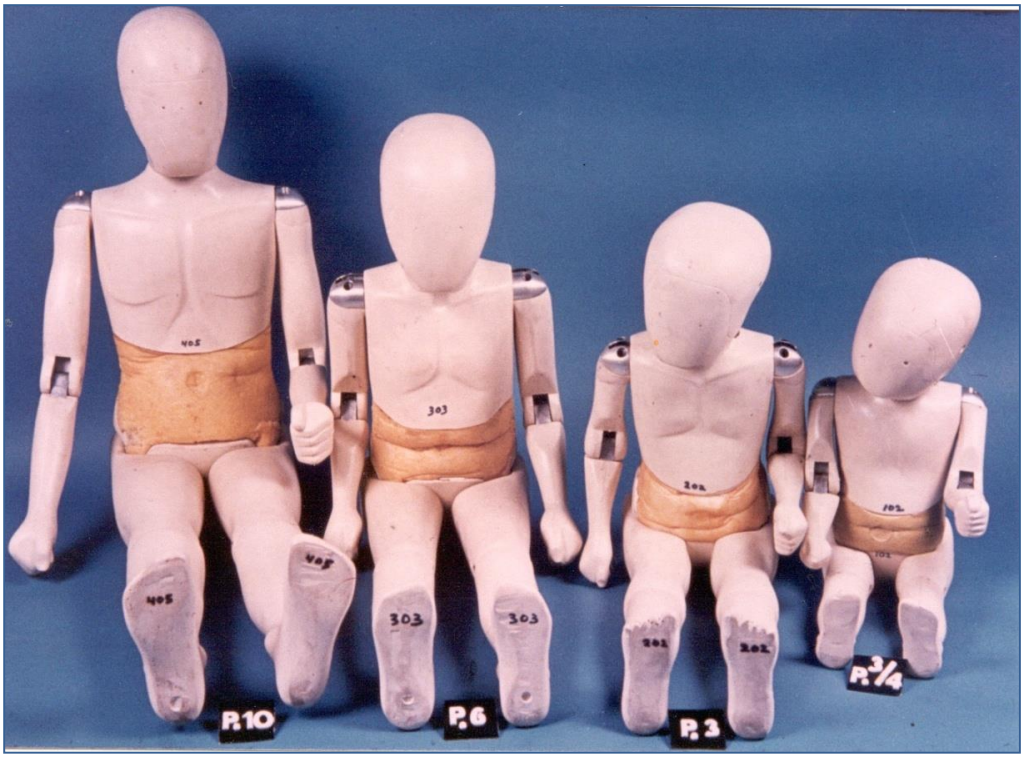
P-Series Child Dummies
P3/4, P3, P6, P10
Users Manual



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

CONTENTS

1. INTRODUCTION

In the mid-seventies, the United Nations' group of experts on passive safety started to work on requirements for child restraint systems. The work resulted in ECE-Regulation 44: "Uniform provisions concerning the approval of restraining devices for child occupants of power driven vehicles" that entered into force in 1982. An ad-hoc group was asked to develop a series of child dummies for this regulation. Originally, the regulation described 4 child dummies including the P¾ (9 months), P3 (3 years), P6 (6 years) and P10 (10 years). In 1988, a 5th dummy was added representing a newborn child, the P0.

Enhancements in child restraint system development and improved knowledge of occupant protection have led in 1995 to the addition of a '0+ group' to ECE-R.44. This group concerns rearward facing child restraint systems for children with a mass less than 13 kg that can be held by a conventional lap and shoulder belt system in front and rear passenger car seats. For the evaluation of this type of CRS, an 18-month-old child dummy has been developed (P1½).

These six dummies are known as the TNO P-series of child dummies. The dimensions and mass distribution of the dummies represent those of 50th percentile children of the respective ages (data given in Table I).

Table I: *Represented ages and masses of the TNO child dummies.*

Child Dummy	Represented age	Nominal mass (kg)
P0	newborn	3.4
P¾	9 months	9
P1½	18 months	11
P3	3 years	15
P6	6 years	22
P10	10 years	32

This manual describes the TNO P¾, P3, P6 and P10 dummies in their essential parts and shows how they are assembled and calibrated. Separate manuals are available for the P0 and P1½ dummies.

2. DESCRIPTION OF THE DUMMIES

2.1 Main Characteristics

The TNO P¾, P3, P6 and P10 dummies consist of a head, neck, torso assembly, lumbar vertebrae assembly, abdomen, upper and lower arms (left and right) and upper and lower legs (left and right). Figure 1 shows the general configuration of the dummies.

