

CONTROLLED COPY NO. 873

LABORATORY NOTEBOOK

NOTEBOOK NO. 873

CONTINUED FROM NOTEBOOK NO. _____

CONTINUED TO NOTEBOOK NO. _____

ASSIGNED TO:

NAME Kuang-Tsan K. Chiang

SIGNATURE K.T. Chiang

DATE 4/30/07

DATE ISSUED April 30, 2007

BY _____

PHONE (210) 522-2308

EMAIL kchiang@swri.org

ORGANISATION Southwest Research Institute®

DEPARTMENT _____

ADDRESS 6220 Culebra Road

CITY San Antonio

PROVINCE/REGION Texas

COUNTRY USA

POSTAL CODE 78238

DATE NOTEBOOK COMPLETED _____

NUMBER OF PAGES FILLED IN _____

NOTES:

 - Luis Ibarra - L.I.
K.T. Chiang KUANG-TSAN K. CHIANG KTC
D.T. Pomeroy DANIEL T POMEROY DTP

TITLE

PROJECT

Continued From Page

5
10
15
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35
40
45

Initial Scientific Notebook Entry for Drip Shield – Waste Package Interaction Test.

Title: Angled (5 degrees, 15 degrees, 45 degrees drip shield) interaction tests, fixed boundary condition tests, free boundary condition tests, ambient temperature tests, elevated temperature test (150 degrees Celcius).

Test Performed by: Luis Ibarra, Daniel Pomerening, Karol Hricisak, Kuang-Tsan Kenneth Chiang

Objective: Study the interaction of drip shield material titanium Grade 5 alloy and waste package material Alloy 22.

Equipment: MTS tensile test machine. *Tinius Olson Universal Test Machine KR 6/8/07*

Materials: Titanium Grade 5, Alloy 22

Specimen Specifications: Titanium Grade 5 plate per ASTM B265, Hastelloy C22 plate per ASTM B575

Measurement Parameters: Mechanical properties as described in TOP-008. Temperature of environments $\pm 2^{\circ}\text{C}$.

Required Level of Accuracy: Ultimate tensile strength ± 0.1 ksi, 0.2% yield strength ± 0.1 ksi, elongation ± 1 percent, reduction in area ± 1 percent

Uncertainty and Source of Error: The uncertainty and source of error shall be included in the test report.

Continued To Page

SIGNATURE <i>R. J. Chiang</i>	DATE 4/30/2007	
DISCLOSED TO AND UNDERSTOOD BY	DATE	PROPRIETARY INFORMATION 4/17/08 MP

Continued From Page Procurement T: Grade 5 plate, 18 pieces 6" x 8" x 1 3/4"

Page 1 of 2
 Date Printed: 05/15/2007
 Date Created: 02/05/2007
 Requisition Date: 02/14/2007

Requisition: 07013003 SOUTHWEST RESEARCH INSTITUTE
 Requisitioner: He, Xihua
 Req Organization: 1.20.01.50 Suggested Supplier: President Titanium
 Phone: (210) 522-5194 City/State: Hanson/MA
 Contact: Fred Travers
 Phone: 1-800-225-0304 Fax: 1-781-293-3753

Special Instructions: The procurement plan is attached

Line #	Item / Description	U/M	Need By Date	Requested Qty	Est Unit Cost	Estimated Costs
1	Titanium Grade 5 plates, thickness 1.75", dimensions 6" by 8", 18 pieces, 6 square feet total Deliver To: Xihua He/Bldg. 57 Account: 704-000 Organization: 1.20.01 Project: 06002.01.342 Allocation Pct: 100.00 Total Estimated Cost: \$15,032.36	LB	2/28/2007	259.00	58.04	15,032.36

Government Project?: YES Property Type: G1 Is Govt. Property being sent to supplier?: NO
 Quality Assurance?: YES Costpoint QC Inspection Required: NO
 Is this requisition for or does this requisition include a service (other than a repair)?: YES
 Is the service to be performed on or off campus: OFF

To Be Used For: ENG2 mechanical tests

Approvals: Requestor: Xihua He 2/8/2007 11:07:31 AM
 Department/Division Management: Asadul H Chowdhury 2/9/2007 8:28:51 AM
 Sitakanta Mohanty 2/9/2007 5:14:17 PM Quality Assurance: Robert D Brient 2/9/2007 3:46:02 PM

Submitted By: Shirlee Garcia 2/14/2007 3:51:45 PM

Your organization will provide goods or services in accordance with the requirements of your quality system or that of the Geosciences and Engineering Division Quality Assurance Manual. Technical and quality assurance procedures required in the performance of your staff members' work will be identified in procurement documents. Documentation requirements shall be specified in the purchase order and will be supplied with the product. If scientific notebooks are utilized, they are subject t

SIGNATURE
 DISCLOSED TO AND UNDERSTOOD BY
 K.T. Chief

DATE

DATE
 5/1/07

PROPRIETARY INFORMATION
 4/17/08 HP

Continued From Page

Page 2 of 2
 Date Printed: 05/15/2007
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Requisition: 07013003 SOUTHWEST RESEARCH INSTITUTE
 Requisitioner: He, Xihua
 Req Organization: 1.20.01.50 Suggested Supplier: President Titanium
 Phone: (210) 522-5194 City/State: Hanson/MA
 Contact: Fred Travers
 Phone: 1-800-225-0304 Fax: 1-781-293-3753

Line #	Item / Description	U/M	Need By Date	Requested Qty	Est Unit Cost	Estimated Costs
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o periodic submittal and review and must be returned at the conclusion of work to the Geosciences and Engineering Division Quality Assurance or payment will be withheld. Your organization's product will be accepted based on an evaluation by Geosciences and Engineering Division staff and will be returned for rework at Seller's expense if the product does not meet requirements. Additionally, there shall be "right of access" to your facility to confirm effective implementation of the quality requirements with the possibility of audits, source inspections, or surveillances. The Seller shall notify Geosciences and Engineering Division Quality Assurance of any nonconformance to the requirements of this purchase order; further work shall not be done unless directed by Geosciences and Engineering Division Quality Assurance. If there are any Quality Assurance-related questions, please call the Director of Quality Assurance at (210) 522-5537.

MATERIAL CERTIFICATION SHALL ACCOMPANY EACH LOT OF ITEMS SHIPPED. CERTIFICATION SHALL STATE CONFORMANCE TO THE PARTICULAR SPECIFICATION(S) AND INCLUDE REFERENCES TO THE APPLICABLE HEAT NUMBER, LOT/BATCH NUMBER OR DATE CODE WHEN APPLICABLE. THE SUPPLIER SHALL NOTIFY INSTITUTE QUALITY SYSTEMS OF ANY DEFICIENCIES DISCOVERED SUBSEQUENT TO THE DELIVERY OF THIS ITEM.

MILL TEST REPORT SHALL ACCOMPANY EACH LOT OF ITEMS SHIPPED. TEST REPORT SHALL BE IN THE FORM OF A PRODUCTION BATCH ANALYSIS OR LADLE ANALYSIS. CHEMICAL AND/OR PHYSICAL TEST DATA SHALL BE PROVIDED. MATERIAL SHALL BE IDENTIFIED BY HEAT NUMBER, IF APPLICABLE.

SIGNATURE
 DISCLOSED TO AND UNDERSTOOD BY
 K.T. Chief

DATE

DATE
 5/1/07

PROPRIETARY INFORMATION
 4/17/08 HP

TITLE PROJECT

Continued From Page Material Receiving Record
Titanium Grade 5, 1 3/4" x 6" x 8", 18 pieces

B I L L O F L A D I N G No: LAX 14445
 Ship From: TITANIUM INDUSTRIES, INC
 SANTA FE SPRINGS SERVICE CENTER
 30020 FREEMAN AVENUE
 SANTA FE SPRINGS, CA 90670
 Tel: 562-906-8188 Fax: 562-906-8198
 Ship Date 12Mar07 at 17:57 From 800
 Probill 821-9985449-1
 Via ROADWAY
 FOB SANTA FE SPRINGS, CA
 Frt COLLECT
 Route 0- 0 Manifest
 Vhcle Trailer
 Stp PAULA MONTES
 Sold To: (4625)
 SOUTHWEST RESEARCH INSTITUTE
 P.O. DRAWER 28510
 SAN ANTONIO, TX 78228-0510
 Consigned To: (001)
 SOUTHWEST RESEARCH INSTITUTE
 9503 WEST COMMERCE
 SHIPPING & RECEIVING BUILDING 242
 SAN ANTONIO, TX 78227-1301
 Tel: 210-522-5829 Fax: 210-522-3964

B I L L O F L A D I N G
 1) Our Order TEX- 317- 1 Your PO # 764783G
 TITANIUM AERO PLATE 6AL-4V ASTM B265 GRADE 5
 1.750" X 6.0000" (+.125/-0) X 8.0" (+.125/-0)
 CONTRACT: NRC0202012
 AOP: 704-000 1.20.01

Heat Number	Tag No	PCS	Wt LBS
A21A(1.750")	21780	6	87
A21A(1.750")	21780C	6	86
A21A(1.750")	21780D	6	85
Total:		18	258

TOTAL: Tags 3 Pcs 18 Wt LBS 258

SHIPPING:
 (1) BOX @ 274 LBS GROSS
 (18) PCS @ 258 LBS NET HEAT# A21A
 TARE: 16 LBS
 DIMS: 10" X 9" X 48" LONG

*****COLLECT*****

DIM QTY PCS WT TRS P/C QCS
 CLASS 70 RELEASE VALUE @ \$.40/LB

RECEIVED, subject to the classification and tariffs in effect on the date of receipt by the carrier of the property described in the Original Bill of Lading.
 The property described above, in apparent good order, except as noted contents and condition of contents of packages (shown), marked, consigned, and delivered as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to his usual place of delivery at said destination, if on his route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any portion of said property over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Freight Bill of Lading set forth (1) in Official, Southern, Western and Alaska Freight Classifications in effect of the date hereof, if the bill is a bill of lading, or (2) in the applicable motor carrier classification or tariff if the bill is a motor carrier shipment.
 Shipper hereby certifies that he is familiar with all the terms and conditions of the said bill of lading, including those of the back thereof, set forth in the classification or tariff which governs transportation of the shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for all purposes.

MEMORANDUM is an acknowledgement that a bill of lading has been issued and is not the Original Bill of Lading, nor a copy or duplicate, covering the property named herein, and is intended solely for filing or record.

SIGNATURE OF CONSIGNOR X	CARRIER X	FREIGHT Prepaid <input type="checkbox"/> Collected <input checked="" type="checkbox"/> O.D. <input type="checkbox"/>
AGENT PER (Driver's Signature) X	SHIPPER'S CERTIFICATION: This is to certify that the above-named material is properly classified, described, packaged, marked and labeled, and is in proper condition for transportation according to the applicable regulations of the Department of Transportation. If charges are to be prepaid, write or stamp here, "To be Prepaid."	SHIPPER'S PRINTS IN lieu of stamp; not a part of Bill of Lading approved by the Interstate Commerce Commission. Note - When the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding class 70 rate. An CERTIFICATE FOR POLAR
RECEIVED To apply in payment of the charges On the property described herein.	AGENT OR CASHIER	CHARGES ADVANCED

Continued To Page

SIGNATURE K. J. Chiang DATE 5/2/07
 DISCLOSED TO AND UNDERSTOOD BY _____ DATE _____
 PROPRIETARY INFORMATION
 4117108 MP

TITLE PROJECT

Continued From Page Certification

Customer QUILIMEN
 PO# 704783G
 SO# TEX-317
 Wgt. 258 Pcs. 18 Page 1 of 5

CERTIFICATE OF TEST

Traveler(s) B 37485

Heat # A21A

Rev 1
 Prof
 Alloy ALLVAC 6-4
 SEE BELOW
 Purchase Order CRP-26609
 Weight 2115 lbs.
 PCS 1
 Completion Date: 03/06/2007 Quality Auditor: Todd Langer
Todd Langer
 ALLVAC
 P.O. Box 460 530 34th Avenue, SW
 Albany, OR 97321-0580
 Phone (541) 967-9000
 Customer Name
 TITANIUM INDUSTRIES, INC.
 Rockaway Service Center 18 Green Pond
 Road
 Rockaway, NJ

SPECIFICATIONS

AMS 2631	B	CLASS A1	AMS 4911	J
AMS-STD-2154	09/05	TYPE 1 CLASS A	AMS-T-9046	A
ASTM B265	2006B	GRADE 5	ASTM F1472	2002A
BS 2TA11	1974		BS 7252 PART 3	05/01/97 ALLOY 6-4
BS TA56	1974	AM.1	DMS 1592	G
ISO 5832-3	3	ALLOY 6-4	LN 9297	91 AMD A1
MIL-STD-2154	09/30/82	TYPE 1 CLASS A	MIL-T-9046	J AM2 CODE AB-1 COND. A
S-1000	01/03/2005		S-400	09/01/2006

PLATE ID / DIMENSIONS:
 A2 - 1.750" X 51.3125" X 143.375"

HEADER REMARKS

THIS PLATE WAS MANUFACTURED AND TESTED UNDER LOT# 37485A. IT HAS BEEN TRANSFERRED TO THIS TRAVELER FOR THE PURPOSE OF SHIPMENT.

TI
 CA
 15

Continued To Page

SIGNATURE K. J. Chiang DATE 5/2/07
 DISCLOSED TO AND UNDERSTOOD BY _____ DATE _____
 PROPRIETARY INFORMATION
 4117108 MP

Traveler(s) Heat # Ingot# 37485 B A21A ALLVAC P.O. Box 460 530 34th Avenue, SW Albany, OR 97321-0580 Phone (541) 987-9000 Page 2 of 5

HEADER REMARKS

This material was manufactured and tested as rolled plate in accordance with the requirements of the plate product specification(s) called out by the purchase order for said material. The test data reported for this product, or portions cut/sectioned from this product, also demonstrates the products capability of meeting the testing requirements of the bar product specification(s) called out by the purchase order for said material, as they may be applicable to and capable of the product sizes provided. Required test specimen orientations and locations are limited to the dimensions of the parent rolled plate product.

CHEMISTRY

Table with columns for C, C Tested At, Si, Mn, Mo, Ti, Al, Ti+Al, V, Fe, Cu, XRF Tested At, B, B Tested At, Zr, Y, Y Tested At, O, N, O/N Tested At, Sn, Sn Tested At, Cr, Cb, Ta, Ni. Rows for TOP and BOTTOM.

H

PLATE A2 .0082

CHEMISTRY REMARKS

Chemistry tested at ALLVAC unless otherwise noted.

BETA TRANSUS CALCULATED BY CHEMISTRY: TOP = 1811F BOTTOM = 1824F

Wah Chang/GE Aircraft Engine Code 91974 applies.

SIGNATURE R. J. Clivier

DATE

DATE 5/2/07

PROPRIETARY INFORMATION

Continued To Page

Traveler(s) Heat # Ingot# 37485 B A21A ALLVAC P.O. Box 460 530 34th Avenue, SW Albany, OR 97321-0580 Phone (541) 987-9000 Page 3 of 5

CHEMISTRY REMARKS

Note: Metallics are analyzed by ICP, gases are analyzed by inert gas fusion or combustion.

As Shipped Tensile Test

Table with columns for Operation, Ingot, Heat Treat Code, Test Dir, Temp F, UTS ksi, 2% Yield ksi, .02% Yield ksi, %EL 40, 5D, %RA, Gage Length 4D, 5D, Tensile Diameter, Tested At. Rows for VCF2 LM, VCF2 LTM, VCF2 LM, VCF2 LTM.

Test Dir: L = Longitudinal, T = Transverse, ST = Short Transverse, LT = Long Transverse, TC = Transverse Center At Size, TM = Transverse Mid-Radius At Size, PC = Pancake, DB = Drawbar, PD = Paddle, TP = Top Transverse At Size, BT = Bottom Transverse At Size, LC = Long Center, TX = Top Transverse Mid-Radius At Size, LM = Longitudinal Mid Radius, LS = Longitudinal Surface, TS = Transverse Surface. Operation: SUPER = Crosshead Sep Rate of .10 inches/minute

TENSILE/STRESS RUPTURE HEAT TREATMENT

Table with columns for HT Code, Furnace, Cool Rate, Temp, Hours, Mins, Per Hrs, Cool Code. Row for PLANT 1480 5 FC VCF 8 HRS. MIN.

METALLOGRAPHY

Microstructure evaluated in accordance with the referenced specifications and found acceptable. Microstructure evaluated and found acceptable to to ETTC-2 Figures A5, & A6. Material evaluated and determined to be free of alpha case.

CONDITION SHIPPED

SIGNATURE R. J. Clivier

DATE

DATE 5/2/07

PROPRIETARY INFORMATION

Continued To Page

TITLE PROJECT

Continued From Page

Traveler(s) Heat # Ingot# 37485 B A21A ALLVAC P.O. Box 460 530 34th Avenue, SW Albany, OR 97321-0580 Phone (541) 967-9000 Page 4 of 5

CONDITION SHIPPED

HEAT TREATMENT: VCF ANNEALED AT 1450F (+/- 25F) FOR 6 HOURS MINIMUM
SURFACE CONDITION: DESCALED
Hot Rolling performed at Allgheny Ludlum (Washington, PA)
Heat Treatment and Final Inspection performed at Rome Metals (Monaca, PA)

REMARKS

Material has been produced, sampled, inspected, and tested in accordance with the customer purchase order and referenced specifications and conforms to the requirements unless otherwise noted in this certificate of test.
Any deviations to specification or customer purchase order requirements relative to testing, test values, hot working fixed practices, have been resolved in writing with customer prior to shipment.
The recording of false, fictitious, or fraudulent statements or entries on this document may violate Federal statutes, including but not limited to Title 18, Chapter 47 of the United States Code, and may be punishable as a felony.
If customer purchase order does not specifically reference a revision to a specification, Allvac will work to the latest revision on file and in effect at time of order placement.
Test methods are per the latest ASTM Standards, currently recognized industry practices; or as agreed upon between Allvac and customer.
Any chemical elements analyzed and found to have values below the actual limits of detection may be reported as < less than or reported at the detection level.
When values are reported to the significant places called for in the specifications, rounding will be done in accordance with ASTM E-29.
This is to certify that during manufacturing, handling, testing and inspection, this material did not come in direct contact with mercury or any device employing a single boundary of containment.
This Certificate of Test shall not be reproduced except in full, without the written approval of Allvac Quality.
No weld repair has been performed on this material.
Material Safety Data Sheets (MSDS) - View or print from our site: www.allvac.com. Printed copies available on request from the Allvac Sales Department.

SIGNATURE R. J. Clisoff DATE 5/2/07 PROPRIETARY INFORMATION

Continued To Page

TITLE PROJECT

Continued From Page

Traveler(s) Heat # Ingot# 37485 B A21A ALLVAC P.O. Box 460 530 34th Avenue, SW Albany, OR 97321-0580 Phone (541) 967-9000 Page 5 of 5

Allvac products have not come in contact with radioactive, fertile or fissionable materials during manufacturing or processing.
Melt source in compliance with DFAR 252.225-7014, Alternate 1.

