



SURFACE VEHICLE INFORMATION REPORT

SAE J2949 DRAFT NOV2010

Issued NOV2010
Proposed Draft

H-III50M Ankle Update to Eliminate Electrical Signal Noise

RATIONALE

This Information Report is intended to provide a comprehensive background and document of electrical signal noise issue caused by the insufficient design of the 1996 NHTSA regulated version of the 45 degree foot design, as well as a document of the validation of a recommended solution.

FOREWORD

In 1986, the Hybrid III 50th Percentile Male Test Dummy was specified in the NHTSA final rule (Federal Register Vol. 51, No. 143, page 26688-26710) to replace the Hybrid II Test Dummy. The ankle joint of the feet in the regulation had approximately 30 degrees dorsiflexion. In 1991, Ford petitioned NHTSA to increase the ankle dorsiflexion. In 1996, NHTSA updated the final rule to incorporate an improved ankle dorsiflexion design, which allows 45 degree dorsiflexion. The design also introduced an ankle bumper to prevent potential metal-to-metal contact. The modified NHTSA drawings in 1996 are 78051-600, -601, and -611, and 730-1 and -2.

In 2007, IIHS identified signal noise from the foot accelerometer signals in high-speed frontal crashes. An investigation concluded the noise was generated by metal-to-metal contact between the ankle joint ball shaft and the bumper retainer. In 2008, SAE Hybrid III Task Force initiated a task to redesign the ankle joint, seeking solutions to eliminate the potential metal-to-metal contact while maintaining the ankle range of motion as specified in the 1996 NHTSA final rule. This information report summarizes the final design and the validation test results from the SAE Hybrid III Task Force. This design concept could also be applied to the Hybrid III Small Female and Large Male ankle joint designs.

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1. SCOPE AND PURPOSE

This Information Report documents the problems with the 1996 NHTSA regulated version of the 45 degree foot, and defines a recommended solution to resolve the problem.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J2856, User's Manual for the 50th Percentile Male Hybrid III Dummy, September 2009.

2.2 Related Publication

The following publications are provided for information purposes and are not a required part of this document.

2.2.1 Federal Publication

Available from the Superintendent of Documents, U.S. Government Printing Office, Mail Stop: SSOP, Washington, DC 20402-9320.

Motor Vehicle Regulation No. 572 Test Dummies Specifications—Anthropomorphic Test Dummy for Applicable Test Procedures

Available from Reprographic Technologies, 9107 Gaither Road, Gaithersburg, MD 20877, (301) 419-5070 as well as from the Department of Transportation Docket Management System

Parts Lists and Drawings Part 572 Subpart E – Hybrid III Test Dummy – December 1998

3. ABBREVIATIONS

IIHS – Insurance Institute for Highway Safety

H-III50M – Hybrid III 50th Percentile Male Crash Test Dummy

H-III TF – Hybrid III Task Force

SHCS – Socket Head Cap Screw

FHCS – Flat Head Cap Screw

NHTSA – National Highway Traffic Safety Administration - of the United States Department of Transportation

4. TECHNICAL REQUIREMENTS

4.1 1996 Regulation Limbs

The H-III50M dummy was first adopted in Part 572 in July 1986, Federal Register Vol. 51, NO. 143, and amended in December 26, 1996, Federal Register Vol 61, No. 249. The NHTSA amendment in 1996 introduced a new design to increase ankle dorsiflexion and femur flexion ranges. These regulations define drawings for the construction of the dummy as well as performance criteria through certification tests in Part 572 Subpart E. The 1996 version of the drawing package

defines the 1996 NHTSA regulation of the dummy. Drawings 78051-600, -601, and -611, and 7310-1, and -2 from this drawing package are most relevant and are included in Appendix A.

4.1.1 Description of Problem

High-speed frontal crash tests conducted by IIHS with HIII50M dummy (with the 1996 version of the ankle design) have shown ringing in the foot accelerometer signals. Postcrash investigation of the dummy revealed the signal ringing was due to metal-to-metal contact between the ankle shaft and the surface just below the ankle bumper. The ringing propagates through the dummy's lower leg, which produces ringing in the tibia and femur load cell signals. The ringing can artificially increase peak injury measures, even after appropriate filtering is applied. In some cases peak injury measure timing from the lower extremity channels occur during a period of ringing in the foot accelerometer channels. In those cases, IIHS had used exclusion zones to limit the reporting of peak lower extremity injury measures to time periods occurring before or after the known time period with signal noise.

Despite the addition of the rubber ankle joint bumpers that were introduced in the 1996 revision, the IIHS test data has shown metal-to-metal contact can still occur. In order to address this problem, the SAE Hybrid III Task Force members agreed to redesign the ankle joint. As part of this revision, the Task Force also decided to improve the mechanical interface at the foot and lower tibia load cell attachment points, which could be another source of mechanical noise.

4.1.2 Tests Demonstrating Problem

IIHS identified the signal noise from foot accelerometer channels in high-speed frontal crash tests. Typical accelerations from the feet are shown in Figure 1.

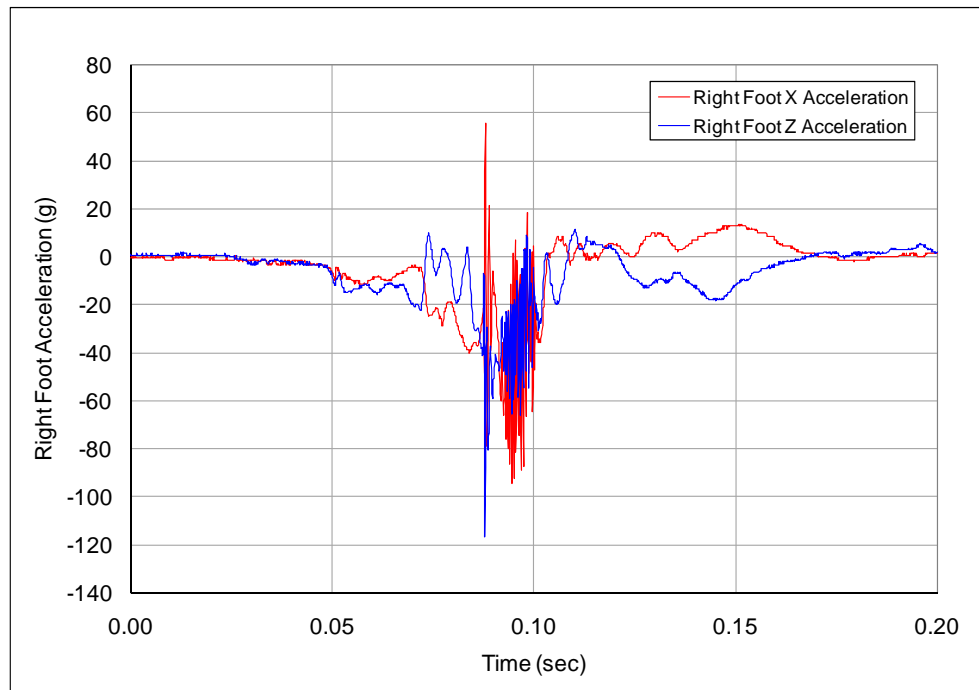


Figure 1. Foot Accelerations with the Ankle Design in 1996 NHTSA Regulation

(Test Configuration: 40 MPH into 10 inch pole, 40% offset)

4.2 Recommended ankle joint Update

4.2.1 Description of Solution

In order to prevent the metal-to-metal contact between the ball shaft and the ankle shell in the Hybrid III ankle joint, the ankle bumper metal insert and the ball retainer have been merged to allow some metal material space to be taken by rubber without changing the overall dimension of the assembly. This change eliminates metal-to-metal contact. A dowel pin/hole feature has been added to prevent the ankle bumper from being installed in the wrong orientation. Figure 2 shows the new design.

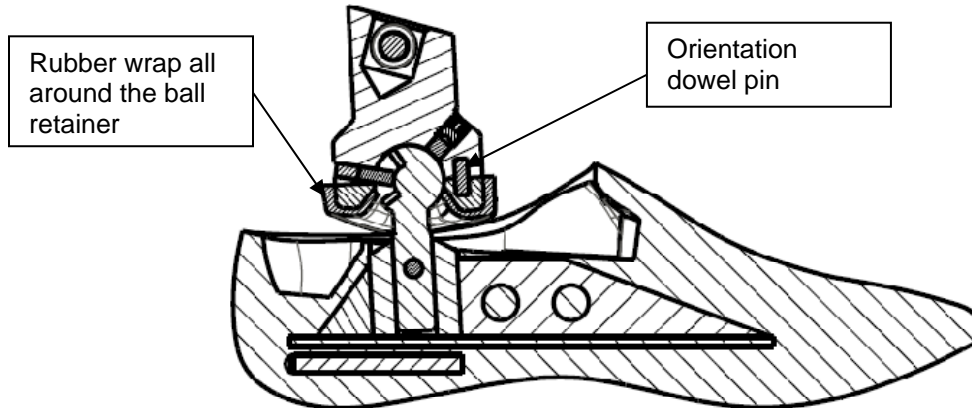


Figure 2 - Design of Upgraded Ankle Joint

In addition to the modifications mentioned above, the ankle joint interface locations were improved to eliminate slop due to the machining tolerances specified for each part. The new design employs clamping nuts to reduce the slop, which eliminates any play at the two connection interfaces. Figure 3 shows the new ankle design with the clamping nut.

