Q10 (10.5 year old child)
User Manual

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

or contact:

Humanetics Innovative Solutions
47460 Galleon Drive
Plymouth, MI 48170, USA
Telephone: 734-451-7878
Fax: 734-451-9549

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

List of Figures

List of Tables

Section 1 Introduction

1.1 Description

In the late 1970's and early 1980's, TNO and others developed the P-dummies, a series of child dummies that cover almost the complete child population up to 10 years. The P-series dummies up to 2013 are still test tools for the European regulation ECE-R44 and are also adopted by many other standards.

In 1993 the international Child Dummy Working Group started the development of a new series of child dummies as a successor to the P-series. This new series was called the Q-series.

The Q series dummies are available in the following age groups: Newborn, 1 year, 1 ½ year, 3 year, 6 year and 10 year old child. The Q3s is a side impact only adaptation of the Q3 dummy designed to complement the Part 572 Subpart P Hybrid III 3 year old child dummy. A Q6s dummy is also available.

Humanetics controls the configuration of the Q-dummies in close contact with dummy user groups and regulatory bodies like EuroNCAP and UNECE-GRSP. Since spring 2004 the design of the Q-dummies was frozen and no changes, that affect the dummy performance or interchangeability of parts, were implemented.

In 2009-2011 the last member of the Q-dummy family was developed and evaluated in a European FP7 Project called EPOCh. In 2011-2012 third parties evaluated the Q10 prototype dummy (SBL-A). These evaluations resulted in recommendation for design updates that were implemented. The updated design is the Q10 production version: This manual describes the Q10 production version. In Chapter 14 an overview of the design updates implemented in the production version is given.

In the European Enhanced Vehicle-Safety Committee Q10 dummy report – Advanced Child Dummies and Injury Criteria for frontal dummies 2015 it is recommended "Based on the extensive evaluation and validation results described in this report, EEVC recommends that the Q10 dummy is used in child restraint homologation tests (UN R129)." For the other recommendations and further details please refer to the full report. [v]

1.2 General Description and Features

1.2.1 Development History

Q10 design started in 2009 and was developed with co-funding from the EU commission within the Seventh Framework program under the project name EPOCh (Enable Protection for Older Children). The Q10 has the anthropometry of a 10.5 year old 50th percentile child as defined in CANDAT (**C**hild **AN**thropometry **DAT**abase). After EPOCH improvements were made taking comments from users into consideration, this raised the standard build level to B. In 2013 a lateral shoulder kit was developed this raised the service build level (SBL) to C.

1.2.2 Application

The Q10 dummy is suitable for frontal as well as side impact CRS evaluations, to be used for both homologation, consumer rating and research purposes. Possible applications include:

- Child Restraint Systems (CRS) testing. This includes the European ECE R44, R129 and the US FMVSS 213 regulations. The Q-dummies have been designed to succeed the P-dummies in CRS evaluation regulations.
- EuroNCAP tests. The dummy has been designed to withstand impacts up to 64 km/h partial overlap and 56 km/h full width frontal tests under the EuroNCAP protocol on the rear seat in modern cars.

- NPACS tests. The New Program for the Assessment of Child-restraint Systems

1.2.3 Features

- The Q-dummies have improved biofidelity over the P-series. Biomechanical information from children and scaled adult biomechanical response curves has been used to define the dummy response [[i]] and [[ii]]. The anthropometry of the dummy is based on CANDAT data [[iii]].
- The dummies can be equipped with accelerometers, angular velocity sensors, load cells, displacement sensors and pressure sensors. This allows evaluation of the injury risk under various circumstances.
- Special attention has been paid to the handling characteristics of the dummy, ensuring the dummy can be assembled and disassembled quickly with the use of metric hex keys.
- The influence of transducers upon the kinematics of the dummy is minimized, and protection of transducers and cables is integrated into the dummy design.

Head
The head is largely made from polyurethane synthetics. The head cavity is large enough to allow use of several instruments, including linear accelerometers, angular velocity sensors and a tilt sensor.

Neck
The neck is flexible and allows shear and bending in all directions. The segmented design prevents buckling and allows realistic rotational behavior. The neck is fitted with a flexible stainless steel wire at its core to prevent failure under high load. A six channel load cell can be mounted at the neck-head and neck-thorax interface.

Thorax
The thorax of the child is represented by a single ribcage. The deformation can be measured with two IR-TRACC 2D sensors located in the upper and lower regions of the ribcage. The shoulders are connected with a flexible joint to the thorax, allowing deformation. Accelerometers can be mounted in the thoracic spine and on the ribcage to measure linear accelerations. Moreover the thoracic spine facilitates the use of angular velocity sensors and a tilt sensor. A side impact shoulder kit can also be fitted.

Abdomen
The abdomen is foam filled covered with a PVC skin. Biomechanical data from children has been used to determine the required stiffness. Pressure sensors can be placed in the abdomen to measure belt loading.

Lumbar spine
The lumbar spine is a flexible rubber column, which allows shear and bending in all directions. A six channel load cell can be mounted between the lumbar spine and the pelvis.

Pelvis
The Q10 dummy pelvis has a different design from other Q-dummies. Its design is similar to the WorldSID dummy with an option to fit a single channel pubic symphysis load cell, two sacro-iliac load cells and Asis load cells. The pelvis therefore has a more compliable design for side impact with plastic bones and a flexible rubber pubis. The anthropometric shape of the bones has been designed to ensure realistic belt interaction [iii] and [[iv]]. Additional space has also been allocated to package onboard DAS systems. Accelerometers, angular velocity sensors, and a tilt sensor can be mounted in this space. Friction can be applied to the hip joint for positioning.

Arms
The friction in the elbow joints and the shoulders can be adjusted to a one g setting. The side impact shoulder kit has a more compliant upper arm with no lower arm.

Legs
Six axis femur load cells can be fitted. The friction in the knee joints can be adjusted to a one g setting. The lower legs use the same part both sides.

Suit
The dummy is dressed in a tight-fitting neoprene suit (010-8000) split with an upper and lower part connected with a zipper at abdomen level. This suit is an integral part of the dummy and should be worn by the dummy during all tests.

Hip Shields
These are fitted over the hip area once the dummy has been positioned. These are for the frontal configuration only.

Main Dimensions

See Section 14.18 at the end of manual.

Mass Distribution

See Section 14.17 at the end of manual.

Standard Dummy (delivery)

The standard Q-dummy is delivered with the following items (if not ordered otherwise):

- Clothing (a yellow suit);
- Hip shields
- Structural replacements in the location of the load cells;
- Mounting blocks for use with uni-axial accelerometers and angular velocity sensors to customer requirements.
- Two 2D-IRTRACCs mounted in the chest
- H-shaped bracket for mounting the 2D-IRTRACC's in side impact configuration
- Provisions for IES tilt sensors in head, thorax and pelvis
- Dummy tool, hip adjuster, head leveling tool
- Manual

1.3 Instrumentation

1.3.1 General

The dummy accepts both accelerometers and load cells as standard instrumentation. Angular velocity sensors (DTS ARS) can be fitted to the head thorax and pelvis. The dummy can be equipped with uni-axial accelerometers for all locations.

The load cells or their structural replacements are a part of the dummy structure; the structural replacements have to be used in absence of the actual transducer. A 6 channel loadcell (FTSS model IF-217-HC, High Capacity) can be placed in the upper neck, lower neck and lumbar spine location. The pelvis can be fitted with a WorldSID pubic loadcell W50-71051S3 and two 6 channel sacro-iliac loadcells. The upper legs can also be fitted with 6 channel femur loadcells. A 3 channel shoulder loadcell can also be fitted with the side impact shoulder kit. Two channel Asis loadcells have recently been added as optional.

1.3.2 Transducers

The Q10 dummy can be fitted to measure the following parameters:

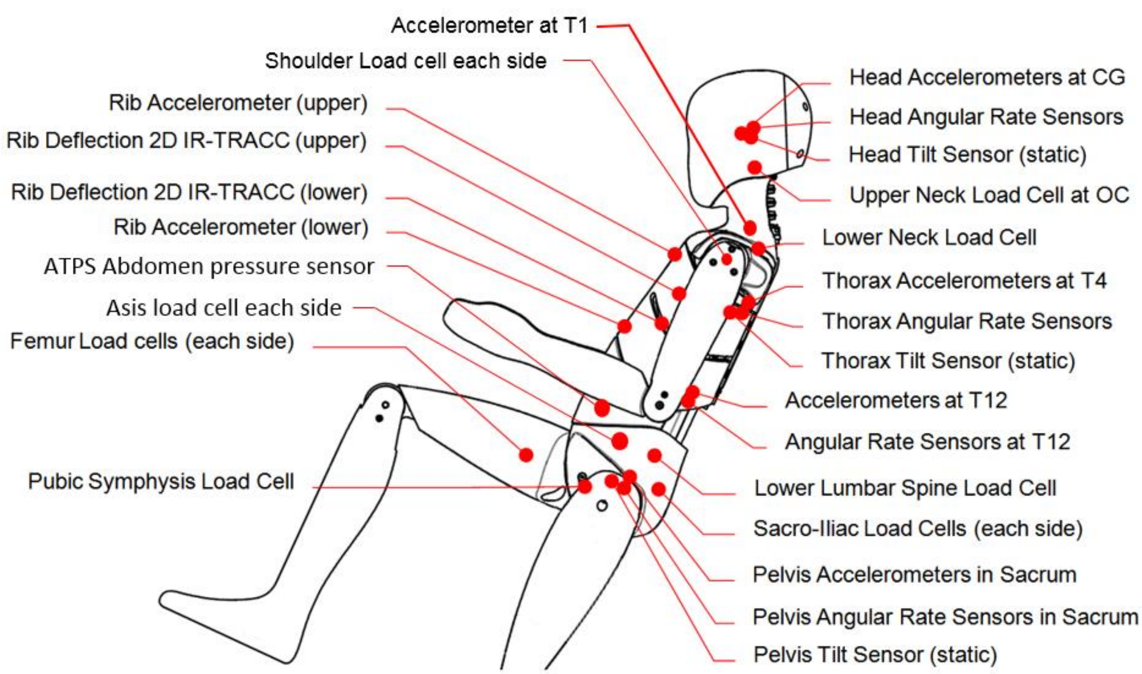


Figure 1. Q10 Instrumentation overview

Head

Standard — 3 uni-axial accelerometers in head (Ax, Ay, Az)

Optional — DTS ARS 3 uni-axial angular velocity sensors (ωx, ωy, ωz)
- IES tilt sensor (for static measurement during dummy positioning)

Neck

Standard
- Upper neck 6 channel load cell, 3 forces, 3 moments (Fx, Fy, Fz, Mx, My, Mz). FTSS Model IF-217-HC (the high capacity version is required)
- Lower neck 6 channel load cell, 3 forces, 3 moments (Fx, Fy, Fz, Mx, My, Mz). FTSS Model IF-217-HC (the high capacity version is required)

Thorax

Standard
- 3 uni-axial accelerometers at T4 location in upper spine (Ax, Ay, Az)
- 2 IR-TRACC 2D sensors to measure chest deformation, frontal or lateral (Dx or Dy and φxy) FTSS model IF-372.

Optional
- additional accelerometers may be installed on the thorax and the rib cage (see notes below) (Ax, Ay).
- DTS ARS 3 uni-axial angular rate sensors (ωx, ωy, ωz)
- T1 acceleration (Ay) for testing optional but used for certification
- Shoulder acceleration (Ay)
- Shoulder forces (Fx, Fy and Fz) side shoulder kit only
- IES tilt sensor (for static measurement during dummy positioning)

Lumbar Spine

Standard
- 6 channel load cell at base of lumbar spine/ pelvis interface (Fx, Fy, Fz, Mx, My, Mz). FTSS Model IF-217-HC

Optional — Ax, Ay accel and ωx, ωy angular rate sensor at top of lumbar spine.

Abdomen

Optional — Twin pressure sensor

Pelvis

Standard
- 3 uni-axial accelerometers and angular rate sensors in sacrum structure (Ax, Ay, Az) and (ωx, ωy, ωz)

Optional
- DTS ARS 3 uni-axial angular rate sensors (ωx, ωy, ωz)
- Lateral pubic load cell (Fy,) model W50-71051S3.
- 6 channel sacro iliac load cells left and right (Fx, Fy, Fz, Mx, My, Mz).
- Asis load cell (Fx, My)

Legs
- 6 channel femur load cell LH and RH (Fx, Fy, Fz, Mx, My, Mz).

Notes:

1. Two IR-TRACCs can be mounted to measure lateral deflection on the left or right side.

2. Information on the installation of the instrumentation can be found in the assembly/disassembly section of this manual.

2. The Upper Neck Load Cell does not require any correction for measurement of the moment around the OC joint. The (theoretical) OC joint coincides with the neutral axis of the moment measurement of the (FTSS) load cell.

1.3.3 Accelerometers Mounts

Humanetics supports these brands/models of accelerometers:

- Endevco 7264A, 7264B & 7264C type
- Kyowa ASM Series
- MS 64C
- EGAS-FS-50

The following accelerometers and mounts can be used for the Q10 dummy:

Accelerometer Type	Location		
	Head	Thorax	Pelvis
ENDEVCO 7264-2000 7264C-2000 7264D MS 64C KYOWA ASM-200BA MSC 126M/CM	034-1201 allows for ARS or 020-1017 without	034-1201 allows for ARS or 020-1017 without	034-1201 allows for ARS or 020-1017 without
7264A 7264B EGAS-FS-50	036-1101 allows for ARS or I.AD without	036-1101 allows for ARS or I.AD without	036-1101 allows for ARS or I.AD without

Table 1. Uni-Axial Accelerometers

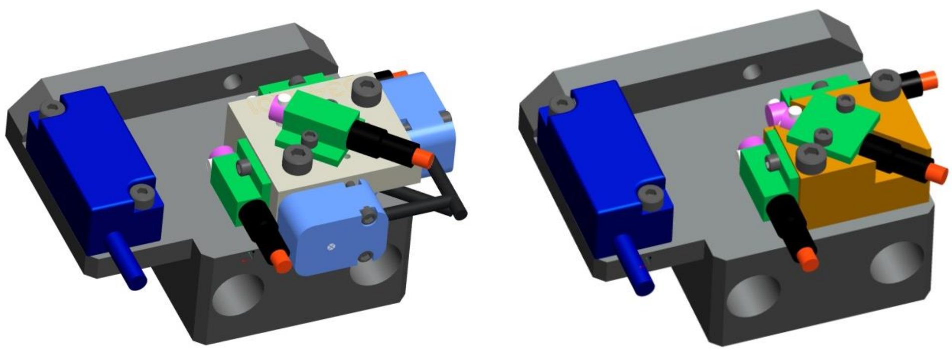


Figure 2. Head accel mounts for type 7264C (034-1201 with ARS and 020-1017 without)

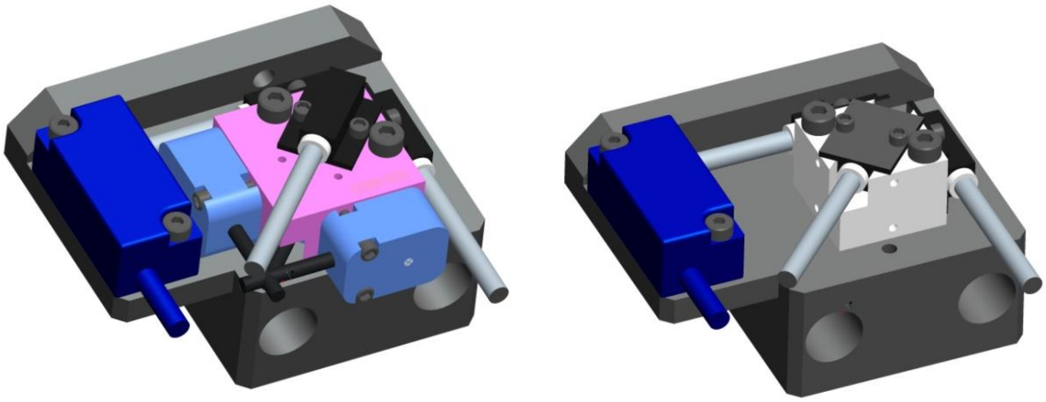


Figure 3. Head accel mounts for type 7264B (036-1101 with ARS and I.AD without) For T1 accelerometer see figure 16

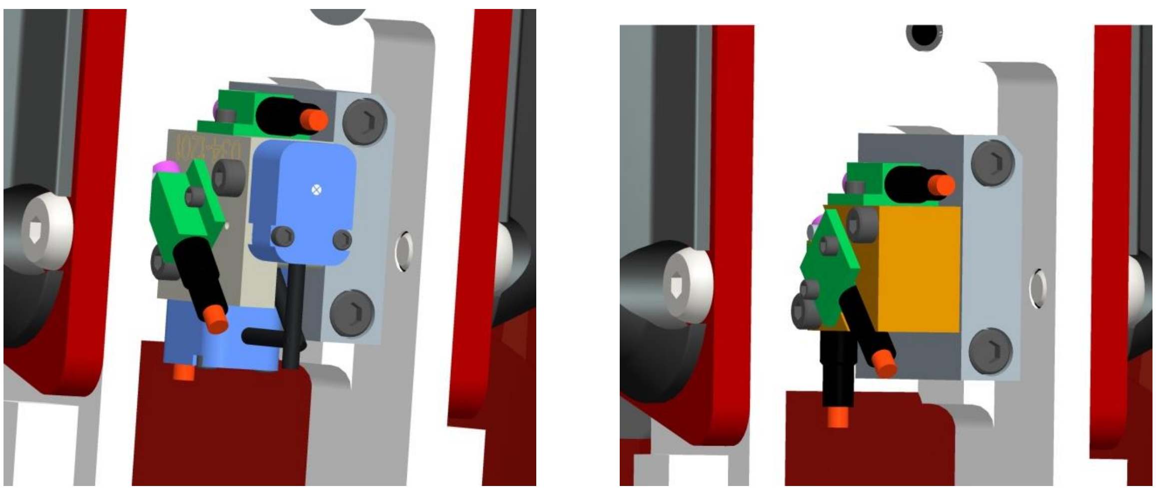


Figure 4. Thorax accel mounts at T4 location for type 7264C (034-1201 with ARS and 020-1017 without)

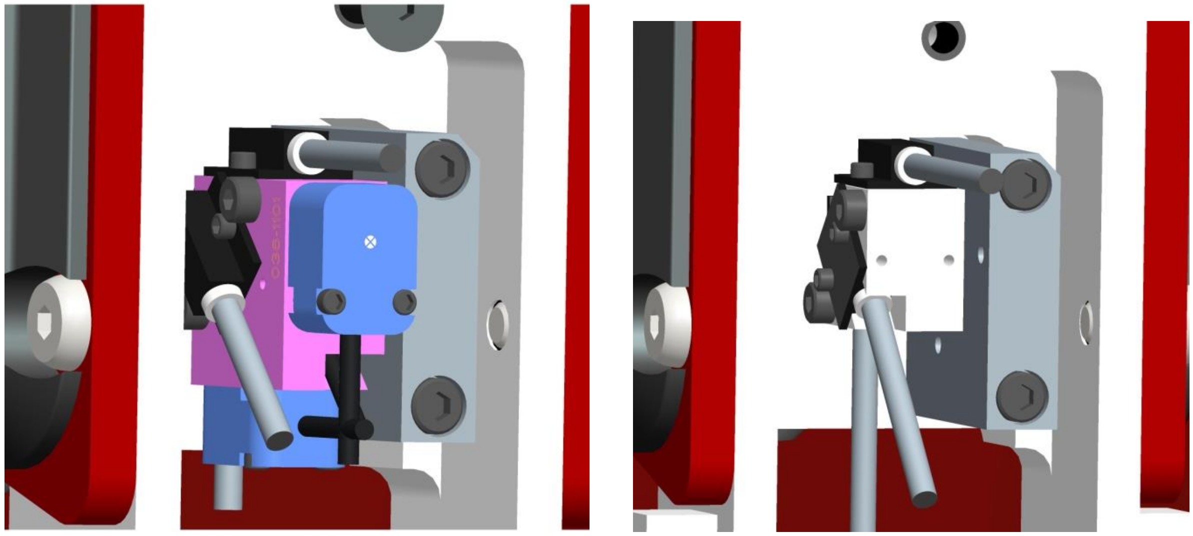


Figure 5. Thorax accel mounts at T4 location for type 7264B (036-1101 with ARS and I.AD without)

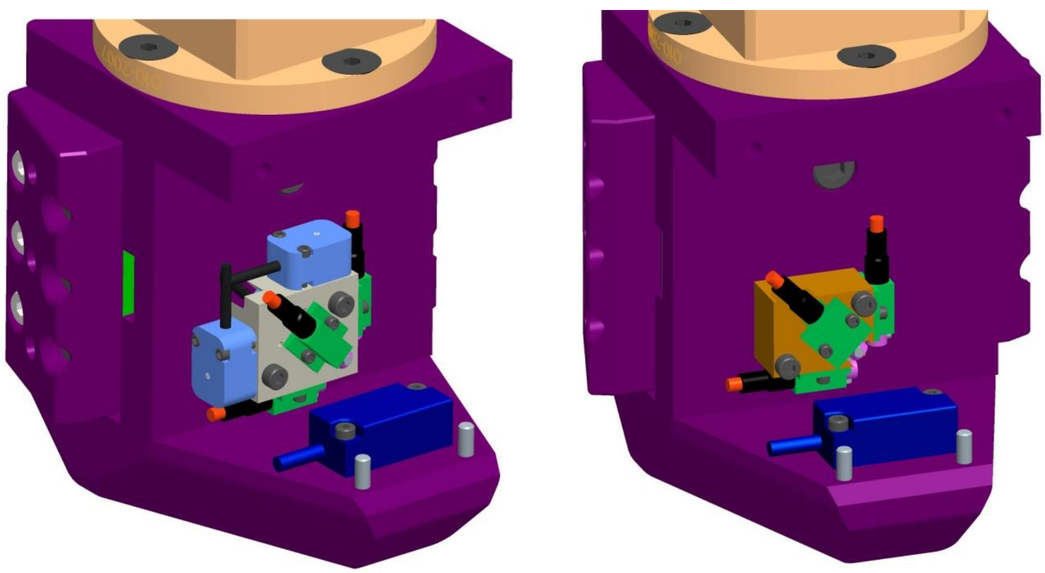


Figure 6. Pelvis accel mounts for type 7264C (034-1201 with ARS and 020-1017 without)

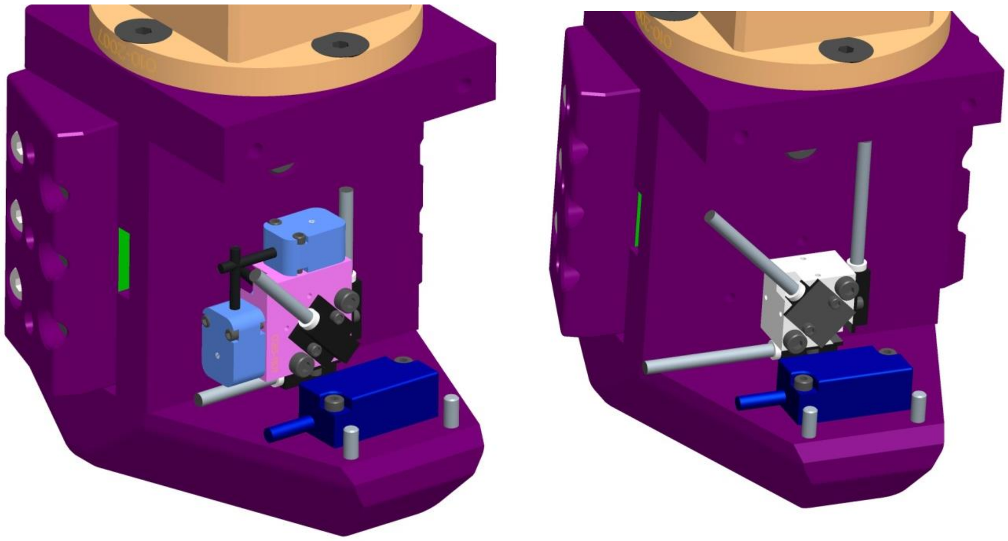


Figure 7. Pelvis accel mounts for type 7264B (036-1101 with ARS and I.AD without)

1.3.4 Cable Routing

The general guideline is that all cables should be routed towards the thoracic spine of the dummy. Cables should run from the top, to the base of the thoracic spine. At the lumbar spine/thorax interface, the cables go either towards the left or the right side. The abdomen has been formed to allow the routing of the cables in such a way that they lie recessed between the rib cage and the pelvis skin. A cable cover is mounted on the back of the thoracic spine. This cover will protect the cables and provides a fixed contour on the back of the dummy.

Consideration must be given to the cables inside the pelvis. The cables of the accelerometers and the angular rate sensors should not protrude to the front or bottom of the sacrum as in lateral impacts the wires could be damaged due to bottoming out of the iliac wing. If fitted the cable of the pubic symphysis load cell should be routed to the non-impact side of the sacrum top plate, to the back of the dummy. The picture below shows recommended wire routing for LH and RH impacts.

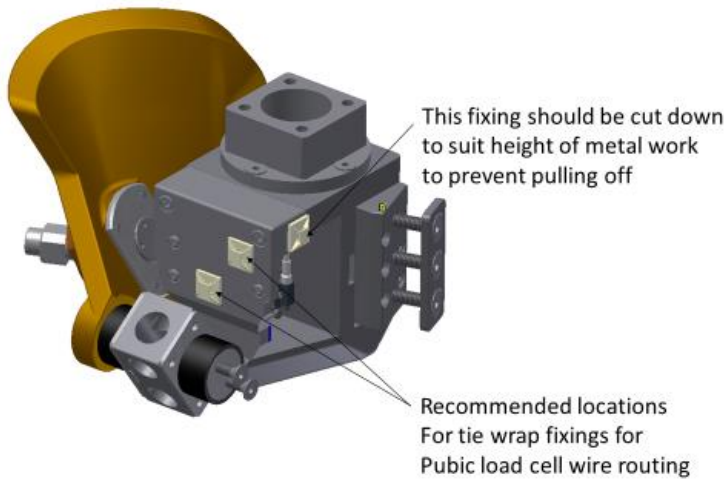


Figure 8. Picture showing recommended wire routing to Pubic Load Cell

1.3.5 Abdomen Pressure Twin Sensor (ATPS)

Purpose

To measure belt pressure on abdomen, particularly for submarining. Injury criteria has been established under regulation R129.

Description

The sensors are polyurethane bladders closed with an aluminum cap and filled with fluid. The pressure generated in the bladder is measured via a sensor in the cap. The ATPS system is expected to be a requirement in regulation R129. The sensor design was developed by IFSTARR and is sold by Transpolis SAS. The bladders come in three sizes 30, 40 and 50 mm diameter. The larger 50 mm diameter is used on Q10.

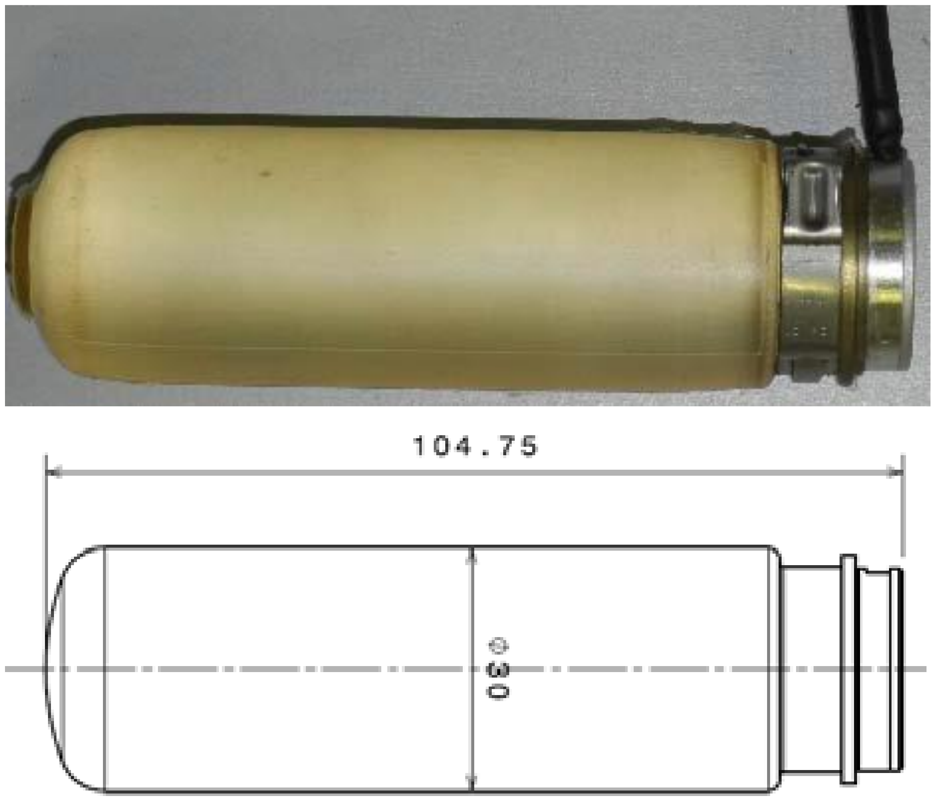


Figure 9. 50 mm Bladder details

The ATPS are mounted inside a special abdomen assembly part number 010-4309. This part has two blind holes for the sensors parallel to the lumbar spine. The ATPS are inserted aluminium cap down and the sensor cables come out through small holes at the base on the blind holes. The bladders are put into Lycra sleeves to reduce friction with the abdomen and held in place with Velcro at the bottom of the hole. The abdomen assembly is delivered with foam plugs to facilitate standard certification of the abdomen as in section 14.16 The Lycra sleeves are not used with the foam plugs.

The ATPS have a higher density than the removed standard foam so there is an increase to the abdomen of around 184 grams.

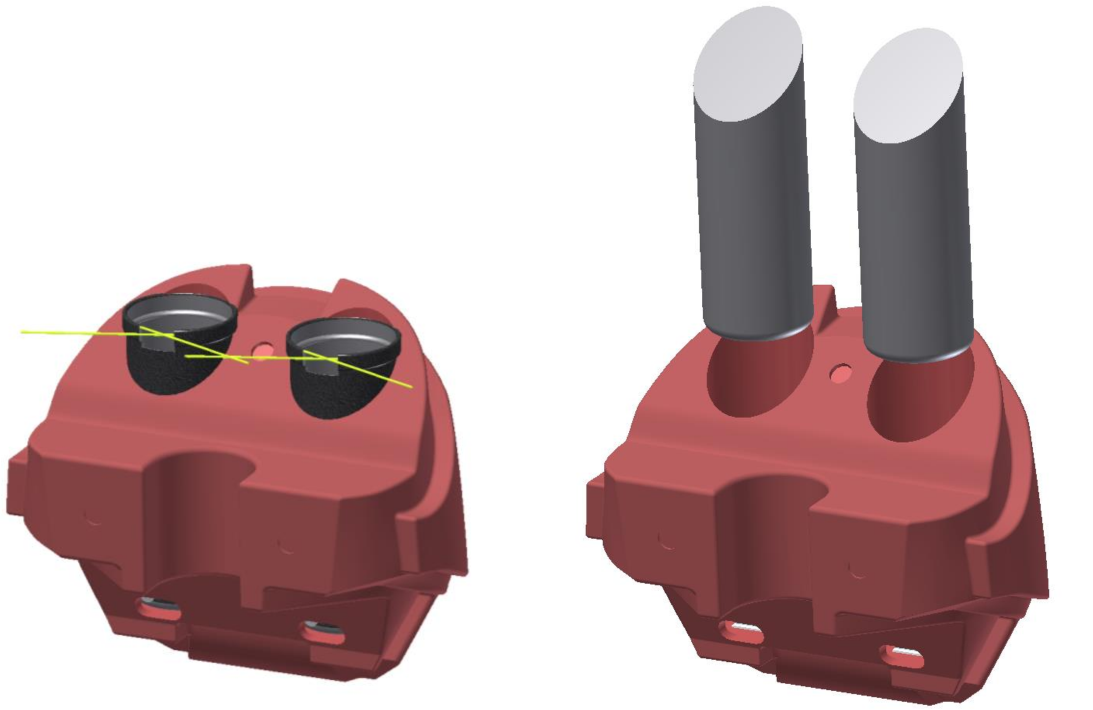


Figure 10. CAD Picture showing Q10 Abdomen APTS sleeves assembled without sensors and with foam plugs for certification

For information on biofidelity, sensitivity, performance, repeatability, reproducibility and injury criteria development refer to EEVC document number 661 (to be submitted summer 2016).

The assembly and component part numbers are listed below

Description	Part Number	Qty in Assembly
Abdomen Assembly, ATPS, Tested & Certified	010-4309	
Abdomen ATPS, Q1	010-4311	1
Sensor Sleeve, Fabric w/string tie	010-4306	2
Sensor Replacement, Foam	010-4307	2

Section 2 Head Assembly

Figure 11 is an exploded view of the Head Assembly. Table 2 gives a general description of each item.

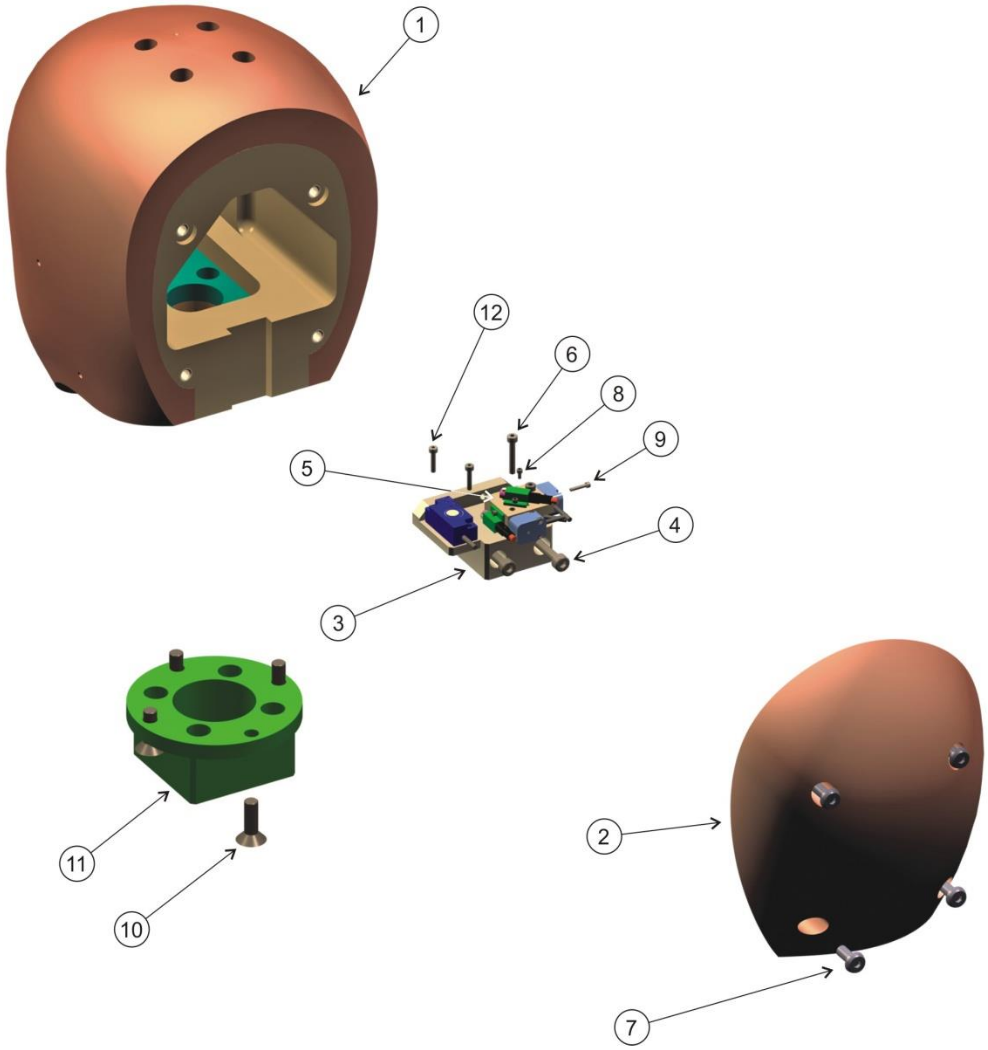


Figure 11. Head Assembly

ITEM	QTY	PART NO.	DESCRIPTION
1	1	010-1002	SKULL MOLDED ASSEMBLY
2	1	010-1005	SKULL CAP MOLDED ASSEMBLY
3	1	010-1004	ACCELEROMETER MOUNTING BRACKET
4	2	5001189	SCREW, SHCS M4 X 0.7 X 20
5	1	034-1201	6 AXIS ACCEL/ARS MOUNT, (7264-2000)
6	2	5001185	SCREW, SHCS M2.5 X .45 X 16
7	4	5000565	SCREW, BHCS M5 X 0.8 X 12
8	6	5000068	SCREW, BHCS M5 X 0.8 X 12, SS
9	6	5000727	SCREW, SHCS M1.4 X 0.3 X 8
10	4	5001177	SCREW, FHCS M5 X 0.8 X 14
11	4	010-2007	LOAD CELL STRUCTURAL REPLACEMENT
12	1	5001184	SCREW, SHCS M2. X .4 X 10

Table 2. Head Assembly (010-1000) Part List

2.1 Disassembly

Remove four M5 x 12 BHCS and the skull cap (010-1005). Next, remove the two M4 x 20 SHCS from the mounting bracket (010-1004). Pull the mounting bracket off its location of a single 3mm dowel and remove from the head. The four M5 x 10 SHCS which attach the upper neck load cell or its replacement to the neck can be accessed through the four holes in the top of the skull. The mounting bracket (010-1004) must be removed first to access these screws. Remove the four M5 screws and detach the head with upper neck load cell from the neck.

