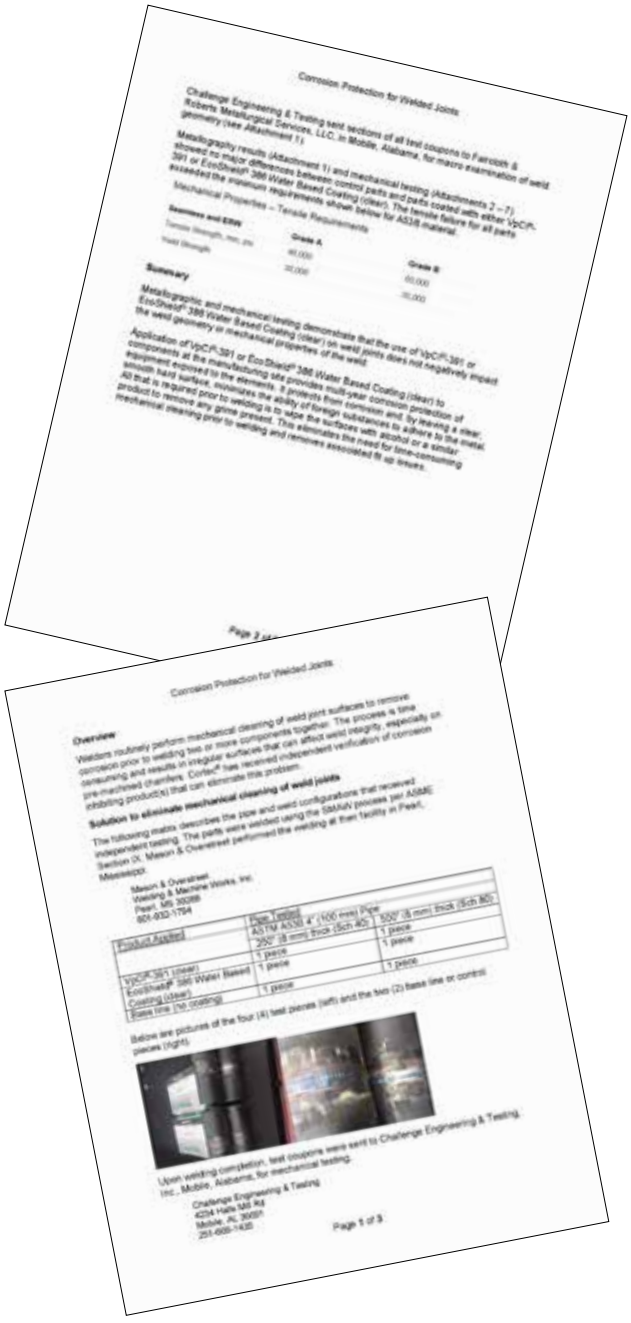
NEWS ALERT

ISO 9001 • ISO 14001
ISO/IEC 17025

New White Paper Confirms Compatibility of Cortec® Coatings for Corrosion Protection of Welded Joints


Corrosion Protection for Welded Joints

Challenge Engineering & Testing sent sections of all test coupons to Ferrotech & Roberts Metallurgical Services, LLC, in Mobile, Alabama, for macro examination of weld geometry (see Attachment 1).

Metallography results (Attachment 1) and mechanical testing (Attachments 2 – 7) showed no major differences between control parts and parts coated with either VpCI®-391 or EcoShield® 386 Water Based Coating (clear). The tensile failure for all parts exceeded the minimum requirements shown below for A53B material.

Mechanical Properties – Tensile Requirements

Summary

Metallographic and mechanical testing demonstrate that the use of VpCI®-391 or EcoShield® 386 Water Based Coating (clear) on weld joints does not negatively impact the weld geometry or mechanical properties of the weld.

Application of VpCI®-391 or EcoShield® 386 Water Based Coating (clear) to components at the manufacturing site provides multi-year corrosion protection of components prior to the elements. It prevents flash rust corrosion and, by leaving a fine, smooth hard surface, minimizes the ability of foreign substances to adhere to the metal. All that is required prior to welding is to wipe the surfaces with alcohol or a similar product to remove any grime present. This eliminates the need for time-consuming mechanical cleaning prior to welding and removes associated fit up issues.

Page 1 of 3

Corrosion Protection for Welded Joints

Overview

Welders routinely perform mechanical cleaning of weld joint surfaces to remove corrosion prior to welding two or more components together. The process is time consuming and results in irregular surfaces that can affect weld integrity, especially on pre-machined chamfers. Cortec® has received independent verification of corrosion inhibiting product(s) that can eliminate this problem.

Solution to eliminate mechanical cleaning of weld joints

The following matrix describes the pipe and weld configurations that received independent testing. The parts were welded using the SMAW process per ASME Section IX. Mason & Overstreet performed the welding at their facility in Pearl, Mississippi.

Mason & Overstreet
Welding & Machine Works, Inc.
Pearl, MS 39208
601-932-1754

Product Applied	Pipe Tested	
	A53 Gr. B ASTM 4" (100 mm) Pipe	
	250" (6 mm) thick (Sch 40)	500" (8 mm) thick (Sch 80)
VpCI®-391 (clear)	1 piece	1 piece
EcoShield® 386 Water Based Coating (clear)	1 piece	1 piece
Base line (no coating)	1 piece	1 piece

Below are pictures of the four (4) test pieces (left) and the two (2) base line or control pieces (right).

