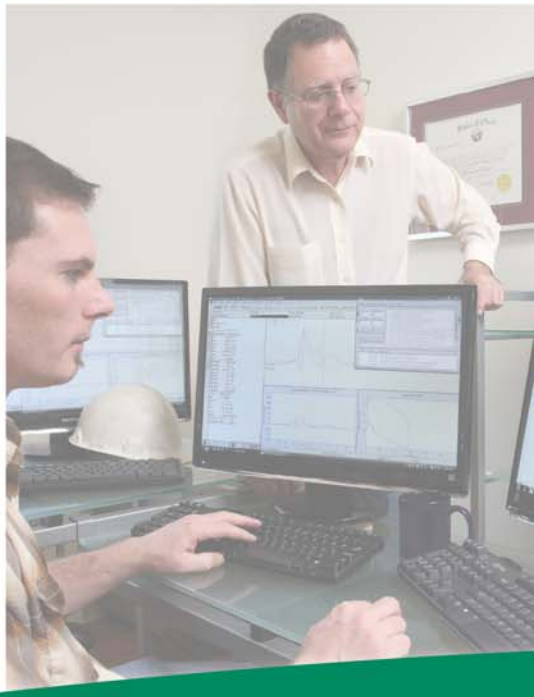

Job No. 212019-1

Report on: Energy Measurement for Dynamic Penetr.
Rig(s): CME 750X SN 361188,
CME 75 SN 413707
Standard Penetration Tests (SPT)
Kiowa, Colorado

Prepared for Authentic Drilling, Inc.

By Camilo Alvarez, MSCE, P.E. and
Anna M. Klesney, MSCE, E.I.T.

August 2, 2021

GRL engineers, inc.
Dynamic Measurements and Analyses

GRL engineers, inc.
Dynamic Measurements and Analyses

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REVISED
10:30 am, Aug 26, 2021

August 2, 2021

Sherri Meiklejohn, General Manager/Owner
Authentic Drilling, Inc.
33555 County Road 37
Kiowa, Colorado 80117

Re: Energy Measurement for Dynamic Penetrometers
Rig(s): CME 750X Serial Number 361188, CME 75 Serial Number 413707
Standard Penetration Tests (SPT)
Kiowa, Colorado GRL Job No. 212019-1

Dear Mrs. Sherri Meiklejohn:

This report transmits our findings from energy measurements and related data analysis conducted by GRL Engineers, Inc. (GRL) for your two drill rigs, with measurements collected in Kiowa, Colorado. Two automatic hammers and penetrometer systems were monitored during Standard Penetration Tests. Dynamic testing summarized herein was conducted on Monday, March 22, 2021.

A Pile Driving Analyzer® Model PAX recorded, processed and displayed the dynamic data to meet the objectives of the hammer system calibration. Discussions on the test methods, limitations and implementation are provided in Appendix A. The energy measurement results are summarized in Tables 1A and 1B, with the average and standard deviation provided in Appendix B, and representative plots of force and normalized velocity provided in Appendix C. Supplemental documents can be found in Appendix D.

EQUIPMENT

Hammer and Penetrometer System

Energy measurements were recorded during standard penetration tests conducted for two automatic hammers and the following drill rig type(s) and serial number(s).

Drill Rig	Serial Number	Drill Rod Size
CME 750X	361188	NWJ
CME 75	413707	NWJ

Measurements were recorded for one boring location for each of the two drill rigs. Authentic Drilling, Inc. (Authentic) advanced the penetrometer to a minimum depth of an approximate 25.0 feet prior to energy measurements. The instrumented subassembly was connected to the top of the drill rod string and measurements recorded at intervals of 2.5 feet for five depths of data.

Measurements were recorded for every blow required to advance the sampler 18 inches. Results are provided for the final 12 inches of the sampler advancement alone (i.e., excluding the initial 6 inches of advancement). ASTM Standard D4633 recommends that tests for energy evaluation be limited to Standard Penetration Test (SPT) N-values between 10 and 50. Energy measurements of all samples are included in the averages reported herein.

The following drill rod dimensions, of rod size NWJ, were employed during testing.

Drill Rod Area sq. inch		Outside Diameter Inch		Inside Diameter inch	
1.46		2.63		2.24	
Depth of Penetrometer feet		Drill Rod Section Lengths feet		Transducer to Penetrometer Length feet	
A	B	A	B	A	B
25.0	25.0	25	25	29.23	29.25
27.5	27.5	27	27	31.23 ɬ	31.25 ɬ
30.0	30.0	30	30	34.23	34.25
32.5	32.5	32	32	36.23 ɬ	36.25 ɬ
35.0	35.0	35	35	39.23	39.25

* A (CME 750X Serial Number 361188); B (CME 75 Serial Number 413707).

ɬ Applicable for the sample depth(s) of 27.5 and 32.5 feet, the measured length of the nominal two-foot sub used was approximately 24.0 inches.

Instrumentation

A Pile Driving Analyzer® Model PAX was employed for recording, processing, and displaying the dynamic data. An instrumented subassembly, inserted at the top of the drill rod string below the hammer and anvil system and above the drill rods, recorded the force and acceleration data. The subassembly was instrumented with two foil strain gages in a full bridge circuit and two piezoresistive accelerometers attached on diametrically opposite sides of the subassembly. Data sampling frequency was 50.0 kHz.

The Model PAX utilizes a digital system, and with the employed sampling frequency of 50.0 kHz, the signal conditioning conforms to ASTM D4633. Results for the maximum hammer operating rate, rod top force and velocity, and transferred energy are provided in Appendix B and summarized in Tables 1A and 1B. Discussions on the test method and its limitations can be found in Appendix A.

Figure 1: Energy Measurements with Instrumented Subassembly

MEASUREMENTS AND CALCULATIONS

The primary objective of testing was the measurement of the energy transmitted from the hammer impact through the anvil into the instrumented subassembly and drill rods. Strain transducers and accelerometers were employed for the calculation of the transferred energy using force, F(t) and velocity v(t), records as follows:

$$EMX = \int_{b}^{a} F(t)v(t)dt$$

where time "b" is to the beginning of the energy transfer and time "a" is to the time at which the energy transfer reaches a maximum. Force is calculated as the product of the measured strain, elastic modulus and cross-sectional area, and measured acceleration is integrated to velocity.

Integrated over the complete impact event and calculated from measured force and velocity, the energy transferred to the top of the drill rod was calculated as a function of time. The maximum transferred energy (i.e., EMX or EFV) is used as an indicator of the energy content of the event. The described method is the only theoretically correct method of measuring energy transfer and automatically corrects for rod non-uniformities such as connector masses or loose joints. The EF2 method results included in Appendix B are inherently incorrect and included in the appendices for reference alone.

TEST RESULTS

Result Discussion

Dynamic data was evaluated for the hammer operating rate, rod top force and velocity, and transferred energy. Appendix B provides the evaluated quantities for blows making up the SPT N-value, with their averages and standard deviation, plotted and printed as a function of depth for the monitored sequences of the standard penetration tests. Measurements collected for all samples are presented herein.

The plots in Appendix B include:

- FMX – the maximum measured rod top force
- VMX – the maximum measured rod top velocity
- BPM – the hammer operating rate, provided in blows per minute
- BLC – the (uncorrected) count of impacts per each 6 inches set, provided by Authentic
- EFV – the maximum calculated energy (EMX) transferred to the rod top
- EF2 – the maximum of the integral of the square of force, a theoretically incorrect energy transfer calculation

Corresponding tables also include:

- CSX – the maximum measured rod top compressive stress, averaged over the cross-sectional area
- CSI – the maximum measured rod top compressive stress at individual foil strain gage
- ETR – ratio of transferred energy (EFV) to the maximum theoretical potential energy

The maximum theoretical potential energy is the product of the standard 140-lb hammer impact mass dropped the standard 30 inches.

A representative plot of force and normalized velocity versus time for a typical blow from each data set is provided in Appendix C to demonstrate the data quality.

Summary of Results

I. Two automatic hammers were monitored during standard penetration tests conducted on March 22, 2021. The average energy transfer ratios calculated with the EFV method for the monitored sequences are tabulated below together with the corresponding, average hammer operating rate(s).

Drill Rig / Serial Number	Energy Transfer Ratio percent	Operating Rate bpm
CME 750X / 361188	82	53
CME 75 / 413707	88	55

II. The uncorrected N-values encountered during the dynamically monitored sequences ranged from 44 to 88 blows.

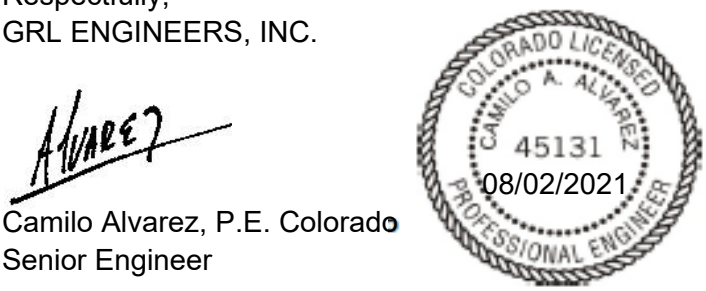
III. To convert the uncorrected N-values for the employed hammer and penetrometer system and operators, the Schmertman correction for adjustment to 60 percent transfer efficiency is

$$N_{60} = \left(\frac{e_m}{60}\right) N_m$$

where N_{60} is the corrected hammer N-value, e_m is the percent energy transfer efficiency (i.e., e_m = 100*ETR) and N_m is the measured SPT N-value. N_{60} values for all measurements and monitored depths are presented in Tables 1A and 1B. The measured overall energy transfer ratio(s), tabulated above, produces the respective N_{60} equivalent of roughly 1.4Nm and 1.5Nm. Further corrections due to overburden stresses in the soil have not been considered but may be made prior to the use of N-values for design purposes.

We appreciate the opportunity to be of assistance to you on this project. Please contact our offices if you have any questions regarding the contents of this report, or if we may be of further service.

Respectfully,
GRL ENGINEERS, INC.



Camilo Alvarez, P.E. Colorado
Senior Engineer

Anna M. Klesney, MSCE, E.I.T.
Project Engineer

Exp: 10/31/2021

TABLE 1A: Summary of Field Results
Energy Measurement for Dynamic Penetrometers

Rig Serial No.	Depth(s)	Uncorrected N value	Corrected N value	Hammer Operating Rate (BPM)	Average Transferred Energy (EFV)	Energy Transfer Ratio (ETR)	Maximum Compressive Measured Top Stress (CSX)	Maximum Compressive Impact Top Force (FMX)
		(1)	(2)		(3)	(3)	(4)	(5)
	ft	blows	N_{60}	bpm	ft-lbs	%	ksi	kips
CME 750X Serial Number 361188								
	25.0 - 26.5	88	120	54	286	82	27.6	40
	27.5 - 29.0	70	94	54	281	80	26.2	38
	30.0 - 31.5	52	71	53	286	82	27.6	40
	32.5 - 34.0	73	100	53	289	82	26.5	39
	35.0 - 36.5	51	71	53	292	83	27.1	40
	Overall System Performance			53	287	82	27.0	39
	Standard Deviation			0.5	4.0	1.1	0.6	0.9

Notes

1. Uncorrected N-value, number of hammer blows required to advance sampler the final 12 inches, unless noted otherwise.
2. Corrected N-value, number of hammer blows required to advance sampler the final 12 inches, corrected for calculated energy transfer ratio (ETR).
3. Average transferred energy at transducer location; ratio of transferred energy to theoretical potential energy of hammer.
4. Average, measured Compressive driving Stress averaged over the drill rod cross section at transducer location.
5. Average, measured Compressive driving Force at transducer location.

TABLE 1B: Summary of Field Results
Energy Measurement for Dynamic Penetrometers

Rig Serial No.	Depth(s)	Uncorrected N value	Corrected N value	Hammer Operating Rate (BPM)	Average Transferred Energy (EFV)	Energy Transfer Ratio (ETR)	Maximum Compressive Measured Top Stress (CSX)	Maximum Compressive Impact Top Force (FMX)
		(1)	(2)		(3)	(3)	(4)	(5)
	ft	blows	N_{60}	bpm	ft-lbs	%	ksi	kips
CME 75 Serial Number 413707								
	25.0 - 26.5	80	115	51	303	87	26.1	38
	27.5 - 29.0	73	106	55	305	87	27.7	40
	30.0 - 31.5	71	104	55	308	88	26.7	39
	32.5 - 34.0	49	74	59	315	90	27.7	40
	35.0 - 36.5	44	64	55	306	87	25.9	38
	Overall System Performance			55	307	88	26.8	39
	Standard Deviation			2.8	4.6	1.3	0.8	1.2

Notes

1. Uncorrected N-value, number of hammer blows required to advance sampler the final 12 inches, unless noted otherwise.
2. Corrected N-value, number of hammer blows required to advance sampler the final 12 inches, corrected for calculated energy transfer ratio (ETR).
3. Average transferred energy at transducer location; ratio of transferred energy to theoretical potential energy of hammer.
4. Average, measured Compressive driving Stress averaged over the drill rod cross section at transducer location.
5. Average, measured Compressive driving Force at transducer location.

APPENDIX A

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC TESTING

1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m [E_m / (0.6E_r)] \quad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a “High Strain Method”. The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the “Wave Equation Analysis” which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two

measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer's ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = {}_0\int^t F(\tau)v(\tau)\, d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer's rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = {}_0\int^t F(\tau)^2 / Z\, d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod's cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v\,Z \qquad (5)$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\,(E/c) \qquad (6)$$

or strain

$$\epsilon = \sigma/E = v / c \qquad (7)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

APPENDIX B

ENERGY MEASUREMENT RESULTS

CME 750X Serial Number 361188

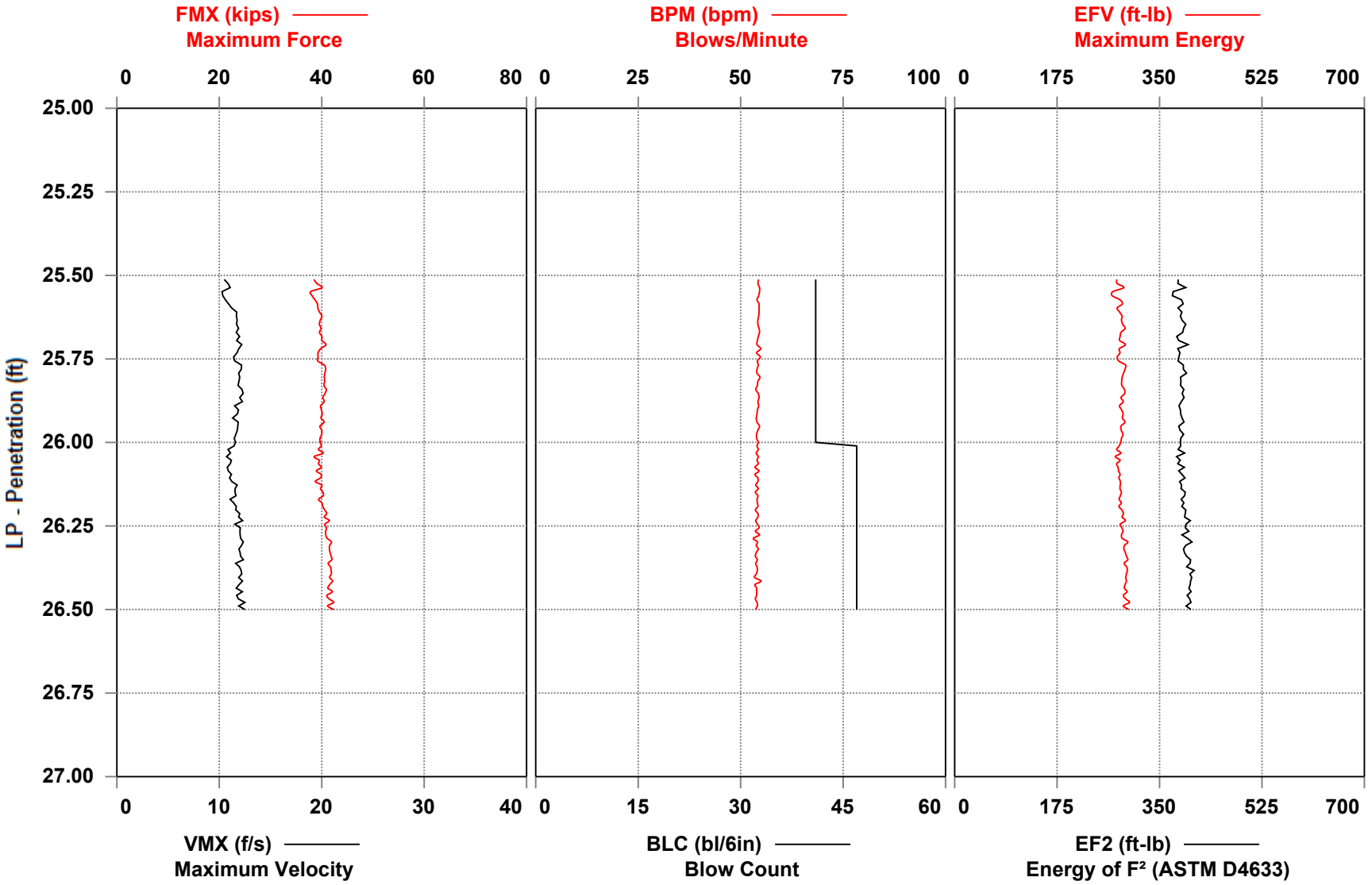
GRL engineers, inc.

