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SELECTED DESIGN PARAMETERS FOR RECLINING SEATS BASED ON ENGINEERING ANTHROPOMETRY

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FOR THE COMMANDER

CHARLES BATES, JR.
Chief
Human Engineering Division
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This report discusses selected engineering anthropometric design criteria for reclining cockpit seats. The reclining back-rest positions selected were 13°, 27°, 51° and 65° from the vertical line through the seat reference point (SRP). Two seat pan angles of 10° and 20° were utilized. Three seating components were considered in this report, these are: the head rest, arm rest, and foot rest. The specific engineering

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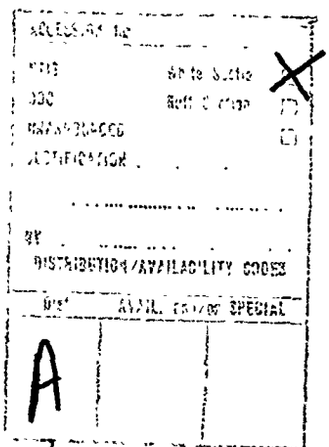
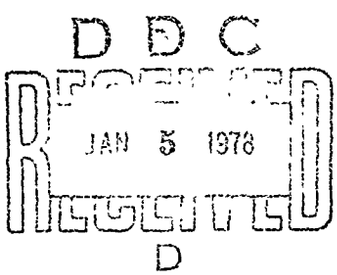
anthropometric design parameters addressed were: (a) The head rest hinge point location, (b) arm rest location and orientation in space as the seat reclines, (c) location of foot rests and (d) the synchronization of arm rest movement with back rest inclination.





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INTRODUCTION

Background

The recent technological advancements in the design of fighter aircraft have resulted in planes which can withstand high G loadings. Therefore, the "High Performance Fighter" has the capability for improved maneuverability resulting in increased demands on the pilot. These planes can sustain the high G loading (up to 15 G) for a considerable period of time. Such capability gives a decisive advantage over the enemy in tactical combat missions, both offensively and defensively (Kulwicki & Sinnett [1]). However, these high G environments can exceed the physiological limits of the pilot and therefore, render him less effective as a component of the weapon system. In essence, even though the technology has been developed to produce an aircraft with superior performance capability, lacking the pilot ability to cope with the super G, results in a system performance short of optimum.

The simple fact is that a fighter pilot in the standard aircraft seat configuration has limited tolerance to withstand high normal acceleration forces (G_z), (Physiology of Flight [2], Bioastronautics Data Book [3]). This is because the "downward g" acceleration pools the blood supply in the lower part of the body and severely curtails the supply to the head. The pilot then experiences "gray out" and "black out" depending on the level and duration of the G environment. This problem can be overcome to a certain extent by wearing an anti-G suit. Special breathing procedures

(M-1 technique, Valsalva method) can also be employed to alleviate the effect of G forces to a certain extent. But these procedures are not effective at G loads beyond about 8 G. Hence recently, serious attention has been directed toward the concept of changing the posture of the pilot from upright towards supine so that the "hydrostatic head" required to supply blood to the pilot's head is reduced. Figure 1 shows this effect pictorially.

This concept is not new. Gell, et. al., [4] report a centrifuge study in which the back rest was varied (up to 85°) in the rear cockpit of a Navy F-7 fighter. The G tolerance of the subject increased beyond 45°, and at 85°, was recorded as 15 G for a period of five seconds.

Crossley, et. al., [5] report an increase in gray out threshold as back angle was changed from 15° to 70° to a maximum of 8 G.

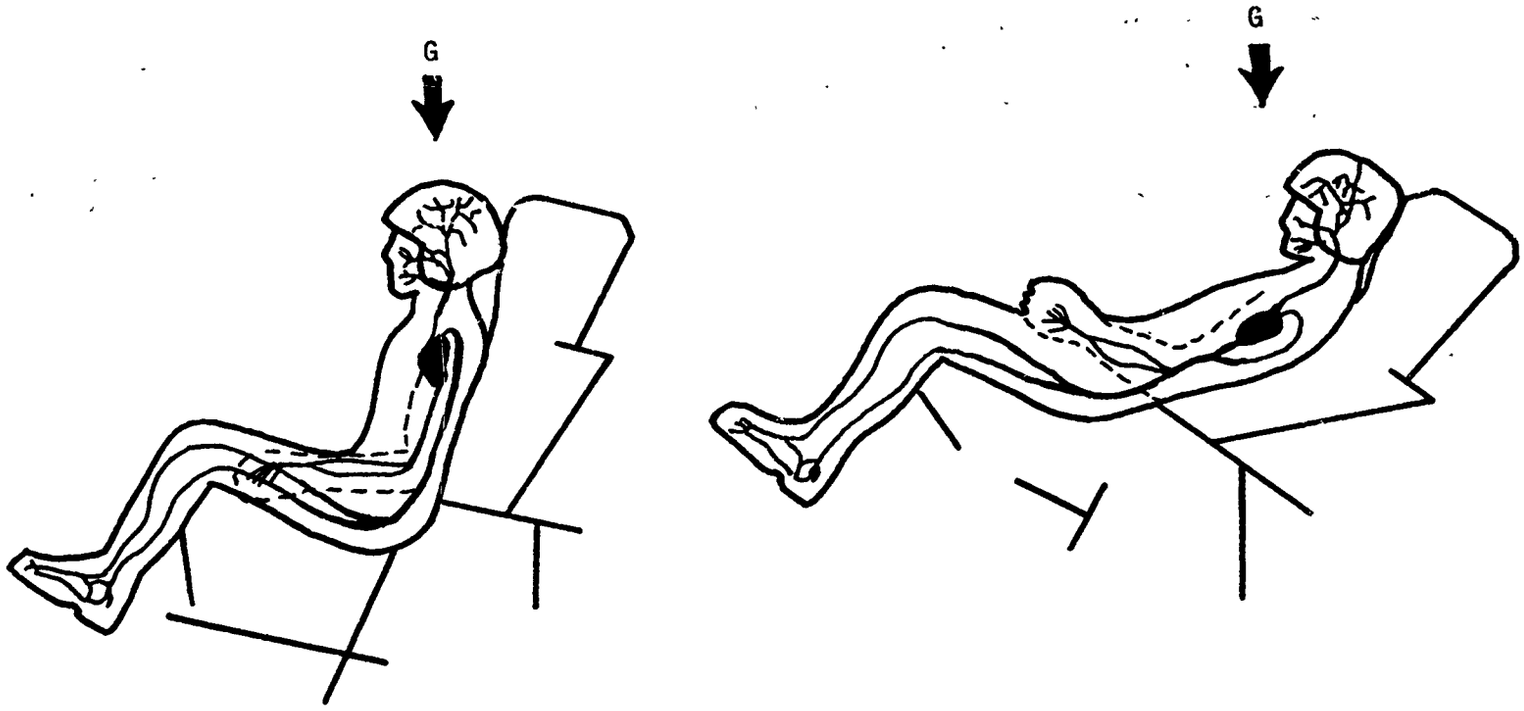
Von Beck [6] lists the following as the three "desirable" design characteristics for a tilt seat:

1. Maintenance of forward visibility.
2. Control and instrument location.
3. Emergency escape system.

He also notes that the pilot should be able to land and take off while reclined.

Replogle, et. al., [7] conducted a centrifuge study using a simulated air combat task to measure the performance of the pilots. Results showed that at 9 G with 65° back angle, the performance was equivalent to that at 7 G with 13° back angle. They also report a lowered heart rate, improved "G on G" performance and subject acceptance of larger back angles.

RECLINED POSITION
IMPROVES HIGH G BLOOD SUPPLY



- Eye Level Blood Pressure Maintained
- Reduced Blood Pooling
- Lower Heart Rate

Figure 1

[from Kulwicki, P. V. and Sinnett, J. M., "The High G Approach" MDC A2109, McDonnell Douglas Aircraft Co., 1973]

Similar beneficial effects were also reported with a reclined seat back under transverse (G_y) acceleration by a number of authors. Taking advantage of these benefits of reclining the pilot on his back to improve the G tolerance, a new approach in cockpit design is being considered. Thus, the "High Acceleration Cockpit (HAC)" concept requires that the pilot assume a 65° or larger back rest position under high G environment. Figure 2 shows the improvement possibility in human tolerance to G forces with a 65° back rest angle. The high G tolerance thus achieved can be put to best use by the pilot to make better utilization of the aircraft capability and gain a specific advantage over his adversary in a tactical combat situation.

While such a tactical superiority can be achieved on G tolerance basis, certain other problems are encountered by a supine pilot. The reduction in forward visibility is a very critical one. The pilot can lose a certain amount of over the nose vision and panel vision as compared to upright seat position. To minimize this effect, the HAC concept calls for raising the seat and rotating the head forward (by rotating the head rest by about 40°). This results in a minimum over the nose vision of -10°. Secondly, the supine position will call for the utilization of new types of controllers. Finally, body movement under G environment itself may produce labyrinthine symptoms [9].

Purpose and Scope of the Study

This study was undertaken to generate engineering/anthropometric data base for the design of head rests, arm rests, and foot rests for high acceleration cockpit seats of the articulating type to insure optimum comfort for

RECLINED POSITION
IMPROVES PILOT G TOLERANCE

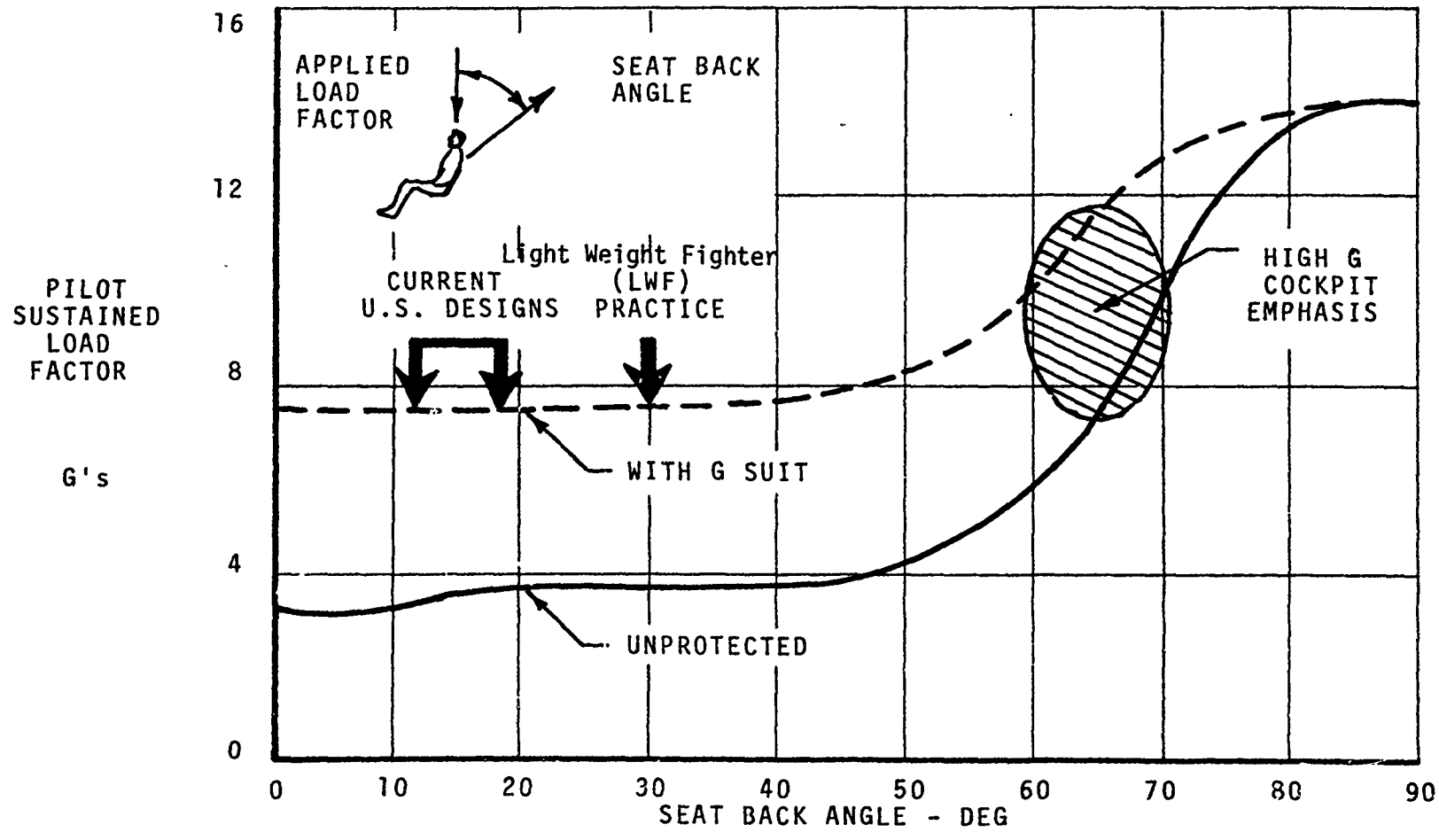


Figure 2

[from Kulwicki, V.P. and Sinnett, J. M., "The High G Approach" MDC A2109, McDonnell Douglas Aircraft Co., 1973]

the pilot under dynamic conditions without sacrificing any combat performance capability. The specific requirements are to provide proper support of the body and limbs under upright, supine and transient conditions. At the same time:

(1) Permit head movement to maintain all-around visibility,

(2) Permit hand and foot mobility to operate essential controls for high G maneuvering of the aircraft.

It is also required that these rests should have adjustability for the comfort of the individual pilot, taking into account pilot population size.

APPROACH

In order to objectively achieve a feasible design for the head rest, arm rest, and foot rest for the high G cockpit seat configurations several design criteria have been selected for each of the components to be designed.

1. Design Criteria

a. Head rest: Based on the changes in seat configurations from the standard 13° back rest to the new high G concept of 65° back rest, the head rest should be designed to:

- provide maximum comfort to the pilot
- cause minimum interference with personal equipment used by the pilot
- provide optimum visibility
- provide freedom of head movement commensurate with visual requirements (or have a mechanized head rest)
- be compatible with ejection seat requirements
- provide adjustability to accommodate the pilot population

b. Arm rest: Since the new high G seat configuration makes it impossible to use "conventional" flight controllers, new controller designs have been proposed [8, 10]. These controllers will likely be mounted on arm rests and operated with the hand and fingers. Therefore, arm rests should be designed to:

- provide the needed support for the entire upper extremity
- cause no interference with the operation of essential controls mounted on these arm rests and immediately adjacent surfaces
- provide upper extremity configurations conducive to maximum biomechanical advantage
- meet ejection seat requirements
- provide individual adjustability
- be synchronized with seat configuration changes

c. Foot rest: Under high G environment, the pilot in the proposed seat configuration must be provided with heel support. It will serve to keep the pilot's feet on the rudder controls, especially under high G levels. The foot rest should be designed to:

- provide support to maintain the position of the feet on the rudder controls throughout their ranges of movement
- provide adjustability
- meet the ejection seat requirements, if any
- maintain reasonable foot-tibia relationship--to minimize any detrimental effect on performance

2. Design Parameters

For each of the head rest, arm rest, and foot rest, there are a few basic individual design parameters that must be considered. The following section discusses these parameters for each.

a. Head rest:

(1) Shape: The head rest must be shaped to provide support to the head (also neck support, if needed). Proper support will have to be provided to the head with its protective gear at the upright and the full range of reclined positions.

(2) Size: Head rest size will be kept as small as possible to minimize interference with lateral and rear visibility. At the same time, it should provide the necessary support at the required areas. Further, the size and shape, as well as freedom of movement requirements, would also determine whether support over the neck area is advantageous.

(3) Hinge Point: Hinge point is the point about which the head rest must articulate relative to the back rest. This point has to be at the proper position with respect to the torso to provide comfort and safety upon ejection and at the same time not cause interference with personal protective clothing when the seat is in the fully reclined configuration.

(4) Range of Movement: Range of movement of head determines the total visibility envelope. Therefore, the head rest should permit movement of the head to meet the minimum visibility requirements, while maintaining the proper support.

(5) Adjustability: The head rest should have enough adjustability to accommodate the range of body sizes found in the USAF pilot population.

b. Arm rest:

(1) Shape: The proper shape and contour to support forearm and controls and to permit easy operation of these controls has to be considered.

(2) Size: The arm rests should provide enough support area for the upper extremity and not interfere with the operation of controls or ejection procedure.

The arm rest should be as small as possible, but at the same time, it must provide adequate support and stability for the arms and space for control instrumentation.

(3) General Location and Orientation: The elevation, bearing, and fore-aft positioning of the arm rests should permit optimum control manipulation and comfort. The ejection procedure requirement also has a definite effect on the location of arm rests.

(4) Adjustability: Enough adjustability must be provided for the range of pilot population.

(5) Synchronization: The arm rest should be synchronized with back rest movement (i.e., from 13° to 65° configurations) to provide the same control location with respect to upper arm configurations at these extreme positions as well as during the transitional movements.

c. Foot rest:

(1) Shape: The foot rest should be shaped to provide enough support at the heel without hindering the foot operation at the rudder pedals under normal or under high G environments.

(2) Size: The foot rest must be large enough to cover the range of heel positions possible, whether the pilot is in the upright or reclining position.

(3) Orientation with Respect to Foot Control: The spatial orientation of the rest should not interfere with the foot control operation at both upright and supine positions. The foot-tibia angle changes from upright to reclined position.

(4) Adjustability: There should be enough built-in adjustability to cover the range of pilot population.

The following section will describe the equipment used to generate the required data as well as the equipment used to reduce and digitize these data.

EQUIPMENT

The major pieces of equipment used in this study were: The AMRL photogrammetric system, the digitizing equipment, and the experimental seating/controller positioning device. Of these, the photogrammetric system and the digitizing equipment have been used earlier. A complete description of these may be found in Ayoub, et. al., [14].

Photogrammetric System

The photogrammetric facility used in this study was designed and built at the Aerospace Medical Research Laboratory of U.S. Air Force. A schematic layout of the system is shown in Figure 3. In essence it consists of two pairs of front surface, minimum distortion mirrors and a 70 millimeter fast sequence camera with strobe units. The components of the system are so laid out as to obtain two orthogonal view images of a task area on a single frame of picture. For additional detailed information, see reference [14].

Digitizer Unit

A Viable Systems x-y digitizer unit was employed to extract coordinates from the film projections. It consists of a 70 mm projector, a rear projection screen with a mirror, a x-y digitizer with a movable cursor and a paper tape punching unit. The system was assembled using commercially available components. Figure 4 shows the x-y digitizer unit.

Targets

The skin surface points were identified by suitable surface type target or extension type targets. Surface type targets were made up of adhesive vinyl tape in black and white and were directly attached to the skin.

At locations where surface type target may not be seen in both views of the picture extension type targets were used. An extension type target consists of thin white plastic tube 1/4" diameter and either 3" or 1.5" long. Figure 5 shows an extension type target 3" long. The ratio of distances AB to BC is 1:2. Thus, if the locations of A and B can be

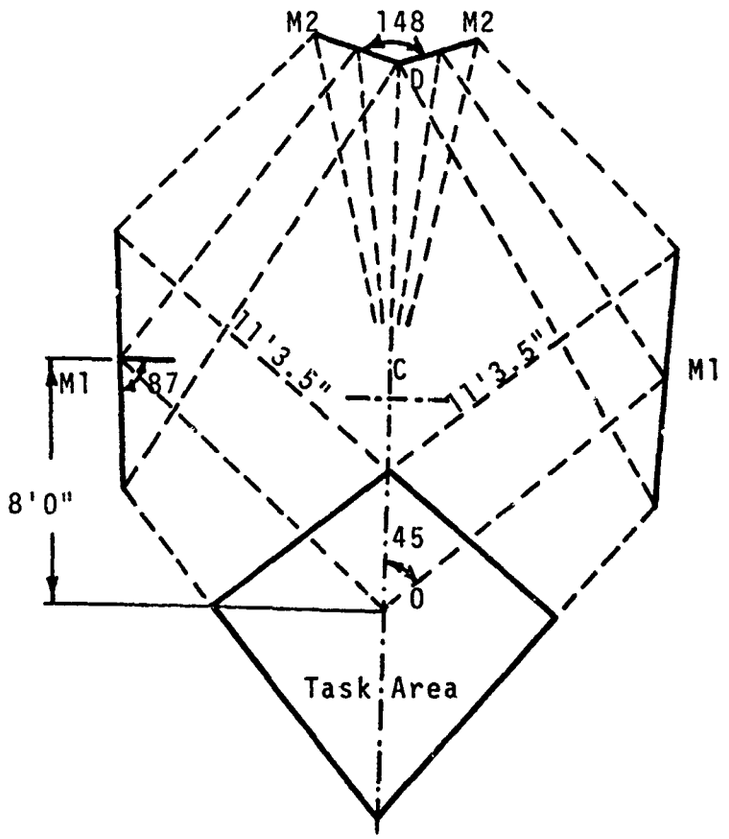


Figure 3 Schematic Layout of Photogrammetric System

M1 - 7'3.5" sq. Mirror
M2 - 2'6" sq. Mirror
C - Camera. O - Center of Task Area
CD - 9'7.25". OC - 6'7.25"

(Modified from the original drawing by K. W. Kennedy, AMRL, Wright-Patterson AFB, Dayton, OH)

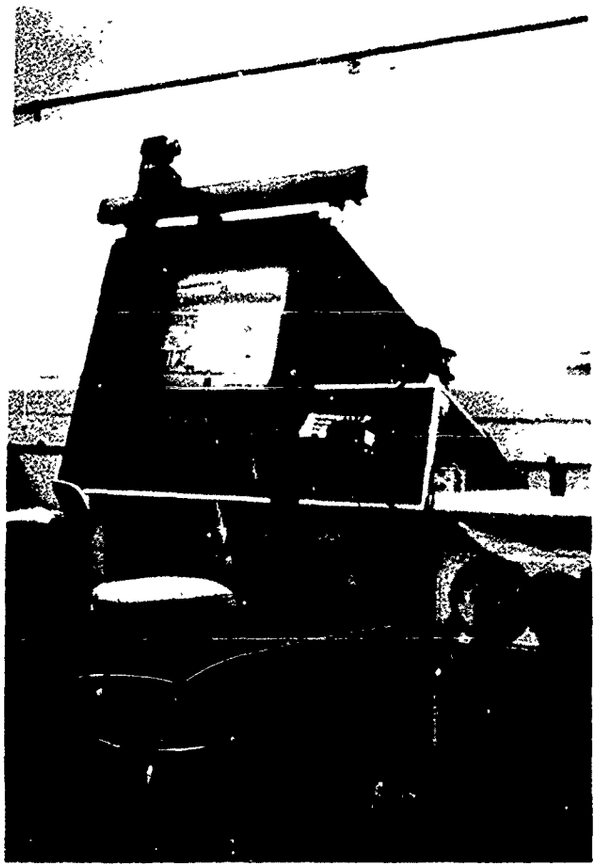


FIGURE 4 THE VIABLE SYSTEMS X-Y DIGITIZER

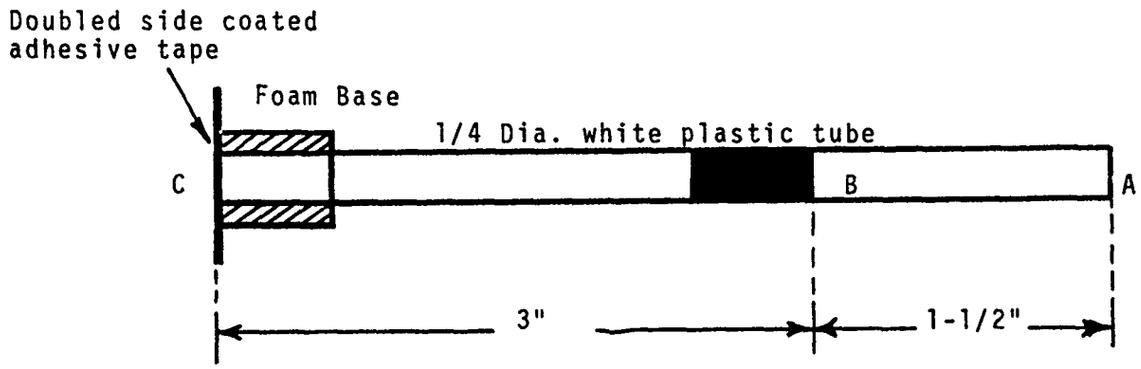


Figure 5 Extension Target (Long 1:2)

determined from the orthogonal views, then the location of skin surface point C can be computed. The point C was always attached to the skin surface point using suitable foam rubber base and adhesive tape.

Seating/Controller Positioning Device

The seating/controller positioning device was specially designed and fabricated at AMRL facilities for this study. It was designed to provide flexibility to change back rest and seat pan configurations, and hand controller and foot controller locations. Figure 6 shows the general arrangement of the seating device along with hand and foot controllers.

Seat Configuration Capability

The seat can be adjusted to provide the following configurations as a function of seat pan, back rest, and head rest angles:

1. Back rest angle 0° to 70° measured backwards from vertical (backwards).
2. Seat pan angle 0° to 30° measured upward from horizontal.
3. Head rest angle 0° (flush with back rest) or 30° (forward of back rest measured from plane of back rest).

Suitably mounted hydraulic jacks provided the basic mechanisms for back rest angle and seat pan angle adjustments. The back rest was made in two segments with provision to adjust the length of back rest from 17" to 25". (See Figures 7 and 8.) This provides adjustability of both the back rest length and the position of the hinge point of the head rest.

Hand Control Location Adjustments

A vertical cylinder 1.5" in diameter and 4" long represented a hand controller. The controller can be located at different points in space

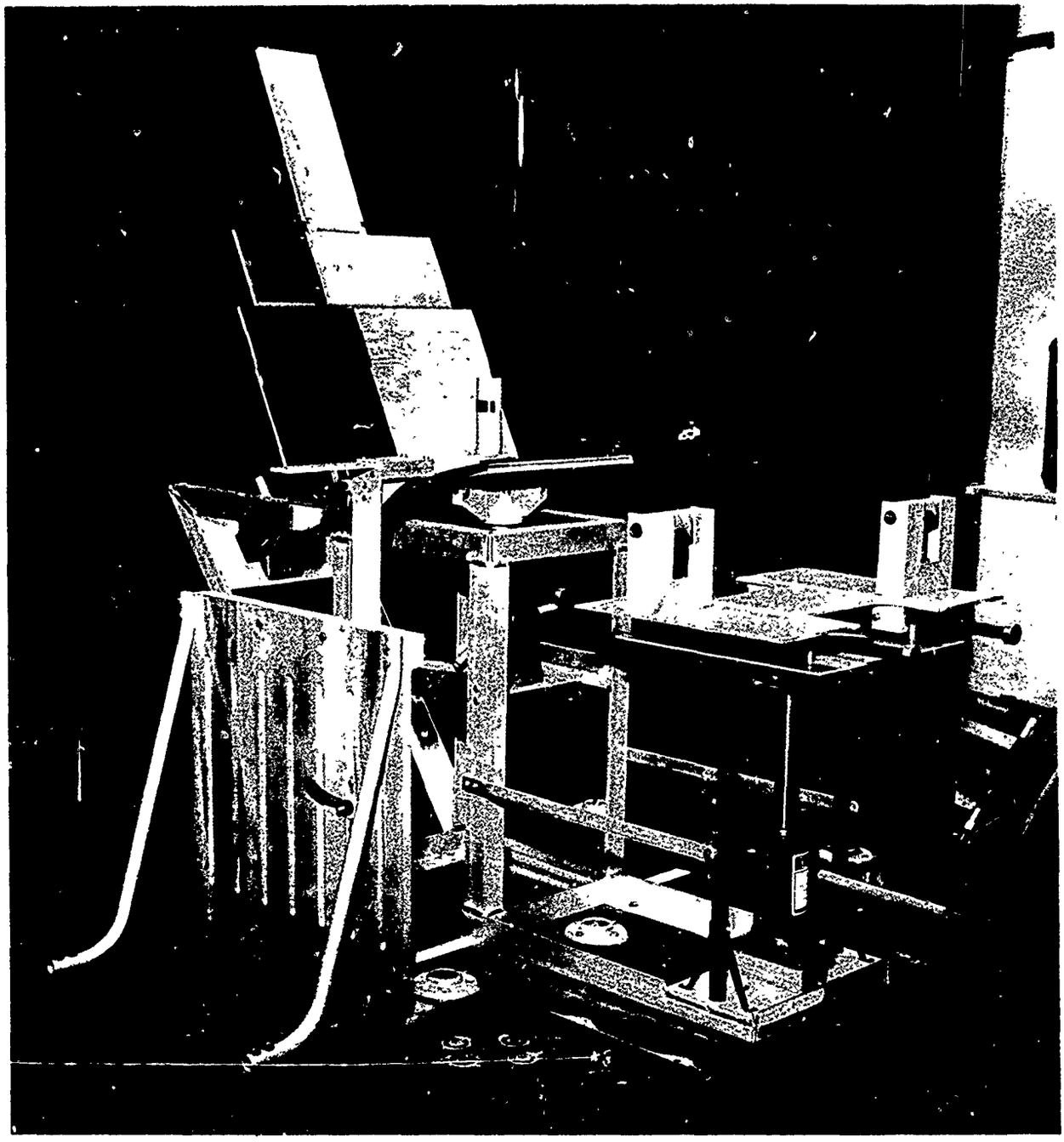


Figure 6 General Arrangement of the Seating Device

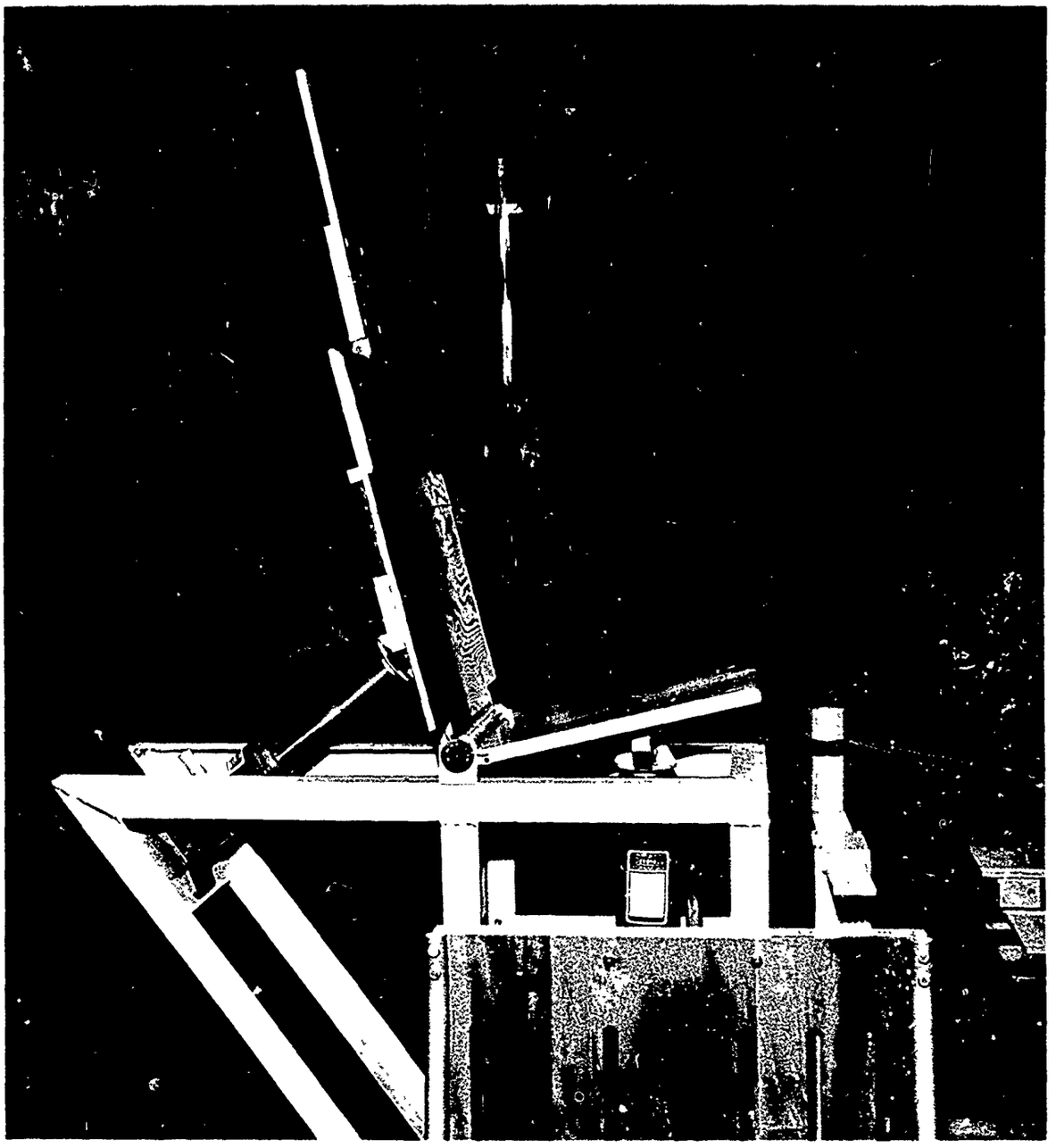


Figure 7 Using Hydraulic Jacks Back Rest and Seat Pan Adjustment Mechanisms

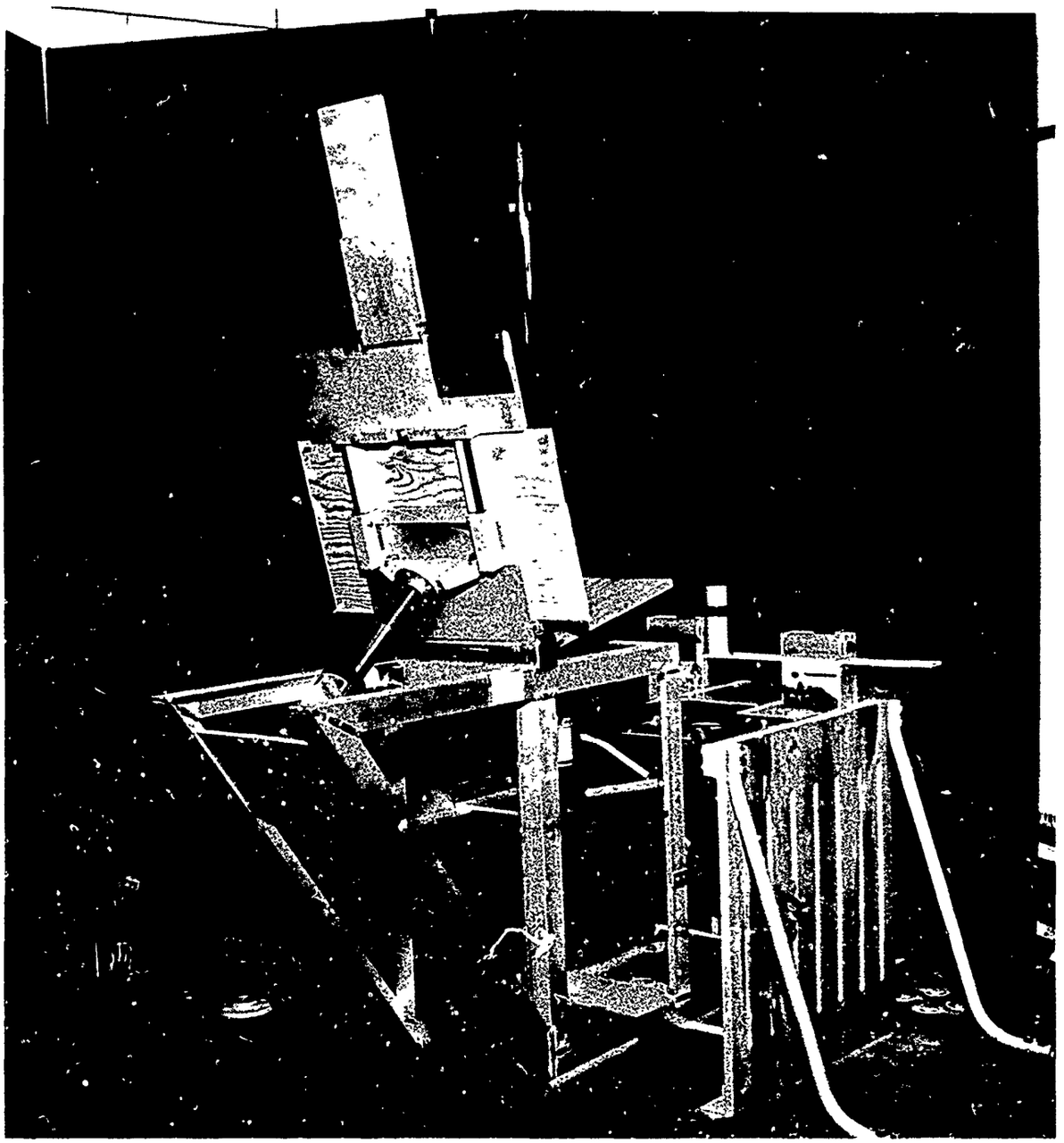


Figure 8 Back View Showing Back Rest and Head Rest and Provisions for Back Rest Length Adjustment

with respect to the Seat Reference Point (SRP) within the following extreme positions:

Fore - aft: +24" to -4"

Up - down: +15" to +3"

Left - right: -3" to -18" (negative coordinate indicates the adjustment was possible on right side only)

The hand controller was supported by means of suitable hardware to provide the needed adjustments. The hand controller was provided on the right hand side of the chair. (See Figure 9.)

Foot Control Adjustment

Two horizontal cylinders 2" in diameter x 6" long represented rudder pedals to be operated by feet. They were mounted on a sliding platform directly in front of the seat. The axes of the pedals were at a height of 5" from the top surface of the sliding platform. A horizontal separation of 18" center to center was maintained between right and left pedals. The pedals can be positioned and locked individually on the sliding platform at 1" intervals over a range of 10" along the fore-aft direction. The sliding platform itself has provision for movement fore and aft, such that a rudder pedal located over the midline of the platform can be positioned from about 30" to 42" forward of SRP. (See Figure 10.)

EXPERIMENTAL DESIGN AND PROCEDURE

Experimental Design

In order to study the effects of upright and semi-reclined body positions on the design requirements of the seat, the five seat configurations shown in Table 1 were selected to be included in the experimental

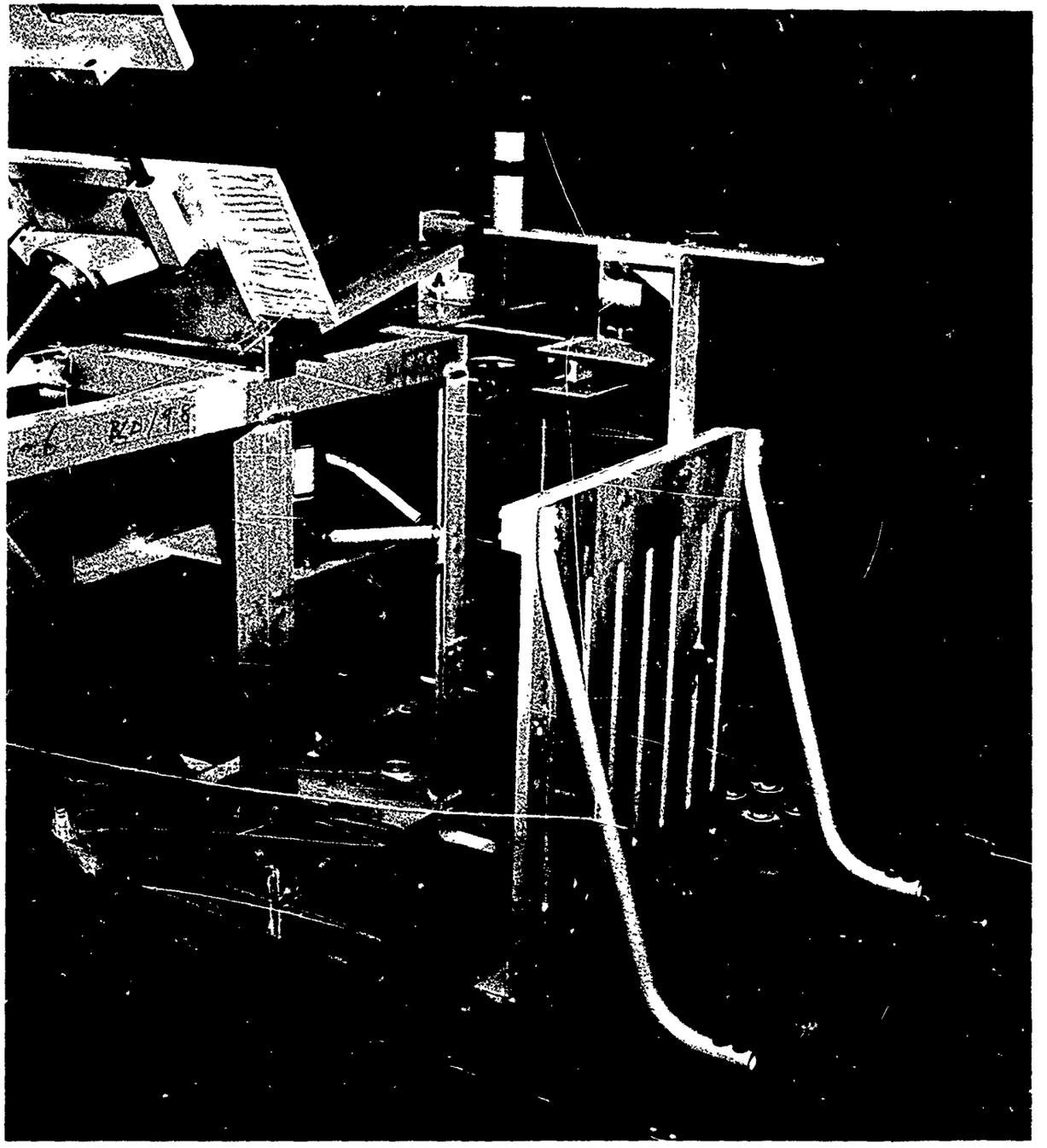


Figure 9 Hand Controller With Adjustment Mechanism

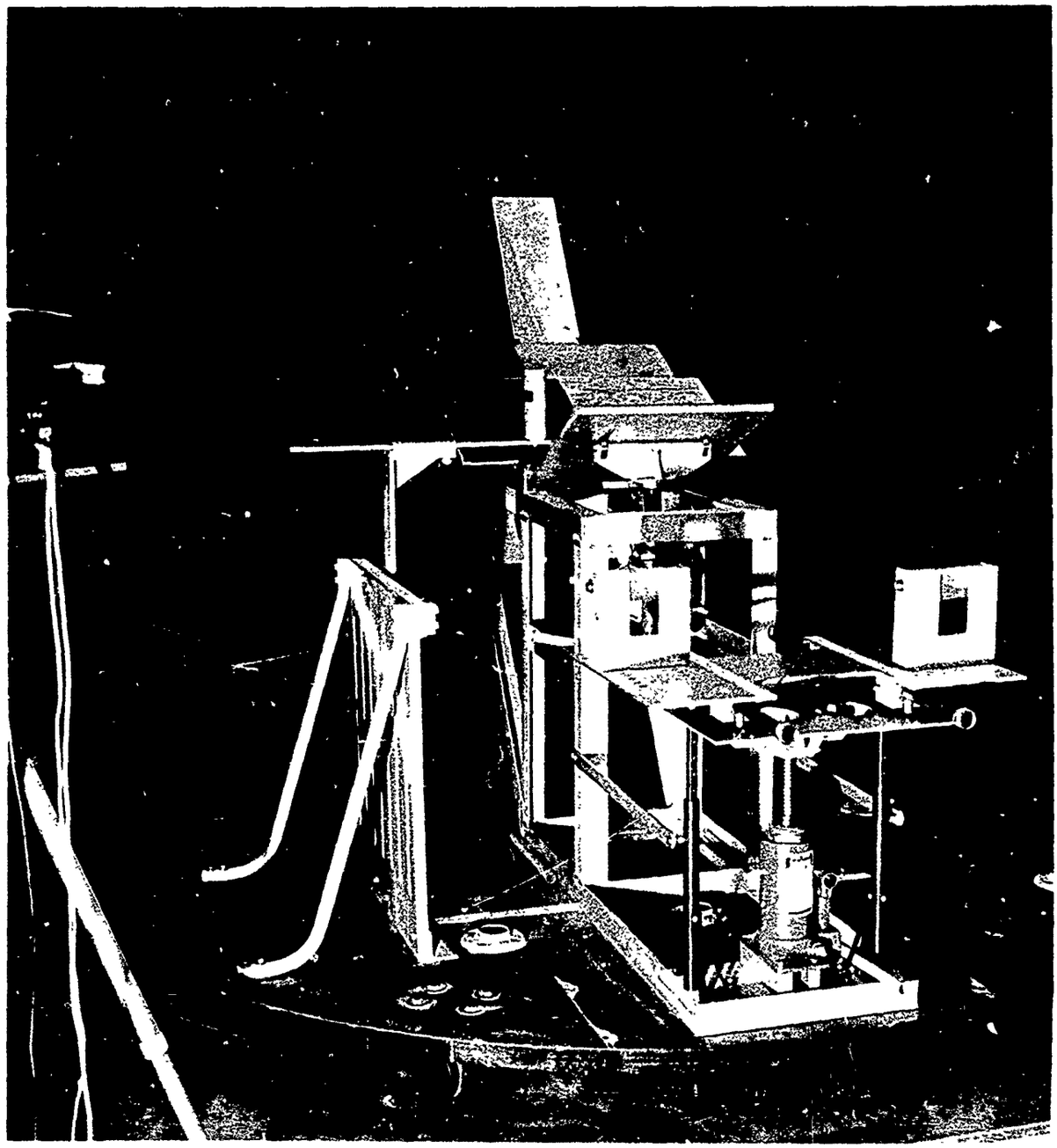


Figure 10 Foot Control Platform and Adjustment Mechanisms

TABLE 1

CHARACTERISTICS OF SEAT CONFIGURATIONS

Seat Configuration	Back Rest Angle	Head Rest Angle*	Seat Pan Angle
I	13°	0°	10°
II	27°	0°	10°
III	51°	30°	10°
IV	65°	30°	10°
V	65°	30°	20°

*Head rest angle measured forward from back rest.

design. Thus the back rest angle chosen for the study are 13°, 27°, 51°, and 65° from the vertical. It was found that at 13° and 27°, the head rest was not essential, but at 51° and 65° back rest angles, the head rest, inclined 30° forward would provide the desired support and comfort to the subject. The fifth seat configuration was different from the fourth in that the seat angle was changed from 10° to 20°. This was done in order to assess the effects of increased seat inclination in providing more area of support to the thighs.

