8909 Jackrabbit Rd.
Houston, TX 77095
Telephone: (281) 855-3200

October 25, 2012

Rowan Companies, Inc.
2800 Post Oak Blvd. Suite 5450
Houston, TX 77056

ATTENTION: Ashley Molbert
RE: Shear Calculation Package for Rowan Companies, Inc.

SHEAR TEST

Shear testing of the BOP and Pipe / Tubular configuration documented below was conducted by Church Energy Services on October 19, 2011 (ref. ER149A). No wellbore pressure was used during the shearing operation.

SHEAR TEST BOP	
Manufacturer	Cameron
Size (in.)	13 5/8
Pressure (psi)	10,000
Type	U
Bonnet Type	LBT
Ram Type	ISR
BOP Actuator Maximum Operating Pressure (psi)	3,000

SHEAR TEST PIPE / TUBULAR	
Size (in.)	5 1/2
Geometry (ppf)	24.7
Grade	S135
Wall Thickness (in.)	0.415

SHEAR TEST RESULTS	
Test Shear Pressure (psi)	1,400
Calculated Shear Pressure (psi)	2,828
Test Shear Pressure / Calculated Shear Pressure (%)	50

SHEAR CALCULATION

Energy Risk Consulting provided calculations to predict the pressure required to shear the below mentioned drill pipe(s) / tubing(s) used in the well. The following information was utilized during calculations.

GENERAL INFORMATION	
Operator	Apache
Rig	Cecil Provine
Well	SMI 48
MASP (psi)	4,030

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Houston, TX 77095
Telephone: (281) 855-3200

BOP INFORMATION	
Manufacturer	Cameron
Size (in.)	13 5/8
Pressure (psi)	10,000
Type	U
Bonnet Type	LBT
Ram Type	DS

Drill Pipe / Tubing calculated shear pressures both without and with consideration of wellbore pressure effects are provided below:

SHEAR CALCULATION INFORMATION / RESULTS					
Size (in)	**Geometry** (ppf)	**Grade**	**Wall Thickness** (in)	**Shear Pressure (No Wellbore Pressure Effects)** (psi)	**Shear Pressure (Including MASP)** (psi)
5	19.5	S135	0.362	2,233	2,467

After review of the test results and calculations, Energy Risk Consulting hereby certifies that the specified BOP including bonnet and ram configurations will shear the pipe(s) referenced above.

FACTORS AFFECTING SHEAR RAM OPERATING PRESSURES

Many factors contribute to a wide range of shearing forces required to shear drill pipe and wellbore tubular. These may include the pipe material strength, toughness and dimensional differences used in the pipe manufacture. Other factors that can affect shearing performance include the BOP's internal dimensions, which include wear, corrosion and drill bit/tool damage to the ram cavities.

If we can be of any other assistance, please let us know.

Wael Abouamin, P.E. 111251
President, Energy Risk Consulting

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Test Shear Pressure / Calculated Shear Pressure (%)	50

SHEAR CALCULATION

Energy Risk Consulting provided calculations to predict the pressure required to shear the below mentioned drill pipe(s) / tubing(s) used in the well. The following information was utilized during calculations.

GENERAL INFORMATION	
Operator	Apache
Rig	Cecil Provine
Well	SMI 48
MASP (psi)	4,855

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BOP INFORMATION	
Manufacturer	Cameron
Size (in.)	13 5/8
Pressure (psi)	10,000
Type	U
Bonnet Type	LBT
Ram Type	DS

Drill Pipe / Tubing calculated shear pressures both without and with consideration of wellbore pressure effects are provided below:

SHEAR CALCULATION INFORMATION / RESULTS					
Size (in)	**Geometry** (ppf)	**Grade**	**Wall Thickness** (in)	**Shear Pressure (No Wellbore Pressure Effects)** (psi)	**Shear Pressure (Including MASP)** (psi)
3 1/2	13.3	S135	0.368	1,523	1,805

After review of the test results and calculations, Energy Risk Consulting hereby certifies that the specified BOP including bonnet and ram configurations will shear the pipe(s) referenced above.

FACTORS AFFECTING SHEAR RAM OPERATING PRESSURES

Many factors contribute to a wide range of shearing forces required to shear drill pipe and wellbore tubular. These may include the pipe material strength, toughness and dimensional differences used in the pipe manufacture. Other factors that can affect shearing performance include the BOP's internal dimensions, which include wear, corrosion and drill bit/tool damage to the ram cavities.

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Wall Thickness (in.)	0.415

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SHEAR CALCULATION

Energy Risk Consulting provided calculations to predict the pressure required to shear the below mentioned drill pipe(s) / tubing(s) used in the well. The following information was utilized during calculations.

GENERAL INFORMATION	
Operator	Apache
Rig	Cecil Provine
Well	SMI 48
MASP (psi)	0

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Houston, TX 77095
Telephone: (281) 855-3200

BOP INFORMATION	
Manufacturer	Cameron
Size (in.)	13 5/8
Pressure (psi)	10,000
Type	U
Bonnet Type	LBT
Ram Type	DS

Drill Pipe / Tubing calculated shear pressures both without and with consideration of wellbore pressure effects are provided below:

SHEAR CALCULATION INFORMATION / RESULTS				
Size (in)	**Geometry** (ppf)	**Grade**	**Wall Thickness** (in)	**Shear Pressure at MASP = 0 (No Wellbore Pressure Effects)** (psi)
5	19.5	S135	0.362	2,233
3 1/2	13.3	S135	0.368	1,523

After review of the test results and calculations, Energy Risk Consulting hereby certifies that the specified BOP including bonnet and ram configurations will shear the pipe(s) referenced above.

FACTORS AFFECTING SHEAR RAM OPERATING PRESSURES

Many factors contribute to a wide range of shearing forces required to shear drill pipe and wellbore tubular. These may include the pipe material strength, toughness and dimensional differences used in the pipe manufacture. Other factors that can affect shearing performance include the BOP's internal dimensions, which include wear, corrosion and drill bit/tool damage to the ram cavities.

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President, Energy Risk Consulting

EnergyRisk CONSULTING

8909 Jackrabbit Road
Houston, Texas 77095
Telephone: (281) 855-3200

Required Shear Pressure Calculation Form

BOP Type/Description: Cameron U Type BOP

DOCUMENT INFORMATION	
Calculation Date:	October 25, 2012
Prepared:	Samih Carroll
Reviewed:	Tamer Ghoneim
Approved	Wael Abouamin, P.E.

TUBULAR GEOMETRIC VERIFICATION CHECK		
BOP Type	13 5/8 10M U DS	
Maximum Wall Thickness (*Note: * indicates no maximum wall thickness requirement*)	*	in
Maximum Diameter	7.53	in
Is the pipe geometry acceptable per PD220-01, Section 5.0 and Cameron Engineering Bulletin EB 702 D?	**YES**	

COMPANY/FACILITY INFORMATION	
CUSTOMER:	Rowan
OPERATOR:	Apache
RIG:	Cecil Provine
LOCATION:	SMI 48

BOP/PIPE CONFIGURATION		
BOP Size:	13 5/8	in.
BOP Pressure:	10,000	psi
Bonnet Type:	LBT	
Large Bore Shear Bonnet with booster assembly		
Ram Type Used:	DS	
Pipe/Tubular Diameter to Shear:	5	in
Pipe/Tubular Geometry (pipe weight per foot - ppf):	19.50	lb/ft
Pipe/Tubular Grade:	S135	
Pipe/Tubular Wall Thickness:	0.362	in
Maximum Allowable Operating Pressure of Bonnet:	3,000	psi
P_w (Wellbore Pressure at the time of the Shear):	4,030	psi

SHEAR CALCULATION

Input Information

C1 =	BOP/Operator constant corresponding to the piston closing area	224	in^2
C2 =	BOP/Operator constant corresponding to the Operator piston rod opening area	13	in^2
C3 =	Shear ram type/pipe grade constant	0.19	
ppf =	Pipe weight per foot	19.50	lb/ft
σ_{yield} =	Minimum yield strength of tubular material	135,000	psi

Shear Pressure Calculation (No Wellbore Pressure Effects)