GRL Engineers, Inc. - PDIPLOT2 Ver 2020.1.60.3 - Case Method & iCAP® Results

Printed: 01-August-2021 Test started: 22-March-2021

CME 750X Serial Number 361188 - CME 750X at 25.0 to 26.5 feet

NWJ



Case Method & iCAP® Results

CME 750X Serial Number 361188 - CME 750X at 25.0 to 26.5 feet NWJ
OP: AK Date: 22-March-2021

AR: 1.46 in² SP: 0.492 k/ft³
LE: 29.23 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

CSX: Compression Stress Maximum
CSI: Comp Stress Max-Individual Sens
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F² (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
22	25.51	41	26.4	26.9	38	10.5	54	277	382	79
23	25.52	41	26.7	27.3	39	10.8	54	278	381	79
24	25.54	41	27.4	27.8	40	11.1	55	289	395	83
25	25.55	41	25.9	26.4	38	10.3	55	270	373	77
26	25.56	41	26.1	26.6	38	10.3	54	269	372	77
27	25.57	41	26.5	27.0	39	10.6	54	282	387	81
28	25.59	41	26.8	27.3	39	10.9	55	287	391	82
29	25.60	41	26.9	27.5	39	11.2	55	278	382	79
30	25.61	41	27.1	27.8	40	11.7	55	282	388	81
31	25.62	41	27.4	27.9	40	11.7	54	286	386	82
32	25.63	41	27.2	27.8	40	11.7	54	285	388	81
33	25.65	41	27.1	27.7	40	11.7	54	287	395	82
34	25.66	41	27.3	27.9	40	11.9	55	291	391	83
35	25.67	41	27.1	27.7	40	11.7	55	284	390	81
36	25.68	41	27.4	28.0	40	12.0	54	283	379	81
37	25.70	41	27.4	27.9	40	11.7	54	282	383	81
38	25.71	41	28.0	28.5	41	12.2	54	292	399	83
39	25.72	41	27.3	27.9	40	11.9	55	281	381	80
40	25.73	41	26.9	27.6	39	11.7	54	282	385	81
41	25.74	41	26.9	27.6	39	11.4	55	278	383	79
42	25.76	41	26.9	27.4	39	11.5	54	280	382	80
43	25.77	41	27.7	28.3	40	12.2	54	292	391	83
44	25.78	41	27.9	28.5	41	12.2	54	291	391	83
45	25.79	41	27.8	28.1	41	11.9	54	288	396	82
46	25.80	41	27.7	28.2	41	12.0	55	286	386	82
47	25.82	41	27.8	28.2	41	11.9	54	285	387	82
48	25.83	41	27.7	28.1	40	11.8	54	286	386	82
49	25.84	41	28.0	28.5	41	12.2	54	290	391	83
50	25.85	41	27.8	28.4	41	12.3	54	290	389	83
51	25.87	41	27.6	28.0	40	12.0	55	284	392	81
52	25.88	41	27.7	28.3	40	12.3	54	288	387	82
53	25.89	41	27.3	27.6	40	11.5	54	282	383	80
54	25.90	41	27.4	27.8	40	11.9	54	285	386	81
55	25.91	41	27.5	27.9	40	11.8	54	288	386	82
56	25.93	41	27.3	27.7	40	11.3	54	286	388	82
57	25.94	41	27.7	28.1	40	11.8	54	291	392	83
58	25.95	41	27.2	27.7	40	11.8	55	284	383	81
59	25.96	41	27.4	27.9	40	11.8	54	285	385	81
60	25.98	41	27.4	27.8	40	11.6	54	287	391	82
61	25.99	41	27.2	27.6	40	11.5	54	285	386	81
62	26.00	41	27.2	27.6	40	11.6	54	284	385	81
63	26.01	47	27.3	27.7	40	11.4	54	281	386	80
64	26.02	47	27.0	27.2	39	10.9	54	277	382	79
65	26.03	47	27.6	28.0	40	11.1	54	284	393	81
66	26.04	47	26.4	26.7	39	10.7	54	274	379	78
67	26.05	47	27.1	27.4	40	11.2	54	283	385	81

Case Method & iCAP® Results

CME 750X Serial Number 361188 - CME 750X at 25.0 to 26.5 feet NWJ
OP: AK Date: 22-March-2021

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
68	26.06	47	27.0	27.2	39	11.1	54	277	381	79
69	26.07	47	27.3	27.6	40	10.8	54	279	392	80
70	26.09	47	26.7	27.0	39	10.9	55	280	383	80
71	26.10	47	27.3	27.6	40	11.2	54	283	388	81
72	26.11	47	27.2	27.5	40	11.0	54	281	393	80
73	26.12	47	26.5	27.0	39	11.2	54	283	384	81
74	26.13	47	27.4	27.8	40	11.7	54	283	388	81
75	26.14	47	27.2	27.5	40	11.5	54	282	387	81
76	26.15	47	27.6	27.9	40	11.5	54	285	394	81
77	26.16	47	27.6	28.0	40	11.6	54	283	393	81
78	26.17	47	27.0	27.2	39	11.0	54	281	387	80
79	26.18	47	27.4	27.6	40	11.4	54	285	392	81
80	26.19	47	27.5	28.0	40	11.7	54	281	388	80
81	26.20	47	27.8	28.0	41	11.6	54	286	395	82
82	26.21	47	28.1	28.5	41	12.0	54	288	394	82
83	26.22	47	27.7	28.1	41	11.9	54	286	393	82
84	26.23	47	28.4	28.8	42	12.3	54	292	403	83
85	26.24	47	27.8	28.0	41	11.5	54	283	395	81
86	26.26	47	28.0	28.4	41	12.0	55	286	394	82
87	26.27	47	27.9	28.2	41	12.0	54	288	400	82
88	26.28	47	27.9	28.4	41	12.0	55	285	388	81
89	26.29	47	28.1	28.4	41	12.1	53	286	398	82
90	26.30	47	28.7	29.0	42	12.3	54	296	405	85
91	26.31	47	28.5	28.7	42	12.2	54	290	395	83
92	26.32	47	28.4	28.6	42	11.9	54	289	391	83
93	26.33	47	28.5	28.8	42	12.0	54	292	393	83
94	26.34	47	28.7	28.9	42	12.1	54	293	396	84
95	26.35	47	28.7	29.3	42	12.4	54	296	403	85
96	26.36	47	28.2	28.4	41	11.6	54	289	402	83
97	26.37	47	28.6	28.7	42	12.0	54	294	396	84
98	26.38	47	28.7	29.0	42	12.1	54	295	409	84
99	26.39	47	28.7	29.2	42	12.2	54	293	402	84
100	26.40	47	28.5	28.7	42	11.9	53	292	405	83
101	26.41	47	28.8	29.3	42	12.3	55	293	403	84
102	26.43	47	28.5	28.7	42	11.9	54	291	402	83
103	26.44	47	28.2	28.5	41	11.7	54	290	400	83
104	26.45	47	28.8	29.2	42	12.3	54	295	404	84
105	26.46	47	28.1	28.3	41	11.7	54	288	397	82
106	26.47	47	28.4	28.6	41	11.9	54	292	402	83
107	26.48	47	29.0	29.5	42	12.5	54	299	404	85
108	26.49	47	28.2	28.5	41	11.9	54	288	395	82
109	26.50	47	29.0	29.4	42	12.5	54	297	403	85
		Average	27.6	28.0	40	11.7	54	286	391	82
		Std. Dev.	0.7	0.6	1	0.5	0	6	8	2
		Maximum	29.0	29.5	42	12.5	55	299	409	85
		Minimum	25.9	26.4	38	10.3	53	269	372	77

Total number of blows analyzed: 88

BL# Sensors

22-109 F1: [162 NWJ-1] 212.8 (1.00); F2: [162 NWJ-2] 213.6 (1.00); A1: [K10734] 434.2 (1.00); A2: [K0304] 372.0 (1.10)

Time Summary

Drive 1 minute 59 seconds 11:00 AM - 11:02 AM BN 1 - 109

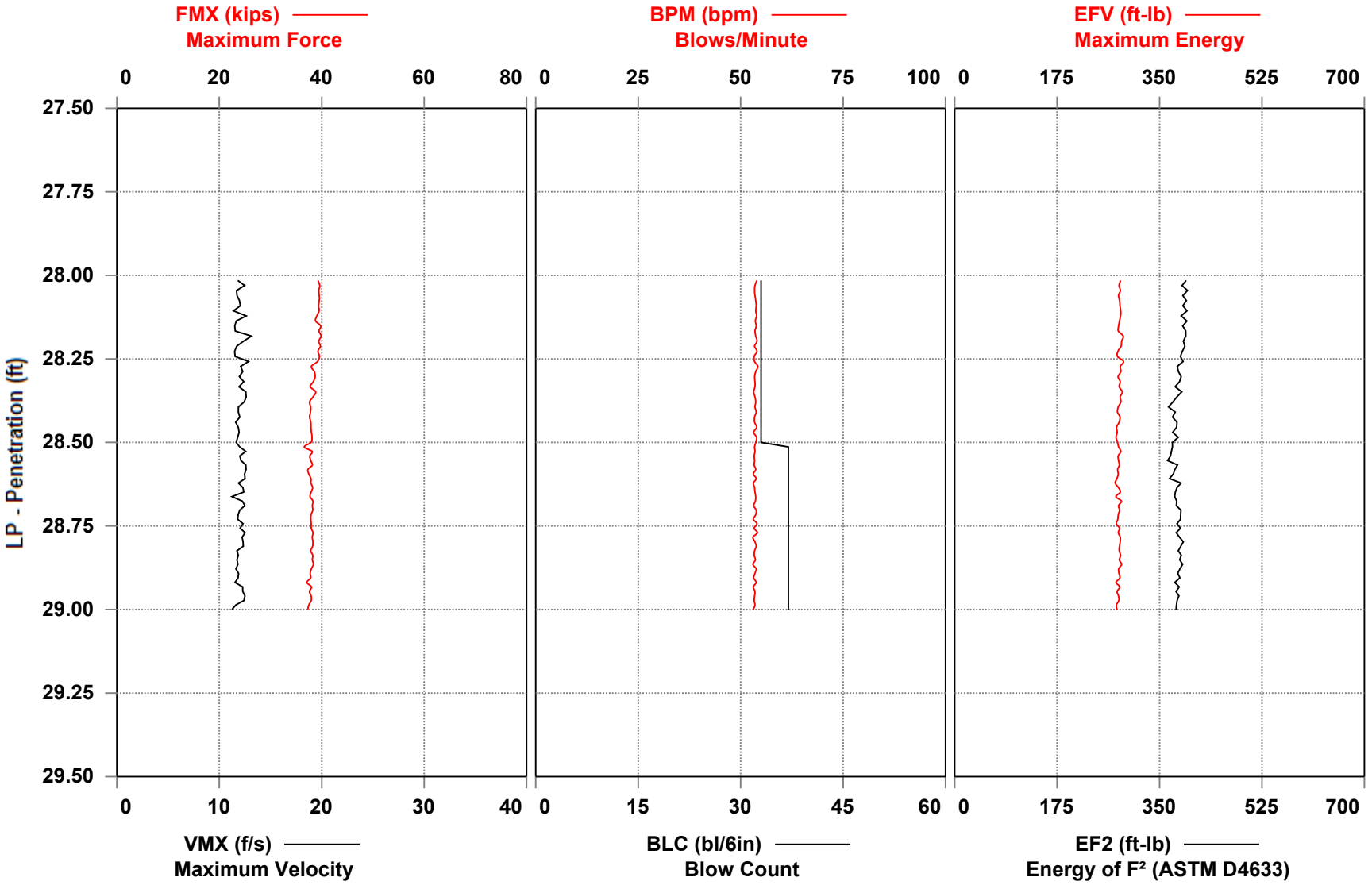
GRL engineers, inc.

GRL Engineers, Inc. - PDIPLOT2 Ver 2020.1.60.3 - Case Method & iCAP® Results

Printed: 01-August-2021 **Test started: 22-March-2021**

CME 750X Serial Number 361188 - CME 750X at 27.5 to 29.0 feet

NWJ



Case Method & iCAP® Results

CME 750X Serial Number 361188 - CME 750X at 27.5 to 29.0 feet NWJ
OP: AK Date: 22-March-2021

AR: 1.46 in² SP: 0.492 k/ft³
LE: 31.23 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

CSX: Compression Stress Maximum
CSI: Comp Stress Max-Individual Sens
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F² (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
18	28.02	33	26.9	27.2	39	11.8	54	284	395	81
19	28.03	33	27.1	27.3	40	12.5	54	281	388	80
20	28.05	33	27.0	27.3	39	11.7	53	283	398	81
21	28.06	33	27.1	27.4	40	11.7	54	280	390	80
22	28.08	33	27.1	27.3	40	12.0	54	282	396	81
23	28.09	33	27.0	27.3	39	12.1	54	282	390	81
24	28.11	33	27.0	27.4	39	11.4	54	284	397	81
25	28.12	33	26.7	27.1	39	12.6	54	283	387	81
26	28.14	33	26.6	26.9	39	11.7	54	282	397	80
27	28.15	33	27.3	27.6	40	11.5	54	280	390	80
28	28.17	33	27.0	27.4	39	11.6	54	280	395	80
29	28.18	33	27.3	27.7	40	13.1	54	288	395	82
30	28.20	33	27.0	27.2	39	12.4	54	285	391	82
31	28.21	33	27.2	27.5	40	11.7	53	284	393	81
32	28.23	33	26.9	27.2	39	11.5	54	279	389	80
33	28.24	33	27.1	27.5	40	11.5	53	278	386	79
34	28.26	33	26.8	27.4	39	12.9	53	288	390	82
35	28.27	33	26.0	26.3	38	12.1	54	283	380	81
36	28.29	33	26.4	26.6	39	12.3	54	284	382	81
37	28.30	33	26.5	26.8	39	12.0	53	279	387	80
38	28.32	33	26.3	26.6	38	12.4	54	283	384	81
39	28.33	33	25.9	26.1	38	11.9	54	281	376	80
40	28.35	33	26.6	26.8	39	12.6	53	286	388	82
41	28.36	33	26.2	26.6	38	12.6	54	283	380	81
42	28.38	33	25.8	26.2	38	12.4	54	284	373	81
43	28.39	33	25.9	26.2	38	11.9	54	279	365	80
44	28.41	33	25.9	26.2	38	11.9	54	278	377	79
45	28.42	33	25.8	26.1	38	12.0	53	282	372	81
46	28.44	33	26.0	26.2	38	11.6	53	281	380	80
47	28.45	33	26.0	26.2	38	11.9	54	277	379	79
48	28.47	33	26.0	26.3	38	11.9	53	278	372	79
49	28.48	33	26.1	26.4	38	11.8	54	276	382	79
50	28.50	33	26.0	26.3	38	11.6	54	278	372	80
51	28.51	37	25.1	25.7	37	12.0	53	280	372	80
52	28.53	37	26.1	26.6	38	12.6	54	284	370	81
53	28.54	37	25.8	26.2	38	12.0	53	279	369	80
54	28.55	37	25.9	26.3	38	12.1	53	280	364	80
55	28.57	37	26.1	26.5	38	12.6	53	281	381	80
56	28.58	37	25.5	26.0	37	12.6	54	278	376	80
57	28.59	37	25.7	26.1	37	12.5	53	279	374	80
58	28.61	37	26.0	26.4	38	12.5	54	277	367	79
59	28.62	37	26.0	26.2	38	11.9	53	274	387	78
60	28.64	37	26.2	26.5	38	12.3	53	280	380	80
61	28.65	37	26.0	26.3	38	12.4	54	283	377	81
62	28.66	37	25.8	26.2	38	11.2	54	275	376	79
63	28.68	37	26.2	26.6	38	12.3	54	285	379	81

Case Method & iCAP® Results

CME 750X Serial Number 361188 - CME 750X at 27.5 to 29.0 feet NWJ
OP: AK Date: 22-March-2021

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
64	28.69	37	26.1	26.6	38	12.5	53	280	379	80
65	28.70	37	26.2	26.5	38	12.0	54	282	386	80
66	28.72	37	26.0	26.3	38	11.8	54	279	386	80
67	28.73	37	25.9	26.3	38	11.8	53	279	386	80
68	28.74	37	26.0	26.4	38	12.3	54	276	380	79
69	28.76	37	26.0	26.3	38	12.0	53	282	386	80
70	28.77	37	26.2	26.6	38	12.5	54	279	378	80
71	28.78	37	26.1	26.4	38	12.2	53	283	384	81
72	28.80	37	26.2	26.5	38	12.3	54	283	391	81
73	28.81	37	26.2	26.5	38	12.3	54	281	386	80
74	28.82	37	25.9	26.2	38	11.7	53	281	382	80
75	28.84	37	26.2	26.5	38	11.9	53	284	387	81
76	28.85	37	26.1	26.4	38	11.7	54	281	384	80
77	28.86	37	26.3	26.6	38	11.8	53	285	389	81
78	28.88	37	26.0	26.3	38	11.6	54	280	385	80
79	28.89	37	25.9	26.2	38	11.9	54	281	381	80
80	28.91	37	25.9	26.3	38	11.8	53	282	385	81
81	28.92	37	25.4	25.8	37	11.5	54	276	376	79
82	28.93	37	26.0	26.4	38	12.3	53	282	384	81
83	28.95	37	25.8	26.2	38	12.3	54	277	378	79
84	28.96	37	26.0	26.5	38	12.5	53	280	383	80
85	28.97	37	26.0	26.5	38	12.4	53	280	380	80
86	28.99	37	25.7	26.1	37	11.6	54	276	379	79
87	29.00	37	25.5	25.9	37	11.2	53	277	378	79
		Average	26.2	26.6	38	12.1	54	281	383	80
		Std. Dev.	0.5	0.5	1	0.4	0	3	8	1
		Maximum	27.3	27.7	40	13.1	54	288	398	82
		Minimum	25.1	25.7	37	11.2	53	274	364	78

Total number of blows analyzed: 70

BL# Sensors

18-87 F1: [162 NWJ-1] 212.8 (1.00); F2: [162 NWJ-2] 213.6 (1.00); A1: [K10734] 434.2 (1.00); A2: [K0304] 372.0 (1.10)

Time Summary

Drive 1 minute 36 seconds 11:15 AM - 11:16 AM BN 1 - 87

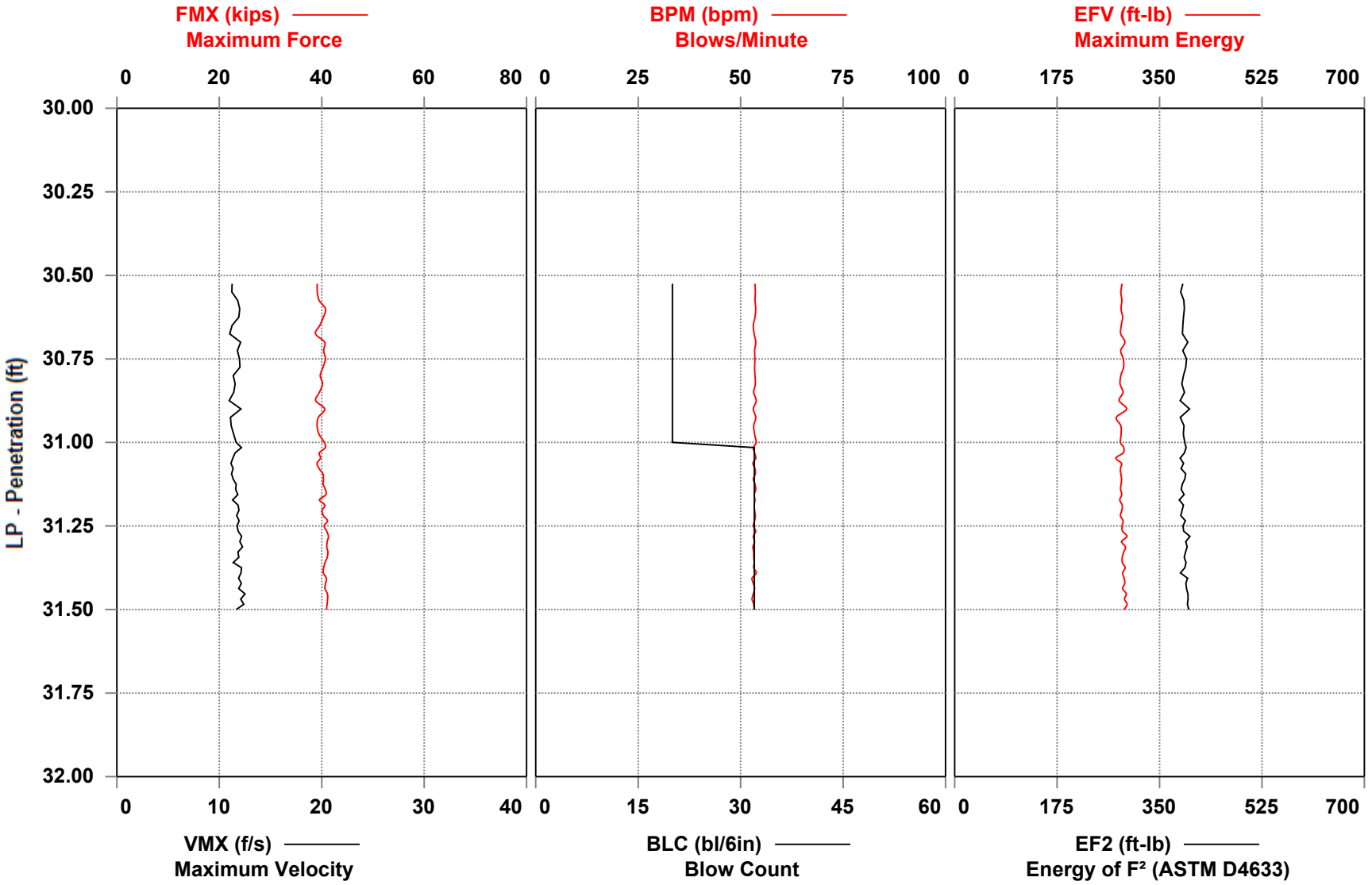
GRL engineers, inc.

