SURFACE VEHICLE INFORMATION REPORT

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Superseding J2857 MAR2011

Hybrid III
3-Year Old Child Dummy
User's Manual

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

STABILIZED NOTICE

This document has been declared "STABILIZED" by SAE Dummy Testing and Equipment Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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INTRODUCTION

The Hybrid III Three-Year Old (H3-3YO) Anthropomorphic Test Device (ATD) was developed by the SAE International Hybrid III Dummy Family Task Group of the Mechanical Human Simulation Subcommittee of the Human Biomechanics and Simulation Standards Committee. The project was initiated at the Task Group's meeting of October 14, 1992.

The H3-3YO dummy was designed to accommodate both sitting and standing postures to allow for frontal loading of the dummy in frontal and out-of-position air bag and child restraint system testing. Its size and mass were based on child anthropometry studies (Schneider et al., 1986; Snyder et al., 1977; Reynolds et al., 1976; Irwin and Mertz, 1997).

TABLE OF CONTENTS

1. SCOPE

This user's manual covers the Hybrid III 3-year old child test dummy. The manual is intended for use by technicians who work with this test device. It covers the construction and clothing, assembly and disassembly, available instrumentation, external dimensions and segment masses, as well as certification and inspection test procedures. It includes guidelines for handling accelerometers, guidelines for flesh repair, and joint adjustment procedures. Finally, it includes drawings for some of the test equipment that is unique to this dummy.

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 issue of SAE publications shall apply.

2.1.1 SAE Publications

Snyder, R.G., Schneider, L.W., Owings, C.L., Reynolds, H.M., Golumb, D.H., and Schork, M.A., "Anthropometry of Infants, Children and Youths to Age 18 for Product Safety Design", SP-450, SAE International, Warrendale, PA, 1977.

Irwin, A.L. and Mertz, H.J., (1997) "Biomechanical Bases for the CRABI and Hybrid III Child Dummies", SAE 973317, 41st Stapp Car Crash Conference.

SAE J211-1 Instrumentation for Impact Test – Part 1 – Electronic Instrumentation

SAE J1733 Sign Convention for Vehicle Crash Testing

SAE J2517 Hybrid III Family Chest Potentiometer Calibration Procedure

2.1.2 Other Publications

Schneider, L.W., Lehman, R.J., Pflug, M.A., and Owings, C.L., "Size and Shape of the Head and Neck from Birth to Four Years", UMTRI-86-2, Ann Arbor, MI 1986.

Reynolds, H.M., Young, J.W., McConville, J.T., and Snyder, R.G., "Development and Evaluation of Masterbody Forms for Three-Year Old and Six-Year Old Child Dummies", DOT HS-801 811, University of Michigan, Ann Arbor, MI, 1976.

3. DEFINITIONS AND ABBREVIATIONS

3.1 BHCS

Button Head Cap Screw

3.2 Certification Tests

Tests conducted to assure that the dummy is manufactured and maintained at the SAE specified performance levels for responses which could affect dummy measurements that are used by government and safety engineers to assess occupant injury potential. Certification tests are performed by the dummy manufacturer to assure the performance of new components or assemblies. Certification tests are performed periodically by dummy users to assure that the dummy is properly maintained.

3.3 Clothing Specifications

3.3.1 Shirt and Pants

Children's XS (size 4-5) cotton-polyester based, tight-fitting shirt with long sleeves and ankle-length pants. The neckline must be small enough to prevent contact between the shoulder belt and the dummy's flesh. The shirt and pant should weigh no more than 0.25 kg (0.55 lb).

3.3.2 Shoes

Drawing: 210-5920, Children’s size 8, canvas oxford style sneakers. Each shoe weighs 0.21 kg ± 0.05 kg (0.47 lb ± 0.10 lb).

3.4 FHCS

Flat Head Cap Screw

3.5 Inspection Tests

Inspection tests are supplemental to the certification tests to insure that a component meets its design intent. Inspection tests are performed by the dummy manufacturer on new parts. Inspection tests may be performed by dummy users when a part is damaged or replaced.

3.6 Midsagittal Plane

The plane that divides the body into left and right halves.

3.7 SHCS

Socket Head Cap Screw

3.8 SHSS

Socket Head Shoulder Screw

3.9 SSCP

Set Screw, Cup Point

3.10 1 g Joint Setting

The torque setting of a joint that supports the weight of its distal limb that will move when a minimal external force is applied (see APPENDIX C – JOINT ADJUSTMENT PROCEDURES).

4. PART NUMBERS

All part numbers in this manual refer to the drawing package in the docket of the National Highway Traffic Safety Administration, or to drawings attached to this manual in Appendix D. Copies of the drawing package for this dummy can be obtained from Reprographic Technologies:

2000 ‘L’ Street N.W., Washington, D.C. 20036,
Voice (202) 331-0576,
Fax (202) 331-0985.
Shop hours: Monday – Friday, 8:00 AM to 10:00 PM
http://www.repro-tech.com/

5. CONSTRUCTION & CONFIGURATION

The skull and head back are manufactured from fiberglass and the head back (skull cap) has an aluminum structural insert for support. Both the head skin and cap skin are molded vinyl. The head assembly allows for the installation of a triaxial configuration of uniaxial accelerometers at the center of gravity (CG). A separate accelerometer can be installed in the rear of the head to measure angular acceleration in the sagittal plane.

A flexible, molded neck is used to give the head-neck assembly human-like flexion and extension characteristics. A six-axis load cell can be mounted at the upper and lower ends of the neck assembly.

Three damped, spring steel ribs make up the chest section and allow for measurement of chest compression through the use of a rotary potentiometer mounted in the thorax. The sternum provides positions for mounting two uniaxial accelerometers.

The shoulders are made of flexible rubber joints to provide the correct biofidelic range of motion. They also have the capability of mounting a two-axes load cell in each shoulder to measure “X” and “Z” axis loading.

The thoracic spine is a welded steel structure that provides mounting locations for three sets of triaxially configured accelerometers at the “T1”,“T4”, and “T12” vertebrae and a single uniaxial x-axis accelerometer that aligns with the third rib opposite the lower sternal accelerometer.

Biomechanical response targets are specified for forehead and sternal impacts, and for fore and aft neck bending. These targets were obtained by scaling of the corresponding requirements of the Hybrid III 50th percentile ATD, taking into account the effects of differences in size, geometry, mass, and tissue properties between children and adults (Irwin and Mertz, 1997).

The welded steel pelvis/lumbar structure includes a flexible molded rubber spine that provides the mounting configuration for a six-axis load cell between the base of the lumbar spine and the top of the pelvis. There is also a two-axes load cell on each iliac wing to measure upper and lower loading in the “X” axis along with a triaxially configured accelerometer at the rear of the pelvis structure.

Table 1 gives the torque specifications for fasteners used in the dummy. The torque values specified apply to clean and dry parts. They should be used, unless specified otherwise. Note that a lubricated screw requires less torque (15% to 25% less) to attain the same clamping force as a non-lubricated screw.

TABLE 1 – TORQUE SPECIFICATIONS

Thread Size	Torque (in-lb)	Torque (N-m)
0-80	1.00	0.113
2-56	2.50	0.283
4-40	12.0	1.36
6-32	23.0	2.60
8-32	41.0	4.63
10-24	60.0	6.78
10-32	68.0	7.68
1/4-20	144	16.3
1/4-28	168	19.0
5/16-17	300	33.9
5/16-24	300	33.9
3/8-16	540	61.0
3/8-24	600	67.8

NOTE:

1. The references for these specifications are Smith Fastener Company, Brake Products Inc., and C & J Fastener Inc.

6. INSTRUMENTATION

Refer to Table 2 and Figure 1.

6.1 Head

Three uniaxial accelerometers mounted in a triaxial configuration (Ax, Ay, Az)

One uniaxial accelerometer for measuring angular acceleration (Az)

6.2 Neck

Two six-axes neck load cells at C1 and C7/T1 (Fx, Fy, Fz, Mx, My, Mz)

6.3 Shoulders

Two 2-axes shoulder load cells (Fx, Fz)

6.4 Thorax

Nine uniaxial accelerometers mounted in three triaxial configurations at T1, T4, and T12 (Ax, Ay, Az)

Two uniaxial sternal accelerometers at Rib 1 and Rib 3 (Ax)

One uniaxial accelerometer on the spine, level with Rib 3 (Ax)

One rotary potentiometer (Dx)

6.5 Pelvis

One 6-axes lumbar spine load cell (Fx, Fy, Fz, Mx, My, Mz)

Three uniaxial accelerometers mounted in a triaxial configuration (Ax, Ay, Az)

One 2-axes pubic load cell (Fx, Fz)

Two uniaxial acetabulum load cells (Fy)

Two 2-axes anterior superior iliac spine load cells (upper Fx & lower Fx)

TABLE 2 - AVAILABLE INSTRUMENTATION

1. Head Accelerometer	3 channels
2. Head Angular Accelerometer	1 channel
3. Upper Neck Load Cell	6 channels
4. Lower Neck Load Cell	6 channels
5. C7/T1 Accelerometer	3 channels
6. Shoulder Load Cell	2 channels (each side)
7. Thorax Accelerometer (T4)	3 channels
8. Lumbar Spine Load Cell	6 channels
9. Pelvis Accelerometer	3 channels
10. Acetabulum Load Cell	1 channel (each side)
11. Pubic Symphysis Load Cell	2 channels
12. Anterior Superior Iliac Spine Load Cell	2 channels (each side)
13. Chest Deflection Potentiometer	1 channel
14. Sternum Accelerometer	2 channels
15. T12 Accelerometer	3 channels
16. Lower Spine Accelerometer	1 channel
Total	50 channels

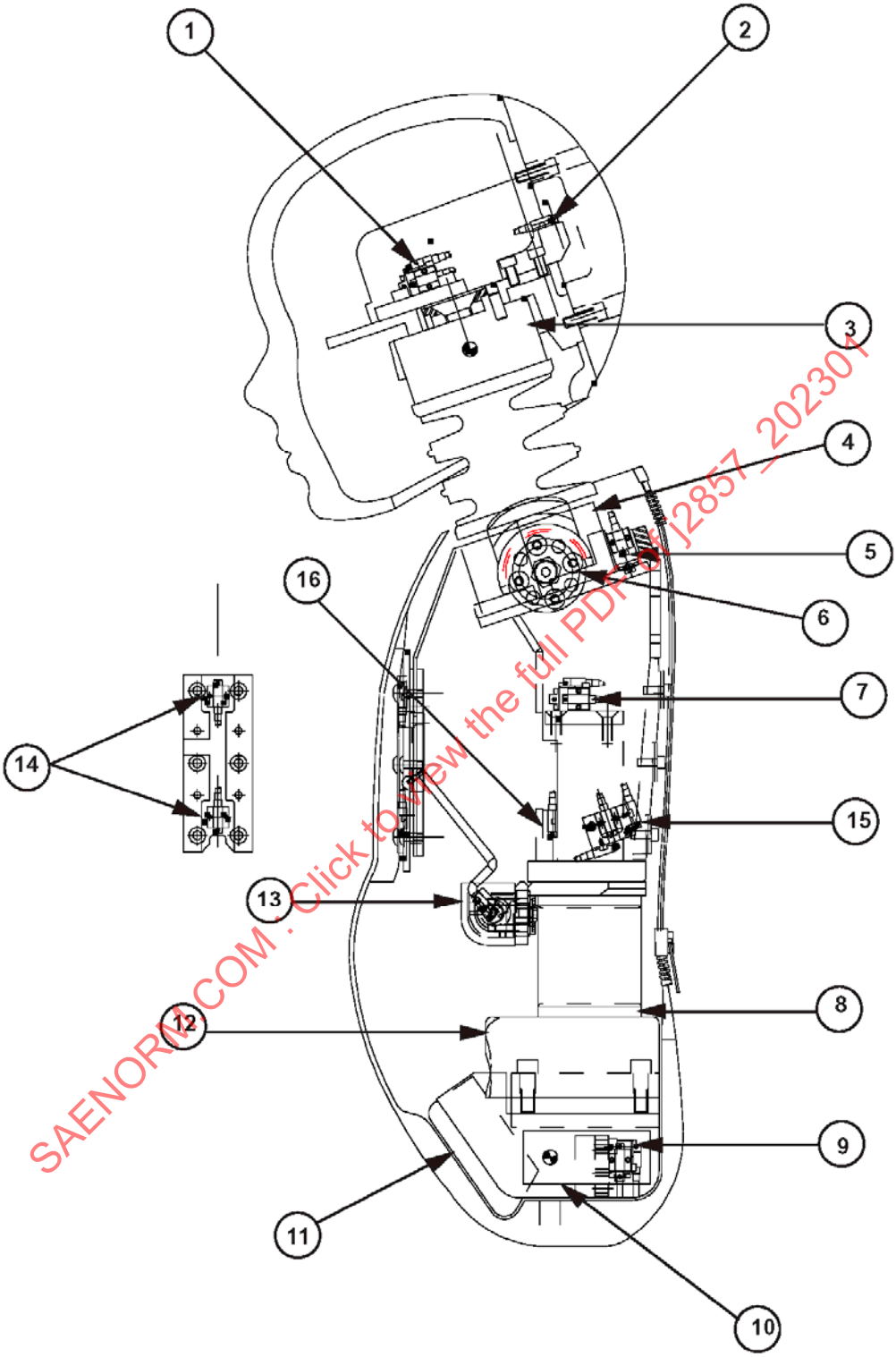


FIGURE 1 - INSTRUMENTATION LOCATIONS

7. DISASSEMBLY AND REASSEMBLY PROCEDURES

7.1 Complete Assembly

The Hybrid III 3-Year Old (H3-3YO) consists of:

Head Assembly	210-1000	Figure 3
Neck Assembly	210-2001	Figure 5
Upper/Lower Torso Assembly	210-3000	Figures 6 & 7
Lower Torso Assembly	210-4000	Figures 9 & 10
Complete Arm Assembly	210-6000-1 (left) & -2 (right)	Figure 13
Complete Leg Assembly	210-5000-1 (left) & -2 (right)	Figure 14

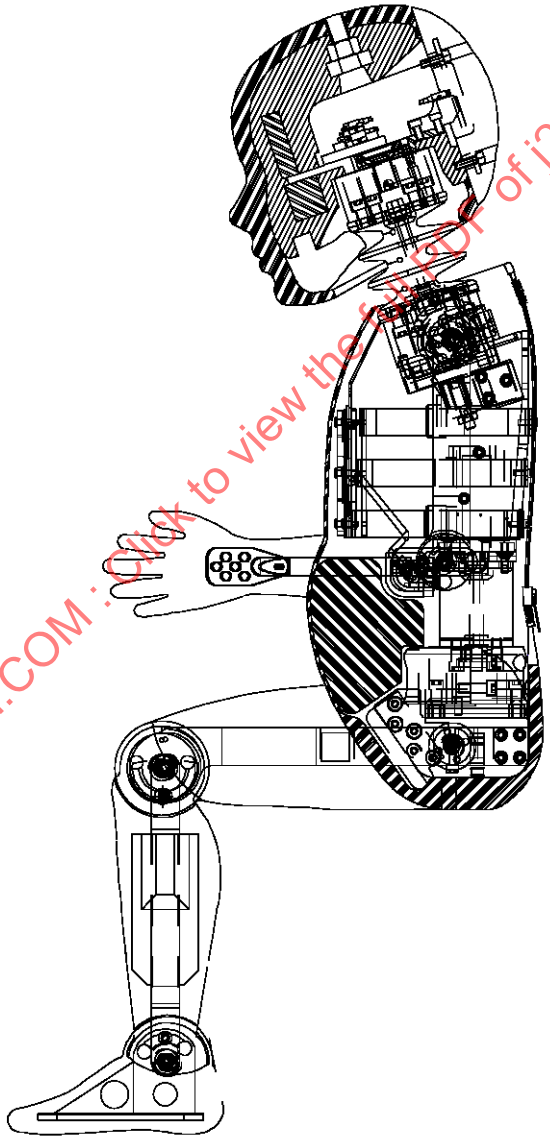


FIGURE 2 - SIDE VIEW H3-3YO ASSEMBLY

7.1.1 Arms, Legs, and Flesh Removal

Torso Flesh	210-3740	Item-10, Figure 7
Rubber Shoulder Damper	210-3607	Item-11, Figure 7
5/16 x 3/4 SHSS	9000652	Item-12, Figure 7
5/16 x ½ SHSS	9000578	Item-13, Figure 7
10-32 x ½ SHCS	9000147	Item-12, Figure 10
Rubber Hip Dampers	210-3606	Item-5, Figure 10

To start the disassembly of the H3-3YO, it is necessary to remove the arms and legs from the main body. This will make it easier to remove the head and neck assemblies and work on the rest of the upper and lower torso. To remove the arms, take out the 5/16 x 3/4 SHSS (Item-12, Figure 7) from each arm pivot joint. With the screws removed, the arm can be pulled off the rubber shoulder damper (210-3607) (Item-11, Figure 7). The legs are removed by taking out the 5/16 x ½ SHSS (Item-13, Figure 7) from the hip pivot and pulling the leg off the rubber hip damper (Item-5, Figure 10) (210-3606). There are four rubber dampers in the H3-3YO dummy: the shoulder dampers are 19.1 mm (3/4 in) long and the hip dampers are 25.4 mm (1.0 in) long.

The acetabulum load cell replacements attach the hip isolation dampers (210-3606) (Item-5, Figure 10) to the pelvic bone. To remove the hip dampers loosen the two 10-32 x ½ SHCS (9000147) (Item-12, Figure 10) and unscrew the dampers from the replacements. With the arms, legs and hip dampers removed, the torso flesh (210-3740) (Item-10, Figure 7) can be taken off. Unzip the flesh at the rear of the dummy and pull the flesh over the shoulders. The flesh can be carefully worked down the upper torso assembly and slid off the lower torso without damaging it.

7.1.2 Arms, Legs, and Flesh Reassembly

- Carefully slide the flesh up the torso.
- Reinstall the 25.4 mm (1.0 in) long hip dampers. Note that they are longer than the shoulder dampers 19.1 mm (0.75 in).
- Reinstall the legs with 5/16 x ½ SHSS.
- Reinstall the arms with 5/16 x 3/4 SHSS.
- Set torques on the arms and legs to 1 g. Refer to APPENDIX C – JOINT ADJUSTMENT PROCEDURES.

7.2 Head

The Head assembly (210-1000) consists of:

10-24 x 5/8 SHCS	9000224	Item-1, Figure 3
½-20 x 1 FHCS	9000150	Item-2, Figure 3
Head Mounting Washer	ATD-6262	Item-3, Figure 3
Head Skin	210-1010	Item-4, Figure 3
Head Back	210-1020	Item-5, Figure 3
Accelerometer Block	ATD-6257-2	Item-6, Figure 3
Dowel Pin	9000072	Item-7, Figure 3
Chin Insert	210-1040	Item-8, Figure 3
Skull	210-1030	Item-9, Figure 3
Adapter, Neck Load Cell	210-8001	Item-10, Figure 3
10-32 x 1-1/8 SHCS	9002075	Item-11, Figure 3
10-32 x ½ SHCS	9000119	Item-12, Figure 3
Accelerometer Block Adapter Plate	ATD-6259	Item-16, Figure 3
Bushing, Occipital Condyle	210-1035	Item-13, Figure 4
Screw, Nylon, 1/4-20 x 0.80	210-1036	Item-14, Figure 4
Velcro®		Item-15, Figure 4

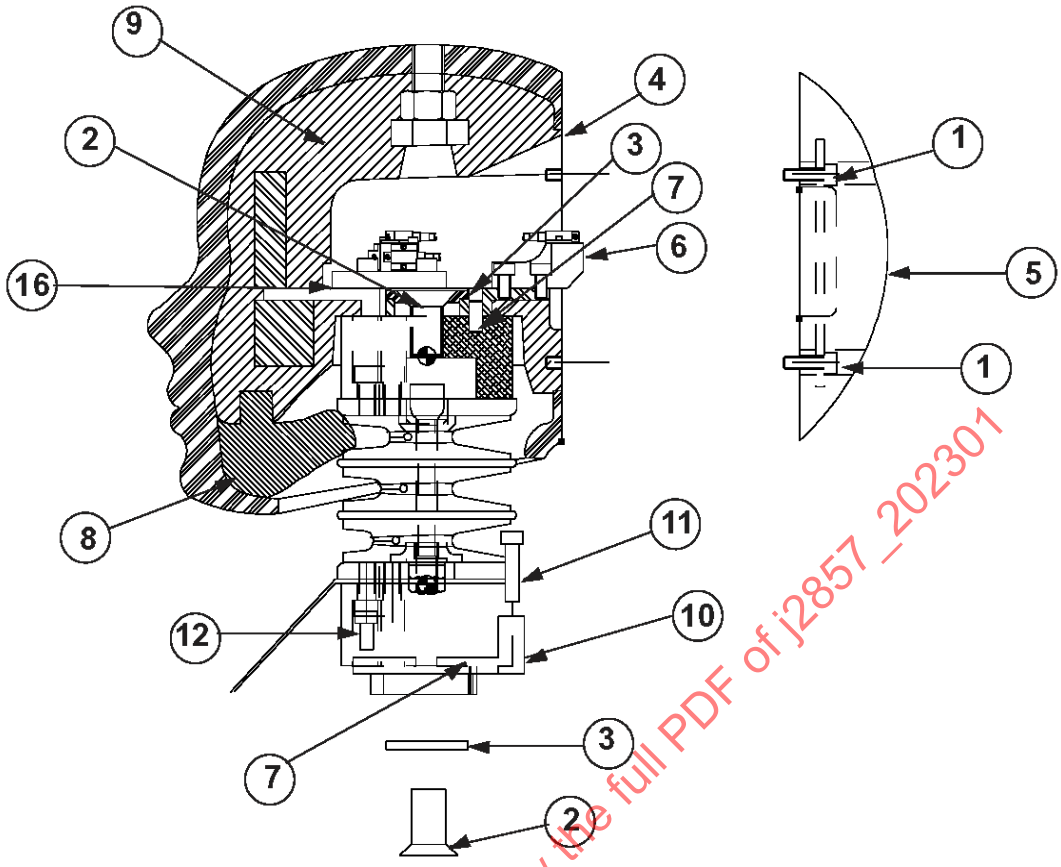


FIGURE 3 - HEAD AND NECK ASSEMBLY

7.2.1 Head Disassembly

To remove the head, take off the head back by removing the four 10-24 x 5/8 SHCS (Item-1, Figure 3) that hold it to the head assembly. Remove the head accelerometer mounts (Item-6, Figure 3 and Item-16, Figure 3). Note: (Item-16, Figure 3) can be removed by accessing the screws through the holes in the top of the head.