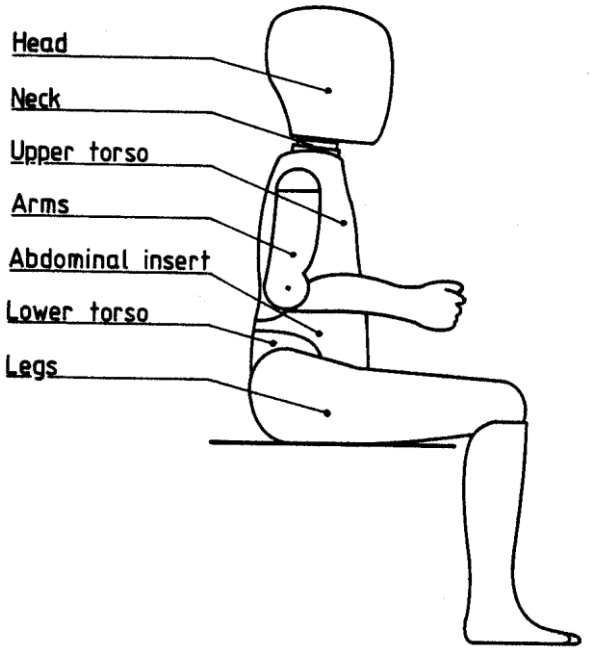


Figure 1: General configuration of the TNO P¾, P3, P6 and P10 child dummies.

HEAD

The head consists of a hollow polyurethane form reinforced by a metal strip. The atlas-axis joint allows rotation of the head with respect to the neck around a vertical axis and around a horizontal lateral axis. Inside the head, at the centre of gravity, a polyamide block provides a mounting plane for instrumentation.

NECK

The neck is made of a core of six polyamide elements, which are fed onto the upper end of the steel spine cable. Polyurethane discs surround the upper five elements. On top of the neck is a polyamide atlas-axis block.

UPPER TORSO

The upper torso consists of a steel T-shaped frame covered with polyurethane. Within the torso, a vertical tube is present used to accommodate the spine cable. This cable consists of two short threaded steel rods connected by two flexible steel cables to a central steel rod with threaded ends. In the chest cavity instrumentation can be mounted.

LUMBAR VERTEBRAE

The lumbar vertebrae assembly consists of a number of polyamide elements held together by two strips. The lower end of the spine cable is fed through a vertical hole in the elements. The shape of the vertebrae allows for bending of the upper torso in forward direction but prevents significant rearward and sideward movement.

LOWER TORSO

The lower torso includes a glassfiber reinforced polyester frame covered with polyurethane. The frame holds the steel hip tube. The lumbar spine cable keeps the assembly of atlas-axis block, neck, upper torso, lumbar vertebrae and lower torso together.

ABDOMINAL INSERT

The abdominal insert is a soft open cell polyurethane foam shape, which completely fills the opening at the front of the lumbar vertebrae between the upper torso and the lower torso. The soft insert represents the soft abdominal tissue of the child and allows for detection of abdominal penetration.

ARMS

The arms consist of an aluminium and/or steel frame covered with polyurethane. The upper arms are connected to the shoulder by means of ball and socket joints. The lower arms are connected to the upper arms by means of hinge joints.

LEGS

The legs consist of an aluminium and/or steel frame covered with polyurethane. The upper legs are connected to the hip tube by means of ball and socket joints. The lower legs are connected to the upper legs by means of hinge joints.

2.2 Principal Dimensions

The principal dimensions of the dummies are based on anthropometrical data. The dimensions are given in table II and figure 2. Please note that these dimensions are NOT equal to the dimensions given in the regulation ECE-R44. TNO, the Netherlands, has petitioned the Dutch Government to propose a change of the dimensions mentioned in the ECE-R44 regulation to the values mentioned below. The protocol to measure these dimensions is available upon request.