Upon welding completion, test coupons were sent to Challenge Engineering & Testing, Inc., Mobile, Alabama, for mechanical testing.

Challenge Engineering & Testing
4204 Halls Mill Rd
Mobile, AL 36651
251-666-1430

Page 1 of 3

Cortec® is pleased to present a new white paper on corrosion protection for welded joints. The white paper was written by a professional engineer who investigated whether coating weld joint surfaces with clear coats of either VpCI®-391 or EcoShield® 386 Water Based Coating for corrosion protection would compromise the integrity of the welded joints. The paper reports that independent testing found no major differences in metallography results and mechanical testing between uncoated parts and those coated with VpCI®-391 or EcoShield® 386. Tensile failure of the parts exceeded minimum requirements.

Knowing that these Cortec® coatings do not negatively impact the geometry and mechanical properties of welded joints frees welders to protect welded surfaces more efficiently. The clear coatings provide multi-year protection and make it easy to clean off any grime that builds up on the surface before welding. By using VpCI®-391 and EcoShield® 386 for corrosion protection, welders can save time and avoid fit up issues associated with mechanical cleaning prior to welding.

Please continue to read the full white paper...

Overview

Welders routinely perform mechanical cleaning of weld joint surfaces to remove corrosion prior to welding two or more components together. The process is time consuming and results in irregular surfaces that can affect weld integrity, especially on pre-machined chamfers. Cortec® has received independent verification of corrosion inhibiting product(s) that can eliminate this problem.

Solution to eliminate mechanical cleaning of weld joints

The following matrix describes the pipe and weld configurations that received independent testing. The parts were welded using the SMAW process per ASME Section IX. Mason & Overstreet performed the welding at their facility in Pearl, Mississippi.

Mason & Overstreet
Welding & Machine Works, Inc.
Pearl, MS 39288
601-932-1794

Product Applied	Pipe Tested	
	ASTM A53B 4" (100 mm) Pipe	
	.250" (8 mm) thick (Sch 40)	.500" (8 mm) thick (Sch 80)
VpCI®-391 (clear)	1 piece	1 piece
EcoShield® 386 Water Based Coating (clear)	1 piece	1 piece
Base line (no coating)	1 piece	1 piece

Below are pictures of the four (4) test pieces (left) and the two (2) base line or control pieces (right).

Upon welding completion, test coupons were sent to Challenge Engineering & Testing, Inc., Mobile, Alabama, for mechanical testing.

Challenge Engineering & Testing
4234 Halls Mill Rd
Mobile, AL 36691
251-666-1435

Challenge Engineering & Testing sent sections of all test coupons to Faircloth & Roberts Metallurgical Services, LLC, in Mobile, Alabama, for macro examination of weld geometry (see Attachment 1).

Metallography results (Attachment 1) and mechanical testing (Attachments 2 – 7) showed no major differences between control parts and parts coated with either VpCI®-391 or EcoShield® 386 Water Based Coating (clear). The tensile failure for all parts exceeded the minimum requirements shown below for A53B material.

Mechanical Properties – Tensile Requirements

Seamless and ERW	Grade A	Grade B
Tensile Strength, min, psi	48,000	60,000
Yield Strength	30,000	35,000

Summary

Metallographic and mechanical testing demonstrate that the use of VpCI®-391 or EcoShield® 386 Water Based Coating (clear) on weld joints does not negatively impact the weld geometry or mechanical properties of the weld.

Application of VpCI®-391 or EcoShield® 386 Water Based Coating (clear) to components at the manufacturing site provides multi-year corrosion protection of equipment exposed to the elements. It protects from corrosion and, by leaving a clear, smooth hard surface, minimizes the ability of foreign substances to adhere to the metal. All that is required prior to welding is to wipe the surfaces with alcohol or a similar product to remove any grime present. This eliminates the need for time-consuming mechanical cleaning prior to welding and removes associated fit up issues.

Attachments

Number	Description
1	Macro Examination with Photographs
2	386 Sch 40 Carbon Steel Pipe A53B (coated with EcoShield® 386)
3	386 - A Sch 80 Carbon Steel Pipe A53B (coated with EcoShield® 386)
4	391 Sch 40 Carbon Steel Pipe A53B (coated with VpCI®-391)
5	391 Sch 80 Carbon Steel Pipe A53B (coated with VpCI®-391)
6	Control Sch 40 Carbon Steel Pipe A53B
7	Control Sch 80 Carbon Steel Pipe A53B