GRL Engineers, Inc. - PDIPLOT2 Ver 2020.1.60.3 - Case Method & iCAP® Results

Printed: 01-August-2021 Test started: 22-March-2021

CME 750X Serial Number 361188 - CME 750X at 30.0 to 31.5 feet

NWJ



Case Method & iCAP® Results

CME 750X Serial Number 361188 - CME 750X at 30.0 to 31.5 feet NWJ
OP: AK Date: 22-March-2021

AR: 1.46 in² SP: 0.492 k/ft³
LE: 34.23 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

CSX: Compression Stress Maximum
CSI: Comp Stress Max-Individual Sens
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F² (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
13	30.53	20	26.8	27.0	39	11.3	54	286	390	82
14	30.55	20	26.8	27.0	39	11.2	54	284	386	81
15	30.58	20	27.1	27.5	39	11.8	54	286	391	82
16	30.60	20	27.9	28.2	41	12.0	54	284	392	81
17	30.63	20	27.6	27.9	40	11.9	54	287	391	82
18	30.65	20	27.1	27.3	40	11.2	53	285	390	81
19	30.68	20	26.6	26.8	39	11.0	53	284	389	81
20	30.70	20	27.8	28.1	41	12.1	54	291	398	83
21	30.73	20	27.7	27.9	40	11.8	53	284	390	81
22	30.75	20	27.9	28.1	41	12.0	54	288	396	82
23	30.78	20	27.6	28.0	40	12.0	53	289	395	82
24	30.80	20	27.2	27.4	40	11.4	54	284	391	81
25	30.83	20	27.5	27.8	40	11.5	54	283	388	81
26	30.85	20	27.1	27.3	40	11.4	53	288	393	82
27	30.88	20	26.6	26.8	39	11.0	54	281	385	80
28	30.90	20	27.8	28.1	41	12.1	53	294	401	84
29	30.93	20	26.9	27.3	39	11.1	54	276	386	79
30	30.95	20	26.8	27.0	39	11.2	53	284	392	81
31	30.98	20	27.0	27.3	39	11.4	53	284	391	81
32	31.00	20	27.7	28.0	41	11.7	54	283	393	81
33	31.02	32	27.9	28.2	41	12.2	53	289	395	83
34	31.03	32	27.1	27.4	40	11.5	53	288	392	82
35	31.05	32	27.2	27.6	40	11.3	54	275	385	79
36	31.06	32	26.8	27.0	39	11.1	53	285	391	81
37	31.08	32	27.0	27.3	39	11.4	54	283	387	81
38	31.09	32	27.6	27.9	40	11.2	54	284	395	81
39	31.11	32	27.6	27.8	40	11.4	53	285	393	81
40	31.13	32	27.6	27.9	40	11.6	54	284	389	81
41	31.14	32	27.9	28.1	41	11.6	54	283	387	81
42	31.16	32	28.0	28.2	41	11.8	53	285	392	82
43	31.17	32	27.1	27.4	40	11.3	54	282	384	81
44	31.19	32	27.8	28.1	41	11.8	53	286	391	82
45	31.20	32	27.5	28.0	40	11.9	53	286	389	82
46	31.22	32	27.6	27.8	40	11.7	54	283	386	81
47	31.23	32	28.2	28.4	41	11.9	53	288	394	82
48	31.25	32	27.7	27.9	40	11.7	53	286	390	82
49	31.27	32	28.1	28.2	41	11.8	54	287	391	82
50	31.28	32	28.3	28.7	41	12.2	53	294	402	84
51	31.30	32	28.1	28.4	41	12.0	53	285	395	82
52	31.31	32	28.1	28.5	41	12.3	53	292	397	83
53	31.33	32	28.2	28.4	41	11.8	53	289	394	83
54	31.34	32	28.1	28.3	41	11.9	53	286	392	82
55	31.36	32	27.8	28.2	41	11.4	53	286	395	82
56	31.38	32	27.7	28.4	40	12.2	53	291	393	83
57	31.39	32	27.6	28.1	40	12.1	54	287	386	82
58	31.41	32	28.0	28.3	41	11.9	53	290	398	83

Case Method & iCAP® Results

CME 750X Serial Number 361188 - CME 750X at 30.0 to 31.5 feet NWJ
OP: AK Date: 22-March-2021

BL#	Depth ft	BLC bl/6in	CSX ksi	CSI ksi	FMX kips	VMX f/s	BPM bpm	EFV ft-lb	EF2 ft-lb	ETR (%)
59	31.42	32	27.9	28.3	41	12.2	53	291	395	83
60	31.44	32	27.8	28.1	41	11.9	53	287	396	82
61	31.45	32	28.2	28.9	41	12.5	53	293	399	84
62	31.47	32	28.2	28.5	41	12.1	53	290	399	83
63	31.48	32	28.1	28.7	41	12.4	53	295	398	84
64	31.50	32	28.0	28.3	41	11.7	53	289	400	83
		Average	27.6	27.9	40	11.7	53	286	392	82
		Std. Dev.	0.5	0.5	1	0.4	0	4	4	1
		Maximum	28.3	28.9	41	12.5	54	295	402	84
		Minimum	26.6	26.8	39	11.0	53	275	384	79

Total number of blows analyzed: 52

BL# Sensors

13-64 F1: [162 NWJ-1] 212.8 (1.00); F2: [162 NWJ-2] 213.6 (1.00); A1: [K10734] 434.2 (1.00); A2: [K0304] 372.0 (1.10)

Time Summary

Drive 1 minute 10 seconds 11:30 AM - 11:31 AM BN 1 - 64

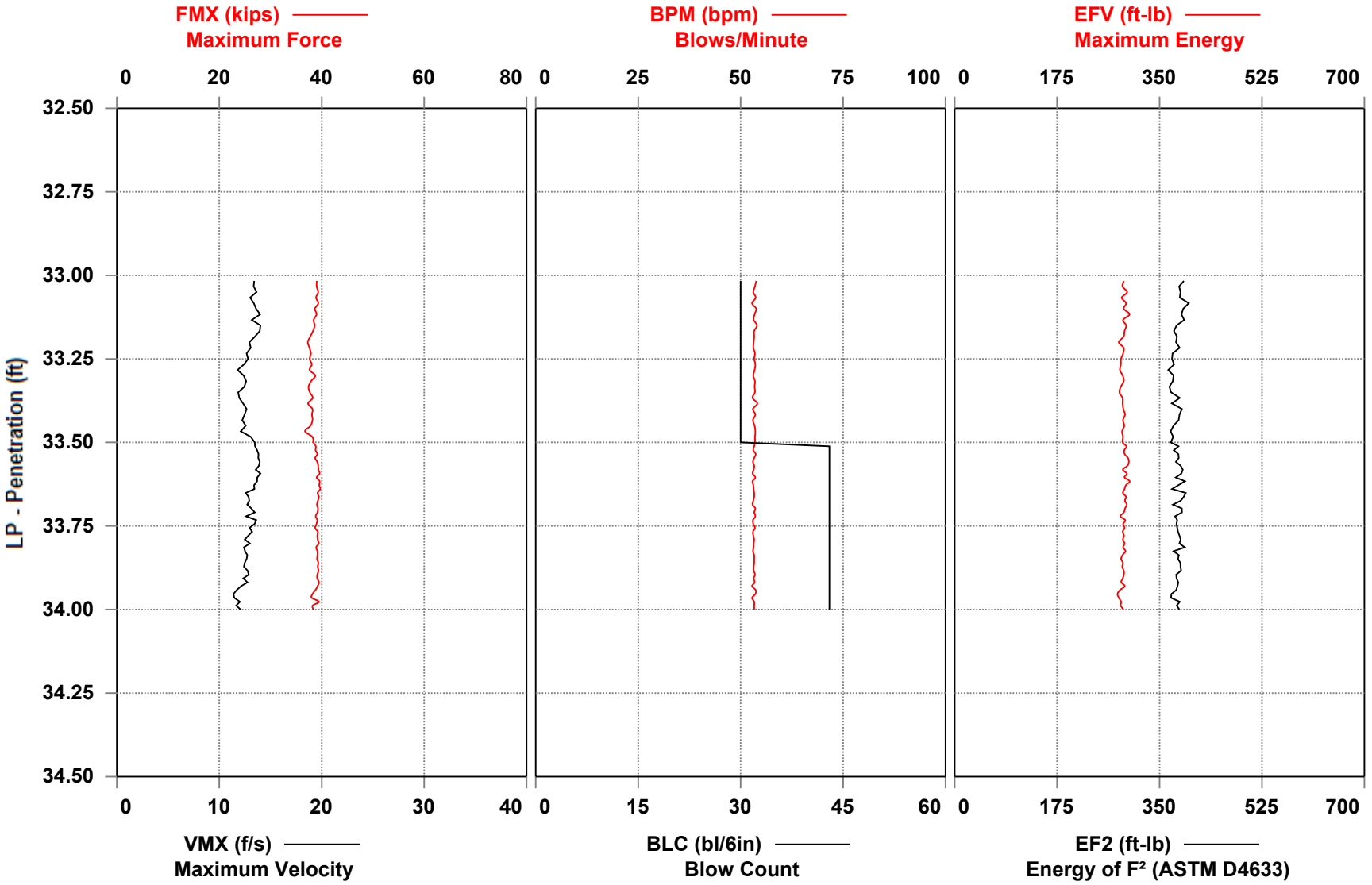
GRL engineers, inc.

GRL Engineers, Inc. - PDIPLOT2 Ver 2020.1.60.3 - Case Method & iCAP® Results

Printed: 01-August-2021 Test started: 22-March-2021

CME 750X Serial Number 361188 - CME 750X at 32.5 to 34.0 feet

NWJ



Case Method & iCAP® Results

CME 750X Serial Number 361188 - CME 750X at 32.5 to 34.0 feet NWJ
OP: AK Date: 22-March-2021

AR: 1.46 in² SP: 0.492 k/ft³
LE: 36.23 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

CSX: Compression Stress Maximum
CSI: Comp Stress Max-Individual Sens
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F² (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
14	33.02	30	26.7	27.2	39	13.4	54	289	391	83
15	33.03	30	26.7	27.2	39	13.4	54	287	383	82
16	33.05	30	26.9	27.5	39	13.6	53	295	386	84
17	33.07	30	26.6	26.9	39	13.0	54	285	385	82
18	33.08	30	26.9	27.2	39	13.4	53	293	400	84
19	33.10	30	26.5	26.9	39	13.6	54	289	390	83
20	33.12	30	26.7	27.4	39	14.0	53	299	387	85
21	33.13	30	26.3	26.6	38	13.2	53	288	392	82
22	33.15	30	26.5	27.1	39	14.0	54	293	379	84
23	33.17	30	26.2	26.9	38	14.0	53	290	375	83
24	33.18	30	25.9	26.3	38	13.5	53	289	380	82
25	33.20	30	25.5	25.8	37	12.9	53	280	378	80
26	33.22	30	25.8	26.1	38	13.1	53	289	384	82
27	33.23	30	26.0	26.0	38	12.7	54	288	372	82
28	33.25	30	25.8	26.1	38	12.8	53	284	371	81
29	33.27	30	26.1	26.4	38	12.4	54	284	375	81
30	33.28	30	25.8	26.3	38	11.8	53	282	365	81
31	33.30	30	26.5	27.1	39	12.4	53	287	374	82
32	33.32	30	26.0	26.1	38	12.6	54	289	373	83
33	33.33	30	25.6	25.8	37	12.4	53	284	367	81
34	33.35	30	25.8	26.2	38	11.8	54	281	370	80
35	33.37	30	26.2	26.7	38	12.0	53	287	384	82
36	33.38	30	25.6	25.9	37	12.3	54	287	371	82
37	33.40	30	26.2	26.3	38	12.7	53	288	388	82
38	33.42	30	26.1	26.3	38	12.5	54	291	384	83
39	33.43	30	26.2	26.5	38	12.2	53	288	383	82
40	33.45	30	25.9	26.0	38	12.6	53	290	374	83
41	33.47	30	25.2	25.4	37	12.1	54	286	369	82
42	33.48	30	26.1	26.6	38	13.1	54	288	373	82
43	33.50	30	26.3	26.8	38	13.5	54	287	369	82
44	33.51	43	26.6	27.1	39	13.5	53	294	382	84
45	33.52	43	26.6	27.3	39	13.7	53	290	374	83
46	33.53	43	26.8	27.5	39	13.8	54	290	382	83
47	33.55	43	26.5	27.3	39	13.8	53	296	383	85
48	33.56	43	26.8	27.6	39	14.0	53	298	378	85
49	33.57	43	26.9	27.7	39	13.9	53	295	386	84
50	33.58	43	27.0	27.5	39	13.6	53	287	390	82
51	33.59	43	27.1	28.0	40	14.0	53	294	387	84
52	33.60	43	26.7	27.6	39	13.7	54	290	378	83
53	33.62	43	27.1	27.8	40	13.7	53	299	393	85
54	33.63	43	27.1	27.6	40	13.4	53	292	382	84
55	33.64	43	27.2	27.7	40	13.4	53	290	371	83
56	33.65	43	26.8	27.2	39	12.6	53	287	395	82
57	33.66	43	27.0	27.4	39	12.9	53	293	391	84
58	33.67	43	26.9	27.1	39	12.9	53	291	386	83
59	33.69	43	26.8	26.9	39	12.7	53	294	373	84

Case Method & iCAP® Results

CME 750X Serial Number 361188 - CME 750X at 32.5 to 34.0 feet NWJ
OP: AK Date: 22-March-2021

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
60	33.70	43	26.9	27.2	39	13.1	54	291	388	83
61	33.71	43	26.8	27.3	39	13.5	53	289	388	83
62	33.72	43	26.6	26.6	39	12.6	54	283	376	81
63	33.73	43	26.8	27.4	39	13.6	53	291	380	83
64	33.74	43	26.7	27.3	39	13.4	53	288	379	82
65	33.76	43	26.5	26.7	39	13.0	54	290	380	83
66	33.77	43	26.9	27.2	39	13.2	53	287	382	82
67	33.78	43	26.8	27.0	39	12.8	53	289	384	83
68	33.79	43	26.9	27.0	39	12.5	53	287	386	82
69	33.80	43	27.0	27.1	39	13.0	53	290	384	83
70	33.81	43	26.7	26.9	39	12.4	53	288	393	82
71	33.83	43	26.8	27.0	39	12.5	53	292	374	83
72	33.84	43	26.8	26.9	39	12.7	53	287	383	82
73	33.85	43	26.8	26.9	39	12.7	53	284	381	81
74	33.86	43	26.9	27.2	39	12.5	53	287	386	82
75	33.87	43	26.9	27.0	39	12.4	53	286	386	82
76	33.88	43	27.0	27.1	39	12.8	53	289	387	83
77	33.90	43	26.8	27.0	39	12.9	54	289	378	83
78	33.91	43	26.8	26.9	39	12.3	53	287	379	82
79	33.92	43	27.0	27.2	39	12.8	53	285	382	81
80	33.93	43	26.8	27.1	39	12.1	53	291	381	83
81	33.94	43	26.6	26.8	39	11.7	54	282	379	81
82	33.95	43	26.2	26.5	38	11.4	54	278	370	79
83	33.97	43	26.1	26.6	38	11.5	53	280	370	80
84	33.98	43	27.0	27.7	39	12.0	53	284	385	81
85	33.99	43	26.2	26.4	38	11.6	53	284	379	81
86	34.00	43	26.3	26.6	38	12.1	53	288	384	82
		Average	26.5	26.9	39	12.9	53	289	381	82
		Std. Dev.	0.5	0.5	1	0.7	0	4	7	1
		Maximum	27.2	28.0	40	14.0	54	299	400	85
		Minimum	25.2	25.4	37	11.4	53	278	365	79

Total number of blows analyzed: 73

BL# Sensors

14-86 F1: [162 NWJ-1] 212.8 (1.00); F2: [162 NWJ-2] 213.6 (1.00); A1: [K10734] 434.2 (1.00); A2: [K0304] 372.0 (1.10)

