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13-TF-0032

MAY 21 2013

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Ms. Hedges:

SUBMITTAL OF HANFORD FEDERAL FACILITY AGREEMENT AND CONSENT ORDER (HFFACO) TARGET DATE M-045-91D-T01 DELIVERABLES

References:

1. Ecology letter from J. J. Lyon to S. L. Samuelson, ORP, "Approval of *Analytical Test Plan for the Removed 241-C-107 Dome Concrete and Rebar,"* 11-NWP-077, dated July 29, 2011. 0097922

2. ORP letter from S. L. Samuelson to J. A. Hedges, Ecology, "Completion of Hanford Federal Facility Agreement and Consent Order (HFFACO) Interim Milestone M-045-91D, Due March 31, 2012," 11-TPD-043, dated June 27, 2011. 0097377

This letter documents completion of HFFACO Target M-045-91D-T-01, due May 31, 2013. The enclosed reports document the results and interpretation of testing and analysis performed on samples of concrete and rebar obtained from the dome of Tank C-107.

Attached are RPP-RPT-50934, Revision 0, "Inspection and Test Report for the Removed 241-C-107 Dome Concrete," and RPP-RPT-54564, Revision 0, "Inspection and Test Report for the Removed 241-C-107 Dome Rebar." Testing and analysis of the concrete and rebar was performed in accordance with RPP-PLAN-48753, Revision 0, "Analytical Test Plan for the Removed 241-C-107 Dome Concrete and Rebar." This plan was previously submitted to the Washington State Department of Ecology and approved (References 1, 2).

The Attached reports will be added to the TPA Administrative Record.

If you have questions, please contact me, or your staff may contact Jeremy M. Johnson at (509)376-1866.

Kevin W. Smith
Manager

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TPD:JMJ

Distribution see Page 2

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ATTACHMENT 1

13-TF-0032

RPP-RPT-50934, INSPECTION AND TEST REPORT FOR THE REMOVED 241-C-107 DOME CONCRETE

DOCUMENT RELEASE FORM

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INSPECTION AND TEST REPORT FOR THE REMOVED 241-C-107 DOME CONCRETE

R.S. Rast
Washington River Protection Solutions

Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-08RV14800

EDT/ECN:	DRF	UC:	
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Key Words: Single Shell Tank, SST, C-107, structural, integrity, concrete, cores, rebar, test, compression, elastic modulus, Poisson ratio, petrographic, transverse frequency, examination, analysis

Abstract: This report presents the results of the examination and testing of the 55 inch diameter concrete dome 'Plug' removed from SST 241-C-107. Photographs and discussion of field inspeciton of the dome 'Plug' cross section are provided. Fourteen concrete cores removed from the dome 'Plug' were sent offsite for testing. Twelve cores were subject to transverse frequency, elastic modulus, Poisson's ratio, and compression testing. Two cores were subjected to petrographic examination. This report documents represents further implementation of the Single Shell Tank Integrity Project Expert Panel recommendation, SI-5, Test Dome Concrete and Rebar 'Plugs'.

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RPP-RPT-50934

Revision 0

INSPECTION AND TEST REPORT FOR THE REMOVED 241-C-107 DOME CONCRETE

Jan 2012

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washington river protection solutions

EXECUTIVE SUMMARY

The Single-Shell Tank Integrity Project (SSTIP) Expert Panel (Panel) was established by WRPS to provide recommendations for implementation of an enhanced SSTIP. The Panel documented their findings in RPP-RPT-43116, *Expert Panel Report for Hanford Site Single-Shell Tank Integrity Project.* In Recommendation SI-5, *Test Dome Concrete and Rebar 'Plugs'*, the Panel recommended obtaining and testing concrete cores and rebar samples from a large section of reinforced concrete (RC) that has been removed from a tank dome. The C-107 Large Riser Project successfully removed such a section from the center of the dome of Single-Shell Tank (SST) 241-C-107.

The field inspection of the concrete 'Plug' revealed that the placement of concrete and rebar generally matches the design drawings. The measured concrete cover also typically matches the design drawings, providing protection for the rebar. There were no visible cracks or large air voids visible in the cross section of the 'Plug'. Additionally, the protective asphaltic membrane and mortar layers were present and intact.

The concrete cores were shipped to CTL Group for inspection, testing, and petrographic examination. Prior to shipment, the cores were surveyed in the field and all exhibited less than a 0.5 mrem/hr dose rates. Additional surveying for radionuclides was conducted offsite and revealed that the C-107 cores were safe to handle.

The inspection of the concrete cores was successfully performed both visually and microscopically at CTL Group. The findings from the initial inspection and petrographic examination indicated that the concrete removed from the 'Plug' is in good condition, not in distress, and does not exhibit any deleterious mechanisms that would cause distress. Twelve of the fourteen cores were subjected to physical testing and the remaining two cores underwent petrographic examination.

The results of the concrete compression, elastic modulus, and Poisson's ratio tests were compared to the values used to define material properties in the SST Analysis of Record (AOR), as shown in Appendix A of RPP-46442, *Single-Shell Tank Structural Evaluation Criteria.* The average compressive strength of all the tested C-107 cores is about 8000-psi, more than 2.5 times the original 28-day design strength specified at the time of construction. The strength of concrete is greater than what is used in the SST Analysis of Record.

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LIST OF TERMS

ACI	American Concrete Institute
ALARA	as low as reasonably achievable
AOR	Analysis of Record
ASTM	American Society for Testing and Materials International
BPF	Blue Print File
DOE	U.S. Department of Energy
GPR	Ground Penetrating Rebar
Panel	Single-Shell Tank Integrity Project Expert Panel
QA	quality assurance
QAL	quality assurance level
QC	quality control
QL	quality level
RC	reinforced concrete
RMA	radioactive material area
R&C	Single-Shell Tank Retrieval and Closure
SSC	structures, systems, and components
SST	single-shell tank
SSTIP	Single-Shell Tank Integrity Project
Tank Integrity	Technical Integration Central Process, Double-Shell Tank and Single-Shell Tank Integrity
TFP	Tank Farm Projects
TOC	Tank Operations Contractor
UPV	ultrasonic pulse velocity
WRPS	Washington River Protection Solutions, LLC

1.0 INTRODUCTION

The Single-Shell Tank Integrity Project (SSTIP) has implemented expert recommendations to examine structural integrity of Hanford Single-Shell Tanks (SSTs). One recommendation states that inspection and testing of concrete and rebar removed from the SSTs should be performed. This was viewed as opportunistic due to the fact that reinforced concrete sections were to be removed from the tank domes to provide openings large enough to support installation of SST retrieval equipment. In this case, a 55-inch diameter section ('Plug') was removed from the center of the dome of SST 241-C-107 (C-107). The 'Plug' was subsequently inspected and cored. Fourteen 4.2-inch diameter cores were removed and shipped offsite for physical testing and petrographic examination. This report provides the results from 'Plug' inspection, physical testing of 12 cores, and petrographic examination of two cores. The results of the physical testing provide engineering mechanics properties that are compared to those used to perform the structural Analysis of Record (AOR) for the SSTs. This report does not discuss rebar testing, as this portion of the recommendation has not been performed.

1.1 Background

The Hanford Site Tank Operations Contractor (TOC), Washington River Protection Solutions, LLC (WRPS) initiated the Single-Shell Tank Integrity Project to improve the understanding of the integrity of the Single-Shell Tanks until the waste can be retrieved from the tanks for treatment. The Single-Shell Tank Integrity Project Expert Panel (Panel) was established by WRPS to provide recommendations for implementation of an enhanced SSTIP. The Panel documented their findings in RPP-RPT-43116, *Expert Panel Report for Hanford Site Single-Shell Tank Integrity Project*. The Panel provided their logic for the development and prioritization of their 33 recommendations with ten providing the basis for a robust plan to enhance the understanding of the SST integrity.

The WRPS adoption of 16 of the Panel's recommendations is addressed in documented in RPP-PLAN-45082, *Implementation Plan for the Single-Shell Tank Integrity Project*. One of the four key elements from the Panel is to improve the understanding of the SST structural integrity (designated as "SI"). Recommendation SI-5 *Test Dome Concrete and Rebar 'Plugs'* addresses obtaining and testing concrete cores and reinforcement bar samples from the 'plug' removed from the dome of an SST.

In Recommendation SI-5, *Test Dome Concrete and Rebar 'Plugs'*, the Panel recommends obtaining and testing concrete cores and rebar samples from a large section of reinforced concrete (RC) that has been removed from a tank dome. This activity was viewed as opportunistic because cutting large holes in the SST domes were planned to support installation of retrieval equipment. One such project was the C-107 Large-Riser Project, which was removing a 55-inch diameter section of the center dome of the tank to allow deployment of the

Mobile Arm Retrieval System. The removal of the plug is shown in RPP-49003-VA, *241-C-107 Large Riser Install for Mobile Arm Retrieval System*, February 2011.

The inspection and testing plan, RPP-PLAN-48753, *Analytical Test Plan for the Removed 241-C-107 Dome Concrete and Rebar*, addresses the objectives for performing inspection and testing of concrete cores and rebar samples from the 55-inch diameter RC section, hereafter referred to as the 'Plug', removed from C-107.

The Tri-Party Agreement for the SSTIP has two milestones that focused on this activity;

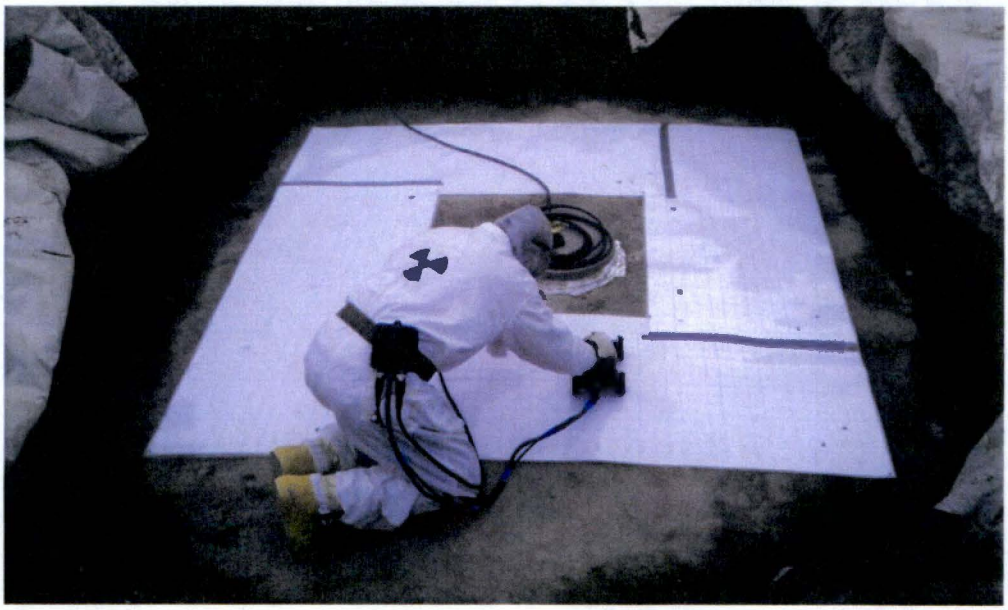
- M-045-91D, "*DOE shall submit to Ecology, for approval, an analytical test plan for the cores removed from the C-107 plug*", due March 31, 2012.
    - The analytical test plan has been reviewed and approved by Ecology.
- M-045-91D-T01, "*DOE shall provide Ecology a report containing the results and interpretation of testing, and analysis, performed on the concrete dome samples obtained from the Tank C-107 plug*", due May 31, 2013.

1.2 Objective

The intent of this report is to describe inspection and testing results of concrete removed from the C-107 'Plug'. The report also provides information resulting from field inspection of the 'Plug'. The results from the testing of concrete are compared to the values used in the SST Analysis of Record, which implements S1-1 from RPP-RPT-43116. The AOR is a detailed modeling effort performed to understand the structural response of the SST during thermal and operating loads and during seismic events.

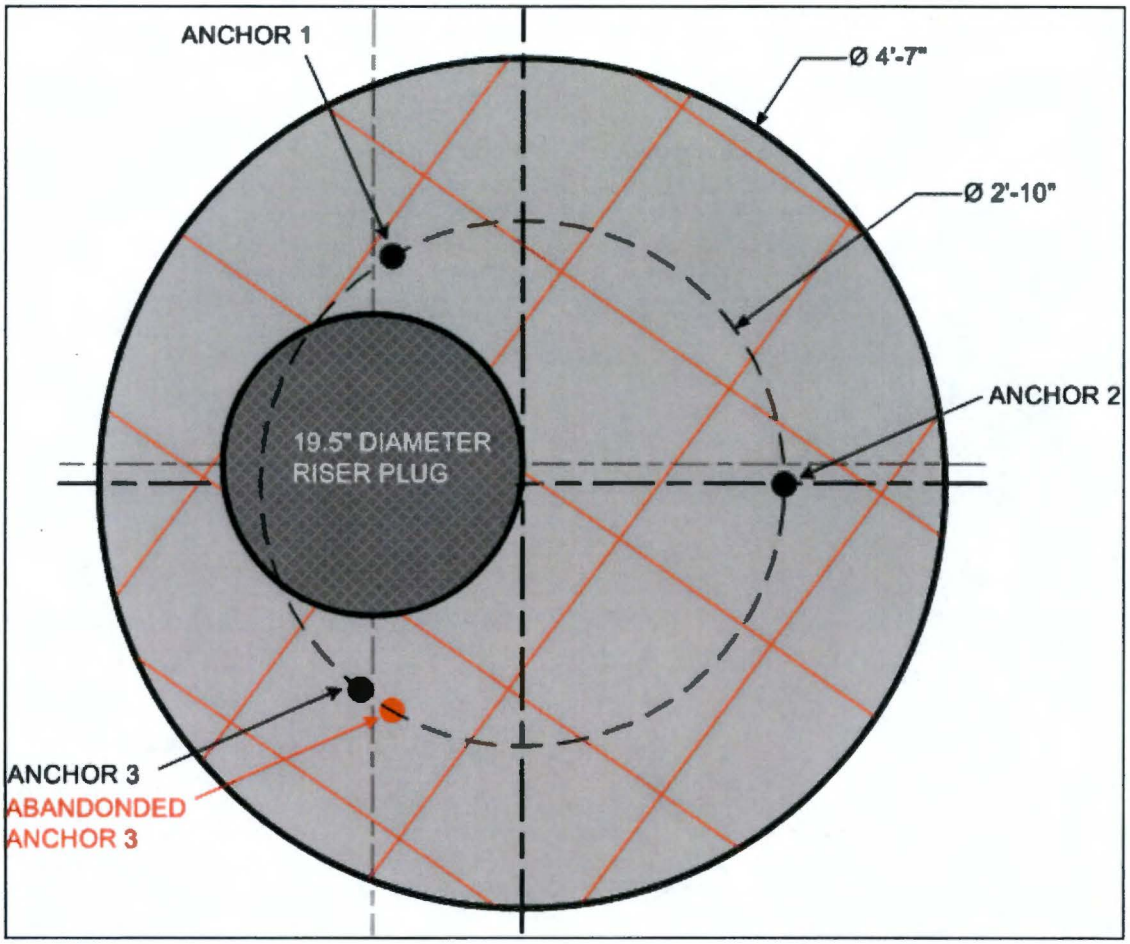
The sections of this report are presented in a chronological order. The 'Plug' was removed in December 2010. Prior to removal, ground penetrating radar (GPR) was used to locate the rebar to facilitate proper placement of anchorage used for hoisting and rigging. Figure 1-1 shows the GPR as applied to the dome of C-107.

Figure 1-1. GPR Scanning of the SST 241-C-107 Dome



A computer aided drafting (CAD) file was generated to digitally display the location of the below surface rebar. The overlay of the located rebar on the dome 'Plug' is shown in Figure 1-2.

Figure 1-2. Plug Rebar Location via GPR

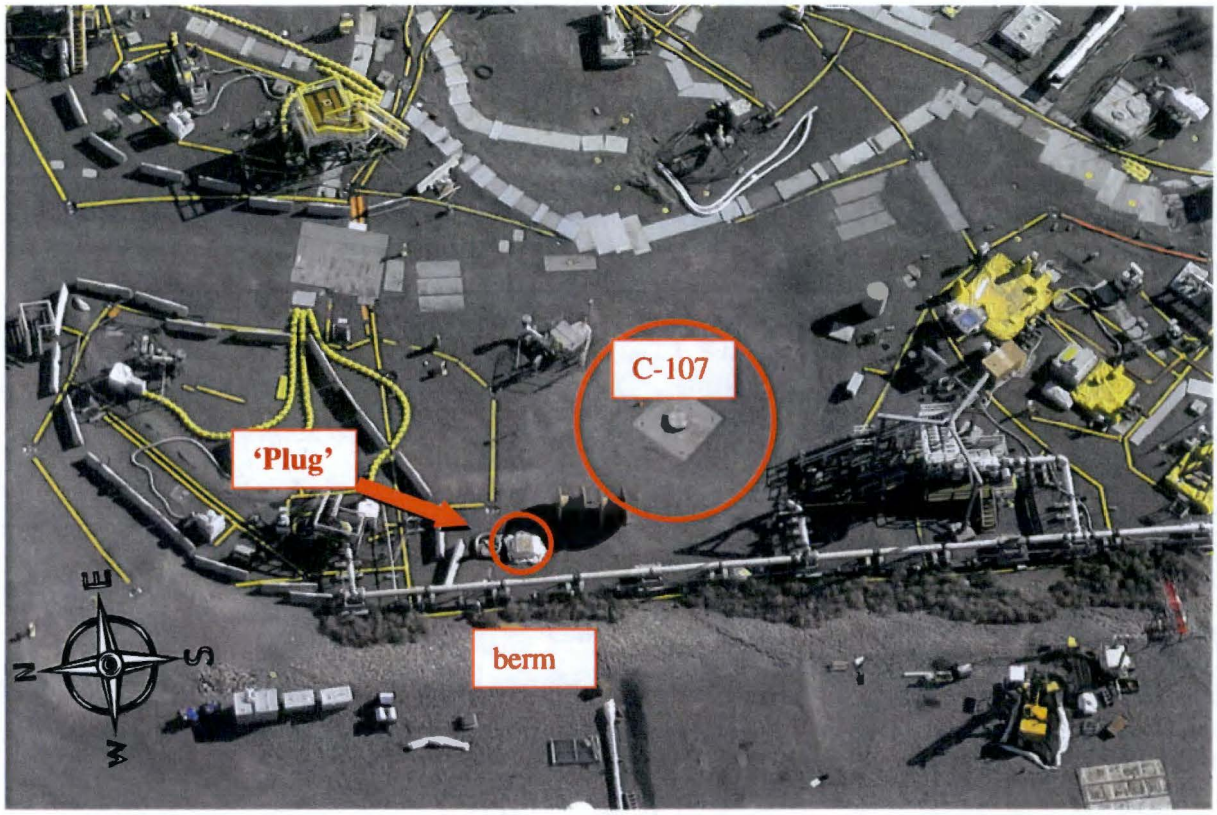


2.0 CONCRETE PLUG FIELD INSPECTION

This section presents field inspection results of 'Plug' condition, geometry, and rebar placement.

The concrete 'Plug' resides in 241-C farm in the 200 East area of the Hanford site. Figure 2-1 shows the location of the 'Plug' during inspection and coring. A concrete pad supporting a large riser is visible, identifying C-107. During the inspection, the berm is considered as being west, as shown by the compass in the figure. In reality a person looking directly at the berm from the 'Plug' location would be facing southwest.

Figure 2-1. Plug Location in C-farm



A team of engineers went to the field soon after the "plug" was cut and removed to take photographs and various measurements. Two separate field inspections were conducted. The first inspection was conducted March 15, 2011. During the first inspection the engineers were permitted to measure and photograph the entire 'Plug' cross-section, through the protective bag. The second inspection was conducted March 29, 2011. During the second inspection, the engineers were not permitted to touch or directly measure to the bottom of the 'Plug'. The combined inspection efforts provide information regarding the overall condition of concrete, section thickness and placement of rebar.

During the combined inspections the following actions were performed:

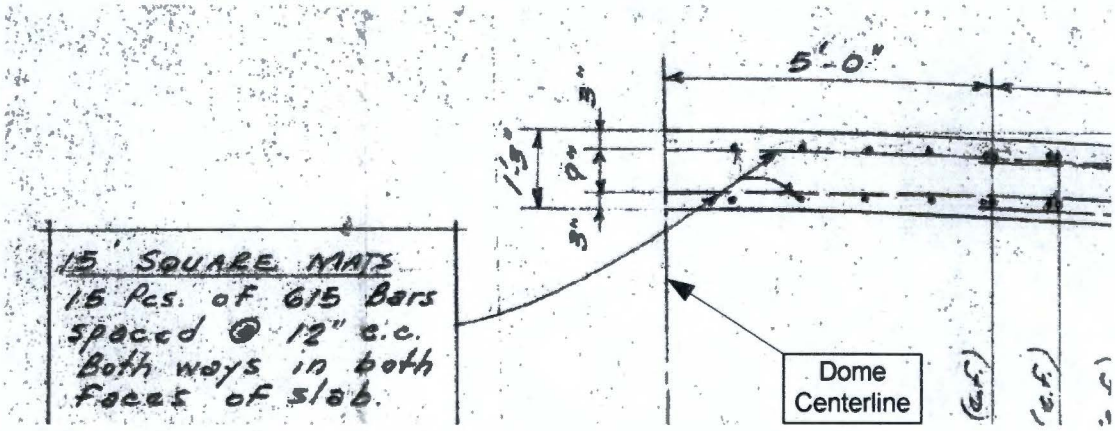
- Measure full depth of 'Plug'
- Measure depth to top mat of rebar
- Measure depth to bottom mat of rebar
- Photograph 'Plug', cracks, voids, rebar, and aggregate

Upon completion of inspection, the 'Plug' was resealed in the LANCS* bag to preserve the integrity of the 'Plug'. The 'Plug' was protected from the effects of ambient moisture (i.e. rainfall) to prevent against moisture exchange that could potentially affect the sample. Figure 2-2 shows the 'Plug' in the protective LANCS* bag.

Figure 2-2. Plug in Bag

The design thickness for the 241-C-107 (and all Type II SSTs) dome is 15-inches. Figure 2-3 shows the design cross section and reinforcement layout for the Type II SSTs. Figure 2-4 shows the field measurement, confirming the section thickness.

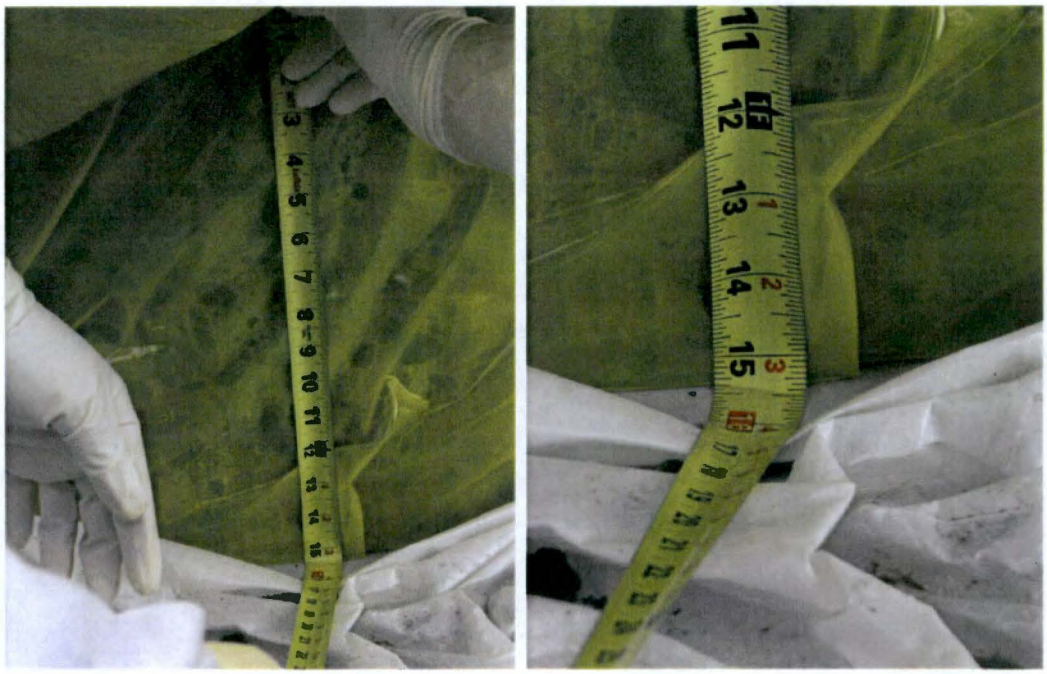
Figure 2-3. 241-C-107 Reinforcing at Dome Center (Section)



Not to scale. Taken from Drawing BPF 73550, D-6

*LANCS is a product of Lancs Industries. 12704 N.E. 124th Street Kirkland, WA 98034

Figure 2-4. Plug Cross-Section Thickness



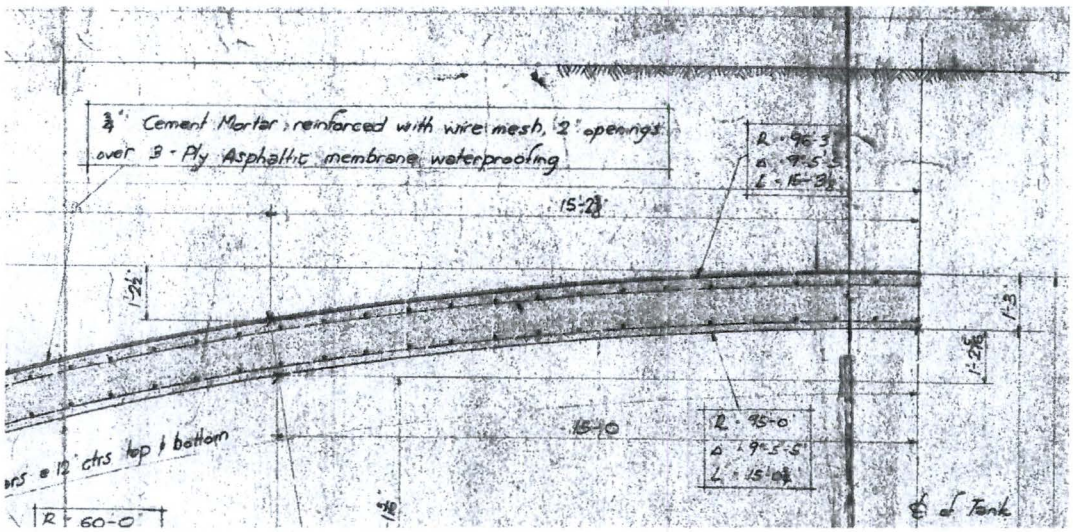
(a) (b)

The second inspection provided insight regarding the general condition of the tank dome concrete. The plug was photographed from a number of angles and measurements taken where desired and permitted. Figure 2-5 shows the overall 'Plug', unwrapped with rigging hardware still attached.

Figure 2-5. Plug Looking West at Berm

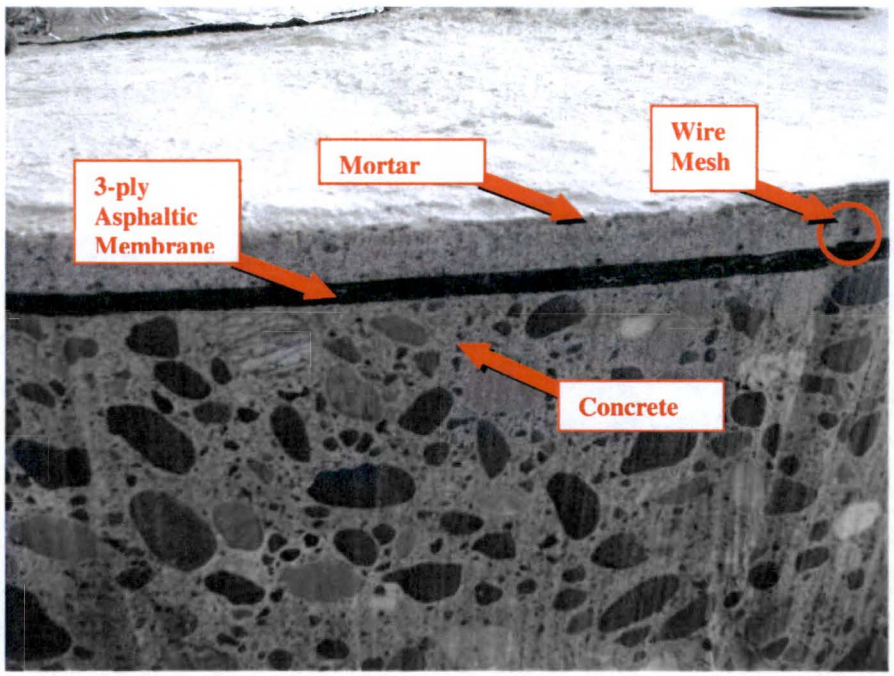
The exterior concrete surface (or the surface in contact with the soil) of 241-C-107 was protected with a 3-ply asphaltic membrane and a thin layer of mortar (gunnite). Figure 2-6 shows the design of the protective coatings per the original tank drawings. Figure 2-7 shows a close up of the cross-section consisting of concrete and the protecting asphaltic membrane and mortar. The asphalt and mortar layers are present, intact, and in generally good condition. The wire mesh used to reinforce the mortar is also visible in the figure.

Figure 2-6. 241-C-107 Mortar and Asphalt at Dome Center



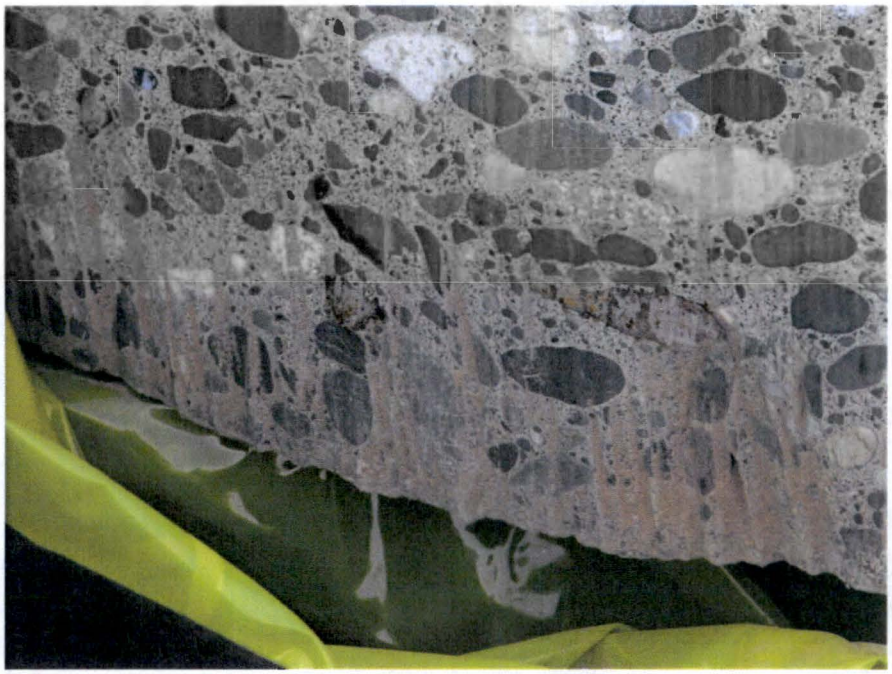
Not to scale.
Taken from Drawing BPF 73550, D-6

Figure 2-7. Plug Top Edge



Engineers inspected the entire cross-section of the 'Plug'. In some cases, rust is apparently forming on the exposed surface of the rebar. This is occurring after the removal of the 'Plug' from the tank dome. There is no evidence (i.e. rust stained concrete) to suggest that the rebar was rusting prior to the 'Plug' removal. A view of the bottom of the 'Plug' section is shown in Figure 2-8. The bottom edge of the 'Plug' is not as smooth as the top edge. This is likely attributed to the reduced velocity of the garnet impregnated water jet used to cut the 'Plug' free. There is obvious discoloration that may be associated with the cutting process. There is a possibility that the discoloration is residue from the garnet itself.

Figure 2-8. Plug Bottom Edge



The cross section of the 'Plug' was examined around its entire circumference. Areas of interest were photographed and at least one photograph was taken for each quadrant, designated as North, South, East, and West. A view of the East side, which is looking toward the berm is shown in Figure 2-9. Red arrows point to top and bottom layers of rebar.

Figure 2-9. Plug East Side

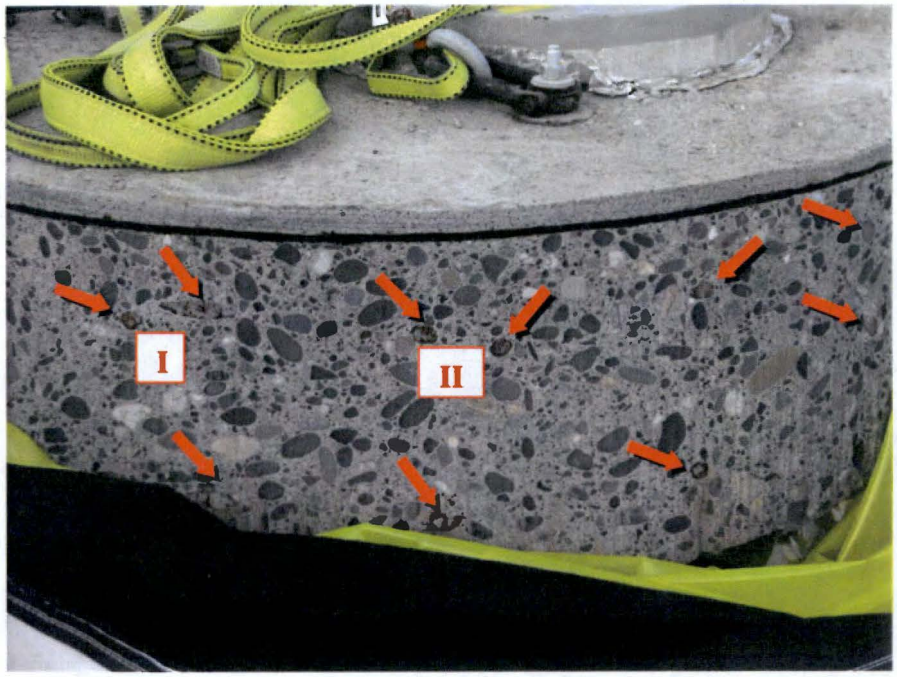


Figure 2-10 shows the measurement of the 'Plug' East side taken at location I from Figure 2-9. The measured concrete cover is 2.5-inches at this location. The design drawings (BPF-73550) indicate a distance of 3-inches (See Figure 2-3) from the top of the concrete to the concrete.

An excerpt from Section (8) of the associated Construction Specification (1944) is as follows:

> (8) Reinforcement Bars. - Steel reinforcement bars shall be placed accurately to the locations and dimensions as shown on the drawings. Unless otherwise shown, measurements made in placing bars shall be to the center lines of bars.

This means that the measured value in of 2.5-inches + 0.5*(0.75-inch diameter) = 2.875-inches is close to the specified 3-inch distance. American Concrete Institute (ACI) 318 requires a 2-inch concrete cover for non-prestressed cast in place concrete exposed to earth for the same size No. 6 (0.75-inch) diameter bar. By comparison, the concrete cover provided is more than adequate for modern design codes. The picture also shows that the reinforcement is 0.75-inch in diameter, matching the design drawings.

Figure 2-10. Plug East Side Top Rebar At Location I

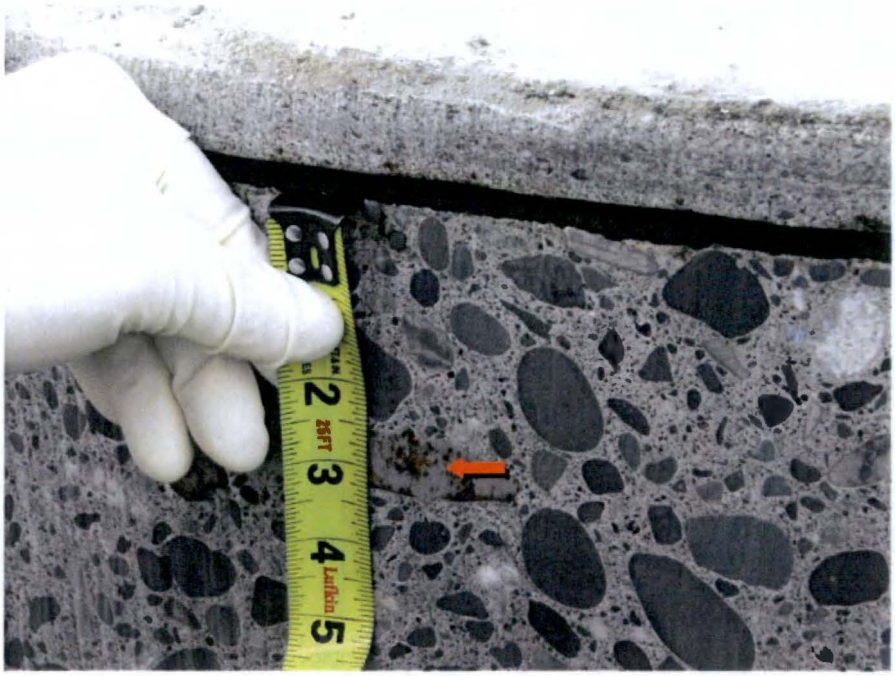


Figure 2-11. shows the top rebar measurement of the 'Plug' East side taken at location II from Figure 2-9. The measured concrete cover is about 3.5-inches at this location.

Figure 2-11. Plug East Side Top Rebar At Location II

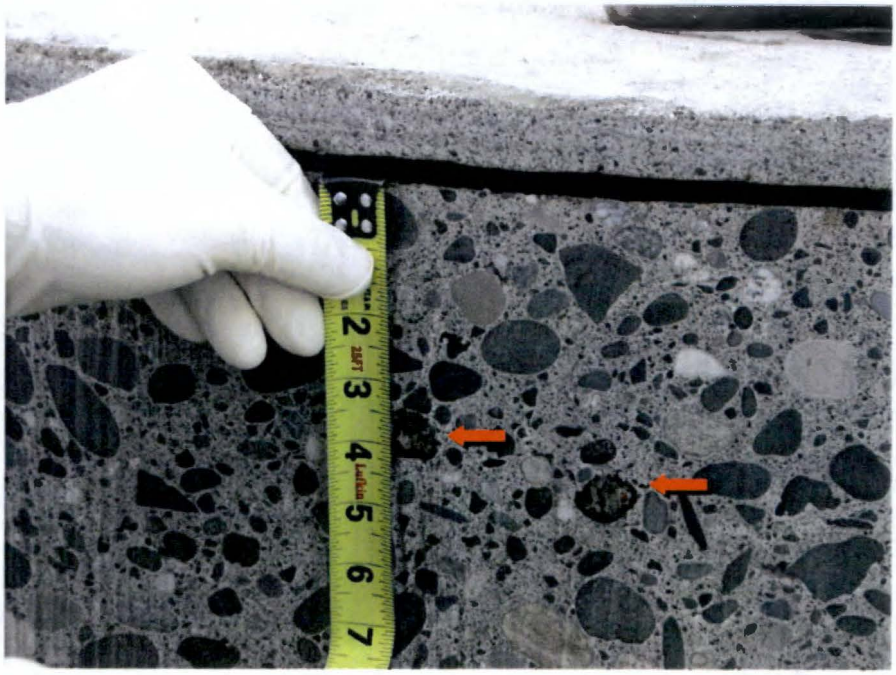


Figure 2-12 shows the top and bottom measurement of the 'Plug' East side taken at location II from Figure 2-9. The measured distance between the top and bottom layers of rebar is about 7-inches. The concrete cover provided to the bottom layer is estimated to be about 3-inches. This measurement was not made in the field as the inspecting engineers were not permitted to contact the bottom edge of the 'Plug'.

Figure 2-12. Plug East Side Top and Bottom Rebar At Location II

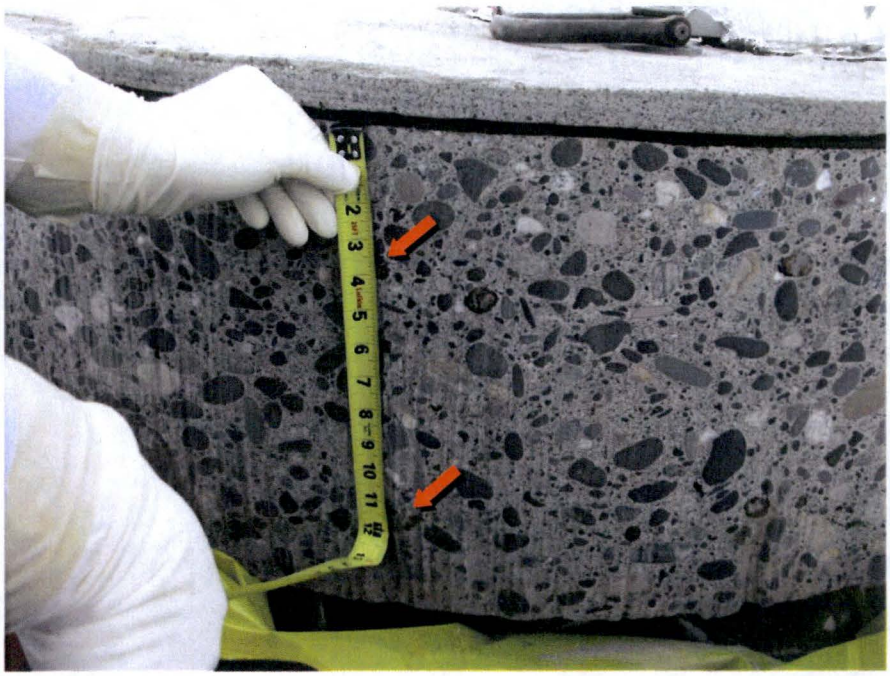


Figure 2-13 shows the measurement of the 'Plug' West side. The concrete cover measured for the top layer of rebar located at Location I is about 3.625-inches. The measured distance between the top and bottom layers of rebar is about 7.5-inches. The concrete cover provided to the bottom layer is estimated to be between 2.5-inches and 3-inches.

Figure 2-13. Plug West Side Rebar Measured At Location I

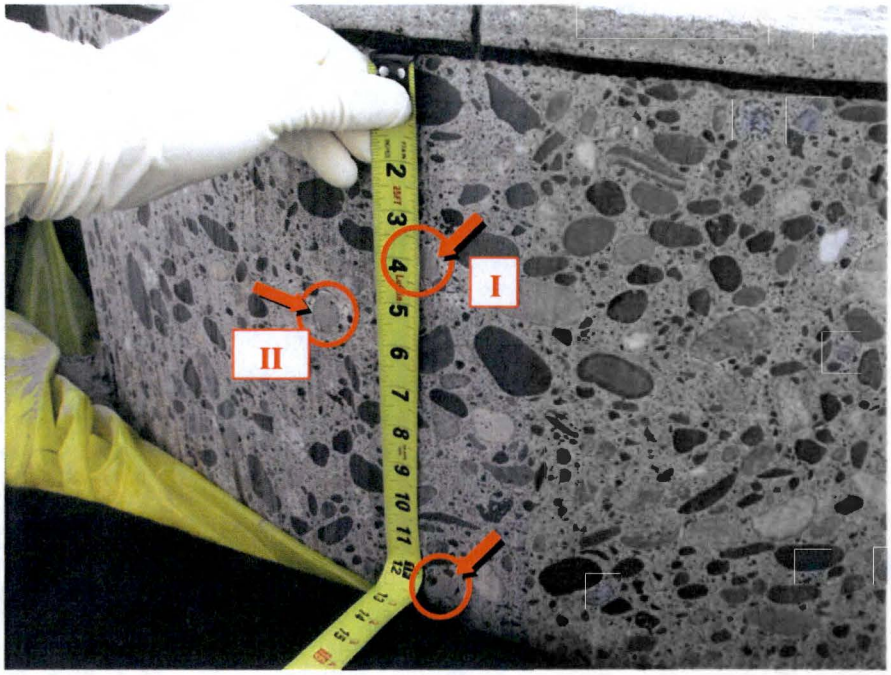
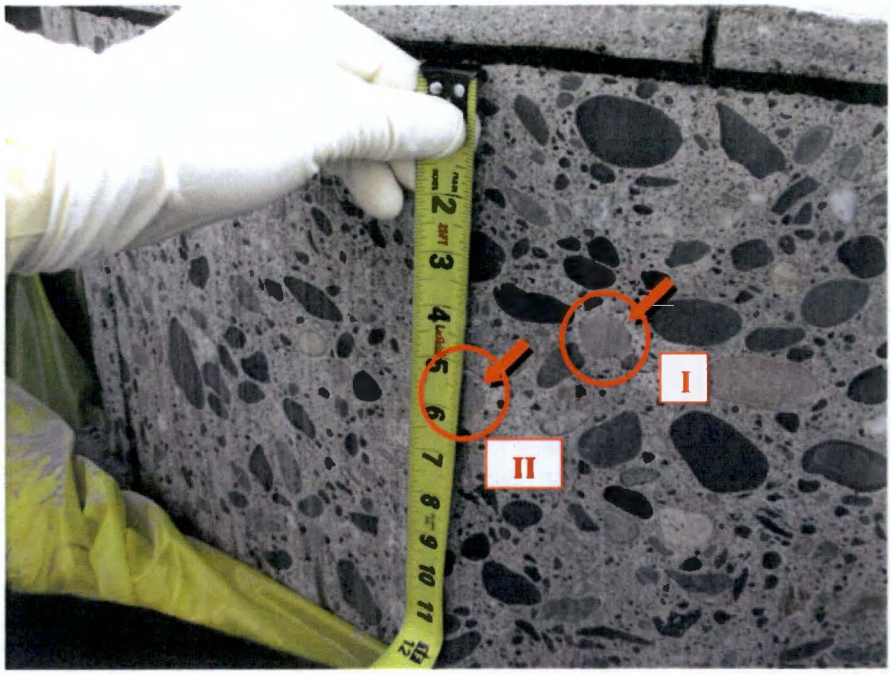


Figure 2-14 shows the measurement of the 'Plug' West side taken at location II from Figure 2-13. The concrete cover measured for the layer of rebar located at Location II is about 5.25-inches. It is unknown the exact nature of this seemingly intermediate rebar.

Figure 2-14. Plug West Side Rebar Measured At Location II



A view of the South side is shown in Figure 2-15. Red arrows point to top and bottom layers of rebar.

Figure 2-15 Plug South Side

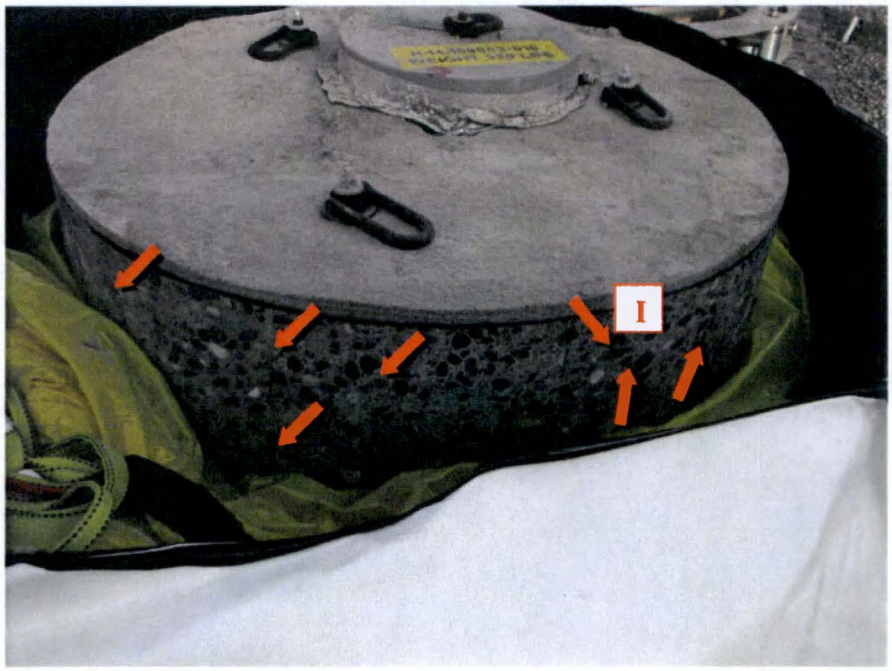
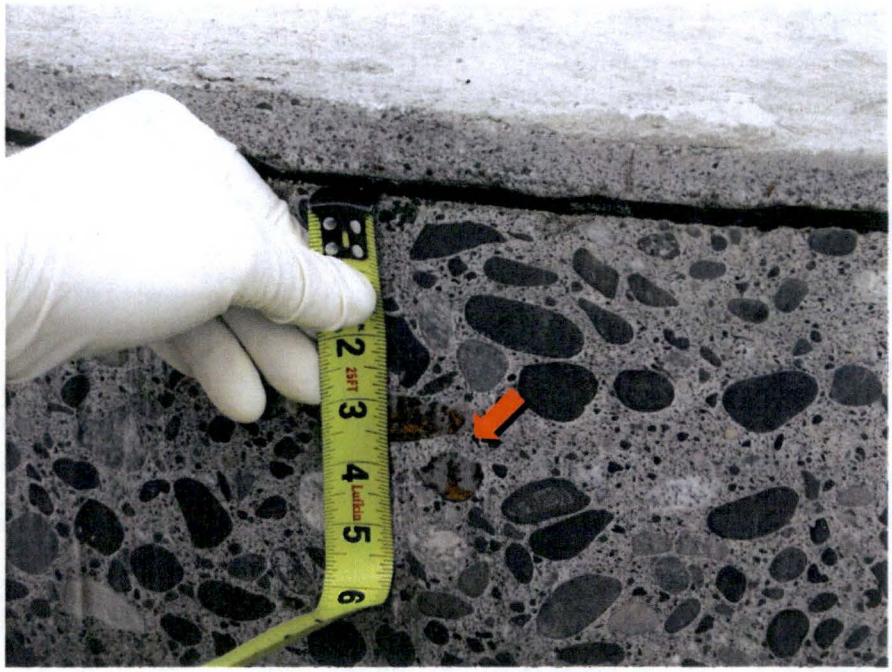


Figure 2-16 shows the measurement of the 'Plug' South side taken at location I from Figure 2-15. The measured concrete cover is 2.75-inches at this location.

Figure 2-16. Plug South Side Top Rebar At Location I



The pilot hole drilled to initiate the 'Plug' cutting from the dome 241-C-107 is shown in Figure 2-17. In reference to the descriptions of the section views of the 'Plug', the pilot hole is located between the North and West sides.

Figure 2-17. Plug Cut Pilot Hole

A view of the North side of the 'Plug' is shown in Figure 2-18. What appears to be an intermediate rebar is located at Location II.

Figure 2-18. Plug North Side

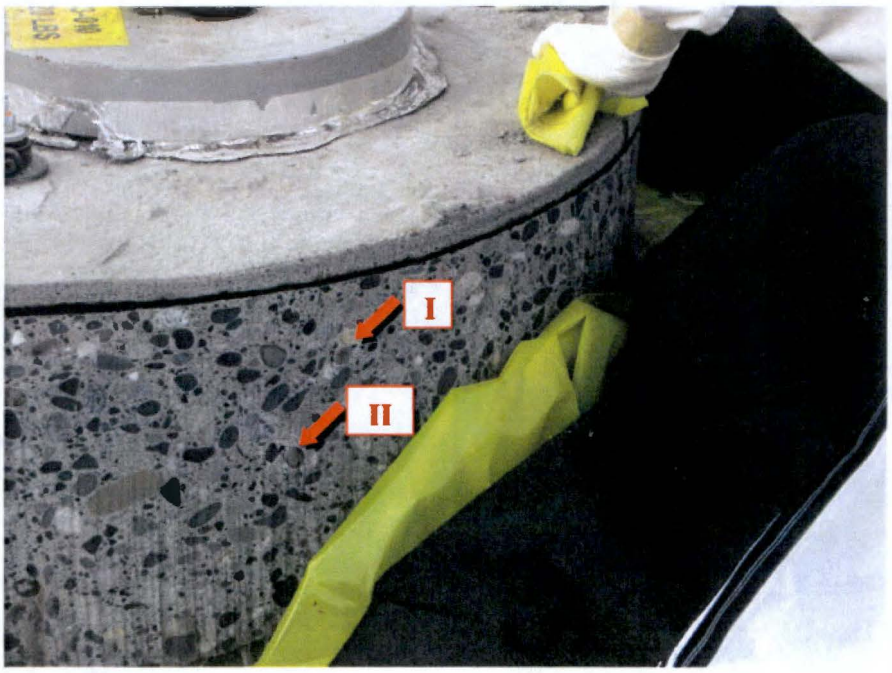
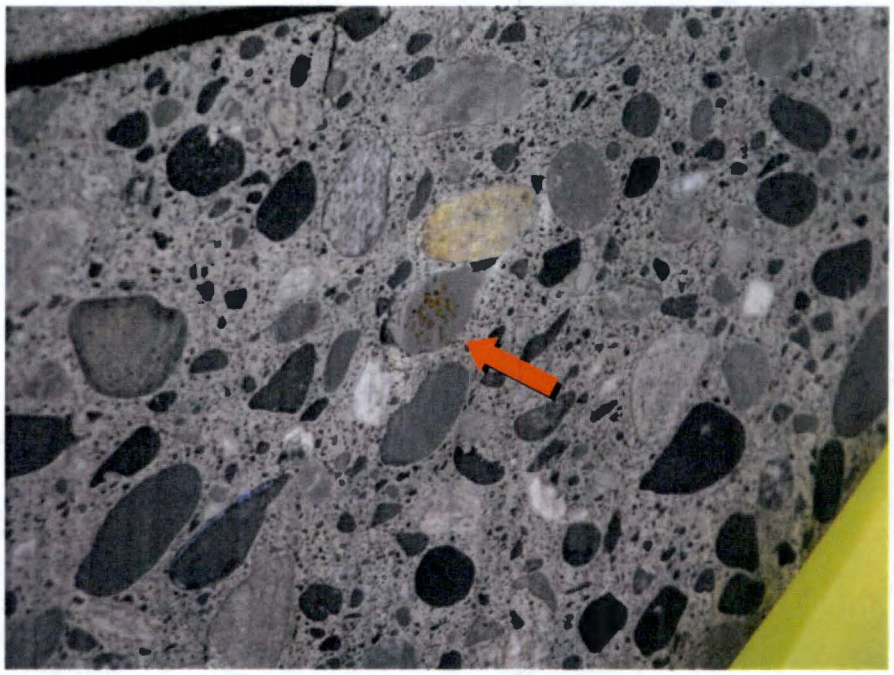


Figure 2-19 shows a close-up of the 'Plug' North side taken at location I from Figure 2-18. The concrete cover is estimated to be about 3-inches at this location.

Figure 2-19. Plug North Side Rebar At Location I

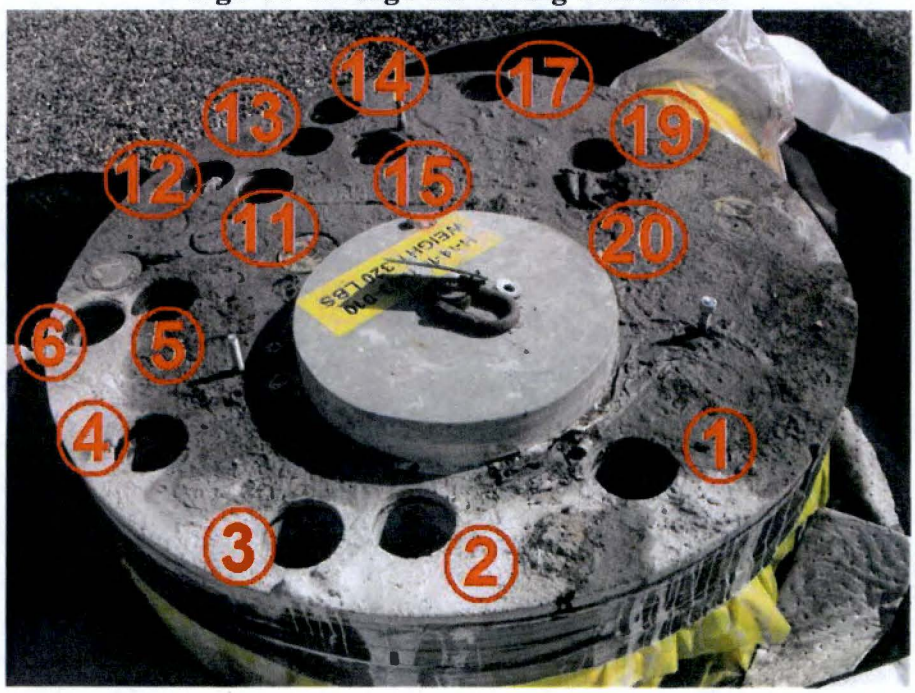


3.0 CONCRETE CORE REMOVAL

A-Core Inc. was the contractor chosen to perform the concrete coring activities. The available barrel sizes were nominally 3.75-inch and 4.25-inch diameters. The chosen diameter for the cores was the 4.25-inch barrel. A-Core was given direction to obtain 22 cores per a provided sketch based on rebar location from the GPR scan and 4.25-inch diameter cores. A physical layout of the proposed cores is shown in Figure 3-1 which matches the sketch provided to A-Core. The concrete cores were removed from the 'Plug' between April 4-5, 2011. Of the 22 proposed cores, only 14 were successfully removed due to unexpected rebar interference. A post-coring layout of the 'Plug' with the identification numbers of the 14 removed cores is shown in Figure 3-2. Selection of the sites for the cores was based on the need to avoid reinforcement bar and to collect as many cores as possible. As stated in RPP-PLAN-48753, at least, eight cores were necessary to satisfy the statistical requirements to obtain a ninety-five percent confidence level in the physical property values measured.

Figure 3-1. Plug Pre-Coring with Labels

Figure 3-2. Plug Post-Coring with Labels



The following list highlights the order of activities performed to successfully remove the concrete cores from the 'Plug':

- Anchor coring machine to Plug over the proposed core location
- Engage the motor for the coring machine
- Core drill the Plug at that location for an approximate 11-inch depth
- Remove concrete core

Figure 3-3 shows the concrete coring drill performing the coring at the location of Core #1. The mortar layer of the concrete section typically broke free first. It was removed from the core barrel to avoid potential damage to the concrete, mortar, and equipment. Figure 3-4 and 3-5 show the hole at Core #1 location after removal of the mortar layer (disc). A photo of the mortar disk for Core #2 is shown in Figure 3-8.

Figure 3-3. Coring Machine Mounted on Plug

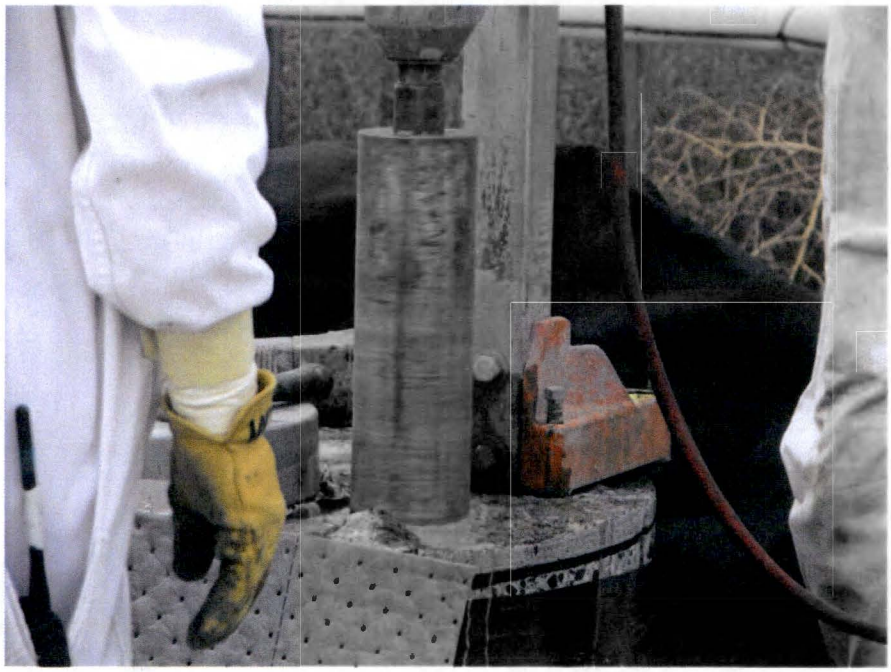


Figure 3-4. Coring Core 1 Asphalt Exposed

Figure 3-5. Coring Exposed Core 1 Asphalt Close-up

After the removal of the first core, it was set aside for proper handling, inspection, measurement, and radiation surveying. Figure 3-6 shows the coring machine at the location for Core #2. The hole for Core #1 is visible to the right. Cores were removed after the desired depth was reached. This removal was accomplished using a specialty core removing tool. The removal of Core #2 is shown in Figure 3-7.

Figure 3-6. Core Machine Mounted at Core #2 Location

Figure 3-7. Removal of Core #2 from Plug

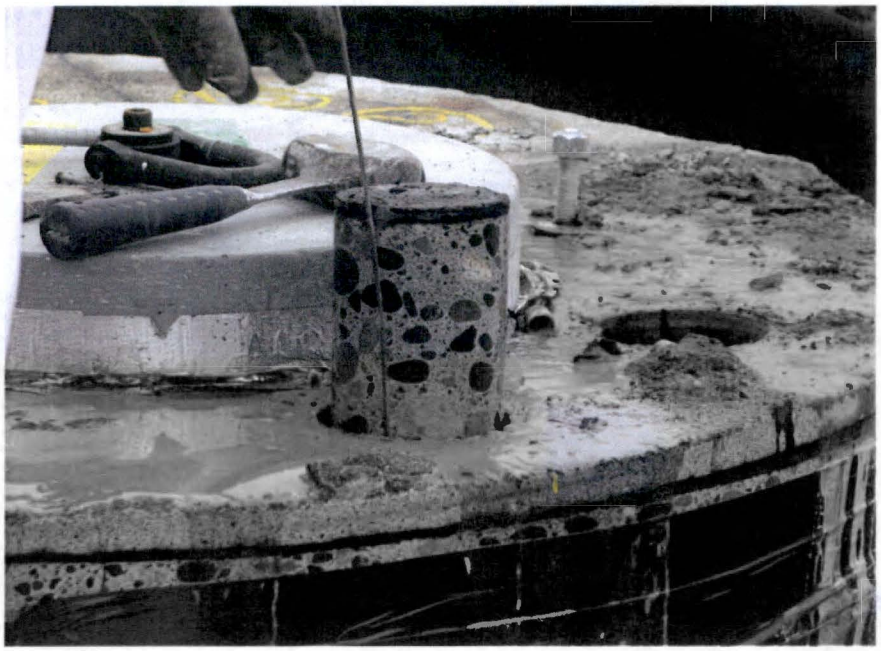
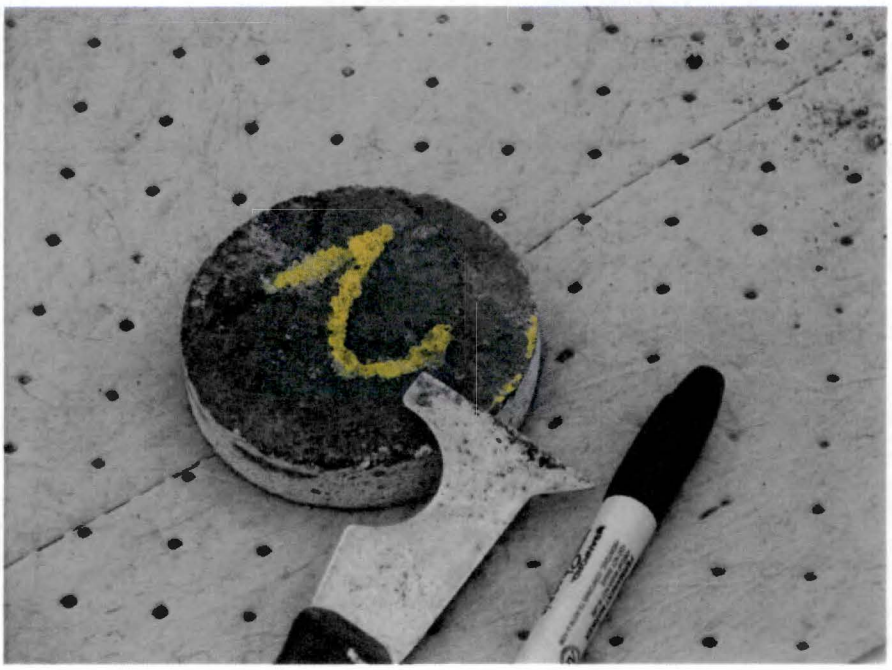


Figure 3-8. Core #2 Mortar



The following steps were taken once the concrete cores were removed from the 'Plug':

- The asphalt membrane was scraped free from the concrete core
- Core and associated mortar disc were set aside to allow surface drying (Figure 3-9 and 3-11)
- Asphaltic membrane was scraped off (Figure 3-10)
- The core was labeled with C107-#N, where N is the core number as it correlates to the template in Figure 3-1. The core was also labeled with the date XX-XX-XXXX when the core was removed. (Figure 3-12)
- A radiological survey of the core was performed (Figure 3-13).

Radiological survey results taken in the field are provided in Appendix K. Dimensions for each core as removed from the 'Plug' are displayed in Table 5-1.

Figure 3-9. Core #2 Drying I

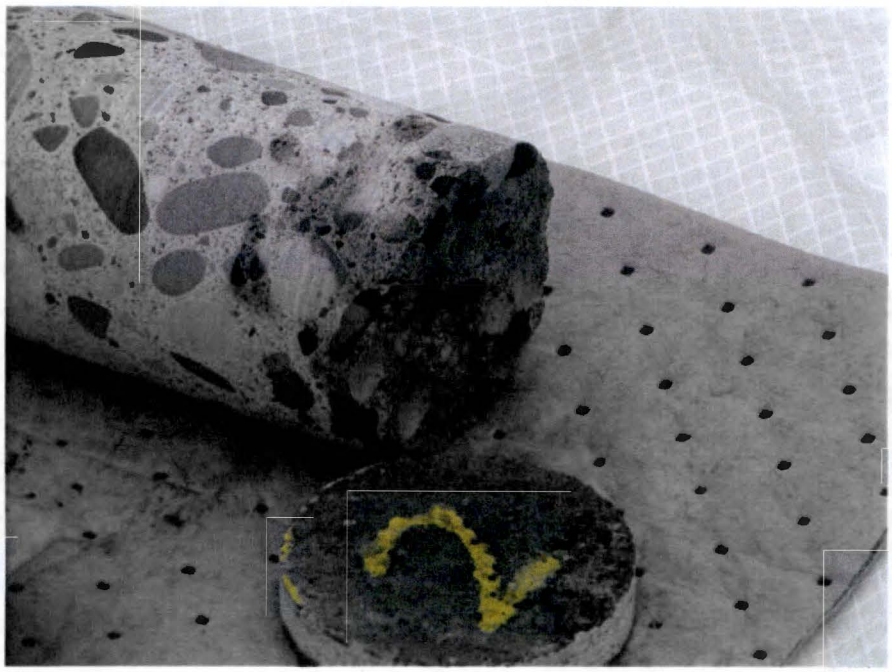


Figure 3-10. Removing Asphaltic Membrane from Core #2

Figure 3-11. Core #2 Drying II

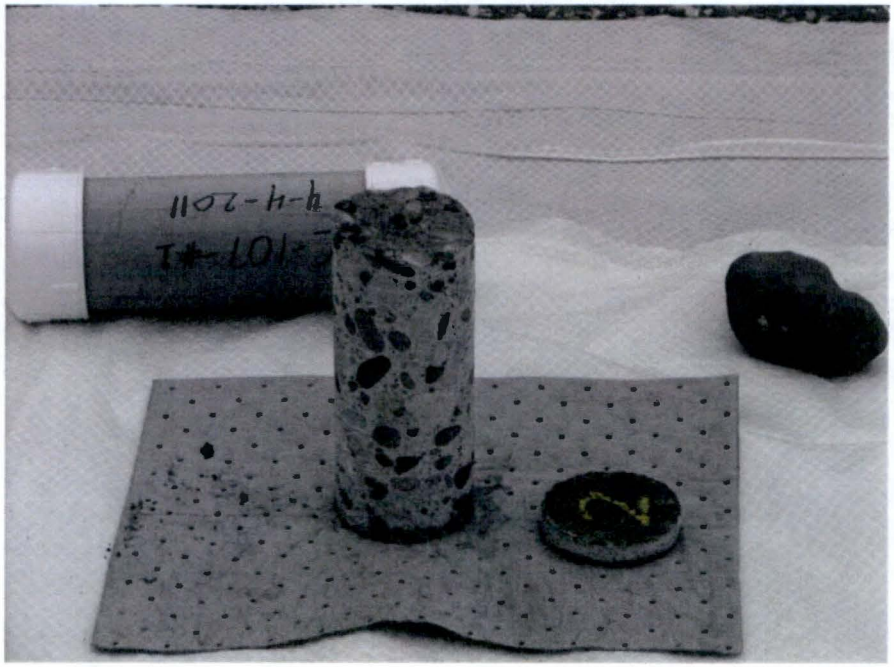


Figure 3-12. Core #2 Field Labeling

Figure 3-13. Core #2 Field Radiation Survey

3.1 Core Packaging

Once the cores have been taken, it was important to prevent the cores from drying out, which could change the physical properties. This work has been conducted under ASTM C42, which states the following concerning sample moisture condition:

> *7.3 Moisture Conditioning – test cores after moisture conditioning as specified in this test method or as directed by the specifier of the tests. The moisture conditioning procedures specified in this test method are intended to preserve the moisture of the drilled core and to provide a reproducible moisture condition that minimizes the effects of moisture gradients introduced by wetting during drilling and specimen preparation.*

The core samples were packaged in PVC tubes with PVC end caps, hereafter referred to as coffins. Ready to use PVC end caps are shown in Figure 3-14 and PVC tubes are shown in Figure 3-15. The coffins were sized so the cores fit snugly with little to no room to move around. The PVC end caps created a tight seal so that the moisture content was preserved within the coffin until analysis could occur. Photographs of the packaged Core #1 and Core #2 are shown in Figures 3-16 thru 3-18.

Figure 3-14. Core Packaging Caps

Figure 3-15. Core Packaging Tubes

Figure 3-16. Packaged Core #1

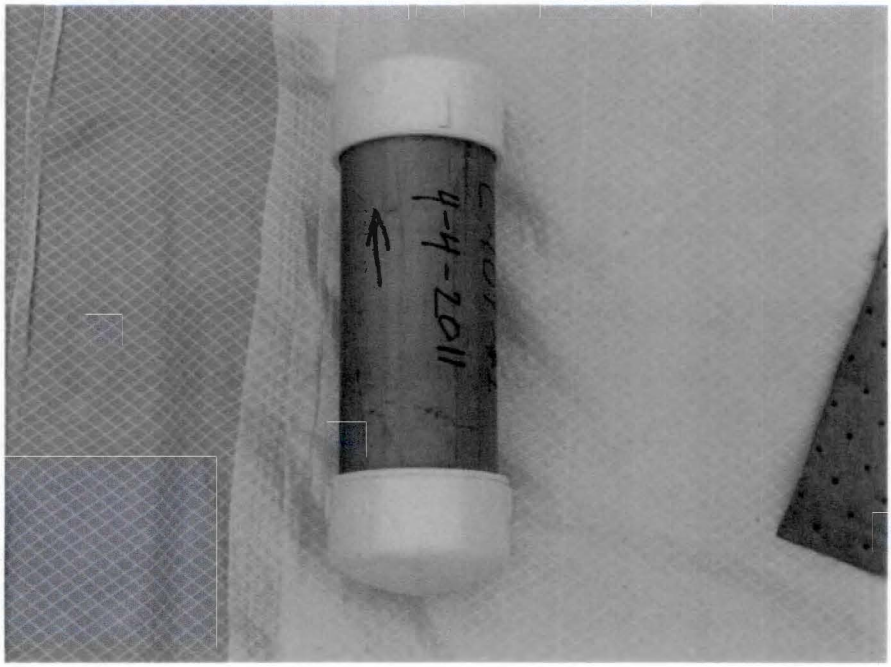


Figure 3-17. Packaging Core # 2

Figure 3-18. Packaged Core #1 and Core #2

3.2 Concrete Core Shipping

The cores were packaged and shipped in accordance with WRPS shipping procedures and practices.

The core samples were expected to have no detectable dose rate and no detectable surface contamination. Due to the inability to survey interior surfaces of the concrete core, free release of the cores was not permitted. Therefore a laboratory with radioactive material handling capabilities was identified. However, measurement in the field of all the cores exhibited a dose rate of less than the minimum detectable dose rate (< 0.5mrem/hr) and therefore, the shipping method chosen was a Type A Low Level Waste package.

The coffins were packaged for shipping using a standard 55 gallon drum as the container with interior packing to restrict movement. A view of the packing material and core coffins inside the shipping container is shown in Figure 3-19. The sealed shipping container is shown in Figure 3-20. The radioactive material warning tag is shown, signifying the fact that the cores could not be free released.

Figure 3-19. Cores in Shipping Container

Figure 3-20. Shipping Container

4.0 CTL GROUP SELECTION

Prior to removal of the cores from the 'Plug', a testing laboratory needed to be identified. Market surveys had been performed for an associated structural integrity task, SST sidewall coring. The results revealed that the well-known CTL Group was capable of handling potentially radioactive concrete and perform all the required physical testing and Petrographic examination of the concrete cores. CTL Group is associated with a separate company Radiation Safety Services Inc. (RSSI) that is capable of performing detailed radionuclide surveys.

Technical staff from CTL Group and WRPS agreed that the cores would be shipped to RSSI and surveyed for contamination. If the cores were below minimum detectable activity levels and safe for handling, the cores would be shipped from RSSI to CTL Group and testing would be performed there. If the cores did not meet the safe levels, testing equipment at RSSI would have to be used by the properly trained technicians from CTL Group. Results from RSSI radionuclide survey are contained in Appendix B. The C-107 concrete cores exhibited safe radionuclide levels.

A proposal for testing was submitted to WRPS by CTL Group. A copy of the CTL Group proposal is shown in Appendix A. WRPS technical staff provided WRPS procurement with non-competitive procurement justification to perform the testing of the C-107 cores. Additional requirements of accreditation to satisfy ISO 17025 were identified and met by CTL Group. Review of CTL Group capabilities for handling and testing of potentially contaminated concrete allowed the contract to be released. A copy of CTL Group accreditation is included as Appendix J.

The justification for non-competitive procurement is as follows:

> *CTL Group is the only testing facility identified that can perform the UPV*, Elastic Modulus, Poisson's Ratio, and Compression tests and Petrographic analysis on radioactive samples. CTL Group is internationally recognized as a leader in materials testing and structural forensics investigation. CTL Group is also the same laboratory that performed all the testing of Hanford tank concrete in the late 1970s and early 1980s. The testing results from CTL are the basis for concrete properties used in the structural analysis of Hanford Single-Shell Tanks. CTL Group is accredited by the International Accreditation Service for ANS/ISO/IEC 17025 and by American Association of State Highway Transportation Officials (AASHTO). Accreditation by AASHTO has also received verification by the U.S. Army Corps of Engineers. CTL Group is very qualified to perform this highly sensitive testing of Hanford Single-Shell Tank Concrete.*

*Ultrasonic Pulse Velocity testing was not performed. An alternate test for Transverse Natural Frequency was chosen in accordance with RPP-PLAN-48753.

5.0 CONCRETE CORE INSPECTION AND PREPARATION

Fourteen cores were shipped to and received by CTL Group. A Logbook provided in Appendix F lists the dates of receipt, inspection, preparation, and testing of the C-107 concrete cores. Prior to mechanics testing, the following actions were taken to perform concrete core inspection:

- Measure diameter and length
- Measure any cracks
- Measure any voids
- Photograph the core, cracks, voids, rebar (if any), aggregate

Detailed results of the initial inspection of the C-107 concrete cores are provided in Appendix B. The cores were reported to be in generally good condition. Due to their short length, Core # 4 and Core #14 would undergo Petrographic examination only. The twelve remaining cores would undergo all the physical testing, but not the petrography. Table 5-1 lists the dimensions and weights of the concrete cores as received at CTL Group.

Table 5-1. As Received Core Dimension and Weight

Core Number	Diameter (in)*	Length (in)	Weight (lbf)
C-107#1	4.25	9.25	11.8
C-107#2	4.25	10.00	12.3
C-107#3	4.25	10.00	12.1
C-107#4	4.25	7.75	9.2
C-107#5	4.25	10.00	12.4
C-107#6	4.25	10.00	12.6
C-107#11	4.25	10.00	12.3
C-107#12	4.25	10.00	12.6
C-107#13	4.25	10.00	12.7
C-107#14	4.25	7.50	9.8
C-107#15	4.25	10.00	11.8
C-107#17	4.25	10.00	12.3
C-107#19	4.25	10.00	12.0
C-107#20	4.25	10.00	12.6

*The CTL Group reports contained within the Appendices of this report indicate 4 ¼-inches and 4.2-inches as the diameter of the cores. The diameter for the cores is about 4 ¼-inches as indicated from the inside diameter of the core barrel drill bit. The diameters of the C-107 cores were not modified during the physical testing process.

5.1 Concrete Core Handling

The moisture of the concrete cores was maintained in the coffins from Hanford to RSSI and from RSSI to CTL Group. After the cores were measured and inspected, they were placed in the re-sealable bags to maintain moisture. The cores were removed only for preparation and testing. A view of the cores in the moisture maintaining bags is shown in Figure 5-1.

Figure 5-1. Sawn Cores in Moisture Maintaining Bags

5.2 Concrete Core Preparation

After the initial inspection, the cores were trimmed so that the ends of the cylinder were flush and the length was nearly two times the diameter. The final sawn (trimmed) length of the cores is 8.2-inches. Because the trimming used water, a period of 5 days was allowed to pass so that the moisture of the concrete cores could stabilize. This was performed in accordance with ASTM C42. Once the moisture of the cores was stabilized, the concrete cores were subjected to the first physical testing, transverse natural frequency.

After the transverse frequency test, CTL Group prepared the concrete cores for modulus of elasticity and compression testing, meeting the requirements of ASTM C42. The cores were capped to provide an even flatter end surface and an L/D ratio closer to 2.0. Capping of the concrete cores was performed in accordance with ASTM C617. The end caps also allow for a better test specimen because it helps to reduce crushing of the specimen ends. Figure 5-2 shows the capping of one of the C-107 concrete cores. The capped length as shown in Table 5-2 was

used to determine the L/D (length/diameter) ratio for the C-107 cores. The following information is excerpted from ASTM C42:

Cores for Compressive Strength:

7.1 Diameter—The diameter of core specimens for the determination of compressive strength in load bearing structural members shall be at least 3.70 in. [94 mm]... For non-load bearing structural members or when it is impossible to obtain cores with length-diameter radio (L/D) greater than or equal to 1, core diameters less than 3.70 in. [94 mm] are not prohibited (see Note 3). For concrete with nominal maximum aggregate size greater than or equal to 1 1/2 in. [37.5 mm], the core diameters shall be as directed by the specifier of the tests (see Note 4).

NOTE 3—The compressive strength of nominal 2-in. [50-mm] diameter cores are known to be somewhat lower and more variable than those of nominal 4-in. [10-mm] diameter cores. In addition, smaller diameter cores appear to be more sensitive to the effect of the length-diameter ratio.

NOTE 4—The preferred minimum core diameter is three times the nominal maximum size of the coarse aggregate, but it should be at least two times the nominal maximum size of the coarse aggregate.

And,

7.2 Length—The preferred length of the capped or ground specimen is between 1.9 and 2.1 times the diameter. If the ratio of the length to the diameter (L/D) of the core exceeds 2.1, reduce the length of the core so that the ratio of the capped or ground specimen is between 1.9 and 2.1. Core specimens with length-diameter ratios equal to or less than 1.75 require corrections to the measured compressive strength [as identified in Section 7.9.1 of this standard]. A strength correction factor is not required for L/D greater than 1.75. A core having a maximum length of less than 95% of its diameter before capping or a length less than its diameter after capping or end grinding shall not be tested.

Figure 5-2. C-107 Core Capping

Table 5-2. Capped Core Dimensions

Core Number	Capped Length (in)	Diameter (in)	Capped Length / Diameter Ratio
C-107#1	8.4	4.2	2.00
C-107#2	8.5	4.2	2.02
C-107#3	8.4	4.2	2.00
C-107#5	8.6	4.2	2.04
C-107#6	8.5	4.2	2.02
C-107#11	8.5	4.2	2.01
C-107#12	8.6	4.2	2.04
C-107#13	8.6	4.2	2.04
C-107#15	8.5	4.2	2.01
C-107#17	8.5	4.2	2.03
C-107#19	8.6	4.2	2.03
C-107#20	8.4	4.2	2.00

6.0 CONCRETE CORE PHYSICAL TESTING

The C-107 cores were subject to non-destructive and destructive physical testing. The integrity of the cores was maintained throughout the testing. Cores were kept in the moisture bags between tests and after capping. In chronological order, the following tests were performed on the C-107 Cores:

- Transverse Natural Frequency (ASTM C215)
- Modulus of Elasticity and
- Poisson's Ratio (ASTM C469)
- Compressive Strength (ASTM C39)

The transverse natural frequency test employed DK5000 computer software to perform Wave transform functions. The DK5000 verification and validation is provided for information in Appendix I. The modulus of elasticity, Poisson's ratio, and compressive strength tests were conducted using a 400,000-lbf capacity Baldwin testing machine (load frame). Documentation of the Baldwin test machine calibration is provided in Appendix H. The CTL Group report documenting the results from the physical testing of the C-107 cores is located in Appendix C. The following subsections provide summaries of results of the C-107 concrete cores physical testing.

6.1 Concrete Transverse Frequency

The transverse frequency of the concrete cores was determined using ASTM C215, *Standard Test Method for Fundamental Transverse, Longitudinal, and Torsional Frequencies of Concrete Specimens*. This test method covers measurement of the fundamental transverse, longitudinal, and torsional resonant frequencies of concrete prisms and cylinders. Due to the exact size and dimensions of the C-107 cores, only the Transverse frequency reading was able to be achieved with consistent and reliable results. This transverse frequency test method allows two alternative procedures to achieve the results: the forced resonance method or the impact resonance method. CTL Group is accredited for, and familiar with, the impact resonance method and therefore this procedure was used. Figure 6-1 shows the setup used to perform the transverse frequency test. Once impacted, the accelerometer recorded the accelerations of the concrete core. Fast Fourier transform method was used to transform the acceleration waveform into a frequency waveform. Three reliable results were used to calculate the average result published. The complete results of the transverse frequency testing are provided in Appendix C. The results are summarized in Table 6-1.

Figure 6-1. C-107 Core Transverse Frequency Test Setup

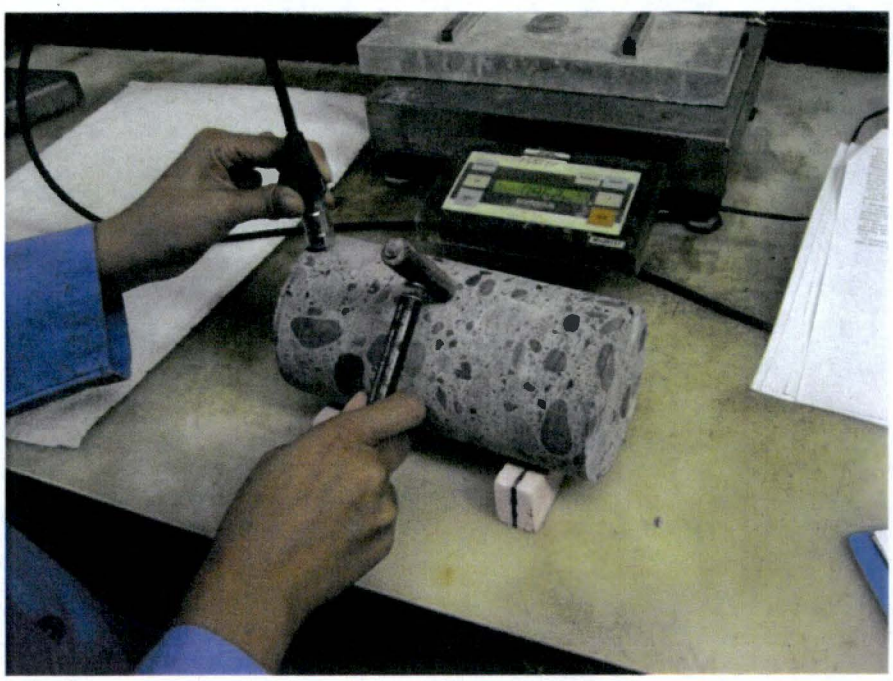


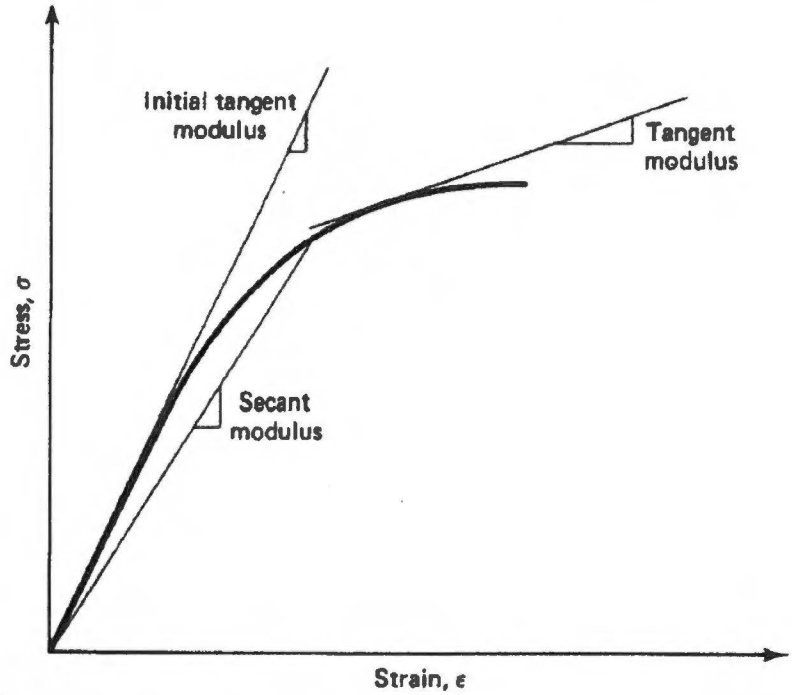
Table 6-1. Core Average Transverse Frequency

Core Number	Average Transverse Frequency (Hz)	Dynamic Modulus (ksi)
C-107#1	6493	6700
C-107#2	6527	6900
C-107#3	6480	6800
C-107#5	6447	6700
C-107#6	6443	6900
C-107#11	6253	6300
C-107#12	6373	6500
C-107#13	6313	6400
C-107#15	6343	6600
C-107#17	6480	6700
C-107#19	6320	6400
C-107#20	6393	6600

The primary purpose of the non-destructive testing for transverse natural frequency is to provide an additional indicator of the performance of the C-107 concrete cores. The transverse frequency result may also be used for comparison to other concrete cores removed from Hanford SSTs. The dynamic modulus of elasticity of the concrete cores is calculated based on the average natural frequency for each of the C-107 cores subject to physical testing. The resulting dynamic modulus provides an indication of strength when compared to the static modulus of

elasticity. In general, the dynamic modulus will be greater than the static modulus. The dynamic modulus of elasticity is often referred to as the initial tangent modulus, whereas the static modulus of elasticity is referred to as the secant (chord) modulus. Figure 6-2 demonstrates the difference between the two. The results of the dynamic modulus are compared to the static modulus in Section 10 of this report.

Figure 6-2. Modulus of Elasticity Comparison



6.2 Concrete Elastic Modulus and Poisson's Ratio

Modulus of elasticity and Poisson's ratio of the C-107 cores were determined using ASTM C 469, *Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression.* This test method covers determination of (1) chord modulus of elasticity (Young's), and (2) Poisson's ratio of molded concrete cylinders and diamond-drilled concrete cores when under longitudinal compressive stress. The core is placed in the compressometer frame that holds the strain dials which record the longitudinal and transverse strains at an assigned load interval. Figure 6-3 shows a C-107 concrete core in the compressometer undergoing the elastic modulus and Poisson's ratio testing. The core in the compressometer was placed in the test frame and subjected to compressive force in the axial (longitudinal) direction. The applied force is recorded along with the associated deformations in the longitudinal and transverse directions. The resulting stresses and strains are plotted and the modulus of elasticity and Poisson's ratio are calculated. The results are summarized in Table 6-2. Details of the Elastic Modulus and Poisson's ratio testing are provided in Appendix C.

Figure 6-3. C-107 Core in Compressometer

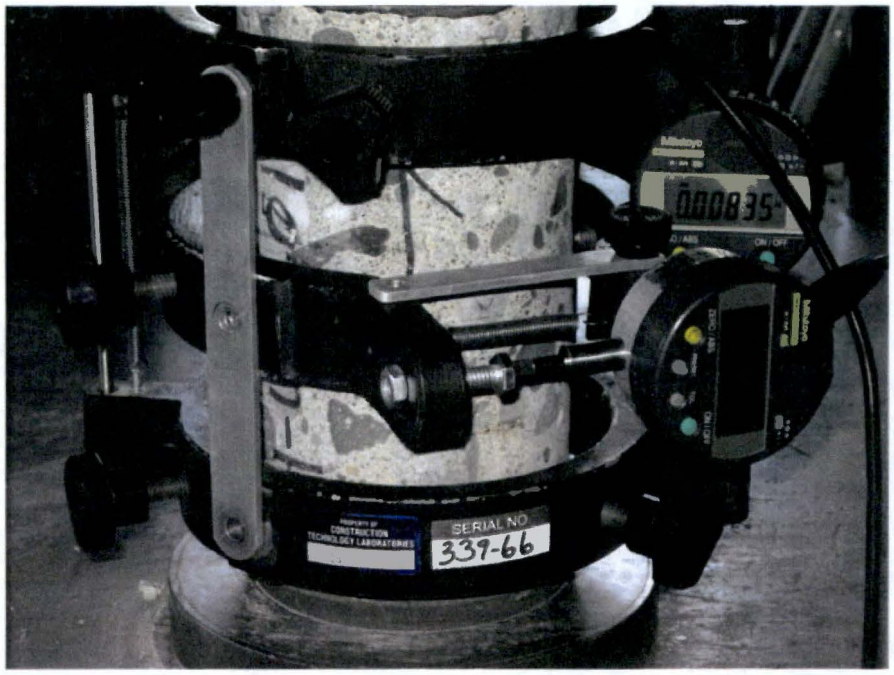


Table 6-2. Core Elastic Modulus and Poisson's Ratio

Core Number	Poisson Ratio	Elastic Modulus (ksi)
C-107#1	0.20	5900
C-107#2	0.23	6500
C-107#3	0.24	6000
C-107#5	0.24	5950
C-107#6	0.23	6000
C-107#11	0.23	5850
C-107#12	0.21	5800
C-107#13	0.23	5750
C-107#15	0.23	5900
C-107#17	0.19	6100
C-107#19	0.20	5550
C-107#20	0.20	5950

6.3 Concrete Compression Test

Compressive strength of the C-107 cores was determined using ASTM C39, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens*. This test method provides standardized procedures for the determination of compressive strength of cylindrical concrete specimens such as molded cylinders and drilled cores. The details of the compressive strength testing are provided in Appendix C. The CTL Group report documents the types of fractures that occurred with the failure of each core. Photographs of the fractured cores are provided in Appendix D. The C-107 concrete core compression test results are summarized in Table 6-3.

Table 6-3. Core Compressive Strength

Core Number	Compressive Strength (psi)
C-107#1	9890
C-107#2	9670
C-107#3	9290
C-107#5	8530
C-107#6	9030
C-107#11	6810
C-107#12	5890
C-107#13	6800
C-107#15	7530
C-107#17	7800
C-107#19	6840
C-107#20	8850

The highest reported compressive strength is 9890 psi for C-107 #1. The lowest reported compressive strength is 5890 psi for C-107 #12. Inspection of the fractured C-107 # 12 core revealed a cluster of large aggregate in the center of the cylindrical core. Figure 6-4 shows the cluster divided into the two main fractured sections of the core. Three large aggregates were located in the center of the core. The large aggregates in the cluster were very close together, nearly in contact on some tangential surfaces. There is insufficient spacing between the aggregate in the cluster and therefore reduced hydrated cement to provide bond. The cluster of large aggregate is likely the cause of the low reported strength of core C-107 # 12. Figure 6-5 shows the fractured C-107 #12 core sections held in space to further detail the aggregate cluster.

Figure 6-4. Core #12 Aggregate Cluster

C-107 Core # 12 Aggregate Cluster Part A

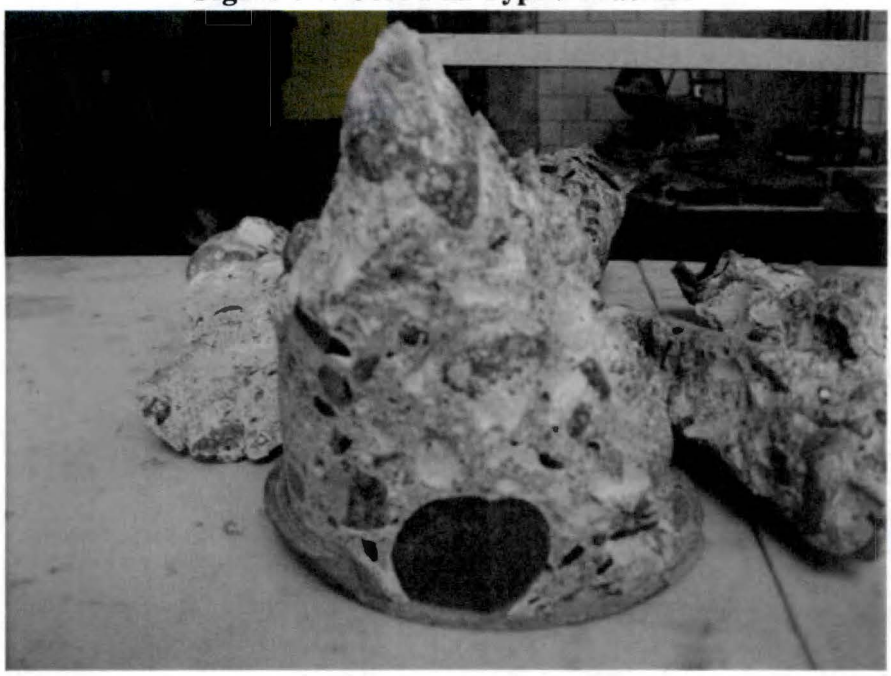
C-107 Core # 12 Aggregate Cluster Part B

Figure 6-5. Core # 12 Combined Aggregate Cluster

The length of a single large aggregate in core C-107 #11 was about 1.75-inches, as shown in Figure 6-6. Although this is greater than the design 1.5-inches coarse aggregate size as specified in the original tank construction documents, it is acceptable because the 1.5-inches is a nominal value and the majority of the observed aggregate is less than this. For the Type I fracture of the C-107 #11 core shown in Figure 6-7, the single large aggregate is located near the center of the core and the fracture appears to propagate from this location.

Figure 6-6. Core # 11 Large Aggregate

Figure 6-7. Core # 11 Type 1 Fracture



7.0 PETROGRAPHIC ANALYSIS OF CONCRETE CORES

Petrographic analysis was performed to ASTM C856, *Standard Practice for Petrographic Examination of Hardened Concrete*. The petrography examination assessed the quality and condition of the concrete and the extent of any deterioration or deleterious reactions occurring within the concrete. Two of the fourteen cores were chosen for petrographic examination. The cores were received by the petrographer and prepared for examination. The cores were visually inspected and photographed as received. Each core was then cut in half longitudinally and one of the resulting halves was ground (lapped) to produce a smooth, flat, semi-polished surface as shown in Figure 7-1. Lapped and freshly broken surfaces of the concrete were examined using a stereomicroscope at magnifications up to 45X. For thin-section study, a small rectangular block was cut from the top surface portion of each core, and one side of each block was lapped to produce a smooth, flat surface. The blocks were cleaned and dried, and the prepared surfaces were mounted on separate ground glass microscope slides with epoxy resin. After the epoxy hardened, the thickness of the mounted blocks was reduced to approximately 20μm (0.0008 in.). The resulting thin sections were examined using a polarized-light (petrographic) microscope at magnifications up to 400X to study aggregate and paste mineralogy and microstructure as shown in Figure 7-2. The full petrographic report is contained in Appendix E.

Figure 7-1. Example of Lapped Concrete Halve (Core #4)

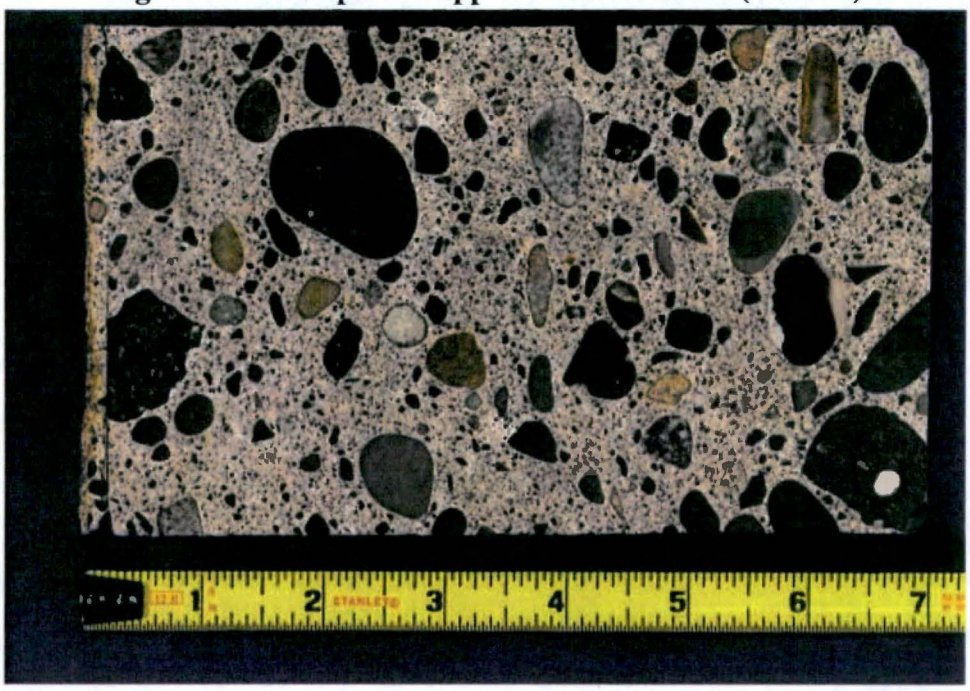
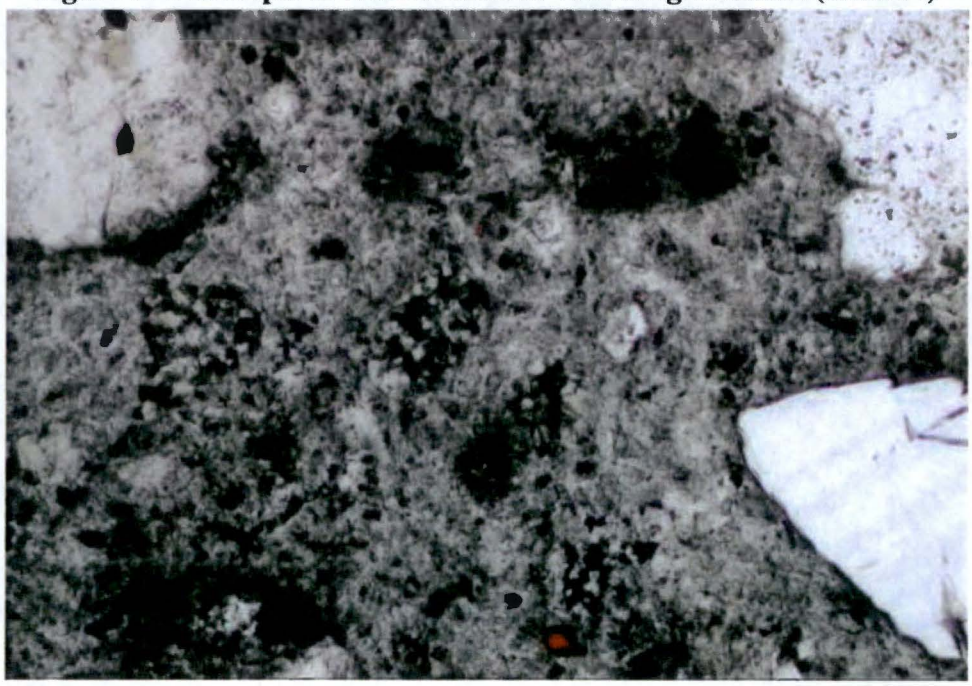


Figure 7-2. Example of Thin Section at 400x Magnification (Core #4)



Based on the results of petrographic examination, the concrete represented by the cores is in good condition. No distress (cracking or excessive microcracking) is observed in either core. The concrete does not show any evidence of chemical attack, significant alkali-aggregate reactions, or other deleterious mechanisms involving aggregates and/or paste constituents. The concrete in both cores exhibits good physical paste properties. Apart from localized softer paste at the immediate top surface, the paste in the cores is hard and dense through the depth of the concrete. Distribution of aggregates and other paste constituents is uniform. Macroscopically, the cores are well consolidated (no large voids). The cement is nearly completely hydrated. The depth of carbonation from the top surface of both cores is reported to be 0.04 to 0.08 inch (1 to 2 mm). The complete CTL Group report with detailed information is provided in Appendix E.

8.0 REBAR INSPECTION AND TESTING

The method for removing the rebar from the C-107 'Plug' has not yet been identified. The removal of the rebar will be a Phase II activity. As allowed by selected removal methodology, the concrete-rebar interface will be inspected for de-bonding and voids around the rebar. Once removed, the diameter of the rebar will be measured and photographs taken. The rebar will be inspected for rust and scaling. Any cracks or elongated sections will be measured. The testing of the rebar will be limited to tensile testing. The specimen will be prepared and tested in accordance with Annex A9 of ASTM A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products.* Figures 8-1 and 8-2 show the appropriate testing machine grips that will be used to perform tensile testing of the rebar.

Figure 8-1. Rebar Tensile Test Grip, View I

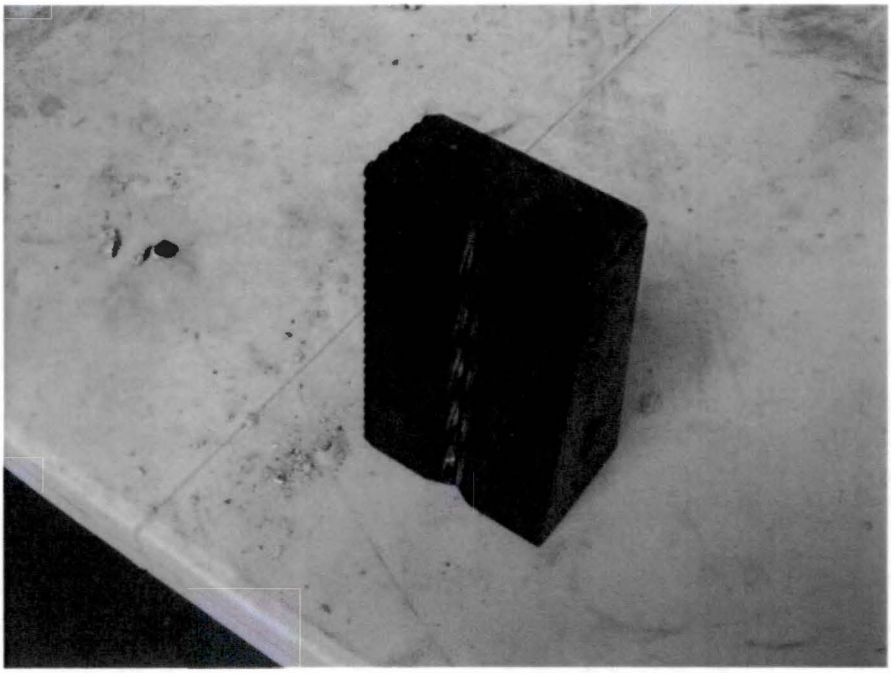


Figure 8-2. Rebar Tensile Test Grip, View II

9.0 QUALITY, CUSTODY, AND MANAGEMENT OF CORES

9.1 Quality Assurance

CTL Group is an accredited testing laboratory, capable and qualified to perform the requested inspection, preparation, physical testing, and petrographic examination of the C-107 concrete cores. CTL Group's ISO 17025 and AASHTO accreditation is located in Appendix J. The Baldwin test machine calibration is located in Appendix H. Verification and validation of the DK-5000 software is located in Appendix I. All of the reports from CTL Group were reviewed by WRPS technical staff prior to acceptance, satisfying the requirement set forth in the contract. Physical testing was also observed by WRPS engineers RS Rast and AE Miller, on location in Skokie, IL.

9.2 Chain of Custody and Material Management

The chain of custody was maintained for the entire lifecycle of the C-107 concrete cores. A copy of the completed chain of custody is provided in Appendix G. CTL Group also provided WRPS with a logbook listing the cores and dates that preparation and testing occurred. The C-107 core logbook is located in Appendix F. The destroyed C-107 cores were returned to the Hanford Site for disposal in October 2011. The remainder of the 'Plug' resides in an area adjacent to C-farm in 200 East area of the Hanford site. To date, the removal and testing of the rebar from the 'Plug' has not been performed.

10.0 DISCUSSION OF RESULTS

The inspection of the concrete 'Plug' reveals that the placement of concrete and rebar generally matches the design drawings. The rebar as measured with a tape is approximately 0.75-inch in diameter. The thickness of the 'Plug' is slightly greater than the 15-inch dome thickness called out in the design drawings. The measured concrete cover typically matches the design drawings, providing protection for the rebar. There are a couple of intermediate rebar located at depths greater than specified in tank drawings. There are no visible cracks or large air voids visible in the cross section of the 'Plug'. Additionally, the protective asphaltic membrane and mortar layers are present and intact.

The cores were shipped to CTL Group for inspection, testing, and petrographic examination. Prior to shipment, the cores were surveyed and all exhibited less than a 0.5 mrem/hr dose rates in the field. Additional surveying for radionuclides was performed offsite at RSSI and revealed that the C-107 cores were safe to handle. At CTL Group, the cores were measured and inspected. The cores were reported to be in good condition with minor air voids and some cracking present in individual aggregates. Twelve of the fourteen cores were subjected to physical testing and the remaining two cores underwent petrographic examination.

A summary of the physical testing results of the C-107 cores is provided in Table 10-1. The values of transverse natural frequency may be used for comparison in the future. The dynamic modulus of elasticity of all the cores is greater than the associated modulus of elasticity. This behavior agrees with the predicted behavior of concrete cores. The compressive strength results are more variable than both the modulus of elasticity and Poisson's ratio of the cores. This is expected as the compressive strength results are more sensitive to the arrangement and location of aggregate. The average compressive strength of all the tested C-107 cores is 8078-psi. This value is 2.7 times the original 28-day design strength specified in the original tank construction.

Table 10-1. C-107 Core Physical Test Results Summary

Core Number	Average Transverse Frequency (Hz)	Dynamic Modulus (ksi)	Elastic Modulus (ksi)	Poisson Ratio	Compressive Strength (psi)
C-107#1	6493	6700	5900	0.20	9890
C-107#2	6527	6900	6500	0.23	9670
C-107#3	6480	6800	6000	0.24	9290
C-107#5	6447	6700	5950	0.24	8530
C-107#6	6443	6900	6000	0.23	9030
C-107#11	6253	6300	5850	0.23	6810
C-107#12	6373	6500	5800	0.21	5890
C-107#13	6313	6400	5750	0.23	6800
C-107#15	6343	6600	5900	0.23	7530
C-107#17	6480	6700	6100	0.19	7800
C-107#19	6320	6400	5550	0.20	6840
C-107#20	6393	6600	5950	0.20	8850

The petrographic examination revealed that the 'Plug' concrete, and likely the tank dome, is in good condition. There are no signs of chemical attack and very limited depth of carbonation from the top surface. This further supports that the protective asphalt and mortar layers are in good condition and have performed satisfactorily. The examination also reveals that the concrete is not subject to any deleterious mechanisms such as excessive micro-cracking. The CTL report states that, overall, the concrete is not in distress. Appendix E provides a detailed description of all the findings and resulting conclusions of the petrographic examination.

The results of the physical testing of the concrete cores removed from the dome of SST 241-C-107 represent concrete that is over 65 years old (as of 2011), with construction of the tanks reported as complete in 1945. SST 241-C-107 is a Type II Single Shell Tank. The reported maximum temperature for the tank is 168°F (RPP-10435). For purpose of comparison, additional higher temperature limits are used to compare the C-107 core data to the material properties used to perform the SST Analysis of Record. The AOR material property data shown in the following plots is located in Tables A.1, A.2, and A.4 of RPP-46442 for compressive strength, modulus of elasticity, and Poisson's ratio, respectively. In the AOR, degradation of concrete compressive strength is considered at temperatures above 200°F. Figure 10-1 compares the compressive strength of the C-107 cores, the average of the C-107 cores, the upper bound, best estimate (mean), and lower bound values at 200°F and 250°F, and the originally specified 28-day design strength. As compared to the upper bound compressive strength at 200°F, 8 out of 12 of the C-107 cores tested at higher strengths. All but one core, C-107#12, resulted in a compressive strength higher than the upper bound compressive strength at 250°F. As stated in section 6.3, C-107#12 contains a cluster of large aggregate in the center of the core.

The elastic moduli of the C-107 cores are higher than the ACI values calculated using the tested compressive strength and the following ACI formula:

$$Ec = 57000 * \sqrt{f'c} \qquad \text{Eqn. 1}$$

The ACI values of elastic modulus are shown in Table 10-2. The difference between the values is expressed in percentage of ACI value. This emphasizes the sensitivity of the compressive strength reported, especially for cores C-107#11 and C-107#12.

Table 10-2. C-107 Elastic Modulus Compared to ACI Value

Core Number	Tested Elastic Modulus (ksi)	ACI Elastic Modulus (ksi)	% difference (greater)
C-107#1	5900	5669	4%
C-107#2	6500	5605	16%
C-107#3	6000	5494	9%
C-107#5	5950	5264	13%
C-107#6	6000	5416	11%
C-107#11	5850	4704	24%
C-107#12	5800	4375	33%
C-107#13	5750	4700	22%
C-107#15	5900	4946	19%
C-107#17	6100	5034	21%
C-107#19	5550	4714	18%
C-107#20	5950	5362	11%

Figure 10-2 compares the modulus of elasticity of the C-107 cores, the average of the C-107 cores, and the upper bound, best estimate (mean), and lower bound values at 150°F and 250°F. The average modulus of elasticity of the C-107 cores is 5938-ksi. All the C-107 cores resulted in a modulus of elasticity higher than the upper bound modulus of elasticity at 250°F and 150°F. Figure 10-3 compares the Poisson's ratio of the C-107 cores, the average of the C-107 cores, and the upper bound, best estimate (mean), and lower bound values at 70°F and 250°F. All the C-107 cores resulted in a Poisson's ratio higher than the upper bound modulus of elasticity at 250°F. Compared to the Poisson's ratio at 70°F upper bound, 7 of 12 of the C-107 cores reported a higher value. The range of Poisson's ratio varies throughout literature and reviewed test data, but is generally in the range of 0.11 to 0.21 and generally in the range of 0.15 to 0.20 (MacGregor). The average Poisson's ratio of the C-107 cores is 0.22.

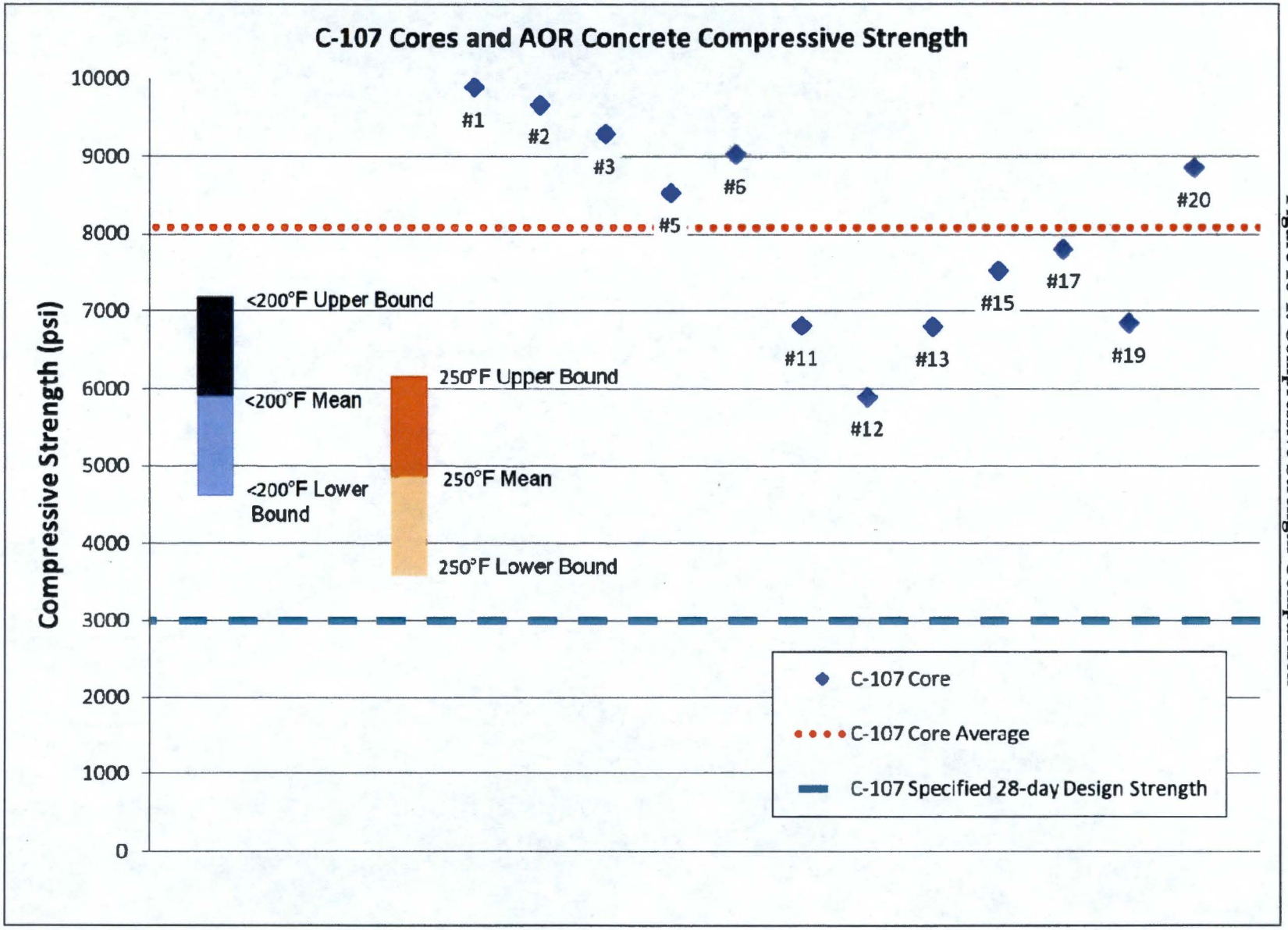


Figure 10-1. Compressive Strength Comparison

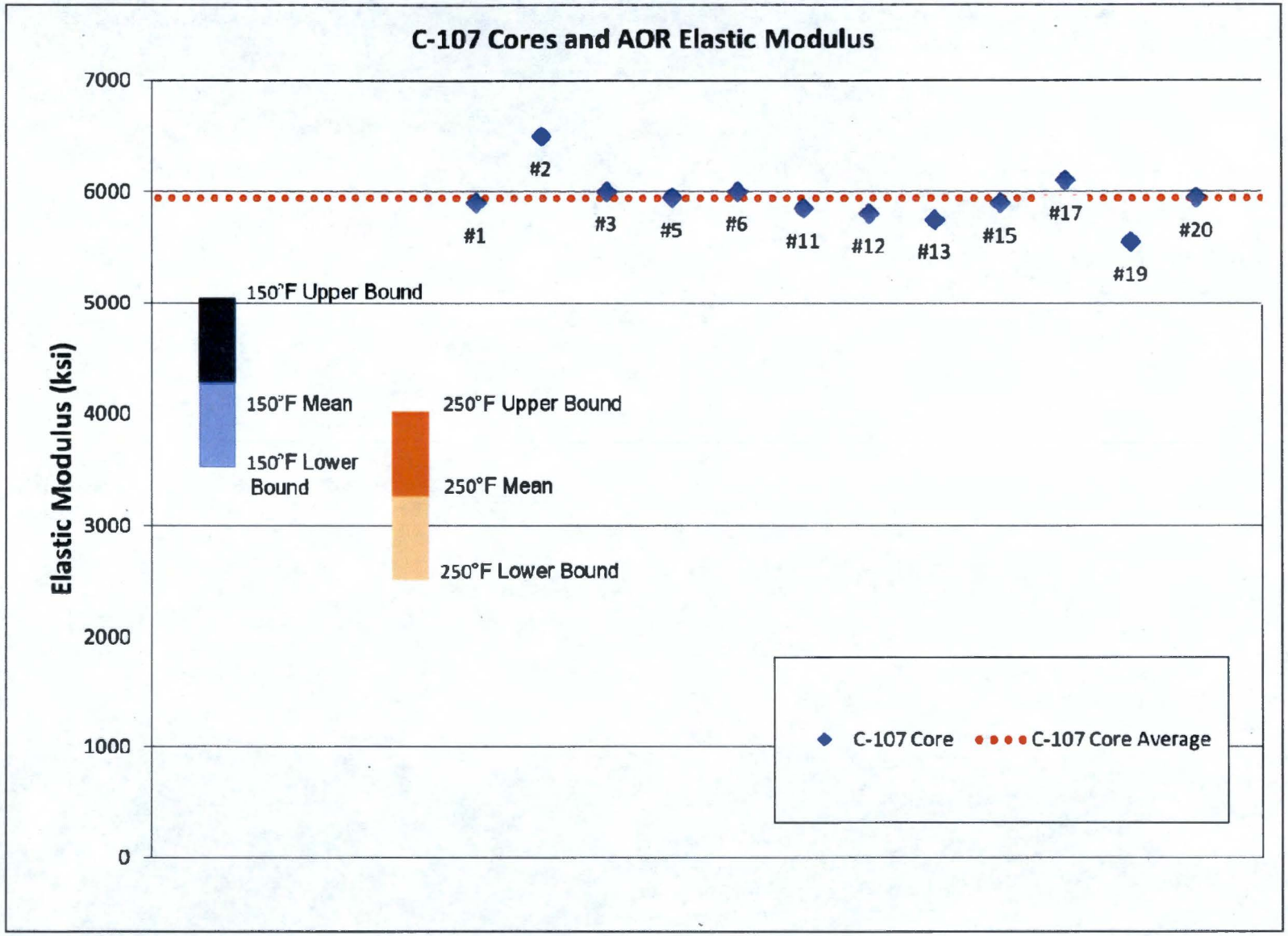


Figure 10-2. Elastic Modulus Comparison

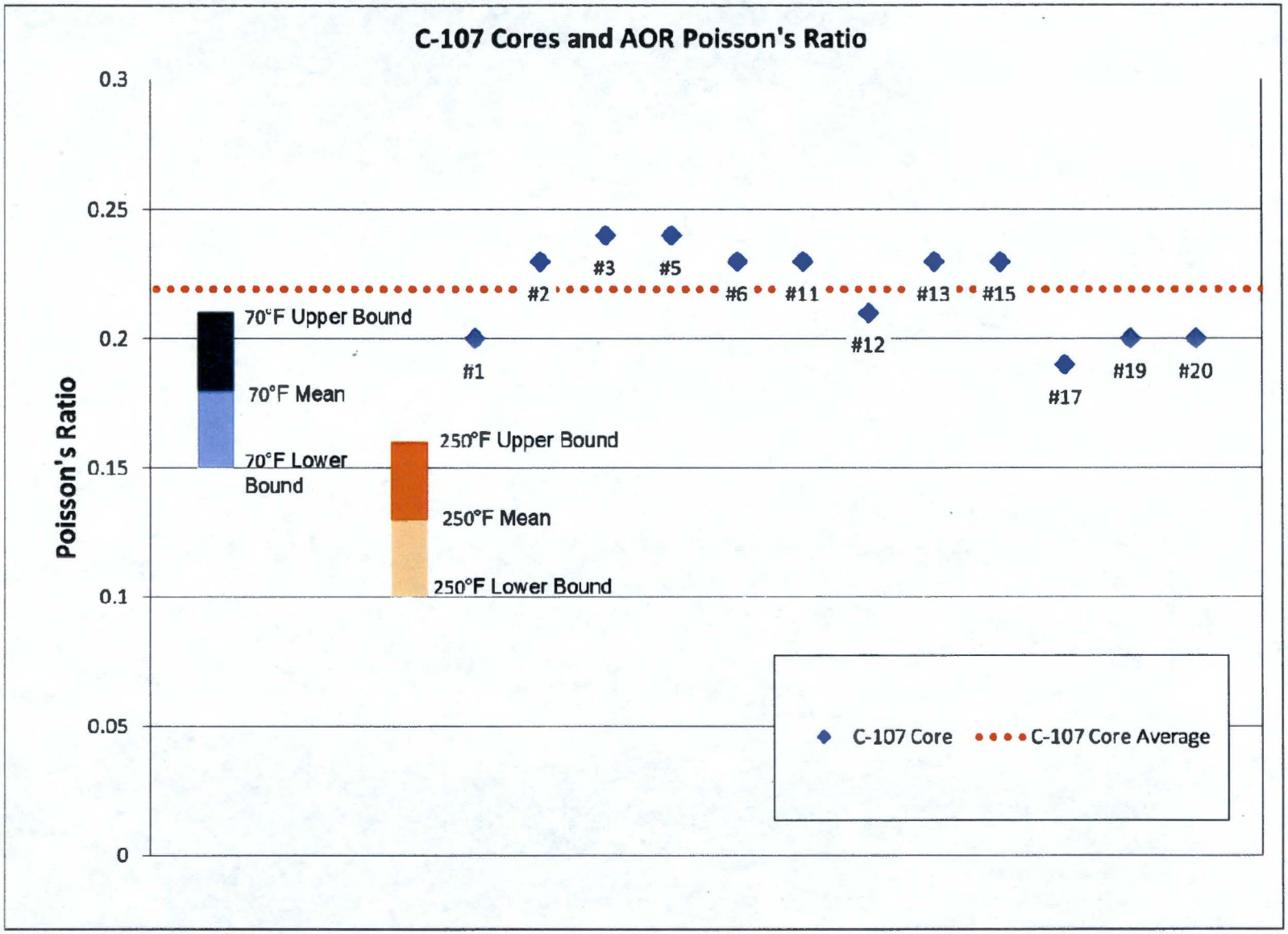


Figure 10-3. Poisson's Ratio Comparison

11.0 CONCLUSIONS

The C-107 'Plug' was successfully inspected in the field prior to the removal of the fourteen cores. The findings suggest that the dome of SST 241-C-107 was constructed as designed. The intact mortar and asphaltic membrane have provided additional protection to the tank dome. Additional inspection could be useful when removing rebar. This may provide assistance in determining the point of origin of intermediate rebar shown in Section 2.0.

The inspection of the cores was successfully performed both visually and microscopically at CTL Group. The findings from the initial inspection and petrographic examination indicate that the concrete removed from the 'Plug' is in good condition, not in distress, and does not exhibit any deleterious mechanisms that would cause distress.

The results of the concrete compression, elastic modulus, and Poisson's ratio tests are compared to the values used to define material properties in the SST Analysis of Record, as shown in Appendix A of RPP-46442, *Single-Shell Tank Structural Evaluation Criteria*. The average concrete compressive strength of the C-107 cores is more than 2.5 times the original 28-day design strength specified at the time of construction.

The successful removal of the 'Plug' from SST 241-C-107 presented an opportunity to perform inspection, sampling, and testing of SST concrete. The removal and testing of the rebar will complete the implementation of the SSTIP Expert Panel recommendation SI-5, *Test Dome Concrete and Rebar 'Plugs'*. Information from this report will also be used to implement Panel recommendation SI-6 which requires the development of an engineering mechanics document. This report represents partial completion of the TPA target milestone, M-045-91D-T01. The inspection and testing of concrete removed from the dome 'Plug' of SST 241-C-107 revealed that the concrete is in good condition and the strength of concrete is greater than originally designed and greater than what is used in the SST Analysis of Record.

12.0 REFERENCES

ACI 214.4R-4, *Guide for Obtaining Cores and Interpreting Compressive Strength Results*, American Concrete Institute, Farmington Hills, Michigan.

ACI 318-05, *Building Code Requirements for Structural Concrete*, American Concrete Institute, Farmington Hills, Michigan.

ASTM A 370-10, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*, American Society for Testing and Materials International, West Conshohocken, Pennsylvania.

ASTM C 39-05, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens*, American Society for Testing and Materials International, West Conshohocken, Pennsylvania.

ASTM C 42-04, *Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete*, American Society for Testing and Materials International, West Conshohocken, Pennsylvania.

ASTM C 215-08, *Standard Test Method for Fundamental Transverse, Longitudinal, and Torsional Resonant Frequencies of Concrete Specimens*, American Society for Testing and Materials International, West Conshohocken, Pennsylvania.

ASTM C 469-02, *Standard Test Method for Static modulus of Elasticity and Poisson's Ratio of Concrete in Compression*, American Society for Testing and Materials International, West Conshohocken, Pennsylvania.

ASTM C 617-11, *Standard Practice for Capping Cylindrical Concrete Specimens*, American Society for Testing and Materials International, West Conshohocken, Pennsylvania.

ASTM C 856-04, *Standard Practice for Petrographic Examination of Hardened Concrete*, American Society for Testing and Materials International, West Conshohocken, Pennsylvania.

BPF-73550, Drawing D-1. *General Layout*. US Department of Energy. Richland, WA.

BPF-73550, Drawing D-2. *Typical Section 75 Foot Tanks*. US Department of Energy. Richland, WA.

BPF-73550, Drawing D-6. *Dome Reinforcing Steel For 75 Foot Tanks*. US Department of Energy. Richland, WA.

MacGregor, J.G., Wight, J.K. *Reinforced Concrete Mechanics and Design*. 2005. 4th Edition. Pearson Prentice Hall, Upper Saddle River, NJ

RPP-10435, Rev. 0. *Single-Shell Tank System Integrity Assessment Report*. US Department of Energy, Richland, Washington.

RPP-46442, Rev. 0. *Single-Shell Tank Structural Evaluation Criteria*. US Department of Energy, Richland, Washington.

RPP-PLAN-45082, Rev 0. *Implementation Plan for the Single-Shell Tank Integrity Project*. US Department of Energy. Richland, WA.

RPP-PLAN-48753, Rev. 0. *Analytical Test Plan for the Removed 241-C-107 Dome Concrete and Rebar*. US Department of Energy. Richland, WA.

RPP-RPT-43116, Rev 0. *Expert Panel Report For Hanford Site Single-Shell Tank Integrity Project*. US Department of Energy. Richland, WA.

RPP-RPT-45921, Rev 0. *Single-Shell Tank Integrity Expert Panel Report*. US Department of Energy. Richland, WA.

1944. *Specifications for Construction of Composite Storage Tanks Bldg. # 241*. Hanford Engineer Works Project 9536. US Department of Energy. Richland, WA.

APPENDIX A

CTL GROUP PROPOSAL

FOR C-107 CONCRETE CORE

INSPECTION AND TESTING

CTLGROUP

May 23, 2011

Bryon Bradley
Senior Procurement Specialist
Washington River Protection Solutions, LLC
P.O. Box 850 H6-04
Richland, WA 99352

Hanford C-107 Plug Concrete Testing and Evaluation Project
CTLGroup Proposal No. 39PA11-024

Dear Mr. Bradley:

CTLGroup is pleased to provide this proposal in response to Requisition # 234378.

1.0 Objective:

The objective of this proposal is to provide inspection and testing of concrete cores removed from the reinforced concrete dome of the Single-Shell Tank, 241-C-107. The inspection and testing shall take place at the subcontractor's facility. This work will assist the Tank Operations Contractor (TOC) in determining the current condition and mechanical properties of Single-Shell Tank concrete.

2.0 Background/Introduction:

In December 2010, tank 241-C-107, located in 241-C Farm, was excavated to the apex of the reinforced concrete dome and a 55" diameter hole was cut and removed. This activity was performed in support of retrieval activities. The 55" diameter concrete section, hereafter referred to as the "plug", is now being used in support of the Single-Shell Tank Integrity Project (SSTIP) to fulfill a recommendation from RPP-PLAN-45082, *Implementation Plan for the Single-Shell Tank Integrity Project* (provided to CTLGroup). The recommendation, SI-5, states to confirm structural integrity by testing a reinforced concrete plug from the dome of a tank. Fourteen concrete cores have been removed from the 241-C-107 plug to date. The removal and testing of 241-C-107 concrete cores is described in RPP-PLAN-48753, *Forensics Plan for the Removed 241-C-107 Dome Concrete and Rebar* (not provided to CTLGroup).