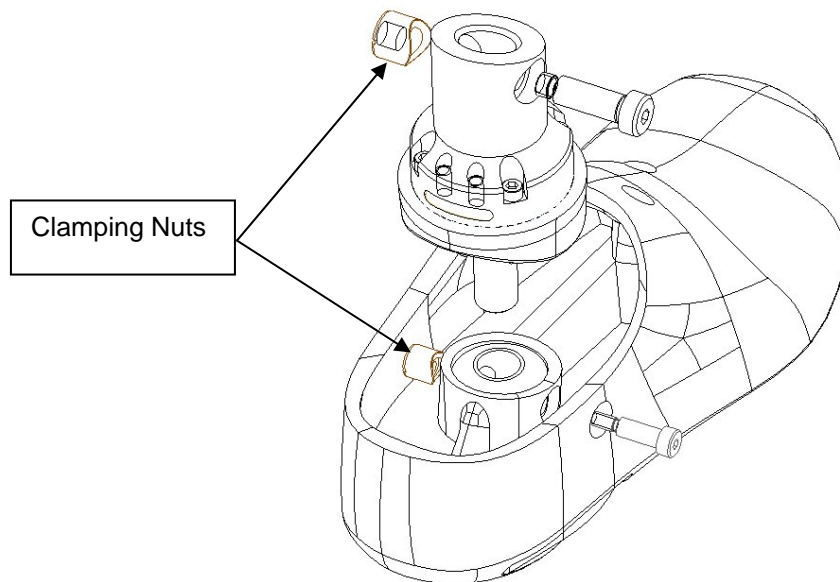


Figure 3– Design of the Upgraded Interfaces above and below the Ankle Joint

Alignment marks were designed for the ankle shell and the shell of the foot bone to assist the alignment of the clamping nut to the shaft of the tibia bone or the ball shaft, see Figure 4. These alignment marks help to prevent potential damage to the half moon feature of the clamping nut due to the misalignment.

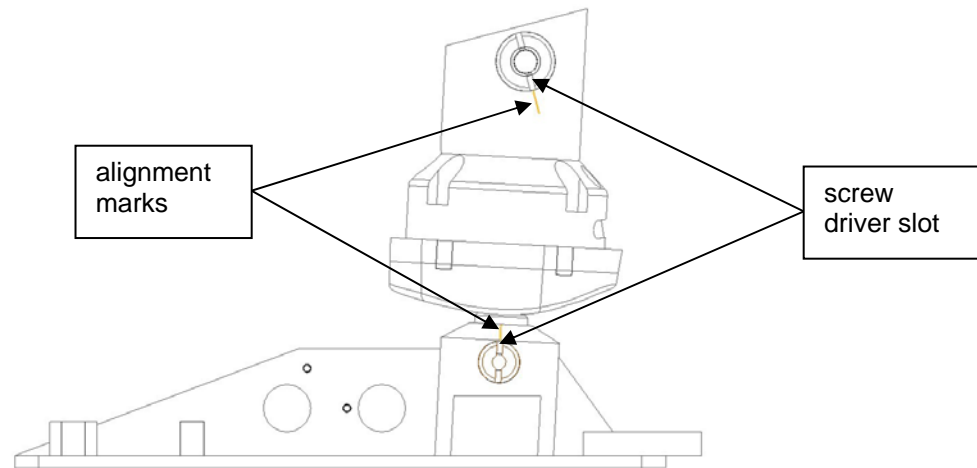


Figure 4, Alignment marks for the clamping nuts

4.2.2 Drawings

Drawings are provided to construct the upgraded ankle joint design.

4.2.2.1 To Make a New Ankle Bumper

To make a new ankle joint from the scratch, the following drawings were required: 78051-640, -641, -642, -643, -644, -645, -646, -648, -649, -650, -651, -652, and -653.

4.2.2.2 To Upgrade a 1996 Regulation Ankle Joint

The whole ankle joint and foot requires replacement. The foot bone can be modified by adding the counterbore to allow the implementation of the clamping nut between the ankle ball shaft and the foot.

4.2.3 Tests Demonstrating Acceptability

4.2.3.1 Vehicle Testing

Vehicle crash tests were conducted by IIHS to verify if the new design is able to reduce or eliminate the signal noise issue as described in section 4.1.2. In each IIHS test an instrumented H350M dummy was placed in the driver seating position.

The test matrix was summarized in Table 1.

Test ID	Ankle/Foot Design	Test Configuration	Vehicle Information	Accelerometer Signal Noise on Foot
CEF0508	Old	40 MPH, 40% frontal offset	2005 Chevy Uplander	Yes
CEF0507	Old	40 MPH, 40% frontal offset	2005 Ford Ranger	Minor noise
CF09004	New	30 MPH into 10 inch pole, 25% offset	2004 Chrysler Concorde	No
CF09005	New	35 MPH into 10 inch pole, 22% offset the pole	2005 Kia Rio	No

CF09006	New	40 MPH into 10 inch pole, 23% offset	2005 Kia Rio	No
CF09007	New	40 MPH into 10 inch pole, 24% offset	2004 Chrysler Concorde	No

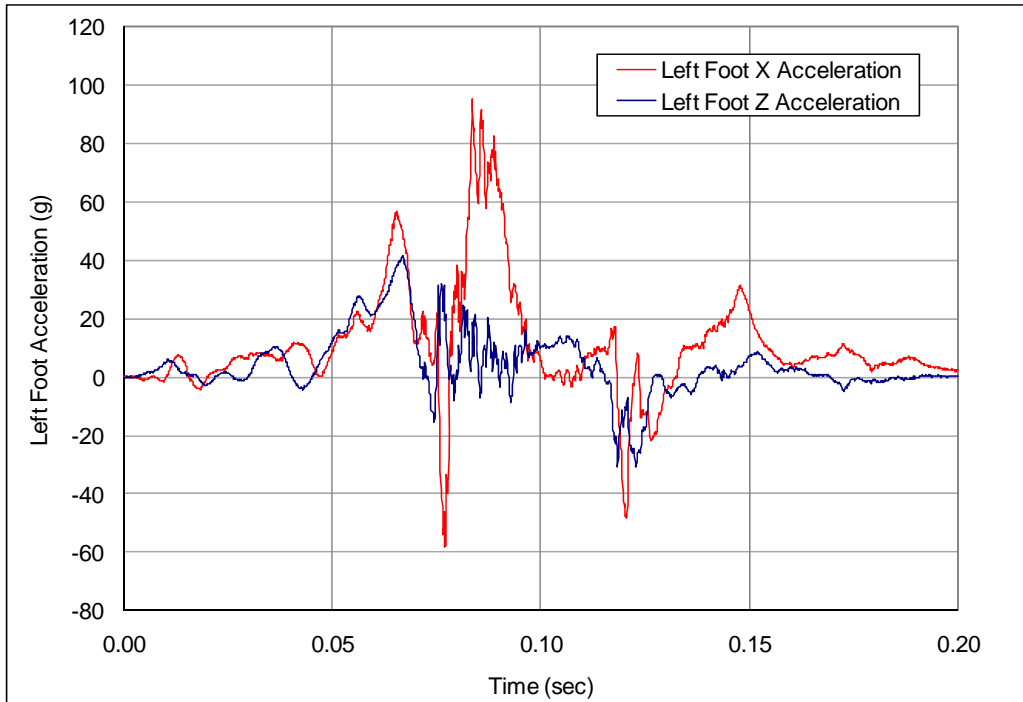


Figure 4a, Left Foot Accelerations with the New Design (Test CF09007)

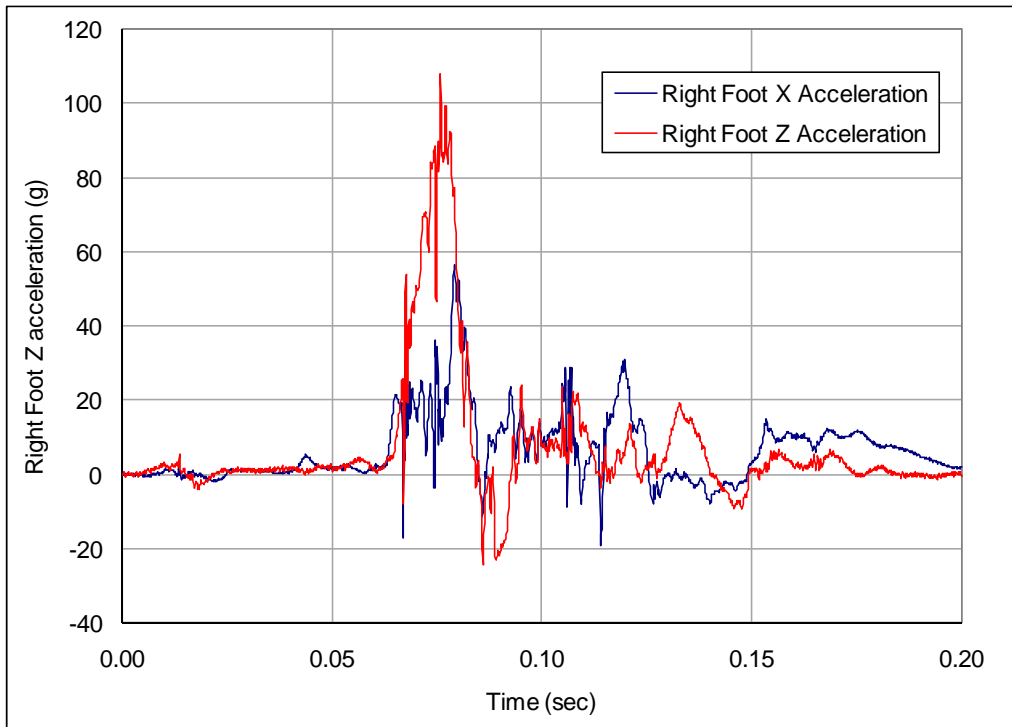


Figure 4b, Right Foot Acceleration with the New Design (CF09007)

4.2.3.2 Mass and Center of Gravity Verification

The center of gravity of the parts was measured and it meets the Hybrid III 50th specifications.