Time Summary

Drive 1 minute 34 seconds 11:44 AM - 11:45 AM BN 2 - 86

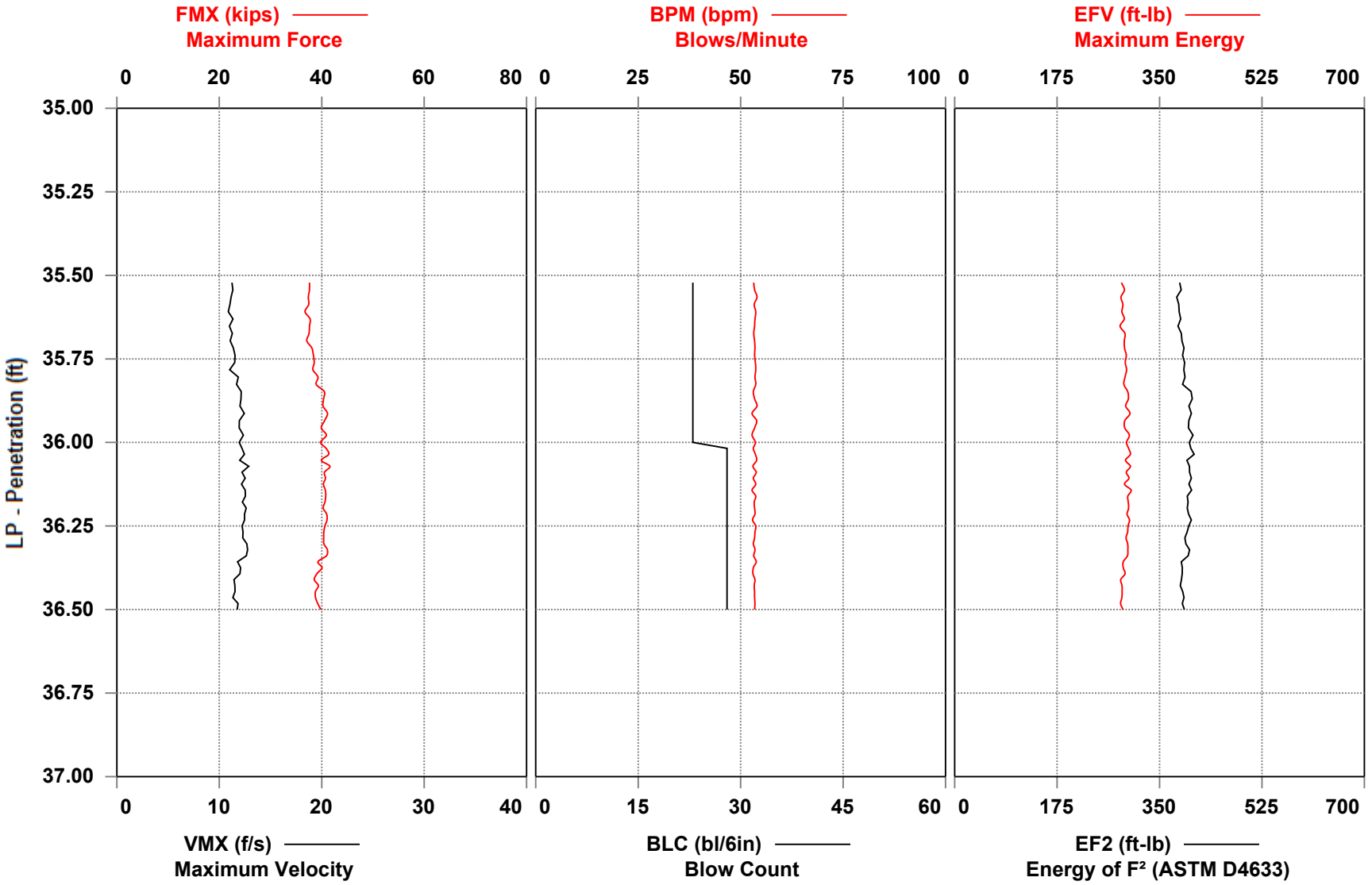
GRL engineers, inc.

GRL Engineers, Inc. - PDIPLOT2 Ver 2020.1.60.3 - Case Method & iCAP® Results

Printed: 01-August-2021 **Test started: 22-March-2021**

CME 750X Serial Number 361188 - CME 750X at 35.0 to 36.5 feet

NWJ



Case Method & iCAP® Results

CME 750X Serial Number 361188 - CME 750X at 35.0 to 36.5 feet NWJ
OP: AK Date: 22-March-2021

AR: 1.46 in² SP: 0.492 k/ft³
LE: 39.23 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

CSX: Compression Stress Maximum
CSI: Comp Stress Max-Individual Sens
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F² (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
18	35.52	23	25.8	25.9	38	11.2	53	285	384	81
19	35.54	23	25.8	25.8	38	11.3	53	290	387	83
20	35.57	23	25.6	25.7	37	11.1	54	284	379	81
21	35.59	23	25.7	25.7	37	11.0	53	287	383	82
22	35.61	23	25.2	25.3	37	10.9	54	286	384	82
23	35.63	23	25.8	26.0	38	11.3	54	290	386	83
24	35.65	23	25.8	25.8	38	11.0	53	283	382	81
25	35.67	23	25.7	25.8	38	11.3	53	291	387	83
26	35.70	23	25.4	25.5	37	11.1	53	290	388	83
27	35.72	23	26.1	26.2	38	11.4	54	290	392	83
28	35.74	23	26.3	26.4	38	11.5	53	293	389	84
29	35.76	23	26.4	26.6	39	11.5	54	291	393	83
30	35.78	23	26.2	26.4	38	11.0	54	294	392	84
31	35.80	23	26.9	27.0	39	11.9	54	291	394	83
32	35.83	23	26.7	26.8	39	11.7	54	289	389	83
33	35.85	23	27.7	28.0	41	12.1	53	296	404	84
34	35.87	23	27.6	27.8	40	12.1	53	297	406	85
35	35.89	23	27.6	27.9	40	12.0	54	292	400	83
36	35.91	23	28.2	28.6	41	12.4	53	300	404	86
37	35.93	23	27.8	27.9	41	12.0	54	291	400	83
38	35.96	23	27.3	27.6	40	11.9	53	291	399	83
39	35.98	23	28.0	28.3	41	12.4	53	298	407	85
40	36.00	23	27.3	27.4	40	11.9	54	294	401	84
41	36.02	28	28.0	28.3	41	12.2	53	297	403	85
42	36.04	28	28.3	28.7	41	12.5	54	300	409	86
43	36.05	28	27.3	27.5	40	12.0	54	292	397	83
44	36.07	28	28.5	28.8	42	12.9	53	300	401	86
45	36.09	28	27.8	28.1	41	12.2	54	293	401	84
46	36.11	28	27.9	28.2	41	12.5	53	298	404	85
47	36.13	28	27.6	27.7	40	12.2	54	290	400	83
48	36.14	28	27.9	28.2	41	12.5	53	301	405	86
49	36.16	28	27.9	28.3	41	12.6	54	296	397	85
50	36.18	28	27.8	28.1	41	12.3	53	297	399	85
51	36.20	28	27.6	27.8	40	12.6	53	297	397	85
52	36.21	28	28.0	28.4	41	12.5	54	295	400	84
53	36.23	28	28.1	28.5	41	12.5	53	299	404	85
54	36.25	28	27.8	28.0	41	12.2	54	296	400	85
55	36.27	28	27.7	28.1	40	12.3	54	296	397	84
56	36.29	28	27.7	27.8	40	12.3	53	293	393	84
57	36.30	28	27.7	27.7	40	12.7	53	296	395	84
58	36.32	28	28.2	28.3	41	12.8	54	296	401	85
59	36.34	28	28.0	28.0	41	12.6	53	295	399	84
60	36.36	28	26.9	27.4	39	11.8	54	288	387	82
61	36.38	28	27.4	27.7	40	12.1	53	288	389	82
62	36.39	28	26.8	27.3	39	12.0	53	291	389	83
63	36.41	28	26.4	27.0	39	11.4	54	284	387	81

Case Method & iCAP® Results

CME 750X Serial Number 361188 - CME 750X at 35.0 to 36.5 feet NWJ
OP: AK Date: 22-March-2021

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
64	36.43	28	26.9	27.4	39	11.5	53	286	385	82
65	36.45	28	26.6	27.1	39	11.5	53	286	389	82
66	36.46	28	26.6	27.1	39	11.3	53	286	392	82
67	36.48	28	26.9	27.4	39	11.8	54	283	389	81
68	36.50	28	27.3	27.7	40	11.7	53	287	392	82
		Average	27.1	27.3	40	11.9	53	292	395	83
		Std. Dev.	0.9	0.9	1	0.5	0	5	7	1
		Maximum	28.5	28.8	42	12.9	54	301	409	86
		Minimum	25.2	25.3	37	10.9	53	283	379	81

Total number of blows analyzed: 51

BL# Sensors

18-68 F1: [162 NWJ-1] 212.8 (1.00); F2: [162 NWJ-2] 213.6 (1.00); A1: [K10734] 434.2 (1.00); A2: [K0304] 372.0 (1.10)

Time Summary

Drive 1 minute 15 seconds 12:09 PM - 12:10 PM BN 1 - 68

CME 75 Serial Number 413707

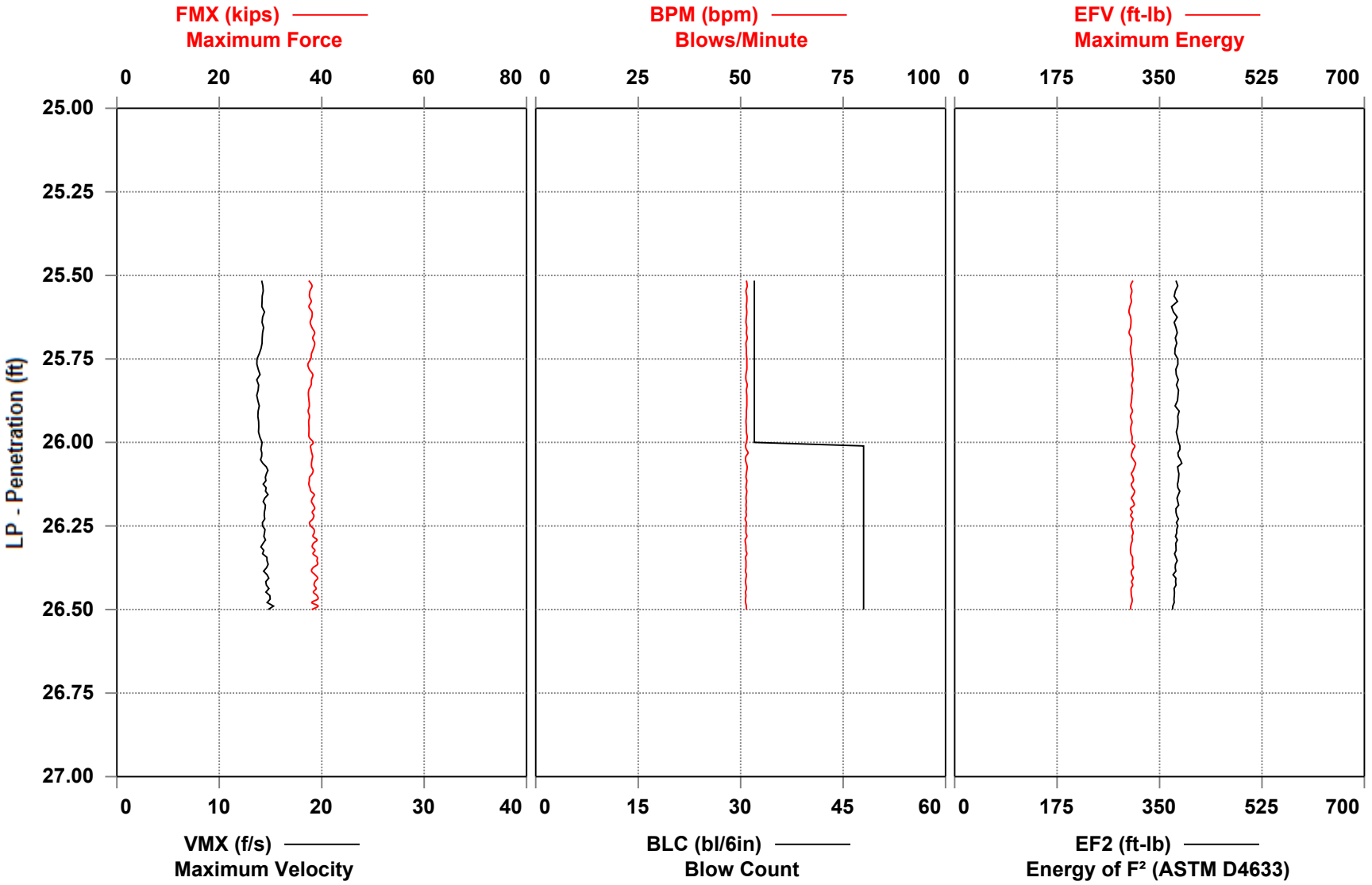
GRL engineers, inc.

GRL Engineers, Inc. - PDIPLOT2 Ver 2020.1.60.3 - Case Method & iCAP® Results

Printed: 01-August-2021 Test started: 22-March-2021

CME 75 Serial Number 413707 - CME 75 at 25.0 to 26.5 feet

NWJ



Case Method & iCAP® Results

CME 75 Serial Number 413707 - CME 75 at 25.0 to 26.5 feet NWJ
OP: AK Date: 22-March-2021

AR: 1.46 in² SP: 0.492 k/ft³
LE: 29.25 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

CSX: Compression Stress Maximum
CSI: Comp Stress Max-Individual Sens
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F² (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
19	25.52	32	25.7	25.7	37	14.1	51	305	378	87
20	25.53	32	26.1	26.2	38	14.3	52	301	381	86
21	25.55	32	25.8	25.9	38	14.3	51	303	377	86
22	25.56	32	25.8	25.8	38	14.2	52	301	375	86
23	25.58	32	26.0	26.0	38	14.2	52	302	381	86
24	25.59	32	25.7	25.7	37	14.1	51	299	370	86
25	25.61	32	26.1	26.2	38	14.4	52	298	374	85
26	25.63	32	26.1	26.1	38	14.2	51	301	380	86
27	25.64	32	25.8	25.9	38	14.2	51	301	375	86
28	25.66	32	26.1	26.2	38	14.3	52	300	378	86
29	25.67	32	26.4	26.5	39	14.2	51	298	380	85
30	25.69	32	26.2	26.2	38	14.2	52	302	377	86
31	25.70	32	26.5	26.5	39	14.2	51	302	379	86
32	25.72	32	26.3	26.4	38	14.1	51	300	377	86
33	25.73	32	26.0	26.2	38	13.9	51	301	376	86
34	25.75	32	25.9	26.2	38	13.7	52	303	381	86
35	25.77	32	25.6	25.8	37	13.7	52	303	381	87
36	25.78	32	25.7	26.0	38	13.8	52	304	378	87
37	25.80	32	26.2	26.3	38	14.0	51	303	379	87
38	25.81	32	26.0	26.1	38	13.7	51	305	382	87
39	25.83	32	26.0	26.1	38	13.8	52	302	379	86
40	25.84	32	25.7	25.9	37	13.8	51	304	382	87
41	25.86	32	25.6	25.8	37	13.7	52	303	382	86
42	25.88	32	25.7	25.9	38	13.8	52	302	381	86
43	25.89	32	25.7	26.0	38	13.9	52	301	377	86
44	25.91	32	25.6	25.9	37	13.8	51	304	384	87
45	25.92	32	25.8	26.1	38	13.8	51	300	381	86
46	25.94	32	25.6	26.0	37	13.8	51	303	382	87
47	25.95	32	25.7	25.9	38	13.9	51	301	381	86
48	25.97	32	25.7	26.1	38	13.8	51	301	379	86
49	25.98	32	25.7	26.0	38	14.0	52	303	381	87
50	26.00	32	26.3	26.5	38	14.2	51	303	383	87
51	26.01	48	25.9	26.2	38	14.1	51	308	385	88
52	26.02	48	26.0	26.2	38	14.1	51	305	385	87
53	26.03	48	26.1	26.2	38	14.2	52	303	381	86
54	26.04	48	26.2	26.5	38	14.1	51	302	382	86
55	26.05	48	26.1	26.6	38	14.0	51	306	386	87
56	26.06	48	26.0	26.3	38	14.2	51	309	388	88
57	26.07	48	26.0	26.2	38	14.6	52	307	381	88
58	26.08	48	26.2	26.4	38	14.7	52	305	382	87
59	26.09	48	26.1	26.2	38	14.6	51	302	383	86
60	26.10	48	25.8	26.0	38	14.5	51	305	383	87
61	26.11	48	25.7	26.1	38	14.5	52	305	382	87
62	26.13	48	25.7	26.1	37	14.3	51	302	381	86
63	26.14	48	25.8	26.2	38	14.6	51	304	381	87
64	26.15	48	25.9	26.2	38	14.5	52	307	385	88

Case Method & iCAP® Results

CME 75 Serial Number 413707 - CME 75 at 25.0 to 26.5 feet NWJ
OP: AK Date: 22-March-2021

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
65	26.16	48	26.4	26.5	39	14.8	51	306	382	87
66	26.17	48	26.2	26.4	38	14.4	51	302	380	86
67	26.18	48	26.0	26.4	38	14.3	51	305	381	87
68	26.19	48	26.3	26.5	38	14.5	51	307	383	88
69	26.20	48	26.5	26.6	39	14.5	51	300	378	86
70	26.21	48	26.1	26.2	38	14.4	51	304	378	87
71	26.22	48	26.3	26.6	38	14.4	51	301	379	86
72	26.23	48	26.2	26.4	38	14.4	51	304	382	87
73	26.24	48	25.8	25.9	38	14.2	51	302	379	86
74	26.25	48	25.9	26.1	38	14.2	51	302	381	86
75	26.26	48	26.4	26.4	38	14.5	51	304	379	87
76	26.27	48	26.4	26.5	39	14.4	51	305	379	87
77	26.28	48	26.2	26.5	38	14.4	52	303	377	87
78	26.29	48	26.8	27.0	39	14.5	51	304	380	87
79	26.30	48	26.3	26.4	38	14.3	51	302	378	86
80	26.31	48	26.1	26.4	38	14.1	51	301	378	86
81	26.32	48	26.5	26.7	39	14.3	51	300	378	86
82	26.33	48	26.2	26.4	38	14.2	52	301	376	86
83	26.34	48	26.8	27.0	39	14.6	51	304	378	87
84	26.35	48	26.8	26.9	39	14.7	51	304	380	87
85	26.36	48	26.8	27.0	39	14.8	51	304	377	87
86	26.38	48	26.2	26.5	38	14.6	51	305	377	87
87	26.39	48	26.0	26.3	38	14.3	51	302	378	86
88	26.40	48	26.5	26.7	39	14.7	51	302	373	86
89	26.41	48	26.9	27.0	39	14.8	51	305	378	87
90	26.42	48	26.5	26.6	39	14.5	51	302	377	86
91	26.43	48	26.4	26.6	39	14.6	51	304	378	87
92	26.44	48	26.7	26.8	39	14.8	51	302	375	86
93	26.45	48	26.3	26.5	38	14.6	51	301	375	86
94	26.46	48	26.8	26.9	39	14.9	51	302	375	86
95	26.47	48	26.9	27.0	39	15.0	51	303	375	87
96	26.48	48	26.1	26.2	38	14.7	51	303	375	86
97	26.49	48	26.9	26.9	39	15.3	51	301	373	86
98	26.50	48	26.1	26.2	38	14.8	51	301	372	86
		Average	26.1	26.3	38	14.3	51	303	379	87
		Std. Dev.	0.3	0.3	1	0.3	0	2	3	1
		Maximum	26.9	27.0	39	15.3	52	309	388	88
		Minimum	25.6	25.7	37	13.7	51	298	370	85