To obtain all the needed data, the experimental design called for three sets of photographs for each seat configuration. These three sets of photographs would relate to head rest, hand rest and foot rest studies, separately. In each of these pictures, the interest was to determine the spatial locations of certain body landmarks. The specific body landmarks considered are listed in Table 2.

Subjects

A total of 24 subjects participated in the study. Of these, three subjects did not participate in the head and upper torso part of the study (see page 35). All the subjects were volunteer male students. They were selected to represent U.S. Air Force pilot population especially with regard to their segment length, i.e. limb and torso. These and other anthropometric characteristics of the subjects are listed in Table 3. Initially, every subject was told about the purpose of the experiment and his responsibilities. Every effort was made to make sure that each subject understood his duties. Table 4 shows a comparison between the subjects' anthropometric characteristics and the corresponding characteristics of the U.S. Air Force flying personnel.

TABLE 2

SPECIFIC LANDMARKS CONSIDERED IN THIS STUDY

AND IDENTIFIED WITH A TARGET

	Location	Target Ratio	Study		
			Head	Hand	Foot
01	Nasion	1:1	*	*	*
02	Menton	surface	*	*	*
03	Supra sternale	1:1	*	*	*
04	Rt. Acromion	1:1	*	*	*
05	Rt. Elbow	1:1		*	
06	Rt. Wrist	1:1		*	
07	Rt. III Meta-Carp.	surface		*	
08	Trochantion, rt.	1:2			*
09	Rt. Knee, top	1:1			*
10	Rt. Knee, pop.notch	1:2			*
11	Rt. Knee, front	surface			*
12	Helmet rear	no Target	*		
13	Upper back	no Target	*		
14	Lower back	no Target	*		

*Indicates the specific landmarks used in the respective part of the study. All landmarks monitored are surface landmarks.

TABLE 3

ANTHROPOMETRIC CHARACTERISTICS OF THE SUBJECTS

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	$\bar{x}$ mean	σ Std. Dev.
Age	21	19	23	23	20	23	19	20	21	22	24	20	21	22	21	21	19	21	21	20	21	19	19	23	20.9	1.48
Weight	156.1	149.8	151.3	137.5	134.7	142.9	144.4	156.9	168.2	199.2	184.7	182.2	137.7	158.0	162.9	173.3	176.3	156.5	154.5	185.5	167.9	171.9	142.9	161.4	160.6	17.0
Stature	72.9	71.2	71.2	68.3	68.5	67.7	69.2	70.4	69.6	70.2	70.2	70.0	68.7	68.3	69.5	69.8	73.0	68.1	71.4	70.6	69.6	71.2	67.1	71.6	69.9	1.54
Glutus fur Ht.	33.7	33.5	32.7	30.1	29.4	30.1	30.2	32.6	31.1	31.9	32.1	31.1	30.6	30.2	27.9	31.8	32.9	31.0	32.4	32.0	29.5	31.8	30.5	32.1	31.3	1.40
Shoulder-Elbow	15.5	15.3	15.4	14.4	13.8	13.7	14.2	15.1	14.8	14.5	14.3	15.0	14.0	14.0	14.2	14.8	15.4	14.5	14.8	14.9	14.2	15.0	14.0	14.6	14.6	.532
Acro-Radiale	14.3	13.6	13.6	12.4	12.5	12.7	13.0	13.5	13.2	13.0	12.4	13.2	12.3	13.1	12.7	13.3	13.6	12.9	13.1	13.2	12.7	13.6	12.7	13.1	13.0	.481
Radiale-Stylion	11.1	10.5	10.8	9.0	9.7	9.8	9.5	9.9	9.7	10.1	9.8	9.8	9.5	9.8	9.8	14.0	10.7	10.0	10.5	10.5	9.6	10.4	9.5	10.1	10.1	.952
Elbow-Grip	15.1	14.9	15.1	13.2	14.3	13.8	13.6	14.4	14.1	15.0	14.3	14.6	13.6	13.7	13.5	14.5	15.0	13.7	14.7	14.4	14.2	14.2	13.4	14.2	14.2	.570
Stylion-Grip	3.1	3.3	3.2	2.7	3.2	3.0	2.9	3.1	3.0	3.1	3.0	3.6	3.0	2.7	2.6	3.2	3.3	2.6	3.1	3.1	2.6	2.6	2.9	3.1	3.0	.260
Trochs Ht.	37.6	36.1	38.6	35.0	35.3	35.6	35.5	37.2	35.2	34.6	36.5	36.4	34.8	35.0	34.7	37.4	39.0	35.0	36.9	37.2	35.1	37.1	35.6	38.1	36.2	1.30
Tibiale Ht.	20.5	18.5	19.7	18.1	18.3	17.9	17.6	18.8	18.1	18.5	18.7	19.6	17.9	17.3	16.9	18.2	20.0	18.4	18.7	18.6	18.3	18.9	18.7	18.7	18.5	.816
Sitting Eye Ht.	32.6	31.4	31.7	29.4	30.8	30.8	31.1	30.5	30.0	31.2	31.1	30.1	31.4	30.3	32.8	31.2	30.0	30.5	31.8	31.2	31.1	32.0	29.6	31.8	31.0	.870
Sitting Acromion Ht.	24.6	24.0	22.5	22.1	24.8	23.6	21.8	23.1	22.5	24.1	23.1	23.6	23.9	23.1	24.9	23.9	23.1	23.1	24.4	24.0	23.3	23.4	22.6	23.7	23.4	.818
Sitting Butt-Knee Len.	24.2	24.2	24.0	22.6	22.3	22.4	23.0	24.1	23.8	23.8	23.9	24.8	22.5	23.3	22.3	24.4	25.8	22.1	23.8	24.2	22.2	24.3	22.4	23.8	23.5	.979
Sitting T_4 Spinous p. Ht	23.1	23.0	20.9	20.3	22.8	21.4	21.1	22.1	20.9	23.0	21.7	20.7	23.5	21.2	22.6	21.3	20.7	21.2	22.8	22.0	22.2	21.5	21.2	22.7	21.8	.921
Sitting Cervicale Ht.	26.0	26.2	24.8	23.8	25.8	24.9	25.0	25.5	24.3	26.7	25.6	24.6	27.4	24.7	27.0	25.6	25.3	25.6	26.4	26.0	26.1	25.5	24.8	25.8	25.5	.859
Sitting Knee Ht.	23.1	21.8	22.3	20.8	21.0	20.6	20.9	22.8	21.3	22.4	22.0	22.2	21.0	21.0	21.5	22.2	23.4	20.7	22.2	22.8	21.5	22.7	21.0	22.0	21.8	.825

NOTE: Age is in years; weight is in pounds; other dimensions are in inches.

TABLE 4

STATISTICAL COMPARISON OF THE ANTHROPOMETRIC CHARACTERISTICS OF THE SUBJECT STUDENT SAMPLE WITH U.S. AIR FORCE PILOT POPULATION

SAMPLE SIZE = 24

Anthropometric Characteristics	Subject Sample		U.S.A.F. - 1967 Survey	
	Mean	Std.Dn.	Mean	Std.Dn.
Age - years	20.9	1.48	24.03	2.84
Weight - lbs.	160.6	17.00	170.00	20.80
Stature - inches*	69.9	1.54	69.88	2.28
Gluteal Furrow Height	31.3	1.40	31.69	1.58
Shoulder - Elbow Length	14.6	0.53	14.09	0.63
Acromion - Radiale Length	13.0	0.53	12.99	0.63
Radiale - Stylion Length	10.1	0.95	10.63	0.55
Elbow - Grip Length	14.2	0.57	13.90	0.59
Stylion - Grip Length	3.0	0.26	Not available	
Trochantion Height	36.2**	1.30	39.97	1.71
Tibiale Height	18.5	0.82	Not available	
Sitting Eye Height	31.0	0.87	31.87	1.19
Sitting Acromial Height	23.4	0.82	23.94	1.10
Buttock - Knee Length	23.5	0.98	23.74	0.98
Sitting T-4 Spinous Process Height	21.8	0.92	Not available	
Sitting Cervicale Height	25.5	0.86	Not available	
Sitting Knee Height	21.8	0.83	21.97	0.94

* All linear dimensions in inches.

** The difference between the study population and the USAF pilots with regard to Trochantion Height appears to be one of technique in measuring.

Experimental Procedure

The following procedural steps were adopted in recording the needed data on film:

- The subject was initially briefed about the experiment and his cooperation was solicited. He removed his clothing except a small brief. The subject wore a standard Air Force helmet and a pair of flight shoes.
- The experimenter measured and recorded all the necessary anthropometric dimensions.
- The specific landmarks were identified and proper targets were affixed on these landmarks.
- A horizontal line at the level of the spinous process of T-4 (4th thoracic vertebra) was drawn on the back of the subject.
- A line joining the right ankle joint and the right knee joint on the lateral surface with the subject standing erect, was also drawn.
- The subject was seated on the chair, which was pre-set to one of the five seat configurations described earlier.
- After the subject was seated, the back rest/head rest hinge axis was adjusted to the line marking the T-4 spinous process. This adjustment was done for every change in seat configuration.

The experimental procedure was divided into several phases. These are:

- Head and upper torso study,
- Forearm and hand study,
- Foot rest study.

These are presented in the following sections.

Head and Upper Torso

After the subject was seated on the seating device, pictures for head rest and mobility data were taken. For this a head rest angle of 30° (forward) was used in conjunction with back rest angles 65° and 51°. In the cases of 13° and 27° back rest angles, the head rest was in line with the back rest, and subjects did not rest their head on the head rest. The subject was required to be seated centrally on the seat. A thin black tape affixed along the centerline of the seat helped in guiding the subject in positioning himself centrally. The subject rested his feet on the foot control platform and rested his arms on his thighs in comfortable positions. While in this basic configuration, six photographs were taken in sequence for the following head/neck postures:

1. Subject's head was in a natural erect posture while looking straight ahead.
2. Subject's head was flexed along midsagittal plane.
3. Subject's head was hyperextended along the midsagittal plane.
4. Subject's head was rotated to the right and looking straight ahead.
5. Subject's head was rotated to the right and flexed downwards.
6. Subject's head was rotated to the right and hyperextended upwards.

All of the above head/neck postures were voluntary maximum head/neck movements without discomfort to the subject. While flexing and extending at the neck, the subject was requested not to shift his original seated posture and try to keep his upper torso in the same position.

Forearm/Hand Study

For this phase of the study, the subject was requested to remain seated centrally on the seat. The hand controller's lateral location was adjusted and locked at 9" to the right of the sagittal plane passing through the SRP. The subject gripped the handle in his right palm and the controller was moved so that (i) the elbow was just touching the back rest and (ii) the forearm was horizontal. The hand controller was fixed in this position, denoted as reference position, and the x (fore-aft) and z (up-down) coordinates of the hand controller were recorded. One set of pictures were taken with the subject holding the controller and looking straight ahead. The hand controller was then adjusted to positions 2 through 6 in sequence and a set of photographs was taken for each controller position while the subject was grasping the controller. Figures 11a and 11b show the different positions adopted for hand control position under different seat configurations. The hand controller was always displaced 9" laterally to the right of the mid-sagittal plane. However, the x and z coordinates varies depending on the reference position which again was determined on the basis of elbow touching the back rest and the forearm being horizontal. Thus, the six locations for hand controller were adopted separately for each of the five seat configurations for any one subject.

Rudder Pedal Study

In the foot rest (rudder pedal) study three locations controller levels, relate to SRP, were studied. They were:

(i) 1" above SRP.

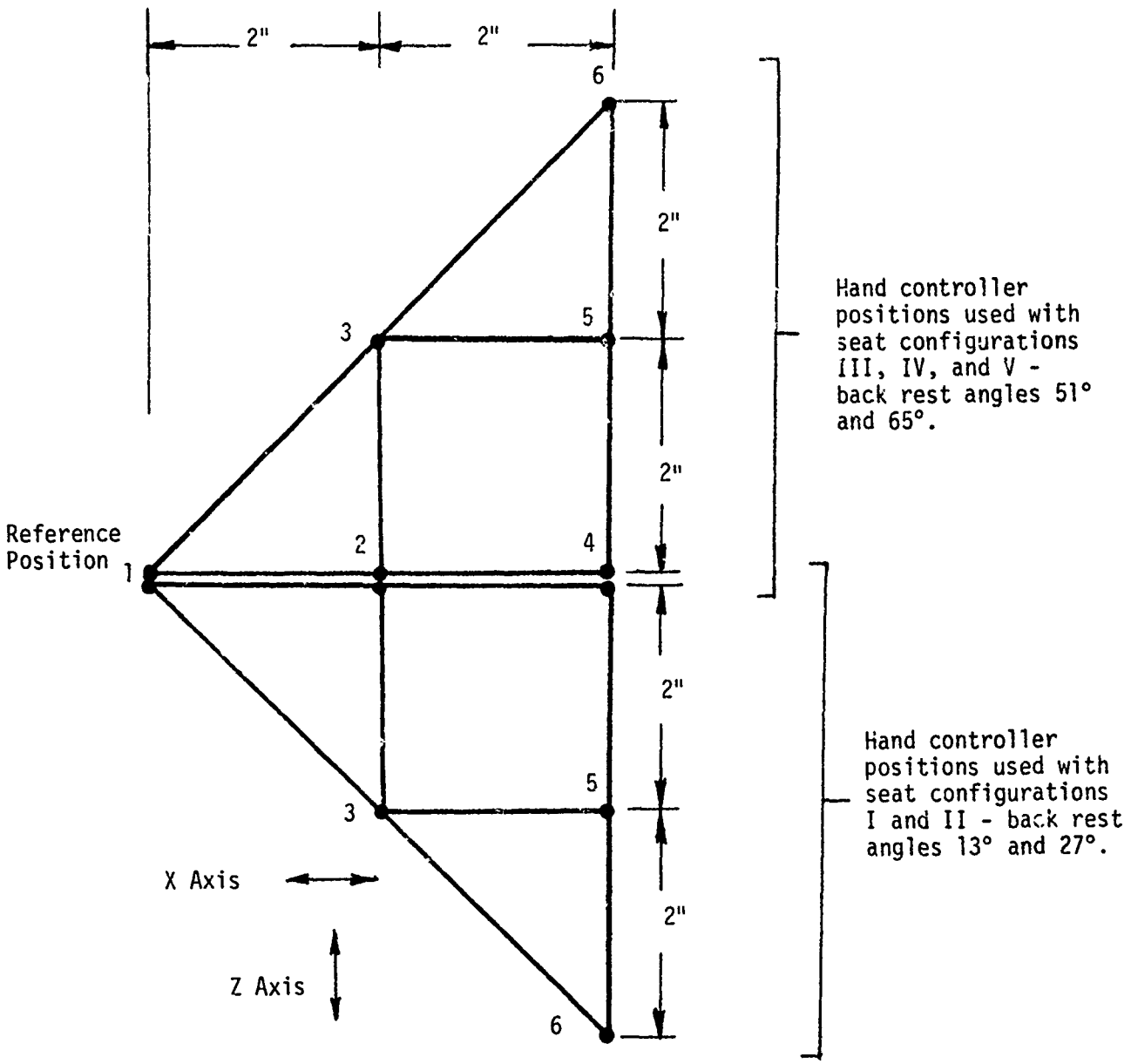


Figure 11 Controller Center Positions Adopted for the Five Seat Configurations

(ii) 1.25" below SRP.

(iii) 3.5" below SRP.

These positions establish the location of the horizontal planes through the axes of rudder pedals. The left foot control was maintained at 6" farther away in front of SRP compared to right rudder pedal. This was done in order to simulate maximum SRP-to-pedal distances to the two extreme positions, assuming a 6" throw (range) for pedal travel. The subject was required to be seated all the way back on the seat and to rest his left foot on the left rudder pedal and push it all the way out as far as he can by extending the leg at the knee. The subject was instructed not to shift his seated position or bend forward during this maneuver. The rudder control platform was then locked in this position with a pair of setscrews. The neutral position of rudder controls (i.e., the mid-point between right and left rudder controls) along x axis was measured from SRP and recorded. The right rudder was then placed on the right foot pedal in a comfortable position. Next a set of pictures was taken with the subject looking straight ahead and resting his feet on the rudder pedals.

Data Reduction

The exposed film was processed at the Technical Photo Branch at Wright-Patterson Air Force Base. The processed film was projected through the digitizing system at AMRL/HED facilities and the specific coordinates of the selected body landmarks were punched on paper tape. This was later converted to real world coordinates with respect to the standard right hand coordinate system with the SRP as the origin.

Body landmarks 1 through 11 were identified with the help of suitable targets. Landmarks 12, 13 and 14 were not identified with any visible

targets, but rather these points were identified in the photographs in the following manner:

Landmark 12 - The rear-most point on the helment.

Landmark 13 - The body surface point about the thoracic vertebral region at which separation between the body and the upper back rest occurs.

Landmark 14 - The body surface point over the lumbar region at which maximum separation between the body surface and the back rest can be observed. (See Figure 12).

The positions of these 3 landmarks on the projected image were determined based on the judgement of the data reduction analyst. Figure 12 shows the location of these landmarks as defined above.

RESULTS

Engineering/anthropometric data generated from this study are presented in three separate sections:

(1) Head/upper torso data,

(2) Hand/arm rest data,

(3) Foot rest data.

Head/upper Torso Data

This part of the study was performed to collect data pertinent to the design of the head rest. Figures 13 through 18 show the spatial locations of nasion, acromion, upper-back-contact point with back rest and the rear most point of helmet under each of the five seat configurations. (See page 35). Points 1, 12 and 13 are generally expected to be along the mid-sagittal plane of the subject. It can be noticed in these figures that

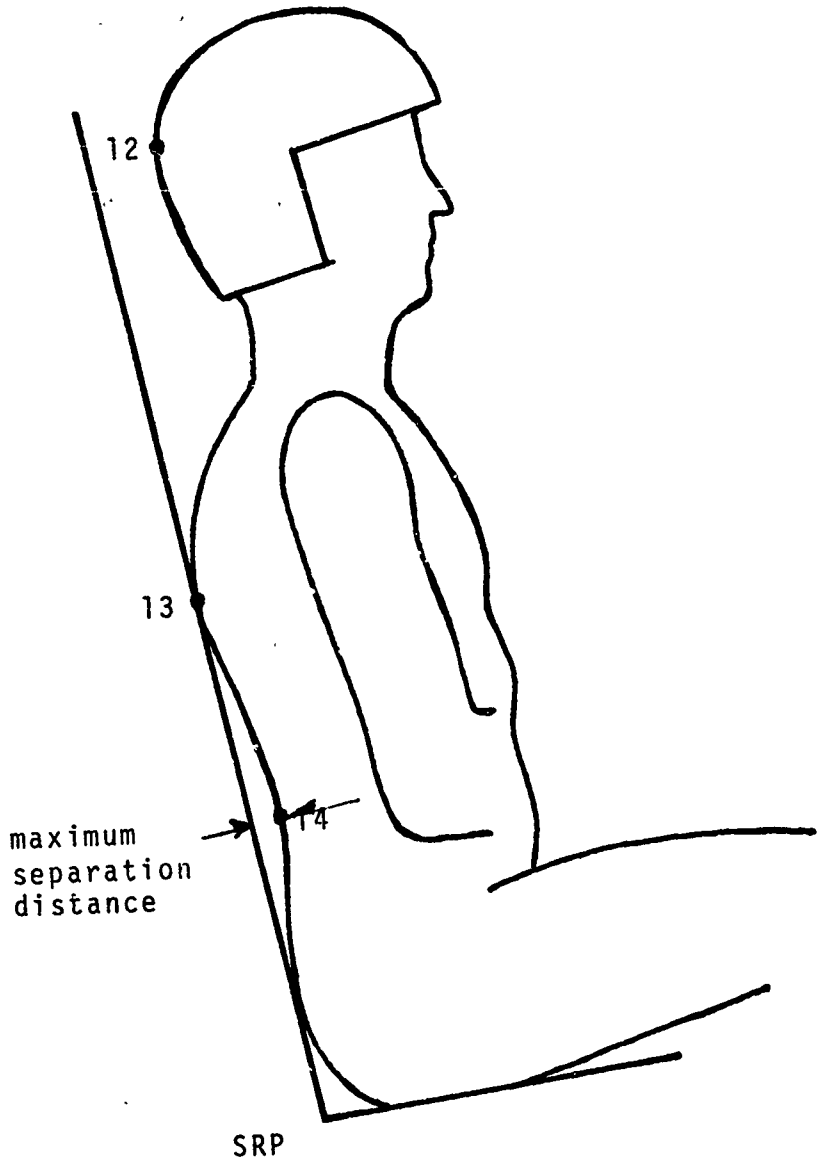


Figure 12 Locations of Landmarks 12, 13, and 14 With Respect to Seat Reference Point

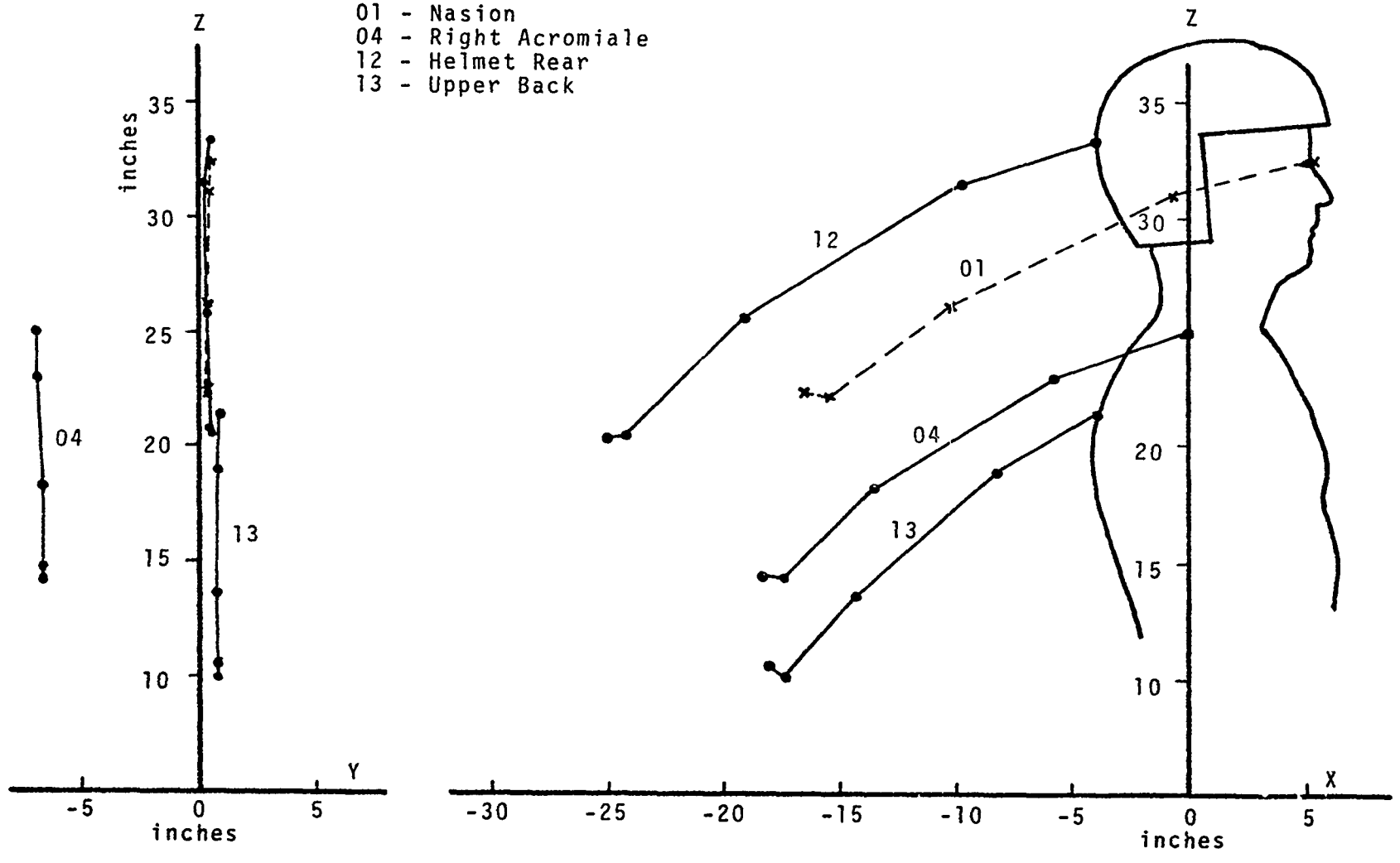


Figure 13 Spatial Locations of the Nasion, Acromion, Helmet Rear, and Upper Back Contact Point for the Five Seat Configurations - Head Position 1

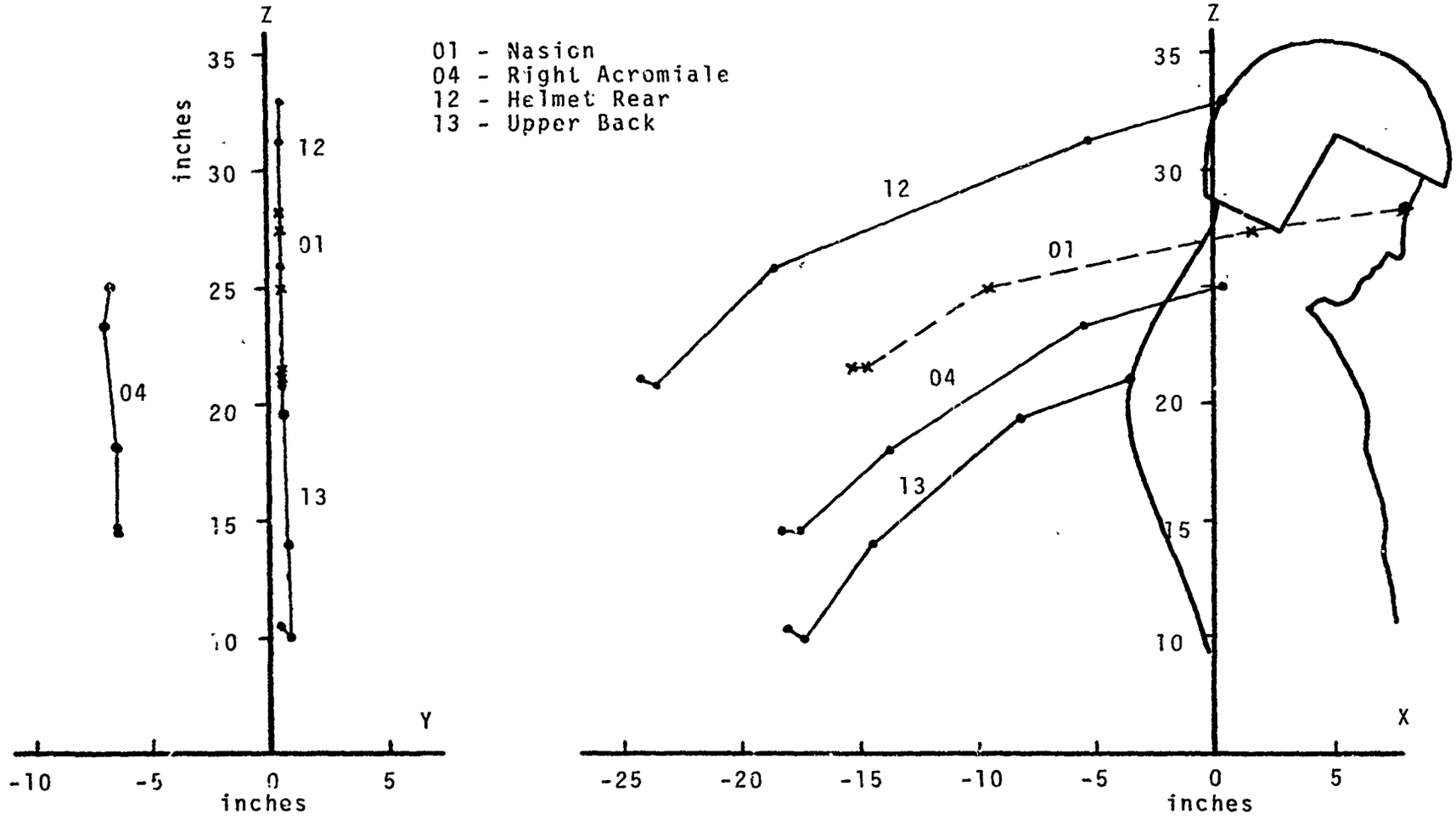


Figure 14 Spatial Locations of the Nasion, Acromion, Helmet Rear, and Upper Back Contact Point for the Five Seat Configurations - Head Position 2

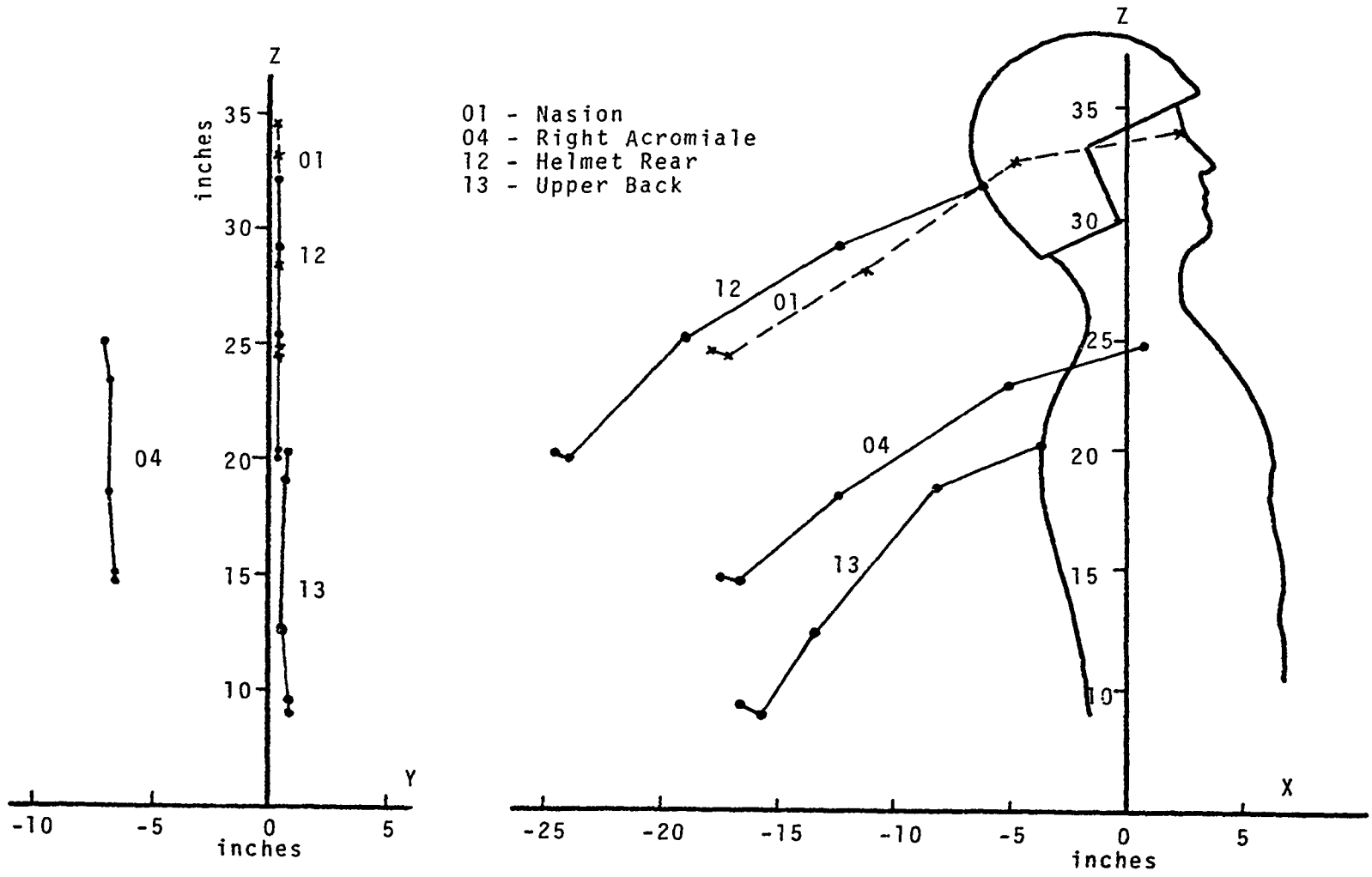


Figure 15 Spatial Locations of the Nasion, Acromion, Helmet Rear, and Upper Back Contact Point for the Five Seat Configurations - Head Position 3

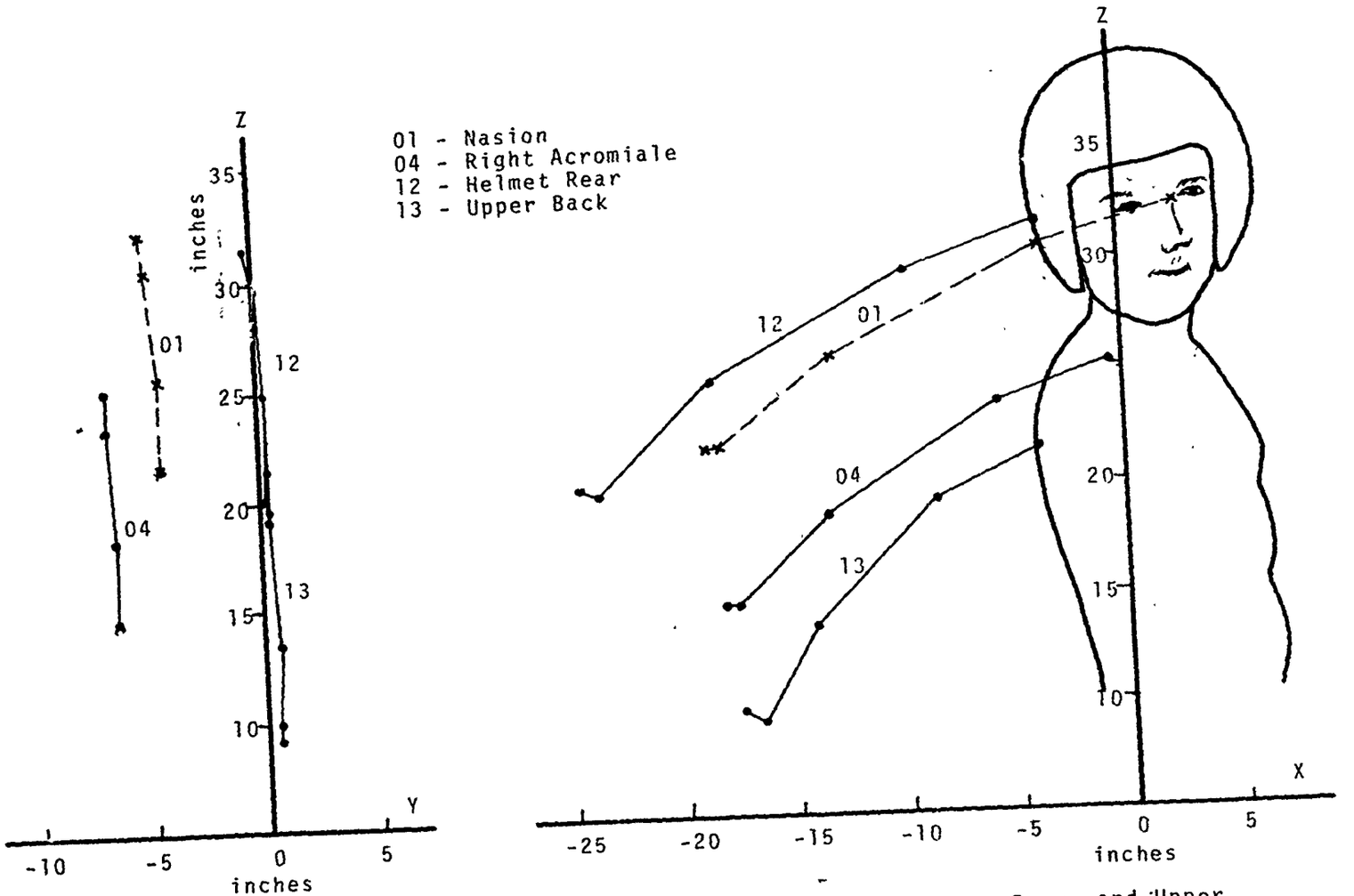


Figure 16 Spatial Locations of the Nasion, Acromion, Helmet Rear, and Upper Back Contact Point for the Five Seat Configurations - Head Position 4

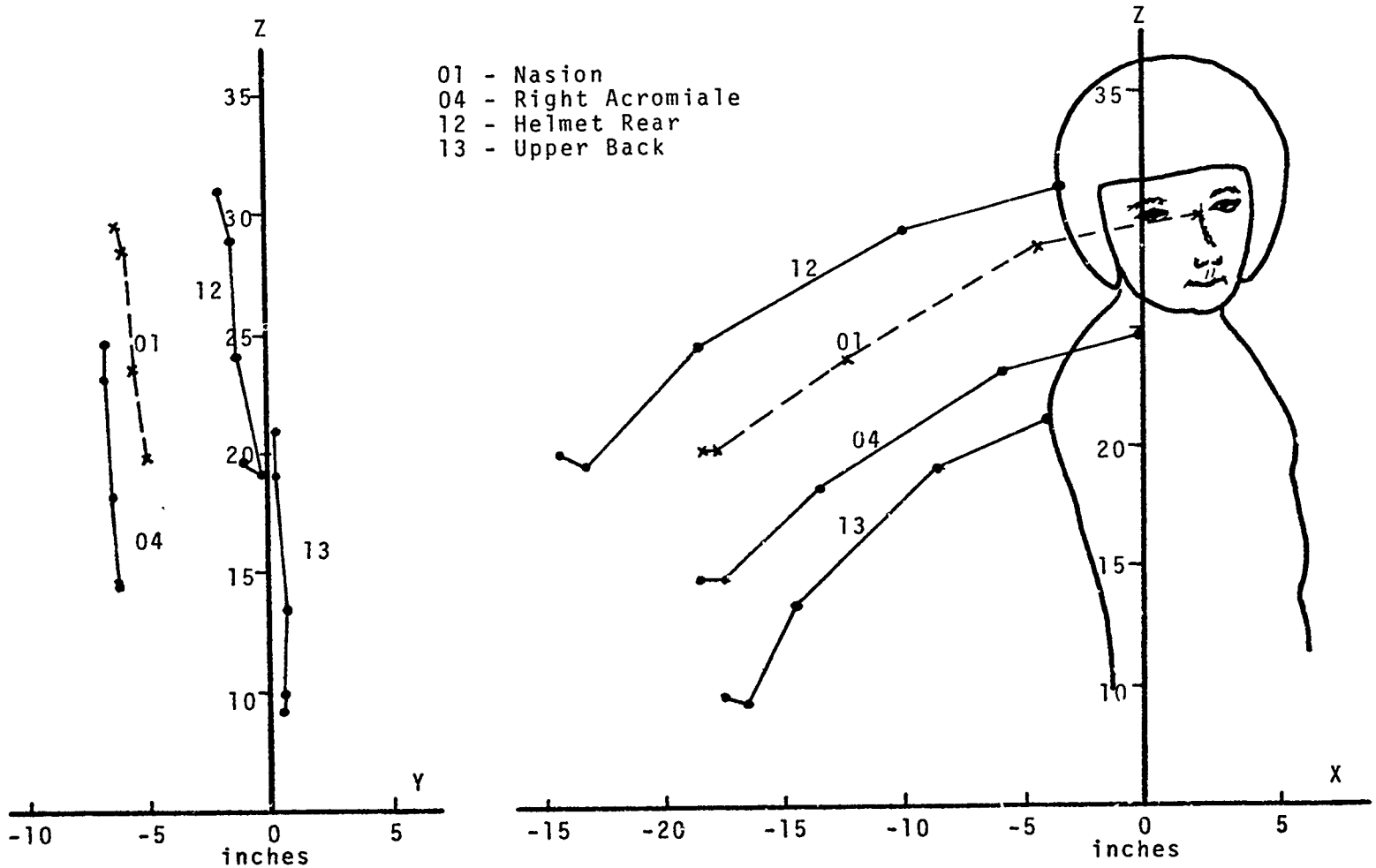


Figure 17 Spatial Locations of the Nasion, Acromion, Helmet Rear, and Upper Back Contact Point for the Five Seat Configurations - Head Position 5

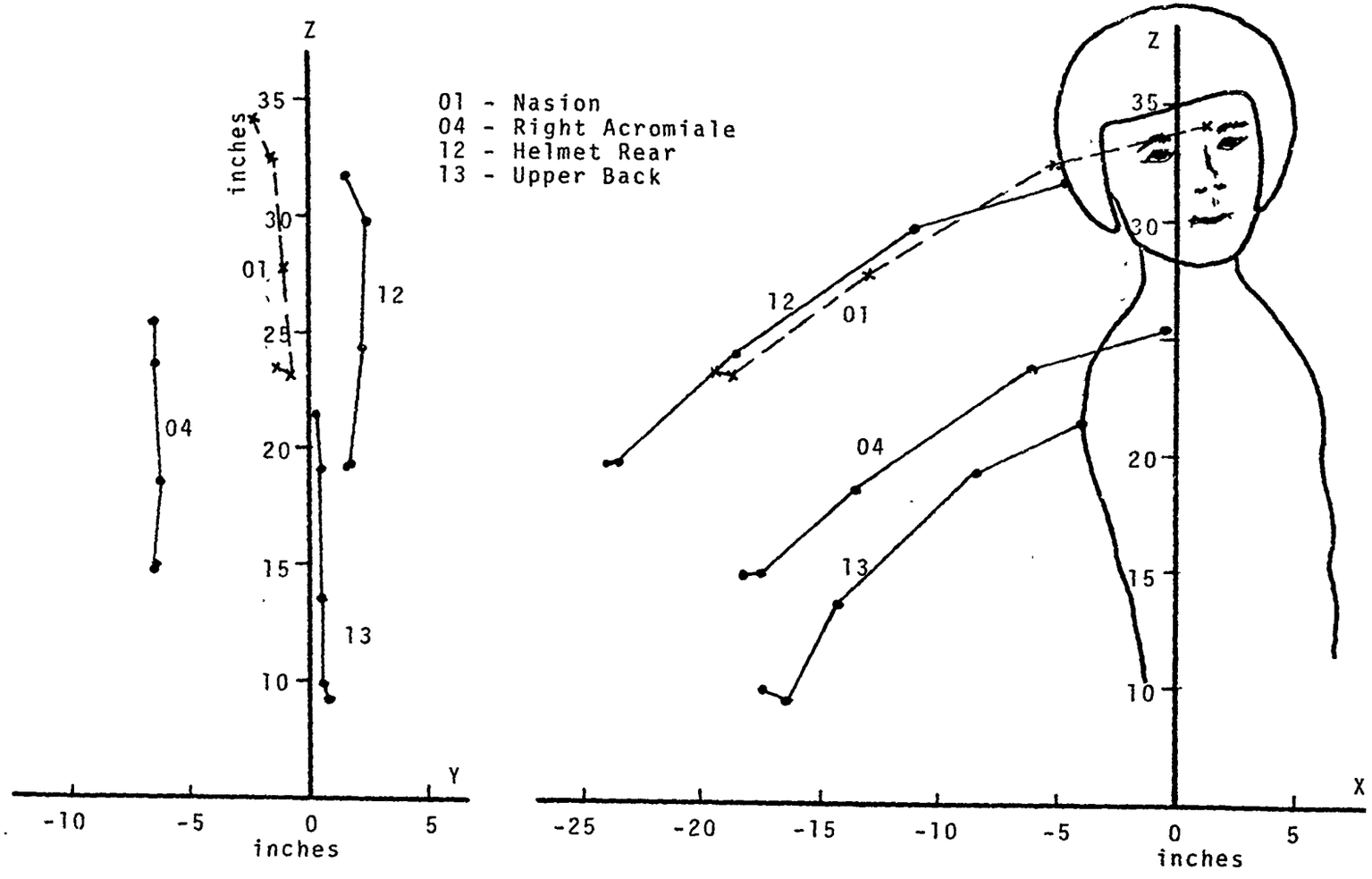


Figure 18 Spatial Locations of the Nasion, Acromion, Helmet Rear, and Upper Back Contact Point for the Five Seat Configurations - Head Position 6

their locations along x and z axes change with the seat configurations. As expected, no appreciable changes were observed with regard to the position of these landmarks along the y axis. Between configurations IV and V, a change of 10° in seat pan angle results in a change of about 1/2" in locations of the points mentioned above. It must be remembered that the landmarks, "helmet rear" and "upper back," are not fixed anatomical points. Their positions are altered with changes in seat geometry. Appendix A-1 contains the same data presented in Figures 13 through 18 in a tabular format. In additions these tables also show the standard deviations for each data point. Figure 19 shows the nasion coordinates alone for the five seat configurations studied. The location of the mean, the 5th and 95th percentile limits in the mid-sagittal plane are shown. It should be noticed that in seat configurations I and II, the range of the nasion location is wider along the x axis than in the other three seat configurations. This is because the head rest was not used in seat configurations I and II. But it was consistently used during configuration III, IV and V. Thus the subject had much more freedom to position his head under configurations I and II than under the other three configurations. This information will be useful in determining the required movement of the seat in the forward and upward directions under a given configuration so that the eye position may be maintained the same as the standard 13° seat configuration. These data are also presented in Appendix A-1 in tabular format.