FAIRCLOTH & ROBERTS
METALLURGICAL SERVICES, LLC

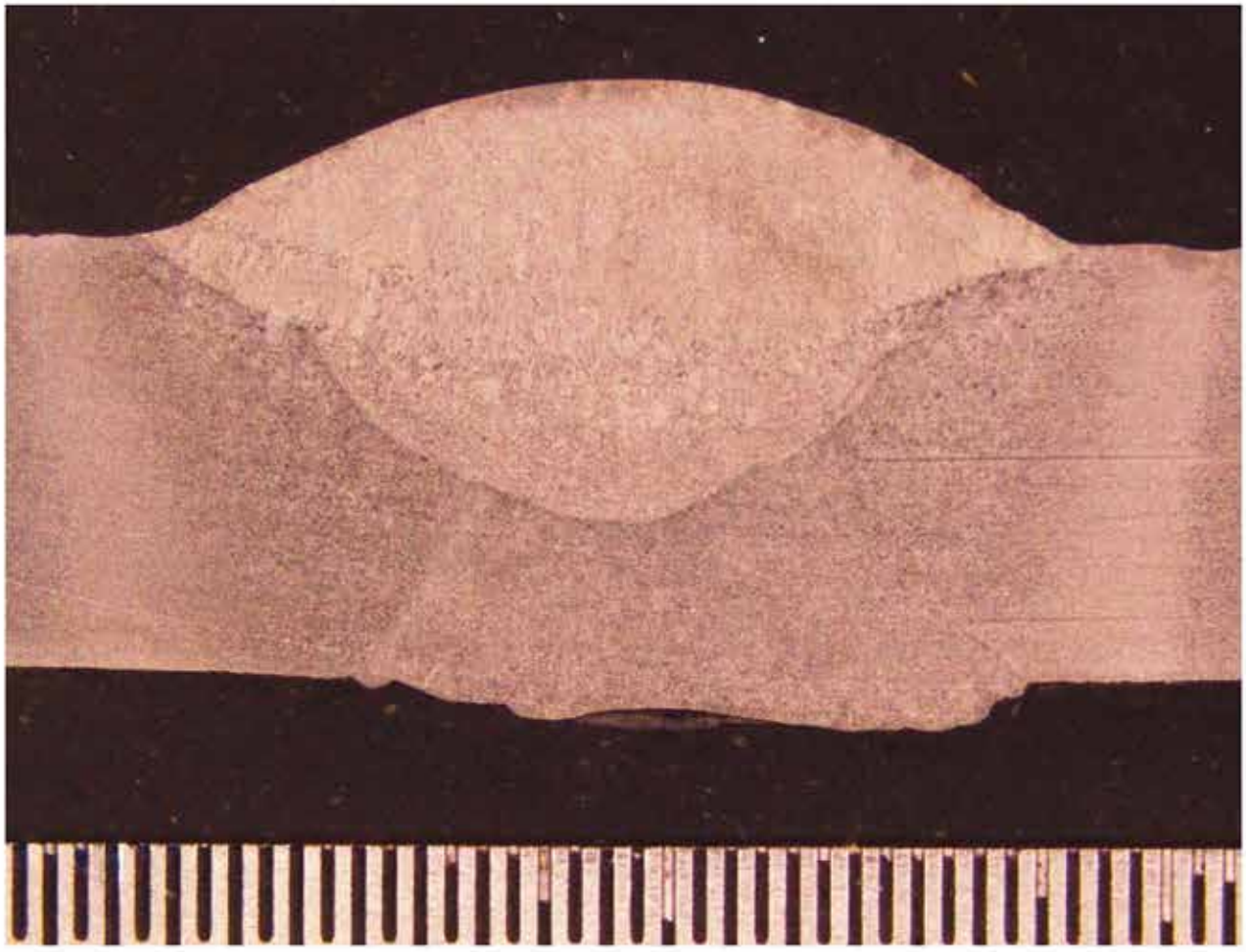
2508 Commercial Park Drive
Mobile, Alabama 36606
Ph: (251) 473-8389 Fax: (251) 473-8325
Email: info@fmsmetallurgical.com

Client:
Challenge Engineering
4234 Halls Mill Rd
Mobile, AL 36693

Document Number: L170913-RPT-101
Date: 12/15/17
Revision: 0
P.O.: 033-51
Material: Sch. 40 and Sch. 80 C/S Pipe
Description: Sample #'s 386, 391, and Control

Table 1- Macro Examination with Photograph

Sample ID	Pipe	Weld Orientation	Etchant	Scale
70913-1-M1 (#386)	Sch. 40 C/S	Transverse	Nital	1/64th Inch



Attachment 1

FAIRCLOTH & ROBERTS
METALLURGICAL SERVICES, LLC

2508 Commercial Park Drive
Mobile, Alabama 36606
Ph: (251) 473-8389 Fax: (251) 473-8325
Email: info@fmsmetallurgical.com

Client:
Challenge Engineering
4234 Halls Mill Rd
Mobile, AL 36693

Document Number: L170913-RPT-101
Date: 12/15/17
Revision: 0
P.O.: 033-51
Material: Sch. 40 and Sch. 80 C/S Pipe
Description: Sample #'s 386, 391, and Control

Table 2- Macro Examination with Photograph

Sample ID	Pipe	Weld Orientation	Etchant	Scale
70913-1-M2 (#391)	Sch. 40 C/S	Transverse	Nital	1/64th Inch