3.0 Scope:

The scope of work contained within this document is for inspection and mechanical testing for up to fourteen concrete cores. The cores are approximately 4 ¼" in diameter and 11" long and must be treated as radiologically controlled material. The proposal scope anticipates external dose rates that are below levels that require a restricted area under applicable regulations. Procedures that must be performed in a restricted area may incur additional expense. Any required changes in the procedures will be evaluated in conjunction with WRPS personnel. It is understood that no detectable level of contamination has been found on the core exteriors, as of May 25, 2011.

CTLGroup shall generate a logbook to track progress of each core through the inspection and testing process. This logbook shall track time complete, date complete, and personnel who performed the action for each core. A logbook record will be provided (for a single core) similar to what is shown in Table 1.

Table 1. Example Core Tracking Logbook

Core #1	**Received**	**Inspected**	**Prepared**	**ASTM C597**	**ASTM C469**	**ASTM C39**	**ASTM C856**
Date							
Time							
Person (Initial)							

The core inspection consists of several actions that must be taken prior to mechanical testing and prior to core size modification. These actions are listed here:

- Measure and record initial diameter and length of each core
- Measure and record weight of each core
- Measure and record length and width of cracks noticeable to the naked eye
- Measure and record length and width of voids noticeable to the naked eye
- Photograph undisturbed cores
- Photograph cracks and voids as required

After inspection has been completed, the cores will need to be prepared for testing. Every attempt will be made to size the cores to 8 ½" in length and testing shall follow the requirements of the American Society for Testing and Materials (ASTM) C42, *Standard Test Method for Obtaining and Testing Drilled Cores and Sawed beams of Concrete*. This will be performed by the methods and standards of CTLGroup. CTLGroup, may deviate from the 8 ½" length with the approval of the TOC (buyer) and as long as the requirements of ASTM C42 are met. If any cores are unable to meet the minimum requirements due to being too short, damaged, or otherwise unusable for testing, they will be put aside and saved. The remaining end pieces from sizing down cores will also be put aside and saved.

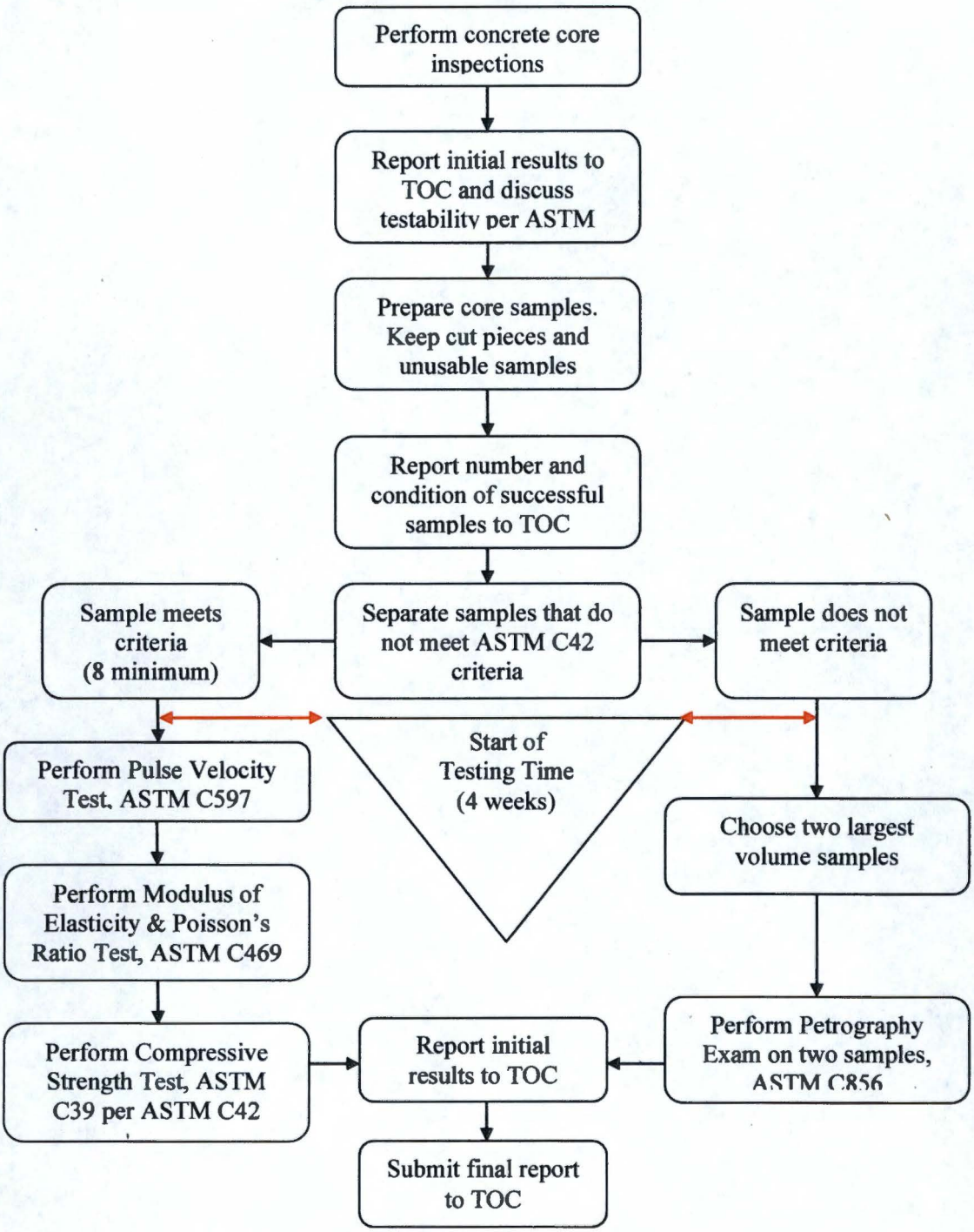
The desired testing activities include several ASTM methods to test concrete for various mechanical properties. They are listed below in Table 2.

Table 2. Desired ASTM Testing Methods for Concrete Core Samples

ASTM Designation	Test Title	Brief Description
ASTM C42	Standard Test Method for Obtaining and Testing Drilled cores and Sawed Beams of Concrete	Describes preparation of concrete core samples for testing
ASTM C597	Standard Test Method for Pulse Velocity Through Concrete	Acoustic based Non-Destructive Examination (NDE) technique to assess uniformity and relative quantity of concrete. (An equivalent NDE technique may be substituted with WRPS Engineering approval)
ASTM C469	Standard Test Method for Static Modulus of Elasticity and Poisson's ratio of Concrete in Compression	Mechanical testing technique to determine Modulus of Elasticity and Poisson's ratio of test sample. (Sample can be reused for compressive test)
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens	Mechanical testing technique to determine compressive strength of a test sample. (Destroys the sample)
ASTM C856	Standard Practice for Petrographic Examination of Hardened Concrete	Invasive analysis of a concrete sample to assess various material properties and composition of concrete

The testing sequence will need to be performed in such a fashion as to maximize sample size before exhausting the available cores. The target number of cores for testing methods ASTM C597, C469, and C39 is a minimum of 8. The target number of cores for testing method ASTM C856 is exactly 2. This sequence of inspection and approval is expected to take between two and three weeks; estimated costs are provided in Table 4. A flowchart is shown in Figure 1 depicting the inspection and testing sequence.

Figure 1. ASTM Testing Sequence Flowchart



Upon testing completion, CTLGroup shall provide a report encompassing the results from the core inspection and from the core testing to the TOC (buyer) along with the logbook. This report shall meet the reporting requirements set forth in the "Report" section of each associated ASTM designation and shall clearly document the steps taken for each test method.

4.0 Deliverables:

The deliverables required from the Vendor/Subcontractor to the TOC (buyer) are summarized in Table 3 below:

Table 3. Table of Deliverables

Deliverable	Purpose	Due Date
Initial Inspection results	TOC Information	Upon inspection completion
Alternate Core Sample Size (if applicable)	TOC review and approval	Before preparing cores
Alternative to ASTM C597 as a test method (if applicable)	TOC review and approval	Before NDE testing start
Proposed Testing Sequence (if applicable)	TOC review and approval	Before mechanical testing start
Initial Testing Results	TOC Information	Upon testing completion
Inspection and Testing Results Report	TOC review and comment	Three weeks after beginning testing sequence
Final Report	TOC review and comment	Four weeks after beginning testing sequence

In addition to the standard test methods described, to successfully execute the testing and evaluation program, the following work items are required:

1. Development of a log book format. This will require involvement from our Quality Management staff. Our preliminary estimate for the time required for this effort is ten hours, with a budget of [redacted]
2. Oversight and interface will be required between laboratory departments and staff. Our preliminary estimate for the time required for this effort is twenty to thirty hours, with a budget of [redacted] to [redacted]
3. If development of an alternative to the pulse velocity test method is necessary (ASTM C597) a new test procedure and staff training of the procedure will be required. A budget of twenty to thirty hours of labor and a cost of [redacted] is estimated for this effort.
4. Project specific procedures for handling radiologically contaminated specimens may require development. This will involve:
   a. Development and documentation of an approach
   b. Installation of the appropriate protective devices
   c. Installation of catch basins for cut material
   d. Oversight of sample preparation and testing by the Radiation Safety Officer.

   It is anticipated this work will require fifty to sixty hours of work (including thirty for the Radiation Safety Officer) and will require a budget of [redacted] to [redacted]
5. Core inspections and measurments are anticipated to require four to five hours of staff time and a budget of approximately [redacted]

Table 4 describes the anticipated time and materials work effort. Table 5 describes unit pricing for the concrete core testing and petrography analysis required in the SOW.

Table 4. Anticipated Time and Materials Work Requirements

Item	Estimated Time	Estimated Budget
Development of Log Book	10 hours	[redacted]
Laboratory Coordination and oversight	30-40 hours	[redacted]
Development of alternative to ASTM C597	20–30 hours	[redacted]
Development of project-specific procedures for Handling Radiologically Contaminated Specimens	50-60 hours	[redacted]
Core classifications and measurements	5-10 hours	[redacted]

Table 5. Unit Prices for Testing Radiologically Contaminated or Potentially Contaminated Specimens

Test Description	Unit Price	Notes
Radiological Assessment of samples	$175	
ASTM C42 Compressive Strength	$215	
ASTM C469 Modulus of Elasticity and Poisson's Ratio	$640	
ASTM C215 Fundamental Transverse, Longitudinal and Toisional Resonant Frequencies	$1,600	$800 for 1 sample $750 each for 2-9 samples $600 each for 10 or more samples tested at same time.
ASTM C856 Petrographic Analysis	$3,600	$3,600 each for 2-5 samples $3,000 each for 6 or more samples

5.0 Acceptance Criteria:

The Inspection and Testing Results Report shall include the requirements set forth in this SOW. All hardcopy and electronic deliverables provided under this SOW shall be complete, accurate, legible and reproducible. Before delivery, documents shall be inspected and reviewed by qualified CTLGroup personnel for quality, technical adequacy and appropriate content in accordance with the CTLGroup's Quality Assurance procedures appropriate for Quality Level 0 (QL-0) procurement .

6.0 Configuration Management and Standards

6.1 Configuration Management Requirements:

There are no specific Configuration Management requirements applicable to this SOW.

6.2 Applicable Standards

The standards applicable to this SOW are listed in Table 2 from Section 3.0 above.

7.0 ESH&Q Requirements

7.1 Quality Assurance Requirements:

CTLGroup shall perform work that is subject to established standards and procedures. This is a Quality Level 0 (QL-0) procurement.

Subcontractor performing testing shall be accredited by the International Accreditation Service (IAS) for the ASTM standards applicable to this SOW to

demonstrate compliance with ANS/ISO/IEC Standard 17025:2005, *General criteria for the competence of testing and calibration laboratories*. Subcontractor shall also be accredited by the American Association of State Highway and Transportation Officials (AASHTO) to demonstrate compliance with AASHTO R18, *Standard Practice for Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories*.

QAP Approval:

This does not apply.

Changes to the Subcontractor's QAP:

This does not apply.

7.2 Price-Anderson Amendments Act Requirements:

Price-Anderson Amendments Act is not applicable to this work.

7.3 Applicable ES&H Requirements:

Hanford Site access is not authorized for work to be completed under this SOW.

8.0 Verification/Hold Points:

Deliverables requiring approval via Section 4.0 shall be dispositioned before proceeding in the next sequence step (if applicable).

9.0 Reserved

10.0 Work Location/Potential Access Requirements:

Testing shall be performed at the subcontractor's facility.

11.0 Training:

CTLGroup's technicians shall be trained and experienced per the applicable ASTM standard listed in Table 2 from Section 3.0 of this SOW before performing testing. CTLGroup's technicians shall be trained in handling procedures for radioactive materials according to the CTLGroup's procedures. No Hanford specific training is required for performance of this work.

12.0 Qualifications:

CTLGroup certificates of accreditation from IAS and AASHTO for the ASTM standards applicable to this SOW are attached. Test methods specified in the SOW that CTLGroup is accredited for include:
ASTM C42
ASTM C469
ASTM C39
ASTM C215

ASTM C856

Additionally, CTLGroup is accredited for ASTM C215, "Standard Test Method for Fundamental Transverse, Longitudinal, and Toisional Resonant Frequencies of Concrete Specimens." This is a suggested alternative NDE Test method to be used in place of C597, subject to TOC review and approval.

13.0 Special Requirements:

No additional requirements are identified for performance of this work.

Hanford Site Access

Testing shall be performed at CTLGroup's facility. Hanford Site access is not required for completion of this work.

Use of Government Vehicles

There is no anticipated need for any CTLGroup employee to use a Government-furnished vehicle in the performance of this statement of work. The Subcontractor's employees, therefore, are specifically prohibited from driving any Government-furnished vehicles under the performance of this statement of work unless this statement of work is formally so modified by the parties and a copy of any applicable driver's license provided to the BTR.

Government Property

No government property will be provided to CTLGroup.

14.0 Reporting/Administration:

Subcontractor information including reports and other documents shall be submitted in both hard copy and electronic format as designated by the Buyer. If electronic formatted documents are required, the documents must be viewable using either Microsoft® Windows®, or Adobe® Acrobat® software.

Subcontractor shall submit a 75% spent notification to the Buyer and the BTR.

15.0 Workplace Substance Abuse Program Requirements:

A Workplace Substance Abuse Program is not required for this SOW.

16.0 Reserved

We appreciate the opportunity to be of service to Washington River Protection Solutions, LLC. Please call me if you have any questions at (847) 972-3146.

Sincerely,

Tim Tonyan, PhD
Vice President
TTonyan@CTLGroup.com
Phone: (847) 972-3146

Name: _____

Title: _____

Company: _____

Signed: _____

Date: _____

Attachments

APPENDIX B

C-107 CONCRETE CORE

OFFSITE RADIATION SURVEY

AND

INITIAL LABORATORY INSPECTION

CTLGROUP

July 22, 2011

Mr. Rick Rast
Washington River Protection Solutions
PO Box 850
Richland, WA 99352
e. Richard_S_Rast@RL.gov

Initial Inspection of Cores Obtained from the Reinforced Concrete Dome of the Single Shell Tank 241-C-107
CTLGroup Project No. 395568
Revision 1

Dear Mr. Rast:

Attached are results from Radiation Safety Services, Inc. (RSSI) and initial observations for the referenced samples. Fourteen concrete cores were received at RSSI on June 28, 2011. The cores were identified by Washington River Protection Solutions (WRPS) as indicated in Table 1. Results provided by RSSI indicate that all the radionuclides in all samples are well below minimum detectable activity (MDA) and any dangerous levels for health concerns. The results from RSSI are shown in Attachment A.

The concrete cores arrived at CTLGroup on July 7, 2011. Upon arrival, visual inspections were performed as an initial assessment of the cores. A summary of observations are listed below; detailed notes are provided in Attachment B. The photos of the undisturbed cores are provided in Attachment C.

- All cores are nominally 4 ¼ inches in diameter and vary in length.
- The concrete appears to be well consolidated.
- The nominal maximum size of the aggregates varies from 1 inch to 1½ inches.
- Elongated particles are observed on some of the cores.
- No cracks are observed with the naked eye within the concrete.
- Some cracks are visible in individual aggregates.
- No significant delaminations were observed at the top of each core.
- No steel was present in any of the cores.
- A black pitch-like material is observed on the top surface of each core. The material is reportedly a 3-ply asphaltic waterproofing membrane. This is expected since it was required by the job specifications from 1944[1] when the structure was first constructed.
- There are numerous "pulled out" aggregates on the bottom fracture surface of each core.
- Brown staining is present from the top surface down to about 5-8mm on average for each core and is most probably due to a black pitch material observed on the top surface of each core.

[1] "Specifications For Construction of Composite Storage Tanks Bldg. No. 241 Hanford Engineer Works Project 9536"

Austin, TX • Chicago, IL • Washington, DC
Corporate Office: 5400 Old Orchard Road, Skokie, IL 60077-1030 P: 847-965-7500 F: 847-965-6541 www.CTLGroup.com
CTLGroup is a registered d/b/a of Construction Technology Laboratories, Inc.

The concrete cores will need to be prepared for testing in accordance with the following test methods:

- ASTM C215 – 08, *Standard Test Method for Fundamental Transverse, Longitudinal, and Torsional Frequencies of Concrete Specimens*
- ASTM C469 / C469M – 10, *Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression*
- ASTM C39 / C39M – 10, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens*
- ASTM C856 – 11, *Standard Practice for Petrographic Examination of Hardened Concrete*

The recorded lengths indicate that twelve cores can be prepared and tested for ASTM C215, ASTM C469, and ASTM C39. Core Sample #4 and Sample #14 are less than 8 inches and will be used for the petrographic exam.

At this time, the core samples are ready to be prepared for testing. Please review this report and provide authorization to begin test preparations.

We appreciate this opportunity to conduct specialized testing for you. Should you have any questions, please contact me.

Sincerely,

CTLGROUP, INC.
An AASHTO Accredited Laboratory – Aggregates, Cement & Concrete

Joni L. Jones, P.E. (Illinois)
Physical Testing Laboratory Supervisor
Materials Laboratory Services
e: JLJones@CTLGroup.com
p: 847.972.3128
f: 847.965.6541

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Attachment A. Report of Radionuclides from RSSI

Radionuclide	Sample 1 (uCi/g)		Sample 2 (uCi/g)		Sample 3 (uCi/g)		Sample 4 (uCi/g)		Sample 5 (uCi/g)		Sample 6 (uCi/g)		Sample 11 (uCi/g)		Sample 12 (uCi/g)		Sample 13 (uCi/g)		Sample 14 (uCi/g)		Sample 15 (uCi/g)		Sample 17 (uCi/g)		Sample 19 (uCi/g)		Sample 20 (uCi/g)	
Ag-110M	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Am-241	<		<		<		<		<		<		#C	1.32E-08	#	2.02E-08	<		<		<		#	2.19E-08	<		<	
Au-195	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Ba-131	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Ba-133	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Ba-140	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Be-7	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Bi-207	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Cd-109	<		<		<		<		<		<		<		<		<			1.85E-07	#C	5.33E-08	<		<		<	
Ce-139	<		<		C	1.21E-09	<		<		<		<		<		<		<			2.85E-09	<		<			1.31E-09
Ce-143	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Ce-141	<		#	4.12E-09	<		<		<		<		<		<		<		<		<		<		<		<	
Ce-144	<		<		<		#C	5.46E-08	<		<		<		<		<		<		#C	1.35E-08	<		<		<	
Co-56	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Co-57	<		<		<		<		#	4.43E-09	<		<		<		<		<		<		<		<		<	
Co-58	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Co-60	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Cr-51	<		#	1.40E-08	<		<		<		<		<		<		<		<		#	1.07E-08	<		<		<	
Cs-134	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Cs-136	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Cs-137	<		<		#	2.22E-09	<		<		<		<		<		<		<		<		<		<		<	
Eu-152	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Eu-154		6.28E-09	<		<		<		<		<		<		<		<		<		<		#C	2.58E-09	<		<	
Eu-155	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Fe-59	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Gd-153	<		<		#C	3.99E-09	<			1.15E-08	<		<		<		<		<		<		<		<		<	
Hf-181	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Hg-203	<		<		<		#	3.70E-09	<		<		<		<		<		<		<		<		#C	4.97E-10	<	
I-131	<		<		<		<		#	1.58E-09	<		<		<		<		<		<		<		<		<	
I-132	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
I-133	<		<		#	1.51E-09	<		<		<		<		<		<		<		<		<		<		<	
Kr-85	<		<		<		B<		<		<		<		<		<		<		#F	1.71E-07	<		<		<	
La-140	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Mn-54	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Na-22	<		<		<		<		<		<		<		<		<		<		<		<		<		<	

Legend	
#	All peaks for activity calculation had bad shape.
<	< Minimum Detectable Activity (MDA)
B	Activity < MDA and failed test.
C	Area < Critical level.
F	Failed fraction or key line test.

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Attachment A Continued. Report of Radionuclides from RSSI

Radionuclide	Sample 1 (uCi/g)		Sample 2 (uCi/g)		Sample 3 (uCi/g)		Sample 4 (uCi/g)		Sample 5 (uCi/g)		Sample 6 (uCi/g)		Sample 11 (uCi/g)		Sample 12 (uCi/g)		Sample 13 (uCi/g)		Sample 14 (uCi/g)		Sample 15 (uCi/g)		Sample 17 (uCi/g)		Sample 19 (uCi/g)		Sample 20 (uCi/g)	
Nb-95	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Nd-147	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Rb-86	<		<		<		<		<		<		<		<		<		<		<		<		<		#C	6.32E-09
Ru-103	<		<		<		<		#	8.07E-10	<		<		<		<		<		<		<		<		<	
Sb-124	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Sc-46	<		#	9.11E-09	<		<		<		<		<		<		<		<		<		<		<		<	
Se-75	<		<		<		<		<		<		<		<		<		<		#	2.78E-09	<		<		<	
Sn-113	<		<		<		<		<		<		<		#	1.45E-09	<			2.60E-09	#	2.42E-09	#	3.54E-09	<		<	
Sr-85	<		<		<		<		<		<		<		<		<		<		B<		B<		<		<	
Ta-182	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Tb-160	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Tc-99M	<		<		<		<		<		#C	8.55E-10	<		<		<		<		<		<		<		<	
Xe-131M	#C	3.94E-08	<		C	6.23E-08	<		<		<		<		<		<		<			1.52E-07	#	1.32E-07	<		<	
Y-88	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Mo-99	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Sb-125	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Pa-233	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Tl-202	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Tl-201	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Ir-192	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Os-191	<		<		<			1.40E-08	<		<		<		<		<		<		<		<		<		#	8.42E-09
Tm-170		2.48E-07	#	3.16E-07	<			4.85E-07	<		<		#	1.74E-07	<			1.70E-07		2.37E-07	<		#	2.02E-07	<		<	
Yb-169	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Te-131m	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
I-130	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Te-129m	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Te-125m	<		<		<		<		<		<		<		#	9.89E-07	#	6.46E-07	<		<		<		<		<	
Sn-119m	<		<		<		<		<		<		<		<		B<		C	1.73E-05	<		<		<		<	
Cd-115m	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
In-114m	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
In-111	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
pd-103	<		<		<			1.47E-05	<		<		<		<		<		<		<		<		<		<	
Zr-97	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Y-91	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Rh-106	<		<		<		<		<		<		<		<			9.87E-09	<		<		<		<		<	
Zn-65	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
As-74	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Ga-67	<		<		<		<		<		<		<		<		<		<		<		<		<		<	
Zr-95	<		<		<		<		<		<		<		<		<		<		<		<		<		<	

Legend	
#	All peaks for activity calculation had bad shape.
<	< Minimum Detectable Activity (MDA)
B	Activity < MDA and failed test.
C	Area < Critical level.
F	Failed fraction or key line test.

Attachment B

Table 1. Concrete Core Identification and Measurements

Core Identification	Diameter, inches	Length, inches	Weight, Lbs.	Testing to be performed
C-107 #1	4 ¼	9 ¼	11.8	ASTM C215, ASTM C469, ASTM C39
C-107 #2	4 ¼	10	12.3	ASTM C215, ASTM C469, ASTM C39
C-107 #3	4 ¼	10	12.1	ASTM C215, ASTM C469, ASTM C39
C-107 #4	4 ¼	7 ¾	9.2	ASTM C856
C-107 #5	4 ¼	10	12.4	ASTM C215, ASTM C469, ASTM C39
C-107 #6	4 ¼	10	12.6	ASTM C215, ASTM C469, ASTM C39
C-107 #11	4 ¼	10	12.3	ASTM C215, ASTM C469, ASTM C39
C-107 #12	4 ¼	10	12.6	ASTM C215, ASTM C469, ASTM C39
C-107 #13	4 ¼	10	12.7	ASTM C215, ASTM C469, ASTM C39
C-107 #14	4 ¼	7 ½	9.8	ASTM C856
C-107 #15	4 ¼	10	11.8	ASTM C215, ASTM C469, ASTM C39
C-107 #17	4 ¼	10	12.3	ASTM C215, ASTM C469, ASTM C39
C-107 #19	4 ¼	10	12.0	ASTM C215, ASTM C469, ASTM C39
C-107 #20	4 ¼	10	12.6	ASTM C215, ASTM C469, ASTM C39

Attachment C
Photographs of Undisturbed Concrete Cores and Documentation of any Cracks and/or Voids

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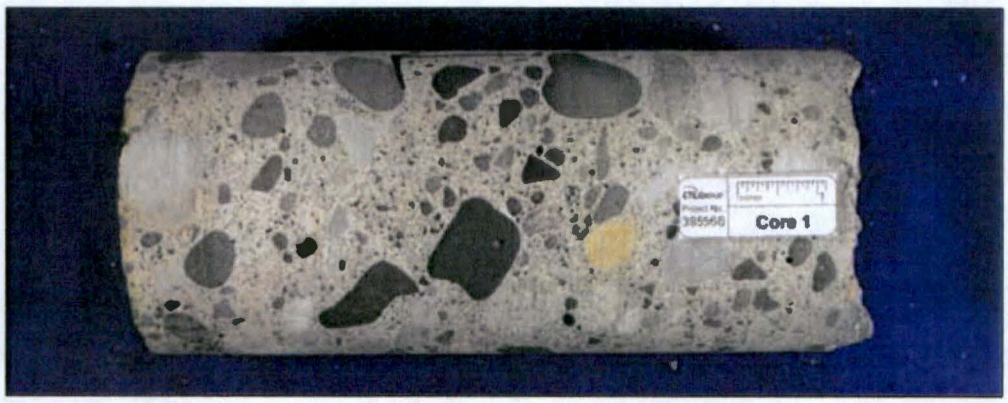
Initial Inspection of Cores Obtained from the Reinforced Concrete Dome of the Single Shell Tank 241-C-107
CTLGroup Project No. 395568

July 22, 2011

Side view of Core #1, Voids vary from < 1mm to 5mm



Side view of Core #1, Voids vary from < 1mm to 5mm

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July 22, 2011

Top view of Core #1

Bottom view of Core #1

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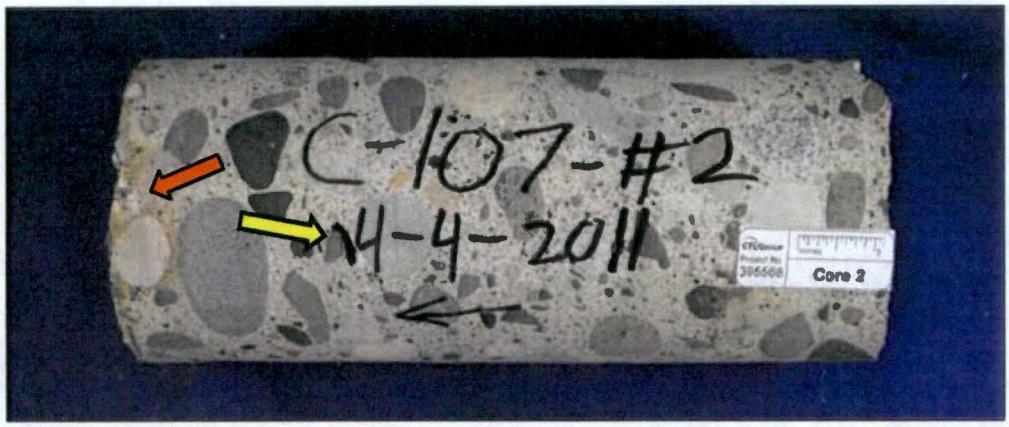
CTLGroup Project No. 395568

July 22, 2011



Side view of Core #2, Voids vary from < 1mm to 5mm. One air void indicate by yellow arrow is 1/8 inch in width and ½ inch long. Brown staining is observed toward the top as indicated by red arrow.

Side view of Core #2, Voids vary from < 1mm to 5mm

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CTLGroup Project No. 395568

July 22, 2011

Top view of Core #2

Bottom view of Core #2

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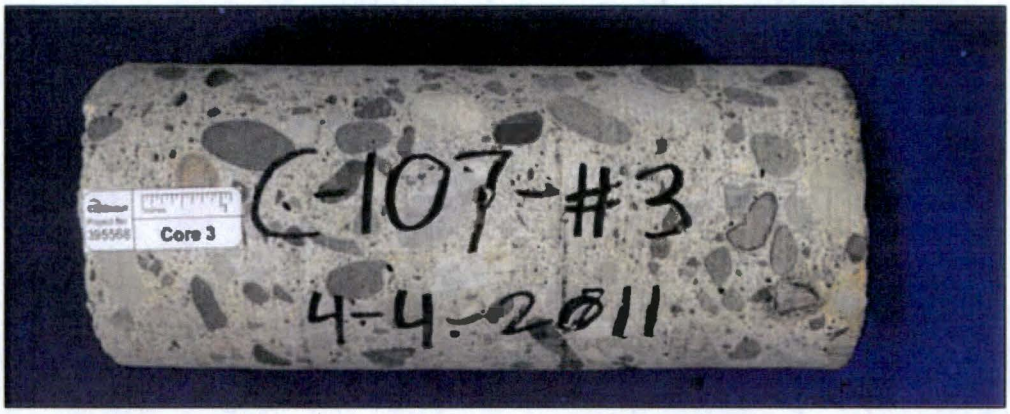
CTLGroup Project No. 395568

July 22, 2011



Side view of Core #3, Voids vary from < 1mm to 5mm

Side view of Core #3, Voids vary from < 1mm to 5mm

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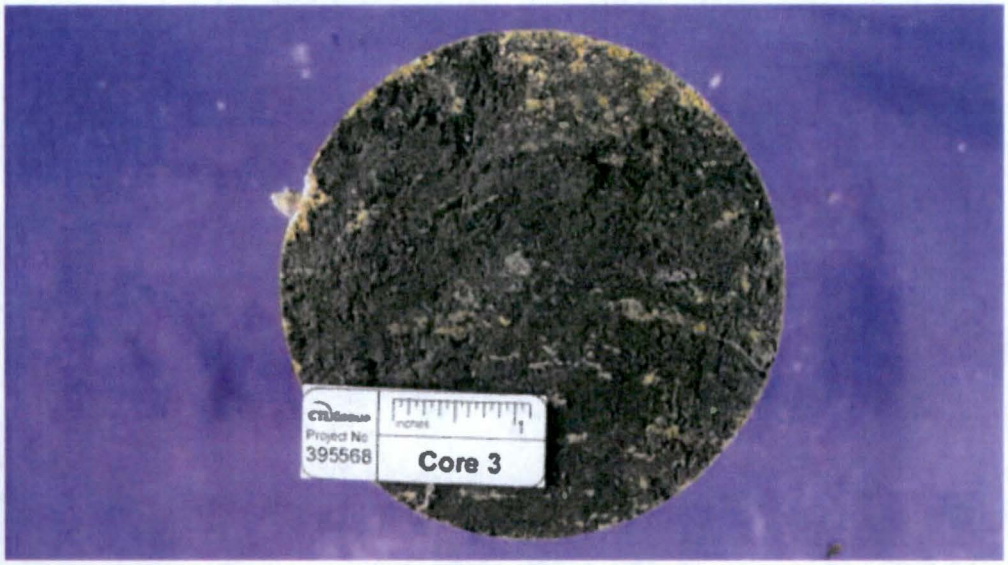
CTLGroup Project No. 395568

July 22, 2011



Top view of Core #3

Bottom view of Core #3

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Side view of Core #4, Voids vary from < 1mm to 8mm

Side view of Core #4, Voids vary from < 1mm to 8mm

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Initial Inspection of Cores Obtained from the Reinforced Concrete Dome of the Single Shell Tank 241-C-107
CTLGroup Project No. 395568

July 22, 2011

Top view of Core #4

Bottom view of Core #4

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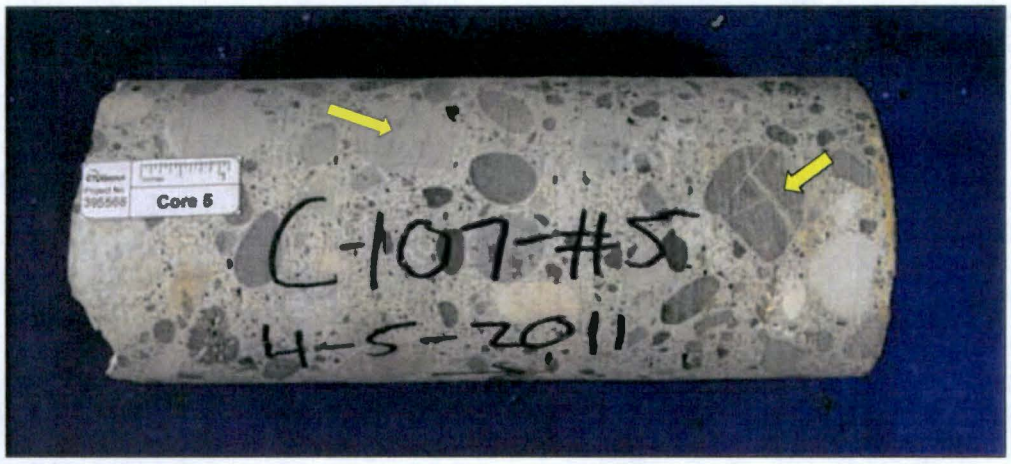
CTLGroup Project No. 395568

July 22, 2011



Side view of Core #5, Voids vary from < 1mm to 5mm, Cracking is observed on the larger coarse aggregate sizes as indicated by yellow arrows. Cracks range from 0.20 mm to 1 mm

Side view of Core #5, Voids vary from < 1mm to 5mm

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CTLGroup Project No. 395568

July 22, 2011

Top view of Core #5

Bottom view of Core #5

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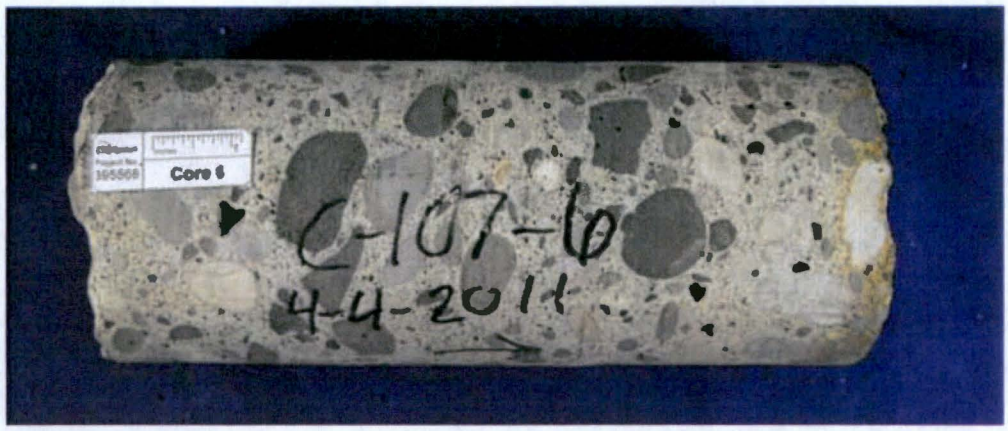
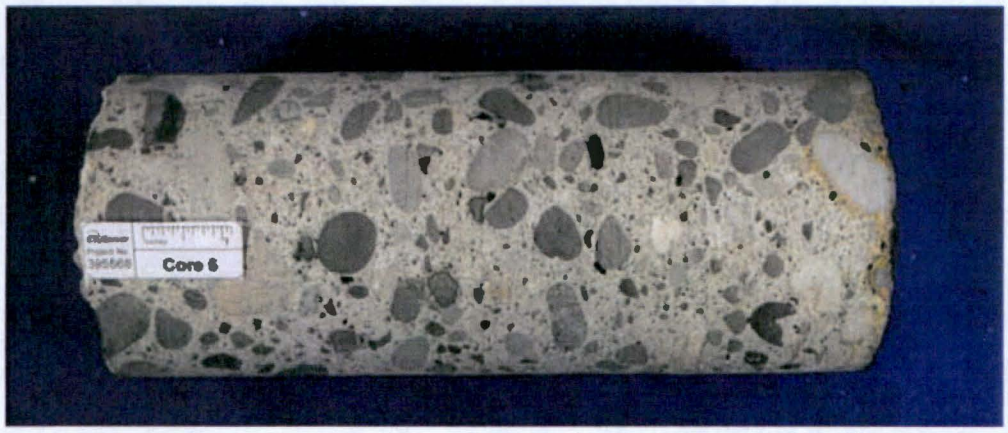


Side view of Core #6, Voids vary from < 1mm to 10mm. Depth of brown staining is observed to be relatively greater than other cores.



Side view of Core #6, Voids vary from < 1mm to 10mm. Depth of brown staining is observed to be relatively greater than other cores.

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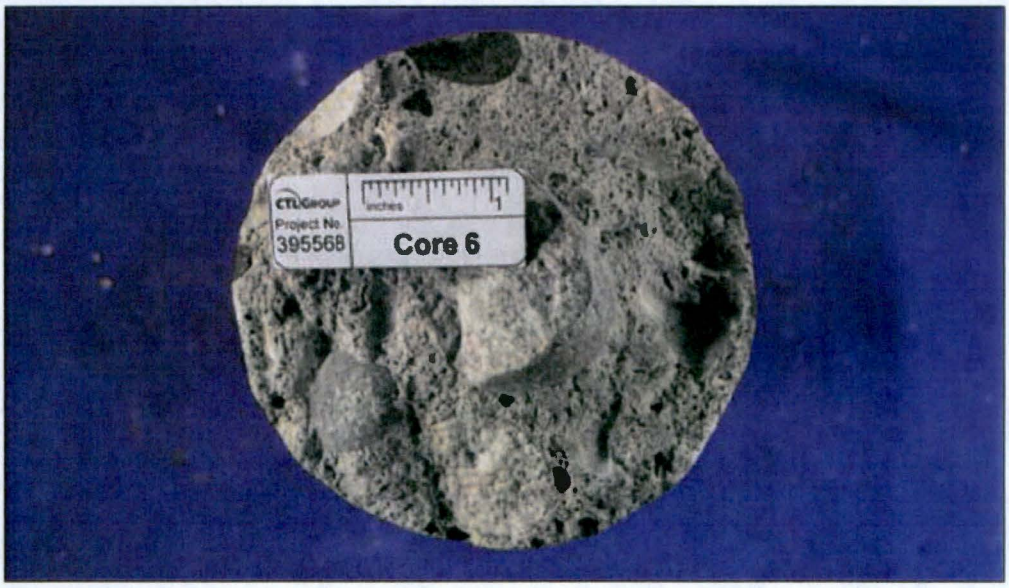
Top view of Core #6



Bottom view of Core #6

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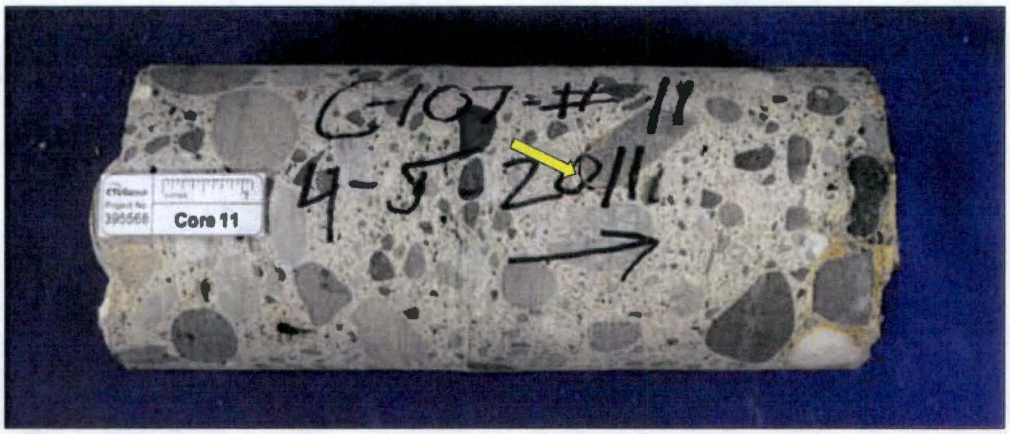
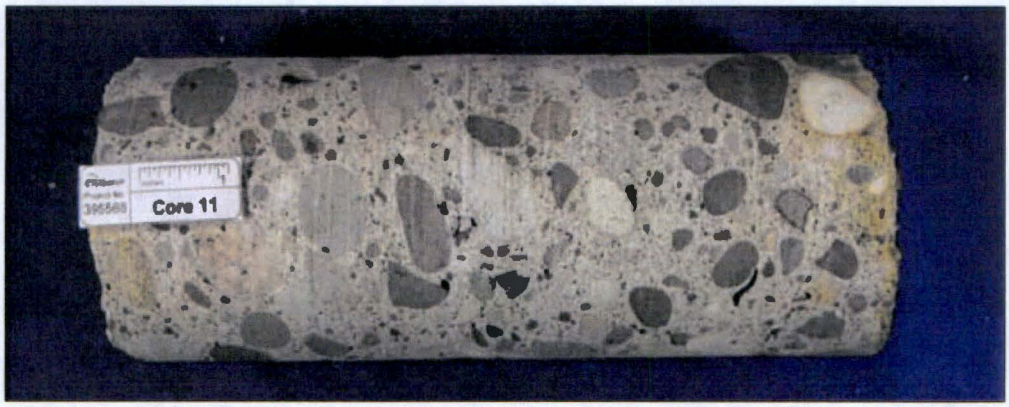


Side view of Core #11, Voids vary from < 1mm to 10mm. Some delamination (0.80 mm gap) is noticed next to elongated coarse aggregate as indicated by yellow arrow. Depth of brown staining is observed to be relatively greater than other cores.



Side view of Core #11, Voids vary from < 1mm to 10mm

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Top view of Core #11

Bottom view of Core #11

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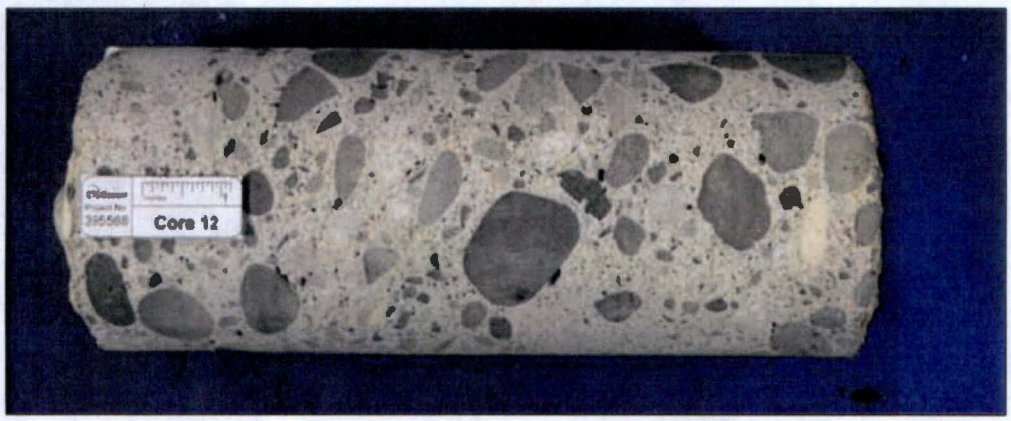
Side view of Core #12, Voids vary from < 1mm to 5mm



Side view of Core #12, Voids vary from < 1mm to 5mm

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Top view of Core #12

Bottom view of Core #12

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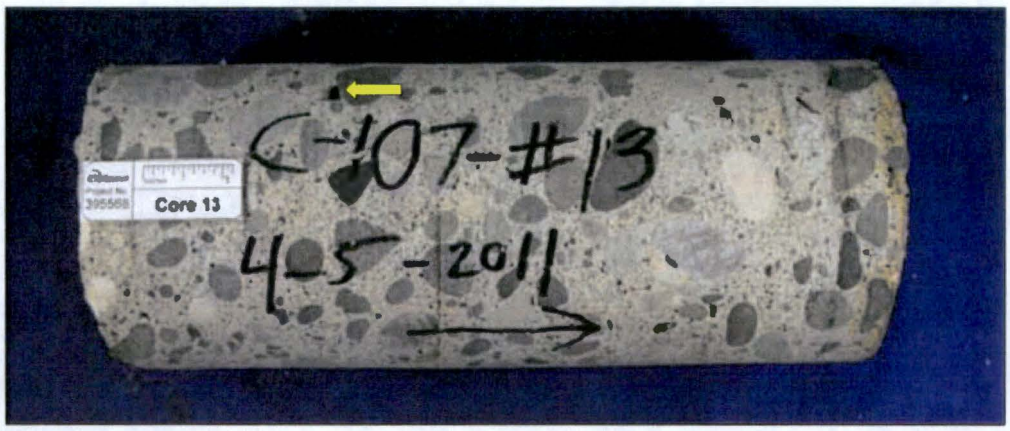

Side view of Core #13, Voids vary from < 1mm to 10mm. Largest void is observed next to large coarse aggregate as indicated by yellow arrow.

Side view of Core #13, Voids vary from < 1mm to 10mm

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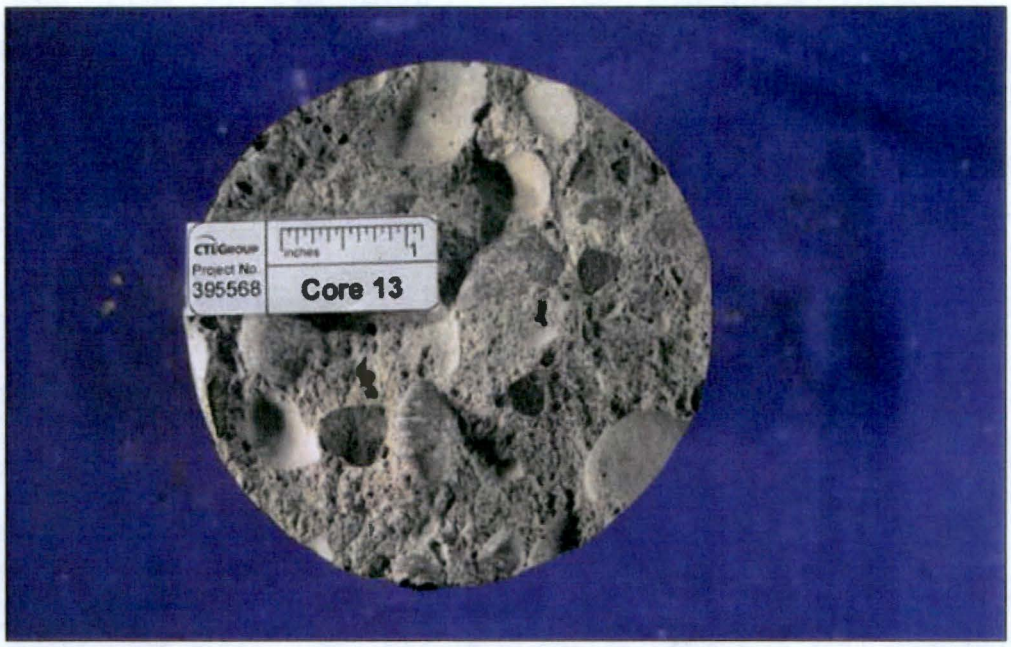

Bottom view of Core #13. Top view was inadvertently not taken.

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Side view of Core #14, Voids vary from < 1mm to 5mm

Side view of Core #14, Voids vary from < 1mm to 5mm

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Top view of Core #14

Bottom view of Core #14

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July 22, 2011

Side view of Core #15, Voids vary from < 1mm to 8mm. 0.33 mm crack is observed on one of the coarse aggregates as indicated with the yellow arrow.

Side view of Core #15, Voids vary from < 1mm to 8mm

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Top view of Core #15

Bottom view of Core #15

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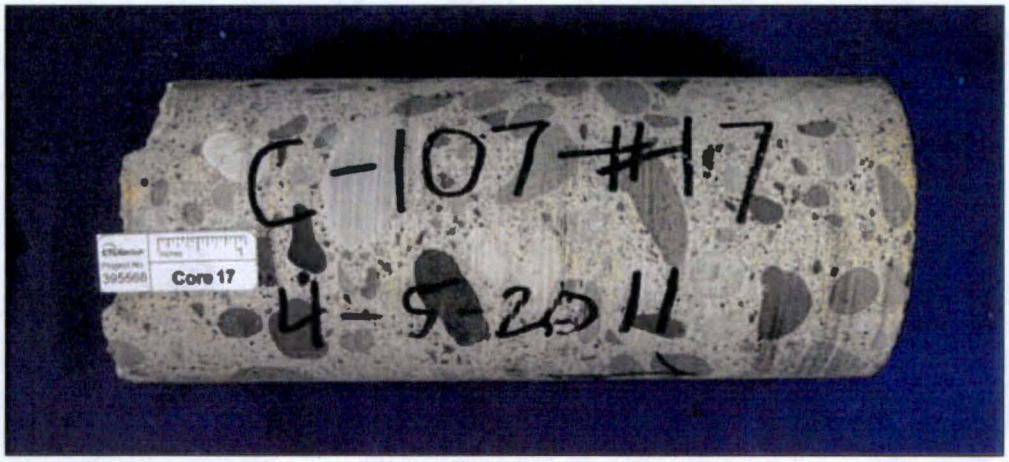

Side view of Core #17, Voids vary from < 1mm to 5mm

Side view of Core #17, Voids vary from < 1mm to 5mm

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Top view of Core #17

Bottom view of Core #17

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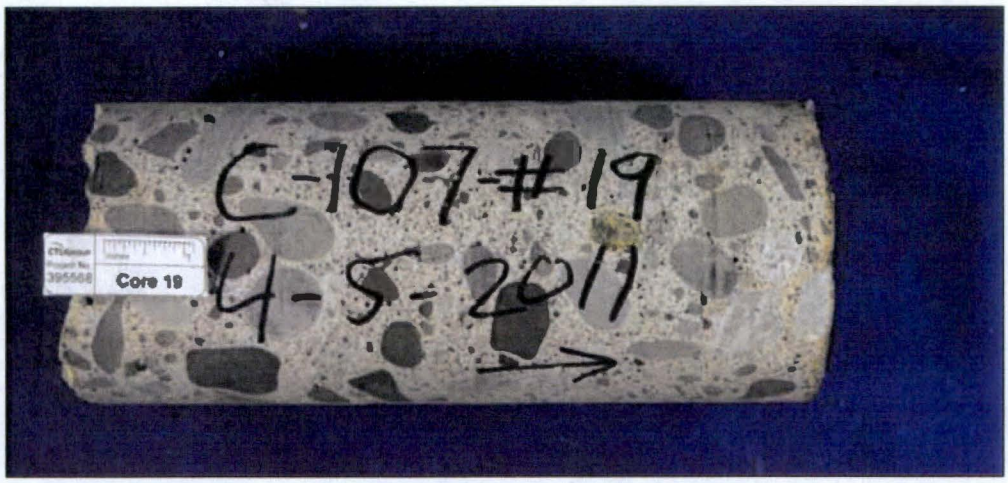

Side view of Core #19, Voids vary from < 1mm to 5mm

Side view of Core #19, Voids vary from < 1mm to 5mm

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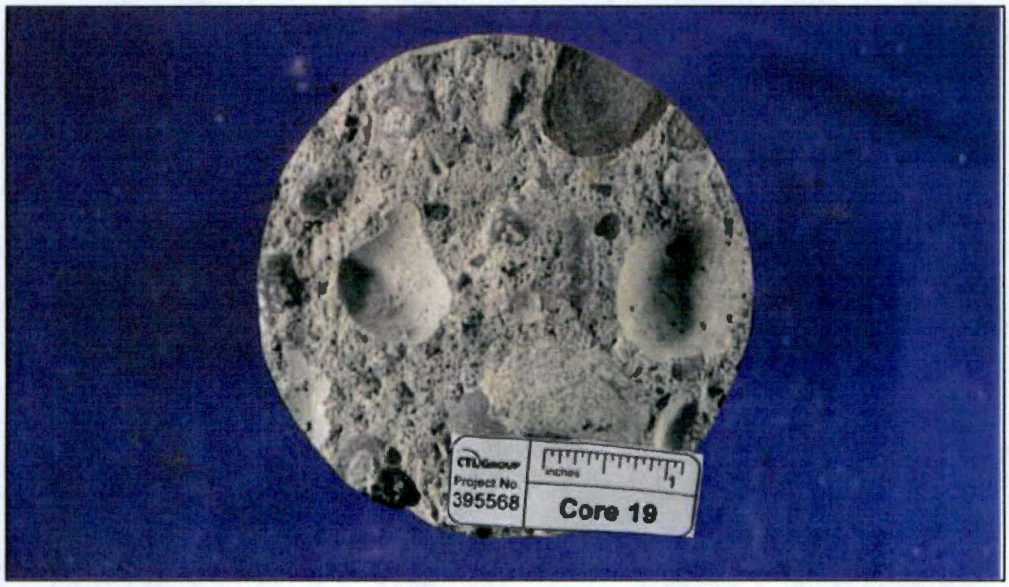
Top view of Core #19



Bottom view of Core #19

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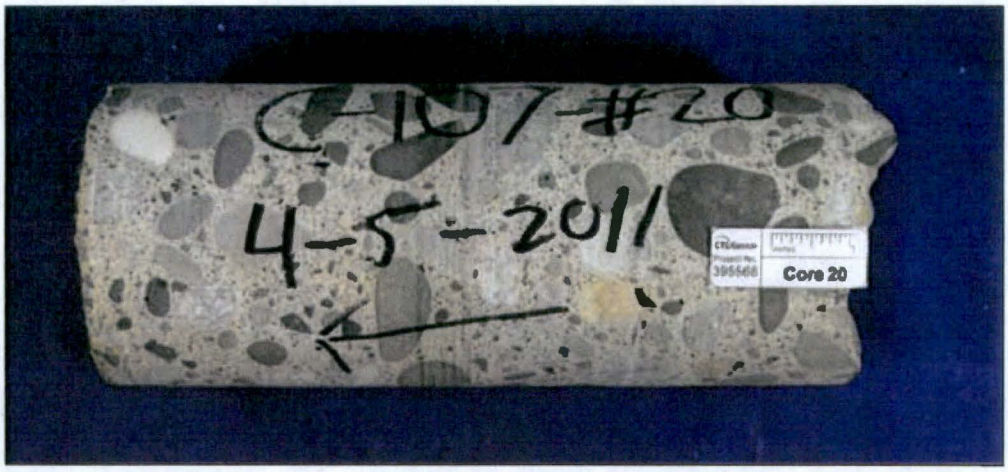

Side view of Core #20, Voids vary from < 1mm to 8mm

Side view of Core #20, Voids vary from < 1mm to 8mm

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CTLGroup Project No. 395568

July 22, 2011

Top view of Core #20

Bottom view of Core #20

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APPENDIX C

C-107 CONCRETE CORE NON-DESTRUCTIVE AND PHYSICAL TESTING RESULTS

CTLGROUP

November 7, 2011

Mr. Rick Rast
Washington River Protection Solutions
PO Box 850
Richland, WA 99352
e. Richard_S_Rast@RL.gov

Non-Destructive and Physical Test Results from Cores Obtained from the Reinforced Concrete Dome of the Single Shell Tank 241-C-107 at the Hanford Site, Washington
WRPS Subcontract No. 46060
CTLGroup Project No. 395568

Dear Mr. Rast:

Attached are test results for the referenced project. Fourteen concrete cores were received by CTLGroup at RSSI on June 28, 2011 for screening. After screening the concrete cores subsequently arrived at CTLGroup on July 7, 2011. The cores were identified by Washington River Protection Solutions (WRPS) and results provided by RSSI indicate that all the radionuclides in all samples are well below minimum detectable activity (MDA) and any dangerous levels for health concerns. The results from RSSI and the visual observations by CTLGroup were provided in the Initial Inspection Report dated July 22, 2011.

The concrete cores were saw cut to a specified length and cured in accordance with ASTM C42 / C42M – 10a, *Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.*

On August 8, 2011 nondestructive evaluation of the cores was performed in accordance with ASTM C215 – 08, *Standard Test Method for Fundamental Transverse, Longitudinal, and Torsional Frequencies of Concrete Specimens.* CTLGroup utilized the Impact Resonance Method per Section 6.2. Due to limitations of the specimen size, only the transverse frequency (TRF) was measured and recorded. Detailed results are presented in Appendix A. Due to the dimensions of Cores #4 and #14, TRF measurements could not be obtained.

Immediately after the nondestructive evaluation, twelve cores were capped in accordance with ASTM C617 – 10, *Standard Practice for Capping Cylindrical Concrete Specimens.* On August 9 through 10, 2011 the modulus of elasticity and Poisson's ratio were determined in accordance with ASTM C469 / C469M – 10, *Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression.* Detailed results are presented in Appendix B.

Once modulus and Poisson' ratio measurements were obtained, the compressive strength of the cores were tested in accordance with ASTM C39 / C39M – 10, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.* Results are presented in Appendix C.

We appreciate this opportunity to conduct specialized testing for you. Should you have any questions, please contact us.

Sincerely,

CTLGROUP, INC.
An AASHTO Accredited Laboratory – Aggregates, Cement & Concrete

Joni L. Jones, P.E. (Illinois)
Physical Testing Laboratory Supervisor
Materials Laboratory Services
e: JLJones@CTLGroup.com
p: 847.972.3128
f: 847.965.6541

Attachments:
1. Summary of Results
2. Appendix A – ASTM C215 Results
3. Appendix B – ASTM C469 Results
4. Appendix C – ASTM C42 Results

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Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Report Date: November 7, 2011

CTLGroup Project No.: 395568
CTLGroup Project Mgr.: J. L. Jones
Approved By: M. D'Ambrosia

Summary of Test Results

Specimen Identification

Client Identification	Core #1	Core #2	Core #3	Core #5	Core #6	Core #11	Core #12	Core #13	Core #15	Core #17	Core #19	Core #20
CTLGroup Identification	2870301	2870302	2870303	2870305	2870306	2870307	2870308	2870309	2870311	2870312	2870313	2870314
Date Core Obtained from the Field	4/4/2011	4/4/2011	4/4/2011	4/4/2011	4/4/2011	4/4/2011	4/4/2011	4/4/2011	4/4/2011	4/4/2011	4/4/2011	4/4/2011
Date Core Placed in Sealed Bag after Saw Cutting	7/28/2011	7/28/2011	7/28/2011	7/28/2011	7/28/2011	7/28/2011	7/28/2011	7/28/2011	7/28/2011	7/28/2011	7/28/2011	7/28/2011
Date Core was Tested	8/9/2011	8/9/2011	8/9/2011	8/9/2011	8/9/2011	8/9/2011	8/9/2011	8/9/2011	8/9/2011	8/9/2011	8/10/2011	8/9/2011

Concrete Description

Nominal Maximum Aggregate Size, in.	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
Concrete Age at Test, years	> 50	> 50	> 50	> 50	> 50	> 50	> 50	> 50	> 50	> 50	> 50	> 50
Moisture Condition at Test	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1
Orientation of Core Axis in Structure	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical

Concrete Dimensions

Length of Core as Drilled, in.	9 1/4	10	10	10	10	10	10	10	10	10	10	10
Diameter 1, in.	4.20	4.20	4.20	4.21	4.20	4.21	4.21	4.21	4.21	4.20	4.21	4.20
Diameter 2, in.	4.21	4.21	4.20	4.21	4.20	4.21	4.21	4.21	4.21	4.21	4.21	4.21
Average Diameter, in.	4.21	4.21	4.20	4.21	4.20	4.21	4.21	4.21	4.21	4.21	4.21	4.21
Cross-Sectional Area, in^2	13.92	13.92	13.85	13.92	13.85	13.92	13.92	13.92	13.92	13.92	13.92	13.92
Length Trimmed, in.	8.2	8.2	8.2	8.2	8.3	8.2	8.2	8.2	8.3	8.2	8.2	8.2
Length Capped, in.	8.4	8.5	8.4	8.6	8.5	8.5	8.6	8.6	8.5	8.5	8.6	8.4
Mass of Core, lbs	10.03	10.09	10.00	10.02	9.98	10.00	10.01	9.98	9.99	10.02	10.04	10.13
Density (mass/volume), lb/ft^3	152	152	152	151	151	151	151	150	150	151	151	153

Non-Destructive Evaluation per ASTM C215

Average Transverse Resonant Frequency, Hz	**6493**	**6527**	**6480**	**6447**	**6443**	**6253**	**6373**	**6313**	**6343**	**6480**	**6320**	**6393**
Dynamic Modulus of Elasticity, ksi	**6700**	**6900**	**6800**	**6700**	**6900**	**6300**	**6500**	**6400**	**6600**	**6700**	**6400**	**6600**

Modulus, Poisson's Ratio, Compressive Strength and Fracture Pattern

Maximum Load, lb	137,600	134,600	128,700	118,800	125,000	94,800	82,000	94,600	104,800	108,600	95,200	123,200
Uncorrected Compressive Strength, psi	9,890	9,670	9,290	8,530	9,030	6,810	5,890	6,800	7,530	7,800	6,840	8,850
Ratio of Capped Length to Diameter	2.00	2.02	2.00	2.04	2.02	2.01	2.04	2.04	2.01	2.03	2.03	2.00
Correction Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Modulus of Elasticity, ksi	**5,900**	**6,500**	**6,000**	**5,950**	**6,000**	**5,850**	**5,800**	**5,750**	**5,900**	**6,100**	**5,550**	**5,950**
Poisson's Ratio	**0.20**	**0.23**	**0.24**	**0.24**	**0.23**	**0.23**	**0.21**	**0.23**	**0.23**	**0.19**	**0.20**	**0.20**
Corrected Compressive Strength, psi	**9,890**	**9,670**	**9,290**	**8,530**	**9,030**	**6,810**	**5,890**	**6,800**	**7,530**	**7,800**	**6,840**	**8,850**
Fracture Pattern	Type 4	Type 4	Type 2	Type 4	Type 1	Type 1	Type 4	Type 2	Type 2	Type 2	Type 1	Type 2

Notes:
1. The test cores were stored in plastic air tight containers after extraction from the C-107 plug until screenings at RSSI and test preparations by CTLGroup. As specified by the client, testing was performed more than the 7 days after extraction. After trimming the cores with the wet saw to the specified length per ASTM C42, the cores were stored in sealed plastic bags until testing.
2. This report represents specifically the samples submitted.
3. This report may not be reproduced except in its entirety.

Washington River Protection Solutions
Subcontract No. 46060, C-107 Concrete Core Testing
CTLGroup Project No. 395568

November 7, 2011

Appendix A
Test Results for
ASTM C215 – 08, *Standard Test Method for Fundamental Transverse, Longitudinal, and Torsional Frequencies of Concrete Specimens.*

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Client: Washington River Protection Solutions
Project: C-107 Cores from Hanford

Report Date: November 7, 2011

CTLGroup Project No.: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: J. L. Jones
Approved By: M. D'Ambrosia

ASTM C 215, Fundamental Transverse Resonant Frequencies of Concrete Specimens

Sample ID	CTLGroup ID	Mass, lbs	Diameter / Width, in.	Length, in.	Transverse frequency, Hz	Ave. Transverse frequency, Hz	Dynamic Modulus, ksi
Core #1	2870301	10.03	4.2	8.2	6550	6493	6700
					6400		
					6530		
Core #2	2870302	10.09	4.2	8.2	6480	6527	6900
					6560		
					6540		
Core #3	2870303	10.00	4.2	8.2	6480	6480	6800
					6480		
					6480		
Core #4	2870304	8.17	4.2	6.8	Note 1	Note 1	Note 1
					Note 1		
					Note 1		
Core #5	2870305	10.02	4.2	8.2	6380	6447	6700
					6480		
					6480		
Core #6	2870306	9.98	4.2	8.2	6380	6443	6900
					6470		
					6480		
Core #11	2870307	10.00	4.2	8.2	6230	6253	6300
					6230		
					6300		
Core #12	2870308	10.00	4.2	8.2	6350	6373	6500
					6430		
					6340		

Notes:
1. Core sample was too short to obtain significant results.
2. The dynamic modulus was calculated using Poisson's ratio obtained by performing ASTM C469.
3. This report may not be reproduced except in its entirety.

Client: Washington River Protection Solutions
Project: C-107 Cores from Hanford

Report Date: November 7, 2011

CTLGroup Project No.: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: J. L. Jones
Approved By: M. D'Ambrosia

ASTM C 215, Fundamental Transverse Resonant Frequencies of Concrete Specimens

Sample ID	CTLGroup ID	Mass, lbs	Diameter / Width, in.	Length, in.	Transverse frequency, Hz	Ave. Transverse frequency, Hz	Dynamic Modulus, ksi
Core #13	2870309	9.98	4.2	8.2	6320	6313	6400
					6310		
					6310		
Core #14	2870310	8.50	4.2	7.0	Note 1	Note 1	Note 1
					Note 1		
					Note 1		
Core #15	2870311	9.98	4.2	8.2	6270	6343	6600
					6380		
					6380		
Core #17	2870312	10.02	4.2	8.2	6540	6480	6700
					6450		
					6450		
Core #19	2870313	10.04	4.2	8.2	6260	6320	6400
					6350		
					6350		
Core #20	2870314	10.12	4.2	8.2	6380	6393	6600
					6420		
					6380		

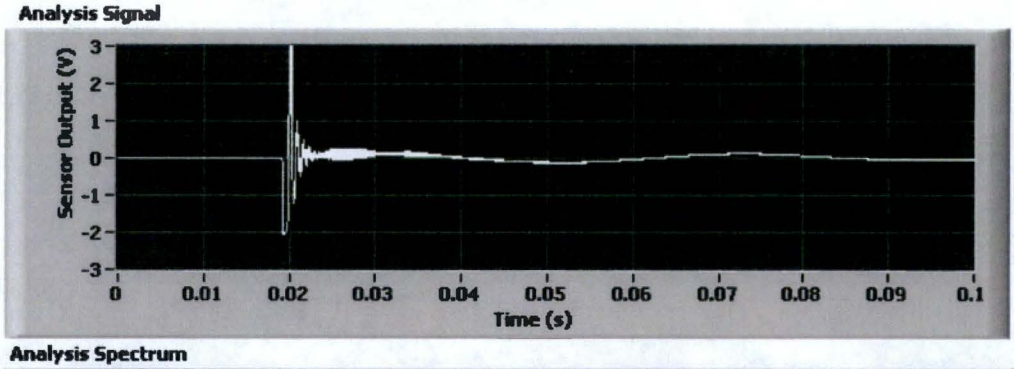
Notes:
1. Core sample was too short to obtain significant results.
2. The dynamic modulus was calculated using Poisson's ratio obtained by performing ASTM C469.
3. This report may not be reproduced except in its entirety.

Washington River Protection Solutions
Subcontract No. 46060: Testing of C-107 Cores from Hanford
CTLGroup Project No. 395568

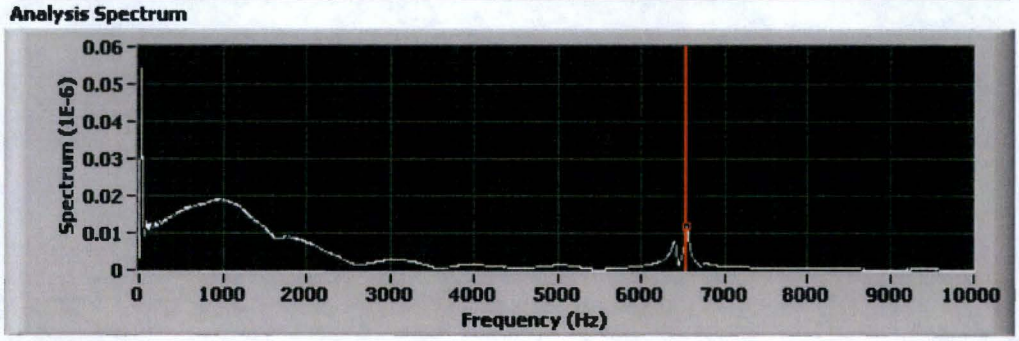
November 7, 2011

Core #1 – Reading 1, Resonant Frequency = 6550 Hz

Analysis Signal

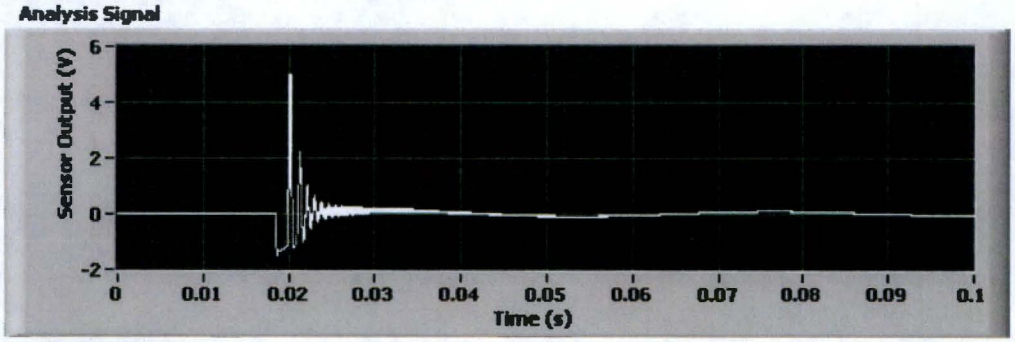


Analysis Spectrum

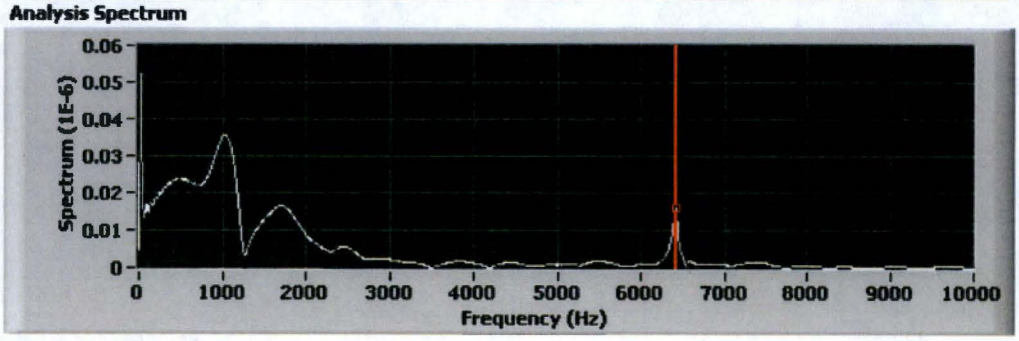


Core #1 – Reading 2, Resonant Frequency = 6400 Hz

Analysis Signal



Analysis Spectrum



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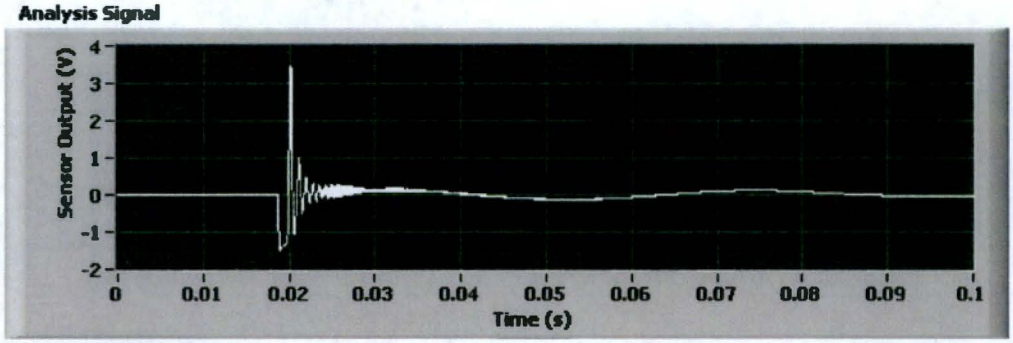
Washington River Protection Solutions
Subcontract No. 46060: Testing of C-107 Cores from Hanford
CTLGroup Project No. 395568

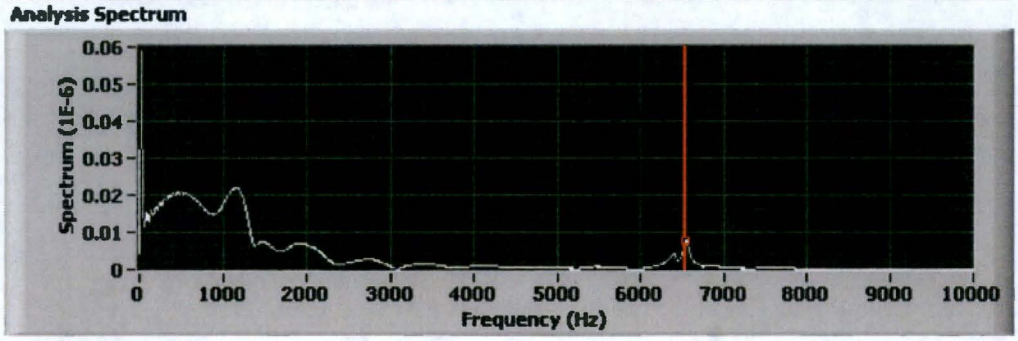
November 7, 2011

Core #1 Reading #3, Resonant Frequency = 6530 Hz

Analysis Signal

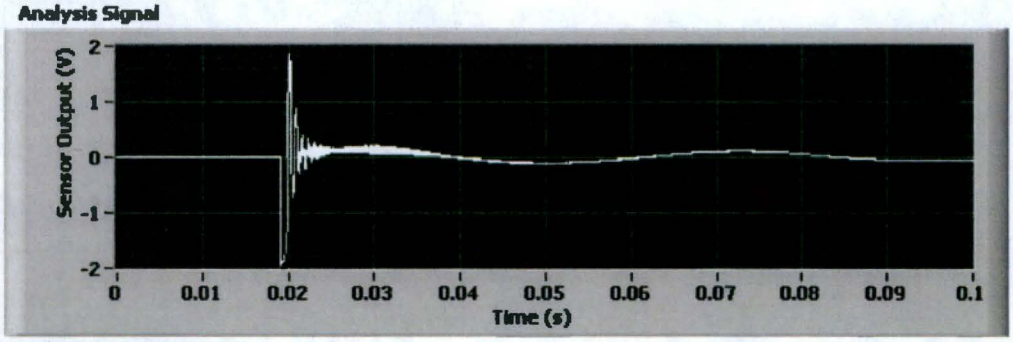


Analysis Spectrum

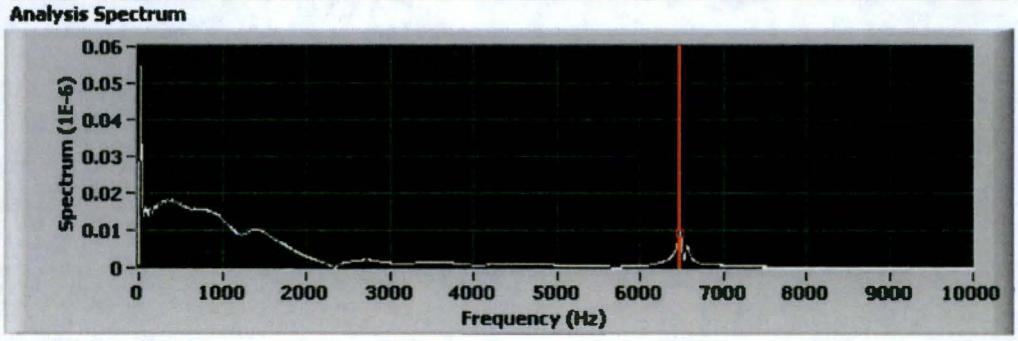


Core #2 Reading 1, Resonant Frequency = 6480 Hz

Analysis Signal



Analysis Spectrum



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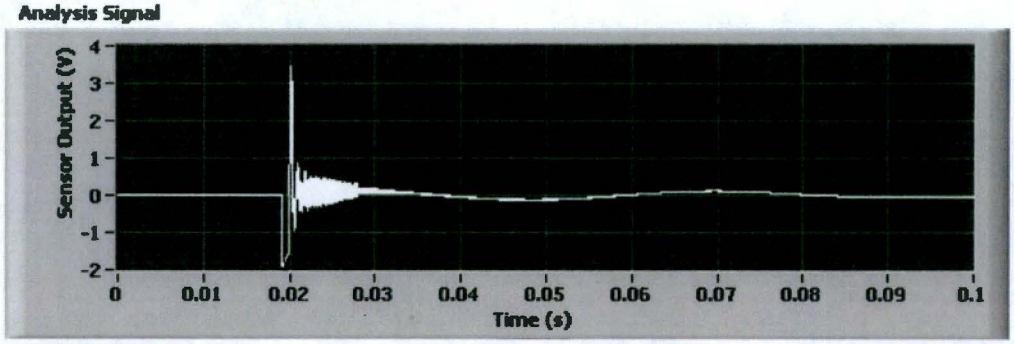
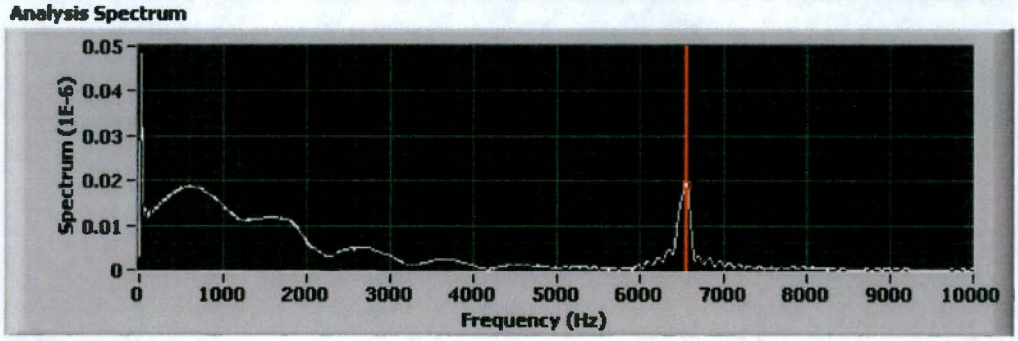
Core #2 Reading 2, Resonant Frequency = 6560 Hz

Analysis Signal

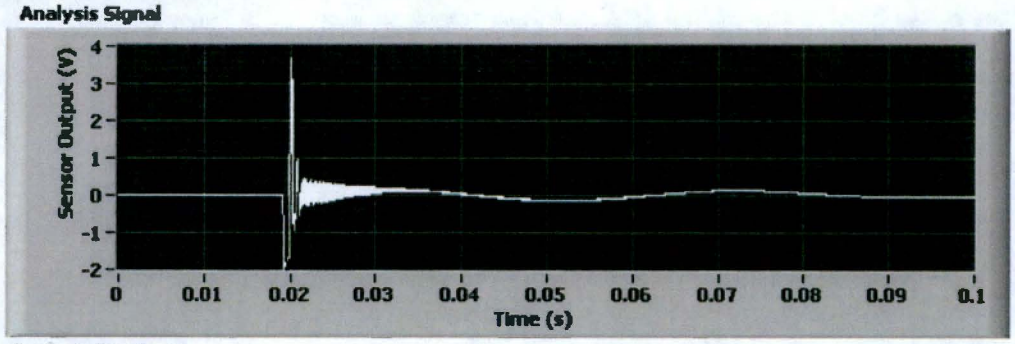


Analysis Spectrum

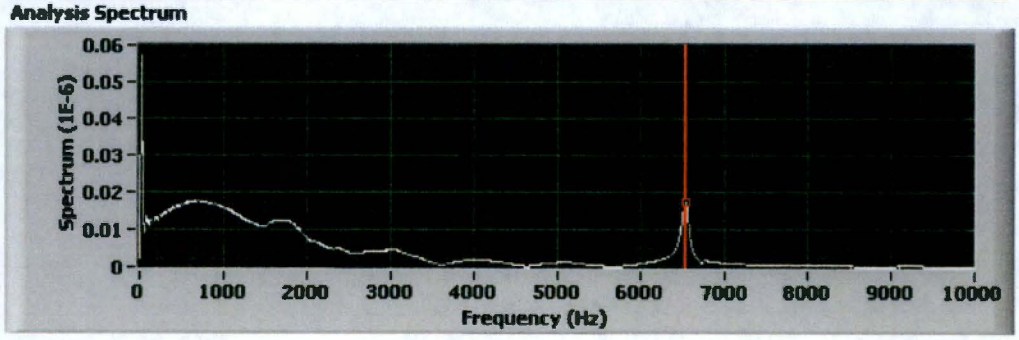


Core #2 Reading 3, Resonant Frequency = 6560 Hz

Analysis Signal



Analysis Spectrum



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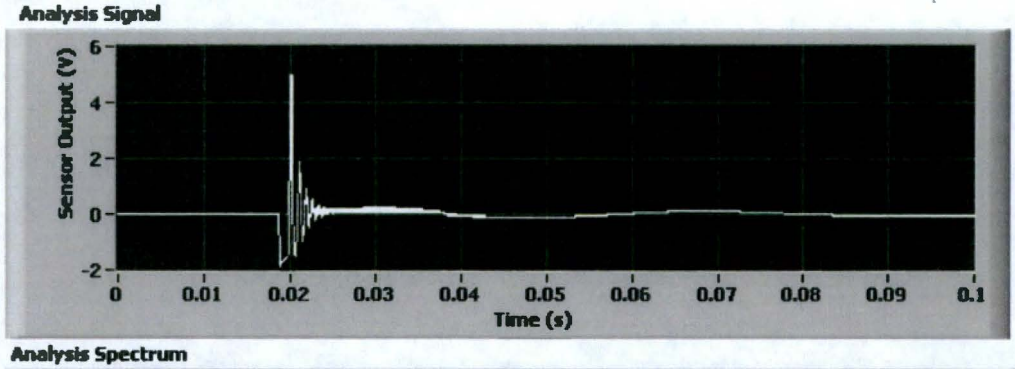
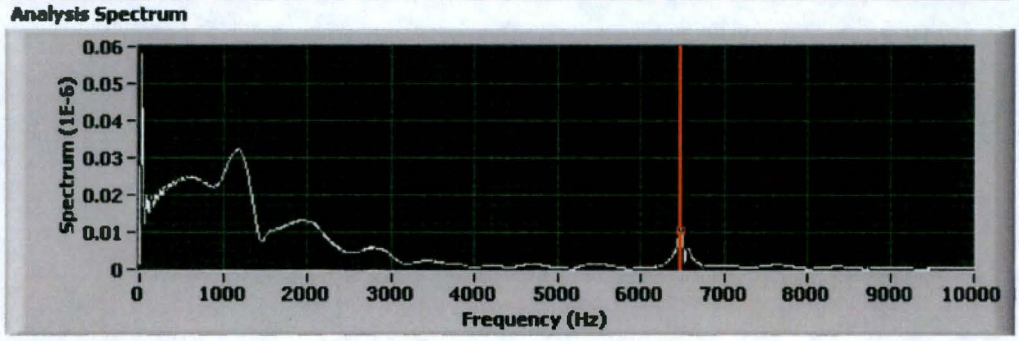
Core #3 Reading 2, Resonant Frequency = 6480 Hz

Analysis Signal

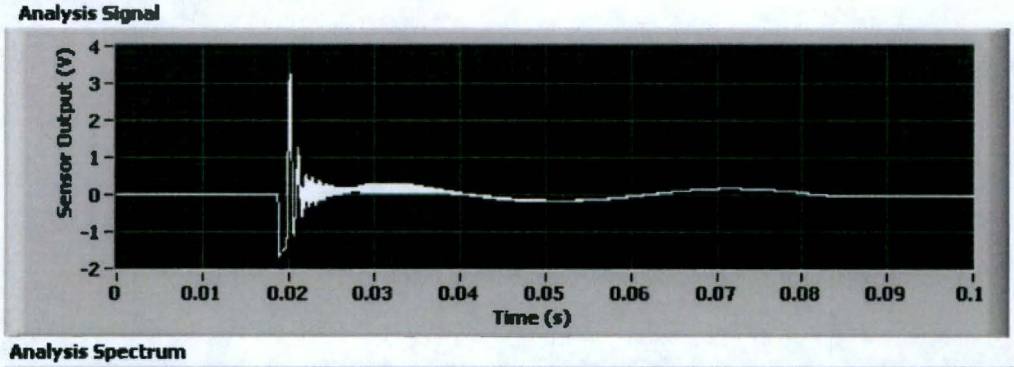


Analysis Spectrum

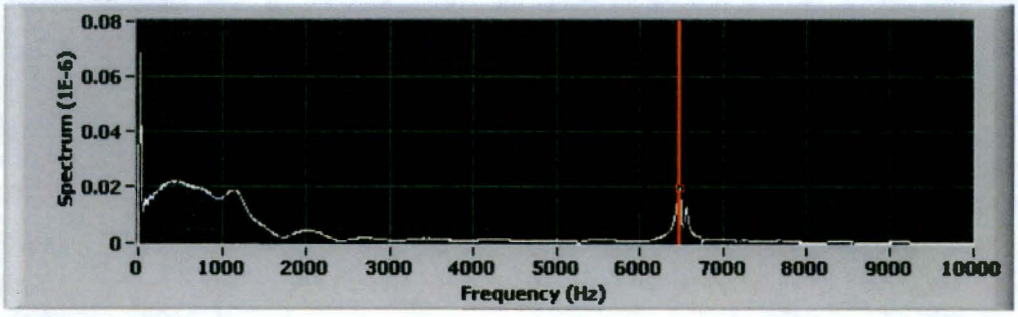


Core #3 Reading 3, Resonant Frequency = 6480 Hz

Analysis Signal



Analysis Spectrum



Note: Graphs for reading 1 from Core #3 was inadvertently not saved.

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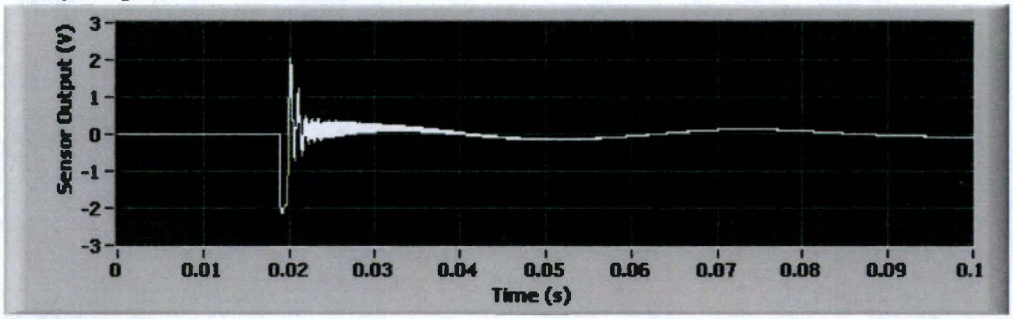
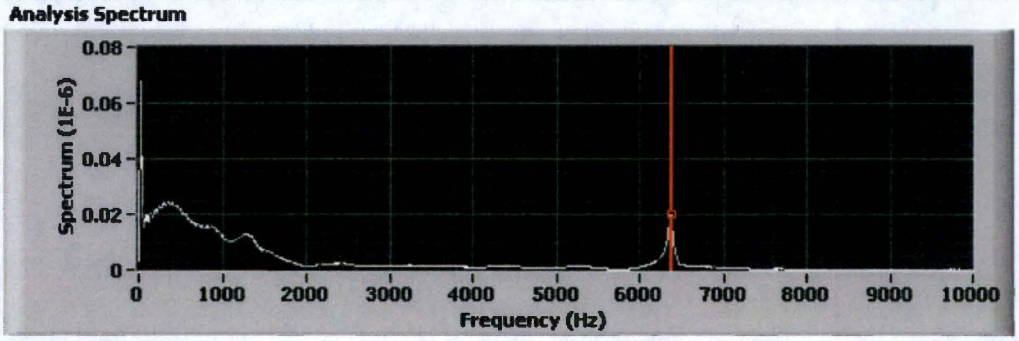
Core #5 Reading 1, Resonant Frequency = 6380 Hz

Analysis Signal

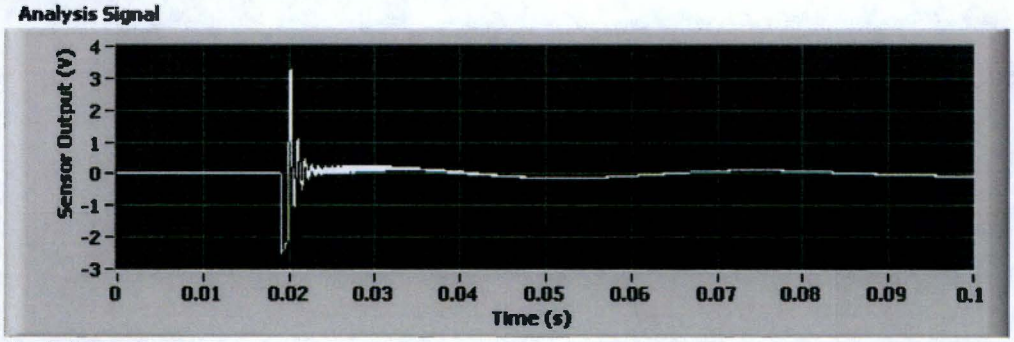


Analysis Spectrum

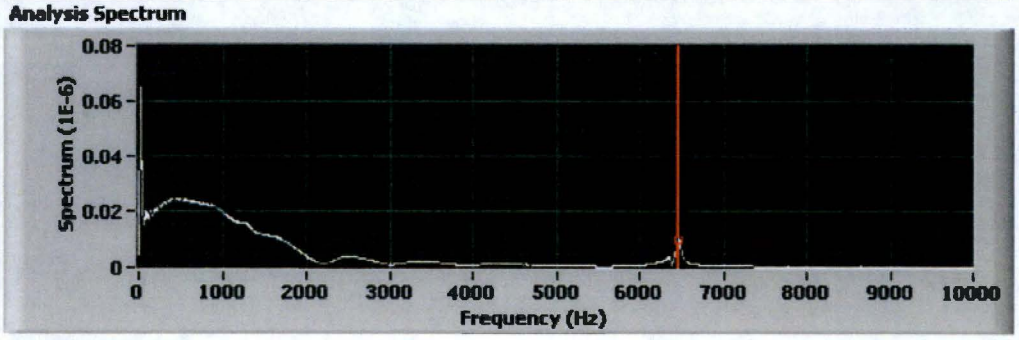


Core #5 Reading 2, Resonant Frequency = 6480 Hz

Analysis Signal



Analysis Spectrum



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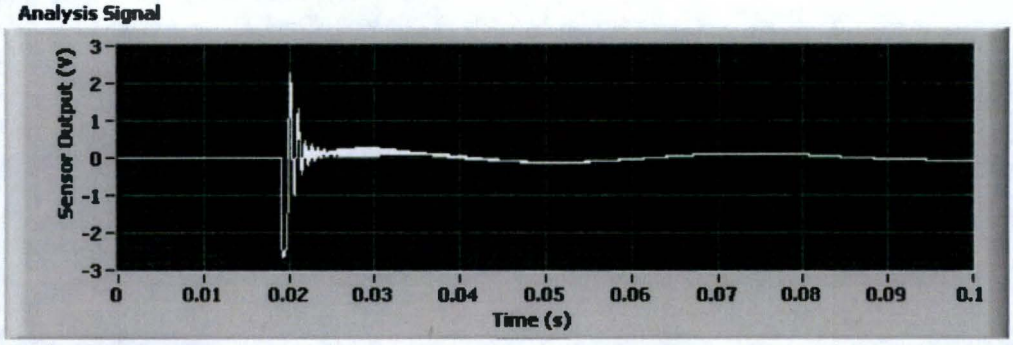
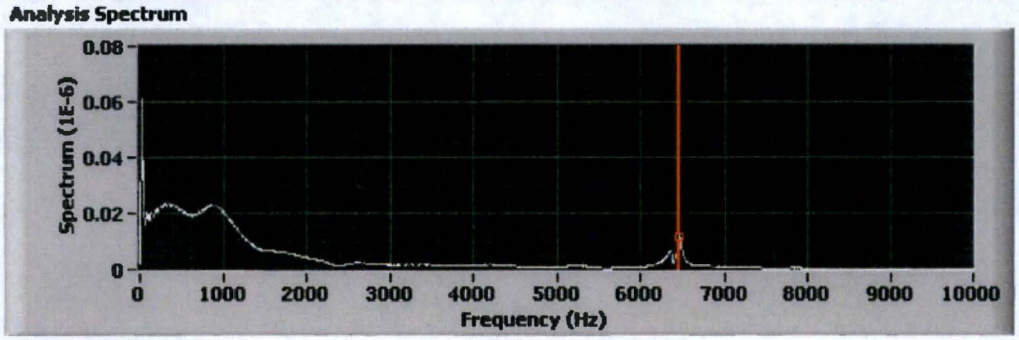
Core #5 Reading 3, Resonant Frequency = 6480 Hz

Analysis Signal

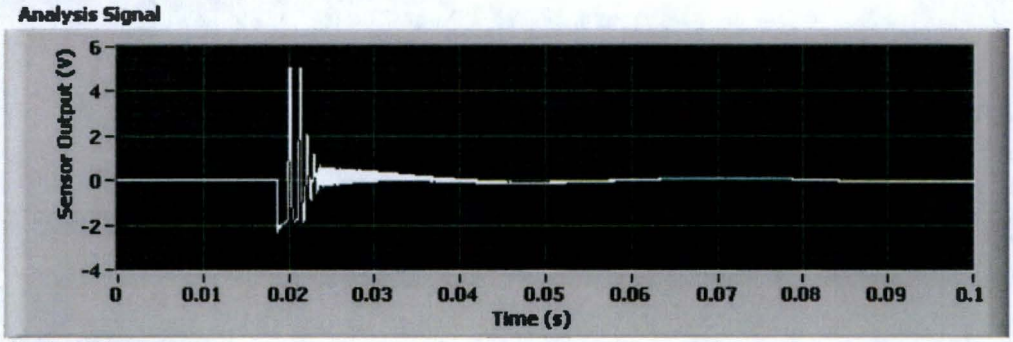


Analysis Spectrum

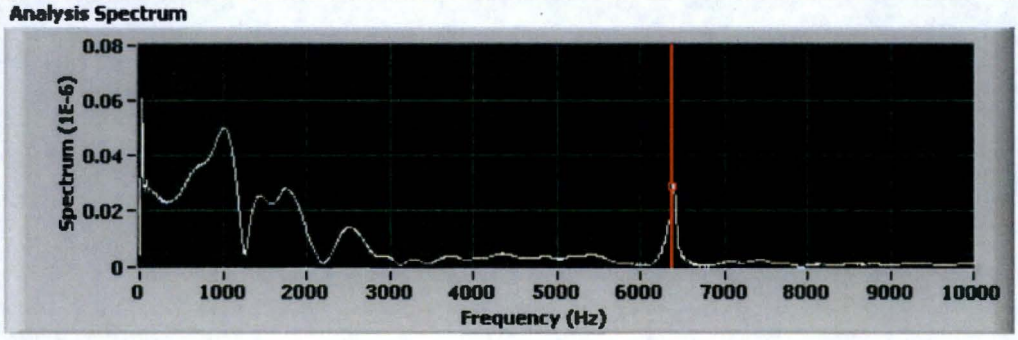


Core #6 Reading 1, Resonant Frequency = 6380 Hz

Analysis Signal



Analysis Spectrum



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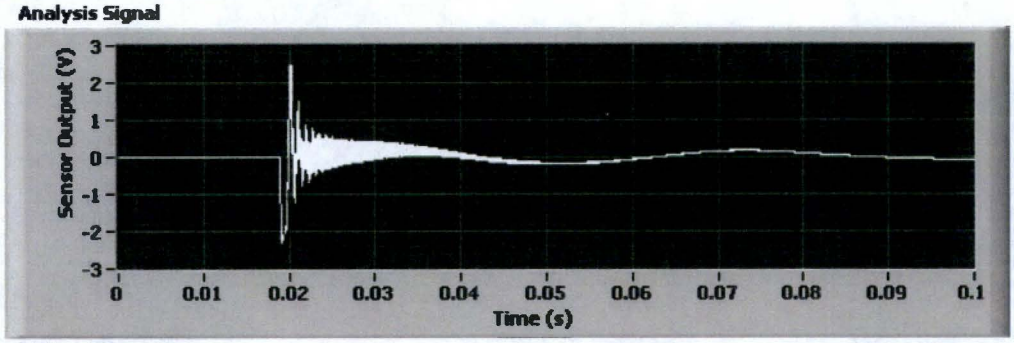
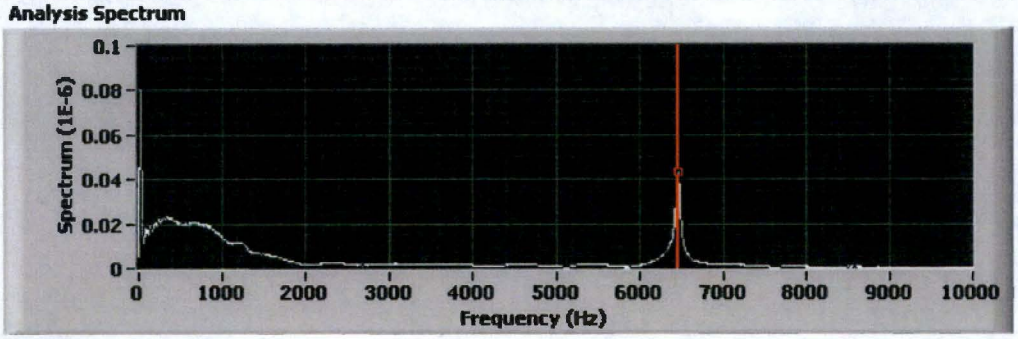
Core #6 Reading 2, Resonant Frequency = 6470 Hz

Analysis Signal

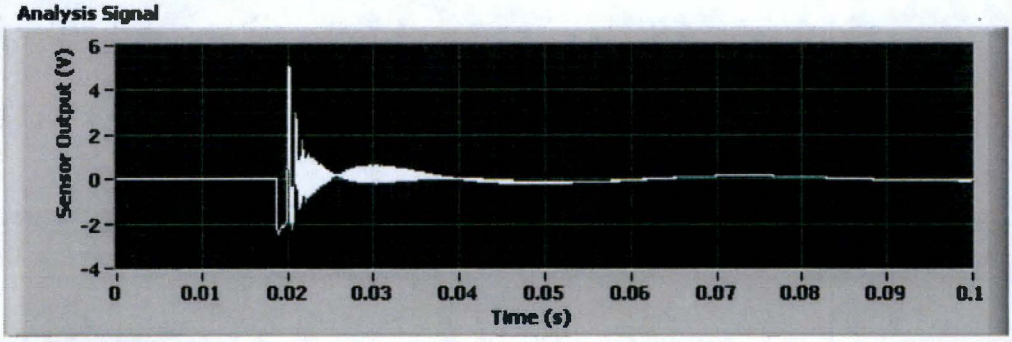


Analysis Spectrum

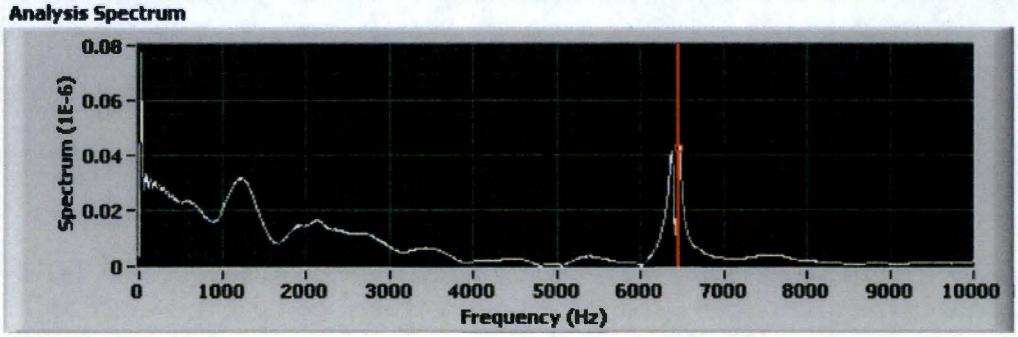


Core #6 Reading 3, , Resonant Frequency = 6480 Hz

Analysis Signal



Analysis Spectrum



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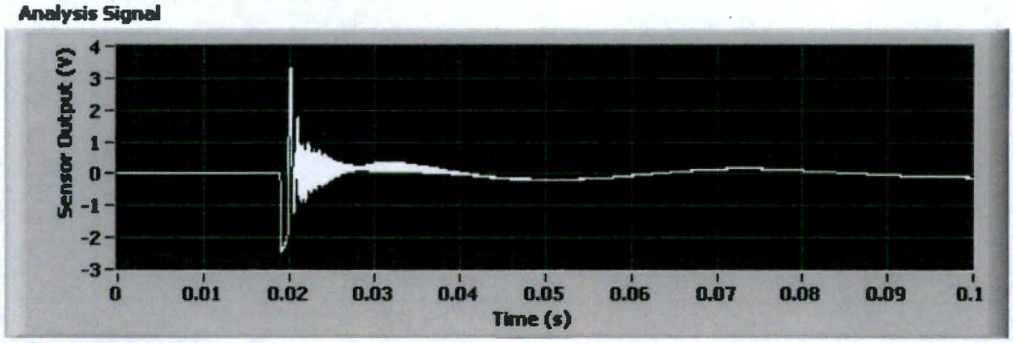
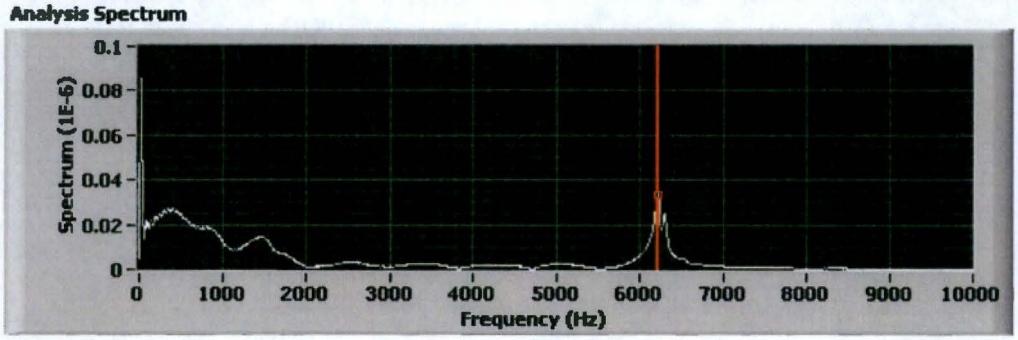
Core #11 Reading 1, Resonant Frequency = 6230 Hz

Analysis Signal

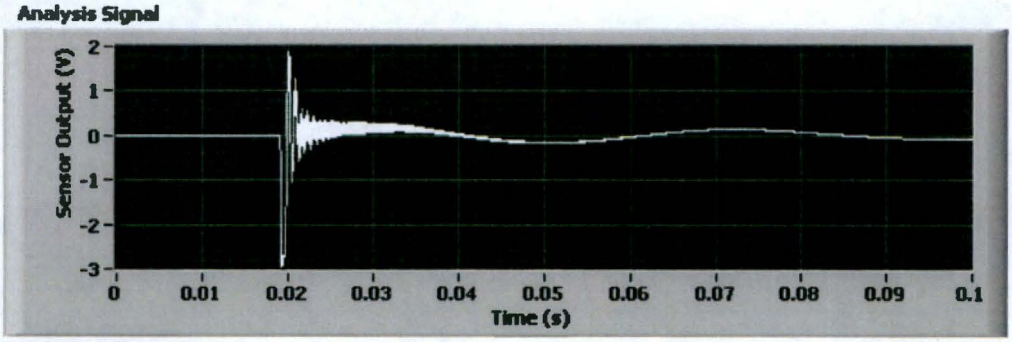


Analysis Spectrum

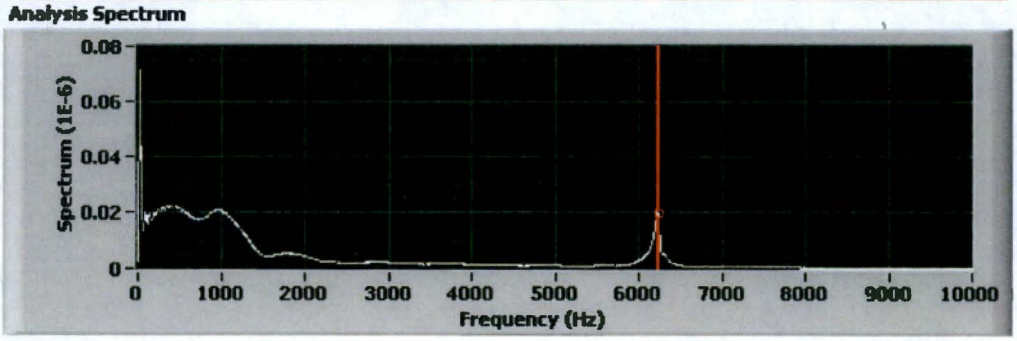


Core #11 Reading 2, Resonant Frequency = 6280 Hz

Analysis Signal



Analysis Spectrum



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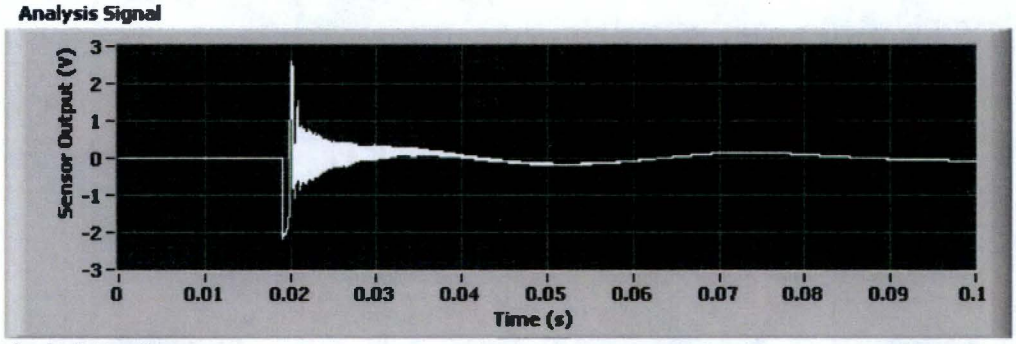
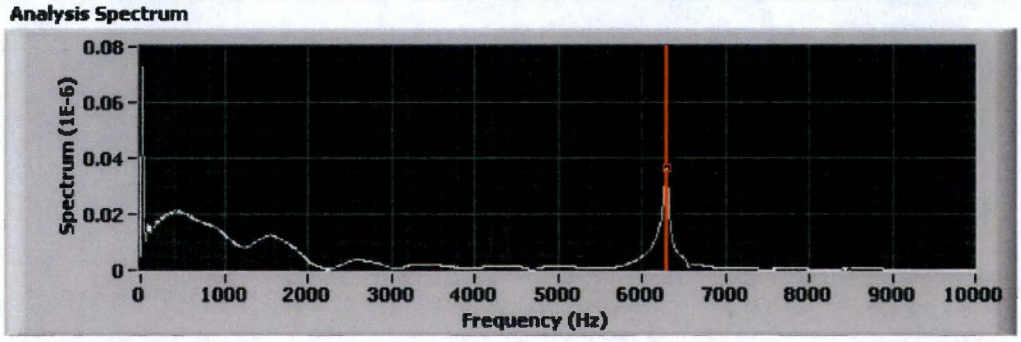
Core #11 reading 3, Resonant Frequency = 6300 Hz

Analysis Signal

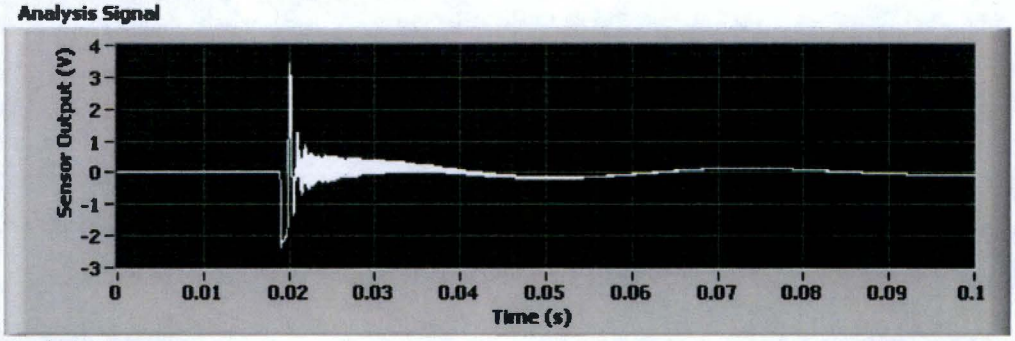


Analysis Spectrum

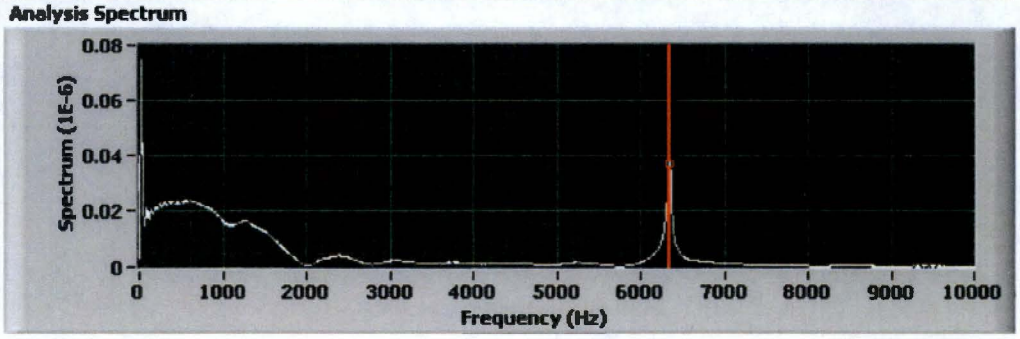


Core #12 reading 1, Resonant Frequency = 6350 Hz

Analysis Signal



Analysis Spectrum



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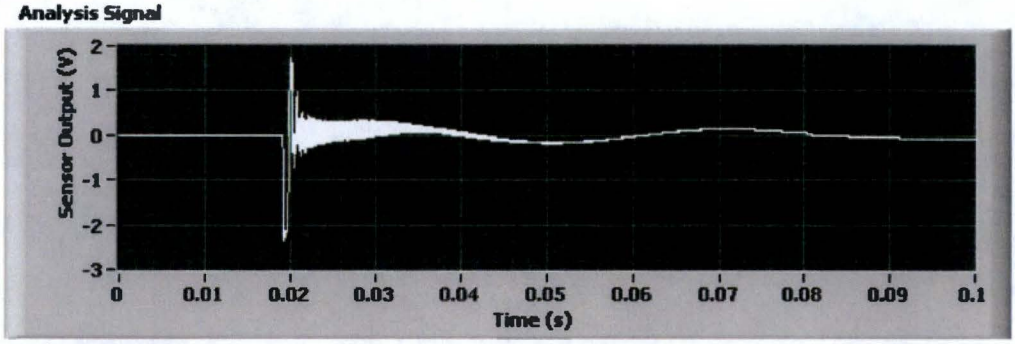
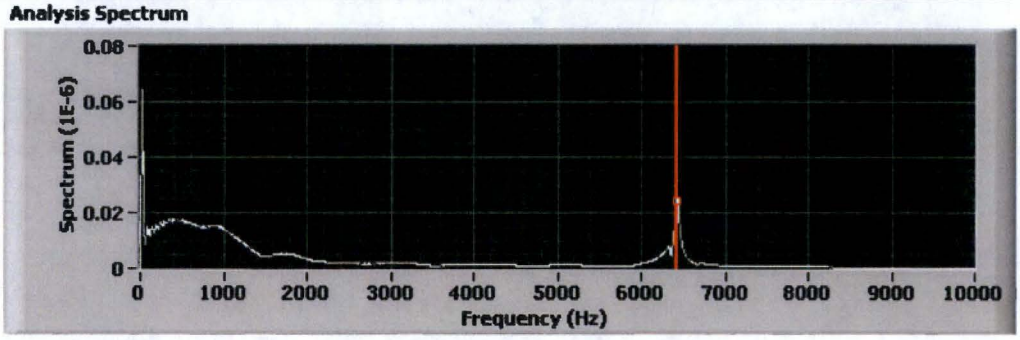
Core #12 Reading 2, Resonant Frequency = 6430 Hz

Analysis Signal

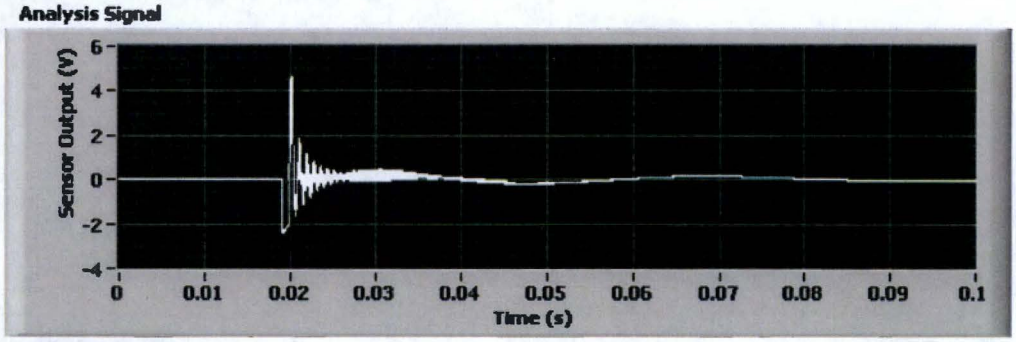


Analysis Spectrum

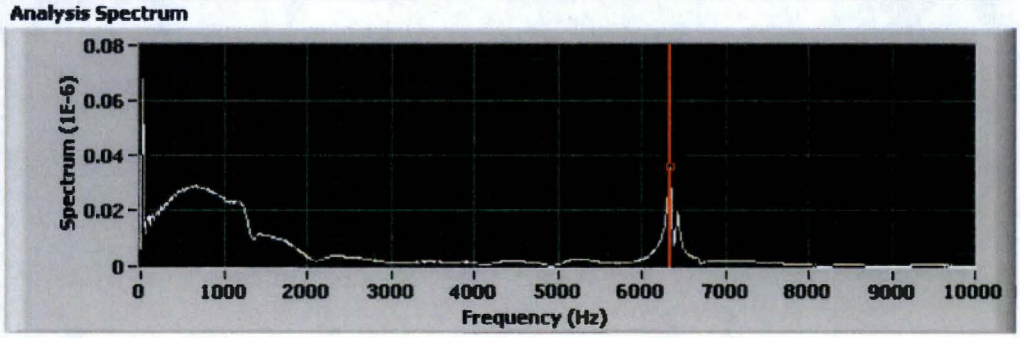


Core #12 Reading 3, Resonant Frequency = 6340 Hz

Analysis Signal



Analysis Spectrum



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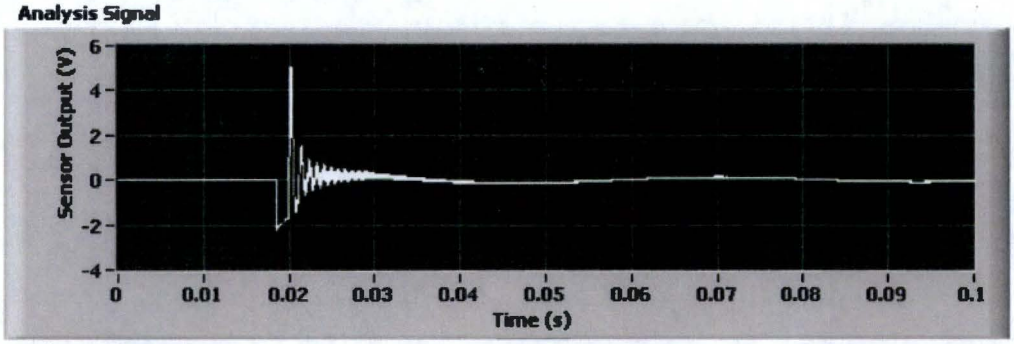
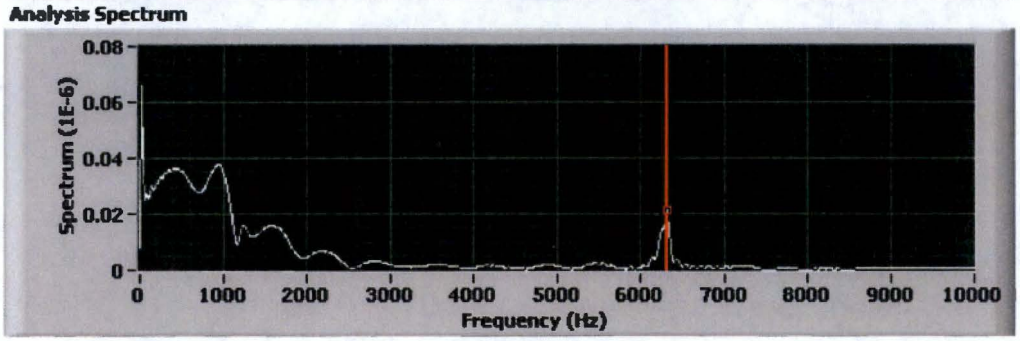
Core #13 Reading 1, Resonant Frequency = 6320 Hz

Analysis Signal

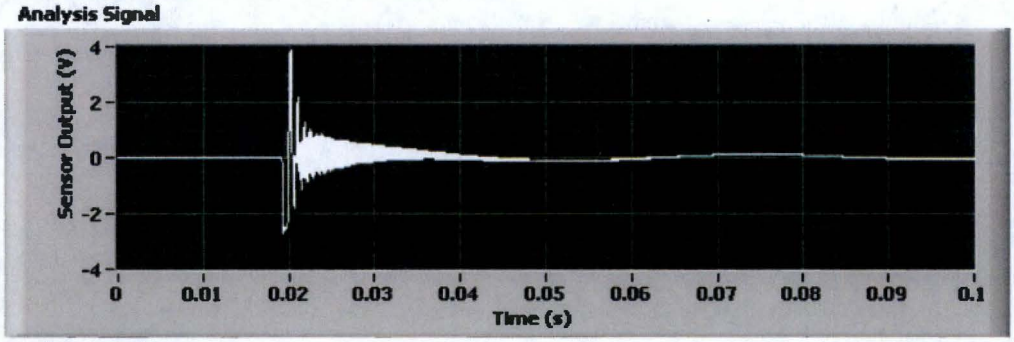


Analysis Spectrum

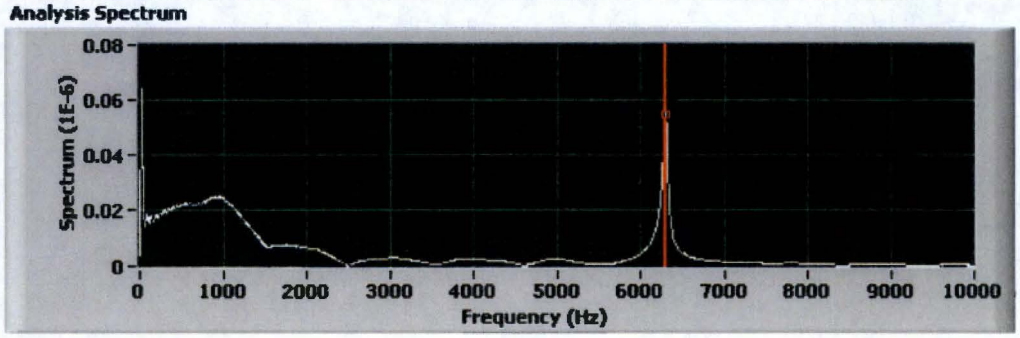


Core #13 Reading 2, Resonant Frequency = 6310 Hz

Analysis Signal



Analysis Spectrum



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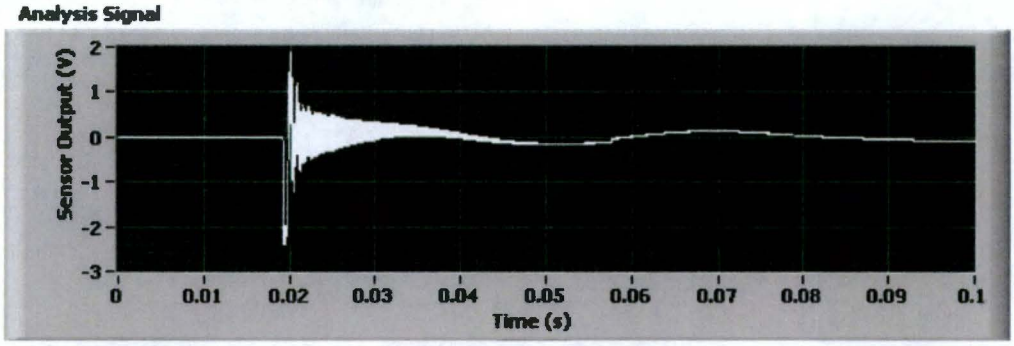
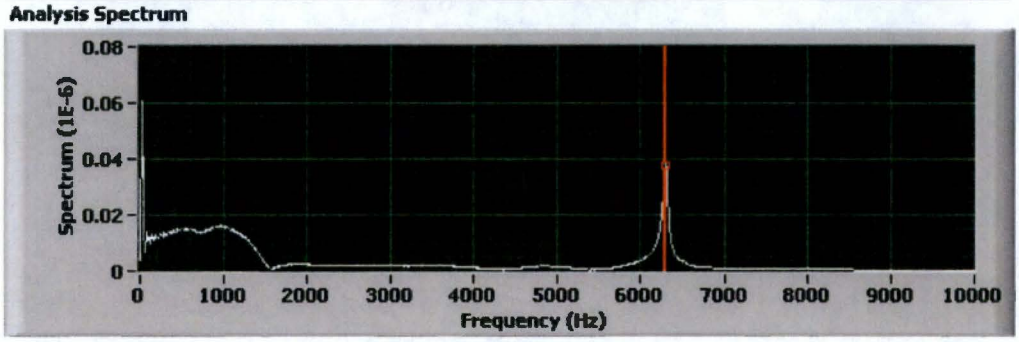
Core #13 Reading 3, Resonant Frequency = 6310 Hz

Analysis Signal

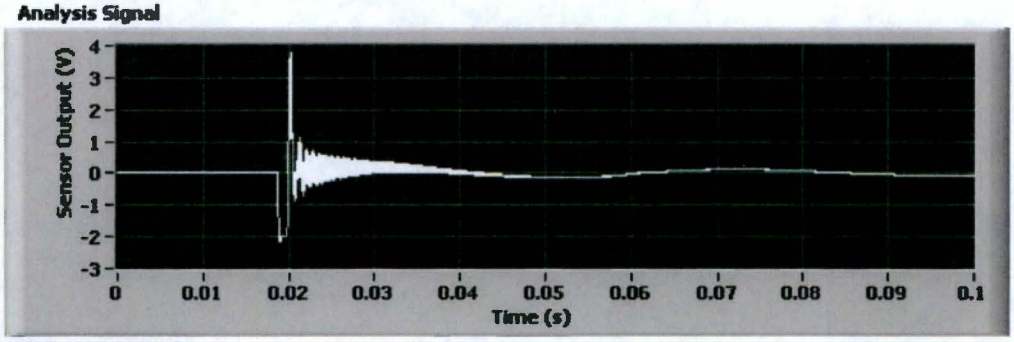


Analysis Spectrum

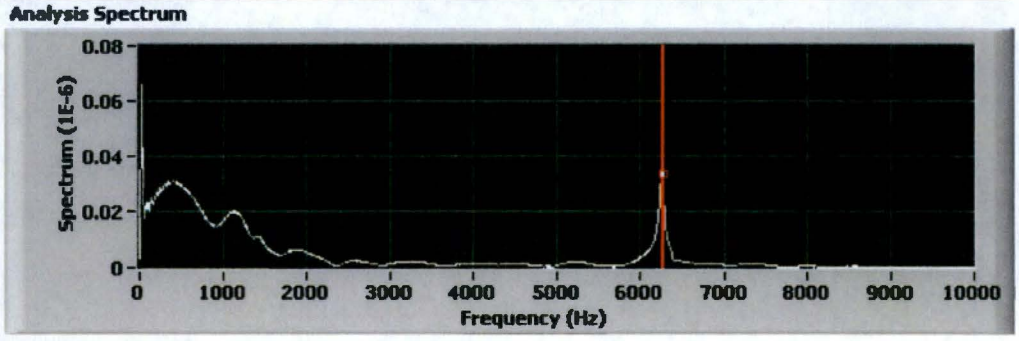


Core #15 Reading 1, Resonant Frequency = 6270 Hz

Analysis Signal



Analysis Spectrum



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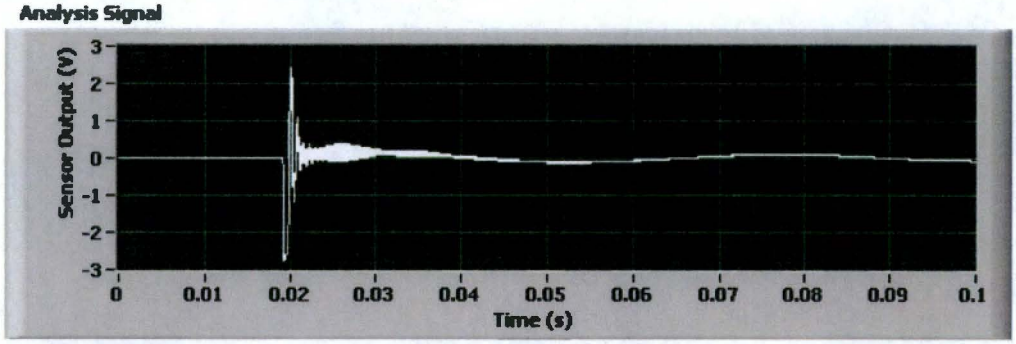
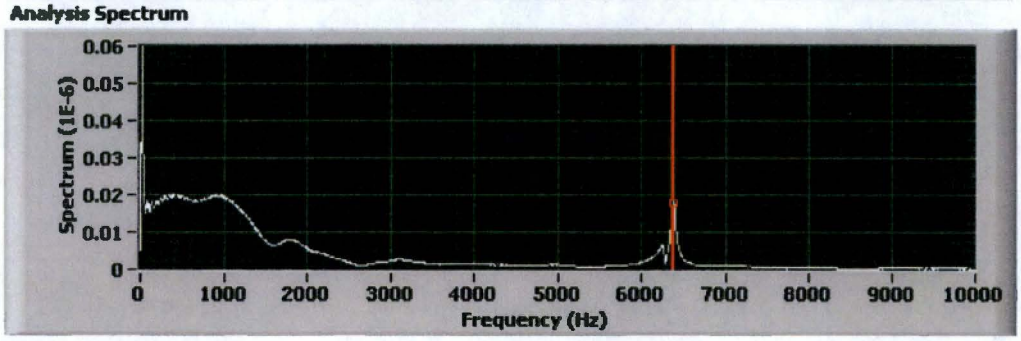
Core #15 Reading 2, Resonant Frequency = 6380 Hz