Total number of blows analyzed: 80

BL# Sensors

19-98 F1: [162 NWJ-1] 212.8 (1.00); F2: [162 NWJ-2] 213.6 (1.00); A1: [K10734] 434.2 (1.00); A2: [K0304] 372.0 (1.10)

Time Summary

Drive 1 minute 53 seconds 11:50 AM - 11:52 AM BN 1 - 98

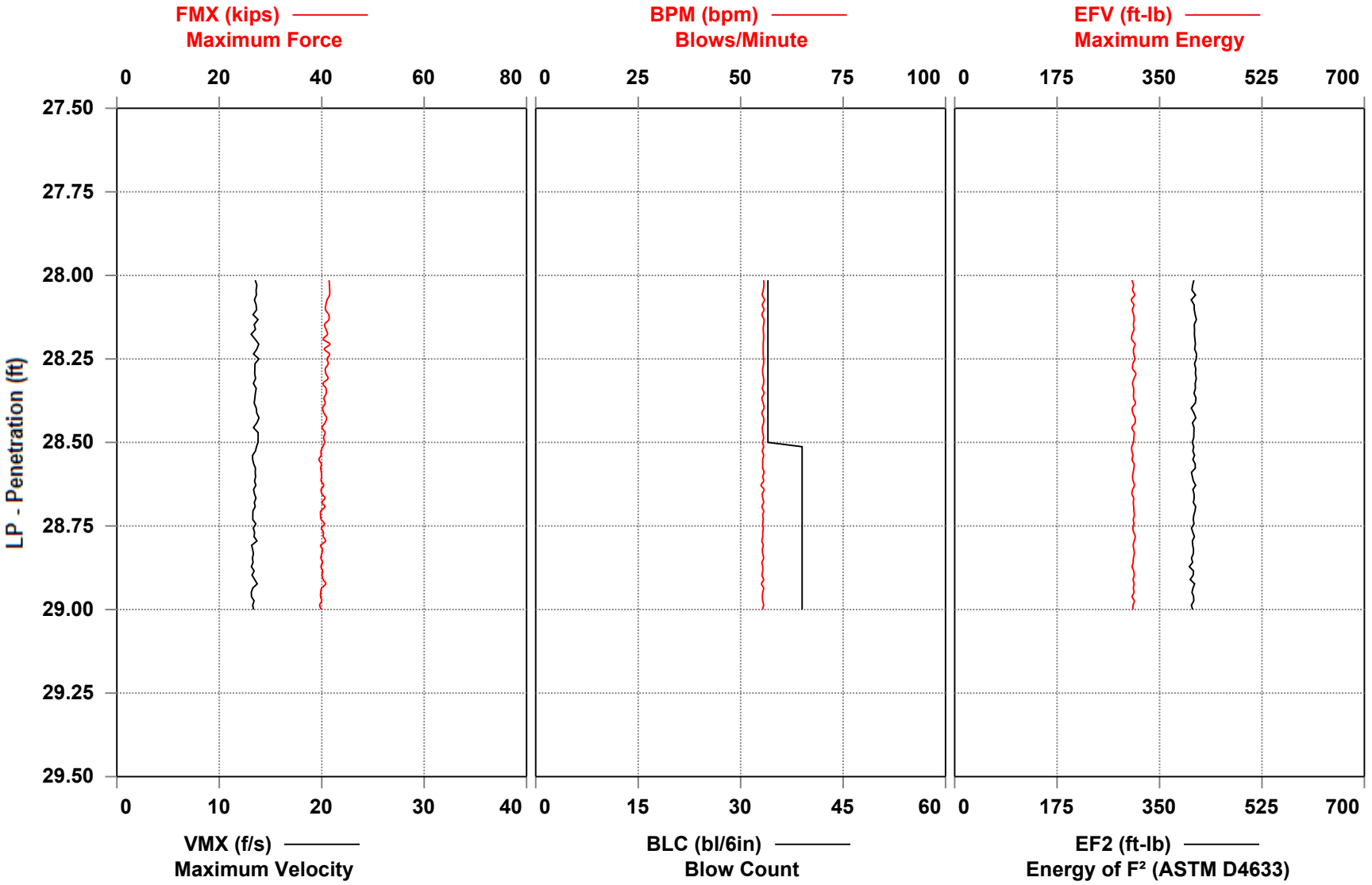
GRL engineers, inc.

GRL Engineers, Inc. - PDIPLOT2 Ver 2020.1.60.3 - Case Method & iCAP® Results

Printed: 01-August-2021 **Test started: 22-March-2021**

CME 75 Serial Number 413707 - CME 75 at 27.5 to 29.0 feet

NWJ



Case Method & iCAP® Results

CME 75 Serial Number 413707 - CME 75 at 27.5 to 29.0 feet NWJ
OP: AK Date: 22-March-2021

AR: 1.46 in² SP: 0.492 k/ft³
LE: 31.25 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

CSX: Compression Stress Maximum
CSI: Comp Stress Max-Individual Sens
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F² (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
7	28.01	34	28.4	29.2	41	13.5	56	303	409	86
8	28.03	34	28.4	29.1	42	13.7	56	305	406	87
9	28.04	34	28.5	29.2	42	13.6	56	304	405	87
10	28.06	34	28.4	29.1	42	13.6	55	307	411	88
11	28.07	34	28.1	28.9	41	13.4	56	302	404	86
12	28.09	34	28.0	28.7	41	13.6	55	306	409	87
13	28.10	34	27.9	28.7	41	13.6	56	304	409	87
14	28.12	34	28.3	29.2	41	13.3	55	306	411	87
15	28.13	34	28.4	29.1	41	13.8	56	307	413	88
16	28.15	34	27.8	28.7	41	13.4	56	305	409	87
17	28.16	34	28.0	28.8	41	13.5	56	306	410	88
18	28.18	34	28.2	29.1	41	13.1	56	303	410	87
19	28.19	34	27.6	28.3	40	13.5	56	303	410	86
20	28.21	34	28.5	29.2	42	13.9	56	308	411	88
21	28.22	34	27.7	28.4	41	13.7	56	306	410	87
22	28.24	34	28.4	29.3	42	13.3	56	306	413	87
23	28.25	34	28.1	28.7	41	13.9	56	308	413	88
24	28.26	34	28.3	29.0	41	13.5	56	305	410	87
25	28.28	34	27.9	28.5	41	13.5	55	304	412	87
26	28.29	34	28.0	28.8	41	13.5	55	309	411	88
27	28.31	34	28.2	28.9	41	13.5	56	306	413	88
28	28.32	34	27.6	28.3	40	13.3	56	304	411	87
29	28.34	34	28.0	28.6	41	13.6	55	306	411	87
30	28.35	34	28.0	28.6	41	13.5	56	306	409	87
31	28.37	34	27.7	28.3	40	13.5	55	306	412	87
32	28.38	34	27.9	28.6	41	13.4	56	309	411	88
33	28.40	34	27.5	27.9	40	13.6	56	303	404	87
34	28.41	34	27.7	28.1	40	13.7	55	304	409	87
35	28.43	34	28.0	28.5	41	13.9	56	308	412	88
36	28.44	34	27.9	28.4	41	13.7	56	308	406	88
37	28.46	34	27.4	28.1	40	13.3	55	303	409	86
38	28.47	34	27.8	28.2	41	13.8	55	307	409	88
39	28.49	34	27.7	28.0	40	13.8	56	306	408	87
40	28.50	34	27.8	28.1	41	13.8	55	305	406	87
41	28.51	39	27.5	27.9	40	13.6	56	302	408	86
42	28.53	39	27.3	27.7	40	13.5	55	303	407	86
43	28.54	39	27.3	28.2	40	13.2	56	305	410	87
44	28.55	39	27.0	27.7	39	13.3	55	303	407	87
45	28.56	39	27.3	28.1	40	13.4	55	306	411	88
46	28.58	39	27.3	27.8	40	13.5	55	306	411	88
47	28.59	39	27.3	27.9	40	13.5	56	305	405	87
48	28.60	39	27.4	27.7	40	13.5	55	304	406	87
49	28.62	39	27.3	28.0	40	13.5	56	305	408	87
50	28.63	39	27.7	28.1	40	13.6	55	307	412	88
51	28.64	39	27.3	27.8	40	13.3	56	304	407	87
52	28.65	39	27.4	27.9	40	13.4	55	303	409	86

Case Method & iCAP® Results

CME 75 Serial Number 413707 - CME 75 at 27.5 to 29.0 feet NWJ
OP: AK Date: 22-March-2021

BL#	Depth ft	BLC bl/6in	CSX ksi	CSI ksi	FMX kips	VMX f/s	BPM bpm	EFV ft-lb	EF2 ft-lb	ETR (%)
53	28.67	39	27.8	28.3	41	13.6	55	306	409	87
54	28.68	39	27.4	27.8	40	13.4	56	305	408	87
55	28.69	39	27.8	28.2	41	13.5	55	306	412	87
56	28.71	39	27.3	27.8	40	13.3	56	306	411	87
57	28.72	39	27.2	27.8	40	13.3	55	307	409	88
58	28.73	39	27.3	27.7	40	13.3	56	305	408	87
59	28.74	39	27.8	28.1	41	13.6	55	306	409	87
60	28.76	39	27.4	27.8	40	13.3	56	304	405	87
61	28.77	39	27.6	28.1	40	13.4	55	306	407	87
62	28.78	39	27.6	28.0	40	13.4	55	308	410	88
63	28.79	39	27.9	28.2	41	13.7	55	307	406	88
64	28.81	39	27.3	27.7	40	13.2	56	305	407	87
65	28.82	39	27.5	27.9	40	13.3	55	306	408	87
66	28.83	39	27.4	27.9	40	13.3	55	307	408	88
67	28.85	39	27.3	27.8	40	13.2	56	305	405	87
68	28.86	39	27.5	27.9	40	13.3	55	305	407	87
69	28.87	39	27.3	27.9	40	13.1	55	303	401	87
70	28.88	39	27.5	28.0	40	13.4	55	306	408	87
71	28.90	39	27.4	27.9	40	13.2	55	307	407	88
72	28.91	39	27.6	28.1	40	13.5	56	305	402	87
73	28.92	39	27.9	28.2	41	13.7	55	306	410	88
74	28.94	39	27.4	27.7	40	13.3	56	305	407	87
75	28.95	39	27.3	27.7	40	13.1	55	306	406	88
76	28.96	39	27.2	27.6	40	13.1	55	303	408	87
77	28.97	39	27.4	27.7	40	13.4	55	307	408	88
78	28.99	39	27.1	27.4	40	13.3	56	305	404	87
79	29.00	39	27.3	27.6	40	13.3	55	304	406	87
		Average	27.7	28.2	40	13.5	55	305	408	87
		Std. Dev.	0.4	0.5	1	0.2	0	2	3	0
		Maximum	28.5	29.3	42	13.9	56	309	413	88
		Minimum	27.0	27.4	39	13.1	55	302	401	86

Total number of blows analyzed: 73

BL# Sensors

7-79 F1: [162 NWJ-1] 212.8 (1.00); F2: [162 NWJ-2] 213.6 (1.00); A1: [K10734] 434.2 (1.00); A2: [K0304] 372.0 (1.10)

Time Summary

Drive 1 minute 24 seconds 12:03 PM - 12:05 PM BN 1 - 79

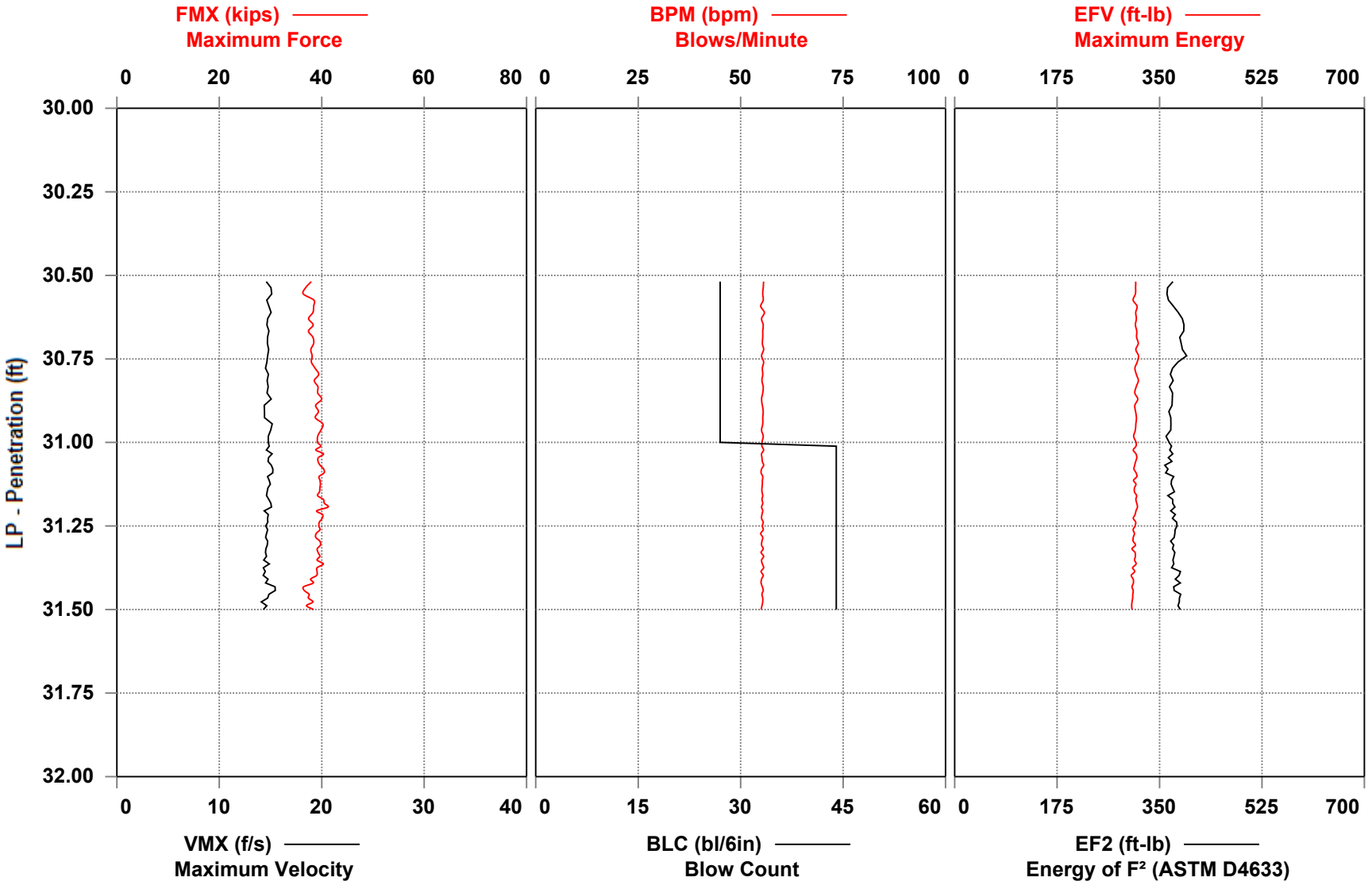
GRL engineers, inc.

GRL Engineers, Inc. - PDIPLOT2 Ver 2020.1.60.3 - Case Method & iCAP® Results

Printed: 01-August-2021 Test started: 22-March-2021

CME 75 Serial Number 413707 - CME 75 at 30.0 to 31.5 feet

NWJ



Case Method & iCAP® Results

CME 75 Serial Number 413707 - CME 75 at 30.0 to 31.5 feet NWJ
OP: AK Date: 22-March-2021

AR: 1.46 in² SP: 0.492 k/ft³
LE: 34.25 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

CSX: Compression Stress Maximum
CSI: Comp Stress Max-Individual Sens
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F² (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
18	30.52	27	26.0	26.3	38	14.6	56	309	373	88
19	30.54	27	25.2	25.5	37	15.1	56	309	364	88
20	30.56	27	24.9	25.3	36	15.1	55	309	363	88
21	30.57	27	26.4	26.7	38	14.6	56	305	365	87
22	30.59	27	26.3	26.5	38	14.8	55	312	374	89
23	30.61	27	26.2	26.6	38	15.1	56	309	382	88
24	30.63	27	25.6	26.0	37	14.7	55	310	389	89
25	30.65	27	26.2	26.5	38	14.6	56	309	392	88
26	30.67	27	25.6	25.9	37	14.8	55	311	391	89
27	30.69	27	26.2	26.4	38	14.7	55	311	385	89
28	30.70	27	26.3	26.6	38	14.7	55	314	387	90
29	30.72	27	25.9	26.3	38	14.8	56	310	389	88
30	30.74	27	26.1	26.4	38	14.7	55	314	396	90
31	30.76	27	26.0	26.1	38	14.6	56	312	382	89
32	30.78	27	26.5	26.8	39	14.5	55	308	372	88
33	30.80	27	27.0	27.3	39	14.8	55	310	369	89
34	30.81	27	26.4	26.7	39	14.7	55	314	373	90
35	30.83	27	26.9	27.2	39	14.8	56	310	367	89
36	30.85	27	26.9	27.2	39	14.7	55	308	372	88
37	30.87	27	27.4	27.8	40	15.1	55	313	372	89
38	30.89	27	26.6	27.0	39	14.4	55	308	371	88
39	30.91	27	27.0	27.3	39	14.4	56	309	366	88
40	30.93	27	26.5	27.0	39	14.4	55	311	369	89
41	30.94	27	27.5	28.0	40	15.2	55	310	369	88
42	30.96	27	27.3	27.8	40	15.0	55	309	369	88
43	30.98	27	26.9	27.2	39	14.8	56	306	361	87
44	31.00	27	26.8	27.2	39	14.8	55	310	366	89
45	31.01	44	27.3	27.6	40	14.9	55	310	370	88
46	31.02	44	26.6	26.9	39	14.6	56	305	367	87
47	31.03	44	27.6	28.0	40	15.2	55	310	373	88
48	31.05	44	26.9	27.3	39	14.8	55	311	365	89
49	31.06	44	26.9	27.3	39	14.8	55	309	371	88
50	31.07	44	27.2	27.7	40	15.1	56	308	359	88
51	31.08	44	27.7	28.2	40	15.2	55	306	364	88
52	31.09	44	27.7	28.1	40	15.2	55	310	361	89
53	31.10	44	27.0	27.4	39	14.7	55	311	374	89
54	31.11	44	27.2	27.6	40	14.9	55	305	371	87
55	31.13	44	27.2	27.5	40	15.0	55	310	370	88
56	31.14	44	27.2	27.5	40	14.8	55	307	372	88
57	31.15	44	27.1	27.3	40	14.7	55	307	376	88
58	31.16	44	26.8	27.2	39	14.6	55	311	364	89
59	31.17	44	27.6	27.9	40	14.8	55	310	372	88
60	31.18	44	27.7	28.2	41	15.0	55	311	372	89
61	31.19	44	28.3	28.6	41	15.1	55	312	376	89
62	31.20	44	26.7	27.2	39	14.4	55	310	369	88
63	31.22	44	27.5	27.9	40	14.8	55	308	377	88

