAILS:



Pass No	Technique	Earth Location	Amps	Volts	Duration sec.	Length mm	ROL (mm/sec)	ARC ENERGY (KJ/mm)
15	STEPBACK	AWAY	177	30	119	430		1,47
16	—	—	177	30	122	—		1,51
17	—	—	177	30	114	—		1,41
18	—	—	177	30	117	—		1,44
19	—	—	177	30	122	—		1,51
20	—	—	177	30	116	—		1,43
21	—	—	177	30	122	—		1,51
22	—	—	177	30	124	—		1,53
23	—	—	177	30	127	—		1,57
24	—	—	177	30	122	—		1,51
25	—	—	177	30	119	—		1,47
26	—	—	177	30	121	—		1,49
27	—	—	177	30	126	—		1,56
28	—	—	177	30	121	—		1,49

First Welding Seam end on No: —
Second Welding Seam end on No: —
Third Welding Seam end on No: —

Welder's Signature:
Operator's Signature:
Class Stamp & Signature:

GEORGE A. MAROUDAS
HSE DIVER S/N 3466/98
MAREX UNDERWATER CONTRACTORS

MAREX UNDERWATER CONTRACTORS

TETE GATS GENERAL APPLIED TECHNOLOGY & SCIENCE

UNDERWATER WET-WELDING RECORD SHEET

TESTING BARRACUDA ELECTRODE GOLD 3.2mm

DATE: 13.12.2012

MATERIAL TYPE: S335J2+N

THICKNESS: 20mm

JOINT TYPE: GROOVE WELD WITH BACKING STRIP

WELDING POSITION: FLAT PA (1G)

ELECTRODE SIZE / TYPE: BARRACUDA GOLD 3.2mm

WELDING DIRECTION: AWAY FROM EARTH.

WELDING SPECIFICATION: AWS.D3.6M:2010-CLASSA.

CABLE SIZE / LOCATION: 50mm²

CLEANING METHOD: CAVITCLEANER

WHITNESSING: MR. ILIAS POULEAS

CLASS: G.A.T.S. LTD

WELDERS NAME: GEORGE MAROUDAS

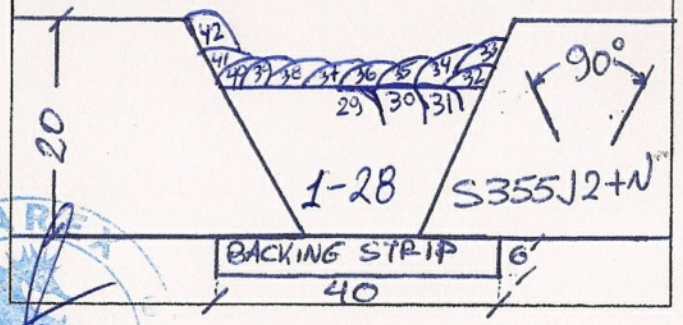
COMPANY: MAREX U.C.

OPERATOR'S NAME: VAVVAKOUSIS. NEKTARIOS

COMPANY: MAREX U.C.

PROJECT NAME/CODE: UNDER AWS.D3.6M-2010 CLASS A OF WELDS.

WELD DRAWING DETAILS:



Pass No	Technique	Earth Location	Amps	Volts	Duration	Length	ROL (mm/sec)	ARC ENERGY (KJ/mm)
29	STEP BACK	AWAY	177	30	121	430		1,49
30	〃	〃	177	30	118	〃		1,46
31	〃	〃	177	30	122	〃		1,51
32	〃	〃	177	30	117	〃		1,44
33	〃	〃	177	30	116	〃		1,43
34	〃	〃	177	30	122	〃		1,51
35	〃	〃	177	30	117	〃		1,44
36	〃	〃	177	30	116	〃		1,43
37	〃	〃	177	30	122	〃		1,51
38	〃	〃	177	30	123	〃		1,52
39	〃	〃	177	30	126	〃		1,56
40	〃	〃	177	30	117	〃		1,44
41	〃	〃	177	30	115	〃		1,42
42	〃	〃	177	30	121	〃		1,49

First Welding Seam end on No: ——

Second Welding Seam end on No: ——

Third Welding Seam end on No: ——

Welder's Signature:

Operator's Signature:

Class Stamp & Signature:

GEORGE A. MAROUDAS
HSE DIVER 56/38466/98
MAREX UNDERWATER CONTRACTORS

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UNDERWATER WET-WELDING RECORD SHEET