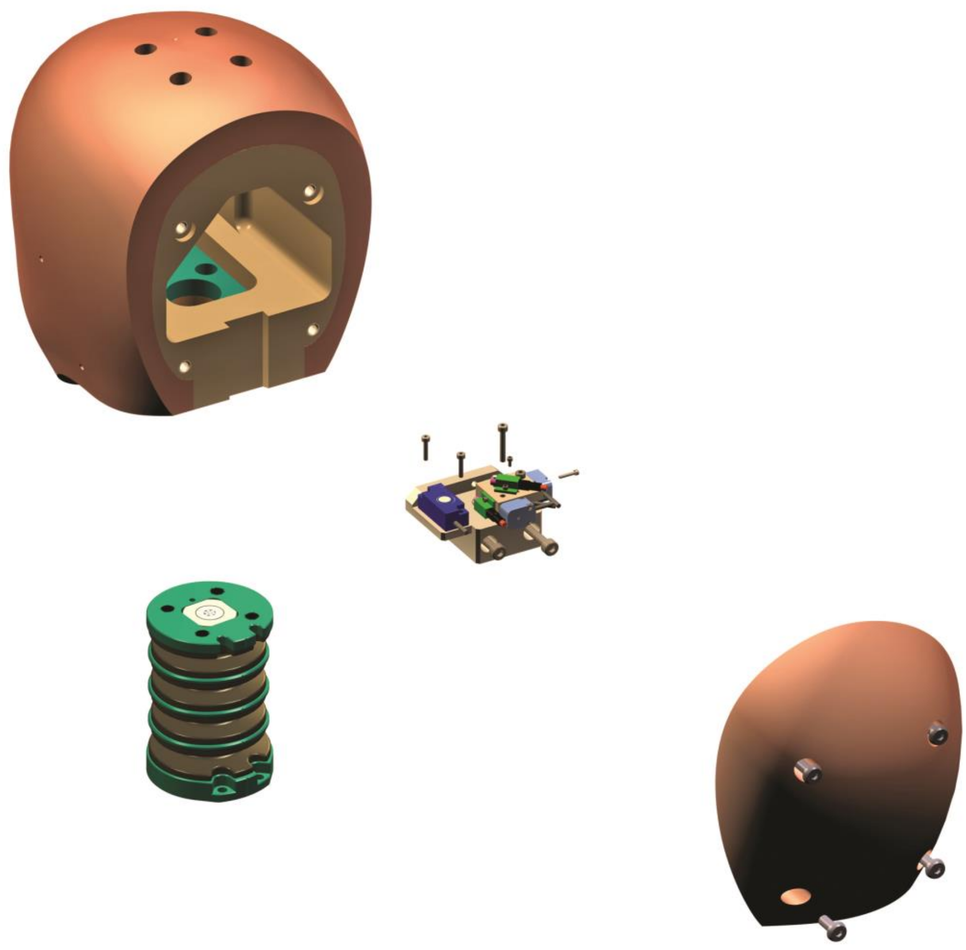


Figure 12. Disassembling the head

Remove the four M5 x 14 FHCS from the load cell or its structural replacement (010-2007) to the head assembly. (Figure 13).

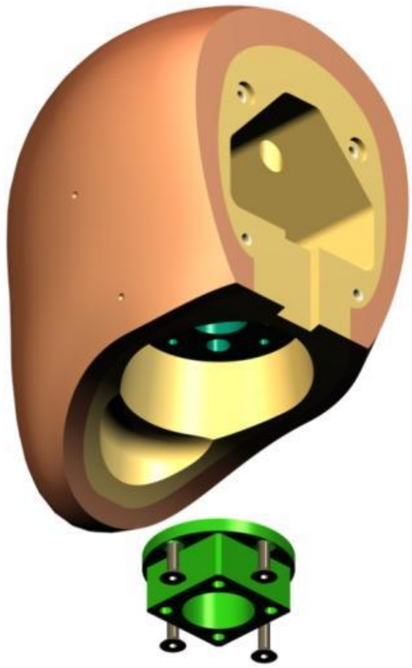


Figure 13. Removing the upper neck load cell or structural replacement

2.2 Reassembly

Reassemble the head in the following order.

1. Attach load cell or structural replacement with four M5 x 14 SHCS.
2. Attach the head to neck with four M5 x 10 SHCS.
3. Attach mounting bracket (010-1004) with two M4 x 20 SHCS.
4. Attach skull cap with four M5 x 12 BHCS.

Section 3 Neck Assembly

Figure 14 is an exploded view of the Neck Assembly. Table 3 gives a general description of each item.

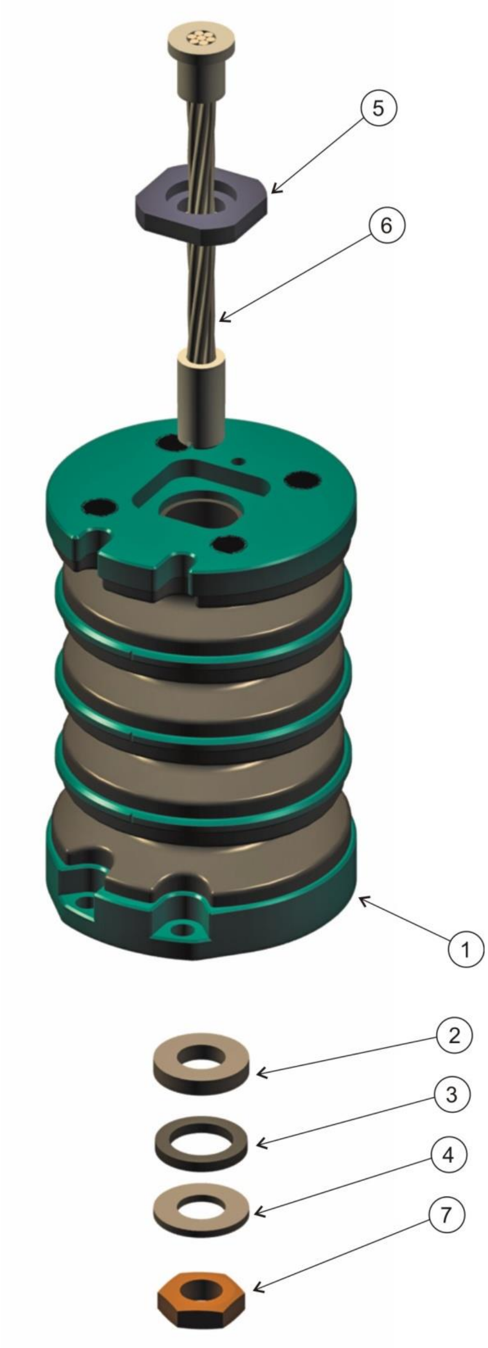


Figure 14. Neck Assembly

ITEM	QTY	PART NO.	DESCRIPTION
1	1	010-2005	Q10 NECK, MOLDED
2	1	010-2008	CABLE SPACER
3	1	9003247	WAVE SPRING WASHER
4	1	010-2009	NYLON WASHER
5	1	010-2004	NECK CABLE BUSHING
6	1	010-2200	NECK CABLE ASSEMBLY
7	1	010-2006	RETAINING NUT

Table 3. Neck Assembly (010-2000) Part List

3.1 Disassembly

Remove the four M5 x 10 SHCS that attach the neck assembly to the neck torso interface plate assembly 010-2010 with plate 010-2015 and dummy lifting strap. To inspect the neck cable assembly, remove the retaining nut and neck cable from the neck.

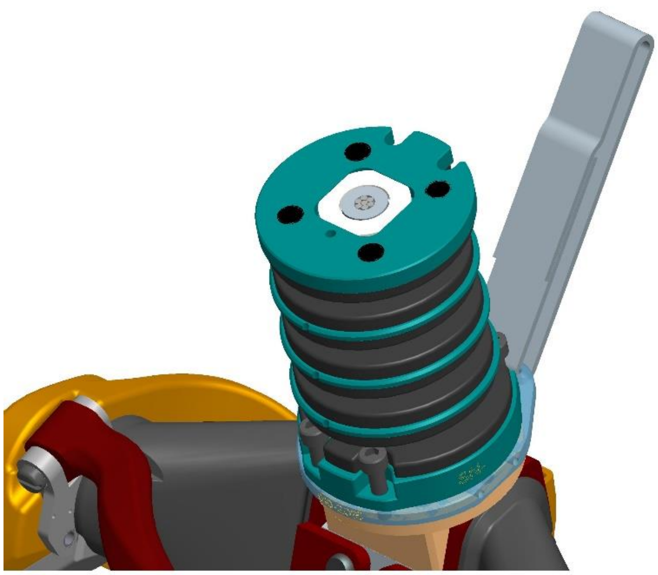


Figure 15. Detaching the neck from the thorax

Remove the four M5 x 10 SHCS that attach the load cell or structural replacement (010-2007) to the spine box (010-4001). When off the dummy remove the four M5 x 12 FHCS that attach the loadcell or its structural replacement to the neck torso interface plate (010-2015) if desired. Picture below shows T1 accelerometer mount 010-4505 attached to torso interface plate with 2x M3 x 8 FHCS.

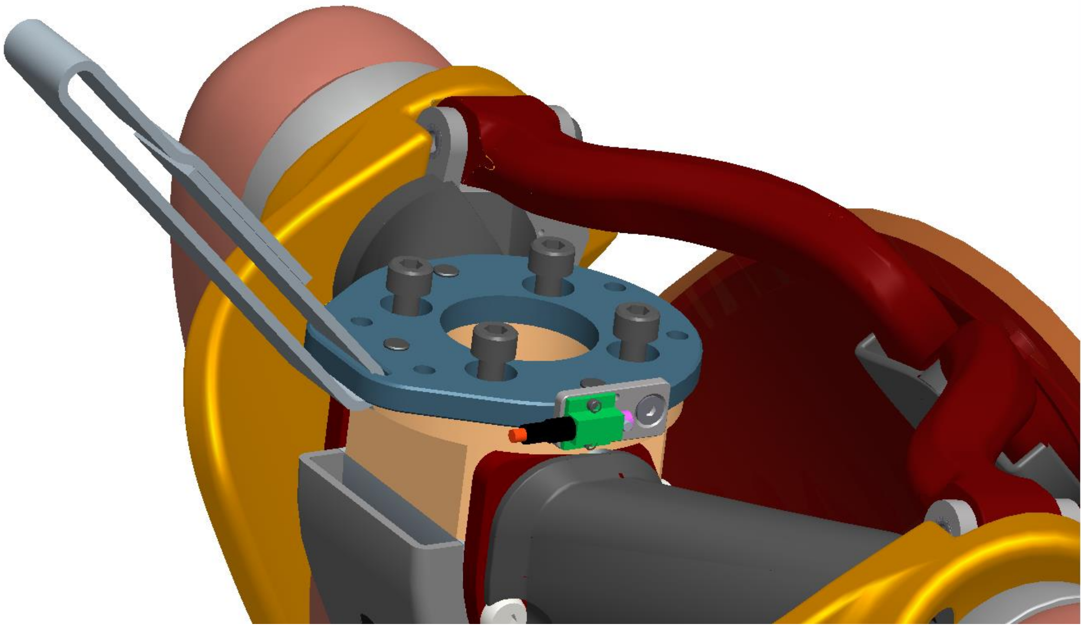


Figure 16. Removing screws from the lower neck load cell

3.2 Assembly

Slide the bushing (010-2004) and the neck cable (010-2200) through the top of the neck and face the grooves on the top plate towards the back. Add the spacer (010-2008), spring washer (9003247) and nylon washer (010-2009) to the bottom of the neck, and then hand tighten the retaining nut (010-2006) to the cable assembly plus half a turn with the wrench.

Section 4 Torso Assembly

Figure 17 is an exploded view of the Torso Assembly. Table 4 gives a general description of each item.

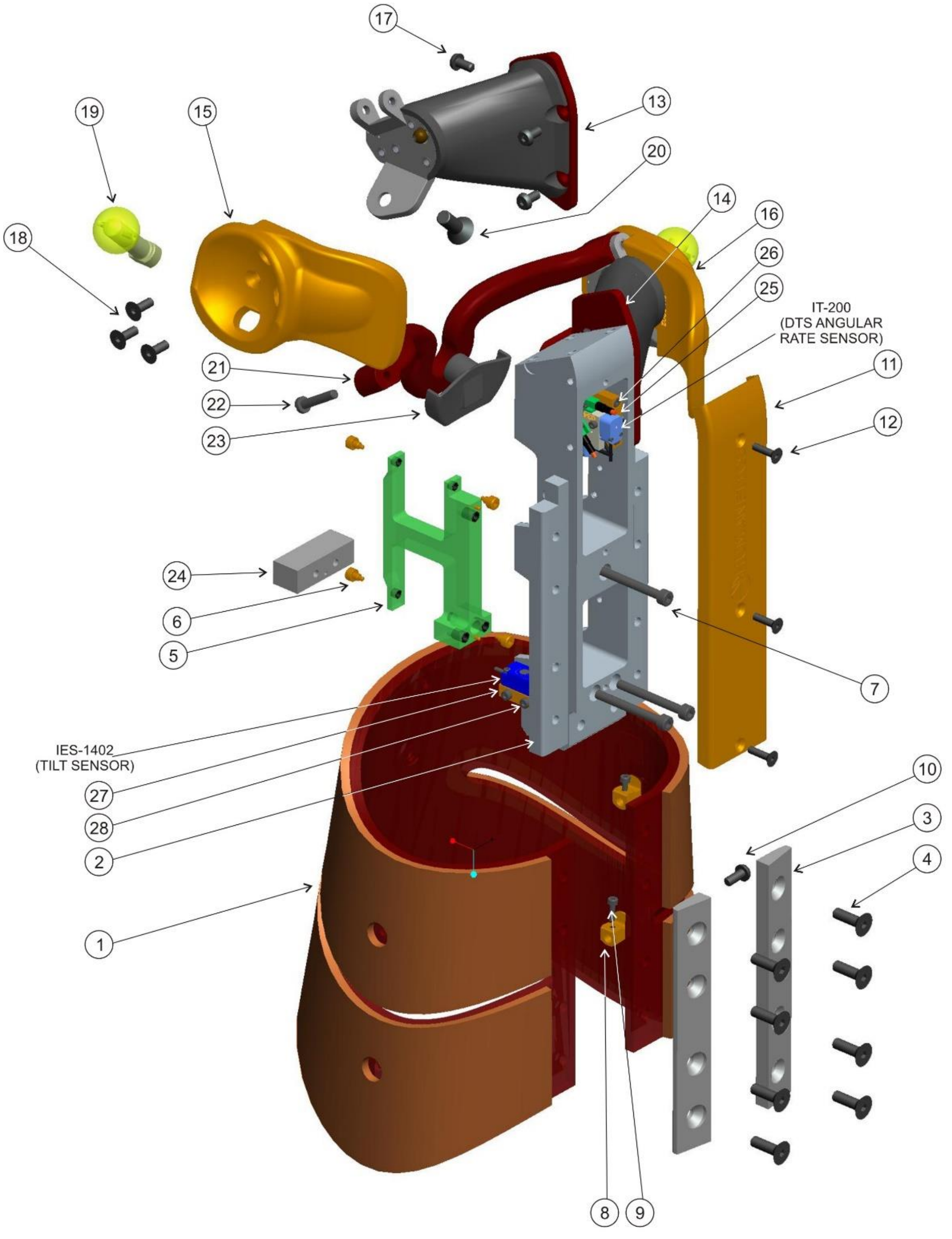


Figure 17. Torso Exploded View

ITEM	QTY	PART NO.	DESCRIPTION
1	1	010-4100	RIBCAGE, Q10
2	1	010-4001	SPINEBOX, Q10
3	2	010-4104	SPINE RAIL
4	8	5001179	SCREW, FHCS M6 X 1 X 20, BZP
5	1	010-4106	SIDE IMPACT IRTRACC MOUNT
6	4	010-4108	PIVOT SCREW
7	3	5001202	SCREW, SHCS M5 X 0.8 X 45, BZP 12.9
8	2	010-4105	IRTRACC ADAPTOR
9	2	5001188	SCREW, SHCS M3 X 0.5 X 10, BZP 12.9
10	3	5000846	SCREW, BHCS M5 X 0.8 X 12, ZINC PLATED
11	1	010-4107	BACK PLATE, MOLDED, Q10
12	3	5001175	SCREW, FHCS M4 X 0.7 X 16, BZP
13	1	010-3501	MOLDED SPINE INTERFACE ASSY, LEFT
14	1	010-3502	MOLDED SPINE INTERFACE ASSY, RIGHT
15	1	010-3301	SCAPULA, Q10 LEFT
16	1	010-3302	SCAPULA, Q10 RIGHT
17	8	5001181	SCREW, BHCS M5 X 0.8 X 10, BZP 8.8
18	6	5001177	SCREW, FHCS M5 X 0.8 X 14, BZP
19	2	010-3004	SHOULDER BALL ASSEMBLY
20	2	010-4006	SCREW, FHCS M8X1.25X20 BZP 10.9, THREAD LOCK
21	1	010-3300	CLAVICAL, Q10
22	2	010-3420	CLAVICLE PIN
23	1	010-4200	CLAVICLE RETAINER
24	1	010-4005	BALLAST, Q10 FRONTAL
25	1	010-4109	MOUNT, UPPER THORAX, Q10
26	2	5001208	SCREW, SHCS M3 X 0.5 X 35, BZP 12.9
27	1	010-4110	THORAX TILT SENSOR BRACKET
28	2	5001186	SCREW, SHCS M3 X 0.5 X 20, BZP 12.9

Table 4. Torso Assembly (010-4000) Part List

4.1 Disassembly

4.1.1. Thorax

To remove the upper and lower torso, you must first separate the abdomen (010-4300) at the lumbar spine. Remove the two M6 x 55 screws from the rear of the spine and lumbar. This method of disassembly is preferred so that it does not stress the abdomen by pulling it out of an assembled torso.

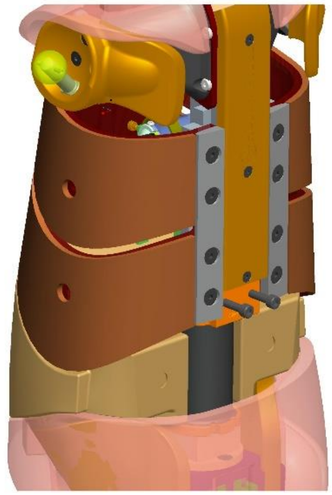


Figure 18. Separating the Upper and Lower Torso

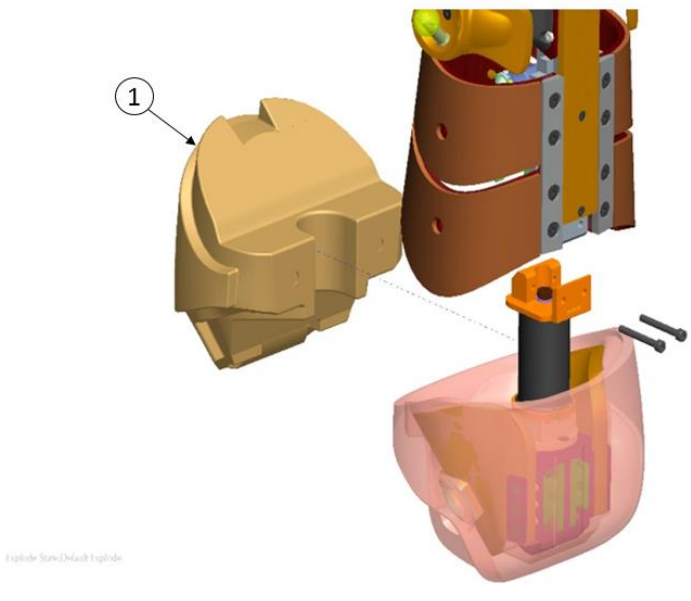


Figure 19. Removing the Abdomen

ITEM	QTY	PART NO.	DESCRIPTION
1	1	010-4300	ABDOMEN

4.1.2. Change of IR-TRACC direction from Lateral to Frontal Position

Remove the two M5 x 12 BHCS from the side of the ribcage assembly (010-4100) that retain the small end of the IR-TRACC's. Remove eight M6 x 18 FHCS that attach the ribcage and spine rails (010-4104) to the spine box (010-4001). Remove the central front M5 x 12 BHCS that attaches the clavicle to the rib cage, this will allow the ribcage to be free. The clavicle retainer (010-4200) will also become detached.

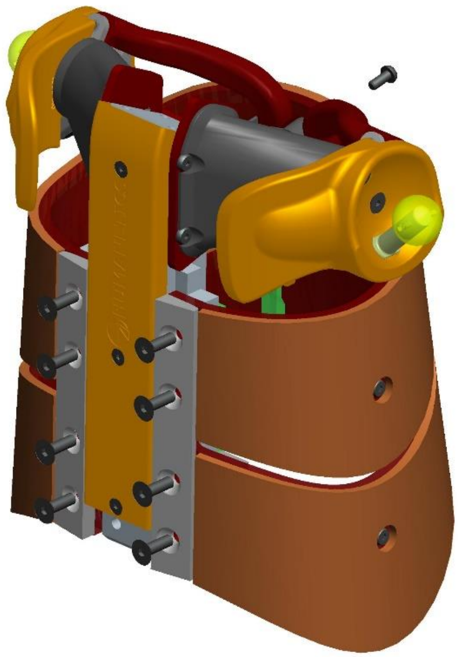


Figure 20. Removing the ribcage

Remove the IR-TRACC's by detaching the back plate (010-4107) by unscrewing three M4 x 16 FHCS. Next, remove three M5 x 45 SHCS, this will allow the side impact IRTRACC mount (010-4106) and IR-TRACC's to be free. To disconnect the IRTRACC's remove the four pivot screws (010-4108) from the IR-TRACC mount. See Figures 21 -22.

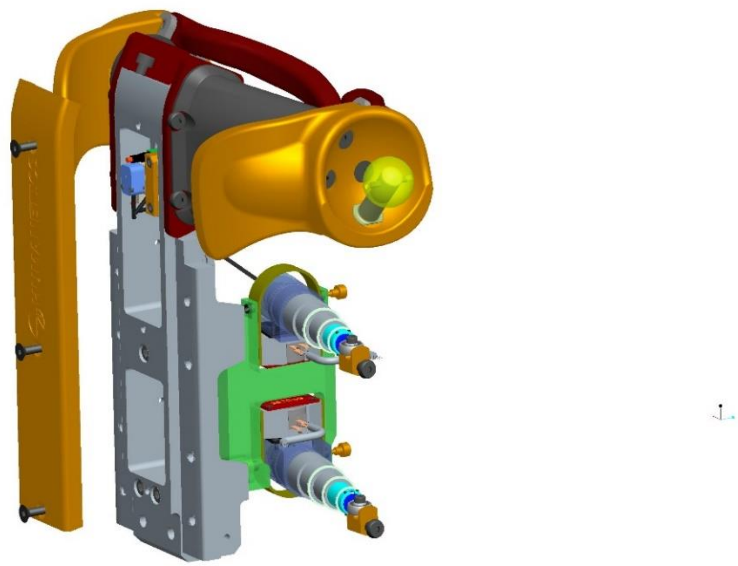


Figure 21. Removing the back plate and IR-TRACC

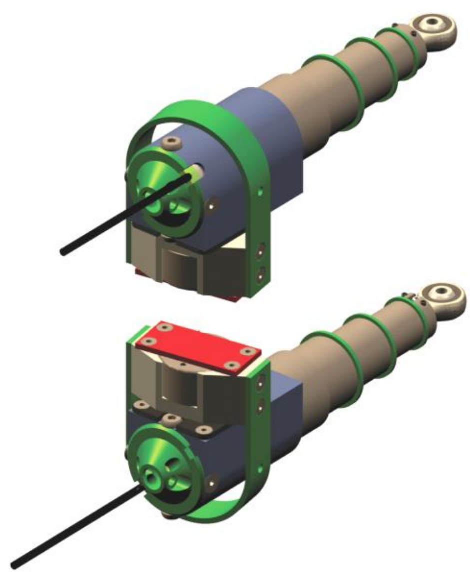


Figure 22. IRTRACC's (side impact configuration) shown free.

4.1.3. IR-TRACC position for frontal impact

For frontal impact remove the side impact IR-TRACC mount (010-4106) and attach the ballast (010-4005) using 2x the same M5 x 45 SHCS. The upper screw shown is not required for frontal IR-TRACC's. Insert the IR-TRACCs in the appropriate cavities of the thoracic spine box with the potentiometers downwards as shown in Figure 23.

For general maintenance it is not necessary to disassemble the parts in the shoulder area.
Make sure that the shoulder joint retainer rings are behind the shoulder ball assemblies before mounting.
It is recommended to inspect the M8 FHCS screws that attach the shoulder ball assemblies (010-3004) to the shoulder interface parts. These screws have a paint dot on their thread to make them self-locking.
Make sure that these M8 FHCS screws are tightened.

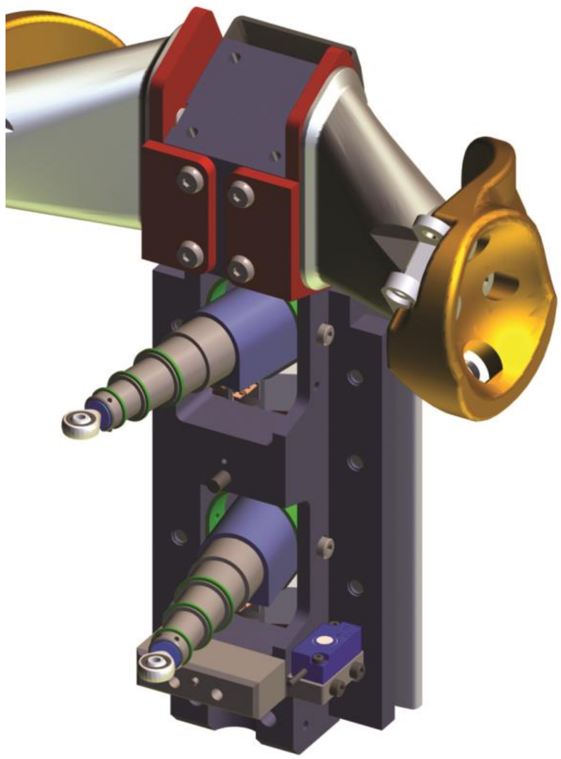


Figure 23. Frontal IR-TRACC's configuration

4.2 Assembly

Before assembly of the thorax, make sure that the IR-TRACC's are in their desired position for frontal or lateral (left or right) impact. The assembly of the Torso, IR-TRACC's and Abdomen is the reversal of the disassembly process.

Section 5 Arm Assembly

Figure 24 is an exploded view of the Arm Assembly. Table 5 and 6 gives a general description of each item.

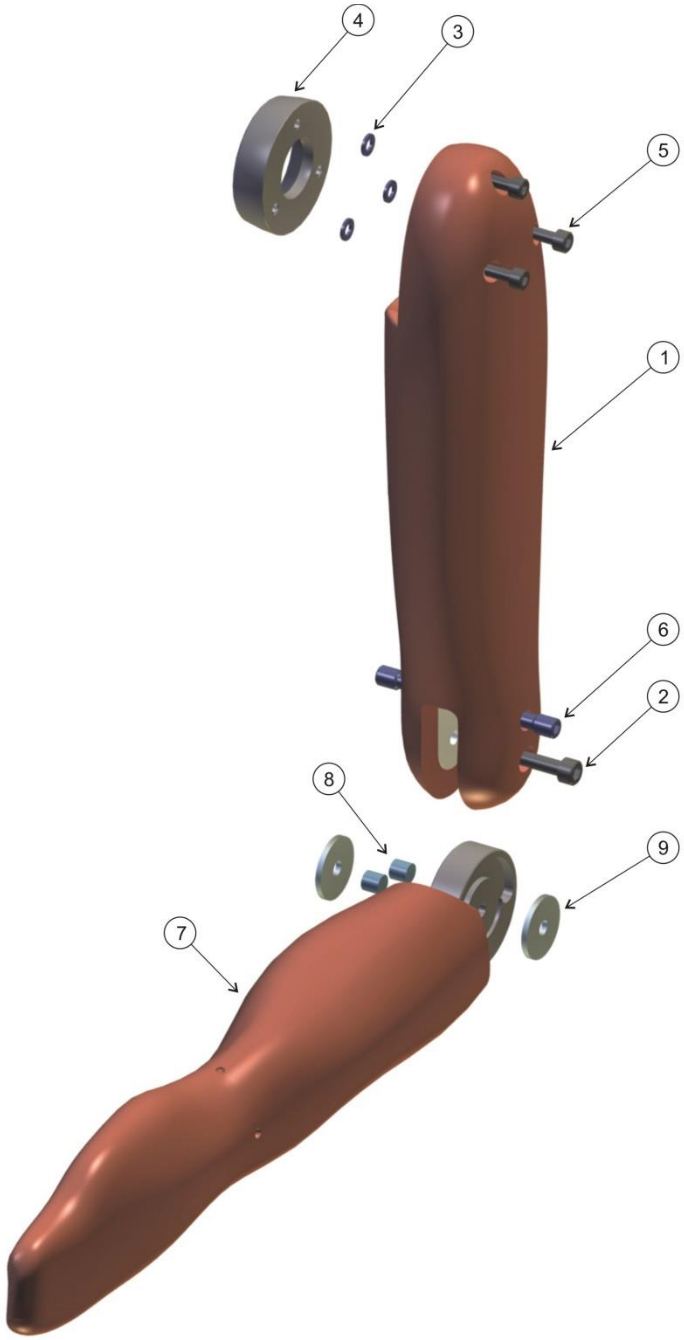


Figure 24. Left Arm Assembly (Right Arm similar but opposite)

ITEM	QTY	PART NO.	DESCRIPTION
1	1	010-9307	UPPER ARM MOLDED, LEFT
2	1	010-9313	ELBOW PIVOT SCREW, SHSS M6 X 26
3	3	010-9312	WASHER, UPPER ARM
4	1	010-9308	SHOULDER BALL RETAINER RING
5	3	5001174	SCREW, SHCS M5 X .8 X 12
6	2	010-9316	SCREW, SSNT M8 X 16
7	1	010-9305	LOWER ARM MOLDED, LEFT
8	2	010-9315	END STOP
9	2	010-9310	WASHER, LOWER ARM

Table 5. Arm Assembly (010-9300 LH) Part List

ITEM	QTY	PART NO.	DESCRIPTION
1	1	010-9407	UPPER ARM MOLDED, RIGHT
2	1	010-9313	ELBOW PIVOT SCREW, SHSS M6 X 26
3	3	010-9312	WASHER, UPPER ARM
4	1	010-9308	SHOULDER BALL RETAINER RING
5	3	5001174	SCREW, SHCS M5 X .8 X 12
6	2	010-9316	SCREW, SSNT M8 X 16
7	1	010-9405	LOWER ARM MOLDED, RIGHT
8	2	010-9315	END STOP
9	2	010-9310	WASHER, LOWER ARM

Table 6. Arm Assembly (010-9400 RH) Part List

5.1 Arm Disassembly

The arms are detached from the shoulder by removing three M5 x 12 SHCS and washers that attach the arms 010-9300 LH, 010-9400 RH to the shoulder ball retainer ring 010-9308. (Figure 25).

The shoulder bearing cup (020-9705) is permanently assembled to the upper arm bone and does not need to be disassembled in normal use and maintenance of the dummy.

To remove the lower arm, remove the outer friction screw (010-9316) and inner friction stop screw (010-9316) then remove the elbow pivot screw (010-9313).

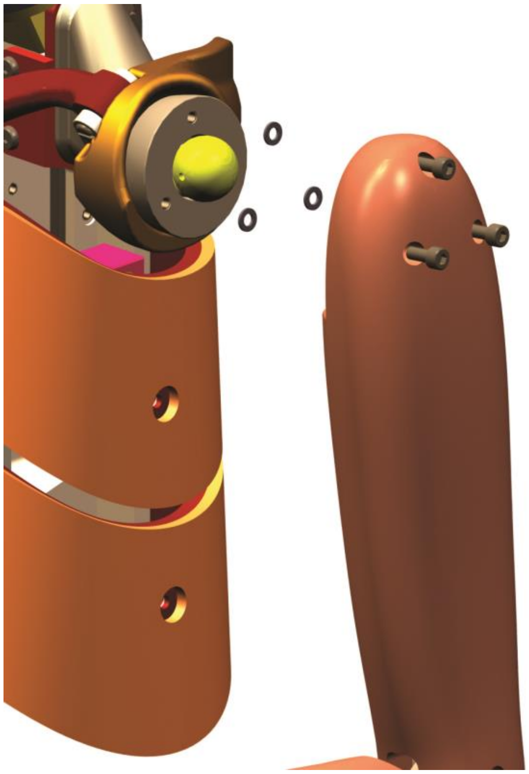


Figure 25. Removing the arm

5.2 Reassembly

The upper arm is attached to the shoulder using three M5 x 12 SHCS. A rubber washer fits on each screw between the upper arm and the shoulder retainer ring. The user can set the friction in the shoulder by adjusting these three screws evenly. The maximum intended friction is 1 g.

Before fitting the lower arm ensure the rubber end stops are in place. Fit the two plastic washers into their recesses in the elbow and slide the lower arm into the yoke of the upper arm, align and fit the elbow pivot screw. The Nylon tipped friction-stop screw fits into the M8 threaded hole on the inside of the upper arm, this is screwed in as far as it will go, but do not over tighten. Screw in the Nylon tipped friction set screw into the M8 threaded hole on the outside of the upper arm just above the elbow pin. Set the elbow friction by tightening or loosening the friction set screws at both sides of the elbow simultaneously. The maximum intended friction is 1 g.

Section 6 Lumbar Spine Assembly

6.1 Lumbar Disassembly

To remove the lumbar (010-6000) from the pelvis (010-7000), unscrew four M5 x 18 FHCS from the load cell or its structural replacement (010-2007).

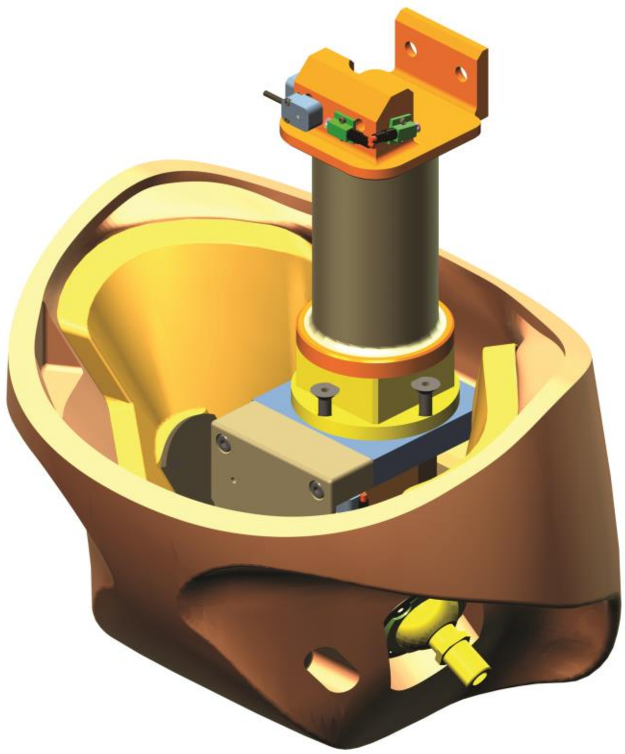


Figure 26. Removing the lumbar

6.2 Reassembly

Insert the four M5 x 18 FHCS in the loadcell structural replacement then into the top ballast (010-7201) on the pelvis assembly.

6.3 Lumbar Cable Disassembly

Remove the cable nut and washer and push down on the cable. The cable can then be pulled out.

6.4 Lumbar Cable Assembly

Push the cable back into the lumbar. Fit the washer and nut, tighten until there is no clearance on the washer. Then tighten half a turn. There is a slot in the end of the cable for a screw driver to prevent the cable rotating on tightening.