SPECIAL REMARKS

Material melted and manufactured in the United States of America.
INGOT SOURCE: ATI ALLVAC (ALBANY, OR)
Allvac Laboratories approved to S400 (Certified Materials Test Laboratory - Metallic Materials).
VENDOR NO. 87012
This material has been produced and qualified in accordance with the manufacturing and approval requirements of DMS 1592 and DMS 2442.

SIGNATURE R. J. Clisoff DATE 5/2/07 PROPRIETARY INFORMATION

Continued To Page

Requisition: **07016662** **SOUTHWEST RESEARCH INSTITUTE** Page 1 of 2
 Requisitioner: Chiang, Kuang-Tsan K Date Printed: 05/15/2007
 Req Organization: 1.20.25.10 Suggested Supplier: Haynes International, Inc. Date Created: 03/08/2007
 Phone: (210) 522-2308 City/State: Houston/TX Contact: Joy Lucas Requisition Date: 03/19/2007
 Phone: 713-937-7597 Fax: 713-937-4596

Special Instructions: Material certification shall be supplied with the material.

Line #	Item / Description	U/M	Need By Date	Requested Qty	Est Unit Cost	Estimated Costs
1	Hastelloy C-22 plate (B575), 3/4"x3"x6" Deliver To: B/57	EA	3/23/2007	18.00	146.03	2,628.54
Account: 704-000 Organization: 1.20.01.55 Project: 06002.01.342 Allocation Pct: 100.00						Total Estimated Cost: \$2,628.54

Government Project?: YES Property Type: G1 Is Govt. Property being sent to supplier?: NO
 Quality Assurance?: YES Costpoint QC Inspection Required: NO Inspection Criteria: Procurement Plan requires confirmatory analysis

To Be Used For: Waste package/drip shield interaction study.

Approvals: Requestor: Kuang-Tsan K Chiang 3/8/2007 1:10:14 PM
 Department/Division Management: Asadul H Chowdhury 3/9/2007 10:56:47 AM
 Sitakanta Mohanty 3/9/2007 3:39:10 PM Quality Assurance: Robert D Brient 3/9/2007 8:40:39 AM

Submitted By: Shirlee Garcia 3/19/2007 8:47:13 AM

Your organization will provide goods or services in accordance with the requirements of your quality system or that of the Geosciences and Engineering Division Quality Assurance Manual. Technical and quality assurance procedures required in the performance of your staff members' work will be identified in procurement documents. Documentation requirements shall be specified in the purchase order and will be supplied with the product. If scientific notebooks are utilized, they are subject to periodic submittal and review and must be returned at the conclusion of work to the Geosciences and Engineering Division Quality Assurance or payment will be withheld. Your organization's product will be accepted based on an evaluation by Geosciences and Engineering Division staff and will be returned for rework at Seller's expense if the product does not meet requirements.

SIGNATURE: *K.T. Chiang*
 DISCLOSED TO AND UNDERSTOOD BY: _____
 DATE: _____
 PROPRIETARY INFORMATION: _____

Requisition: **07016662** **SOUTHWEST RESEARCH INSTITUTE** Page 2 of 2
 Requisitioner: Chiang, Kuang-Tsan K Date Printed: 05/15/2007
 Req Organization: 1.20.25.10 Suggested Supplier: Haynes International, Inc. Date Created: 03/08/2007
 Phone: (210) 522-2308 City/State: Houston/TX Contact: Joy Lucas Requisition Date: 03/19/2007
 Phone: 713-937-7597 Fax: 713-937-4596

Line #	Item / Description	U/M	Need By Date	Requested Qty	Est Unit Cost	Estimated Costs
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requirements. Additionally, there shall be "right of access" to your facility to confirm effective implementation of the quality requirements with the possibility of audits, source inspections, or surveillances. The Seller shall notify Geosciences and Engineering Division Quality Assurance of any nonconformance to the requirements of this purchase order; further work shall not be done unless directed by Geosciences and Engineering Division Quality Assurance. If there are any Quality Assurance-related questions, please call the Director of Quality Assurance at (210) 522-5537.

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SIGNATURE: *K.T. Chiang*
 DISCLOSED TO AND UNDERSTOOD BY: _____
 DATE: _____
 PROPRIETARY INFORMATION: _____

TITLE C-22 Plate, Receiving Record PROJECT

Continued From Page

03/27/2007
 Receipt ID: RC-0319505
 Receipt Date: 03/27/2007
 PO: 764987G
 Rel: 0
 Change Ord: 0
 Vendor: 509360
 HAYNES INTERNATIONAL, INC

SOUTHWEST RESEARCH INSTITUTE
 RECEIPT TRAVELER
 Warehouse: RBC
 Packing Slip: 491664-1-0
 Receiver: Rios, Ignacio R.

Page 1

Receipt Notes: UPS-34-35

Item: 1
 U/M: EA
 Deliver To: B57
 Qty Recv: 18.0000
 Location: 20/57
 Lot Recvd:

Unit Cost: \$146.0300
 Hastelloy C-22 Plate (B57S), 3/4"x3"x6"

Planner:
 Source Insp Reqd: N
 Order Ref: G1
 Qty Accept: 18.0000
 Location: 704-000

Prime Contract: NRC0202012
 Priority: NONE
 Project: 06002.01.342
 Organization: 1.20.01.55
 Account: 704-000

Notes:

UNLESS YOU NOTIFY RECEIVING (encl. 6618) OF ANY DISCREPANCIES WITHIN SEVEN WORK DAYS OF THE RECEIPT DATE SHOWN AT THE TOP LEFT, PAYMENT WILL BE PROCESSED AND COSTS POSTED TO YOUR ACCOUNT.
 REJECTION CODE _____
 (IN CASE OF DISCREPANCY)
 INSPECT YOUR SHIPMENT NOW!

SIGNATURE: K. J. Clifton
 DATE: 5/5/07
 DISCLOSED TO AND UNDERSTOOD BY: DATE: 4/17/08

PROPRIETARY INFORMATION

TITLE C22 Certification PROJECT

Continued From Page

CUSTOMER COPY
 Haynes International
 1020 West Park Avenue
 PO Box 9013
 Kokomo, Indiana, 46902

HAYNES International

Product Description • Description Produit • Material Beschreibung
 0.750 x 3 x 6
HASTELLOY(R) C-22 (R) ALLOY - PLATE
 Nadcap CERTIFICATE NUMBER 0089
 S400 9/01/2006, S1000 1/3/2005, EN 10204 3.1, AS9100

Sales Order No. 491664001-0
 Reference Com mande Bestellungs Nr 491664001-0
 Date Entered 03/21/07
 Date De Commande Bestelldatum 03/21/07
 Customer Reference 764987G
 Reference Client Kundenbestelldaten 764987G
 Report No. 20070323053
 Report No Zeugnis Nr 20070323053
 Pages of Pages 1 Of 4
 Page de Pages Anzahl der Seiten 1 Of 4

Sold To • Client • Bestellauschrift
SOUTHWEST RESEARCH INSTITUTE
 6220 CULEBRA RD
 SAN ANTONIO
 TX 782280510 USA

Ship To • Destinataire • Bestellmenge
SOUTHWEST RESEARCH INSTITUTE
 9503 W COMMERCE
 SAN ANTONIO
 TX 78277 USA

Specification • Specification • Spezifikation
 ASME-SB-575, 04, UNS# N06022; ASTM-B-574, 06, UNS# N06022

Quantity Ordered 18 PC
 Quantity Shipped 18 PC

Heat Number Numero De Coque Charge Nr	Chemical Analysis • Analyse Chimique • Chemische Analyse															
	Al	B	C	Co	Cr	Cu	Fe	Mn	Mo	Ni	P	S	Si	Ti	V	W
2277 6 3120			0.004	0.55	21.30		3.70	0.26	13.20	BAL	0.006	0.004	0.02		<0.01	2.90
2277 6 3120																

Certified By • Certifié Par • Bescheinigt Durch: Tamara Mains
 Certification Technician 3/23/2007

SIGNATURE: K. J. Clifton
 DATE: 5/5/07
 DISCLOSED TO AND UNDERSTOOD BY: DATE: 4/17/08

PROPRIETARY INFORMATION

TITLE PROJECT

Continued From Page

CERTIFICATION OF TESTS • RAPPORT D'ESSAIS CERTIFIE • WERKSZEUGNIS															
Sales Order No Reference Commande Bestellungs Nr 491664001-0		Date Entered Date De Commande Bestelldatum 03/21/07		Customer Reference Reference Client Kundenbezeichnung 764987G		Report No. Rapport No Zeugnis Nr 20070323053		Pages of Pages Page de Pages Anzahl der Seiten 2 Of 4							
Sold To • Client • Bestelleranschrift SOUTHWEST RESEARCH INSTITUTE 6220 CULEBRA RD SAN ANTONIO TX 782280510 USA					Ship To • Destinataire • Bestellmenge SOUTHWEST RESEARCH INSTITUTE 9503 W COMMERCE SAN ANTONIO TX 78277 USA										
Product Description • Description Produit • Material Beschreibung 0.750 x 3 x 6 HASTELLOY(R) C-22 (R) ALLOY - PLATE Nadcap CERTIFICATE NUMBER 0089 S400 9/01/2006, S1000 1/3/2005, EN 10204 3.1, AS9100															
Specification • Specification • Spezifikation ASME-SB-575, 04, UNS# N06022; ASTM-E-574, 06, UNS# N06022						Quantity Ordered Quantite Commandee Bestellmenge 18 PC		Quantity Shipped Quantite Expediee Liefermenge 18 PC							
Tensile Test at Room Temperature • Essai De Traction A Temp. Ambiante • Zugversuch Bei Raum Temp.					Tensile Test at Elevated Temperature • Essai De Traction A Hte. Temp. Warm Zugversuch					Stress Rupture Temperature • Essai A Charge De Rupture Zelstandversuch					
Ultimate Zugfestigkeit	1% Yield Lim. Elast. A 1% 1% Streckgrenze	0.2% Yield Lim. Elast. A 0.2% 0.2% Streckgrenze	% Elong In % Allong EN % Dehnung 4D	%RA	Test Essai Versuch	Ultimate Zugfestigkeit	1% Yield Lim. Elast. A 1% 1% Streckgrenze	0.2% Yield Lim. Elast. A 0.2% 0.2% Streckgrenze	% Elong In % Allong EN % Dehnung	%RA	Test Essai Versuch	Stress Constrainte Spannung	Hours Heures Stunden	% Elong In % Allong EN % Dehnung	% RA
108000 PSI	52000 PSI	49000 PSI	70 %	81.5 %	1) A)										

Certified By • Certifie Par • Bescheinigt Durch: **Tamara Mains** 3/23/2007 1) 2744566901
Certification Technician

Tamara Mains

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5/5/07
PROPRIETARY INFORMATION
4/17/08

TITLE PROJECT

Continued From Page

CERTIFICATION OF TESTS • RAPPORT D'ESSAIS CERTIFIE • WERKSZEUGNIS																				
Sales Order No Reference Commande Bestellungs Nr 491664001-0		Date Entered Date De Commande Bestelldatum 03/21/07		Customer Reference Reference Client Kundenbezeichnung 764987G		Report No. Rapport No Zeugnis Nr 20070323053		Pages of Pages Page de Pages Anzahl der Seiten 3 Of 4												
Sold To • Client • Bestelleranschrift SOUTHWEST RESEARCH INSTITUTE 6220 CULEBRA RD SAN ANTONIO TX 782280510 USA					Ship To • Destinataire • Bestellmenge SOUTHWEST RESEARCH INSTITUTE 9503 W COMMERCE SAN ANTONIO TX 78277 USA															
Product Description • Description Produit • Material Beschreibung 0.750 x 3 x 6 HASTELLOY(R) C-22 (R) ALLOY - PLATE Nadcap CERTIFICATE NUMBER 0089 S400 9/01/2006, S1000 1/3/2005, EN 10204 3.1, AS9100																				
Specification • Specification • Spezifikation ASME-SB-575, 04, UNS# N06022; ASTM-B-574, 06, UNS# N06022						Quantity Ordered Quantite Commandee Bestellmenge 18 PC		Quantity Shipped Quantite Expediee Liefermenge 18 PC												
Annealed Hardness Durete Result Gehtueht Haerte		Aged Hardness Durete Vieilli Gealtert Haerte		Grain Size Grosceur De Grain Korngroesse			IGA	Uniformity	Corrosion Rate	Oxidation Rate	Charpy Impact Test			Creep Rupture						
90 HRB			1) A)	2					MPY			Toughness Avg	Toughness 1	Toughness 2	Toughness 3	Test Essai Versuch	Stress Constrainte Spannung	Hours Heures Stunden	% Elong In % Allong EN % Dehnung	% Elong @ 15 Hrs

Certified By • Certifie Par • Bescheinigt Durch: **Tamara Mains** 3/23/2007 1) 2744566901
Certification Technician

Tamara Mains

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4/17/08

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CERTIFICATION OF TESTS • RAPPORT D'ESSAIS CERTIFIE • WERKSZEUGNIS				
Sales Order No Reference Commande Bestellungs Nr 491664001-0	Date Entered Date De Commande Bestelldatum 03/21/07	Customer Reference Reference Client Kundenbestellnr. 764987G	Report No. Rapport No Zeugnis Nr 20070323053	Pages of Pages Page de Pages Anzahl der Seiten 4 Of 4
Sold To • Client • Bestellanschrift SOUTHWEST RESEARCH INSTITUTE 6220 CULEBRA RD SAN ANTONIO TX 782280510 USA		Ship To • Destinataire • Bestimmung SOUTHWEST RESEARCH INSTITUTE 9503 W COMMERCE SAN ANTONIO TX 78277 USA		Product Description • Description Produit • Material Beschreibung 0.750 x 3 x 6 HASTELLOY(R) C-22 (R) ALLOY - PLATE Nadcap CERTIFICATE NUMBER 0089 S400 9/01/2006, S1000 1/3/2005, EN 10204 3.1, AS9100
Specification • Specification • Spezifikation ASME-SB-575, 04, UNS# N06022; ASTM-B-574, 06, UNS# N06022		Quantity Ordered Quantite Commandee Bestellemenge 18 PC	Quantity Shipped Quantite Expeditee Liefermenge 18 PC	

**HAYNES
International**

CUSTOMER COPY

Haynes International
1020 West Park Avenue
PO Box 9013
Kokomo, Indiana, 46902

All tests and inspections have been performed and results meet specification requirements.
THIS MATERIAL IS FREE FROM MERCURY, CADMIUM, RADIUM, AND ALPHA SOURCE CONTAMINATION.
THIS MATERIAL WAS MELTED AND MANUFACTURED IN THE UNITED STATES.
Mill Orders Used: 2744566901 (18 PC)
A) 2000 °F to 2100 °F

Certified By • Certifie Par • Bescheinigt Durch: **Tamara Mains** 3/23/2007
Certification Technician

Tamara Mains

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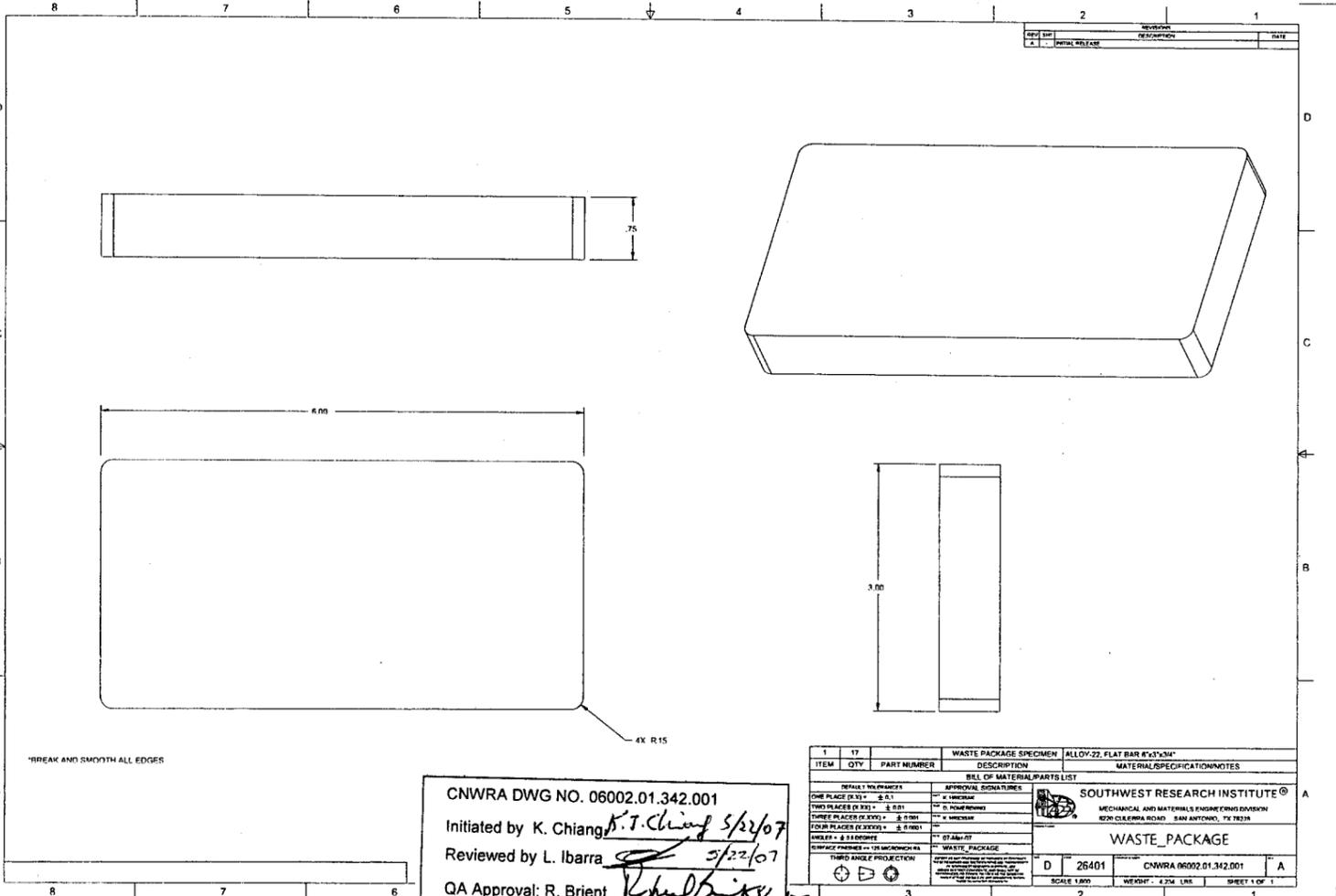
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5/5/07
PROPRIETARY INFORMATION
4/17/08 mw

