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Light Water Reactor Sustainability Program: Report on the Completion of the Machining of Zion Unit 1 Reactor Pressure Vessel Blocks into Mechanical and Microstructural Test Specimens and Chemical Analysis Coupons

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May 2018

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OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE US DEPARTMENT OF ENERGY

ORNL/TM-2018/861

Materials Science and Technology Division

Milestone Report: M2LW-18OR0407012

LIGHT WATER REACTOR SUSTAINABILITY PROGRAM:

REPORT ON THE COMPLETION OF THE MACHINING OF ZION UNIT 1 REACTOR PRESSURE VESSEL BLOCKS INTO MECHANICAL AND MICROSTRUCTURAL TEST SPECIMENS AND CHEMICAL ANALYSIS COUPONS

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May 2018

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Materials Research Pathway

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EXECUTIVE SUMMARY

The decommissioning of the Zion Units 1 and 2 Nuclear Generating Station in Zion, Illinois, presented a unique opportunity for developing a better understanding of materials degradation and other issues associated with extending the lifetime of existing nuclear power plants (NPPs) beyond 60 years of service. In support of extended service and current operations of the US nuclear reactor fleet, the Oak Ridge National Laboratory (ORNL), through the Department of Energy (DOE), Light Water Reactor Sustainability (LWRS) Program, coordinated with Zion Solutions, LLC, a subsidiary of Energy Solutions (ES), the selective procurement of materials, structures, and components, from the decommissioned reactors including multiple segments of the Zion Unit 1 Reactor Pressure Vessel (RPV).

As described in three previous LWRS milestone reports, the LWRS Materials Research Pathway acquired (Phase 1) four reactor pressure vessel (RPV) segments were harvested (December 2015) from the Zion Unit 1 NPP and shipped the segments by rail (April 2016) to the Energy Solutions (ES) Memphis Processing Facility (MPF) in Memphis, Tennessee [1]. At the MPF (Phase 2), the Zion Unit 1 RPV ORNL Beltline Weld Segment 1, which contained well-characterized base metal, heat B7835-1, and a section of the well-characterized WF-70 beltline weld (between the lower and the intermediate shells) was cut into seven blocks (September 2016): five base metal and two beltline weld from the high fluence region of the segment [2]. Upon completion of the cutting operation, the seven blocks were packaged and transferred to BWX Technologies, Inc. (BWXT), Lynchburg, VA (October 2016) and the cutting waste and unused RPV segments shipped to the ES waste disposal site in Clive UT (December 2016) [3].

This report documents the machining of through-wall test specimens at BWXT, Lynchburg, VA, and summarizes Phase 1 (harvested segments of the Zion Unit 1 RPV) and Phase 2 (cutting blocks from the Zion Unit 1 RPV ORNL Beltline Weld Segment 1 at the MPF. Specifically, it provides detailed descriptions of the machining of four blocks (3 base metal blocks and 1 weld block) into mechanical test specimens and coupons for microstructural characterization and chemical analysis (Phase 3). Moreover, in Phase 4 of the Zion Harvesting Project (ZHP), through-wall specimens, machined from the beltline WF-70 weld and based metal heat B7835-1 and having a peak fluence $< 7 \times 10^{18}$ n/cm^2, will be tested to evaluate the change in mechanical and microstructural properties as function of depth (neutron fuence attenuation). These results will be used to compare with previously reported surveillance data, assess current radiation damage models [4,5,6] and validate current codes and standards for evaluating transition temperature shifts [6].

This project is critically important because access to materials from active or decommissioned NPPs provide an invaluable resource for which there is limited operational data or experience to inform relicensing decisions and assessments of current degradation models to further develop the scientific basis for understanding and predicting long-term environmental degradation behavior.

1. INTRODUCTION

1.1 BACKGROUND

As described in ORNL report, ORNL/TM-2016/240**,** "Report on the Harvesting and Acquisition of Zion Unit 1 Reactor Pressure Vessel Segments," [1] components and structures in a NPP must withstand a very harsh operating environment, including time at temperature, stress from operational loads, neutron irradiation, and a corrosive media. Moreover, extending reactor service beyond 60 years will increase those demands and possibly introduce new modes of degradation [7]. Although the numerous modes of degradation are complex and vary depending on location and material, understanding and managing materials degradation is key for the continued safe and reliable operation of NPPs. As noted in Volume 3 of the Expanded Materials Degradation Assessment (EMDA) [8], an important element of understanding aging-related degradation modes of the RPV and associated components is the examination of service-aged materials. And an important source of service-aged materials has been the LWRS *Zion Harvesting Project (ZHP)* [4]. This project is important because access to materials from active or decommissioned NPPs provide an invaluable resource for which there is limited operational data or experience to inform relicensing decisions and assessments of current degradation models to further develop the scientific basis for understanding and predicting long-term environmental degradation behavior.

The ZHP, in cooperation with Zion Solutions, LLC, a subsidiary of Energy Solutions (ES), an international nuclear services company, was established in 2011 to coordinate the selective procurement of materials, structures, components, and other items of interest to the LWRS Program from the Zion Station (a former nuclear generating facility), in support of extended service and current operations of the U.S. nuclear reactor fleet. The Zion Station was a decommissioned, two unit, Westinghouse 4-loop PWR facility, with each unit capable of producing 1,040 MWe. The units were commissioned in 1973, permanently shut down in 1998, and placed into SAFSTOR (a method of decommissioning where a nuclear facility is placed and maintained in a condition that allows the facility to be safely stored and subsequently decontaminated to levels that permit release for unrestricted use) in 2010. Materials of high interest include low-voltage cabling, concrete core samples, through-wall-thickness sections of the RPV, and other structures and components of interest to researchers evaluating aging management issues [4, 5, 6].

The RPV is a potentially life-limiting component in light-water reactors (LWR) because replacement of the RPV is not considered a viable option [4]. Researchers studying the effects of radiation on RPV materials have long been interested in evaluating service-irradiated materials to validate codes and standards and physically-informed correlations of transition-temperature-shift predication models [8, 9]. For these reasons, the acquisition of segments (Phase 1) of the Zion Station Unit 1 RPV, cutting the segments into blocks (Phase 2) from the well-characterized beltline weld [10 - 11] and base metal [12,13], and machining the blocks (Phase 3) into mechanical (Charpy, compact tension, and tensile) test specimens and coupons for microstructural (transmission electron microscopy, atom probe tomography, small angle neutron scattering, and micro hardness) and chemical composition characterization (Phase 4) will provide critical data to assess current radiation damage models [4,5,6].

This report documents the machining of through-wall test specimens at BWX Technologies, Inc., Lynchburg, VA and summarizes Phase 1 (harvested segments of the Zion Unit 1 RPV) and Phase 2 (cutting blocks from the Zion Unit 1 RPV ORNL Beltline Weld Segment 1 at the ES MPF) accomplishments.

1.2 CIRCUMFERENTIAL FLUENCE

An important consideration in the evaluation of which RPV segments to harvest is the circumferential fluence. As shown at the bottom of in Figure 1, peak circumferential fluence varies approximately by a

factor of three over a 45° arc from the vertical weld positions to midway between the vertical welds. Based on this variation, the optimum region of beltline weld to harvest is a section midway between the upper (intermediate shell) and lower (lower shell) vertical welds [3].

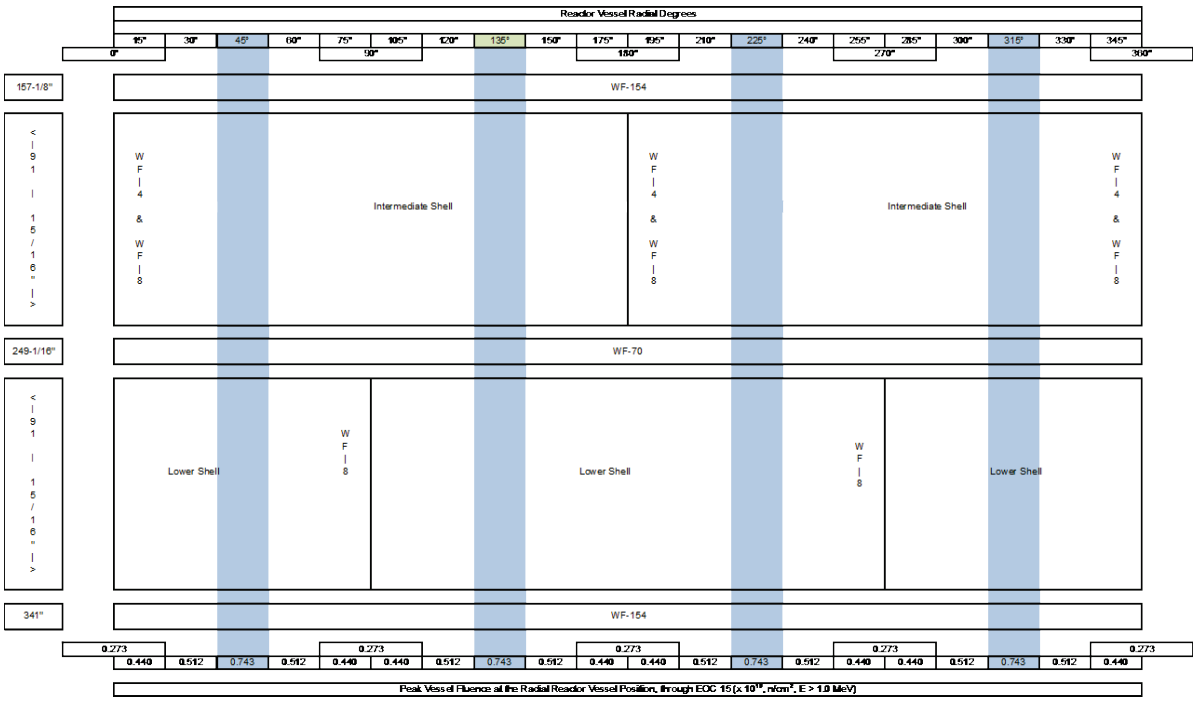


Figure 1. Peak vessel fluence along the circumferential weld of the Zion Unit 1 RPV through End of Cycle (EOC) 13 (x 10^{19} n/cm^2, E > 1.0 MeV) [14].

1.3 RPV SPECIFICATIONS

The Zion Unit 1 RPV was composed of the head, three ring or shell sections composed of hemispherical plates with two vertical welds, and a bottom plate as shown in the segmentation plan (Fig. 2) with horizontal cuts along the three ring sections (nozzle, intermediate shell, and lower shell) and the bottom plate. It had a total height without the head plate of approximately 419 inches (1,064 cm). The vessel wall had an inner diameter of 173 inches (439 cm) and thickness of 8.8 inches (22.4 cm) over the beltline region. The nozzle ring section is approximately 11 inches thick. Including cladding, the reactor vessel weighed about 700,000 lbs. (317,515 kg) and had a total activity of about 400 curies [3].

1.4 SEGMENTATION

The Zion Unit 1 RPV was cut using an oxy-propylene torch into 17 segments over four levels as shown in Figure 2. Level l, which includes the inlet and outlet nozzles, was cut into eight 45°segments of 157.5" (400 cm) in height. Level 2 was also cut into eight 45°segments of 157.5" (400 cm) in height and 72.9" (185.2 cm) in length as measured from end to end of the outer diameter. Because the vessel could not be rotated 22.5° after the nozzle segments were cut due to the location of the overhead bridge, the level 2 segments, which include most of the intermediate shell and a portion of the lower shell and the well-characterized WF-70 beltline weld, were cut along the same vertical lines as the nozzle cuts i.e., at the two vertical welds of the intermediate shell, directly above the vertical welds of the lower shell, and in the middle of the peak circumferential fluence (Figure 1). Moreover, four segments (including 1 and 2) also contained the well-characterized base metal B7835-1 in the upper shell (Figure 2 and Figure 3). The

beltline pieces cut from the vessel are 8.8 inches thick including a 3/16th inch stainless steel cladding on the internal surface. Each piece weighed approximately 28,000 lbs. (12,727 kg). [3]

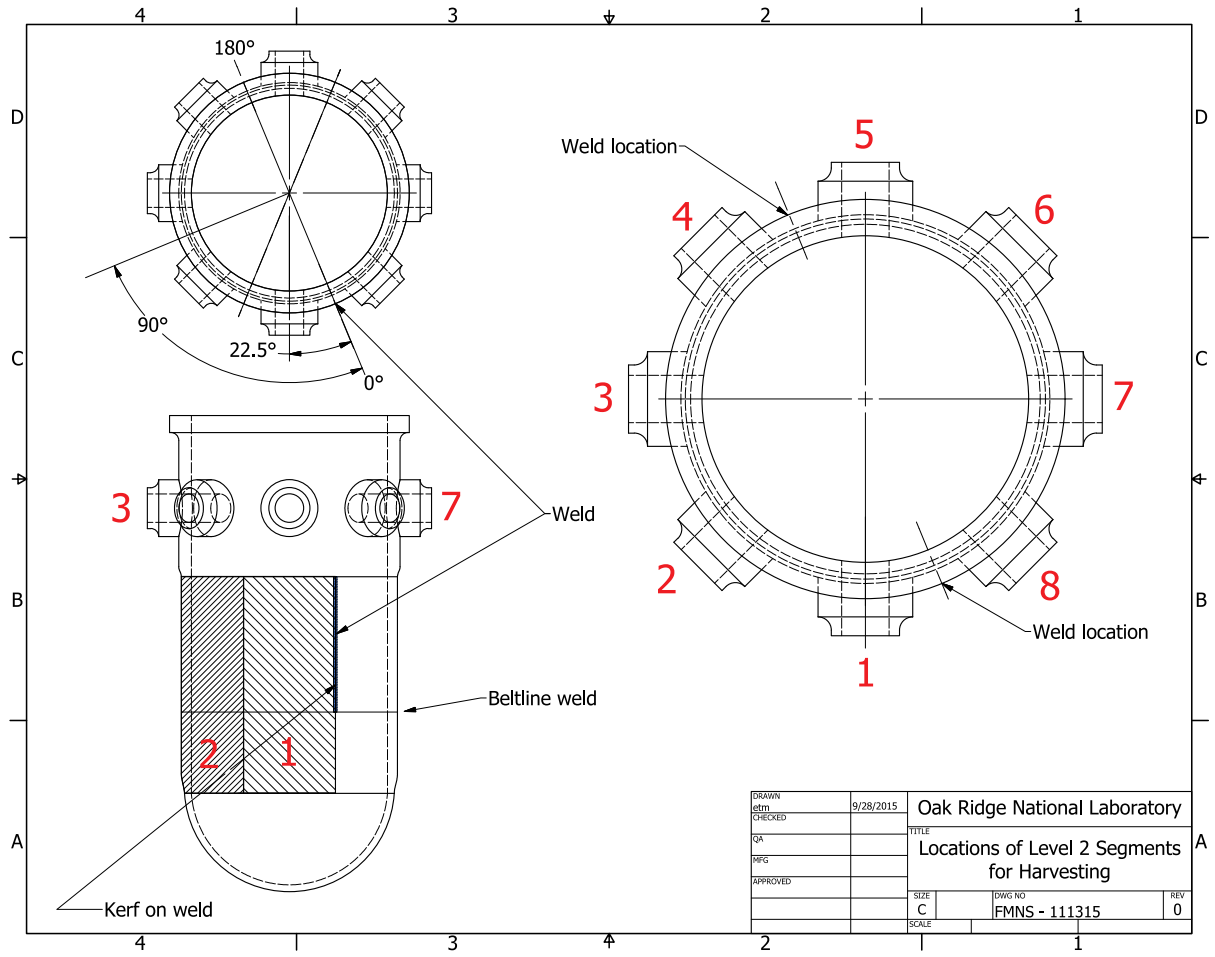


Figure 2. Identification of Level 2 segments (1, 2, 5, and 6) collected as part of process to harvest Segment 1. Segment 1 (as well as Segments 2) contains the well-characterized base metal B7835-1 (intermediate shell) and a section of the well-characterized WF-70 beltline weld [15].

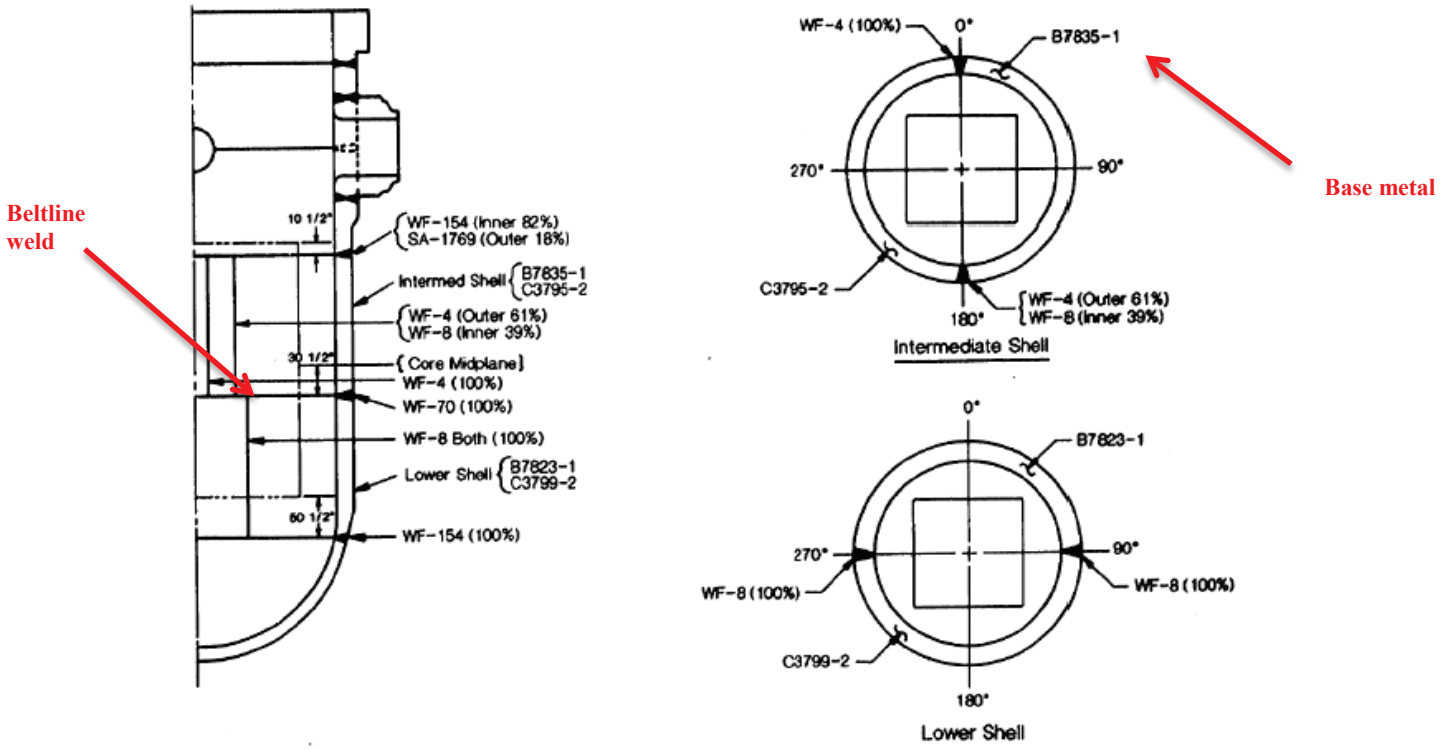


Figure 3. Location of materials (weld and base metal) used in the fabrication of the Zion Unit 1 beltline (intermediate shell to lower shell), two vertical welds above the beltline, and base metal heats [16].

2. ZION RPV PHASE 1: HARVESTING

As previously described [1, 2, 3 5, 6,], the Zion Unit 1 Beltline Weld Segment 1, with dimensions of ~ 13' x 6' (157.5" x 72.9" x 8.8") and containing the well-characterized WF-70 beltline weld and the well-characterized base metal heat B7835-1 (Figure 3), was cut from just below the circumferential weld between the nozzle section and the intermediate shell to just above the circumferential weld between the lower shell and the bottom plate using an oxy-propane torch (Figure 4). The right edge (as viewed from the outer wall of the RPV) begins at the 0° / WF-4 vertical weld (Figure 2 and Figure 3). The cut segment (Segment 1) was removed using a gripper crane and positioned onto the "down-ender" frame to allow proper positioning in the steel-shipping box. The first segment was loaded face up and the matching segment (opposite side segment: Segment 5) was loaded face down to provide clam-shell shielding in the same manner as used to ship RPV sections to the Energy Solutions, Clive, Utah waste disposal site [3].

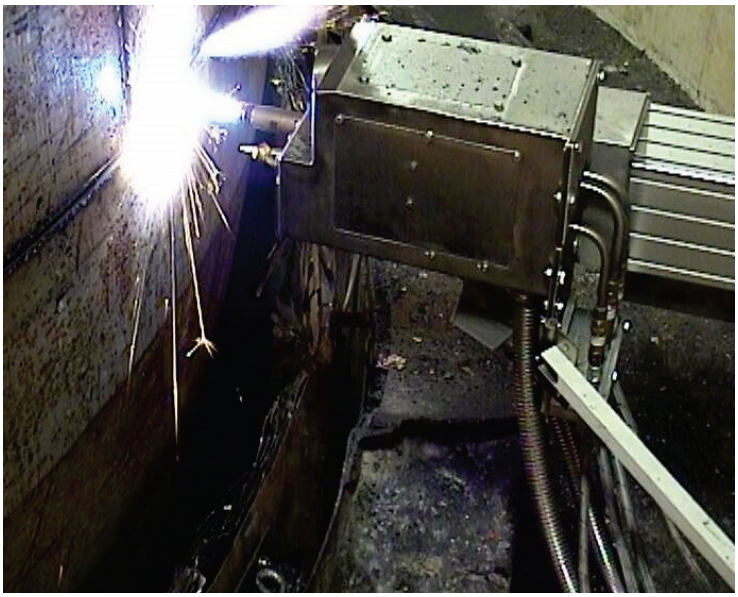


Figure 4. Vertical cut using an oxy-propane torch of a Zion Unit 1 RPV Level 2 Segment [15].

3. TRANSPORTATION OF ZION RPV SEGMENTS TO ES MPF

Due to the size and weight of the four (Segments 1 and 5 and Segments 2 and 6) Zion Unit 1 RPV Level 2 beltline sections, (~ 13' x 6' or 157.5" x 72.9" x 8.8" thick including a 3/16th inch SS cladding on the internal surface, weighing ~ 28,000 lbs. each) in two large steel boxes with a combined weight of ~180,000 lbs, a rail car was used to ship the RPV segments to the Energy Solutions, MPF site on March 31, 2016, for cutting Segment 1 into blocks for eventual specimen machining. On April 12, 2016, the railcar containing the four segments arrived at the Energy Solutions MPF site and was received, inspected, and temporarily stored while a revised contract with Energy Solutions for cutting seven blocks from the Zion Unit 1 RPV Segment 1 was finalized. The cutting phase of the project (Phase 3) began on June 20, 2016 [2].

4. PHASE 2: BLOCK CUTTING

As shown in Figure 5 and Figure 6, seven blocks, varying in length from approximately 5.7 x 2.0 x 8.8 inches to 7.6 x 3.0 x 8.8 inches to 11.25 x 3.0 x 8.8 inches and designated "**F,**" "**C,**" and "**CF,**" were cut using a diamond wire saw from ORNL RPV Segment 1. The plan for the 4 "**F**" block was to machine it into compact tension specimens for fracture toughness testing; the 2 "**C**" blocks to machine it into Charpy V-notch (CVN), SS-3 tensile specimens, and coupons for chemical and microstructural characterization; and the "**CF**" block machined into alternating rows of **C**harpy blocks (CVN, tensiles, and coupons) and compact tension specimens for fracture toughness testing. Prior to cutting the "**C1,**" and **"CF,"** blocks, the centerline of the beltline weld was identified using chemical etching on the through thickness cross-section of the segment. Each of the seven (7) blocks were uniquely numbered for identification, orientation, and tracking (Figure 7) and packaged for shipment to the Phase 3 machining vendor (BWXT). The cutting waste and remaining unused segments was packaged and shipped to the Energy Solutions, Clive, Utah site (see Section 6 for details) [3].

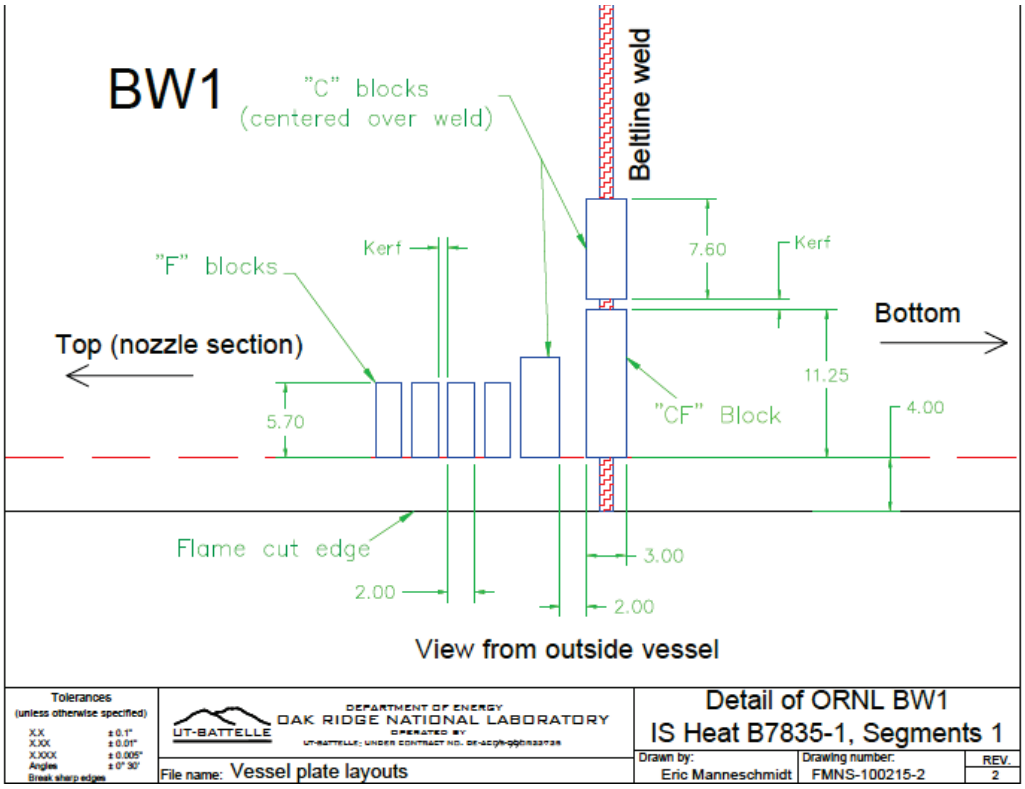


Figure 5. Location of 5 base metal and 2 beltline blocks cut from Zion Unit 1 RPV Segment 1.

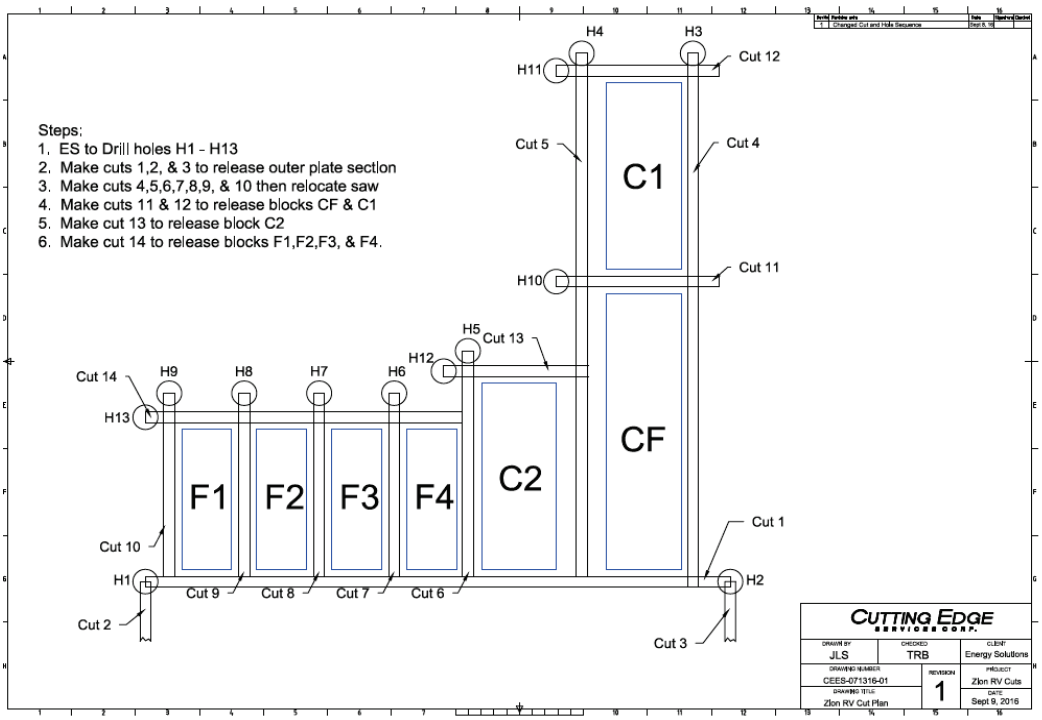


Figure 6. Cut plan (based on Figure 5) noting the blocks (blue outline), the wire saw access holes and cut lines with kerf. [15]

Figure 7. The four "F," two "C," and single "CF" blocks were marked and the orientation noted (Y axis is perpendicular to the beltline weld with the arrow pointing to the top of the segment and the X axis is parallel to the beltline weld with the arrow pointing away from the high fluence edge) [15].

5. PACKAGING AND TRANSPORTATION TO BWXT

Seven RPV blocks cut from the Zion Unit 1 RPV Segment 1 at the MPF, with individual lift magnets attached, were loaded into two 55-gallon drums with **F1-F4** blocks (fracture toughness samples) in one drum and CF (Charpy, tensile, and fracture toughness samples), **C1**, and **C2** (Charpy and tensile specimens) in the second drum. Following the loading of the Zion RPV blocks, the two drums were loaded into a B-25 box with 1" steel shielding beneath and 1" steel shielding around the side of the drum as shown in Figure 8. Sand was added into the B-25 box as a filler material and provides additional shielding as seen in Figure 9. Since the dose rates with the shielding, including the bottom plate, were within Energy Solutions administrative limits for shipping (and consequently within U.S. DOT limits), no additional shielding was added to reduce these dose rates (except for the sand fill). On October 27, 2016, the B-25 box containing the sample bearing drums was loaded onto a flatbed trailer, secured and shipped to BWXT in Lynchburg, Virginia. The B-25 box arrived on October 28th at the BWXT site and was unloaded without incident [3].

Figure 8. Two drums loaded into the B-25 box with 1" steel shielding beneath and surrounding the drum.

Figure 9. Final layout of the B-25 box with sand added.

6. BLOCK CUTTING WASTE DISPOSAL

The waste resulting from the weld position identification work and block cutting was placed into B-25 boxes which in turn were loaded into a 20' "sealand" container and loaded onto an ABC flat car (Figure 10) and shipped by Canadian Railroad to the ES Clive, UT waste disposal site. This ABC flat car was also loaded with 3 other sealand containers holding waste from other ES MPF projects. "Sharing" this ABC car lowered rail transport costs for the LWRS waste. The ES MPF targeted shipment of the ABC rail car and the gondola car holding Zion Unit 1 segments 2, 5, and 6 and partial segment 1 to Clive, UT, in December 2016. Moreover, the Zion Harvesting Project was only responsible for cost differential for shipping the gondola car with the segments to Clive from Memphis vs. the cost to ship the segments to Clive from Zion [3].

Figure 10. ABC railcar with multiple sealed containers for shipment to the ES Clive Utah waste site [15].

7. PHASE 3: MACHINING SPECIMENS FROM BLOCKS:

The work performed in this section of the report was performed by BWXT NOG Technologies, Inc. under Subcontract Number 4000149923 with ORNL/UT Battelle. Specifically, it describes the results of machining irradiated specimens from blocks cut from ORNL Beltline Weld Segment 1, which was harvested from the Zion Unit 1 RPV. Moreover, the through thickness chemical compositions of both the base and weld metal were obtained using Laser Ablation, Inductively Coupled Plasma Mass Spectroscopy (LA ICPMS).

7.1 INTRODUCTION

A kick-off meeting with the BWXT machining team was held in Lynchburg, VA on Thursday, October 27, 2016. The purpose was to review the details of the machining plans, including the removal of the cladding, the block orientation to clearly identify the location of the high fluence edge and relationship to the top / bottom of the RPV, how to best fit the proposed ORNL cut plan into the actual dimensions of the cut blocks, developing unique sample identification numbers, surface finish, the final identification of the **C** and **F** reserve blocks, block cutting order (2 **F** blocks, followed by **C2** and **CF** blocks) and the estimated schedule for the project.

The work scope, which originally included facility preparation, visual inspections, machining using conventional CNC and wire electrical discharge machining (EDM), specimen labeling and packaging, disposal of radioactive waste, project management, and reporting, was expanded in March 2017 to perform through-wall chemical analyses of selected locations through the thickness of the C2 base metal block and the CF beltline weld block and at both ends of the block (highest to lowest fluence along the circumferential direction).

7.2 BLOCK RECEIPT

7.2.1 Overview

The Zion blocks were received by BWXT on October 28, 2016. After receipt, the blocks were photographed and the seven blocks designated**: F1, F2, F3, F4, C1, C2,** and **CF**, were inventoried. As part of the Civilian Nuclear Working Group (CNWG) framework, the LWRS Program provided the Central Research Institute of Energy Power Industry (CRIEPI) with base metal block "**F2**" for their investigation and collaboration with the LWRS Program.

7.2.2 Block Orientation

The seven blocks cut from the ORNL Zion Unit 1 Beltline Weld Segment 1 were cut four (4) inches off center from the vertical hotline to avoid material that may have experienced annealing during the flame cutting of the RPV segments [2]. Moreover, since the fluence was higher along this edge of the segment and blocks, specimen machining was performed as close to the block edge as feasible. The following section outlines the orientation and markings on each block to achieve traceability to the reactor vessel location.

Figure 11 shows the outer diameter view of the sectioned reactor vessel. Blocks F1, F2, F3, F4, and C2 are base medal, while blocks CF and C1 encompass the beltline weld.

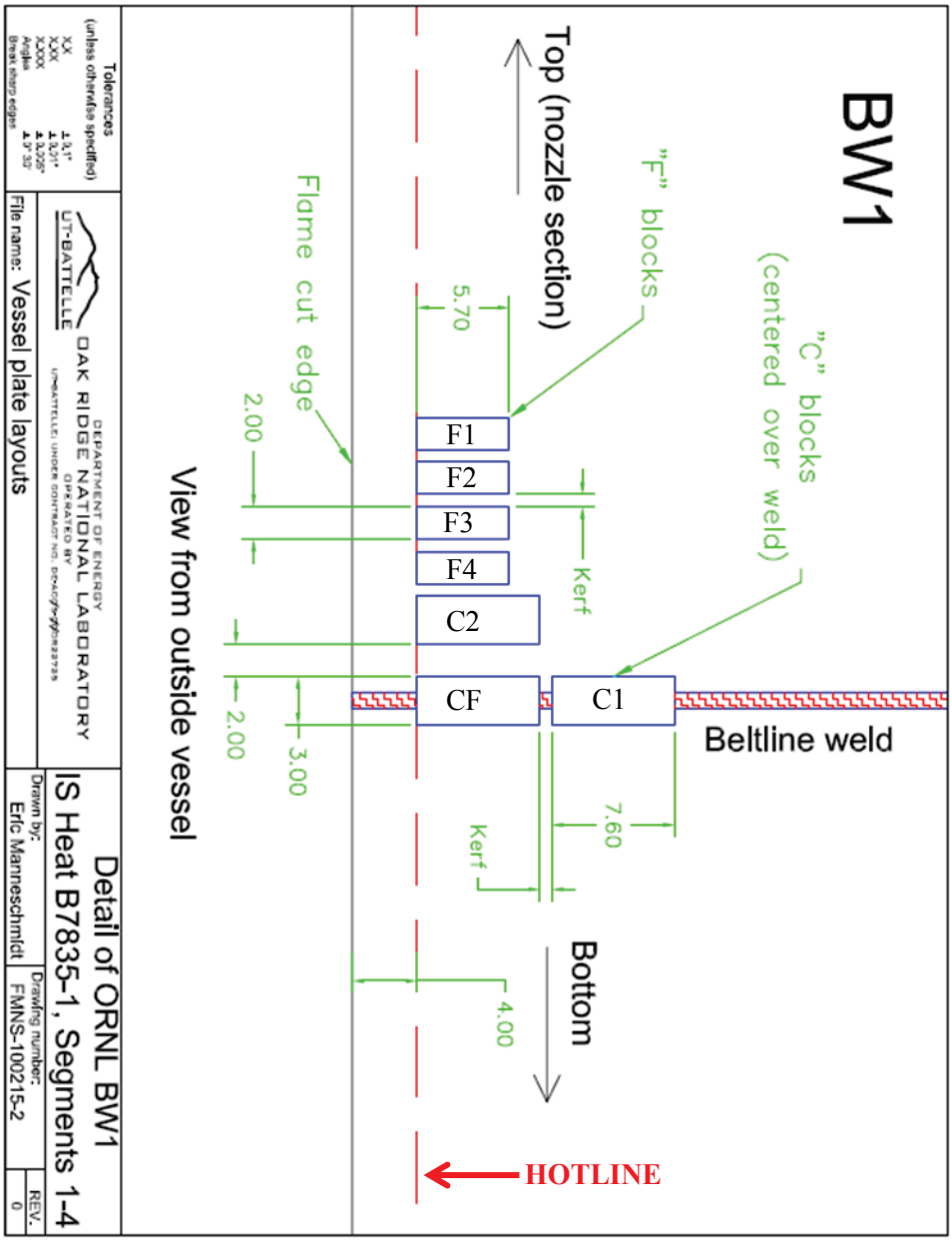


Figure 11. ORNL provided orientation drawing with block labels. The hotline in the z axis is shown with a dashed red line.

7.2.3 As-Received Condition

Once the blocks arrived at BWXT, they were removed from the shipping containers and photographed to document the "as received" condition. All the blocks were photographed (Figure 12 – Figure 18) in the same orientation as shown in Figure 11. Figure 12 has been labeled to serve as an orientation guide for the remaining block photos. The axes marked with arrows on the outer diameter of the blocks show the z axis (vertical direction pointing to the top of the RPV) and the theta/circumferential axis (horizontal direction). This orientation was carried through all machining steps and marked on all remnant pieces. The edge of the blocks farthest in the negative theta direction (left side of the photo) was the one closest to the hotline

in the reactor. An effort was made by BWXT, in consultation with ORNL, to machine as many specimens from the negative theta/inner diameter corner of each block to obtain samples with the highest fluence.

7.2.3.1 Block F1

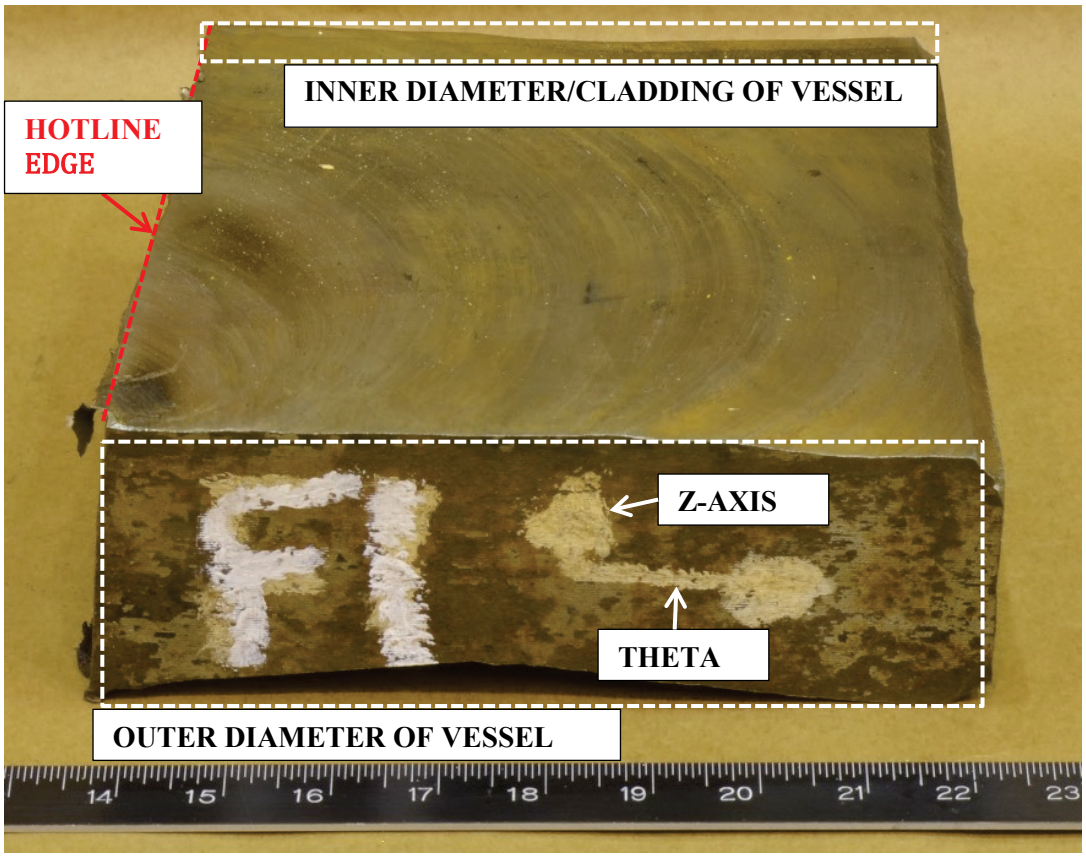


Figure 12. Base metal – block F1 as-received condition [17].

7.2.3.2 Block F2

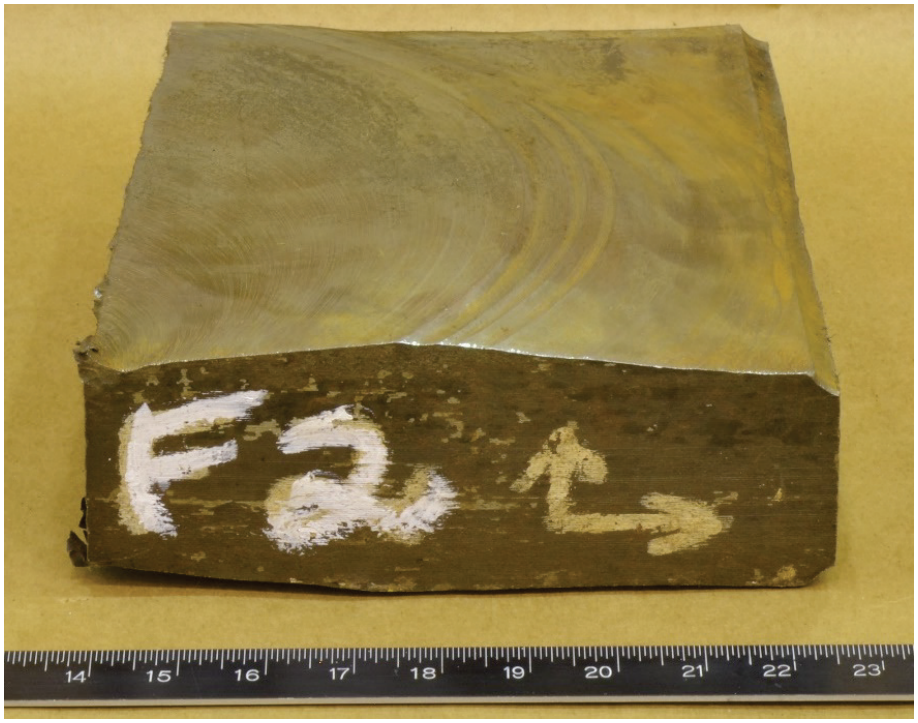


Figure 13. Base metal – block F2 as-received condition [17].

7.2.3.3 Block F3

Figure 14. Base metal – block F3 as-received condition [17].

7.2.3.4 Block F4

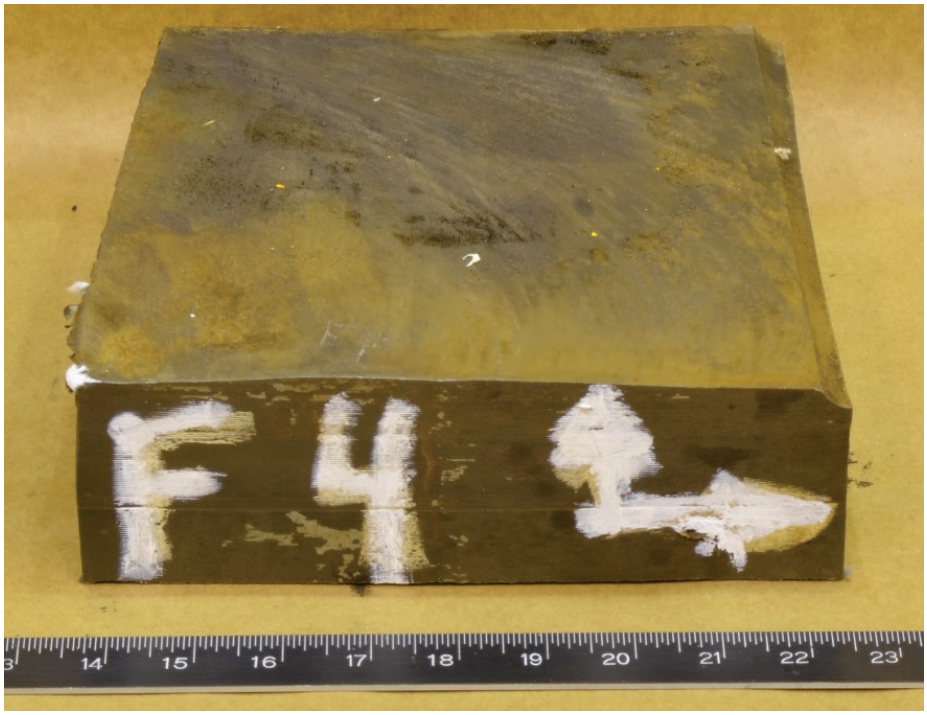


Figure 15. Base metal – block F4 as-received condition [17].

7.2.3.5 Block C2

Figure 16. Base metal – block C2 as-received condition [17].

7.2.3.6 Block C1

Figure 17. Block C1 as-received condition [17].

7.2.3.7 Block CF

Figure 18. Block CF as-received condition [17].

7.3 CLADDING REMOVAL

The first machining operation was the removal of the cladding from each of the seven blocks. To reduce kerf and maximize usable material near the inner diameter of the vessel, each block was stripped of the cladding using an electrical discharge machine (EDM). The cladding was stored and blended with lower activated material and will be disposed of as waste.

Removal of the cladding from the blocks began on Friday, November 4, with a straight ~0.1" cut above the apex of the cladding, approximately 0.35" into the block from the outside of the cladding. The cladding thickness was measured manually to verify that no remnant pieces remained on the carbon steel block. The cut was made with 0.010" diameter wire. A rough sketch of the cut is shown in Figure 19.

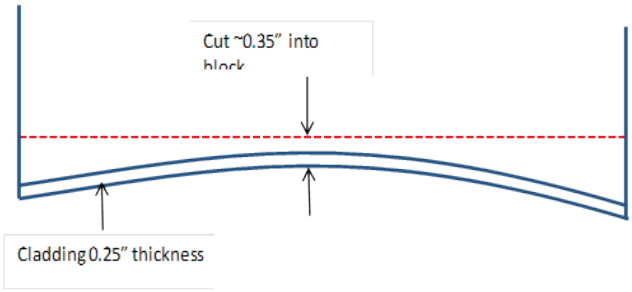


Figure 19. Sketch of 5/16" cladding cut off the Zion Unit 1, Segment 1 blocks [17].

This operation concluded the machining of Blocks F1 and C1, which have been shipped to ORNL for future evaluation. Figure 20 shows an EDM cut that removed the cladding on block F4 and the separated cladding. The orientations were maintained on the cladding. All blocks had the cladding removed in this manner.

Figure 20. Block F4 cladding removed via EDM (top view) and separated cladding slab with orientation noted [17].

7.4 SPECIMEN DETAIL DRAWINGS

In this section, detailed specimen drawings (Figure 21 – Figure 26) and the general machining steps are outlined for each type of specimen and will be referenced in the discussion of the individual block machining in Sections 7.4 – 7.9 and include block specific details such as specimen identification, dimension verification, and dose rates prior to shipment to ORNL.

7.4.1 0.5T Compact Tension Specimen (Blocks F3 and f4)

Machining Technique:

- Cut slabs from the F3 and F4 blocks to 0.500” thickness
- Drill pilot holes through the slab for EDM threading using a computer numerically controlled (CNC) end mill
- Cut hole final dimensions using an EDM
- Cut final profile using an EDM
- Place specimen on dot matrix to be labeled (Sections 7.5.2 and 7.6.2)
- Measure and record dimensional QA (Appendix A)

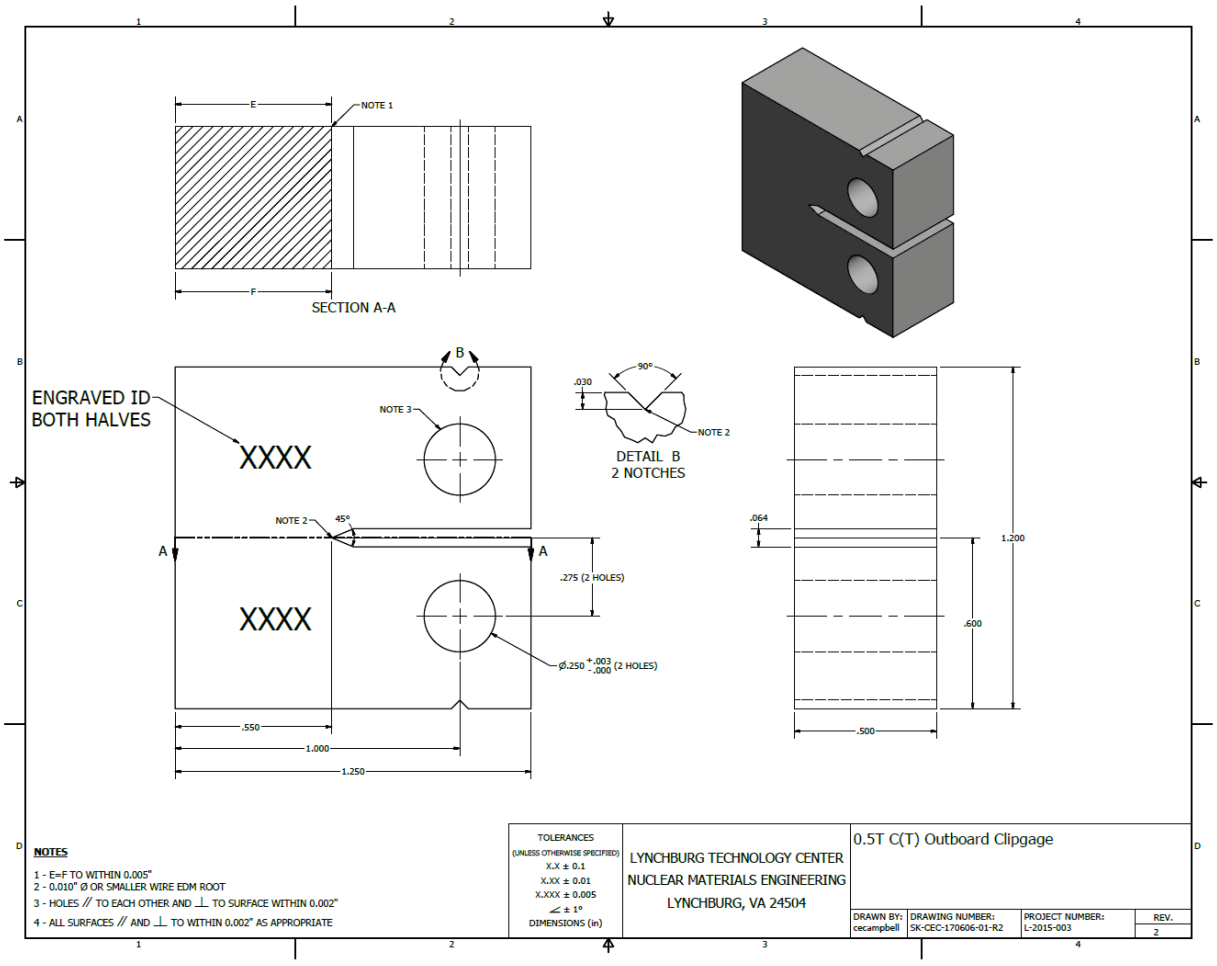


Figure 21. 0.5T compact tension detail drawing.