Figure 20 shows the distances of T-4 position and landmark #13 from SRP along the back rest. T-4 point is the skin surface mark which identifies the 4th thoracic vertebra at upright seated position. Point #13 is the body point of contact with the subject's back and the back rest. T-4 mark

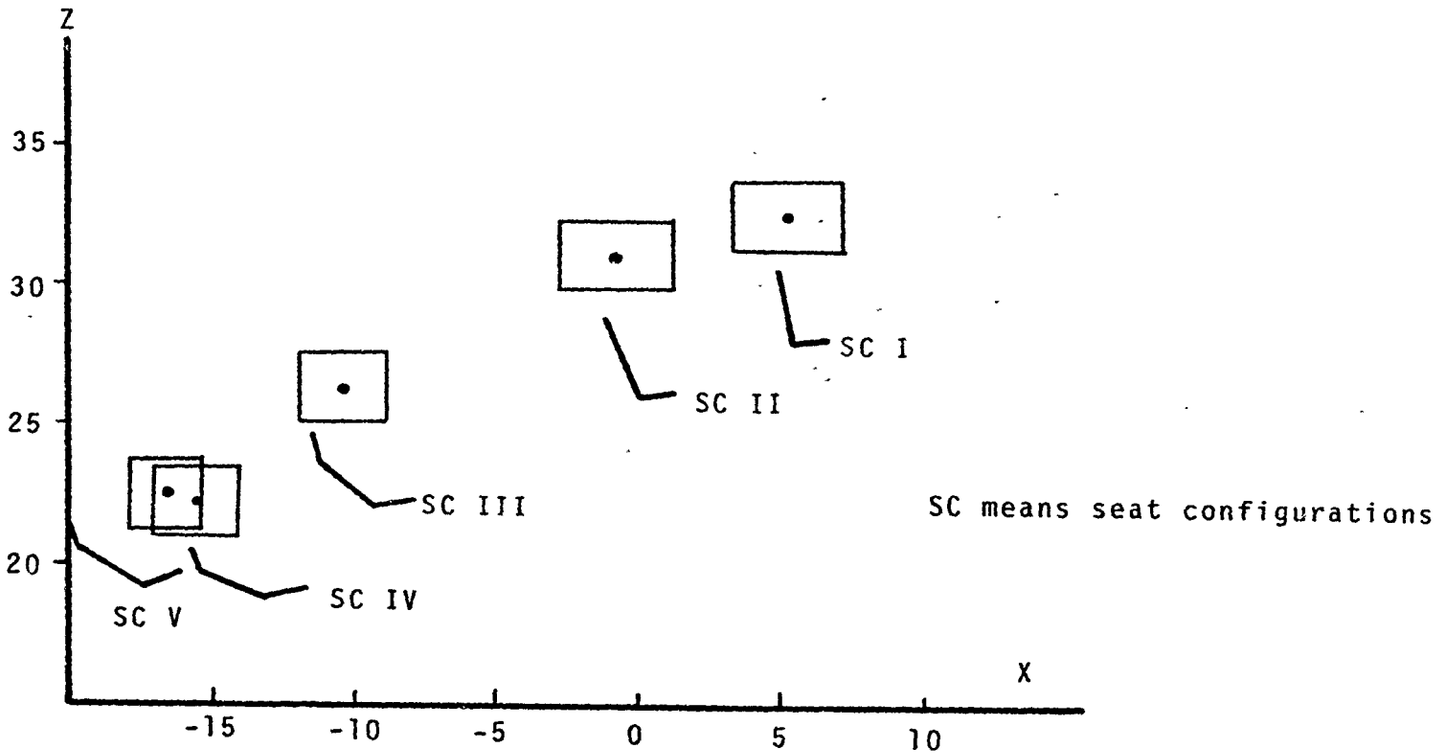


Figure 19 The 5th, 50th, and 95th Percentile Positions With Respect to SRP for Naison - Head Position 1. The rectangle represents the 5th and 95th percentiles for both axes.

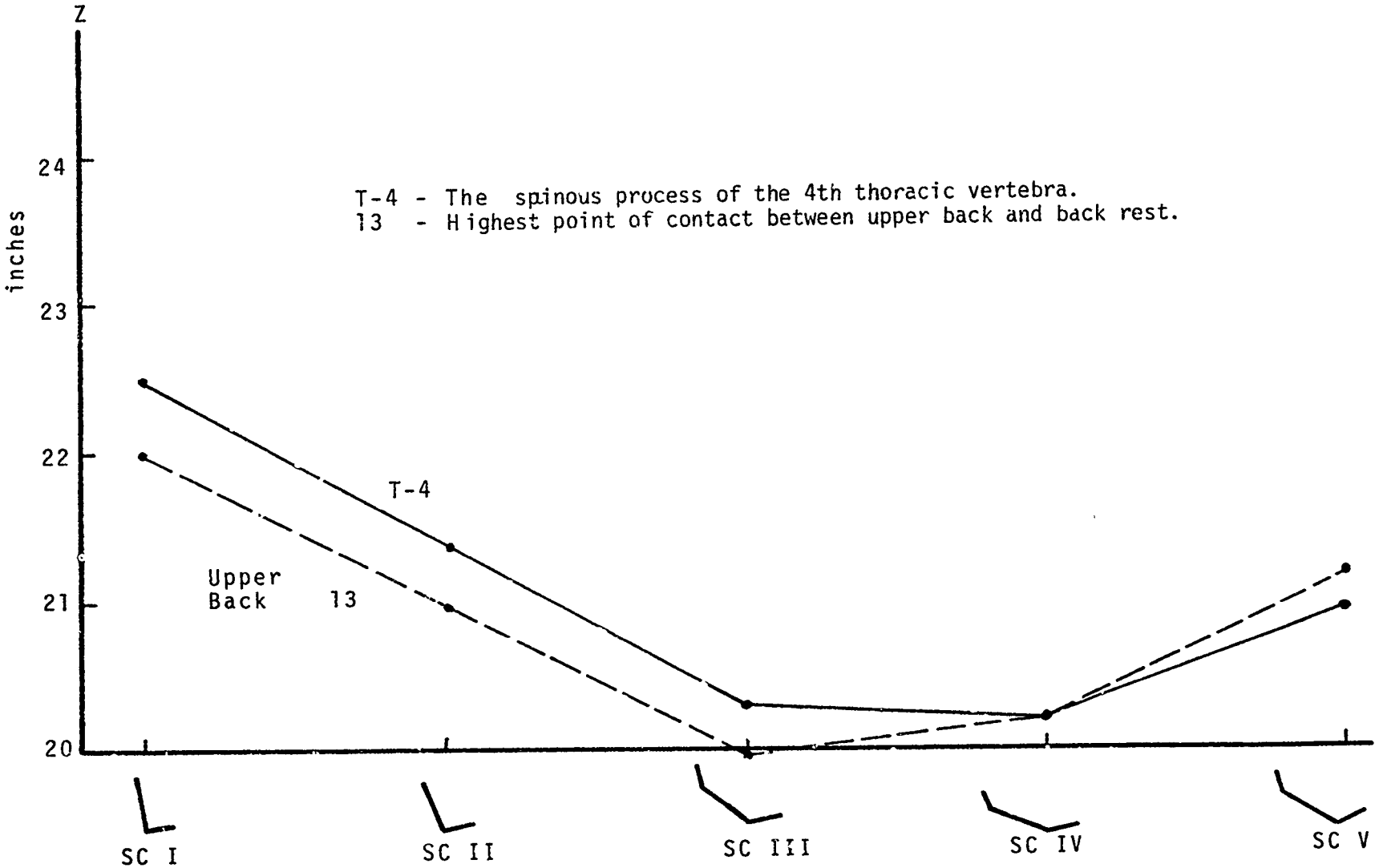


Figure 20 The Distance Between T-4 and Highest Point of Contact Between Upper Back and Back Rest, Measured Along the Back Rest

is a fixed mark on body surface while landmark #13 may be changing with seat configurations. Under 13°, 27° and 51° back rest configurations, point #13 is below T-4 mark level. In other words, if point #13 can be taken as the hinge point for back rest, this hinge point can be located below T-4 surface mark for 13°, 27° and 51° configurations. However, at 65° back rest configuration point #13 and T-4 mark seem to coincide when the seat pan angle is 10°. But when the seat pan angle was raised to 20°, this shifted the entire upper body. Such a change resulted in moving the position of T-4 mark above landmark #13.

The data on locations of mention (point #2) and suprasternale (point #3) under different seat configurations and head positions are given in Appendix A-2. This information will be useful in determining the clearances available in the region forward of neck for purposes of possible interferences with face masks.

Hand-Arm Study

This study was performed to gather data on arm-hand configurations as a function of controller locations. These data will be useful in providing arm rest design parameters. Figure 21 shows the locations of nasion, acromion, elbow and third metacarpal joint for hand position 1 (i.e., the elbow in most rearward position against the back rest) under different seat configurations. Position 1 serves as reference and varies from subject to subject. Figures 22 through 26 show the same locations of nasion, acromion, elbow and third metacarpal for hand positions 2 through 6 respectively. It should be noted that hand positions 3, 5 and 6 were lower than hand position 1 for seat configurations I and II only. In the case of seat configurations III, IV and V hand positions 3, 5 and 6 were

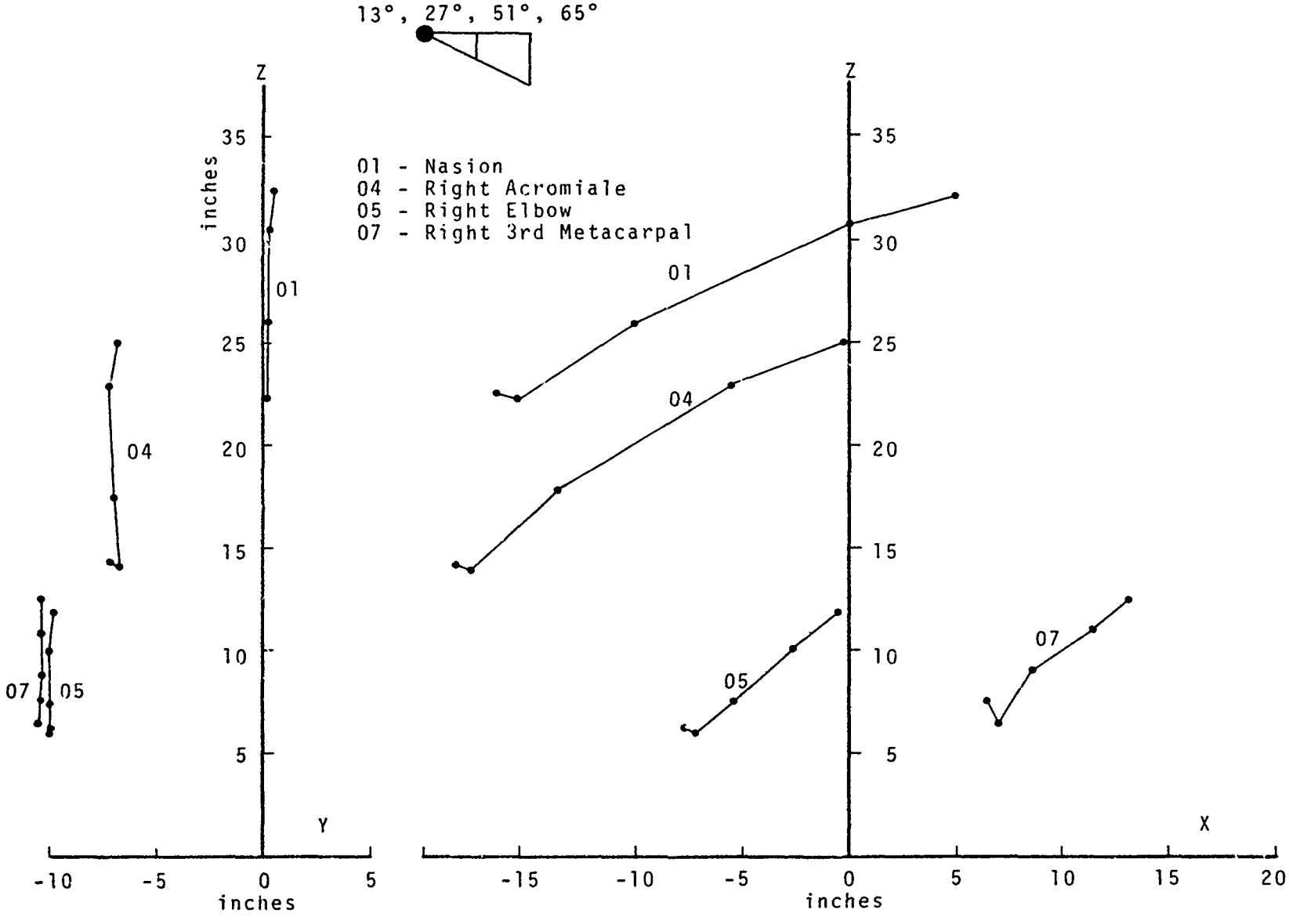


Figure 21 Spatial Locations of the Nasion, Right Acromion, Right Elbow, and Right 3rd Metacarpal for the Five Seat Configurations - Hand Position 1

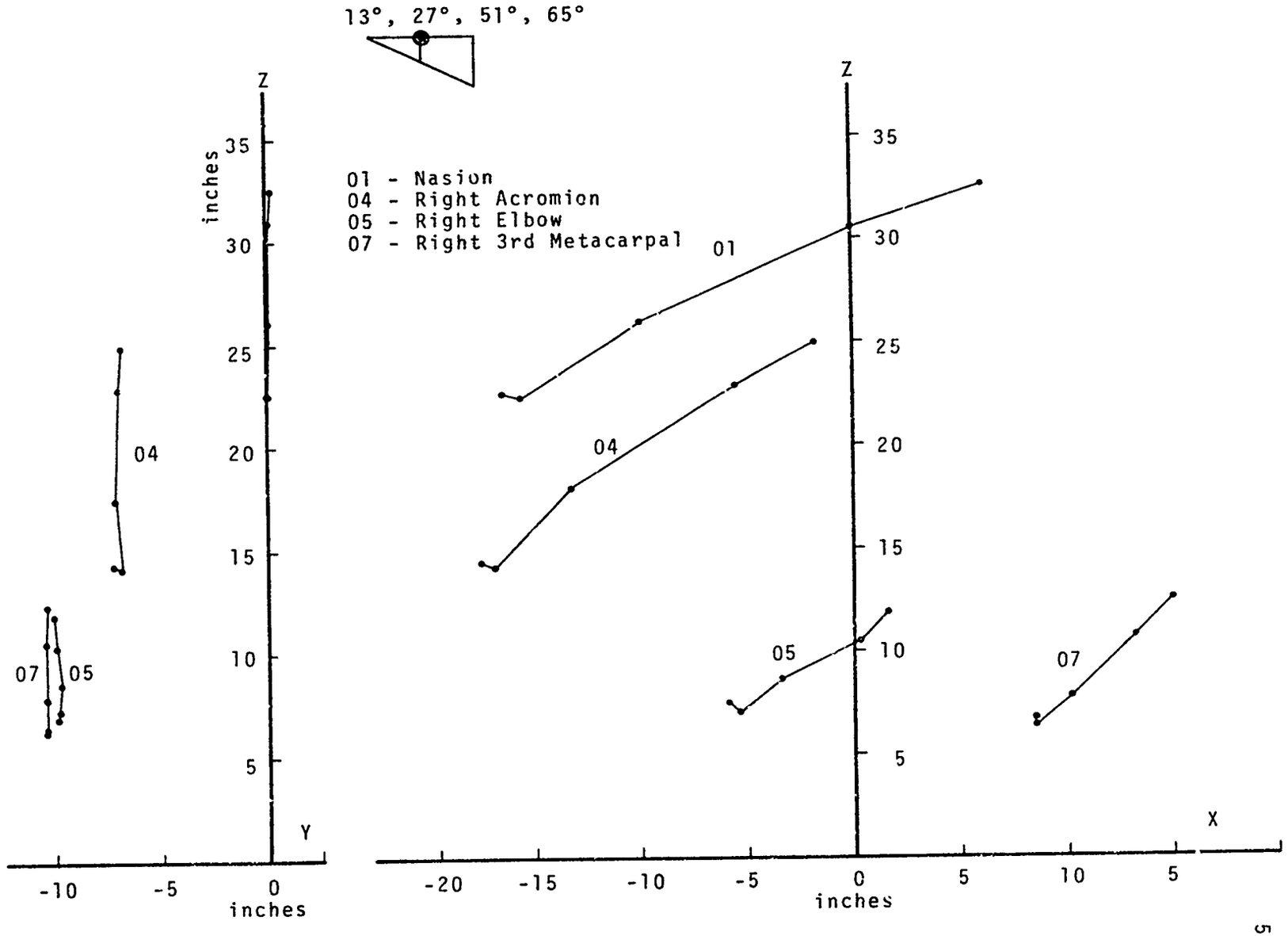


Figure 22 Spatial Locations of the Nasion, Right Acromion, Right Elbow, and Right 3rd Metacarpal for the Five Seat Configurations - Hand Position 2

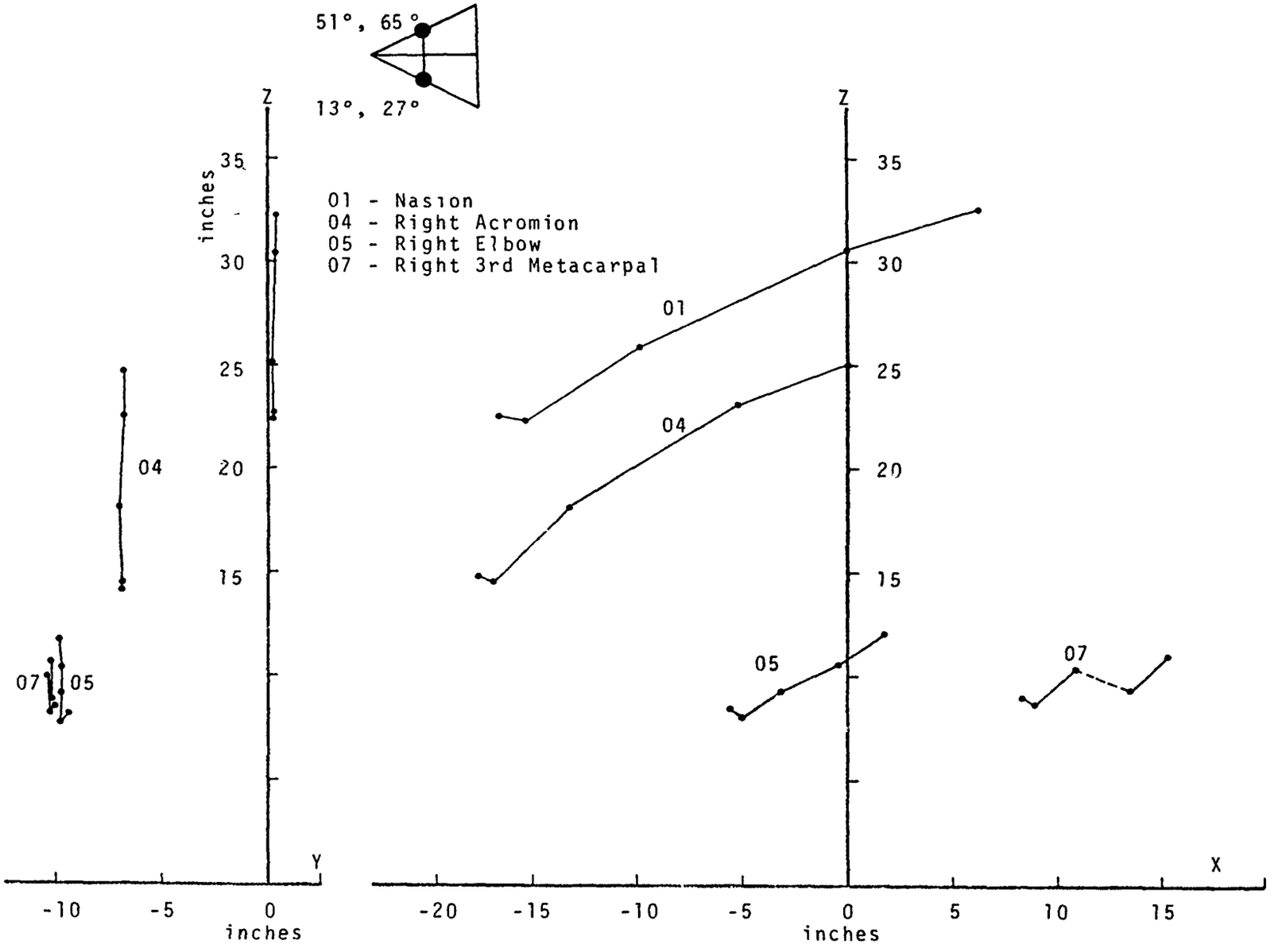


Figure 23 Spatial Locations of the Nasion, Right Acromion, Right Elbow, and Right 3rd Metacarpal for the Five Seat Configurations - Hand Position 3

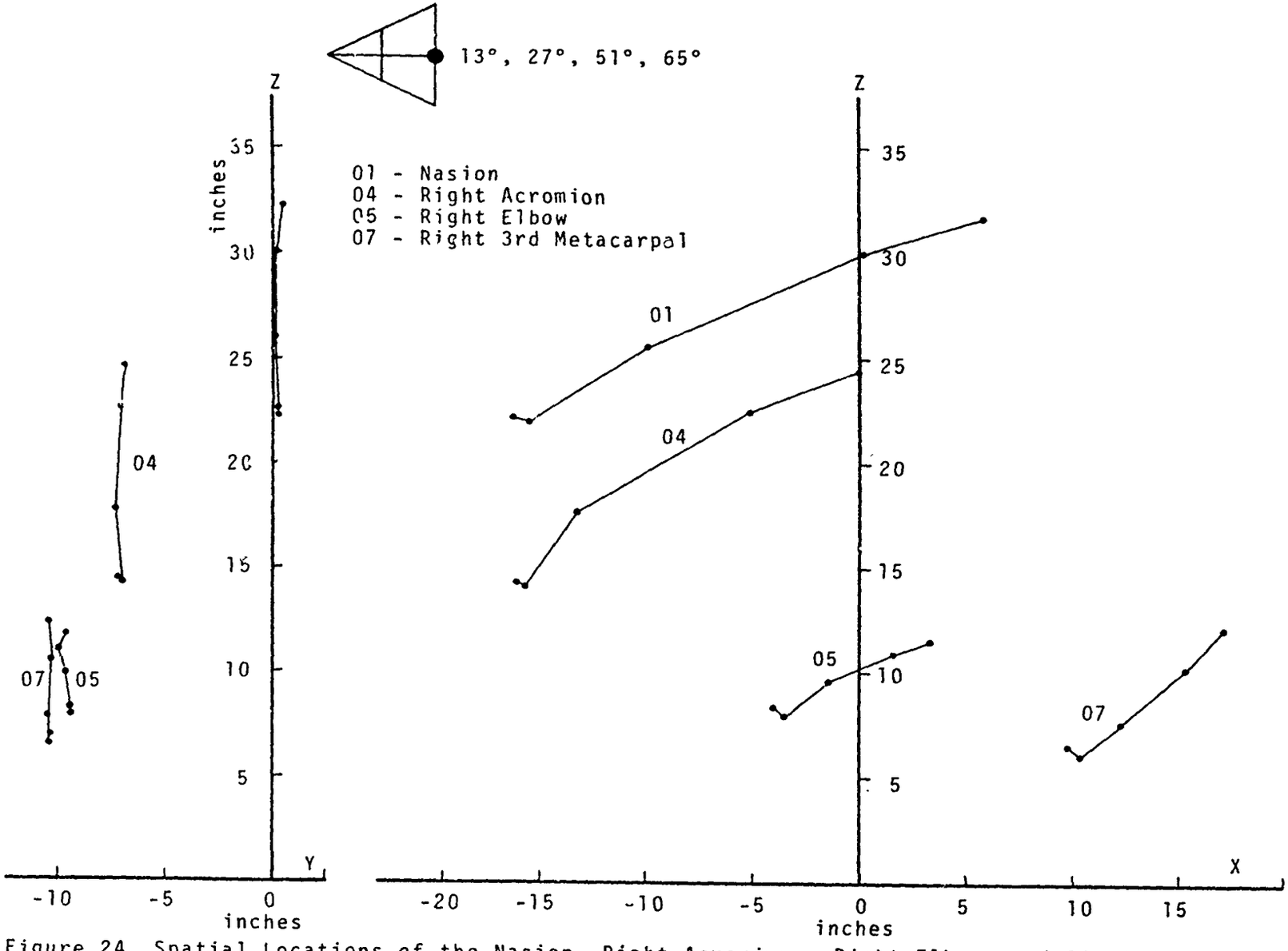


Figure 24 Spatial Locations of the Nasion, Right Acromion, Right Elbow, and Right 3rd Metacarpal for the Five Seat Configurations - Hand Position 4

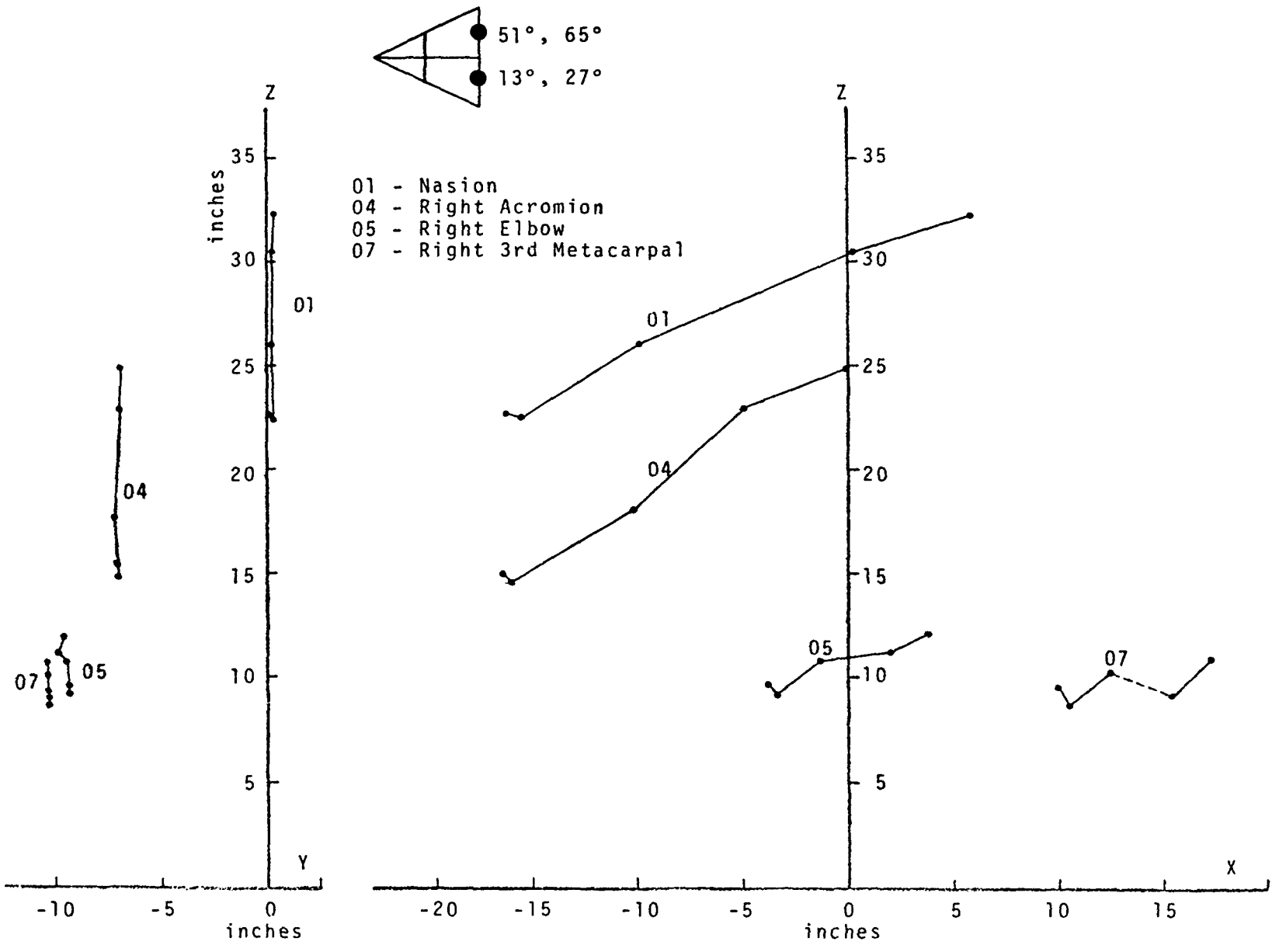


Figure 25 Spatial Locations of the Nasion, Right Acromion, Right Elbow, and Right 3rd Metacarpal for the Five Seat Configurations - Hand Position 5

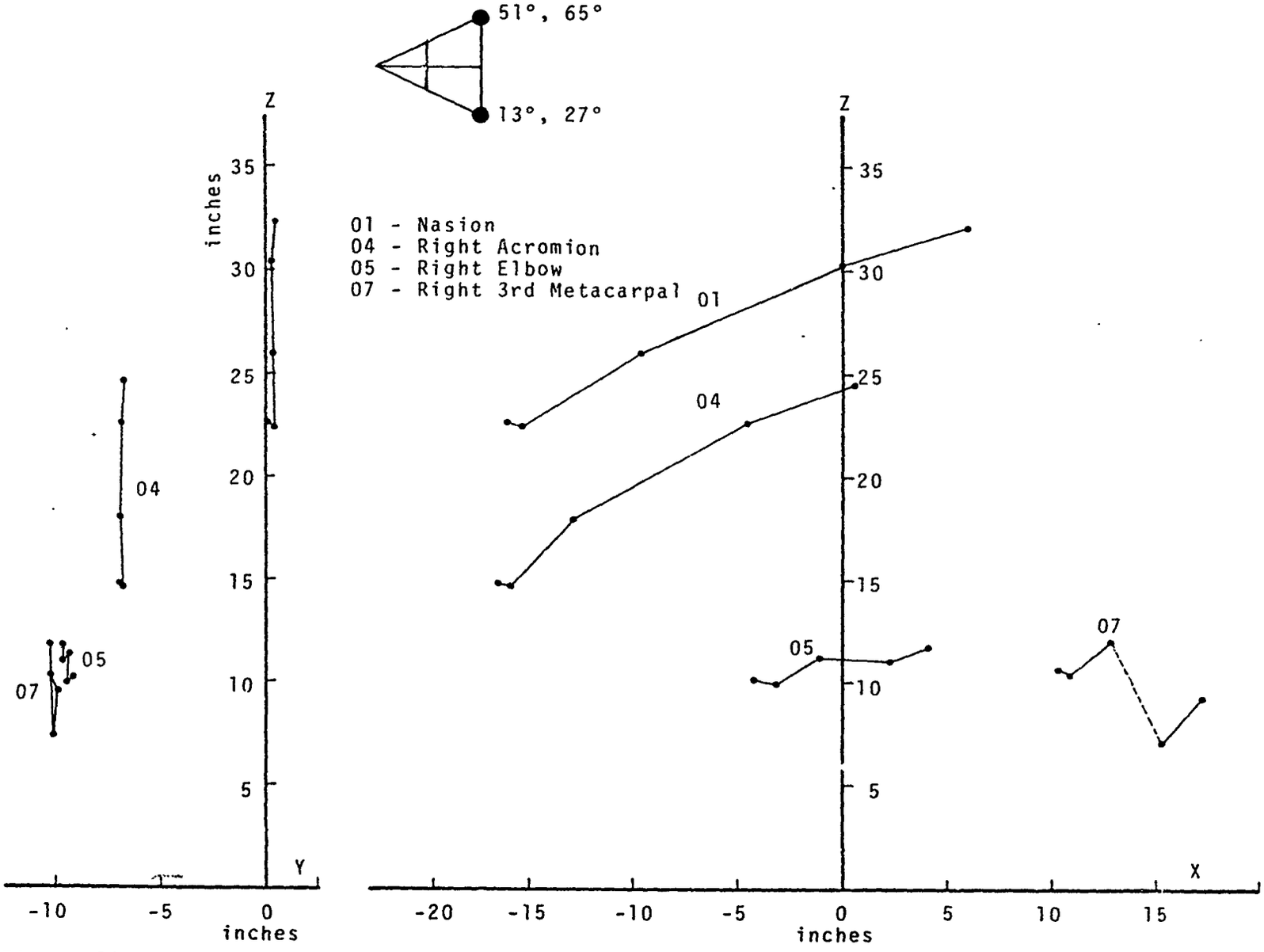


Figure 26 Spatial Locations of the Nasion, Right Acromion, Right Elbow, and Right 3rd Metacarpal for the Five Seat Configurations - Hand Position 6

higher than position 1. The legend shown in each of these diagrams would be of help in noting this. The information shown in these figures is also presented in Appendix A-3.

Figure 27 shows the mean elbow locations along with the 5th and 95th percentile limits for hand position 1 under the different seat configurations.

The same data are also provided in Appnedix A-3. This set of data is useful in determining the forward location of a hand control because any location of the controller rear of hand position 1 may cause the back rest to interfere with elbow movement and hence controller activation. Figure 27 also shows relative shift in the elbow locations under the five seat configurations.

Figures 28 through 32 show the change in elbow and wrist locations for changes in controller positions under each of the given seat configurations. These data are useful in establishing the orientation and length of forearm support. As can be seen in Figures 28 through 32, the vertical displacements of the elbow for different controller positions are small for upright seated positions and are considerably larger for reclined positions.

Figures 33 and 34 show the mean locations of the hand controller along the x and z axis. Broken lines are used to indicate the effect of change in selecting hand controller positions for upright (13° and 27°) and reclined (51° and 65°) back rest configurations. Table 5 gives the mean locations along with the standard deviations for hand controller position under the five seat configurations. It must be remembered that the lateral location of the hand controller was fixed at 9" to the right of the SRP.

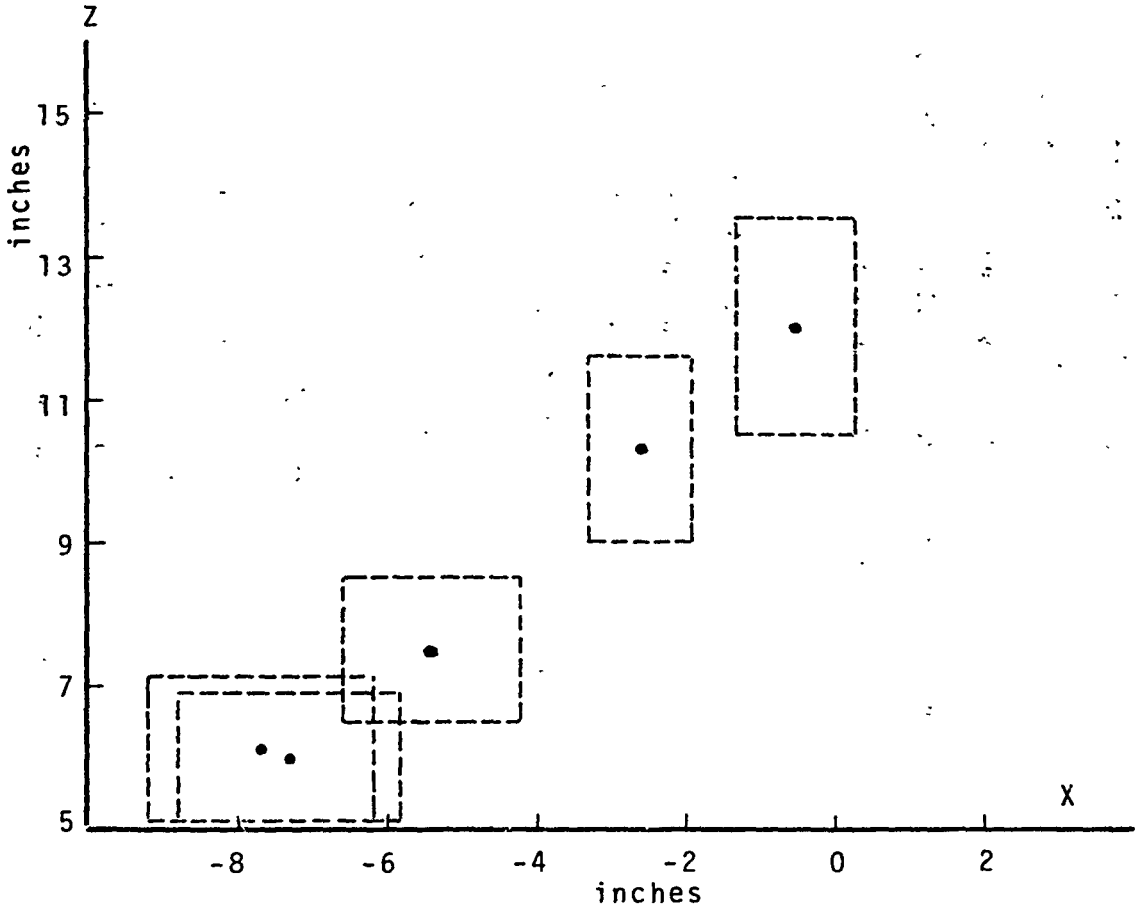


Figure 27 The 5th, 50th, and 95th Percentile Positions Above SRP for the Elbow - Hand Position 1. The rectangle represents the 5th and 95th percentiles for both axes.