5. NOTES

5.1 Marginal Indicia

A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY THE HYBRID III DUMMY FAMILY TASK FORCE
OF THE DUMMY DEVELOPMENT AND EVALUATION ADVISORY GROUP
OF THE HUMAN BIOMECHANICS AND SIMULATION STEERING COMMITTEE

Appendix A – Drawings for Design in this Standard

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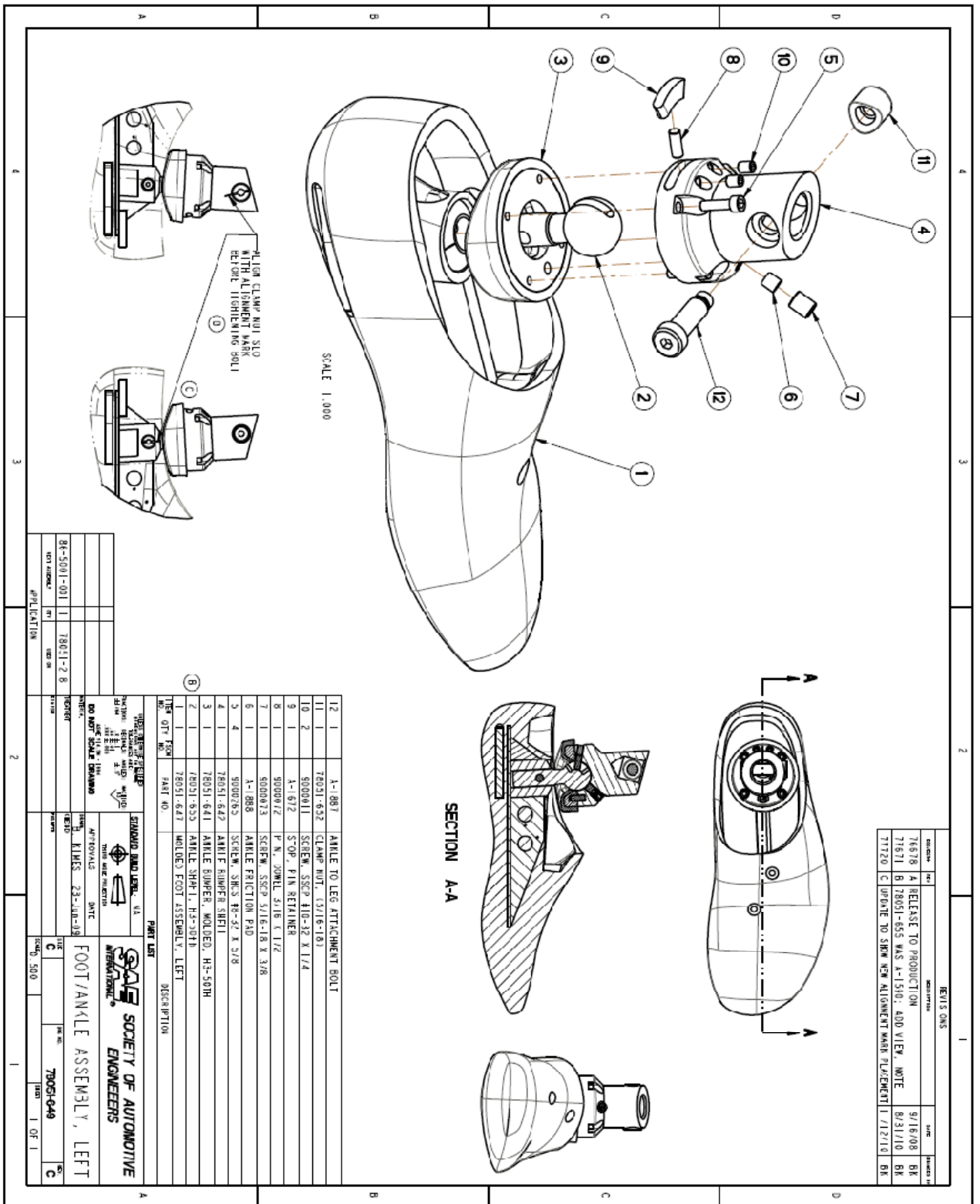
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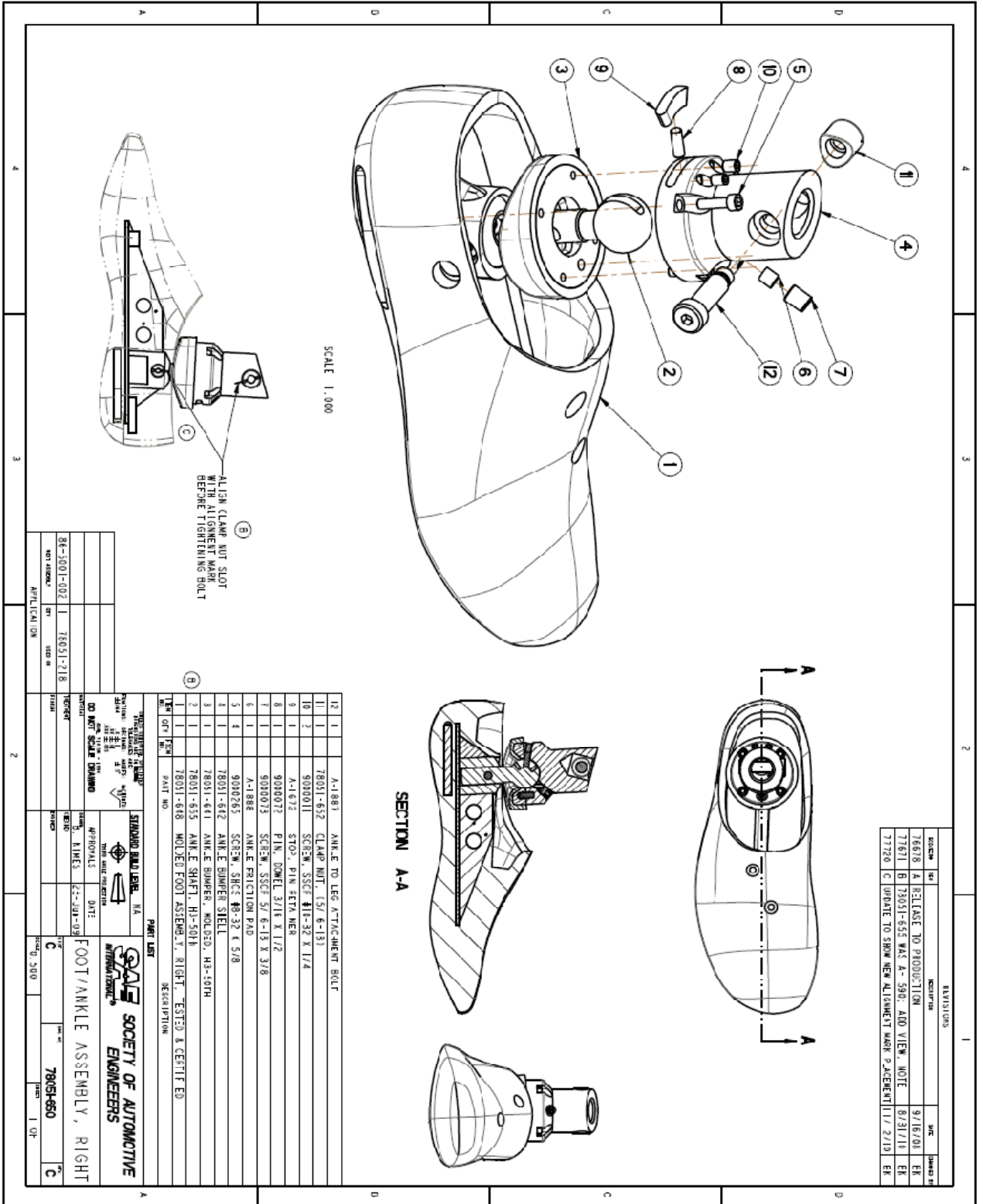
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REVISIONS			
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1	9/16/08	RELEASE TO PRODUCTION	EK
2	8/31/11	ADD VIEW NOTE	EK
3	2/19/10	UPDATE TO SHOW NEW ALIGNMENT MARK PLACEMENT	EK