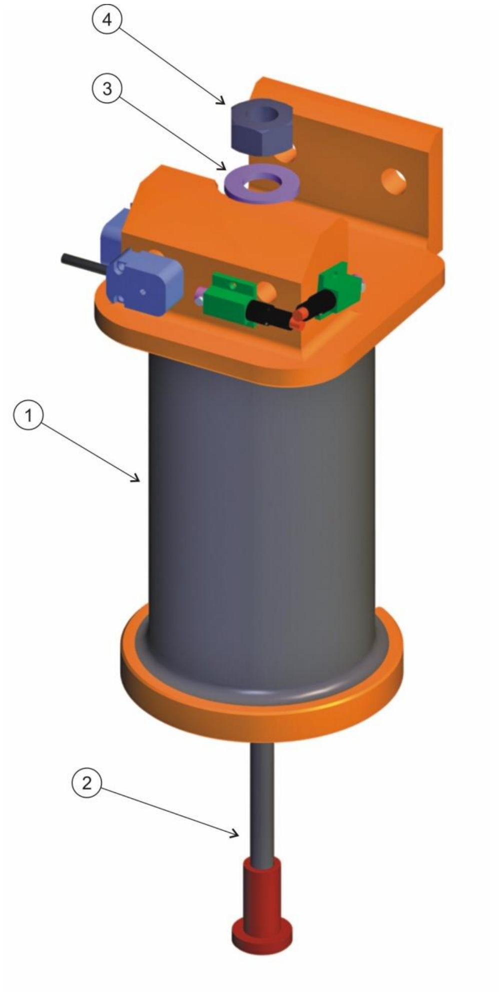


Figure 27. Lumbar Spine Assembly

ITEM	QTY	PART NO.	DESCRIPTION
1	1	010-6001	LUMBAR SPINE, MOLDED
2	1	010-6100	LUMBAR SPINE CABLE ASSEMBLY
3	1	5000552	WASHER, FLAT M8
4	1	5000486	HEX NUT, M8 NYLOK

Table 7. Lumbar Spine (010-6000), Part List

Section 7 Pelvis Assembly

Figures 28 and 29 are exploded views of the Pelvis Assembly. Table 8 gives a general description of each item.

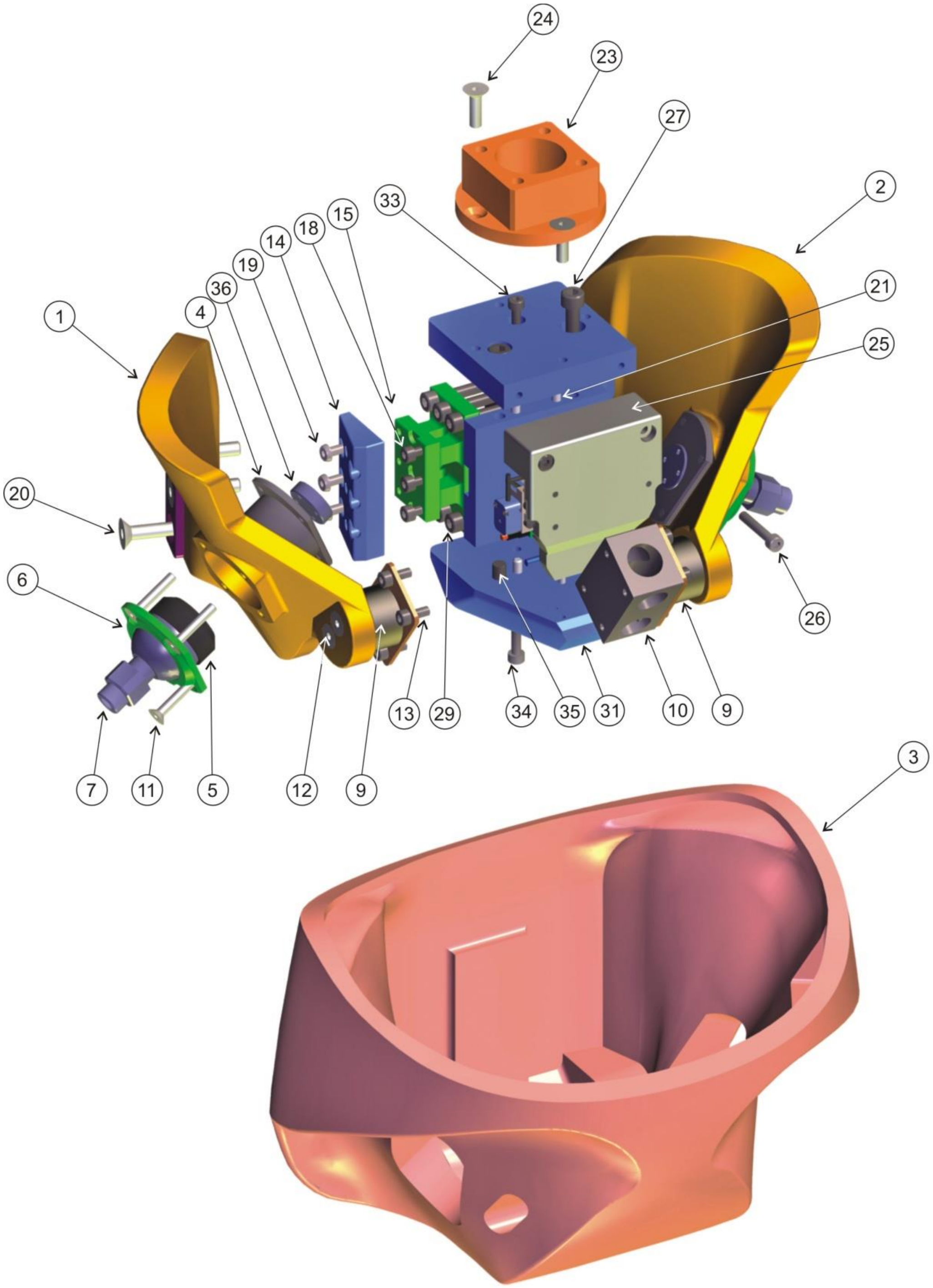


Figure 28. Pelvis Assembly, Exploded View

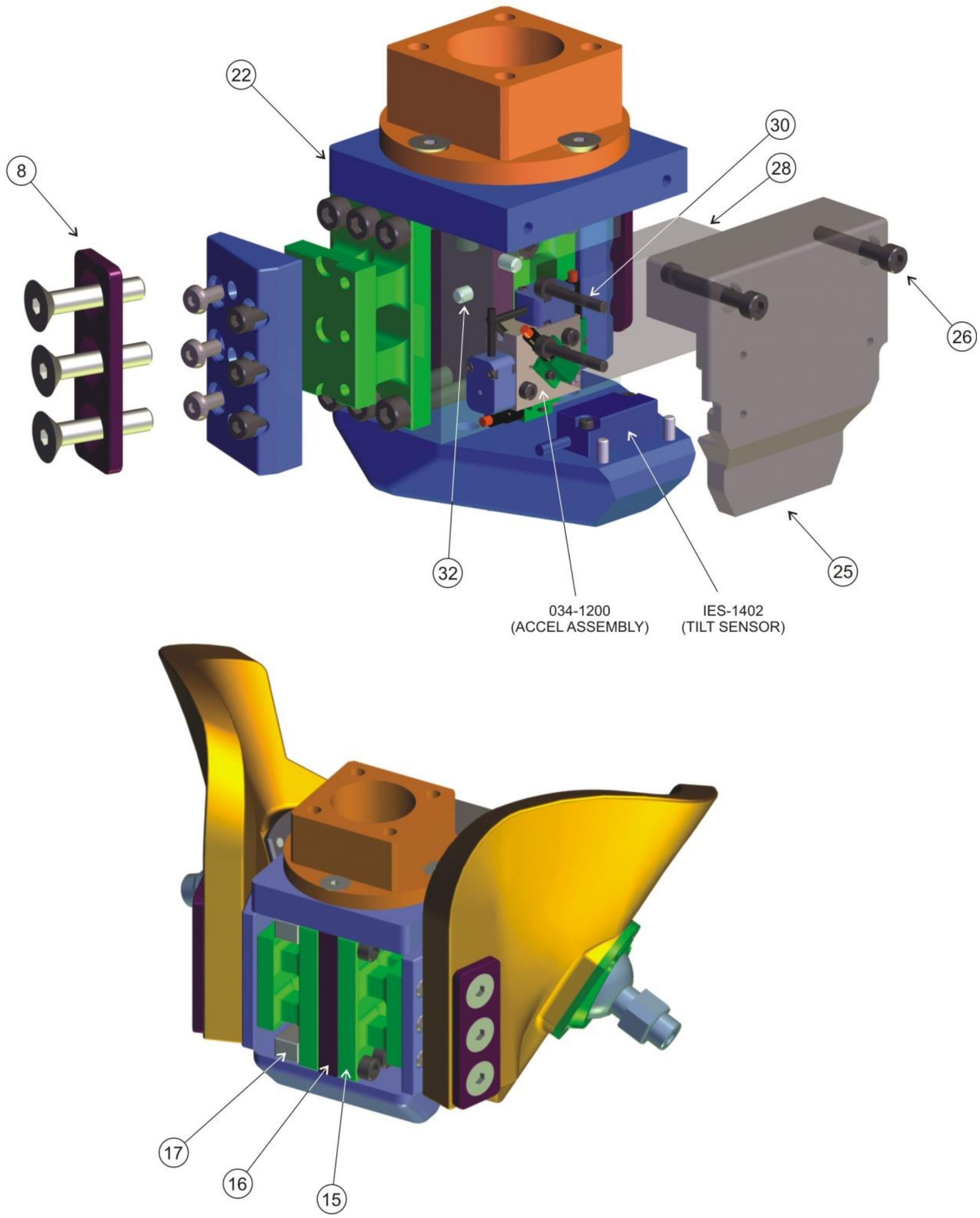


Figure 29. Pelvis Assembly, Exploded View

ITEM	QTY	PART NO.	DESCRIPTION
1	1	010-7302	ILIAC WING, RIGHT
2	1	010-7301	ILIAC WING, LEFT
3	1	010-7002	PELVIC FLESH
4	2	010-7003	HIP CUP
5	2	010-7005	HIP BEARING
6	2	010-7004	HIP BALL RETAINING PLATE
7	2	010-7006	FEMUR BALL ASSEMBLY
8	2	010-7009	RETAINING PLATE, PELVIS BONE
9	2	010-7012	PUBIC BUFFER, MOLDED
10	1	W50-71059	STRUCTURAL REPLACEMENT, PUBIC LOADCELL
11	8	5001197	SCREW, FHCS M4 X 0.7 X 25
12	4	5001198	SCREW, FHCS M5 X 0.8 X 16
13	8	5001187	SCREW, SHCS M4 X 0.7 X 10
14	2	010-7022	INTERFACE SACRO ILIAC LC
15	2	010-7023	Q10 SACROILIAC LC STRUCTURAL REPLACEMENT
16	1	010-7250	SACRUM, CENTRAL SUPPORT ASSEMBLY
17	2	010-7024	NUT PLATE
18	6	5001191	SCREW, SHCS M4 X 0.7 X 8
19	6	5001201	SCREW, BHCS M4 X 0.7 X 8
20	6	5001200	SCREW, FHCS M6 X 1 X 30
21	4	5000414	PIN, DOWEL M4 X 10
22	1	010-7201	BALLAST, SACRUM TOP
23	1	010-2007	LOAD CELL STRUCTURAL REPLACEMENT
24	4	5001199	SCREW, FHCS M5 X 0.8 X 18
25	1	010-7203	SACRUM, FRONT PLATE
26	2	5001190	SCREW, SHCS M4 X 0.7 X 25
27	2	5001193	SCREW, SHCS M6 X 1 X 16
28	1	010-7021	DAS, BALLAST PELVIS
29	6	5001192	SCREW, SHCS M5 X 0.8 X 35
30	3	5001186	SCREW, SHCS M3 X 0.5 X 20
31	1	010-7202	SACRUM BOTTOM PLATE
32	1	5000477	PIN, DOWEL M4 X 16
33	1	5001182	SCREW, SHCS M4 X 0.7 X 12
34	1	5001189	SCREW, SHCS M4 X 0.7 X 20
35	2	5001183	SCREW, SHCS M6 X 1 X 20
36	2	010-7020	HIP ADJUSTER

Table 8. Pelvis Assembly (010-7000) Part List

7.1 Pelvis Disassembly

To remove the pelvis flesh (010-7002), point the hip shafts downwards or remove femur ball assemblies and hip ball retainer plates and lift the iliac wing-Sacrum structure away, out of the flesh part.

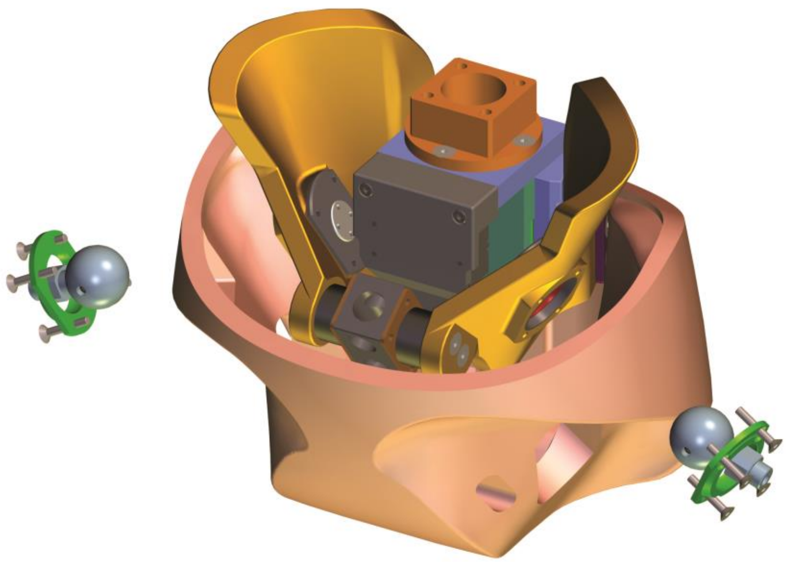


Figure 30. Removing the femur ball assemblies, hip ball retainer plates and flesh.

To disassemble the pelvis further, remove the iliac wings (010-7301 and 010-7302) by unscrewing three M6 x 30 FHCS from each side this will allow the two retaining plates (010-7009) to detach as well. Next, remove the two M5 x 16 FHCS that attach to the pubic buffer.

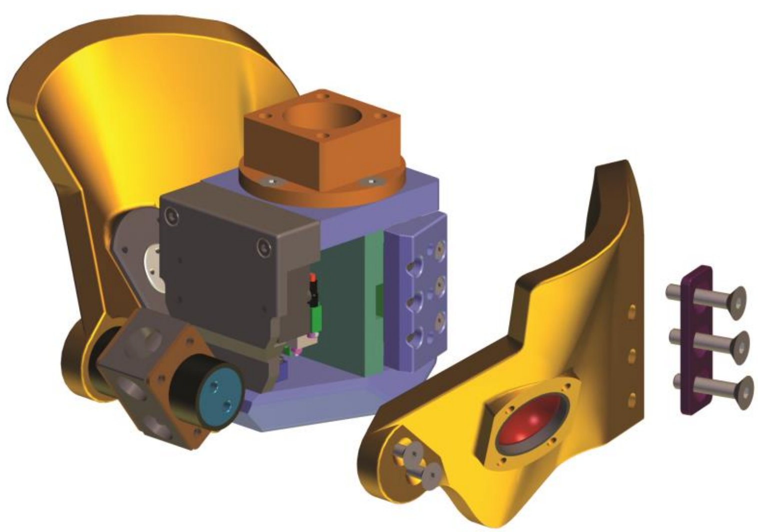


Figure 31. Disassembling the iliac wings

Remove the two M4 x 25 SHCS at the front of the sacrum, this will allow the sacrum front plate (010-7203) to be detached, lift the plate vertically to disengage the dowel pins from the bottom plate. This generally provides sufficient access to the instrumentation bay in the sacrum block.

Once the sacrum front plate and the iliac wings are removed there is improved access to the instrumentation (see Figure 32).

To remove the Sacro-Iliac load cell (replacement) detach the load cell interface plates by unscrewing the six M4 BHCS screws per side. Both Sacro-Iliac load cell structural replacements can be detached from one side by unscrewing the six M5x35 SHCS screws through the sacrum middle flange.

If desired the tungsten sacrum block top and bottom plate can be removed (see Figure 33).

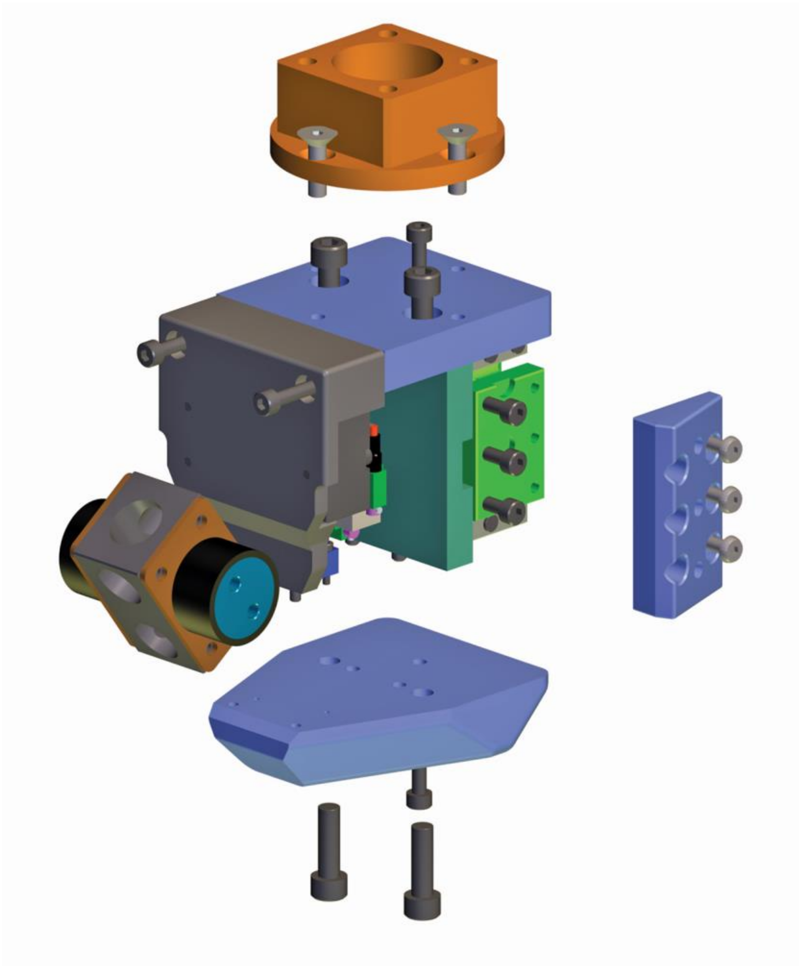


Figure 32. Disassembling the pelvis

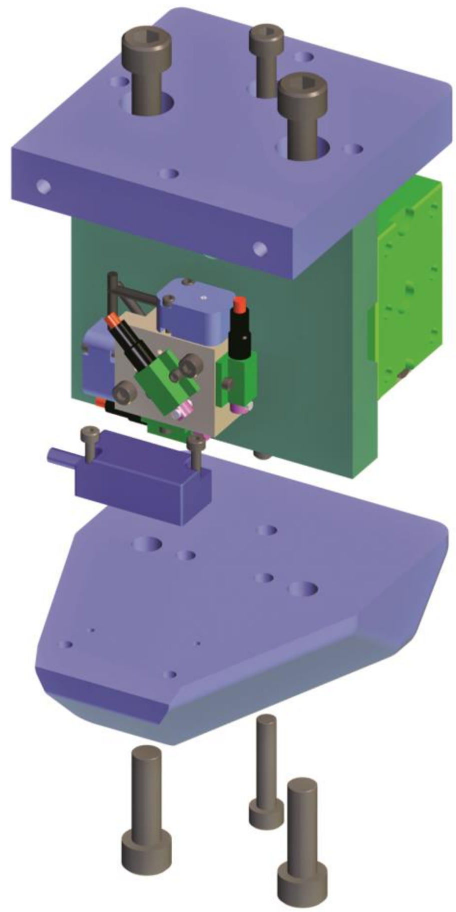


Figure 33. Disassembling the pelvis

7.2 Reassembly

The assembly of the pelvis is the reversal of the disassembly process. If the hip balls have play or feel lose, the hip joints will need re-adjusting. The hip adjusters 010-7020 are located at the back of the hip cups inside the pelvis cavity. These are locked with low strength thread lock on assembly to prevent them loosening, so should be stiff to remove. There is a special two prong tool in the tool kit which locates into holes in the adjuster. Remove the adjuster, clean the threads male and female and reassemble the adjuster. Turn clockwise to remove play: the joint should rotate and some friction should be felt in the hip ball when correctly adjusted. (The joint is not designed to apply a 1 g setting). Apply low strength thread lock before final adjustment approximately 2 turns before final position.

Section 8 Leg Assembly

Figure 34 is an exploded view of the Leg Assembly. Tables 9 & 10 give general descriptions of each item.

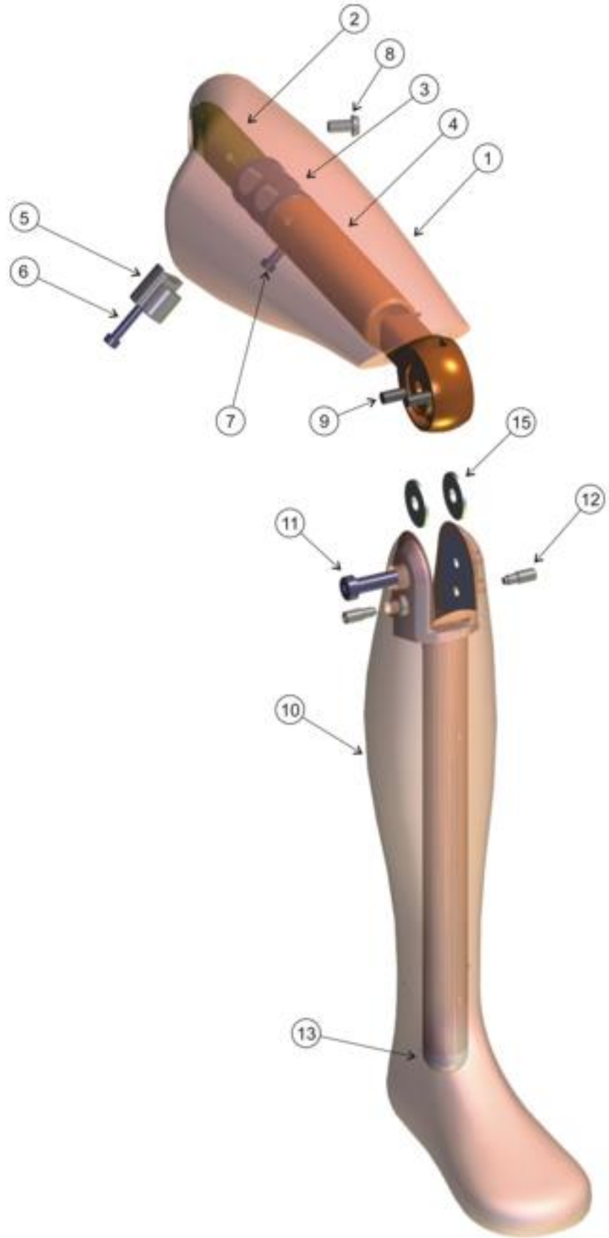


Figure 34. Left Leg Assembly, (Right Leg similar but opposite)

ITEM	QTY	PART NO.	DESCRIPTION
1	1	010-9107	UPPER LEG FLESH, LEFT
2	1	010-9106	FEMUR BONE, LEFT
3	1	010-9311	FEMUR LOADCELL STRUCT. REPLACEMENT
4	1	020-9108	UPPER LEG WELDMENT, LEFT
5	1	010-9109	FLESH RESTRAINT INSERT
6	1	5001206	SCREW, SHSS M6 X 40
7	1	5000626	SCREW, SHSS M6 X 20
8	1	5001203	SCREW, BHSS M8 X 16
9	2	010-9110	KNEE BUFFER
10	1	010-9209	LOWER LEG WELDMENT
11	1	010-9217	SCREW, SHSS M10 X 35, MODIFIED
12	2	010-9215	SCREW, SSNT M8 X 20, MODIFIED
13	1	010-9213	END CAP
15	2	010-9216	WASHER, KNEE SPACER

Table 9. Leg Assembly (010-9100 LH) Part List

ITEM	QTY	PART NO.	DESCRIPTION
1	1	010-9207	UPPER LEG FLESH, RIGHT
2	1	010-9206	FEMUR BONE, RIGHT
3	1	010-9311	FEMUR LOADCELL STRUCT. REPLACEMENT
4	1	020-9208	UPPER LEG WELDMENT, RIGHT
5	1	010-9109	FLESH RESTRAINT INSERT
6	1	5001206	SCREW, SHSS M6 X 40
7	1	5000626	SCREW, SHSS M6 X 20
8	1	5001203	SCREW, BHSS M8 X 16
9	2	010-9110	KNEE BUFFER
10	1	010-9209	LOWER LEG WELDMENT
11	1	010-9217	SCREW, SHSS M10 X 35, MODIFIED
12	2	010-9215	SCREW, SSNT M8 X 20, MODIFIED
13	1	010-9213	END CAP
15	2	010-9216	WASHER, KNEE SPACER

Table 10. Leg Assembly (010-9200 RH) Part List

8.1 Leg Disassembly

Remove the two M8 x 16 BHCS that attach the legs (010-9100) (L) and (010-9200) (R) to the pelvis (010-7000).

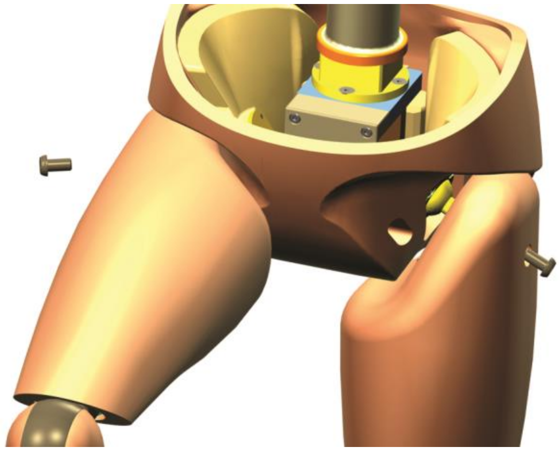


Figure 35. Leg and Torso attachment

To separate the lower and upper leg, take out the two SSNT M8 x 20 (010-9215) then remove the knee pivot SHSS M10 x 35 (010-9217). See Figure 35.

8.2 Reassembly

Before fitting the lower leg, ensure the rubber end stops are in place. Fit the two plastic washers (010-9216) into their recesses in the knee and slide the lower leg yoke over the knee of the upper leg, align and fit the knee pivot SHSS M10 x 35. The two Nylon tipped friction-stop SSNT M8 x 20 fit into the M8 threaded hole on both sides of the lower leg, these are screwed in as far as it will go. Set the knee friction by tightening or loosening evenly the friction set screws at both sides of the knee. The maximum intended friction is 1 g.

Section 9 Q10 Side Impact Shoulder Kit

For improved biofidelity a side impact shoulder kit was developed, ref. Carroll et. al. ‘Side impact shoulder for the Q10 dummy – design and evaluation’, proceedings of the 2014 IRCOBI Conference, 10-12 September 2014, Berlin. The kit is recommended to be used in full scale side impact testing.

9.1 Side Impact Kit Description

See Figure 36 for the Q10 side impact kit shoulder parts. These consist of:

1. T1 accelerometer plate.
2. Scapula right hand and left hand with recess for load cell or structural replacement which is attached with one M6 screw and clamped by the structural replacement load cell.
3. The structural replacement load cell is attached with three M5 countersunk screws. (Caution: When the load cell is fitted, it is not suitable for use in frontal impact tests).
4. Shoulder joint parts:
    a. Bronze shoulder joint block with two set screws to apply friction to the joint for flexion and extension range of motion.
    b. One attachment screw and steel washer plus waved washer to eliminate end play.
5. Upper arm solid flesh part with integral plastic bone inside, attached with two shoulder screws.

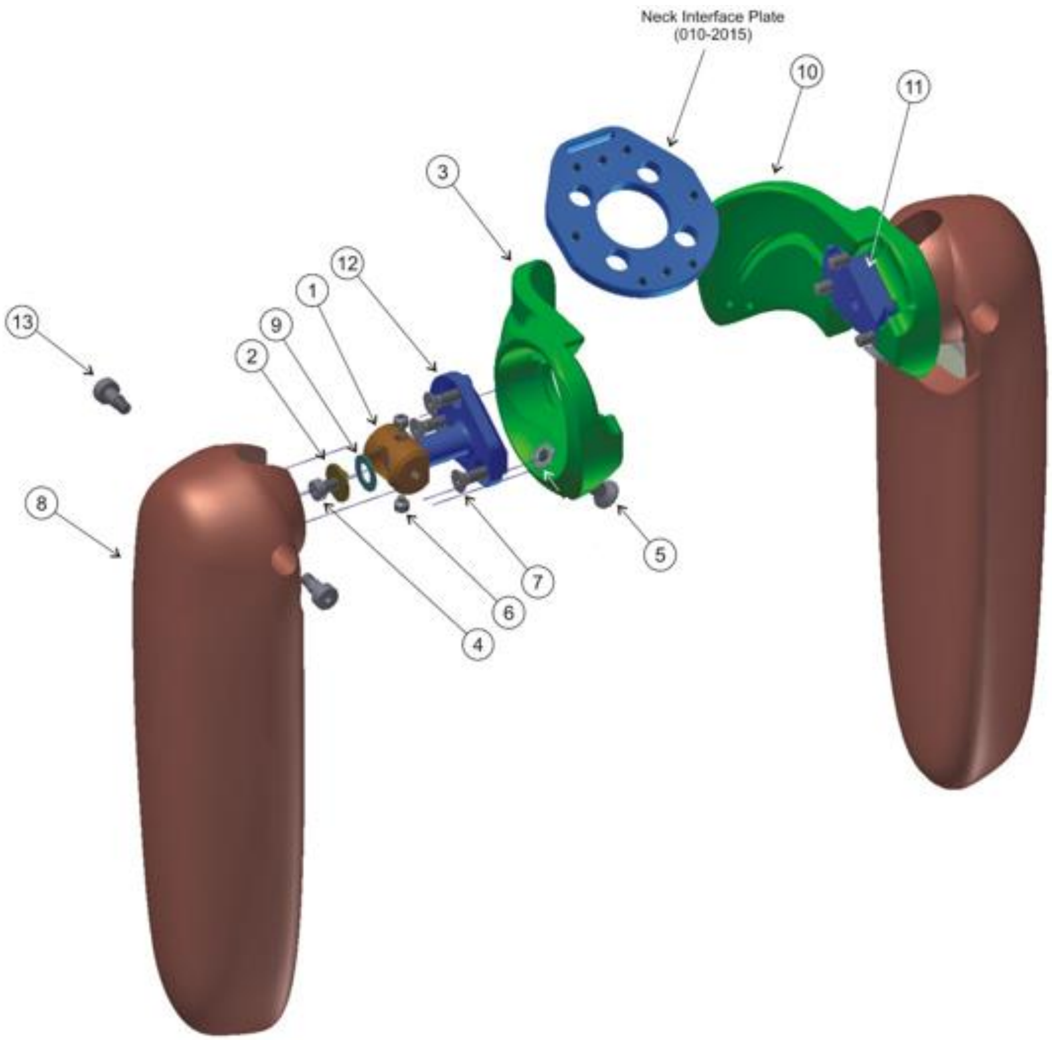


Figure 36. Q10 Side Impact Kit Shoulder parts

ITEM	QTY	PART NO.	DESCRIPTION
1	2	010-4503	SHOULDER PIVOT, SIDE IMPACT
2	2	010-4504	SHOULDER WASHER, SIDE IMPACT
3	1	010-4502	SCAPULAR, RIGHT
4	2	5000743	SCREW, LHCS, M5 X 0.8 X 8
5	2	5000139	SCREW, FHCS M6 X 1 X 12
6	4	5000995	SCREW, SSNP M6 X 1 X 6
7	6	5000467	SCREW, FHCS M5 X 0.8 X 16
8	2	010-4510	ARM ASSEMBLY MOLDING
9	2	5001248	WAVE WASHER, M8
10	1	010-4501	SCAPULAR, LEFT
11	1	10979	STRUCTURAL REPLACEMENT, LEFT
12	1	10969	STRUCTURAL REPLACEMENT, RIGHT
13	4	5001273	SCREW, SHSS M6 X 7

Table 11. Side Impact Kit (010-4500)

9.2 Assembly and Disassembly

The Q10 Side Impact Kit (010-4500) should be assembled as described below. There can be two starting conditions depending on the service build level (SBL):

1. Q10 frontal with the old rubber shoulder interface part and the old lower neck interface plate SBL A and B.
2. Q10 frontal with the new standard rubber shoulder interface part and lower neck interface plate SBL C or above December 2013.

9.2.1. Starting Condition with Old Shoulder Interface Part and Lower Neck Interface Plate

1. Remove the suit from the shoulder area
2. Remove the neck shield
3. Remove the rubber shoulder interfaces and arm by:
    a. Detaching the slotted screw, that attach the clavicle to rubber shoulder Interface parts.
    b. Detaching the four SHCS, that attach the rubber shoulder interface part to the thoracic spine.
4. Install the complete Q10 side impact kit arm and rubber shoulder interface part assembly on the dummy by:
    a. Attaching the four SHCS, that attach the rubber shoulder interface part to the thoracic spine and
    b. Attach the slotted screws that attach clavicle to rubber shoulder interface part.
5. Remove the Lower Neck Interface plate by:
    a. Detaching the head and neck assembly by removing the four SHCS of lower neck.
    b. Detaching the four SHCS of lower neck load cell to thoracic spine attachment.
    c. Detaching the four FHCS of lower neck load cell to interface plate.
6. Install the lower neck interface plate (with mount provisions for a T1 accelerometer) by:
    a. Attaching the four FHCS of lower neck load cell to interface plate.
    b. Attaching the four SHCS of lower neck load cell to thoracic spine
    c. Attaching the head and neck assembly by fitting the four SHCS of lower neck to interface plate.
7. Install the neck shield
8. Refit the suit.

9.2.2. Starting Condition with New Shoulder Interface Part and Lower Neck Interface Plate

1. Remove the Suit from the shoulder area.
2. Remove the arm attachment pin by:
    a. Detaching the M8 FHCS in the arm pit
    b. Pulling out the arm attachment pin from the scapula.
3. Remove the scapula from the rubber shoulder interface part by detaching the three M5 FHCS
4. Remove the Q10 Side Impact upper arm from the shoulder kit assembly by detaching the two M5 shoulder screws. If the kit is not assembled, assemble as per Figure 37 without arm.
5. Attach the Q10 side impact kit without arm by:
    a. Installation of the three M5 FHCS through the shoulder load cell flange.
    b. Installation of one M6 FHCS through the lug of the rubber shoulder interface part at the arm pit in to the nut molded in the scapula.
6. Attach the side impact upper arm on the shoulder joint by installing the two M5 shoulder screws.
7. Refit the suit

9.3 Instrumentation

The Q10 side impact shoulder kit facilitates provisions for three sensors:

1. Three axis (Fx, Fy and Fz) shoulder joint load cell (capacity: 2000N, 4000N, 2000N) (Caution: This load cell is not suitable for use in frontal impact tests)
2. Accelerometer (Ay) to rubber shoulder interface end plate (inside, see fig 34, left)
3. Accelerometer (Ay) to the lower neck interface plate (called T1 location, see fig 34, right)

Figure 37. Q10 Side Impact Kit with shoulder joint accelerometer Ay (left) and T1 Ay accelerometers installed

Section 10 Dummy Suit, Hip Shields and Hip Insert

The dummy is dressed in a tight-fitting neoprene suit (010-8000). This suit is an integral part of the dummy and should be worn during all tests. There is an upper and a lower suit part that are connected by a zipper at abdomen level. A suit with a 50 x 50mm grid on the chest is optional, part 010-8000 GS for high speed video analysis.

To put the suit on, put the lower suit part on over the legs and pull the pants section well into the crotch and over the buttocks. Rolling the dummy on each of its sides subsequently helps when fitting the lower suit.

Then put the arms through the sleeves of the upper suit and pull it upward towards the arm pits. Turn the sleeves around the upper arms and pull them towards the elbow, so that the shoulder part of the sleeves fit properly over the upper arm. Zip up the zipper around the abdomen then close the suit at the back using the hook and loop fasteners (Velcro). Pull the pants towards the knees so that the suit pants are flush over the dummy.

The dummy does not wear shoes.

10.1 Hip Shields

The hip shields, right hand and left hand are meant to prevent the belt trapping between pelvis and thigh in frontal tests only, these should be installed in contour with pelvis and thigh, when the dummy is in its desired test position. See pictures below. The hip shields are attached with Velcro as shown in Figure 38. When fitted there should be a gap between the hips shields of 154 mm minimum to allow the belt to freely load the pelvis bones without interference from the shields. See Figure 39.
It is recommended that the shields are replaced after 20 tests (frontal and side impact) or when the dummy is being recertified.