Shear Pressure withough consideration of wellbore pressure effects, $P_{shearNWB}$, is calculated using the following equation:

$$P_{shearNWB} = \left[\frac{(C_3)(ppf)(\sigma_{yield})}{C_1} \right]$$

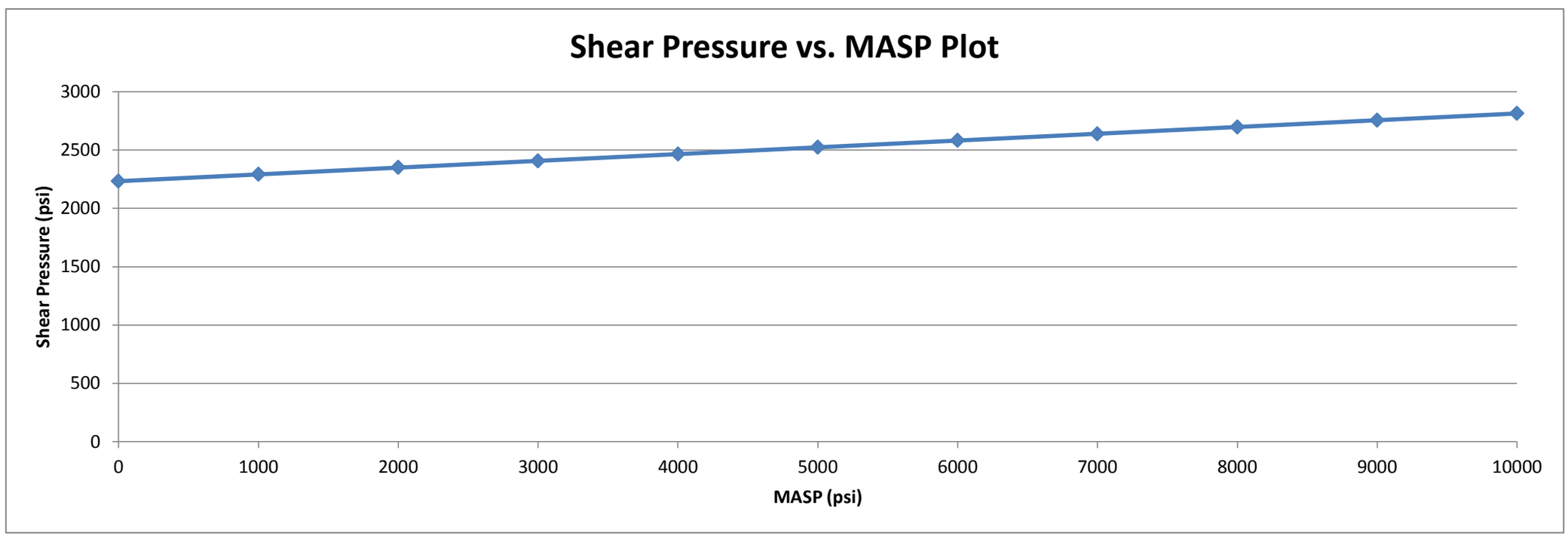
$P_{shearNWB}$ (Bonnet Shear Pressure) = 2,233 psi

Shear Pressure Calculation (Including Wellbore Pressure Effects)

Shear Pressure including wellbore pressure effects, P_{shear}, is calculated using the following equation:

$$P_{shear} = \left[\frac{(C_3)(ppf)(\sigma_{yield}) + (P_W)(C_2)}{C_1} \right]$$

P_{shear} (Bonnet Shear Pressure) = 2,467 psi



EnergyRisk CONSULTING

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Required Shear Pressure Calculation Form

BOP Type/Description: Cameron U Type BOP

DOCUMENT INFORMATION	
Calculation Date:	October 25, 2012
Prepared:	Samih Carroll
Reviewed:	Tamer Ghoneim
Approved	Wael Abouamin, P.E.

TUBULAR GEOMETRIC VERIFICATION CHECK		
BOP Type	13 5/8 10M U DS	
Maximum Wall Thickness (*Note: * indicates no maximum wall thickness requirement*)	*	in
Maximum Diameter	7.53	in
Is the pipe geometry acceptable per PD220-01, Section 5.0 and Cameron Engineering Bulletin EB 702 D?	**YES**	

COMPANY/FACILITY INFORMATION	
CUSTOMER:	Rowan
OPERATOR:	Apache
RIG:	Cecil Provine
LOCATION:	SMI 48

BOP/PIPE CONFIGURATION		
BOP Size:	13 5/8	in.
BOP Pressure:	10,000	psi
Bonnet Type:	LBT	
Large Bore Shear Bonnet with booster assembly		
Ram Type Used:	DS	
Pipe/Tubular Diameter to Shear:	3 1/2	in
Pipe/Tubular Geometry (pipe weight per foot - ppf):	13.30	lb/ft
Pipe/Tubular Grade:	S135	
Pipe/Tubular Wall Thickness:	0.368	in
Maximum Allowable Operating Pressure of Bonnet:	3,000	psi
P_w (Wellbore Pressure at the time of the Shear):	4,855	psi

SHEAR CALCULATION

Input Information

C1 =	BOP/Operator constant corresponding to the piston closing area	224	in^2
C2 =	BOP/Operator constant corresponding to the Operator piston rod opening area	13	in^2
C3 =	Shear ram type/pipe grade constant	0.19	
ppf =	Pipe weight per foot	13.30	lb/ft
σ_{yield} =	Minimum yield strength of tubular material	135,000	psi

Shear Pressure Calculation (No Wellbore Pressure Effects)

Shear Pressure withough consideration of wellbore pressure effects, $P_{shearNWB}$, is calculated using the following equation:

$$P_{shearNWB} = \left[\frac{(C_3)(ppf)(\sigma_{yield})}{C_1} \right]$$

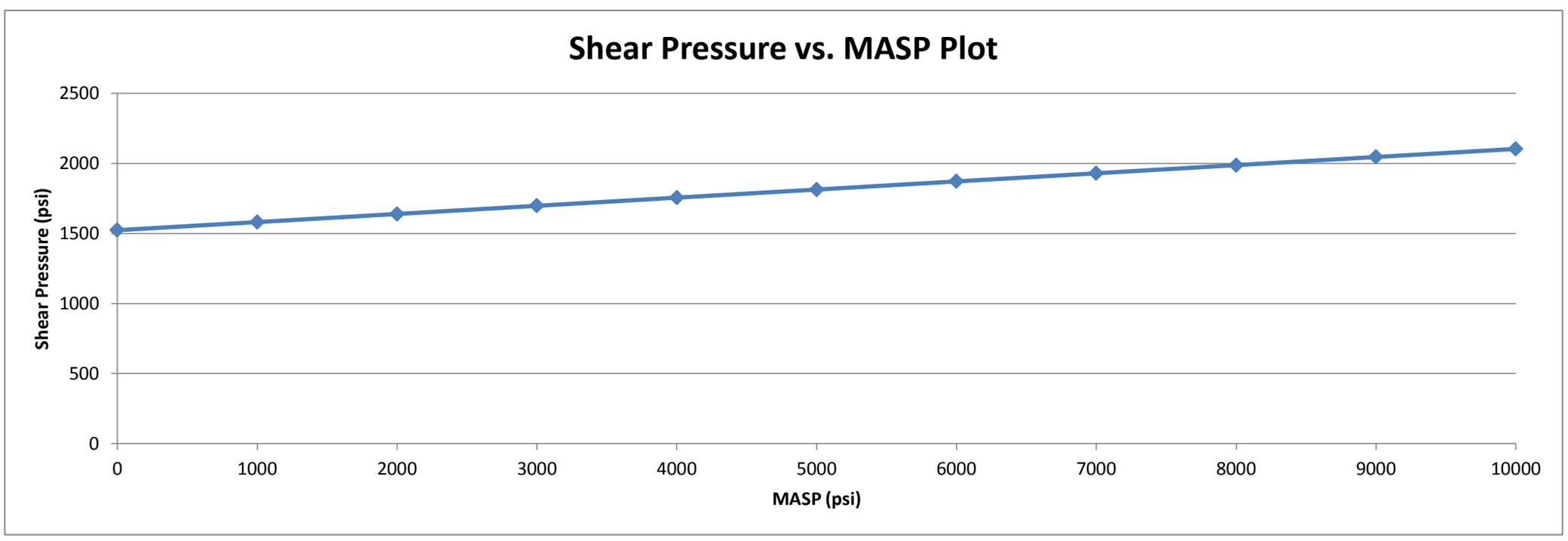
$P_{shearNWB}$ (Bonnet Shear Pressure) = 1,523 psi

Shear Pressure Calculation (Including Wellbore Pressure Effects)

Shear Pressure including wellbore pressure effects, P_{shear}, is calculated using the following equation:

$$P_{shear} = \left[\frac{(C_3)(ppf)(\sigma_{yield}) + (P_W)(C_2)}{C_1} \right]$$

P_{shear} (Bonnet Shear Pressure) = 1,805 psi



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Maximum Diameter	7.53	in
Is the pipe geometry acceptable per PD220-01, Section 5.0 and Cameron Engineering Bulletin EB 702 D?	YES	

COMPANY/FACILITY INFORMATION	
CUSTOMER:	Rowan
OPERATOR:	Apache
RIG:	Cecil Provine
LOCATION:	SMI 48

BOP/PIPE CONFIGURATION		
BOP Size:	13 5/8	in.
BOP Pressure:	10,000	psi
Bonnet Type:	LBT	
Large Bore Shear Bonnet with booster assembly		
Ram Type Used:	DS	
Pipe/Tubular Diameter to Shear:	5	in
Pipe/Tubular Geometry (pipe weight per foot - ppf):	19.50	lb/ft
Pipe/Tubular Grade:	S135	
Pipe/Tubular Wall Thickness:	0.362	in
Maximum Allowable Operating Pressure of Bonnet:	3,000	psi
P_w (Wellbore Pressure at the time of the Shear):	0	psi