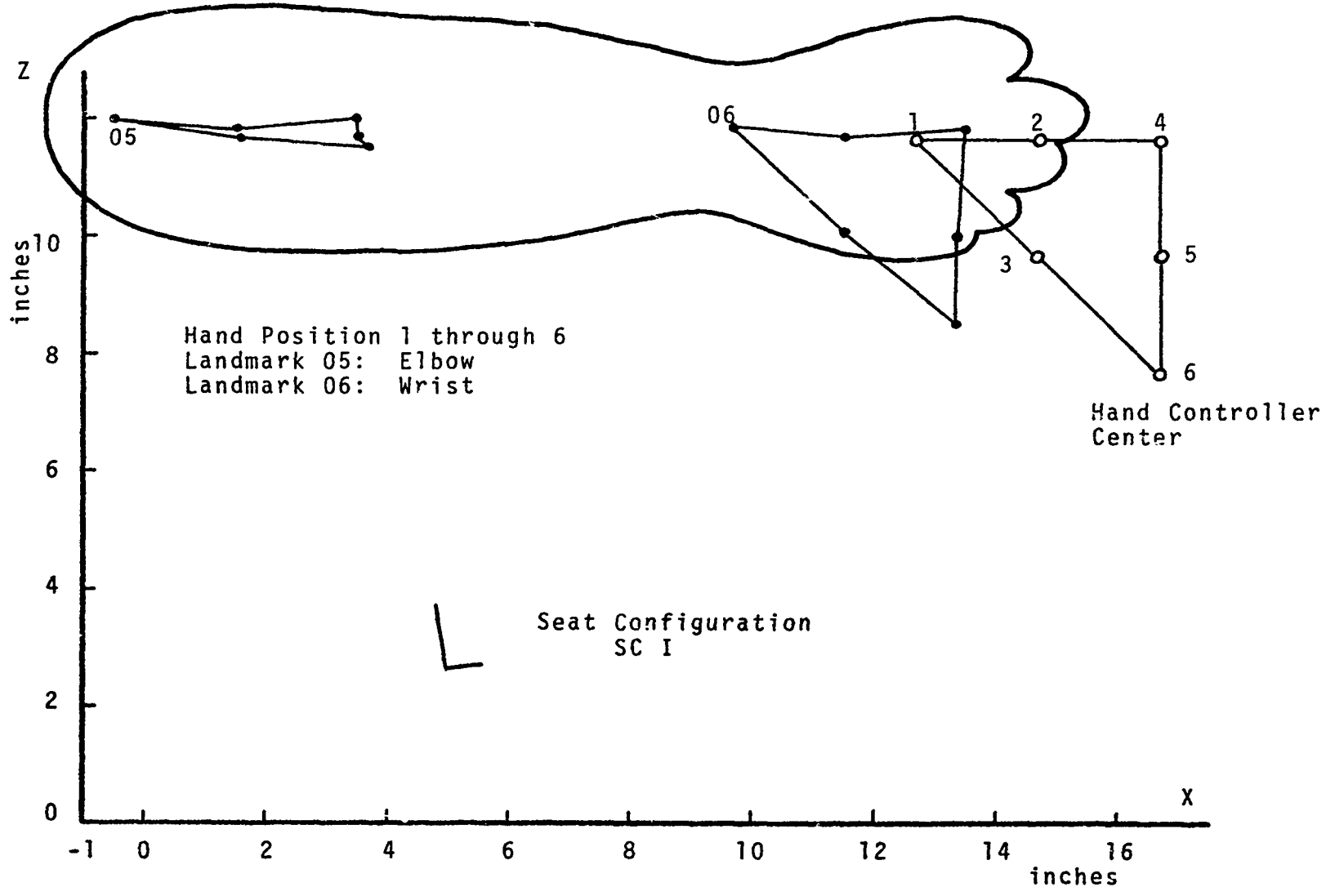


Figure 28 Changes in Right Elbow and 3rd Metacarpal Positions for All 6 Hand Controller Positions - Seat Configuration I

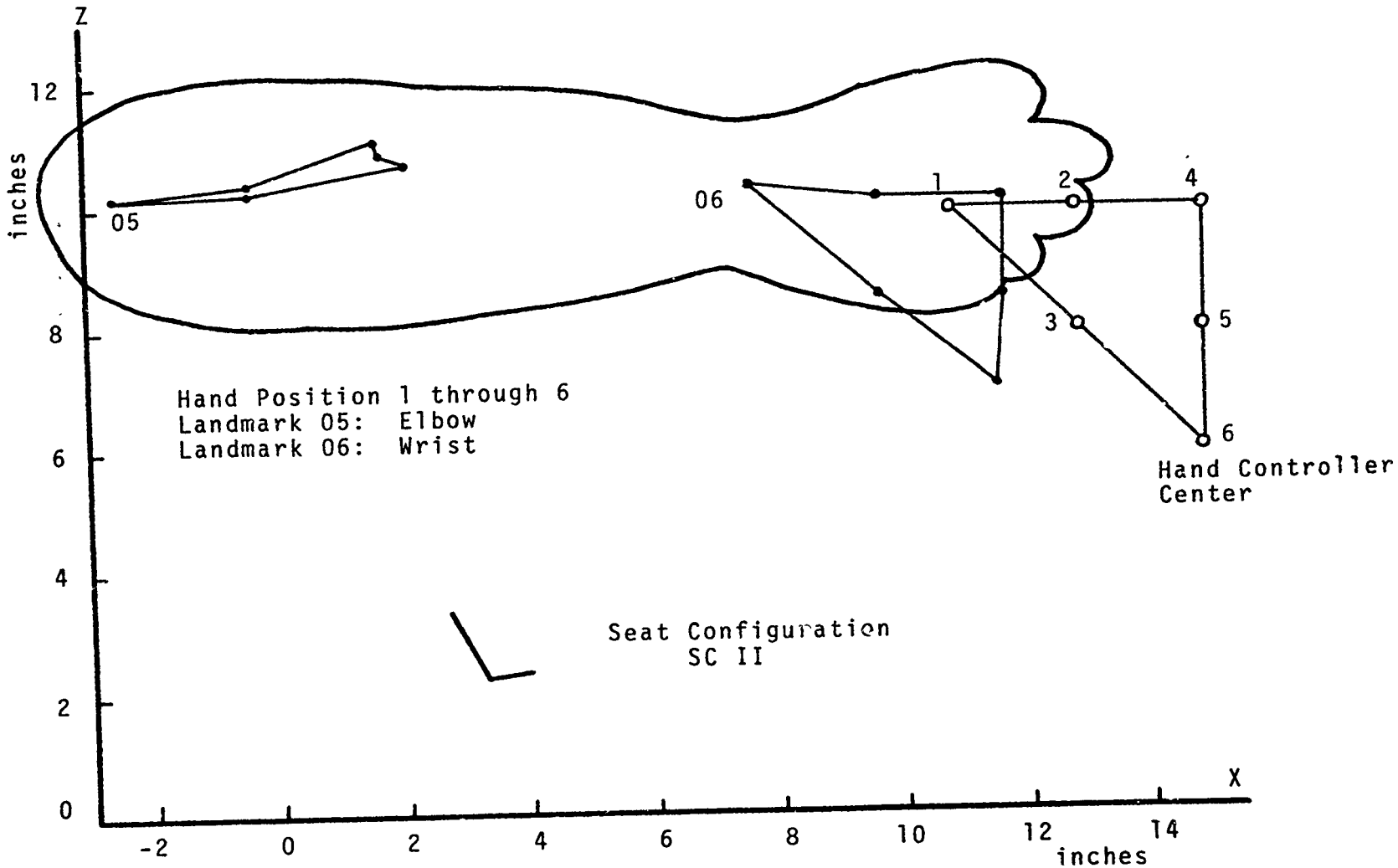


Figure 29 Changes in Right Elbow and 3rd Metacarpal Positions for All 6 Hand Controller Positions - Seat Configuration II

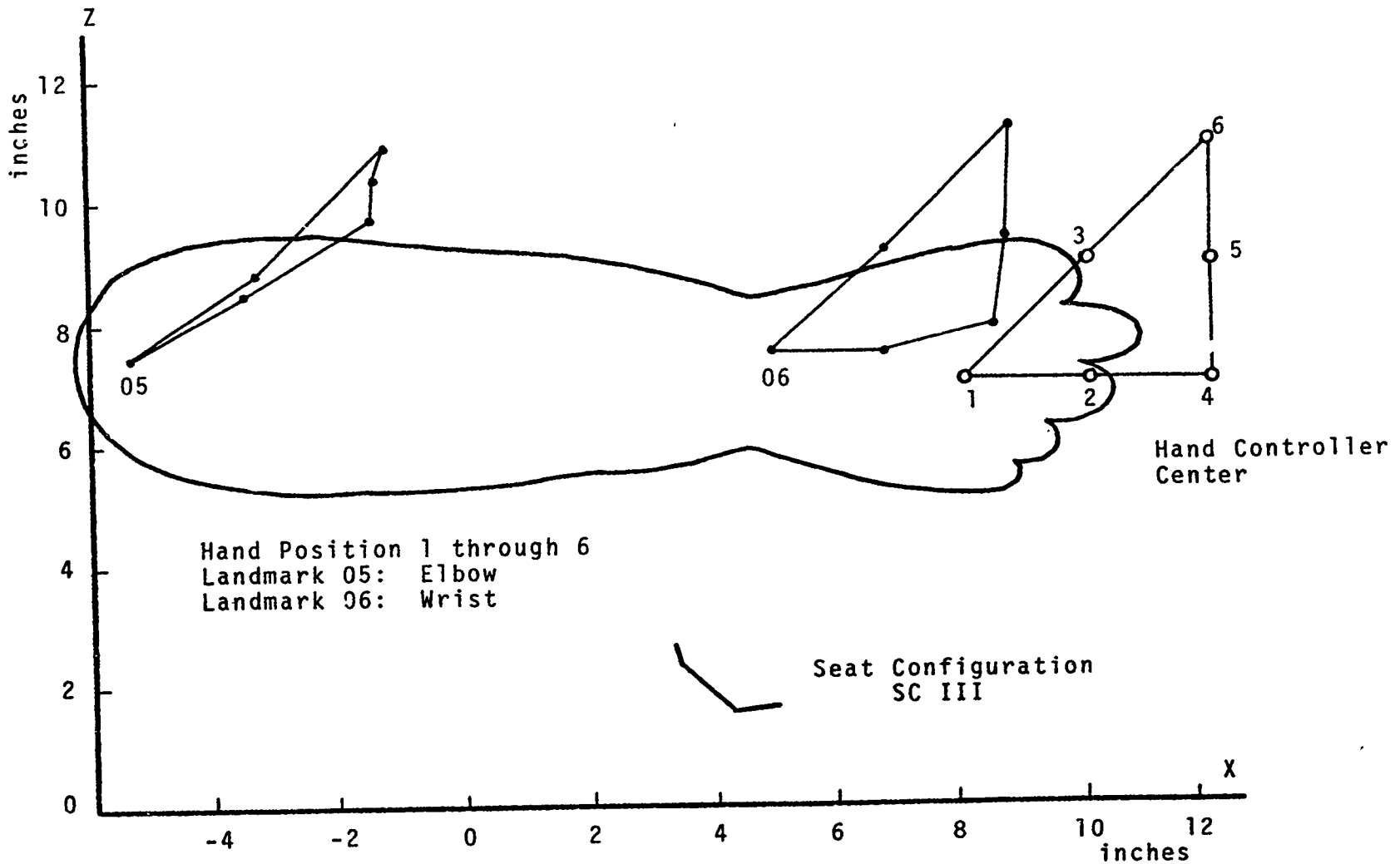


Figure 30 Changes in Right Elbow and 3rd Metacarpal Positions for All 6 Hand Controller Positions - Seat Configuration III

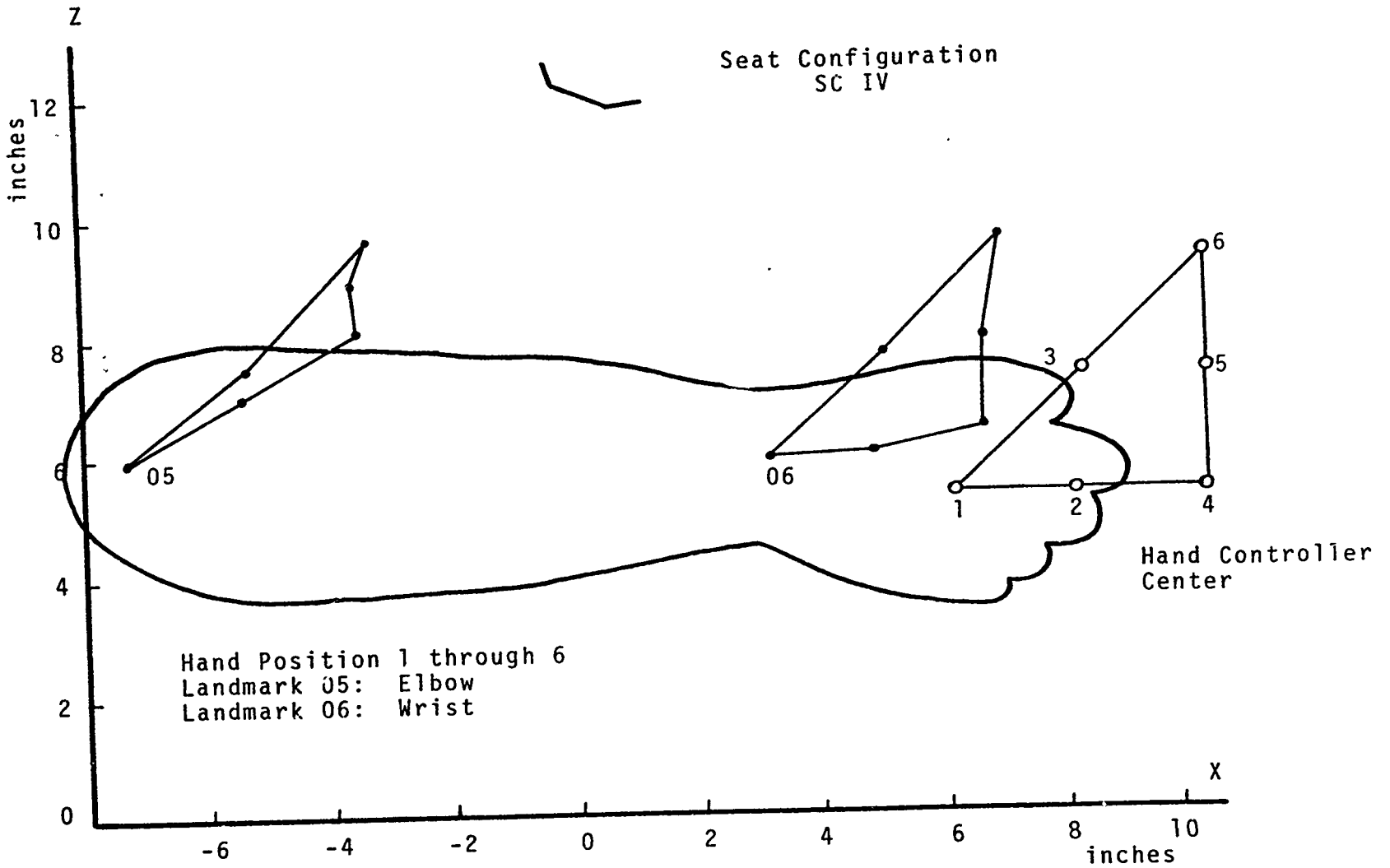


Figure 31 Changes in Right Elbow and 3rd Metacarpal Positions for All 6 Hand Controller Positions - Seat Configuration IV

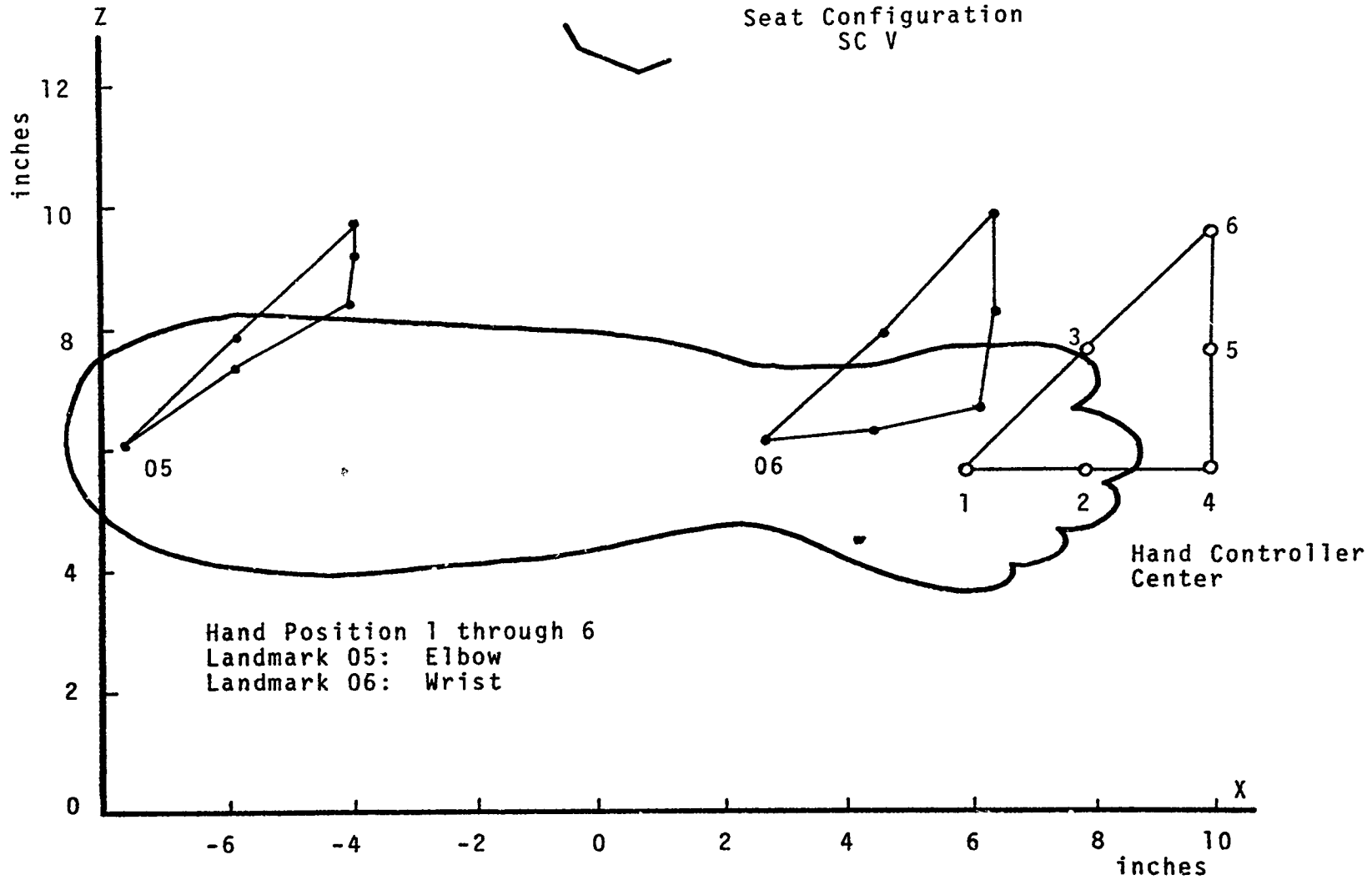


Figure 32 Changes in Right Elbow and 3rd Metacarpal Positions for All 6 Hand Controller Positions - Seat Configuration V

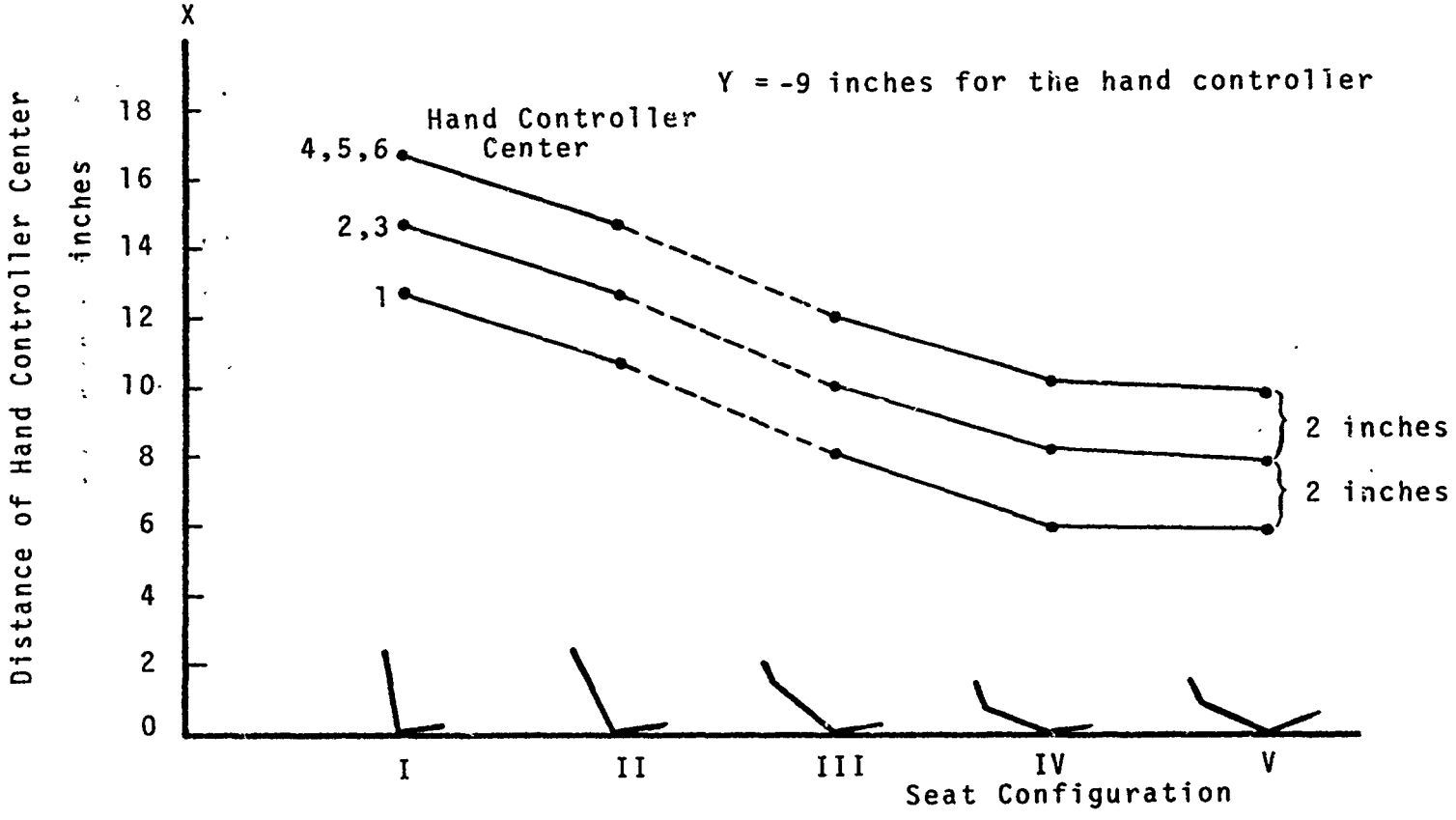


Figure 33 Mean Location of the Hand Controller Center Along the X-Axis for All Seat Configurations

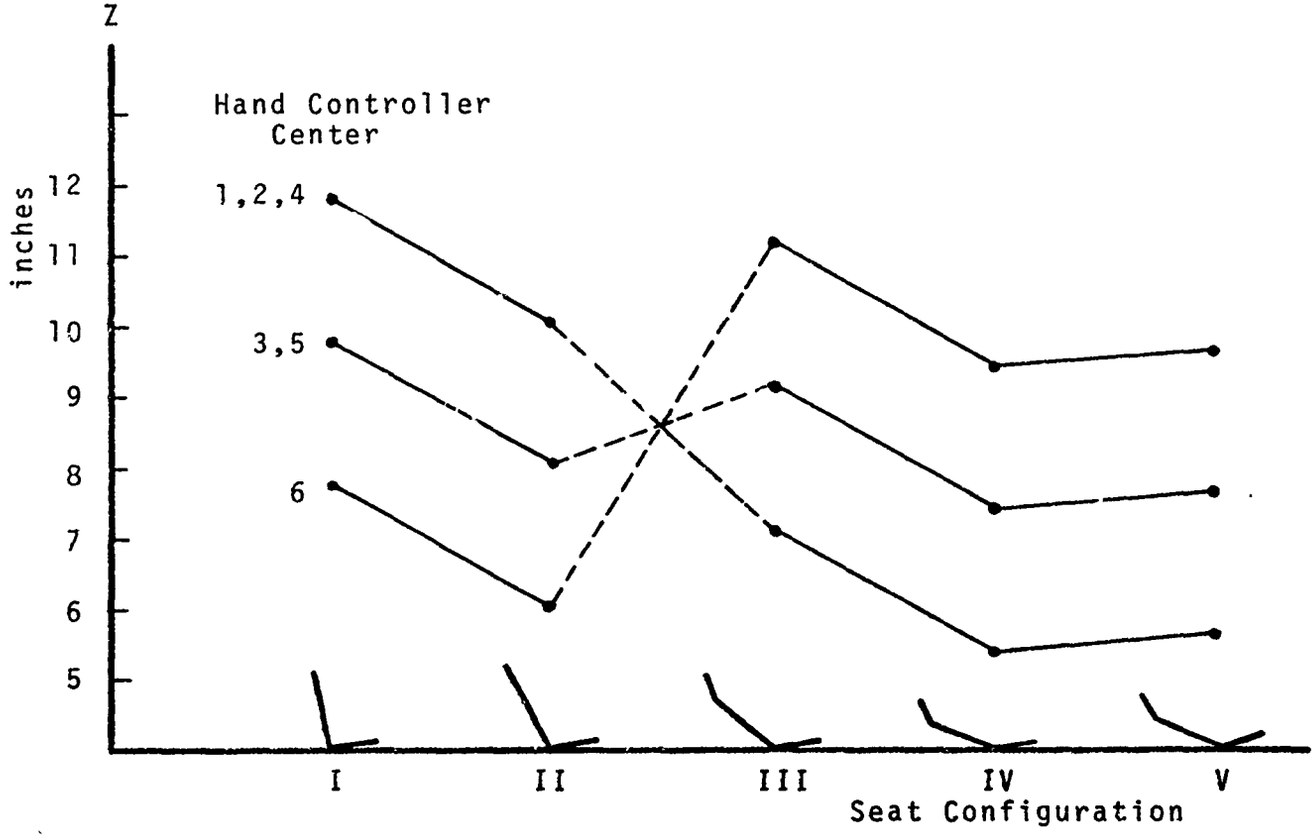
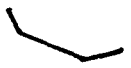


Figure 34 Mean Location of the Hand Controller Center Along the Z-Axis for All Seat Configurations

TABLE 5
X and Z Coordinates for Controller
Midpoint Location*†

Seat Config.	Coordinates	Statistics	Hand Controller Positions** 1	2	3	4	5	6
I	X	Mean	12.68	14.68	14.68	16.68	16.68	16.68
		Std. Dev.	0.68	0.68	0.68	0.68	0.68	0.68
	Z	Mean	11.74	11.74	9.74	11.74	9.74	7.74
		Std. Dev.	0.79	0.79	0.79	0.79	0.79	0.79
II 	X	Mean	10.85	12.85	12.85	14.85	14.85	14.85
		Std. Dev.	0.76	0.76	0.76	0.76	0.76	0.76
	Z	Mean	10.01	10.01	8.01	10.01	8.01	6.01
		Std. Dev.	0.74	0.74	0.74	0.74	0.74	0.74
III 	X	Mean	8.07	10.07	10.07	12.07	12.07	12.07
		Std. Dev.	1.11	1.11	1.11	1.11	1.11	1.11
	Z	Mean	7.13	7.13	9.13	7.13	9.13	11.13
		Std. Dev.	0.61	0.61	0.61	0.61	0.61	0.61
IV 	X	Mean	6.29	6.29	8.29.	10.29	10.29	10.29
		Std. Dev.	1.09	1.09	1.09	1.09	1.09	1.09
	Z	Mean	5.38	5.38	7.38	5.38	7.38	9.38
		Std. Dev.	0.47	0.47	0.47	0.47	0.47	0.47
V 	X	Mean	5.92	7.92	7.92	9.92	9.92	9.92
		Std. Dev.	1.30	1.30	1.30	1.30	1.30	1.30
	Z	Mean	5.72	5.72	7.72	5.72	7.72	9.72
		Std. Dev.	0.47	0.47	0.47	0.47	0.47	0.47

Y Coordinate was maintained at 9" right of SRP

† Dimensions are in inches.

** Hand positions varies from subject to subject.

When the back rest angle changes from the standard 13° configuration, the pilot's arm configuration is altered. These changes are in terms of the inclination of the upper and lower arms with respect to the x axis. Since arm configuration changes may influence the maximum isometric force exerted on the arm controller, it was decided to include these data in Figures 35 through 40 for future reference. In these figures, angle alpha (α) refers to the inclination of the straight line joining radiale and stylion to the horizontal. Angle beta (β) refers to the inclination of the straight line joining acromion and radiale to the horizontal. Thus, α provides information requiring forearm orientation and β provides information on upper arm orientation. These data are also presented in tabular format in Appendix A-4.

Foot Rest Study

The information on the average foot reach limit under different seat configurations and foot rest heights is presented in Figure 41 and also provided in the tables in Appendix A-5. This set of tables also gives information on the standard deviations for each reach.

The information regarding visual interference with the knee was sought as a part of this study. Figures 42 through 45 show the mean locations of eye and knee top for the five seat configurations under three foot rest heights. Also shown are the mean locations of acromion and trachantion surface targets. Figures 26 and 47 show the relative displacements of knee top for change in seat configuration. These figures show the mean position and 5th and 95th percentile limits. The same data presented in Figures 41 through 47 also are presented in tabular form in Appendix A-5.

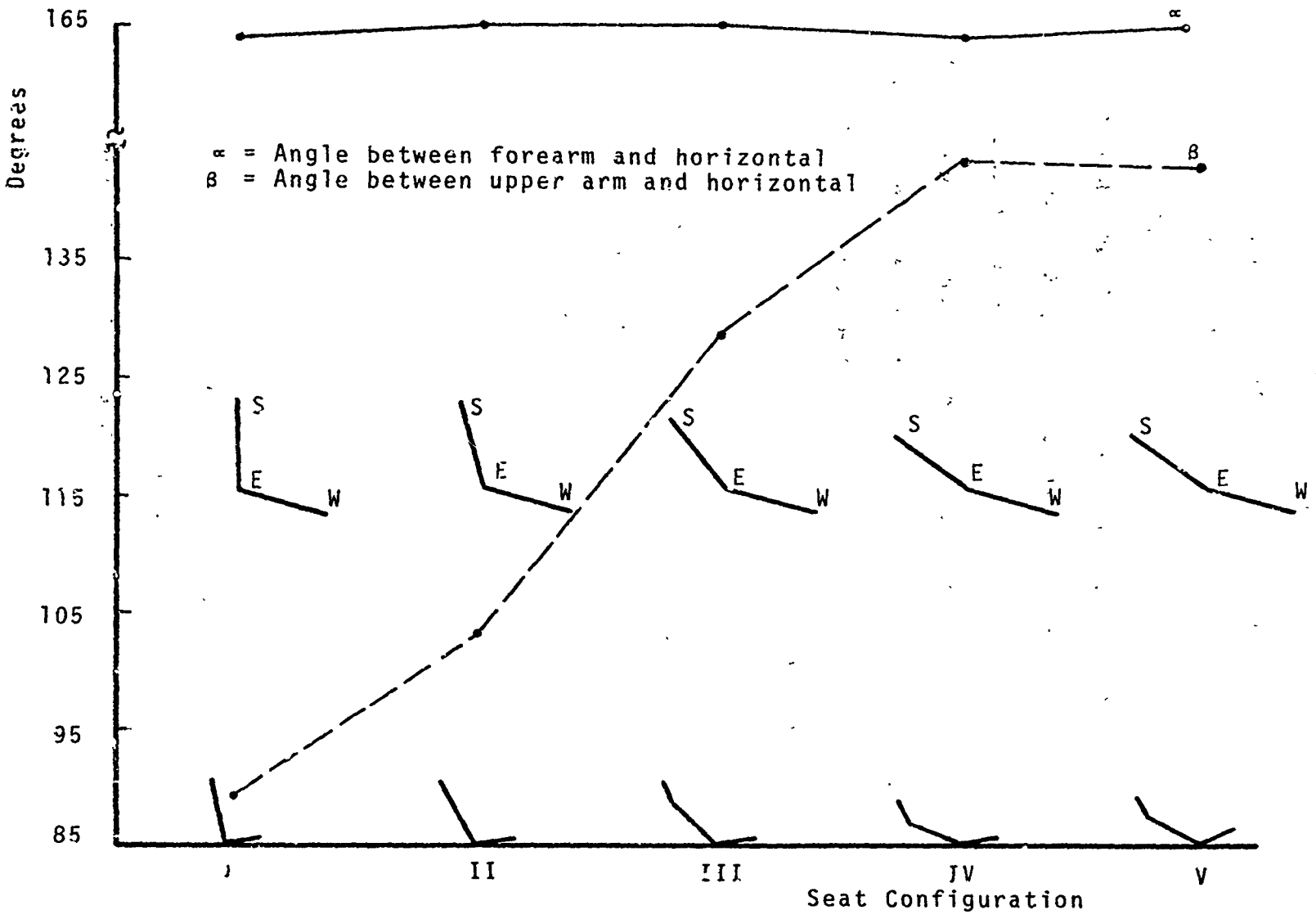


Figure 35 Mean Angles for the Forearm and Upper Arm for the Five Seat Configurations Measured From the Horizontal - Hand Position 1

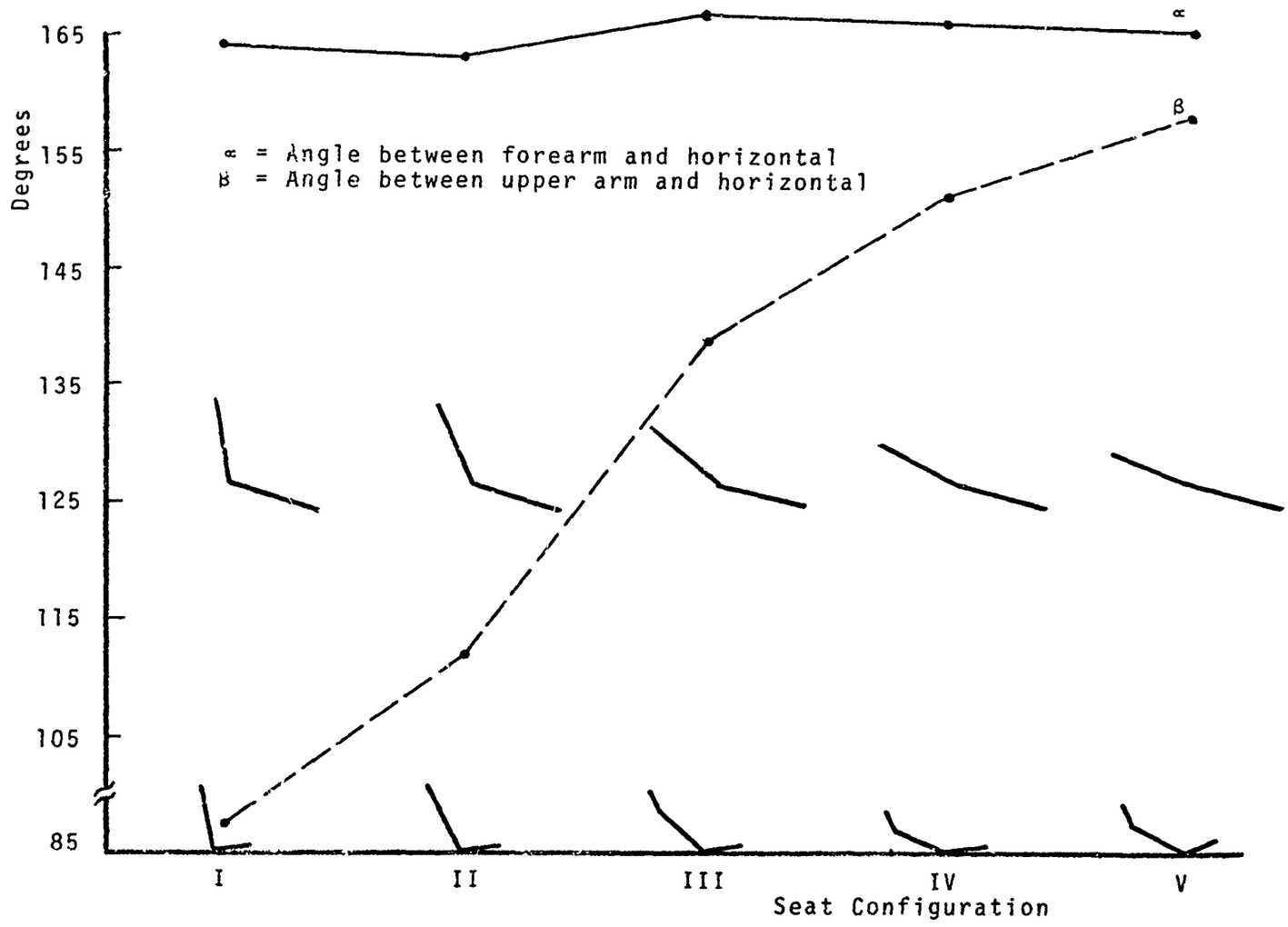


Figure 36 Mean Angles for the Forearm and Upper Arm for the Five Seat Configurations Measured From the Horizontal - Hand Position 2

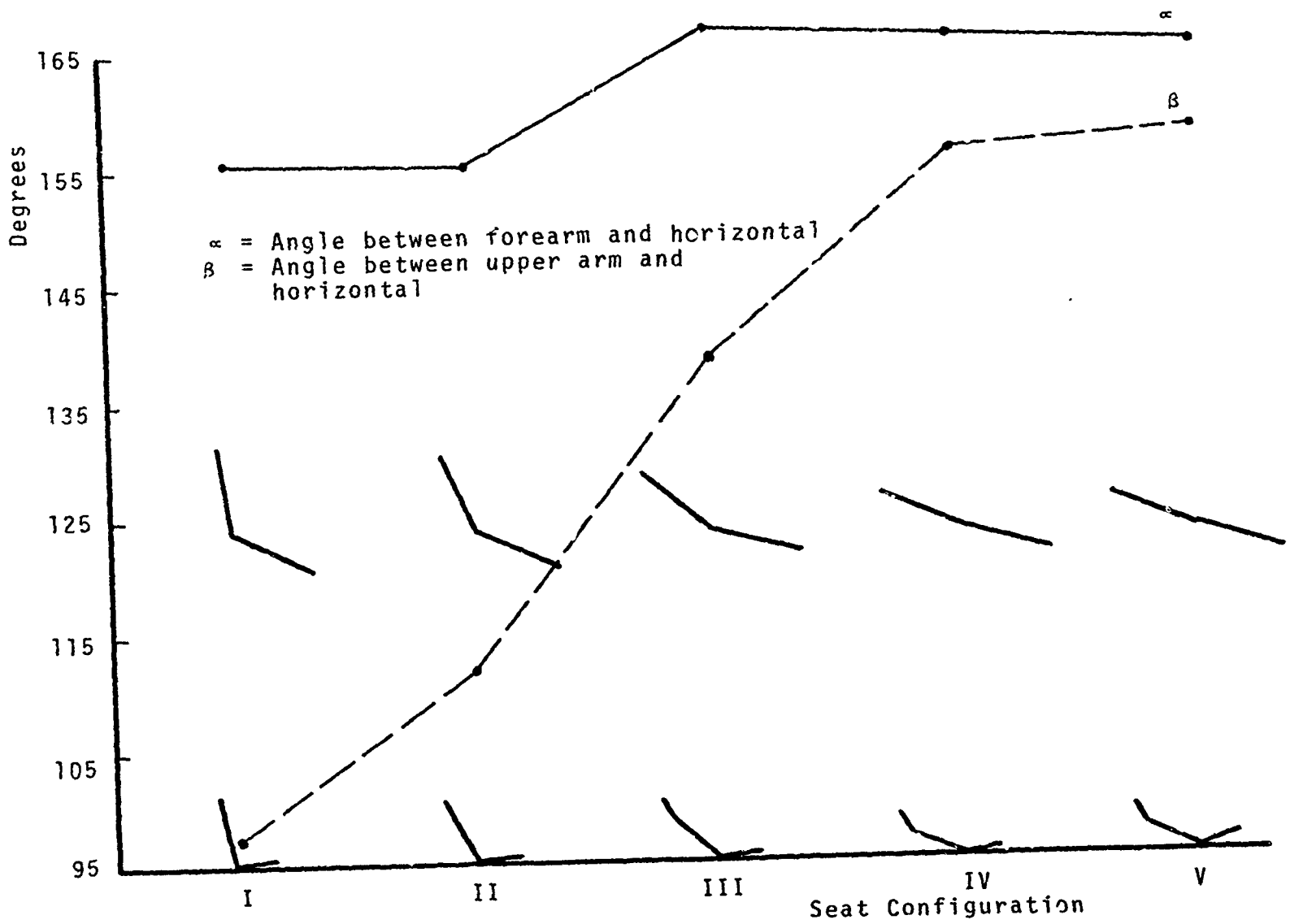


Figure 37 Mean Angles for the Forearm and Upper Arm for the Five Seat Configurations Measured From the Horizontal - Hand Position 3