SECTION A-A

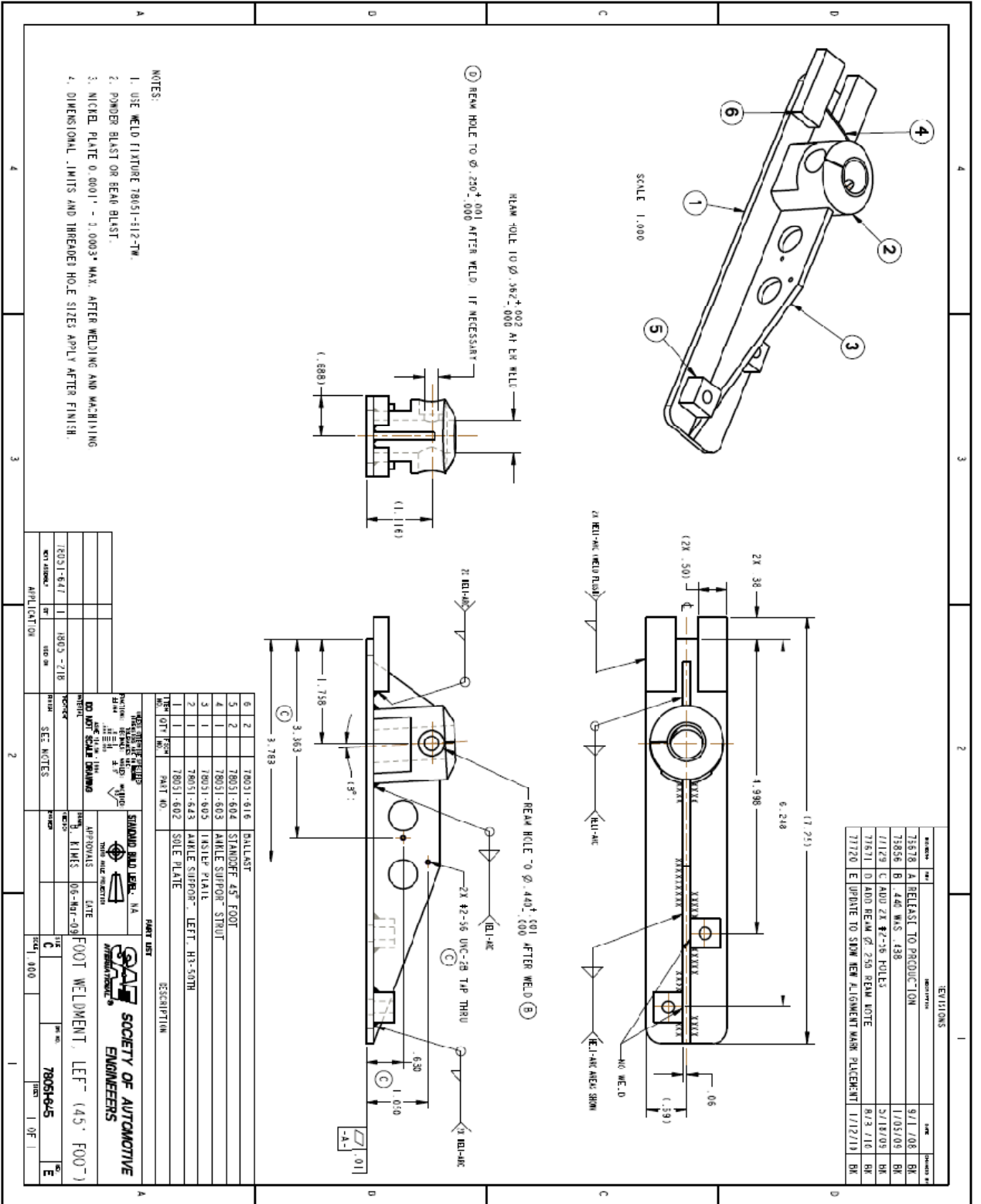
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DATE	DATE
BY	BY
APPROVAL	APPROVAL

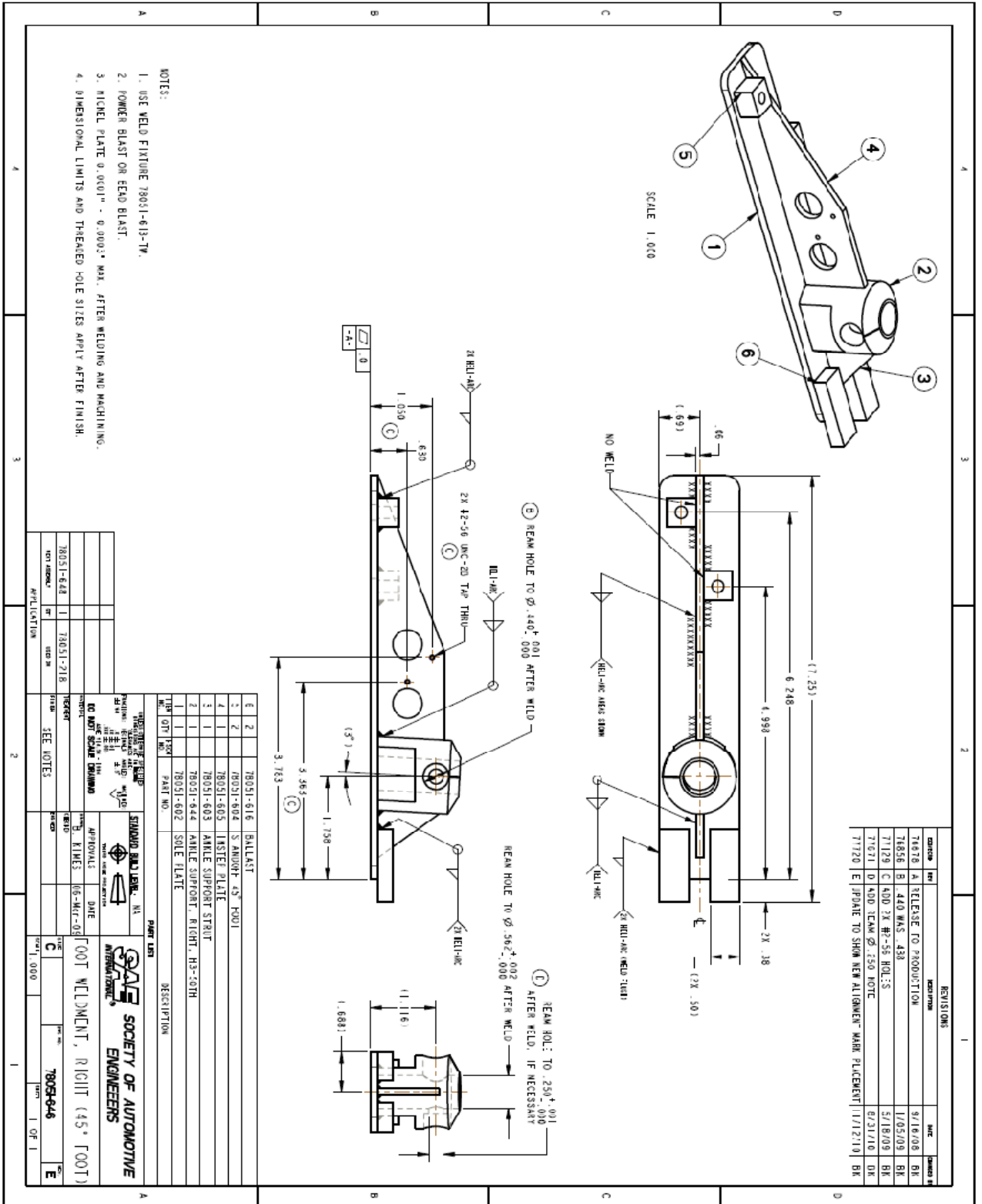
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4	1	A-1-672 STOP, PIN FEM NER
5	1	9090072 PIN, DONEL 3/16 X 1/2
6	1	9090073 SCREW, SEC. 5/7 6-13 X 3/8
7	1	A-1-888 ANKLE FRICTION PAD
8	1	9090765 SCREW, SEC. #8-32 X 5/8
9	1	78051-612 ANKLE BUMPER SHELL
10	1	78051-611 ANKLE BUMPER, MCLSD, H3-507H
11	1	78051-655 ANKLE SHAFT, H3-507H
12	1	78051-618 MCLD FOOT ASSEMBLY, RIGHT, ESTD & CERTIF ED

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78051-650

1 CP





REV	DESCRIPTION	DATE	BY
1	RELEASE TO PRODUCTION	8/18/08	BR
2	440 WAS .430	1/05/09	BR
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5	3CAM TO SHOW NEW ALIGNMENT MARK PLACEMENT	11/12/10	BR

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 2. POWDER BLAST ON EEDD BLAST.
 3. NICKEL PLATE 0.0001" - 0.0003" MAX. AFTER WELDING AND MACHINING.
 4. DIMENSIONAL LIMITS AND TOLERANCES APPLY AFTER FINISH.