7.4.2 0.4T Compact Tension Specimen (Alternating rows of Block CF)

Machining Technique:

- Cut a slab from alternating rows of block CF to 0.400” thickness
- Drill pilot holes through the slab for EDM threading using a CNC end mill
- Cut hole final dimensions using an EDM
- Cut final profile using an EDM
- Place specimen in dot matrix to be labeled (Section 7.8.1.6)
- Measure and record dimensional QA (Appendix A)

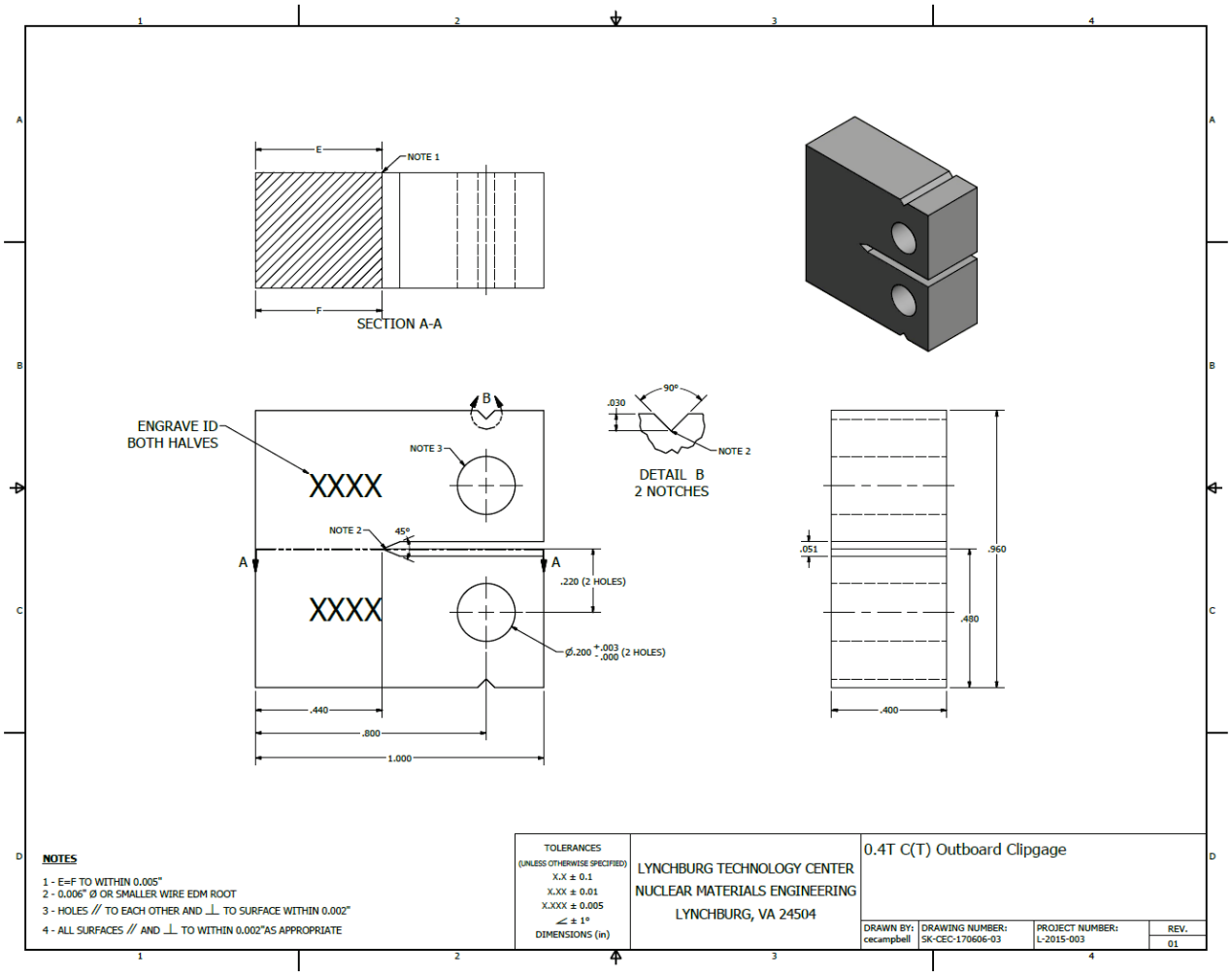


Figure 22. 0.4T compact tension specimen.

7.4.3 Charpy V-Notch Specimen (Block C2 & alternating rows of Block CF)

Machining Technique:

- Mill entire block to a thickness equal to 2.165”
- Cut the 0.394” x 0.394” (Charpy block) profile via EDM
- Fixture (2.165” x 0.394” x 0.394”) blanks on vertical mill to be notched

- Place specimen in dot matrix to be labeled (Section 7.7.2 and 7. 8.1.6)
- Measure and record dimensional QA (Appendix A)

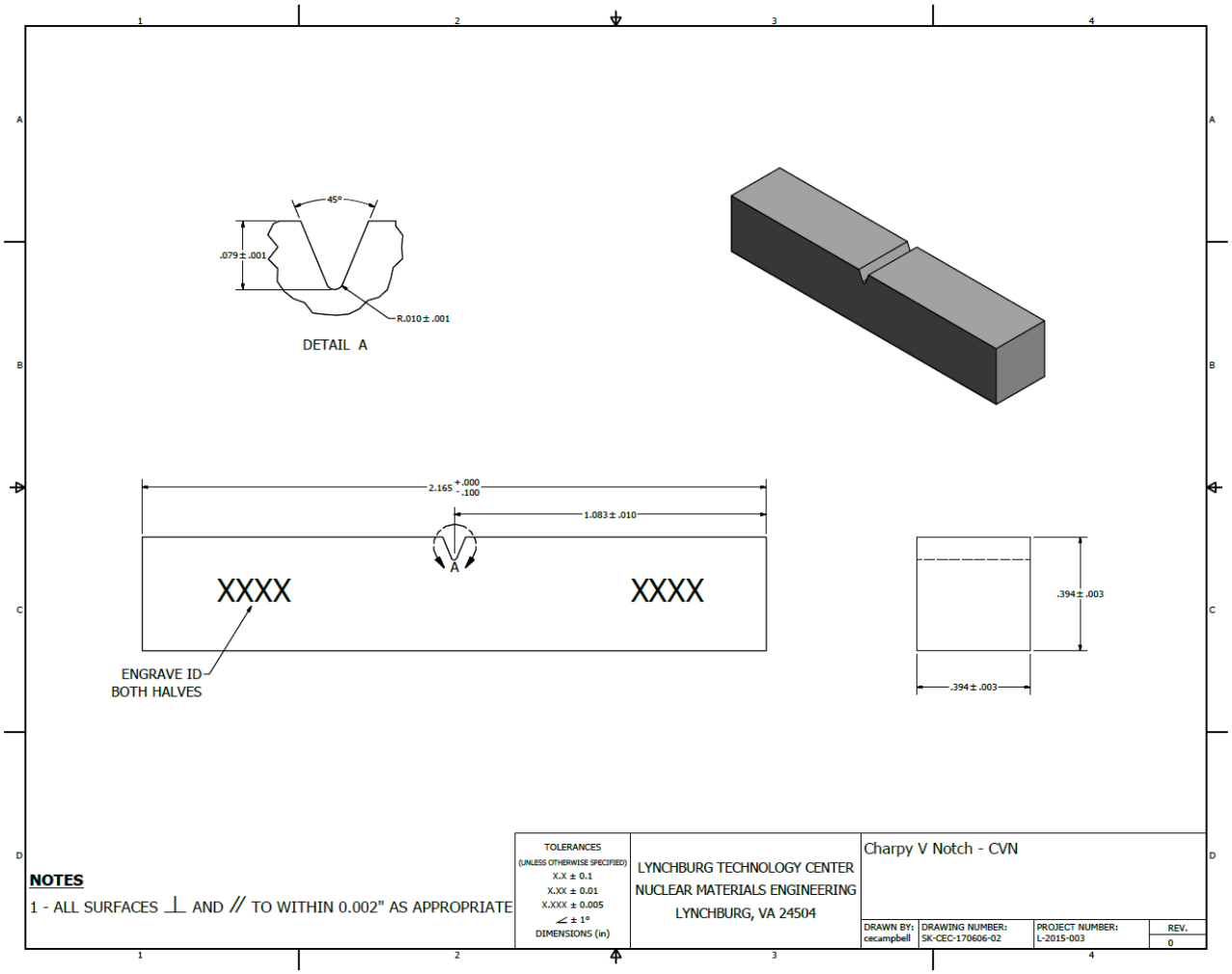


Figure 23. Charpy V Notch specimen.

7.4.4 Microstructural Specimen Coupons (alternating rows of Blocks C2 & CF)

Machining Technique:

- Fixture CVN blank on the EDM
- Cut the 0.394” x 0.394” x 0.020” profile using an EDM
- Vibra-etch specimen to label (Sections7. 6.2 and 7.7.2)
- Measure and record dimensional QA (Appendix A)

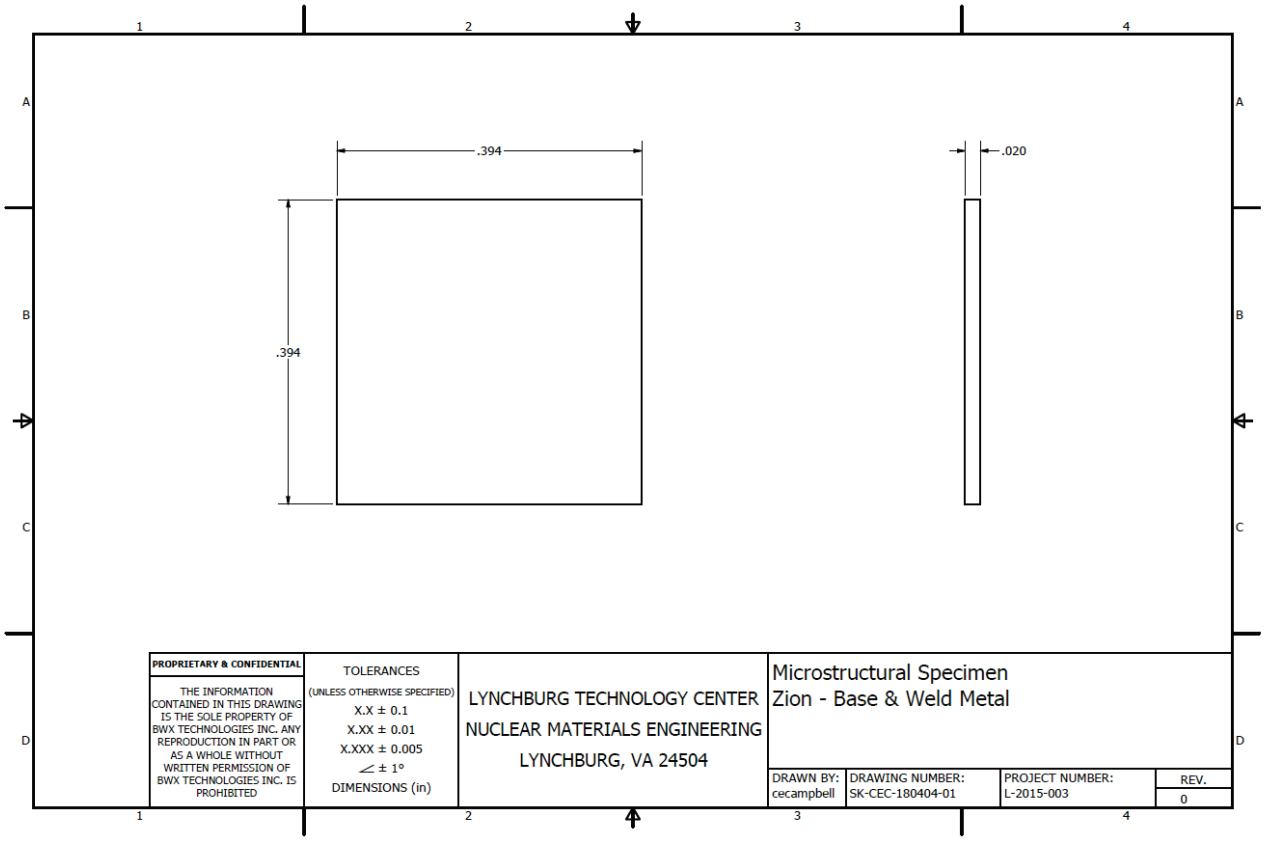


Figure 24. Coupons for microstructural specimen. 7.4.5

(unlimited use by ORNL since drawing is not BWXT Proprietary)

SS-3 Tensile Specimen (alternating rows of Blocks C2 & CF) *Machining Technique*

- Fixture CVN (2.165” x 0.394” x 0.394”) blank on the EDM
- Cut the SS-3 profile using an EDM that is in the 0.394” thickness direction
- Retrieve, rotate, and re-fixture the profile
- Cut the specimens to a 0.030” thickness using an EDM
- Place specimen in dot matrix to label (Sections 7.6. 2, 7.7.2, and 7.8.1.6)
- Measure and record dimensional QA (Appendix A)

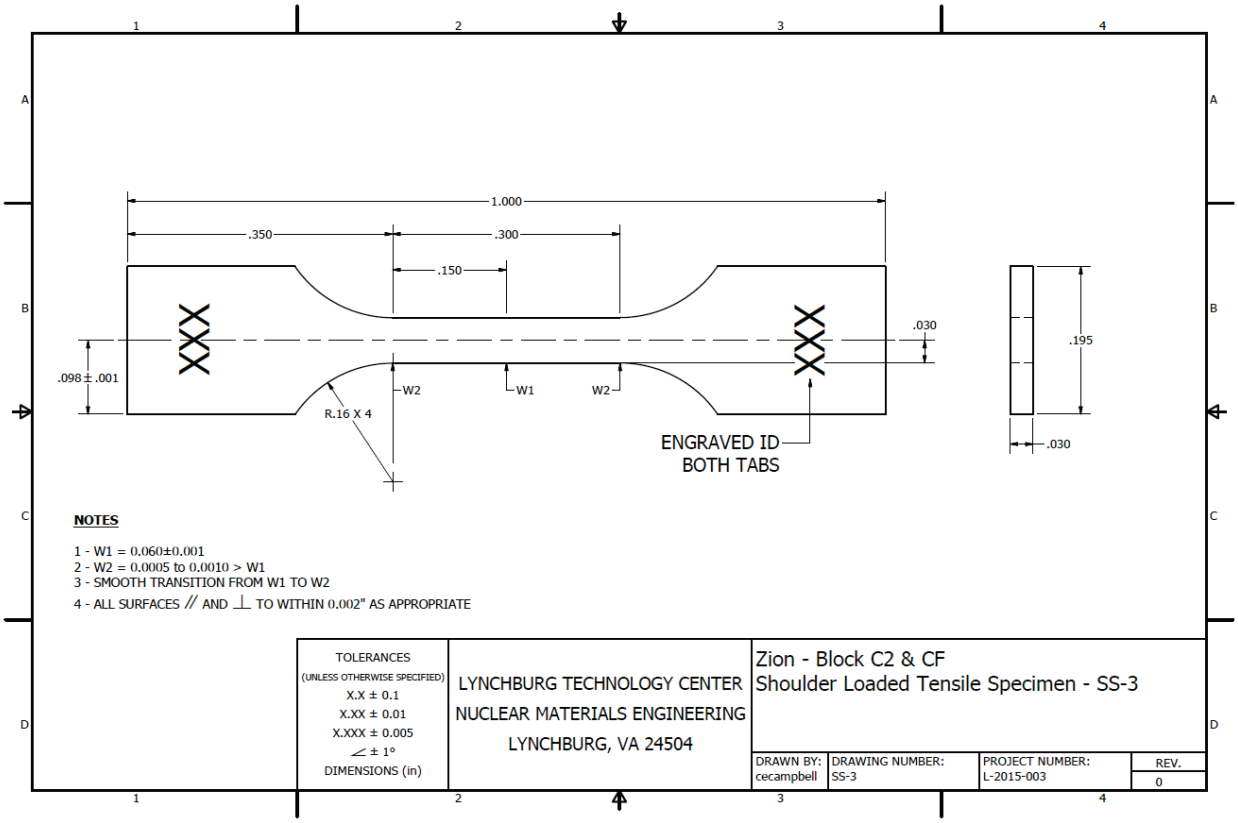


Figure 25. SS-3 shoulder loaded tensile specimen.

7.4.6 Miniature Compact Tension Specimen (Blocks F3, F4, and CF)

Machining Technique

- Cut a slab to 4.15 mm thickness
- Drill pilot holes through the slab for EDM threading using a CNC end mill
- Cut hole final dimensions using an EDM
- Cut final profile using an EDM
- Vibra-etch top and bottom halves of specimen to label (Sections 7.5.2, 7.6.2, and 7.8.1.6)
- Measure and record dimensional QA (Appendix A)

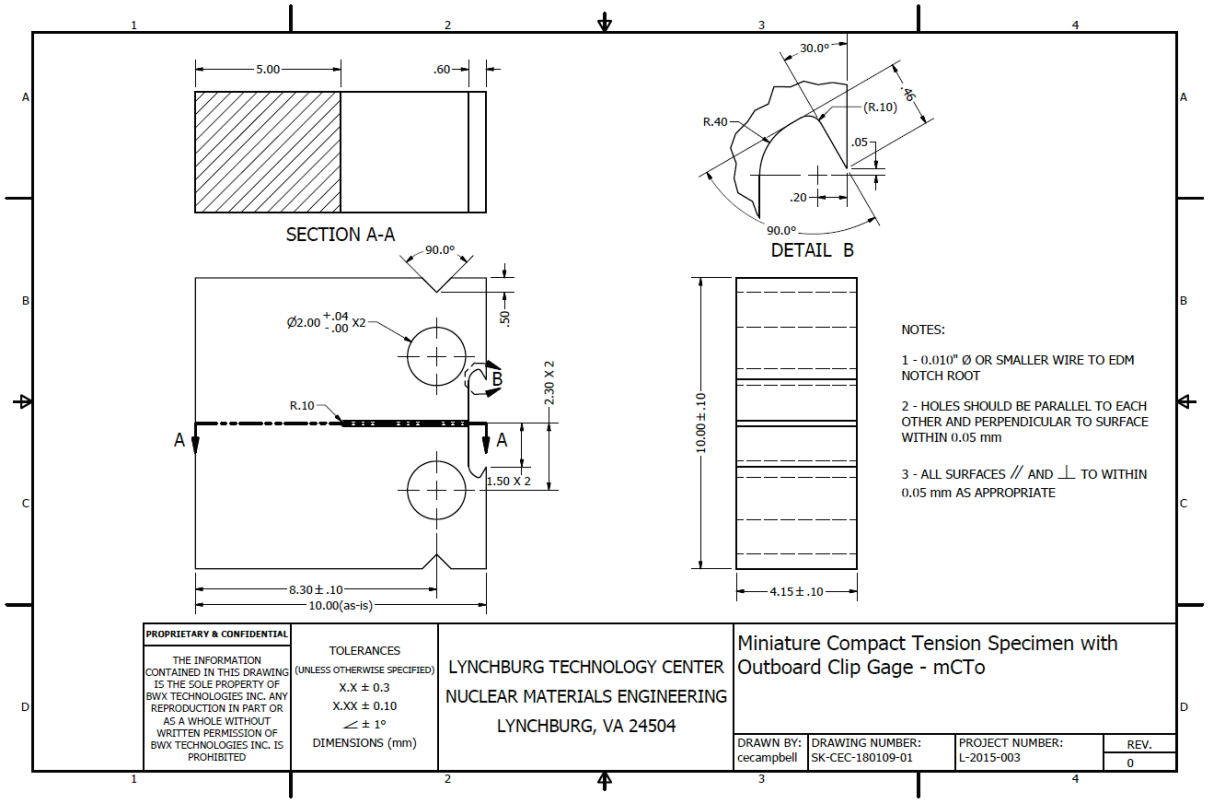


Figure 26. Miniature compact tension specimen (mini-C(T)) with an outboard clip gage notch.

(unlimited use by ORNL since drawing is not BWXT Proprietary)

7.5 BLOCK F3

As shown in Figure 27, 56 0.5T compact tension C(T) specimens were to be machined from blocks F3 and F4 with an orientation of 4 specimens along the theta (circumferential direction) and 14 rows through the thickness of the block [5,6]. However, due to several machining anomalies (marked with a **red X**) in rows A, C, K, L, and M, BWXT, in consultation with ORNL, agreed to machine up to 9 mini-C(T) specimens to replace each of the lost 0.5T specimens from the first two blanks in rows K, L, and M so as to have a sufficient number of samples for a valid ASTM E-1921 test. To maintain the integrity of the data, the mini-C(T) specimens were machined from the rejected 0.5T specimens rather than a different location further from the hotline. Table 7.5-1 lists the number of specimens machined from block F3.

Table 7.5-1. Block F3 Specimen Overview.

Type	Quantity	Drawing
0.5T	48	Figure 4.1
mini-C(T)	28	Figure 4.6
Total	76	-

7.5.1 Machining

7.5.1.1 0.5T Compact Tension

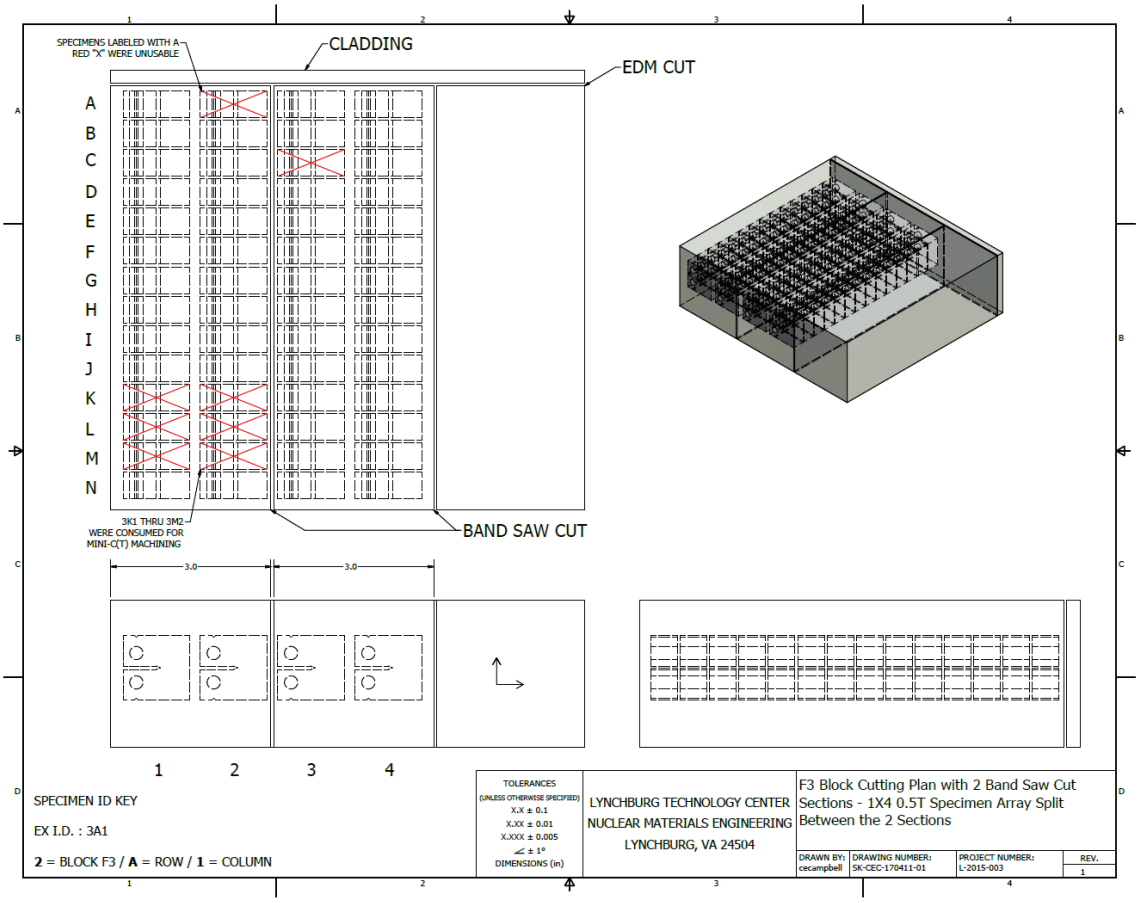


Figure 27. Block F3 cutting plan overview.

Prior to machining the F3 block 0.5T specimens, BWXT proposed and ORNL agreed to a cut plan using a 2x2 array to obtain specimen with the maximum fluence. However, once the first section was cut on the band saw, it became apparent that the inner block thickness was too thin to stack the specimens vertically in the z-axis. To accommodate the original 1x4 array, a second section was cut such that it split the two sections. The 0.5T specimen machining then followed the outline in Section 7.4.1. The F3 block remnant and the slabs from the first step of machining are shown below in Figure 28.

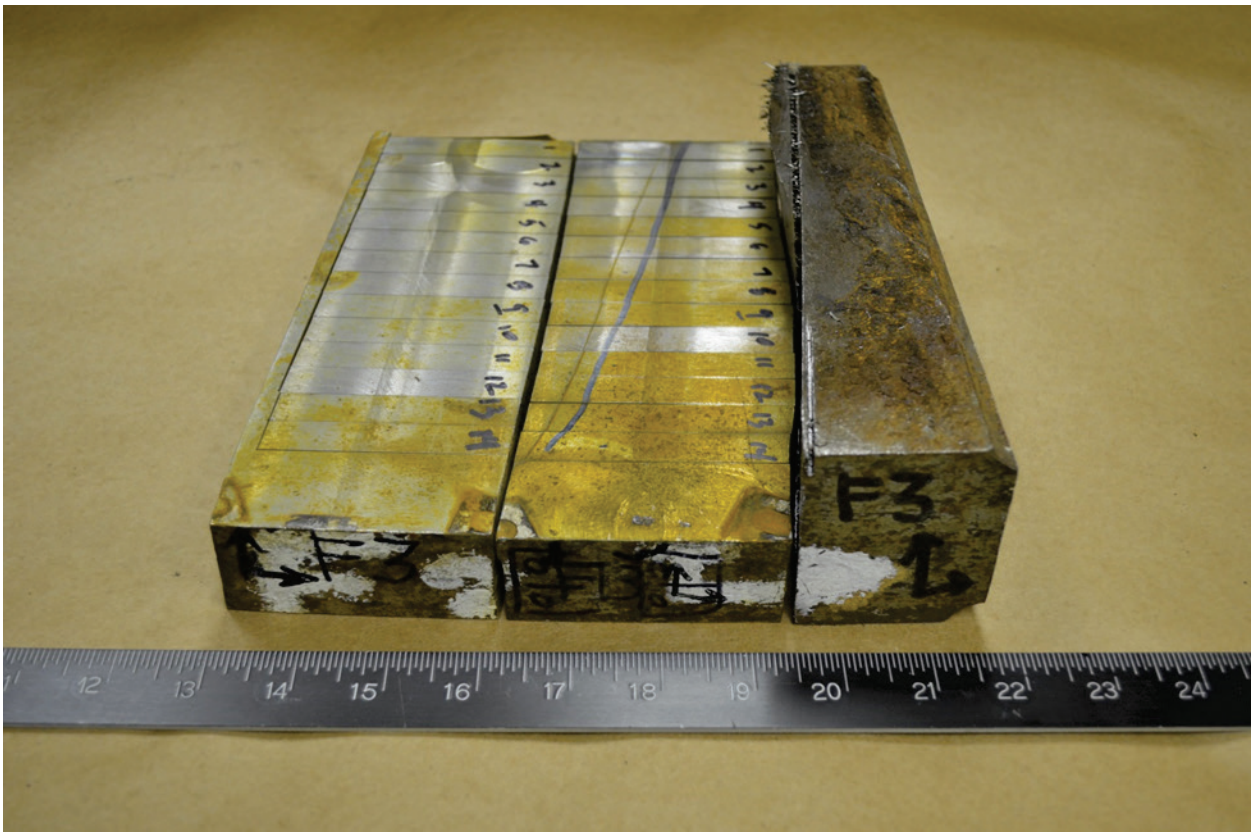
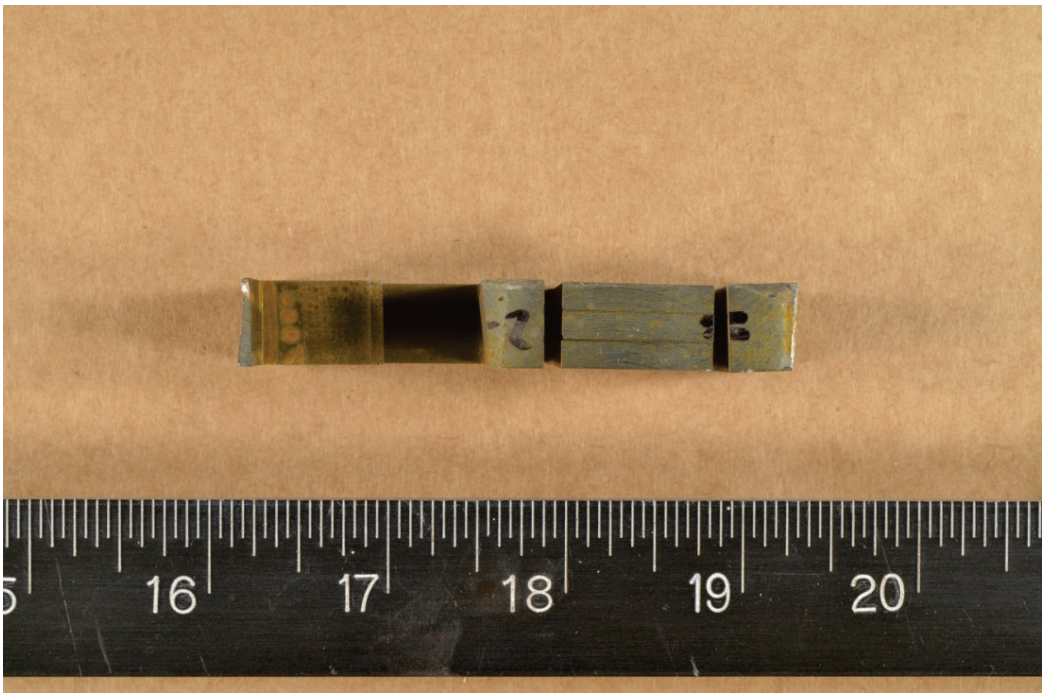


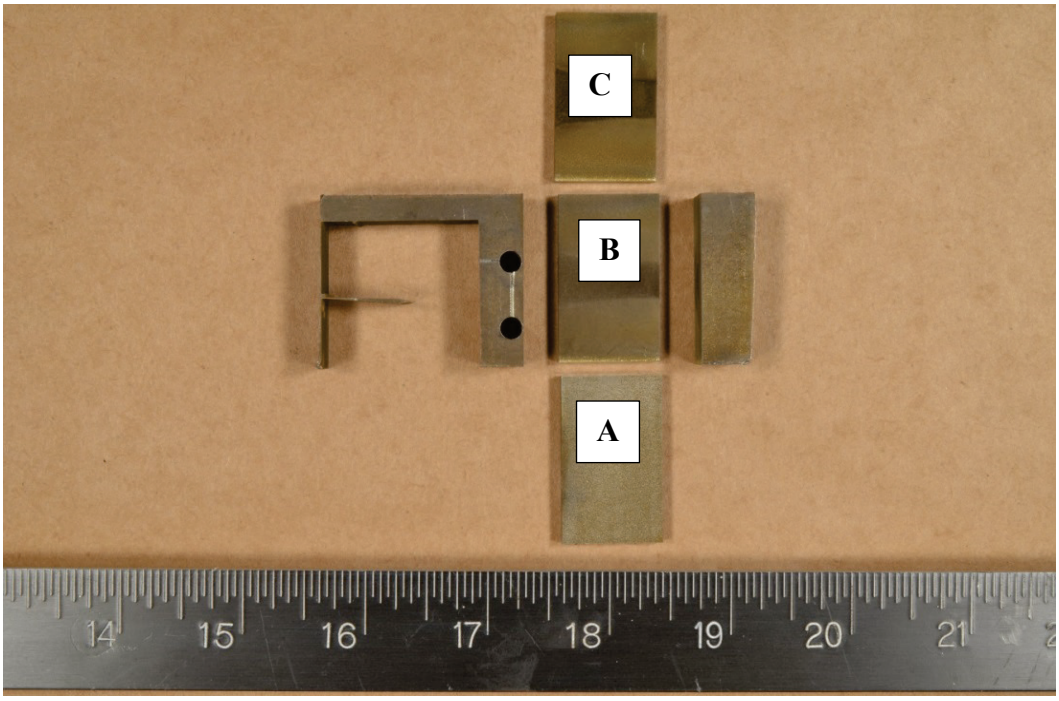
Figure 28. 0.5T slabs and remnant piece of block F3 [17].

7.5.1.2 Miniature Compact Tension

As stated in the Section 7.5.1, mini-C(T) specimens were machined from the rejected 0.5T specimens in layers K, L, and M. The slabs for these specimens were cut intentionally to a 4.00 mm thickness so that three slabs could be retrieved from the 0.5T remnants. The following figures show the sectioning of the mini-C(T) specimens. Specifically, and as shown and noted in Figure 29 – Figure 31 and listed in Appendix A, 9 mini CTs were machined from damaged specimen 3K2 (3 each from positions A [**3K2A-1,-2, -3**], B, and C), 9 mini CTs were machined from damaged specimen 3L1; and 6 mini CTs from specimen position 3M1 and 4 mini CTs from position 3M2 for a total of 28 mini CTs (Table 7.5-1). Since specimens 3A2 and 3C3 did not have sufficient material to machine 9 mini CTs, additional mini CTs were machined from Block F4 (Figure 33).

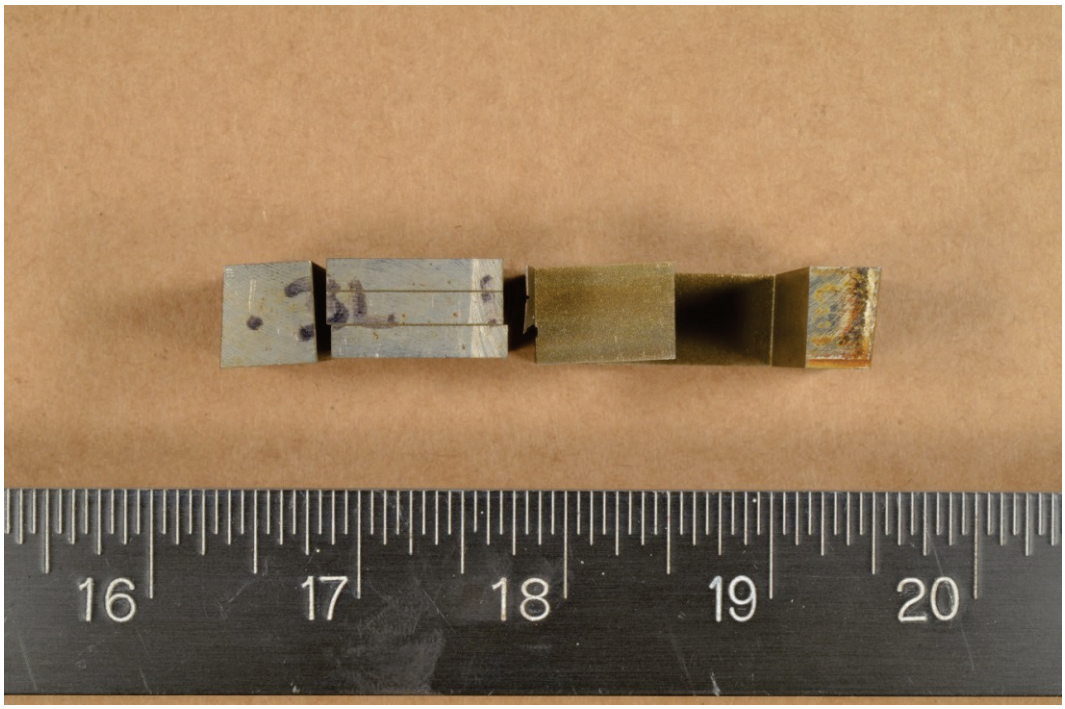


(TOP VIEW)

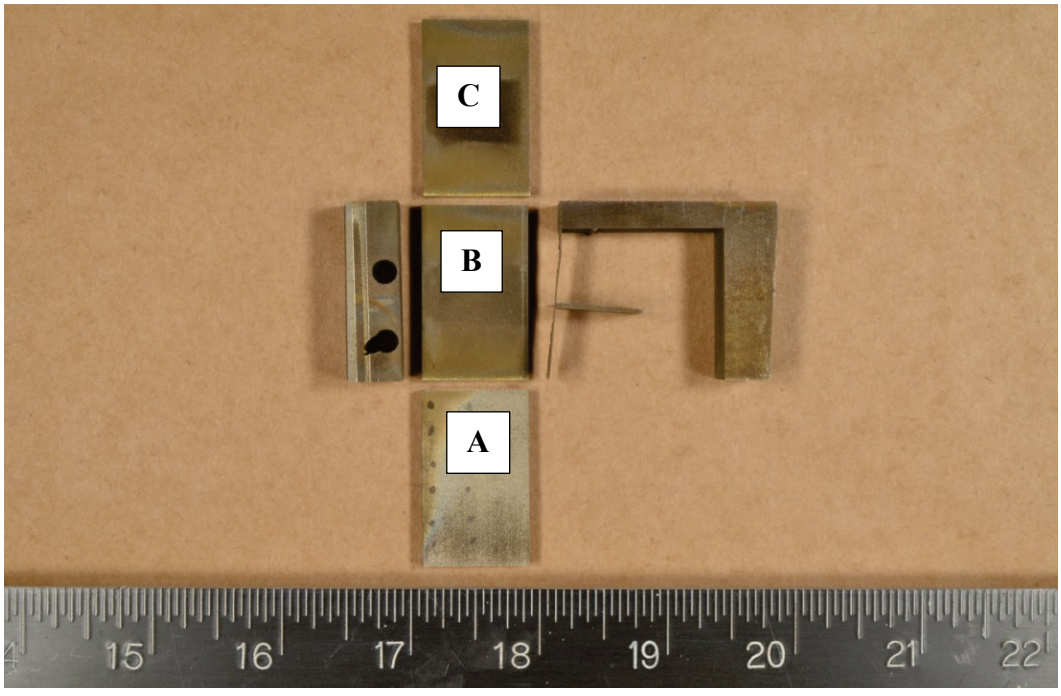


(FRONT VIEW)

Figure 29. Block F3 layer K – 9 total specimens were cut from the slabs [17].

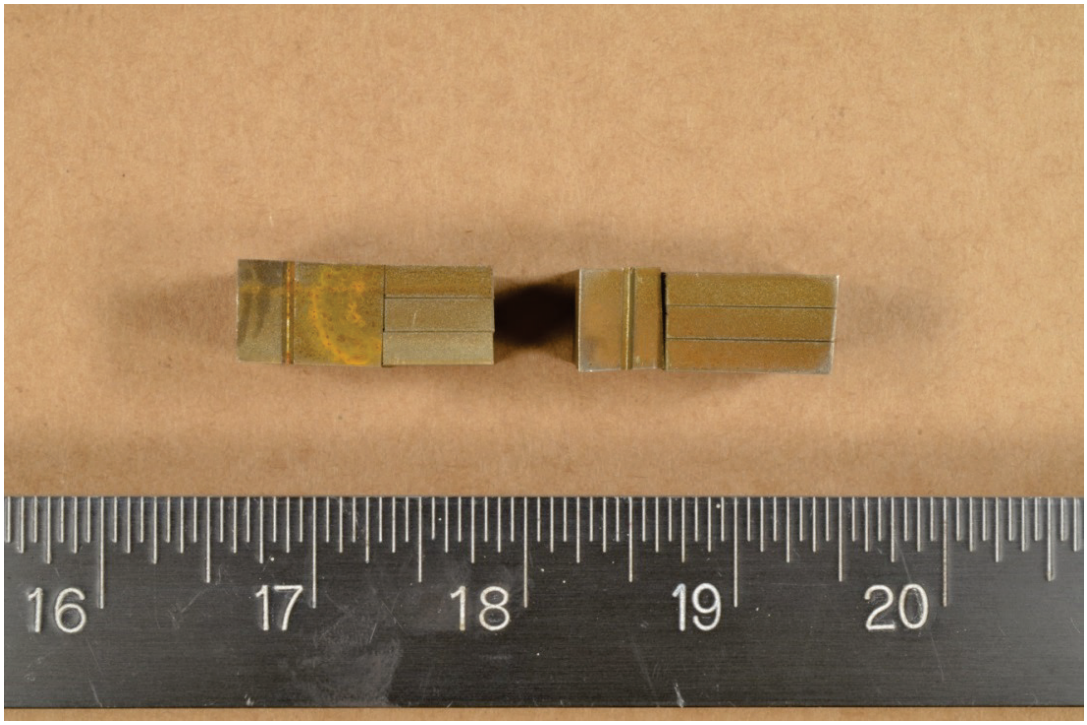


(TOP VIEW)

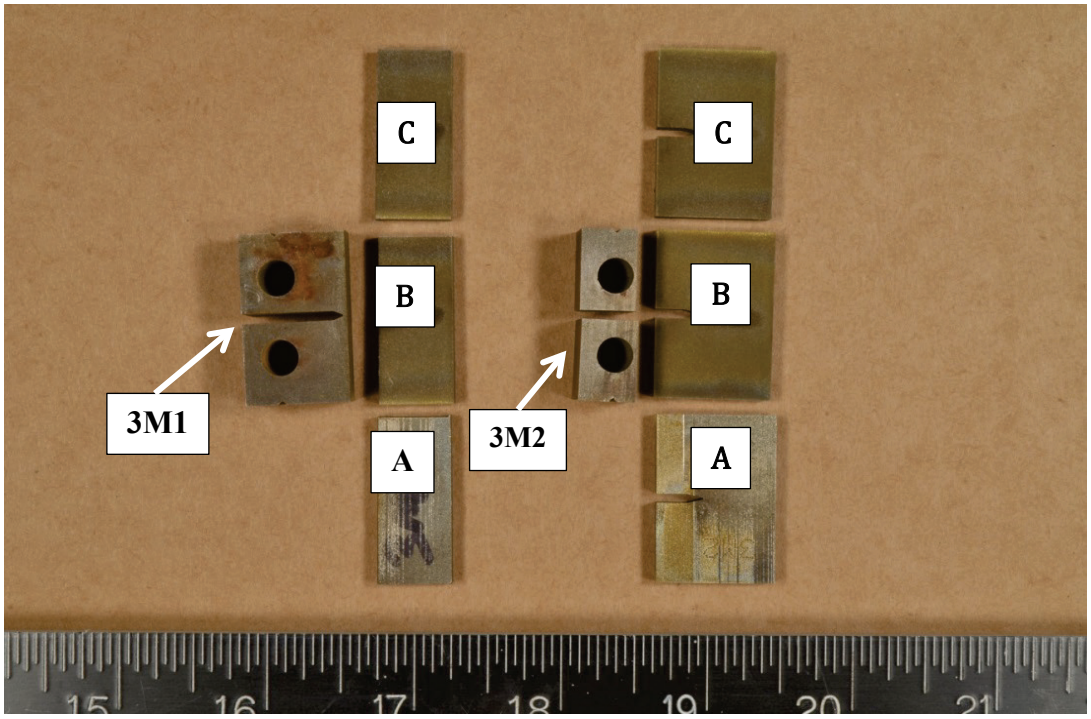


(FRONT VIEW)

Figure 30. Block F3 layer L – 9 total specimens were cut from the slabs [17].



(TOP VIEW)



(FRONT VIEW)

Figure 31. Block F3 layer M – 10 total specimens were cut from the slabs [17].

7.5.2 Specimen Identification

The traceability of each specimen to the original position within the block was paramount during this project. The table below outlines the labeling convention for each specimen type cut from block F3.

Table 7.5-2. Block F3 Specimen ID Definitions.

Specimen Type	Example ID	Definition
0.5T Compact Tension	3K3	3 = Block F3 / K = row / 3 = column
mini-C(T)	3K2A-1*	3K2 = 0.5T ID / A = slab closest to cladding / 1 = top specimen in a 1x3 column

*Figure 29 – Figure 31 for reference on slabs.

7.5.3 Specimen Dimension Verification (Appendix A)

As noted in the specimen matrix as shown in Figure 28, 0.5T specimen marked with a red "X" were rejected during the QA process. Table 7.5-3 summarizes the machining errors and the corresponding resolution.

Table 7.5-3. Block F3 Specimen Rejection Overview.

Specimen/s	Error	Resolution
3A2	Anomaly	Machine mini-C(T)s from Block F4
3C3	Anomaly	
3K1 – 3K2	Specimen cut after part off	Sacrifice 0.5T for mini-C(T)s – 3K2, 3L1, 3M1, & 3M2. No specimens cut from 3K1 & 3L2.
3L1 – 3L2	Anomaly	
3M1 – 3M2	Specimen cut after part off	

The specimen QA documentation for block F3 can be found in Appendix A – Block F3.

7.5.4 Dose Rates

During the packaging process each row of 0.5T specimens was measured for dose rate at 2". The packaged rows were photographed and are shown in Figure 32. Note that rows K, L, and M include the mini-C(T)'s. The dose rates showed a distinct gradient through the thickness of the reactor vessel. The dose rate information is listed in Table 7.5-4.

Figure 32. Block F3 0.5T & mini-C(T) specimens packaged for shipment [17].

Table 7.5-4. Block F3 Specimen Radiation Levels.

Row ID – Bagged Groups (0.5T and mini-C(T))	Rad Level (mR/hr@2")
3A	55
3B	40
3C	27
3D	18
3E	13
3F	10
3G	8
3H	7
3I	6
3J	5.5
3K*	3
3L*	2
3M#	2
3N	3.5

* 9 mini-C(T)s and two 0.5 C(T)s and 10 mini-C(T)s and two 0.5 C(T)s

7.6 BLOCK F4

Like base metal block F3, the F4 machining plan called for the machining of 56, 0.5T, compact tension C(T) specimens from a 2 x 2 array as shown in Figure 33. As described in the block F3 summary, several 0.5T samples were rejected. The reconciliation for the lost samples was to machine additional mini-C(T) specimens from the same row location (A & C) as the "lost F3 0.5T specimen out of block F4. Therefore, 20 additional mini-C(T) specimens were machined from the remnant piece of block F4 as shown in Figure 33 (**blue ellipses**). The total number of machined specimen from block F4 is outlined in Table 7.6-1.

Table 7.6-1. Block F4 Specimen Types & Quantities.

Type	Quantity	Drawing
0.5T	56	Figure 21
mini-C(T)	20	Figure 26
Total	74	-

7.6.1 Machining

7.6.1.1 0.5T Compact Tension

Block F4 was the thicker than F3, which allowed the specimens to be stacked in a 2 x 2 matrix along the hotline side of the block. This both conserved material and placed the specimens in a higher fluence position within the block. The first operation was to separate off the portion to be used for 0.5T machining via band saw. The 0.5T specimen machining then followed the outline in Section 4.1.

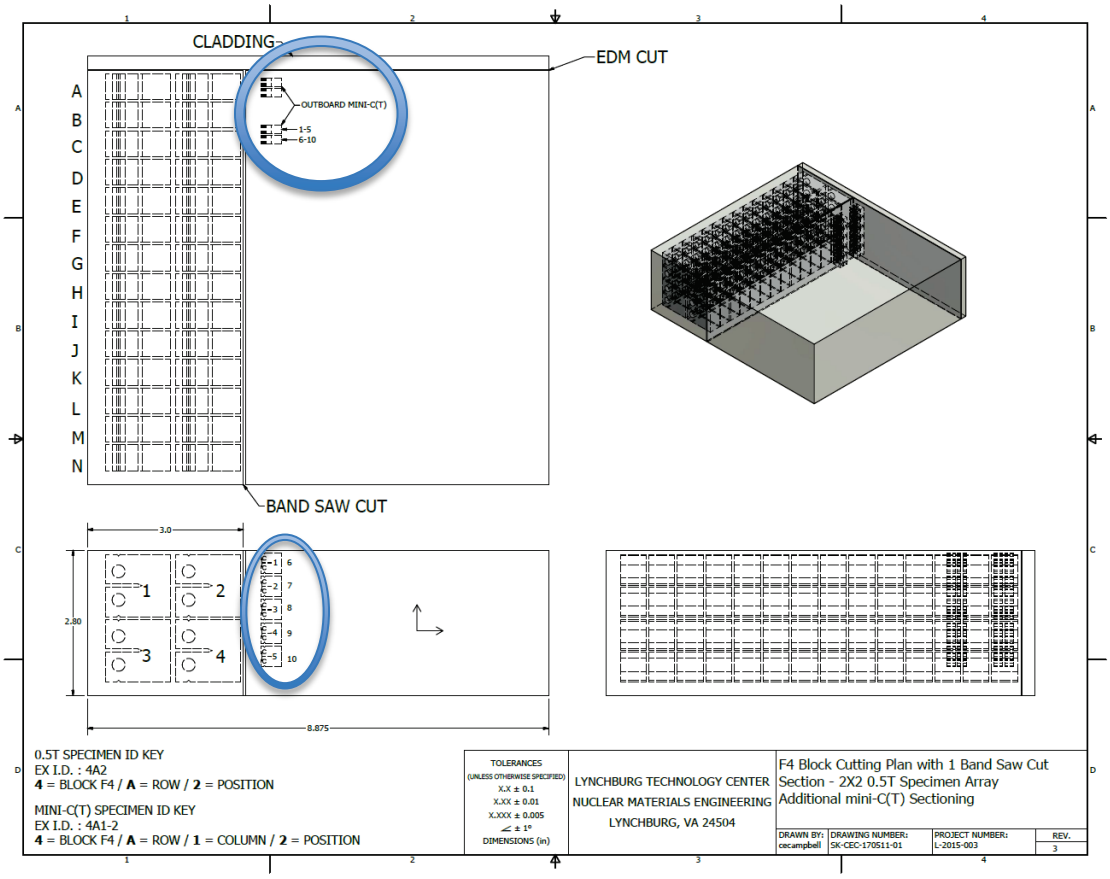


Figure 33. Block F4 cutting plan overview.

7.6.1.2 Miniature Compact Tension

After the 0.5T specimens were cut off and slabbed out, two small slabs along the circumferential direction were cut out to machine the mini-C(T) specimens in rows A and C, position 3 and labeled 4A1- (1-5) and 4A2 (6-10) and 4C1-(1-5) and 4C2 (6-10). The slabs for both the mini-C(T) and 0.5T specimens are identified in Figure 33, Figure 34, and Figure 35.

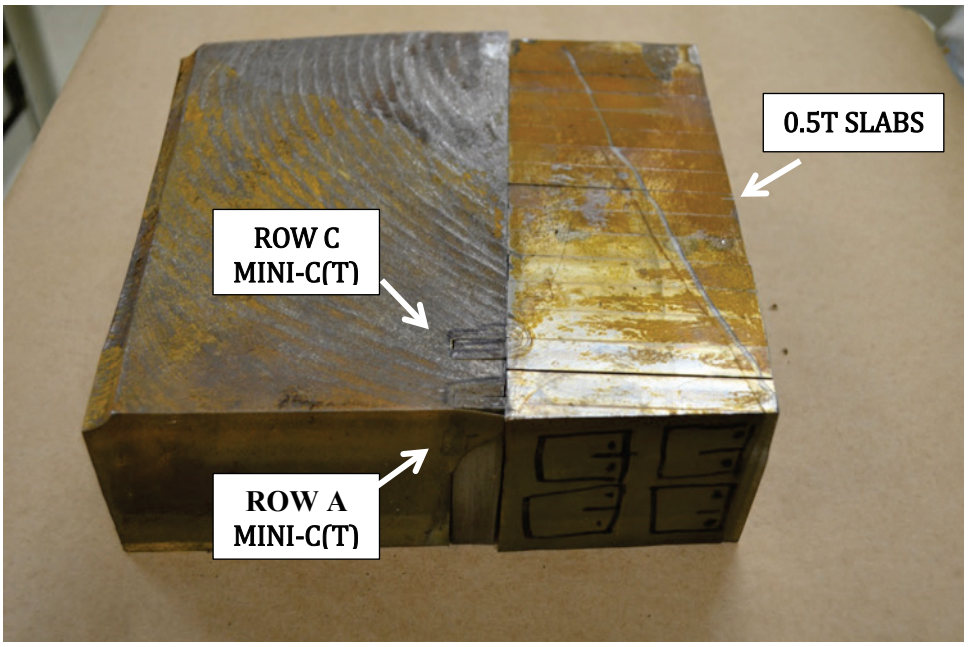


Figure 34. Block F4 0.5T and mini-C(T) slabs in relation to remnant [17].

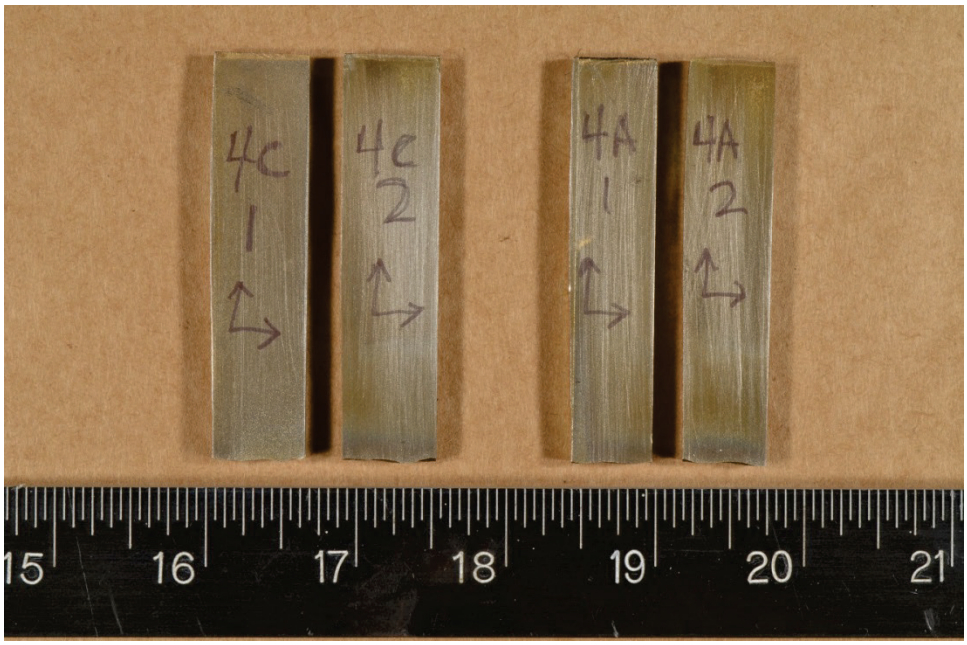


Figure 35. 10 mini C(T) specimens each were cut from layers A and C [17].

