WorldSID 50th

User Manual

For information on Humanetics products, please visit our web site at www.humaneticsatd.com or contact:

Humanetics Innovative Solutions
23300 Haggerty Rd.
Farmington Hills, MI 48335, USA
Telephone: +1 (248) 778-2000
Fax: +1 (248) 778-2001

Notice: This product may contain lead

A list of components that may contain lead is being maintained on the Humanetics web site. The list, organized by dummy type, shows subcomponents that may currently or in the past have contained lead or a lead based alloy. Please refer to the Humanetics web site under **ATD Lead Disclosure** for information regarding lead in this product.
http://www.humaneticsatd.com/Lead_Disclosure

Table of Contents

Section 1 Head 12

1.1 Parts List 12

1.2 Disassembly 15

1.3 Instrumentation 17

1.4 Re-Assembly 18

Section 2 Neck 19

2.1 Parts List 19

2.2 Disassembly 20

2.3 Instrumentation 22

2.4 Re-Assembly 23

Section 3 Thorax/Abdomen/Shoulder 26

3.1 Parts List 26

3.2 Disassembly 33

3.3 Instrumentation 44

3.4 Re-Assembly 46

Section 4 Spine Box 58

4.1 Parts List 58

4.2 Disassembly 60

4.3 Instrumentation 70

4.4 Re-Assembly 71

Section 5 2D IR-TRACC 77

5.1 Introduction 78

5.2 2D IR-TRACC 78

5.3 Assembly - Disassembly 80

5.4 Assembly of the Potentiometer, Pot Axis, and Pot Base 84

5.5 IR-TRACC Rod End Position and Fixation with counter nut 86

5.6 Calibration 87

5.7 2D IR-TRACC Zero-Position Verification 88

5.8 Theory of the Procedure 89

5.9 Data Post Processing 94

5.10 Checking polarity 96

Section 6 Pelvis 97

6.1 Parts List 97

6.2 Disassembly 102

6.3 Instrumentation 111
6.4 Re-Assembly 112
Section 7 Legs 119
7.1 Parts List 119
7.2 Disassembly 120
7.2.1 Upper Leg 121
7.2.2 Femoral Neck Assembly 123
7.2.3 Knee 125
7.2.4 Lower Leg 129
7.2.5 Lower Leg Assembly 131
7.2.6 Ankle Assembly 133
7.3 Instrumentation 137
7.4 Re-Assembly 139
7.4.1 Knee Re-Assembly 139
7.4.2 Ankle Re-Assembly 142
7.4.3 Leg to Pelvis Assembly 144
Section 8 Verification Procedures 145
8.1 Visual Inspections 145
8.2 Certification of Instrumentation 145
8.3 Component Certifications 145
8.4 Head Tests 146
8.5 Neck Tests 150
8.6 Full-body Tests 153
8.7 Shoulder Verification 156
8.8 Thorax without Arm Verification 158
8.9 Abdomen Verification 160
8.10 Pelvis Verification Test 162
Section 9 External Measurement Procedure 164
9.1 Equipment required: 164
9.2 Measurement set up: 165
9.3 Angular set-up measurement summary 165
9.4 Linear Measurements 166
Section 10 Mass Measurements 170
10.1 Segment and total weight 170
Section 11 Appendix A 171

11.1 Tool kit 171
Manual Update Log 172

List of Figures

Figure 1-1 WorldSID head components. 13
Figure 1-2 Diagram of marker for CG and OC. 14
Figure 1-3 Removal of molded head. 15
Figure 1-4 Removing upper neck load cell from instrumented head core. 15
Figure 1-5 Removing the neck load cell structural replacement from the neck assembly. 16
Figure 1-6 WorldSID head instrumentation. 17
Figure 1-7 Wire routing for head instrumentation. 18
Figure 2-1 WorldSID neck components. 19
Figure 2-2 Removing lower neck bracket. 20
Figure 2-3 Removing upper neck bracket. 20
Figure 2-4 Using clamp to remove neck interface plate. 21
Figure 2-5 Neck buffers are free to remove when interface plates are removed. 21
Figure 2-6 Neck instrumentation. 22
Figure 2-7 Circular and square buffers are aligned. 23
Figure 2-8 Lateral positions for neck buffers. 23
Figure 2-9 Assembly of neck buffers. 24
Figure 2-10 Detailed view of lateral buffers. 24
Figure 2-11 Neck triaxial accelerometer installation. 25
Figure 3-1 WorldSID thorax components, shoulder pads, thorax pad, and half arm. 28
Figure 3-2 WorldSID thorax components, sternum thorax bib, rib coupler, and shoulder ribs. 29
Figure 3-3 WorldSID thorax components, 2-D IR-TRACC. 30
Figure 3-4 WorldSID thorax components, DAS mounting bracket, thorax. 31
Figure 3-5 Components of thorax rib, damping clamp. 32
Figure 3-6 Components of thorax rib, rib clamping bracket. 32
Figure 3-7 Removing thorax pads and shoulder pads. 33
Figure 3-8 Detaching the rib coupler, abdominal. 34
Figure 3-9 Detaching thorax rib sternum. 34
Figure 3-10 Removing linear triaxial accelerometer from shoulder rib mounting bracket. 35
Figure 3-11 Removing the shoulder load cell assembly. 36
Figure 3-12 Removing the shoulder load cell assembly, on non-struck side. 36
Figure 3-13 Removing rib mount screw. 37
Figure 3-14 Removing shoulder rib 2D IR-TRACC from the side plate. 37

Figure 3-15 Removing molded rib stops and inner rib. 38
Figure 3-16 Detaching the rib from the spine box at the rear. 38
Figure 3-17 Removing the thorax and abdominal rib clamping bracket. 39
Figure 3-18 Removing the linear triaxial accelerometer and 2D IR-TRACC. 39
Figure 3-19 Removing 2D IR-TRACC for ribs 2-6. 40
Figure 3-20 Removing the ribs and inner band. 40
Figure 3-21 Removing the thorax and abdominal rib sternum mounting strip. 41
Figure 3-22 Attaching the abdominal rib coupler. 42
Figure 3-23 Ribs and inner bands. 42
Figure 3-24 Non-impact side DAS assembly. 43
Figure 3-25 WorldSID rib instrumentation. 44
Figure 3-26 Assembling 2D IR-TRACC. 44
Figure 3-27 Shoulder assembly, load cell. 45
Figure 3-28 Shoulder rib is gray, the first thoracic rib is red, and the second and third thoracic ribs and abdominal ribs are white. 46
Figure 3-29 Assembling the shoulder rib assembly. 47
Figure 3-30 Assembling the inner shoulder rib assembly on non-struck side. 47
Figure 3-31 Assembling the inner band with 2D IR-TRACC. 48
Figure 3-32 Wiring routing for rib instrumentation. 49
Figure 3-33 Rib instrumentation cables routed in the front to the DAS modules mounted in the spine box. 49
Figure 3-34 Assembling the shoulder rib mounting bracket. 50
Figure 3-35 Assembling the accelerometer, linear triaxial. 51
Figure 3-36 Assembling the thorax and abdominal rib clamping bracket. 51
Figure 3-37 Attaching the two spine ballast stand-off. 52
Figure 3-38 Attaching shoulder mounting strips. 53
Figure 3-39 Detailed view of attaching shoulder mounting strips. 53
Figure 3-40 Attaching the thorax and abdominal mounting strips. 54
Figure 3-41 Detailed view of attaching the thorax and abdominal mounting strips. 54
Figure 3-42 Attaching thorax and abdominal mounting strips to the bottom two ribs. 55
Figure 3-43 Detailed view of attaching the thorax and abdominal mounting strip to the bottom two ribs. 55
Figure 3-44 The sternum, thorax bib and abdominal rib coupler are attached to the ribs after instrumentation is plugged in. 56
Figure 3-45 Attaching lower neck bracket with M6 X 1 X 16 LG. SHCS. 56
Figure 3-46 Attaching the thorax pads and shoulder pads. 57
Figure 4-1 Spine box components for WorldSID. 59

Figure 4-2 Detaching the right side plate. 60
Figure 4-3 Example of internal spine box assembly with optional DAS. 61
Figure 4-4 Removing the M4 X 0.7 X 25 LG. SHCS on the mounting brackets #2 and #1. 62
Figure 4-5 Detaching the spine box cover plate. 62
Figure 4-6 Detaching the interposer replacement. 63
Figure 4-7 Removing the backup plate mounting bracket and connector, housing replacement. 63
Figure 4-8 Removing the lower DAS replacement. 64
Figure 4-9 Removing the T12 accelerometer mount. 64
Figure 4-10 Removing the T4 accelerometer from the top of the spine box weldment. 65
Figure 4-11 Detaching the angular accelerometer from the angular accelerometer/tilt sensor mount bracket. 66
Figure 4-12 Optional IES. 66
Figure 4-13 Detaching the angular accelerometer structural replacement from the rotational accelerometer mount bracket. 67
Figure 4-14 Removing spacers. 68
Figure 4-15 Detailed view of removing spacers. 68
Figure 4-16 Separating the upper spine box bracket weldment from the left side plate. 69
Figure 4-17 Spinebox instrumentation. 70
Figure 4-18 Attaching the spaces and the spine box upper bracket weldment. 71
Figure 4-19 Attaching the bottom DAS structural replacement. 72
Figure 4-20 Connecting the interposer replacement. 72
Figure 4-21 Attaching the backup plate mounting bracket. 73
Figure 4-22 Assembling the angular accelerometer mount. 74
Figure 4-23 Attaching the x-axis angular accelerometer. 74
Figure 4-24 Attaching T12 accelerometer mount. 75
Figure 4-25 Attaching the linear triaxial accelerometer to top of spine box weldment. 75
Figure 4-26 Attaching the right side plate. 76
Figure 5-1 Shoulder Rib, IF-368. 77
Figure 5-2 Thorax and Abdomen Ribs, IF-367. 77
Figure 5-3 Orientation of 2D IR-TRACCs in the thorax. Note deviating Shoulder 2D IR-TRACC orientation. 79
Figure 5-4 Left: thorax and abdomen bracket (3670-22); right: shoulder bracket (3670-23). 79
Figure 5-5 Shoulder 2D IR-TRACC (3680-00). 80
Figure 5-6 Thorax-Abdomen 2D IR-TRACC (3670-00). 82
Figure 5-7 Applying light grease on Pot Axis. 84
Figure 5-8 Align Pot Axis and Pot Base 84

Figure 5-9 Flat faces aligned on potentiometers. 85
Figure 5-10 Rod End at angle of about 45° 86
Figure 5-11 5.5mm Hex Wrench, 6004602 86
Figure 5-12 TE-3700-IRKIT, Calibration Fixture 87
Figure 5-13 TH-4000-2D, 2D IR-TRACC VERIFICATION FIXTURE KIT 88
Figure 5-14 Example 2D IR-TRACC assembly Zero-Position calibration sheet. 89
Figure 5-15 IR-TRACC Parameters (example). 90
Figure 5-16 Angle sensor parameters (example). 90
Figure 5-17 2D IR-TRACC assembly in co-ordinate system for right hand struck side, seen from top. 91
Figure 5-18 Orientation angle, Offset angle, Reference angle definitions. 92
Figure 5-19 Example of a verification sheet (Note: apply the numbers on the verification sheet per sensor Serial Number, not the numbers in this example). 93
Figure 5-20 Example ISO codes for Thorax rib1 in SI units. 95
Figure 5-21 Co-ordinate system of the dummy, left struck side instrumented shown here. 96
Figure 6-1 WorldSID pelvis components. 99
Figure 6-2 Rear view of pelvis assembly. 100
Figure 6-3 Front view of pelvis assembly. 100
Figure 6-4 Close-up view of pubic assembly. 101
Figure 6-5 Close-up view of lumbar assembly. 101
Figure 6-6 Removing spine box from the pelvis. 102
Figure 6-7 Detaching the femur assemblies. 103
Figure 6-8 Pelvis flesh. 104
Figure 6-9 Removing sacroiliac backing plates to separate the pelvic bone-pubis assembly. 104
Figure 6-10 Separating molded pelvis bone from pubis assembly. 105
Figure 6-11 Separating pubic buffers from pubic load cell replacement. 105
Figure 6-12 Detaching the lumbar spine. 106
Figure 6-13 Separating the upper lumbar clamping plate and lumbar mounting wedge from the lumbar spine. 106
Figure 6-14 Removing the lower lumbar mounting bracket weldment 107
Figure 6-15 Removing the sacroiliac load cell interface. 107
Figure 6-16 Removing pelvis instrumentation cover plate. 108
Figure 6-17 Removing the pelvis instrumentation bracket. 108
Figure 6-18 Detaching the battery. 109
Figure 6-19 Separating the sacroiliac and lumbar spine load cell replacements. 110
Figure 6-20 Pelvis instrumentation. 111

Figure 6-21 Assembling the lumbar spine load cell and sacroiliac load cell. 112
Figure 6-22 Attaching the battery container. 113
Figure 6-23 Attaching the accelerometer. 114
Figure 6-24 Attaching sacroiliac load cell interfaces. 115
Figure 6-25 Routing of wires for pelvis instrumentation. 116
Figure 6-26 Inserting hip joint. 117
Figure 6-27 Assembling spine box to lumbar wedge. 118
Figure 7-1 Full Leg Assembly. 119
Figure 7-2 Separating the upper leg from the lower leg. 120
Figure 7-3 Components of upper leg assembly, Right. 121
Figure 7-4 Upper leg flesh, right. 122
Figure 7-5 Parts list for femoral neck assembly, W50-51034. 123
Figure 7-6 Removing the femoral neck load cell. 124
Figure 7-7 Removing the trochanter assembly. 124
Figure 7-8 Knee Assembly, Right. 125
Figure 7-9 Removing the knee covers. 126
Figure 7-10 Removing the knee bone assembly. 127
Figure 7-11 Removing the knee shaft assembly. 128
Figure 7-12 Lower leg. 129
Figure 7-13 Lower Leg and Ankle Assembly. 130
Figure 7-14 Lower Leg and Ankle Assembly. 131
Figure 7-15 Lower Leg and Ankle Assembly. 132
Figure 7-16 Removing washers from lower leg. 132
Figure 7-17 Ankle Assembly. 133
Figure 7-18 Y-Version Assembly Harmonized, W50-57003. 134
Figure 7-19 Removing the ankle friction shoulder bolt. 135
Figure 7-20 Removing the stop ring. 135
Figure 7-21 X-Version. 136
Figure 7-22 Upper leg instrumentation. 137
Figure 7-23 Knee instrumentation. 137
Figure 7-24 Lower leg instrumentation. 138
Figure 7-25 Knee Re-Assembly, Right. 139
Figure 7-26 Knee Pot Installation. 140
Figure 7-27 Knee Pot Wiring 140
Figure 7-28 Torqueing the Knee Contact Load Cell 140

Figure 7-29 Re-attaching the knee cover and knee pad. 141
Figure 7-30 "X' and 'Y' version re-assembly. 142
Figure 7-31 Re-assembling the “X” version. 143
Figure 7-32 Removing the “Y” version. 143
Figure 7-33 Leg to Pelvis Assembly. 144
Figure 8-1 Installing brackets for lateral head certification test. Lateral bracket left photo, frontal bracket right photo. 146
Figure 8-2 Test setup of head certification test with impact to the forehead. 148
Figure 8-3 Test setup of head certification test with impact to the left side of the head. 149
Figure 8-4 Neck and headform assembled for neck certification. 150
Figure 8-5 Front view of setup for full dummy verification tests. 154
Figure 8-6 Side view of setup for full dummy verification tests. 154
Figure 8-7 Using an inclinometer with the pelvic angle tool to check pelvis angle. 155
Figure 8-8 Front view of shoulder impact test. 157
Figure 8-9 Side view of shoulder impact test. 157
Figure 8-10 Front view of thorax test without arm 159
Figure 8-11 Front view of abdomen test setup. 161
Figure 8-12 Side view of abdomen test setup. 161
Figure 8-13 Side view of WorldSID pelvis test. 163
Figure 8-14 Front view of WorldSID pelvis test. 163
Figure 9-1 External measurements. 167
Figure 9-2 External measurements front. 168
Figure 11-1 W50-TOOL-KIT drawing. 171

List of Tables

Table 1-1 Parts list WorldSID 50th head. 12
Table 2-1 Parts list for WorldSID neck assembly. 19
Table 3-1 Parts list for the WorldSID thorax/abdomen/shoulder. 27
Table 4-1 Parts list for WorldSID spine box assembly 58
Table 5-1 Parts list 2D-IR-TRACC for single sided instrumentation. 78
Table 5-2 Parts list 2D-IR-TRACC for double sided instrumentation 78
Table 5-3 Shoulder 2D IR-TRACC (3680-00) Parts List 81
Table 5-4 Thorax-Abdomen 2D IR-TRACC (3670-00) Parts List 83
Table 5-5 Calculation parameters, symbols and description 94
Table 5-6 Dummy manipulations and parameter responses (*after post processing) 96

Table 6-1 Parts list for WorldSID pelvis..... 98
Table 7-1 Parts list for the WorldSID Leg. 119
Table 7-2 Parts list for Upper Leg Assembly 121
Table 7-3 Parts list for Femoral Neck Assembly..... 123
Table 7-4 Parts list for Knee Assembly, Right 125
Table 7-5 Parts list for Lower Leg, Right 129
Table 7-6 Parts list for Lower Leg Assembly, Right 131
Table 7-7 Parts list for Ankle Assembly..... 133
Table 7-8 Parts list for Y-Verson Assembly Harmonize, W50-57003 134
Table 8-1 WorldSID head drop specifications. 147
Table 8-2 WorldSID neck certification specifications. 152
Table 8-3 Dummy set-up orientations. 153
Table 8-4 WorldSID shoulder certification specifications. 156
Table 8-5 WorldSID thorax without arm certification specifications..... 158
Table 8-6 WorldSID abdomen certification specifications..... 160
Table 8-7 WorldSID pelvis certification specifications. 162
Table 9-1 Angular set-up measurement summary 165
Table 9-2 Angular tolerance based on measurement method. Set up angle tolerances are tightest. 169
Table 9-3 Linear tolerance is ±15% maximum 30 mm. Specification and tolerance to be refined based on manufacturing data. 169
Table 10-1 Mass measurements. 170

Section 1 Head

1.1 Parts List

Table 1-1 lists the parts required for the WorldSID head assembly, which are illustrated in Figure 1-1. Part numbers correspond to those on drawing W50-10000.

ITEM	QTY	PART NO.	DESCRIPTION
1	1	W50-10007	HEAD CORE
2	1	W50-14014	HEAD, MOLDED, TESTED AND CERTIFIED
3	3	W50-10010	ROTATIONAL ACCELEROMETER REPLACEMENT (REF)
4	1	W50-71003	NECK LOAD CELL STRUCTURAL REPLACEMENT
5	1	W50-24013	NECK SHROUD ASSEMBLY
6	6	5000393	M3 X 0.5 X 6 LG. SHCS
7	1	5000123	M8 FLAT WASHER PLAIN ZINC
8	1	5000255	M8 X 1.25 X 25 LG. BHCS
9	4	5000281	M6 X 1 X 12 LG SHCS
10	5	5000010	M4 X 0.7 X 10 LG. BHCS SS
11	1	5000254	M2 X 0.4 X 16 LG. CHMSS SS
12	1	W50-10011	TILT SENSOR STRUCTURAL REPLACEMENT
13	1	5000151	M4 X 0.7 X 10 LG. SHCS
14	4	5000604	M6 X 1 X 14 LG. SHCS
15	1	W5-1012	BRACKET, CABLE RETAINER
16	2	5000063	M1.6 X 0.35 X 3 LG. SHCS

Table 1-1 Parts list WorldSID 50th head.

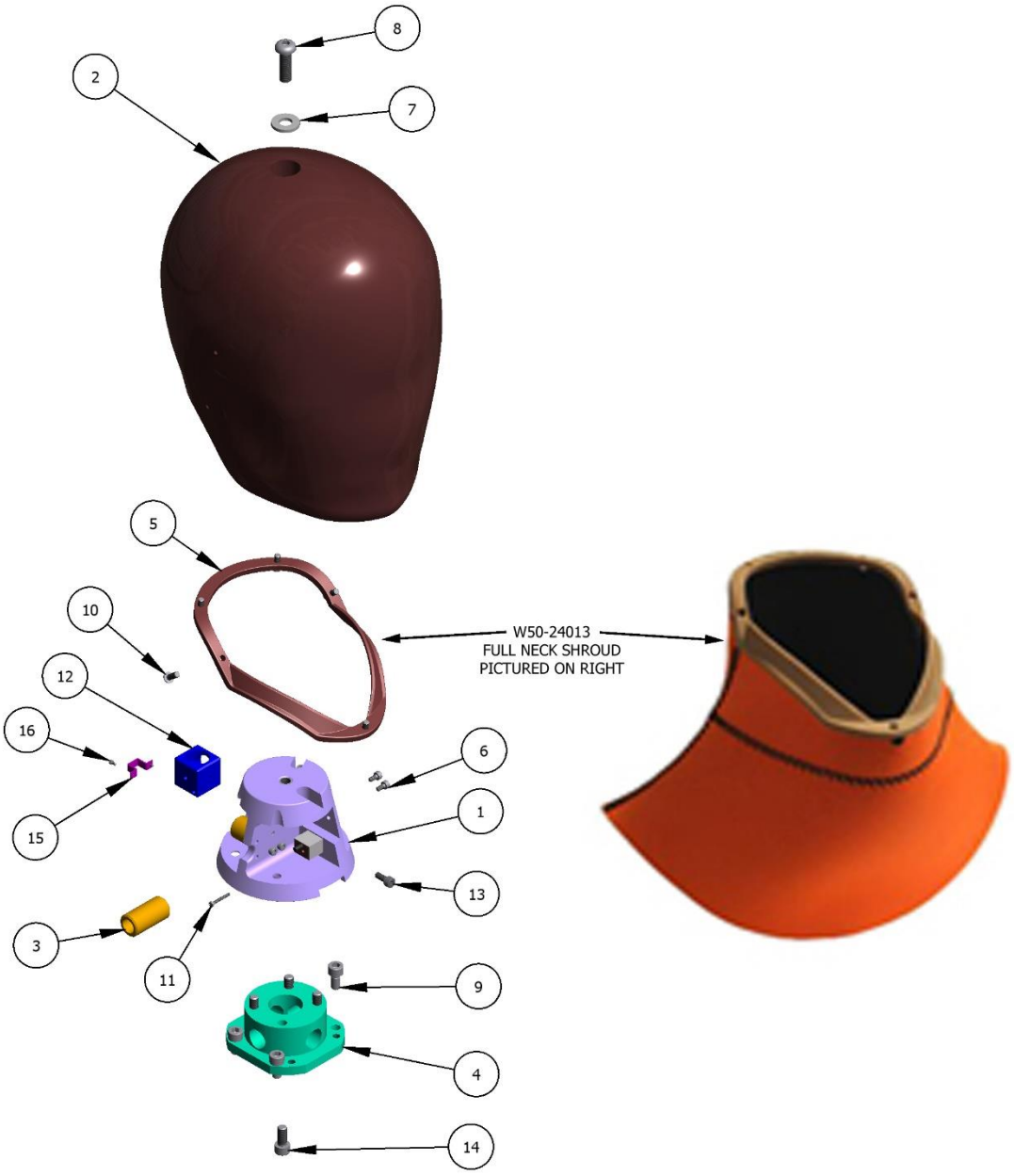


Figure 1-1 WorldSID head components.

See Figure 1-2 for location of CG and OC marker.

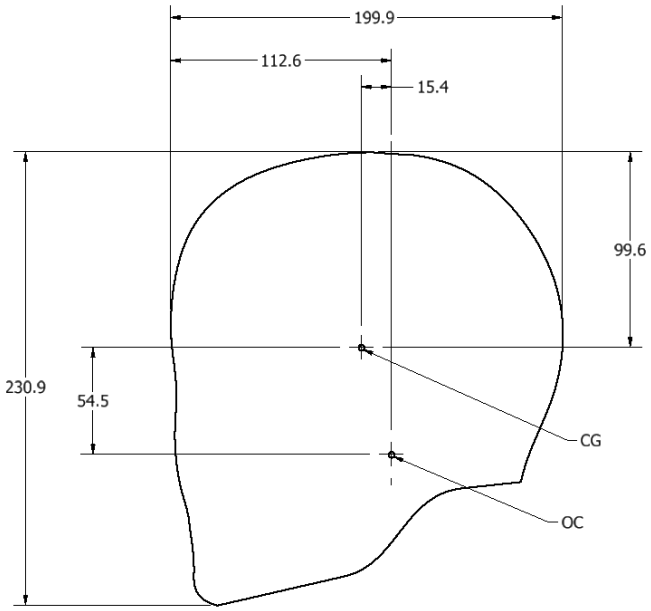


Figure 1-2 Diagram of marker for CG and OC.

1.2 Disassembly

As shown in Figure 1-3, remove the M8 X 1.25 X 25 LG. BHCS (5000255) and M8 flat washer (5000123) from the top of the head. The molded head (W50-14014) can now be lifted off the head core assembly. If the head sticks to the core, tap the bottom edge of the head lightly with a plastic hammer. Detach the neck shroud assembly (W50-24013) from the head by removing five screws, M4 x 0.7 x 10 LG. BHCS SS (5000010).

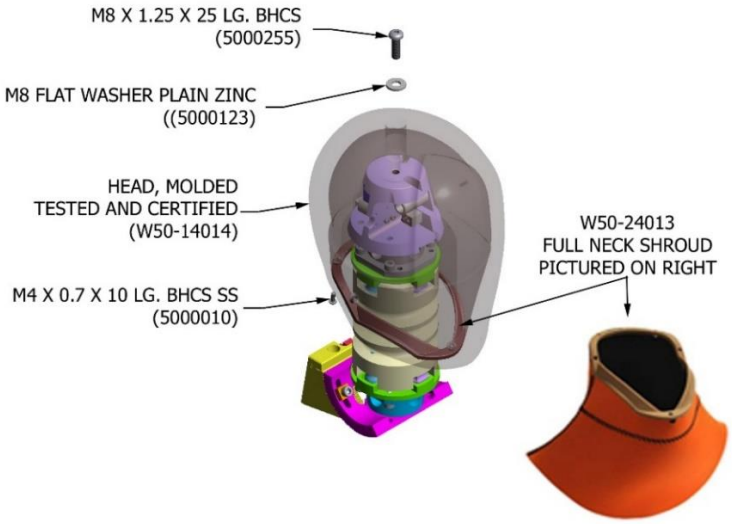


Figure 1-3 Removal of molded head.

Remove the four M6 x 14 SHCS (5000604) from the bottom of the upper neck load cell replacement (W50-71003) that attaches it to the bottom of the head core (W50-10007).

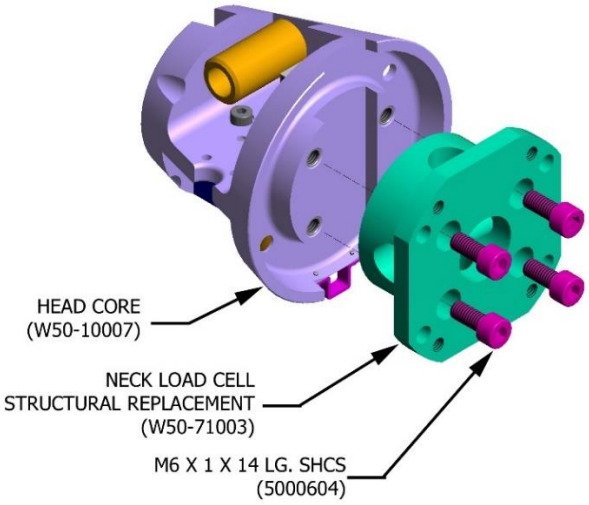


Figure 1-4 Removing upper neck load cell from instrumented head core.

Remove the four M6 X 1 X 12 LG. SHCS (5000281) that connect the neck load cell structural replacement (W50-71003) to the neck assembly (W50-20000).

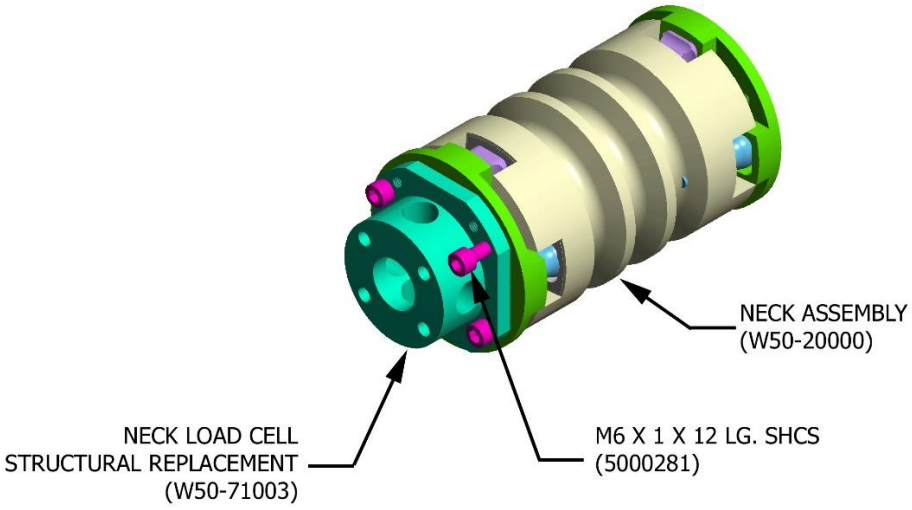


Figure 1-5 Removing the neck load cell structural replacement from the neck assembly.

1.3 Instrumentation

As shown in Figure 1-6, the head core (W50-10007) can be instrumented with three angular rate sensor (ARS), one linear triaxial accelerometer, and one dual-axis tilt sensor. Each ARS is secured with two M3 X 0.5 X 6 SHCS (5000393). The y-axis ARS is mounted in the right-front chamber with screws accessed from the left-front chamber. The z-axis ARS is mounted in the left-rear chamber with screws accessed from the top. The x-axis ARS is mounted in the right-rear chamber with screws accessed from the right-front chamber. The linear triaxial accelerometer is mounted in the right-front chamber with one M2 X 16 cheese screw (5000254) that is accessed from the right. The tilt sensor is mounted in the right-rear chamber with one M4 X 0.7 X 10 SHCS (5000151) accessed from the right-front chamber. The instrumentation in the right-rear chamber must be installed before the instrumentation in the right-front chamber. The upper neck load cell (W50-71003) is also considered part of the head assembly instrumentation.

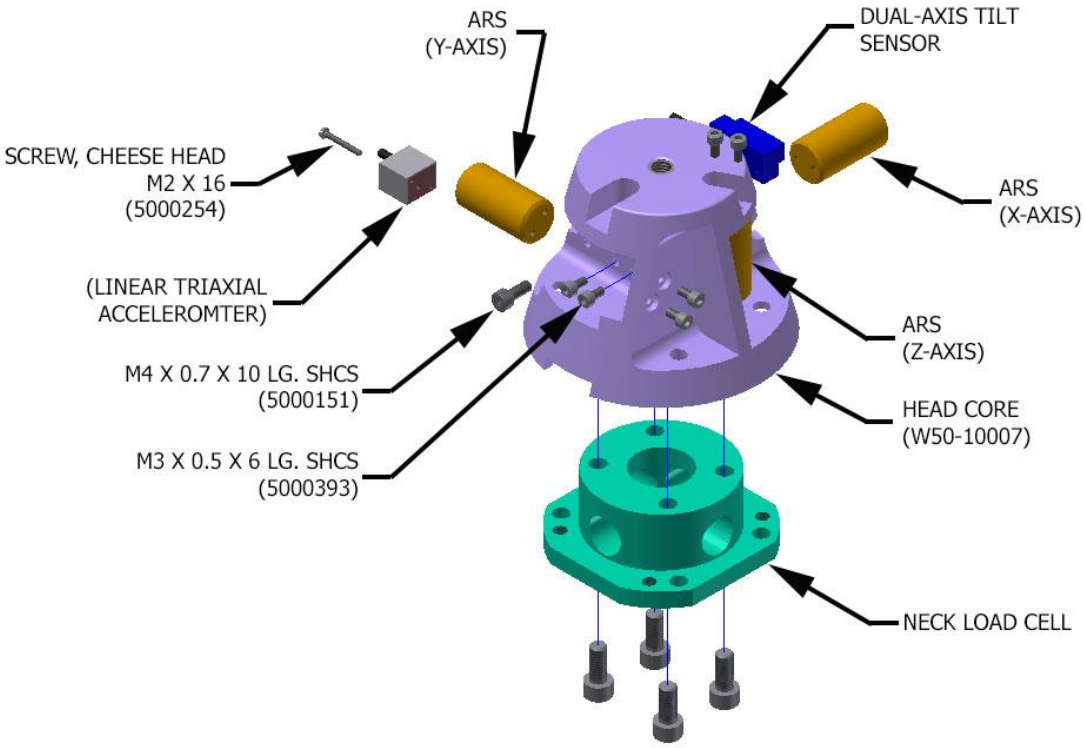


Figure 1-6 WorldSID head instrumentation.

1.4 Re-Assembly

Install the head instrumentation as described in the preceding section. Use four M6 X 1 X 14 LG. SHCS (5000604) to attach the upper neck load cell to the bottom of the head core (W50-10007). The top front of the head core has a slot without holes. Make sure the slot in the core is lined up with the connector for the upper neck load cell. Torque the screws to 6 Nm. Attach the head core assembly to the neck assembly using four M6 X 1 X 12 LG. SHCS (5000281). Torque the screws to 6 Nm.

Mount the neck shroud assembly (W50-24013) to the molded head ((W50-14014) using five M4 x 10 BHCS (5000151). Place the head/neck shroud assembly over the instrumented core, making sure that all wires are free. Place the M8 flat washer (5000123) into the recess at the top of the head and connect the head to the instrumented core using the M8 X 1.25 X 25 LG. BHCS (5000255).

Figure 1-7 shows how the wires from the head instrumentation are bundled together at the rear with cable ties and routed down the back of the neck over to the non-struck side of the dummy. The cables pass between the shoulder rib and first thoracic rib to be plugged into the DAS modules from the front of the dummy.

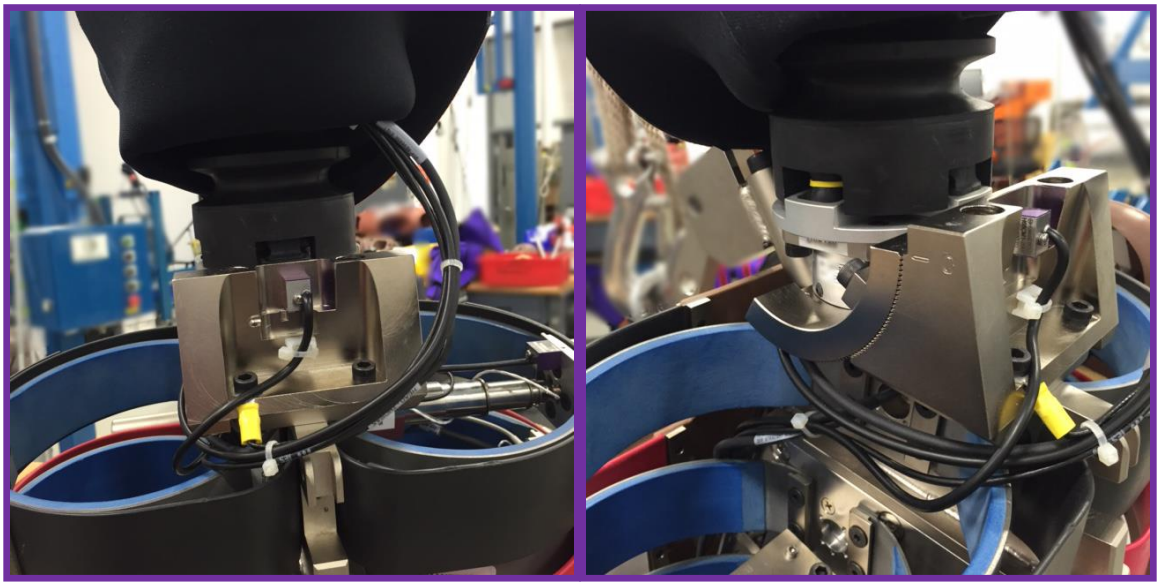


Figure 1-7 Wire routing for head instrumentation.

Section 2 Neck

2.1 Parts List

Table 2-1 lists the parts required for assembly of the neck, which are shown in Figure 2-1. Part numbers correspond to those found on drawing W50-20000.

ITEM	QTY	PART NO.	DESCRIPTION
1	1	W50-20101-1	7264C LOWER NECK BRACKET
2	1	W50-20102	UPPER NECK BRACKET
3	1	W50-21001	NECK ASSEMBLY
4	8	5000281	M6 X 1 X 12 LG. SHCS
5	2	W50-20103	SPACER, NECK
6	2	5000008	M6 X 1 X 30 LG. SHCS
7	1	6002036	CABLE TIE MOUNT, #4 SCREW
8	1	5000399	M3 X 0.5 X 6 LG. BHCS SS
9	1	W50-71003	NECK LOAD CELL STRUCTURAL REPLACEMENT
10	1	5000254	M2 X 0.4 X 16 LG. CHMSS SS

Table 2-1 Parts list for WorldSID neck assembly.

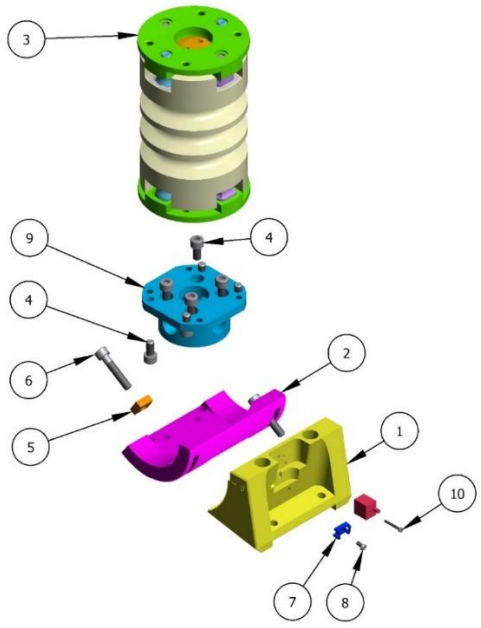


Figure 2-1 WorldSID neck components.

2.2 Disassembly

Separate the upper (W50-20102) and lower (W50-20101-1) neck brackets by removing two M6 X 1 X 30 LG. SHCS (5000008) accessed from the front of the dummy. Two neck spacers (W50-20103), accessed from either side, will be free to remove.

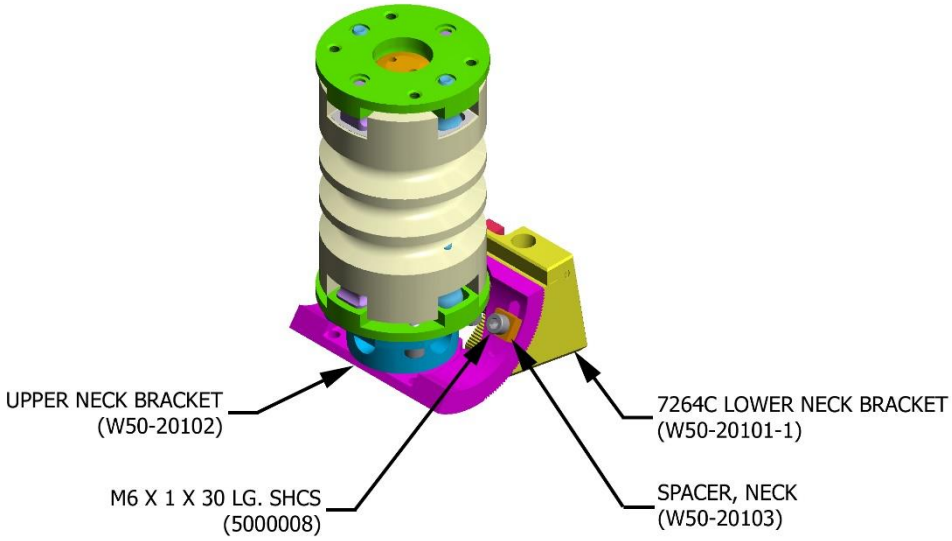


Figure 2-2 Removing lower neck bracket.

Remove the upper part of the neck bracket (W50-20102) and lower neck load cell replacement (W50-71003) from the neck assembly (W50-20000) by removing four M6 X 1 X 12 LG. SHCS (5000281) accessed from the bottom (Figure 2-3). The lower neck load cell (W50-71003) is removed from the upper neck bracket (W50-20102) by removing four M6 X 1 X 12 LG. SHCS (5000281).

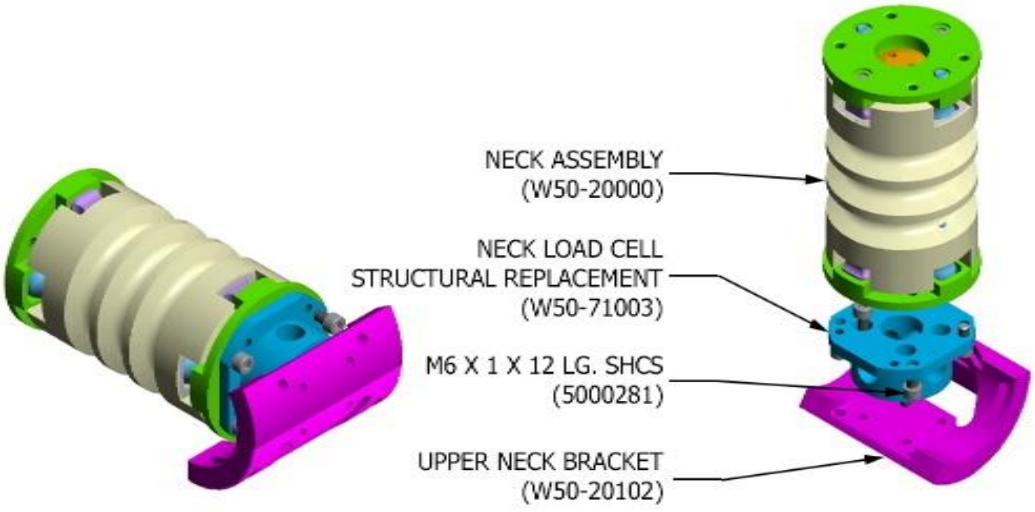


Figure 2-3 Removing upper neck bracket.

To take apart the neck assembly, use the neck compression wrench to remove the half-spherical screw from the neck (Figure 2-4). The interface plates will come off, and the four buffers (two round, 2 square) can be removed by pulling them out (Figure 2-5).

Figure 2-4 Using clamp to remove neck interface plate.

Figure 2-5 Neck buffers are free to remove when interface plates are removed.

2.3 Instrumentation

The neck assembly includes a lower neck load cell (the upper neck load cell is considered part of the head assembly). A triaxial accelerometer can be mounted in a recess in the back of the lower neck bracket, T1 location.

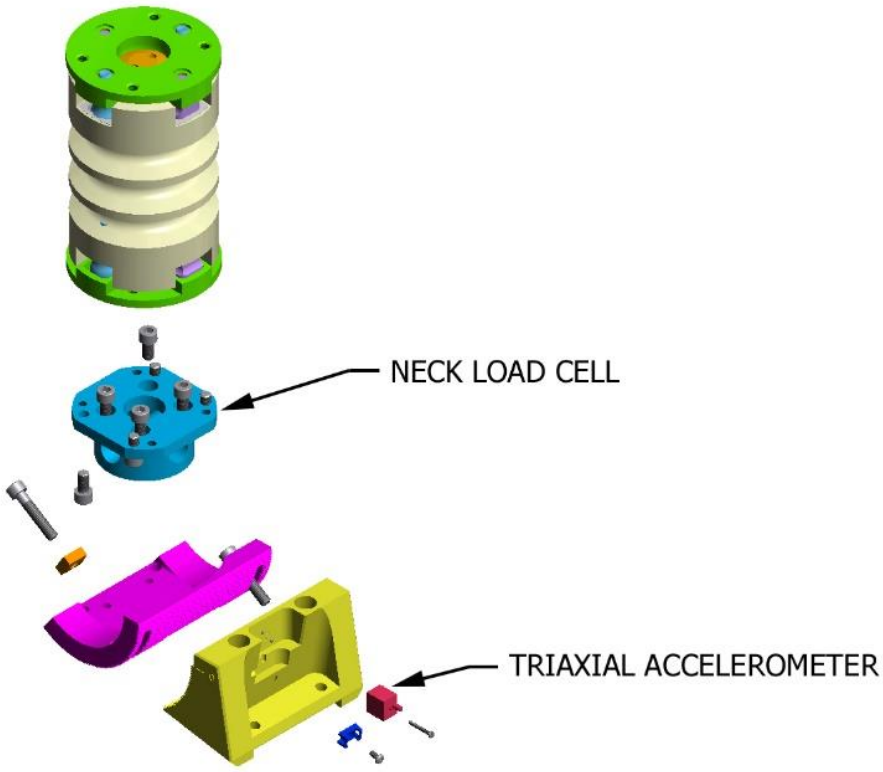


Figure 2-6 Neck instrumentation.

2.4 Re-Assembly

When assembling the neck, the neck buffers with the circular cross-sections are mounted on the sides, and the neck buffers with the square cross-sections are mounted in the front and rear. Square buffers and circular buffers should be aligned in the upper and lower necks. See Figure 2-7. As shown in Figure 2-8, the lateral locations for the buffers in the interface plates are closest to the holes for mounting the neck to the head and torso.

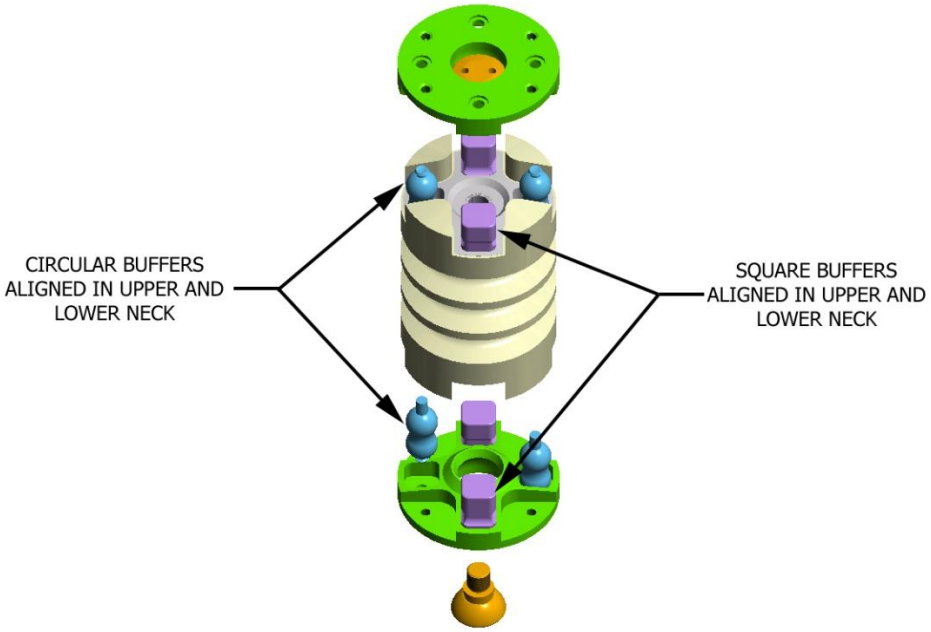


Figure 2-7 Circular and square buffers are aligned.

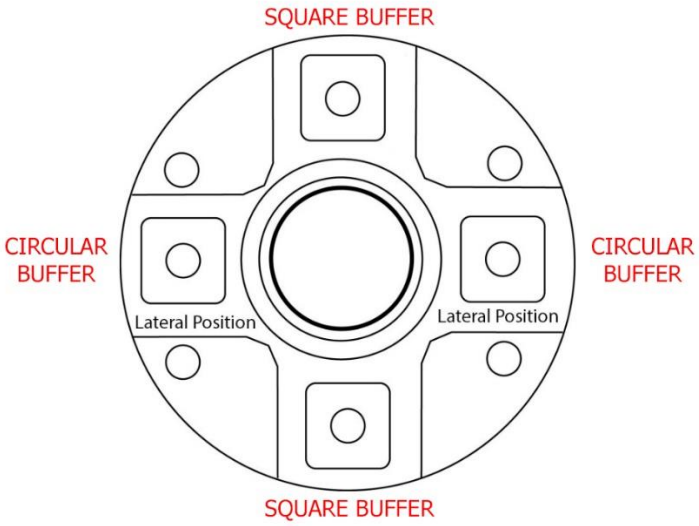


Figure 2-8 Lateral positions for neck buffers.

The circular cross-section buffers have a cylindrical end and a mushroom-shaped end. The mushroom ends must be pressed firmly into the top and bottom interface plates. The mushroom cap should protrude into the counter bore on the flat face of the interface plate. A turning action during assembly helps to get the circular buffers positioned correctly. Three different harnesses', 60 shore A (red), 70 shore A (yellow), and 80 shore A (blue)) of lateral circular cross-section buffers are available to tune the correct response of the neck in lateral bending. (Do not mix the colors in one neck.) When installing the flexion/extension buffers in the interface plates, position them as shown in Figure 2-9, so the end that sticks out further is facing the molded neck. The flexion/extension buffers are only available in one hardness.

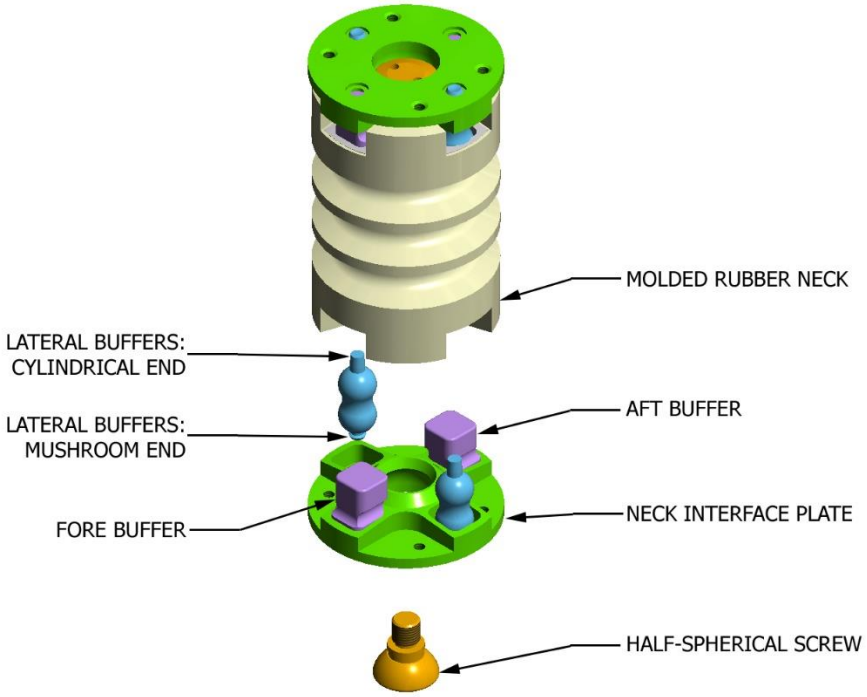


Figure 2-9 Assembly of neck buffers.

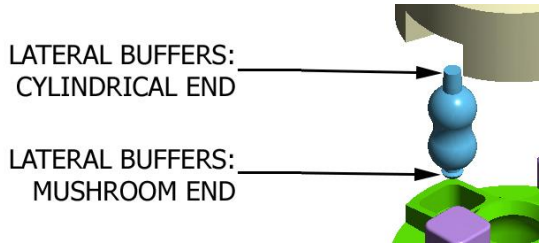


Figure 2-10 Detailed view of lateral buffers.

Position the interface plate with installed buffers over one end of the neck. Lubricate the surface of the half-spherical screw with "Never Seez" high-pressure grease, which is provided in the toolbox. Attach the interface plate to the neck by tightening the half-spherical screws to 10 Nm using the neck compression tool. Repeat for the other end of the neck.

Place the upper neck bracket (W50-20102) over the lower neck bracket (W50-20101-1) and engage the teeth in the desired orientation. Insert the neck spacer (W50-20103) into the slot on one side and orient it so the hole in the nut lines up with the hole accessed from the back of the lower neck bracket. Insert the M6 X 1 X 30 LG. SHCS (5000008) to secure the brackets together. Repeat with the second neck bracket nut and SHCS on the other side. Take extra care to ensure that the teeth are lined up properly. The fine teeth may make it easily misaligned.

Mount the neck load cell or its replacement (W50-71003) to the neck bracket with four M6 X 1 X 12 LG. SHCS (5000281). Tighten the screws to 6 Nm. First the lower neck load cell or its structural replacement has to be mounted to the upper neck bracket and then assemble this to the lower neck bracket. Attach the neck assembly (W50-21001) to the neck bracket/load cell assembly with four M6 X 1 X 12 LG. SHCS (5000281) accessed from the bottom. Tighten the screws to 6 Nm.

Install the triaxial accelerometer to the upper neck bracket using a M2 X 16 cheese screw (5000254).

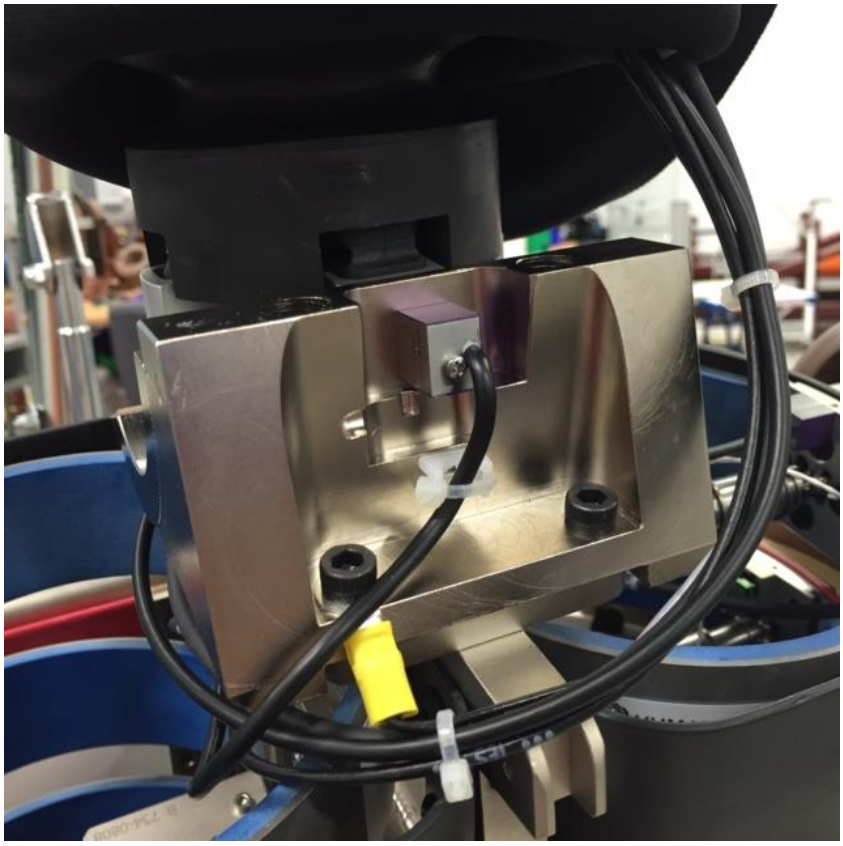


Figure 2-11 Neck triaxial accelerometer installation.

Section 3 Thorax/Abdomen/Shoulder

3.1 Parts List

Table 3-1 lists the parts required for assembly of the WorldSID thorax, abdomen, and shoulder, which are illustrated in Figures 3-1 thru 3-4. Part numbers correspond to those on drawing W50-30000.

ITEM	QTY	PART NO.	DESCRIPTION
1	1	W50-31000	SPINE BOX ASSEMBLY
2	5	IF-367	IR-TRACC ASSEMBLY, 2D RIB 2-6 (REF)
3	2	W50-32111	THORAX RIB ASSEMBLY 1
4	8	W50-32131	THORAX RIB ASSEMBLY 2 & 3
5	1	W50-35022	STERNUM, THORAX RIB
6	1	W50-35021	RIB COUPLER, ABDOMINAL
7	2	W50-32177	SHOULDER RIB STERNUM MOUNTING STRIP
8	10	W50-32178	THORAX AND ABDOMINAL RIB STERNUM MOUNTING STRIP
9	10	W50-32176	THORAX AND ABDOMINAL RIB MOUNTING STRIP, THREADED
10	24	5000003	M5 X 0.8 X 10 LG. BHCS
11	2	W50-32160-2	SHOULDER RIB ASSEMBLY, INNER BAND
12	6	W50-32150-2	THORAX RIB ASSEMBLY, INNER BAND
13	4	W50-32155-2	ABDOMEN RIB ASSEMBLY, INNER BAND
14	2	W50-32171	SHOULDER RIB MOUNTING BRACKET
15	10	W50-32172	THORAX AND ABDOMINAL RIB ACCELEROMETER MOUNTING BRACKET
16	6	7268C-M1	ACCELEROMETER, LINEAR TRIAXIAL, ENDEVCO 7268C-M1 (REF)
17	2	W50-32001	RIB ASSEMBLY, SHOULDER
18	2	W50-32175	SHOULDER RIB STERNUM MOUNTING STRIP, THREADED
19	10	W50-32173	THORAX AND ABDOMINAL RIB CLAMPING BRACKET
20	8	5000386	M5 X 0.8 X 16 LG. FHCS
21	6	W50-32179	SCREW, RIB IR-TRACC MOUNT
22	2	W50-32010	RIB DOUBLER, SHOULDER
23	2	W50-61053	SHOULDER ASSEMBLY, L.C. STRUCTURAL REPLACEMENT
24	12	W50-32180	CLAMP, DAMPING
25	24	5000084	M5 X 0.8 X 10 LG. FHCS
26	24	5000214	M5 X 0.8 X 6 LG. BHCS
27	1	W50-35023-1	SHOULDER PAD, LEFT
28	1	W50-35023-2	SHOULDER PAD, RIGHT
29	4	5000208	M2.5 X 0.45 X 10 LG. BHCS
30	2	5000462	M12 X 1.75 HEX LOCK NUT ZINC
31	2	W50-35024	THORAX PAD
32	4	5000081	M6 X 1 X 16 LG. SHCS
33	6	5000254	M2 X 0.4 X 16 LG. CHMSS SS
34	8	6002035	CABLE TIE MOUNT, .50 X .50, NYLON, ADHESIVE BACKED
35	1	6002036	CABLE TIE MOUNT, #4 SCREW, NYLON

36	1	5000399	M3 X 0.5 X 6 LG. BHCS SS
37	8	6002055	CABLE TIE, HOOK & LOOP, 11 INCH (NOT SHOWN)
38	1	734-0808	TEMPERATURE LOGGER ASSY (REF)
39	1	W50-37013	BATTERY MOUNTING BRACKET
40	2	W50-37014	SPINE BALLAST STAND OFFS
41	1	W50-37015	DAS MOUNTING BRACKET, THORAX
42	1	W50-74307	DAS STRUCTURAL REPLACEMENT
43	2	5000721	M5 X 0.8 X 25 LG. SHCS
44	40	5000654	M5 X 0.8 X 12 LG. BHCS
45	4	9003044	#6-32 X 1 1/4 LG. BHCS SS
46	6	5000568	M3 X 0.5 X 12 LG. SHCS SS
47	1	556-5125-2	STRUCTURAL REPLACEMENT COVER
48	1	5000281	M6 x 1.0 x 12 LG. SHCS
49	1	IF-368	IR-TRACC ASSEMBLY, 2D SHOULDER (REF)
50	24	5000774	M5 X 0.8 X 10 LG. LHCS
51	2	W50-62000	HALF ARM ASSEMBLY

Table 3-1 Parts list for the WorldSID thorax/abdomen/shoulder.

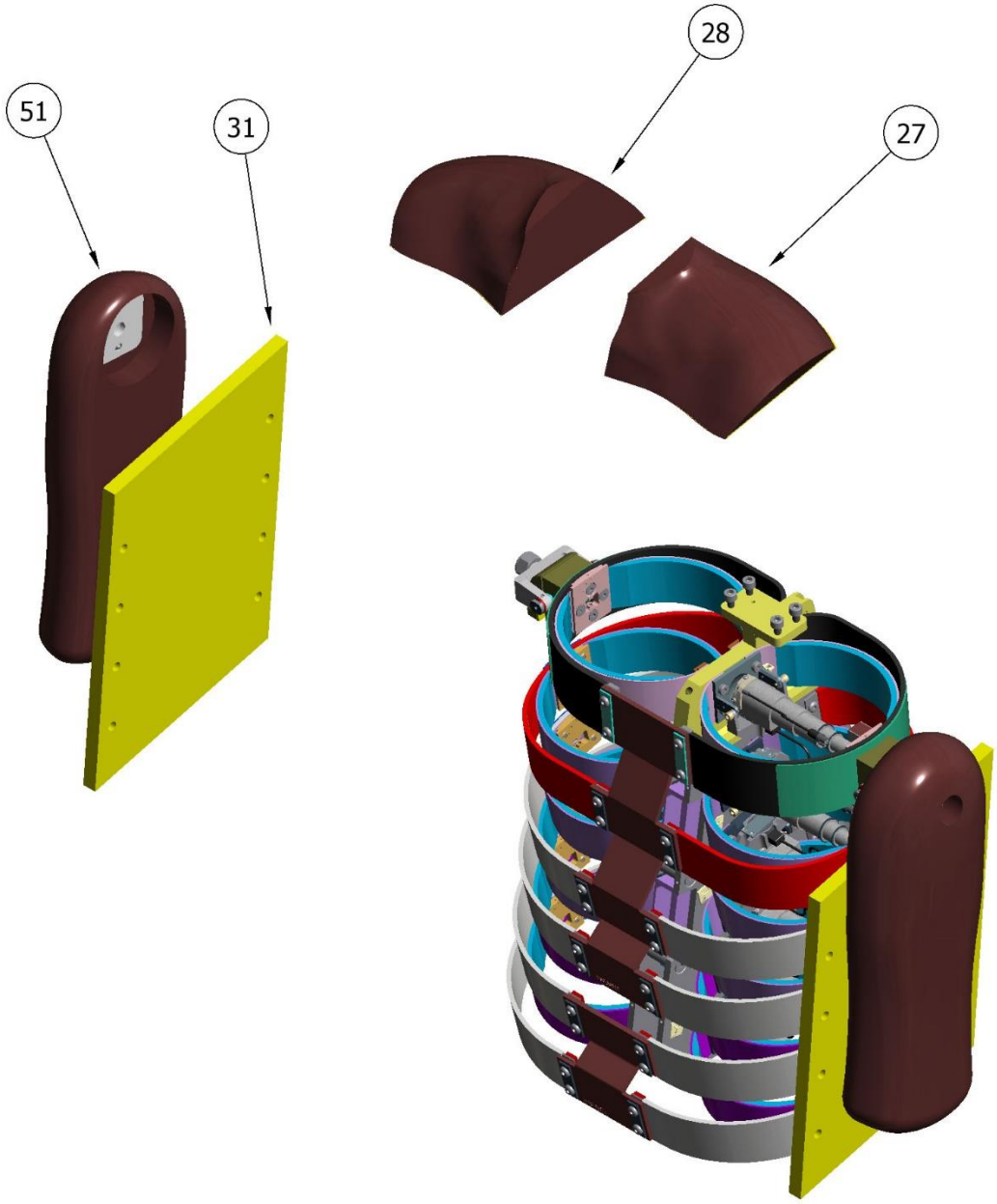


Figure 3-1 WorldSID thorax components, shoulder pads, thorax pad, and half arm.