TITLE

PROJECT

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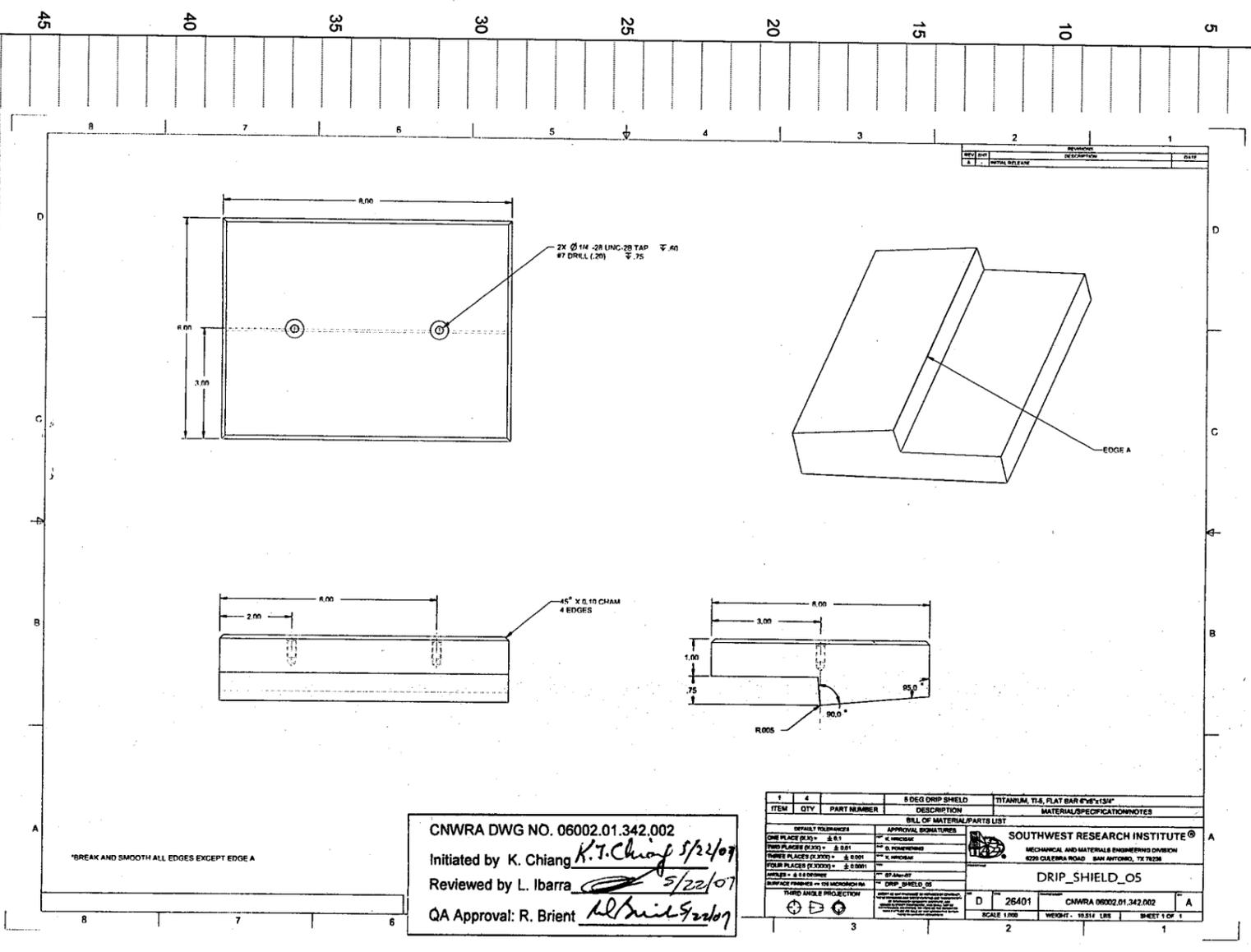
SIGNATURE
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DATE

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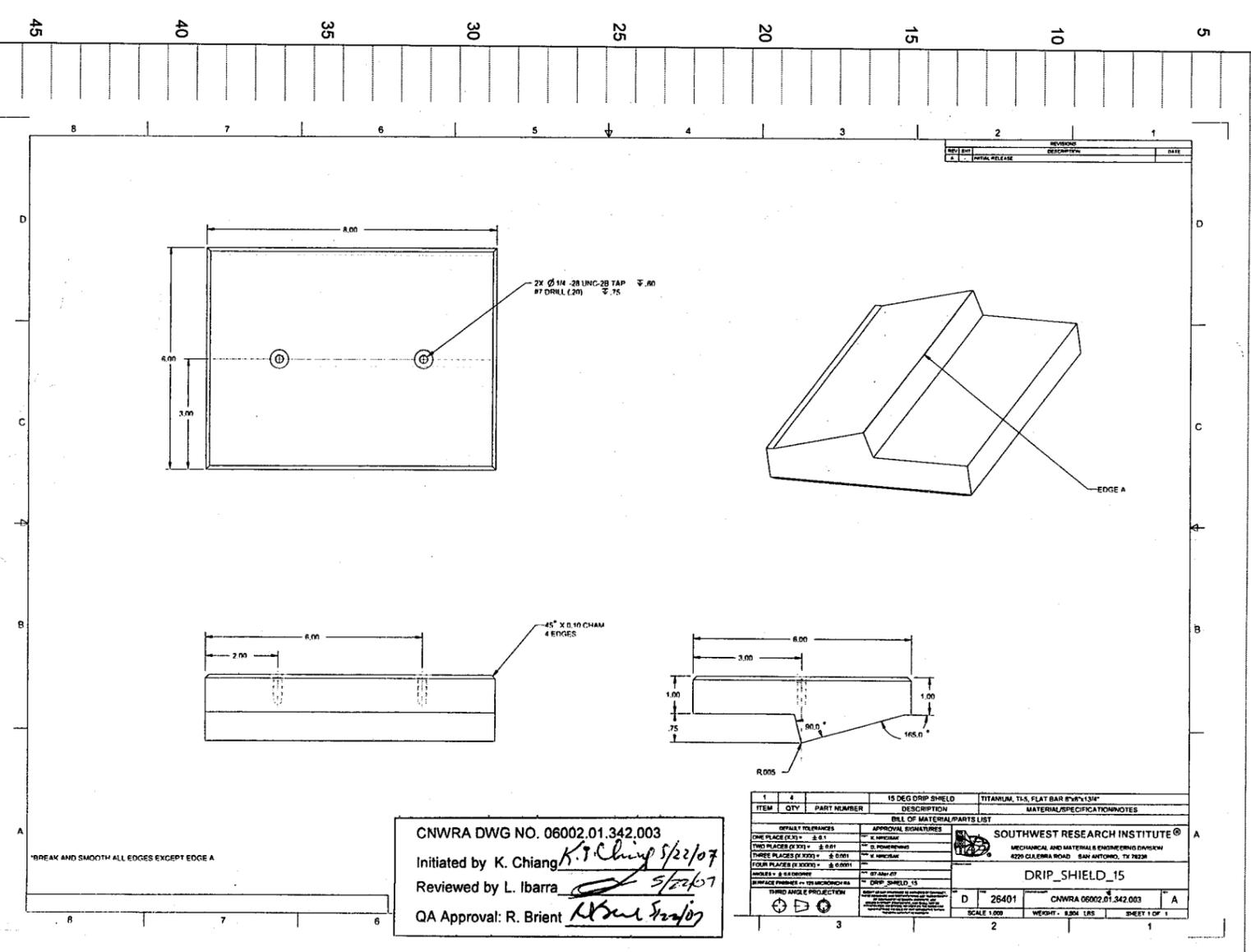


CNwRA DWG NO. 06002.01.342.002
Initiated by K. Chiang *K.T. Chiang 5/22/07*
Reviewed by L. Ibarra *L. Ibarra 5/22/07*
QA Approval: R. Brient *R. Brient 5/22/07*

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL/SPECIFICATION/NOTES
1	1		5 DEG DRIP SHIELD	TITANIUM, T15, FLAT BAR 6"x6"x1/8"
BILL OF MATERIAL/PARTS LIST				
SPECIAL TOLERANCES				
APPROVAL SIGNATURES				
SOUTHWEST RESEARCH INSTITUTE®				
MECHANICAL AND MATERIALS ENGINEERING DIVISION				
6729 CALLE ERA ROAD SAN ANTONIO, TX 78238				
DRIP_SHIELD_05				
D 26401 CNWRA 06002.01.342.002 A				
SCALE 1:100 WEIGHT - 10.914 LBS SHEET 1 OF 1				

SIGNATURE *K.T. Chiang*
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DATE 5/22/07
DATE 4/17/08
PROPRIETARY INFORMATION
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TITLE PROJECT
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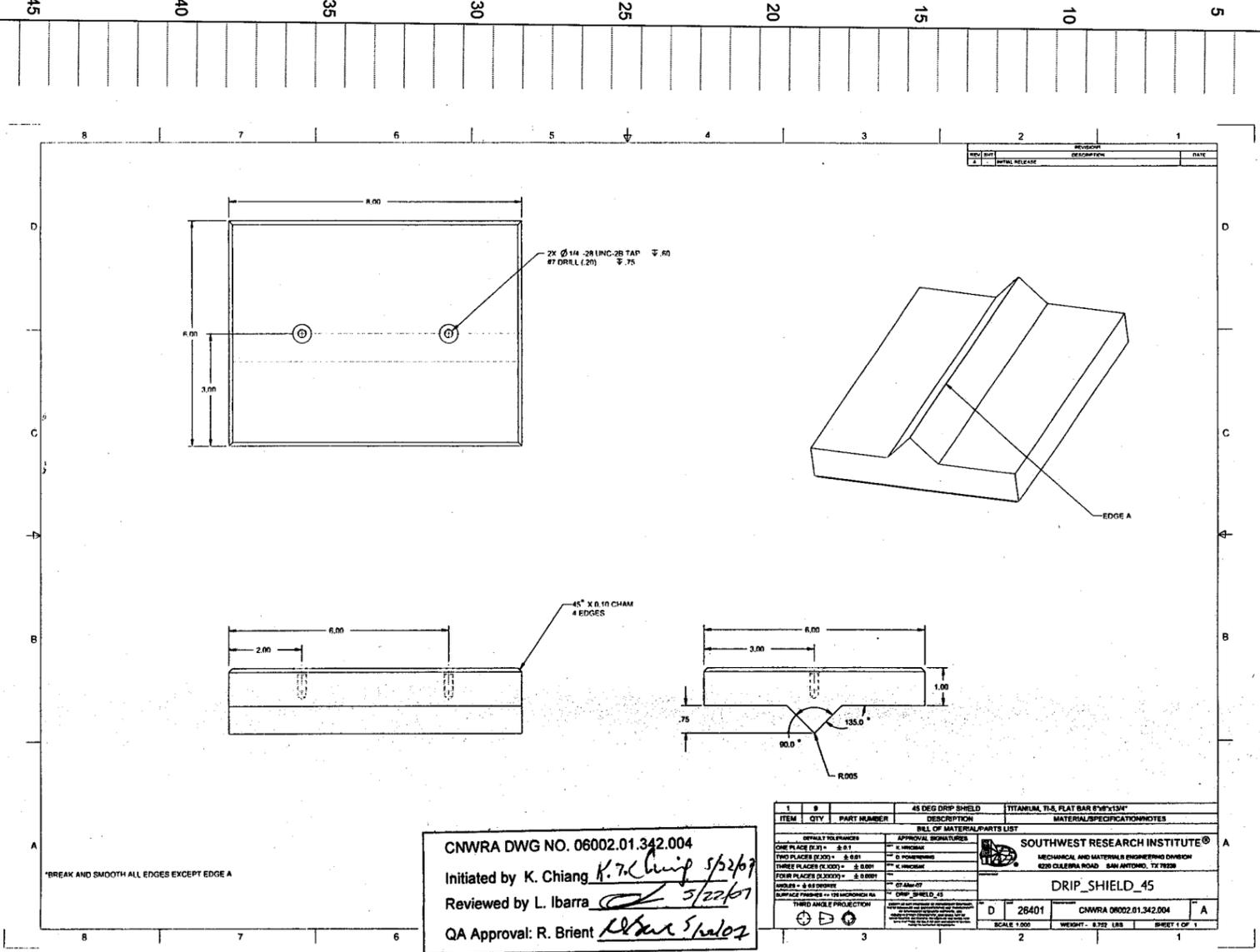


CNwRA DWG NO. 06002.01.342.003
Initiated by K. Chiang *K.T. Chiang 5/22/07*
Reviewed by L. Ibarra *L. Ibarra 5/22/07*
QA Approval: R. Brient *R. Brient 5/22/07*

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL/SPECIFICATION/NOTES
1	1		15 DEG DRIP SHIELD	TITANIUM, T15, FLAT BAR 6"x6"x1/8"
BILL OF MATERIAL/PARTS LIST				
SPECIAL TOLERANCES				
APPROVAL SIGNATURES				
SOUTHWEST RESEARCH INSTITUTE®				
MECHANICAL AND MATERIALS ENGINEERING DIVISION				
6729 CALLE ERA ROAD SAN ANTONIO, TX 78238				
DRIP_SHIELD_15				
D 26401 CNWRA 06002.01.342.003 A				
SCALE 1:100 WEIGHT - 8.904 LBS SHEET 1 OF 1				

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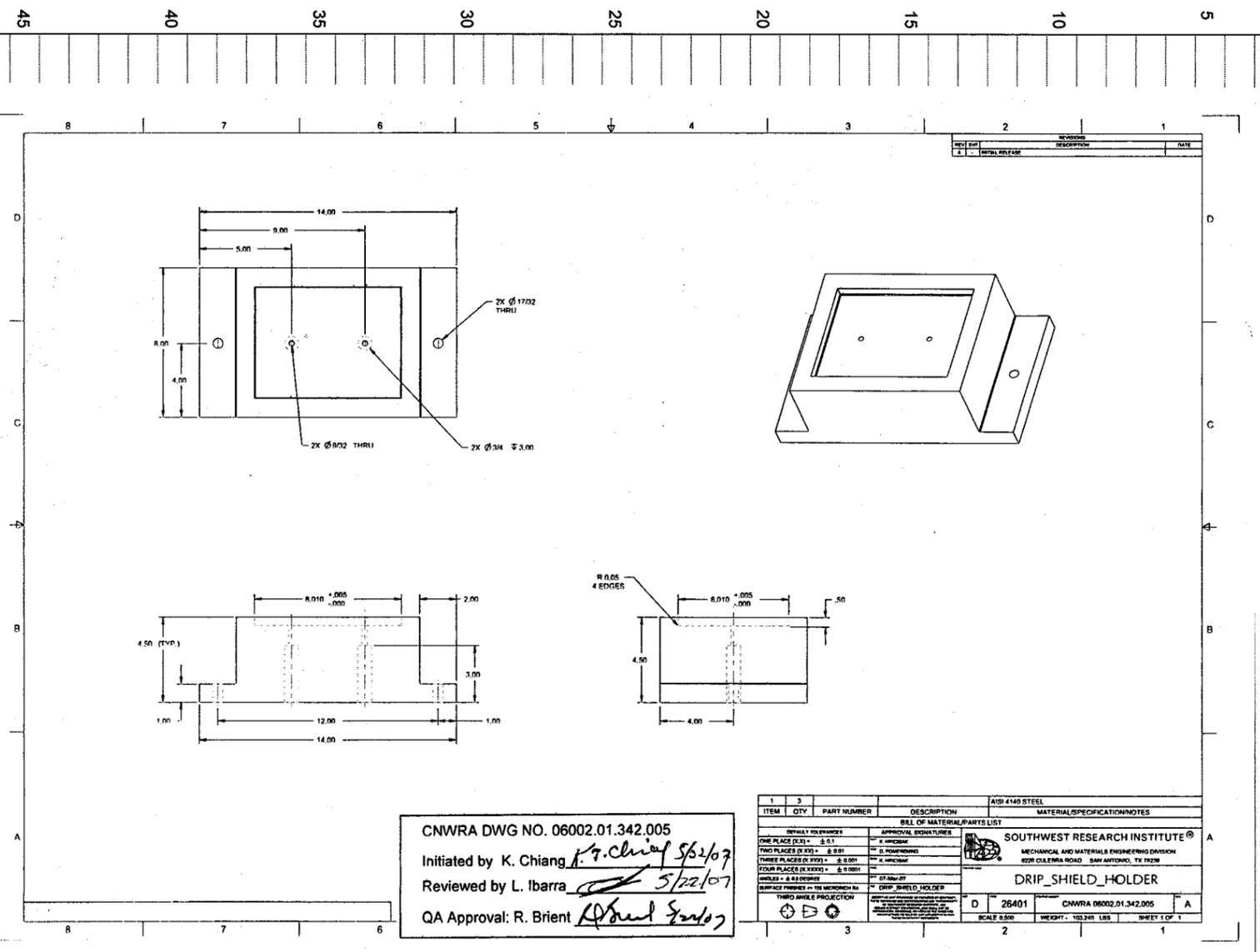
CNWR A DWG NO. 06002.01.342.004
 Initiated by K. Chiang *K. Chiang 5/22/07*
 Reviewed by L. Ibarra *L. Ibarra 5/22/07*
 QA Approval: R. Brient *R. Brient 5/22/07*

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL/SPECIFICATION/NOTES
45 DEG DRIP SHIELD				
TITANIUM, T1-8, FLAT BAR 6"X1/2"				
BILL OF MATERIALS/PARTS LIST				
APPROVAL SIGNATURES				
SOUTHWEST RESEARCH INSTITUTE				
MECHANICAL AND MATERIALS ENGINEERING DIVISION				
8229 CULBERT ROAD SAN ANTONIO, TX 78228				
DRIP_SHIELD_45				
D 26401 CNWRA 06002.01.342.004 A				
SCALE 1:200 WEIGHT - 0.322 LBS SHEET 1 OF 1				

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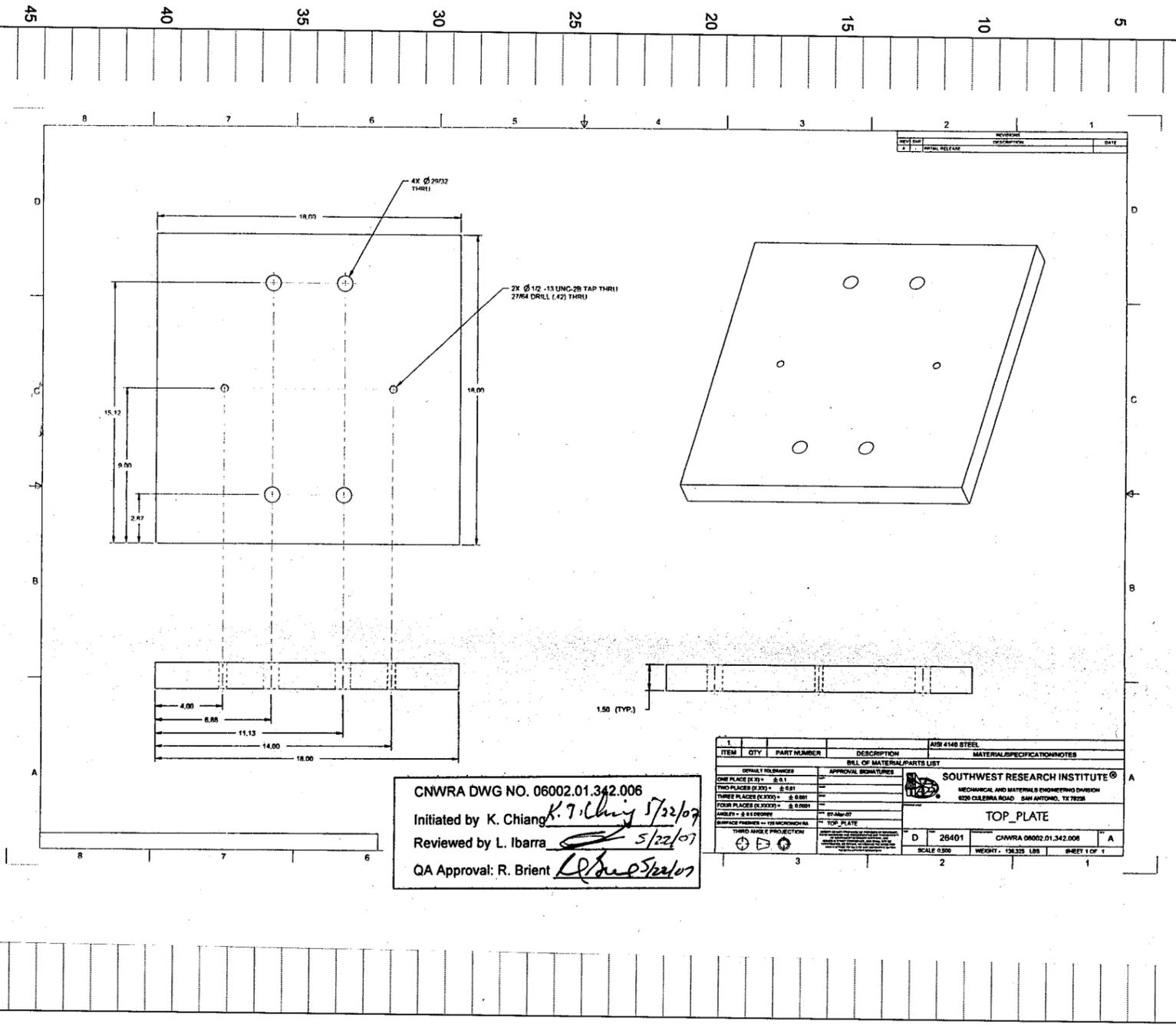