Take out the ½-20 x 1 FHCS (Item-2, Figure 3) from inside the head by inserting an Allen wrench though the hole in top of the head. Then the head assembly can be taken off the neck. The head mounting washer (ATD-6262) (Item-3, Figure 3) can fall out while pulling the head from the neck assembly. The washer sits inside the head to provide the proper surface for the flat head cap screw to locate and hold the head-neck assembly together.

The head skin can be removed by first removing the head back and then removing the two screws (Item-14, Figure 4) on the lower sides of the head. Then opening the Velcro® strip (Item-15, Figure 4) at the lower rear of the head skin, and carefully removing the head skin from the skull.

Inspect the chin insert (Item-8, Figure 3) to make sure that it is still attached to the skull and is not torn or damaged. If it is damaged then it should be replaced by gluing a new one in place.

7.2.2 Head Reassembly

- If head skin was removed, carefully reinstall head skin and the two bushings and screws at the lower sides of the head and re-seal the Velcro® strip at the lower rear of the head skin. Make sure that there is a good tight fit between the head skin and the skull when reassembled. (Refer to APPENDIX B – GUIDELINES FOR FLESH REPAIR).
- Attach the head to the neck, using appropriate hardware.
- Install the head accelerometers.
- Install the head back.

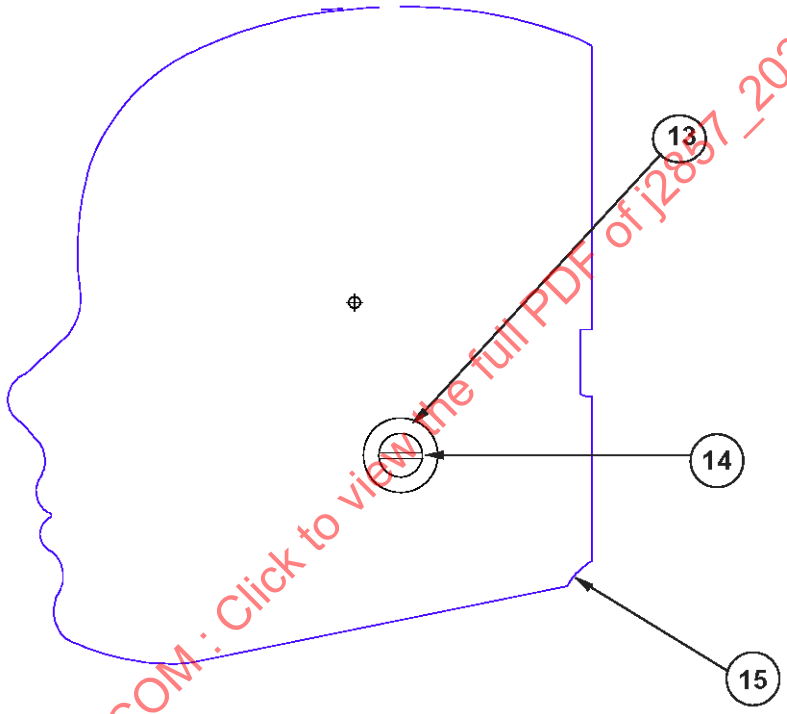


FIGURE 4 - HEAD ASSEMBLY

7.3 Neck

The Neck assembly (210-2001) consists of:

Neck Assembly, Molded	210-2015	Item-1, Figure 5
Neck Cable	210-2040	Item-2, Figure 5
Upper Mount Plate Insert	910420-048	Item-3, Figure 5
Lower Mount Plate Insert	9001373	Item-4, Figure 5
Urethane Washer	210-2050	Item-5, Figure 5
5/16-24 Jam Nut	9001336	Item-6, Figure 5
1/4-20 x ½ SHCS	9000121	Item-7, Figure 5
Transducer Structural Replacement	ATD-6204	Item-8, Figure 5
Adapter, Neck load cell	210-8001	Item-9, Figure 5
Neck Mounting Washer	ATD-6262	Item-10, Figure 5
1/2-20 x 1 FHCS	9000150	Item-11, Figure 5

7.3.1 Neck Disassembly

With the head assembly removed, the neck can be taken off the upper/lower torso assembly by removing the two 10-32 x ½ SHCS (Item-12, Figure 3) and the two 10-32 x 1-1/8 SHCS (Item-11, Figure 3) that mount the neck assembly to the top of the spine box. This allows access to the 1/2-20 x 1 FHCS (Item-11, Figure 5) so the neck load cell adapter (Item-9, Figure 5) can be removed from the neck assembly. Be careful not to lose the special washer (Item-10, Figure 5).

To detach the bib assembly from the neck, remove the eight 1/4-20 x ½ SHCS (Item-7, Figure 5) at the underside of the neck-head transducer structural replacement (Item-8, Figure 5). This structural replacement is the same component used on the top of the neck assembly.

After removing the structural replacement at the base of the neck, the two 5/16-24 jam nuts (Item-6, Figure 5) can be taken off. When the jam nuts are removed the lower mount plate insert (9001373) (Item-4, Figure 5) and the urethane washer (Item-5, Figure 5) can be taken out of the assembly. At the top of the neck there is another mount plate insert (upper) (910420-048) (Item-3, Figure 5). These inserts are used to dampen noise in the neck cable. Take off the structural replacement on the top of the assembly by removing the eight 1/4-20 x ½ SHCS (Item-7, Figure 5) that hold it in place and pull the neck cable (Item-2, Figure 5) out of the assembly. Notice the location of the dowel pin (Item-7, Figure 3) in the load cell structural replacement. This pin is in a different location from the pin used in both the upper and lower neck load cells. To install the structural replacement, the pin must be positioned toward the rear of the head and spine box. The load cells have a different arrangement to attach them to the skull and spine box, as compared to the load cell structural replacements. The load cells have new bolts and a plate supplied with them. Be sure to save the original bolt and washer in case you wish to reinstall the load cell structural replacement.

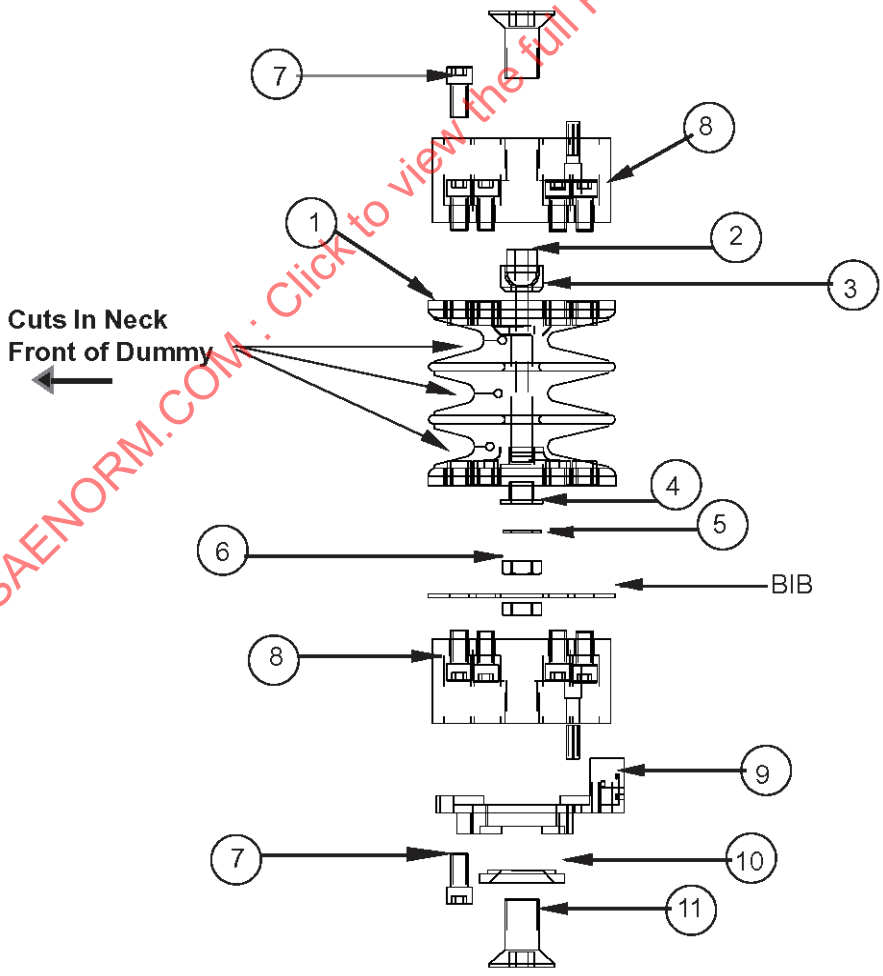


FIGURE 5 - NECK ASSEMBLY

7.3.2 Neck Reassembly

- Install the upper and lower mount plate inserts and the neck cable. Put the urethane washer and jam nuts on the lower end of the neck cable.
- Torque the neck cable nut to 0.23 N-m ± 0.02 N-m. (2.0 in-lb ± 0.2 in-lb). To properly torque it, the cable must be held with a screwdriver in the slot in the end of the cable. This prevents the cable from winding up as the nut is torqued. Install the upper neck load cell or structural replacement onto the neck.
- Attach the neck and lower neck load cell or structural replacement to the bib.
- Attach the neck load cell adapter to the bottom of the neck assembly.
- Attach the neck and bib to the spine box using the appropriate hardware. If using the lower neck load cell, feed the cable through the clearance holes in the top of the spine box and out the opening on the rear side of the spine box.
- If the uniaxial lower spine accelerometer and the triaxial T4 accelerometers are being used, route their cables up through the spine box and out the rear opening.
- Attach neck to head using the appropriate hardware. Feed the upper neck load cell cables up through clearance holes in the base of the skull, if necessary.
- The same load cell can be used on either the upper or lower neck. When installed correctly be aware that the Y & Z axis sign convention will be opposite between the upper and lower neck load cells.
- The neck assembly can be installed backwards and upside down. Be sure that the cuts in the front of the neck are toward the front of the dummy during installation with the deepest cut at the top end (see Figure 5). The hex nut is down towards the spine box.

7.4 Upper Torso

The Upper Torso (210-3000) consists of:

Spine Box	210-8020	Item-1, Figure 6
Rear Rib Supports	210-8107	Item-5, Figure 6
Clavicle Stop	210-3603	Item-8, Figure 6
Sternum Stop Pad	210-8090	Item-9, Figure 6
6-32 x 3/8 SHCS	9000379	Item-11, Figure 6
10-32 x 1-1/8 SHCS	9002075	Item-13, Figure 6
Bib Assembly	210-3730	Item-21, Figure 6
10-32 x ½ SHCS	9000147	Item-24, Figure 6
Transducer Assembly	210-8150	Item-27, Figure 6
6-32 x 5/8 SHCS	9000380	Item-32, Figure 6
Abdominal Insert	210-4300	Item-34, Figure 6
6-32 x 3/8 BHCS	9001213	Item-2, Figure 7
Rib Set	210-RSVP	Item-3, Figure 7
6-32 x 3/8 BHCS	9001213	Item-4, Figure 7
Bib Assembly	210-3730	Item-5, Figure 7
Front Rib Stiffener	210-3560	Item-7, Figure 7
Sternum and Sternum Slider	210-8030	Item-9, Figure 7
Torso Flesh	210-3740	Item-10, Figure 7
Shoulder Assembly	210-3604	Item-11, Figure 7
5/16 x 3/4 SHSS	9000578	Item-12, Figure 7
5/16 x1/2 SHSS	9001024	Item-13, Figure 7
Lower Rib Stop- Left, Right	210-8090-1&2	Item-22, Figure 7
Assembly, Top Rib Stop	210-8010	Item-35, Figure 7

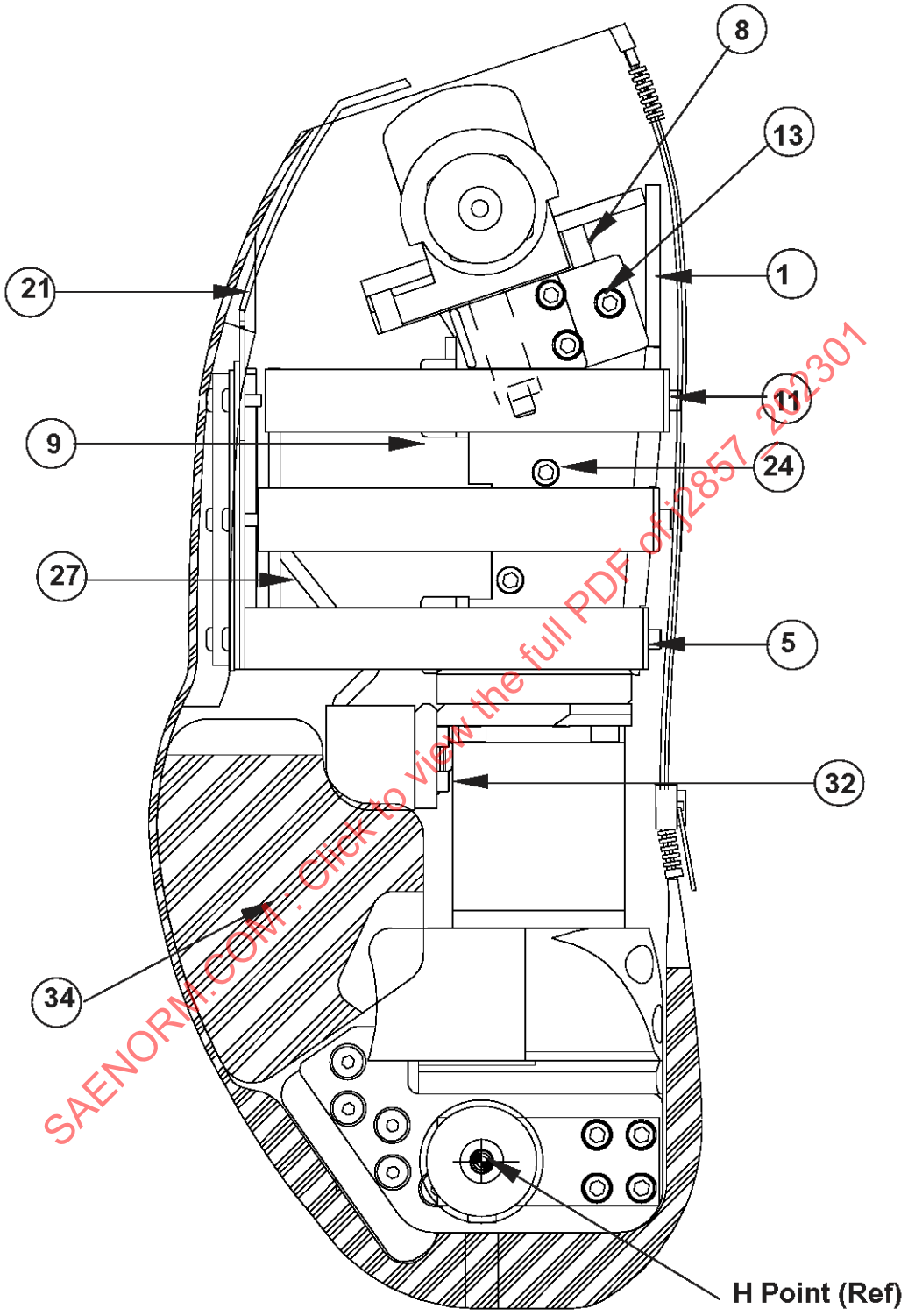


FIGURE 6 - SIDE VIEW OF TORSO ASSEMBLY

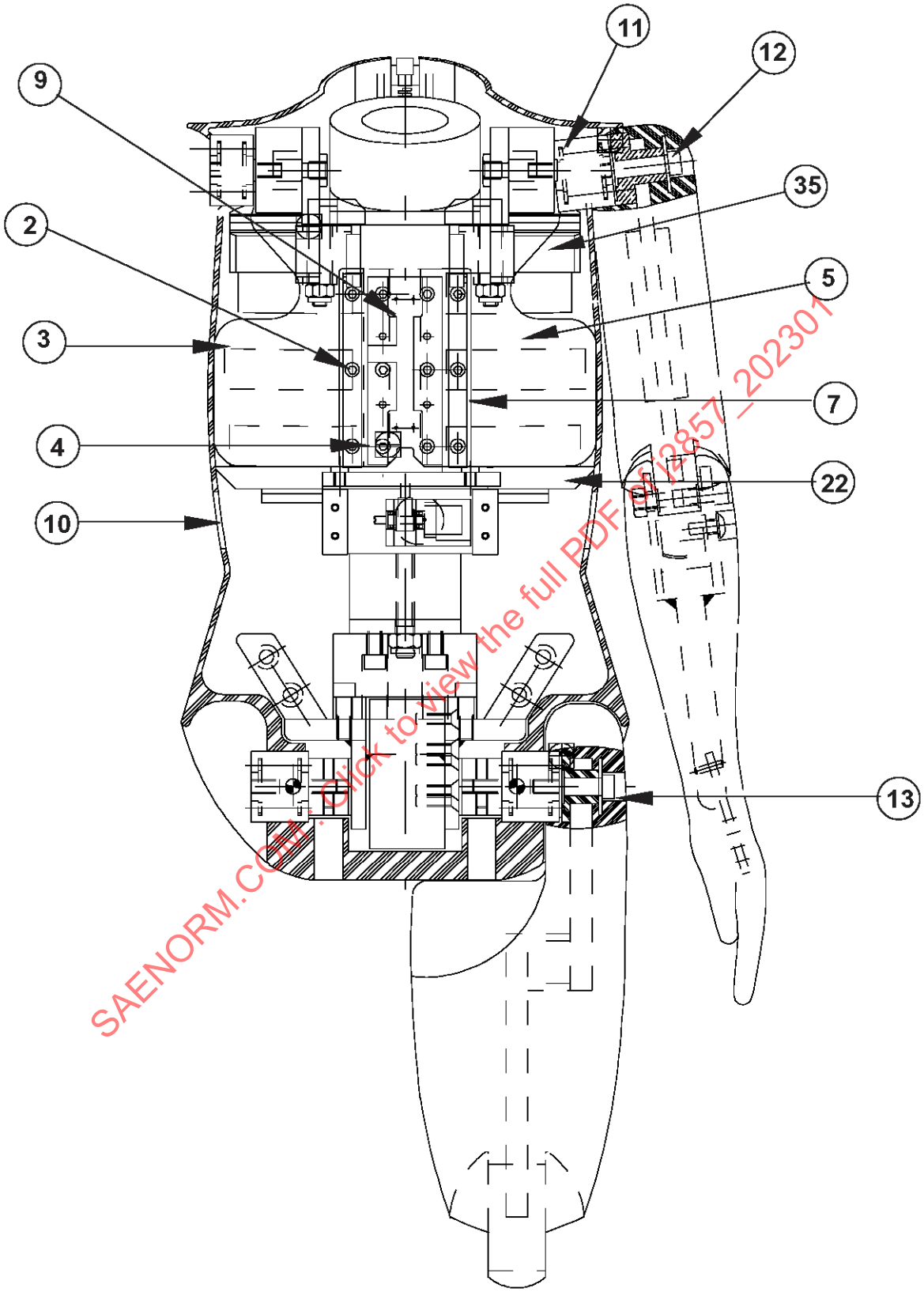


FIGURE 7 - FRONT VIEW OF TORSO ASSEMBLY

7.4.1 Upper Torso Disassembly

Remove the four 10-32 x ½ SHCS (Item-24, Figure 6) from the sides of the spine box. Be careful not to damage the chest deflection arm (Item-27, Figure 6) when separating the upper and lower torso. To further disassemble the upper torso section remove the shoulder assemblies and top rib stop assemblies by taking out the six 10-32 x 1-1/8 SHCS (three on each side of the spine box) (Item-13, Figure 6) that attach them and the upper rib stops (Item-35, Figure 7) to the spine box. On each shoulder assembly there will be a urethane clavicle stop (Item-8, Figure 6 & Item-10, Figure 8). Be careful not to lose them, and note the position of the large chamfer in relation to the spine box.

The sternum and sternum slider (210-8030) (Item-9, Figure 7) are removed by taking out the six 6-32 x 3/8 BHCS (Item-4, Figure 7) that attach it to the bib (210-3730) (Item-21, Figure 6). Watch for the threaded sternum support behind slider that will fall out.

The ribs can be detached from the bib assembly by taking out the six 6-32 x 3/8 BHCS (Item-2, Figure 7) at the front of the bib assembly (Item-21, Figure 6). Watch for the threaded plates that will fall out (Item-7, Figure 7).

To remove the ribs from the assembly, take out the six 6-32 x 3/8 SHCS (Item-11, Figure 6) along with the rear rib supports (210-8107) (Item-5, Figure 6) at the rear of the torso and pull the ribs up over the top of the spine box (Item-1, Figure 6).

The sternum accelerometers (see Item-14, Figure 1) are fastened to the sternum and sternum slider (Item-9, Figure 7) with two 0-80 x 1/8 SHCS for each accelerometer.

The sternum stop pads (210-8090) (Item-9, Figure 6) are attached to the spine box using an adhesive cement. If a pad should become loose or fall off, glue it back into its original position with Loctite ® 406 (P/N 9001020)

7.4.2 Upper Torso Reassembly

- Reinstall the ribs on the rear of the spine box, making sure to mount the ribs in the correct sequence (No. 1 on the top, No. 2 in the middle, and No. 3 at the bottom). Be sure to include the rear rib supports.
- Attach the sternum assembly to the bib, making sure that the chest deflection arm is in the slider groove. Be careful not to damage the chest deflection arm while reconnecting it.
- Attach the shoulder assemblies. Be sure that the urethane stops are installed with the chamfer up. If needed, install the sternum accelerometers.