Table II: *Main body dimensions of the P-dummies.*

		Dimensions [mm]			
No.	**Description**	**P3/4**	**P3**	**P6**	**P10**
1	Back of buttocks to front knee	200 ± 5	335 ± 5	375 ± 5	460 ± 5
2	Centre of gravity to seat	180 ± 10	180 ± 10	195 ± 10	190 ± 10
3	Head width	125 ± 5	140 ± 5	145 ± 5	140 ± 5
4	Head length	165 ± 5	175 ± 5	175 ± 5	185 ± 5
5	Hip depth	130 ± 5	150 ± 5	160 ± 5	190 ± 5
6	Hip width	160 ± 10	200 ± 10	230 ± 10	250 ± 10
7	Shoulder width	215 ± 10	245 ± 10	290 ± 10	345 ± 10
8	Sitting Height	460 ± 10	550 ± 10	635 ± 10	730 ± 10
9	Full length	710 ± 10	985 ± 10	1170 ± 10	1385 ± 10

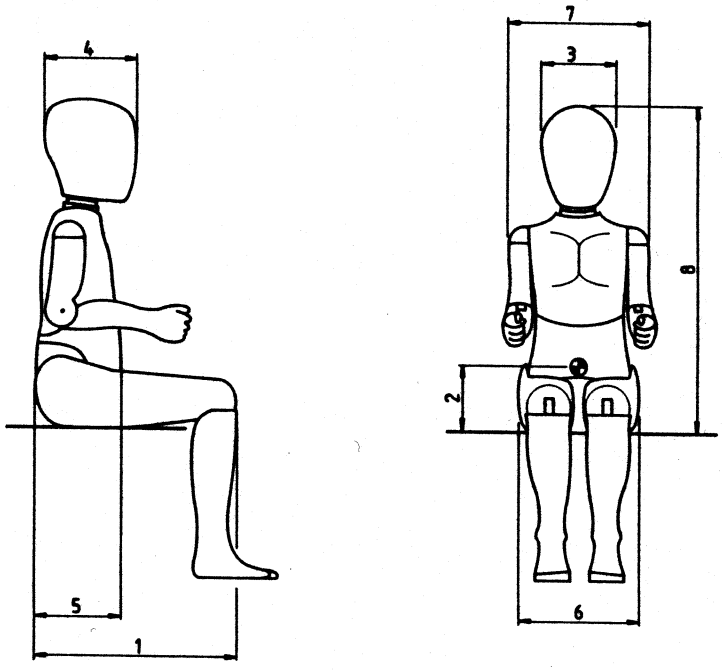


Figure 2: *Principal dimensions of the P¾, P3, P6 and P10 dummies*

2.3 Mass Distribution

Table III shows the masses of the various components of the dummies. The masses given include all necessary mounting and connecting materials, but exclude instrumentation. Please note that this is NOT equal to the mass-distribution shown in the current ECE-R44 regulation. TNO, the Netherlands, has petitioned the Dutch Government to propose a change of the mass distribution in this ECE-R44 regulation to the values mentioned below.

Table III: *TNO P-dummy mass breakdown (2000).*

Part	P3/4	P3	P6	P10
Head+Neck	2.250 ± 0.100	2.850 ± 0.125	3.500 ± 0.150	3.550 ± 0.200
Torso+Spine cable	3.700 ± 0.175	5.950 ± 0.275	8.500 ± 0.400	12.500 ± 0.600
Upper Arm (2x)	0.650 ± 0.050	1.100 ± 0.050	1.850 ± 0.100	2.100 ± 0.100
Lower Arm (2x)	0.400 ± 0.050	0.650 ± 0.050	1.200 ± 0.100	1.600 ± 0.100
Upper Leg (2x)	1.150 ± 0.050	2.850 ± 0.150	4.00 ± 0.200	7.250 ± 0.350
Lower Leg (2x)	0.850 ± 0.050	1.600 ± 0.100	2.950 ± 0.150	5.000 ± 0.250
Total Mass	9.000 ± 0.475	15.000 ± 0.750	22.000 ± 1.100	32.000 ± 1.600

2.4 Locations for Instrumentation

The dummies possess two standard locations for accelerometers. Triaxial accelerometers can be mounted on the polyamide accelerometer-mounting block in the head cavity and on the mounting surface in the opening at the back of the torso. For the latter position PVC mounting plates are supplied with the dummies. It is also possible to equip the dummies at both locations with three uniaxial accelerometers using a special mounting block. If accelerometer types are used other than those recommended by TNO, care should be taken that the centre of the sensitive axes coincides with the centre of gravity with an accuracy of ± 8mm.

For P¾ and P3 dummies 3-channel and 6-channel neck load transducers are available. These transducers are supplied with mounting kits.

All dummies are supplied with two pieces of modelling clay for evaluation of abdominal penetration. When shaped in the right dimensions (see section 4.8), this clay is positioned on the front of the lumbar vertebrae before the soft abdominal insert is put into place. Abdominal penetration can be detected by analysing the deformation of the clay after a dynamic test.