7.6.2 Specimen Identification

The traceability of each specimen to the original position within the block was paramount during this project. Table 7.6-2 outlines the labeling convention for each specimen type cut from block F4.

Table 7.6-2. Block F4 Specimen ID Definitions.

Specimen Type	Example ID	Definition
0.5T Compact Tension	4B3*	4 = Block F4 / B = row / 3 = matrix location
mini-C(T)	4C1-4*	4 = Block F4 / C = row / 1 = column / 4 = position

*refer to Figure 32, Figure 33, and Figure 34 for location and position within rows

7.6.3 Specimen Dimension Verification

There were no rejections during the QA review process for block F4 (Appendix A).

7.6.4 Dose Rates

During the packaging process, each row of 0.5T specimens was measured for dose rate at 2". The packaged rows were photographed and are shown below in Figure 36. The dose rate information is listed in Table 7.6-3.

Figure 36. Block F4 0.5T & mini-C(T) specimens packaged for shipment [17].

Table 7.6-3. Block F4 Specimen Radiation Level.

Row ID – Bagged Groups (0.5T and mini-C(T))	Rad Level (mR/hr@2")
4A*	55
4B	40
4C*	26
4D	19
4E	14
4F	12
4G	11
4H	9
4I	8
4J	7
4K	5.5
4L	4.4
4M	4.2
4N	4.2

*includes 10 mini-C(T)s at 4A3 and 4C3 and labeled: 4A1 (1-5), 4A2 (6-10), 4C1 (1-5) and 4C2 (6-10)

7.7 BLOCK C2

Block C2 was the first of the four blocks machined by BWXT. It was chosen to be first to evaluate machining protocols and to ensure cutting protocols would be optimized when machining the beltline weld Block CF. The quantity and type of specimens cut from block C2 are outlined below in Table 7.7-1. The detailed drawing for each specimen type may be found in Figure 23 – Figure 25 and Figure 38.

Table 7.7-1. Block C2 Specimen Types & Quantities.

Type	Quantity	Drawing
CVN	245	Figure 23
Microstructural (MS)	68	Figure 24
SS-3	134	Figure 25
Chemical Composition (CC)	17	Figure 38
Total	464	-

7.7.1 Machining

7.7.1.1 CVN

The base metal C2 block was milled to the thickness equal to the length of a CVN, 2.165”. After milling to the correct thickness, an EDM was used to cut a matrix of 15x17 CVN specimen blanks. The specimen matrix is outlined below in the Figure 37.

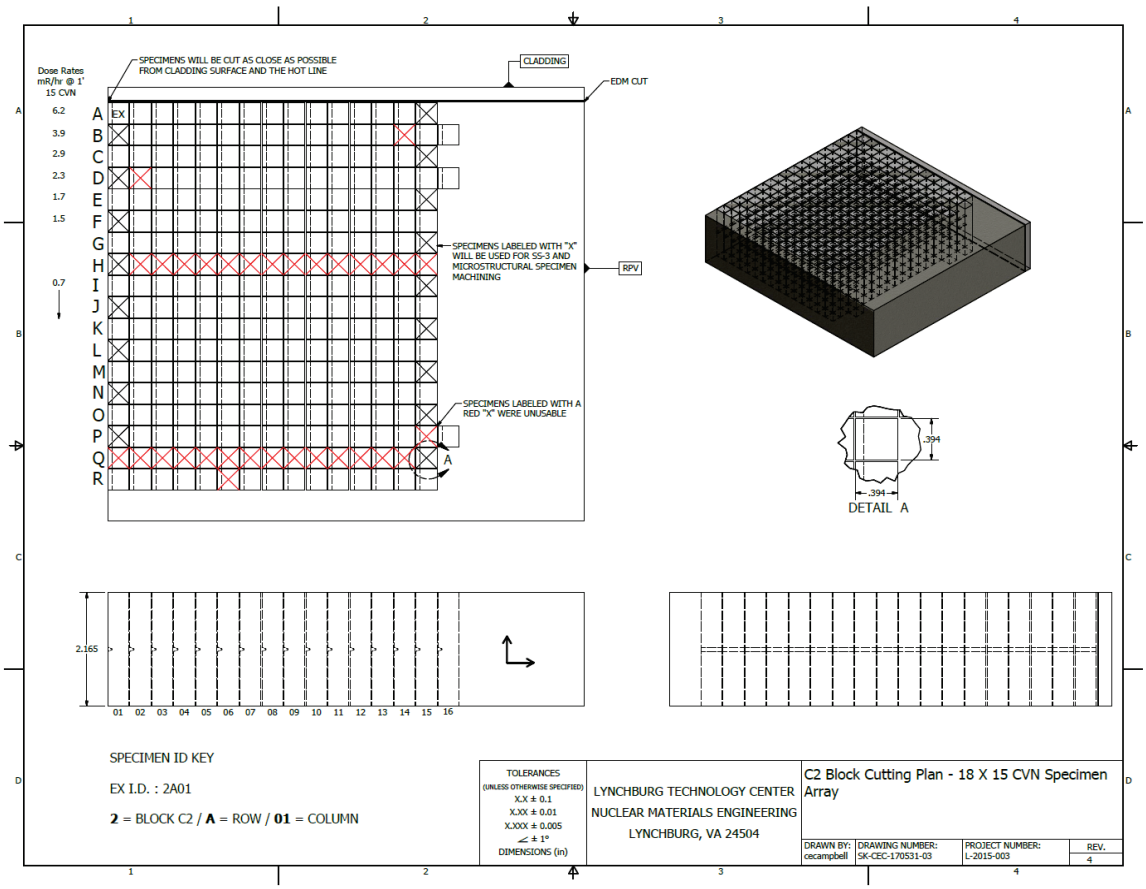


Figure 37. Block C2 cutting plan overview.

7.7.1.2 Chemical Composition / Microstructural / SS-3 Tensile Specimens

In Figure 37, specimens marked with a **black** "**X**," on alternating rows from the high fluence and low fluence sides were used to machine the SS-3 tensile specimens and coupons for microstructural specimens. Remnants from the coupon machining were used for chemical characterization. The detailed sectioning plan for the tensile and microstructural specimens is shown in Figure 38. Note that the SS-3 specimens were cut starting at the cladding face and slabbed off to thickness in the thickness direction of the vessel. The offal from profiling the SS-3 specimens was mounted and used for the chemical composition analysis. Lastly, the microstructural specimens were cut in a 2 x 2 array of 10 x 10 x 0.5 mm squares.

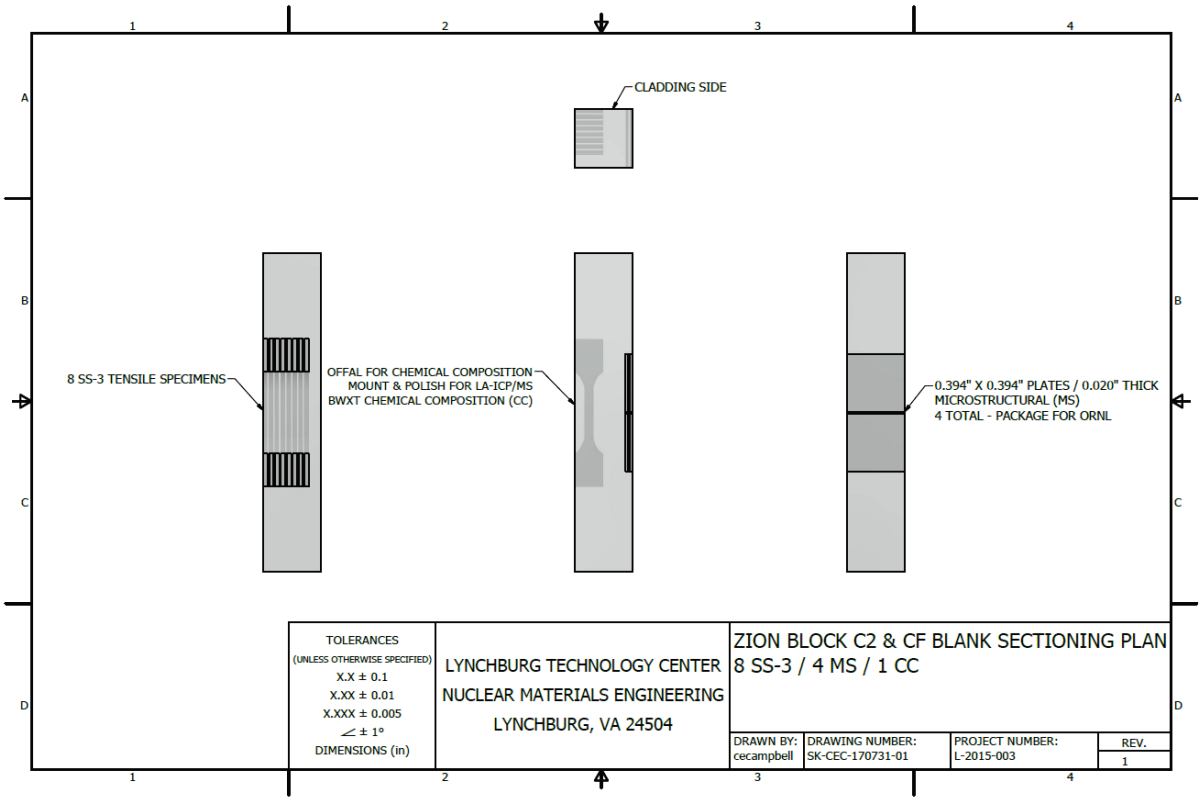


Figure 38. CVN blank cutting plan overview.

7.7.2 Specimen Identification

The traceability of each specimen to the original position within the block was paramount during this project. The table below outlines the labeling convention for each specimen type cut from block C2. An example of the sectioning and labeling of CVN blank 2B01 is shown below in Figure 39, note that the chemical composition specimens are not shown.

Table 7.7-2. Block C2 Specimen ID Definitions.

Specimen Type	Example ID	Definition
CVN	2A01	2 = Block C2 / A = row / 01 = column
SS-3	A1*	A = row / 1 = specimen closest to cladding
Microstructural (MS)	B1	B = row / 1 = arbitrary label of the 4 specimens
Chemical Composition (CC)	2A01	Replicated the CVN specimen it was cut from.

*SS-3 specimens from the C2 block were labeled by row since only one CVN blank was consumed in each row.

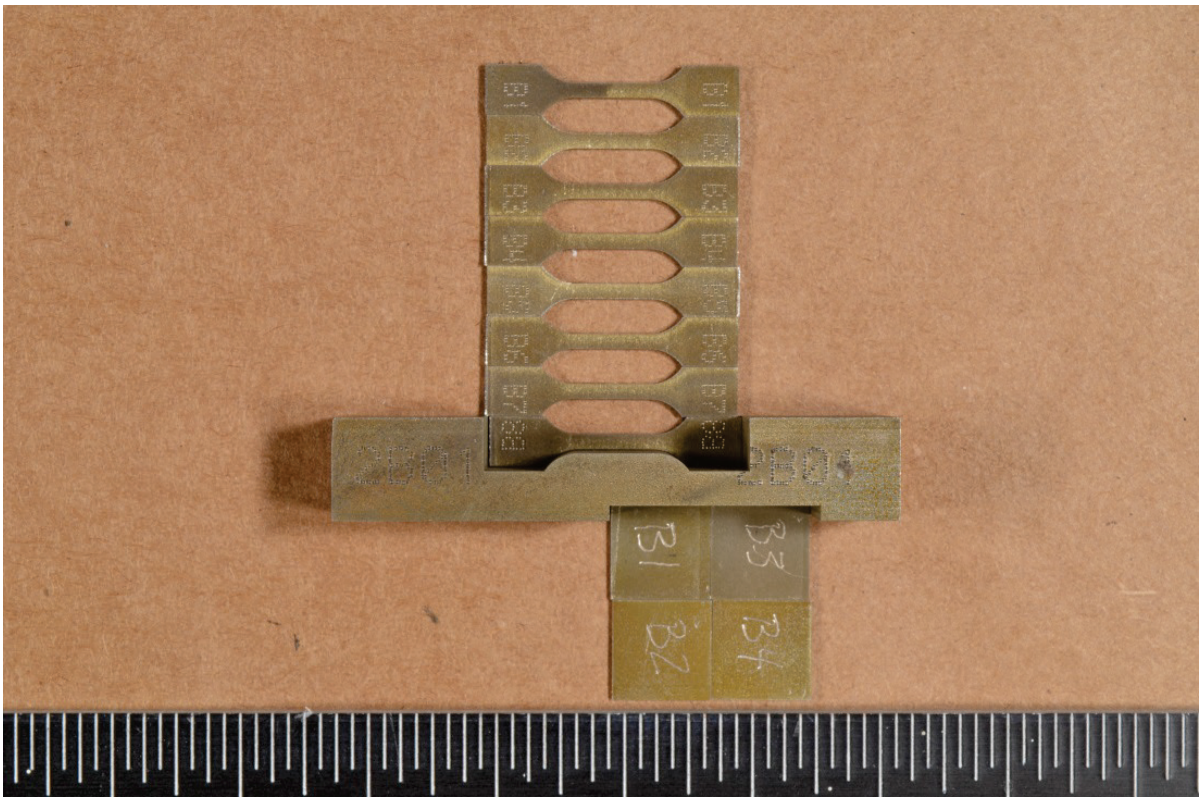


Figure 39. CVN blank – 2B01. CVN blank cutting plan with labeled specimen example [17].

7.7.3 Specimen Dimension Verification (Appendix A)

As noted in the specimen matrix and shown in Figure 37, those CVN specimen blocks marked with a red "X" were rejected during the QA evaluation. Table 7.7-3 summarizes the machining errors and the corresponding resolution.

Table 7.7-3. Block C2 Specimen Rejection Overview.

Specimen/s	Error	Resolution
2B14	Anomaly	NA
2D02	Anomaly	NA
2H02 – 2H15	Indicated on recast rather than block. Dimension w was systematically low	Brush off block to remove recast before running each layer
2P15	EDM break down during cut.	NA
2Q01 – 2Q14	Indicated on recast rather than block. Dimension w was systematically low	Brush off block to remove recast before running each layer
2R06	Notch miss-cut	Put a stop in notching fixture to prevent contact.

7.7.4 Activity & Dose Rates

During the packaging process, each row of 14 CVN specimens was measured for dose rate at 2" with the packaged Q Row specimens shown in Figure 40. Each bag contains 14 CVN, 4 microstructural, and 8 SS-3 tensile specimens. A gamma spectrum analysis was completed on the C Row chemical composition

specimen to determine the nuclides present. The only reportable nuclide was Co-60. Knowing these dose rates and that the only nuclide is Co-60 activity was calculated for the shipment.

Figure 40. Row Q CVN, tensile, and coupons specimen bagged for shipping [17].

Table 7.7-4. Block C2 Specimen Radiation Level.

Row ID – Bagged Group (14 CVNs)	Rad Level (mR/hr@2")
2A	122
2B	75
2C	54
2D	45
2E	30
2F	25
2G	20
2H	16
2I	14
2J	13
2K	11
2L	10
2M	8
2N	7
2O	7
2P	7
2Q	6
2R	6

Note that the rad levels are only for the 14 CVN specimens, 10% contingency was added to the activity for the shipment to account for the microstructural and SS-3 tensile specimens.

7.8 BLOCK CF

The CF block was machined last due to the importance of the weld metal and since it was more complex because it was a hybrid of the two base metal machining plans discussed earlier with alternating rows of compact tension and CVN specimens. Moreover, two CVN blanks from each CVN row were machined

into SS-3, chemical, and microstructural specimens, as shown in Figure 44. However, unlike blocks F3 and F4, 0.4T compact tension specimens were machined from block CF such that 10 specimens would span the width of the block. During the cutting of the first several CVN row A blanks, there was an EDM program error that rendered 5 specimens untestable as CVNs. However, there was sufficient material to machine a set of nine mini-C(T)s. The quantity and type of specimens cut from block CF are outlined below in Table 7.8-1. The detailed drawings for each specimen are linked to the respective figures given in Section 7.4 and 7.8.1.2.

Table 7.8-1. Block CF Specimen Overview.

Type	Quantity	Drawing
CVN	174	Figure 23
Microstructural (MS)	72	Figure 24
SS-3	142	Figure 25
Chemical Composition (CC)	18	Figure 38
0.4T	77	Figure 22
mini-C(T)	9	Figure 26
Total	492	-

7.8.1 Machining

7.8.1.1 Centering Weld

Block CF was machined differently than the rest of the blocks because the weld was not centered when it arrived. Once the cladding face was removed, a gross etch of the inner surface was performed to reveal the weld line, as shown in Figure 41.

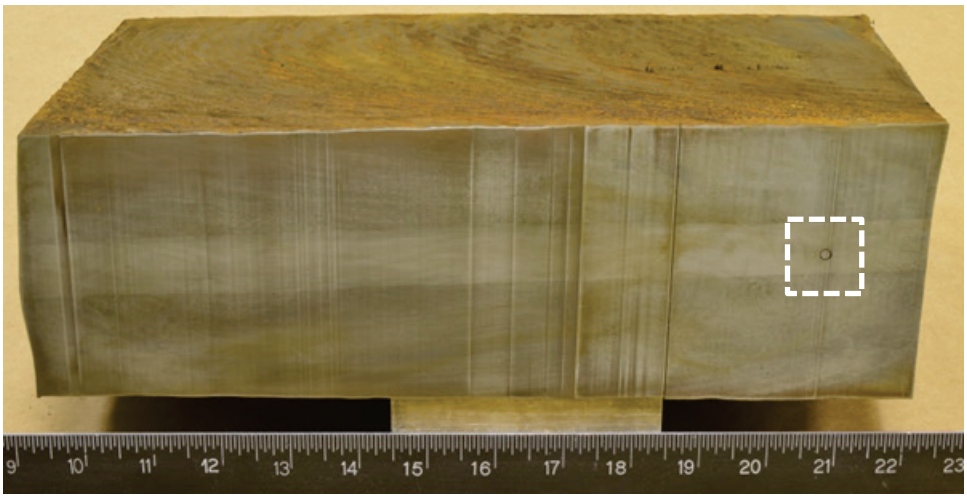


Figure 41. Etched inner diameter with cladding removed. Note the highlighted void in the weld. See Figure 51 for more details [17].

To center the weld, the block was fastened to thee jack stands and leveled such that the weld was true to the table on the end mill. It was then milled until half a CVN width was to the center of the weld, as shown in Figure 42.

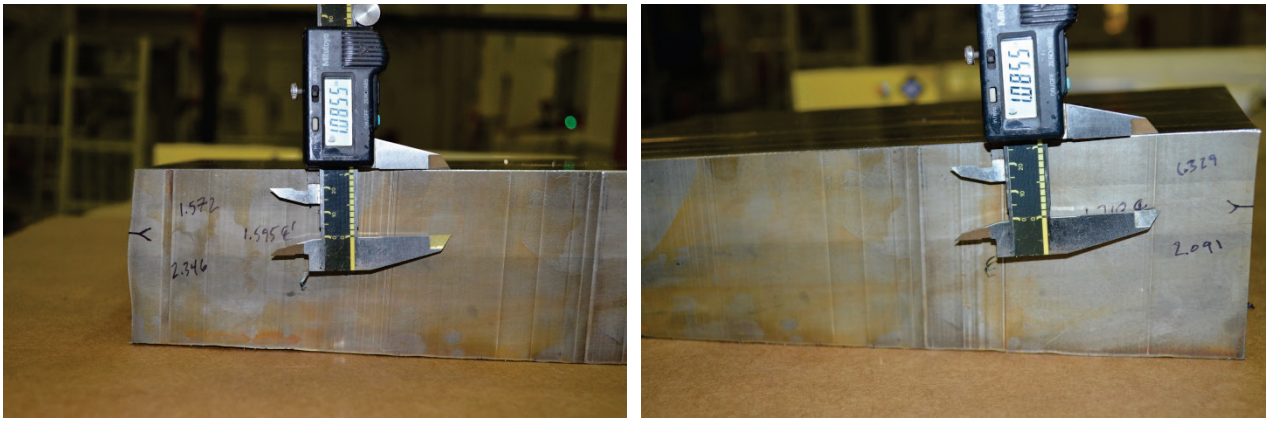


Figure 42. Partially milled CF block, showing centered weld on left and right edges of block [17].

To complete the centering of the weld, the block was flipped over on the freshly milled surface and milled to the final 2.165" thickness, placing the weld directly in the center of the block. The B Row slab, which was cut to machine 0.4T specimens, revealed the centered weld line as shown in Figure 43.

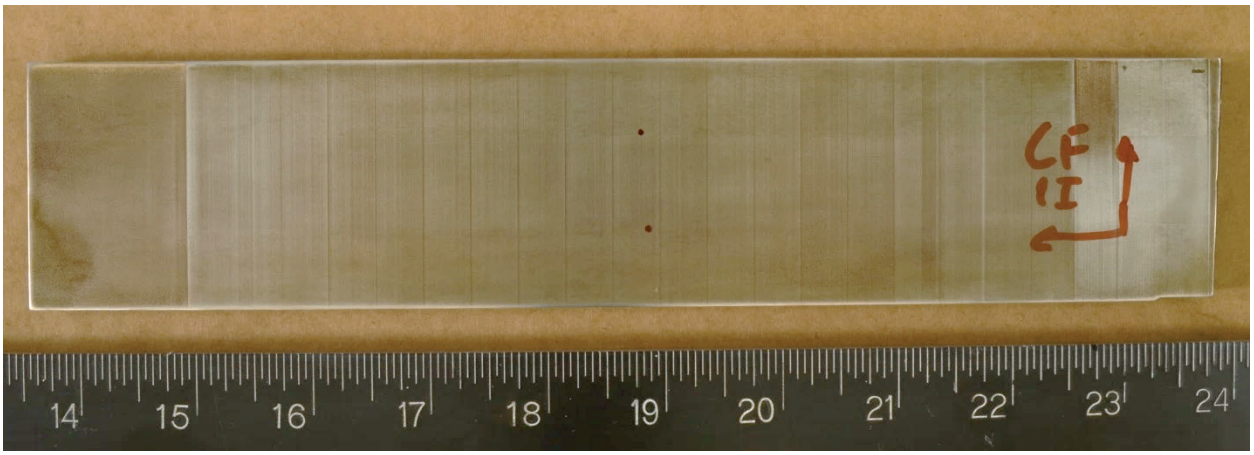


Figure 43. Row B slab cut (0.4 C(T)) illustrates the weld centerline of the CF Block [17].

7.8.1.2 CVN & 0.4T Compact Tension

After the weld was centered, machining proceeded using an EDM to cut 0.394" x 0.394" CVN blanks and 0.4" slabs for 0.4T specimens according to the cut plan. The specimen matrix is outlined in Figure 44.

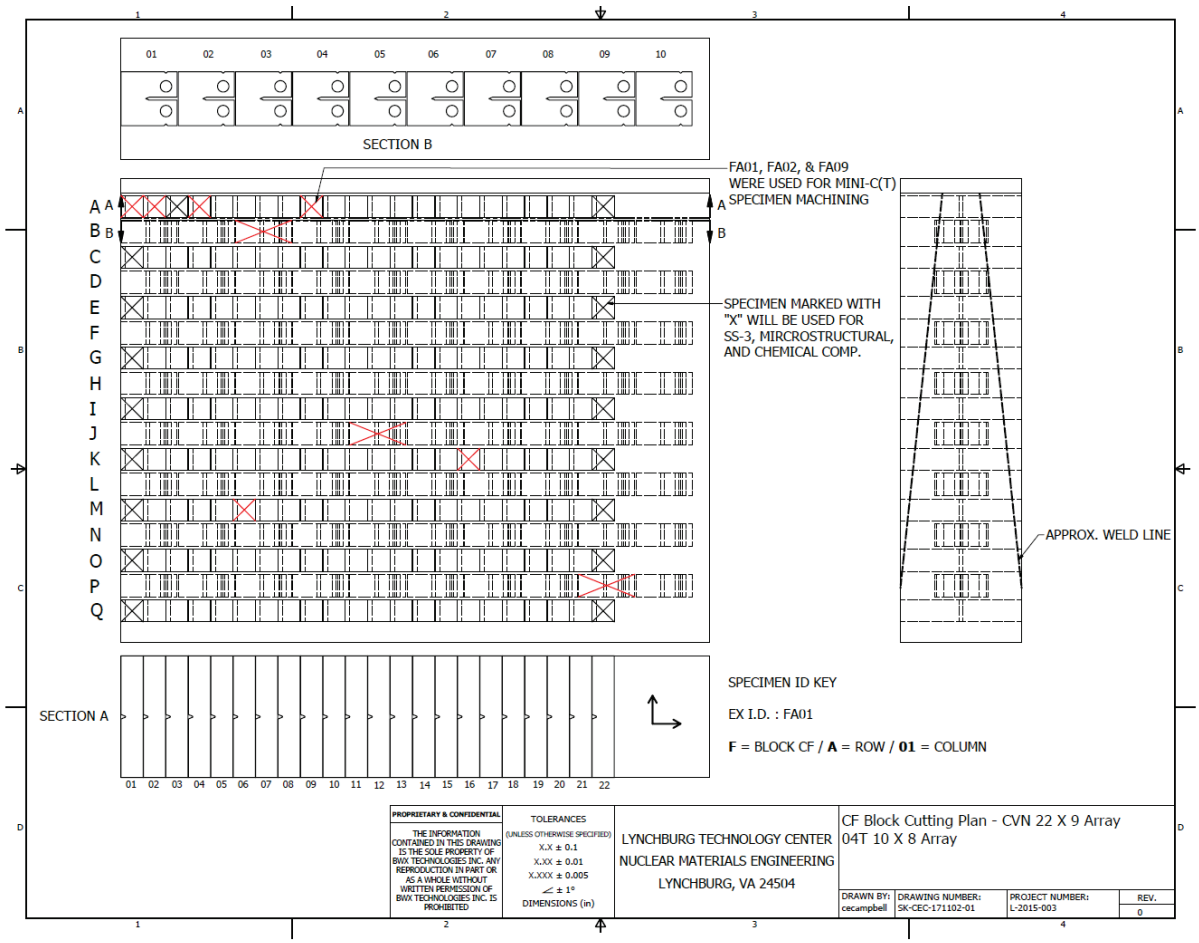


Figure 44. Block CF cutting plan overview.

(unlimited use by ORNL since drawing is not BWXT Proprietary)

The first several rows of 0.4T slabs were etched to ensure the weld did not travel outside of the centerline. The slabs from rows B through F are shown in Figure 45, where the weld is shown to be thicker than the 0.4T compact tension specimens.

Figure 45. (TOP) Row B slab | (MIDDLE) Row D slab | (BOTTOM) Row F slab [17].

The remnant from block CF below clearly shows the execution of the machining plan outline in Figure 46.

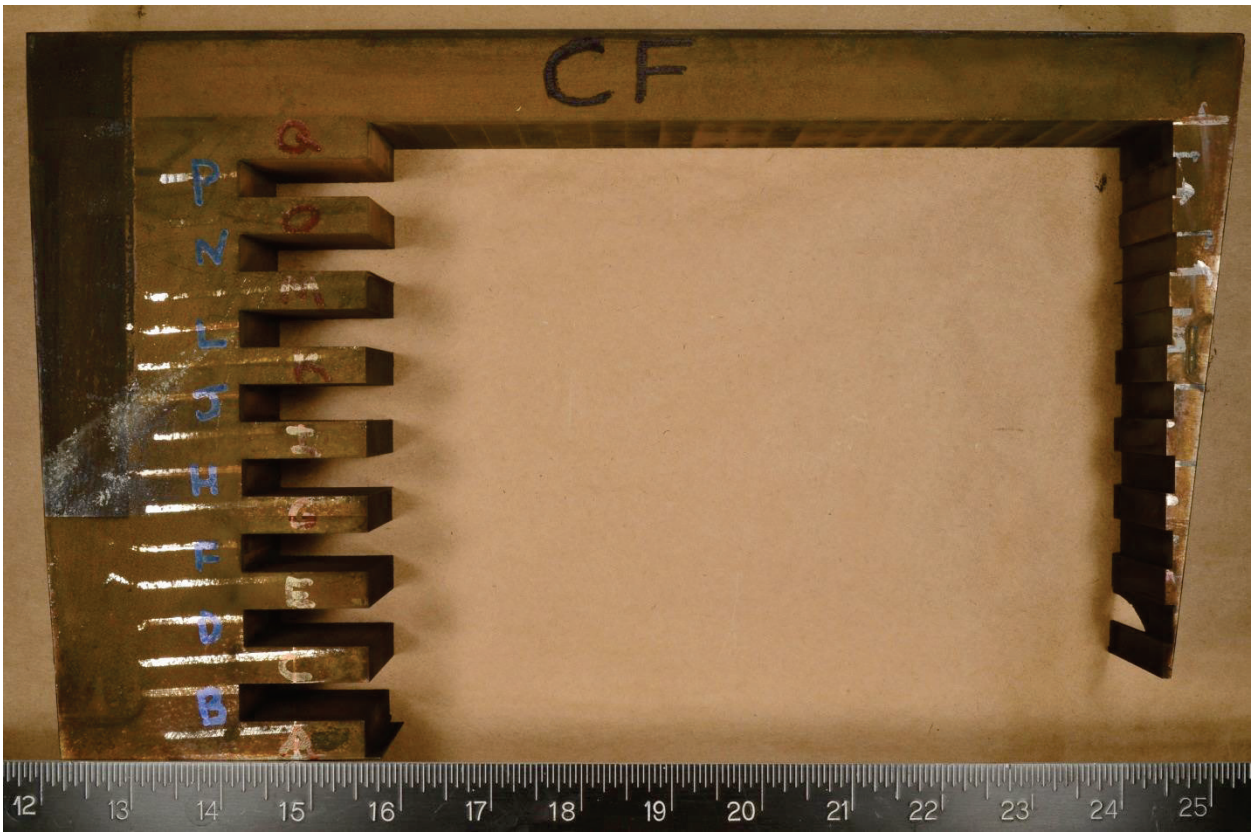


Figure 46. Block CF remnant after cutting all the CVN and 0.4T slabs [17].

7.8.1.3 Chemical Composition / Microstructural / SS-3 Tensile Specimens

Unlike block C2, each row of CVN specimens had two blanks removed to be machined into SS-3, chemical composition, and microstructural specimens. In Figure 44, the CVN blanks marked with a **black "X"** were selected to machine SS-3 tensile and coupons for microstructural specimens is shown in Figure 38. The offal from profiling the SS-3 specimens was mounted and used for the chemical composition analysis. Lastly, the coupons for microstructural specimens were cut in a 1 x 4 array of 10 x 10 x 0.5 mm squares to ensure they were taken from the weld as shown in Figure 47 rather than the 2x2 used in the base metal machining shown in Figure 38. The general specimen outline for the SS-3, chemical composition, and coupons from a CF CVN blank is shown in Figure 48.

Initially, the CVN blanks were etched as machining progressed into the block to ensure the weld traveled straight. Once the weld was shown to be thicker than the SS-3 tensile specimens etching the CVN blanks was discontinued. Figure 47 and Figure 48, show the cross section of block CF and the path of the fusion line in relation to the SS-3 and chemical composition specimens.

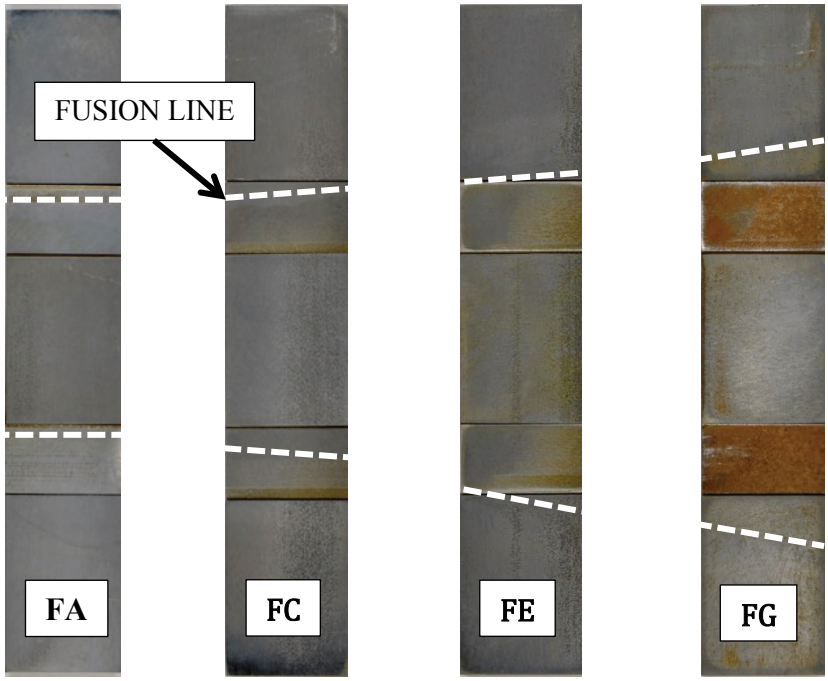


Figure 47. Side view of etched FA, FC, FE, and FG CVN blanks that were used to machine SS-3 & chemical composition specimens. Beginning with row G the entire SS-3 specimen was machined from weld [17].

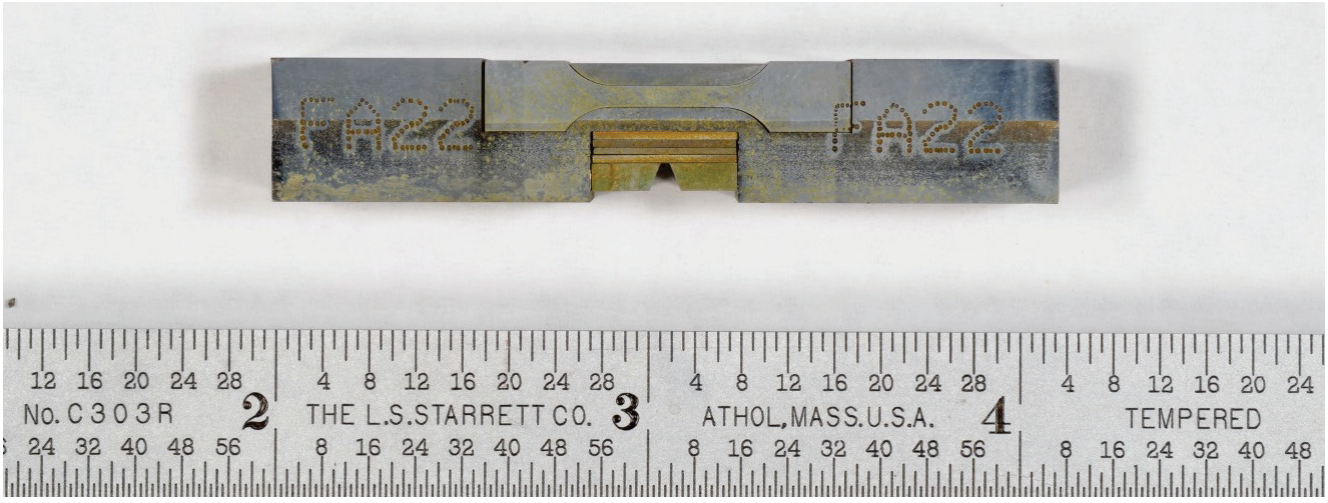


Figure 48. Charpy block FA22 had the smallest weld cross section for machining SS-3 and microstructural specimens. A 1x4 array of microstructural specimens was used to ensure they were taken from weld, rather than the 2x2 used in the base metal machining shown in Figure 38 [17].

7.8.1.4 Miniature Compact Tension

The miniature C(T) specimens cut from row A were retrieved from CVN blanks: FA01, FA02, and FA09. Due to the location of the wire burns, the only orientation that would allow for a full lot of nine machined specimens was in the radial direction. This is shown in Figure 49 and Figure 53, the labeling on all CVN specimens is on the cladding side, therefore the crack growth for the mini-C(T) specimens will be in the radial direction. The details of the specimen machining are described in Section 7.4.6.

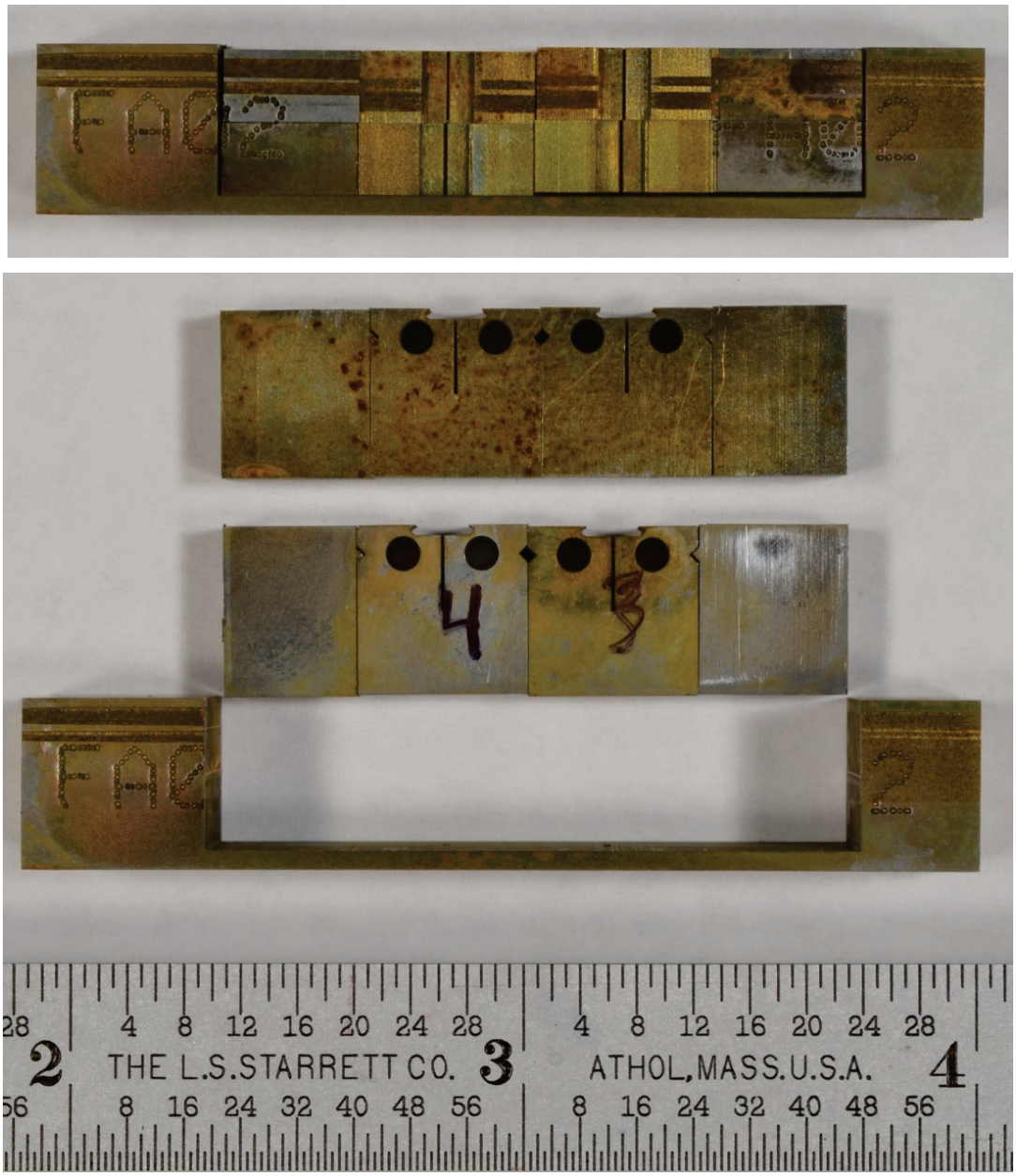


Figure 49. CVN blank FA02 – reconstructed mini-C(T) machining profile [17].

7.8.1.5 Weld Defects

While machining the weld metal block CF, several inclusions or voids were encountered. The first visible void was shown near the cladding surface in CVN specimen FA04. Attempts to machine through the void were unsuccessful because the non-conductive inclusion bent the EDM wire and did not allow it to charge. This anomaly is shown below in Figure 50.

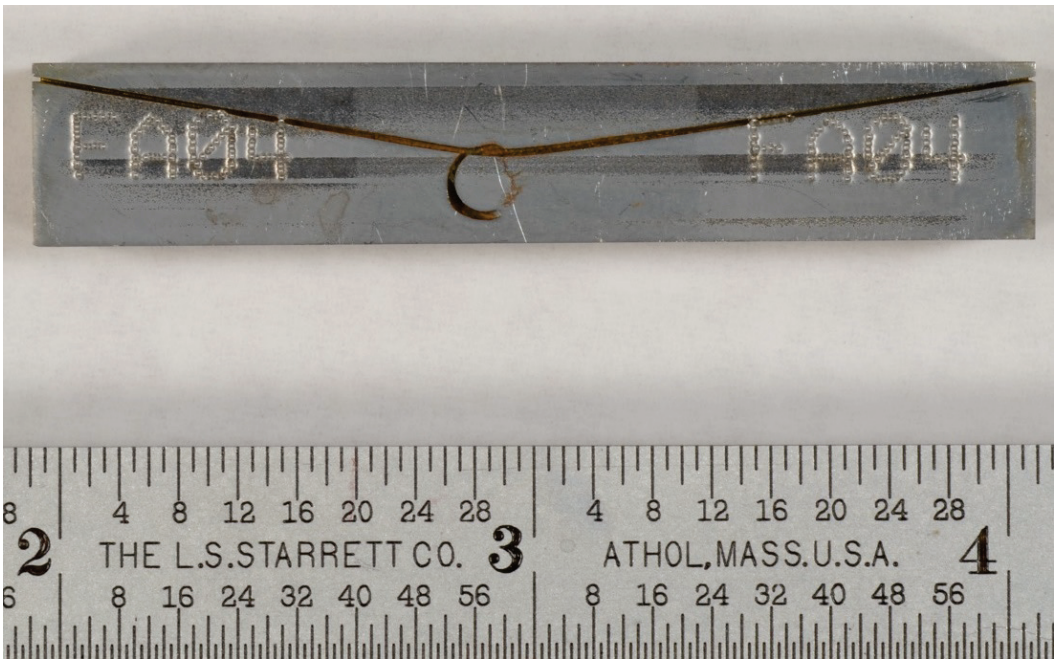


Figure 50. CVN blank FA04 showing weld void that caused EDM gap fault [17].

The next inclusion was found in row M, CVN specimen FM06. In order to retrieve the remaining specimens, FM06 was sacrificed and the wire moved around the inclusion. The inclusion piece was removed and photographed as shown in Figure 51.

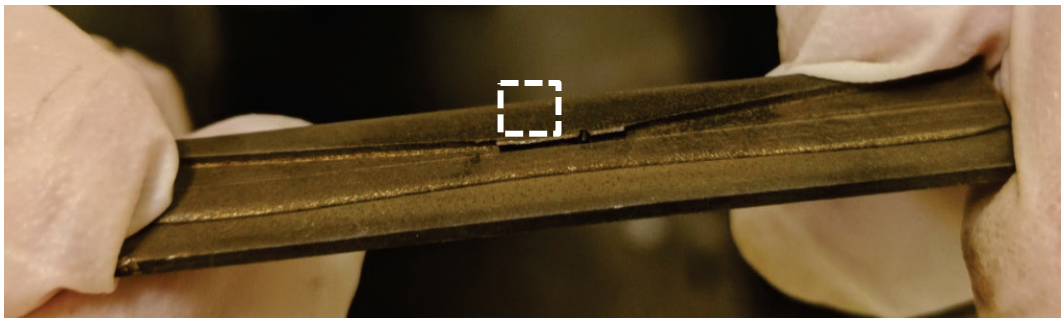


Figure 51. The EDM wire stuck an inclusion while cutting CVN specimen FM06. The wire was moved ~0.040" to avoid the inclusion and to remove it [17].

7.8.2 Specimen Identification

As previously noted, the traceability of each specimen to the original position within the block was paramount during this project. Table 7.8-2 outlines the labeling convention for each specimen type cut from block CF.

Table 7.8-2. Block CF Specimen ID Definitions.

Specimen Type	Example ID	Definition
CVN	FA01	F = Block CF / A = row / 01 = column
SS-3	A11*	A = row / 1 = cut from CVN 01 / 1 = specimen closest to cladding
	A21	A = row / 2 = cut from CVN 22 / 1 = specimen closest to cladding
Microstructural (MS)	A11	A = row / 1 = cut from CVN 01 / 1 = arbitrary label of the 4 specimens
	A21	A = row / 2 = cut from CVN 22 / 1 = arbitrary label of the 4 specimens
Chemical Composition (CC)	FA22	Replicated the CVN specimen it was cut from.
0.4T Compact Tension	FB01	F = Block CF / B = row / 01 = column
mini-C(T)	FA21	F = Block CF / A = row / 2 = column / 1 = arbitrary label of the # of specimens

*SS-3, CC, MS specimens from row A were cut from FA03 due to FA01 being consumed for mini-C(T) specimens.

7.8.3 Specimen Dimension Verification

As noted on the specimen matrix in Figure 44, those CVN and 0.4T specimen marked with a red "X" were rejected during the QA process. Table 7.8-3 summarizes the machining errors and the corresponding resolution.

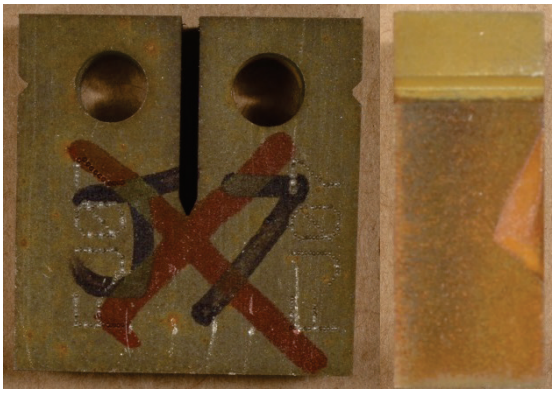
Table 7.8-3. Block CF Specimen Rejection Overview.

Specimen/s	Error	Resolution
FA01	Anomaly	Machine 3 mini-C(T) specimens
FA02	Anomaly	Machine 4 mini-C(T) specimens
FA03	**Anomaly**	**Used for SS-3, CC, and MS specimens**
FA04	Weld void	NA
FA09	Weld inclusion	Machine 2 mini-C(T) specimens
FK16	Angle cut on backside of specimen due to axis motor failure	Motor was replaced and specimen rejected.
FM06	Weld inclusion	NA
FB03	Cut after being parted off due to hanging up in the offal	Added a stop in the program 0.020" before completing the cut so a technician could receive the specimen as it was parted off.
FJ05	Anomaly, complete misalignment in the x axis and asymmetric profile.	Inspected EDM, could not find cause.
FP09	Wire contacts wore out, misaligning the specimen profile.	Contacts replaced.

In addition to the rejections noted above in Table 7.8-3, there were three additional specimens that had defects but may still produce valuable data. They are outlined in Figure 52.

(FH03)

(FH05)



(FJ07)

Figure 52. Specimen with defects: Specimen FH03 has two oblong holes due to an alignment error. Specimen FH05 has a burn in the top of the specimen due to offal getting caught and charged. Specimen FJ07 has a burn in the top of the specimen due to offal getting caught and charged [17].

7.8.3.1 Row A & B Reference

An overview of both CF rows A and B are shown reassembled as they would appear in the block is shown in Figure 53 for visual clarity and reference.

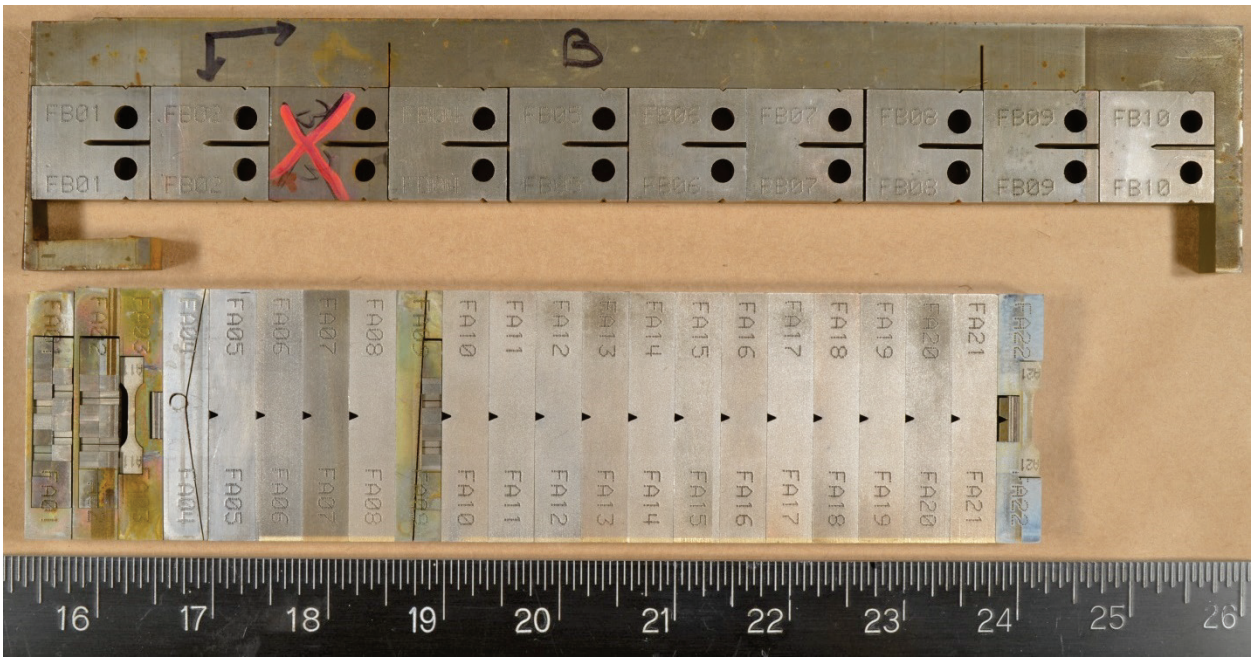


Figure 53. Block CF rows A & B overview: all the specimens that were machined and labeled from both rows were assembled as they came from the block [17].

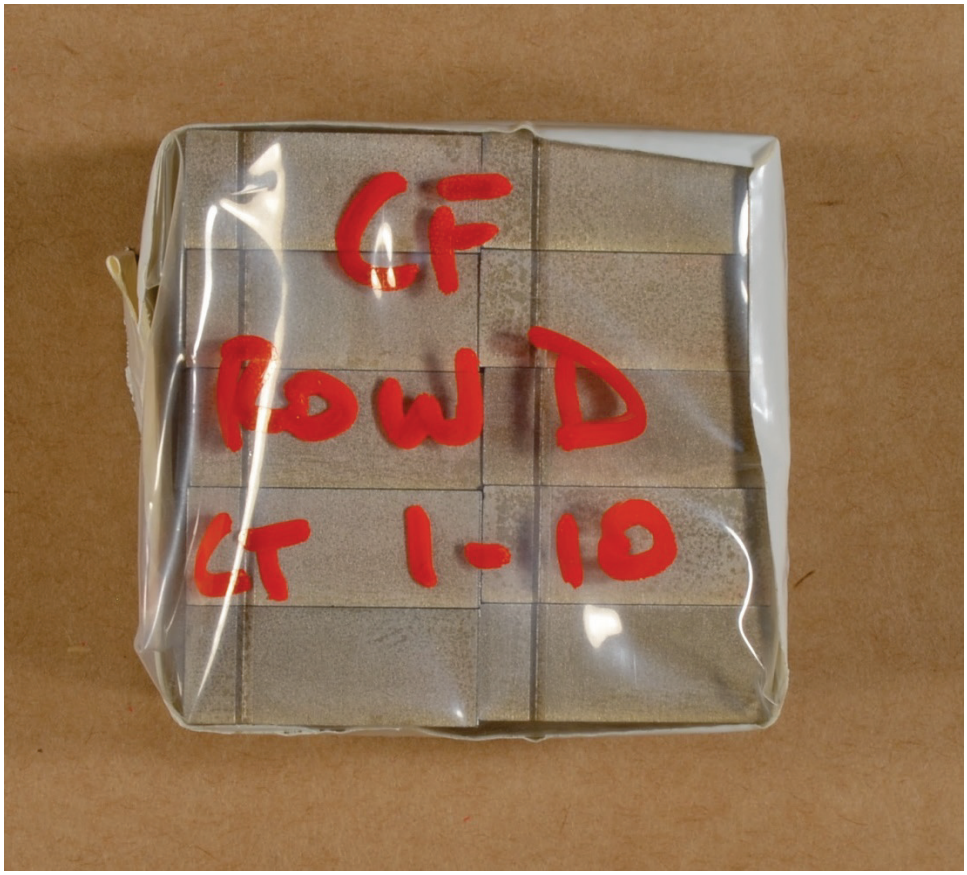
7.8.4 Dose Rates

During the packaging process, each row of specimens was measured for dose rate at 2". A packaged row of each type was photographed and is shown in Figure 54 and the dose rate information recorded in Table 7.8-4.