Case Method & iCAP® Results

CME 75 Serial Number 413707 - CME 75 at 30.0 to 31.5 feet NWJ
OP: AK Date: 22-March-2021

BL#	Depth ft	BLC bl/6in	CSX ksi	CSI ksi	FMX kips	VMX f/s	BPM bpm	EFV ft-lb	EF2 ft-lb	ETR (%)
64	31.23	44	27.5	27.8	40	14.7	55	305	372	87
65	31.24	44	27.1	27.5	40	14.7	56	309	379	88
66	31.25	44	27.0	27.5	39	14.5	55	308	380	88
67	31.26	44	27.1	27.6	40	14.7	56	305	377	87
68	31.27	44	26.6	27.1	39	14.6	55	307	376	88
69	31.28	44	26.6	27.1	39	14.5	55	305	375	87
70	31.30	44	27.1	27.6	40	14.7	55	305	369	87
71	31.31	44	27.2	27.7	40	14.7	55	309	374	88
72	31.32	44	26.8	27.2	39	14.5	56	303	372	87
73	31.33	44	26.9	27.3	39	14.5	55	308	376	88
74	31.34	44	27.1	27.6	40	14.6	56	309	375	88
75	31.35	44	26.8	27.1	39	14.3	55	307	373	88
76	31.36	44	27.6	28.1	40	14.9	55	310	374	89
77	31.38	44	26.8	27.2	39	14.3	56	304	371	87
78	31.39	44	26.8	27.2	39	14.5	55	308	386	88
79	31.40	44	26.7	27.1	39	14.3	56	302	383	86
80	31.41	44	25.9	26.2	38	14.8	55	305	377	87
81	31.42	44	26.3	26.7	38	14.5	55	305	385	87
82	31.43	44	25.0	25.4	36	15.4	55	303	374	87
83	31.44	44	25.1	25.4	37	15.5	56	305	375	87
84	31.45	44	25.7	26.1	38	14.8	55	304	386	87
85	31.47	44	25.6	26.2	37	14.7	55	304	384	87
86	31.48	44	26.2	26.5	38	14.1	55	303	384	87
87	31.49	44	25.4	25.6	37	14.6	55	302	381	86
88	31.50	44	26.3	26.7	38	14.3	55	303	385	87
		Average	26.7	27.0	39	14.7	55	308	375	88
		Std. Dev.	0.7	0.7	1	0.3	0	3	8	1
		Maximum	28.3	28.6	41	15.5	56	314	396	90
		Minimum	24.9	25.3	36	14.1	55	302	359	86

Total number of blows analyzed: 71

BL# Sensors

18-88 F1: [162 NWJ-1] 212.8 (1.00); F2: [162 NWJ-2] 213.6 (1.00); A1: [K10734] 434.2 (1.00); A2: [K0304] 372.0 (1.10)

Time Summary

Drive 1 minute 34 seconds 12:14 PM - 12:16 PM BN 1 - 88

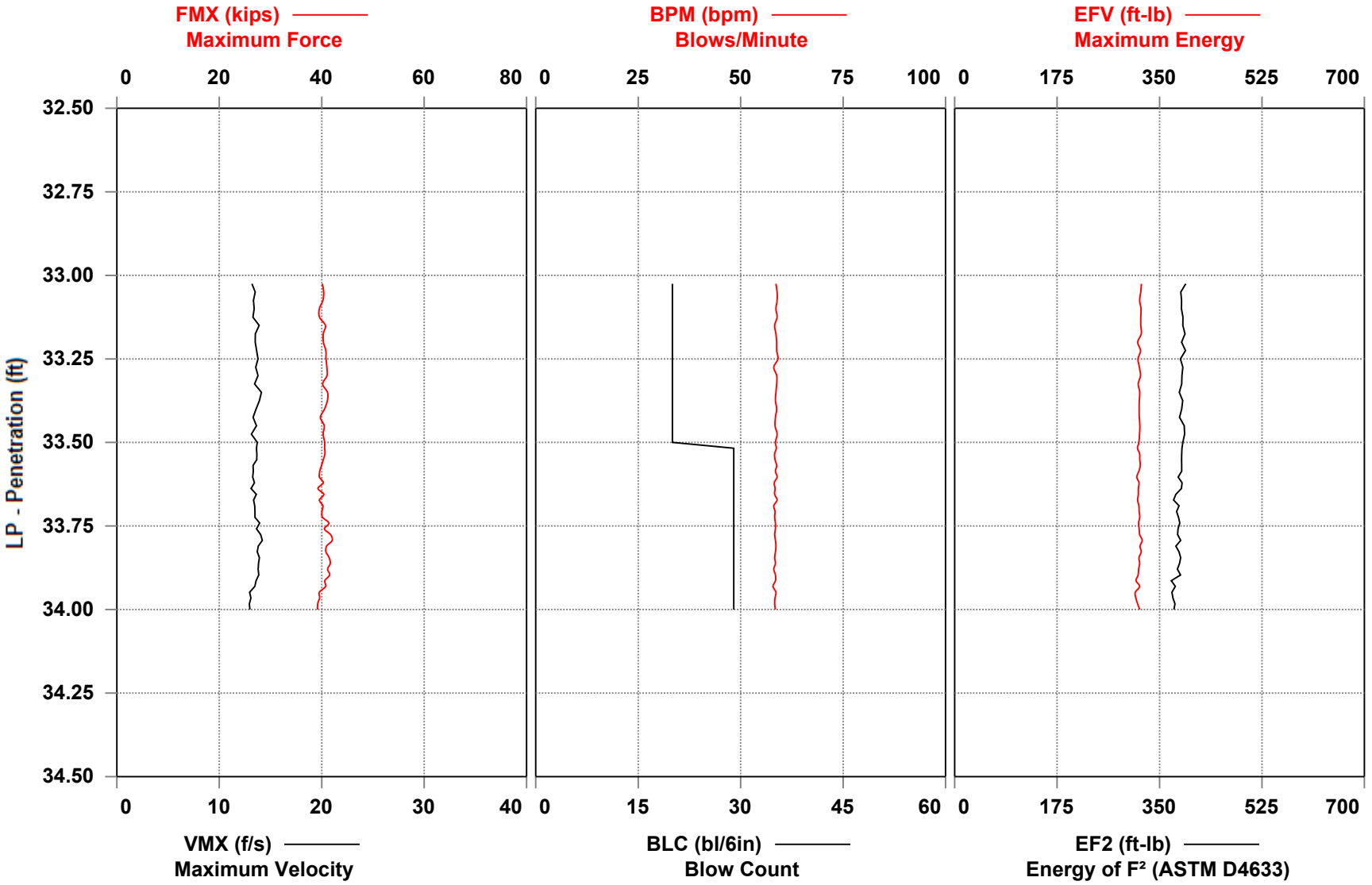
GRL engineers, inc.

GRL Engineers, Inc. - PDIPLOT2 Ver 2020.1.60.3 - Case Method & iCAP® Results

Printed: 01-August-2021 Test started: 22-March-2021

CME 75 Serial Number 413707 - CME 75 at 32.5 to 34.0 feet

NWJ



Case Method & iCAP® Results

CME 75 Serial Number 413707 - CME 75 at 32.5 to 34.0 feet NWJ
OP: AK Date: 22-March-2021

AR: 1.46 in² SP: 0.492 k/ft³
LE: 36.25 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

CSX: Compression Stress Maximum
CSI: Comp Stress Max-Individual Sens
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F² (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
13	33.03	20	27.5	27.6	40	13.2	59	319	395	91
14	33.05	20	27.7	27.8	40	13.5	59	318	386	91
15	33.08	20	27.6	27.7	40	13.3	59	316	388	90
16	33.10	20	27.1	27.2	40	13.4	59	318	387	91
17	33.13	20	27.1	27.1	40	13.3	59	318	390	91
18	33.15	20	27.9	28.0	41	13.9	58	318	390	91
19	33.18	20	27.6	27.8	40	13.5	59	319	394	91
20	33.20	20	27.6	27.8	40	13.5	59	313	388	89
21	33.23	20	27.9	28.0	41	13.6	59	317	394	91
22	33.25	20	28.0	28.2	41	13.8	59	313	386	89
23	33.28	20	28.1	28.3	41	13.6	58	315	390	90
24	33.30	20	28.1	28.3	41	13.8	59	317	388	91
25	33.33	20	27.5	27.7	40	13.4	59	314	388	90
26	33.35	20	28.2	28.6	41	14.1	59	316	384	90
27	33.38	20	28.1	28.6	41	13.9	59	315	390	90
28	33.40	20	27.8	28.1	41	13.6	59	315	388	90
29	33.43	20	27.2	27.4	40	13.3	59	315	384	90
30	33.45	20	27.7	28.2	40	13.6	58	316	392	90
31	33.48	20	27.6	28.0	40	13.1	59	316	393	90
32	33.50	20	27.8	28.3	41	13.7	59	315	390	90
33	33.52	29	27.8	28.1	41	13.6	59	312	388	89
34	33.53	29	27.8	28.3	41	13.7	58	316	388	90
35	33.55	29	27.6	28.1	40	13.7	58	316	388	90
36	33.57	29	27.4	27.7	40	13.3	59	317	388	91
37	33.59	29	27.1	27.6	40	13.3	59	315	388	90
38	33.60	29	27.1	27.5	40	13.3	59	311	382	89
39	33.62	29	27.6	28.0	40	13.4	58	315	388	90
40	33.64	29	26.9	27.5	39	13.1	58	314	387	90
41	33.66	29	27.7	28.2	40	13.6	58	314	378	90
42	33.67	29	27.1	27.6	40	13.3	59	313	374	89
43	33.69	29	27.5	28.0	40	13.5	58	315	383	90
44	33.71	29	27.4	27.9	40	13.5	58	315	379	90
45	33.72	29	27.5	28.0	40	13.5	58	316	382	90
46	33.74	29	28.3	28.8	41	13.9	59	314	385	90
47	33.76	29	27.8	28.2	41	13.6	59	315	382	90
48	33.78	29	28.6	29.1	42	14.0	58	316	381	90
49	33.79	29	28.8	29.4	42	14.2	59	320	386	92
50	33.81	29	28.0	28.5	41	13.8	59	317	378	90
51	33.83	29	28.0	28.4	41	13.7	59	319	383	91
52	33.84	29	28.4	28.9	41	13.9	58	315	386	90
53	33.86	29	28.5	29.0	42	13.8	59	316	384	90
54	33.88	29	28.2	28.6	41	13.8	58	314	380	90
55	33.90	29	28.5	28.9	42	13.9	59	313	386	90
56	33.91	29	27.8	28.0	41	13.6	59	310	370	89
57	33.93	29	27.9	28.0	41	13.5	58	316	377	90
58	33.95	29	27.1	27.1	40	13.0	59	309	371	88

Case Method & iCAP® Results

CME 75 Serial Number 413707 - CME 75 at 32.5 to 34.0 feet NWJ
OP: AK Date: 22-March-2021

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
59	33.97	29	27.1	27.2	40	13.1	58	310	373	88
60	33.98	29	26.9	27.1	39	12.9	58	313	376	89
61	34.00	29	26.8	27.1	39	13.0	59	316	375	90
		Average	27.7	28.0	40	13.5	59	315	385	90
		Std. Dev.	0.5	0.5	1	0.3	0	2	6	1
		Maximum	28.8	29.4	42	14.2	59	320	395	92
		Minimum	26.8	27.1	39	12.9	58	309	370	88

Total number of blows analyzed: 49

BL# Sensors

13-61 F1: [162 NWJ-1] 212.8 (1.00); F2: [162 NWJ-2] 213.6 (1.00); A1: [K10734] 434.2 (1.00); A2: [K0304] 372.0 (1.10)

Time Summary

Drive 1 minute 1 second 12:26 PM - 12:27 PM BN 1 - 61

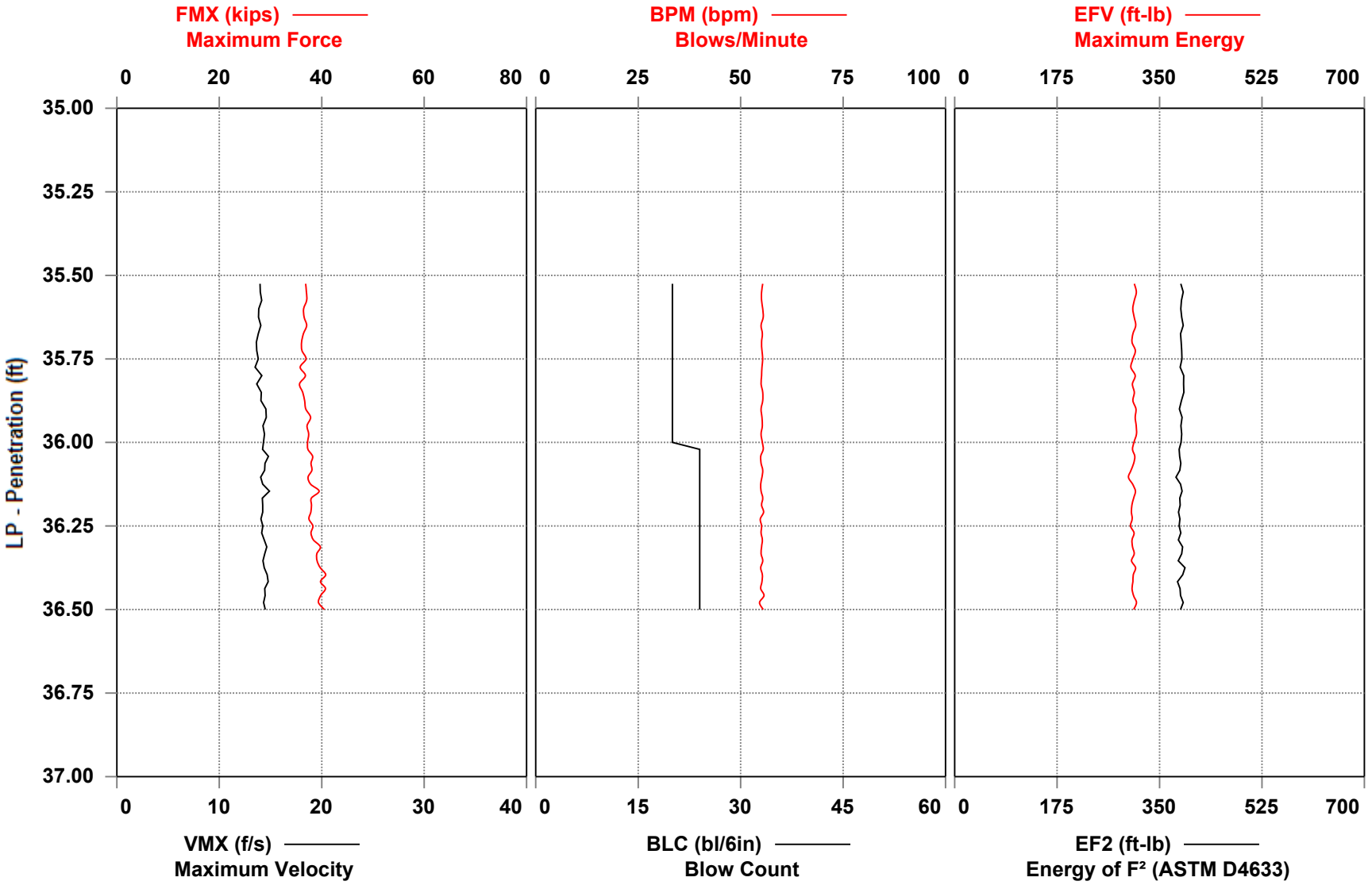
GRL engineers, inc.