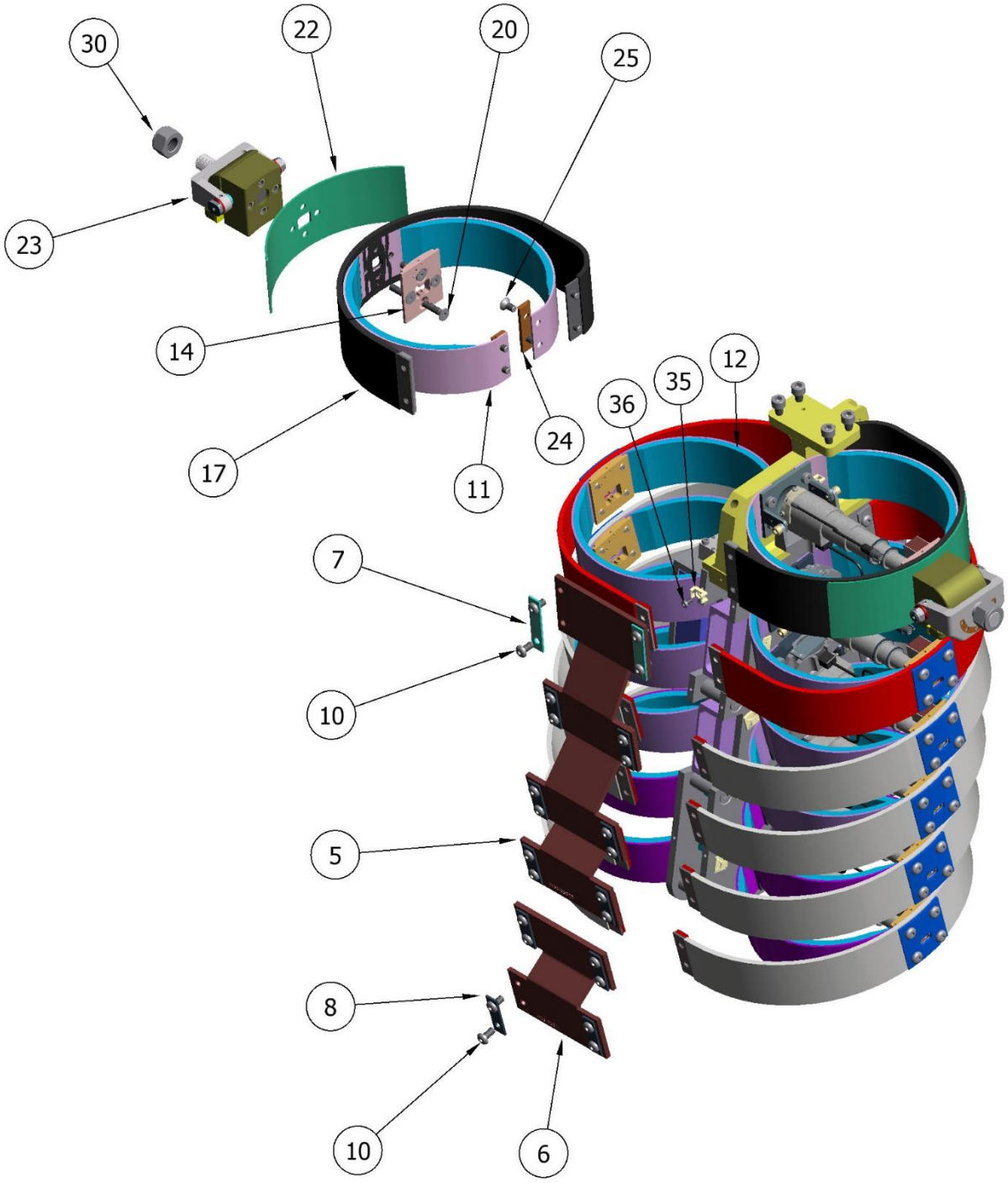


Figure 3-2 WorldSID thorax components, sternum thorax bib, rib coupler, and shoulder ribs.

Orientation of 2-D IR-TRACC in shoulder is rotated 180°, compared to other IR-TRACC as shown in Figure 3-3.

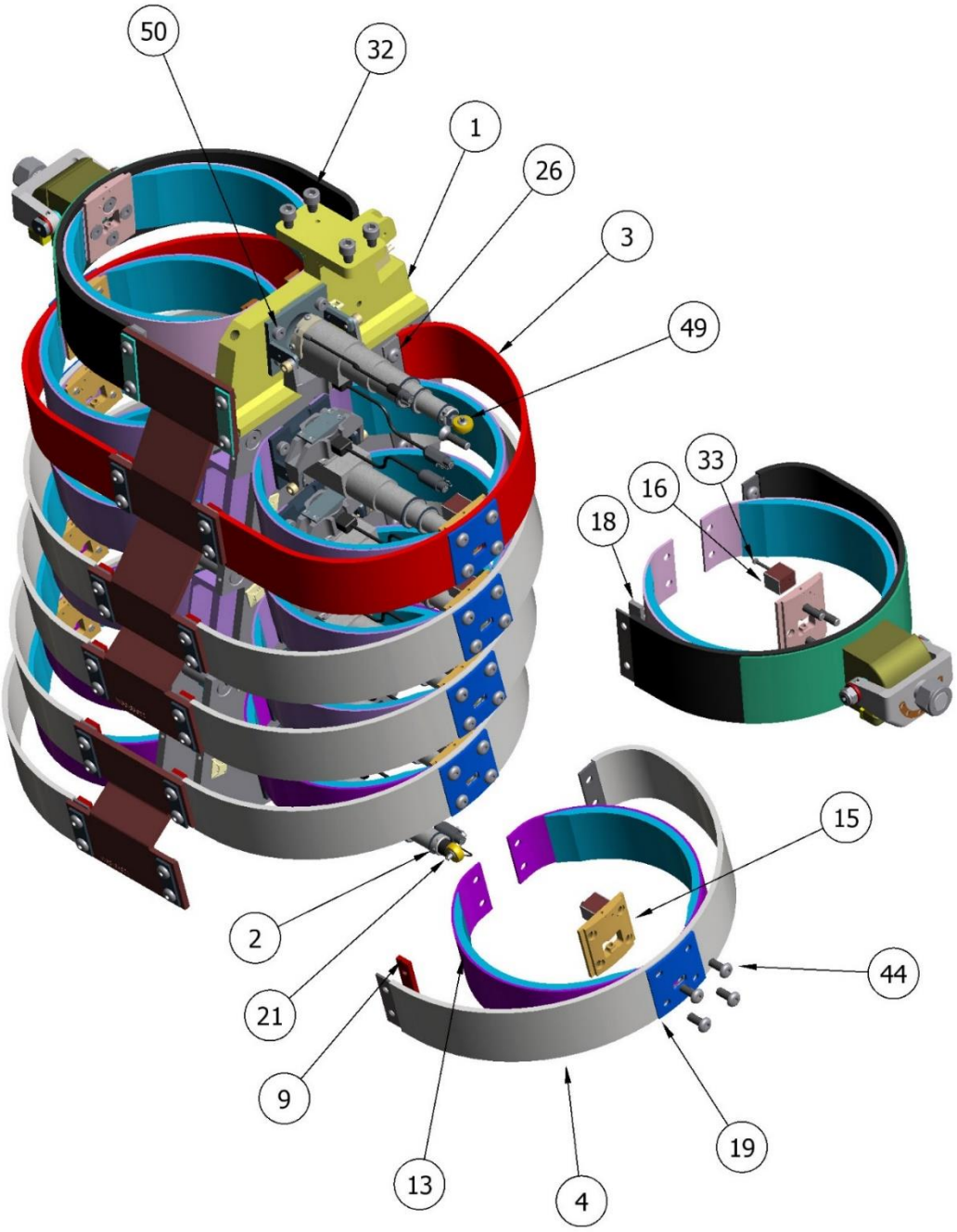


Figure 3-3 WorldSID thorax components, 2-D IR-TRACC.

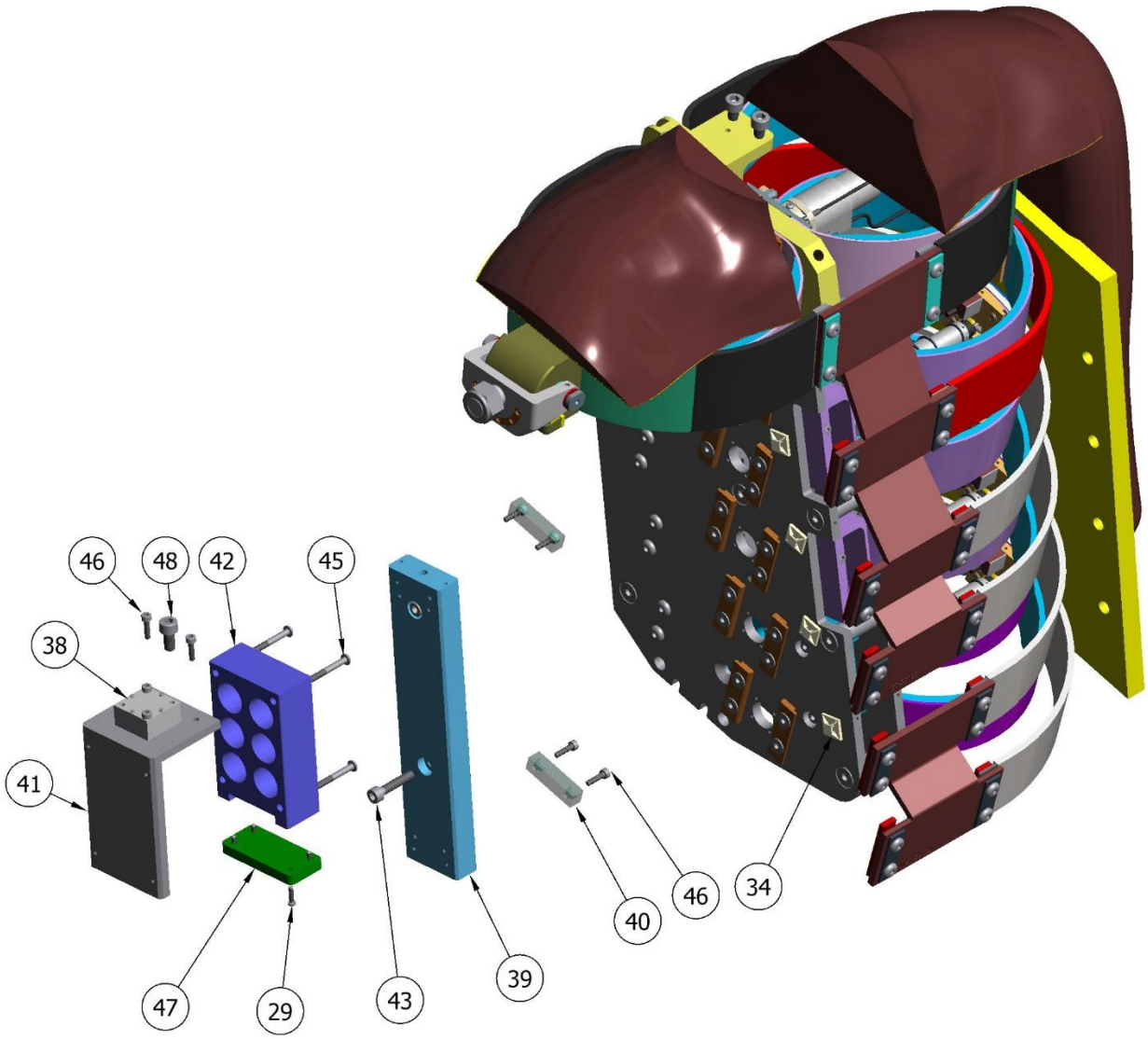


Figure 3-4 WorldSID thorax components, DAS mounting bracket, thorax.

As an example, Figure 3-5 and 3-6 shows the arrangement of the components in the first thoracic WorldSID rib. All of the ribs have a similar general assembly. The inner band of the rib is attached to the side plate with damping clamps and M5 X 0.8 X 10 LG. FHCS (5000084). The rib is attached to the side plate at the rear with M5 X 0.8 X 6 LG. BHCS (5000214), and to the thorax rib sternum (W50-35022) at the front using M5 X 0.8 X 10 LG. BHCS (5000003) and the sternum mounting strip (W50-32178) and threaded sternum mounting strip (W50-32176). The 2D IR-TRACC assembly is attached with a M5 X 0.8 X 10 LG. LHCS (5001278) to the side plate. The 2D IR-TRACC is secured to the rib accelerometer mounting bracket (W50-32172) with a special mounting screw (W50-32179) accessed from the bottom. A linear triaxial accelerometer is attached to the rib accelerometer mounting bracket (W50-32172), which is then secured to the inner rib, rib, and rib clamping bracket (W50-32173) with M5 X 0.8 12 LG. BHCS (5000654).

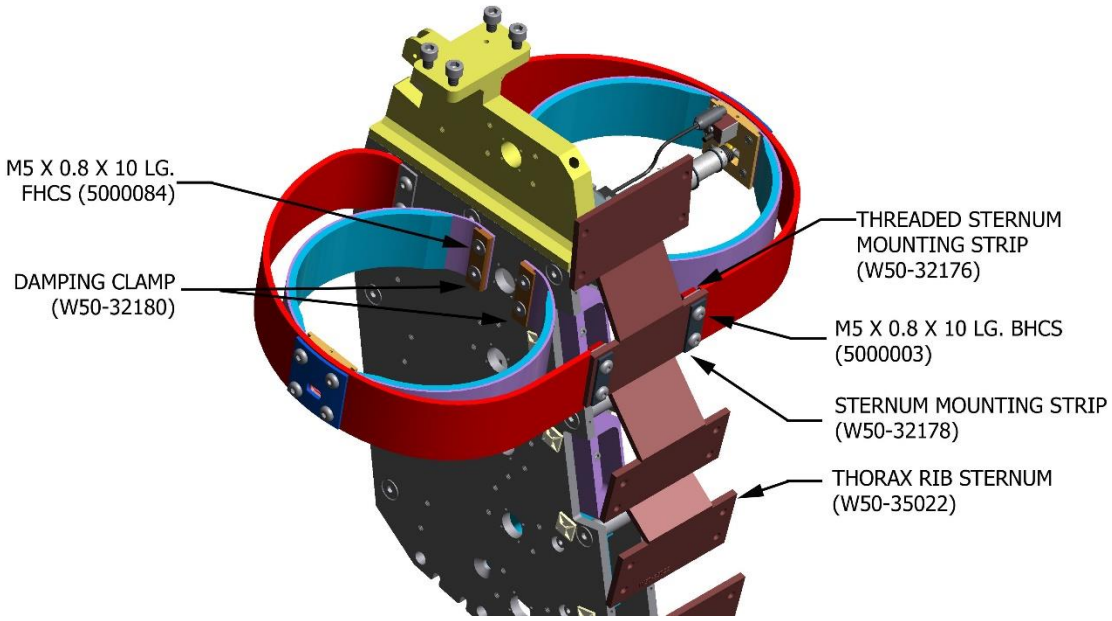


Figure 3-5 Components of thorax rib, damping clamp.

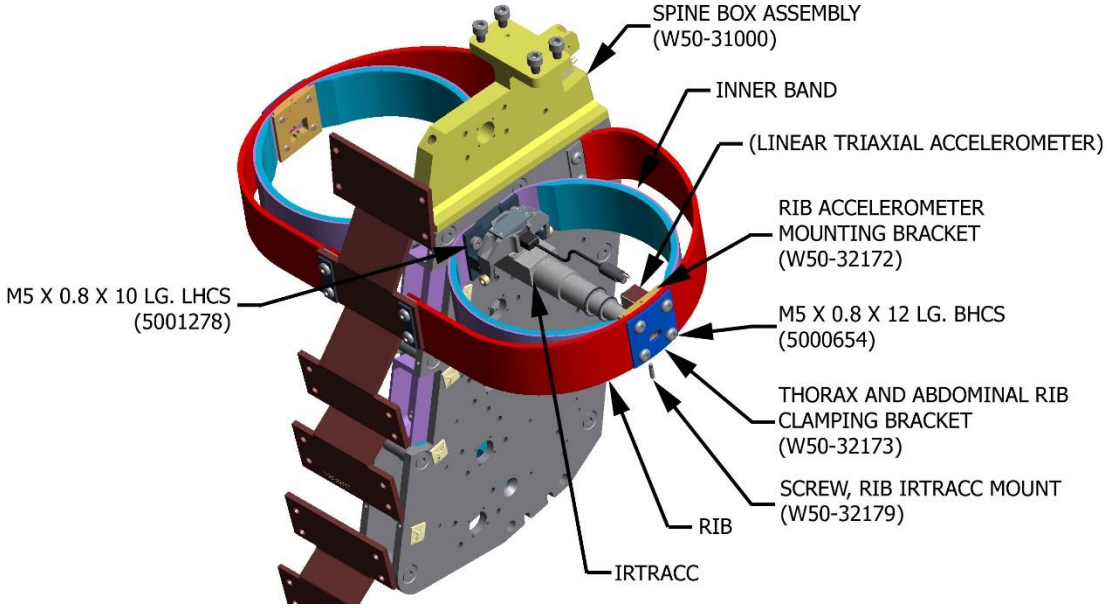


Figure 3-6 Components of thorax rib, rib clamping bracket.

3.2 Disassembly

Remove the thorax pad (W50-35024) by removing the Velcro ties that hold them in place. Remove the shoulder pads (W50-35023-1 and W50-35023-2) by lifting them off of the dummy. Remove the lower neck bracket from the spine box by removing four M6 X 1 X 16 SHCS (5000081).

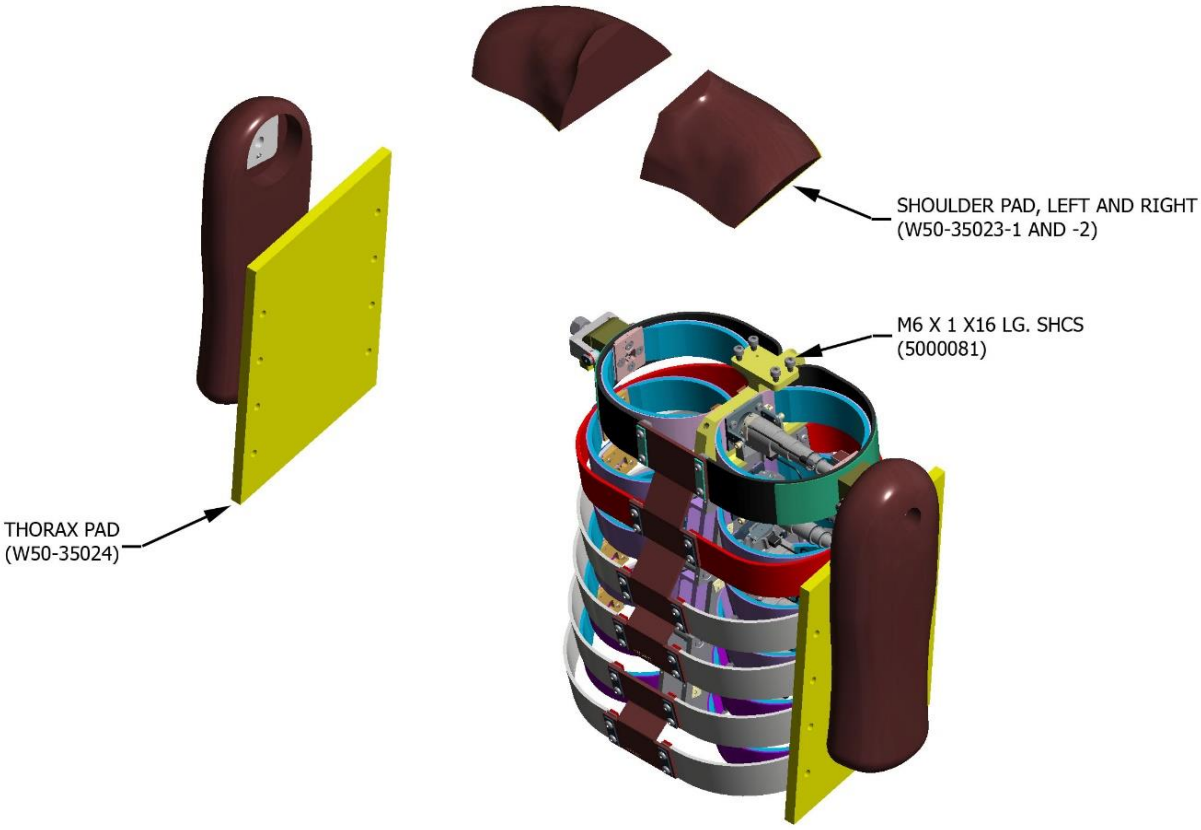


Figure 3-7 Removing thorax pads and shoulder pads.

It is best to remove the abdominal rib coupler (W50-35021) and the thorax rib sternum (W50-35022), before removing the ribs. Disconnect the shoulder rib (W50-32001) at the front by removing the two M5 X 0.8 X 10 LG. BHCS (5000003) that attach the left and right shoulder ribs to the thorax rib sternum (W50-35022). A shoulder rib sternum mounting strip (W50-32177) and a threaded shoulder rib sternum mounting strip (W50-32175) will be free to remove from each side. If possible, it is best to separate the spine box first from the pelvis, then remove the head assembly.

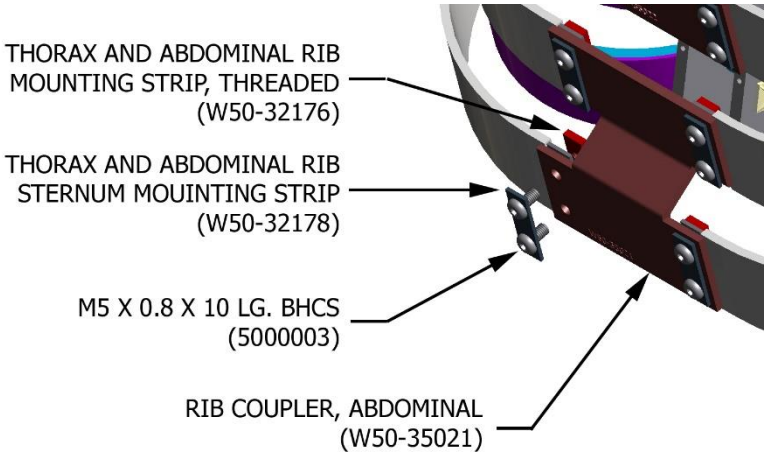


Figure 3-8 Detaching the rib coupler, abdominal.

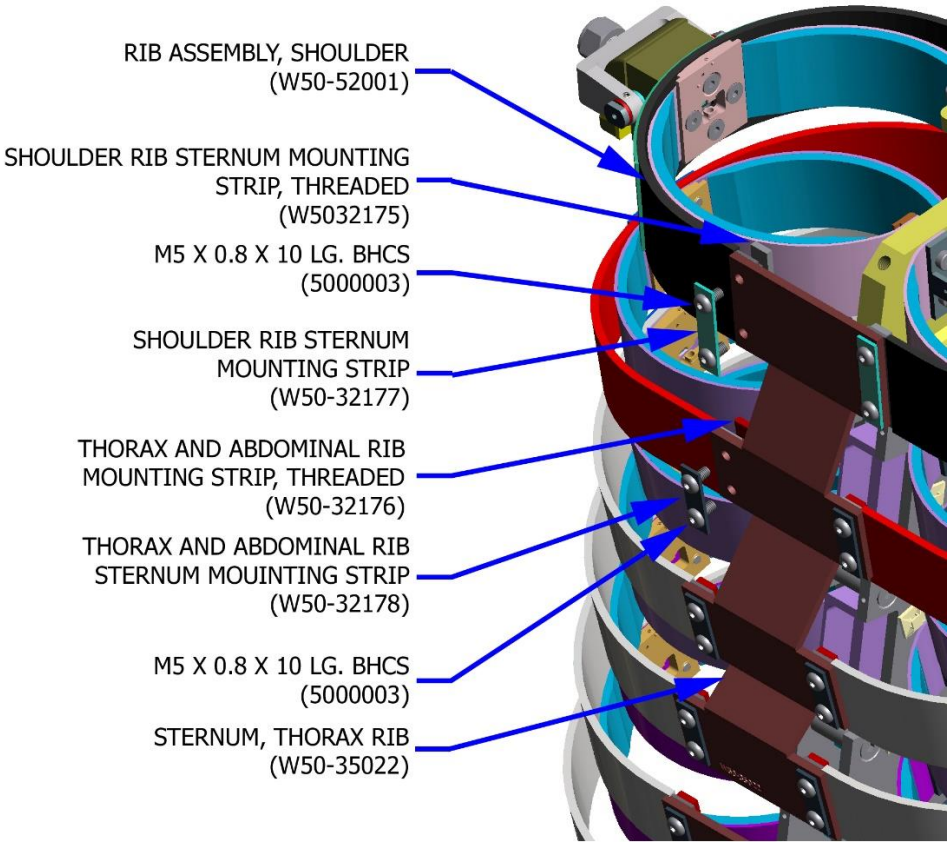


Figure 3-9 Detaching thorax rib sternum.

Remove the linear triaxial accelerometer (7268C-M1) from the shoulder rib mounting bracket by removing the M2 X 0.4 X 16 LG. cheese screw (5000254).

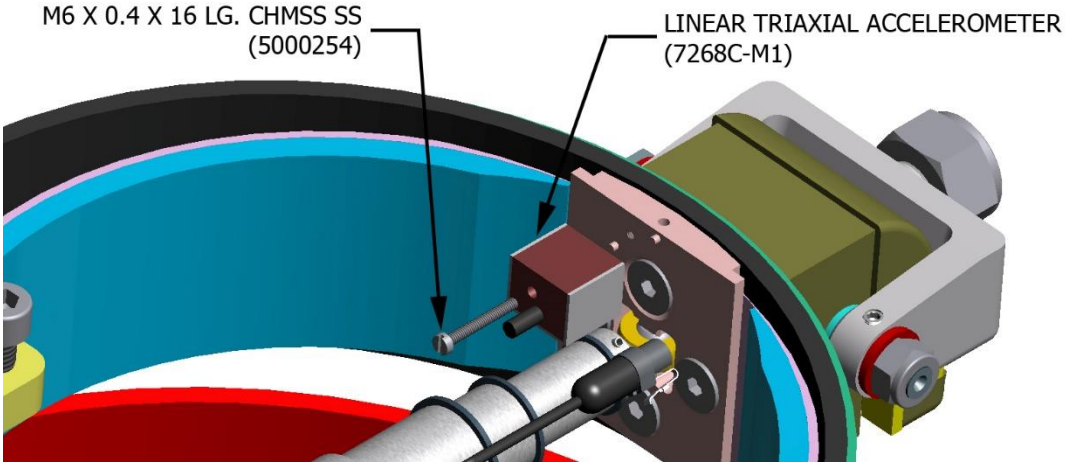


Figure 3-10 Removing linear triaxial accelerometer from shoulder rib mounting bracket.

Remove the shoulder load cell assemblies (W50-61053) by removing four M5 X 0.8 X 16 LG. FHCS (5000386) that hold each in place. The shoulder rib mounting brackets (W50-32171) will be free to remove at this time.

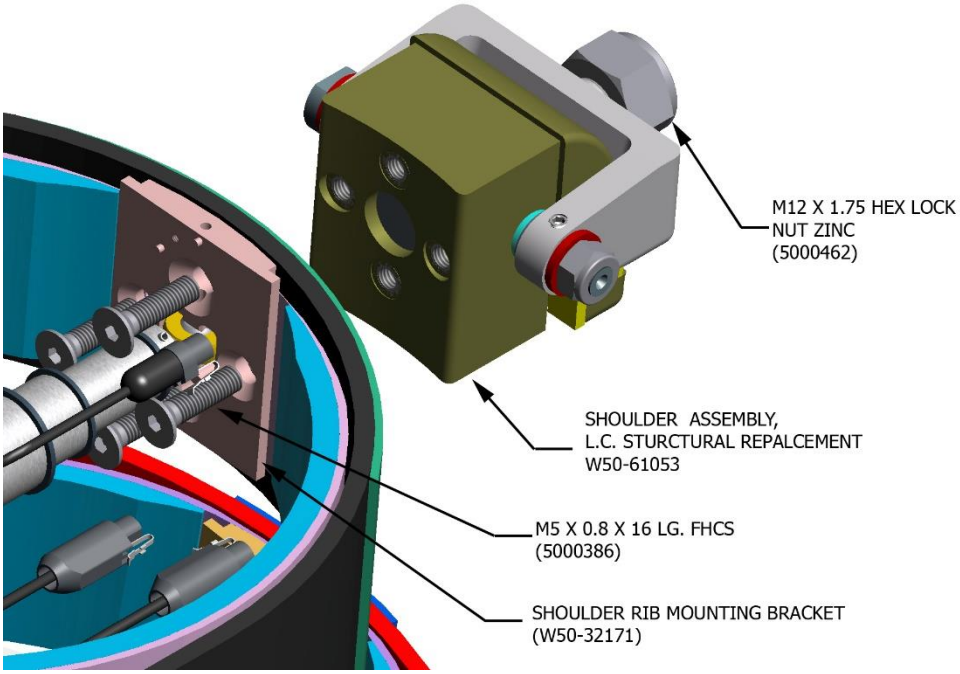


Figure 3-11 Removing the shoulder load cell assembly.

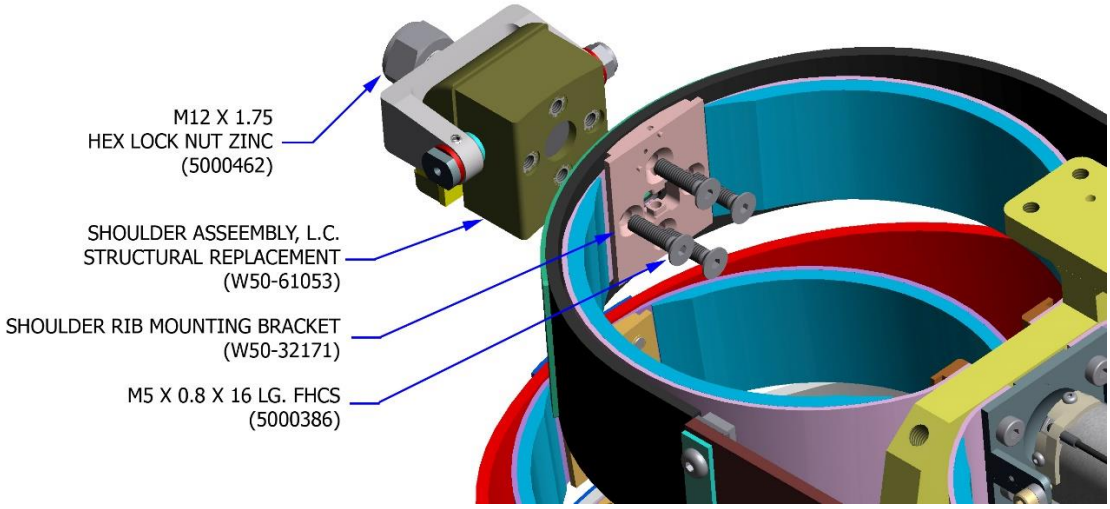


Figure 3-12 Removing the shoulder load cell assembly, on non-struck side.

Detach the shoulder rib 2D IR-TRACC (IF-368) from the shoulder rib mounting bracket by removing the 2D IR-TRACC rib mount screw (W50-32179), accessed from the bottom of the shoulder rib mounting bracket.

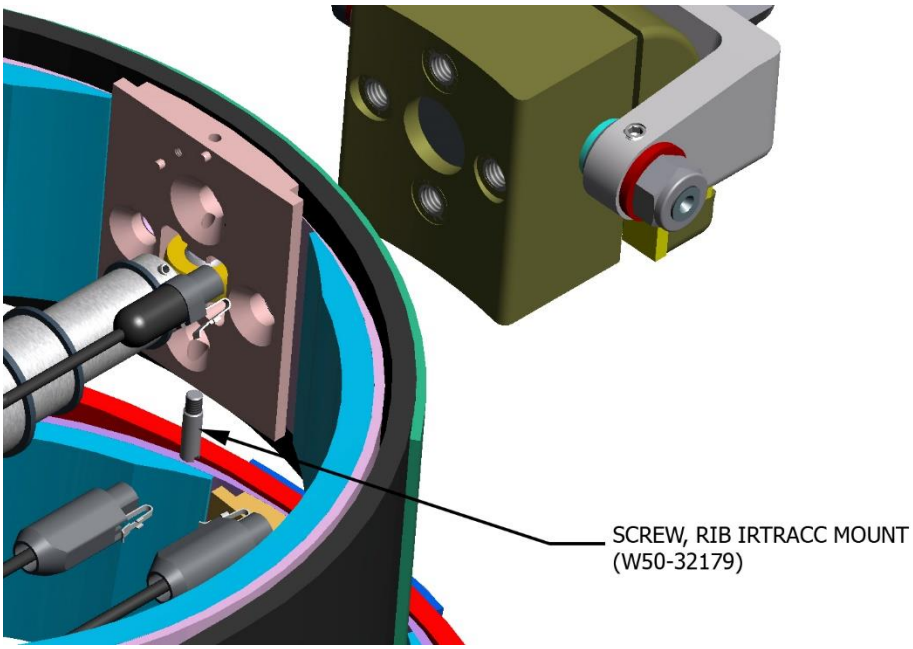


Figure 3-13 Removing rib mount screw.

Detach the shoulder 2D IR-TRACC assembly from the spine box by removing the M2.5 X 0.8 X 10 LG. LHCS (5000774).

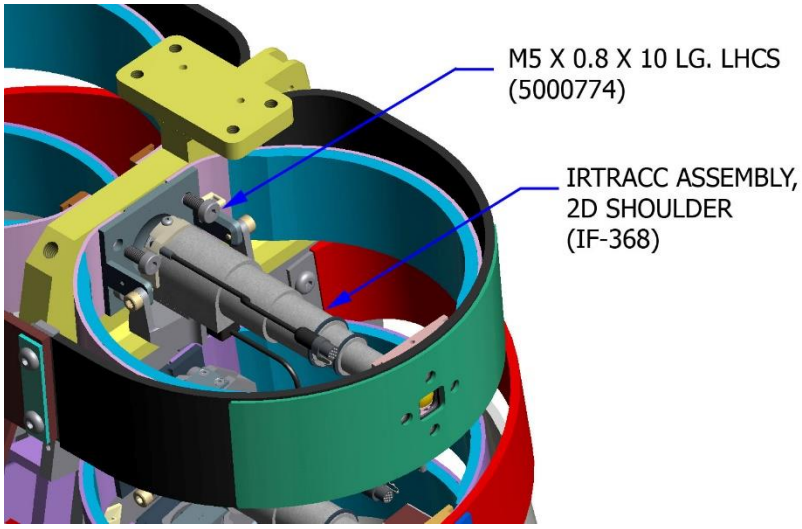


Figure 3-14 Removing shoulder rib 2D IR-TRACC from the side plate.

Figure 3-15 shows the non-struck side and the inner band of the shoulder rib assembly (W50-32160-2). The two damping clamps (W50-32180) are removed when the four M5 X 0.8 X 10 LG. FHCS (5000084) are removed, at the same time the inner will be detached.

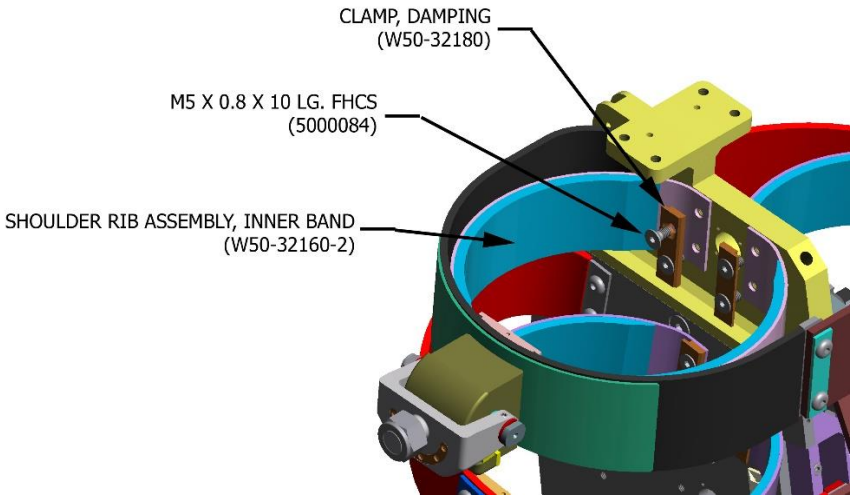


Figure 3-15 Removing molded rib stops and inner rib.

Detach the left and right shoulder ribs (W50-32001) from the spine box at the rear by removing two M5 X 0.8 X 6 LG. BHCS (5000214) that hold each in place (Figure 3-16).

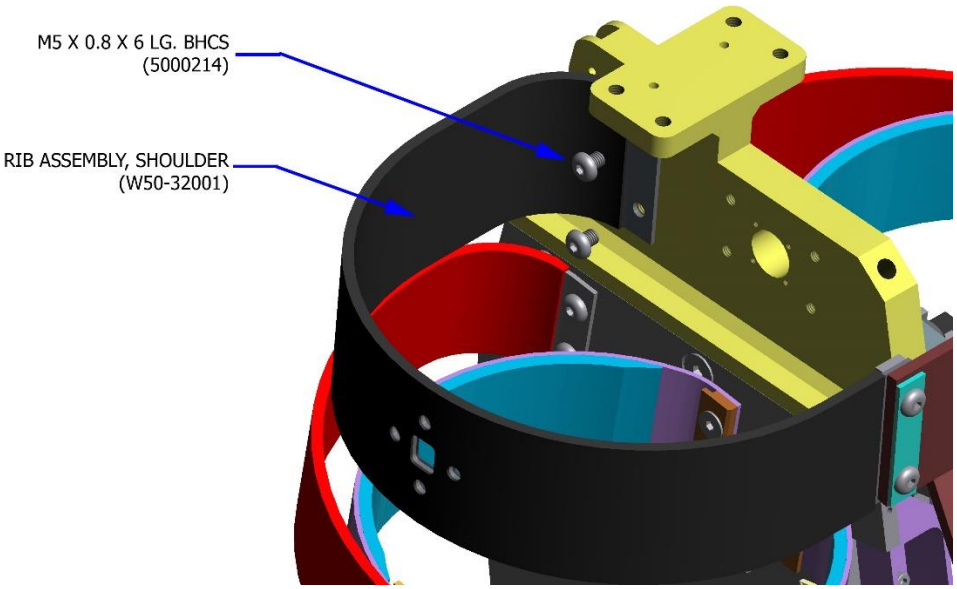


Figure 3-16 Detaching the rib from the spine box at the rear.

The procedures for disassembling the remaining ribs are similar to those for the shoulder rib, but details for the first thoracic rib are included here to include references to the correct part numbers. When 2D IR-TRACC's are installed, it is best to start the disassembly at the lower abdomen rib. Detach the rib clamping bracket (W50-32180) and the rib accelerometer mounting bracket (W50-32172) by removing the four M5 X 0.8 X 12 LG. BHCS (5000654).

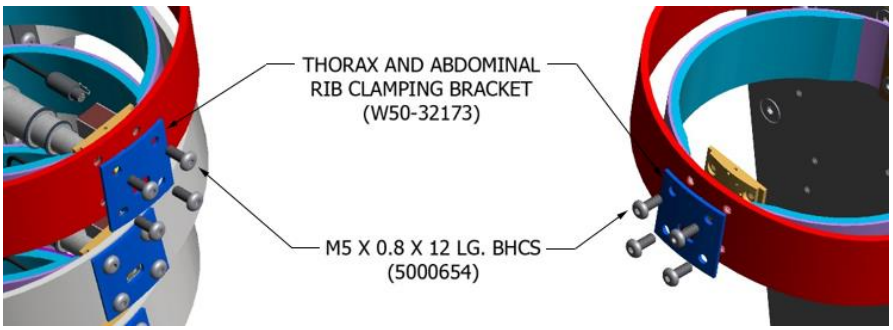


Figure 3-17 Removing the thorax and abdominal rib clamping bracket.

Remove the triaxial accelerometer (7268C-M1) from the rib accelerometer mounting bracket (W50-32172) by removing the M2 X 16 cheese screw (5000254). Detach the IR-TRACC from the rib accelerometer bracket by removing the IR-TRACC mount screw (W50-32179), which is accessed from the bottom of the rib accelerometer bracket.

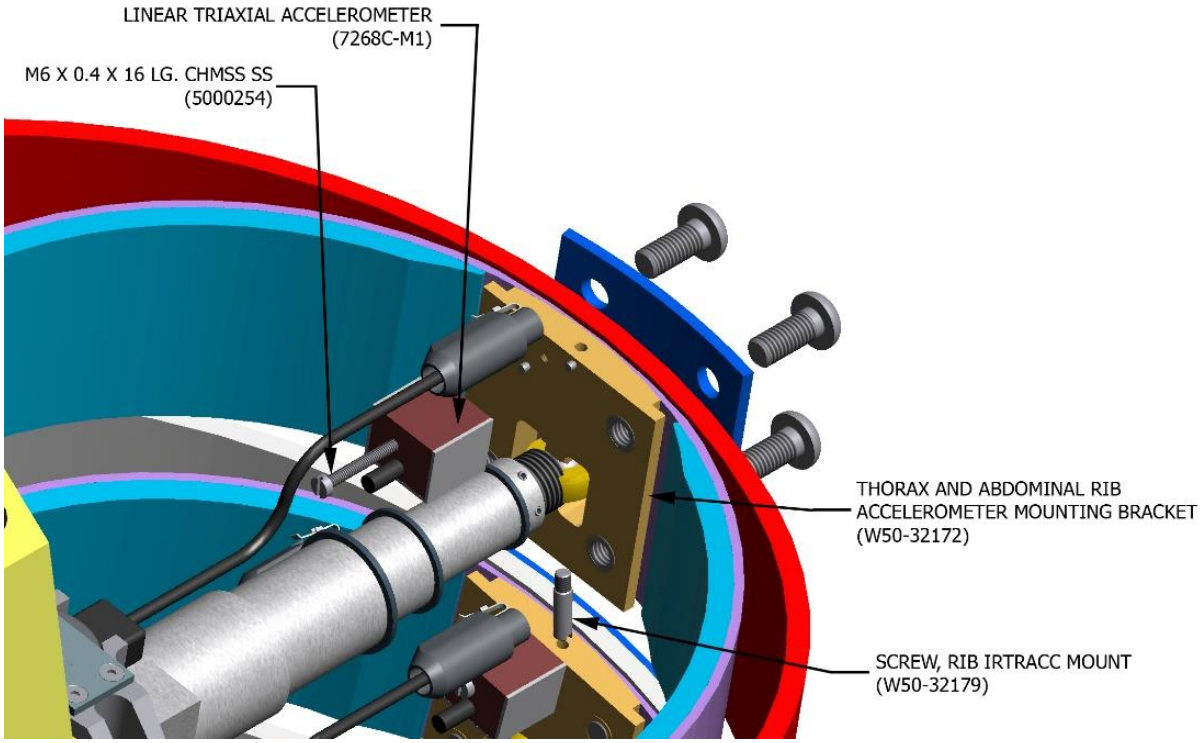


Figure 3-18 Removing the linear triaxial accelerometer and 2D IR-TRACC.

The IR-TRACC can be removed by removing the M5 X 0.8 X 10 LHCS (5000774) that secures it to the side plate.

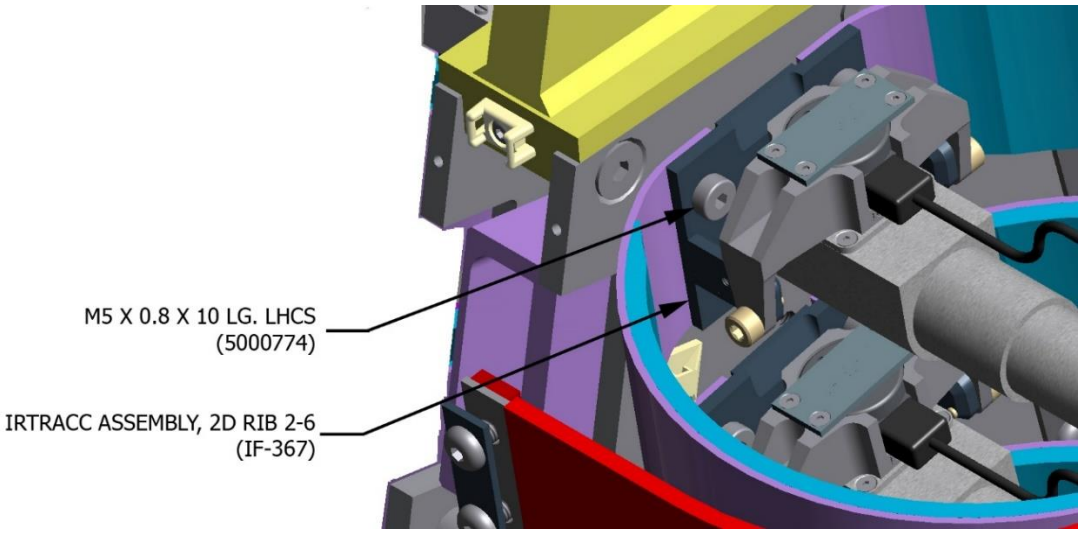


Figure 3-19 Removing 2D IR-TRACC for ribs 2-6.

Detach the inner band of the thorax rib by removing the four M5 X 0.8 X 10 LG. FHCS (5000084) that holds them in place. Two damping clamps (W50-32180) will be free to remove as well. The damping clamps are only available at the non-impact side, not when a 2D IR-TRACC is mounted. Detach the rib from the spine box at the rear by removing two M5 X 0.8 X 6 LG. BHCS (5000214) that hold them in place.

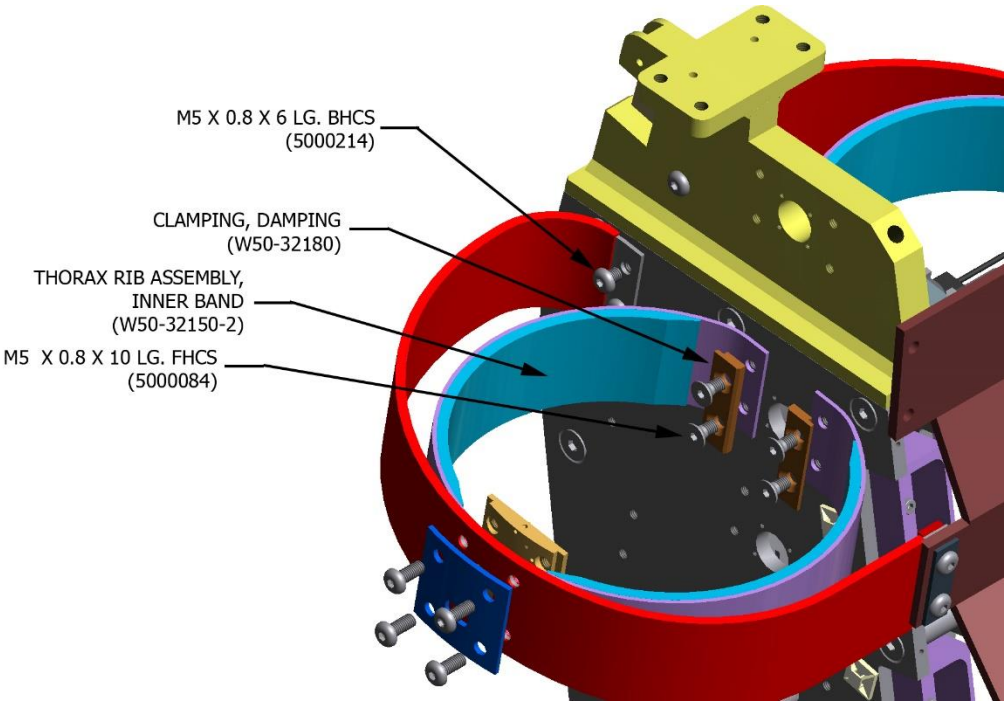


Figure 3-20 Removing the ribs and inner band.

Detach the thorax rib at the front by removing the four M5 X 0.8 X 10 LG. BHCS (5000003) that connects it to the thorax rib sternum (W50-35022). Two sternum rib mounting strips (W50-32178) and two threaded rib mounting strips (W050-32176) will be free to remove at this time.

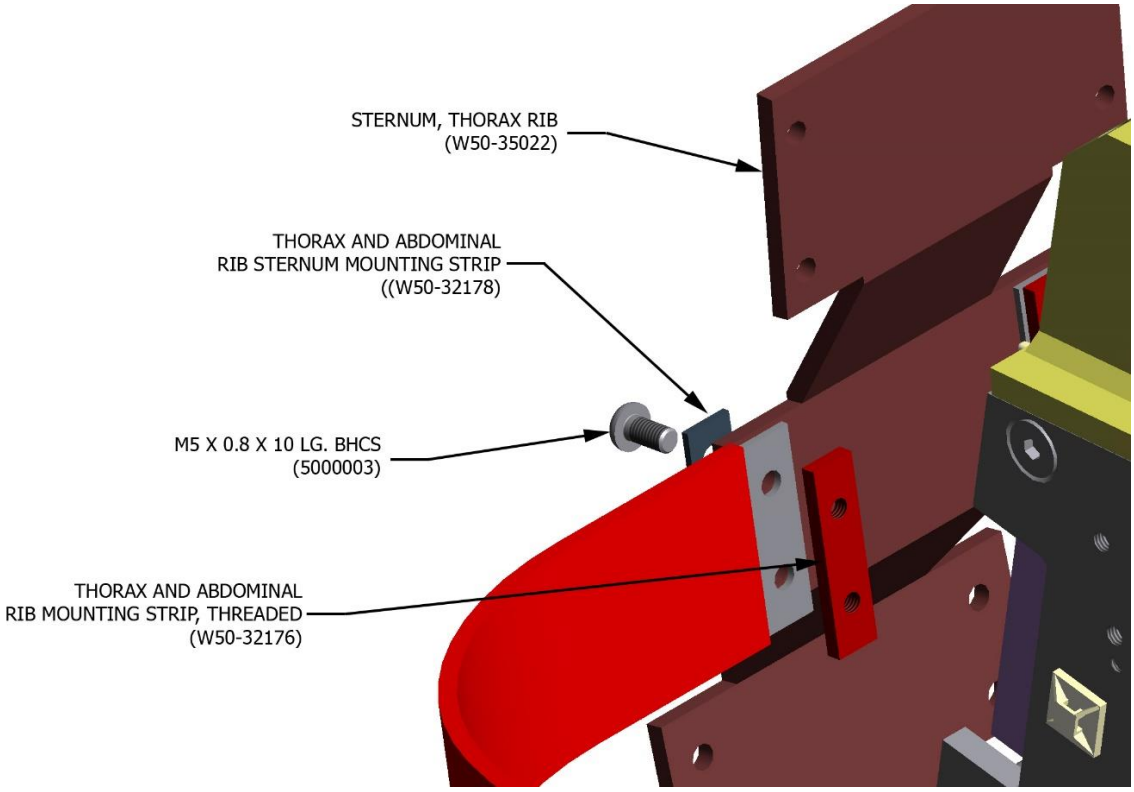


Figure 3-21 Removing the thorax and abdominal rib sternum mounting strip.

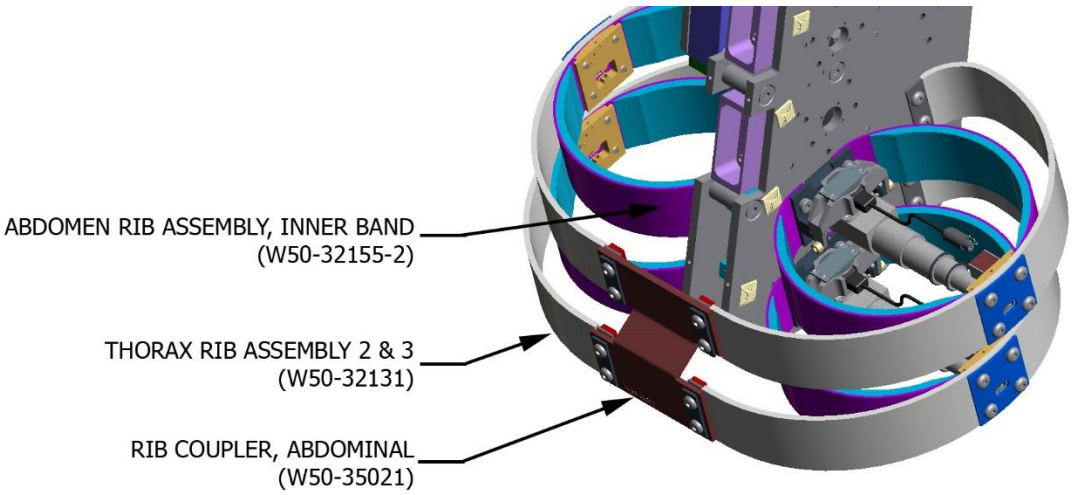


Figure 3-22 Attaching the abdominal rib coupler.

This procedure is repeated for the second and third thorax ribs and the two abdominal ribs with the few differences in parts described here. The two ribs are attached at the front to the abdominal rib coupler (W50-35021). The inner rib bands of the two abdomen ribs (W50-32155-2) are different than the inner bands of the other ribs. The damping material on the abdominal ribs is thicker than that on the thoracic ribs. The first thorax rib (W50-32111) is different from the thorax ribs #3, 4, 5, and 6 (W50-32131) and the abdominal ribs, which are the same.

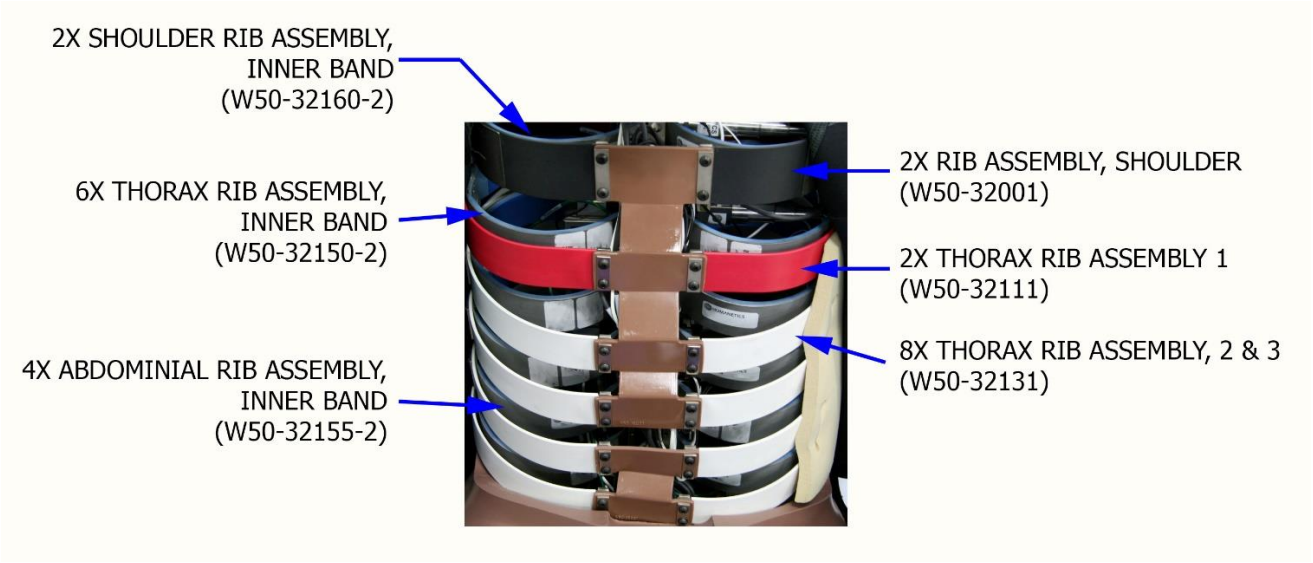


Figure 3-23 Ribs and inner bands.

Before the ribs are removed, detach the DAS mounting bracket from the non-struck side by removing two M3 X 0.5 X 12 LG. SHCS (5000568) and one M6 X 1 X 12 LG. SHCS (5000281). Then detach the DAS structural replacement by removing the four #6-32 X 1-1/4 BHCS SS (9003044). Detach the cover by removing the four M2.5 X 0.45 X 10 LG. BHCS (5000208). Next remove the battery mounting bracket by detaching the two M5 X 0.8 X 25 LG. BHCS (5000721) that secures it to the spine box. Detach the spine ballast stand-offs from the battery mounting bracket by removing the M3 X 0.5 X 12 LG. SHCS SS (5000568).

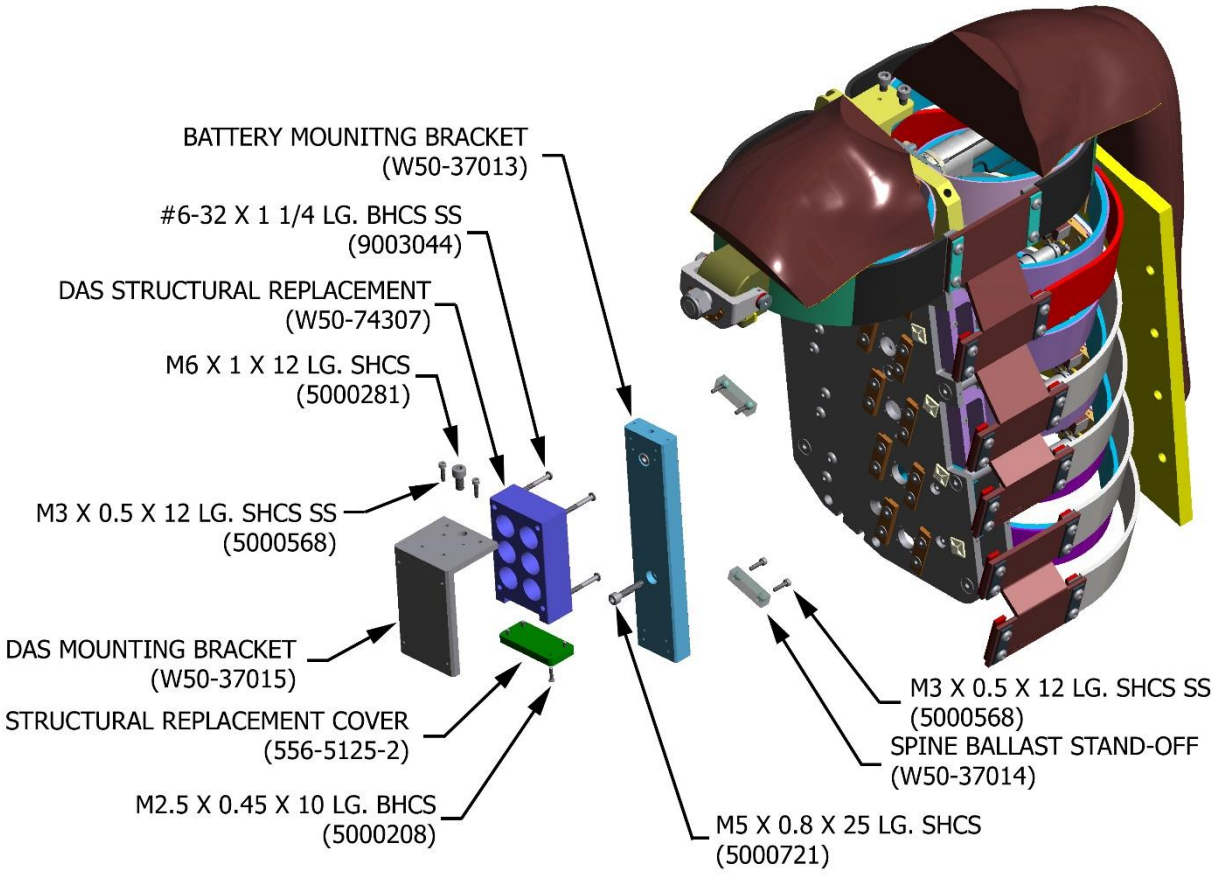


Figure 3-24 Non-impact side DAS assembly.

(Ribs are removed on this side for clarity.)

3.3 Instrumentation

Thorax instrumentation for the WorldSID includes a 2D IR-TRACC deflection measurement assembly for each struck side rib, plus a triaxial accelerometer attached to the inner struck side of each rib. Figure 3-25 illustrates the configuration for the assembly of the rib with instrumentation. Please note that the 2D IR-TRACCs can be mounted on either side. The side it is mounted on is considered the struck side. The 2D IR-TRACC assembly is attached to the spine box with four M5 X 0.8 X 10 LG. LHCS (5000774). The other end of the 2D IR-TRACC assembly is attached to the rib accelerometer mounting bracket (W50-32171) with a 2D IR-TRACC rib mount screw (W50-32179) accessed from the bottom of the rib. A linear triaxial accelerometer (7268C-M1) is secured to the rib accelerometer mounting bracket (W50-32171) with a cheese screw M2 X 0.4 X 16 LG. (5000254). The rib accelerometer mounting bracket (W50-32171) is secured to the inner band of the rib (W50-32150-2), the thorax rib, and the rib clamping bracket (W50-32173) with four M5 X 0.8 X 12 BHCS (5000654).