SHEAR CALCULATION

Input Information

C1 =	BOP/Operator constant corresponding to the piston closing area	224	in^2
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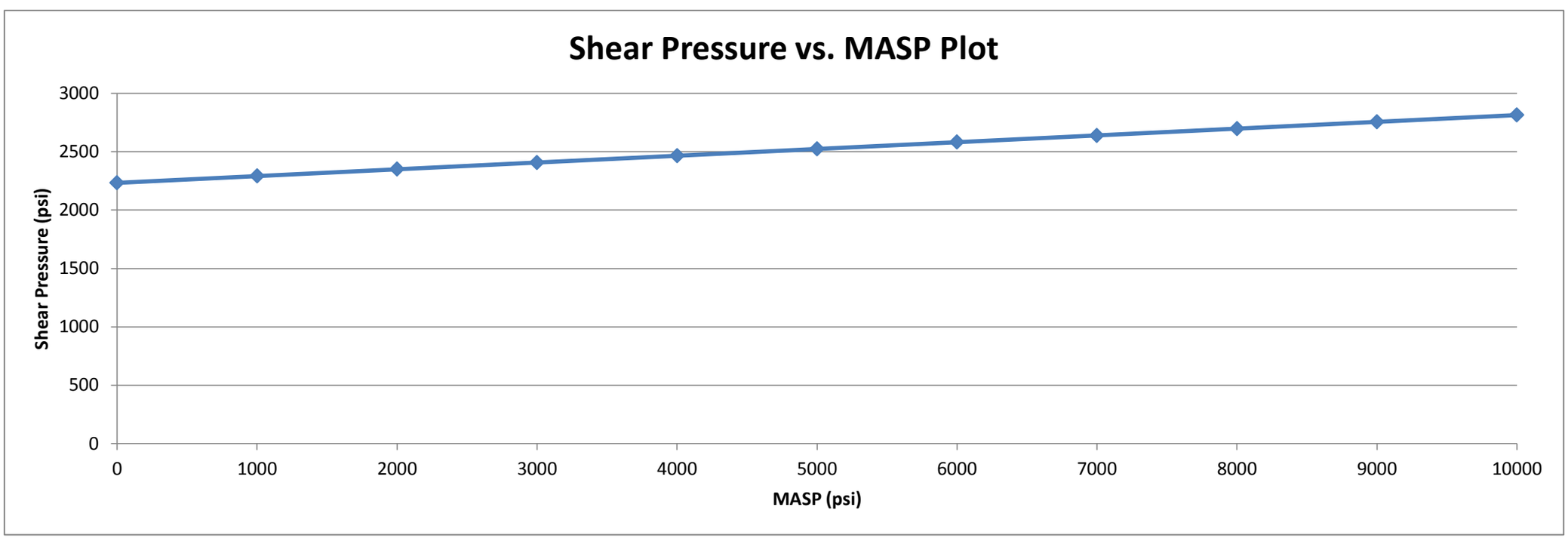

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BOP Pressure:	10,000	psi
Bonnet Type:	LBT	
Large Bore Shear Bonnet with booster assembly		
Ram Type Used:	DS	
Pipe/Tubular Diameter to Shear:	3 1/2	in
Pipe/Tubular Geometry (pipe weight per foot - ppf):	13.30	lb/ft
Pipe/Tubular Grade:	S135	
Pipe/Tubular Wall Thickness:	0.368	in
Maximum Allowable Operating Pressure of Bonnet:	3,000	psi
P_w (Wellbore Pressure at the time of the Shear):	0	psi

SHEAR CALCULATION

Input Information

C1 =	BOP/Operator constant corresponding to the piston closing area	224	in^2
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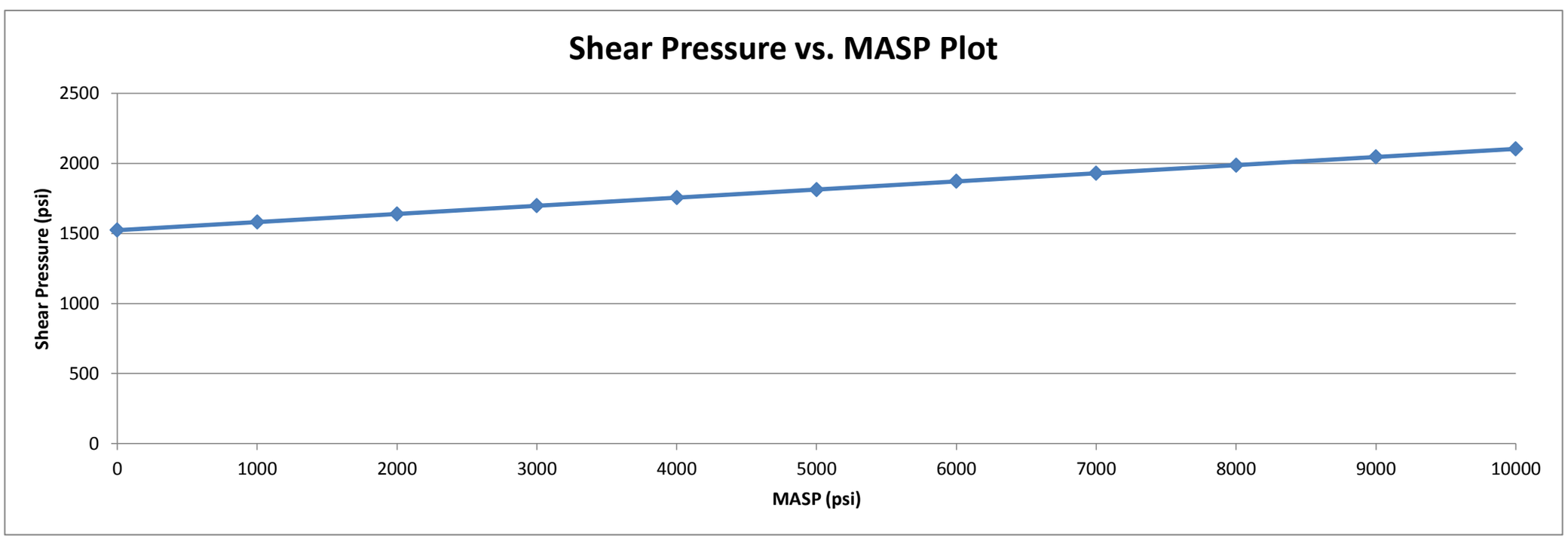

EnergyRisk
CONSULTING

8909 Jackrabbit Rd.
Houston, TX 77095
(281) 855-3200

Energy Risk Consulting Qualification Statement

Energy Risk Consulting is an independent professionally licensed engineering firm that meet all the requirements of an independent third party as outlined in CFR250:

- Energy Risk Consulting is a licensed engineering firm, registration no. F-14442.
- Energy Risk Consulting carries professional liability insurance.
- Energy Risk Consulting have no record of violations of applicable laws or ethical guidelines.
- Energy Risk Consulting will allow an official representative of BOEM and BSEE access to verify records and witness tests (if applicable).
- Experience: principal engineers have almost 20 years of experience in certification, design review, and risk assessment of BOP's and BOP control systems in addition to well control equipment.
- All statements and certifications are made and signed under penalty of perjury.

Wael Abouamin, P.E.

STATE OF TEXAS
WAEL ABOUAMIN
111251
LICENSED
PROFESSIONAL ENGINEER

TEXAS BOARD OF PROFESSIONAL ENGINEERS
CERTIFICATE OF REGISTRATION

This acknowledges that

Oil & Gas Consulting, Inc.

(dba) Energy Risk Consulting

has fulfilled the requirements of the State of Texas
to offer and perform engineering services in the
State of Texas.

In witness whereof
we have hereunto set our hands and affixed the seal of the Board,
this 20th day of June 2012.

BOARD CHAIR

BOARD SECRETARY

Registration # F-14442

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY) 08/14/2012

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER
MCGRIFF, SEIBELS & WILLIAMS OF TEXAS, INC.
818 Town & Country Blvd, Suite 500
Houston, TX 77024-4549

CONTACT NAME:
PHONE (A/C, No, Ext): 713-877-8975 FAX (A/C, No): 713-877-8974
E-MAIL ADDRESS:

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A : American Safety Indemnity Company	25433
INSURER B : Commerce and Industry Ins Co	
INSURER C :	
INSURER D :	
INSURER E :	
INSURER F :	

INSURED
Oil & Gas Risk Consulting Inc. dba Energy Risk Consulting
8909 Jackrabbit Road
Houston, TX 77095

COVERAGES **CERTIFICATE NUMBER:** 7SWJZ3WX **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS		
A	GENERAL LIABILITY			ELS1001524-1201	08/11/2012	08/11/2013	EACH OCCURRENCE	$	1,000,000
	X COMMERCIAL GENERAL LIABILITY						DAMAGE TO RENTED PREMISES (Ea occurrence)	$	50,000
	CLAIMS-MADE X OCCUR						MED EXP (Any one person)	$	
							PERSONAL & ADV INJURY	$	1,000,000
							GENERAL AGGREGATE	$	2,000,000
	GEN'L AGGREGATE LIMIT APPLIES PER:						PRODUCTS - COMP/OP AGG	$	2,000,000
	X POLICY PRO-JECT LOC							$	
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident)	$	
	ANY AUTO						BODILY INJURY (Per person)	$	
	ALL OWNED AUTOS / SCHEDULED AUTOS						BODILY INJURY (Per accident)	$	
	HIRED AUTOS / NON-OWNED AUTOS						PROPERTY DAMAGE (Per accident)	$	
								$	
B	X UMBRELLA LIAB X OCCUR			BE39700139	08/11/2012	08/11/2013	EACH OCCURRENCE	$	5,000,000
	EXCESS LIAB CLAIMS-MADE						AGGREGATE	$	5,000,000
	DED X RETENTION $ 10,000							$	
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y / N						WC STATU-TORY LIMITS / OTH-ER		
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH)	N / A					E.L. EACH ACCIDENT	$	
	If yes, describe under DESCRIPTION OF OPERATIONS below						E.L. DISEASE - EA EMPLOYEE	$	
							E.L. DISEASE - POLICY LIMIT	$	
								$	
								$	
								$	
								$	
								$	

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

CERTIFICATE HOLDER

For Information Only

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

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The ACORD name and logo are registered marks of ACORD

AXON | PRESSURE PRODUCTS
Church Energy SERVICES LTD.