Attachment 1

FAIRCLOTH & ROBERTS
METALLURGICAL SERVICES, LLC

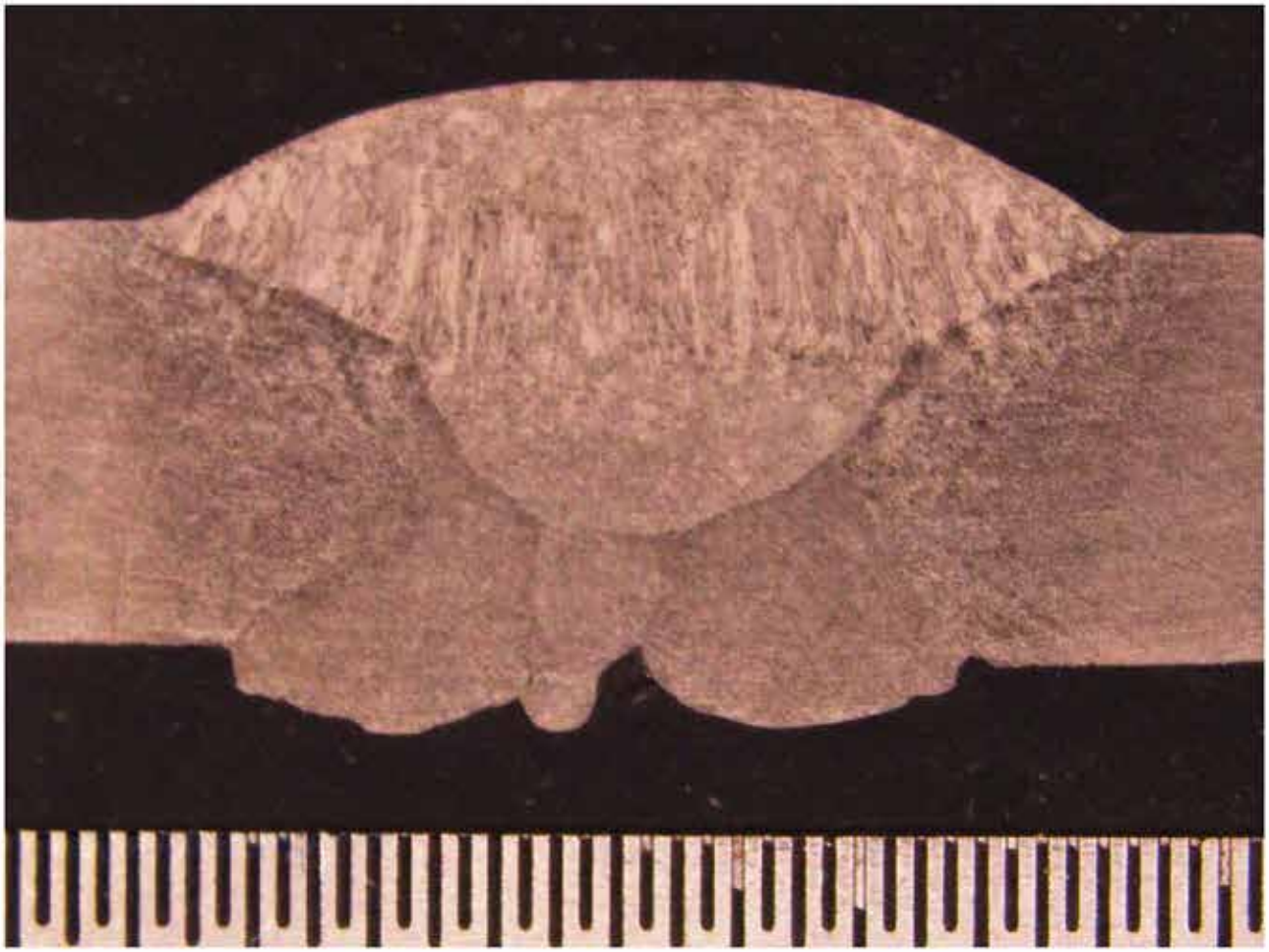
2508 Commercial Park Drive
Mobile, Alabama 36606
Ph: (251) 473-8389 Fax: (251) 473-8325
Email: info@fmsmetallurgical.com

Client:
Challenge Engineering
4234 Halls Mill Rd
Mobile, AL 36693

Document Number: L170913-RPT-101
Date: 12/15/17
Revision: 0
P.O.: 033-51
Material: Sch. 40 and Sch. 80 C/S Pipe
Description: Sample #'s 386, 391, and Control

Table 3- Macro Examination with Photograph

Sample ID	Pipe	Weld Orientation	Etchant	Scale
70913-1-M3 (Control)	Sch. 40 C/S	Transverse	Nital	1/64th Inch