Analysis Signal

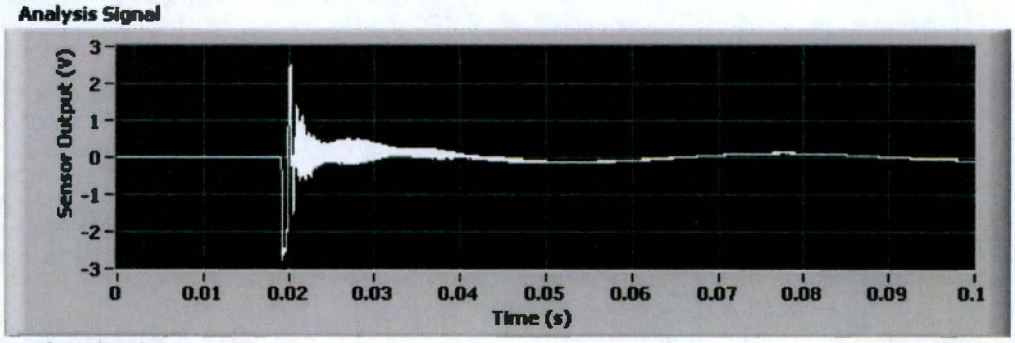


Analysis Spectrum

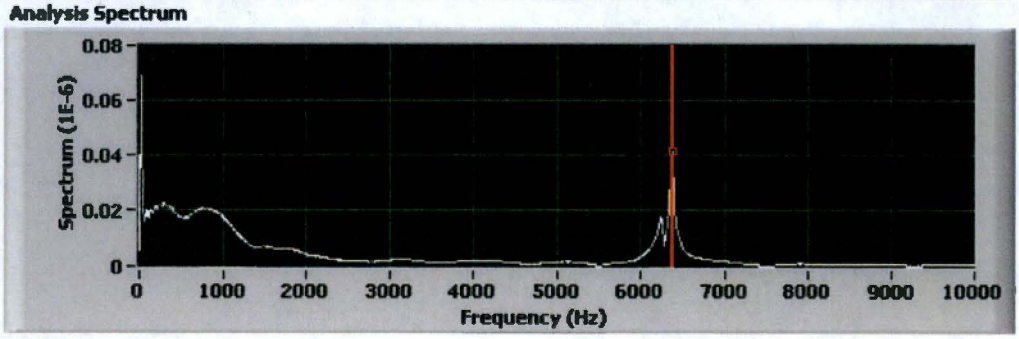


Core #15 Reading 3, Resonant Frequency = 6380 Hz

Analysis Signal



Analysis Spectrum



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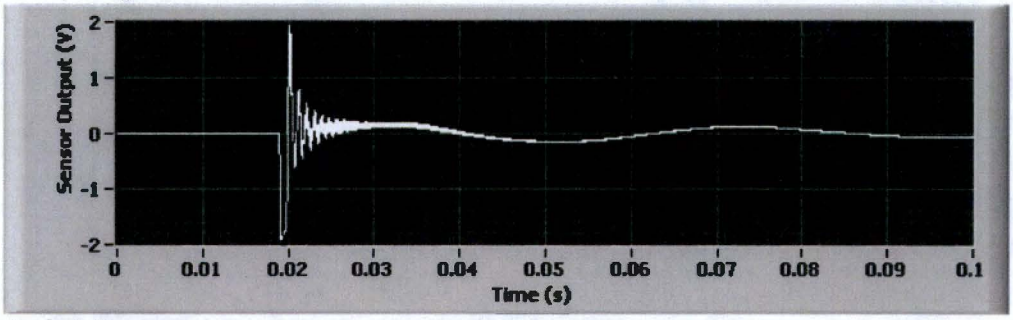
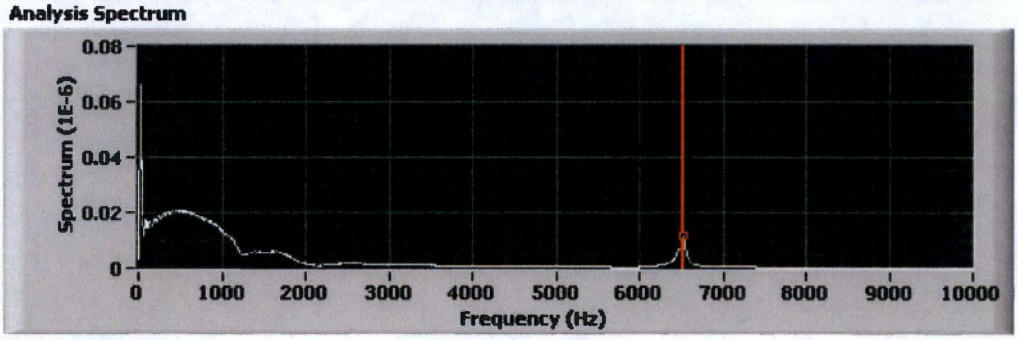
Core #17 Reading 1, Resonant Frequency = 6540 Hz

Analysis Signal

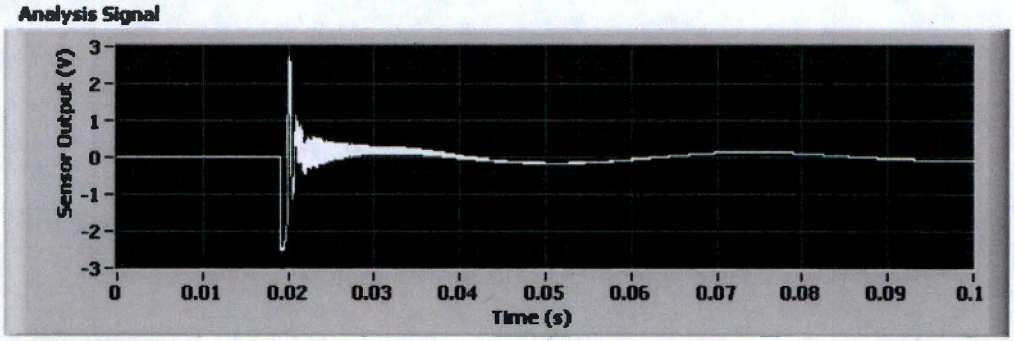


Analysis Spectrum

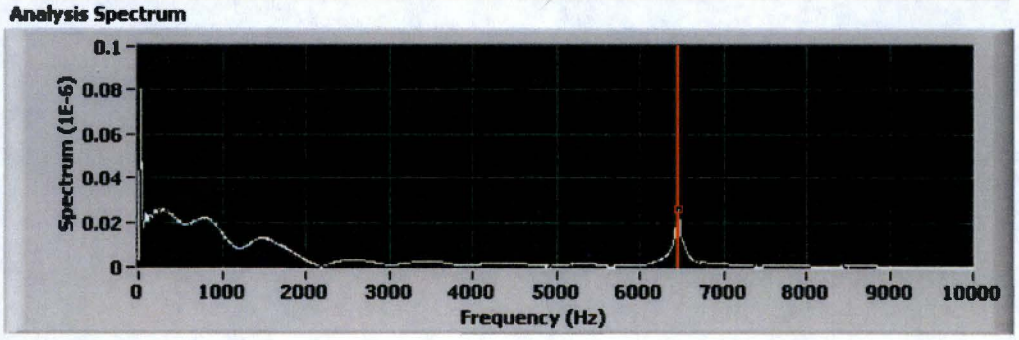


Core #17 Reading 2, Resonant Frequency = 6450 Hz

Analysis Signal



Analysis Spectrum



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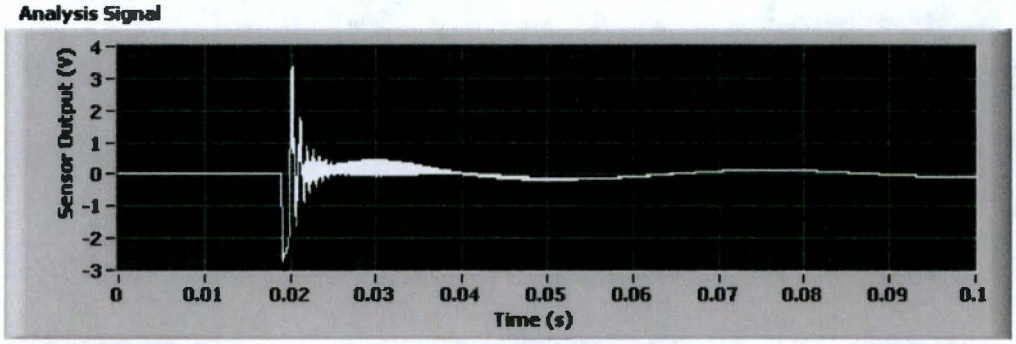
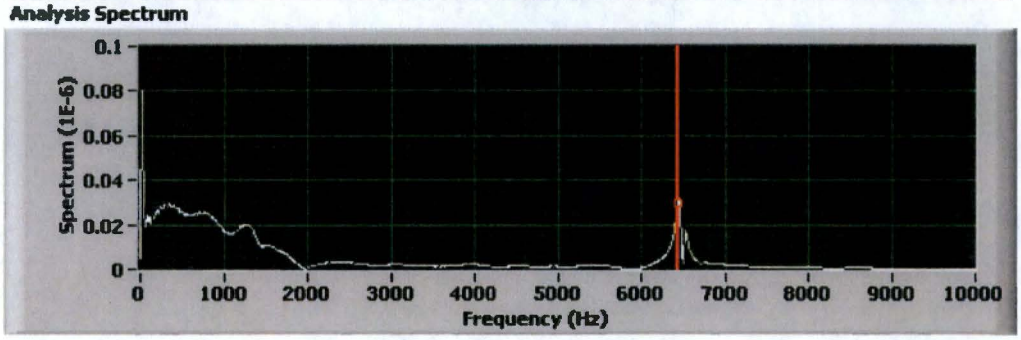
Core #17 Reading 3, Resonant Frequency = 6450 Hz

Analysis Signal

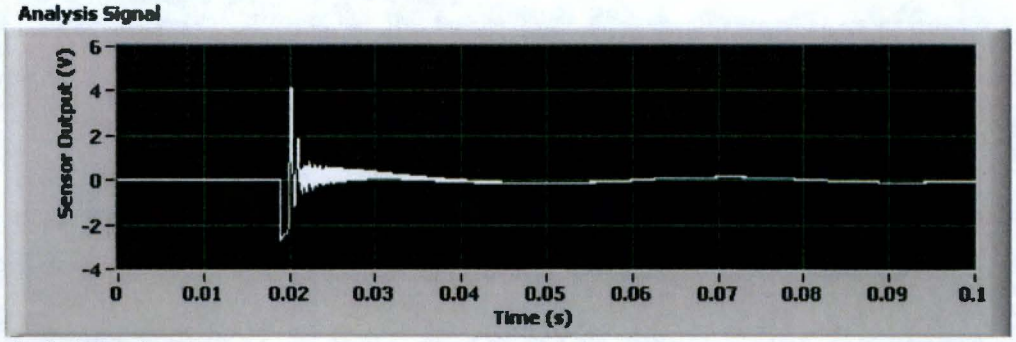


Analysis Spectrum



Core #19 Reading 1, Resonant Frequency = 6260 Hz

Analysis Signal



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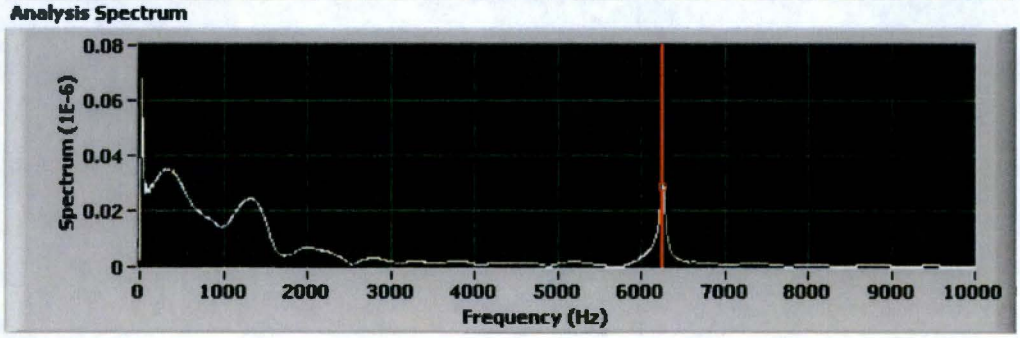

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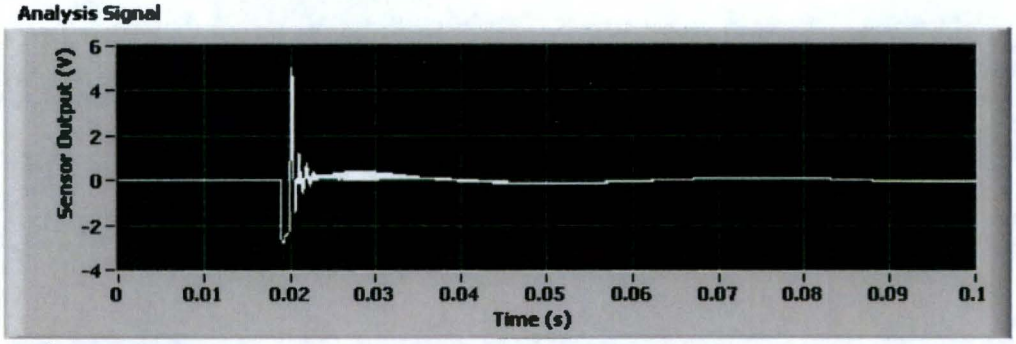
CTLGroup Project No. 395568

November 7, 2011

Core #19 Reading 2, Resonant Frequency = 6350 Hz

Analysis Signal



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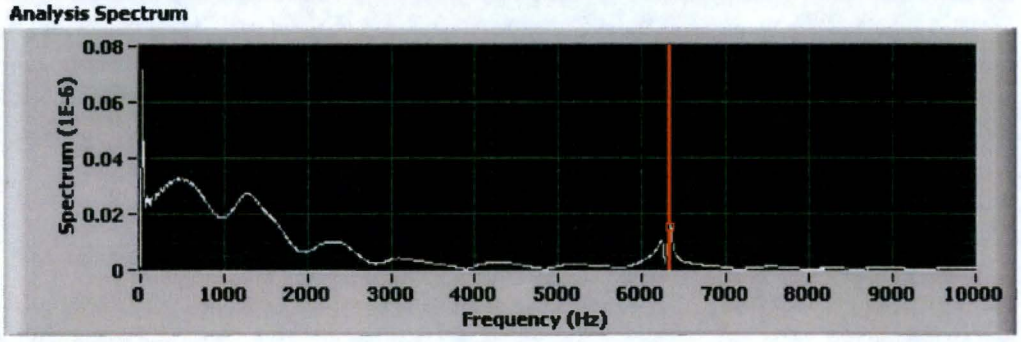
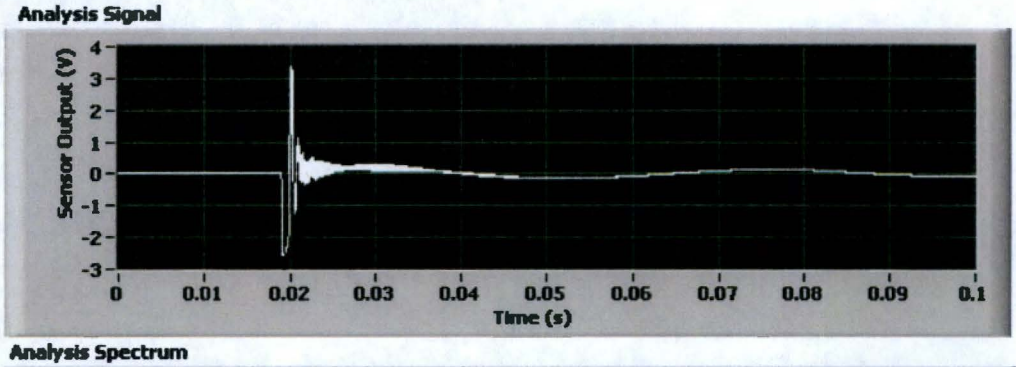
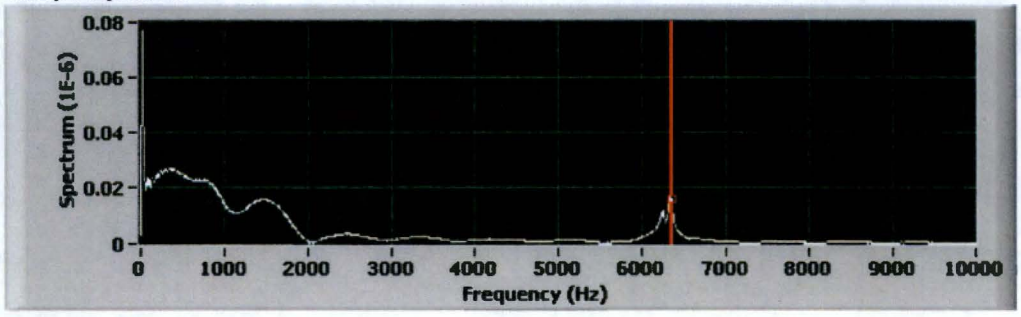


Core #19 Reading 3, Resonant Frequency = 6350 Hz

Analysis Signal



Analysis Spectrum

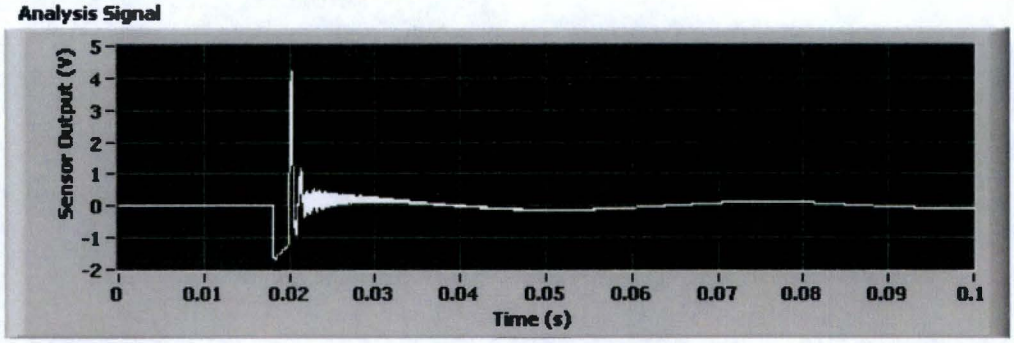


Washington River Protection Solutions
Subcontract No. 46060: Testing of C-107 Cores from Hanford
CTLGroup Project No. 395568

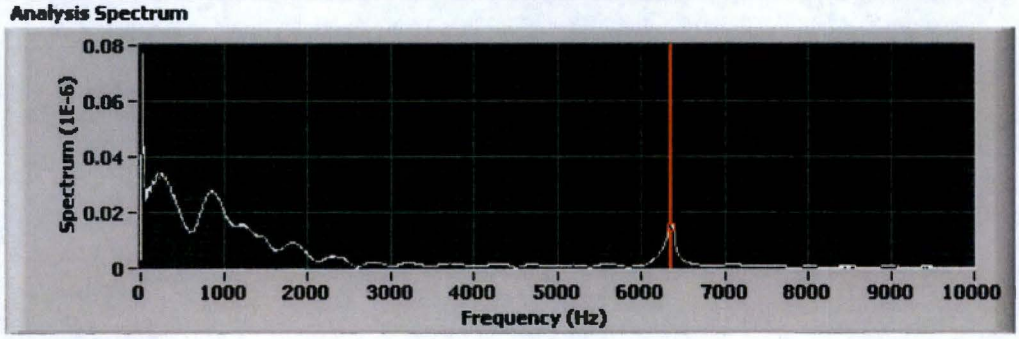
November 7, 2011

Core #20 Reading 1, Resonant Frequency = 6380 Hz

Analysis Signal

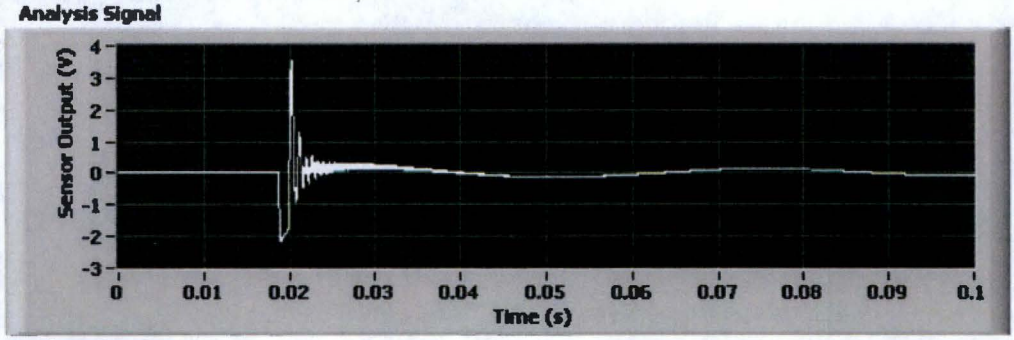


Analysis Spectrum

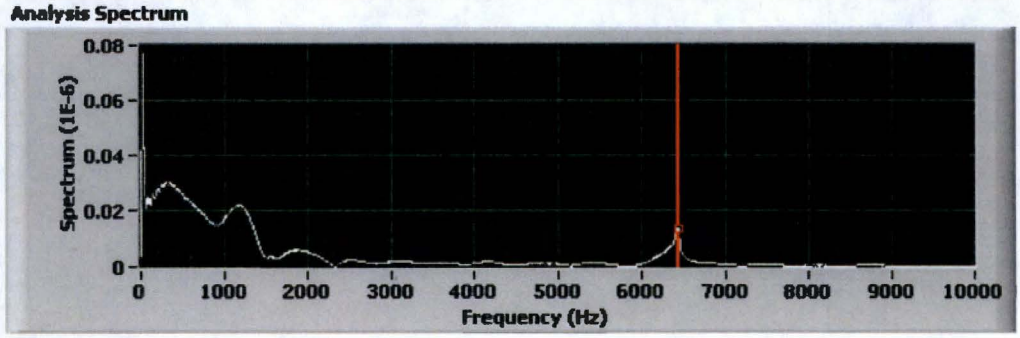


Core #20 Reading 2, Resonant Frequency = 6420 Hz

Analysis Signal



Analysis Spectrum



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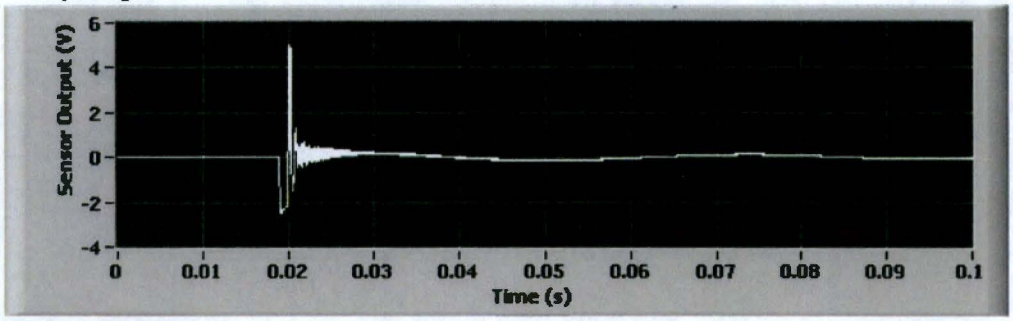
Subcontract No. 46060: Testing of C-107 Cores from Hanford
CTLGroup Project No. 395568

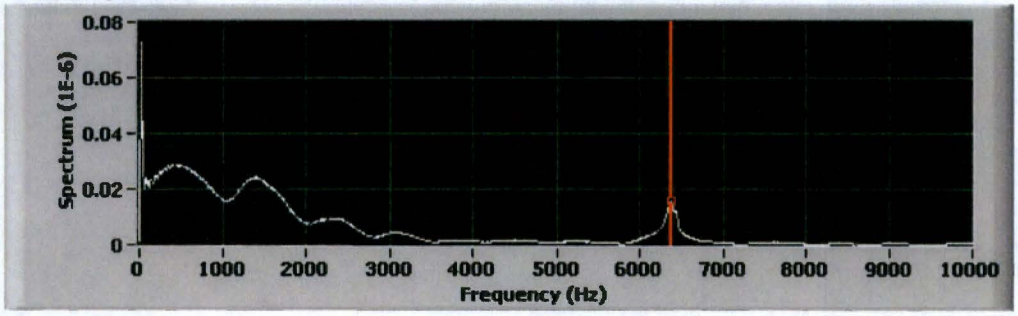
November 7, 2011

Core #20 Reading 3, Resonant Frequency = 6380 Hz

Analysis Signal



Analysis Spectrum



Washington River Protection Solutions
Subcontract No. 46060, C-107 Concrete Core Testing
CTLGroup Project No. 395568

November 7, 2011

Appendix B
Test Results for
ASTM C469 / C469M – 10, *Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression*

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Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Contact: Mr. Richard Rast
Submitter: Mr. Richard Rast

CTLGroup Project No: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved: M. D'Ambrosia
Date: August 30, 2011

Test Results of Modified ASTM C469-02
Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

Core Identification: **Core #1**

Diameter 1 (in.)	4.20
Diameter 2 (in.)	4.21
Cross-sectional Area (in.^{2})	13.89
Length Trimmed (in.)	8.22
Length Capped (in.)	8.30
Weight in Air (lb)	10.03
Calculated Unit Weight (pcf)	152
Load Increment (lbs)	3,400
Maximum Load (lbs)	137,600
Compressive Strength (psi)	**9,910**
Ratio of Capped Length to Dia.	1.97
Correction Factor	1.00
Corrected f_c (psi)	**9910**
20% f_c (psi)	**1,982**

Measured E_c Linear Reg. (psi)	**5,900,000**
ASTM Ec @ 20% fc (psi)	**5,910,000**
ASTM Ec @ 20% fc (psi) nearest 50,000 psi	**5,900,000**
ASTM E_c @ 450 µstrain (psi)	**5,750,000**

Longitudinal Input Data

Multiplication Factor	2.1005
Gage Length (in.)	8
No. of Readings	11
Rig Factor*	1.07

Transverse Input Data

Multiplication Factor	2.3278689
Gage Length (in.)**	4.21
No. of Readings	11
Rig Factor*	0.98
Poisson's Ratio	**0.20**

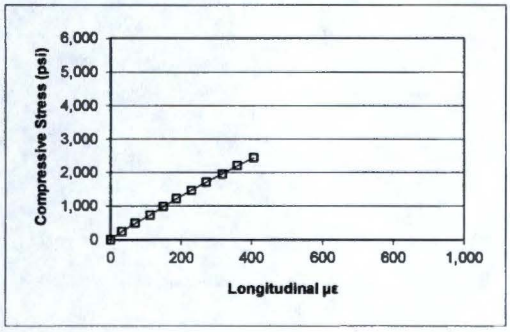
* rig factor = (gage length x multiplication factor) ÷ 10
** if cylinders are cores, gage length = diameter

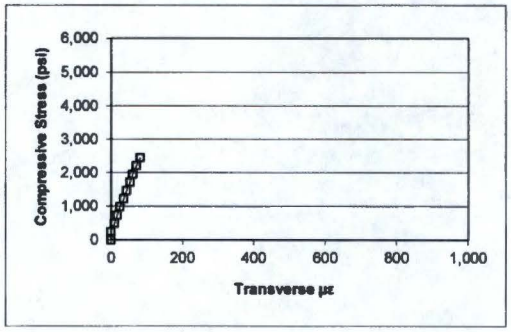
Longitudinal Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain	3-pt tang. E_c (psi)
1	0	10	10	0	--
2	245	45	45	33	6,970,000
3	490	85	85	70	6,150,000
4	734	130	130	112	6,150,000
5	979	170	170	150	6,540,000
6	1,224	210	210	187	6,150,000
7	1,469	255	255	229	5,820,000
8	1,714	300	300	271	5,500,000
9	1,959	350	350	318	5,500,000
10	2,203	395	395	360	5,500,000
11	2,448	445	445	407	

Transverse Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain
1	0	10	15	0
2	245	10	15	0
3	490	20	25	10
4	734	30	30	18
5	979	35	40	26
6	1,224	45	50	36
7	1,469	55	55	43
8	1,714	65	65	54
9	1,959	70	75	61
10	2,203	80	85	72
11	2,448	90	95	82





Notes:
1. The compressive strength was not known prior to testing. Strain measurements were only measured up to 20% of the ultimate load which modified the test method.
2. The modulus and Poisson's ratio are based on 20% of the ultimate load.
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CTLGROUP

Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Contact: Mr. Richard Rast
Submitter: Mr. Richard Rast

CTLGroup Project No: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved: M. D'Ambrosia
Date: August 30, 2011

Test Results of ASTM C469-02
Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

Core Identification: **Core #2**

Diameter 1 (in.)	4.20
Diameter 2 (in.)	4.21
Cross-sectional Area (in.^{2})	13.89
Length Trimmed (in.)	8.23
Length Capped (in.)	8.50
Weight in Air (lb)	10.09
Calculated Unit Weight (pcf)	153
Load Increment (lbs)	7,000
Maximum Load (lbs)	134,600
Compressive Strength (psi)	**9,690**
Ratio of Capped Length to Dia.	2.02
Correction Factor	1.00
Corrected f_c (psi)	**9690**
40% f_c (psi)	**3,876**

Measured E_c Linear Reg. (psi)	**6,450,000**
ASTM E_c @ 40% f_c (psi)	**6,480,000**
ASTM E_c @ 40% f_c (psi) nearest 50,000 psi	**6,500,000**
ASTM E_c @ 400 µstrain (psi)	**6,450,000**

Longitudinal Input Data

Multiplication Factor	2.1005
Gage Length (in.)	8
No. of Readings	11
Rig Factor*	1.07

Transverse Input Data

Multiplication Factor	2.3278689
Gage Length (in.)**	4.21
No. of Readings	11
Rig Factor*	0.98
Poisson's Ratio	**0.23**

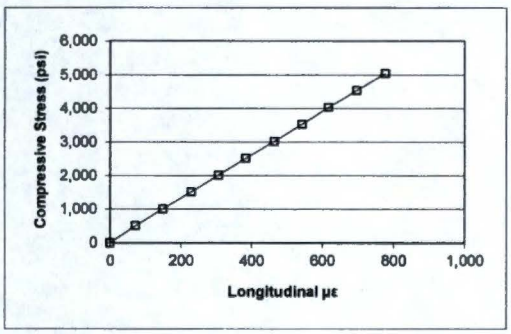
* rig factor = (gage length x multiplication factor) ÷ 10
** if cylinders are cores, gage length = diameter

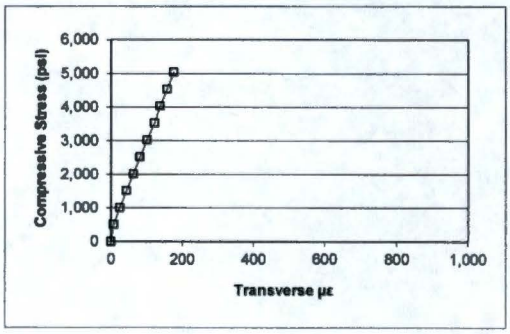
Longitudinal Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain	3-pt tang. E_c (psi)
1	0	30	35	0	–
2	504	110	110	72	6,730,000
3	1,008	190	195	150	6,430,000
4	1,512	275	280	229	6,430,000
5	2,016	355	365	306	6,530,000
6	2,520	440	445	384	6,340,000
7	3,024	525	535	465	6,340,000
8	3,528	610	615	543	6,630,000
9	4,032	690	695	617	6,530,000
10	4,536	775	780	697	6,340,000
11	5,041	860	865	776	

Transverse Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain
1	0	10	10	0
2	504	15	20	8
3	1,008	35	35	26
4	1,512	50	55	43
5	2,016	70	75	64
6	2,520	90	90	82
7	3,024	110	110	102
8	3,528	130	130	123
9	4,032	145	145	138
10	4,536	165	165	158
11	5,041	180	185	176





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Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Contact: Mr. Richard Rast
Submitter: Mr. Richard Rast

CTLGroup Project No: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved: M. D'Ambrosia
Date: August 30, 2011

Test Results of ASTM C469-02
Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

Core Identification: **Core #3**

Diameter 1 (in.)	4.20
Diameter 2 (in.)	4.20
Cross-sectional Area (in.^{2})	13.86
Length Trimmed (in.)	8.23
Length Capped (in.)	8.40
Weight in Air (lb)	10.00
Calculated Unit Weight (pcf)	152
Load Increment (lbs)	7,000
Maximum Load (lbs)	128,700
Compressive Strength (psi)	**9,290**
Ratio of Capped Length to Dia.	2.00
Correction Factor	1.00
Corrected f_c (psi)	**9290**
40% f_c (psi)	**3,716**

Measured E_c Linear Reg. (psi)	**6,000,000**
ASTM E_c @ 40% f_c (psi)	**6,020,000**
ASTM E_c @ 40% f_c (psi) nearest 50,000 psi	**6,000,000**
ASTM E_c @ 450 µstrain (psi)	**6,060,000**

Longitudinal Input Data

Multiplication Factor	2.1005
Gage Length (in.)	8
No. of Readings	11
Rig Factor*	1.07

Transverse Input Data

Multiplication Factor	2.3278689
Gage Length (in.)**	4.20
No. of Readings	11
Rig Factor*	0.98
Poisson's Ratio	**0.24**

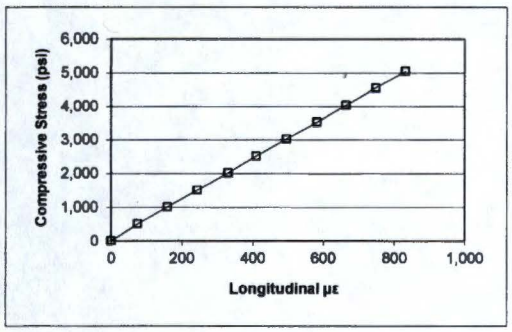
* rig factor = (gage length x multiplication factor) ÷ 10
** if cylinders are cores, gage length = diameter

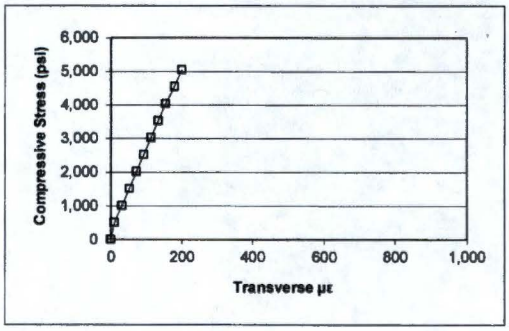
Longitudinal Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain	3-pt tang. E_c (psi)
1	0	70	80	0	–
2	505	150	160	75	6,340,000
3	1,010	240	250	159	6,000,000
4	1,515	330	340	243	5,920,000
5	2,020	420	435	330	6,080,000
6	2,525	505	520	409	6,080,000
7	3,030	600	610	496	5,840,000
8	3,535	690	705	582	6,000,000
9	4,040	780	790	664	6,080,000
10	4,545	870	880	748	6,000,000
11	5,050	960	970	833	

Transverse Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain
1	0	20	25	0
2	505	30	35	10
3	1,010	50	55	31
4	1,515	70	75	51
5	2,020	90	95	72
6	2,525	110	115	92
7	3,030	130	135	112
8	3,535	150	155	133
9	4,040	170	175	153
10	4,545	195	200	179
11	5,050	215	220	199





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CTLGROUP

Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Contact: Mr. Richard Rast
Submitter: Mr. Richard Rast

CTLGroup Project No: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved: M. D'Ambrosia
Date: August 30, 2011

Test Results of ASTM C469-02
Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

Core Identification: **Core #5**

Diameter 1 (in.)	4.21
Diameter 2 (in.)	4.21
Cross-sectional Area (in.^{2})	13.91
Length Trimmed (in.)	8.24
Length Capped (in.)	8.59
Weight in Air (lb)	10.02
Calculated Unit Weight (pcf)	151
Load Increment (lbs)	6,600
Maximum Load (lbs)	118,800
Compressive Strength (psi)	**8,540**
Ratio of Capped Length to Dia.	2.04
Correction Factor	1.00
Corrected f_c (psi)	**8540**
40% f_c (psi)	**3,416**

Measured E_c Linear Reg. (psi)	**5,920,000**
ASTM E_c @ 40% f_c (psi)	**5,960,000**
ASTM E_c @ 40% f_c (psi) nearest 50,000 psi	**5,950,000**
ASTM E_c @ 450 µstrain (psi)	**6,020,000**

Longitudinal Input Data

Multiplication Factor	2.1005
Gage Length (in.)	8
No. of Readings	11
Rig Factor*	1.07

Transverse Input Data

Multiplication Factor	2.3278689
Gage Length (in.)**	4.21
No. of Readings	11
Rig Factor*	0.98
Poisson's Ratio	**0.24**

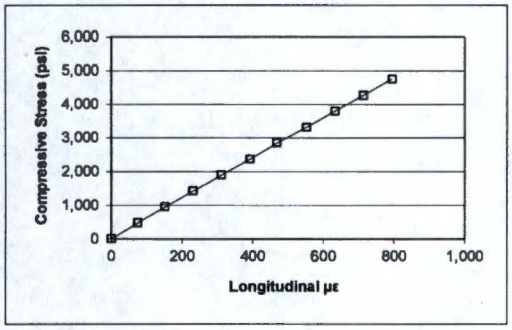
* rig factor = (gage length x multiplication factor) ÷ 10
** If cylinders are cores, gage length = diameter

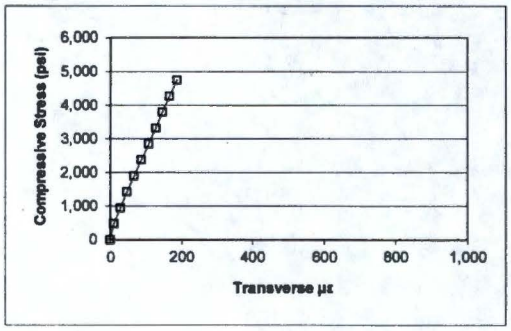
Longitudinal Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain	3-pt tang. E_c (psi)
1	0	30	30	0	–
2	475	110	110	75	6,240,000
3	949	190	195	152	6,060,000
4	1,424	275	280	232	5,970,000
5	1,898	360	365	311	5,880,000
6	2,373	450	450	393	5,970,000
7	2,847	530	535	470	5,880,000
8	3,322	620	625	554	5,800,000
9	3,797	705	710	634	5,970,000
10	4,271	790	795	713	5,880,000
11	4,746	880	880	795	

Transverse Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain
1	0	20	25	0
2	475	30	35	10
3	949	50	50	28
4	1,424	65	70	46
5	1,898	85	90	66
6	2,373	105	110	87
7	2,847	125	130	107
8	3,322	145	150	128
9	3,797	165	165	145
10	4,271	185	185	166
11	4,746	205	205	186





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CTLGROUP

Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Contact: Mr. Richard Rast
Submitter: Mr. Richard Rast

CTLGroup Project No: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved: M. D'Ambrosia
Date: August 30, 2011

Test Results of ASTM C469-02
Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

Core Identification: **Core #6**

Diameter 1 (in.)	4.20
Diameter 2 (in.)	4.20
Cross-sectional Area (in.^{2})	13.87
Length Trimmed (in.)	8.25
Length Capped (in.)	8.48
Weight in Air (lb)	9.98
Calculated Unit Weight (pcf)	151
Load Increment (lbs)	6,600
Maximum Load (lbs)	125,000
Compressive Strength (psi)	**9,010**
Ratio of Capped Length to Dia.	2.02
Correction Factor	1.00
Corrected f_c (psi)	**9010**
40% f_c (psi)	**3,604**

Measured E_c Linear Reg. (psi)	**5,940,000**
ASTM E_c @ 40% f_c (psi)	**6,020,000**
ASTM E_c @ 40% f_c (psi) nearest 50,000 psi	**6,000,000**
ASTM E_c @ 450 µstrain (psi)	**6,030,000**

Longitudinal Input Data

Multiplication Factor	2.1005
Gage Length (in.)	8
No. of Readings	11
Rig Factor*	1.07

Transverse Input Data

Multiplication Factor	2.3278689
Gage Length (in.)**	4.20
No. of Readings	11
Rig Factor*	0.98
Poisson's Ratio	**0.23**

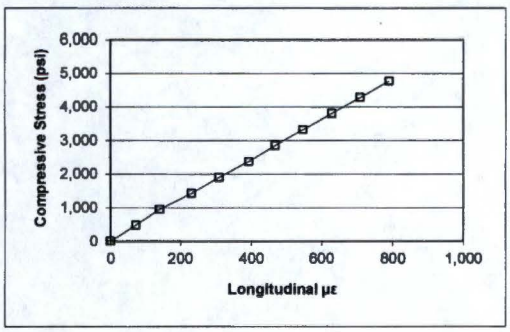
* rig factor = (gage length x multiplication factor) ÷ 10
** If cylinders are cores, gage length = diameter

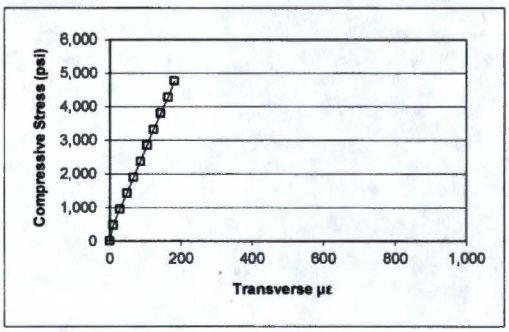
Longitudinal Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Run 3	µstrain	3-pt tang. E_c (psi)
1	0	30	35	0	–
2	476	110	110	72	6,780,000
3	951	195	170	140	5,940,000
4	1,427	280	280	232	5,640,000
5	1,903	360	365	309	5,890,000
6	2,379	450	455	393	5,980,000
7	2,854	530	535	468	6,160,000
8	3,330	615	620	547	5,900,000
9	3,806	700	710	629	5,900,000
10	4,281	785	795	709	5,900,000
11	4,757	875	880	790	

Transverse Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Run 3	µstrain
1	0	30	40	0
2	476	40	50	10
3	951	60	65	28
4	1,427	80	85	49
5	1,903	95	105	66
6	2,379	115	125	87
7	2,854	135	140	105
8	3,330	150	160	123
9	3,806	170	180	143
10	4,281	190	200	164
11	4,757	210	215	181





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CTLGROUP

Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Contact: Mr. Richard Rast
Submitter: Mr. Richard Rast

CTLGroup Project No: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved: M. D'Ambrosia
Date: August 30, 2011

Test Results of ASTM C469-02
Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

Core Identification: **Core #11**

Diameter 1 (in.)	4.21
Diameter 2 (in.)	4.21
Cross-sectional Area (in.^{2})	13.89
Length Trimmed (in.)	8.24
Length Capped (in.)	8.46
Weight in Air (lb)	10.00
Calculated Unit Weight (pcf)	151
Load Increment (lbs)	6,200
Maximum Load (lbs)	94,800
Compressive Strength (psi)	**6,820**
Ratio of Capped Length to Dia.	2.01
Correction Factor	1.00
Corrected f_c (psi)	**6820**
40% f_c (psi)	**2,728**

Measured E_c Linear Reg. (psi)	**5,820,000**
ASTM E_c @ 40% f_c (psi)	**5,830,000**
ASTM E_c @ 40% f_c (psi) nearest 50,000 psi	**5,850,000**
ASTM E_c @ 450 µstrain (psi)	**5,830,000**

Longitudinal Input Data

Multiplication Factor	2.1005
Gage Length (in.)	8
No. of Readings	11
Rig Factor*	1.07

Transverse Input Data

Multiplication Factor	2.3278689
Gage Length (in.)**	4.21
No. of Readings	11
Rig Factor*	0.98
Poisson's Ratio	**0.23**

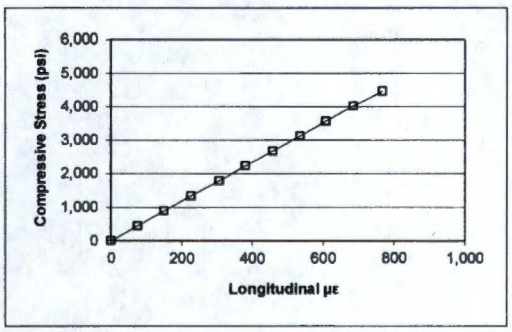
* rig factor = (gage length x multiplication factor) ÷ 10
** if cylinders are cores, gage length = diameter

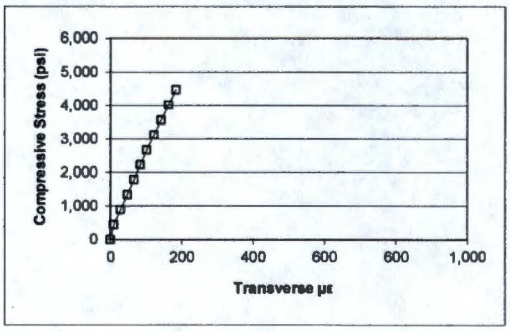
Longitudinal Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain	3-pt tang. E_c (psi)
1	0	50	55	0	–
2	446	130	135	75	5,960,000
3	892	205	220	150	5,870,000
4	1,339	290	300	227	5,700,000
5	1,785	375	385	306	5,780,000
6	2,231	455	465	381	5,870,000
7	2,677	535	550	458	5,780,000
8	3,124	620	630	536	5,960,000
9	3,570	695	710	608	5,960,000
10	4,016	780	790	685	5,610,000
11	4,462	865	880	767	

Transverse Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain
1	0	10	15	0
2	446	20	25	10
3	892	40	40	28
4	1,339	60	60	49
5	1,785	75	80	66
6	2,231	95	95	84
7	2,677	110	115	102
8	3,124	130	135	123
9	3,570	150	155	143
10	4,016	170	175	163
11	4,462	190	195	184





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CTLGROUP

Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Contact: Mr. Richard Rast
Submitter: Mr. Richard Rast

CTLGroup Project No: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved: M. D'Ambrosia
Date: August 30, 2011

Test Results of ASTM C469-02
Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

Core Identification: **Core #12**

Diameter 1 (in.)	4.21
Diameter 2 (in.)	4.21
Cross-sectional Area (in.^{2})	13.90
Length Trimmed (in.)	8.23
Length Capped (in.)	8.58
Weight in Air (lb)	10.01
Calculated Unit Weight (pcf)	151
Load Increment (lbs)	6,200
Maximum Load (lbs)	82,000
Compressive Strength (psi)	**5,900**
Ratio of Capped Length to Dia.	2.04
Correction Factor	1.00
Corrected f_c (psi)	**5900**
40% f_c (psi)	**2,360**

Measured E_c Linear Reg. (psi)	**5,730,000**
ASTM E_c @ 40% f_c (psi)	**5,790,000**
ASTM E_c @ 40% f_c (psi) nearest 50,000 psi	**5,800,000**
ASTM E_c @ 450 µstrain (psi)	**5,770,000**

Longitudinal Input Data

Multiplication Factor	2.1005
Gage Length (in.)	8
No. of Readings	11
Rig Factor*	1.07

Transverse Input Data

Multiplication Factor	2.3278689
Gage Length (in.)**	4.21
No. of Readings	11
Rig Factor*	0.98
Poisson's Ratio	**0.21**

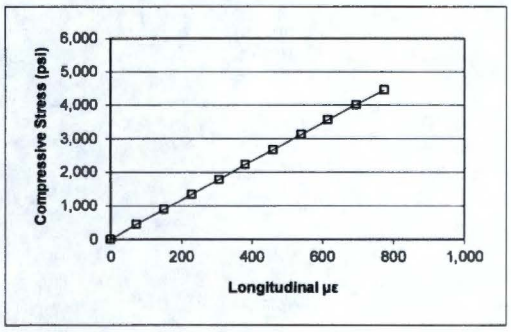
* rig factor = (gage length x multiplication factor) ÷ 10
** if cylinders are cores, gage length = diameter

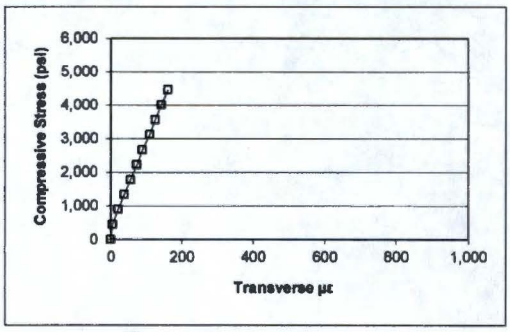
Longitudinal Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain	3-pt tang. E_c (psi)
1	0	30	30	0	–
2	446	105	110	72	5,960,000
3	892	185	195	150	5,690,000
4	1,338	270	280	229	5,690,000
5	1,784	350	365	306	5,870,000
6	2,230	430	445	381	5,780,000
7	2,675	515	530	461	5,610,000
8	3,121	600	615	540	5,780,000
9	3,567	680	695	615	5,780,000
10	4,013	765	780	695	5,610,000
11	4,459	850	865	774	

Transverse Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain
1	0	10	10	0
2	446	15	15	5
3	892	30	30	20
4	1,338	45	50	38
5	1,784	65	65	56
6	2,230	80	85	74
7	2,675	95	100	89
8	3,121	115	120	110
9	3,567	130	135	125
10	4,013	150	150	143
11	4,459	165	170	161





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CTLGROUP

Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Contact: Mr. Richard Rast
Submitter: Mr. Richard Rast

CTLGroup Project No: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved: M. D'Ambrosia
Date: August 30, 2011

Test Results of ASTM C469-02
Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

Core Identification: **Core #13**

Diameter 1 (in.)	4.21
Diameter 2 (in.)	4.21
Cross-sectional Area (in.^{2})	13.90
Length Trimmed (in.)	8.24
Length Capped (in.)	8.57
Weight in Air (lb)	9.98
Calculated Unit Weight (pcf)	151
Load Increment (lbs)	6,000
Maximum Load (lbs)	94,600
Compressive Strength (psi)	**6,800**
Ratio of Capped Length to Dia.	2.04
Correction Factor	1.00
Corrected f_c (psi)	**6800**
40% f_c (psi)	**2,720**

Measured E_c Linear Reg. (psi)	**5,750,000**
ASTM E_c @ 40% f_c (psi)	**5,740,000**
ASTM E_c @ 40% f_c (psi) nearest 50,000 psi	**5,750,000**
ASTM E_c @ 450 µstrain (psi)	**5,730,000**

Longitudinal Input Data

Multiplication Factor	2.1005
Gage Length (in.)	8
No. of Readings	11
Rig Factor*	1.07

Transverse Input Data

Multiplication Factor	2.3278689
Gage Length (in.)**	4.21
No. of Readings	11
Rig Factor*	0.98
Poisson's Ratio	**0.23**

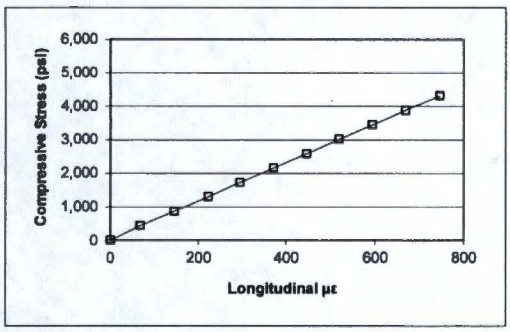
* rig factor = (gage length x multiplication factor) ÷ 10
** If cylinders are cores, gage length = diameter

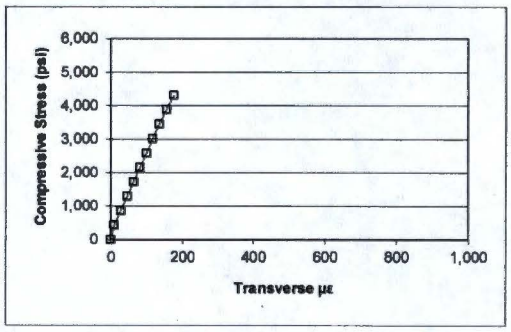
Longitudinal Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain	3-pt tang. E_c (psi)
1	0	40	50	0	--
2	432	115	120	68	5,940,000
3	863	195	205	145	5,590,000
4	1,295	280	285	222	5,760,000
5	1,726	355	365	295	5,760,000
6	2,158	435	450	372	5,680,000
7	2,589	515	530	447	5,860,000
8	3,021	595	605	519	5,860,000
9	3,452	675	685	594	5,770,000
10	3,884	755	765	669	5,680,000
11	4,315	840	845	746	

Transverse Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain
1	0	40	55	0
2	432	55	60	10
3	863	70	80	28
4	1,295	85	100	46
5	1,726	105	115	64
6	2,158	125	130	82
7	2,589	140	150	100
8	3,021	160	165	117
9	3,452	175	185	135
10	3,884	195	205	156
11	4,315	215	225	176





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CTLGROUP

Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Contact: Mr. Richard Rast
Submitter: Mr. Richard Rast

CTLGroup Project No: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved: M. D'Ambrosia
Date: August 30, 2011

Test Results of ASTM C469-02
Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

Core Identification: **Core #15**

Diameter 1 (in.)	4.21
Diameter 2 (in.)	4.21
Cross-sectional Area (in.^{2})	13.93
Length Trimmed (in.)	8.25
Length Capped (in.)	8.46
Weight in Air (lb)	9.99
Calculated Unit Weight (pcf)	150
Load Increment (lbs)	5,000
Maximum Load (lbs)	104,800
Compressive Strength (psi)	**7,520**
Ratio of Capped Length to Dia.	2.01
Correction Factor	1.00
Corrected f_c (psi)	**7520**
40% f_c (psi)	**3,008**

Measured E_c Linear Reg. (psi)	**5,820,000**
ASTM E_c @ 40% f_c (psi)	**5,880,000**
ASTM E_c @ 40% f_c (psi) nearest 50,000 psi	**5,900,000**
ASTM E_c @ 450 µstrain (psi)	**5,900,000**

Longitudinal Input Data

Multiplication Factor	2.1005
Gage Length (in.)	8
No. of Readings	11
Rig Factor*	1.07

Transverse Input Data

Multiplication Factor	2.3278689
Gage Length (in.)**	4.21
No. of Readings	11
Rig Factor*	0.98
Poisson's Ratio	**0.23**

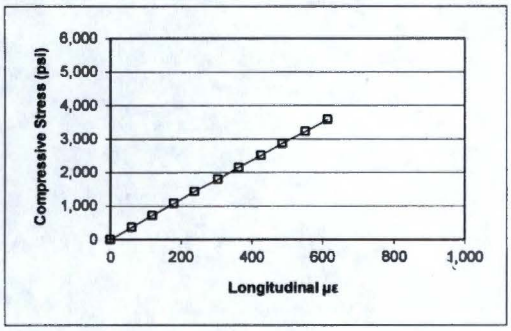
* rig factor = (gage length x multiplication factor) ÷ 10
** if cylinders are cores, gage length = diameter

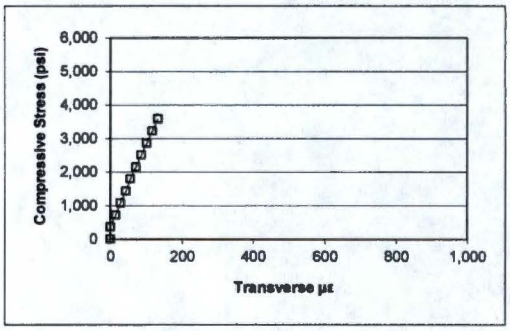
Longitudinal Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Run 3	µstrain	3-pt tang. E_c (psi)
1	0	15	20	0	--
2	359	80	85	61	6,020,000
3	718	145	145	119	6,020,000
4	1,077	210	210	180	6,020,000
5	1,436	270	275	239	5,790,000
6	1,795	340	345	304	5,790,000
7	2,154	405	405	362	5,900,000
8	2,512	470	475	426	5,790,000
9	2,871	535	540	486	5,680,000
10	3,230	605	610	552	5,580,000
11	3,589	675	675	615	

Transverse Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Run 3	µstrain
1	0	20	20	0
2	359	20	20	0
3	718	35	35	15
4	1,077	45	50	28
5	1,436	60	65	43
6	1,795	75	75	56
7	2,154	90	90	71
8	2,512	105	105	87
9	2,871	120	120	102
10	3,230	135	135	117
11	3,589	150	150	133





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Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Contact: Mr. Richard Rast
Submitter: Mr. Richard Rast

CTLGroup Project No: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved: M. D'Ambrosia
Date: August 30, 2011

Test Results of ASTM C469-02
Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

Core Identification: **Core #17**

Diameter 1 (in.)	4.20
Diameter 2 (in.)	4.20
Cross-sectional Area (in.^{2})	13.87
Length Trimmed (in.)	8.24
Length Capped (in.)	8.54
Weight in Air (lb)	10.02
Calculated Unit Weight (pcf)	152
Load Increment (lbs)	6,000
Maximum Load (lbs)	108,600
Compressive Strength (psi)	**7,830**
Ratio of Capped Length to Dia.	2.03
Correction Factor	1.00
Corrected f_c (psi)	**7830**
40% f_c (psi)	**3,132**

Measured E_c Linear Reg. (psi)	**6,110,000**
ASTM E_c @ 40% f_c (psi)	**6,120,000**
ASTM E_c @ 40% f_c (psi) nearest 50,000 psi	**6,100,000**
ASTM E_c @ 450 µstrain (psi)	**6,110,000**

Longitudinal Input Data

Multiplication Factor	2.1005
Gage Length (in.)	8
No. of Readings	11
Rig Factor*	1.07

Transverse Input Data

Multiplication Factor	2.3278689
Gage Length (in.)**	4.20
No. of Readings	11
Rig Factor*	0.98
Poisson's Ratio	**0.19**

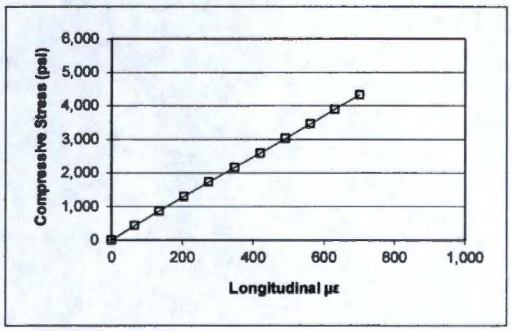
* rig factor = (gage length x multiplication factor) ÷ 10
** if cylinders are cores, gage length = diameter

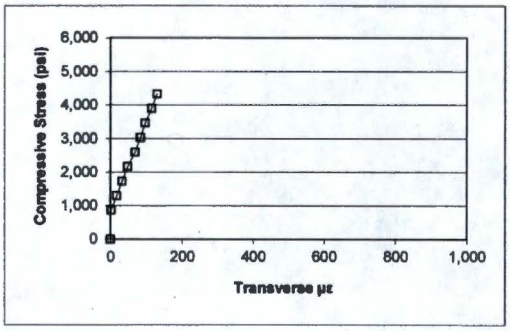
Longitudinal Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain	3-pt tang. E_c (psi)
1	0	10	10	0	–
2	433	80	80	65	6,380,000
3	865	155	155	136	6,170,000
4	1,298	230	230	206	6,170,000
5	1,731	305	305	276	6,070,000
6	2,163	380	385	348	5,970,000
7	2,596	460	460	421	6,070,000
8	3,029	535	535	491	6,170,000
9	3,461	610	610	561	6,170,000
10	3,894	685	685	631	6,170,000
11	4,327	760	760	702	

Transverse Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain
1	0	15	20	0
2	433	15	15	-3
3	865	20	20	3
4	1,298	35	35	18
5	1,731	50	50	33
6	2,163	65	65	49
7	2,596	85	85	69
8	3,029	100	100	84
9	3,461	110	115	97
10	3,894	130	130	115
11	4,327	145	145	130





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Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Contact: Mr. Richard Rast
Submitter: Mr. Richard Rast

CTLGroup Project No: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved: M. D'Ambrosia
Date: August 30, 2011

Test Results of ASTM C469-02
Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

Core Identification: **Core #19**

Diameter 1 (in.)	4.21
Diameter 2 (in.)	4.21
Cross-sectional Area (in.^{2})	13.91
Length Trimmed (in.)	8.23
Length Capped (in.)	8.56
Weight in Air (lb)	10.04
Calculated Unit Weight (pcf)	151
Load Increment (lbs)	6,000
Maximum Load (lbs)	95,200
Compressive Strength (psi)	**6,840**
Ratio of Capped Length to Dia.	2.03
Correction Factor	1.00
Corrected f_c (psi)	**6840**
40% f_c (psi)	**2,736**

Measured E_c Linear Reg. (psi)	**5,590,000**
ASTM E_c @ 40% f_c (psi)	**5,540,000**
ASTM E_c @ 40% f_c (psi) nearest 50,000 psi	**5,550,000**
ASTM E_c @ 450 µstrain (psi)	**5,530,000**

Longitudinal Input Data

Multiplication Factor	2.1005
Gage Length (in.)	8
No. of Readings	11
Rig Factor*	1.07

Transverse Input Data

Multiplication Factor	2.3278689
Gage Length (in.)**	4.21
No. of Readings	11
Rig Factor*	0.98
Poisson's Ratio	**0.20**

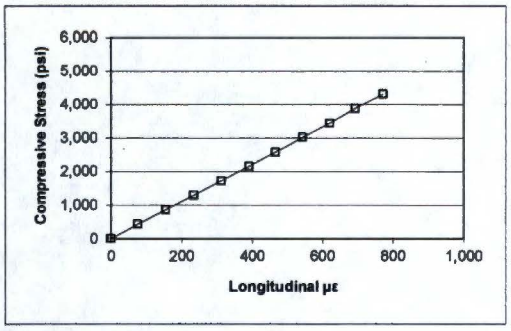
* rig factor = (gage length x multiplication factor) ÷ 10
** if cylinders are cores, gage length = diameter

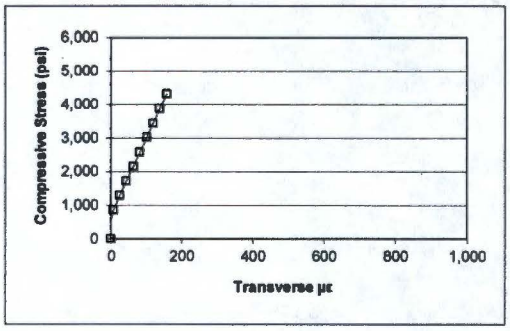
Longitudinal Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain	3-pt tang. E_c (psi)
1	0	35	35	0	--
2	431	110	120	75	5,590,000
3	863	195	205	154	5,420,000
4	1,294	280	290	234	5,510,000
5	1,725	360	375	311	5,510,000
6	2,157	445	460	391	5,590,000
7	2,588	530	535	465	5,670,000
8	3,019	610	620	543	5,590,000
9	3,451	690	705	620	5,760,000
10	3,882	770	780	692	5,670,000
11	4,313	855	865	772	

Transverse Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain
1	0	15	20	0
2	431	15	15	-3
3	863	25	25	8
4	1,294	40	45	26
5	1,725	60	60	43
6	2,157	80	80	64
7	2,588	95	100	82
8	3,019	115	120	102
9	3,451	135	135	120
10	3,882	150	155	138
11	4,313	170	175	158





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Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Contact: Mr. Richard Rast
Submitter: Mr. Richard Rast

CTLGroup Project No: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved: M. D'Ambrosia
Date: August 30, 2011

Test Results of ASTM C469-02
Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

Core Identification: **Core #20**

Diameter 1 (in.)	4.20
Diameter 2 (in.)	4.21
Cross-sectional Area (in.^{2})	13.89
Length Trimmed (in.)	8.20
Length Capped (in.)	8.41
Weight in Air (lb)	10.13
Calculated Unit Weight (pcf)	154
Load Increment (lbs)	5,600
Maximum Load (lbs)	123,200
Compressive Strength (psi)	**8,870**
Ratio of Capped Length to Dia.	2.00
Correction Factor	1.00
Corrected f_c (psi)	**8870**
40% f_c (psi)	**3,548**

Measured E_c Linear Reg. (psi)	**5,970,000**
ASTM E_c @ 40% f_c (psi)	**5,960,000**
ASTM E_c @ 40% f_c (psi) nearest 50,000 psi	**5,950,000**
ASTM E_c @ 450 µstrain (psi)	**5,940,000**

Longitudinal Input Data

Multiplication Factor	2.1005
Gage Length (in.)	8
No. of Readings	11
Rig Factor*	1.07

Transverse Input Data

Multiplication Factor	2.3278689
Gage Length (in.)**	4.21
No. of Readings	11
Rig Factor*	0.98
Poisson's Ratio	**0.20**

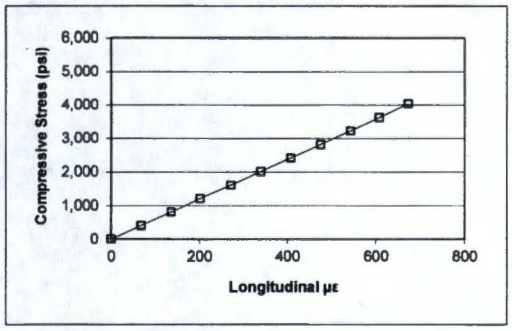
* rig factor = (gage length x multiplication factor) ÷ 10
** If cylinders are cores, gage length = diameter

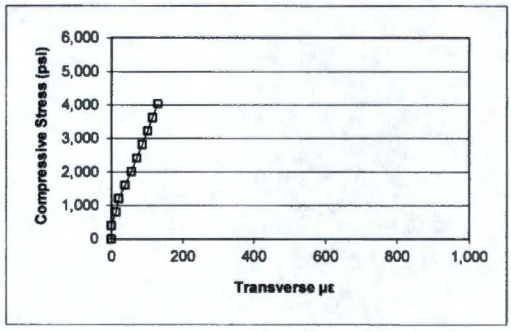
Longitudinal Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain	3-pt tang. E_c (psi)
1	0	5	5	0	--
2	403	75	80	68	5,940,000
3	806	150	150	136	6,050,000
4	1,209	220	220	201	5,940,000
5	1,613	295	295	271	5,840,000
6	2,016	365	370	339	5,940,000
7	2,419	440	440	407	5,940,000
8	2,822	510	515	475	5,940,000
9	3,225	585	585	543	6,050,000
10	3,628	655	655	608	6,160,000
11	4,031	725	725	674	

Transverse Readings

Reading No.	Stress (psi)	Gage Readings Run 2	Gage Readings Run 3	µstrain
1	0	25	30	0
2	403	25	30	0
3	806	35	45	13
4	1,209	45	50	20
5	1,613	65	65	38
6	2,016	80	85	56
7	2,419	95	100	72
8	2,822	110	115	87
9	3,225	125	130	102
10	3,628	140	140	115
11	4,031	155	155	130





Notes:
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Washington River Protection Solutions
Subcontract No. 46060, C-107 Concrete Core Testing
CTLGroup Project No. 395568

November 7, 2011

Appendix C
Measurements Obtained per ASTM C42 / C42M – 10a, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

and

Test Results for ASTM C39 / C39M – 10, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens*

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Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Report Date: August 30, 2011

CTLGroup Project No.: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved By: M. D'Ambrosia

ASTM C 42 / C 42M - 04
Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
Section 7: Cores for Compressive Strength

Specimen Identification

Client Identification	Core #1	Core #2	Core #3
CTLGroup Identification	2870301	2870302	2870303
Date Core Obtained from the Field	4/4/2011	4/4/2011	4/4/2011
Date Core Placed in Sealed Bag after Saw Cutting	7/28/2011	7/28/2011	7/28/2011
Date Core was Tested	8/9/2011	8/9/2011	8/9/2011

Concrete Description

Nominal Maximum Aggregate Size, in.	1 1/2	1 1/2	1 1/2
Concrete Age at Test, years	> 50	> 50	> 50
Moisture Condition at Test	Note 1	Note 1	Note 1
Orientation of Core Axis in Structure	Vertical	Vertical	Vertical

Concrete Dimensions

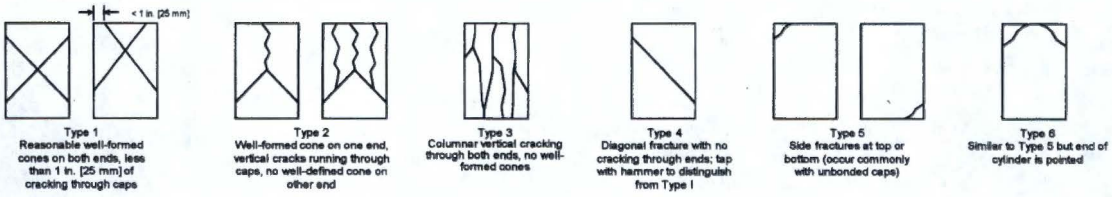
Length of Core as Drilled, in.	9 1/4	10	10
Diameter 1, in.	4.20	4.20	4.20
Diameter 2, in.	4.21	4.21	4.20
Average Diameter, in.	4.21	4.21	4.20
Cross-Sectional Area, in^2	13.92	13.92	13.85
Length Trimmed, in.	8.2	8.2	8.2
Length Capped, in.	8.4	8.5	8.4

Density, lb/ft^3	152	152	152

Compressive Strength and Fracture Pattern

Maximum Load, lb	137,600	134,600	128,700
Uncorrected Compressive Strength, psi	9,890	9,670	9,290
Ratio of Capped Length to Diameter	2.00	2.02	2.00
Correction Factor	1.00	1.00	1.00
Corrected Compressive Strength, psi	**9,890**	**9,670**	**9,290**
Fracture Pattern	Type 4	Type 4	Type 2

Schematic of Typical Fracture Patterns



Notes:
1. After the cores were extracted from the C-107 plug, there were stored in plastic air tight containers until test preparations. After trimming with the wet saw, the cores were stored in sealed plastic bags until testing.
2. This report represents specifically the samples submitted.
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CTLGROUP

Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Report Date: August 30, 2011

CTLGroup Project No.: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved By: M. D'Ambrosia

ASTM C 42 / C 42M - 04
Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
Section 7: Cores for Compressive Strength

Specimen Identification

Client Identification	Core #5	Core #6	Core #11
CTLGroup Identification	2870305	2870306	2870307
Date Core Obtained from the Field	4/4/2011	4/4/2011	4/4/2011
Date Core Placed in Sealed Bag after Saw Cutting	7/28/2011	7/28/2011	7/28/2011
Date Core was Tested	8/9/2011	8/9/2011	8/9/2011

Concrete Description

Nominal Maximum Aggregate Size, in.	1 1/2	1 1/2	1 1/2
Concrete Age at Test, years	> 50	> 50	> 50
Moisture Condition at Test	Note 1	Note 1	Note 1
Orientation of Core Axis in Structure	Vertical	Vertical	Vertical

Concrete Dimensions

Length of Core as Drilled, in.	10	10	10
Diameter 1, in.	4.21	4.20	4.21
Diameter 2, in.	4.21	4.20	4.21
Average Diameter, in.	4.21	4.20	4.21
Cross-Sectional Area, in^2	13.92	13.85	13.92
Length Trimmed, in.	8.2	8.3	8.2
Length Capped, in.	8.6	8.5	8.5
Density, lb/ft^3	151	151	151

Compressive Strength and Fracture Pattern

Maximum Load, lb	118,800	125,000	94,800
Uncorrected Compressive Strength, psi	8,530	9,030	6,810
Ratio of Capped Length to Diameter	2.04	2.02	2.01
Correction Factor	1.00	1.00	1.00
Corrected Compressive Strength, psi	**8,530**	**9,030**	**6,810**
Fracture Pattern	Type 4	Type 1	Type 1

Schematic of Typical Fracture Patterns

Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbonded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Notes:
1. After the cores were extracted from the C-107 plug, there were stored in plastic air tight containers until test preparations. After trimming with the wet saw, the cores were stored in sealed plastic bags until testing.
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CTLGROUP

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Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Report Date: August 30, 2011

CTLGroup Project No.: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved By: M. D'Ambrosia

ASTM C 42 / C 42M - 04
Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
Section 7: Cores for Compressive Strength

Specimen Identification

Client Identification	Core #12	Core #13	Core #15
CTLGroup Identification	2870308	2870309	2870311
Date Core Obtained from the Field	4/4/2011	4/4/2011	4/4/2011
Date Core Placed in Sealed Bag after Saw Cutting	7/28/2011	7/28/2011	7/28/2011
Date Core was Tested	8/9/2011	8/9/2011	8/9/2011

Concrete Description

Nominal Maximum Aggregate Size, in.	1 1/2	1 1/2	1 1/2
Concrete Age at Test, years	> 50	> 50	> 50
Moisture Condition at Test	Note 1	Note 1	Note 1
Orientation of Core Axis in Structure	Vertical	Vertical	Vertical

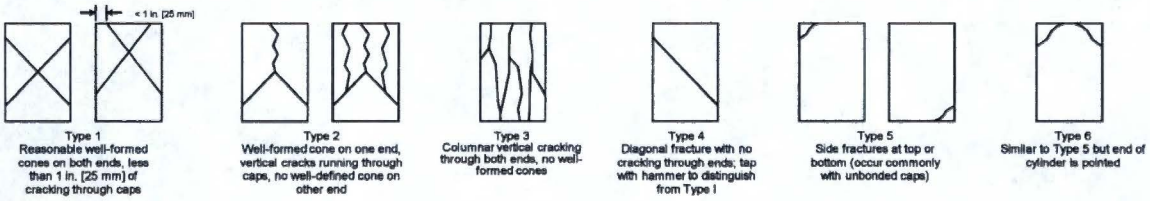
Concrete Dimensions

Length of Core as Drilled, in.	10	10	10
Diameter 1, in.	4.21	4.21	4.21
Diameter 2, in.	4.21	4.21	4.21
Average Diameter, in.	4.21	4.21	4.21
Cross-Sectional Area, in^2	13.92	13.92	13.92
Length Trimmed, in.	8.2	8.2	8.3
Length Capped, in.	8.6	8.6	8.5
Density, lb/ft^3	151	150	150

Compressive Strength and Fracture Pattern

Maximum Load, lb	82,000	94,600	104,800
Uncorrected Compressive Strength, psi	5,890	6,800	7,530
Ratio of Capped Length to Diameter	2.04	2.04	2.01
Correction Factor	1.00	1.00	1.00
Corrected Compressive Strength, psi	**5,890**	**6,800**	**7,530**
Fracture Pattern	Type 4	Type 2	Type 2

Schematic of Typical Fracture Patterns



Notes:
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CTLGROUP

Client: Washington River Protection Solutions
Project: Subcontract No. 46060,
C-107 Plug Concrete Core Testing
Report Date: August 30, 2011

CTLGroup Project No.: 395568
CTLGroup Project Mgr.: J. L. Jones
Technician: P. Brindise
Approved By: M. D'Ambrosia

ASTM C 42 / C 42M - 04
Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
Section 7: Cores for Compressive Strength

Specimen Identification

Client Identification	Core #17	Core #19	Core #20
CTLGroup Identification	2870312	2870313	2870314
Date Core Obtained from the Field	4/4/2011	4/4/2011	4/4/2011
Date Core Placed in Sealed Bag after Saw Cutting	7/28/2011	7/28/2011	7/28/2011
Date Core was Tested	8/9/2011	8/10/2011	8/9/2011

Concrete Description

Nominal Maximum Aggregate Size, in.	1 1/2	1 1/2	1 1/2
Concrete Age at Test, years	> 50	> 50	> 50
Moisture Condition at Test	Note 1	Note 1	Note 1
Orientation of Core Axis in Structure	Vertical	Vertical	Vertical

Concrete Dimensions

Length of Core as Drilled, in.	10	10	10
Diameter 1, in.	4.20	4.21	4.20
Diameter 2, in.	4.21	4.21	4.21
Average Diameter, in.	4.21	4.21	4.21
Cross-Sectional Area, in^2	13.92	13.92	13.92
Length Trimmed, in.	8.2	8.2	8.2
Length Capped, in.	8.5	8.6	8.4
Density, lb/ft^3	151	151	153

Compressive Strength and Fracture Pattern

Maximum Load, lb	108,600	95,200	123,200
Uncorrected Compressive Strength, psi	7,800	6,840	8,850
Ratio of Capped Length to Diameter	2.03	2.03	2.00
Correction Factor	1.00	1.00	1.00
Corrected Compressive Strength, psi	**7,800**	**6,840**	**8,850**
Fracture Pattern	Type 2	Type 1	Type 2

Schematic of Typical Fracture Patterns

Type 1
Reasonable well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end

Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type I

Type 5
Side fractures at top or bottom (occur commonly with unbonded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

Notes:
1. After the cores were extracted from the C-107 plug, there were stored in plastic air tight containers until test preparations. After trimming with the wet saw, the cores were stored in sealed plastic bags until testing.
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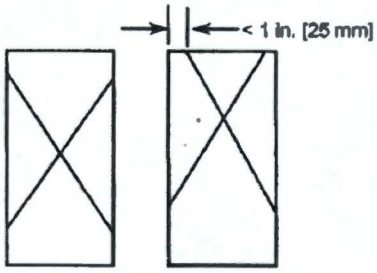
APPENDIX D

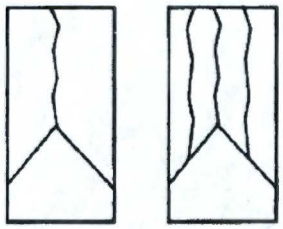
C-107 CONCRETE CORE

CYLINDER FRACTURES

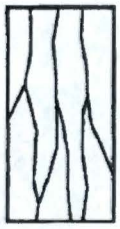
Schematic of Typical Fracture Patterns from ASTM C39



Type 1
Reasonably well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps

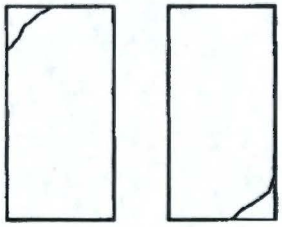


Type 2
Well-formed cone on one end, vertical cracks running through caps, no well-defined cone on other end



Type 3
Columnar vertical cracking through both ends, no well-formed cones

Type 4
Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type 1



Type 5
Side fractures at top or bottom (occur commonly with unbonded caps)

Type 6
Similar to Type 5 but end of cylinder is pointed

C-107 Core # 1 Type 4 Fracture

C-107 Core # 1 Type 4 Fracture

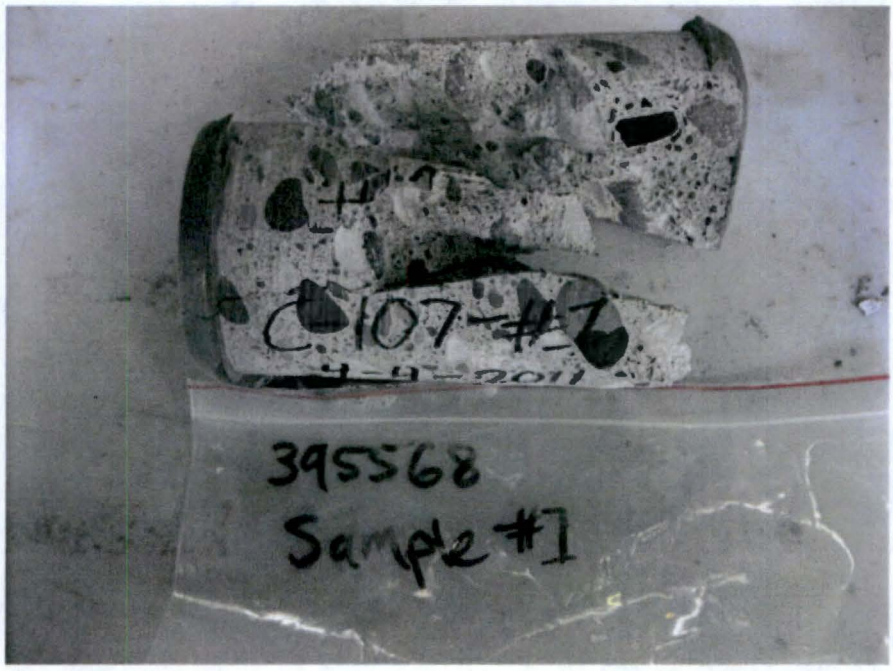
C-107 Core # 1 Type 4 Fracture

C-107 Core # 1 Type 4 Fracture

C-107 Core # 1 Type 4 Fracture

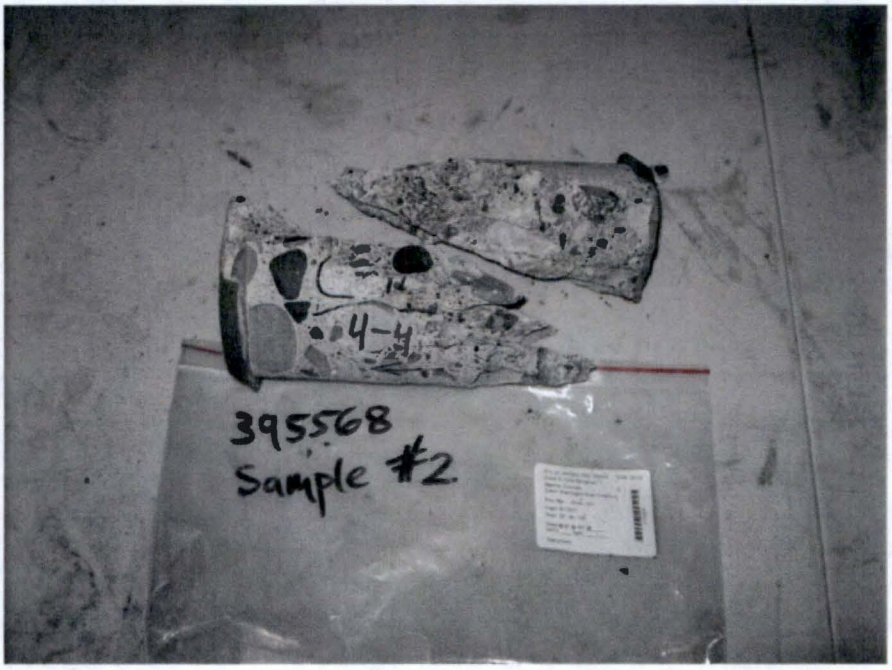
C-107 Core # 1 Type 4 Fracture

C-107 Core # 1 Type 4 Fracture



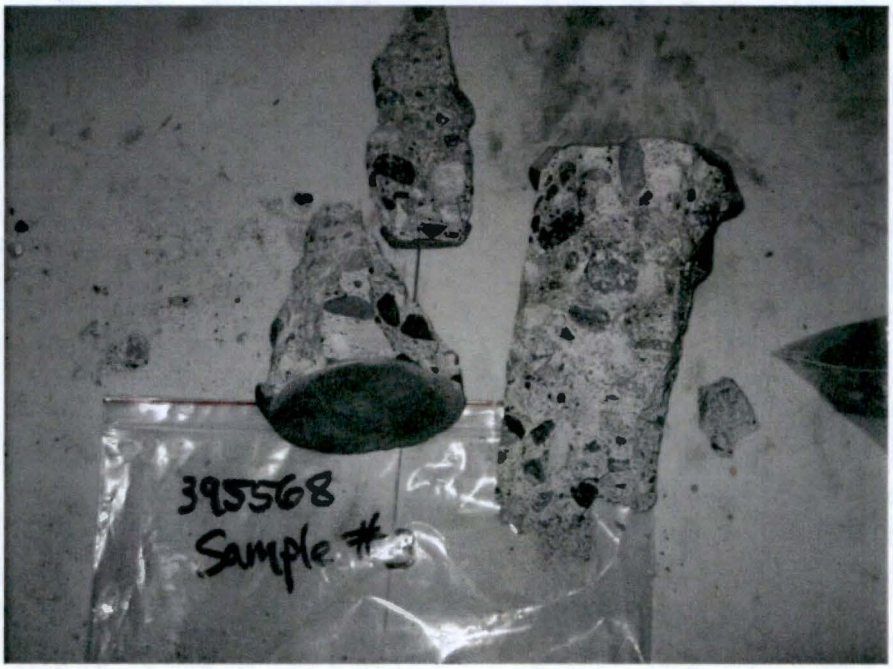
C-107 Core # 2 Type 4 Fracture

C-107 Core # 2 Type 4 Fracture

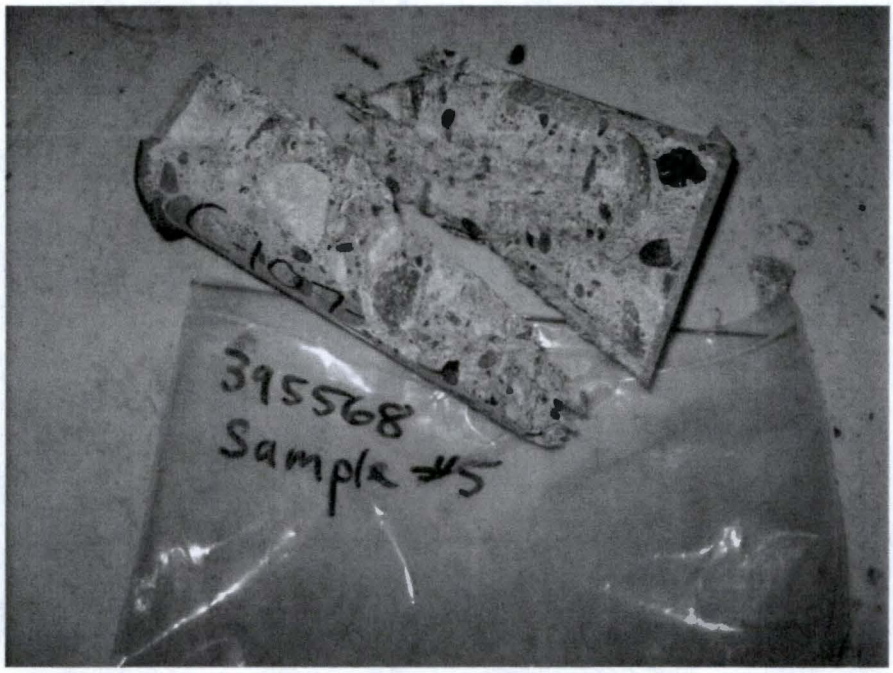


C-107 Core # 3 Type 2 Fracture

C-107 Core # 3 Type 2 Fracture

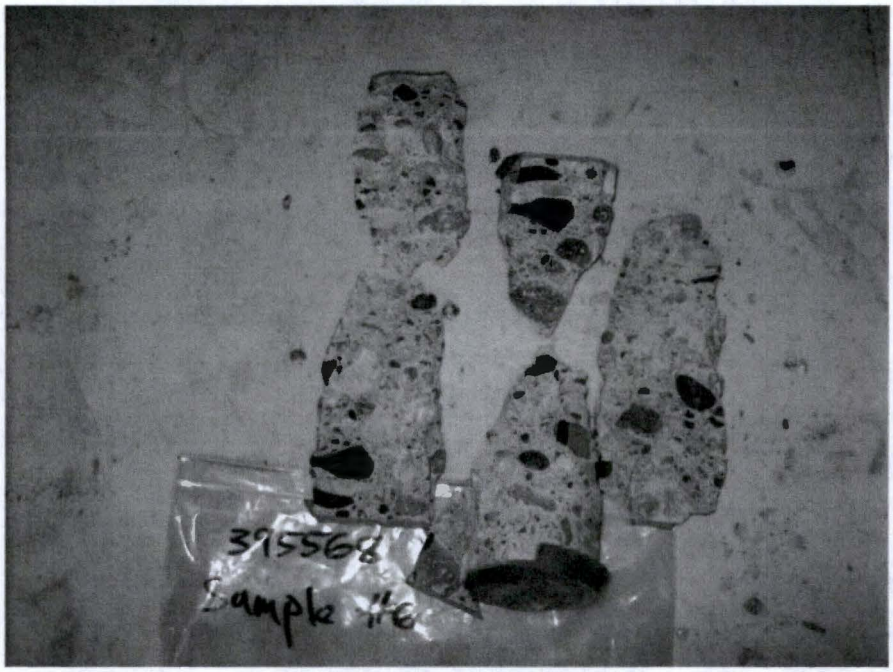


C-107 Core # 5 Type 4 Fracture



C-107 Core # 5 Type 4 Fracture

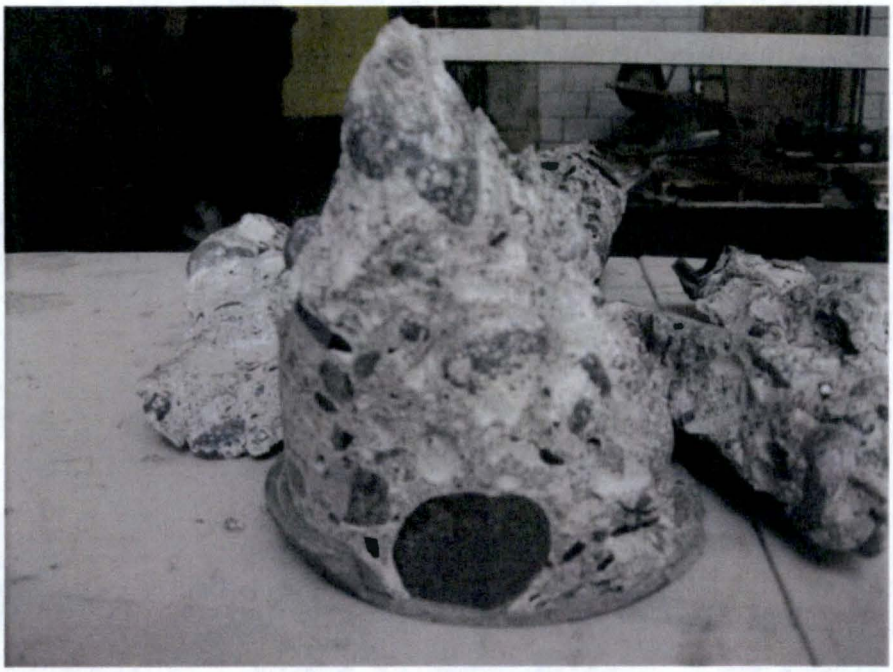
C-107 Core # 6 Type 1 Fracture



C-107 Core # 11 Type 1 Fracture

C-107 Core # 11 Type 1 Fracture

C-107 Core # 11 Type 1 Fracture

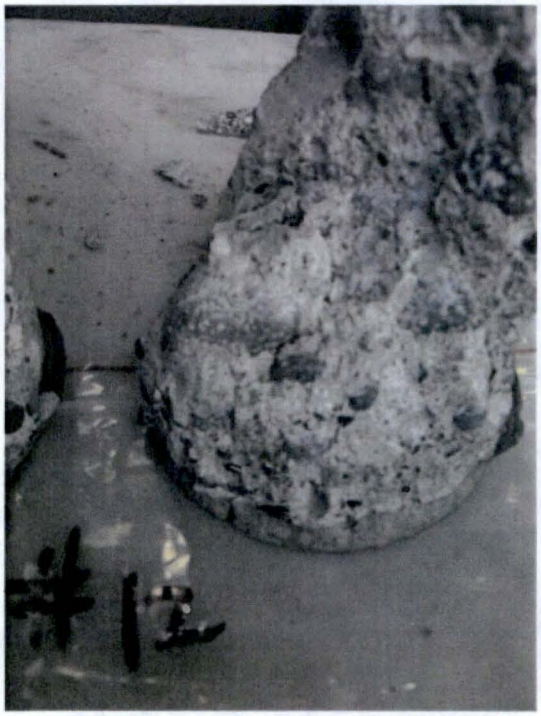


C-107 Core # 11 Type 1 Fracture

C-107 Core # 12 Type 4 Fracture

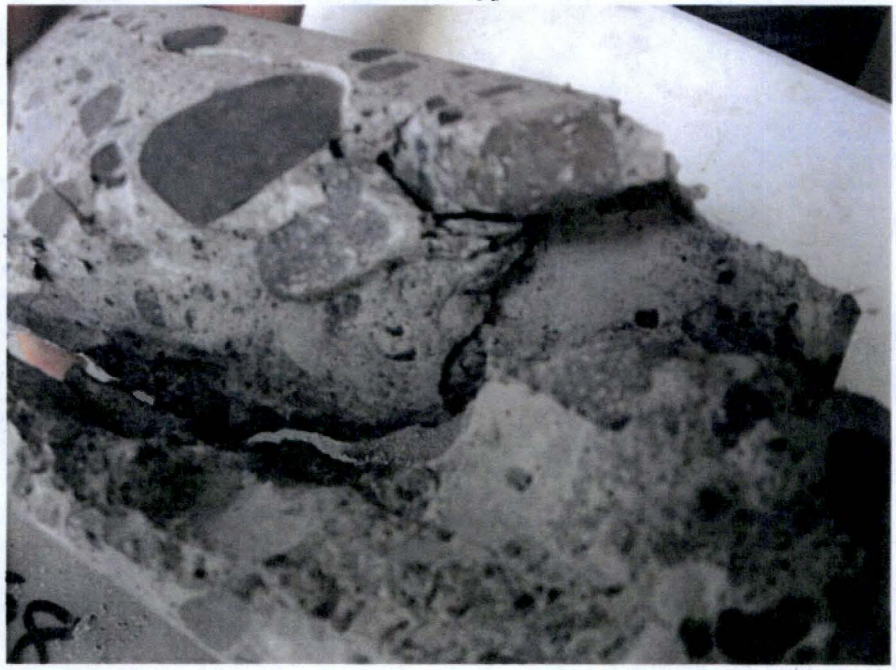
C-107 Core # 12 Type 4 Fracture

C-107 Core # 12 Type 4 Fracture



C-107 Core # 12 Type 4 Fracture

C-107 Core # 12 Type 4 Fracture

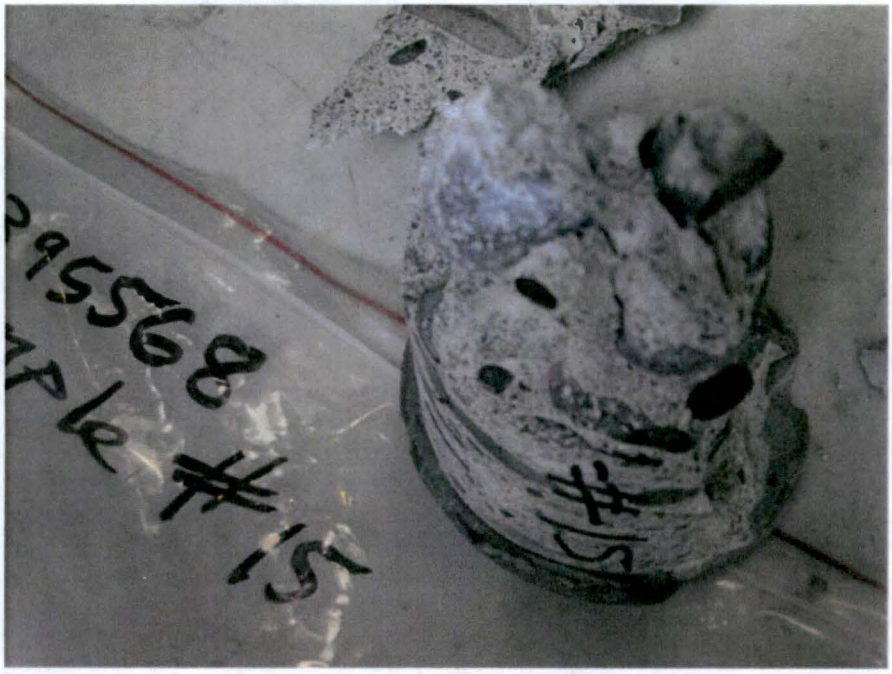


C-107 Core # 13 Type 2 Fracture

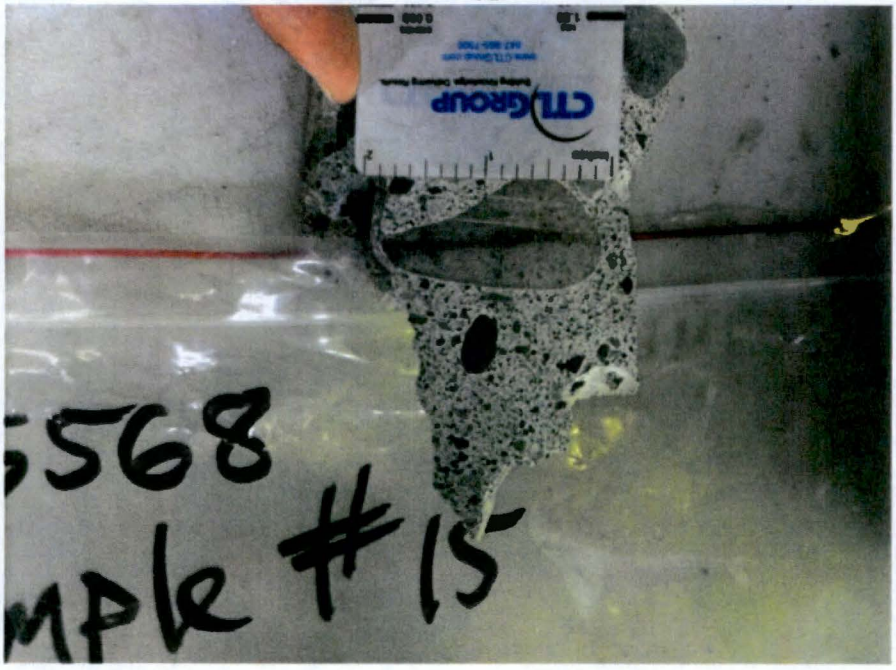
C-107 Core # 13 Type 2 Fracture

C-107 Core # 15 Type 2 Fracture

C-107 Core # 15 Type 2 Fracture



C-107 Core # 15 Type 2 Fracture



C-107 Core # 17 Type 2 Fracture

C-107 Core # 19 Type 1 Fracture

C-107 Core # 20 Type 2 Fracture

APPENDIX E

C-107 CONCRETE CORE

PETROGRAPHIC EXAMINATION

RESULTS

Copy No. 1

Report for
Washington River Protection Solutions, LLC

Project Number 395568

Petrographic Examination of Concrete Cores from Reinforced Concrete Dome of Single Shell Tank 241-C0107, Hanford, Washington

September 1, 2011

Submitted by:
Sang Y. Lee

COA # 232040001869

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REPORT OF PETROGRAPHIC EXAMINATION

Date: September 1, 2011

CTLGroup Project No.: 395568

Petrographic Examination of Concrete Cores from Reinforced Concrete Dome of Single Shell Tank 241-C0107, Hanford, Washington

Two concrete cores, designated #4 (Fig. 1) and #14 (Fig. 2), were received on August 19, 2011 from Ms. Joni Jones, CTLGroup Engineer and Supervisor on behalf of Mr. Richard Rast of Washington River Protection Solutions, LLC. Mr. Rast provided the following background information for the concrete cores:

Background Information: The single shell tank consists of a carbon steel shell surrounded by reinforced concrete. The tanks store radioactive sludge from plutonium processing. Tank 241-C-107, located in 241-C Farm at the Hanford site, was excavated to the apex of the reinforced concrete dome, and a 55-in. diameter hole, referred to as a "plug," was cut and removed. Fourteen cores have been taken from the "plug," including the two cores submitted for petrographic examination.

Petrographic examination (ASTM C856) was requested to evaluate general condition and characteristics of the concrete represented by the cores.

FINDINGS

Figure 3 shows the cut and lapped cross-sections of the cores, illustrating overall condition and appearance of the concrete in the cores. Based on the results of petrographic examination, the concrete represented by the cores is in good condition. No distress (cracking or excessive microcracking) is observed in either core. The concrete does not show any evidence of chemical attack, significant alkali-aggregate reactions, or other deleterious mechanisms involving aggregates and/or paste constituents.

The concrete in both cores exhibits good physical paste properties. Apart from localized softer paste at the immediate top surface, the paste in the cores is hard and dense through the depth

of the concrete. Distribution of aggregates and other paste constituents is uniform. Macroscopically, the cores are well consolidated (no large voids).

Other findings are described below. Additional information is provided in the attached figure pages and data sheets.

- Apart from slight variation in aggregate top size and gradation, both cores exhibit generally similar concrete composition and characteristics. The concrete in the cores contains siliceous coarse and fine aggregates in a hardened portland cement paste (Figs. 3 and 4). No supplementary cementitious materials such as fly ash are observed. The aggregate particles in the concrete are evenly graded to an observed top size of 0.9 to 1.3 in.

- The top surface of both cores is coated with a black bituminous material, presumably the 3-ply asphaltic membrane (waterproofing membrane). The bituminous membrane is slightly flexible to brittle, and locally exhibits fine desiccation microcracks. The immediate top surface of the concrete below the bituminous membrane is stained brown, and locally somewhat soft.
- The concrete exhibits very little residual portland cement but relics of in-situ hydrated cement particles are common, indicating continued hydration of the cement over the life of the concrete. Due to the advanced state of cement hydration, water-cement ratio (w/c) could not be estimated.

- Leaching of calcium hydroxide is observed in the top surface portion of both cores where thin-section microscopy was performed. Absence of significant paste softening in the cores suggests that the leaching did not have significantly compromised overall soundness and good quality of the concrete. This feature, as well as the advanced cement hydration, indicates prolonged moisture migration through the concrete.

- Trace amounts of alkali-silica reaction gel deposits are locally observed in a few voids and along the periphery of chert aggregate particles in both cores. No distress (cracking or microcracking) is associated with the occurrence of these localized gel deposits, indicating that the observed alkali-silica reaction is not deleterious.

- Estimated air content is 1 to 3% in both cores. The air voids mostly occur as small, spherical to elliptical voids with occasional coarser, irregular voids. Depth of paste carbonation in the cores is approximately 0.04 to 0.08 in. from the top surface.

METHODS OF TEST

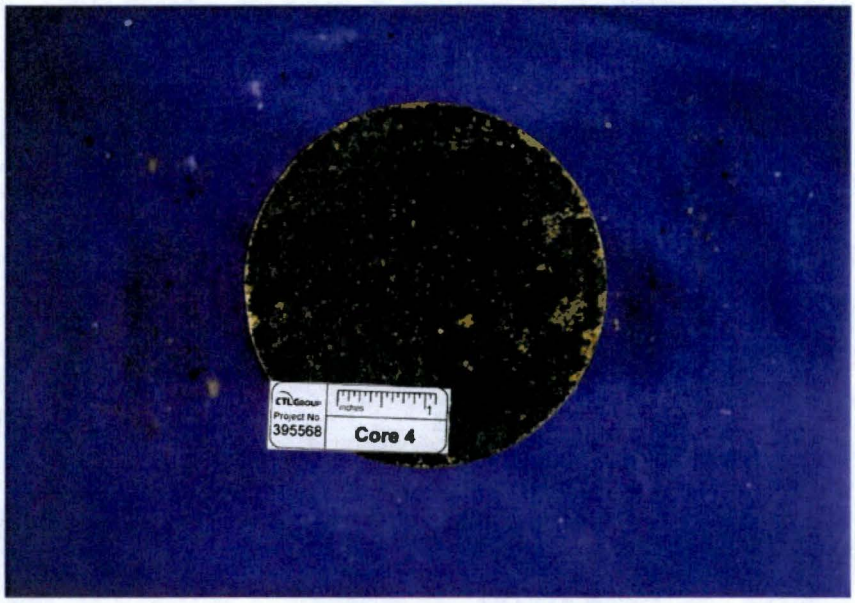
Petrographic examination of the provided cores was performed in accordance with ASTM C 856, "Standard Practice for Petrographic Examination of Hardened Concrete." The cores were visually inspected and photographed as received. Each core was then cut in half longitudinally and one of the resulting halves was ground (lapped) to produce a smooth, flat, semi-polished surface. Lapped and freshly broken surfaces of the concrete were examined using a stereomicroscope at magnifications up to 45X. For thin-section study, a small rectangular block was cut from the top surface portion of each core, and one side of each block was lapped to produce a smooth, flat surface. The blocks were cleaned and dried, and the prepared surfaces were mounted on separate ground glass microscope slides with epoxy resin. After the epoxy hardened, the thickness of the mounted blocks was reduced to approximately 20 μm (0.0008 in.). The resulting thin sections were examined using a polarized-light (petrographic) microscope at magnifications up to 400X to study aggregate and paste mineralogy and microstructure.

Depth and pattern of paste carbonation was initially determined by application of a pH indicator solution (phenolphthalein) to freshly cut and fractured concrete surfaces. The solution imparts a deep magenta stain to high pH, non-carbonated paste. Carbonated paste does not change color. The extent of paste carbonation was confirmed in thin-section.

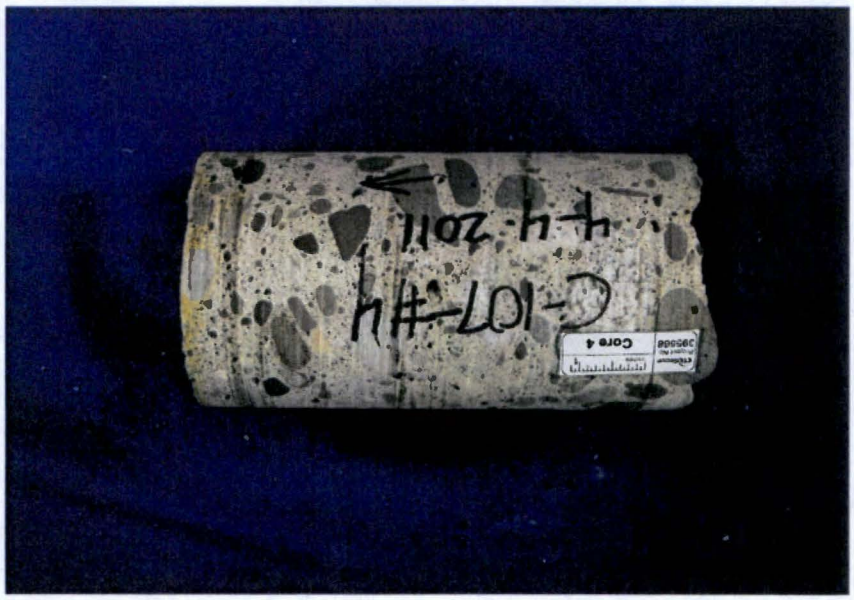
Sang Y. Lee, Ph.D., PE (Texas), PG (Indiana)
Senior Petrographer
Petrography Group

SYL

Notes:
1. Results refer specifically to the samples submitted.
2. This report may not be reproduced except in its entirety.
3. The samples will be retained for 30 days, after which they will be discarded unless we hear otherwise from you.

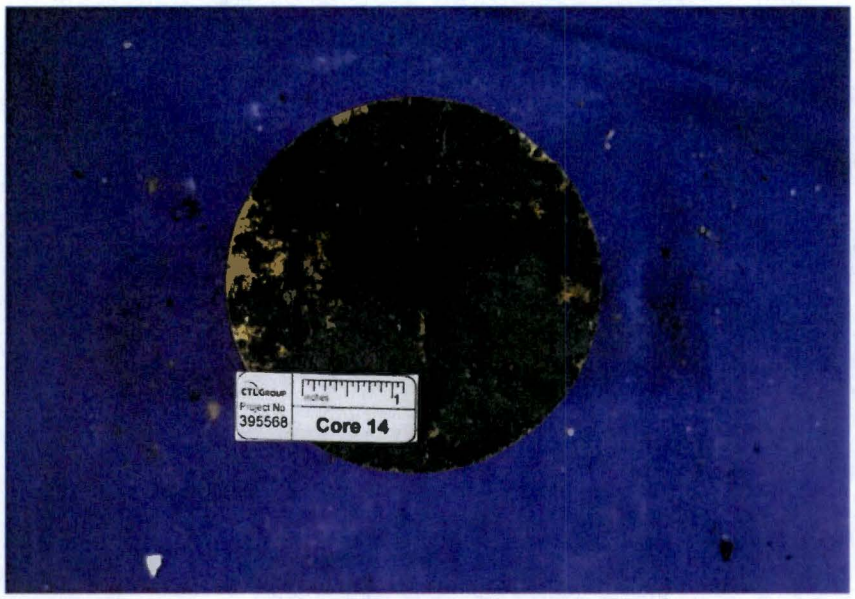


1a. Top surface, coated with a black bituminous material.

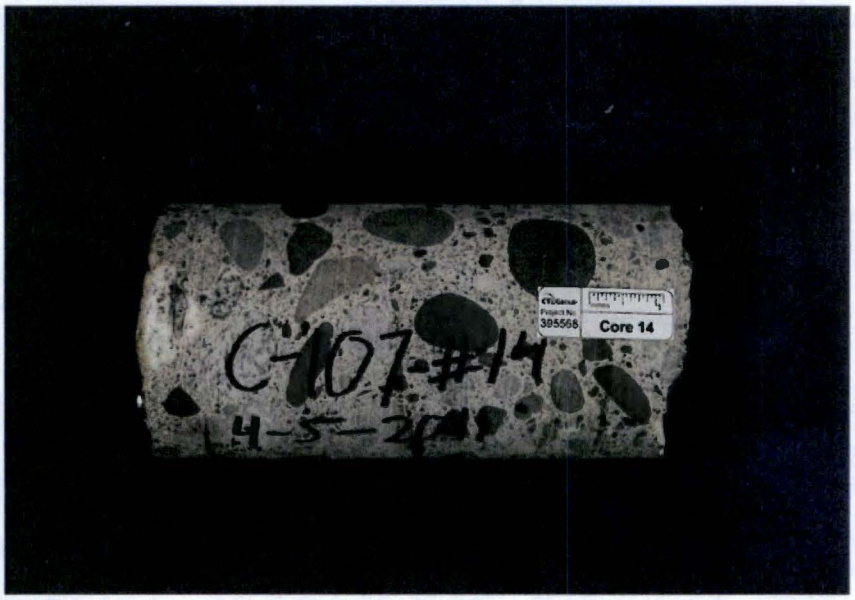


1b. Side view. Top surface is to the left.

Fig. 1 Core #4 as received for examination. Scale is in inches.

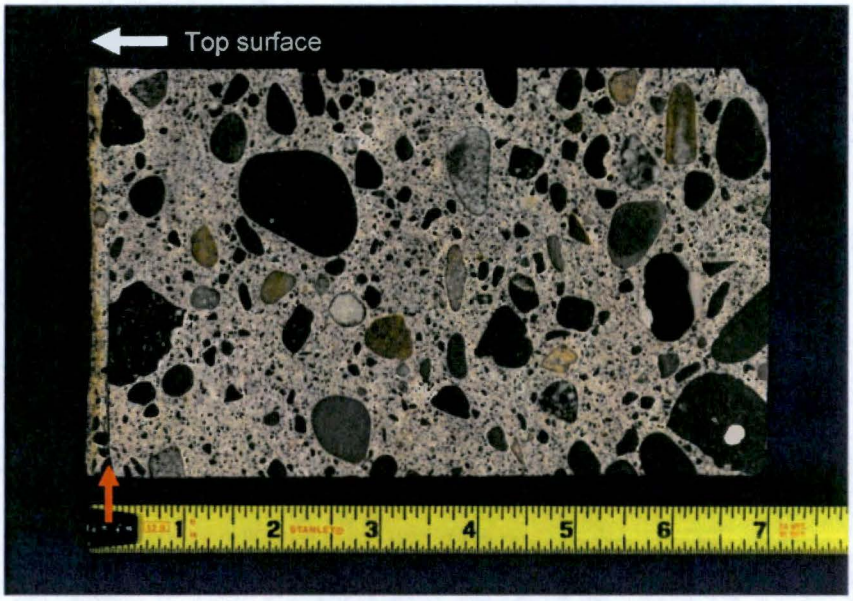


2a. Top surface, coated with a black bituminous material (waterproofing membrane).

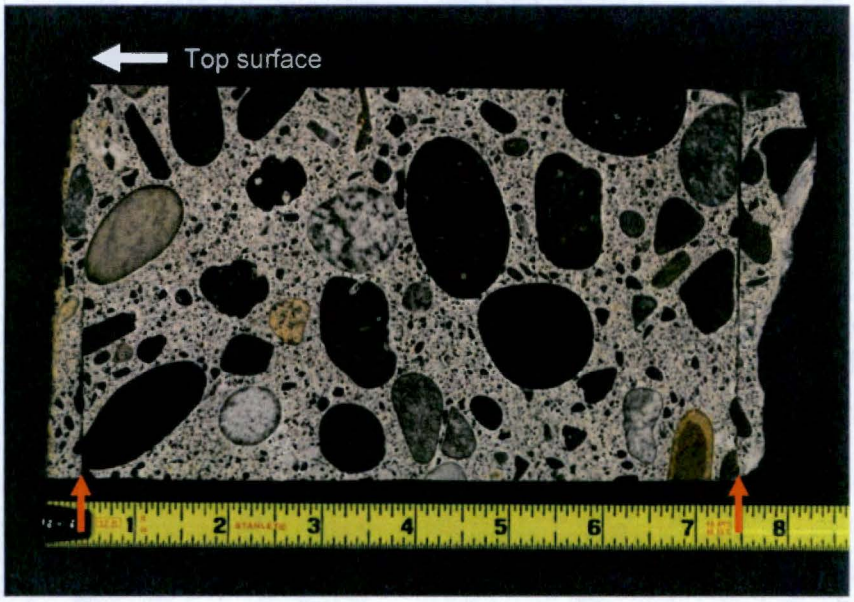


2b. Side view. Top surface is to the left.

Fig. 2 Core #14 as received for examination. Scale is in inches.

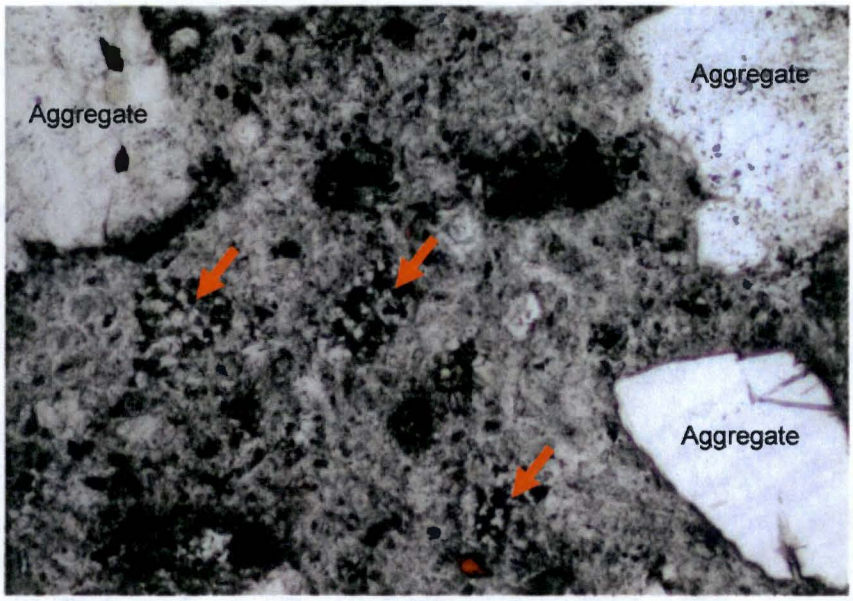


3a. Core #4.

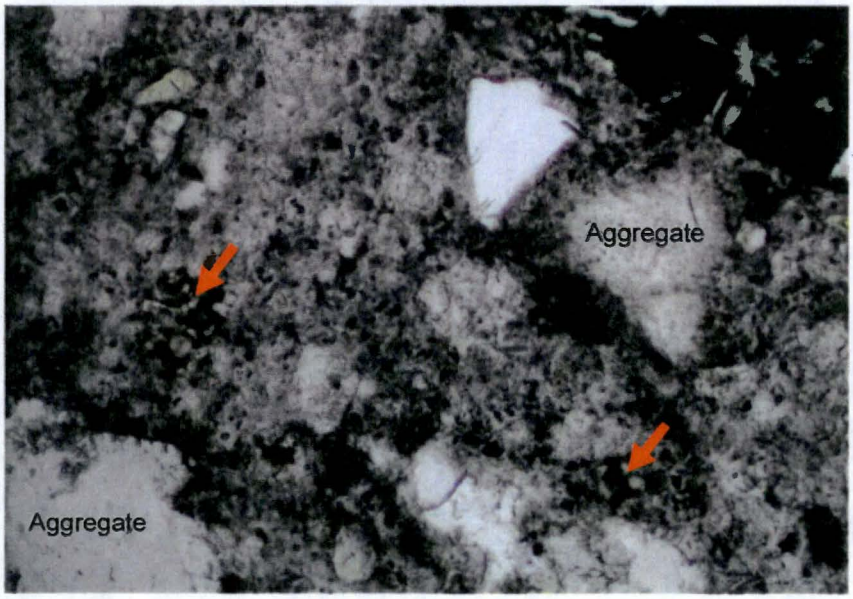


3b. Core #14.

Fig. 3 Cut and lapped cross-sections of the cores, illustrating general condition and appearance of concrete in the cores. No visible cracks are observed in either core. Arrows designate saw-cut surfaces in the laboratory. Scale is in inches.



4a. Core #4.



4b. Core #14.

Fig. 4 Thin-section photomicrographs taken in a plane-polarized light mode, showing the hardened cement paste in the cores. The paste exhibits very little residual portland cement but relics of in-situ hydrated cement particles (arrows) are commonly observed, indicating continued hydration of the cement over the life of the concrete. Field of view is approximately 0.06 in. across.

PETROGRAPHIC EXAMINATION OF HARDENED CONCRETE, ASTM C 856

STRUCTURE: Concrete Dome of Single Shell Tank *DATE RECEIVED*: August 19, 2011

LOCATION: Hanford, Washington *EXAMINED BY*: Sang Lee

SAMPLE

Client Identification: Core #4.

CTLGroup Identification: 2870304.

Dimensions: Core diameter = 4.2 in. (107 mm). Core length = approximately 7.4 to 7.8 in. (188 to 198 mm); partial concrete dome (tank roof) thickness.

Top Surface: Rough surface coated with a black bituminous material (3-ply asphaltic membrane), presumably a waterproofing membrane. The bituminous membrane is slightly flexible to brittle, and locally exhibits fine desiccation microcracks.

Bottom Surface: Irregular, rough, fractured surface, passing mostly around and locally through coarse aggregate particles.

Cracks, Joints, Large Voids: No visible cracks, joints, or large voids are observed. A few coarse entrapped voids, up to 0.7 in. wide (18 mm), are locally observed in the core body.

Reinforcement: None observed in the core sample.

AGGREGATES

Coarse: Siliceous rocks consisting mainly of fine-grained igneous rocks (volcanic rocks) and lesser amounts of medium to coarse-grained igneous rocks, quartzite, sandstone, and chert. The majority of coarse aggregate particles are hard and dense.

Fine: Siliceous sand consisting mainly of quartz, feldspar, various igneous rocks, quartzite, and small amounts of chert (microcrystalline quartz) and other rocks/minerals.

Gradation & Top Size: Visually appears evenly graded to an observed top size of 0.9 in. (23 mm).

Shape, Texture, Distribution: Coarse- rounded to sub-rounded, and equant to oblong with generally smooth surfaces; distribution is uniform. Fine- rounded to sub-angular, and equant to oblong; distribution is uniform.

PASTE

Color: Slightly mottled light to light medium gray; the top approximately 0.1 to 0.15 in. (3 to 4 mm) of the paste is stained brown.

Hardness: Hard; the brown-stained, immediate top surface paste is locally somewhat soft.

Luster: Subvitreous.

Paste-Aggregate Bond: Moderately weak to moderately tight. Fresh fractures frequently pass around coarse aggregate particles, and pass both through and around fine aggregate particles. Evaluation of paste-aggregate bond is somewhat speculative due to hard and dense nature of some coarse aggregate particles.

Air Content: Estimated at 1 to 3%; the concrete is not air entrained based on the scarcity of small, spherical air voids.

Depth of Carbonation: Approximately 0.04 to 0.08 in. (1 to 2 mm) from the top surface.

Calcium Hydroxide*: Calcium hydroxide is rare in the examined top surface region of the core, and is likely leached.

Residual Portland Cement Clinker Particles: Almost fully hydrated; a trace amount of partially hydrated portland cement particles are observed. Relicts of hydrated portland cement particles are commonly observed in the paste.

Supplementary Cementitious Materials: None observed.

Secondary Deposits: A trace amount of alkali-silica reaction gel deposits is observed in a few voids and along the periphery of a few chert aggregate particles. Secondary ettringite needles line some voids.

MICROCRACKING: Short, randomly-oriented microcracks are frequently observed in the paste between aggregate particles throughout the body of the core; these microcracks are not related to any deleterious mechanisms in the concrete.

ESTIMATED WATER-CEMENT RATIO: Water-cement ratio of the concrete is not estimated due to the advanced state of cement hydration (continued cement hydration over the lifetime of the concrete due to exposure to moisture).

MISCELLANEOUS:

- The cement paste is dense; water droplets applied to fresh fractures are slowly absorbed by the paste.
- A few coarse aggregate particles exhibit darkened rims; no significant distress is associated with these rimmed aggregate particles.

---

*percent by volume of paste

PETROGRAPHIC EXAMINATION OF HARDENED CONCRETE, ASTM C 856

STRUCTURE: Concrete Dome of Single Shell Tank

DATE RECEIVED: August 19, 2011

LOCATION: Hanford, Washington

EXAMINED BY: Sang Lee

SAMPLE

Client Identification: Core #14.

CTLGroup Identification: 2870310.

Dimensions: Core diameter = 4.2 in. (107 mm). Core length = 7.4 to 8.1 in. (188 to 206 mm); partial concrete dome (tank roof) thickness.

Top Surface: Rough surface coated with a black bituminous material.

Bottom Surface: Irregular, rough, fractured surface, passing mostly around and locally through coarse aggregate particles.

Cracks, Joints, Large Voids: No visible cracks, joints, or large voids are observed. A few coarse entrapped voids, up to 0.2 in. wide (5 mm), are locally observed in the core body.

Reinforcement: None observed in the core sample.

AGGREGATES

Coarse: Siliceous rocks consisting mainly of fine-grained igneous rocks (volcanic rocks) and lesser amounts of medium to coarse-grained igneous rocks, quartzite, sandstone, and chert. The majority of coarse aggregate particles are hard and dense.

Fine: Siliceous sand consisting mainly of quartz, feldspar, various igneous rocks, quartzite, microcrystalline quartz, and small amounts of chert and other rocks/minerals.

Gradation & Top Size: Visually appears evenly graded to an observed top size of 1.3 in. (33 mm).

Shape, Texture, Distribution: Coarse- rounded to sub-rounded, and equant to oblong with generally smooth surfaces; distribution is uniform. Fine- rounded to sub-angular, and equant to oblong; distribution is uniform.

PASTE

Color: Light gray; the top approximately 0.1 in. (3 mm) of the paste is stained brown.

Hardness: Hard; the brown-stained, immediate top surface paste is locally somewhat soft.

Luster: Subvitreous.

Paste-Aggregate Bond: Moderately weak to moderately tight. Fresh fractures frequently pass around coarse aggregate particles, and pass both through and around fine aggregate

particles. Evaluation of paste-aggregate bond is somewhat speculative due to hard and dense nature of some coarse aggregate particles.

Air Content: Estimated at 1 to 3%; the concrete is not air entrained based on the scarcity of small, spherical air voids.

Depth of Carbonation: Approximately 0.04 to 0.08 in. (1 to 2 mm) from the top surface.

Calcium Hydroxide*: Calcium hydroxide is rare in the examined top surface region of the core, and is likely leached.

Residual Portland Cement Clinker Particles: Fully hydrated. Relicts of hydrated portland cement particles are occasionally observed in the paste.

Supplementary Cementitious Materials: None observed.

Secondary Deposits: Trace amounts of alkali-silica reaction gel deposits are observed in a few voids and along the periphery of a few chert aggregate particles. Secondary ettringite needles line some voids.

MICROCRACKING: Short, randomly-oriented microcracks are frequently observed in the paste between aggregate particles throughout the body of the core; these microcracks are not related to any deleterious mechanisms in the concrete.

ESTIMATED WATER-CEMENT RATIO: Water-cement ratio of the concrete is not estimated due to the advanced state of cement hydration.

MISCELLANEOUS:

- The cement paste is dense; water droplets applied to fresh fractures are slowly absorbed by the paste.
- A few coarse aggregate particles exhibit darkened rims; no significant distress is associated with these rimmed aggregate particles.

---

*percent by volume of paste

APPENDIX F

C-107 CONCRETE CORE

TRACKING

LOG BOOK

CTL GROUP

Core Tracking Log Book
Sample ID: Core Sample #1

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	08/09/11	08/09/11	not requested
Time	14:00	13:00	14:00	13:00	15:00	11:00	11:15	N/A
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	PBB	PBB	N/A

Core Tracking Log Book
Sample ID: Core Sample #2

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	08/09/11	08/09/11	not requested
Time	14:00	13:00	14:00	13:00	15:00	11:20	11:25	N/A
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	PBB	PBB	N/A

Core Tracking Log Book
Sample ID: Core Sample #3

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	08/09/11	08/09/11	not requested
Time	14:00	13:00	14:00	13:00	15:00	11:45	11:50	N/A
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	PBB	PBB	N/A

CTL GROUP

Core Tracking Log Book
Sample ID: Core Sample #4

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	N/A	N/A	09/01/11
Time	14:00	13:00	14:00	13:00	15:00	N/A	N/A	12:00
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	N/A	N/A	SL

Core Tracking Log Book
Sample ID: Core Sample #5

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	08/09/11	08/09/11	not requested
Time	14:00	13:00	14:00	13:00	15:00	13:20	13:25	N/A
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	PBB	PBB	N/A

Core Tracking Log Book
Sample ID: Core Sample #6

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	08/09/11	08/09/11	not requested
Time	14:00	13:00	14:00	13:00	15:00	13:50	13:55	N/A
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	PBB	PBB	N/A

Corporate Office and Laboratory: 5400 Old Orchard Road, Skokie, IL 60077-1030

CTL GROUP

Core Tracking Log Book
Sample ID: Core Sample #11

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	8/9/2011	08/09/11	not requested
Time	14:00	13:00	14:00	13:00	15:00	14:25	14:35	N/A
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	PBB	PBB	N/A

Core Tracking Log Book
Sample ID: Core Sample #12

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	8/9/2011	08/09/11	not requested
Time	14:00	13:00	14:00	13:00	15:00	14:55	15:00	N/A
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	PBB	PBB	N/A

Core Tracking Log Book
Sample ID: Core Sample #13

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	08/09/11	08/09/11	not requested
Time	14:00	13:00	14:00	13:00	15:00	15:20	15:25	N/A
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	PBB	PBB	N/A

Corporate Office and Laboratory: 5400 Old Orchard Road, Skokie, IL 60077-1030

CTL GROUP

Core Tracking Log Book
Sample ID: Core Sample #14

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	N/A	N/A	09/01/11
Time	14:00	13:00	14:00	13:00	15:00	N/A	N/A	12:00
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	N/A	N/A	SL

Core Tracking Log Book
Sample ID: Core Sample #15

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	08/09/11	08/09/11	not requested
Time	14:00	13:00	14:00	13:00	15:00	15:55	16:00	N/A
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	PBB	PBB	N/A

Core Tracking Log Book
Sample ID: Core Sample #17

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	08/09/11	08/09/11	not requested
Time	14:00	13:00	14:00	13:00	15:00	16:15	16:25	N/A
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	PBB	PBB	N/A

Corporate Office and Laboratory: 5400 Old Orchard Road, Skokie, IL 60077-1030

CTL GROUP

Core Tracking Log Book
Sample ID: Core Sample #19

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	08/10/11	08/10/11	not requested
Time	14:00	13:00	14:00	13:00	15:00	10:30	10:35	N/A
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	PBB	PBB	N/A

Core Tracking Log Book
Sample ID: Core Sample #20

Task	Received at RSSI	Inspected	Received at CTL	Prepared	ASTM C215	ASTM C469	ASTM C39	ASTMC856
Date	6/24/11	6/28/11	7/7/11	07/28/11	08/08/11	08/10/11	08/10/11	not requested
Time	14:00	13:00	14:00	13:00	15:00	10:55	11:15	N/A
Person (initial)	SHN	TMW	JLJ	PBB	JLJ	PBB	PBB	N/A

Corporate Office and Laboratory: 5400 Old Orchard Road, Skokie, IL 60077-1030

APPENDIX G

C-107 CONCRETE CORE

CHAIN OF CUSTODY

PARTS AND TOOLS RETURN (PTR) FORM
PROJECT HANFORD, 2355 STEVENS DR., RICHLAND, WA 99354

REFERENCE BUSINESS PROCESS GUIDE - MATERIAL RETURNS

SECTION A - Material Information

Company: WRPS Date: 6/6/2011

One of the following is REQUIRED:

PO/Release No.:

Contract/Rel. No.: 234378

P-Card Log No.:

Other:

Contract Specialist Name: Carson Maestas

Phone Number: 376-3592

Material Coordinator/P-Card Holder Name: Jim Castleberry

Phone Number: 373-5011

PTR No.: 28208

Total Pieces: 1

Line Item No.	Quantity	U/M	Q Level	Description (Catalog ID No., S/N, Gov. Tag No.)/Include Reason for Return	Unit Price	Value
	1		3	Fourteen 4 1/2" Diameter x 11" long concrete cores stored in similarly dimensioned PVC tubes with PVC caps. The cores are packaged in a 55 gallon drum with packing to prevent shifting and sliding during transportation. Approximate weight (not including drum) is 200 lbs		

SECTION B - Financial Transaction Information

Passport Purchase Order Financial Transaction - Check One

- ○ Credit - Return for Credit - PP Receipt Required
- ○ Replace - Return for Replacement - PP Receipt Required
- ○ Inventory - Return to PHMC Inventory
- ○ Return - QA-Non-NCR Material (Credit)

*Requires identification of controlling Purchase Order, Contract, or PHMC Property Custodian accountable for the Govt. property in accordance with Regulations.

Contract/P-Card/Other - No Financial Transaction Created from PTR

- ◉ Credit - Contract/P-Card
- ○ Repair
- ○ Ship Supplier Owned Materials, Containers, Samples, etc.
- ○ *Ship Govt. Owned Materials, Containers, Samples, etc.
- ○ OTHER
- ○ Core Charge - Return for Credit of Deposit
- ○ Replace
- ○ Ship Waste/Material for Disposal
- ○ Over Shipment

SECTION C - Hazardous Material Information

Hazardous Material: ◉ Yes* ○ No

Radioactive Material: ◉ Yes* ○ No

Rad. Control Survey: ◉ Yes ○ No

*T&P Inspections (req'd) ○ Yes ○ No

Include appropriate shipping document. Radioactive Material is also Hazardous.