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4	400 3CAM Ø.750 HOLE	8/31/10	DK
5	3CAM TO SHOW NEW ALIGNMENT MARK PLACEMENT	11/12/10	BR

REV	DESCRIPTION	DATE	BY
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2	440 WAS .430	1/05/09	BR
3	400 7X #2-55 HOLE'S	5/18/09	BR
4	400 3CAM Ø.750 HOLE	8/31/10	DK
5	3CAM TO SHOW NEW ALIGNMENT MARK PLACEMENT	11/12/10	BR

REV	DESCRIPTION	DATE	BY
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2	440 WAS .430	1/05/09	BR
3	400 7X #2-55 HOLE'S	5/18/09	BR
4	400 3CAM Ø.750 HOLE	8/31/10	DK
5	3CAM TO SHOW NEW ALIGNMENT MARK PLACEMENT	11/12/10	BR

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STANDARD BALL BEARING BALLAST

78051-616 BALLAST

78051-602 3 ARMOUNT 45° HOOD

78051-603 INSIDE PLATE

78051-603 ANKLE SUPPORT STRUT

78051-644 ANKLE SUPPORT, RIGHT, H3-10TH

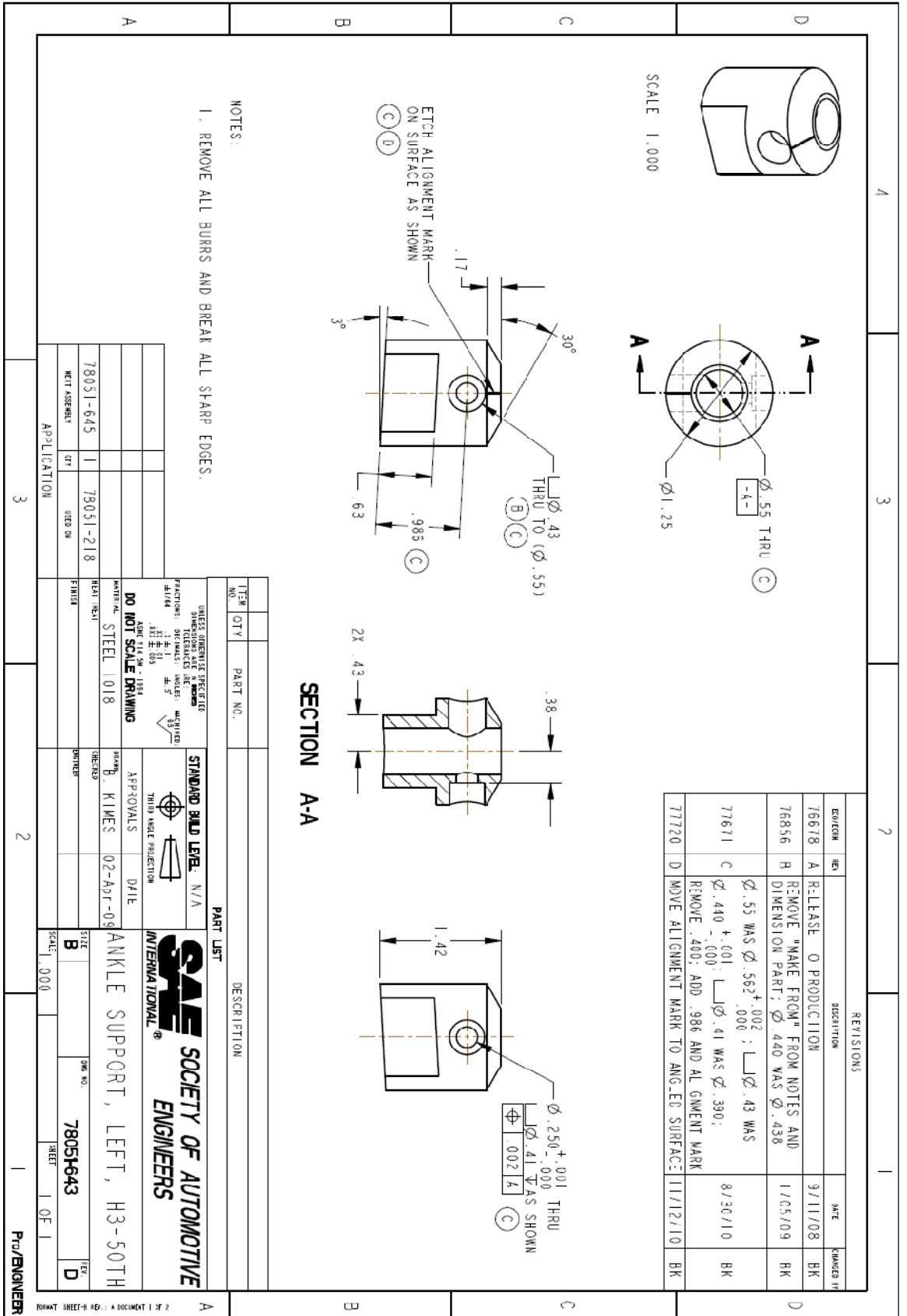
78051-602 SOLE PLATE

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SEE NOTES

78051-644



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77671	C Ø.55 WAS Ø.562+.002; Ø.43 WAS Ø.440+.001; Ø.41 WAS Ø.390; REMOVE .400; ADD .986 AND ALIGNMENT MARK	8/30/10	BK
77720	D MOVE ALIGNMENT MARK TO ANGLED SURFACE	11/12/10	BK

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FINISH: BEAT NEAT			
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DRAWN BY: B. KINES			
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SHEET 1 OF 1			

78051-645	NET ASSEMBLY	QTY	78051-218	USED ON
APPLICATION				

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ANKLE SUPPORT, LEFT, H3-50TH