7.5 Complete Shoulder

The Shoulder Assembly consists of:

Shoulder Support Housing	210-3601	Item-1, Figure 8
Shoulder Support Bracket	210-3602-1 (left) & -2 (right)	Item-2, Figure 8
Transducer Replacement	210-3800	Item-3, Figure 8
Shoulder Joint Assembly	210-3604	Item-4, Figure 8
Clavicle Stop	210-3603	Item-5, Figure 8
5/16-18 Hex Jam Nut	9000656	Item-6, Figure 8
10-24 x 5/8 FHCS	9000566	Item-7, Figure 8
1/4-20 Elastic Lock Nut	9000353	Item-8, Figure 8
Plastic Bearing	6000212	Item-9, Figure 8
Shoulder Stop	210-8120	Item-10, Figure 8

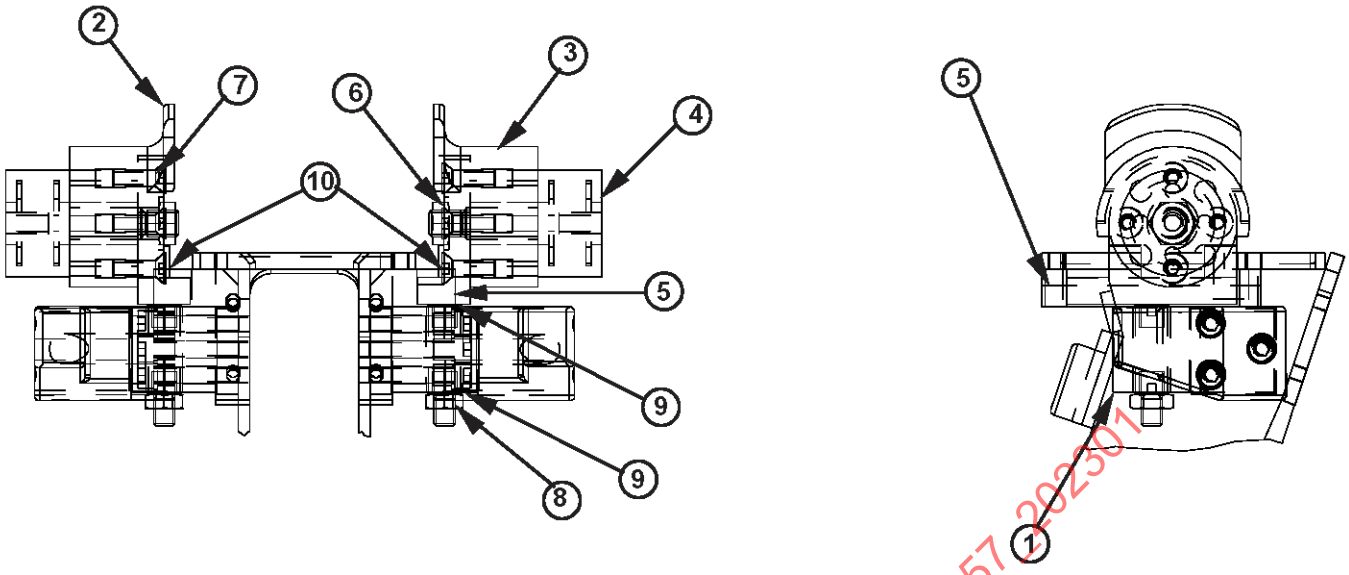


FIGURE 8 - COMPLETE SHOULDER ASSEMBLY

7.5.1 Complete Shoulder Disassembly

To disassemble the complete shoulder assembly, start by taking off the 5/16-18 Hex Jam Nut (Item-6, Figure 8) that holds the shoulder joint assembly to the shoulder support bracket and unscrew the shoulder assembly (Item-4, Figure 8) from the shoulder support bracket (Item-2, Figure 8). The shoulder joint assembly consists of the rubber damper and the standoff screw. Then remove the four 10-24 x 5/8 FHCS (Item-7, Figure 8) that hold the transducer structural replacement to the shoulder support bracket.

To detach the shoulder support bracket from the shoulder housing, remove the 1/4-20 elastic lock nut (Item-8, Figure 8) from the shoulder support bracket and pull the housing away from the bracket. When pulling the bracket away from the housing notice the plastic bearings (6000212) (Item-9, Figure 8) at each end of the housing. These bearings should be checked frequently for wear. If the joint does not move freely, the bearings should be replaced.

7.5.2 Complete Shoulder Reassembly

- Place the shoulder support bracket into the shoulder housing with a plastic bearing on each end. Notice that there are right and left brackets, and the tab points forward.
- Torque the elastic lock nut 1.13 to 1.36 N-m (10 to 12 in-lb) until there is no clearance between the nut and the face of the bearing, but allows the shoulder bracket to freely rotate. If the shoulder bracket does not turn freely in the shoulder housing, then the plastic bearing may need to be replaced.
- Attach the transducer structural replacement or load cell to shoulder support bracket.
- Screw the shoulder joint assembly into the shoulder support and install the nut.
- When placing the Shoulder Joint Assemblies on the spine, be sure to include the urethane clavicle stop. Note: The larger chamfer goes up and the shoulder bracket should be free to rotate when fully assembled.
- Notice that there are left and right shoulder support brackets.

7.6 Lower Torso

The Lower Torso consists of:

10-32 x 3/4 SHCS	9000151	Item-7, Figure 9
Transducer Mount Weldment	210-8070	Item-14, Figure 9
10-32 x 1/4 BHCS	9000321	Item-15, Figure 9
6-32 x 5/8 SHCS	9000380	Item-16, Figure 9
Thorax Stops	127-2064	Item-17, Figure 9
Washer, Flat #10 x 0.50 x 0.049	9000054	Item-18, Figure 9
Pubic Symphysis Replacement	921022-036	Item-20, Figure 9
Lumbar Structural Replacement	210-4150	Item-2, Figures 9 & 10
Pelvic Bone Weldment	210-4510	Item-3, Figures 9 & 10
Hip Isolation Dampers	210-3606	Item-5, Figures 9 & 10
Thoracic Insert	210-8050	Item-6, Figures 9 & 10
1/4-28 x 5/8 SHCS	9000126	Item-8, Figures 9 & 10
1/4-20 x 3/4 SHCS	9000454	Item-9, Figures 9 & 10
10-24 x 3/4 FHCS	9000195	Item-10, Figures 9 & 10
10-32 x 1/2 SHCS	9000147	Item-12, Figures 9 & 10
Lumbar Assembly	210-4110	Item-1, Figures 9, 10, 11
Acetabulum L/C Replacements	210-4520	Item-4, Figure 10
10-32 x 1/2 FHCS	9000208	Item-13, Figure 10
A.S.I.S. Load Cell Simulator	210-4540-1(lh)-2 (rh)	Items-18 &19, Figure 10
Lower Rib Stop	210-8090	Item-22, Figure 10
10-32 x 5/8 FHCS	9000725	Item-23, Figure 10
Spine Cable	210-2040	Item-2, Figure 11
5/16-24 Jam Nut	9001336	Item-3, Figure 11
Mounting Plate Insert	910420-048	Item-4, Figure 11
Plastic Shoulder Bushing	9001373	Item-5, Figure 11
Chest Deflection Assembly	210-8150	Figure 12

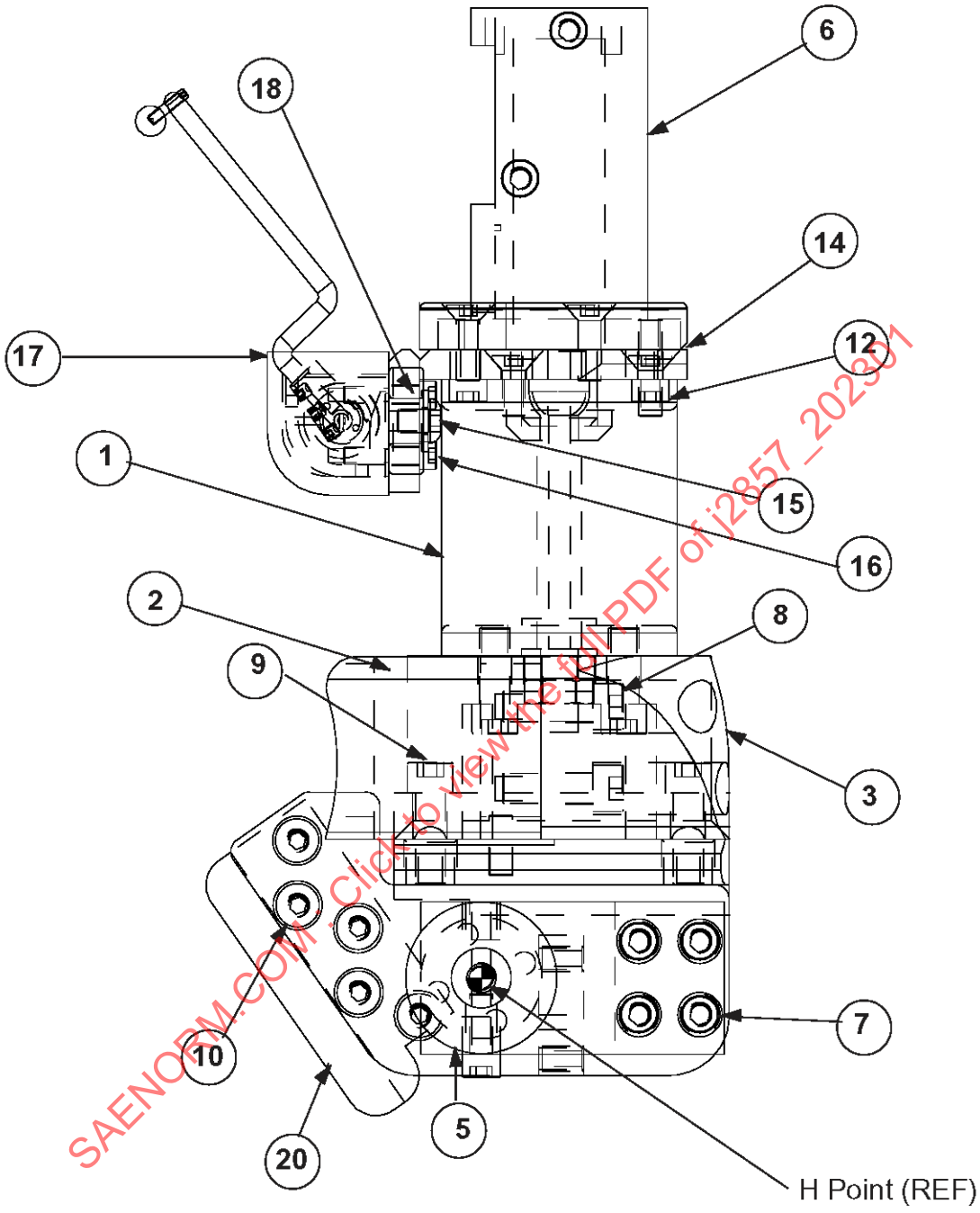


FIGURE 9 - SIDE VIEW LOWER TORSO ASSEMBLY

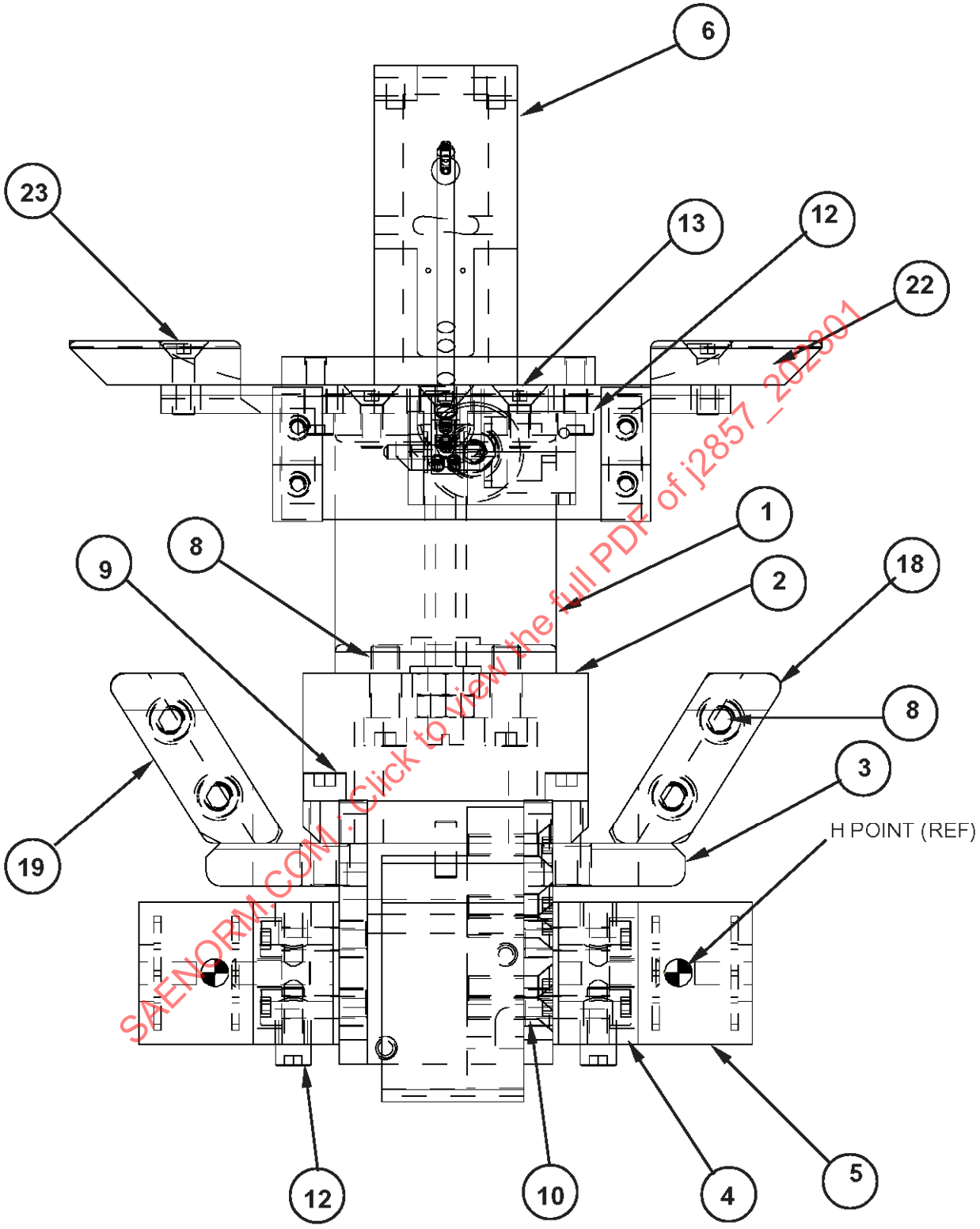


FIGURE 10 - FRONT VIEW OF LOWER TORSO ASSEMBLY

7.6.1 Lower Torso Disassembly

Disassembly of the lower torso section starts with the removal of the transducer and lumbar assemblies. To do this, take out the four 1/4-20 x 3/4 SHCS (Item-9, Figure 9) that hold the assembly to the pelvic bone. With the lumbar assembly off the pelvic bone (Item-3, Figure 9), detach the lumbar spine (Item-1, Figure 9). The lumbar spine is removed from the lumbar load cell structural replacement (210-4150) (Item-2, Figure 10) by taking out the four 1/4-28 x 5/8 SHCS (Item-8, Figure 9) that hold the two together. Next, take off the thoracic insert assembly (Item-6, Figure 9) by removing the four 10-32 x ½ SHCS (Item-12, Figure 9) that hold it to the transducer mount weldment (210-8070) (Item-14, Figure 9). To remove the transducer mount weldment take out the three 10-32 x ½ FHCS (Item-13, Figure 10) holding the weldment to the molded spine. With the weldment removed, remove the 10-32 x 1/4 BHCS (Item-15, Figure 9) and the flat washer (Item-18, Figure 9) that hold the potentiometer bracket assembly in position (127-2075) (Item 1, Figure 12).

Two thorax stops (127-2064) (Item-17, Figure 9) are positioned on the transducer mount weldment. These are detached by taking out the four 6-32 x 5/8 SHCS (two on each stop) (Item-16, Figure 9) holding them in position. With the transducer weldment and structural replacement removed, take out the spine cable (210-2040) (Item-2, Figure 11). Do this by removing the 5/16-24 elastic lock nut (Item-3, Figure 11) at the base of the cable. When removing the spine cable, notice the plastic shoulder bushing (9001373) (Item-5, Figure 11) at the bottom of the spine. This bushing must be reinstalled during reassembly. At the top of the spine, there is a plastic bushing called a mounting plate insert (910420-048) (Item-4, Figure 11). Be sure to reinstall this during reassembly.

The pelvic bone assembly is disassembled by removing the eight 10-32 x 3/4 SHCS (Item-7, Figure 9) (four on each side of the pelvic bone) that hold the acetabulum load cell replacements (Item-4, Figure 10) in position. The acetabulum load cell replacements attach the hip isolation dampers (210-3606) (Item-5, Figure 10) to the pelvic bone.

At the midsagittal plane, or center, of the pelvic bone is the pubic symphysis load cell replacement (Item-20, Figure 9). To remove this replacement take out the five 10-24 x 3/4 FHCS (Item-10, Figure 9) that hold it in position and slide out the replacement. The final component on the pelvic bone is the anterior superior iliac spine (A.S.I.S.) load cell simulator (210-4540-1 (left) & -2 (right)) (Items-18 &19, Figure 10). To remove the A.S.I.S. load cell simulator take out the four 1/4-20 x 3/4 SHCS (two on each iliac wing) (Item-9, Figure 10). Make note of the position of the large bevel on the A.S.I.S. load cell simulator to insure proper placement during reassembly.

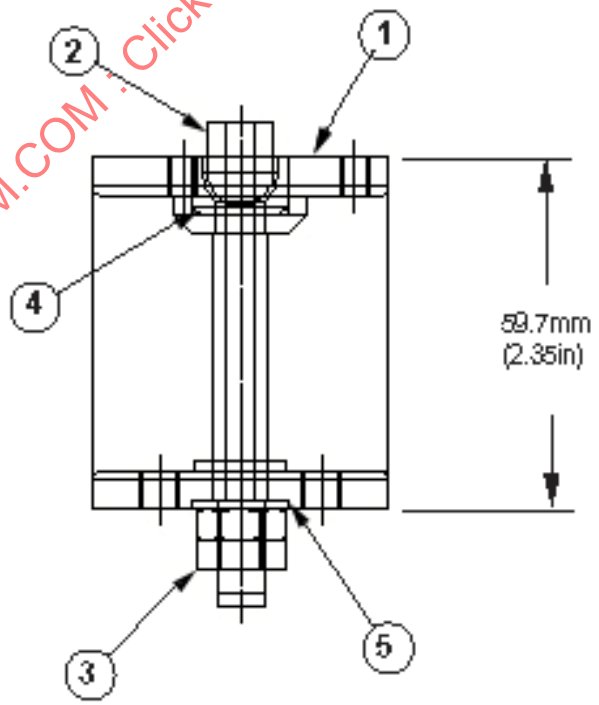


FIGURE 11 - SPINE ASSEMBLY

7.6.2 Lower Torso Reassembly

- Attach the A.S.I.S. load cell replacements or load cells to the pelvic bone. The large chamfer on the simulator goes up and to the outside.
- Attach the pubic symphysis load cell replacement or load cell to the pelvic bone.
- Bolt the acetabulum load cell replacements or load cells to the pelvic bone.
- Install plastic bushings and spine cable into the spine. (Note: The spine cable and the neck cable are identical.)
- Screw on the elastic lock nut and torque spine cable nut to 0.23 N-m ± 0.02 N-m (2.0 in-lb ± 0.2 in-lb). To properly torque it, the cable must be held with a screwdriver in the slot in the end of the cable. This prevents the cable from winding up as the nut is torqued.
- The overall length of the spine is 59.7 mm ± 0.25 mm (2.35 in ± 0.01 in). Do not adjust the torque to obtain this dimension. The spine should be replaced if it exceeds these limits.
- Attach the spine assembly, with the nut down, to a lumbar load cell replacement or load cell.
- Connect the chest deflection assembly to the transducer mount. Be sure to reinstall the flat washer, or the chest deflection assembly will not be tight.
- Bolt the thorax stops to the transducer mount.
- Bolt the transducer mount assembly to the top of lumbar spine assembly.
- Attach the thoracic insert on top of the transducer mount assembly.