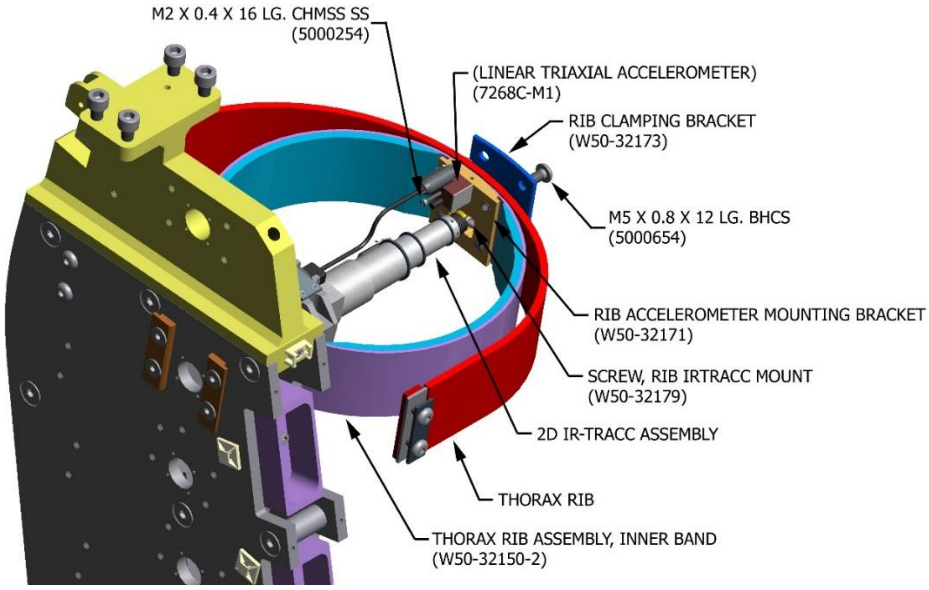


Figure 3-25 WorldSID rib instrumentation.

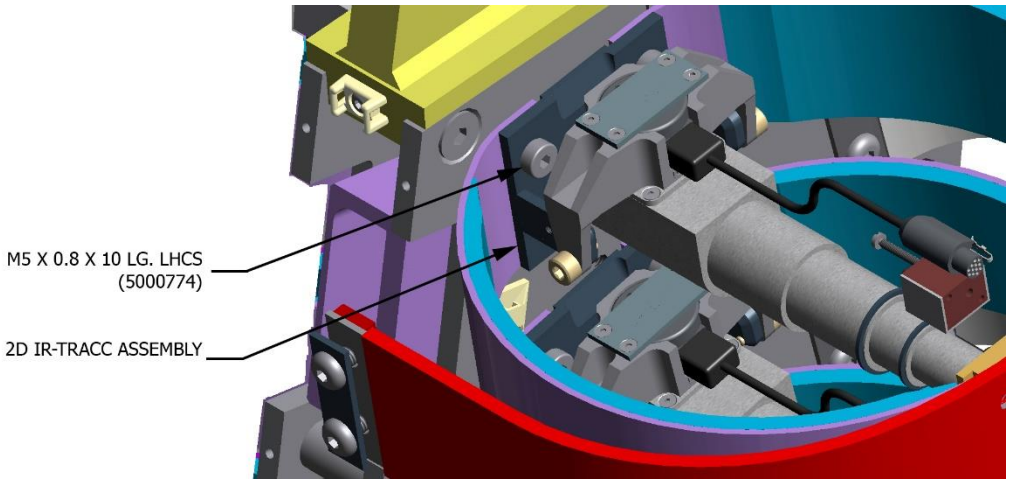


Figure 3-26 Assembling 2D IR-TRACC.

The upper torso also consists of the shoulder assembly load cell and the temperature logger assembly is referenced.

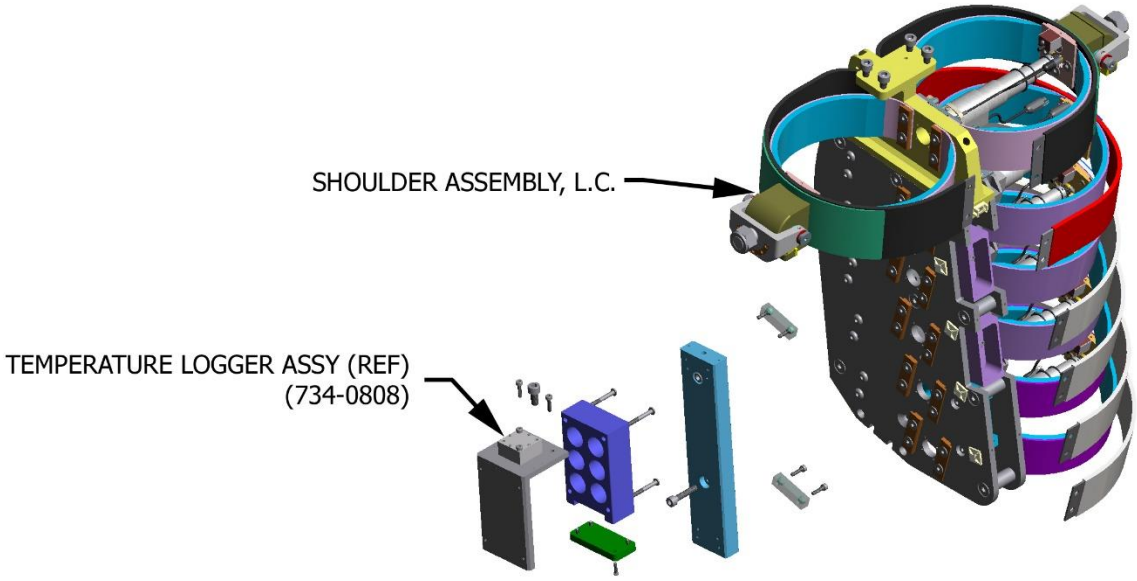


Figure 3-27 Shoulder assembly, load cell.

Additional instrumentation attached to the spine box is described in the disassembly/assembly section for the spine box.

3.4 Re-Assembly

Figure 3-28 shows the color coding scheme for the WorldSID ribs. The shoulder rib is gray, the first thoracic rib is red, and the remaining ribs (thoracic number two and three, both abdominal) are white. The inner bands of the two abdominal ribs (W50-32155-2) have a thicker layer of damping material than the inner bands of the thoracic ribs (W50-32150-2). The inner band of the shoulder rib (W50-32160-2) is different from the other inner bands. The part number and name are on the part label.

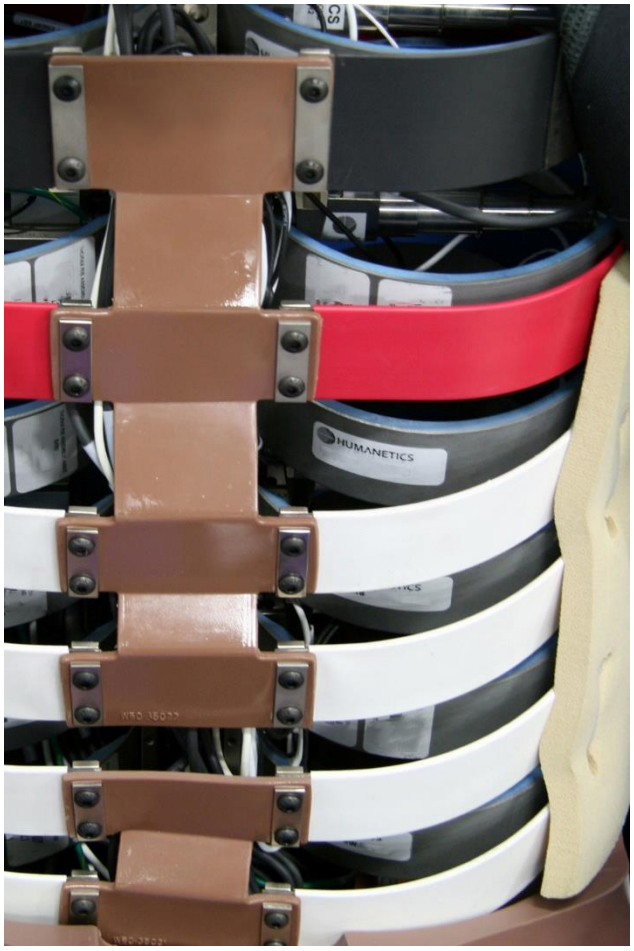


Figure 3-28 Shoulder rib is gray, the first thoracic rib is red, and the second and third thoracic ribs and abdominal ribs are white.

Begin assembly of the ribs from the top to bottom. The left and right sides can be assembled consecutively or simultaneously. Attach the shoulder rib assembly (W50-32001) to the spine box using two M5 X 0.8 X 6 LG. BHCS (5000214).

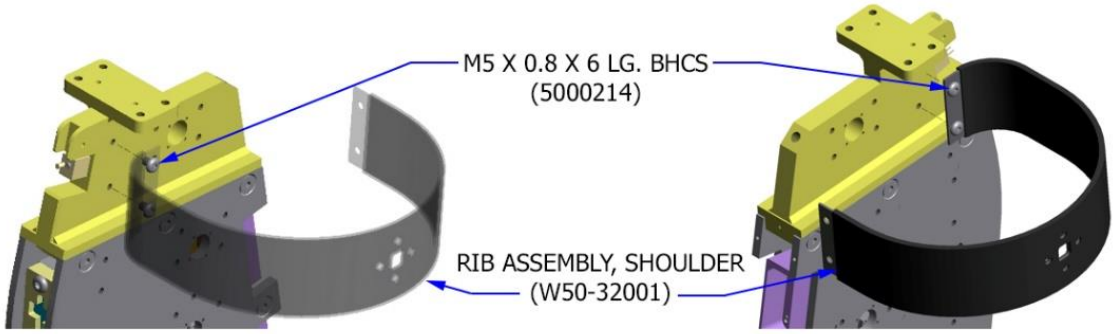


Figure 3-29 Assembling the shoulder rib assembly.

Secure the inner band of the shoulder rib assembly (W50-32160-2) with two damping clamps (W50-32180) and four M5 X 0.8 X 10 LG. FHCS (5000084). To permit easier access to the connector boxes in the spine box, wait until the instrumentation has been plugged in and working properly before attaching the ribs to the thorax rib sternum and abdominal rib coupler.

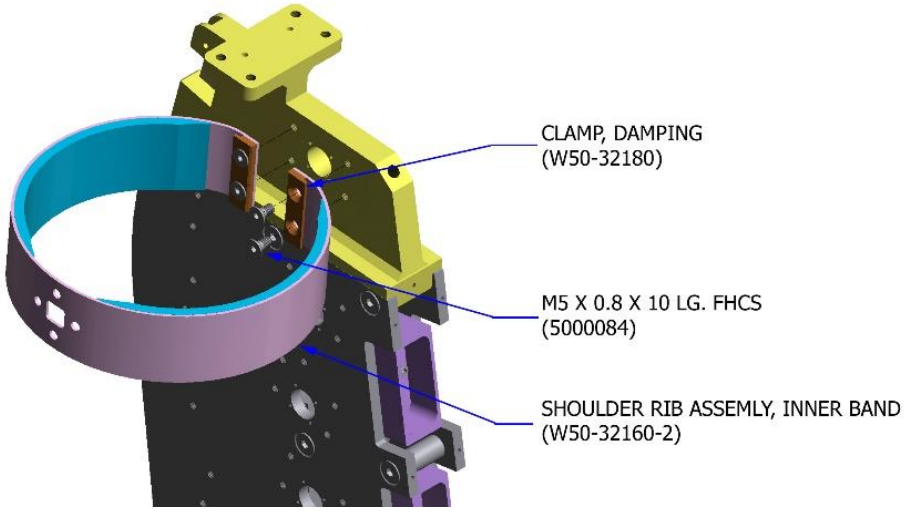


Figure 3-30 Assembling the inner shoulder rib assembly on non-struck side.

Attach the 2D IR-TRACC to the spine box with four M5 X 0.8 X 10 LG. LHCS (5000774) going through the ribs and then into the spine box. Connect it to the shoulder rib accelerometer mounting bracket (W50-32171) with the 2D IR-TRACC mount screw (W50-32179), accessed from the bottom of the rib accelerometer bracket.

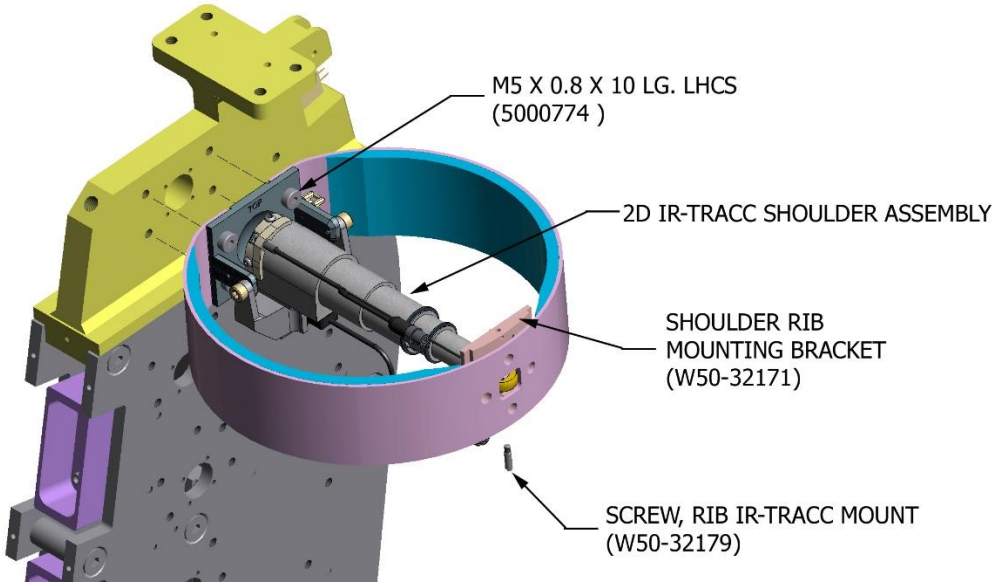


Figure 3-31 Assembling the inner band with 2D IR-TRACC.

As each 2D IR-TRACC assembly and accelerometer is installed, the cables should be routed toward the center front of the dummy and plugged into the DAS. Note: make sure to attach the IR-TRACC spherical joint to the rib with the white wire exit oriented on the same side as the white wire exit point on the IR-TRACC big end, to match the orientation during calibration.

Figure 3-32 Wiring routing for rib instrumentation.

Figure 3-33 Rib instrumentation cables routed in the front to the DAS modules mounted in the spine box.

Fasten four M5 X 0.8 X 16 FHCS (5000386) to the shoulder rib mounting bracket (W50-32171) to the inner band and rib doubler, shoulder (W50-32010), shoulder assembly, load cell structural replacement (W50-61053), and M12 X 1.75 hex lock nut zinc (5000462) on the outside of the shoulder rib assembly.

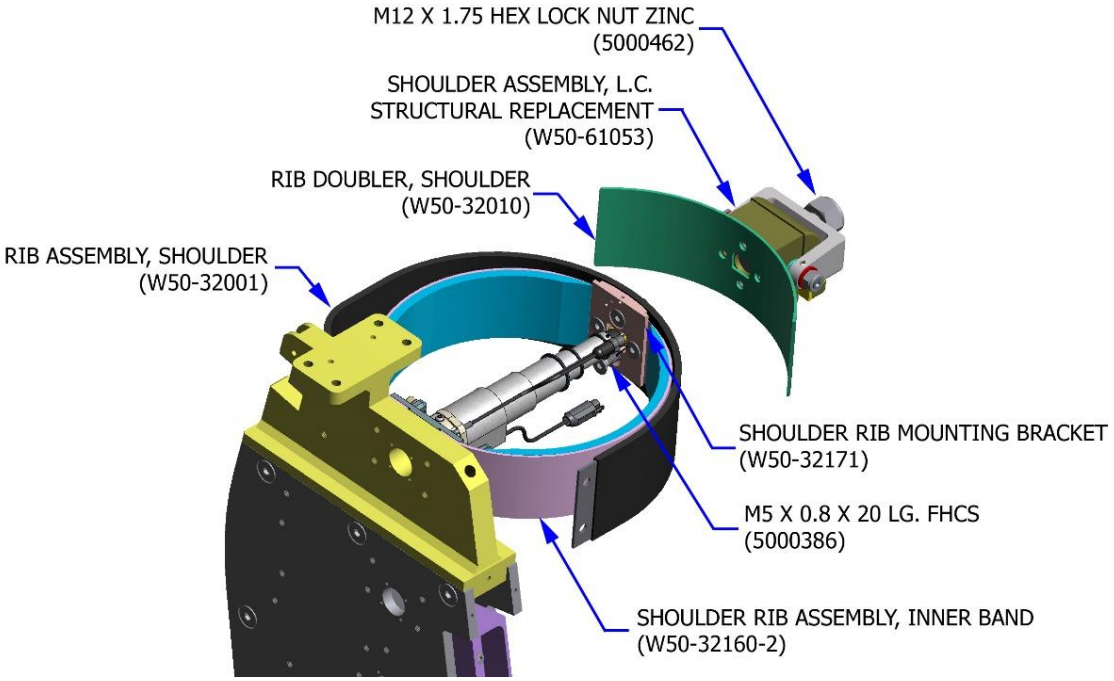


Figure 3-34 Assembling the shoulder rib mounting bracket.

Secure the triaxial accelerometer (7268C-M1) to the rib accelerometer mounting bracket (W50-32172) with a M2 X 0.4 X 16 cheese screw (5000254).

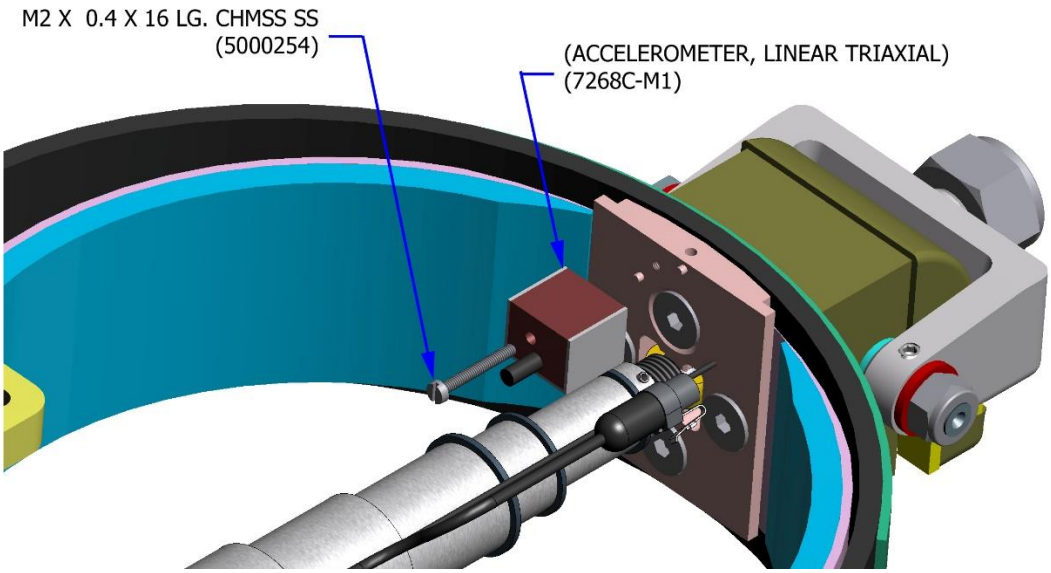


Figure 3-35 Assembling the accelerometer, linear triaxial.

For the thorax and abdominal ribs, connect the thorax and abdominal rib clamping bracket (W50-32173) and the thorax and abdominal rib accelerometer mounting bracket (W50-32172) to the inner band and rib with four M5 X 0.8 X 12 LG. BHCS (5000654). Secure the triaxial accelerometer (7268C-M1) to the thorax and abdominal rib accelerometer mounting bracket (w50-32172) with an M2 X 0.4 X 16 LG. cheese screw (5000254).

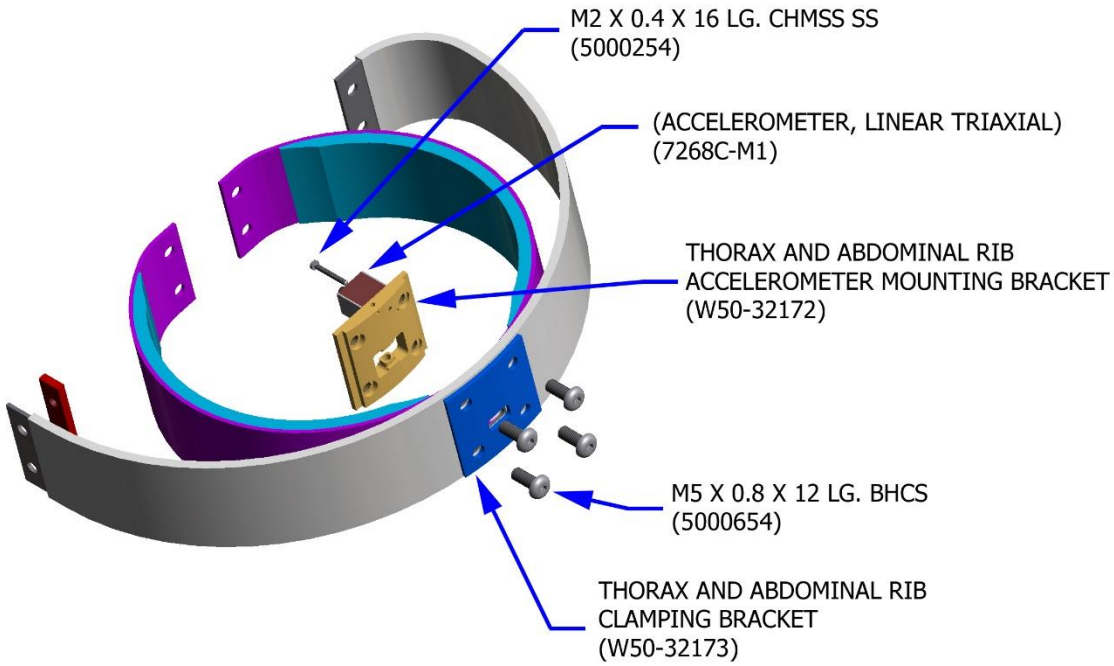


Figure 3-36 Assembling the thorax and abdominal rib clamping bracket.

Attach the two spine ballast stand offs (W50-37014) to the battery mounting bracket (W50-37013) with M3 X 0.5 X 12 SHCS (5000568). Then attach the battery mounting bracket (W50-37013) with two M5 X 0.8 X 25 SHCS (5000721) that secures it to the spine box on the non-struck side. Attach the DAS structural replacement (W50-74307) with four #6-32 x 1 1/4 BHCS (9003044) to the DAS mounting bracket (W50-37015). Attach the DAS cover (556-5125-2) to the DAS replacement with M2.5 x 10 BHCS (5000208). Then attach the temperature logger assembly (734-0808, referenced) to the battery mounting bracket (W50-37013).

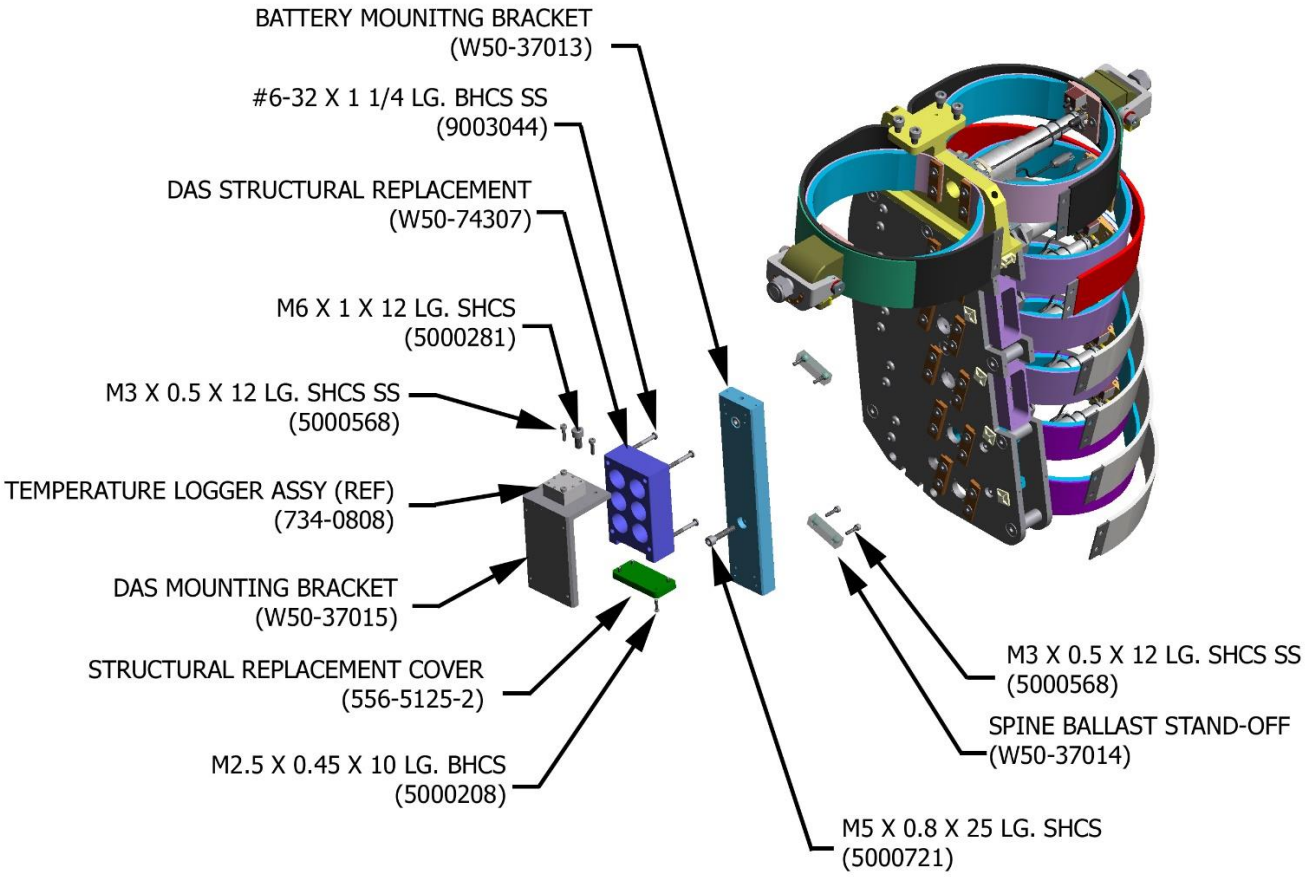


Figure 3-37 Attaching the two spine ballast stand-off.

(Ribs are removed for clarity.)

Continue installing the ribs with the preceding procedure. The shoulder rib mounting bracket (W50-32171) is attached to the shoulder rib and shoulder load cell assembly (W50-61053) with four M5 X 0.8 X 16 LG. FHCS (5000386).

After the instrumentation is plugged into the connectors, position the threaded shoulder rib sternum mounting strip (W50-32175) behind the front holes of the shoulder ribs, and place the sternum, thorax bib (W50-35022) over it. Put the shoulder rib sternum mounting strip (W50-32148) over the thorax bib and secure the bib at the front with two M5 X 0.8 X 10 LG. BHCS (5000003).

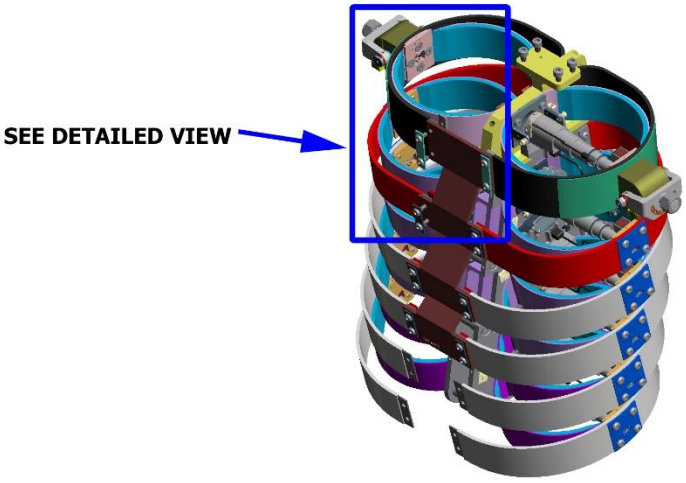


Figure 3-38 Attaching shoulder mounting strips.

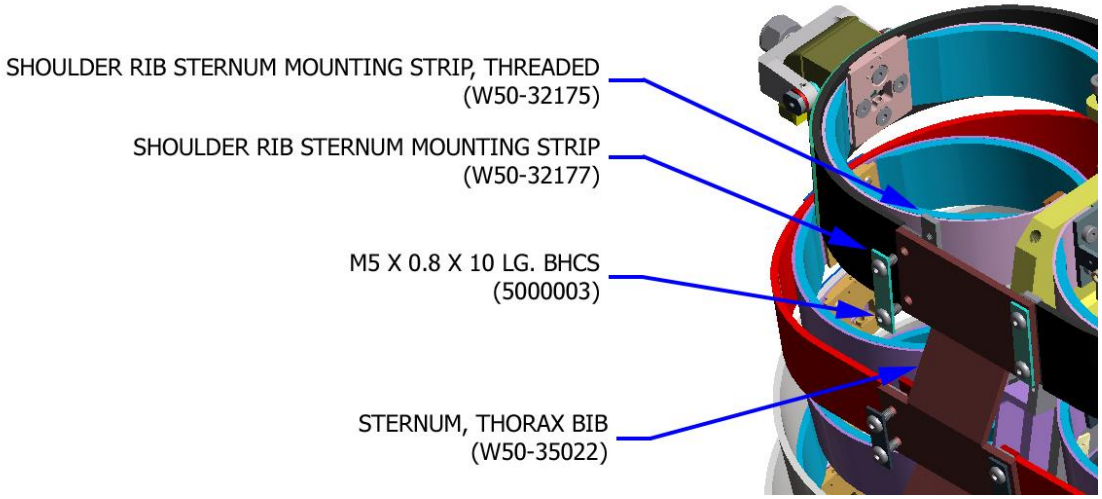


Figure 3-39 Detailed view of attaching shoulder mounting strips.

Attach the threaded thorax and abdominal rib mounting strip (W50-32176) behind the front holes of the thorax and abdominal ribs. Put the thorax and abdominal rib sternum mounting strip (W50-32148) over the thorax bib and secure the bib at the front with two M5 X 0.8 X 10 LG. BHCS (5000003).

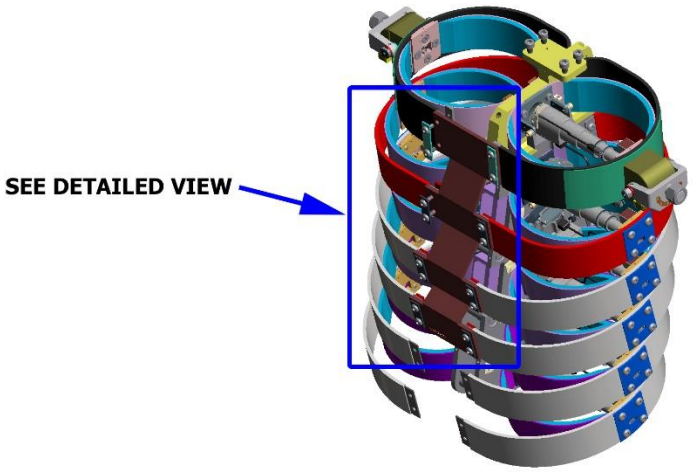


Figure 3-40 Attaching the thorax and abdominal mounting strips.

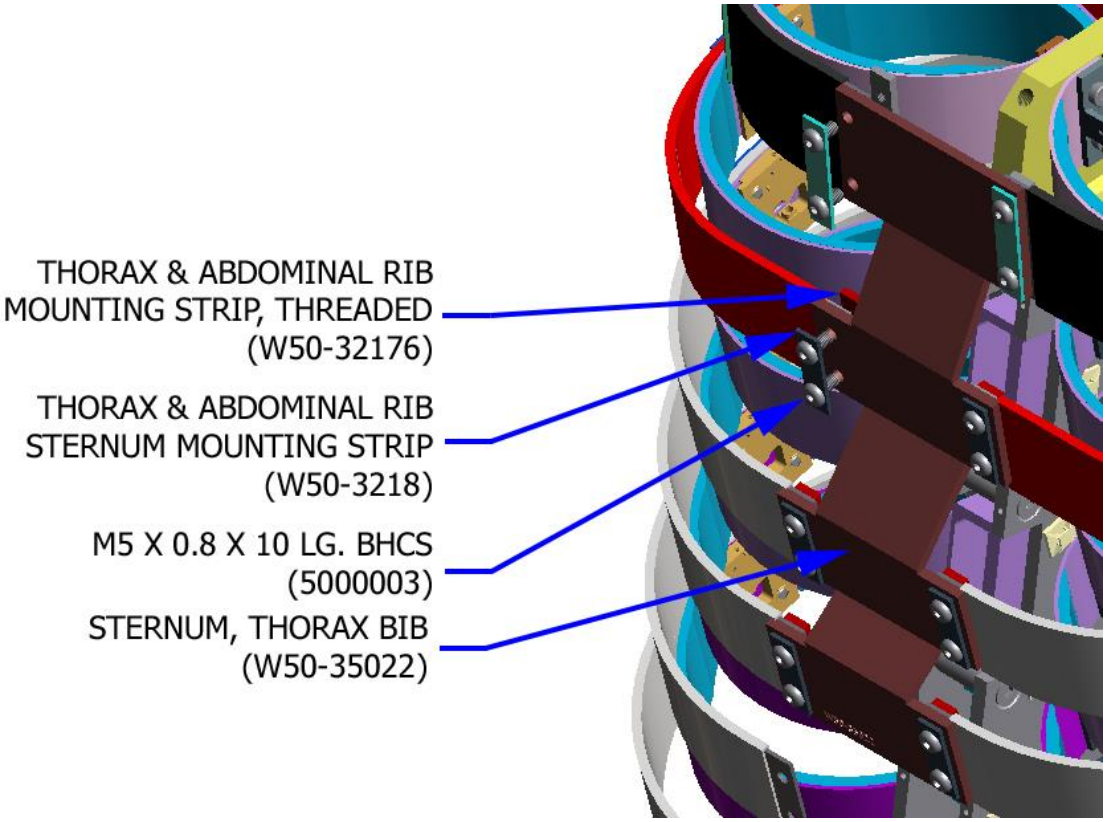


Figure 3-41 Detailed view of attaching the thorax and abdominal mounting strips.

The installed rib coupler is shown below. See detailed view Figure 3-43.

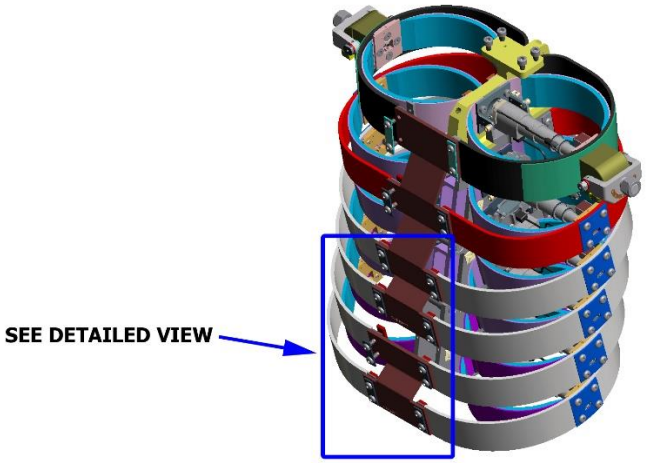


Figure 3-42 Attaching thorax and abdominal mounting strips to the bottom two ribs.

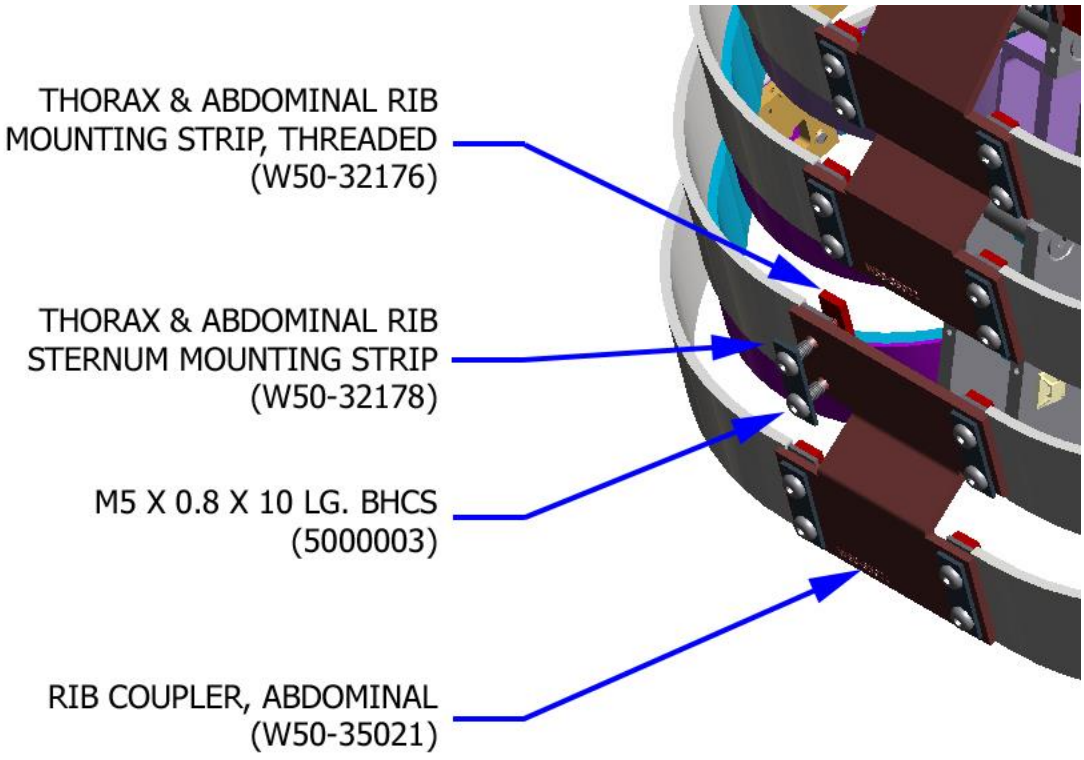


Figure 3-43 Detailed view of attaching the thorax and abdominal mounting strip to the bottom two ribs.

Figure 3-44 The sternum, thorax bib and abdominal rib coupler are attached to the ribs after instrumentation is plugged in.

Attach the lower neck bracket to the spine box with four M6 X 1 X 16 LG. SHCS (5000081).

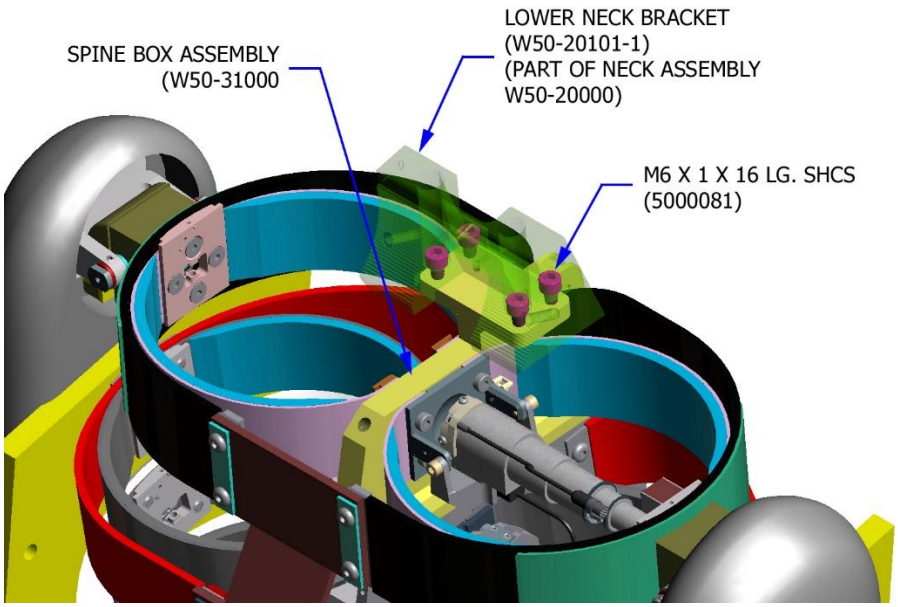


Figure 3-45 Attaching lower neck bracket with M6 X 1 X 16 LG. SHCS.

Attach the thorax pad (W50-35024) with velcro. Place the shoulder pads (W50-35023-1 and W50-35023-2) in position. Please ensure that the thorax pad centerline is aligned with the most lateral position of the ribs.

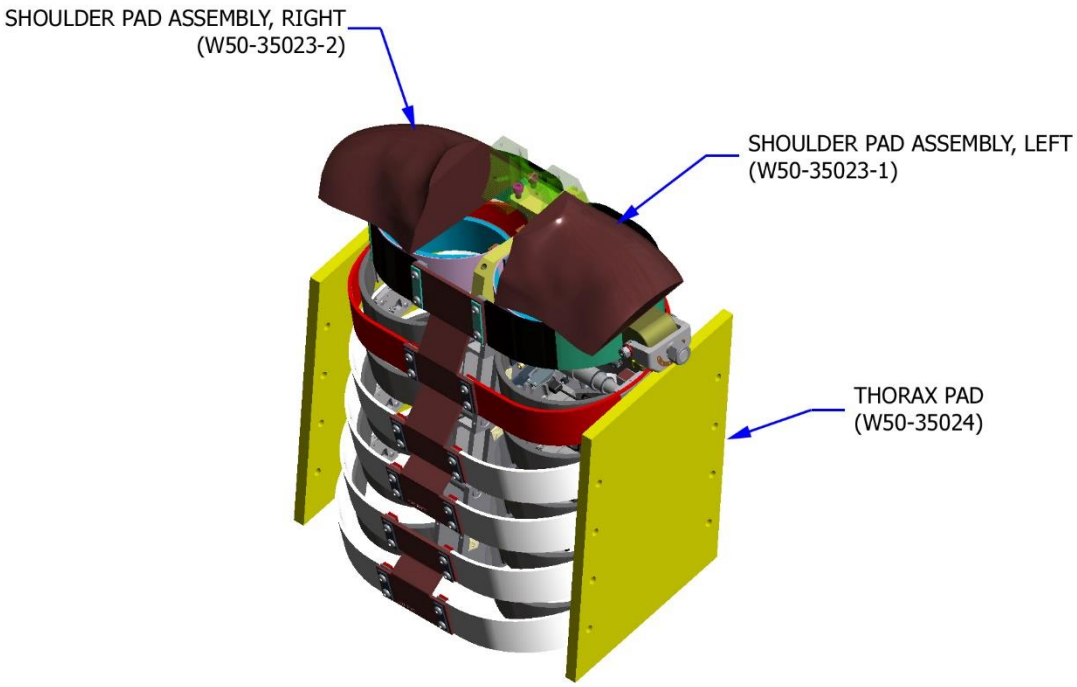


Figure 3-46 Attaching the thorax pads and shoulder pads.

Section 4 Spine Box

4.1 Parts List

Table 4-1 lists the parts required for assembly of the WorldSID spine box. Part numbers correspond to those on drawing W50-31000 and shown in Figure 4-1.

ITEM	OTY.	PART NO.	DESCRIPTION
1	2	W50-31042	MOUNTING BRACKET #1
2	1	W50-31010	UPPER BRACKET WELDMENT - SPINE BOX
3	2	W50-75001	INTERPOSER REPLACEMENT
4	1	W50-31020	SIDE PLATE, LEFT
5	7	5000119	M3 X 0.5 X 10 LG. SHCS
6	6	W50-31041	SPACER
7	1	W50-37024	T12 ACCELEROMETER MOUNT
8	1	W50-31030	SIDE PLATE, RIGHT
9	8	5000388	M3 X 0.5 X 8 LG SHCS
10	2	W50-75002	CONNECTOR, HOUSING REPLACEMENT
11	2	W50-37022	BACKUP PLATE MOUNTING BRACKET
12	4	5000151	M4 X 0.7 X 10 LG. SHCS
13	18	5000204	M6 X 1 X 10 LG. FHCS
14	8	5000382	M2 X 0.4 X 12 LG. SHCS
15	2	5000254	M2 X 0.4 X 16 LG. CHMSS SS
16	4	5000465	M6 X 1 X 18 LG. BHCS
17	1	W50-37023	ANGULAR ACCELEROMETER/TILT SENSOR MOUNT BRACKET
18	2	W50-31043	MOUNTING BRACKET #2
19	3	W50-74307	DAS STRUCTURAL REPLACEMENT
20	2	W50-31045	COVER PLATE SPINE BOX
21	1	W50-37029	BRACKET, ROTATIONAL ACCEL MOUNT
22	8	5000461	M4 X 0.7 X 25 LG. SHCS
23	2	5000203	M3 X 0.5 X 10 LG. FHCS
24	1	5000024	M4 X 0.7 X 8 LG. SHCS ZINC
25	2	5000463	M4 X 0.7 X 30 LG. SHCS
26	1	W50-10011	TILT SENSOR STRUCTURAL REPLACEMENT
27	2	W50-10010	ROTATIONAL ACCELEROMETER REPLACEMENT (REF)

Table 4-1 Parts list for WorldSID spine box assembly.

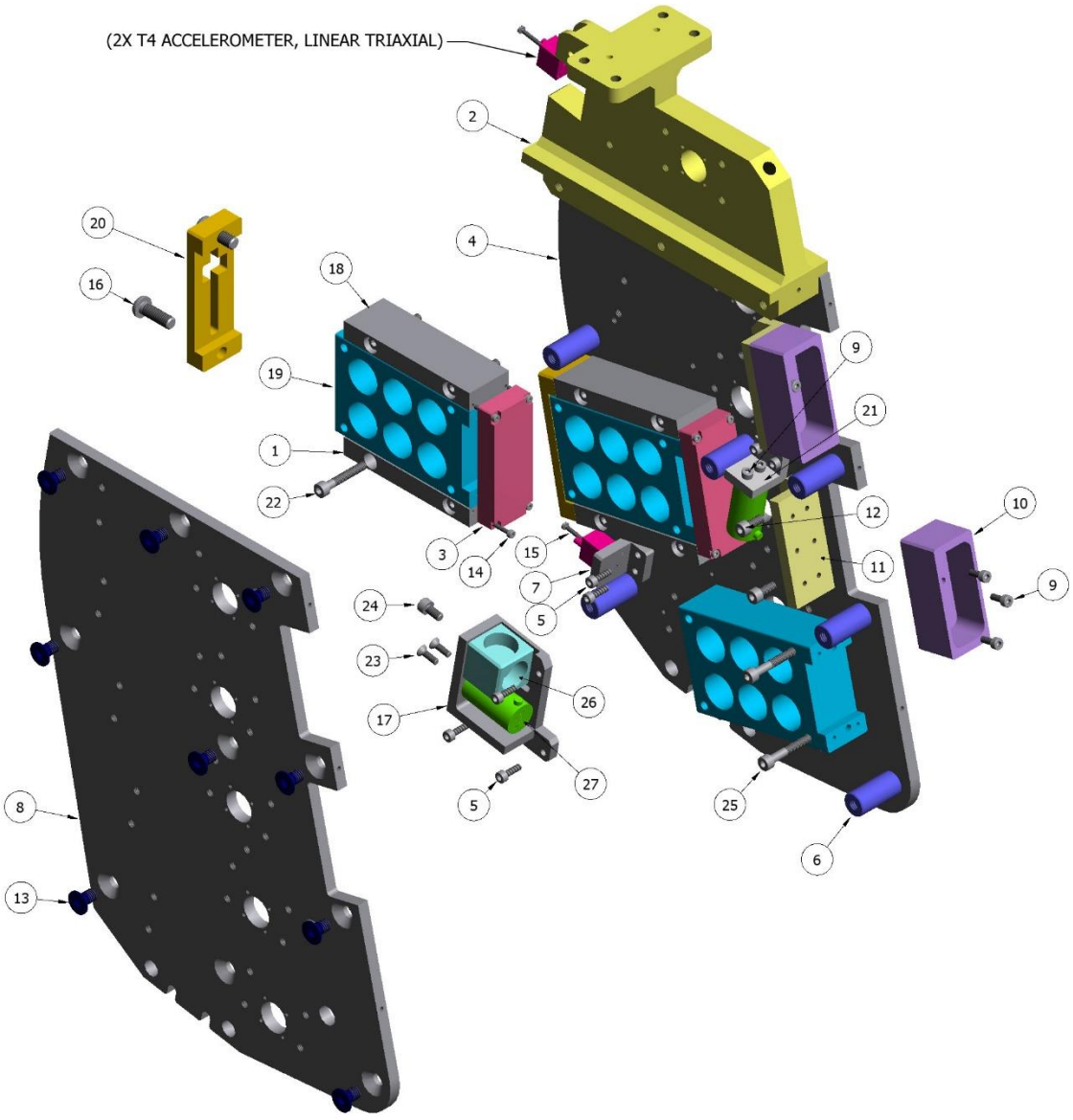


Figure 4-1 Spine box components for WorldSID.

4.2 Disassembly

Detach the right side plate (W50-31030) from the spacers and the left side plate by removing nine M6 X 1 X 10 LG. FHCS (5000204).

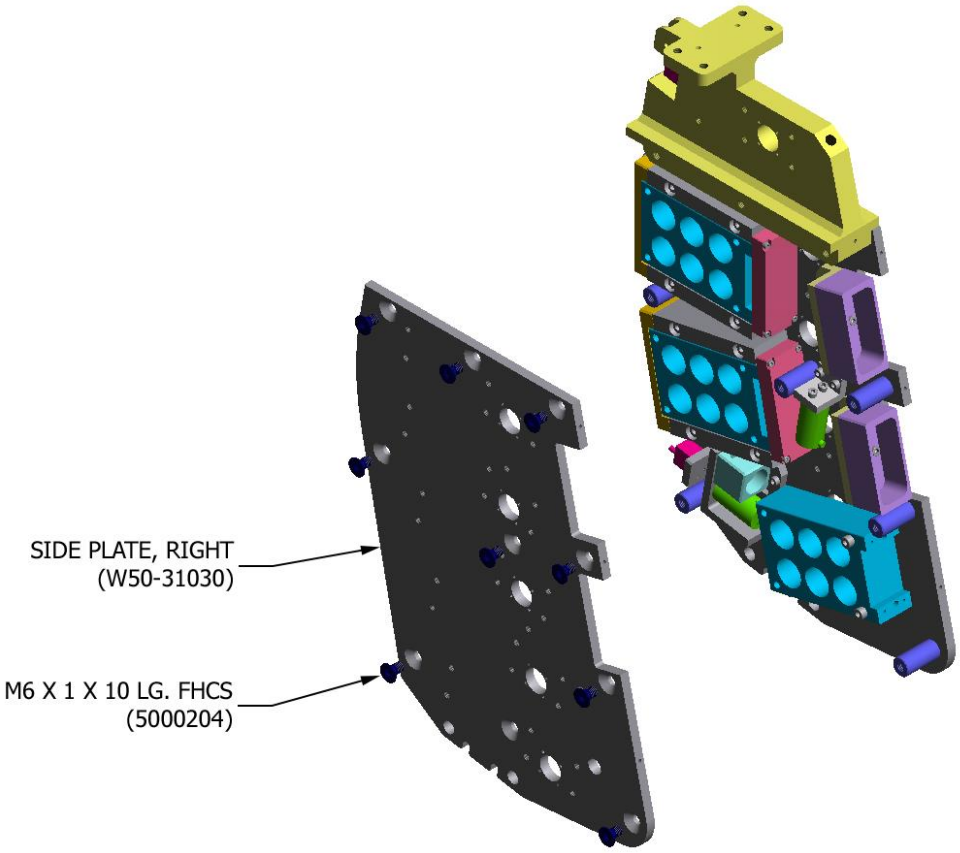


Figure 4-2 Detaching the right side plate.

The internal components of the spine box will now be visible (Figure 4-3).

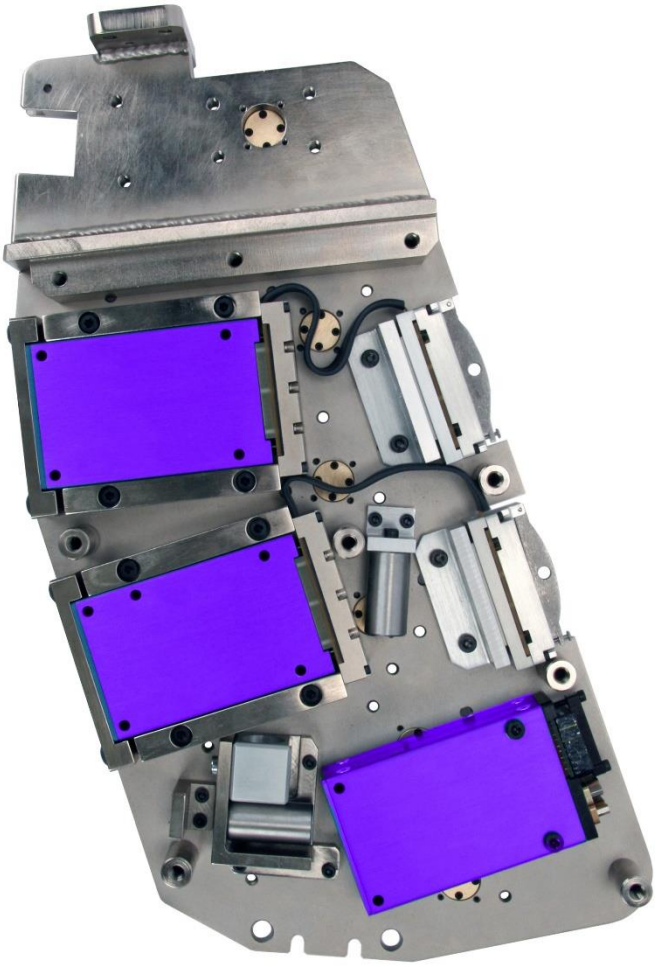


Figure 4-3 Example of internal spine box assembly with optional DAS. Layout will depend on selected DAS type.

Begin removal of the upper or middle DAS replacements (W50-74307) by removing two M4 X 0.7 X 25 LG. SHCS (5000461) that secures the #2 mounting brackets (W50-31043) to the side plate, left (W50-31020). Remove two more M4 X 0.7 X 25 LG. SHCS (5000461) that secure the #1 mounting brackets (W50-31042) to the side plate, left. The middle or upper DAS replacement assembly can now be removed.

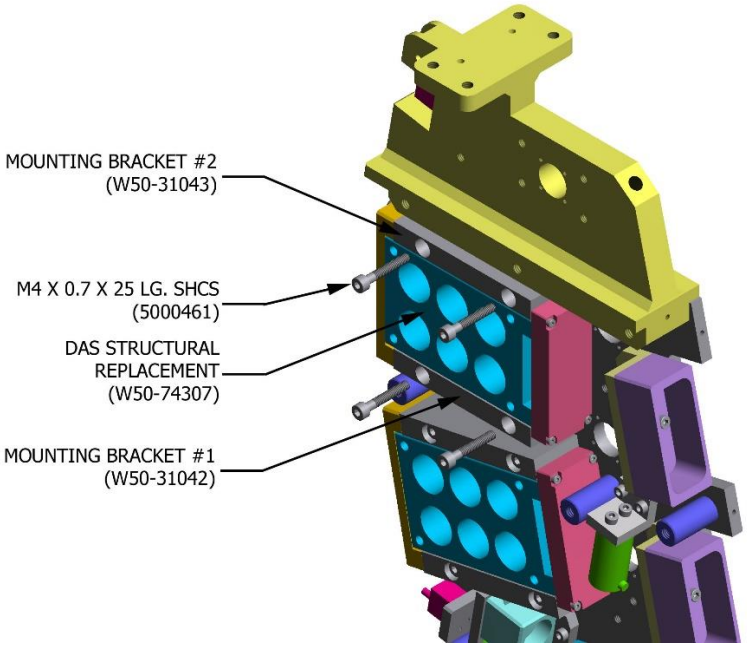


Figure 4-4 Removing the M4 X 0.7 X 25 LG. SHCS on the mounting brackets #2 and #1.

Detach the spine box cover plate (W50-31045) from the back of each DAS replacement by removing two M6 X 1 X 18 LG. BHCS (5000465). The DAS replacement can be slid out from between the two mounting brackets.

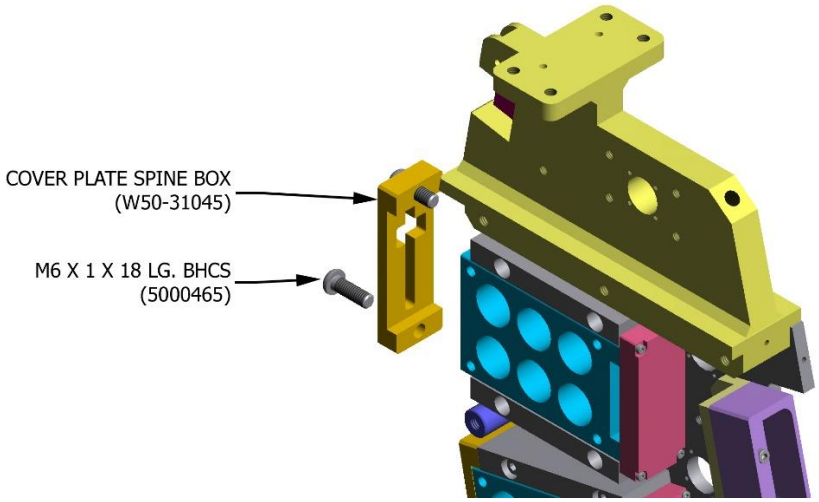


Figure 4-5 Detaching the spine box cover plate.

Each interposer replacement (W50-75001) can be detached from the mounting brackets by removing four M2 X 0.4 X 12 LG. SHCS (5000382).

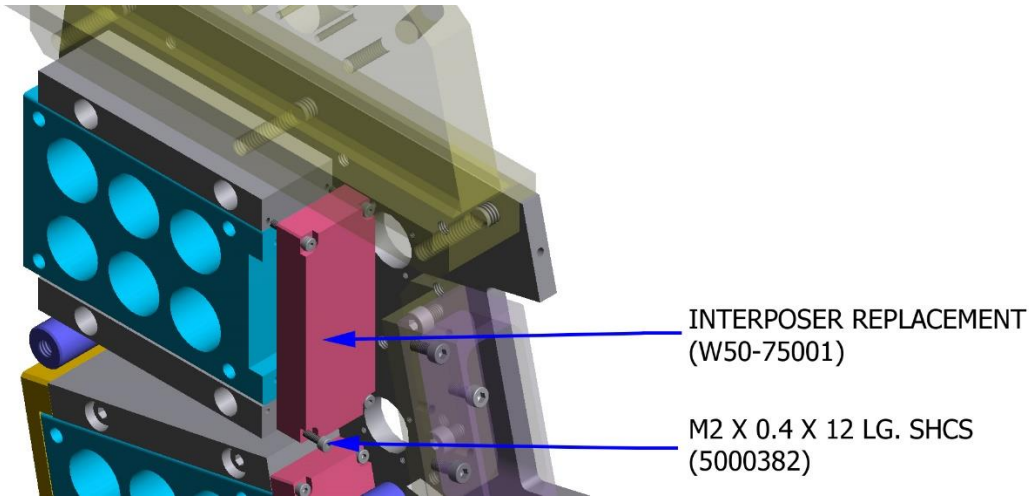


Figure 4-6 Detaching the interposer replacement.

The two backup plate mounting brackets (W50-37022) are removed from the side plate by removing the two M4 X 0.7 X 10 LG. SHCS (5000151) that hold each in place. Each connector housing replacement (W50-75002) is removed from its backup plate mounting bracket (W50-3702) by removing three M3X 0.5 X 8 LG. SHCS (5000388).

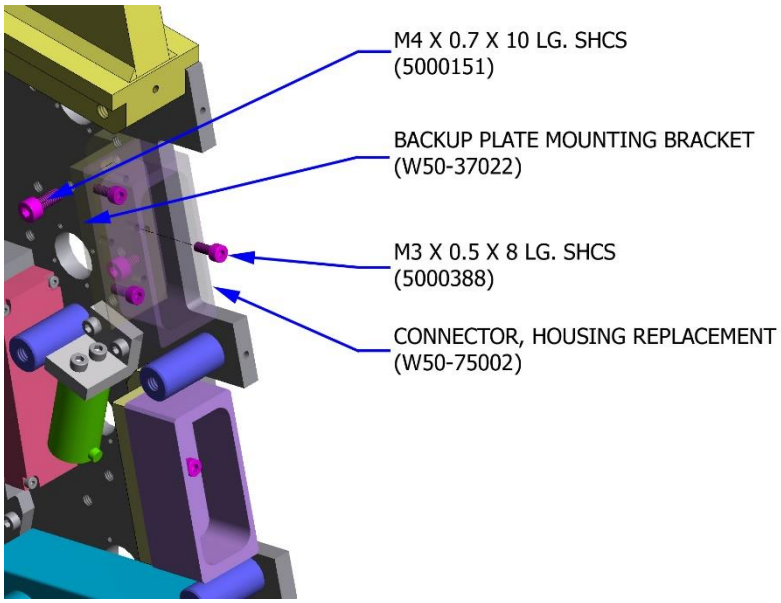


Figure 4-7 Removing the backup plate mounting bracket and connector, housing replacement.

The bottom DAS replacement is removed from the side plate by detaching two M4 X 0.7 X 30 LG. SHCS (5000463). This cannot be removed as easily as the top or middle DAS models.

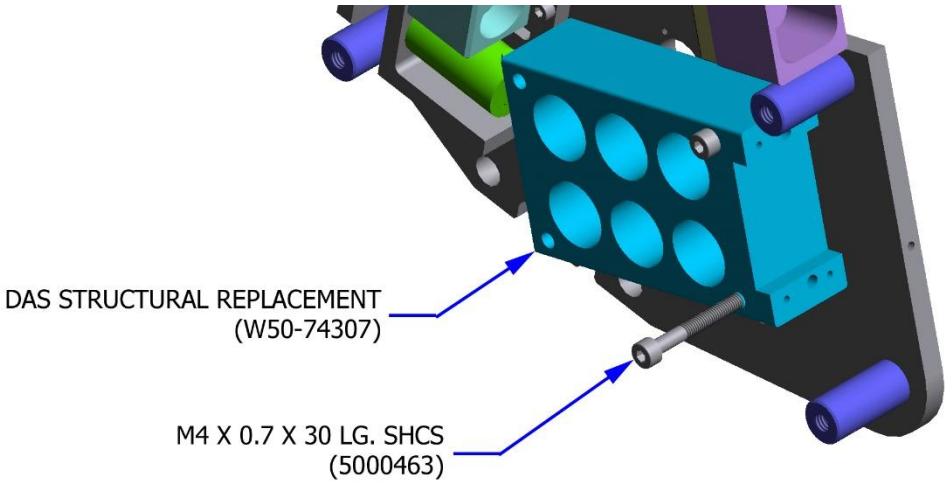


Figure 4-8 Removing the lower DAS replacement.

Remove the T12 accelerometer mount (W50-37024) from the side plate by removing the two M3 X 0.5 X 10 LG. SHCS (5000119) that secures the mount. Remove the linear triaxial accelerometer by removing M2 X 0.4 X 16 LG. cheese screw (5000254).