7805H943

DATE: 11/12/10

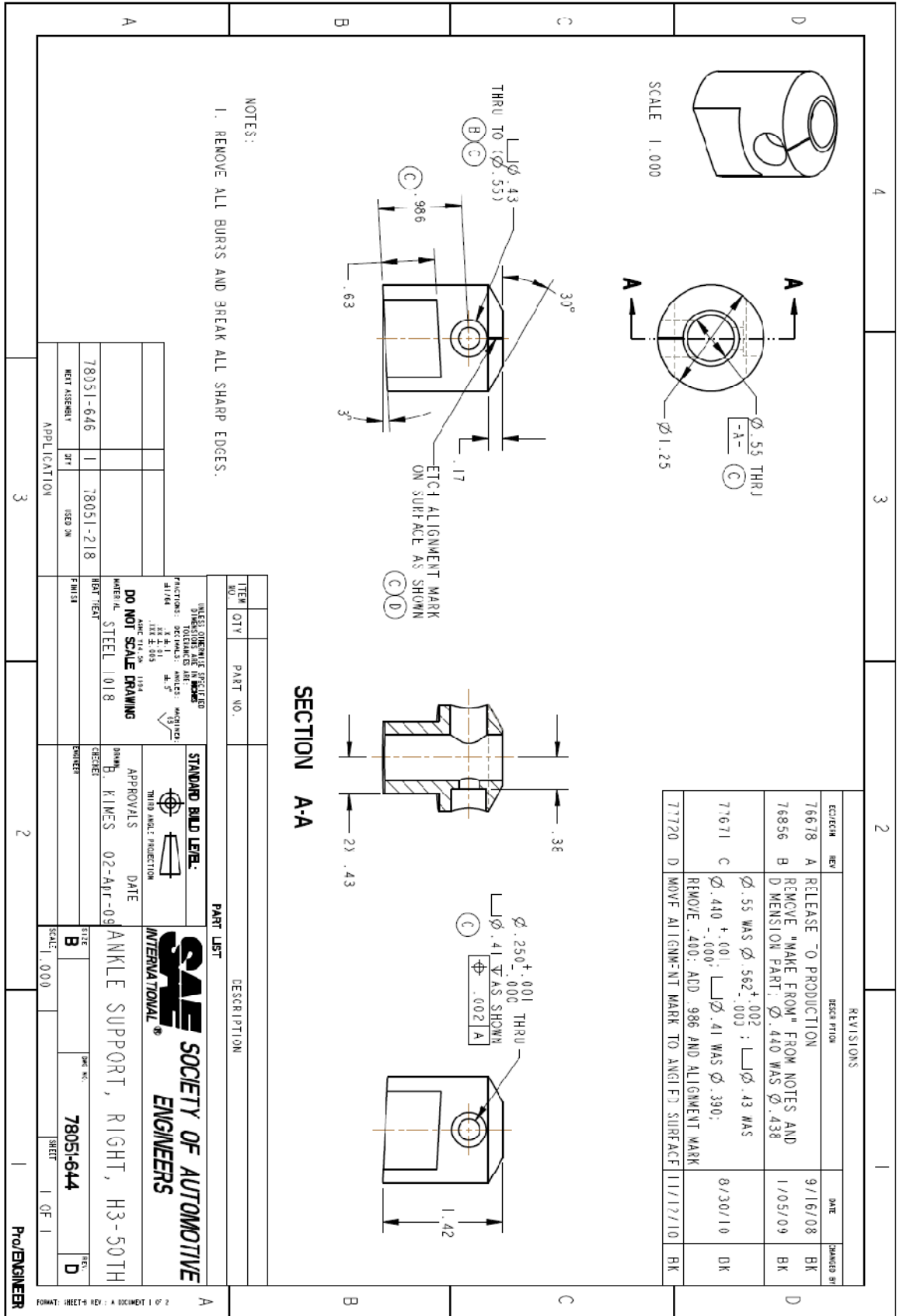
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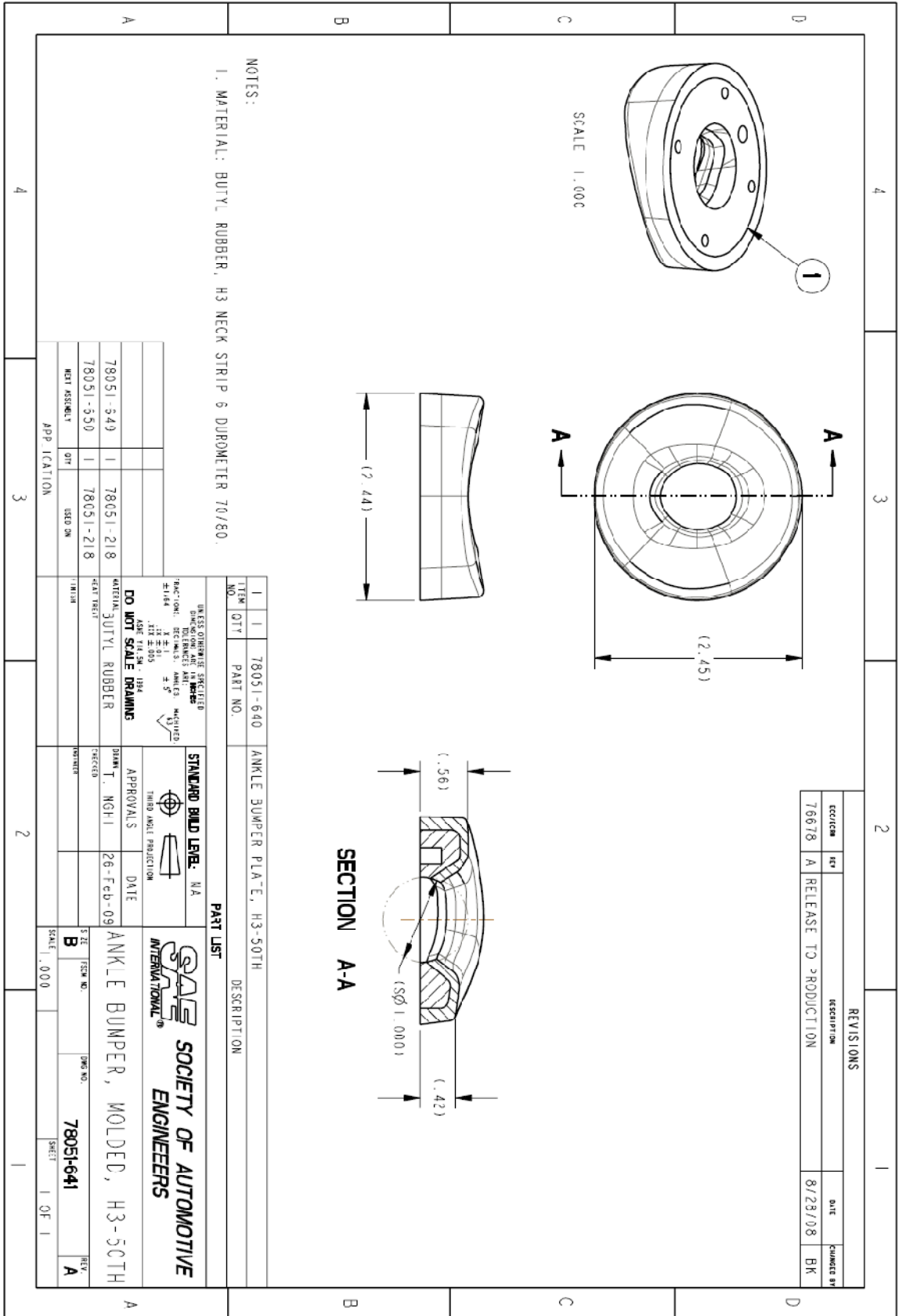
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SHEET 1 OF 1