For more information on the instrumentation, please contact your local sales and marketing representative.

3. ASSEMBLY INSTRUCTIONS

Figure 3 shows an exploded view of the dummies. The description of the parts of the dummies is given in table IV.

3.1 Starting Assembly of the Dummies

The child dummies are delivered in fully assembled state. However, partial disassembly of the dummies is necessary, both for calibration purposes as well as for mounting of instrumentation. It is recommended to follow the assembly procedure given below for reassembly of the dummies. The only tools required are spanners and standard Allen keys except for the special tool to adjust the hip joint nuts that are supplied with the dummies. The numbers between brackets given in the assembly instructions refer to the numbers given in figure 3 and table IV.

3.2 Assembly Procedures

1. Feed the spine cable (22) through the tubular opening in the upper torso (10). Place the polyethylene bushes (40) over the spine cable. Position the first bush just inside the lower part of the torso tube near the lumbar vertebrae assembly. Position the second bush just inside the upper part of the torso tube near the neck. The tapered side of both bushes should point towards the inside of the upper torso. Subsequently, connect the spine cable firmly to the torso by two nuts (37), one at each end of the torso tube. Care should be taken that the spine cable is mounted with the correct side upward. The shorter of the two threaded ends should be at the top (neck) side.

2. Place one of the spiral shaped bushes (41) over the upper flexible part of the spine cable. Hereafter, place the recessed neck core element over the top end of the spine cable and nut (37), followed by the four identical elements and finally the flat end element on top with its flat end facing upward. Subsequently, place the five polyurethane neck discs (2) over the neck core elements in order of decreasing diameter.

3. Place the atlas-axis block (4) on top of the upper neck core element with its lower recessed part facing downward. The hole for the head bolt should be in front of the spine cable.

4. Fasten the neck assembly to the upper torso by means of the neck adjustment nut (24) and washer (26).

5. Place the other spiral shaped bush (41) over the lower flexible part of the spine cable. Position the lumbar vertebrae assembly (21) over the lower protruding end of the spine cable with the rounded off edges facing front and the recess enclosing the nut (37).

6. Feed the lower end of the spine cable through the hole in the lower torso (23) fixing the torso by means of a spring (27), a washer (26) and a nut (25).

7. Place the abdominal insert (28) in the opening at the front of the lumbar vertebrae between the upper and lower torso.

8. Clamp the upper arms (15,16) onto the shoulder ball joints (11) by means of the shoulder joint sockets (12), bolts (13) and spring washers (14). Mount the lower arms (17,18) in their natural position using the friction washers (38), elbow tensioner bolts (19) and nuts (20).

9. Connect the upper legs (31,32) to the lower torso by clamping the hip joint balls (29) between the hip tube and the hip joint nut/sockets (30). The clamping force can be adjusted with the special tool (44) provided with the dummies. Mount the lower legs (33,34) in their natural position by using the knee tensioner bolts (35), nuts (36) and friction washers (39).

10. Position the accelerometer-mounting block (5) with the recessed part facing down and the slots in the sides fitting the protrusions in the head (1) cavity using the two bolts (6). Do not yet tighten the bolts.

11. Position the head over the atlas-axis block. Use the head bolt (7) and nut (8) to connect the head to the rest of the assembly.