Table 7.8-4. Block CF Specimen Radiation Level.

CVN		0.4T Compact Tension	
Row ID – Bagged Groups	**Rad Level (mR/hr@2")**	**Row ID – Bagged Groups**	**Rad Level (mR/hr@2")**
FA	112	FB	75
FC	60	FD	32
FE	32	FF	19
FG	21	FH	13
FI	15	FJ	9
FK	12	FL	8
FM	10	FN	6
FO	10	FP	6
FQ	9		

(TOP)



(BOTTOM)

Figure 54. Typical packaging for all specimens machined from block CF. (TOP) CVN, SS-3, coupons, and mini-C(T)s from row A. (BOTTOM) 0.4T compact tension row D [17].

7.9 CHEMICAL COMPOSITION

Laser Ablation Inductively Coupled Plasma Mass spectroscopy (LA-ICP-MS) for silicon, phosphorus, chromium, manganese, nickel, copper, and molybdenum was performed on samples that were mounted and ground with 600 grit sand paper. The ablation was performed using an ESI NWR213 laser ablation system coupled with a Nu Instruments ATTOM, magnetic sector ICP-MS. The samples were analyzed by first removing the oxide layer with a cleaning pass, followed by an analytical pass. Both ablations were performed at laser settings of 45%, 10HZ, 40u spot size, and 2u/sec line speed. The ICP-MS method employed was a deflector scan method using 2500 resolution. The elements were bracketed by three NIST standards: SRM 1134, SRM 1271, and SRM1762. Before each analytical run, the standards were ablated and collected to build the regression calibration curves.

The results of the analyzed specimen from base metal block C2 are shown in Table 7.9-1. The copper content ranged from 0.11 to 0.15 wt%. The second analysis was on the weld metal in block CF. Those results are reported in Table 7.9-2. The copper content roughly tripled from the content found in the base metal, ranging from 0.27 to 0.37 wt%. Table 7.9-3 lists NIST Standard Reference Material (SRM)-chemical composition results for comparison [18,19,20].

7.9.1 Base Metal (C2)

Table 7.9-1. Block C2 – Base Metal – Chemical Composition Results.

CVN I.D.	Chemical Composition (wt%)						
	Si	P	Cr	Mn	Ni	Cu	Mo
2A15	0.29	0.007	0.11	1.36	0.44	0.12	0.44
2B01	0.22	0.006	0.13	1.34	0.50	0.13	0.48
2C15	0.26	0.008	0.10	1.31	0.46	0.11	0.46
2D01	0.25	0.006	0.10	1.48	0.51	0.13	0.47
2E15	0.21	0.016	0.10	1.34	0.53	0.14	0.47
2F01	0.24	0.008	0.10	1.26	0.52	0.13	0.48
2G15	0.24	0.008	0.10	1.27	0.46	0.11	0.47
2H01	0.26	0.009	0.11	1.52	0.54	0.14	0.51
2I15	0.22	0.006	0.09	1.28	0.49	0.12	0.47
2J01	0.24	0.009	0.09	1.32	0.48	0.11	0.46
2K15	0.30	0.010	0.12	1.39	0.58	0.16	0.53
2L01	0.25	0.008	0.12	1.42	0.56	0.15	0.58
2M15	0.29	0.010	0.10	1.41	0.51	0.12	0.51
2N01	0.30	0.012	0.13	1.31	0.50	0.13	0.44
2O15	0.21	0.006	0.09	1.46	0.50	0.12	0.46
2P01	0.25	0.009	0.10	1.34	0.51	0.12	0.54
2Q15	0.20	0.006	0.13	1.38	0.52	0.13	0.47

7.9.2 Weld Metal (CF)

Table 7.9-2. Block CF – Weld Metal – Chemical Composition Results.

CVN I.D.	Chemical Composition (wt%)						
	Si	P	Cr	Mn	Ni	Cu	Mo
FA03	0.66	0.017	0.10	1.59	0.58	0.37	0.41
FA22	0.68	0.018	0.10	1.42	0.55	0.34	0.43
FC01	0.59	0.016	0.08	1.35	0.53	0.34	0.34
FC22	0.64	0.016	0.09	1.59	0.58	0.37	0.38
FE01	0.66	0.018	0.08	1.49	0.57	0.34	0.37
FE22	0.58	0.015	0.07	1.47	0.48	0.27	0.34
FG01	0.63	0.016	0.08	1.43	0.50	0.33	0.33
FG22	0.57	0.019	0.07	1.51	0.54	0.32	0.35
FI01	0.58	0.017	0.06	1.57	0.51	0.28	0.34
FI22	0.68	0.017	0.10	1.62	0.54	0.32	0.39
FK01	0.68	0.019	0.10	1.49	0.54	0.35	0.39
FK22	0.69	0.020	0.09	1.66	0.55	0.33	0.39
FM01	0.63	0.019	0.06	1.65	0.57	0.37	0.38
FM22	0.67	0.020	0.06	1.66	0.59	0.35	0.38
FO01	0.70	0.015	0.10	1.34	0.52	0.36	0.38
FO22	0.61	0.017	0.07	1.47	0.51	0.35	0.37
FQ01	0.71	0.020	0.09	1.60	0.60	0.29	0.42
FQ22	0.59	0.018	0.06	1.47	0.55	0.27	0.32

7.9.3 Standards Verification

Table 7.9-3. NIST Standard Reference Material – Chemical Composition Results.

I.D.	Chemical Composition (wt%)							
	Si	P	Cr	Mn	Ni	Cu	Mo	
SRM 1134	2.89	0.028	0.02	0.28	0.04	0.07	0.01	Standard
	2.89	0.025	0.02	0.32	0.05	0.06	0.01	Run
SRM 1271	0.33	0.005	0.55	0.73	3.34	1.48	0.54	Standard
	0.36	0.006	0.55	0.68	3.34	1.48	0.54	Run
SRM 1762	0.35	0.035	0.92	1.91	1.16	0.12	0.35	Standard
	0.33	0.036	0.93	1.92	1.14	0.13	0.35	Run

Based on the NIST standards used to calibrate the BWXT ICP-MS instrument [18,19,20], the elemental measurements were within the standard value with a deviation of 0.04%.

7.10 WASTE

BWXT disposed of low-level Class A (non-hazardous) process waste (gloves, paper, and plastic) according to established company procedures. BWXT also disposed of EDM filters and resins, small pieces of vessel offal, and chips associated with machining.

The large remnant pieces of RPV material, shown throughout the report, will be stored at BWXT for at least one year, and until the need for disposal is reached. Cladding was placed in appropriate waste streams at conclusion of the project.

7.11 MACHINING SUMMARY

Summary tables of the original Zion Unit 1 RPV specimen plan and the actual specimens machined by BWXT are shown in Table 7.11-1 and Table 7.11-2. It should be noted that the higher number of specimens was primarily due to two separate issues. First, the mini C(T) specimens were added to the plan to compensate for the damaged / non-conforming 0.5 C(T) specimens resulting from machining issues. Second, the through-wall chemical composition data was intended to be performed on one microstructural coupon from each of the 25 Charpy blocks obtained on alternating rows (through-wall) and maximum and minimum fluence locations (circumferential direction) of the C2 and CF blocks. However, to reduce shipping costs, the characterization was added to the BWXT contract in March 2017, and BWXT suggested using the offal or scrap from the Charpy block used for machining tensile and microstructural coupon specimen.

Table 7.11-1. Original Machined Specimens Plan.

Type	F3	F4	C2	CF	TOTAL
CVN	-	-	239	180	419
Microstructural (MS)	-	-	64	72	136
SS-3	-	-	128	142	272
Chemical Composition (CC)	-	-	--	--	--
0.4T	-	-	-	80	80
0.5T	56	56	-	-	112
mini-C(T)	0	0	-	0	0
PER BLOCK	56	56	431	474	**1017**

Table 7.11-2. Actual Machined Specimens.

Type	F3	F4	C2	CF	TOTAL
CVN	-	-	245	174	419
Microstructural (MS)	-	-	68	72	140
SS-3	-	-	134	142	276
Chemical Composition (CC)	-	-	17	18	35
0.4T	-	-	-	77	77
0.5T	48	56	-	-	102
mini-C(T)	28	20	-	9	57
PER BLOCK	76	74	464	492	**1106**

8. SUMMARY AND CONCLUSIONS

This report documents Phase 3 of the Zion RPV Harvesting Project: the machining of through-wall mechanical specimens (compact tension, tensile, Charpy V-notch), microstructural coupons for transmission electron microscopy, atom probe tomography, small angle neutron scattering, small angle x-ray scattering, and micro hardness, and chemical analysis specimens from the well-characterized beltline

weld [10 – 12] and base metal [13, 14] of the Zion Unit 1 RPV at BWXT, Lynchburg, VA. It also summarizes Phase 1 (harvested segments of the Zion Unit 1 RPV) and Phase 2 (cutting blocks from the Zion Unit 1 RPV ORNL Beltline Weld Segment 1) accomplishments.

This project is critically important because access to materials from active or decommissioned NPPs provide an invaluable resource for which there is limited operational data or experience to inform relicensing decisions and assessments of current degradation models to further develop the scientific basis for understanding and predicting long-term environmental degradation behavior and, therefore, a sound basis for informed aging management.

Specifically, data from RPV surveillance specimens containing similar WF-70 weld materials are available in the literature for a comparison of hardening and changes in fracture toughness and microstructure [10-12]. Similarly, data from surveillance specimens containing B7835-1 base metal plate material are available for a comparison of hardening and changes in fracture toughness [14]. Access to service-irradiated RPV welds and plate sections will allow through-wall attenuation studies to be performed, which will be used to assess current radiation damage models [4,5,6] and validate codes and standards.

9. REFERENCES

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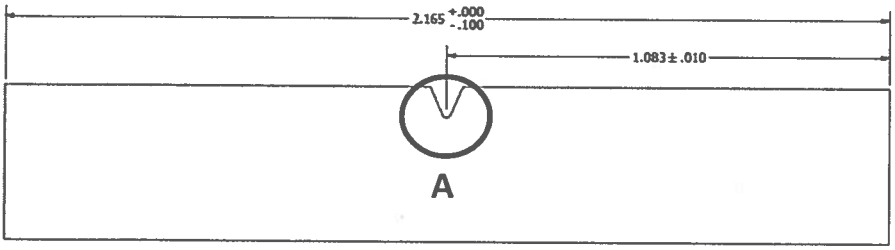
14. Figure provided by B. Burgos, (2012). Westinghouse Electric Company
15. Figures provided by Energy Solutions
16. Figure provided by B. Hall, Westinghouse Electric Company, 2013
17. Figure provided by C. Campbell, BWXT, 2016, 2017, 2018.
18. NIST, Standard Reference Material (SRM) 1134, Low-Alloy, High-Silicon Steel
19. NIST, Standard Reference Material (SRM) 1271, Low-Alloy Steel, (Ni-Cr-Cu-Mo) (HSLA 100)
20. NIST, Standard Reference Material (SRM) 1762a, Low-Alloy Steel

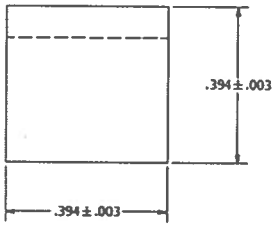
APPENDIX A. SPECIMEN QUALITY ASSURANCE MEASUREMENTS

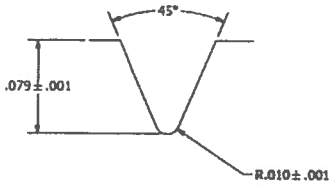
Appendix A: Specimen QA

Block C2

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2A01	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2A02	2.156	1.076	0.394	0.393	0.078	45.0°	0.010
2A03	2.156	1.076	0.394	0.393	0.078	45.0°	0.010
2A04	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2A05	2.157	1.077	0.393	0.393	0.078	45.0°	0.010
2A06	2.157	1.077	0.393	0.393	0.078	45.0°	0.010
2A07	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2A08	2.156	1.076	0.394	0.394	0.078	45.0°	0.010
2A09	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2A10	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2A11	2.157	1.077	0.393	0.393	0.078	45.0°	0.010
2A12	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2A13	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2A14	2.156	1.076	0.393	0.393	0.078	45.0°	0.010

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

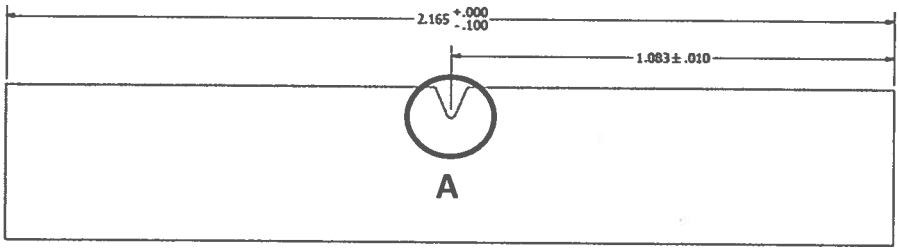
Cal Date: 5-24-17 Cal Date: 5-24-17

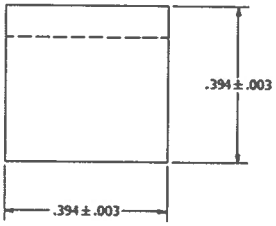
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-3-17

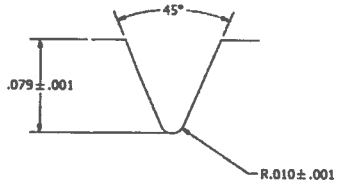
DIGITAL MIC 0-6" MITUTOYO

OPTICAL COMPARATOR CHERIC - TUMICO

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2B02	2.156	1.076	0.394	0.393	0.078	45.0°	0.010
2B03	2.157	1.077	0.393	0.393	0.078	45.0°	0.010
2B04	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2B05	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2B06	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2B07	2.156	1.076	0.394	0.393	0.078	45.0°	0.010
~~2B08~~ 2B08	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2B09	2.157	1.077	0.393	0.393	0.078	45.0°	0.010
2B10	2.157	1.077	0.394	0.393	0.078	45.0°	0.010
2B11	2.156	1.076	0.394	0.393	0.078	45.0°	0.010
2B12	2.157	1.077	0.393	0.393	0.078	45.0°	0.010
2B13	2.157	1.077	0.393	0.393	0.078	45.0°	0.010
~~2B14~~ 2B16 TO	2.157	1.077	0.393	0.393	0.078	45.0°	0.010
2B15	2.157	1.077	0.394	0.393	0.078	45.0°	0.010

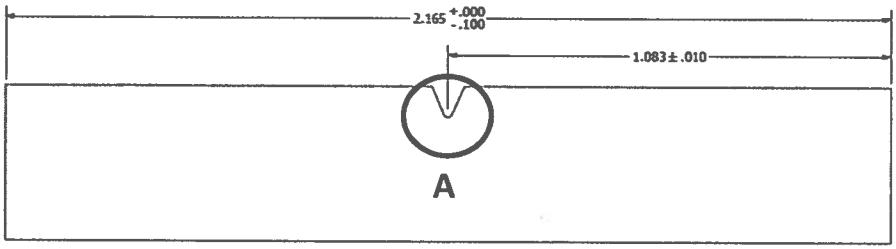
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

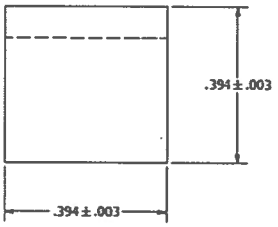
Cal Date: 5-24-17 Cal Date: 5-24-17

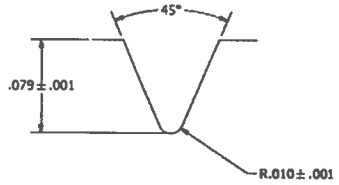
Due Date: 5-24-18 Due Date: 5-24-18 Date: 6-3-17

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2C02	2.157	1.077	0.394	0.393	0.078	45.0°	0.010
2C03	2.157	1.077	0.393	0.393	0.078	45.0°	0.010
2C04	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2C05	2.156	1.076	0.394	0.393	0.078	45.0°	0.010
2C06	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2C07	2.156	1.076	0.394	0.394	0.078	45.0°	0.010
2C08	2.156	1.076	0.393	0.394	0.078	45.0°	0.010
2C09	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2C10	2.157	1.077	0.393	0.393	0.078	45.0°	0.010
2C11	2.156	1.076	0.394	0.393	0.078	45.0°	0.010
2C12	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2C13	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2C14	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2C01	2.156	1.076	0.393	0.393	0.078	45.0°	0.010

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. CROOM

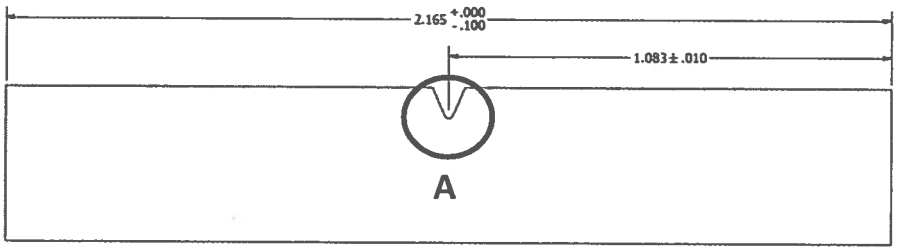
Cal Date: 5-24-17 Cal Date: 5-24-17

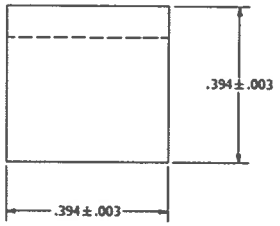
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-3-17

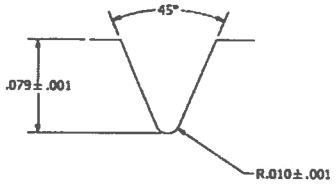
DIGITAL MIC OPTICAL COMPARATOR

0-6" MITUTOYO

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

*- SPECIMEN NOTCHED RESULTING IN TWO DIFFERENT WIDTH MEASUREMENTS.

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2D02	2.157	1.077	.394/.394 *	0.393	0.079	45.0°	R.010
2D03	2.157	1.077	0.393	0.393	0.079	45.0°	0.010
2D04	2.157	1.077	0.393	0.393	0.079	45.0°	0.010
2D05	2.156	1.076	0.393	0.393	0.079	45.0°	0.010
2D06	2.157	1.077	0.393	0.393	0.079	45.0°	0.010
2D07	2.157	1.077	0.393	0.393	0.079	45.0°	0.010
2D08	2.156	1.076	0.393	0.393	0.079	45.0°	0.010
2D09	2.156	1.076	0.395	0.393	0.079	45.0°	0.010
2D10	2.156	1.076	0.395	0.393	0.079	45.0°	0.010
2D11	2.157	1.076	0.393	0.393	0.079	45.0°	0.010
2D12	2.156	1.076	0.393	0.393	0.079	45.0°	0.010
2D13	2.156	1.076	0.393	0.393	0.079	45.0°	0.010
2D14	2.156	1.076	0.393	0.393	0.079	45.0°	0.010
2D15	2.157	1.077	0.393	0.393	0.079	45.0°	0.010
2D16	2.157	1.077	0.394	0.394	0.078	45.0°	0.010

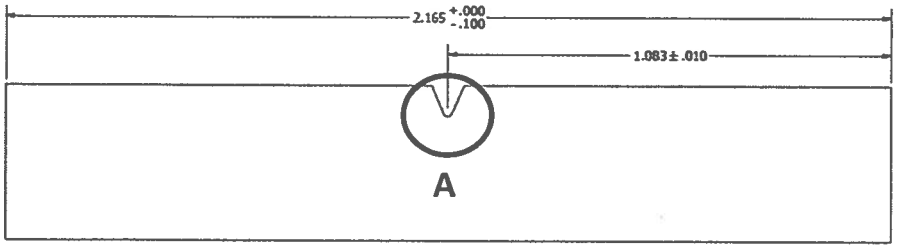
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

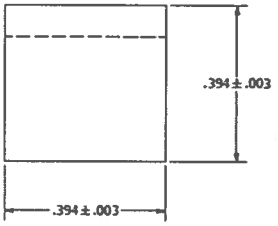
Cal Date: 5-24-17 Cal Date: 5-24-17

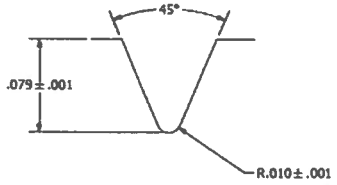
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-3-17

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2E01	2.156	1.076	0.394	0.394	0.080	45.0°	0.010
2E02	2.156	1.076	0.394	0.394	0.080	45.0°	0.010
2E03	2.157	1.077	0.395	0.394	0.080	45.0°	0.010
2E04	2.157	1.077	0.393	0.394	0.080	45.0°	0.010
2E05	2.157	1.077	0.394	0.394	0.080	45.0°	0.010
2E06	2.157	1.077	0.394	0.393	0.080	45.0°	0.010
2E07	2.156	1.076	0.394	0.394	0.080	45.0°	0.010
2E08	2.157	1.077	0.394	0.394	0.080	45.0°	0.010
2E09	2.156	1.076	0.393	0.393	0.080	45.0°	0.010
2E10	2.157	1.077	0.393	0.394	0.080	45.0°	0.010
2E11	2.157	1.077	0.394	0.394	0.080	45.0°	0.010
2E12	2.157	1.077	0.394	0.394	0.080	45.0°	0.010
2E13	2.157	1.077	0.394	0.394	0.080	45.0°	0.010
2E14	2.157	1.077	0.394	0.394	0.080	45.0°	0.010

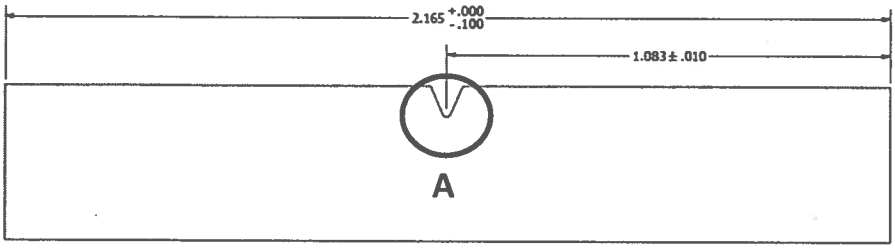
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

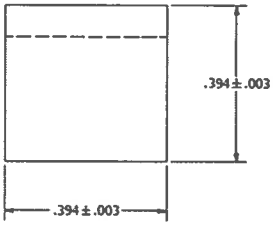
Cal Date: 5-24-17 Cal Date: 5-24-17

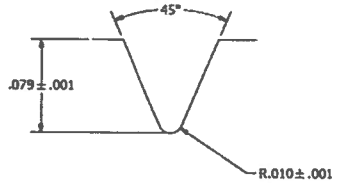
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-3-17

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2F02	2.155	1.075	0.393	0.393	0.080	45.0°	0.010
2F03	2.155	1.075	0.393	0.393	0.080	45.0°	0.010
2F04	2.155	1.075	0.393	0.393	0.080	45.0°	0.010
2F05	2.155	1.075	0.393	0.393	0.080	45.0°	0.010
2F06	2.155	1.075	0.393	0.393	0.080	45.0°	0.010
2F07	2.155	1.075	0.394	0.393	0.080	45.0°	0.010
2F08	2.155	1.075	0.393	0.393	0.080	45.0°	0.010
2F09	2.155	1.075	0.395	0.393	0.080	45.0°	0.010
2F10	2.155	1.075	0.394	0.394	0.080	45.0°	0.010
2F11	2.155	1.075	0.393	0.393	0.080	45.0°	0.010
2F12	2.155	1.075	0.394	0.394	0.080	45.0°	0.010
2F13	2.155	1.075	0.393	0.393	0.080	45.0°	0.010
2F14	2.155	1.075	0.393	0.394	0.080	45.0°	0.010
2F15	2.155	1.075	0.393	0.393	0.080	45.0°	0.010

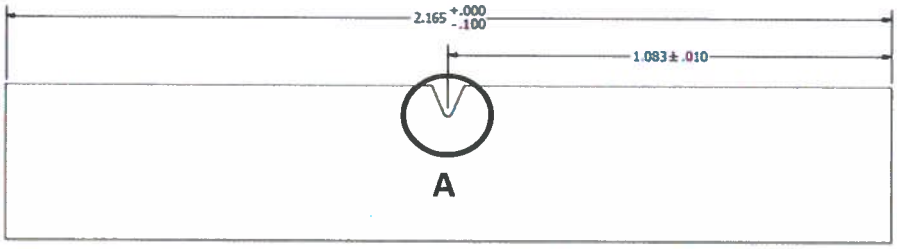
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Gibson

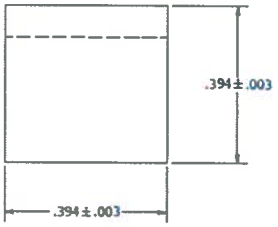
Cal Date: 5-24-17 Cal Date: 5-24-17

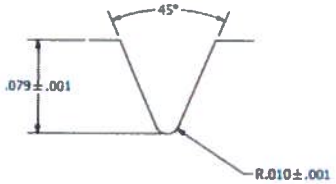
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-3-17

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2601	2.157	1.077	0.394	0.393	0.080	45.0°	0.010
2602	2.157	1.077	0.393	0.394	0.080	45.0°	0.010
2603	2.156	1.076	0.393	0.393	0.080	45.0°	0.010
2604	2.156	1.076	0.394	0.394	0.080	45.0°	0.010
2605	2.157	1.077	0.393	0.394	0.080	45.0°	0.010
2606	2.157	1.077	0.393	0.393	0.080	45.0°	0.010
2607	2.158	1.078	0.394	0.394	0.080	45.0°	0.010
2608	2.157	1.077	0.394	0.394	0.080	45.0°	0.010
2609	2.156	1.076	0.394	0.394	0.080	45.0°	0.010
2610	2.156	1.076	0.393	0.394	0.080	45.0°	0.010
2611	2.157	1.077	0.394	0.394	0.080	45.0°	0.010
2612	2.157	1.077	0.393	0.393	0.080	45.0°	0.010
2613	2.157	1.077	0.394	0.394	0.080	45.0°	0.010
2614	2.157	1.077	0.393	0.394	0.080	45.0°	0.010

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. CROOM

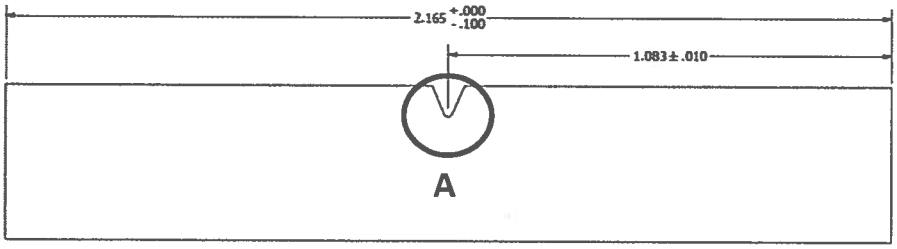
Cal Date: 5-24-17 Cal Date: 5-24-17

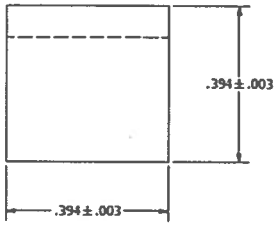
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-3-17

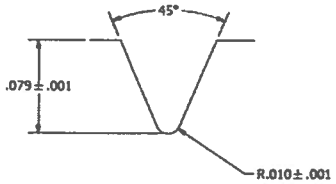
DIGITAL MIC OPTICAL COMPARATOR

0-6" MITUTOYO

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

★ - MEASUREMENT OUT OF TOLERANCE

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2H02	2.157	1.077	0.381★	0.394	0.080	45.0°	0.010
2H03	2.158	1.078	0.382★	0.392	0.080	45.0°	0.010
2H04	2.157	1.077	0.381★	0.394	0.080	45.0°	0.010
2H05	2.156	1.076	0.382★	0.393	0.080	45.0°	0.010
2H06	2.156	1.076	0.382★	0.391	0.080	45.0°	0.010
2H07	2.157	1.077	0.381★	0.394	0.080	45.0°	0.010
2H08	2.157	1.077	0.382★	0.394	0.080	45.0°	0.010
2H09	2.157	1.077	0.381★	0.393	0.080	45.0°	0.010
2H10	2.156	1.076	0.381★	0.392	0.080	45.0°	0.010
2H11	2.157	1.077	0.382★	0.394	0.080	45.0°	0.010
2H12	2.158	1.078	0.381★	0.394	0.080	45.0°	0.010
2H13	2.156	1.076	0.381★	0.393	0.080	45.0°	0.010
2H14	2.156	1.076	0.381★	0.394	0.080	45.0°	0.010
2H15	2.157	1.077	0.381★	0.394	0.080	45.0°	0.010

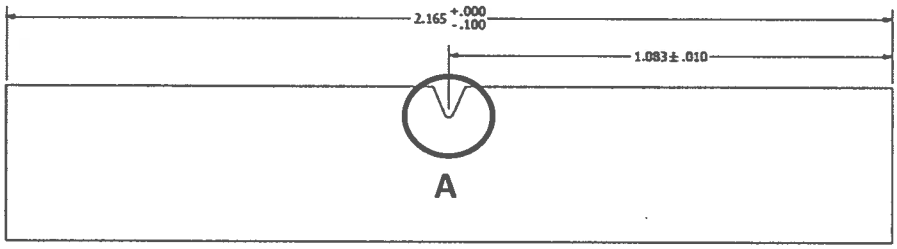
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

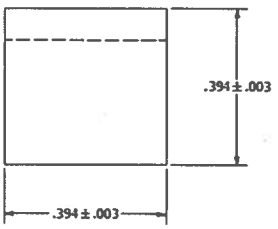
Cal Date: 5-24-17 Cal Date: 5-24-17

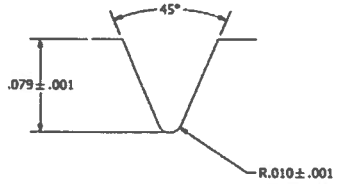
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-2-17

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2I01	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2I02	2.156	1.076	0.393	0.394	0.079	45.0°	0.010
2I03	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2I04	2.155	1.075	0.393	0.393	0.079	45.0°	0.010
2I05	2.157	1.077	0.394	0.394	0.079	45.0°	0.010
2I06	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2I07	2.157	1.077	0.393	0.394	0.079	45.0°	0.010
2I08	2.156	1.076	0.394	0.393	0.079	45.0°	0.010
2I09	2.157	1.077	0.393	0.393	0.079	45.0°	0.010
2I10	2.157	1.077	0.394	0.394	0.079	45.0°	0.010
2I11	2.157	1.077	0.394	0.394	0.079	45.0°	0.010
2I12	2.156	1.076	0.393	0.394	0.079	45.0°	0.010
2I13	2.156	1.076	0.393	0.394	0.079	45.0°	0.010
2I14	2.156	1.076	0.394	0.394	0.079	45.0°	0.010

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

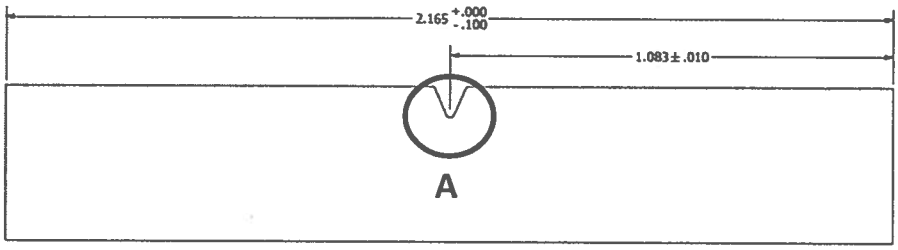
Cal Date: 5-24-17 Cal Date: 5-24-17

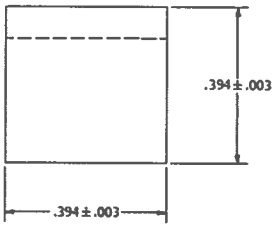
Due Date: 5-24-18 Due Date: 5-24-18 Date: 6-2-17

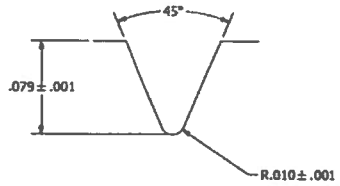
DIGITAL MIC 0-6" MITUTOYO

OPTICAL COMPARATOR SCHERR - TUMICO

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2J02	2.157	1.077	0.394	0.394	0.080	45.0°	0.010
2J03	2.157	1.077	0.393	0.393	0.080	45.0°	0.010
2J04	2.157	1.077	0.394	0.394	0.080	45.0°	0.010
2J05	2.156	1.076	0.394	0.394	0.080	45.0°	0.010
2J06	2.157	1.077	0.393	0.393	0.080	45.0°	0.010
2J07	2.156	1.076	0.394	0.393	0.080	45.0°	0.010
2J08	2.156	1.076	0.394	0.394	0.080	45.0°	0.010
2J09	2.158	1.078	0.391	0.393	0.080	45.0°	0.010
2J10	2.156	1.076	0.394	0.394	0.080	45.0°	0.010
2J11	2.156	1.076	0.393	0.394	0.080	45.0°	0.010
2J12	2.156	1.076	0.394	0.394	0.080	45.0°	0.010
2J13	2.157	1.077	0.394	0.393	0.080	45.0°	0.010
2J14	2.157	1.077	0.394	0.394	0.080	45.0°	0.010
2J15	2.156	1.076	0.394	0.393	0.080	45.0°	0.010

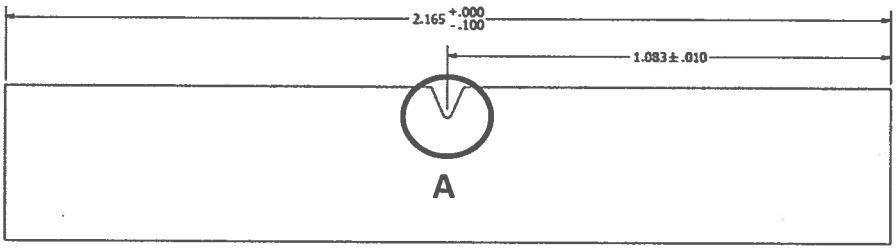
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Cream

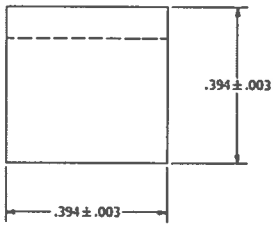
Cal Date: 5-24-17 Cal Date: 5-24-17

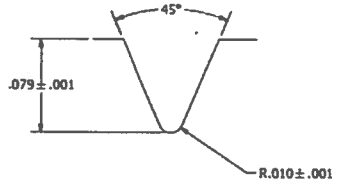
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-2-17

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2K01	2.155	1.075	0.391	0.393	0.080	45.0°	0.010
2K02	2.156	1.076	0.392	0.393	0.080	45.0°	0.010
2K03	2.155	1.075	0.391	0.392	0.080	45.0°	0.010
2K04	2.155	1.075	0.391	0.392	0.080	45.0°	0.010
2K05	2.156	1.076	0.393	0.393	0.080	45.0°	0.010
2K06	2.157	1.077	0.393	0.392	0.080	45.0°	0.010
2K07	2.156	1.076	0.391	0.391	0.080	45.0°	0.010
2K08	2.156	1.076	0.391	0.391	0.080	45.0°	0.010
2K09	2.157	1.077	0.392	0.392	0.080	45.0°	0.010
2K10	2.156	1.076	0.392	0.392	0.080	45.0°	0.010
2K11	2.156	1.076	0.391	0.391	0.080	45.0°	0.010
2K12	2.156	1.076	0.392	0.392	0.080	45.0°	0.010
2K13	2.156	1.076	0.391	0.391	0.080	45.0°	0.010
2K14	2.156	1.076	0.392	0.392	0.080	45.0°	0.010

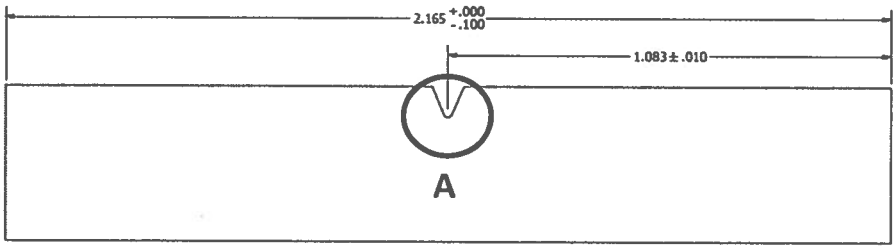
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

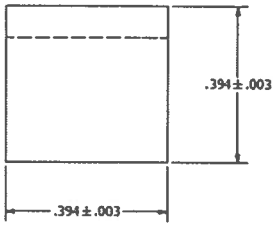
Cal Date: 5-24-17 Cal Date: 5-24-17

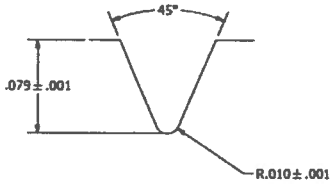
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-2-17

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2L02	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2L03	2.156	~~1.0~~ 1.076	0.393	0.394	0.079	45.0°	0.010
2L04	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2L05	2.156	1.076	0.393	0.394	0.079	45.0°	0.010
2L06	2.157	1.077	0.394	0.394	0.079	45.0°	0.010
2L07	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2L08	2.158	1.078	0.393	0.393	0.079	45.0°	0.010
2L09	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2L10	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2L11	2.156	1.076	0.394	0.394	0.080	45.0°	0.010
2L12	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2L13	2.157	1.077	0.394	0.394	0.079	45.0°	0.010
2L14	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2L15	2.156	1.076	0.394	0.394	0.079	45.0°	0.010

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

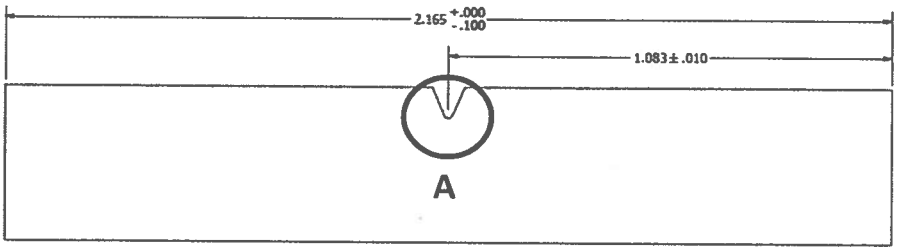
Cal Date: 5-24-17 Cal Date: 5-24-17

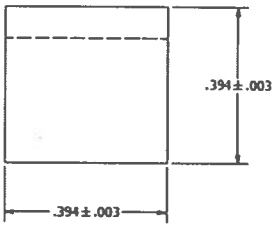
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-2-17

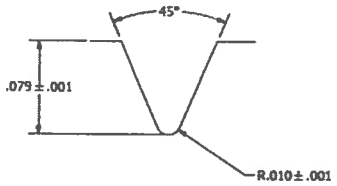
DIGITAL MIC 0-6" MITUTOYO

OPTICAL COMPARATOR SCHUTTER TUMICA

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2M01	2.156	1.076	0.394	0.393	0.079	45.0°	0.010
2M02	2.157	1.077	0.394	0.393	0.079	45.0°	0.010
2M03	2.158	1.078	0.394	0.394	0.079	45.0°	0.010
2M04	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2M05	2.156	1.076	0.393	0.393	0.079	45.0°	0.010
2M06	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2M07	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2M08	2.156	1.076	0.394	0.393	0.079	45.0°	0.010
2M09	2.158	1.078	0.394	0.394	0.079	45.0°	0.010
2M10	2.158	1.078	0.393	0.393	0.079	45.0°	0.010
2M11	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2M12	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2M13	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
2M14	2.156	1.076	0.394	0.394	0.079	45.0°	0.010
~~2M15~~							

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Circom

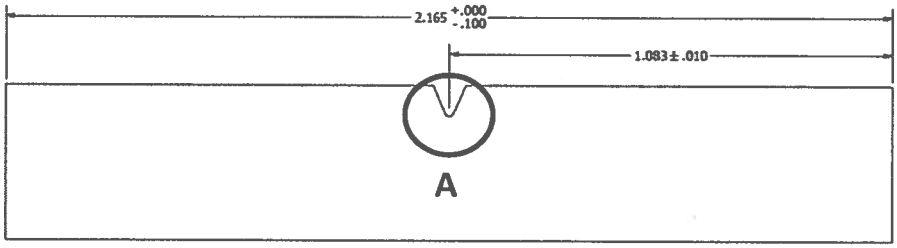
Cal Date: 5-24-17 Cal Date: 5-24-17

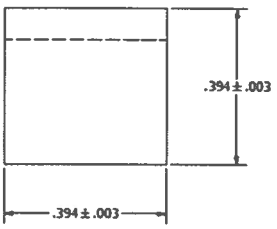
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-2-17

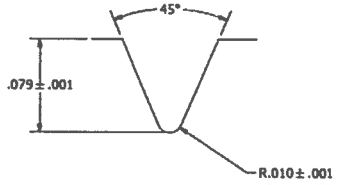
DIGITAL MIC

OPTICAL COMPARATOR SCHERR-TUMICO

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2N01							
2N02	2.157	1.076	0.393	0.393	0.079	45.0°	0.010
2N03	2.157	1.076	0.393	0.393	0.079	45.0°	0.010
2N04	2.157	1.076	0.393	0.393	0.079	45.0°	0.010
2N05	2.156	1.076	0.393	0.393	0.078	45.0°	0.010
2N06	2.158	1.077	0.393	0.393	0.078	45.0°	0.010
2N07	2.158	1.076	0.393	0.394	0.078	45.0°	0.010
2N08	2.155	1.077	0.393	0.394	0.078	45.0°	0.010
2N09	2.160	1.077	0.394	0.394	0.078	45.0°	0.010
2N10	2.158	1.076	0.393	0.394	0.078	45.0°	0.010
2N11	2.157	1.076	0.393	0.393	0.078	45.0°	0.010
2N12	2.159	1.077	0.393	0.394	0.078	45.0°	0.010
2N13	2.159	1.077	0.394	0.394	0.078	45.0°	0.010
2N14	2.158	1.076	0.393	0.393	0.078	45.0°	0.010
2N15	2.157	1.076	0.393	0.394	0.078	45.0°	0.010

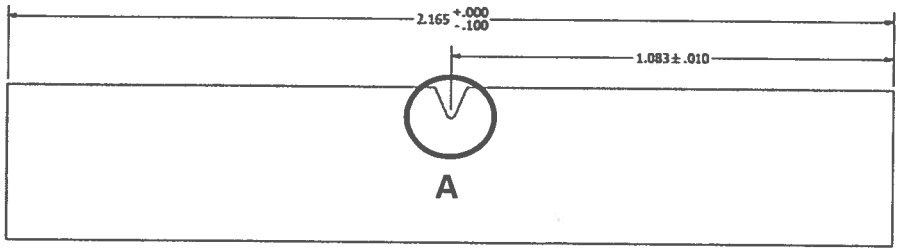
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

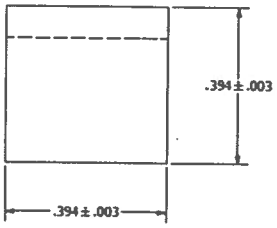
Cal Date: 5-24-17 Cal Date: 5-24-17

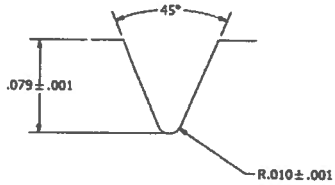
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-2-17

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2001	2.157	1.076	0.393	0.397	0.080	45.0°	0.010
2002	2.158	1.077	0.394	0.394	0.080	45.0°	0.010
2003	2.158	1.077	0.393	0.394	0.080	45.0°	0.010
2004	2.158	1.077	0.394	0.394	0.080	45.0°	0.010
2005	2.157	1.076	0.394	0.394	0.080	45.0°	0.010
2006	2.158	1.077	0.393	0.393	0.080	45.0°	0.010
2007	2.158	1.077	0.393	0.393	0.080	45.0°	0.010
2008	2.158	1.077	0.393	0.394	0.080	45.0°	0.010
2009	2.157	1.076	0.393	0.394	0.080	45.0°	0.010
2010	2.158	1.076	0.394	0.394	0.080	45.0°	0.010
2011	2.157	1.076	0.394	0.394	0.080	45.0°	0.010
2012	2.157	1.076	0.393	0.393	0.080	45.0°	0.010
2013	2.157	1.076	0.394	0.394	0.080	45.0°	0.010
2014	2.158	1.077	0.394	0.394	0.080	45.0°	0.010

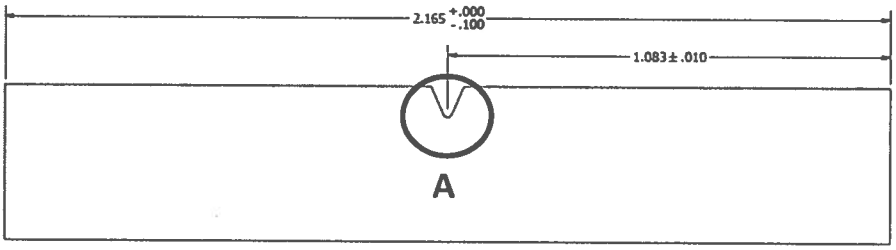
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

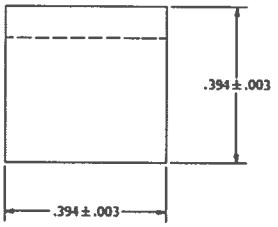
Cal Date: 5-24-17 Cal Date: 5-24-17

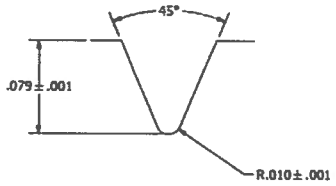
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-2-17

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2P02	2.158	1.078	0.394	0.394	0.078	45.0°	0.010
2P03	2.158	1.078	0.394	0.394	0.078	45.0°	0.010
2P04	2.158	1.078	0.394	0.394	0.078	45.0°	0.010
2P05	2.158	1.078	0.394	0.394	0.078	45.0°	0.010
2P06	2.158	1.078	0.394	0.394	0.078	45.0°	0.010
2P07	2.158	1.078	0.394	0.394	0.078	45.0°	0.010
2P08	2.158	1.078	0.394	0.394	0.078	45.0°	0.010
2P09	2.158	1.078	0.394	0.394	0.078	45.0°	0.010
2P10	2.158	1.078	0.394	0.394	0.078	45.0°	0.010
2P11	2.158	1.078	0.394	0.394	0.078	45.0°	0.010
2P12	2.158	1.078	0.394	0.394	0.078	45.0°	0.010
2P13	2.158	1.078	0.394	0.394	0.078	45.0°	0.010
2P14	2.158	1.078	0.394	0.394	0.078	45.0°	0.010
2P16	2.158	1.078	0.394	0.394	0.078	45.0°	0.010

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Edson

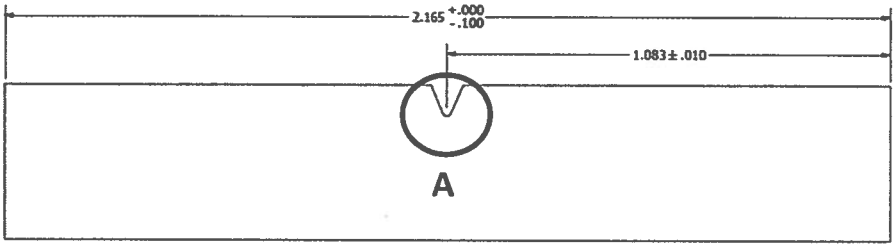
Cal Date: 5-24-17 Cal Date: 5-24-17

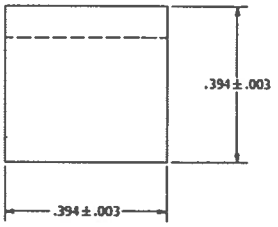
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-16-17

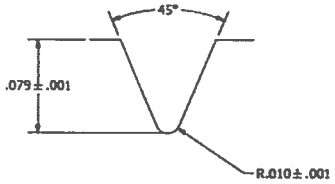
DIGITAL MIC 0-6" micrometer

OPTICAL COMPARATOR Schedd - Tumico

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

* - WIDTH OUT OF TOLERANCE PER SPECIFICATION

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
ZQ01	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010
ZQ02	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010
ZQ03	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010
ZQ04	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010
ZQ05	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010
ZQ06	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010
ZQ07	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010
ZQ08	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010
ZQ09	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010
ZQ10	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010
ZQ11	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010
ZQ12	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010
ZQ13	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010
ZQ14	2.158	1.078	0.386*	0.394	0.079	45.0°	0.010

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Crowe

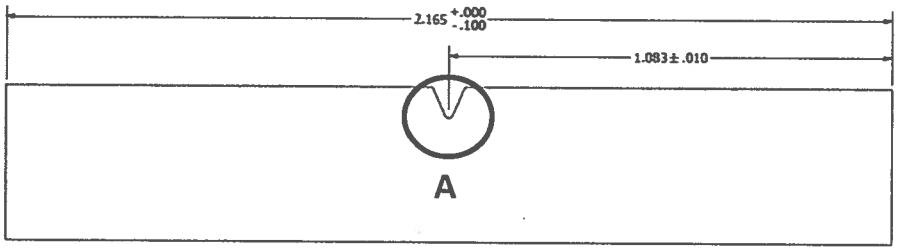
Cal Date: 5-24-17 Cal Date: 5-24-17

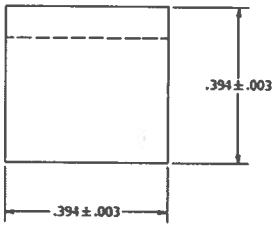
Due Date: 5-24-18 Due Date: 5-24-18 Date: 8-16-17

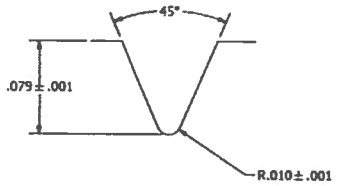
DIGITAL MIC 0-6" MITUTOYO

OPTICAL COMPARATOR SCHERR-TUMICO

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

★ - HEIGHT OUT OF SPECIFICATION DUE TO SPECIMEN BEING NOTCHED

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
2R01	2.158	1.078	0.395	0.395	0.080	45.0°	0.010
2R02	2.158	1.078	0.395	0.395	0.080	45.0°	0.010
2R03	2.158	1.078	0.395	0.395	0.080	45.0°	0.010
2R04	2.158	1.078	0.395	0.395	0.080	45.0°	0.010
2R05	2.158	1.078	0.395	0.395	0.080	45.0°	0.010
2R06 ★	2.158	1.078	0.395	0.395 ★	0.080	45.0°	0.010
2R07	2.158	1.078	0.395	0.395	0.080	45.0°	0.010
2R08	2.158	1.078	0.395	0.395	0.080	45.0°	0.010
2R09	2.158	1.078	0.395	0.395	0.080	45.0°	0.010
2R10	2.158	1.078	0.395	0.395	0.080	45.0°	0.010
2R11	2.158	1.078	0.395	0.395	0.080	45.0°	0.010
2R12	2.158	1.078	0.395	0.395	0.080	45.0°	0.010
2R13	2.158	1.078	0.395	0.395	0.080	45.0°	0.010
2R14	2.158	1.078	0.395	0.395	0.080	45.0°	0.010
2R15	2.158	1.078	0.395	0.395	0.080	45.0°	0.010

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Crowder

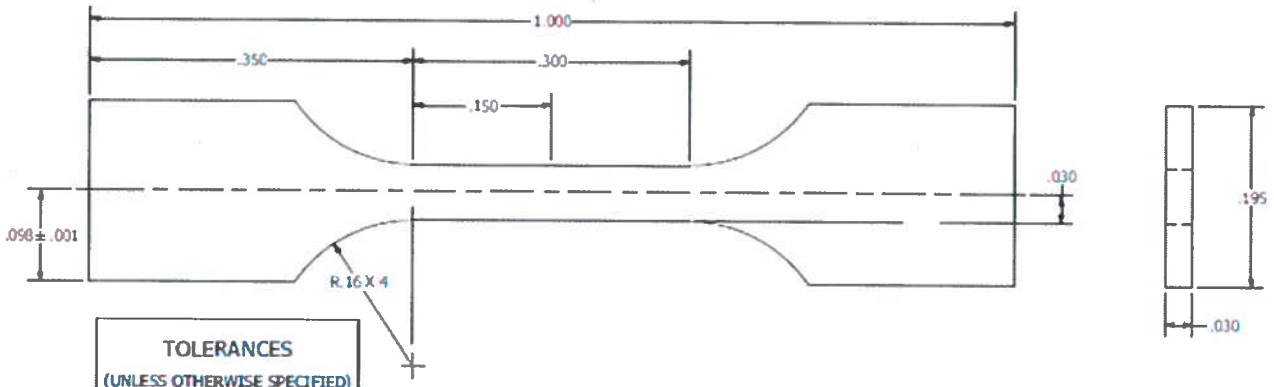
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 6-16-17