Figure 38. Fitting of hip shields

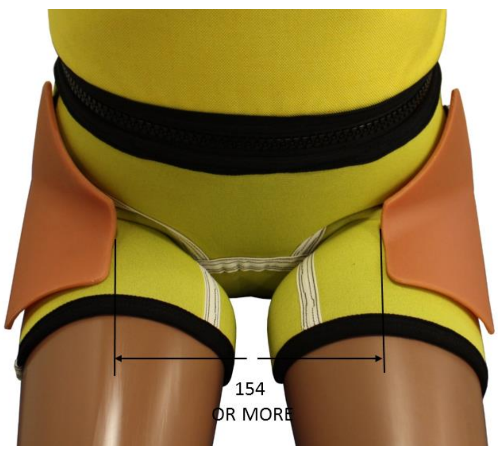


Figure 39. Fitted hip shields showing recommended minimum distance between shields

10.2 Hip Insert (Prototype)

The hip insert is currently in the prototype stage and was developed for regulation R129 to prevent the lap belt being trapped in the gap between the upper leg and the pelvis flesh, thus potentially restraining the dummy from submarining. The insert is made from a soft polyurethane to maintain dummy range of motion. There is some free range of motion for abduction for positioning. There is also an overlap at the top of the insert to help prevent the lap belt going under the abdomen. The insert is fitted to the dummy before fitting the suit see figure 40 and 41. The insert makes the suit shorts more difficult to fit as the legs will need to start straight. So after fitting feel through the suit to check the insert is fitted correctly. The suit should feel smooth around the dummy flesh in this area. This checks the insert has not been folded over. Push back into place if not smooth. The abdomen zip may have to be undone to do this.

Figure 40. Hip Insert fitted: dummy shown in sitting position

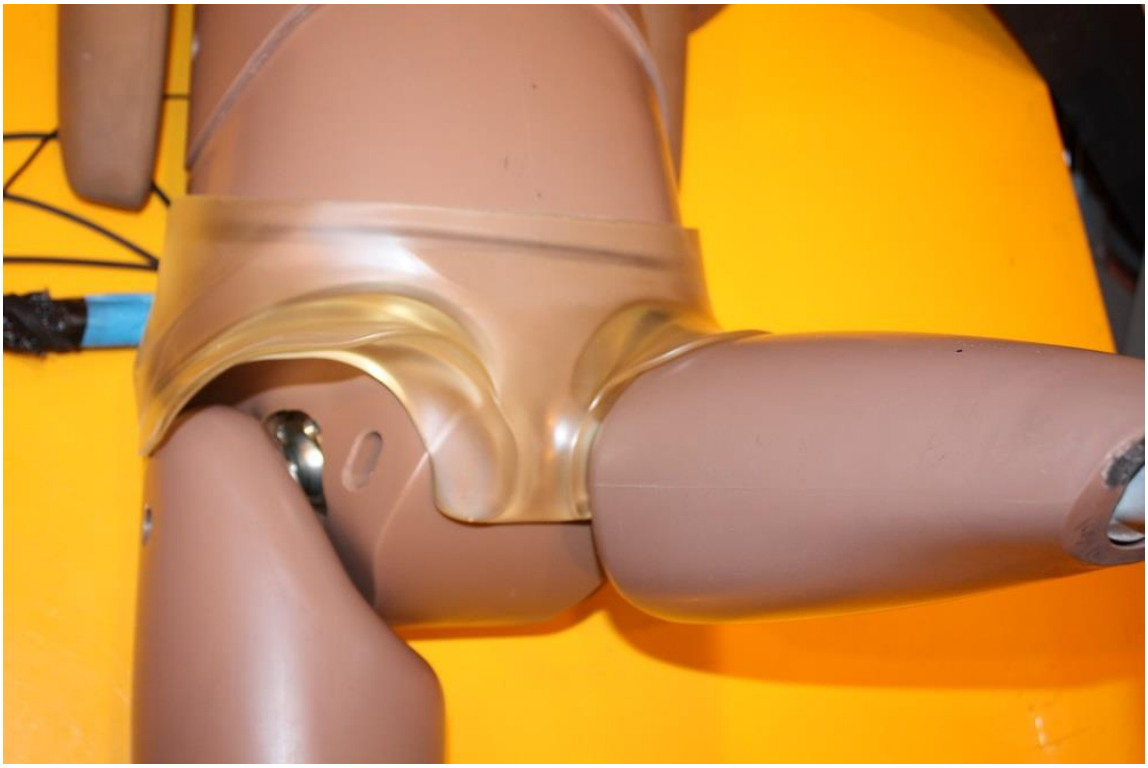


Figure 41. Hip insert fitted: showing right leg in straight position

Section 11 Pre-Test Checks

Before performing a test, a visual inspection of the dummy should be performed. Special attention should be paid to the following items.

Neck
The rubber-molded parts of the neck should not be damaged, that is: it should not show any tear and wear. By bending the neck slightly small cracks can be detected. The neck cable should be checked on visible damage only periodically.

Neck Shield
Check for signs of damage, this part is still usable with some damage as long as it maintains integrity. After testing, check that the neck shield is in the correct position before testing.

Shoulders
Periodically examine the shoulder to spine interface for splits in the rubber or delaminating from the end plates.

Clavicle
Inspect the clavicle periodically for cracks in the material.

Rib Cage
Check the rib cage for tears and cracks in the material. Deform the rib by hand, as this will show cracks, if present. Cracks can be hidden by PVC skin that covers the outside of the rib cage. To find significant damage, pay special attention to the rear of the rib at the spine interface and around any holes and edges.

Lumbar Spine
Inspect the rubber molding for tears and cracks.
Replace if the spine is damaged. The cable must be inserted and the nut at the top screwed on. There is no pretension required the nut should be tightened up until play is eliminated.

Abdomen
The abdomen should be checked periodically (10 tests) for tearing of the PVC skin. Note that the wear of the abdomen is reduced by observing the proper installation procedure. First remove the upper torso. The abdomen can then be removed by lifting it out of the pelvis. After testing check that the abdomen is in the correct location before testing.

Pelvis
Check the legs rotate freely in the hip socket there should be a light friction feel.

Arms
Check the friction setting of the shoulder and elbow regularly.

Legs
Check the leg attachment bolts are tight. Check the friction setting of the knees regularly.

Cable Routing
Always provide sufficient slack in the cables to allow the dummy to deform without putting any strain on the cables. This is especially important for the instrumentation located in the head (accelerometers, load cell). Please note that the slack can cause the cables to snag behind some other object in the test set-up, which can result in damage of the head instrumentation.

Suit

Check the suit for major cuts and tears that would affect performance. When the dummy is installed in the crash environment, pull the sleeves towards the elbow and the pants towards the knees so that they fit smoothly over the dummy. Install the hip shields when the dummy is in its desired test position, these are meant to prevent the belt trapping between pelvis and thigh in frontal tests.

Dummy Certification

Besides the inspections to be performed before each test as described above, the dummy should be regularly certified to check its performance. It is advised to certify the dummy regularly as described in section 14.

Time Interval between Tests

When conducting tests with the dummy or with dummy components a time interval of at least 30 minutes should be observed between consecutive tests. This also applies when, for example, a lateral test is followed by a frontal test using the same dummy component.

Section 12 Dummy Parts List and Recommended Spare Parts

PART NO.	DESCRIPION	QTY
010-0000	DUMMY ASSEMBLY, Q10, NON-INST	1
010-1000	HEAD ASSEMBLY, Q10	1
010-1004	ACCELEROMETER MOUNTING BRACKET, Q10	1
010-1005	SKULL CAP ASSEMBLY, Q10	1
010-2000	NECK ASSEMBLY, Q10	1
010-2004	NECK CABLE BUSHING, Q10	1
010-2005	MOLDED NECK, Q10	1
010-2006	RETAINING NUT, Q10	1
010-2007	LOAD CELL STRUCTURAL REPLACEMENT, Q10	3
010-2008	SPACER, CABLE, Q10	1
010-2009	NYLON WASHER, Q10	1
010-2010	NECK INTERFACE ASSEMBLY, Q10	1
010-2015	NECK TO TORSO INTERFACE PLATE, Q10	1
010-2200	NECK CABLE ASSEMBLY, Q10	1
010-3003	SHOULDER SHAFT, Q10	2
010-3300	CLAVICAL, Q10	1
010-3301	SCAPULA, LEFT, Q10	1
010-3302	SCAPULA, RIGHT, Q10	1
010-3420	CLAVICLE PIN, Q10	2
010-3501	MOLDED SPINE INTERFACE ASSEMBLY LEFT,Q10	1
010-3502	MOLDED SPINE INTERFACE ASS'Y, RIGHT, Q10	1
010-3522	SHOULDER SPINE MOUNT PLATE, RIGHT, Q10	1
010-3622	SHOULDER INTERFACE PLATE, RIGHT, Q10	1
010-3015	CABLE, SWAGED END, THREAD END, Q10	1
010-3800	NECK SHIELD Q10	1
010-4000	THORAX ASSEMBLY, Q10	1
010-4001	SPINEBOX, Q10	1
010-4005	BALLAST, Q10	1
5000064-FT	PIN DOWEL M2 X 8	1
010-4006	SCREW, FHCS M8X1.25X20 BZP 10.9 THD. LOC	2
010-4100	RIB CAGE ASSEMBLY, Q10	1
010-4104	SPINE RAIL, Q10	2
010-4105	IRTRACC ADAPTER	2
010-4106	SIDE IMPACT, IRTRACC MOUNT, Q10	1
010-4107	MOLDED BACK PLATE, Q10	1
010-4108	PIVOT SCREW, Q10	4
5000024-FT	SCREW SHCS M4 X 0.7 X 8 ZINC	1
010-4109	MOUNT, UPPER THORAX, Q10	1

PART NO.	DESCRIPION	QTY
010-4110	BRACKET, THORAX TILT SENSOR, Q10	1
010-4200	CLAVICLE RETAINER, Q10	1
010-4300	ABDOMEN, Q10	1
010-6001	LUMBAR SPINE, MOLDED Q10 UNTESTED	1
010-6100	LUMBAR SPINE CABLE ASSEMBLY, Q10	1
010-7000	PELVIS ASSEMBLY, Q10	1
010-7002	PELVIS FLESH, Q10	1
010-7003	HIP CUP, Q10	2
010-7004	HIP BALL RETAINING PLATE, Q10	2
010-7005	HIP BEARING, Q10	2
010-7007	FEMUR BALL, Q10	4
010-7008	HIP SHAFT, Q10	4
010-7009	RETAINING PLATE, PELVIS BONE, Q10	2
010-7012	PUBIC BUFFER MOLDED, Q10	2
010-7020	HIP ADJUSTER	2
010-7021	BALLAST, PELVIS, DAS, Q10	1
010-7022	LC, INTERFACE SACRO ILIAC Q10	2
010-7023	LC, S. R. INTERFACE SACRO ILIAC Q10	2
010-7024	PLATE, NUT, Q10	2
010-7201	SACRUM TOP BALLAST, Q10	1
010-7202	SACRUM BOTTOM PLATE, Q10	1
010-7203	SACRUM, FRONT PLATE, Q10	1
010-7251	SACRUM CENTRAL SUPPORT, FRONT, Q10	1
010-7252	SACRUM CENTRAL SUPPORT, REAR, Q10	1
010-7301	ILIAC WING, LEFT, Q10	1
010-7302	ILIAC WING, RIGHT, Q10	1
010-9106	FEMUR BONE, LEFT, Q10	1
010-9107	UPPER LEG FLESH, LEFT, Q10	1
010-9108	UPPER LEG WELDMENT, LEFT	1
010-9109	INSERT, FLESH RESTRAINT, Q10	2
010-9110	KNEE BUFFER, Q10	4
010-9202	LOWER LEG ASSEMBLY, Q10	2
010-9217	SCREW, SHSS M10X35 MODIFIED	1
010-9215	SCREW, SSNT MODIFIED M8 X20, Q10	2
5001174-FT	SCREW SHCS M5 X 0.8 X 12 ZINC	2
010-9216	WASHER, KNEE, SPACER Q10	2
010-9206	FEMUR BONE, RIGHT, Q10	1
010-9207	UPPER LEG FLESH, RIGHT Q10	1
010-9208	UPPER LEG WELDMENT, RIGHT	1
010-9305	LOWER ARM, MOLDED, LEFT, Q10	1
010-9307	UPPER ARM, MOLDED, LEFT, Q10	1
020-9705	SHOULDER BEARING	1
010-9308	SHOULDER BALL RETAINER RING, Q10	2

PART NO.	DESCRIPION	QTY
010-9310	WASHER, LOWER ARM, Q10	4
010-9311	FEMUR LOAD CELL STRUCT. REPLACEMENT, Q10	2
010-9312	UPPER ARM WASHER, Q10	6
010-9313	SCREW,SHCS MODIFIED M6 X 26, Q10	2
5001195-FT	SCREW SHCS M6 X 1.0 X 40 ZINC	1
010-9315	END STOP, ELBOW, Q10	4
010-9316	SCREW,SSNT M8X16 MODIFIED	4
5001209-FT	SCREW, SSNT M8 X 1.25 X 16	1
010-9405	LOWER ARM, MOLDED, RIGHT, Q10	1
020-9705	SHOULDER BEARING	1
020-3537	BALL, SHOULDER	2
034-1201	MOUNT-HEAD/PELVIS,ARS/7264-2000	2
5000068-FT	SCREW SHCS M1.4 X 0.3 X 3	6
5000188-FT	PIN COILED M3 X 18	2
5000414-FT	PIN DOWEL M4 X 10	6
5000477-FT	PIN DOWEL M4 X 16	1
5000486-FT	NUT HEX NYLON INSERT M8 X 1.25 ZINC	1
5000552-FT	WASHER FLAT M8 (8.4 X 16 X 1.6) ZINC	1
5000565-FT	SCREW BHCS M5 X 0.8 X 12 18-8 SS	4
5000626-FT	SCREW SHSS M6 X 20 (M5 X 0.8 THREAD)	2
5000719-FT	PIN ROLL M5 X 24	2
5000727-FT	SCREW SHCS M1.4 X 0.3 X 8	12
5000846-FT	SCREW BHCS M5 X 0.8 X 12, ZINC PLATED	3
5001173-FT	SCREW SHCS M5 X 0.8 X 10 ZINC	16
5001174-FT	SCREW SHCS M5 X 0.8 X 12 ZINC	3
5001175-FT	SCREW FHCS M4 X 0.7 X 16 ZINC	3
5001176-FT	SCREW FHCS M5 X 0.8 X 12 ZINC	4
5001177-FT	SCREW FHCS M5 X 0.8 X 14 ZINC	10
5001179-FT	SCREW FHCS M6 X 1.0 X 20 ZINC	8
5001181-FT	SCREW BHCS M5 X 0.8 X 10 ZINC	8
5001182-FT	SCREW SHCS M4 X 0.7 X 12 ZINC	1
5001183-FT	SCREW SHCS M6 X 1.0 X 20 ZINC	2
5001184-FT	SCREW SHCS M2 X 0.4 X 10 ZINC	4
5001185-FT	SCREW SHCS M2.5 X 0.45 X 16 ZINC	4
5001186-FT	SCREW SHCS M3 X 0.5 X 20 ZINC	5
5001187-FT	SCREW SHCS M4 X 0.7 X 10 ZINC	8
5001188-FT	SCREW SHCS M4 X 0.7 X 16 ZINC	2
5001189-FT	SCREW SHCS M4 X 0.7 X 20 ZINC	3
5001190-FT	SCREW SHCS M4 X 0.7 X 25 ZINC	2
5001191-FT	SCREW SHCS M4 X 0.7 X 8 ZINC	6
5001192-FT	SCREW SHCS M5 X 0.8 X 35 ZINC	6
5001193-FT	SCREW SHCS M6 X 1.0 X 16 ZINC	2
5001197-FT	SCREW FHCS M4 X 0.7 X 25 ZINC	8

PART NO.	DESCRIPION	QTY
5001198-FT	SCREW FHCS M5 X 0.8 X 16 ZINC	4
5001199-FT	SCREW FHCS M5 X 0.8 X 18 ZINC	4
5001200-FT	SCREW FHCS M6 X 1.0 X 30 ZINC	6
5001201-FT	SCREW BHCS M4 X 0.7 X 8 ZINC	6
5001202-FT	SCREW SHCS M5 X 0.8 X 45 ZINC	3
5001203-FT	SCREW BHCS M8 X 1.25 X 16 ZINC	2
5001207-FT	SCREW SHCS M6 X 1.0 X 55 PART THD ZINC	2
5001208-FT	SCREW SHCS M3 X 0.5 X 35 ZINC	2
9003247-FT	WASHER WAVE SPRNG (.53 X .376 X .09)	1
W50-71059-DN	STRUCT. REPL. PUBIC LOAD CELL	1

Recommended Spare Parts

During operation dummy parts can fail. When the dummy is exposed to extreme pulses a failure can suddenly occur. Normally, however, an early warning for a part that may fail is noticed during the certification procedures. It is recommended that the dummy is inspected as described above before each test and certify the dummy regularly as described in section 12 and 13. To safeguard continuous operation with the Q10 dummy it is recommended to take and maintain the following spare parts in stock:

Description	Part Number	Quantity in Assembly
Ribcage assembly Tested and Certified	010-4100	1
Suit	010-8000	1
Neck	010-2000	1
Lumbar spine	010-6000	1
Ball joint IRTRACC	3670-10	2
Hip shield Left hand	010-8001	1
Hip shield right hand	010-8002	1

If the ball joint is replaced the IRTRACC should be subjected to the absolute length verification as described in section 16.

Section 13 Certification Equipment

13.1 Requirements

The frequency of the Q10 certification and the number of tests that can be performed between certifications strongly depends on the type and severity of the tests in which the dummy is used, as well as the test frequency. Which certification tests have to be carried out depends on the dummy application (UNECE-Regulation, Full Scale NCAP, Airbag), and is different for frontal and side impact tests. When used in side impact applications, the dummy must be certified depending on the side of impact. Although it can be assumed that the dummy performance is symmetrical it is recommended to certify for lateral impact the side that will be impacted. For NCAP it is recommended to certify the dummy every 20 tests, frontal and side combined.

The dummy and dummy parts should be kept in the test environment at least 4 hours prior to the use in a test. The testing laboratory environment should be controlled to have:

- A temperature of 20 ± 2 degrees Celsius.
- A relative humidity of 40 ± 30%.

When conducting certification tests a time interval of at least 30 minutes should be observed between two consecutive tests. This also applies when, for example, a lateral test is followed by a frontal test using the same dummy or dummy component.

When certifying the dummy, a particular order of operation should be observed:

1. Perform the component tests: head, neck, lumbar spine and abdomen,
2. Perform the full body tests on the dummy with the certified components: thorax for frontal and shoulder, thorax and pelvis for lateral impact.

To perform the certification tests, certain test setups are required: a head drop table, a wire-suspended pendulum for the full body impacts, an abdomen compression device, a part 572 neck pendulum and a Q series headform for neck and lumbar spine certifications. In chapter 13.2 the use of the test setups and some dedicated Q10 test equipment is described.

13.2 Equipment

13.2.1 Head Drop

For the free-fall head drop test a support and release mechanism is necessary as well as steel plate with a thickness of at least 50 mm this will act as an impact surface. This plate should be similar to the plate described in CFR 49, Part 572 Hybrid III head drop test, and should have equivalent roughness and size. In the drop test the head should be equipped with an additional head certification mass (TE-010-1007) which represents half a load cell (replacement).

13.2.2 Neck and Lumbar Spine Certification Equipment

A pendulum which meets the requirements of CFR 49 part 572.33(c) is needed to perform the certifications of the neck and lumbar spine, see below. The spine or neck are mounted upside down on the pendulum arm using an interface plate which replaces the standard part 572 pendulum mounting plate. To load the part, a headform is used, which is shown in Figure 42 and 43.

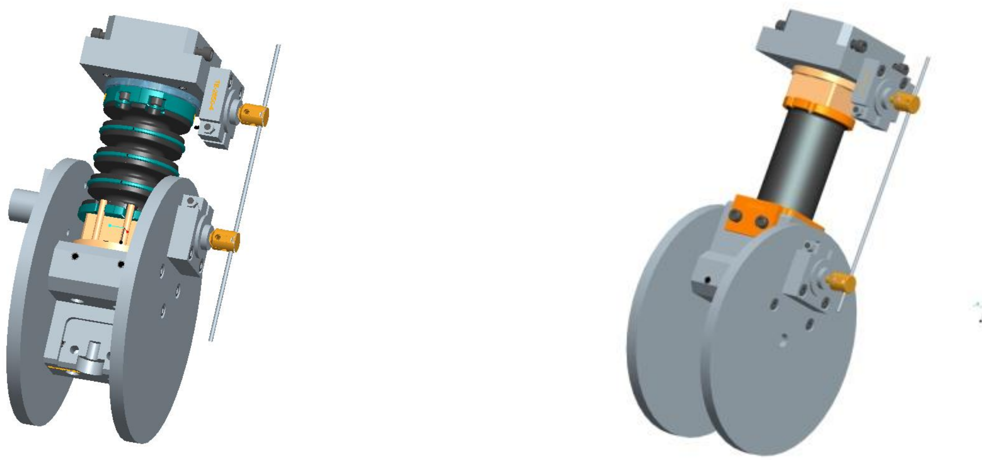


Figure 42. Q10 neck (left) and lumbar spine (right) headform test set-up for frontal test

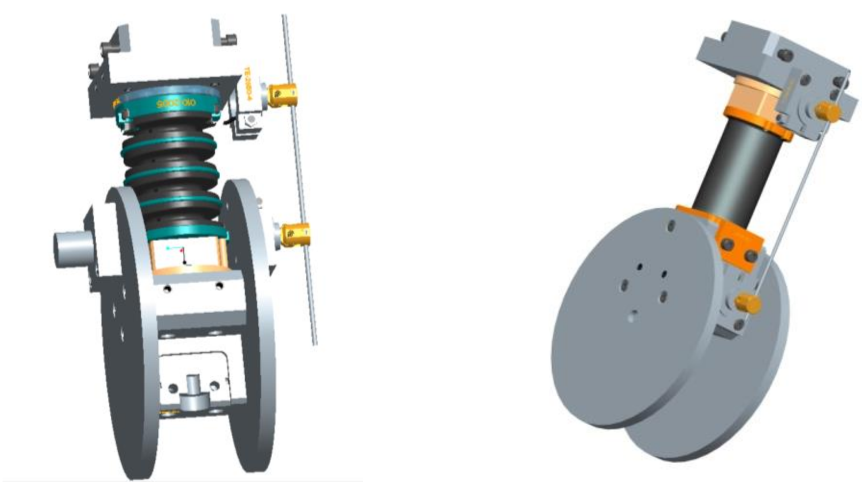


Figure 43. Q10 neck (left) and lumbar spine (right) headform test set-up for lateral test

The total mass of the neck headform should be 2.736 ± 0.05 kg, including the high capacity loadcell. The total mass of the lumbar headform should be 2.48 ± 0.05 kg. The interface to the part 572 pendulum should weigh 0.95 ± 0.02 kg.

The neck or lumbar spine is attached upside down to this pendulum. The neck is attached to the pendulum base with a neck adaptor plate TE 010-2015. Between the pendulum base and the lumbar spine a load cell (IF-217-HC) or load cell structural replacement (010-2007) is mounted. A headform is used to load the neck or lumbar spine. This headform consists of two flat disks connected by an interface, which allows certification of both the neck and the lumbar spine. Moreover the headform carries a potentiometer at one side and ballast mass at the opposite side.

The headform has different configurations: one for testing the neck and one for testing the lumbar spine. Figure 42 sheet 1 and 2 shows the headform setup in neck testing configuration. The central block (TE-2650-14 in sheet 2 and 3) is dedicated for Q10, because of the Q10 lumbar spine upper attachment asymmetry.

For testing the neck, the large end of the central block is facing towards the pendulum arm.
When testing the neck, a load cell (IF-217-HC) is mounted between the neck and the central block.

To test the lumbar spine, the discs need to be removed and mounted on a dedicated Q10 central block TE-010-2650-14. The large end of the central block must be facing away from the pendulum. Note: That the central block is mounted 180 degrees relative to the neck mounting. The upper lumbar bracket mounts directly to the small end of the central block. Make sure that the lumbar spine column centerline is in the same plane as the centerline of the headform disks. In the lumbar spine test no load cell or load cell structural replacement is required between the lumbar spine and the headform. (See Figure 42 right and Figure 43 right).

Two rotational potentiometers are used to measure the angle of the headform relative to the pendulum arm. One potentiometer is attached to the pendulum interface, the other to the headform (see Figure 42 and Figure 43). A thin rod connects the potentiometers. The rod should be fixed to the headform potentiometer (using an M3 set screw), but be able to slide freely through the hub on the axis of the pendulum interface potentiometer. The rod must be protruding from both potentiometer axes equal length. A balance mass is attached to the opposite side of the headform to assure symmetrical loading of the neck and lumbar spine. The potentiometer and balance mass are mounted on the sides of the headform with their common centerline perpendicular to the movement of the pendulum. This can be seen in Figures 41 and 42.

The neck and lumbar spine test fixture can be used for both frontal and lateral testing of the neck and lumbar spine. For testing in frontal direction the headform discs are parallel to the axis of the pendulum. For lateral lumbar test the headform discs are perpendicular to the axis of the pendulum for lateral neck the discs are parallel, see figure 43. Both configurations use three screws for fixing the discs to the central block. The angle transducer and the balance weight of the headform must be repositioned when changing from frontal to lateral testing and vice versa.

13.2.3 Full Body Pendulum

The full body pendulum, part number TE-010-9920 "Q10 Probe Assembly" (see Figure 44), consists of a hollow metal tube closed at both ends, two axles with suspension pulleys and a speed vane. An accelerometer which measures the longitudinal acceleration must be mounted on the rear end. An Endevco model 2262CA-200 or equivalent is recommended.

The total mass, including instrumentation, suspension pulley wheels and speed vane (the release wire not included) as well as the impactor face dimensions are specified in the table below.

Description	Q10 Probe
Probe weight including speed vane, accelerometers and rigidly attached hardware (including 1/3 of the suspension wires)	8.76 ± 0.1 kg
Probe impact face diameter	112 mm
Impact face round off radius	5 mm

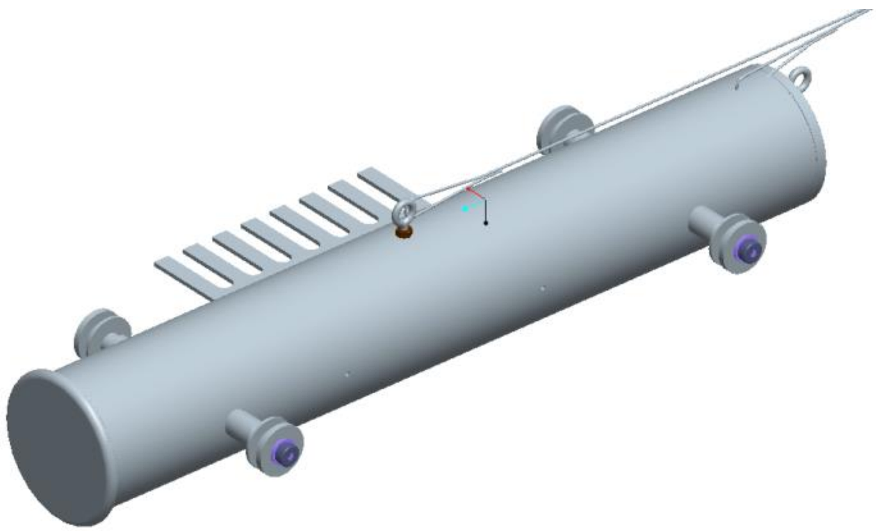


Figure 44. Q10 Full body impactor

The impactor is suspended as a guided pendulum by six 7 x 7 stainless steel wires (2 mm diameter). Figure 45 shows a front view of the impactor and four of the suspension wires in the required cross configuration. At the rear pulleys four suspension wires are used: two wires forming a trapezoid and two crossing wires. At the front pulleys only the two outer wires forming a trapezoid and no cross wires are used.

A flat, horizontal surface should be available to sit the dummy on. The impact velocity of the impactor must be measured and recorded.

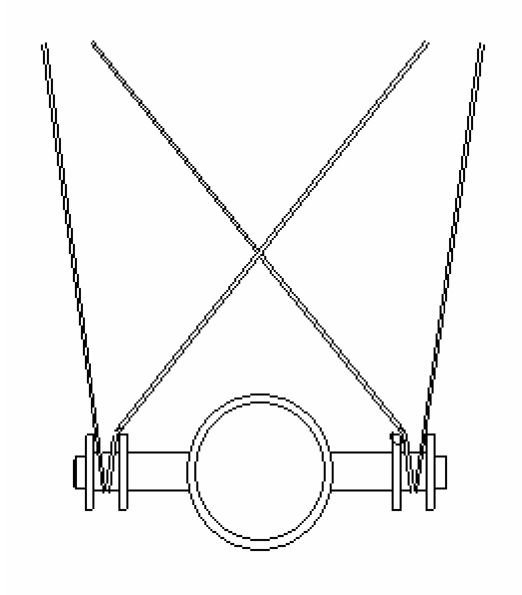


Figure 45. Full body pendulum impactor suspension wire diagram (two wires at the front and four at the rear pulley)

13.2.4 Abdomen Test Rig

The abdomen test compresses the abdominal insert between a Q10 abdomen certification support block (Part number TE-010-9910) and a flat plate. The support block shape matches the shape of the rear side of the abdomen. The support is placed on a horizontal surface, and the abdomen is placed on the block with the front outer surface facing up. A guided flat plate should be placed parallel to the horizontal base plate on top of the abdomen. The dimensions of this plate are 300 by 250 mm, and the mass is 2.05 ± 0.025 kg. A picture of the set-up is shown in Figure 54.

13.3 Equipment List

In Table 11 the equipment required for certification is specified (see also paragraph 13.19).

Part Number	Description	Test
TE-010-1007	Head Certification Mass	Head Drop
TE-2651	Head positioning Basket	Head Drop
TE-2650	Headform Q dummies	Neck and Lumbar Spine
TE-010-2015	Intermediate Plate	Neck
TE-2650-14	Central Block	Lumbar
TE-010-9910	Abdomen Certification	Abdomen
TE-010-9920	Body Probe Q10	Thorax

Table 12. Equipment Parts List

Section 14 Certification Procedures

14.1 Head Certification

General

No tears or cracks in the skin and skull are allowed.
The head is suspended above a rigid, thick, metal plate. The properties of this plate are described in section 13.2.1 under the heading “Head Drop” of this manual. The Head test is performed with a head drop table as described in CFR 49, Part 572.152
Mount the half load cell replacement (head drop ballast TE-010-1007) to the lower face of the head base.

The data acquisition system and all instrumentation must comply with the requirements of SAE J211, version March 1995. All data channels should be filtered using a hardware filter prior to A/D conversion according to SAE J211, version March 1995.

Instrumentation

Mount three uni-axial accelerometers to one of the accelerometer mounts in table 1 and fit into the head as shown figures 2 and 3 (the angular rate sensors shown in the pictures are not required).

14.2 Frontal Impact Head Certification

Test Procedure

1. The head is suspended above a Part 572 plate. Users are advised to use a thin wire basket (TE-2651) to position the head. The net has a piece of steel attached to it, which allows the use of a magnet to keep the head in place. The net allows easy adjustment of the head in any orientation.

2. The z-axis of the head should make an angle of 28 ± 2 degrees with the horizontal plane, and the medial-lateral axis should be horizontal, ± 1 degree. When released, the head should impact the surface with its forehead. The z-axis of the head is parallel to the skull cap plane, see Figure 46.

3. The lowest point of the head should be 130 ± 1mm above the impact surface.

4. Release the head.

5. The minimum time interval to observe on same location is 30 minutes.

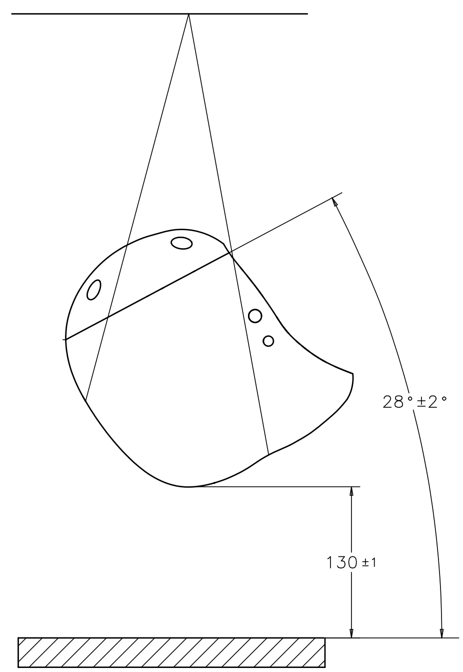


Figure 46. Frontal Impact Test Procedure

Data Processing
1. All three accelerations should be filtered at CFC1000.
2. Determine the resultant head acceleration.

Requirement
1. The maximum resultant head acceleration response should be between 124.2 – 151.8 g's.
2. The acceleration in Y-direction should be between -10 and 10 g.

14.3 Lateral Impact Head Certification

Test Procedure

1. The head is suspended above a Part 572 metal plate. Users are advised to use a thin wire basket (TE-2651) to position the head. The net has a piece of steel attached to it, which allows the use of a magnet to keep the head in place. The net allows easy adjustment of the head in any orientation.

2. Position the head in such a way that the mid-sagittal plane has an angle of 35 ± 2 degrees with the horizontal axis, and the anterior-posterior axis is horizontal, ± 1 degree. This corresponds to an angle between the horizontal plane and the head base plane of 55 ± 2 degrees, see Figure 47.
When released, the head should impact the surface with the side of its head. Both side's left hand and right hand can be tested in accordance with what is desired.

3. The lowest point of the head should be 130 ± 1 mm above the impact surface.

4. Release the head.

5. The minimum time interval to observe on same location is 30 minutes.

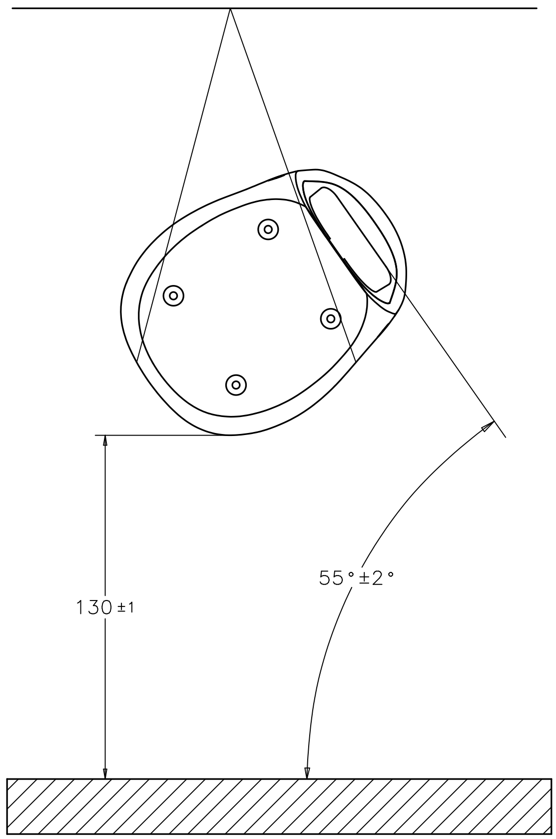


Figure 47. Lateral Impact Test Procedure

Data Processing
1. All three accelerations should be filtered at CFC1000.
2. Determine the resultant head acceleration.

Requirement
1. The maximum resultant head acceleration response should be between 128.7 – 157.3 g's.
2. The acceleration in X-direction should be between -20 and 20 g.

14.4 Neck Certification

General

The neck test is a component test, which is performed using a pendulum as defined in CFR49 part 572. The complete neck consists of the following parts:

Description	Parts Q10	QTY
Neck Molding	010-2005	1
Neck Cable Assembly	010-2200	1
Screw FHCS M5 x 12	5000374	4
Screw SHCS M5 x 10	5000291	4
Loadcell	IF-217 HC	1

Table 13. Neck Parts Lists

The neck is attached upside down to the pendulum base (TE-2650-1). A headform is used to load the neck. This headform consists of two flat disks connected by central block (TE-2650-14), which allows certification of both the neck and the lumbar spine. The headform orientation is measured using two rotational potentiometers. One is installed on the base of the neck-pendulum interface. The second one is attached to the headform. The sum of the two angles measured on the potentiometers is the angle of the head relative to the pendulum. Moment is measured using an upper neck load cell IF-217 HC mounted between the headform and the neck.

The data acquisition system and all instrumentation must comply with the requirements of SAE J211, version March 1995. All data channels should be filtered using a hardware filter prior to A/D conversion according to SAE J211, version March 1995.

The pendulum acceleration should be measured with an accelerometer, which is located on the pendulum arm, 1657.4 mm from the pendulum pivot in accordance with the CFR 49 Part 572.