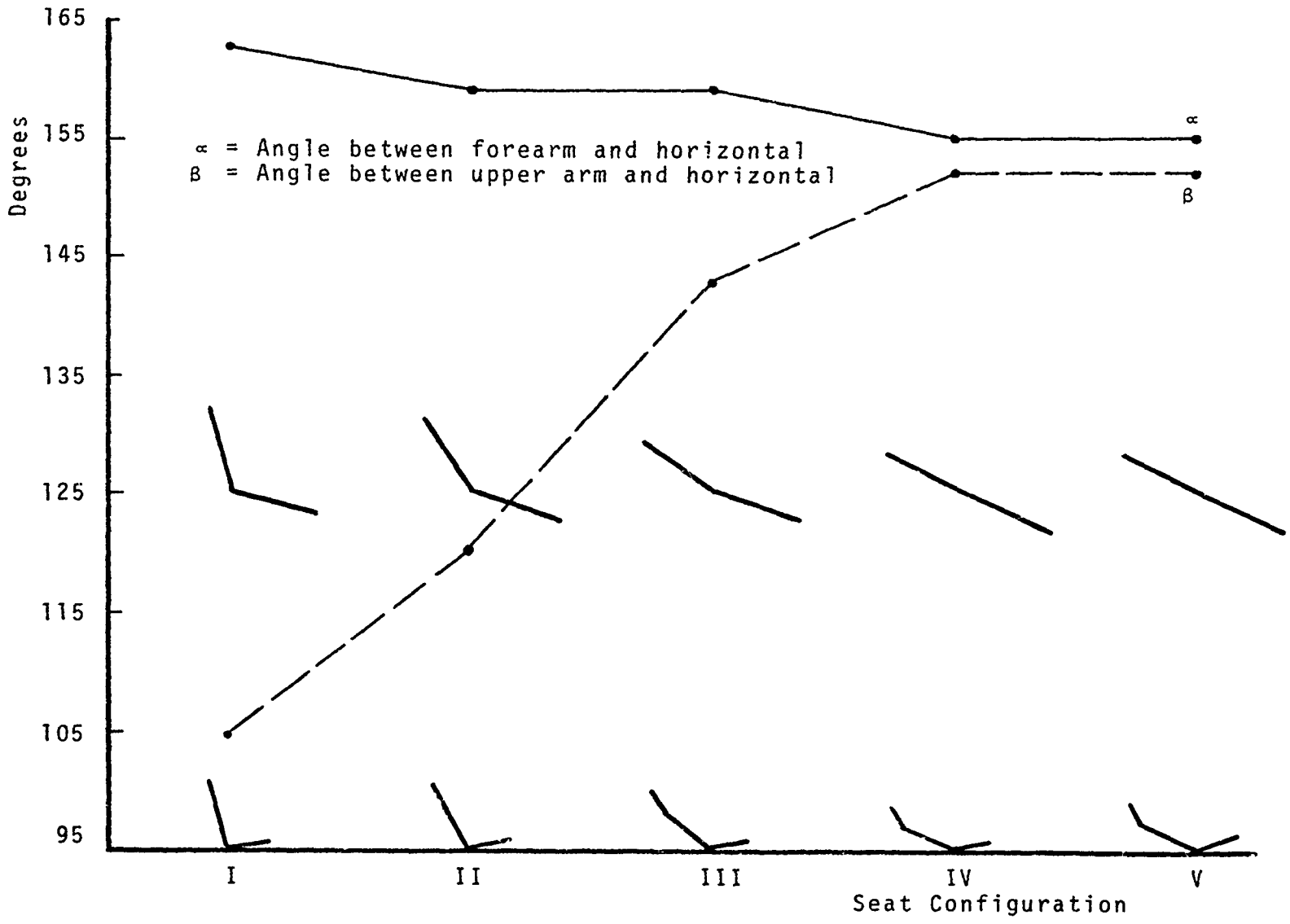


Figure 38 Mean Angles for the Forearm and Upper Arm for the Five Seat Configurations Measured From the Horizontal - Hand Position 4

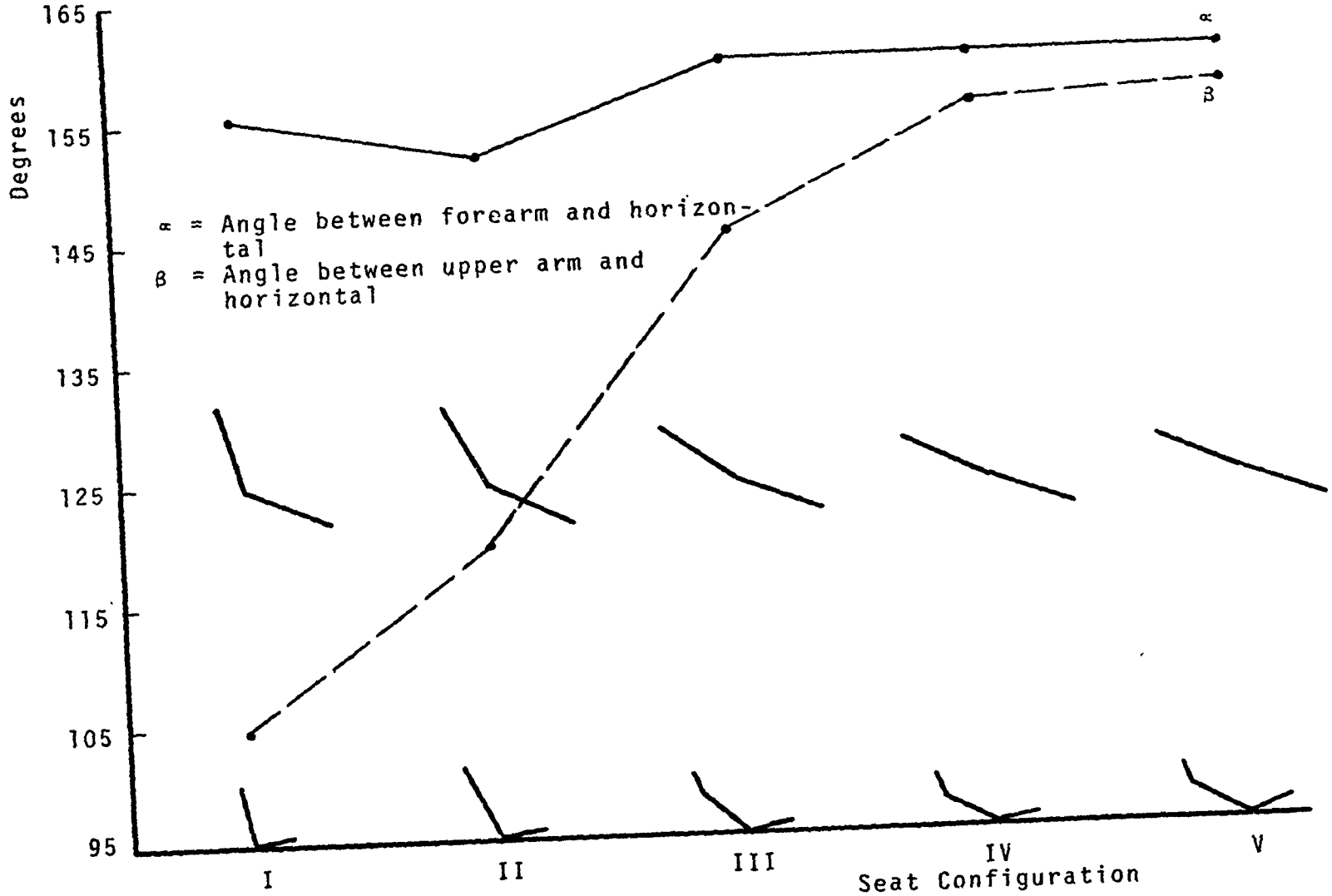


Figure 39 Mean Angles for the Forearm and Upper Arm for the Five Seat Configurations Measured From the Horizontal - Hand Position 5

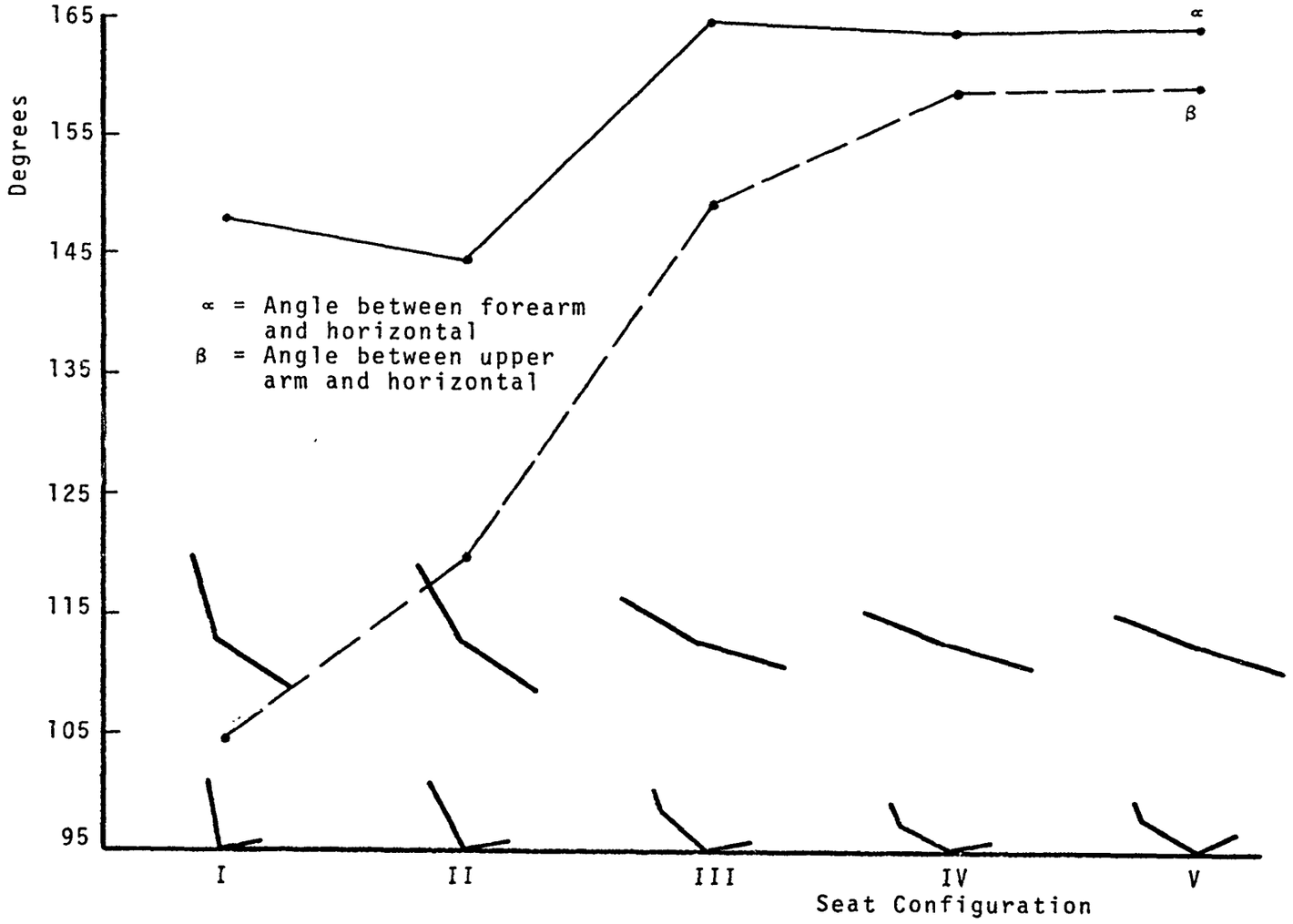


Figure 40 Mean Angles for the Forearm and Upper Arm for the Five Seat Configurations Measured From the Horizontal - Hand Position 6

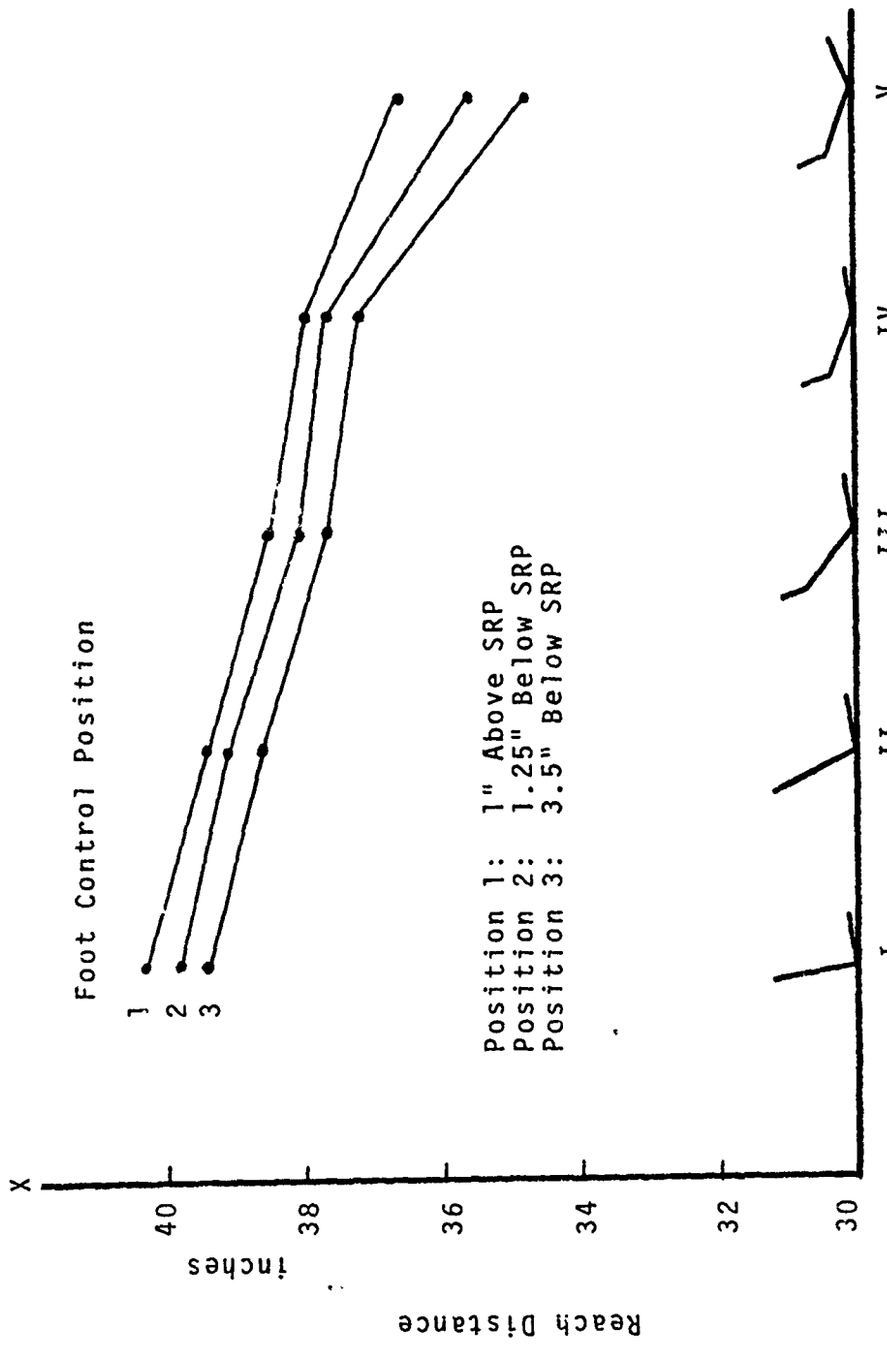


Figure 41 Average Foot Reach for Different Seat Configurations and Foot Control Location

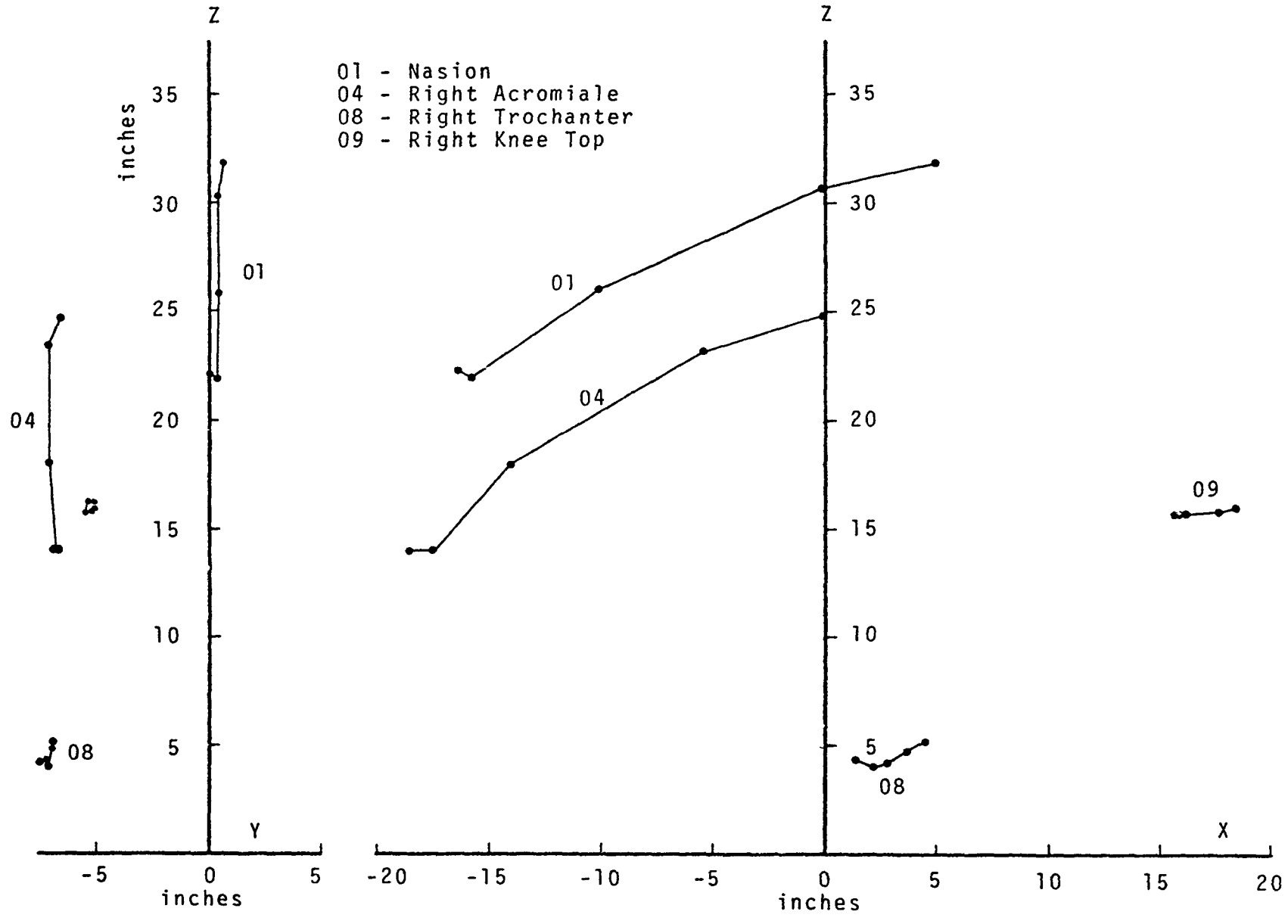


Figure 42 Mean Position of the Nasion, Right Acromiale, Right Trochanter, Right Knee Top for Five Seat Configurations - Foot Position 1

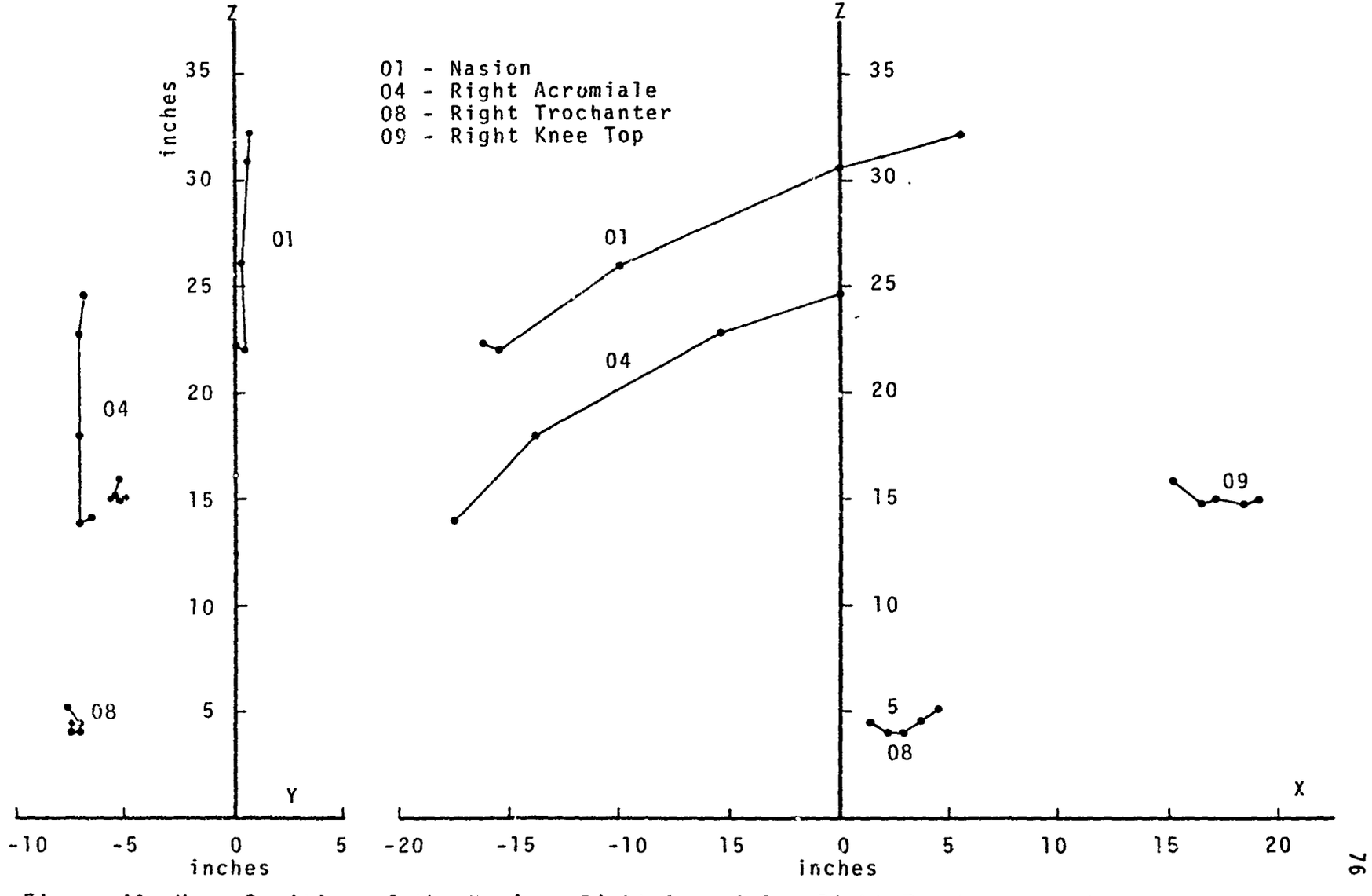


Figure 43 Mean Position of the Nasion, Right Acromiale, Right Trochanter, Right Knee Top for Five Seat Configurations - Foot Position 2

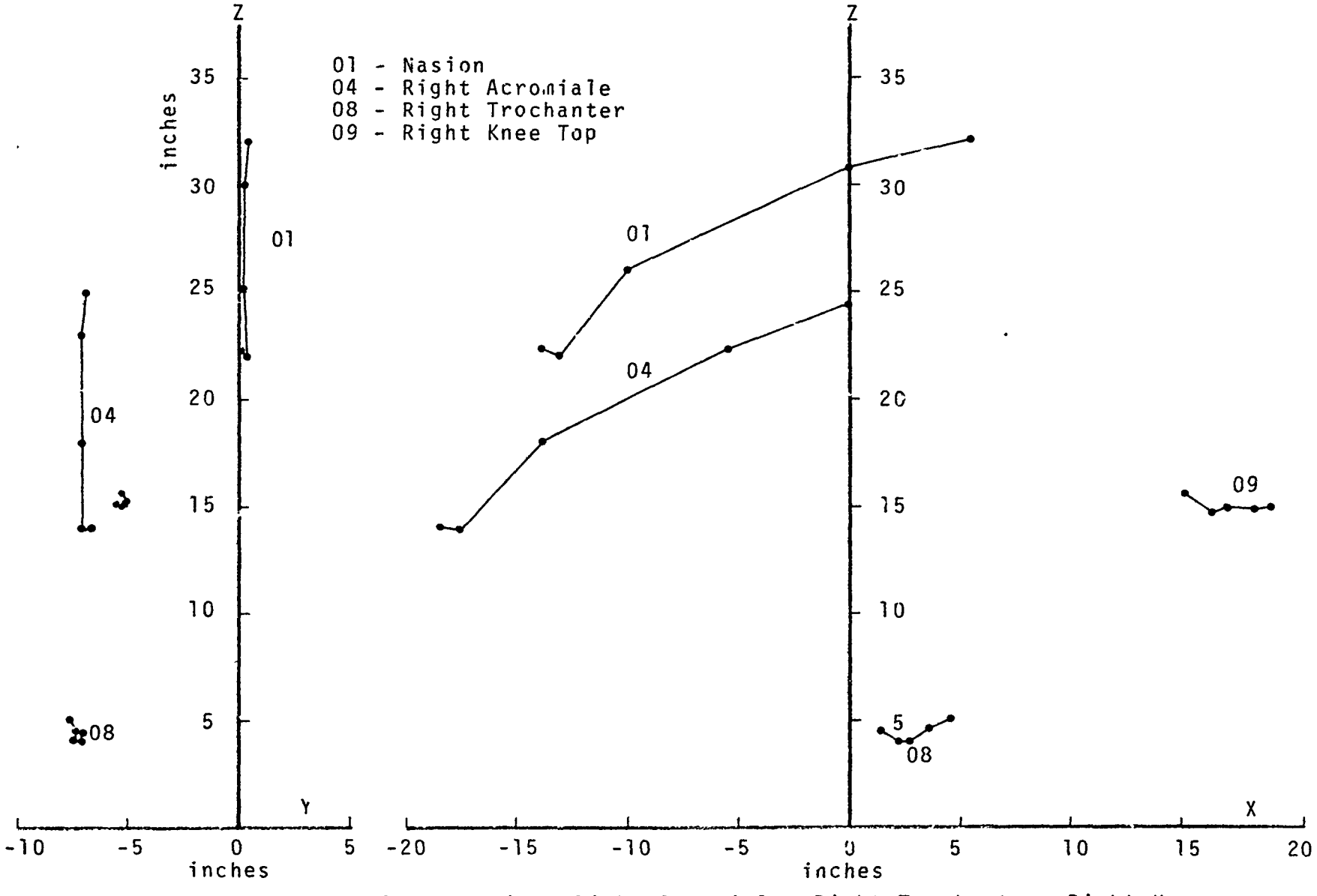


Figure 44 Mean Position of the Nasion, Right Acromiale, Right Trochanter, Right Knee Top for Five Seat Configurations - Foot Position 3

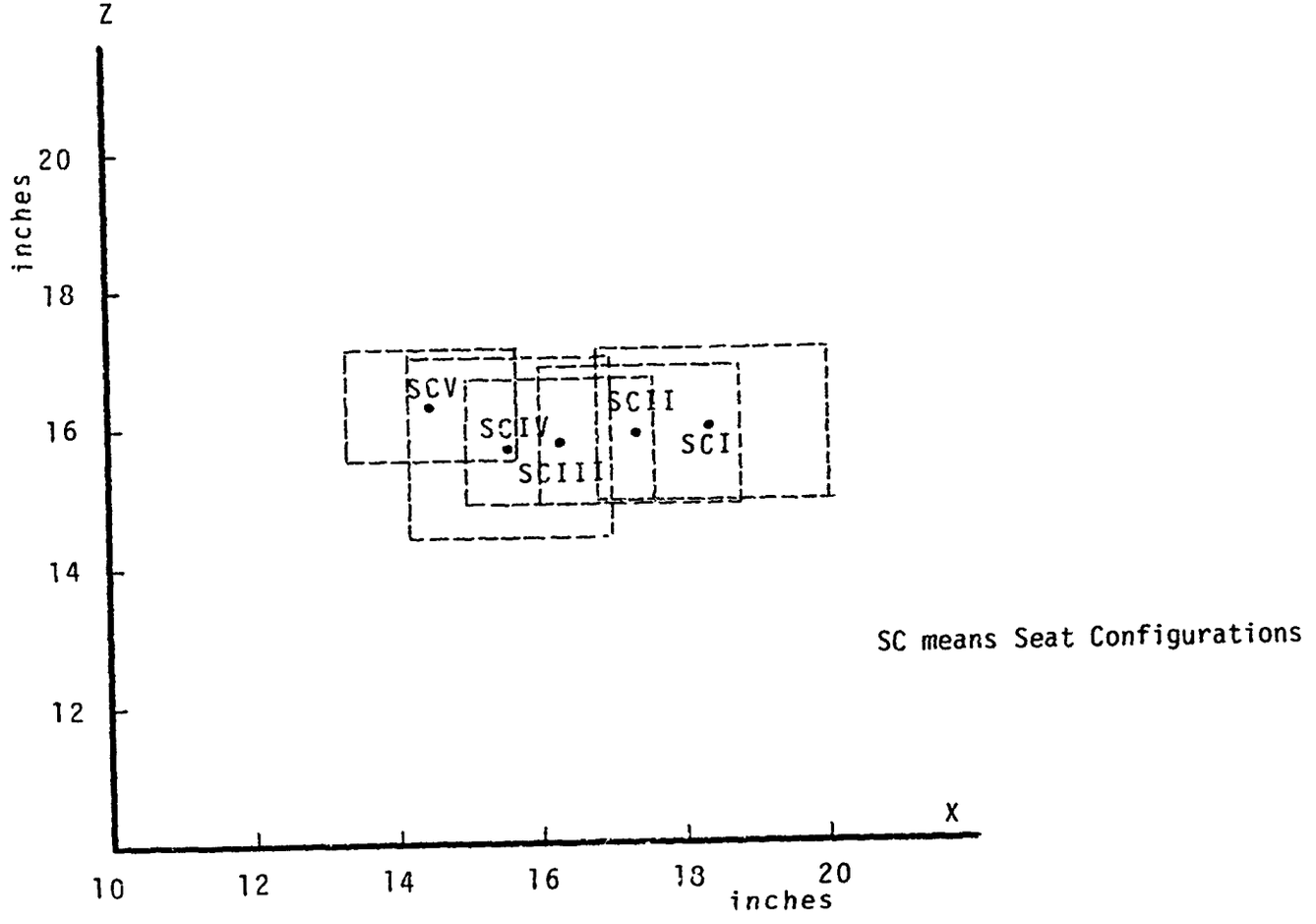


Figure 45 The 5th, 50th, and 95th Percentiles Positions With Respect to SRP for the Top of Right Knee for the Five Seat Configuration - Foot Position 1. The rectangle represents the 5th and 95th percentiles for both axes.

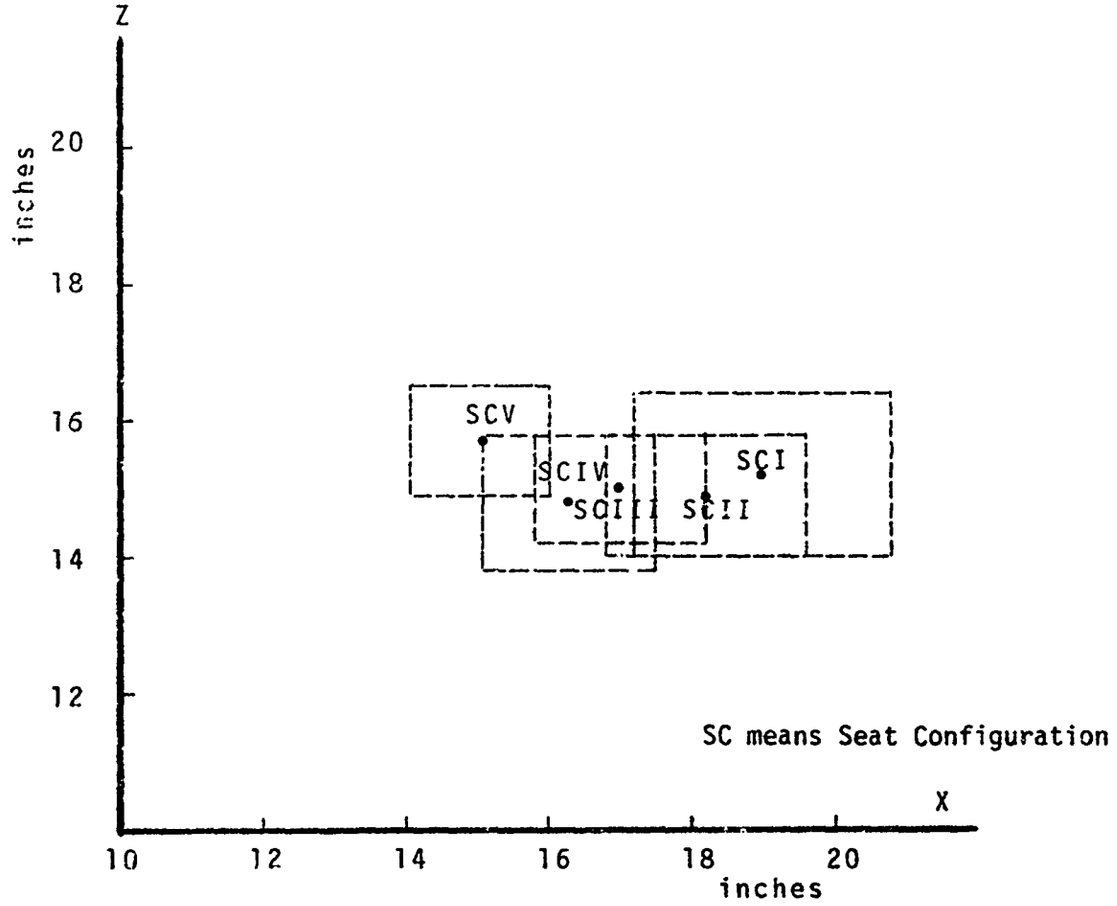


Figure 46 The 5th, 50th, and 95th Percentiles Positions With Respect to SRP for the Top of Right Knee for the Five Seat Configuration - Foot Position 2. The rectangle represents the 5th and 95th percentiles for both axes.

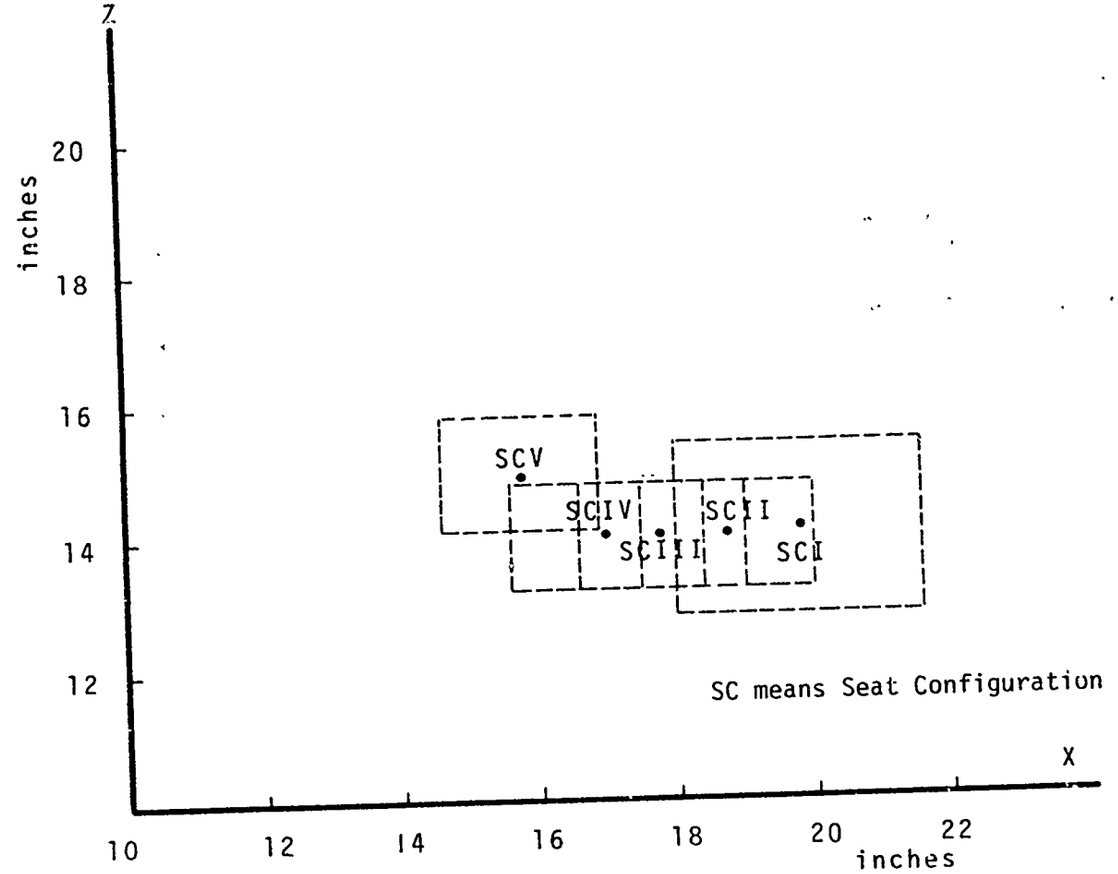


Figure 47 The 5th, 50th, and 95th Percentiles Positions With Respect to SRP for the Top of Right Knee for the Five Seat Configuration - Foot Position 3. The rectangle represents the 5th and 95th percentiles for both axes.

CONCLUSIONS

The design conclusions based on the engineering anthropometric data collected are presented in four sections. These are: head rest, arm rest, foot rest, and eye design height which influences the position of the SRP as the seat reclines from the standard configuration (13° back angle) to the 65° back angle.

Head Rest

To adequately design a head rest, a minimum of two parameters are needed. These are the location of the hinge point and the length of the head rest.

The location of hinge point for the back rest is most difficult to obtain accurately. However, based on the data presented in Figure 20, the highest point of contact of the torso with the back rest ranges around the level of the spinous process of the fourth thoracic vertebra. Therefore, it may be assumed that the hinge point for the back rest should be at the same location on the back rest as the supinous process of the fourth thoracic vertebra. It should be noted that the head rest is not used for seat configuration I, II (back rest angles 13° and 27°).

The length of head rest based on the data shown in Appendix A-1 should be approximately 15.84 inches. This represents the distance for 95 percentile (based on the subject population used) from the hinge point to the helmet rear contact point. This value is based on head position 3 for seat configuration V which requires the longest head rest among all head position - seat configuration combinations.

Arm Rest

The arm rest parameters of interest in this study were:

1. Location of arm rest.
2. Orientation of the arm rest.
3. The change of orientation of arm rest as the back rest reclines for a given controller location.

Figures 29 through 32 show for a given location of the hand controller, the position of the desired seat configuration. These data, also available in Appendix A-4, provide the needed information to establish the expected position of the arm-rest in space. In addition they give the relative change in orientation as the seat reclines from the standard seat configuration (SCI) to seat configuration IV (65° back rest, 10° seat pan). This is illustrated in Figure 48 which shows the spatial histories of several landmarks as the seat reclines.

To obtain the arm configuration during reclining of the seat, Appendix A-4 provides the tabulated data for the elbow and wrist positions from which the arm rest orientation during reclining of the seat can be determined.

Foot Rest

Three foot rest locations were used to establish maximum reach as well as the position of the knee when the seat is fully reclined. The data obtained give information on the line of vision of the pilot in the various seat configuration to the top of the knee. These data, given the location and dimensions of the instrument panel, can define the areas of the panel tha are obstructed to view by the pilot's knees in the different seat configurations.

The maximum reach data give the design limit for location of the foot controls forward of the seat reference point along the X-axis.

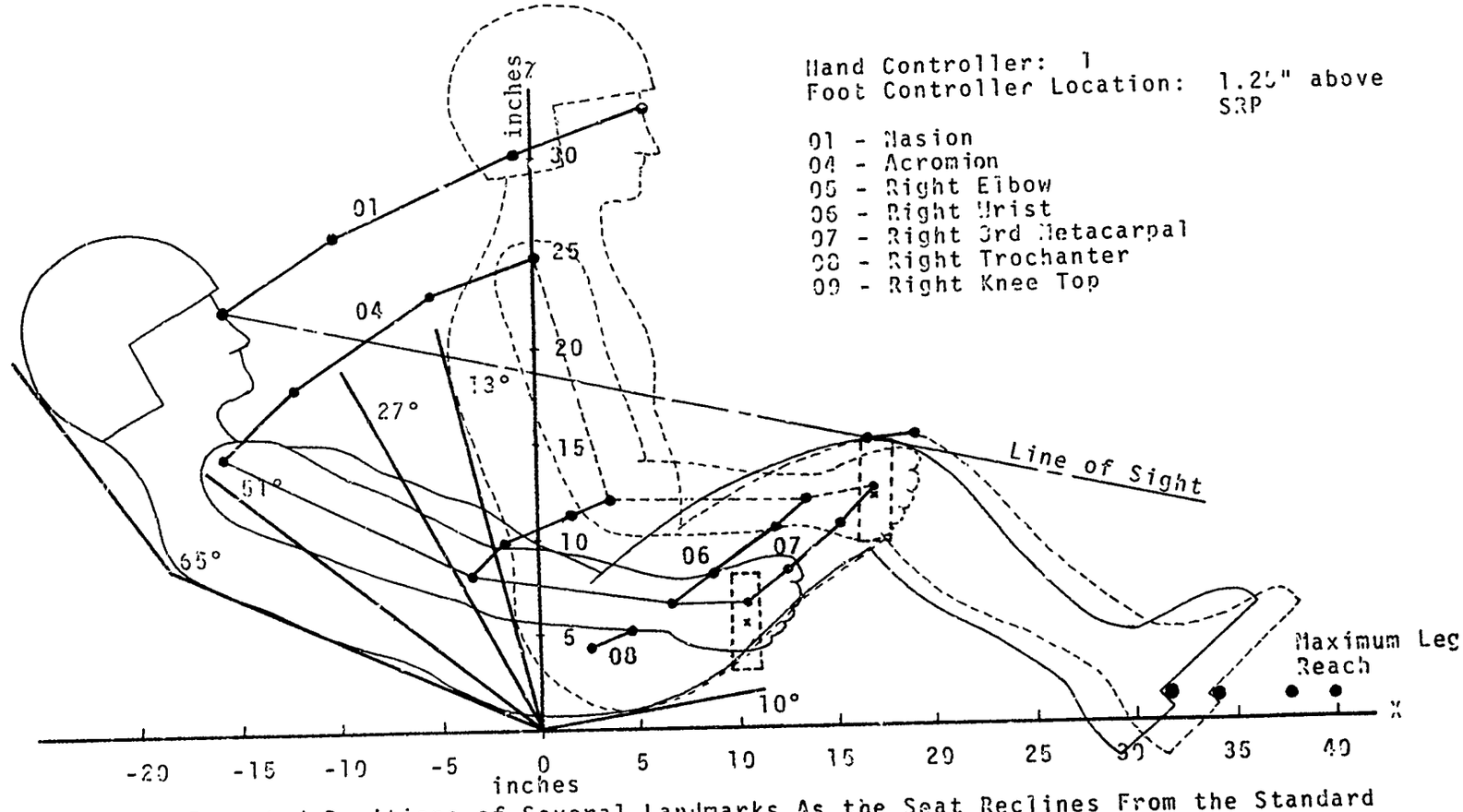


Figure 48 The Expected Positions of Several Landmarks As the Seat Reclines From the Standard Seat Configuration (SCI) to Seat Configuration Having the Back Rest at 65° and Seat Pan of 10°(SCIV)

Table 6 gives the maximum foot reach measured from the mid position of foot controllers.