CNWR A DWG NO. 06002.01.342.005
 Initiated by K. Chiang *K. Chiang 5/22/07*
 Reviewed by L. Ibarra *L. Ibarra 5/22/07*
 QA Approval: R. Brient *R. Brient 5/22/07*

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL/SPECIFICATION/NOTES
45 DEG DRIP SHIELD				
AISI 4140 STEEL				
BILL OF MATERIALS/PARTS LIST				
APPROVAL SIGNATURES				
SOUTHWEST RESEARCH INSTITUTE				
MECHANICAL AND MATERIALS ENGINEERING DIVISION				
8229 CULBERT ROAD SAN ANTONIO, TX 78228				
DRIP_SHIELD_HOLDER				
D 26401 CNWRA 06002.01.342.005 A				
SCALE 1:200 WEIGHT - 103.249 LBS SHEET 1 OF 1				

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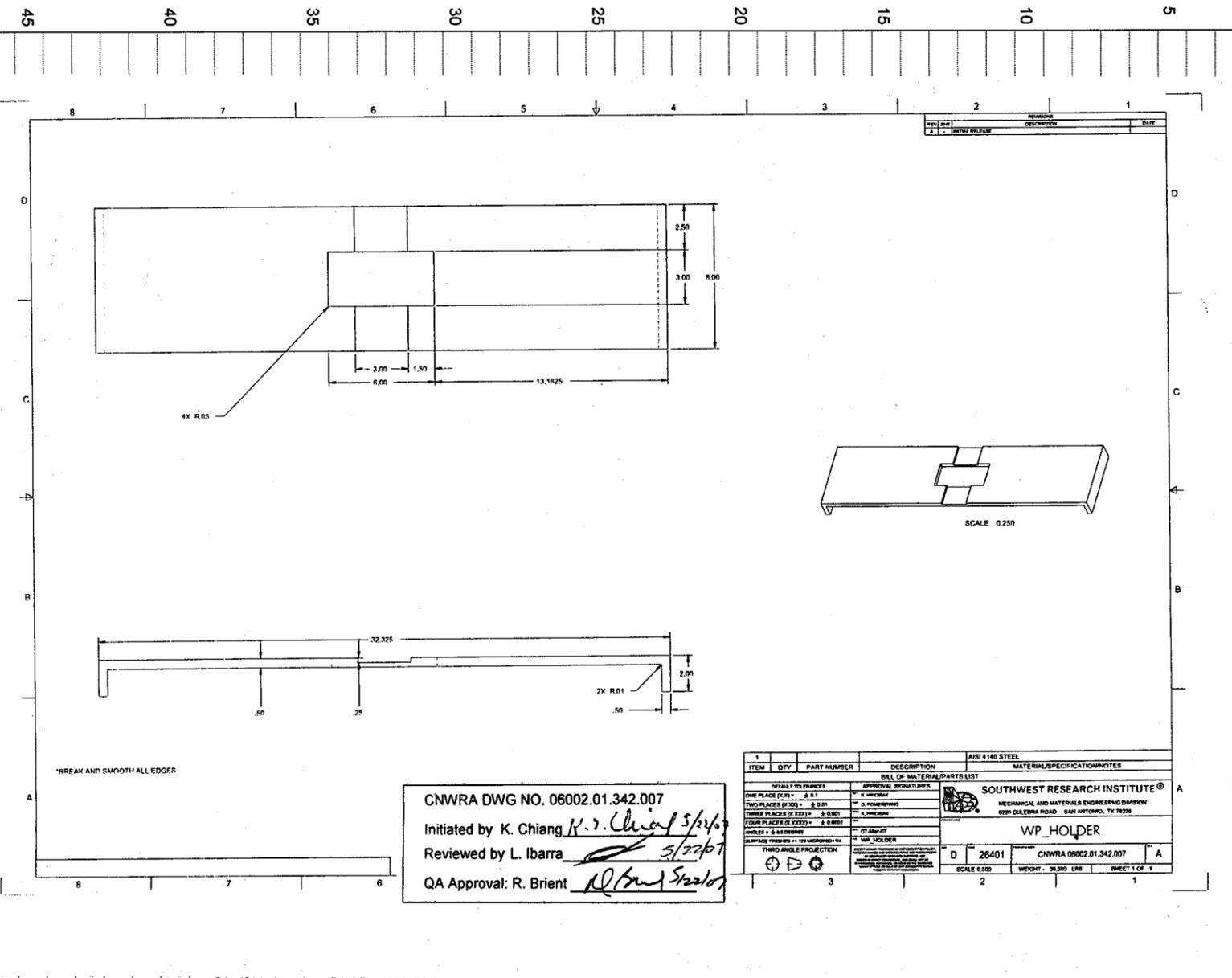


ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL/SPECIFICATION/NOTES
BILL OF MATERIAL/PARTS LIST				
ONE PLACE (X.12) - Ø.01				
TWO PLACES (X.25) - Ø.01				
THREE PLACES (X.375) - Ø.01				
FOUR PLACES (X.50) - Ø.01				
APPROVAL SIGNATURES				
INITIATED BY: K. CHIANG				
REVIEWED BY: L. IBARRA				
QA APPROVAL: R. BRIENT				
SOUTHWEST RESEARCH INSTITUTE®				
MECHANICAL AND MATERIALS ENGINEERING DIVISION				
6229 CALLEMA ROAD - SAN ANTONIO, TX 78238				
TOP_PLATE				
D 26401 CNWRA 06002.01.342.006 A				
SCALE 0.500 WEIGHT - 136.325 LBS SHEET 1 OF 1				

CNWRA DWG NO. 06002.01.342.006
 Initiated by K. Chiang *K. Chiang 5/22/07*
 Reviewed by L. Ibarra *L. Ibarra 5/22/07*
 QA Approval: R. Brient *R. Brient 5/22/07*

SIGNATURE: *K. Chiang*
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 DATE: _____
 DATE: 5/22/07
 PROPRIETARY INFORMATION: 4/17/07 WJ

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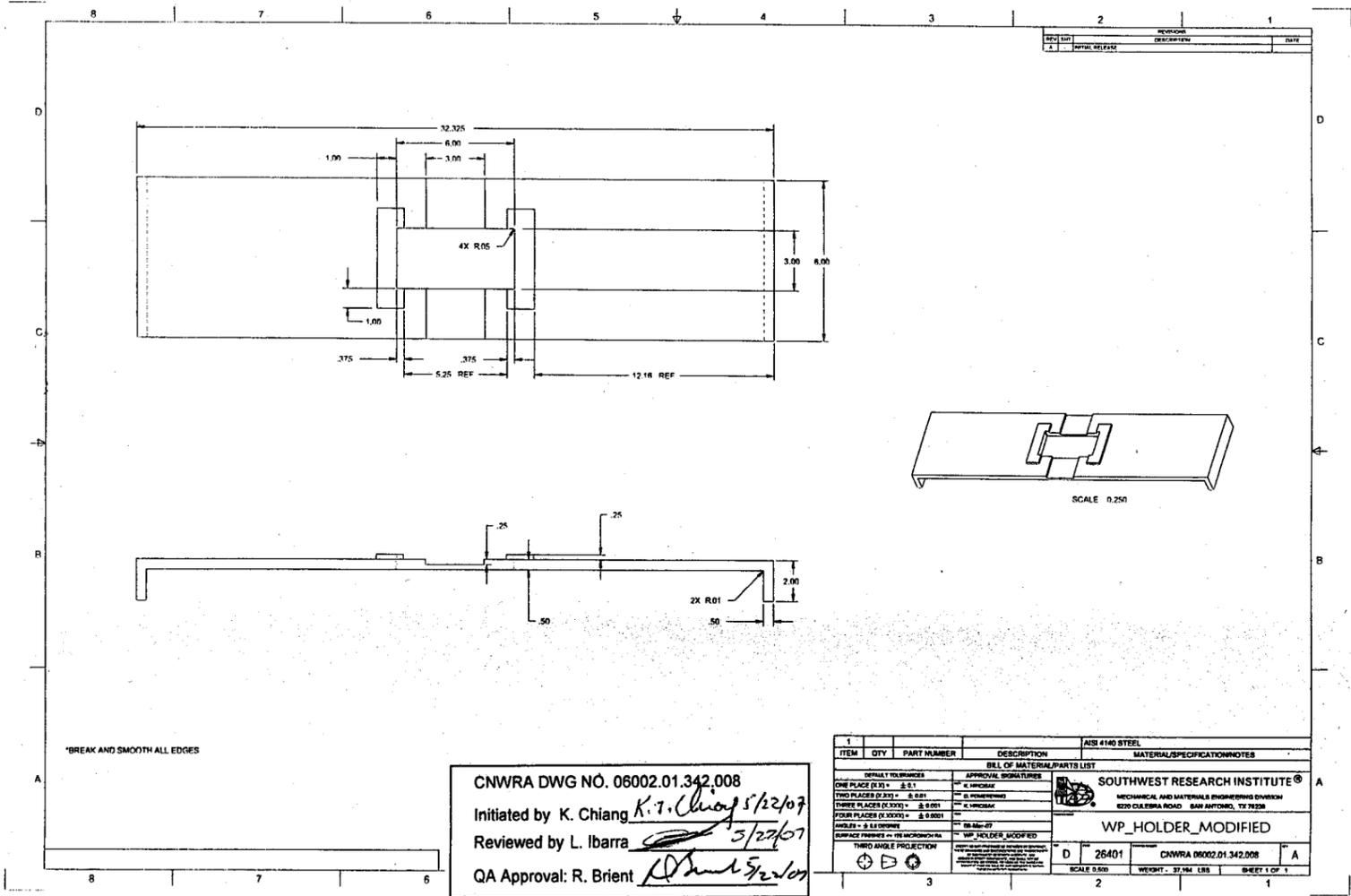


ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL/SPECIFICATION/NOTES
BILL OF MATERIAL/PARTS LIST				
ONE PLACE (X.12) - Ø.01				
TWO PLACES (X.25) - Ø.01				
THREE PLACES (X.375) - Ø.01				
FOUR PLACES (X.50) - Ø.01				
APPROVAL SIGNATURES				
INITIATED BY: K. CHIANG				
REVIEWED BY: L. IBARRA				
QA APPROVAL: R. BRIENT				
SOUTHWEST RESEARCH INSTITUTE®				
MECHANICAL AND MATERIALS ENGINEERING DIVISION				
6229 CALLEMA ROAD - SAN ANTONIO, TX 78238				
WP_HOLDER				
D 26401 CNWRA 06002.01.342.007 A				
SCALE 0.500 WEIGHT - 36.380 LBS SHEET 1 OF 1				

CNWRA DWG NO. 06002.01.342.007
 Initiated by K. Chiang *K. Chiang 5/22/07*
 Reviewed by L. Ibarra *L. Ibarra 5/22/07*
 QA Approval: R. Brient *R. Brient 5/22/07*

SIGNATURE: *K. Chiang*
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 DATE: _____
 DATE: 5/22/07
 PROPRIETARY INFORMATION: 4/17/07 WJ

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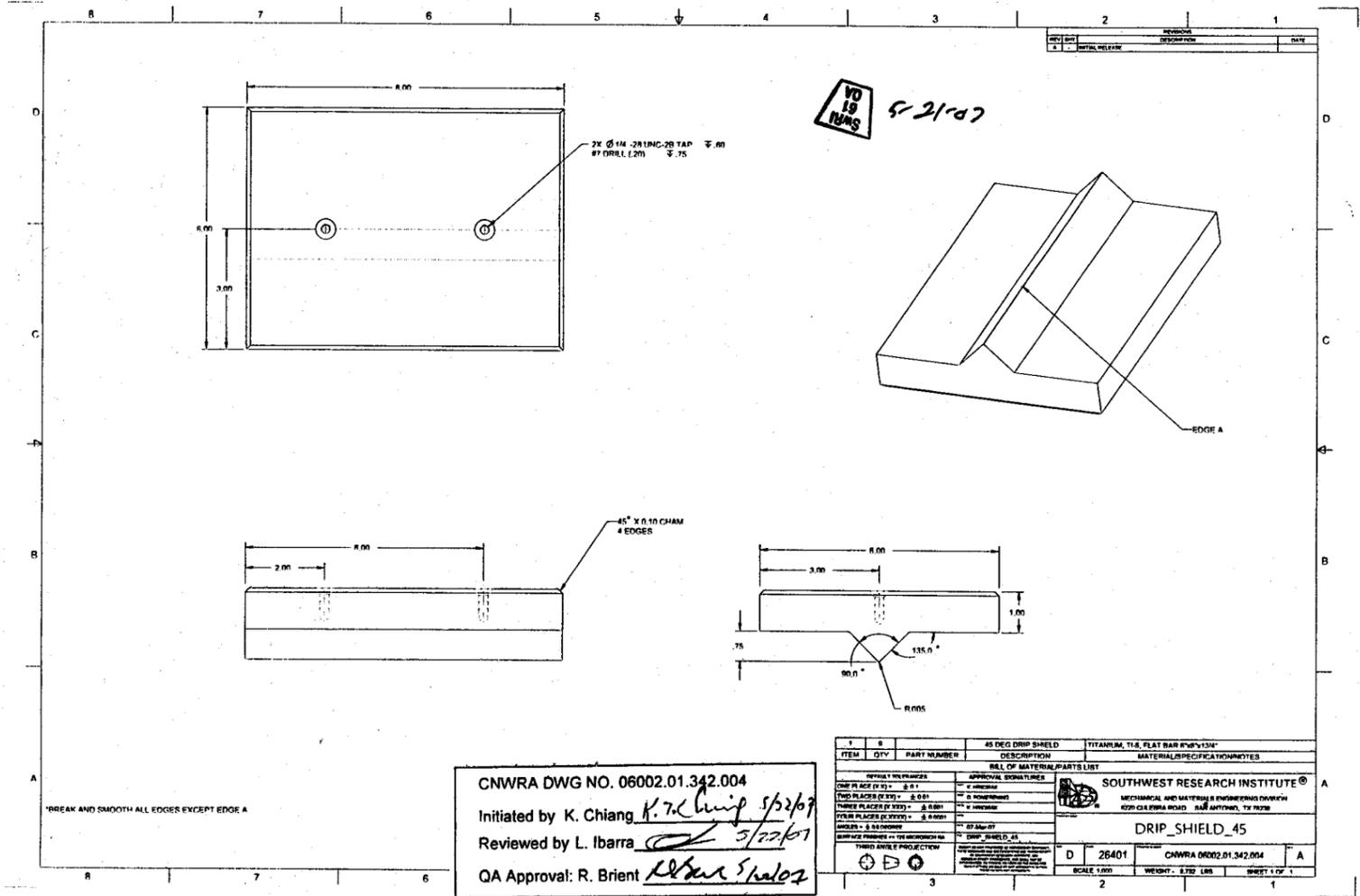
SIGNATURE
R. T. Brient

DATE

DATE
5/22/07

PROPRIETARY INFORMATION
4/17/07 m

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SIGNATURE
R. T. Brient

DATE

DATE
5/23/07

PROPRIETARY INFORMATION
4/17/07 m

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TITLE PROJECT

Continued From Page Inspection Record

5-21-07

	#1	#2	
Overall 8x6	.750 8.003 x 6.002	.750 8.003 / 6.000	
Hole 2x6	2.001 x 6.001	2.004 / 6.002	
45° EDGE	✓	✓	
1.00	1.003	1.004	
.75	.754	.753	
90°	89.58°	89.53°	
135°	134.87°	134.88°	
3.00	3.004	3.001	
#3	#4	#5	
.750	.754	.750	
7.999 / 6.000	7.998 / 5.997	8.000 / 6.002	
2.005 / 6.005	2.003 / 6.004	2.003 / 6.003	
45° ✓	✓	✓	
1.004	1.006	1.004	
.754	.750	.754	
89.56°	89.58	89.58	
134.87°	134.87	134.89	
3.005	3.004	3.004	
#6	#7	#8	#9
.735	.755	.755	.755
8.002 / 6.002	7.999 / 6.000	8.002 / 6.002	7.998 / 6.001
2.004 / 6.004	2.002 / 6.003	2.003 / 6.005	2.002 / 6.003
45° ✓	✓	45° ✓	45° ✓
1.002	1.006	1.000	1.0005
.750	.755	.749	.749
89.57	89.58	89.58	89.58
134.88	134.90	134.88	134.88
3.006	3.005	3.003	3.003
ASSET # 002157			
" # 006149			
" # 006793			

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4/17/08 m7

TITLE PROJECT

Continued From Page

Kuang-Tsan Ken Chiang

5 From: Mark Arnold [mark.arnold@swri.org]
Sent: Friday, May 18, 2007 1:13 PM
To: kuang-tsan.chiang@swri.org
Subject: Waste Package

10 Ken,

I have finished the inspection on the waste package plates. I have one part that is .002 u/s on the 3.0 +/- .010 dimension.
If this is with in expectable parameters let me know and the parts will be sitting in the window for pick up.