7.7 Chest Deflection Assembly

The Chest Deflection Assembly (210-8150) consists of:

Potentiometer Bracket Assembly	127-2075	Item-1, Figure 12
Potentiometer	SA572-S50	Item-2, Figure 12
-“O” Ring 5/8 O.D. x ½ I.D. x 1/16 Tk	9001309	Item-3, Figure 12
Arm Connector	127-2073	Item-4, Figure 12
Screw #4-40 x 1/8 SSCP	90000154	Item-5, Figure 12
Transducer Arm	210-8061	Item-6, Figure 12
Transducer Ball	127-2071	Item-7, Figure 12
Screw #2-56 x 3/8 SSCP	9001367	Item-8, Figure 12

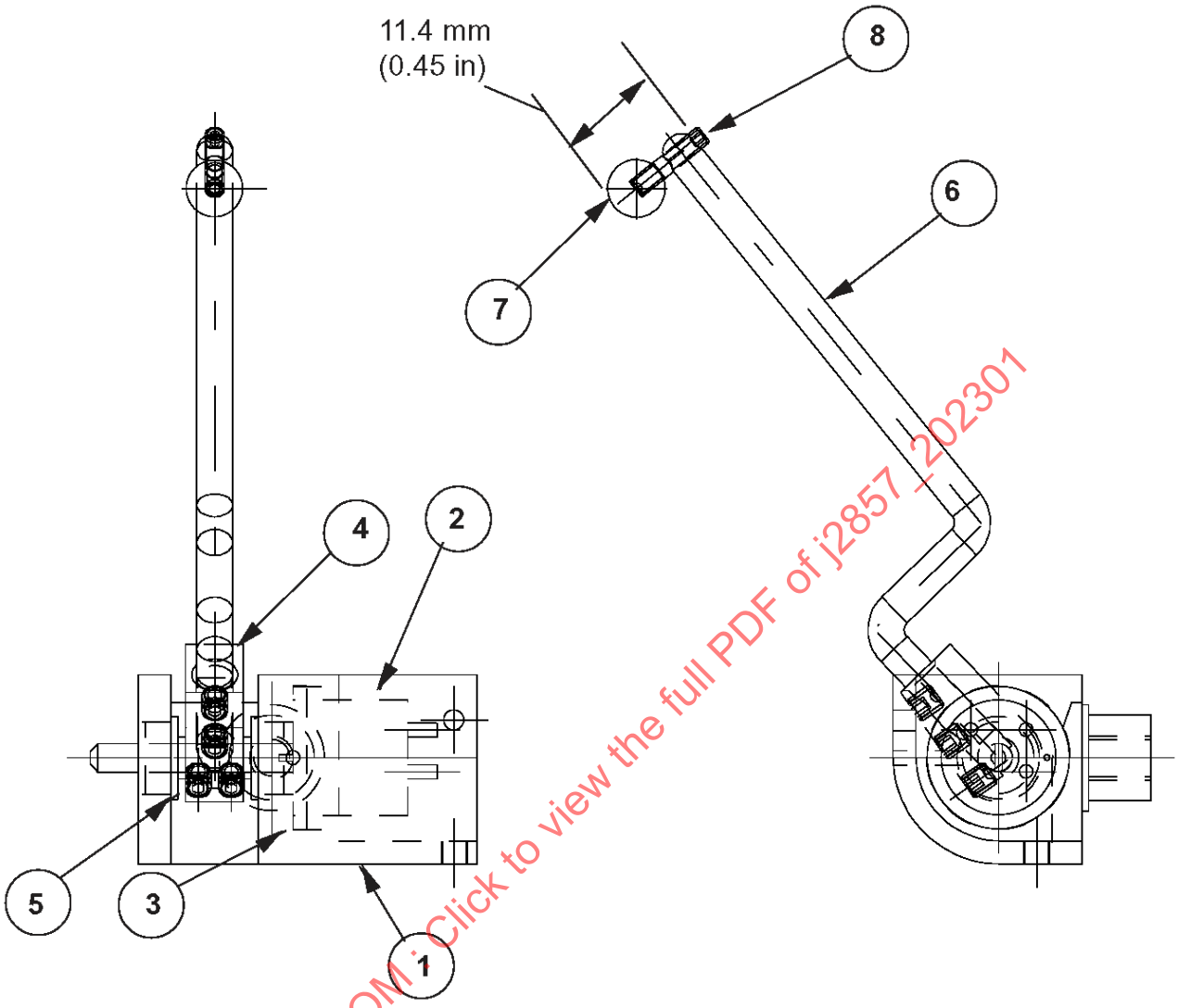


FIGURE 12 - CHEST DEFLECTION ASSEMBLY

7.7.1 Chest Deflection Transducer Disassembly

If the potentiometer is damaged, then proceed with the following disassembly instructions. If not, it is recommended that you do not remove the potentiometer. To disassemble the potentiometer bracket assembly, loosen the two 4-40 x 1/8 SSCP (Item-5, Figure 12) that secure the potentiometer shaft to the arm connector (127-2073) (Item-4, Figure 12). By pushing on the shaft, slide the potentiometer out of the bracket and arm connector. As you push the potentiometer from the bracket you will see an “O-ring” (9001309) (Item-3, Figure 12) that is positioned at the end of the potentiometer body. Be sure to reinstall this “O-ring” during reassembly.

7.7.2 Chest Deflection Transducer Reassembly

Follow the above disassembly procedure in reverse order.

Note that the transducer arm is unique to the H3-3YO, even though the potentiometer bracket assembly is common with the H3 6-Year Old.

Note that the chest deflection transducer assembly must be calibrated per J2517 after it is reassembled.

7.8 Arms

The Complete Arm Assembly (210-6000-1 (left) & -2 (right)) consists of:

Upper Arm Assembly	210-6100-1 (left) & -2 (right)	Item-1, Figure 13
Lower Arm Assembly	210-6500-1 (left) & -2 (right)	Item-2, Figure 13
Elbow Screw	210-6515	Item-3, Figure 13
Stop Screw	210-6516	Item-4, Figure 13
Nylon Washer	9001317	Item-5, Figure 13
Urethane Stops	210-6130	Item-6, Figure 13
Nyliner® Bearings	6000082	Item-7, Figure 13
Sleeve	210-6120	Item-8, Figure 13

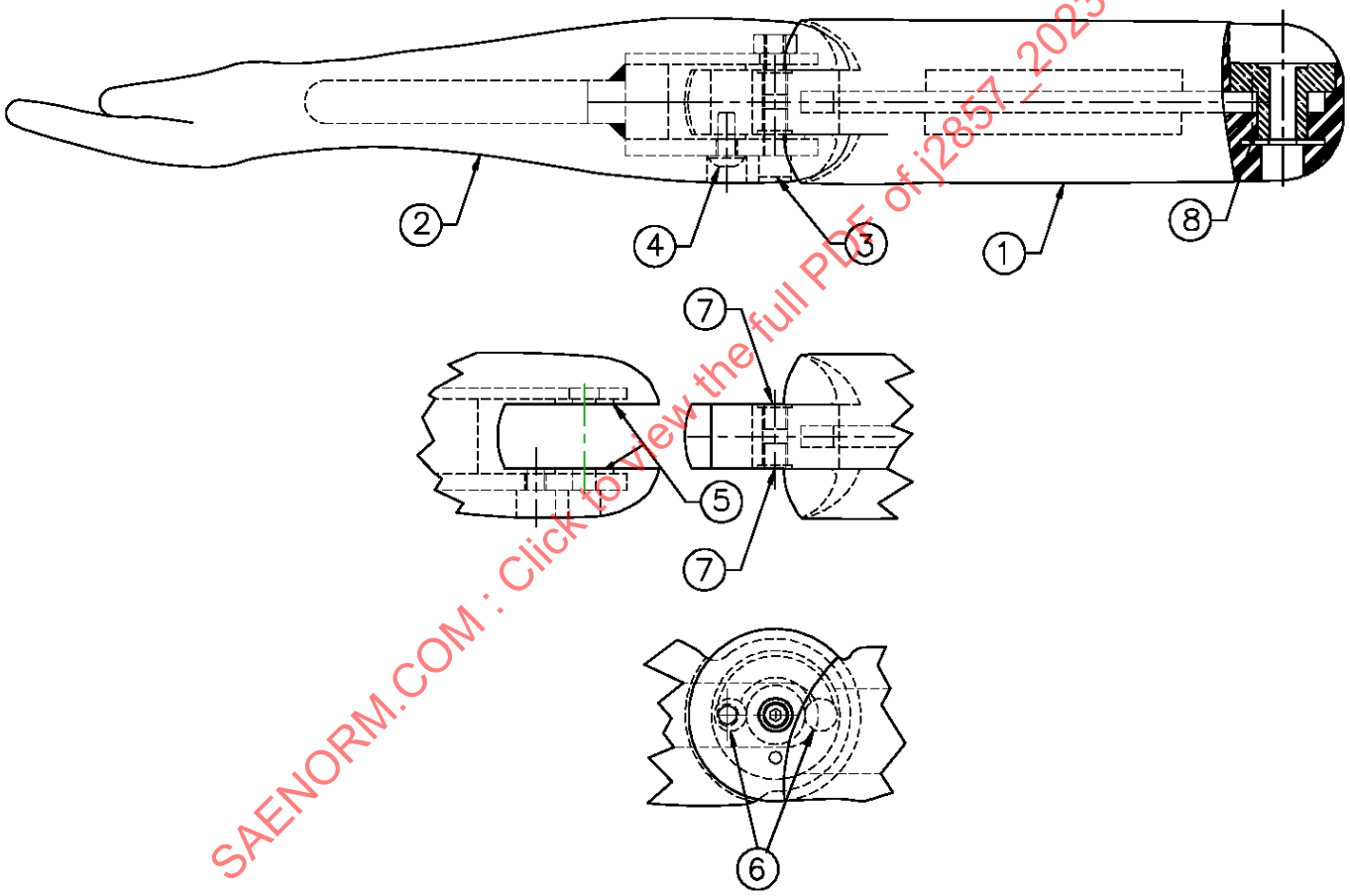


FIGURE 13 - COMPLETE ARM ASSEMBLY

7.8.1 Arm Disassembly

The arm assemblies are quite simple in construction. To begin disassembly remove the elbow screw (210-6515) (Item-3, Figure 13) from the elbow joint and take out the stop screw (210-6516) (Item-4, Figure 13). Then pull the upper and lower arm components apart.

The upper and lower arms are one-piece, molded components. The only parts that can be removed are the two urethane stops (Item-6, Figure 13) (same as those used in the knee and foot) and the two Nyliner® bearings (6000082) (Item-7, Figure 13). The two Nyliner® bearings are pressed into the elbow joint to reduce friction in the joint. The stop screw (Item-4, Figure 13) in the lower arm joint limits the range of motion of the lower arm by hitting the urethane stops (Item-6, Figure 13). After repeated use, the stop should be checked for signs of tearing and replaced if damaged.

7.8.2 Arm Reassembly

- Install the urethane stops. If they are damaged replace them.
- Inspect the nylon washers in the arm joint. If they are loose, glue them in with Loctite® 406 (PN 9001020)
- Put the upper and lower arm together. Install the elbow screw and the stop screw with limbs at mid-rotation so the stop screw does not damage the urethane stops.

7.9 Legs

The Complete Leg Assembly (210-5000-1 (left) & -2 (right)) consists of:

Upper Leg Assembly	210-5100-1 (left) & -2 (right)	Item-1, Figure 14
Lower Leg Assembly	210-5500-1 (left) & -2 (right)	Item-2, Figure 14
Foot	210-5900-1 (left) & -2 (right)	Item-3, Figure 14
Knee Bolt	210-5301	Item-4, Figure 14
Stop Screw	210-6516	Item-5, Figure 14
Nyliner® Bearings	6000082	Item-6, Figure 14
Urethane Stops	210-6130	Item-7, Figure 14
Urethane Sleeve	210-6121	Item-8, Figure 14
Nylon Washers	9001317	Item-9, Figure 14
Ankle Bolt	210-5701	Item-10, Figure 14

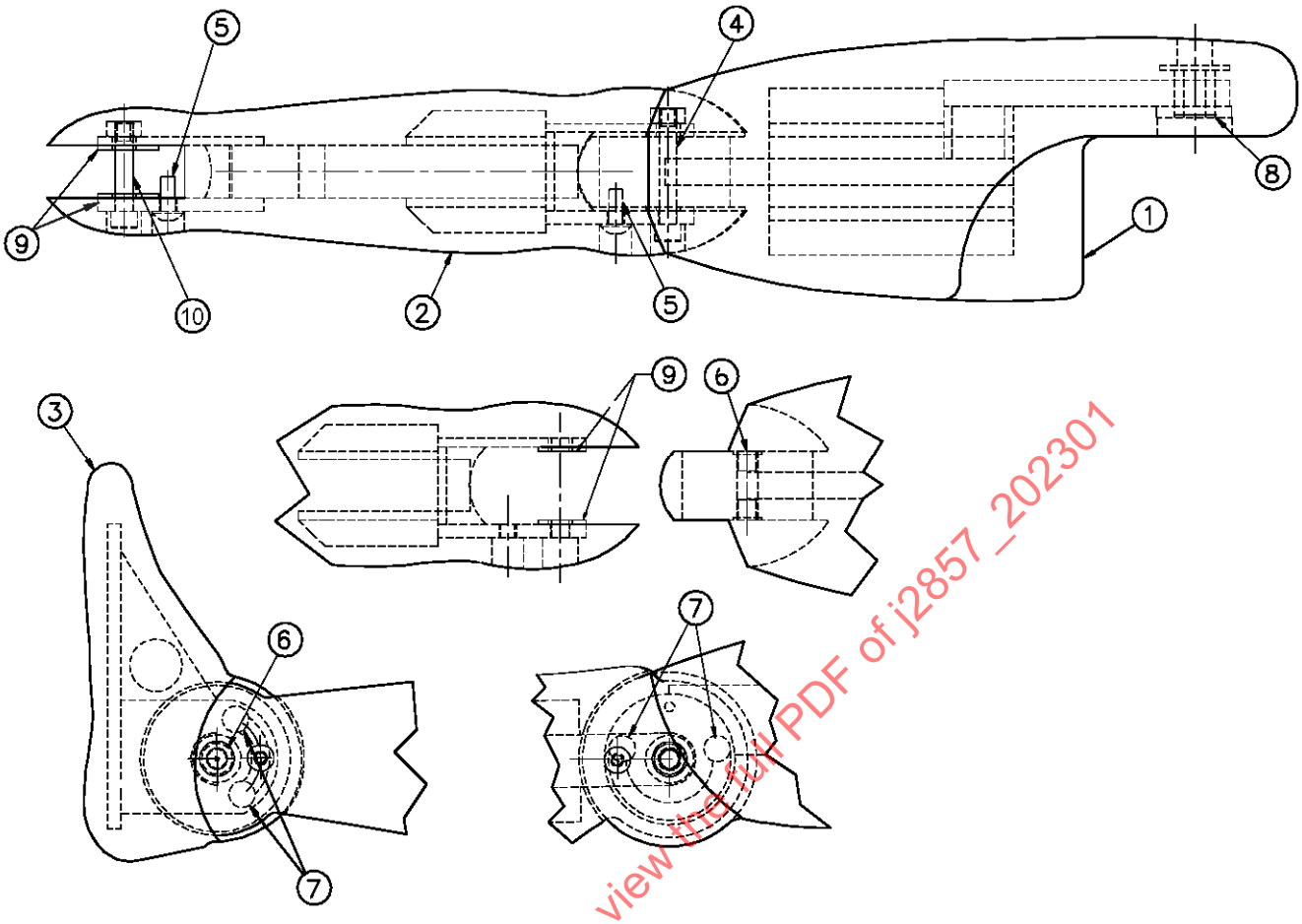


FIGURE 14 - COMPLETE LEG ASSEMBLY

7.9.1 Leg Disassembly

To disassemble the leg, start by taking out the knee bolt (210-5301) (Item-4, Figure 14) and the stop screw (210-6516) (Item-5, Figure 14). This is the same type screw used in the elbow. Pull the upper and lower leg assemblies apart.

Both the upper and lower leg assemblies are completely molded, one-piece units. The bones cannot be removed from the flesh. The only removable components are the two Nyliner® bearings (Item-6, Figure 14), and the two knee stops (210-6130) (Item-7, Figure 14).

To remove the foot, take out the ankle bolt (210-5701) (Item-10, Figure 14) and the stop screw (same type as in the knee and elbow), (Item-5, Figure 14) and then pull the foot off the lower leg.

In the foot there are two Nyliner® bearings (Item-6, Figure 14), and two urethane stops (Item-7, Figure 14) (the same type stop used in the knee and elbow). In both the knee and foot joint there are thin plastic washers (Item-9, Figure 14). If any of these washers come loose, use Loctite®406 (PN 9001020) to glue them back on.

7.9.2 Leg Reassembly

- Install the urethane stops in foot joint. If stops are damaged replace with new ones.
- Install the ankle bolt. Place the limb at mid rotation before installing the stop screw. This will prevent damage to the urethane stops.
- Install the urethane stops in the knee joint. If the stops are damaged, replace with new ones.
- Attach the lower leg/foot to the upper leg. Place the limb at mid-rotation before installing the stop screw. This will prevent damage to the urethane stops.

8. CARE AND MAINTENANCE

8.1 General Inspection

The most important function in caring for the Hybrid III 3-Year Old test dummy is the diligent and frequent inspection of the complete dummy. It is in this practice that the user can find potential failures and damage and thus avoid needless loss of test time.

The inspection should cover the entire dummy and be conducted from head to toe. View each section of the dummy. A careful inspection of the dummy can reveal many items of importance. Cracks in the rib damping material mean that the ribs need to be re-certified and maybe replaced. These seemingly small factors could easily add up to invalid test data and loss of test time.

The inspection must continue throughout the dummy. Never assume anything! Too many things can happen during a test. It is too easy to miss potential problems.

8.1.1 Head

- Check the head skin for cracks or tears. Repair the head skin as indicated in APPENDIX B – GUIDELINES FOR REPAIRING FLESH. Do not repair damage in the forehead region as this will affect test results. Instead, replace the head skin.
- Is the skin soft and pliable? If not, re-certify or replace.
- Whenever the head skin is removed, check the skull for cracks or dents. Replace the skull if damaged in any way.

8.1.2 Neck

- Check the neck for unusual or permanent deformations, and tears or breaks in the rubber. Replace the neck if you notice any of these problems.
- Check the neck cable by observing the strands. If they are not tightly wound or the cable seems fatter on one end, replace the cable. If the cable cannot be properly torqued, replace the cable.

8.1.3 Upper/Lower Torso

- Check the ribs and rib damping material for cracks or warping of the damping material. Recertify and/or replace the ribs.
- Check the sternum stop pad on the spine box. If it is loose or has fallen off, glue it back into place using Loctite®406 (P/N 9001020).

8.1.4 Shoulder

- Check the plastic bearings (Item-9, Figure 8) in the shoulder housing for wear by turning the shoulder bracket in the housing. If the joint does not move freely, replace the bearings.
- Check the rubber joint damper (Item-4, Figure 8) to make sure that it is not torn or damaged. If it is torn, replace it.
- Check the urethane bushing (Item-8, Figure 13) in the upper arm and make sure that it is not damaged and is still securely attached to the bone. If it is damaged replace it. If it is loose re-glue it with Loctite ®406 (PN 9001020)
- Clean the mating surfaces between the rubber joint bushing and the urethane bushing with isopropyl alcohol to remove any dirt, grease and oil. These mating surfaces provide the friction for maintaining the 1 g joint setting.

8.1.5 Hip

- Check the rubber joint damper (Item-5, Figure 9 & Figure 10) to make sure that it is not torn or damaged. If it is torn, replace it.
- Check the urethane bushing (Item-8, Figure 14) in the upper leg and make sure that it is not damaged and is still securely attached to the bone and flesh. If it is damaged, replace it. If it is loose, re-glue it with Loctite®406 (PN 9001020).
- Clean the mating surface between the rubber joint bushing and the urethane bushing with isopropyl alcohol to remove any dirt, grease and oil. These mating surfaces provide the friction for maintaining the 1 g joint setting.

8.1.6 Limbs (all)

- Check all limbs for rips or tears. If damaged, small tears or rips may be repaired by cleaning out the tear and gluing the tear back together with Loctite® 406 (PN 9001020).
- If any limb flesh has been seriously damaged it can be returned to the manufacturer and remolded.
- Check all the urethane stops (Item-6, Figure 13) and (Item-7, Figure 14) in each joint (elbow, knee, & ankle) and replace if damaged. Note that these stops can be easily torn.
- Check all the plastic bushings (Item-7, Figure 13) and (Item-6, Figure 14) in each joint (elbow, knee, & ankle) and replace if damaged.
- Check all the plastic washers (Item-5, Figure 13) and (Item-9, Figure 14) in each joint (elbow, knee, & ankle). If any washer is loose re-glue it with Loctite® 406 PN 9001020). If any washer is damaged, replace it.
- Check all stop bolts (Item-4, Figure 13) and (Item-5, Figure 14) to see if they are bent or otherwise damaged. If so replace them.

8.2 Storage of Rubber Parts

- Spare rubber parts should be stored in a cool, dark location as sun light and ozone cause the rubber to harden with age.

9. CERTIFICATION PROCEDURES FOR THE HYBRID III 3-YEAR OLD

9.1 Head Drop Test

The following is a list of fasteners, their part numbers and locations, to properly attach the necessary components listed in (B) below, required to conduct a head drop test:

10-32 x 3/8 SHCS, (2)	9000153	Mounting bracket
10-32 x 5/8 SHCS, (3)	9000137	Adapter plate
2-56 x 5/8 SHCS, (2)	9000531	Mounting block
0-80 x 1/8 SHCS, (6)	9000152	Accelerometer
10-24 x 5/8 SHCS, (3)	9000224	Skull plate
½-20 x 3/4 FHCS, (1)	9000524	Mass simulation
Washer, (1)	ATD6262	Mass simulation

(A) The test measures the forehead response to frontal impacts with a hard surface.

(B) The head should be tested with the skull cap attached, the adapter plate, mounting block, accelerometer mounting bracket, mass simulation of ½ of the load cell (P/N: TE-107-001), and three (3) accelerometers all installed with proper hardware (see above listing).The mass of the head assembly is 2.724 kg ± 0.045 kg (6.00 lb ± 0.01 lb).

(C) The test fixture consists of a structure to suspend the head assembly and a rigidly supported, flat, horizontal, steel plate. The square plate should be 50.8 mm ± 2 mm (2.0 in ± 0.08 in) thick, with a length and width of 610 mm ± 10 mm (24 in ± 0.4 in), and have a smooth surface finish of 8 to 80 micro inches/inch rms. A surface finish close to 8 micro inch/inch is recommended to minimize the external forces acting on the head.

(D) The Data Acquisition System, including transducers, must conform to the requirements of SAE Recommended Practice J211-1. Filter all data channels using phaseless Channel Class 1000.

(E) Test Procedure

1. Visually inspect the head skin for cracks, cuts, and abrasions. Replace the head skin if abrasions or cuts to the frontal area are more than superficial. Torque the 10-24 skull cap screws, and the 10-24 accelerometer mount cap screws to 1.1 N-m (10 in-lb).

2. Soak the head assembly in a controlled environment with a temperature from 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70 percent for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

3. Mount the accelerometers in the head on the horizontal transverse bulkhead so the sensitive axes intersect at the Center of Gravity point (CG) as defined by drawing 210-0000 CG Location X = 15.2 mm ± 2.5 mm (0.60 inch ± 0.10 inch) Z = 38.1 mm ± 2.5 mm (1.50 inch ± 0.10 inch). One accelerometer is aligned with the sensitive axis perpendicular to the horizontal bulkhead in the midsagittal plane (‘Z’ axis). The second accelerometer is aligned with the sensitive axis parallel to the horizontal bulkhead in the midsagittal plane (‘X’ axis). The third accelerometer is aligned with the sensitive axis parallel to the horizontal bulkhead and perpendicular to the midsagittal plane (‘Y’ axis). Ensure that all transducers are properly installed, oriented and calibrated.