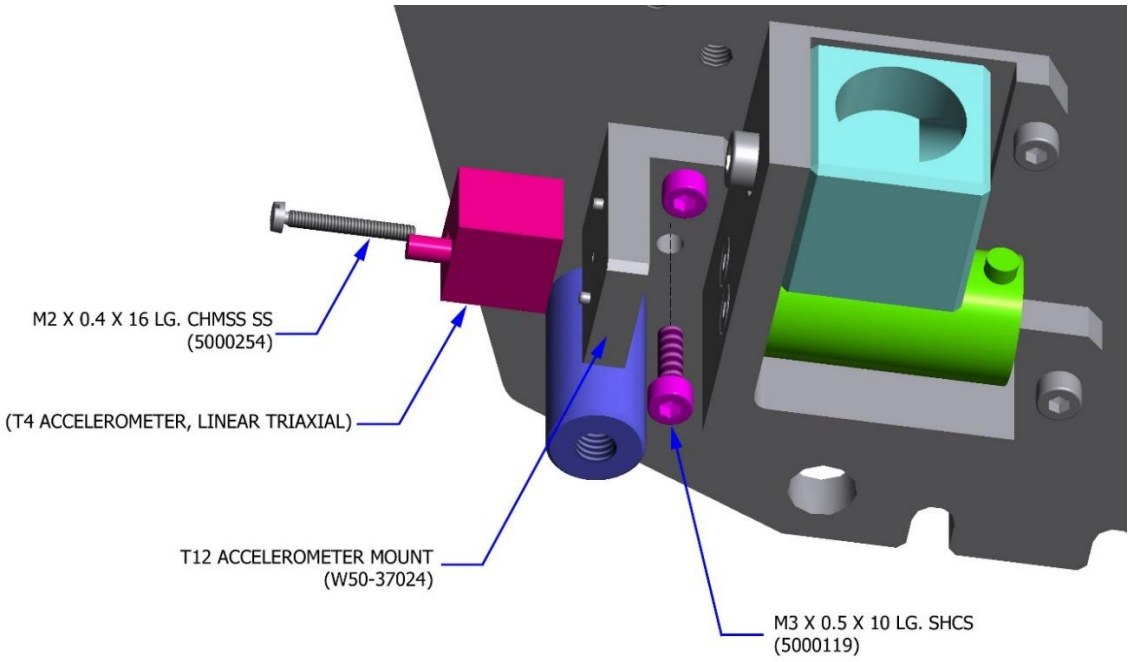


Figure 4-9 Removing the T12 accelerometer mount.

From the top of the spine box weldment, remove the linear triaxial accelerometer by removing M2 X 0.4 X 16 LG. cheese screw (5000254).

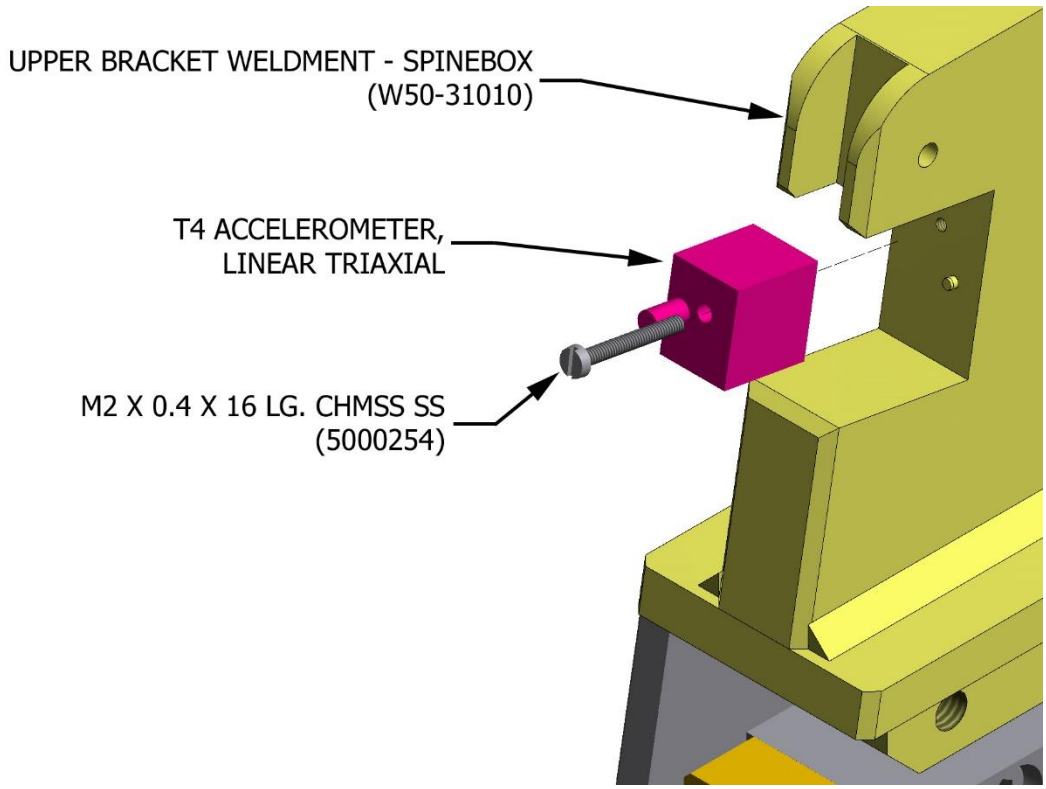


Figure 4-10 Removing the T4 accelerometer from the top of the spine box weldment.

The angular accelerometer is shown in the figures below. To detach the angular accelerometer mount bracket from the side plate, remove the M3 X 0.5 X 10 LG SHCS (5000119) that secures it to the side plate. Remove the dual-axis tilt sensor from the angular accelerometer bracket by removing the M4 X 0.7 X 8 LG. SHCS (5000024) from the back of the bracket. Figure 4-12 shows the optional IES mount assembly that can be used. Detach the angular accelerometer by removing the two M3 X 0.5 X 10 FHCS (5000203) that secures it to the bracket.

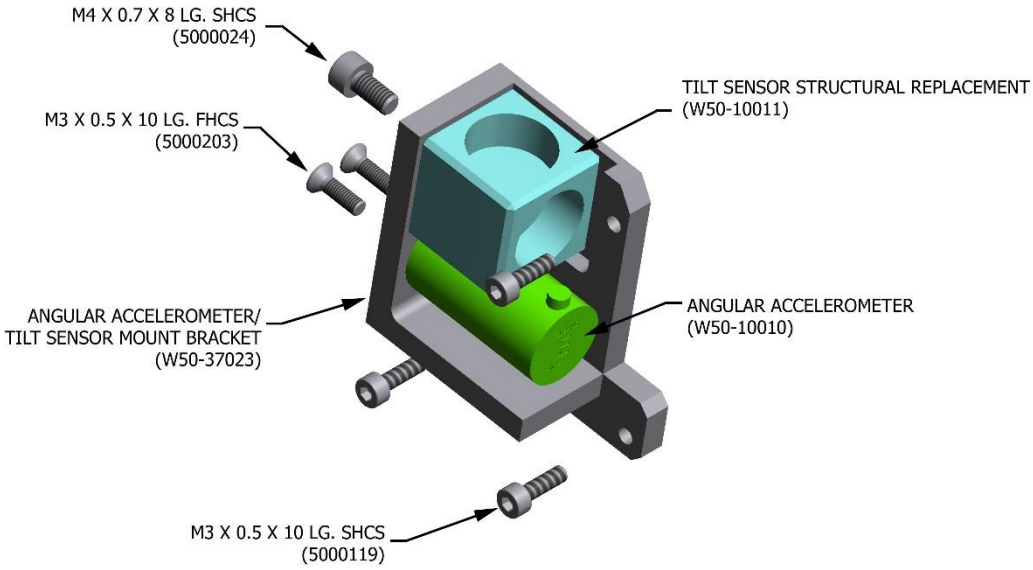


Figure 4-11 Detaching the angular accelerometer from the angular accelerometer/tilt sensor mount bracket.

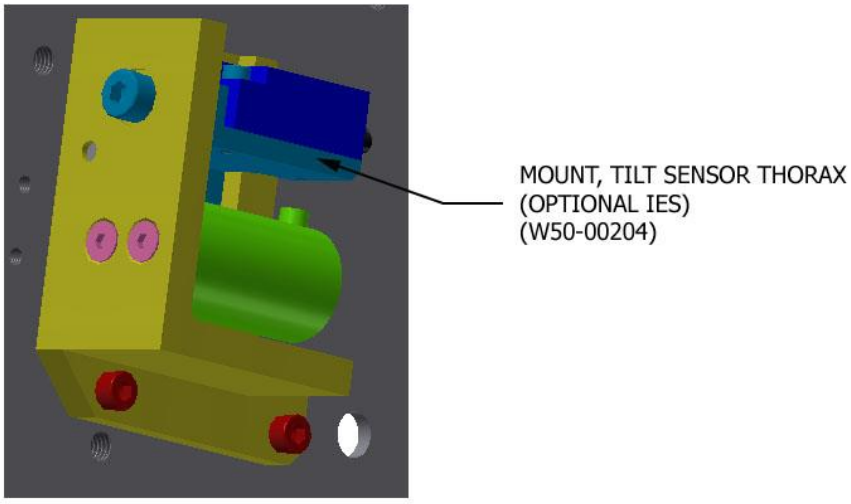


Figure 4-12 Optional IES.

Remove two M3 X 0.5 X 10 LG. SHCS (5000119) that secure the angular accelerometer from the rotational accelerometer mount bracket (W50-37029) to the side plate. To detach the angular accelerometer from the rotational accelerometer mount bracket (W50-37029), remove two M3 X 0.5 X 8 LG. SHCS (5000388).

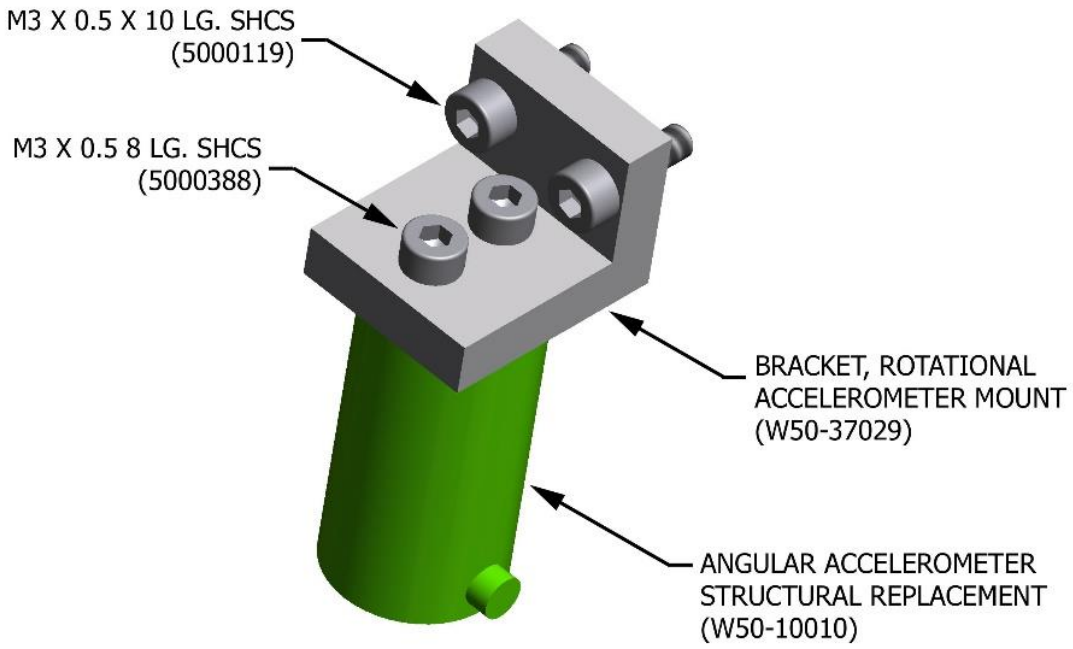


Figure 4-13 Detaching the angular accelerometer structural replacement from the rotational accelerometer mount bracket.

Turn the spine box over and remove seven M6 X 1 X 10 LG. FHCS (5000204) to remove the seven spacers (W50-31041) from the left side plate (W50-31041).

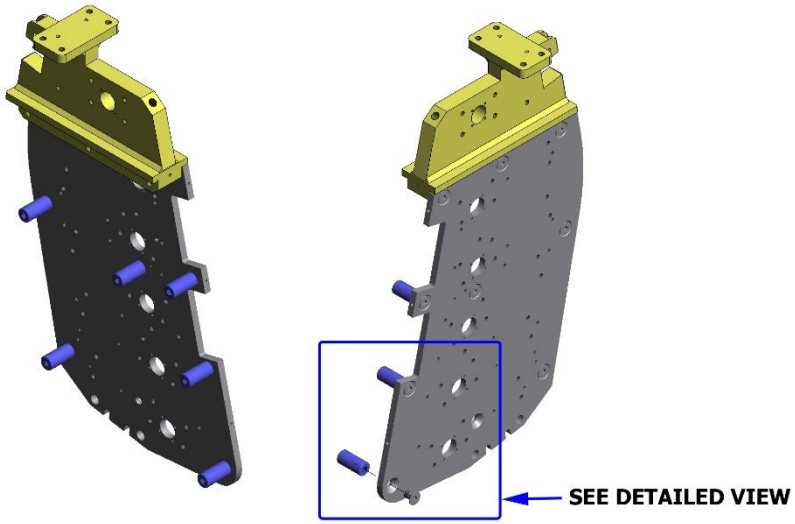


Figure 4-14 Removing spacers.

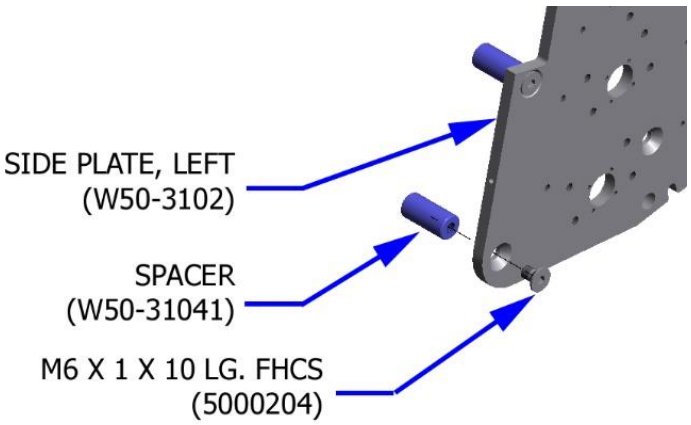


Figure 4-15 Detailed view of removing spacers.

Remove three more of the M6 X 1 X 10 LG. FHCS (5000204) to separate the upper spine box bracket weldment (W50-31010) from the left side plate (W50-31020).

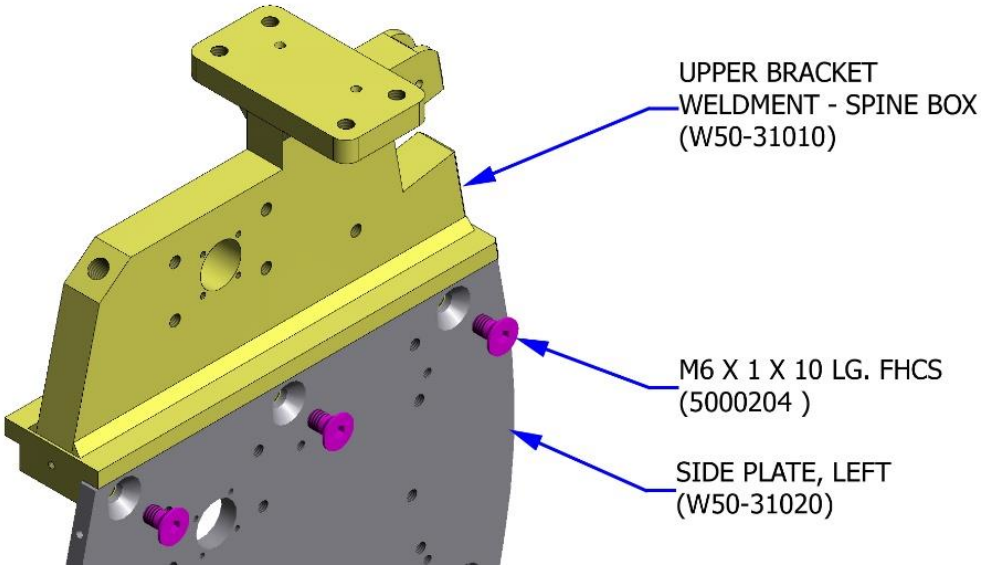


Figure 4-16 Separating the upper spine box bracket weldment from the left side plate.

4.3 Instrumentation

Instrumentation in the spine box includes a linear triaxial accelerometer mounted directly to the spine box near the top. A second linear triaxial accelerometer is mounted to a bracket attached to the spine box at the T4 location near the location of the T12 thoracic vertebra. An angular accelerometer assembly, which includes rotational accelerometers to measure x- and z-axis angular acceleration, plus a dual-axis tilt sensor, is mounted near the bottom of the spine box.

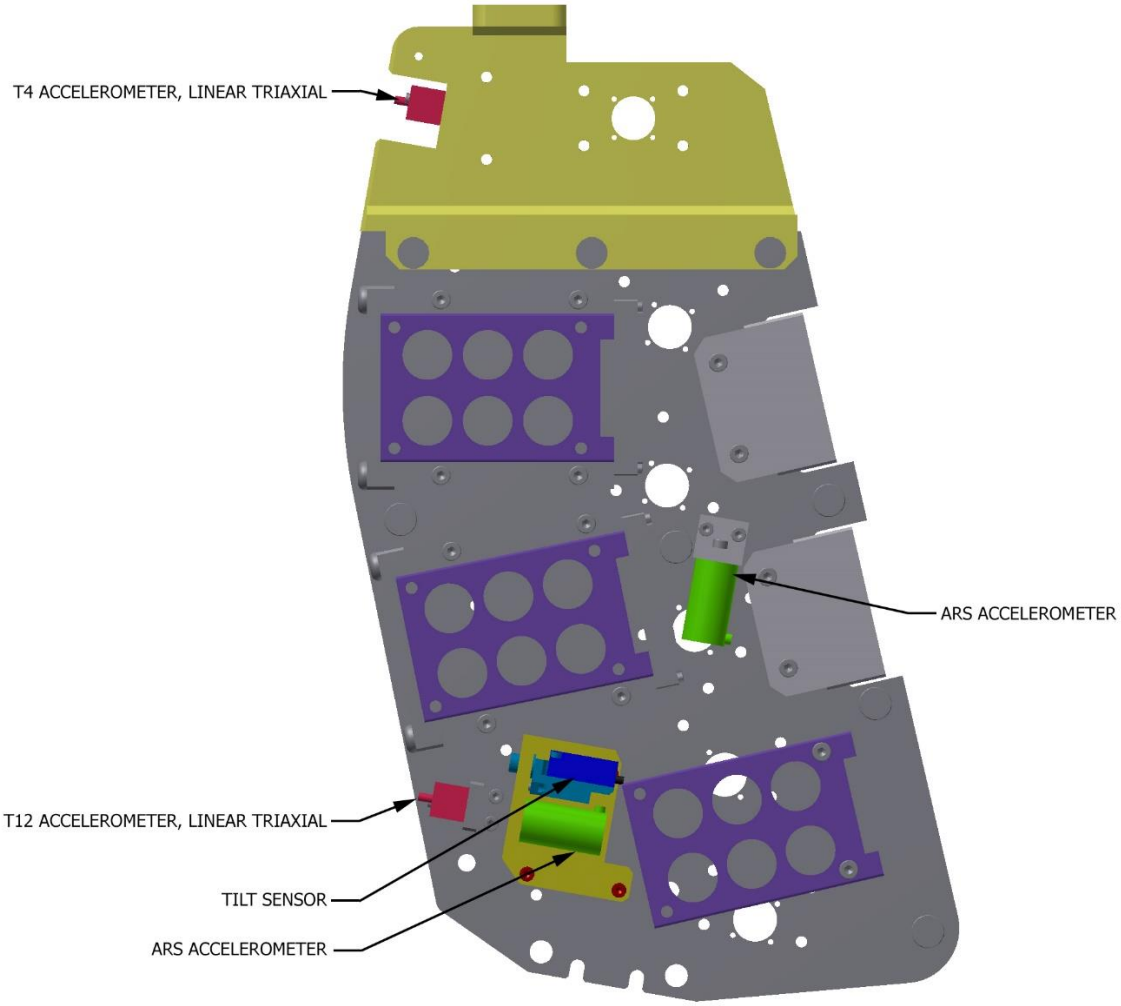


Figure 4-17 Spinebox instrumentation.

4.4 Re-Assembly

Attach the six spacers (W50-31041) to the left side plate (W50-31020) using six M6 x 10 FHCS (5000204). Attach the upper spine box bracket weldment (W50-31010) to the left side plate with three more M6 X 1 X 10 LG. FHCS (5000204).

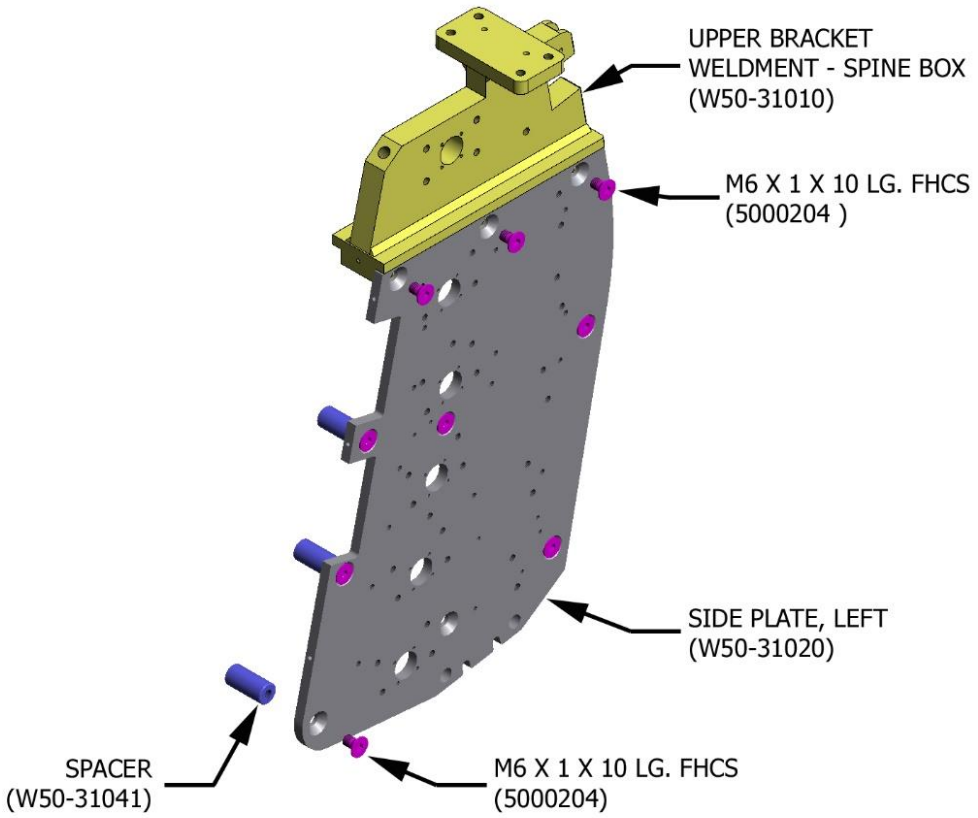


Figure 4-18 Attaching the spaces and the spine box upper bracket weldment.

Attach the bottom DAS module or its replacement to the left side plate with two M4 X 0.7 X 30 LG. SHCS (5000463).

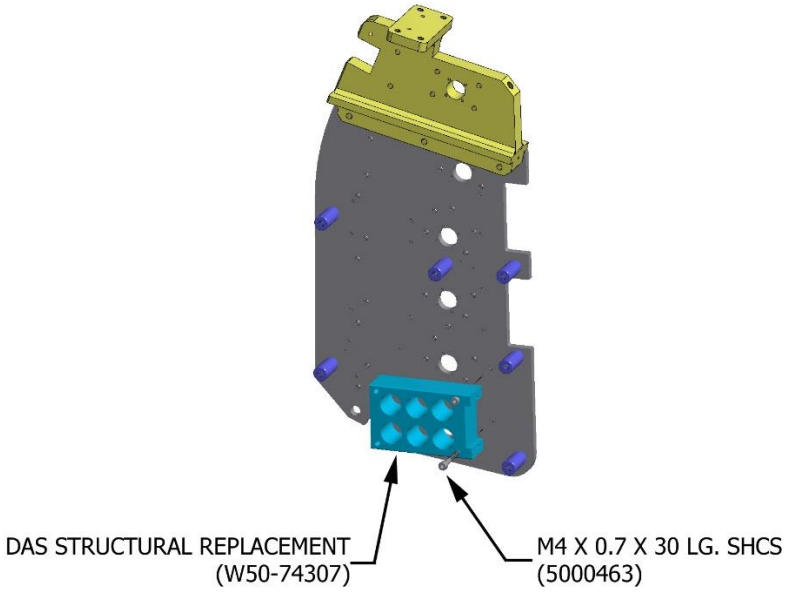


Figure 4-19 Attaching the bottom DAS structural replacement.

Connect each interposer or its replacement (W50-75001) to the mounting brackets #1 (W50-31042) and #2 (W50-31043) with four M2 X 0.4 X 12 LG. SHCS (5000382). Secure the mounting brackets/interposers to the left side plate with four M4 X 0.7 X 25 LG. SHCS (5000461). Slide the DAS replacements (W50-74307) into the mounting brackets and connect them to the interposers. Attach the cover plate spine box (W50-31045) to the back of each DAS module or its replacement with two M6 X 1 X 18 LG. BHCS (5000465).

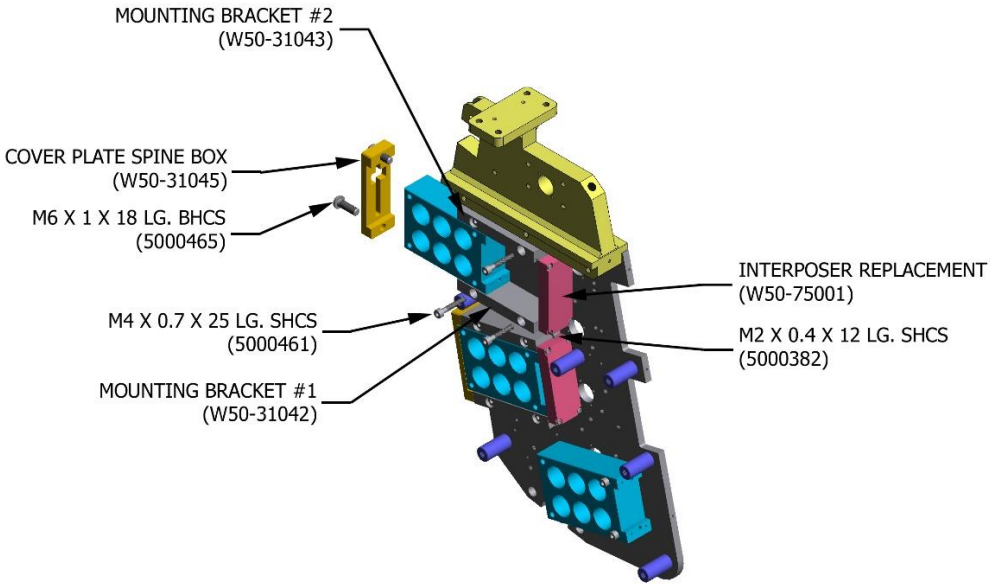


Figure 4-20 Connecting the interposer replacement.

Attach each backup plate mounting bracket (W50-37022) to the left side plate with two M4 X 0.7 X 10 LG. SHCS (5000151). Attach each connector housing or its replacement (W50-75002) to its backup plate mounting bracket (W50-37022) with three M3 X 0.5 X 8 LG. SHCS (5000388).

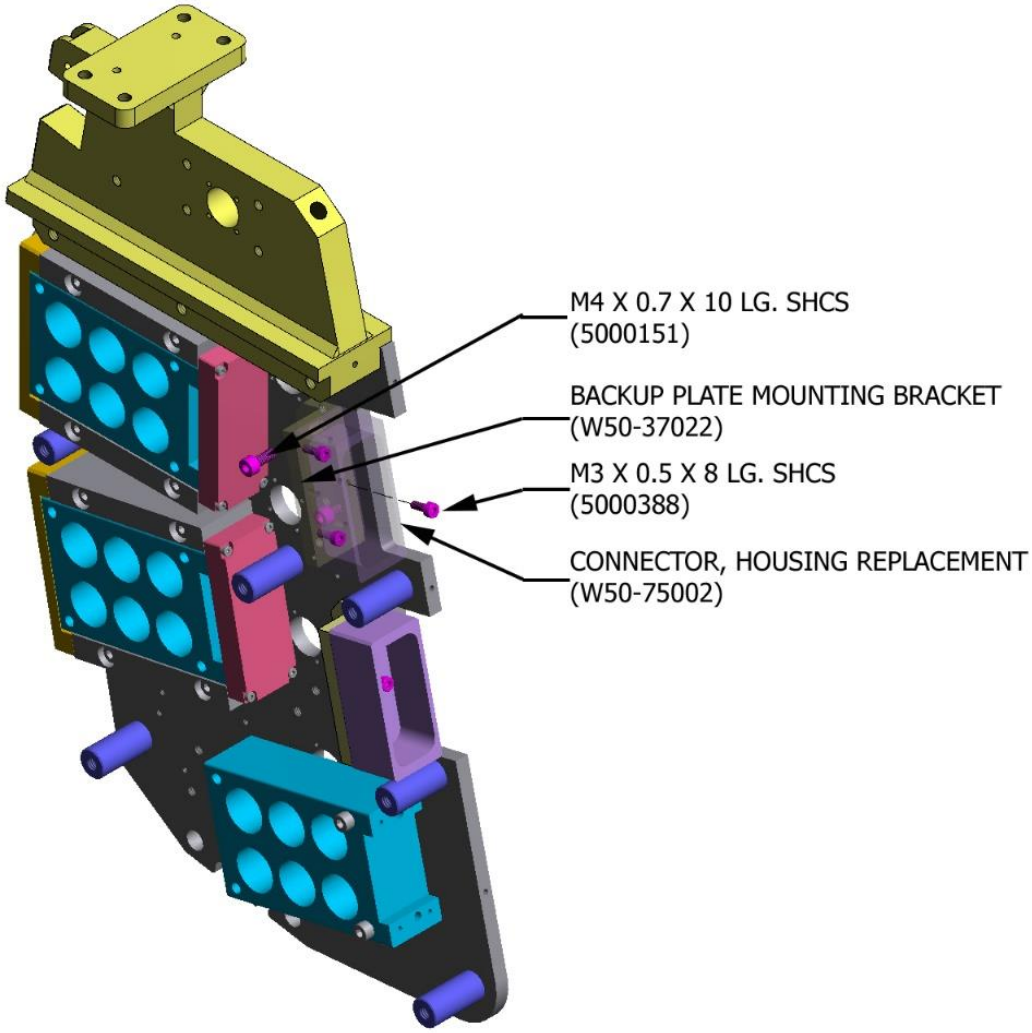


Figure 4-21 Attaching the backup plate mounting bracket.

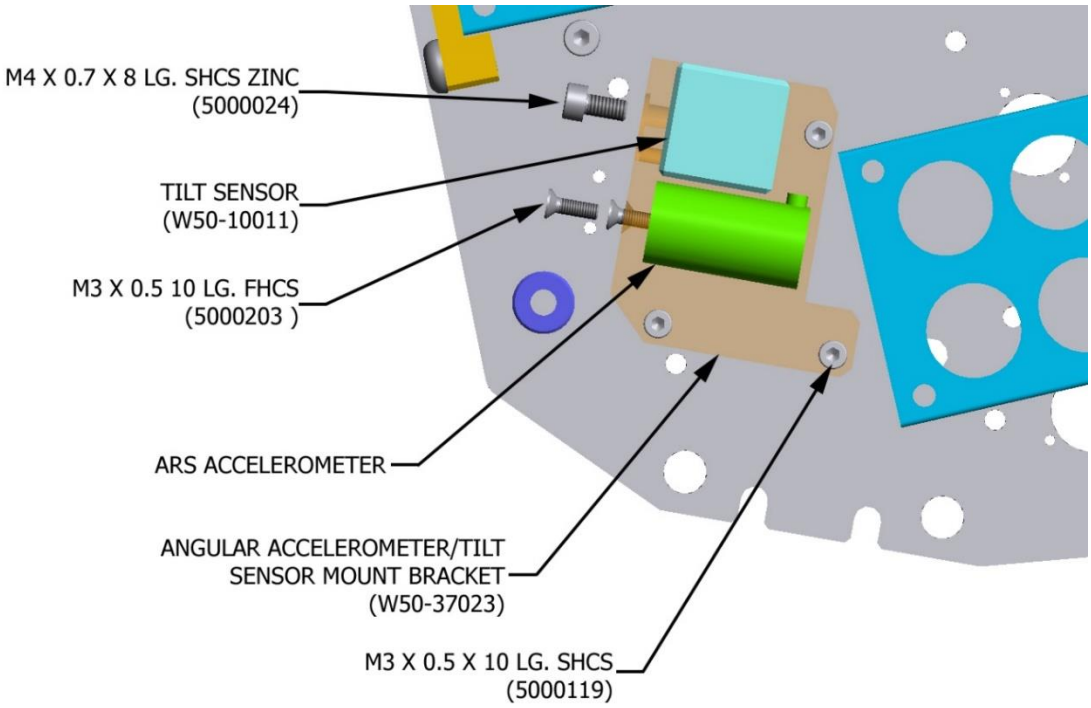


Figure 4-22 Assembling the angular accelerometer mount.

Next assemble the angular accelerometer mount (W50-37023). Attach the z-axis angular accelerometer to the bottom of the bracket with two M3 X 0.5 10 LG. FHCS (5000203). Attach the dual-axis tilt sensor to the back of the bracket with a SHCS. Position the angular accelerometer assembly on the spine box and secure it with three M3 X 0.5 X 10 LG. SHCS (5000119). Plug the cables for the angular accelerometers sensors into a DAS module, but leave the connectors for the dual-axis tilt sensor free to be plugged into the off-board readout during dummy setup.

Attach the x-axis angular accelerometer to the back of the bracket, rotational accelerometer mount (W50-37029) with two M3 X 0.5 X 8 LG. SHCS so it is parallel to the bottom of the bracket (W50-37029).

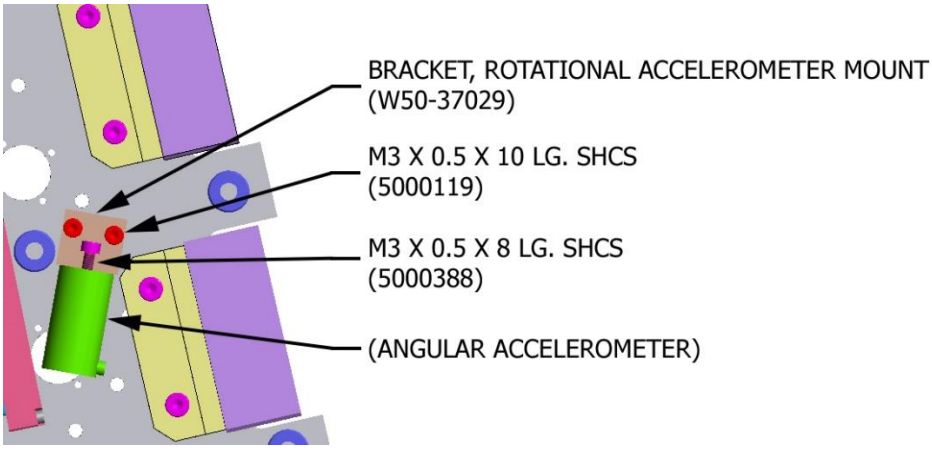


Figure 4-23 Attaching the x-axis angular accelerometer.

Attach the T12 accelerometer mount (W50-37024) to the left side plate with two M3 X 0.5 X 10 LG. SHCS (5000119). The linear triaxial accelerometer is attached to the mount with a M2 X 0.4 X 16 LG. cheese screw (5000254). Orient the accelerometer so the cable points upward and can be routed between the middle DAS module and angular accelerometer assembly to be plugged into the DAS module.

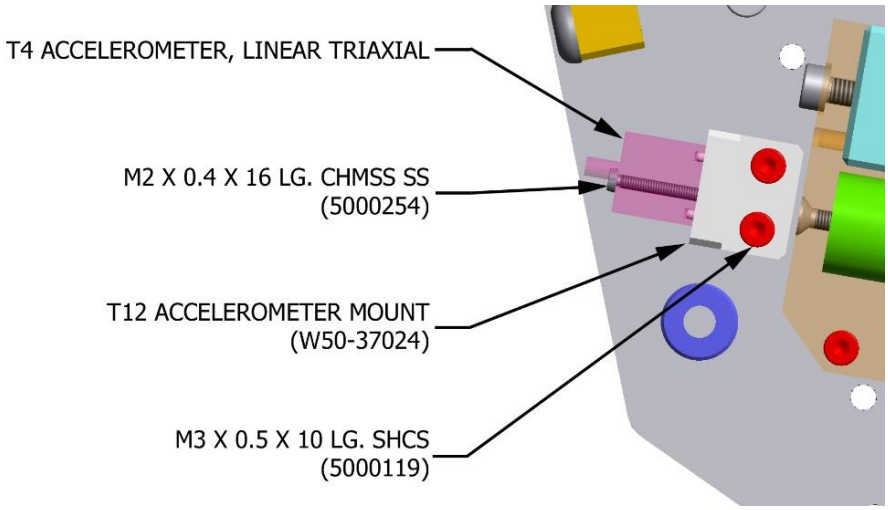


Figure 4-24 Attaching T12 accelerometer mount.

Attach the linear triaxial accelerometer to the top of the spine box weldment with a M2 X 0.4 X 16 LG. cheese screw (5000254). The cable for the upper accelerometer is plugged into the DAS module after the ribs are installed.

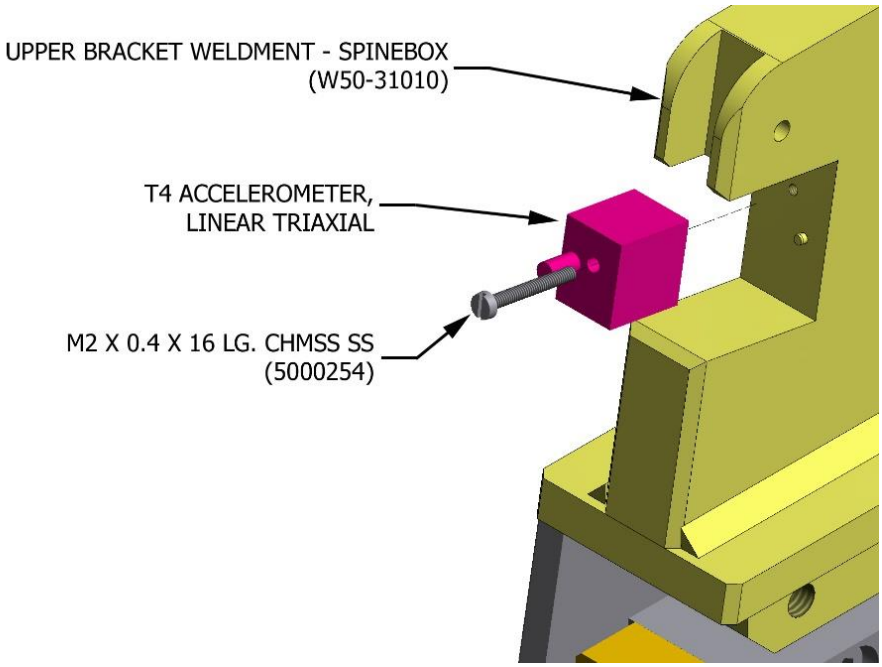


Figure 4-25 Attaching the linear triaxial accelerometer to top of spine box weldment.

Attach the right side plate (W50-31030) to the spacers with nine M6 X 1 X 10 LG. FHCS (5000204). Make sure the cables from the T12 or angular accelerometer assembly are not pinched by the side plate.

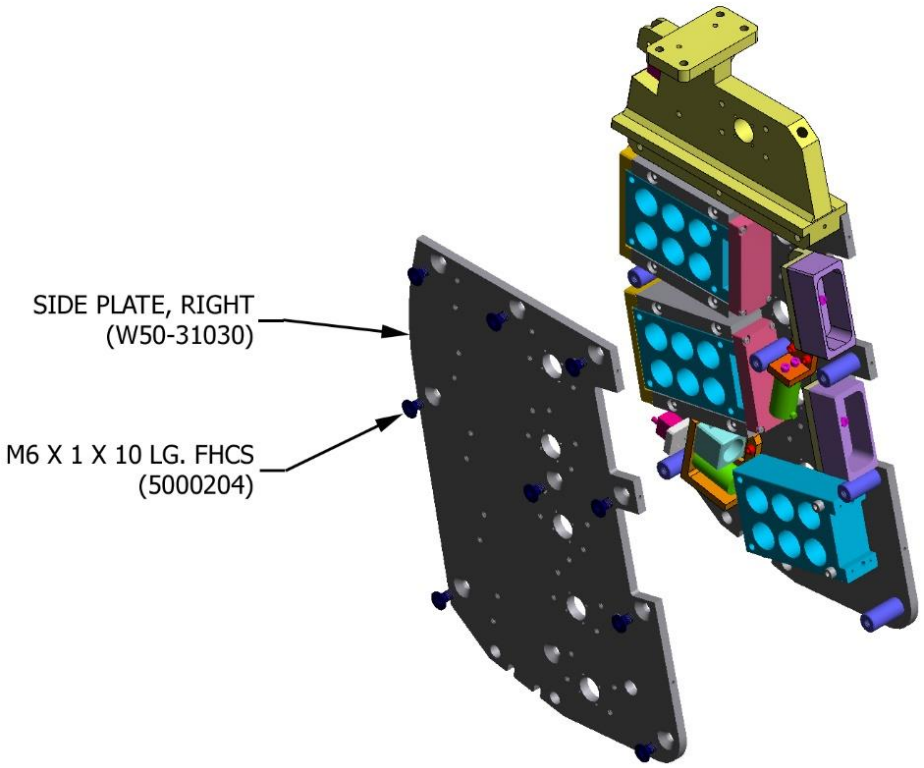


Figure 4-26 Attaching the right side plate.

Section 5 2D IR-TRACC

2D IR-TRACC, IF-368 and IF-367

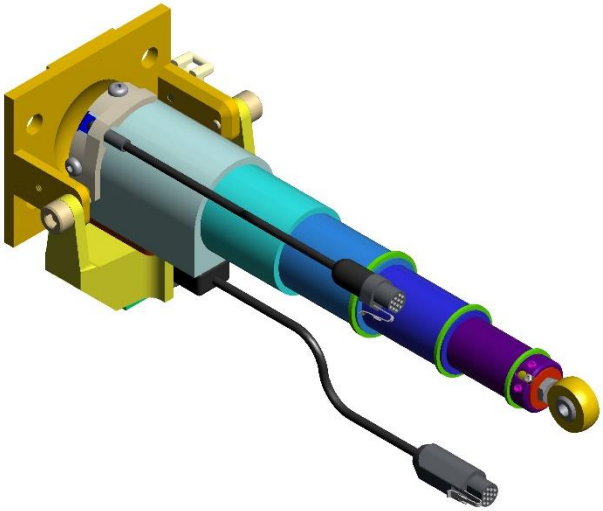


Figure 5-1 Shoulder Rib, IF-368.

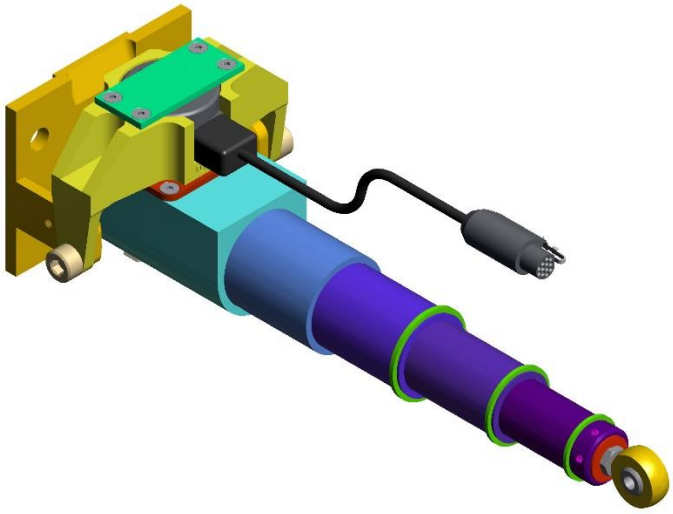


Figure 5-2 Thorax and Abdomen Ribs, IF-367.

5.1 Introduction

In the European Framework Program 6 Integrated Project APROSYS, a computer model study (reported in AP SP52 0025) was carried on oblique impact sensitivity of the WorldSID dummy. The study was set up to assess candidate systems that could lead to improved sensitivity of the WorldSID thorax to oblique impact. This study indicated that there was potential for 2-dimensional rib deflection sensor the output of which correlates well with both impact angle and impact severity. Based on this study a 2D deflection sensor system was designed and prototypes were built. Prototypes were installed in the WorldSID small female dummy for evaluation. The 2D rib deflection system measures the position of the most lateral rib segment in the XY rib plane to improve oblique impact sensitivity of the thorax and abdomen ribs. The current version, of IF-367/ IF-368 was developed for the WorldSID 50th percentile Male dummy. This part is suitable for left and right struck side assembly, as well as for simultaneous use with both sides instrumented. The rotation range is between 45° forward and backward from lateral. Interpretation software was written to calculate rib deflection in x and y direction in the dummy co-ordinate system and the resultant deformation of the rib in the x-y plane. The data processing is explained in Section 5.8.

5.2 2D IR-TRACC

PART NO.	QTY	DESCRIPTION
IF-368	1	2D IR-TRACC for shoulder WorldSID 50M
IF-367	5	2D IR-TRACC for thorax & abdomen ribs WorldSID 50M
3670-08	6	Non struck side ballast rib clamps

Table 5-1 Parts list 2D-IR-TRACC for single sided instrumentation.

PART NO.	QTY	DESCRIPTION
IF-368	2	2D IR-TRACC for shoulder WorldSID 50M
IF-367	10	2D IR-TRACC for thorax & abdomen ribs WorldSID 50M

Table 5-2 Parts list 2D-IR-TRACC for double sided instrumentation.

The 2D-IR-TRACC can be implemented into a standard WorldSID 50th percentile male dummy without modifications. The standard IR-TRACCs and rib clamps must be replaced with 2D-IR-TRACCs. Rib clamps are integrated into the 2D-IR-TRACC bracket. The compression range of motion is identical to the original IR-TRACC. The range of rotation is about 45 degrees forward and backward of lateral. The range is much increased with respect to original 1D IR-TRACC spherical joint (about ±19 degrees).

To compensate for the additional mass of the 2D-IR-TRACC dedicated ballasts should be used. For single struck side instrumentation the original ballast and DAS structural replacement in the non-struck chest cavity should be replaced by ballast rib clamps: 6x part 3670-08. For two sided left and right instrumented operation no further ballast will be used on the spine box.

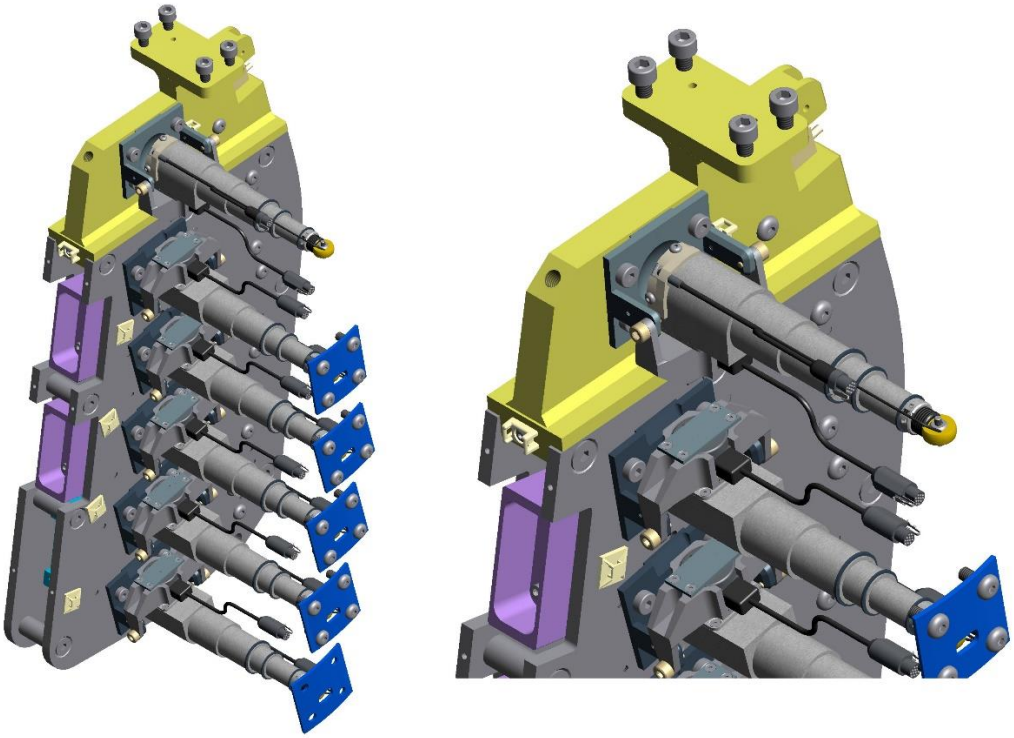


Figure 5-3 Orientation of 2D IR-TRACCs in the thorax. Note deviating Shoulder 2D IR-TRACC orientation.

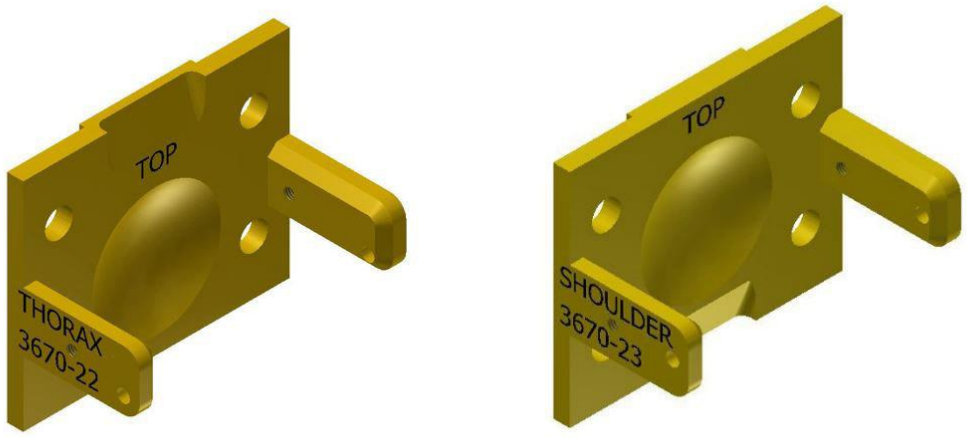


Figure 5-4 Left: thorax and abdomen bracket (3670-22); right: shoulder bracket (3670-23).

5.3 Assembly - Disassembly

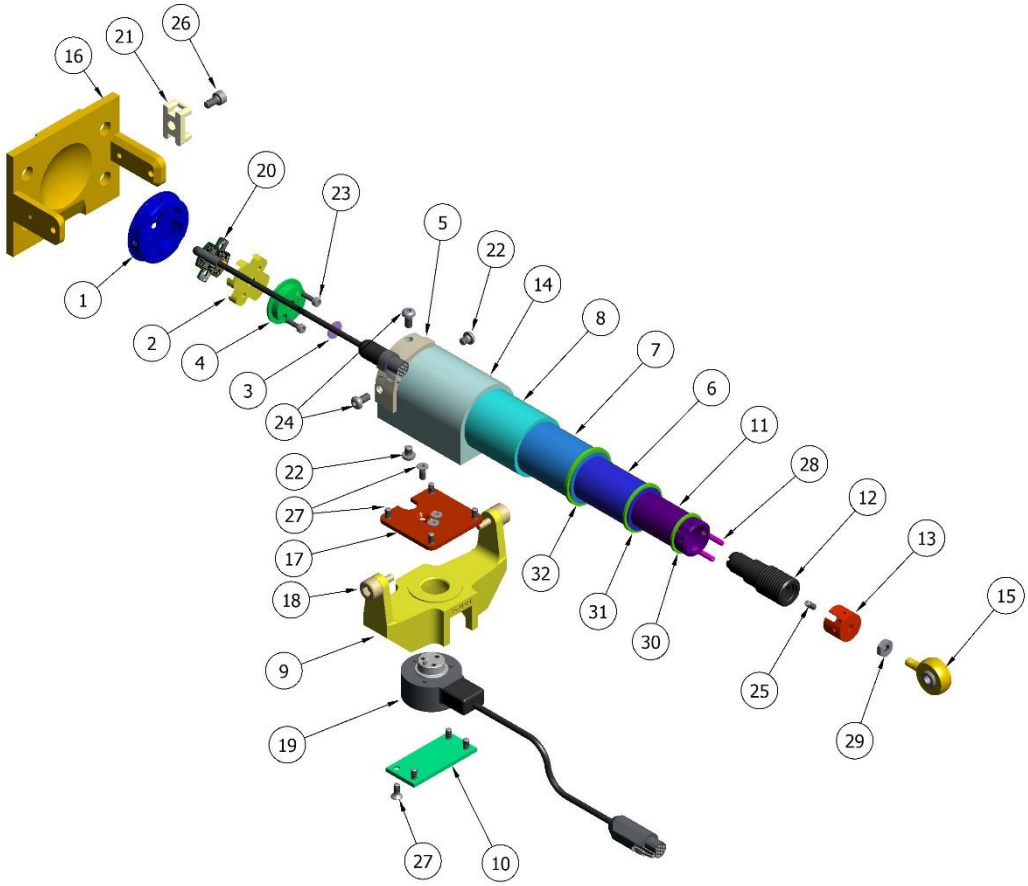


Figure 5-5 Shoulder 2D IR-TRACC (3680-00).

Table 5-3 lists the parts for shoulder 2D IR-TRACC, 3680-00.

ITEM	QTY.	PART NO.	DESCRIPTION
1	1	3620-06	ENDCAP
2	1	3620-16	LED MOUNTING DISK
3	1	3620-46	DIFFUSER
4	1	3620-47	DIFFUSER MOUNT
5	1	3620-49	CABLE CLAMP, BASE END
6	1	3630-02	COLUMN #2, IR-TRACC
7	1	3630-03	COLUMN #3, IR-TRACC
8	1	3630-04	COLUMN #4, IR-TRACC
9	1	3670-01	YOKE
10	1	3670-03	COVER, POTENTIOMETER
11	1	3670-04	COLUMN #1, IR-TRACC
12	1	3670-05	SLEEVE, SENSOR (REF)
13	1	3670-06	BALL JOINT ADAPTOR
14	1	3670-07	BIG END – 2D IR-TRACC
15	1	3670-10	BALL JOINT
16	1	3670-23	BRACKET, RIB
17	1	3700-03	POTENTIOMETER BASE
18	2	3700-08	PIVOT SCREW
19	1	3670-11	POTENTIOMETER TO 12 PIN W/LATCH
20	1	3670-50	ELECTRONICS ASSEMBLY
21	1	6002036	CABLE TIE MOUNT, #4 SCREW
22	2	5000248	M2.5 X 0.45 X 3 LG. BHCS
23	2	5000343	M1.6 X 0.35 X 6 LG. SHCS
24	2	5000429	M2.5 X 0.45 X 5 LG. BHCS
25	1	5000474	M2 X 0.4 X 5 LG. SSCP SS
26	1	5000641	M2.5 X 0.45 X 5 LG. SHCS SS
27	11	5000753	M2 X 0.4 X 5 LG. FHCS
28	2	5000839	M1.5 X 12 LG. ROLL PIN SS
29	1	5001003	M3 X 0.5 HEX JAM NUT SS
30	1	9002957	RETAINING RING, 1/2 EXTERNAL SS
31	1	9002958	RETAINING RING, 5/8 EXTERNAL SS
32	1	9002959	RETAINING RING, 3/4 EXTERNAL SS

Table 5-3 Shoulder 2D IR-TRACC (3680-00) Parts List

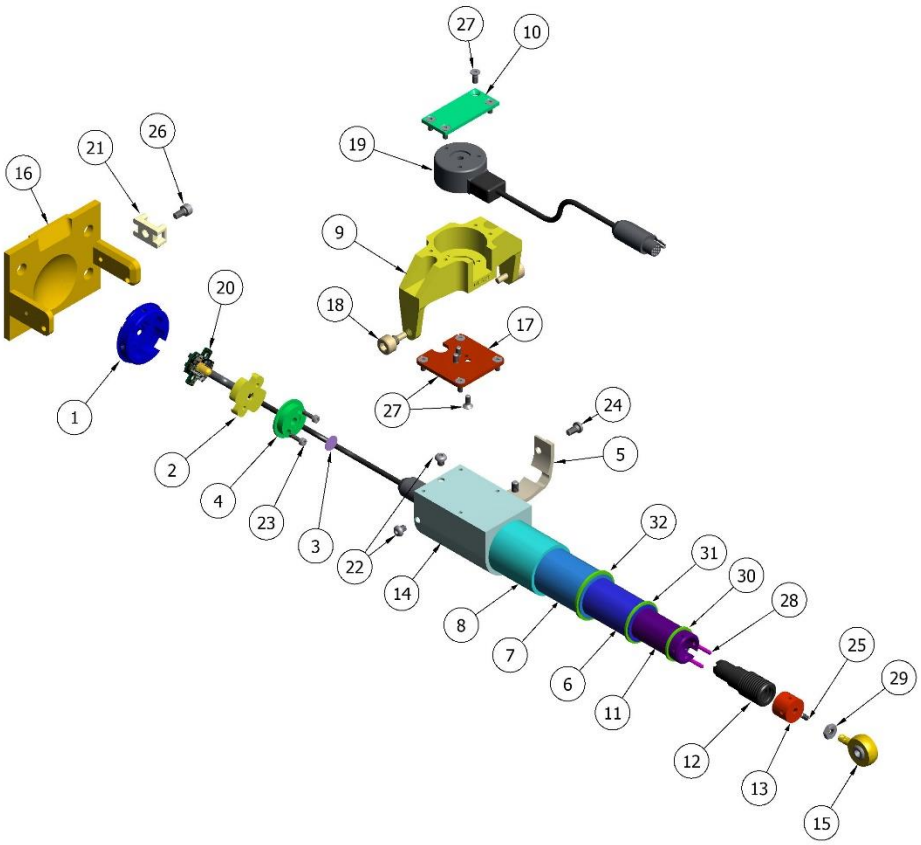


Figure 5-6 Thorax-Abdomen 2D IR-TRACC (3670-00).

Table 5-4 lists the parts for Thorax-Abdomen 2D IR-TRACC, 3670-00.

ITEM	QTY.	PART NO.	DESCRIPTION
1	1	3620-06	ENDCAP
2	1	3620-16	LED MOUNTING DISK
3	1	3620-46	DIFFUSER
4	1	3620-47	DIFFUSER MOUNT
5	1	3620-49	CABLE CLAMP, BASE END
6	1	3630-02	COLUMN #2, IR-TRACC
7	1	3630-03	COLUMN #3, IR-TRACC
8	1	3630-04	COLUMN #4, IR-TRACC
9	1	3670-01	YOKE
10	1	3670-03	COVER, POTENTIOMETER
11	1	3670-04	COLUMN #1, IR-TRACC
12	1	3670-05	SLEEVE, SENSOR (REF)
13	1	3670-06	BALL JOINT ADAPTOR
14	1	3670-07	BIG END – 2D IR-TRACC
15	1	3670-10	BALL JOINT
16	1	3670-22	BRACKET, THORAX/ABDOMEN
17	1	3700-03	POTENTIOMETER BASE
18	2	3700-08	PIVOT SCREW
19	1	3670-11	POTENTIOMETER TO 12 PIN W/LATCH
20	1	3670-50	ELECTRONICS ASSEMBLY
21	1	6002036	CABLE TIE MOUNT, #4 SCREW
22	2	5000248	M2.5 X 0.45 X 3 LG. BHCS
23	2	5000343	M1.6 X 0.35 X 6 LG. SHCS
24	2	5000429	M2.5 X 0.45 X 5 LG. BHCS
25	1	5000474	M2 X 0.4 X 5 LG. SSCP SS
26	1	5000641	M2.5 X 0.45 X 5 LG. SHCS SS
27	11	5000753	M2 X 0.4 X 5 LG. FHCS
28	2	5000839	M1.5 X 12 LG. ROLL PIN SS
29	1	5001003	M3 X 0.5 HEX JAM NUT SS
30	1	9002957	RETAINING RING, 1/2 EXTERNAL SS
31	1	9002958	RETAINING RING, 5/8 EXTERNAL SS
32	1	9002959	RETAINING RING, 3/4 EXTERNAL SS

Table 5-4 Thorax-Abdomen 2D IR-TRACC (3670-00) Parts List

5.4 Assembly of the Potentiometer, Pot Axis, and Pot Base

Apply a small quantity of multi-purpose light grease (CHUCK-EEZ®) on the Pot Axis (3700-04) when inserting it into the Yoke (3670-01) and on the Pot Base (3700-03), see pictures below.

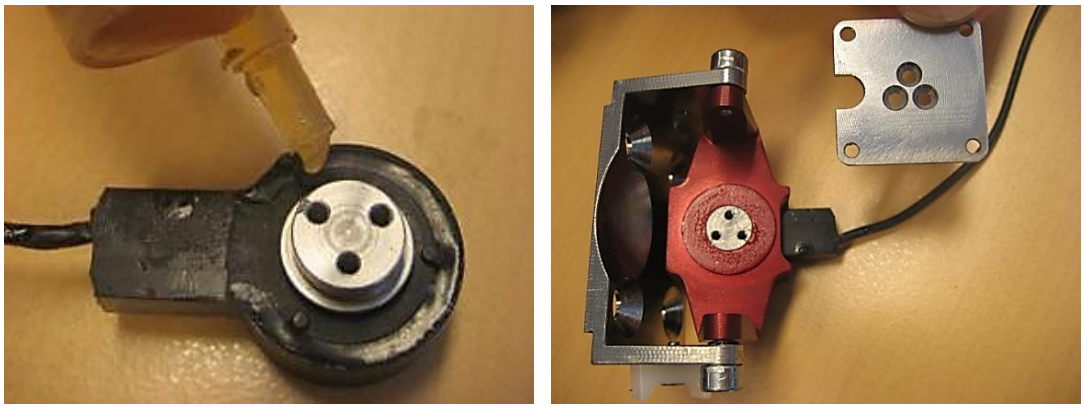


Figure 5-7 Applying light grease on Pot Axis.