Certified Free of Contamination ○ Yes ○ No

Certifier's Name/Date

Custodian:

Telephone:

Current Location of Material: 241-C-Farm Middle "Tent" Trailer just outside MO512

Date Available to Ship: 6/7/2011

SECTION D - Vendor/Ship To Information

Ship To: Radiation Safety Services, Inc. (RSSI)
6312 West Oakton Street
Morton Grove, IL 60053

Contact: Eli Port

Contact Phone: 847-965-1999

RA No.:

F.O.B.:

Contractor: CTLGroup
Attn: Joni Jones
5400 Old Orchard Road
Skokie, IL 60077
847-972-3128

Item	% Cost	Cost Center	CACN	COA
		~~TKE00~~ 2MH00	200972	BJ40

SECTION E - Shipping Information - To be completed by Shipping Department

Routing: YRC Inc.

B/L No.: PRO# 968174540-8

B/L Wt.: 287 LBS.

Frt. Collect:

Acct. No.:

SECTION F - OSD&D/Shipping Notice Information - To be completed by Shipping/Procurement

By:

Date Shipped:

OSD&D No.:

Shipping Notice No.:

Receipt No.:

A-6001-535 (03/05)

Assembler	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST	C.O.C. No.
NA		Page 2 of 2

Collector: AE Miller	Contact/Requestor: Aaron E Miller	Telephone No. (509) 551-8413 MSIN S7-90 FAX
SAF No.	Sample Origin: 241-C-107	Purchase Order/Charge Code: 200972
Project Title: Test Dome Concrete and Rebar 'Plugs'	Logbook/ Work Package No.: TFC-WO-11-1383	Ice Chest No.: NA Temp.: NA
Shipped To (Lab): Construction Technology Services	Method of Shipment: Ground	Bill of Lading/Air Bill No.
Protocol	Data Turnaround: NA	Parts and Return No.: 28208

Sample No.	Lab ID	*	Date	Time	No./Type Container	Sample Analysis	Preservative
C-107-#1		SO	04/04/11	1000	1/PVC	RPP-PLAN-48753	NA
C-107-#2		SO	04/04/11	1300	1/PVC	RPP-PLAN-48753	NA
C-107-#3		SO	04/04/11	1400	1/PVC	RPP-PLAN-48753	NA
C-107-#4		SO	04/04/11	1500	1/PVC	RPP-PLAN-48753	NA
C-107-#6		SO	04/04/11	1600	1/PVC	RPP-PLAN-48753	NA

POSSIBLE SAMPLE HAZARDS/REMARKS (List all known wastes) MSDS ○ Yes ◉ No

Samples were taken from a Contaminated/Radioactive Area; however, the samples have no detectable contamination at the surface and less than 0.5mRem/hr beta/gamma readings.

SPECIAL INSTRUCTIONS: NA

Hold Time: NA

Relinquished By (Print / Sign)	Date/Time	Received By (Print / Sign)	Date/Time
AE Miller	6-7-11/0845	DE Jackson Jr	6-7-11
Douglas E Jackson Jr	6/7/11	JIM Foss	6-7-11
		Sangho Nam	6/28/11
Sangho Nam	7/7/11	Joni Jones	7/7/11

Matrix*

S	= Soil	DL	= Drum Liquids
SE	= Sediment	T	= Tissue
SO	= Solid	WI	= Wipe
SL	= Sludge	L	= Liquid
W	= Water	V	= Vegetation
O	= Oil	VA	= Vapor
A	= Air	X	= Other
DS	= Drum Solids		

FINAL SAMPLE DISPOSITION: Disposal Method (e.g., Return to customer, per lab procedure, used in process) Disposed By Date/Time

All samples containing hazardous materials shall be picked up by requestor and returned to parent container or site of origin.

A-6003-962 (03/05)

Assembler	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST	C.O.C. No.
NA		Page 1 of 2

Collector: AE Miller	Contact/Requestor: Aaron E Miller	Telephone No. (509) 551-8413 MSIN S7-90 FAX
SAF No.	Sample Origin: 241-C-107	Purchase Order/Charge Code: 200972
Project Title: Test Dome Concrete and Rebar 'Plugs'	Logbook/ Work Package No.: TFC-WO-11-1383	Ice Chest No.: NA Temp.: NA
Shipped To (Lab): Construction Technology Services	Method of Shipment: Ground	Bill of Lading/Air Bill No.
Protocol	Data Turnaround: NA	Parts and Return No. 282089

Sample No.	Lab ID	*	Date	Time	No./Type Container	Sample Analysis	Preservative
C-107-#5		SO	04/05/11	0900	1/PVC	RPP-PLAN-48753	NA
C-107-#11		SO	04/05/11	0945	1/PVC	RPP-PLAN-48753	NA
C-107-#12		SO	04/05/11	1030	1/PVC	RPP-PLAN-48753	NA
C-107-#13		SO	04/05/11	1100	1/PVC	RPP-PLAN-48753	NA
C-107-#14		SO	04/05/11	1300	1/PVC	RPP-PLAN-48753	NA
C-107-#15		SO	04/05/11	1345	1/PVC	RPP-PLAN-48753	NA
C-107-#17		SO	04/05/11	1430	1/PVC	RPP-PLAN-48753	NA
C-107-#19		SO	04/05/11	1500	1/PVC	RPP-PLAN-48753	NA
C-107-#20		SO	04/05/11	1530	1/PVC	RPP-PLAN-48753	NA

POSSIBLE SAMPLE HAZARDS/REMARKS (List all known wastes) MSDS ○ Yes ◉ No

Samples were taken from a Contaminated/Radioactive Area; however, the samples have no detectable contamination at the surface and less than 0.5mRem/hr beta/gamma readings.

SPECIAL INSTRUCTIONS: NA

Hold Time: NA

Relinquished By (Print / Sign)	Date/Time	Received By (Print / Sign)	Date/Time
AE Miller	6-7-11/0845	DE Jackson	6/7/11
DE Jackson	6/7/11	Jim Foss	6-7-11
		Sangho Nam	6/28/11
Sangho Nam	7/7/11	Joni Jones	7/7/11

Matrix*

S	= Soil	DL	= Drum Liquids
SE	= Sediment	T	= Tissue
SO	= Solid	WI	= Wipe
SL	= Sludge	L	= Liquid
W	= Water	V	= Vegetation
O	= Oil	VA	= Vapor
A	= Air	X	= Other
DS	= Drum Solids		

FINAL SAMPLE DISPOSITION: Disposal Method (e.g., Return to customer, per lab procedure, used in process) Disposed By Date/Time

All samples containing hazardous materials shall be picked up by requestor and returned to parent container or site of origin.

A-6003-962 (03/05)

APPENDIX H

CTL GROUP

TESTING MACHINE

CALIBRATION

James Glazbrook

Digitally signed by James Glazbrook
DN: cn=James Glazbrook, o=CTLGroup, ou=Quality, email=jglazbrook@ctlgroup.com, c=US
Reason: I have reviewed this document
Date: 2011.01.26 15:13:28 -06'00'

Report and Certificate of Calibration

by

Cal-Cert

6709 S.E. Lake Road Milwaukie, OR 97222 (800)356-4662 Fax (503)654-9670

ACCREDITED
Laboratory Code: CL-108

Report #:	36322-C-37		
Customer Name:	CTL Group		
Customer Address:	5400 Old Orchard Road		
City:	Skokie	**State:** IL	**Zip:** 60077
Contact:	Jeffrey Leavitt		
Service Address:	5400 Old Orchard Road, Skokie, IL 60077		

Calibration Standards

12-600K/00167 Revere Load Cell s/n: 994229 TS Cal date: 8/12/10 Due: 8/12/11 Vendor:CC Range 10,224 to 600k NIST# 35704-C-01
12-50K/00356 Sensotec Load Cell SN 1293217 Cal Date: 8/11/10 Cal Due: 8/11/11 Range 1,304 to 50K Vendor: CC NIST# 35704-C-03
12-10k/00096 AdMet/Honeywell Load cell s/n 1032361 Cal Date: 8/11/10 Due Date: 8/11/11 Vendor CC Range: 2,498 to 10K NIST# 35704-C-04
12-RH/00080 Comark Temp/Humidity s/n 06213950025 Cal Date 8/13/10 Due Date: 8/13/11 Vendor: CC NIST# 35704-C-14

Instrument Data

Calibration Date:	October 19, 2010	**Method Used:**		ASTM E-4
Recommended Due Date:	October 19, 2011	**Number of Ranges:**		Three
Calibration Frequency:	12 Months	**Indicating System:**		Gauge
Manufacturer:	Baldwin	**Temperature:**	69	°F
Type:	Testing Machine	**Humidity:**	46%	RH
Model Number:	BTE	**Cal Factor:**		None
Serial #:	150054	**Asset #:**		None
Capacity:	400,000 lbs.	**Service Location:**		Service Address
		As Found:		Pass
		As Left:		Pass

Machine Inspection/Service:

Cleaned, Tightened and Lubricated Spherical Seat:	Acceptable	Pump Oil Level Check:	Acceptable
Springs, Safety Brackets, Holding Stem Inspection:	Acceptable	Piston Retraction Check:	Acceptable
Upper Platen Planeness Inspection:	Acceptable	Hydraulic System Leak Check:	Acceptable
Lower Platen Planeness Inspection:	Acceptable		

Instrument Range: 16,000 **lbs.** **Range Resolution:** 20 **lbs.** **Mode Verified:** Compression

Unit Under Test Reading	As Found	As Found Percentage Error	Verification Reading #1	Error	Percentage Error	Verification Reading # 2	Error	Percentage Error	Algebraic Difference
0	0.0	0.00%	0.0	0.0	0.00%	0.0	0.0	0.00%	0.00%
2,000	1,982.5	-0.88%	1,982.5	(17.5)	-0.88%	1,981.0	(19.0)	-0.95%	0.07%
3,200	3,172.5	-0.86%	3,172.5	(27.5)	-0.86%	3,171.5	(28.5)	-0.89%	0.03%
6,400	6,356.0	-0.69%	6,356.0	(44.0)	-0.69%	6,354.5	(45.5)	-0.71%	0.02%
9,600	9,550.0	-0.52%	9,550.0	(50.0)	-0.52%	9,533.0	(67.0)	-0.70%	0.18%
12,800	12,765	-0.27%	12,765	(35.0)	-0.27%	12,775	(25.0)	-0.20%	-0.08%
15,200	15,205	0.03%	15,205	5.0	0.03%	15,225	25.0	0.16%	-0.13%
0	0.0	0.00%	0.0	0.0	0.00%	0.0	0.0	0.00%	0.00%

Machine - 3 Ranges CF-001-05 Revision 6 9/13/2010

Page: 1 of 2

Manufacturer: Baldwin **Type:** Testing Machine **Serial #:** 150054

Instrument Range:			160,000 **lbs.**	**Range Resolution:**		200 **lbs**	**Mode Verified:**		Compression
Unit Under Test Reading	As Found	As Found Percentage Error	Verification Reading #1	Error	Percentage Error	Verification Reading # 2	Error	Percentage Error	Algebraic Difference
0	0.0	0.00%	0.0	0.0	0.00%	0.0	0.0	0.00%	0.00%
20,000	20,005.0	0.03%	20,005.0	5.0	0.03%	20,140.0	140.0	0.70%	-0.68%
32,000	31,965.0	-0.11%	31,965.0	(35.0)	-0.11%	32,055.0	55.0	0.17%	-0.28%
64,000	63,755.0	-0.38%	63,755.0	(245.0)	-0.38%	63,700.0	(300.0)	-0.47%	0.09%
96,000	95,830.0	-0.18%	95,830.0	(170.0)	-0.18%	95,840.0	(160.0)	-0.17%	-0.01%
128,000	127,765.0	-0.18%	127,765.0	(235.0)	-0.18%	127,915.0	(85.0)	-0.07%	-0.12%
152,000	151,975.0	-0.02%	151,975.0	(25.0)	-0.02%	151,930.0	(70.0)	-0.05%	0.03%
0	0.0	0.00%	0.0	0.0	0.00%	0.0	0.0	0.00%	0.00%

Instrument Range:			400,000 **lbs**	**Range Resolution:**		500 **lbs**	**Mode Verified:**		Compression
Unit Under Test Reading	As Found	As Found Percentage Error	Verification Reading #1	Error	Percentage Error	Verification Reading # 2	Error	Percentage Error	Algebraic Difference
0	0.0	0.00%	0.0	0.0	0.00%	0.0	0.0	0.00%	0.00%
50,000	50,125	0.25%	50,125	125.0	0.25%	50,205	205.0	0.41%	-0.16%
80,000	80,165	0.21%	80,165	165.0	0.21%	80,225	225.0	0.28%	-0.08%
160,000	160,190	0.12%	160,190	190.0	0.12%	160,280	280.0	0.18%	-0.06%
240,000	240,510	0.21%	240,510	510.0	0.21%	240,580	580.0	0.24%	-0.03%
320,000	320,595	0.19%	320,595	595.0	0.19%	320,665	665.0	0.21%	-0.02%
380,000	381,685	0.44%	381,685	1,685.0	0.44%	381,340	1,340.0	0.35%	0.09%
0	0.0	0.00%	0.0	0.0	0.00%	0.0	0.0	0.00%	0.00%

REMARKS:

Room Location Million Pound room, Purchase Order # 46943B.

Service Engineer: ROBERT OWENS **Date:** October 19, 2010

Technical Manager: MARSHALL DOYLE **Signature:** MDoyle

Uncertainty: The UUT % uncertainty includes the uncertainty of the Calibration standards used combined with the uncertainty of the measurement process using the RSS method with a K factor of 2 for an approximate 95% level of confidence. The uncertainty for this measurement is < 0.25% of the test load applied unless otherwise stated. The calibration process meets or exceeds a ratio of 4:1.

We sincerely thank you for your business.
Please call us at 1-800-356-4662 for all your calibration needs.
Cleaning and preventive maintenance were preformed before calibration of this equipment.
Any software associated with this instrument was verified as part of this calibration.

Tested with Reference Standards Traceable to the National Institute of Standards and Technology using ASTM E-4 Follow the Force Tests Methods. Cal-Cert Test Method: CP-001. The Tolerance for this instrument is ±1% of Applied Load

Accredited by the International Accreditation Service, Inc. (IAS) under Calibration Laboratory Code CL-108.
This Laboratory meets the requirements of ISO/IEC 17025 AND ANSI/NCSL Z540-1

The above system (Instrument, Load Cell, Integral Software and Output Device(s), and accessories has been calibrated in accordance with ASTM E4 - Standard Practices for Force Verification of Testing machines using apparatus and standards calibrated in accordance to ASTM E74 - Standard practice for Calibration of Force-Measuring Instruments for Verifying the Load Indication of Testing Machines and which are traceable to NIST (National Institute of Standards and Technology). The information provided on this form complies with the data gathering and reporting requirements of ISO/IEC Guide 17025 and ANSI/NCSL-1.

This Certificate is issued as a statement of the fact that on this date the above instrument(s) had an accuracy as indicated. It should not be construed or regarded as a Guarantee or Warranty of any kind (in favor of the client, the client's customers, or the public at large) that the instrument(s) will continue to retain the same percentage (%) of accuracy or efficiency as determined on the date when the calibration, and adjustments if required, was performed and reported by "CAL-CERT", since the calibrator has absolutely no control over the future operation, damage, maintenance, repairs, and overall condition of the instrument(s) and hereby expressly disclaims any and all liability for damage or loss sustained by all parties arising or resulting from deterioration, obsolescence, malfunction, or substandard performance of said instrument(s); which shall be deemed to be and which shall remain the sole responsibility of the machines regular custodian, owner, and/or manufacturer.

This report shall not be reproduced except in full, without written approval from Cal-Cert.

Report #: 36322-C-37

Machine - 3 Ranges CF-001-05 **Revision 6** **9/13/2010**

APPENDIX I

CTL GROUP

VERIFICATION OF

DK-5000 SOFTWARE

November 22, 2010

Checker's name: Asad Bassam, CTLGroup

VERIFICATION OF DK-5000 SOFTWARE

DK-5000 is a LabView™ based software that CTLGroup uses to obtain the resonant frequencies of concrete test specimen. The minimum requirements for Labview based softwares are 1GB of RAM and a Pentium™ 4 processor. The computer dedicated for the resonant frequency measurements has a Pentium Dual core 2.6 GHz processor and 2 GB of RAM and therefore meets the software requirements of the DK-5000. The data is acquired using a National Instruments PCI- 6013 DAQ card, which has a sampling rate capacity of 200 KS/s and therefore meets the 50 KS/s sampling rate required by the software to analyze the data. For verification of the DK-5000, three tests were performed using the same accelerometer and excitation hammer that CTLGroup uses to obtain the dynamic modulus of concrete when using the DK-5000 software. A concrete test sample was tested by applying an impact and recording the accelerations. For verification purposes, the recorded time histories for each test were then converted to frequency domain using Welch Method in MATLAB™ as an alternate to the DK-5000 frequency conversion. The results obtained using both MATLAB and DK-5000 are shown below.

The results match fairly well with less than 0.2% difference. This verifies the calculation procedures used in DK-5000 software.

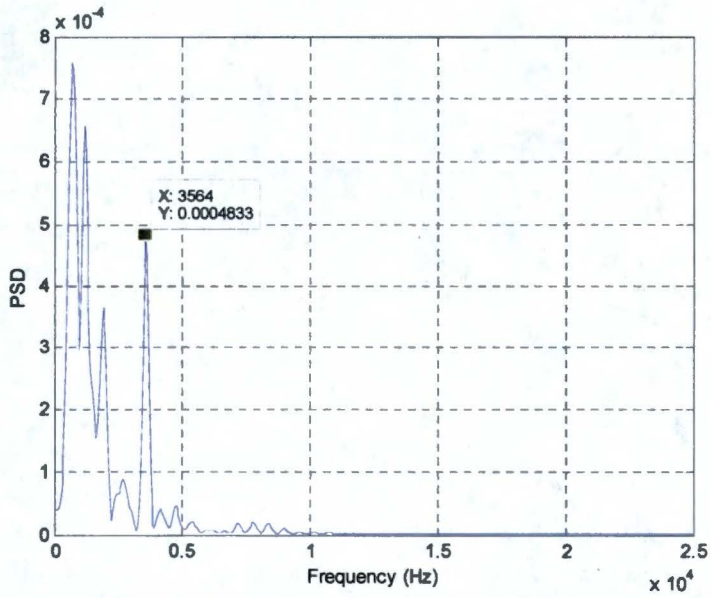


Figure 1: Power Spectral Density plot of the first test

Labview is a registered trademark (TM) of National Instruments Corporation, Austin, TX.
MATLAB is a registered trademark (TM) of MathWorks, Inc., Natick, MA
Pentium is a registered trademark (TM) of Intel Corporation, Santa Clara, CA.

CTLGroup Project No. 39QA11

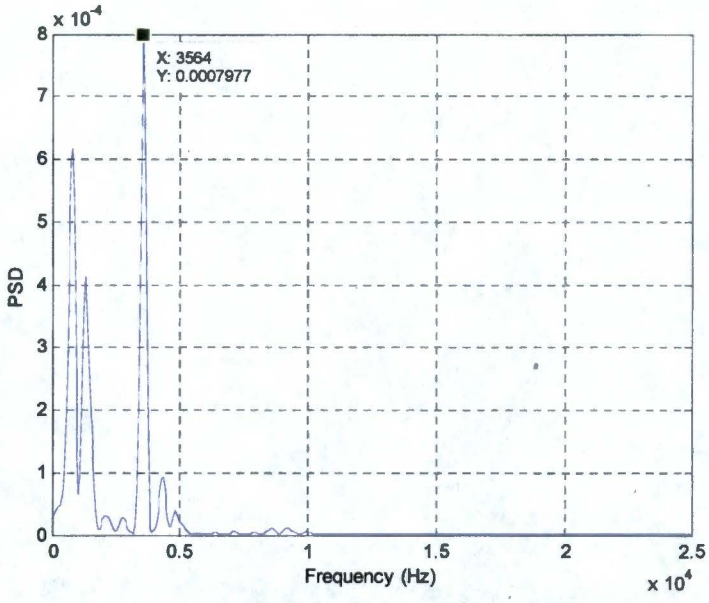


Figure 2: Power Spectral Density plot of the first test

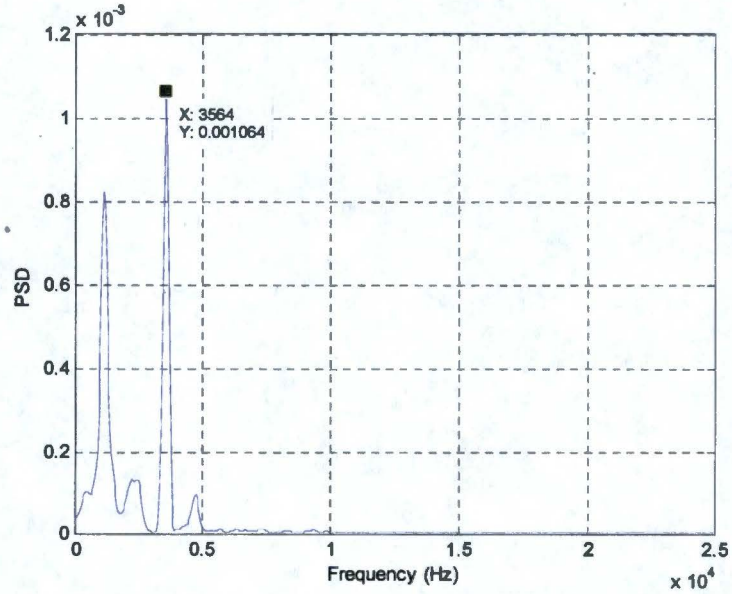


Figure 3: Power Spectral Density plot of the third test

Table 1: Comparison of the results

	Test 1	Test 2	Test 3
Frequency computed by Matlab	3564	3564	3564
Frequency computed by DK-5000	3570	3570	3570
Difference (%)	**0.2**	**0.2**	**0.2**

APPENDIX J

CTL GROUP

ACCREDITATION

International Accreditation Service

CERTIFICATE OF ACCREDITATION

This is to signify that

CTLGROUP
5400 OLD ORCHARD ROAD
SKOKIE, ILLINOIS 60077

Testing Laboratory TL-200
(February 7, 2011)

has met the requirements of the IAS Accreditation Criteria for Testing Laboratories (AC89), has demonstrated compliance with ANS/ISO/IEC Standard 17025:2005, *General criteria for the competence of testing and calibration laboratories*, and has been accredited, commencing March 10, 2010, for the test methods listed in the approved scope of accreditation.

Patrick V. McCullen
Vice President

C. P. Ramani, P.E.
President

ilac-MRA

IAS
ACCREDITED

(see attached scope of accreditation for fields of testing and accredited test methods)

Print Date: 02/08/2011

This accreditation certificate supersedes any IAS accreditation certificate bearing an earlier date. The certificate becomes invalid upon suspension, cancellation or revocation of accreditation. See the IAS Accreditation Listings on the web at www.iasonline.org for current accreditation information, or contact IAS directly at (562) 699-0541

Page 1 of 3

IAS is a subsidiary of the International Code Council

ICC INTERNATIONAL CODE COUNCIL

10-03355

International Accreditation Service

SCOPE OF ACCREDITATION

CTLGroup TL-200
(Revised February 7, 2011)

CTLGroup
5400 Old Orchard Rd
Skokie, IL 60077

Jeffrey Leavitt
Quality Manager
(847) 972-3058

FIELDS OF TESTING	ACCREDITED TEST METHODS
Concrete (including fiber-reinforced concrete, masonry, cement, mortar and grout) and aggregates	ASTM Standards C 29, C 31, C 39, C 40, C 42, C 67, C 78, C 88, C 91, C 109, C 114, C 117, C 123, C 127, C 128, C 131, C 136, C 138, C 140, C 142, C 143, C 151, C 157, C 172, C 173, C 185, C 187, C 190, C 191, C 192, C 204, C 215, C 227, C 231, C 232, C 234, C 266, C 270, C 289, C 293, C 348, C 403, C 426, C 430, C 441, C 451, C 457, C 469, C 482, C 496, C 512, C 535, C 566, C 567, C 617, C 641, C 642, C 666, C 672, C 702, C 779, C 780, C 856, C 947, C 1018, C 1019, C 1064, C 1077, C 1105, C 1116, C 1152, C 1202, C 1218, C 1222, C 1314, C 1357, C 1388, C 1581, E 514, E 518, and E 519; Test methods referenced in Sections 3 and 4 of ICC-ES Acceptance Criteria AC51
Steel wire, bar and strand materials; Steel studs, joists and tracks	ASTM Standards A 82, A 184, A 185, A 370, A 416, A 421, A 496, A 497, A 615, A 616, A 617, A 706, A 722, A 767, A 775, A 882, A 884, A 934, A 944 and E 328; Test methods referenced in Sections 3 and 4 of ICC-ES Acceptance Criteria AC46
Welded and mechanical connections for concrete reinforcing steel; Post-tensioning anchorages and couplers	1997 UBC Standard 19-1; Test methods referenced in Sections 3 and 4 of ICC-ES Acceptance Criteria AC133 and AC303; Caltrans Test 670

March 10, 2010
Commencement Date

ACCREDITED

C. P. Ramani, P.E.
President

Print Date: 02/08/2011

This accreditation certificate supersedes any IAS accreditation certificate bearing an earlier date. The certificate becomes invalid upon suspension, cancellation or revocation of accreditation. See the IAS Accreditation Listings on the web at www.iasonline.org for current accreditation information, or contact IAS directly at (562) 699-0541

IAS is a subsidiary of the International Code Council

10-03356

International Accreditation Service

SCOPE OF ACCREDITATION

CTLGroup TL-200
(Revised February 7, 2011)

FIELDS OF TESTING	ACCREDITED TEST METHODS
Adhesive and mechanical anchors in concrete and masonry elements	Test methods referenced in Section 5.0 of ICC-ES Acceptance Criteria AC01 and Sections 3 and 4 of AC58, Tables 4.1, 4.2 and 4.3 AC193 and Tables 4.1, 4.2, 4.3 and 4.4 of AC308; ASTM Standards E 488, E 754 and E 1512
Wall panels	ASTM Standards C 1452 (Section 9 only), E 72, E 330 and E 661; Test methods referenced in Section 4.0 of AC32 and AC86.
Reinforced and prestressed concrete pipe	ASTM Standard C 497
Seismic isolation/damping system components	1997 UBC Section 1665
Fasteners	ASTM Standard E 1190; Test methods referenced in Sections 3 and 4 of ICC-ES Acceptance Criteria AC118
Deck board and guardrail systems	Test methods referenced in Sections 3, 4 and 5 of ICC-ES Acceptance Criteria AC174 (except Sections 3.9 and 3.10)
Cement-based fabric composite system	Test methods referenced in Sections 3 and 4 of ICC-ES Acceptance Criteria AC218 (except Sections 4.1, 4.2 and 4.6)
Construction materials	ASTM E 96

March 10, 2010
Commencement Date

ACCREDITED

C. P. Ramani, P.E.
President

Print Date: 02/08/2011

This accreditation certificate supersedes any IAS accreditation certificate bearing an earlier date. The certificate becomes invalid upon suspension, cancellation or revocation of accreditation. See the IAS Accreditation Listings on the web at www.iasonline.org for current accreditation information, or contact IAS directly at (562) 699-0541

IAS is a subsidiary of the International Code Council.

10 03356

American Association of State Highway and Transportation Officials

AASHTO Accreditation Program - Certificate of Accreditation

This is to signify that

Construction Technology Laboratories, Inc.

Skokie, Illinois

has demonstrated proficiency for the testing of construction materials
and has met the minimum requirements in AASHTO R18
set forth by the AASHTO Highway Subcommittee on Materials.

The scope of accreditation can be obtained by viewing
the AAP Directories of Accredited Laboratories (www.nist.gov/amrl)
or by contacting AMRL.

Executive Director

Chair, AASHTO Highway
Subcommittee on Materials

AAP
AASHTO R18

APPENDIX K

C-107 CONCRETE CORE

RADIOLOGICAL SURVEY REPORTS

TANK OPERATIONS CONTRACTOR RADIOLOGICAL SURVEY REPORT

RSR No. COC-003561

Date	Start/Stop Time	Area/Location	RWP/Rev.
04/04/11	0800 / 1600	200E / C FARM / C 107	CO-111 REV 17

Purpose of Survey

- ☐ Material Release – Confidence Level
  - ☐ 67% ☐ 95%
- ☐ RAM Shipment: N/A
- ☐ Required Task: N/A
- ☒ Job Coverage: TFC-WO-11-1383
- ☐ Other: N/A

Description of Work/Comments:

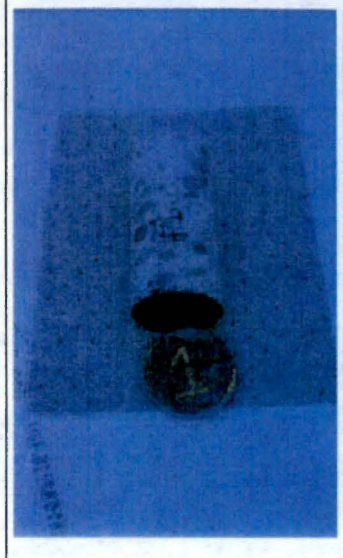
COVERED CORE DRILLING ON THE C 107 DOME CUT. COVERAGE WAS CONTINUOUS. FIVE CORES, #1, #2, #3, #4, #6, OF 14+ CORES WERE DRILLED AND REMOVED. THESE CORES WERE PLACES IN PVC TUBING, CAPPED, AND TAGGED AS RAD MATERIAL. CORE REMAINED IN LANCS BAG, COVERED IN GRIFFLON, AND TAGGED AS RAD MATERIAL. NO ANOMALIES WERE ENCOUNTED DURING WORK ACTIVIIES.

No.	Description	Dose Rate Measurements								Contamination Measurements							
		Note[1] F = Field (≥30 cm) C = Contact (≤1 cm)								Direct Gross cpm/PA		Background cpm		Total dpm/100 cm²		Removable dpm/100 cm²	
		Dist. (cm) Note[1]	WO mR/hr	WC mR/hr	CF β	CF γ	Neutron Dose mrem/hr	Shallow Dose mrem/hr	Deep Dose mrem/hr	βγ	α	βγ	α	βγ	α	βγ	α
1	PRE JOB SURVEY	F/C	<0.5/<05	<0.5/<0.5	2/2	1/1	N/A	<0.5/<0.5	<0.5/<0.5	150	0	150	0	NA/	N/A	<1000	<20
2	CORE SAMPLE # 1	F/C	<0.5/<0.5	<0.5/<05	2/2	1/1	N/A	<0.5/<0.5	<0.5/<0.5	150	0	150	0	<5000	<100	<1000	<20
3	CORE SAMPLE # 2	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<0.5	<0.5/<0.5	150	0	150	0	<5000	<100	<1000	<20
4	CORE SAMPLE # 3	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<0.5	<0.5/<0.5	150	0	150	0	<5000	<100	<1000	<20
6	CORE SAMPLE # 4	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<0.5	<0.5/<0.5	150	0	150	0	<5000	<100	<1000	<20
5	CORE SAMPLE # 6	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<0.5	<0.5/<0.5	150	0	150	0	<5000	<100	<1000	<20
6	DRILL BIT	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<0.5	<0.5/<0.5	150	0	150	0	<5000	<100	<1000	<20
7	POST JOB SURVEY	F/C	<0.5/<0.5	<0.5/<0.5	2/2	1/1	N/A	<0.5/<0.5	<0.5/<0.5	150	0	150	0	N/A	N/A	<1000	<20
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

BD-6003-343 (REV 4)

TANK OPERATIONS CONTRACTOR RADIOLOGICAL SURVEY REPORT	RSR No. COC-003561	Page 2 of 2

Map/Sketch



Legend:	# Direct Measurement	Air Sample	Smear	LAW	Neutron	Field Dose Rate	Note: Dose Rates in mrem/hr unless otherwise noted.
	-------- (designation inside) -------- Radiological Area Boundary					* Contact Dose Rate	

Instruments

Instrument/Probe Model	RO-20	GM Model g-m Probe	PAM Probe	N/A	N/A	N/A	N/A	N/A
Serial No.	ICEB9-0002	CMEB3-0255	ACHN2-0085	N/A	N/A	N/A	N/A	N/A
		DTHNC-0354	CTHN3-0372	N/A	N/A	N/A	N/A	N/A
Efficiency (used)	N/A	.10	.17	N/A	N/A	N/A	N/A	N/A

	Air Sample Log Number		Smear Log Number	HPT: Date: 4/04/11	Payroll No: 84608	Initial Review Date & Initials: 04-07-11 CP Final Review Date & Payroll No.: 04 07 11 89870
1	N/A	☐ Breathing Zone ☐ General Area	N/A	Name (Print): G. EVANSON		Name (Print): CHRIS PARMENTER
2	N/A	☐ Breathing Zone ☐ General Area	N/A	Signature: [signature]		Signature: [signature]

BD-6003-343 (REV 4)

TANK OPERATIONS CONTRACTOR RADIOLOGICAL SURVEY REPORT

RSR No. COC-003572

Date	Start/Stop Time	Area/Location	RWP/Rev.
04/05/11	0800 / 1600	200E / C FARM / C 107	CO-111 REV 17

Purpose of Survey

- ☐ Material Release – Confidence Level
  - ☐ 67% ☐ 95%
- ☐ RAM Shipment: N/A
- ☐ Required Task: N/A
- ☒ Job Coverage: TFC-WO-11-1383
- ☐ Other: N/A

Description of Work/Comments:

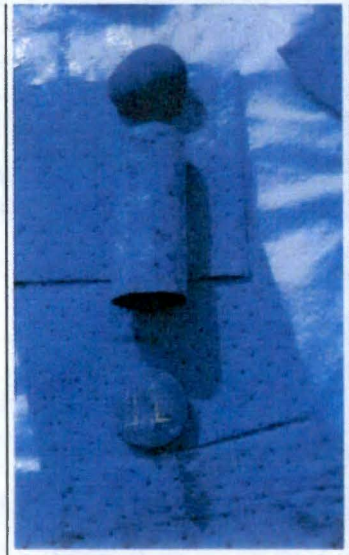
COVERED CORE DRILLING ON THE C 107 DOME CUT. COVERAGE WAS CONTINUOUS. 9 CORES, #5, #11, #12, #13, #14, #15, #17, #19, and #20 CORES WERE DRILLED AND REMOVED. THESE CORES WERE PLACES IN PVC TUBING, LABLED, CAPPED, AND TAGGED AS RAD MATERIAL. DOME CUT REMAINED IN LANCS BAG, COVERED IN GRIFFLON, AND TAGGED AS RAD MATERIAL. DURING THE WORK ACTIVITY IT WAS DISCOVERED THAT APROXIMATELY ONE GALLON WATER LEAKED THROUGH THE RISER OPENING ON TOP OF THE DOME CUT INTO THE SLEEVING. SP400 WAS ADDED TO THE LIQUID TO TURN IT INTO A GEL.

No.	Description	Dose Rate Measurements								Contamination Measurements							
		Note[1] F = Field (≥30 cm) C = Contact (≤1 cm)								Direct Gross cpm/PA		Background cpm		Total dpm/100 cm²		Removable dpm/100 cm²	
		Dist. (cm) Note[1]	WO mR/hr	WC mR/hr	CF β	CF γ	Neutron Dose mrem/hr	Shallow Dose mrem/hr	Deep Dose mrem/hr	βγ	α	βγ	α	βγ	α	βγ	α
1	PRE JOB SURVEY	F/C	<0.5/<05	<0.5/<0.5	2/2	1/1	N/A	<0.5/<0.5	<0.5/<0.5	150	0	150	0	NA/	N/A	<1000	<20
2	CORE SAMPLE # 5	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<05	<0.5/<05	150	0	150	0	<5000	<100	<1000	<20
3	CORE SAMPLE # 11	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<05	<0.5/<05	150	0	150	0	<5000	<100	<1000	<20
4	CORE SAMPLE # 12	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<05	<0.5/<05	150	0	150	0	<5000	<100	<1000	<20
6	CORE SAMPLE # 13	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<05	<0.5/<05	150	0	150	0	<5000	<100	<1000	<20
5	CORE SAMPLE # 14	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<05	<0.5/<05	150	0	150	0	<5000	<100	<1000	<20
6	CORE SAMPLE # 15	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<05	<0.5/<05	150	0	150	0	<5000	<100	<1000	<20
7	CORE SAMPLE # 17	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<05	<0.5/<05	150	0	150	0	<5000	<100	<1000	<20
8	CORE SAMPLE #19	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<05	<0.5/<05	150	0	150	0	<5000	<100	<1000	<20
9	CORE SAMPLE # 20	F/C	<0.5/<05	<0.5/<05	2/2	1/1	N/A	<0.5/<05	<0.5/<05	150	0	150	0	<5000	<100	<1000	<20
10	POST JOB SURVEY	F/C	<0.5/<0.5	<0.5/<0.5	2/2	1/1	N/A	<0.5/<0.5	<0.5/<0.5	150	0	150	0	N/A	N/A	<1000	<20
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

BD-6003-343 (REV 4)

TANK OPERATIONS CONTRACTOR RADIOLOGICAL SURVEY REPORT	RSR No. COC-003572	Page 2 of 3

Map/Sketch



Legend:	# Direct Measurement	Air Sample	Smear	LAW	Neutron	Field Dose Rate * Contact Dose Rate	Note: Dose Rates in mrem/hr unless otherwise noted.
	-------- (designation inside) -------- Radiological Area Boundary						

Instruments

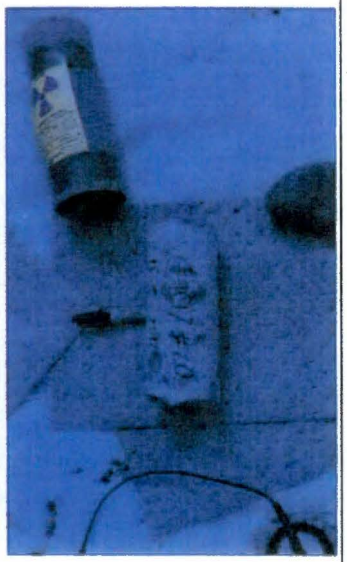
Instrument/Probe Model	RO-20	GM Model g-m Probe	PAM Probe	2360	N/A	N/A	N/A	N/A
Serial No.	ICEB9-0023	CMEB3-0046	N/A	SCLL8-0345	N/A	N/A	N/A	N/A
		DTHNC-0232	N/A	DTLLP-0451	N/A	N/A	N/A	N/A
Efficiency (used)	N/A	.10	N/A	N/A	15.2/14.8	N/A	N/A	N/A

	Air Sample Log Number		Smear Log Number	HPT: Date: 4/05/11	Payroll No: 84608	Initial Review Date & Initials: 04-07-11
						Final Review Date & Payroll No.: 04-07-11 89872
1	N/A	☐ Breathing Zone ☐ General Area	N/A	Name (Print): G. EVANSON		Name (Print): CHRIS PALMERTON
2	N/A	☐ Breathing Zone ☐ General Area	N/A	Signature:		Signature:

BD-6003-343 (REV 4)

TANK OPERATIONS CONTRACTOR RADIOLOGICAL SURVEY REPORT	RSR No. COC-003572	Page 3 of 3

Map/Sketch

				
	N/A	N/A	N/A	N/A

Legend:	# Direct Measurement	Air Sample	Smear	LAW	Neutron	Field Dose Rate * Contact Dose Rate	Note: Dose Rates in mrem/hr unless otherwise noted.
	-------- (designation inside) -------- Radiological Area Boundary						

BD-6003-343.2 (REV 3)

ATTACHMENT 2

13-TF-0032

RPP-RPT-54564, INSPECTION AND TEST REPORT FOR THE REMOVED 241-C-107 DOME REBAR

DOCUMENT RELEASE FORM

(1) Document Number: RPP-RPT-54564	(2) Revision Number: 0	(3) Effective Date: on release	
(4) Document Type: ☐ Digital Image ☐ Hard copy ☒ PDF ☐ Video	(a) Number of pages (including the DRF) or number of digital images: 243		
(5) Release Type: ☒ New ☐ Cancel	☐ Page Change ☐ Complete Revision		
(6) Document Title: INSPECTION AND TEST REPORT FOR THE REMOVED 241-C-107 DOME REBAR	(7) USQ No.: R- ☒ N/A USQ Evaluator Sign/Date		
(8) Change/Release Description: initial release			
(9) Change Justification: n/a			
(10) Associated Structure, System, and Component (SSC) and Building Number:	(a) Structure Location: 13C107	(c) Building Number: 241-C-107	(e) Project Number: n/a
	(b) System Designator: WST	(d) Equipment ID Number (EIN): n/a	

(11) Impacted Documents:	(a) Document Type	(b) Document Number	(c) Document Revision
	n/a	n/a	n/a

(12) Approvals:

(a) Author (Print/Sign): R.S. Rast — Date: 04APR2013

(b) Reviewer (Optional, Print/Sign): T.A. Misiak — Date: 4/4/13

(c) Responsible Manager (Print/Sign): D.J. Washenfelder — Date: 04-04-2013

(13) Distribution:

(a) Name	(b) MSIN	(a) Name	(b) MSIN
J.L. Castleberry	R3-26	K.D. Boomer	R2-53
D.J. Washenfelder	R2-53	T.J. Venetz	R2-53
W.L. Isom	R2-58	J.M. Johnson	H6-60
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R.S. Rast	R2-58	P.M. Howard	S7-83
T.A. Misiak	R2-58	T.G. Myer	S7-75
R.E. Gregory	S7-68	J.J. Luke	H6-14

Release Stamp: DATE: Apr 16, 2013 HANFORD RELEASE

(14) Clearance	(a) Cleared for Public Release	(b) Restricted Information?	(c) Restriction Type:
	☒ Yes ☐ No	☐ Yes ☒ No	

(15) Clearance Review (Print/Sign): APPROVED By Julia Raymer at 10:01 am, Apr 16, 2013 — Date:

A-6003-881 (REV 5)

Raymer, Julia R

From: Lane, James <jlane@ctlgroup.com>
Sent: Tuesday, April 16, 2013 9:37 AM
To: Rast, Richard S
Subject: FW: Calibration Release

Importance: High

Rick,

Will this suffice?

Thanks,

James

From: Glazbrook, James
Sent: Tuesday, April 16, 2013 11:28 AM
To: Lane, James
Cc: Leavitt, Jeffrey
Subject: FW: Calibration Release
Importance: High

Hi James,

Please see email below from Cal-Rite.

Please let me know if you require anything else.

Thanks,
James

James Glazbrook
Quality Management Systems

CTLGROUP
5400 Old Orchard Road
Skokie, IL 60077-1030
847.972.3342 Direct
JGlazbrook@CTLGroup.com
www.CTLGroup.com

From: Greg Duka [mailto:greg@cal-rite.com]
Sent: Tuesday, April 16, 2013 11:23 AM
To: Glazbrook, James
Subject: Calibration Release

James,

Please accept this email as our written permission for the "release" of CTL Group and Exova's calibration reports and certificates required per this email. If you have any questions, please give me a call.

Respectfully,

Gregory Duka
President

Cal-Rite Corporation
1665 Quincy Avenue #123
Naperville, IL 60540
Ph: 630.355.1522
Fx: 630.355.1544
greg@cal-rite.com
http://www.cal-rite.com

From: "Glazbrook, James" <JGlazbrook@ctlgroup.com>
Date: April 16, 2013 10:56:57 AM CDT
To: Nathan Hathaway <nathan@cal-rite.com>
Cc: Julie Duka <julie@cal-rite.com>, "Lane, James" <jlane@ctlgroup.com>, "Leavitt, Jeffrey" <JLeavitt@ctlgroup.com>
Subject: FW: Calibration Release

Hi Nathan,

Please see email below regarding a "release" we require to include Cal-Rite calibration records as part of a CTL report to be issued to the DOE.

A response to this email will suffice.

Any priority attention you can give this matter is greatly appreciated as this is an urgent matter.

Please contact me with any questions/concerns.

Thanks,
James

James Glazbrook
Quality Management Systems

CTL GROUP
5400 Old Orchard Road
Skokie, IL 60077-1030
847.972.3342 Direct
JGlazbrook@CTLGroup.com

www.CTLGroup.com

From: Lane, James
Sent: Tuesday, April 16, 2013 10:50 AM
To: Glazbrook, James
Cc: Leavitt, Jeffrey
Subject: Calibration Release

On the bottom of the Cal-Rite certificates (for both CTLGroup and Exova), there is a clause that says that the reports are confidential and cannot be reproduced without express written permission from Cal-Rite. Our client, Washington River Protection Services (WRPS), has requested that we obtain a release from Cal-Rite for both our equipment and Exova's equipment calibration records provided by Cal-Rite. They have stated that an email release wouls be sufficient. They intend to include the calibration records as part of the report issued to the DOE.

They need the release to be provided to Exova, CTLGroup and WRPS. Exova included their certificates in the report to us, we included ours and Exova's in a report to WRPS and WRPS will include Exova's and ours to DOE.

Our client needs this very quickly. They are under deadlines and this is something that came from the non-technical review.

Thanks,

James

James F. Lane, P.E.
Director, Principal Engineer
Structural & Transportation Laboratory

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INSPECTION AND TEST REPORT FOR THE REMOVED 241-C-107 DOME REBAR

Author Name:
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Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-08RV14800

EDT/ECN:	DRF	UC:	
Cost Center:	2KE00	Charge Code:	
B&R Code:		Total Pages:	~~240~~ 243 JRR 4/16/13

Key Words: Single Shell Tank, SST, C-106, structure, concrete, core, rebar, structural integrity, yield strength, tensile strength

Abstract: This report presents the results of the additional examination of the 55 inch diameter reinforced concrete dome 'Plug' removed from SST 241-C-107. Photographs and discussion of field inspeciton of the dome 'Plug' cross section are provided. Rebar pieces were removed from the dome 'Plug' and sent offsite for testing. Rebar specimens were subject to tension and mechanics testing. This report documents represents further implementation of the Single Shell Tank Integrity Project Expert Panel recommendation, SI-5, Test Dome Concrete and Rebar 'Plugs'.

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APPROVED
By Julia Raymer at 10:03 am, Apr 16, 2013

Release Approval Date

DATE:
Apr 16, 2013
HANFORD RELEASE

Release Stamp

Approved For Public Release

RPP-RPT-54564

Revision 0

INSPECTION AND TEST REPORT FOR THE REMOVED 241-C-107 DOME REBAR

April 2013

Prepared by:

RS Rast

Washington River Protection Solutions, LLC
Richland, Washington

washington river protection solutions

EXECUTIVE SUMMARY

The Single-Shell Tank Integrity Project (SSTIP) Expert Panel (Panel) was established by WRPS to provide recommendations for implementation of an enhanced SSTIP. The Panel documented their findings in RPP-RPT-43116, *Expert Panel Report for Hanford Site Single-Shell Tank Integrity Project.* In Recommendation SI-5, *Test Dome Concrete and Rebar 'Plugs'*, the Panel recommended obtaining and testing concrete cores and rebar samples from a large section of reinforced concrete (RC) that has been removed from a tank dome. The recommendation served to better determine the current condition and mechanics properties of Single-Shell Tank concrete and rebar. The C-107 Large Riser Project successfully removed such a section from the center of the dome of Single-Shell Tank (SST) 241-C-107.

The field inspection of the concrete 'Plug' revealed that the placement of concrete and rebar generally matches the design drawings. The measured concrete cover also typically matches the design drawings, providing protection for the rebar. There were no visible cracks or large air voids visible in the cross section of the 'Plug'. Additionally, the protective asphaltic membrane and mortar layers were present and intact.

The rebar was shipped to CTL Group for inspection and testing. Visual inspection of the rebar was successfully performed at CTL Group. The inspection indicated that the rebar removed from the 'Plug' is in good condition, with no cracks or defects. Fifty-three total specimens were prepared and subjected to tension testing. Additional impact and hardness testing was performed on the remaining rebar material.

The results of the rebar tension tests were compared to the values used to define material properties in the SST Analysis of Record (AOR), as shown in Appendix A of RPP-46442, *Single-Shell Tank Structural Evaluation Criteria.* The average yield strength of all the tested C-107 rebar is about 47.24-ksi, which is greater than the specified 40-ksi yield strength of the Grade 40 rebar. The results from the testing of rebar are compared to the values used in the SST Analysis of Record, which implements S1-1 from RPP-RPT-43116. The strength of rebar is greater than what is used in the SST Analysis of Record.

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LIST OF TERMS

AOR	Analysis of Record
ASTM	American Society for Testing and Materials International
BPF	Blue Print File
DOE	U.S. Department of Energy
Panel	Single-Shell Tank Integrity Project Expert Panel
RC	reinforced concrete
SST	single-shell tank
SSTIP	Single-Shell Tank Integrity Project
TOC	Tank Operations Contractor
WRPS	Washington River Protection Solutions, LLC

1.0 INTRODUCTION

The Single-Shell Tank Integrity Project (SSTIP) has implemented expert recommendations to examine structural integrity of Hanford Single-Shell Tanks (SSTs). One recommendation states that inspection and testing of concrete and rebar removed from the SSTs should be performed. This was viewed as opportunistic due to the fact that reinforced concrete sections were to be removed from the tank domes to provide openings large enough to support installation of SST retrieval equipment. In this case, a 55-inch diameter section ('Plug') was removed from the center of the dome of SST 241-C-107 (C-107). The 'Plug' was subsequently inspected and cored. Fourteen concrete cores were removed and shipped offsite for physical testing and petrographic examination. The results of the concrete testing are documented in RPP-RPT-50934, *Inspection and Test Report for the Removed 241-C-107 Dome Concrete*. Additionally, the top layer of rebar was successfully removed and shipped off-site for testing. This report provides the results from supplemental 'Plug' inspection, and physical testing of the removed rebar. The results of the physical testing provide engineering mechanics properties that are compared to those used to perform the structural Analysis of Record (AOR) for the SSTs.

1.1 Background

The Hanford Site Tank Operations Contractor (TOC), Washington River Protection Solutions, LLC (WRPS) initiated the Single-Shell Tank Integrity Project to improve the understanding of the integrity of the Single-Shell Tanks until the waste can be retrieved from the tanks for treatment. The Single-Shell Tank Integrity Project Expert Panel (Panel) was established by WRPS to provide recommendations for implementation of an enhanced SSTIP. The Panel documented their findings in RPP-RPT-43116, *Expert Panel Report for Hanford Site Single-Shell Tank Integrity Project*. The Panel provided their logic for the development and prioritization of their 33 recommendations with ten providing the basis for a robust plan to enhance the understanding of the SST integrity.

The WRPS adoption of 16 of the Panel's recommendations is addressed and documented in RPP-PLAN-45082, *Implementation Plan for the Single-Shell Tank Integrity Project*. One of the four key elements from the Panel is to improve the understanding of the SST structural integrity (designated as "SI"). Recommendation SI-5 *Test Dome Concrete and Rebar 'Plugs'* addresses obtaining and testing concrete cores and reinforcement bar samples from the 'plug' removed from the dome of an SST. The recommendation served to better determine the current condition and mechanics properties of Single-Shell Tank concrete and rebar.

In Recommendation SI-5, *Test Dome Concrete and Rebar 'Plugs'*, the Panel recommends obtaining and testing concrete cores and rebar samples from a large section of reinforced concrete (RC) that has been removed from a tank dome. This activity was viewed as opportunistic because cutting large holes in the SST domes were planned to support installation of retrieval equipment. One such project was the C-107 Large-Riser Project, which removed a

55-inch diameter section of the center dome of the tank to allow deployment of the Mobile Arm Retrieval System. The removal of the plug is shown in RPP-49003-VA, *241-C-107 Large Riser Install for Mobile Arm Retrieval System*, February 2011.

The inspection and testing plan, RPP-PLAN-48753, *Analytical Test Plan for the Removed 241-C-107 Dome Concrete and Rebar*, addresses the objectives for performing inspection and testing of concrete cores and rebar samples from the 55-inch diameter RC section, hereafter referred to as the 'Plug', removed from C-107.

The Tri-Party Agreement for the SSTIP has one interim milestone and one target that focused on this activity;

- M-045-91D, "*DOE shall submit to Ecology, for approval, an analytical test plan for the cores removed from the C-107 plug*", due March 31, 2012.
    - The analytical test plan has been reviewed and approved by Ecology.
- M-045-91D-T01, "*DOE shall provide Ecology a report containing the results and interpretation of testing, and analysis, performed on the concrete dome samples obtained from the Tank C-107 plug*", due May 31, 2013.

The results of the inspection and testing of concrete removed from the dome 'Plug' of SST 241-C-107 are provided in RPP-RPT-50934, *Inspection and Test Report for the Removed 241-C-107 Dome Concrete*.

1.2 Objective

The intent of this report is to describe inspection and testing results of rebar removed from the C-107 'Plug'. The report also provides information resulting from additional field inspection of the 'Plug'. The results from the testing of rebar are compared to the values used in the SST Analysis of Record, which implements S1-1 from RPP-RPT-43116. The AOR is a detailed modeling effort performed to understand the structural response of the SST during thermal and operating loads and during seismic events.

The sections of this report are presented in a chronological order. The 'Plug' was removed in December 2010. The 'Plug' was inspected in March 2011. The concrete cores were removed in April 2011. The cores were tested at CTL Group in August 2011. Details of the initial 'Plug' inspection, concrete core removal, and concrete core testing are documented in RPP-RPT-50934.

The 'Plug' was subjected to a supplemental inspection in August 2012. The 'Plug' was demolished and rebar removed in September 2012. The rebar was sent off-site in December 2012. The rebar was subsequently subjected to mechanics testing in January 2013.

2.0 SUPPLEMENTAL CONCRETE PLUG FIELD INSPECTION

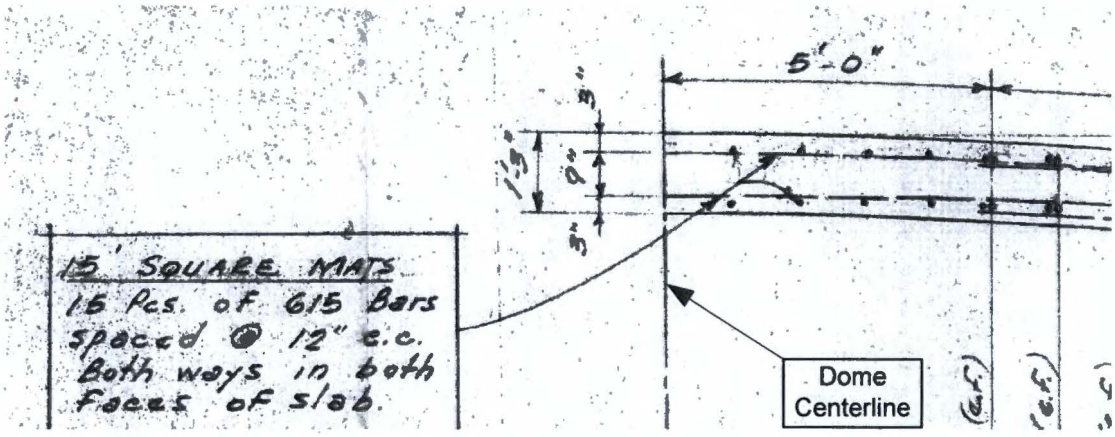
This section presents additional field inspection results of 'Plug' rebar placement.

A team of engineers went to the field soon after the "plug" was cut and removed to take photographs and various measurements. Two separate initial field inspections were conducted. The first inspection was conducted March 15, 2011. During the first inspection the engineers were permitted to measure and photograph the entire 'Plug' cross-section, through the protective bag. The second inspection was conducted March 29, 2011. During the second inspection, the engineers were not permitted to touch or directly measure to the bottom of the 'Plug'. The combined inspection efforts provided information regarding the overall condition of concrete, section thickness and placement of rebar. This information is documented in Section 2 of RPP-RPT-50934.

Intermediate rebar was identified in the initial field inspections and is shown in Figures 2-14, 2-15, and 2-18 of RPP-RPT-50934, which are copied here in Figures 2-2, 2-4, and 2-6. The supplemental inspection of the 'Plug' prior to rebar removal occurred on August 14, 2012. At the time of the inspection the holes from the cored concrete had been backfilled with concrete to facilitate the 'Plug' demolition.

The design thickness for the 241-C-107 (and all Type II SSTs) dome is 15-inches. Figure 2-1 shows the design cross section and reinforcement layout for the Type II SSTs.

Figure 2-1. 241-C-107 Reinforcing at Dome Center (Section)



Not to scale. Taken from Drawing BPF 73550, D-6

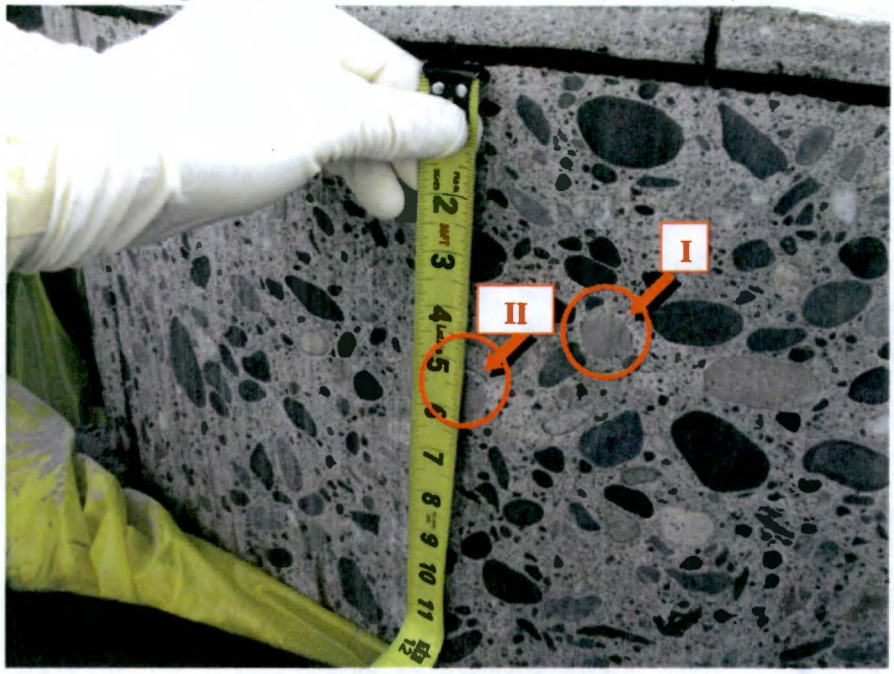
The supplemental inspection of the 'Plug' confirmed the presence of the "intermediate" rebar mentioned in RPP-RPT-50934. Figures 2-3, 2-5, 2-7, and 2-8, provide additional documentation of the intermediate rebar.

The intermediate rebar are called out as Intermediate Rebar 1, 2, 3, or 4 in Figures 2-2 through 2-9. The concrete cover for the intermediate rebar is:

- Intermediate Rebar 1 – 5.25-inches
- Intermediate Rebar 2 – 4.50-inches
- Intermediate Rebar 3 – 6.5-inches
- Intermediate Rebar 4 – 7.25-inches

Based on the orientation and similar cover depth, intermediate rebar 1 and 2 are connected and intermediate rebar 3 and 4 are connected. Figure 2-9 shows the chalk lines used to mark the presence of the 12-inch x 12-inch rebar grid that agrees with the original tank drawing BPF-73550, shown in Figure 2-1. The additional intermediate rebar does not invalidate the construction of SST 241-C-107 dome reinforced concrete. The design rebar closely matches the drawings with respect to size and placement. The two additional pieces of intermediate rebar were likely extra rebar that was added to the apex of the dome for convenience.

Figure 2-2. Intermediate Rebar 1 (Mar 2011)



(Figure 2-14 from RPP-RPT-50934)

Figure 2-3. Intermediate Rebar 1 (Aug 2012)

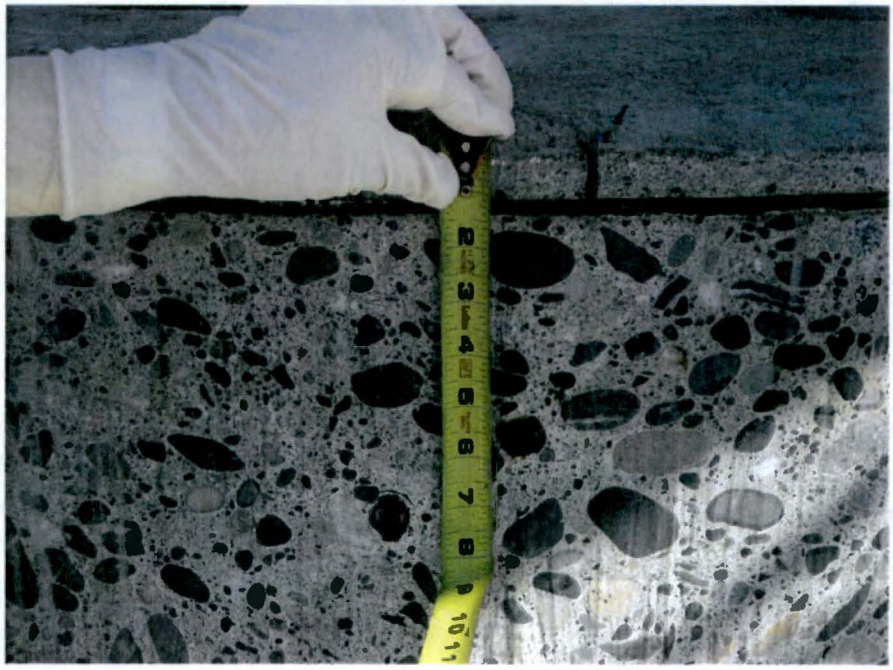


Figure 2-4. Intermediate Rebar 2 (Mar 2011)

(Figure 2-15 from RPP-RPT-50934)

Figure 2-5. Intermediate Rebar 2 (Aug 2012)

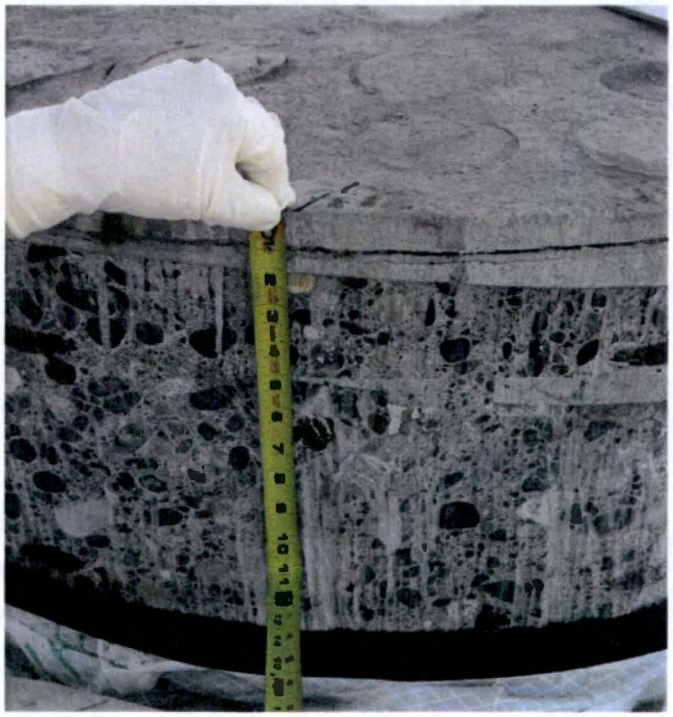
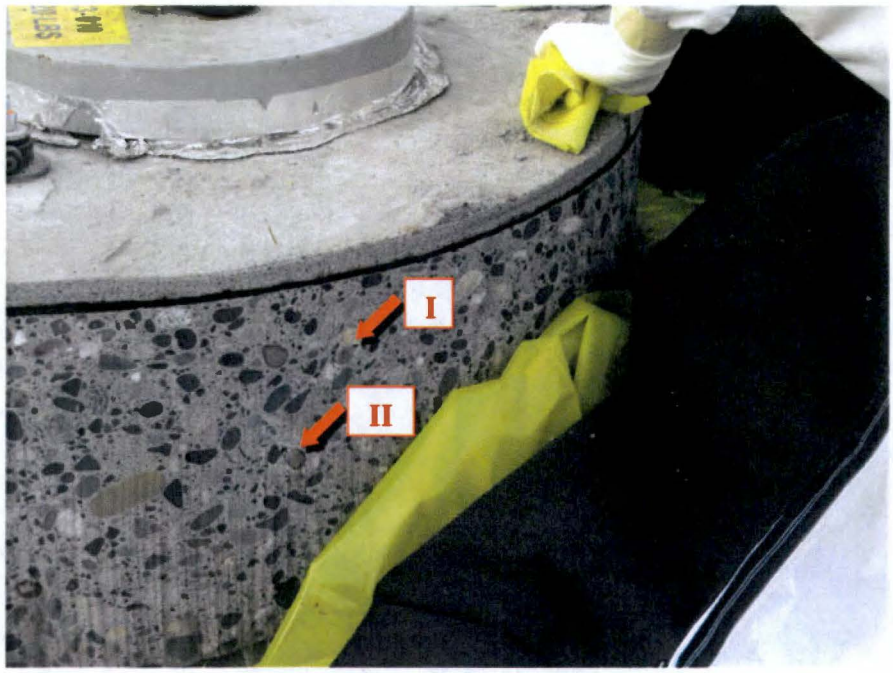


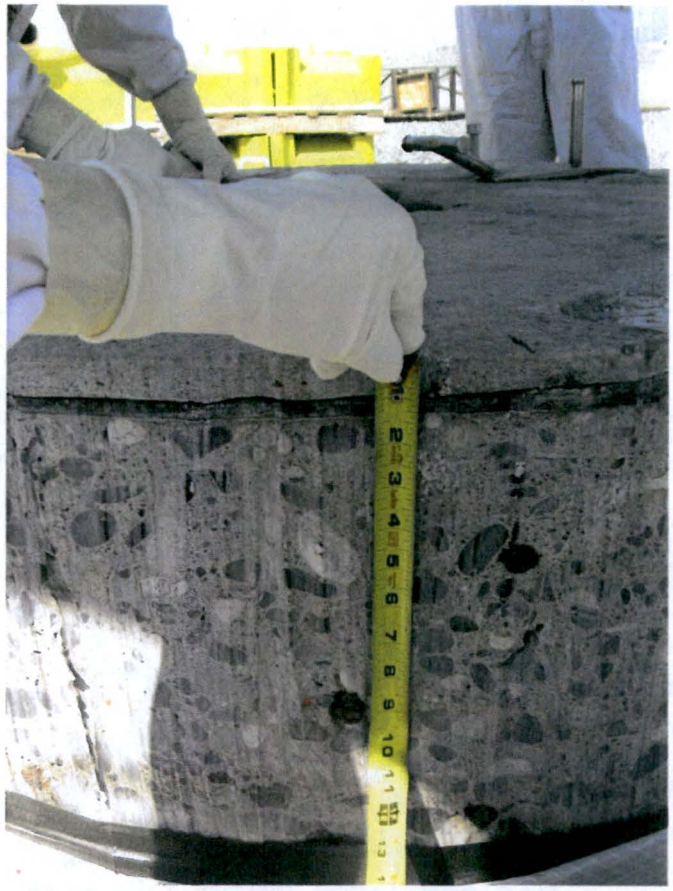
Figure 2-6. Intermediate Rebar 3 (Mar 2011)



(Figure 2-18 from RPP-RPT-50934)

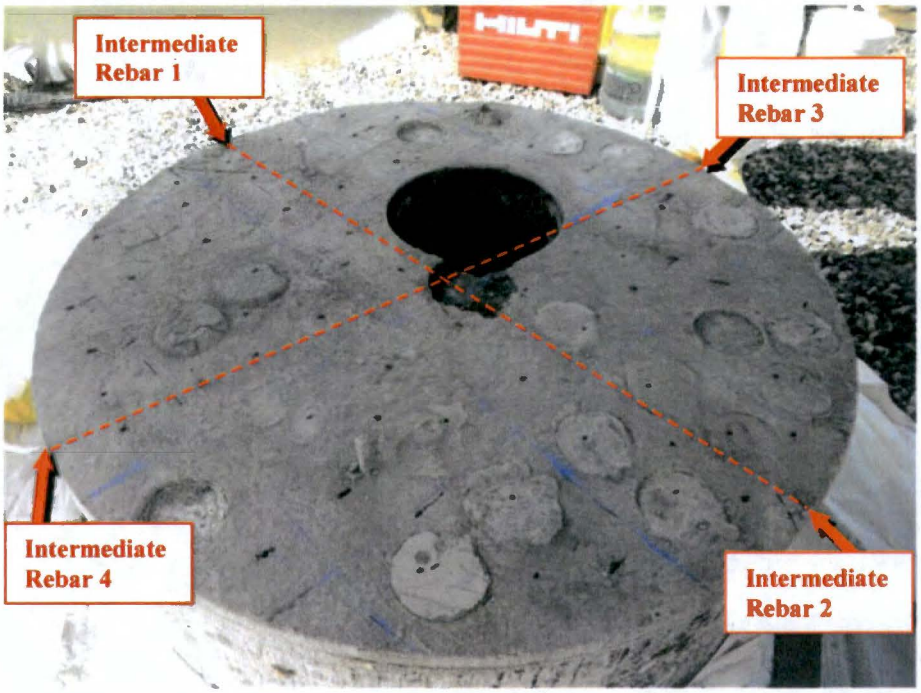
Figure 2-7. Intermediate Rebar 3 (Aug 2012)

Figure 2-8. Intermediate Rebar 4 (Aug 2012)



(No Corresponding Picture from RPP-RPT-50934)

Figure 2-9. Rebar Layout Pre-Demolition (Aug 2012)



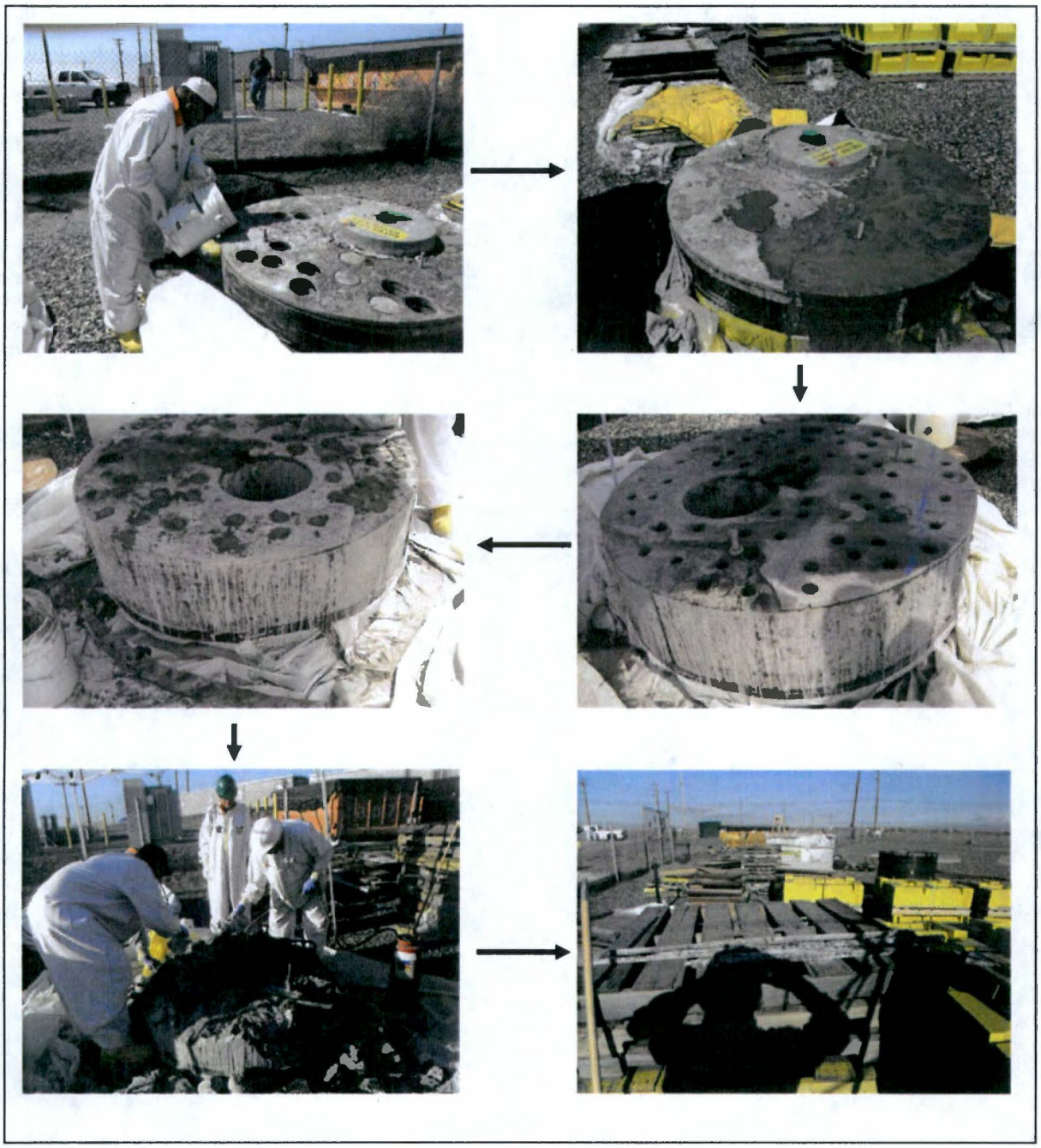
3.0 REBAR REMOVAL

Removal of the rebar from the C-107 'Plug' required demolition of the plug itself. Dexpan® Non-Explosive Expansive Grout was used for demolition of the 'Plug'. The holes remaining from the removed concrete cores were backfilled with concrete. Once cured past 28 days, the 'Plug' was bored to support the placement of expanding grout that was used for demolition. The 1 ½-inch diameter holes were drilled to a depth of 8-inches. The expanding grout was then poured and allowed to cure for 3 days. The broken concrete facilitated the removal of the top layer of C-107 rebar. The sequence for removal of the rebar is shown in Figure 3-1.

During removal of the rebar, a concern of asbestos was raised and the asphaltic membrane had to be tested prior to handling the disturbed material. The laboratory results confirmed that the asphaltic membrane did not contain asbestos. Results of the laboratory analysis are provided in Appendix F.

Dexpan® is a registered trademark of Archer Company, USA

Figure 3-1. Plug Demolition and Rebar Removal



3.1 Rebar Shipping

The rebar was packaged and shipped in accordance with WRPS shipping procedures and practices. The rebar samples were expected to have no detectable dose rate and no detectable surface contamination. Due to the limitations of field instruments, free release of the rebar was not permitted. Therefore a laboratory with radioactive material handling capabilities was identified. However, measurement in the field of all the rebar exhibited a dose rate of less than the minimum detectable dose rate (< 0.5 mrem/hr) and therefore, the shipping method chosen was a Type A Low Level Waste package, as shown in Figure 3-2. Shipping information for the C-107 rebar is provided in Appendix H.

Figure 3-2. Rebar Shipping Container

4.0 CTL GROUP SELECTION

Prior to removal of the rebar from the 'Plug', a testing laboratory was identified. Market surveys had been performed for an associated structural integrity task, SST sidewall coring. The results revealed that the well-known CTL Group was capable of handling potentially radioactive rebar and perform all the required physical testing of the rebar. CTL Group is associated with a separate company Radiation Safety Services Inc. (RSSI) that is capable of performing detailed radioactive contamination surveys. CTL Group has also performed the testing of the concrete cores removed from the C-107 'Plug', as documented in RPP-RPT-50934.

Technical staff from CTL Group and WRPS agreed that the rebar would be shipped to RSSI and surveyed for contamination. If the rebar pieces were below minimum detectable activity levels and safe for handling, they would be shipped from RSSI to CTL Group and testing would be performed there. If the rebar did not meet the safe levels, testing equipment at RSSI would have to be used by the properly trained technicians from CTL Group. Results from the RSSI removable contamination survey are contained in Appendix B. The C-107 rebar exhibited activity levels that were below the 3.7×10^{-6} μCi limit of detection.

A proposal for testing was submitted to WRPS by CTL Group. A copy of the CTL Group proposal is shown in Appendix A. WRPS technical staff provided WRPS procurement with a non-competitive procurement justification to perform the testing of the C-107 rebar. Additional requirements of accreditation to satisfy ISO 17025 were identified and met by CTL Group. Review of CTL Group capabilities for handling and testing of potentially contaminated rebar allowed the contract to be released. A copy of CTL Group accreditation is included as Appendix G.

5.0 REBAR INSPECTION AND PREPARATION

Nine bundles of rebar were shipped to and received by CTL Group. Figures 5-1 and 5-2 show the rebar as received in the 55 gallon shipping container and laid out on a table prior to separation.

Figure 5-1. Rebar Bundles in Shipping Container

Figure 5-2. As-Received Rebar Bundles

Prior to mechanics testing, the following actions were taken to perform rebar inspection:

- Measure diameter and length
- Photograph the rebar for any visible defects

Results of the initial inspection of the C-107 rebar are provided in Appendix B. The rebar was reported to be in good condition, with no observable cracking or defects. The length of the as-received rebar pieces determined if a sample would be tested per ASTM A615 or ASTM A370. Table 5-1 lists the dimensions of the rebar as received at CTL Group.

Table 5-1. As-Received Rebar Dimensions

Rebar ID	Diameter (in)	Length (in)
37-1	0.6870	11
37-2	0.6855	16
37-3	0.6860	31
37-4	0.6885	32
38	0.6860	28
39-1	0.6835	6
39-2	0.6880	22
39-3	0.6865	33
39-4	0.6835	31
40	0.6860	26
41-1	0.6850	4.5
41-2	0.6840	4.5
41-3	0.6850	26
42	0.6835	27
43-1	0.6880	11
43-2	0.6835	24
43-3	0.6870	22
44-1	0.6845	16
44-2	0.6850	14
45	0.6850	15

6.0 REBAR TESTING

The C-107 rebar were segregated based on length. The five specimens 28 inches or longer were subjected to ASTM A615 testing and not modified prior to testing. With the exception of Sample 44, specimens less than 28 inches long were cut, machined, and reduced to the size required for ASTM A370 testing. Extra material was leftover from the A370 specimen preparation and was subject to hardness testing. Sample 44 rebar pieces were machined for and subjected to impact testing. The following subsections provide descriptions of the mechanics testing of the C-107 rebar. A significant number of photographs were taken during observation of the testing. A representative number of photographs are presented in this section. The entire collection of photographs is contained in Appendix D.

6.1 ASTM A370 TENSION TESTING

Fourteen pieces of rebar were cut to be used for ASTM A370 testing. The rebar was cut to maximize the number of samples for testing. Out of the fourteen pieces, forty-eighty test specimens were prepared. The IDs of the test specimens were correlated back to the original bundle of rebar received. Table 6-1 lists all the specimens that can be correlated to the as-received rebar identification.

The original rebar pieces were cut to lengths to facilitate standard test specimens. Due to the diameter of the rebar a standard 0.250 inch diameter specimen was selected. In accordance with ASTM A370, the cut rebar was machined to "dog bone" shapes with a reduced diameter of approximately 0.250 inch and a 1 inch gauge length. Figure 4 of ASTM A370 provides details of the dimensions for the standard test specimen. An example of a 0.250 in test specimen of the C-107 rebar is shown in Figure 6-1.

The forty-eight specimens were loaded in the calibrated test frame in accordance with test procedures described in ASTM A370. The test data provided included yield and tensile strengths, modulus of elasticity, and percent elongation. The yield strength was determined using the 0.2% Offset Method, in accordance with ASTM A370. The results are shown in Table 6-1. The CTL Group report provided in Appendix B contains the same data and additionally, the stress-strain curves for the forty-eight test specimens.

6.1.1 ASTM E18 ROCKWELL HARDNESS TESTING

Each of the sample sets of ASTM A370 tension specimens contained extra material for additional mechanics testing. A single sample from each of the 14 sets was machined plane and subjected to hardness testing. An example of the hardness test specimen for the C-107 rebar is shown in Figure 6-2. Hardness test results are provided in Table 6-1.

Figure 6-1. C-107 ASTM A370 Tension Test Specimen

Figure 6-2. C-107 ASTM A370 Rockwell Hardness Specimen

Table 6-1. C-107 Rebar ASTM A370 Tension and Hardness Test Results

CTLSample ID	Yield Strength (ksi)	Tensile Strength (ksi)	Elongation (%)	Modulus of Elasticity (ksi x 1000)	Hardness (Rockwell B)
37-1a	50.50	83.50	28.00	34.00	83
37-1b	51.50	84.00	30.00	32.50	
37-2a	47.70	78.50	33.00	28.50	78
37-2b	44.60	78.50	33.00	30.30	
37-2c	46.80	78.00	33.00	27.50	
39-1	49.40	79.00	32.00	32.70	82
39-2a	47.30	76.50	32.00	29.70	79
39-2b	44.70	76.00	32.00	29.80	
39-2c	46.00	76.50	34.00	14.50*	
39-2d	47.70	76.50	33.00	25.10	
39-2e	47.20	76.00	32.00	28.60	
40a	45.20	76.00	31.00	27.30	79
40b	43.90	77.00	33.00	28.80	
40c	43.50	77.00	33.00	35.80	
40d	42.10	77.50	31.00	27.70	
40e	43.70	78.00	31.00	27.10	
41-1	48.70	83.00	30.00	31.30	80
41-2	47.80	79.50	30.00	25.70	81
41-3a	48.30	76.50	30.00	29.60	82
41-3b	45.60	77.00	32.00	32.30	
41-3c	47.90	77.00	32.00	26.60	
41-3d	48.60	77.00	31.00	28.30	
41-3e	48.00	77.00	33.00	28.10	
41-4a	49.40	80.00	33.00	30.30	80
41-4b	48.50	79.50	33.00	27.30	
41-4c	45.10	79.00	33.00	28.00	
41-4d	49.60	80.00	34.00	28.70	
41-4e	46.50	80.50	33.00	32.30	
41-4f	47.00	79.50	33.00	28.00	
42a	51.00	80.50	33.00	28.10	81
42b	47.80	80.50	29.00	29.10	
42c	46.40	78.50	32.00	30.00	
42d	44.60	78.00	33.00	33.20	
43-1a	44.00	76.00	31.00	28.50	78
43-1b	46.70	77.00	32.00	31.20	
43-2a	45.70	80.00	32.00	29.90	80
43-2b	48.70	80.00	32.00	28.80	
43-2c	47.70	80.50	32.00	31.60	
43-2d	47.20	80.50	32.00	29.10	
43-2e	45.90	79.50	32.00	25.10	

Table 6-1 (cont'd). C-107 Rebar ASTM A370 Tension and Hardness Test Results

CTLSample ID	Yield Strength (ksi)	Tensile Strength (ksi)	Elongation (%)	Modulus of Elasticity (ksi x 1000)	Hardness (Rockwell B)
43-3a	49.00	84.50	30.00	27.60	83
43-3b	48.90	84.00	32.00	26.20	
43-3c	48.90	84.00	32.00	26.90	
43-3d	47.70	83.50	31.00	31.60	
43-3e	51.50	83.50	30.00	30.30	
45a	46.00	77.00	32.00	30.50	79
45b	44.80	77.50	32.00	26.40	
45c	47.90	77.00	32.00	26.30	
AVERAGE	**47.15**	**79.08**	**31.85**	**28.89**	**80**

*Low modulus attributed to misplacement of extensometer (Appendix B)

6.2 ASTM A615 TENSION TESTING

Five rebar pieces were 28 inches or longer, as received. These rebar samples were tension tested as full rebar sections, in accordance with ASTM A615. An 8 inch gauge length with 2 inch gauge marks was provided between the load frame grips (Figure 6-3). An example of the rebar test specimen prepared for testing is provided in Figure 6-4. The results of the tension tests on the full section rebar are provided in Table 6-2.

Figure 6-3. Rebar Tensile Test Grip

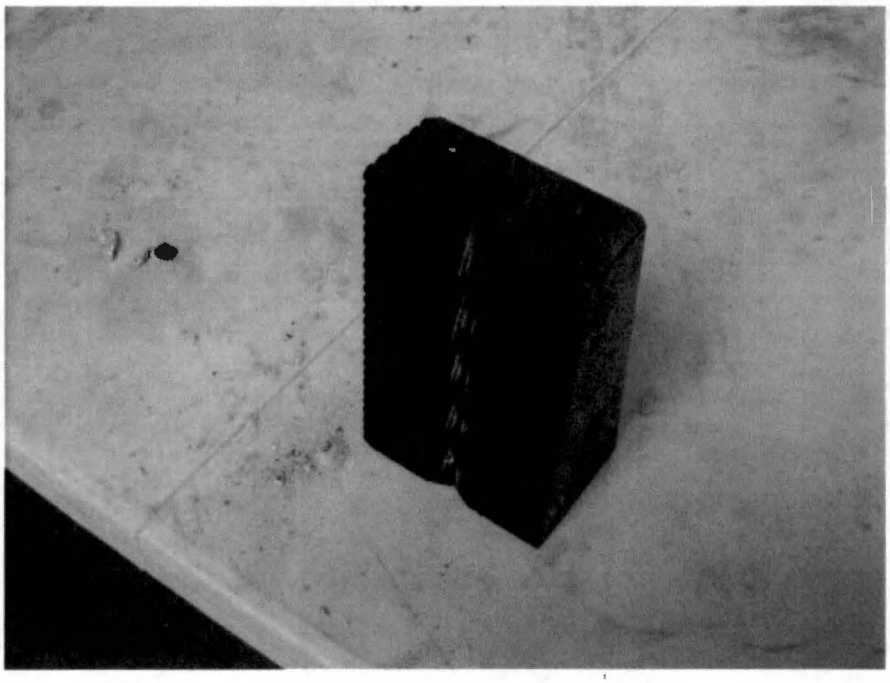


Figure 6-4. C-107 ASTM A615 Tension Test Specimens

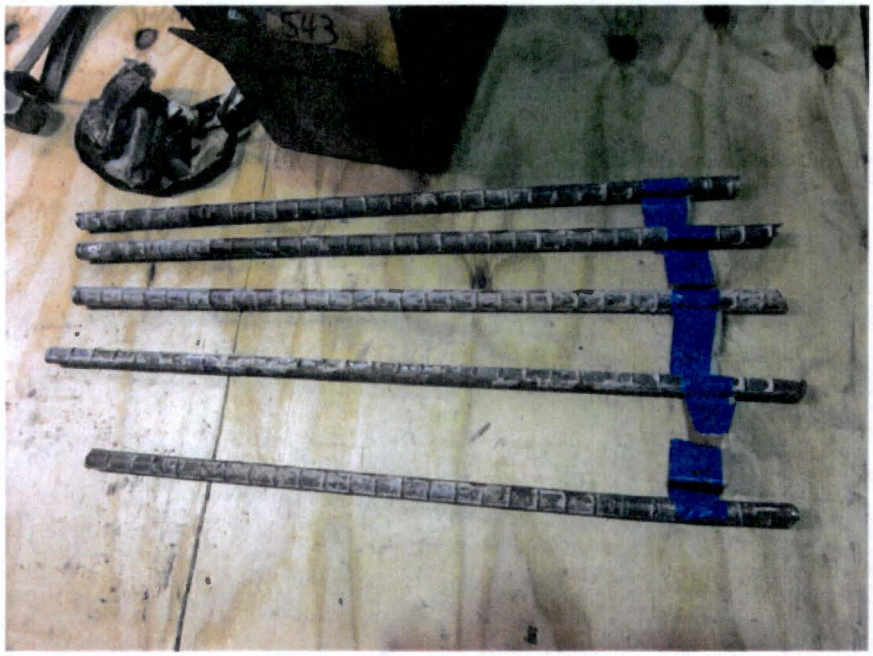


Table 6-2. C-107 Rebar ASTM A615 Tension Test Results

CTLSample ID	Yield Strength (ksi)	Tensile Strength (ksi)	Elongation (%)
37-3	46.4	65.0	5.6
37-4	49.5	76.0	19
38	47.3	74.0	15
39-3	46.4	73.5	18
39-4	50.9	75.5	24
AVERAGE	**48.1**	**72.8**	**16.32**

6.3 ASTM E23 CHARPY IMPACT TESTING

Two pieces, 44-1 and 44-2, were selected for impact testing. The two pieces were cut and three Charpy V-Notch specimens were machined from each. Figure 6-5 shows the impact specimens for Rebar ID 44-2. Results from the impact testing are shown in Table 6-3.

Figure 6-5. C-107 ASTM A615 Tension Test Specimens

Table 6-3. C-107 Rebar ASTM A 370 Charpy Impact Test Results

CTL Group Sample ID	Subset	Impact Energy (@ 70F) (ft-lbf)
44-1	1	35
	2	30
	3	30
44-2	1	27
	2	30
	3	27

7.0 QUALITY ASSURANCE

CTL Group is an accredited testing laboratory, capable and qualified to perform the requested inspection, preparation, and physical testing of the C-107 rebar. CTL Group's ISO 17025 and AASHTO accreditations are located in Appendix G. All testing machines used were shown to have current calibration. All of the reports from CTL Group were reviewed by WRPS technical staff prior to acceptance, satisfying the requirement set forth in the contract. All physical testing was witnessed by WRPS engineer RS Rast.

8.0 DISCUSSION OF RESULTS

The inspection of the concrete 'Plug' reveals that the placement of concrete and rebar generally matches the design drawings. The measured concrete cover typically matches the design drawings, providing protection for the rebar. There are two intermediate rebar that are not shown on tank drawings. The intermediate rebar are apparently extra bars placed at the apex of the dome of SST 241-C-107 and do not invalidate any of the design drawings for the tank structure.

Removal of the rebar from the C-107 'Plug' required demolition of the plug itself. Non-explosive demolition of the 'Plug' was performed using expanding grout. The top rebar was removed, packaged, and shipped to CTL Group for inspection and testing. Prior to shipment, the rebar were surveyed for contamination and all exhibited less than a 0.5 mrem/hr dose rates in the field. Additional surveying for radioactive contamination was performed offsite at RSSI and showed that the C-107 rebar exhibited activity levels below the 3.7×10^{-6} μCi limit of detection. At CTL Group, the rebar was measured and inspected. The rebar was reported to be in good condition with no cracking or defects present. From the rebar sent, forty-eight were tension tested as standard size metallic specimens, five were subjected to full section rebar testing, fourteen were subjected to hardness testing, and two were subjected to impact testing.

Incorporating A370 and A615 testing, the average yield strength of all the C-107 rebar is 47.24-ksi. This value is greater than the 40-ksi yield strength for the Grade 40 rebar specified in the original tank construction and therefore greater than the value used in the Analysis of Record. This is expected as the 40-ksi yield strength is a minimum value with nominal values typically higher. The impact and hardness test results are provided for information only. These properties are not used in the Analysis of Record. Figure 8-1 shows a comparison of the individual C-107 rebar specimens, C-107 rebar average, and the specified Grade 40 rebar yield strength. Figure 8-2 shows a comparison of the individual C-107 rebar specimens, C-107 rebar average, and the Grade 40 rebar tensile strength.

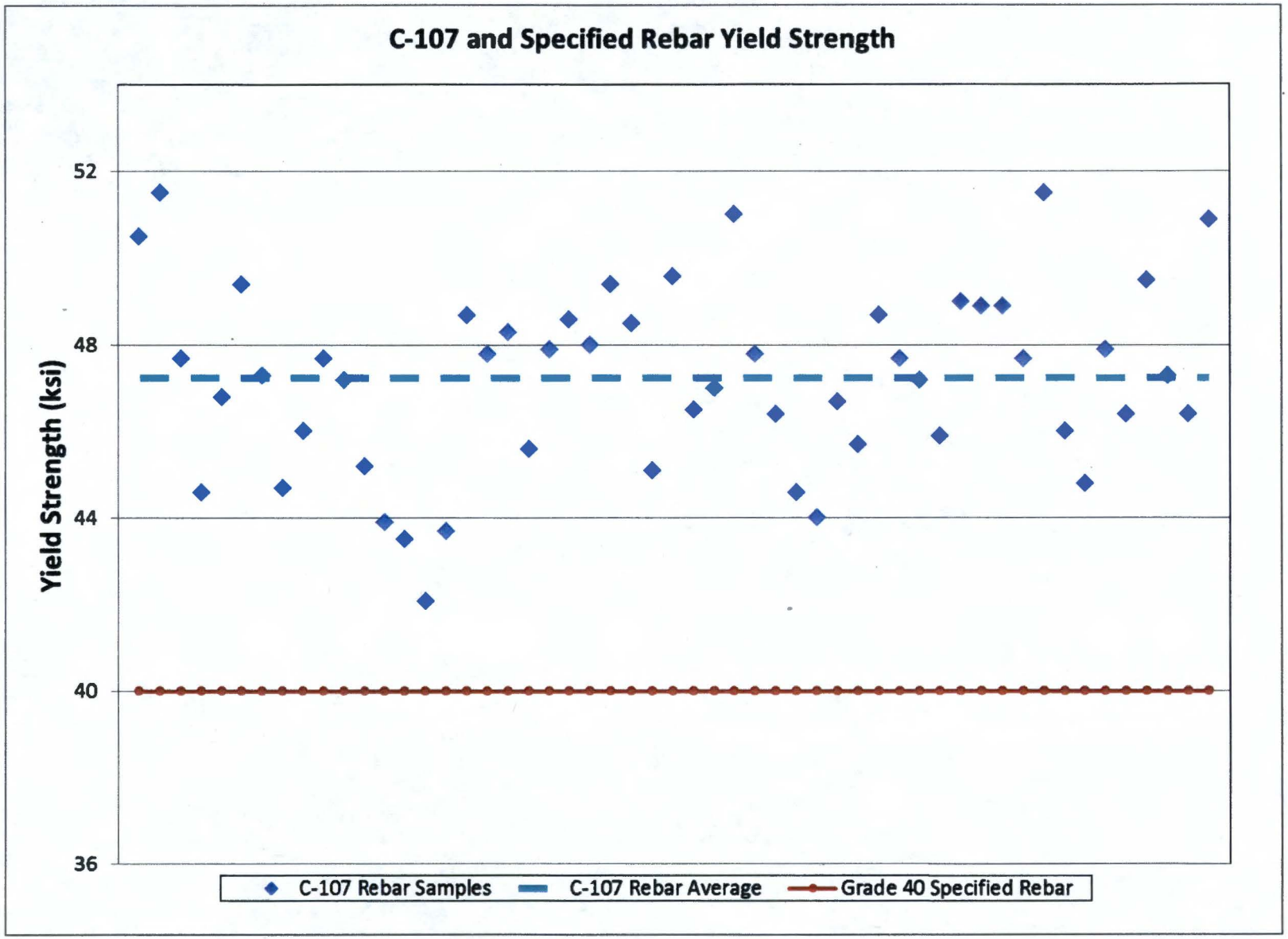


Figure 8-1. Yield Strength Comparison

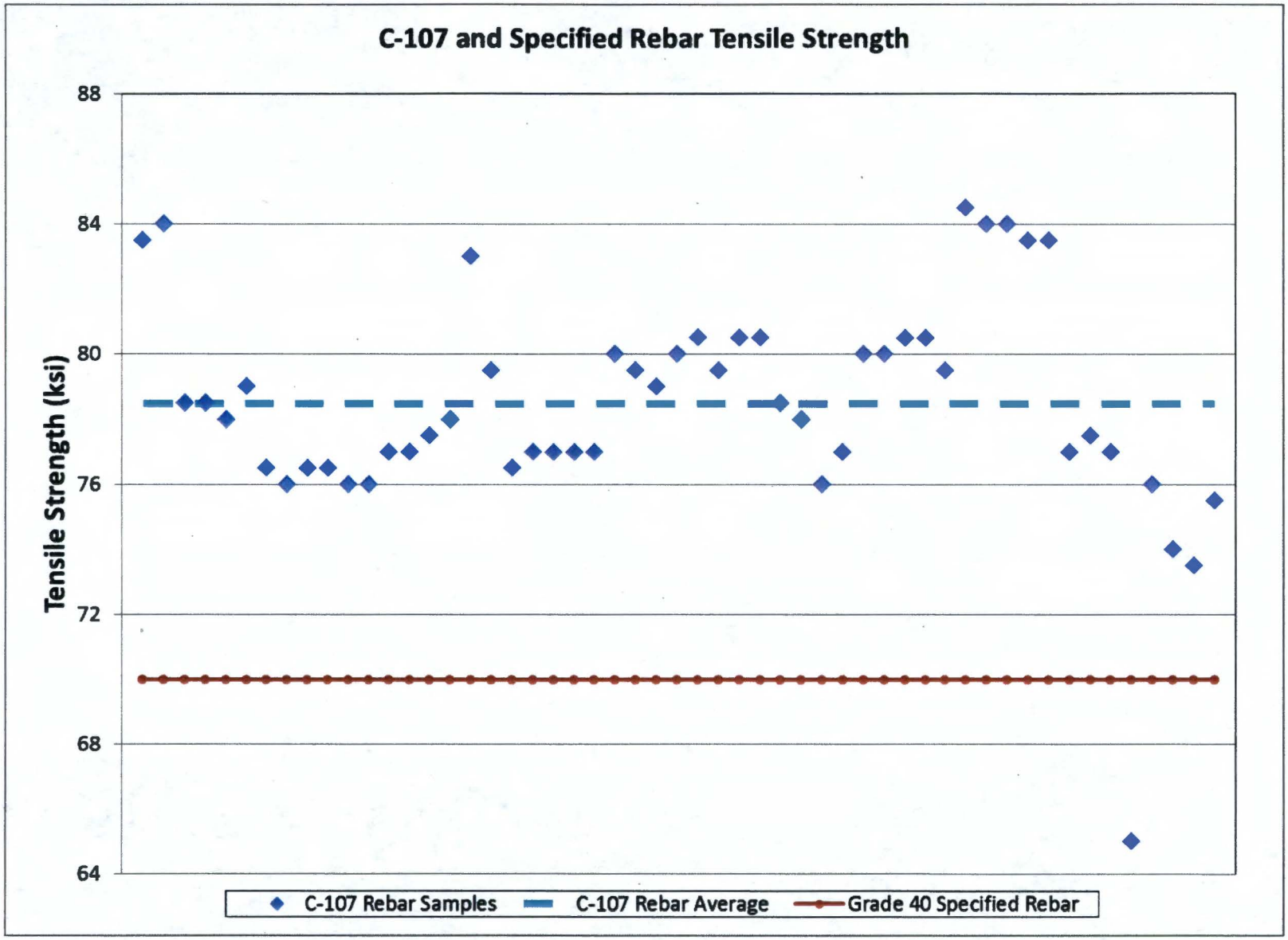


Figure 8-2. Tensile Strength Comparison

9.0 CONCLUSIONS

The C-107 'Plug' was subjected to additional field inspection prior to the removal of the rebar. The results indicate that the dome of SST 241-C-107 was constructed as designed. Additional inspection of intermediate rebar revealed that the extra rebar was placed at the apex of the tank dome during construction. The additional rebar does not invalidate or contradict design drawings used for subsequent tank analyses.

The visual inspection of the rebar was successfully performed at CTL Group. The findings from the initial inspection indicate that the rebar removed from the 'Plug' is in good condition, with no cracking or defects.

The results of the tension testing are compared to the values used to define material properties in the SST Analysis of Record, as shown in Appendix A of RPP-46442, *Single-Shell Tank Structural Evaluation Criteria*. The average yield strength of the C-107 rebar is greater than the Grade 40 rebar specified at the time of construction.

The successful removal of the 'Plug' from SST 241-C-107 presented an opportunity to perform inspection, sampling, and testing of SST concrete and rebar. The testing of the concrete and rebar completes the implementation of the SSTIP Expert Panel recommendation SI-5, *Test Dome Concrete and Rebar 'Plugs'*. Information from this report will also be used to implement Panel recommendation SI-6 which requires the development of an engineering mechanics document. In combination with concrete results documented in RPP-RPT-50934, this report represents completion of the TPA target, M-045-91D-T01. The inspection and testing of concrete and rebar removed from the dome 'Plug' of SST 241-C-107 revealed that both are in good condition and the material strengths are greater than originally specified and greater than what is used in the SST Analysis of Record.

10.0 REFERENCES

ASTM A370-12a, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*, American Society for Testing and Materials International, West Conshohocken, Pennsylvania.

ASTM 615-12, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement*, American Society for Testing and Materials International, West Conshohocken, Pennsylvania.

ASTM E18-12, *Standard Test Methods for Rockwell Hardness of Metallic Materials*, American Society for Testing and Materials International, West Conshohocken, Pennsylvania.

ASTM E23-12c, *Standard Test Methods for Notched Bar Impact Testing of Metallic Materials*, American Society for Testing and Materials International, West Conshohocken, Pennsylvania.

BPF-73550, Drawing D-6. *Dome Reinforcing Steel For 75 Foot Tanks*. Hanford Engineer Works. Richland, WA.

RPP-46442, Rev. 0. *Single-Shell Tank Structural Evaluation Criteria*. U.S. Department of Energy, Richland, Washington.

RPP-49003-VA, Rev. 0. *241-C-107 Large Riser Install for Mobile Arm Retrieval System*. U.S. Department of Energy. Richland, WA.

RPP-PLAN-45082, Rev 0. *Implementation Plan for the Single-Shell Tank Integrity Project*. U.S. Department of Energy. Richland, WA.

RPP-PLAN-48753, Rev. 0. *Analytical Test Plan for the Removed 241-C-107 Dome Concrete and Rebar*. U.S. Department of Energy. Richland, WA.

RPP-RPT-43116, Rev 0. *Expert Panel Report For Hanford Site Single-Shell Tank Integrity Project*. U.S. Department of Energy. Richland, WA.

RPP-RPT-50934, Rev 0. *Inspection and Test Report for the Removed 241-C-107 Dome Concrete*. U.S. Department of Energy. Richland, WA.

Appendix A

CTL Group Proposal

for

C-107 Rebar Testing

CTLGROUP

October 25, 2012

Bryon Bradley
Senior Procurement Specialist
Washington River Protection Solutions, LLC
P.O. Box 850 H6-04
Richland, WA 99352

Hanford C-107 Plug Rebar Testing Project
CTLGroup Proposal No. 25PA12-069

Dear Mr. Bradley:

CTLGroup is pleased to provide this proposal in response to Requisition # 250512.

1.0 Objective:

The objective of the Statement of Work (SOW) is to obtain inspection and testing of the steel rebar removed from the reinforced concrete dome of the Single-Shell Tank, 241-C-107. The inspection and testing shall take place at the subcontractor's facility. This work will assist the Tank Operations Contractor (TOC) in determining the current condition and mechanical properties of Single-Shell Tank rebar.

2.0 Background/Introduction:

In December 2010, tank 241-C-107, located in 241-C Farm, was excavated to the apex of the reinforced concrete dome and a 55" diameter hole was cut and removed. This activity was performed in support of retrieval activities. The 55" diameter concrete section, hereafter referred to as the "plug", is now being used in support of the Single-Shell Tank Integrity Project (SSTIP) to fulfill a recommendation from RPP-PLAN-45082, *Implementation Plan for the Single-Shell Tank Integrity Project*. The recommendation, SI-5, states to confirm structural integrity by testing a reinforced concrete plug from the dome of a tank. Fourteen concrete cores have been removed from the 241-C-107 plug to date. The removal and testing of 241-C-107 concrete cores is described in RPP-PLAN-48753, *Forensics Plan for the Removed 241-C-107 Dome Concrete and Rebar.* The 14 concrete cores removed from the 241-C-107 plug were sent to CTL Group in Skokie, IL. Multiple reports were developed detailing the results of visual inspection, mechanics testing, and petrographic examination of the C-107 plug concrete. These reports were delivered to WRPS and combined with field inspection and testing observations and are documented in RPP-RPT-50714, *Inspection and Test Report for the Removed 241-C-107 Dome Concrete*. Testing of the rebar and developing and engineering report will satisfy completion of the M-045-91D-T01 target milestone.

3.0 Scope:

The scope of work contained within this document is for inspection and mechanical testing for steel reinforcing bars (rebar) removed from the C-107 plug. Per the as-built tank drawings, the rebar is No.8 rebar and approximately 1-inch in diameter, varying in length. The rebar is understood to be Grade 40 (Fy = 40ksi) steel.

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CTLGroup is a registered d/b/a of Construction Technology Laboratories, Inc.

The subcontractor shall generate a logbook to track progress of each rebar through the inspection and testing process. This logbook shall track time complete, date complete, and personnel who performed the action for each rebar. A sample logbook record for a single core is shown below in Table 1.

Table 1. Example Rebar Tracking Logbook

Rebar #1	Received	Inspected	Prepared	ASTM A615 Rebar Tension Test	ASTM A370 Steel Tension Test	Other ASTM
Date						
Time						
Person (Initial)						

3.0.1 Rebar Inspection

Upon receipt, CTL Group shall document the as-received condition of the rebar, including photographs.

- Measure and record initial diameter and length of each rebar
- Measure and record length and width of cracks or other defects noticeable to the naked eye
- Photograph as-received rebar
- Photograph cracks or other defects, as required

The rebar shall be segregated based on the length.

Additional examination of the condition of the rebar may be performed pending TOC technical staff approval.

3.0.2 Steel Mechanics Properties Testing of Standard Rebar

Rebar of suitable length shall be tested in accordance with ASTM A615, for yield and tensile strength. It is anticipated that multiple pieces of rebar will be 30 inches or more in length. These rebar specimen shall be tested in accordance with the ASTM A615 methodology.

Prior to any mechanical testing a rebar specimen count per applicable ASTM testing methodology shall be shared with and approved by TOC technical staff.

3.0.3 Steel Mechanics Properties Testing of Machined Rebar

The remaining rebar that do not meet the length requirements for ASTM A615 testing shall be cut to standard lengths which will the maximum number of test specimens for ASTM A370 testing for round metallic materials. The rebar specimens shall be machined to required dimensions to satisfy metallic material

testing for ASTM A370 tension testing. Specimens prepared in accordance with ASTM A370 shall be tension tested to determine the following:

Elastic Modulus, Poisson's Ratio, Yield Strength, Tensile Strength

This work will be outsourced to a properly accredited subcontractor. After ASTM A370 sizing requirements are met and metal specimens prepared, if there are any remaining small pieces of rebar (secondary) that are of suitable size for materials testing, WRPS shall be contacted to determine which tests shall be performed. Possible tests to be considered for secondary rebar are hardness and impact. Hardness and impact testing will be priced based on the size of the samples provided.

Prior to any mechanical testing a rebar specimen count per applicable ASTM testing methodology shall be shared with and approved by TOC technical staff.

4.0 Material Handling

Prior to shipment from the Hanford Site, the rebar will be examined for radiological and/or chemical contamination. Pending the results of radiological and chemical surveys, the removed rebar may need to be treated as a radiological controlled material as determined by DOE Order 5400.5, Chapter II 5. (c) (6). If this is the case, the subcontractor must be able to perform inspection and testing on rebar samples with less than 0.5 mRem/hr. Beta/Gamma dose rates.

Independent of how the rebar specimens are shipped off the Hanford Site, they will be returned in the same package. The custody of the rebar specimens will be documented on a Chain of Custody form.

5.0 Deliverables:

The deliverables to the TOC (buyer) are summarized in Table 3 below:

Table 3. Table of Deliverables

Deliverable	Purpose	Due Date
Initial Inspection results	TOC Information	Upon inspection completion
Proposed Testing Sequence	TOC review and approval	Before mechanical testing start
Initial Testing Results	TOC Information	Upon testing completion
Inspection and Testing Results Report	TOC review and comment	Three weeks after beginning testing sequence
Final Report	TOC review and comment	Four weeks after beginning testing sequence

In addition to the standard test methods described, to successfully execute the testing and evaluation program, the following work items are required:

1. Development of a log book format. This will require involvement from our Quality Management staff.
2. Oversight and interface will be required between laboratory departments and staff.
3. Project specific procedures for handling radiologically contaminated specimens may require development. This will involve:
   a. Development and documentation of an approach
   b. Design and fabrication of applicable fixturing (or outsourcing to facilities capable of handling contaminated specimens)
   c. Oversight of sample preparation and testing by the Radiation Safety Officer (RSO).

   It is anticipated this work will require fifty to sixty hours of work (including thirty for the Radiation Safety Officer).

6.0 Acceptance Criteria:

The Inspection and Testing Results Report shall include the requirements set forth in the SOW. All hardcopy and electronic deliverables provided under the SOW will be complete, accurate, legible and reproducible. Before delivery, documents shall be inspected and reviewed by qualified personnel for quality, technical adequacy and appropriate content in accordance with the CTLGroup's Quality Assurance procedures. Approval by TOC technical staff will be considered acceptance of the deliverables.

7.0 Configuration Management and Standards

7.1 Configuration Management Requirements:

There are no specific Configuration Management requirements applicable to the SOW.

7.2 Applicable Standards

There are no applicable TOC engineering standards for this SOW. Applicable industry standards are: ASTM A615 and ASTM A370.

8.0 ESH&Q Requirements

CTLGroup will perform this work scope within the quality assurance requirements set forth in the following paragraphs provided in the SOW:

8.1 Quality Assurance Requirements:

The Subcontractor shall perform work that is subject to established standards and procedures. This is Quality Level 3 (QL-3) procurement.

The Subcontractor shall have implemented a Quality Assurance Program that meets the following specific requirements:

- Subcontractor performing testing shall be accredited by the International Accreditation Service (IAS) for the ASTM standards applicable to this SOW to demonstrate compliance with ANS/ISO/IEC Standard 17025:2005, *General criteria for the competence of testing and calibration laboratories.* Subcontractor shall also be accredited by the American Association of State Highway and Transportation Officials (AASHTO) to demonstrate compliance with AASHTO R18, *Standard Practice for Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories*

- The Subcontractor shall have an implemented Quality Assurance Program. The program is required to be reviewed, evaluated, and approved by WRPS. The program shall be equivalent to the following requirements from the American Society of Mechanical Engineers, NQA-1-2004, *Quality Assurance Requirements for Nuclear Facility Applications,* including NQA-1a-2005 and NQA-1b-2007 Addenda, or later version

NQA-1 Criteria	Title	All Sections	Specific Sections
Part I, Req. 1	Organization	X	
Part I, Req. 2	Quality Assurance Program		100, 200
Part I, Req. 5	Instructions, Procedures, and Drawings	X	
Part I, Req. 6	Document Control		100, 200
Part I, Req. 11	Test Control		100, 200
Part I, Req. 12	Control of Measuring and Test Equipment		100, 200
Part I, Req. 13	Handling, Storage, and Shipping		100, 200, 301
Part I, Req. 16	Corrective Action	X	
Part I, Req. 17	Quality Assurance Records		100, 200, 800

8.1.1 Supplier Quality Assurance Program:
The Subcontractor's Quality Assurance Program shall be subject to review at all times, including prior to award.

8.1.2 Supplier Quality Assurance Program Changes
The Subcontractor shall, during the performance of this subcontract, submit proposed changes to their approved quality assurance program to the WRPS Buyer for review and concurrence prior to implementation.

8.1.3 Quality Assurance Oversight
Not Applicable

8.1.4 Quality Assurance Requirements for Analytical Laboratory Services
Not Applicable

***8.2* Price-Anderson Amendments Act Requirements:**

This 8.2 section and the General Provisions article entitled *Price-Anderson Amendments Act (PAAA)* are both determined to be N/A.

8.3 Applicable ES&H Requirements:

Hanford Site access is not authorized for work to be completed under this SOW.

9.0 Verification/Hold Points:

Rebar specimen count and ASTM test applicability shall be provided to TOC technical staff for review and approval, prior to specimen preparation.

After specimen preparation, testing shall not commence until TOC technical staff are present for observation, unless directed to do so by TOC technical staff.

Contract deliverables shall be reviewed by WRPS technical staff prior to acceptance.

10.0 Reserved

11.0 Work Location/Potential Access Requirements:

Testing shall be performed at CTLGroup's Skokie, IL facility or at their designated partner location if the radiological surveys indicate levels above acceptable allowance on the CTLGroup campus.

12.0 Training:

The subcontractor's technicians shall be trained and experienced per the applicable ASTM standard listed in Section 3.0 of this SOW before performing testing. If applicable, the subcontractor's technicians shall be trained in handling procedures for radioactive materials according to the CTLGroup's procedures. No Hanford specific training is required for performance of this work.

13.0 Qualifications:

CTLGroup is certified by the IAS and AASHTO for the ASTM standards applicable to the SOW.

14.0 Special Requirements:

No additional requirements are identified for performance of this work.

Hanford Site Access

Testing shall be performed at the CTLGroup's facility. Hanford Site access is not required for completion of this work.

Use of Government Vehicles

There is no anticipated need for any CTLGroup employees to use a Government-furnished vehicle in the performance of this statement of work. CTLGroup's employees, therefore, are specifically prohibited from driving any Government-furnished vehicles under the performance of this statement of work unless this statement of work is formally

so modified by the parties and a copy of any applicable driver's license provided to the BTR.

Government Property

There is no anticipated need for any CTLGroup employees to use of government property in the performance of this statement of work.

15.0 Reporting/Administration:

CTLGroup formatted reports are acceptable for the contract deliverables.

16.0 Workplace Substance Abuse Program Requirements:

A Workplace Substance Abuse Program is not required for this SOW.

17.0 Reserved

18.0 Fee Schedule

Table 4 describes the fees for the testing, assuming no special radiological controls or special handling are required. If it is determined that special radiological controls and specimen handling is required to test the rebar, pricing will be revised based on the approach described in Item 3 of Section 5 above. Pricing in this case will be on a Time & Materials basis.

Table 4. Anticipated Time and Materials Work Requirements

Item	Estimated Budget
Development of Log Book	[redacted]
Laboratory Coordination and oversight	[redacted]
Preparation for Handling and Testing of Contaminated Specimens	[redacted]
Radiological Assessment	[redacted]
Rebar Inspection	[redacted]
ASTM A615 Testing	[redacted]
ASTM A 370 Testing	[redacted]

Closing

CTLGroup will perform its services under this Agreement in conformance with the care and skill ordinarily exercised by reputable members of the procession practicing under similar conditions at the same time. NO OTHER WARRANTY OF ANY KIND, EXPRFESSED OR IMPLIED< IN FACT OR BY LAW, IS MADE OR INTENDED.

We appreciate the opportunity to be of service to the Washington River Protection Solutions, LLC. Please call me if you have any questions at (847) 972-3204.

Sincerely,

2012.10.25 13:28:18
-05'00'

James F. Lane, P.E.
Director
Structural and Transportation Laboratory
JLane@ctlgroup.com
Phone: 847-972-3204
Fax: 847-965-8997

Attachment

Name:_____

Title: _____

Company: _____

Signed:_____

Date:_____

CTLGROUP
www.CTLGroup.com

Appendix B

CTL Group Test Report

for

C-107 Rebar

Report for
Washington River Protection Solutions, LLC
P.O. Box 850 H6-04, Richland WA 99352

CTLGroup Project No. 251289 Revision 1

Hanford C-107 Plug Rebar Testing Project

March 18, 2013

Submitted by:
James F. Lane

5400 Old Orchard Road
Skokie, Illinois 60077-1030
(847) 965-7500

Austin, TX • Chicago, IL • Naperville, IL • Washington, DC

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CTLGROUP

March 18, 2013

Bryon Bradley
Senior Procurement Specialist
Washington River Protection Solutions, LLC
P.O. Box 850 H6-04
Richland, WA 99352

Hanford C-107 Plug Rebar Testing Project
CTLGroup Project No. 251289 Revision 1[1]

Dear Mr. Bradley:

CTLGroup is pleased to provide this report for testing performed in response to Requisition # 250512.

1.0 Objective:

The objective of the Statement of Work (SOW) was to obtain inspection and testing of the steel rebar removed from the reinforced concrete dome of the Single-Shell Tank, 241-C-107 at the Hanford facility in Richland, Washington. The inspection and testing took place at the CTLGroup's Skokie, Illinois facility and at Exova, Inc. This work will assist the Tank Operations Contractor (TOC) in determining the current condition and mechanical properties of the Single-Shell Tank rebar.

2.0 Background/Introduction:

In December 2010, tank 241-C-107, located in 241-C Farm, was excavated to the apex of the reinforced concrete dome and a 55" diameter hole was cut and removed. This activity was performed in support of retrieval activities. The 55" diameter concrete section, hereafter referred to as the "plug", is now being used in support of the Single-Shell Tank Integrity Project (SSTIP) in fulfillment of a recommendation from RPP-PLAN-45082, *Implementation Plan for the Single-Shell Tank Integrity Project*. The recommendation, SI-5, stated to confirm structural integrity by testing a reinforced concrete plug from the dome of a tank. Fourteen concrete cores have been removed from the 241-C-107 plug to date. The removal and testing of 241-C-107 concrete cores is described in RPP-PLAN-48753, *Forensics Plan for the Removed 241-C-107 Dome Concrete and Rebar*. The 14 concrete cores removed from the 241-C-107 plug were sent to CTLGroup in Skokie, IL. Multiple reports were developed detailing the results of visual inspection, mechanics testing, and petrographic examination of the C-107 plug concrete. These reports were delivered to WRPS and combined with field inspection and testing observations and are documented in RPP-RPT-50714, *Inspection and Test Report for the Removed 241-C-107 Dome Concrete*. Testing of the rebar and developing an engineering report will satisfy completion of the M-045-91D-T01 target milestone.

3.0 Material Handling

Prior to shipment from the Hanford Site, the rebar was examined for radiological and/or chemical contamination. Pending the results of radiological and chemical surveys, the removed rebar was treated as a radiological-controlled material as determined by DOE

[1] Revised to correct rebar size in Section 4.0, a typographical error in Table I, formatting on selected charts in Appendix C, and provide an explanation for the low elastic modulus result for Sample 29-2c.

Order 5400.5, Chapter II 5. (c) (6). CTLGroup, through RSSI in Morton Grove, Illinois, performed inspection and testing and determined the rebar samples had less than $3.7x10^{-6}$ µCi (below the detection limit of the instrument) of removable contamination. The results of the survey are presented in Appendix A.

4.0 Procedures:

The scope of work performed in accordance with the proposal document was for inspection and mechanical testing of steel reinforcing bars (rebar) removed from the C-107 plug. Per the as-built tank drawings, the rebar was supposed to be No.6 rebar (approximately ¾-inch in diameter) of varying length. The rebar was understood to be Grade 40 (Fy = 40ksi) steel. The original Statement of Work indicated the rebar was No. 8. The rebar lengths received were confirmed to be No. 6.

4.0.1 Rebar Inspection

Upon receipt, CTLGroup documented the as-received condition of the rebar, including photographs. This log is presented in Appendix B. All references to individual samples follow the sample designations provided by WRPS. Multiple samples from the same group were arbitrarily labeled 1, 2, 3 and 4, depending on how many separate pieces of rebar were in than number designation. For example, Sample #37 contained four sections of rebar, thusly designated 37-1, 37-2, 37-3 and 37-4, arbitrarily. The following initial inspection tasks were performed ion each sample:

- Measured and recorded initial diameter and length of each rebar
- Measured and recorded length and width of cracks or other defects noticeable to the naked eye
- Photographed as-received rebar
- Photographed cracks or other defects, as required

The rebar was then segregated based on the length. Rebar longer than 28 inches was tested full size in accordance with ASTM A615-12. Rebar shorter than 28 inches was tested as a machined, reduced-section specimen in accordance with ASTM A370-12a.

4.0.2 Mechanical Properties of Standard Rebar Samples

Rebar samples at least 28 inches long were tested in accordance with ASTM A615-12, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement*, for yield and tensile strength. Five samples met this criterion and were tested in accordance with the ASTM A615 methodology. The five samples were identified as: 37-3, 37-4, 38, 39-3 and 39-4. The results of this testing is presented in Table I of Appendix B.

4.0.3 Mechanical Properties of Machined Rebar Specimens

The remaining rebar that did not meet the length requirements for ASTM A615 testing were cut to lengths which maximized the number of test specimens for ASTM A370-12a, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*. The rebar specimens were machined to meet the subsize requirements, per ASTM A370, for the largest size specimen machinable from the No. 6 rebar (¼-inch reduced section, with a 1-inch gauge length).

Each sub-specimen was identified with a unique alpha sequence added to the end of the numerical description. For instance, Sample 37-1 was sub-divided into two sub-specimens, designated 37-1a and 37-1b. A complete list of specimen and sub-specimen designations (which totaled 48) is presented below:

37-1(a)(b)	37-2(a)(b)(c)
39-1	39-2(a)(b)(c)(d)(e)
40(a)(b)(c)(d)(e)	41-1
41-2	41-3(a)(b)(c)(d)(e)
41-4(a)(b)(c)(d)(e)(f)	42(a)(b)(c)(d)
43-1(a)(b)	43-2(a)(b)(c)(d)(e)
43-3(a)(b)(c)(d)(e)	45(a)(b)(c)

Specimens prepared in accordance with ASTM A370-12a, were tested in tension to determine the following: Elastic Modulus, Yield Strength (0.2% Offset), Tensile Strength, and Percent Elongation. The stress-strain curves for each sub-specimen in presented in Appendix C. The Elastic Modulus was determined by calculating the slope of the elastic region of the curve.

Several curves exhibited an unusual feature associated with the beginning of the plastic deformation region. These curves indicate that during testing, the samples experienced a slight unloading (and relaxation of strain). This phenomenon is most likely associated with a delayed response between the load frame and the extensometer under strain-rate controlled testing. As the yield point is approached, the machine has to speed up to maintain a constant strain rate. The response is not adequate to maintain load, and the observed unloading occurs. Not all samples were so affected.

Additionally, the stress-strain plot for Sample 39-2c exhibited unusual behavior in the elastic regime, with a corresponding elastic modulus of 14.500 ksi. The cause of the low modulus value could not be determined for this sample. However, the yield strength, ultimate tensile strength and elongation results for this sample were consistent with companion samples, suggesting that the irregular result may have been related to the placement of the extensometer on the specimen.

This work was outsourced to a properly accredited subcontractor and surveilled by CTLGroup and WRPS personnel. Calibration records are presented in Appendix D.

4.0.4 Mechanical Properties of Additional Rebar Material

After ASTM A370 tensile sample sizing requirements were met and the specimens prepared, a sample from each specimen tested was retained for hardness testing in accordance with ASTM E 18-11, *Standard Test Methods for Rockwell Hardness Testing of Metallic Materials*. A total of 14 specimens were tested. The results are presented in Appendix B.

Additionally, Samples 44-1 and 44-2 were not tensile or hardness tested, but prepared for Charpy impact testing in accordance with ASTM A 370-12a. Two sets of three impact specimens were machined from the samples (one from each sample). The impacts were tested at 70°F, and the results are presented in Appendix B. Calibration records are presented in Appendix D.

Closing

We appreciate the opportunity to be of service to the Washington River Protection Solutions, LLC. Please call me if you have any questions at (847) 972-3204.

Sincerely,

James F. Lane, P.E.
Director
Structural and Transportation Laboratory
JLane@ctlgroup.com
Phone: 847-972-3204
Fax: 847-965-8997

Appendices A-D

Name:_____

Title: _____

Company: _____

Signed:_____

Date:_____

Appendix A

RSSI

6312 W. Oakton Street
Morton Grove, IL 60053-2723
847-965-1999

WIPE TEST ANALYSIS REPORT

Facility: CTL Group
Address: 5400 Old Orchard Road
Skokie, IL 60077

Person Submitting Samples: James Lane
Date Samples Collected: 12/18/2012
Send Results To:

ATTN: James Lane

Telephone: 847-972-3128
FAX:
E-Mail:
License No.:

RSSI SAMPLE NUMBER	CLIENT REFERENCE	RADIO-NUCLIDE	ACTIVITY (mCi)	SOURCE CALIBRATION DATE	SAMPLE TYPE	SOURCE MODEL NUMBER	SOURCE SERIAL NUMBER	RESULTS* (μCi)
P122541	37	Cs-137			Rebar			$<3.7\times10^{-6}$
P122542	38	Cs-137			Rebar			$<3.7\times10^{-6}$
P122543	39	Cs-137			Rebar			$<3.7\times10^{-6}$
P122544	40	Cs-137			Rebar			$<3.7\times10^{-6}$
P122545	41	Cs-137			Rebar			$<3.7\times10^{-6}$
P122546	42	Cs-137			Rebar			$<3.7\times10^{-6}$
P122547	43	Cs-137			Rebar			$<3.7\times10^{-6}$

Analysis authorized by license No. IL-01429-01. Analysis approved by the Canadian Nuclear Safety Commission, meeting the criteria and requirements of R-116. Analysis instrument: Nuclear-Chicago Spectro Shield 1152 α/β counter. Serial number 28458. Calibrated August 1, 2012. Measuring time = 5 minutes. Alpha background = 0.12 cpm. Beta/Gamma background = 3.86 cpm.

Most regulatory agencies consider a source to be leaking if a leak test indicates the presence of more than 0.005 μCi (5×10^{-3} μCi) of removable contamination. Sources for which the results indicate the presence of 5×10^{-4} μCi or more of removable activity should be investigated.

* < followed by a number indicates the activity is below the limit of detection.

A highlighted result exceeds regulatory limits and was reported by telephone to the person submitting the sample and/or _____ on _____.

Analyzed by: Jeremy Kieser
P122541-49.pdf

Date: December 19, 2012

RSSI

6312 W. Oakton Street
Morton Grove, IL 60053-2723
847-965-1999

WIPE TEST ANALYSIS REPORT

Facility: CTL Group
Address: 5400 Old Orchard Road
Skokie, IL 60077

Telephone: 847-972-3128
FAX:
E-Mail:
License No.:

Person Submitting Samples: James Lane
Date Samples Collected: 12/18/2012
Send Results To:

ATTN: James Lane

RSSI SAMPLE NUMBER	CLIENT REFERENCE	RADIO-NUCLIDE	ACTIVITY (mCi)	SOURCE CALIBRATION DATE	SAMPLE TYPE	SOURCE MODEL NUMBER	SOURCE SERIAL NUMBER	RESULTS* (μCi)
P122548	44	Cs-137			Rebar			$<3.7\times10^{-6}$
P122549	45	Cs-137			Rebar			$<3.7\times10^{-6}$

Analysis authorized by license No. IL-01429-01. Analysis approved by the Canadian Nuclear Safety Commission, meeting the criteria and requirements of R-116. Analysis instrument: Nuclear-Chicago Spectro Shield 1152 α/β counter. Serial number 28458. Calibrated August 1, 2012. Measuring time = 5 minutes. Alpha background = 0.12 cpm. Beta/Gamma background = 3.86 cpm.

Most regulatory agencies consider a source to be leaking if a leak test indicates the presence of more than 0.005 μCi (5×10^{-3} μCi) of removable contamination. Sources for which the results indicate the presence of 5×10^{-4} μCi or more of removable activity should be investigated.

* < followed by a number indicates the activity is below the limit of detection.

A highlighted result exceeds regulatory limits and was reported by telephone to the person submitting the sample and/or _____ on _____.