4. Prior to the test, clean the impact surface of the skin and the impact plate surface with isopropyl alcohol, or an equivalent. The impact surface and the skin must be clean and dry for testing.

5. Suspend the head assembly in a manner similar to that shown in Figure 15. The lowest point on the forehead is 376.0 mm ± 1.0 mm (14.8 in ± 0.04 in) from the impact surface. The 1.57 mm (0.062 in) diameter holes located on either side of the dummy’s head can be used to ensure that the head is level with respect to the impact surface. The angle is 62 degrees ± 1 degree between the lower surface of the transducer structural replacement and the impact surface. This angle can be measured by placing an inclinometer on to the bottom of the mass simulator.

6. Drop the head assembly onto the impact surface from a height of 376.0 mm ± 1.0 mm (14.8 in ± 0.04 in) by a means that ensures a smooth, instant release.

7. Wait at least 2 hours between successive tests on the same head assembly.

8. Time-zero is defined as the point of contact between the head and the impact surface. All data channels must be at the zero level at this time.

(F) Performance Specifications

1. The peak resultant acceleration should be greater than 250 g and less than 280 g.

2. The resultant acceleration versus time history curve should be unimodal; oscillations occurring after the main pulse should be less than 10 percent of the peak resultant acceleration.

3. The peak lateral acceleration should not exceed ±15 g.

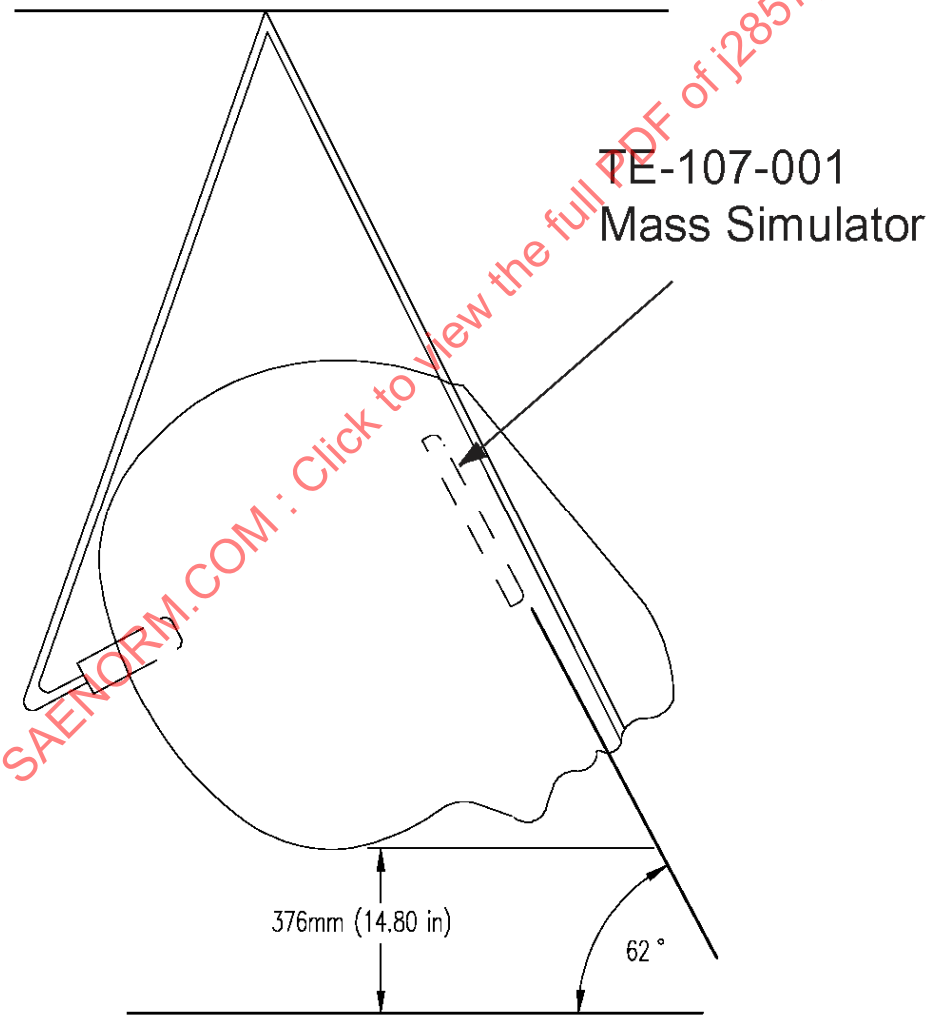


FIGURE 15 - HEAD DROP SETUP

9.2 Neck Tests

The components required for the neck tests are:

Part 572, subpart 'E', Neck Pendulum
H3-3YO Neck Adapter Plate TE-250-21
H3 Neck Mounting Plate
Rotation Measurement Unit
Force/Moment Measurement Unit (load cell)
Molded Rubber Neck 210-2001
Head Form TE-208-000
Bib Simulator TE-208-050
Zeroing Bracket TE-208-020
Rotary Pot Simulator TE-208-100

(A) The test fixture pendulum arm with specifications appears in Figure 16. The aluminum honeycomb material is commercial grade, 152.4 mm (6.0 in) thick, 28.8 kg/m^3 (1.8 lb/ft^3) with 19 mm (0.75 in) diameter cells. Mount the accelerometer with its sensitive axis aligned with the arc formed at a radius 1657.4 mm (65.25 in) from the pivot point.

(B) The Data Acquisition System, including transducers, must conform to the requirements of SAE Recommended Practice J211-1. Filter the neck M_y data channel using phaseless Channel Class 600, the pendulum acceleration data channel using phaseless Channel Class 180, and the neck rotation data channels using phaseless Channel Class 60.

(C) Test Procedure

1. Inspect the neck assembly for cracks, cuts and separation of the rubber from the metal segments. Replace if required.

2. Soak the neck assembly in a controlled environment at a temperature between 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70 percent for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

3. Check all the neck assembly parts that are used in this certification, which include neck assembly (210-2015), cable (210-2040), Jam nut 5/16-24 (9001336), inserts (910420-048 and 9001373), bib simulator (TE-208-050) and washer (210-2050).

4. Assemble the neck parts, listed above, together according to assembly drawing (210-2001) and set the cable torque to 0.23 N-m ± 0.02 N-m. (2.0 in-lb ± 0.2 in-lb). To properly torque it, the cable must be held with a screwdriver in the slot in the end of the cable. This prevents the cable from winding up as the nut is torqued.

5. Put the bib simulator between the neck bottom face and the neck adapter plate. Assemble the neck and the neck adapter plate with eight pieces of 1/4-20 x ½ SHCS. The side face of the bracket adapter plate, which has two 1/4-20 tap holes, should face the back of the neck. It will be used to mount the zeroing bracket later.

6. Install the load cell on top of the neck with eight pieces of 1/4-20 x ½ SHCS.

7. Install the head form to the load cell with the load cell attaching hardware. The head form must be installed so that the longer offset is towards the front of the neck (side with the cuts).

8. Take the head form/load cell/neck/neck adapter plate assembly and mount the neck adapter plate end with four pieces of 5/16-24 x 1-3/4 to the end of pendulum.

9. Install the rotary pot assembly on one side and the pot simulator assembly to the other side of the head form and pendulum. Tighten the 8-32 x 1/4 SHCP on the columns to secure the pot shaft.

10. Cut the aluminum honeycomb and mount it on the test fixture frame.

11. Carefully rest the pendulum against the aluminum honeycomb.

12. Install the zeroing bracket to the back of the head form and the neck adapter with 4 pieces of 1/4-20 x ½ FHCS.

13. Zero the load cell and rotation measurement data channels. The load cell data channel shall be zeroed to within ±0.2 N-m. The rotation data channels shall be zeroed within ±0.2 degrees. Note: It is important to be aware of zero drift. It is recommended that care should be taken to warm up the data system and transducers according to manufacturers' recommendations before establishing the data channel zero levels. Also, it is recommended to run the test as soon as possible after the channels are zeroed to further minimize channel zero drift that normally occurs over time.

14. Remove the zeroing bracket. Note: If pre-crushing of the honeycomb is to be done, it shall be done at this time.

15. Raise the pendulum to achieve 5.50 m/s for flexion test (83°reference), or 3.65 m/s for extension test (53°reference).

16. Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. The pendulum accelerometer data channel shall be at the zero level at this time.

17. Wait at least 30 minutes between successive tests on the same neck.

(E) Performance Specifications - Neck Flexion

1. Release the pendulum from an angle and allow it to fall freely to achieve an impact velocity of 5.50 m/s ± 0.10 m/s (18.05 ft/s ± 0.4 ft/s), measured at the center of the pendulum accelerometer.

2. Stop the pendulum from the initial velocity with an acceleration versus time pulse which meets the velocity change as specified below. Integrate the pendulum acceleration data channel to obtain the velocity versus time curve.

Time	Pendulum Impulse (Flexion)	
ms	m/s	ft/s
10	2.00 – 2.70	6.6 – 8.9
15	3.00 – 4.00	9.8 – 13.1
20	4.00 – 5.10	13.1 – 16.7

3. The maximum rotation of the D-plane of the head should not be less than 70 degrees and not more than 82 degrees.

4. During the time interval while rotation is within the corridor specified in Section 9.2 (E) 3, the peak moment about the "Y" axis of the head, measured with respect to the occipital condyles, shall be not less than 42 N-m (31.0 ft-lbf) and not more than 53 N-m (39.1 ft-lbf). The positive moment shall decay for the first time to 10 N-m (7.4 ft-lbf) between 60 and 80 ms after time zero (T_0).

(F) Performance Specifications - Neck Extension

1. Release the pendulum from an angle and allow it to fall freely to achieve an impact velocity of 3.65 m/s ± 0.10 m/s (11.98 ft/s ± 0.40 ft/s), measured at the center of the pendulum accelerometer.

2. Stop the pendulum from the initial velocity with an acceleration versus time pulse which meets the velocity change as specified below. Integrate the pendulum acceleration data channel to obtain the velocity versus time curve.

Time	Pendulum Impulse (Extension)	
ms	m/s	ft/s
6	1.00 – 1.40	3.3 – 4.6
10	1.90 – 2.50	6.2 – 8.2
14	2.80 – 3.50	9.2 – 11.5

3. The maximum rotation of the D-plane of the head should be not less than 83 degrees and not more than 93 degrees.

4. During the time interval while the rotation is within the corridor specified in Section 9.2 (F) 3, the peak moment about the “Y” axis of the head, measured with respect to the occipital condyles, shall be not more than -43.7 N-m (-32.2 ft-lbf) and not less than -53.3 N-m (39.3 ft-lbf). The negative moment shall decay for the first time to -10 N-m (-7.4 ft-lbf) between 60 and 80 ms after time zero (T_0).”

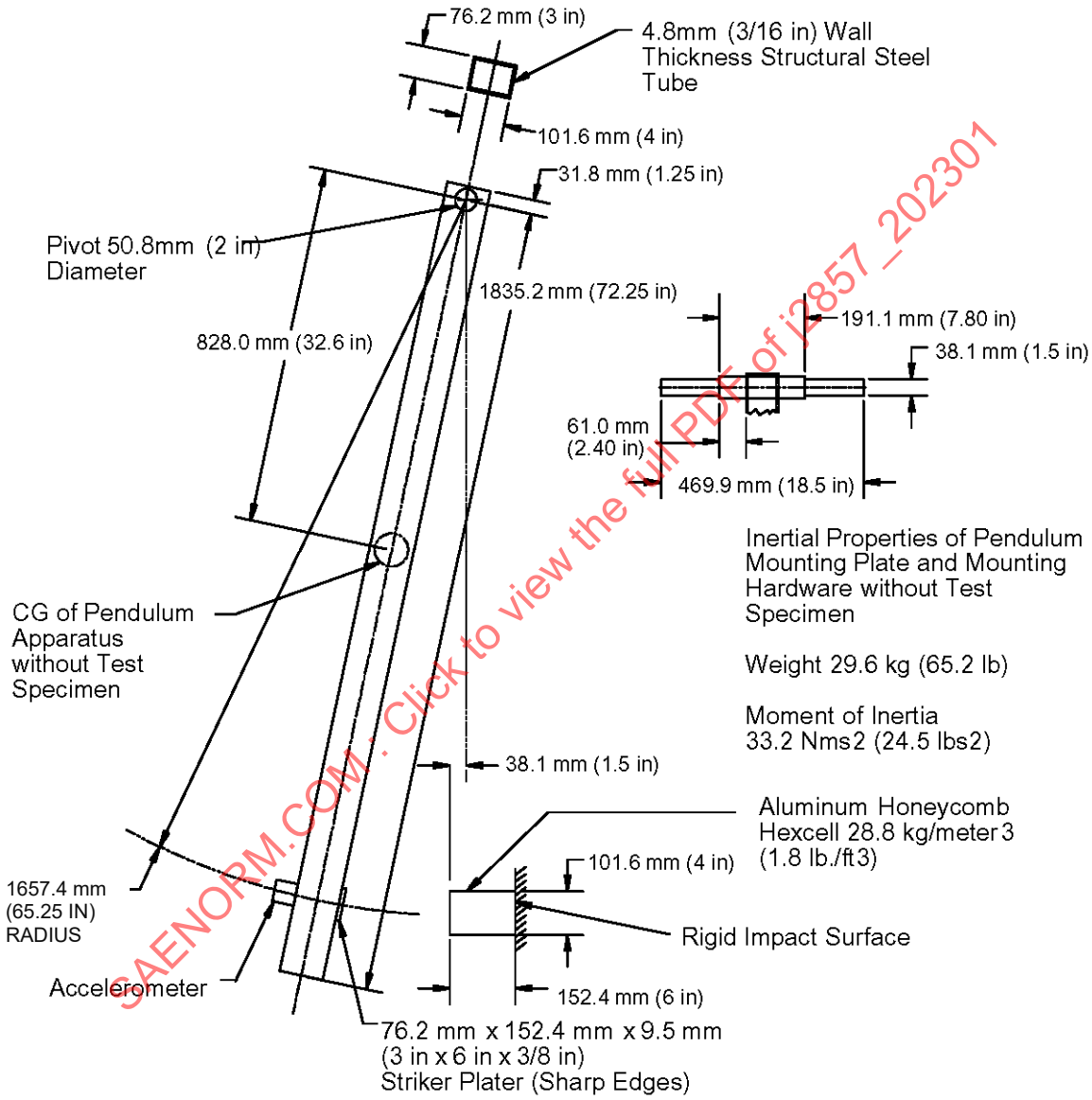


FIGURE 16 - PART 572 NECK PENDULUM

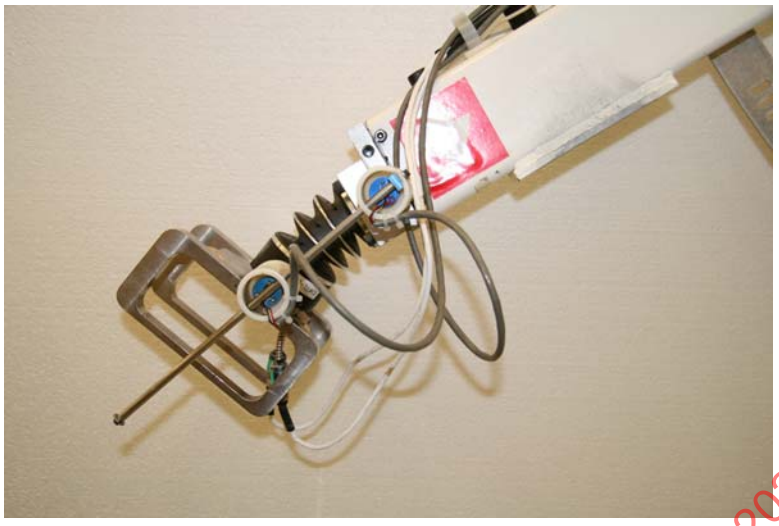


FIGURE 17 - NECK EXTENSION TEST ASSEMBLY

FIGURE 18 - NECK FLEXION TEST ASSEMBLY

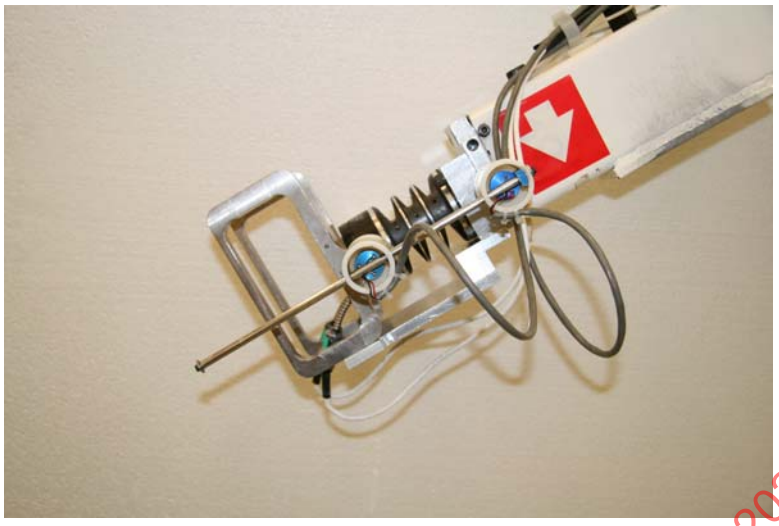


FIGURE 19 - NECK EXTENSION WITH ZERO BRACKET INSTALLED

FIGURE 20 - NECK FLEXION WITH ZERO BRACKET INSTALLED

9.3 Thorax Impact Test

See Figure 21.

The components required for the thorax tests are:

Thorax Impact Fixture
Impact Table w/Stainless Steel Surface
Impact Probe 1.7 kg (3.75 lb)
Inclinometer

(A) The complete assembled dummy (Ref. drawing 210-000) is required, including the clothing [shirt and pants], but without the shoes.

(B) The fixture consists of a smooth, clean, dry, steel seating surface and a rigid test probe. The test probe mass is 1.70 kg ± 0.02 kg (3.75 lb ± 0.05 lb) including instrumentation, rigid attachments, and the lower 1/3 of the suspension cable mass. The diameter of the impacting face is 50.8 mm ± 0.2 mm (2.00 in ± 0.01 in) and has a flat, right angle face with an edge radius of 12.7 mm (0.5 in). Mount an accelerometer to the probe with its sensitive axis in line with the longitudinal centerline of the test probe.

(C) The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211-1. Filter the probe acceleration channel using a phaseless Channel Class 180 filter and filter the sternum displacement using a phaseless Channel Class 600 filter.

(D) Test Procedure

1. Check the torque of the nuts on the lumbar spine and neck. Reference the appropriate sections of the User's Manual.

2. Reassemble the dummy. Reference the reassembly sections of the User's Manual.

3. Measure the chest depth. Reference Performance Specifications given in Section 9.4 Chest Depth Measurement Procedure and Figure 23.

4. Soak the test dummy in a controlled environment at a temperature between 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70 percent for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

5. Check that all transducers are properly installed, oriented and calibrated.

6. Seat the dummy on the test fixture surface. The surface must be long enough to support the pelvis and outstretched legs.

7. Place the upper arm assemblies vertical and the forearm assemblies horizontal (±2 degrees) and supported. Set the joints to 1 g by tightening the SHSS at the shoulder and hip. Set the upper back plate of the spine box at 90.0 degrees ± 0.5 degree from the horizontal. The midsagittal plane of the dummy is vertical ±1.0 degree and within 2.0 degrees of being parallel to the centerline of the test probe. The longitudinal centerline of the test probe is centered on the midsagittal plane of the dummy within ±2.5 mm (±0.1 in). Align the test probe so its longitudinal centerline is centered on the No. 2 rib ±2.5 mm (±0.1 in) and is within 0.5 degree of a horizontal line in the dummy's midsagittal plane.

8. Impact the thorax with the test probe so the probe's longitudinal centerline is within 2 degrees of a horizontal line in the dummy's midsagittal plane at the moment of impact.

9. Guide the probe so no significant off-axis lateral, vertical or rotational motion takes place during the impact.

10. The test probe velocity at the time of impact is 6.0 m/s ± 0.10 m/s (19.69 ft/s ± 0.33 ft/s).

11. Time-zero is defined as the time of initial contact between the test probe and the torso flesh. All data channels must be at the zero level at this time.

12. Wait at least 30 minutes between successive tests on the same thorax.

(E) Performance Specifications

1. During the time interval while the deflection is between 12.5 and 32 mm, the peak force shall be less than 0.91 kN (205 lbf). Calculate this force by multiplying the test probe mass, defined in Section 9.3 (B), by its acceleration.

2. The maximum sternum-to-spine deflection, as measured by the chest displacement transducer, should measure not less than 32 mm (1.3 in) and not more than 38 mm (1.5 in).

3. During the time interval while the deflection is within the corridor specified in Section 9.3 (E) 2, the peak force shall be not less than 0.68 kN (153 lbf) and not more than 0.81 kN (182 lbf). Calculate this force by multiplying the test probe mass, defined in Section 9.3 (B), by its acceleration.

4. The internal hysteresis should be greater than 65 percent but less than 85 percent. The Hysteresis, determined from the force versus deflection curve, is the ratio of the area between the loading and unloading portions of the curve to the area under the loading portion of the curve, as shown in Figure 22.

5. The minimum clearance between the sternum and the spine box should be at least 40 mm (1.57 in). This is verified by following the procedure described in Section 9.4 and Figure 23 using the tool (210-8600) shown in APPENDIX D - DRAWINGS.