GRL Engineers, Inc. - PDIPLOT2 Ver 2020.1.60.3 - Case Method & iCAP® Results

Printed: 01-August-2021 Test started: 22-March-2021

CME 75 Serial Number 413707 - CME 75 at 35.0 to 36.5 feet

NWJ



Case Method & iCAP® Results

CME 75 Serial Number 413707 - CME 75 at 35.0 to 36.5 feet NWJ
OP: AK Date: 22-March-2021

AR: 1.46 in² SP: 0.492 k/ft³
LE: 39.25 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

CSX: Compression Stress Maximum
CSI: Comp Stress Max-Individual Sens
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F² (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
15	35.53	20	25.2	25.8	37	14.0	55	307	386	88
16	35.55	20	25.4	25.9	37	14.0	55	310	390	89
17	35.58	20	25.4	25.8	37	14.1	55	307	387	88
18	35.60	20	25.0	25.6	36	13.9	55	304	386	87
19	35.63	20	25.0	25.5	37	13.8	56	307	388	88
20	35.65	20	25.4	25.9	37	14.0	55	309	390	88
21	35.68	20	24.9	25.4	36	13.8	55	305	386	87
22	35.70	20	24.7	25.2	36	13.6	55	303	387	87
23	35.73	20	24.7	25.4	36	13.7	55	309	388	88
24	35.75	20	25.3	25.6	37	13.8	55	305	388	87
25	35.78	20	24.5	24.9	36	13.5	55	301	385	86
26	35.80	20	25.2	25.6	37	14.2	55	308	391	88
27	35.83	20	24.4	24.8	36	13.7	55	304	391	87
28	35.85	20	24.8	25.2	36	14.1	55	307	392	88
29	35.88	20	25.1	25.2	37	14.1	55	304	387	87
30	35.90	20	25.3	25.8	37	14.5	55	310	384	89
31	35.93	20	25.9	26.6	38	14.6	55	308	388	88
32	35.95	20	25.4	26.0	37	14.3	55	310	387	89
33	35.98	20	25.7	26.2	37	14.4	55	310	388	89
34	36.00	20	25.5	26.1	37	14.3	55	306	387	88
35	36.02	24	25.6	26.1	37	14.2	56	304	384	87
36	36.04	24	26.2	26.8	38	14.8	55	308	384	88
37	36.06	24	26.0	26.7	38	14.5	55	306	386	87
38	36.08	24	26.1	26.7	38	14.4	55	301	385	86
39	36.10	24	25.6	26.2	37	14.0	55	297	378	85
40	36.13	24	25.9	26.6	38	14.2	55	304	386	87
41	36.15	24	27.0	27.9	39	14.9	55	309	388	88
42	36.17	24	26.0	26.8	38	14.2	55	306	385	87
43	36.19	24	26.0	26.9	38	14.2	55	303	385	87
44	36.21	24	25.9	26.8	38	14.2	56	302	382	86
45	36.23	24	25.7	26.5	37	14.1	55	303	385	87
46	36.25	24	26.2	27.0	38	14.2	55	300	383	86
47	36.27	24	26.0	26.8	38	14.1	55	306	386	88
48	36.29	24	26.3	27.2	38	14.4	55	303	382	87
49	36.31	24	27.2	28.1	40	14.6	55	304	389	87
50	36.33	24	26.7	27.7	39	14.4	55	307	388	88
51	36.35	24	26.8	27.8	39	14.3	55	302	382	86
52	36.38	24	27.2	28.2	40	14.4	55	309	393	88
53	36.40	24	27.9	29.0	41	14.7	55	305	390	87
54	36.42	24	27.2	28.1	40	14.8	55	304	381	87
55	36.44	24	27.9	28.5	41	14.4	55	303	385	87
56	36.46	24	27.3	27.9	40	14.5	56	305	386	87
57	36.48	24	27.0	27.6	39	14.3	55	311	390	89
58	36.50	24	27.7	28.4	40	14.5	56	306	386	87
		Average	25.9	26.6	38	14.2	55	306	387	87
		Std. Dev.	0.9	1.1	1	0.3	0	3	3	1

Case Method & iCAP® Results

CME 75 Serial Number 413707 - CME 75 at 35.0 to 36.5 feet NWJ
OP: AK Date: 22-March-2021

BL#	Depth	BLC	CSX	CSI	FMX	VMX	BPM	EFV	EF2	ETR
	ft	bl/6in	ksi	ksi	kips	f/s	bpm	ft-lb	ft-lb	(%)
	Maximum		27.9	29.0	41	14.9	56	311	393	89
	Minimum		24.4	24.8	36	13.5	55	297	378	85

Total number of blows analyzed: 44

BL# Sensors

15-58 F1: [162 NWJ-1] 212.8 (1.00); F2: [162 NWJ-2] 213.6 (1.00); A1: [K10734] 434.2 (1.00); A2: [K0304] 372.0 (1.10)

Time Summary

Drive 1 minute 1 second 12:42 PM - 12:43 PM BN 1 - 58

APPENDIX C

REPRESENTATIVE PLOTS

CME 750X Serial Number 361188

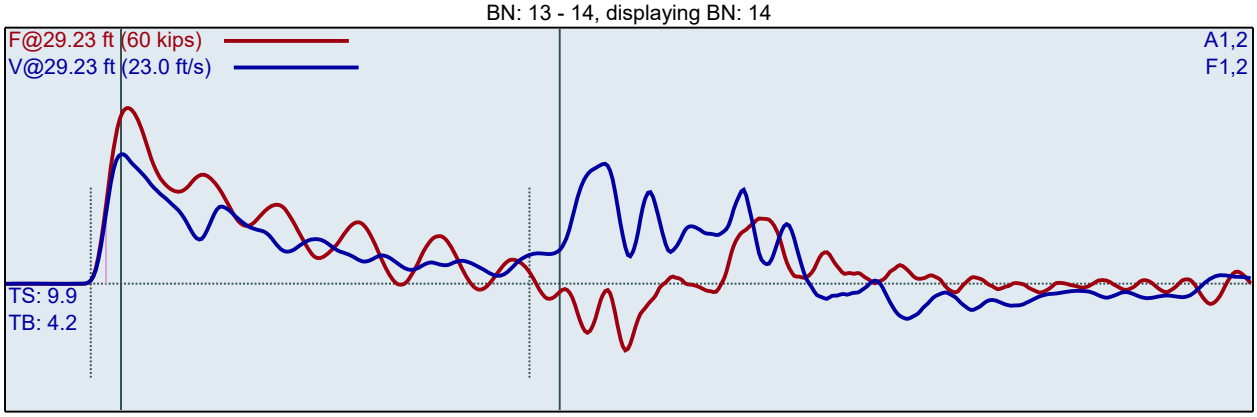
CME 750X Serial Number 361188
AK
NWJ

CME 750X at 25.0 to 26.5 feet
Interval start: 3/22/2021

AR: 1.5 in^2
LE: 29.23 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

BN: 13 - 14, displaying BN: 14



F1 : [162 NWJ-1] 212.78 PDICAL (1) FF6
F2 : [162 NWJ-2] 213.59 PDICAL (1) FF6

A1 (PR): [K10734] 434.2 mv/6.4v/5000g (1) VF6
A2 (PR): [K0304] 372 mv/6.4v/5000g (1.1) VF6

CSX: Compression Stress Maximum
CSI: Compression Stress Maximum - Individual Sensor
FMX: Maximum Force
VMX: Maximum Velocity

BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F^2 (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	CSX ksi	CSI ksi	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	EF2 ft-lb	ETR %
13	28.7	29.3	42	12.1	54.5	292	403	83.4
14	28.2	28.7	41	11.6	54.4	292	393	83.5
Average	28.5	29.0	42	11.8	54.5	292	398	83.4
Std Dev	0.3	0.3	0	0.2	0.1	0	5	0.1
Maximum	28.7	29.3	42	12.1	54.5	292	403	83.5
Minimum	28.2	28.7	41	11.6	54.4	292	393	83.4

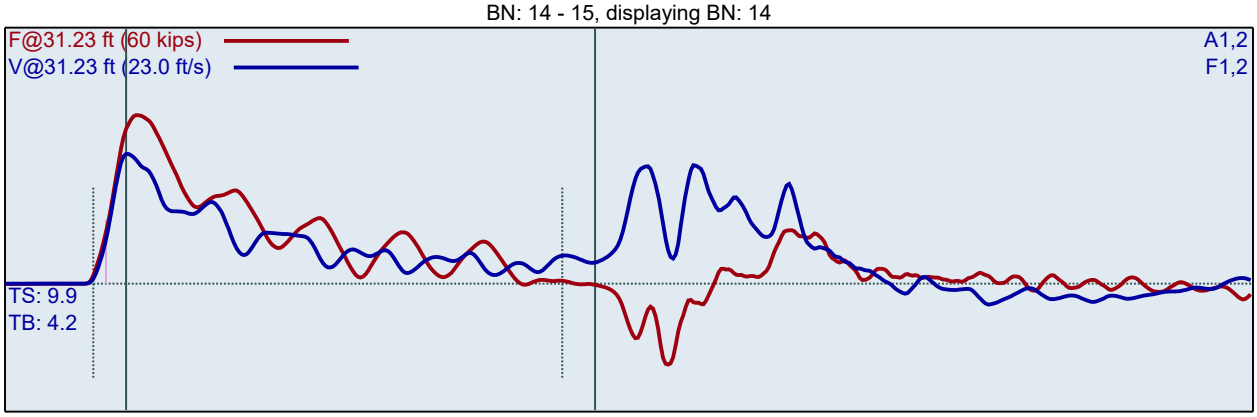
Sample Interval Time: 1.11 seconds.

CME 750X Serial Number 361188
AK
NWJ

CME 750X at 27.5 to 29.0 feet
Interval start: 3/22/2021

AR:	1.5	in^2	
LE:	31.23	ft	
WS:	16807.9	ft/s	
SP:	0.492	k/ft3	
EM:	30000	ksi	

BN: 14 - 15, displaying BN: 14



F1 : [162 NWJ-1] 212.78 PDICAL (1) FF6
F2 : [162 NWJ-2] 213.59 PDICAL (1) FF6

A1 (PR): [K10734] 434.2 mv/6.4v/5000g (1) VF6
A2 (PR): [K0304] 372 mv/6.4v/5000g (1.1) VF6

CSX: Compression Stress Maximum
CSI: Compression Stress Maximum - Individual Sensor
FMX: Maximum Force
VMX: Maximum Velocity

BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F^2 (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	CSX ksi	CSI ksi	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	EF2 ft-lb	ETR %
14	27.0	27.4	39	11.7	53.8	286	400	81.6
15	26.9	27.2	39	11.2	53.5	283	393	80.9
Average	27.0	27.3	39	11.4	53.7	284	397	81.3
Std Dev	0.1	0.1	0	0.2	0.2	1	3	0.3
Maximum	27.0	27.4	39	11.7	53.8	286	400	81.6
Minimum	26.9	27.2	39	11.2	53.5	283	393	80.9

Sample Interval Time: 1.12 seconds.

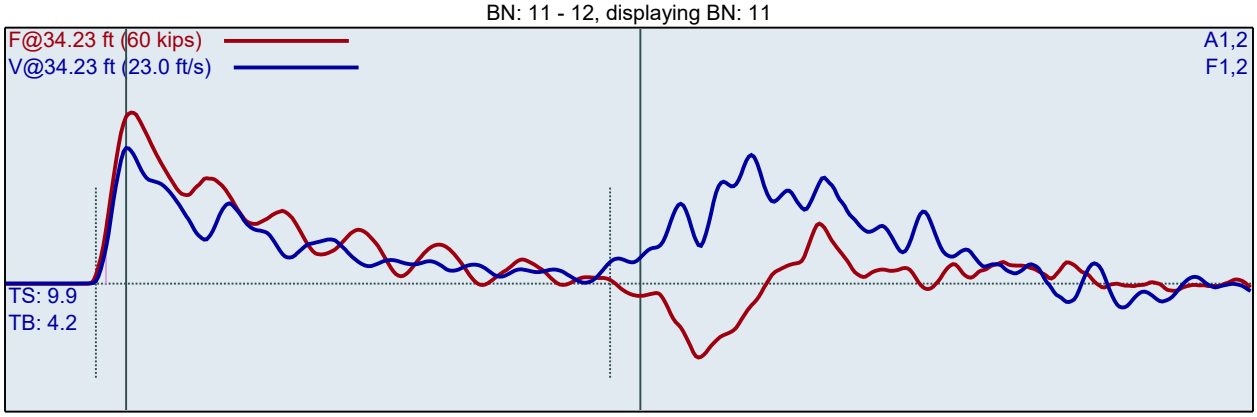
CME 750X Serial Number 361188
AK
NWJ

CME 750X at 30.0 to 31.5 feet
Interval start: 3/22/2021

AR: 1.5 in^2
LE: 34.23 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

BN: 11 - 12, displaying BN: 11



F1 : [162 NWJ-1] 212.78 PDICAL (1) FF6
F2 : [162 NWJ-2] 213.59 PDICAL (1) FF6

A1 (PR): [K10734] 434.2 mv/6.4v/5000g (1) VF6
A2 (PR): [K0304] 372 mv/6.4v/5000g (1.1) VF6

CSX: Compression Stress Maximum
CSI: Compression Stress Maximum - Individual Sensor
FMX: Maximum Force
VMX: Maximum Velocity

BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F^2 (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	CSX ksi	CSI ksi	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	EF2 ft-lb	ETR %
11	27.5	28.0	40	12.2	53.7	289	392	82.6
12	27.8	28.1	41	12.1	53.4	289	393	82.5
Average	27.6	28.1	40	12.1	53.6	289	392	82.6
Std Dev	0.2	0.1	0	0.1	0.2	0	0	0.0
Maximum	27.8	28.1	41	12.2	53.7	289	393	82.6
Minimum	27.5	28.0	40	12.1	53.4	289	392	82.5

Sample Interval Time: 1.13 seconds.

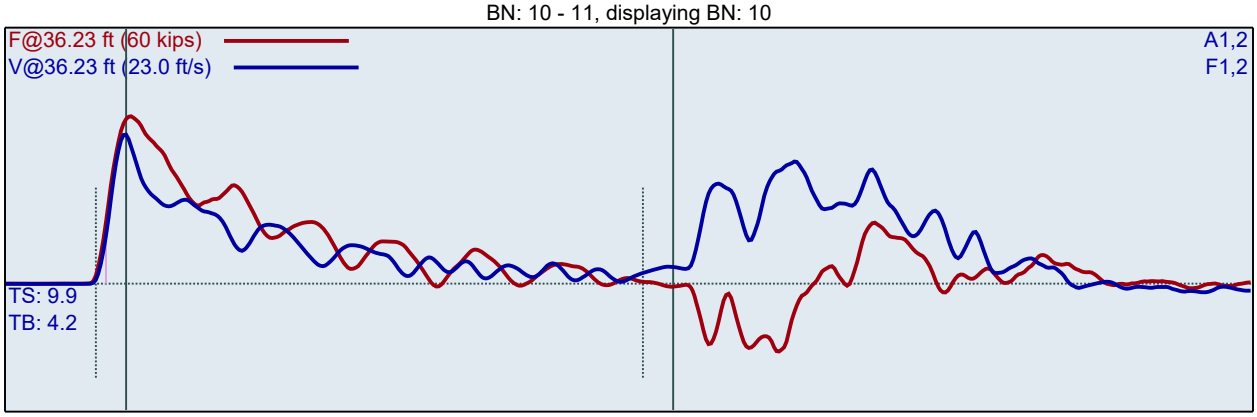
CME 750X Serial Number 361188
AK
NWJ

CME 750X at 32.5 to 34.0 feet
Interval start: 3/22/2021

AR: 1.5 in^2
LE: 36.23 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

BN: 10 - 11, displaying BN: 10



F1 : [162 NWJ-1] 212.78 PDICAL (1) FF6
F2 : [162 NWJ-2] 213.59 PDICAL (1) FF6

A1 (PR): [K10734] 434.2 mv/6.4v/5000g (1) VF6
A2 (PR): [K0304] 372 mv/6.4v/5000g (1.1) VF6

CSX: Compression Stress Maximum
CSI: Compression Stress Maximum - Individual Sensor
FMX: Maximum Force
VMX: Maximum Velocity

BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F^2 (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	CSX ksi	CSI ksi	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	EF2 ft-lb	ETR %
10	26.9	27.6	39	13.4	53.6	290	388	82.9
11	26.9	27.4	39	13.4	53.4	290	389	82.9
Average	26.9	27.5	39	13.4	53.5	290	389	82.9
Std Dev	0.0	0.1	0	0.0	0.1	0	0	0.0
Maximum	26.9	27.6	39	13.4	53.6	290	389	82.9
Minimum	26.9	27.4	39	13.4	53.4	290	388	82.9

Sample Interval Time: 1.12 seconds.

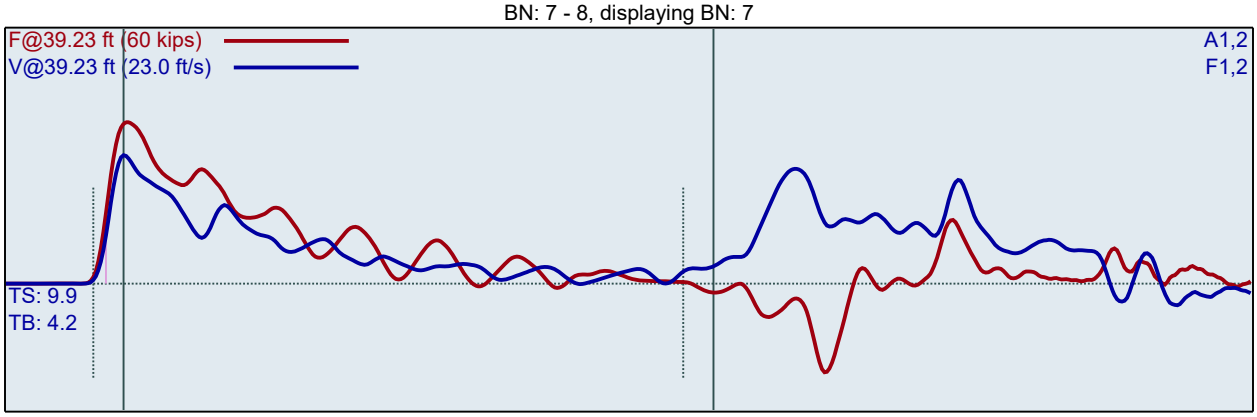
CME 750X Serial Number 361188
AK
NWJ

CME 750X at 35.0 to 36.5 feet
Interval start: 3/22/2021

AR: 1.5 in^2
LE: 39.23 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

BN: 7 - 8, displaying BN: 7



F1 : [162 NWJ-1] 212.78 PDICAL (1) FF6
F2 : [162 NWJ-2] 213.59 PDICAL (1) FF6

A1 (PR): [K10734] 434.2 mv/6.4v/5000g (1) VF6
A2 (PR): [K0304] 372 mv/6.4v/5000g (1.1) VF6

CSX: Compression Stress Maximum
CSI: Compression Stress Maximum - Individual Sensor
FMX: Maximum Force
VMX: Maximum Velocity

BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F^2 (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	BC /6"	CSX ksi	CSI ksi	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	EF2 ft-lb	ETR %
7	0	25.9	26.2	38	11.6	53.5	284	395	81.2
8	0	25.2	25.3	37	11.1	53.5	281	383	80.1
	Average	25.6	25.7	37	11.3	53.5	282	389	80.7
	Std Dev	0.4	0.5	1	0.2	0.0	2	6	0.5
	Maximum	25.9	26.2	38	11.6	53.5	284	395	81.2
	Minimum	25.2	25.3	37	11.1	53.5	281	383	80.1

N-value: 2

Sample Interval Time: 1.13 seconds.