When assembling the Pot Axis (3700-04) to the Pot Base (3700-03) make sure that the flat on the Pot Axis is aligned with the compression axis of the IR-TRACC, see pictures below. The grease makes for smooth operation.

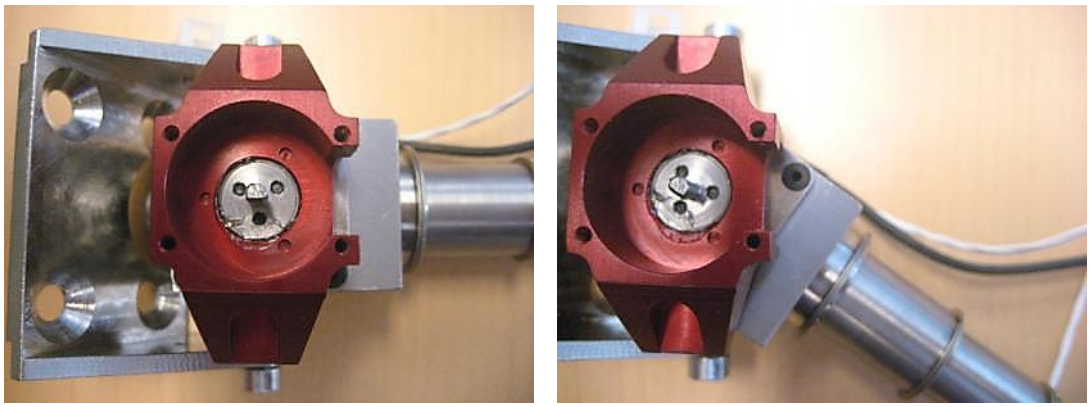


Figure 5-8 Align Pot Axis and Pot Base.

When assembling the Potentiometer onto the Pot Axis, make sure that the flat face in the bore of the Potentiometer is aligned with the flat on the Pot Axis, see picture below. The flat face of the Potentiometer can be aligned by gently inserting a small screw driver in the bore and gently rotate the bore to align with the flat on the axis.

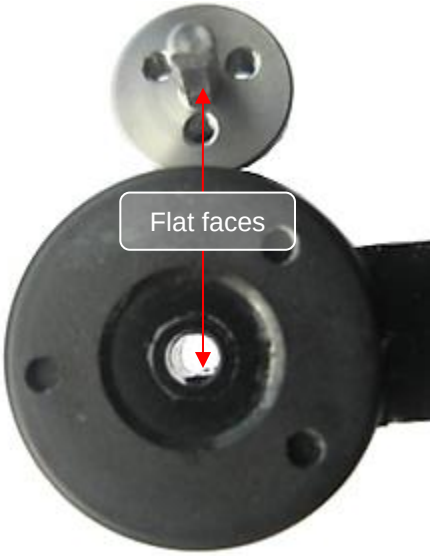


Figure 5-9 Flat faces aligned on potentiometers.

5.5 IR-TRACC Rod End Position and Fixation with Counter Nut

Follow the steps to position the Rod End for the IR-TRACC.

1. Screw the M3 nut, 5001003 all the way on the rod end thread, 3670-10;
2. Screw in the rod end and nut into the small end of the IR-TRACC 3670-06 all the way down;
3. Rotate the rod end backward to orient the rod end plane under an angle of about 45 degrees with the small end electrical wire exit plane, see Figure 5-10 (Note: ignore the big end wire exit location seen in the background);

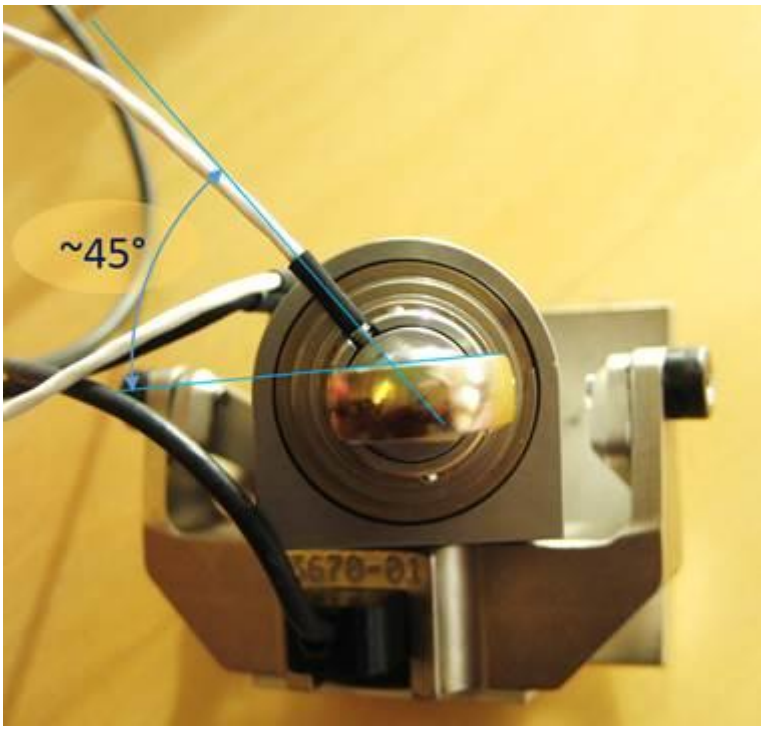


Figure 5-10 Rod End at angle of about 45°

4. From the latter position rotate back another half turn (180 degrees);
5. Now keeping the rod end in this position, tighten the M3 nut back to the IR-TRACC small tube 3670-06. Use a narrow 5.5mm hex wrench, 6004602 (max 2mm thick). See Figure 5-11.

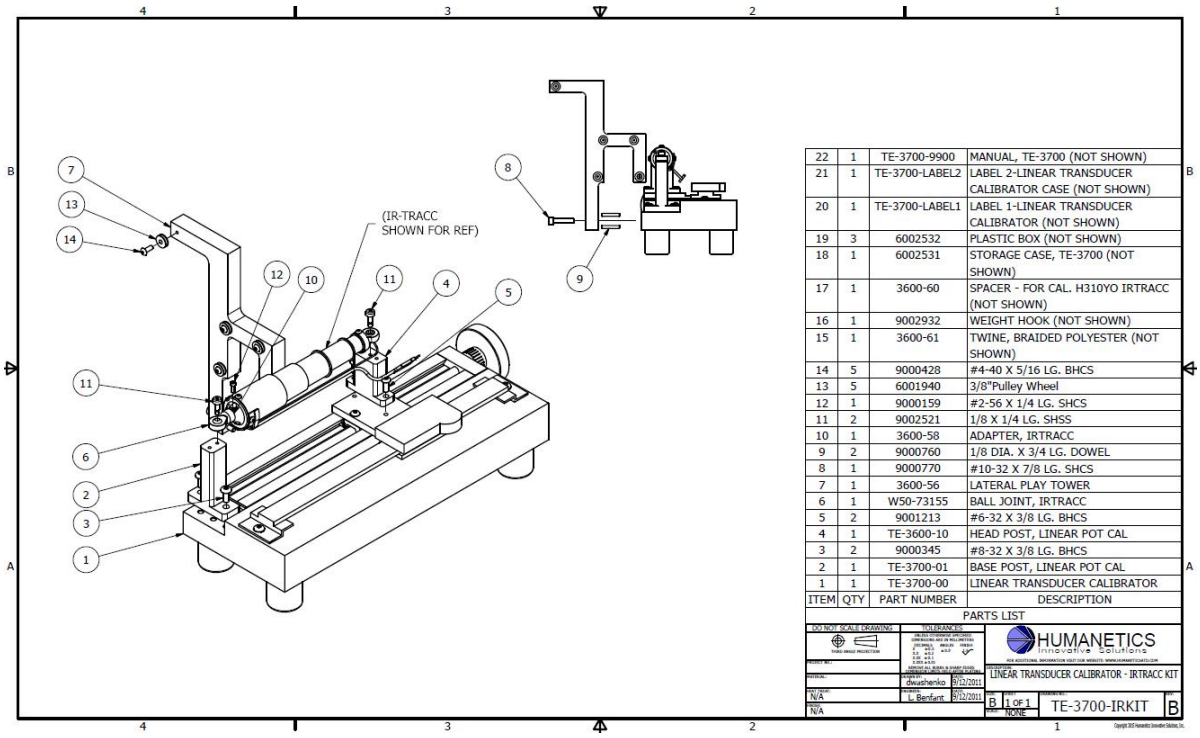
Figure 5-11 5.5mm Hex Wrench, 6004602

6. Tighten the M2 set screw, 5000474 using a 0.9mm hex key.

5.6 Calibration

The IR-TRACC can be calibrated using conventional linear potentiometer calibration procedures. Humanetics also offers an IR-TRACC bench top calibration fixture (TE-3700-IRKIT, Figure 5-12) designed to enable accurate determination of scale factors and linearity. This calibration device consists of a fixture to which both ends of the telescoping rod is attached, a mechanical gear drive and digital micrometer caliper for accurate distance measurement, precision voltmeter and internal power supply. A spreadsheet is provided which calculates linearity and sensitivity in mm/volts.

Rotational pot is calibrated just as any other pot.



ITEM	QTY	PART NUMBER	DESCRIPTION
22	1	TE-3700-9900	MANUAL, TE-3700 (NOT SHOWN)
21	1	TE-3700-LABEL2	LABEL 2-LINEAR TRANSDUCER CALIBRATOR CASE (NOT SHOWN)
20	1	TE-3700-LABEL1	LABEL 1-LINEAR TRANSDUCER CALIBRATOR (NOT SHOWN)
19	3	6002532	PLASTIC BOX (NOT SHOWN)
18	1	6002531	STORAGE CASE, TE-3700 (NOT SHOWN)
17	1	3600-60	SPACER - FOR CAL. H310YO IRTRACC (NOT SHOWN)
16	1	9002932	WEIGHT HOOK (NOT SHOWN)
15	1	3600-61	TWINE, BRAIDED POLYESTER (NOT SHOWN)
14	5	9000428	#4-40 X 5/16 LG. BHCS
13	5	6001940	3/8"Pulley Wheel
12	1	9000159	#2-56 X 1/4 LG. SHCS
11	2	9002521	1/8 X 1/4 LG. SHSS
10	1	3600-58	ADAPTER, IRTRACC
9	2	9000760	1/8 DIA. X 3/4 LG. DOWEL
8	1	9000770	#10-32 X 7/8 LG. SHCS
7	1	3600-56	LATERAL PLAY TOWER
6	1	W50-73155	BALL JOINT, IRTRACC
5	2	9001213	#6-32 X 3/8 LG. BHCS
4	1	TE-3600-10	HEAD POST, LINEAR POT CAL
3	2	9000345	#8-32 X 3/8 LG. BHCS
2	1	TE-3700-01	BASE POST, LINEAR POT CAL
1	1	TE-3700-00	LINEAR TRANSDUCER CALIBRATOR

PARTS LIST

DO NOT SCALE DRAWING | TOLERANCES | HUMANETICS Innovative Solutions

LINEAR TRANSDUCER CALIBRATOR - IRTRACC KIT

TE-3700-IRKIT | B

Figure 5-12 TE-3700-IRKIT, Calibration Fixture

5.7 2D IR-TRACC Zero-Position Verification

Euro NCAP implemented the WorldSID dummy with 2D IR-TRACCs in their 2015 protocols. The Euro NCAP injury parameter is based on the lateral compression of the ribs. This requires calculation of the rib position in a co-ordinate system fixed to the thoracic spine. The Zero-Position Verification Procedure was developed to facilitate this and is applicable to the 2D IR-TRACCs implemented in the WorldSID dummies and the Q10 dummy. For more information see Humanetics Service Bulletin 'IR-TRACC Zero-Position and Angle Calibration' (to be issued).

The Zero-Position Verification is applicable to all versions of the 2D IR-TRACCs implemented in the left side and right side of the WorldSID and in the Q10 dummy in both lateral as well as in frontal orientation.

This manual section provides information on how to implement the verification and calibration parameters in the data acquisition system and/or post processing calculations in the next sections dependent on the IR-TRACC orientation in the dummy.

There are two important benefits of Zero-Position Verification. Firstly, the output of the 2D IR-TRACC makes that the actual rib position is known at any time. This for instance allows checking the rib position between tests and allows to check if the dummy has deformation with respect to previous tests. A deviation may indicate a problem with rib permanent set or incorrect verification parameters. Secondly, when changing over the IR-TRACC position from left side to right side, the lab operator only has to correct the reference angle parameter in DAS or post process; all other verification parameters and post processing formulas will remain the same and are independent of the orientation of the IR-TRACC.

IMPORTANT NOTE: the Zero-Position Verification procedure must be carried out after replacement of a ball joint or angle sensor, as these items affect Zero-Position Intercept and Offset Angle, Cal Factor and Polarity. Also IR-TRACC Length calibration must be carried out after ball joint replacement of the IR-TRACC.

The 2D IR-TRACC verification fixture kit (Figure 5-13) can be used to verify the Zero-Position.

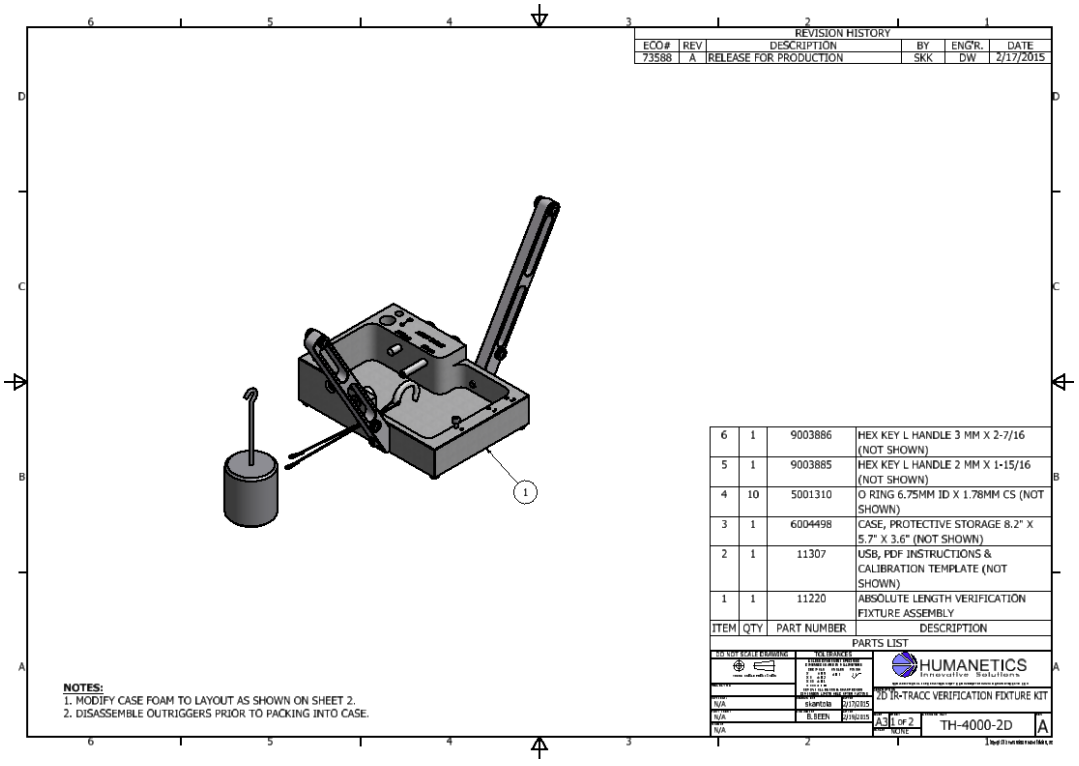


Figure 5-13 TH-4000-2D, 2D IR-TRACC VERIFICATION FIXTURE KIT

5.8 Theory of the Procedure

When the 2D IR-TRACC Zero-Position is not implemented the data of length and angle are represented in a polar co-ordinate system which is not accurately defined nor fixed. The Zero-Position Verification defines the coordinate system according SAE-J211 (Figure 5-19) at the spine and fixes individual sensor parameters to this coordinate system. The relevant parameters of individual sensors are determined at the assembly level in a reproducible and traceable verification procedure. The verification parameters are given in the purple* fields of the verification sheet, see example sheet Figure 5-14 (*Note: color may vary per MS Office version used).

2D IR-TRACC ASSEMBLY- ZERO-POSITION VERIFICATION SHEET Applies for Right Hand Side IRTRACC Orientation							Calculate IRTRACC Radius with Cal Factor: R = (Vsensor ^ -0.4514) * 33.87+11.62		
IRTRACC		**Angle Sensor**			**Date**		Original Calibr Intercept [mm		111.99
Test No.	101614DS3170	Test Nr.	10162014DQ5978		TEST No.		Linearization exponent		-0.4514
Model No.	IF-367-R257	Model / SN	3670-11s		Technician	your name	Calibration Factor [mm/V]		33.867
Serial No.	DS3170	Ang cal/polarity	-0.003169	V_{sen}/V_{exc}/deg	Temp / Hum	23.2 / 45	Zero-Position Intercept [mm]		11.62
Calibration Range [mm]	80	Excitation [V]	5.0060	90	REF Length [mm]	105	123.61	Sensitivity [V/mm] 0.02953	Zero Intercept [V] 0.3433
IRTRACC Pos0 [V]	0.1058	Angle Pos0 [V]	-0.0504	φ0ffset$_{Sensor}$ [deg]	3.18	φ_{IRT} [deg]	R [mm]	x [mm]	y [mm]
IRT pos0 tubes-in [V]	0.1055	Ang pos0 near[V]	-0.0562	φ_{REF} RIGHT	-86.82	90.4	105.1	-0.7	105.1
IRT pos0 tubes-out [V]	0.1060	Ang pos0 far [V]	-0.0446	Ang cal/polarity	-0.003169	89.6	104.9	0.7	104.9
IRTRACC pos1 [V]	0.0918	Ang pos1 [V]	0.2541	φ_{REF} LEFT	93.18	70.8	111.2	36.6	105.0
IRTRACC pos2 [V]	0.0777	Ang pos2 [V]	0.4009	φ_{REF} FRONT	3.18	61.5	118.9	56.7	104.6

Figure 5-14 Example 2D IR-TRACC assembly Zero-Position calibration sheet.

The verification sheet gives the formula to calculate the IR-TRACC Radius R in [mm] from the sensor output voltage using the Linearization Exponent, Calibration Factor [mm/V] and Zero-Position Intercept [mm]. These values can be implemented in the DAS system or in the data analysis software (post-process). When implemented the parameters give the calibrated Radius of the IR-TRACC (pivot-to-pivot length). The angle sensor parameters *Cal Factor*, *Polarity* and *Offset* determine the IR-TRACC angle in the co-ordinate system. The polar coordinates Radius and Angle can be converted to the Cartesian coordinates x and y by using the trigonometric functions sine and cosine. This is further defined in section 5.8 Data Post Processing.

Various DAS systems require the IR-TRACC Sensitivity to be entered in [V/mm] and Zero-Intercept in [V] (this is the inverse of the calibration factor). Other DAS systems apply units according the SI system in [m] for length and [rad] for angle. It is very important to use the correct unit as this will obviously affect the output results. The verification sheet gives a summary of calibration parameters in various units for IR-TRACCs and angle sensor, see examples in Figure 5-15 and Figure 5-16 (Note: do not apply the numbers from these examples!). There is also an alternative formula given to calculate the IR-TRACC Radius R in [mm] from the sensor output voltage using the Exponent, Sensitivity [V/mm] and Zero Intercept [V_{linear}].

Summary of IRTRACC calibration parameters			SI UNITS	
Linearization exponent [-]	-0.4514			
Calibration Factor	[mm/V]	33.867	0.033867	[m/V]
Zero-Position Intercept	[mm]	11.62	0.01162	[m]
Sensitivity	[V_{linear}/mm]	0.02953	29.53	[V_{linear}/m]
Zero Intercept [V_{linear}]	0.3433			
Calculate IRTRACC Radius using Sensitivity: **R = (Vsensor ^ -0.4514 + 0.3433) / 0.02953**				

Figure 5-15 IR-TRACC Parameters (example).

Parameters WorldSID50 thorax /abdomen & Q10 lower lateral (Angle sensor sits on top of IR TRACC)			
	Left	**Frontal**	**Right**
Φ_{REF} [**deg**]	93.18	3.178	-86.82
Φ_{REF} [**Rad**]	1.626	0.05546	-1.515
Angle Cal/Polarity			
[Vsen/Vexc/**deg**]	-0.003169		
[Vsen/Vexc/**Rad**]	-0.1815		
Parameters for upside-down mounted 2D-IRTRACC (Angle sensor sits below IR-TRACC) **WorldSID5F & WorldSID50 shoulder & Q10 (except lower lateral)**			
	Left		**Right**
Φ_{REF} [**deg**]	-86.82		93.18
Φ_{REF} [**Rad**]	-1.515		1.626
Angle Cal/Polarity			
[Vsen/Vexc/**deg**]	0.003169		
[Vsen/Vexc/**Rad**]	0.1815		

Figure 5-16 Angle sensor parameters (example).

The 2D IR-TRACCs are implemented in various orientations in the dummy: left side, right side, frontal (Q10) and upside down (WorldSID 5th Female, WorldSID 50th Male shoulder, all Q10 except lower lateral position). The current procedure was developed with the intention to keep trigonometric functions for post processing identical and independent of the orientation of the IR-TRACC in the dummy.

The chosen coordinate system follows SAE-J211. In this coordinate system the x and y co-ordinates are positive in right hand and frontal quadrant of the dummy, and the angle is 0 when aligned with the positive x-axis and increasing according the right hand rule (cork screw). The example shown in Figure 5-16 and Figure 5-17 is the right side of the thorax, the angle sensor seen from the top, reflecting IR-TRACCs of the thorax and abdomen. When the IR-TRACC is aligned with the y-axis the IR-TRACC angle must read +90°.

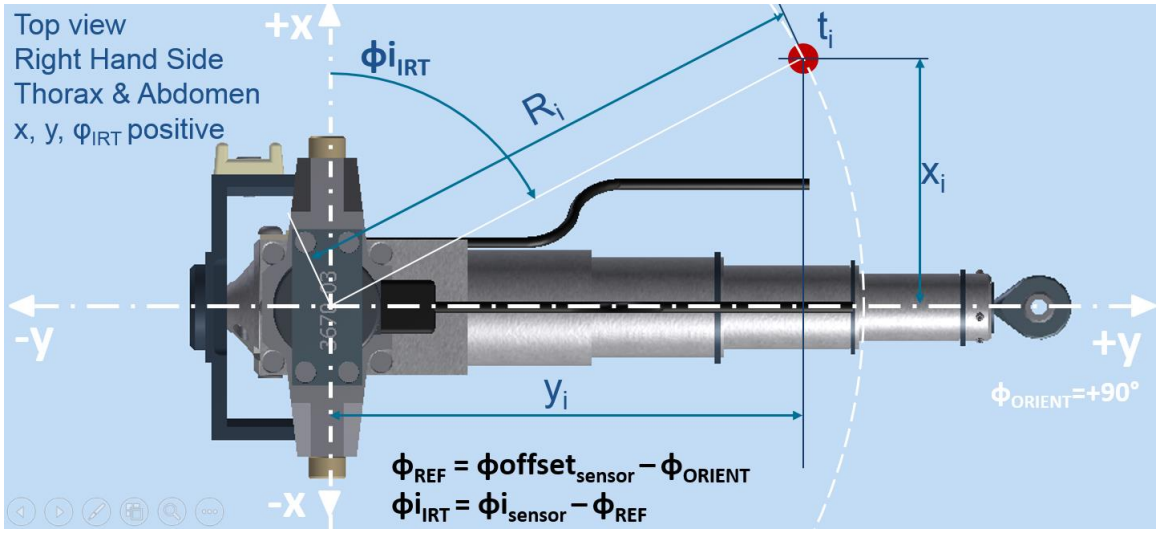


Figure 5-17 2D IR-TRACC assembly in co-ordinate system for right hand struck side, seen from top.

The IR-TRACC orientation in the dummy is reflected in two parameters: the polarity of the angle sensor defines the positive direction of the angle; the orientation angle ϕ_{ORIENT} defines the IR-TRACC orientation angle with respect to the spine box. The Zero-Position Verification procedure takes data in the standard orientation, ϕ_{ORIENT} = +90°, (Figure 5-17) and the angle sensor facing up. In this position the polarity (+/- sign for positive angle) and the Offset angle of the sensor, $\phi offset_{sensor}$, are determined. The Reference angle ϕ_{REF} takes into account the Orientation angle and the Offset angle, see definitions given in Figure 5-18. The diagrams in Figure 5-17 and Figure 5-18, reflect the dummy seen from the top of the head looking down in positive Z-direction.

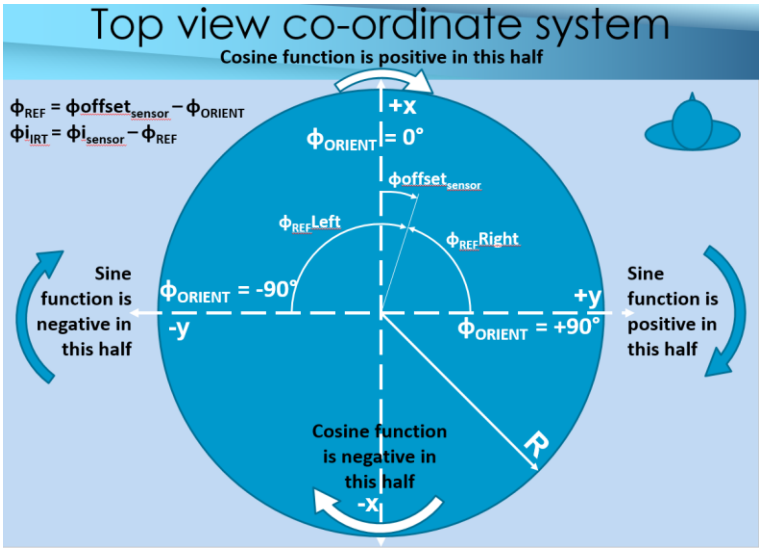


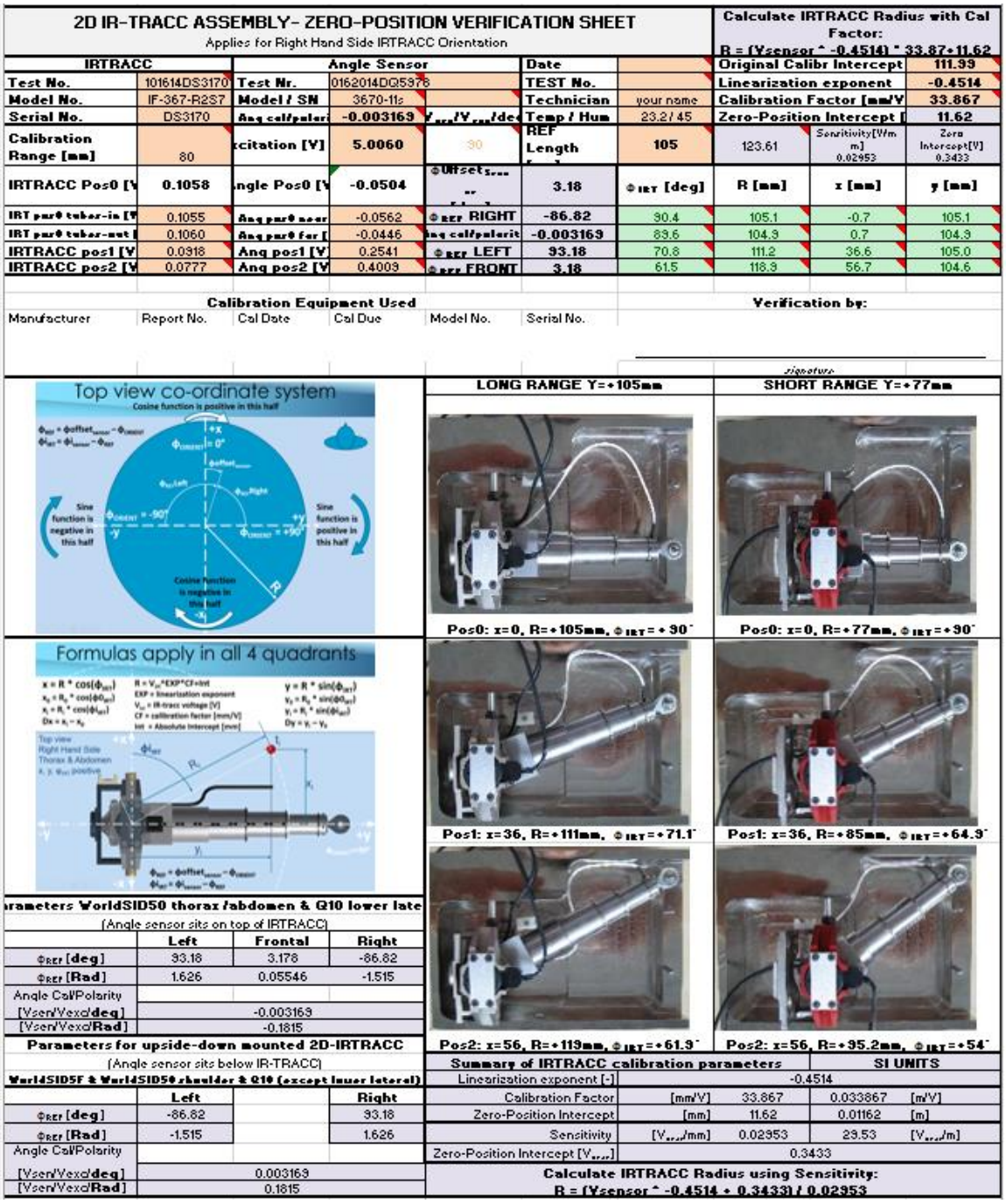
Figure 5-18 Orientation angle, Offset angle, Reference angle definitions.

In some dummy applications or positions, the 2D IR-TRACC is mounted upside down. When this is the case (angle sensor below the IR-TRACC), the polarity of the angle sensor needs to flip sign (from + to -, or from – to +) to achieve positive output according the coordinate system. As the angle polarity and offset angle are linked, flipping the polarity has an effect on the offset angle.

Based on the values obtained in the standard orientation, the verification sheet gives Reference Angle ϕ_{REF} and Polarity for all possible IR-TRACC orientations in the dummy. When an operator implements a sensor in the dummy and the data acquisition system, or changes the orientation of the sensor inside the dummy, the following sequence should be applied:

a. Check the pertaining verification sheet for the serial number of the sensor;
b. Take notice of the sensor orientation in the dummy (left, right or front and up or down);
c. Select in the table the values for Reference Angle ϕ_{REF} and Polarity pertaining to the required orientation;
d. Also note the values are given in two units: degree and radian. Make sure you select the correct unit.
e. Enter the values in the DAS and/or Data Analysis (post processing) software.

See Figure 5-19 for an example verification sheet.



2D IR-TRACC ASSEMBLY- ZERO-POSITION VERIFICATION SHEET

Applies for Right Hand Side IRTRACC Orientation

Calculate IRTRACC Radius with Cal Factor:
R = (Vsensor ^ -0.4514) * 33.87+11.62

IRTRACC		Angle Sensor			Date		Original Calibr Intercept		111.93
Test No.	101614DS3170	Test Nr.	0162014DQ5378		TEST No.		Linearization exponent		-0.4514
Model No.	IF-367-R2S7	Model / SN	3670-11s		Technician	your name	Calibration Factor [mm/V		33.867
Serial No.	DS3170	Ang cal/polari	-0.003169	V_sen/V_exc/dec	Temp / Hum	23.2 / 45	Zero-Position Intercept [		11.62
Calibration Range [mm]	80	xcitation [V]	5.0060	30	REF Length	105	123.61	Sensitivity[Vm m] 0.02953	Zero Intercept[V] 0.3433
IRTRACC Pos0 [V	0.1058	ngle Pos0 [V	-0.0504	Offset_sen...	3.18	Φ IRT [deg]	R [mm]	x [mm]	y [mm]
IRT pur0 tuber-in [V	0.1055	Ang pur0 near	-0.0562	Φ REF RIGHT	-86.82	90.4	105.1	-0.7	105.1
IRT pur0 tuber-out [	0.1060	Ang pur0 far [	-0.0445	ng cal/polarit	-0.003163	83.6	104.9	0.7	104.9
IRTRACC pos1 [V	0.0318	Ang pos1 [V	0.2541	Φ REF LEFT	93.18	70.8	111.2	36.6	105.0
IRTRACC pos2 [V	0.0777	Ang pos2 [V	0.4003	Φ REF FRONT	3.18	61.5	118.9	56.7	104.6

Calibration Equipment Used

Manufacturer	Report No.	Cal Date	Cal Due	Model No.	Serial No.

Verification by:

signature

LONG RANGE Y=+105mm

Pos0: x=0, R=+105mm, Φ IRT=+90°

Pos1: x=36, R=+111mm, Φ IRT=+71.1°

Pos2: x=56, R=+119mm, Φ IRT=+61.3°

SHORT RANGE Y=+77mm

Pos0: x=0, R=+77mm, Φ IRT=+90°

Pos1: x=36, R=+85mm, Φ IRT=+64.9°

Pos2: x=56, R=+95.2mm, Φ IRT=+54°

rameters WorldSID50 thorax /abdomen & Q10 lower late

(Angle sensor sits on top of IRTRACC)

	Left	Frontal	Right
Φ REF [deg]	93.18	3.178	-86.82
Φ REF [Rad]	1.626	0.05546	-1.515
Angle Cal/Polarity [Vsen/Vexc/deg]	-0.003169		
[Vsen/Vexc/Rad]	-0.1815		

Parameters for upside-down mounted 2D-IRTRACC

(Angle sensor sits below IR-TRACC)

WorldSID5F & WorldSID50 shoulder & Q10 (except lower lateral)

	Left		Right
Φ REF [deg]	-86.82		93.18
Φ REF [Rad]	-1.515		1.626
Angle Cal/Polarity [Vsen/Vexc/deg]	0.003169		
[Vsen/Vexc/Rad]	0.1815		

Summary of IRTRACC calibration parameters

			SI UNITS	
Linearization exponent [-]	-0.4514			
Calibration Factor	[mm/V]	33.867	0.033867	[m/V]
Zero-Position Intercept	[mm]	11.62	0.01162	[m]
Sensitivity	[V.../mm]	0.02953	29.53	[V.../m]
Zero-Position Intercept [V...]	0.3433			

Calculate IRTRACC Radius using Sensitivity:
R = (Vsensor ^ -0.4514 + 0.3433) / 0.02953

Figure 5-19 Example of a verification sheet (Note: apply the numbers on the verification sheet per sensor Serial Number, not the numbers in this example).

5.9 Data Post Processing

Figure 5-17 shows the thorax and abdomen 2D IR-TRACC on the right struck side in the local spine co-ordinate system. The formulas to calculate the position of the rib in x and y co-ordinates from the sensor Radius and Angle are given below. The parameters in the formulas are defined in Table 5-5 and Figure 5-16. The calculation formulas are applicable in all 4 quadrants of the co-ordinate system, provided that the correct Reference angle and Polarity are implemented according to the assembly orientation (see previous paragraph).

IMPORTANT NOTE: the IR-TRACC is a non-linear device and the offset at time 0 shall not be zeroed by the data acquisition system, as this will invalidate the IR-TRACC measurement beyond recovery. Neither shall the angle channel be zeroed, as the angle is fixed to the co-ordinate system. If offset zeroing at t_0 is defaulted by the DAS, than the IR-TRACC and angle voltages at t_0 must be stored along with the data set.

PARAMETER	DESCRIPTION
t_0 , t_i [s]	Time zero, Time i
V_{IRT} [V]	IR-TRACC output
EXP	Linearization exponent IR-TRACC output
Calibration Factor [mm/V]	Linearized voltage calibration factor IR-TRACC
Sensitivity [V/mm]	Linearized voltage Sensitivity IR-TRACC
Zero-Position Intercept [mm]	IR-TRACC offset length in pivot co-ordinate system
Zero-Intercept [V_{lin}]	IR-TRACC linearized offset voltage (used with Sensitivity V/mm)
R, R_0, R_i [mm]	Sensor Radius at t_0, at t_i
x, x_0, x_i [mm]	x- co-ordinate, x at t_0, x at t_i
y, y_0, y_i [mm]	y- co-ordinate, y at t_0, y at t_i
Dx_i [mm]	Deflection in x direction at t_i
Dy_i [mm]	Deflection in y direction at t_i
ϕ_{ORIENT} [degrees]	Orientation angle of assembled IR-TRACC, see Figure 5-19
$\phi offset_{sensor}$ [degrees]	Sensor offset angle Zero-Position verification, see Figure 5-19
ϕ_{REF} [degrees]	Reference angle, see Figure 5-19
ϕ_{sensor} , $\phi 0_{sensor}$, ϕi_{sensor} [degrees]	Angle sensor output, at t_0, at t_i
ϕ_{IRT}, $\phi 0_{IRT}$, ϕi_{IRT} [degrees]	IR-TRACC angle along z-axis, at t_0 and at t_i

Table 5-5 Calculation parameters, symbols and description

Calculation formulas

R [mm] = (V_{IRT}^EXP) * Calibration Factor [mm/V] + Zero-Position Intercept [mm]

R [mm] = (V_{IRT}^EXP + Zero-Intercept [V]) / Sensitivity [V/mm]

$\phi_{REF} = \phi offset_{sensor} - \phi_{ORIENT}$ [deg]

$\phi i_{IRT} = \phi i_{sensor} - \phi_{REF}$, $\phi 0_{IRT} = \phi 0_{sensor} - \phi_{REF}$ [deg]

$x = R * \cos(\phi_{IRT})$, $x_0 = R_0 * \cos(\phi 0_{IRT})$, $x_i = R_i * \cos(\phi i_{IRT})$ [mm]

$Dx = x_i - x_0$ [mm]

$y = R * \sin(\phi_{IRT})$, $y_0 = R_0 * \sin(\phi 0_{IRT})$, $y_i = R_i * \sin(\phi i_{IRT})$ [mm]

$Dy = y_i - y_0$ [mm]

PARAMETER	CHANNEL DESCRIPTION	ISO CODE (EXAMPLE LEFT THORAX1)
V_{IRT} [V]	Raw IR-TRACC output (analog)	??TRRILE01WSVO0P
V_{IRT} [LSB]	Raw IR-TRACC output (digital)	New code for LSB to be defined
EXP	CONSTANT Cal factor Linearization exponent	.Power func exponent (header)
Calibration Factor [m/V^{EXP}]	CONSTANT Cal factor Linearized voltage	.Power func sensitivity (header)
Zero-Pos Intercept [m]	CONSTANT Cal factor offset length	.Power func eng offset (header)
Zero-Intercept [V]	CONSTANT	.Power func electr offset (header)
Zero-Intercept [LSB]	CONSTANT	.Power func electr offset (header)
R [m]	IR-TRACC Radius	??TRRILE01WSDC0P
φi_{sensor} [Rad]	Raw Angle sensor output	Not needed for export
Angle Cal/polarity [Rad/V]	polynomial coefficient (linear)	Inverse polynom coeff C (header)
φ_{REF} [Rad]	CONSTANT Reference angle	Inverse polynom coeff M (header)
		.Transfer function used (header)
φi_{IRT} [Rad]	Calculated [Filtered?] IR-TRACC z-angle w.r.t. dummy co-ordinate system	??TRRILE01WSANZ?
x [m]	Calculated [Filtered?] x- co-ordinate	??TRRILE01WSDCX?
y [m]	Calculated [Filtered?] y- co-ordinate	??TRRILE01WSDCY?
Dx_i [m]	Calculated [Filtered?] x Deflection	??TRRILE01WSDSX?
Dy_i [m]	Calculated [Filtered?] y Deflection	??TRRILE01WSDSY?

Figure 5-20 Example ISO codes for Thorax rib1 in SI units.

5.10 Checking polarity

After implementation of the verification and calibration parameters and channel post processing according the calibration sheet, it is important to check the polarities and output of sensors in the dummy with a live Data Acquisition System (DAS) and active post processing of data channels. The dummy co-ordinate system is shown in Figure 5-21. Check the polarities in on-line measurement mode by manipulating the dummy. The correct polarities are given in Table 5-6. The typical value stated in the table is the expected output when the IR-TRACC is assembled in the dummy. The values are indicative and may vary, for instance when the dummy is seated in a vehicle, ribs are rotated forward because of seat interaction, or mild permanent set has occurred on the ribs.

If one (or more) of the polarities is (are) not matching, all calibration parameters should be checked and corrected. If no error can be found there may be a polarity switched somewhere in the measurement chain. It is recommended to perform (repeat) the Zero-Position verification procedure using the exact same measurement chain as used for dummy data acquisition.

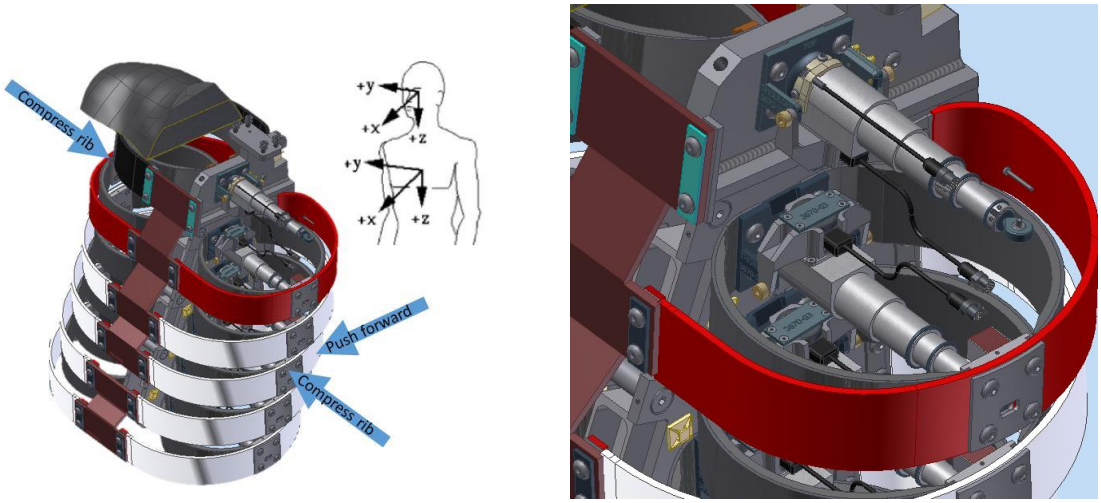


Figure 5-21 Co-ordinate system of the dummy, left struck side instrumented shown here.

PARAMETER	POSITION	MANIPULATION	EXPECTED OUTPUT	TYPICAL STARTING VALUE
Angle ϕ_{IRT}	Left	Push rib forward	Angle increases (to zero)	~–90 degrees
	Right		Angle decreases (to zero)	~+90 degrees
x*	Left		X increases	~0mm
	Right			
Radius R	Left	Compress rib	Radius decreases (to zero)	~+118mm
	Right			
y*	Left		Y increases (to zero)	~–118mm
	Right		Y decreases (to zero)	~+118mm

Table 5-6 Dummy manipulations and parameter responses (*after post processing)

Section 6 Pelvis

6.1 Parts List

Table 6-1 lists the parts required for the WorldSID pelvis assembly. Part numbers refer to those on drawing W50-40000.

ITEM	QTY.	PART NO.	DESCRIPTION
1	1	W50-71975	STRUCTURAL REPLACEMENT SACROILIAC LC
2	1	W50-71122	LUMBAR SPINE STRUCTURAL REPLACEMENT
3	1	W50-42016	SI LC INTERFACE LH
4	1	W50-42017	SI LC INTERFACE RH
5	1	W50-42010	PELVIS BONE LH
6	1	W50-42011	PELVIS BONE RH
7	2	W50-42002	SI LC BACKING PLATE
8	2	W50-42510	PUBIC BUFFER, MOLDED
9	1	W50-71059	STRUCTURAL REPLACEMENT PUBIC LOAD CELL
10	1	W50-42040	INSTRUMENTATION BRACKET PELVIS
11	1	W50-75002	CONNECTOR HOUSING REPLACEMENT
12	1	W50-42019-1	PELVIS FLESH, TESTED/CERTIFIED
13	1	W50-41030	WELDMENT, LOWER LUMBAR MOUNTING BRACKET
14	4	5000090	M6 X 1 X 16 LG. FHCS
15	1	W50-41018	LUMBAR SPINE RUBBER
16	6	W50-41019	BUSHING, LUMBAR
17	2	W50-41021	LUMBAR LOWER CLAMPING PLATE
18	1	W50-41022	LUMBAR UPPER CLAMPING PLATE
19	1	W50-41026	LUMBAR MOUNTING WEDGE
20	4	5000466	M5 X 0.8 X 25 LG. BHCS
21	4	5000209	M8 X 1.25 X 18 LG. SHCS
22	1	W50-10011	SR FOR MSC 260D/GP-M TILT SENSOR
23	1	W50-42031	INSTRUMENTATION COVER PLATE, PELVIS
24	2	W50-42005	HIP JOINT SOCKET
25	2	W50-42007	INNER RING HIP JOINT
26	2	W50-42008	RETAINER, HIP SOCKET
27	6	5000036	M6 X 1 X 20 LG. FHCS SS
28	8	5000265	M6 X 1 X 30 LG. FHCS
29	1	5000646	M4 X 0.7 X 8 LG. FHCS
30	3	5000023	M4 X 0.7 X 10 LG. FHCS
31	4	5000222	SCREW, CHEESE M3 X 6
32	2	5000123	M8 FLAT WASHER PLAIN ZINC
33	8	5000024	M4 X 0.7 X 8 LG. SHCS ZINC
34	6	5000155	M4 FLAT WASHER PLAIN ZINC

35	6	5000153	M4 X 0.7 X 16 LG. BHCS
36	16	5000457	M6 X 1 X 10 LG. SHCS
37	3	5000388	M3 X 0.5 X 8 LG. SHCS
38	2	5000569	M8 X 1.25 X 10 LG. HHCS ZINC
39	6	5000438	M6 X 1 X 20 LG. BHCS
40	1	5000254	M2 X 0.4 X 16 LG. CHMSS SS
41	6	5000464	M4 X 0.7 X 6 LG. SSSFP
42	4	5000001	M6 X 1 X 20 LG. SHCS
43	4	W50-41020	BUSHING, LUMBAR SPINE, TOP
44	2	6002036	CABLE TIE MOUNT, #4 SCREW
45	2	5000399	M3 X 0.5 X 6 LG. BHCS SS
46	1	W50-10010	ANGULAR ACCELEROMETER REPLACEMENT, ENDEVCO 7302BM4
47	2	5000098	M3 X 0.5 X 6 LG. FHCS
48	1	W50-43001	BATTERY CONTAINER
49	4	5000203	M3 X 0.5 X 10 LG. FHCS
50	1	W5-3325	BATTERY REPLACEMENT
51	1	W5-3326	THERMAL PAD (NOT SHOWN)
52	1	W50-43002	BATTERY COVER
53	3	5000103	M4 X 0.7 X 8 LG. BHCS
54	2	5000455	M3 X 0.5 X 16 LG. FHCS

Table 6-1 Parts list for WorldSID pelvis.

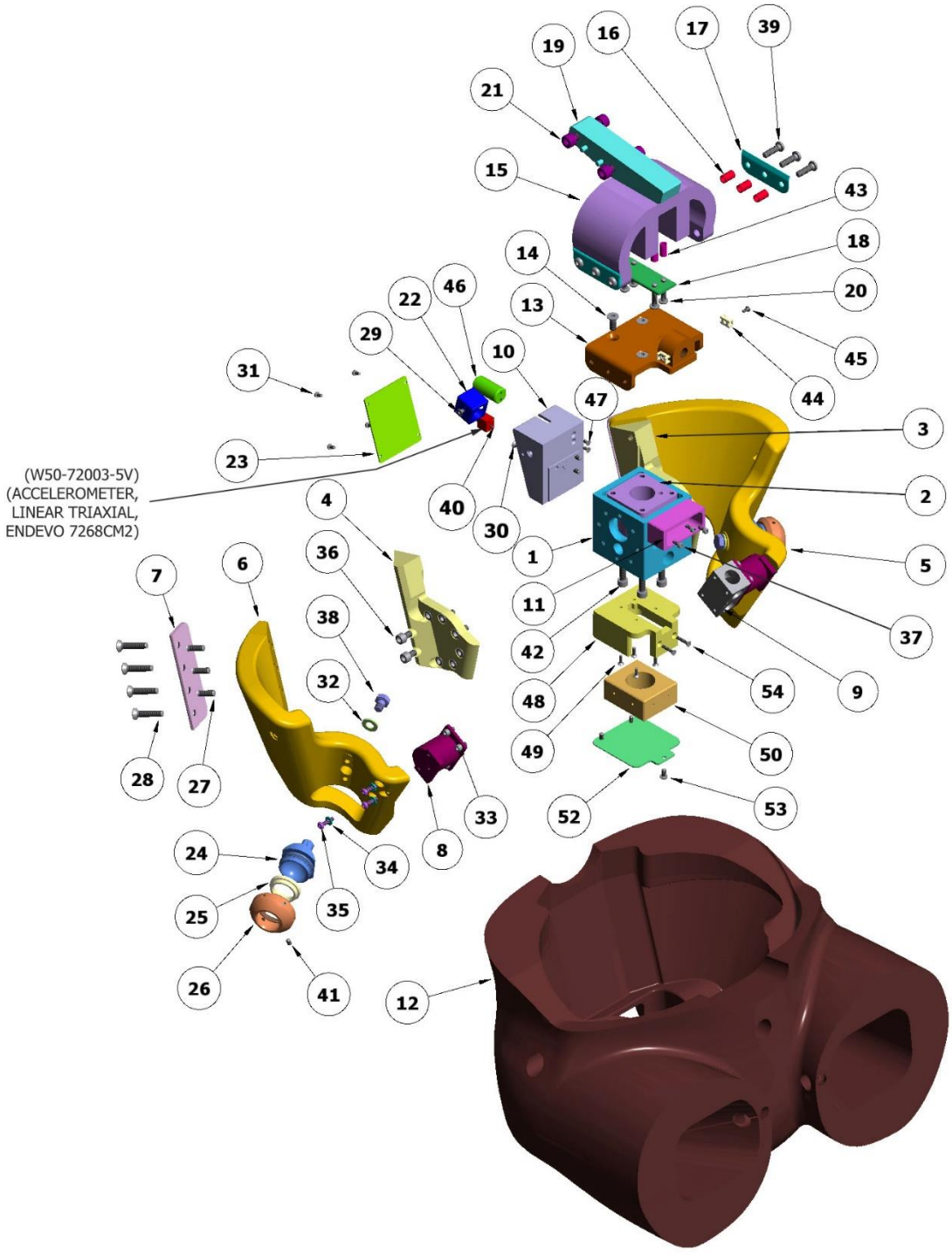


Figure 6-1 WorldSID pelvis components.

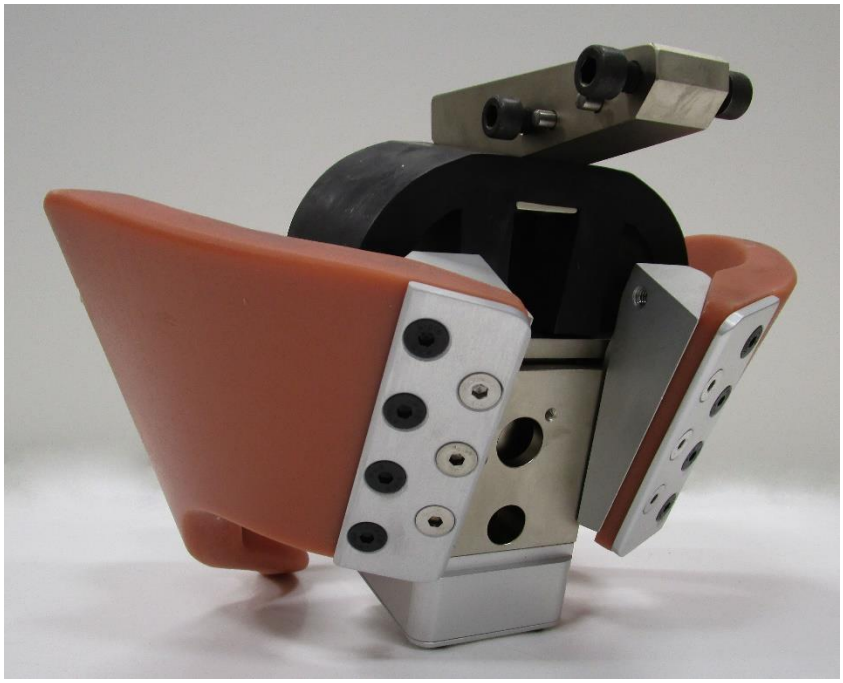


Figure 6-2 Rear view of pelvis assembly.

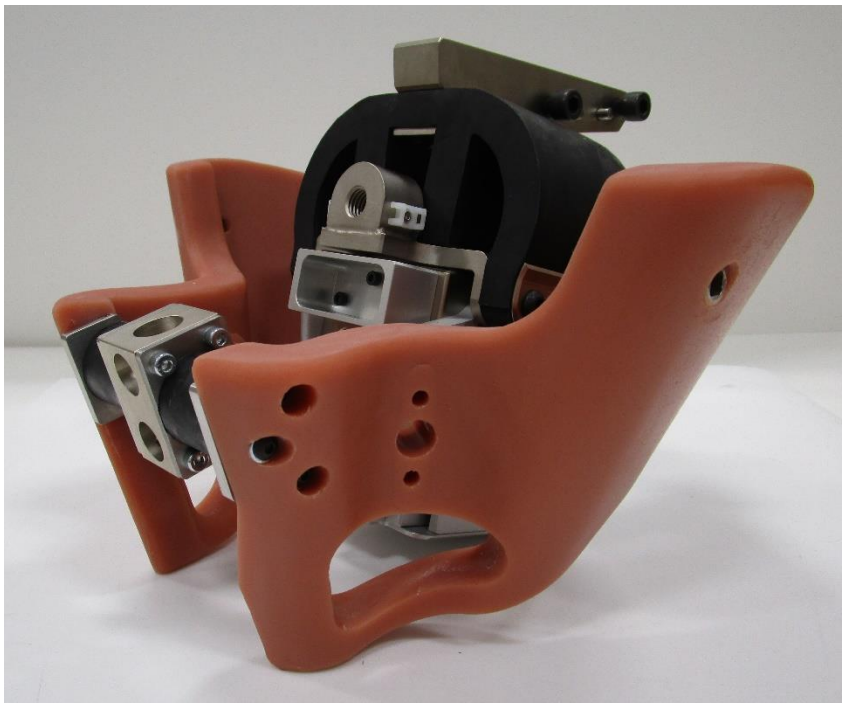


Figure 6-3 Front view of pelvis assembly.

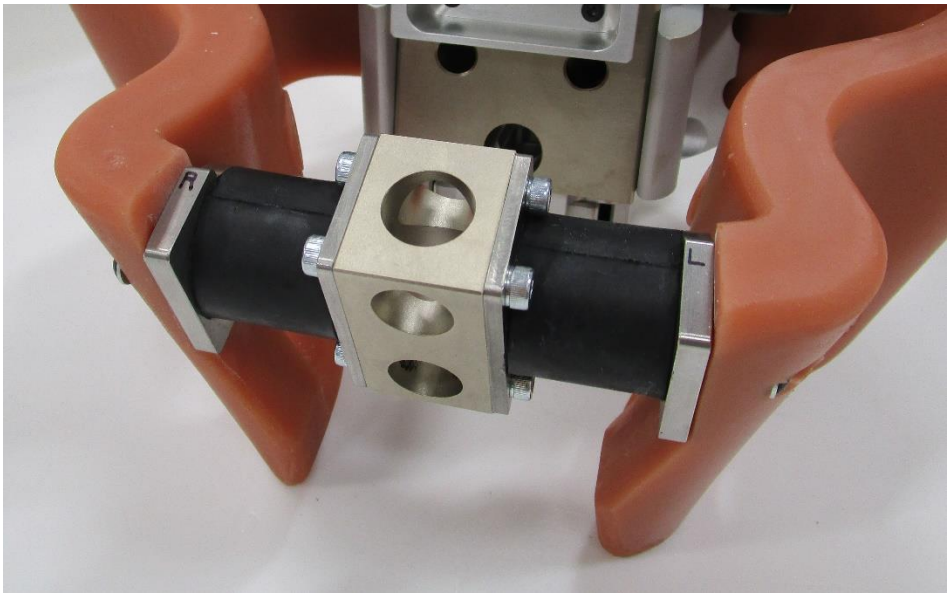


Figure 6-4 Close-up view of pubic assembly.

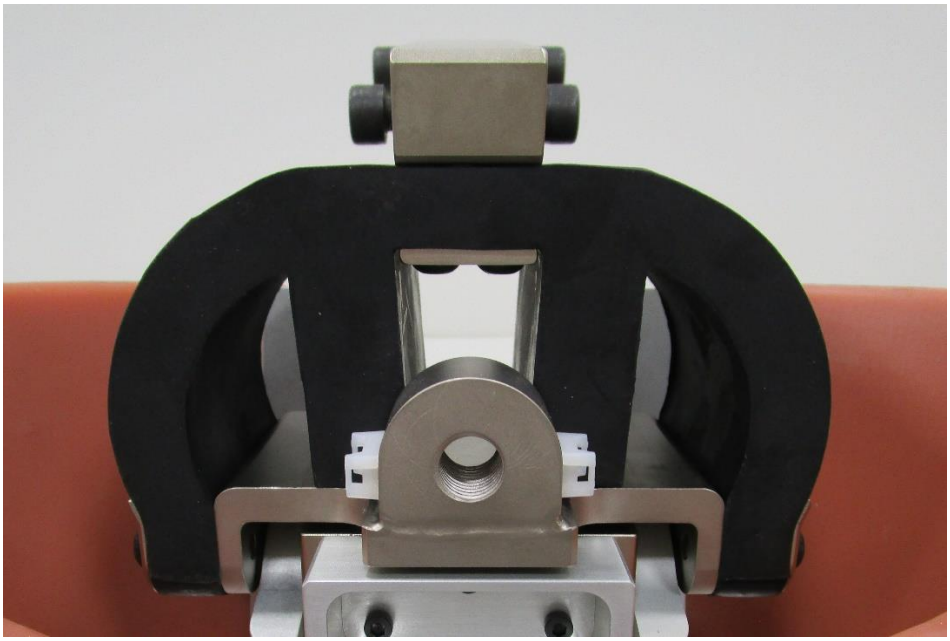


Figure 6-5 Close-up view of lumbar assembly.

6.2 Disassembly

As illustrated in Figure 6-6, remove the spine box from the pelvis assembly by removing four M8 X 1.25 X 18 LG. SHCS (5000209) that connects it to the lumbar mounting wedge (W50-41026).

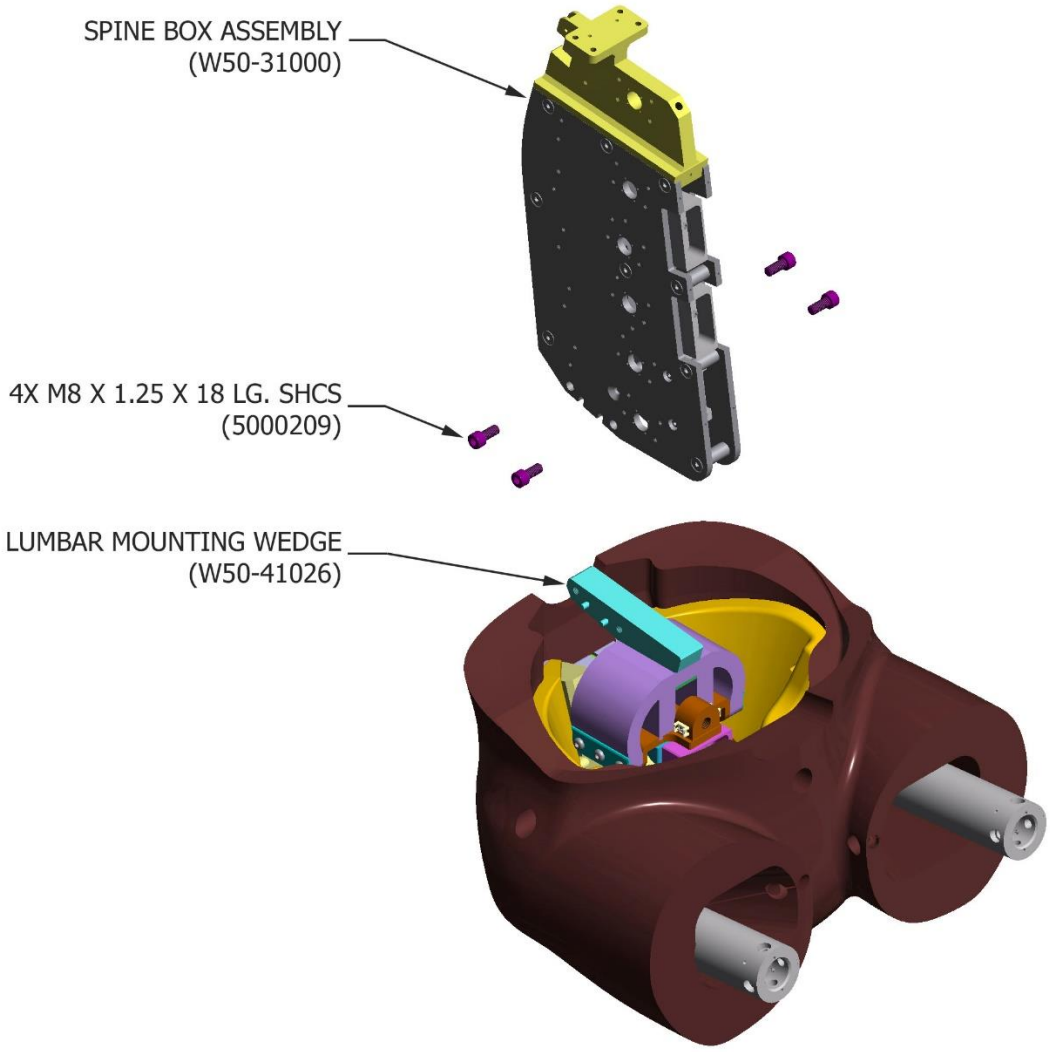


Figure 6-6 Removing spine box from the pelvis.

Detach the femur assemblies by removing the M8 X 1.25 X 10 LG. HHCS ZINC (5000569) and M8 FLAT WASHER PLAIN ZINC (5000123) that attaches each to the pelvis assembly. They are accessible from the interior of the pelvis bone and removed with a box end wrench or a wring rachet.