Attachment 1

FAIRCLOTH & ROBERTS
METALLURGICAL SERVICES, LLC

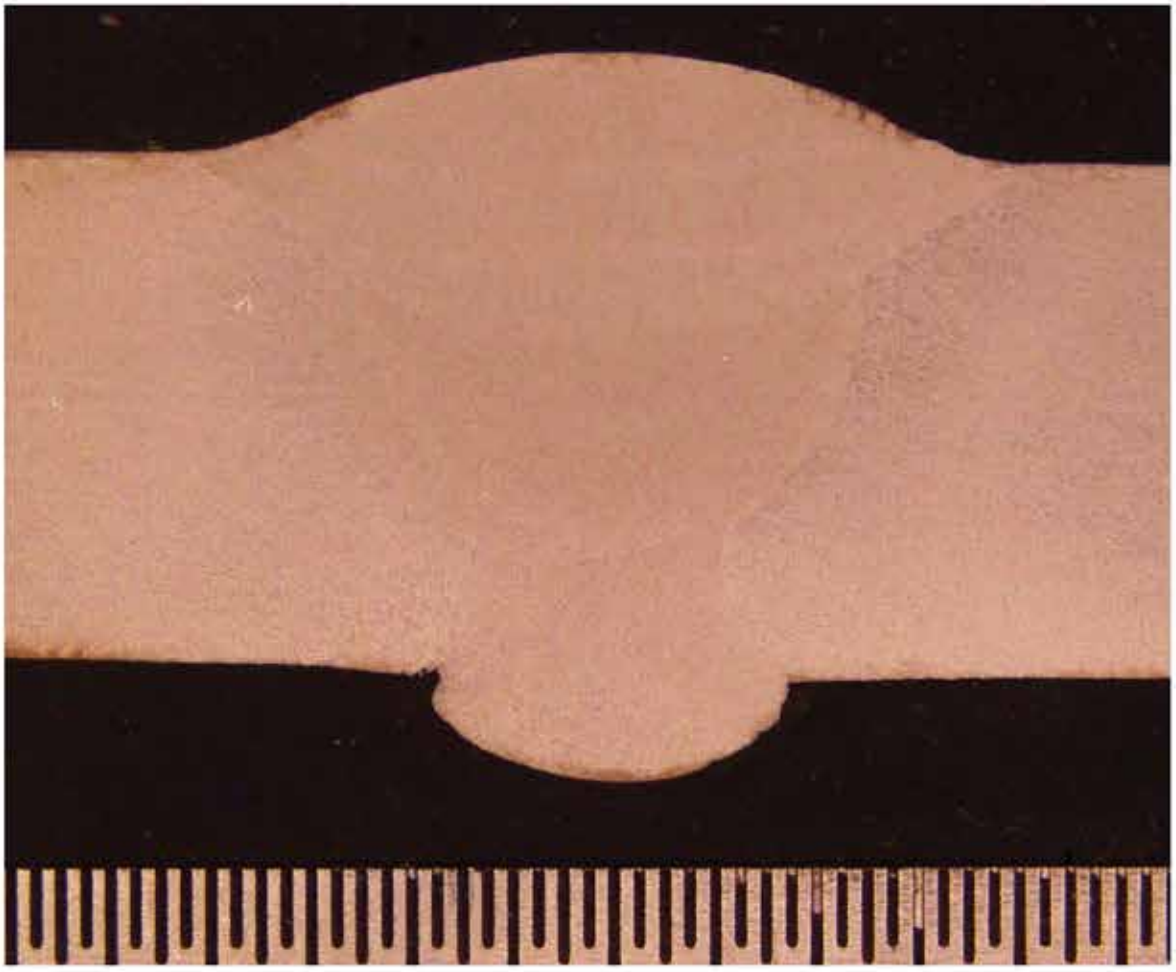
2508 Commercial Park Drive
Mobile, Alabama 36606
Ph: (251) 473-8389 Fax: (251) 473-8325
Email: info@fmsmetallurgical.com

Client:
Challenge Engineering
4234 Halls Mill Rd
Mobile, AL 36693

Document Number: L170913-RPT-101
Date: 12/15/17
Revision: 0
P.O.: 033-51
Material: Sch. 40 and Sch. 80 C/S Pipe
Description: Sample #'s 386, 391, and Control

Table 4- Macro Examination with Photograph

Sample ID	Pipe	Weld Orientation	Etchant	Scale
70913-1-M4 (#386)	Sch. 80 C/S	Transverse	Nital	1/64th Inch



Attachment 1

FAIRCLOTH & ROBERTS
METALLURGICAL SERVICES, LLC

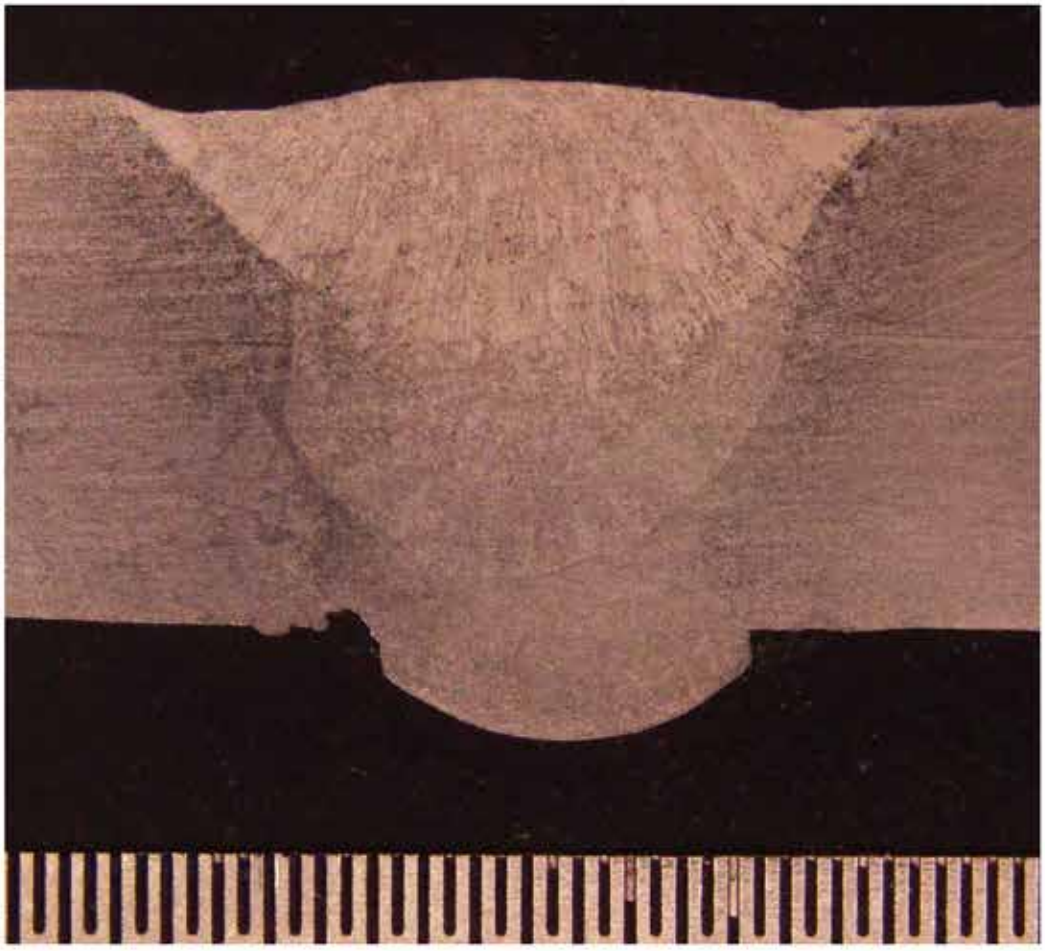
2508 Commercial Park Drive
Mobile, Alabama 36606
Ph: (251) 473-8389 Fax: (251) 473-8325
Email: info@fmsmetallurgical.com