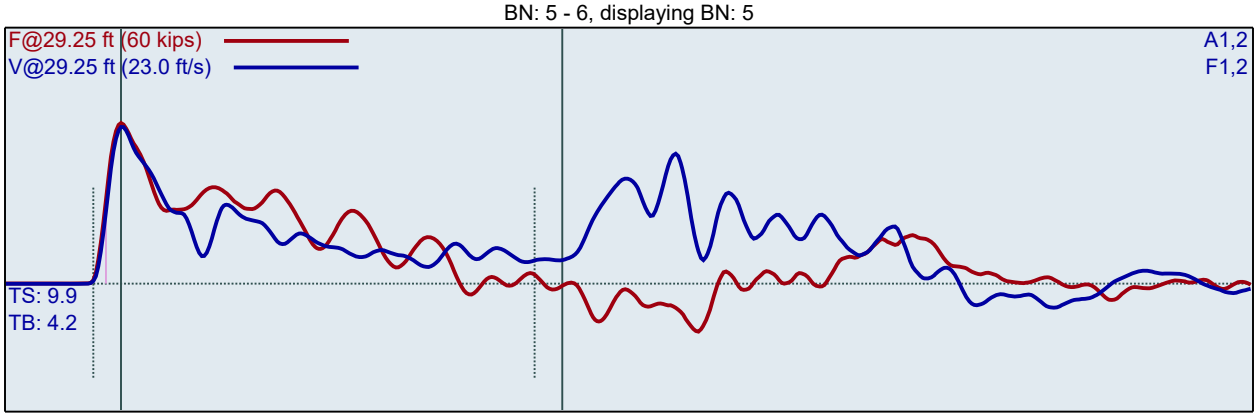
CME 75 Serial Number 413707

CME 75 Serial Number 413707
AK
NWJ

CME 75 at 25.0 to 26.5 feet
Interval start: 3/22/2021

AR:	1.5	in^2	
LE:	29.25	ft	
WS:	16807.9	ft/s	
SP:	0.492	k/ft3	
EM:	30000	ksi	

BN: 5 - 6, displaying BN: 5



F1 : [162 NWJ-1] 212.78 PDICAL (1) FF6
F2 : [162 NWJ-2] 213.59 PDICAL (1) FF6

A1 (PR): [K10734] 434.2 mv/6.4v/5000g (1) VF6
A2 (PR): [K0304] 372 mv/6.4v/5000g (1.1) VF6

CSX: Compression Stress Maximum
CSI: Compression Stress Maximum - Individual Sensor
FMX: Maximum Force
VMX: Maximum Velocity

BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F^2 (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	CSX ksi	CSI ksi	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	EF2 ft-lb	ETR %
5	25.8	25.9	38	14.1	51.4	301	372	85.9
6	25.7	25.9	38	14.0	51.4	305	375	87.1
Average	25.8	25.9	38	14.1	51.4	303	373	86.5
Std Dev	0.0	0.0	0	0.0	0.0	2	2	0.6
Maximum	25.8	25.9	38	14.1	51.4	305	375	87.1
Minimum	25.7	25.9	38	14.0	51.4	301	372	85.9

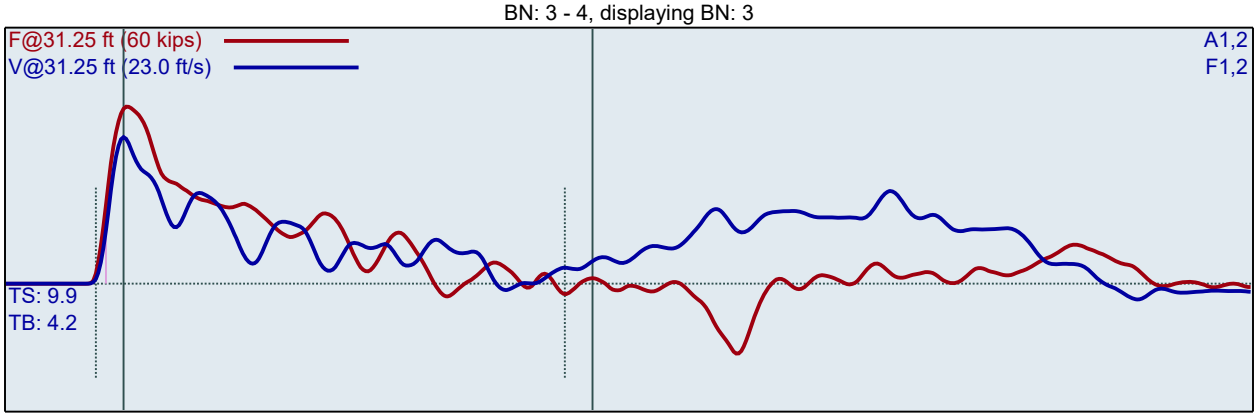
Sample Interval Time: 1.16 seconds.

CME 75 Serial Number 413707
AK
NWJ

CME 75 at 27.5 feet
Interval start: 3/22/2021

AR:	1.5	in^2	
LE:	31.25	ft	
WS:	16807.9	ft/s	
SP:	0.492	k/ft3	
EM:	30000	ksi	

BN: 3 - 4, displaying BN: 3



F1 : [162 NWJ-1] 212.78 PDICAL (1) FF6
F2 : [162 NWJ-2] 213.59 PDICAL (1) FF6

A1 (PR): [K10734] 434.2 mv/6.4v/5000g (1) VF6
A2 (PR): [K0304] 372 mv/6.4v/5000g (1.1) VF6

CSX: Compression Stress Maximum
CSI: Compression Stress Maximum - Individual Sensor
FMX: Maximum Force
VMX: Maximum Velocity

BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F^2 (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	CSX ksi	CSI ksi	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	EF2 ft-lb	ETR %
3	28.4	29.5	42	13.2	55.7	302	405	86.3
4	28.5	29.3	42	13.8	55.5	305	408	87.1
Average	28.5	29.4	42	13.5	55.6	303	407	86.7
Std Dev	0.0	0.1	0	0.3	0.1	1	1	0.4
Maximum	28.5	29.5	42	13.8	55.7	305	408	87.1
Minimum	28.4	29.3	42	13.2	55.5	302	405	86.3

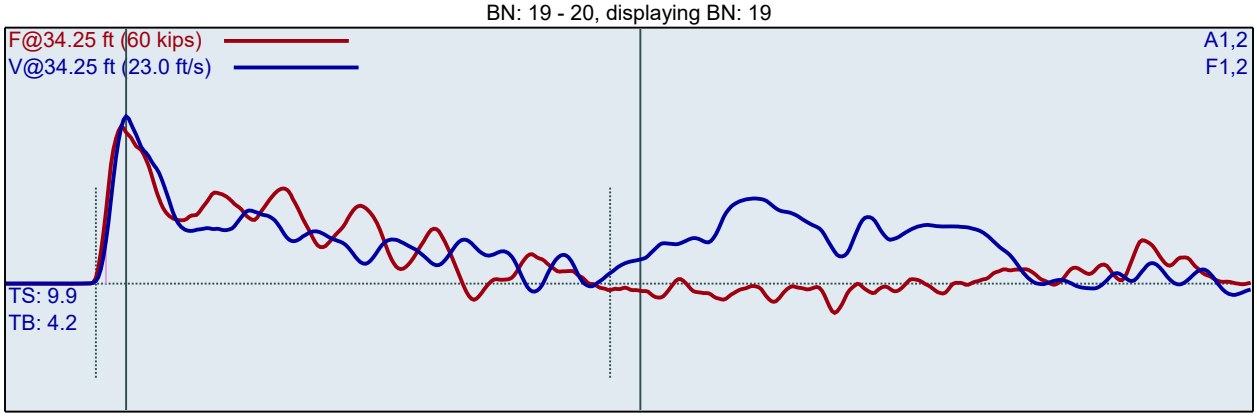
Sample Interval Time: 1.04 seconds.

CME 75 Serial Number 413707
AK
NWJ

CME 75 at 30.0 feet
Interval start: 3/22/2021

AR:	1.5	in^2	
LE:	34.25	ft	
WS:	16807.9	ft/s	
SP:	0.492	k/ft3	
EM:	30000	ksi	

BN: 19 - 20, displaying BN: 19



F1 : [162 NWJ-1] 212.78 PDICAL (1) FF6
F2 : [162 NWJ-2] 213.59 PDICAL (1) FF6

A1 (PR): [K10734] 434.2 mv/6.4v/5000g (1) VF6
A2 (PR): [K0304] 372 mv/6.4v/5000g (1.1) VF6

CSX: Compression Stress Maximum
CSI: Compression Stress Maximum - Individual Sensor
FMX: Maximum Force
VMX: Maximum Velocity

BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F^2 (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	CSX ksi	CSI ksi	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	EF2 ft-lb	ETR %
19	25.2	25.5	37	15.1	55.5	309	364	88.3
20	24.9	25.3	36	15.1	55.4	309	363	88.2
Average	25.1	25.4	37	15.1	55.5	309	363	88.3
Std Dev	0.2	0.1	0	0.0	0.1	0	0	0.1
Maximum	25.2	25.5	37	15.1	55.5	309	364	88.3
Minimum	24.9	25.3	36	15.1	55.4	309	363	88.2

Sample Interval Time: 1.09 seconds.

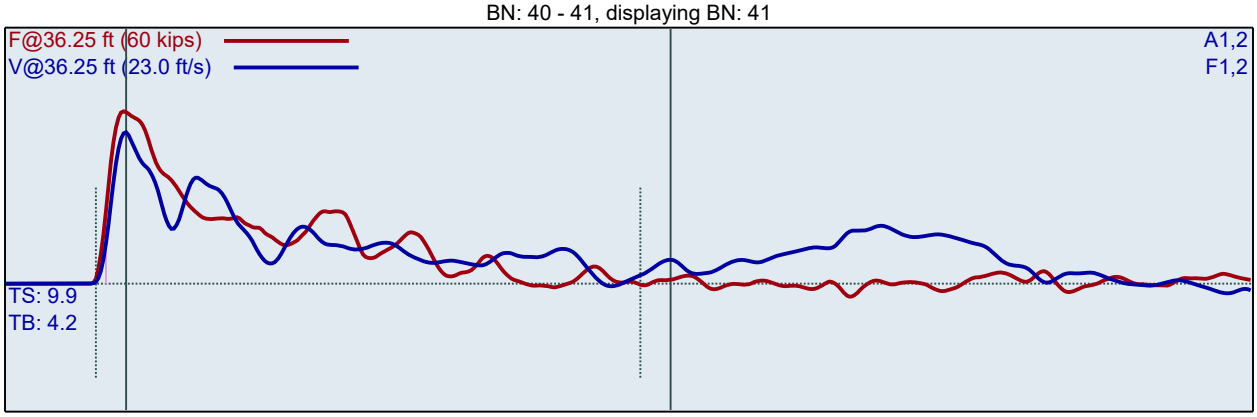
CME 75 Serial Number 413707
AK
NWJ

CME 75 at 32.5 feet
Interval start: 3/22/2021

AR: 1.5 in^2
LE: 36.25 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

BN: 40 - 41, displaying BN: 41



F1 : [162 NWJ-1] 212.78 PDICAL (1) FF6
F2 : [162 NWJ-2] 213.59 PDICAL (1) FF6

A1 (PR): [K10734] 434.2 mv/6.4v/5000g (1) VF6
A2 (PR): [K0304] 372 mv/6.4v/5000g (1.1) VF6

CSX: Compression Stress Maximum
CSI: Compression Stress Maximum - Individual Sensor
FMX: Maximum Force
VMX: Maximum Velocity

BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F^2 (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	CSX ksi	CSI ksi	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	EF2 ft-lb	ETR %
40	26.9	27.5	39	13.1	58.4	314	387	89.7
41	27.7	28.2	40	13.6	58.3	314	378	89.7
Average	27.3	27.8	40	13.4	58.4	314	383	89.7
Std Dev	0.4	0.4	1	0.3	0.1	0	5	0.0
Maximum	27.7	28.2	40	13.6	58.4	314	387	89.7
Minimum	26.9	27.5	39	13.1	58.3	314	378	89.7

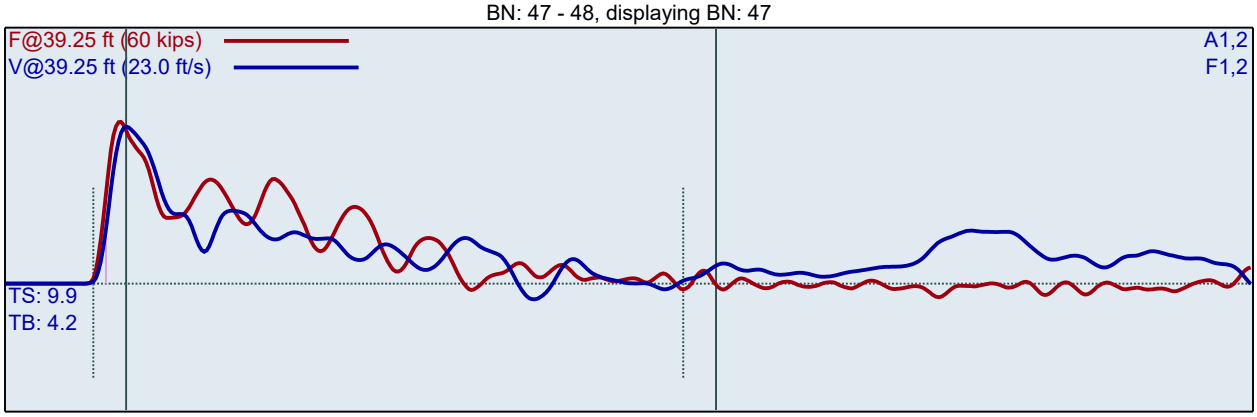
Sample Interval Time: 1.02 seconds.

CME 75 Serial Number 413707
AK
NWJ

CME 75 at 35.0 feet
Interval start: 3/22/2021

AR:	1.5	in^2	
LE:	39.25	ft	
WS:	16807.9	ft/s	
SP:	0.492	k/ft3	
EM:	30000	ksi	

BN: 47 - 48, displaying BN: 47



F1 : [162 NWJ-1] 212.78 PDICAL (1) FF6
F2 : [162 NWJ-2] 213.59 PDICAL (1) FF6

A1 (PR): [K10734] 434.2 mv/6.4v/5000g (1) VF6
A2 (PR): [K0304] 372 mv/6.4v/5000g (1.1) VF6

CSX: Compression Stress Maximum
CSI: Compression Stress Maximum - Individual Sensor
FMX: Maximum Force
VMX: Maximum Velocity

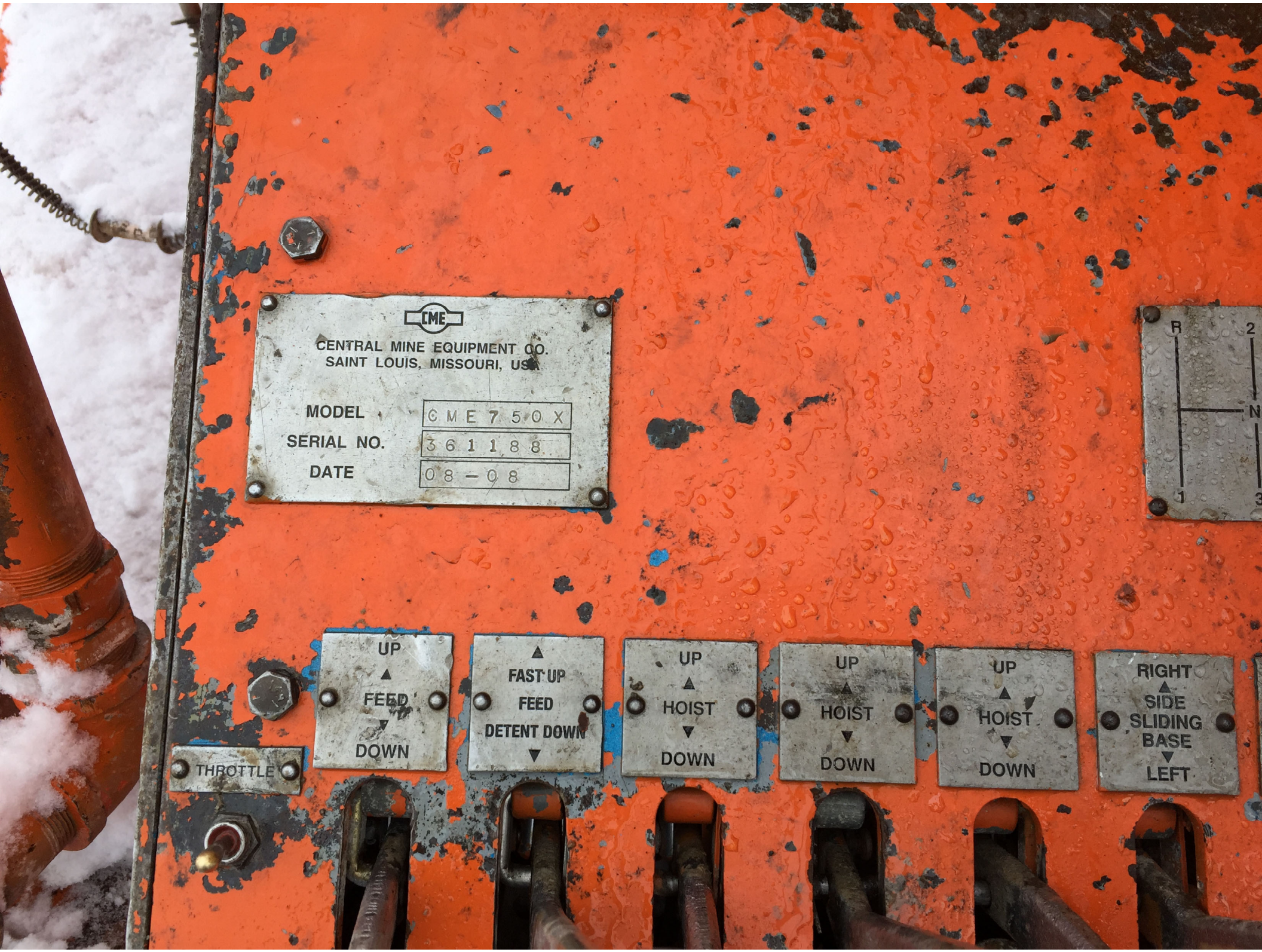
BPM: Blows/Minute
EFV: Maximum Energy
EF2: Energy of F^2 (ASTM D4633)
ETR: Energy Transfer Ratio - Rated

BL#	CSX ksi	CSI ksi	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	EF2 ft-lb	ETR %
47	26.0	26.8	38	14.1	55.0	306	386	87.5
48	26.3	27.2	38	14.4	55.3	303	382	86.6
Average	26.1	27.0	38	14.3	55.2	305	384	87.0
Std Dev	0.2	0.2	0	0.1	0.2	2	2	0.5
Maximum	26.3	27.2	38	14.4	55.3	306	386	87.5
Minimum	26.0	26.8	38	14.1	55.0	303	382	86.6

Sample Interval Time: 1.08 seconds.

APPENDIX D

SUPPLEMENTAL DOCUMENTS


CME
CENTRAL MINE EQUIPMENT CO.
SAINT LOUIS, MISSOURI, USA
MODEL CME 750X
SERIAL NO. 361188
DATE 08-08
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RIGHT
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SLIDING
BASE
LEFT


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GINE ECM HAS NOT
/SAFETY SHUTDOWN
CME
ENTRAL MINE EQUIPMENT CO.
SAINT LOUIS, MISSOURI, USA
MODEL
SERIAL NO.
DATE
CME 75
413707
4-20
UP