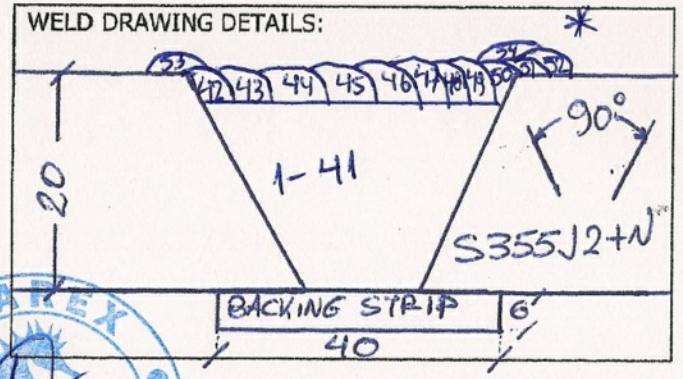
TESTING BARRACUDA ELECTRODE GOLD 3.2mm

PROJECT NAME/CODE: UNDER AWS.D3.6M-2010 CLASS A OF WELDS.

DATE: 13.12.2012
MATERIAL TYPE: S355J2+N
THICKNESS: 20mm
JOINT TYPE: GROOVE WELD WITH BACKING STRIP
WELDING POSITION: FLAT PA (1G)
ELECTRODE SIZE / TYPE: BARRACUDA GOLD 3.2mm
WELDING DIRECTION: AWAY FROM EARTH.
WELDING SPECIFICATION: AWS.D3.6M:2010-CLASSA.
CABLE SIZE / LOCATION: 50mm²
CLEANING METHOD: CAVITCLEANER
WHITNESSING: MR. ILIAS POULEAS
CLASS: G.A.T.S. LTD
WELDERS NAME: GEORGE MAROUDAS
COMPANY: MAREX U.C.
OPERATOR'S NAME: VAVVAKOUSIS. NEKTARIOS
COMPANY: MAREX U.C.

WELD DRAWING DETAILS:

*Sp. Detail



Pass No	Technique	Earth Location	Amps	Volts	Duration	Length	ROL (mm/sec)	ARC ENERGY (KJ/mm)
43	STEPBACK	AWAY	177	30	123	430		1,52
44	〃	〃	177	30	119	〃		1,47
45	〃	〃	177	30	115	〃		1,42
46	〃	〃	177	30	122	〃		1,51
47	〃	〃	177	30	121	〃		1,49
48	DRAG	〃	165	30	116	〃		1,34
49	〃	〃	165	30	112	〃		1,29
50	〃	〃	165	30	109	〃		1,25
51	〃	〃	165	30	114	〃		1,31
52	〃	〃	165	30	109	〃		1,25
53	〃	〃	165	30	107	〃		1,23
54	〃	〃	165	30	111	〃		1,28

First Welding Seam end on No: —
Second Welding Seam end on No: —
Third Welding Seam end on No: —

Welder's Signature:
Operator's Signature:
Class Stamp & Signature:

GEORGE A. MAROUDAS
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Fig 3: Test Piece as welded, looking side “A” to “B”.