Client:
Challenge Engineering
4234 Halls Mill Rd
Mobile, AL 36693

Document Number: L170913-RPT-101
Date: 12/15/17
Revision: 0
P.O.: 033-51
Material: Sch. 40 and Sch. 80 C/S Pipe
Description: Sample #'s 386, 391, and Control

Table 5- Macro Examination with Photograph

Sample ID	Pipe	Weld Orientation	Etchant	Scale
70913-1-M5 (#391)	Sch. 80 C/S	Transverse	Nital	1/64th Inch



Attachment 1

Table 6- Macro Examination with Photograph

Sample ID	Pipe	Weld Orientation	Etchant	Scale

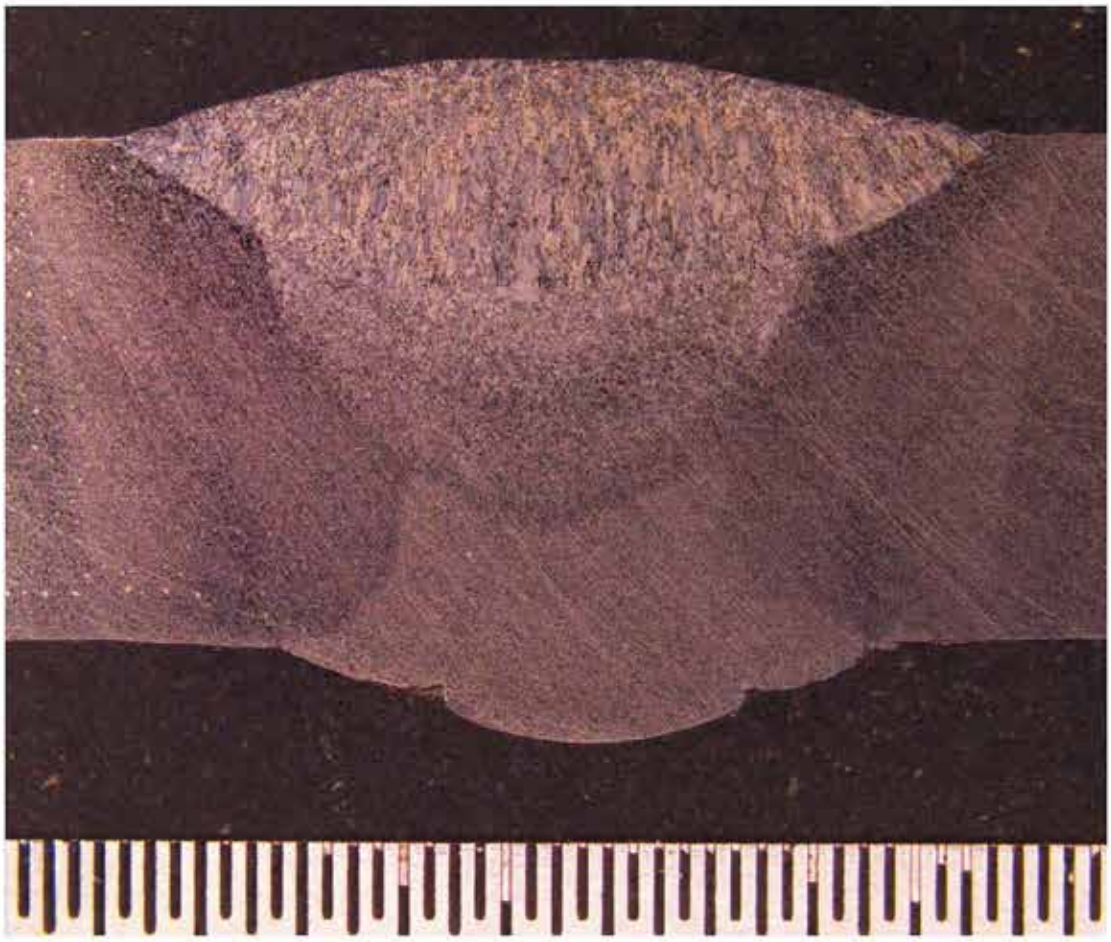
FAIRCLOTH & ROBERTS
METALLURGICAL SERVICES, LLC

2508 Commercial Park Drive
Mobile, Alabama 36606
Ph: (251) 473-8389 Fax: (251) 473-8325
Email: info@fmsmetallurgical.com

Client:
Challenge Engineering
4234 Halls Mill Rd
Mobile, AL 36693

Document Number: L170913-RPT-101
Date: 12/15/17
Revision: 0
P.O.: 033-51
Material: Sch. 40 and Sch. 80 C/S Pipe
Description: Sample #'s 386, 391, and Control

70913-1-M4 (Control)	Sch. 80 C/S	Transverse	Nital	1/64th Inch



David Roberts

David Roberts, P.E.