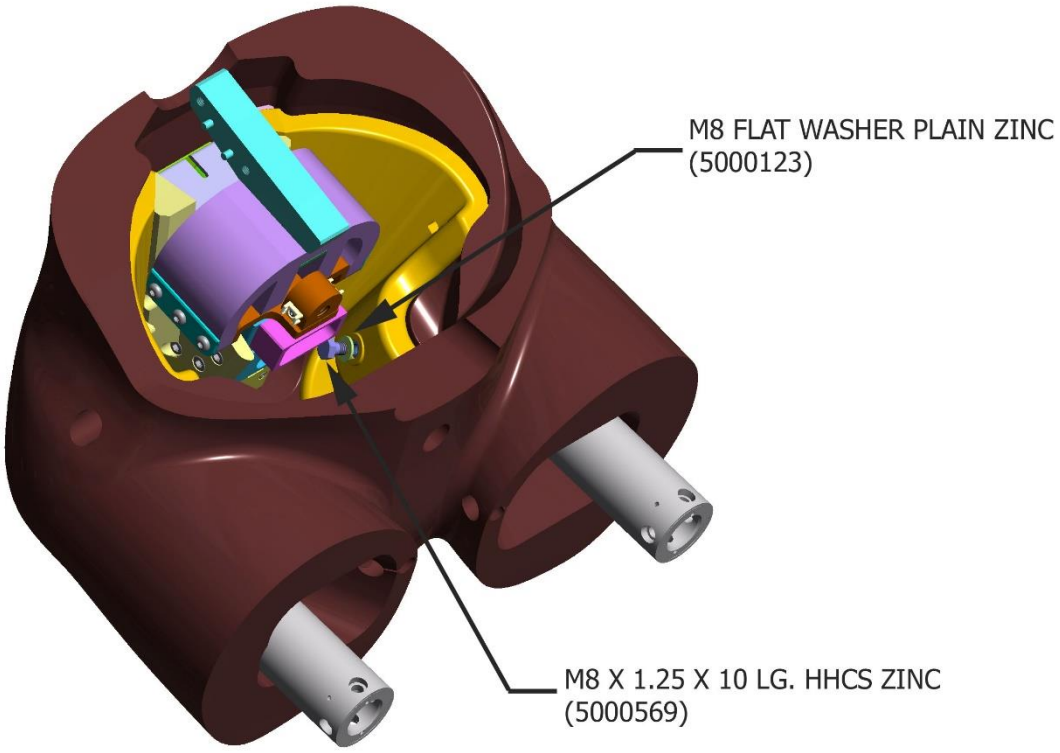


Figure 6-7 Detaching the femur assemblies.

Remove the pelvis flesh (W50-42019-1) by peeling it away from the pelvis.

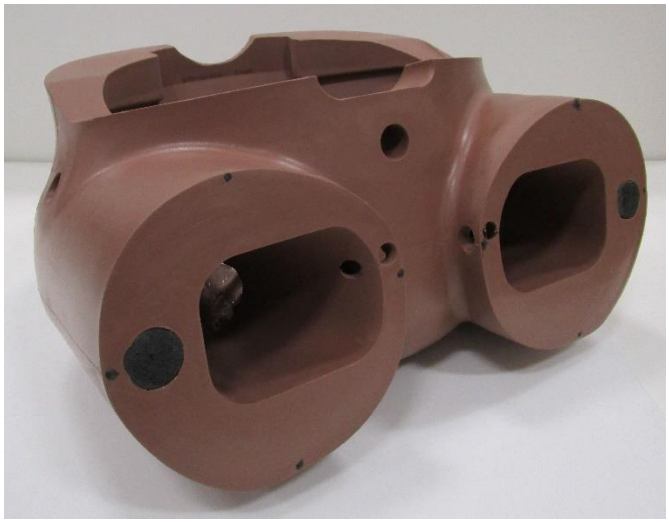


Figure 6-8 Pelvis flesh.

Remove the sacroiliac load cell backing plates (W50-42002) by removing the four M6 X 1 X 30 LG.FHCS (5000265) and three M6 X 1 X 20 LG. FHCS SS (5000036) that secure them. The two pelvis bones (W50-42010 and W50-42011), connected by the pubic buffers (W50-42510) and pubic load cell (W50-71059), will now be separated from the lumbar/instrumentation assembly.

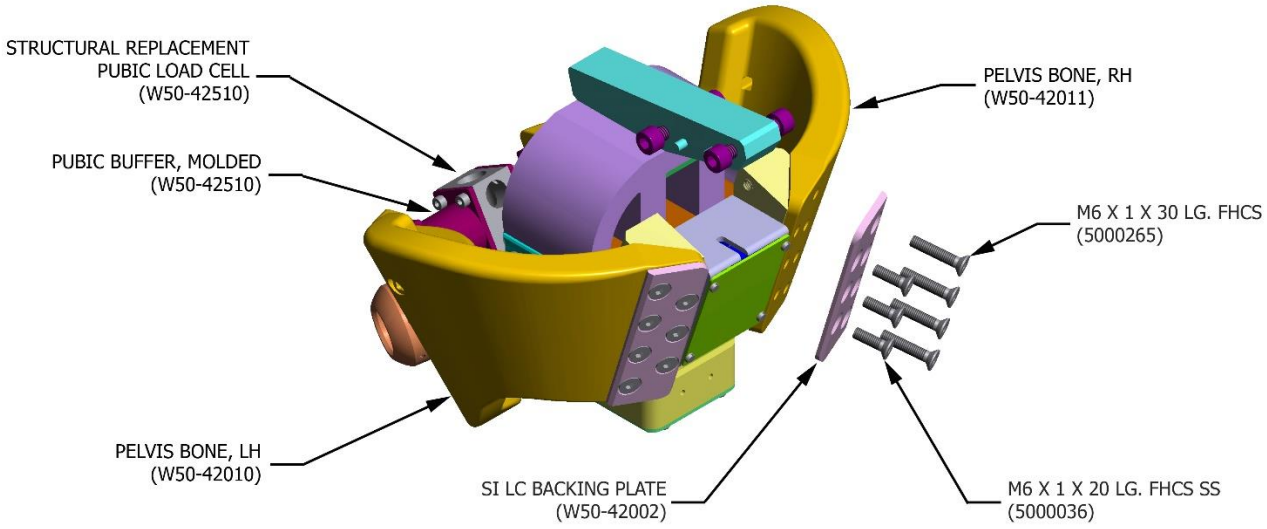


Figure 6-9 Removing sacroiliac backing plates to separate the pelvic bone-pubis assembly.

The molded pubic buffers (W50-42510) are detached from the molded pelvis by removing the three M4 X 0.7 X 16 LG. BHCS (5000153) and M4 FLAT WASHER PLAIN ZINC (5000155) that hold each in place.

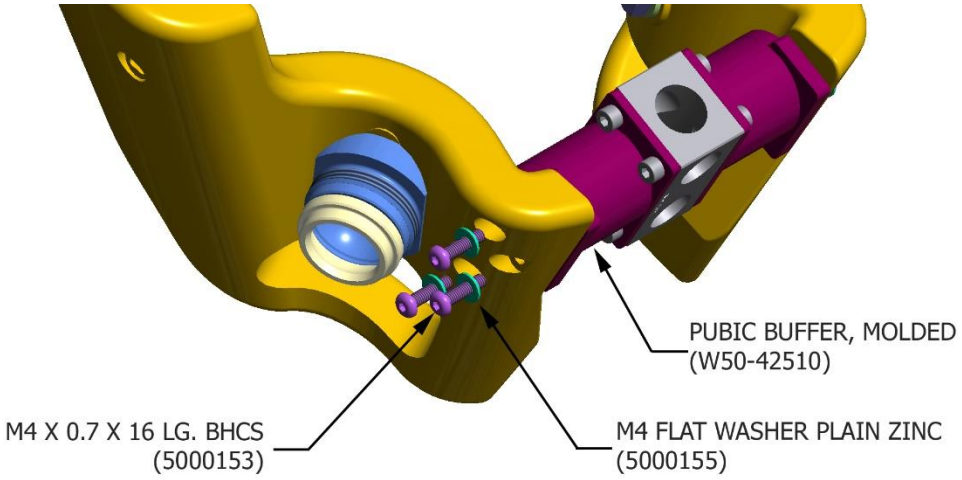


Figure 6-10 Separating molded pelvis bone from pubis assembly.

Detach the pubic buffers from the pubic load cell structural replacement (W50-71059) by removing four M4 X 0.7 X 8 LG. SHCS (5000024) from each side.

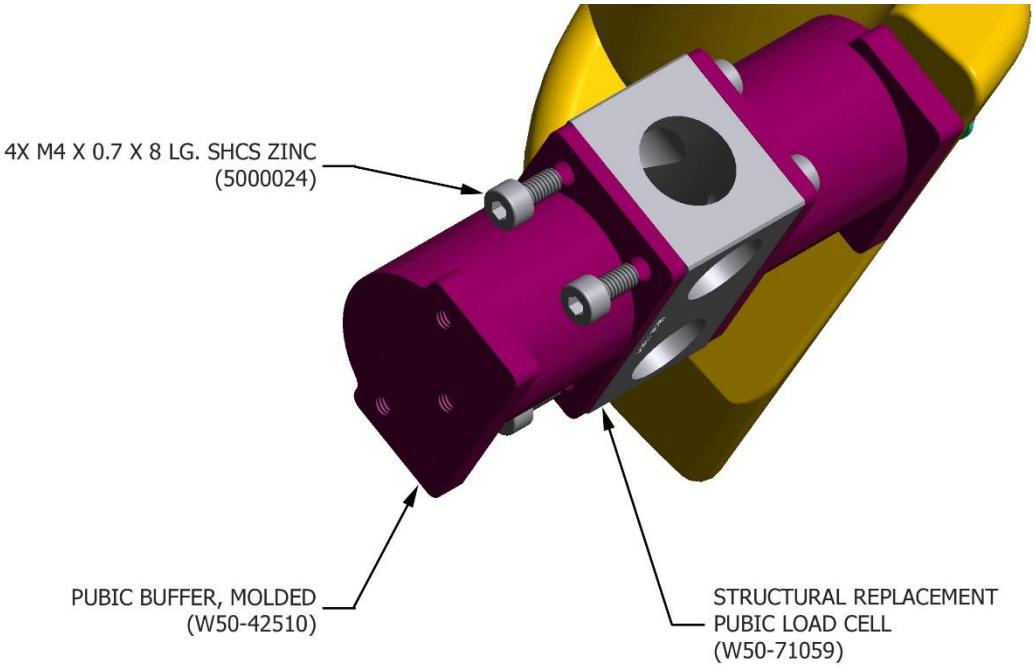


Figure 6-11 Separating pubic buffers from pubic load cell replacement.

As shown in Figure 6-12, to detach the lumbar spine (W50-41018), remove the six M6 x 20 BHCS (5000646) and six lumbar bushings (W50-41019) that attach it to the lower lumbar mounting bracket weldment (W50-41021). Two lower lumbar clamping plates (W50-41030) will also be free to remove at this time.

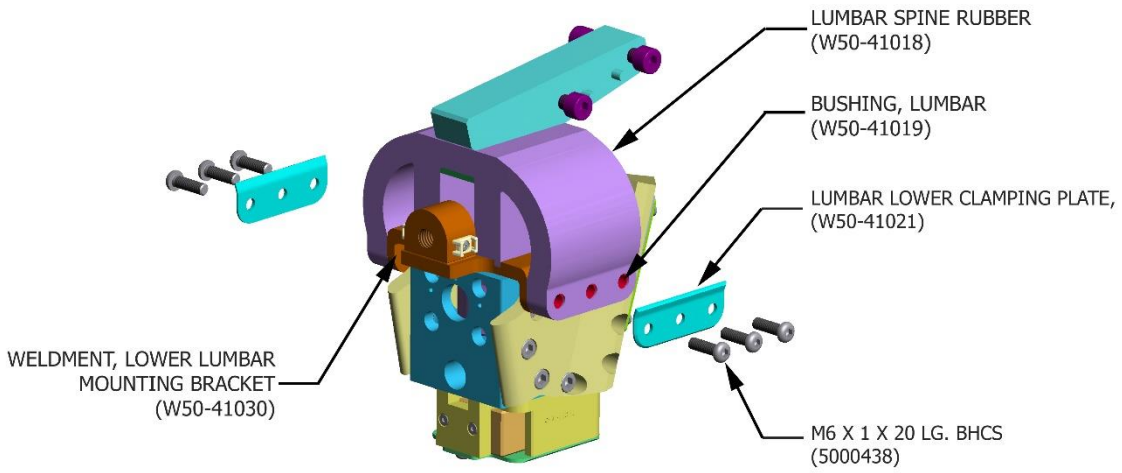


Figure 6-12 Detaching the lumbar spine.

Remove the upper lumbar clamping plate (W50-41022) from the lumbar spine by removing the four M5 X .8 X 25 LG. BHCS (5000466) that secures it. The lumbar mounting wedge (W50-41026) will be free to remove at this time as well.

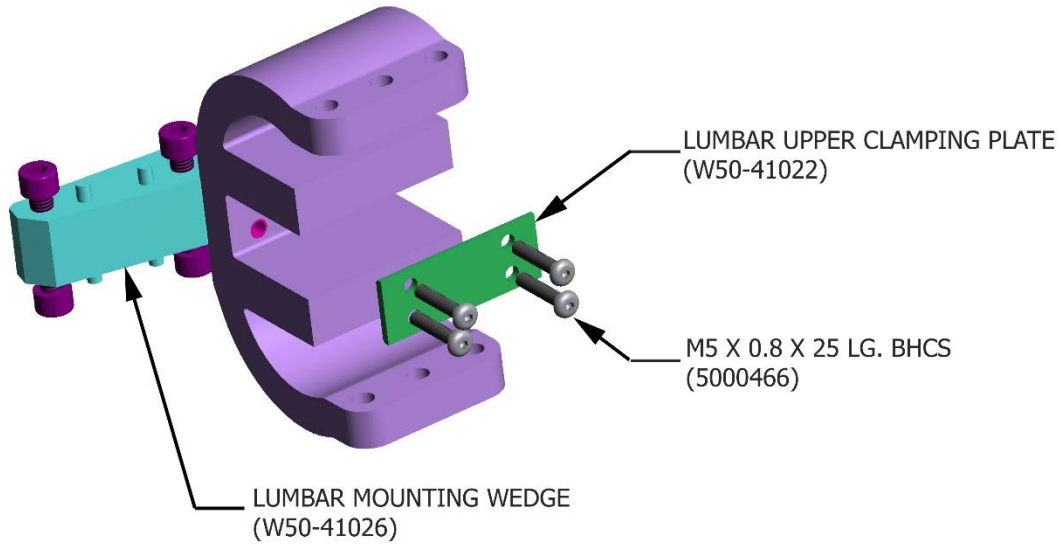


Figure 6-13 Separating the upper lumbar clamping plate and lumbar mounting wedge from the lumbar spine.

Remove the lower lumbar mounting bracket weldment (W50-41030) from the lumbar load cell structural replacement (W50-71122, shown in Figure 6-15) by removing four M6 X 1 X 16 LG. FHCS (5000090).

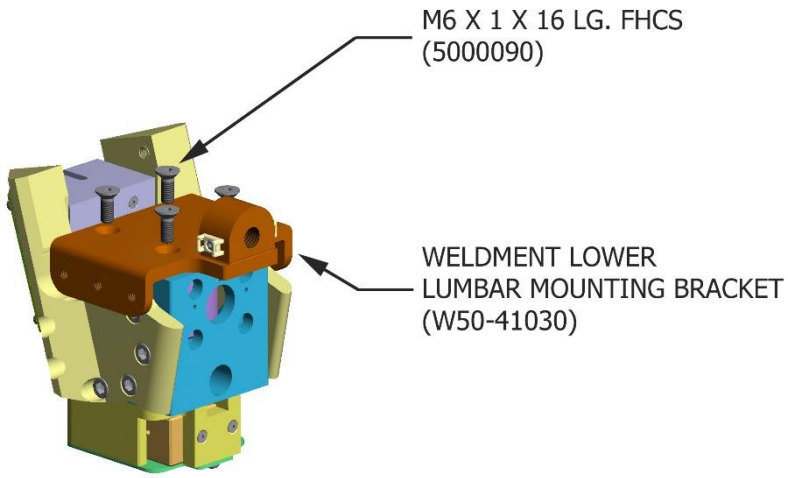


Figure 6-14 Removing the lower lumbar mounting bracket weldment.

Detach the left and right sacroiliac load cell interfaces (W50-42016 and W50-42017) by removing the eight M6 X 1 X 10 LG. SHCS (5000457) that hold each in place (Figure 6-15).

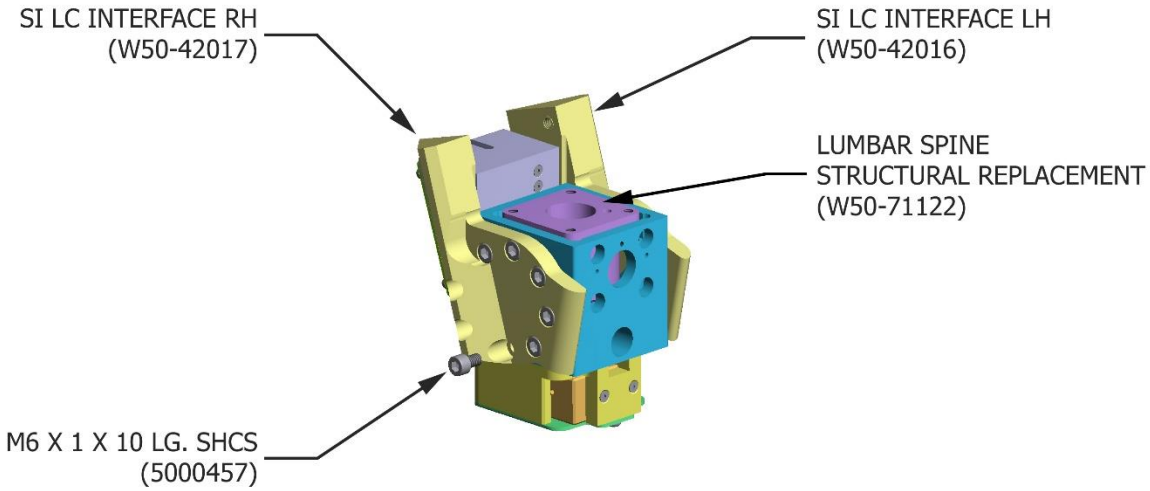


Figure 6-15 Removing the sacroiliac load cell interface.

Remove the pelvis instrumentation cover plate (W50-42031) by removing four M3 X 6 cheese screws (5000222).

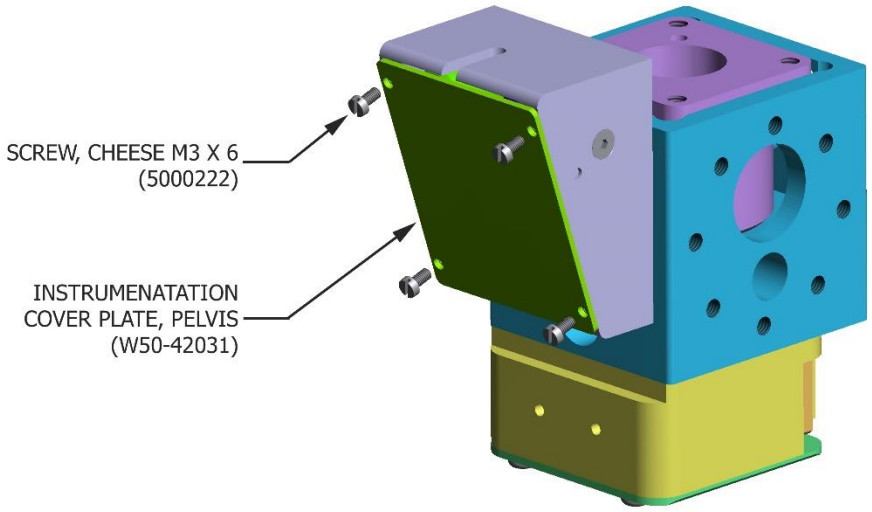


Figure 6-16 Removing pelvis instrumentation cover plate.

Detach the pelvis instrumentation bracket (W50-42040) from the sacroiliac load cell structural replacement (W50-71975) by removing three M4 X 0.7 X 10 LG. FHCS (5000023) accessed from the back.

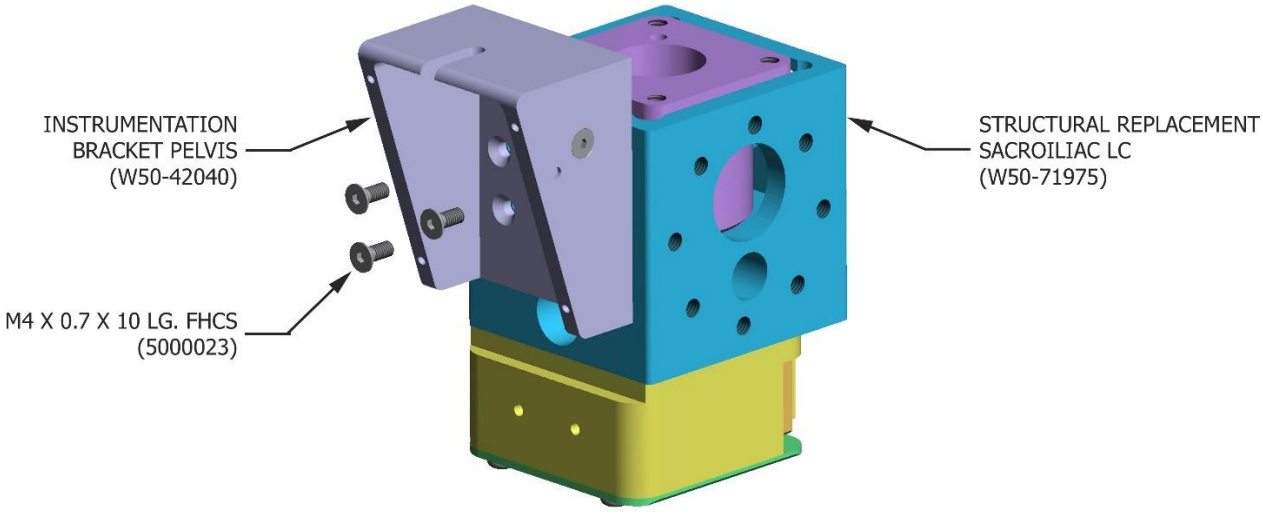


Figure 6-17 Removing the pelvis instrumentation bracket.

Detach the battery cover (W50-43002) by removing three M4 X 0.7 X 8 LG. BHCS (5000103). Then remove two M3 X 0.5 X 16 LG. FHCS (5000455) to free the battery replacement. Next, remove the four M3 X 0.5 X 10 LG. FHCS (5000203), this will allow the battery container (W50-43001) to be detached from the sacroiliac load cell replacement (W50-71975).

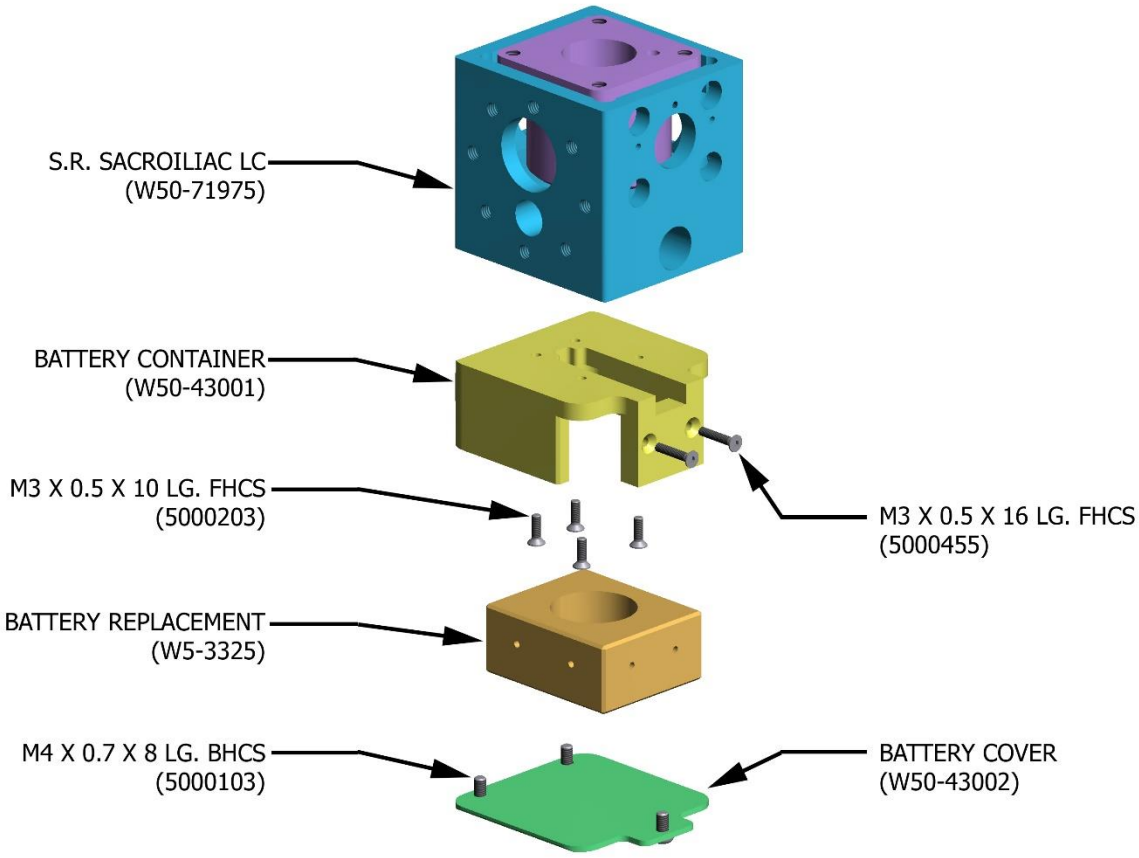


Figure 6-18 Detaching the battery.

As shown in Figure 6-19, the replacements for the sacroiliac (W50-71975) and lumbar spine load cells (W50-71122) are separated by removing the four M6 X 1 X 20 LG. SHCS (5000001) accessed from the bottom.

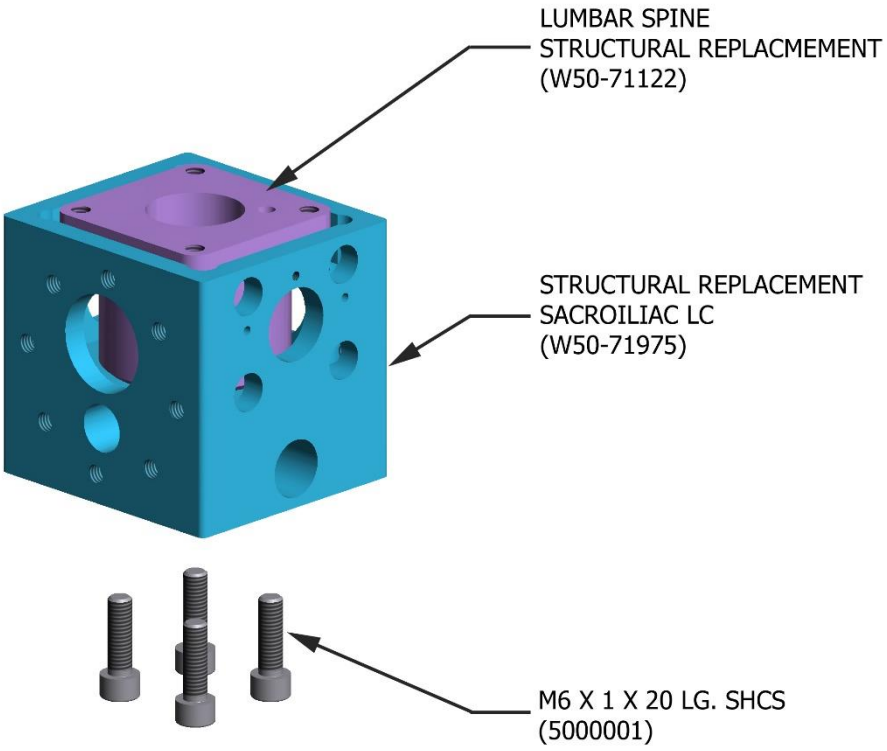


Figure 6-19 Separating the sacroiliac and lumbar spine load cell replacements.

6.3 Instrumentation

Pelvis instrumentation for the WorldSID includes pubic, sacroiliac, and lumbar spine load cells. A battery and the container can be mounted to the bottom of the pelvis assembly. The pelvis instrumentation cavity can be equipped with a linear triaxial accelerometer and a dual-axis tilt sensor, and one angular can also be mounted.

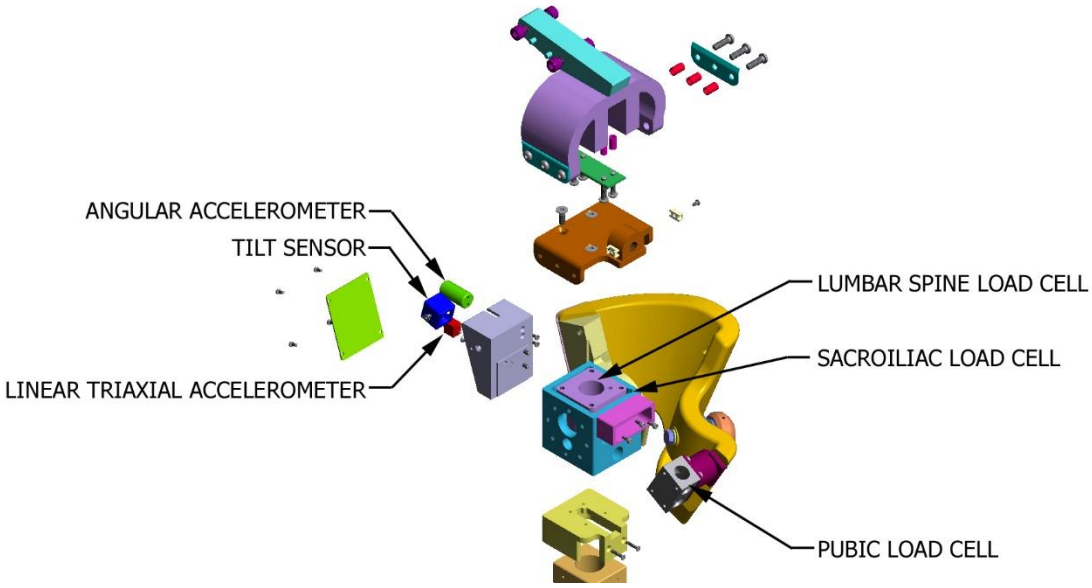


Figure 6-20 Pelvis instrumentation.

6.4 Re-Assembly

Join the lumbar spine load cell (W50-71122) to the sacroiliac load cell (W50-71975) using four M6 X 1 X 20 LG. SHCS (5000001). The connectors are at the bottom of the load cells and face the front of the dummy.

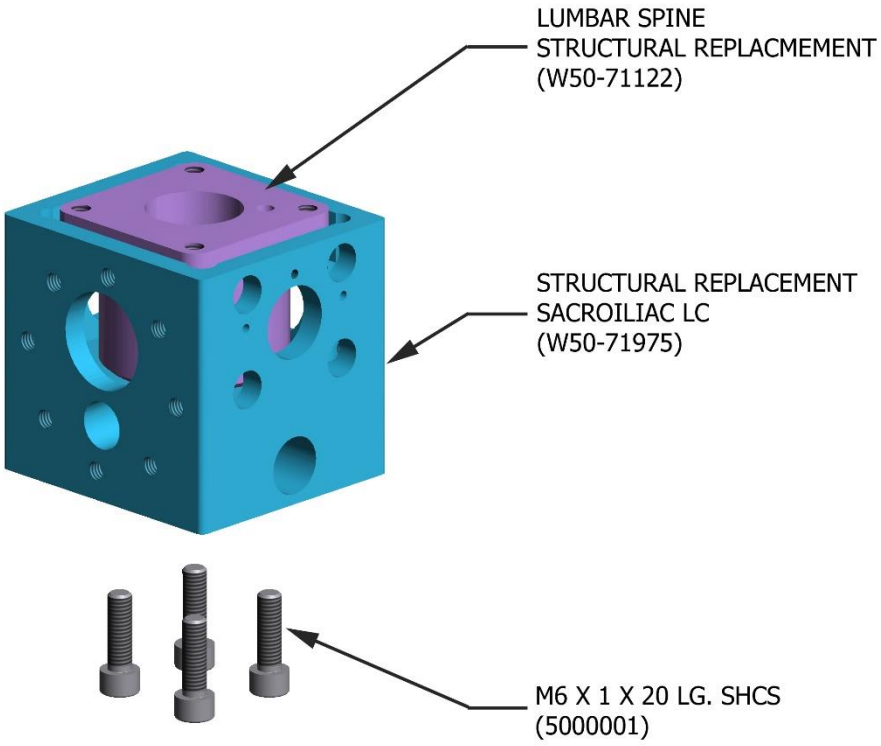


Figure 6-21 Assembling the lumbar spine load cell and sacroiliac load cell.

Attach the container to the sacroiliac load cell with four M3 X 0.5 X 10 LG. FHCS (5000203). Next place the battery into the container. Attach the cover (W50-43002) with three M4 X 0.7 X 8 LG. BHCS (5000103). Secure the connector or its replacement (W50-75002) to the front of the sacro-iliac load cell with three M3 X 0.5 X 8 LG. SHCS (5000388).

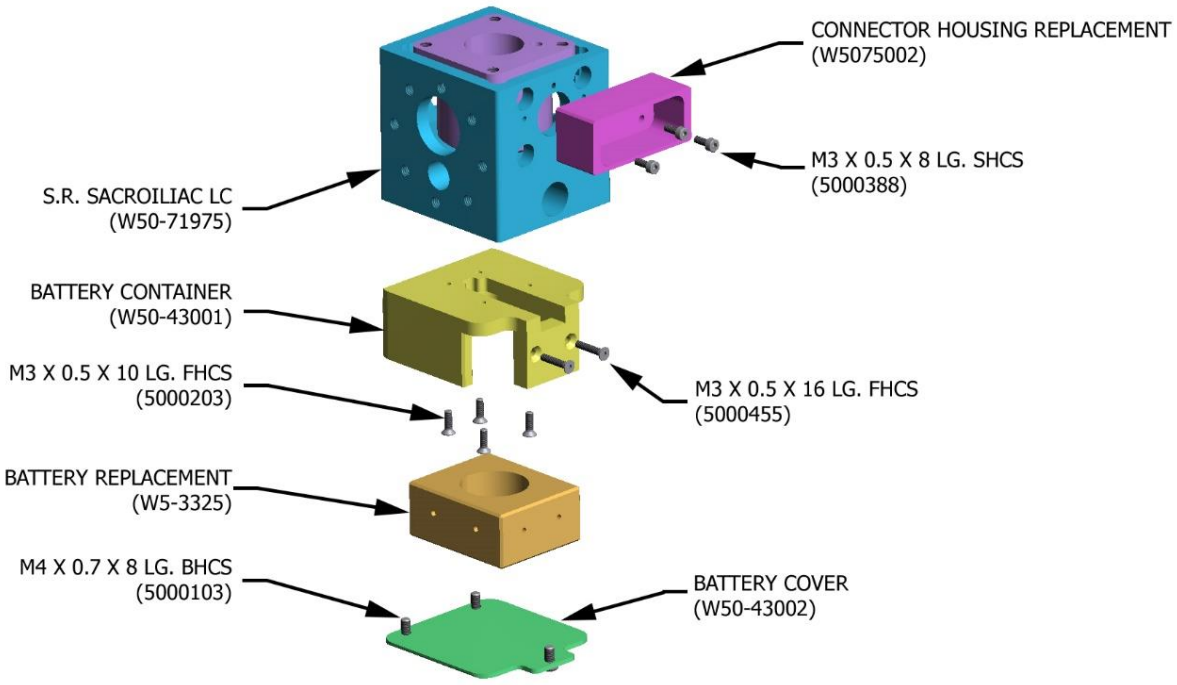


Figure 6-22 Attaching the battery container.

Mount the linear triaxial accelerometer (referneced) to the pelvis instrumentation bracket (W50-42040) using a M2 x 16 cheese screw (5000254) accessed from the back. Attach the dual-axis tilt sensor (W50-10011) with a M4 X 0.7 X 8 LG. FHCS (5000646) accessed from the side. Secure the pelvis instrumentation bracket (W50-42040) to the sacroiliac load cell or its structural replacement (W50-71975) with three M4 X 0.7 X 10 LG. FHCS (5000023). Mount the pelvis instrumentation cover plate (W50-42031) with four M3 X 6 cheese screws (5000222). The wires for the accelerometer and tilt sensor should exit the slot in the top of the instrumentation bracket. The accelerometer wire should be routed over non-struck sacroiliac load cell interface towards the front of the dummy.

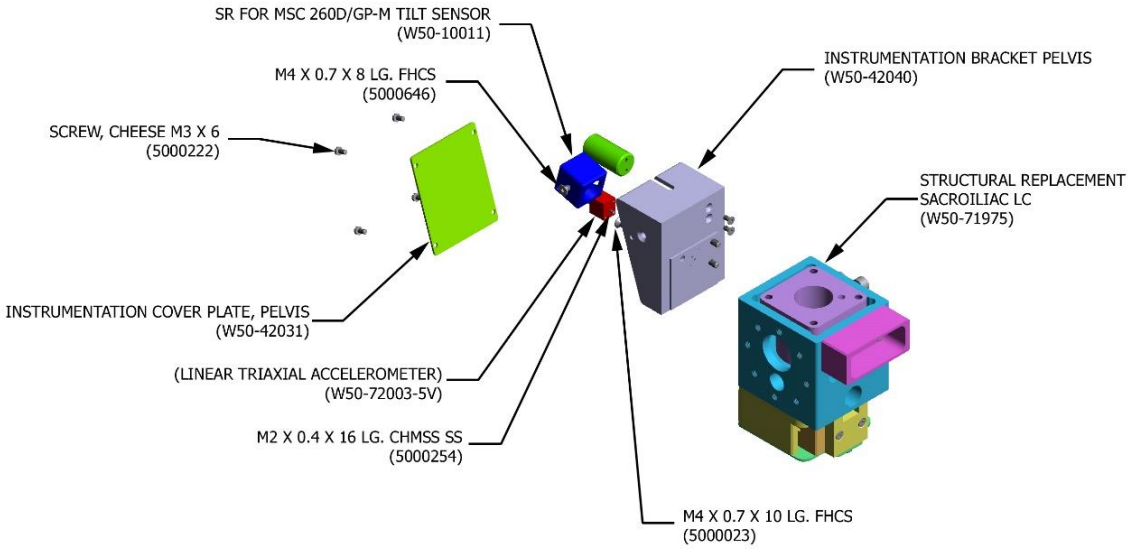


Figure 6-23 Attaching the accelerometer.

Attach the left and right sacroiliac load cell interfaces (W50-42016 and W50-42017) with eight M6 X 1 X 10 LG. SHCS (5000457) that hold each in place. Connect the lumbar mounting bracket weldment (W50-41030) to the lumbar load cell or its structural replacement (W50-71122) with four M6 X 1 X 16 LG. FHCS (5000090). Place the lumbar mounting wedge (W50-41026) on top of the lumbar spine (W50-41018), lining up the threaded holes on the bottom with those in the lumbar spine. Place the upper lumbar clamping plate (W50-41022) over the holes in the lumbar spine and secure it with four M5 X 0.8 X 25 LG. BHCS (5000466) and four bushings (W50-41020).

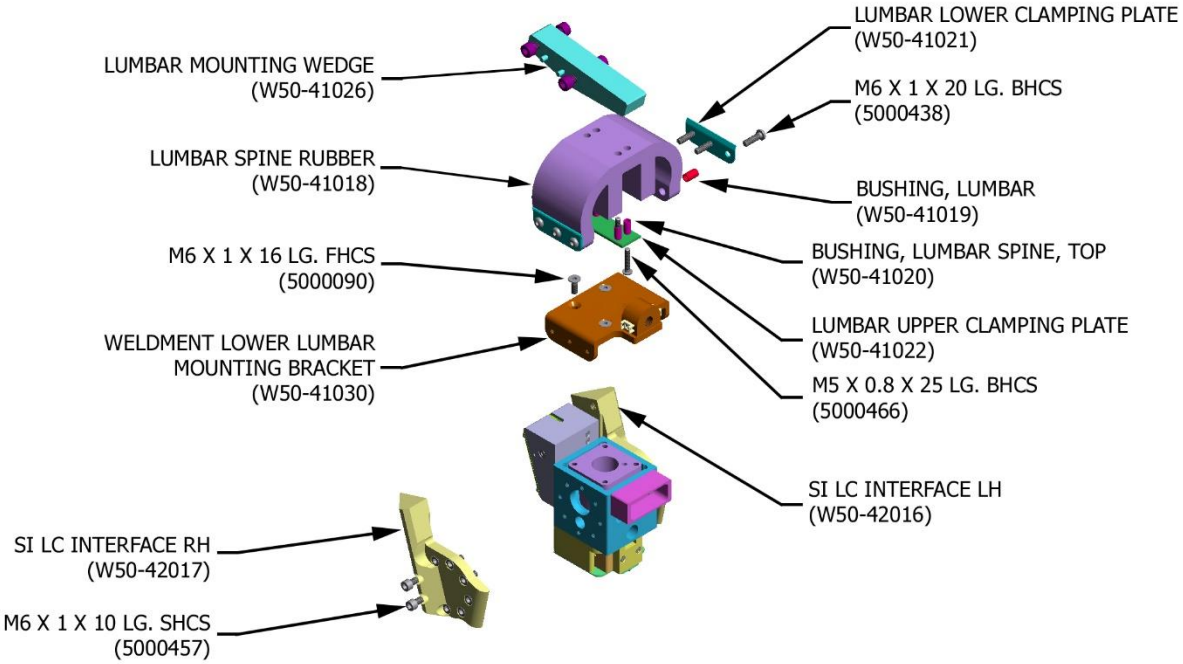


Figure 6-24 Attaching sacroiliac load cell interfaces.

Place the assembled lumbar spine (W50-41018) over the lumbar mounting bracket. Position a lower lumbar clamping plate (W50-41021) over the holes in the side of the lumbar spine so the curve of the plate matches the curve in the rubber, with the radius edge facing down. Secure the lumbar spine and clamping plate to the mounting bracket with three M6 X 1 X 20 LG. BHCS (5000438) and three lumbar bushings (W50-41019). Repeat the procedure for the other side of the lumbar spine.

Connect the pubic buffers to the pubic load cell or its structural replacement (W50-71059) with four M4 X 0.7 X 8 LG. SHCS ZINC (5000024) on each side. Attach the molded pubic buffers (W50-42510) to the molded pelvis with three M4 X 0.7 X 16 LG. BHCS (5000153) and M4 flat washers (5000155) on each side. Position the central assembled portion of the pelvis within the molded pelvis/pubic assembly. Attach each sacroiliac load cell backing plates (W50-42002) with four M6 X 1 X 30LG. FHCS (5000265) and three M6 X 1 X 20 LG. FHCS SS (5000036). The shorter screws are used on the inboard holes.

Plug in the connectors for the lumbar, pubic, and sacroiliac load cells and the pelvis triaxial accelerometer (Figure 6-25). Make sure the connectors for the tilt sensor are free so they can be connected to the off-board readout later. The wires should be routed toward the front along the non-struck side so they can be plugged into the non-struck side DAS module on the spine box.

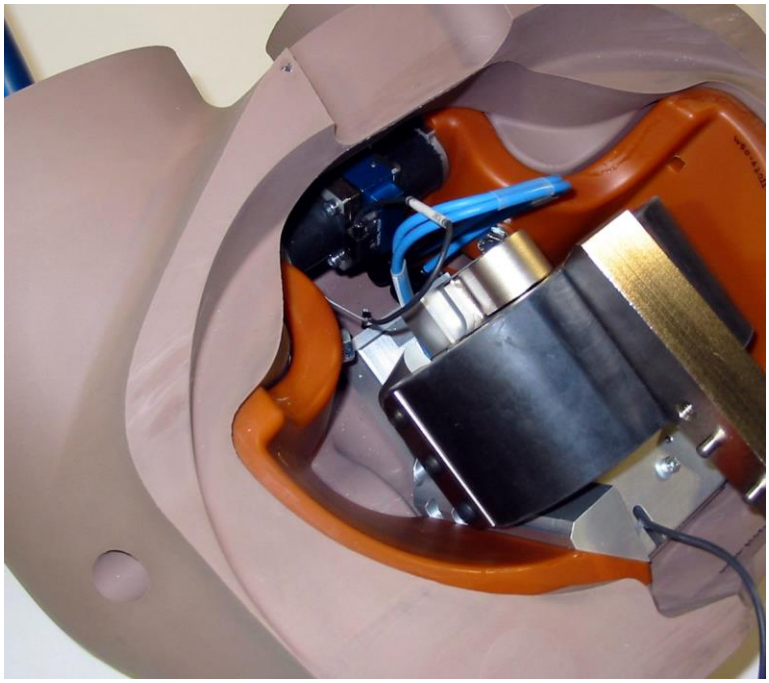


Figure 6-25 Routing of wires for pelvis instrumentation.

Place the pelvis into the pelvis flesh, placing the pubic assembly in first, and then adjusting the flesh over the pelvic bones. Make sure the flesh is correctly positioned over the pelvis by checking that access holes in the pelvis flesh line up with screws in the pelvis.

Insert the hip joint assembly through the front access hole in the pelvis flesh. Secure from the inside of the pelvis with a M8 washer (I5000123) and a M8 X 1.25 X 10 LG. HHCS ZINC (5000569).

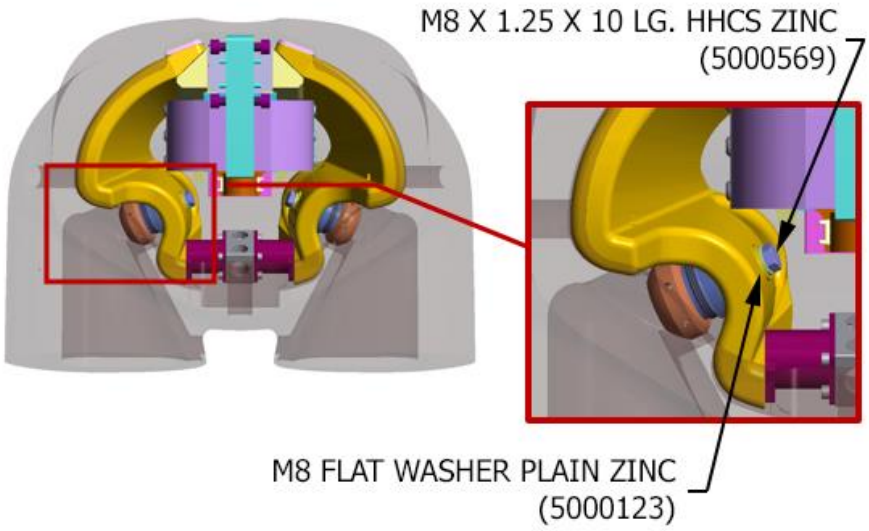


Figure 6-26 Inserting hip joint.

Place the assembled spine box (W50-31000) over the lumbar wedge (W50-41026) and secure with four M8 X 1.25 X 18 LG. SHCS (5000209).

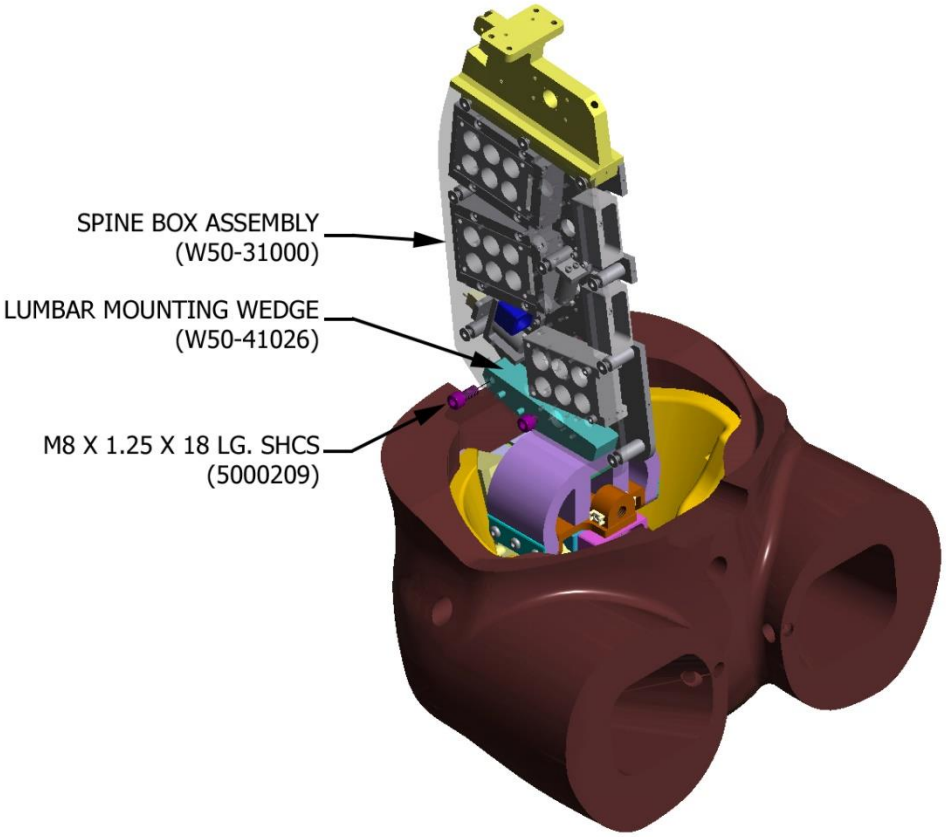


Figure 6-27 Assembling spine box to lumbar wedge.

Section 7 Legs

7.1 Parts List

Table 7-1 lists the parts required for assembly of the WorldSID leg assemblies. Part numbers correspond to those on drawing W50-50000.

ITEM	QTY	PART NO.	DESCRIPTION
1	1	W50-51000	UPPER LEG ASSEMBLY-RIGHT
2	1	W50-54055	LOWER LEG-RIGHT
3	4	W50-61042	MODIFIED BHSS M6 THREAD

Table 7-1 Parts list for the WorldSID Leg.

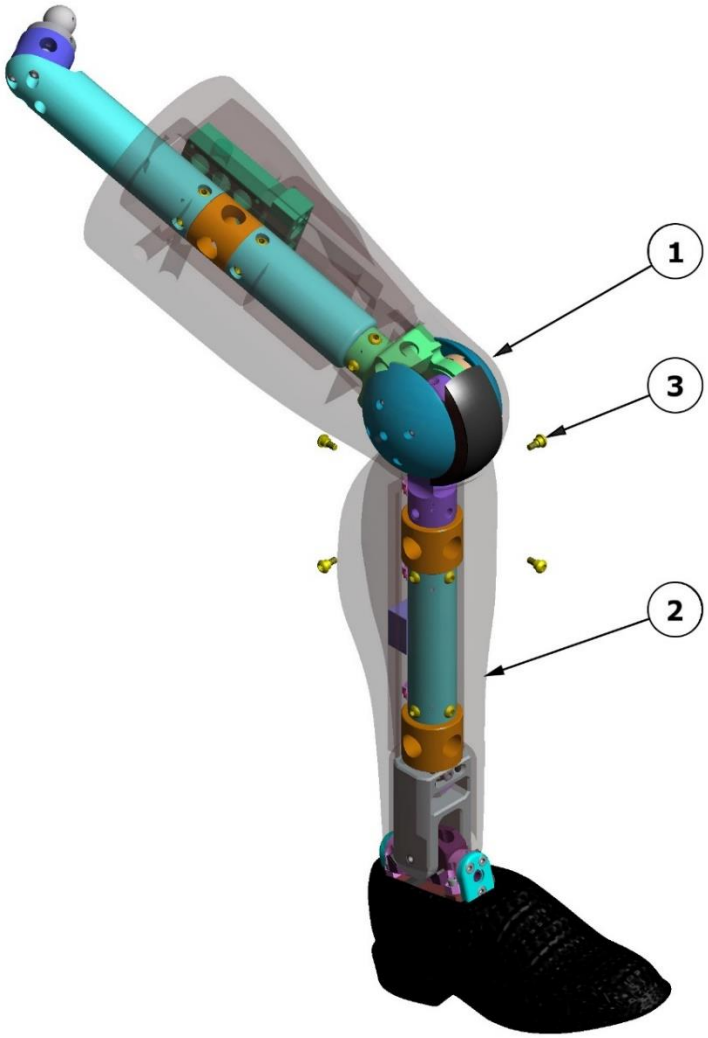


Figure 7-1 Full Leg Assembly.

7.2 Disassembly

To separate the upper leg from the lower leg, remove four MODIFIED BHSS M6 THREAD (W50-61042).

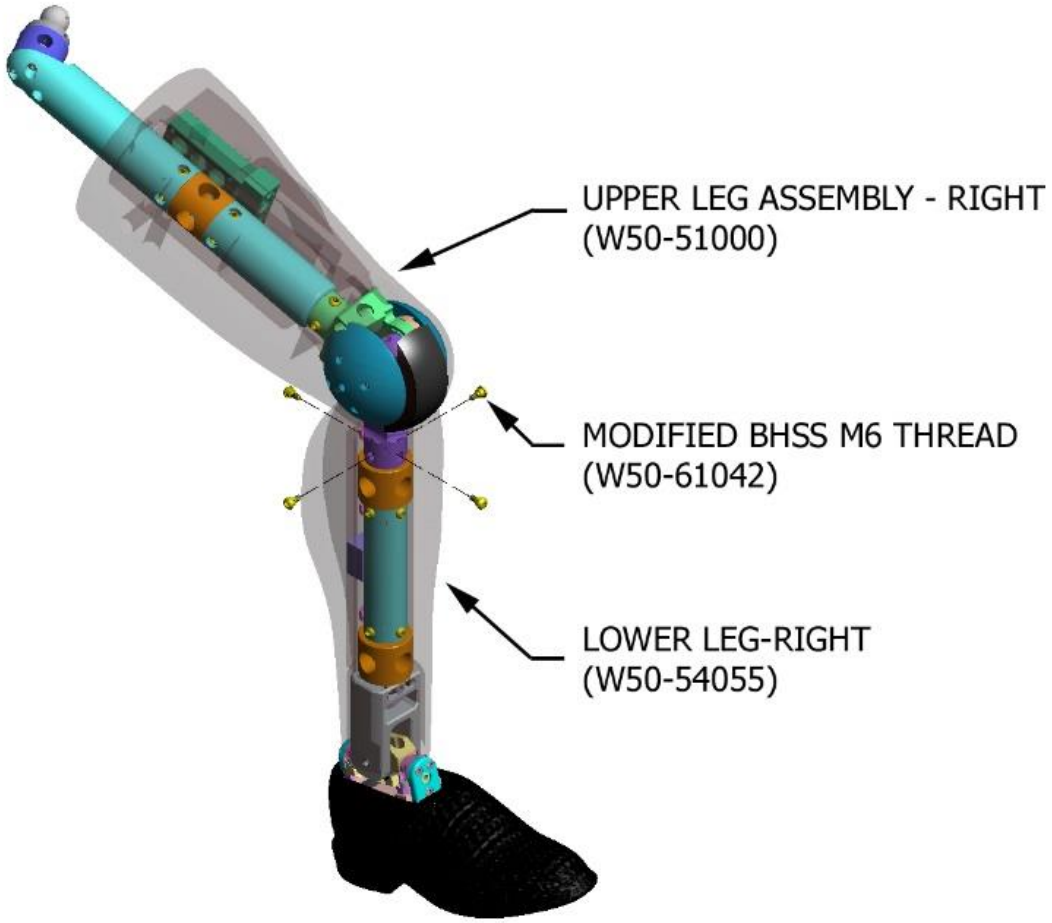


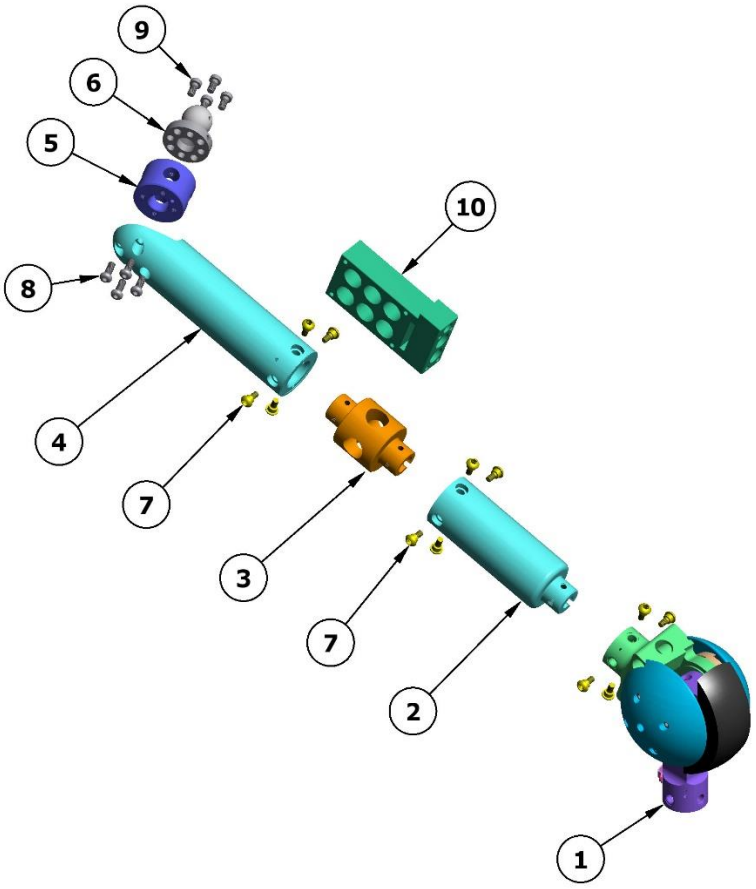
Figure 7-2 Separating the upper leg from the lower leg.

7.2.1 Upper Leg

Table 7-2 lists the part numbers that correspond to those on drawing W50-51000, upper leg assembly.

ITEM	QTY	PART NO.	DESCRIPTION
1	1	W50-52001	KNEE ASSEMBLY-RIGHT
2	1	W50-51067	LEG TUBE ASSEMBLY
3	4	W50-51060	UNIVERSAL LEG L.C. S.R. BODY
4	1	W50-51022	TROCHANTER ASSEMBLY-RIGHT
5	1	W50-71965	STRUCTURAL REPLACEMENT, FEMORAL NECK L.C.
6	1	W50-51034	FEMORAL NECK ASSEMBLY
7	12	W50-61042	MODIFIED BHSS M6 THREAD
8	4	5000072	M6 X 1 X 16 LG. BHCS
9	4	5000194	SCREW, LWSHCS M6 X 1 X 12 MM
10	1	W50-51053	DAS S.R.ASSEMBLY
11	1	W50-51058	UPPER LEG FLESH-RIGHT

Table 7-2 Parts list for Upper Leg Assembly



The upper leg assembly consist of: the femoral neck assembly (W50-51034, Item 6), femoral neck load cell (W50-71965, Item 5), trochanter assembly (W50-51022, Item 4), leg load cell (W50-51060, Item 3), DAS structural replacement (W50-51053, Item 10), leg tube assembly (W50-51067, Item 2), knee assembly (W50-52001, Item 1).

Figure 7-3 Components of upper leg assembly, Right.

To begin disassembly of the upper leg, start by disconnecting all the cable connectors and removing the cable guides.

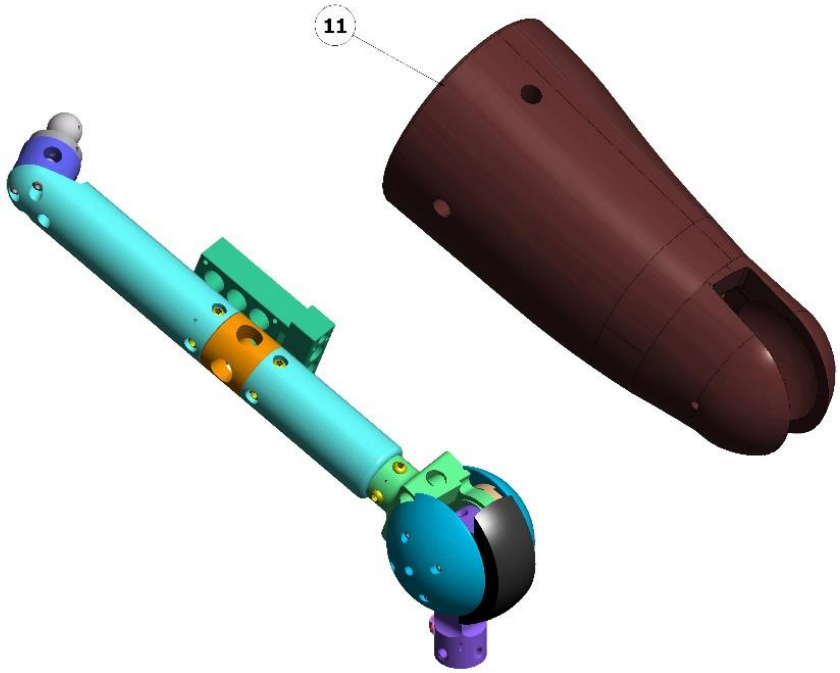


Figure 7-4 Upper leg flesh, right.

7.2.2 Femoral Neck Assembly

Table 7-3 lists the part numbers that correspond to those on drawing W50-51034, femoral neck assembly.

ITEM	QTY	PART NO.	DESCRIPTION
1	1	W50-51035	FEMORAL NECK
2	1	W50-51038	FEMORAL BALL
3	1	5000582	SCREW SSCP M4 X 0.7 X 6 18-8 SS CONE PT

Table 7-3 Parts list for Femoral Neck Assembly

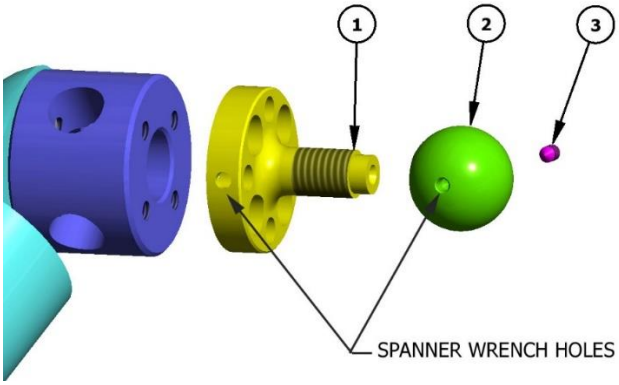


Figure 7-5 Parts list for femoral neck assembly, W50-51034.