Eye Design Position

Because of the reclining seat configurations, the eye position moves both backward and downward as the back rest is reclined. Therefore, in order to maintain the eye position the same, the seat reference point (SRP) must be repositioned in order that the eye position is maintained the same.

Table 7 shows the x-z coordinates for the SRP for the standard as well as the other seat configurations for the 5th, 50th and 95th percentiles of the U.S. pilot population. From these data the needed SRP translations along the x and z axes have been computed and are also shown in Table 7.

TABLE 6

Maximum Foot Reach Measured from the

Mid Position of Foot Controllers

Seat Configurations			I	II	III	IV	V
Foot Position	1	$\bar{x}$	40.29	39.41	38.47	38.01	36.55
		σ	1.42	1.35	1.30	1.34	1.63
	2	$\bar{x}$	39.75	39.14	38.06	37.66	35.63
		σ	1.42	1.47	1.28	1.35	1.53
	3	$\bar{x}$	39.38	38.60	37.72	37.17	34.75
		σ	1.37	1.49	1.32	1.47	1.56

Note: (i) Distances are in inches.

(ii) Controller maximum travel is 6 inches.

TABLE 7

Translation of SRP required to maintain the eye position of Head position 1, SC I, for 5th to 95th percentile (±1.65 std. dev.).

	SEAT CONFIGURATION					
COORDINATES	I	II	III	IV	V	Percentile
X	7.18	1.44	-8.66	-13.98	-15.17	→95th
	5.28	-.69	-10.21	-15.63	-16.46	→50th
	3.38	-2.82	-11.76	-17.28	-17.75	→ 5th
Z	33.83	32.17	27.31	23.55	23.68	→95th
	32.53	30.90	26.20	22.31	22.47	→50th
	31.23	29.63	25.09	21.07	21.26	→ 5th
TRANSLATION						
Along X axis		5.74	15.84	21.16	22.35	→95th
		5.97	15.49	20.91	21.74	→50th
		6.20	15.14	20.66	21.13	→ 5th
Along Z axis		1.66	6.52	10.28	10.15	→95th
		1.63	6.33	10.22	11.27	→50th
		1.60	6.14	10.16	9.97	→ 5th

*Distances are in inches.

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APPENDIX A-1

Head/Upper Torso Data

Note: 1. All linear dimensions in the following appendices are specified in inches. Angles are specified in degrees.

2. A blank space indicates that the specific data was not available.

HEAD POSITION 1

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	21	5.28	1.15	0.38	0.63	32.53	0.79
13	10	2	21	4.81	1.06	0.44	0.59	28.01	0.75
13	10	3	21	2.97	0.72	0.54	0.46	23.93	0.59
13	10	4	21	-0.02	1.12	-6.96	0.44	25.03	0.69
13	10	12	21	-3.98	0.99	0.40	0.63	33.25	1.02
13	10	13	21	-3.95	0.51	0.69	0.47	21.40	1.16
13	10	14	21	-0.96	0.48	0.77	0.46	9.56	1.63
27	10	1	21	-0.69	1.29	0.30	0.58	30.90	0.77
27	10	2	21	-1.03	1.18	0.37	0.55	26.20	0.73
27	10	3	21	-2.27	0.67	0.49	0.43	22.63	0.56
27	10	4	21	-5.64	0.84	-7.01	0.47	23.11	0.73
27	10	12	21	-9.84	1.22	0.32	0.56	31.62	0.67
27	10	13	21	-8.28	0.45	0.67	0.45	19.01	0.83
27	10	14	21	-2.50	0.59	0.69	0.43	8.01	1.01
51	10	1	21	-10.21	0.94	0.29	0.51	26.20	0.67
51	10	2	21	-9.72	0.89	0.38	0.46	21.55	0.67
51	10	3	21	-9.95	0.71	0.52	0.53	18.79	0.49
51	10	4	21	-13.51	0.97	-6.89	0.48	18.16	0.58
51	10	12	21	-19.17	0.90	0.32	0.49	25.80	0.80
51	10	13	21	-14.17	0.82	0.81	0.45	13.46	1.00
51	10	14	21	-3.99	0.99	0.56	0.46	5.28	0.85
65	10	1	21	-15.63	1.00	0.38	0.61	22.31	0.75
65	10	2	21	-14.28	0.96	0.45	0.59	17.78	0.83
65	10	3	21	-14.03	0.80	0.52	0.56	15.51	0.50
65	10	4	21	-17.48	0.92	-6.78	0.73	14.30	0.68
65	10	12	21	-24.33	0.78	0.49	0.59	20.47	0.72
65	10	13	21	-17.24	1.07	0.76	0.41	10.02	1.24
65	10	14	21	-4.78	1.17	0.51	0.40	3.99	0.49
65	20	1	20	-16.46	0.78	0.29	0.42	22.47	0.73
65	20	2	20	-14.95	0.91	0.41	0.43	18.05	0.77
65	20	3	20	-14.71	0.79	0.54	0.38	15.79	0.41
65	20	4	20	-18.30	1.00	-6.72	0.46	14.37	0.71
65	20	12	20	-25.12	0.71	0.38	0.41	20.51	0.80
65	20	13	20	-18.08	1.13	0.62	0.29	10.48	1.25
65	20	14	20	-5.49	1.13	0.45	0.28	4.20	0.41

HEAD POSITION 2

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	20	7.76	0.86	0.47	0.53	28.25	1.68
13	10	2	20	4.21	0.72	0.52	0.46	25.11	1.27
13	10	3	20	3.27	0.58	0.54	0.50	23.68	0.68
13	10	4	20	0.25	0.93	-6.86	0.49	25.07	0.63
13	10	12	19	0.72	1.91	0.47	0.58	32.92	1.00
13	10	13	19	-3.83	0.33	0.63	0.49	21.29	0.81
13	10	14	20	-0.90	0.52	0.86	0.56	9.67	1.77
27	10	1	21	1.57	1.91	0.43	0.52	27.51	1.53
27	10	2	21	-1.46	1.11	0.49	0.45	23.88	1.11
27	10	3	21	-2.14	0.78	0.59	0.44	22.53	0.68
27	10	4	21	-5.58	0.91	-6.92	0.53	23.25	0.75
27	10	12	20	-5.88	2.10	0.44	0.64	31.38	0.92
27	10	13	20	-8.27	0.49	0.61	0.48	19.17	0.83
27	10	14	21	-2.49	0.54	0.62	0.49	7.94	0.88
51	10	1	21	-9.47	1.40	0.45	0.45	24.89	0.65
51	10	2	21	-10.09	1.12	0.45	0.40	20.35	0.61
51	10	3	21	-10.18	0.82	0.48	0.39	18.68	0.47
51	10	4	21	-13.66	1.04	-6.87	0.54	18.13	0.57
51	10	12	21	-18.31	1.42	0.50	0.50	25.70	0.69
51	10	13	21	-14.58	0.74	0.82	0.44	13.92	1.24
51	10	14	21	-4.02	0.97	0.70	0.50	5.32	0.75
65	10	1	21	-14.71	1.66	0.52	0.56	21.47	0.63
65	10	2	21	-14.18	1.35	0.58	0.55	16.91	0.53
65	10	3	21	-13.99	0.96	0.57	0.47	15.47	0.40
65	10	4	21	-17.39	0.98	-6.71	0.73	14.37	0.56
65	10	12	20	-23.77	1.26	0.58	0.55	20.72	1.06
65	10	13	20	-17.39	0.95	0.68	0.52	9.99	1.15
65	10	14	21	-5.08	1.11	0.55	0.42	4.07	0.40
65	20	1	20	-15.22	2.09	0.48	0.54	21.62	0.59
65	20	2	20	-14.84	1.55	0.49	0.52	17.08	0.57
65	20	3	20	-14.59	1.00	0.52	0.39	15.67	0.44
65	20	4	20	-18.22	1.04	-6.63	0.45	14.51	0.70
65	20	12	20	-24.17	1.90	0.51	0.62	21.04	1.29
65	20	13	20	-18.03	1.49	0.61	0.38	10.36	1.44
65	20	14	20	-5.32	1.12	0.48	0.33	4.15	0.36

HEAD POSITION 3

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	21	2.22	1.44	0.34	0.61	34.60	0.96
13	10	2	21	5.01	0.93	0.33	0.56	30.76	1.16
13	10	3	21	3.29	0.74	0.55	0.44	23.93	0.72
13	10	4	21	0.55	1.01	-6.94	0.45	24.89	0.64
13	10	12	21	-6.15	1.05	0.42	0.54	31.96	1.24
13	10	13	21	-3.68	0.54	0.74	0.59	20.82	1.16
13	10	14	21	-0.89	0.57	0.81	0.51	9.46	1.81
27	10	1	21	-5.10	1.51	0.48	0.62	33.13	0.80
27	10	2	21	-1.57	1.10	0.47	0.61	29.64	1.02
27	10	3	21	-2.12	0.72	0.71	0.49	22.90	0.67
27	10	4	21	-5.33	0.81	-6.87	0.50	23.24	0.71
27	10	12	21	-12.66	0.99	0.58	0.62	29.35	1.27
27	10	13	21	-8.16	0.44	0.83	0.50	18.92	0.71
27	10	14	21	-2.49	0.57	0.82	0.47	8.11	0.82
51	10	1	21	-11.20	1.09	0.30	0.52	28.30	0.90
51	10	2	21	-8.08	0.87	0.34	0.52	24.71	1.23
51	10	3	21	-8.90	0.96	0.47	0.44	19.00	0.46
51	10	4	21	-12.57	1.30	-6.85	0.37	18.53	0.74
51	10	12	21	-18.95	0.87	0.35	0.56	25.23	0.86
51	10	13	21	-13.43	0.89	0.57	0.73	12.66	0.78
51	10	14	21	-3.93	0.94	0.60	0.55	5.22	0.67
65	10	1	21	-17.14	1.10	0.52	0.57	24.38	0.85
65	10	2	21	-13.43	0.96	0.57	0.66	21.38	1.48
65	10	3	21	-13.01	1.18	0.61	0.53	16.10	0.51
65	10	4	21	-16.71	1.28	-6.63	0.75	14.83	0.80
65	10	12	21	-24.12	0.82	0.60	0.57	20.04	0.69
65	10	13	21	-15.84	1.42	0.74	0.46	8.92	0.81
65	10	14	21	-4.79	1.24	0.57	0.32	4.00	0.50
65	20	1	21	-17.90	1.07	0.39	0.51	24.67	0.76
65	20	2	21	-14.14	0.92	0.42	0.58	21.63	1.42
65	20	3	21	-13.65	1.01	0.51	0.46	16.31	0.52
65	20	4	21	-17.53	1.36	-6.32	1.54	14.92	0.87
65	20	12	20	-24.86	0.77	0.55	0.49	20.29	0.73
65	20	13	20	-16.82	1.18	0.67	0.45	9.50	0.79
65	20	14	21	-5.41	1.08	0.53	0.29	4.18	0.49

HEAD POSITION 4

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	21	2.44	2.13	-4.96	1.00	32.14	0.92
13	10	2	21	2.84	1.52	-3.89	0.83	27.45	0.93
13	10	3	21	3.22	0.70	0.32	0.47	23.90	0.64
13	10	4	21	-0.67	1.79	-6.67	0.45	25.19	0.78
13	10	12	20	-3.79	1.44	-0.22	0.69	31.54	0.76
13	10	13	20	-4.01	0.43	0.49	0.49	21.48	1.01
13	10	14	21	-0.77	0.83	0.77	0.50	9.35	1.70
27	10	1	21	-3.87	2.09	-4.65	0.87	30.59	0.70
27	10	2	21	-3.09	1.48	-3.80	0.77	25.91	0.73
27	10	3	21	-1.97	0.81	0.33	0.48	22.78	0.62
27	10	4	21	-5.77	0.87	-6.69	0.52	23.45	0.80
27	10	12	21	-9.68	1.61	0.02	0.92	29.61	0.94
27	10	13	21	-8.41	0.46	0.50	0.41	19.14	0.82
27	10	14	21	-2.53	0.57	0.58	0.34	8.08	0.85
51	10	1	20	-12.93	1.03	-4.19	0.93	25.65	0.81
51	10	2	20	-11.30	0.97	-3.48	0.82	21.11	0.85
51	10	3	20	-9.61	0.73	0.42	0.49	18.92	0.52
51	10	4	20	-13.61	1.02	-6.49	0.68	18.36	0.72
51	10	12	20	-18.55	0.83	0.17	0.97	24.70	1.09
51	10	13	20	-14.10	0.87	0.74	0.47	13.48	1.08
51	10	14	20	-4.11	1.06	0.55	0.37	5.36	0.72
65	10	1	21	-18.17	1.27	-3.89	1.16	21.71	0.59
65	10	2	21	-15.78	0.99	-3.32	0.87	17.48	0.69
65	10	3	21	-13.65	0.91	0.32	0.78	15.74	0.44
65	10	4	21	-17.46	0.98	-6.63	1.01	14.46	0.67
65	10	12	21	-23.72	1.00	0.08	1.39	19.67	1.00
65	10	13	21	-16.64	1.04	0.51	0.63	9.30	0.84
65	10	14	21	-4.92	1.27	0.44	0.53	4.03	0.48
65	20	1	20	-18.80	1.49	-4.20	1.04	21.73	0.61
65	20	2	20	-16.43	1.14	-3.44	0.85	17.58	0.77
65	20	3	20	-14.31	0.88	0.09	0.55	15.99	0.42
65	20	4	20	-18.13	1.04	-6.64	0.69	14.54	0.83
65	20	12	20	-24.46	1.14	-0.28	0.99	20.05	1.27
65	20	13	20	-17.57	1.11	0.54	0.46	9.87	0.99
65	20	14	20	-5.55	1.17	0.52	0.31	4.18	0.47

HEAD POSITION 5

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	21	2.42	2.06	-6.37	1.21	29.77	1.17
13	10	2	21	2.38	1.41	-3.61	0.99	25.78	0.99
13	10	3	21	3.14	0.76	0.06	0.69	23.94	0.60
13	10	4	21	-0.32	1.11	-6.88	0.54	24.87	0.76
13	10	12	21	-3.62	1.66	-2.01	1.03	31.03	0.89
13	10	13	21	-3.90	0.53	0.48	0.60	21.34	1.06
13	10	14	21	-0.91	0.52	0.95	0.71	9.49	1.73
27	10	1	21	-4.19	2.17	-6.10	1.06	28.49	0.80
27	10	2	21	-3.49	1.40	-3.64	0.98	24.47	0.89
27	10	3	21	-2.12	0.73	0.13	0.70	22.72	0.64
27	10	4	21	-5.87	0.92	-6.78	0.62	23.20	0.77
27	10	12	21	-10.04	1.72	-1.63	1.16	29.10	0.93
27	10	13	21	-8.39	0.50	0.60	0.45	19.14	0.73
27	10	14	21	-2.55	0.54	0.68	0.41	8.04	0.94
51	10	1	21	-12.28	1.12	-5.35	1.06	23.87	0.68
51	10	2	21	-11.22	0.87	-3.09	0.91	19.71	0.70
51	10	3	21	-9.65	0.77	0.34	0.69	18.85	0.52
51	10	4	21	-13.66	1.01	-6.51	0.75	18.26	0.72
51	10	12	21	-18.49	0.96	-1.19	1.01	24.32	1.04
51	10	13	21	-14.24	0.84	0.77	0.50	13.51	0.99
51	10	14	21	-4.05	1.03	0.53	0.47	5.34	0.74
65	10	1	21	-17.82	1.17	-5.06	1.11	20.01	0.60
65	10	2	21	-15.58	0.88	-3.10	1.02	16.23	0.52
65	10	3	21	-13.51	0.91	0.34	0.84	15.73	0.47
65	10	4	21	-17.51	0.97	-6.26	1.00	14.46	0.62
65	10	12	21	-23.54	0.91	-0.83	1.25	19.27	1.10
65	10	13	21	-16.64	0.91	0.59	0.53	9.33	0.85
65	10	14	21	-5.01	1.33	0.46	0.46	4.02	0.48
65	20	1	21	-18.28	1.20	-5.28	1.11	20.11	0.55
65	20	2	21	-16.10	1.01	-3.19	1.01	16.31	0.45
65	20	3	21	-14.23	0.82	0.18	0.60	15.92	0.40
65	20	4	21	-18.20	1.00	-6.45	0.87	14.47	0.81
65	20	12	21	-24.26	1.04	-1.11	1.17	19.72	1.23
65	20	13	21	-17.52	1.02	0.56	0.47	9.84	1.07
65	20	14	21	-5.39	1.08	0.54	0.37	4.13	0.45

HEAD POSITION 6

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	21	1.17	2.22	-2.17	1.39	34.20	1.05
13	10	2	21	2.87	1.57	-3.51	0.93	29.82	1.32
13	10	3	21	3.29	0.74	0.18	0.68	24.09	0.70
13	10	4	21	-0.49	1.22	-6.60	0.55	25.46	0.81
13	10	12	21	-4.66	1.57	1.38	1.31	31.74	1.13
13	10	13	21	-3.95	0.41	0.32	0.74	21.52	1.07
13	10	14	21	-0.90	0.51	0.72	0.59	9.49	1.70
27	10	1	20	-5.28	2.33	-1.53	1.33	32.50	0.88
27	10	2	20	-3.26	1.74	-2.95	0.96	28.25	1.05
27	10	3	20	-1.95	0.81	0.32	0.59	22.95	0.68
27	10	4	20	-6.07	0.82	-6.42	0.50	23.81	0.86
27	10	12	20	-10.89	1.72	1.96	1.41	29.75	1.21
27	10	13	20	-8.45	0.47	0.41	0.44	19.31	0.85
27	10	14	20	-2.56	0.66	0.64	0.49	8.23	1.00
51	10	1	21	-12.94	1.43	-0.98	1.71	27.66	0.85
51	10	2	21	-10.90	1.21	-2.55	1.34	23.57	1.07
51	10	3	21	-9.39	0.74	0.50	0.54	19.01	0.52
51	10	4	21	-13.61	0.98	-6.32	0.60	18.57	0.65
51	10	12	21	-18.30	1.43	2.28	1.57	24.49	1.74
51	10	13	20	-14.21	0.86	0.62	0.51	13.62	1.08
51	10	14	21	-4.16	1.15	0.67	0.57	5.38	0.78
65	10	1	21	-18.78	1.32	-0.85	1.80	23.36	0.75
65	10	2	21	-16.01	1.09	-2.48	1.15	19.79	1.06
65	10	3	21	-13.44	0.96	0.43	0.63	15.93	0.45
65	10	4	21	-17.59	0.91	-6.47	0.63	14.71	0.70
65	10	12	21	-23.72	0.88	1.81	1.56	19.59	0.89
65	10	13	21	-16.38	1.07	0.65	0.60	9.15	0.89
65	10	14	21	-4.86	1.13	0.56	0.54	3.96	0.46
65	20	1	20	-19.48	1.20	-1.13	1.69	23.39	0.80
65	20	2	20	-16.71	1.01	-2.59	1.08	19.77	1.05
65	20	3	20	-14.13	0.89	0.33	0.55	16.16	0.46
65	20	4	20	-18.25	1.06	-6.44	0.61	14.73	0.81
65	20	12	20	-24.23	1.00	1.71	1.44	19.86	1.06
65	20	13	20	-17.54	1.11	0.63	0.50	9.81	1.14
65	20	14	20	-5.65	1.11	0.58	0.39	4.22	0.50

Upper Torso Information
Head Position 1

			SC I	II	III	IV	V
Helmet Rear to Upper Back	Distance	Mean	11.87	12.75	13.33	12.63	12.26
		Std. Dev.	0.76	0.63	1.03	1.83	1.61
	Angle	Mean	90.30	97.10	112.00	124.20	125.10
		Std. Dev.	3.30	4.80	2.39	1.77	1.93

UPPER TORSO INFORMATION

Head Position 2

			SC I	II	III	IV	V
Helmet Rear to Upper Back	Distance	Mean	12.58	12.53	12.41	12.52	12.43
		Std. Dev.	1.14	1.34	1.64	1.74	1.73
	Angle	Mean	68.90	79.40	107.50	121.00	119.90
		Std. Dev.	7.26	7.30	4.89	4.61	7.52

UPPER TORSO INFORMATION

Head Position 3

			SC I	II	III	IV	V
Helmet Rear to Upper Back	Distance	Mean	11.45	11.41	13.74	13.88	13.47
		Std. Dev.	0.83	1.01	0.88	1.45	1.44
	Angle	Mean	102.70	113.60	113.70	126.60	126.70
		Std. Dev.	4.99	5.57	2.20	2.23	2.16

UPPER TORSO INFORMATION

Head Position 4

			SC I	II	III	IV	V
Helmet Rear to Upper Back	Distance	Mean	10.12	10.64	12.08	12.57	12.35
		Std. Dev.	0.99	1.15	1.30	1.61	1.52
	Angle	Mean	89.30	97.70	111.60	124.40	124.00
		Std. Dev.	6.93	8.53	2.30	2.61	5.74

UPPER TORSO INFORMATION
Head Position 5

			SC I	II	III	IV	V
Helmet Rear to Upper Back	Distance	Mean	9.78	10.21	11.63	12.12	12.00
		Std. Dev.	1.21	1.01	1.35	1.46	1.74
	Angle	Mean	89.20	100.00	111.50	124.80	124.40
		Std. Dev.	8.30	8.97	3.13	2.97	4.80

UPPER TORSO INFORMATION

Head Position 6

			SC I	II	III	IV	V
Helmet Rear to Upper Back	Distance	Mean	10.34	10.84	11.98	12.77	12.10
		Std. Dev.	1.14	1.31	1.64	1.65	1.79
	Angle	Mean	94.30	103.50	111.10	125.10	123.70
		Std. Dev.	8.18	8.64	2.50	2.90	3.04

APPENDIX A-2

Menton Data

HEAD POSITION 1
BACK REST ANGLE IS 13 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	11.574	91.4	4.442	-0.99	0.04	-4.33
2	10.992	95.6	4.805	-1.64	0.25	-4.51
3						
4						
5						
6	11.410	90.2	4.173	-1.85	-0.04	-3.74
7	11.288	93.2	3.851	-0.98	0.33	-3.71
8	11.937	88.0	4.075	-1.51	-0.20	-3.78
9	10.894	96.2	3.376	-0.70	0.12	-3.30
10	12.760	89.8	4.930	-1.80	0.0	-4.59
11	12.699	86.9	4.372	-1.76	0.13	-4.00
12	12.180	90.2	4.577	-1.87	-0.56	-4.14
13	12.193	88.8	5.275	-2.26	0.40	-4.75
14	11.962	86.5	4.184	-2.18	-0.08	-3.57
15	12.591	89.5	4.951	-1.89	0.57	-4.54
16	12.303	94.8	4.807	-2.04	-0.53	-4.32
17	11.644	87.2	4.910	-2.66	-0.24	-4.12
18	10.093	95.9	4.492	-1.60	0.25	-4.19
19	12.735	87.2	4.522	-2.05	-0.03	-4.03
20	11.564	88.5	4.350	-1.80	-0.04	-3.96
21	11.390	90.5	4.315	-1.33	0.78	-4.03
22	11.891	90.6	5.277	-2.96	0.28	-4.36
23	11.860	90.4	3.973	-1.84	0.08	-3.52
24	13.417	84.3	5.174	-2.80	0.52	-4.32
MEAN VL	11.875	90.3	4.516	-1.83	0.10	-4.09
STD DEV	0.76	3.30	0.49	0.57	0.33	0.38

HEAD POSITION 1
BACK REST ANGLE IS 27 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	12.447	96.8	3.229	-1.48	0.0	-2.87
2	12.753	98.0	4.385	-1.52	0.17	-4.11
3						
4						
5						
6	13.395	100.3	2.957	-0.62	-0.09	-2.89
7	11.278	98.3	3.202	-0.53	0.74	-3.07
8	12.761	98.5	3.409	-0.61	-0.17	-3.35
9	12.155	112.5	3.240	0.70	-0.29	-3.15
10	12.294	100.5	3.382	-0.28	0.04	-3.37
11	13.770	93.8	3.464	-1.22	0.12	-3.24
12	13.023	92.6	3.659	-1.60	-0.08	-3.29
13	12.885	95.3	5.006	-1.80	-0.08	-4.67
14	13.103	91.3	3.973	-1.88	0.0	-3.50
15	12.589	97.5	3.786	-0.53	0.37	-3.73
16	12.649	98.2	3.827	-2.05	-0.28	-3.22
17	13.238	92.0	4.569	-2.17	-0.09	-4.02
18	11.836	102.8	4.657	-1.11	0.54	-4.49
19	13.718	94.8	4.321	-1.84	0.0	-3.91
20	11.761	90.8	3.874	-1.80	0.0	-3.43
21	13.171	93.3	4.239	-1.14	0.82	-4.00
22	12.748	100.1	3.663	-1.39	0.25	-3.38
23	12.888	95.9	3.718	-1.04	0.42	-3.31
24	13.208	96.6	4.201	-1.56	0.05	-3.90
MEAN VL	12.746	97.1	3.846	-1.24	0.12	-3.57
STD DEV	0.63	4.80	0.54	0.71	0.31	0.49

HEAD POSITION 1
BACK REST ANGLE IS 51 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	14.385	112.4	2.347	-0.28	0.04	-2.33
2	15.415	114.2	3.635	-0.15	0.67	-3.57
3						
4						
5						
6	13.388	114.6	2.990	-0.54	0.08	-2.94
7	13.427	110.9	2.453	0.01	0.25	-2.44
8	13.463	110.8	2.161	-0.05	-0.21	-2.15
9	13.417	104.0	1.989	-0.68	0.84	-1.67
10	12.702	112.0	2.503	0.29	-0.17	-2.48
11	14.375	110.8	2.617	-0.37	-0.05	-2.59
12	11.195	110.0	1.465	-0.12	0.04	-1.46
13	15.089	115.1	4.202	-0.11	0.42	-4.18
14	13.058	110.6	2.918	-0.62	-0.25	-2.84
15	13.827	114.1	2.346	0.46	0.22	-2.29
16	13.033	112.5	3.019	-1.15	-0.08	-2.79
17	14.260	115.5	3.512	-0.12	-0.05	-3.51
18	11.342	112.0	3.497	-0.03	0.34	-3.48
19	12.943	111.3	3.397	0.16	-0.30	-3.38
20	13.153	111.8	3.262	0.12	0.0	-3.26
21	12.442	111.7	2.847	0.10	0.80	-2.73
22	12.728	112.0	2.624	-0.39	0.30	-2.45
23	13.046	112.3	2.433	-0.73	0.08	-2.32
24	13.138	112.7	3.167	-0.33	0.0	-3.15
MEAN VL	13.327	112.0	2.828	-0.24	0.14	-2.76
STD DEV	1.03	2.39	0.64	0.41	0.33	0.66

HEAD POSITION 1
BACK REST ANGLE IS 65 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	13.279	122.2	2.036	0.34	0.26	-1.99
2	13.163	121.4	2.861	0.08	0.0	-2.86
3						
4						
5						
6	9.949	124.4	2.259	-0.18	-0.43	-2.21
7	14.542	123.3	1.577	0.78	0.04	-1.37
8	12.328	121.3	1.223	0.45	-0.13	-1.13
9	13.091	121.3	2.042	-0.78	-0.17	-1.88
10	12.704	124.6	1.553	0.65	-0.04	-1.41
11	14.564	127.1	2.422	0.08	-0.05	-2.42
12	14.561	124.1	2.354	0.34	0.30	-2.31
13	14.867	123.2	3.729	1.21	0.51	-3.49
14	11.382	121.9	2.612	0.24	-0.08	-2.60
15	15.207	124.8	2.271	0.75	0.13	-2.14
16	14.046	124.3	2.296	-0.30	-0.17	-2.27
17	14.375	125.3	2.859	0.33	0.0	-2.84
18	10.376	125.7	3.251	0.37	-0.04	-3.23
19	13.708	125.9	3.176	0.58	0.12	-3.12
20	9.921	125.1	2.537	0.38	0.30	-2.49
21	9.601	125.5	2.125	0.75	0.39	-1.95
22	10.907	124.8	1.929	-0.53	0.13	-1.85
23	10.968	124.7	2.196	-0.72	0.38	-2.04
24	11.726	127.2	2.189	0.41	0.0	-2.15
MEAN VL	12.632	124.2	2.357	0.25	0.07	-2.27
STD DEV	1.83	1.77	0.59	0.51	0.23	0.61

HEAD POSITION 1
BACK REST ANGLE IS 65 SEAT PAN ANGLE IS 20

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	11.982	123.8	2.047	0.22	0.51	-1.97
2	12.420	123.8	3.641	0.30	0.25	-3.62
3						
4						
5						
6	10.707	125.2	2.315	-0.08	-0.12	-2.31
7	10.338	126.5	1.062	0.47	0.34	-0.89
8	12.586	125.4	1.531	0.62	0.0	-1.40
9	13.094	123.1	1.502	-0.46	-0.17	-1.42
10	12.353	128.0	1.951	0.02	0.0	-1.85
11	12.184	123.2	2.429	0.61	-0.08	-2.35
12	13.769	123.1	2.170	0.06	0.68	-2.06
13						
14	13.640	123.8	2.671	0.33	0.05	-2.65
15	14.297	122.1	1.360	0.57	0.0	-1.77
16	14.306	123.6	2.695	-0.16	0.0	-2.69
17	14.654	125.8	3.261	0.37	0.0	-3.24
18	12.758	126.8	3.366	0.46	0.17	-3.33
19	13.685	127.5	2.941	0.90	0.0	-2.80
20	10.885	129.0	2.033	0.54	0.0	-1.96
21	8.386	126.5	2.418	0.19	0.72	-2.30
22	11.322	124.2	2.140	-0.41	0.05	-2.10
23	10.728	124.1	2.105	-0.44	0.34	-2.03
24	11.134	126.9	2.556	0.16	-0.08	-2.55
MEAN VL	12.261	125.1	2.335	0.24	0.13	-2.26
STD DEV	1.61	1.93	0.65	0.39	0.26	0.68

HEAD POSITION 2
BACK REST ANGLE IS 13 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	13.365	58.9	0.851	-0.78	0.01	-0.34
2	12.013	68.4	2.164	-1.48	0.16	-1.57
3						
4						
5						
6	13.546	63.8	0.664	-0.13	-0.12	-0.64
7	11.786	75.1	1.920	-0.70	0.45	-1.73
8	11.840	71.2	1.946	-0.78	0.21	-1.77
9	11.685	75.8	0.781	-0.04	0.0	-0.78
10	12.623	75.1	2.761	-0.74	0.0	-2.66
11	12.060	72.6	2.638	-1.44	0.21	-2.20
12	13.489	61.2	1.034	-0.77	-0.20	-0.66
13	13.097	77.0	3.503	-1.47	0.0	-3.18
14	11.641	70.9	2.444	-1.64	-0.08	-1.81
15	10.802	64.4	1.917	-0.66	0.53	-1.72
16	11.730	69.1	1.653	-1.52	-0.16	-0.63
17	15.623	62.5	2.008	-1.59	-0.52	-1.11
18						
19	13.601	73.3	2.276	-1.18	-0.25	-1.93
20	13.560	53.4	0.376	-0.16	0.0	-0.34
21			1.327	-0.78	-0.08	-1.07
22	12.367	61.0	0.144	-0.08	0.0	-0.12
23	11.199	80.3	2.288	-1.40	0.0	-1.81
24	13.080	74.8	2.949	-1.40	0.17	-2.59
MEAN VL	12.585	68.9	1.782	-0.94	0.02	-1.43
STD DEV	1.14	7.26	0.91	0.55	0.23	0.86

HEAD POSITION 2
BACK REST ANGLE IS 27 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	12.691	71.0	0.369	-0.08	0.0	-0.36
2	11.911	75.5	2.163	-1.43	0.41	-1.57
3						
4						
5						
6	14.657	83.1	0.845	-0.08	-0.04	-0.84
7	10.963	83.4	1.579	-0.36	0.54	-1.44
8	11.763	80.8	1.036	-0.37	-0.12	-0.96
9			2.448	0.55	0.0	-2.36
10	11.443	84.5	1.197	0.04	0.12	-1.19
11	12.381	84.3	2.391	-1.43	0.46	-1.86
12	14.273	64.4	0.766	-0.70	0.0	-0.31
13	12.622	84.8	2.876	-0.99	-0.04	-2.70
14	12.339	83.5	2.418	-1.40	-0.08	-1.97
15	12.467	77.7	1.304	-0.09	0.04	-1.30
16	11.893	78.9	1.753	-1.50	0.0	-0.80
17	16.539	64.9	1.772	-1.64	-0.05	-0.67
18	10.372	94.5	2.433	-0.82	0.04	-2.29
19	12.434	80.7	1.716	-0.90	-0.04	-1.46
20	12.343	71.0	0.796	-0.20	0.0	-0.77
21	12.534	77.1	1.871	-0.82	0.45	-1.62
22	11.893	79.1	0.781	-0.66	0.21	-0.36
23	12.359	82.4	1.357	-0.61	0.08	-1.21
24	12.829	86.2	2.528	-0.90	0.24	-2.35
MEAN VL	12.535	79.4	1.638	-0.58	0.11	-1.35
STD DEV	1.34	7.30	0.72	0.61	0.20	0.71

HEAD POSITION 2
BACK REST ANGLE IS 51 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	12.463	109.1	1.180	-0.03	0.34	-1.13
2	10.587	108.7	1.798	-0.24	0.09	-1.78
3						
4						
5						
6	13.803	108.2	1.846	-0.58	-0.09	-1.75
7	13.890	110.4	1.709	0.25	0.04	-1.69
8	12.766	108.7	1.497	0.53	-0.17	-1.39
9	11.897	103.7	1.400	0.0	0.0	-1.40
10	12.392	110.1	1.295	0.33	0.08	-1.25
11	14.481	104.8	1.757	-0.45	-0.17	-1.69
12	10.111	99.2	1.188	-0.24	0.38	-1.10
13	14.093	112.4	2.889	0.37	-0.17	-2.86
14	13.035	108.8	2.155	-0.21	-0.25	-2.13
15	13.555	113.0	1.604	0.45	0.17	-1.53
16	13.514	100.4	1.613	-1.15	0.05	-1.13
17	14.822	112.5	2.350	0.0	0.0	-2.35
18	8.619	110.4	2.303	-0.12	0.0	-2.30
19	11.512	111.0	2.303	0.49	0.0	-2.25
20	9.472	111.6	1.521	0.04	0.0	-1.52
21	12.322	98.1	1.978	-0.98	0.17	-1.71
22	12.584	98.4	0.939	-0.20	0.12	-0.91
23	12.907	106.4	1.511	-0.45	0.08	-1.44
24	11.695	112.7	1.886	0.36	-0.08	-1.85
MEAN VL	12.406	107.5	1.749	-0.09	0.03	-1.67
STD DEV	1.64	4.89	0.47	0.46	0.16	0.49

HEAD POSITION 2
BACK REST ANGLE IS 65 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	11.901	121.6	0.920	0.54	0.08	-0.74
2	11.948	114.5	1.817	-0.49	0.0	-1.75
3						
4						
5						
6	11.456	118.0	1.363	0.0	-0.09	-1.36
7	14.857	125.1	1.612	0.78	0.04	-1.41
8	12.714	122.4	1.178	0.60	-0.26	-0.98
9	13.060	121.1	1.314	-0.14	-0.56	-1.18
10	13.214	123.0	1.479	0.62	0.08	-1.34
11	14.969	111.9	1.299	-0.57	-0.13	-1.16
12	13.547	122.3	1.200	0.37	0.22	-1.12
13	12.264	121.0	2.688	1.03	0.25	-2.47
14	10.827	121.5	1.887	0.45	-0.21	-1.82
15	14.106	124.0	1.440	0.41	0.04	-1.38
16	14.337	112.6	1.085	-0.36	0.09	-1.02
17	14.471	122.8	1.928	0.33	0.0	-1.90
18	9.209	126.2	2.254	0.25	-0.05	-2.24
19	14.324	119.7	1.965	0.36	-0.21	-1.92
20	9.787	124.8	1.543	0.58	0.0	-1.43
21			1.540	-0.74	0.04	-1.35
22	12.440	113.6	1.117	-0.53	0.21	-0.96
23	10.415	125.6	1.451	-0.15	0.39	-1.39
24	10.613	127.5	1.578	0.56	-0.13	-1.47
MEAN VL	12.523	121.0	1.555	0.19	-0.01	-1.45
STD DEV	1.74	4.61	0.42	0.50	0.21	0.43

HEAD POSITION 2
BACK REST ANGLE IS 65 SEAT PAN ANGLE IS 20

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	11.445	115.7	1.210	-0.16	0.34	-1.15
2	11.667	104.6	1.566	-0.70	-0.17	-1.39
3						
4						
5						
6	10.817	118.8	1.706	-0.26	-0.39	-1.64
7	8.129	123.6	1.324	0.75	0.26	-1.06
8	12.153	126.3	1.335	0.89	-0.17	-0.98
9	12.600	124.9	1.286	-0.12	-0.94	-0.87
10	14.248	125.4	1.421	0.82	0.0	-1.16
11	14.521	107.2	1.263	-0.85	0.09	-0.93
12	14.103	123.4	2.099	0.81	0.85	-1.74
13	11.483	120.3	2.489	1.28	0.25	-2.12
14	11.828	121.3	1.991	0.49	0.0	-1.93
15	15.225	122.9	1.396	0.81	-0.13	-1.13
16	13.800	115.3	1.356	-0.57	0.0	-1.23
17	15.009	124.5	2.226	0.45	0.0	-2.18
18	12.144	126.8	2.073	0.49	0.13	-2.01
19	13.304	127.0	2.176	0.73	-0.04	-2.05
20	11.052	127.9	1.060	0.49	0.0	-0.94
21	12.654	104.5	1.611	-0.85	0.51	-1.27
22	11.553	112.3	1.042	-0.37	0.09	-0.97
23						
24	10.801	125.2	1.571	0.69	-0.05	-1.41
MEAN VL	12.427	119.9	1.610	0.24	0.03	-1.41
STD DEV	1.73	7.52	0.42	0.66	0.35	0.45

HEAD POSITION 3
BACK REST ANGLE IS 13 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	12.214	102.4	7.121	-1.72	0.04	-6.91
2	10.959	109.2	9.303	-1.03	0.69	-9.22
3						
4						
5						
6	12.486	99.1	6.295	-1.80	0.16	-6.03
7	11.370	106.3	7.124	-1.27	0.04	-7.01
8	11.573	100.2	5.921	-1.14	0.01	-5.81
9	12.109	100.9	6.107	-1.64	0.17	-5.88
10	13.187	92.9	7.226	-2.63	0.37	-6.72
11	11.998	95.1	6.598	-2.01	-0.23	-6.28
12	11.598	104.5	7.323	-0.77	-0.20	-7.28
13	11.252	104.8	6.643	-1.32	0.81	-6.46
14	10.872	99.6	6.426	-2.10	0.20	-6.07
15	12.361	101.3	7.499	-1.65	0.61	-7.29
16	11.213	102.7	6.910	-2.14	-0.04	-6.57
17	10.577	96.5	6.747	-2.95	-0.32	-6.06
18	10.906	101.2	7.666	-1.81	0.37	-7.44
19	11.799	100.8	7.226	-2.50	-0.04	-6.78
20	10.074	111.2	7.070	-0.09	0.53	-7.05
21	10.226	110.8	7.957	-1.45	1.14	-7.74
22	10.847	108.6	7.650	-1.94	-0.01	-7.40
23	10.406	100.9	7.010	-2.79	0.09	-6.43
24	12.384	107.8	7.117	-1.36	0.29	-6.98
MEAN VL	11.450	102.7	7.092	-1.72	0.22	-6.83
STD DEV	0.83	4.99	0.73	0.69	0.37	0.78

HEAD POSITION 3
BACK REST ANGLE IS 27 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	12.180	113.3	7.294	-0.21	0.13	-7.29
2	13.221	111.1	8.840	-0.65	0.99	-8.76
3						
4						
5						
6	10.579	111.4	6.289	-1.11	0.0	-6.19
7	11.220	119.8	6.935	0.20	0.17	-6.93
8	12.507	109.8	5.221	-0.20	0.42	-5.20
9	11.507	115.0	6.639	0.01	0.50	-6.62
10	12.418	108.2	5.877	-0.95	0.34	-5.79
11	12.953	108.3	6.554	-0.90	0.17	-6.49
12	10.912	118.2	7.128	0.33	0.0	-7.12
13	10.637	118.6	6.978	-0.32	0.08	-6.97
14	12.208	99.5	6.294	-2.67	-0.04	-5.70
15	11.718	113.3	7.546	0.0	0.29	-7.54
16	10.794	113.5	6.550	-1.56	-0.12	-6.36
17	11.445	109.2	6.710	-1.15	-0.07	-6.61
18	9.857	114.1	5.415	-0.69	0.66	-5.33
19	10.725	113.2	7.028	-0.90	-0.04	-6.97
20	9.055	122.2	7.194	0.78	0.13	-7.15
21	12.194	111.1	7.299	-0.78	0.91	-7.20
22	10.858	121.5	7.235	-0.16	0.20	-7.23
23	11.486	112.5	6.780	-1.19	0.45	-6.66
24	11.083	123.1	7.322	0.41	0.04	-7.31
MEAN VL	11.409	113.6	6.815	-0.56	0.25	-6.73
STD DEV	1.01	5.57	0.77	0.78	0.31	0.81