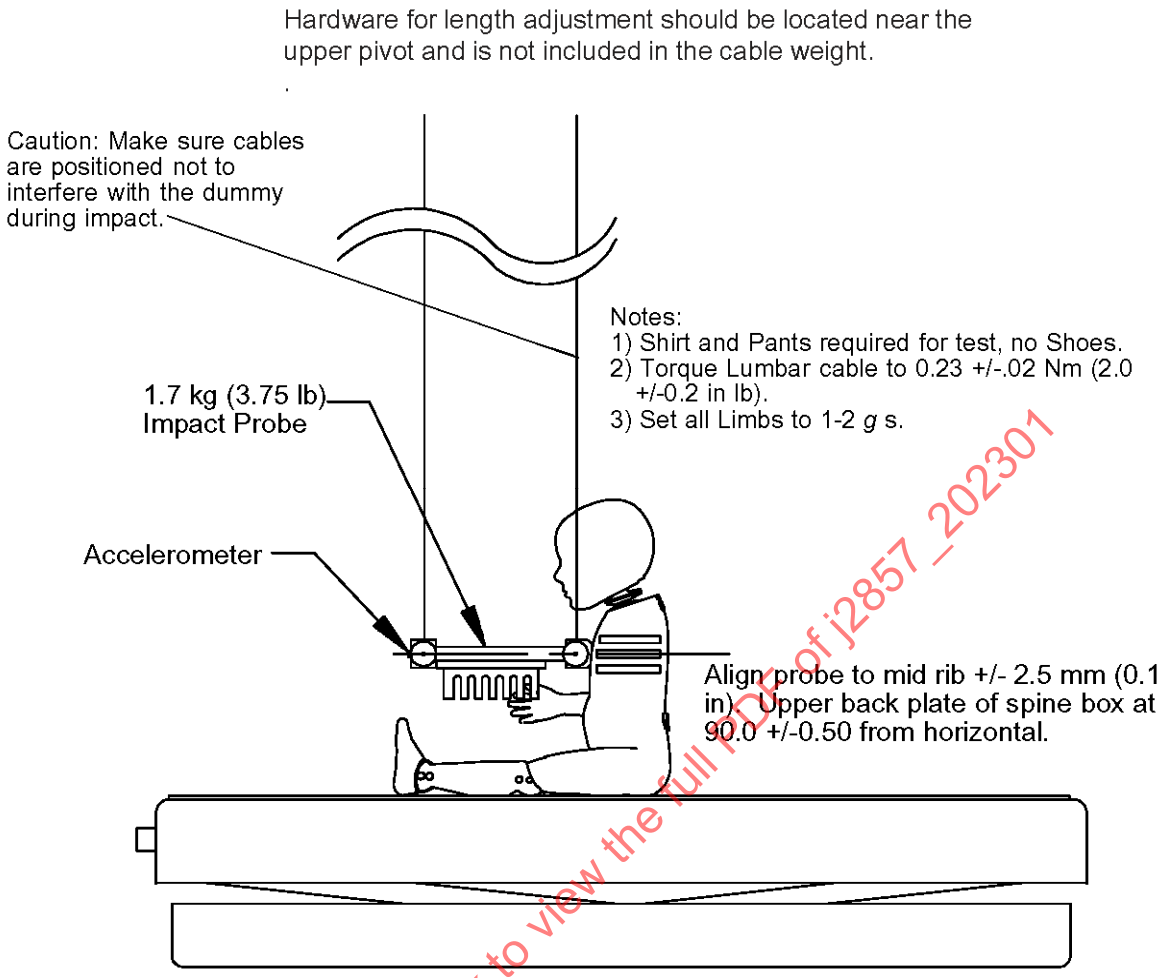


FIGURE 21 - THORAX IMPACT SETUP

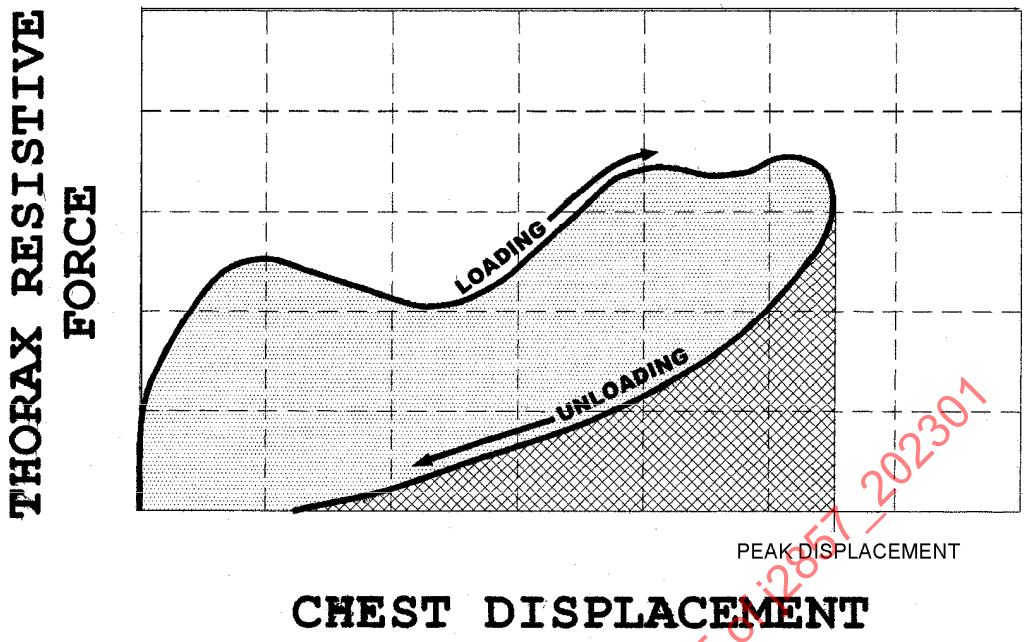


FIGURE 22 - HYSTERESIS REGIONS

9.4 Chest Depth Measurement Procedure

1. Measuring Procedure Between Rib #1 & Rib #2. The measurement is made with the rib cage fully assembled. To measure the chest depth at rib #1 and rib #2, the longer 105.08 mm (4.137 in) rod of the gauge is inserted between rib #1 and rib #2. The flat beveled surface (surface A) on the handle is held against the surface between rib #1 and rib #2 on the spine box (210-8020) with the short end of the bevel up so that the rod is parallel to rib #1. If the rod touches the threaded strip (210-3560), the chest depth has decreased below the 40 mm (1.57 in) acceptable range. If this happens the ribs should be replaced.

2. Measuring Procedure for Rib #2 & Rib #3. The measurement is made with the rib cage fully assembled. To measure the chest depth at rib #2 and rib #3, the rod of the gauge is inserted between rib #2 and rib #3. The flat beveled surface (surface B) on the handle is held against the surface between rib #2 and rib #3 on the spine box (210-8020) with the short end of the bevel up so that the rod is parallel to rib #2. If the rod touches the threaded strip (210-3560), the chest depth has decreased below the 40 mm (1.57 in) acceptable range. If this happens the ribs should be replaced.

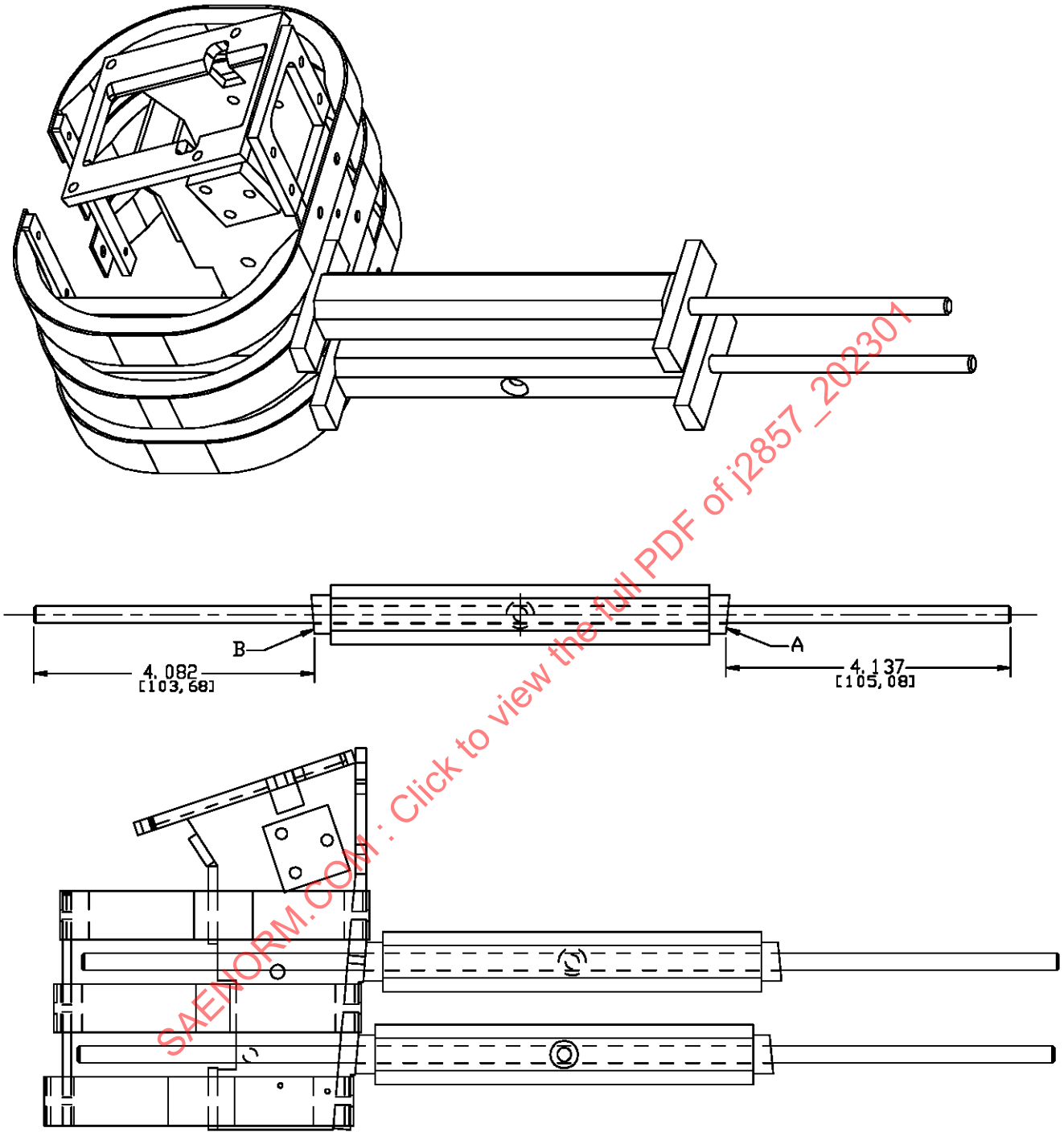


FIGURE 23 - CHEST DEPTH CHECKING PROCEDURE

10. INSPECTION TEST PROCEDURES

10.1 External Measurements

1. Check the torque of the nuts on the lumbar spine (Item 3, Figure 11) and neck (Item 6, Figure 5). Reference the appropriate sections of the User's Manual.

2. Reassemble the dummy. Reference the Disassembly and Reassembly Procedures section the User's Manual.

3. Place the dummy on a flat, rigid, smooth, clean, dry, horizontal surface, as shown in Figure 24. The dummy's midsagittal plane is vertical and centered on the test surface.

4. Secure the dummy to the test fixture so the rear surfaces of the upper torso and buttocks are tangent (or as near tangent as possible) to the rear vertical surface of the fixture. The dummy's midsagittal plane should be vertical.

5. The center lines of the upper arms are vertical and the lower arms horizontal.

6. The upper legs should be parallel to each other.

7. The lower legs should be perpendicular to the upper legs and the bottom of the feet horizontal.

8. Record the following dimensions (the symbols and description for each measurement are indicated in Figure 24). They should conform to the dimensions specified in Table 3.

   A- Total Sitting Height - Seat surface to highest point on top of the head with the head pulled back to touch the vertical surface of the fixture

   B- Shoulder Pivot Height - Centerline of shoulder pivot bolt to the seat surface

   C- Hip Pivot Height

   D- Hip Pivot from Backline

   E- Shoulder Pivot from Backline, with the shoulders in the neutral position

   F- Thigh Clearance - Seat surface to highest point on the upper femur segment

   G- Back of Elbow to Finger tip - The back of the elbow flesh to the finger tip, in line with the elbow and wrist centerlines

   H- Head Back from Backline with the head resting in its natural position

   I- Shoulder to Elbow Length - The highest point on top of the arm to the lowest part of the flesh on the elbow, in line with the elbow pivot bolt

   J- Elbow Rest Height

   K- Buttock to Knee Length - The most forward part of the knee flesh to the fixture's rear vertical surface

L-Popliteal Height - The bottom of the foot to the top of the seat surface

M-Knee Pivot Height

N-Buttock to Popliteal Length - The most forward portion of the crevice between the upper and lower legs behind the knee to the fixture's rear vertical surface

O-Chest Depth with Jacket - The distance from the anterior surface of the chest to the fixture's vertical surface, through the mid-sagittal plane, at the No. 2 rib

P-Foot Length

Q-Stature - Lay the dummy out on a flat surface with the rear surfaces of the head, upper torso, buttocks and heels touching the surface and with the bottom of the feet perpendicular to that surface. Measure the distance from the bottom of the feet to the top of the head.

R-Buttock to Knee Pivot Length - The knee pivot to the fixture's rear vertical surface

S-Head Breadth - The distance across the width of the head at the widest point

T-Head Depth - The distance from the most forward point of the forehead to the point nearest the rear of the skull cap, through the midsagitial plane

U-Hip Breadth - The distance across the width of the hip at the widest point

V-Shoulder Breadth - Between outside edges of shoulder flesh, in line with the shoulder pivot bolt

W-Foot Breadth - Widest part of the foot

X-Head Circumference - at the largest location

Y-Chest Circumference - The distance around chest at reference location AA; with the jacket on

Z-Waist Circumference - The distance around waist at reference location BB, with the jacket on

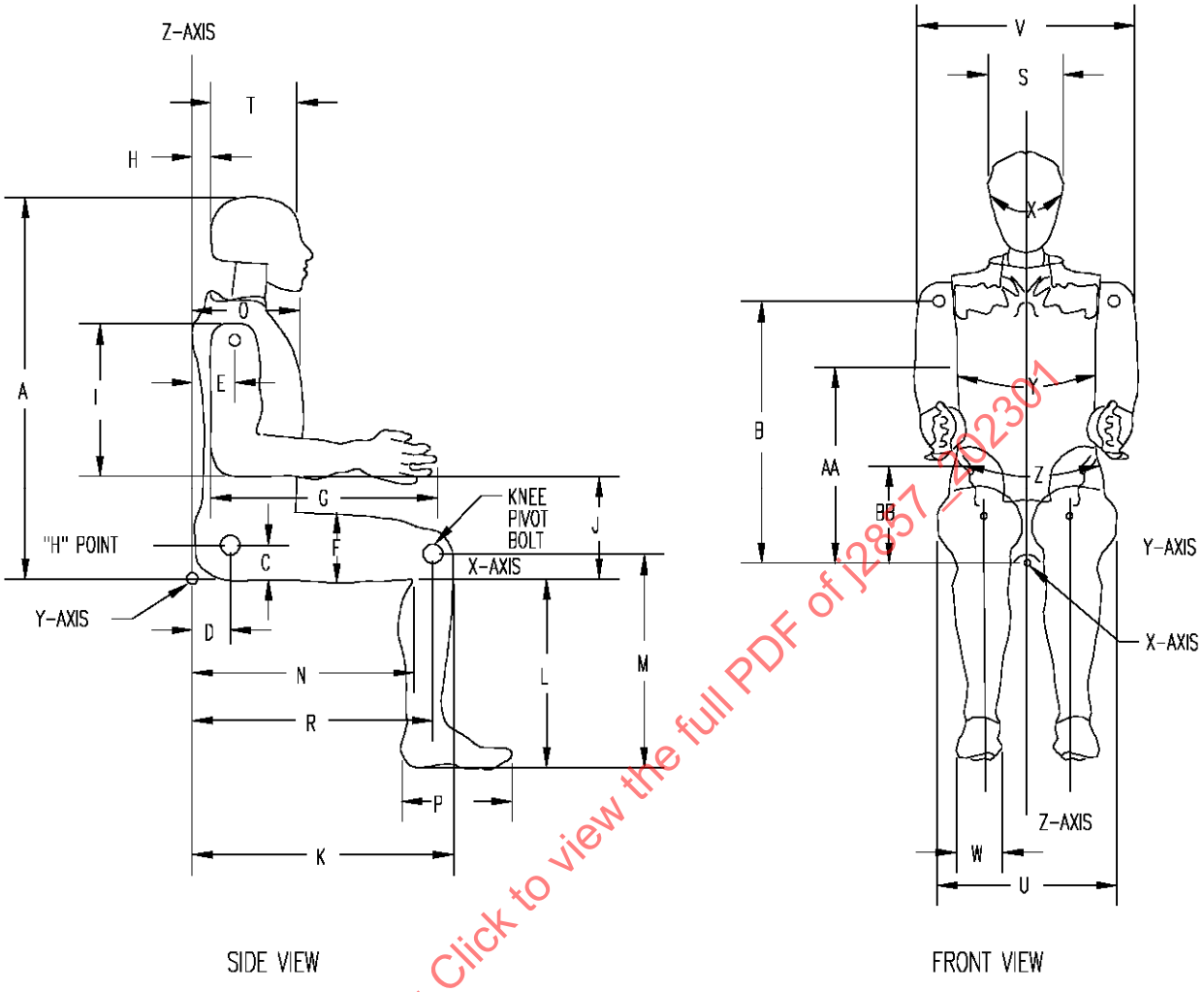


FIGURE 24 - EXTERNAL DIMENSIONS

TABLE 3 - EXTERNAL DIMENSIONS

TEST PARAMETER	DESIGNATION	in	mm
Erect Sitting Height	(A)	21.50 ± 0.30	546.1 ± 7.6
Shoulder Pivot Height	(B)	12.40 ± 0.30	315.0 ± 7.6
Hip Pivot Height	(C)	1.55 ± 0.20	39.4 ± 5.1
Hip Pivot from Backline	(D)	2.44 ± 0.20	62.0 ± 5.1
Shoulder Pivot from Backline	(E)	2.60 ± 0.20	66.0 ± 5.1
Thigh Clearance	(F)	3.39 ± 0.20	86.1 ± 5.1
Back of Elbow to Finger Tip	(G)	10.04 ± 0.30	255.0 ± 7.6
Head Back from Backline	(H)	2.10 ± 0.20	53.3 ± 5.1
Shoulder to Elbow Length	(I)	7.60 ± 0.30	193.0 ± 7.6
Elbow Rest Height	(J)	5.56 ± 0.30	141.2 ± 7.6
Buttock to Knee Length	(K)	11.51 ± 0.30	292.4 ± 7.6
Popliteal Height	(L)	8.90 ± 0.30	226.1 ± 7.6
Knee Pivot Height	(M)	9.81 ± 0.30	249.2 ± 7.6
Buttock Popliteal Length	(N)	8.88 ± 0.30	225.6 ± 7.6
Chest Depth with Jacket	(O)	5.75 ± 0.30	146.1 ± 7.6
Foot Length	(P)	5.62 ± 0.20	142.7 ± 5.1
Stature	(Q)	37.20 ± 0.50	944.9 ± 12.7
Buttock to Knee Pivot Length	(R)	10.10 ± 0.20	256.5 ± 5.1
Head Breadth	(S)	5.35 ± 0.30	135.9 ± 7.6
Head Depth	(T)	6.89 ± 0.30	175.0 ± 7.6
Hip Breadth	(U)	8.20 ± 0.30	208.3 ± 7.6
Shoulder Breadth	(V)	9.61 ± 0.30	244.1 ± 7.6
Foot Breadth	(W)	2.31 ± 0.20	58.7 ± 5.1
Head Circumference	(X)	20.00 ± 0.30	508.0 ± 7.6
Chest Circumference with Jacket	(Y)	21.25 ± 0.50	539.8 ± 12.7
Waist Circumference	(Z)	21.25 ± 0.50	539.8 ± 12.7
Reference Location Chest Circumference	(AA)	10.00 ± 0.20	254.0 ± 5.1
Reference Location Waist Circumference	(BB)	6.50 ± 0.20	165.1 ± 5.1

TABLE 4 - ASSEMBLY MASSES

ASSEMBLY	MASS (lb)	MASS (kg)
Head Assembly	6.0 ± 0.10	2.72 ± 0.05
Neck Assembly	1.74 ± 0.10	0.79 ± 0.05
Torso Assembly with Torso Jacket	15.43 ± 0.40	7.00 ± 0.18
Upper Arm	0.97 ± 0.10	0.44 ± 0.05
Lower Arm with Hand	1.01 ± 0.10	0.46 ± 0.05
Upper Leg	2.23 ± 0.15	1.01 ± 0.07
Lower Leg	1.34 ± 0.10	0.61 ± 0.05
Foot	0.68 ± 0.10	0.31 ± 0.05
Total Dummy Mass	35.65 ± 1.70	16.19 ± 0.77

10.2 Mass Measurements

(A) Check the weights of the various dummy segment assemblies on initial inspection. They should conform to the mass specified in Table 4.

(B) After replacing parts or accelerometers, recheck the mass of the pertinent segment.

10.3 Head Center of Gravity Location

Location of CG of head is: 15.2 mm ± 2.5 mm (0.60 in ± 0.10 in) in the X axis and 38.1 mm ± 2.5 mm (1.50 in ± 0.10 in) in the Z axis from the occipital condyle (Ref. Drawing 210-0000).

The weight of the head includes: head skin, skull, skull cap, adapter plate, accelerometer mounting block, accelerometer mounting bracket, chin insert, one flat head cap screw and washer, mass simulator 0.09 kg (0.20 lb) (P/N TE-107-001), and all the screws associated with each component of the head assembly.

The weight of the neck includes: molded and machined neck assembly, mass simulator load cell replacement, mass simulator 0.09 kg (0.20 lb) (P/N TE-107-001), neck load cell adapter, sixteen SHCS, one FHCS and washer, one bib simulator.

10.4 Torso Flexion Test Procedure

See Figure 25.

Components required for this test are:

Torso Flexion Pull Bracket: TE 825-000 (Ref)
Pelvic Bracket: TE 831-000 (Ref)
Table: Torso flexion test table
Inclinometer
Tension Force Gauge

(A) This procedure tests the forward flexion of the torso of the dummy. The fully assembled dummy is used in this test excluding clothing and shoes.