The femoral neck (W50-51035) is disassembled by loosening the M4 X 6 SSCP (5000582) that holds the femoral ball (W50-51038) in place and unthread the ball from the neck base. A spanner wrench is used to remove the ball (modified 25 mm to 28 mm dia.; P/N: W50-51001). Be careful not to damage the surface of the ball during disassembly/re-assembly.

To disassemble the femoral neck assembly after it has been removed from the leg tube assembly a second spanner wrench for the base will be necessary (40 mm to 42 mm dia.; P/N: W50-51002).

Next, remove the four M6 x 12 LWSHCS (5000194) that attaches the assembly to the femoral neck load cell (W50-71965). These screws can be removed without removing the ball using a modified hex key wrench (P/N: W50-51003).

The femoral neck load cell (W50-71965) is removed by taking out the four M6 X 1 X 16 LG. BHCS (5000072) that attach it to the trochanter assembly (W50-51022).

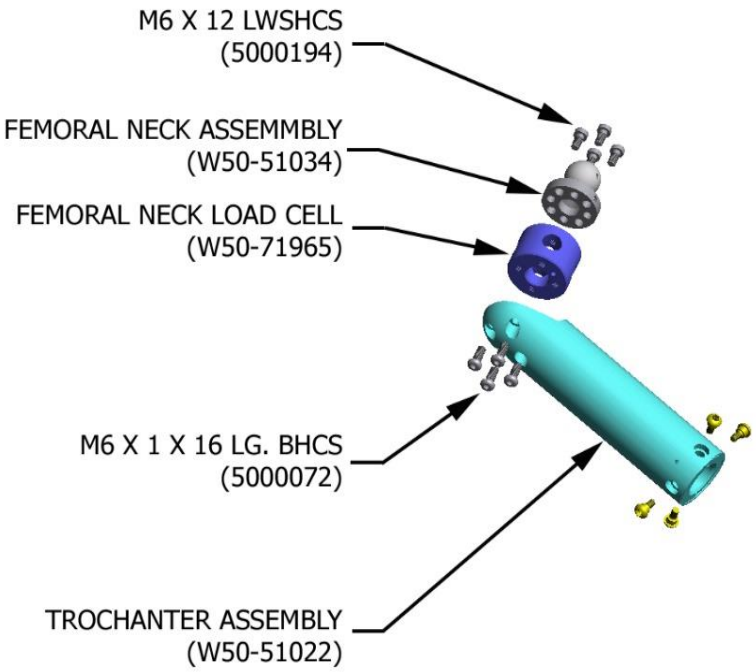


Figure 7-6 Removing the femoral neck load cell.

Take out the four modified BHCS (W50-61042) that attaches the trochanter (W50-51022) to the leg load cell (W50-51060). Separate these assemblies. Continue separating each section of the upper leg assembly in the same manner.

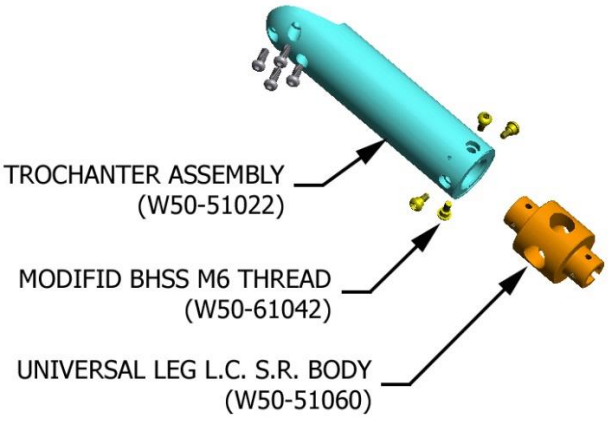


Figure 7-7 Removing the trochanter assembly.

7.2.3 Knee

Table 7-4 lists the part numbers that correspond to those on drawing W50-52001, knee assembly, right.

ITEM	QTY	PART NO.	DESCRIPTION
1	1	W50-52009	KNEE CLEVIS ASSEMBLY
2	1	W50-52008	KNEE SHAFT ASSEMBLY
3	1	W50-61123	ELBOW POTENTIOMETER ASSEMBLY - S.R.
4	1	W50-52064	BRAKE WASHER ASSEMBLY
5	1	W50-61016	COMPRESSION WASHER
6	1	W50-61014	ELBOW CLAMP WASHER
7	2	W50-52015	STRUCTURAL REPLACEMENT KNEE CONTACT L.C.
8	1	W50-52002	KNEE BONE ASSEMBLY
9	1	W50-52010	MOLDED KNEE PAD ASSEMBLY
10	2	W50-52004	KNEE COVER
11	1	W50-61030	CABLE GUIDE
12	8	5000151	M4 X 0.7 X 10 LG. SHCS
13	4	5001020	M3 X 0.5 X 6 LG. BHCS
14	1	5000185	M6 X 1 X 12 LG. SSDP
15	6	5000005	M4 X 0.7 X 12 LG. BHCS
16	1	5000539	M10 X 1.5 X 20 LG. BHCS
17	8	5000975	M4 X 0.7 X 14 LG. BHCS

Table 7-4 Parts list for Knee Assembly, Right

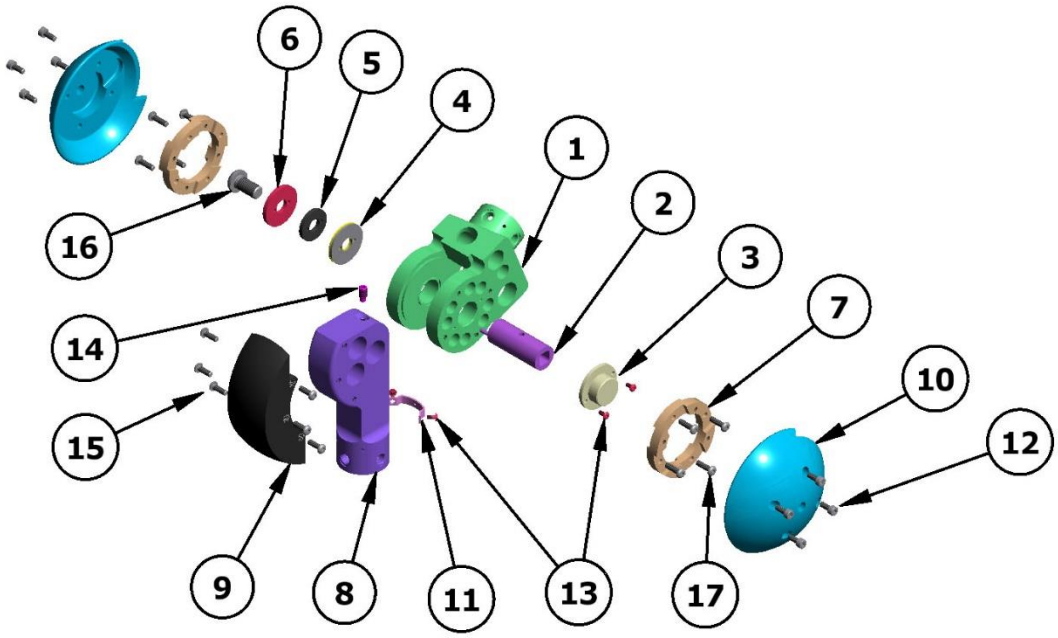


Figure 7-8 Knee Assembly, Right.

Disassembly of the knee assembly starts by removing the knee covers (W50-52004). This is done by taking out the four M4 X 0.7 X 10 LG. SHCS (5000151) holding each cover in place. Next, remove the potentiometer assembly (W50-61123) by taking out the M3 X 0.5 X 6 LG. BHCS (5001020) at each side of the potentiometer. These screws hold the retaining clip that holds the potentiometer body in place. The knee contact load cell (W50-52015) is positioned directly beneath the knee cover and is removed by taking out four M4 X 0.7 X 14 LG. SHCS (5000975) for each load cell.

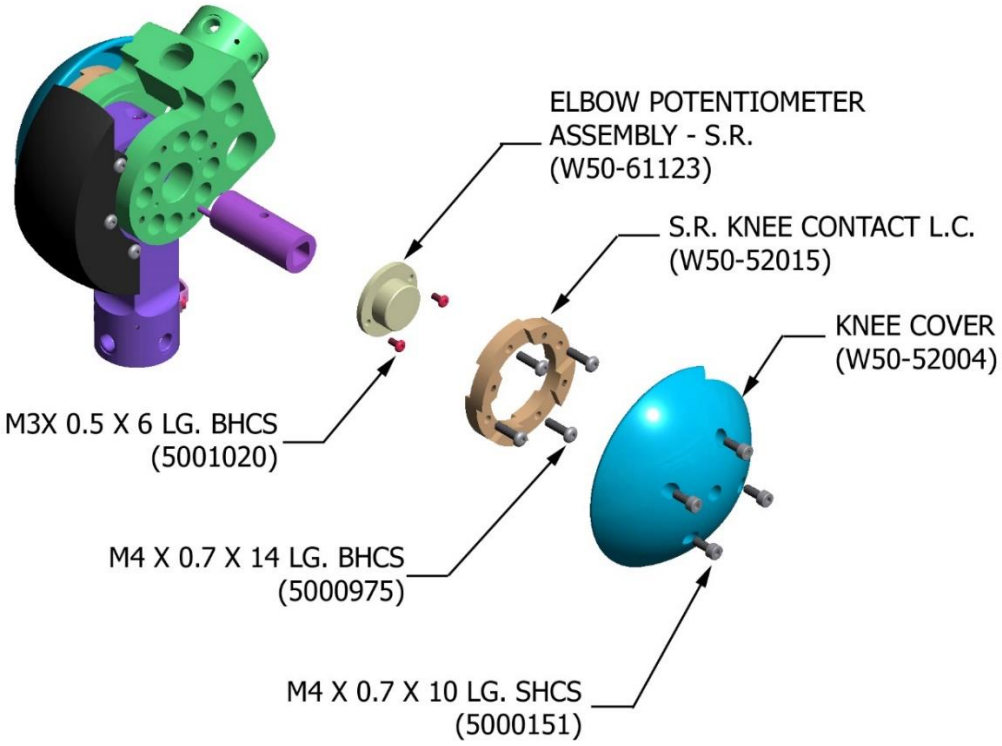


Figure 7-9 Removing the knee covers.

Next, the knee bone assembly (W50-52002) can be removed by taking out the M6 x 12 SSHDP (5000185). Then, take out the M10 X 1.5 X 20 LG. BHCS (5000539) along with the associated washers (W50-52064, W50-61016, and W50-61014). Inspect these washers for damage and wear. The middle washer (W50-61016) is the compression washer and is made from a soft neoprene rubber. Because it is a soft material permanent compression and/or tearing could occur. If the part is permanently compressed or damaged in any way it should be replaced.

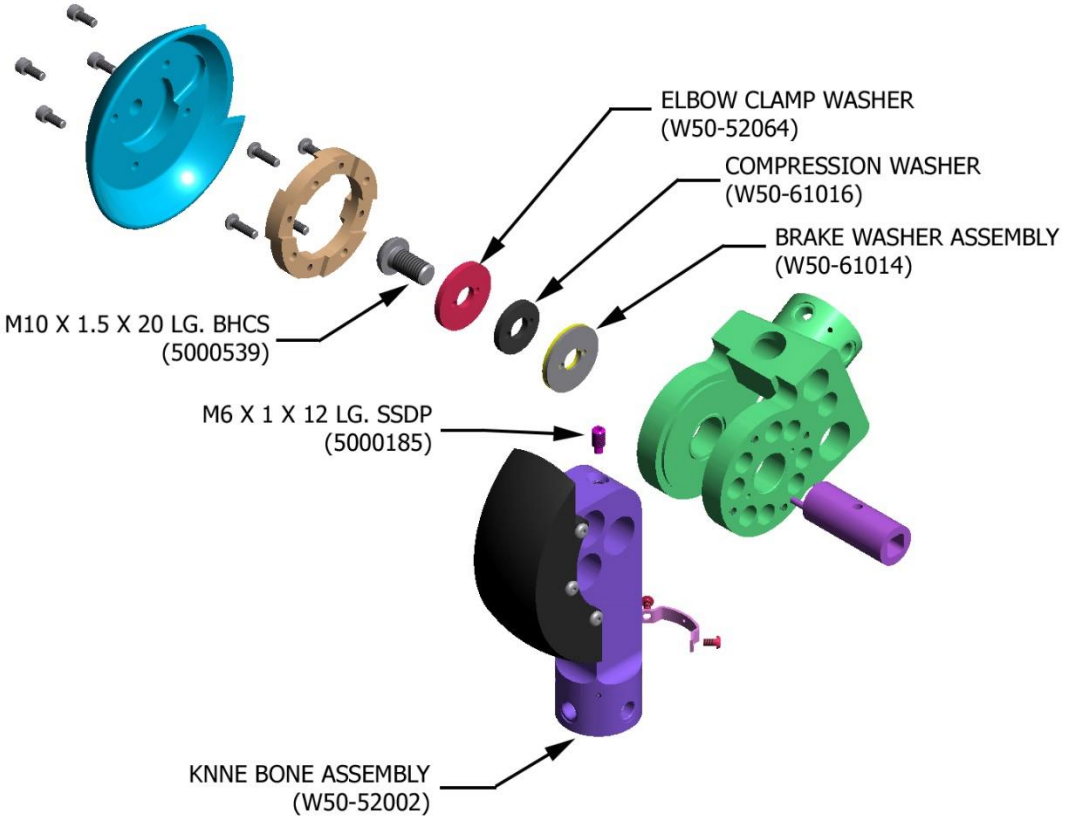


Figure 7-10 Removing the knee bone assembly.

Remove the knee shaft assembly (W50-52008) by sliding it out of the assembly and the knee bone (W50-52002) should easily slide out of the knee clevis assembly (W50-52009). The knee pad (W50-52010) is removed from the knee bone by taking out the six M4 X 0.7 X 12 LG. BHCS (5000005) (three on each side) that hold it in position. Inspect the knee pad for tearing and/or cuts in the material.

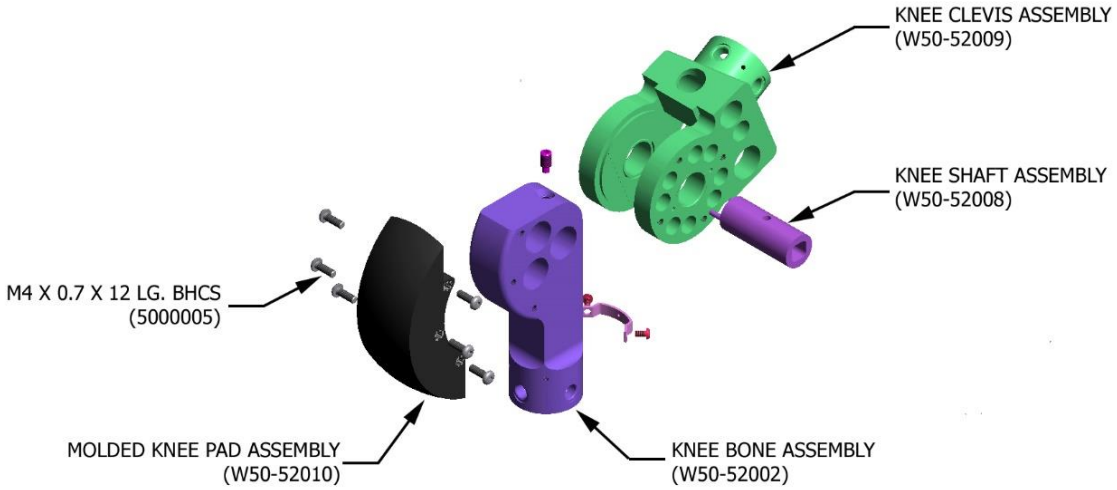


Figure 7-11 Removing the knee shaft assembly.

7.2.4 Lower Leg

Table 7-5 lists the part numbers that correspond to those on drawing W50-54055, lower leg, right.

ITEM	QTY	PART NO.	DESCRIPTION
1	1	W50-57000	ANKLE ASSEMBLY HARMONIZED
2	1	W50-54053	LOWER LEG ASSEMBLY
3	1	W50-53002	LOWER LEG FLESH
4	4	5000020	SCREW, SHCS M5 X 0.8 X 16 MM
5	1	W50-55005	SHOE, RIGHT

Table 7-5 Parts list for Lower Leg, Right

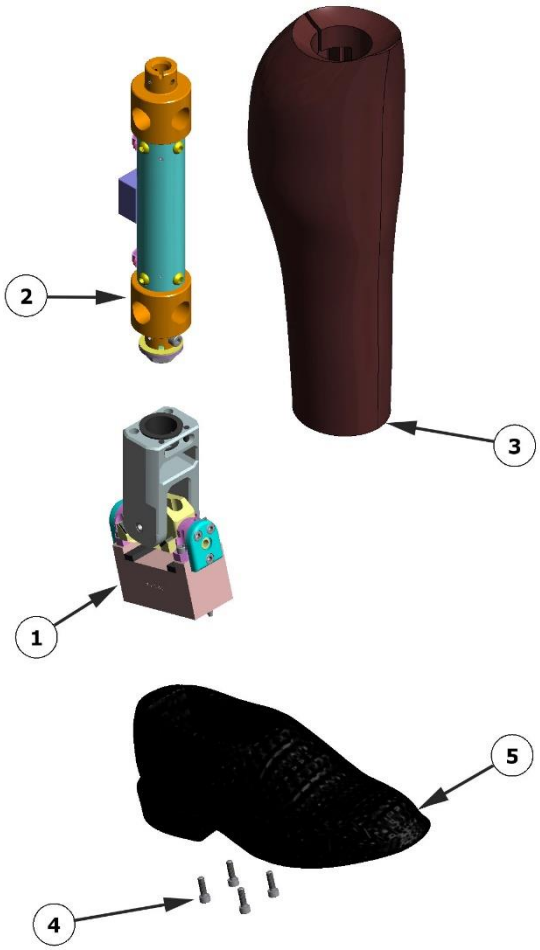


Figure 7-12 Lower leg.

To remove the molded foot, take out the four M5 X 0.8 X 16 LG. SHCS (5000020) that secure the foot to the ankle assembly.

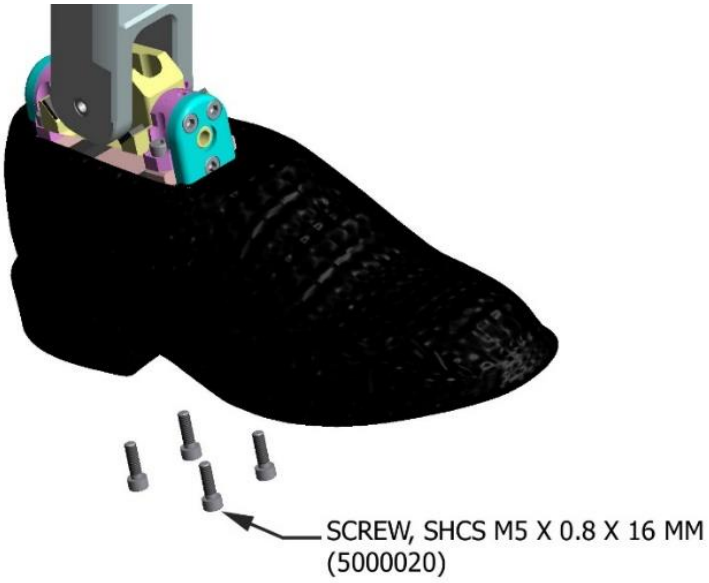


Figure 7-13 Lower Leg and Ankle Assembly.

7.2.5 Lower Leg Assembly

Table 7-6 lists the part numbers that correspond to drawing W50-54053, lower leg assembly, right.

ITEM	QTY	PART NO.	DESCRIPTION
1	1	W50-53001	LOWER LEG TUBE
2	2	W50-51060	UNIVERSAL LEG L.C. S.R. BODY
3	1	W50-54009	Z-PIVOT PIN
4	1	W50-54024	Z-AXIS ANTI-RATTLE WASHER
5	1	W50-54010	Z-AXIS ROTATIONAL WASHER
6	1	W50-54023	Z-AXIS NUT
7	1	W50-54041	Z-AXIS RADIAL LIMIT SCREW
8	4	5000171	SCREW, BHCS M3 X 0.5 X 6 MM
9	1	5000281	M6 X 1 X 12 LG. SHCS
10	1	W50-54038	ORIENT BLOCK – LEG FLESH
11	3	5000622	M6 X 1 X 8 LG. SSSCP
12	1	5000166	M3 X 12 LG. ROLL PIN
13	1	5000205	M4 X 12 LG. ROLL PIN SS
14	8	W50-61042	MODIFIED BHSS M6 THREAD
15	2	W50-61030	CABLE GUIDE

Table 7-6 Parts list for Lower Leg Assembly, Right

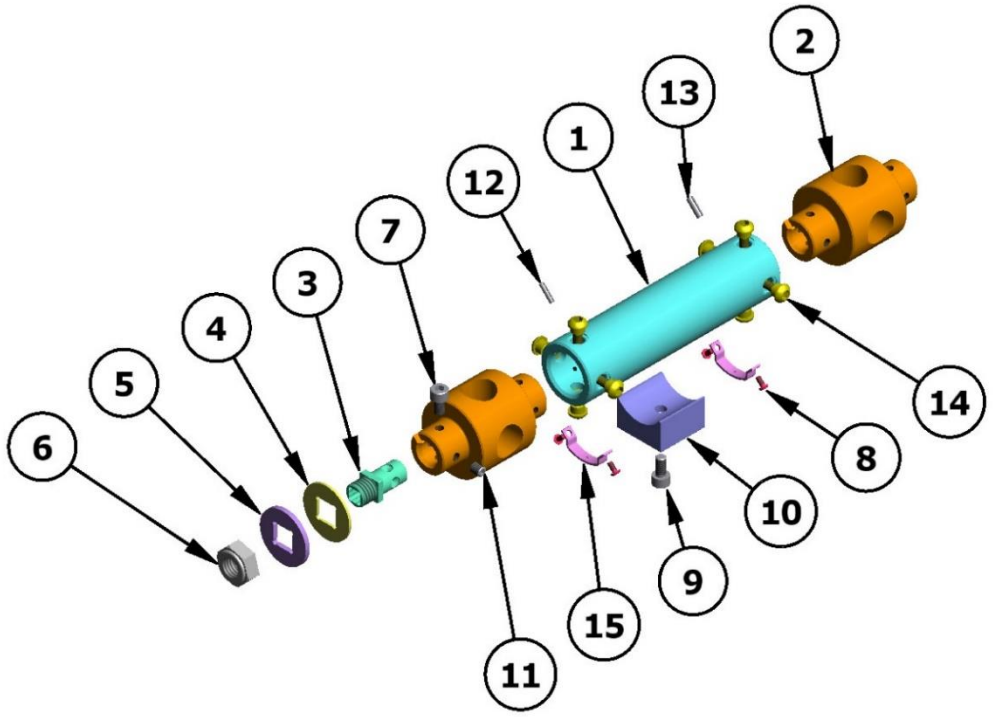


Figure 7-14 Lower Leg and Ankle Assembly.

To remove the lower tibia leg load cell first remove the z-axis radial limit screw (W50-54041). Loosen the M6 X 1 X 8 LG. SSSCP (5000622). This set screw is used to adjust the 'Z' axis rotational friction for the lower tibia load cell. Disconnect the cables from both of the tibia loads. Using a modified 22 mm open-end wrench (P/N: W50-51004), hold the Z-Axis Nut (W50-54023) in place while rotating the leg tube and load cell assembly until the lower tibia leg load cell can be pulled from the ankle assembly (W50-57000). Once the Z-Axis Nut is loose and the tibia load cell is pulled out, the anti-rattle (W50-54024) and rotational washers (W50-54010) will be free to be removed from the assembly.

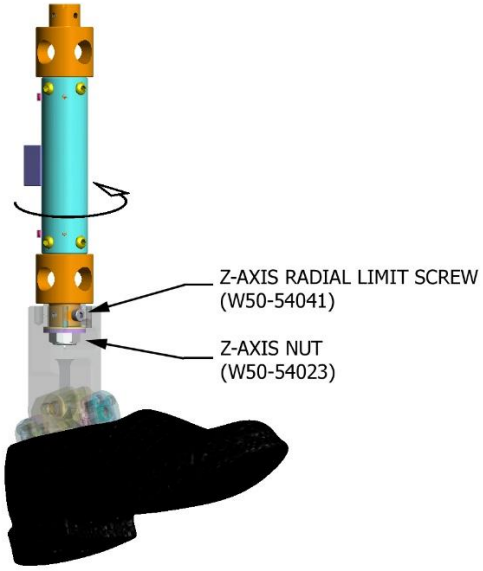


Figure 7-15 Lower Leg and Ankle Assembly.

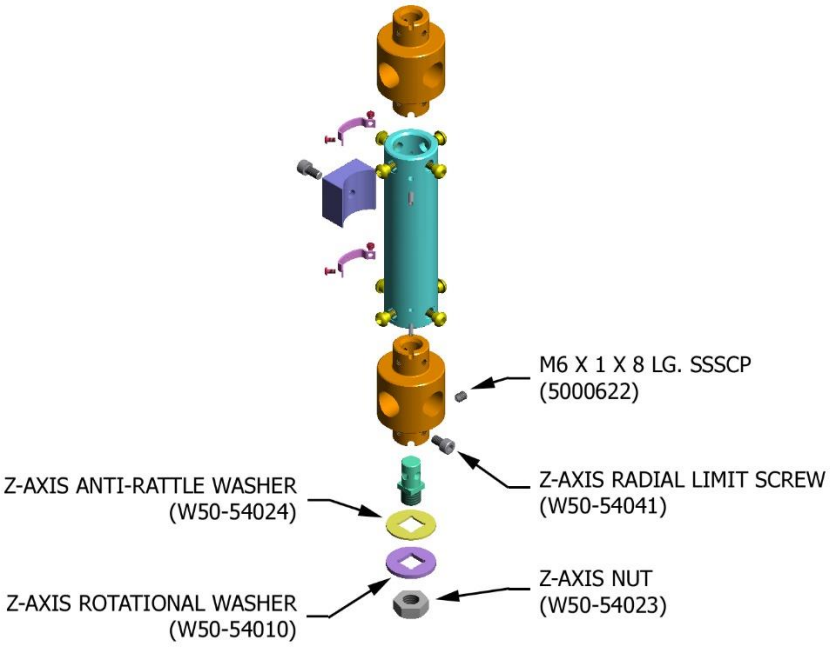


Figure 7-16 Removing washers from lower leg.

7.2.6 Ankle Assembly

Table 7-7 lists the part numbers that correspond to drawing W50-57000, ankle assembly harmonized.

ITEM	QTY	PART NO.	DESCRIPTION
1	1	W5-5704	ANKLE JOINT ASSEMBLY
2	8	W5-5435	X-VERSION RESISTIVE ELEMENT
3	2	W5-5443	REAR BEARING COVER
4	2	W5-5701	RETAINER BRACKET
5	1	W50-57005	BASE PLATE ASSY HARMONIZED
6	1	W50-57003	Y-VERSION ASSEMBLY HARMONIZED
7	6	5000002	M5 X 0.8 X 12 LG. SHCS
8	4	5000020	M5 X 0.8 X 16 LG. SHCS

Table 7-7 Parts list for Ankle Assembly

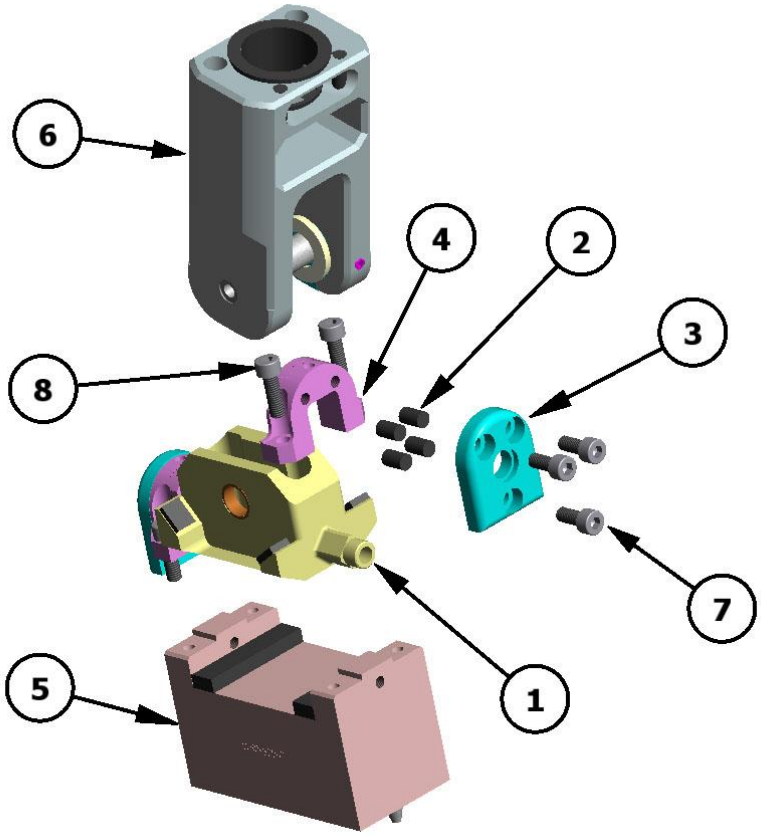


Figure 7-17 Ankle Assembly.

ITEM	QTY	PART NO.	DESCRIPTION
1	1	W50-57002	ANKLE CLEVIS ASSY HARMONIZED
2	1	5000165	M6 X 1 X 6 LG. SSSDP
3	1	W5-5724	ANKLE FRICTION SHOULDER BOLT
4	1	5000889	SPRING, BELLEVILLE DISC, 11.2 ID X 22.5 OD X 0.8 THK.
5	1	W5-5723	STOP RING
6	2	5000888	WASHER, FLAT 13 ID X 24 OD X 2.5 THK, NYLON
7	1	5000887	M5 X 0.8 X 6 LG. SSSNP SS

Table 7-8 Parts list for Y-Verson Assembly Harmonize, W50-57003

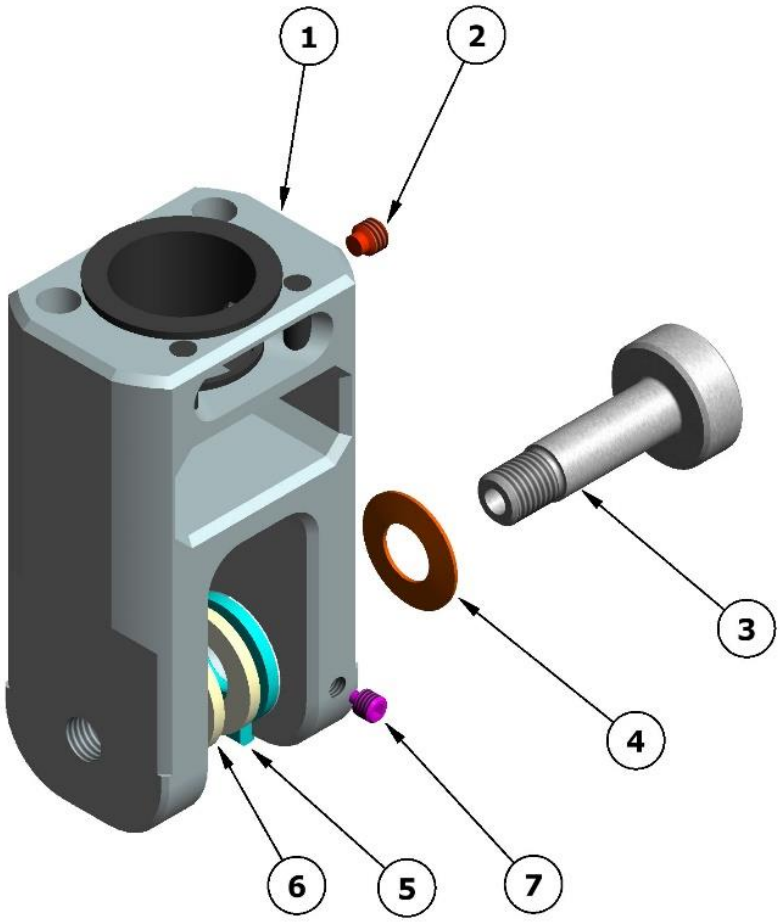


Figure 7-18 Y-Version Assembly Harmonized, W50-57003.

To disassemble the ankle, start by separating the x-version assembly from the y-version assembly (Figure 7-19). Before the two sections can be separated the y-axis potentiometer must be removed, if equipped.

Remove the ankle friction shoulder bolt (W5-5724) and the flat washers (5000888), stop ring (W5-5723) and Belleville disc (5000889). Lift the y-version assembly off the c-version assembly.

With the two assemblies apart, check the resistive elements for signs of permanent deformation, crushing or cracks.

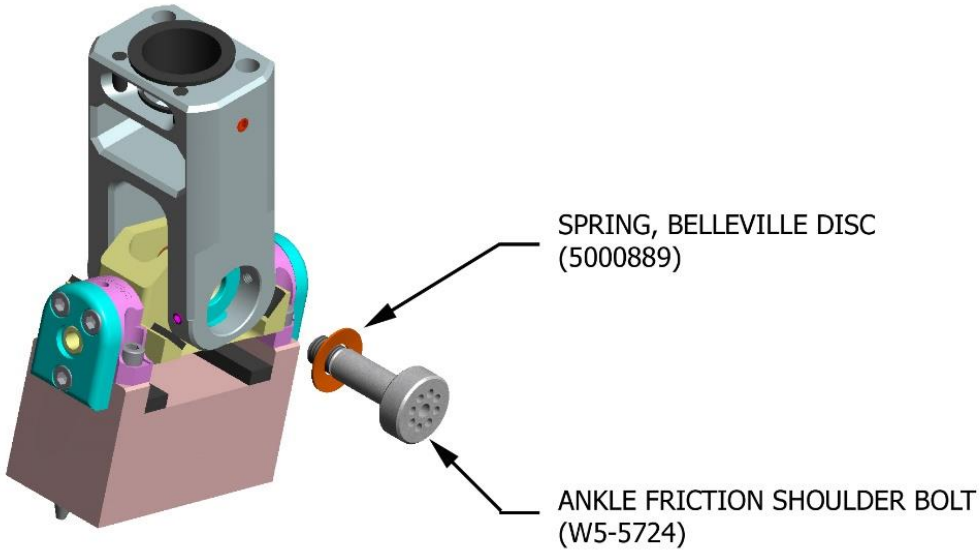


Figure 7-19 Removing the ankle friction shoulder bolt.

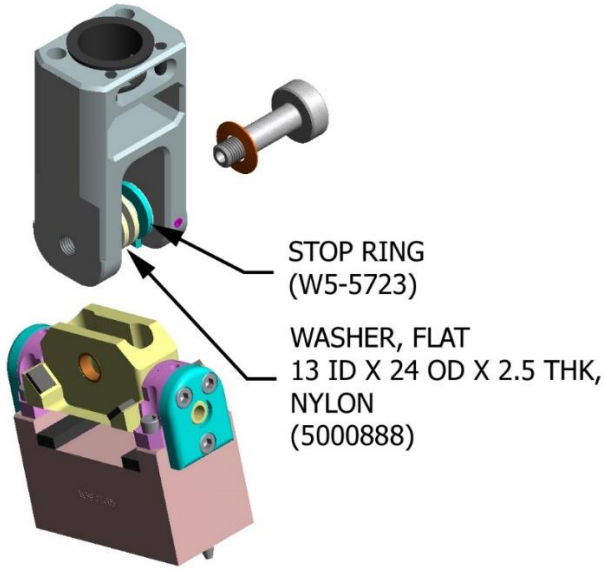


Figure 7-20 Removing the stop ring.

Disassembly of the x-version assembly starts with taking out the two M5 X 0.8 X 16 LG. SHCS (5000020) each side that secures the retainer brackets (W5-5701). The rear bearing covers (W5-5443) can be removed by taking out the three M5 X 0.8 X 12 LG. SHCS (5000002) each side. With the retainer brackets (W5-5701) and bearing covers (W5-5443) removed the ankle joint assembly (W5-5704) is detached.

While removing the retainer brackets and bearing covers, the x-version resistive elements (W5-5435) may fall out. This is a good time to check the resistive elements for crushing, deformation or cracks.

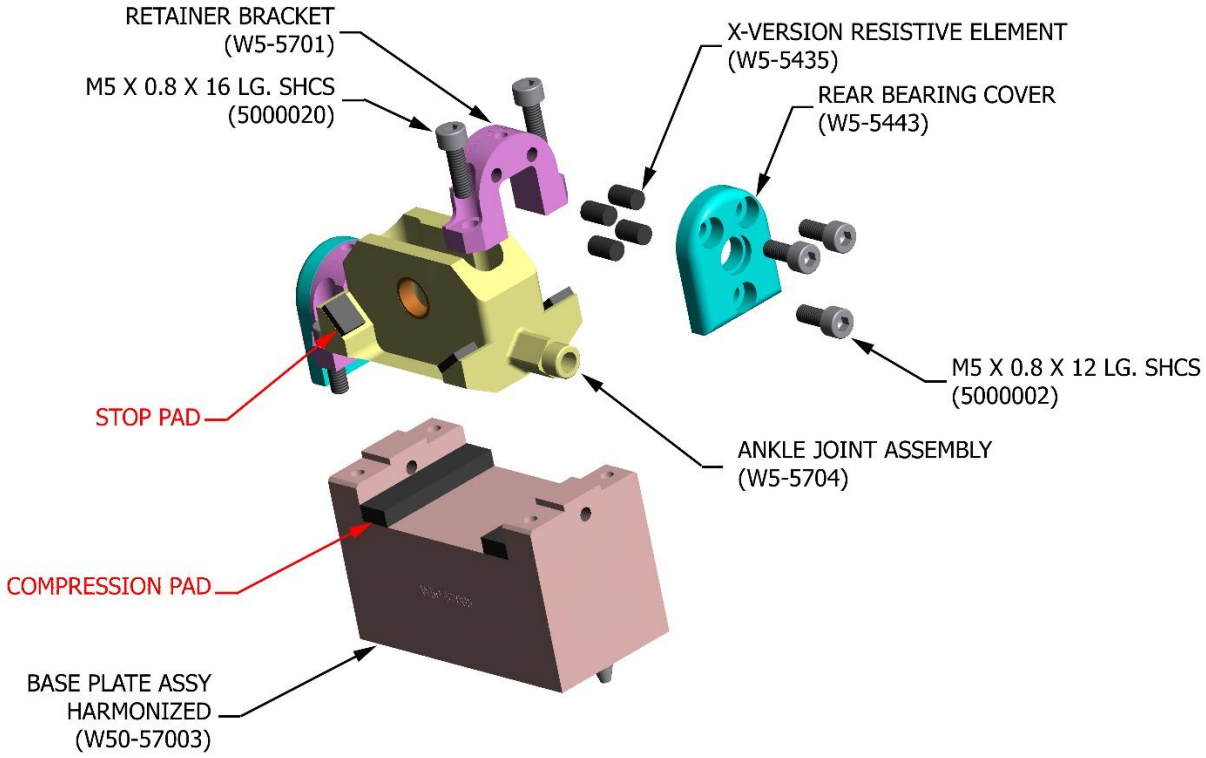


Figure 7-21 X-Version.

The stop and compression pads bonded to the base plate assembly (W50-57003) and ankle joint assembly (W5-5704) should be checked for tears and deformation. If the pads should come loose secure them using Loctite 414 (superglue).

7.3 Instrumentation

The instrumentation for the upper leg includes the femoral neck load cell, DAS assembly, and universal leg load cell. The instrumentation for the knee includes the elbow potentiometer assembly and knee contact load cell. And lower leg has two universal leg load cell. The following figures show the instrumentation for the legs.

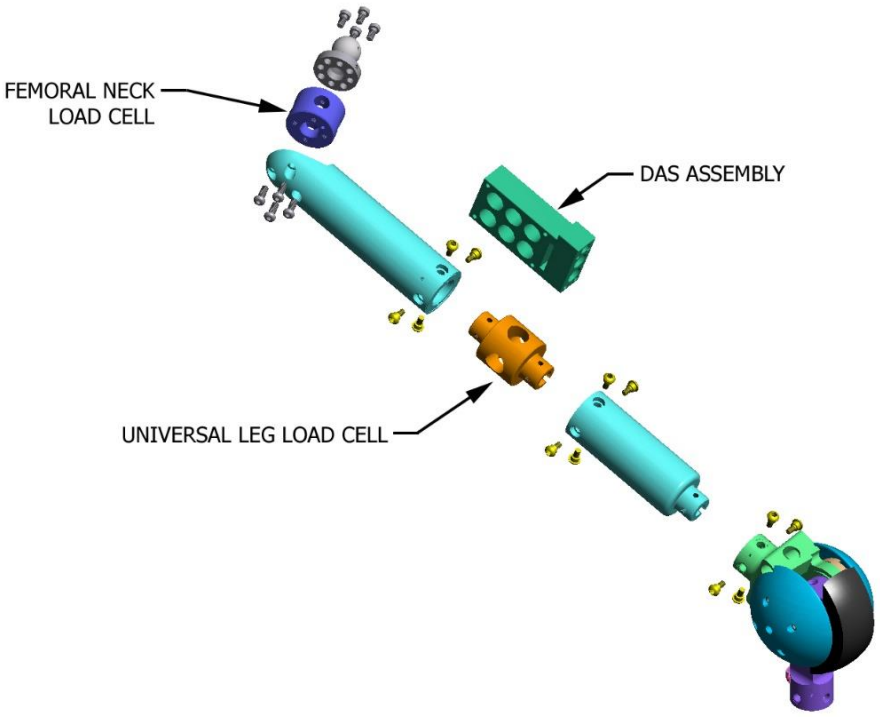


Figure 7-22 Upper leg instrumentation.

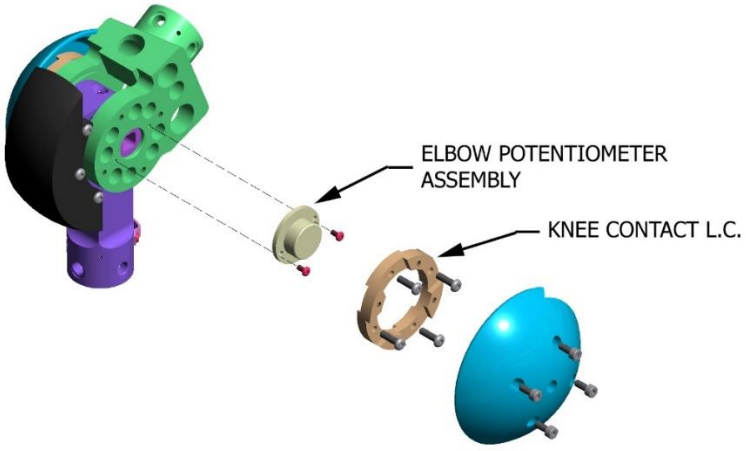


Figure 7-23 Knee instrumentation.

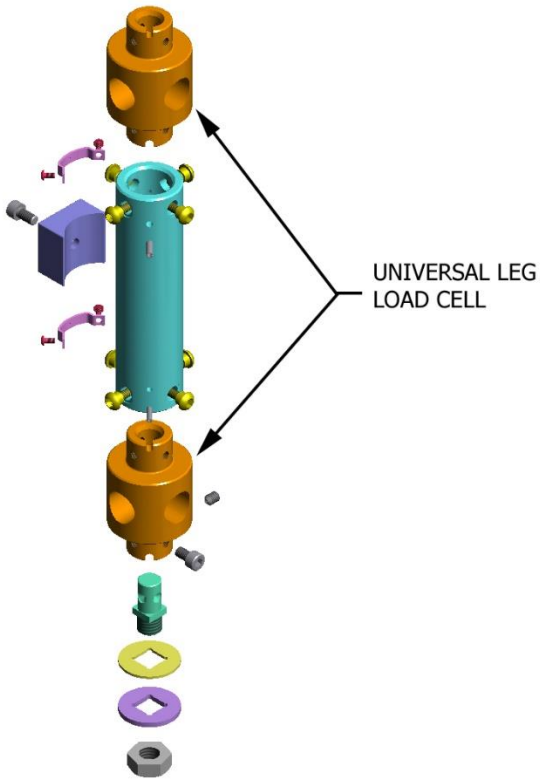


Figure 7-24 Lower leg instrumentation.

7.4 Re-Assembly

7.4.1 Knee Re-Assembly

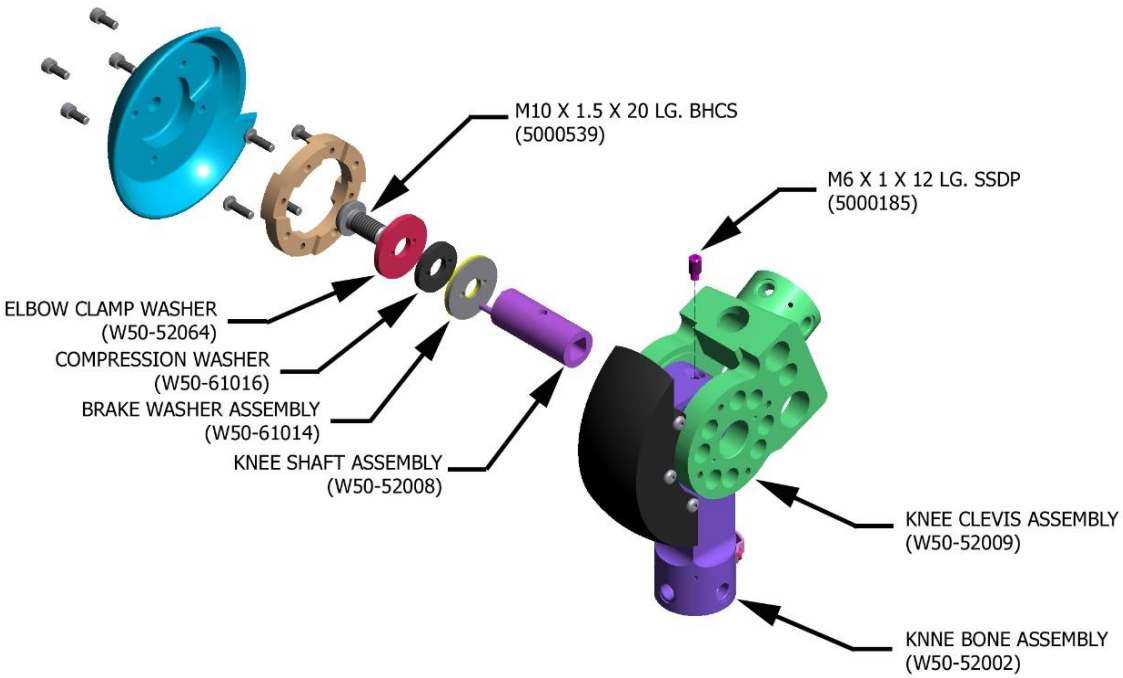


Figure 7-25 Knee Re-Assembly, Right.

To reassemble the knee start by placing the knee bone (W50-52002) in the knee clevis (W50-52009) and push the knee shaft assembly (W50-52008) into the pivot hole. The shaft-locking hole should be aligned with the M6 X 1 X 12 LG. SSDP (5000185) Tighten the M6 SSDP so that the knee shaft is locked in place. If the shaft is not locked into the knee bone the shaft will not rotate with the knee bone during testing. Once the knee shaft is in place the brake washer (W50-52064), compression washer (W50-61016) and clamping washer (W50-61014) can be installed. The brake washer (W50-52064) is a made up of two disks. One disk is steel and the other is a commercial braking material. Push the brake washer on to the knee shaft pin so that the braking material side of the washer is against the knee clevis (W50-52009). Next, install the compression and clamping washers and secure them with an M10 X 1.5 X 20 LG. BHCS (5000539). This M10 screw is the adjustment for the 1 to 2 G adjustment of the knee section.

The knee rotation potentiometer (knee pot) can be re-assembled next. To install the knee pot place the pot insert into the square hole end of the knee pivot shaft (see Figure 7-26). The pot clips hold the pot in place on the knee clevis. As can be seen in the 'Detail View' of Figure 7-26, the pot clips are inserted into the channel at the base of the pot. Insert the two M3 X 0.5 X 6 LG. BHCS (5001020) into the pot clips and thread them into the knee clevis. Tighten these two M3 BHCS so that the pot body is secure and will not rotate, do not over tighten or damage may be done to the pot.
Notice that one of the M3 BHCS also has an M3 flat washer. This flat washer is provided for the grounding strap that should be connected to the skeletal frame of the dummy.

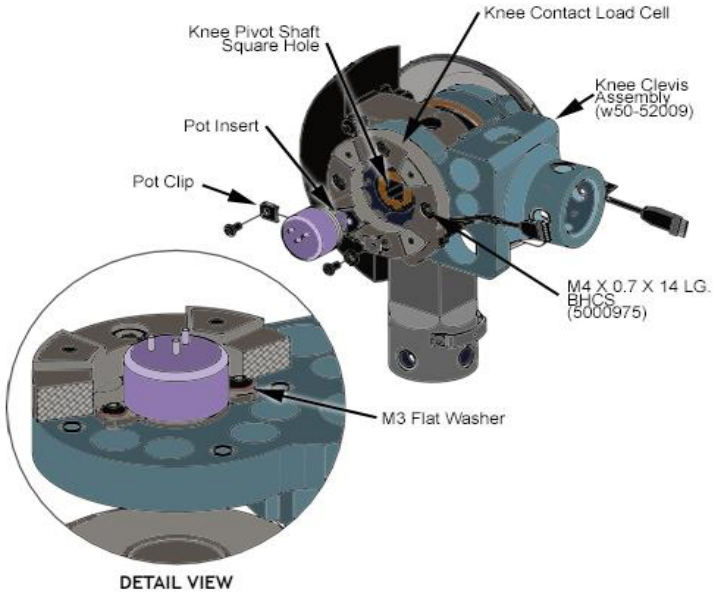


Figure 7-26 Knee Pot Installation.

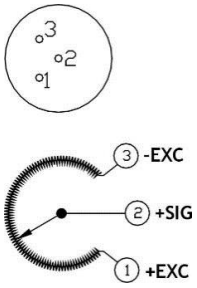


Figure 7-27 Knee Pot Wiring

To attach the knee contact load cell use four M4 X 0.7 X 14 LG. BHCS (5000975) for each load cell. The load cell is installed directly on to the knee clevis (W50-52009) and the M4 screws are installed in the counter bored holes as shown. These M4 screws should be tightened to 5 Nm (44 in-lbf). The M4 screws should be tightened in a "star" pattern (Figure 7-28) so as to distribute the load equally across the load cell.

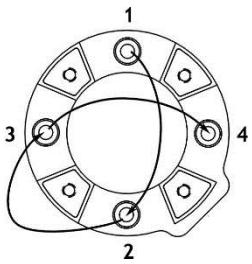


Figure 7-28 Torqueing the Knee Contact Load Cell

After re-installing the knee pot and knee contact load cells, the knee covers (W50-52004) and knee pad (W50-52010) can be re-attached. The knee covers are attached directly to the knee contact load cells with four M4 X 0.7 X 10 LG. SHCS (5000151). Re-attach the knee covers using the same “star” pattern as the knee contact load cell (Figure 7-29). The knee pad is attached using six M4 X 0.7 X 12 LG. BHCS (5000005).

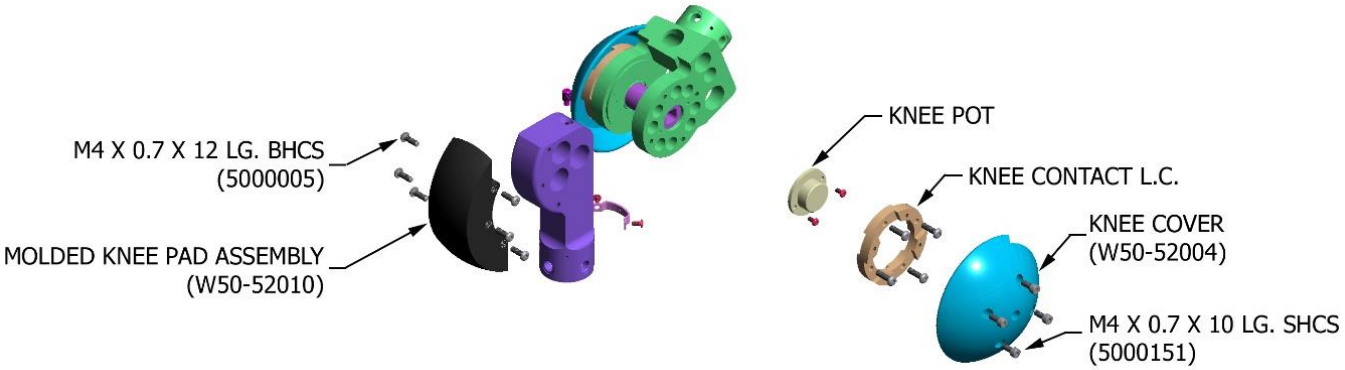


Figure 7-29 Re-attaching the knee cover and knee pad.

7.4.2 Ankle Re-Assembly

The ankle assembly is made up of two sections: ‘X’ version and ‘Y’ version. The upper section is the ‘Y’ version assembly. The lower section of the ankle assembly is known as the ‘X’ version assembly.

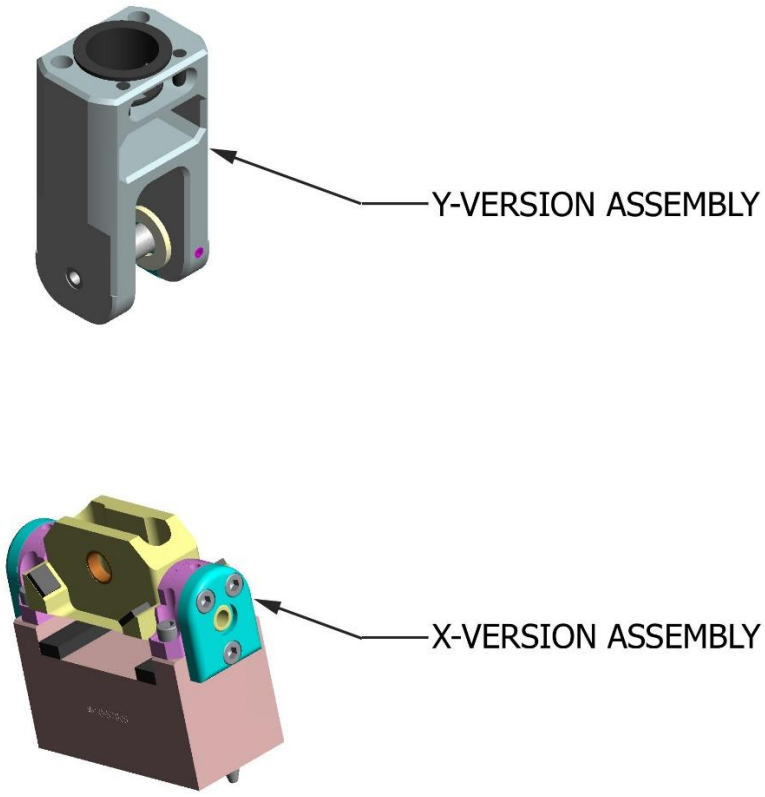


Figure 7-30 "X' and 'Y' version re-assembly.

To re-assemble the ankle components ('X' and 'Y' versions; respectively) re-assemble the rear bearing cover (W5-5443) with the retainer bracket (W5-5701) using the top two of the three M5 X 0.8 X 12 LG. SHCS (5000002). Place the resistive elements (W5-5435) on the ankle joint assembly (W5-5704) and replace the cover and bracket, securing with the third M5 X 0.8 X 12 LG. SHCS (5000002).

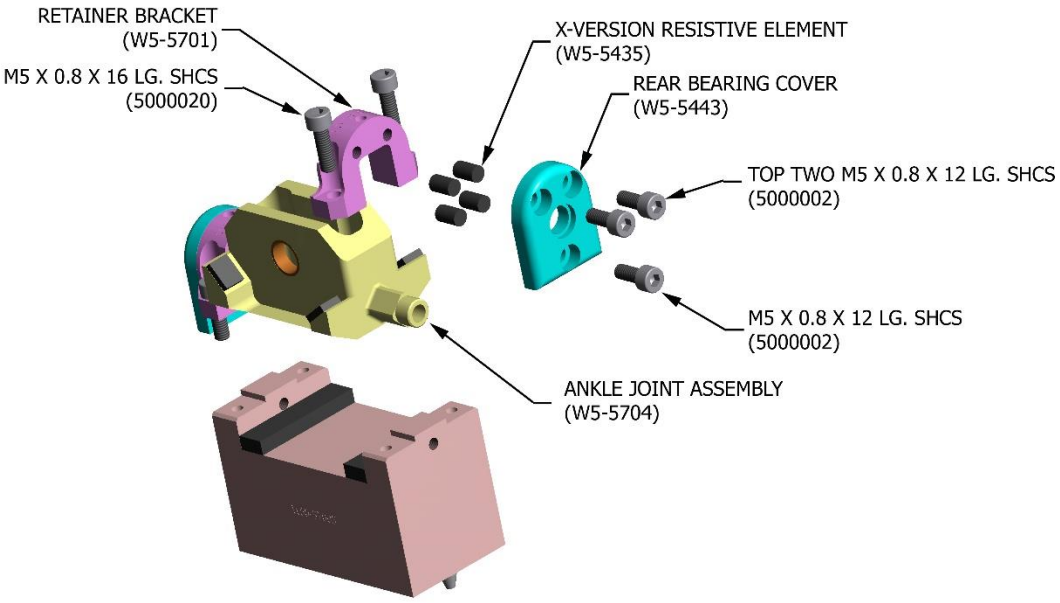


Figure 7-31 Re-assembling the "X" version.

Re-position the y-version assembly (W50-57003) onto the ankle joint assembly (W5-5704) with the washers (5000888), stop ring (W5-5723), and Belleville Disc (5000889) assembled on the inside of the y-version clevis (W50-57002). Secure with the ankle friction shoulder bolt (W5-5724).

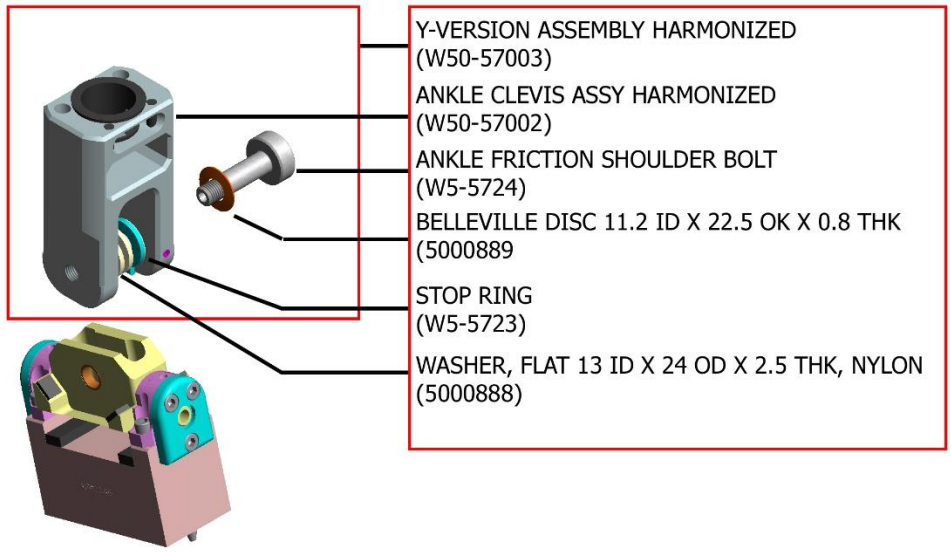


Figure 7-32 Removing the "Y" version.

7.4.3 Leg to Pelvis Assembly

To attach the leg assembly to the pelvis:

1. Push the dowel pins (2) into the Hip Joint Socket (W50-42005).
2. Stack hip joint ball (Figure 7-33), hip joint inner ring (W50-42007), hip joint Socket Retainer (W50-42008) and femoral neck (W50-51035) and screw the femoral neck into the ball. Make sure the inner ring spherical race is facing the ball. Use a spanner wrench tool to grip the ball.
3. Screw set screw (5000464) into the ball and tighten.
4. Screw three set screws M4 X 0.7 X 6 LG., a few turns into the outer ring but make sure they are not protruding on the inside.
5. Clamp the hip joint socket in a vice with the opening facing up. Use soft metal jaws on the vice for this operation. Grease the spherical face and the thread lightly with 'Never Seez®' grease.
6. Also grease the spherical race of the inner ring and screw the outer ring onto the socket. Tighten the outer ring lightly with a spanner wrench until all play is taken. Check that the femoral neck can be moved by hand, if not screw the outer ring.
7. After the correct setting has been established tighten the three set screws in the outer ring to 1.0 Nm.
8. After assembly of the upper leg, the hip joint assembly can be screwed to the femoral neck load cell with four low head SHCS M6 X 1 X 12 LG. (5000194). Move the hip joint socket away to give room for screw and Allen key.

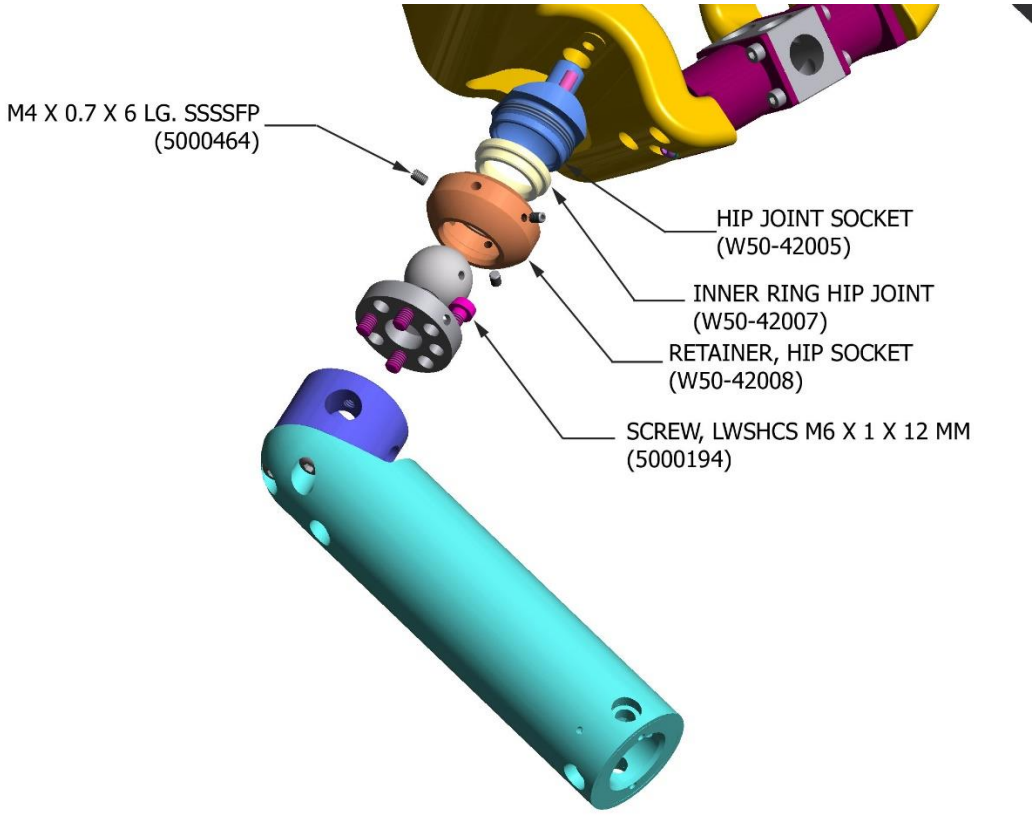


Figure 7-33 Leg to Pelvis Assembly.