15 Thank You,

20 **Mark D. Arnold**
SR. QA Inspector, CMI, CQT
Institute Quality Systems
Mark.Arnold@SWRI.org
(210) 522-5477

25

30

35

40

45

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TITLE PROJECT

Continued From Page NOTES ON DS-43-01 TESTING

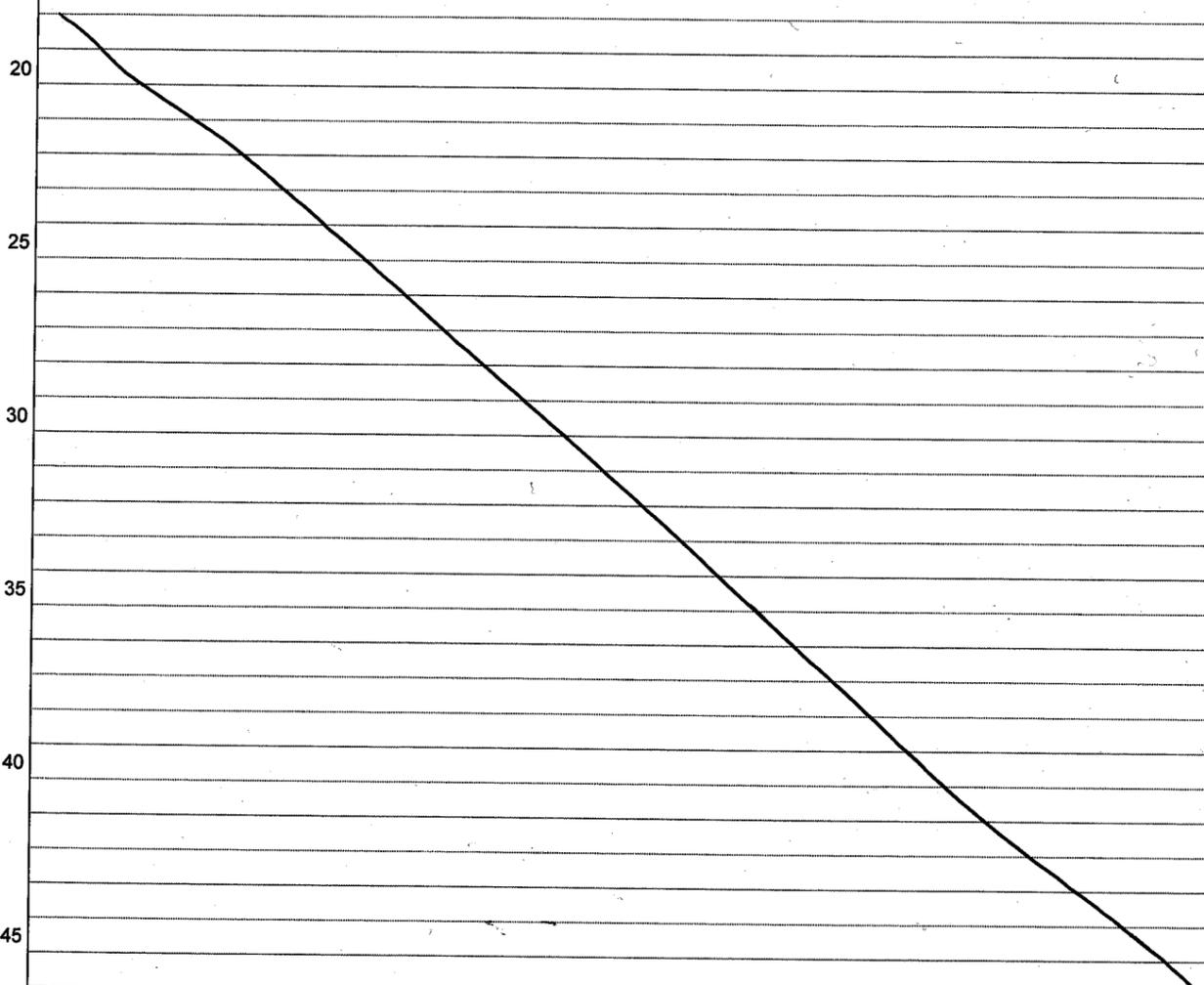
TESTING PERFORMED ON ONE SAMPLE EACH
 APPROX 22 WASTE PACKAGE (1)
 TITANIUM 45° PENETRATOR (1)

TEST PARAMETERS IDENTIFIED AS
 LOAD APPLICATION RATE 0.01 in/min [0.254 mm/min]
 MAX LOAD 400,000 lbs [1774 kN]
 MAX DJP 0.323 inches [8.26 mm]

TESTING AT AMBIENT CONDITION 76°F [24.4°C]

TESTING DONE ON 6/28/2007 - SEE PROCESS TRAVELER

TESTING STOPPED BASED ON REACHING MAXIMUM DISPLACEMENT.



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TITLE PROJECT

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PROCESS TRAVELER
 Drip Shield - Waste package Mechanical Interaction Test

SECTION 1

Project Number: 06002.01.342
 Customer Name: NRC, Div 20, Luis Ibarra
 Purchase or Work Order Number: NA
 Product Name: Material Samples
 Quantity of EUT: 1 each Waste Package Plate, 1 each 45° Drip Shield Penetrator
 Unique ID(s): See Details Below
 Require Services From Outside MSS: Yes No If yes information provided in steps below.
 QA Participation Required: Yes No If yes generate a Quality Plan.
 Project Manager Initial & Date: Daniel J Pomeroy June 27, 2007

SECTION 2

Step	Task	Target Date	Initial & Date Completion
1	Receiving inspection based on Fabrication and Inspection at SwRI Machine Shop <input checked="" type="checkbox"/> Accept <input type="checkbox"/> Reject	X	KH 6/28/07
	Identify Unique Sample ID(s) Waste Package Plate WP-01 45° Drip Shield Penetrator DS-45-01		KH 6/28/07
	Photographic Documentation of Samples with Scale in Picture(s) Notes:		KH 6/28/07
2	Perform tests on EUT as described below:		
2.1	Equipment Calibration Identify calibration of equipment and load frame functional check.	X	6/28/07
	Load Cell ID _____		
	Cal Due Date _____		
	Frame Displacement ID _____		
	Cal Due Date _____		
Secondary Displacement ID _____			
Cal Due Date _____			
Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step			
Notes: CALIBRATION SHEET PROVIDED			

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[Signature] 3 Sept 2007

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SIGNATURE [Signature] DATE 3 Sept 2007
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TITLE PROJECT

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SECTION 2			
Step	Task	Target Date	Initial & Date Completion
2.2	Facility Configuration Checks Configure the test facility with the designed apparatus and document with photographs. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:	X	6/28/07 KH
2.3	Install Test Specimens Verify that the appropriate specimens are available as identified in Step 1 and install them in the test facility. Document with photographs. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:	X	6/28/07 KH
2.4	Test Parameters Confirm the following test parameters. Load application rate (in/min) 0.01 0.01 in/min Max Load 380, 370 # 177 Max Displacement after Contact 0.33 9.53 mm 0.254 mm/min Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:	X	6/28/07 KH
2.5	Hold Point Test hold point based on configuration and test parameters. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:	X	6/28/07 KH
2.6	Initial Loading of Specimen Preload specimen to 1000 lbs. Transition the load frame for contact between the drip shield plate and the waste package penetrator. At initial contact record load and displacement values. First Contact Load 20000 18.353 E-04 # First Contact Displacement 1.884 E-04 in Load specimen up to a value of 1000 lbs and use this as a secondary hold point 1000 lb Load Actual 1010.42 4.49 KN 1000 lb Displacement 0.00102 in 0.0254 mm Record Ambient Temperature Nominal Test Facility Temperature 76° 24.4 Document Configuration with Photos Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:	X	6/28/07 KH

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DTP 3 Sept 2007

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SECTION 2			
Step	Task	Target Date	Initial & Date Completion
2.7	Constant Rate Loading Test Test at the specified load until one of the two following conditions: Load Capacity of the Load Frame (400,000 lbs) is reached or Maximum displacement of 0.325 inches (8.26 mm) Document testing with Photos during and at end of testing. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:	X	6/28/07 KH
2.8	Unload and Remove Specimen Unload the specimen by backing of the load frame. Document configuration with photos while specimens are still in the load frame. Remove the specimens from the load frame. Document the configuration with photos. Anomalies? <input checked="" type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes: SPECIMEN JAMMED INSIDE THE SPECIMEN HOLDER PLATE.	X	6/28/07 KH
2.9	Post Test Load Deflection Data Reduction Supply test engineer with electronic data of the load deflection data for reduction and presentation. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:	X	6/28/07 KH
2.10	Post Test Geometric Measurement of Test Specimen Document the as tested geometry of the waste package plate and drip shield penetrator over the area of deformation. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes: MEASUREMENT TAKEN USING DLS AND COORDINATE MEASURING MACHINE	X	8/1/07 KH
2.11	Data Transfer to Report Transfer data for inclusion in report. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:	X	8/24/07 KH

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DTP 4 Sept 2007

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SIGNATURE: *[Signature]* DATE: 3 Sept 2007

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SECTION 2			
Step	Task	Target Date	Initial & Date Completion
2.12	Final Inspection and Storage of Test Specimens Final Inspection in accordance with instructions from project manager. <input checked="" type="checkbox"/> Accept <input type="checkbox"/> Reject Storage Location <u>CURRENT STORAGE BLDG. 71</u> Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:	X	8/27/07 KH
Reporting			
3	If requested or appropriate, prepare Draft Test Report in accordance with SwRI Procedures and deliver electronic copy to customer (optional).	NA DSP	9/3/2007
4	Complete Test Report in accordance with SwRI Procedures and deliver as appropriate. ____ copies (with/without) CD-ROM PDF file to customer 1 copy, marked "Record Copy B" to Sara Domine, QA copies to all signers of report cover letter only to Tim Fey, Danny Deffenbaugh	NA DSP	9/3/2007
5	Transfer project file to Div 20 for document storage.	DSP	9/3/2007

Put information into Project Laboratory Notebook 873

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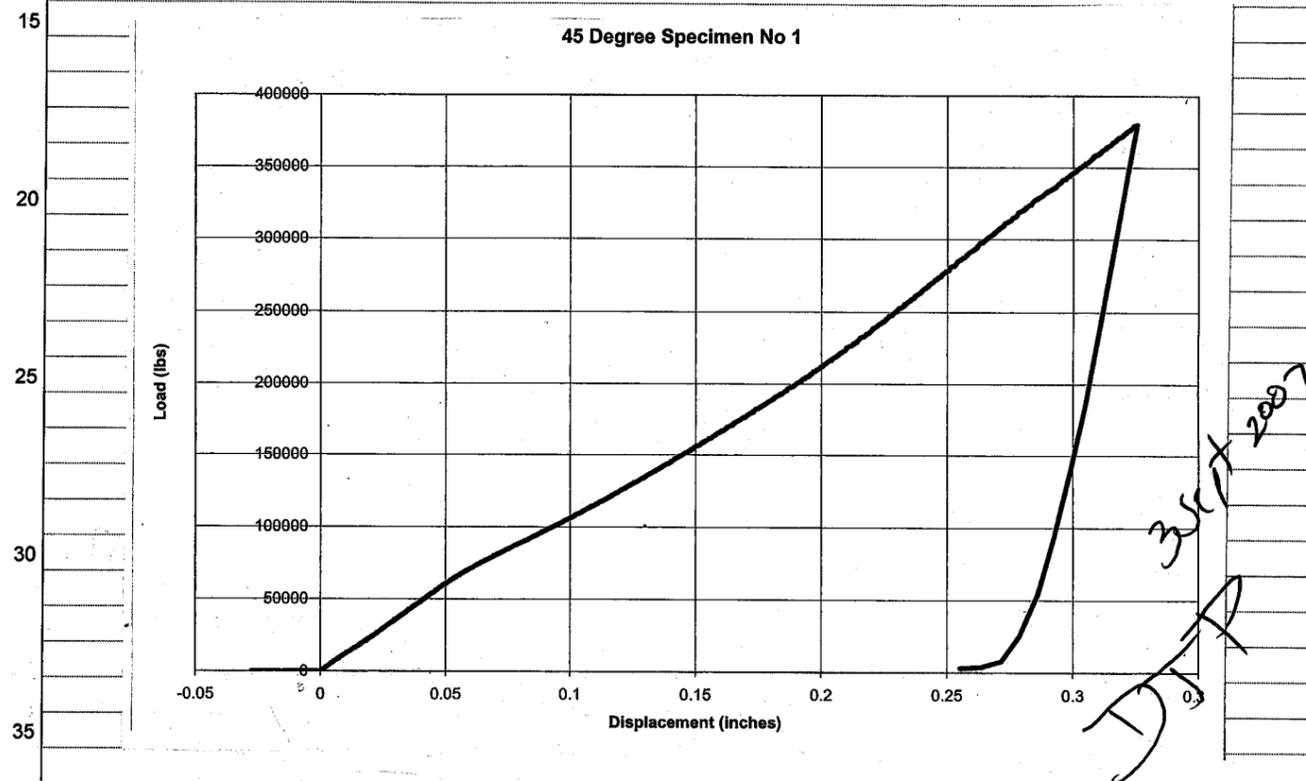
Continued From Page

DATA REDUCTION FOR DS-45-01

LOAD - DEFLECTION

The raw data contained in DS-45-01.txt
 There are three columns of useful data load, displacement 1,
 and displacement 2. This data was imported into an
 EXCEL SPREADSHEET FOR processing and display. In
 the spreadsheet the data was converted to metric units from
 english. The data was plotted. Curve fits were done
 using function built into Excel to identify specific regions
 of the load-displacement time history.

DS-45-01 LOAD DEFLECTION .XLS



DSL SCANS

The Alloy 22 and TITANIUM Perforator were scanned using
 the DSL process by Div Personnel. Scans at base metal did not
 result in useful data because of reflectance of material. Scans were
 run with a light coat of powder. The resulting surface was
 rough. Additional scans were run with a light coat of white
 paint. Scan data was taken. Data was imported into
 Solid Works for display. Summary of results of DSL scans
 are given in Drip-Shield-Measurement Scan.ppt

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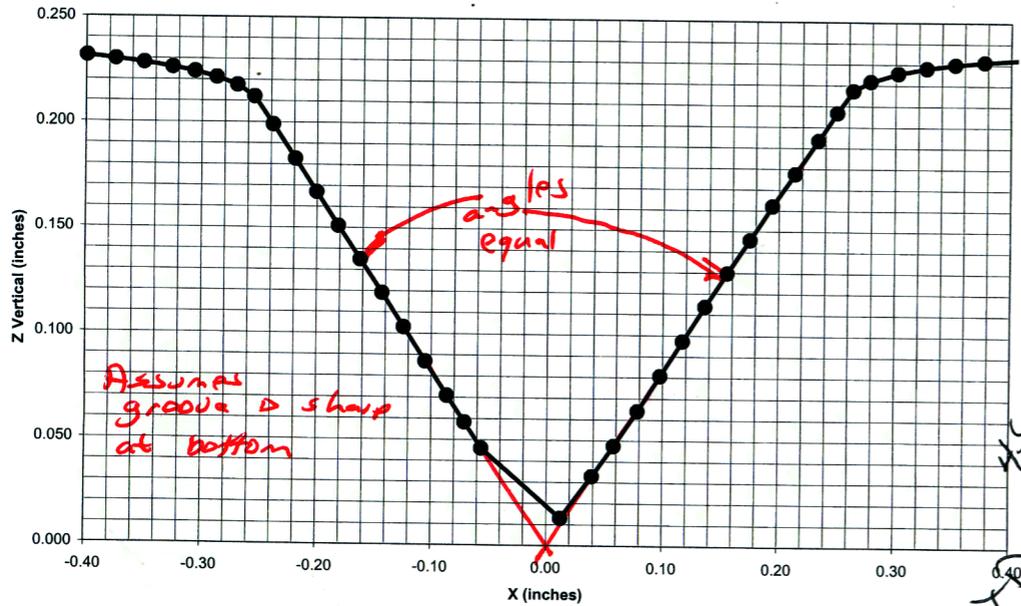
Continued From Page 33

CMM Scans

A single line scan perpendicular to the groove (X-Axis) was made for the Alloy 22 material ^{4 Sept 2007} following loading. There was an obvious bow to the material. This made it difficult to clearly define the upper surface to get a depth of the groove. To orient the specimen the slopes of the side walls of the groove were matched and the scan data transformed to this coordinate system. The resulting data is shown below. The Excel spreadsheet used to do this is given.

DS-45-01 X Scans

400k Z



A single line scan perpendicular to the ^{4 Sept 2007} right edge of the titanium penetrator was made following loading. The raw data was again transformed to account for minor variations in the set-up. In the first the slope of the sides were set equal and the intersection of these two lines set at 0.0 in. The tip of the titanium has been reduced and rounded over.

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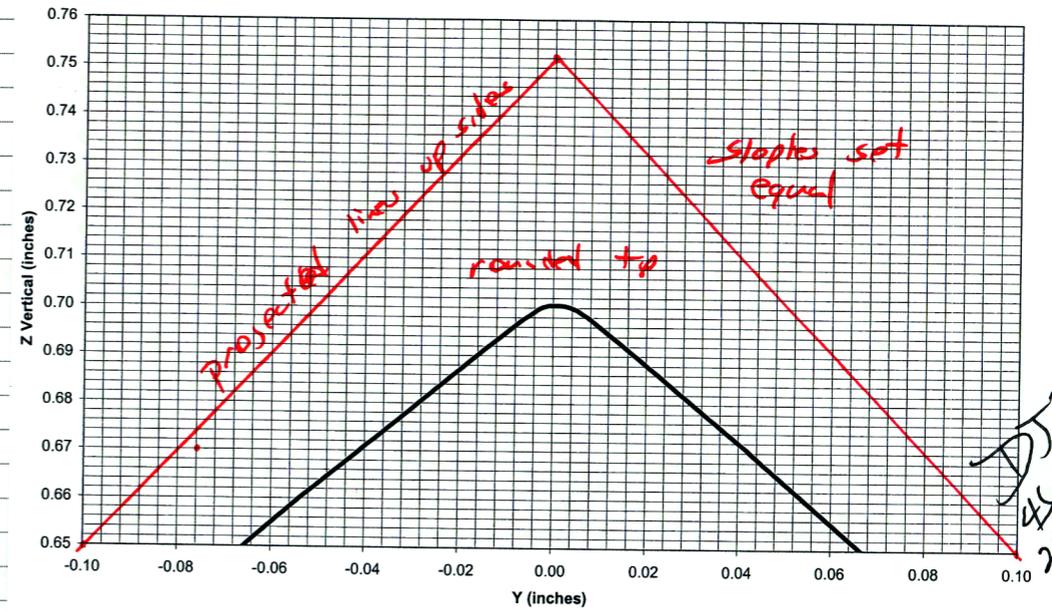
TITLE

PROJECT

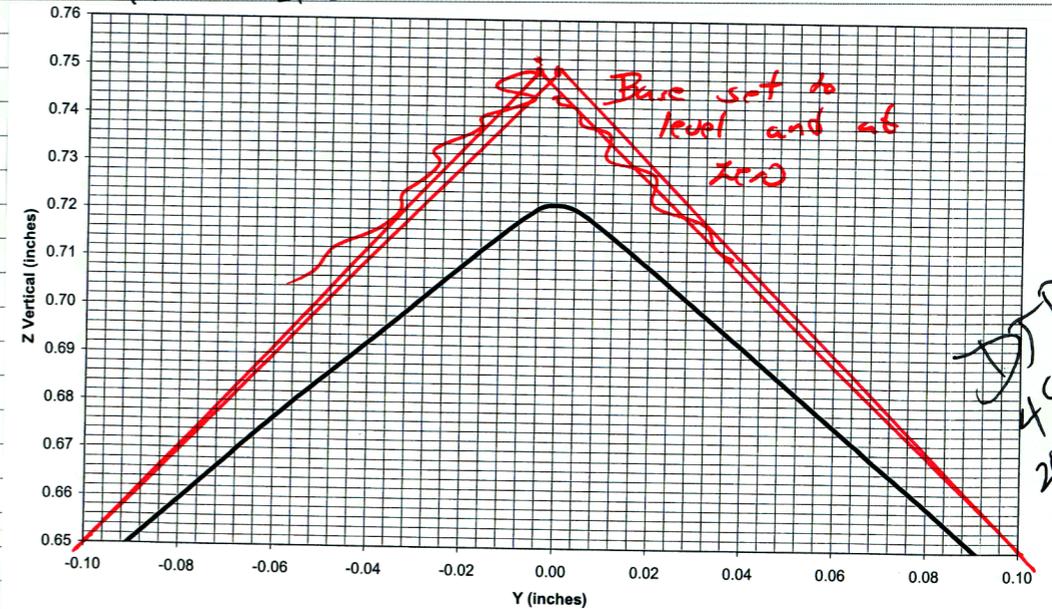
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DS-45-01 Y Scans

400k Z



In the second process the base of the penetrator was assumed to have remained flat and the data was transformed to make this level. The vertical coordinates at the base, averaged, was set to zero.