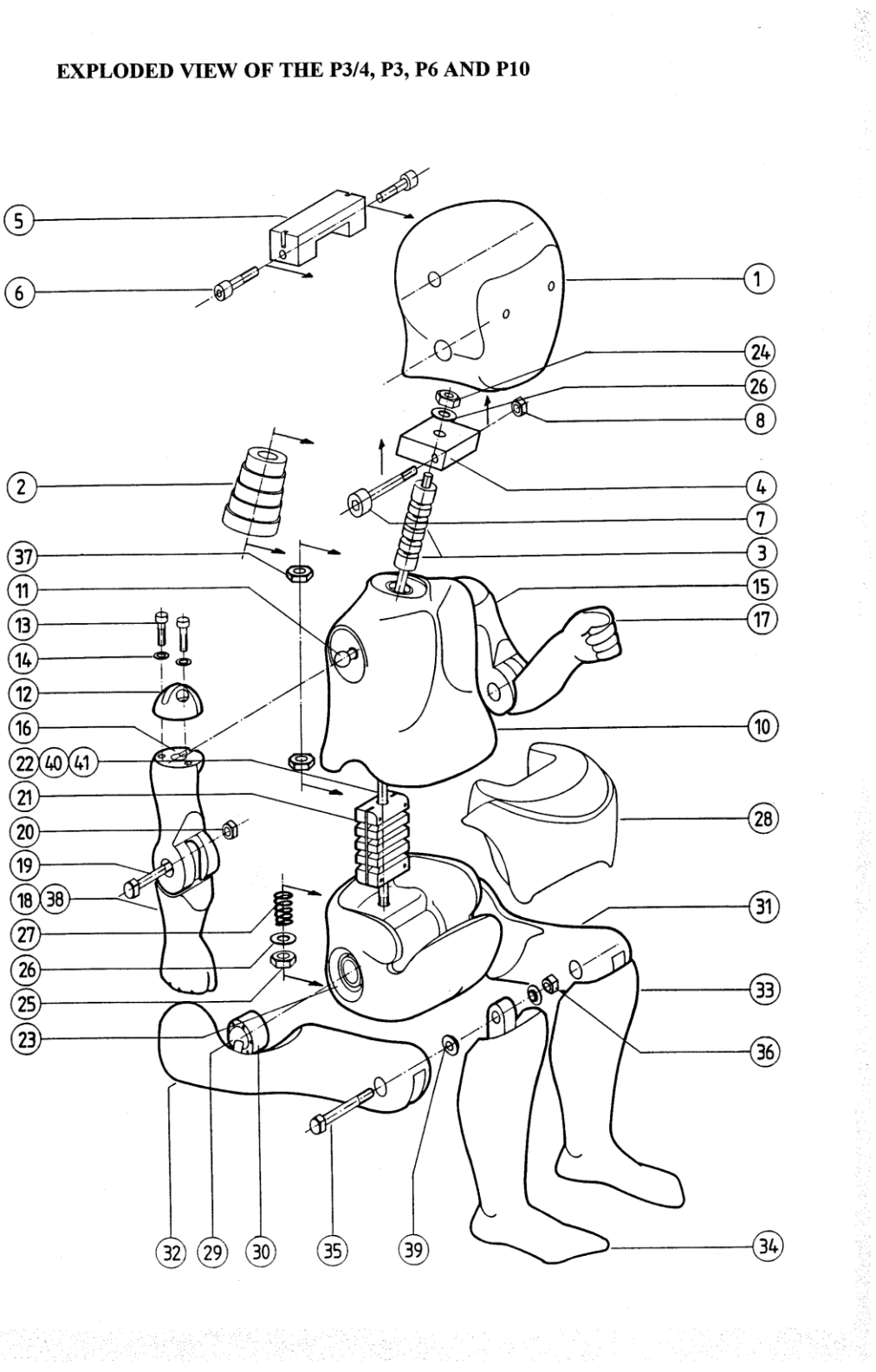


Figure 3: Exploded view of a P¾, P3, P6 or P10 child dummy.

Table IV: Parts list of the P¾, P3, P6 and P10 dummies (: not shown in figure 3)*

Ref. No.	Name	Qty.
1	Head	1
2	Neck elements	5
3	Neck core elements (polyamide)	6
4	Atlas-axis block	1
5	Accelerometer mounting block	1
6	Acc. mounting block attachment bolt	2
7	Head bolt	1
8	Head tensioner nut	1
10	Upper torso	1
11	Shoulder joint ball	2
12	Shoulder joint socket	2
13	Shoulder joint adjustment bolt	4
14	Spring washer	4
15	Upper arm left	1
16	Upper arm right	1
17	Lower arm left	1
18	Lower arm right	1
19	Elbow tensioner bolt	2
20	Elbow tensioner nut	2
21	Lumbar vertebrae assembly	1
22	Spine cable	1
23	Lower torso	1
24	Neck adjustment nut	1
25	Lumbar vertebrae adjustment nut	1
26	Washer	2
27	Spring	1
28	Abdominal insert	1
29	Hip ball joint	2
30	Hip joint nut/socket	2
31	Upper leg left	1
32	Upper leg right	1
33	Lower leg left	1
34	Lower leg right	1

35	Knee tensioner bolt	2
36	Knee tensioner nut	2
37	Spine cable fixation nuts	2
38	Friction washer	4
39	Friction washer	4
40	Bush (polyethylene)	2
41	Spiral shaped bush	2
42	Modelling clay	1*
43	Cotton stretch clothing	1*
44	Hip joint adjustment tool	1*

4. CALIBRATION PROCEDURES

4.0 General

In order to achieve reproducible results, it is essential to specify and control the friction at each joint, and the tension in the neck and lumbar spine according to standard procedures. A static calibration has been chosen for reasons of simplicity. Disassembly of the head, lower arms and legs should be performed before starting the calibration procedure. It is recommended to follow the calibration procedures of this chapter in the order as presented. The numbers between brackets given in the calibration procedures refer to the numbers given in figure 3 and table IV.