2810 Washington Drive
Houston, TX 77038-3319
Telephone: (281) 931-1400
Facsimile: (281) 931-8700

ENGINEERING REPORT NO: ER149A

FOR:

ROWAN COMPANIES, INC.

TEST REPORT ON SHEAR RAM PERFORMANCE

13-5/8" 10,000 PSI W.P. CAMERON TYPE U BOP EQUIPPED WITH LARGE BORE SHEAR BONNETS AND SHEAR BOOSTERS WITH TYPE ISR SHEAR RAMS

Disclaimer:
The information contained within this report is based on the shear testing witnessed by a representative from Church Energy Services (CES) Ltd. The shear testing was performed in accordance with NTL No. 2010-N05 (OMB Control Number: 1010-0182) to verify that the blind shear rams will shear the pipe specified herein. This report does not certify the actual BOP equipment used during the testing per API RECOMMENDED PRACTICE 53, Recommended Practices for Blowout Prevention Equipment Systems for Drilling Wells, (3rd Edition), March 1997.

PREPARED BY: A. DHUNGEL

DATE: OCTOBER 24, 2011

AXON | PRESSURE PRODUCTS
Church Energy SERVICES LTD.

2810 Washington Drive
Houston, TX 77038-3319
Telephone: (281) 931-1400
Facsimile: (281) 931-8700

TABLE OF CONTENTS

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3.0 SHEAR PRESSURE CALCULATIONS

4.0 EQUIPMENT IDENTIFICATION

5.0 TEST PRESSURE CHARTS

6.0 TEST PIPE INFORMATON

7.0 MISCELLANEOUS

AXON | PRESSURE PRODUCTS
Church Energy SERVICES LTD.

2810 Washington Drive
Houston, TX 77038-3319
Telephone: (281) 931-1400
Facsimile: (281) 931-8700

1.0 ENGINEERING REPORT

AXON | PRESSURE PRODUCTS
Church Energy SERVICES LTD.

2810 Washington Drive
Houston, TX 77038-3319
Telephone: (281) 931-1400
Facsimile: (281) 931-8700

ENGINEERING REPORT

REPORT NO.: ER149A
DATE: 10.24.11

TITLE: Test Report on shear ram performance conducted at Church Energy Services facility for a 13-5/8" 10000 psi W.P. Type U (Cameron) blowout preventer (BOP) equipped with large bore shear bonnets and shear boosters (LBT) with type ISR shear rams installed.

DATE OF TEST: 19th October 2011

BACKGROUND: Church Energy Services was requested by Rowan Companies, Inc. to witness shear ram testing on 5-1/2" 24.7 ppf S-135 (.415" wall thickness) drill pipe used by the company in their offshore drilling operations. This was initiated by a request from the United States Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) for verification of the equipment to perform its required function.

EQUIPMENT: A double ram Cameron Type U BOP was used in performing the shear test. The BOP consisted of standard bonnets on the upper cavity and large bore shear bonnets with tandem shear boosters on the lower cavity. The BOP was remanufactured by Cameron. The shear rams were manufactured new by B.O.P. Products, LLC. Hydrostatic test equipment and facilities were provided by Church Energy Services.

PROCEDURE: Surface NDE (Magnetic Particle Inspection (MPI)) was performed on the rams before the shear test. The hydraulics on the BOP (close) was tested. A 5-1/2" 24.7ppf S-135 (.415" wall thickness) drill pipe was suspended into the BOP past the shear rams. Strip chart recorders were used to monitor the closing pressure and the bore pressures after shearing. No well bore pressure was used during the shearing operation. After the shear test, low pressure and the working pressure of the BOP was applied below the shear rams. The rams were then removed and surface NDE (MPI) was performed on the shearing blade surfaces.

SUMMARY: Church Energy Services supplied calculations to predict the maximum operating shearing pressure of 5-1/2" 24.7 ppf S-135 (0.415" wall thickness) to be 2828 psi. The actual operating shearing pressure from the test was approximately 1400 psi (50% of calculated). The hydraulics (close) test and the high pressure testing below the rams were found to be acceptable. A gradual drop in the pressure was noticed while conducting the low pressure testing below the rams. Visual inspection of the rams showed that the blade seal on the upper ram was damaged. It was also noticed that the upper ram shear blade area had minor brinelling which was dressed using emery paper by hand. Surface NDE (MPI) showed no indications caused by the shear tests.

ATTENDEES: The test was witnessed by Ronald W. Sralla of Rowan Companies, Inc., Philip Kuentz of West Engineering Services, Ronald E. Champagne, Ravi Velamarthy and testing personnel of Axon Pressure Products.

R. M. Church Jr.

Richard M. Church, Jr. P.E.
Vice President of Engineering and Quality

AXON | PRESSURE PRODUCTS
Church Energy SERVICES LTD.

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Facsimile: (281) 931-8700

2.0 SHEAR TEST PROCEDURE AND DATA

AXON | PRESSURE PRODUCTS
Church Energy SERVICES LTD.

2810 Washington Drive
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Telephone: (281) 931-1400
Facsimile: (281) 931-8700

CAMERON TYPE U RAM BLOWOUT PREVENTER

SHEAR TEST DATA AND PROCEDURE

CUSTOMER: Rowan Companies, Inc. **DATE:** 10-17-2011

BOP size: 13-5/8" Pressure: 10,000 psi

Bonnet type: Large Bore Shear Bonnets with Boosters (LBT)

Ram type: ISR

Pipe / Tubular to shear: 5-1/2" 24.7 ppf S-135 (.415" wall thickness)

Maximum allowable operating pressure of bonnet: 3,000 psi

Is the pipe geometry acceptable per the requirements of PD220-01, Section 5.0? Yes

Shear pressure, P_{Shear} calculated using the equation in PD220-01, Section 6.0: 2,828 psi

PROCEDURE:

1. Fill in the data recording sheet with equipment identification numbers, actual test pipe measured information and other relevant data
2. Test the hydraulics (open and close) to at least 3000 psi for 5 minutes. (Per API RP 53, 3rd Edition, Sec. 17)

   Accept: YES (TESTED ONLY CLOSE)
3. Lower the pipe into the BOP and suspend it approximately 12" below the shear rams.
4. Close the shear rams and monitor the pressure to shear. Pressure to shear: 1400 psi
5. Apply pressure below the rams and hold for 10 mins.
   a. Low Pressure: 250 psi Accept: NO
   b. High Pressure: 10,000 psi Accept: YES
6. Open shear rams and remove from bonnets.
7. Inspect ram cavities and rams for damage.

Data recorded by:

Name / Signature	Company	Date
Ravi Velamarthy / [signature]	AXON PRESSURE PRODUCTS	10/19/2011

Witness:

Name / Signature	Company	Date
Ronald W. Drall	Rowan Co	10/19/2011

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3.0 SHEAR PRESSURE CALCULATIONS

AXON | PRESSURE PRODUCTS
Church Energy SERVICES LTD.

2810 Washington Drive
Houston, TX 77038-3319
Telephone: (281) 931-1400
Facsimile: (281) 931-8700

CAMERON TYPE U RAM BLOWOUT PREVENTER
REQUIRED SHEAR PRESSURE CALCULATION FORM

CUSTOMER: Rowan Companies, Inc. **DATE:** 10-17-2011

BOP Size: 13-5/8" Pressure: 10,000 psi

Bonnet Type: Large Bore Shear Bonnets with Boosters (LBT)

Ram Type used: ISR

Pipe / Tubular to Shear: 5-1/2" 24.7 ppf S-135 (.415" wall thickness)

Maximum Allowable Operating Pressure of Bonnet: 3,000 psi

P_W (Wellbore Pressure at the time of the Shear): 0 psi

Is the pipe geometry acceptable per the requirements of PD220-01, Section 5.0 and Cameron Engineering Bulletin EB 702 D? Yes

INPUT VARIABLES:

C_1 = 224 BOP / Bonnet constant corresponding to the piston closing area

C_2 = 13 BOP / Bonnet constant corresponding to the piston rod opening area

C_3 = .19 Shear ram type / pipe grade constant

ppf = 24.7 lbf/ft

σ_{yield} = 135,000 Minimum Yield Strength of Pipe Material (psi)

Shear pressure, $\mathbf{P}_{\mathbf{Shear}}$ is calculated using the following equation:

$$\mathbf{P}_{\mathbf{Shear}} = \left[\frac{(C_3)(ppf)(\sigma_{yield}) + (P_W)(C_2)}{C_1} \right]$$

$\mathbf{P}_{\mathbf{Shear}}$ (Bonnet Shear Pressure) = 2,828 psi

Therefore, since $\mathbf{P}_{\mathbf{Shear}}$ is less than the maximum allowable operator pressure, the BOP is acceptable for the shearing operation.