14.5 Flexion Neck Test

Set-up

1. Assemble the complete neck, as described in section 3.
2. Attach the IF-217-HC 6 Axis Load Cell to the top of the neck with four M5 x 12 SHCS with wires aligned with cut outs in neck plate. Attach the loadcell and neck to the headform with four M5 x 12 SHCS with loadcell wires to non-impact side.
3. Attach the intermediate plate TE-010-2015 to the pendulum base with four M5 countersunk screws see drawing TE-2650 Figure 57. Attach the neck to the pendulum interface plate (four, M5 SHCS).
4. Align the neck and the interface, making sure that longitudinal axis of the neck is in the direction of motion of the pendulum arm.
5. Attach the headform-neck system to the Part 572 pendulum. The front of the neck should point in the direction of motion of the pendulum. See Figure 48.
6. Install the potentiometers to the mounting interface and on the headform. Mount the balance weight for the potentiometer on the other side of the headform. This ensures that the inertial properties of the head are symmetrical in the impact direction.
7. Insert the rod connecting the axes of the potentiometers and tighten the screw on the bottom-most axis (headform potentiometer) to secure the rod. The other end of the rod should be able to slide freely through the upper most transducer axis (pendulum base potentiometer). The rod must be protruding from both sides of the transducers axes equal length.
8. The minimum time interval to observe between tests on the neck is 30 minutes.

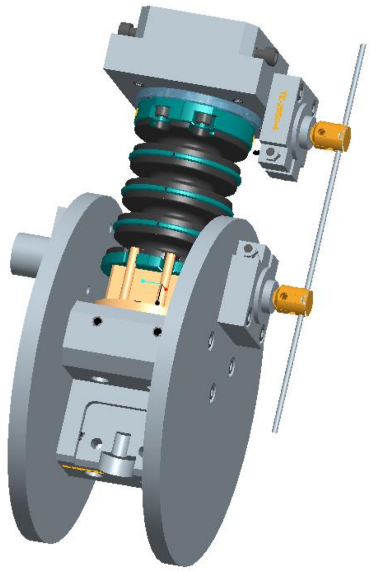


Figure 48. Q10 Neck Certification setup for frontal flexion test, view from rear in drop position

Performing the Test

1. To stop the pendulum, attach honeycomb material to the pendulum anvil. Use 152.4 mm (6”) thick aluminum Hexcel density 28.8 Kg/m^3 (1.8 lb/ft^3) with a number cells appropriate to meet the pulse requirement in Table 14.
2. Auto-balancing and shunt calibration of the transducer signals should be performed with the pendulum arm in the vertical position.
3. Lift the pendulum up to its pre-test height and check that the headform is in the correct initial position (symmetric with respect to neck top yoke). Do not leave the head-neck system in this position for more than 1 minute, as the neck will start to deform due to the mass-gravity loading of the headform.
4. Release the pendulum.

Data Processing

1. Filter the pendulum acceleration at CFC180.
2. Filter the potentiometer readings at CFC600.
3. Filter the load cell readings at CFC600
4. Determine time zero of the impact by finding the 1 g deceleration level in the pendulum signal (after software filtering).
5. Software zero all transducer readings by averaging the part of the signal before time zero and subtracting this from the transducer reading.
6. Integrate the pendulum acceleration to check the deceleration velocity of the pendulum. The velocity of the arm must be calculated at a point 1657.4 mm from the pendulum pivot point.
7. Sum the potentiometer signals to derive the total head angle of the headform relative to pendulum arm.

Requirements
1. The impact velocity should be at 4.8 ±0.1 m/s.
2. The pendulum velocity decrease should be as indicated in the table below.

Time (ms)	Lower Limit (m/s)	Upper Limit (m/s)
10	1.0	2.0
20	2.3	3.4
30	3.6	4.8

Table 14. Pendulum Velocity

To meet the requirements of the frontal neck certification test:
- The maximum head angle should be 50.4 – 61.6 degrees.
- The peak moment within the head angle corridor shall be 28.8 – 35.2 Nm.

14.6 Extension Neck Test

Set-up
1. Assemble the complete neck, as described in section 3.
2. Attach the IF-217-HC 6 Axis Load Cell to the top of the neck with four M5 x 12 SHCS with wires aligned with cut outs in neck plate. Attach the loadcell and neck to the headform with four M5 x 12 SHCS with loadcell wires to non-impact side.
3. Attach the intermediate plate TE-010-2015 to the pendulum base with four M5 countersunk screws. Attach the neck to the pendulum interface plate (four, M5).
4. Align the neck and the interface, making sure that longitudinal axis of the neck is in the direction against the motion of the pendulum arm.
5. Attach the headform-neck system to the Part 572 pendulum. The front of the neck should point in the direction against the motion of the pendulum. See Figure 49.
6. Install the potentiometers to the mounting interface and to the headform. Mount the balance weight for the potentiometer on the other side of the headform. This ensures that the inertial properties of the head are symmetrical in the impact direction.
7. Insert the rod connecting the axes of the potentiometers and tighten the screw on the bottom-most axis (headform potentiometer) to secure the rod. The other end of the rod should be able to slide freely through the upper most transducer axis (pendulum base potentiometer). The rod must be protruding from both sides of the transducers axes equal length.
8. The minimum time interval to observe between tests on the neck is 30 minutes.

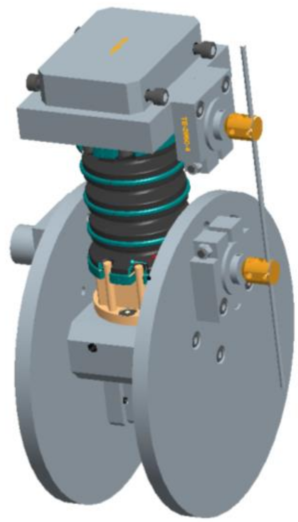


Figure 49. Q10 Neck Certification setup for frontal extension test, view looking from front in drop position

Performing the Test

1. To stop the pendulum, attach honeycomb material to the pendulum anvil. Use 152.4 mm (6") thick aluminum Hexcel density 28.8 Kg/m^3 (1.8 lb/ft^3) with a number cells appropriate to meet the pulse requirement in Table 15.
2. Auto-balancing and shunt calibration of the transducer signals should be performed with the pendulum arm in the vertical position.
3. Lift the pendulum up to its pre-test height and check that the headform is in the correct initial position (symmetric with respect to neck top yoke). Do not leave the head-neck system in this position for more than 1 minute, as the neck will start to deform due to the mass-gravity loading of the headform.
4. Release the pendulum.

Data Processing

1. Filter the pendulum acceleration at CFC180.
2. Filter the potentiometer readings at CFC600.
3. Filter the load cell readings at CFC600
4. Determine time zero of the impact by finding the 1 g deceleration level in the pendulum signal (after software filtering).
5. Software zero all transducer readings by averaging the part of the signal before time zero and subtracting this from the transducer reading.
6. Integrate the pendulum acceleration to check the deceleration velocity of the pendulum. The velocity of the arm must be calculated at a point 1657.4 mm from the pendulum pivot point.
7. Sum the potentiometer signals to derive the total head angle of the headform relative to pendulum arm.

Requirements
1. The impact velocity should be at 3.7 ±0.1 m/s.
2. The pendulum velocity decrease should be as indicated in the table below.

Time (ms)	Lower Limit (m/s)	Upper Limit (m/s)
10	0.7	1.7
20	1.7	2.8
30	2.8	4.0

Table 15. Pendulum Velocity

To meet the requirements of the frontal neck certification test:
- The maximum head angle should be 56.7 – 69.3 degrees.
- The peak moment shall be [-12.96] – [-15.84] Nm.

14.7 Lateral Neck Test

Set-up
1. Assemble the complete neck as described in section 3.
2. Attach the IF-217-HC 6 Axis Load Cell to the top of the neck with four M5 x 12 SHCS with wires aligned with cut outs in neck plate. Attach the loadcell and neck to the headform with four M5 x 12 SHCS, with lateral axis RH and LH aligned with the direction of motion of the headform.
3. Attach the intermediate plate TE-010-2015 to the pendulum base with four M5 countersunk screws. Attach the neck to the pendulum interface plate (four, M5 SHCS).
4. Align the neck and the interface, making sure that <u>lateral</u> axis of the neck is in the direction of motion of the pendulum arm. Also, make sure that the bending direction of the neck in the certification is the same as the initial bending direction experienced in the test the dummy is being certified for (LHS or RHS).
5. Attach the headform-neck system to the part 572 pendulum. The impact side of the neck should point in the direction of motion of the pendulum. See Figure 50.
6. Install the potentiometers to the mounting interface and on the headform. Mount the balance weight for the potentiometer on the other side of the headform. This ensures that the inertial properties of the head are symmetrical in the impact direction. Figure 50 indicates the proper position and orientation of the potentiometers.
7. Insert the rod connecting the axes of the potentiometers and tighten the screw on the bottom-most axis (headform potentiometer) to secure the rod to that potentiometer. The other end of the rod should be able to slide freely through the upper most transducer axis (pendulum base potentiometer). The rod must be protruding from both sides of the transducer axes equal length.
8. The minimum time interval to observe between tests on the neck is 30 minutes.

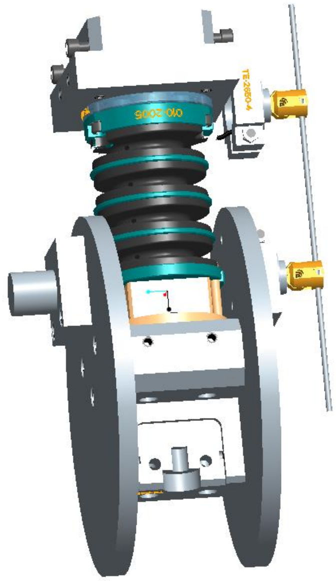


Figure 50. Q10 Neck Certification setup for lateral test, view from rear in drop position

Performing the Test

1. To stop the pendulum, attach honeycomb material to the pendulum anvil. Use 152.4 mm (6”) thick aluminum Hexcel density 28.8 Kg/m^3 (1.8 lb/ft^3) with a number cells appropriate to meet the pulse requirement in Table 16.
2. Auto-balancing and shunt calibration of the transducer signals should be performed with the pendulum arm in the vertical position.
3. Lift the pendulum up to its pre-test height. Do not leave the head-neck system in this position for more than 1 minute, as the neck will start to deform due to the mass-gravity loading of the headform.
4. Release the pendulum.

Data Processing

1. Filter the pendulum acceleration at CFC180.
2. Filter the potentiometer readings at CFC600.
3. Filter the load cell readings at CFC600
4. Determine time zero of the impact by finding the 1 g deceleration level in the pendulum signal (after software filtering).
5. Software zero all transducer readings by averaging the part of the signal before time zero and subtracting this from the transducer reading.
6. Integrate the pendulum acceleration to check the deceleration velocity of the pendulum. The velocity of the arm must be calculated at a point 1657.4 mm from the pendulum pivot point.
7. Sum the potentiometer signals to derive the total head angle of the headform relative to pendulum arm.

Requirements
1. The impact velocity should be 3.7 ±0.1 m/s.
2. The pendulum velocity decrease should be as indicated in the table below.

Time (ms)	Lower Limit (m/s)	Upper Limit (m/s)
10	0.7	1.7
20	1.7	2.8
30	2.8	4.0

Table 16. Pendulum Velocity

To meet the requirements of the lateral neck certification test:
- The maximum head angle should be between 45.9 – 56.1 degrees.
- The peak moment shall be 14.85 – 18.15 Nm.

14.8 Lumbar Spine Certification

General
The lumbar spine is tested with the same device as the neck. The direction of central block of the headform must be changed. To certify the lumbar spine, separate tests are defined for side and frontal impact. In each test the angle between the base and the headform is measured.
The headform orientation is measured using two rotational potentiometers. One is installed on the base of the spine-pendulum interface. The second one is attached to the test head. The sum of the two angles measured on the potentiometers is the head relative to the pendulum angle.
The data acquisition system and all instrumentation must comply with the requirements of SAE J211, version March 1995. All data channels should be filtered using a hardware filter prior to A/D conversion according to SAE J211, version March 1995.

The pendulum acceleration should be measured with an accelerometer which is located on the pendulum arm, 1657.4 mm from the pendulum pivot in accordance with the CFR 49 Part 572.

The Lumbar Spine test is a component test, which is performed using a pendulum as defined in CFR49 part 572. The complete Lumbar Spine consists of the following parts:

DESCRIPTION	Q10 PARTS	QTY
Lumbar Spine Molding	010-6001	1
Lumbar Spine Cable	010-6100	1
Lumbar Spine mounting M6x55 SHCS screw	5001207	2
Nyloc Nut M8	5000486	1
Plain Washer	5000552	1
Screw SHCS M5 x 12	5000002	4
Load Cell Structural Replacement	010-2007	1

Table 17. Lumbar parts

14.9 Frontal Spine Test

Set-up

1. Remove the lumbar spine assembly, including the lower lumbar load cell (replacement), from the dummy.
2. Disassembly the disks of the headform and remount them in the correct position around the specific central block for Q10 TE-2650-14 for lumbar spine testing. See Figure 51.
3. Slide the lumbar spine-thorax interface bracket over the headform, such that the lumbar spine rubber column is symmetrically attached to the headform. Insert and tighten the two long M6 SHCS.
4. Attach the lumbar spine load cell replacement 010-2007 to the bottom plate of the lumbar spine using M5 x 12 SHCS.
5. Align the lumbar spine, making sure that longitudinal axis of the lumbar spine is in the direction of motion of the pendulum arm.
6. Attach the headform-spine system to the Part 572 pendulum arm. The front of the headform should point in the direction of motion of the pendulum. See Figure 51.
7. Install the potentiometers to the mounting interface and on the headform. Mount the balance weight for the potentiometer on the other side of the head. This ensures that the inertial properties of the head are symmetrical in the impact direction.
8. Insert the rod connecting the axes of the potentiometers and tighten the screw on the bottom-most axis (headform potentiometer) to secure the rod. The other end of the rod should be able to slide freely through the upper most transducer axis (pendulum base potentiometer). The rod must be protruding from both sides of the transducers axes equal length.
9. The minimum time interval to observe between tests on the lumbar spine is 30 minutes.

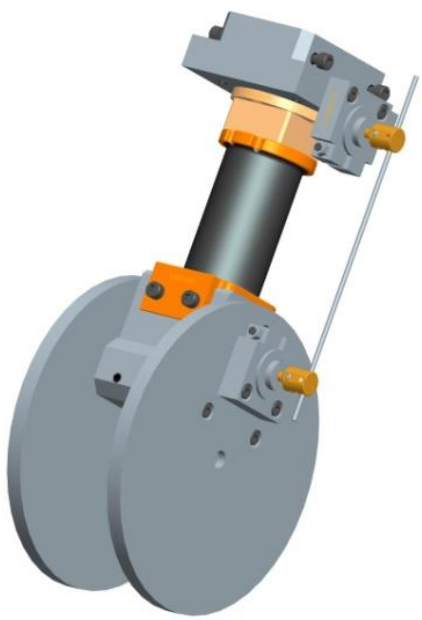


Figure 51. Q10 Lumbar Spine frontal set-up, view from rear in drop position

Performing the Test

1. To stop the pendulum, attach honeycomb material to the pendulum anvil. Use 152.4 mm (6”) thick aluminum Hexcel density 28.8 Kg/m^3 (1.8 lb/ft^3) with a number cells appropriate to meet the pulse requirement in Table 18.
2. Auto-balancing and shunt calibration of the transducer signals should be performed with the pendulum arm in the vertical position.
3. Lift the pendulum up to its pre-test height and check that the head is in the correct initial position. Do not leave the head-spine system in this position for more than 1 minute, as the neck will start to deform due to the mass-gravity loading of the headform.
4. Release the pendulum.

Data Processing

1. Filter the pendulum acceleration at CFC180.
2. Filter the potentiometer readings at CFC600.
3. Determine time zero of the impact by finding the 1 g deceleration level in the pendulum signal (after filtering).
4. Software zero all transducer readings by averaging the part of the signal before time zero and subtracting this from the transducer reading.
5. Integrate the pendulum acceleration to check the deceleration velocity of the pendulum. The velocity of the arm must be calculated at a point 1657.4 mm from the pendulum pivot point.
6. Sum the potentiometer signals to derive the total head relative to pendulum arm angle.

Requirements

1. The impact velocity should be 4.4 ±0.1 m/s.
2. The pendulum velocity decrease should be as indicated in the table below:

Time (ms)	Lower Limit (m/s)	Upper Limit (m/s)
10	0.9	1.9
20	2.3	3.4
30	3.4	4.6

Table 18. Pendulum Velocity

To meet the requirements of the frontal lumbar spine certification test:

- The maximum frontal rotation should be between 45.9 – 56.1 degrees.
- Time of maximum rotation 60.3 – 73.7 msec

14.10 Lateral Spine Test

Set-up

1. Remove the lumbar spine assembly, including the lower lumbar load cell (replacement), from the dummy.
2. Disassembly the disks of the headform and remount them in the correct position around the specific central block for Q10 TE-2650-14 for lumbar spine testing.

3. Slide the spine-thorax interface bracket end of lumbar spine over the headform central block such that the lumbar spine rubber column is symmetrically attached to the headform. Insert and tighten the two long M6 socket head screws.
4. Attach the lumbar spine load cell replacement 010-2007 to the bottom plate of the lumbar spine using M5 x 12 SHCS. Then attach the loadcell to the pendulum interface plate. Align the lumbar spine and the interface, making sure that lateral axis of the headform is in the direction of movement of the pendulum arm.
5. Attach the headform-spine system to the part 572 pendulum arm. The side of the headform should point in the direction of motion of the pendulum. See Figure 52.
6. Install the potentiometers to the mounting interface and on the headform's central block. Mount the balance weight for the potentiometer on the side of the headform's central block. This ensures that the inertial properties of the head are symmetrical in the impact direction. Refer to Figure 52 to indicate the proper position and orientation of the potentiometers.
7. Insert the rod connecting the axes of the potentiometers and tighten the screw on the bottom-most axis (headform potentiometer) to secure the rod. The other end of the rod should be able to slide freely through the upper most transducer axis (pendulum base potentiometer). The rod must be protruding from both sides of the transducers axes equal length.
8. The minimum time interval to observe between tests on the lumbar spine is 30 minutes.

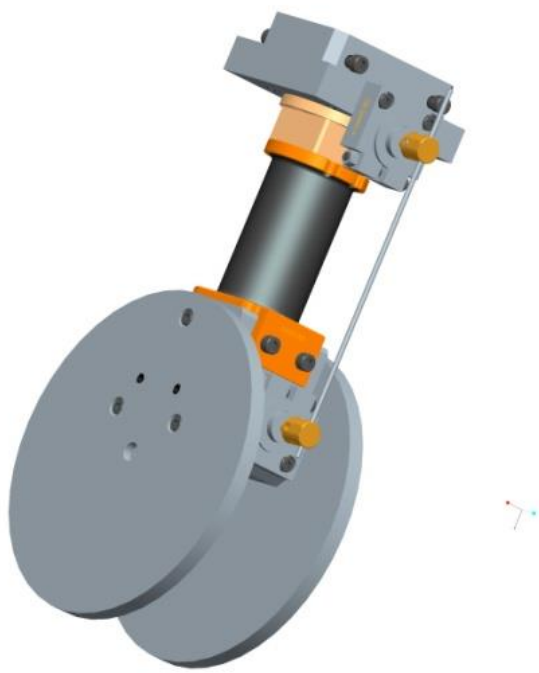


Figure 52. Q10 Lumbar Spine lateral set-up, view from rear in drop position

Performing the Test

1. Attach honeycomb material to arrest the pendulum to meet the pulse.
2. Auto-balancing and shunt calibration of the transducer signals should be performed with the pendulum arm in the vertical position.
3. Lift the pendulum up to its pre-test height and check that the head is in the correct initial position. Do not leave the head-spine system in this position for more than 1 minute, as the neck will start to deform due to the mass-gravity loading of the headform.
4. Release the pendulum.

Data Processing

1. Filter the pendulum acceleration at CFC180.
2. Filter the potentiometer readings at CFC600.
3. Determine time zero of the impact by finding the 1 g deceleration level in the pendulum signal (after filtering).
4. Software zero all transducer readings by averaging the part of the signal before time zero and subtracting this from the transducer reading.
5. Integrate the pendulum acceleration to check the deceleration velocity of the pendulum. The velocity of the arm must be calculated at a point 1657.4 mm from the pendulum pivot point.
6. Sum the potentiometer signals to derive the total head relative to pendulum arm angle.

Requirements
1. The impact velocity should be 4.4 ± 0.1 m/s.
2. The pendulum velocity decrease should be as indicated in the table below:

Time (ms)	Lower Limit (m/s)	Upper Limit (m/s)
10	0.9	1.9
20	2.3	3.4
30	3.4	4.6

Table 19. Pendulum Velocity

To meet the requirements of the lateral lumbar spine certification test:

- The maximum lateral rotation should be between 45.9 – 56.1 degrees
- Time of maximum rotation 60.3 -73.7 msec

14.11 Thorax Certification

General

A complete standard Q10 dummy, **<u>with the neck shield</u>** is used in this test. The dummy is to be tested with the suit. The hip shields do not need to be fitted to the dummy for certification testing.
Prior to the test, the dummy should be inspected for possible damage. It is particularly important for the thorax tests to check the condition of the rib cage, the shoulder spine interface and the clavicle.
No cracks or tears are allowed. Also check that all screws have been tightened.
As the performance of several components will affect this full body thorax impact test, make sure that this test is performed as the last test in the certification procedure, where all dummy parts have passed their applicable certification tests successfully.

The data acquisition system and all instrumentation must comply with the requirements of SAE J211, version March 1995. All data channels should be filtered using a hardware filter prior to A/D conversion according to SAE J211, version March 1995.

14.12 Frontal Impact Thorax Test

Instrumentation
The dummy must be equipped with two IF-372 IR-TRACCs to measure frontal chest deflection.
Use the 8.76 kg test probe as described in section 13.2.3, equipped with an accelerometer to measure the impact deceleration.
The impact velocity must be measured and recorded. This can be done with the speed vane on the test probe.

Test procedure.

1. Dummy positioning
   - The dummy should be seated on a clean dry surface, consisting of two sandwiched flat plates of 2 mm Teflon sheet, with the legs stretched forward towards the impactor.
   - Place the dummy with its thoracic spine in a vertical orientation, within ±1 degree to the vertical. The Q10 is stable enough to sit with the leg stretched forward without outwards leg rotation.
   - Make sure the dummy is motionless.
   - Place the upper arms vertically alongside the body, and let the lower arms rotate downward to let the hands touch the seating surface.
2. Impactor alignment
   - Let the impactor hang in its lowest position. Check that the probe is in a horizontal position, that is, within ± 2 degrees.
   - The impactor front surface should be directly in front of the dummy sternum within 5 mm.
   - The height of the center line of the impactor over the seating surface should be chosen in such a way, that the center line of the impactor aligns with the sternum and is mid-way ±1 mm between the upper and lower IR-TRACC to rib cage attachment points.
   - The center line of the Impactor should be in the mid-sagittal plane.
3. Make sure that the IR-TRACCs are mounted for frontal impact as the frontal impact test can cause damage to the IR-TRACCs when set-up in position for lateral impacts.
4. Measure and record the following signals:
   - Impact velocity with the speed vane on the probe.
   - Impactor acceleration
   - Upper and lower IRTRACC displacements
5. The minimum time interval to observe between tests on the thorax is 30 minutes.

Data Processing

1. All data channels should be filtered at CFC600.
2. Set time zero at the 1 g deceleration level in the impactor signal (after filtering with CFC600 software filter).
3. Software zero all transducer readings by averaging the part of the signal before time zero and subtracting this from the transducer reading.
4. Calculate the Impactor force by multiplying the impactor acceleration (in m/s2) with the impactor mass (8.76 kg)

Requirement
To pass the certification requirements for frontal thoracic impact:

1. The impactor velocity should be between 4.2 and 4.4 m/s.
2. The maximum averaged upper and lower thorax deflection should be between [-31.95] – [-39.05] mm
3. The peak force should be between [-1530] – [-1870] N

14.13 Side Impact Thorax Test

Instrumentation
The dummy must be equipped with two IF-372 IR-TRACCs to measure lateral chest deflection (see for changing the IR-TRACC direction paragraph 4.1.2).
The side being impacted in the tests must be the side that is certified.

Use the 8.76 kg test probe as described in section 13.2.3 equipped with an accelerometer to measure the impact deceleration.
The impact velocity must be measured and recorded. This can be done with the speed vane on the test probe.

Test procedure
1. Dummy positioning
   - The dummy should be seated on a clean dry surface, consisting of two sandwiched flat plates of 2 mm Teflon sheet, with the legs stretched forward perpendicular to the impact direction.
   - Place the dummy with its thoracic spine in a vertical orientation, within ±1 degree with the vertical.
   - Make sure the dummy is motionless.
   - Place the upper arms vertically alongside the body, and let the lower arms rotate downward to let the hands touch the seating surface.
   - Lift the arm on the impact side above and over the head. Tape the arm to the head to make sure the impactor cannot come in contact with the arm.

2. Impactor alignment
   - Let the impactor hang in its lowest position. Check that the impactor is in a horizontal position (within ± 2 degrees).
   - The impactor front surface should be within 5 mm distance of the most lateral rib surface.
   - The height of the center line of the impactor over the seating surface should be chosen in such a way, that the center line of the impactor is aligned midway between the two IRTRACC to rib cage attachment points at the side of the rib cage.
   - The center line of the Impactor should be in line with the vertical plane through IRTRACC to rib cage attachments at the side of the rib cage.
3. Make sure that the IR-TRACCs are mounted for lateral impact as the side impact test can cause damage to the IR-TRACCs when set-up in position for frontal impacts.
4. Measure and record the following signals:
   - Impact velocity with the speed vane on the probe.
   - Impactor acceleration
   - Upper and lower IRTRACC displacements
5. The minimum time interval to observe between tests on the thorax is 30 minutes.

Data Processing
1. All data channels should be filtered at CFC600.
2. Set the time zero at the 1 g deceleration level in the impactor signal (after filtering with CFC600 software filter).
3. Software zero all transducer readings by averaging the part of the signal before time zero and subtracting this from the transducer reading.
4. Calculate the impactor force by multiplying the impactor acceleration (in m/s2) with the impactor mass (8.76 kg).

Requirement
To pass the certification requirements for lateral thoracic impact:

1. The impactor velocity should be between 4.2 and 4.4 m/s.
2. The maximum averaged upper and lower IR-TRACC deflection should be between 24.39 – 29.81 mm
3. The peak force should be between 2025 – 2475 N

14.14 Shoulder Lateral Impact Test / Application for Frontal Dummy with Full Arms

Instrumentation
Use the 8.76 kg test probe as described in section 13.2.3 equipped with an accelerometer to measure the impact deceleration.
The impact velocity must be measured and recorded. This can be done with the speed vane on the test probe.

Test procedure

1. This test should be performed with the dummy in the frontal configuration (with upper and lower arms installed) and with the neck shield installed.

2. Dummy positioning
   - The dummy should be seated on a clean dry surface, consisting of two sandwiched flat plates of 2 mm Teflon sheet, with the legs stretched forward perpendicular to the impact direction.
   - Place the dummy with its thoracic spine in a vertical orientation, within ±1 degree with the vertical.
   - Make sure the dummy is motionless.
   - Place the upper arms vertically alongside the body, and let the lower arms rotate downward to let the hands touch the seating surface.
   - Impactor alignment
   - Let the impactor hang in its lowest position. Check that the Impactor is in a horizontal position (within ± 2 degrees).
   - The impactor front surface should be within 5 mm distance of the most lateral shoulder surface.
   - The height of the center line of the impactor over the seating surface should be chosen in such a way, that the center line of the impactor is aligned with the shoulder joint (midway between the three shoulder joint screw locations in the upper arm).
   - The center line of the Impactor should be in line with the vertical plane through the shoulder joint (midway between the three shoulder joint screw locations in the upper arm).

2. Measure and record the following signals:
   - Impact velocity with the speed vane on the probe.
   - Impactor acceleration
   - T1 acceleration in the Ay direction (measured on non-struck side).

3. The minimum time interval to observe between tests on the thorax is 30 minutes.

Data Processing

1. The Probe Force channel should be filtered at CFC600 and the T1 acceleration at CFC180.
2. Set the time zero at the 1 g deceleration level in the impactor signal (after filtering with CFC600 software filter).
3. Software zero all transducer readings by averaging the part of the signal before time zero and subtracting this from the transducer reading.
4. Calculate the impactor force by multiplying the impactor acceleration (in m/s2) with the impactor mass (8.76 kg).

Requirement
To pass the certification requirements for lateral shoulder impact, dummy with full arms:

1. The impactor velocity should be between 4.2 and 4.4 m/s.
2. The maximum T1 acceleration should be between 48.0 – 68.0 G (Provisional)
3. The maximum impact force should be between 2385 – 2915 N

14.15 Side Impact Pelvis Test

Instrumentation
Use the 8.76 kg test probe as described in section 13.2.3 equipped with an accelerometer to measure the impact deceleration.
The impact velocity must be measured and recorded. This can be done with the speed vane on the test probe.

Test procedure
1. Dummy positioning
   - The dummy should be seated on a clean dry surface, consisting of two sandwiched flat plates of 2 mm Teflon sheet, with the legs stretched forward perpendicular to the impact direction. To prevent curling of the Teflon sheet and potential interference with the probe, the dummy may be placed over the edge of the Teflon.
   - Place the dummy with its thoracic spine in a vertical orientation, within ±1 degree in X and Y from the vertical.
   - Align the legs so that the inner faces of the round part of the femur at the knee are approximately 98 mm apart. The toes and knees must be pointing upward. To ensure the legs are correctly positioned you can check by putting an Allen key into the knee pivot screw or leg attachment screw. The Allen key should be horizontal. Note: you cannot use a ball ended Allen key for this check.
   - Place the upper arms so that they are resting on the upper legs as shown in Figure 53.
   - Make sure the dummy is motionless.

Figure 53. Front view of pelvis certification setup

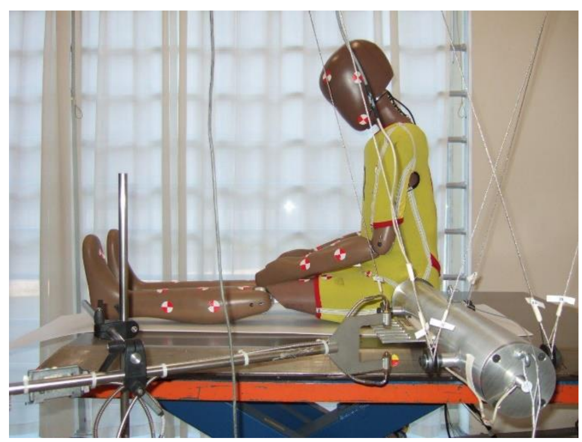


Figure 54. Side view of pelvis certification setup

2. Impactor alignment

- Let the impactor hang in its lowest position. Check that the Impactor is in a horizontal position (within ± 2 degrees).
- The impactor front surface should be within 5 mm distance of the most lateral pelvis surface.
- The height of the center line of the impactor over the seating surface should be chosen in such a way, that the center line of the impactor is aligned with the H-point. This should be 66 mm above the Teflon sheeting (not including suit thickness) and 358 mm from the knee pivot.
- The center line of the Impactor should be in line with the vertical plane through the H-point. There is a raised dimple in the flesh at the outer H-point impact point that is correctly positioned when the above dummy positioning is carried out.

3. Measure and record the following signals:
   - Impact velocity with the speed vane on the probe.
   - Impactor acceleration.
   - Pubic Symphysis load obtained from the pubic load cell if fitted.
4. The minimum time interval to observe between tests on the thorax is 30 minutes.

Data Processing

1. All data channels should be filtered at CFC600.
2. Set the time zero at the 1 g deceleration level in the impactor signal (after filtering with CFC600 software filter).
3. Software zero all transducer readings by averaging the part of the signal before time zero and subtracting this from the transducer reading.
4. Calculate the impactor force by multiplying the impactor acceleration (in m/s2) with the impactor mass (8.76 kg).

Requirement

To pass the certification requirements for lateral thoracic impact:

1. The impactor velocity should be between 4.2 and 4.4 m/s.
2. The maximum Pubic Symphysis load requirement is under development, but the data should be recorded.
3. The maximum impact force should be between 3735 – 4565 N

14.16 Abdomen Certification

General

The abdomen test is a component test. The abdomen should be removed from the dummy. The test equipment is described in section 13.2.4. To test the correct performance of the dummy abdomen an "Additional weight" is placed on the top plate and the additional flat plate intrusion is measured.

Instrumentation

The only instrumentation necessary to perform this test is a caliper rule or dial test indicator to measure the distance difference between the two plate heights before and after application of the additional mass.

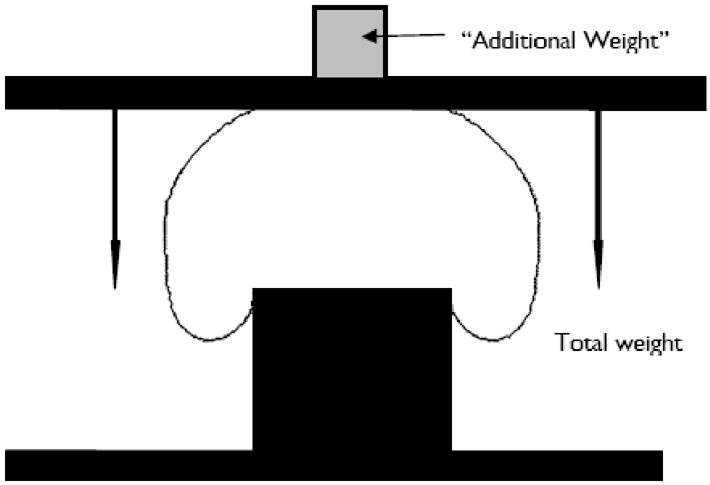


Figure 55. Abdomen Certification Test set-up

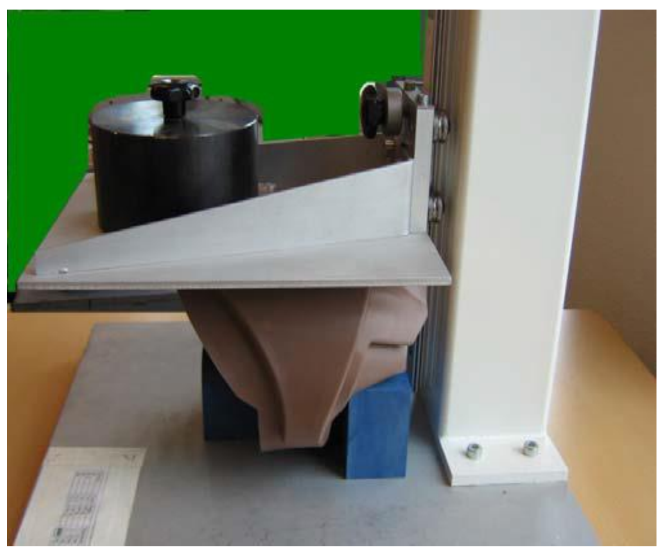



Figure 56. Abdomen Certification Test set-up

Description	Q10 Weight
“Flat plate mass”	2.05 ± 0.025 kg.
“Additional mass”	8.05 ± 0.025 kg.
“Total mass”	10.10 ± 0.050 kg.
Abdomen support part no.	TE-010-9910

Table 20. Weight

Test Procedure
1. Place the abdomen on the appropriate Q10 abdomen certification support (TE-010-9910). Ensure a good fit and orientation of the abdomen over the block. Lower the top plate (with a weight of 2.05 ±0.025 kg.) on the abdomen. Within 10 seconds determine this point as zero for the displacement measurement then apply an additional weight of 8.05 kg ±0.025 onto the top plate

2. Let the top plate compress the abdomen for a period of 2 minutes (± 10 sec.).

3. Read the measurement.

4. Remove the mass and top plate.

5. Observe an interval of at least 30 minutes between successive tests on the same abdomen.

Data Processing
Subtract the final reading from the initial reading

Requirement
The deformation of the abdomen should be between 8.4 – 12.4 mm.

14.17 Shoulder Lateral Impact Test / Application for Side Impact Shoulder Kit

Instrumentation
Use the 8.76 kg test probe as described in section 13.2.3 equipped with an accelerometer to measure the impact deceleration.
The impact velocity must be measured and recorded. This can be done with the speed vane on the test probe.

Test procedure

1. This test is performed with the Side Impact shoulder kit fitted (upper short arm) along with torso interface plate with flats for T1 accelerometer mounting and with the neck shield.

2. Dummy positioning

- The dummy should be seated on a clean dry surface, consisting of two sandwiched flat plates of 2 mm Teflon sheet, with the legs stretched forward perpendicular to the impact direction.
- Place the dummy with its thoracic spine in a vertical orientation, within ±1 degree with the vertical.
- Make sure the dummy is motionless.
- Place the upper arms vertically alongside the body.
- Impactor alignment
- Let the impactor hang in its lowest position. Check that the Impactor is in a horizontal position (within ± 2 degrees).
- The impactor front surface should be within 5 mm distance of the most lateral shoulder surface.
- The height of the centerline of the impactor over the seating surface should be chosen in such a way, that the centerline of the impactor is aligned with the shoulder joint. This is on the centerline of the two side holes at the top of the upper arm. These can be felt through the suit.
- The centerline of the Impactor should be in line with the vertical plane through the shoulder joint. Therefore the vertical center of the arm flesh.