4.1 Neck

1. Place the torso (10) with its back flat on a horizontal plane (see figure 4).
2. Tighten the neck adjustment nut (24) on the atlas-axis block (4) firmly.
3. Place the head bolt (7) through the hole in the atlas-axis block.
4. Apply a vertical load of 50 N to the centre of the neck head bolt without rotating the atlas-axis block.
5. Record the vertical displacement of the centre of the atlas-axis block. The atlas-axis block should show a vertical displacement of 10 ± 1 mm.
6. If the displacement does not meet this requirement, remove the load and release or tighten the neck adjustment nut. Repeat steps 4 to 6 until the displacement fulfils the requirement.

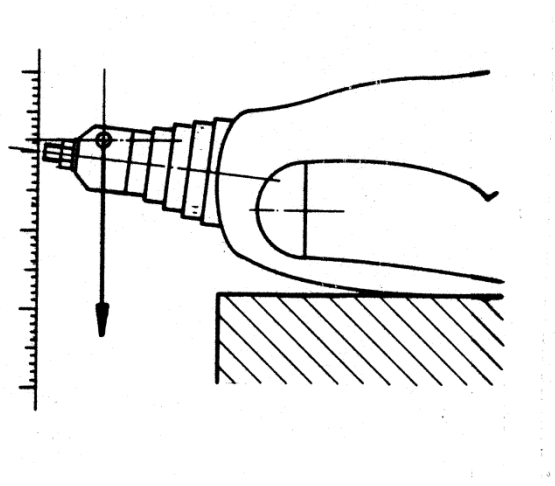


Figure 4: *Calibration of the neck.*

4.2 Atlas-Axis Joint

1. Place the torso with its back flat on a horizontal plane (see figure 5).
2. Mount the head (1) on the neck assembly.
3. Tighten the head bolt (7) and tensioner nut (8) firmly with the head in a horizontal position.
4. Loosen the head bolt slowly until the head starts moving because of its own weight.

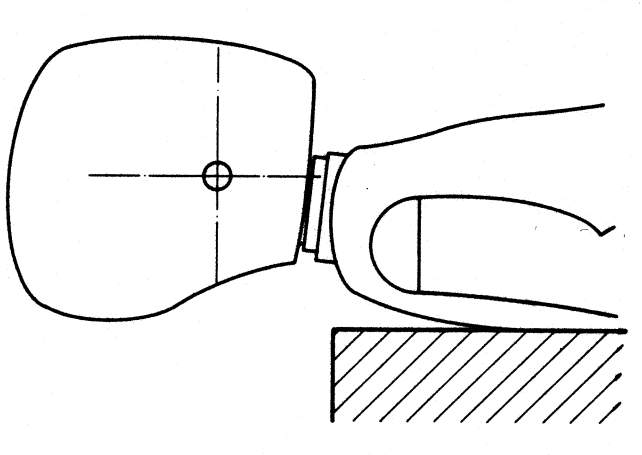


Figure 5: Calibration of the atlas-axis joint.

4.3 Hip Joints

1. Place the torso on its front on a horizontal plane, with the hip joint near the edge (see figure 6). The plane should support the lower torso.
2. Mount the upper leg (31,32) to the pelvis.
3. Tighten the hip joint nut/socket (30) firmly with the upper leg in a horizontal position.
4. Loosen the hip joint nut/socket until the upper leg starts moving because of its own weight.

With new dummies the hip joint adjustments should be checked frequently because of "running in".