Attachment 1

SPECIALIZED SOILS
EXPLORATION, PHYSICAL
TESTING, ENGINEERING AND
NDT EXAMINATION SERVICES

CHALLENGE
ENGINEERING & TESTING, INC.

P.O. Box 91937
4234 HALLS MILL ROAD
MOBILE, ALABAMA 36691
PHONE: (251) 666-1439
FAX: (251) 666-1438
WWW.CHALLENGETESTING.COM

WELDING PROCEDURE QUALIFICTION TEST REPORT

CLIENT:	Cortec Corporation	**JOB DATE:**	12 / 15 / 2011
ORDERED BY:	James E. Holden, P.E.	**TECHNICIAN:**	Leonard S. Hobson
P.O. NO.:	# 100364	**TYPE OF TEST:**	WPQT
CHALLENGE JOB NO.:	P17-339	**CODE OR SPECS:**	API 1104
WITNESSED BY:	N/A	**DATE WITNESSED:**	N/A

GUIDED BEND AND NICK- BREAK TEST RESULTS

SPECIMEN I.D.	DESCRIPTION	TYPE	RESULTS
SAMPLE# 386	4" Sch. 40 Carbon Steel Pipe	Face Bend	Acceptable
	A53	Face Bend	Acceptable
		Root Bend	Acceptable
		Root Bend	Acceptable
		Nick-Break	Acceptable
		Nick-Break	Acceptable

TENSILE TEST RESULTS

Specimen ID	Width	Thickness	Area	Failure Lbs.	Failure PSI	Results
T-A	.679	.206	.140	9,500	67,857	Base Metal
T-B	.679	.199	.135	9,500	70,741	Base Metal
Remarks:						

Signature: Leonard S. Hobson AWS/CWT#98030041
Physical Laboratory Manager
NDE Level II

Attachement 2

SPECIALIZING IN SOILS EXPLORATION, PHYSICAL TESTING, ENGINEERING AND NDT EXAMINATION SERVICES

CHALLENGE
ENGINEERING & TESTING, INC.

P.O. Box 01537
4234 HALLS MILL ROAD
MOBILE, ALABAMA 36601
PHONE: (251) 666-1435
FAX: (251) 666-1438
WWW.CHALLENGETESTING.COM

WELDING PROCEDURE QUALIFICTION TEST REPORT

CLIENT:	Cortec Corporation	**JOB DATE:**	12 / 15 /2011
ORDERED BY:	James E. Holden, P.E.	**TECHNICIAN:**	Leonard S. Hobson
P.O. NO.:	# 100364	**TYPE OF TEST:**	WPQT
CHALLENGE JOB NO.:	PI 7-339	**CODE OR SPECS:**	API 1104
WITNESSED BY:	N/A	**DATE WITNESSED:**	N/A

GUIDED BEND AND NICK- BREAK TEST RESULTS

SPECIMEN I.D.	DESCRIPTION	TYPE	RESULTS
SAMPLE# 386-A	4" Sch. 80 Carbon Steel Pipe	Face Bend	Acceptable
	A53	Face Bend	Acceptable
		Root Bend	Acceptable
		Root Bend	Acceptable
		Nick-Break	Acceptable
		Nick-Break	Acceptable

TENSILE TEST RESULTS

Specimen ID	Width	Thickness	Area	Failure Lbs.	Failure PSI	Results
T-A	.682	.306	.209	15, 100	72,249	Base Metal
T-B	.686	.304	.209	15,050	72, 010	Base Metal
Remarks:						

Signature: Leonard S. Hobson AWS/CWI#98030041
Physical Laboratory Manager
NOE Level II

Attachment 3

SPECIALIZING IN SOILS
EXPLORATION, PHYSICAL
LABORATORY TESTING AND
HIGHWAY MATERIALS SERVICES

CHALLENGE
ENGINEERING & TESTING, INC.

P.O. Box 91537
4234 HALLS MILL ROAD
MOBILE, ALABAMA 36691
PHONE: (251) 666-1435
FAX: (251) 666-1438
WWW.CHALLENGETESTING.COM

WELDING PROCEDURE QUALIFICTION TEST REPORT

CLIENT:	Cortec Corporation	**JOB DATE:**	12/15/2017
ORDERED BY:	James E. Holden. P.E.	**TECHNICIAN:**	Leonard S. Hobson
P.O. NO.:	# 100364	**TYPE OF TEST:**	WPQT
CHALLENGE JOB NO.:	Pl 7-339	**CODE OR SPECS:**	API 1104
WITNESSED BY:	*N/A*	**DATE WITNESSED:**	*N/A*

GUIDED BEND AND NICK- BREAK TEST RESULTS

SPECIMEN I.D.	DESCRIPTION	TYPE	RESULTS
SAMPLE# 391	4" Sch. 40 Carbon Steel Pipe	Face Bend	Acceptable
	A53	Face Bend	Acceptable
		Root Bend	Acceptable
		Root Bend	Acceptable
		Nick-Break	Acceptable
		Nick-Break	Acceptable

TENSILE TEST RESULTS

Specimen ID	Width	Thickness	Area	Failure Lbs.	Failure PSI	Results
T-A	.778	.207	.161	10,900	67,702	Base Metal
T-B	.769	.207	.159	11,000	69,182	Base Metal
Remarks:						

Signature: Leonard S. Hobson AWSICW1#98030041
Physical Laboratory Manager
NDE Level II

SPECIALIZING IN SOILS EXPLORATION, PHYSICAL TESTING, ENGINEERING AND NDT EXAMINATION SERVICES

CHALLENGE
ENGINEERING & TESTING, INC.