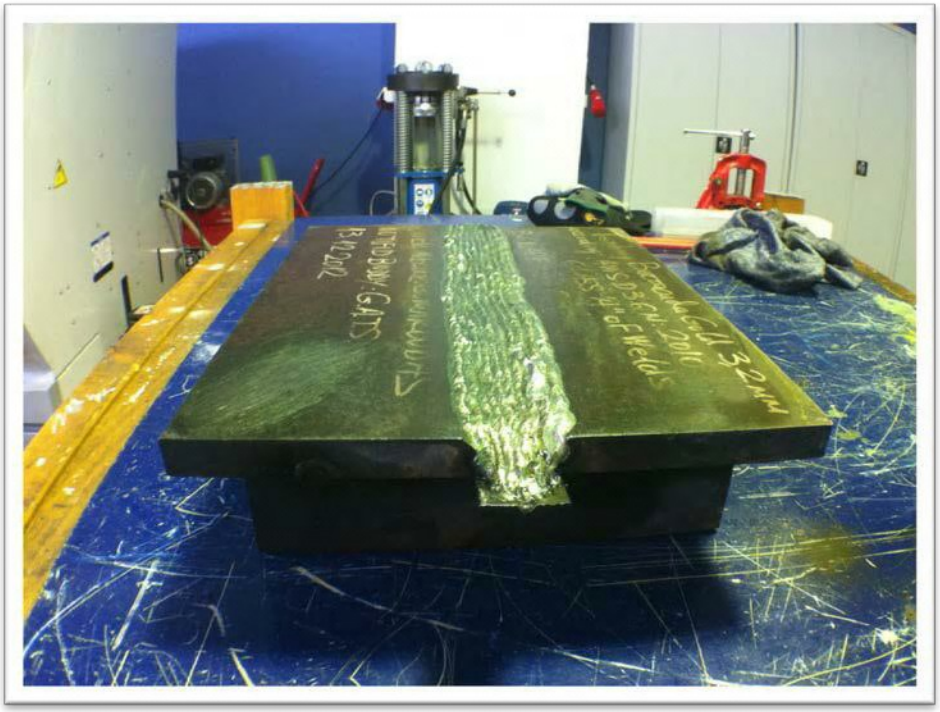

Fig 4: Test Piece as welded, looking longitudinally.

Fig 5: Mr. **George FYRIGOS** & **Ilias POULEAS** of **G.A.T.S. Ltd** (General Applications Technology & Science – Testing Laboratories) during specimen's examination.

Fig 6: The cleaning system we used during the trial, called "**Cavitcleaner**".

ΓΕΤΕ
GATS

General Applications of Technology and Science Testing Laboratories

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E-mail: info_the@gatsndt.gr

RADIOGRAPHIC TEST REPORT- RT

G3/NDTR1 (10/08/2006)

Report N°:	A/12/080 RT: 007	Page N°:	1/1	Sample Received Date (if applicable):	17.12.12	Contract N°	- - -
Client - Address:	MAREX U.C			Test Location:	GATS. LAB. ATH		
Contractor:	MAREX U.C			Project:	--		
Item:	PLATE			Material:	S355J2+N		
Test According To:	AWS D3.6M :2010 CLAUSE 6 PART III			Accep. Standard According To:	AWS D3.6M :2010 CLAUSE 7 PART III		
Rad. source:	Ir.192	Activity (Ci):	13,72	Source size (mm):	2.0 x 1.4	Heat Treat:	- - -
Film:	KODAK (D4)	Density:	2-4	Screens (mm):	0,027	F.F.D. (mm):	500
Development	Automatic / ~~Manual~~	Time:	5'	I.Q.I. Standard:	ASME	Exp. Techn.	SWSI/DWSI/DWDI
		Temperature :	20° C	Location:	FS or SS		
X-ray:		KV:		mA:		Time:	

Diam.	Item	Joint N°	Zone	Welder	Thick. (mm)	I.Q.I%	Faults	Conclusion A.	Conclusion N.A	Remarks
-	PLATE	WT	A - B	01	20,0	13		A	-	PA (1G) SMAW AFTER WELDING

Aa:	Gas Pores	C:	Incomplete Fusion	Eb:	Transverse Cracks	FF:	Film Defect
Ab:	Worm Holes	D:	Incomplete Penetration	F:	Undercut	Rx:	Reshoot
Ba:	Slag Inclusions	Tr:	Excess Penetration	Kv:	Linear Misalignment	A.:	Accepted
Bb:	Slag Lines	Ea:	Longitudinal Cracks	Ru:	Root Concavity	N.A.:	Not Accepted
Ti:	Tungsten Inclusions						

Report Approved By:	Issue Date:	Report Made By:	Test Made By:
		E. SAVOPOULOS LEVEL II RT-MT-PT-VT-UT	E. SAVOPOULOS LEVEL II RT-MT-PT-VT-UT
			Date: 17.12.2012

Certificate of Approval N°: 42158/B.V.Q.I.

Fig 7: G.A.T.S. Ltd Laboratories. Tensile Machine, model **DMG-T4284**.