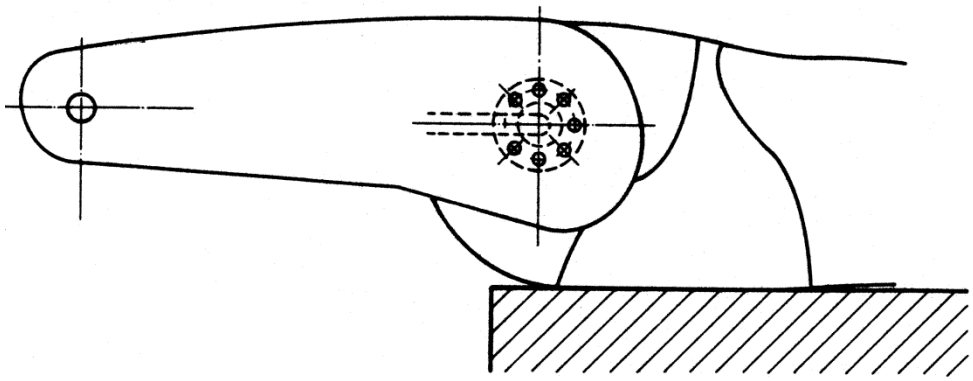


Figure 6: Calibration of the hip joints.

4.4 Knee Joints

1. Place the dummy on its back on a horizontal flat plane with the knee over the edge (see figure 7).
2. Mount the lower leg horizontally and tighten the knee tensioner bolt (35) and nut (36) firmly.

3. Release the nut until the lower leg starts moving because of its own weight.

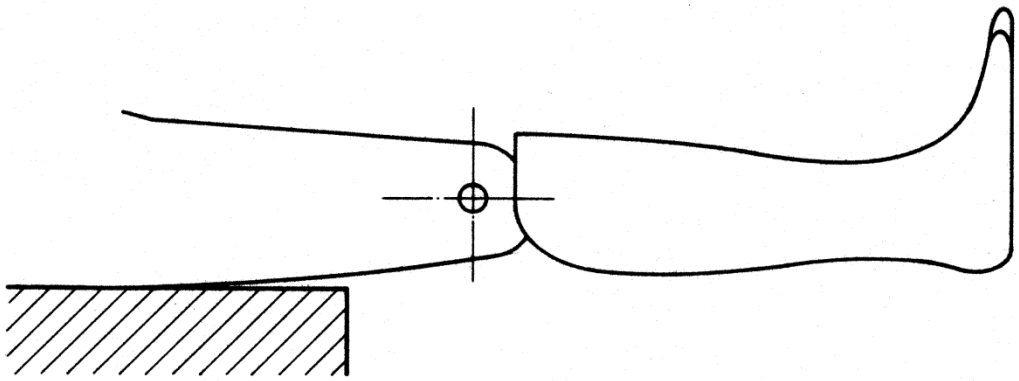


Figure 7: Calibration of the knee joints.

4.5 Shoulder Joints

1. Place the torso in an upright vertical position (see figure 8).
2. Mount the upper arm only and tighten the shoulder joint socket (12) with the shoulder joint bolt (13) with the upper arm in horizontal position.
3. Loosen the bolt until the upper arm starts moving because of its own weight.

With new dummies the shoulder joint adjustments should be checked frequently because of "running in".

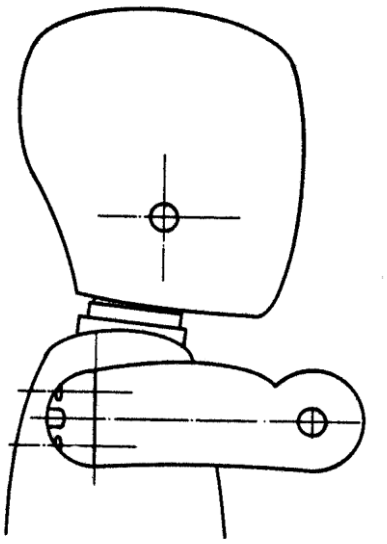


Figure 8: Calibration of the shoulder joints.

4.6 Elbow Joint

1. Place the upper arm in a vertical position (see figure 9).
2. Mount the lower arm in a horizontal position and tighten the elbow tensioner bolt (19) and nut (20) firmly.
3. Loosen the elbow tensioner nut until the lower arm starts moving because of its own weight.