HEAD POSITION 3
BACK REST ANGLE IS 51 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	14.232	115.6	5.910	-0.81	0.21	-5.85
2	15.331	114.6	7.949	0.10	0.67	-7.92
3						
4						
5						
6	13.800	114.7	4.721	-0.86	0.13	-4.64
7	11.962	111.0	5.992	-2.80	0.71	-5.25
8	13.596	114.4	4.165	-0.45	0.04	-4.14
9	14.272	107.1	5.559	-1.30	0.22	-5.40
10	12.829	113.0	4.179	-0.82	0.25	-4.09
11	14.735	114.2	6.184	-0.67	-0.84	-6.09
12	13.998	111.5	5.219	-0.86	0.42	-5.13
13	13.307	111.7	6.794	0.17	0.17	-6.79
14	14.380	112.1	4.906	-1.16	-0.25	-4.76
15	14.175	114.8	5.937	-0.53	0.21	-5.91
16	12.708	112.4	5.206	-1.40	-0.21	-5.01
17	13.305	115.0	5.116	-0.82	0.0	-5.05
18	12.770	113.7	6.275	-0.53	0.17	-6.25
19	13.658	116.5	7.205	-0.34	-0.50	-7.18
20	13.377	116.0	6.490	-0.04	0.0	-6.49
21	14.918	115.4	7.175	0.05	0.46	-7.16
22	14.357	114.0	6.090	-1.31	0.30	-5.94
23	12.397	113.1	5.247	-1.68	0.33	-4.96
24	14.459	116.3	5.972	-1.02	0.21	-5.88
MEAN VL	13.741	113.7	5.823	-0.81	0.13	-5.71
STD DEV	0.88	2.20	0.98	0.68	0.36	1.02

HEAD POSITION 3
BACK REST ANGLE IS 65 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	15.679	130.7	6.559	1.07	0.12	-6.47
2	15.505	125.7	6.843	0.71	0.59	-6.78
3						
4						
5						
6	14.473	124.9	4.245	0.0	-0.21	-4.24
7	13.880	127.0	4.373	0.09	0.13	-4.37
8	13.051	125.2	3.250	0.0	0.04	-3.25
9	13.234	125.5	3.827	-0.36	0.04	-3.81
10	13.954	124.1	3.193	0.13	0.04	-3.19
11	13.445	128.7	5.567	0.63	-0.59	-5.50
12	13.562	127.1	6.009	0.40	-0.25	-5.99
13	16.075	126.3	6.464	1.52	0.17	-6.28
14	15.579	126.3	4.791	0.24	-0.21	-4.78
15	15.181	129.8	6.599	1.93	0.04	-6.31
16	14.085	124.3	4.811	-0.79	-0.38	-4.73
17	13.886	124.5	5.149	-0.01	-0.30	-5.14
18	12.855	129.6	7.060	1.89	0.16	-6.80
19	12.215	125.0	6.816	0.76	-0.85	-6.72
20	10.840	124.6	5.450	0.04	0.0	-5.45
21	15.700	131.0	7.152	2.08	1.06	-6.76
22	13.758	125.5	5.182	-0.47	0.72	-5.11
23	11.009	124.3	4.265	-1.22	0.47	-4.06
24	13.075	128.4	5.241	0.08	0.0	-5.24
MEAN VL	13.878	126.6	5.373	0.42	0.04	-5.28
STD DEV	1.45	2.23	1.24	0.88	0.43	1.17

HEAD POSITION 3
BACK REST ANGLE IS 65 SEAT PAN ANGLE IS 20

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	15.116	128.7	6.132	0.87	0.60	-6.04
2	14.265	124.3	7.589	1.87	0.81	-7.31
3						
4						
5						
6	11.151	126.1	3.999	0.24	-0.12	-3.99
7	11.991	126.0	5.117	0.75	0.47	-5.04
8	12.428	126.7	4.590	0.32	-0.51	-4.55
9	13.408	125.8	4.084	-0.95	-1.28	-3.76
10	13.596	126.0	3.690	0.04	-0.04	-3.69
11	13.080	123.7	6.172	1.45	-0.48	-5.98
12	13.635	124.0	4.647	-0.27	0.60	-4.60
13	16.449	128.0	6.404	1.56	0.13	-6.21
14			4.515	0.33	0.17	-4.50
15	14.951	127.6	5.860	0.73	-0.22	-5.81
16	14.251	123.2	4.853	-0.46	-0.12	-4.83
17	14.193	124.3	3.930	0.04	-0.04	-3.93
18	13.929	129.0	6.303	1.23	0.13	-6.18
19	14.329	129.2	6.738	0.81	-0.34	-6.68
20	12.024	127.0	6.195	0.83	0.34	-6.13
21	13.883	130.8	7.652	2.40	0.72	-7.23
22	13.298	127.1	5.064	-0.61	0.26	-5.02
23	10.053	125.9	4.872	-0.87	0.89	-4.71
24	13.295	130.0	5.470	-0.04	0.0	-5.47
MEAN VL	13.466	126.7	5.423	0.49	0.09	-5.32
STD DEV	1.44	2.16	1.16	0.90	0.51	1.10

HEAD POSITION 4
BACK REST ANGLE IS 13 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	11.073	77.5	5.144	0.45	3.77	-3.47
2	9.140	92.7	7.122	1.92	5.52	-4.07
3						
4						
5						
6	11.860	87.6	4.932	-0.49	3.53	-3.41
7	9.455	91.8	5.560	0.56	4.20	-3.60
8	10.657	84.1	5.234	0.09	3.41	-3.97
9	10.200	89.8	4.570	0.27	3.30	-3.15
10	10.233	82.7	5.772	0.12	4.15	-4.01
11	10.967	84.7	5.490	0.04	4.11	-3.64
12	10.729	84.5	5.312	0.24	4.67	-2.52
13	10.410	90.3	5.981	-0.03	3.87	-4.56
14	9.753	91.5	4.985	0.34	3.92	-3.06
15	9.760	90.1	6.003	1.13	4.70	-3.56
16	10.261	89.1	5.342	-0.08	4.12	-3.40
17			5.095	-1.86	3.59	-3.10
18	7.811	100.9	6.559	1.97	5.34	-3.26
19	11.463	85.6	5.765	-0.45	4.44	-3.65
20	8.344	109.6	6.409	2.95	4.18	-3.86
21	10.131	90.7	6.403	0.66	4.89	-4.08
22	9.440	93.8	5.868	0.96	4.70	-3.38
23	9.741	85.4	4.895	-0.03	3.78	-3.11
24	10.958	83.6	5.627	-0.82	4.15	-3.71
MEAN VL	10.119	89.3	5.622	0.38	4.21	-3.55
STD DEV	0.99	6.93	0.64	1.03	0.60	0.45

HEAD POSITION 4
BACK REST ANGLE IS 27 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	11.920	90.4	4.287	0.38	3.38	-2.61
2	10.363	101.4	6.858	3.02	5.23	-3.25
3						
4						
5						
6	11.967	99.3	4.663	0.76	3.47	-3.02
7	9.767	106.6	5.336	1.90	4.36	-2.42
8	11.831	95.8	4.900	0.67	3.30	-3.56
9	9.753	107.7	5.237	1.68	3.98	-2.96
10	11.084	99.9	4.597	1.05	3.40	-2.91
11	11.473	91.3	5.229	0.64	4.17	-3.09
12	10.910	90.1	5.491	1.58	4.38	-2.91
13	11.166	93.9	5.870	-0.18	3.80	-4.47
14	10.778	98.5	4.905	0.56	3.84	-3.00
15	9.953	97.4	5.453	1.89	4.35	-2.69
16	10.520	94.3	4.661	0.10	3.88	-2.58
17	12.002	81.8	5.335	-0.45	4.34	-3.07
18	9.617	104.3	6.405	2.07	5.35	-2.85
19	11.456	95.1	6.271	0.77	4.99	-3.72
20	6.953	123.3	6.404	3.39	4.51	-3.03
21	10.942	91.2	6.045	1.34	4.54	-3.76
22	9.764	102.8	5.608	1.19	4.39	-3.28
23	10.457	92.1	5.094	1.09	4.00	-2.96
24	10.797	94.1	4.839	-0.03	3.13	-3.69
MEAN VL	10.642	97.7	5.404	1.12	4.13	-3.13
STD DEV	1.15	8.53	0.69	0.99	0.61	0.48

HEAD POSITION 4
BACK REST ANGLE IS 51 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	12.772	110.5	4.129	1.81	3.08	-2.07
2	14.242	112.6	6.660	3.02	5.11	-3.02
3						
4						
5						
6	13.259	113.3	4.492	1.29	3.71	-2.18
7	10.815	109.7	4.735	1.48	3.94	-2.17
8	12.067	109.7	4.314	1.44	3.29	-2.39
9	11.947	107.1	3.896	0.48	3.35	-1.93
10	12.190	110.2	4.108	1.55	3.60	-1.23
11	12.298	109.7	4.431	1.20	3.54	-2.38
12	9.449	110.0	3.971	1.86	3.29	-1.22
13	13.996	111.9	5.497	1.87	3.84	-3.46
14	14.273	112.9	4.219	1.08	3.67	-1.78
15	12.702	114.8	4.677	2.24	3.64	-1.90
16	11.647	113.6	4.244	1.09	3.96	-1.07
17	12.302	106.9	4.601	0.83	3.83	-2.41
18	10.137	113.3	6.196	1.99	5.27	-2.58
19	12.202	114.7	6.117	2.36	4.05	-3.93
20	12.071	112.4	5.740	2.85	4.65	-1.79
21	11.764	114.6	5.587	2.62	4.26	-2.49
22	10.902	112.0	4.578	1.67	3.85	-1.83
23	10.522	112.2	4.694	1.05	4.08	-2.07
24						
MEAN VL	12.078	111.6	4.844	1.69	3.90	-2.19
STD DEV	1.30	2.30	0.82	0.68	0.57	0.71

HEAD POSITION 4
BACK REST ANGLE IS 65 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	13.768	124.0	3.762	1.52	3.29	-1.01
2	14.856	122.7	5.633	3.27	4.26	-1.70
3						
4						
5						
6	14.789	123.0	3.945	1.71	3.03	-1.86
7	12.555	129.1	4.601	2.37	3.60	-1.61
8	12.151	123.5	4.212	1.75	3.23	-2.06
9	12.019	126.0	3.860	1.09	3.31	-1.66
10	12.086	124.8	4.049	1.78	3.43	-1.21
11	13.042	115.9	3.672	1.21	3.23	-1.26
12	12.446	124.4	4.747	2.31	3.76	-1.75
13	15.808	125.1	5.704	2.83	4.31	-2.44
14	14.846	122.8	3.877	1.60	3.28	-1.31
15	12.476	124.2	4.109	2.37	2.90	-1.69
16	13.508	122.0	4.473	1.46	3.84	-1.77
17	12.139	126.3	4.916	2.38	3.66	-2.26
18	10.292	126.3	5.863	2.72	4.70	-2.21
19	12.335	126.2	6.372	3.13	4.78	-2.82
20	9.861	126.2	5.765	3.54	4.41	-1.12
21	11.582	127.2	5.438	2.98	4.09	-1.99
22	10.464	123.5	3.979	1.73	3.41	-1.10
23	10.468	124.6	3.675	1.26	3.16	-1.39
24	12.465	125.6	3.974	1.74	2.70	-2.34
MEAN VL	12.571	124.4	4.001	2.13	3.64	-1.74
STD DEV	1.61	2.61	0.85	0.73	0.59	0.49

HEAD POSITION 4
BACK REST ANGLE IS 65 SEAT PAN ANGLE IS 20

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	12.657	122.7	3.886	1.78	3.42	-0.49
2	14.824	123.4	6.515	3.68	4.84	-2.34
3						
4						
5						
6	11.071	120.4	4.266	2.06	3.38	-1.59
7	10.909	121.8	4.791	2.80	3.71	-1.16
8	11.042	126.9	3.331	1.65	2.56	-1.35
9	11.788	125.5	3.928	0.67	3.76	-0.92
10	12.662	127.2	4.113	2.19	3.30	-1.11
11	11.918	101.7	3.373	0.87	3.06	-1.12
12	12.664	123.2	4.228	2.19	3.39	-1.26
13	15.758	126.1	5.870	3.11	4.11	-2.81
14	14.691	122.6	4.204	1.70	3.51	-1.57
15	11.871	124.2	4.070	2.45	2.70	-1.81
16	12.258	125.7	3.880	1.02	3.32	-1.73
17	13.001	128.0	4.561	1.97	3.41	-2.30
18	11.499	125.5	5.856	2.82	4.92	-1.46
19	14.020	127.8	5.588	2.60	3.72	-3.26
20	11.380	128.8	4.825	2.54	4.06	-0.59
21	12.058	127.3	5.265	2.90	4.06	-1.68
22						
23	9.499	123.6	3.432	1.66	2.81	-1.06
24	11.345	127.6	3.694	1.62	2.53	-2.15
MEAN VL	12.348	124.0	4.484	2.11	3.53	-1.59
STD DEV	1.52	5.74	0.91	0.77	0.66	0.71

HEAD POSITION 5
BACK REST ANGLE IS 13 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	HELMET REAR TO UPPER BACK ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	11.554	74.8	3.430	0.20	3.16	-1.32
2	8.425	91.9	5.255	1.34	4.70	-1.93
3						
4						
5						
6	11.729	86.8	4.209	0.18	3.62	-2.14
7	9.033	94.1	3.916	1.27	3.35	-1.58
8	11.017	77.8	3.594	-0.18	2.73	-2.33
9	9.315	88.2	4.227	1.04	3.63	-1.90
10	10.180	86.5	4.503	0.66	3.74	-2.42
11	10.581	81.0	3.884	0.66	3.50	-1.55
12	10.098	83.3	3.505	1.12	3.27	-0.58
13	10.760	89.9	4.131	-0.27	2.93	-2.90
14	9.801	90.6	4.314	0.56	3.71	-2.13
15	9.144	95.6	4.607	1.84	3.72	-2.00
16	10.312	88.9	3.387	-0.02	3.22	-1.05
17	10.795	87.0	4.459	-1.03	3.56	-2.48
18	8.140	100.3	5.606	1.76	4.92	-2.03
19	9.796	86.7	3.915	0.35	3.22	-2.20
20	7.395	112.3	5.890	2.84	4.48	-2.56
21	10.134	88.3	4.434	0.92	4.04	-1.58
22	7.594	99.5	4.662	2.05	4.15	-0.56
23	8.872	88.8	4.280	0.75	3.96	-1.44
24	10.623	80.6	3.909	-0.03	3.37	-1.98
MEAN VL	9.776	89.2	4.291	0.76	3.67	-1.84
STD DEV	1.21	8.30	0.66	0.90	0.56	0.61

HEAD POSITION 5
BACK REST ANGLE IS 27 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	11.103	95.1	3.441	0.93	3.10	-1.17
2	10.376	107.6	5.227	2.19	4.57	-1.28
3						
4						
5						
6	11.755	96.0	3.382	0.43	2.98	-1.54
7	9.345	106.3	3.986	1.81	3.49	-0.66
8	11.590	90.0	3.456	0.30	2.72	-2.11
9	9.764	106.5	4.695	2.01	4.07	-1.20
10	10.997	100.6	4.684	1.64	3.94	-1.93
11	11.102	91.1	4.155	0.84	3.72	-1.65
12	9.888	96.2	4.979	2.04	4.17	-1.80
13	10.478	96.5	4.391	0.52	3.22	-2.94
14	10.232	97.7	4.316	0.89	3.73	-1.98
15	9.943	103.2	4.366	2.09	3.61	-1.29
16	10.076	96.0	3.111	0.38	2.81	-1.28
17	11.038	85.2	4.469	0.13	4.19	-1.55
18	8.238	113.2	6.071	2.61	5.16	-1.85
19	11.269	103.2	4.727	1.59	3.93	-2.09
20	8.440	121.6	6.198	3.19	4.25	-3.19
21	10.231	89.4	4.845	0.88	4.08	-2.46
22	8.623	113.3	4.866	2.61	4.04	-0.74
23	9.186	97.4	4.616	1.38	4.18	-1.39
24	10.817	94.7	4.223	0.39	3.19	-2.74
MEAN VL	10.214	100.0	4.486	1.37	3.77	-1.75
STD DEV	1.01	8.97	0.79	0.89	0.61	0.67

HEAD POSITION 5
BACK REST ANGLE IS 51 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	12.803	112.6	3.723	1.51	3.21	-1.13
2	12.736	110.0	4.701	2.37	3.97	-0.85
3						
4						
5						
6	11.575	109.1	3.347	1.31	2.91	-1.01
7	9.582	110.6	3.424	1.32	3.13	-0.43
8	11.632	112.3	3.464	1.54	2.70	-1.53
9	11.564	105.2	3.355	0.69	3.23	-0.59
10	12.429	110.4	3.556	1.44	3.09	-1.01
11	11.982	108.1	4.074	1.16	3.84	-0.71
12	8.708	111.0	3.928	1.80	3.46	-0.03
13	14.473	113.0	3.956	1.81	3.20	-1.46
14	13.587	111.0	3.658	1.19	3.28	-1.10
15	12.658	114.8	4.131	2.47	3.13	-1.08
16	11.162	112.9	3.447	1.03	3.29	-0.01
17	12.210	103.4	3.844	1.08	3.66	-0.46
18	10.144	114.0	4.798	1.43	4.46	-1.04
19	12.353	116.0	3.722	1.61	3.20	-1.01
20	10.643	113.8	4.573	2.12	3.97	-0.81
21	11.650	112.7	4.536	2.16	3.72	-1.44
22	10.458	114.6	4.213	1.71	3.85	-0.07
23	10.230	111.9	4.338	1.83	3.84	-0.85
24	11.736	114.2	3.422	1.23	2.84	-1.46
MEAN VL	11.634	111.5	3.915	1.57	3.43	-0.86
STD DEV	1.35	3.13	0.47	0.46	0.45	0.46

HEAD POSITION 5
BACK REST ANGLE IS 65 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	HELMET REAR TO UPPER BACK ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	13.327	121.3	3.942	2.20	3.27	0.07
2	13.854	120.9	4.836	2.48	4.12	-0.51
3						
4						
5						
6	11.364	122.2	3.324	1.38	3.02	-0.16
7	13.131	133.1	4.195	2.11	3.60	-0.43
8	11.305	123.7	3.126	1.60	2.59	-0.71
9	11.094	125.0	3.638	1.47	3.28	-0.56
10	11.910	127.8	4.486	1.77	4.10	-0.43
11	12.364	119.9	3.717	1.51	3.36	-0.50
12	12.450	123.6	4.431	1.96	3.89	-0.81
13	15.171	125.6	4.313	2.36	3.49	-0.87
14	14.803	124.4	4.100	2.05	3.46	-0.80
15	11.483	126.0	3.603	2.44	2.57	-0.65
16	14.168	122.3	3.734	1.40	3.46	-0.09
17	11.809	124.7	4.174	2.63	3.24	-0.07
18	10.508	122.7	4.963	2.46	4.31	0.02
19	11.863	128.2	5.070	3.05	3.88	-1.16
20	10.352	127.3	4.627	2.57	3.81	-0.54
21	11.154	127.2	4.020	2.28	3.15	-1.02
22	10.132	125.2	4.178	2.10	3.58	0.48
23	10.604	124.4	3.616	1.76	3.11	-0.55
24	11.632	125.4	3.642	1.79	2.86	-1.37
MEAN VL	12.118	124.8	4.083	2.07	3.44	-0.51
STD DEV	1.46	2.97	0.53	0.46	0.48	0.44

HEAD POSITION 5
BACK REST ANGLE IS 65 SEAT PAN ANGLE IS 20

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	12.619	121.3	3.517	1.99	2.90	0.05
2	13.917	123.7	4.753	2.53	4.00	-0.44
3						
4						
5						
6	10.992	122.9	3.767	1.92	3.16	-0.72
7	9.592	126.6	3.536	2.17	2.79	0.11
8	11.132	127.3	2.951	1.57	2.39	-0.73
9	12.102	125.1	3.652	1.40	3.37	-0.15
10	11.969	125.6	3.859	1.82	3.30	-0.83
11	12.970	105.0	3.414	0.97	3.27	-0.15
12	12.850	124.3	4.855	1.74	4.53	-0.15
13	15.311	125.7	4.252	2.43	3.33	-1.04
14	15.230	124.8	4.365	1.95	3.89	-0.35
15	11.770	125.4	3.766	2.54	2.78	-0.03
16	12.129	126.2	2.446	0.65	2.30	-0.52
17	12.568	122.9	3.905	1.56	3.58	-0.01
18	10.935	127.5	4.739	1.85	4.36	0.17
19	14.059	128.9	4.598	2.56	3.71	-0.91
20	11.651	127.6	4.292	1.79	3.89	-0.29
21	11.412	126.7	4.560	2.76	3.58	-0.60
22	8.779	125.4	4.092	1.79	3.68	0.01
23	9.288	123.7	3.717	1.60	3.29	-0.66
24	10.744	125.4	3.281	1.57	2.69	-1.03
MEAN VL	12.001	124.4	3.920	1.86	3.37	-0.39
STD DEV	1.74	4.80	0.63	0.52	0.60	0.39

HEAD POSITION 6
BACK REST ANGLE IS 13 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	11.161	84.5	6.601	0.01	2.96	-5.90
2	11.371	99.4	8.337	2.13	4.67	-6.57
3						
4						
5						
6	11.889	85.4	5.738	-0.34	3.74	-4.34
7	10.349	96.6	6.977	0.60	3.80	-5.82
8	11.562	87.4	5.866	-0.24	3.42	-4.76
9	9.473	91.5	6.103	0.30	3.87	-4.71
10	10.098	80.9	6.465	-0.29	3.69	-5.30
11	11.650	90.4	6.820	-0.04	4.06	-5.48
12	10.590	85.9	7.208	-0.99	3.61	-6.16
13	9.752	106.5	7.342	0.19	2.81	-6.78
14	9.830	90.2	5.834	-0.07	3.92	-4.32
15	10.854	97.9	7.222	1.13	3.23	-6.36
16	9.830	92.6	6.706	-0.32	3.66	-5.61
17	9.887	97.6	7.130	-0.43	2.51	-6.66
18	8.612	101.8	6.966	1.92	4.71	-4.76
19	12.453	99.2	7.834	-0.15	4.40	-6.48
20	8.489	109.5	7.929	3.08	3.75	-6.27
21	9.436	108.3	8.222	2.33	2.75	-7.39
22	9.655	98.0	7.608	0.92	3.76	-6.55
23	8.680	84.5	6.142	0.21	4.40	-4.28
24	11.515	87.1	6.901	-1.07	3.74	-5.70
MEAN VL	10.344	94.3	6.950	0.42	3.69	-5.72
STD DEV	1.14	8.18	0.77	1.11	0.60	0.92

HEAD POSITION 6
BACK REST ANGLE IS 27 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	11.493	100.5	5.700	0.91	1.65	-5.38
2	12.288	105.3	8.151	3.59	4.50	-5.77
3						
4						
5						
6	11.369	98.3	5.736	1.05	3.10	-4.71
7	11.303	117.7	6.708	2.15	3.75	-5.13
8	11.561	98.3	5.575	0.47	2.88	-4.75
9	9.299	109.6	6.095	2.05	3.65	-4.43
10	11.465	99.1	6.031	0.86	4.14	-4.30
11	13.148	97.3	6.089	0.26	3.09	-5.24
12	10.153	101.2	7.165	0.17	2.76	-6.61
13						
14	11.155	96.2	5.948	-0.14	3.84	-4.54
15	11.581	102.9	6.711	1.88	2.74	-5.83
16	10.020	97.7	5.991	-0.03	3.01	-5.18
17	9.937	96.6	6.360	0.58	2.92	-5.62
18	7.916	112.2	7.056	2.73	4.69	-4.51
19	12.300	100.4	7.305	0.39	3.50	-6.40
20	8.559	125.2	6.939	3.37	3.30	-5.09
21	11.953	109.8	7.921	2.50	3.56	-6.62
22	10.605	113.6	7.202	2.96	3.04	-5.82
23	9.781	89.4	5.275	0.07	3.25	-4.10
24	10.852	99.3	6.431	-0.23	2.14	-6.06
MEAN VL	10.837	103.5	6.519	1.31	3.28	-5.30
STD DEV	1.31	8.64	0.78	1.23	0.73	0.77

HEAD POSITION 6
BACK REST ANGLE IS 51 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	13.152	114.1	5.073	1.47	1.43	-4.64
2	13.618	111.3	7.848	3.95	4.28	-5.26
3						
4						
5						
6	9.927	111.4	5.005	1.93	3.21	-3.32
7	9.218	108.9	5.504	1.35	2.45	-4.74
8	12.368	108.5	4.829	1.02	2.98	-3 66
9	12.112	104.2	4.748	-0.26	3.22	-3.48
10	12.527	110.8	5.220	1.09	3.60	-3.62
11	12.055	111.1	5.624	1.14	2.95	-4.65
12	10.424	105.3	5.261	0.33	2.15	-4.79
13	14.527	113.0	6.011	2.22	3.17	-5.36
14	14.367	111.5	5.339	0.55	4.08	-3.40
15	11.736	111.8	5.765	2.48	2.15	-4.74
16	11.499	112.9	5.094	1.22	2.99	-4.69
17	12.078	109.1	5.718	1.12	3.45	-4.42
18	10.877	109.6	6.011	2.20	4.01	-3.90
19			7.225	1.43	3.33	-6.25
20	9.108	111.9	6.823	3.91	3.25	-4.55
21	13.724	114.2	7.510	2.16	3.92	-6.03
22	11.962	112.8	6.292	1.86	3.51	-4.88
23	10.303	110.5	5.366	1.53	3.74	-3.53
24	14.040	115.6	5.847	-1.06	0.0	-5.75
MEAN VL	11.981	111.1	5.872	1.51	3.04	-4.56
STD DEV	1.64	2.50	0.88	1.17	0.99	0.87

HEAD POSITION 6
BACK REST ANGLE IS 65 SEAT PAN ANGLE IS 10

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	ANGLE	MENTON TO SUPRASTERNALE DISTANCE	DEL-X	DEL-Y	DEL-Z
1	14.747	125.3	5.596	2.96	2.31	-4.15
2	14.370	124.9	7.638	4.92	3.12	-4.94
3						
4						
5						
6	15.725	127.4	4.684	2.59	3.21	-2.22
7	13.517	131.5	5.191	2.28	3.43	-3.16
8	11.855	124.4	4.478	1.23	2.59	-3.44
9	12.361	124.7	4.395	0.97	2.94	-3.12
10	13.287	127.7	4.736	1.68	3.21	-3.05
11	12.421	119.8	4.533	1.31	1.45	-4.09
12	12.894	120.0	5.187	1.09	2.00	-4.66
13	15.978	126.5	6.900	4.02	3.25	-4.57
14	14.189	122.1	4.257	1.58	3.07	-2.49
15	11.591	124.0	5.324	2.57	0.76	-4.60
16	14.102	121.2	5.209	1.64	3.28	-3.70
17	12.346	125.1	5.713	2.51	2.59	-4.43
18	10.678	123.2	6.276	3.42	3.63	-3.81
19	11.715	127.6	7.523	3.89	4.19	-4.89
20	10.295	125.0	6.994	3.93	3.56	-4.56
21	12.732	127.2	6.585	4.15	3.21	-3.98
22	10.850	125.0	5.929	3.49	4.02	-2.61
23	10.365	124.4	4.716	1.75	3.19	-3.00
24	12.223	129.3	6.223	2.00	2.09	-5.51
MEAN VL	12.773	125.1	5.623	2.57	2.91	-3.86
STD DEV	1.65	2.90	1.05	1.17	0.82	0.90

HEAD POSITION 6
BACK REST ANGLE IS 65 SEAT PAN ANGLE IS 20

SUBJECT	HELMET REAR TO UPPER BACK DISTANCE	HELMET REAR TO UPPER BACK ANGLE	MENTON TO SUPRASTERNALE DISTANCE	MENTON TO SUPRASTERNALE DEL-X	MENTON TO SUPRASTERNALE DEL-Y	MENTON TO SUPRASTERNALE DEL-Z
1	12.263	122.8	5.232	2.84	2.19	-3.81
2	14.560	121.8	7.942	5.24	3.64	-4.73
3						
4						
5						
6	11.216	121.9	4.757	2.75	3.12	-2.31
7	9.220	124.5	5.240	2.72	2.11	-3.95
8	11.228	125.1	3.893	1.14	2.09	-3.08
9	12.410	122.7	4.318	1.17	2.78	-3.09
10	13.030	128.0	4.800	2.20	3.69	-2.14
11	12.121	115.6	5.055	2.65	2.04	-3.79
12	12.518	120.9	5.393	2.08	2.82	-4.10
13	15.601	126.3	6.933	3.89	2.87	-4.97
14	14.220	122.1	4.734	1.57	4.02	-1.86
15	12.951	119.5	5.401	2.76	1.29	-4.46
16	12.066	125.1	5.363	1.60	3.28	-3.93
17	13.328	125.1	5.623	2.18	3.63	-3.70
18	10.930	122.0	5.909	2.67	3.25	-4.15
19	14.186	127.7	7.195	3.47	3.85	-4.99
20	10.554	127.3	5.585	3.11	2.95	-3.58
21						
22	9.328	124.5	5.583	3.02	3.77	-2.80
23	9.327	123.6	4.947	2.29	3.15	-3.05
24	10.896	126.8	4.742	2.16	1.92	-3.76
MEAN VL	12.098	123.7	5.432	2.58	2.92	-3.61
STD DEV	1.79	3.04	0.97	0.94	0.76	0.89

UPPER TORSO INFORMATION

Head Position 1

			SC I	II	III	IV	V
Menton to Suprasternale	Distance	Mean	4.52	3.846	2.83	2.36	2.33
		Std. Dev.	0.49	0.54	0.64	0.59	0.65
	Distance X	Mean	-1.83	-1.24	-0.24	0.25	0.24
		Std. Dev.	0.57	0.71	0.41	0.51	0.39
	Distance Y	Mean	0.10	0.12	0.14	0.07	0.13
		Std. Dev.	0.33	0.31	0.33	0.23	0.26
	Distance Z	Mean	-4.09	-3.57	-2.76	-2.27	-2.26
		Std. Dev.	0.38	0.49	0.66	0.61	0.68

UPPER TORSO INFORMATION

Head Position 2

			SC I	II	III	IV	V
Menton to Suprasternale	Distance	Mean	1.78	1.64	1.75	1.55	1.61
		Std. Dev.	0.91	0.72	0.47	0.42	0.42
	Distance X	Mean	-0.94	-0.68	-0.09	0.19	0.24
		Std. Dev.	0.55	0.61	0.46	0.50	0.66
	Distance Y	Mean	0.02	0.11	0.03	-0.01	0.03
		Std. Dev.	0.23	0.20	0.16	0.21	0.35
	Distance Z	Mean	-1.43	-1.35	-1.67	-1.45	-1.41
		Std. Dev.	0.86	0.71	0.49	0.43	0.45

UPPER TORSO INFORMATION

Head Position 3

			SC I	II	III	IV	V
Menton to Suprasternale	Distance	Mean	7.09	6.815	5.82	5.373	5.42
		Std. Dev.	0.73	0.77	0.98	1.24	1.16
	Distance X	Mean	-1.72	-0.56	-0.81	0.42	0.49
		Std. Dev.	0.69	0.78	0.68	0.88	0.90
	Distance Y	Mean	0.22	0.25	0.13	0.04	0.09
		Std. Dev.	0.37	0.31	0.36	0.43	0.51
	Distance Z	Mean	-6.83	-6.73	-5.71	-5.28	-5.32
		Std. Dev.	0.78	0.81	1.02	1.17	1.10

UPPER TORSO INFORMATION

Head Position 4

			SC I	II	III	IV	V
Menton to Suprasternale	Distance	Mean	5.62	5.40	4.84	4.60	4.48
		Std. Dev.	0.64	0.69	0.82	0.85	0.91
	Distance X	Mean	0.38	1.12	1.69	2.13	2.11
		Std. Dev.	1.03	0.99	0.68	0.73	0.77
	Distance Y	Mean	4.21	4.13	3.90	3.64	3.53
		Std. Dev.	0.60	0.61	0.57	0.59	0.66
	Distance Z	Mean	-3.55	-3.13	-2.19	-1.74	-1.59
		Std. Dev.	0.45	0.48	0.71	0.49	0.71

UPPER TORSO INFORMATION
Head Position 5

			SC I	II	III	IV	V
Menton to Suprasternale	Distance	Mean	4.29	4.49	3.91	4.08	3.92
		Std. Dev.	0.66	0.79	0.47	0.53	0.63
	Distance X	Mean	0.76	1.37	1.57	2.07	1.86
		Std. Dev.	0.90	0.89	0.46	0.46	0.52
	Distance Y	Mean	3.67	3.77	3.43	3.44	3.37
		Std. Dev.	0.56	0.61	0.45	0.48	0.60
	Distance Z	Mean	-1.86	-1.75	-0.86	-0.51	-0.39
		Std. Dev.	0.61	0.67	0.46	0.44	0.39

UPPER TORSO INFORMATION
Head Position 6

			SC I	II	III	IV	V
Menton to Suprasternale	Distance X	Mean	6.95	6.52	5.87	5.62	5.43
		Std. Dev.	0.77	0.78	0.88	1.05	0.97
	Distance Y	Mean	0.42	1.31	1.51	2.57	2.58
		Std. Dev.	1.11	1.23	1.17	1.17	0.94
	Distance Z	Mean	3.69	3.28	3.04	2.91	2.92
		Std. Dev.	0.60	0.73	0.99	0.82	0.76
		Mean	-5.72	-5.30	-4.56	-3.86	-3.61
		Std. Dev.	0.92	0.77	0.87	0.90	0.89

APPENDIX A-3

Hand-arm Rest Data

HAND POSITION 1

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	23	5.75	1.08	0.32	0.62	32.32	0.88
13	10	2	23	5.12	1.08	0.44	0.55	27.61	0.86
13	10	3	23	3.18	0.67	0.58	0.49	23.65	0.77
13	10	4	24	-0.33	1.04	-6.73	0.44	24.94	0.78
13	10	5	24	-0.50	0.47	-9.82	0.68	11.98	0.92
13	10	6	24	9.55	0.64	-10.23	0.37	11.91	0.84
13	10	7	24	13.05	0.86	-10.37	0.29	12.48	0.87
27	10	1	24	0.09	1.02	0.20	0.52	30.66	0.86
27	10	2	24	-0.41	0.96	0.32	0.54	25.95	0.79
27	10	3	24	-1.92	0.68	0.48	0.49	22.39	0.57
27	10	4	24	-5.53	0.86	-6.98	0.50	23.00	0.72
27	10	5	24	-2.59	0.45	-10.05	0.60	10.28	0.77
27	10	6	24	7.62	0.62	-10.27	0.40	10.38	0.73
27	10	7	24	11.10	0.81	-10.42	0.34	10.84	0.65
51	10	1	24	-9.93	1.27	0.16	0.59	25.93	0.73
51	10	2	24	-9.61	0.94	0.24	0.55	21.22	0.72
51	10	3	24	-9.85	0.79	0.37	0.49	18.62	0.55
51	10	4	24	-13.72	1.04	-6.94	0.72	17.85	0.65
51	10	5	24	-5.44	0.74	-10.03	0.66	7.50	0.63
51	10	6	24	5.05	0.93	-10.32	0.40	7.58	0.58
51	10	7	24	8.59	1.04	-10.40	0.36	7.99	0.62
65	10	1	24	-15.53	1.20	0.17	0.71	22.19	0.80
65	10	2	24	-14.12	1.05	0.20	0.61	17.73	0.81
65	10	3	24	-13.88	0.86	0.42	0.77	15.40	0.46
65	10	4	24	-17.73	0.92	-6.63	0.93	14.06	0.62
65	10	5	24	-7.27	0.90	-10.01	0.65	6.01	0.56
65	10	6	24	3.18	1.11	-10.46	0.48	5.94	0.51
65	10	7	24	6.89	1.19	-10.52	0.29	6.35	0.47
65	20	1	24	-16.31	1.03	0.18	0.61	22.41	0.68
65	20	2	24	-14.91	0.93	0.23	0.62	17.99	0.73
65	20	3	24	-14.57	0.82	0.39	0.54	15.64	0.39
65	20	4	24	-18.36	0.89	-6.82	0.75	14.14	0.73
65	20	5	24	-7.68	0.92	-10.30	0.75	6.14	0.61
65	20	6	24	2.73	1.25	-10.39	0.49	6.22	0.57
65	20	7	24	6.40	1.34	-10.45	0.35	6.63	0.53

HAND POSITION 2

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	24	5.76	1.17	0.31	0.62	32.26	0.90
13	10	2	24	5.13	0.92	0.44	0.58	27.53	0.93
13	10	3	24	3.24	0.60	0.62	0.53	23.53	0.73
13	10	4	24	-0.17	0.90	-6.77	0.48	24.86	0.74
13	10	5	24	1.54	0.49	-10.01	0.71	11.81	0.89
13	10	6	24	11.49	0.77	-10.17	0.39	11.77	0.88
13	10	7	24	15.04	0.85	-10.34	0.25	12.50	0.83
27	10	1	24	0.09	1.17	0.22	0.52	30.63	0.85
27	10	2	24	-0.39	1.09	0.31	0.50	25.94	0.80
27	10	3	24	-1.89	0.72	0.49	0.49	22.30	0.58
27	10	4	24	-5.40	0.96	-6.97	0.61	22.94	0.78
27	10	5	24	-0.42	0.47	-9.80	0.68	10.49	0.74
27	10	6	24	9.72	0.68	-10.20	0.35	10.24	0.66
27	10	7	24	13.28	0.87	-10.42	0.42	10.73	0.65
51	10	1	24	-9.89	1.25	0.20	0.42	25.96	0.68
51	10	2	24	-9.58	0.96	0.20	0.41	21.25	0.58
51	10	3	24	-9.83	0.78	0.33	0.44	18.59	0.51
51	10	4	24	-13.28	0.95	-7.09	0.58	17.82	0.61
51	10	5	24	-3.46	0.92	-9.70	0.73	8.59	0.68
51	10	6	24	6.85	1.03	-10.18	0.38	7.63	0.53
51	10	7	24	10.40	1.16	-10.37	0.36	7.96	0.58
65	10	1	23	-15.46	1.13	0.11	0.63	22.18	0.74
65	10	2	23	-14.13	0.88	0.17	0.59	17.73	0.73
65	10	3	23	-13.76	0.88	0.33	0.67	15.45	0.42
65	10	4	23	-16.84	0.80	-6.88	0.82	14.20	0.54
65	10	5	23	-5.41	0.80	-9.79	0.64	7.07	0.84
65	10	6	22	4.91	1.04	-10.26	0.38	6.12	0.55
65	10	7	23	8.57	1.18	-10.43	0.30	6.33	0.48
65	20	1	23	-16.37	1.02	0.21	0.56	22.36	0.70
65	20	2	23	-14.93	0.92	0.18	0.70	17.95	0.74
65	20	3	23	-14.43	0.84	0.42	0.65	15.65	0.41
65	20	4	23	-17.46	0.87	-6.95	0.73	14.31	0.71
65	20	5	23	-5.79	0.95	-9.74	0.62	7.51	0.70
65	20	6	23	4.53	1.25	-10.22	0.42	6.35	0.56
65	20	7	23	8.18	1.45	-10.30	0.22	6.58	0.56

HAND POSITION 3

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	24	5.64	1.01	0.28	0.68	32.32	0.83
13	10	2	24	5.03	0.80	0.39	0.64	27.65	0.88
13	10	3	24	3.21	0.64	0.43	0.78	23.71	0.89
13	10	4	24	-0.10	0.87	-6.83	0.47	24.83	0.76
13	10	5	24	1.65	0.44	-10.01	0.71	11.74	0.98
13	10	6	24	11.50	0.63	-10.13	0.40	10.10	0.95
13	10	7	24	14.93	0.84	-10.35	0.34	10.49	0.87
27	10	1	24	0.01	0.92	0.26	0.52	30.58	0.76
27	10	2	24	-0.46	0.94	0.41	0.52	25.92	0.68
27	10	3	24	-1.87	0.67	0.54	0.50	22.34	0.57
27	10	4	24	-5.32	0.94	-6.96	0.60	22.87	0.72
27	10	5	24	-0.35	0.46	-9.79	0.78	10.38	0.78
27	10	6	24	9.66	0.66	-10.10	0.46	8.61	0.61
27	10	7	24	13.18	0.93	-10.27	0.41	8.81	0.66
51	10	1	24	-9.94	1.29	0.10	0.47	25.89	0.74
51	10	2	24	-9.65	0.98	0.14	0.40	21.19	0.67
51	10	3	24	-9.87	0.80	0.27	0.43	18.59	0.59
51	10	4	24	-13.46	0.92	-7.13	0.52	17.89	0.65
51	10	5	24	-3.34	0.85	-9.84	0.68	8.90	0.91
51	10	6	24	6.93	1.02	-10.24	0.46	9.30	0.53
51	10	7	24	10.46	1.10	-10.42	0.30	9.92	0.59
65	10	1	24	-15.52	1.21	0.13	0.62	22.15	0.69
65	10	2	24	-14.17	1.03	0.18	0.59	17.67	0.72
65	10	3	24	-13.85	0.91	0.33	0.73	15.41	0.47
65	10	4	24	-17.07	0.84	-6.85	0.84	14.13	0.52
65	10	5	24	-5.29	0.83	-9.91	0.81	7.59	0.92
65	10	6	24	5.09	1.06	-10.33	0.45	7.75	0.55
65	10	7	24	8.70	1.12	-10.40	0.35	8.19	0.48
65	20	1	23	-16.27	1.03	0.18	0.61	22.33	0.65
65	20	2	23	-14.94	0.88	0.23	0.66	17.89	0.68
65	20	3	23	-14.57	0.83	0.41	0.58	15.68	0.35
65	20	4	23	-17.71	0.84	-6.92	0.73	14.27	0.68
65	20	5	23	-5.75	1.06	-9.71	0.65	8.02	0.64
65	20	6	23	4.60	1.32	-10.10	0.38	8.04	0.60
65	20	7	23	8.12	1.50	-10.34	0.37	8.51	0.50