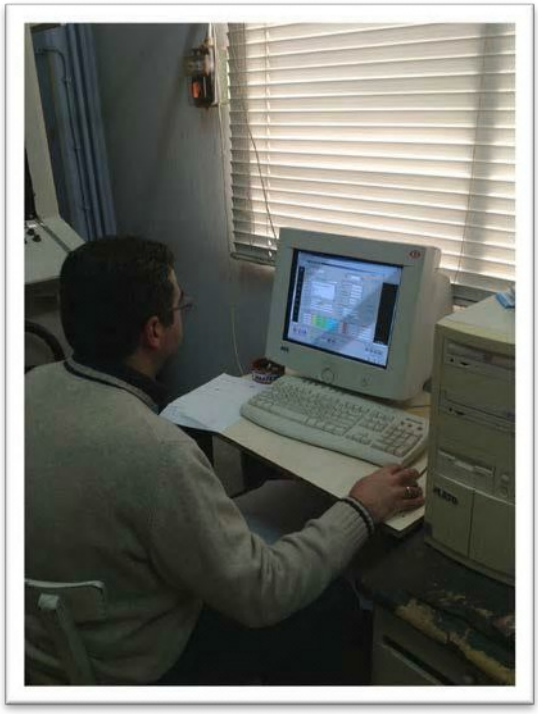

Fig 8: G.A.T.S. Ltd Laboratories. Operator fills in data before starts tensile.

Fig 9: General plan of specimen after destructive test. Evident the difference between used one and unused.

Fig 10: Specimen Close Up.

Fig 11: Close up of left specimen's side.

Fig 12: Close up of right specimen's side.

ΓΕΤΕ
GATS

General Applications of Technology and Science Testing Laboratories

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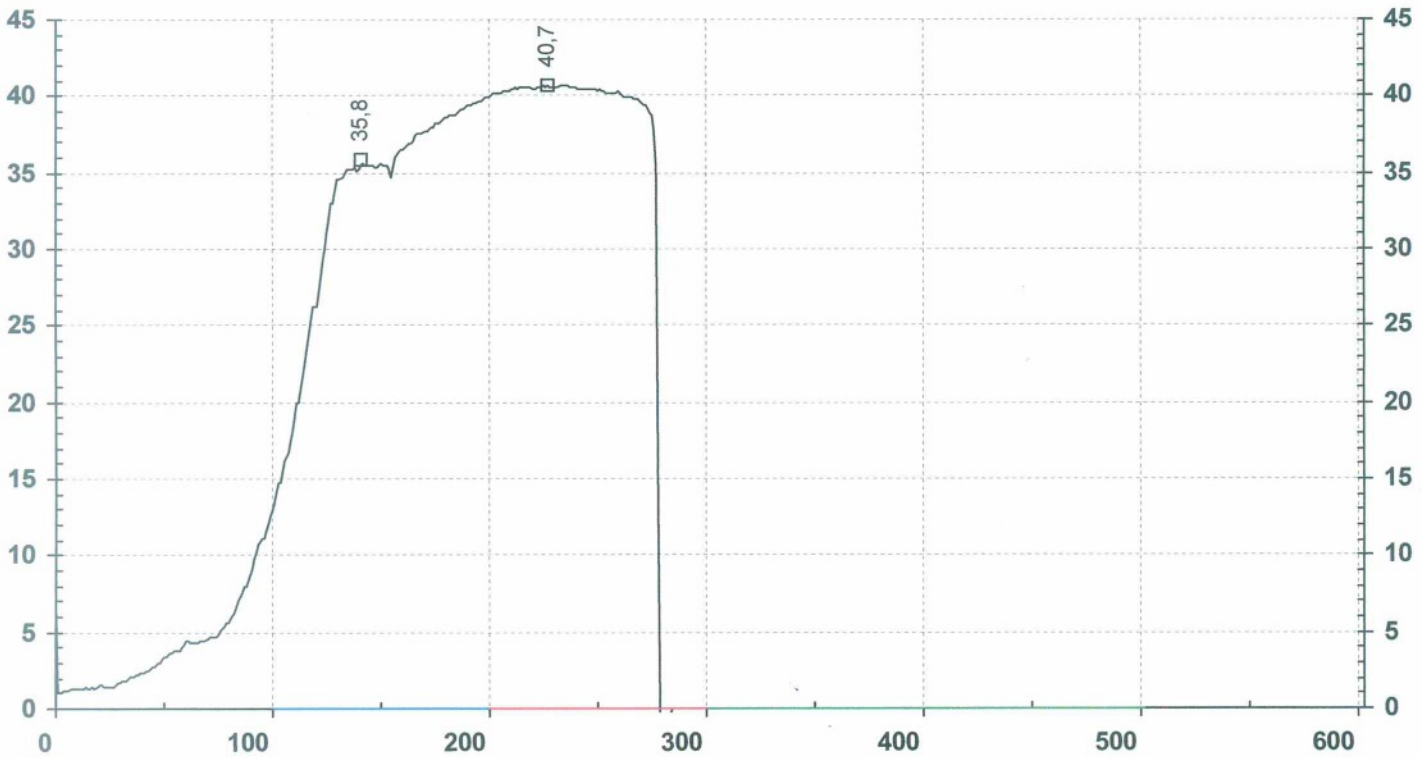
TENSILE TEST CERTIFICATE