(B) Test Procedure.

1. The dummy must be held at a temperature of 20.6 to 22.2 °C (69 to 72 °F) and 10 to 70% relative humidity for 4 hours before the test and the test must be performed under these conditions.

2. Minimum time between tests on the same components is 30 minutes.

3. Disassemble the load cell or structural replacement from the pelvis separating the dummy. Adjust the torque on the lumbar cable hex nut to 0.23 N-m ± 0.02 N-m (2.0 in-lb ± 0.2 in-lb).

4. Attach a pelvic support bracket on top of the bolt flange of the lumbar load cell or structural replacement, using four longer ¼ - 20 bolts as needed and reassemble to the pelvis.

5. Adjust all joint torques to 1 g. Refer to APPENDIX C – JOINT ADJUSTMENT PROCEDURES.

6. Mount the dummy rigidly onto the torso flexion test table using the pelvic support bracket. The pelvic surface to which the lumbar spine mounts should be horizontal ±1 degree. The dummy may sit on the table surface.

7. Position the upper arms downward. Flex the elbow joints 90 degrees and point the forearms forward.

8. Attach a torso pull bracket to the back of the spine box instrument cavity using four 6-32 x 3/8 SHCS.

9. Attach an inclinometer to measure the angle of the spine box instrument cavity mating surface relative to vertical.

10. Exercise the torso by flexing the thorax forward from vertical 3 times until the spine box instrument cavity mating surface is 30 degrees ± 2 degrees from vertical.

11. Remove the applied force and support the thorax in a vertical position for 30 minutes to prevent it from drooping. Remove the vertical support. Wait 2 minutes. Then measure the angle of the spine box instrument cavity mating surface. It should not be more than 15 degrees forward of vertical.

10. Apply a forward pull force to the pull bracket through a cable attached at the occipital condyle location to flex the dummy forward at any rate between 0.5 and 1.5 degrees per second.

11. Flex the dummy forward until the spine box instrument cavity mating surface is at 45 degrees forward of vertical. The applied force should be perpendicular to the undeformed neck centerline at 45 degrees. (This will be a pull angle of 62 to 65 degrees from horizontal.)

12. Record the highest force required to flex the dummy to the 45 degree angle.

13. Release the applied force and measure the angle of the spine box instrument cavity mating surface within 3 to 4 minutes after the force is released.

(C) Performance Specifications. When tested per the listed procedure the dummy will flex forward to an angle reading of 45 degrees from vertical as measured on the instrument cavity mating surface at the back of the thoracic spine. The force required to flex the dummy to this angle shall not be less than 130 N (29.2 lb) and not more than 180 N (40.5 lb). Within 3 to 4 minutes after releasing the applied force, the measured angle of the spine box instrument cavity mating surface shall be less than 10 degrees.

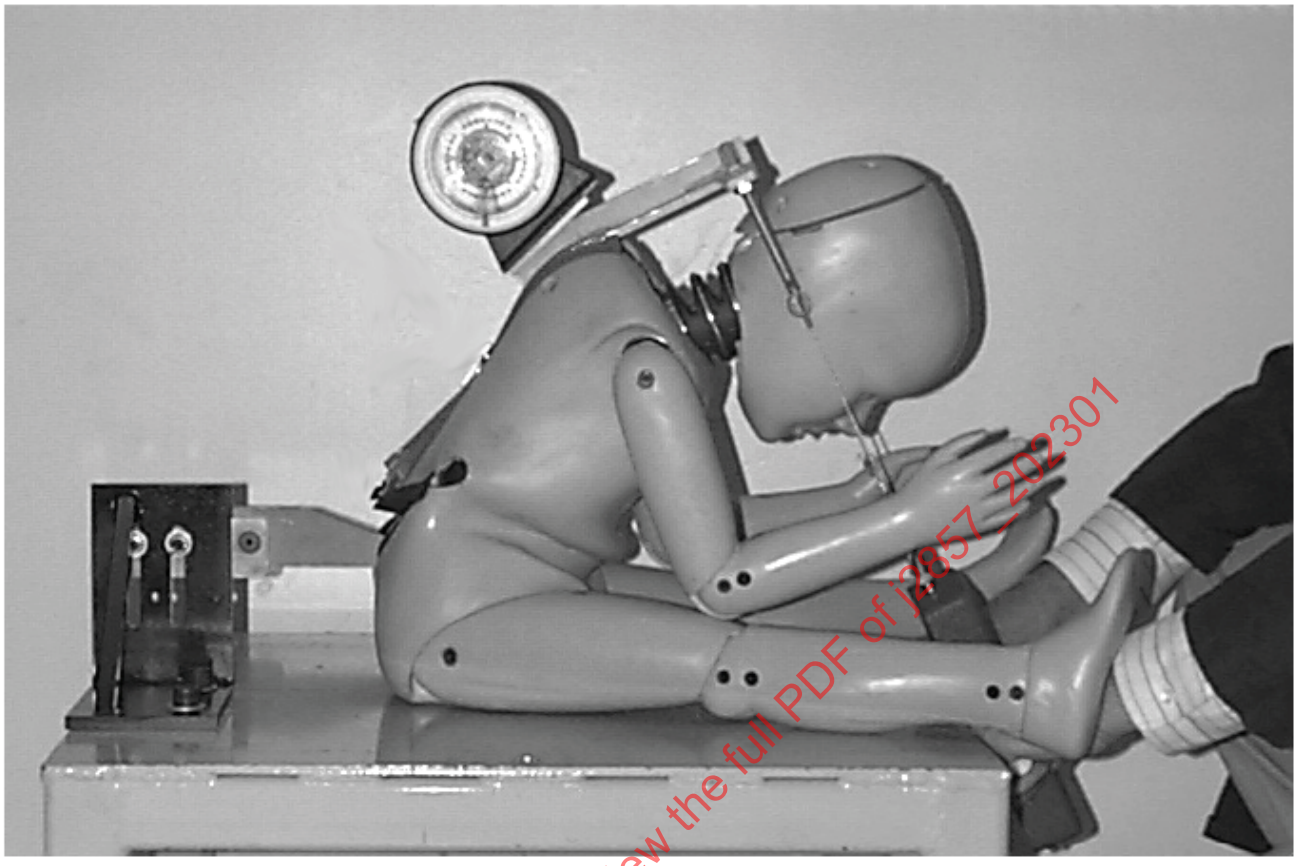


FIGURE 25 – TORSO FLEXION TEST

11. NOTES

11.1 Marginal Indicia

A change bar (l) 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 SAE DUMMY TESTING EQUIPMENT COMMITTEE
OF THE SAE HUMAN BIOMECHANICS AND SIMULATIONS STANDARDS STEERING COMMITTEE

APPENDIX A - ACCELEROMETER HANDLING GUIDELINES

GENERAL

The accelerometers used in anthropomorphic test dummies, such as the Hybrid III Dummy Family, are small, low mass piezoresistive accelerometers. Because of their design and inherent mechanics, certain precautions must be observed when handling and mounting accelerometers to avoid damaging them.

When handling and mounting the accelerometer, avoid dropping the accelerometer or striking the unit against hard surfaces. Keep the unit in its protective sleeve until the unit is installed.

PRELIMINARY CHECK-OUT

Before installing any accelerometer into the dummy, check that it operates properly. Three simple tests that require minimal test equipment should be conducted:

Impedance test

Read the input impedance (Red to Black) and output impedance (Green to White) with an ohmmeter. Compare the measured values to those on the accelerometer Certification Data Sheet. The measured impedance should be within ±25 percent of the calibrated value.

Insulation Resistance

If the input and output impedances are within acceptable limits, use a multimeter, ohmmeter, or megohmmeter set at 50 volts maximum. Measure the insulation resistance between:

- all leads connected together and the cable shield.
- all leads connected together and the accelerometer case.
- cable shield and the accelerometer case.

All three readings should be at least 100 megohms. Be careful when connecting 50 VDC to eliminate the possibility of voltage spikes.

Zero Measure and Output

After the impedance and insulation resistance tests, measure the output of the accelerometer with 0 g acceleration. With the unit still in its sleeve, turn the unit on its side so the accelerometer mounting surface is perpendicular to the table top (sensitive axis horizontal and perpendicular to the gravity field). Apply the specified excitation voltage to the accelerometer and measure its output with a DC millivolt meter. Allow the unit to warm-up for 2 minutes. The accelerometer should have a Zero Measure and Output (ZMO) within the manufacturer's specified limits.

If any of these initial checks do not give proper readings, indicating a possible malfunction, remove the excitation source immediately and take the following measurements.

- Check and record leg 1, leg 2, leg 3, and leg 4 resistances.
- Disconnect, check and record excitation voltage from the source.
- Reconnect, check, and record excitation with the unit connected.
- Check and record ZMO again.

- Check and record static outputs +1 g and -1 g and compare to calibrated sensitivity.
- Check that the temperature and environment fall within accelerometer specification.
- Check to see if the accelerometer case is under stress.
- Check leads for abrasion or cuts.

If the reason for the erroneous reading cannot be found, contact the accelerometer manufacturer.

INSTALLATION

When mounting or removing the accelerometer, you must use the proper techniques and tools. The mounting surface should be clean and free of burrs. A recommended surface roughness is 32 micro-inch rms or less. Make sure that no dirt or particles can be clamped between the unit and mounting surfaces.

Remove the unit from the protective sleeve. With the sleeve absent, handle the unit by the case, not the cable. This will prevent the unit from slapping the mounting surface during installation. Place the unit on the mounting surface and align the mounting holes.

Correct torque is important to ensure correct mounting and performance. When mounting the accelerometer, use only the materials and parts which are supplied with the accelerometer. Always use the proper mounting torque recommended by the accelerometer manufacturer. If applicable, use the supplied mounting washers and screws, or mounting stud. Using the supplied wrench, turn the screws into the mounting holes using the recommended torque. Usually, this is roughly equivalent to finger tight with the supplied wrench. Installation of the unit with higher torque values, dry threads, or thread adhesives is not recommended as excessive torque will be required to break the screw loose when the accelerometer is dismounted.

EXCESSIVE TORQUE CAN CREATE AN OVERRANGE TRANSIENT SHOCK PULSE, UPON REMOVAL OF THE UNIT, WITH SUFFICIENT HIGH FREQUENCY CONTENT TO DAMAGE OR DESTROY THE UNIT.

Do not over torque the screws.
Do not use snap type torque wrenches.
Do not cement the unit to the mounting structure.

Where practical, tie down the cable within 4 to 6 cm (1.6 to 2.4 inches) of the unit. Whipping of the cable during vibration and shock will strain the cable unnecessarily at the unit.

Connect the unit to the signal conditioner and check for proper functioning through the use of standard techniques such as shunt certification across the passive arms of the accelerometer.

RECALIBRATION

Sensitivity and Zero should be performed at 6 to 12 month intervals, depending on usage. Usually, a 12 month interval is sufficient if the accelerometer has not been used beyond its rated specifications. If the unit is used under severe environments, the shorter certification interval may be desirable.

CLEANING

Dirty units may be wiped clean using a damp cloth and a solvent such as acetone. DO NOT SOAK OR IMMERSE the unit in any solvent or water. Do not use any sharp tool such as a screwdriver to remove dirt or contaminants. If tools such as pliers are needed to handle the accelerometer, cover the jaws with masking tape to prevent unwanted metal to metal contact.

APPENDIX B - GUIDELINES FOR REPAIRING FLESH

WARNING: Isopropyl alcohol is flammable. Apply only in a well ventilated area.

Unlike other dummies in the Hybrid III family, you should not attempt to repair the flesh with a soldering iron. The flesh of the H3 3-YO, except for the head skin, is made of urethane instead of polyvinyl (PVC).

HEAD SKIN REPAIR

The only skin on the H3 3-YO that can be repaired is the head skin, it is made from polyvinyl (PVC). The flesh of the head skin can be repaired with a heating iron. The only repairs that can be done to the head skin are mending cracks or splits in the flesh and these should not be repaired in the frontal, or forehead region. Any repairs done to the skin in the frontal region will affect the performance of the head assembly during testing.

PVC dummy flesh is often damaged, but can be repaired. The most common types of flesh damage are punctures, tears, and scrapes. Scrapes can be fixed by rubbing an iron, at low temperature, over the affected area several times. Punctures and tears require patching.

To repair the flesh, use an iron to bond the dummy's flesh to patches of repair materials. The iron is similar to a standard electronic soldering iron. Its output should range from 60 to 90 Watts. The best tip is a broad, flat paddle tip like the one in the dummy tool kit provided by the dummy manufacturers. For best results, a variable power supply should be used to control the heat output from the iron. Without this control, repairs will be more difficult and may be unsightly from black flakes of burnt flesh imbedded in the flesh. These flakes are caused by overheating the flesh, which happens when an iron is too hot or remains in one position too long. Another cause of black residue in the flesh is improper or infrequent cleaning of the iron tip. The tip should be cleaned frequently during the repair job, between each melting of flesh if possible. The best method for doing this is to tap the iron quickly on a buffing wheel.

Conduct all flesh preparations and repairs in a well ventilated area. When patching, first clear away any loose material which may be hanging from the damaged areas, such as shredded vinyl or foam. Clean the area with 99% solution isopropyl alcohol and dry for 15 minutes. Any residue from tape or chalk must be removed. If it remains after the initial cleaning, continue to clean with isopropyl alcohol until the area is completely clean. Since isopropyl alcohol is flammable, make sure the surface is dry before applying heat. Do not use soldering flux or any other chemical on the flesh or repair iron.

After preparation, a patch can be bonded to the flesh. Cut a patch of adequate size from the material provided in the dummy tool kit. The patch should be approximately 10 mm (0.4 in) wider than the damaged area on all sides. To check that the iron is at a usable temperature, test it on a small piece of patch material. The flesh should easily melt but not instantly burn. With the patch held over the damaged area, slide the iron between the patch and dummy flesh. Hold the iron in position until you see both materials melting. When both the patch and the flesh look like a gel, move the iron to a new point while holding the patch in place until they have both cooled. Continue this all the way around the damaged area until the patch is completely bonded to the flesh.

For large areas, or areas where the patch must bend to conform to the dummy part, it may be easier to "tack" a few points around the edge of the patch to hold it in place, then return to fill in the unbonded sections. Once you bond the patch to the flesh, you need to blend the patch into the flesh. This will eliminate any protruding edges that may later snag and ruin the repair. To blend the patch, work the iron tip around the patch edges in a circular motion, blending the patch material into the flesh as you work your way around the patch. If the iron is too hot, black flakes will appear; if it is too cold, the patch will not readily melt, and the patch is probably not very well bonded to the flesh. Continue working the patch into the flesh until the repair is fairly well hidden and let it cool. After the area cools, you can return to touch-up any areas.

OTHER FLESH REPAIRS

If a certain area of flesh is frequently damaged and is not expected to contribute significantly to dummy response, duct tape can be placed on the flesh but under the clothing to help protect it. Tape should not be used on any area which directly affects the test data, such as head, neck, ribs or spine. The engineer running the test should approve use of additional reinforcement such as tape before conducting tests.

Minor lacerations to non-critical areas of the dummy's extremities can be repaired with Loctite® 406 (P/N 9001020). Major damages to any of the extremities should be cause to re-skin or replace the parts in question.

APPENDIX C - JOINT ADJUSTMENT PROCEDURES

The joints of the Hybrid III dummy are adjusted to a “1 g suspended setting.” This is defined as a torque level on the joint where the friction will allow an assembly to move toward the earth when a small force is applied to the unsupported end of the assembly. For example, when the dummy’s arm is fully extended so it is perpendicular to the body, the shoulder bolt should be tight enough to support the weight of the arm, but loose enough so when you tap the dummy’s wrist, the whole arm will slowly fall towards the dummy. The following sections describe how to position the body parts and which joints to tighten to allow a 1 g setting.

Upper and Lower Arms

1. Rotate the complete arm assembly so it points forward and is horizontal. Adjust the shoulder bolt so the arm is suspended at 1 g.

2. Position the lower arm so it points forward and is horizontal. Adjust the elbow pivot bolt through access holes in the lower arm flesh at the elbow to hold the lower arm suspended at 1 g.

3. Repeat procedure for the other hand and arm.

Legs and Feet

1. With the lower leg at 90 degrees to the upper leg, and the dummy in a seated position, lift the upper leg assembly above horizontal. Adjust the femur bolt so the upper leg is held suspended at 1 g.

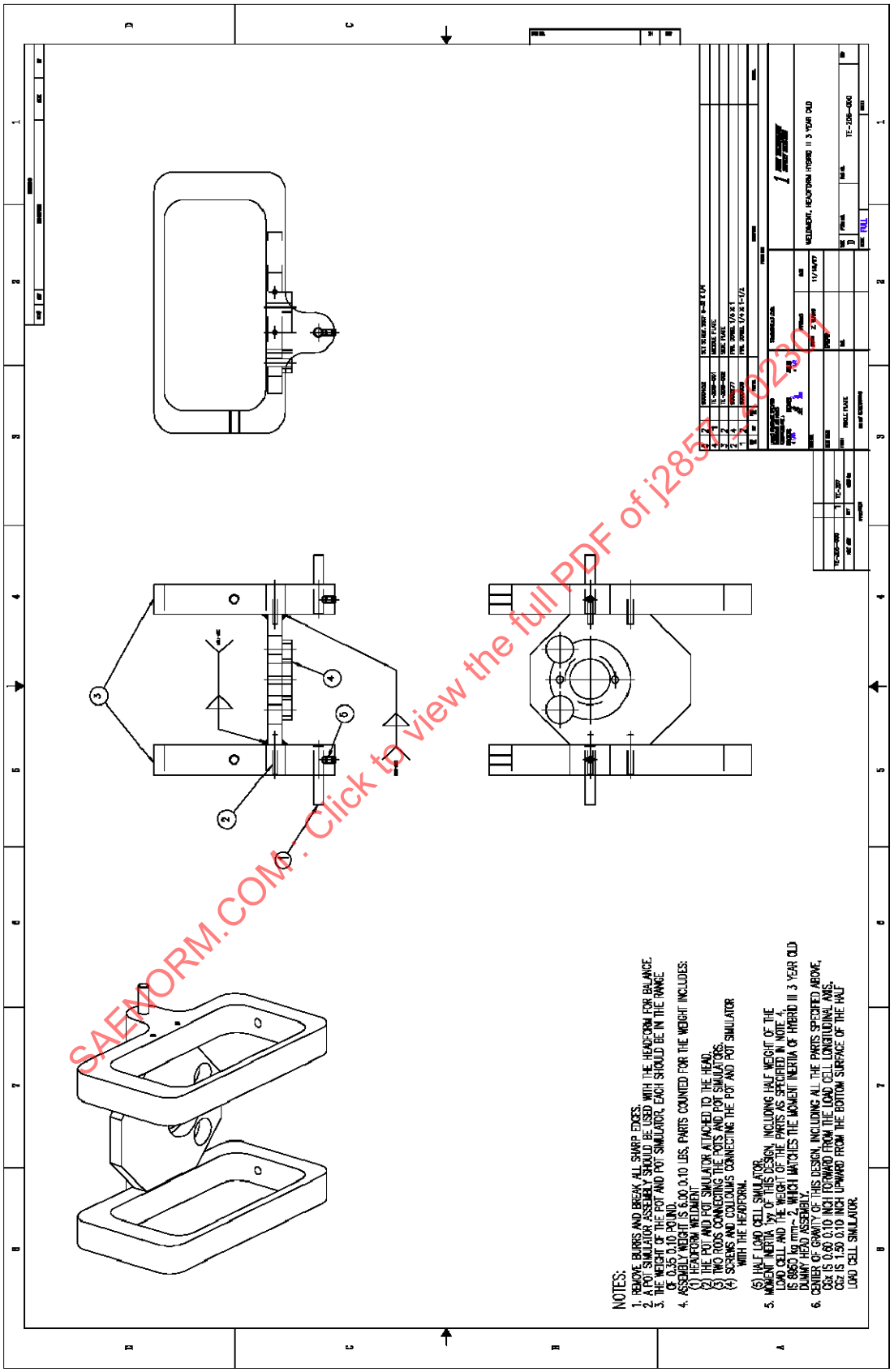
2. Rotate the lower leg assembly so it is horizontal. Adjust the knee clevis bolt so the lower leg is held suspended at 1 g.