AXON | PRESSURE PRODUCTS
Church Energy SERVICES LTD.

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4.0 EQUIPMENT IDENTIFICATION

AXON PRESSURE PRODUCTS
Church Energy SERVICES LTD.

2810 Washington Drive
Houston, TX 77038-3319
Telephone: (281) 931-1400
Facsimile: (281) 931-8700

Data Recording Sheet

1) Equipment identification:

BOP Type: Type U Double Manufacturer: Cameron

BOP size and pressure: 13-5/8" 10,000 psi W.P.

Serial Numbers and Part Numbers:

BOP Assembly: Assy. No.: 2245115-02 Rev 02 SN: 110739178-01

Ram Body: Manufacturer: B.O.P. Products, LLC.

Upper: PN: 2164773-01 S N: 722-11 H N: 217P267

Lower: PN: 2164774-01 S N: 725-11 H N: 217P267

2) Test pipe information:

Actual Pipe OD: 5.520" Actual Wall thickness: 0.44" Grade: S-135

Pipe Manufacturer: Texas Steel Conversion, Inc. Heat Number: 727533

Material certificates (MTR): ✓

3) Test Equipment:

Serial number/ID of chart recorders: SN/ID: CES 508-02 / CES 510-02 / CES 509-02

Calibration certificates: ✓

4) Shearing Tests:

Pressure test below the rams for Shear Blind Rams: ✓

Test pressure charts: ✓

CAMERON

Drilling and Production Systems

Cameron – Thomas Rd.
6039 Thomas Rd. Bldg. G
Houston, TX 77041
USA
281-504-2500
281-504-2530
www.c-a-m.com

Drilling Systems Certificate of Conformance
Repair/Remanufacture

Date:	03/2011		
Certified as of:			
Customer:	ROWAN COMPANIES	Cameron Customer Property Number:	08-1417871
Customer PO Number:	N/A	Cameron Internal Tracking Number:	300114069

Disclaimer

Cameron certifies that the item(s) described below has (have) been repaired/remanufactured, inspected, and tested in conformance with the requirements of the above Purchase Order Number, Repair Level, and fully comply with applicable Cameron repair/remanufacture specifications in effect at the date the repair/remanufacture took place. All related documentation in support of the above statement is retained on file by Cameron for a minimum of 10 years from date of repair/remanufacture and can be made available to the purchaser upon request. The Cameron Equipment has been repaired or replaced to meet the requirements of API or Cameron product specifications, where applicable.

Item #	Part Number	Rev #	Description	Qty	Serial Number(s)	Heat Numbers	Line Item Notes
10	2245115-02	02	13.5/8" 10K TYPE U BOP,DOUBLE UNIT FLANGED TOP AND BOTTOM BX-159 W FOUR 4.1/16" 10K FLANGE OUTLETS BX-155 ALL RING GROOVES INCONEL 625 LINED BONNETS BOLTS AND LOCKING SCREWS ON LOWER CAVITY LARGE BORE SHEAR BONNETS PER API 16A T-20 3RD ED PDC:02 13 10 20 MM YY (MM=MONTH , YY=YEAR)	1	110739178-01		

Additional Endorsements (If applicable)	Endorsement Report Number (If Applicable)
Complies with NACE MR0175	
Complies with ASME Sect. VIII and IX	
Complies with API RP 53, Major Inspections, latest edition.	

Notes on Scope of Certification: Please Select one of the options listed below:

☐ First Class per SP-1060-03
- All 15M or greater BOP Equipment (BOPE) regardless of size
- All 18-3/4" 10M BOPE

☒ Working Class per SP-1060-04
- All 3M, 5M, 10M BOPE (except 18-3/4" 10M)

		☐ Combination Class per SP-1060-09 - All BOPE - May not need all traceability (HT#, Serial #, etc) - Wellbore wetted and pressure containing components-First Class Repair - Hydraulic System-Working Class Repair - Wellbore wetted, pressure controlling (i.e. Rams) per Cameron Acceptance Criteria. ☐ Stump and Test ☐ Norwegian Specification per SP-1060-16
Additional Information:	The re-certification period is for 5 years unless otherwise noted in the Special Conditions / Exceptions section of this certificate. The re-certification period starts at the Date of Certification.	
Special Conditions / Exceptions	***CoC's are not a declaration of warranty. Warranty Information is contained in Cameron Standard Terms & Conditions.*** *The following special conditions and / or exceptions apply: TBA*	

All documents and inspection reports to support this certificate of conformance have been verified to the best of my knowledge to be true and correct

Ryannel Johnton	Ryannel Johnston	Inspector I	03/07/2011
Cameron Quality Representative Name	**Signature**	**Stamp**	**Date Signed: (MM/DD/YYYY)**

B.O.P. PRODUCTS

B.O.P. PRODUCTS, LLC

P.O. BOX 692172 HOUSTON, TX 77269 USA
Phone: 281.955.6321 – Fax: 281.955.6329
Sales@bop-products.com

CERTIFICATE OF CONFORMANCE

CUSTOMER:	PICKETT OILFIELD
P.O. NUMBER:	4500121451
DESCRIPTION:	RAM BLOCKS, TYPE U, 13-5/8" 3/10M X ISR
SERIAL NUMBERS:	725-11, 722-11
QUANTITY:	2

Ram Blocks were manufactured and inspected in accordance with B.O.P. Products, LLC and API (16A-0250) Specification requirements. Ram Blocks meet API 16A 3rd Edition & Nace MR-0175 Specification requirements. Ram Blocks are suitable for H2S service application.

All material acceptances, dimensional acceptance, functional checks and processing surveillance were performed by the Quality Control Department in accordance with established B.O.P. Products, LLC procedures. If required, all non-destructive testing was performed by B.O.P. Products, LLC certified personnel or approved sources that meet customer requirements.

Lisa Bordovsky
B.O.P. Products, LLC

October 13, 2011
Date

B.O.P. PRODUCTS

B.O.P. PRODUCTS, LLC

P.O. BOX 692172 HOUSTON, TX 77269 USA
Phone: 281.955.6321 – Fax: 281.955.6329
Sales@bop-products.com

MATERIAL CERTIFICATION REPORT

DATE: 10/13/2011

CUSTOMER: PICKETT OILFIELD

CUSTOMER P.O.: 4500121451

ATTENTION QUALITY CONTROL DEPARTMENT

THE RAMS LISTED BELOW WERE MACHINED FROM MATERIAL SUPPLIED BY:

EFI, ISG STEELTON

EACH RAM IS IDENTIFIED ON THE BUTT WITH: MFG USA, SERIAL AND HEAT NUMBER

QTY	SIZE	PIPE SIZE	DRIFT/GAUGE	HEAT #	SERIAL #
1	13-5/8" 3/10M	ISR- LOWER	PASSED	217P267	725-11
1	13-5/8" 3/10M	ISR- UPPER	PASSED	217P267	722-11
BOP PRODUCTS, LLC					
QUALITY CONTROL DEPARTMENT					

B.O.P. PRODUCTS

B.O.P. PRODUCTS, LLC

P.O. BOX 692172 HOUSTON, TX 77269 USA
Phone: 281.955.6321 – Fax: 281.955.6329
Sales@bop-products.com

HARDNESS CERTIFICATION REPORT

DATE: 10/13/2011

CUSTOMER: PICKETT OILFIELD

CUSTOMER P.O.: 4500121451

ATTENTION QUALITY CONTROL DEPARTMENT

THE RAMS LISTED BELOW WERE HEAT TREATED AS PER BOP PROCESS IN-450-A AND B CORE HARDNESS REQUIREMENTS:
INDUCTION HARDENED BLADE REQUIREMENTS: IN-450B 48-53RC
INDUCTION HARDENED PIPE REQUIREMENTS: IN-450A 43-53RC
KING HARDNESS TESTER: MODEL FM030, SERIAL UH-45 RECALL DATE 7-07--10 TO 07-07-2011

PURCHASE ORDER	SERIAL #	CORE HARDNESS	BLADE HARDNESS	PIPE HARDNESS
4500121451	725-11	255 BHN	N/A	CORE BHN
4500121451	722-11	255 BHN	N/A	CORE BHN
BOP PRODUCTS, LLC				
QUALITY CONTROL DEPARTMENT				

AXON | PRESSURE PRODUCTS
Church Energy SERVICES LTD.