DIGITAL MIC 0-6" MITUTOYO

OPTICAL COMPARATOR SCHUZ - TUMICO

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

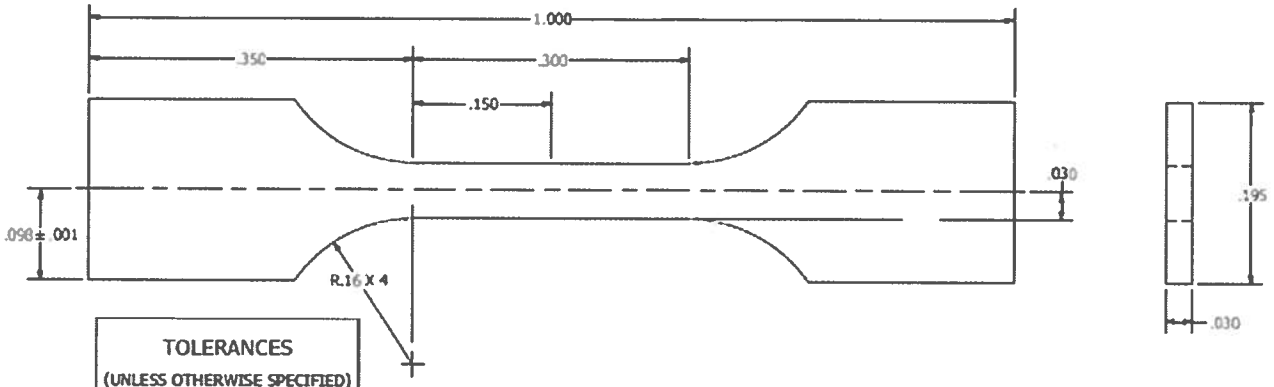
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2A 15 1	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
2	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
3	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
4	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
5	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
6	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
7	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
8	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR - TUMICO

Inspector: T. Cizdem
Date: 8-16-17

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

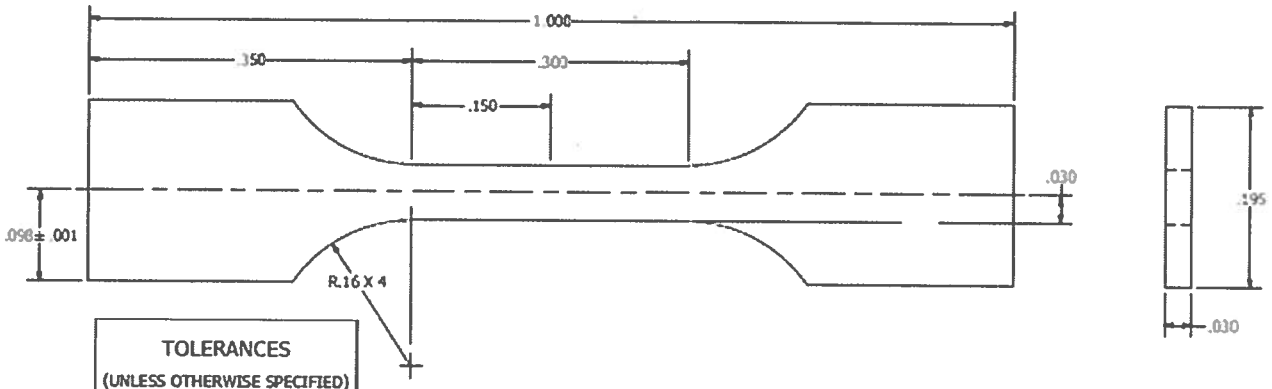
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2B01 1	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
2	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
3	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
4	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
5	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
6	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
7	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
8	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR - TUMICO

Inspector: T. Croom
Date: 8-16-17

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

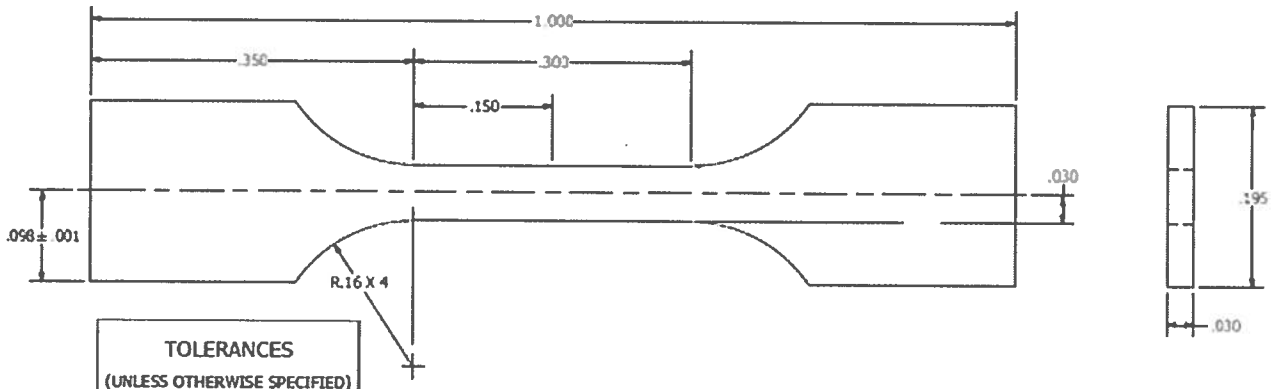
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2C15 - 1	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
2	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
3	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
4	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
5	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
6	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
7	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
8	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR-TUMICO

Inspector: T. Croom
Date: 8-14-17

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

NOTE (1) - SPECIMEN FAILED QA DUE TO MACHINING ANOMALY

Key: TH = Thickness GL = Gage Length

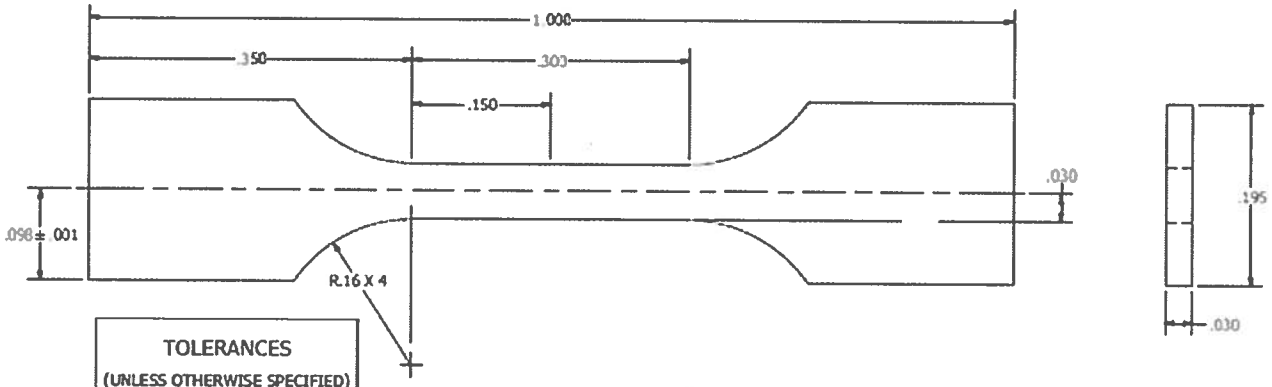
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2D01 1	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
2	1.00	0.197	~~0.30~~ 0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
3	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
4	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
5	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
6	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
7	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
8	NOTE (1)	NOTE (1)	NOTE (1)	NOTE (1)	NOTE (1)	NOTE (1)	NOTE (1)	NOTE (1)

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC 0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR SCHARR - TUMICO

Inspector: T. Croom
Date: 8-17-17

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

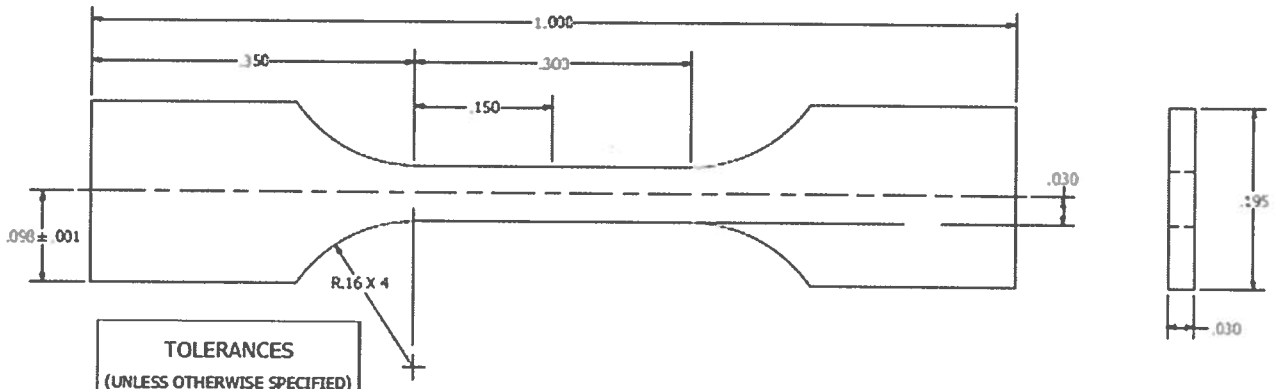
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2E15 1	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
2	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
3	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
4	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
5	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
6	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
7	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
8	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR-TUMICO

Inspector: T. Cason
Date: 8-16-17

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

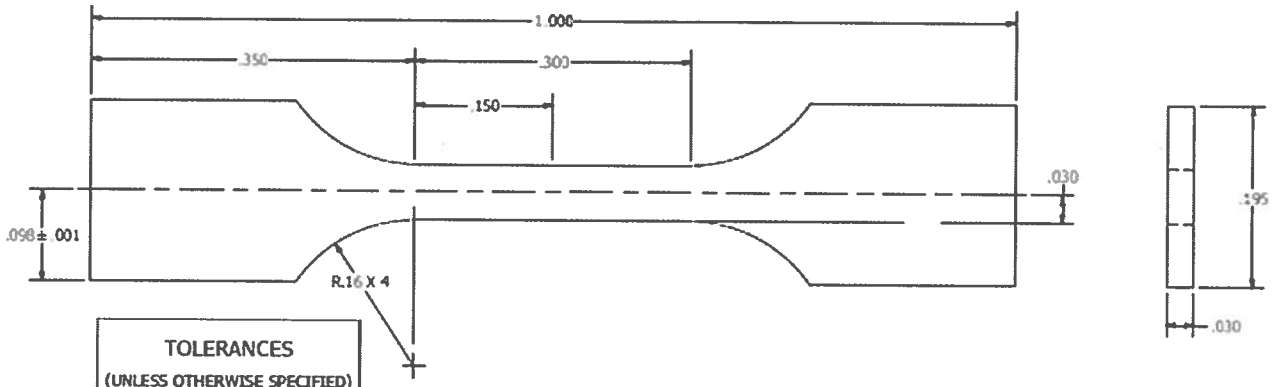
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2F01 - 1	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
2	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
3	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
4	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
5	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
6	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
7	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
8	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR - TUMICO

Inspector: T. CROOM
Date: 8-14-17

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

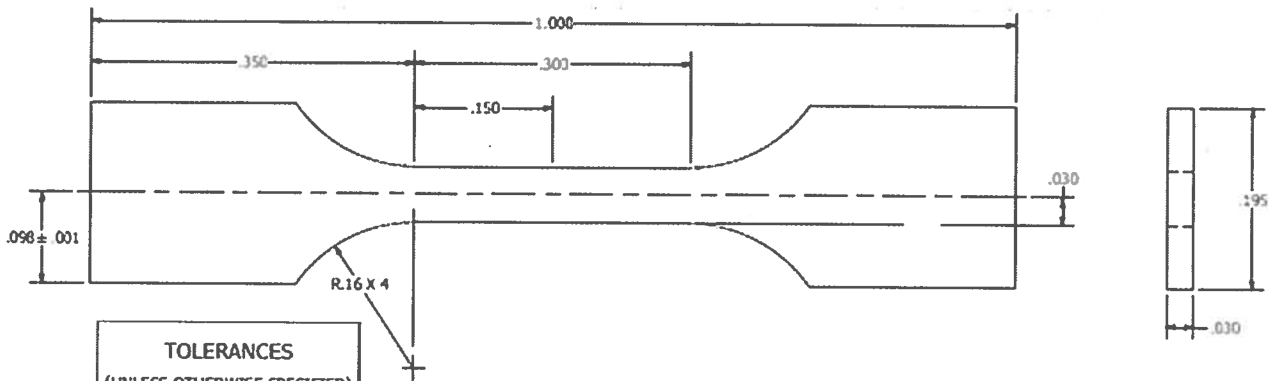
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2615 1	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
2	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
3	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
4	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
5	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
6	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
7	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
8	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR - TUMICO

Inspector: T. Elsom
Date: 8-14-17

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2H01 1	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
2	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
3	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
4	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
5	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
6	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
7	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
8	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030

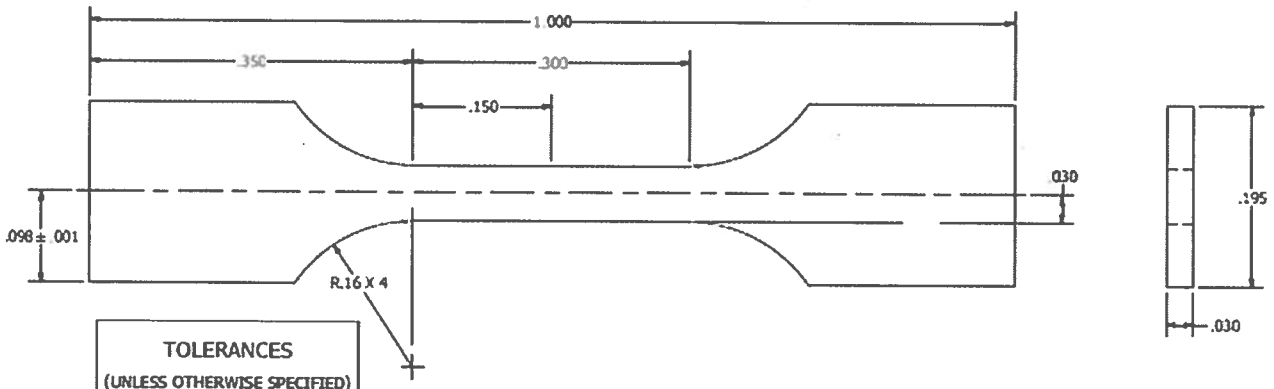
Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR-TUMICO

Inspector: [signature] T. [illegible]

Date: 8-17-17

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

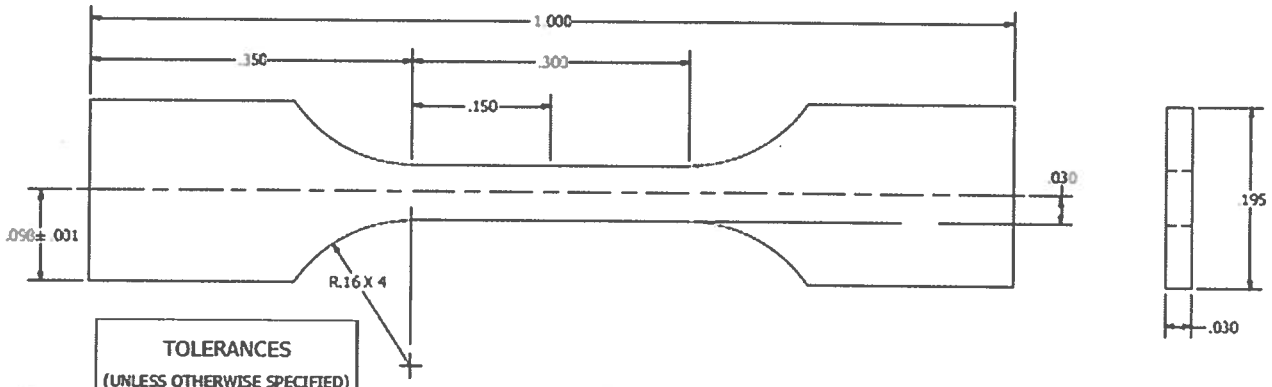
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2I 15 1	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
2	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
3	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
4	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
5	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
6	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
7	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030
8	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.059	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR - TUMICO

Inspector: T. Croom
Date: 8-14-17

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

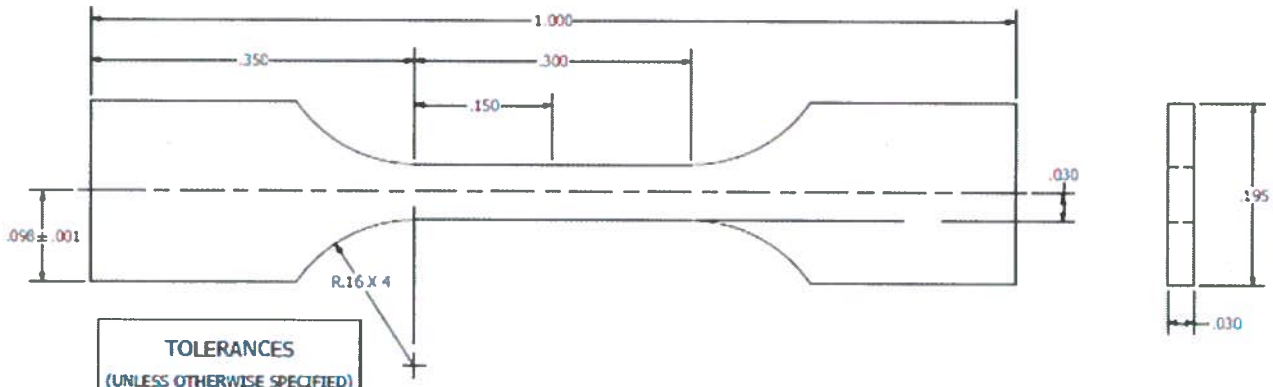
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2J01 1	1.00	0.194	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
2	1.00	0.194	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
3	1.00	0.194	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
4	1.00	0.194	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
5	1.00	0.194	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
6	1.00	0.194	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
7	1.00	0.194	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
8	1.00	0.194	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17th 17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR-TUMICO

Inspector: T. Erwin
Date: 8-16-17

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

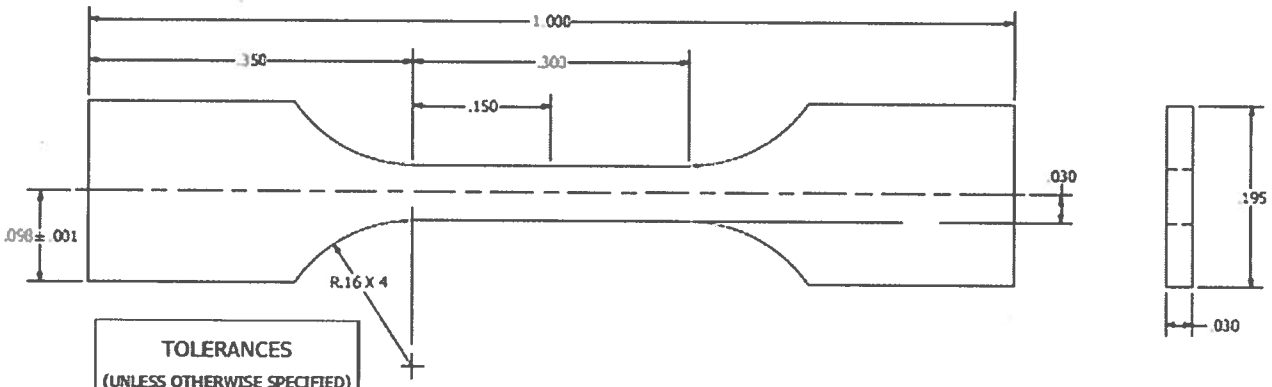
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2K 15 1	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
2	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
3	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
4	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
5	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
6	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
7	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
8	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR - TUMICO

Inspector: T. CROOM
Date: 8-14-17

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

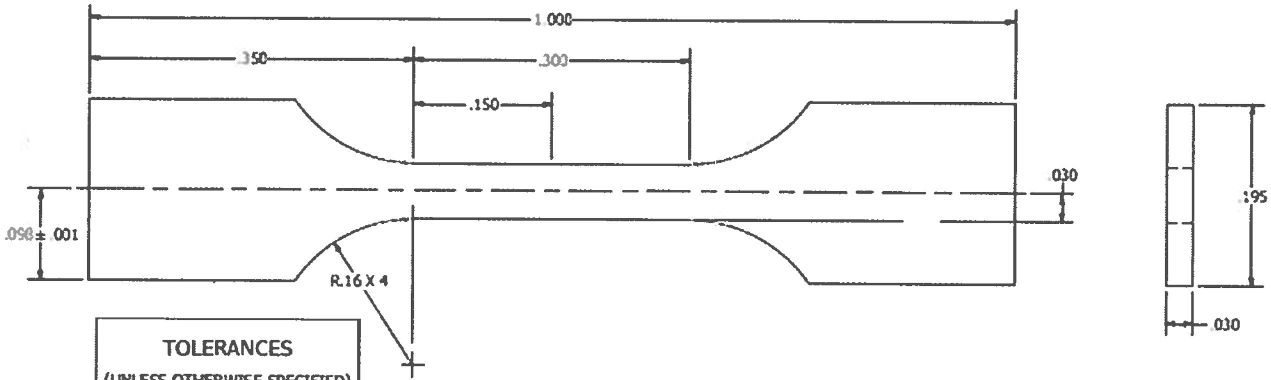
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2L01 1	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
2	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
3	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
4	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
5	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
6	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
7	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
8	1.00	0.198	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR-TUMICO

Inspector: T. Lincoln
Date: 8-17-17

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2M15 1	1.00	0.195	0.350	0.300	0.16 / 0.16	0.16 / 0.16	0.060	0.030
2	1.00	0.195	0.350	0.300	0.16 / 0.16	0.16 / 0.16	0.060	0.030
3	1.00	0.195	0.350	0.300	0.16 / 0.16	0.16 / 0.16	0.060	0.030
4	1.00	0.195	0.350	0.300	0.16 / 0.16	0.16 / 0.16	0.060	0.030
5	1.00	0.195	0.350	0.300	0.16 / 0.16	0.16 / 0.16	0.060	0.030
6	1.00	0.195	0.350	0.300	0.16 / 0.16	0.16 / 0.16	0.060	0.030
7	1.00	0.195	0.350	0.300	0.16 / 0.16	0.16 / 0.16	0.060	0.030
8	1.00	0.195	0.350	0.300	0.16 / 0.16	0.16 / 0.16	0.060	0.030

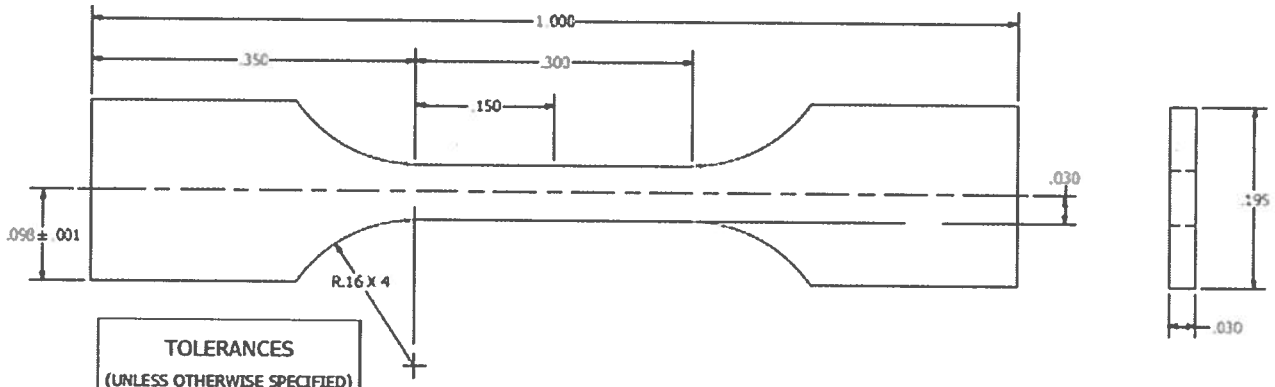
Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR - TUMICO

Inspector: [signature] T. CROOM

Date: 8-14-17

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

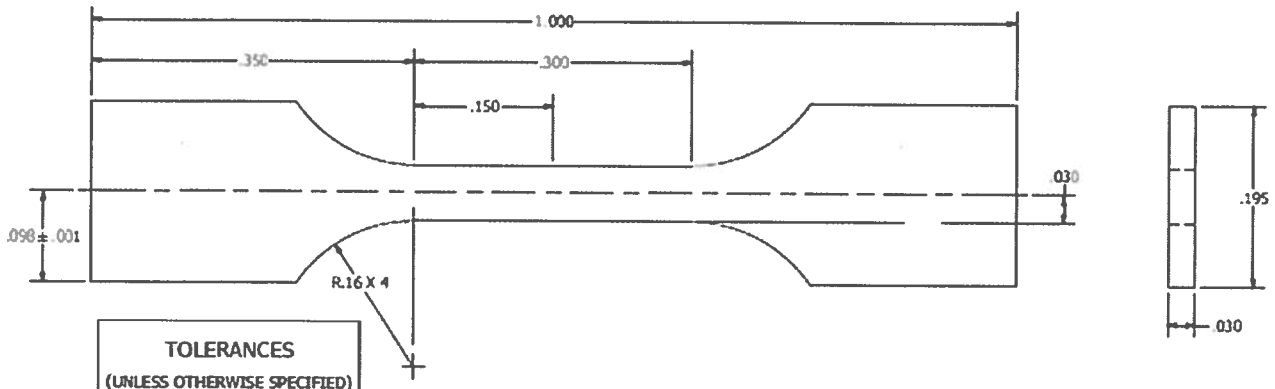
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2N01 1	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
2	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
3	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
4	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
5	1.00	0.195	0.350	0.300 ~~0.300~~ TL	0.16 0.16	0.16 0.16	0.058	0.030
6	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
7	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
8	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR-TUMICO

Inspector: JC T. Crown
Date: 8-16-17

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

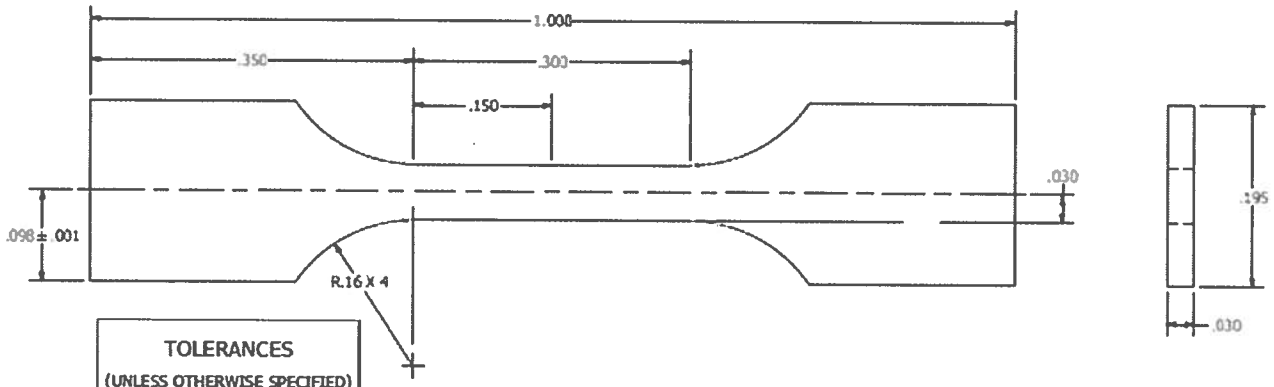
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2015 1	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
2	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
3	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
4	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
5	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
6	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
7	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
8	1.00	0.196	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR - TUMICO

Inspector: T.C. Room
Date: 8-17-17

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

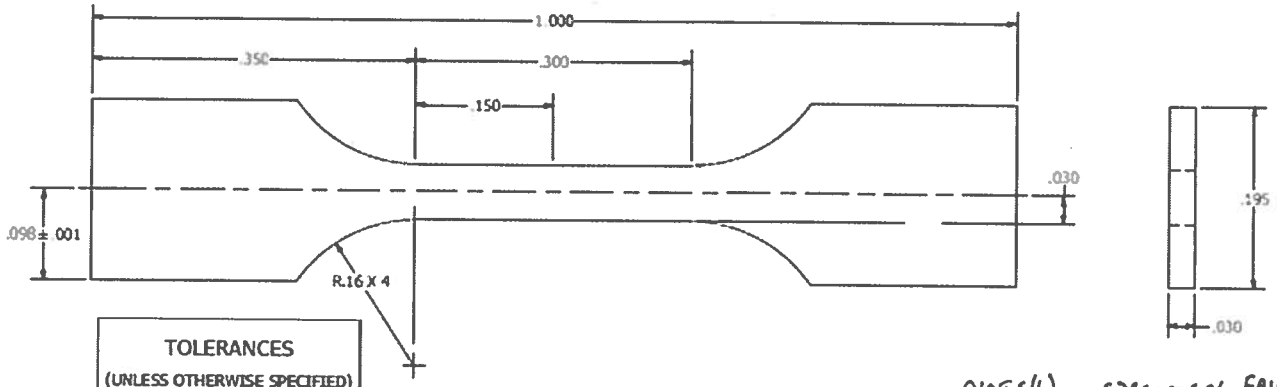
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2P01 1	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
2	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
3	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
4	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
5	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
6	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
7	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
8	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC
0-6" MITUTOYO

Instrument: 1-0000-1240
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR TUMICO

Inspector: T. Croom
Date: 8-16-17

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

NOTE(1) - SPECIMEN FAILED QA DUE TO MACHINING ANOMALY

Key: TH = Thickness GL = Gage Length

AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
2Q15 1	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
2	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
3	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
4	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
5	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
6	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
7	1.00	0.197	0.350	0.300	0.16 0.16	0.16 0.16	0.060	0.030
8	NOTE (1)	NOTE (1)	NOTE (1)	NOTE (1)	NOTE (1)	NOTE (1)	NOTE (1)	NOTE (1)

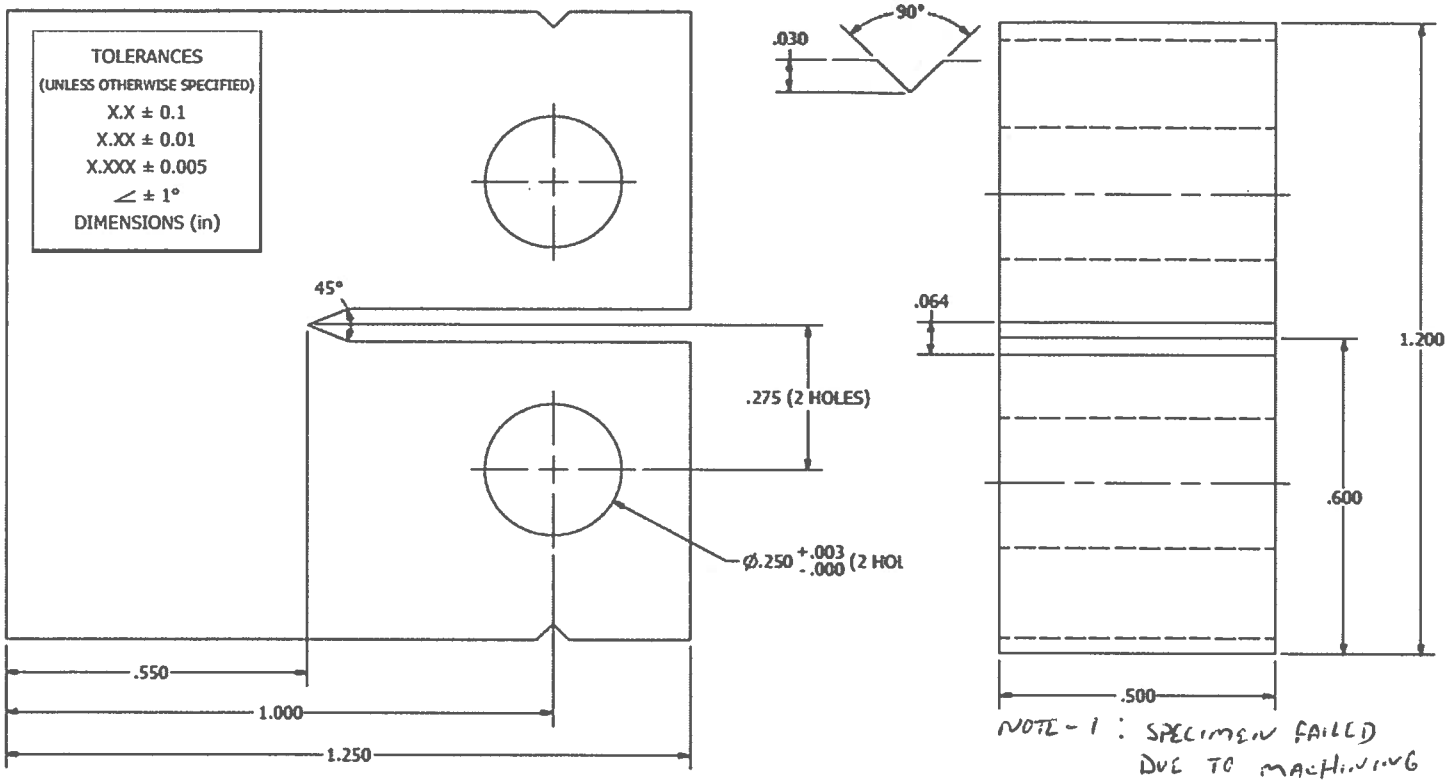
Instrument: 60000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL MIC 0-6" MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR SCHERR - TUMICO

Inspector: T. CROOM
Date: 8-17-17

Block F3

Zion 0.5 C(T) Specimen



NOTE-1 : SPECIMEN FAILED DUE TO MACHINING ANOMALLY

Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
3N ~~3A~~ - 1	1.251	1.202	1.000	0.555	45.0°	0.030 0.030	90.0° 90.0°	T 0.274 B 0.274	T 0.250 B 0.250	0.499	0.600	0.064
3N ~~3A~~ - 2	1.252	1.200	1.000	0.555	45.0°	0.030 0.030	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.499	0.600	0.064
3A - 1	1.251	1.202	1.000	0.554	45.0°	0.030 0.030	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
3A - 2	NOTE-1	NOTE-1	NOTE1	NOTE-1	NOTE-1	NOTE-1	NOTE-1	T NOTE-1 B	T NOTE-1 B	NOTE-1	NOTE-1	NOTE-1
3B - 1	1.250	1.202	1.000	0.554	45.0°	0.030 0.030	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
3B - 2	1.250	1.201	1.000	0.554	45.0°	0.030 0.030	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
3D - 1	1.251	1.202	1.000	0.554	45.0°	0.030 0.030	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
3D - 2	1.250	1.201	1.000	0.554	45.0°	0.030 0.030	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064

Instrument: I-1280-0000 Instrument: I-0000-7161 Inspector: T. Crean

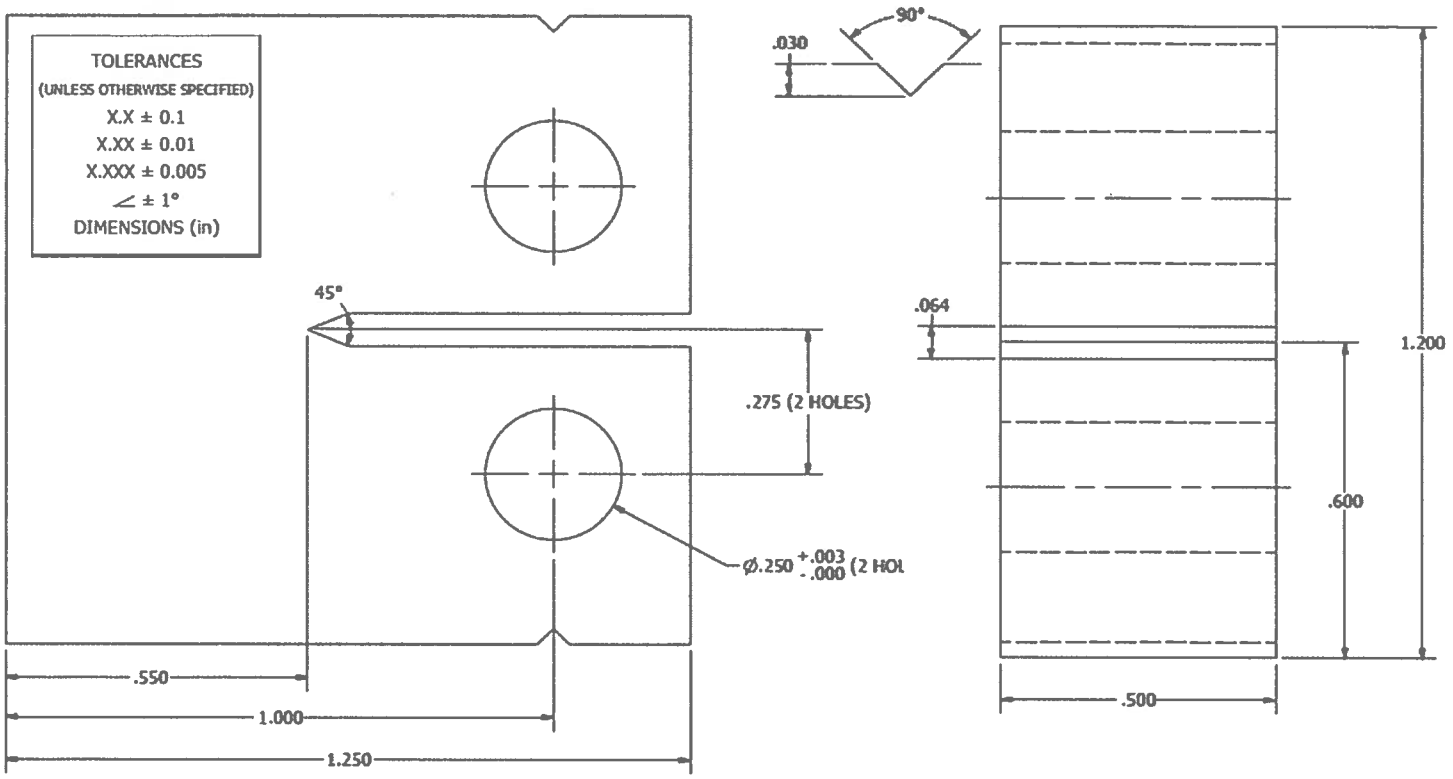
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 9-27-17

OPTICAL COMPARATOR SCHEZR - TUMICO

DIGITAL OUTSIDE/INSIDE MIC 0-6" MITUTOYO

Zion 0.5 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
3E-1	1.250	1.201	1.000	0.554	45.0	0.030	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.030	90.0°	B 0.275	B 0.250			
3E-2	1.250	1.201	1.000	0.554	45.0	0.030	90.0°	T 0.275	T 0.250	0.499	0.600	0.064
						0.030	90.0°	B 0.275	B 0.250			
3F-1	1.250	1.201	1.000	0.554	45.0°	0.030	90.0°	T 0.275	T 0.250	0.499	0.600	0.064
						0.030	90.0°	B 0.275	B 0.250			
3F-2	1.251	1.201	1.000	0.552	45.0°	0.030	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.029	90.0°	B 0.275	B 0.250			
3G-1	1.250	1.201	1.000	0.552	45.0°	0.030	90.0°	T 0.275	T 0.253	0.500	0.600	0.064
						0.029	90.0°	B 0.275	B 0.253			
3G-2	1.251	1.200	1.000	0.554	45.0°	0.030	90.0°	T 0.275	T 0.254	0.499	0.600	0.064
						0.029	90.0°	B 0.275	B 0.254			
3H-1	1.251	1.200	1.000	0.552	45.0°	0.029	90.0°	T 0.275	T 0.254	0.500	0.600	0.064
						0.029	90.0°	B 0.275	B 0.254			
3H-2	1.245	1.201	1.000	0.552	45.0°	0.029	90.0°	T 0.275	T 0.252	0.499	0.600	0.064
						0.029	90.0°	B 0.275	B 0.252			

Instrument: 1-1280-6000 Instrument: 1-0000-7161 Inspector: T. Edwards

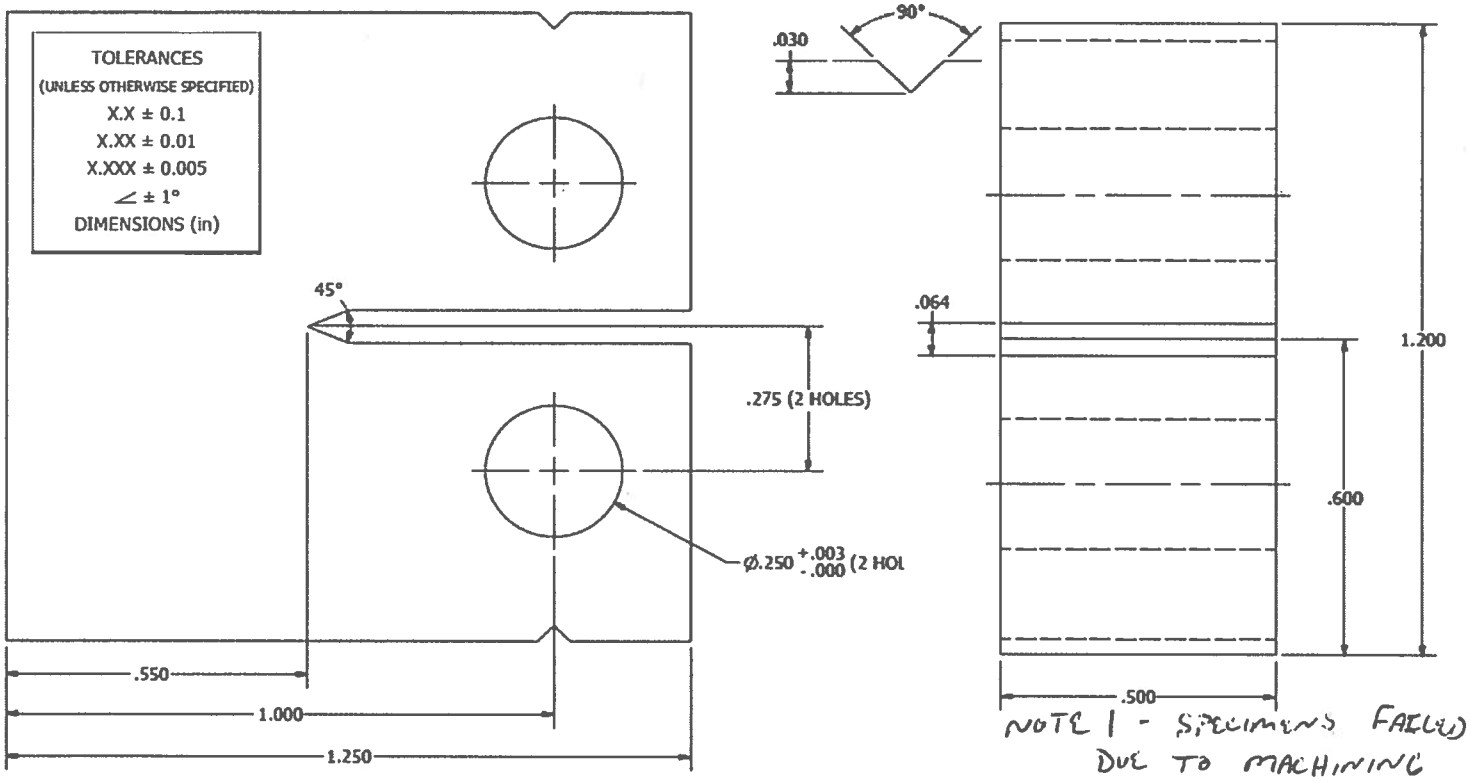
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 10-13-17

OPTICAL COMPARATOR
SCHOZZ - TUMICO

DIGITAL OUTSIDE/INSIDE MIC
0-6" MITUTOYO

Zion 0.5 C(T) Specimen



NOTE 1 - SPECIMENS FAILED DUE TO MACHINING ERROR

Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
3N-3	1.252	1.202	1.000	0.553	45.0°	0.028	90.0°	T 0.275	T 0.250	0.501	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3N-4	1.252	1.201	1.000	0.553	45.0°	0.028	90.0°	T 0.275	T 0.250	0.502	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3K-1								T	T			
								B	B			
3K-2								T	T			
								B	B			
3L-1								T	T			
								B	B			
3L-2								T	T			
								B	B			
3C-3								T	T			
								B	B			
3C-4								T	T			
								B	B			

NOTE

Instrument: 1-1280-0000 Instrument: 1-0000-7161 Inspector: T. Croom

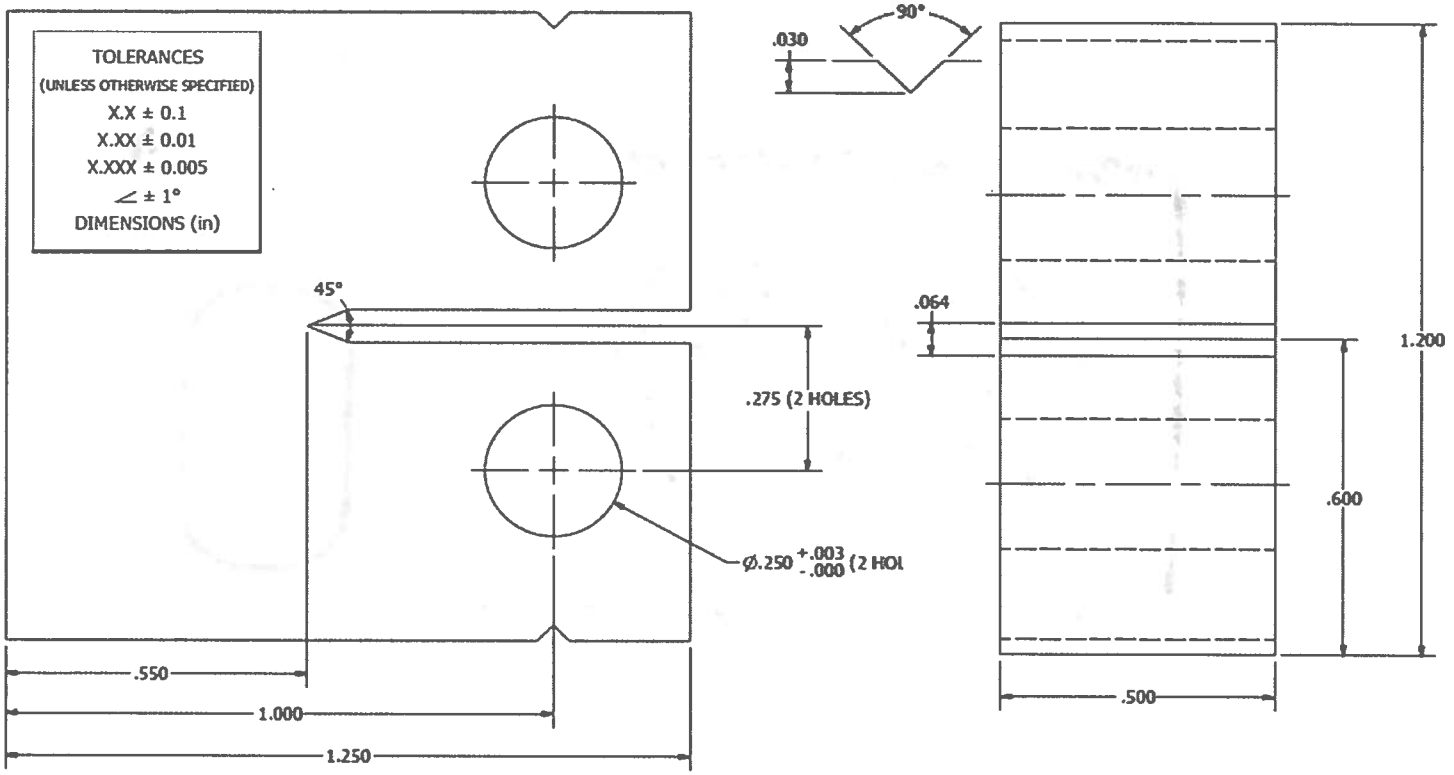
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 11-6-17

OPTICAL COMPARATOR
SCHERR-TUM.CO

DIGITAL OUTSIDE/INSIDE MIC
0-6" MITUTOYO

Zion 0.5 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
3A-3	1.250	1.200	1.000	0.554	45.0°	0.029	90.0°	T 0.275	T 0.256	0.499	0.600	0.064
						0.029	90.0°	B 0.275	B 0.250			
3A-4	1.250	1.200	1.000	0.554	45.0°	0.029	90.0°	T 0.275	T 0.250	0.498	0.600	0.064
						0.029	90.0°	B 0.275	B 0.250			
3E-3	1.257	1.203	1.000	0.554	45.0°	0.029	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.029	90.0°	B 0.275	B 0.250			
3E-4	1.251	1.201	1.000	0.554	45.0°	0.028	90.0°	T 0.275	T 0.250	0.502	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3B-3	1.255 ~~1.247~~	1.203	1.000	0.555	45.0°	0.028	90.0°	T 0.275	T 0.250	0.501	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3B-4	1.247	1.202	1.000	0.555	45.0°	0.028	90.0°	T 0.275	T 0.250	0.501	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3D-3	1.253	1.202	1.000	0.554	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3D-4	1.253	1.203	1.000	0.554	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			

Instrument: 1-1280-0000 Instrument: 1-0000-7161 Inspector: T. Croom

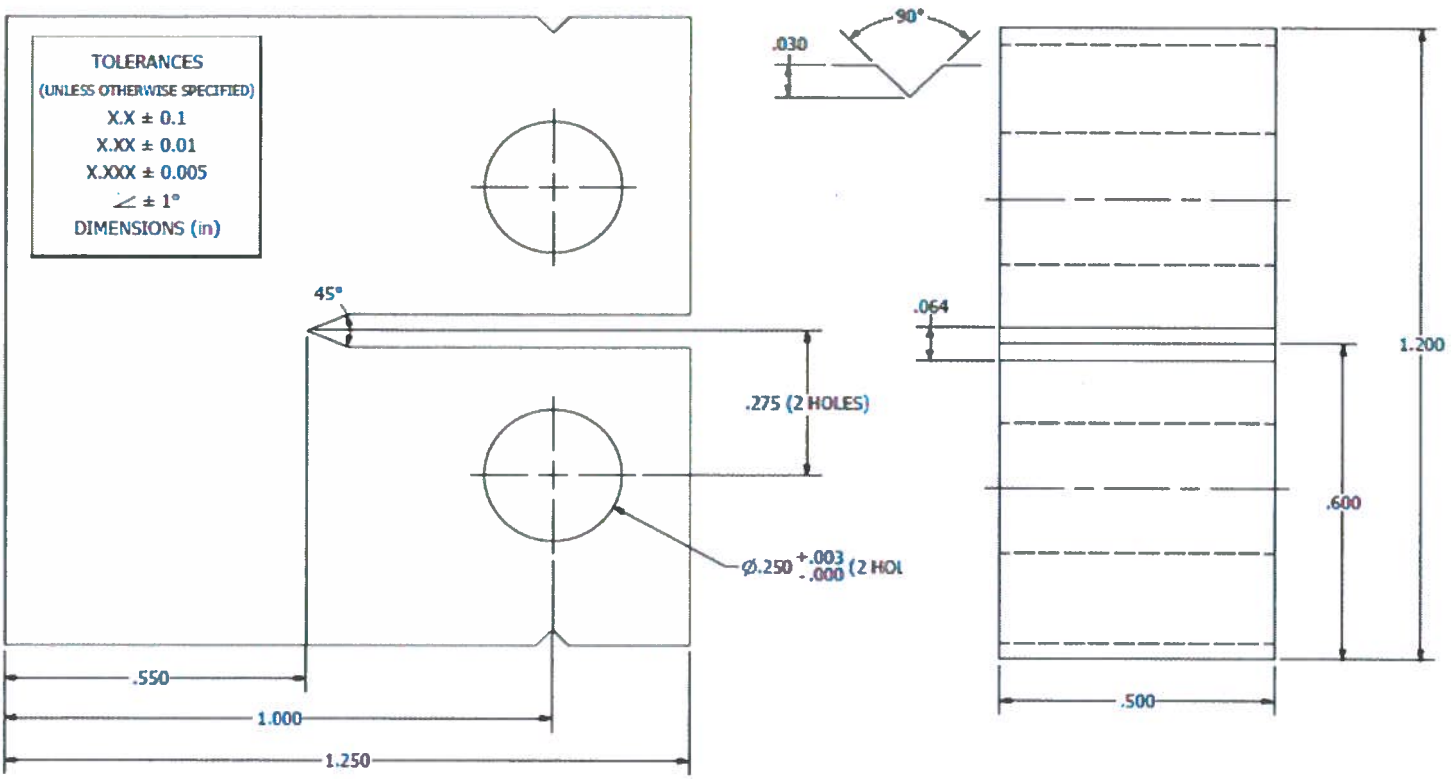
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 11-6-17

OPTICAL COMPARATOR
SCHERR-TUMICO

DIGITAL OUTSIDE/INSIDE MIC
0-6" MITUTOYO

Zion 0.5 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
3F -3	1.253	1.201	1.000	0.553	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.502	0.600	0.064
3F -4	1.252	1.201	1.000	0.553	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.501	0.600	0.064
3G -3	1.252	1.202	1.000	0.553	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.502	0.600	0.064
3G -4	1.252	1.201	1.000	0.553	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.503	0.600	0.064
3H -3	1.251	1.202	1.000	0.553	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.502	0.600	0.064
3H -4	1.253	1.203	1.000	0.553	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.503	0.600	0.064
3I -3	1.252	1.202	1.000	0.553	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.502	0.600	0.064
3I -4	1.252	1.201	1.000	0.553	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.502	0.600	0.064