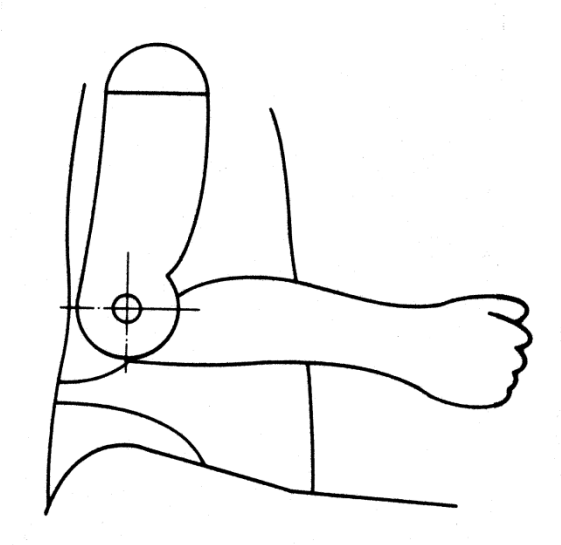


Figure 9: *Calibration of the elbow joints.*

4.7 Lumbar Spine Cable

1. Release the spine cable fixation nut (37) in the lower torso.
2. Tighten the fixation nut until the spring (27) is compressed to 2/3 of its unloaded length.

4.8 Dimensions of the Modeling Clay

The modelling clay, placed in the abdomen of the dummy for detection of abdominal penetration, should have a rectangular shape with the following dimensions for the various dummies:

P3/4	:	40 x 60 x 25 mm
P3	:	60 x 80 x 25 mm
P6	:	60 x 95 x 25 mm
P10	:	80 x 125 x 25 mm

4.9 Abdomen- use of the P-dummy Abdomen Test Rig (part number H.K)

1. Introduction

The P-dummy Abdomen test rig (part no H.K) is designed to test the abdominal insert of all P-dummies according to the procedure described in the regulation ECE-44. The standard test rig is equipped to test the abdomen of the P3/4, P3. P6 and P10 dummy.

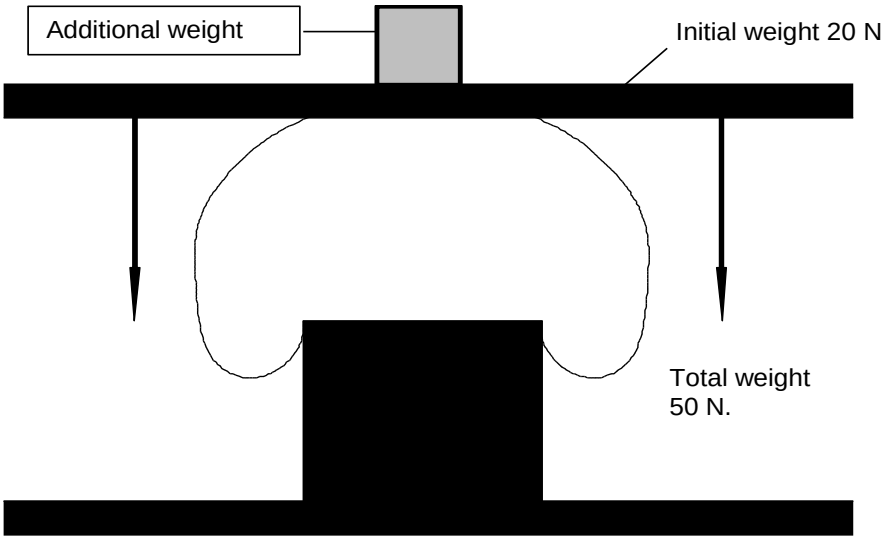
2. General assembly and installation

The P-dummy abdomen test rig comes completely assembled and ready for use. The test rig is operated by manually; there is no requirement for a power supply.
Please install the test rig in a room with a temperature of 18-22°C and a relative humidity of 10-70%. The test rig is designed to install on a table for a comfortable working height. We recommend a standard table with a height of approx. 80 cm. The test rig does not need to be secured to the table.

3. Performing the test.

Each P-dummy abdomen has its own support block for this test. To test the abdomen, the following procedure should be followed.

- Place the appropriate block on the location pins of the calibration rig.
- Place the abdomen over the block, making sure that the rear of the abdomen lines up with the end of the block.
- Place the plate carefully on the abdomen (this is the initial load of 20 N).
- Immediately read the ruler, and note the initial value.
- Place the additional weight on the plate within 10 seconds of placing the initial weight (this makes the total load 50 N).
- Read the deflection at the ruler after a period of 2 minutes. Calculate the deflection using the initial value and value taken after two minutes.



The deflection shall be:

- P3/4 dummy 9.5 – 13.5 mm
- P3 dummy 9.5 – 13.5 mm
- P6 dummy 11.0 – 15.0 mm
- P10 dummy 11.0 – 15.0 mm

A detailed drawing of the rig is provided when purchased.

Manual Update Log

Rev. B, Mar. 2011 Manual changed from FTSS to Humanetics

Rev. C, Jul. 2015 **Page 2:** Added lead material statement