G8/DTR51(20/1/2001)

Test No:	606	Page:	1 from 1
Report No:	A/12/017 - T01 -REV1-20/03/2014 ★	Date:	18/12/2012
Testing machine:	DMG-T4284 SN:24822	Filler metal 1:	AWS E7014
Sample Received Date:	18/12/2012	Filler metal 2:	-
Client:	MAREX U.C.	Diameter:	D=10mm
Client Address:		Thickness:	-
Contractor:	MAREX U.C.	Procedure:	WPS 005 - SMAW - PA (1G)
Project:	Testing Barracuda Gold Φ3,2mm	Test according to:	AWS D3.6M:2010 CLASS A
Material:	TESTED ONLY ELECTRODE ★	Test temperature:	19C
Material Type:	WELDED PLATE S355J2+N ★	Comments:	WELDER "MAROUDAS G. - W01"

Specim. No	Specimen dimensions/ diameter			Yeld Point		Tensile strength		Elong Lo=	50	Failure Character Location	Remarks
	(W) mm	(t)mm	Area mm2	KN	N/mm2 ★	KN	N/mm2 ★	mm	%		
1	10,0	-	78,6	35,8	460,000	40,7	522,000	58,0	16,0		SPECIMEN 1T
2	-	-	-	-	-	-	-	-	-		
3	-	-	-	-	-	-	-	-	-		
4	-	-	-	-	-	-	-	-	-		



Witnessed:
-

Note: The Test is for:

- ☐ Welding Procedure qualificatio
- ☐ Welder's Qualificatio
- ☑ Material

For GATS Ltd:
G.FYRIGOS

Test made by.
Roulias Ilias
Destructive Testing Responsible

Speciality Welds — Experts to the Welding Industry

MAREX OVERSEAS CONTRACTORS

Weldcraft Pro

WELDING PROCEDURE SPECIFICATION (WPS)

Date: Tuesday, Dec18, 2012

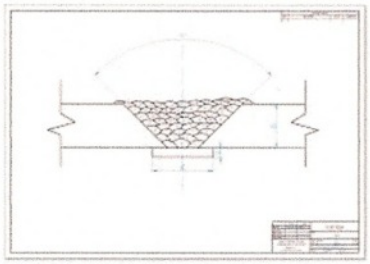
Welding Specification: AWS D3.6M-2010-CLASS A

Manufacturer/Client: Marex U.C.

WPS: #3

Welder's Name: **Maroudas, George**

Weld Test Details		Pass	Ampers	Volts	ROL (mm/min)
Welding Process:	MMA/SMAW (111)	*1-8*	*160-170A*	*29-31V*	*220-230 KJ*
Plate or Pipe:	Plate	*9-45*	*170-180A*	*29-31V*	*210-220 KJ*
Material Thickness:	20mm	*46-54*	*160-170A*	*29-31V*	*220-230 KJ*
Parent Metal Group:	S355J2+N				
Type of Joint:	Groove Weld with Backing				
Method of Preparation:	Point Welded				
Test Dimensions:	400X320X20				
Welding Position:	1G				
Filler Material:	Barracuda Gold, 3.2mm				
Electrode Type:	E 422 (AWS 7014)				
Waterproof Coating:	Special Formula Acrylic Lac				
Storage of Electrodes:	Use directly from box				
Method of Trans/tation:	Wet Quiver				
Total Immersion Time:	60 min. max.				
Cleaning Method:	CavitCleaner				
Joint Fit-up Tolerance:	10mm				



Joint CEV (%): 0.45%

Backing CEV (%): 0.16%

Speciment Temp. (C): 7C

Welding Parameters		Type of Test	Results
Polarity:	DCSP (-)	Visual:	PASS
Techniques Used:	Drag & Step Back	Radiography:	PASS
Visibility & Depth:	Good @ test depth (3m)	MPI:	N/A
Water Type & State:	Freshwater - Tank 7C	Macro:	N/A
Machine Model:	Telwin Inverter	Fracture:	N/A
		Bend:	N/A
		Tensile:	PASS

Author of WPS

MAREX U.C.

MAREX UNDERWATER CONTRACTORS

Test House

G.A.T.S. LAB

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