Instrument: 1-1280-0000 Instrument: 1-0000-7161 Inspector: T.C.Room

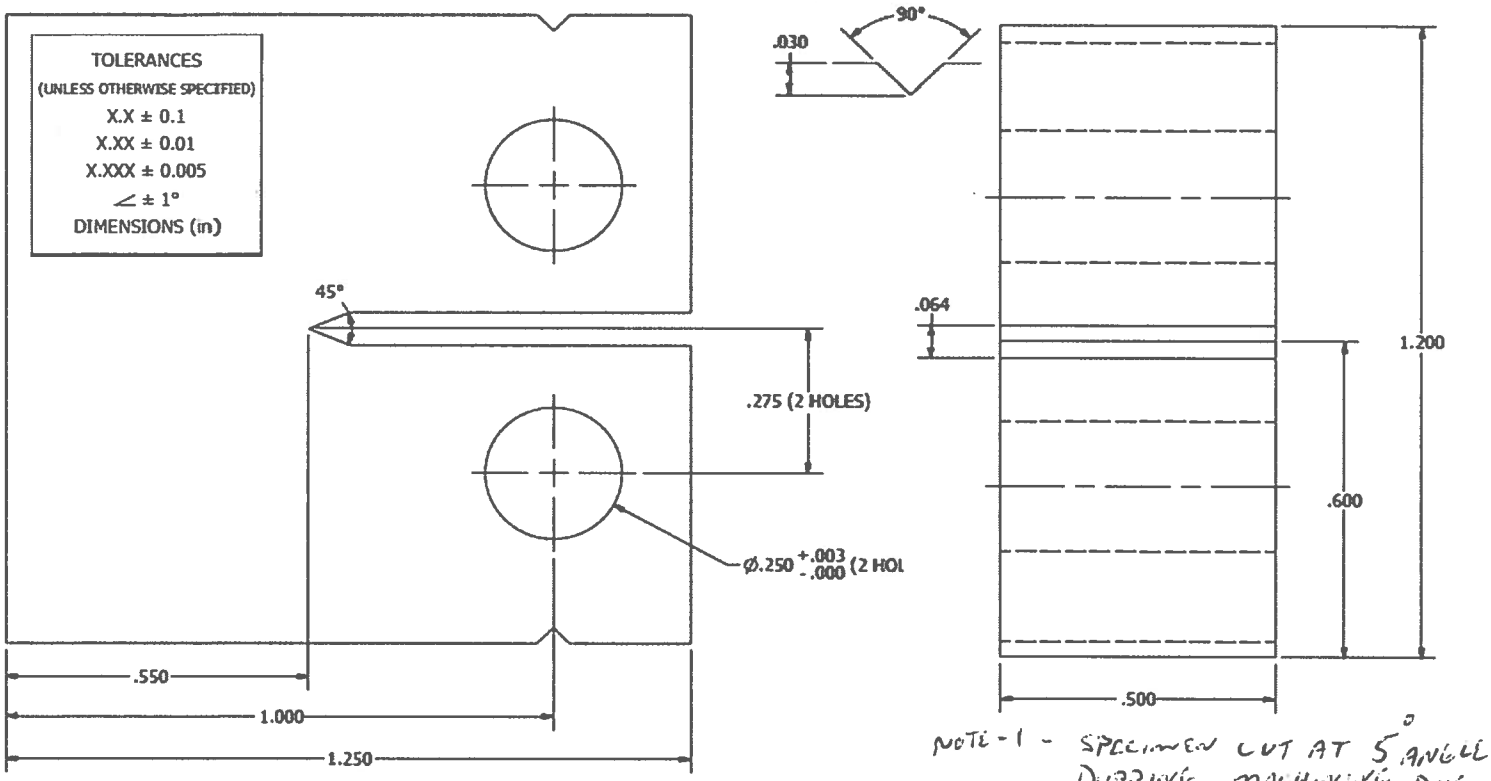
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 11-6-17

OPTICAL COMPARATOR
SCHERR-TUMICO

DIGITAL OUTSIDE/INSIDE MIC
0-6" MITUTOYO

Zion 0.5 C(T) Specimen



NOTE-1 - SPECIMEN CUT AT 5° ANGLE DURING MACHINING DUE TO MISALIGNMENT

Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
3I-1	1.250	1.202	1.000	0.554	45.0°	0.029 0.029	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.499	0.600	0.064
3I-2	1.250	1.201	1.000	0.554 ~~0.553~~ NOTE-1	45.0°	0.029 0.029	90.0° 90.0°	T 0.275 B 0.275	T 0.254 B 0.254	0.499	0.600	0.064
3J-1	1.250	1.201	1.000	0.554	45.0°	0.029 0.029	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.498	0.600	0.064
3J-2	1.251	1.201	1.000	0.554	45.0°	0.029 0.029	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.498	0.600	0.064
3M-1	1.250	1.202	NOTE-1	NOTE-1	45.0°	0.029 0.029	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.499	0.600	0.064
3M-2	1.249	1.201	NOTE-1	NOTE-1	45.0°	0.029 0.029	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.497	0.600	0.064
3C-1	1.251	1.202	1.00	0.553	45.0°	0.029 0.030	90.0° 90.0°	T 0.275 B 0.275	T 0.252 B 0.252	0.500	0.600	0.064
3C-2	1.251	1.202	1.00	0.553	45.0°	0.030 0.030	90.0° 90.0°	T 0.275 B 0.275	T NOTE-2 B NOTE-2	0.500	0.600	0.064

Instrument: 1-1250-0000 Instrument: 1-0000-7161 Inspector: T. Erwin

Cal Date: 5-24-17 Cal Date: 5-24-17

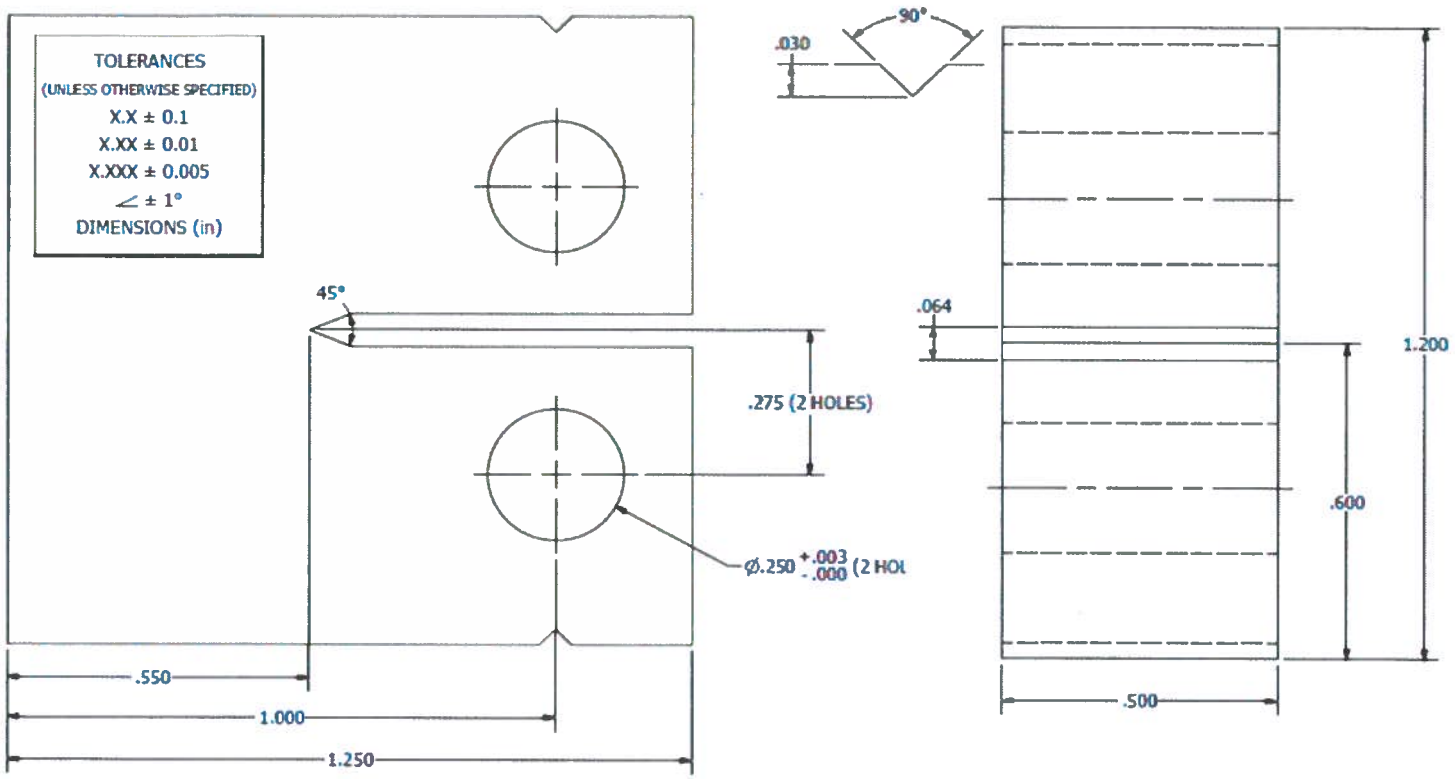
Due Date: 5-24-18 Due Date: 5-24-18 Date: 10-18-17

OPTICAL COMPARATO SCHERR-TUMICO

DIGITAL OUTSIDE/INSIDE MIC 0-6" MITUTOYO

NOTE-2 - SPECIMEN HOLES SLIGHTLY SCALLOPED DUE TO PILOTING ERROR.

Zion 0.5 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
3J-3	1.251	1.202	1.000	0.553	45.0°	0.028	90.0°	T 0.275	T 0.256	0.501	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3J-4	1.252	1.202	1.000	0.553	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3K-3	1.253	1.203	1.000	0.553	45.0°	0.028	90.0°	T 0.275	T 0.256	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3K-4	1.252	1.202	1.000	0.553	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3L-3	1.251	1.201	1.000	0.553	45.0°	0.028	90.0°	T 0.275	T 0.258	0.503	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3L-4	1.253	1.202	1.000	0.553	45.0°	0.028	90.0°	T 0.275	T 0.250	0.502	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3M-3	1.251	1.200	1.000	0.553	45.0°	0.028	90.0°	T 0.275	T 0.250	0.503	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3M-4	1.252	1.201	1.000	0.553	45.0°	0.028	90.0°	T 0.275	T 0.250	0.503	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			

Instrument: 1-1280-0000 Instrument: 1-0000-7161 Inspector: T. CROOM

Cal Date: 5-24-17 Cal Date: 5-24-17

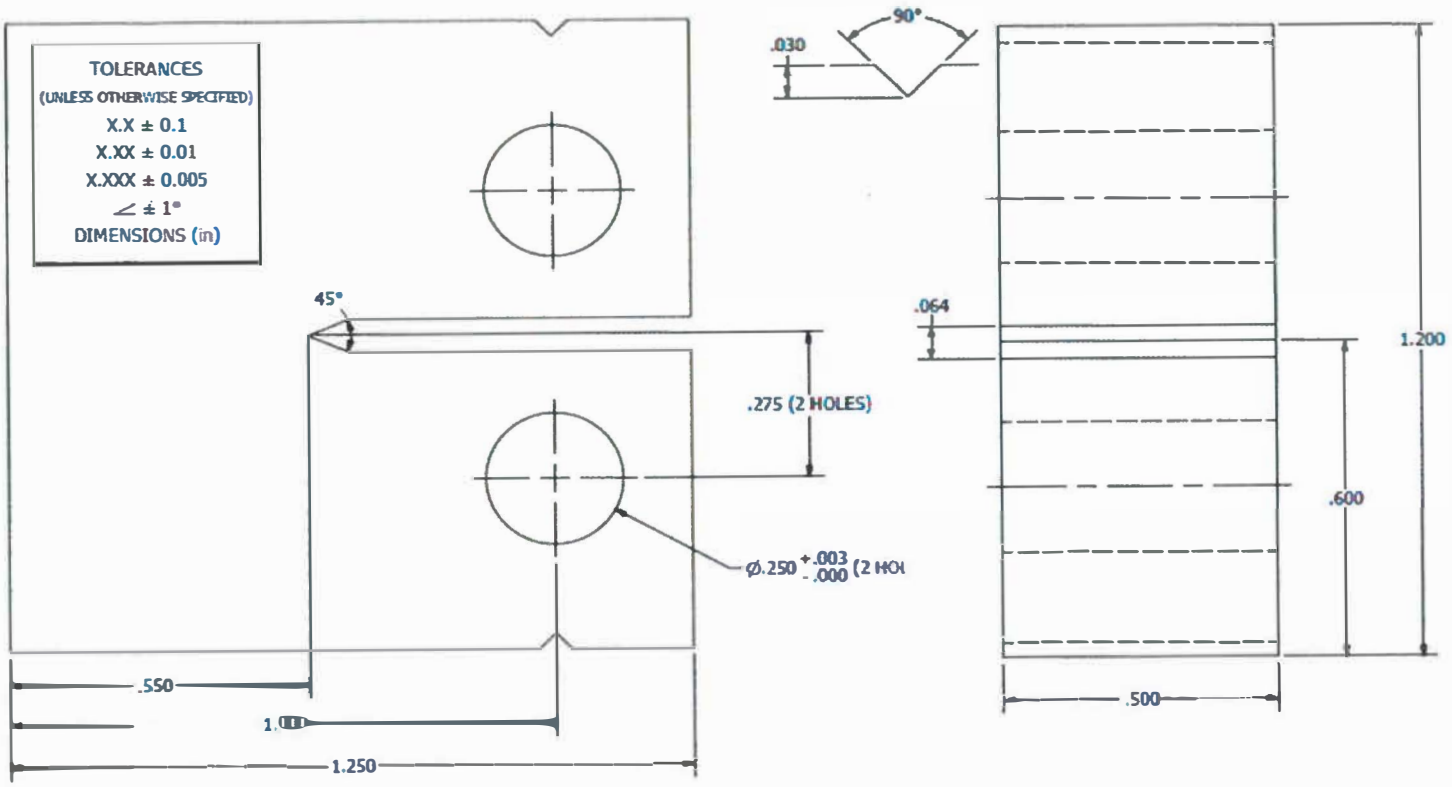
Due Date: 5-24-18 Due Date: 5-24-18 Date: 11-6-17

OPTICAL COMPARATOR SCHEZR - TUM.CO

DIGITAL OUTSIDE/INSIDE MIC 0-6" M.TUTOYO

Block F4

Zion 0.5 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
4A - 1	1.251	1.200	1.001	0.551	45.0°	0.028 0.026	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
2	1.251	1.200	1.001	0.551	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
3	1.251	1.200	1.001	0.551	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
4	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
4B - 1	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
2	1.251	1.200	1.001	0.551	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
3	1.251	1.200	1.001	0.551	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
4	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064

Instrument: 1-1280-0000 Instrument: 1-0000-7161 Inspector: T. Crosson

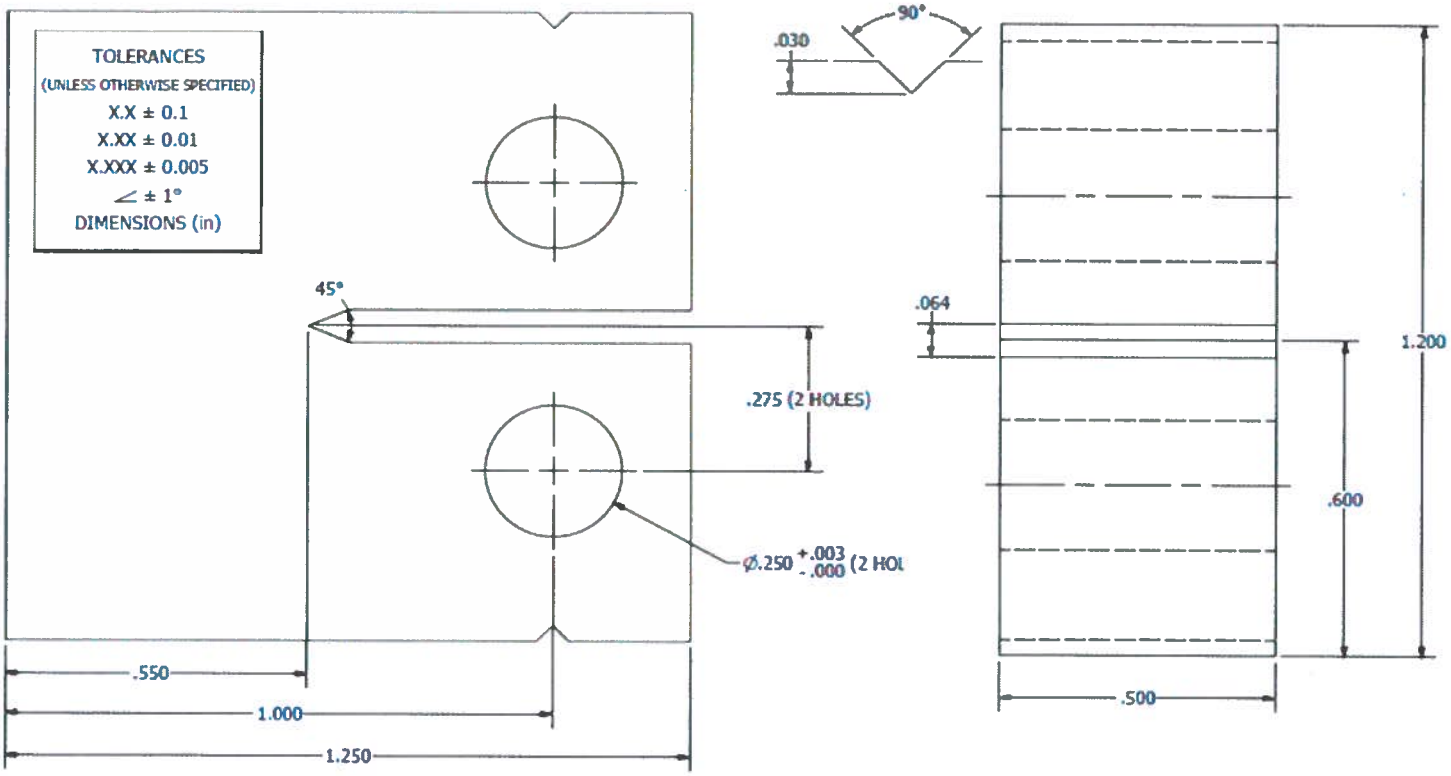
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 18 DEC 17

OPTICAL COMPARATOR — DIGITAL OUTSIDE/INSIDE MIC

SCHERR - TUMICO — 0-6" MITUTOYO

Zion 0.5 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
4C - 1	1.251	1.200	1.001	0.551	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
2	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
4	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
4D - 1	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
2	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
4	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			

Instrument: 1-1280-0000 Instrument: 1-0000-7161 Inspector: T. CROOM

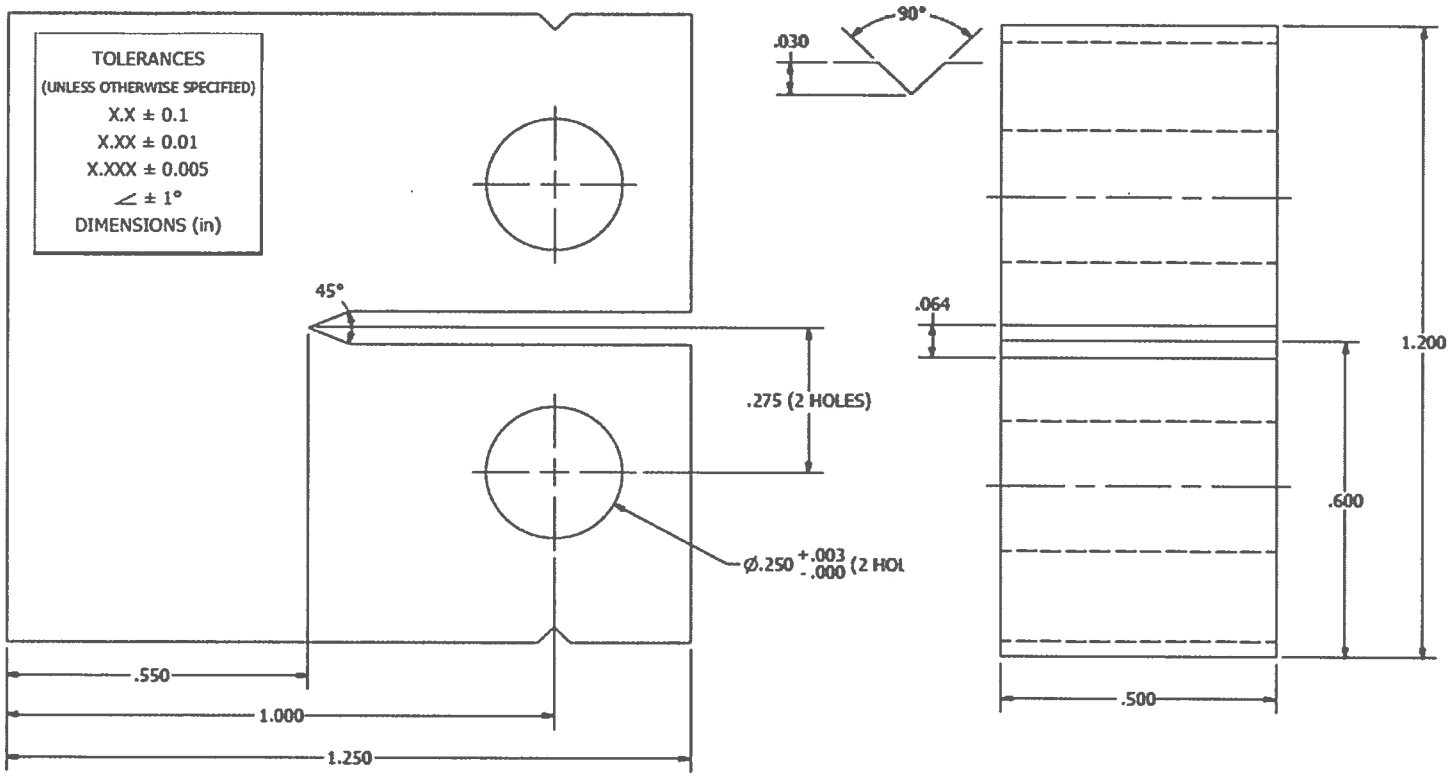
Cal Date: 5-24-~~16~~ 17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 18 DEC 17

OPTICAL COMPARATOR DIGITAL OUT/INSIDE MIC

SCHERR - TUMICO 0-6" MITUTOYO

Zion 0.5 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
4E-1	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
E-2	1.251	1.200	1.001 ~~1.000~~ TC	0.551	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
4	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
4F-1	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
2	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
4	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			

Instrument: 1-1280-0000 Instrument: 1-0000-7181 Inspector: T. Adams

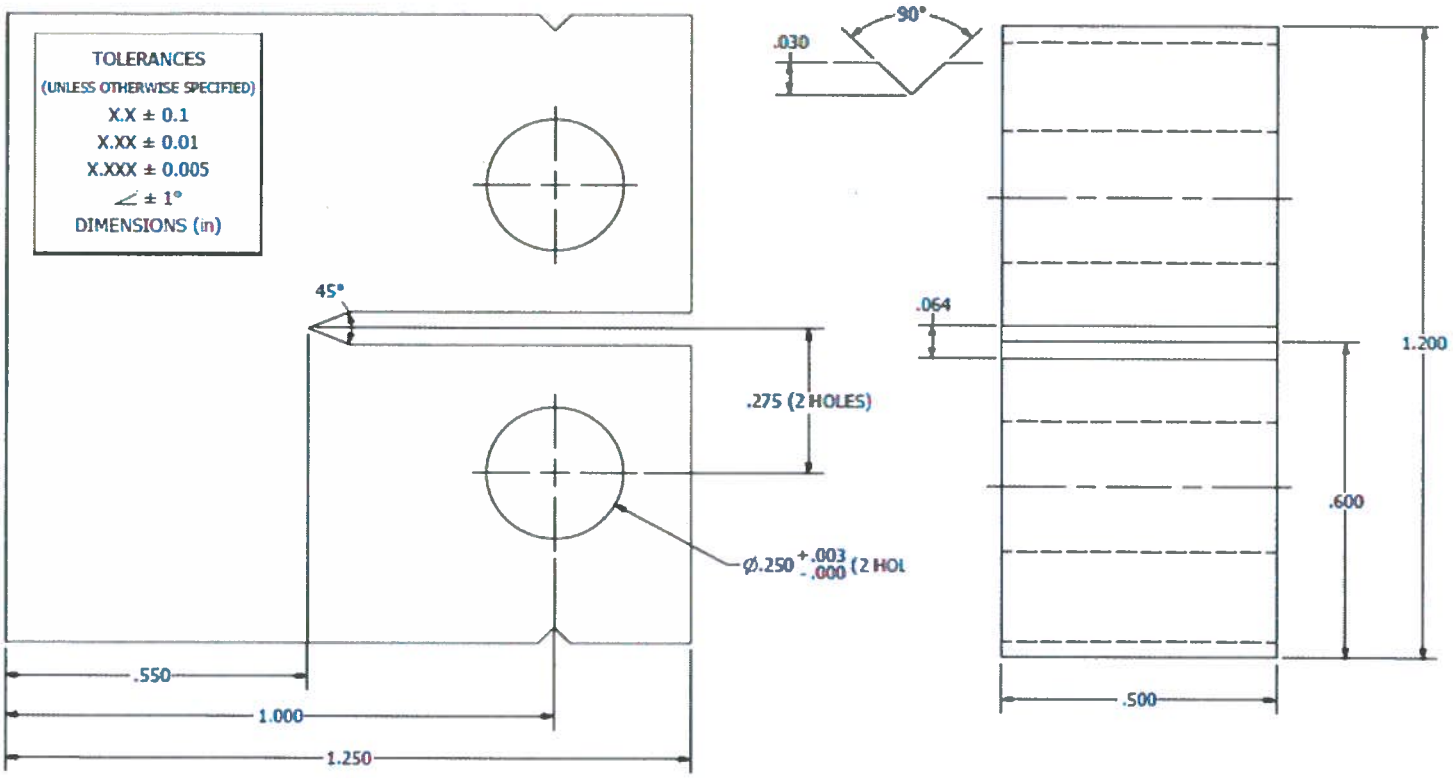
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 18 DEC 17

OPTICAL COMPARATOR — DIGITAL ODT/INSIDE MIC

SCHERR - TUMICO — 0-6" MITUTOYO

Zion 0.5 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
4G-1	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
2	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
3	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
4	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
4H-1	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
2	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
3	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
4	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064

Instrument: 1-1280-0000 Instrument: 1-8000-7161 Inspector: T. Croom

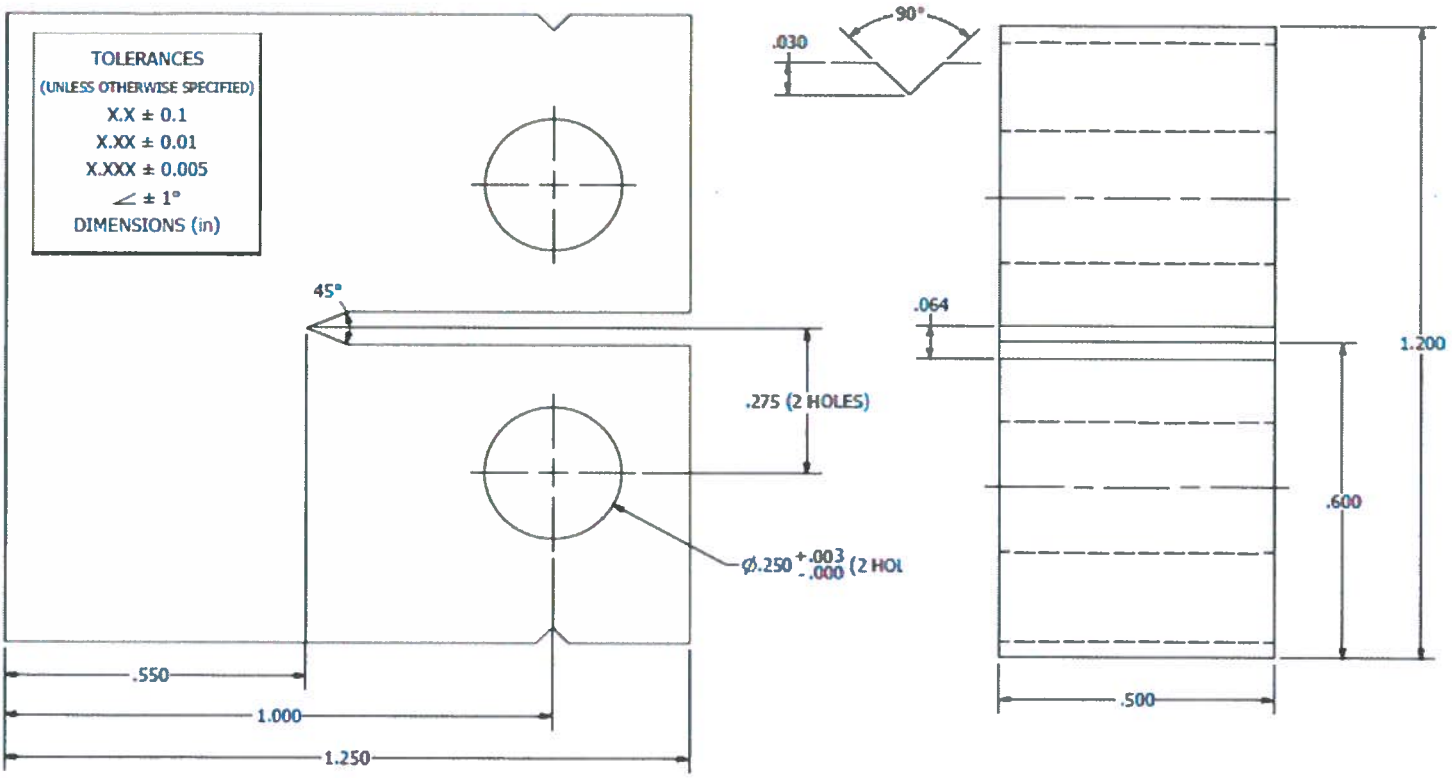
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 18 DEC 17

OPTICAL COMPARATOR
SCHERR TUM.CO

DIGITAL OUT/INSIDE MIC
0-6" MITUTOYO

Zion 0.5 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
4J-1	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
2	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
4	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
4K-1	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
2	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
4	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			

Instrument: 1-0000-7161 Instrument: 1-1281-0000 Inspector: T. Cram

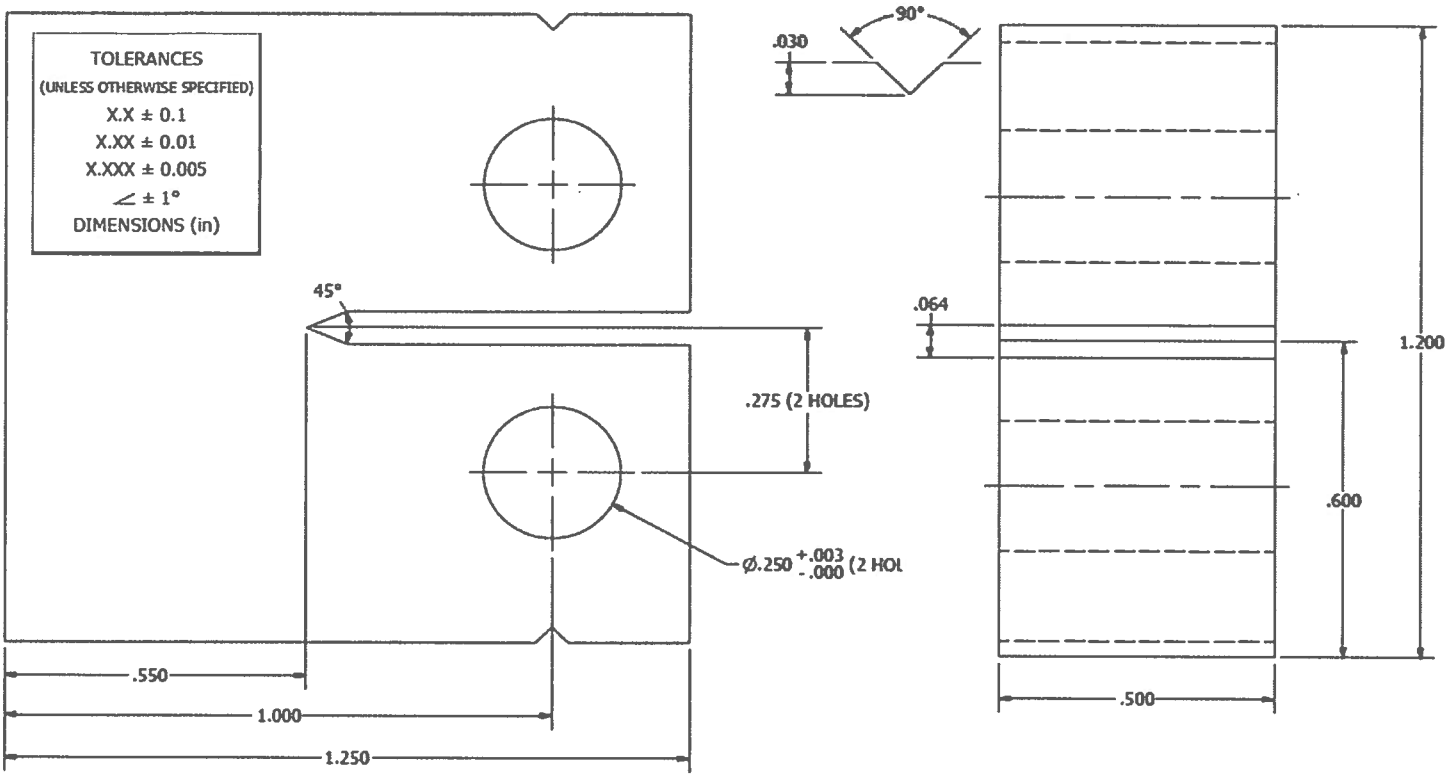
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 18 DEC 17

DIGITAL OUT/INSIDE MIC
0-6" MITUTOYO

OPTICAL COMPARATOR
SHERLINE - TUMICC

Zion 0.5 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
4L - 1	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
2	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
3	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
4	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
4M - 1	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
2	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
3	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064
4	1.250	1.200	1.000	0.550	45.0°	0.028 0.028	90.0° 90.0°	T 0.275 B 0.275	T 0.250 B 0.250	0.500	0.600	0.064

Instrument: 1-1281-0000 Instrument: 1-0000-7161 Inspector: T. Crook

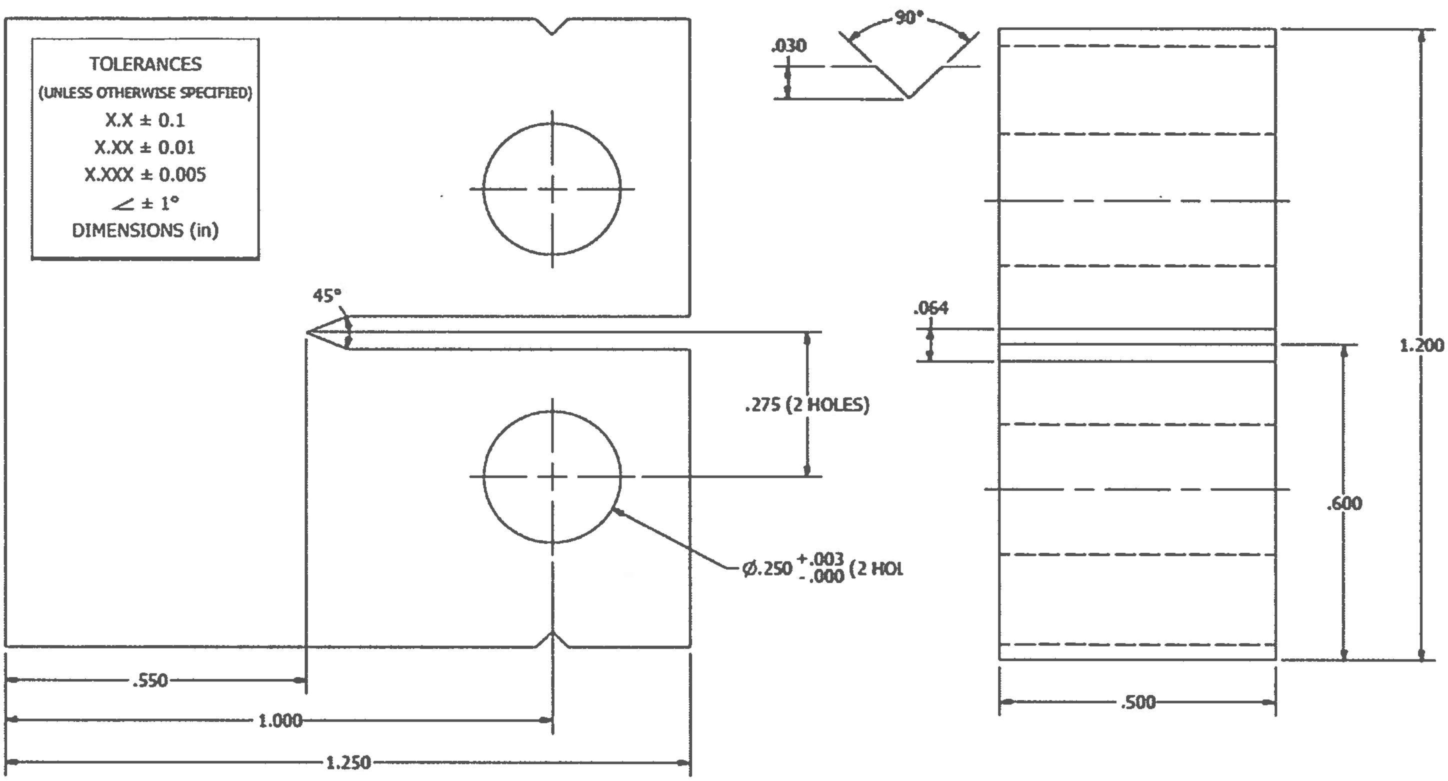
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 18 DEC 17

OPTICAL COMPARATOR
SHEZR-TUNICO

DIGITAL OUT/INSIDE MIC
0-6" MITUTOYO

Zion 0.5 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.250"	"1.200"	"1.000"	"0.550"	"45.0°"	"0.030"	"90.0°"	"0.275"	"0.250"	"0.500"	"0.600"	"0.064"
4N-1	1.251	1.200	1.001	0.551	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
2	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
3	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
4	1.250	1.200	1.000	0.550	45.0°	0.028	90.0°	T 0.275	T 0.250	0.500	0.600	0.064
						0.028	90.0°	B 0.275	B 0.250			
								T	T			
								B	B			
								T	T			
								B	B			
								T	T			
								B	B			
								T	T			
								B	B			

Instrument: 1-1281-0000 Instrument: 1-0000-7161 Inspector: [illegible signature] F. Crooks

Cal Date: 5-24-17 Cal Date: 5-24-17

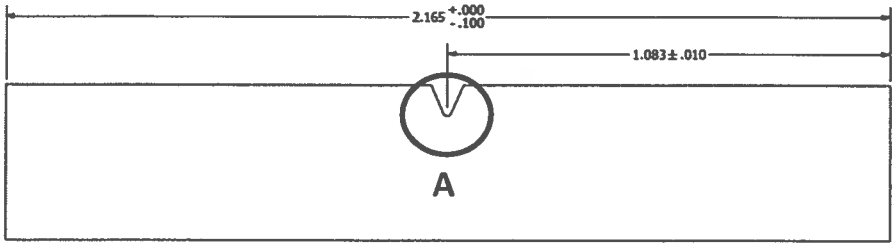
Due Date: 5-24-18 Due Date: 5-24-18 Date: 18 DEC 17

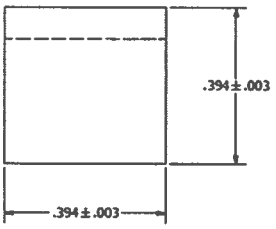
OPTICAL COMPARATOR DIGITAL OUT/INSIDE MIC

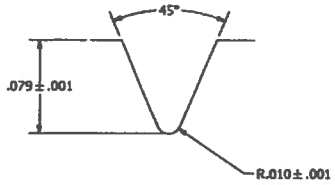
SCHERR-TUMICO 0-6" MITUTOYO

Block CF

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
FA 05	2.150	1.075	0.396	0.395	0.079	45.0°	0.010
06	2.150	1.075	0.396	0.392	0.079	45.0°	0.010
07	2.150	1.075	0.396	0.393	0.079	45.0°	0.010
08	2.147	1.073	0.396	0.394	0.079	45.0°	0.010
10	2.148	1.074	0.396	0.395	0.079	45.0°	0.010
11	2.148	1.074	0.396	0.395	0.079	45.0°	0.010
12	2.147	1.073	0.394	0.395	0.080	45.0°	0.010
13	2.147	1.073	0.396	0.394	0.080	45.0°	0.010
14	2.148	1.074	0.394	0.396	0.080	45.0°	0.010
15	2.147	1.073	0.394	0.396	0.080	45.0°	0.010
16	2.147	1.073	0.394	0.395	0.080	45.0°	0.010
17	2.147	1.073	0.394	0.395	0.080	45.0°	0.010
18	2.152	1.076	0.394	0.395	0.080	45.0°	0.010
19	2.147	1.073	0.394	0.395	0.080	45.0°	0.010
20	2.147	1.073	0.395	0.396	0.080	45.0°	0.010

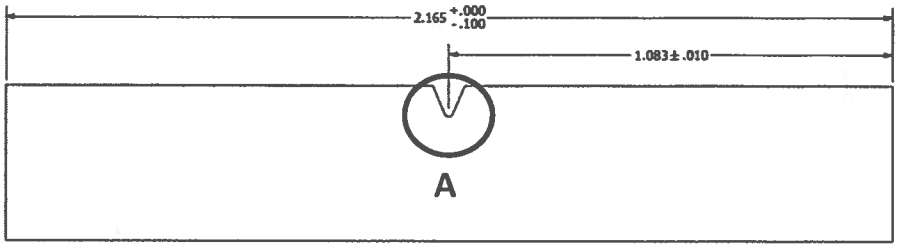
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. L. Zoor

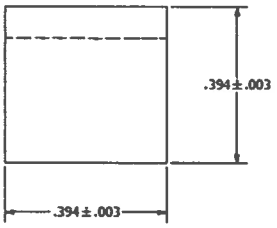
Cal Date: 5-24-17 Cal Date: 5-24-17

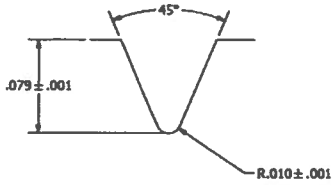
Due Date: 5-24-18 Due Date: 5-24-18 Date: 12 MAR 18

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
FA 21	2.147	1.073	0.395	0.395	0.080	45.0°	0.010
↓ 22	2.147	1.073	0.395	0.395	0.080	45.0°	0.010
FC 02	2.150	1.075	0.395	0.396	0.078	45.0°	0.010
03	2.149	1.074	0.396	0.395	0.078	45.0°	0.010
04	2.147	1.073	0.396	0.395	0.078	45.0°	0.010
05	2.150	1.075	0.396	0.395	0.078	45.0°	0.010
06	2.150	1.075	0.396	0.393	0.078	45.0°	0.010
07	2.149	1.074	0.396	0.395	0.078	45.0°	0.010
08	2.148	1.074	0.396	0.395	0.078	45.0°	0.010
09	2.150	1.075	0.396	0.395	0.078	45.0°	0.010
10	2.148	1.074	0.396	0.395	0.078	45.0°	0.010
11	2.149	1.074	0.396	0.395	0.078	45.0°	0.010
12	2.148	1.074	0.396	0.395	0.078	45.0°	0.010
13	2.148	1.074	0.396	0.395	0.078	45.0°	0.010
↓ 14	2.149	1.074	0.396	0.395	0.078	45.0°	0.010

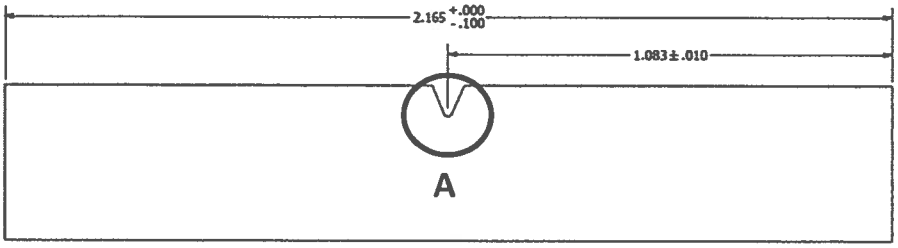
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. CROOM

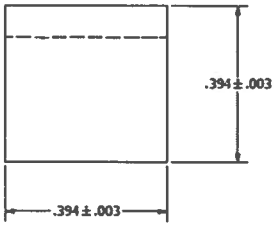
Cal Date: 5-24-17 Cal Date: 5-24-17

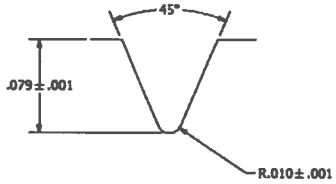
Due Date: 5-24-18 Due Date: 5-24-18 Date: 12 MAR 18

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
Fc 15	2.148	1.074	0.396	0.395	0.078	45.0° ~~0.078~~ TC	0.010
16	2.150	1.075	0.396	0.395	0.078	45.0°	0.010
17	2.148	1.074	0.396	0.395	0.078	45.0°	0.010
18	2.147	1.073	0.396	0.395	0.078	45.0°	0.010
19	2.147	1.073	0.396	0.395	0.078	45.0°	0.010
20	2.147	1.073	0.396	0.395	0.078	45.0°	0.010
↓ 21	2.147	1.073	0.396	0.395	0.078	45.0°	0.010
FE 02	2.147	1.073	0.395	0.395	0.079	45.0°	0.010
03	2.150	1.075	0.395	0.395	0.079	45.0°	0.010
04	2.148	1.074	0.397	0.395	0.079	45.0°	0.010
05	2.150	1.075	0.396	0.395	0.079	45.0°	0.010
06	2.147	1.073	0.394	0.395	0.079	45.0°	0.010
07	2.148	1.074	0.394	0.395	0.079	45.0°	0.010
08	2.147	1.073	0.394	0.394	0.079	45.0°	0.010
↓ 09	2.147	1.073	0.395	0.394	0.079	45.0°	0.010

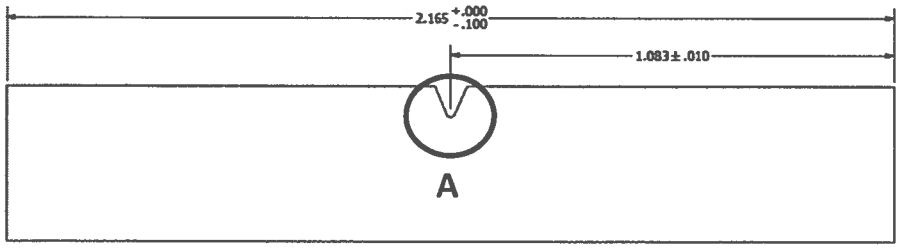
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: J.C T. Croom

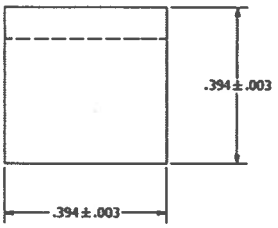
Cal Date: 5-24-17 Cal Date: 5-24-17

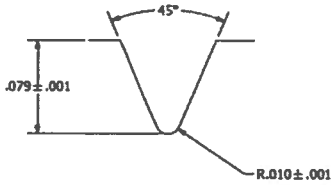
Due Date: 5-24-18 Due Date: 5-24-18 Date: 12 MAR 18

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
FE 10	2.149	1.074	0.394	0.395	0.079	45.0°	0.010
11	2.149	1.074	0.395	0.394	0.079	45.0°	0.010
12	2.148	1.074	0.395	0.395	0.079	45.0°	0.010
13	2.149	1.074	0.395	0.396	0.079	45.0°	0.010
14	2.148	1.074	0.395	0.394	0.079	45.0°	0.010
15	2.147	1.073	0.395	0.394	0.079	45.0°	0.010
16	2.149	1.074	0.394	0.394	0.079	45.0°	0.010
17	2.148	1.074	0.395	0.394	0.079	45.0°	0.010
18	2.148	1.074	0.394	0.394	0.079	45.0°	0.010
19	2.147	1.073	0.394	0.394	0.079	45.0°	0.010
20	2.148	1.074	0.395	0.394	0.079	45.0°	0.010
21	2.147	1.073	0.395	0.394	0.079	45.0°	0.010
FG 02	2.153	1.076	0.395	0.395	0.078	45.0°	0.010
03	2.153	1.076	0.394	0.394	0.078	45.0°	0.010
04	2.148	1.074	0.394	0.394	0.078	45.0°	0.010

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Broom

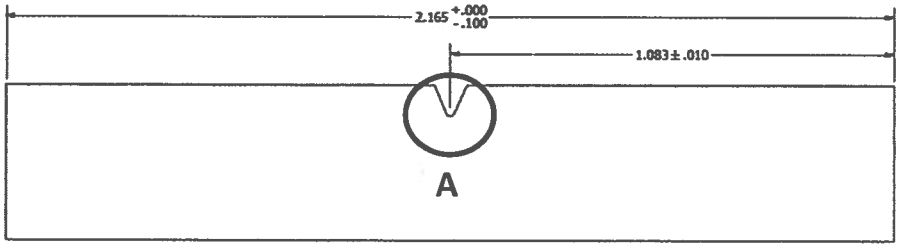
Cal Date: 5-24-17 Cal Date: 5-24-17

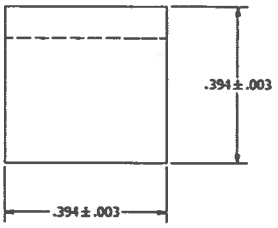
Due Date: 5-24-18 Due Date: 5-24-18 Date: 12 MAR 18

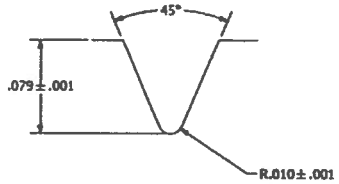
DIGITAL MIC

OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
F6 05	2.153	1.076	0.394	0.394	0.078	45.0°	0.010
06	2.154	1.077	0.394	0.394	0.078	45.0°	0.010
07	2.153	1.076	0.394	0.394	0.078	45.0°	0.010
08	2.153	1.076	0.394	0.394	0.078	45.0°	0.010
09	2.153	1.076	0.394	0.394	0.078	45.0°	0.010
10	2.153	1.076	0.394	0.394	0.078	45.0°	0.010
11	2.153	1.076	0.394	0.394	0.078	45.0°	0.010
12	2.153	1.076	0.394	0.394	0.078	45.0°	0.010
13	2.149	1.074	0.394	0.394	0.078	45.0°	0.010
14	2.151	1.075	0.394	0.394	0.078	45.0°	0.010
15	2.148	1.074	0.394	0.394	0.078	45.0°	0.010
16	2.151	1.075	0.394	0.394	0.078	45.0°	0.010
17	2.150	1.075	0.394	0.394	0.078	45.0°	0.010
18	2.152	1.076	0.394	0.394	0.078	45.0°	0.010
↓ 19	2.151	1.075	0.394	0.394	0.078	45.0°	0.010

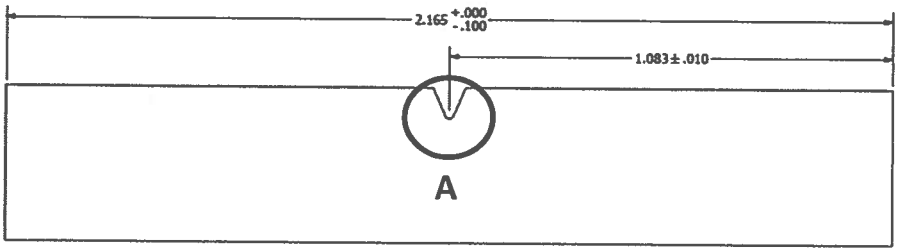
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. CROOM

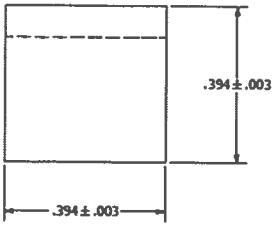
Cal Date: 5-24-17 Cal Date: 5-24-17

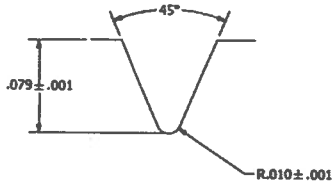
Due Date: 5-24-18 Due Date: 5-24-18 Date: 12 MAR 18

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
FG 20	2.151	1.075	0.394	0.394	0.078	45.0°	0.010
↓ 21	2.150	1.075	0.394	0.394	0.078	45.0°	0.010
FI 02	2.165	1.082	0.395	0.395	0.078	45.0°	0.010
03	2.165	1.082	0.395	0.395	0.078	45.0°	0.010
04	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
05	2.165	1.082	0.395	0.396	0.078	45.0°	0.010
06	2.165	1.082	0.395	0.396	0.078	45.0°	0.010
07	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
08	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
09	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
10	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
11	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
12	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
13	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
↓ 14	2.165	1.082	0.396	0.396	0.078	45.0°	0.010

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

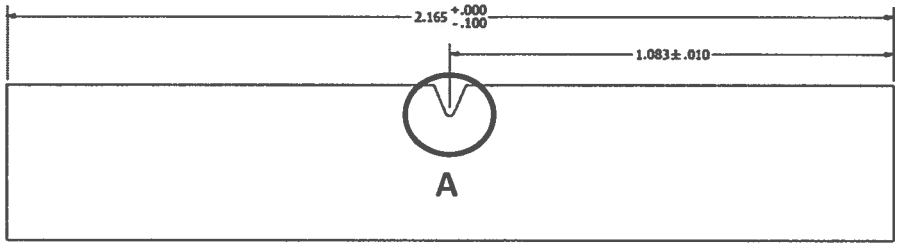
Cal Date: 5-24-17 Cal Date: 5-24-17

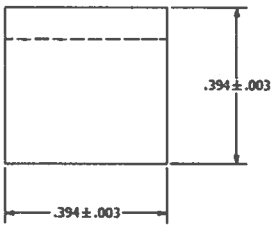
Due Date: 5-24-18 Due Date: 5-24-18 Date: 12 MAR 18

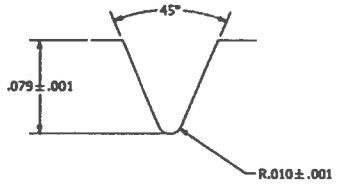
DIGITAL MIC OPTICAL COMPARATOR

0-6" MITUTOYO SCHUTZ-TURNER

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
FI 15	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
16	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
17	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
18	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
19	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
20	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
21	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
FK 02	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
03	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
04	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
05	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
06	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
07	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
08	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
09	2.165	1.082	0.396	0.396	0.079	45.0°	0.010

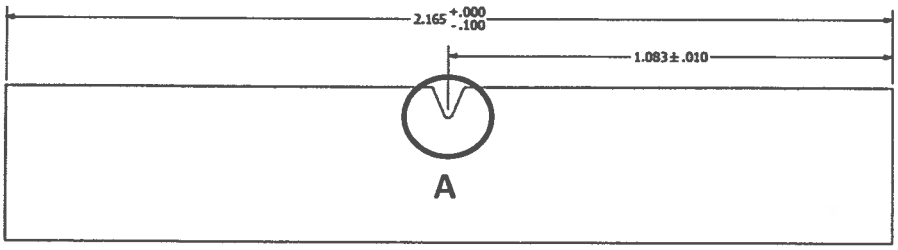
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Crozier

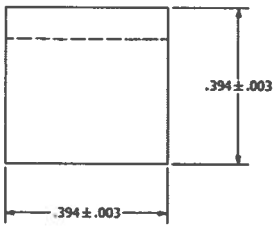
Cal Date: 5-24-17 Cal Date: 5-24-17

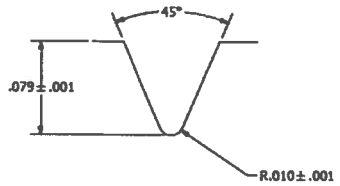
Due Date: 5-24-18 Due Date: 5-24-18 Date: 12 MAR 18

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

* SPECIMEN HAS WIRE BURN ACROSS BOTTOM of SAMPLE PERPENDICULAR TO NOTCH.