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DATA FROM DS-45-01

DS-45-01 TESTING

DS-45-01 Load Detection

DS-45-01 Load Detection . xls

DS-45-01 . txt

DS-45-01 SCANS

txt files original data

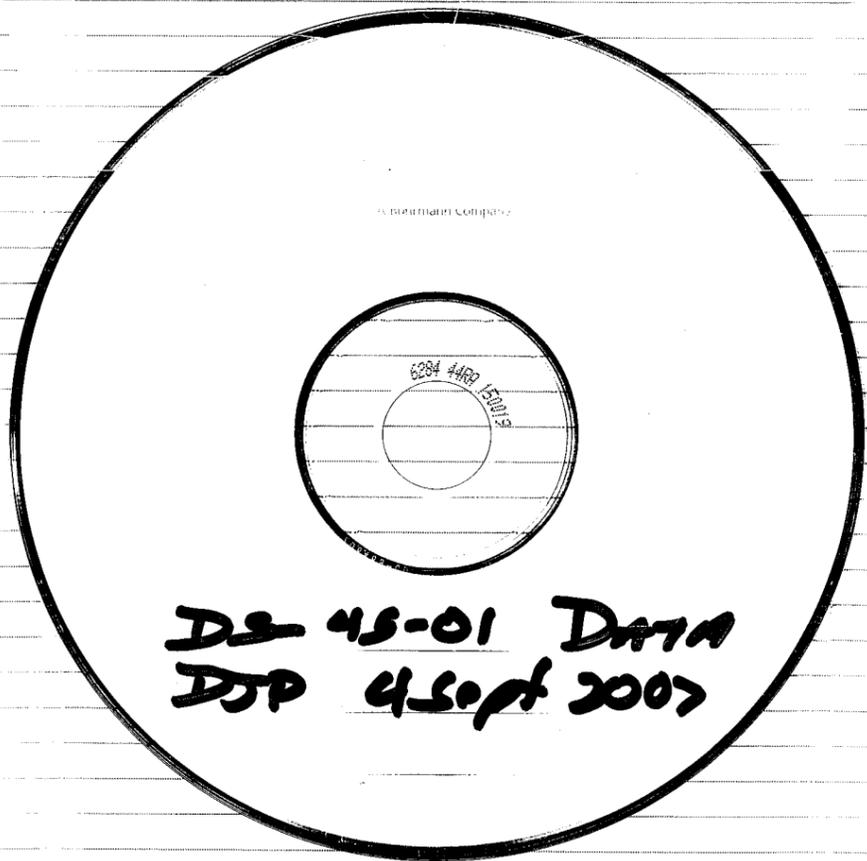
xls processed files

DSH scan data and pot

PICS-DS-45-01

Process traveler

Calibration records for load frame (pdf)



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TESTING CONTROLLED USING PROCESS TRAVELER



PROCESS TRAVELER Drip Shield - Waste package Mechanical Interaction Test

SECTION 1

Project Number: 06002.01.342

Customer Name: NRC, Div 20, Luis Ibarra

Purchase or Work Order Number: NA

Product Name: Material Samples

Quantity of EUT: 1 each Waste Package Plate, 1 each 45° Drip Shield Penetrator

Unique ID(s): See Details Below

Require Services From Outside MSS: Yes No If yes information provided in steps below.

QA Participation Required: Yes No If yes generate a Quality Plan.

Project Manager Initial & Date: Daniel J Pomeroy August 3rd, 2007

SECTION 2

Step	Task	Target Date	Initial & Date Completion
1	Receiving Inspection based on Fabrication and Inspection at SwRI Machine Shop <input checked="" type="checkbox"/> Accept <input type="checkbox"/> Reject		8/7
	Identify Unique Sample ID(s) Waste Package Plate WP-02 45° Drip Shield Penetrator DS-45-02 Photographic Documentation of Samples with Scale in Picture(s) Notes:		VK
2	Perform tests on EUT as described below:		
Testing on EUT 1			
2.1	Equipment Calibration Identify calibration of equipment and load frame functional check. Load Cell ID _____ Cal Due Date _____ Frame Displacement ID _____ Cal Due Date _____ Secondary Displacement ID _____ Cal Due Date _____ Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes: <i>OWN CALIBRATION DATA SHEET PROVIDED.</i>		

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SECTION 2			
Step	Task	Target Date	Initial & Date Completion
2.2	Facility Configuration Checks Configure the test facility with the designed apparatus. Document with photographs. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		
2.3	Install Test Specimens Verify that the appropriate specimens are available as identified in Step 1 and install them in the test facility. Document with photographs. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		
2.4	Test Parameters Confirm the following test parameters. <u>0.01 in/min</u> Load application rate (in/min) Max Load _____ Max Displacement after Contact _____ Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		
2.5	Hold Point Test hold point based on configuration and test parameters. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes: <u>1000 lbf HOLD POINT ESTABLISHED FOR ALL INCREMENTS</u>		
2.6	Constant Rate Loading - 1st Increment (24,000 lbf) Load specimen up to a value of 24,000 lbs and use this as a hold point. Record the actual load and displacement values: 24,000 lbs Load Actual <u>24,001 #</u> 24,000 lbs Displacement _____ Record Ambient Temperature _____ Nominal Test Facility Temperature _____ Document Configuration with Photos Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		

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SECTION 2			
Step	Task	Target Date	Initial & Date Completion
2.7	Unload and Remove Specimen and Penetrator Unload the specimen by backing of the load frame. Document configuration with photos while specimens are still in the load frame. Remove the specimens from the load frame. Document the configuration with photos. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes: <u>PENETRATOR - SHOWS NO INDENTATION ALLOY 22 - TRACED - 2 FILES (X,Y)</u>		
2.8	Geometric Measurement of Test Specimen and Penetrator Document the tested geometry of the waste package plate and drip shield penetrator over the area of deformation. Document the configuration with photos. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		
2.9	Install Test Specimens and Penetrator Verify that the specimen and the drip shield penetrator are correctly aligned. Install them in the test facility. Document with photographs. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		
2.10	Constant Rate Loading - 2nd Increment (50,000 lbf) Load specimen up to a value of 50,000 lbs and use this as a hold point. Record the actual load and displacement values: 50,000 lbs Load Actual <u>50,002 #</u> 50,000 lbs Displacement _____ Record Ambient Temperature _____ Nominal Test Facility Temperature _____ Document Configuration with Photos Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		

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SECTION 2			
Step	Task	Target Date	Initial & Date Completion
2.11	Unload and Remove Specimen and Penetrator Unload the specimen by backing of the load frame. Document configuration with photos while specimens are still in the load frame. Remove the specimens from the load frame. Document the configuration with photos. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		
2.12	Geometric Measurement of Test Specimen and Penetrator Document the tested geometry of the waste package plate and drip shield penetrator over the area of deformation. Document the configuration with photos. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes: DEWET - 2 FILES AL0722 - 2 FILES		
2.13	Install Test Specimens and Penetrator Verify that the specimen and the drip shield penetrator are correctly aligned. Install them in the test facility. Document with photographs. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		
2.14	Constant Rate Loading - 3rd Increment (100,000 lbf) Load specimen up to a value of 100,000 lbs and use this as a hold point. Record the actual load and displacement values: 100,000 lbs Load Actual <u>100,001 #</u> 100,000 lbs Displacement _____ Record Ambient Temperature _____ Nominal Test Facility Temperature _____ Document Configuration with Photos Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		

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SECTION 2			
Step	Task	Target Date	Initial & Date Completion
2.15	Unload and Remove Specimen and Penetrator Unload the specimen by backing of the load frame. Document configuration with photos while specimens are still in the load frame. Remove the specimens from the load frame. Document the configuration with photos. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		
2.16	Geometric Measurement of Test Specimen and Penetrator Document the tested geometry of the waste package plate and drip shield penetrator over the area of deformation. Document the configuration with photos. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		
2.17	Install Test Specimens and Penetrator Verify that the specimen and the drip shield penetrator are correctly aligned. Install them in the test facility. Document with photographs. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		
2.18	Constant Rate Loading - 4th Increment (200,000 lbf) Load specimen up to a value of 200,000 lbs and use this as a hold point. Record the actual load and displacement values: 200,000 lbs Load Actual <u>200,000 lbf</u> 200,000 lbs Displacement _____ Record Ambient Temperature _____ Nominal Test Facility Temperature _____ Document Configuration with Photos Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		

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SECTION 2			
Step	Task	Target Date	Initial & Date Completion
2.19	Unload and Remove Specimen and Penetrator Unload the specimen by backing of the load frame. Document configuration with photos while specimens are still in the load frame. Remove the specimens from the load frame. Document the configuration with photos. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		
2.20	Geometric Measurement of Test Specimen and Penetrator Document the tested geometry of the waste package plate and drip shield penetrator over the area of deformation. Document the configuration with photos. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		
2.21	Install Test Specimens and Penetrator Verify that the specimen and the drip shield penetrator are correctly aligned. Install them in the test facility. Document with photographs. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		
2.22	Constant Rate Loading - 5th Increment (300,000 lbf) Load specimen up to a value of 300,000 lbs and use this as a hold point. Record the actual load and displacement values: 300,000 lbs Load Actual <u>300,000 lbf</u> 300,000 lbs Displacement _____ Record Ambient Temperature _____ Nominal Test Facility Temperature _____ Document Configuration with Photos Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		

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SECTION 2			
Step	Task	Target Date	Initial & Date Completion
2.23	Unload and Remove Specimen and Penetrator Unload the specimen by backing of the load frame. Document configuration with photos while specimens are still in the load frame. Remove the specimens from the load frame. Document the configuration with photos. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes: Bow is EVIDENT IN THE SPECIMEN.		KH 8/6/07
2.24	Geometric Measurement of Test Specimen and Penetrator Document the tested geometry of the waste package plate and drip shield penetrator over the area of deformation. Document the configuration with photos. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes: 4 PEGS ARE USED TO SUPPORT THE SPECIMEN.		KH 8/6/07
2.25	Install Test Specimens and Penetrator Verify that the specimen and the drip shield penetrator are correctly aligned. Install them in the test facility. Document with photographs. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		KH 8/6/07
2.26	Constant Rate Loading - 6th Increment (max lbf) Test at the specified load until one of the two following conditions: Load Capacity of the Load Frame (400,000 lbs) is reached or Maximum displacement of 0.325 inches (8.26 mm) Record Ambient Temperature _____ Nominal Test Facility Temperature <u>400,000 #</u> Document Configuration with Photos Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		KH 8/6/07
2.27	Unload and Remove Specimen and Penetrator Unload the specimen by backing of the load frame. Document configuration with photos while specimens are still in the load frame. Remove the specimens from the load frame. Document the configuration with photos. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		KH 8/6/07

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SECTION 2			
Step	Task	Target Date	Initial & Date Completion
2.28	Geometric Measurement of Test Specimen and Penetrator Document the tested geometry of the waste package plate and drip shield penetrator over the area of deformation. Document the configuration with photos. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		Kg 8/6/07
2.29	Post Test Load Deflection Data Reduction Supply test engineer with electronic data of the load deflection data for reduction and presentation. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		Kg 8/6/07
2.30	Data Transfer to Report Transfer data for inclusion in report. Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		8/25/07 Kg
2.31	Final Inspection and Storage of Test Specimens Final Inspection in accordance with instructions from project manager. <input checked="" type="checkbox"/> Accept <input type="checkbox"/> Reject Storage Location <u>CURRENT LOCATION - BLDG. 71</u> Anomalies? <input type="checkbox"/> Yes If "Yes", notify PM to provide disposition <input checked="" type="checkbox"/> No Proceed to next step Notes:		8/27/07 Kg
Reporting			
3	If requested or appropriate, prepare Draft Test Report in accordance with SwRI Procedures and deliver electronic copy to customer (optional).		
4	Complete Test Report in accordance with SwRI Procedures and deliver as appropriate. _____ copies (with/without) CD-ROM PDF file to customer 1 copy, marked "Record Copy B" to Sara Domine, QA copies to all signers of report cover letter only to Tim Fey, Danny Deffenbaugh		
5	Transfer project file to Div 20 for document storage.		

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I WILL ADD TO THIS SCIENTIFIC NOTEBOOK THE ASSOCIATED FINITE ELEMENT ANALYSES USED FOR COMPARISON TO THE EXPERIMENTAL RESULTS PRESENTED PREVIOUSLY.

THOMAS WILT

Thom E 22 9/4/2007 TSW

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Conti

TITANIUM TRUE STRESSES AND STRAINS

For the Titanium Aero Plate 6AL-4V Grade 5 per ASTM B265 material, the true stress calculations are based on the average of the values reported by the vendor:

$\sigma_{y,eng} = 135.6$ ksi
 $\sigma_{UTS,eng} = 144.4$ ksi
 $\epsilon_{failure,eng} = 0.177$

Conversion at Yielding
 The Young's modulus for titanium is:
 $E = 15,500$ ksi
 Thus, the strain at yielding is:
 $\epsilon_{y,eng} = \sigma_{y,eng} / E = 0.0087$

Then, the true strain at yielding is:
 $\epsilon_{UTS,true} = \ln(1 + \epsilon_{UTS,eng}) = 0.0087$

The true stress at yielding is:
 $\sigma_{y,true} = \sigma_{y,eng} (1 + \epsilon_{y,eng}) = 136.8$ ksi = 943 MPa

Conversion at UTS
 To obtain the true stresses and strains at the UTS, it is assumed that the strain at UTS is 90% of the strain at failure. Then,
 $\epsilon_{UTS,eng} = 0.159$

Then, the true strain at UTS is:
 $\epsilon_{UTS,true} = \ln(1 + \epsilon_{UTS,eng}) = 0.148$

The true stress at UTS is:
 $\sigma_{UTS,true} = \sigma_{UTS,eng} (1 + \epsilon_{UTS,eng}) = 167.4$ ksi = 1,153 MPa

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ALLOY 22 TRUE STRESSES AND STRAINS

For Hastelloy C-22 Alloys, the following data is provided by the fabricant,

$\sigma_{y,eng} = 49.0$ ksi
 $\sigma_{UTS,eng} = 108$ ksi
 $\epsilon_{failure,eng} = 0.70$

Conversion at Yielding
 The Young's modulus for Alloy 22 is taken from Ibarra, et al. (2007) as:
 $E = 26,100$ ksi

Thus, the engineering strain at yielding is:
 $\epsilon_{y,eng} = \sigma_{y,eng} / E = 0.00188$

Then, the true strain at yielding is:
 $\epsilon_{UTS,true} = \ln(1 + \epsilon_{UTS,eng}) = 0.00188$

The true stress at yielding is:
 $\sigma_{y,true} = \sigma_{y,eng} (1 + \epsilon_{y,eng}) = 49.1$ ksi = 338 MPa

Conversion at UTS
 To obtain the true stresses and strains at the UTS, it is assumed that the strain at UTS is 90% of the strain at failure. Then,
 $\epsilon_{UTS,eng} = 0.63$

Then, the true strain at UTS is:
 $\epsilon_{UTS,true} = \ln(1 + \epsilon_{UTS,eng}) = 0.490$

The true stress at UTS is:
 $\sigma_{UTS,true} = \sigma_{UTS,eng} (1 + \epsilon_{UTS,eng}) = 176.0$ ksi = 1,213 MPa

Ibarra, L., T. Wilt, G. Ofoegbu, R. Kazban, F. Ferrante, and A. Chowdhury. "Drip Shield-Waste Package Mechanical Interaction." San Antonio, Texas: Center for Nuclear Waste Regulatory Analyses. 2007.