2. Measure and record the following signals:
   - Impact velocity with the speed vane on the probe.
   - Impactor acceleration
   - T1 acceleration in the Ay direction (measured on non-struck side).
3. The minimum time interval to observe between tests on the thorax is 30 minutes.

Data Processing

1. The Probe Force channel should be filtered at CFC600 and the T1 acceleration at CFC180.
2. Set the time zero at the 1 g deceleration level in the impactor signal (after filtering with CFC600 software filter).
3. Software zero all transducer readings by averaging the part of the signal before time zero and subtracting this from the transducer reading.
4. Calculate the impactor force by multiplying the impactor acceleration (in m/s2) with the impactor mass (8.76 kg).

Requirement

To pass the certification requirements for the Shoulder lateral impact test for Side Impact Shoulder Kit:
These corridors are provisional until further results can finalize.

1. The impactor velocity should be between 4.2 and 4.4 m/s.
2. The maximum T1 acceleration 47.7 to 58.3
3. The maximum impact force 2199 to 2688 N

14.18 Mass Grouping

Q10 Segment Assembly	Mass (kg)	Tolerance +/-
Head & Upper Neck L.C	3.695	0.10
Neck & interface	0.515	0.05
Thorax, Neck Shield, Lower Neck L.C.	4.482	0.20
Pelvis, Abdomen & Lumbar Spine	9.798	0.30
Upper Arm (each)	1.09	0.05
Lower Arm & Hand (each)	0.90	0.05
Upper Leg (each)	3.71	0.10
Lower Leg & Foot (each)	2.53	0.12
Suit	0.63	0.1
Total	**35.58**	**0.60**

Table 21. Q10 Assembly Masses

(Masses specified are based on anthropometry requirements but the values are adapted to a practical grouping of parts.

14.19 Q10 External Dimensions

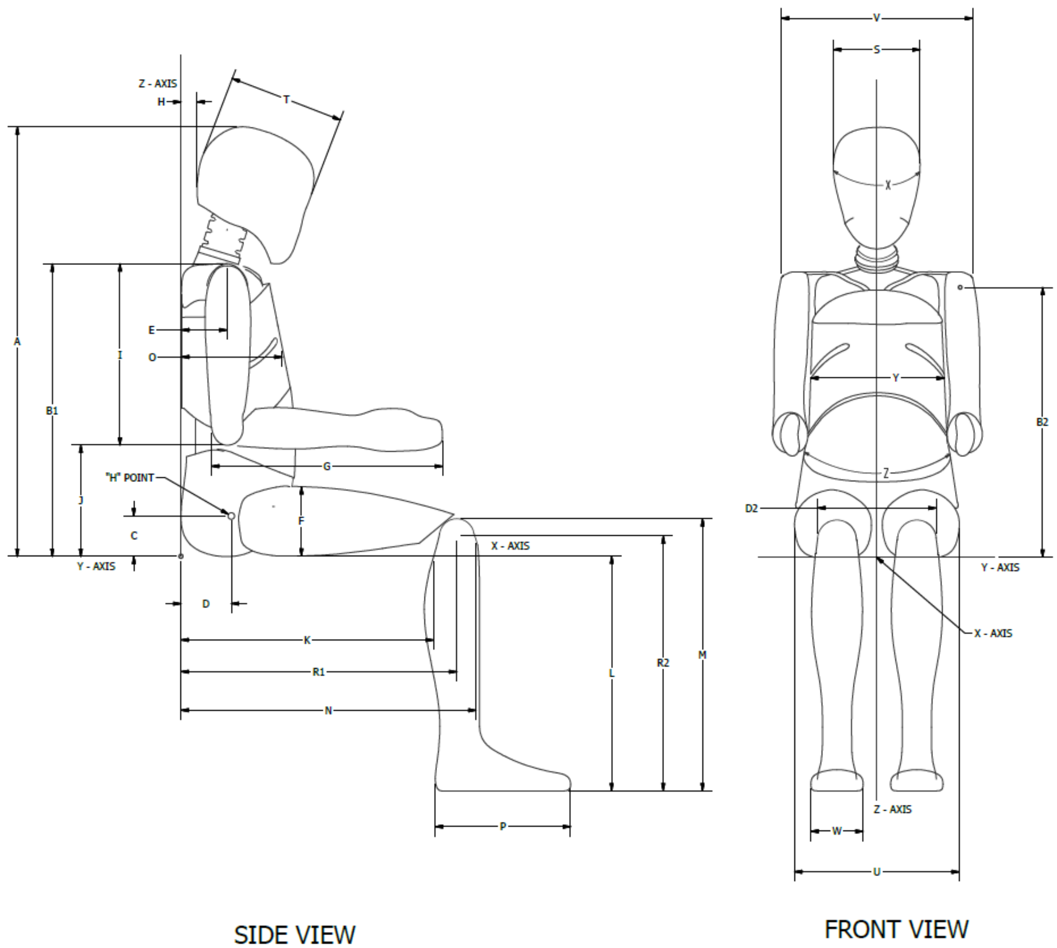


Figure 57. External Dimension Measurement

EXTERNAL DIMENSIONS			
SYMBOL	DESCRIPTION *	SPEC. (MM)	TOL.± (MM)
A1	Total Sitting Height (head tilt forward 27°)	733.7	9
A2	Sitting Height (erected measured via T1)	748.4	9
A3	Sitting Height (erected measured via mid neck)	738.5	9
B1	Shoulder Height (top of arm)	472.6	6
B2	Shoulder Pivot Height	443.8	6
C	Hip Pivot Height	65.9	3
D1	Hip Pivot From Backline	90.4	3
D2	Hip Joint Distance	132.0	3
E	Shoulder Pivot From Backline	75.4	6
F	Thigh Height	114.0	3
G	Lower Arm & Hand Length	376.2	6
H	Head Back from Backline	32.4	3
I	Shoulder to Elbow Length	291.6	3
J	Elbow Rest Height	181.0	9
K	Buttock Popliteal Length	414.9	6

EXTERNAL DIMENSIONS			
SYMBOL	**DESCRIPTION ***	**SPEC. (MM)**	**TOL.± (MM)**
L	Popliteal Height	405.7	6
M	Floor to Top of Knee	451.0	6
N	Buttock to Knee Length	485.4	6
O	Chest Depth at Nipples	171.0	3
P	Foot Length	220.0	3
Q1	Standing Height (head tilt forward 27°)	1453.2	9
R1	Buttock to Knee Pivot Length	448.4	6
R2	Floor to Knee Pivot	422	6
S	Head Breadth	144	3
T	Head Depth	186.5	3
U	Hip Breadth	271.5	6
V	Shoulder Breadth	334.8	6
W	Foot Breadth	86	3
X	Head Circumference	534	6
Y1	Chest Circumference at Axilla Height	594.4	6
Y2	Chest Circumference at Nipples Height	623.6	6
Z	Waist Circumference (target: standing actual: sitting)	664.6	6

Table 22. External Dimensions

*Measurements are valid for dummy without suit

14.20 Q10 Certification Equipment

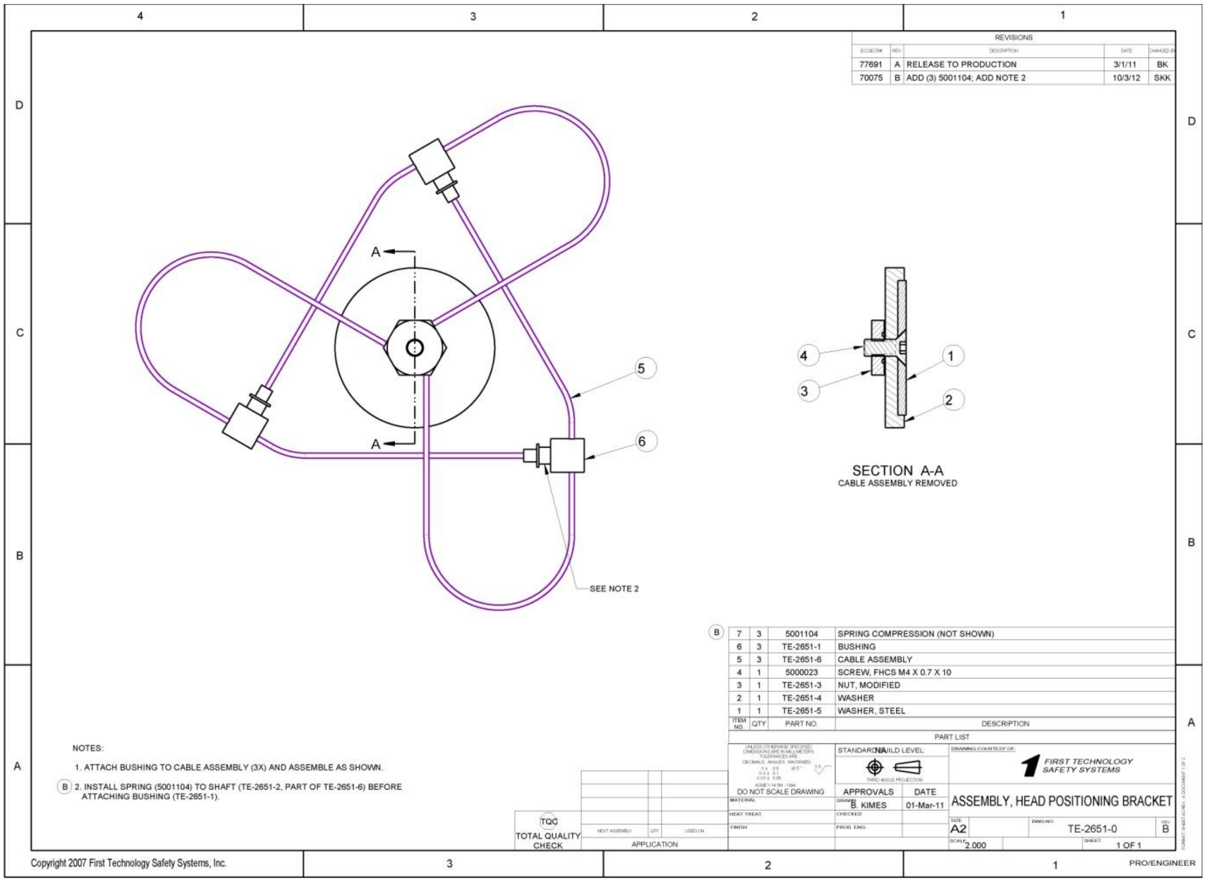
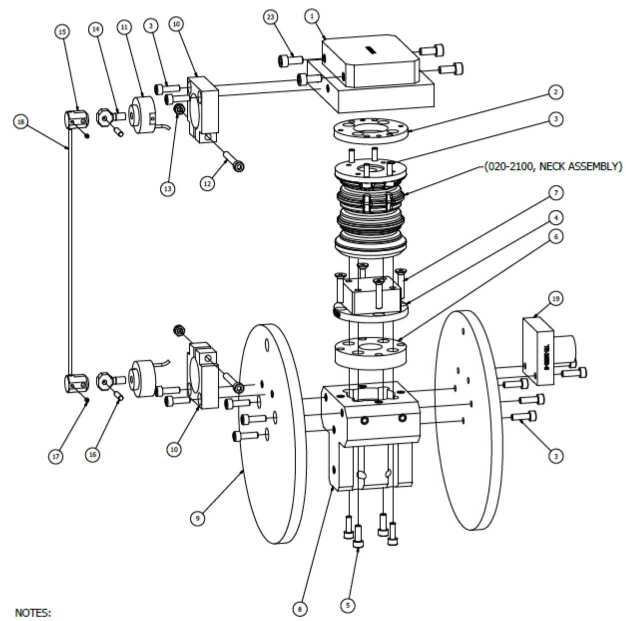
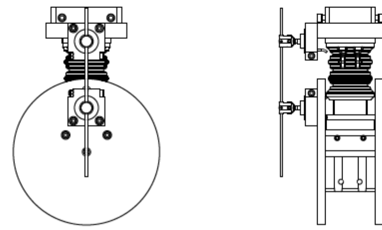


Figure 58. TE-2651 Head drop fixture





REVISION HISTORY					
ECO#	REV	DESCRIPTION	BY	ENG'R.	DATE
	A	RELEASE TO PRODUCTION	BK		4/6/05
6063	B	ADD TE-2650-13 & WEIGHT CHART	BK		10/02/06
77818	C	REDRAWN, SHEET 1 VIEWS REORIENTED REMOVED NOTE 1, ADDED NOTE 3, CLARIFIED NOTE 4 REVISED MASS TABLE AND SPEC DELETED TE-2650-13 ADDED (4) 5000002, (2) 020-9902, (2) 5000865 ADDED SHEETS 2 & 3 WITH ADDITIONAL NECK & LUMBAR CONFIGURATION VIEW	DW		3/11/11
77885	D	ADD (4) 5000604	BK		5/19/11
71583	E	REDRAWN IN INVENTOR; 5001207 WAS 5000865; ADD 5000096; UPDATE SHEET 2 VIEW TO SHOW (REF) IF-217-HC LC; UPDATE SHEET 3 VIEW TO SHOW (REF) 010-2007 LC S.R.; UPDATE SOME ASSEMBLY NOTES; CLARIFY REF NOTES TO ADD SOLD SEPERATELY	DW	DW	3/13/2014

NOTES:

1. TIGHTEN 5000156 AND 5000628 LIGHTLY ONLY.
2. PRESS FIT 5000477 INTO TE-2650-5 AS SHOWN.
3. (C) NECK LOAD STRUCTURAL REPLACEMENT SHOWN FOR ASSEMBLY PURPOSES ONLY. ACTUAL LOAD CELL WILL BE USED IN NECK CONFIGURATION. STRUCTURAL REPLACEMENT WILL BE USED IN LUMBAR CONFIGURATION. SEE SHEET 3.
4. (C) MASSES FOR LOWER PORTION OF CALIBRATION FIXTURE (PARTS REPRESENTING HEAD MASS) ARE TABULATED AT RIGHT.

ITEM #	PART #	QTY	MASS (kg)	TOTAL (kg)
3	5000020	10	0.004	0.040
5	5000300	4	0.004	0.016
6	TE-2650-11	1	0.220	0.220
7	5000394	4	0.005	0.020
8	TE-2650-2	1	0.650	0.650
9	TE-2650-3	2	0.762	1.524
10	TE-2650-4	1	0.050	0.050
11	6002209	1	0.020	0.020
12	5000628	1	0.008	0.008
13	5000156	1	0.002	0.002
14	TE-2650-5	1	0.010	0.010
15	TE-2650-6	1	0.016	0.016
18	TE-2650-7	1/2	0.011	0.006
19	TE-2650-8	1	0.115	0.115
TOTAL MASS: 2.700 kg ± .050 kg				

ITEM	QTY	PART NUMBER	DESCRIPTION
24	4	5000096	M5 X 0.8 X 12 LG. FHCS
23	4	5000604	M6 X 1 X 14 LG. SHCS
22	2	5001207	M6 X 1 X 55 LG. SHCS SS
21	2	020-9902	SCREW, LUMBAR SPINE MOUNTING
20	4	5000002	M5 X 0.8 X 12 LG. SHCS
19	1	TE-2650-8	BALANCE WEIGHT
18	1	TE-2650-7	ROD
17	2	5000470	M3 X 0.5 X 4 LG. SSSCP SS
16	2	5000477	M4 X 16 LG. DOWEL PIN SS
15	2	TE-2650-6	FORK
14	2	TE-2650-5	POT SHAFT
13	2	5000156	M5 X 0.8 HEX LOCK NUT SS
12	2	5000628	M5 X 0.8 X 40 LG. SHCS SS
11	2	6002209	ROTARY POT
10	2	TE-2650-4	POTENTIOMETER YOKE
9	2	TE-2650-3	HEAD FORM DISC
8	1	TE-2650-2	CENTRAL BLOCK
7	4	5000394	M5 X 0.8 X 25 LG. FHCS
6	1	TE-2650-11	SPACER, FLEXION HEAD FORM
5	4	5000300	M5 X 0.8 X 14 LG. SHCS
4	1	020-2007	LOAD CELL STRUCTURAL REPLACEMENT
3	16	5000020	M5 X 0.8 X 16 LG. SHCS
2	1	TE-2650-9	NECK/TORSO INTERFACE PLATE
1	1	TE-2650-1	PENDULUM INTERFACE

PARTS LIST

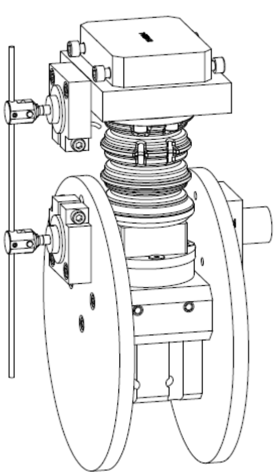
HUMANETICS Innovative Solutions

HEADFORM/CALIBRATION, LUMBAR SPINE & NECK, Q DUMMIES

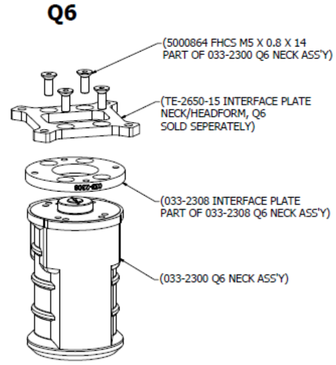
A1 1 OF 3 TE-2650 E

NECK CONFIGURATIONS / SPECIAL ASSEMBLIES

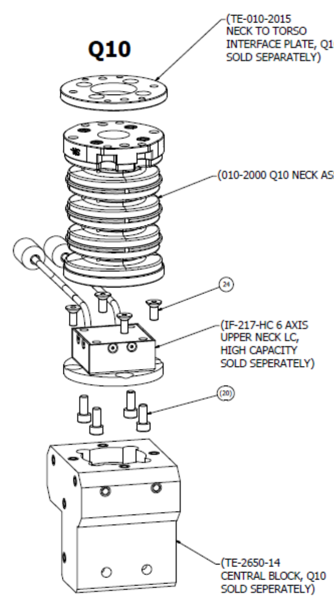
Q1 / Q1.5 / Q3



Q6



Q10



NOTES:

1. Q1 / Q1.5 / Q3: HEAD FORM IS ASSEMBLED AS SHOWN ON SHEET 1.
2. Q6: REPLACE EXISTING 033-2308 INTERFACE PLATE (PART OF 033-2300 Q6 NECK ASSEMBLY) WITH TE-2650-15. ASSEMBLE WITH EXISTING M5 X 0.8 X 14 FHCS (ALSO PART OF 033-2300). OTHERWISE, ASSEMBLE ACCORDING TO SHEET 1 VIEW.
3. Q10: ASSEMBLE TE-010-2015 IN PLACE OF TE-2650-9 & TE-2650-14 IN PLACE OF TE-2650-2, IF-217-HC LOADCELL IN PLACE OF 020-2007, M5 X 12 FHCS IN PLACE OF M5 X 25 FHCS AND M5 X 12 SHCS IN PLACE OF M5 X 14 SHCS. OTHERWISE, ASSEMBLE HEADFORM AS SHOWN IN SHEET 1.

HUMANETICS Innovative Solutions

HEADFORM/CALIBRATION, LUMBAR SPINE & NECK, Q DUMMIES

TE-2650 E

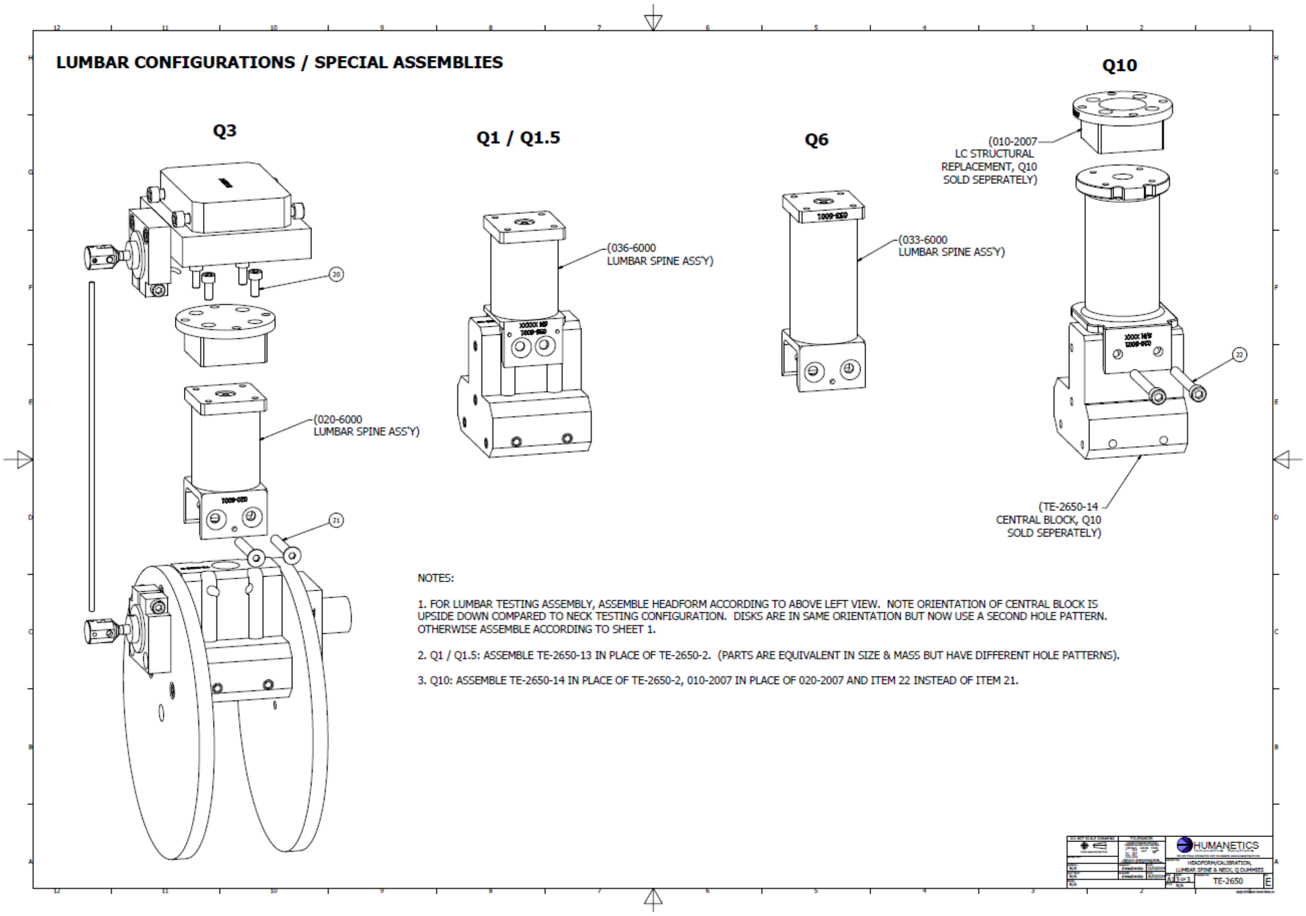


Figure 59. TE-2650 Neck and Lumbar Pendulum

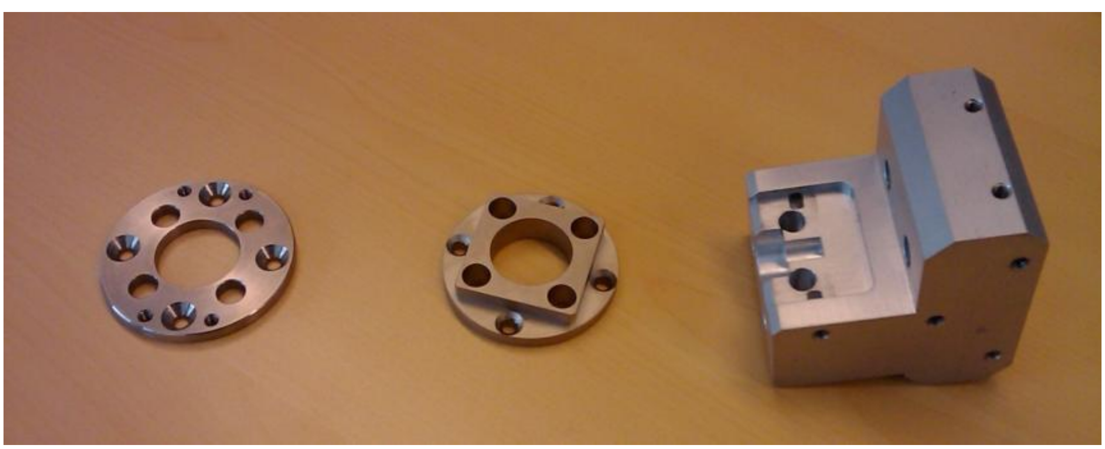


Figure 60. Picture showing from the left, neck adaptor plate (TE-010-2015), head drop ballast TE-010-1007 and lumbar central block TE-010-2650-14

Section 15 Dummy Setup and Positioning Procedure

15.1 Guidelines for set-up and positioning

This chapter provides some guidelines for setting up and positioning the dummy in the crash test environment. The outline presented here will be verified in a setup and positioning workshop to be organised by stakeholders from regulatory bodies, consumer organisations and car as well as child restraint system manufacturers. After this workshop the procedures given here are to be confirmed.

- Before using a dummy in a test make sure that it is appropriately inspected and certified according to the required (company) quality procedures.

- Instrument the dummy with the required instrumentation to obtain the desired data recordings. (Check if the IR-TRACCs are mounted in the appropriate direction.)

- Set all extremity joints (Shoulders, Elbows, Hips and Knees) to the desired friction setting.

- Install the dummy in the crash test environment according to the test protocol.
  Here an extensive description of the dummy setup and positioning steps can be incorporated.
    - *Put the dummy on the Child Restraint System or seat*
    - *Push the lower torso and legs backward in the seat so that the back of the buttocks engage with the seat back*
    - *For frontal testing fit the hip shields 154 min apart. See section 10 figures 38 and 39.*
    - *Apply the seat belt in the appropriate way over the dummy and tighten it according to the test protocol*
    - *Ensure that the dummy is centered in the desired position*
    - *Put the legs straight forward with a distance of TBA mm between the knees*
    - *Let the upper arms align with the torso as suitable in the given seat environment.*
    - *Put the lower arms with the hands on top of the upper leg thighs*

- After setup and positioning the dummy and the seat belt, appropriate static measurements should be taken to control and document the dummy position and the seat belt routing.
  Possible features that can be used:
    - Head, Thorax and Pelvis tilt angles φx and φy. See Figure 61 below for head levelling fixture. This is inserted into the holes in the top of the head and can be used for forward and side levelling. An inclinometer is placed on top of the tool.
    - Position measurement relative to the crash test environment features (tape measure) or a global coordinate system (Faro-Arm). To facilitate this, the dummy is equipped with numerous markers (see Figure 62).
    - Level indicator measurements on upper torso and extremities (see Figure 62).

Figure 61. Q Dummy head levelling tool TF-100-1060

15.2 Marker and Instrumentation locations

In this section the location coordinates of the markers and the instrumentation is specified. Moreover some relevant joint location coordinates (Shoulder and Hip joints) and dimensions (such as chest depth IRTRACC length and Knee distance) are specified.

15.2.1. General

Coordinate Systems

The coordinates are specified in local coordinate systems per body part:

- Head and Neck
  Origin: Occipital Condoyle
  Directions: X-axis forward, Y-axis to the right, Z-axis downward (along the neck centerline which is tilt forward 27 degrees with respect to the thoracic spine)
- Torso
  Origin: In Erected seating the intersection of Seat back-, Seating- and Mid-sagittal-plane
  Directions: X-axis forward, Y-axis to the right, Z-axis downward
- Arms
  Origin: Elbow joint center, Upper arm bone vertical, Lower arm bone horizontal
  Directions: X-axis forward, Y-axis outward, Z-axis downward
- Legs
  Origin: Knee joint center, Upper leg bone horizontal, Lower leg bone vertical
  Directions: X-axis forward, Y-axis outward, Z-axis downward

Accuracy

The specified coordinates are theoretical values obtained from the 3D design model. In practice, parts production and dummy assembly will result in deviations. In general the tolerance to be anticipated is ±5 mm. If soft parts such as neck, rib cage, lumbar spine and upper leg flesh are involved in the buildup of specified dimensions, the tolerance to be anticipated can increase up to ±9 mm. These values are specified between brackets.

15.2.2. Markers location coordinates and relevant dimensions

Markers on the dummy are depicted in Figure 62 and listed in tables 23 through 26. The markers on the dummy have different character. Anticipating the use of a FARO-arm with a pointer ball (radius of 2 mm), the ball point center is specified. The different marker characters are:

- Dimple
  Ball diameter 4.1 mm and diameter at dummy surface 3.0 to 3.5 mm.
  Anticipated Ball Center (BC) 1.0 mm outside dummy contour.
- Hex recess of screw head:
  - Hex 3 mm: Anticipated Ball Center (BC) 1.0 mm outside screw head top face
  - Hex 4 and Hex 5 mm: Anticipated Ball Center (BC) 2.0 mm from bottom of Hex recess
- Diameter hole 3.5 mm: Anticipated Ball Center (BC) 1.0 mm from screw tip
- Ball diameter 3 mm: Anticipated Ball Center (BC) 1.0 mm outside screw head top face (difficult to define)

Blue dots - existing on the prototype dummy
Red dots – introduced in production version
Green rectangles – Locations to use a level indicator

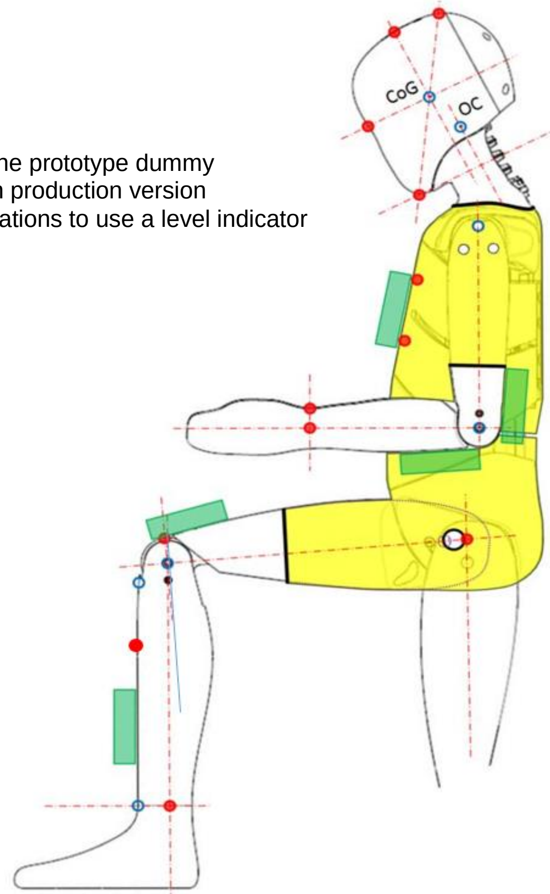


Figure 62. Marker positions on the dummy

Point Description	X [mm]	Y [mm]	Z [mm]	Remark
Occipital Condoyle (OC) (Upper Neck load cell center)	0.0	0.0	0.0	
Center of Gravity (CoG)	16.0	0.0	-50.9	
Marker dimples OC Left and Right	0	±58.4	0	BC - Dimple
Marker dimples CoG Left and Right	16.0	±70.0	-50.9	BC - Dimple
Marker dimple CoG Top	16.0	0.0	-145.2	BC - Dimple
Marker dimple CoG Front	99.3	0.0	-50.9	BC - Dimple
Marker dimple Top rear (33 degr nose up from vertical)	-42.8	0.0	-141.4	BC – Dimple (to be implemented)
Marker dimple Chin (33 degr nose up from vertical)	84.1	0.0	54.0	BC – Dimple (to be implemented)

Table 23. Markers Head and Neck, Origin: Occipital Condoyle

Point Description	X [mm]	Y [mm]	Z [mm]	Remark
Ball centers Shoulder joints	75.0	(±130.1)	(-443.8)	
Screw head recess Upper IRTRACC to rib attachment (frontal)	(154.7)	0.0	(-381.3)	BC – Hex 3 mm
Screw head recess Upper IRTRACC to rib attachment (lateral)	(75.0)	(±108.0)	(-343.4)	BC – Hex 3 mm
Screw head recess Lower IRTRACC to rib attachment (frontal)	(170.7)	0.0	(-301.3)	BC – Hex 3 mm
Screw head recess Lower IRTRACC to rib attachment (lateral)	(75.0)	(±112.0)	(-263.4)	BC – Hex 3 mm
Chest depth Upper IRTRACC (frontal , no suit)				Distance 155.0 mm
Chest depth Upper IRTRACC (Lateral left to right, no suit)				Distance 217.6 mm
Chest depth Lower IRTRACC (frontal, no suit)				Distance 171.0 mm
Chest depth Lower IRTRACC (Lateral left to right, no suit)				Distance 225.8 mm
Ball centers Hip joints	90.2	± 65.6	-66.1	

Table 24. Markers Torso, Origin: Erected seating, intersection of Seat back-, Seating- and Mid-sagittal-plane

Point Description	X [mm]	Y [mm]	Z [mm]	Remark
Screw head recess of Top screw of shoulder joint	0.0	-8.6	-257.8	BC - Hex 4 mm
Screw head recess Elbow	0.0	16.7	0.0	BC - Hex 5 mm
Ball center Shoulder joint	0.0	-14.6	-238.0	BC - Hex 5 mm
Marker dimple Wrist (outer)	195.7	17.1	0.0	BC - Dimple
Marker dimple Wrist (top)	195.7	0.0	-24.4	BC - Dimple

Table 25. Markers Arms, Origin: Elbow joint center, Upper arm bone vertical, Lower arm bone horizontal

Point Description	X [mm]	Y [mm]	Z [mm]	Remark
Marker ball (d = 3 mm) H-point	(-359.5)	(-68.8)	(-8.5)	BC - Ball
Screw head recess Knee (LHS, RHS opposite)	0.0	-25.7 or 29	0.0	BC - Hex 5 mm (RHS) or BC - D=3.5 mm (LHS)
Ball center Hip joint	-359.4	0.0	0.2	
Marker dimple Tibia (front near knee)	36.2	0.0	30.0	BC - Dimple
Marker dimple Tibia (front mid tibia)	38.0	0.0	109.0	BC - Dimple
Marker dimple Ankle (front)	38.0	0.0	309.0	BC - Dimple
Marker dimple Ankle (outer)	0.0	24.9	309.0	BC - Dimple
Marker dimple Ankle (inner)	0.0	-24.9	309.0	BC - Dimple
Distance between Knee centers and Tibia center lines				Distance 130.7 mm
Gap between Knees				Distance 67.5 mm

Table 26. Markers Legs, Origin: Knee joint center, Upper leg bone horizontal, Lower leg bone vertical

15.2.3. Instrumentation location coordinates and relevant dimensions

Point Description	X [mm]	Y [mm]	Z [mm]	Remark
Head accelerometers intersection point (CoG)	16.0	0.0	-50.9	
Upper Neck Load Cell center (at the OC)	0.0	0.0	0.0	
Lower Neck Load Cell center	0.0	0.0	(124.6)	
Head and Neck forward tilt		27 Deg		

Table 27. Markers Head and Neck, Origin: Occipital Condoyle

Point Description	X [mm]	Y [mm]	Z [mm]	Remark
Lower Neck Load Cell center	40.3	0.0	(-478.2)	
T4 accelerometers intersection point	27.00	0.0	(-427.9)	
Upper IRTRACC length (frontal)				Distance 106.2 mm
Upper IRTRACC hinge point at rib side (frontal)	(136.2)	0.0	(-386.0)	
Upper IRTRACC hinge point at spine side (frontal)	30.0	0.0	(-386.0)	
Upper IRTRACC length (lateral)				Distance 91.8 mm
Upper IRTRACC hinge point at rib side (lateral)	(75.0)	90.5	(-350.6)	
Upper IRTRACC hinge point at spine side (lateral)	90.2	0.0	(-350.6)	
Lower IRTRACC length (frontal)				Distance 122.2 mm
Lower IRTRACC hinge point at rib side (frontal)	(152.15)	0.0	(-306)	
Lower IRTRACC hinge point at spine side (frontal)	30.0	0.0	(-306)	
Lower IRTRACC length (lateral)				Distance 95.8 mm
Lower IRTRACC hinge point at rib side (lateral)	(75.0)	94.6	(-270.6)	
Lower IRTRACC hinge point at spine side (lateral)	90.1	0.0	(-270.6)	
Lower Lumbar load cell center	47.6	0.0	-127.5	
Pelvis accelerometers intersection point	62.9	-0.8	-58.3	
Pubic Load Cell center	131.8	0.0	-55.0	
Iliac to Sacrum Load Cells centers	30.4	±17.7	-73.5	Load cell to be designed

Table 28. Markers Torso, Origin: Erected seating, intersection of Seat back-, Seating- and Mid-sagittal-plane

Section 16 IR-TRACC Processing

16.1 2D IR-TRACC ‘Absolute Length’ 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 with respect to the thoracic spine. The Absolute Length Verification Procedure was developed to facilitate this and is applicable to the 2D IR-TRACCs implemented in the WorldSID dummies and the Q10 dummy. The 2D IR-TRACCs can be implemented in the Q10 dummy in left hand, right hand and in frontal orientation.