Section 8 Verification Procedures

8.1 Visual Inspections

All components of the WorldSID should undergo visual inspection before subjecting the dummy to a test. Visual inspection of the components is considered a standard element in certifying the dummy. Visual inspection is best performed during assembly of the dummy.

All certification testing must be performed at a temperature between 20.6 and 22.2 degrees Celsius and a humidity of 10 to 70%.

8.2 Certification of Instrumentation

All instrumentation components, including sensors, sensor modules, connectors, cables, and data acquisition systems should be checked to make sure they comply with the certification requirements specified by the manufacturer or supplier.

8.3 Component Certifications

The head and neck are certified during component tests before the dummy is assembled.

8.4 Head Tests

1) The head certification procedures consist of a 200 mm lateral drop on each side of the head and a 376 mm drop on the forehead. The head should be visually inspected for damage to the skin or skull.

2) The head must be dropped on a flat, rigid, horizontal impact surface, as described in Part 572. The surface finish should be between 8 and 80 micro-inches.

3) The following components are used in all head drop test configurations.

    a. Head drop tool assembly (W50-82100)

    b. Instrumented head assembly (W50-10000)

    c. Two SHCS M6 x 12

4) The head linear triaxial accelerations are recorded during the test. However, the upper neck load cell, angular accelerometers and dual-axis tilt sensor, or their mass replacements, must be installed to achieve the correct head mass.

5) Attach the head drop tool to the bottom of the upper neck load cell (or its replacement) with the two M6x12 SHCS (Figure 8-1). The tool can be mounted for left, right, or frontal drops. When mounted for lateral drops, it positions the head such that its midsagittal plane has an angle of 35 +/- 1 degree with the impact surface and its anterior-posterior axis is horizontal within 1 degree.

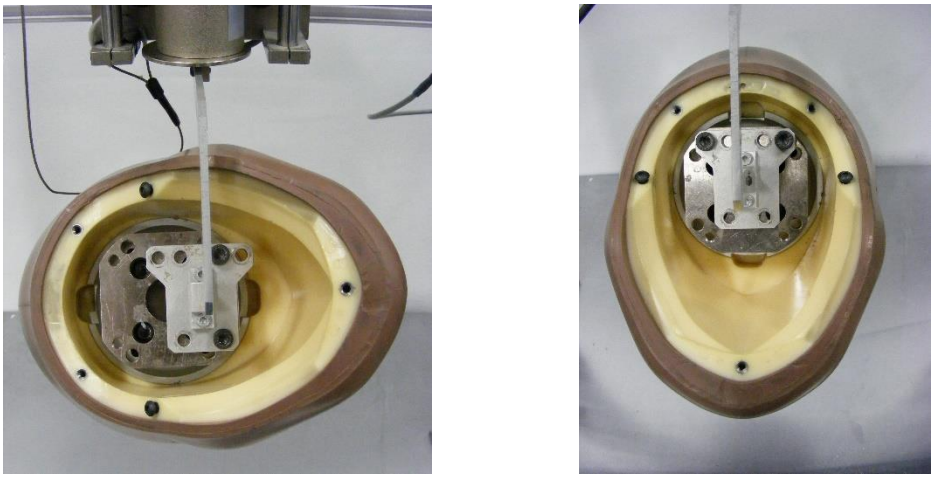


Figure 8-1 Installing brackets for lateral head certification test. Lateral bracket left photo, frontal bracket right photo.

6) Use the head drop tool and an electromagnet to suspend the head above the drop table. The magnet should act as a quick release mechanism allowing the head to trigger the data acquisition system.

7) For a lateral test, position the head to the side, so its lowest point is 200 +/- 0.25 mm above the impact surface and drop the head (Figure 8-1, left photo).

8) For a frontal test, position the head so the forehead is 376 +/- 0.25 mm above the impact surface (Figure 8-1, right photo).

9) Filter the head accelerations using ISO 6487 or SAE J211 Channel filter class 1000.

10) The head passes the lateral drop test if the peak resultant head acceleration is between 104 g and 123 g at CG, when the peak longitudinal acceleration is lower than 15 g and when the unimodal is lower than 10%.

11) The head passes the frontal drop test if the peak head acceleration at the CG is between 205 g and 255 g, when the frontal lateral acceleration is lower than 15 g and when the unimodal is lower than 10%.

12) Allow at least 2 hours between successive tests on the same head location.

HEAD DROP	
Channels	**Filters**
Ax	CFC1000
Ay	CFC1000
Az	CFC1000
Frontal **Parameters**	**WorldSID Specifications**
Temperature (°C)	20.6 - 22.2
Humidity (%)	10.0 - 70.0
Peak resultant acceleration at CG	205 - 255
Peak lateral acceleration (Ay) (g)	<15
Unimodal (%)	<10%
Lateral **Parameters**	**WorldSID Specifications**
Temperature (°C)	20.6 - 22.2
Humidity (%)	10.0 - 70.0
Peak resultant acceleration at CG	104 - 123
Peak longitudinal acceleration (Ax) (g)	<15
Unimodal (%)	<10%

Table 8-1 WorldSID head drop specifications.

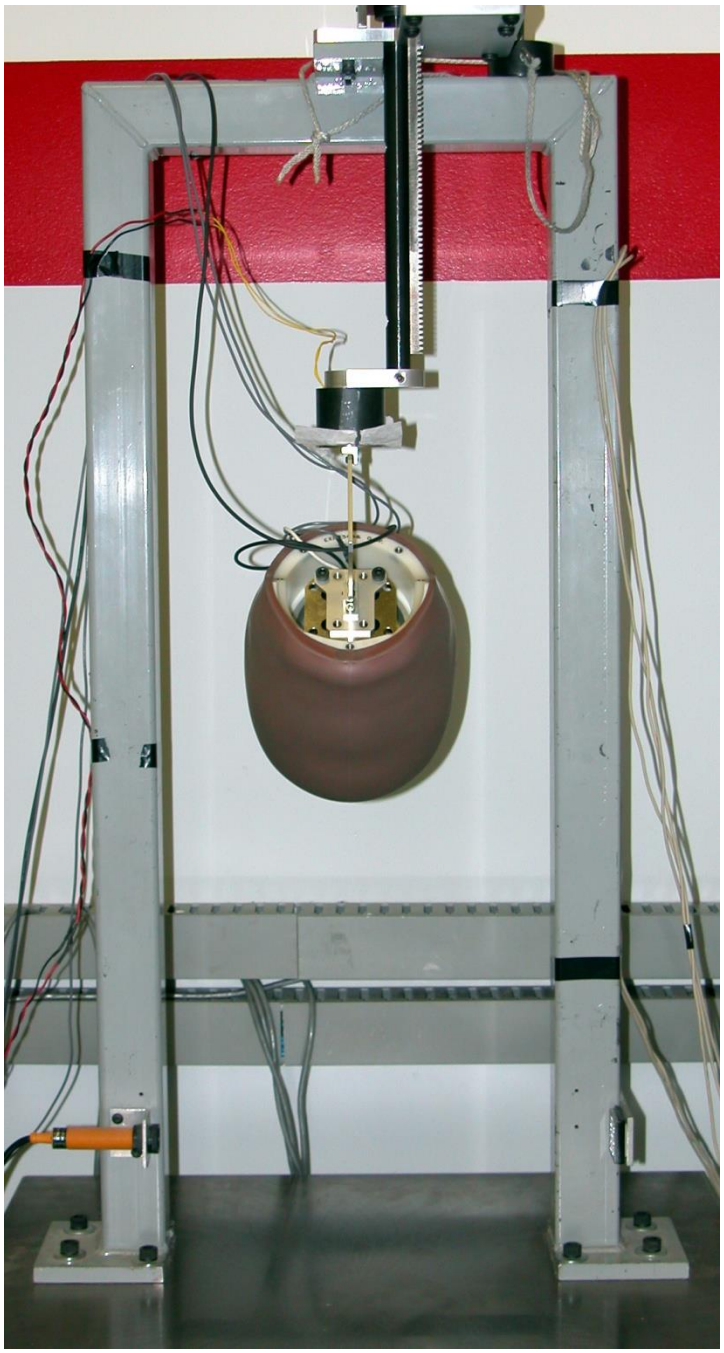


Figure 8-2 Test setup of head certification test with impact to the forehead.

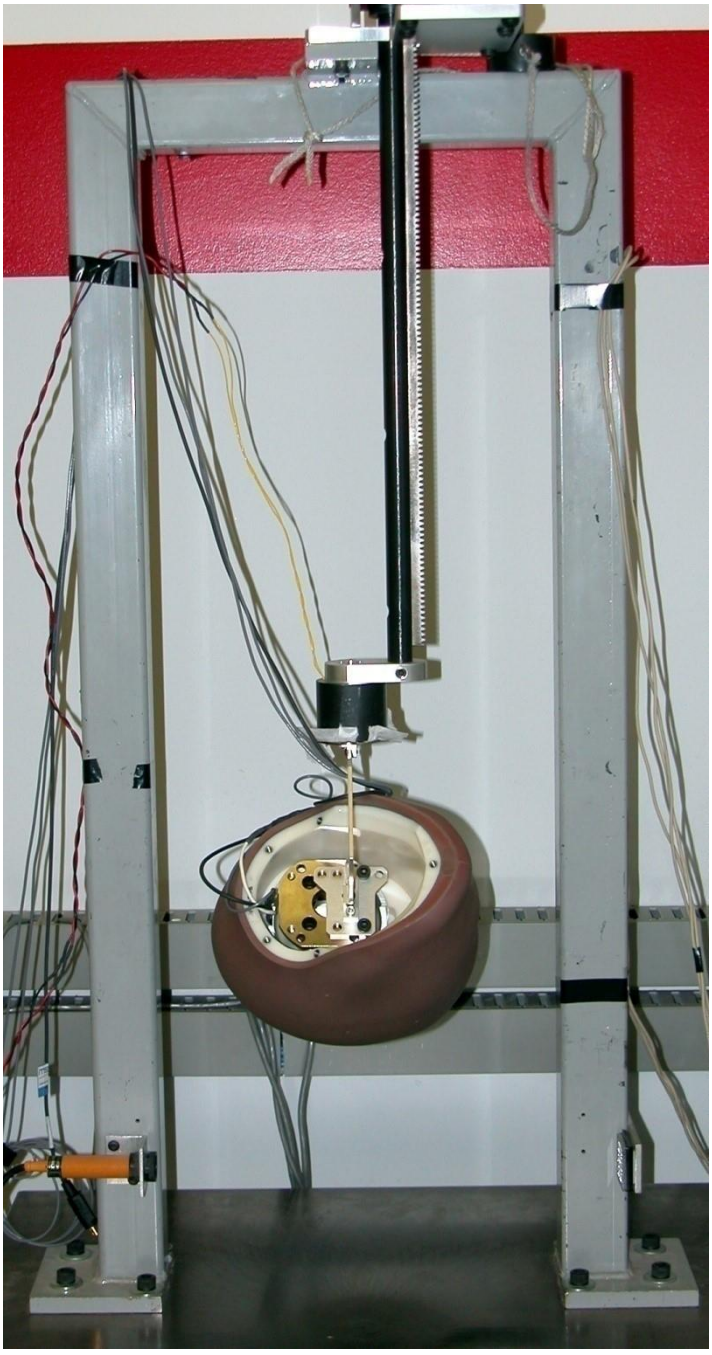


Figure 8-3 Test setup of head certification test with impact to the left side of the head.

8.5 Neck Tests

1) The neck certification procedure consists of a pendulum test similar to that used for the ES-2 neck.

2) A part 572 neck pendulum is used to certify the neck. The pendulum is decelerated by aluminum honeycomb (1.8 lb/cu. ft.) The nominal height of the honeycomb should be 76.2 mm (3 in). The pendulum must be vertical when the impact speed is zero m/s. The pendulum should be equipped with a uniaxial accelerometer so its sensitive axis is 1657.4 mm from the pendulum pivot and oriented according to Part 572.

3) The headform used to test the neck is shown in figure 8-4. The WorldSID headform (P/N W50-83000), instrumented with three rotational potentiometers and upper neck load cell, is attached to the WorldSID neck.

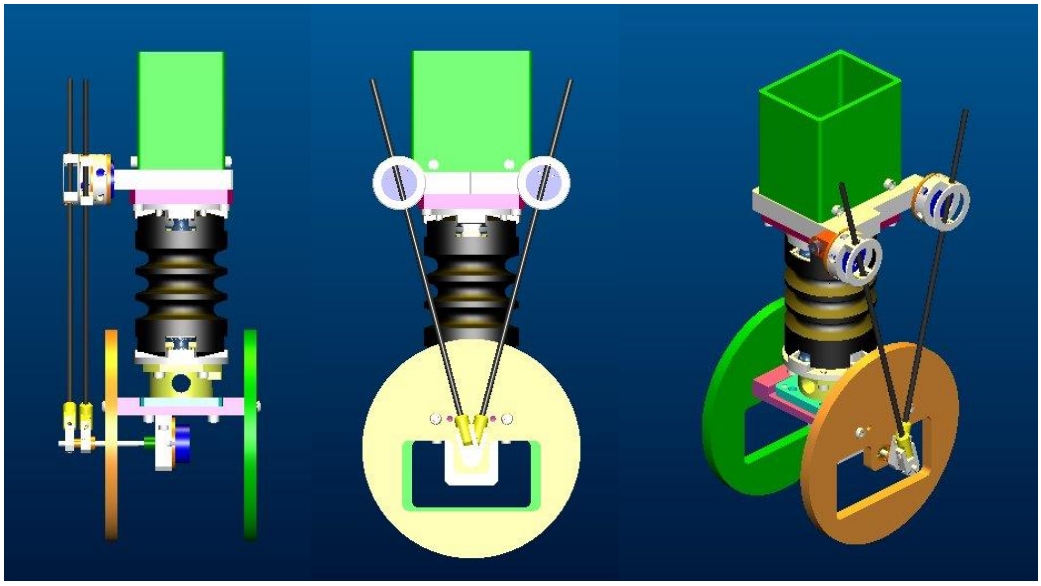


Figure 8-4 Neck and headform assembled for neck certification.

4) Attach the bottom of the neck to the aluminum plate, which attaches to the pendulum interface with M5 screws. Make sure these screws do not protrude into the neck rubber since this will influence performance. Install the 6-asix load cell to the top of the neck using M5 screws. Mount the pendulum interface assembly to the pendulum.

5) Slide the carbon fiber rods through the potentiometer housings on the pendulum. First slide the pivot of the rear potentiometer (closest to the pendulum) over the central steel rod in the headform, then install the small spacer ring and the second pivot from the forward potentiometer, which has to be carefully tightened with the two M2 set screws.

6) Soak the neck for at least four hours in the conditions required for performing the test at a temperature between 20.6 and 22.2 degrees C and a humidity of 10 to 70%.

7) The time between raising the pendulum and releasing it should not exceed 5 minutes.

8) The minimum time between repeated tests on the same WorldSID neck should be 30 minutes.

9) The pendulum velocity at impact, measured at the center of the pendulum accelerometer (1657.4 +/- 0.25 mm from the pivot), should be 3.4 m/s +/- 0.1 m/s, which is achieved by raising the pendulum to approximately 49° from verticle.

10) The pendulum acceleration should be filtered at CFC 60 according to SAE J211. Integrate the filtered acceleration.

11) The headform rotations are measured with the three rotational potentiometers using an ISO 6487 or SAE J211 CFC 1000 hardware filter. The fore (Θ_A) and aft (Θ_B) pendulum base angles are directly measured during the certification test. The flexion angle of the headform (β) must be determined using the following equation:

$$\beta = \theta_A + \theta_C - \frac{\pi}{2}, \text{ or } \beta = d\theta_A + d\theta_C,$$

where $d\Theta_A$ and $d\Theta_C$ are the derivatives of angles Θ_A and Θ_C

After this calculation, all rotations are digitally filtered using ISO 6487 or SAE J211 CFC 180.

12) Calculate the moment about the occipital condyle using the following equation:

$$Mocx = Mx + (Fy) \times (0.0195m)$$

Where Mx and Fy data is obtained from the load cell attached to the neck and have polarities in accordance with the SAE J211 sign convention.

13) The preliminary corridors for the test are listed below:

NECK Lateral	
Channels	**Filters**
Pendulum acceleration	CFC60
Pot forward	CFC1000
Pot rearward	CFC1000
Pot headform	CFC1000
Neck moment Mx	CFC600
Neck Force Fy	CFC1000
Parameters	**WorldSID Specifications**
Temperature (°C)	20.6 - 22.2
Humidity (%)	10.0 - 70.0
Impact Velocity (m/s)	3.3 – 3.5
Pendulum pulse (m/s)	
4 ms	0.77 – 1.04
8 ms	1.60 – 1.90
12 ms	2.43 - 3.29
Maximum rotation (degree)	50 - 61
Rotation decay time to 0 degree (ms)	58 - 72
Max Moment at Occipital Condyle (Nm)	55 - 68
Max moment decay time to 0 Nm (ms)	71 -87
Max forward potentiometer rotation (degree)	32 - 39
Time of maximum forward potentiometer rotation (ms)	56 - 68
Max rearward potentiometer rotation (degree)	30 - 37
Time of maximum rearward potentiometer rotation (ms)	56 - 68

Table 8-2 WorldSID neck certification specifications.

14) If the given values cannot be achieved, the eight or four on each side lateral circular section buffers can be replaced with buffers of a different hardness. A set of circular section buffers with a hardness of 60 (red), 70 (yellow) and 80 (blue) Shore A is supplied in the toolbox. If the given values cannot be achieved by changing the buffers, the central rubber portion of the neck should be replaced.

8.6 Full-body Tests

For all of the full-dummy verification tests, the dummy is seated on a rigid seat as shown in Figure 8-5 and Figure 8-6. The seat base and back are covered with Teflon® sheets. The H-point tool (W50-82500, included in the tool box) is shown in position in Figure 8-6 and in use with an inclinometer or tilt sensor in Figure 8-7. Dummy setup can be either set by mechanical measurement on a dummy component or tilt sensors. Dual axis tilt sensors are installed in the head, thorax and pelvis to check the angles along x and y direction. The mechanical measurement and the tilt sensor have the following relationship.

Location	Dummy Component Orientation	Tilt Sensor
Head Zero	Land mark on head is horizontal	X=0°, Y=0°
Thorax Zero	Top of the lower neck bracket is horizontal	X=0°, Y=0°
Pelvis Zero	X angle zero degree H-point tool oriented at 45° (Y)	X=0° Y=0°

Table 8-3 Dummy set-up orientations.

The dummy is set up according to the following criteria.

1) Thorax should be setup to 0±2 degrees.
2) Pelvic angle is at 5±2°, which coincident with H-point tool at 40±2° degrees, tilt sensor to 5±2°. Due to the low friction of the Teflon pieces, the dummy is not able to sit at zero pelvis angle. Five degrees is an achievable angle on the test bench.
3) Knee centers are at about 11.0±2.0 inch (279±50 mm)
4) The minimum time between repeated tests on the same WorldSID dummy should be 30 minutes.

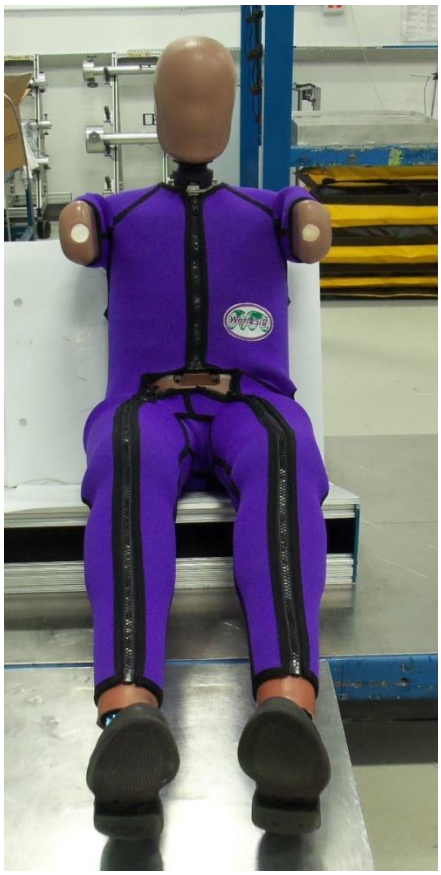


Figure 8-5 Front view of setup for full dummy verification tests.

Figure 8-6 Side view of setup for full dummy verification tests.

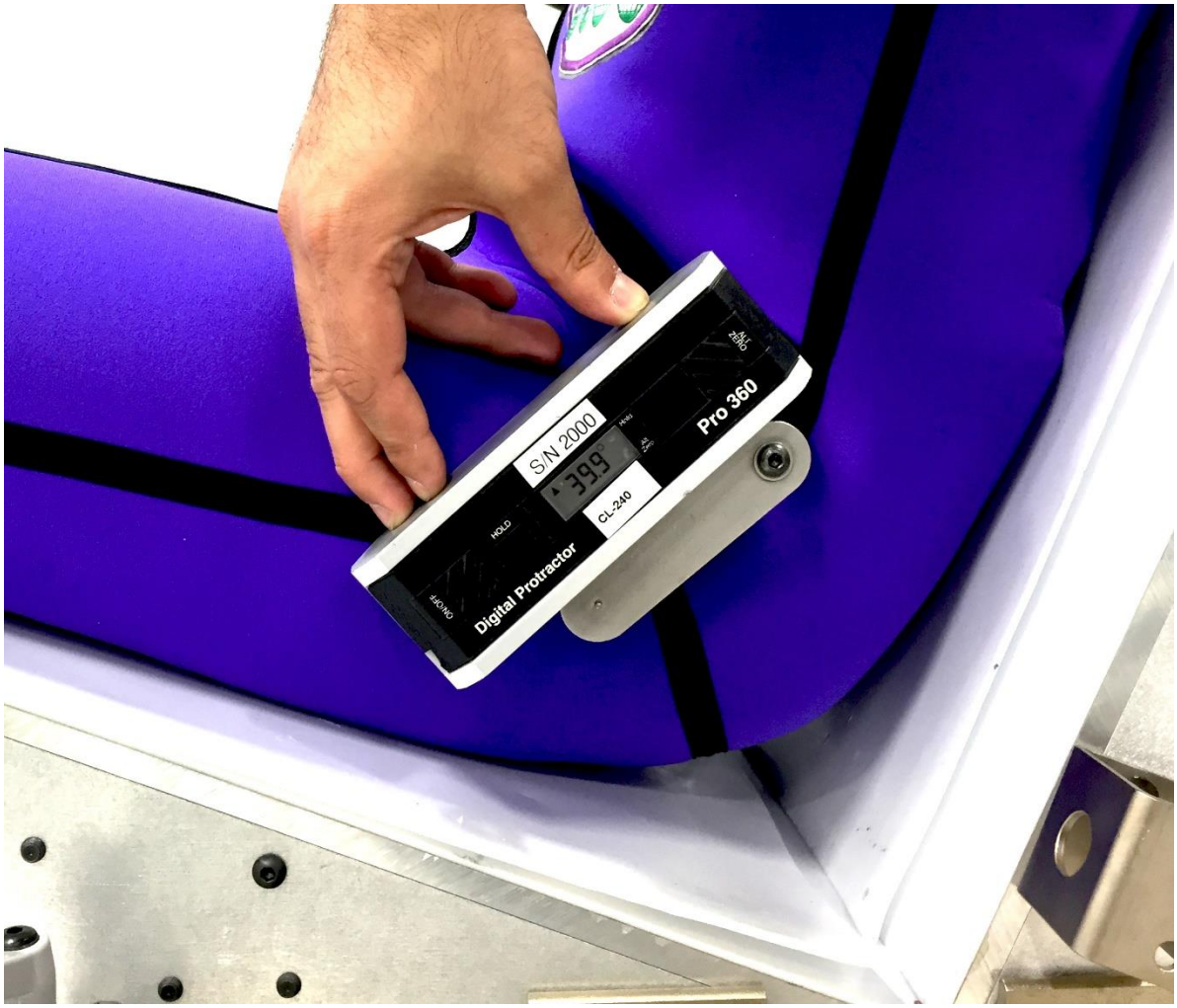


Figure 8-7 Using an inclinometer with the pelvic angle tool to check pelvis angle.

8.7 Shoulder Verification

1) Set up the dummy in standard test posture as specified in section 8.6 with the arms clicking at the horizontal stop or in the driving posture as shown in Figure 8-8 and Figure 8-9.
2) Use the Hybrid III 50th percentile pendulum (23.4 kg pendulum, 152.4 mm face diameter).
3) Align the pendulum centerline with the centerline of the shoulder plug and in contact with the dummy when the pendulum is hanging at its lowest point
4) Collect data from the following channels:
    a) Shoulder Deflection (IR-TRACC)
    b) Pendulum Acceleration
    c) Impact Velocity
5) Raise the pendulum to achieve an impact velocity of 4.3 m/s +/- 0.1 m/s.
6) Release the pendulum to impact the dummy.
7) Filter the data as in the table below. Calculate pendulum force by multiplying its mass and acceleration.
8) The preliminary corridors for the test are listed below:

SHOULDER	
Channels	**Filters**
Pendulum Acceleration	CFC 180
Shoulder Deflection	CFC 600
Parameters	**WorldSID Specifications**
Temperature (°C)	20.6 - 22.2
Humidity (%)	10.0 - 70.0
Impact Velocity (m/s)	4.2 - 4.4
Maximum Shoulder Deflection (mm)	35 - 45
Pendulum Force (kN)	2.60 – 3.30

Table 8-4 WorldSID shoulder certification specifications.

9) Allow at least 30 minutes between successive shoulder tests on the same dummy.

Figure 8-8 Front view of shoulder impact test.

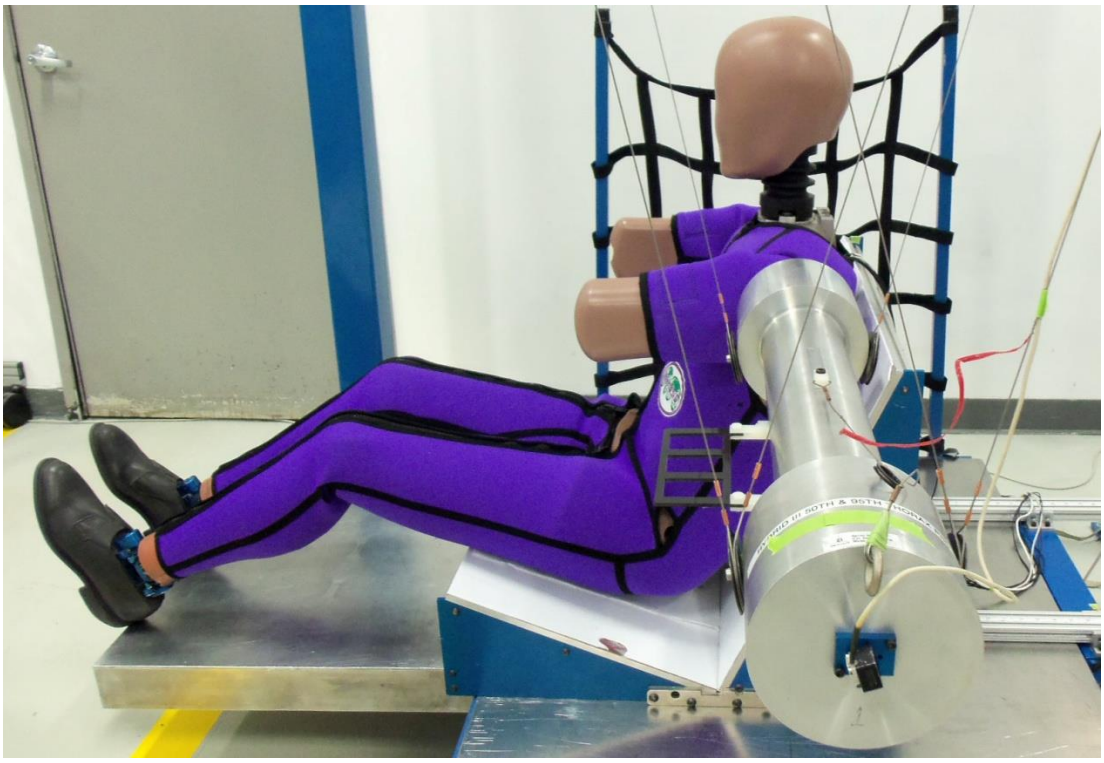


Figure 8-9 Side view of shoulder impact test.

8.8 Thorax without Arm Verification

1) Set up the dummy in standard test posture as specified in section 8.6. Raise the arm on the impact side of the dummy to a vertical position click stop as shown in figure 8-10. The arm may be taped on the side of the head for more clearance.
2) Use the Hybrid III 50th percentile pendulum (23.4 kg pendulum, 152.4 mm face diameter).
3) Align the pendulum centerline with the centerline of the middle thorax rib and in contact with the dummy when the pendulum is hanging at its lowest point. The pendulum should not hit the arm prior to contacting the thorax during the test. The arm can be rotated if required to hit the correct position of the ribs.
4) Collect data from the following channels:
    a) First, Second, and Third Rib Deflections (2D IR-TRACC)
    b) Pendulum Acceleration
    c) Upper Spine (T4) Y-axis Acceleration
    d) Lower Spine (T12) Y-axis Acceleration
    e) Impact Velocity
5) Raise the pendulum to achieve an impact velocity of 4.3 m/s ± 0.1 m/s.
6) Release the pendulum to impact the dummy.
7) Filter the data as in the table below. Calculate pendulum force by multiplying its mass and acceleration.
8) The preliminary corridors for the test are listed below:

THORAX without Arm	
Channels	**Filters**
Pendulum, T4, T12 Acceleration	CFC 180
Thorax Rib 1 Deflection	CFC 600
Thorax Rib 2 Deflection	CFC 600
Thorax Rib 3 Deflection	CFC 600
Parameters	**WorldSID Specifications**
Temperature (°C)	20.6 - 22.2
Humidity (%)	10.0 - 70.0
Impact Velocity (m/s)	4.2 - 4.4
Max Thorax Rib 1 Deflection (mm)	33 – 43
Max Thorax Rib 2 Deflection (mm)	35 - 43
Max Thorax Rib 3 Deflection (mm)	32 - 40
Pendulum Force (kN)	3.2 – 3.8
T4 Acceleration along Y axis (g)	14 - 20
T12 Acceleration along Y axis (g)	14 - 22

Table 8-5 WorldSID thorax without arm certification specifications.

9) Allow at least 30 minutes between successive thorax tests on the same dummy.

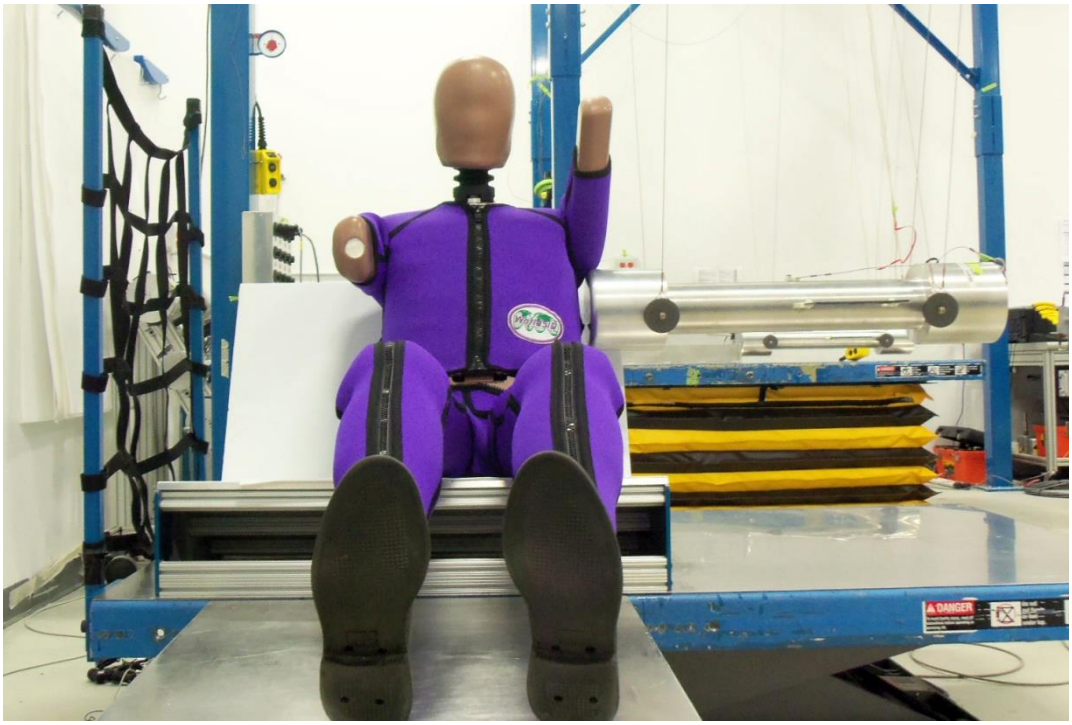


Figure 8-10 Front view of thorax test without arm.

8.9 Abdomen Verification

1) Setup the dummy in standard test posture as specified in section 8.6 with the arms horizontal or in the driving posture, as shown in Figure 8-11 and Figure 8-12.

2) Use the EuroSID2re abdomen pendulum, which consists of the Hybrid III 50th percentile pendulum (23.4 kg pendulum, 152.4 mm face diameter) and block to simulate an arm rest that has its wide surface horizontally oriented and centered on the longitudinal axis of the probe's impact face.

3) Align the block face so it is aligned with and parallel to the middle of the two abdomen ribs and in contact with the dummy when the pendulum is hanging at its lowest point.

4) Collect data from the following channels:
   a. First and Second Abdomen Rib Deflections (2D IR-TRACC)
   b. Pendulum Acceleration
   c. Lower Spine (T12) Y-axis acceleration
   d. Impact Velocity

5) Raise the pendulum to achieve an impact velocity of 4.3 m/s ± 0.1m/s.

6) Release the pendulum to impact the dummy.

7) Filter the data as in the table below. Calculate pendulum force by multiplying its mass and acceleration.

8) The preliminary corridors for the test are listed below:

ABDOMEN Impact	
Channels	**Filters**
Pendulum and T12 Acceleration	CFC 180
Abdomen Rib 1 Deflection	CFC 600
Abdomen Rib 2 Deflection	CFC 600
Parameters	**WorldSID Specifications**
Temperature (°C)	20.6 - 22.2
Humidity (%)	10.0 - 70.0
Impact Velocity (m/s)	4.2 - 4.4
Max Abdomen Rib 1 Deflection (mm)	33 - 40
Max Abdomen Rib 2 Deflection (mm)	30 - 36
Pendulum Force (kN)	2.7 – 3.1
T12 Acceleration along Y axis (g)	15 - 20

Table 8-6 WorldSID abdomen certification specifications

9) Allow at least 30 minutes between successive abdomen tests on the same dummy.

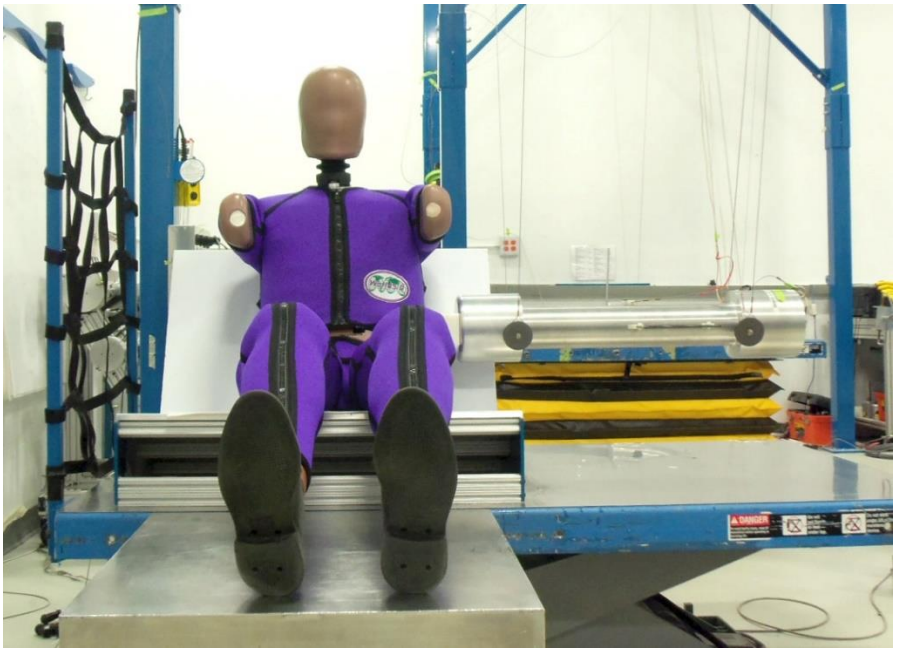


Figure 8-11 Front view of abdomen test setup.

Figure 8-12 Side view of abdomen test setup.

8.10 Pelvis Verification Test

1) Setup the dummy in standard test posture as specified in section 8.6 with the arms horizontal or in the driving posture as shown Figure 8-13 and 8-14.

2) Use the Hybrid III 50th percentile pendulum (23.4 kg pendulum, 152.4 mm face diameter).

3) Install the H-point tool on the impact side of the dummy

4) Align the pendulum centerline so it is aligned to the H-point, which is found with the H-point tool and in contact with the dummy when the pendulum is hanging at its lowest point.

5) Collect data from the following channels:
   a) Pelvis Y-axis Acceleration
   b) Pendulum Acceleration
   c) Impact Velocity

6) Raise the pendulum to achieve an impact velocity of 6.7m/s ± 0.1 m/s.

7) Release the pendulum to impact the dummy.

8) Filter the data as in the table below. Calculate pendulum force by multiplying its mass and acceleration.

9) The preliminary corridors for the tests are listed below:

PELVIS	
Channels	**Filters**
Pendulum Acceleration	CFC 180
Pelvis Acceleration	CFC 180
T12 Acceleration	CFC 180
Parameters	**WorldSID Specifications**
Temperature (°C)	20.6 - 22.2
Humidity (%)	10.0 - 70.0
Impact Velocity (m/s)	6.6 - 6.8
Maximum Pelvis Acceleration (g)	37 - 47
Max T12 Acceleration along Y axis (g)	10 -14
Peak Pendulum Force (kN)	6.8 – 8.2
Peak Pubic Force	Monitor

Table 8-7 WorldSID pelvis certification specifications.

10) Allow at least 30 minutes between successive pelvis tests on the same side of the dummy.

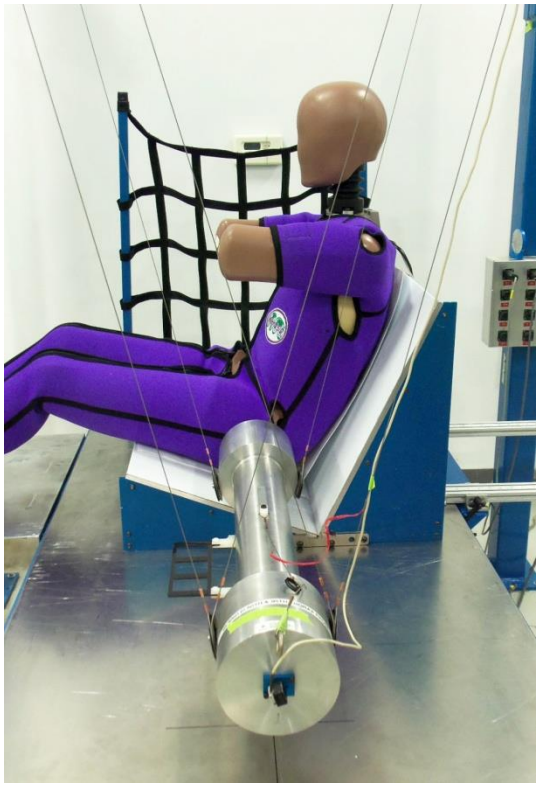


Figure 8-13 Side view of WorldSID pelvis test.

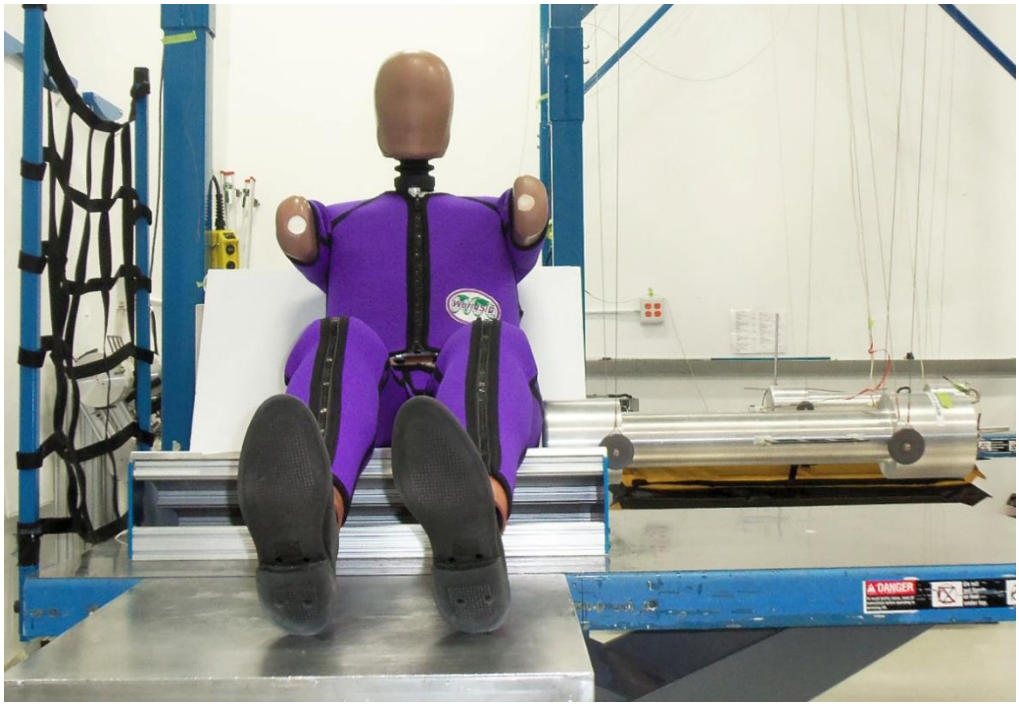


Figure 8-14 Front view of WorldSID pelvis test.

Section 9 External Measurement Procedure

- External measurements are taken on the dummy as a final quality check during production. This insures that the dummy has been assembled properly with the correct components. The measurements are in addition to the normal quality controls on the production of the dummy's mechanical and molded parts.

- External measurements are taken when the dummy is being used in the vehicle test facility to determine whether there has been damage to the dummy during use. Deformed parts tend to change the external measurement readings.

- The external measurement procedures is still under discussion in the ISO TG and may be subject to change.

9.1 Equipment required:

1. WorldSID calibration bench, W50-82200 resting on a table to support the feet. The junction between the seat pan and the seat back is to be 5-25 mm above the table surface.
2. WorldSID-50th H-point locators, two.
3. Height gage or equivalent to measure up to 900 mm.
4. Parallel arm calipers to measure up to 700 mm.
5. Digital protractor.

9.2 Measurement set up:

1. Remove the loose Teflon® sheets from the seat. Seat the dummy on the WorldSID calibration bench or equivalent fixture. Verify that the seat pan angle is 21.6±2.0° to horizontal. Verify that the seat-pan-to-seat-back angle is 93.0±2.0°.

2. Remove the body jacket (W50-80100).

3. Push the dummy back against the seat back so that both sides of the back of the spine box are in full contact with the seat back.

4. Position the pelvis so that the bottoms of the thigh portions are in full contact with the seat.

5. Position the legs so that the bottoms of the thigh portions are in full contact with the seat. Set the lateral distance between the knee centerlines (centerline locations estimated by eye) to 279±50 mm and set the legs parallel to the dummy's midsagittal plane (perpendicular to the seat back).

6. Positioning the legs in step 5 will set the angle of the lower legs. Allow the angle of the ankles to attain their natural position due to the internal frictional components.

7. Adjust the upper neck bracket X axis angle A1 (roll angle) to 0.0±2.0° Record the Y axis angle A2 (pitch angle), specification -3.6±3.0° (down to the back).

9.3 Angular set-up measurement summary

Set-up Angle	Symbol	Specification, degrees
Seat Pan to Horizontal	-	21.6±2.0
Seat Back to Seat Pan	-	93.0±2.0
Neck Bracket X-Axis Angle (Roll Angle)	A1	00.0±2.0
Neck Bracket Y-Axis Angle (Pitch Angle)	A2	-3.6±2.0

Table 9-1 Angular set-up measurement summary

9.4 Linear Measurements

1. Seated Height: Measure seated height to the top of the head, from and perpendicular to, the seat pan, using a height gage with scribe and height extension if necessary.

2. Hip pivot height: Install an H point indicator tool into each side of the pelvis with the blade positioned down and to the front. Measure the left and right hip pivot height to the center of the H point indicator reference hole (Ø1.995 mm hole at the lower end of indicator) from and perpendicular to the seat pan. Use a height gage with scribe or with a pin with a diameter less than that of the reference hole.

3. Hip pivot to back line: Measure the hip pivot distance to the H point indicator reference hole from and perpendicular to the seat back. Use a height gage with a scribe or with a pin, held to the seat back, or equivalent method insuring perpendicularity.

4. Thigh clearance: Measure the thigh clearance as the height of the top of the thigh portion of the pelvis (each side) above and perpendicular to the seat pan. Use a height gage with scribe. Do not measure these values to the top of the thigh portion of the upper legs.

5. Knee height: Measure the knee height to the top of the knee flesh flap (integral to the lower leg) from the plane of the heel of the shoe parallel and in line with the knee pivot-ankle pivot line. Use a divider calipers with parallel arms at each end.

6. Knee to backline: Measure the distance to the front of the integral knee flesh at the notch where the knee flesh joins the lower leg from and perpendicular to the seat back. Use a height gage with a scribe or a divider caliper with parallel arms at each end held perpendicular to the seat back.

7. Head back to seat back: Measure the distance from the back of the head to the backline perpendicular to the seat back using a height gage or divider calipers with parallel arms at each end held perpendicular to the seat back.

8. Rib number one depth: Measure the depth of the number one rib with calipers parallel to the plane of the rib from the back surface to the front of the rib on each side of the bib.

9. Rib number five depth: Measure the depth of the number five rib with calipers parallel to the plane of the rib from the back surface to the front of the bib on each side of the rib with a caliper.

10. Arm length: Measure the length of each arm from the top to the bottom with a caliper.

11. Width across arms: Measure the width across the arms with a caliper at the center line of the attachment bolts without compressing the flesh.

12. Waist width: Measure the width of the waist at the top of the pelvis flesh with a caliper.

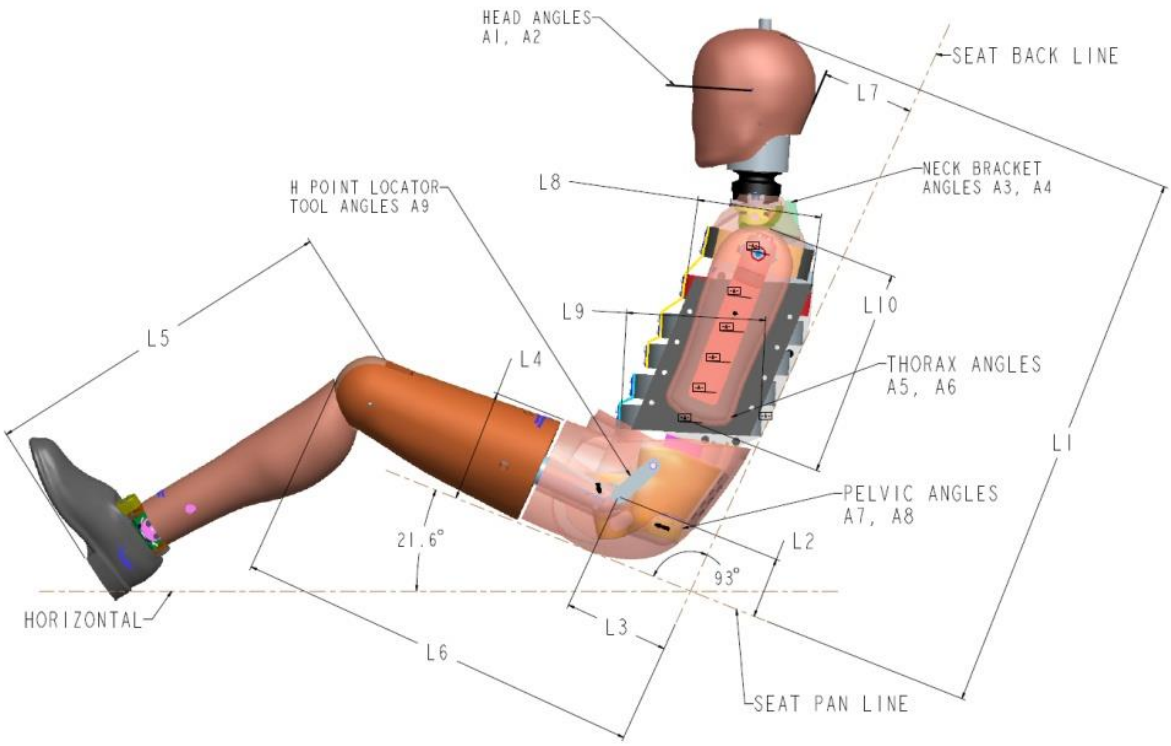


Figure 9-1 External measurements.

Note: Spine box side plates are in contact with seat back; heels are on, not below horizontal plane; bottom of thighs and pelvis are in contact with seat pan.

Head and ankles assume natural position based upon elastomeric element properties.

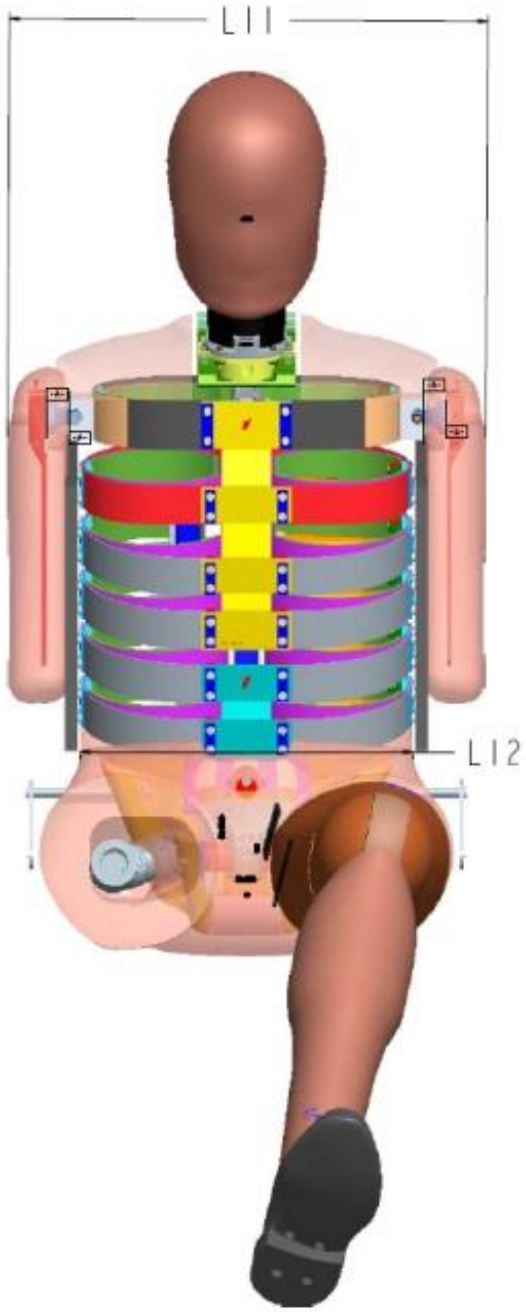


Figure 9-2 External measurements front.

Measurement Values

Angle	Symbol	Tilt Sensor	Inclinometer		
			Center	Left	Right
Head X-Axis Angle (Roll Angle)	A1	1.5±3.0	n/a	n/a	n/a
Head Y-Axis Angle (Pitch Angle)	A2	-3.0±3.0	n/a	2.6±5.0	2.6±5.0
Neck Bracket X-Axis Angle (Roll Angle)	A3	n/a	0.0±2.0	n/a	n/a
Neck Bracket Y-Axis Angle (Pitch angle)	A4	n/a	-3.6±2.0	n/a	n/a
Thorax X-Axis Angle (Roll Angle), Tilt Sensor	A5	-.60±3.0	n/a	n/a	n/a
Thorax Y-Axis Angle (Pitch Angle), Tilt Sensor	A6	3.65±3.0	n/a	n/a	n/a
Pelvis X-Axis Angle (Roll Angle), Tilt Sensor	A7	0.80±3.0	n/a	n/a	n/a
Pelvis Y-Axis Angle (Pitch Angle), Tilt Sensor	A8	11.7±3.0	n/a	n/a	n/a
H-Point Angle, Inclinometer	A9	n/a	n/a	32.3±5.0	32.3±5.0

Table 9-2 Angular tolerance based on measurement method. Set up angle tolerances are tightest.

Linear parameter	Symbol	Specified Value and Tolerance, mm		
		Center	Left	Right
Seated Height	L1	869±30	n/a	n/a
Hip Pivot Height	L2	n/a	79±15	79±15
Hip Pivot to Back Line	L3	n/a	175±28	175±28
Thigh Clearance	L4	n/a	176±29	176±29
Knee Height	L5	n/a	588±30	588±30
Knee to Backline	L6	n/a	670±30	670±30
Head Back to Seat Back	L7	147±22	n/a	n/a
Rib Number 1 front to back	L8	n/a	208±30	208±30
Rib Number 5 front to back	L9	n/a	228±30	228±30
Arm Length	L10	n/a	330±30	330±30
Width Over Arms	L11	468±30	n/a	n/a
Waist Width	L12	324±30	n/a	n/a

Table 9-3 Linear tolerance is ±15% maximum 30 mm. Specification and tolerance to be refined based on manufacturing data.

Section 10 Mass Measurements

10.1 Segment and total weight

Table 10-1 shows current ISO specification and recommended masses for updated ISO Part 5.

		ISO 15830-2:2013 Mass specification (kg)				2015 Updated specifications with alternative split line (kg)[2]			
NO.	ITEM	Mass (KG)	+/- (KG)	ISO range		Mass (KG)	+/- (KG)	New Range	
1	Head	4.22	0.05	4.17	4.27	**4.29**	**0.05**	4.24	4.34
2	Neck	2.84	0.15	2.69	2.99	**2.86**	**0.02**	2.84	2.88
3	Upper Torso	20.55	1.00	19.55	21.55	**20.56**	**0.35**	20.21	20.91
4	Lower Torso [1]	17.77	0.90	16.87	18.67	**19.30**	**0.20**	19.10	19.50
5	Arm Left	1.77	0.09	1.68	1.86	**1.76**	**0.04**	1.72	1.80
6	Arm Right	1.77	0.09	1.68	1.86	**1.76**	**0.04**	1.72	1.80
7	Upper Leg, Left [1]	6.71	0.30	6.41	7.01	**5.86**	**0.04**	5.82	5.90
8	Lower Leg, Left	5.09	0.13	4.96	5.22	**5.06**	**0.07**	4.99	5.13
10	Upper Leg, Right [1]	6.71	0.30	6.41	7.01	**5.86**	**0.04**	5.82	5.90
11	Lower Leg, Right	5.09	0.13	4.96	5.22	**5.06**	**0.07**	4.99	5.13
12	Clothing; with sleeves[3]	1.85	0.09	1.76	1.94				
12	Clothing: without sleeves					**1.54**	**0.10**	1.44	1.64
	Total[1]	74.35	3.74	70.61	78.09	**73.91**	**1.02**	72.89	74.93

Footnotes:

1 Humanetics included upper femurs & ball joint assembly in the total mass of lower torso. ISO includes femur & ball joint hardware in upper leg.

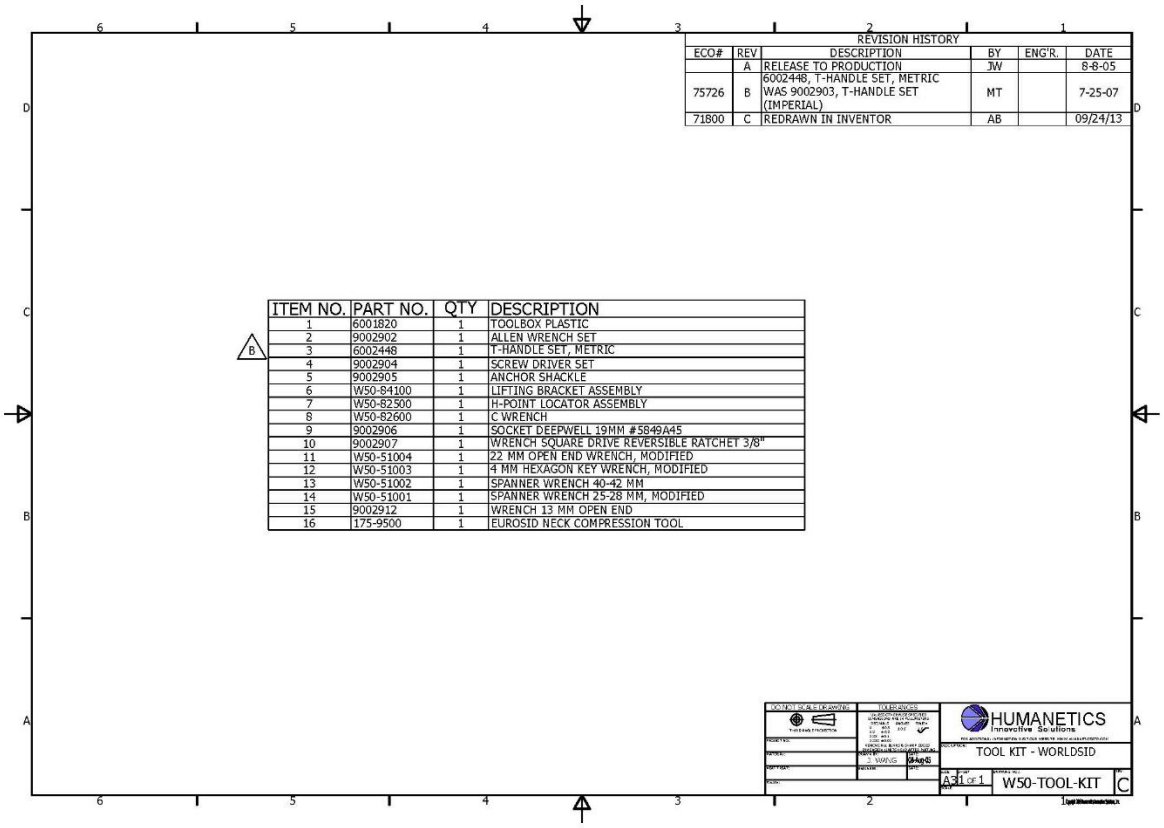
2 ISO updated ISO/PDTS 15830-5 is currently in review.

3 ISO will be adopting alternative suit without sleeves; pending committee approved design.

Table 10-1 Mass measurements.

Section 11 Appendix A

11.1 Tool kit



REVISION HISTORY

ECO#	REV	DESCRIPTION	BY	ENG'R.	DATE
	A	RELEASE TO PRODUCTION	JW		8-8-05
75726	B	6002448, T-HANDLE SET, METRIC WAS 9002903, T-HANDLE SET (IMPERIAL)	MT		7-25-07
71800	C	REDRAWN IN INVENTOR	AB		09/24/13

ITEM NO.	PART NO.	QTY	DESCRIPTION
1	6001820	1	TOOLBOX PLASTIC
2	9002902	1	ALLEN WRENCH SET
3	6002448	1	T-HANDLE SET, METRIC
4	9002904	1	SCREW DRIVER SET
5	9002905	1	ANCHOR SHACKLE
6	W50-84100	1	LIFTING BRACKET ASSEMBLY
7	W50-82500	1	H-POINT LOCATOR ASSEMBLY
8	W50-82600	1	C WRENCH
9	9002906	1	SOCKET DEEPWELL 19MM #5849A45
10	9002907	1	WRENCH SQUARE DRIVE REVERSIBLE RATCHET 3/8"
11	W50-51004	1	22 MM OPEN END WRENCH, MODIFIED
12	W50-51003	1	4 MM HEXAGON KEY WRENCH, MODIFIED
13	W50-51002	1	SPANNER WRENCH 40-42 MM
14	W50-51001	1	SPANNER WRENCH 25-28 MM, MODIFIED
15	9002912	1	WRENCH 13 MM OPEN END
16	175-9500	1	EUROSID NECK COMPRESSION TOOL

Figure 11-1 W50-TOOL-KIT drawing.

Manual Update Log

Rev. D, Nov. 2011

Manual changed from FTSS to Humanetics

Rev. E, Mar. 2012

Update parameters in Head Drop & Neck Lateral

Rev. E.1, Jan. 2013

Added SBL E Leg section, updated parameters in Head Drop & Pelvis Lateral

Rev. F, May 2014

Updated for correct neck and abdomen parameters, integrate legs, update ankle, replace dummy certification photos using new jacket, integrate 2D-IR-TRACC (SBL F) into main body, add External Dimensions procedure, removed Thorax Test with Arm, misc. photo replacements.

Rev. F, Jul. 2015

Page 2: Added lead material statement

Rev. G, Oct. 2015

Updated sections; Renumbered Tables and Figures; Added Appendix A

Rev. H, Jan. 2016

Added Section 5.5, IR-TRACC Rod End Position and Fixation with Counter Nut.

Rev. I, Sept. 2017

Added Peak Pubic Force specification per ISO Committee Approval.

Rev. J, Dec. 2017

Table 8-7: removed Peak Pubic Force

Rev. K, Feb. 2018

Table 8-7: added Peak Pubic Force: Monitor