2810 Washington Drive
Houston, TX 77038-3319
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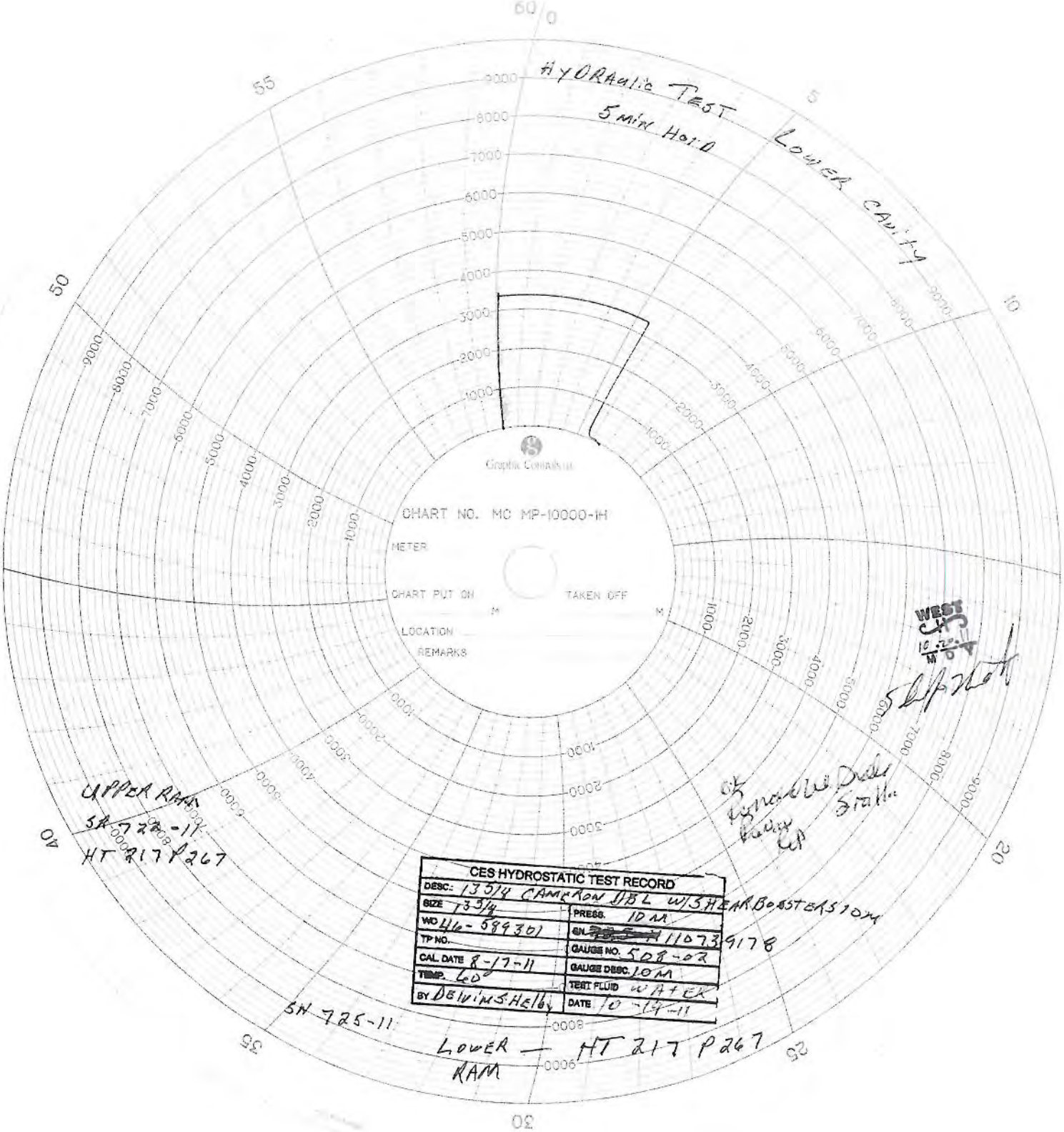
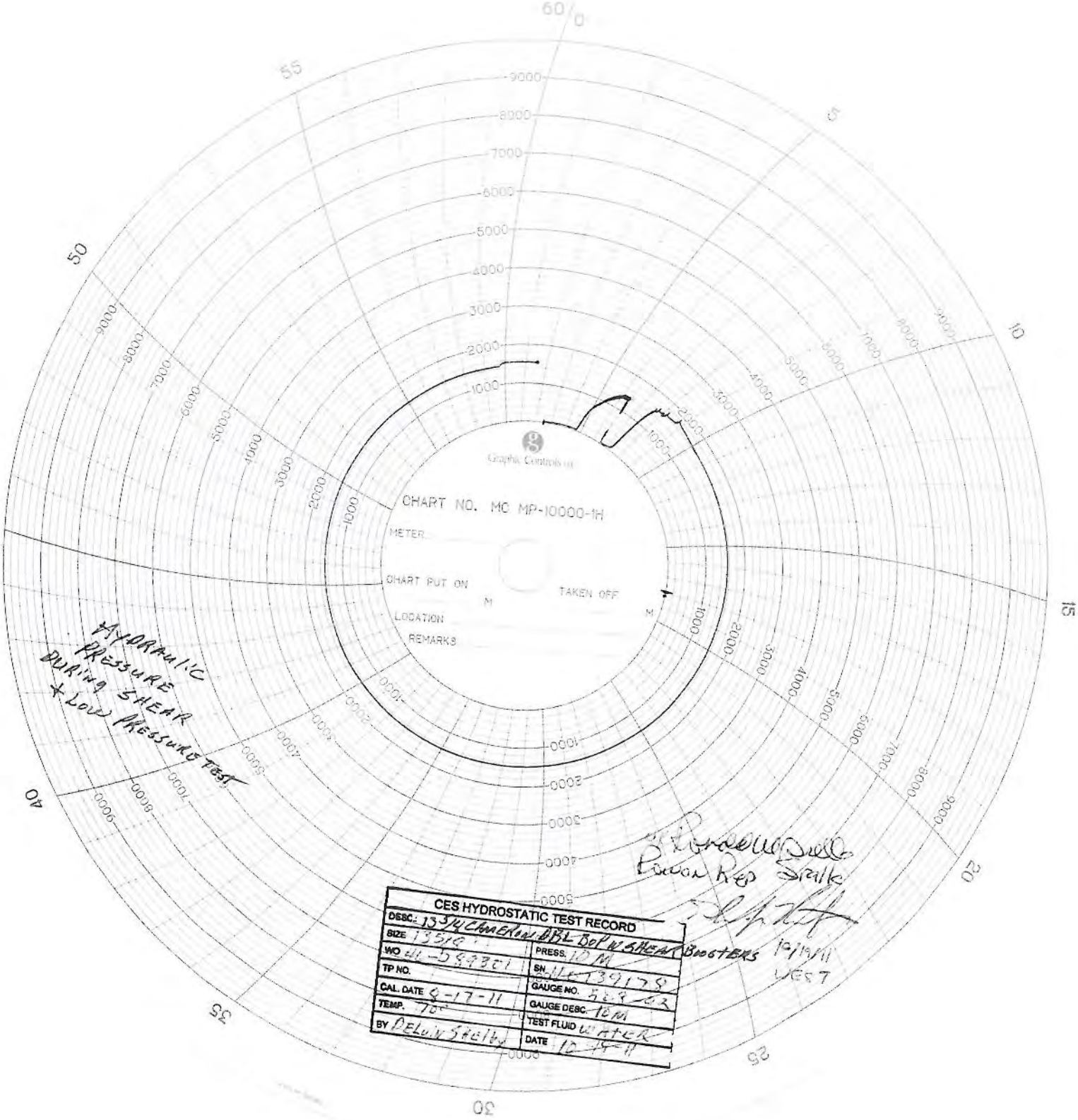
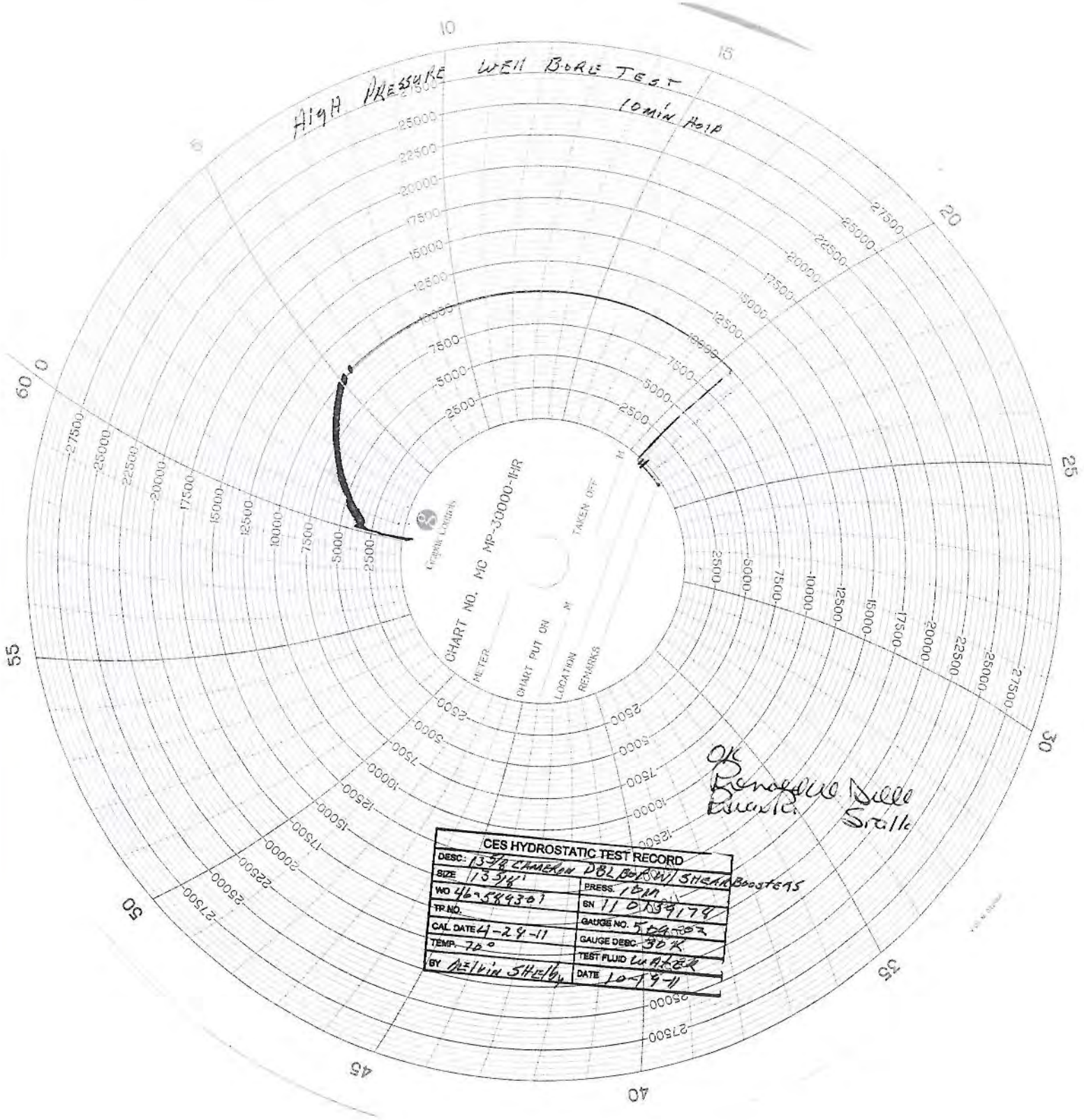
Facsimile: (281) 931-8700