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
FK 10	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
11	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
12	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
13	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
14	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
15	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
16 *	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
17	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
18	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
19	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
20	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
21	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
FM 02	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
03	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
04	2.165	1.082	0.396	0.396	0.078	45.0°	0.010

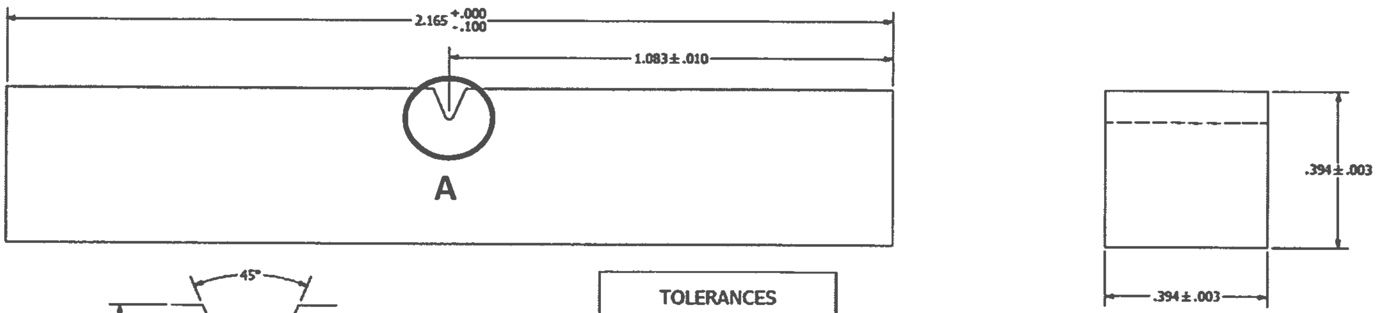
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. CROOM

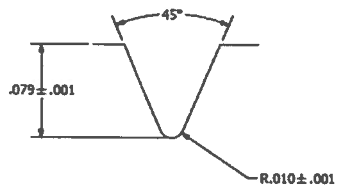
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 12 MAR 18

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen





DETAIL A

TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

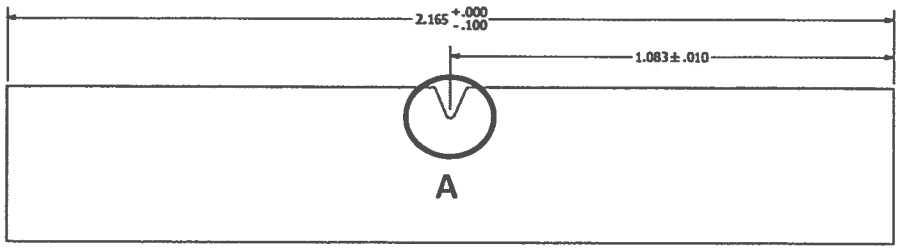
NOTE 1 - SPECIMEN REJECTED DUE TO WIDTH BEING CUT THIN. DUE TO INCLUSION

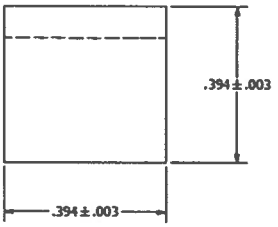
Key: W = Width, H = Height

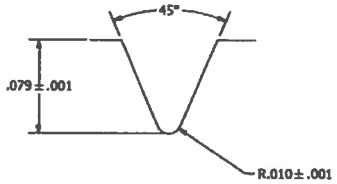
AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
FM 05	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
NOTE 1 → 06	2.165	1.082	0.326 TL ~~0.396~~	0.396	0.078	45.0°	0.010
07	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
08	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
09	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
10	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
11	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
12	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
13	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
14	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
15	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
16	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
17	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
18	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
19	2.165	1.082	0.396	0.396	0.078	45.0°	0.010

Instrument:	1-0000-7161	Instrument:	1-0000-1280	Inspector:	[signature] Teroom
Cal Date:	5-24-17	Cal Date:	5-24-17		
Due Date:	5-24-18	Due Date:	5-24-18	Date:	12MAR18
	DIGITAL MIC 0-1" MITUTOYO		OPTICAL COMPARATOR SCHERR - TUMICO		

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
FM 20	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
↓ 21	2.165	1.082	0.396	0.396	0.078	45.0°	0.010
FO 02	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
03	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
04	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
05	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
06	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
07	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
08	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
09	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
10	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
11	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
12	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
13	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
↓ 14	2.165	1.082	0.396	0.395	0.078	45.0°	0.010

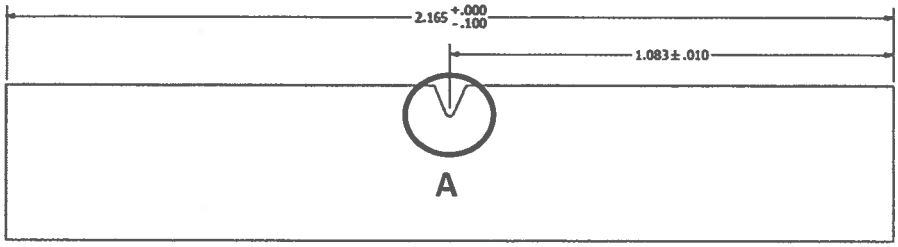
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

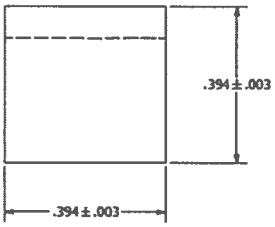
Cal Date: 5-24-17 Cal Date: 5-24-17

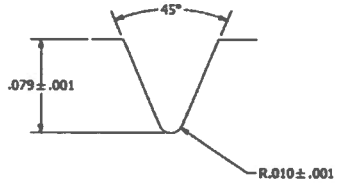
Due Date: 5-24-18 Due Date: 5-24-18 Date: 12 MAR 18

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
FQ 15	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
16	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
17	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
18	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
19	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
20	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
21	2.165	1.082	0.396	0.395	0.078	45.0°	0.010
FQ 02	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
03	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
04	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
05	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
06	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
07	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
08	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
09	2.165	1.082	0.396	0.396	0.079	45.0°	0.010

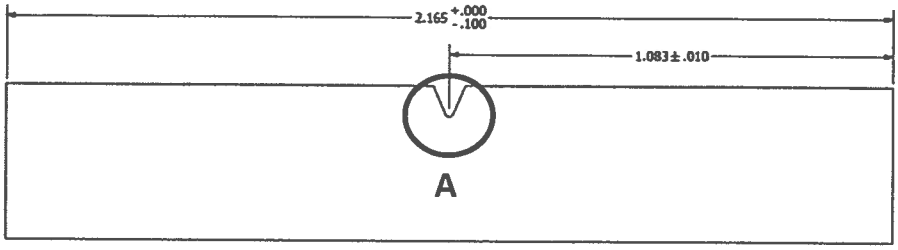
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. CROOM

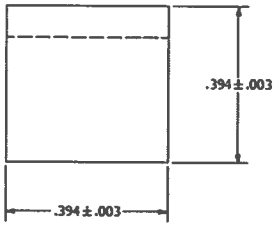
Cal Date: 5-24-17 Cal Date: 5-24-17

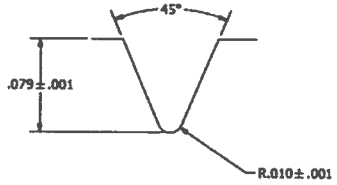
Due Date: 5-24-18 Due Date: 5-24-18 Date: 12 MAR 18

DIGITAL MIC OPTICAL COMPARATOR

Zion CVN Specimen







DETAIL A

TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: W = Width, H = Height

AS MACHINED DIMENSIONS							
SPECIMEN I.D.	"2.165"	"1.083"	W "0.394"	H "0.394"	"0.079"	"45.0°"	"R0.010"
FQ 10	2.165	1.087	0.396	0.394	0.079	45.0°	0.010
11	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
12	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
13	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
14	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
15	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
16	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
17	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
18	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
19	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
20	2.165	1.082	0.396	0.396	0.079	45.0°	0.010
21	2.165	1.082	0.396	0.396	0.079	45.0°	0.010

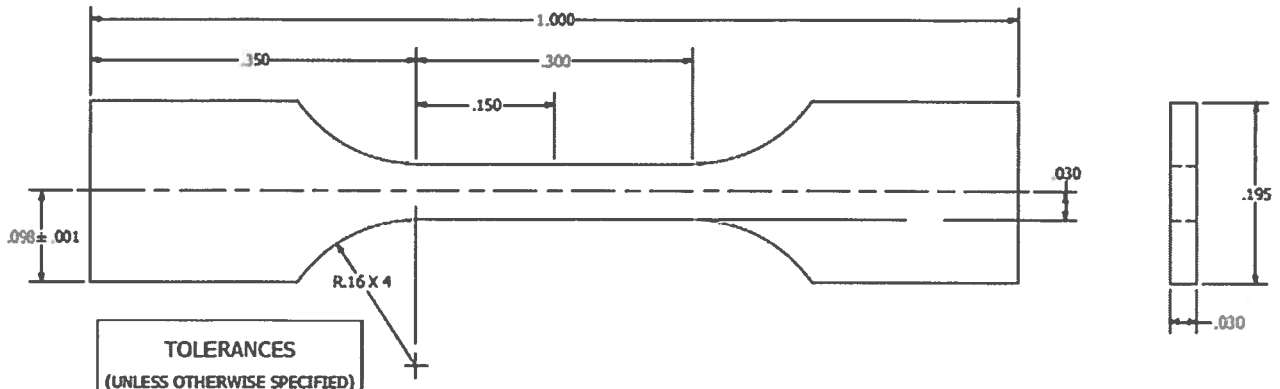
Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Crain

Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 12 MAR 18

DIGITAL MIC OPTICAL COMPARATOR

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

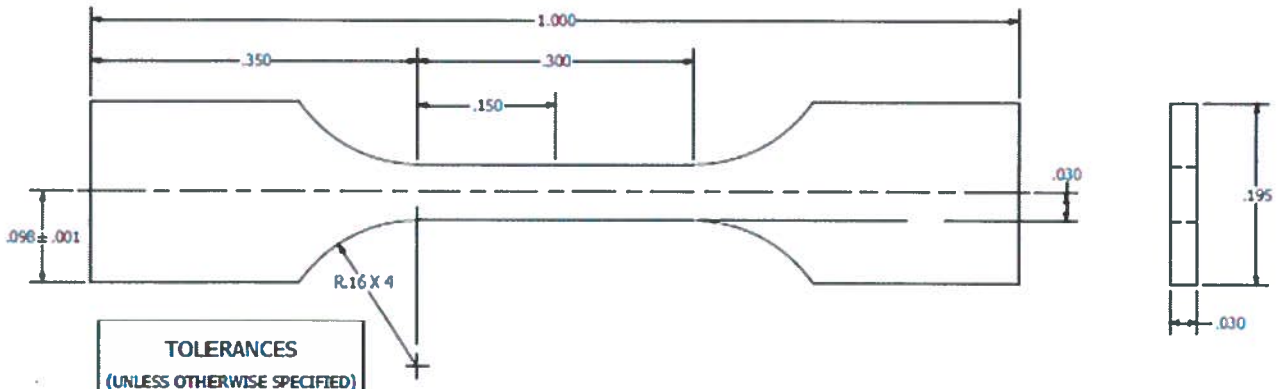
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FA03 - 11	0.99	0.195	0.348	0.298	0.16 0.16	0.16 0.16	0.058	0.030
12	0.99	0.195	0.348	0.298	0.16 0.16	0.16 0.16	0.058	0.030
13	0.99	0.195	0.348	0.298	0.16 0.16	0.16 0.16	0.058	0.030
14	0.99	0.195	0.348	0.298	0.16 0.16	0.16 0.16	0.058	0.030
15	0.99	0.195	0.348	0.298	0.16 0.16	0.16 0.16	0.058	0.030
16	0.99	0.195	0.348	0.298	0.16 0.16	0.16 0.16	0.058	0.030
17	0.99	0.195	0.348	0.298	0.16 0.16	0.16 0.16	0.058	0.030
18	0.99	0.195	0.348	0.298	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" DIGITAL MIC
MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR-TUMICO

Inspector: T. Coon
Date: 9 APR 18

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

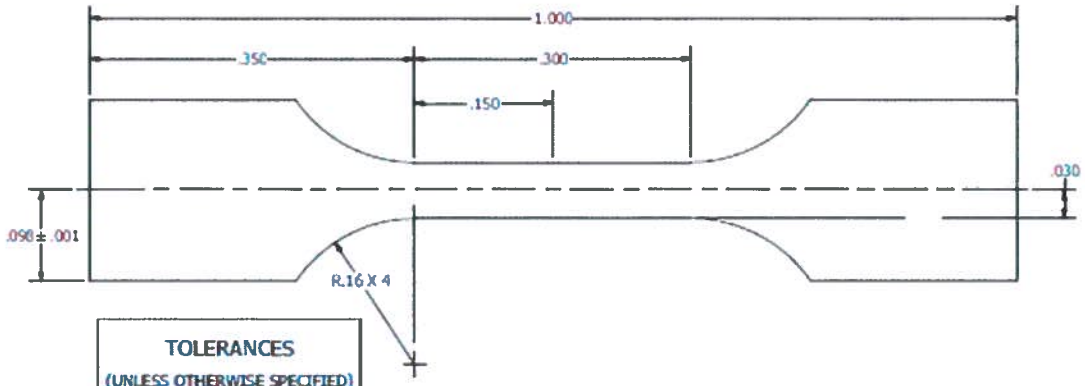
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FA22 - 21	1.00	0.195	0.350	0.300	0.16	0.16	0.060	0.030
					0.16	0.16		
22	1.00	0.195	0.350	0.300	0.16	0.16	0.060	0.030
					0.16	0.16		
23	1.00	0.195	0.350	0.300	0.16	0.16	0.060	0.030
					0.16	0.16		
24	1.00	0.195	0.350	0.300	0.16	0.16	0.060	0.030
					0.16	0.16		
25	1.00	0.195	0.350	0.300	0.16	0.16	0.060	0.030
					0.16	0.16		
26	1.00	0.195	0.350	0.300	0.16	0.16	0.060	0.030
					0.16	0.16		
27	1.00	0.195	0.350	0.300	0.16	0.16	0.060	0.030
					0.16	0.16		
28	1.00	0.195	0.350	0.300	0.16	0.16	0.060	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" DIGITAL MIC
MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR-TUMICO

Inspector: T. Lizzom
Date: 9 APR 18

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

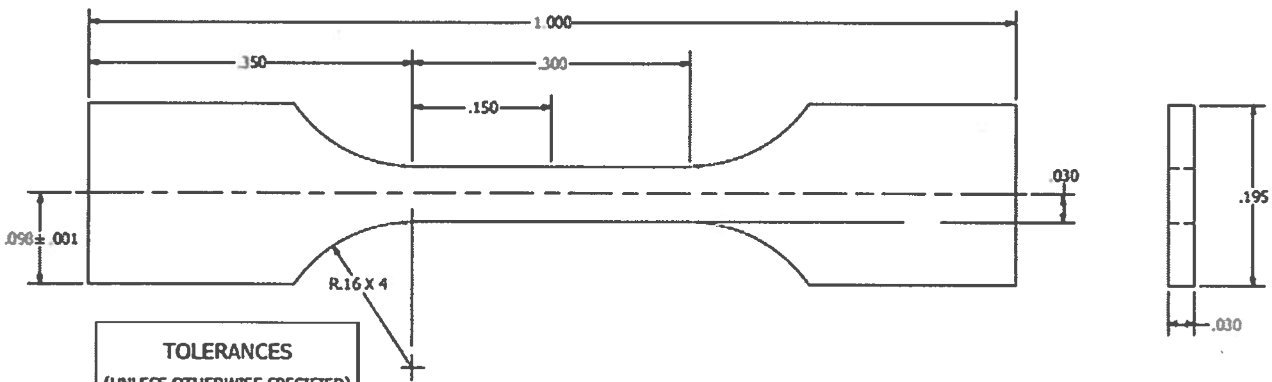
NOTE 1 - SPECIMEN THICKNESS CUT AT ANGLE RESULTING IN VARYING THICKNESS

Key: TH = Thickness GL = Gage Length

AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FC01 - 11	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
12	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
13	1.00	0.195	0.350	0.300	0.16 0.14	0.16 0.16	0.058	0.030
14	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
15	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
16	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
17	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
18	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	NOTE 1

Instrument:	1-0000-7161	Instrument:	1-0000-1280	Inspector:	T. CROOM
Cal Date:	5-24-17	Cal Date:	5-24-17		
Due Date:	5-24-18	Due Date:	5-24-18	Date:	12 APR 18
	0-6" DIGITAL MIC		OPTICAL COMPARATOR		
	MITUTOYO		SCHERR - TUMICO		

Zion SS3 Specimen



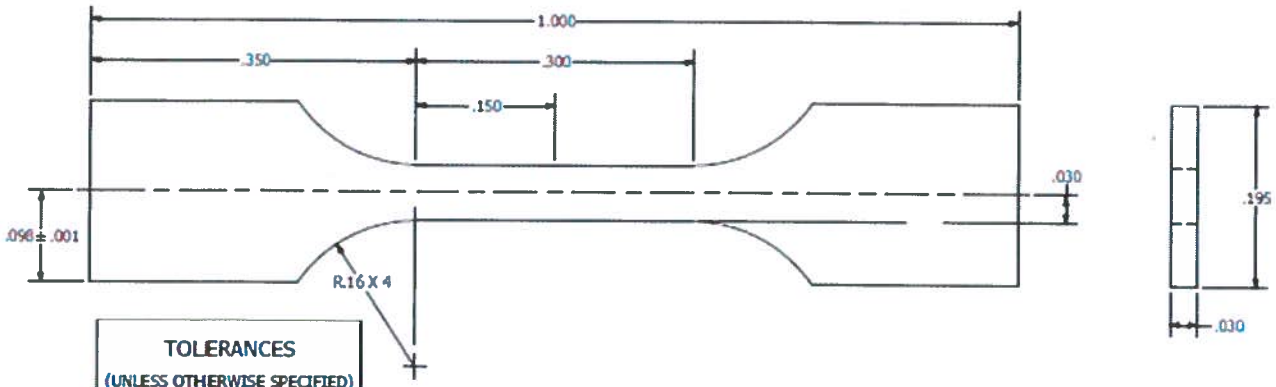
TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FC22-21	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
22	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
23	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
24	1.00	0.195	0.350	0.500	0.16 0.16	0.16 0.16	0.058	0.030
25	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
26	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
27	1.00	0.195	0.350	0.300	0.16 0.14	0.16 0.16	0.058	0.030
28	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument:	1-0000-7161	Instrument:	1-0000-1280	Inspector:	[signature] T. Crzoom
Cal Date:	5-24-17	Cal Date:	5-24-17		
Due Date:	5-24-18	Due Date:	5-24-18	Date:	12Apr18
	0-6" DIGITAL MIC MITUTOYO		OPTICAL COMPARATOR SCHERR - TUMICO		

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

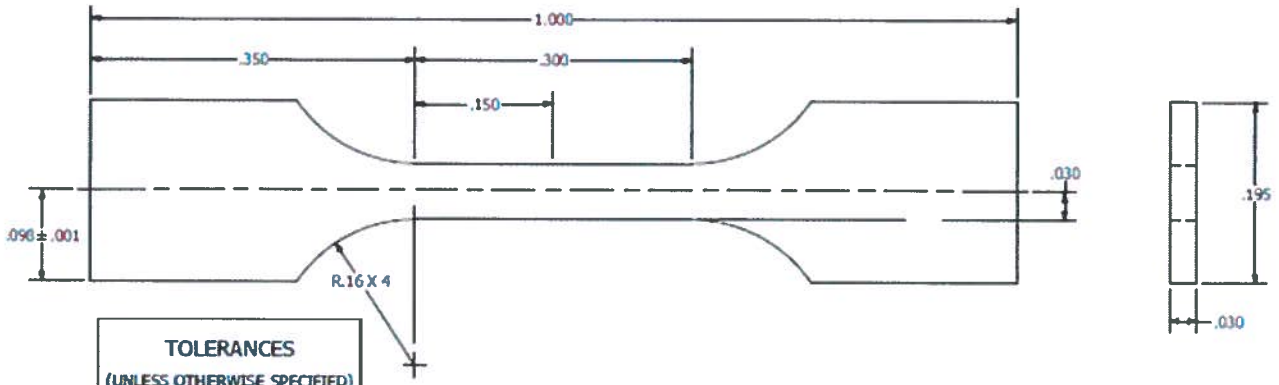
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FE01 - 11	1.00	0.195	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
12	1.00	0.195	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
13	1.00	0.195	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
14	1.00	0.195	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
15	1.00	0.195	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
16	1.00	0.195	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
17	1.00	0.195	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		
18	1.00	0.195	0.350	0.300	0.16	0.16	0.058	0.030
					0.16	0.16		

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" DIGIMATIC
MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR - TUMICO

Inspector: T. Croom
Date: 12/22/18

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

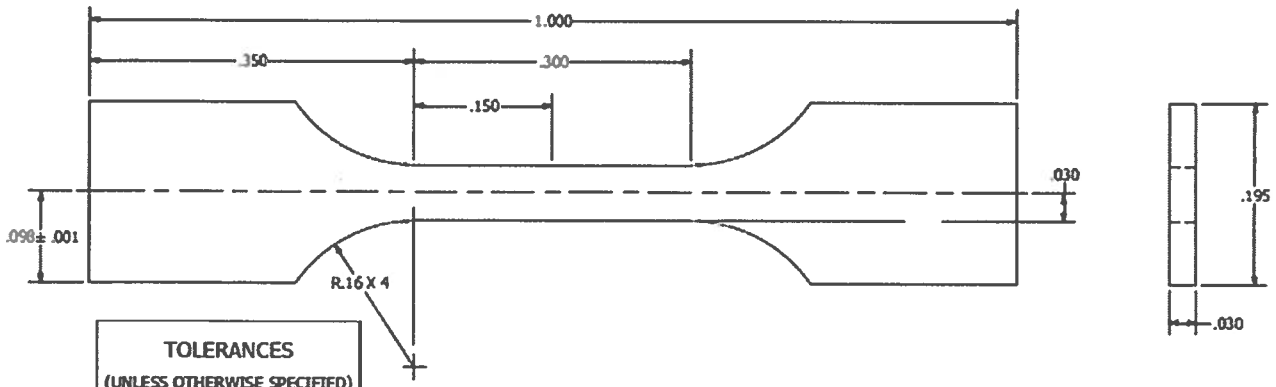
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FE 22-21	1.00	0.195	0.350	0.300	0.16 0.14	0.16 0.16	0.058	0.030
22	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.14	0.058	0.030
23	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0058	0.030
24	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
25	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
26	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
27	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
28	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" DIGITAL MIC
MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHEZZ - TUMICA

Inspector: T. Crum
Date: 12.2.18

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

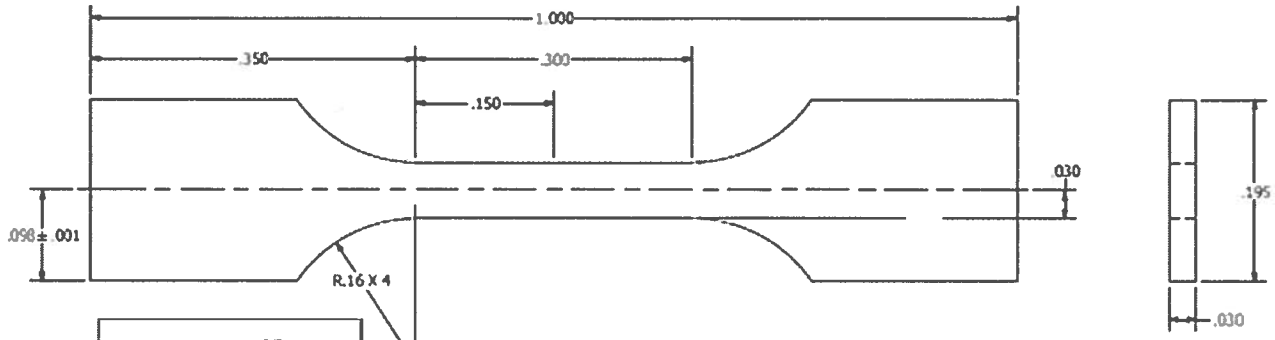
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FG01 - 11	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
12	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
13	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
14	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
15	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
16	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
17	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
18	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" DIGITAL MIC
MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR - TUMICO

Inspector: T. Croom
Date: 12 A.J. 18

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

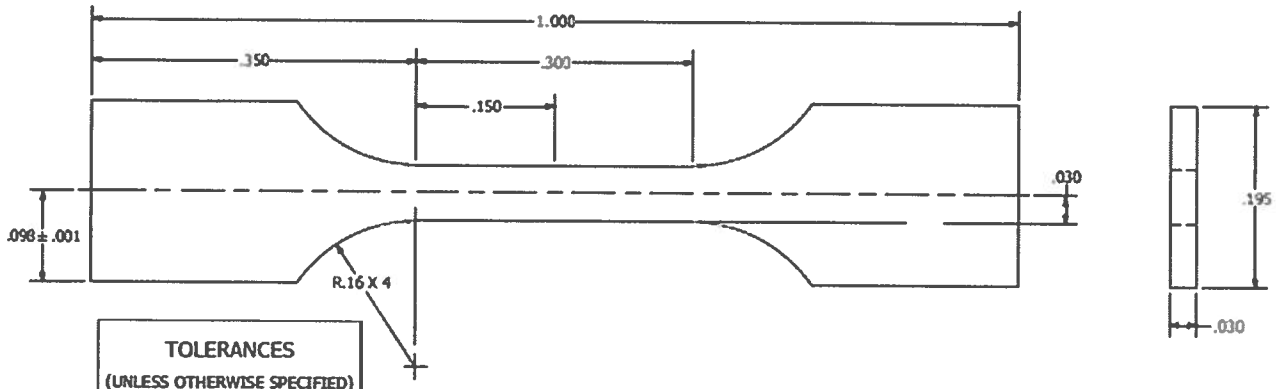
NOTE 1 - SPECIMEN REJECTED DUE TO BENDING IN VICE DURRING MACHINING

Key: TH = Thickness GL = Gage Length

AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
F622 - 21	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
22	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
23	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
24	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
25	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
26	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
27	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
28	NOTE 1							

Instrument:	1-0000-7161	Instrument:	1-0000-1280	Inspector:	T. Wilcom
Cal Date:	5-24-17	Cal Date:	5-24-17		
Due Date:	5-24-18	Due Date:	5-24-18	Date:	12 APR 18
	0-6" DIGITAL MIC MITUTOYO		OPTICAL COMPARATOR SCHERR-TUMICO		

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

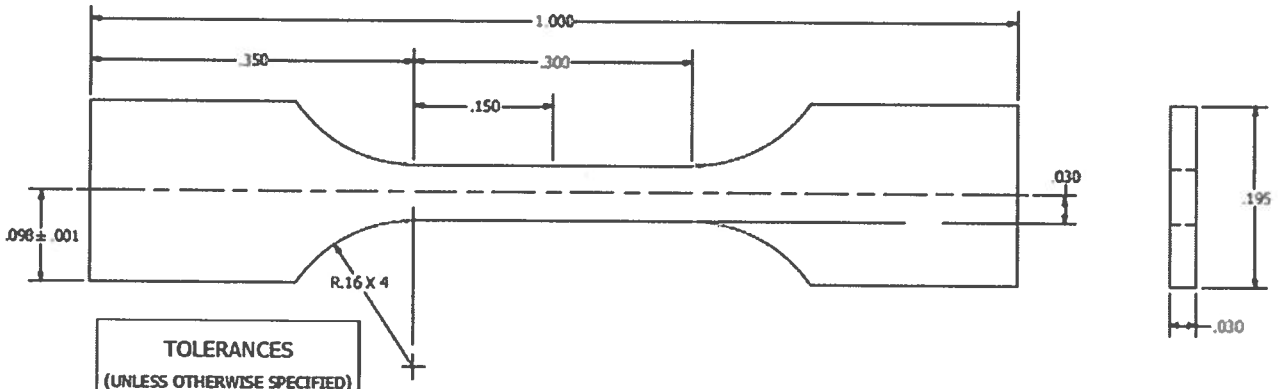
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FI01 - 11	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
12	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
13	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
14	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
15	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
16	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
17	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
18	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" DIGITAL MIC
MITUTOYO

Instrument: 1-0000-1780
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR - TUMICO

Inspector: T. Croom
Date: 12 APR 18

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

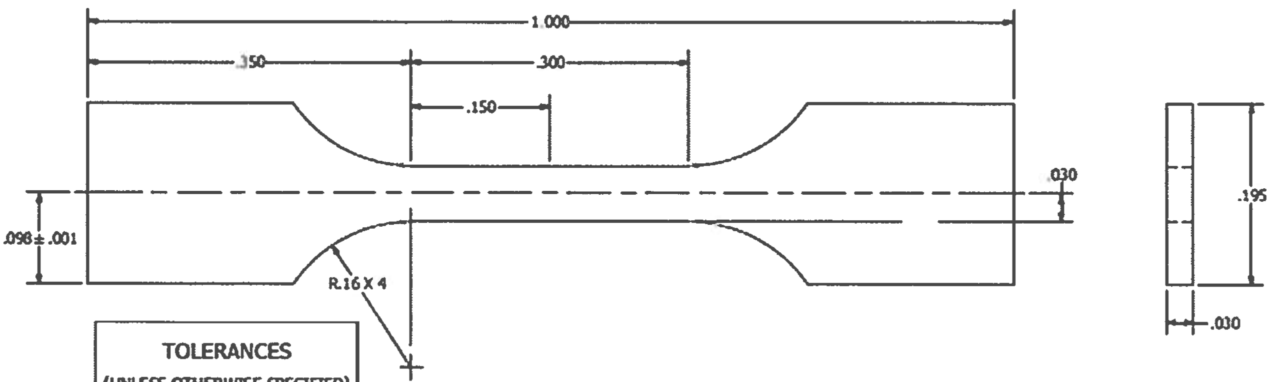
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FI 22 - 21	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
22	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
23	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
24	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
25	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
26	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
27	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
28	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" MITUTOYO DIGITAL MIC

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR SCHERR-TUMICO

Inspector: T. CROOM
Date: 12APR18

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

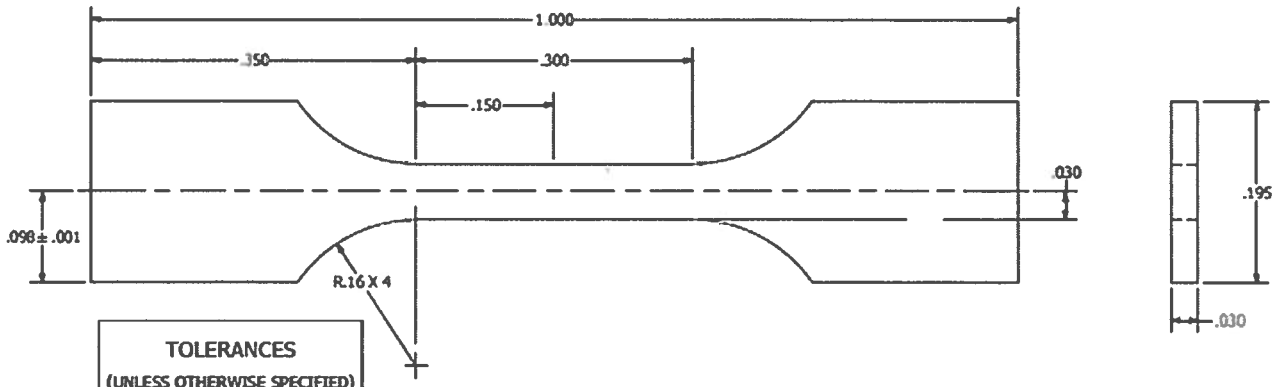
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FK01 - 11	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
12	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
13	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
14	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
15	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
16	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
17	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
18	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" DIGITAL MIC
MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR - TUMICO

Inspector: [signature] TICUROOM
Date: 12 APR 18

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

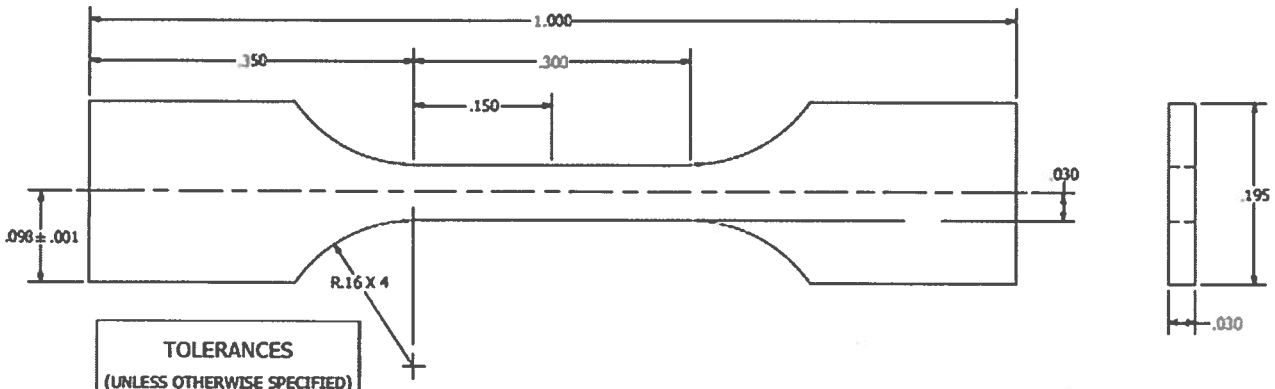
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FK22 - 21	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
22	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
23	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
24	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
25	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
26	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
27	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
28	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" DIGITAL MIC
MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHEER-TUMICO

Inspector: T.C. Loom
Date: 12APR18

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FM01-11	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
12	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
13	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
14	1.00	0.195	0350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
15	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
16	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
17	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
18	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

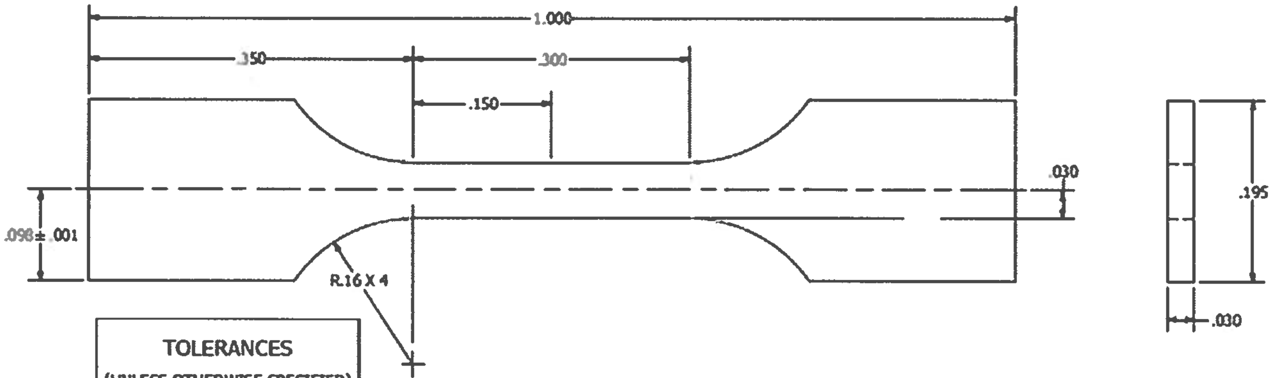
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 9 APR 18

0-6" DIGITAL MIC OPTICAL COMPARATOR

MITUTOYO SCHERR-TUMICO

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

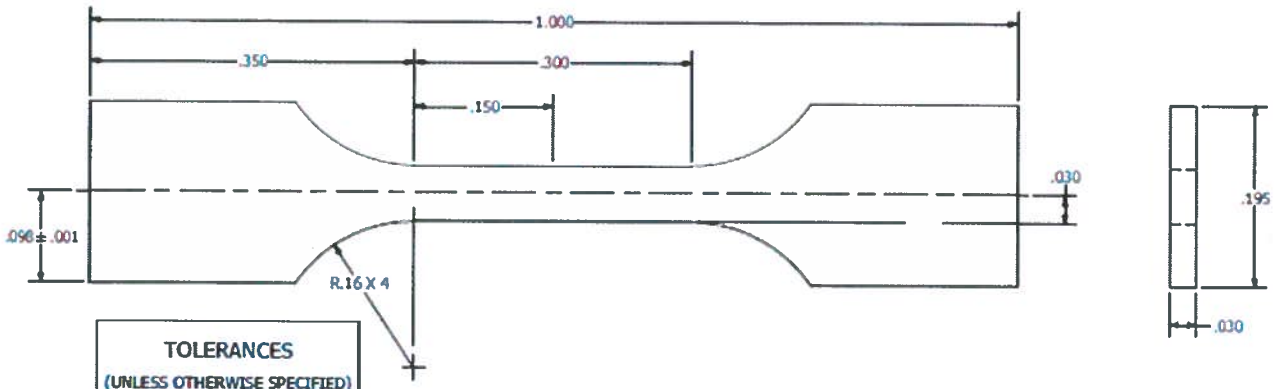
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FM22-21	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
22	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
23	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
24	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
25	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
26	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
27	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
28	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" MITUTOYO DIGITAL MIC

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR SCHERR-TUMICO

Inspector: [signature] T. Lizzoon
Date: 9 APR 18

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

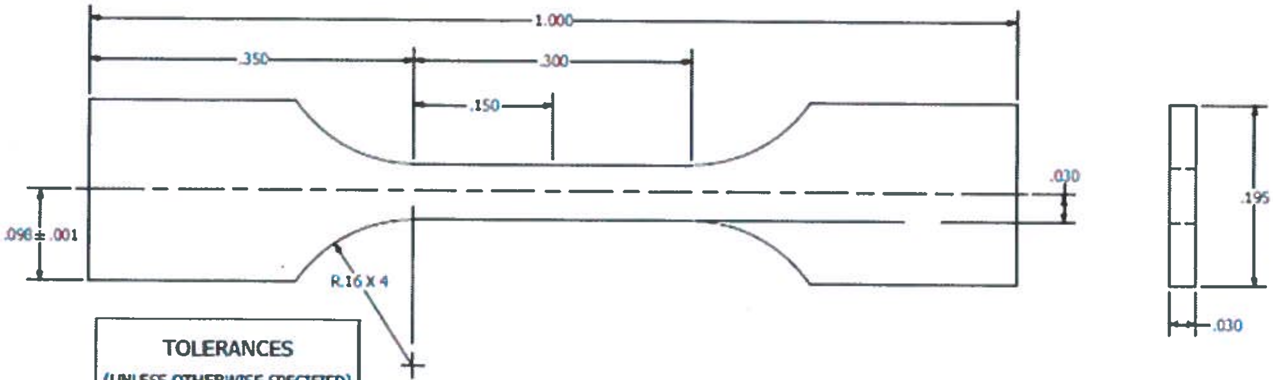
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
F0 01 - 11	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
12	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
13	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
14	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
15	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
16	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
17	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
18	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" MITUTOYO DIGITAL MIC

Instrument: 1-0000-1240
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR SCHERR-TUMICO

Inspector: T. Croom
Date: 9 April 18

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

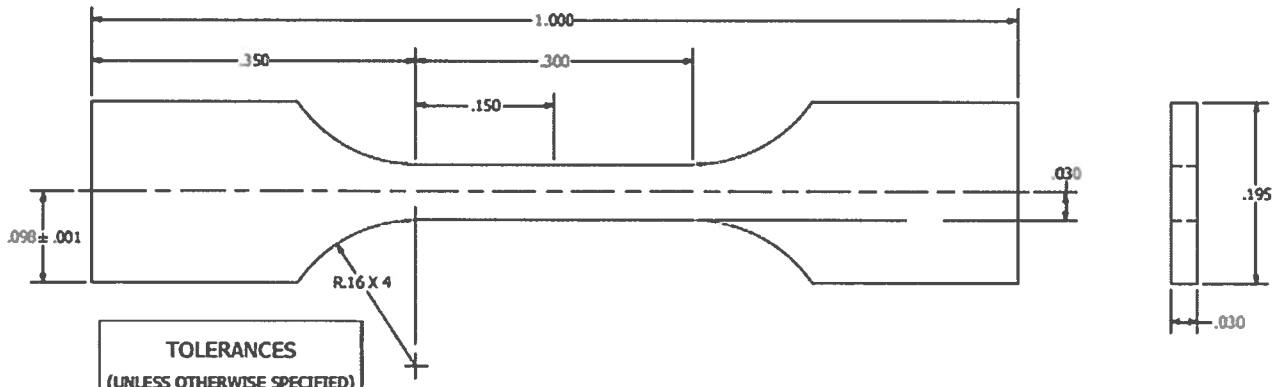
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
F022- 21	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
22	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
23	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
24	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
25	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
26	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
27	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
28	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" DIGITAL MIC
MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR-TUMICO

Inspector: [signature]
Date: 9APR18

Zion SS3 Specimen



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

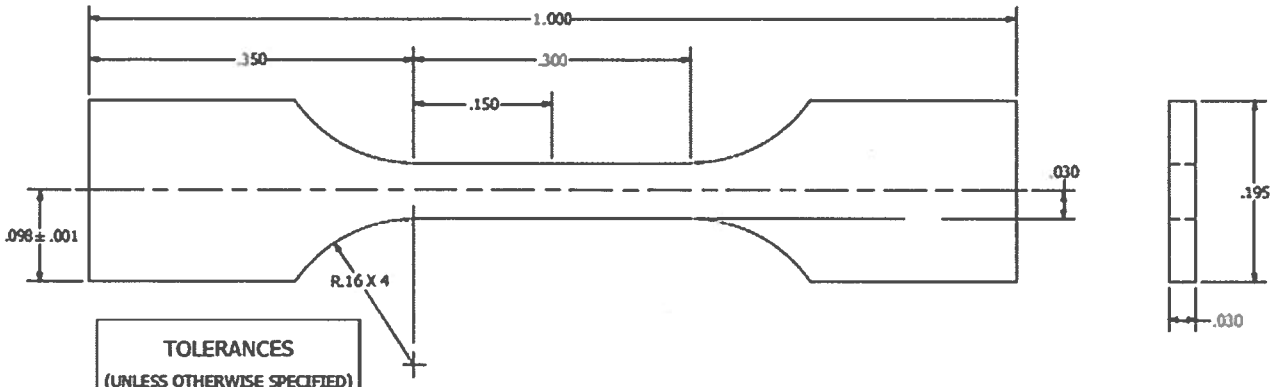
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FQ01 - 11	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
12	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
13	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
14	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
15	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
16	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
17	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
18	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" DIGITAL mic
MITUTOYO

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHEID - TUMICO

Inspector: T. Gibson
Date: 9/27/18

Zion SS3 Specimen



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

Key: TH = Thickness GL = Gage Length

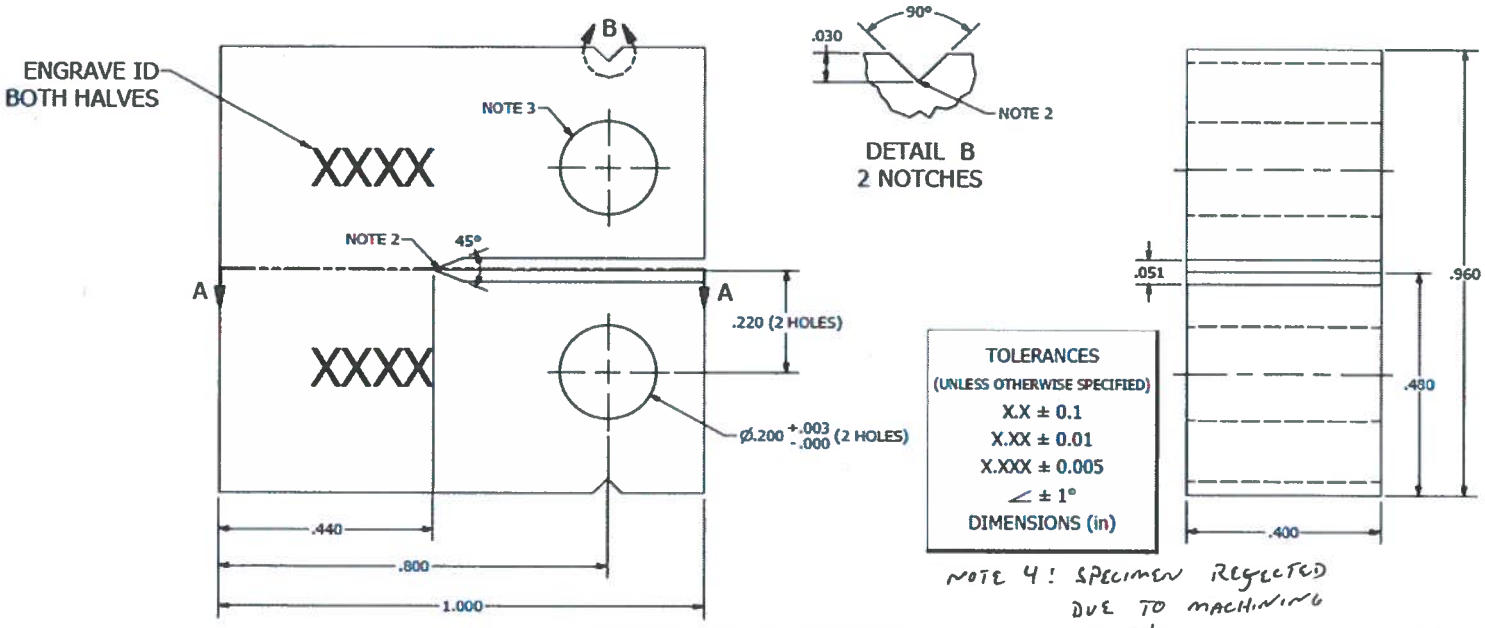
AS MACHINED DIMENSIONS								
SPECIMEN I.D.	"1.00"	"0.195"	"0.350"	"0.300"	"R0.16"		GL "0.060"	TH "0.030"
FA22 - 21	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
22	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
23	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
24	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
25	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
26	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
27	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030
28	1.00	0.195	0.350	0.300	0.16 0.16	0.16 0.16	0.058	0.030

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
0-6" MITUTOYO
DIGITAL MIC

Instrument: 1-0000-1280
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR - TUMICO

Inspector: T. Gibson
Date: 9 APR 18

Zion 0.4 C(T) Specimen



NOTE 4: SPECIMEN REJECTED DUE TO MACHINING ANOMOLY

Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.000"	"0.960"	"0.800"	"0.440"	"45.0°"	"0.030"	"90.0°"	"0.220"	"0.200"	"0.400"	"0.480"	"0.051"
FB-01	1.003	0.961	0.799	0.445	45.0°	0.028	90.0°	T 0.220	T 0.200	0.402	0.475	0.050
						0.028	90.0°	B 0.220	B 0.200			
02	1.003	0.961	0.799	0.443	45.0°	0.028	90.0°	T 0.220	T 0.200	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B 0.200			
03	NOTE 4							T	T			
								B	B			
04	1.003	0.961	0.799	0.442	45.0°	0.028	90.0°	T 0.220	T 0.203	0.402	0.475	0.050
						0.028	90.0°	B 0.220	B 0.203			
05	1.002	0.960	0.799	0.442	45.0°	0.028	90.0°	T 0.220	T 0.202	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
06	1.001	0.961	0.799	0.442	45.0°	0.026	90.0°	T 0.220	T 0.203	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
07	1.001	0.960	0.799	0.442	45.0°	0.028	90.0°	T 0.220	T 0.203	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
08	1.001	0.960	0.799	0.442	45.0°	0.028	90.0°	T 0.220	T 0.203	0.402	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
09	1.000	0.960	0.799	0.442	45.0°	0.028	90.0°	T 0.220	T 0.202	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
10	1.001	0.961	0.799	0.442	45.0°	0.028	90.0°	T 0.220	T 0.202	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Cram

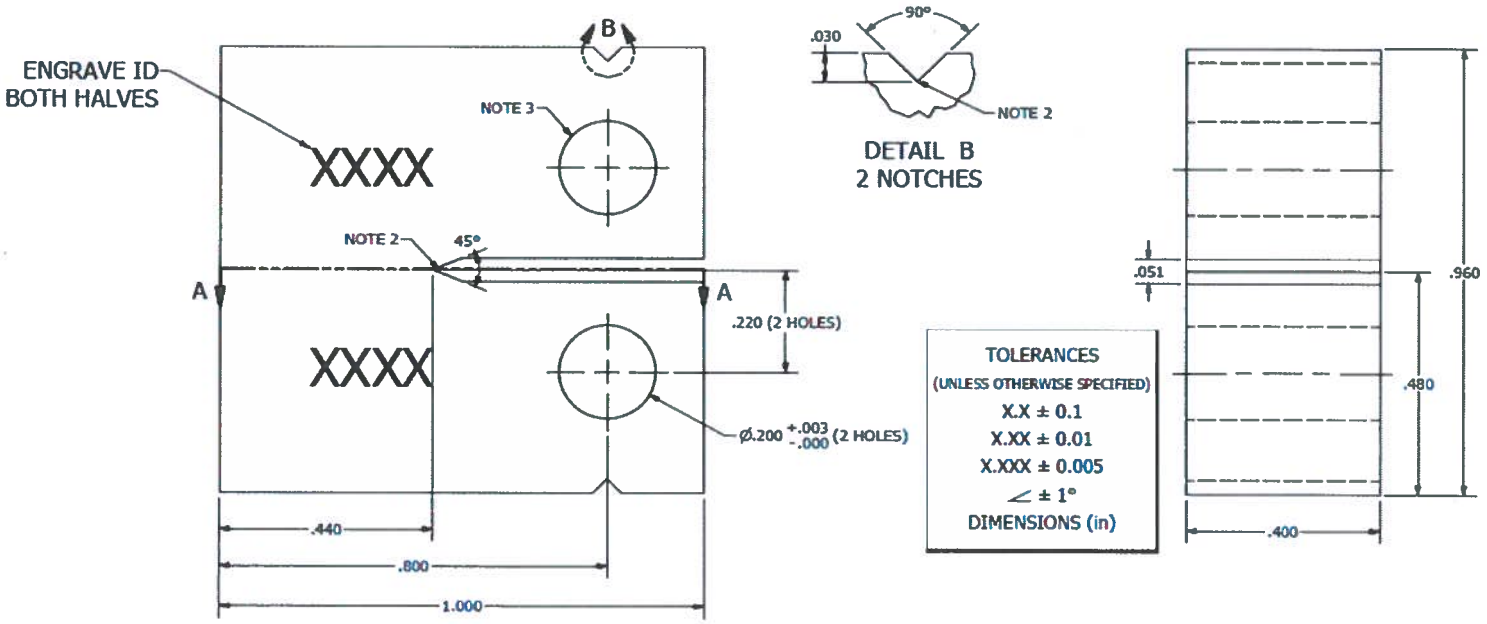
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 24 APR 18