Analyzed by: Jeremy Kieser
P122541-49.pdf

Date: December 19, 2012

Appendix B

REBAR INITIAL INSPECTION

Performed by: JFL Date: 1/13/13 Reviewed by: BS Date: 1/18/13

1. Measuring Device Type: 25' Tape Measure [1] S/N: N/A Cal Date: N/A
2. Measuring Device Type: 6" Caliper S/N: 101030188 Cal Date: 1/18/12

Sample ID	Length (in.) 1	Diameter (in.) 2	Visual Examination/Observations
37-1	11	0.6870	No Observable Cracks/Defects
37-2	16	0.6855	No Observable Cracks/Defects
37-3	31	0.6860	No Observable Cracks/Defects
37-4	32	0.6885	No Observable Cracks/Defects
38	28	0.6860	No Observable Cracks/Defects
39-1	6	0.6835	No Observable Cracks/Defects
39-2	22	0.6880	No Observable Cracks/Defects
39-3	33	0.6865	No Observable Cracks/Defects
39-4	31	0.6835	No Observable Cracks/Defects
40	26	0.6860	No Observable Cracks/Defects
41-1	4½	0.6850	No Observable Cracks/Defects
41-2	4½	0.6840	No Observable Cracks/Defects
41-3	26	0.6850	No Observable Cracks/Defects
42	27	0.6835	No Observable Cracks/Defects
43-1	11	0.6880	No Observable Cracks/Defects
43-2	24	0.6835	No Observable Cracks/Defects
43-3	22	0.6870	No Observable Cracks/Defects
44-1	16	0.6845	No Observable Cracks/Defects
44-2	14	0.6850	No Observable Cracks/Defects
45	15	0.6850	No Observable Cracks/Defects

Note 1: Commercial Device

Table I
Mechanical Testing Data (ASTM A 370-12a)

Sample ID	Yield Strength (ksi)	Tensile Strength (ksi)	Elongation (%)	Mod. of Elast. (ksi x 1000)	Hardness (HRB)
37-1a	50.5	83.5	28	34.0	83
37-1b	51.5	84.0	30	32.5	
37-2a	47.7	78.5	33	28.5	78
37-2b	44.6	78.5	33	30.3	
37-2c	46.8	78.0	33	27.5	
39-1	49.4	79.0	32	32.7	82
39-2a	47.3	76.5	32	29.7	79
39-2b	44.7	76.0	32	29.8	
39-2c	46.0	76.5	34	14.5*	
39-2d	47.7	76.5	33	25.1	
39-2e	47.2	76.0	32	28.6	
40a	45.2	76.0	31	27.3	79
40b	43.9	77.0	33	28.8	
40c	43.5	77.0	33	35.8	
40d	42.1	77.5	31	27.7	
40e	43.7	78.0	31	27.1	
41-1	48.7	83.0	30	31.3	80
41-2	47.8	79.5	30	25.7	81
41-3a	48.3	76.5	30	29.6	82
41-3b	45.6	77.0	32	32.3	
41-3c	47.9	77.0	32	26.6	
41-3d	48.6	77.0	31	28.3	
41-3e	48.0	77.0	33	28.1	
41-4a	49.4	80.0	33	30.3	80
41-4b	48.5	79.5	33	27.3	
41-4c	45.1	79.0	33	28.0	
41-4d	49.6	80.0	34	28.7	
41-4e	46.5	80.5	33	32.3	
41-4f	47.0	79.5	33	28.0	
42a	51.0	80.5	33	28.1	81
42b	47.8	80.5	29	29.1	
42c	46.4	78.5	32	30.0	
42d	44.6	78.0	33	33.2	
43-1a	44.0	76.0	31	28.5	78
43-1b	46.7	77.0	32	31.2	
43-2a	45.7	80.0	32	29.9	80
43-2b	48.7	80.0	32	28.8	
43-2c	47.7	80.5	32	31.6	
43-2d	47.2	80.5	32	29.1	
43-2e	45.9	79.5	32	25.1	
43-3a	49.0	84.5	30	27.6	83
43-3b	48.9	84.0	32	26.2	
43-3c	48.9	84.0	32	26.9	
43-3d	47.7	83.5	31	31.6	
43-3e	51.5	83.5	30	30.3	
45a	46.0	77.0	32	30.5	79
45b	44.8	77.5	32	26.4	
45c	47.9	77.0	32	26.3	

Table II
Mechanical Testing Data (ASTM A615-12)

Sample ID	Yield Strength (ksi)	Tensile Strength (ksi)	Elongation (%)
37-3	46.4	65.0	5.6
37-4	49.5	76.0	19
38	47.3	74.0	15
39-3	46.4	73.5	18
39-4	50.9	75.5	24

Table III
Charpy Impact Testing Data (ASTM A 370-12a)

Sample ID	Impact Energy (@70°F) ($ft\text{-}lb_f$)
44-1	35, 30, 30
44-2	27, 30, 27

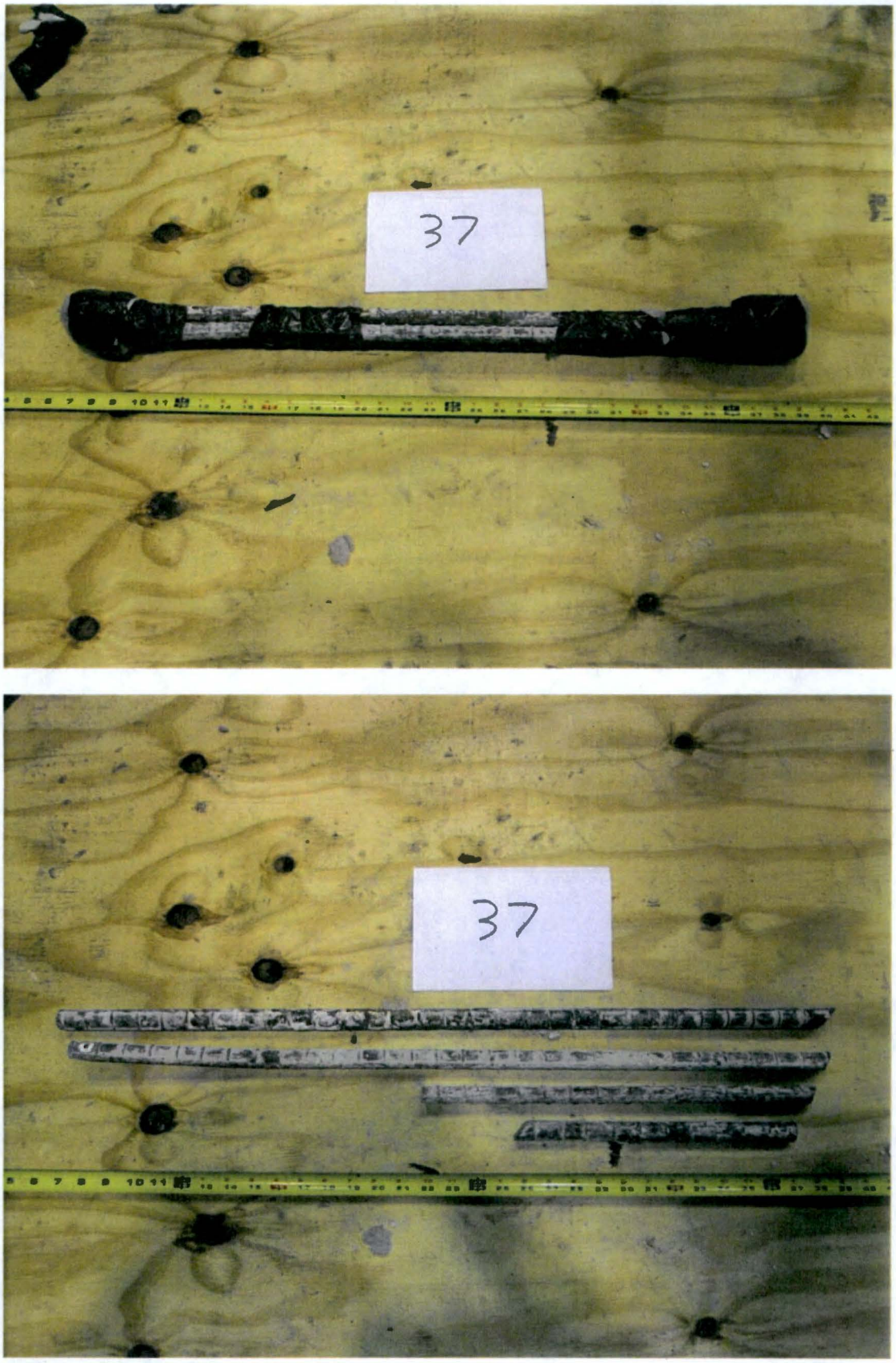


Figure 1: Photograph of Sample 37 wrapped and unwrapped

Figure 2: Photograph of Sample 38 wrapped and unwrapped

Figure 3: Photograph of Sample 39 wrapped and unwrapped

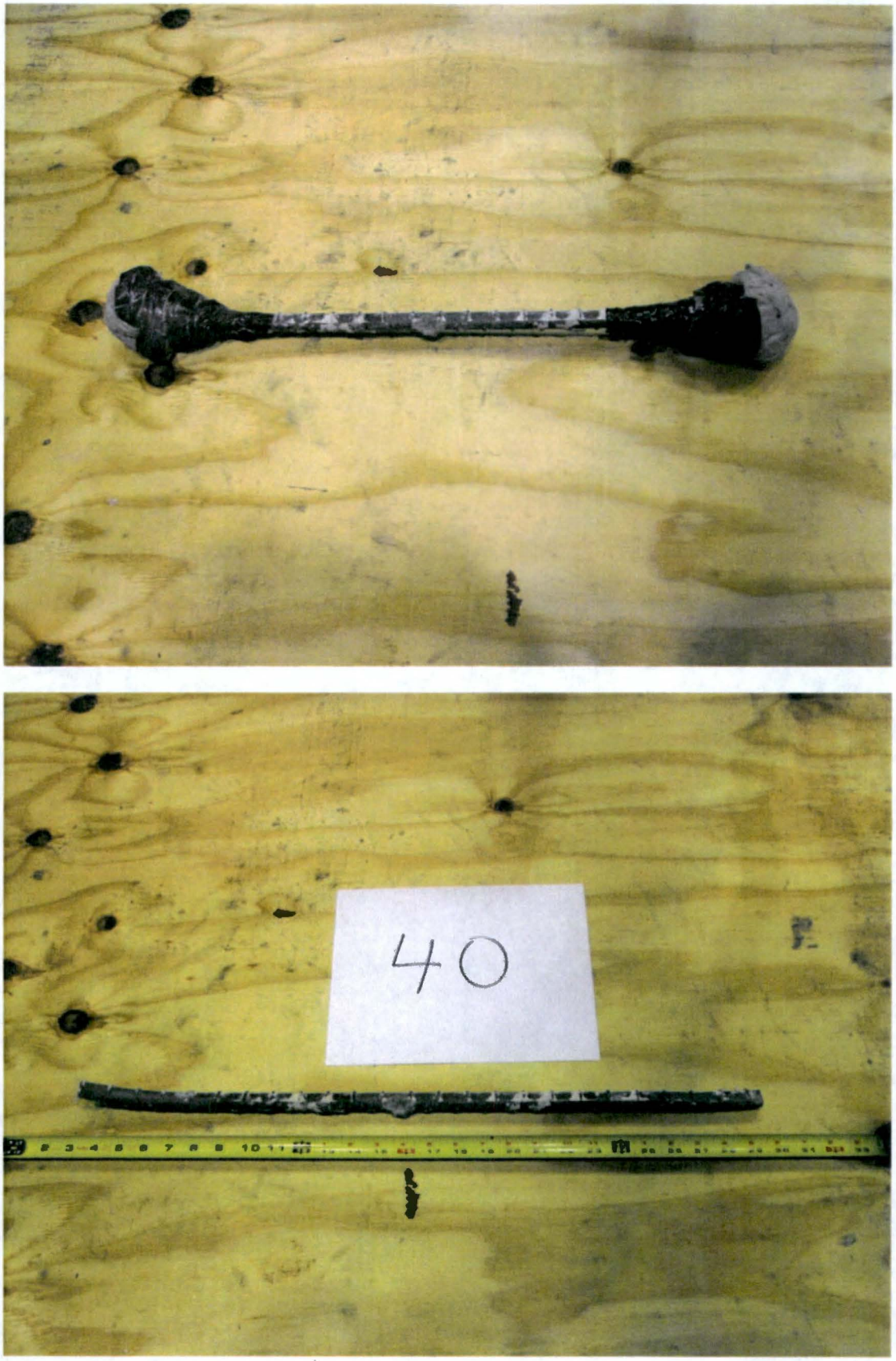


Figure 4: Photograph of Sample 40 wrapped and unwrapped

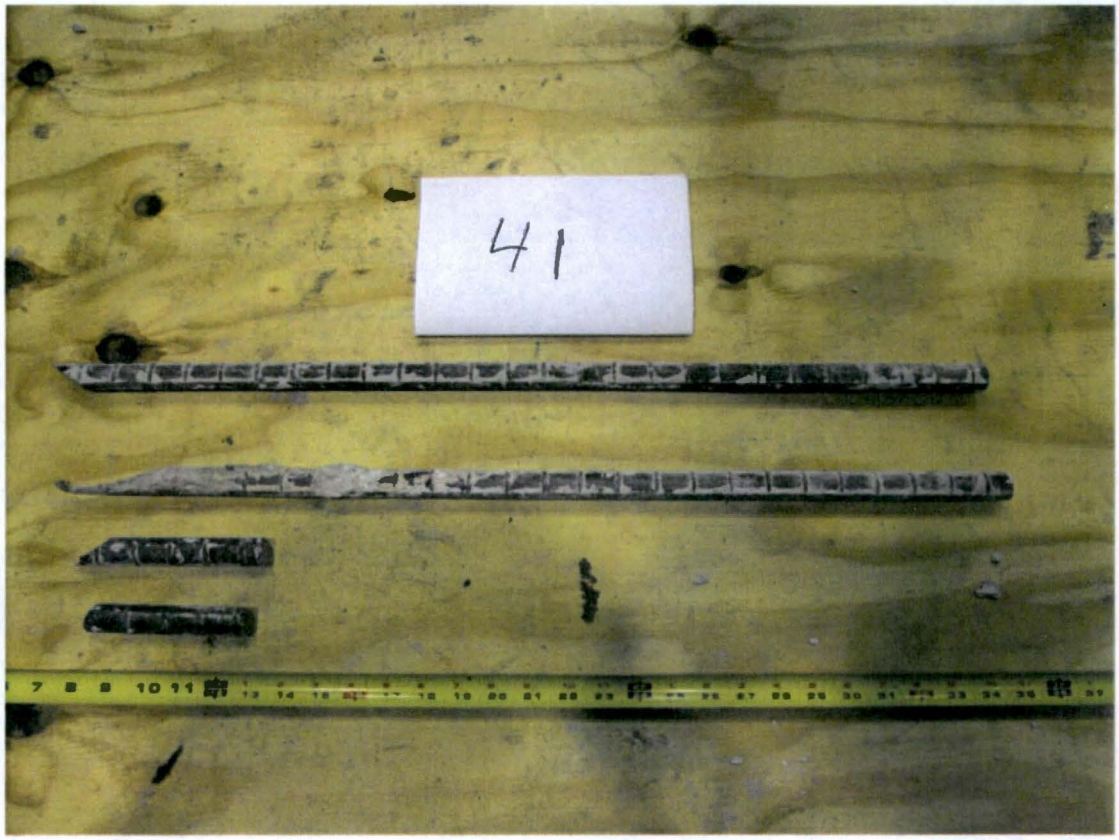


Figure 5: Photograph of Sample 41 unwrapped

Figure 6: Photograph of Sample 42 wrapped and unwrapped

Figure 7: Photograph of Sample 43 wrapped and unwrapped

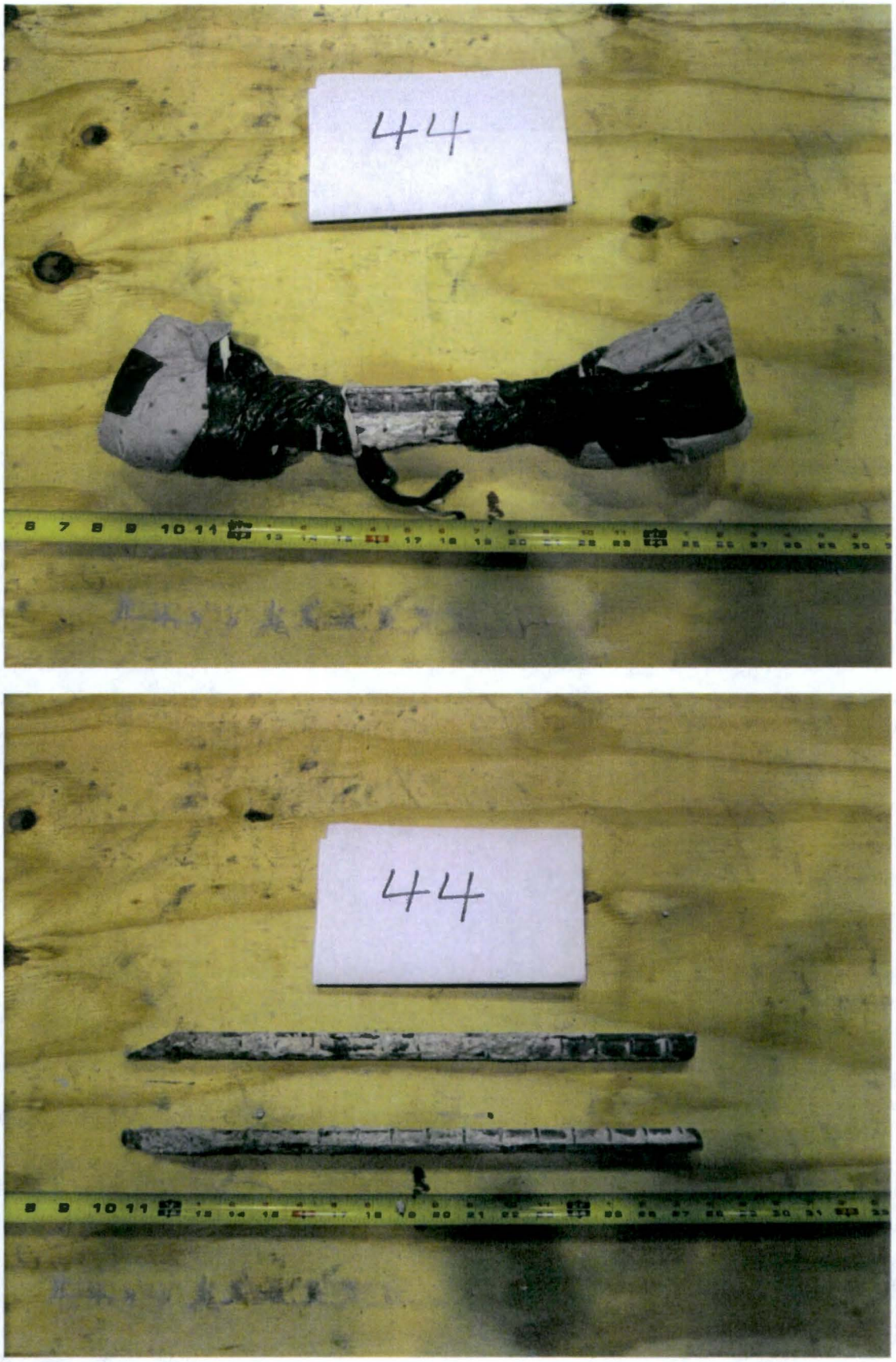


Figure 8: Photograph of Sample 44 wrapped and unwrapped

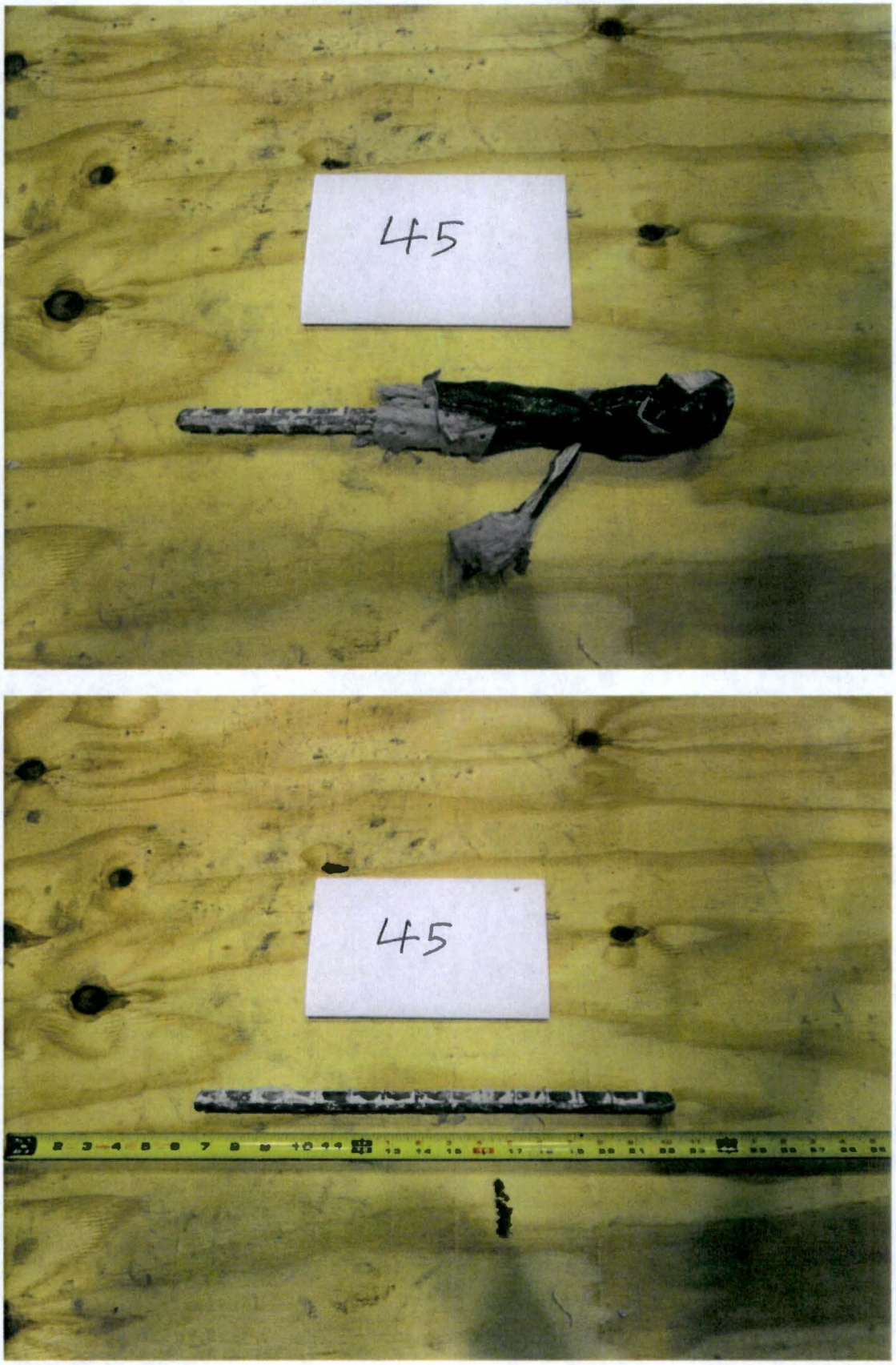
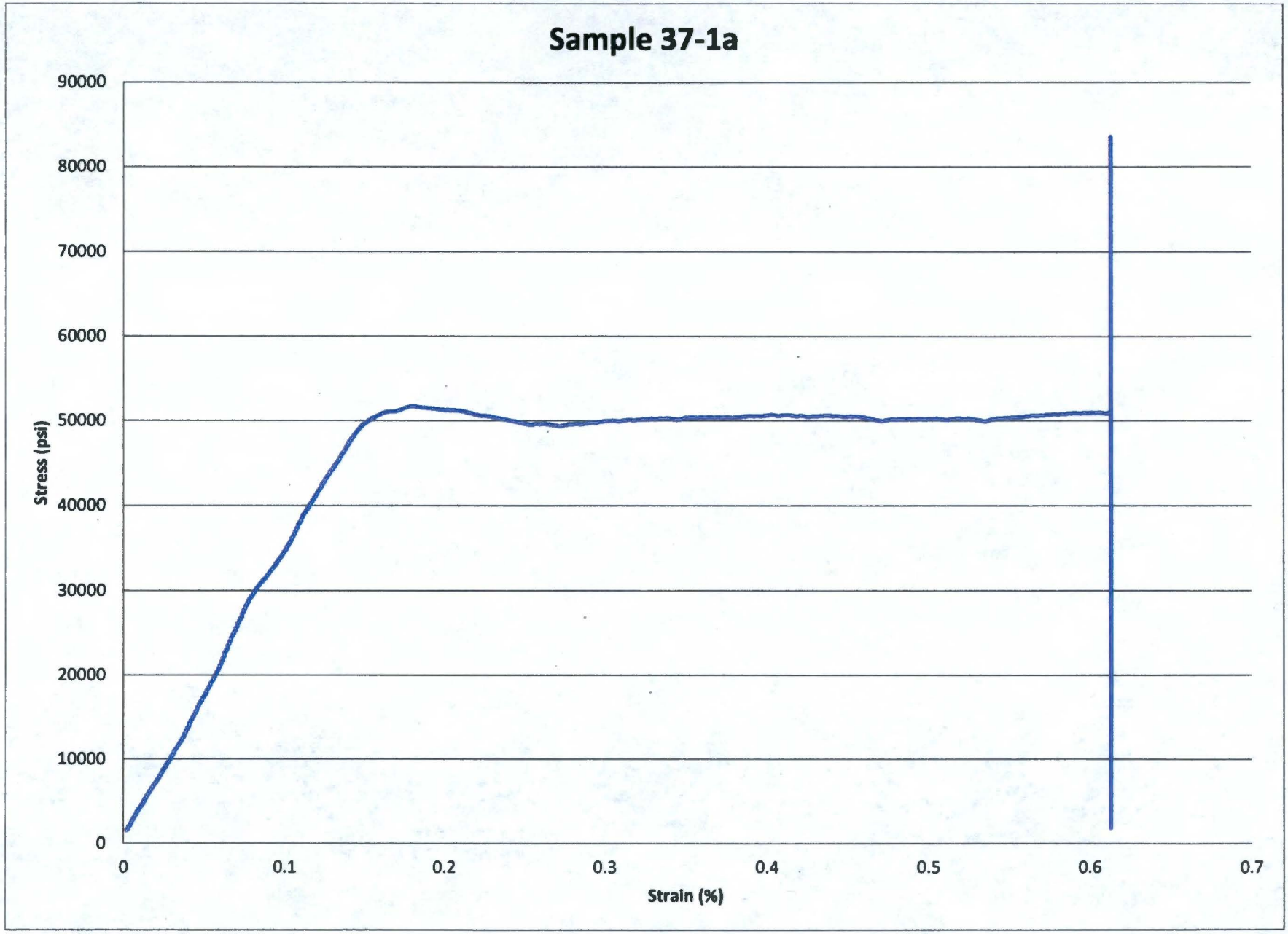
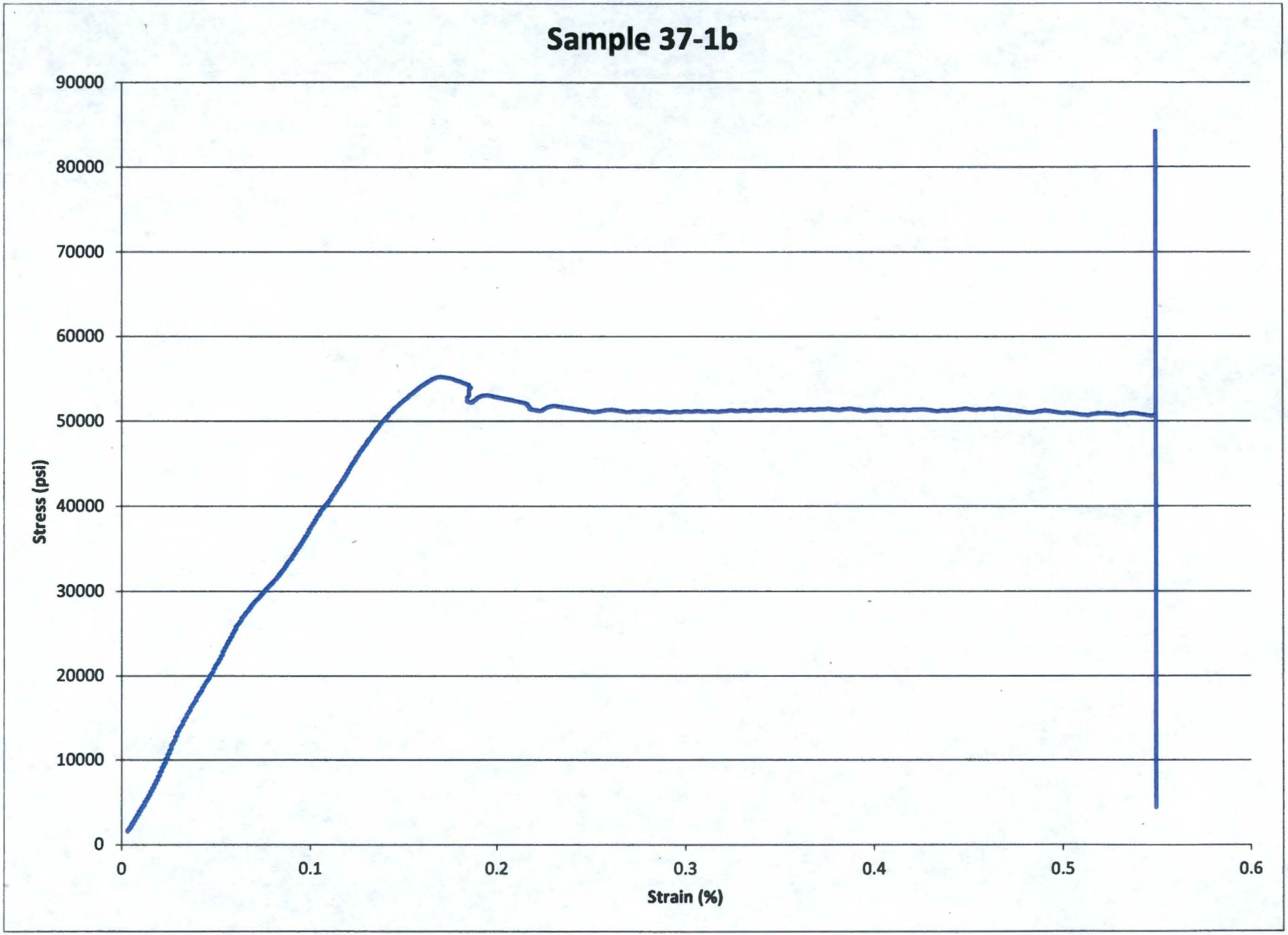
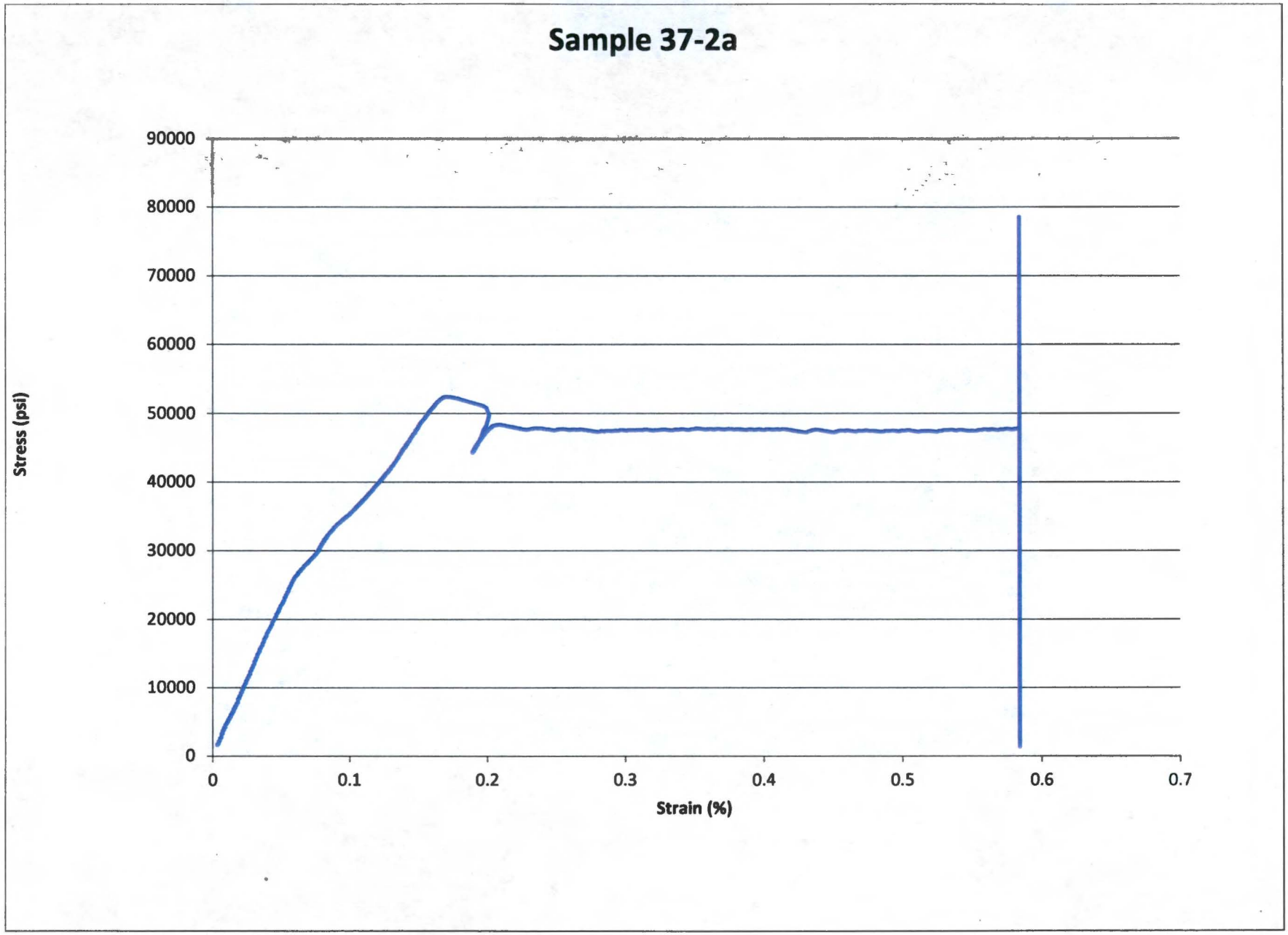


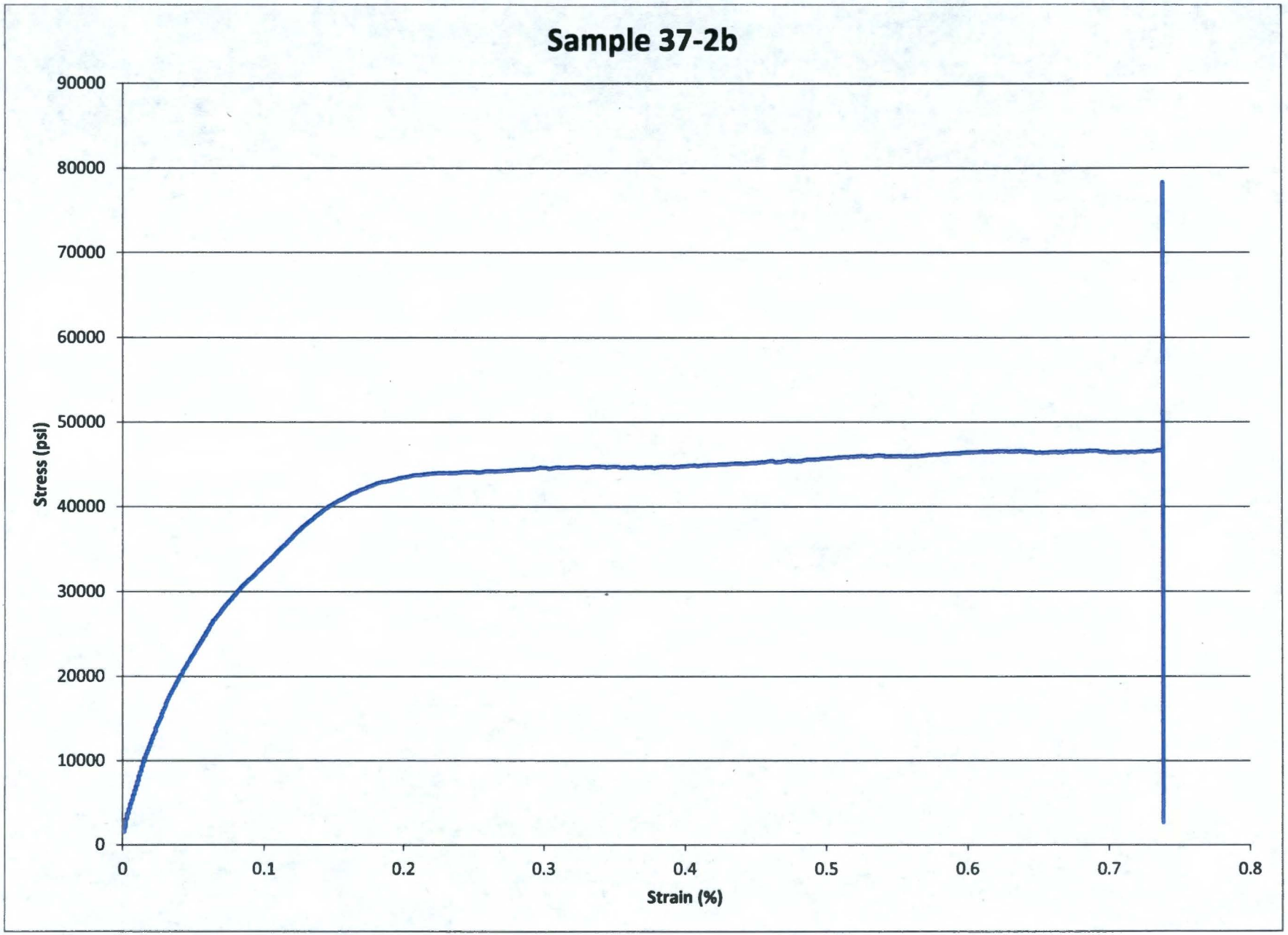
Figure 9: Photograph of Sample 45 wrapped and unwrapped

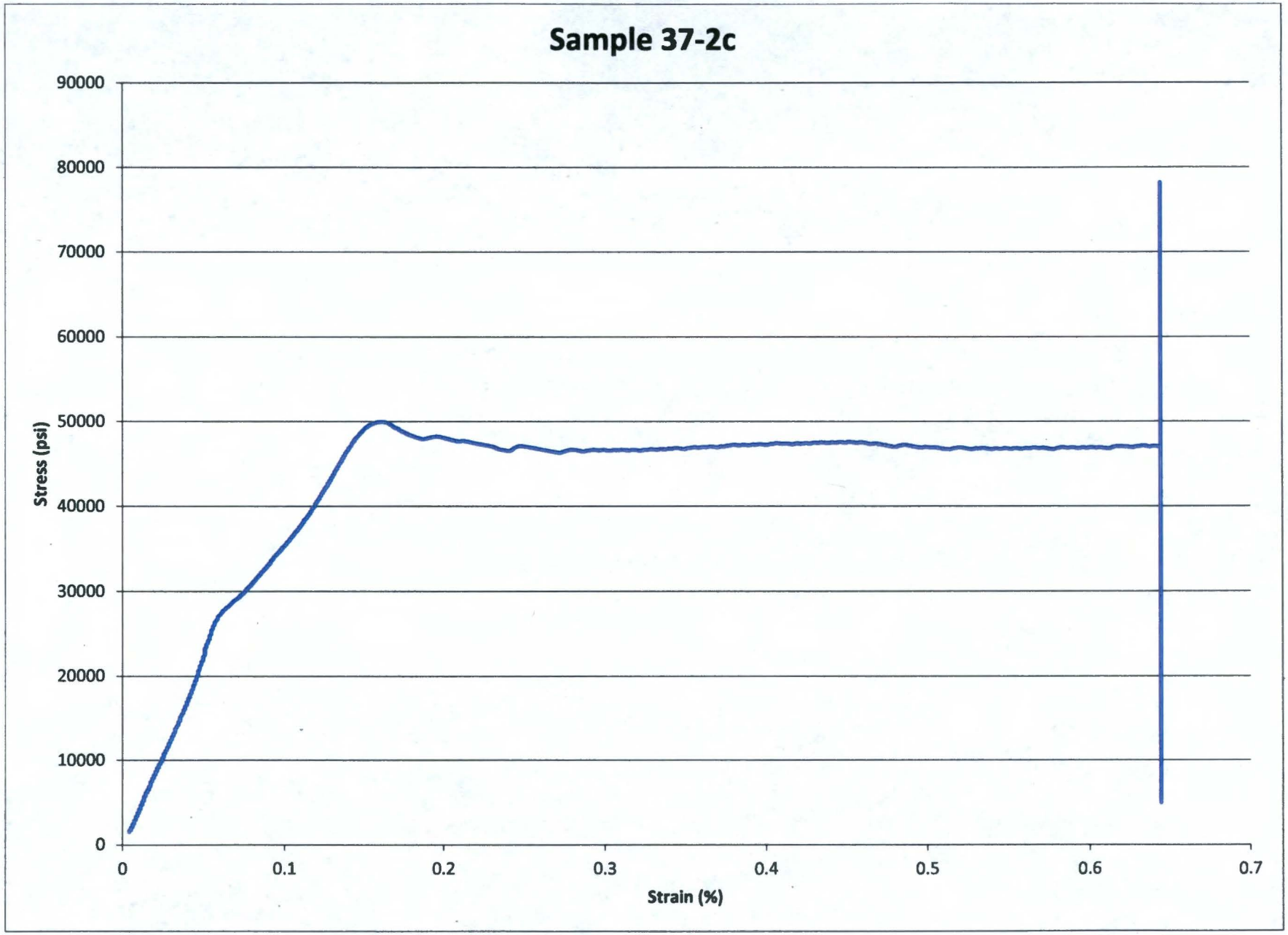
Appendix C

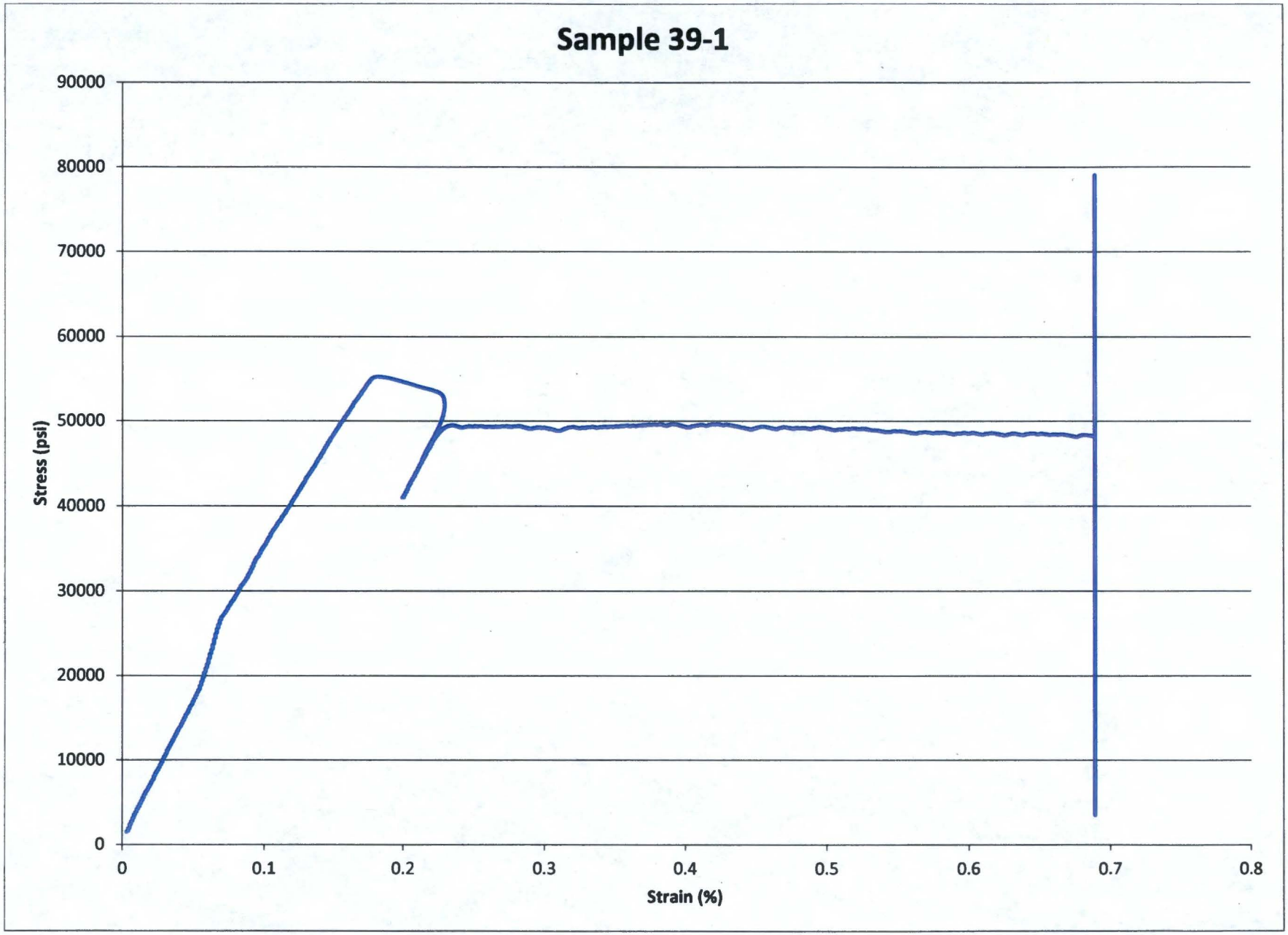

Sample 37-1a
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
Stress (psi)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)

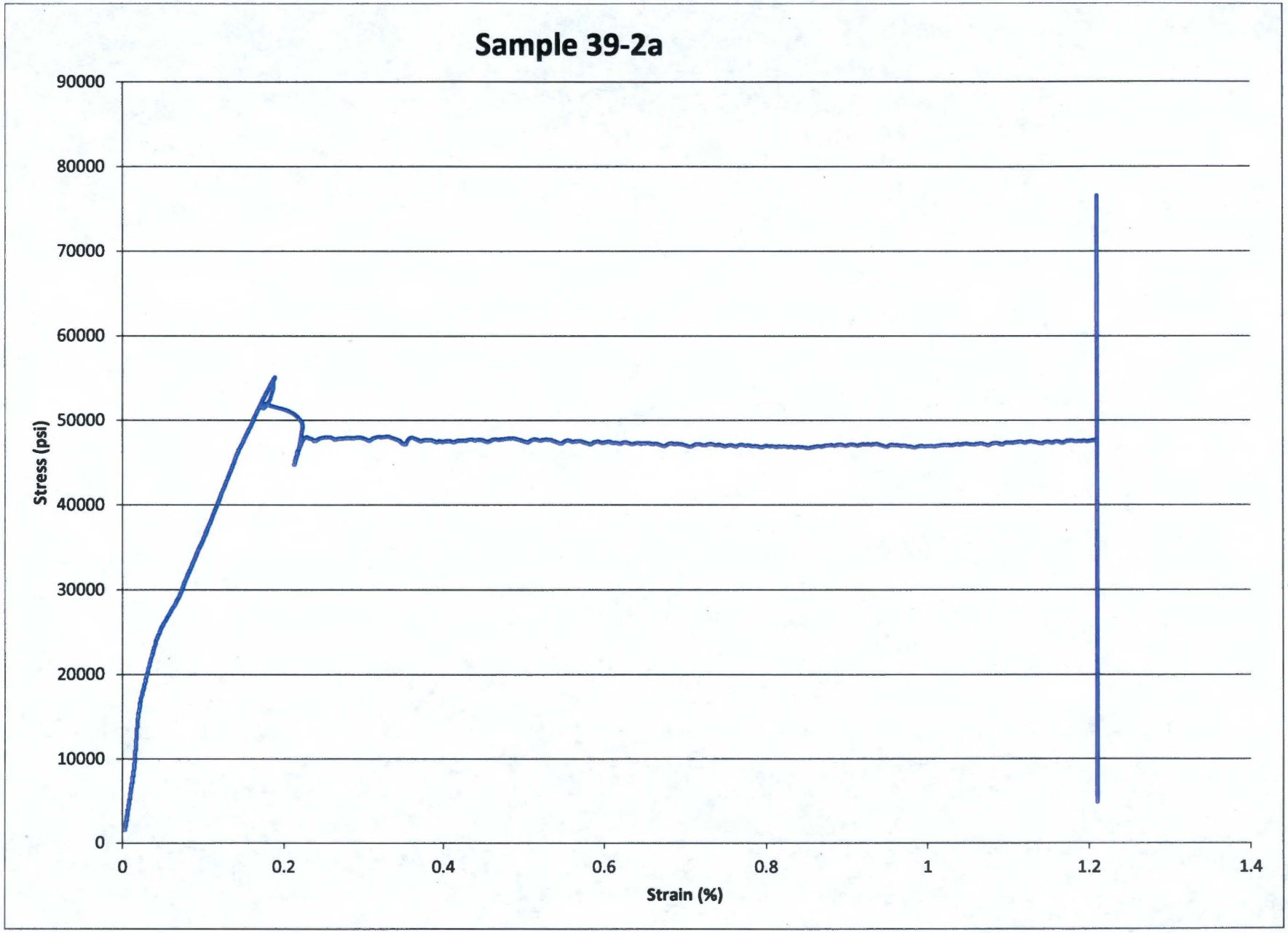

Sample 37-1b
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
Stress (psi)
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)

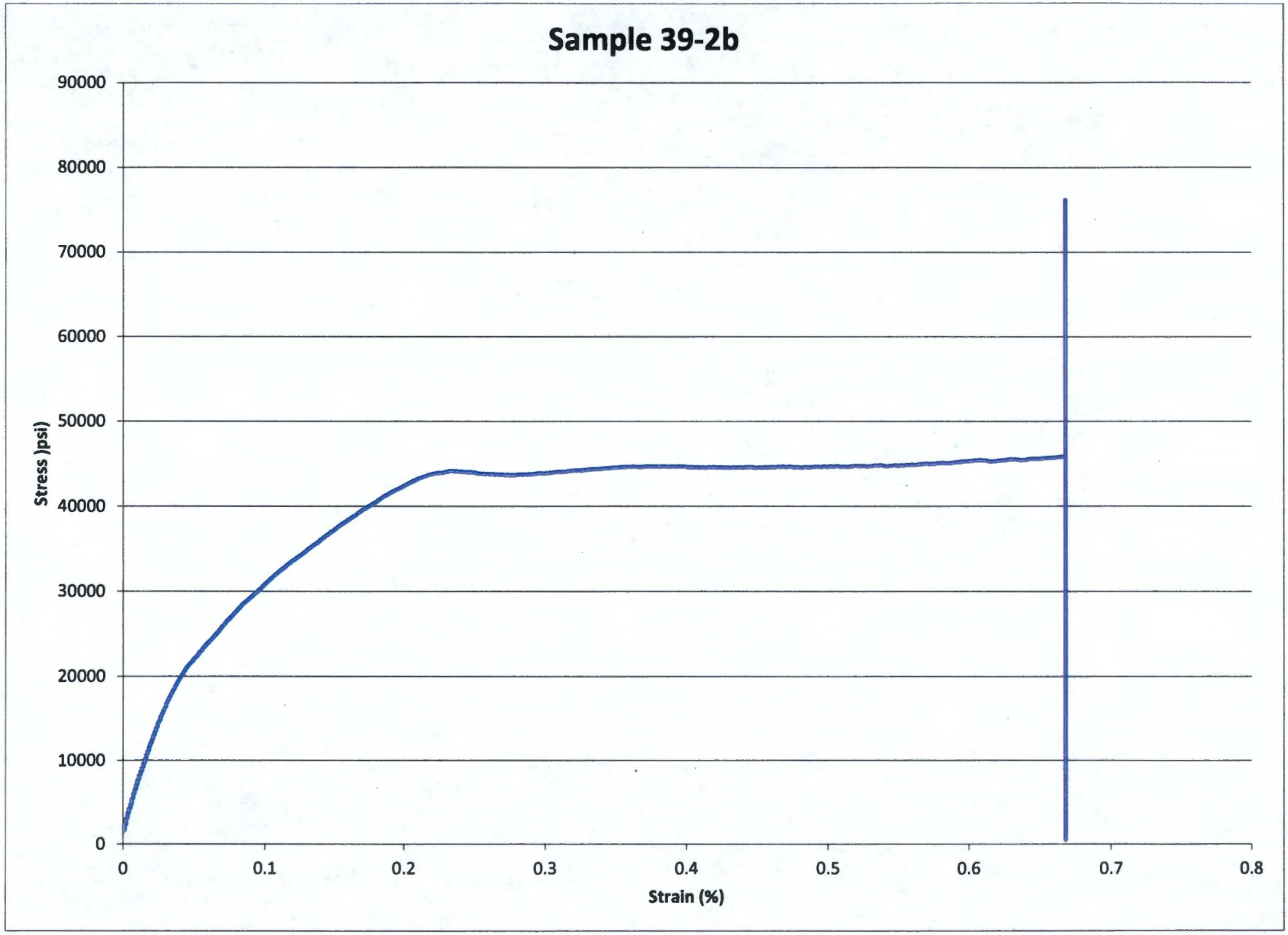

Sample 37-2a
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)

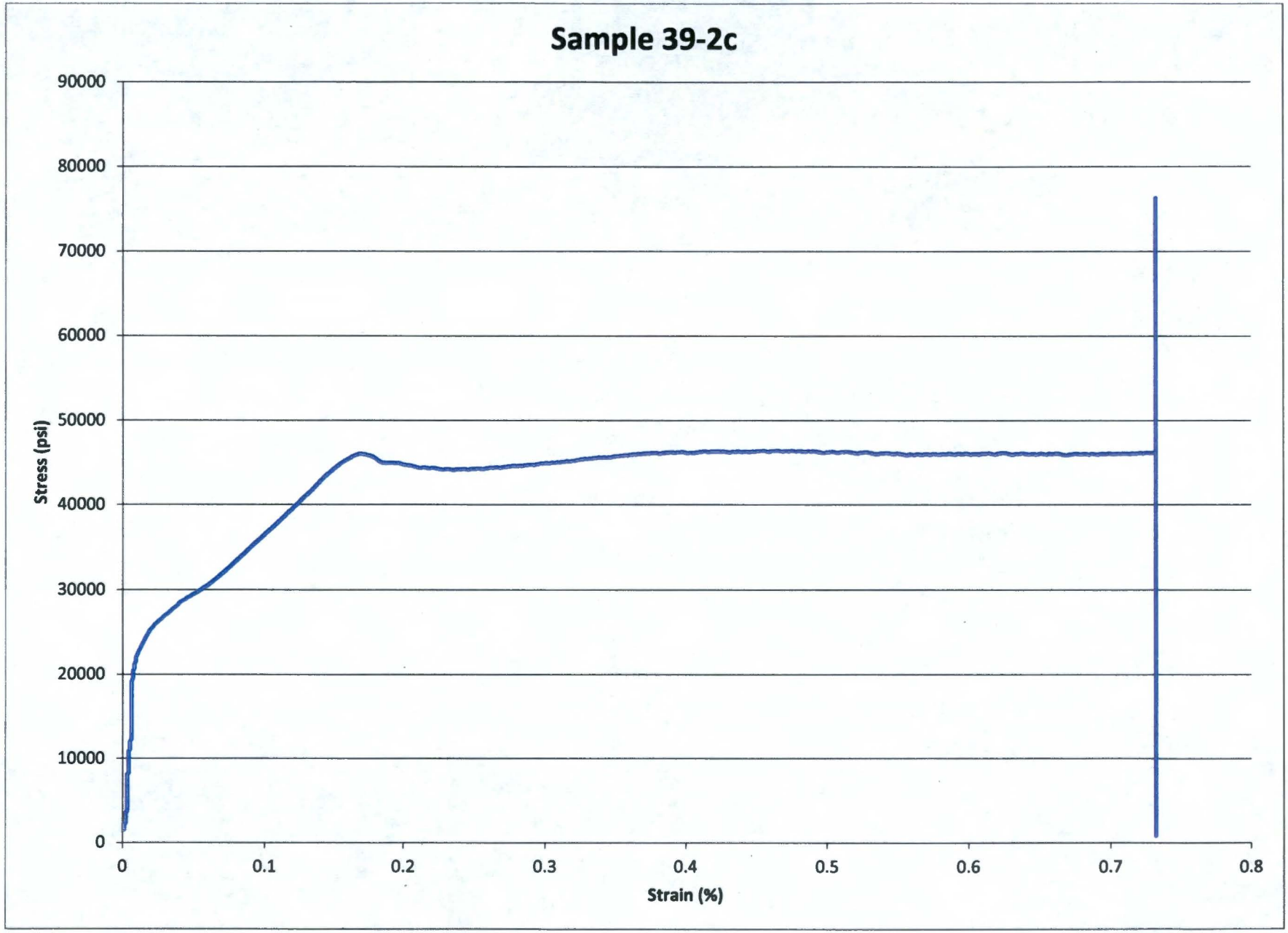

Sample 37-2b
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Strain (%)

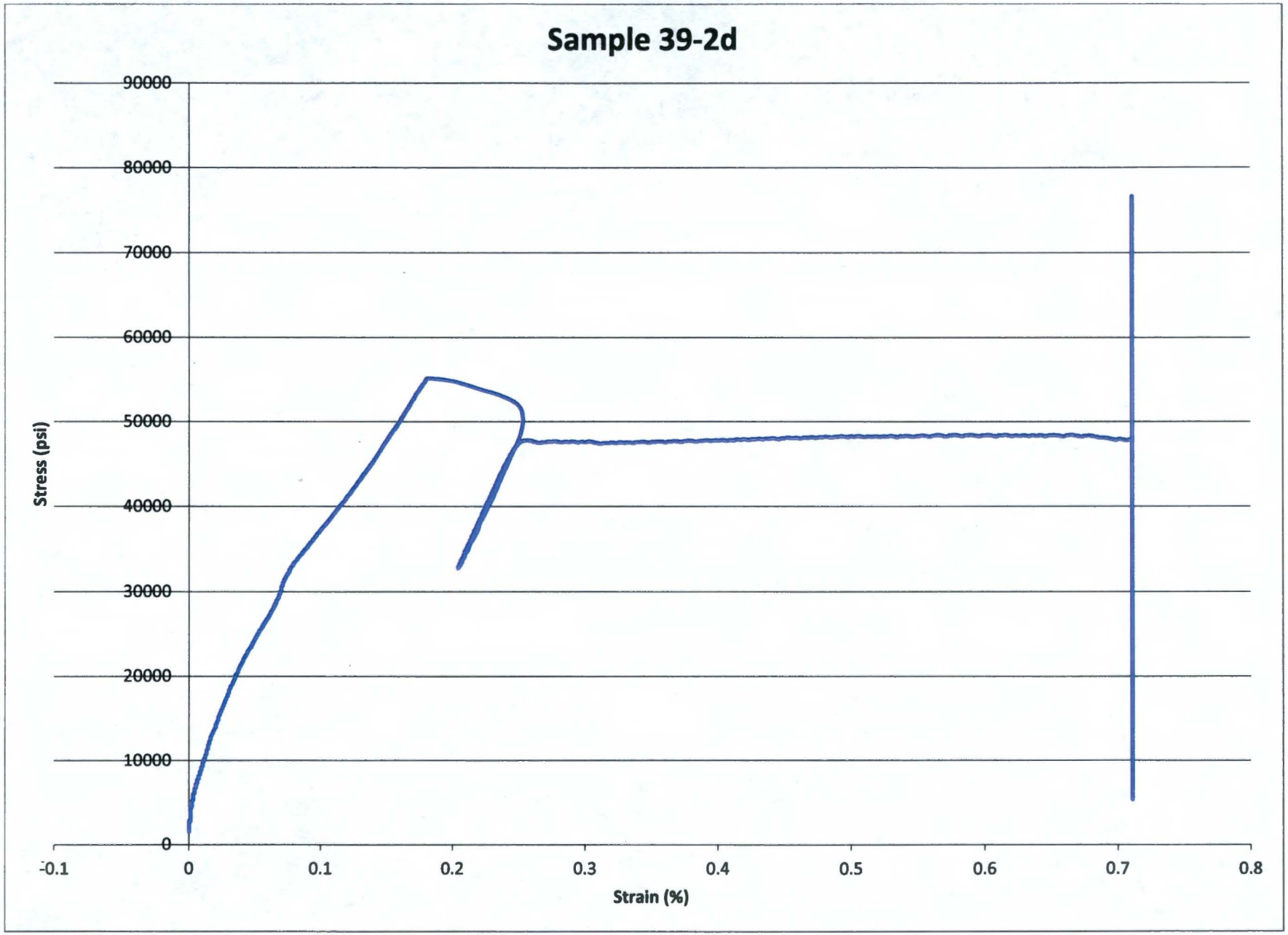

Sample 37-2c
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)

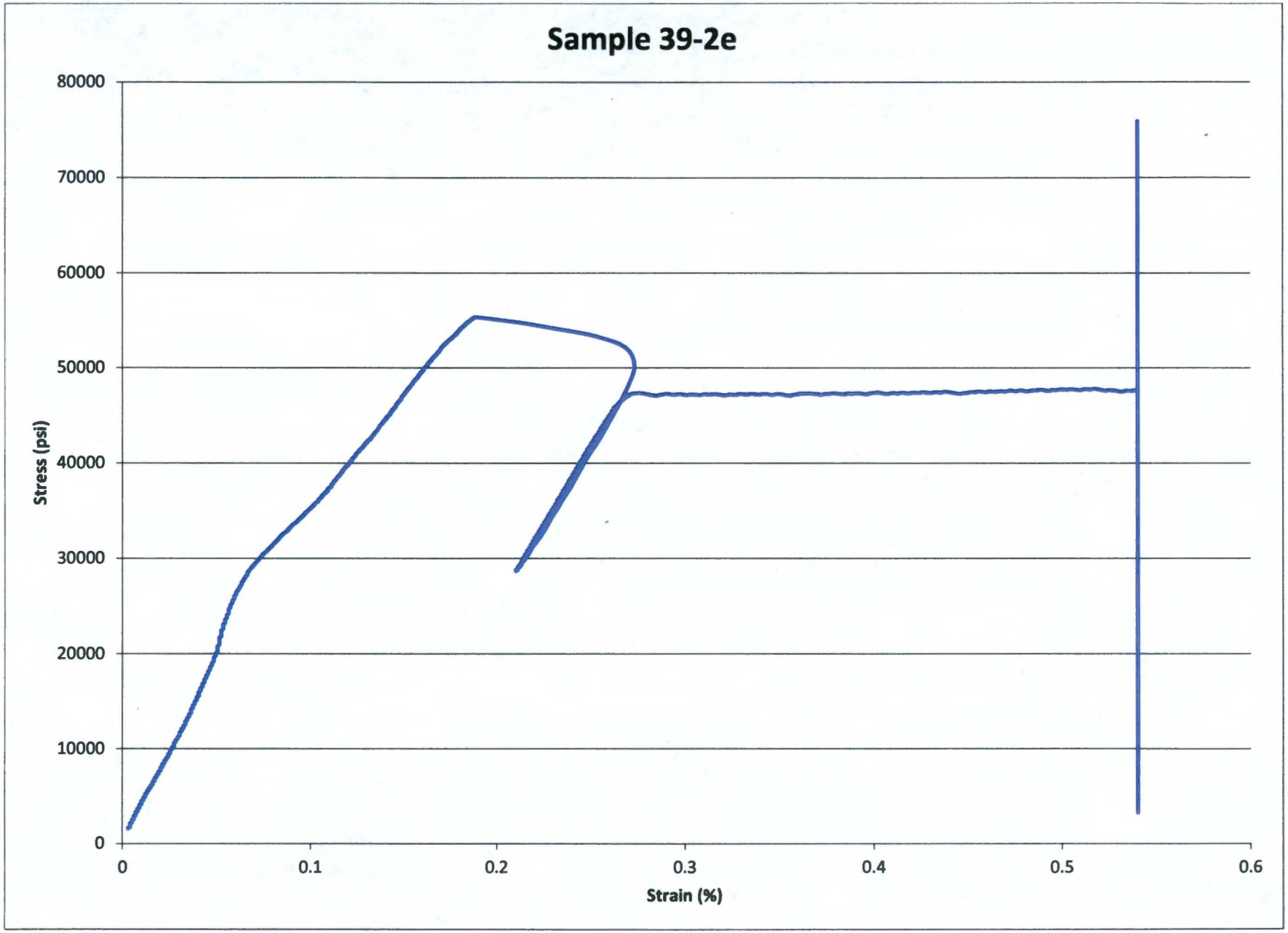

Sample 39-1
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Strain (%)

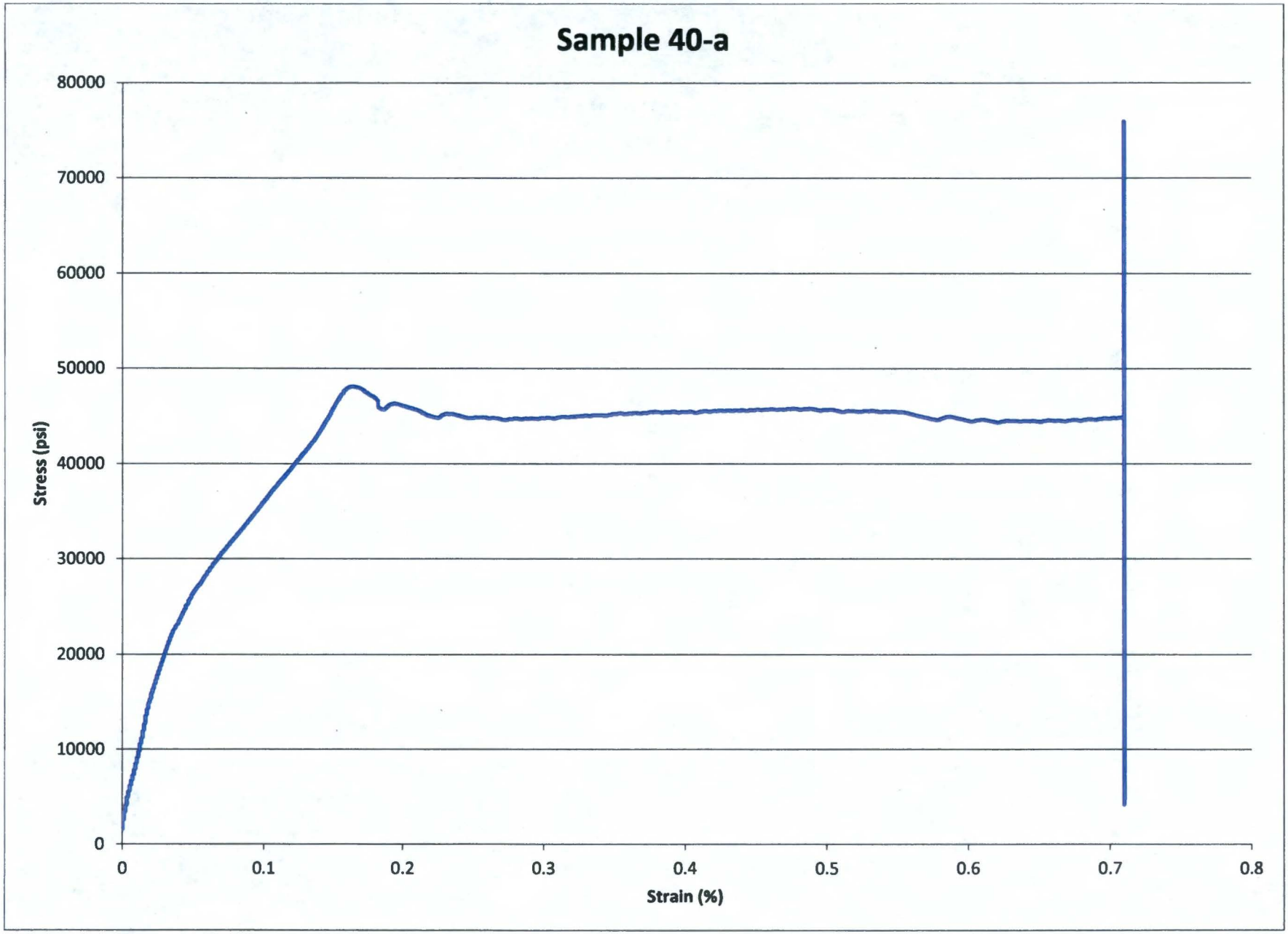

Sample 39-2a
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Strain (%)

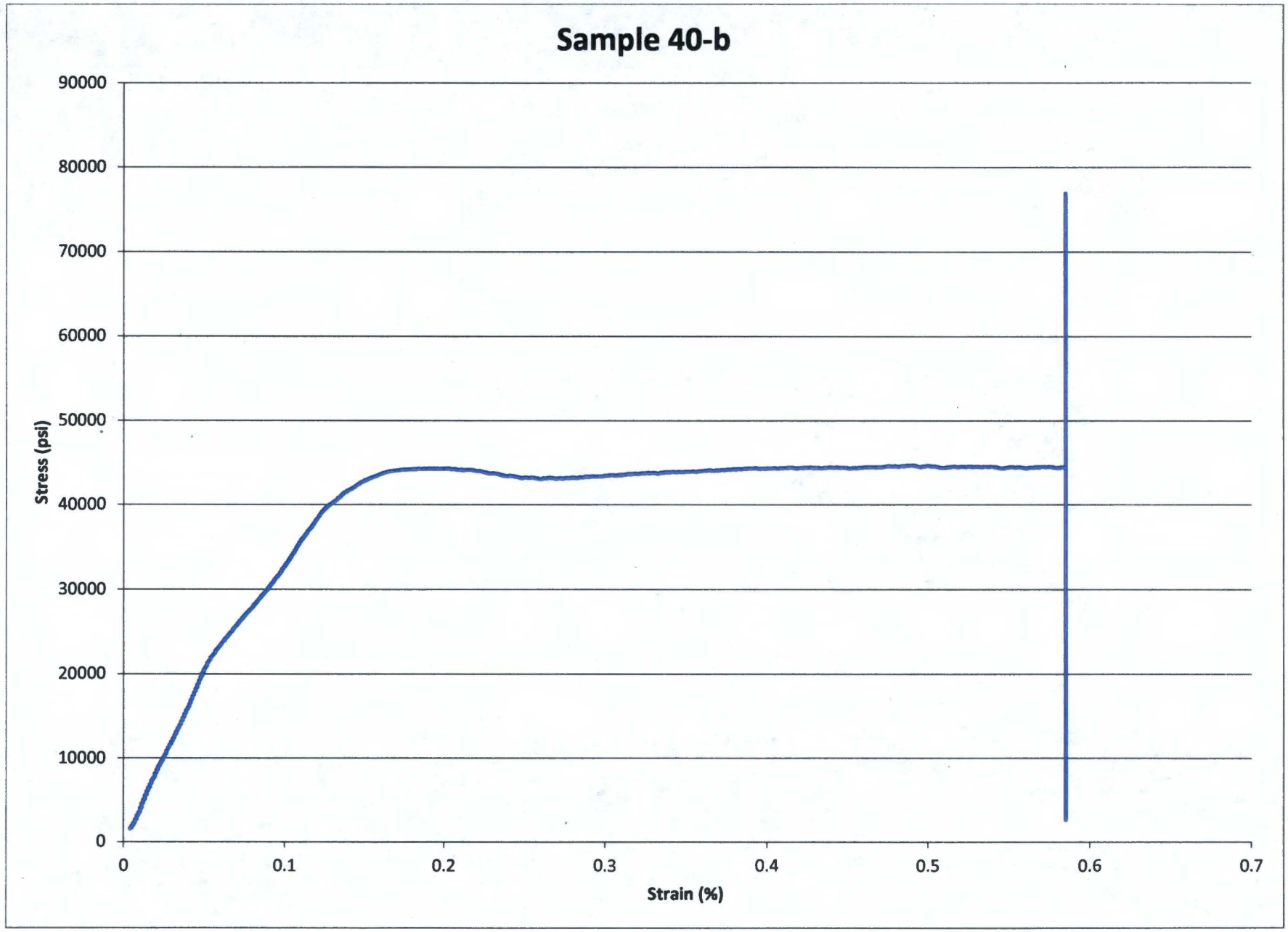

Sample 39-2b
Stress)psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Strain (%)

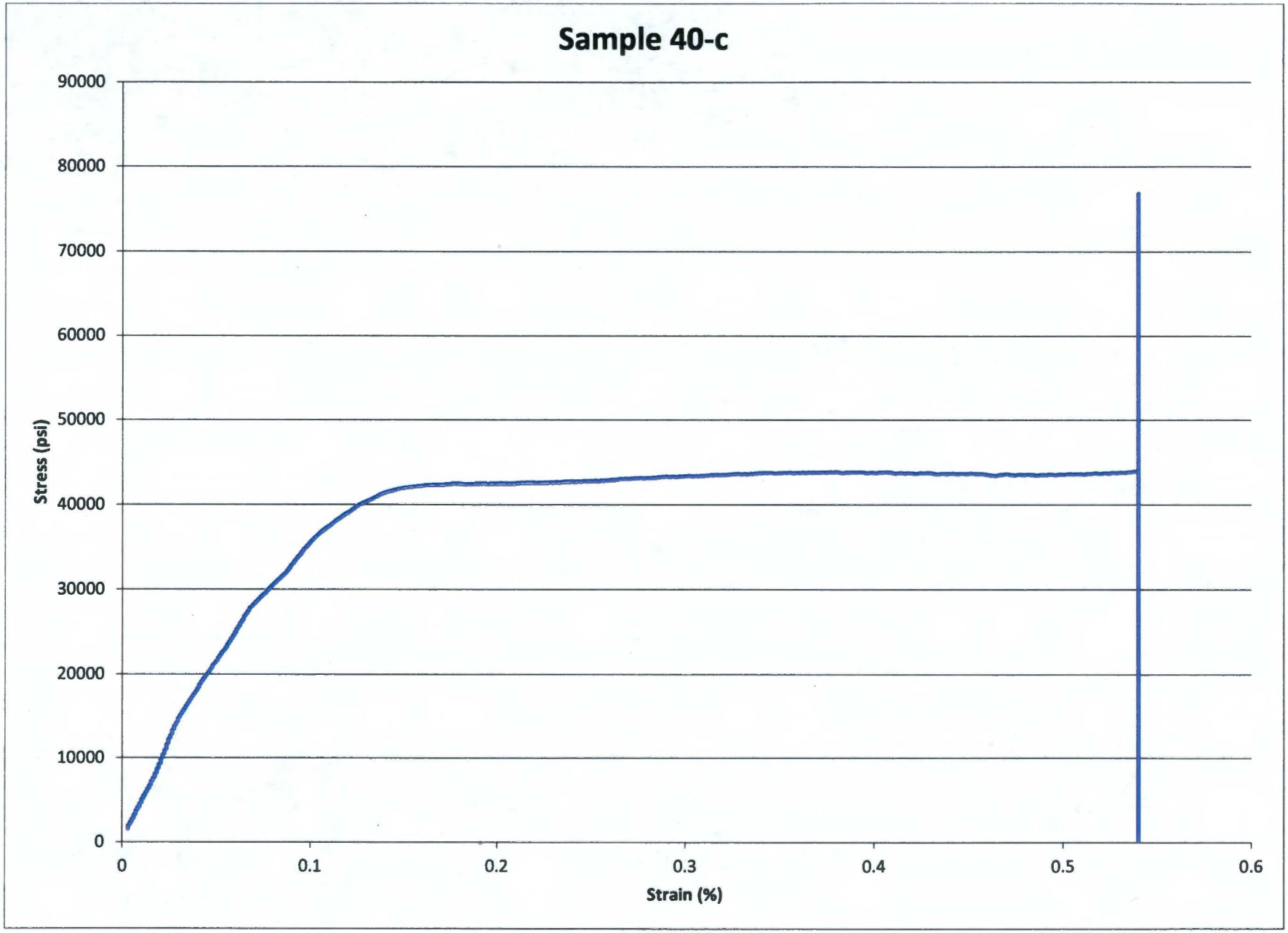

Sample 39-2c
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Strain (%)

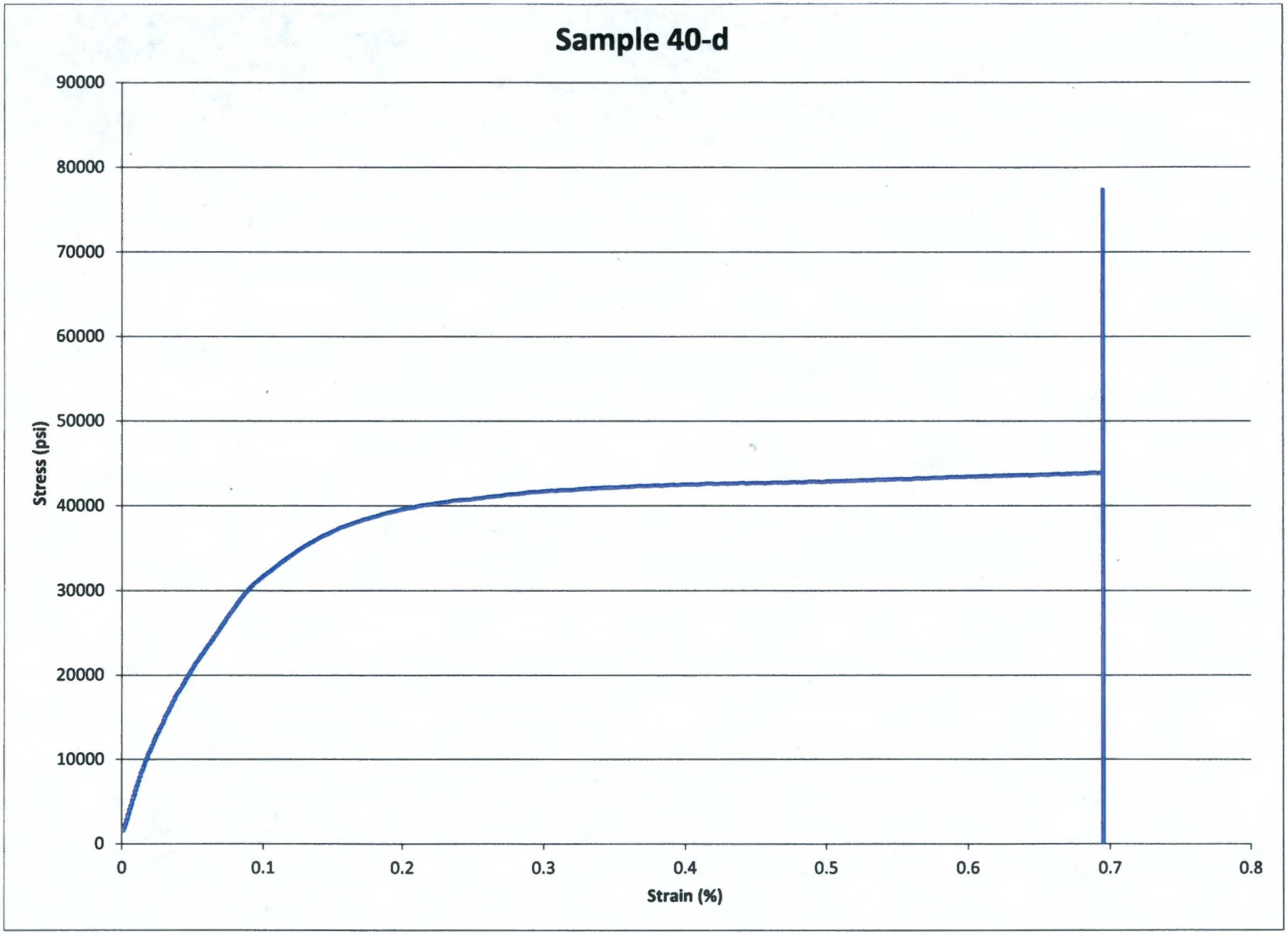

Sample 39-2d
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Strain (%)

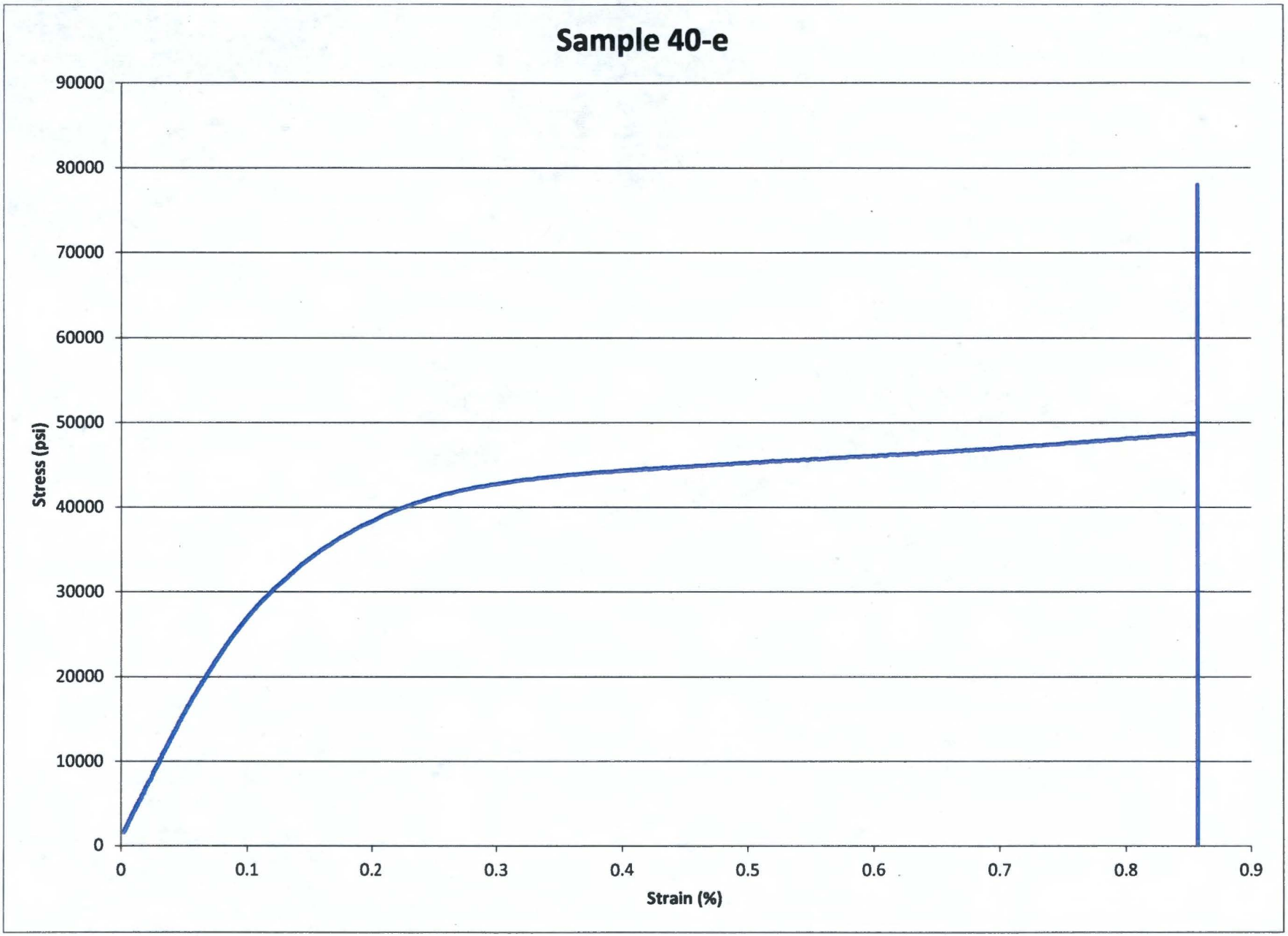

Sample 39-2e
Stress (psi)
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)

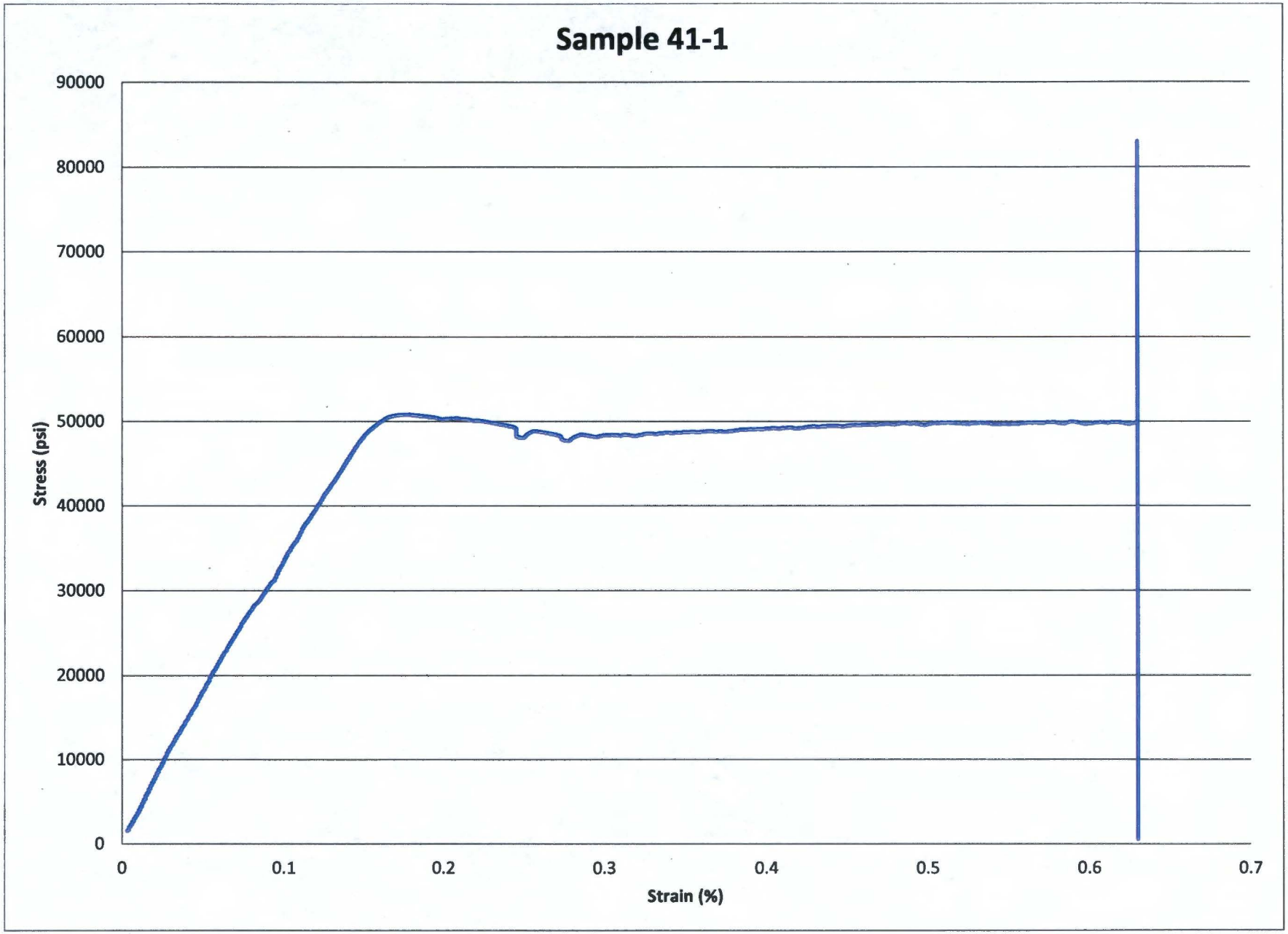

Sample 40-a
Stress (psi)
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Strain (%)

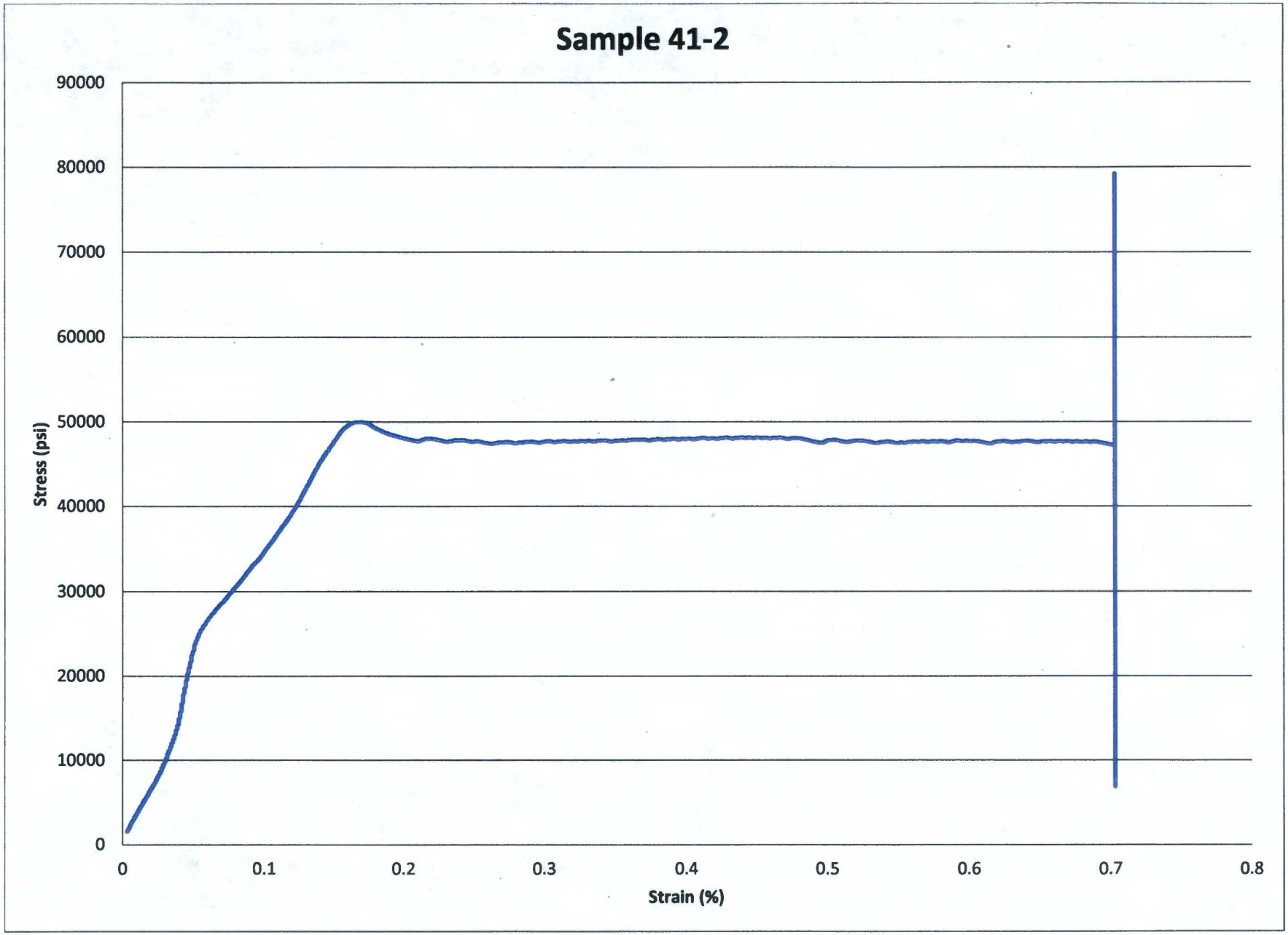

Sample 40-b
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)

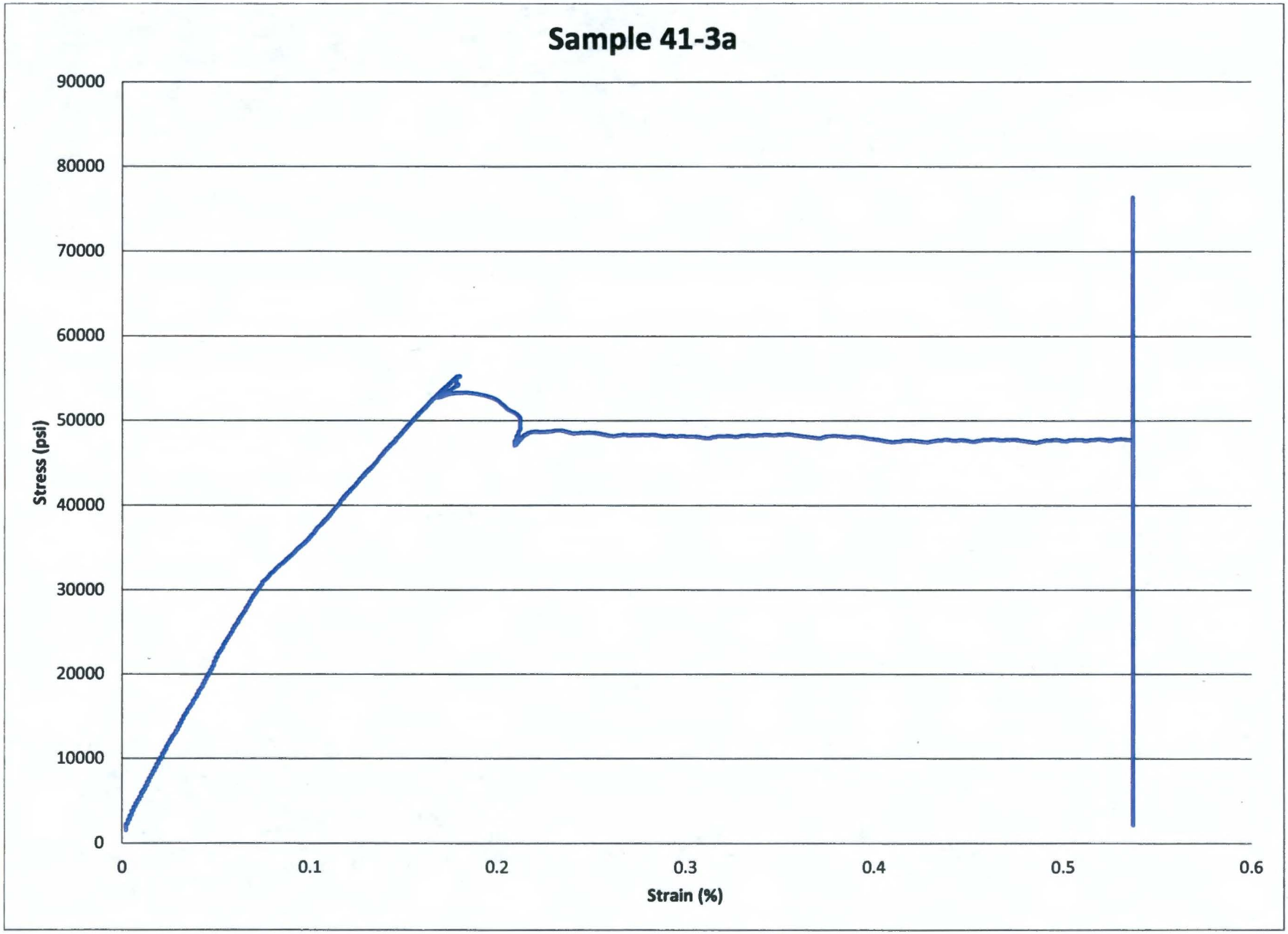

Sample 40-c
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)

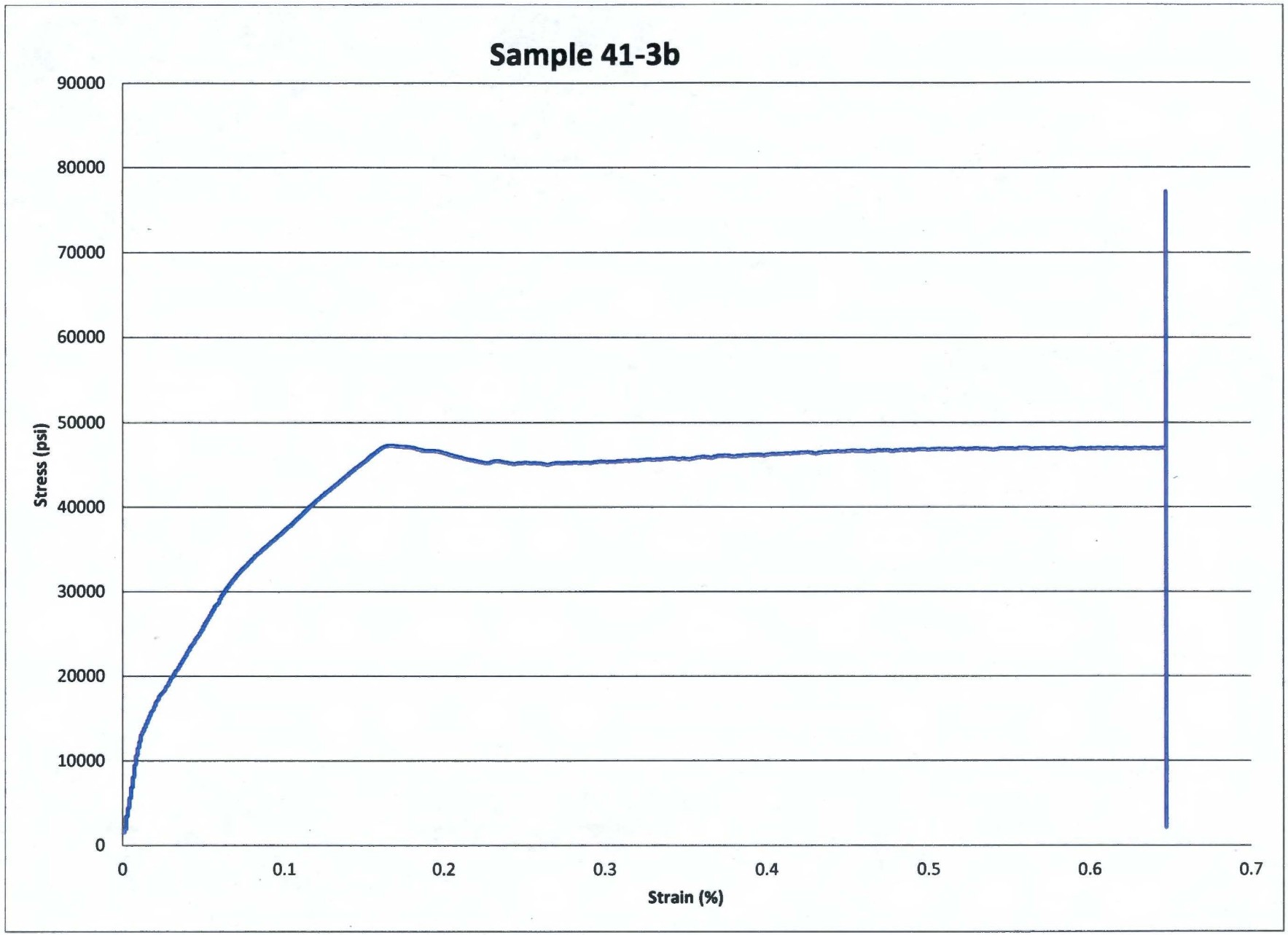

Sample 40-d
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Strain (%)

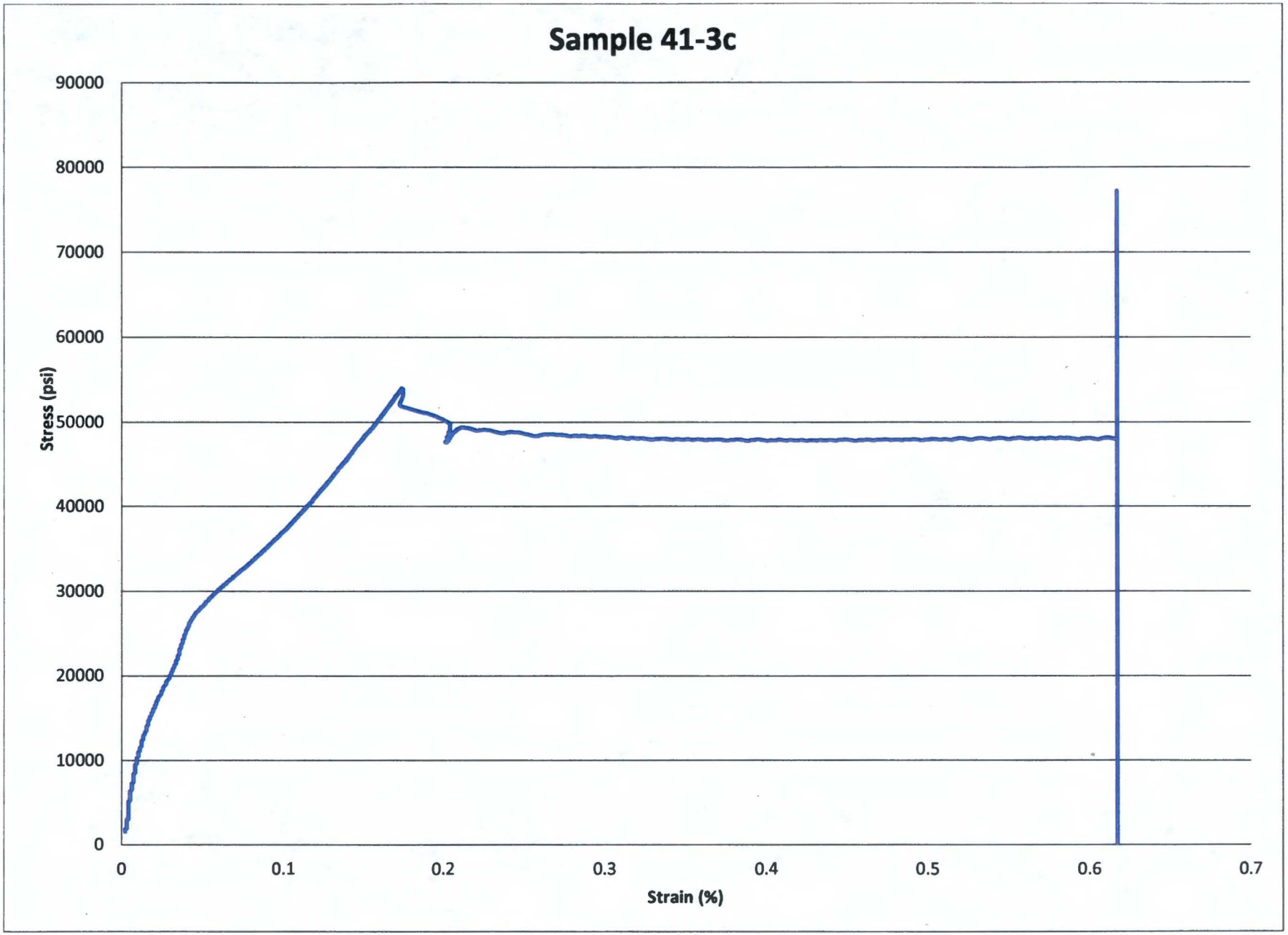

Sample 40-e
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Strain (%)

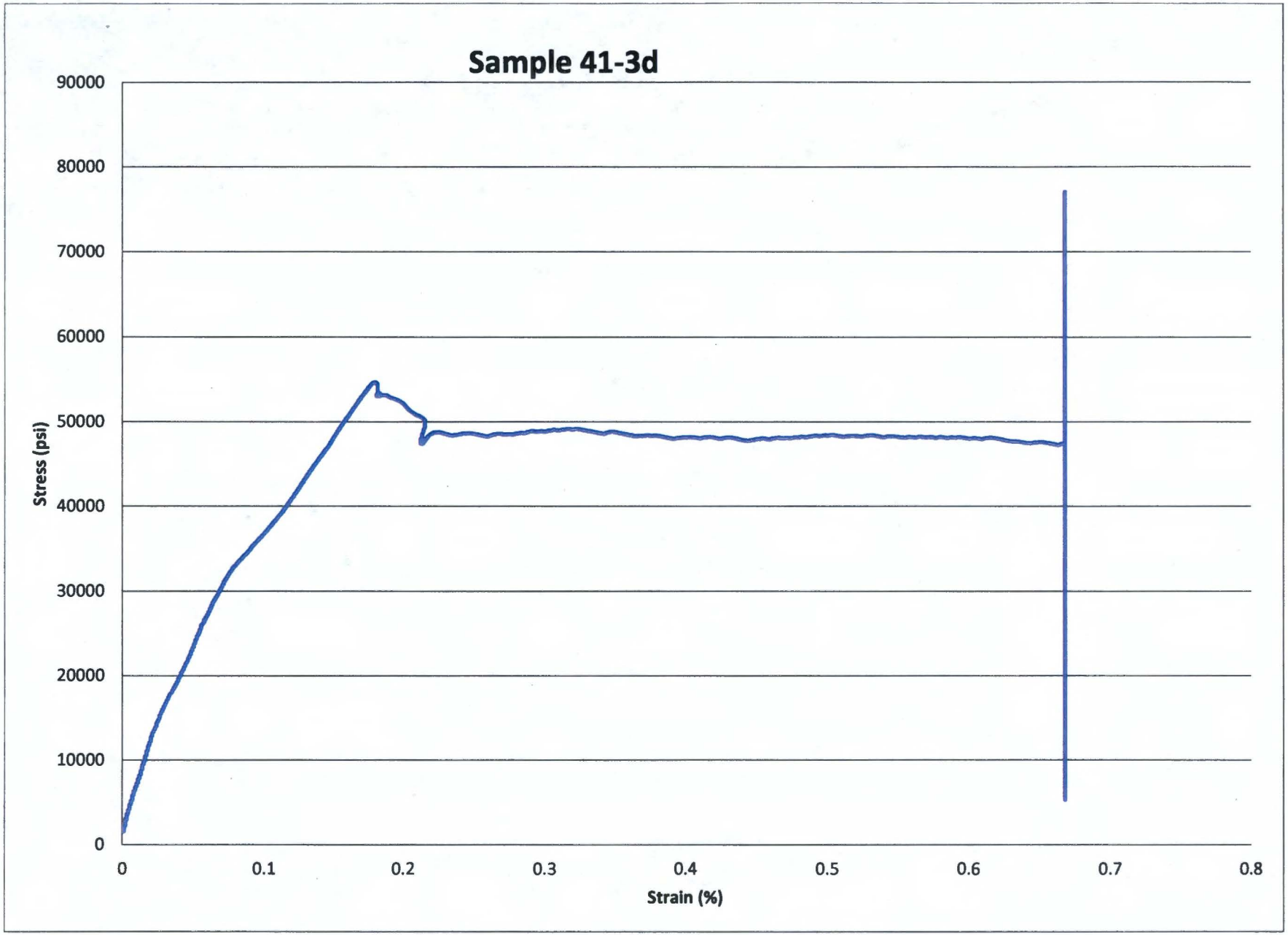

Sample 41-1
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)

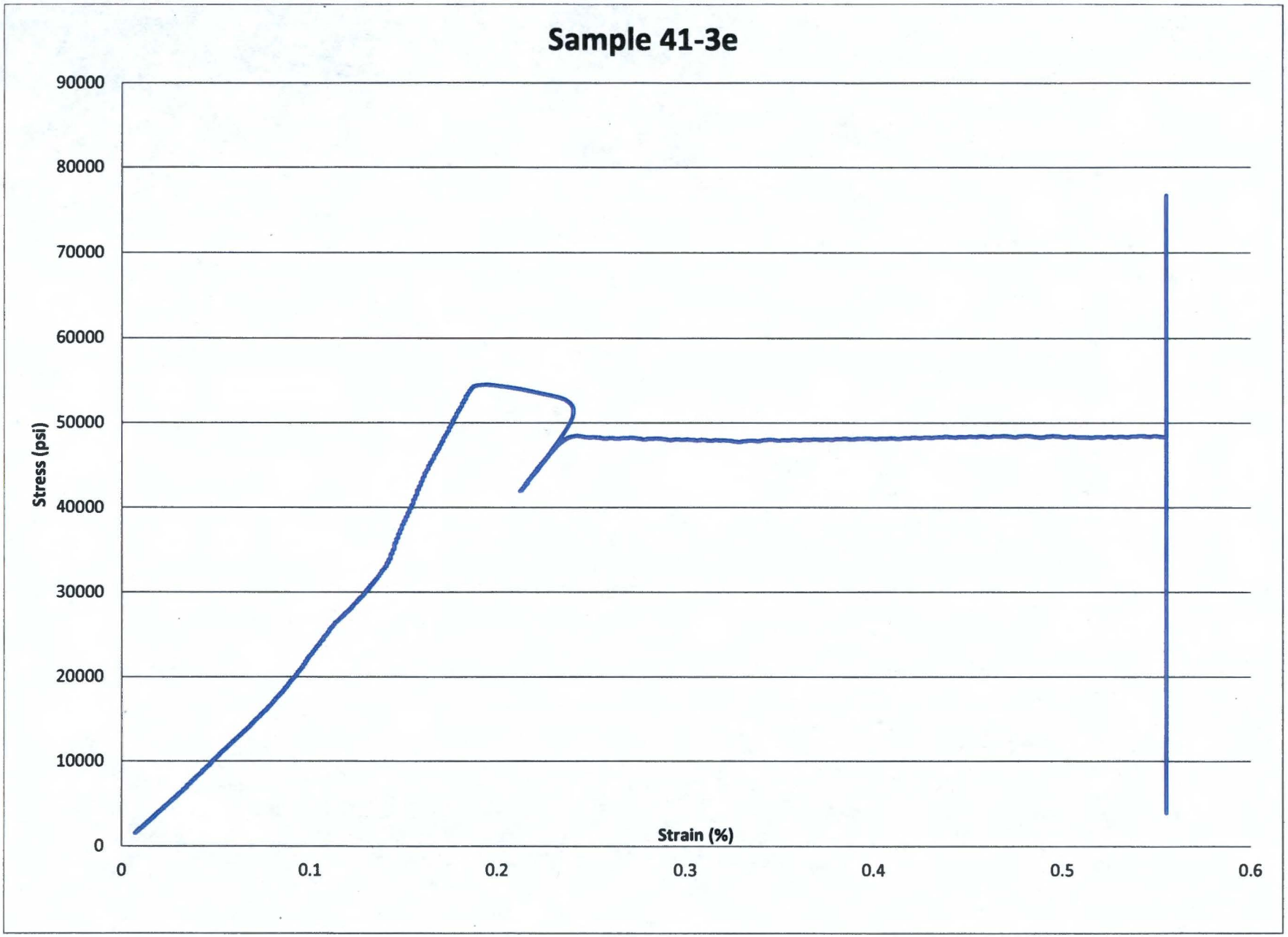

Sample 41-2
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Strain (%)

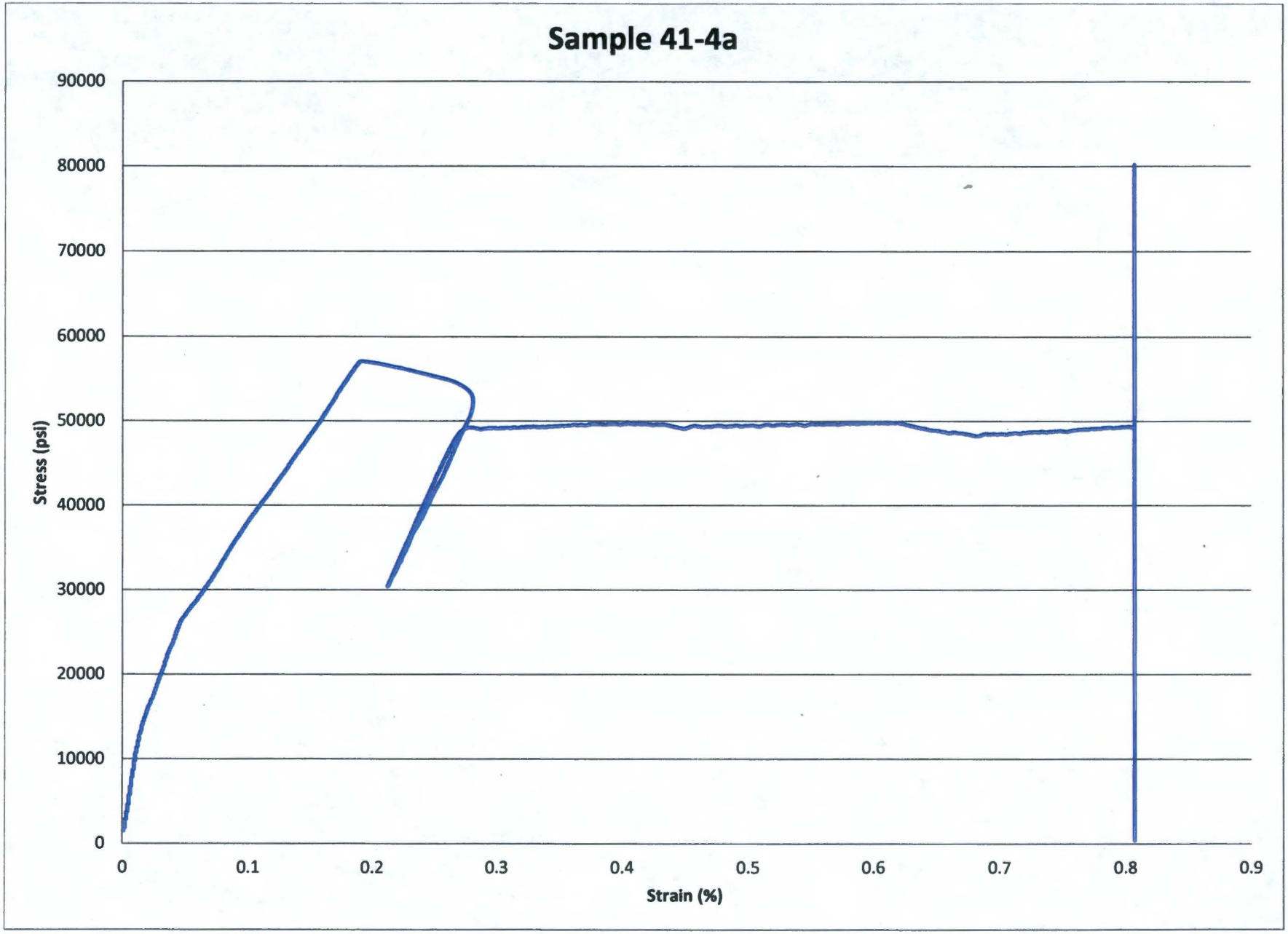

Sample 41-3a
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)

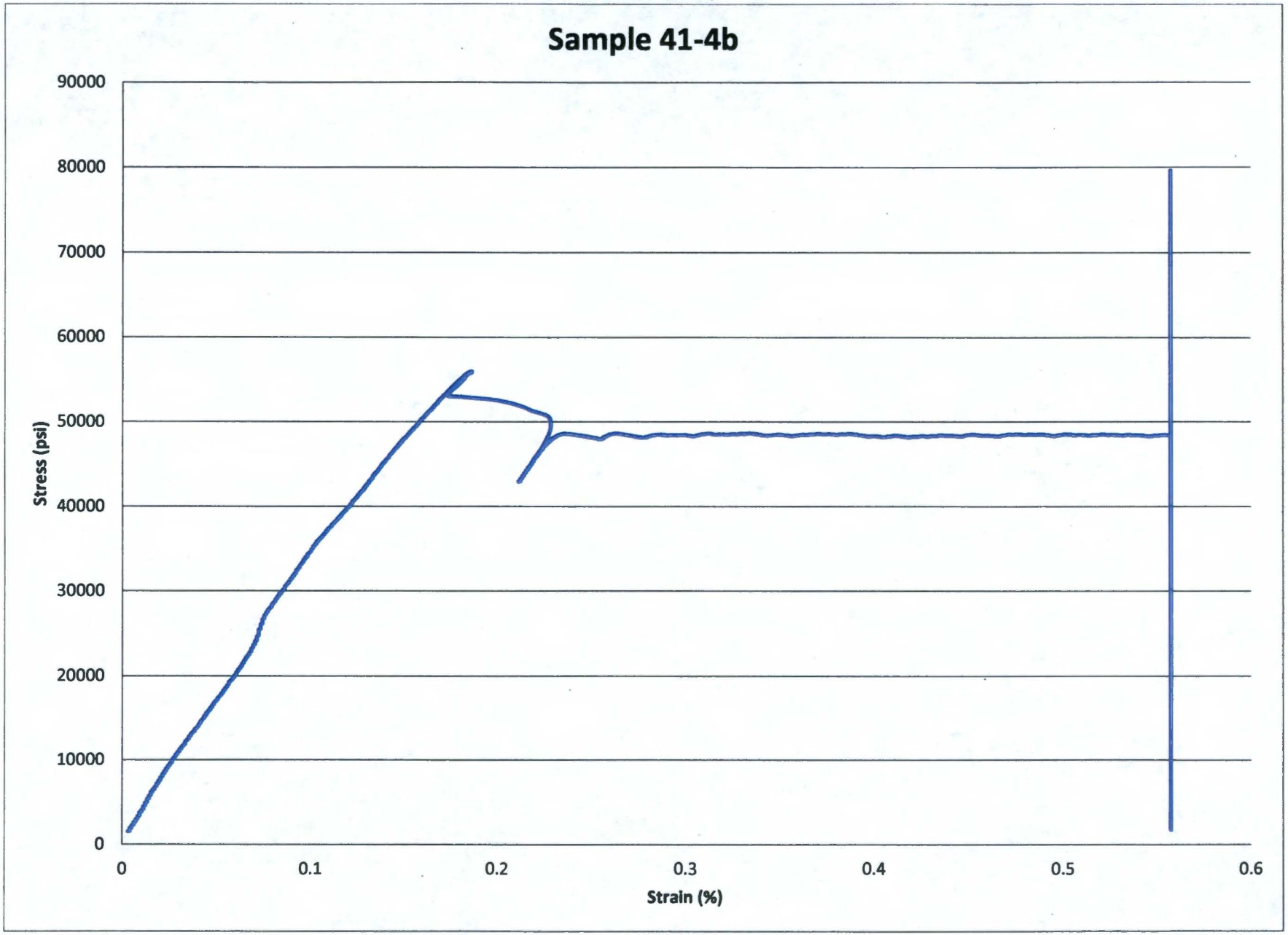

Sample 41-3b
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)

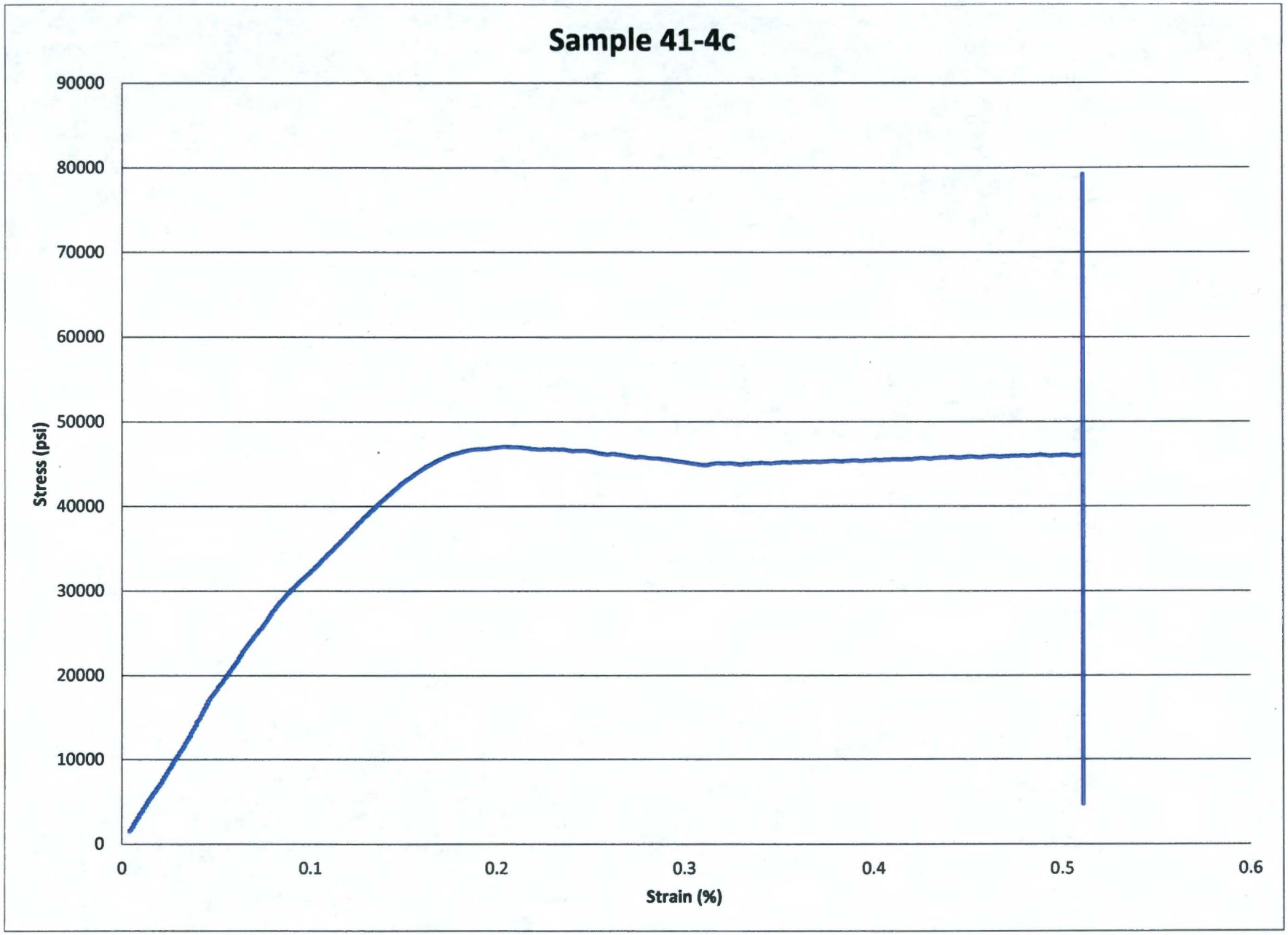

Sample 41-3c
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)

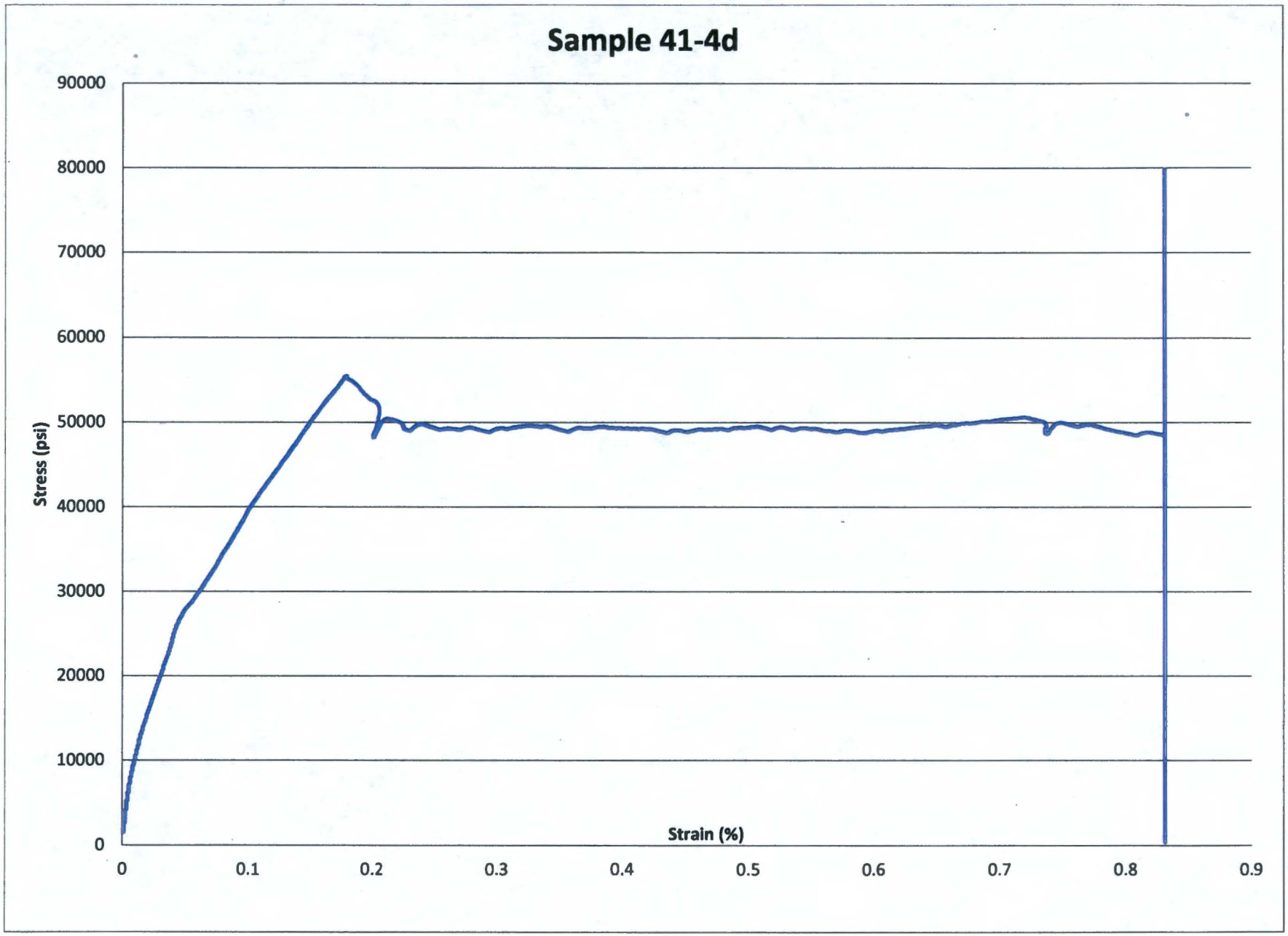

Sample 41-3d
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Strain (%)

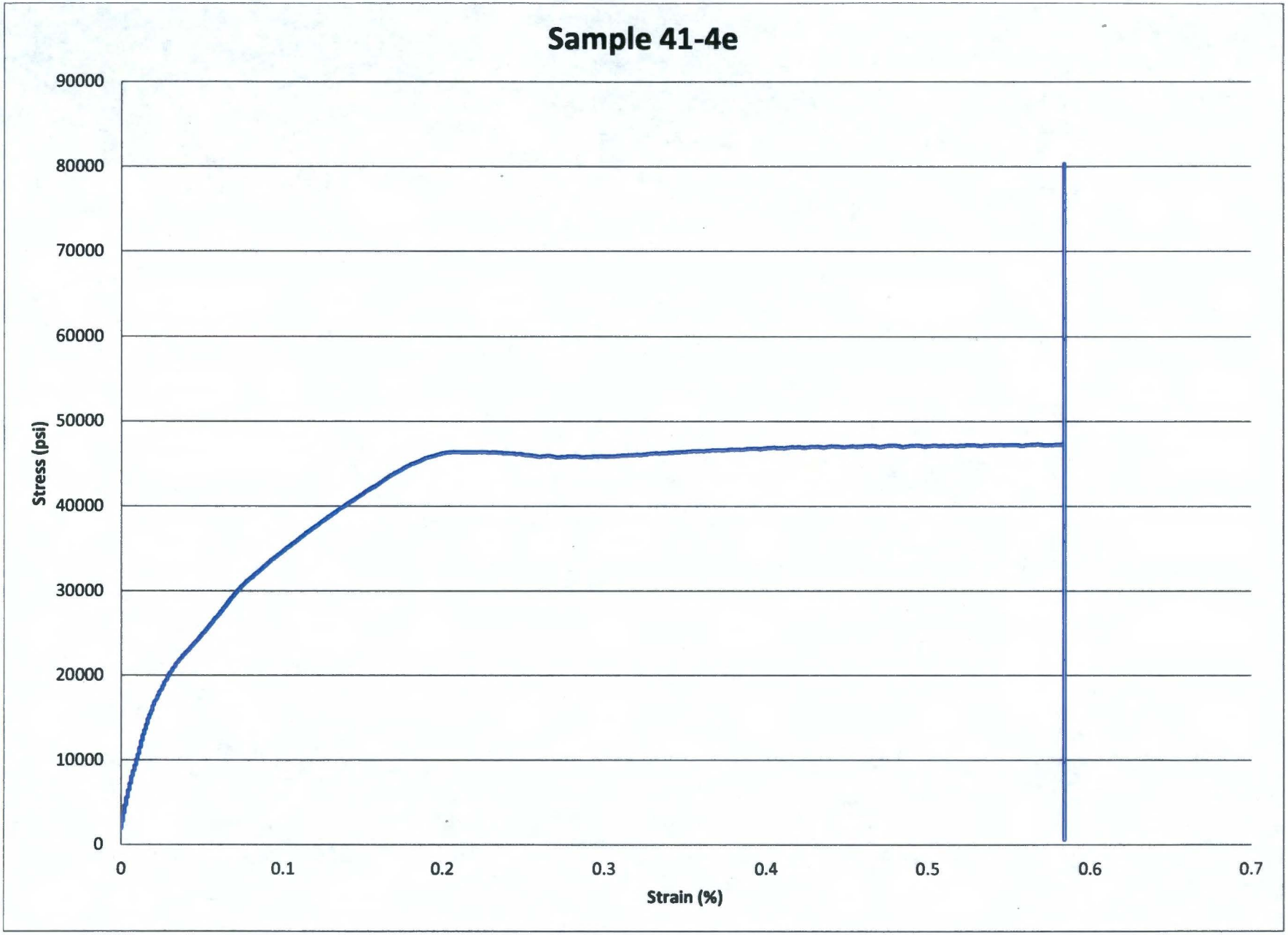

Sample 41-3e
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
Strain (%)
0
0.1
0.2
0.3
0.4
0.5
0.6