PRO/ENGINEER





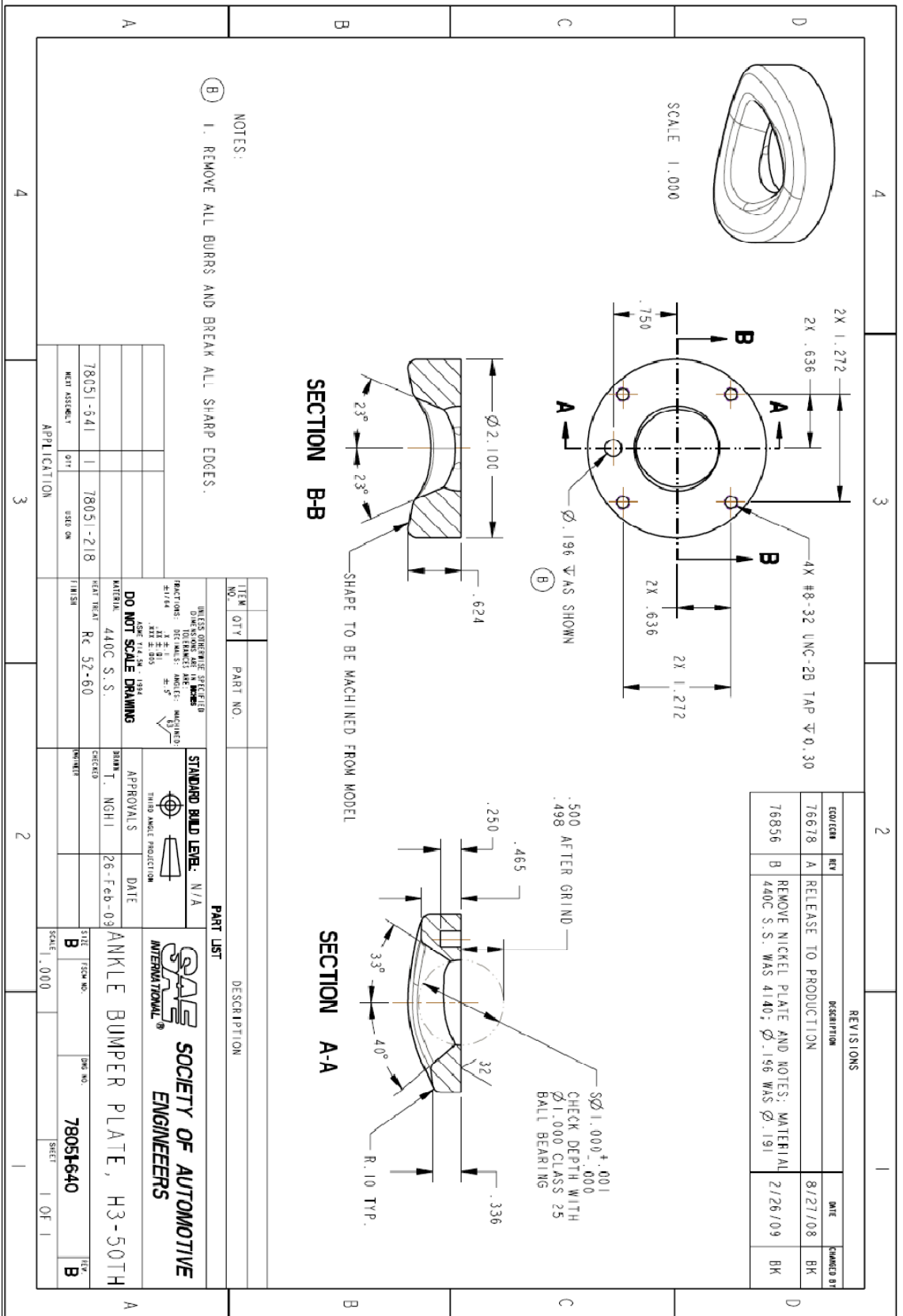
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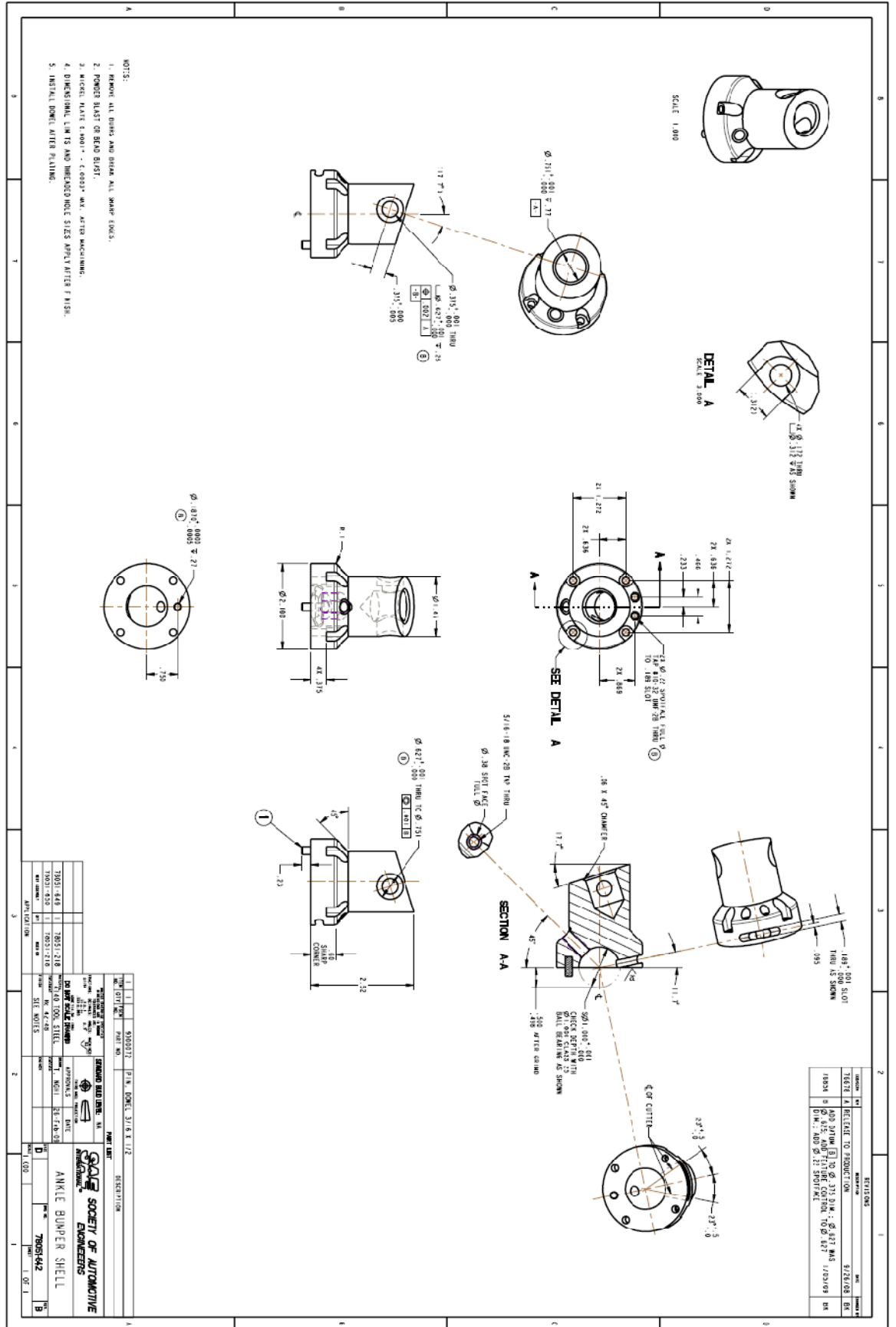
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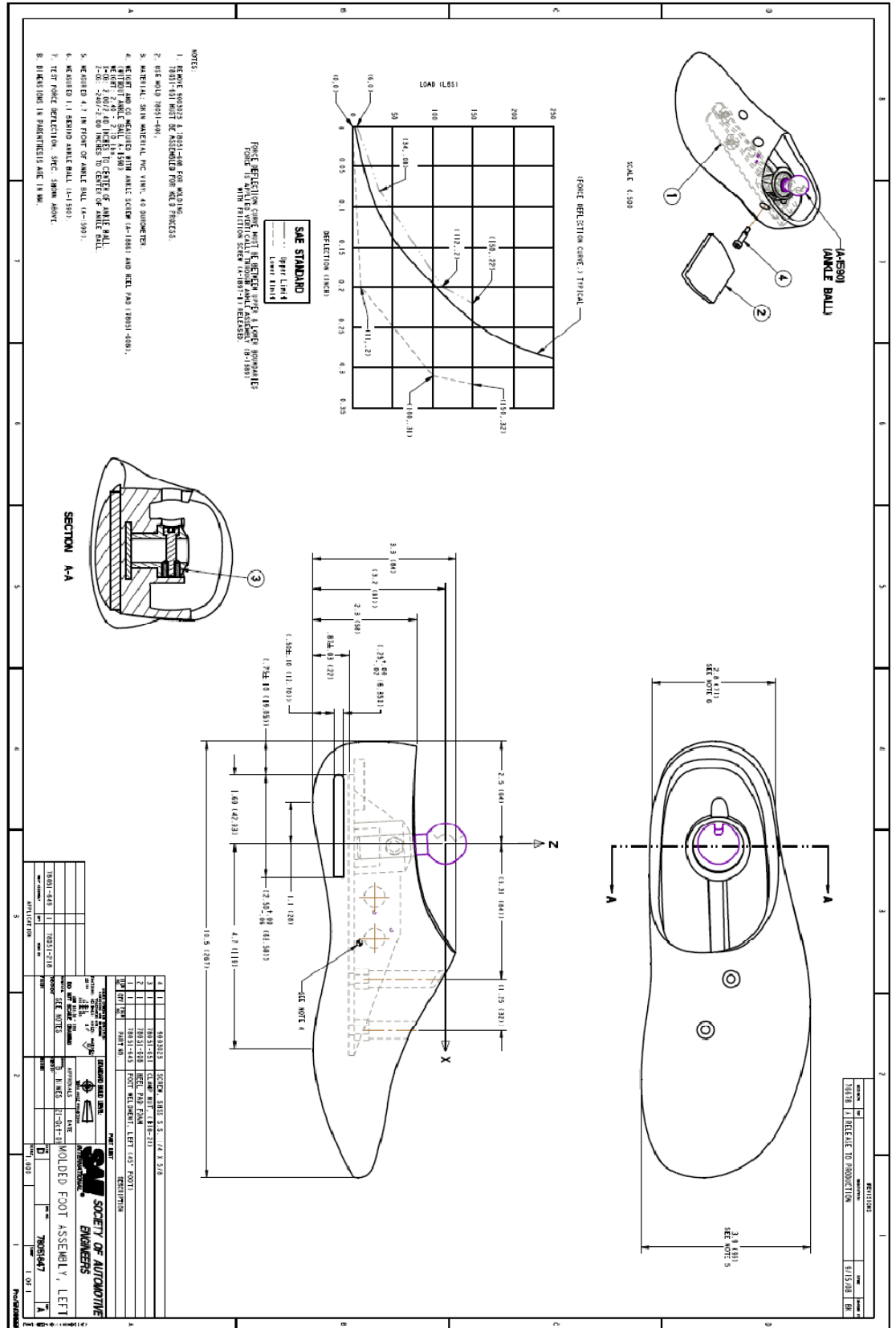
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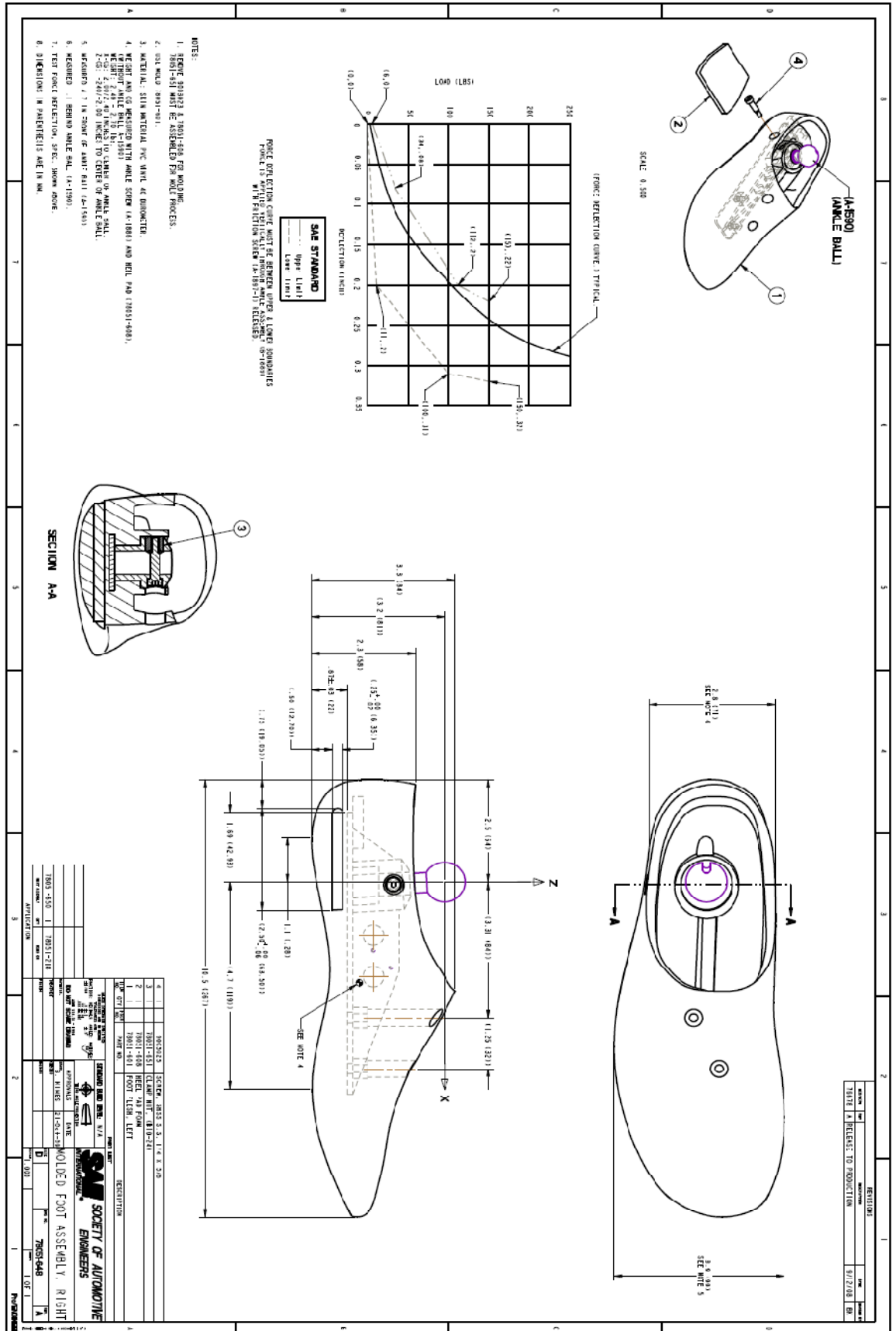
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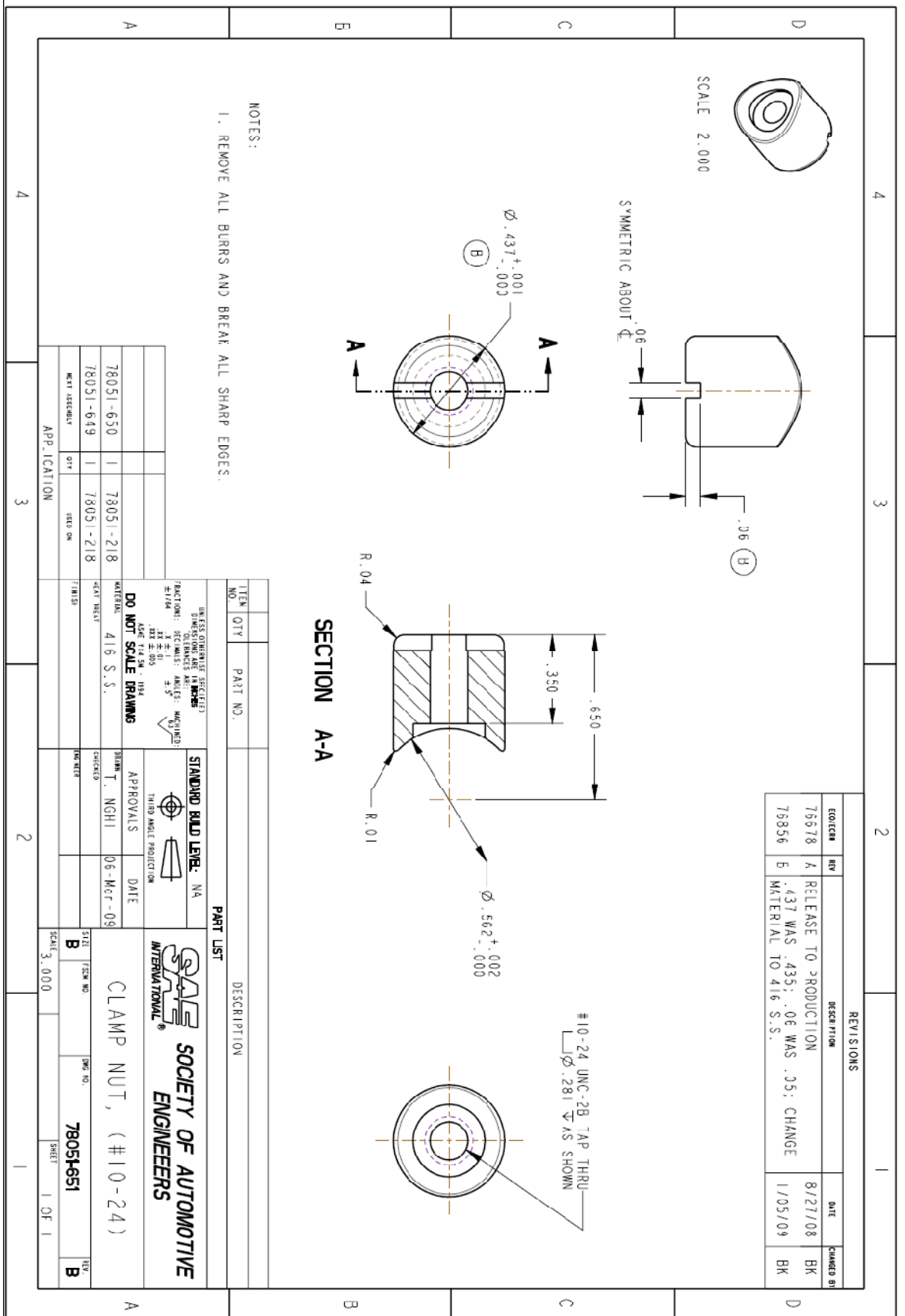