5.0 TEST PRESSURE CHARTS


HYDRAulic TEST
5 MIN HOLD
LOWER CAVITY
Graphic Controls
CHART NO. MC MP-10000-1H
METER
CHART PUT ON
TAKEN OFF
LOCATION
REMARKS
WEST
UPPER RAM
SN 722-11
HT 217 P267
SN 725-11
LOWER RAM
HT 217 P267
CES HYDROSTATIC TEST RECORD
DESC: 13 5/4 CAMERON DBL W/SHEAR BOOSTERS 10M
SIZE 13 5/4
PRESS. 10 M
WO 46-589301
SN 110739178
TP NO.
GAUGE NO. 508-02
CAL. DATE 8-17-11
GAUGE DESC. 10M
TEMP. 60°
TEST FLUID WATER
BY DELVIN S. HELBY
DATE 10-19-11



Graphic Controls
CHART NO. MC MP-10000-1H
METER
CHART PUT ON
M
TAKEN OFF
M
LOCATION
REMARKS
HYDRAULIC PRESSURE DURING SHEAR + LOW PRESSURE TEST
Rowan Rep Stalk
19/19/11
WEST
CES HYDROSTATIC TEST RECORD
DESC: 13 3/4 CAMERON DBL BOP W SHEAR BOOSTERS
SIZE 13 5/8
WO 41-589301
PRESS. 10 M
TP NO.
SN. 11-139178
CAL. DATE 8-17-11
GAUGE NO. 528-02
TEMP. 70°
GAUGE DESC. 10 M
BY DELVIN SHELBY
TEST FLUID WATER
DATE 10-19-11


HIGH PRESSURE WELL BORE TEST
10 MIN HOLD
CHART NO. MC MP-30000-1HR
METER
CHART PUT ON
LOCATION
REMARKS
TAKEN OFF
OK
Brandon Dell
Frank Stalk
CES HYDROSTATIC TEST RECORD
DESC: 13 5/8 CAMERON DBL BOR W/ SHEAR BOOSTERS
SIZE 13 5/8'
PRESS. 10M
WO 46-589301
SN 11 0139178
TP NO.
GAUGE NO. 509202
CAL DATE 4-24-11
GAUGE DESC. 30K
TEMP. 70°
TEST FLUID WATER
BY Melvin Shelby
DATE 10-19-11

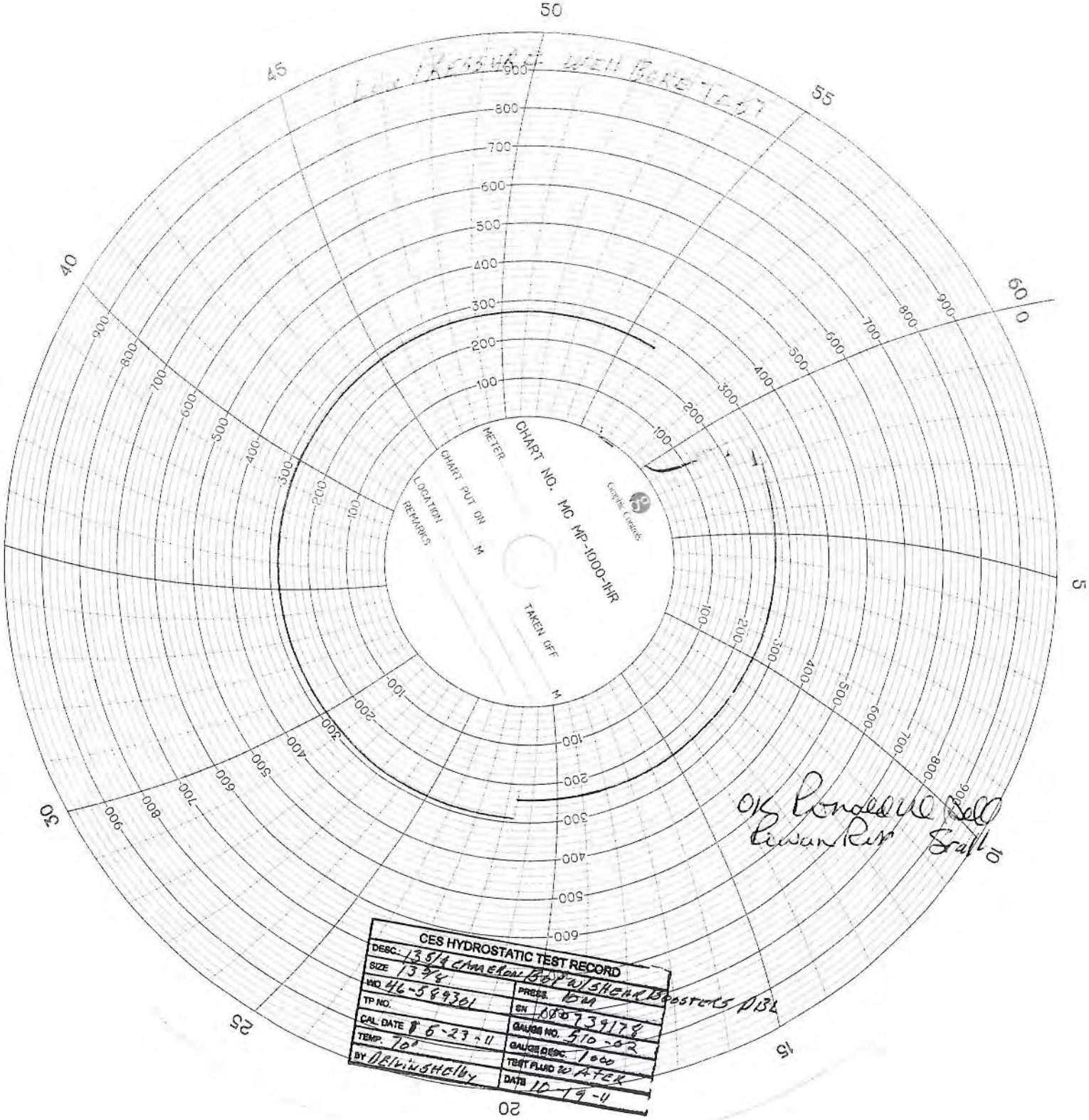


CHART NO. MC MP-1000-1HR
METER
CHART PUT ON
LOCATION
REMARKS
TAKEN OFF
M
Graphic Controls
OK Ronald W Bell
Rowan Rig Scall
CES HYDROSTATIC TEST RECORD
DESC. 13 5/8 CAMERON BOP W/SHEAR BOOSTERS DBL
SIZE 13 5/8
WO 46-589301
PRESS. 10M
TP NO.
SN 000739178
CAL. DATE 5-23-11
GAUGE NO. 510-02
TEMP. 70°
GAUGE DESC. 1000
BY DELVIN SHELBY
TEST FLUID WATER
DATE 10-19-11

AXON | PRESSURE PRODUCTS
Church Energy SERVICES LTD.

2810 Washington Drive
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Facsimile: (281) 931-8700

6.0 TEST PIPE INFORMATION

TEXAS STEEL CONVERSION, INC.

CERTIFICATE of COMPLIANCE

SMITH INTERNATIONAL, INC. - PURCHASE ORDER NUMBER
230983
SMITH INT'L/ROWAN
457/0070A
Rowan Po# 057-0404-049117

SPECIFICATIONS (applicable parts):
API: 5D Rev. 5 (04-30-02)
API: 7 Rev. 40 (03-01-02)

This hereby certifies that the herein described material meets all of the requirements of the above referenced documents.