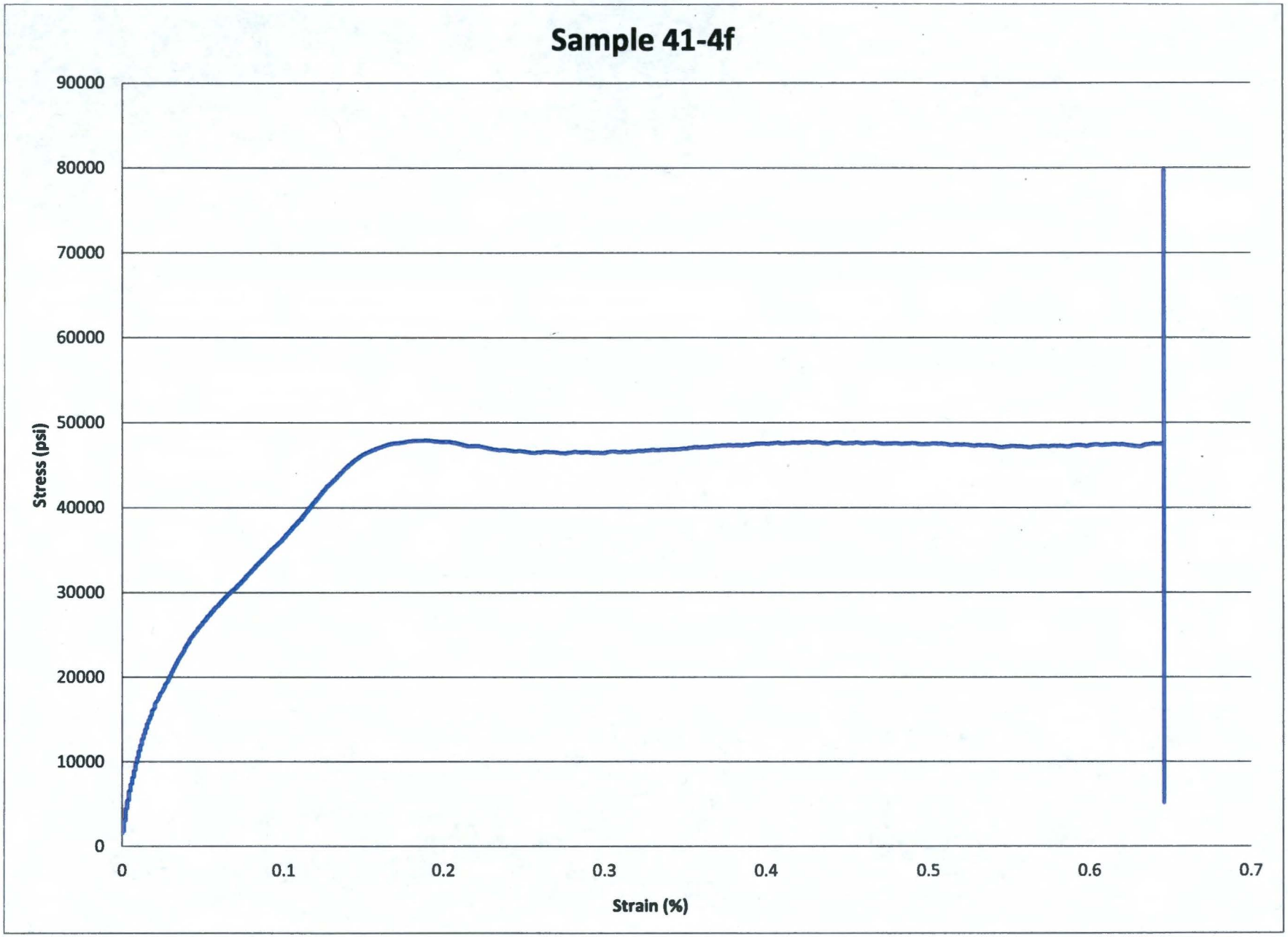

Sample 41-4a
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Strain (%)

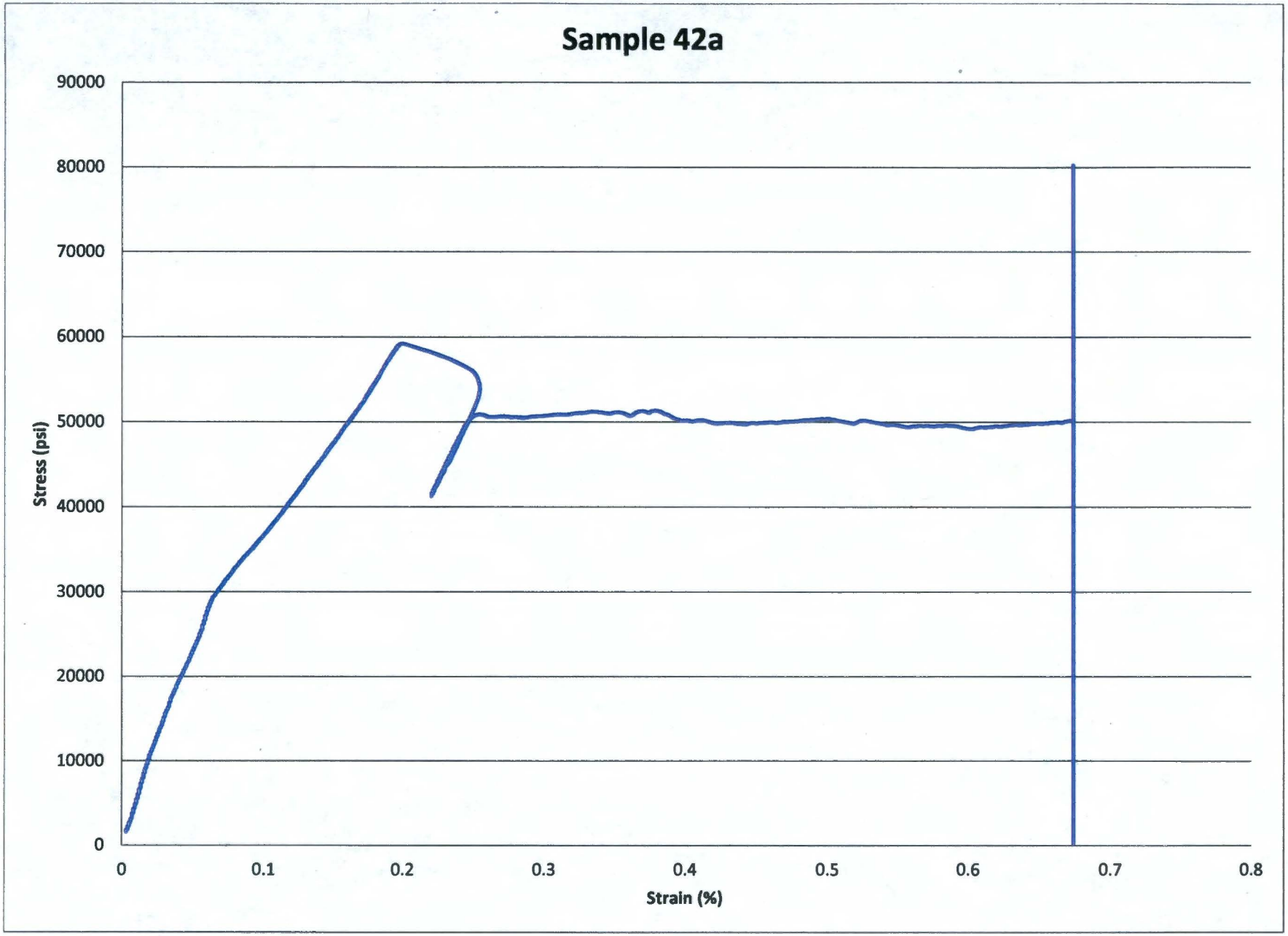

Sample 41-4b
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)

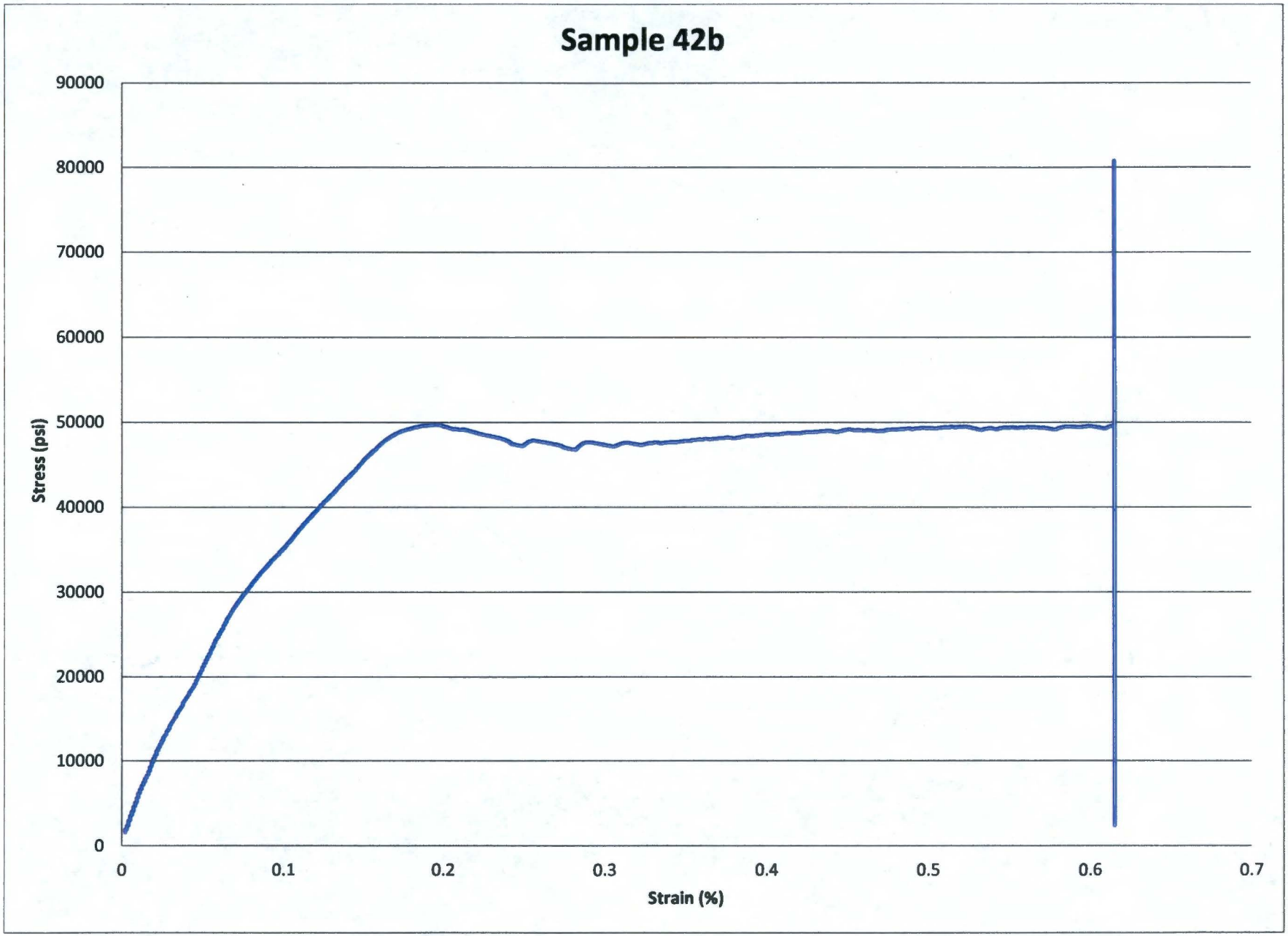

Sample 41-4c
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)

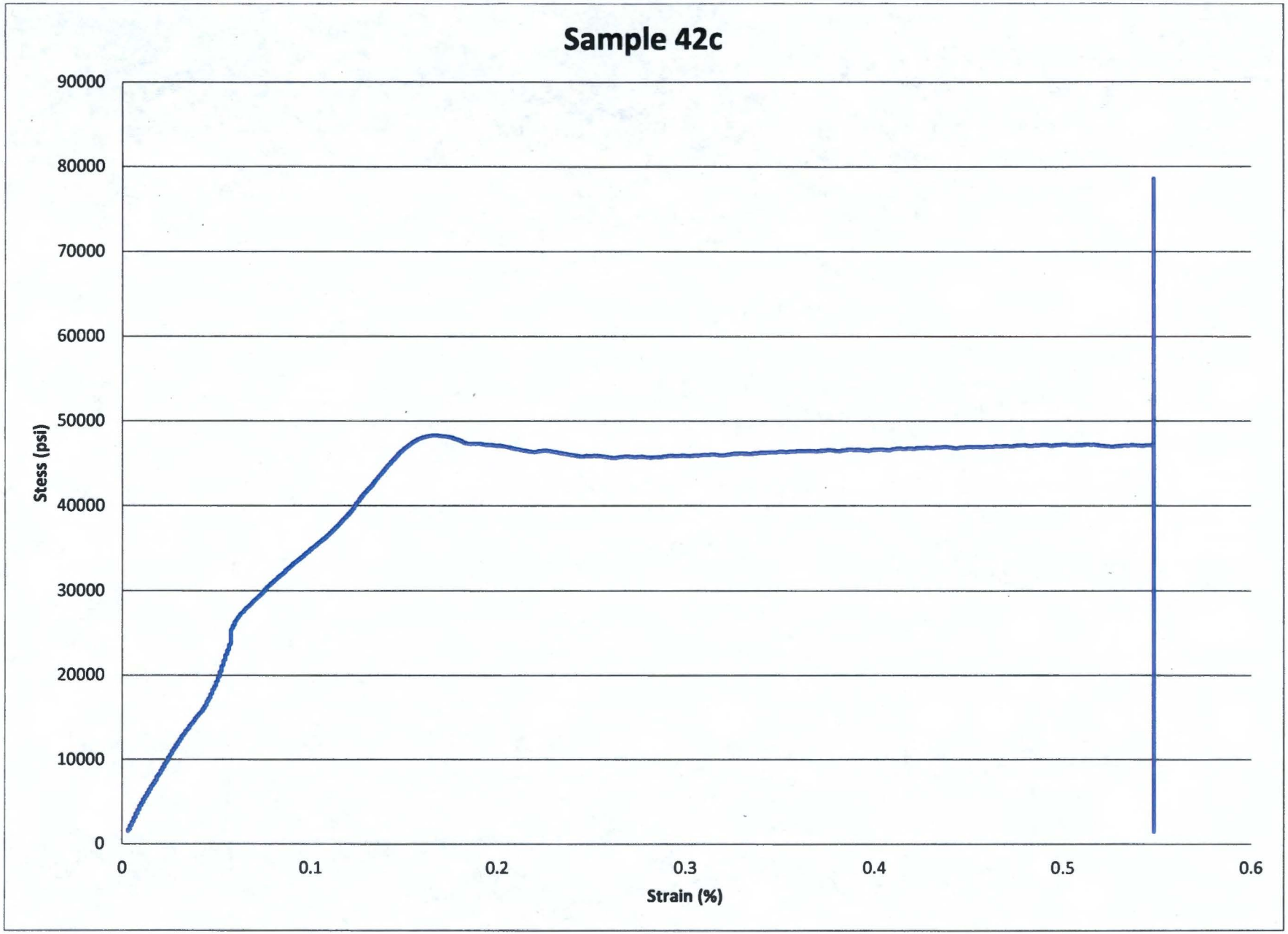

Sample 41-4d
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
Strain (%)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

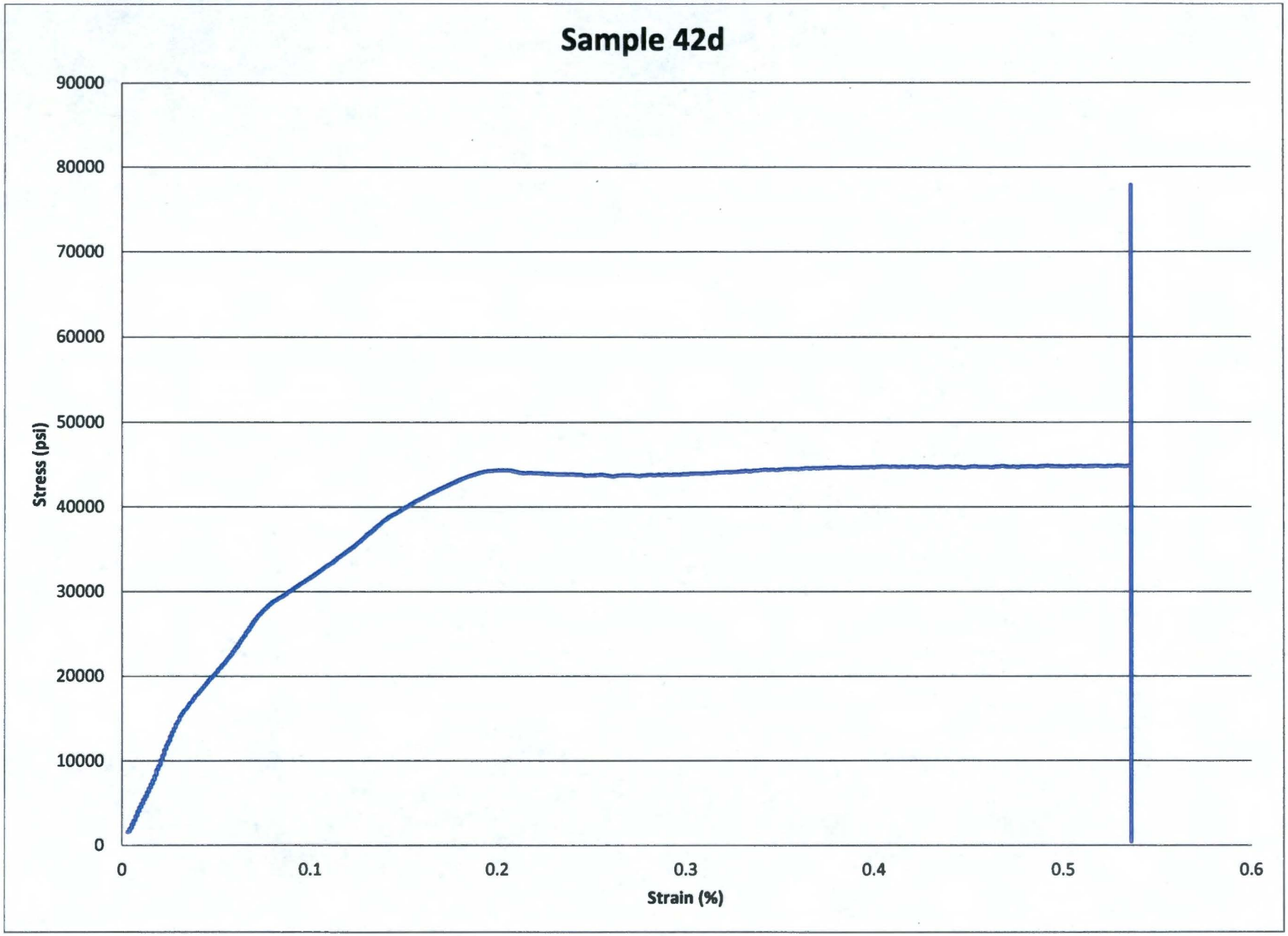

Sample 41-4e
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)

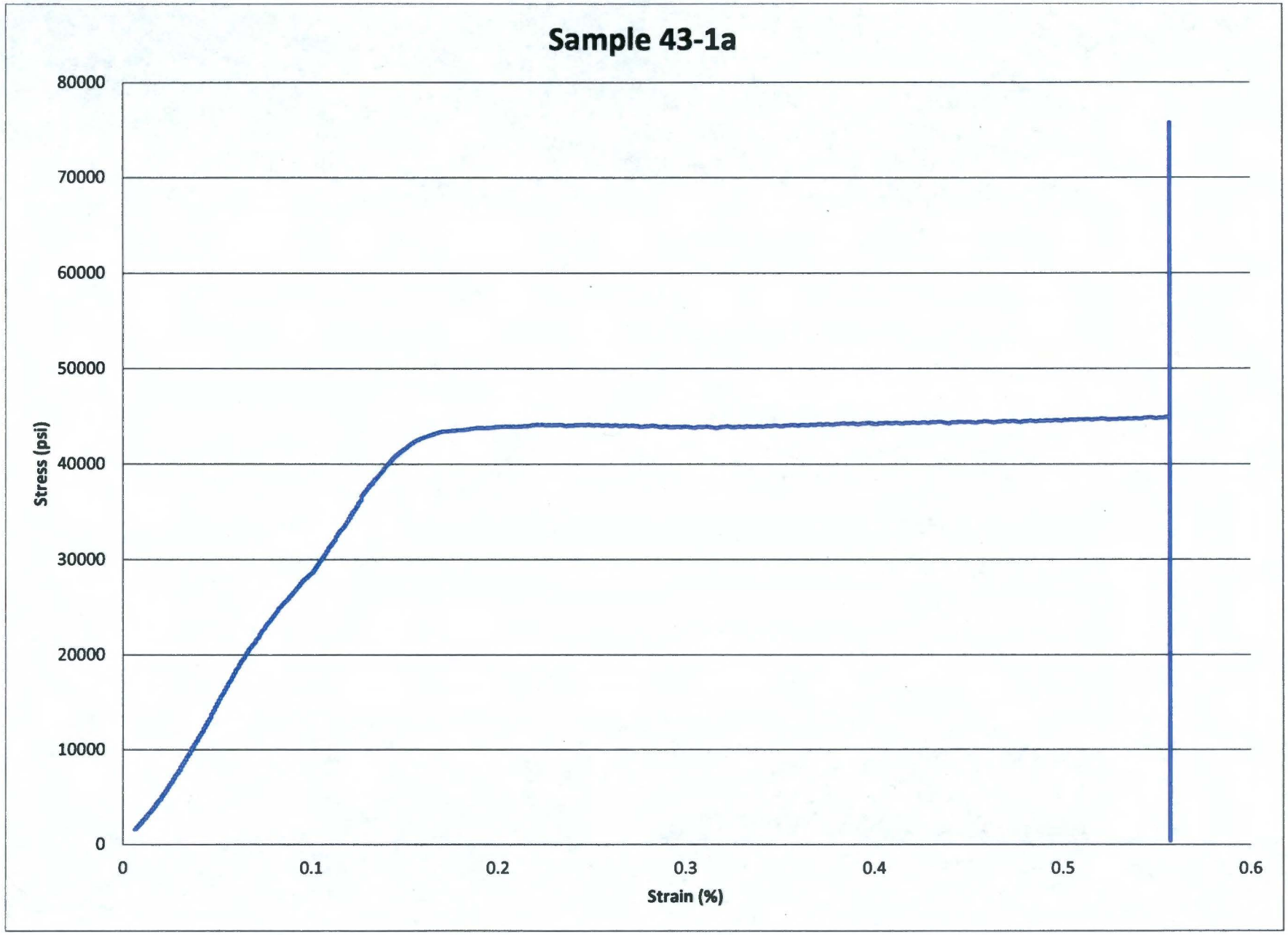

Sample 41-4f
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)

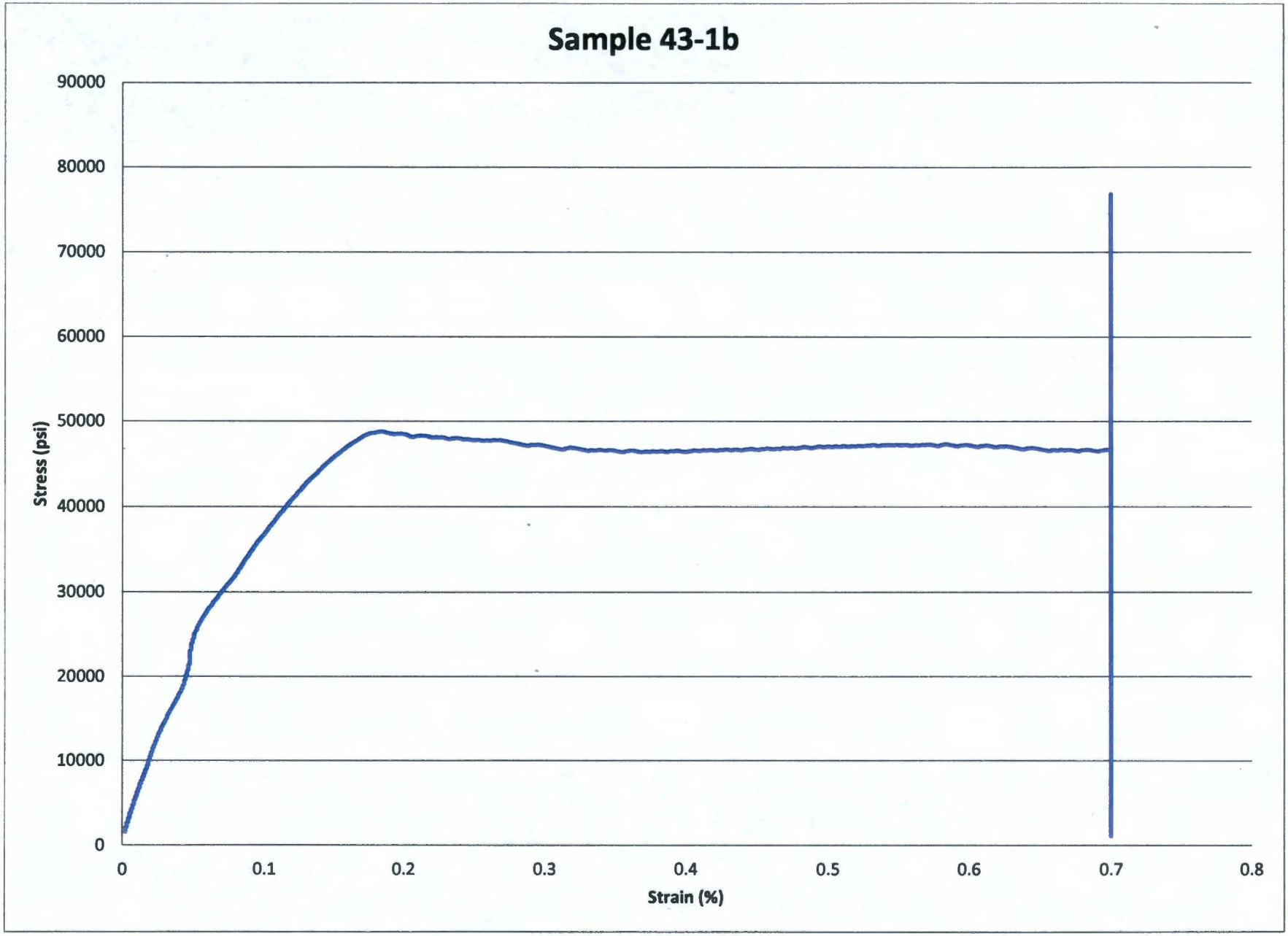

Sample 42a
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Strain (%)

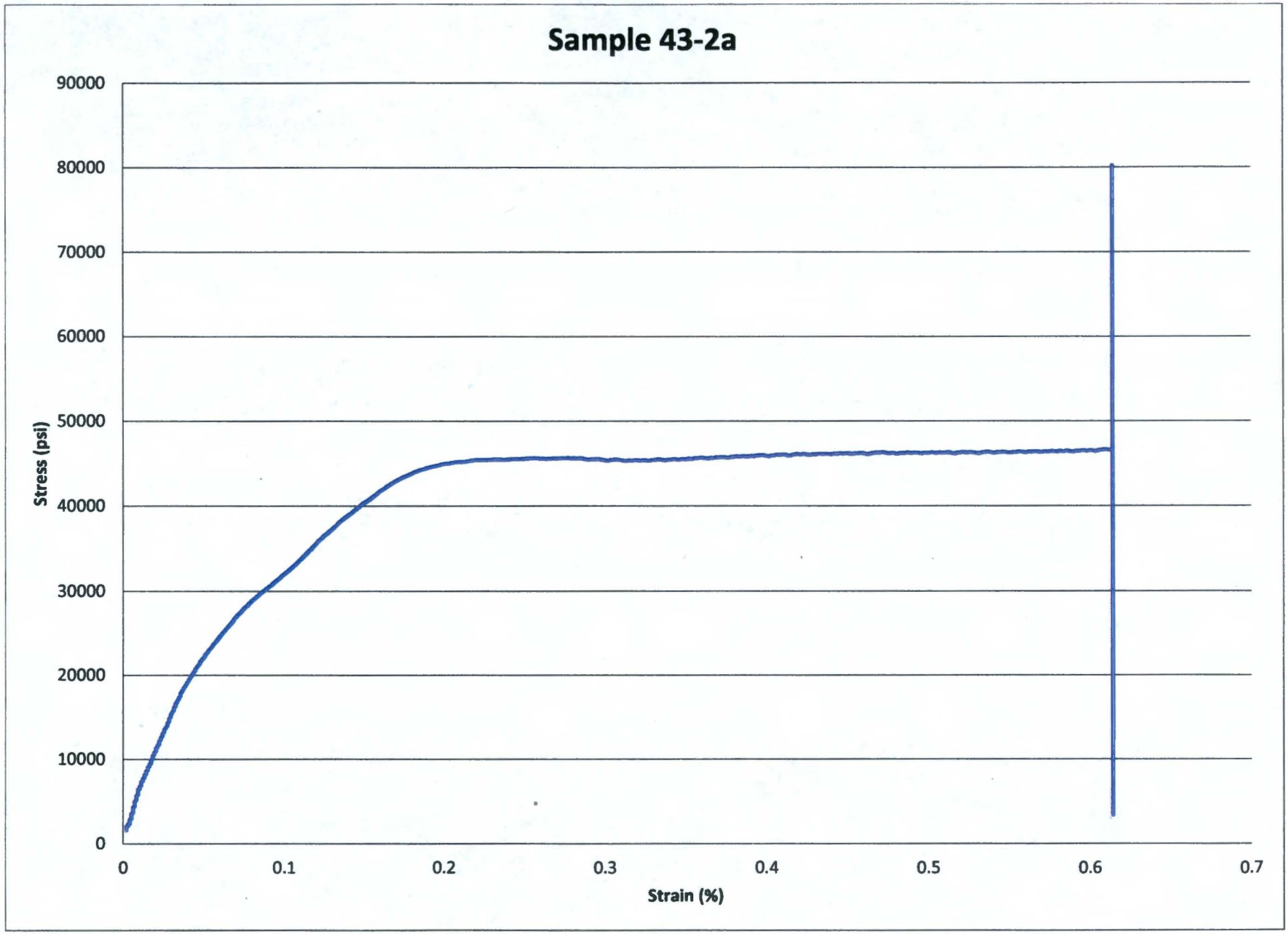

Sample 42b
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)

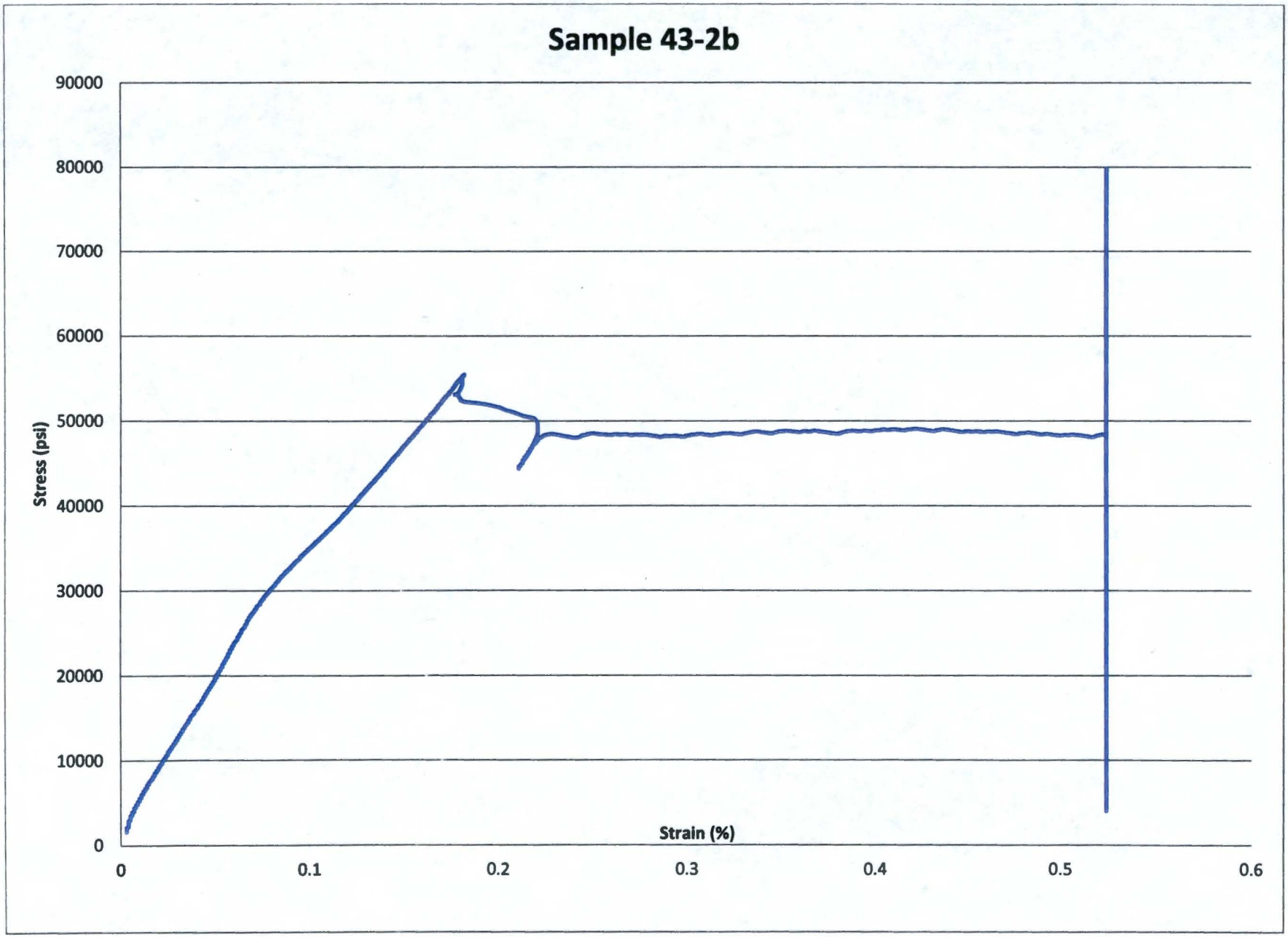

Sample 42c
Stess (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)

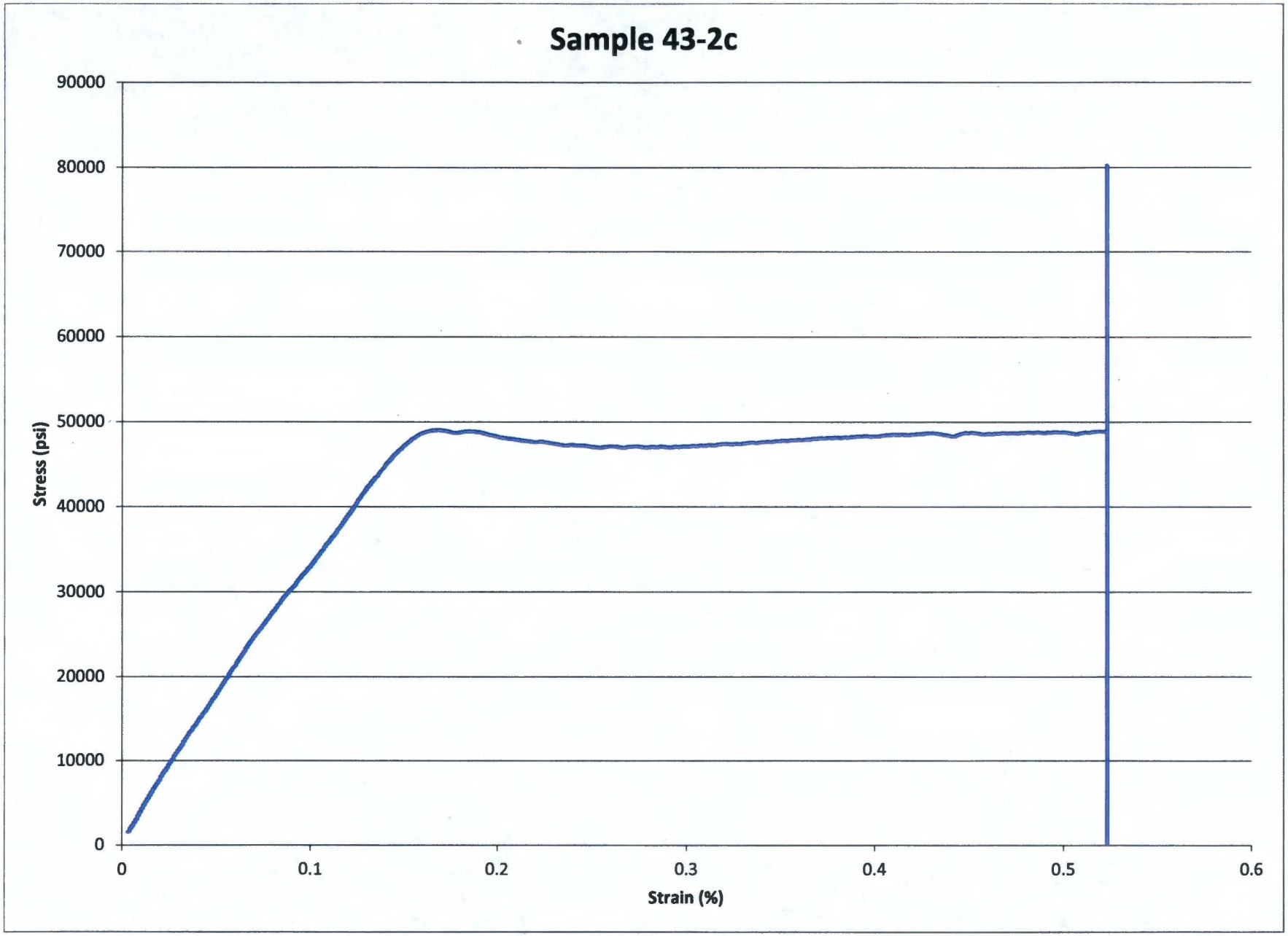

Sample 42d
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)

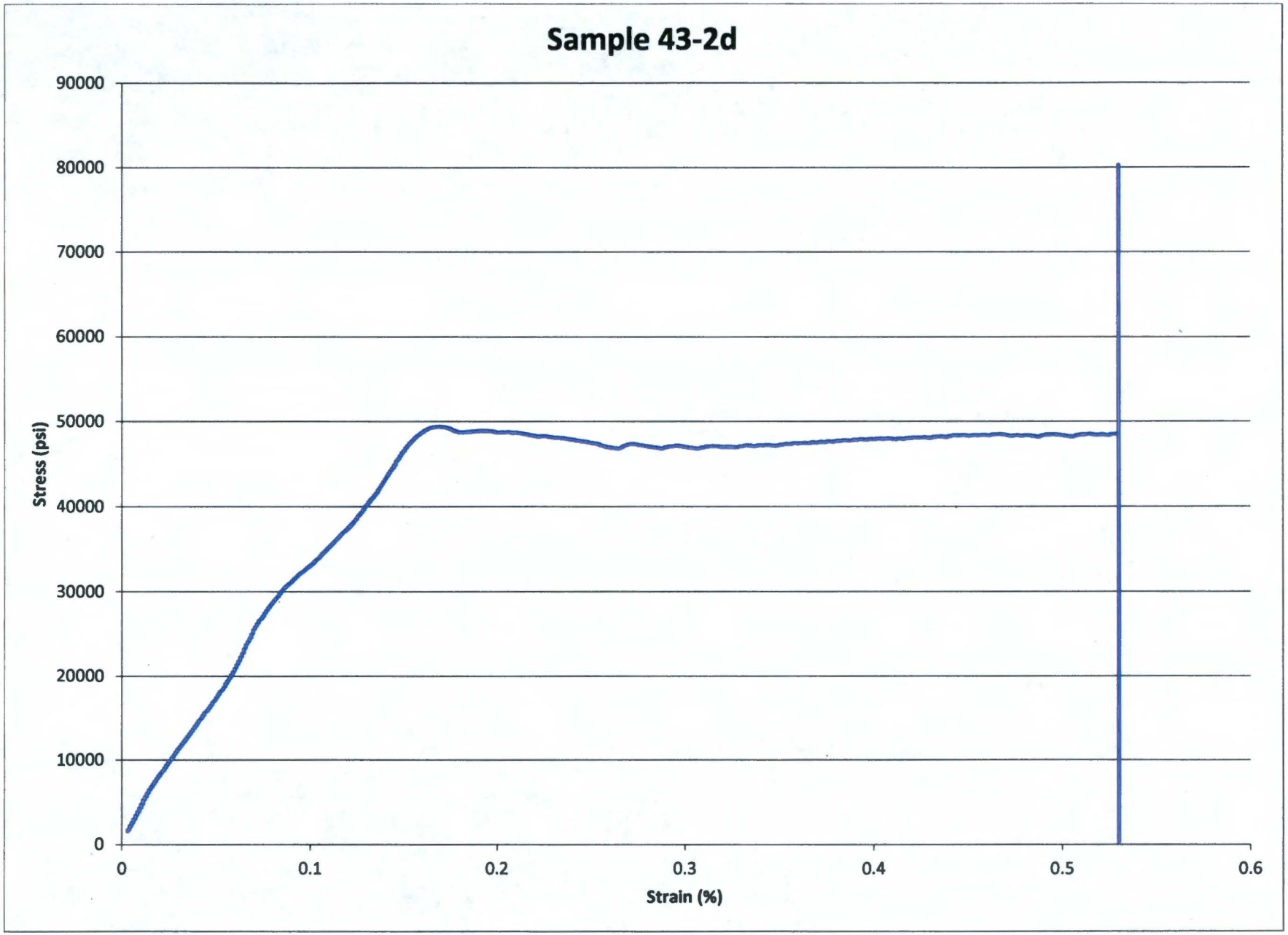

Sample 43-1a
Stress (psi)
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)

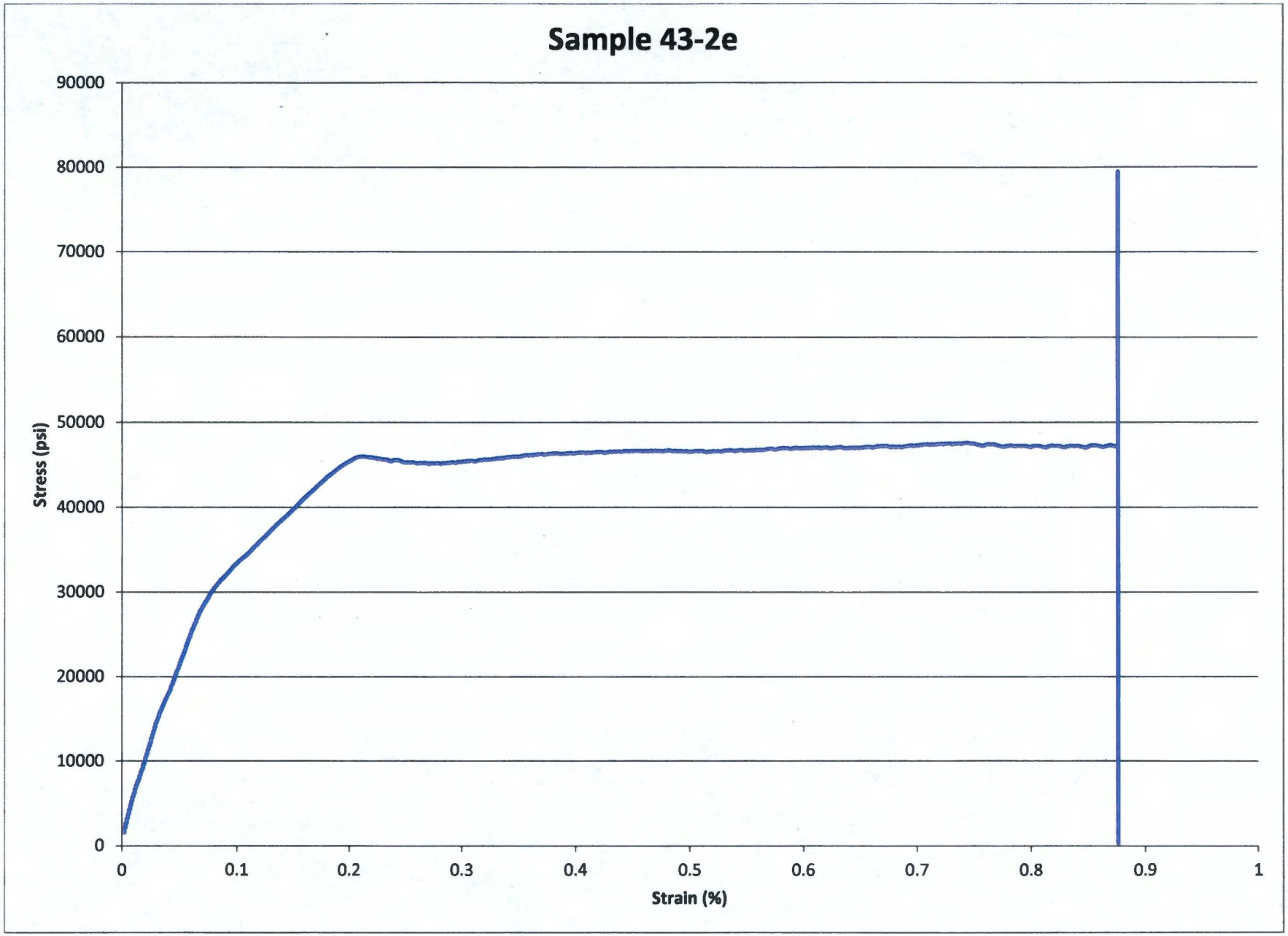

Sample 43-1b
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Strain (%)

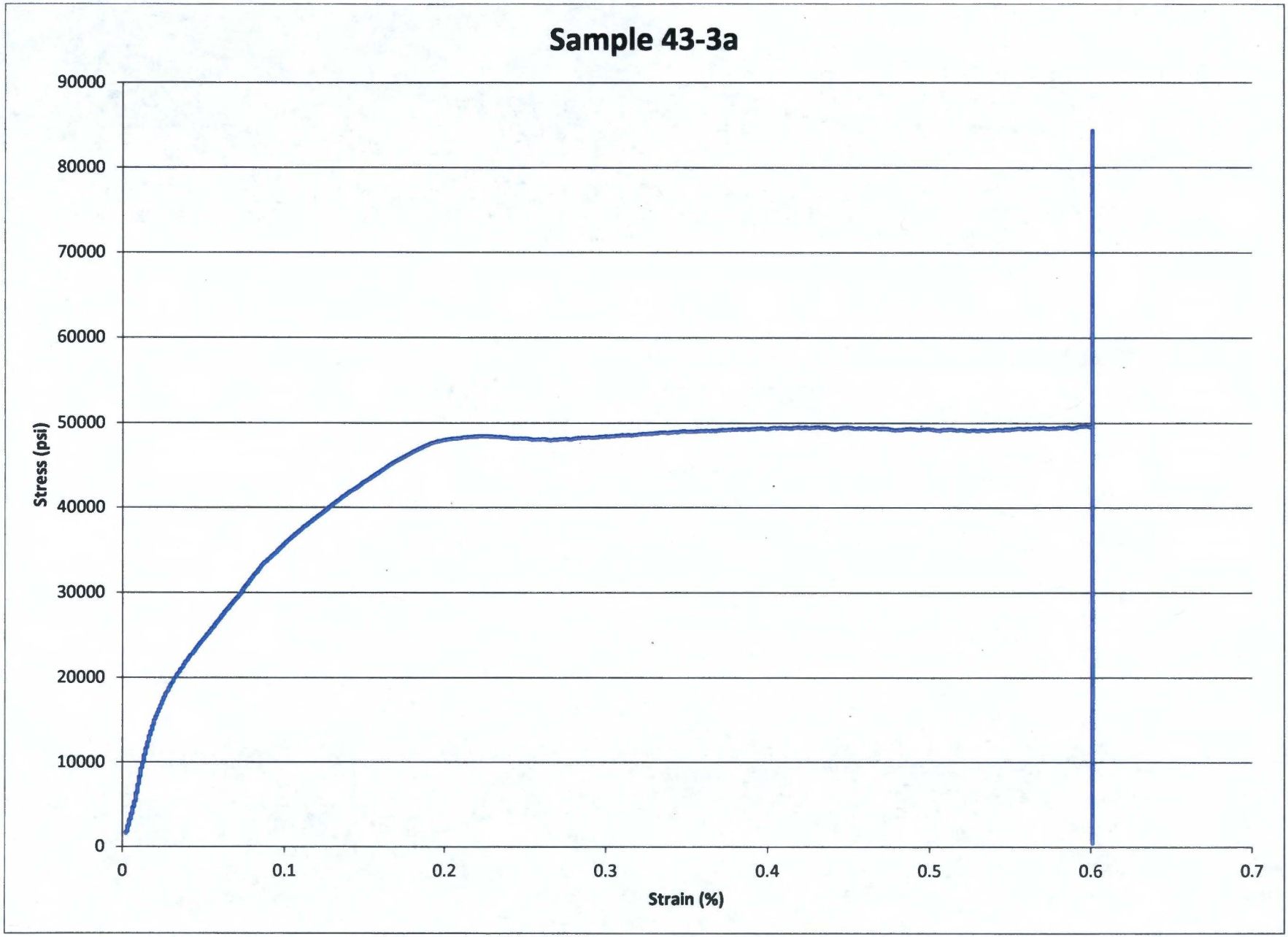

Sample 43-2a
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)

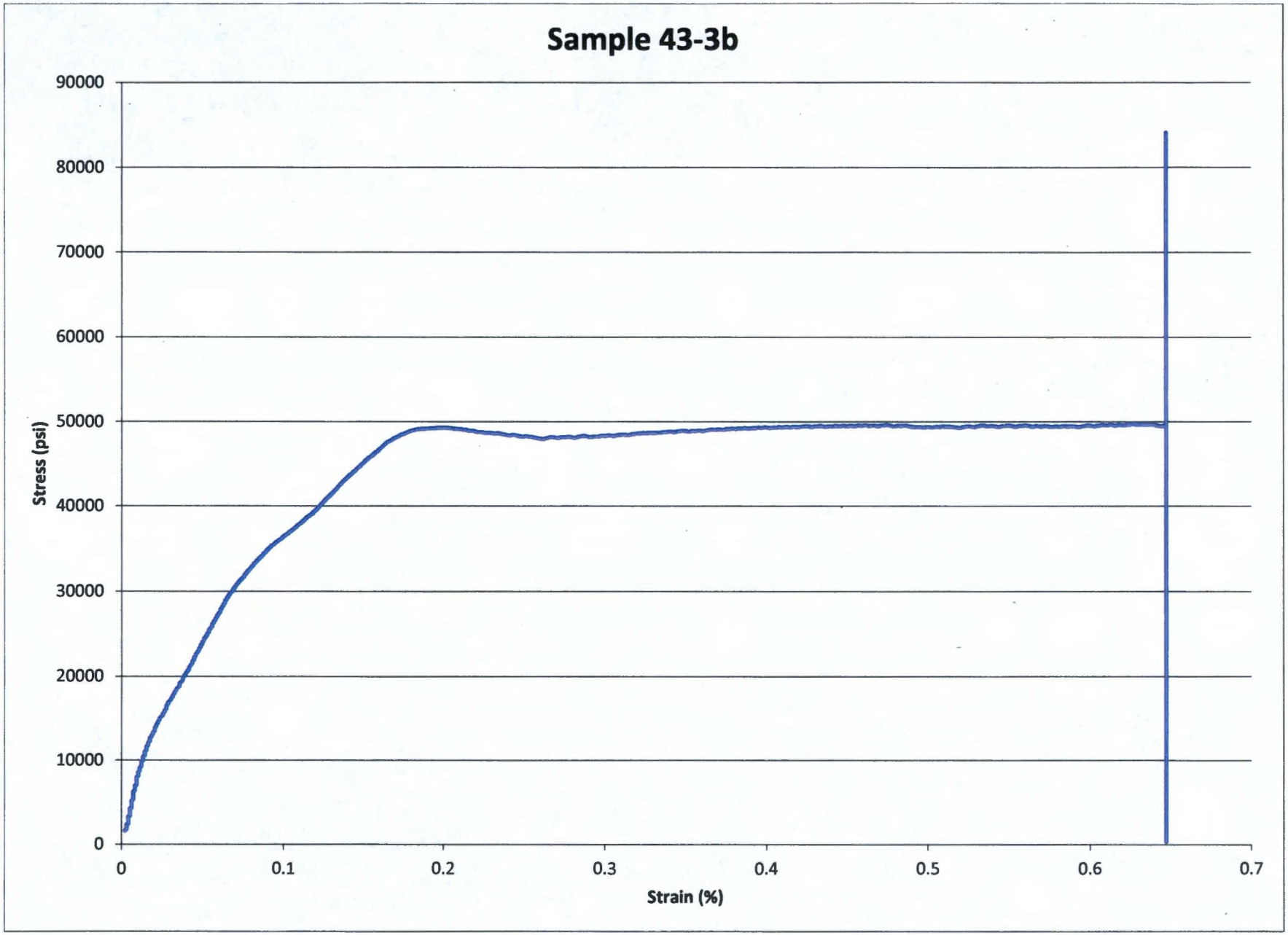

Sample 43-2b
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
Strain (%)
0
0.1
0.2
0.3
0.4
0.5
0.6

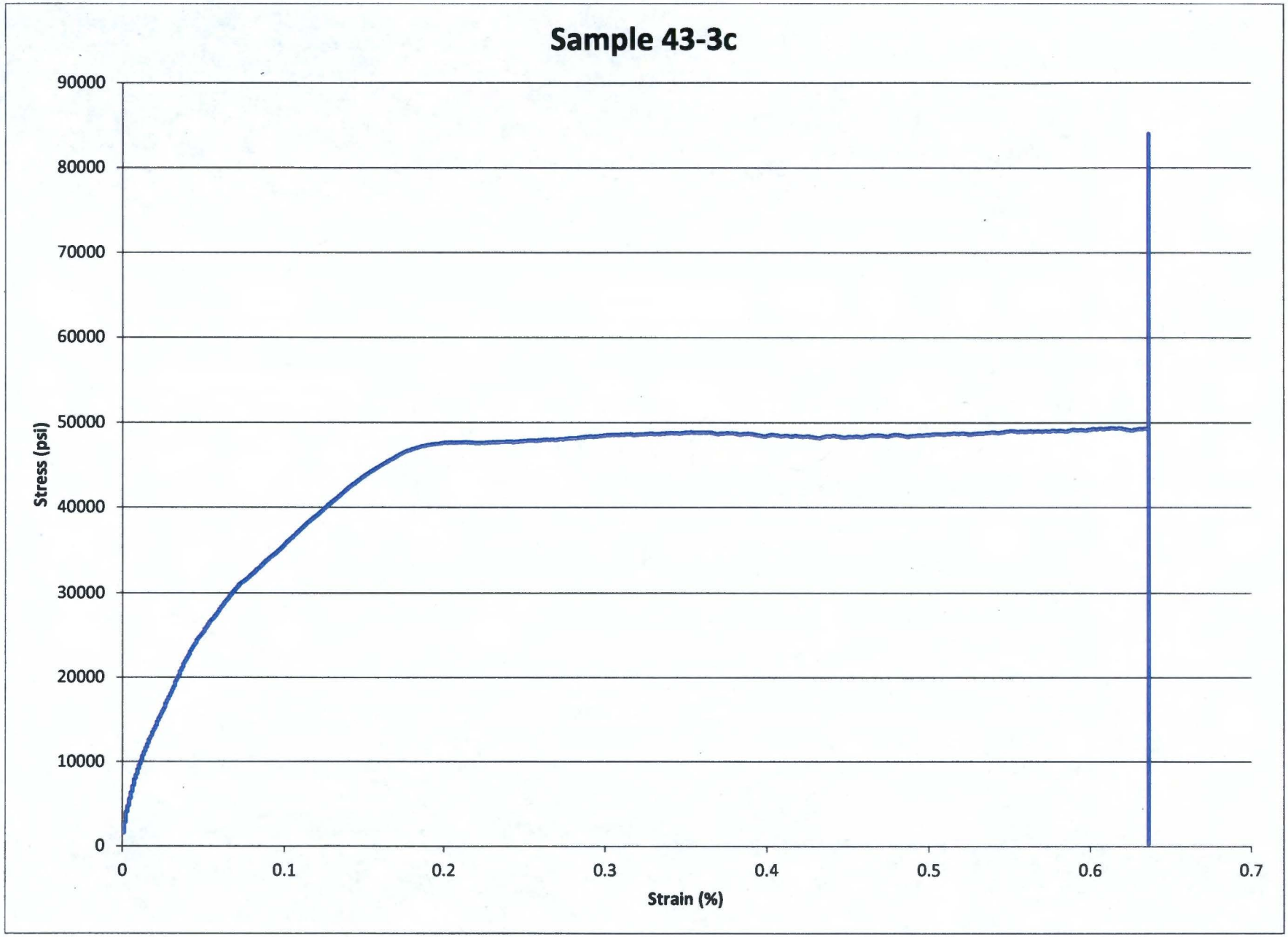

Sample 43-2c
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)

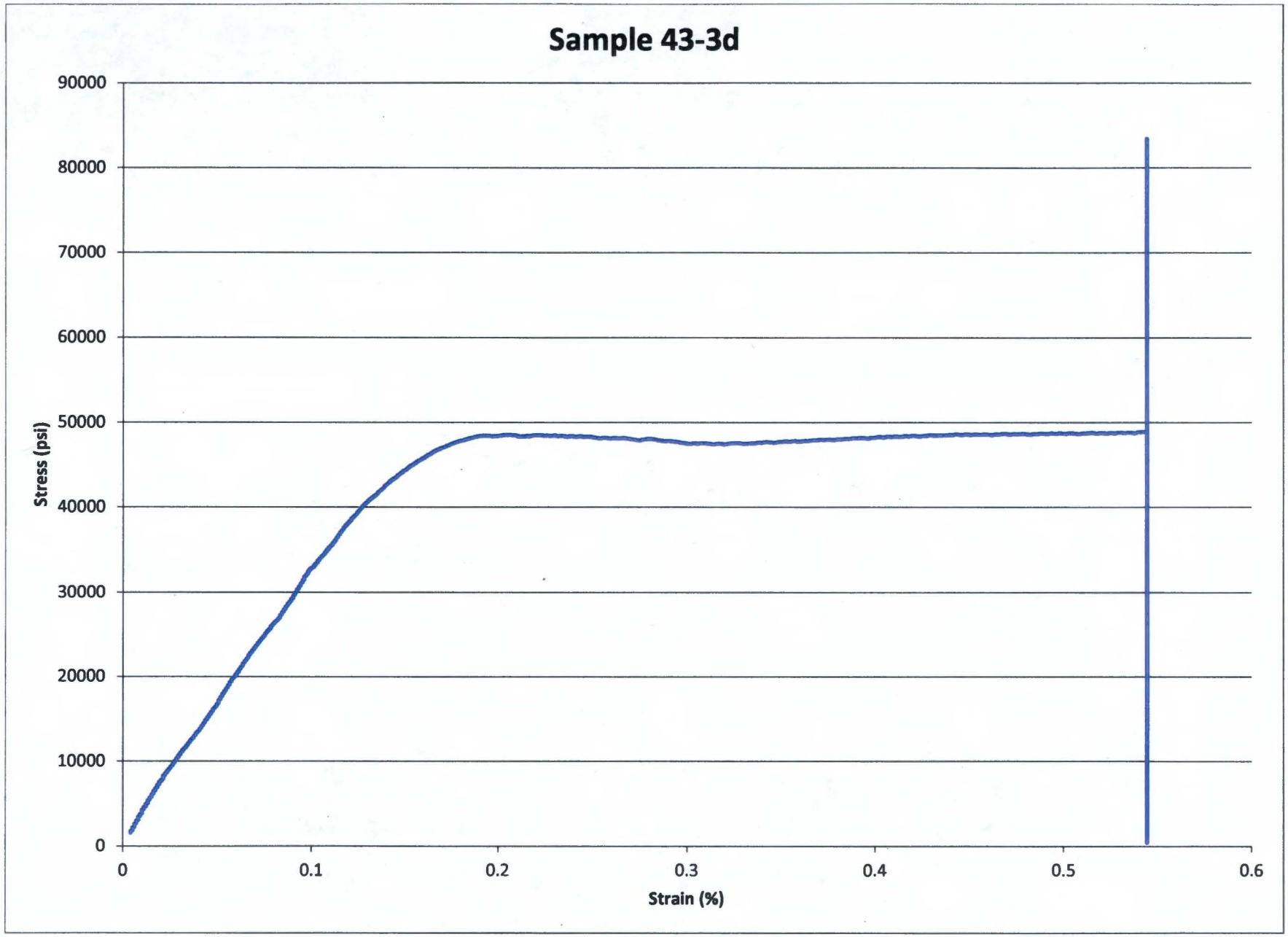

Sample 43-2d
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)

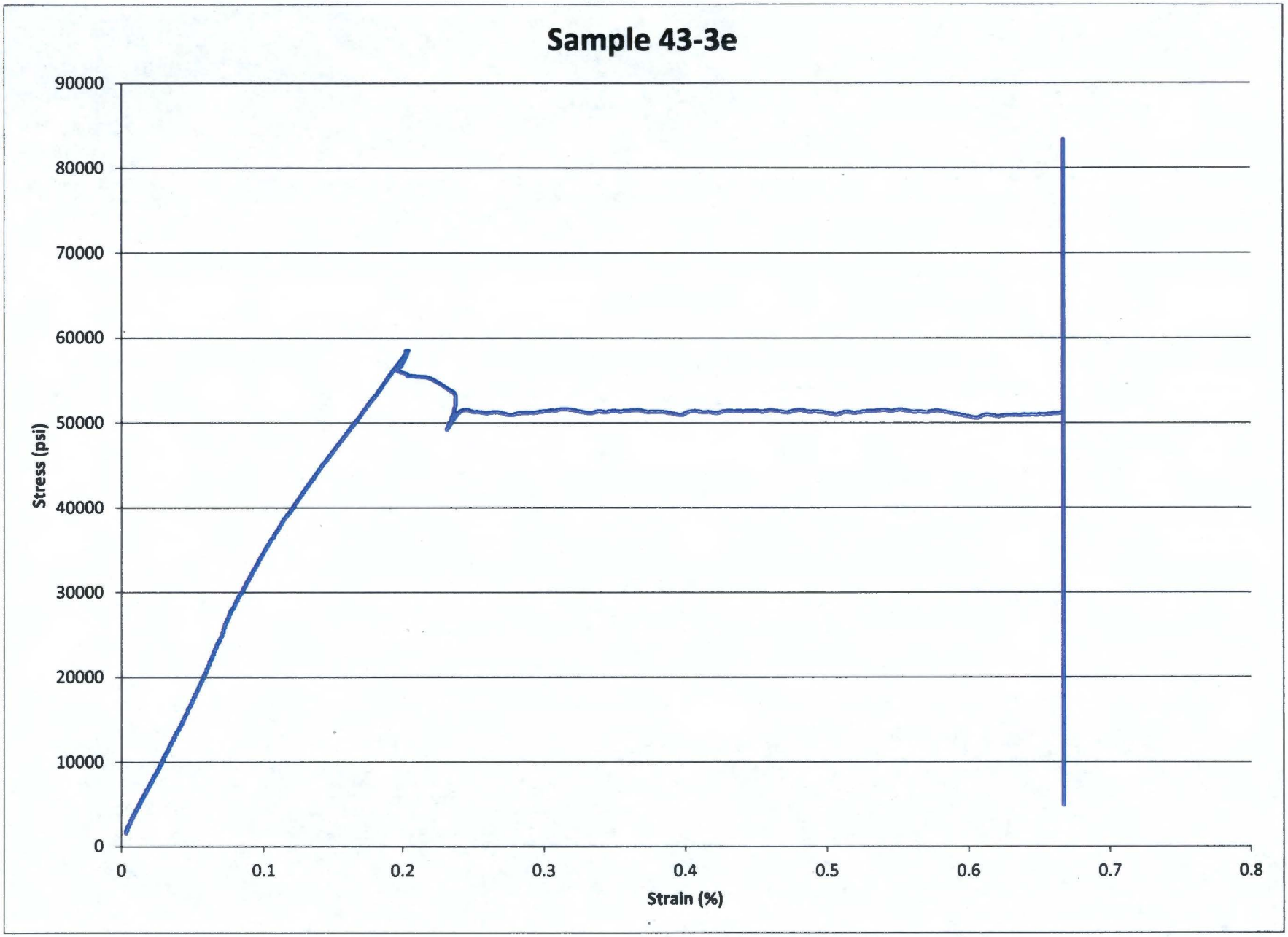

Sample 43-2e
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Strain (%)

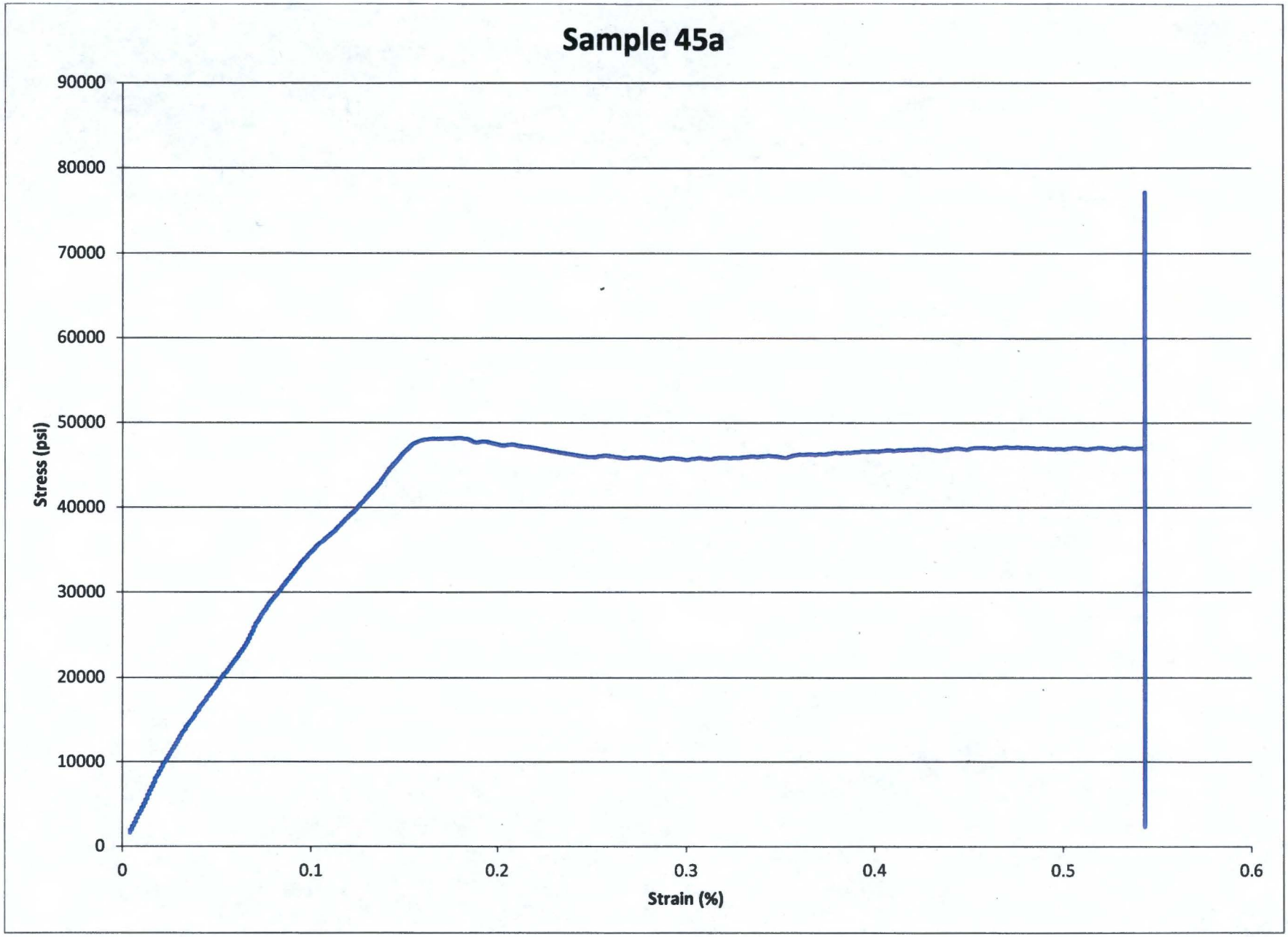

Sample 43-3a
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)

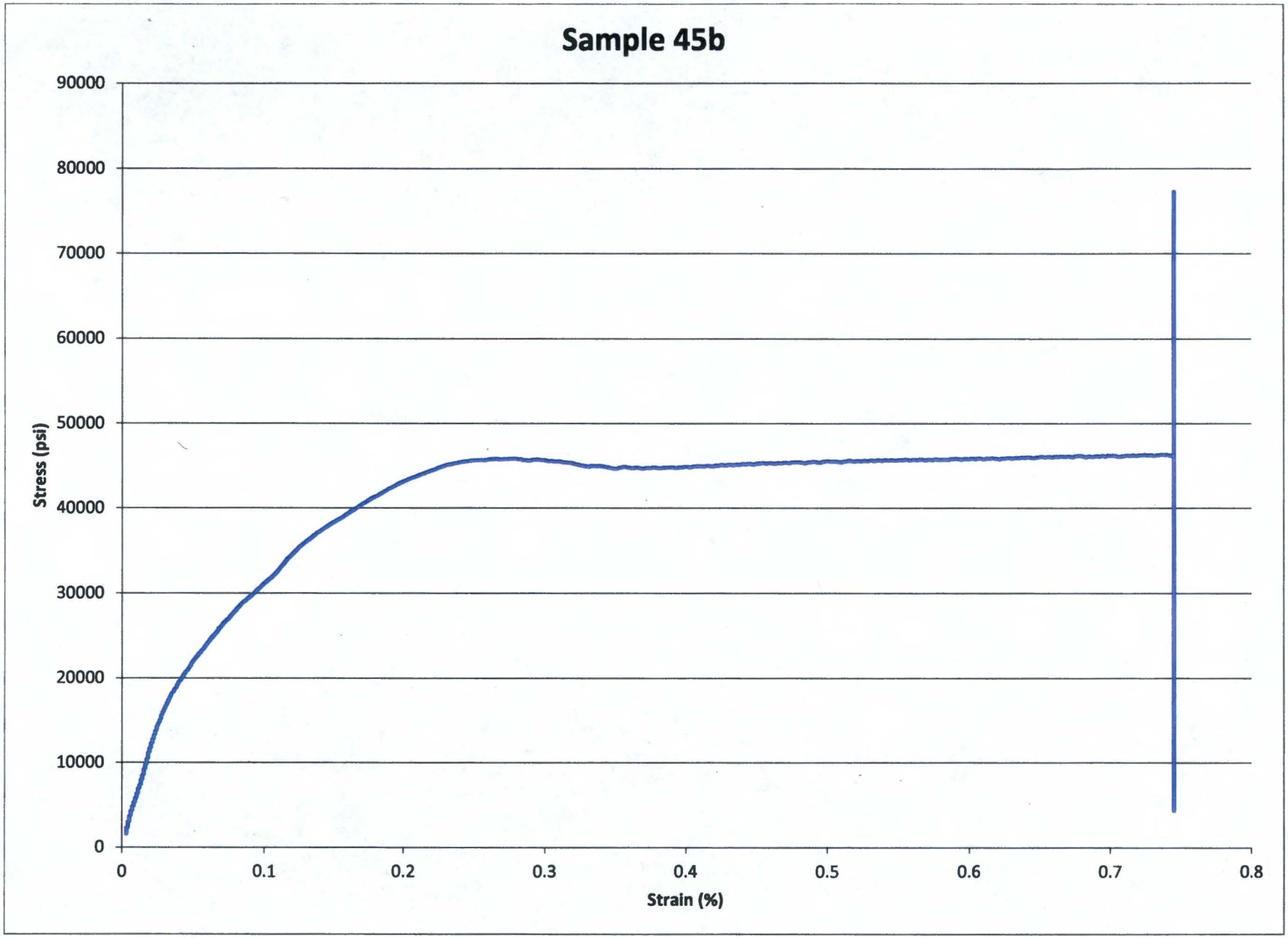

Sample 43-3b
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)

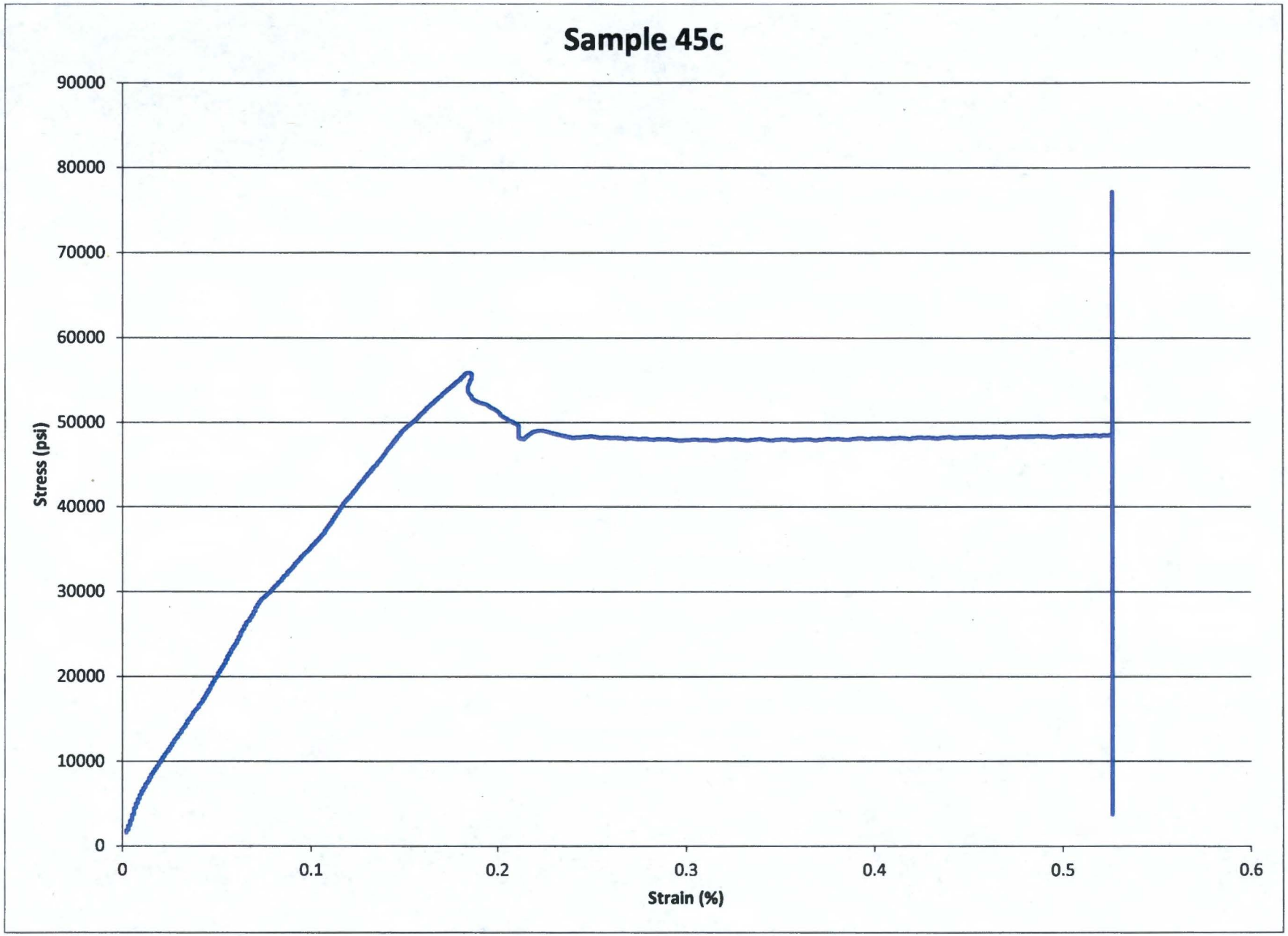

Sample 43-3c
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Strain (%)


Sample 43-3d
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)


Sample 43-3e
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Strain (%)


Sample 45a
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)


Sample 45b
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Strain (%)


Sample 45c
Stress (psi)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Strain (%)

Appendix D

QA Reviewed by
Oct-29-2012

Certificate Of Calibration

Equipment Calibration was performed at the address below for

CTL GROUP
5400 OLD ORCHARD ROAD
SKOKIE, IL 60077-1030

Date of Calibration

Wednesday, October 03, 2012

Calibration Performed By

Cal~Rite Corporation, Naperville, IL

Machine Profile Customer #:

Manufacturer:	*BALDWIN*	**Capacity:**	*400000*	**Next Calibration:**	*03-Oct-2013*
Model:	*BTE*	**Serial #:**	*150054*	**Temp/Humidity:**	*70.0 F/46.0%*

Force Calibration Result Language: Lbs Accuracy 1.0 %

Range	Verified Range Force	Uncertainty %	Maximum Error %
400000.000	40000.000 - 400000.000	0.30	0.18
160000.000	16000.000 - 160000.000	0.30	0.55
16000.000	1600.000 - 16000.000	0.30	0.39

CAL-RITE CORPORATION HAS CALIBRATED THE TESTING EQUIPMENT DESCRIBED ABOVE IN ACCORDANCE WITH THE LATEST SPECIFICATIONS (10-CFR-21, ISO/IEC 17025 AND ISO 10012-1 AND MIL-STD 45662A). ALL VERIFICATION DEVICES CALIBRATED IN ACCORDANCE WITH ASTM-E74 PRACTICES AND ARE TRACEABLE TO NIST. THIS CERTIFICATE RELATES ONLY TO THE ITEMS CALIBRATED.

THE UNCERTAINTY OF THE CALIBRATION PROCESS WAS ESTIMATED AT THE 95% CONFIDENCE LEVEL (K=2).
THE EQUIPMENT LISTED ABOVE HAS MET ALL APPLICABLE CLAUSES OF THE GOVERNING SPECIFICATION UNLESS NOTED BELOW.

- ☐ 10.1 Lower Limit below 200X Resolution
- ☐ 10.3 Less than 5 readings taken below 10% FS
- ☐ 10.5 Does not return to zero in 30 seconds
- ☐ 18.3 Does not meet +/- 1 % accuracy requirement.

Specification: **ASTM E 4-10**

Calibration Procedure: **CR100 Rev 14**

ACCREDITED
Certificate # 866.01
Calibration

Service Order #: ***12780 - 3***

11/9/2012

SERVICE ENGINEER ***DATE***

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.

STDM 01-12 Page 1 of 2 Customer PO #: 50158B.

Cal~Rite Corporation

1665 QUINCY AVENUE, UNIT 123, NAPERVILLE, IL 60540
P 630.355.1522 F 630.355.1544 WWW.CAL-RITE.COM

ACCREDITED
Certificate # 866.01
Calibration

REPORT OF CALIBRATION

CTL GROUP
5400 OLD ORCHARD ROAD
SKOKIE, IL 60077-1030

Calibration Date: 03-Oct-2012
Next Calibration: 03-Oct-2013
Customer #:
Temp/Humidity: 70.0 F/46.0%

Manufacture: BALDWIN
Model: BTE
Indicator: DIAL

Capacity: 400000
Serial #: 150054
Shunt #: N/A

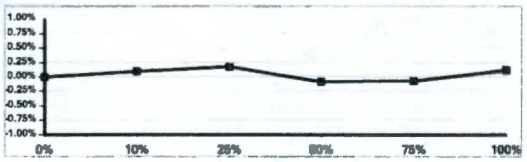
Test Direction: COMPRESSION
External Cell: N/A
Temp Variance: 1.1

Range: 400000 Lbs **Resolution:** 125.00000 **Accuracy +/-:** 1.0 %

FS %	Reading	As Found	As Adj.	As Left	Repeatability %	Max Error	Error %
0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
10.00	40,000.00	40,038.583	0.000	40,002.573	0.090	38.583	0.096
25.00	100,000.00	100,176.488	0.000	100,066.524	0.110	176.488	0.176
50.00	200,000.00	199,888.657	0.000	199,838.669	0.025	-161.331	-0.081
75.00	300,000.00	299,819.523	0.000	299,799.526	0.007	-200.474	-0.067
100.00	400,000.00	400,469.114	0.000	400,419.117	0.012	469.114	0.117

Zero Return: 0.00 % 0.00 % 0.00 %

Linearity Profile (Percent Full Scale)

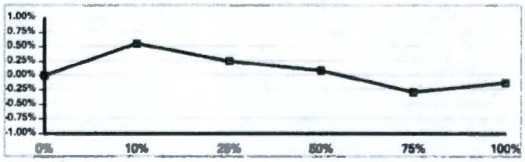


Range: 160000 Lbs **Resolution:** 50.00000 **Accuracy +/-:** 1.0 %

FS %	Reading	As Found	As Adj.	As Left	Repeatability %	Max Error	Error %
0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
10.00	16,000.00	16,088.587	0.000	16,080.585	0.050	88.587	0.554
25.00	40,000.00	40,098.599	0.000	40,026.580	0.180	98.599	0.246
50.00	80,000.00	80,053.164	0.000	80,069.158	-0.020	69.158	0.086
75.00	120,000.00	119,660.364	0.000	119,860.303	-0.167	-339.636	-0.283
100.00	160,000.00	159,798.797	0.000	159,823.791	-0.016	-201.203	-0.126

Zero Return: 0.00 % 0.00 % 0.00 %

Linearity Profile (Percent Full Scale)

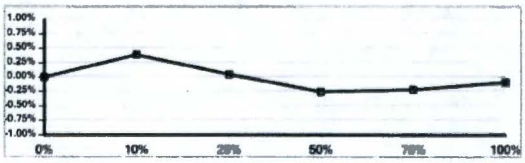


Range: 16000 Lbs **Resolution:** 5.00000 **Accuracy +/-:** 1.0 %

FS %	Reading	As Found	As Adj.	As Left	Repeatability %	Max Error	Error %
0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
10.00	1,600.00	1,606.177	0.000	1,604.177	0.125	6.177	0.386
25.00	4,000.00	4,001.863	0.000	3,999.864	0.050	1.863	0.047
50.00	8,000.00	7,980.023	0.000	7,992.027	-0.150	-19.977	-0.250
75.00	12,000.00	11,974.299	0.000	11,994.305	-0.167	-25.701	-0.214
100.00	16,000.00	15,985.555	0.000	15,995.558	-0.063	-14.445	-0.090

Zero Return: 0.00 % 0.00 % 0.00 %

Linearity Profile (Percent Full Scale)

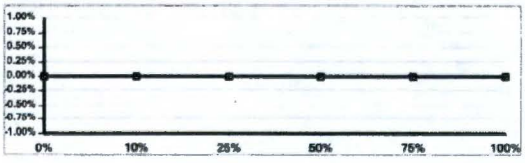


Range: 0 Lbs **Resolution:** 0.00000 **Accuracy +/-:** 1.0 %

FS %	Reading	As Found	As Adj.	As Left	Repeatability %	Max Error	Error %
0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
10.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
25.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
50.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
75.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
100.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000

Zero Return: 0.00 % 0.00 % 0.00 %

Linearity Profile (Percent Full Scale)



Calibrating Apparatus Used

Manufacture	Serial Number	Capacity	Class A	Calibration Date	Calibration Due
STRAINSENSE	101208	600000	46844	4/4/2011	4/4/2013
STRAINSENSE	030210	60000	5153.4	4/4/2011	4/4/2013
STRAINSENSE	940215B	6000	575.99	4/4/2011	4/4/2013

Specification: ASTM E 4-10

☐ REPAIRED: ☐ ADJUSTED: CONDITION: Fair

Calibration Procedure: **CR100 Rev 14**

☐ A-1 Verified Outside Testing Machine ☐ 7.3 Interchangeability Established

Service Order #: ***12780 - 3***

GIL GUTIERREZ ***11/9/2012***
SERVICE ENGINEER ***DATE***

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.

METROLOGY

Certificate of Calibration

2032001247

ACCREDITED
Certificate #1618.01

Customer Information

On Site Calibration
CTLGroup
5400 Old Orchard Road
Skokie, IL 60077

PO #: 50620B
Reference #: 1333515dd
Account #: 09879
SO #: 33515

Instrument Identification

Instrument Id: **10130188**
Noun: Caliper, 4"/0.0005" Digital
Mfr: Mitutoyo
Accuracy: ±0.001"

Location:
Model: 500-195-20
Serial #: 10130188

Certification Information

Reason For Service: Calibration with Data
Type Of Calibration: Accredited 17025 with Uncertainties
As Found Condition: In Tolerance
As Left Condition: Left As Found
Procedure: JH003340049 : Calipers

Technician: Oscar Trinidad, Jr
Cal Date: 17 JAN 13
Cal Due: 17 JAN 14
Temperature: 22.0 °C
Humidity: 42.0 %

Technician Remarks: Uncertainty of measurements can be found in the As Left column. Dent on the outside jaws.

Calibration Data

✓ In Tolerance ✗ Out of Tolerance

Range	Nominal	As Found		As Left		Min	Max
Outside Diameter							
0 - 4 Inches	0.5000	0.4990	✓	0.000336"		0.4990	0.5010
	1.0000	0.9990	✓	0.000336"		0.9990	1.0010
	2.0000	1.9990	✓	0.000336"		1.9990	2.0010

No sampling plan or other procedure was used for this calibration. Measurements and information on this certificate are valid at time of calibration only and any number of factors may cause calibration to drift out of tolerance prior to calibration due date.

This instrument has been calibrated using standards with accuracies traceable to the National Institute of Standards and Technology, derived from natural physical constants, from ratio measurements, or compared to consensus standards.

The expanded uncertainty of the measurement process has not exceeded 25% of the tolerance allowed for the individual characteristics measured, unless otherwise stated. The uncertainties are based on a 95% confidence level, K=2.

J.H. Metrology Co., Inc's Calibration Control System complies with applicable requirements of ANSI Z540-1-1994, ISO 9001, and ISO/IEC 17025-2005.

The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without the written approval of J.H. Metrology Co., Inc.

Approved by: Vice President

Date: Jan 23, 2013

Printed: 1/25/2013 15:13:33

JH Metrology Co, Inc. • 1801 Hicks Road, Unit E • Rolling Meadows, Illinois 60008 • Phone: (847) 991-0290 • Fax: (847) 991-0348

METROLOGY

Certificate of Calibration

2032001247

ACCREDITED
Certificate #1618.01

✓ In Tolerance ✗ Out of Tolerance

Calibration Data

Range	Nominal	As Found		As Left		Min	Max
Outside Diameter							
	4.0000	3.9990	✓	0.000336"		3.9990	4.0010
Inside Diameter							
0 - 4 Inches	0.5000	0.4995	✓	0.000336"		0.4990	0.5010
	1.0000	0.9995	✓	0.000336"		0.9990	1.0010
	2.0000	1.9995	✓	0.000336"		1.9990	2.0010
	4.0000	3.9995	✓	0.000336"		3.9990	4.0010
Depth Rod Check	0.0000	0.0000	✓	0.000336"		--	--
Step Measurement	0.5000	0.49990	✓	0.000336"		--	--

End of Datasheet

Calibration Standards

NIST Traceable #	Instrument ID#	Description	Model	Calibration Date	Date Due
1000164402	01171	Gage Block Set, 81 Piece, Grade 0	516-902-26	12 SEP 2012	30 SEP 2013

No sampling plan or other procedure was used for this calibration. Measurements and information on this certificate are valid at time of calibration only and any number of factors may cause calibration to drift out of tolerance prior to calibration due date.

This instrument has been calibrated using standards with accuracies traceable to the National Institute of Standards and Technology, derived from natural physical constants, from ratio measurements, or compared to consensus standards.

The expanded uncertainty of the measurement process has not exceeded 25% of the tolerance allowed for the individual characteristics measured, unless otherwise stated. The uncertainties are based on a 95% confidence level, K=2.

J.H. Metrology Co., Inc's Calibration Control System complies with applicable requirements of ANSI Z540-1-1994, ISO 9001, and ISO/IEC 17025-2005.

The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without the written approval of J.H. Metrology Co., Inc.

Approved by: Vice President

Date: Jan 23, 2013

Printed: 1/25/2013 15:13:33

JH Metrology Co, Inc. • 1801 Hicks Road, Unit E • Rolling Meadows, Illinois 60008 • Phone: (847) 991-0290 • Fax: (847) 991-0348

METROLOGY

Certificate of Calibration

2032001254

ACCREDITED
Certificate #1618.01

Customer Information

On Site Calibration
CTLGroup
5400 Old Orchard Road
Skokie, IL 60077

PO #: 50620B
Reference #: 1333515dd
Account #: 09879
SO #: 33515

Instrument Identification

Instrument Id: **0045261**
Noun: Caliper, 12"/0.0005" Digital
Mfr: Mitutoyo
Accuracy: ±0.0015"

Location:
Model: 500-193
Serial #: 0045261

Certification Information

Reason For Service: Calibration with Data
Type Of Calibration: Accredited 17025 with Uncertainties
As Found Condition: In Tolerance
As Left Condition: Left As Found
Procedure: JH003340049 : Calipers
Technician Remarks: Uncertainty of measurements can be found in the As Left column.

Technician: Oscar Trinidad, Jr
Cal Date: 17 JAN 13
Cal Due: 17 JAN 14
Temperature: 22.0 °C
Humidity: 42.0 %

Calibration Data

✓ In Tolerance ✗ Out of Tolerance

Range	Nominal	As Found		As Left		Min	Max
Outside Diameter							
0-12 Inches	0.500	0.5000	✓	0.000651"		0.498	0.502
	1.000	1.0000	✓	0.000651"		0.998	1.002
	2.000	2.0000	✓	0.000651"		1.998	2.002

No sampling plan or other procedure was used for this calibration. Measurements and information on this certificate are valid at time of calibration only and any number of factors may cause calibration to drift out of tolerance prior to calibration due date.

This instrument has been calibrated using standards with accuracies traceable to the National Institute of Standards and Technology, derived from natural physical constants, from ratio measurements, or compared to consensus standards.

The expanded uncertainty of the measurement process has not exceeded 25% of the tolerance allowed for the individual characteristics measured, unless otherwise stated. The uncertainties are based on a 95% confidence level, K=2.

J.H. Metrology Co., Inc's Calibration Control System complies with applicable requirements of ANSI Z540-1-1994, ISO 9001, and ISO/IEC 17025-2005.

The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without the written approval of J.H. Metrology Co., Inc.

Approved by: Vice President

Date: Jan 25, 2013

Printed: 1/25/2013 16:22:27

JH Metrology Co, Inc. • 1801 Hicks Road, Unit E • Rolling Meadows, Illinois 60008 • Phone: (847) 991-0290 • Fax: (847) 991-0348

METROLOGY

Certificate of Calibration

2032001254

ACCREDITED
Certificate #1618.01

✓ In Tolerance ✗ Out of Tolerance

Calibration Data

Range	Nominal	As Found		As Left		Min	Max
Outside Diameter							
	4.000	4.0000	✓	0.000651"		3.998	4.002
	6.000	6.0000	✓	0.000651"		5.998	6.002
	8.000	8.0000	✓	0.000651"		7.998	8.002
	10.000	10.0000	✓	0.000651"		9.998	10.002
	12.000	12.0000	✓	0.000651"		11.998	12.002
Inside Diameter							
0-12 Inches	0.500	0.5000	✓	0.000651"		0.498	0.502
	1.000	1.0000	✓	0.000651"		0.998	1.002
	2.000	2.0000	✓	0.000651"		1.998	2.002
	4.000	4.0000	✓	0.000651"		3.998	4.002
	6.000	6.0000	✓	0.000651"		5.998	6.002
	8.000	8.0000	✓	0.000651"		7.998	8.002
	10.000	10.0000	✓	0.000651"		9.998	10.002
	12.000	12.0000	✓	0.000651"		11.998	12.002
Depth Rod Check	0.000	0.0000	✓	0.000651"		--	--
0.5" Step	0.500	0.5000	✓	0.000651"		--	--

End of Datasheet

Calibration Standards

NIST Traceable #	Instrument ID#	Description	Model	Calibration Date	Date Due
1000160938	00924	Gage Block Set, 81 Piece, Grade 2	516-902	09 MAY 2012	31 MAY 2013
1000164402	01171	Gage Block Set, 81 Piece, Grade 0	516-902-26	12 SEP 2012	30 SEP 2013

No sampling plan or other procedure was used for this calibration. Measurements and information on this certificate are valid at time of calibration only and any number of factors may cause calibration to drift out of tolerance prior to calibration due date.

This instrument has been calibrated using standards with accuracies traceable to the National Institute of Standards and Technology, derived from natural physical constants, from ratio measurements, or compared to consensus standards.

The expanded uncertainty of the measurement process has not exceeded 25% of the tolerance allowed for the individual characteristics measured, unless otherwise stated. The uncertainties are based on a 95% confidence level, K=2.

J.H. Metrology Co., Inc's Calibration Control System complies with applicable requirements of ANSI Z540-1-1994, ISO 9001, and ISO/IEC 17025-2005.

The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without the written approval of J.H. Metrology Co., Inc.

Approved by: Vice President

Date: Jan 25, 2013

Printed: 1/25/2013 16:22:27

JH Metrology Co, Inc. • 1801 Hicks Road, Unit E • Rolling Meadows, Illinois 60008 • Phone: (847) 991-0290 • Fax: (847) 991-0348

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
325 Broadway
Boulder, CO 80305-3337

REVIEWED OK
by Joe Hansen date 11/26/12

November 15, 2012

Joe Hansen
Exova
194 Internationale Boulevard
Glendale Hts, IL 60139

Dear Mr. Hansen:

Charpy verification specimens tested on the 357.9 J (264.0 ft-lbf) capacity Tinus Olsen Machine, Serial No. 135327, have been received for evaluation along with the completed questionnaire. We have analyzed the results (see attached table) and find that the average values fall within the acceptable ranges at the energy levels tested. The following paragraphs describe further analysis of the questionnaire, the test results, and the fractured specimens.

This machine has tested the lowest and highest impact verification specimens commercially available (ASTM E23 section A2.4.4) and satisfies the indirect verification requirements of the current ASTM Standard E 23 from 8.5 J (6.3 ft-lbf) to 80% of the maximum capacity of the machine.

Enclosed is a Charpy Verification Sticker to attach to your machine.

If the machine is moved or undergoes any major repairs or adjustments, this verification becomes invalid and the machine must be rechecked (see ASTM E23). If a specimen stops the pendulum during a test, the machine should be checked to assure that the pendulum is straight, the anvils and striker have not been damaged, and that all bolts are still tight.

If you have any questions concerning the verification of your machine, you may contact me by phone at (303) 497-3351, by fax at (303) 497-5939, or by email at charpy@boulder.nist.gov.

Sincerely,

Raymond Santoyo

Raymond L. Santoyo
Materials Reliability Division

3 Enclosures

NIST

National Institute of Standards and Technology
Materials Reliability Division
325 Broadway
Boulder, CO 80305-3328

Facility: Exova, 194 Internationale Boulevard
Glendale Hts, IL 60139

Machine Manufacturer: Tinus Olsen Serial Number: 135327

Test Date: 11/7/2012

SERIES NUMBER	CLIENT VALUES					UNITS	AVERAGE (J)		VARIANCE	STATUS
	1	2	3	4	5		CLIENT	NIST		
Low LL-128	15.9	16.3	17.0	17.0	17.0	J	16.6	16.3	0.3 J	Pass
High HH-131	94.9	89.5	94.2	93.6	88.8	J	92.2	91.5	0.8%	Pass
Super High N/A										N/A

Allowable Variance is 1.4 J or 5%, whichever is greater (ASTM Standard E 23)

N/A = Not Commercially Available

Additional Information

The information contained in Table 2 can be used to compute the uncertainty for a new material tested in your laboratory using a procedure outlined in NIST SP 960-18 [1].
http://www.nist.gov/msel/materials_reliability/structural_materials/charpy-verification-program.cfm.

Table 2. Summary statistics for SRM materials and customers verification test result.

Series Number	Client Statistics					NIST SRM Statistics			
	Client Average $\overline{V}$ (J)	Standard Deviation S_V (J)	Number of Tests n_V	$S_V/\sqrt{n_V}$ (J)	Degrees Of Freedom df_V	Certified Reference Value R (J)	Combined Uncertainty $u(R)$ (J)	Degrees Of Freedom df_R	*Expanded Uncertainty* U (J)
LL-128	16.6	0.48	5	0.22	4	16.3	0.08	112	0.159
HH-131	92.2	2.84	5	1.27	4	91.5	0.178	138	0.351

The fifth column, labeled $S_V/\sqrt{n_V}$, is the uncertainty of the verification test mean, $\overline{V}$, if there are no additional sources of systematic error that need to be included. It is the customer's responsibility to determine the final uncertainty of $\overline{V}$.

The expanded uncertainty of the NIST reference value (U), corresponding to a 95 % uncertainty interval, is based on a coverage factor from the Student's t distribution with df_R degrees of freedom. The expanded uncertainties include sources of error in the measurement and testing process at NIST, and are not the expanded uncertainties of the individual verification specimens or the uncertainties of tests performed in your laboratory.

References

[1] Splett, J. D., McCowan, C. N., Iyer, H. K., Wang, C.-M., "NIST Recommended Practice Guide: Computing Uncertainty for Charpy Impact Machine Test Results," NIST Special Publication 960-18, September, 2007.

NIST Charpy Verification Sticker

This machine meets the indirect verification requirements of the current ASTM Std E 23

Machine Serial Number:	*135327*
Verification Date:	November 7, 2012
Range of Verification:	*From 8.5 J (6.3 ft-lbf) to 80% of the machine capacity*
Signature:	Raymond Santoyo

Raymond Santoyo, Charpy Program Coordinator
National Institute of Standards and Technology

QUALITY CALIBRATION SERVICE, INC.
10205 West Greenfield Avenue • West Allis, WI 53214
414-256-8900 • FAX: 414-256-8911 • Toll Free: 800-285-0035
e-mail: QCS@QualityCalibration.com • www.QualityCalibration.com

Certificate of Calibration

ISO/IEC 17025:2005 ACCREDITED & ISO 9001:2008
REGISTERED CALIBRATION LABORATORY

ACCREDITED No. 462.01 "Calibration"

00201
№ 1033038

OK Joe Hamer 10/15/12

For EXOVA
194 INTERNATIONAL BOULEVARD
GLENDALE HEIGHTS, IL 60139

P.O. 050520

Type of Gage/s DIGITAL CALIPER
Identification 2-96
Date 09-21-2012

Manufacturer MITUTOYO
Model Number 573-221-10
Recalibration Date 03-21-2013

Nominal	Before
OD Jaws - Front	
1.0000	0.9995
OD Jaws - Back	
1.0000	1.0000
ID Jaws	
1.0000	1.0000
Depth Rod	
1.0000	1.0000
Step Height	
1.0000	1.0000

OD Jaws Full Range	
0.0000	0.0000
1.0000	1.0000
2.0000	2.0000
3.0000	3.0000
4.0000	4.0000
5.0000	5.0000
6.0000	6.0000

Remarks * See reverse side for additional comments.

Gages listed were checked against masters traceable to the National Institute of Standards & Technology at a measuring temperature of 68°F (20°C) 45% Relative Humidity (max.). This calibration was performed in accordance with requirements of: ISO/IEC 17025, ANSI/NCSL Z540, ISO10012-1, 10CFR50, MIL-I-45208A, MIL-STD-45662A, MIL-Q-9858A, MIL-STD-120, ANSI/ASME B89.1.13, ANSI/ASME B89.1.6, Fed. Std. H28, ANSI/ASME B1.2, B1.20.5, BS 21, ISO 7, ISO 228-1 for Screw Threads on instrument # Q-456/507/539 Calibrated Prior To Use Per QCS M1.

Inspected by Mark Sherman Lab Technician N.I.S.T. Test Number 821/279484-10 Date 02-29-2012

Subscribed and sworn to before me this 21st day of September Yr. 2012 Kristy J Waagen Notary Public

QUALITY CALIBRATION SERVICE, INC.
10205 West Greenfield Avenue • West Allis, WI 53214
414-256-8900 • FAX: 414-256-8911 • Toll Free: 800-285-0035
e-mail: QCS@QualityCalibration.com • www.QualityCalibration.com

Certificate of Calibration

ISO/IEC 17025:2005 ACCREDITED & ISO 9001:2008
REGISTERED CALIBRATION LABORATORY

ACCREDITED No. 462.01 "Calibration"

№ 00419 1033044

Ok Joe Henrice 10/15/12

For EXOVA
194 INTERNATIONAL BOULEVARD
GLENDALE HEIGHTS, IL 60139

P.O. 050520

Type of Gage/s DIGITAL CALIPER
Identification 2-126
Date 09-21-2012

Manufacturer MITUTOYO
Model Number 500-196
Recalibration Date 03-21-2013

Nominal	Before
OD Jaws - Front	
1.0000	0.9995
OD Jaws - Back	
1.0000	1.0000
ID Jaws	
1.0000	1.0005
Depth Rod	
1.0000	1.0000
Step Height	
1.0000	1.0000

OD Jaws Full Range	
0.0000	0.0000
1.0000	1.0000
2.0000	2.0000
3.0000	3.0000
4.0000	4.0000
5.0000	5.0000
6.0000	5.9995

Remarks * See reverse side for additional comments.

Gages listed were checked against masters traceable to the National Institute of Standards & Technology at a measuring temperature of 68°F (20°C) 45% Relative Humidity (max.). This calibration was performed in accordance with requirements of: ISO/IEC 17025, ANSI/NCSL Z540, ISO10012-1, 10CFR50, MIL-I-45208A, MIL-STD-45662A, MIL-Q-9858A, MIL-STD-120, ANSI/ASME B89.1.13, ANSI/ASME B89.1.6, Fed. Std. H28, ANSI/ASME B1.2, B1.20.5, BS 21, ISO 7, ISO 228-1 for Screw Threads on instrument # Q-456/507/789 Calibrated Prior To Use Per QCS M1.

Inspected by Mark Shannon Lab Technician N.I.S.T. Test Number 821/279484-10 Date 02-29-2012

Subscribed and sworn to before me this 21st day of September Yr. 2012 Kristy J Waagen
Notary Public

QA Reviewed by

Certificate Of Calibration

Equipment Calibration was performed at the address below for

EXOVA

194 INTERNATIONALE BLVD

GLENDALE HEIGHTS, IL 60139-

8/11/12

Date of Calibration

Tuesday, July 10, 2012

DISPLACEMENT RATE

Calibration Performed By

Cal~Rite Corporation, Naperville, IL

Instrument Profile

Manufacture:	*UNITED*	**Serial #:**	*0402530-SP*	**Next Calibration:**	*10-Jul-2013*
Model:	*SFM-30*	**Customer #:**	*2-17*	**Temp/Humidity:**	*71.4 F/ 43.8%*
				Accuracy Class:	*Class B(1%)*

Range: 0.5 IN/MIN **Resolution:** 0.0001 **Uncertainty:** 0.0120

Rate / Min	As Found	As Adjusted	As Left	Repeatability %	Max Error	Error %
0.0500	0.05020	0.00000	0.05020	0.000	-0.00020	0.4000
0.2500	0.25120	0.00000	0.25100	0.080	-0.00120	0.4800
0.5000	0.50210	0.00000	0.50240	0.060	-0.00240	0.4800
0.0000	0.00000	0.00000	0.00000	0.000	0.00000	0.0000

Calibrating Apparatus Used

Manufacture	Serial Number	Model	Calibration Date	Calibration Due
CELESCO	I2109194B	DPT250	10/13/2011	10/13/2012
ROBIC	S2	SC-507	1/14/2011	1/14/2013

CAL-RITE CORPORATION HAS CALIBRATED THE TESTING EQUIPMENT DESCRIBED ABOVE IN ACCORDANCE WITH THE LATEST SPECIFICATIONS (10-CFR-21, ISO/IEC 17025 AND ISO 10012-1 AND MIL-STD 45662A). ALL VERIFICATION DEVICES ARE TRACEABLE TO NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY(NIST). THIS CERTIFICATE RELATES ONLY TO THE ITEMS CALIBRATED.

THE UNCERTAINTY OF THE CALIBRATION PROCESS WAS ESTIMATED AT THE 95% CONFIDENCE LEVEL (K=2).

ACCREDITED

Certificate # 866.01
Calibration

Specification: **ASTM E 2658-11**

Calibration Procedure: **CR103 Rev 6**

Service Order #: ***12642 - 2***

SERVICE ENGINEER ***7/18/2012*** ***DATE***

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.

INST-SP0109 Page 1 of 1 Customer PO # 049069

QA Reviewed by

Certificate Of Calibration

Equipment Calibration was performed at the address below for

EXOVA

194 INTERNATIONALE BLVD
GLENDALE HEIGHTS, IL 60139-

OK for Use
8/11/12

Date of Calibration

DISPLACEMENT

Tuesday, July 10, 2012

Calibration Performed By

Cal-Rite Corporation, Naperville, IL

Instrument Profile

Manufacture:	*UNITED*	**Serial #:**	*0402530-P*	**Next Calibration:**	*10-Jul-2013*
Model:	*SFM-30*	**Travel FS:**	*4*	**Temp/Humidity:**	*71.5 F/47.5%*
Language:	*INCHES*	**Customer #:**	*2-17*	**Classification:**	*B (+/-1.0%)*

Instrument Calibration Results

Direction	Range	Verified Range	Uncertainty	Maximum Error %
Tension	4.000	0.0500 - 4.0000	0.008101	0.225
Compression	(4.000)	-0.0500 - -4.0000	0.008101	0.800

CAL-RITE CORPORATION HAS CALIBRATED THE TESTING EQUIPMENT DESCRIBED ABOVE IN ACCORDANCE WITH THE LATEST SPECIFICATIONS (10-CFR-21, ISO/IEC 17025 AND ISO 10012-1 AND MIL-STD 45662A). ALL VERIFICATION DEVICES ARE TRACEABLE TO NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY(NIST). THIS CERTIFICATE RELATES ONLY TO THE ITEMS CALIBRATED.

THE UNCERTAINTY OF THE CALIBRATION PROCESS WAS ESTIMATED AT THE 95% CONFIDENCE LEVEL (K=2).

Specification: **ASTM E 2309-05 (2011)e1**

Calibration Procedure: **CR102 Rev 8**

ACCREDITED

Certificate # 866.01
Calibration

7/18/2012

SERVICE ENGINEER *DATE*

Service Order #: ***12642 - 1***

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.

Cal-Rite Corporation

1665 QUINCY AVENUE, UNIT 123, NAPERVILLE, IL 60540
P 630.355.1522 F 630.355.1544 WWW.CAL-RITE.COM

Certificate # 866.01
Calibration

REPORT OF CALIBRATION

EXOVA
194 INTERNATIONALE BLVD
GLENDALE HEIGHTS, IL 60139-

Calibration Date: 10-Jul-2012
Next Calibration: 10-Jul-2013
Temp/Humidity: 71.5 F/47.5%
Temp Variance: 0.5

Manufacture: UNITED **Serial #:** 0402530-P **Customer #:** 2-17
Model: SFM-30 **Travel FS:** 4.0 **Transducer MFR:** 0402530-P
Language: INCHES **Classification:** B (+/-1.0%) **Transducer #:** UNITED

Tension **Range:** 4 **Resolution:** 0.0001 **Uncertainty:** 0.008101 (IN)

Range %	Readout UUT	As Found	As Adj.	As Left	Repeatability %	Max Error	Error %
1.25	0.05000	0.05003	0.00000	0.05002	0.020	-0.00003	0.0600
2.50	0.10000	0.09980	0.00000	0.09980	0.000	0.00020	-0.2000
5.00	0.20000	0.19960	0.00000	0.19960	0.000	0.00040	-0.2000
7.50	0.30000	0.29980	0.00000	0.29970	0.033	0.00030	-0.1000
10.00	0.40000	0.40000	0.00000	0.40020	0.050	-0.00020	0.0500
25.00	1.00000	1.00210	0.00000	1.00180	0.030	-0.00210	0.2100
50.00	2.00000	2.00270	0.00000	2.00230	0.020	-0.00270	0.1350
75.00	3.00000	3.00590	0.00000	3.00450	0.047	-0.00590	0.1967
100.00	4.00000	4.00700	0.00000	4.00900	0.050	-0.00900	0.2250

Compression **Range:** -4 **Resolution:** 0.0001 **Uncertainty:** 0.008101 (IN)

Range %	Readout UUT	As Found	As Adj.	As Left	Repeatability %	Max Error	Error %
1.25	-0.05000	-0.05040	0.00000	-0.05040	0.000	0.00040	0.8000
2.50	-0.10000	-0.10070	0.00000	-0.10060	0.099	0.00070	0.7000
5.00	-0.20000	-0.20110	0.00000	-0.20090	0.100	0.00110	0.5500
7.50	-0.30000	-0.30110	0.00000	-0.30140	0.100	0.00140	0.4667
10.00	-0.40000	-0.40050	0.00000	-0.40090	0.100	0.00090	0.2250
25.00	-1.00000	-1.00180	0.00000	-1.00240	0.060	0.00240	0.2400
50.00	-2.00000	-2.00370	0.00000	-2.00410	0.020	0.00410	0.2050
75.00	-3.00000	-3.00330	0.00000	-3.00260	0.023	0.00330	0.1100
100.00	-4.00000	-4.00540	0.00000	-4.00430	0.027	0.00540	0.1350

Calibrating Apparatus Used

Manufacture	Serial Number	Model	Calibration Date	Calibration Due
CELESCO	I2109194B	DPT250	10/13/2011	10/13/2012

☑ SPECIFICATION COMPLIANT ☐ REPAIRED: ☐ ADJUSTED: CONDITION: Good

Specification: ASTM E 2309-05 (2011)e1 ***Calibration Procedure:*** **CR102 Rev 8**

Service Order #: ***12642 - 1***

MICHAEL CROSBY ***7/18/2012***
SERVICE ENGINEER ***DATE***

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.

REVIEWED ok
by [illegible] date 11/27/12

QA Reviewed by [illegible]
Nov-26-2012

Certificate Of Calibration

Equipment Calibration was performed at the address below for

EXOVA
194 INTERNATIONALE BLVD
GLENDALE HEIGHTS ,IL 60139-

LOAD CELL

Date of Calibration

Wednesday, November 07, 2012

Calibration Performed By

Cal-Rite Corporation, Naperville, IL

Machine Profile

Customer #: *2-17*

Manufacturer: *UNITED* **Capacity:** *30000* **Next Calibration:** *07-Nov-2013*

Model: *SFM-30* **Serial #:** *0402530* **Temp/Humidity:** *74.2/29.9*

Force Calibration Results

Language: Lbs **ASTM Accuracy +/-: 1.0 %**

Range Capacity	Verified Range Force	Uncertainty %	Maximum Error %	ISO Class
30000.00	300 - 20000	0.30	-0.47	1.00

CAL-RITE CORPORATION HAS CALIBRATED THE TESTING EQUIPMENT DESCRIBED ABOVE IN ACCORDANCE WITH THE LATEST SPECIFICATIONS (10-CFR-21, ISO/IEC 17025, ISO7500-1, ISO 10012-1 AND MIL-STD 45662A). ALL VERIFICATION DEVICES CALIBRATED IN ACCORDANCE WITH ASTM-E74 AND ISO376 PRACTICES AND ARE TRACEABLE TO NIST. THIS CERTIFICATE RELATES ONLY TO THE ITEMS CALIBRATED.

THE UNCERTAINTY OF THE CALIBRATION PROCESS WAS ESTIMATED AT THE 95% CONFIDENCE LEVEL (K=2).

THE EQUIPMENT LISTED ABOVE HAS MET ALL APLICABLE CLAUSES OF THE GOVERNING SPECIFICATION(S) AS NOTED BELOW.

Specification's: **ASTM E 4-10 / ISO 7500-1:2004**

Calibration Procedure: **CR100 Rev 14**

ACCREDITED
Certificate # 866.01
Calibration

[signature] ***11/27/2012***

SERVICE ENGINEER ***DATE***

Service Order #: ***12851 - 1***

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.

ARM-ISO 01-12 Page 1 of 2 Customer PO # 051928

Cal-Rite Corporation

1665 QUINCY AVENUE, UNIT 123, NAPERVILLE, IL 60540
P 630.355.1522 F 630.355.1544 WWW.CAL-RITE.COM

ACCREDITED
Certificate # 866.01
Calibration

REPORT OF CALIBRATION

EXOVA
194 INTERNATIONALE BLVD
GLENDALE HEIGHTS ,IL 60139-

Calibration Date: 07-Nov-2012
Next Calibration: 07-Nov-2013
Customer #: 2-17
Temp/Humidity: 74.2/29.9

Manufacture: UNITED
Model: SFM-30
Indicator: DIGITAL

Capacity: 30000
Serial #: 0402530
Shunt #: N/A

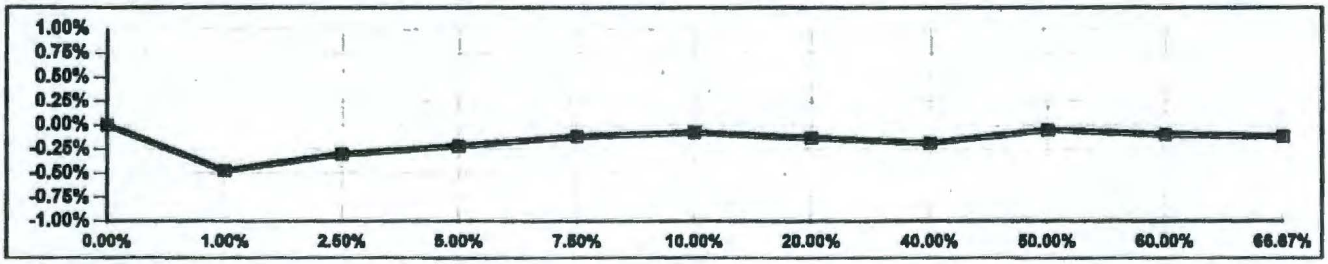
Test Direction: TENSION
External Cell: 80482A
Temp Variance: 0.4

Range: 30000 Lbs **Resolution: 1 Lbs** **Accuracy +/-: 1.0 %**

%FS	Readout UUT	Run 1 (As Found)	Run 2	Run 3	Run 4 (As Required)	Repeatability %	Max Error	Error %	Resolution
0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
1.00	300.00	298.885	298.885	298.585	0.000	0.100	1.415	-0.472	1.000
2.50	750.00	747.549	749.049	747.749	0.000	0.200	2.251	-0.300	1.000
5.00	1,500.00	1,496.676	1,497.976	1,496.776	0.000	0.087	3.224	-0.215	1.000
7.50	2,250.00	2,247.887	2,247.587	2,247.387	0.000	0.022	2.613	-0.116	1.000
10.00	3,000.00	3,000.782	3,000.782	2,997.782	0.000	0.100	2.218	-0.074	1.000
20.00	6,000.00	5,994.137	5,994.137	5,992.138	0.000	0.033	7.862	-0.131	1.000
40.00	12,000.00	11,996.851	11,982.857	11,977.858	0.000	0.158	22.142	-0.185	1.000
50.00	15,000.00	15,003.708	15,005.707	14,992.712	0.000	0.087	7.288	-0.049	1.000
60.00	18,000.00	17,995.572	17,984.576	17,982.577	0.000	0.072	17.423	-0.097	1.000
66.67	20,000.00	19,986.816	19,984.817	19,976.820	0.000	0.050	23.180	-0.116	1.000

Zero Return: 0.03 % 0.02 % 0.04 % 0.00 %

Linearity Profile (Percent Full Scale)



Calibrating Apparatus Used

Manufacture	Type	Serial Number	Class	Capacity	Class A	Cert. #	Cal. Date	Cal. Due
STRAINSENSE	SST603UF	090917	1	60,000	4000	822/268391	11/17/2011	11/17/2013
MOREHOUSE	P	P-8013	1	6,000	150	822/255038	11/17/2011	11/17/2013

Specification's: ASTM E 4-10 / ISO 7500-1:2004 ☑ SPECIFICATION COMPLIANT
Calibration Procedure: **CR100 Rev 14** ☐ REPAIRED: ☐ ADJUSTED: CONDITION: Good

☐ A-1 Verified Outside Testing Machine ☐ 7.3 Interchangeability Established

Service Order #: ***12851 - 1***

NATHAN HATHAWAY ***11/27/2012***
SERVICE ENGINEER ***DATE***

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.

NOTE: 1ST TIME CALIBRATION TO 20,000 LBS MAX PREVIOUSLY WENT TO 30,000 LBS

REVIEWED-OIC
by [illegible] date 1/22/13

Certificate Of Calibration

Equipment Calibration was performed at the address below for

EXOVA

194 INTERNATIONALE BLVD

GLENDALE HEIGHTS, IL 60139-

EXTENSOMETER

Date of Calibration

Friday, December 07, 2012

Next Calibration Due

Saturday, December 07, 2013

QA Reviewed by [illegible] Dec-12-2012

Calibration Performed By

Cal~Rite Corporation, Naperville, IL

ACCREDITED
Certificate # 866.01
Calibration

Instrument Profile

Customer # : 2-93

Manufacture:	*UNITED*	**Mach/Rec#:**	*0402530*	**G.L. Measurement:**	*DIRECT*
Model #:	*EZ.1-1*	**Scaling #:**	*N/A*	**G.L. Measure(1/2):**	*0.996/0.995*
Serial #:	*4657-UNITED*	**Temp/Humid:**	*76.1/28.8*	**G.L. Error (1/2):**	*0.40% / 0.50%*

Instrument Calibration Results

Range Capacity	Verified Range IN/IN	Uncertainty	Maximum Error	ASTM Class
0.1000	0.001 - 0.1	0.000055	-0.00025	B-2

EXTENSOMETER WAS CALIBRATED BY MOUNTING ONTO A CALIBRATOR FRAME WITH A MICROMETER HEAD. THE ACCURACY OF THE CALIBRATION APPARATUS IS EQUAL TO OR BETTER THAN 1/3 OF THE CLASSIFICATION CRITERIA.
CAL-RITE CORPORATION HAS CALIBRATED THE TESTING EQUIPMENT DESCRIBED ABOVE IN ACCORDANCE WITH THE LATEST SPECIFICATIONS (10-CFR-21, ISO/IEC 17025 AND ISO 10012-1 AND MIL-STD 45662A). ALL VERIFICATION DEVICES ARE TRACEABLE TO NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY(NIST).
THIS CERTIFICATE RELATES ONLY TO THE ITEMS CALIBRATED.
THE UNCERTAINTY OF THE CALIBRATION PROCESS WAS ESTIMATED AT THE 95% CONFIDENCE LEVEL (K=2).

Specification: **ASTM E 83-10a** ***Calibration Procedure:*** **CR101 Rev 12**

Comments: Verified proper operation of extensometer. Calibrated instrument in accordance with ASTM Standards. Made adjustments to instrument calibration. All readings within tolerance and repeatable. Extensometer is in good condition and functioning properly at this time.
NOTE - I attempted to adjust the gauge length, but the GL adjusting screws are stuck and I did not want to risk damaging the instrument.

Service Order ***12896 - 9***

[illegible] ***12/20/2012***

SERVICE ENGINEER ***DATE***

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reservered pending our prior written approval.

Cal-Rite Corporation

1665 QUINCY AVENUE, UNIT 123, NAPERVILLE, IL 60540
P 630.355.1522 F 630.355.1544 WWW.CAL-RITE.COM

Certificate # 866.01
Calibration

REPORT OF CALIBRATION

EXOVA
194 INTERNATIONALE BLVD
GLENDALE HEIGHTS, IL 60139-

Calibration Date: 07-Dec-2012
Next Calibration: 07-Dec-2013
Temp Variance: 0.5
Temp/Humidity: 76.1/28.8

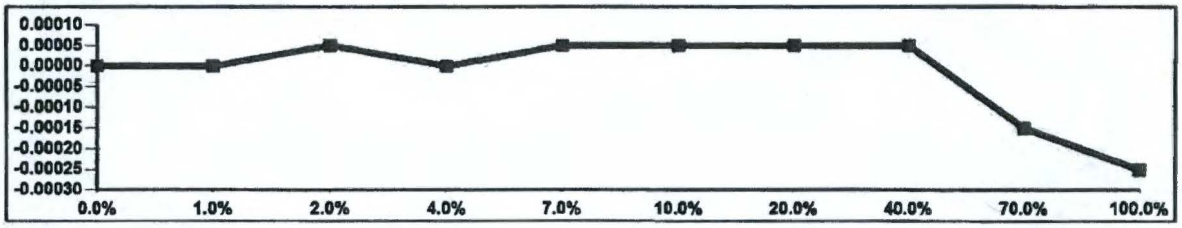
Instrument Profile

Manufacture:	UNITED	**Serial #:**	4657-UNITED	**G.L. Measurement:**	DIRECT
Model:	EZ.1-1	**Customer #:**	2-93	**G.L. Measured(1/2):**	0.996/0.995
Mach/Rec #:	0402530	**Scaling #:**	N/A	**G.L. Error(1/2):**	0.40% / 0.50%

Range: 0.1 IN/IN **Resolution:** 0.00001 **Uncertainty:** 0.000055

Range %	Readout UUT	As Found	As Adjusted	As Left	Repeat %	Fixed Error	Relative Error %	Class
0.00	0.000000	0.000000	0.000000	0.000000	0.000	0.00000	0.0000	
1.00	0.001000	0.000950	0.001000	0.001000	0.000	0.00000	0.0000	B-2
2.00	0.002000	0.001950	0.002000	0.001950	2.532	0.00005	2.5000	B-2
4.00	0.004000	0.003950	0.004000	0.004000	0.000	0.00000	0.0000	B-2
7.00	0.007000	0.006950	0.006950	0.007000	0.717	0.00005	0.7143	B-2
10.00	0.010000	0.009950	0.009950	0.010000	0.501	0.00005	0.5000	B-2
20.00	0.020000	0.019900	0.019950	0.020050	0.500	0.00005	0.2500	B-2
40.00	0.040000	0.039850	0.039950	0.040050	0.250	0.00005	0.1250	B-2
70.00	0.070000	0.069700	0.070000	0.070150	0.214	-0.00015	-0.2143	B-2
100.00	0.100000	0.099550	0.099900	0.100250	0.350	-0.00025	-0.2500	B-2

Linearity Profile (Percent Full Scale)



Calibrating Apparatus Used

Manufacture	Serial Number	Model	Calibration Date	Calibration Due
MITUTOYO	11357059	CALIPERS	10/11/2011	10/11/2013
MITUTOYO	511474	164-162	11/13/2012	11/13/2013

☑ SPECIFICATION COMPLIANT ☐ REPAIRED: ☑ ADJUSTED: CONDITION: Good

Specification: ASTM E 83-10a ***Calibration Procedure:*** **CR101 Rev 12**

Service Order #: ***12896 - 9***

NATHAN HATHAWAY ***12/20/2012***
SERVICE ENGINEER ***DATE***

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.

QA Reviewed by

Certificate Of Calibration

Equipment Calibration was performed at the address below for

EXOVA
194 INTERNATIONALE BLVD
GLENDALE HEIGHTS, IL 60139-

OK 8/11/12

Date of Calibration
Wednesday, July 11, 2012

Calibration Performed By Cal~Rite Corporation, Naperville, IL

Rockwell Profile **Customer #:**

Manufacture:	*CLARK*	**Serial #:**	*CR0211*	**Temp/Humidity:**	*72.9 F/50.1%*
Model:	*CR-3e*	**Resolution:**	*0.10*	**Temp Variance:**	*0.6*

In-Direct Hardness Calibration Results

Scale Block	Mean	Mean Error	Uncertainty	Scale Block	Mean	Mean Error	Uncertainty
A64.2+/-1.0	63.920	-0.2800	0.59	45T27.5+/-1.5	27.900	0.4000	1.31
A75.8+/-1.0	75.160	-0.6400	0.48	45T43.4+/-1.0	43.320	-0.0800	0.72
A81.9+/-0.5	81.480	-0.4200	0.37	45T59.8+/-1.0	59.900	0.1000	1.25
C24.4+/-1.0	24.900	0.5000	0.66	15N75.8+/-1.0	75.520	-0.2800	0.63
C44.9+/-1.0	44.960	0.0600	0.65	15N84.3+/-1.0	84.360	0.0600	0.59
C62.8+/-0.5	62.500	-0.3000	0.47	15N91.7+/-0.7	91.580	-0.1200	0.49
B42.3+/-1.5	42.040	-0.2600	1.30	30N45.9+/-1.0	45.520	-0.3800	0.78
B72.6+/-1.0	72.460	-0.1400	1.34	30N68.7+/-1.0	68.480	-0.2200	0.86
B97.9+/-1.0	97.920	0.0200	0.99	30N79.3+/-0.7	79.500	0.2000	0.63
15T75.2+/-1.5	74.680	-0.5200	0.81	45N28.6+/-1.0	28.180	-0.4200	0.71
15T82.1+/-1.0	81.700	-0.4000	0.69	45N53.1+/-1.0	52.580	-0.5200	0.58
15T90.8+/-1.0	90.540	-0.2600	0.69	45N67.1+/-0.7	66.980	-0.1200	0.76
30T50.9+/-1.5	50.880	-0.0200	0.57	E75.4+/-1.0	75.640	0.2400	0.81
30T64.6+/-1.0	64.460	-0.1400	1.05	E84.4+/-1.0	84.640	0.2400	0.78
30T76.7+/-1.0	77.000	0.3000	0.69	E97.6+/-1.0	97.880	0.2800	0.59

CAL-RITE CORPORATION HAS CALIBRATED THE TESTING EQUIPMENT DESCRIBED ABOVE IN ACCORDANCE WITH THE LATEST SPECIFICATIONS (10-CFR-21, ISO/IEC 17025 AND ISO 10012-1 AND MIL-STD 45662A). ALL VERIFICATION DEVICES ARE TRACEABLE TO NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY(NIST). THIS CERTIFICATE RELATES ONLY TO THE ITEMS CALIBRATED.

THE UNCERTAINTY OF THE CALIBRATION PROCESS WAS ESTIMATED AT THE 95% CONFIDENCE LEVEL (K=2).

ACCREDITED

Certificate # 866.01
Calibration

Specification: **ASTM E 18-11**

Calibration Procedure: **CR104 Rev 10**

8/8/2012

SERVICE ENGINEER *DATE*

Service Order #: ***12643 - 18***

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reservered pending our prior written approval.

ROCK 01-12 Page 1 of 5 Customer PO # 049068

QA Reviewed by

Certificate Of Calibration

Equipment Calibration was performed at the address below for

EXOVA
194 INTERNATIONALE BLVD
GLENDALE HEIGHTS, IL 60139-

Date of Calibration
Wednesday, July 11, 2012

Calibration Performed By Cal~Rite Corporation, Naperville, IL

Rockwell Profile **Customer #:**

Manufacture:	*CLARK*	**Serial #:**	*CR0211*	**Temp/Humidity:**	*72.9 F/50.1%*
Model:	*CR-3e*	**Resolution:**	*0.10*	**Temp Variance:**	*0.6*

In-Direct Hardness Calibration Results

H90.4+/-1.0	90.920	0.5200	0.91
H99.3+/-1.0	99.320	0.0200	0.80

CAL-RITE CORPORATION HAS CALIBRATED THE TESTING EQUIPMENT DESCRIBED ABOVE IN ACCORDANCE WITH THE LATEST SPECIFICATIONS (10-CFR-21, ISO/IEC 17025 AND ISO 10012-1 AND MIL-STD 45662A). ALL VERIFICATION DEVICES ARE TRACEABLE TO NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY(NIST). THIS CERTIFICATE RELATES ONLY TO THE ITEMS CALIBRATED.

THE UNCERTAINTY OF THE CALIBRATION PROCESS WAS ESTIMATED AT THE 95% CONFIDENCE LEVEL (K=2).

ACCREDITED

Certificate # 866.01
Calibration

Specification: **ASTM E 18-11**

Calibration Procedure: **CR104 Rev 10**

8/8/2012

Service Order #: ***12643 - 18***

SERVICE ENGINEER ***DATE***

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Cal~Rite Corporation

1665 QUINCY AVENUE, UNIT 123, NAPERVILLE, IL 60540
P 630.355.1522 F 630.355 1544 WWW.CAL-RITE.COM

Certificate # 866.01
Calibration

REPORT OF CALIBRATION

EXOVA
194 INTERNATIONALE BLVD
GLENDALE HEIGHTS, IL 60139-

Calibration Date: 11-Jul-2012
Next Calibration: 11-Jul-2013
Customer ID#:

Manufacturer: CLARK **Serial #:** CR0211 **Indirect/Direct:** Indirect
Model: CR-3e **Indicator:** DIGITAL **Resolution:** 0.1

All machine readings reported in as left condition.