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SAMPLE ABAQUS INPUT FILE FOR Ti-24 ALLOY 22 INTERACTIO ANALYSIS

*Heading
** Job name: optmesh50rnd2body Model name: Model-1
***Preprint, echo=NO, model=NO, history=NO, contact=NO
**
** PARTS
**
*Part, name=Part-2
*End Part
**
*Part, name=Part-5
*End Part
**
** ASSEMBLY
**
*Assembly, name=Assembly
**
*Instance, name=Part-2-6, part=Part-2 ALLOY 22 MODEL
*Node
1, 0.061999999, -0.00100000005
2, 0.061999999, -0.010999999
3, 0.0379999988, -0.010999999
4, 0.0379999988, -0.00100000005
12477, 0.0381249972, -0.00135714281
12478, 0.0381250009, -0.00117857149
} TYPICAL NODAL DATA
*Element, type=CPE4 PLANE STRAIN ELEMENT
1, 1000, 22, 23, 1001
2, 424, 425, 670, 624
3, 986, 1364, 1337, 1629
4, 902, 1019, 1190, 1255
12316, 12477, 12478, 309, 308
12317, 12478, 623, 4, 309
} CONNECTIVITIES
*Nset, nset=PickedSet9, internal, generate
1, 12478, 1
*Elset, elset=PickedSet9, internal, generate
1, 12317, 1
** Region: (wp:Picked)
*Elset, elset=PickedSet9, internal, generate
1, 12317, 1
** Section: wp
*Solid Section, elset=PickedSet9, material=alloy22 ASSIGNMENT TO ALLOY 22 MATERIAL
1.,
*End Instance
**
*Instance, name=Part-5-6, part=Part-5 Ti-24 MODEL
0.0165516844118473, 0.0378406204335659, 0.
0.0165516844118473, 0.0378406204335659, 0.,
0.0165516844118473, 0.0378406204335659, -1., 44.9999993411413
*Node
1, 0.0500456654, 0.0200001318
2, 0.0300456639, 0.0200001318
3, 0.0300456639, 1.31087035e-07
4, 0.0460456647, 1.31087035e-07
9652, 0.0183867291, 0.0109851938
9653, 0.0184678994, 0.00887299702
*Element, type=CPE4 PLANE STRAIN ELEMENT
1, 903, 251, 252, 913
2, 733, 37, 38, 734
3, 1006, 1005, 1425, 1330

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4, 730, 91, 92, 776
9444, 9445, 9446, 9447, 9448, 9449, 9450, 9451, 9452, 9453, 9454, 9455,
9456, 9457, 9458, 9459
9460, 9461, 9462, 9463, 9464, 9465, 9466, 9467, 9468, 9469, 9470, 9471,
9472
** Section: stiffrigid
*Solid Section, elset=PickedSet7, material=rigid
1.,
** Region: (stiffrigid:Picked)
*Elset, elset=PickedSet6, internal, generate
7427, 8286, 1
** Section: stiffrigid
*Solid Section, elset=PickedSet6, material=rigid
1.,
*Elset, elset=PickedSet8, internal, generate
1, 6807, 1
** Region: (stiff2:Picked)
*Elset, elset=PickedSet8, internal, generate
1, 6807, 1
** Section: stiff2
*Solid Section, elset=PickedSet8, material=ti24 ASSIGNMENT TO Ti-24 MATERIAL
1.,
*ELEMENT, TYPE=SPRING1, ELSET=YGRND
20004, 14
20005, 19
*SPRING, ELSET=YGRND
2,
1.0E+02,
*End Instance
**
*Nset, nset=PickedSet636, internal, instance=Part-2-6
6, 7, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366,
367, 368
369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382,
383, 384
385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398,
399, 400
401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413
*Elset, elset=PickedSet636, internal, instance=Part-2-6
5, 42, 136, 165, 204, 206, 208, 210, 211, 213, 214, 272, 273, 276,
279, 281
283, 284, 286, 287, 289, 290, 292, 293, 295, 296, 298, 300, 304, 305,
307, 310
311, 313, 314, 316, 318, 319, 322, 325, 326, 330, 338, 346, 350, 353,
371, 386
414, 423, 429, 484, 573, 646, 662, 682, 685, 688, 691, 706
*Nset, nset=PickedSet694, internal, instance=Part-2-6
5, 6, 350, 351, 352, 353, 354
*Elset, elset=PickedSet694, internal, instance=Part-2-6
301, 302, 305, 674, 677, 679
*Nset, nset=PickedSet844, internal, instance=Part-5-6
14, 16, 17
*Nset, nset=n432, instance=Part-5-6
432
*Nset, nset=n14, instance=Part-5-6
14
*Nset, nset=n4479, instance=Part-5-6
4479
*Nset, nset=n4895, instance=Part-5-6
4895
*Nset, nset=n5363, instance=Part-5-6

TITLE PROJECT

*Density
** 8691.5,
1.0E-33
***Elastic
** 1.97e+11, 0.31
***Plastic
** 2.547e+08, 0.
** 9.541e+08, 0.335
** 11.545e+08, 0.525
*Elastic
1.799e+11, 0.31
*Plastic
338.0e+06, 0.
1213.0e+06, 0.490
5000.0e+06, 2.690

Alloy 22

*Material, name=rigid
*Density
4429.,
*Elastic
1.072e+11, 0.31
*Plastic
1e+21,0.
*Material, name=ti24
*Density
4429.,
*Elastic
1.072e+11, 0.31
*Plastic
943.0e+06, 0.
1153.0e+06, 0.148
5000.0e+06, 2.86

Ti-24

** INTERACTION PROPERTIES

*Surface Interaction, name=IntProp-1
1.,
*Friction, slip tolerance=0.005
0.4,
*Surface Behavior, no separation, pressure-overclosure=HARD

CONTACT DATA

** BOUNDARY CONDITIONS

** Name: BC-3 Type: Displacement/Rotation
*Boundary
PickedSet694, 1, 1
** Name: BC-4 Type: Displacement/Rotation
*Boundary
PickedSet844, 1, 1
** Name: BC-6 Type: Displacement/Rotation
*Boundary
PickedSet636, 2, 2

BOUNDARY CONDITIONS

** INTERACTIONS

** Interaction: Int-1
*Contact Pair, interaction=IntProp-1
PickedSurf835, PickedSurf834

CONTACT DATA

** STEP: Step-1

NEW

Continued to Page

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TITLE PROJECT

*Step, name=Step-1, nlgeom=YES, inc=10000
*Static
0.0001, 1., 1e-10, 1.0
** LOADS
** Name: Load-1 Type: Pressure
*dload, op=mod
stiff, grav, 9.81, 0.0, -1.0
***Dsload
** PickedSurf650, P, 1.

LOAD STEP DATA

** OUTPUT REQUESTS
***Restart, write, frequency=0
** FIELD OUTPUT: F-Output-1
** Output, field, variable=PRESELECT
** HISTORY OUTPUT: H-Output-1
** Output, history, variable=PRESELECT
***node output, nset=n432
**u1,u2
***node print, nset=n432
**u1,u2
*contact output
carea
*contact print, frequency=1
carea
*End Step

** STEP: Step-2
*Step, name=Step-2, nlgeom=YES, inc=1000
*Static
0.01, 1., 1e-05, 0.1
** LOADS
** Name: Load-1 Type: Pressure
*dload, op=mod
stiff, grav, 544210.0, 0.0, -1.0
stiff, grav, 1088420.0, 0.0, -1.0
***Dsload
** PickedSurf650, P, 56.58E+07

LOAD STEP DATA

** OUTPUT REQUESTS
***Restart, write, frequency=1
** FIELD OUTPUT: F-Output-1
** Output, field, variable=PRESELECT
** HISTORY OUTPUT: H-Output-1
** Output, history, variable=PRESELECT, frequency=1
***Output, history

APPLY LOADS

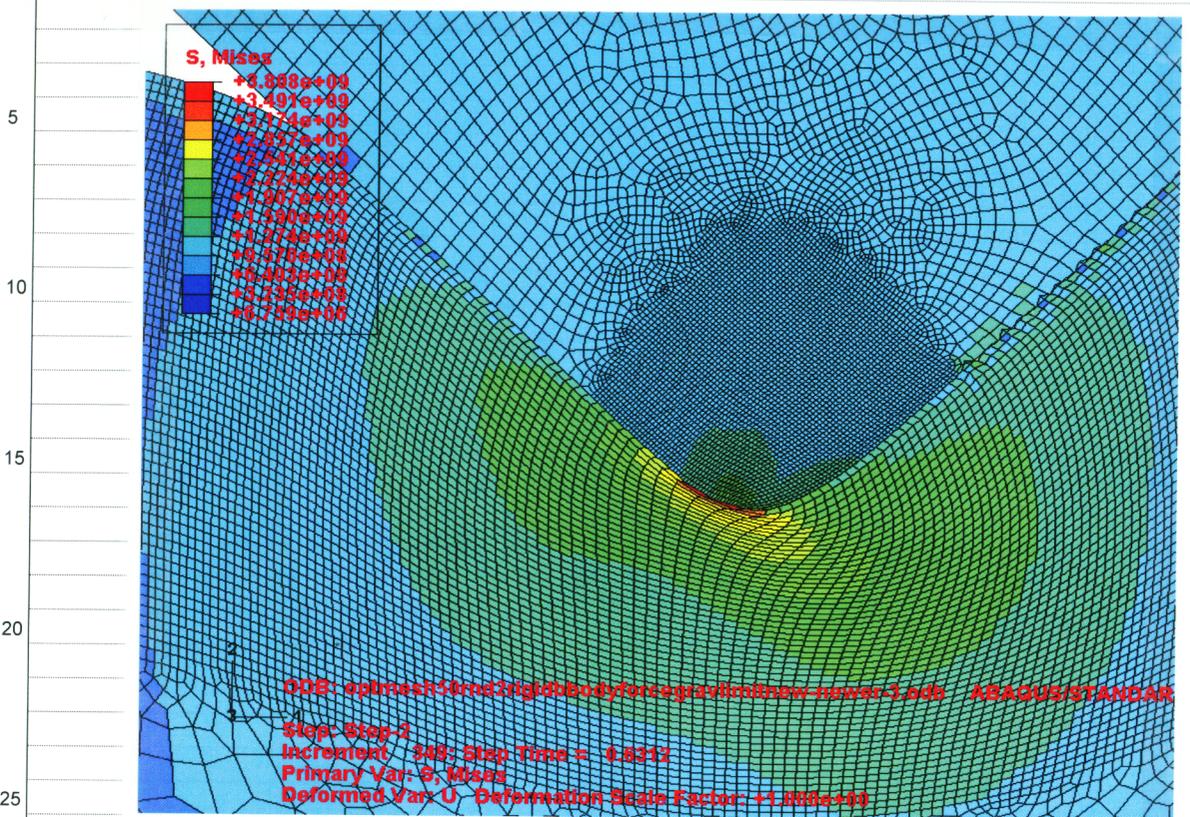
ASSIGN OUTPUT VARIABLES

NEW

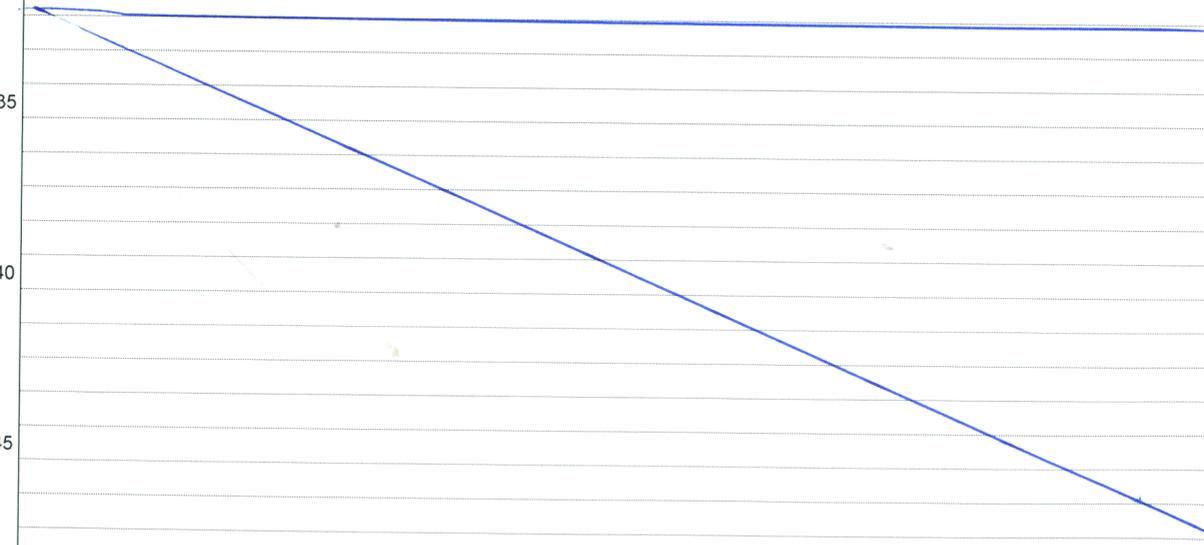
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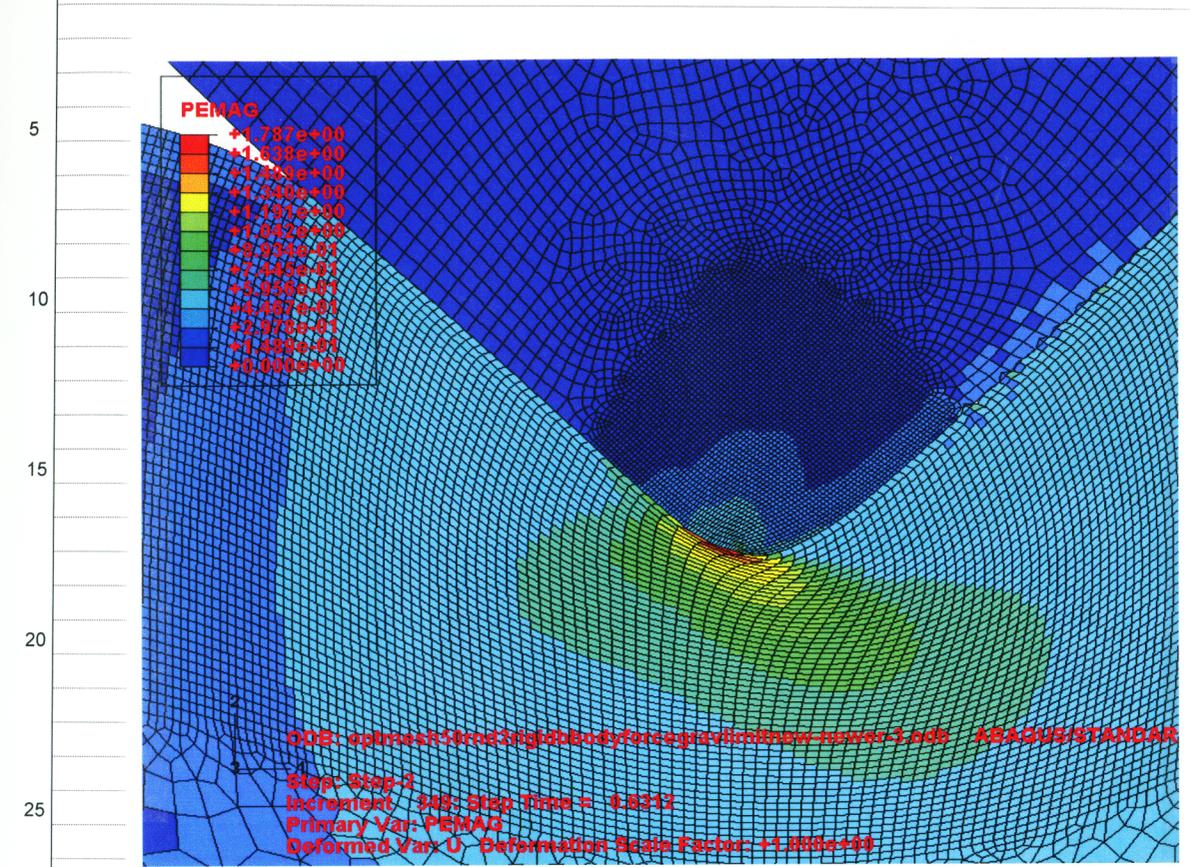
TEW
VOW^{TEW} MISES STRESS



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<i>John E. ...</i>	9/4/2007		
		PROPRIETARY INFORMATION	
		4/17/08 MW	

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TEW
TEW
MAGNITUDE OF PLASTIC STRAIN



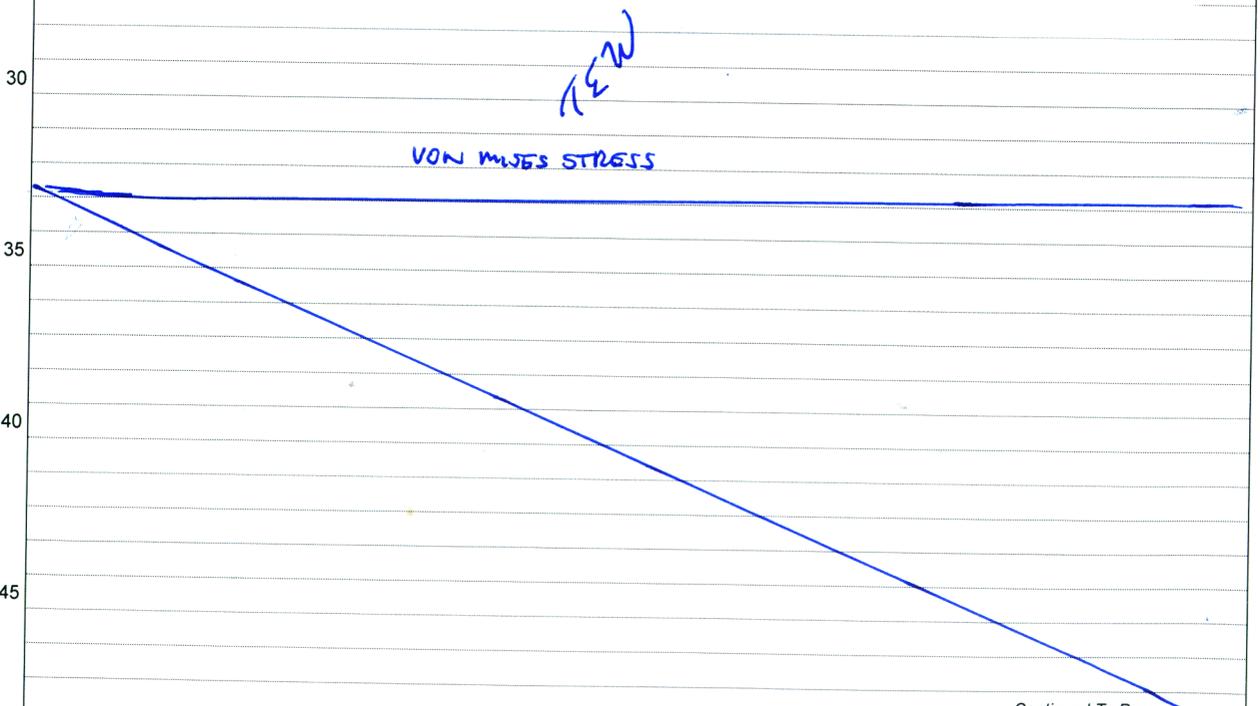
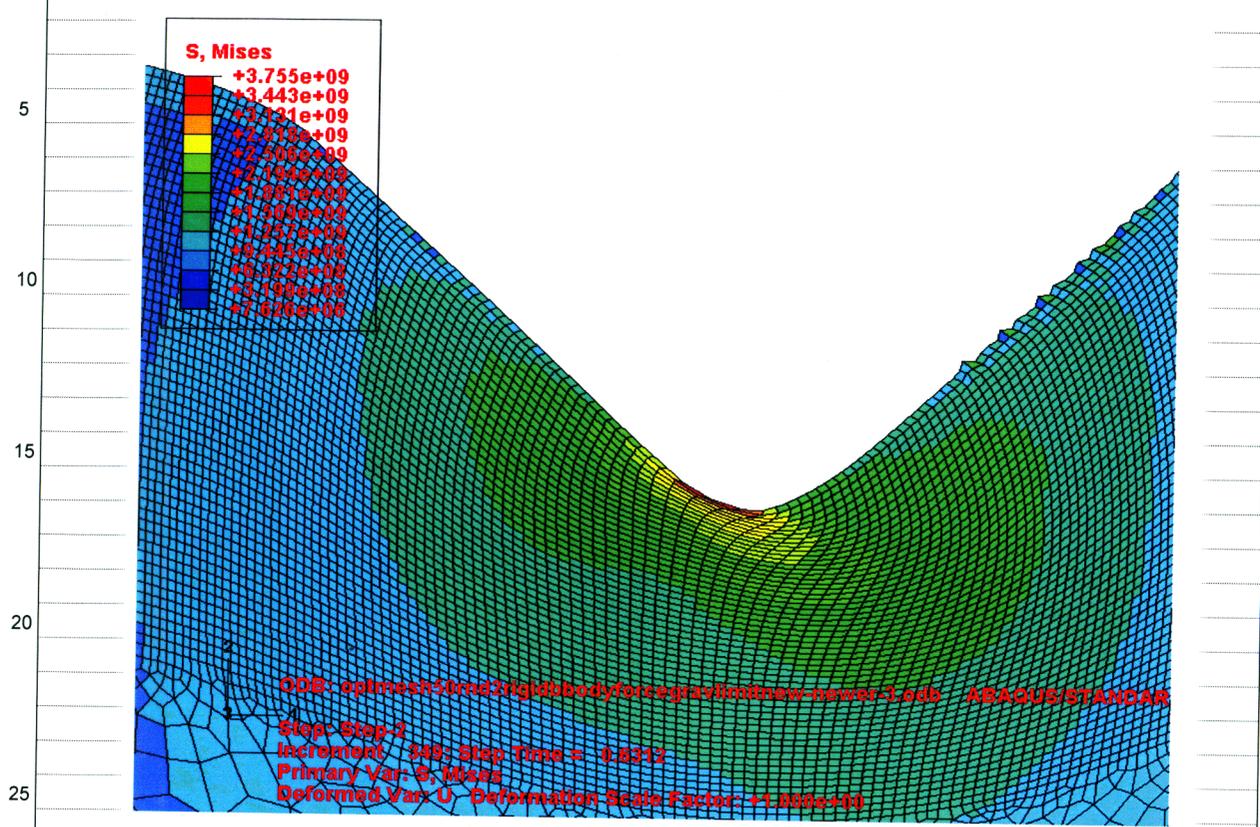
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<i>John E. ...</i>	9/4/2007		
		PROPRIETARY INFORMATION	
		4/17/08 MW	