0-6" DIGITAL MIC MITUTOYO

OPTICAL COMPARATOR SCHERR-TUMICO

Zion 0.4 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.000"	"0.960"	"0.800"	"0.440"	"45.0°"	"0.030"	"90.0°"	"0.220"	"0.200"	"0.400"	"0.480"	"0.051"
FD - 01	1.003	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
02	1.001	0.960	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.402	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
03	1.001	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.402	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
04	1.001	0.960	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.402	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
05	1.001	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
06	1.001	0.960	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.203	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
07	1.000	0.960	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.402	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
08	1.000	0.960	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
09	1.001	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.402	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
10	1.001	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B			

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

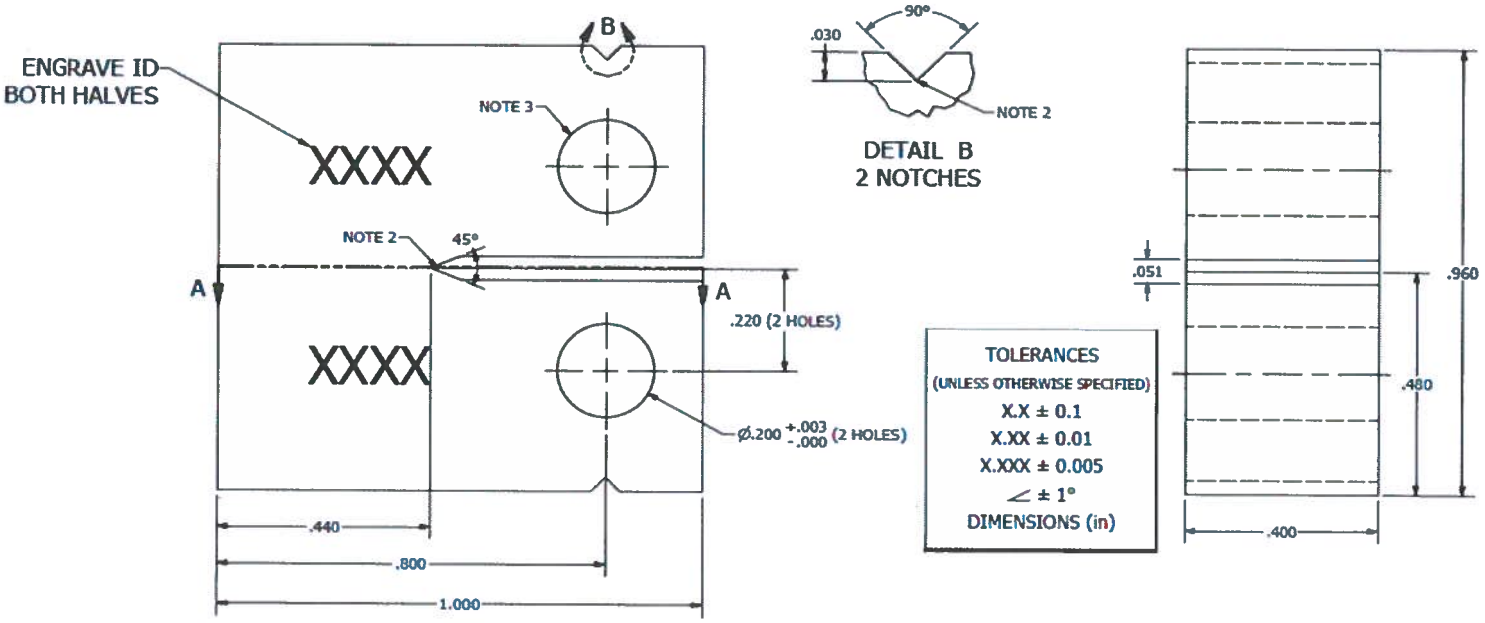
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 24 Apr 2018

0-6" DIGITAL MIC — OPTICAL COMPARATOR

MITUTOYO — SCHERR - TUMICO

Zion 0.4 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.000"	"0.960"	"0.800"	"0.440"	"45.0°"	"0.030"	"90.0°"	"0.220"	"0.200"	"0.400"	"0.480"	"0.051"
FF - 01	1.002	0.960	0.800	0.442	45.0°	0.028	90.0°	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
02	1.001	0.960	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
03	1.002	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.203	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
04	1.002	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
05	1.001	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.203	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
06	1.001	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
07	1.001	0.960	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
08	1.001	0.960	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
09	1.001	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
10	1.001	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

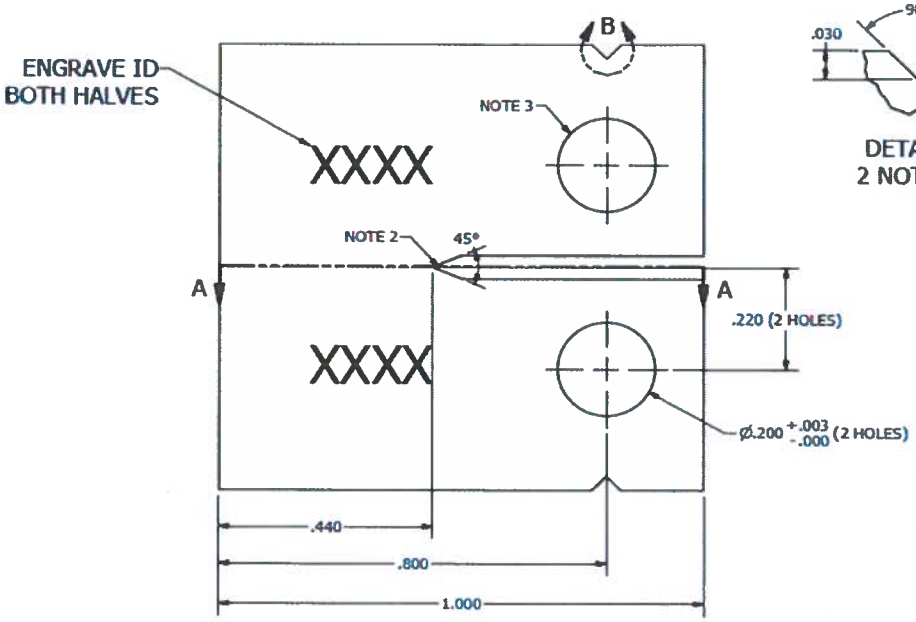
Cal Date: 5-24-17 Cal Date: 5-24-17

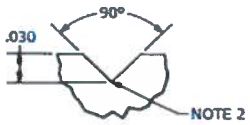
Due Date: 5-24-18 Due Date: 5-24-18 Date: 24 APR 18

0-6" DIGITAL MIC — OPTICAL COMPARATOR

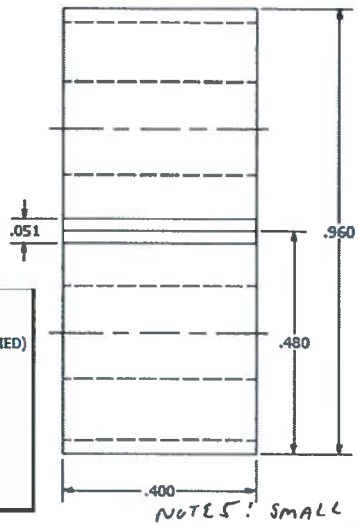
MITUTOYO — SCHEER - TUMICO

Zion 0.4 C(T) Specimen





DETAIL B
2 NOTCHES



TOLERANCES
(UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

NOTE 4: SPECIMEN HOLES SCALLOPED DUE TO MACHINING ANOMOLY

NOTE 5: SMALL KNIC ON SIDE OF SAMPLE DUE TO ALL-FALL PIECE BEING CHARGED

Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.000"	"0.960"	"0.800"	"0.440"	"45.0°"	"0.030"	"90.0°"	"0.220"	"0.200"	"0.400"	"0.480"	"0.051"
FH - 01	1.000	0.961	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.203 B 0.203	0.401	0.480	0.050
02	1.001	0.960	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.203 B 0.203	0.401	0.480	0.050
03	1.001	0.961	0.800	0.442	45.0°	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T NOTE 4 B	0.401	0.480	0.050
04	1.001	0.960	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.202 B 0.202	0.401	0.480	0.050
NOTE 5 05	1.000	0.961	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.202 B 0.202	0.401	0.480	0.050
06	1.000	0.961	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.203 B 0.203	0.401	0.480	0.050
07	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.203 B 0.203	0.401	0.480	0.050
08	1.000	0.960	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.203 B 0.203	0.400	0.480	0.050
09	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.203 B 0.203	0.401	0.480	0.050
10	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.202 B 0.202	0.401	0.480	0.050

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

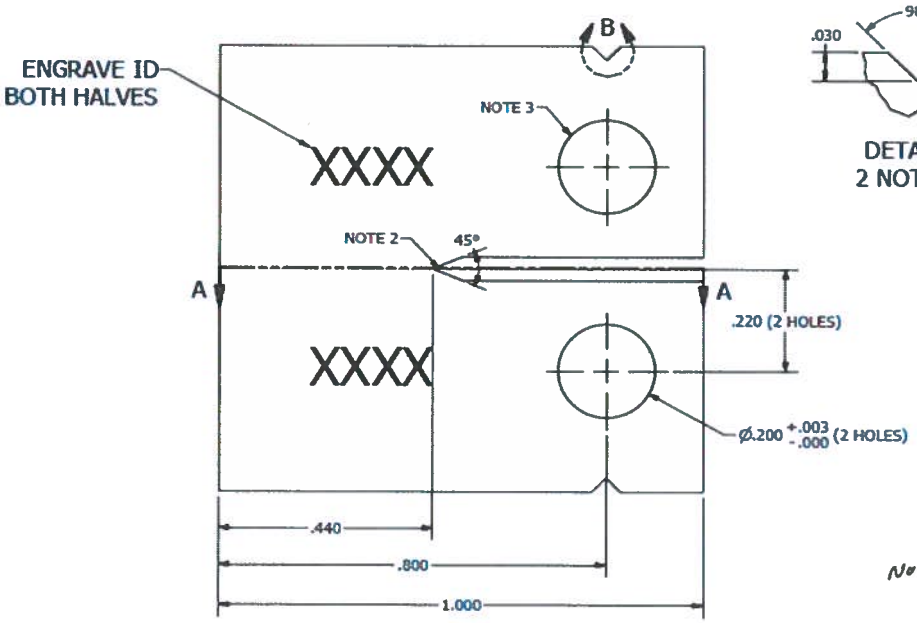
Cal Date: 5-24-17 Cal Date: 5-24-17

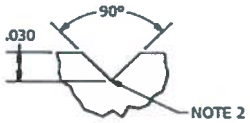
Due Date: 5-24-18 Due Date: 5-24-18 Date: 24 APR 18

0-6" DIGITAL MIC
MITUTOYO

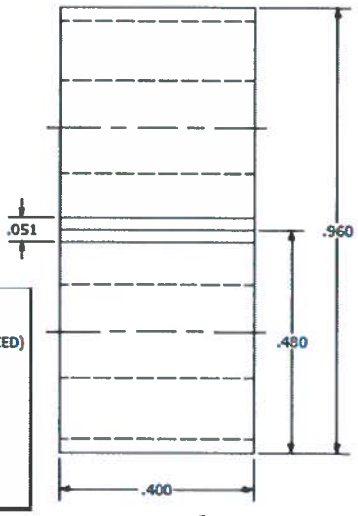
OPTICAL COMPARATOR
SCHERR-TUMICO

Zion 0.4 C(T) Specimen





DETAIL B
2 NOTCHES



TOLERANCES (UNLESS OTHERWISE SPECIFIED)
X.X ± 0.1
X.XX ± 0.01
X.XXX ± 0.005
∠ ± 1°
DIMENSIONS (in)

NOTE 4: SPECIMEN REJECTED DUE TO MISSMACHINING ALL SPECS OUT OF TOLERANCE

NOTE 5: SMALL KNICK ON SIDE OF SAMPLE DUE TO ALL-FALL PIECE BEING CHARGED

Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.000"	"0.960"	"0.800"	"0.440"	"45.0°"	"0.030"	"90.0°"	"0.220"	"0.200"	"0.400"	"0.480"	"0.051"
FJ-01	1.002	0.960	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.203 B 0.203	0.402	0.480	0.050
02	1.001	0.960	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.203 B 0.203	0.402	0.480	0.050
03	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.202 B 0.202	0.402	0.480	0.050
04	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.202 B 0.202	0.402	0.480	0.050
05	NOTE 4							T B	T B			
06	1.000	0.960	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.203 B 0.203	0.402	0.480	0.050
NOTE 5 07	1.001	0.960	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.202 B 0.202	0.402	0.480	0.050
08	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.203 B 0.203	0.401	0.480	0.050
09	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.203 B 0.203	0.402	0.480	0.050
10	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0° 90.0°	T 0.220 B 0.220	T 0.203 B 0.203	0.402	0.480	0.050

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Crocom

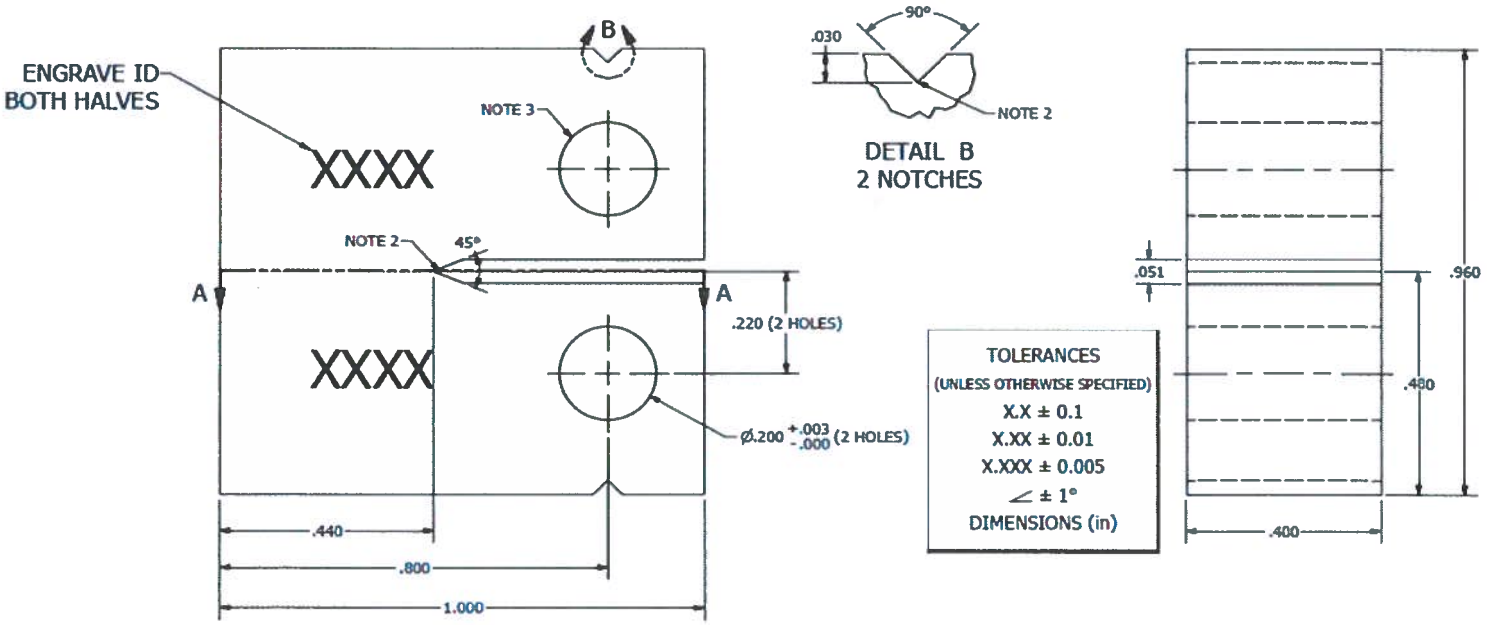
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 24 APR 18

0-6" ~~OPTICAL COMPR~~ TR
DIGITAL MIC
MITUTOYO

OPTICAL COMPARATOR
SCHERR-TUMICO

Zion 0.4 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.000"	"0.960"	"0.800"	"0.440"	"45.0°"	"0.030"	"90.0°"	"0.220"	"0.200"	"0.400"	"0.480"	"0.051"
FL - 01	1.001	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.202	0.401	0.480	0.050
						0.028	90.0°	B 0.220	B 0.202			
02	1.001	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
03	1.001	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
04	1.001	0.960	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
05	1.001	0.960	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
06	1.001	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
07	1.001	0.960	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
08	0.995	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
09	1.001	0.961	0.800	0.442	45.0	0.028	90.0°	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0°	B 0.220	B 0.203			
10	1.001	0.961	0.800	0.442	45.0	0.028	90.0	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0	B 0.220	B 0.203			

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Croom

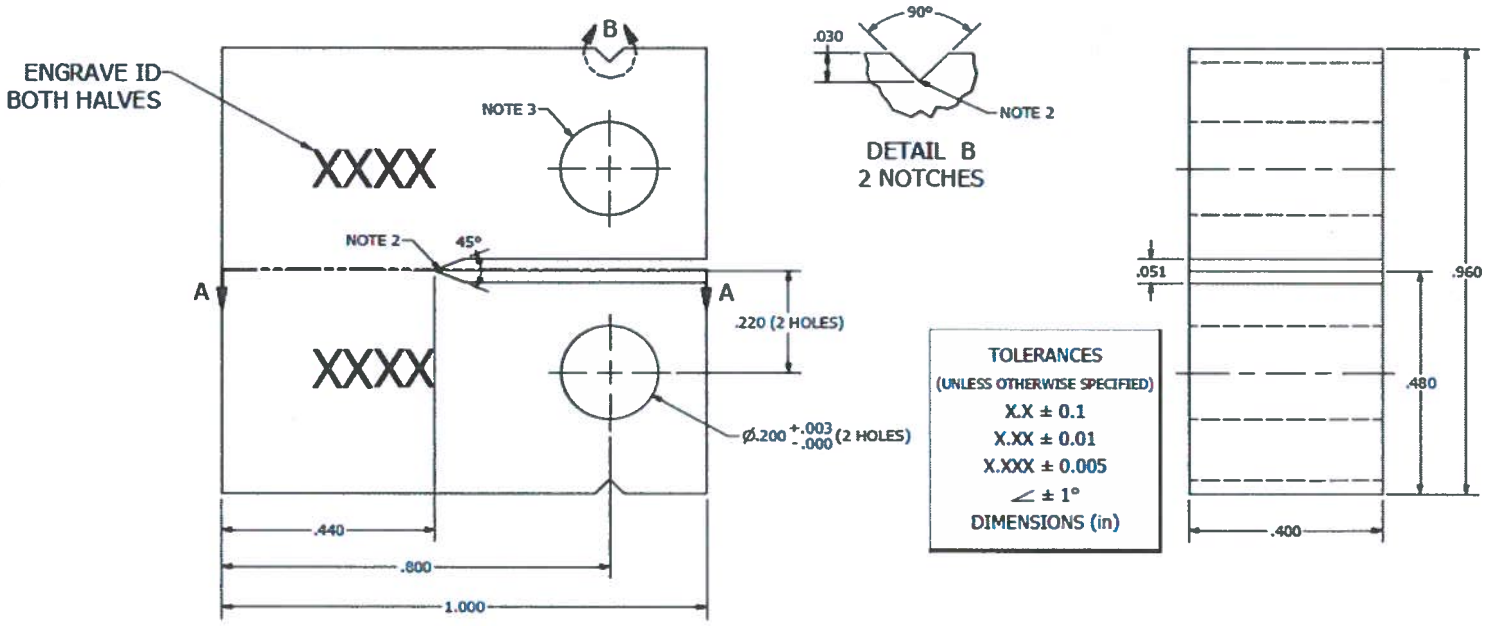
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 24 APR 18

0-6" DIGITAL MIC
MITUTOYO

OPTICAL COMPARATOR
SCHK22 - TUMICO

Zion 0.4 C(T) Specimen



Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.000"	"0.960"	"0.800"	"0.440"	"45.0°"	"0.030"	"90.0°"	"0.220"	"0.200"	"0.400"	"0.480"	"0.051"
FN - 01	1.001	0.961	0.800	0.442	45.0	0.028	90.0	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0	B 0.220	B 0.203			
02	1.001	0.961	0.800	0.442	45.0	0.028	90.0	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0	B 0.220	B 0.203			
03	1.001	0.961	0.800	0.442	45.0	0.028	90.0	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0	B 0.220	B 0.203			
04	1.001	0.961	0.800	0.442	45.0	0.028	90.0	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0	B 0.220	B 0.203			
05	1.001	0.961	0.800	0.442	45.0	0.028	90.0	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0	B 0.220	B 0.203			
06	1.001	0.961	0.800	0.442	45.0	0.028	90.0	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0	B 0.220	B 0.203			
07	1.001	0.961	0.800	0.442	45.0	0.028	90.0	T 0.220	T 0.203	0.400	0.480	0.050
						0.028	90.0	B 0.220	B 0.203			
08	1.000	0.961	0.800	0.442	45.0	0.028	90.0	T 0.220	T 0.203	0.401	0.480	0.050
						0.028	90.0	B 0.220	B 0.203			
09	1.001	0.960	0.800	0.442	45.0	0.028	90.0	T 0.220	T 0.203	0.401	0.480	0.050
						0.028	90.0	B 0.220	B 0.203			
10	1.001	0.960	0.800	0.442	45.0	0.028	90.0	T 0.220	T 0.203	0.402	0.480	0.050
						0.028	90.0	B 0.220	B 0.203			

Instrument: 1-0000-7161 Instrument: 1-0000-128 Inspector: T. Clemons

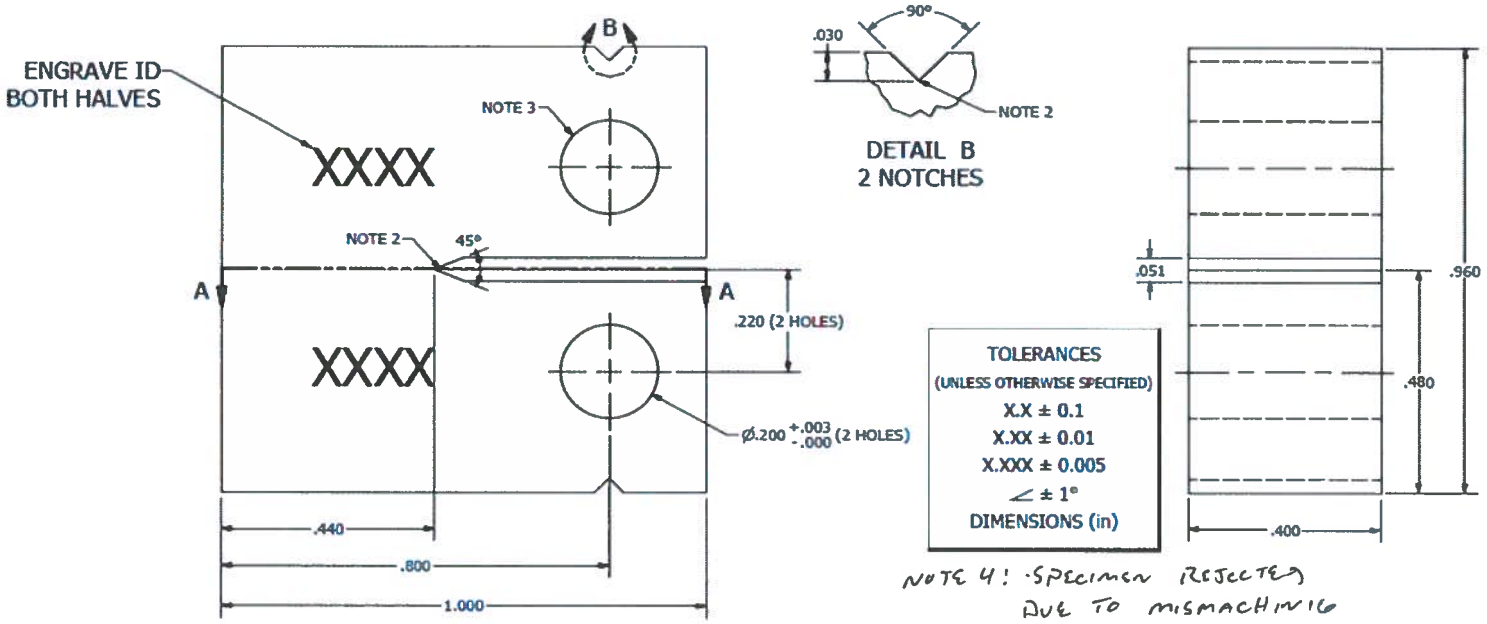
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 24.7.2.18

0-6" DIGITAL MIC
MITUTOYO

OPTICAL COMPARITOR
SCHERR-TUMICO

Zion 0.4 C(T) Specimen



NOTE 4: SPECIMEN REJECTED DUE TO MISMACHINING

Key: T = Top, B = Bottom

AS MACHINED DIMENSIONS												
SPECIMEN I.D.	"1.000"	"0.960"	"0.800"	"0.440"	"45.0°"	"0.030"	"90.0°"	"0.220"	"0.200"	"0.400"	"0.480"	"0.051"
FP-01	1.001	0.961	0.800	0.442	45.0	T 0.028 B 0.028	90.0 90.0	T 0.220 B 0.220	T 0.203 B 0.203	0.405	0.480	0.050
02	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0 90.0	T 0.220 B 0.220	T 0.203 B 0.203	0.404	0.480	0.050
03	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0 90.0	T 0.220 B 0.220	T 0.203 B 0.203	0.403	0.480	0.050
04	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0 90.0	T 0.220 B 0.220	T 0.203 B 0.203	0.402	0.480	0.050
05	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0 90.0	T 0.220 B 0.220	T 0.203 B 0.203	0.400	0.480	0.050
06	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0 90.0	T 0.220 B 0.220	T 0.203 B 0.203	0.400	0.480	0.050
07	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0 90.0	T 0.220 B 0.220	T 0.203 B 0.203	0.400	0.480	0.050
08	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0 90.0	T 0.220 B 0.220	T 0.203 B 0.203	0.400	0.480	0.050
09	NOTE 4							T B	T B			
10	1.001	0.961	0.800	0.442	45.0	0.028 0.028	90.0 90.0	T 0.220 B 0.220	T 0.203 B 0.203	0.400	0.480	0.050

Instrument: 1-0000-7161 Instrument: 1-0000-1280 Inspector: T. Crowe

Cal Date: 5-24-17 Cal Date: 5-24-17

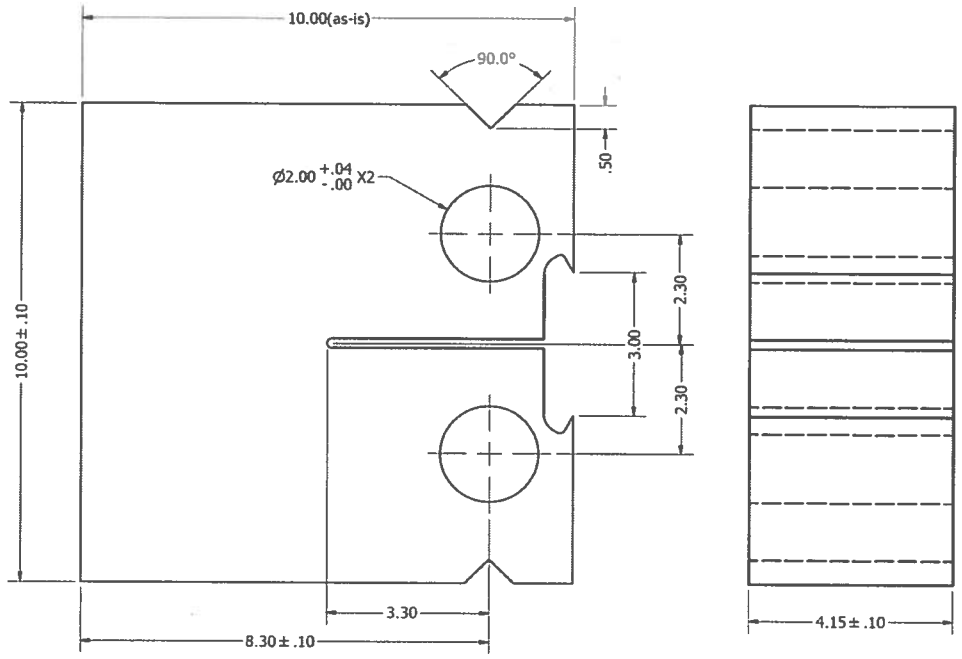
Due Date: 5-24-18 Due Date: 5-24-18 Date: 24APR18

0-6" DIGITAL MIC — OPTICAL COMPARATOR

MITUTOYO — SCHERR - TUMICO

Miniature Compact Tension Specimens
Block CF
Block F4
Block F3

ORNL mini-C(T) Specimen



ALL DIMENSIONS ARE IN (mm)
ALL TOLERANCES ARE ±0.04 (mm) UNLESS OTHERWISE NOTED

Key: T = Top, B = Bottom, GL = Gage Length

AS MACHINED DIMENSIONS										
SPECIMEN I.D.	"10.00"	"10.00(as-is)"	"8.30"	"3.30"	GL "3.00"	"2.30"	"2.00"	"4.15"	"0.50"	"90.0°"
FA01-1	10.02	10.04	8.30	3.34	3.04	T 2.30	T 2.00	4.15	0.50	90.0°
						B 2.30	B 2.00		0.50	90.0°
2	10.00	10.01	8.30	3.30	3.04	T 2.30	T 2.00	4.15	0.50	90.0°
						B 2.30	B 2.00		0.50	90.0°
3	10.01	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.15	0.50	90.0°
						B 2.30	B 2.00		0.50	90.0°
FA02-1	10.00	9.92	8.26	3.30	3.04	T 2.30	T 2.00	4.15	0.50	90.0°
						B 2.30	B 2.00		0.50	90.0°
2	10.00	9.92	8.26	3.30	3.04	T 2.30	T 2.00	4.15	0.50	90.0°
						B 2.30	B 2.00		0.50	90.0°
3	10.00	9.92	8.26	3.30	3.04	T 2.30	T 2.00	4.15	0.50	90.0°
						B 2.30	B 2.00		0.50	90.0°
4	10.00	9.92	8.26	3.30	3.04	T 2.30	T 2.00	4.15	0.50	90.0°
						B 2.30	B 2.00		0.50	90.0°
FA09-1	10.01	10.01	8.30	3.30	3.04	T 2.30	T 2.00	4.15	0.50	90.0°
						B 2.30	B 2.00		0.50	90.0°
2	10.01	10.01	8.30	3.30	3.04	T 2.30	T 2.00	4.15	0.50	90.0°
						B 2.30	B 2.00		0.50	90.0°

Instrument: 1-0000-7161

Cal Date: 5-24-17

Due Date: 5-24-18

0-6" DIGITAL MIC

MITUTOYO

Instrument: 1-0000-1280

Cal Date: 5-24-17

Due Date: 5-24-18

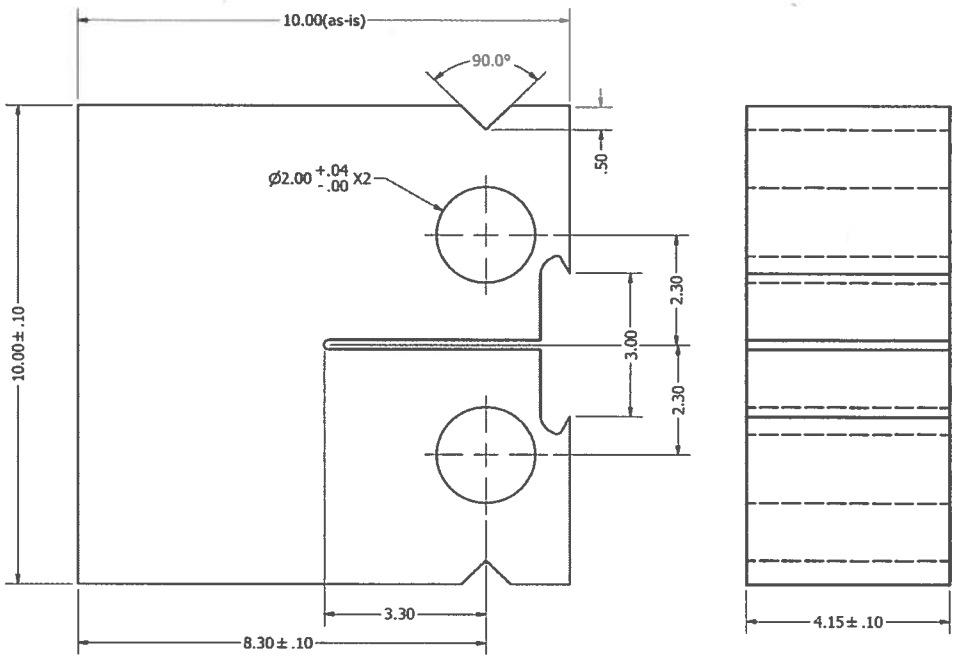
OPTICAL COMPARATOR

SCHERR-TUMICO

Inspector: [signature]

Date: 23 APR 18

ORNL mini-C(T) Specimen



ALL DIMENSIONS ARE IN (mm)
ALL TOLERANCES ARE ±0.04 (mm) UNLESS OTHERWISE NOTED

Key: T = Top, B = Bottom, GL = Gage Length

AS MACHINED DIMENSIONS										
SPECIMEN I.D.	"10.00"	"10.00(as-is)"	"8.30"	"3.30"	GL "3.00"	"2.30"	"2.00"	"4.15"	"0.50"	"90.0°"
HA1 - 1	10.00	9.97	8.30	3.30	3.04	T 2.31	T 2.00	4.07	0.48	90.0°
						B 2.31	B 2.00		0.48	90.0°
2	9.98	10.01	8.30	3.30	3.02	T 2.31	T 2.00	4.08	0.48	90.0°
						B 2.31	B 2.00		0.48	90.0°
3	9.98	9.98	8.30	3.30	3.04	T 2.31	T 2.00	4.09	0.48	90.0°
						B 2.31	B 2.00		0.48	90.0°
4	9.98	9.99	8.30	3.30	3.04	T 2.31	T 2.00	4.09	0.48	90.0°
						B 2.31	B 2.00		0.48	90.0°
5	9.98	9.99	8.30	3.30	3.04	T 2.31	T 2.00	4.08	0.48	90.0°
						B 2.31	B 2.00		0.48	90.0°
6	9.98	9.98	8.30	3.30	3.04	T 2.31	T 2.00	4.13	0.48	90.0°
						B 2.31	B 2.00		0.48	90.0°
7	10.02	10.01	8.30	3.30	3.04	T 2.31	T 2.00	4.10	0.48	90.0°
						B 2.31	B 2.00		0.48	90.0°
8	10.02	10.00	8.30	3.30	3.04	T 2.31	T 2.00	4.10	0.48	90.0°
						B 2.31	B 2.00		0.48	90.0°
9	9.98	9.98	8.30	3.30	3.04	T 2.31	T 2.00	4.10	0.48	90.0°
						B 2.31	B 2.00		0.48	90.0°

Instrument: 1-1280-0000 Instrument: 1-0000-7161 Inspector: T. Cross

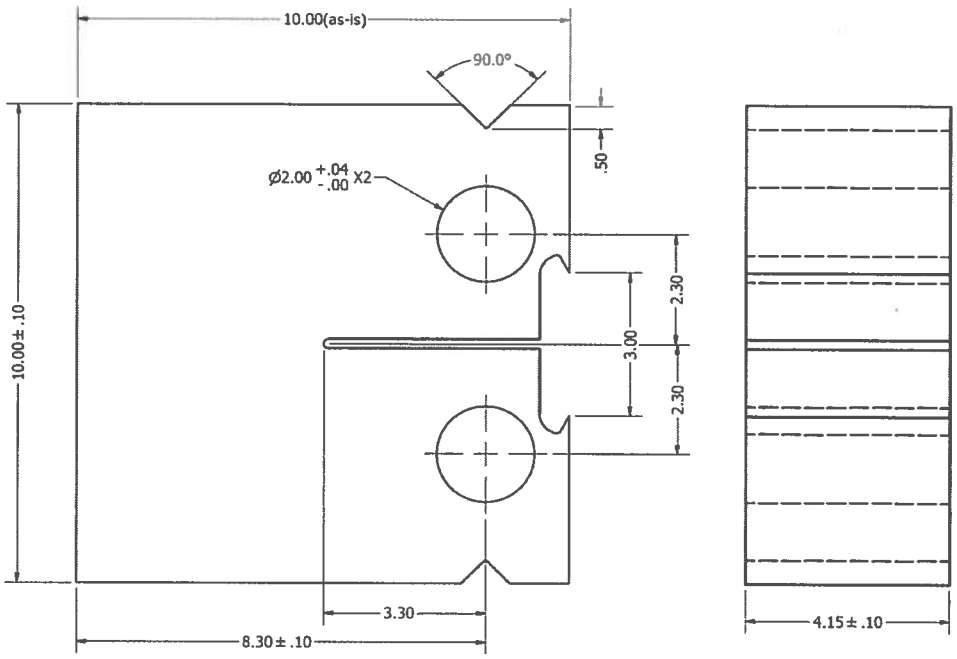
Cal Date: 5-24-17 Cal Date: 5-24-17

Due Date: 5-24-18 Due Date: 5-24-18 Date: 7 DEC 17

OPTICAL COMPARATOR SCHERR-TUMICO

DIGITAL OUT/INSIDE MIC 0-6" MITUTOYO

ORNL mini-C(T) Specimen



ALL DIMENSIONS ARE IN (mm)
ALL TOLERANCES ARE ±0.04 (mm) UNLESS OTHERWISE NOTED

Key: T = Top, B = Bottom, GL = Gage Length

AS MACHINED DIMENSIONS										
SPECIMEN I.D.	"10.00"	"10.00(as-is)"	"8.30"	"3.30"	GL "3.00"	"2.30"	"2.00"	"4.15"	"0.50"	"90.0°"
4C1 - 1	10.00	10.01	8.30	3.30	3.041	T 2.30	T 2.00	4.13	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
2	9.98	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.11	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
3	9.98	10.01	8.30	3.30	3.04	T 2.30	T 2.00	4.11	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
4	9.98	10.01	8.30	3.30	3.04	T 2.30	T 2.00	4.11	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
5	9.99	10.02	8.30	3.30	3.041	T 2.30	T 2.00	4.11	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
6	10.01	10.02	8.30	3.30	3.04	T 2.30	T 2.00	4.11	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
7	10.00	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.11	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
8	9.99	10.01	8.30	3.30	3.04	T 2.30	T 2.00	4.11	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
9	10.00	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.10	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°

Instrument: 1-1280-0000

Cal Date: 5-24-17

Due Date: 5-24-18

OPTICAL COMPARATOR

SCHERR - TUMICO

Instrument: 1-0000-7161

Cal Date: 5-24-17

Due Date: 5-24-18

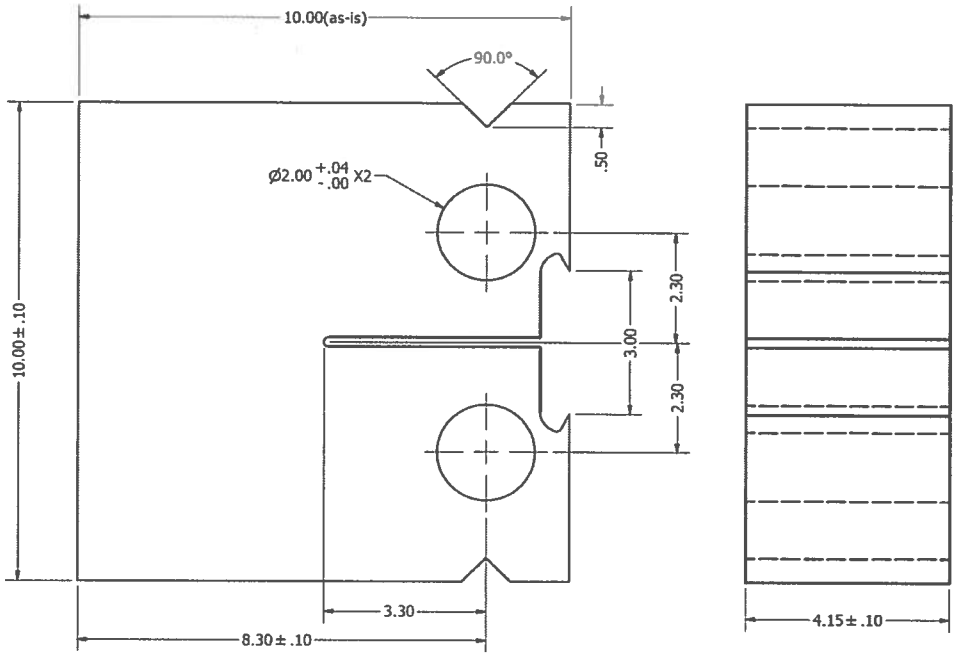
DIGITAL OUT/INSIDE MIC

0-6" MITUTOYO

Inspector: J. Tatum

Date: 14 DEC 17

ORNL mini-C(T) Specimen



ALL DIMENSIONS ARE IN (mm)
ALL TOLERANCES ARE ±0.04 (mm) UNLESS OTHERWISE NOTED

* CALIPERS MISREAD
ACTUAL MEASUREMENT - 4.0

Key: T = Top, B = Bottom, GL = Gage Length

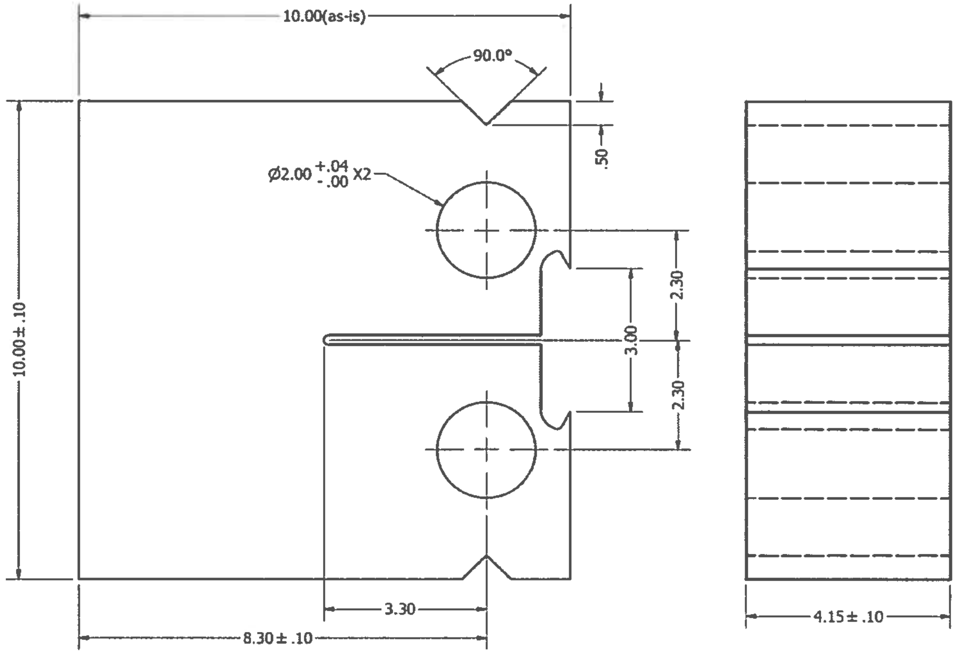
AS MACHINED DIMENSIONS										
SPECIMEN I.D.	"10.00"	"10.00(as-is)"	"8.30"	"3.30"	GL "3.00"	"2.30"	"2.00"	"4.15"	"0.50"	"90.0°"
4A1-10	9.98	9.98	8.30	3.30	3.04	T 2.30	T 2.00	4.10	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
3K2C-1	9.98	10.01	8.30	3.30	3.04	T 2.30	T 2.00	TC * 4.07	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
2	9.98	9.99	8.30	3.30	3.04	T 2.30	T 2.00	TC * 4.07	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
3	9.99	10.01	8.30	3.30	3.04	T 2.30	T 2.00	TC * 4.07	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
3K2A-1	10.00	10.00	8.30	3.30	3.04	T 2.30	T 2.00	TC * 4.07	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
2	10.00	10.00	8.30	3.30	3.04	T 2.30	T 2.00	TC * 4.07	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
3	10.00	10.00	8.30	3.30	3.04	T 2.30	T 2.00	TC * 4.07	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
						T	T			
						B	B			
						T	T			
						B	B			

Instrument: 1-1280-0000
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR-TUMICO

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL OUT / INSIDE MIC
0-6" MITUTOYO

Inspector: T. Circo
Date: 8 DEC 17

ORNL mini-C(T) Specimen



ALL DIMENSIONS ARE IN (mm)
ALL TOLERANCES ARE ±0.04 (mm) UNLESS OTHERWISE NOTED

* CALIPERS MISREAD – ACTUAL MEASUREMENT – 4.05

Key: T = Top, B = Bottom, GL = Gage Length

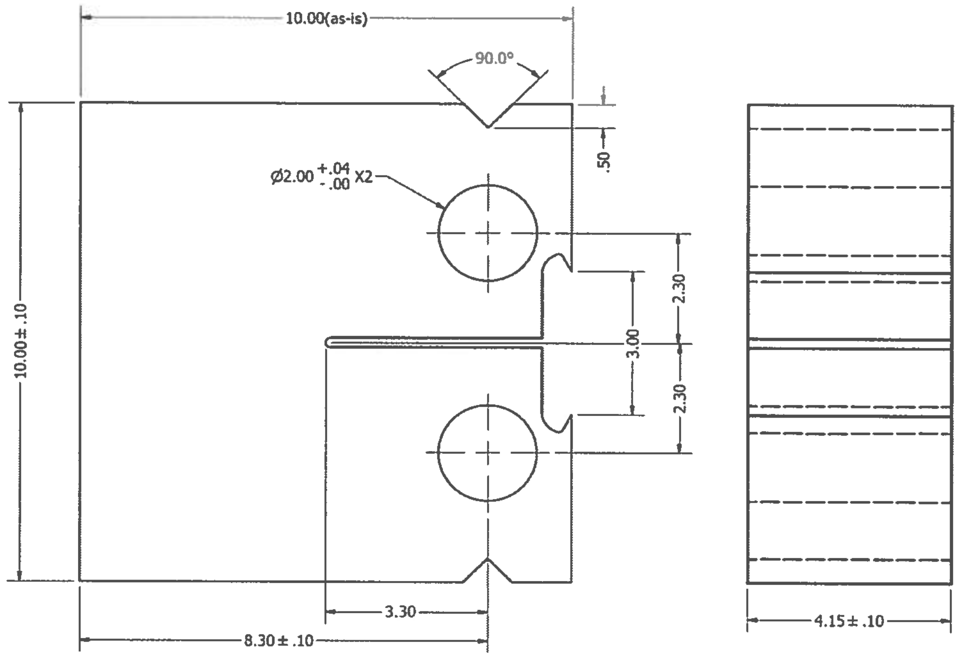
AS MACHINED DIMENSIONS										
SPECIMEN I.D.	"10.00"	"10.00(as-is)"	"8.30"	"3.30"	GL "3.00"	"2.30"	"2.00"	"4.15"	"0.50"	"90.0°"
3K2B-1	10.01	10.01	8.30	3.30	3.04	T 2.30 B 2.30	T 2.00 B 2.00	~~4.03~~ TC*	0.48 0.48	90.0° 90.0°
2	10.00	10.01	8.30	3.30	3.04	T 2.30 B 2.30	T 2.00 B 2.00	~~4.03~~ TC*	0.48 0.48	90.0° 90.0°
3	10.00	10.00	8.30	3.30	3.04	T 2.30 B 2.30	T 2.00 B 2.00	~~4.03~~ TC*	0.48 0.48	90.0° 90.0°
3L1A-1	10.00	10.00	8.30	3.30	3.04	T 2.30 B 2.30	T 2.00 B 2.00	~~4.03~~ TC*	0.48 0.48	90.0° 90.0°
2	9.99	10.01	8.30	3.30	3.04	T 2.30 B 2.30	T 2.00 B 2.00	~~4.03~~ TC*	0.48 0.48	90.0° 90.0°
3	10.00	10.00	8.30	3.30	3.04	T 2.30 B 2.30	T 2.00 B 2.00	~~4.03~~ TC*	0.48 0.48	90.0° 90.0°
3L1B-1	10.01	10.00	8.30	3.30	3.04	T 2.30 B 2.30	T 2.00 B 2.00	4.05	0.48 0.48	90.0° 90.0°
2	10.00	10.00	8.30	3.30	3.04	T 2.30 B 2.30	T 2.00 B 2.00	4.05	0.48 0.48	90.0° 90.0°
3	10.00	10.01	8.30	3.30	3.04	T 2.30 B 2.30	T 2.00 B 2.00	4.05	0.48 0.48	90.0° 90.0°

Instrument: 1-R80-0000
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR SCHERR-TUMICO

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL OUT/INSIDE MIC 0-6" MITUTOYO

Inspector: [signature] T. Lezroom
Date: 8-DEC-17

ORNL mini-C(T) Specimen



ALL DIMENSIONS ARE IN (mm)
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Key: T = Top, B = Bottom, GL = Gage Length

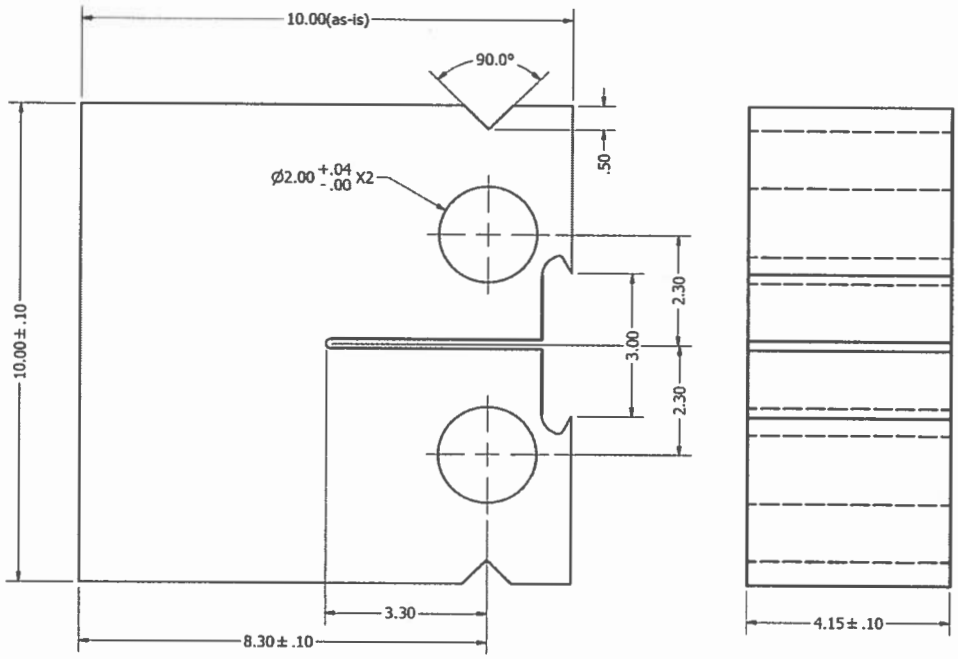
AS MACHINED DIMENSIONS										
SPECIMEN I.D.	"10.00"	"10.00(as-is)"	"8.30"	"3.30"	GL "3.00"	"2.30"	"2.00"	"4.15"	"0.50"	"90.0°"
4C1-10	10.01	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.11	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
3L1C-1	10.00	10.06	8.30	3.30	3.04	T 2.30	T 2.00	4.05	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
2	10.01	10.01	8.30	3.30	3.04	T 2.30	T 2.00	4.05	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
3	10.00	10.01	8.30	3.30	3.04	T 2.30	T 2.00	4.05	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
3M1B-1	10.00	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.05	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
2	10.00	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.05	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
3M1C-1	10.00	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.05	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
2	10.00	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.05	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
						T	T			
						B	B			

Instrument: i-1280-0000
Cal Date: 5-24-17
Due Date: 5-24-18
OPTICAL COMPARATOR
SCHERR-TUMICO

Instrument: 1-0000-7161
Cal Date: 5-24-17
Due Date: 5-24-18
DIGITAL OUT/INSIDE MIC
0-6" MITUTOYO

Inspector: [signature] T. Cram
Date: 8 DEC 17

ORNL mini-C(T) Specimen



ALL DIMENSIONS ARE IN (mm)
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Key: T = Top, B = Bottom, GL = Gage Length

AS MACHINED DIMENSIONS										
SPECIMEN I.D.	"10.00"	"10.00(as-is)"	"8.30"	"3.30"	GL "3.00"	"2.30"	"2.00"	"4.15"	"0.50"	"90.0°"
3M2A-1	10.01	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.05	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
2	10.00	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.05	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
3M1A-1	10.00	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.05	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
2	10.01	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.05	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
3M2B-1	10.00	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.05	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
2	10.00	10.00	8.30	3.30	3.04	T 2.30	T 2.00	4.05	0.48	90.0°
						B 2.30	B 2.00		0.48	90.0°
						T	T			
						B	B			
						T	T			
						B	B			
						T	T			
						B	B			

Instrument: 1-1280-0000

Cal Date: 5-24-17

Due Date: 5-24-18

OPTICAL COMPARATOR
SCHERR TUMICO

Instrument: 1-0000-7161

Cal Date: 5-24-17

Due Date: 5-24-18

DIGITAL OUT/INSIDE MIC
0-6" MITUTOYO

Inspector: T.C. Zan

Date: 18 DEC 17

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