Test Blk #: 112599		Test Blk #: 122613		Test Blk #: 124505		Test Blk #: 114657		Test Blk #: 105427	
Scale/Value:	A64.2	Scale/Value:	C24.4	Scale/Value:	B42.3	Scale/Value:	15T75.2	Scale/Blk #:	30T50.9
Blk Uncert:	0.44	Blk Uncert:	0.42	Blk Uncert:	0.70	Blk Uncert:	0.68	Blk Uncert:	0.50
Readings	Tol: 1.0	Readings	Tol: 1.0	Readings	Tol: 1.5	Readings	Tol: 1.5	Readings	Tol: 1.5
1	63.70 Mean:	1	24.80 Mean:	1	41.50 Mean:	1	74.60 Mean:	1	50.80 Mean:
2	63.90 63.920	2	24.80 24.900	2	41.90 42.040	2	74.70 74.680	2	50.80 50.880
3	64.00	3	25.20	3	42.00	3	74.70	3	51.00
4	64.00 Mean Error:	4	24.90 Mean Error:	4	42.40 Mean Error:	4	74.90 Mean Error:	4	50.90 Mean Error:
5	64.00 -0.2800	5	24.80 0.5000	5	42.40 -0.2600	5	74.50 -0.5200	5	50.90 -0.0200

Test Blk #: 104934		Test Blk #: 124271		Test Blk #: 117274		Test Blk #: 116614		Test Blk #: 117700	
Scale/Value:	A75.8	Scale/Value:	C44.9	Scale/Value:	B72.6	Scale/Value:	15T82.1	Scale/Value:	30T64.6
Blk Uncert:	0.33	Blk Uncert:	0.42	Blk Uncert:	0.70	Blk Uncert:	0.62	Blk Uncert:	0.45
Readings	Tol: 1.0	Readings	Tol: 1.0	Readings	Tol: 1.0	Readings	Tol: 1.0	Readings	Tol: 1.0
1	75.00 Mean:	1	44.80 Mean:	1	72.80 Mean:	1	81.60 Mean:	1	64.20 Mean:
2	75.20 75.160	2	45.00 44.960	2	72.20 72.460	2	81.80 81.700	2	64.40 64.460
3	75.30	3	45.20	3	71.90	3	81.70	3	64.20
4	75.20 Mean Error:	4	45.00 Mean Error:	4	72.80 Mean Error:	4	81.80 Mean Error:	4	64.50 Mean Error:
5	75.10 -0.6400	5	44.80 0.0600	5	72.60 -0.1400	5	81.60 -0.4000	5	65.00 -0.1400

Test Blk #: 106106		Test Blk #: 126267		Test Blk #: 119859		Test Blk #: 099901		Test Blk #: 109518	
Scale/Value:	A81.9	Scale/Value:	C62.8	Scale/Value:	B97.9	Scale/Value:	15T90.8	Scale/Value:	30T76.7
Blk Uncert:	0.26	Blk Uncert:	0.35	Blk Uncert:	0.61	Blk Uncert:	0.39	Blk Uncert:	0.41
Readings	Tol: 0.5	Readings	Tol: 0.5	Readings	Tol: 1.0	Readings	Tol: 1.0	Readings	Tol: 1.0
1	81.40 Mean:	1	62.60 Mean:	1	97.50 Mean:	1	90.30 Mean:	1	76.80 Mean:
2	81.50 81.480	2	62.60 62.500	2	97.90 97.920	2	90.40 90.540	2	77.00 77.000
3	81.40	3	62.50	3	98.20	3	90.60	3	77.00
4	81.50 Mean Error:	4	62.40 Mean Error:	4	97.90 Mean Error:	4	90.60 Mean Error:	4	76.90 Mean Error:
5	81.60 -0.4200	5	62.40 -0.3000	5	98.10 0.0200	5	90.80 -0.2600	5	77.30 0.3000

Certified Indenters

☑ C Diamond	☑ N Diamond	☑ 1/16 Ball	☑ 1/8 Ball	☐ 1/4 Ball	☐ 1/2 Ball
S/N: 110402	S/N: GD48450	S/N: 090119w	S/N: 080691w	S/N:	S/N:

☐ AS LEFT DATA ☑ AS FOUND AS LEFT DATA ☑ SPECIFICATION COMPLIANT ☐ REPAIRED: ☐ ADJUSTED:

Specification: ASTM E 18-11

CONDITION: Good

Calibration Procedure: CR104 Rev 10

Service Order #: *12643 - 18*

MITCHELL VINCENT *8/8/2012*
SERVICE ENGINEER *DATE*

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.

Cal-Rite Corporation

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P 630.355.1522 F 630.355.1544 WWW.CAL-RITE.COM

ACCREDITED
Certificate # 866.01
Calibration

REPORT OF CALIBRATION

EXOVA
194 INTERNATIONALE BLVD
GLENDALE HEIGHTS, IL 60139-

Calibration Date: 11-Jul-2012
Next Calibration: 11-Jul-2013
Customer ID#:

Manufacturer: CLARK **Serial #:** CR0211 **Indirect/Direct:** Indirect
Model: CR-3e **Indicator:** DIGITAL **Resolution:** 0.1

All machine readings reported in as left condition.

Test Blk #: 115640	Test Blk #: 103262	Test Blk #: 092404	Test Blk #: 072322	Test Blk #: 113419
Scale/Value: 45T27.5	Scale/Value: 15N75.8	Scale/Value: 30N45.9	Scale/Value: 45N28.6	Scale/Value: E75.4
Blk Uncert: 0.55	Blk Uncert: 0.57	Blk Uncert: 0.67	Blk Uncert: 0.47	Blk Uncert: 0.61
Readings Tol: 1.5	Readings Tol: 1.0	Readings Tol: 1.0	Readings Tol: 1.0	Readings Tol: 1.0
1 27.20 Mean:	1 75.40 Mean:	1 45.40 Mean:	1 28.20 Mean:	1 75.60 Mean:
2 27.90 27.900	2 75.60 75.520	2 45.60 45.520	2 28.40 28.180	2 75.40 75.640
3 28.20	3 75.60	3 45.50	3 28.20	3 75.90
4 28.20 Mean Error:	4 75.50 Mean Error:	4 45.40 Mean Error:	4 28.20 Mean Error:	4 75.60 Mean Error:
5 28.00 0.4000	5 75.50 -0.2800	5 45.70 -0.3800	5 27.90 -0.4200	5 75.70 0.2400

Test Blk #: 107153	Test Blk #: 104159	Test Blk #: 104090	Test Blk #: 074602	Test Blk #: 114896
Scale/Value: 45T43.4	Scale/Value: 15N84.3	Scale/Value: 30N68.7	Scale/Value: 45N53.1	Scale/Value: E84.4
Blk Uncert: 0.60	Blk Uncert: 0.56	Blk Uncert: 0.58	Blk Uncert: 0.55	Blk Uncert: 0.60
Readings Tol: 1.0	Readings Tol: 1.0	Readings Tol: 1.0	Readings Tol: 1.0	Readings Tol: 1.0
1 43.20 Mean:	1 84.30 Mean:	1 68.10 Mean:	1 52.50 Mean:	1 84.60 Mean:
2 43.50 43.320	2 84.40 84.360	2 68.60 68.480	2 52.60 52.580	2 84.40 84.640
3 43.30	3 84.30	3 68.60	3 52.60	3 84.80
4 43.40 Mean Error:	4 84.40 Mean Error:	4 68.50 Mean Error:	4 52.60 Mean Error:	4 84.80 Mean Error:
5 43.20 -0.0800	5 84.40 0.0600	5 68.60 -0.2200	5 52.60 -0.5200	5 84.60 0.2400

Test Blk #: 078746	Test Blk #: 116261	Test Blk #: 106432	Test Blk #: 076281	Test Blk #: 116650
Scale/Value: 45T59.8	Scale/Value: 15N91.7	Scale/Value: 30N79.3	Scale/Value: 45N67.1	Scale/Value: E97.6
Blk Uncert: 0.63	Blk Uncert: 0.41	Blk Uncert: 0.55	Blk Uncert: 0.51	Blk Uncert: 0.53
Readings Tol: 1.0	Readings Tol: 0.7	Readings Tol: 0.7	Readings Tol: 0.7	Readings Tol: 1.0
1 59.40 Mean:	1 91.50 Mean:	1 79.60 Mean:	1 66.70 Mean:	1 97.80 Mean:
2 59.60 59.900	2 91.60 91.580	2 79.40 79.500	2 67.20 66.980	2 98.00 97.880
3 60.20	3 91.50	3 79.50	3 67.10	3 97.90
4 60.20 Mean Error:	4 91.70 Mean Error:	4 79.40 Mean Error:	4 87.00 Mean Error:	4 97.80 Mean Error:
5 60.10 0.1000	5 91.60 -0.1200	5 79.60 0.2000	5 66.90 -0.1200	5 97.90 0.2800

Certified Indenters

☑ C Diamond	☑ N Diamond	☑ 1/16 Ball	☑ 1/8 Ball	☐ 1/4 Ball	☐ 1/2 Ball
S/N: 110402	S/N: GD48450	S/N: 090119w	S/N: 080691w	S/N:	S/N:

☐ AS LEFT DATA ☑ AS FOUND AS LEFT DATA ☑ SPECIFICATION COMPLIANT ☐ REPAIRED: ☐ ADJUSTED:

Specification: ASTM E 18-11

CONDITION: Good

Calibration Procedure: CR104 Rev 10

Service Order #: *12643 - 18*

MITCHELL VINCENT *8/8/2012*
SERVICE ENGINEER *DATE*

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.

Cal~Rite Corporation

1665 QUINCY AVENUE, UNIT 123, NAPERVILLE, IL 60540
P 630.355.1522 F 630.355 1544 WWW.CAL-RITE.COM

Certificate # 866.01
Calibration

REPORT OF CALIBRATION

EXOVA
194 INTERNATIONALE BLVD
GLENDALE HEIGHTS, IL 60139-

Calibration Date: 11-Jul-2012
Next Calibration: 11-Jul-2013
Customer ID#:

Manufacturer: CLARK **Serial #:** CR0211 **Indirect/Direct:** Indirect
Model: CR-3e **Indicator:** DIGITAL **Resolution:** 0.1

All machine readings reported in as left condition.

Test Blk #:	080858		
Scale/Value:	H90.4		
Blk Uncert:	0.62		
Readings	**Tol:** 1.0		
1	90.60	**Mean:**	
2	91.20		90.920
3	91.00		
4	91.00	**Mean Error:**	
5	90.80		0.5200

Test Blk #:	083219		
Scale/Value:	H99.3		
Blk Uncert:	0.44		
Readings	**Tol:** 1.0		
1	99.10	**Mean:**	
2	99.30		99.320
3	99.10		
4	99.50	**Mean Error:**	
5	99.60		0.0200

Certified Indenters

☑ C Diamond	☑ N Diamond	☑ 1/16 Ball	☑ 1/8 Ball	☐ 1/4 Ball	☐ 1/2 Ball
S/N: 110402	S/N: GD48450	S/N: 090119w	S/N: 080691w	S/N:	S/N:

☐ AS LEFT DATA ☑ AS FOUND AS LEFT DATA ☑ SPECIFICATION COMPLIANT ☐ REPAIRED: ☐ ADJUSTED:

Specification: ASTM E 18-11

CONDITION: Good

Calibration Procedure: **CR104 Rev 10**

Service Order #: ***12643 - 18***

MITCHELL VINCENT — *SERVICE ENGINEER*
8/8/2012 — ***DATE***

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Appendix C

C-107 Rebar Testing

Raw Data Sheets

Exova Inc.
Glendale Heights Laboratory

Date 01/16/13 Time 09.32 OpId MCF

T301058 W O R K S H E E T T301058

Client Construction Technology Labs
5420 Old Orchard Road
Skokie, IL

60077-1030
Contact JAMES LANE
Tel No 847 965 7500
Fax No 847 965 8997
Material CARBON STEEL

Ref No T301058 : Issue 1
MIF No

Ord No 50619D
Ledger Code CON100 (CTLI)
Terms Net
Date Instructed 01/16/13
Date Received 01/16/13
Date Required 01/31/13
Engineer Michael Fec

Item MACHINE AND TEST, 40 SAMPLES

Specification ASTM A370-12a

Data in CTL- folder (Public)

Date Instructed 01/16/13 Clear Workshop By 01/17/13 Date Required 01/31/13
Date Received 01/16/13 Complete Testing By 01/30/13

2-96

Tensile Test Test Specification ASTM E8 -11 .2% offset

			----- Dimensions ----- [in dia]	Area [in²]	GL [in]	YL [lbs]	UTL [lbs]	L_u [in]	S_u	Frac Loc	Yld Pt.
477(001)	Longitudinal	37-1a	0.2500	0.0491	1.00	2476	4102	1.285	.190	c	2,539
478(002)	Longitudinal	37-1b	~~0.2500~~ 249	0.0491	1.00	2500	4102	1.30	.180	c	2,691
479(003)	Longitudinal	37-2a	~~0.2500~~ 249	0.0491	1.00	2325	3825	1.33	.169	c	2,553
480(004)	Longitudinal	37-2b	0.2500	0.0491	1.00	2192	3846	1.33	.170	c	~~[illegible]~~
481(005)	Longitudinal	37-2c	0.2500	0.0491	1.00	2300	3839	1.33	.170	c	2453
482(006)	Longitudinal	39-1	0.2500	0.0491	1.00	2425	3882	1.32	.167	c	2,714
483(007)	Longitudinal	39-2a	0.2500	0.0491	1.00	2321	3760	1.32	.170	c	2,684
484(008)	Longitudinal	39-2b	0.2500	0.0491	1.00	2194	3742	1.32	.172	c	—
485(009)	Longitudinal	39-2c	0.2500	0.0491	1.00	2259	3747	1.34	.168	c	2,262
486(010)	Longitudinal	39-2d	~~0.2500~~ 249	0.0491	1.00	2321	3734	1.33	.167	c	2,680
487(011)	Longitudinal	39-2e	0.2500	0.0491	1.00	2319	3729	1.32	.164	c	2,716
488(012)	Longitudinal	40a	0.2500	0.0491	1.00	2217	3729	1.31	.164	c	2,362

1.22.13 CL

Exova Inc.
Glendale Heights Laboratory

Date 01/16/13 Time 09.32 OpId MCF

T301058 W O R K S H E E T T301058

Client Construction Technology Labs
5420 Old Orchard Road
Skokie, IL

Ref No T301058 : Issue 1
MIF No

2-126

Tensile Test Test Specification ASTM E8 -11

		----- Dimensions ----- [in dia]	Area [in^2]	GL [in]	YL [lbs]	UTL [lbs]	L_u [in]	S_u	Frac Loc	
489(013) Longitudinal	40b	0.2500	0.0491	1.00	2155	3779	1.33	.170	c	2,175
490(014) Longitudinal	40c	0.2500	0.0491	1.00	2136	3776	1.33	.170	c	—
491(015) Longitudinal	40d	~~0.2500~~ .249	0.0491	1.00	2050	3769	1.31	.167	c	—
492(016) Longitudinal	40e	~~0.2500~~ .249	0:0491	1.00	2127	3799	1.31	.166	c	—
493(017) Longitudinal	41-2	~~0.2500~~ .249	0.0491	1.00	2326	3860	1.32	.167	c	2,434
494(018) Longitudinal	41-3a	0.2500	0.0491	1.00	2373	3752	1.30	.163	c	2,714
495(019) Longitudinal	41-3b	~~0.2500~~ .249	0.0491	1.00	2222	3759	1.315	.173	c	2,302
496(020) Longitudinal	41-3c	~~0.2500~~ .249	0.0491	1.00	2331	3762	1.32	.176	c	2,630
497(021) Longitudinal	41-3d	~~0.2500~~ .248	0.0491	1.00	2348	3726	1.31	.165	c	2,639
498(022) Longitudinal	41-3e	~~0.2500~~ .249	0.0491	1.00	2338	3738	1.33	.164	c	2,655
499(023) Longitudinal	41-1	~~0.2500~~ .249	0.0491	1.00	2374	4044	1.30	.178	c	2,475
500(024) Longitudinal	41-4a	~~0.2500~~ .253	0.0491	1.00	2487	4036	1.33	.165	c	2,871
501(025) Longitudinal	41-4b	0.2500	0.0491	1.00	2381	3911	1.33	.165	c	2,748
502(026) Longitudinal	41-4c	~~0.2500~~ .253	0.0491	1.00	2270	3987	1.33	.163	c	2,367
503(027) Longitudinal	41-4d	0.2500	0.0491	1.00	2433	3920	1.34	.161	c	2,725
504(028) Longitudinal	41-4e	~~0.2500~~ .248	0.0491	1.00	2246	3881	1.33	.162	c	—
505(029) Longitudinal	41-4f	~~0.2500~~ .249	0.0491	1.00	2291	3882	1.33	.161	c	—
506(030) Longitudinal	42a	~~0.2500~~ .247	0.0491	1.00	2451	3845	1.31	.166	c	2838
507(031) Longitudinal	42b	~~0.2500~~ .246	0.0491	1.00	2269	3835	1.29	.170	c	2362

1.22.13 GL

Exova Inc.
Glendale Heights Laboratory

Date 01/16/13 Time 09.32 OpId MCF

T301058 W O R K S H E E T T301058

Client Construction Technology Labs
5420 Old Orchard Road
Skokie, IL

Ref No T301058 : Issue 1
MIF No

Tensile Test Test Specification ASTM E8 -11 2-126

			----- Dimensions ----- [in dia]	Area [in^2]	GL [in]	YL [lbs]	UTL [lbs]	L_u [in]	S_u	Frac Loc	
											1.22 13
508(032)	Longitudinal	42c	0.2500	0.0491	1.00	2277	3859	1.32	.167	c	2373
509(033)	Longitudinal	42d	.247 ~~0.2500~~	0.0491	1.00	2135	3732	1.33	.165	C	—
510(034)	Longitudinal	43-1a	.245 ~~0.2500~~	0.0491	1.00	2074	3568	1.31	.162	c	—
511(035)	Longitudinal	43-1b	.248 ~~0.2500~~	0.0491	1.00	2254	3711	1.32	.161	c	2,358
512(036)	Longitudinal	43-2a	.246 ~~0.2500~~	0.0491	1.00	2169	3811	1.32	.167	c	—
513(037)	Longitudinal	43-2b	.246 ~~0.2500~~	0.0491	1.00	2315	3792	1.32	.166	c	2,636
514(038)	Longitudinal	43-2c	.245 ~~0.2500~~	0.0491	1.00	2249	3780	1.32	.162	c	2,311
515(039)	Longitudinal	43-2d	.245 ~~0.2500~~	0.0491	1.00	2223	3782	1.32	.167	c	2,327
516(040)	Longitudinal	43-2e	.248 ~~0.2500~~	0.0491	1.00	2216	3839	1.32	.167	c	

Tested By ..... Date ..... 1.23.13 [illegible]

Worksheet Comments

CONTRACT REVIEW

CHECK			ACTION REQUIRED
REPEAT SCOPE OF WORK--------	Y	(N)	SEE _____
TEST REQUIREMENTS DEFINED---	(Y)		
MAT'L SPEC&ISSUE DEFINED----	Y	(N/A)	
MAT'L SPEC/ISSUE AVAILABLE--	Y	(N/A)	
ACCREDITATIONS REQ'D--------	Y	(N)	17025 NADCAP NUCLEAR PRATT GE RR
TESTS WITHIN SCOPE----------	(Y)	N/A	
RESOURCES AVAILABLE---------	(Y)		
SUBCONTRACTING REQUIRED-----	Y	(N)	VENDOR _____
MATERIAL OK FOR REQUEST-----	(Y)		

Exova Inc.
Glendale Heights Laboratory

Date 01/16/13 Time 14.13 OpId MCF

T301058 W O R K S H E E T T301058

Client Construction Technology Labs
5420 Old Orchard Road
Skokie, IL

Ref No T301058 : Issue 1
MIF No

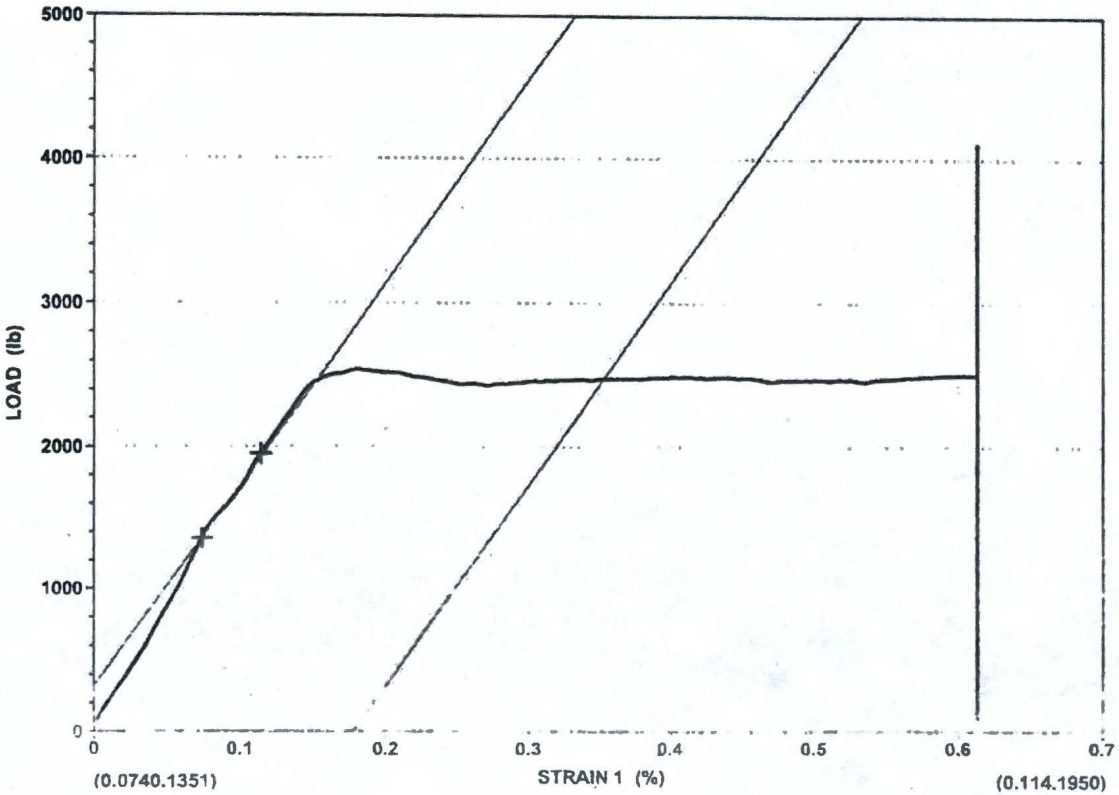
Tensile Test Test Specification ASTM E8 -11

		----- Dimensions ----- [in dia]	Area [in^2]	GL [in]	YL [lbs]	UTL [lbs]	L_u [in]	S_u	Frac Loc	
508(032) Longitudinal		0.2500	0.0491	1.00		~~4042~~				
509(033) Longitudinal		0.2500	0.0491	1.00						
510(034) Longitudinal		0.2500	0.0491	1.00						
511(035) Longitudinal		0.2500	0.0491	1.00						
512(036) Longitudinal		0.2500	0.0491	1.00						
513(037) Longitudinal		0.2500	0.0491	1.00						
514(038) Longitudinal		0.2500	0.0491	1.00						
515(039) Longitudinal		0.2500	0.0491	1.00						
516(040) Longitudinal		0.2500	0.0491	1.00						2-126
536(041) Longitudinal	43-3a	~~0.2500~~ .247	0.0491	1.00	2349	4042	1.305	.169	c	—
537(042) Longitudinal	43-3b	~~0.2500~~ .247	0.0491	1.00	2341	4030	1.32	.171	c	2,362
538(043) Longitudinal	43-3c	~~0.2500~~ .248	0.0491	1.00	2360	4058	1.32	.168	c	—
539(044) Longitudinal	43-3d	~~0.2500~~ .248	0.0491	1.00	2306	4031	1.31	.170	c	—
540(045) Longitudinal	43-3e	~~0.2500~~ .247	0.0491	1.00	2470	3995	1.30	.170	c	2,780
541(046) Longitudinal	45a	~~0.2500~~ .247	0.0491	1.00	2204	3697	1.32	.164	c	2,309
542(047) Longitudinal	45b	~~0.2500~~ .247	0.0491	1.00	2147	3703	1.315	.165	c	—
543(048) Longitudinal	45c	~~0.2500~~ .247	0.0491	1.00	2294	3697	1.32	.163	c	2,676

1.23.13 QV

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-477-1
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



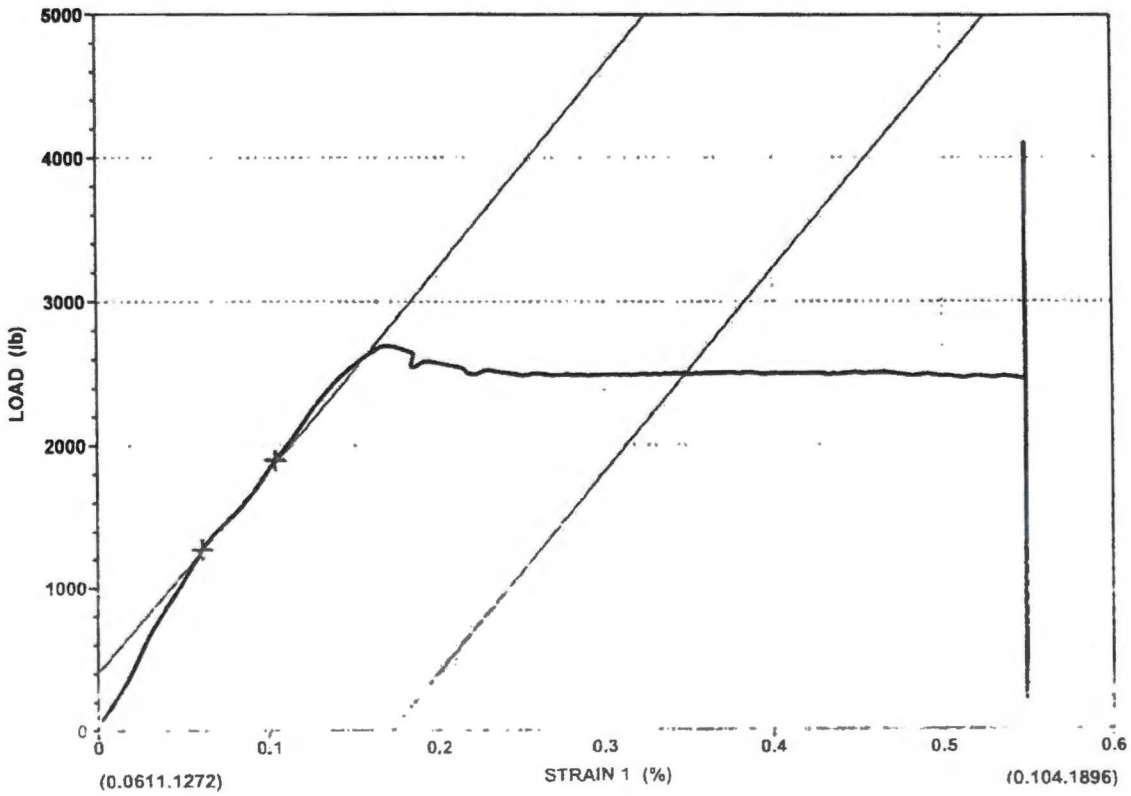
Date: 01/22/13

Time: 09:59:35
Elapsed: 00:06:57

Peak Load	4102 lb
Peak Stress	83544 psi
Modulus of Elasticity	28663116 psi
Yield @ 0.20% Offset	50428 psi
Yield @ 0.20% Offset	2476 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	28.50 %
Gage Length	1.0000 in
Reduction of Area	42.24 %
Yield-Halt of Force	51647 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-478
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2490 in
Gage Length:	1.0000 in
Area:	0.0487 sq in



Date: 01/22/13

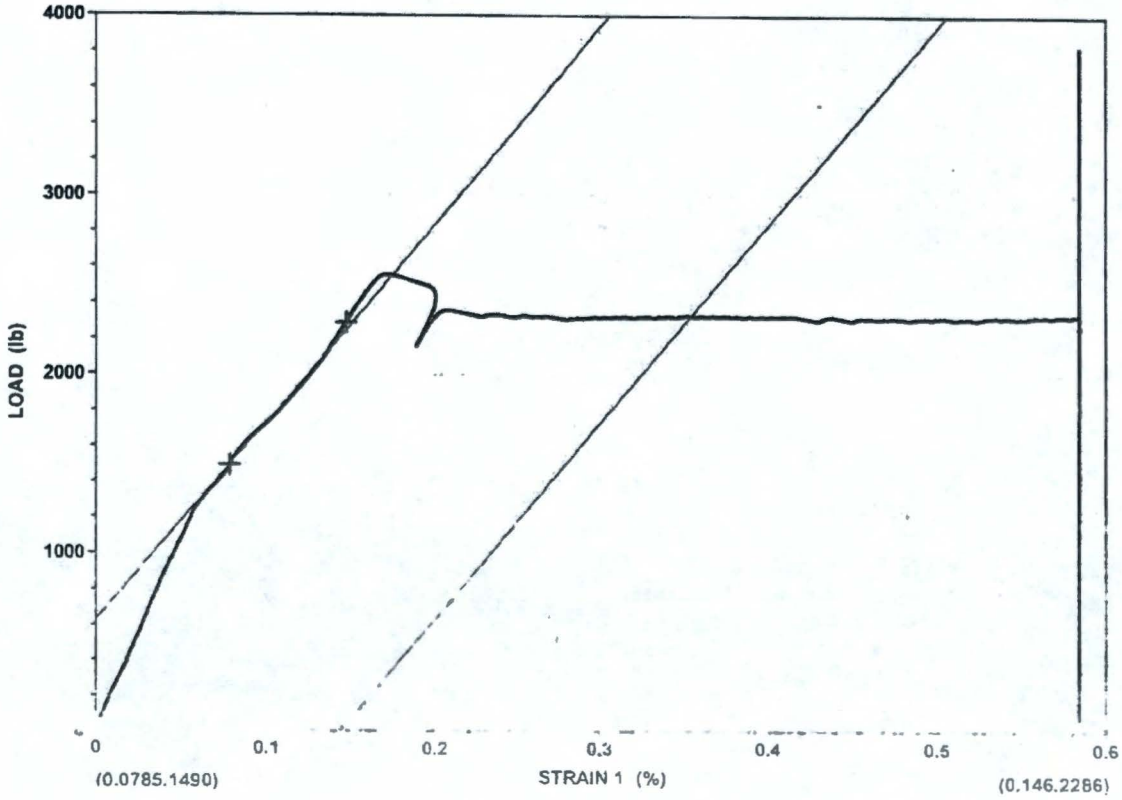
Time: 10:10:13
Elapsed: 00:07:35

Peak Load	4102 lb
Peak Stress	84230 psi
Modulus of Elasticity	28972639 psi
Yield @ 0.20% Offset	51335 psi
Yield @ 0.20% Offset	2500 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	30.00 %
Gage Length	1.0000 in
Reduction of Area	47.74 %
Yield-Halt of Force	54922 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

477.

Specimen #:	301058-479
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2490 in
Gage Length:	1.0000 in
Area:	0.0487 sq in



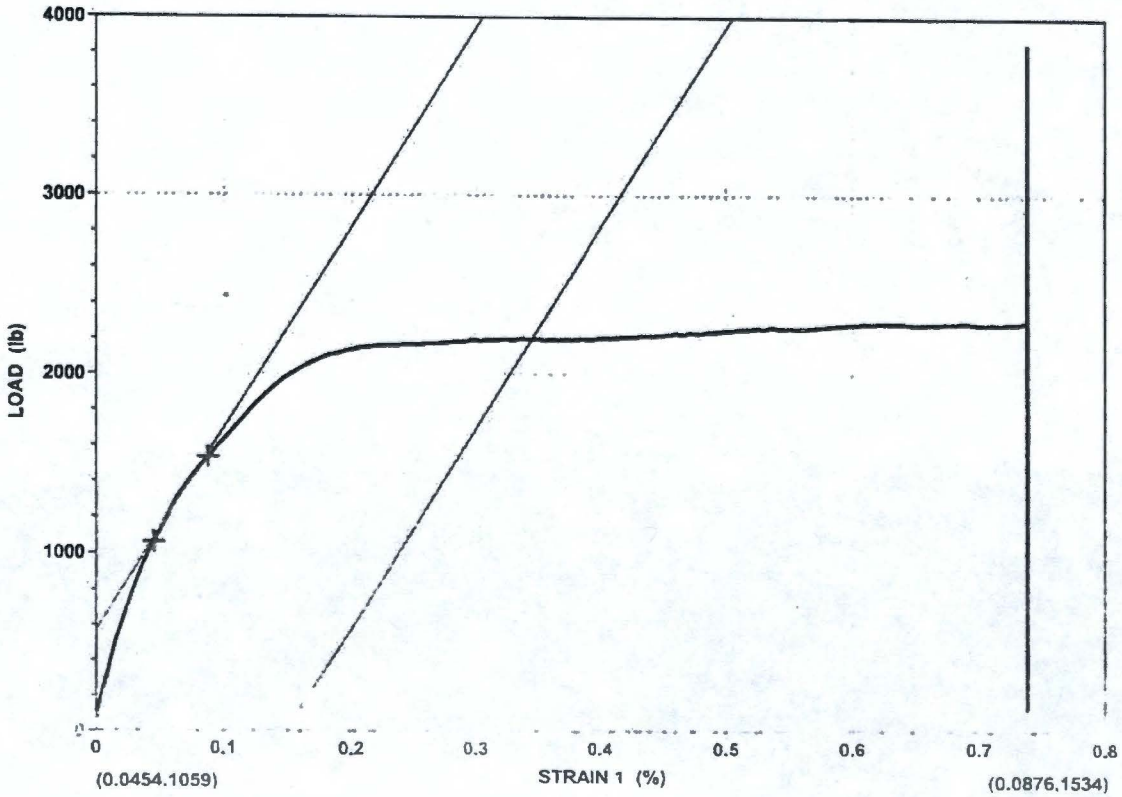
Date: 01/22/13

Time: 09:11:34
Elapsed: 00:07:58

Peak Load	3825 lb
Peak Stress	78542 psi
Modulus of Elasticity	22646360 psi
Yield @ 0.20% Offset	47741 psi
Yield @ 0.20% Offset	2325 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	33.00 %
Gage Length	1.0000 in
Reduction of Area	53.93 %
Yield-Halt of Force	51856 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-480
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



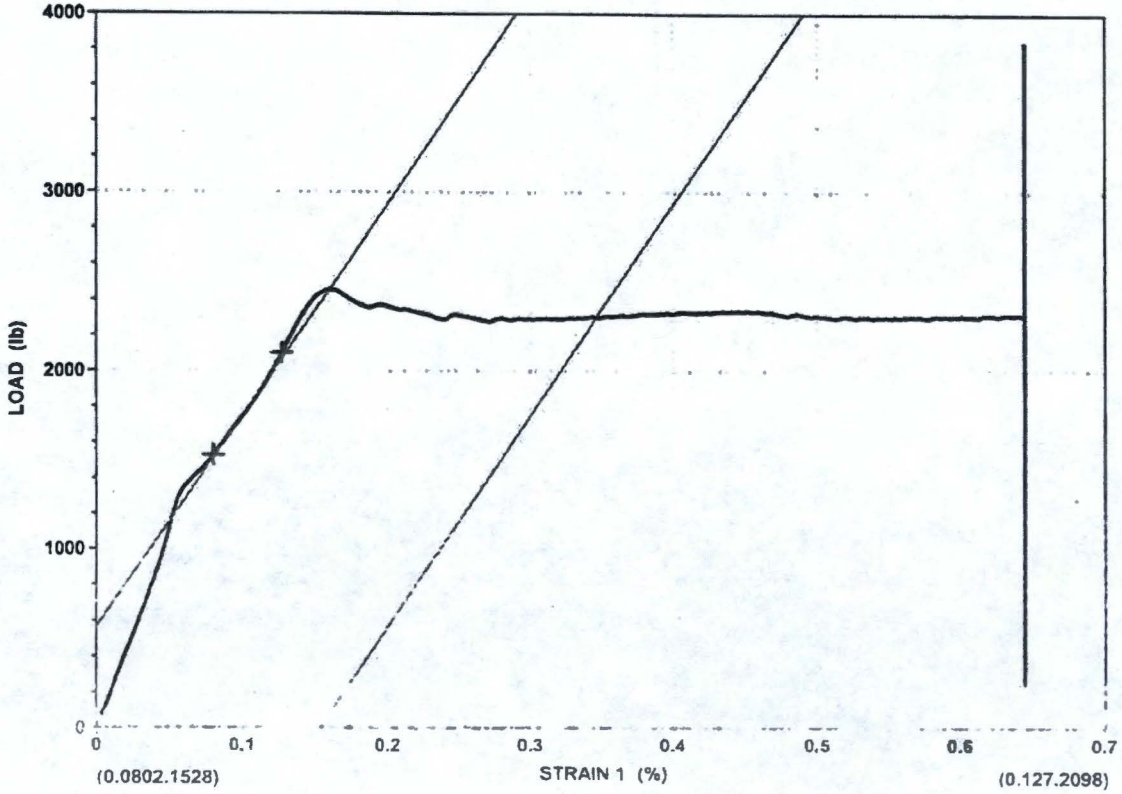
Date: 01/22/13

Time: 09:26:27
Elapsed: 00:08:16

Peak Load	3846 lb
Peak Stress	78330 psi
Modulus of Elasticity	22844667 psi
Yield @ 0.20% Offset	44644 psi
Yield @ 0.20% Offset	2192 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	33.00 %
Gage Length	1.0000 in
Reduction of Area	53.76 %
Yield-Halt of Force	43997 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-481
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in

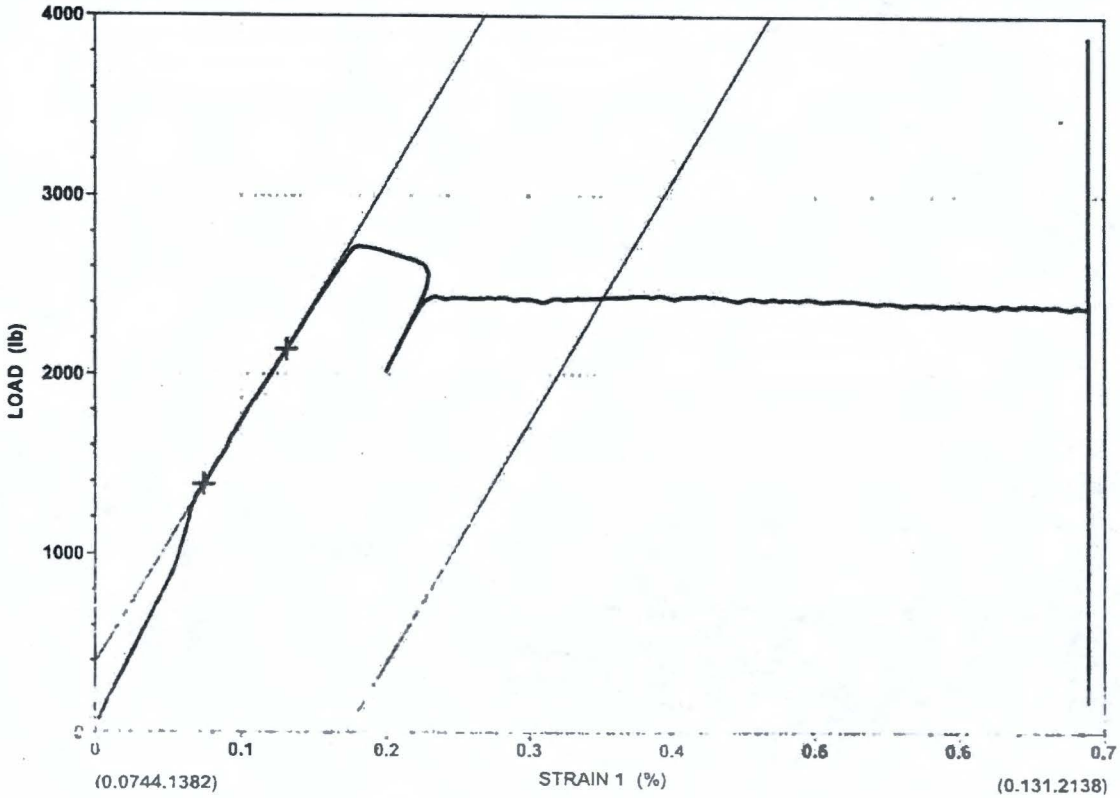


Date: 01/22/13 Time: 09:37:55
Elapsed: 00:08:07

Peak Load	3839 lb
Peak Stress	78187 psi
Modulus of Elasticity	24116871 psi
Yield @ 0.20% Offset	46843 psi
Yield @ 0.20% Offset	2300 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	33.00 %
Gage Length	1.0000 in
Reduction of Area	53.76 %
Yield-Halt of Force	49700 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-482
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



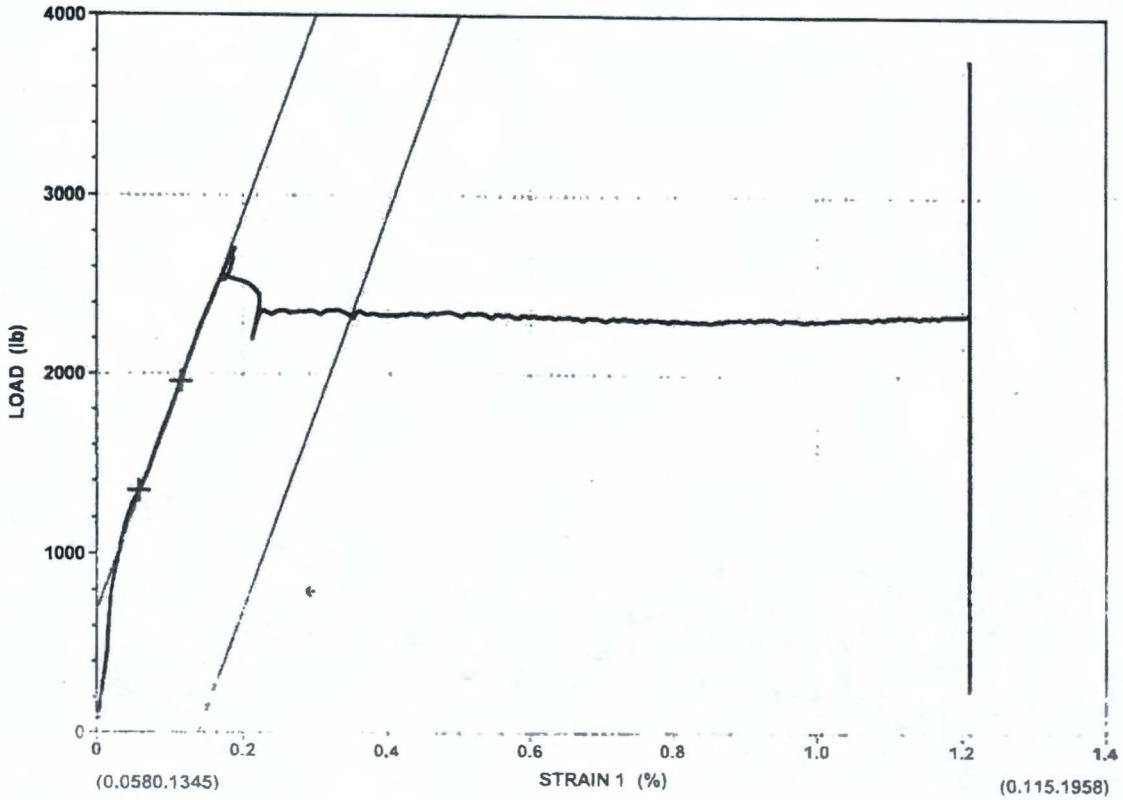
Date: 01/22/13

Time: 09:48:55
Elapsed: 00:07:54

Peak Load	3882 lb
Peak Stress	79063 psi
Modulus of Elasticity	27398640 psi
Yield @ 0.20% Offset	49389 psi
Yield @ 0.20% Offset	2425 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	55.38 %
Yield-Halt of Force	54627 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-483
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



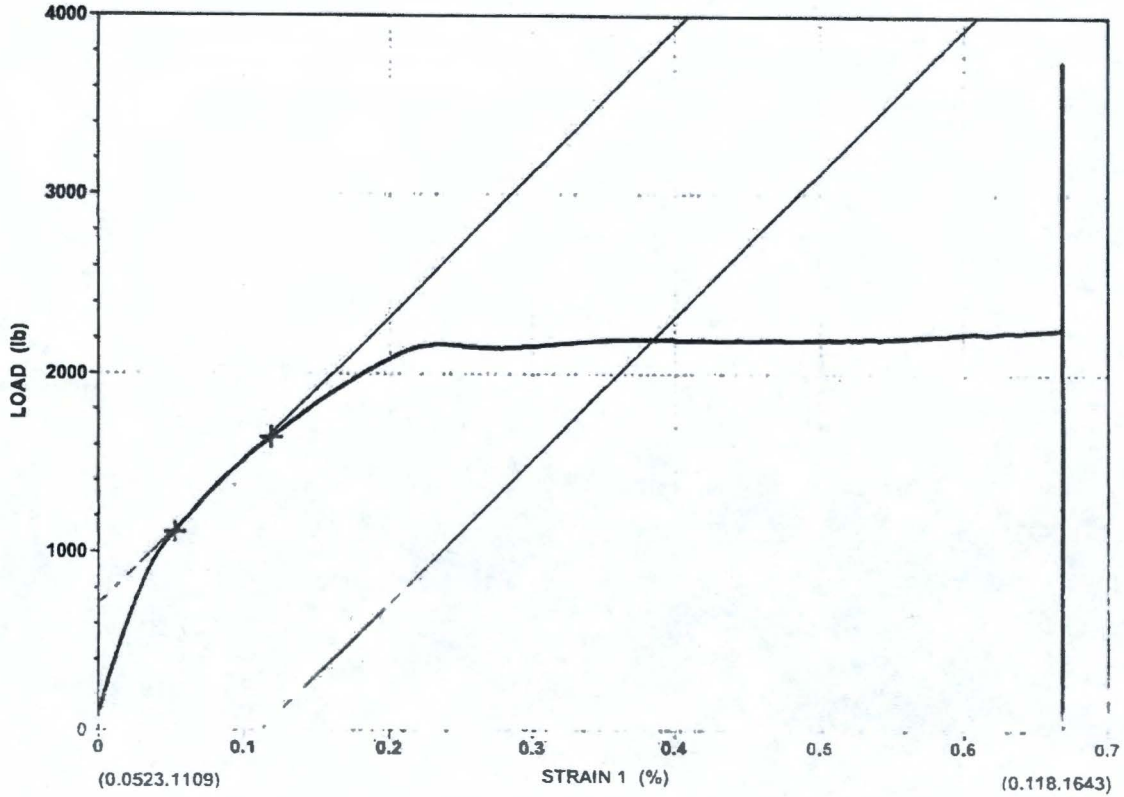
Date: 01/22/13

Time: 10:26:35
Elapsed: 00:09:01

Peak Load	3760 lb
Peak Stress	76578 psi
Modulus of Elasticity	22535152 psi
Yield @ 0.20% Offset	47271 psi
Yield @ 0.20% Offset	2321 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	53.76 %
Yield-Halt of Force	54668 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-484
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



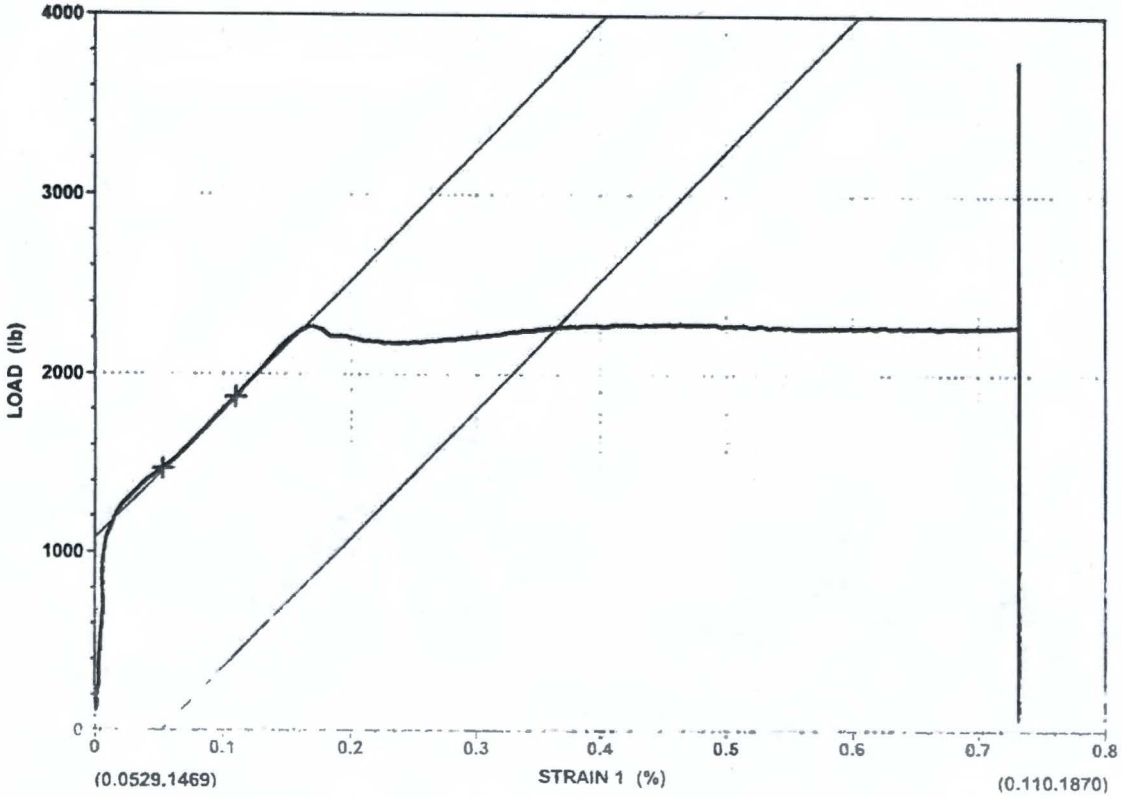
Date: 01/22/13

Time: 10:39:01
Elapsed: 00:08:18

Peak Load	3742 lb
Peak Stress	76212 psi
Modulus of Elasticity	16361061 psi
Yield @ 0.20% Offset	44684 psi
Yield @ 0.20% Offset	2194 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	52.67 %
Yield-Halt of Force	44094 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-485
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



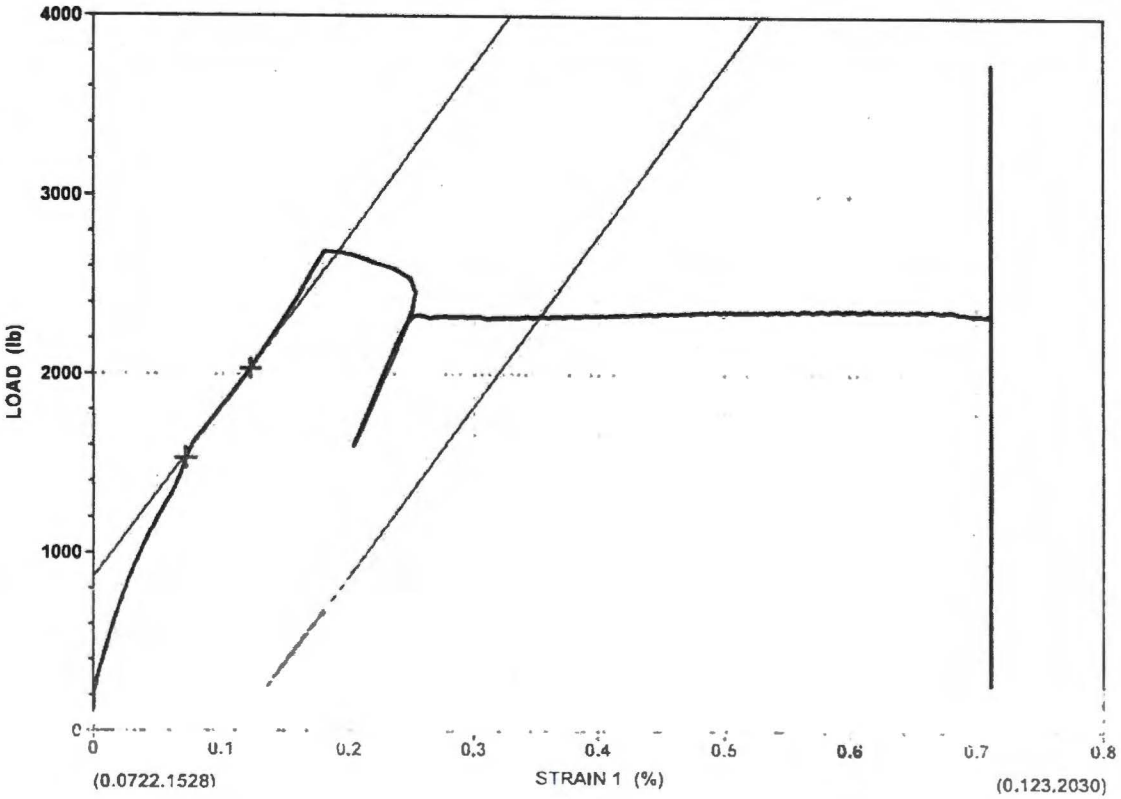
Date: 01/22/13

Time: 10:51:11
Elapsed: 00:08:29

Peak Load	3747 lb
Peak Stress	76314 psi
Modulus of Elasticity	14702096 psi
Yield @ 0.20% Offset	46008 psi
Yield @ 0.20% Offset	2259 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	34.00 %
Gage Length	1.0000 in
Reduction of Area	54.84 %
Yield-Halt of Force	45969 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-486
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2490 in
Gage Length:	1.0000 in
Area:	0.0487 sq in



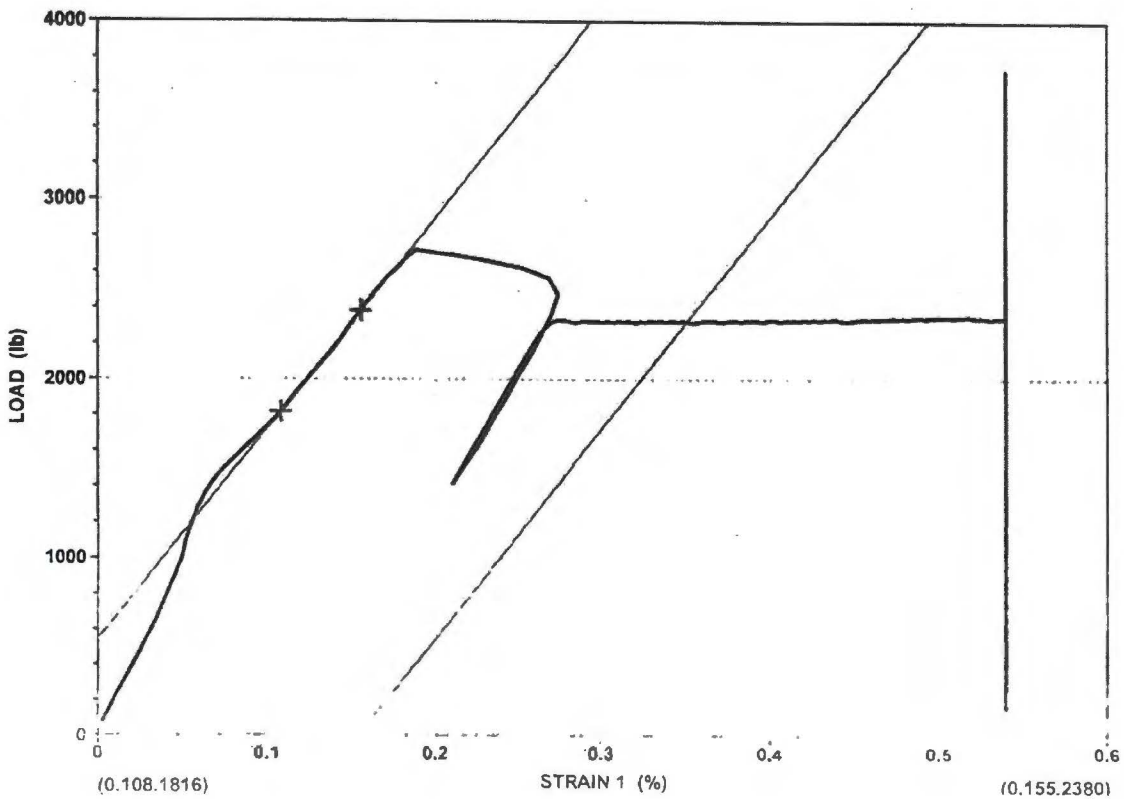
Date: 01/22/13

Time: 11:02:15
Elapsed: 00:08:12

Peak Load	3734 lb
Peak Stress	76674 psi
Modulus of Elasticity	19568869 psi
Yield @ 0.20% Offset	47659 psi
Yield @ 0.20% Offset	2321 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	33.00 %
Gage Length	1.0000 in
Reduction of Area	55.02 %
Yield-Halt of Force	54251 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-487
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



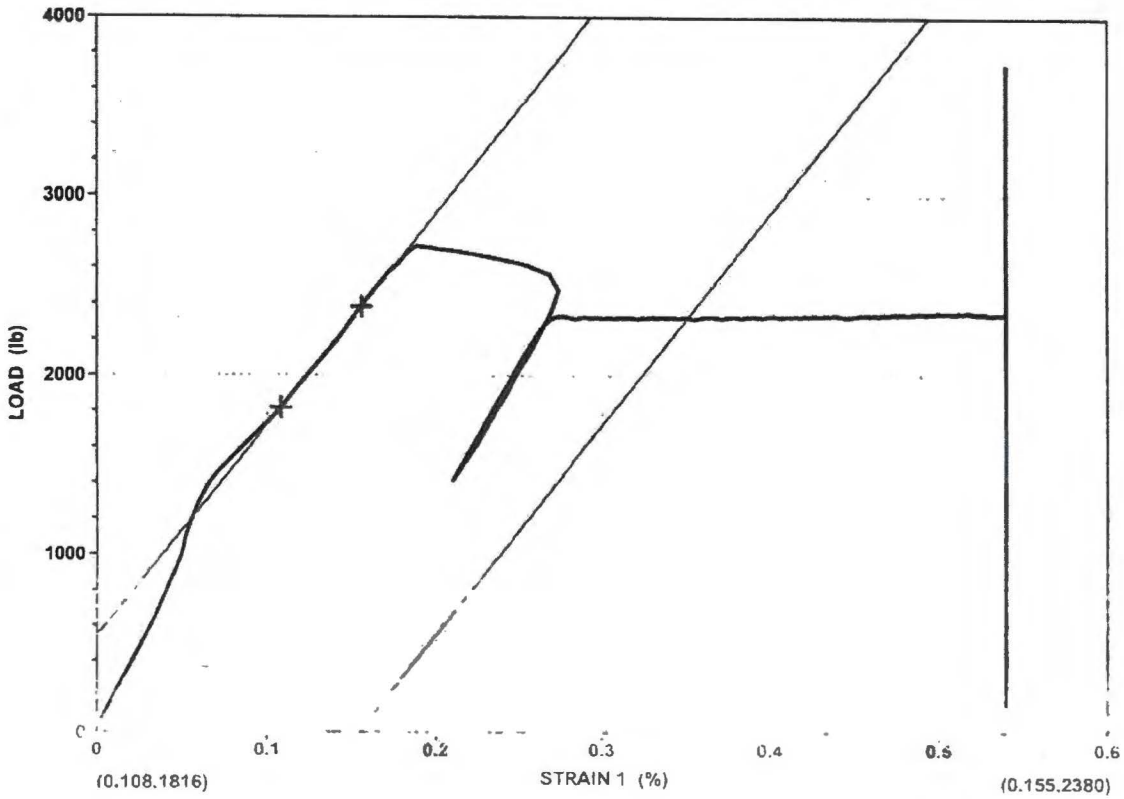
Date: 01/22/13

Time: 11:16:46
Elapsed: 00:07:51

Peak Load	3729 lb
Peak Stress	75947 psi
Modulus of Elasticity	23969699 psi
Yield @ 0.20% Offset	47230 psi
Yield @ 0.20% Offset	2319 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	56.97 %
Yield-Halt of Force	54542 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-487
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



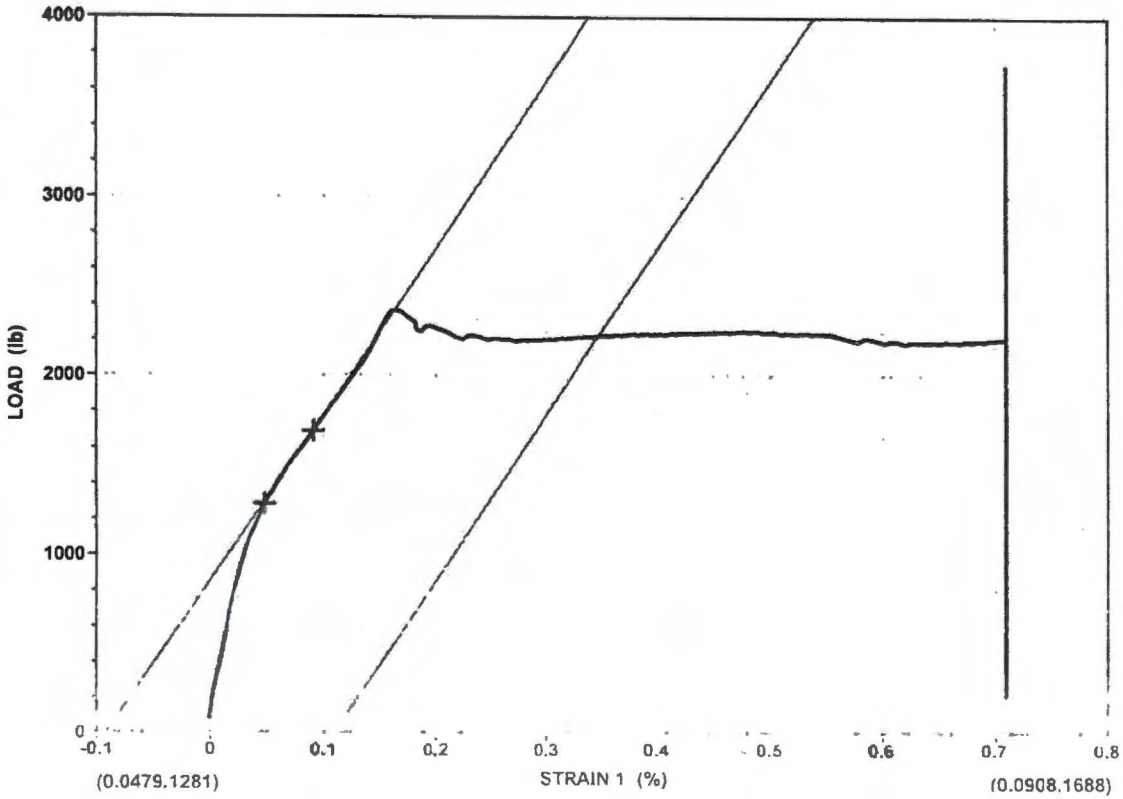
Date: 01/22/13

Time: 11:16:46
Elapsed: 00:07:51

Peak Load	3729 lb
Peak Stress	75947 psi
Modulus of Elasticity	23969699 psi
Yield @ 0.20% Offset	47230 psi
Yield @ 0.20% Offset	2319 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	56.97 %
Yield-Halt of Force	54542 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-488
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



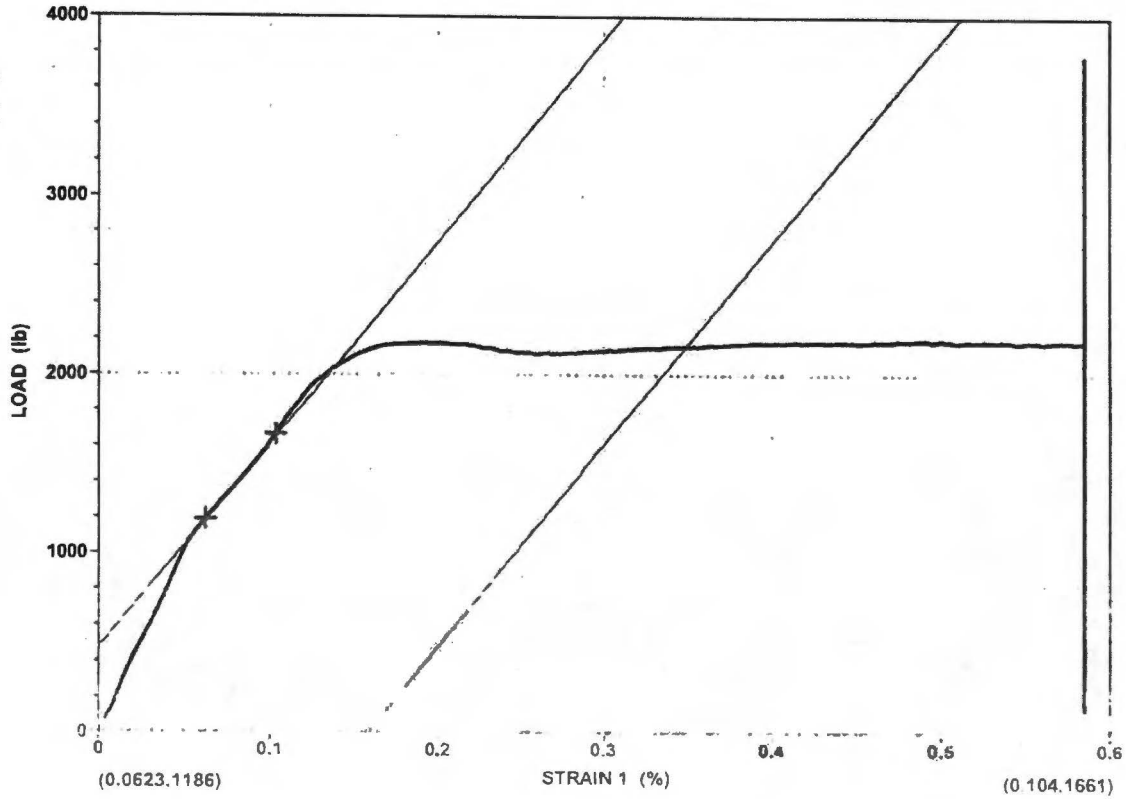
Date: 01/22/13

Time: 11:27:43
Elapsed: 00:08:03

Peak Load	3729 lb
Peak Stress	75947 psi
Modulus of Elasticity	18929677 psi
Yield @ 0.20% Offset	45153 psi
Yield @ 0.20% Offset	2217 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	31.00 %
Gage Length	1.0000 in
Reduction of Area	56.97 %
Yield-Halt of Force	47763 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-489
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



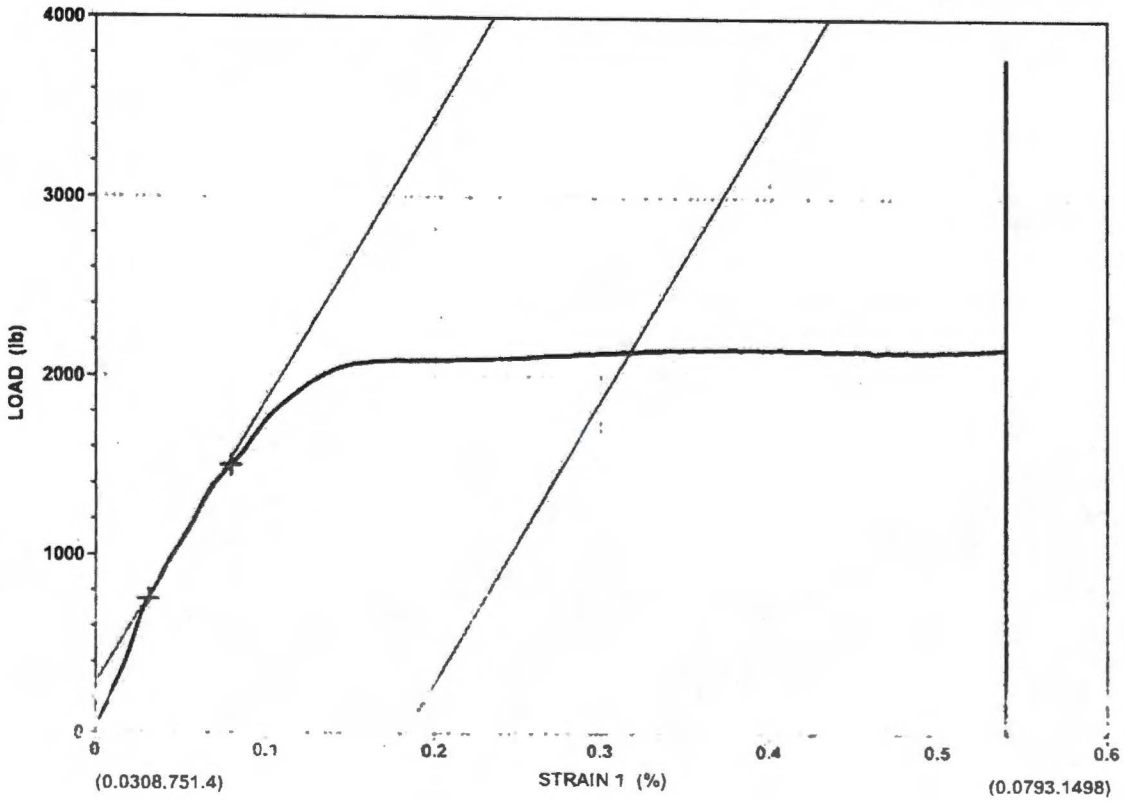
Date: 01/22/13

Time: 11:39:19
Elapsed: 00:08:13

Peak Load	3779 lb
Peak Stress	76965 psi
Modulus of Elasticity	23052271 psi
Yield @ 0.20% Offset	43890 psi
Yield @ 0.20% Offset	2155 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	33.00 %
Gage Length	1.0000 in
Reduction of Area	53.76 %
Yield-Halt of Force	44275 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-490
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



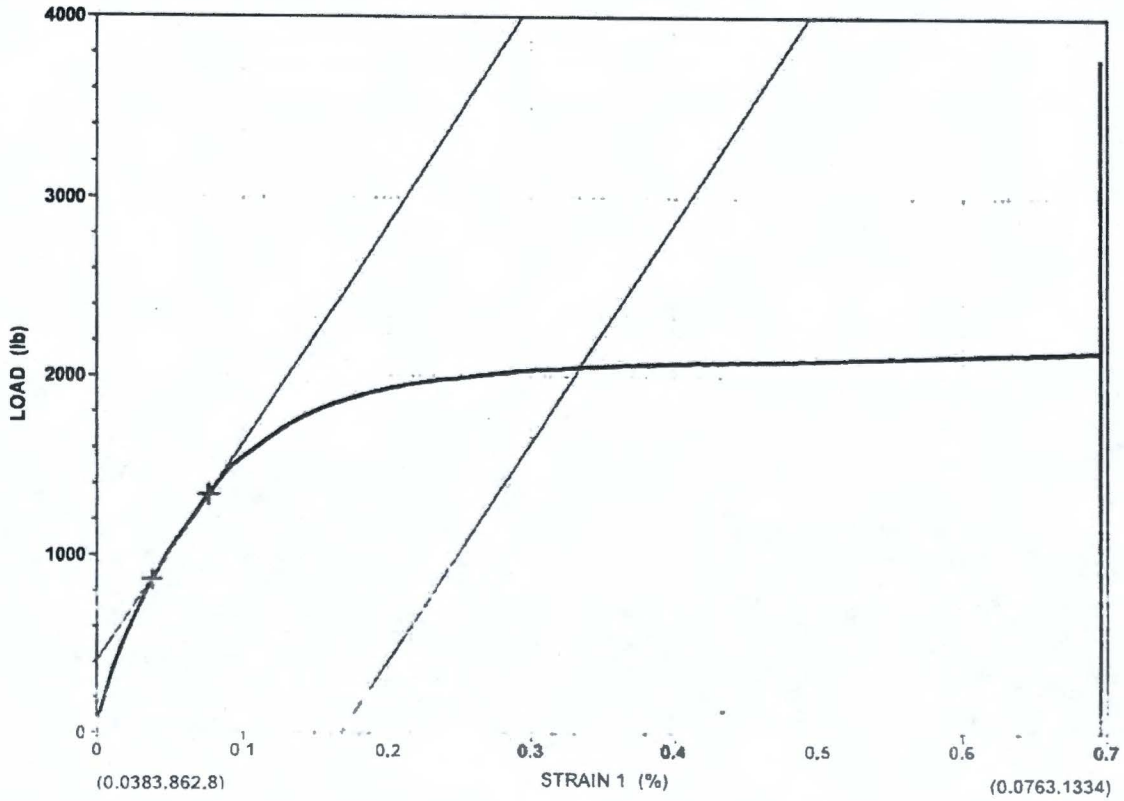
Date: 01/22/13

Time: 11:49:44
Elapsed: 00:08:12

Peak Load	3776 lb
Peak Stress	76904 psi
Modulus of Elasticity	32180604 psi
Yield @ 0.20% Offset	43503 psi
Yield @ 0.20% Offset	2136 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	33.00 %
Gage Length	1.0000 in
Reduction of Area	53.76 %
Yield-Halt of Force	42479 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-491
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2490 in
Gage Length:	1.0000 in
Area:	0.0487 sq in



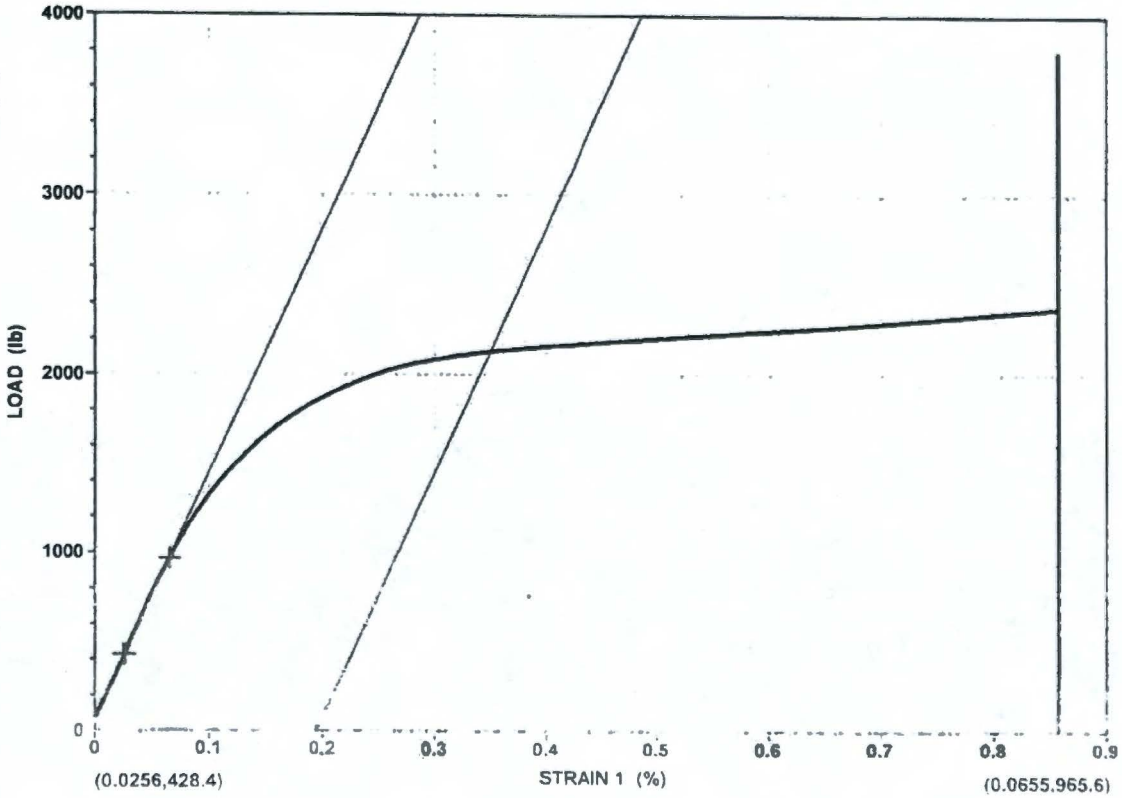
Date: 01/22/13

Time: 12:00:01
Elapsed: 00:08:07

Peak Load	3769 lb
Peak Stress	77392 psi
Modulus of Elasticity	25083200 psi
Yield @ 0.20% Offset	42094 psi
Yield @ 0.20% Offset	2050 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	31.00 %
Gage Length	1.0000 in
Reduction of Area	55.02 %
Yield-Halt of Force	42357 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-492
Operator:	TS
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2490 in
Gage Length:	1.0000 in
Area:	0.0487 sq in



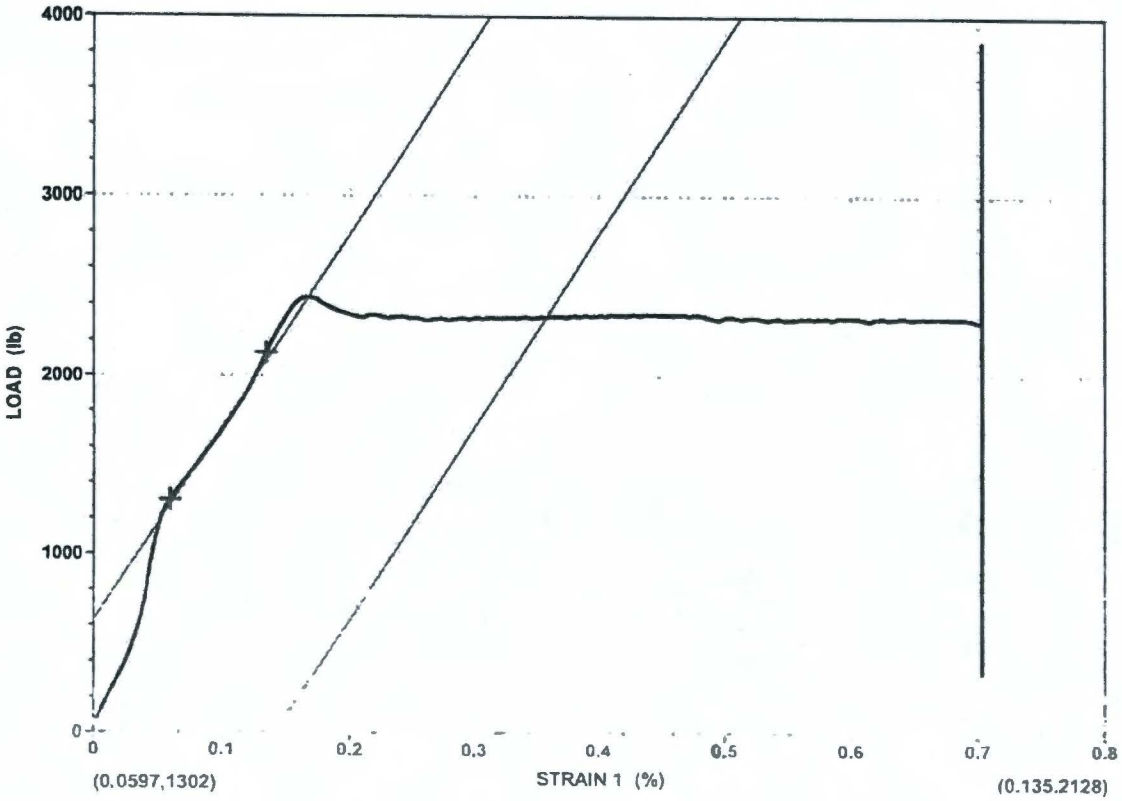
Date: 01/22/13

Time: 12:37:48
Elapsed: 00:07:54

Peak Load	3799 lb
Peak Stress	78008 psi
Modulus of Elasticity	28016041 psi
Yield @ 0.20% Offset	43676 psi
Yield @ 0.20% Offset	2127 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	31.00 %
Gage Length	1.0000 in
Reduction of Area	55.56 %
Yield-Halt of Force	44513 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-493
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2490 in
Gage Length:	1.0000 in
Area:	0.0487 sq in



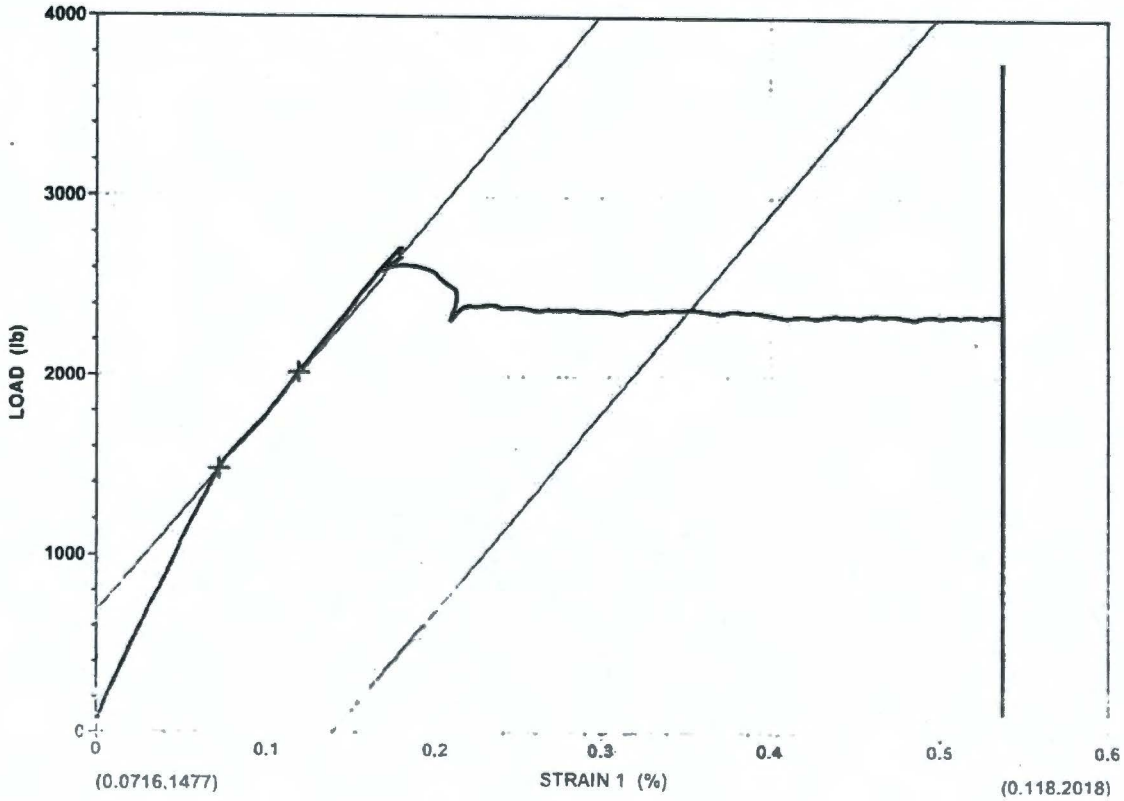
Date: 01/22/13

Time: 12:48:32
Elapsed: 00:08:26

Peak Load	3860 lb
Peak Stress	79261 psi
Modulus of Elasticity	22125861 psi
Yield @ 0.20% Offset	47762 psi
Yield @ 0.20% Offset	2326 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	55.02 %
Yield-Halt of Force	49850 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-494
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



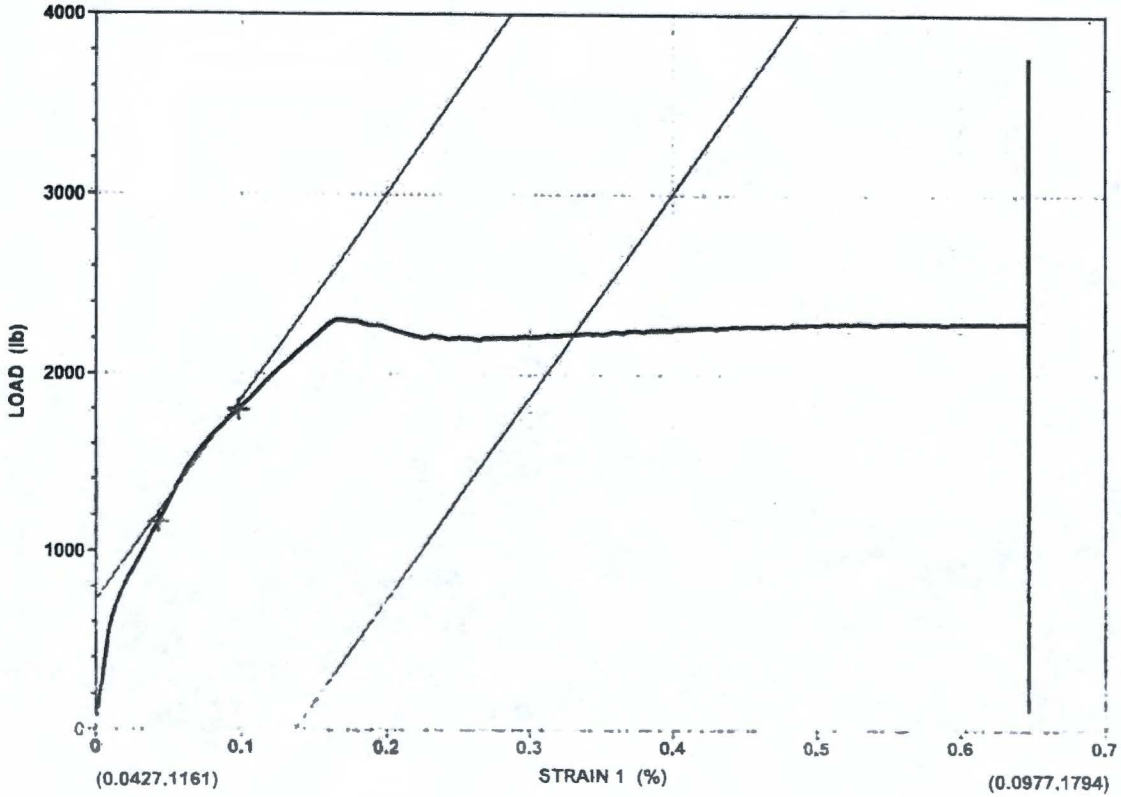
Date: 01/22/13

Time: 13:01:40
Elapsed: 00:07:41

Peak Load	3752 lb
Peak Stress	76415 psi
Modulus of Elasticity	22643232 psi
Yield @ 0.20% Offset	48330 psi
Yield @ 0.20% Offset	2373 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	30.00 %
Gage Length	1.0000 in
Reduction of Area	57.49 %
Yield-Halt of Force	54966 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-495
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2490 in
Gage Length:	1.0000 in
Area:	0.0487 sq in



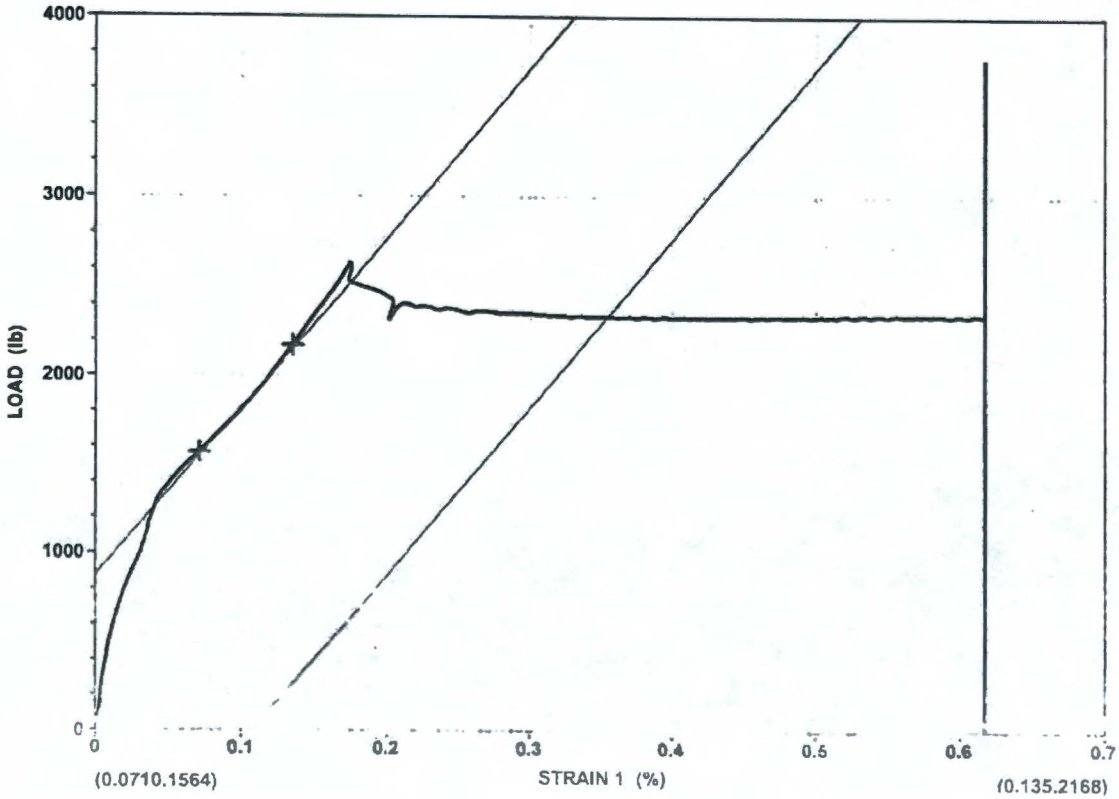
Date: 01/22/13

Time: 13:12:09
Elapsed: 00:07:53

Peak Load	3759 lb
Peak Stress	77187 psi
Modulus of Elasticity	23421107 psi
Yield @ 0.20% Offset	45626 psi
Yield @ 0.20% Offset	2222 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	31.50 %
Gage Length	1.0000 in
Reduction of Area	51.73 %
Yield-Halt of Force	47186 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-496
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2490 in
Gage Length:	1.0000 in
Area:	0.0487 sq in



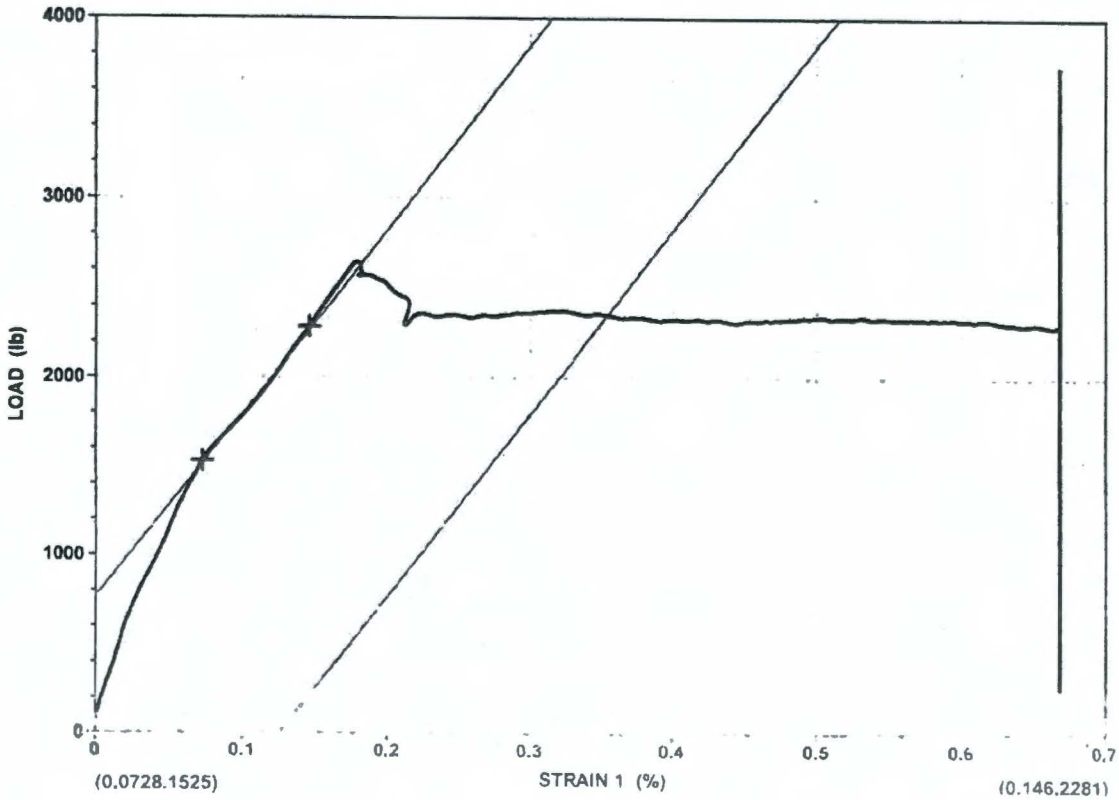
Date: 01/22/13

Time: 13:22:38
Elapsed: 00:07:51

Peak Load	3762 lb
Peak Stress	77248 psi
Modulus of Elasticity	19400486 psi
Yield @ 0.20% Offset	47864 psi
Yield @ 0.20% Offset	2331 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	50.04 %
Yield-Halt of Force	53583 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-497
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2480 in
Gage Length:	1.0000 in
Area:	0.0483 sq in



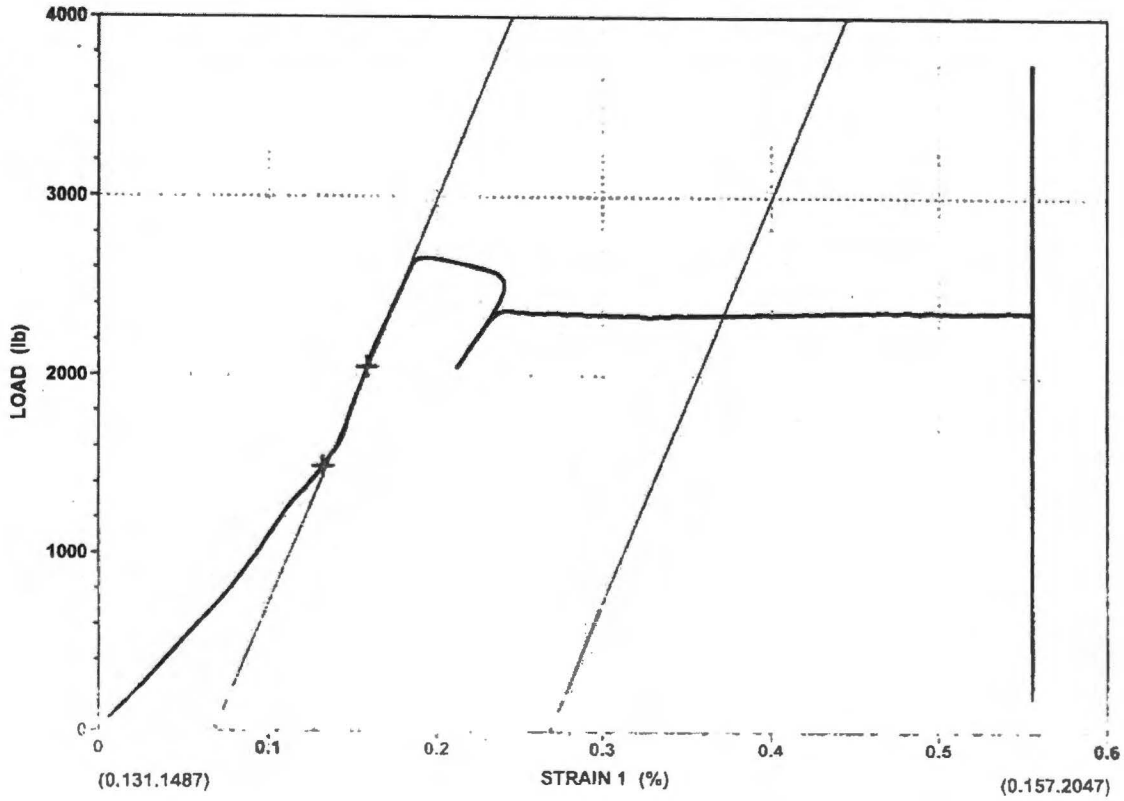
Date: 01/22/13

Time: 13:32:57
Elapsed: 00:07:54

Peak Load	3726 lb
Peak Stress	77143 psi
Modulus of Elasticity	21236747 psi
Yield @ 0.20% Offset	48613 psi
Yield @ 0.20% Offset	2348 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	31.00 %
Gage Length	1.0000 in
Reduction of Area	55.73 %
Yield-Halt of Force	54274 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-498
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2490 in
Gage Length:	1.0000 in
Area:	0.0487 sq in



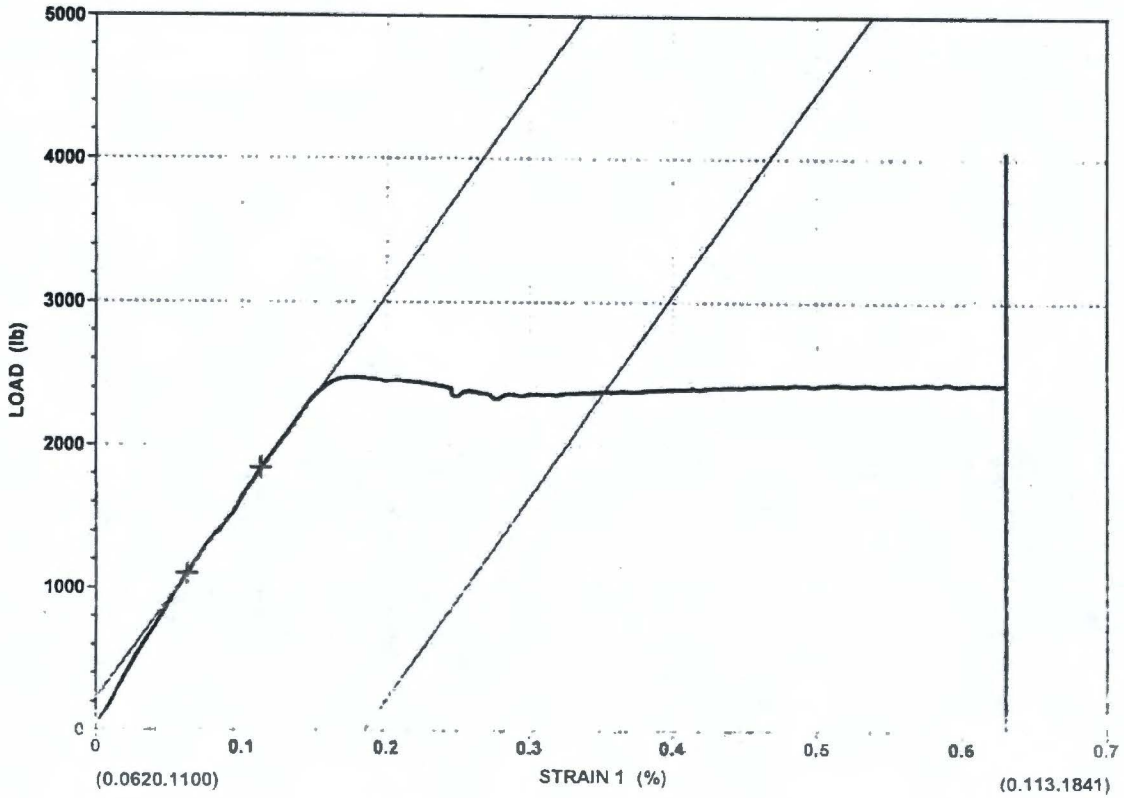
Date: 01/22/13

Time: 13:43:06
Elapsed: 00:08:23

Peak Load	3738 lb
Peak Stress	76756 psi
Modulus of Elasticity	46340478 psi
Yield @ 0.20% Offset	48008 psi
Yield @ 0.20% Offset	2338 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	33.00 %
Gage Length	1.0000 in
Reduction of Area	56.62 %
Yield-Halt of Force	53265 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-499
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2490 in
Gage Length:	1.0000 in
Area:	0.0487 sq in



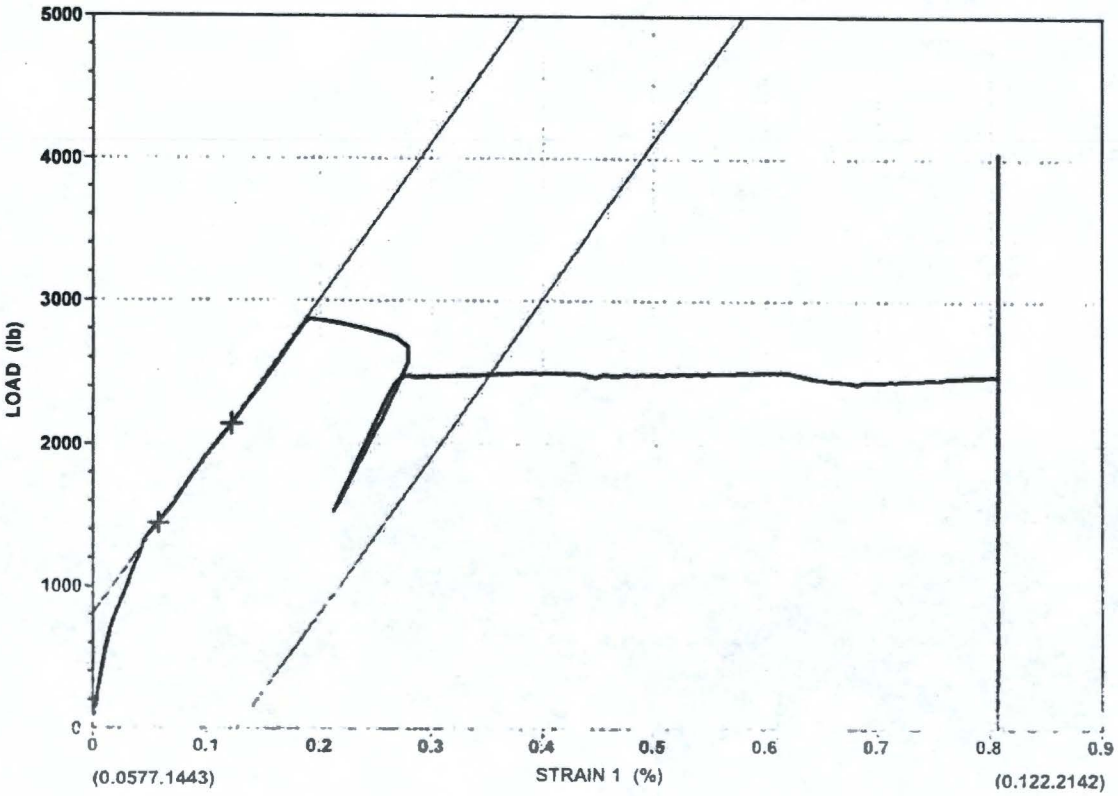
Date: 01/22/13

Time: 13:53:41
Elapsed: 00:07:44

Peak Load	4044 lb
Peak Stress	83039 psi
Modulus of Elasticity	29038613 psi
Yield @ 0.20% Offset	48747 psi
Yield @ 0.20% Offset	2374 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	30.00 %
Gage Length	1.0000 in
Reduction of Area	48.90 %
Yield-Halt of Force	50780 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-500
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2530 in
Gage Length:	1.0000 in
Area:	0.0503 sq in



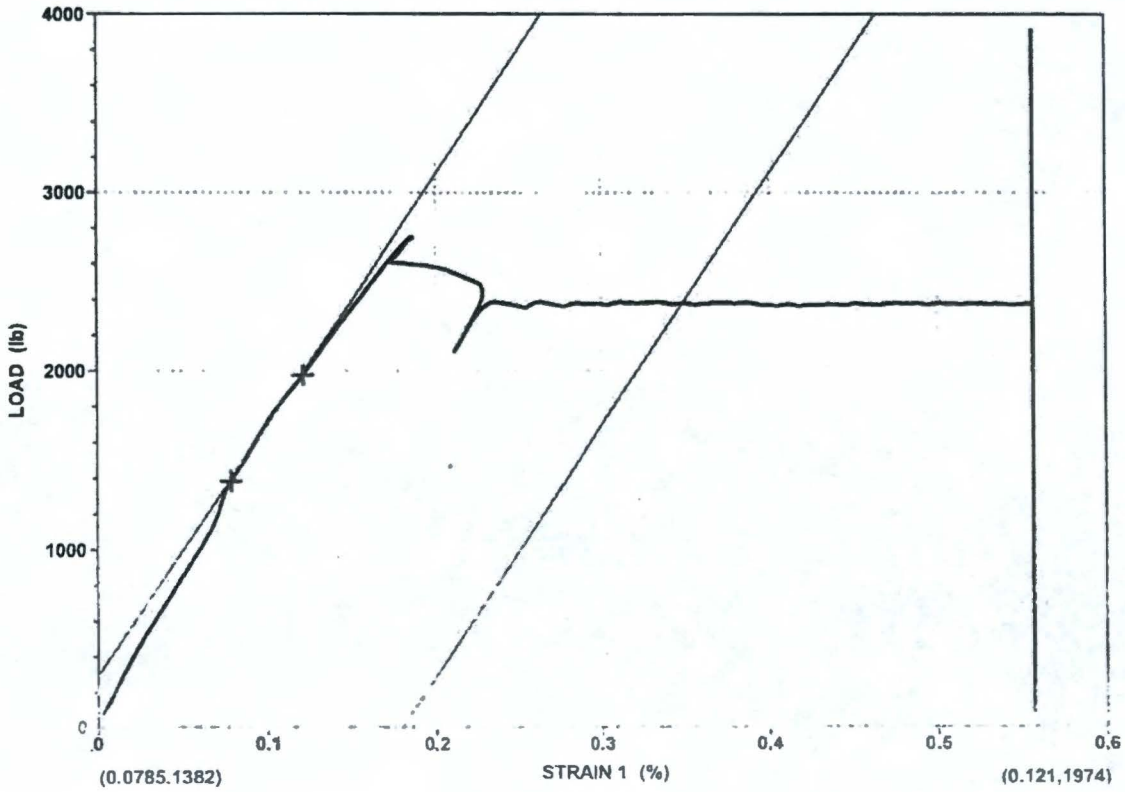
Date: 01/22/13

Time: 14:05:18
Elapsed: 00:08:30

Peak Load	4036 lb
Peak Stress	80239 psi
Modulus of Elasticity	21900147 psi
Yield @ 0.20% Offset	49443 psi
Yield @ 0.20% Offset	2487 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	33.00 %
Gage Length	1.0000 in
Reduction of Area	57.47 %
Yield-Halt of Force	56300 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-501
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



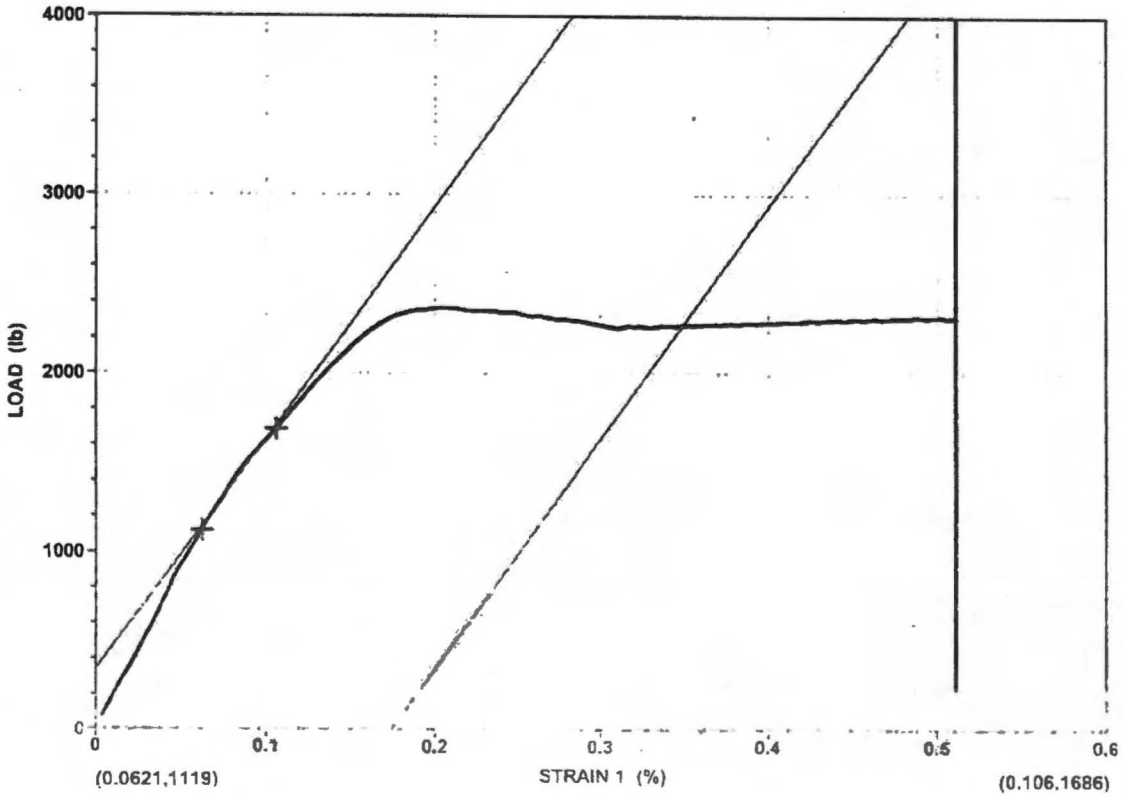
Date: 01/22/13

Time: 14:16:22
Elapsed: 00:07:55

Peak Load	3911 lb
Peak Stress	79654 psi
Modulus of Elasticity	28618961 psi
Yield @ 0.20% Offset	48493 psi
Yield @ 0.20% Offset	2381 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	33.00 %
Gage Length	1.0000 in
Reduction of Area	56.44 %
Yield-Halt of Force	55582 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-502
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2530 in
Gage Length:	1.0000 in
Area:	0.0503 sq in



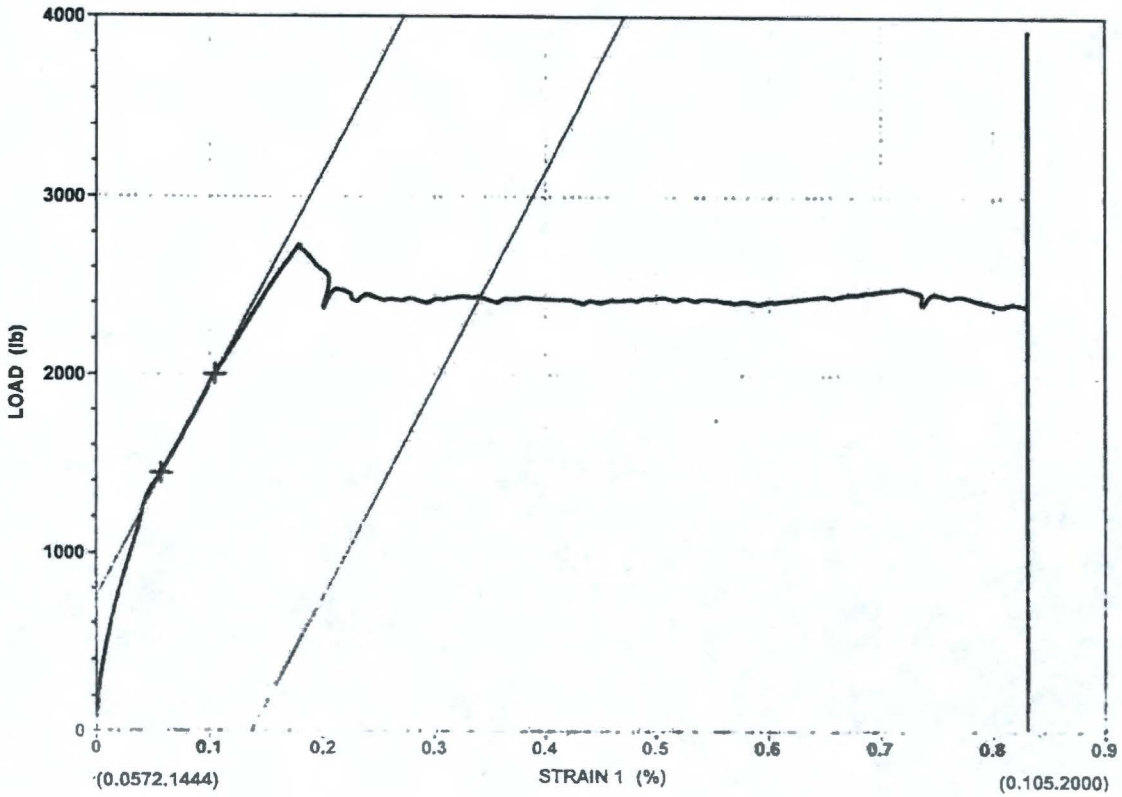
Date: 01/22/13

Time: 14:29:41
Elapsed: 00:07:58

Peak Load	3987 lb
Peak Stress	79264 psi
Modulus of Elasticity	25759402 psi
Yield @ 0.20% Offset	45129 psi
Yield @ 0.20% Offset	2270 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	33.00 %
Gage Length	1.0000 in
Reduction of Area	58.49 %
Yield-Halt of Force	47017 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-503
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



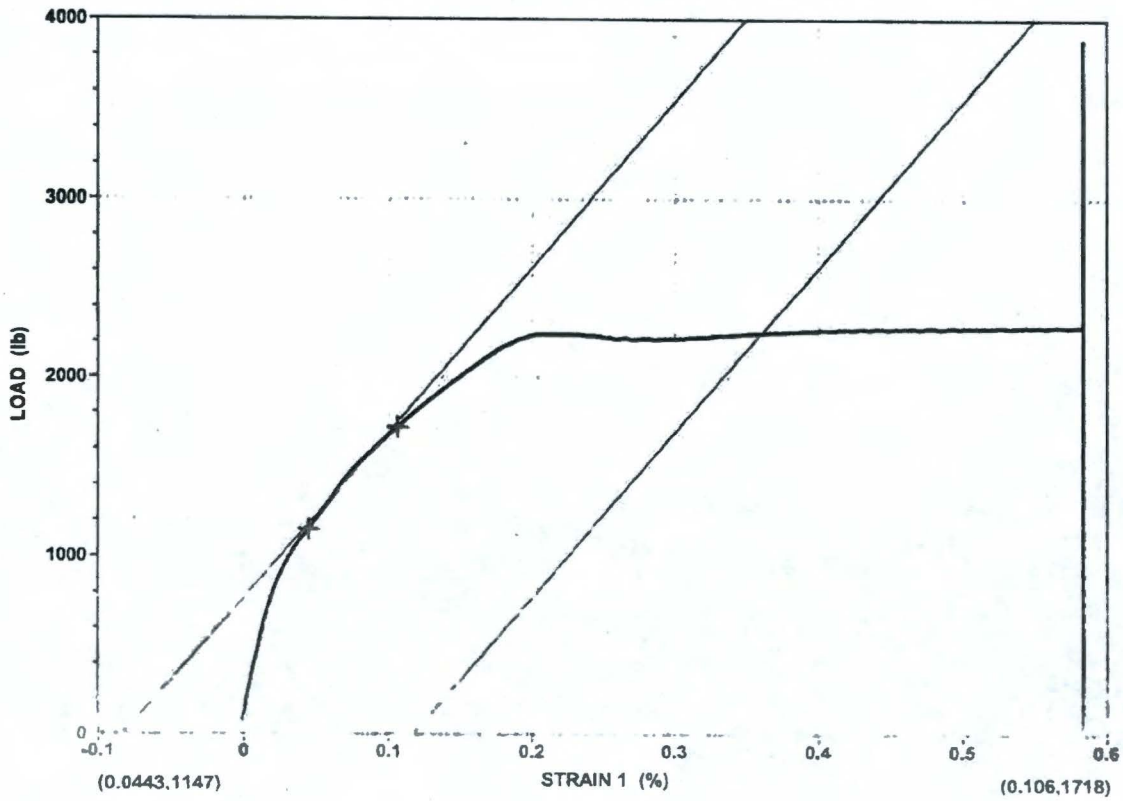
Date: 01/22/13

Time: 14:39:48
Elapsed: 00:08:26

Peak Load	3920 lb
Peak Stress	79837 psi
Modulus of Elasticity	24301265 psi
Yield @ 0.20% Offset	49552 psi
Yield @ 0.20% Offset	2433 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	34.00 %
Gage Length	1.0000 in
Reduction of Area	58.53 %
Yield-Halt of Force	55037 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-504
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2480 in
Gage Length:	1.0000 in
Area:	0.0483 sq in



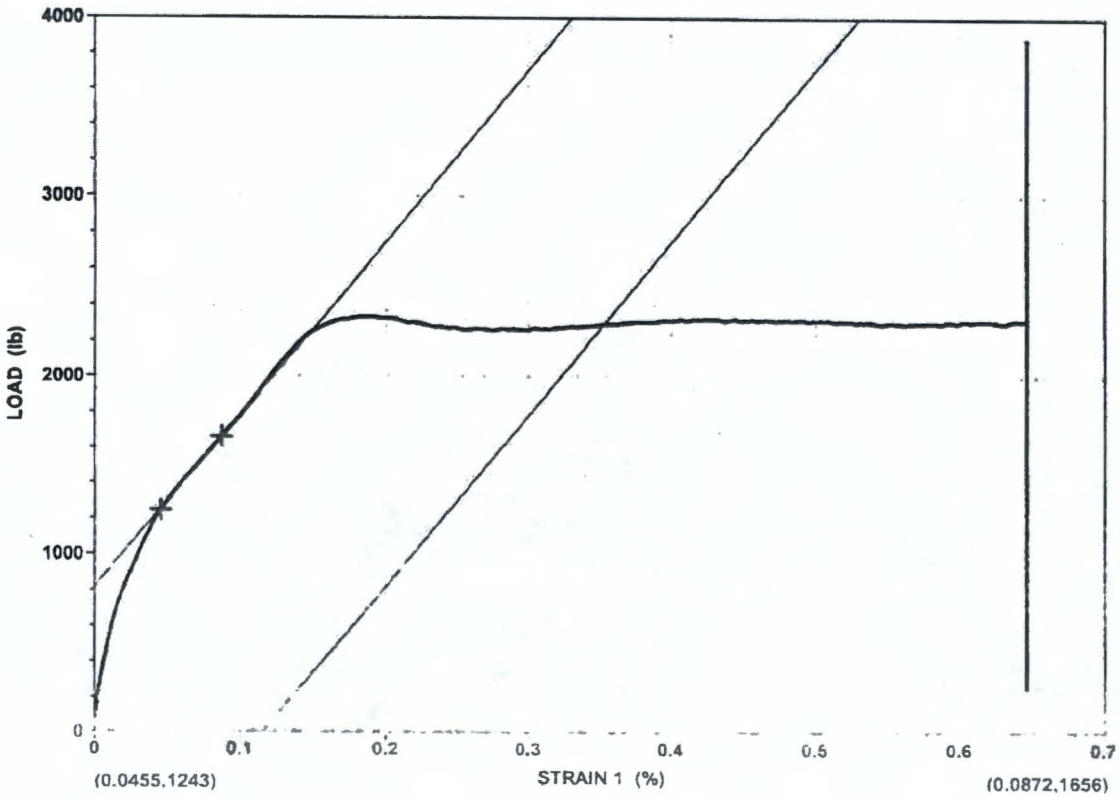
Date: 01/22/13

Time: 14:52:24
Elapsed: 00:08:05

Peak Load	3881 lb
Peak Stress	80352 psi
Modulus of Elasticity	19124678 psi
Yield @ 0.20% Offset	46501 psi
Yield @ 0.20% Offset	2246 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	33.00 %
Gage Length	1.0000 in
Reduction of Area	57.33 %
Yield-Halt of Force	46380 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-505
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2490 in
Gage Length:	1.0000 in
Area:	0.0487 sq in



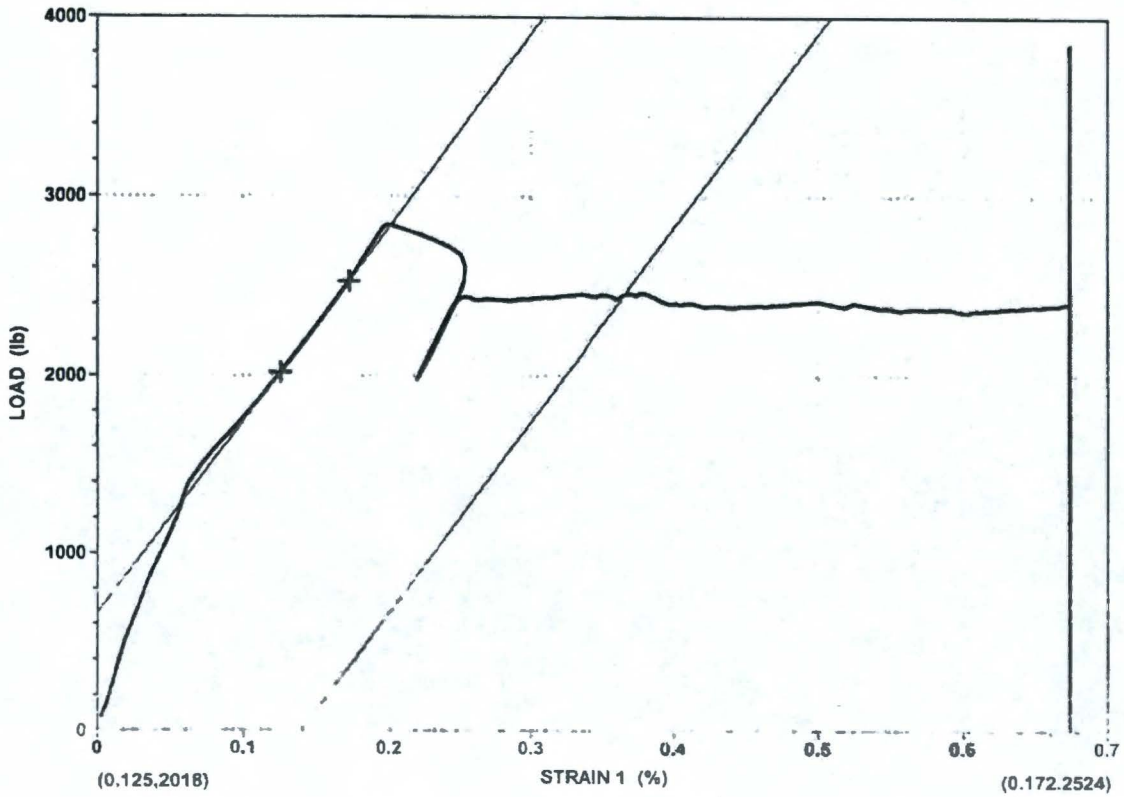
Date: 01/22/13

Time: 15:03:15
Elapsed: 00:08:24

Peak Load	3882 lb
Peak Stress	79713 psi
Modulus of Elasticity	19788589 psi
Yield @ 0.20% Offset	47043 psi
Yield @ 0.20% Offset	2291 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	33.00 %
Gage Length	1.0000 in
Reduction of Area	58.19 %
Yield-Halt of Force	47872 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-506
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2470 in
Gage Length:	1.0000 in
Area:	0.0479 sq in



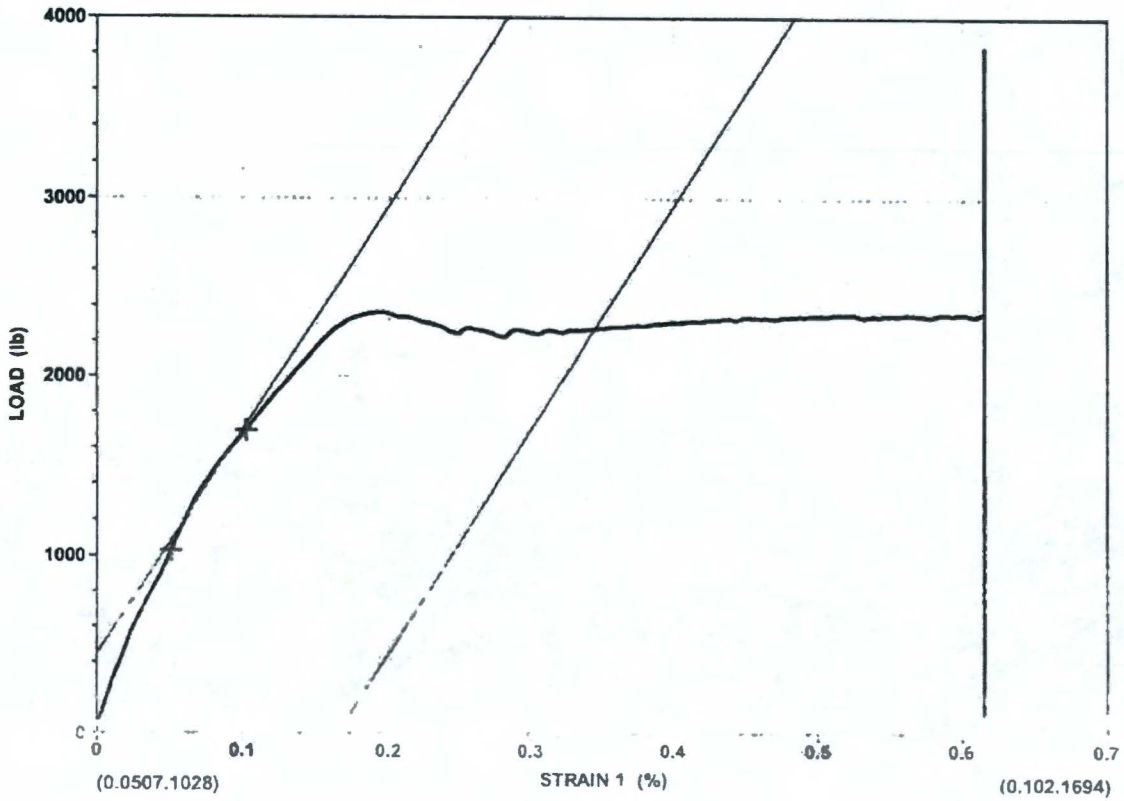
Date: 01/22/13

Time: 15:13:57
Elapsed: 00:07:34

Peak Load	3845 lb
Peak Stress	80271 psi
Modulus of Elasticity	22585577 psi
Yield @ 0.20% Offset	51169 psi
Yield @ 0.20% Offset	2451 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	31.00 %
Gage Length	1.0000 in
Reduction of Area	54.83 %
Yield-Halt of Force	58429 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-507
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2460 in
Gage Length:	1.0000 in
Area:	0.0475 sq in



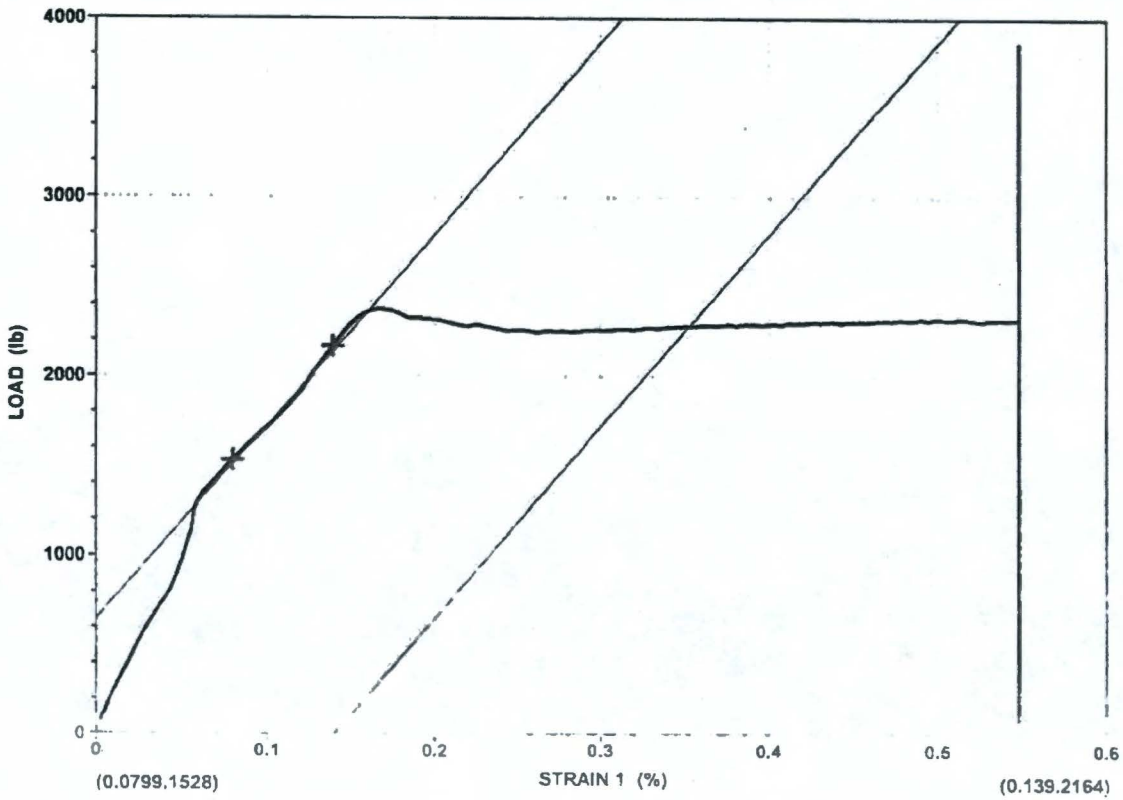
Date: 01/22/13

Time: 15:24:29
Elapsed: 00:07:16

Peak Load	3835 lb
Peak Stress	80737 psi
Modulus of Elasticity	26360550 psi
Yield @ 0.20% Offset	47768 psi
Yield @ 0.20% Offset	2269 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	29.00 %
Gage Length	1.0000 in
Reduction of Area	52.24 %
Yield-Halt of Force	49687 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-508
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2500 in
Gage Length:	1.0000 in
Area:	0.0491 sq in