This manual section provides information how to implement the resulting verification and calibration parameters in the data acquisition system and/or post processing software (paragraph 16.3) dependent on the IRTRACC orientation in the dummy.

There are two important benefits of Absolute Length Verification.

- 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 calibration parameters.
- When changing over the IR-TRACC position from Left side to Right side, one only has to correct the Reference angle parameter in DAS or post process; all other calibration parameters and post processing formulas will remain the same and are independent of the orientation of the IR-TRACC.

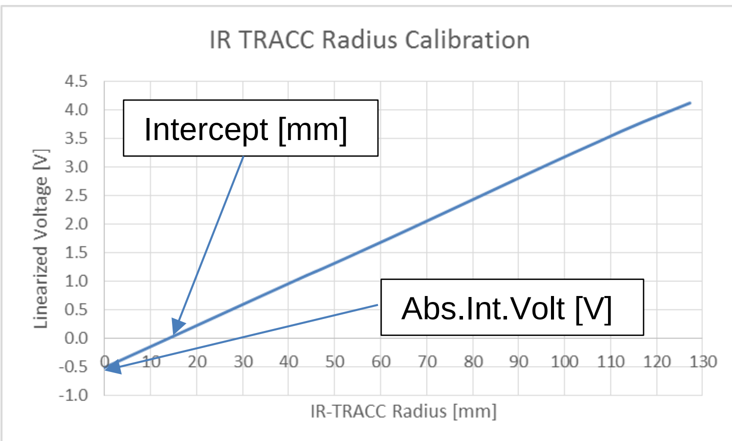
<u>IMPORTANT NOTE:</u> the Absolute Length Verification procedure shall be carried out after replacement of a ball joint or angle sensor, as these items affect Absolute Intercept and Reference Angle and Polarity.

16.2 Theory of the procedure

When the 2D IR-TRACC absolute length 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 Absolute Length Verification defines the coordinate system according SAE-J211 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 figure 63. The length calibration factors are also given in inverse units: the Inverse CF (slope) in [V/mm] and the Absolute Intercept Voltage [V]. The relation between Intercept in mm and Volts is given in figure 64.

2D IR-TRACC ASSEMBLY- ABSOLUTE LENGTH VERIFICATION SHEET Applies for Right Hand Side IR-TRACC Orientation							Calculate IRTRACC Radius using formula: R = (Vsensor ^ -0.5) * 27.16+14.06		
IR-TRACC		Angle Sensor			Date	06-Mar-15	Absolute Length Calibration Factors		
Test No.	21315DT4252	Test Nr.	21315DT1574		TEST No.	7936	Linearization exponent		-0.5000
Model No.	IF-372-R2	Model / SN	3720-11		Technician	Helmut Loth	Calibration Factor [mm/V]		27.1558
Serial No.	DT4252	Ang cal/polarit	0.003141	V_{sen}/V_{exc}/deg	Temp / Hum	22,1/30,3	Absolute Intercept [mm]		14.06
Calibration Range [mm]	87	Excitation [V]	5.0002	90	REF Length [mm]	105	127.23	Inv CF [V/mm] 0.03682	Abs.Interc.[V] -0.51739
V_{REF} Length [V]	0.0892	V_{REF} Angle [V]	0.0454	$\varphi 0ffset_{Sensor}$ [deg]	2.89	φ_{IRT} [deg]	R [mm]	x [mm]	y [mm]
V_{REF} Tubes In [V]	0.0893	V_{REF} far [V]	0.0425	φ_{REF} RIGHT	-87.11	89.8	104.9	0.3	104.9
V_{REF} Tubes Out [V]	0.0890	V_{REF} near [V]	0.0482	Ang cal/polarity	0.003141	90.2	105.1	-0.3	105.1
IR-TRACC pos1 [V]	0.0782	Ang pos1 [V]	-0.2480	φ_{REF} LEFT	92.89	71.3	111.2	35.6	105.3
IR-TRACC pos2 [V]	0.0000	Ang pos2 [V]	0.0000	φ_{REF} FRONT	2.89	87.1			

Figure 63. Example 2D-IR-TRACC assembly Absolute Length verification sheet



Absolute Length Calibration Factors		
Linearization exponent		-0.5000
Calibration Factor [mm/V]		27.0425
Absolute Intercept [mm]		14.44
127.40	Inv CF V/mm 0.0369788	Abs.Int.Volt -0.533592

Figure 64. Relation between Absolute Intercept in mm and Volts and values given in verification sheet

When implemented the parameters *Linearization Exponent*, *Calibration Factor* and *Absolute Intercept* give the calibrated Radius of the IR-TRACC (pivot-to-pivot length). The angle sensor *Calibration 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 paragraph 16.3.

In the Q10 the 2D IR-TRACCs are implemented in various orientations in the dummy:

- Frontal upper and lower with potentiometer down (IR-TRACC upside down)
- Left side and right side upper with potentiometer down (IR-TRACC upside down)
- Left side and right side lower with potentiometer up

The procedure described in this section 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 coordinates 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 64 is the IR-TRACC in frontal impact mounting position. The angle sensor is downwards so upside down with respect to the absolute length verification.

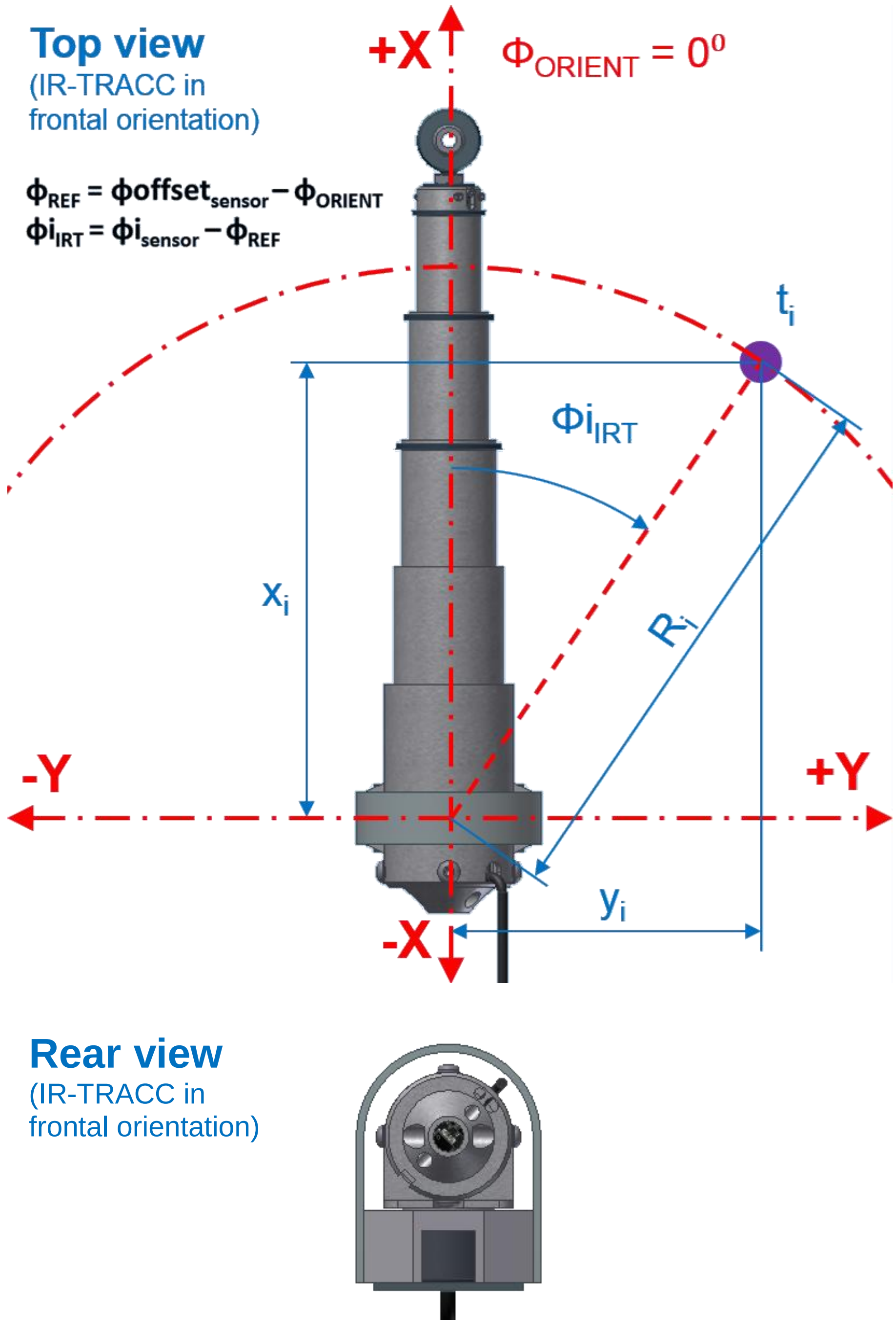


Figure 65. Q10 2D IR-TRACC assembly in co-ordinate system in frontal impact orientation with angle sensor down (IR-TRACC upside down with respect to Absolute Length Verification)

The IR-TRACC orientation is reflected in two parameters: the Polarity of the angle sensor defines the positive direction of the angle and the Orientation Angle φ_{ORIENT} defines the IR-TRACC orientation angle with respect to the spine box (In figure 65 the IRTRACC is in frontal impact orientation, φ_{ORIENT} = 0°).

The Absolute Length Verification procedure takes data in the standard orientation and the angle sensor facing up. In this position the polarity (+/- sign for positive angle) and the Offset angle of the sensor, $\varphi offset_{sensor}$ are determined. The Reference angle φ_{REF} takes in account the Orientation angle and the Offset angle. The definitions are given in Figure 66.

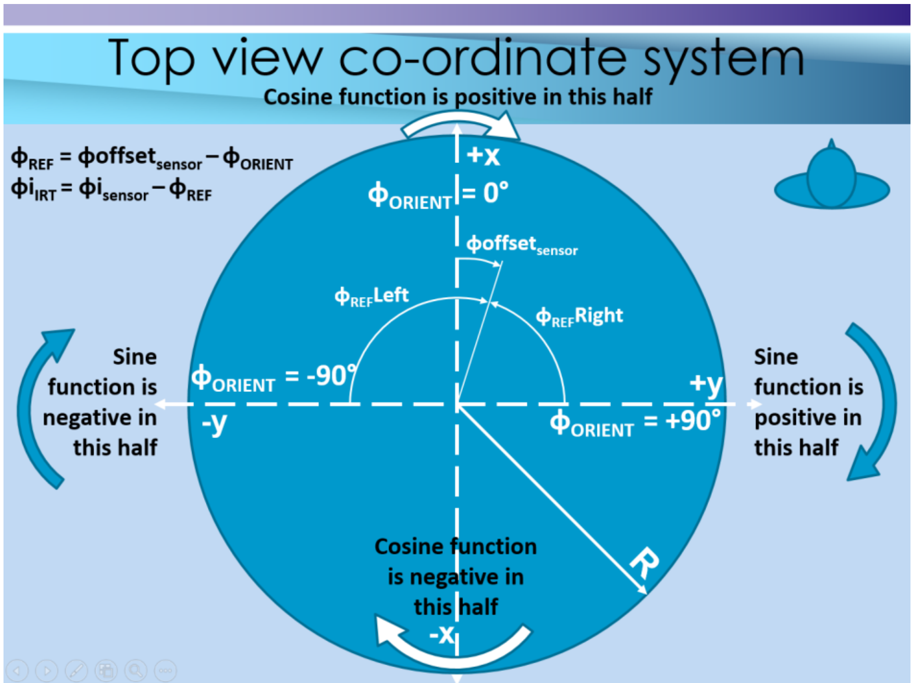


Figure 66. Orientation angle, Offset angle, Reference angle definitions

In some dummy applications or positions, the 2D IRTRACC is mounted upside down. When this is the case (angle sensor below the IRTRACC), 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.

The five possible orientations in Q10 are:

1. Angle sensor below the IR-TRACC
    a. Left upper
    b. Frontal upper and lower
    c. Right upper
2. Angle sensor on top the of IR-TRACC
    a. Left lower
    b. Right lower

Based on the values obtained in the standard orientation, the verification sheet gives Reference Angle φ_{REF} and Polarity for all possible IRTRACC orientations in the dummy. When you implement a sensor in the dummy and the data acquisition system, or change the orientation of the sensor inside the dummy, apply the following sequence:

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 post processing software.

See Figure 67 for an example verification sheet.

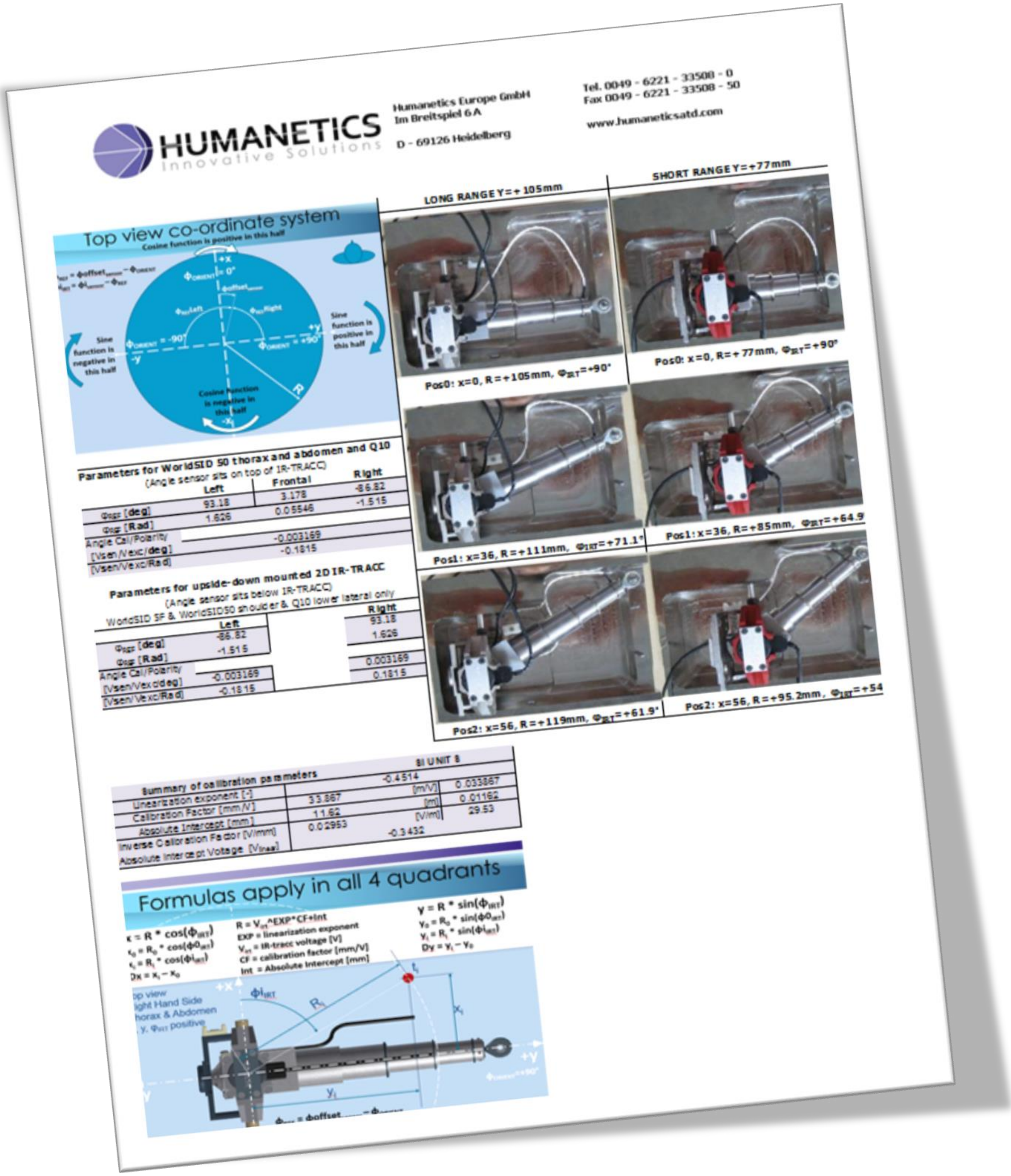


Figure 67. An example of a verification sheet (Note: apply the numbers on the verification sheet per sensor Serial Number, not the numbers in this example).

16.3 Data Post Processing

Figure 65 shows the 2D IR-TRACC in the frontal orientation 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 30 and Figure 66. 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 the assembly orientation.

IMPORTANT NOTE: the IR-TRACC is a none-linear device and the offset at time 0 shall not be zero-ed by the data acquisition system, as this will invalidate the IR-TRACC measurement beyond recovery. Neither the angle channel shall be zero-ed, as the angle is fixed to the co-ordinate system. If offset zero-ing at t0 is defaulted by the DAS, then the IR-TRACC and angle voltages at t0 must be stored along with the data set.

PARAMETER	DESCRIPTION
t_0 , t_i [s]	Time zero, Time i
V_{IRT} [V or LSB]	IR-TRACC output
EXP	Linearization exponent IR-TRACC output
Calibration Factor [mm/V]	Linearized voltage calibration factor IR-TRACC
Absolute Intercept [mm]	IR-TRACC offset length in pivot co-ordinate system
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 65
$\varphi offset_{sensor}$ [degrees]	Sensor offset angle Absolute Length Calibration, see Figure 65
φ_{REF} [degrees]	Reference angle, see Figure 65
φ_{sensor} , $\varphi 0_{sensor}$, φi_{sensor} [degrees]	Angle sensor output, at t_0, at t_i
φ_{IRT}, $\varphi 0_{IRT}$, φi_{IRT} [degrees]	IR-TRACC angle along z-axis, at t_0 and at t_i

Table 29. Calculation parameters, symbols and description

Calculation formulae

$R = (V_{IRT}\text{^}EXP) * (\text{Calibration Factor}) + \text{Absolute Intercept}$ [mm]

$\varphi_{REF} = \varphi offset_{sensor} - \varphi_{ORIENT}$ [deg]

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

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

$Dx = x_i - x_0$ [mm]

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

$Dy = y_i - y_0$ [mm]

PARAMETER	CHANNEL DESCRIPTION	ISO CODE (EXAMPLE FOR FRONTAL)
V_{IRT} [V]	Raw IR-TRACC output	?? CHST UP 00 QA VO 0 P ?? CHST LO 00 QA VO 0 P
V_{IRT} [LSB]	Raw IR-TRACC output	Define new code for LSB
EXP	CONSTANT Cal factor Linearization exponent	.Power func exponent (header)
Calibration Factor [m/V^{EXP}]	CONSTANT Cal factor Linearized voltage	.Power func sensitivity (header)
Absolute Intercept [m]	CONSTANT Cal factor offset length	.Power func eng offset (header)
Electrical offset [V]	CONSTANT	.Power func electr offset (header)
Electrical offset [LSB]	CONSTANT	.Power func electr offset (header)
R [m]	Absolute Length (IR-TRACC Radius)	?? CHST UP 00 QA DC 0 P
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	?? CHST UP 00 QA AN Z? ?? CHST LO 00 QA AN Z?
x [m]	Calculated [Filtered?] x- co-ordinate	?? CHST UP 00 QA DC X? ?? CHST LO 00 QA DC X?
y [m]	Calculated [Filtered?] y- co-ordinate	?? CHST UP 00 QA DC Y? ?? CHST LO 00 QA DC Y?
Dx_i [m]	Calculated [Filtered?] x Deflection	?? CHST UP 00 QA DS X? ?? CHST LO 00 QA DS X?
Dy_i [m]	Calculated [Filtered?] y Deflection	?? CHST UP 00 QA DS Y? ?? CHST LO 00 QA DS Y?

Table 30. Example ISO codes for Upper and Lower 2D IRTRACCs in SI units

16.4 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. Check the polarities in on-line measurement mode by manipulating the dummy. The correct polarities are given in Table 31. The typical value stated in the Table 31 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 Absolute Length verification procedure using the exact same measurement chain as used for dummy data acquisition.

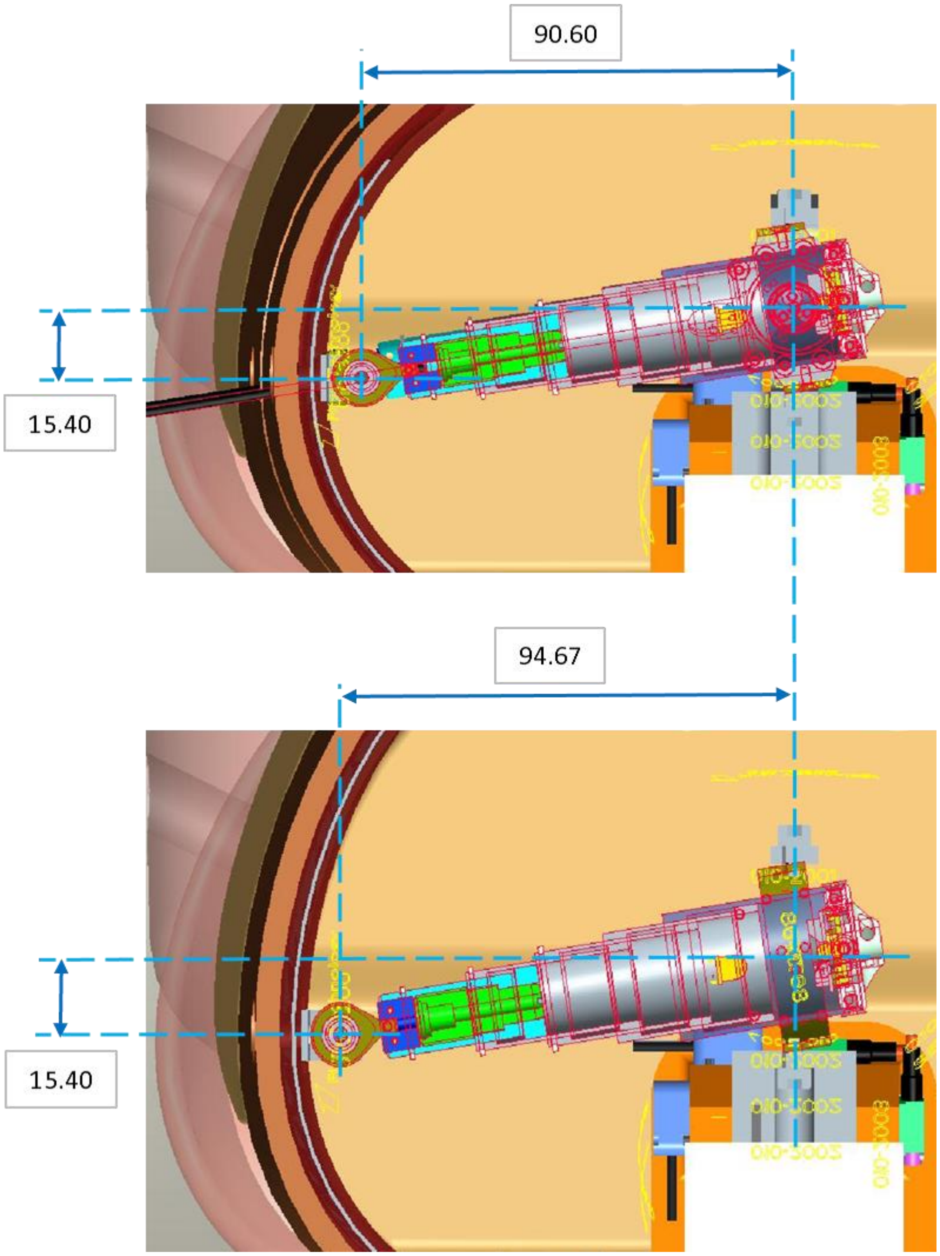


Figure 68. Q10 2D IRTRACCs in lateral left hand side impact configuration (top view); Top picture: upper IRTRACC (angle sensor below IRTRACC); Bottom picture: lower IRTRACC (angle sensor above IRTRACC)

PARAMETER	POSITION	MANIPULATION	EXPECTED OUTPUT	STARTING VALUE *	
				UPPER IRTRACC	LOWER IRTRACC
Angle φ_{IRT} [degrees]	Frontal	Push ribcage right	Angle increases (to zero)	~0	~0
	Left	Push rib cage forward	Angle increases (to zero)	~-99	~-99
	Right		Angle decreases (to zero)	~+99	~+99
X [mm]	Frontal	Compress rib cage	X decreases (to zero)	~+106	~+122
	Left	Push rib cage forward	X increases (to zero)	-15	-15
	Right		X increases (to zero)	~-15	~-15
Y [mm]	Frontal	Push ribcage right	Y increases (to zero)	~0	~0
	Left	Compress rib cage	Y increases (to zero)	~-91	~-95
	Right		Y decreases (to zero)	~+91	~+95
Radius R [mm]	Frontal	Compress rib cage	R decreases (to zero)	~106	~122
	Left	Push rib cage forward	R decreases (to zero)	~92	~96
	Right		R decreases (to zero)	~92	~96

*Note *: Starting values are indicative the actual values may vary*

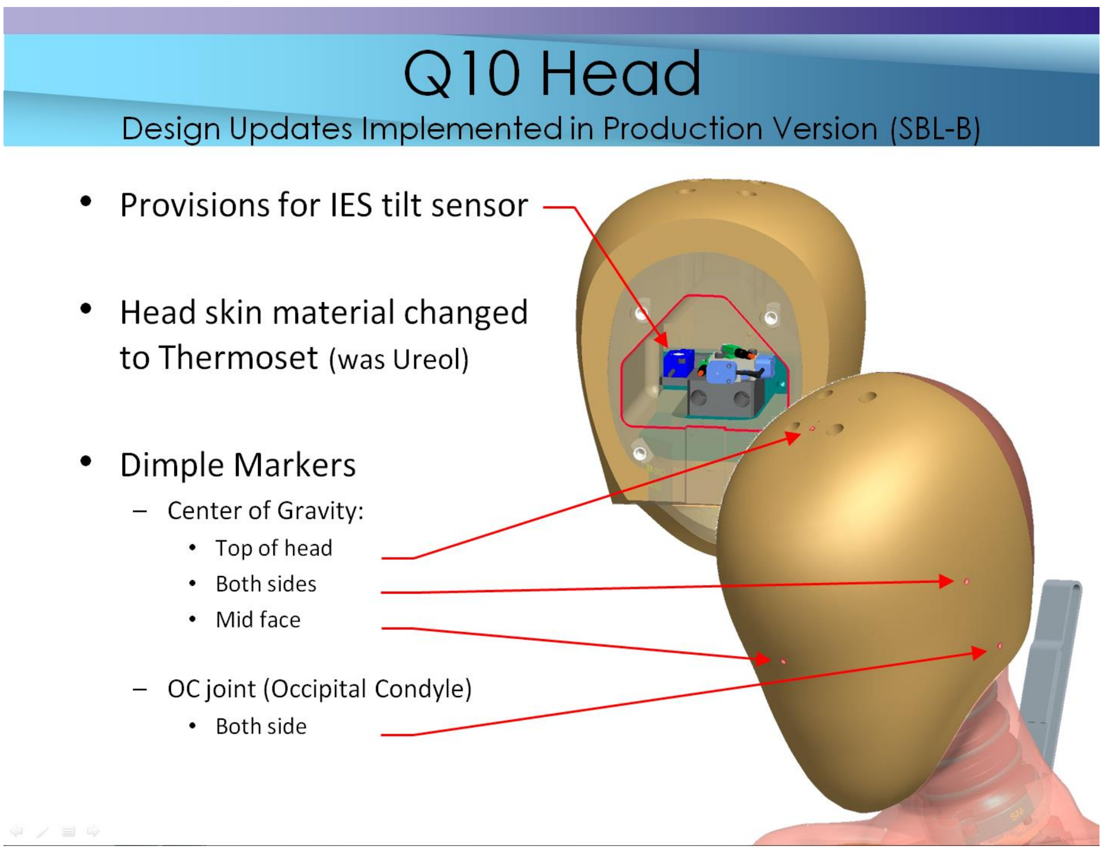
Table 31. Dummy manipulations and parameter responses (after post processing)

Section 17 Overview of Design Updates (SBL-B)

This chapter provides an overview of the design updates that were implemented to the prototype dummy configuration (SBL-A) to obtain the production version (SBL-B). The prototype dummy was developed and evaluated in the EPOCh project (January 2009 to January 2012) and tested in a third party evaluation program in Europe and Japan (October 2011 to March 2013). The feedback obtained from EPOCh and the third party test participants was considered in the design update. In the paragraphs below the design updates are listed and illustrated with presentation slides shown in the third party evaluation meeting October 09, 2012 in Heidelberg.

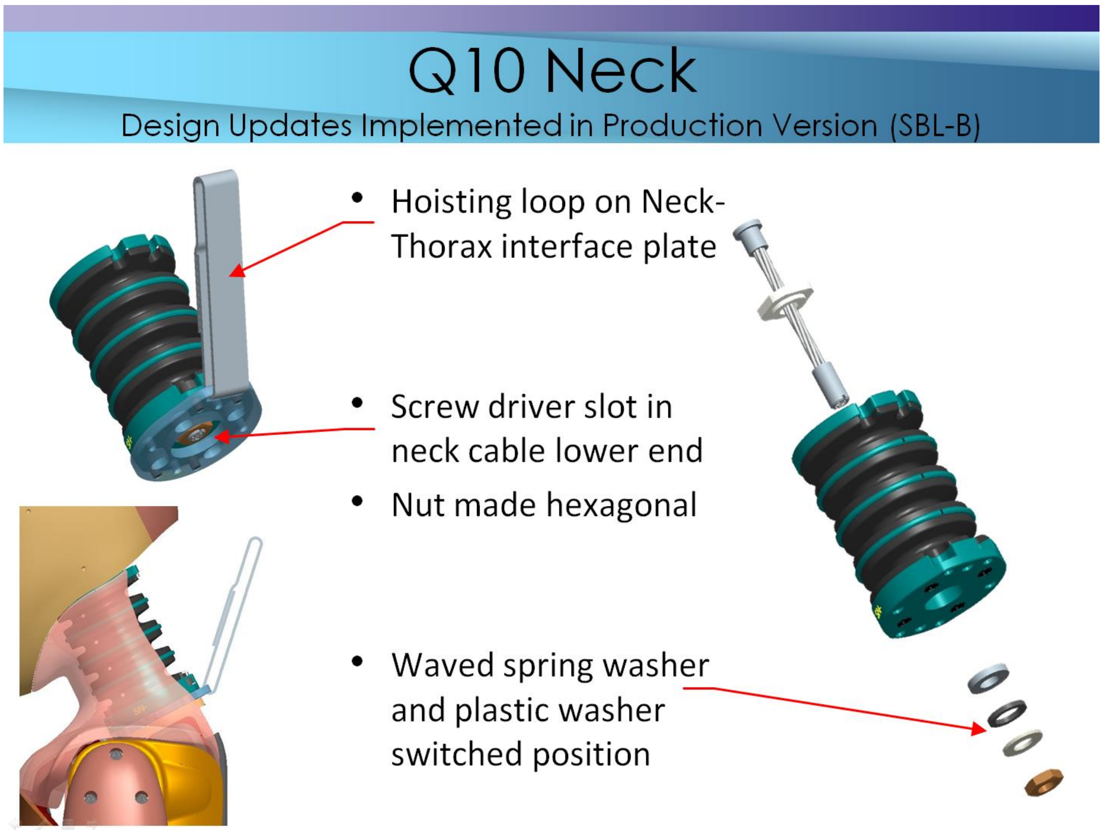
17.1 Head

		Part	Description of design update	Drawing Number	SBL-A	SBL-B	Reason
16.1	1	Skin	Material Thermoset (was Ureol)	010-1001	A	C	Mat'l banning
16.1	2	Skin	Skin addition of CoG markers at top and front, chin and crown (diagonal through CoG)	010-1001	A	C	Handling and setup
16.1	3	ACC mount	ACC mounting bracket: Changed tilt sensor interface	010-1000 010-1004	C A	D B	Tilt sensor change



17.2 Neck and Neck Shield

		Part	Description of design update	Drawing Number	SBL-A	SBL-B	Reason
16.2	1	Washer	Washes 9003247 and 010-2009 switched position, Washer 010-2009 was 020-2414	010-2000	B	C	General update
16.2	2	Neck cable	Introduction of screwdriver slot and hexagonal nut	010-2200 010-2006	A B	B C	Handling and setup
16.2	3	Neck-torso interface plate	Introduction of hoisting loop	010-2015	B	C	Handling and setup

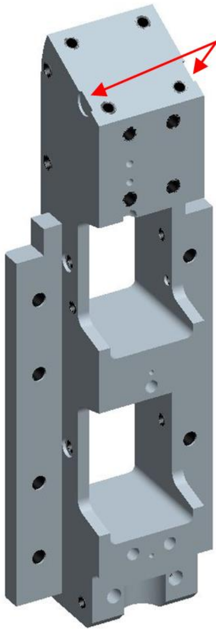


17.3 Thorax

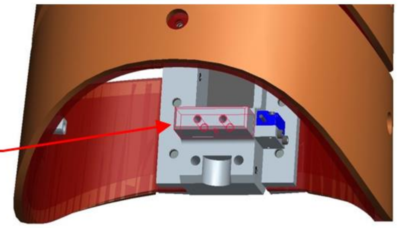
		Part	Description of design update	Drawing Number	SBL-A	SBL-B	Reason
16.3	1	Rib cage	Material Thermoset (was Ureol)	010-4101	A	B	Mat'l banning
16.3	2	General	Mass tuned	010-4109 010-4104	 A	A B	General update
16.3	3	Threaded inserts	Implementation of self-locking feature on threaded inserts where desired	010-4105 3720-40	A B	B C	Handling and setup
16.3	4	Tilt sensor mount	Tilt sensor mounting bracket implemented	010-4001	B	C	Tilt sensor change
16.3	5	Ballast frontal	Addition of dowel pin	010-4005	A	B	General update
16.3	6	Shoulder cable	Increase of cable diameter to 1/8" (was 3/32"), ball diameter to 8 mm was 6.4 mm and cable routing more horizontal (cut out recess in spine box)	010-3015 010-3621 010-3622 010-4001	B B B B	C C C C	Durability
16.3	7	Scapula’s	Scapula’s recess for shoulder cable ball increased, recess for shoulder pin adapted	010-3301 010-3302	A A	B B	Durability
16.3	8	Shoulder pin	Shoulder pin increased base diameter (16 mm was 13) and double flat retainer (12 mm) in scapula (was single flat)	010-3301 010-3302 010-3003	A A A	B B B	Durability
16.3	9	IR-TRACC	Wire exit to the rear (was radial)	3720-00 3720-06	B	C A	Durability
16.3	10	IR-TRACC mounting	Washer between IR-TRACC eye ball rod end and Rib attachment bracket omitted	010-0000 010-4000	B B	C C	General update
16.3	11	Side impact kit	Improvements to shoulder for lateral impact: - omit lower arms - Plastic upper arm bones - Soft upper arm flesh foam - Shoulder load cell (3 axis: Fx, Fy, Fz)				Add on for side impact

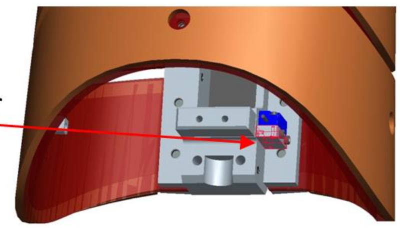
Q10 Thorax (1 of 3)

Design Updates Implemented in Production Version (SBL-B)



- Recess for shoulder cable end
- Self locking Helicoils where desired
- Additional dowel pin ballast frontal to prevent wrong assembly
- Mount bracket for IES Tilt sensor

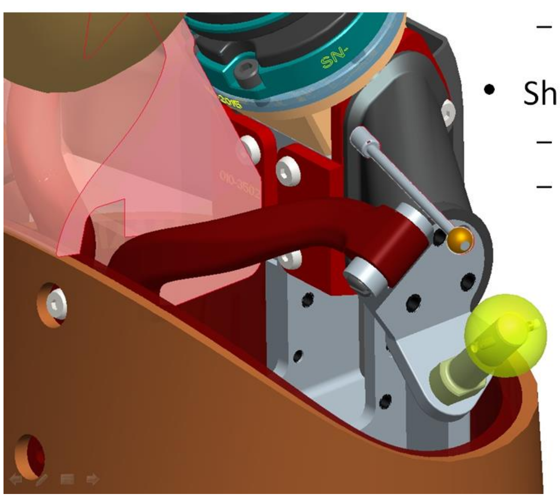




Q10 Thorax (2 of 3)