ROWAN STRING# 15S
SERIAL #s: 001-648

648 JTS., 20,652.36', 5.5", .415w, S135, 95% WALL,
RANGE 2, IEU, 7 1/2" OD TOOL JOINTS (2" LTS), 5.5 API FH(+ 2"),
STANDARD THREADS, ARMACOR M HARDBAND (BOX & PIN),
MAKE & BREAK, TK-34 INTERNAL PLASTIC COAT,
DRILLTEC OPEN PLASTIC THREAD PROTECTORS

V.P. QUALITY

06/13/04
DATE

TEXAS STEEL CONVERSION, INC

QUALITY TEST REPORT - DRILL PIPE

CUSTOMER: SMITH INT'L/ROWAN

TEST # 48068

SO# 457/0070A
PO# 230983
MILL: TSC

SIZE : 5.500X0.415
UPSET: IEU
GRADE: S135 .7% EUL
SPEC : API:5D
04/30/02

LOT # 457772
HEAT # 727533
MFG.PROC. : SMLS
HEAT TREAT: Q&T
JTS/LOT : 103

TENSILE TEST

DIMENSIONS (Inches)	AREA (Sq.In.)	YIELD STRENGTH (Lbs/Sq.In.)	TENSILE STRENGTH (Lbs/Sq.In.)	% ELONG (IN 2")	ROA (%)
0.432X0.962	0.418	(B) 152200	163600	20.6	55.7
0.504 (BAR DIAM.)		(U) 145100	156700	15.3	60.2

BODY TYPE: LONGITUDINAL STRIP

TENSILE SPECIMEN HARDNESS VALUES (HRC)

O.D.	36.3
MID	36.2
I.D.	35.4

UPSET HARDNESS VARIATION (HRC)

QUADRANT	1	2
O.D. VALUE	36.5	36.3
MID VALUE	36.0	36.0
I.D. VALUE	35.4	35.1

CHARPY IMPACT TEST

CHARPY TYPE	IMPACT (ftXlbs)	LATERAL EXPANSION (mils)	FRACTURE (% D/F)
LOCATION: BODY-MID WALL			
TESTED AT +70°F	75.0	40	100
SIZE: 10X10 mm	67.0	37	100
ORIENTATION:LONGITUDINAL	67.0	35	100
Average	69.7		

CHEMICAL PRODUCT ANALYSIS

#	C	Si	Mn	P	S	Cr	Mo	Ni	V	Al	Nb	Sn	Ti	Cu	Ca	B
2	.27	.29	.90	.007	.000	1.01	.40	.12	.004	.022	.003	.009	.003	.11	.0005	.0004

Daniel M. 8-11-04

Daniel Mendoza
Lab Technician

DATE

3101 Holmes Road, Houston, TX 77051-1199. Tel#:(713)733-6013. FAX#:(713)733-9248. Form QC10. 05/27/03. Rev #5

AXON | PRESSURE PRODUCTS
Church Energy SERVICES LTD.

2810 Washington Drive
Houston, TX 77038-3319
Telephone: (281) 931-1400
Facsimile: (281) 931-8700

7.0 MISCELLANEOUS

PREPARED BY: R. CHURCH DATE: 03.02.09
APPROVED BY: G. HARTWIG DATE: 03.02.09

EXHIBIT 1

MAGNETIC PARTICLE EXAMINATION REPORT

PART NUMBER: _____ REV: ____ WORK ORDER: 46-589301 QTY: 2

DESCRIPTION: 13 5/8-10m Upper & Lower ISR Rams
SN 722-11 upper 725-11 lower

PROCEDURE USED: CES QS151 REV. C

EQUIPMENT/TECHNIQUE

MAGNETIC PARTICLE EXAMINATION

DIRECT: ✓ AMPS: _____

COILS: _____ TURNS: _____ AMPS: _____

CENTRAL CONDUCTOR: _____ DIAMETER: _____ AMPS: _____

PRODS: _____ PROD SPACING: _____ AMPS: _____

YOKE: BMS 208-01 YOKE SPACING: 3'-5' LIFT. FORCE: 10 lbs

COMMENTS:

EXAMINATION RESULTS:

QUANTITY ACCEPTED: 2 QUANTITY REJECTED: 0

REMARKS: before shear test of pipe

INSPECTOR: [signature] LEVEL: II DATE: 10/19/11

PREPARED BY: R. CHURCH DATE: 03.02.09
APPROVED BY: G. HARTWIG DATE: 03.02.09

EXHIBIT 1

MAGNETIC PARTICLE EXAMINATION REPORT

PART NUMBER: _____ REV: ____ WORK ORDER: 46-589301 QTY: 2

DESCRIPTION: 13 5/8-10m Upper & Lower ISR RAMS
Upper 722-11 Lower 725-11

PROCEDURE USED: CES QS151 REV. C

EQUIPMENT/TECHNIQUE

MAGNETIC PARTICLE EXAMINATION

DIRECT: ✓ AMPS: _____

COILS: _____ TURNS: _____ AMPS: _____

CENTRAL CONDUCTOR: _____ DIAMETER: _____ AMPS: _____

PRODS: _____ PROD SPACING: _____ AMPS: _____

YOKE: BS 208-01 YOKE SPACING: 3'-5 LIFT. FORCE: 10 lbs

COMMENTS:

EXAMINATION RESULTS:

QUANTITY ACCEPTED: 2 QUANTITY REJECTED: Ø

REMARKS: after shear test of pipe

INSPECTOR: Steven Payne LEVEL: II DATE: 10/19/11

Rentals Available

JOHNNY'S GAUGE & METER REPAIRS

(713) 695-1038 • 718 DUNWOODY
HOUSTON, TEXAS 77076-1914

CALIBRATION CERTIFICATE

CUSTOMER Axxon Pressure Products
8909 Jackrabbit Rd.
Houston, Texas 77095

DATE CALIBRATED 8-17-2011
OUR INVOICE NO. 5311
CUSTOMER'S P. O. NO. 46-11538

INDICATED RANGE 0-10,000# ACCURACY ± 0.5 % SERIAL NO. CES508-02

TYPE OF INSTRUMENT CALIBRATED 12" Barton Pressure Recorder

TYPE OF STANDARD USED TO CALIBRATE Crosby Deadweight Tester
S/N-39037

ALL STANDARDS DIRECTLY TRACEABLE TO
NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGIES TEST NO. 2.6/172409 & 6.6/139577

LAB STANDARDS	BEFORE CALIBRATION	AFTER CALIBRATION
0	0	0
2,500	2,500	NO
5,000	5,000	ADJUSTMENT
7,500	7,500	NEEDED

ROOM TEMPERATURE AT TEST 74 °F

DATE OF CALIBRATION DUE 2-17-2012

INSPECTOR Fred Snell

Rentals Available

JOHNNY'S GAUGE & METER REPAIRS

(713) 695-1038 • 718 DUNWOODY
HOUSTON, TEXAS 77076-1914

CALIBRATION CERTIFICATE

CUSTOMER Church Energy Services LTD.
2810 Washington Drive
Houston, Texas 77038-3319

DATE CALIBRATED 4-28-2011
OUR INVOICE NO. 4708
CUSTOMER'S P. O. NO. 521113

INDICATED RANGE 0-30,000# ACCURACY ± 0.5 % SERIAL NO. CES509-02

TYPE OF INSTRUMENT CALIBRATED 12" Barton Pressure Recorder

TYPE OF STANDARD USED TO CALIBRATE Crosby Deadweight Tester
S/N-39037

ALL STANDARDS DIRECTLY TRACEABLE TO
NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGIES TEST NO. 2.6/172409 & 6.6/139577

LAB STANDARDS	BEFORE CALIBRATION	AFTER CALIBRATION
0	0	0
7,500	7,500	NO
15,000	15,000	ADJUSTMENT
22,500	22,500	NEEDED

ROOM TEMPERATURE AT TEST 74 °F

DATE OF CALIBRATION DUE 10-28-2011

INSPECTOR Fred Snell

Rentals Available

JOHNNY'S GAUGE & METER REPAIRS

(713) 695-1038 • 718 DUNWOODY
HOUSTON, TEXAS 77076-1914

CALIBRATION CERTIFICATE

CUSTOMER Church Energy Services LTD.
8909 Jackrabbit Rd.
Houston, Texas 77095

DATE CALIBRATED 5-23-2011
OUR INVOICE NO. 4847
CUSTOMER'S P. O. NO. 521127

INDICATED RANGE 0-1,000# ACCURACY ± 0.5 % SERIAL NO. CES510-02

TYPE OF INSTRUMENT CALIBRATED 12" O.G.M.E. Pressure Recorder

TYPE OF STANDARD USED TO CALIBRATE Crosby Deadweight Tester
S/N-39037

ALL STANDARDS DIRECTLY TRACEABLE TO
NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGIES TEST NO. 2.6/172409 & 6.6/139577

LAB STANDARDS	BEFORE CALIBRATION	AFTER CALIBRATION
0	0	0
250	250	NO
500	500	ADJUSTMENT
750	750	NEEDED

ROOM TEMPERATURE AT TEST 74 °F

DATE OF CALIBRATION DUE 11-23-2011

INSPECTOR Fred Snell