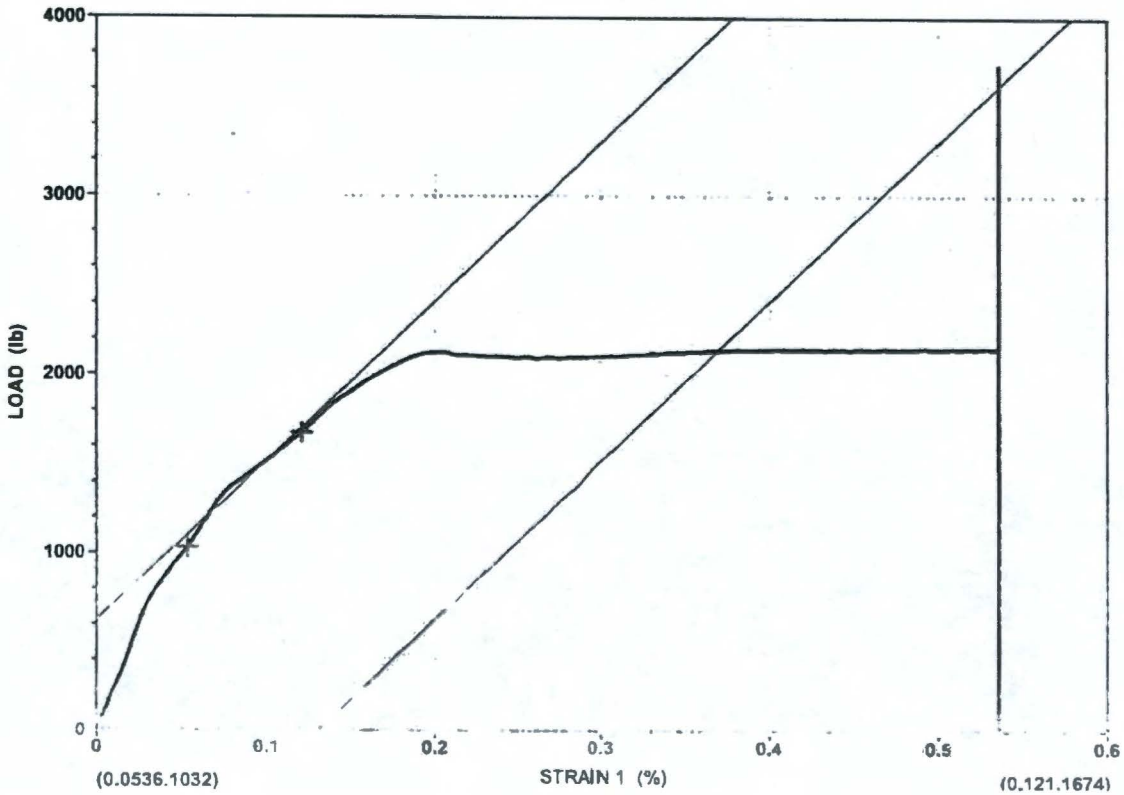
Date: 01/22/13

Time: 15:34:04
Elapsed: 00:07:58

Peak Load	3859 lb
Peak Stress	78595 psi
Modulus of Elasticity	21817957 psi
Yield @ 0.20% Offset	46375 psi
Yield @ 0.20% Offset	2277 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	55.38 %
Yield-Halt of Force	48237 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-509
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2470 in
Gage Length:	1.0000 in
Area:	0.0479 sq in



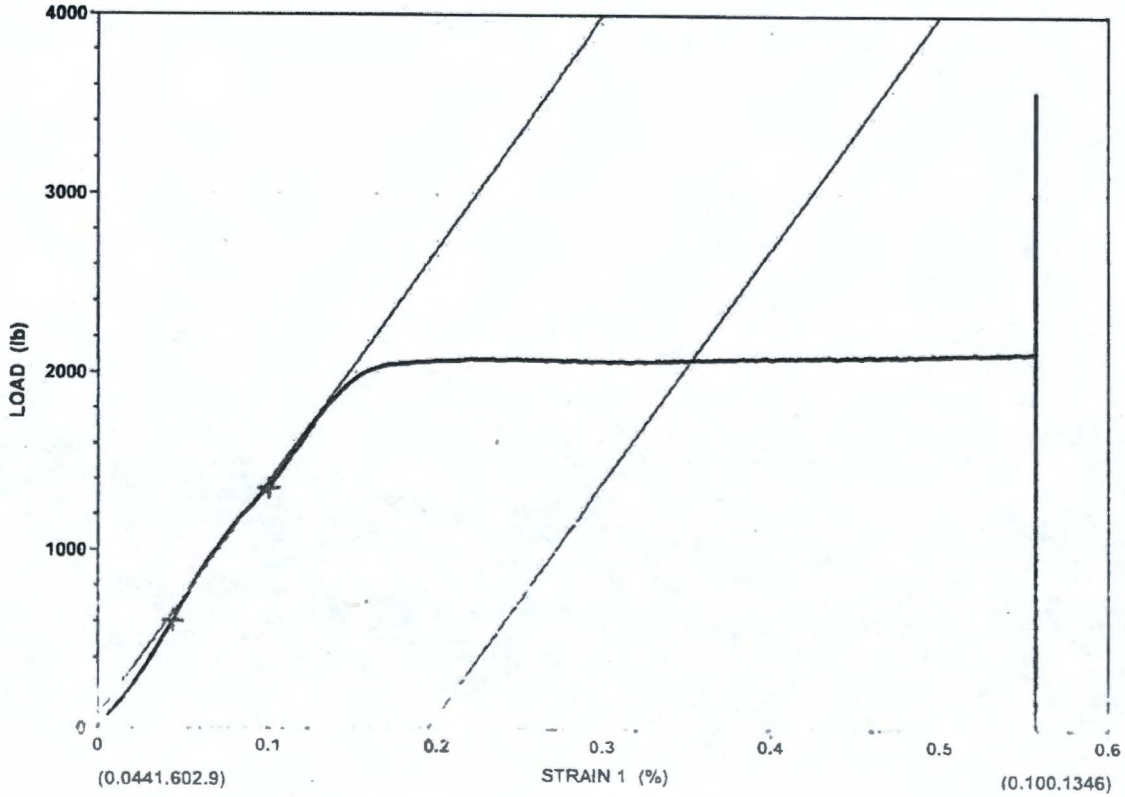
Date: 01/22/13

Time: 15:44:30
Elapsed: 00:07:21

Peak Load	3732 lb
Peak Stress	77912 psi
Modulus of Elasticity	18608540 psi
Yield @ 0.20% Offset	44572 psi
Yield @ 0.20% Offset	2135 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	33.00 %
Gage Length	1.0000 in
Reduction of Area	55.38 %
Yield-Halt of Force	44322 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-510
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2450 in
Gage Length:	1.0000 in
Area:	0.0471 sq in



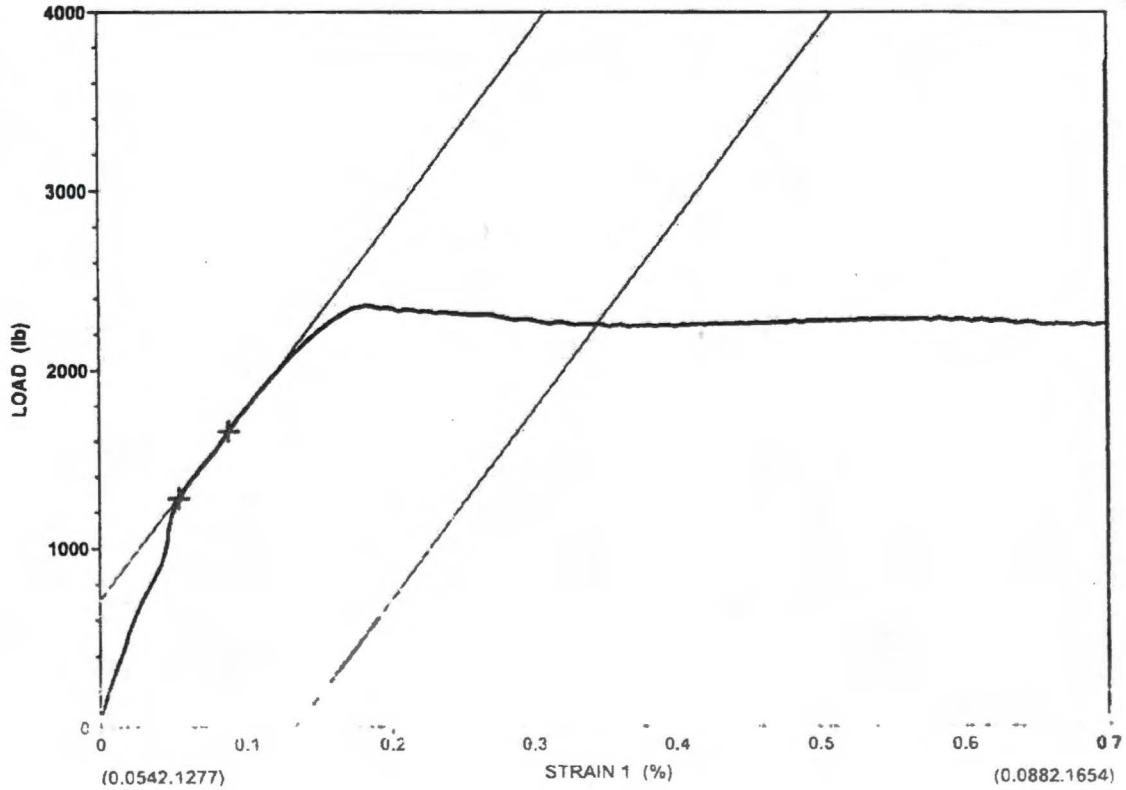
Date: 01/23/13

Time: 08:14:48
Elapsed: 00:07:44

Peak Load	3568 lb
Peak Stress	75754 psi
Modulus of Elasticity	27753033 psi
Yield @ 0.20% Offset	44034 psi
Yield @ 0.20% Offset	2074 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	31.00 %
Gage Length	1.0000 in
Reduction of Area	56.28 %
Yield-Halt of Force	44092 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-511
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2480 in
Gage Length:	1.0000 in
Area:	0.0483 sq in



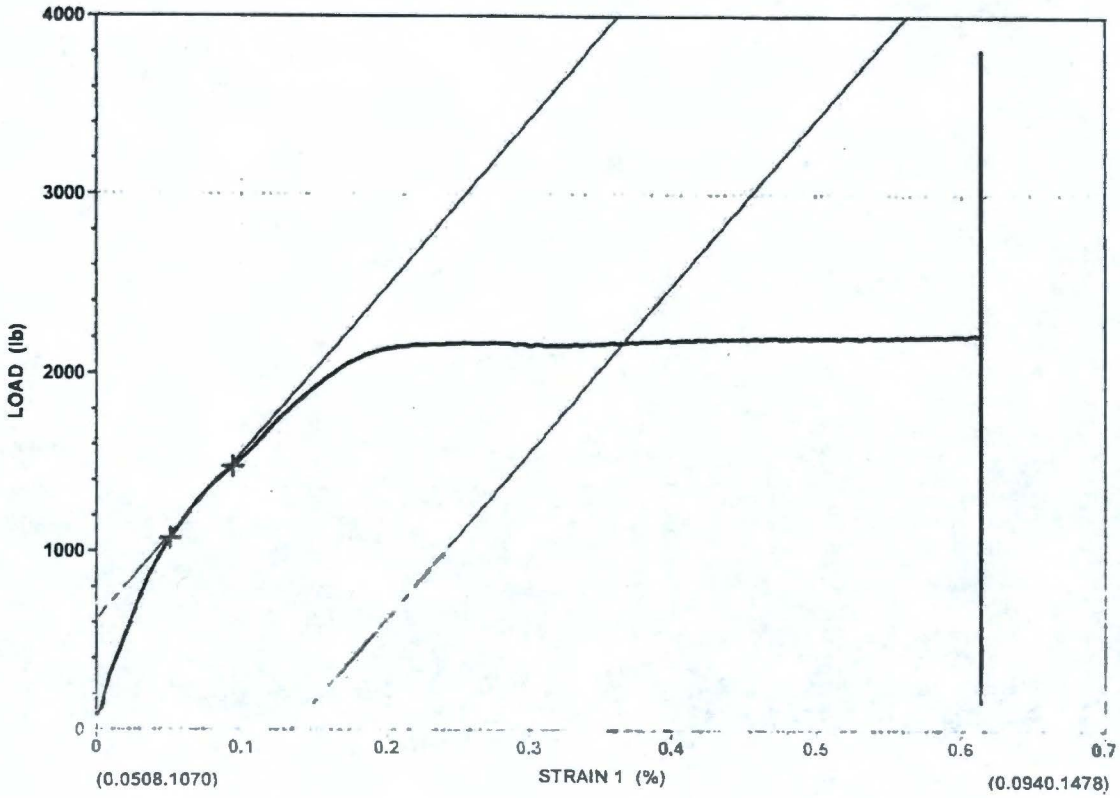
Date: 01/23/13

Time: 08:24:33
Elapsed: 00:08:18

Peak Load	3711 lb
Peak Stress	76832 psi
Modulus of Elasticity	21959454 psi
Yield @ 0.20% Offset	46667 psi
Yield @ 0.20% Offset	2254 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	57.85 %
Yield-Halt of Force	48738 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-512
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2460 in
Gage Length:	1.0000 in
Area:	0.0475 sq in

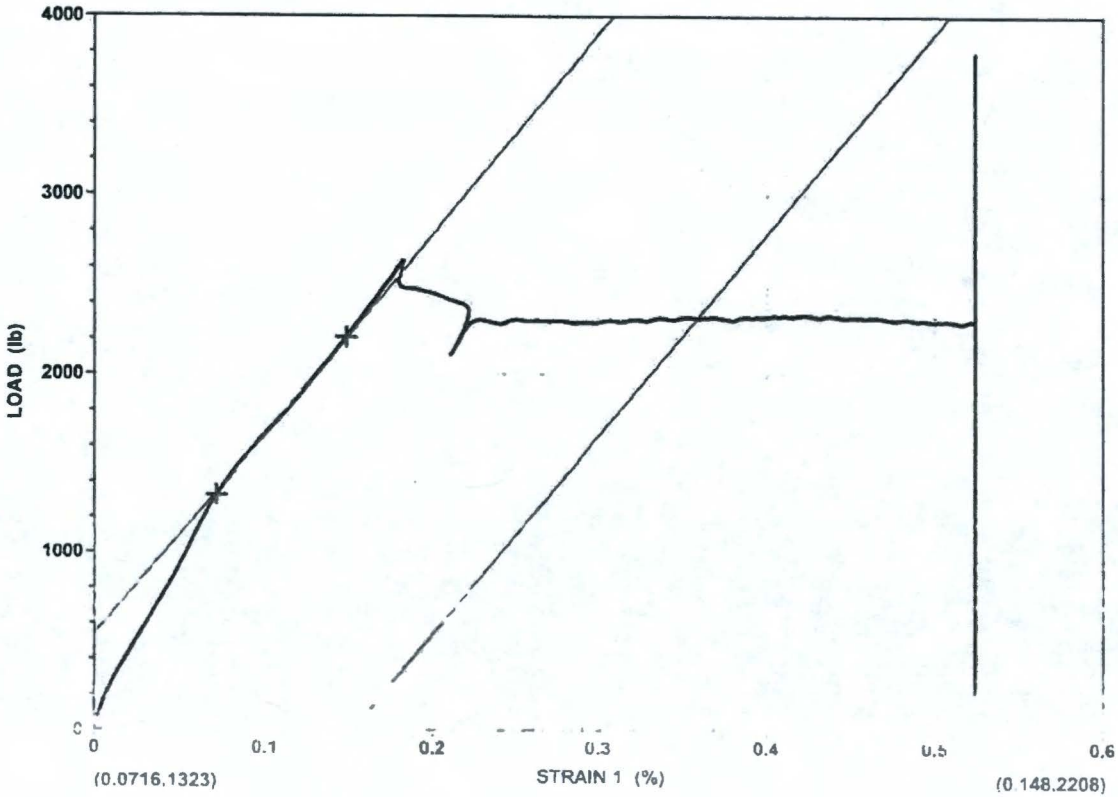


Date: 01/23/13 Time: 08:35:12
Elapsed: 00:08:04

Peak Load	3811 lb
Peak Stress	80232 psi
Modulus of Elasticity	19616983 psi
Yield @ 0.20% Offset	45663 psi
Yield @ 0.20% Offset	2169 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	53.91 %
Yield-Halt of Force	45437 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-513
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2460 in
Gage Length:	1.0000 in
Area:	0.0475 sq in



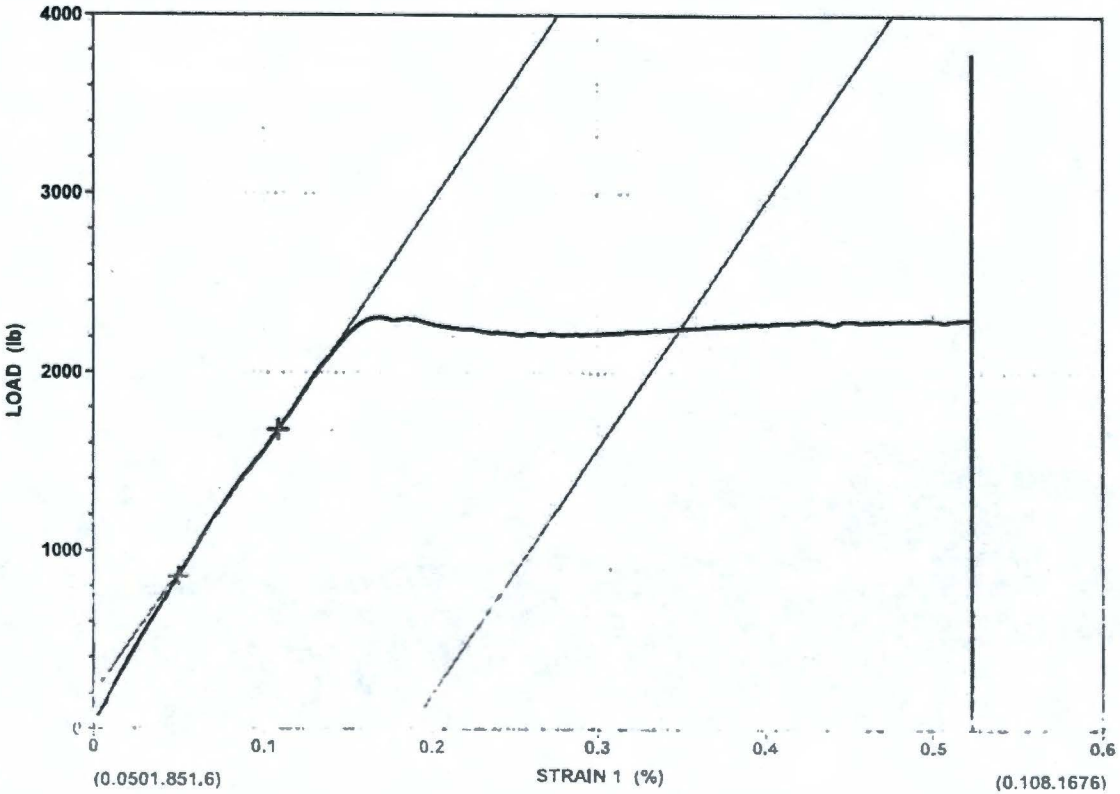
Date: 01/23/13

Time: 08:46:08
Elapsed: 00:07:46

Peak Load	3792 lb
Peak Stress	79832 psi
Modulus of Elasticity	23568832 psi
Yield @ 0.20% Offset	48737 psi
Yield @ 0.20% Offset	2315 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	54.46 %
Yield-Halt of Force	54877 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-514
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2450 in
Gage Length:	1.0000 in
Area:	0.0471 sq in



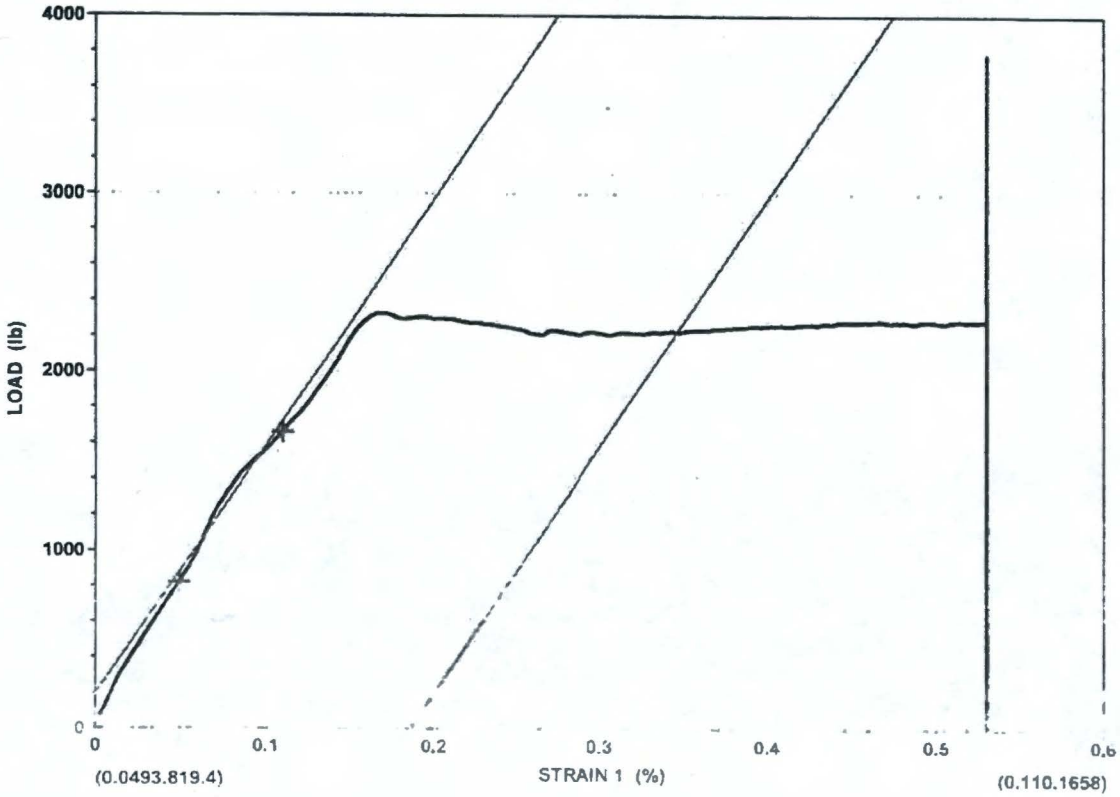
Date: 01/23/13

Time: 08:56:40
Elapsed: 00:07:58

Peak Load	3780 lb
Peak Stress	80255 psi
Modulus of Elasticity	29286834 psi
Yield @ 0.20% Offset	47749 psi
Yield @ 0.20% Offset	2249 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	56.28 %
Yield-Halt of Force	48967 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-515
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2450 in
Gage Length:	1.0000 in
Area:	0.0471 sq in



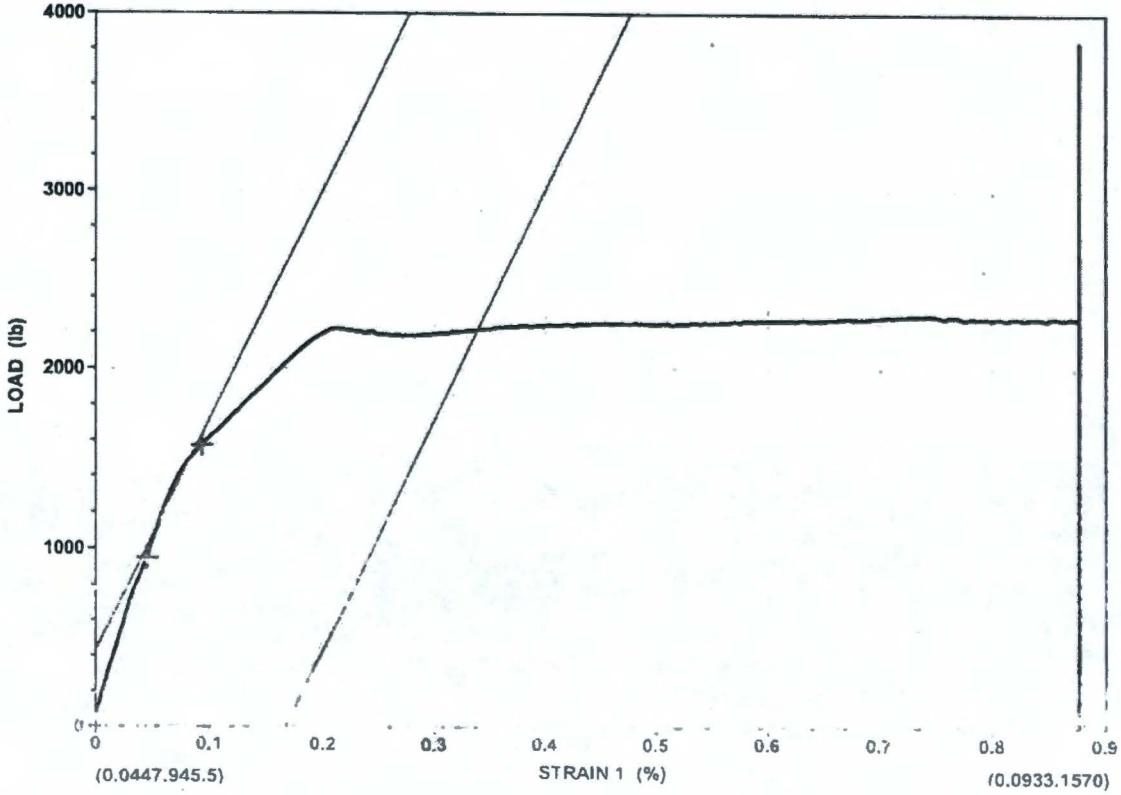
Date: 01/23/13

Time: 09:06:47
Elapsed: 00:07:54

Peak Load	3782 lb
Peak Stress	80297 psi
Modulus of Elasticity	29413812 psi
Yield @ 0.20% Offset	47197 psi
Yield @ 0.20% Offset	2223 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	53.54 %
Yield-Halt of Force	49223 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-516
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2480 in
Gage Length:	1.0000 in
Area:	0.0483 sq in



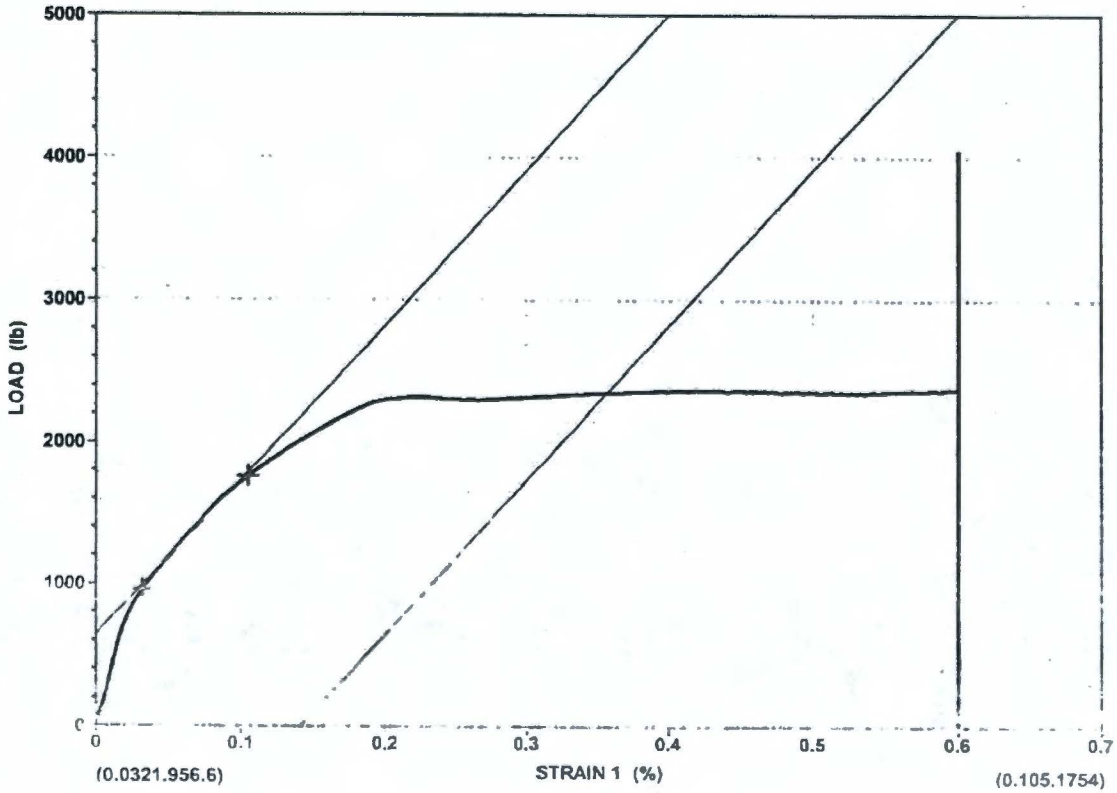
Date: 01/23/13

Time: 09:17:31
Elapsed: 00:08:25

Peak Load	3839 lb
Peak Stress	79482 psi
Modulus of Elasticity	26684721 psi
Yield @ 0.20% Offset	45880 psi
Yield @ 0.20% Offset	2216 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	54.65 %
Yield-Halt of Force	45972 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-536
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2470 in
Gage Length:	1.0000 in
Area:	0.0479 sq in



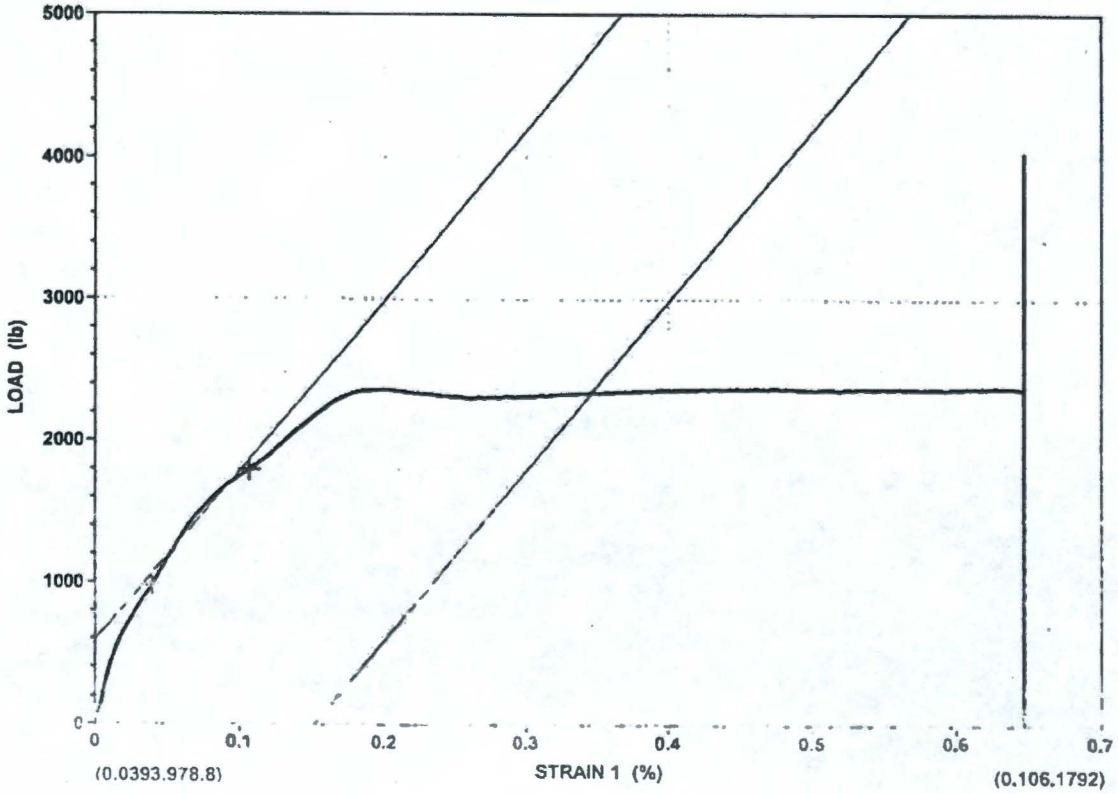
Date: 01/23/13

Time: 09:31:04
Elapsed: 00:07:41

Peak Load	4042 lb
Peak Stress	84384 psi
Modulus of Elasticity	22736713 psi
Yield @ 0.20% Offset	49040 psi
Yield @ 0.20% Offset	2349 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	30.50 %
Gage Length	1.0000 in
Reduction of Area	53.19 %
Yield-Halt of Force	48433 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-537
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2470 in
Gage Length:	1.0000 in
Area:	0.0479 sq in



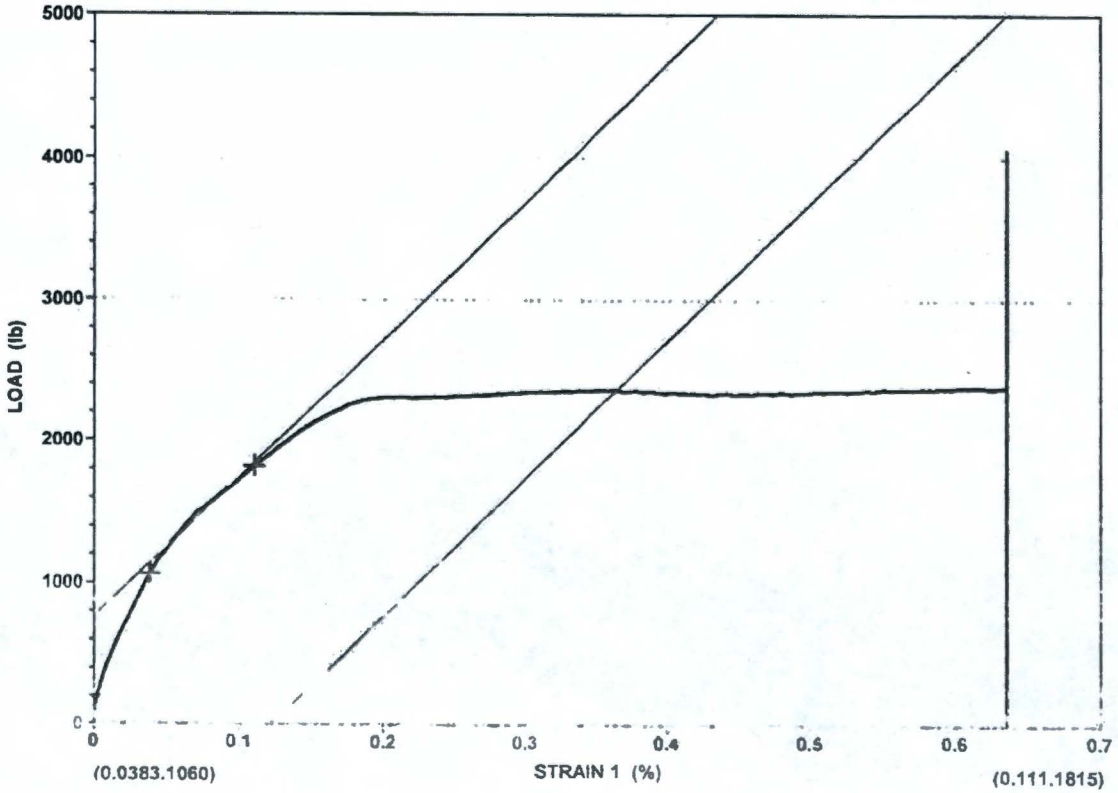
Date: 01/23/13

Time: 09:41:12
Elapsed: 00:07:59

Peak Load	4030 lb
Peak Stress	84134 psi
Modulus of Elasticity	25028990 psi
Yield @ 0.20% Offset	48873 psi
Yield @ 0.20% Offset	2341 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	52.07 %
Yield-Halt of Force	49282 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-538
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2480 in
Gage Length:	1.0000 in
Area:	0.0483 sq in



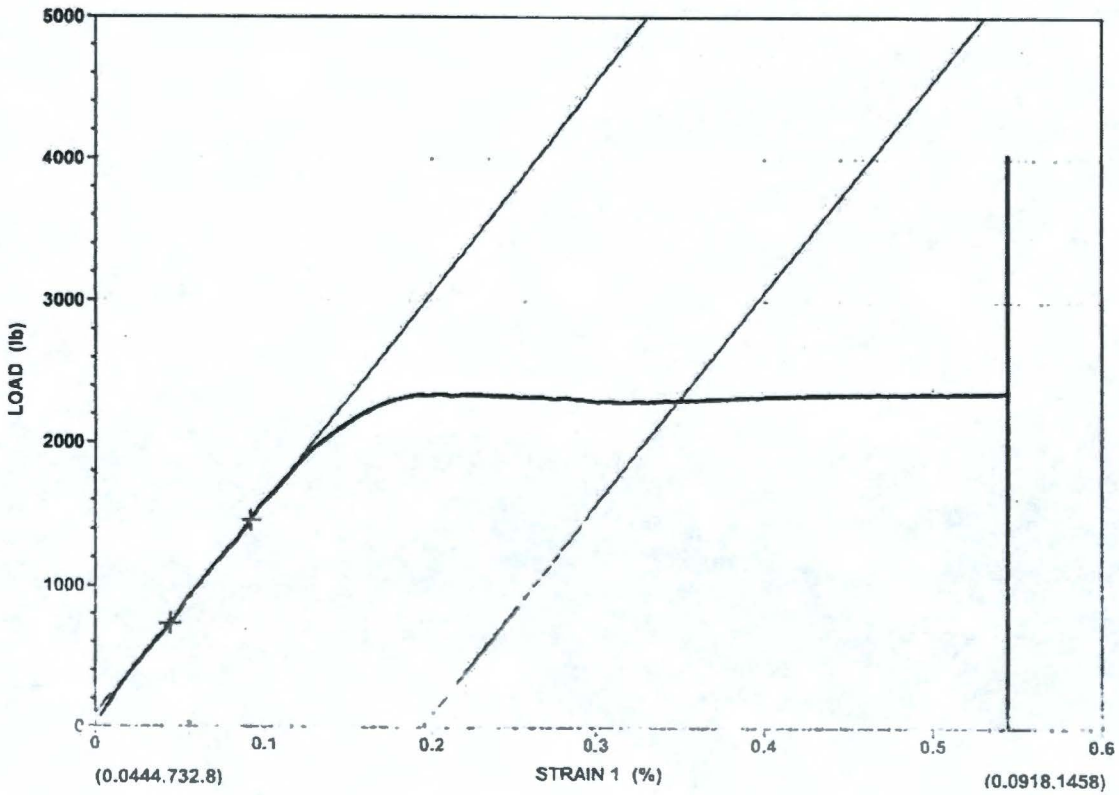
Date: 01/23/13

Time: 09:52:02
Elapsed: 00:07:55

Peak Load	4058 lb
Peak Stress	84017 psi
Modulus of Elasticity	20147834 psi
Yield @ 0.20% Offset	48861 psi
Yield @ 0.20% Offset	2360 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	54.11 %
Yield-Halt of Force	47674 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-539
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2480 in
Gage Length:	1.0000 in
Area:	0.0483 sq in



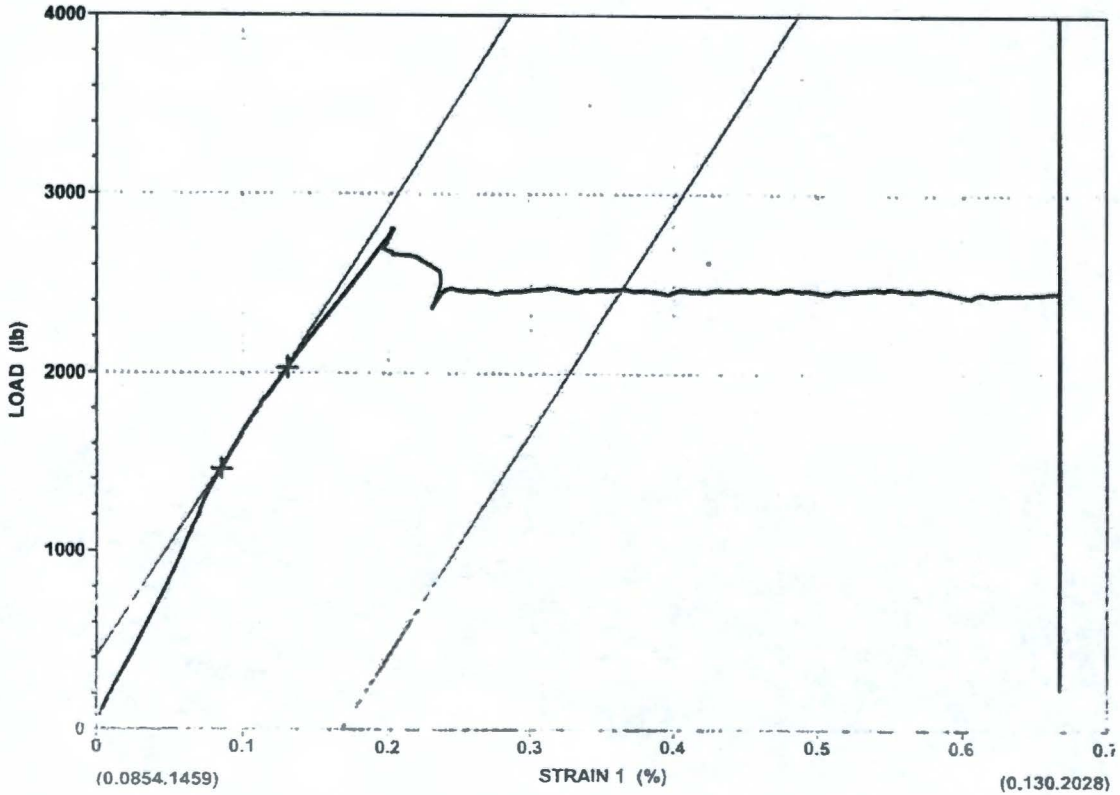
Date: 01/23/13

Time: 10:02:49
Elapsed: 00:07:46

Peak Load	4031 lb
Peak Stress	83458 psi
Modulus of Elasticity	30753176 psi
Yield @ 0.20% Offset	47743 psi
Yield @ 0.20% Offset	2306 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	31.00 %
Gage Length	1.0000 in
Reduction of Area	53.01 %
Yield-Halt of Force	48414 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-540
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2470 in
Gage Length:	1.0000 in
Area:	0.0479 sq in



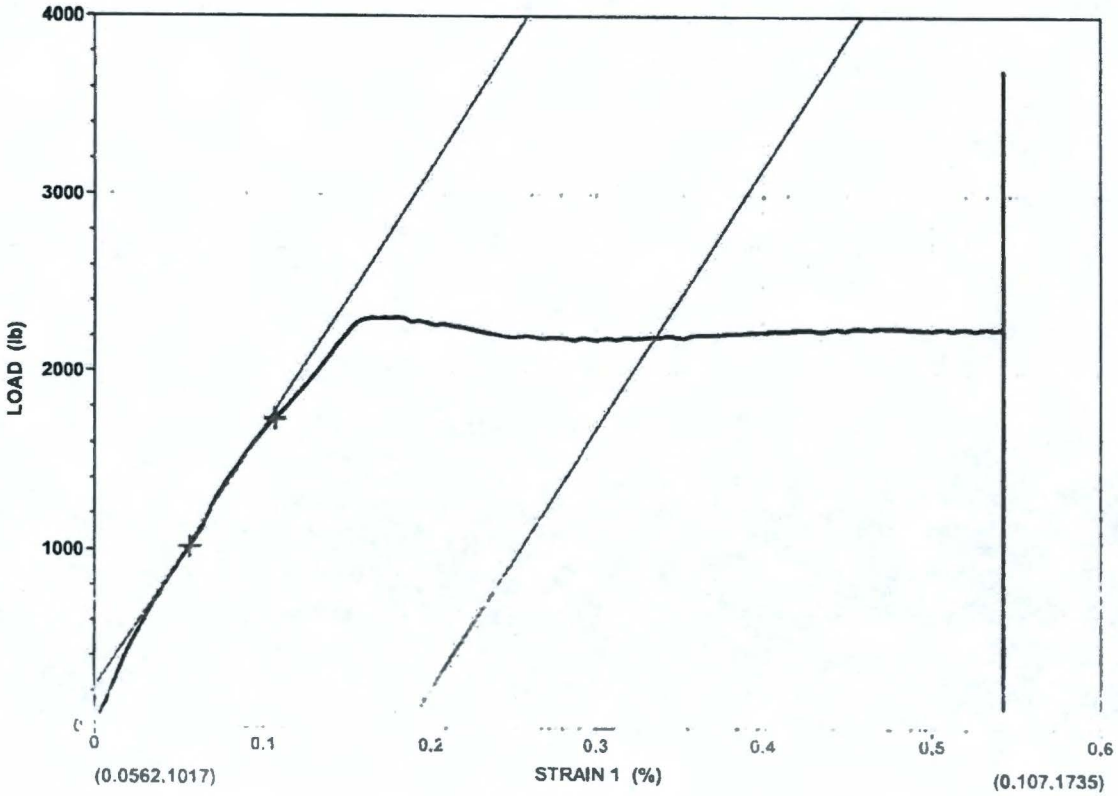
Date: 01/23/13

Time: 10:13:08
Elapsed: 00:07:50

Peak Load	3995 lb
Peak Stress	83403 psi
Modulus of Elasticity	26182631 psi
Yield @ 0.20% Offset	51566 psi
Yield @ 0.20% Offset	2470 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	30.00 %
Gage Length	1.0000 in
Reduction of Area	52.63 %
Yield-Halt of Force	58046 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-541
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2470 in
Gage Length:	1.0000 in
Area:	0.0479 sq in



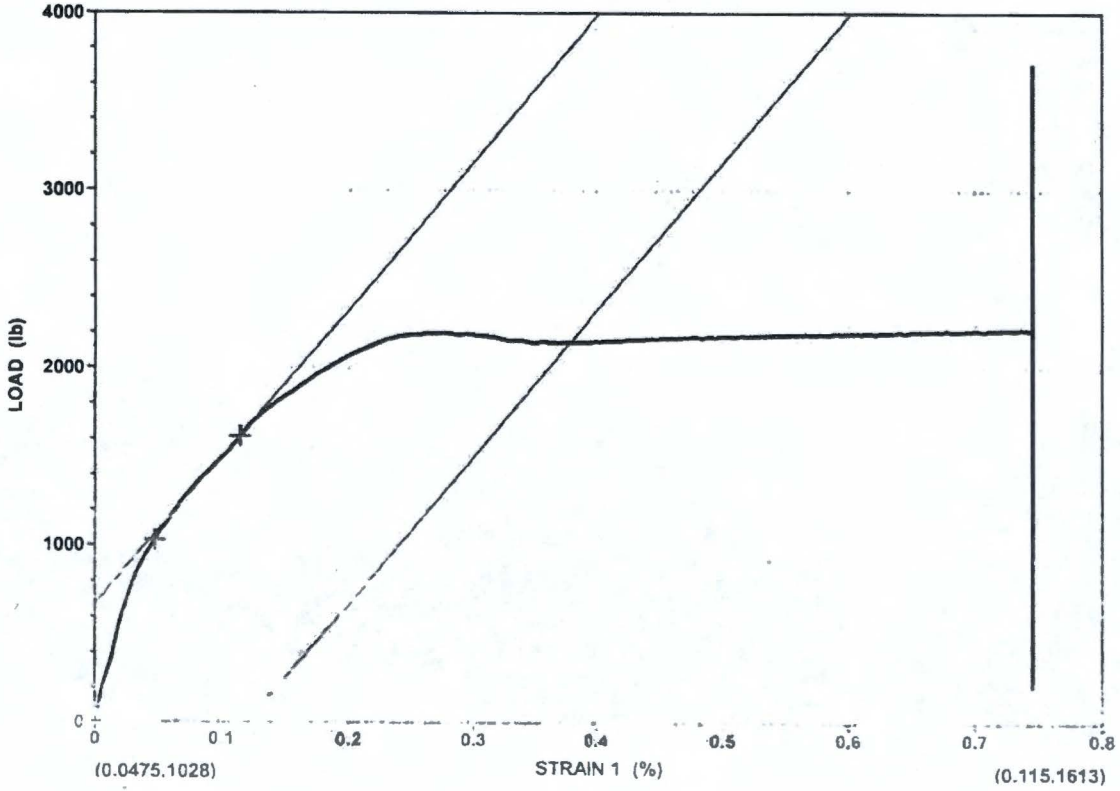
Date: 01/23/13

Time: 10:24:29
Elapsed: 00:07:57

Peak Load	3697 lb
Peak Stress	77182 psi
Modulus of Elasticity	30597427 psi
Yield @ 0.20% Offset	46013 psi
Yield @ 0.20% Offset	2204 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	55.91 %
Yield-Halt of Force	48149 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-542
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2470 in
Gage Length:	1.0000 in
Area:	0.0479 sq in



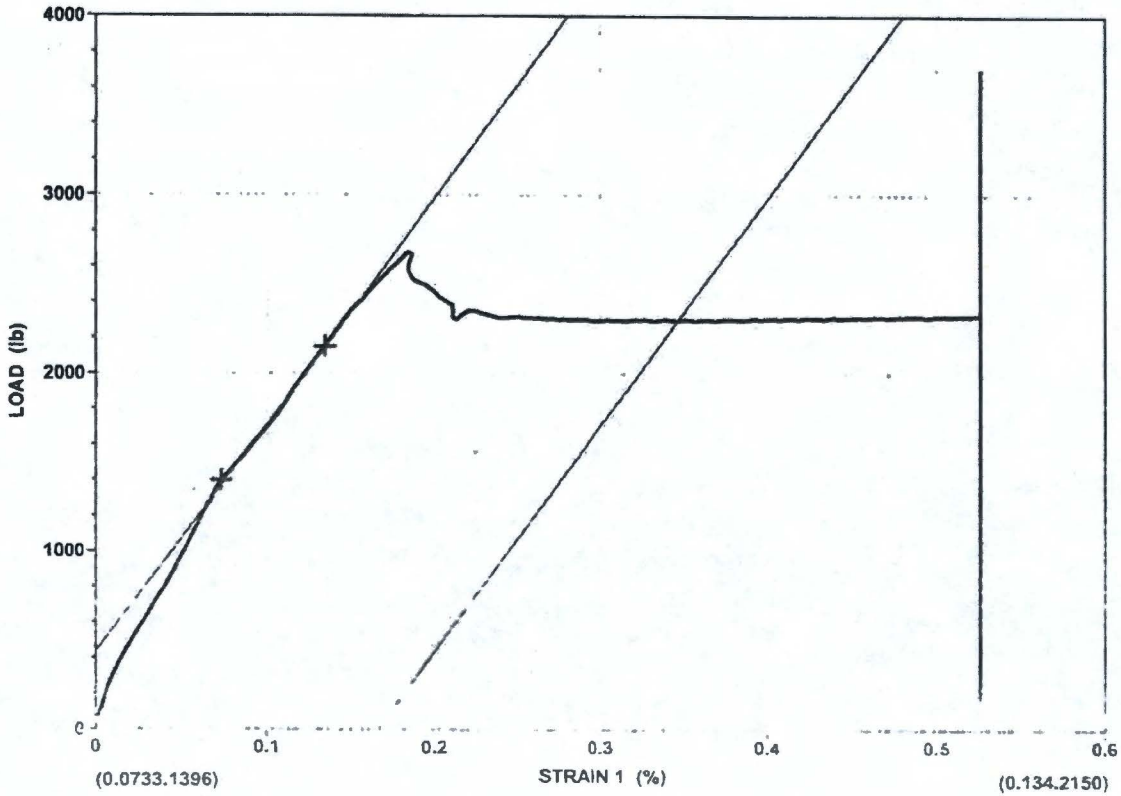
Date: 01/23/13

Time: 10:34:44
Elapsed: 00:08:25

Peak Load	3703 lb
Peak Stress	77307 psi
Modulus of Elasticity	17272075 psi
Yield @ 0.20% Offset	44823 psi
Yield @ 0.20% Offset	2147 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	31.50 %
Gage Length	1.0000 in
Reduction of Area	55.38 %
Yield-Halt of Force	45808 psi

EXOVA - Glendale Hts.
194 Internationale Blvd.
Glendale Hts. IL 60139

Specimen #:	301058-543
Operator:	EB
Client Name:	CTL
Lab Number:	301058
Engineer:	MF
ASTM Spec:	E-8
Pre-Yield Speed:	0.5% /Min
Post Yield Speed:	.0625 "/Min
UNITED FRAME :	2-17
EXT. #:	4657
LOADCELL CAP.:	30K
Cal Due Date:	12/2013
Geometry:	Round
Diameter:	0.2470 in
Gage Length:	1.0000 in
Area:	0.0479 sq in



Date: 01/23/13 Time: 10:45:27
Elapsed: 00:07:49

Peak Load	3697 lb
Peak Stress	77182 psi
Modulus of Elasticity	26584462 psi
Yield @ 0.20% Offset	47891 psi
Yield @ 0.20% Offset	2294 lb
Yield @ 2.25% Extension-EUL	NA
Yield @ 2.25% Extension-EUL	NA
Man. Elong. @ Break	32.00 %
Gage Length	1.0000 in
Reduction of Area	56.45 %
Yield-Halt of Force	55412 psi

Exova Inc.
Glendale Heights Laboratory

Date 01/22/13 Time 09.54 OpId SJJ

T301058 S U B T E S T T301058

Client Construction Technology Labs
5420 Old Orchard Road
Skokie, IL

60077-1030
Contact JAMES LANE
Tel No 847 965 7500
Fax No 847 965 8997
Material CARBON STEEL

Ref No T301058 : Issue 1
MIF No

Ord No 50619D
Ledger Code CON100 (CTLI)
Terms Net
Date Instructed 01/16/13
Date Received 01/16/13
Date Required 01/31/13
Engineer Michael Fec

Item MACHINE AND TEST, 48 SAMPLES

Specification ASTM A370-12a

Date Instructed 01/16/13 Clear Workshop By 01/17/13 Date Required 01/31/13
Date Received 01/16/13 Complete Testing By 01/30/13

Hardness Test Test Specification ASTM E18 -11

		Method	Load [Kgf]	Test Temp [°C]	Results						
623(001) Core Hardness	477	HRB	100		83.4	~~84.6~~	83.5	~~82.5~~	82.7		
624(002) Core Hardness	~~482~~ 439	HRB	100		79.8	78.7	79.9				
625(003) Core Hardness	482	HRB	100	✓	81.2	82.3	82.4				
626(004) Core Hardness	483	HRB	100		79.0	79.0	79.0				
627(005) Core Hardness	488	HRB	100		79.8	AL ~~79.9~~	78.8	78.9			
628(006) Core Hardness	493	HRB	100		~~79.7~~	81.9	~~83.0~~	80.0	80.5		
629(007) Core Hardness	494	HRB	100		~~80.6~~	82.3	82.0	81.5	~~84.0~~		
630(008) Core Hardness	499	HRB	100		~~82.6~~	81.7	81.1	~~80.2~~	80.5		
631(009) Core Hardness	500	HRB	100		80.0	79.6	80.4				
632(010) Core Hardness	506	HRB	100		80.6	80.5	80.4				
633(011) Core Hardness	510	HRB	100		78.0	77.6	77.6				
634(012) Core Hardness	512	HRB	100		80.3	80.3	80.3				

Exova Inc.
Glendale Heights Laboratory

Date 01/22/13 Time 09.54 OpId SJJ

T301058 S U B T E S T T301058

Client Construction Technology Labs
5420 Old Orchard Road
Skokie, IL

Ref No T301058 : Issue 1
MIF No

Hardness Test Test Specification ASTM E18 -11

	Method	Load [Kgf]	Test Temp [°C]	Results							
635(013) Core Hardness 536	HRB	100		82.6	82.8	82.9					
636(014) Core Hardness 541	HRB	100		79.0	79.0	78.8					
637(015) Core Hardness	HRB	100									
638(016) Core Hardness	HRB	100									

Tested By ..... Date 1-23-13 .....

Worksheet Comments

std 78.1 ± 1.0 → 77.87 HRB

Exova Inc.
Glendale Heights Laboratory

Date 01/22/13 Time 09.54 OpId SJJ.

T301058 S U B T E S T T301058

Client Construction Technology Labs
5420 Old Orchard Road
Skokie, IL

60077-1030
Contact JAMES LANE
Tel No 847 965 7500
Fax No 847 965 8997
Material CARBON STEEL

Ref No T301058 : Issue 1
MIF No

Ord No 50619D
Ledger Code CON100 (CTLI)
Terms Net
Date Instructed 01/16/13
Date Received 01/16/13
Date Required ~~01/31/13~~ 1/28/13
Engineer Michael Fec

Item MACHINE AND TEST, 48 SAMPLES

Specification ASTM A370-12a

WITNESS

Date Instructed 01/16/13 Clear Workshop By 01/17/13 Date Required 01/31/13
Date Received 01/16/13 Complete Testing By 01/30/13

Charpy Test Test Specification ASTM A370 -12a

		Position	Dimensions [mm]	Denomination	Test Temp	M/c No	Energy Absorbed [ft.lbf]			
K96					70F					
621(001)	Longitudinal	N/A	10x10.00x2V	44-1	R/T F	2	35	30	30	
622(002)	Longitudinal	N/A	10x10.00x2V	44-2	R/T F	2	27	30	27	
K97										

Tested By PERM Date 1/24/13

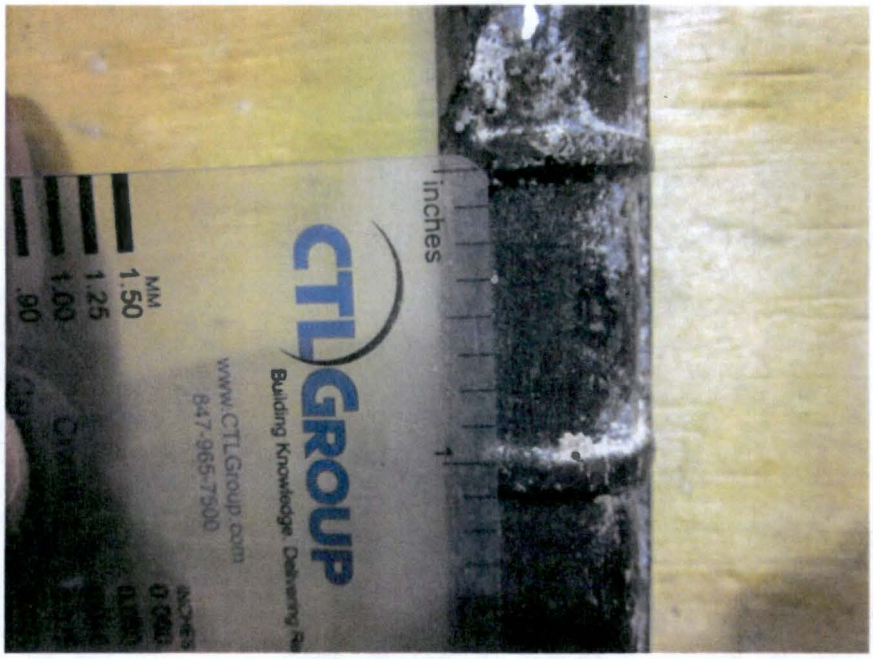
Worksheet Comments

Appendix D

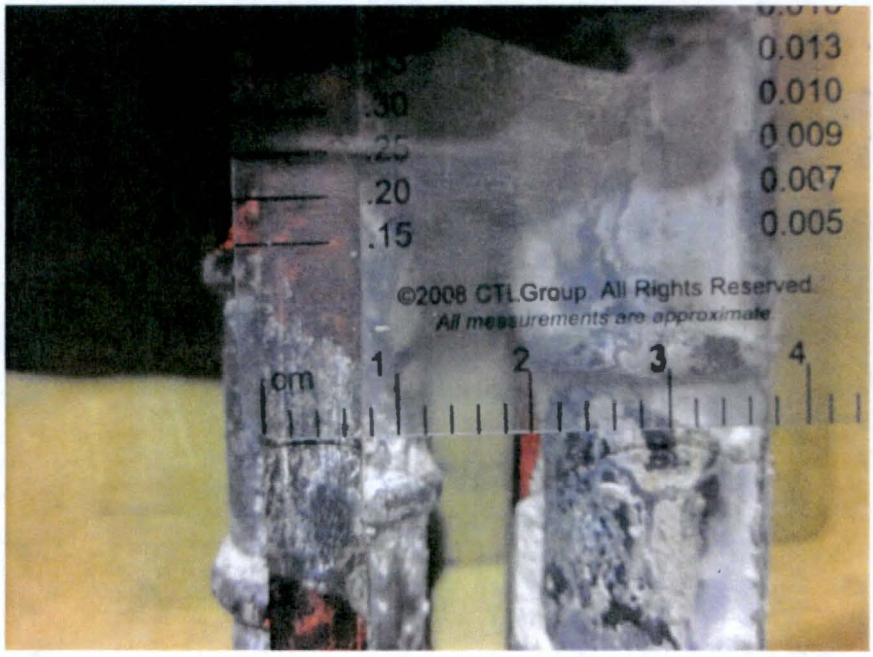
C-107 Rebar

Specimen Testing Photographs

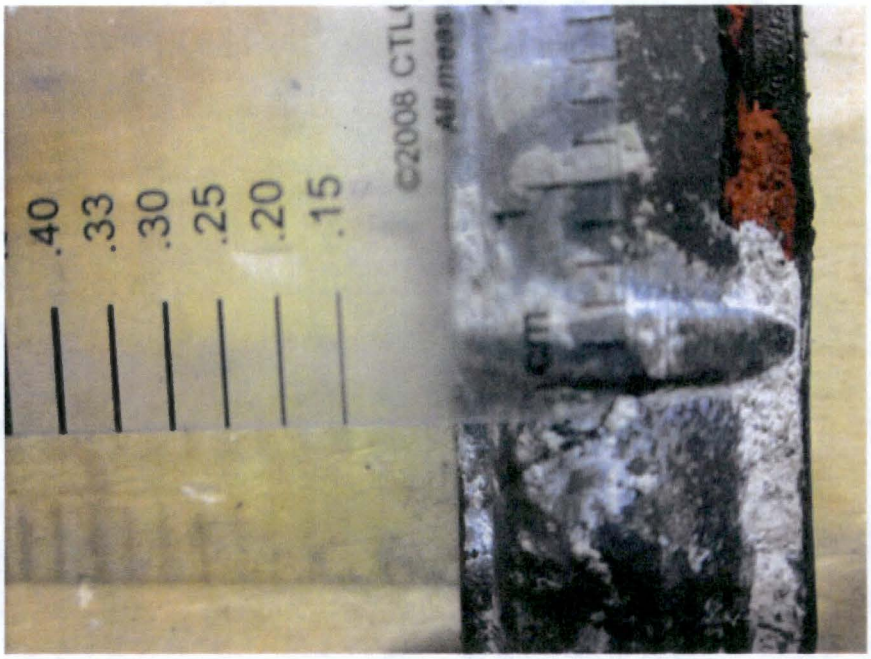
C-107 Rebar Deformation Spacing (in.)



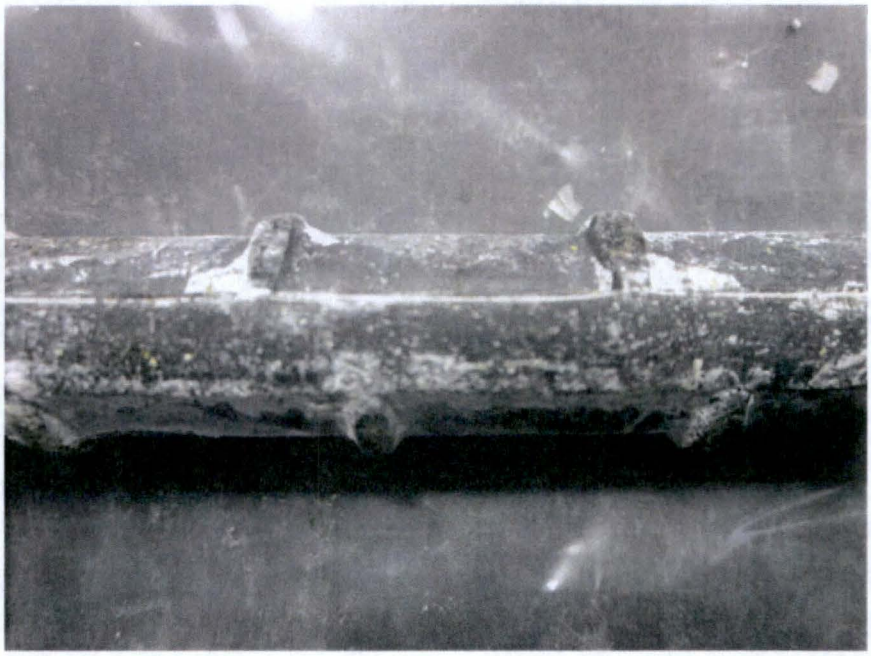
C-107 Rebar Rib Width (cm.)



C-107 Rebar Deformation Width (cm.)

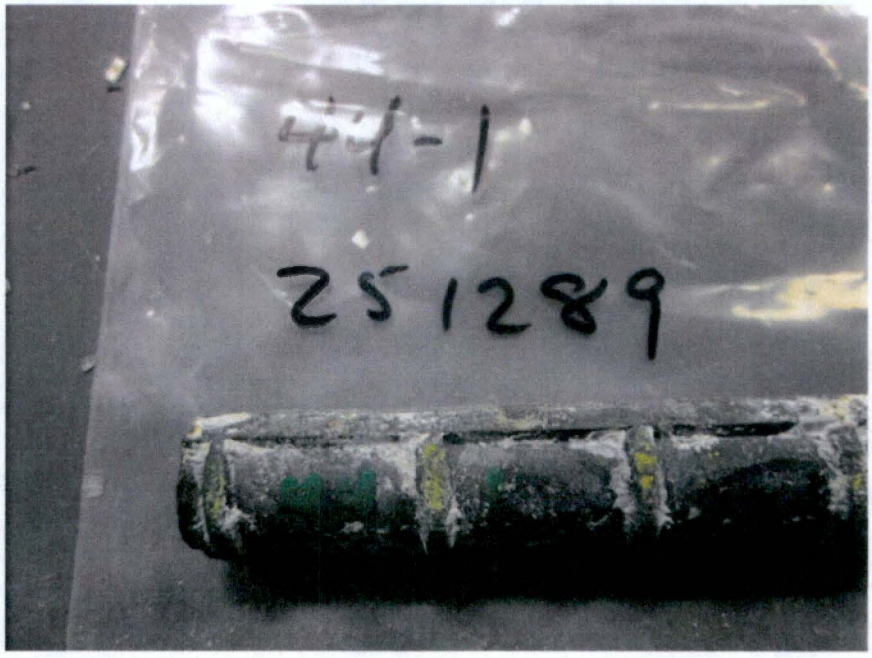


C-107 Rebar 44-2 Close-up of Deformations



C-107 Rebar 44-2 Close-up of Deformations

C-107 Rebar 44-1 Correlation of Marking of Sample ID to Sample Bag to Contract Number. This was typical for all rebar samples.



C-107 Rebar 43-2 Machined Samples Ready for Lathe Grip End to be removed

C-107 Rebar 43-2 with EXOVA ID of 515

C-107 ASTM A370 Test Specimen

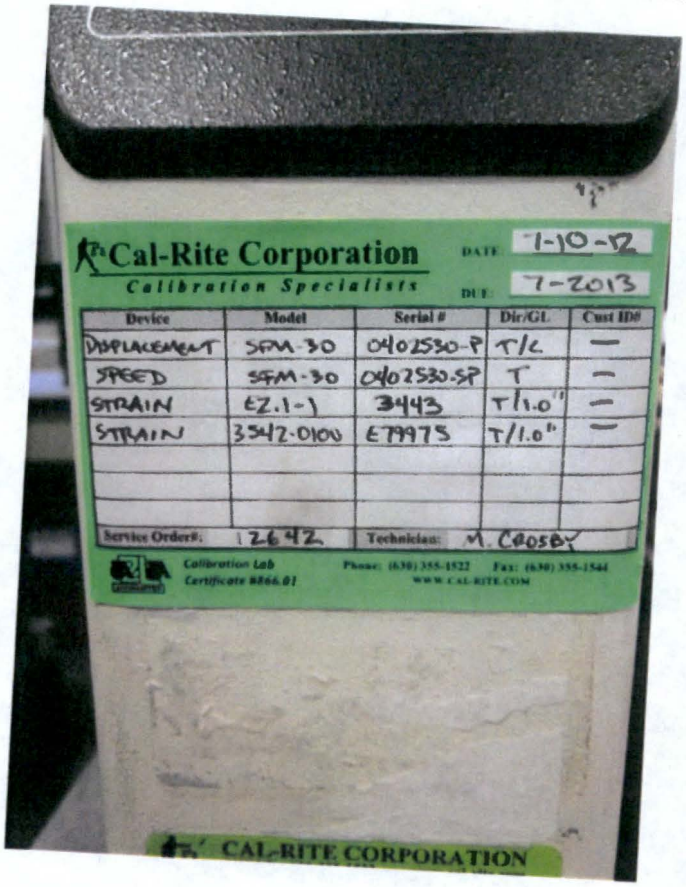
ASTM A370 Test Apparatus with Strain Gauge Attached to C-107 Rebar Test Specimen

C-107 Rebar ASTM A370 Test Specimen in Testing Machine Pre-test

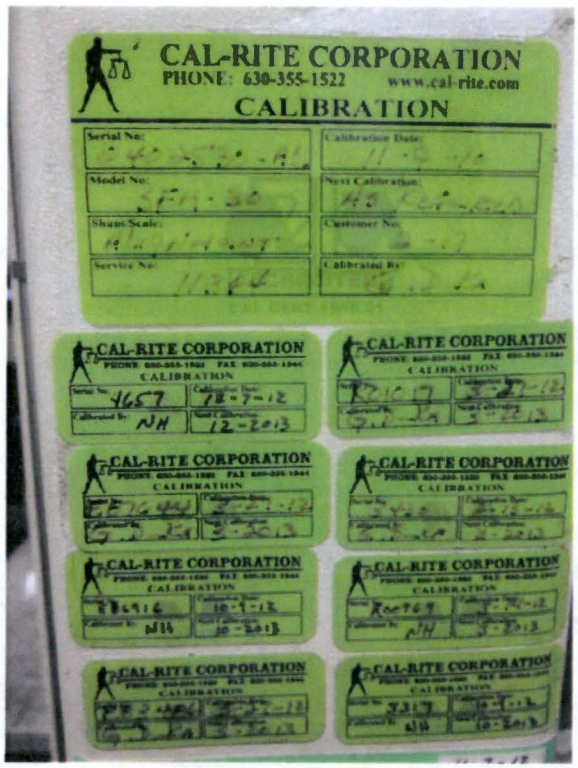
C-107 Rebar ASTM A370 Test Specimen in Testing Machine Post-Test

United SFM Testing Machine (Load Frame)

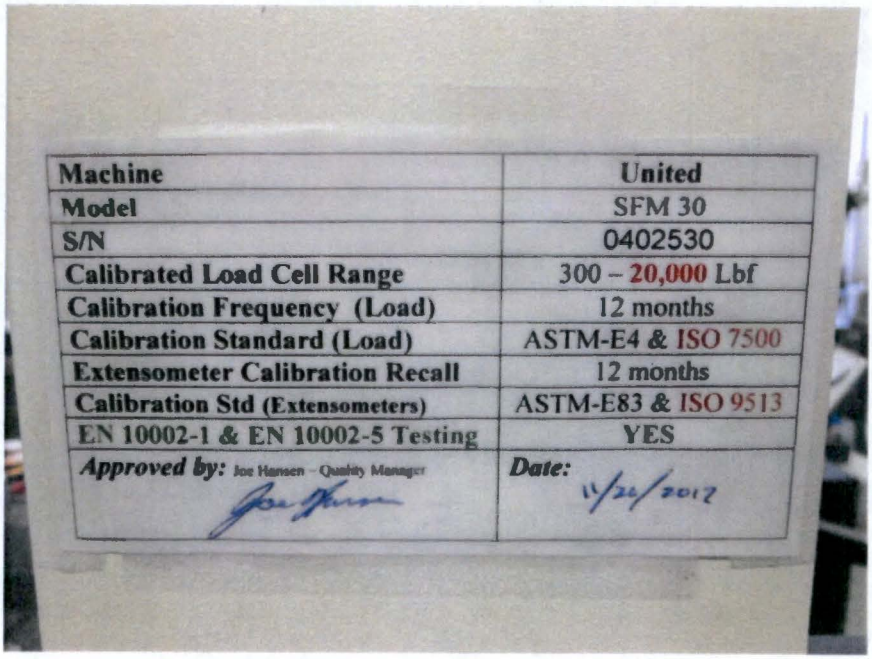
United SFM Testing Machine (Load Frame) Calibration 1



United SFM Testing Machine (Load Frame) Calibration 2

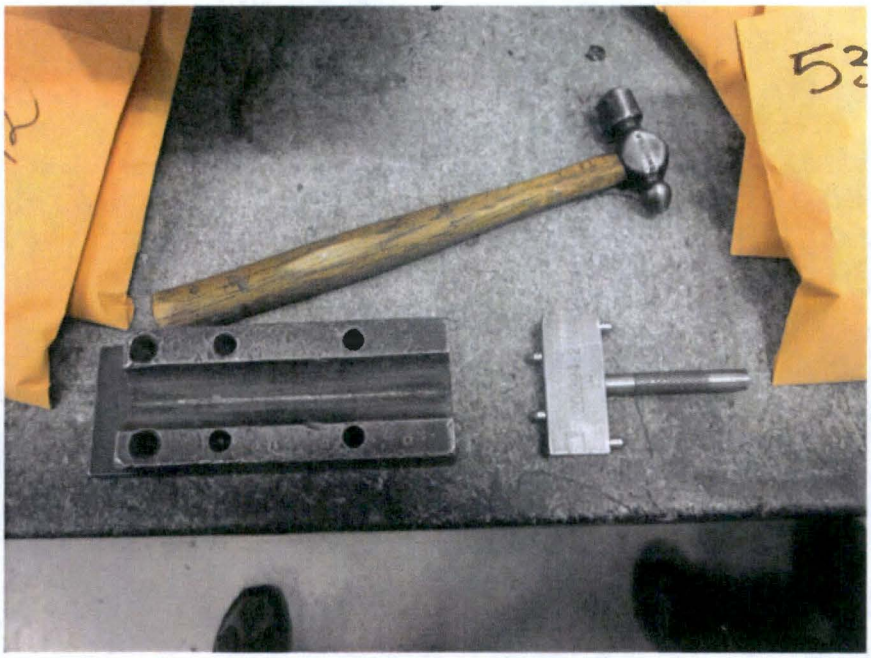


United SFM Testing Machine (Load Frame) Calibration 3

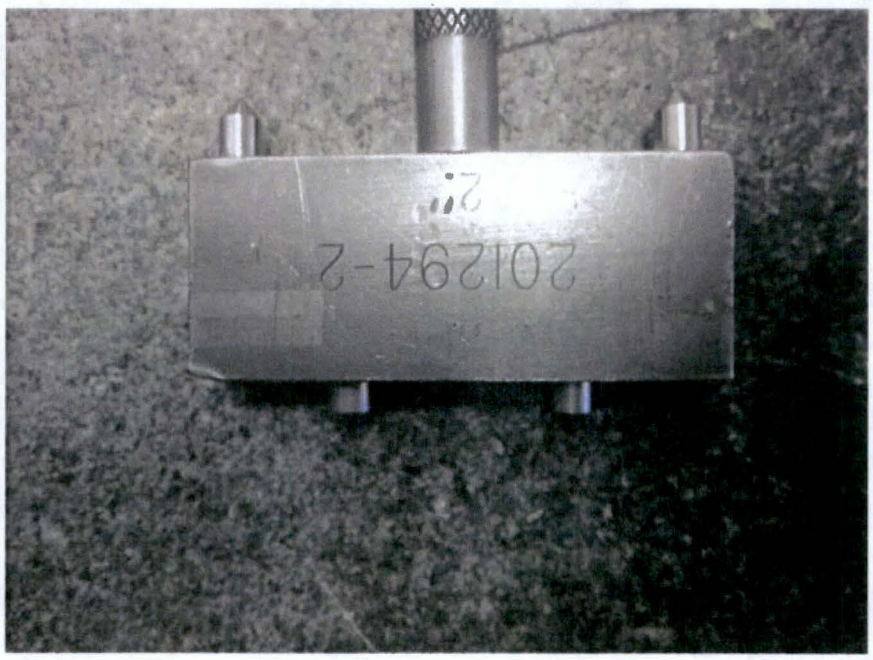


Machine	**United**
Model	SFM 30
S/N	0402530
Calibrated Load Cell Range	300 – 20,000 Lbf
Calibration Frequency (Load)	12 months
Calibration Standard (Load)	ASTM-E4 & ISO 7500
Extensometer Calibration Recall	12 months
Calibration Std (Extensometers)	ASTM-E83 & ISO 9513
EN 10002-1 & EN 10002-5 Testing	**YES**
Approved by: Joe Hansen – Quality Manager	***Date:*** 11/22/2017

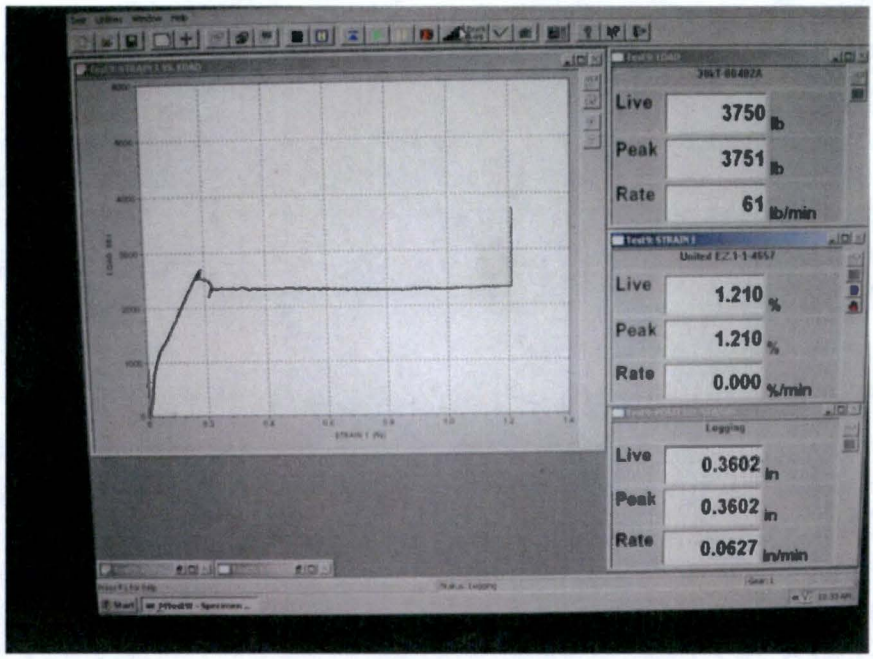
Gauge Length Stamping Jig



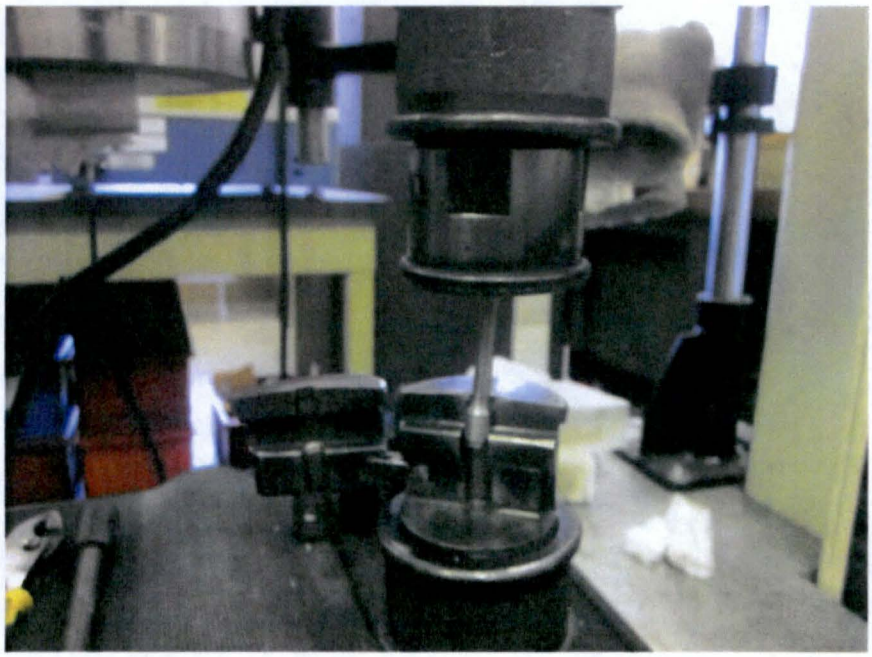
Gauge Length Stamp



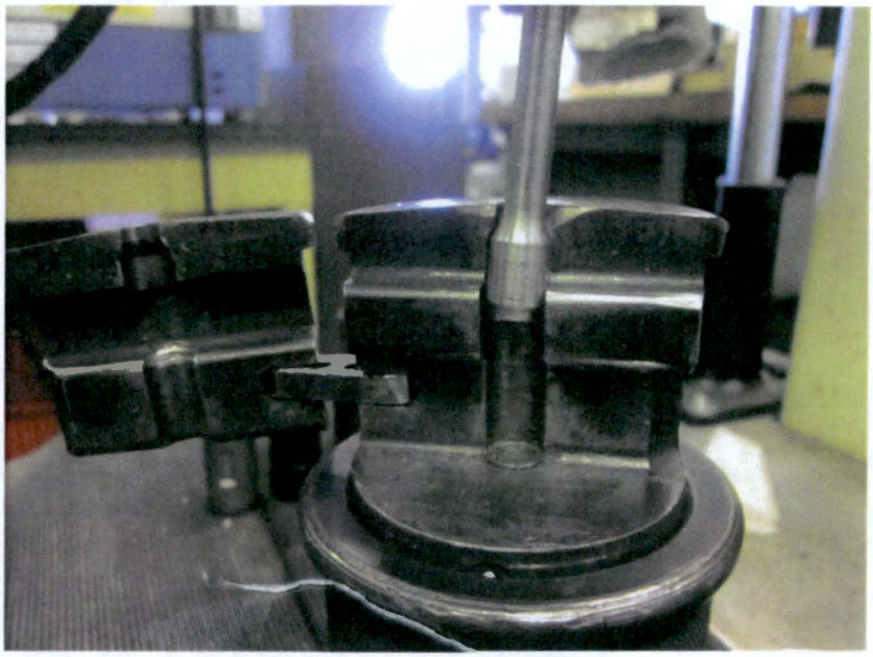
United SFM Testing Machine (Load Frame) Data Acquisition Screen



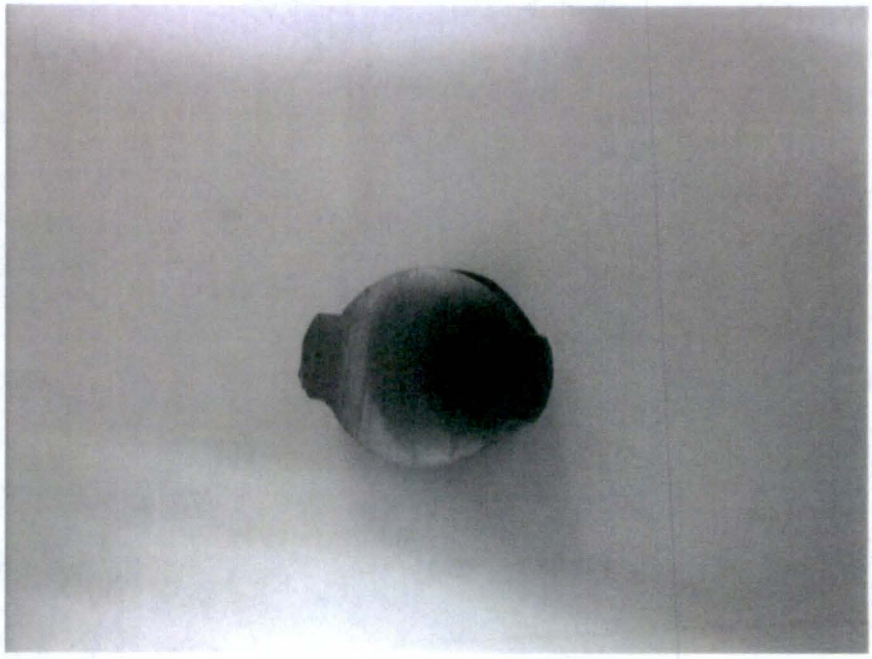
United SFM Testing Machine (Load Frame) Specimen Grip



United SFM Testing Machine (Load Frame) Specimen Grip (Close-Up)

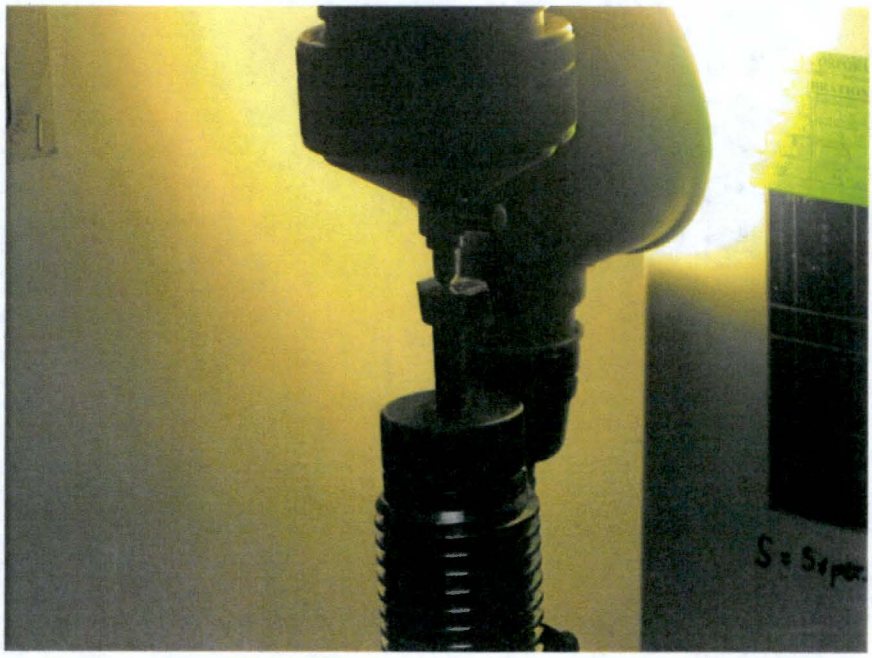


C-107 Rebar Rockwell Hardness Test Specimen (Plan)



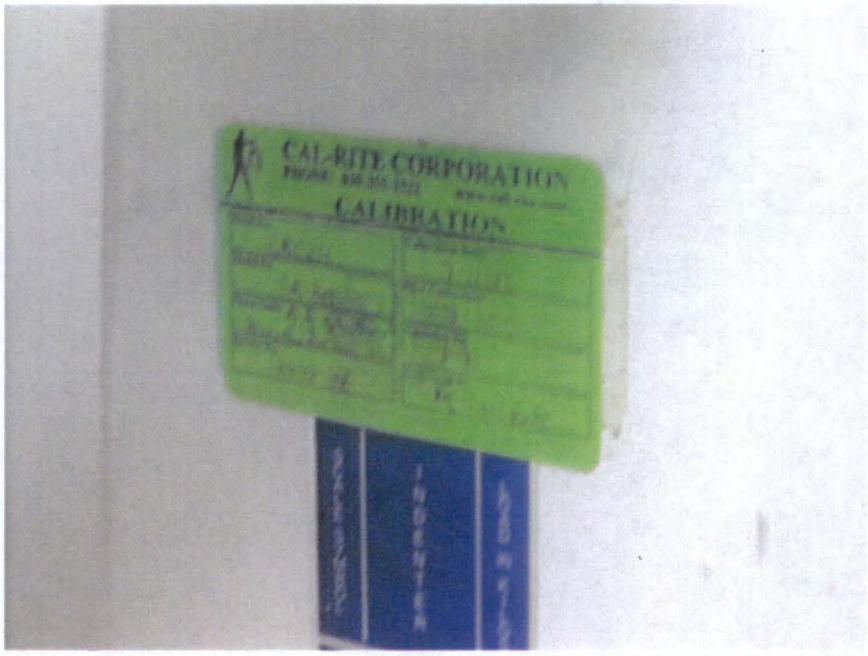
C-107 Rebar Rockwell Hardness Test Specimen (Isometric)

C-107 Rebar Rockwell Hardness Test Specimen in Test Machine



Rockwell Hardness Test Machine

Rockwell Hardness Test Machine Calibration



C-107 Rebar 44-2 Prior to Machining for Impact Tests

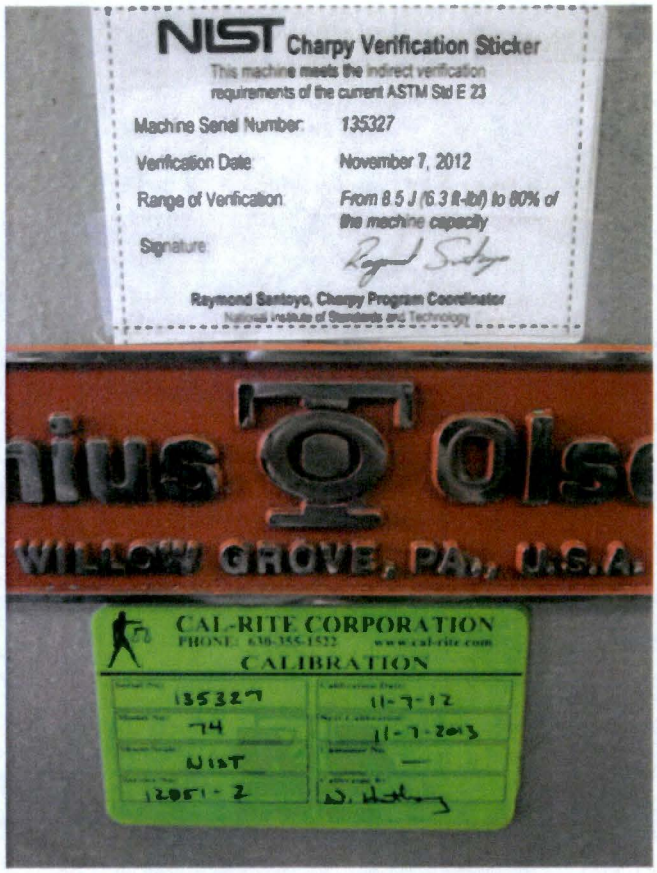
C-107 Rebar Sample 44-2 Charpy V-Notch Specimen (I)

C-107 Rebar Sample 44-2 Charpy V-Notch Specimen (II)

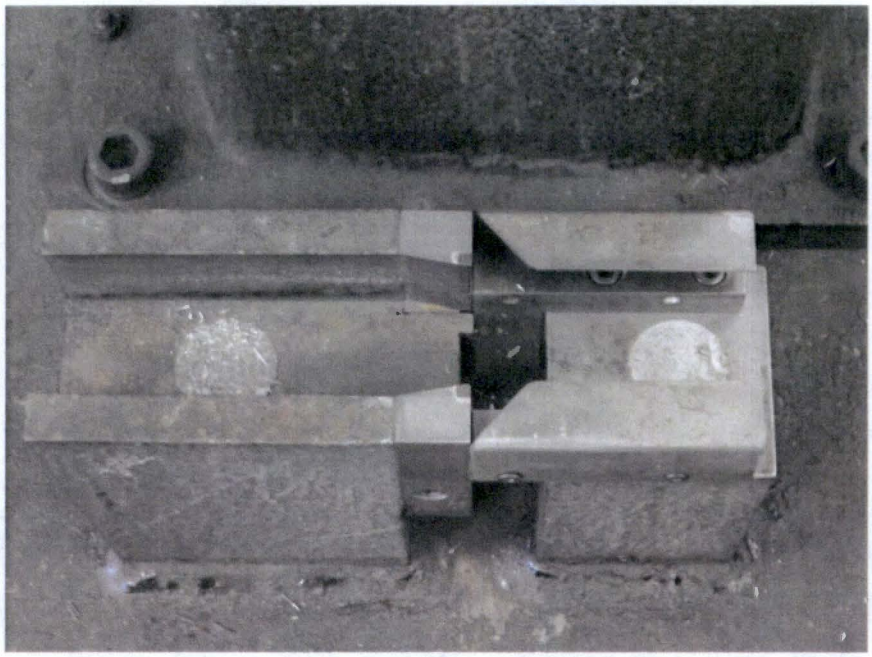
Tinius Olsen Impact Test Machine

Tinius Olsen Impact Test Machine Scale

Tinius Olsen Impact Test Machine Calibration



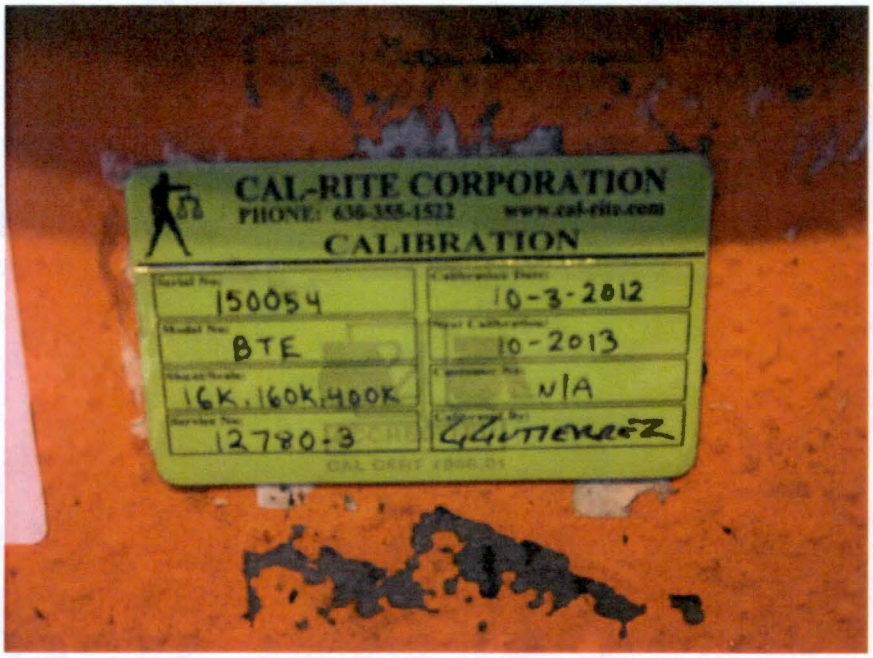
Tinius Olsen Impact Test Specimen Holder



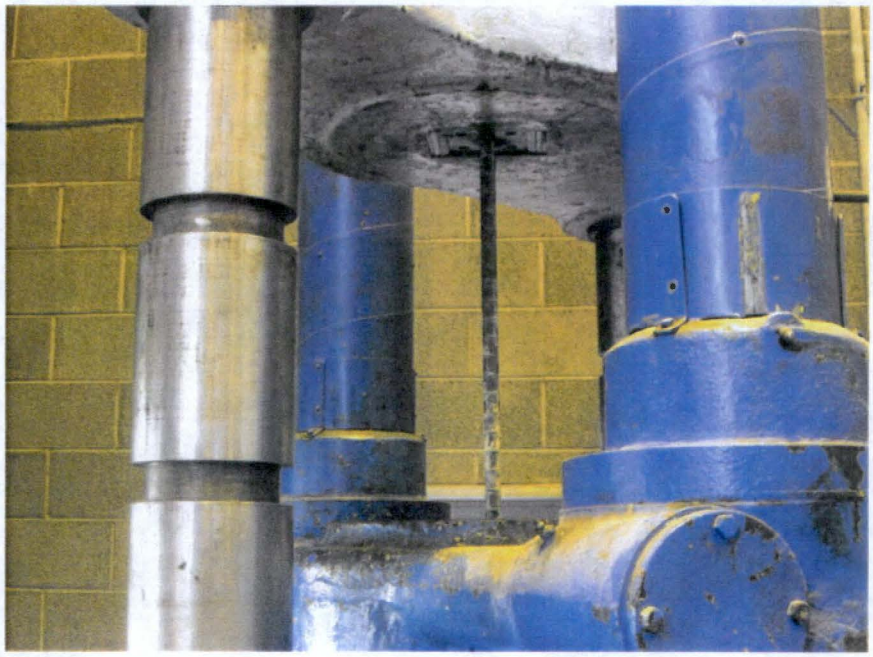
C-107 Rebar ASTM A615 Test Specimens

Baldwin BTE Test Machine for ASTM A615 Specimens

Baldwin BTE Test Machine Calibration



C-107 Rebar A615 Specimen in Load Frame with Top Rebar Grips Visible



C-107 Rebar A615 Specimen in Load Frame with Bottom Rebar Grips Visible

Appendix E

C-107 Rebar

Radiological Survey Report

TANK OPERATIONS CONTRACTOR RADIOLOGICAL SURVEY REPORT

RSR No. COC-005242

Date	Start/Stop Time	Area/Location	RWP/Rev.
9/10/12	0600 / 1500	200-E-241-C-TANK FARM	CO-732 REV.3

Purpose of Survey

[ ] Material Release – Confidence Level

[ ] 67% [ ] 95%

[ ] RAM Shipment:

[ ] Required Task:

[X] Job Coverage: TFC-WO-12-3327

[ ] Other:

Description of Work/Comments:

C TANK FARM IS A POSTED RADIATION AND CONTAMINATION AREA.JOB ENTAILS REMOVING REBAR FROM C-107 MARS CORE.DOSERATE FELT AND CONCRETE RUBBLE WAS BAGGED AND TAGGED PRIOR TO REBAR REMOVAL.CONCRETE RUBBLE WAS MOVED AWAY FROM REBAR,REBAR REMOVED,SIZED AND PLACED INTO A WASTE DRUM FOR SHIPMENT.INITIALY LABORERS USED WET MEATHODS TO SUPPRESS EMITTED DUST.DOME CORE WAS WRAPPED POST REBAR REMOVAL.

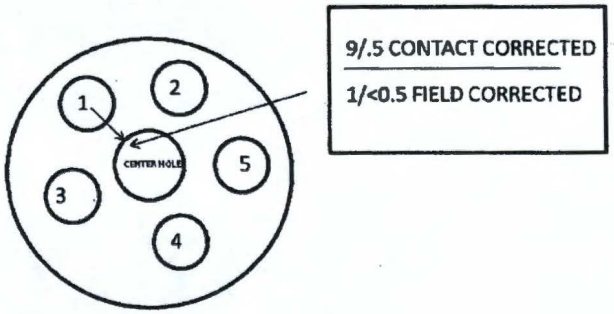
No.	Description	Dose Rate Measurements								Contamination Measurements							
		Note[1] F = Field (≥30 cm) C = Contact (≤1 cm)								Direct Gross cpm/PA		Background cpm		Total dpm/100 cm^2		Removable dpm/100 cm^2	
		Dist. (cm) Note[1]	WO mR/hr	WC mR/hr	CF β	CF γ	Neutron Dose mrem/hr	Shallow Dose mrem/hr	Deep Dose mrem/hr	βγ	α	βγ	α	βγ	α	βγ	α
1	CENTER HOLE-LEFT PRE JOB	C/F	4/.5	1/<0.5	2	1	N/A	9/1	1/<0.5	40000	0	150	0	400000	<100	N/A	N/A
2	DOSERATE AREA-SMEAR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	0	N/A	N/A	<1000	<20
3	SMEARS-10 POST DOSERATE FELT AND RUBBLE REMOVED	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	0	N/A	N/A	<1000	<20
4	DOME SURFACE-DIRECT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	N/A	150	0	<5000	<100	N/A	N/A
5	CENTER HOLE-DIRECT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2000	0	150	0	20000	<100	N/A	N/A
6	SMEARS CENTER HOLE-5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	0	N/A	N/A	<1000	<20
7	DISCARDED CONCRETE RUBBLE-SMEARS-10-DIRECT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	0	150	0	<5000	<100	<1000	<20
8	WASTE DRUM-TFP-12-235-02-DOSERATE-SMEARS-5	C/F	<0.5/<0.5	<0.5/<0.5	2	1	N/A	<0.5/<0.5	<0.5/<0.5	N/A	N/A	150	0	N/A	N/A	<1000	<20
9	REBAR-DIRECT-SMEARS-10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	0	150	0	<5000	<100	<1000	<20
10	WRAPPED DOME CORE-GRIFFLON OUTSIDE POST JOB	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	0	N/A	N/A	<1000	<20
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

COPY

BD-6003-343 (REV 7)

TANK OPERATIONS CONTRACTOR RADIOLOGICAL SURVEY REPORT	RSR No. COC-005242	Page 2 of 2

Map/Sketch



C-107 MARS DOME CORE PRE FELT REMOVAL

Legend:	Direct Measurement	Air Sample	Smear	LAW	Neutron	Field Dose Rate * Contact Dose Rate	Note: Dose Rates in mrem/hr unless otherwise noted.
	-------- (designation inside) -------- Radiological Area Boundary						

Instruments

Instrument/Probe Model	RO-20	GM Model g-m Probe	PAM Probe	N/A	N/A	N/A	N/A	N/A
Serial No.	ICEB9-0087	EMEB3-0284	ACHN2-0639	N/A	N/A	N/A	N/A	N/A
		DTHNC-0994	DTHN3-0261	N/A	N/A	N/A	N/A	N/A
Efficiency (used)	N/A	.1	.16	N/A	N/A	N/A	N/A	N/A

	Air Sample Log Number		Smear Log Number	HPT: Date: 9/10/12	HID: H0079920	Initial Review Date & Initials: 9/13/12 Final Review Date & HID: 9/18/12
1	N/A	[ ] Breathing Zone [ ] General Area	N/A	Name (Print): R.A. MCCOY		Name (Print): K. Engebretson
2	N/A	[ ] Breathing Zone [ ] General Area	N/A	Signature:		Signature:

COPY

BD-6003-343 (REV 7)

Appendix F

C-107 'Plug'

Asphalt Membrane

Asbestos Screening Results

WSCF
ANALYTICAL LABORATORY REPORT

Analysis of Bulk Samples for Fiber Content
for

WRPS
Richland, WA 99352

Attention: Keith Fuller

Survey ID: 12-03499

Data Validator Bruce E. Hey

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Group#: 20120772
Report Date:27-Aug-2012

WSCF Laboratory
PO Box 1000 S3-30
Richland, WA 99352
Jonathan_B_Kon@rl.gov

PHONE (509)373-5366

WSCF
ANALYTICAL LABORATORY REPORT
Analysis of Bulk Samples for Fiber Content
Disclaimer

Attention: Keith Fuller | WRPS Bulk Asbestos | **Group #:** 20120772

Survey ID: 12-03499

Your samples have been analyzed for fiber content using polarized light microscopy and dispersion staining in accordance with Industrial Hygiene Laboratory Procedure LA-519-403, based on 40 CFR Part 763, Subpart E, App. E and EPA method EPA/600/R-93/116. The results are attached.

This method provides a visual estimate of the percentage of each fiber type present. It is a semiquantitative method intended to identify materials containing > or = 1% asbestos fibers.* Reported fiber percentages for samples and sample layers are based on the samples as received by the laboratory. The laboratory cannot verify that these values are representative of the original material sampled.

The Waste Sampling and Characterization Facility is accredited by the American Industrial Hygiene Association (AIHA) to analyze bulk samples for asbestos content. This accreditation does not constitute approval or endorsement of analytical results by AIHA.

If there are questions concerning this report, please contact the data validator listed on the cover page of this report.

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*** Because of the nonhomogeneous nature of soils, results will be reported using the following terms rather than percentages:**

1. **None - No asbestos fibers found.**
2. **Trace detectable - With extensive searching, a few fibers of the type indicated were found; concentration very low, well below 1%**
3. **Obvious presence - Fibers easily found but overall concentration still low.**
4. **Significant presence - Fibers readily found; overall concentration may approach or exceed 1% level.**

Polarized light microscopy (PLM) may not be the preferred method for identification of asbestos in floor tile. Most vinyl floor tiles marketed in the late sixties to mid-seventies contained asbestos milled so fine as to be below detection limits for PLM techniques. Tiles of that vintage, showing any detectable asbestos fibers should be considered to be asbestos-containing material. Non-detection of asbestos by PLM should not be considered conclusive proof that the tiles do not contain asbestos. Results for such samples will be reported as 'indeterminate'. Confirmatory analysis by TEM is strongly recommended.

RPP-RPT-54564, Rev. 0

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WSCF
ANALYTICAL LABORATORY REPORT
Analysis of Bulk Samples for Fiber Content
Analysis Results

Attention: Keith Fuller — WRPS Bulk Asbestos — **Group #:** 20120772

Survey ID: 12-03499

Sample #	Client ID	Test Performed	Range	Result	Units	Sampled	Received	Analyzed
W12H005655	12-03499-001	The following are the results of this test -W12H005655IH Asbestos Bulk Layer 1				08/24/2012	08/24/2012	08/27/2012
Analyst: HEY, BRUCE		**IH AREV:** GRANT, MARGIE				**IH CREV:** HEY, BRUCE		
		Cellulose		5	Percent			
		Non-Asbestos		95	Percent			
	Analysis Comment - Non-homogenous sample. This layer: dark asphalt; 85% of bulk sample.							
W12H005655	12-03499-001	The following are the results of this test -W12H005655IH Asbestos Bulk Layer 2				08/24/2012	08/24/2012	08/27/2012
Analyst: HEY, BRUCE		**IH AREV:** GRANT, MARGIE				**IH CREV:** HEY, BRUCE		
		Cellulose		90	Percent			
		Non-Asbestos		10	Percent			
	Analysis Comment - Non-homogenous sample. This layer: cellulosic felt; 15% of bulk sample.							

F-3

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WSCF
ANALYTICAL LABORATORY REPORT
Analysis of Bulk Samples for Fiber Content
Comments

Attention: Keith Fuller | WRPS Bulk Asbestos | **Group #:** 20120772

Survey ID: 12-03499

Sample #	Client ID	Lab Area	Test	Comment
				I certify that this analytical report is in compliance with the Hanford SOW,both technically and for completeness. Release of the data contained in this hardcopy report has been authorized by the IH Technical Manager or a designee as verified by the signature on the first page of this report. The results provided in this report relate only to the items tested.
		Verification		Validated on 8/27/12 by BE Hey, IH Technical Manager.

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INDUSTRIAL HYGIENE CHAIN OF CUSTODY AND LABORATORY REQUEST

20120772

Contractor: Washington River Protection Solutions			**Date Sampled:** 08/24/2012
COA: CB20	CACN: 200278	**Survey No.:** 12-03499 - C-107 Plug Sample	
Contact Name: Dobb, Jennifer L	**Phone:** (509)373-0608		**Date Needed:** 08-27-12
Return Report To: Caldwell, Joyce A		**MSIN:** S7-70	**Phone:** (509)376-0737

Laboratory Log No.	Sample ID/Type/Description	Required Analysis
W12H00S6S5	12-03499-001 / Bulk (container)	Asbestos - asphaltic (black) layer only

Special Instructions:

	Signature	Printed Name	Location	Date	Time
Delivered to Storage:		BAC			
Retrieved from Storage:		08-24-12			

	Signature	Printed Name	Date	Time
Relinquished By:	[signature]	Robert G Silvey	8-24-12	1341
Received By:	[signature]	BRETT GARNER	8-24-12	1341
Relinquished By:	[signature]	BRETT GARNER	8-24-12	1350
Received By:	[signature]	TA FRAZIER	8-24-12	1350
Relinquished By:				
Received By:				

Additional Comments:

Appendix G

CTL Group Accreditations

International Accreditation Service

CERTIFICATE OF ACCREDITATION

This is to signify that

CTLGROUP
5400 OLD ORCHARD ROAD
SKOKIE, ILLINOIS 60077

Testing Laboratory TL-200
(February 7, 2011)

has met the requirements of the IAS Accreditation Criteria for Testing Laboratories (AC89), has demonstrated compliance with ANS/ISO/IEC Standard 17025:2005, *General criteria for the competence of testing and calibration laboratories*, and has been accredited, commencing March 10, 2010, for the test methods listed in the approved scope of accreditation.

Patrick V. McCullen
Vice President

C. P. Ramani, P.E.
President

ilac-MRA

IAS
ACCREDITED

(see attached scope of accreditation for fields of testing and accredited test methods)

Print Date: 02/08/2011

This accreditation certificate supersedes any IAS accreditation certificate bearing an earlier date. The certificate becomes invalid upon suspension, cancellation or revocation of accreditation. See the IAS Accreditation Listings on the web at www.iasonline.org for current accreditation information, or contact IAS directly at (562) 699-0541

Page 1 of 3

IAS is a subsidiary of the International Code Council

ICC INTERNATIONAL CODE COUNCIL

10-03355

International Accreditation Service

SCOPE OF ACCREDITATION

CTLGroup TL-200
(Revised February 7, 2011)

CTLGroup
5400 Old Orchard Rd
Skokie, IL 60077

Jeffrey Leavitt
Quality Manager
(847) 972-3058

FIELDS OF TESTING	ACCREDITED TEST METHODS
Concrete (including fiber-reinforced concrete, masonry, cement, mortar and grout) and aggregates	ASTM Standards C 29, C 31, C 39, C 40, C 42, C 67, C 78, C 88, C 91, C 109, C 114, C 117, C 123, C 127, C 128, C 131, C 136, C 138, C 140, C 142, C 143, C 151, C 157, C 172, C 173, C 185, C 187, C 190, C 191, C 192, C 204, C 215, C 227, C 231, C 232, C 234, C 266, C 270, C 289, C 293, C 348, C 403, C 426, C 430, C 441, C 451, C 457, C 469, C 482, C 496, C 512, C 535, C 566, C 567, C 617, C 641, C 642, C 666, C 672, C 702, C 779, C 780, C 856, C 947, C 1018, C 1019, C 1064, C 1077, C 1105, C 1116, C 1152, C 1202, C 1218, C 1222, C 1314, C 1357, C 1388, C 1581, E 514, E 518, and E 519; Test methods referenced in Sections 3 and 4 of ICC-ES Acceptance Criteria AC51
Steel wire, bar and strand materials; Steel studs, joists and tracks	ASTM Standards A 82, A 184, A 185, A 370, A 416, A 421, A 496, A 497, A 615, A 616, A 617, A 706, A 722, A 767, A 775, A 882, A 884, A 934, A 944 and E 328; Test methods referenced in Sections 3 and 4 of ICC-ES Acceptance Criteria AC46
Welded and mechanical connections for concrete reinforcing steel; Post-tensioning anchorages and couplers	1997 UBC Standard 19-1; Test methods referenced in Sections 3 and 4 of ICC-ES Acceptance Criteria AC133 and AC303; Caltrans Test 670

March 10, 2010
Commencement Date

ACCREDITED

C. P. Ramani, P.E.
President

Print Date: 02/08/2011

This accreditation certificate supersedes any IAS accreditation certificate bearing an earlier date. The certificate becomes invalid upon suspension, cancellation or revocation of accreditation. See the IAS Accreditation Listings on the web at www.iasonline.org for current accreditation information, or contact IAS directly at (562) 699-0541

IAS is a subsidiary of the International Code Council

10-03356

International Accreditation Service

SCOPE OF ACCREDITATION

CTLGroup TL-200
(Revised February 7, 2011)

FIELDS OF TESTING	ACCREDITED TEST METHODS
Adhesive and mechanical anchors in concrete and masonry elements	Test methods referenced in Section 5.0 of ICC-ES Acceptance Criteria AC01 and Sections 3 and 4 of AC58, Tables 4.1, 4.2 and 4.3 AC193 and Tables 4.1, 4.2, 4.3 and 4.4 of AC308; ASTM Standards E 488, E 754 and E 1512
Wall panels	ASTM Standards C 1452 (Section 9 only), E 72, E 330 and E 661; Test methods referenced in Section 4.0 of AC32 and AC86.
Reinforced and prestressed concrete pipe	ASTM Standard C 497
Seismic isolation/damping system components	1997 UBC Section 1665
Fasteners	ASTM Standard E 1190; Test methods referenced in Sections 3 and 4 of ICC-ES Acceptance Criteria AC118
Deck board and guardrail systems	Test methods referenced in Sections 3, 4 and 5 of ICC-ES Acceptance Criteria AC174 (except Sections 3.9 and 3.10)
Cement-based fabric composite system	Test methods referenced in Sections 3 and 4 of ICC-ES Acceptance Criteria AC218 (except Sections 4.1, 4.2 and 4.6)
Construction materials	ASTM E 96

March 10, 2010
Commencement Date

ACCREDITED

C. P. Ramani, P.E.
President

Print Date: 02/08/2011

This accreditation certificate supersedes any IAS accreditation certificate bearing an earlier date. The certificate becomes invalid upon suspension, cancellation or revocation of accreditation. See the IAS Accreditation Listings on the web at www.iasonline.org for current accreditation information, or contact IAS directly at (562) 699-0541

IAS is a subsidiary of the International Code Council

10 03356

American Association of State Highway and Transportation Officials

AASHTO Accreditation Program - Certificate of Accreditation

This is to signify that

Construction Technology Laboratories, Inc.

Skokie, Illinois

has demonstrated proficiency for the testing of construction materials
and has met the minimum requirements in AASHTO R18
set forth by the AASHTO Highway Subcommittee on Materials.

The scope of accreditation can be obtained by viewing
the AAP Directories of Accredited Laboratories (www.nist.gov/amrl)
or by contacting AMRL.

Executive Director

Chair, AASHTO Highway
Subcommittee on Materials

AAP
AASHTO R18

Appendix H

C-107 Rebar

Shipping Information

STRAIGHT BILL OF LADING - SHORT FORM - ORIGINAL - Not Negotiable SHIPPERS NUMBER TF1289 DATE: 12/03/2012

Shipper (from)	Consignee (to)
U.S. DEPT. OF ENERGY C/O WRPS 2355 STEVENS DR. G1-10 RICHLAND WA 99354- TECHNICAL CONTACT: JOB/WORK ORDER: ROUTE:	RADIATION SAFETY SERVICES, INC. HIGH RESOLUTION GAMMA SPEC. LAB 6312 WEST OAKTON STREET MORTON GROVE IL 60053- CONTACT NAME: ELI PORT 847-965-1999 REFERENCE #:

9681745619 *RDWY*

No. Shipping Units	Type of Package	HM	Description of Articles, Special Marks, and Exceptions (Subject to Correction)	NMFC Item No.	Class	Rate	Weight (Subject to correction)
1	METAL DRUM	X	UN2910, RADIOACTIVE MATERIAL, EXCEPTED PACKAGE-LIMITED QUANTITY OF MATERIAL, 7, EMERGENCY RESPONSE GUIDE #161 ATTACHED Tender 2914 Cost Code: 2MH00 200972 EX00 Item 164900 Sub 1 Class 70 "Released value not exceeding 40 cents per pound."				120 lb
1	<<<Total Pieces		IN THE EVENT OF EMERGENCY, TELEPHONE (888) 766-0771 - 24 HRS Contact or Registrant Name, or Contract Number Keith Smith (509)366-5255				120 lb 54 kg

3/02/09 968-174561-9

968

YRC tariffs are incorporated herein (copies available upon request). YRC tariffs limit its liability. This shipment is subject to the terms and conditions of the Uniform Straight Bill of Lading as stated in the NMFC 100 series tariff.

CK/I | PCS | O/B UNIT | DEST

In the event of damage or loss of the material described in this Bill of Lading while in the possession of the carrier, the carrier agrees to notify the shipper/consigner within two hours.

FREIGHT CHARGES ARE:
- [x] Prepaid
- [ ] Collect
- [ ] 3rd Party

(see Remarks)

If this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement: The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

U.S. DOE

This shipment is for the U.S. Department of Energy and the actual total transportation charges paid to the carrier(s) by the consignor or consignee are assignable to, and shall be reimbursed by, the U.S. Government and is subject to the terms and conditions set forth in the standard form of the U.S. Government Bill of Lading and to any available special rates or charges (41 CFR 109-40.50 and 41 CFR 109-40.3)

[x] Yes [ ] No

SECTION 13712/10721 RATES APPLY - TENDER NO. 2914

Remarks:

Received, subject to individually determined rates or contracts that have been agreed upon in writing between the carrier and shipper, if applicable, otherwise to the rates, classifications and rules that have been established by the carrier and are available to the shipper, on request. The property described above, in apparent good order, except as noted (contents and conditions of contents of packages unknown) marked, consigned and destined as shown herein, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, unless otherwise specifically stated in individually determined rates and contracts that have been agreed upon in writing between the carrier and shipper, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at anytime interested in all or any of said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Straight Bill of Lading set forth (1) in Uniform Freight Classification in effect on the date hereof, if this is a rail or rail-water shipment, or (2) in the applicable motor carrier classification or tariff if this is a motor carrier shipment. Shipper hereby certifies they are familiar with all terms and conditions of the said bill of lading, set forth in the classification or tariff which governs the transportation of this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for him/herself and their assigns.

This is to certify that the above named materials are properly classified, described, packaged, marked, labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation (Applicable for Hazardous Materials Only)

Shipper, Acting under contract DE-AC27-08RV14800 with the U.S. Department of Energy:

WRPS, PO BOX 850, MSIN G2-02, RICHLAND, WA 99354

Per SHANDA L. ICAYAN Shanda L Icayan Date 12/03/2012

Trailer Loaded by: [x] Shipper [ ] Driver

Freight Counted by:
- [ ] Shipper
- [ ] Driver, Loose pieces
- [ ] Driver, pallet said to contain
- [ ] Driver, pallets containing

Vehicle/Car No:

Seal:

Placards Required N/A

Label(s) applied N/A

Carrier RDWY / YRC INC.

Per CRyan Date 12-3-12

TRANSPORTATION DEPARTMENT - PERMANENT POST OFFICE ADDRESS OF SHIPPER

Trailer# 821200 Received 1 drum

H-1

RPP-RPT-54564, Rev. 0

POTENTIAL HAZARDS

HEALTH

- Radiation presents minimal risk to transport workers, emergency response personnel and the public during transportation accidents. Packaging durability increases as potential hazard of radioactive content increases.
- Very low levels of contained radioactive materials and low radiation levels outside packages result in low risks to people. Damaged packages may release measurable amounts of radioactive material, but the resulting risks are expected to be low.
- Some radioactive materials cannot be detected by commonly available instruments.
- Packages do not have RADIOACTIVE I, II, or III labels. Some may have EMPTY labels or may have the word "Radioactive" in the package marking.

FIRE OR EXPLOSION

- Some of these materials may burn, but most do not ignite readily.
- Many have cardboard outer packaging; content (physically large or small) can be of many different physical forms.
- Radioactivity does not change flammability or other properties of materials.

PUBLIC SAFETY

- **CALL EMERGENCY RESPONSE Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- **Priorities for rescue, life-saving, first aid, fire control and other hazards are higher than the priority for measuring radiation levels.**
- Radiation Authority must be notified of accident conditions. Radiation Authority is usually responsible for decisions about radiological consequences and closure of emergencies.
- As an immediate precautionary measure, isolate spill or leak area for at least 25 meters (75 feet) in all directions.
- Stay upwind.
- Keep unauthorized personnel away.
- Detain or isolate uninjured persons or equipment suspected to be contaminated; delay decontamination and cleanup until instructions are received from Radiation Authority.

PROTECTIVE CLOTHING

- Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 100 meters (330 feet).

Fire

- When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions.

EMERGENCY RESPONSE

FIRE

- Presence of radioactive material will not influence the fire control processes and should not influence selection of techniques.
- Move containers from fire area if you can do it without risk.
- Do not move damaged packages; move undamaged packages out of fire zone.

Small Fire

- Dry chemical, CO_2, water spray or regular foam.

Large Fire

- Water spray, fog (flooding amounts).

SPILL OR LEAK

- Do not touch damaged packages or spilled material.
- Cover liquid spill with sand, earth or other non-combustible absorbent material.
- Cover powder spill with plastic sheet or tarp to minimize spreading.

FIRST AID

- Call 911 or emergency medical service.
- Medical problems take priority over radiological concerns.
- Use first aid treatment according to the nature of the injury.
- Do not delay care and transport of a seriously injured person.
- Give artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Injured persons contaminated by contact with released material are not a serious hazard to health care personnel, equipment or facilities.
- Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination.

UN2910, RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - LIMITED QUANTITY OF MATERIAL, 7

RADIOACTIVE SHIPMENT RECORD

3. Page 1 of 1 | 4. Ship Prepaid | 5. Via Motor

1. SHIP FROM U.S. DEPT. OF ENERGY C/O
Company WRPS
Address PO Box 850
City, State, Zip Richland, WA 99352
Contact Jim Castleberry
Phone 509 373-5501

2. SHIP TO ☐ U.S. DEPT. OF ENERGY C/0
Company Radiation Safety Services, Inc.
Address 6312 West Oakton Street
City, State, Zip Morton Grove, IL 60053
Attention High Resolution Gamma Spec. Lab
Phone Eli Port 847-965-1999

6. SHIPMENT AUTHORIZATION NUMBER TF1289

7. EMERGENCY CONTACT INFO
Telephone 1-888-766-0771
ERG #s 161
Charge Code 200972

8. HM UN ID Proper Shipping Name: PRI HAZ SUB HAZ
X UN2910 Radioactive Material, excepted package-limited quantity of material 7

9. No. Pkg.	Model Package	COC/Spec	Serial No.	Seal No.	Isotopes	C.S.I.	T.I.	Bq/Package	Gr. Wt. Kg.
1	Steel drum	UN1A2	*	Tape	Cs-137	N/A	N/A	8.0E-03 MBq	54

10. Identify for Normal Form Only
Physical Form Solid
Chemical Form Metal

11.
☐ Highway Route Controlled Quantity
☐ Exclusive Use Shipment with instructions
☐ Placards Applied
☒ Fissile Excepted, Grams < 2
☒ UN ID Marking UN2910

12. LABELS APPLIED

13. ADDITIONAL INFO / LABELS / MARKINGS
*"RADIOACTIVE" / TFP-12-235-02
(rebar from C-107 dome for analysis)

8. HM UN ID Proper Shipping Name: PRI HAZ SUB HAZ

9. No. Pkg.	Model Package	COC/Spec	Serial No.	Seal No.	Isotopes	C.S.I.	T.I.	Bq/Package	Gr. Wt. Kg.

10. Identify for Normal Form Only
Physical Form
Chemical Form

11.
☐ Highway Route Controlled Quantity
☐ Exclusive Use Shipment with instructions
☐ Placards Applied
☐ Fissile Excepted, Grams
☐ UN ID Marking

12. LABELS APPLIED

13. ADDITIONAL INFO / LABELS / MARKINGS

8. HM UN ID Proper Shipping Name: PRI HAZ SUB HAZ

9. No. Pkg.	Model Package	COC/Spec	Serial No.	Seal No.	Isotopes	C.S.I.	T.I.	Bq/Package	Gr. Wt. Kg.

10. Identify for Normal Form Only
Physical Form
Chemical Form

11.
☐ Highway Route Controlled Quantity
☐ Exclusive Use Shipment with instructions
☐ Placards Applied
☐ Fissile Excepted, Grams
☐ UN ID Marking

12. LABELS APPLIED

13. ADDITIONAL INFO / LABELS / MARKINGS

14. Shipment DE-Ci: 5.06E-9

Shipment Totals	C.S.I.	T.I.	Bq/Package	Gr. Wt. Kg.
	N/A	N/A	8.0E-03 MBq	54

15. Surface Dose Rate of Package
☒ <0.005 or _____ mSv/hr
<0.5 or _____ mrem/hr (N+ß γ)

Dose Rate @ 1 Meter from Surface of Package
☒ <0.005 or _____ mSv/hr
<0.5 or _____ mrem/hr (N+ß γ)

Smears of Outer Container
☐ <4.0 Bq (220 dpm) ß γ /cm²
☐ <0.4 Bq (22 dpm) α /cm²
☒ <Tbl. 2-2 HNF-5173 Limits

TRUCK LOAD OR EXCLUSIVE USE
Surface ☒ <2 mSv/hr (200 mrem/hr)
@ 2 meters ☒ <0.1 mSv/hr (10 mrem/hr)
@ Cab or sleeper ☒ <0.02 mSv/hr (2 mrem/hr) (Using N+ß γ)

Additional Data and Instructions (inc. Readings on Internal Packaging)
N/A

Bldg. 616 | Survey No. WTO-025164 | Date 12-3-12

16. TRANSPORTER
Vehicle Number GTI-03186
DRIVER SIGNATURE Lupe Benavidez
PRINT NAME Lupe Benavidez

17. RECEIVER
RECEIVER SIGNATURE
PRINT NAME
Date

18. This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

Certifier's Signature	Print Name	On behalf of DOE-RL	Date	Organization
Randall Clausen	Randall Clausen		12-3-12	WRPS-WTS

19. AUTHORIZATION FOR SHIPMENT

AIR TRANSPORT CERTIFICATION
☒ N/A

CARGO AIRCRAFT
☐ Cargo Aircraft Only Labels Applied

PASSENGER AIRCRAFT
☐ Ltd Qty ☐ Research/Medical Diagnosis
☐ <3 T.I. ☐ Human Medical Research

Pkg. Dimensions (cm)

20. OFFSITE AUTHORIZATION
Survey No. SR120516 | Date Shipped 12-3-12 | Routing YRC PRO# 968174561 9 | ETA 12-10-12
Approved for Shipment Offsite: Amanda Kolanyan | Date 12-3-12

A-6003-214.1 (REV 4)

PARTS AND TOOLS RETURN (PTR) FORM
PROJECT HANFORD, 2355 STEVENS DR., RICHLAND, WA 99354

REFERENCE BUSINESS PROCESS GUIDE - MATERIAL RETURNS

SECTION A - Material Information

Company WRPS Date 07NOV2012
One of the following is **REQUIRED**:
PO/Release No.
Contract/Rel. No. 50256
P-Card Log No.
Other

Contract Specialist Name: Bryon Bradley
Phone Number 5093723035
Material Coordinator/P-Card Holder Name: Jim Castleberry
Phone Number 5093735501

PTR No. 36656
Total Pieces 1

Line Item No.	Quantity	U/M	Q Level	Description (Catalog ID No., S/N, Gov. Tag No.)/Include Reason for Return	Unit Price	Value
1	1	Lot	3	Approximately 21 pieces of 1-inch diameter steel rebar packaged in a 55 gallon waste drum. Total drum weight is less than 200 lbs. Waste Drum TFP-12-235-02 contains the rebar.		

SECTION B - Financial Transaction Information

Passport Purchase Order Financial Transaction - Check One
- ☐ **Credit** - Return for Credit - PP Receipt Required
- ☐ **Replace** - Return for Replacement - PP Receipt Required
- ☐ **Inventory** - Return to PHMC Inventory
- ☐ **Return** - QA-Non-NCR Material (Credit)

*Requires identification of controlling Purchase Order, Contract, or PHMC Property Custodian accountable for the Govt. property in accordance with Regulations.

Contract/P-Card/Other - No Financial Transaction Created from PTR
- ☐ Credit - Contract/P-Card
- ☐ Repair
- ☐ Ship Supplier Owned Materials, Containers, Samples, etc.
- ☒ *Ship Govt. Owned Materials, Containers, Samples, etc.
- ☐ Other
- ☐ Core Charge - Return for Credit of Deposit
- ☐ Replace
- ☐ Over Shipment

SECTION C - Hazardous Material Information

Hazardous Material ☒ Yes* ☐ No
Radioactive Material ☒ Yes ☐ No
Rad. Control Survey ☒ Yes ☐ No

*T&P Inspections (req'd) ☐ Yes ☒ No
Include appropriate shipping document.
Radioactive Material is also Hazardous.

Certified Free of Contamination ☐ Yes ☒ No
Certifier's Name/Date

Custodian: R. L. Clawson
Telephone: 372-0653

Current Location of Material: RMA-3 outside of C-farm

Date Available to Ship: 10SEP2012

SECTION D - Vendor/Ship To Information

Ship To:
Radiation Safety Services Inc.
Attn: High Res. Gamma Spec. Lab
6312 West Oakton Street
Morton Grove, IL 60053
847-965-1999

Contractor:
CTL Group
Attn: James Lane (alt: Joni Jones)
5400 Old Orchard Road
Skokie, IL 60077
847-972-3128

Contact: Eli Port
Contact Phone: 847-965-1999
RA No.:
F.O.B.:

Item	% Cost	Cost Center	CACN	COA
All	100	2MH00	200972	211

SECTION E - Shipping Information – To be completed by Shipping Department
Routing YRC
B/L No. 9681745619
B/L Wt. 120 LBS.
Frt. Collect
Acct. No.

SECTION F - OSD&D/Shipping Notice Information To be completed by Shipping/Procurement
By
Date Shipped
OSD&D No.
Shipping Notice No.
Receipt No.

A-6001-535 (REV 1)

Shipment Tracking

PRO Number:	Status:	Pickup Date:	*Estimated Delivery Date:	Ship From:	Ship To:
968-174561-9	DELIVERED DATE: 12/10/2012 TRAILER 841775	12/03/2012	12/10/2012	HANFORD WORKS, WA 99352	MORTON GROVE, IL 60053