Design Updates Implemented in Production Version (SBL-B)

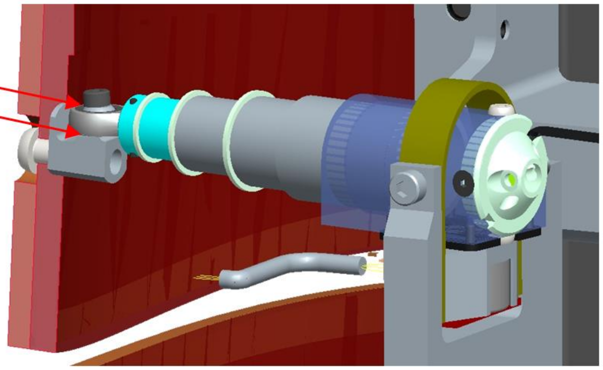
- Shoulder cable improvement
  - Reinforcement:
    Diameter 1/8” (was 3/32”)
    Ball 8 mm (was 6.4 mm)
  - Rerouting: more horizontal
- Shoulder pin retainer reinforced
  - Increased diameter
  - Double flat (was single flat)



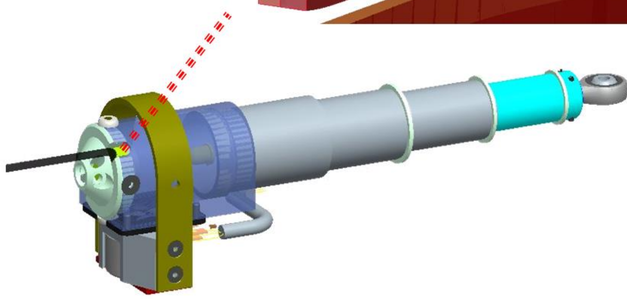
Q10 Thorax (3 of 3)

Design Updates Implemented in Production Version (SBL-B)

- Plastic washers omitted

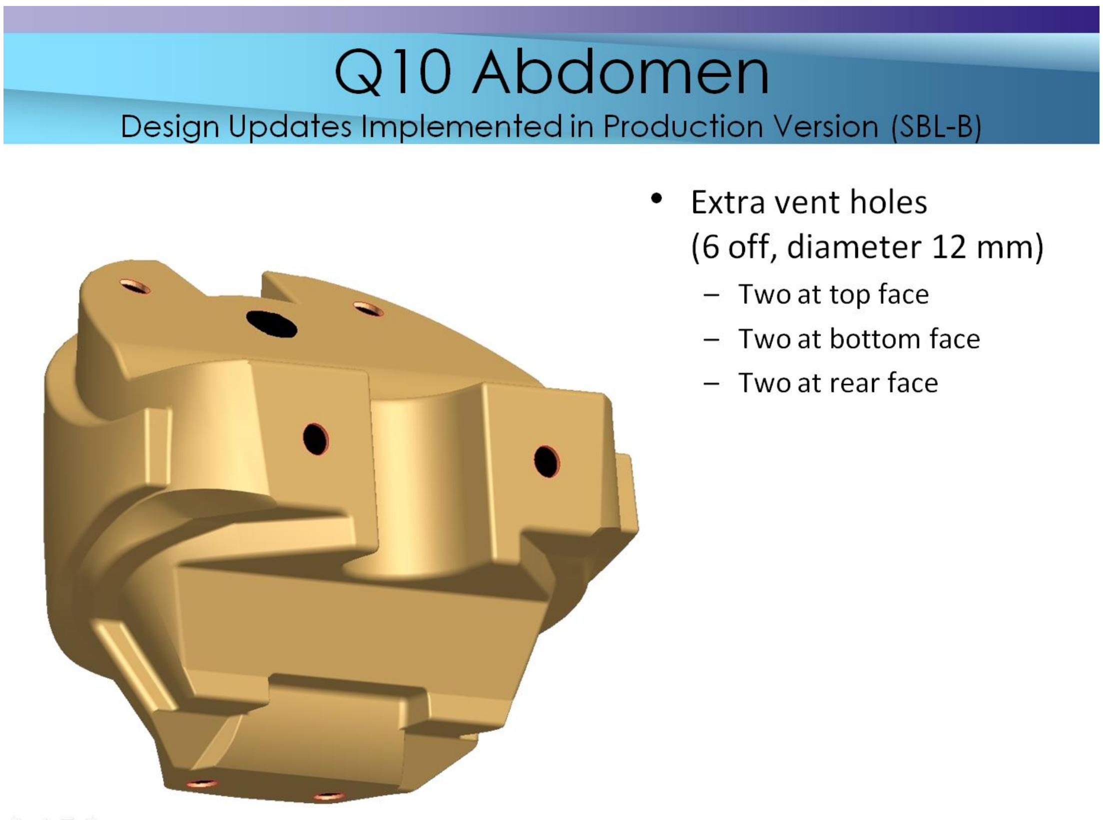


- IRTACC axial wire exit
  (was radial and interfering with U-frame)



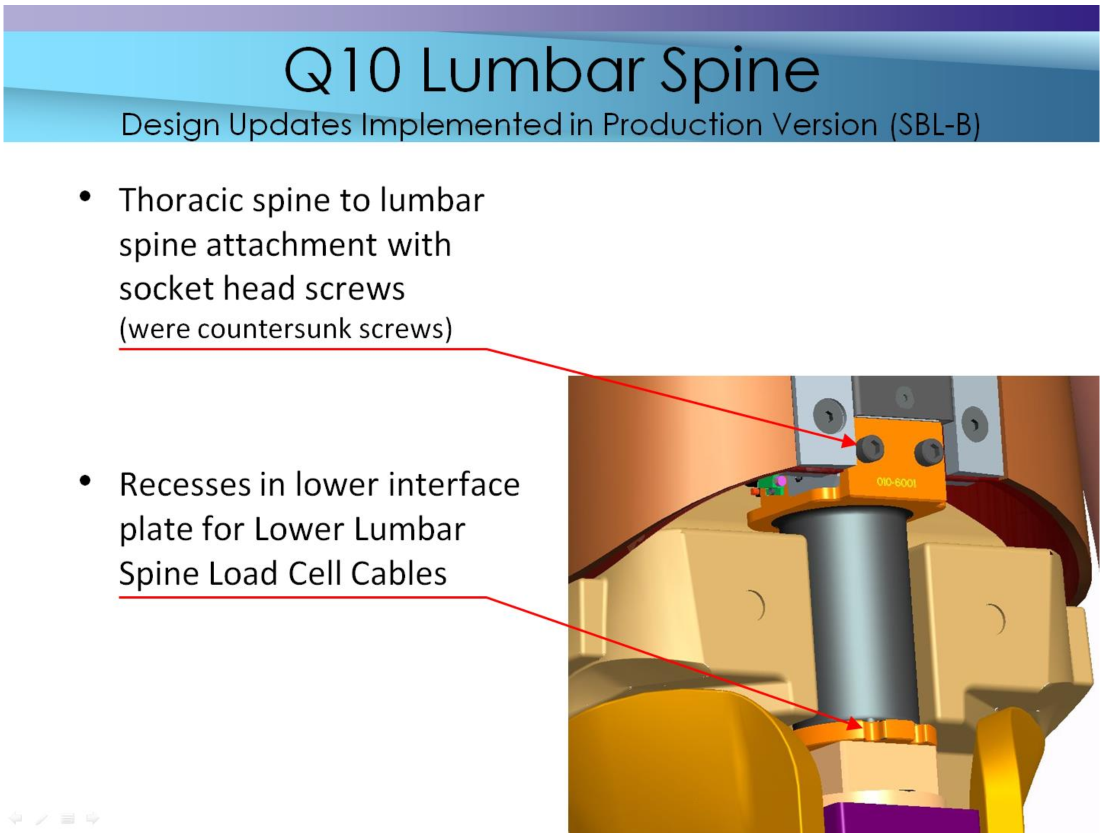
17.4 Abdomen

		Part	Description of design update	Drawing Number	SBL-A	SBL-B	Reason
16.4	1	Skin	Application of 6 venting holes (diameter 12 mm)	010-4300	A	B	General update
16.4	2	Foam	Increased mass was 1.25 Kg revised to 1.39	010-4300	A	B	Mass distribution



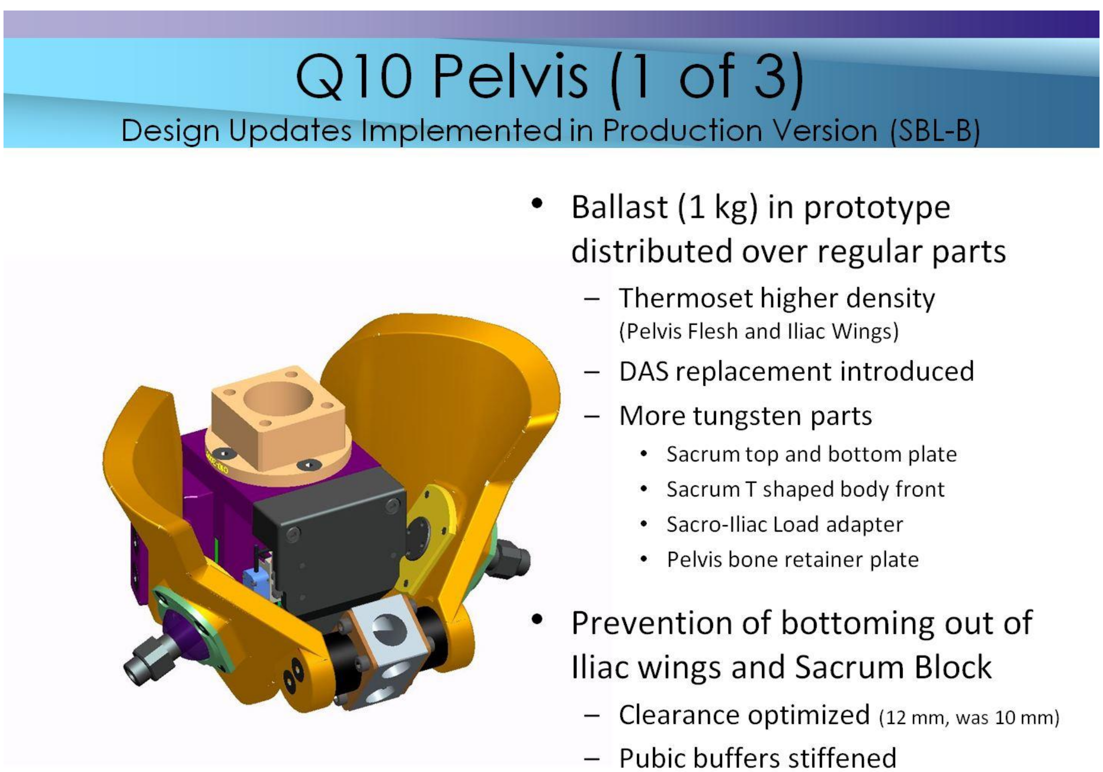
17.5 Lumbar Spine

		Part	Description of design update	Drawing Number	SBL-A	SBL-B	Reason
16.5	1	Upper bracket	Socket head upper attachment screws (were countersunk)	010-6002	B	C	Handling and setup
16.5	2	Lower plate	Application of recesses for lower lumber load cell wires	010-6003	B	C	Handling and setup



17.6 Pelvis

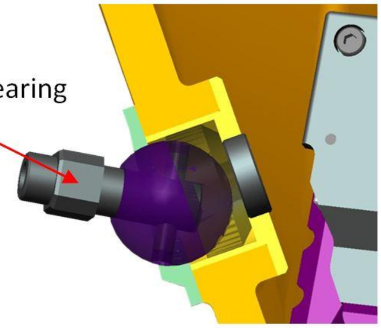
		Part	Description of design update	Drawing Number	SBL-A	SBL-B	Reason
16.6	1	Iliac bones	Material Thermoset (was Ureol)	010-7301 010-7302	A A	B B	Mat'l banning
16.6	2	Pelvis flesh	Material Thermoset (was Ureol)	010-7002	A	B	Mat'l banning
16.6	3	General	Mass tuned (ballast distributed)	010-7002 010-7201 010-7202 010-7203 010-7009 010-7251 010-7252	A A A A A	B B B B B A A	General update
16.6	4	Sacrum assembly	Clearances with Iliac bones and Hip-joint hardware optimised, Pubic buffer stiffened	010-7202 010-7012	A A	B B	General update
16.6	5	Sacro-Iliac Load cell	Updated design for Sacro-Iliac Load cell structural replacement	010-7022 010-7023 010-7024		A A A	General update
16.6	6	Hip joint	Hip-joint friction made adjustable	010-7003 010-7005 010-7020	A A	B B A	Handling and setup
16.6	7	Hip pin	Interface with upper femur adapted	010-7008	A	B	Durability
16.6	8	Pubic load cell	Cable routing of connector potting				Durability

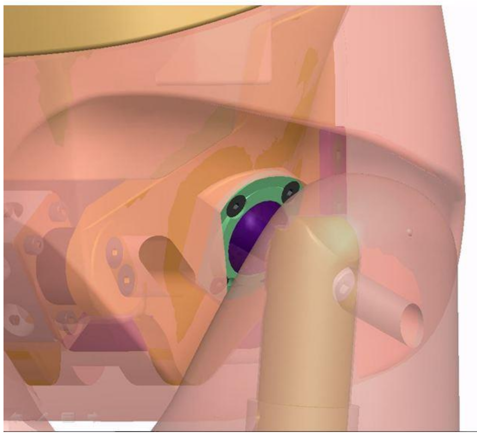


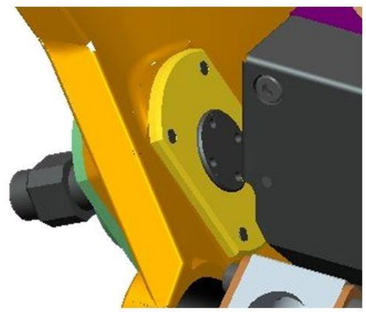
Q10 Pelvis (2 of 3)

Design Updates Implemented in Production Version (SBL-B)

- Hip ball fiction may adjustable
  - Threaded disk (M25 x 1.0) pushes plastic bearing
- Longer squared part on Hip Pin
  - Equipped with leading chamfer



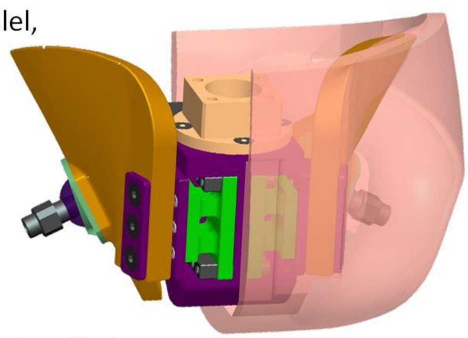




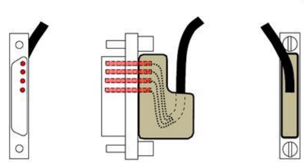
Q10 Pelvis (3 of 3)

Design Updates Implemented in Production Version (SBL-B)

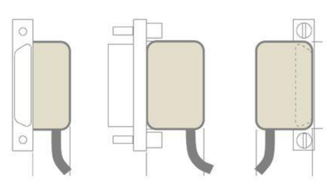
- Optimized Sacro-Iliac Load Cell structure
  (Load cell structure (green) made parallel,
  adapter part added at Iliac wing side)



- Cable exit of Pubic Symphysis load cell changed

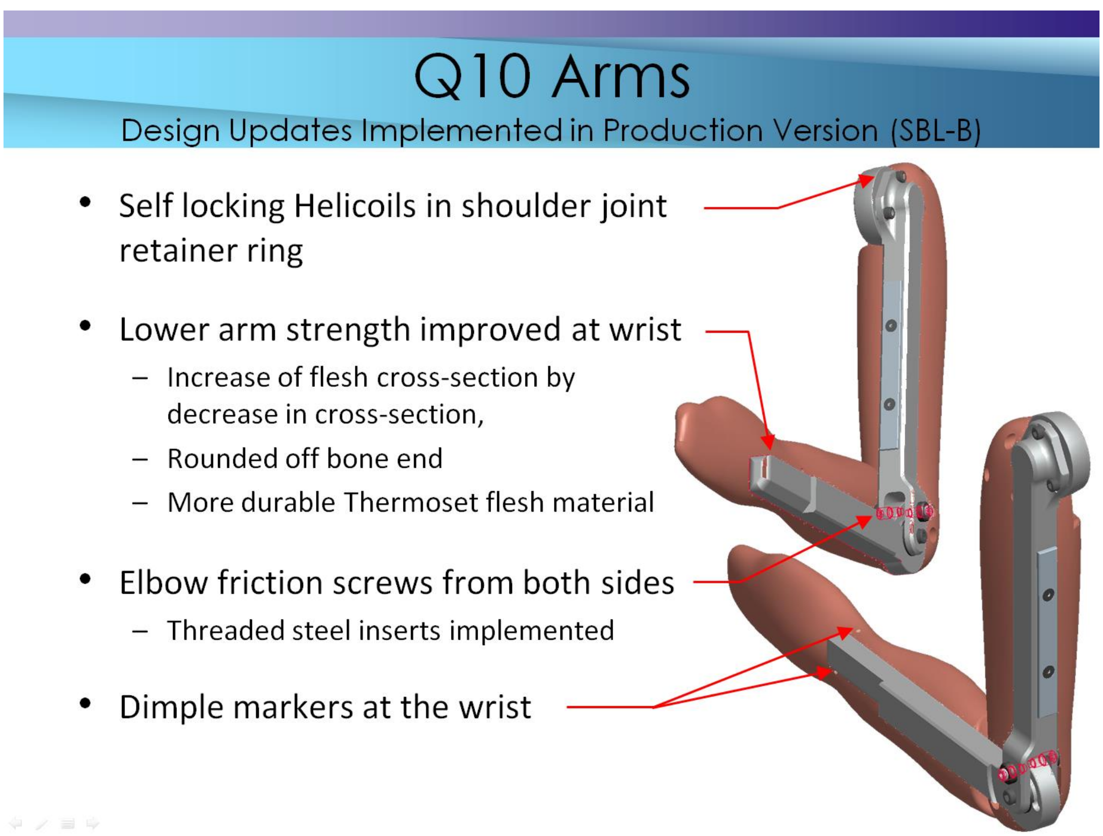


was



17.7 Arms

		Part	Description of design update	Drawing Number	SBL-A	SBL-B	Reason
16.7	1	Arm flesh	Material was Ureol	010-9305 010-9405 010-9307 010-9407	A A B B	B B C C	Mat'l banning
16.7	2	General	Mass tuned				General update
16.7	3	Threaded inserts	Implementation of self-locking feature on threaded inserts where desired	010-9308	A	B	Handling and setup
16.7	4	Elbow	Implementation: - Friction screws from both sides (was one side) - Combined friction-stop screws - Inserted for friction screws - Pivot screw M6 (was M5)	010-9403 010-9306 010-9313 010-9314 010-9315 010-9316	A B	B C A A A A	Handling and setup and Durability
16.7	5	Lower arm	Dimple markers at the wrist implemented	010-9305 010-9405	A A	B B	Handling and setup
16.7	6	Lower arm	bone end adapted (Bone extended, decreased section and rounded off tip)	010-9303 010-9403	A A	B B	Durability



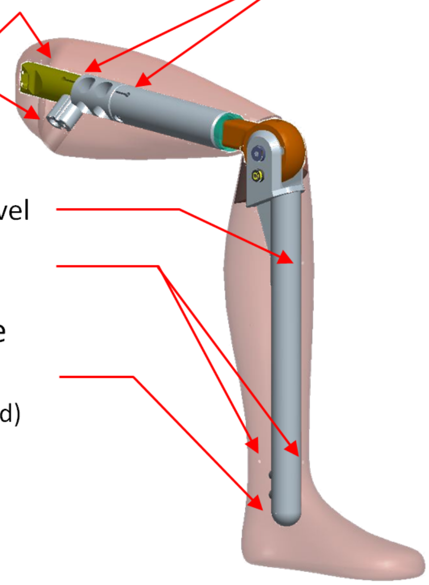
17.8 Legs

		Part	Description of design update	Drawing Number	SBL-A	SBL-B	Reason
16.8	1	Lower leg flesh	Material Thermoset (was Ureol)	010-9107 010-9207	A A	B B	Mat'l banning
16.8	2	Threaded inserts	Implementation of self-locking feature on threaded inserts where desired	010-9103 010-9203 010-9206 010-9207	B B A A	C C B B	Handling and setup
16.8	3	Upper leg	Dimple markers at H-point	010-9107 010-9207	A A	B B	Handling and setup
16.8	4	Upper leg flesh	Flesh retainer introduced at upper femur and adapt SHSS screws one 20 mm and one 40 mm (were 16 mm)	010-9108 010-9109	A	B A	Durability
16.8	5	Knee	Implementation: - Interface for H-point tool, - Anti-fretting washers - Combined friction-stop screws - Inserted for friction screws - Continuous end stop buffers - Special pivot screw	010-9105 010-9205 010-9209 010-9210 010-9215 010-9110 010-9214 010-9215 010-9216 010-9217	A A A A - - - - - -	B B B B A A A A A A	Handling and setup and Durability
16.8	6	Upper femur	Interface with hip pin adapted	010-9106 010-9206 010-9107 010-9207	A A A A	B B B B	Durability
16.8	7	Lower legs	Dimple markers at the ankle joint level at both sides and front and at tibia leading edge 200 mm above ankle level	010-9202	A	B	Handling and setup
16.8	8	Lower legs	Tibia tube extended from ankle level to mid of foot, flat spots for end cap attachment screws omitted and End Cap material aluminium (was steel)	010-9211 010-9213	A A	B B	Durability

Q10 Legs (1 of 2)

Design Updates Implemented in Production Version (SBL-B)

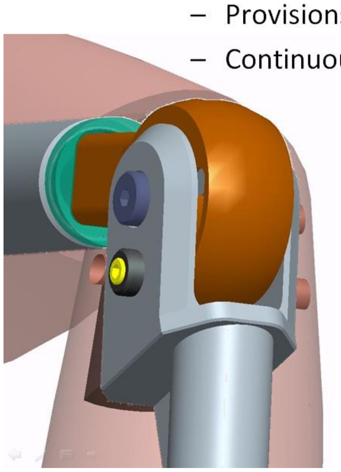
- Self locking Helicoils for Femur Load Cell attachments
- Upper flesh retainer
- Dimple markers
  - H-point
  - Tibia front, 200 mm above ankle joint level
  - Ankle joint level (at both sides and front)
- Lower leg strength improved at ankle
  - Tibia bone slightly extended into foot (increased flesh cross-section at the bone end)
  - More durable Thermoset flesh material
- Tibia end cap in aluminum (was steel)

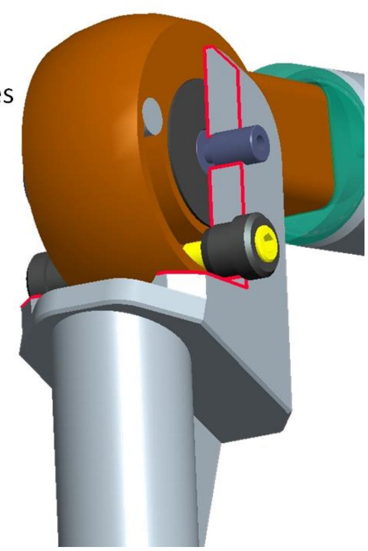


Q10 Legs (2 of 2)

Design Updates Implemented in Production Version (SBL-B)

- Knee improvements
  - Screws (yellow) with combined friction / stop function
  - Threaded steel inserts
  - Anti fretting washers
  - Provisions to mount H-point tool on knees
  - Continuous rubber buffers





17.9 Suit

		Part	Description of design update	Drawing Number	SBL-A	SBL-B	Reason
16.9	1	Split in upper and lower part	Split with zipper implemented at abdomen level				Handling and setup
16.9	2	Upper torso	Front panel reinforced with Codura fabric				Durability
16.9	3	Sleeves	Sleeves shortened by 25 mm and 3 mm wider circumference				Handling and setup
16.9	4	Screw access	Access holes for screws and markers: - Shoulders (2 x 3off) - IRTRACC attachments to rib cage (2 off) - Hip joint screws and H-point marker (2 x 1off)				Handling and setup
16.9	5	Lap belt	Lab belt liners applied externally on suit to prevent belt intrusion between pelvis and thigh				Add on

Q10 Suit

Design Updates Implemented in Production Version (SBL-B)

- Improvements to be implemented
  - Reinforce front skirt with Codura fabric (stitched at seams, was bond on)
  - Upper and lower part split with zipper at abdomen level
  - Access holes for screws
    - Shoulder joint screw holes diameter 10 mm, 6 off
    - IRTRACC-Rib Cage attachments diameter 10 mm, 2 off
    - Hip joint attachment and H-point marker diameter 25 mm, 2 off
  - Adaption to final lap belt liner

  Tailor made implementation

Section 18 Overview of Design Updates (SBL-C)

The changes to SBL C (Standard Build Level C) can be seen in the service bulletin below. The shoulder interface rubber parts right hand and left hand had the arm end flange modified to fit a shoulder loadcell and an accelerometer fixing was added to this flange protrusion. These parts then accommodate the shoulder side kit. The lower neck interface plate (see service bulletin below) part 010-2015 had flats machined on both sides of the plate to accommodate an accelerometer at T1.
SBL B is easily updated to SBL C if not already fitted with these parts. Below shows pictures of SBL C shoulder rubber fig 55 and fig 56 with frontal full arm (left picture) and side impact half arm (right picture).

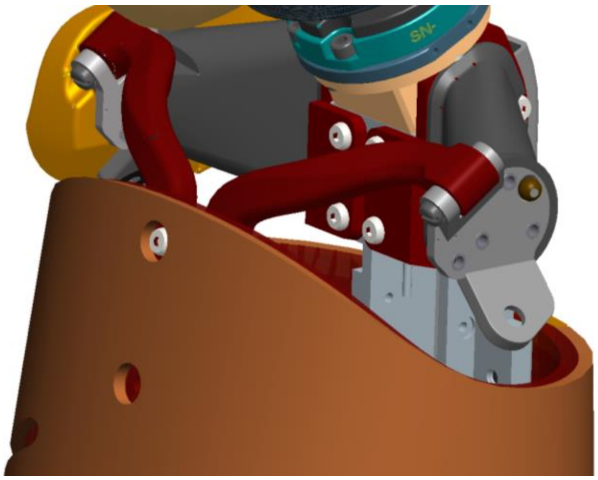


Figure 69. Showing SBL C shoulder rubbers fitted

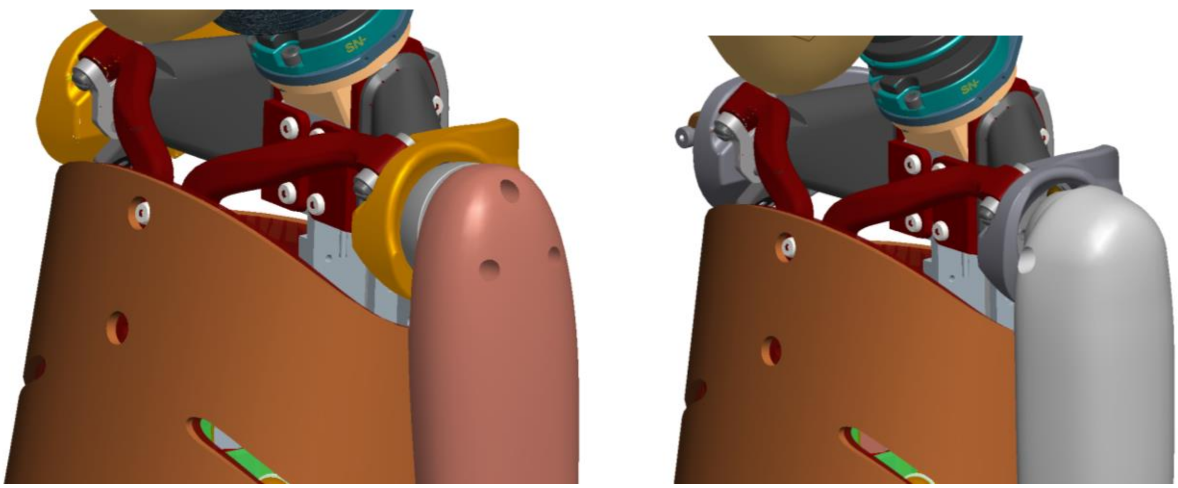


Figure 70. Showing SBL C shoulder rubbers with frontal arm and side impact shoulder kit

Q10 ATD
Side Impact Shoulder Kit
(010-4500)
Publication Date: Dec., 2014

Humanetics offers a Q10 dummy with an add-on side impact shoulder kit needed for Euro NCAP testing. Retrofit kits for existing ATDs are now available.

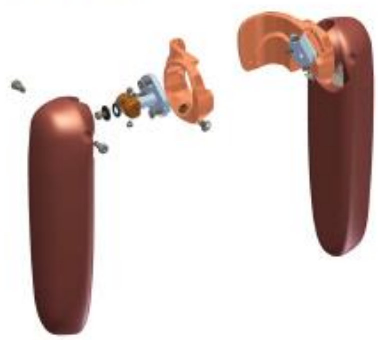
Q10 Background

Extensive evaluations of the Q10 ATD prototypes were carried out worldwide. Multitudes of data were collected and assessed following the completion of these projects. As a result, an updated version of Q10 was developed based on the test results as well as feedback from experts within the industry.

In their meeting on September 19, 2014 the Euro NCAP Child Safety Working Group decided to use the Q10 with the full arm in their frontal tests and the Q10 with the side impact kit in their lateral impact tests. The new protocol will be effective in 2016.

Q10 Side Impact Shoulder Kit 010-4500

Humanetics offers a complete Side Impact Shoulder Kit (010-4500) for installation on existing Q10 dummies.



010-4500 Q10 Side Impact Shoulder Kit

When the impact direction of the Q10 is switched from the frontal to the side impact configuration, a change in the IRTRACCs, the full arm, the shoulder joint, and the scapula is required. The side impact components are easily mounted and exchanged with the frontal arms. The kit is delivered certified with provisional corridors for T1 acceleration and pendulum force in the lateral shoulder impact test.

For internal development studies, optional left and right hand side shoulder load cells are available that are compatible with the side impact shoulder kit.

A complete Q10 ATD part number that includes the side impact kit may be available in the near future.

010-4500 Kit Components		
10969	Structural Repl Q10 RH Shoulder	1
10979	Structural Repl Q10 LH Shoulder	1
010-4501	Scapular Left- Side Impact	1
010-4502	Scapular Right - Side Impact	1
010-4503	Shoulder Pivot - Side Impact	2
010-4504	Shoulder Washer - Side Impact	2
010-4510	Arm Assy Molding - Side Impact	2
Misc.	Fasteners	
Optional		
IH-10980JI4	LC, 3X, LH Q10 SHOULDER	1
IH-10970JI4	LC, 3X, RH Q10 SHOULDER	1
ATD		
010-0000	DUMMY ASSY, Q10, NON-INST	1

(Con't on page 2)

Service Bulletin

Q10 ATD Side Impact Shoulder Kit (Con't)

Q10 Shoulder Update

Customers who have a Q10 dummy that was purchased prior to August 2013 and wish to fit the side impact shoulder will need the updated rubber shoulders (010-3501 and 010-3502). These parts have a new end plate to fit the shoulder load cell or its structural replacement. This along with a revised neck interface plate to attach a T1 accelerometer constituted the change to Standard Build Level C (SBL C).

New Standard Update Components		
010-3501	Shoulder Interface Assy Left, Q10	1
010-3502	Shoulder Interface Assy Right, Q10	1
010-2010	Neck Interface Assembly, Q10	1
010-4505	T1 Accel Mount	1

SBL Definitions

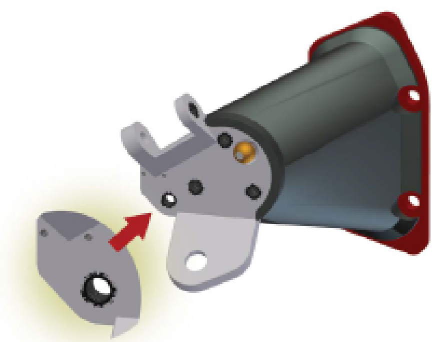
010-0000, Q10 ATD	
SBL A	Prototype
SBL B	Production dummy -Frontal only, not able to accept side impact kit
SBL C	Production dummy with updates that allow side impact kit installation. **Parts Required for SBL C:** 1. Rubber shoulders that have load cell interface update • 010-3501 & 010-3502 2. Neck Interface Ring for T1 mount • 010-2010 3. T1 Mount • 010-4505

Q10 DAS Integration

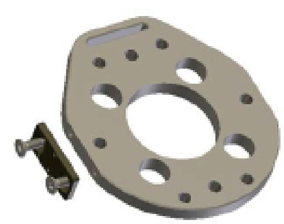
DAS integration solutions are available for frontal and side impact configurations. Specific DAS products can be considered for integration upon customer request.

Q10 Side Impact Shoulder and Arm

OLD Shoulder Rubber Interface



NEW Shoulder Rubber Interface



Neck Interface Ring and T1 mount

For further inquiries please contact Humanetics Customer Service or your account manager.

Section 19 Manual Update Log

February 2011: Draft Release

February 2013: Provisional release for first production dummy.

The following parts are not yet final in this manual:

- *Feedback from, external hands-on assembly and disassembly workshop to be incorporated. To be organized.*
- *Certification corridors to be inserted when established.*
- *Dummy setup and positioning procedure to be updated after, external workshop. To be organized.*

June 2014: Revision C, general updates, hip shields, side impact shoulder kit and certification corridors added.

The following parts are not yet final in this manual:

- *Feedback from, external hands-on assembly and disassembly workshop to be incorporated. To be organized.*
- *Dummy setup and positioning procedure to be updated after external workshop. To be organized.*

November 2014: Revision D, T1 certification accel corridor updated for frontal dummy shoulder, T1 mount moved from side kit to frontal dummy. T4 accel clarified in figures, side impact certification added and 010-2010 lifting strap defined. Ensure the use of neck shields for all full body impact tests. Remove references to IRTRACC angle potentiometers for measuring thorax displacement.

April 2015: Revision E, In 1.1 ref to EEVC report 642 made. 1.2.3 – Hip adjuster tool added to delivery list. 1.3.2 – Testing with T1 accel optional but used for certification, T1 accel added to fig 1. 1.3.3 – T1 picture ref added. 1.3.4 Pelvis cable routing note added. Page 26, abdomen identified. 7.2 hip adjustment procedure added. Section 10 – wording revised. Section 12 – added rod end and hip shields to recommended spares list and note on verification of IRTRACC absolute length if ball joint is replaced. 13.1 – recommended 20 tests for hip shields. 14.1 – removed specific accel mount requirement for head drop. 14.12 & 14.13 – timing restriction removed for certification requirements and tested with neck shield added to procedure wording on Thorax lateral test. Fig 50 and Figs 52 revised. Section 16 inserted and other sections moved up. SBL C detail added including figs 55 and 56 and service bulletin.
For side impact shoulder kit, certification corridors were made TBD.

July 2015: Revision F, Added lead material statement

February 2016: Revision G, Added figure to show pubic LC wire routing. Page 42 neck cable assy was 010-2100 not 010-2200. Provisional added to frontal shoulder side impact T1 accel certification corridor. In weight table neck 0.515 was 0.495 Kg. Wording for Shoulder joint rings removed from thorax description. Added para 1.3.5 ATPS sensor. Added Hip insert para 10.2. Removed item 14 M8 jam nut from table 11 and balloon from fig. Abdomen certification weights were +/- 0.05 revised to +/- 0.025. Shoulder side impact kit corridors added. Added Asis load cell and twin pressure sensor to instrumentation section. Added table index. Added head leveling tool detail, now standard in dummy tool kit.

REFERENCES

[i] Waagmeester, C.D., Burleigh, M., Hynd, M., Longton, A., Salters, E., Girard, B. (2010). Q10 dummy Development Status Review – Biofidelity Performance Validation, Protection of Children in Cars Conference, Munich, Germany 2010.

[ii] Hynd, M., McGrath, M., Waagmeester, C.D., Salters, E., Longton, A., Cirovic, S. (2011). EPOCh Project Dissemination, Protection of Children in Cars Conference, Munich, Germany 2011.

[iii] Waagmeester, C.D., Burleigh, M., Hynd, M., Longton, A., Salters, E., Girard, B., (2009). Q10 dummy Development Status Review, Protection of Children in Cars Conference, Munich December 2009

[iv] Reed, M.P., Sochor, M.M., Rupp, J.D., Klinich, K.D., Manary M.M., Anthropometric Specification of Child Crash Dummy Pelves through Statistical Analysis of the Skeletal Geometry, Journal of Biomechanics 42 (2009) 1143-1145.

[v] Wisman, J., Waagmeester, K., Lemmen, P., Burleigh, M., Carroll, J., Visvikis, C., Beillas, P., Martinez, L., Q10 Dummy report – Advanced Child Dummies and Injury Criteria for frontal Impact, EEVC WG12 report, EEVC Document 642, January 2015