TITLE

PROJECT

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DATE: 9/4/2007

DATE: _____

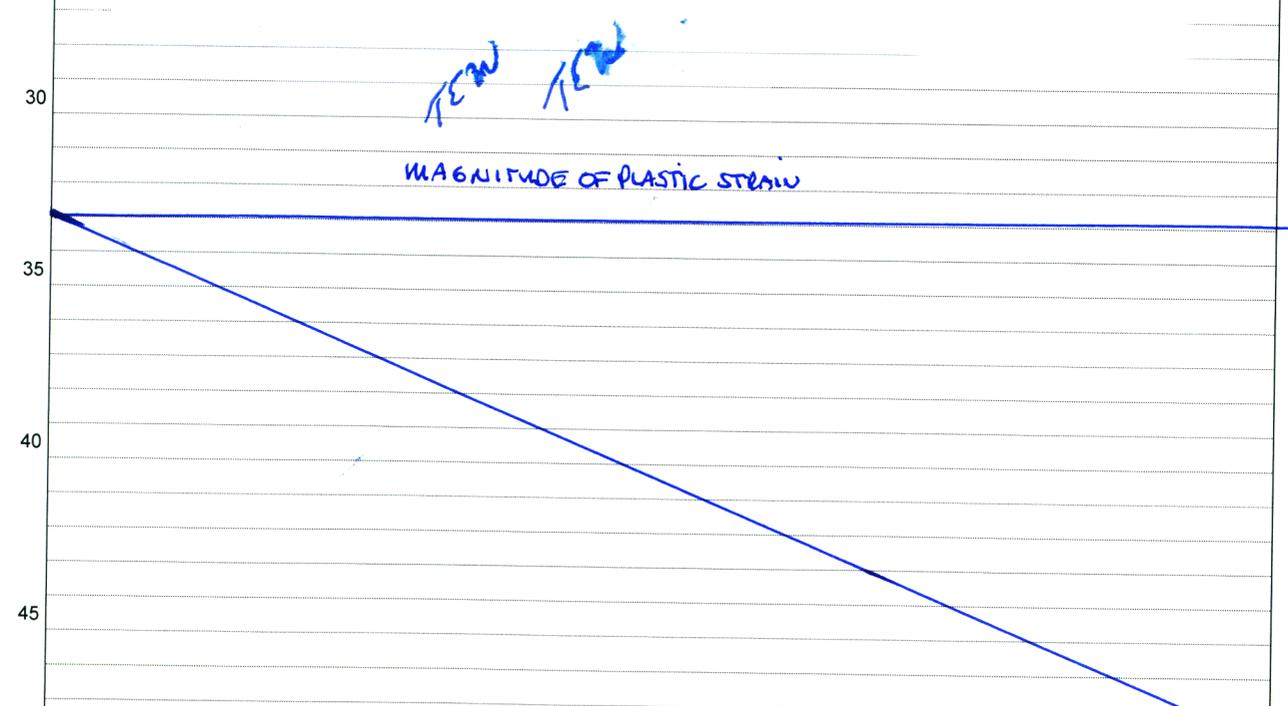
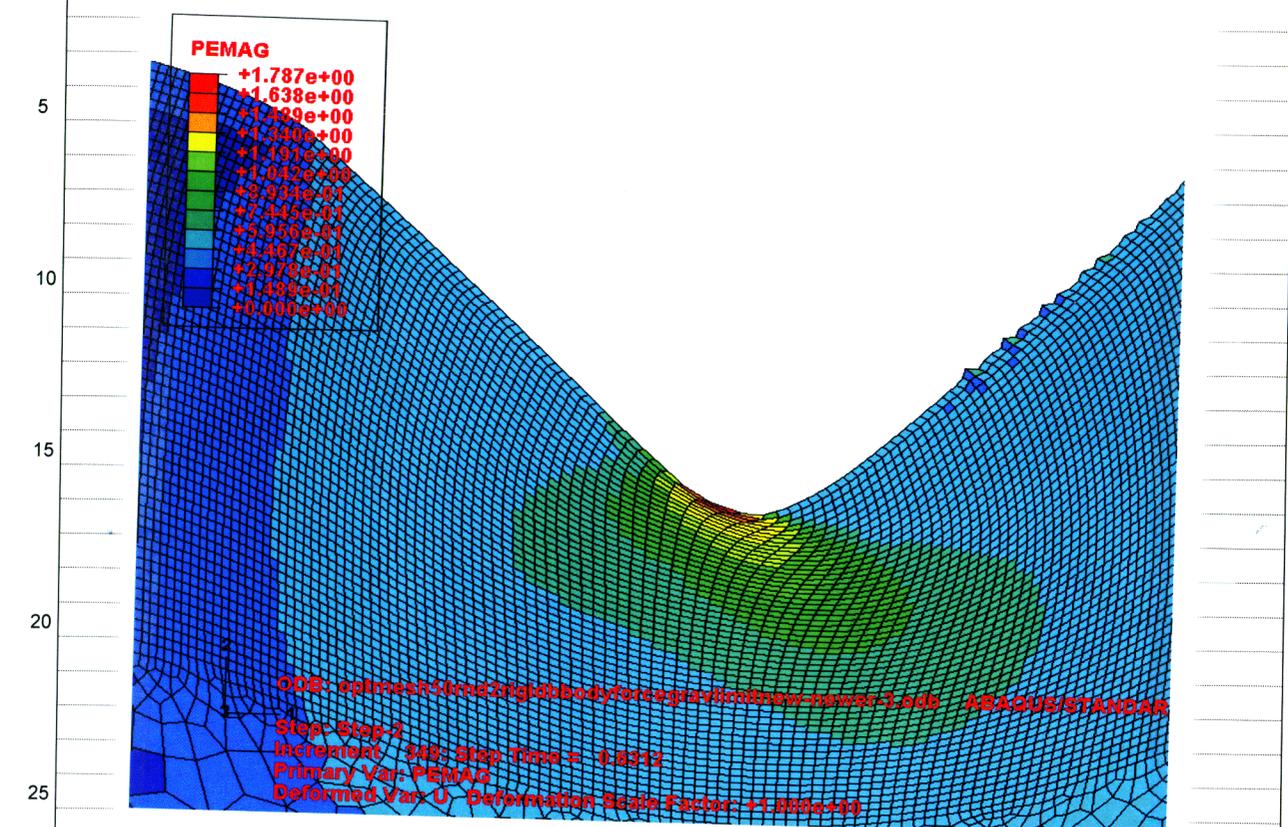
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TITLE

PROJECT

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DATE: 9/4/2007

DATE: _____

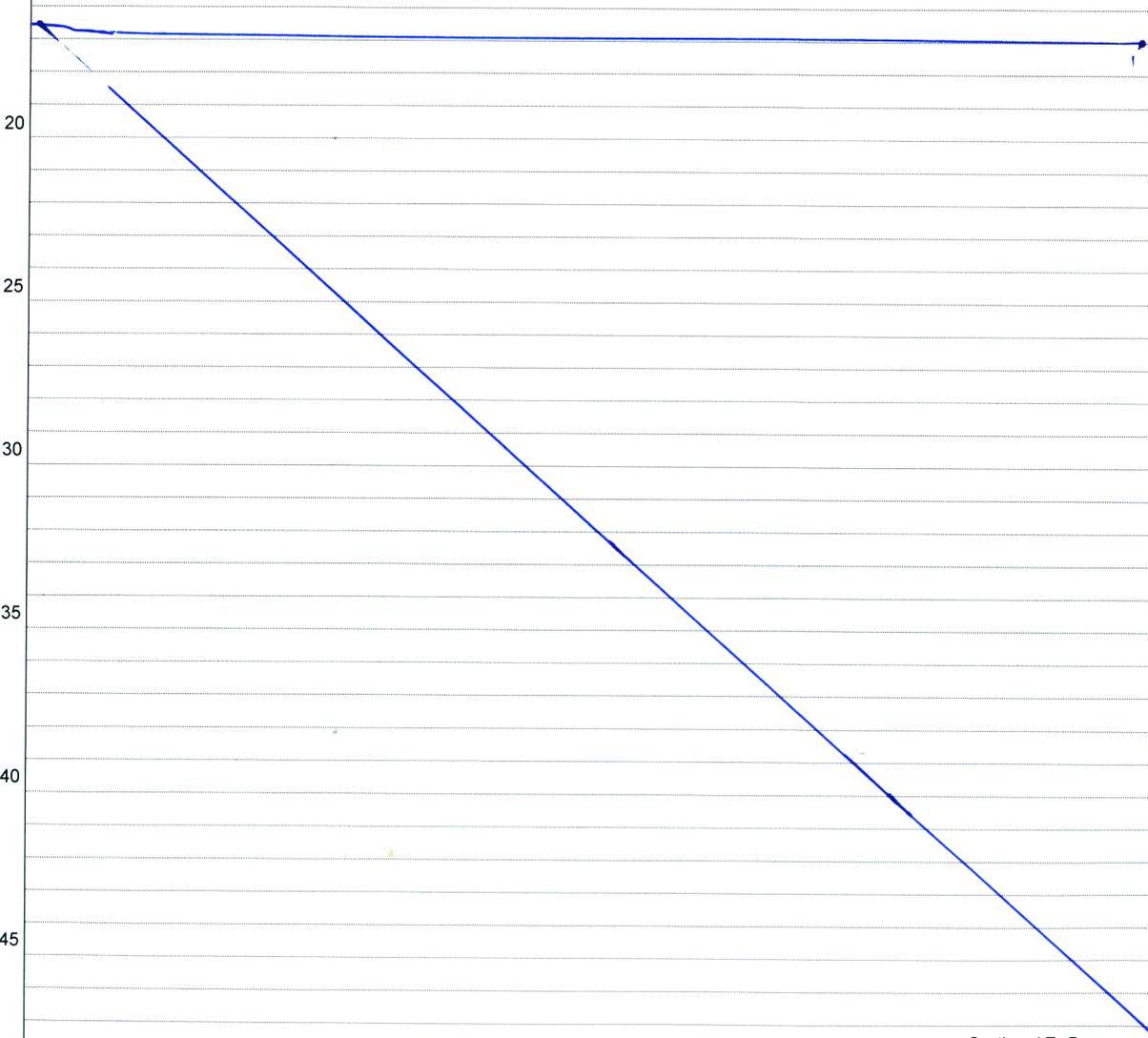
PROPRIETARY INFORMATION

4/17/08 MW

TITLE PROJECT

Continued From Page

PLEASE NOTE THAT ON PAGES 52 - 55
 THE LOAD LEVEL IS APPROXIMATELY 1690039 N
 WHICH CORRESPONDS TO THE PEAK LOAD FROM
 THE ACTUAL TEST.
 (THE PLOTS ON PAGES 57 AND 58 ALSO ARE AT THIS
 LOAD LEVEL)



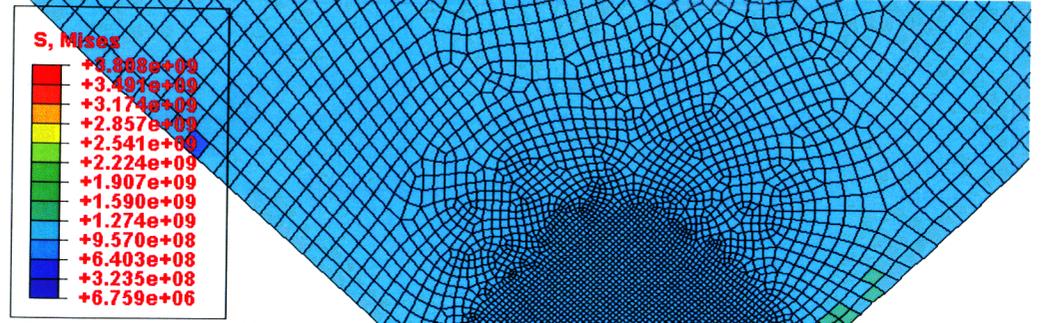
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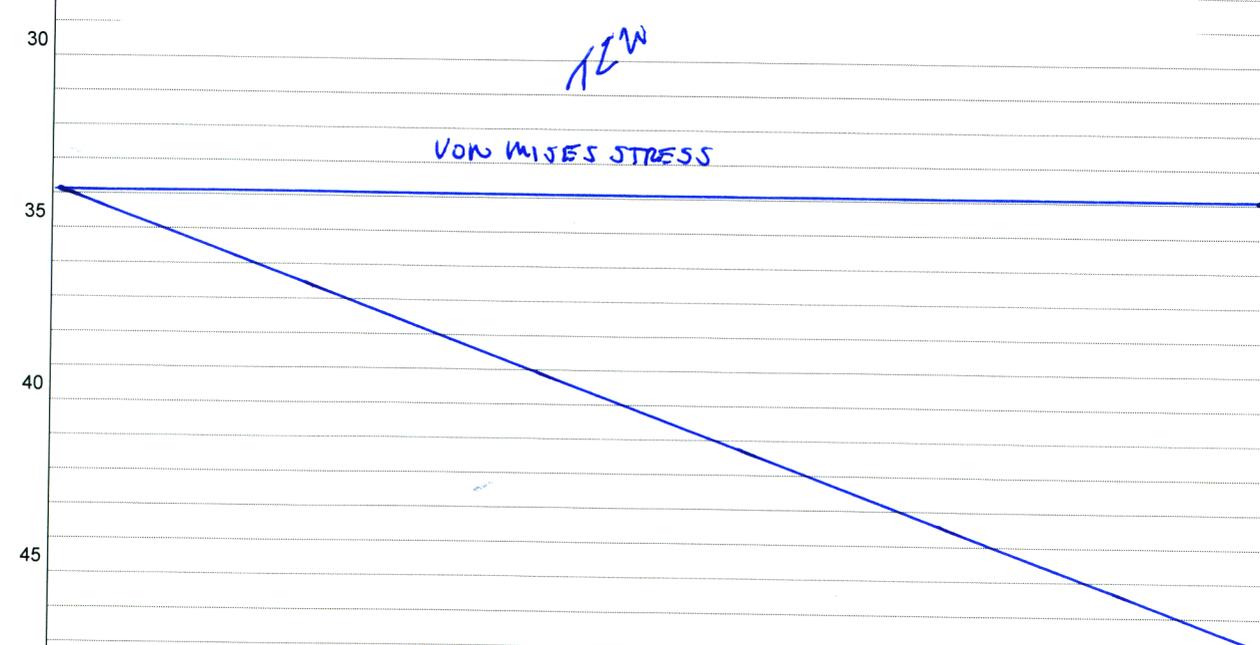
TITLE PROJECT

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2
 1
 3

ODB: optmesh50rnd2rigidbodyforcegravlimitnew-newer-3.odb ABAQUS/STANDAR
 Step: Step-2
 Increment 349: Step Time = 0.6312
 Primary Var: S, Mises
 Deformed Var: U Deformation Scale Factor: +1.000e+00



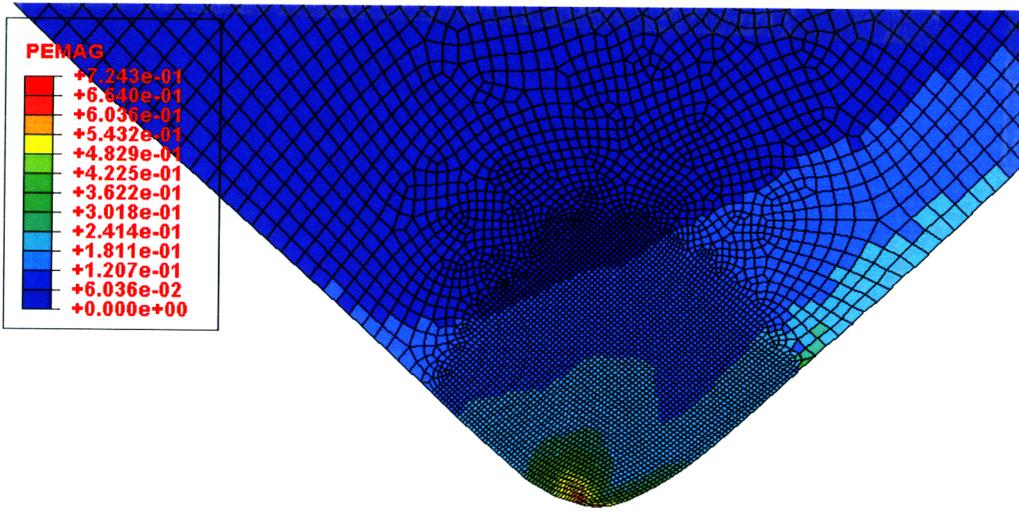
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TITLE PROJECT

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PEMAG

+	7.243e-01
+	6.640e-01
+	6.036e-01
+	5.432e-01
+	4.829e-01
+	4.225e-01
+	3.622e-01
+	3.018e-01
+	2.414e-01
+	1.811e-01
+	1.207e-01
+	6.036e-02
+	0.000e+00

2
3
1

ODB: optmesh50rnd2rigidbodyforcegravlimitnew-newer-3.odb ABAQUS/STANDAR
 Step: Step-2
 Increment 349: Step Time = 0.6312
 Primary Var: PEMAG
 Deformed Var: U Deformation Scale Factor: +1.000e+00

TEW
 MAGNITUDE OF PLASTIC STRAINS

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ATTACHED IS A CD CONTAINING THE ABAQUS INPUT FILE
 AND TEXT OF OUTPUT FILE.

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ADDITIONAL INFORMATION FOR SCIENTIFIC NOTEBOOK NO. 873

Document Date:	09/04/2007
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Contact:	Southwest Research Institute® Center for Nuclear Waste Regulatory Analyses 6220 Culebra Road San Antonio, TX 78228-5166 Attn.: Director of Administration 210.522.5054
Data Sensitivity:	<input checked="" type="checkbox"/> "Non-Sensitive" <input type="checkbox"/> Sensitive <input type="checkbox"/> "Non-Sensitive - Copyright" <input type="checkbox"/> Sensitive - Copyright
Date Generated:	09/04/2007
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Application Used: (including version number)	
Media Type: (CDs, 3 1/2, 5 1/4 disks, etc.)	2 CDs
File Types: (.exe, .bat, .zip, etc.)	Pdf., doc, xls, ppt, jpg, dat, inp
Remarks: (computer runs, etc.)	Media contains: Software change forms, tables, development plan, run-time