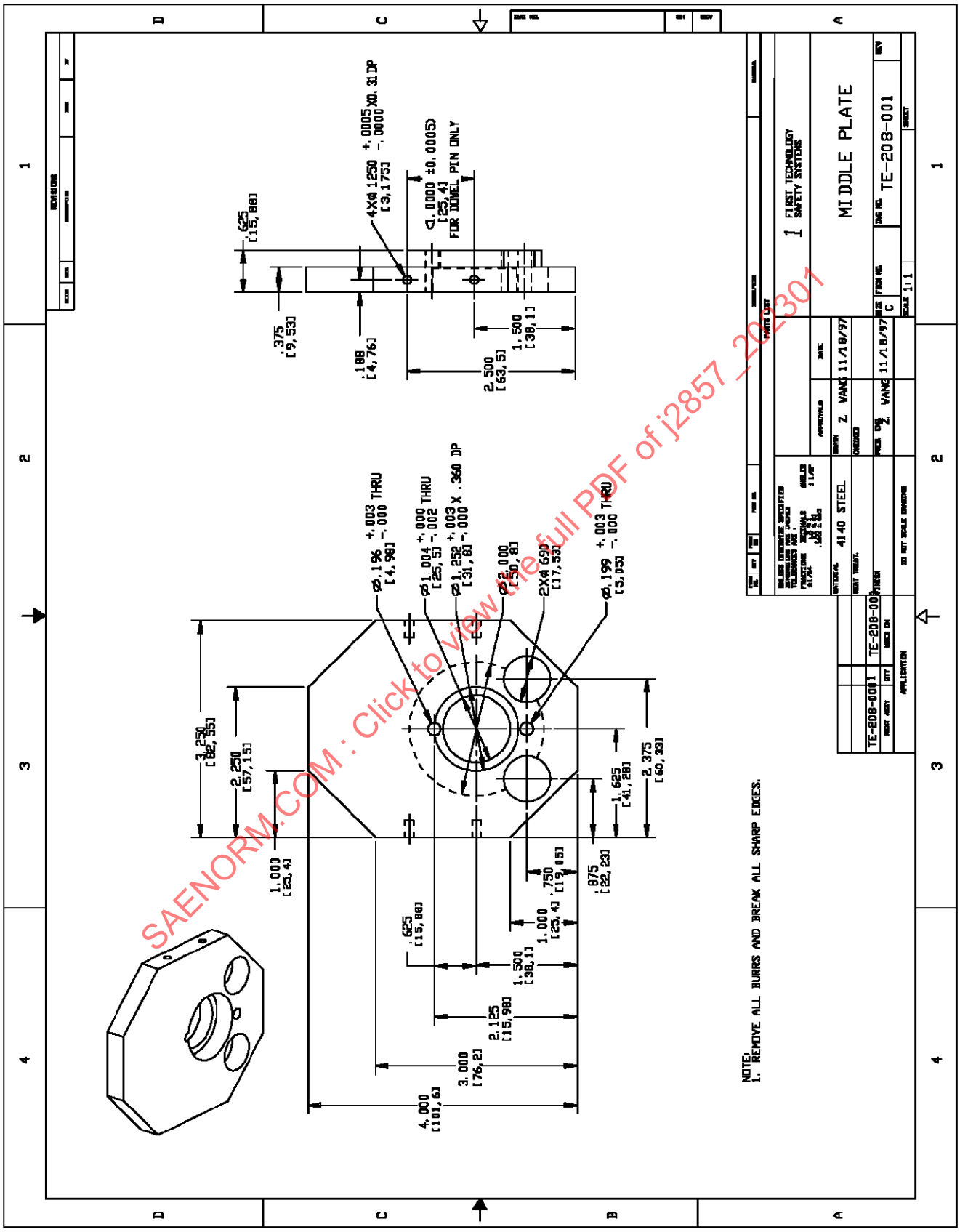
3. Adjust the ankle bolt so the foot is held suspended at 1 g. The ankle adjustment is not critical and is determined by individual feel.

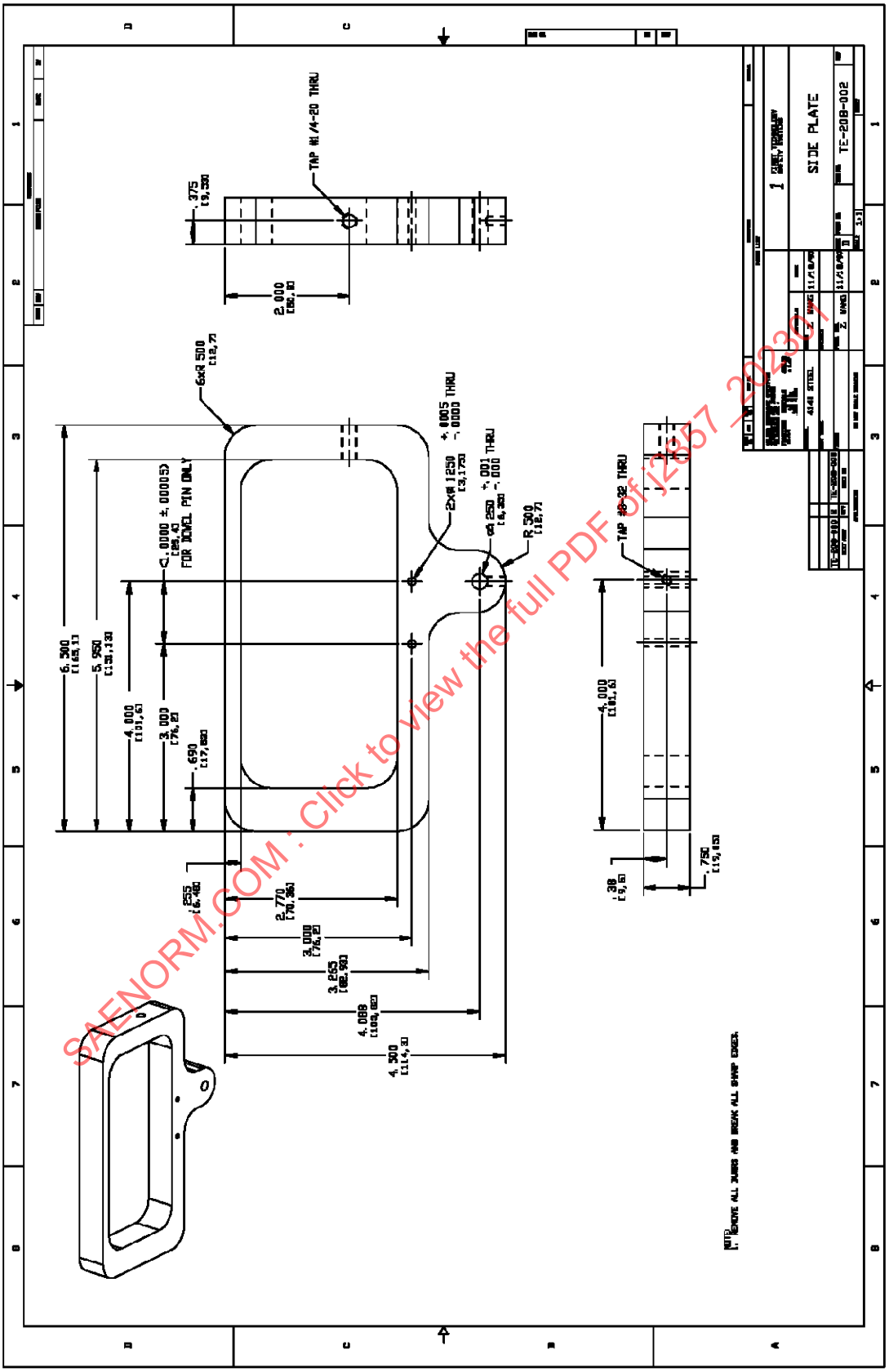
4. Repeat procedure on the other leg and foot.

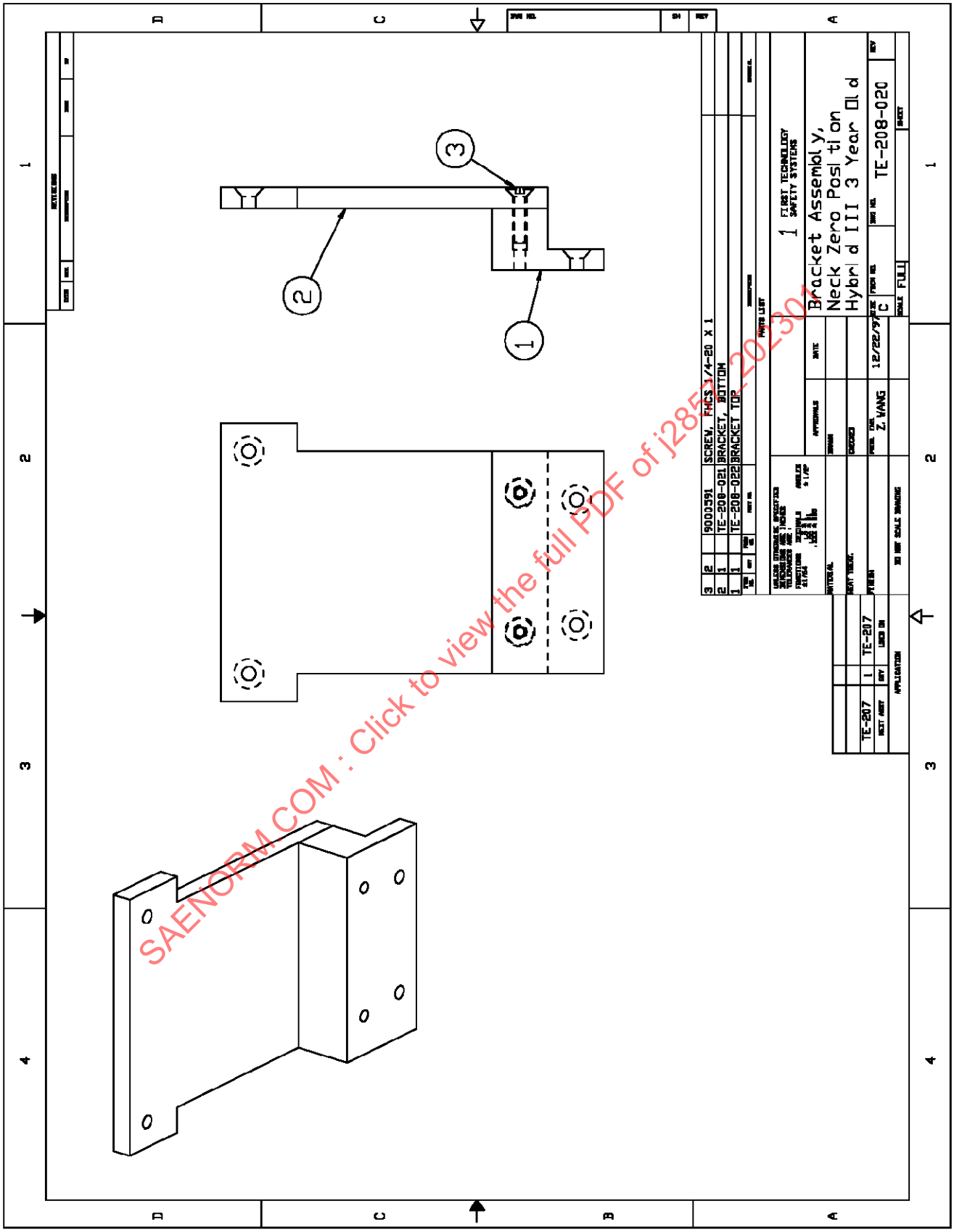
APPENDIX D - DRAWINGS

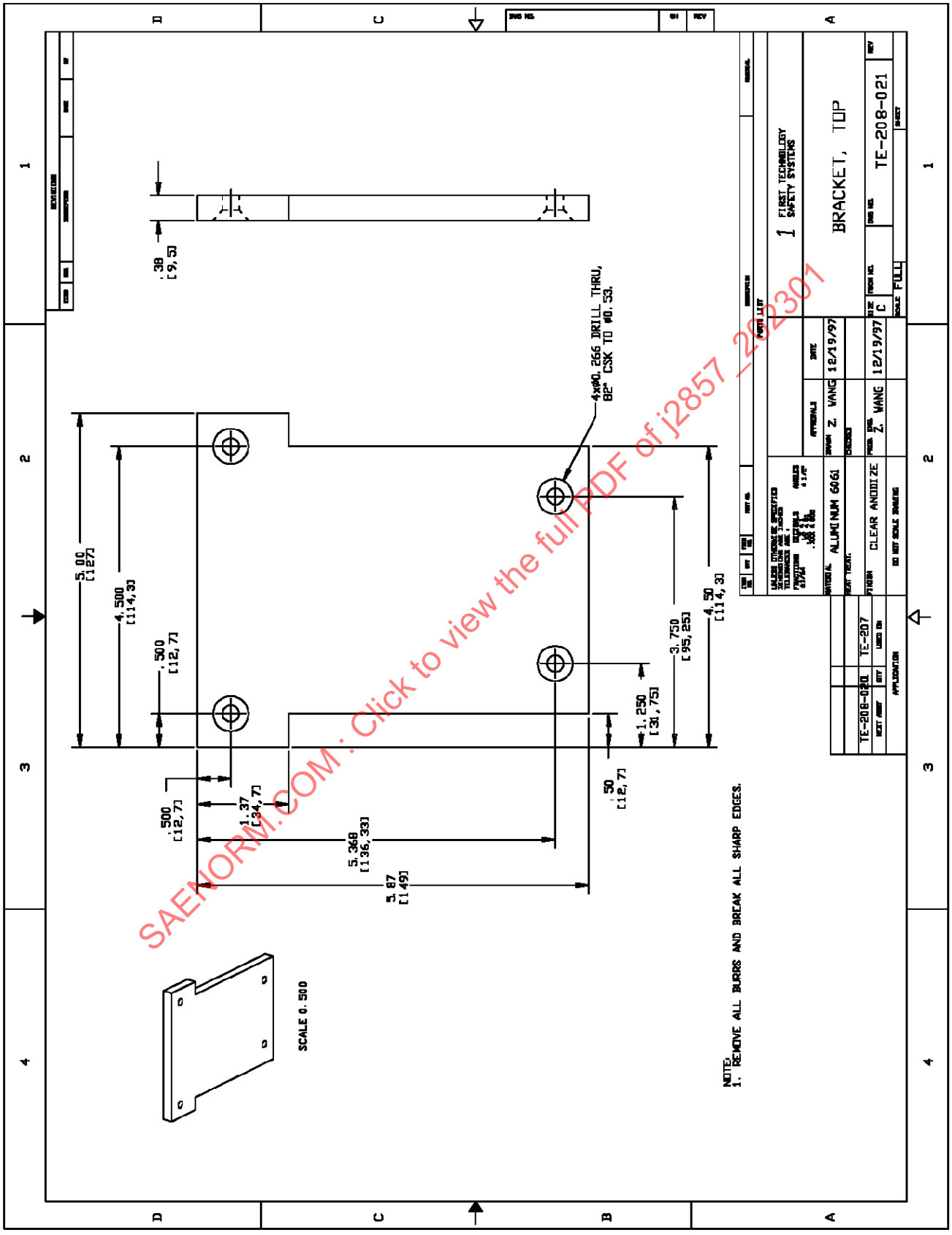
TE-208-000	Weldment, Hybrid III 3-Year Old Headform
TE-208-001	Middle Plate
TE-208-002	Side Plate
TE-208-020	Bracket Assembly, Neck Zero Position Hybrid III 3-Year Old
TE-208-021	Bracket, Top
TE-208-022	Bracket, Bottom
TE-208-100	Pot Simulator Assembly
TE-250-6	Housing Washer Concave
TE-250-7	Housing Washer Convex
TE-250-8	Connecting Rod
TE-208-010	Balance Pot Assembly
TE-208-011	Balance Pot Housing
TE-208-012	Collar
TE-208-013	Shaft
TE-250-21	Neck Mounting Plate
210-8600-1	Chest Gage Assembly (3YR H3)
210-8600-2	Chest Gage Assembly (3YR H3)
210-8601	Chest Depth Gage Handle Assemble
210-8602	Chest Depth Gage Handle
210-8603	Chest Depth Rod
210-8604	Gauge Block
TE-107-001	1/2 Mass Neck Transducer Structural Replacement
TE-825-000	Hybrid III 3-Year Old, Torso Flexion Pull Bracket Assembly
TE-831-000	Hybrid III 3-Year Old, Torso Flexion Pelvic Bracket Weldment
TE-208-050	Bib Simulator

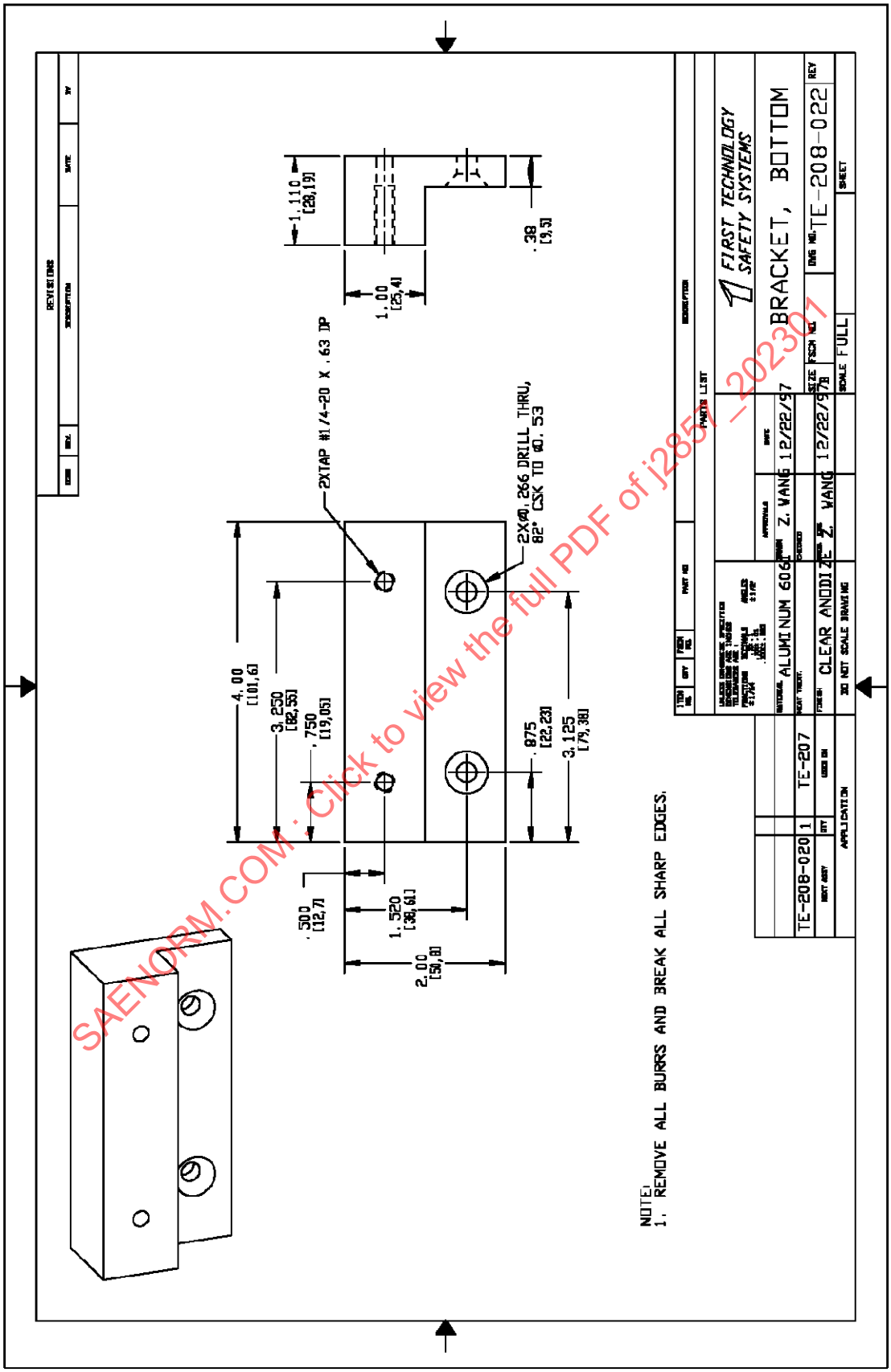


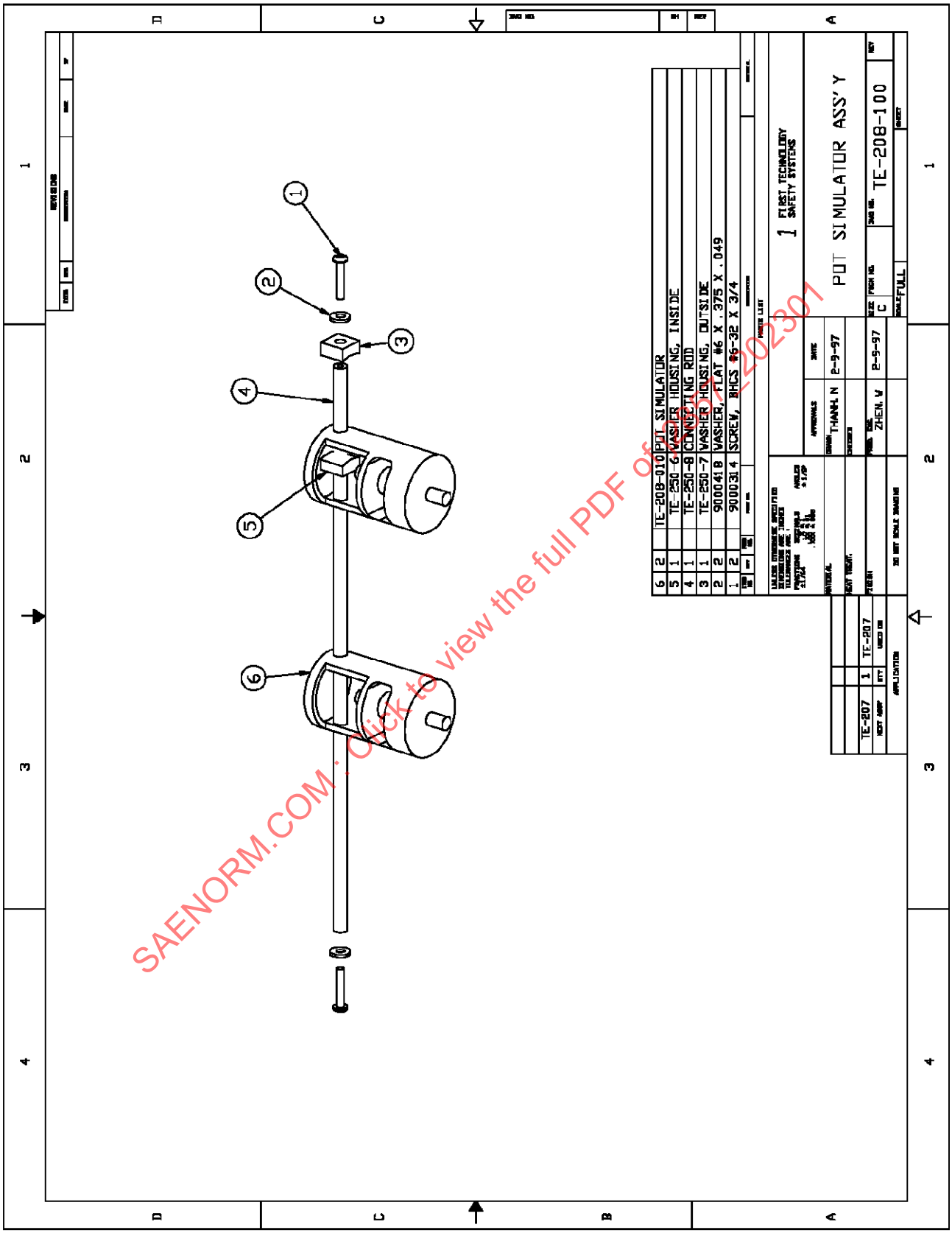








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