PO Box 91537
4234 HALLS MILL ROAD
MOBILE, ALABAMA 36691
PHONE: (251) 666-1435
FAX: (251) 666-1438
WWW.CHALLENGETEST.COM

WELDING PROCEDURE QUALIFICTION TEST REPORT

CLIENT: I Cartee Corporation	**I JOB DATE:** 112/15/2017
ORDERED BY: I James E. Holden, P.E.	**TECHNICIAN:** I Leonard S. Hobson
P.O. NO.: 1# 100364	**TYPE OF TEST:** 1 WPQT
CHALLENGE JOB NO.: IP17-339	**CODE OR SPECS:** I API 1104
WITNESSED BY: I N/A	**DATE WITNESSED:** I *NIA*

GUIDED BEND AND NICK- BREAK TEST RESULTS

SPECIMEN I.D.	DESCRIPTION	TYPE	RESULTS
SAMPLE# 391-A	4" Sch. 80 Carbon Steel Pipe	Face Bend	Acceptable
	A53	Face Bend	Acceptable
		Root Bend	Acceptable
		Root Bend	Acceptable
		Nick-Break	Acceptable
		Nick-Break	Acceptable

TENSILE TEST RESULTS

Specimen ID	Width	Thickness	Area	Failure Lbs.	Failure PSI	Results
T-A	.801	.304	.244	17,500	71, 721	Base Metal
T-B	.800	.310	.248	18,600	75,000	Base Metal
Remarks:						

Signature: Leonard S. Hobson AWS/CWI#98030041
Physical Laboratory Manager
NDE Level II

Attachment 5

SPECIALIZING IN SOILS EXPLORATION, PHYSICAL TESTING, ENGINEERING AND NDT EXAMINATION SERVICES

CHALLENGE
ENGINEERING & TESTING, INC.

P.O. Box 9157
4234 HALLS MILL ROAD
MOBILE, ALABAMA 36691
PHONE: (251) 666-1435
FAX: (251) 666-1438
WWW.CHALLENGEEST.COM

WELDING PROCEDURE QUALIFICTION TEST REPORT

CLIENT: Cartee Corporation	**JOB DATE:** 12; 18; 2011
ORDERED BY: James E. Holde P.E.	**TECHNICIAN:** Leonard S. Hobson
P.O. NO.: # 100364	**TYPE OF TEST:** WPQT
CHALLENGE JOB NO.: P17-339	**CODE OR SPECS:** API 1104
WITNESSED BY: N/A	**DATE WITNESSED:** N/A

GUIDED BEND AND NICK-BREAK TEST RESULTS

SPECIMEN I.D.	DESCRIPTION	TYPE	RESULTS
SAMPLE# Control-A	4" Sch. 80 Carbon Steel Pipe	Face Bend	Acceptable
	A53	Face Bend	Acceptable
		Root Bend	Acceptable
		Root Bend	Acceptable
		Nick-Break	Acceptable
		Nick-Break	Acceptable

TENSILE TEST RESULTS

Specimen ID	Width	Thickness	Area	Failure Lbs.	Failure PSI	Results
T-A	.798	.304	.243	17,400	71,605	Base Metal
T-B	.798	.310	.247	18,200	73,684	Base Metal
Remarks:						

Signature: Leonard S. Hobson AWS/CWI#9803004
Physical Laboratory Manager
NDE Level II

SPECIALIZING IN SOILS
EXPLORATION, PHYSICAL
TESTING, ENGINEERING AND
CONSTRUCTION EXAMINATION SERVICES

CHALLENGE
ENGINEERING & TESTING, INC.

P.O. Box 7137
4234 HALL MILL ROAD
MOBILE, ALABAMA 36691
PHONE: 12511666-1435
FAX: (251) 666-1438
WWW.CHALLENGETESTINGCORP.COM

WELDING PROCEDURE QUALIFICTION TEST REPORT

CLIENT: Cartee Corporation	**JOB DATE:** 12/15/2017
ORDERED BY: James E. Holden, P.E.	**TECHNICIAN:** Leonard S. Hobson
P.O. NO.: I # 100364	**TYPE OF TEST:** WPQT
CHALLENGE JOB NO.: P17-339	**CODE OR SPECS:** API 1104
WITNESSED BY: *NIA*	**DATE WITNESSED:** N/A

GUIDED BEND AND NICK- BREAK TEST RESULTS

SPECIMEN I.D.	DESCRIPTION	TYPE	RESULTS
SAMPLE# Control	4" Sch. 40 Carbon Steel Pipe	Face Bend	Acceptable
	A53	Face Bend	Acceptable
		Root Bend	Acceptable
		Root Bend	Acceptable
		Nick-Break	Acceptable
		Nick-Break	Acceptable

TENSILE TEST RESULTS

Specimen ID	Width	Thickness	Area	Failure Lbs.	Failure PSI	Results
1-A	.712	.208	.148	10,000	67,568	Base Metal
T-B	.714	.208	.149	9,950	66, 779	Base Metal
Remarks:						

Signature: Leonard S. Hobson AWS/CWI#98030041
Physical Laboratory Manager
NDE Level II