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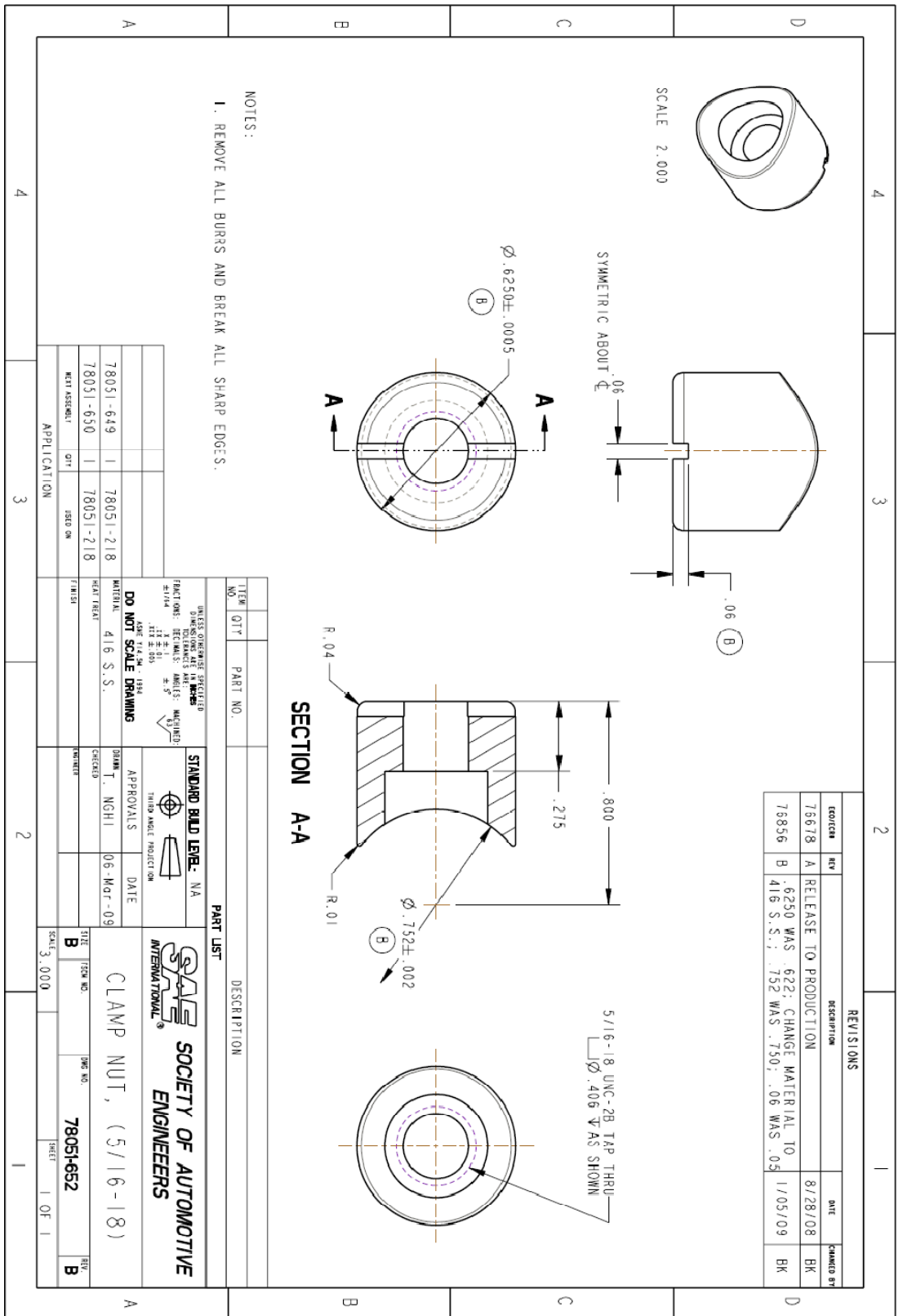
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CLAMP NUT, (#10-24)

78051651



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78051-650	1	78051-218

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FINISH		DRAWN T. NGH	
SCALE 3.000		SHEET 1 OF 1	

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