HAND POSITION 4

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	23	5.68	1.15	0.39	0.60	32.35	0.81
13	10	2	23	5.12	1.06	0.50	0.54	27.63	0.93
13	10	3	23	3.23	0.69	0.67	0.46	23.54	0.75
13	10	4	23	0.05	1.03	-6.78	0.47	24.88	0.74
13	10	5	23	3.49	0.45	-9.66	0.82	11.95	0.81
13	10	6	23	13.50	0.71	-10.09	0.42	11.87	0.85
13	10	7	23	16.97	0.92	-10.29	0.33	12.47	0.78
27	10	1	24	0.01	1.15	0.15	0.54	30.59	0.85
27	10	2	24	-0.51	1.03	0.27	0.52	25.90	0.83
27	10	3	24	-1.90	0.65	0.49	0.53	22.33	0.66
27	10	4	24	-5.25	1.03	-6.99	0.56	22.82	0.79
27	10	5	24	1.57	0.50	-9.82	0.71	11.22	0.89
27	10	6	24	11.61	0.76	-10.17	0.39	10.22	0.71
27	10	7	24	15.21	0.99	-10.20	0.37	10.64	0.75
51	10	1	24	-9.95	1.23	0.04	0.41	25.93	0.70
51	10	2	24	-9.59	0.96	0.03	0.43	21.26	0.64
51	10	3	24	-9.70	0.77	0.34	0.38	18.57	0.52
51	10	4	24	-12.38	0.79	-7.24	0.46	17.98	0.67
51	10	5	24	-1.44	0.86	-9.49	0.56	9.91	0.73
51	10	6	24	8.65	1.06	-10.05	0.39	7.98	0.57
51	10	7	24	12.36	1.21	-10.28	0.56	8.03	0.57
65	10	1	24	-15.55	1.21	0.12	0.60	22.31	0.76
65	10	2	24	-14.08	1.01	0.03	0.53	17.92	0.88
65	10	3	24	-13.52	0.93	0.37	0.57	15.51	0.46
65	10	4	24	-15.60	0.84	-6.93	0.77	14.40	0.43
65	10	5	24	-3.50	0.84	-9.32	0.58	8.16	0.58
65	10	6	24	6.70	0.92	-10.13	0.41	6.50	0.59
65	10	7	24	10.34	1.08	-10.36	0.36	6.43	0.50
65	20	1	23	-16.21	1.12	0.09	0.54	22.55	0.69
65	20	2	23	-14.74	0.94	0.02	0.56	18.16	0.77
65	20	3	23	-14.14	0.79	0.33	0.62	15.77	0.40
65	20	4	23	-16.05	0.82	-7.00	0.63	14.58	0.57
65	20	5	23	-3.99	0.96	-9.33	0.50	8.49	0.48
65	20	6	23	6.21	1.19	-10.03	0.41	6.81	0.66
65	20	7	23	9.87	1.34	-10.25	0.31	6.77	0.57

HAND POSITION 5

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	24	5.75	1.16	0.33	0.64	32.31	0.87
13	10	2	24	5.14	1.07	0.44	0.55	27.58	0.88
13	10	3	24	3.28	0.70	0.63	0.49	23.49	0.75
13	10	4	24	0.24	1.05	-6.85	0.45	24.69	0.77
13	10	5	24	3.57	0.53	-9.66	0.80	11.71	0.95
13	10	6	24	13.45	0.77	-10.02	0.35	10.12	0.86
13	10	7	24	17.05	0.92	-10.28	0.34	10.52	0.81
27	10	1	24	0.24	0.94	0.17	0.56	30.47	0.83
27	10	2	24	-0.38	0.98	0.31	0.50	25.83	0.73
27	10	3	24	-1.86	0.60	0.48	0.46	22.30	0.67
27	10	4	24	-5.00	0.93	-7.08	0.47	22.82	0.77
27	10	5	24	1.69	0.45	-9.84	0.67	10.97	0.75
27	10	6	24	11.57	0.72	-10.08	0.51	8.65	0.71
27	10	7	24	15.25	0.90	-10.29	0.29	8.75	0.72
51	10	1	24	-9.91	1.30	0.16	0.38	25.94	0.63
51	10	2	24	-9.58	0.97	0.19	0.40	21.27	0.60
51	10	3	24	-9.74	0.76	0.38	0.32	18.53	0.52
51	10	4	24	-12.67	0.84	-7.19	0.46	17.98	0.58
51	10	5	24	-1.41	0.92	-9.47	0.52	10.49	0.83
51	10	6	24	8.83	1.08	-10.13	0.42	9.55	0.55
51	10	7	24	12.43	1.24	-10.30	0.37	9.91	0.54
65	10	1	24	-15.55	1.14	0.25	0.47	22.20	0.72
65	10	2	24	-14.15	1.00	0.20	0.44	17.79	0.80
65	10	3	24	-13.63	0.91	0.46	0.57	15.49	0.50
65	10	4	24	-15.91	0.82	-6.89	0.78	14.43	0.45
65	10	5	24	-3.55	0.87	-9.36	0.71	8.95	0.62
65	10	6	24	6.74	1.02	-10.08	0.41	8.07	0.61
65	10	7	24	10.36	1.12	-10.31	0.38	8.21	0.52
65	20	1	23	-16.18	1.10	0.05	0.52	22.51	0.74
65	20	2	23	-14.69	0.92	0.06	0.58	18.12	0.77
65	20	3	23	-14.18	0.80	0.38	0.61	15.73	0.37
65	20	4	23	-16.34	0.86	-6.99	0.68	14.60	0.64
65	20	5	23	-3.91	0.94	-9.30	0.67	9.28	0.57
65	20	6	23	6.39	1.19	-10.00	0.40	8.41	0.69
65	20	7	23	9.99	1.36	-10.29	0.29	8.59	0.57

HAND POSITION 6

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	24	5.84	1.08	0.27	0.61	32.30	0.82
13	10	2	24	5.27	1.03	0.34	0.53	27.62	0.86
13	10	3	24	3.32	0.65	0.61	0.47	23.47	0.68
13	10	4	24	0.41	0.90	-6.85	0.47	24.55	0.76
13	10	5	24	3.75	0.53	-9.73	0.73	11.52	0.79
13	10	6	24	13.35	0.70	-9.99	0.26	8.50	0.86
13	10	7	24	16.85	0.89	-10.16	0.37	8.61	0.75
27	10	1	24	0.20	0.93	0.13	0.60	30.59	0.70
27	10	2	24	-0.35	1.09	0.23	0.56	25.92	0.65
27	10	3	24	-1.80	0.73	0.47	0.49	22.29	0.63
27	10	4	24	-4.68	0.99	-7.09	0.54	22.67	0.76
27	10	5	24	2.10	0.53	-9.71	0.56	10.82	0.77
27	10	6	24	11.46	0.71	-10.05	0.34	7.11	0.67
27	10	7	24	15.08	0.89	-10.22	0.35	6.81	0.66
51	10	1	24	-9.88	1.25	0.18	0.39	25.88	0.65
51	10	2	23	-9.60	1.00	0.20	0.41	21.17	0.59
51	10	3	24	-9.80	0.81	0.38	0.41	18.57	0.56
51	10	4	24	-12.92	0.82	-7.09	0.52	17.98	0.55
51	10	5	24	-1.23	0.86	-9.56	0.60	11.13	0.95
51	10	6	24	8.90	1.01	-10.12	0.52	11.35	0.56
51	10	7	24	12.54	1.21	-10.29	0.31	11.93	0.60
65	10	1	24	-15.54	1.20	0.26	0.57	22.22	0.72
65	10	2	24	-14.16	1.01	0.22	0.53	17.75	0.79
65	10	3	24	-13.67	0.89	0.46	0.61	15.46	0.46
65	10	4	24	-16.02	0.75	-6.80	0.68	14.45	0.42
65	10	5	23	-3.33	0.80	-9.52	0.75	9.77	0.76
65	10	6	23	6.98	0.97	-10.09	0.42	9.79	0.63
65	10	7	23	10.61	1.10	-10.34	0.28	10.19	0.48
65	20	1	23	-16.23	1.07	0.05	0.44	22.46	0.62
65	20	2	23	-14.84	0.96	0.01	0.48	18.03	0.71
65	20	3	23	-14.24	1.16	0.30	0.62	15.71	0.35
65	20	4	23	-16.61	0.83	-7.08	0.82	14.55	0.61
65	20	5	23	-3.87	0.93	-9.42	0.81	9.92	0.65
65	20	6	23	6.40	1.19	-10.11	0.50	10.02	0.62
65	20	7	23	10.00	1.35	-10.30	0.31	10.49	0.57

Elbow Joint Position for 5th to 95th Percentile as a Function of Seat Configuration for Hand Position 1

Coordinates	I	II	III	IV	V	Percentile
X	.28	-1.85	-4.22	-5.80	-6.15	95th
	-.50	-2.59	-5.44	-7.27	-7.68	50th
	-1.28	-3.33	-6.66	-8.74	-9.21	5th
Z	13.50	11.55	8.54	6.93	7.15	95th
	11.98	10.28	7.50	6.01	6.14	50th
	10.46	9.01	6.46	5.09	5.13	5th
Displacement						
X		-2.13	-4.50	-6.08	-6.43	95th
		-2.09	-4.94	-6.77	-7.18	50th
		-2.05	-5.38	-7.46	-7.93	5th
Z		-1.95	-4.96	-6.57	-6.35	95th
		-1.70	-4.48	-5.97	-5.84	50th
		-1.45	-4.00	-5.37	-5.33	5th

APPENDIX A-4

Hand-arm Rest Data

HAND POSITION 1
LENGTH IS DISTANCE FROM ELBOW TO STYLION
ALPHA IS ITS ASSOCIATED ANGLE
BETA IS THE ANGLE ASSOCIATED WITH ACROMIALE-ELBOW ORIENTATION

SUBJECT	BR=13SP=10			BR=27SP=10			BR=51SP=10			BR=65SP=10			BR=65SP=20		
	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA
1	11.45	166.4	87.3	10.79	166.8	105.4	11.00	168.9	129.2	10.89	170.8	144.0	10.81	170.4	147.5
2	11.01	164.2	90.9	11.14	166.9	106.1	11.35	166.4	125.8	11.70	167.3	141.4	11.55	165.8	143.8
3	11.31	165.0	88.8	11.36	168.0	102.8	11.65	168.9	129.2	11.51	167.0	140.6	11.47	168.0	142.6
4	9.95	162.2	85.4	10.38	164.5	98.6	10.42	166.8	124.5	10.44	166.4	140.4	10.45	164.3	140.5
5	10.36	162.1	79.3	10.50	167.7	98.5	10.34	167.6	124.9	10.66	166.6	141.0	10.63	168.9	138.9
6	10.13	164.4	89.8	10.41	160.3	103.6	10.69	161.0	128.5	10.51	163.7	142.5	10.55	164.3	144.1
7	10.04	169.2	102.6	10.33	166.0	111.4	11.39	163.2	136.0	10.76	157.8	150.1	10.28	166.0	146.5
8	10.67	167.6	88.7	11.07	163.6	103.3	10.72	164.6	134.3	11.42	164.6	146.9	11.04	165.9	145.7
9	10.24	160.2	95.1	10.17	162.8	110.7	10.34	161.3	126.1	10.99	161.3	145.4	10.68	164.0	144.8
10	10.71	162.1	91.5	11.01	164.9	102.2	11.35	166.2	129.7	11.19	164.9	140.9	11.51	164.4	139.1
11	10.85	164.9	85.6	10.54	167.7	101.8	11.37	162.9	128.4	10.95	163.8	142.3	10.75	166.1	144.3
12	10.51	162.6	92.8	10.52	165.4	108.6	11.24	165.4	132.5	11.30	165.0	140.4	11.23	163.3	147.5
13	10.04	161.3	85.0	10.50	164.4	97.4	10.15	165.1	124.4	10.10	161.9	142.1	10.09	164.0	140.9
14	10.36	164.6	86.4	10.65	163.8	101.3	10.73	164.7	127.2	10.70	165.0	140.1	10.75	161.2	143.1
15	9.95	162.5	89.8	9.88	163.5	105.2	10.25	167.1	125.4	10.25	161.6	139.4	9.83	163.1	142.4
16	10.68	164.7	90.2	10.53	165.0	103.3	10.78	165.0	130.8	10.72	166.6	143.6	10.60	165.6	144.2
17	10.50	164.9	86.4	11.11	164.2	98.7	11.28	166.7	129.7	11.28	164.1	138.9	11.71	165.8	141.4
18	10.10	162.0	93.6	10.18	167.6	103.5	10.33	164.2	128.9	10.36	162.2	140.7	10.09	163.6	140.9
19	11.37	162.4	91.1	10.99	163.5	105.2	11.38	165.1	128.2	11.45	163.0	142.6	11.28	164.6	142.9
20	11.01	164.0	85.9	10.77	165.1	96.4	11.73	165.2	127.2	11.61	164.8	140.2	11.55	164.5	139.6
21	9.93	163.8	85.5	10.32	163.1	97.7	10.44	164.3	125.3	10.61	163.1	139.6	10.01	163.1	139.9
22	10.42	161.8	94.2	10.05	163.8	104.7	10.82	165.4	130.6	10.74	164.5	142.4	11.02	166.2	144.1
23	9.99	161.7	87.3	10.27	163.8	102.4	10.43	164.2	128.8	10.38	162.3	143.0	9.99	162.9	143.3
24	10.47	165.6	89.1	10.83	164.8	103.4	10.54	164.5	131.4	10.88	166.3	143.9	10.67	165.1	147.0
MEAN VL	10.50	163.8	89.3	10.60	164.9	103.0	10.86	165.2	128.6	10.89	164.3	142.4	10.80	165.0	143.1
STD DEV	0.47	2.1	4.6	0.38	1.9	3.9	0.49	2.0	3.0	0.45	2.6	2.7	0.54	2.0	2.6

HAND POSITION 2
LENGTH IS DISTANCE FROM ELBOW TO STYLION
ALPHA IS ITS ASSOCIATED ANGLE
BETA IS THE ANGLE ASSOCIATED WITH ACROMIALE-ELBOW ORIENTATION

SUBJECT	BR=13SP=10			BR=27SP=10			BR=51SP=10			BR=65SP=10			BR=65SP=20		
	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA
1	11.32	168.0	95.8	10.73	166.2	117.5	11.19	161.5	135.9	11.03	166.9	147.3	11.12	164.9	151.0
2	11.14	164.7	98.4	10.90	165.3	114.4	11.57	157.1	138.2	11.59	164.6	143.1	11.90	160.0	149.4
3	11.09	164.9	96.9	11.59	165.2	113.4	12.24	158.9	140.8	12.10	158.9	151.1	12.04	159.9	151.1
4	10.18	160.9	94.5	10.23	163.2	106.3	10.30	166.8	126.5	10.48	166.5	143.4	10.57	161.4	145.0
5	10.43	161.4	90.3	10.66	161.3	106.3	10.84	165.0	131.8	11.15	158.9	149.7	10.99	161.7	147.3
6	9.75	164.5	97.5	10.65	156.6	114.9	10.69	157.3	136.8	10.56	162.0	145.3	10.55	160.1	148.4
7	10.22	169.4	108.5	10.54	164.3	120.2	10.93	157.6	142.1	10.90	152.7	154.4	10.83	154.9	157.1
8	10.77	163.8	97.0	10.87	162.6	113.0	11.13	164.1	137.0	11.76	158.9	151.9	11.46	161.9	150.9
9	10.21	160.1	104.5	10.33	161.1	117.3	10.90	157.2	133.9	11.35	157.0	147.3	11.05	156.9	150.7
10	10.75	164.4	97.1	11.11	161.7	112.0	11.57	159.7	137.1				12.14	157.2	147.4
11	10.68	166.1	96.5	11.11	163.1	114.4	10.83	162.4	130.7	11.29	158.8	149.7	11.26	155.6	155.5
12	10.59	162.8	98.1	10.61	165.4	113.4	11.31	157.1	141.7	11.22	156.4	154.8	11.38	157.0	153.5
13	9.68	162.4	95.1	10.36	162.2	106.9	10.22	160.1	132.4	10.34	156.8	150.3	10.59	154.3	148.7
14	10.37	163.6	95.2	10.53	160.3	110.0	11.02	156.9	137.4	11.00	159.2	148.2	10.81	159.8	147.6
15	9.39	163.5	97.9	9.78	162.6	111.4	10.70	152.6	143.0	10.97	154.0	150.6	10.69	152.6	152.7
16	10.45	165.0	99.5	10.71	161.0	113.0	11.10	159.3	139.3	11.51	155.4	152.1	11.22	159.9	150.0
17	10.51	164.6	93.3	11.23	165.6	106.4	11.39	164.8	136.7	11.32	170.2	139.9	11.77	159.9	147.6
18	10.19	163.2	102.6	10.35	160.9	117.0	10.89	157.0	140.2	10.76	153.3	150.0	11.01	152.6	149.8
19	10.89	160.4	100.5	10.89	163.6	110.1	11.66	162.6	134.2			147.4			
20	10.99	163.1	95.1	11.32	165.1	104.7	11.91	157.4	138.2	11.78	156.1	149.1	11.57	157.0	148.4
21	9.85	166.1	95.6	9.87	162.3	106.1	10.14	159.8	132.8	10.90	157.4	145.2	10.59	161.2	143.7
22	10.06	159.4	104.8	10.29	163.6	113.3	10.84	162.3	137.3	10.67	166.6	143.2	10.69	162.8	149.5
23	9.35	162.1	88.7	9.94	163.6	108.2	10.48	158.5	135.9	10.61	163.1	143.7	10.46	158.4	148.0
24	10.41	166.0	95.3	10.55	165.2	111.4	11.05	157.4	141.8	11.31	163.0	148.0	10.89	160.7	151.8
MEAN VL	10.39	163.8	97.4	10.63	163.0	111.8	11.04	159.7	136.7	11.11	159.8	148.1	11.11	158.7	149.8
STD DEV	0.53	2.5	4.4	0.46	2.2	4.2	0.52	3.3	4.0	0.46	4.9	3.8	0.50	3.3	3.1

HAND POSITION 3
LENGTH IS DISTANCE FROM ELBOW TO STYLION
ALPHA IS ITS ASSOCIATED ANGLE
BETA IS THE ANGLE ASSOCIATED WITH ACROMIALE-ELBOW ORIENTATION

SUBJECT	BR=13SP=10			BR=27SP=10			BR=51SP=10			BR=65SP=10			BR=65SP=20		
	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA
1	11.71	161.3	99.1	11.68	151.6	119.2	10.59	172.2	137.1	11.01	171.4	149.9	11.03	166.6	153.9
2	11.61	152.2	100.3	11.23	166.2	112.3	11.09	168.3	135.4	11.32	169.4	148.5	11.17	167.7	150.9
3	11.40	157.6	98.9	11.81	158.9	113.5	11.64	170.4	140.0	11.82	165.6	153.0	11.80	162.7	154.9
4	10.63	152.0	92.7	10.60	156.9	104.2	9.71	174.1	127.8	10.12	170.6	147.0	10.25	165.8	148.9
5	10.73	153.6	99.1	11.06	152.4	111.6	10.28	173.8	131.6	10.93	166.0	151.9	10.84	168.4	148.6
6	10.27	155.9	94.4	10.66	153.0	113.9	10.64	162.0	138.3	10.34	168.5	148.3	10.23	168.4	150.0
7	10.60	158.3	106.7	10.88	156.8	119.3	10.66	162.3	141.1	10.53	158.2	160.5	10.45	161.8	160.3
8	10.97	156.3	96.7	11.30	154.1	112.7	9.91	174.1	139.4	11.01	165.6	153.8	10.94	167.9	152.5
9	10.87	153.1	101.9	10.96	154.7	116.6	10.71	161.3	137.4	10.27	165.6	149.6	10.90	163.8	153.6
10	11.04	155.5	96.8	11.51	154.1	111.2	11.22	164.5	139.0	11.01	166.4	148.8	11.89	161.2	151.0
11	11.23	158.4	93.9	11.45	151.0	116.8	10.92	170.1	133.7	11.12	166.3	149.4	10.98	160.5	158.7
12	11.00	153.0	99.9	11.31	155.3	112.6	11.03	163.0	143.7	11.03	165.8	155.3	11.25	164.7	154.9
13	10.79	151.1	95.2	11.02	153.1	106.8	9.74	168.9	133.5	10.07	163.3	151.9	10.22	162.9	151.4
14	10.57	153.6	94.6	10.85	152.0	112.2	10.63	161.5	141.4	10.70	163.4	152.9	10.42	165.0	151.2
15	10.18	154.3	96.5	10.22	153.9	109.9	10.13	161.2	142.1	10.21	160.5	151.5	10.19	159.9	152.8
16	10.88	156.3	97.7	11.35	152.7	113.9	10.74	165.4	141.4	11.40	158.9	156.8	10.54	168.1	150.8
17	11.33	156.2	94.7	11.62	156.7	107.8	10.76	171.2	136.6	10.56	177.3	141.5	10.99	166.5	150.6
18	10.46	154.7	102.9	10.79	152.4	117.7	10.62	161.4	144.4	10.79	158.3	153.2	10.72	159.1	151.8
19	11.51	154.9	99.1	11.58	156.0	109.5	11.20	167.3	137.9	11.36	163.9	149.4			
20	11.07	157.8	89.5	11.40	156.3	103.6	11.37	160.7	143.6	11.44	159.9	154.0	11.46	164.1	149.0
21	10.28	157.2	94.7	10.16	155.8	106.0	10.19	166.4	136.4	10.40	162.1	148.7	10.00	164.0	150.2
22	10.75	155.0	100.9	10.73	158.0	111.2	10.57	171.6	136.6	10.65	169.0	149.0	10.30	169.9	150.4
23	10.17	149.5	99.9	10.46	156.3	106.9	10.00	162.1	141.4	10.35	166.5	149.9	10.45	164.3	151.9
24	10.74	158.5	95.8	10.98	157.1	111.6	10.52	165.5	141.1	10.51	168.6	149.9	10.65	165.6	156.9
MEAN VL	10.87	155.5	97.6	11.07	155.2	111.7	10.62	166.6	138.4	10.79	165.5	151.0	10.77	164.7	152.4
STD DEV	0.44	2.8	3.7	0.45	3.2	4.4	0.51	4.7	4.1	0.47	4.6	3.7	0.51	3.0	3.0

HAND POSITION 4
LENGTH IS DISTANCE FROM ELBOW TO STYLION
ALPHA IS ITS ASSOCIATED ANGLE
BETA IS THE ANGLE ASSOCIATED WITH ACROMIALE-ELBOW ORIENTATION

SUBJECT	BR=13SP=10			BR=27SP=10			BR=51SP=10			BR=65SP=10			BR=65SP=20		
	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA
1	11.17	165.7	107.8	11.73	151.5	125.0	10.90	161.6	138.9	10.93	164.2	152.5	10.93	163.4	149.2
2	10.86	162.9	105.2	11.41	158.9	125.7	11.77	155.3	144.8	11.83	158.8	150.7	12.05	156.2	155.2
3	11.46	161.3	109.4	11.59	160.1	122.6	12.79	152.2	150.7	12.30	154.8	155.4	12.20	155.6	155.6
4	10.16	163.2	101.2	9.89	164.0	111.3	10.25	164.5	131.4	10.60	158.0	150.8	10.84	153.8	150.7
5	10.47	162.1	96.2	10.85	155.5	118.7	10.81	160.1	139.5	10.86	156.6	153.6	11.08	158.4	151.9
6	9.58	166.7	103.6	10.61	158.2	121.0	11.19	152.0	145.8	10.62	156.7	151.8	10.67	156.3	152.8
7	9.86	167.8	115.9	10.95	155.0	131.8	10.96	156.1	141.9	11.39	155.9	153.2	10.68	156.1	155.7
8	10.85	164.5	104.5	10.92	160.2	121.6	11.19	155.5	144.7	11.53	155.8	153.6	11.57	153.9	156.2
9	10.26	160.6	113.0	10.30	160.5	121.3	11.30	150.6	140.1	11.45	153.7	152.6	11.40	153.1	153.7
10	10.89	164.2	104.7	11.15	158.3	121.8	11.95	148.9	140.6	11.67	150.9	153.3	11.93	152.8	152.6
11	10.72	164.6	103.1	11.02	157.1	122.3	11.52	151.9	143.8	11.29	154.1	152.8	11.44	150.7	158.3
12	10.72	163.2	105.4	11.03	156.4	126.8	11.60	150.6	149.3	11.63	154.1	157.7	11.53	154.3	156.1
13	9.94	162.3	102.9	10.65	154.2	117.5	10.61	154.7	140.7	10.71	154.1	152.5	10.73	152.2	152.6
14	10.33	163.7	100.5	10.59	157.7	119.9	10.83	154.5	142.0	11.02	159.0	152.0	10.85	159.9	150.5
15	9.83	163.8	102.1	9.73	160.2	119.0	10.53	150.7	146.5	10.79	150.9	152.2	10.57	153.4	152.9
16	10.55	164.0	105.0	11.03	158.7	122.6	11.49	152.5	148.0	11.68	153.7	155.4	11.48	155.6	155.2
17	10.79	165.2	99.9	11.53	158.4	118.5	12.13	156.2	144.4	11.66	165.2	147.4	12.10	158.0	149.8
18	10.18	161.2	112.4	10.47	161.0	124.2	10.67	151.9	145.6	10.55	155.7	150.1	10.82	155.8	150.5
19	10.92	162.7	108.0	11.19	161.8	118.5	11.75	156.8	142.6	11.57	151.9	154.5			
20	10.47	164.6	97.8	11.07	160.9	113.0	12.01	154.0	145.6	11.93	156.5	152.2	11.81	156.5	152.7
21	9.98	166.0	101.6	10.18	162.7	111.6	10.34	154.0	141.8	10.86	152.6	153.7	10.46	156.0	153.2
22	10.60	161.3	108.8	10.43	159.8	124.3	10.96	162.0	141.7	11.17	158.8	152.8	11.25	162.8	151.0
23				10.01	163.1	115.2	10.48	152.5	143.8	10.14	156.5	149.8	10.42	156.8	152.6
24	10.28	164.1	102.3	10.55	164.1	115.6	11.08	155.1	145.8	10.98	159.4	154.2	10.91	158.6	154.8
MEAN VL	10.47	163.7	104.8	10.79	159.1	120.4	11.21	154.8	143.6	11.22	156.2	152.7	11.20	156.1	153.2
STD DEV	0.46	1.8	4.8	0.54	3.1	4.9	0.64	4.0	4.0	0.54	3.6	2.1	0.55	3.1	2.4

HAND POSITION 5
LENGTH IS DISTANCE FROM ELBOW TO STYLION
ALPHA IS ITS ASSOCIATED ANGLE
BETA IS THE ANGLE ASSOCIATED WITH ACROMIALE-ELBOW ORIENTATION

SUBJECT	BR=13SP=10			BR=27SP=10			BR=51SP=10			BR=65SP=10			BR=85SP=20		
	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA
1	12.00	160.1	102.9	11.56	151.5	125.3	10.70	168.9	140.9	10.90	166.6	155.3	10.85	166.3	150.9
2	11.30	152.7	105.6	11.81	153.5	121.2	11.68	157.3	147.5	11.65	163.3	153.8	11.72	161.4	158.7
3	11.53	158.4	108.6	12.49	150.3	123.7	12.62	154.1	155.4	12.27	156.6	161.2	12.18	160.5	159.1
4	10.21	158.5	98.0	10.88	154.6	113.7	9.91	170.5	134.0	10.16	164.5	152.4	10.44	159.8	153.2
5	10.77	157.0	94.4	11.15	149.4	117.7	10.41	168.6	139.0	10.78	163.4	155.6	10.76	160.4	157.7
6	10.38	158.9	102.3	10.81	151.8	120.1	10.39	157.5	146.2	10.43	163.1	155.0	10.54	162.4	155.8
7	10.74	157.9	115.8	10.90	150.0	129.1	10.69	161.6	145.4	11.28	158.0	159.9	10.64	159.8	160.3
8	10.99	157.8	103.5	11.39	152.9	119.7	10.97	163.5	147.6	10.95	160.1	157.2	11.30	160.3	158.6
9	10.76	151.1	110.8	10.78	152.5	121.0	10.86	155.0	141.7	11.07	157.4	153.8	11.55	157.5	156.8
10	11.27	155.1	105.3	11.79	150.1	119.5	11.72	155.3	149.2	11.83	156.2	156.8	11.80	155.7	155.7
11	11.24	156.1	104.0	11.44	152.0	120.5	11.45	158.8	144.0	11.11	153.2	159.8	11.05	154.5	161.5
12	11.88	152.7	105.1	11.77	153.1	122.2	11.32	154.5	151.3	11.15	160.7	161.3	11.41	157.9	159.7
13	10.67	149.2	103.9	10.88	152.4	115.7	10.20	163.5	142.1	10.36	159.3	154.1	10.46	156.1	157.1
14	10.30	158.3	101.6	11.01	151.0	118.4	10.73	156.8	147.0	11.06	161.3	156.2	10.73	164.0	155.1
15	10.03	155.3	101.5	10.49	151.6	116.9	10.27	156.2	150.0	10.43	156.5	154.5	10.46	159.7	155.2
16	11.23	155.2	105.6	11.40	147.2	124.1	11.00	156.6	149.9	11.40	157.2	159.9	11.34	158.0	159.3
17	11.52	157.9	99.0	11.72	153.9	116.0	11.23	161.3	146.2	10.87	168.9	150.8	11.45	162.9	154.8
18	10.65	152.7	111.7	10.59	152.6	125.2	10.85	154.6	152.7	10.91	157.1	155.1	10.77	156.4	155.6
19	11.40	155.1	100.2	11.71	152.4	118.7	11.58	158.1	148.4	11.52	158.4	155.2			
20	11.12	156.6	97.6	11.44	153.8	113.6	11.57	160.3	145.6	11.51	159.0	155.6	11.78	160.1	155.1
21	10.19	158.9	102.5	10.45	154.6	111.7	11.02	160.9	144.5	11.10	157.6	155.9	10.69	159.2	157.3
22	10.33	151.4	110.7	10.65	158.5	118.9	10.72	162.8	148.5	10.48	164.1	153.5	10.37	168.8	152.6
23	10.29	155.4	105.4	10.48	153.3	116.7	10.37	160.3	145.2	9.88	160.5	154.2	10.04	159.3	156.9
24	10.54	156.3	103.3	10.82	155.4	115.8	11.01	159.7	149.4	11.00	160.4	158.5	10.88	163.0	160.2
MEAN VL	10.89	155.8	104.4	11.18	152.4	119.4	10.95	159.9	146.3	11.01	160.1	156.1	11.01	160.2	156.8
STD DEV	0.56	2.9	4.8	0.54	2.3	4.2	0.63	4.7	4.6	0.55	3.7	2.8	0.56	3.4	2.7

HAND POSITION 6
LENGTH IS DISTANCE FROM ELBOW TO STYLION
ALPHA IS ITS ASSOCIATED ANGLE
BETA IS THE ANGLE ASSOCIATED WITH ACROMIALE-ELBOW ORIENTATION

	BR=13SP=10			BR=27SP=10			BR=51SP=10			BR=65SP=10			BR=65SP=20		
SUBJECT	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA	LENGTH	ALPHA	BETA
1	12.25	150.7	103.1	11.81	148.4	124.9	10.24	175.4	144.5	10.36	172.1	159.1	10.88	170.5	156.5
2	12.07	146.9	104.7	12.44	146.8	121.0	11.44	159.9	152.8	11.44	166.4	158.6	11.37	163.2	160.5
3	12.02	150.8	109.4	12.25	144.4	123.0	11.80	160.1	157.5	11.56	164.6	161.0	11.53	164.9	162.3
4	11.29	145.2	101.1	11.05	148.6	111.8	9.31	177.9	137.0	10.14	166.6	157.5	10.56	162.4	158.1
5	10.80	151.6	94.0	11.37	143.4	115.6	10.22	175.6	144.4	10.64	167.0	159.6	10.54	165.4	159.9
6	10.64	151.0	103.9	10.94	144.9	120.0	10.26	164.2	147.5	10.19	167.5	157.2	10.46	165.4	160.2
7	10.88	152.4	111.5	11.36	143.2	132.3	10.36	164.2	151.1	10.82	158.0	165.2	9.87	165.3	164.3
8	11.49	148.8	104.4	11.75	144.3	121.1	10.00	171.1	143.6	10.56	164.5	161.4	11.08	168.3	159.3
9	10.90	145.1	111.5	11.19	146.2	119.9	10.45	161.3	147.5	11.21	161.6	157.9	11.35	163.7	160.5
10	11.62	147.9	105.6	11.97	139.3	122.7	11.45	162.1	151.5	11.27	160.0	161.3	11.37	163.9	156.8
11	11.54	149.4	101.9	11.74	144.9	118.7	10.33	170.8	144.6	11.49	157.2	164.1	10.99	159.6	166.6
12	11.70	145.8	106.3	11.61	144.7	121.9	11.50	157.7	155.7	11.22	163.7	163.9	11.24	161.6	163.6
13	10.78	145.6	103.1	10.99	142.0	117.3	9.85	171.0	144.2	9.97	165.4	158.0	10.03	163.4	158.6
14	11.13	149.4	101.1	11.32	143.4	120.2	10.43	162.3	150.9				10.47	167.3	158.4
15	10.46	146.6	102.2	10.91	145.6	116.2	9.78	163.5	151.7	10.29	159.5	161.0	9.74	162.5	159.9
16	11.60	147.6	108.0	11.84	139.7	123.9	11.09	157.6	156.8	11.19	160.2	163.4	11.00	165.3	161.7
17	11.70	150.3	100.0	12.04	144.5	120.0	10.56	168.0	148.7	10.39	173.5	154.4	10.46	170.1	155.5
18	11.31	144.4	113.4	11.03	141.9	125.9	10.42	160.2	155.2	10.25	161.8	160.6	10.60	163.5	159.3
19	11.83	148.9	106.3	11.92	147.3	118.1	11.07	169.5	147.9	11.12	168.0	154.9			
20	11.24	151.1	98.7	11.44	146.8	113.7	11.22	164.2	149.2	11.60	164.2	159.2	11.49	162.2	158.4
21	10.34	151.3	102.5	10.51	149.2	112.0	10.34	164.0	148.0	10.32	162.7	158.7	10.19	162.7	160.5
22	10.99	145.2	108.6	11.41	144.9	123.1	10.65	169.4	150.5	10.70	171.5	156.1	10.04	176.1	154.2
23	11.13	149.6	100.8	10.78	146.8	115.5	9.93	161.3	151.6	9.96	166.9	157.0	10.38	164.1	161.1
24	11.12	149.5	103.0	11.28	148.0	115.1	10.64	163.5	154.4	10.54	165.2	161.8	10.43	165.6	164.3
MEAN VL	11.29	148.5	104.4	11.40	145.0	119.7	10.56	165.6	149.7	10.76	164.7	159.6	10.70	165.1	160.0
STD DEV	0.51	2.4	4.5	0.49	2.6	4.7	0.62	5.8	4.7	0.54	4.3	2.9	0.54	3.5	3.0

APPENDIX A-5

Foot Rest Data

FOOT POSITION 1

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	24	5.62	1.09	0.57	0.67	32.07	0.82
13	10	2	24	4.98	1.03	0.73	0.62	27.39	0.82
13	10	3	24	3.19	0.79	0.79	0.54	23.41	0.61
13	10	4	24	-0.20	1.20	-6.54	0.63	24.70	0.72
13	10	8	24	4.61	1.08	-7.15	1.20	5.22	0.54
13	10	9	24	18.44	1.00	-5.03	1.42	16.01	0.66
13	10	10	24	19.78	1.36	-7.62	1.55	12.41	1.47
13	10	11	24	20.95	1.50	-6.42	1.89	14.10	1.86
27	10	1	24	0.08	0.96	0.30	0.52	30.69	0.79
27	10	2	24	-0.36	1.02	0.40	0.57	26.01	0.71
27	10	3	24	-1.92	0.64	0.44	0.53	22.37	0.53
27	10	4	24	-5.44	0.97	-6.97	0.50	22.95	0.73
27	10	8	24	3.71	0.68	-7.11	0.91	4.82	0.54
27	10	9	24	17.44	0.87	-5.17	1.37	15.90	0.59
27	10	10	24	18.78	1.13	-7.70	1.42	12.24	1.44
27	10	11	24	20.07	1.47	-6.57	1.94	14.10	1.99
51	10	1	24	-10.07	1.20	0.27	0.70	25.96	0.64
51	10	2	24	-9.77	0.99	0.31	0.59	21.27	0.57
51	10	3	24	-10.09	0.80	0.37	0.51	18.64	0.57
51	10	4	24	-13.85	0.88	-7.00	0.63	17.92	0.70
51	10	8	24	2.74	0.72	-7.33	0.76	4.21	0.51
51	10	9	24	16.28	0.76	-5.32	1.44	15.79	0.52
51	10	10	24	17.49	0.97	-7.91	1.45	11.98	1.37
51	10	11	24	19.07	1.20	-6.63	1.79	14.35	1.68
65	10	1	24	-15.70	1.15	0.28	0.61	22.14	0.69
65	10	2	24	-14.23	0.98	0.37	0.67	17.68	0.76
65	10	3	24	-13.99	0.90	0.35	0.66	15.36	0.44
65	10	4	23	-17.59	1.08	-6.74	0.78	13.89	0.47
65	10	8	24	2.38	0.85	-7.20	1.03	3.99	0.58
65	10	9	24	15.63	0.80	-5.44	1.33	15.73	0.78
65	10	10	24	16.97	1.16	-8.18	2.17	12.10	1.77
65	10	11	24	18.28	1.27	-6.91	1.77	14.01	1.71
65	20	1	23	-16.31	1.23	0.09	0.50	22.37	0.68
65	20	2	23	-15.02	0.97	0.15	0.48	17.87	0.74
65	20	3	23	-14.77	0.79	0.29	0.54	15.65	0.36
65	20	4	23	-18.42	1.04	-6.70	0.70	14.06	0.54
65	20	8	23	1.39	0.82	-7.44	1.51	4.32	0.70
65	20	9	23	14.49	0.73	-5.37	1.42	16.26	0.49
65	20	10	23	15.87	1.18	-7.63	1.70	12.67	1.81
65	20	11	23	17.05	1.39	-7.07	1.75	14.35	1.70

FOOT POSITION 2

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	24	5.59	1.16	0.52	0.66	32.15	0.85
13	10	2	24	4.98	1.02	0.61	0.58	27.43	0.84
13	10	3	24	3.18	0.75	0.68	0.49	23.44	0.64
13	10	4	24	-0.06	1.20	-6.83	0.48	24.64	0.76
13	10	8	24	4.56	1.01	-7.63	1.02	5.15	0.64
13	10	9	24	18.97	1.06	-5.04	1.21	15.18	0.69
13	10	10	24	20.12	1.46	-7.64	1.40	11.50	1.42
13	10	11	24	21.42	1.52	-6.53	1.96	13.00	2.06
27	10	1	24	0.03	1.00	0.38	0.70	30.72	0.77
27	10	2	24	-0.26	0.93	0.51	0.69	26.04	0.72
27	10	3	24	-1.89	0.62	0.57	0.68	22.32	0.57
27	10	4	24	-5.35	0.98	-6.95	0.61	22.88	0.75
27	10	8	24	3.61	0.69	-7.27	1.07	4.64	0.62
27	10	9	24	18.20	0.81	-5.20	1.60	14.86	0.54
27	10	10	24	19.29	1.15	-7.78	1.47	11.13	1.38
27	10	11	24	20.72	1.53	-6.58	2.12	12.86	2.02
51	10	1	24	-10.04	1.20	0.17	0.61	26.00	0.67
51	10	2	24	-9.71	0.94	0.28	0.53	21.29	0.60
51	10	3	24	-10.05	0.75	0.33	0.46	18.65	0.50
51	10	4	23	-13.84	0.91	-7.04	0.61	17.95	0.71
51	10	8	24	2.82	0.64	-7.38	0.98	4.13	0.56
51	10	9	24	16.98	0.69	-5.51	1.37	15.04	0.48
51	10	10	24	17.99	1.01	-8.02	1.30	11.06	1.41
51	10	11	24	19.64	1.26	-6.78	1.78	13.33	1.58
65	10	1	24	-15.55	1.08	0.34	0.67	22.06	0.60
65	10	2	24	-14.16	0.93	0.38	0.66	17.56	0.70
65	10	3	24	-13.94	0.90	0.36	0.73	15.38	0.38
65	10	4	24	-17.45	1.23	-6.97	0.73	13.84	0.41
65	10	8	24	2.34	0.73	-7.19	1.05	4.12	1.15
65	10	9	24	16.33	0.72	-5.60	1.56	14.79	0.60
65	10	10	24	17.44	1.19	-7.88	1.56	11.10	1.55
65	10	11	24	18.90	1.32	-7.05	1.87	12.96	1.68
65	20	1	23	-16.28	1.16	0.19	0.48	22.29	0.68
65	20	2	23	-15.06	0.93	0.22	0.47	17.82	0.78
65	20	3	23	-14.77	0.82	0.30	0.58	15.65	0.40
65	20	4	23	-18.46	1.07	-6.66	0.65	14.05	0.62
65	20	8	23	1.38	0.65	-7.24	1.34	4.46	0.74
65	20	9	23	15.13	0.64	-5.25	1.25	15.68	0.48
65	20	10	23	16.30	1.24	-7.55	1.72	12.06	1.55
65	20	11	23	17.59	1.40	-7.00	1.52	13.62	1.76

FOOT POSITION 3

BACK REST ANGLE	SEAT PAN ANGLE	POINT NO.	SAMPLE SIZE	X-MEAN	X-STAND DEVIATION	Y-MEAN	Y-STAND DEVIATION	Z-MEAN	Z-STAND DEVIATION
13	10	1	24	5.72	1.20	0.43	0.70	32.16	0.81
13	10	2	24	5.12	1.11	0.54	0.65	27.44	0.86
13	10	3	24	3.29	0.72	0.61	0.57	23.37	0.67
13	10	4	24	0.07	1.22	-6.83	0.54	24.61	0.75
13	10	8	24	4.54	1.00	-7.76	0.95	5.05	0.59
13	10	9	24	19.77	1.07	-5.08	1.32	14.07	0.80
13	10	10	24	20.62	1.59	-7.67	1.66	10.39	1.28
13	10	11	24	21.95	1.62	-6.61	1.83	11.86	1.83
27	10	1	24	0.03	1.09	0.37	0.70	30.66	0.76
27	10	2	24	-0.32	0.98	0.50	0.64	25.97	0.73
27	10	3	24	-1.86	0.62	0.55	0.59	22.27	0.58
27	10	4	24	-5.34	1.11	-6.92	0.49	22.89	0.70
27	10	8	24	3.73	0.79	-7.66	0.86	4.57	0.57
27	10	9	24	18.82	0.82	-5.23	1.45	13.97	0.49
27	10	10	24	19.70	1.23	-7.94	1.98	10.21	1.24
27	10	11	24	21.24	1.55	-6.69	1.76	11.81	1.99
51	10	1	24	-10.04	1.19	0.23	0.61	25.82	0.65
51	10	2	24	-9.81	0.97	0.27	0.65	21.12	0.63
51	10	3	24	-10.04	0.80	0.28	0.56	18.65	0.49
51	10	4	23	-13.72	0.85	-7.11	0.59	17.95	0.70
51	10	8	24	2.85	0.72	-7.47	1.03	4.06	0.55
51	10	9	24	17.80	0.71	-5.23	1.27	13.96	0.44
51	10	10	24	18.53	1.20	-7.82	1.40	10.11	1.28
51	10	11	24	20.32	1.24	-6.56	1.72	12.13	1.43
65	10	1	24	-15.53	1.15	0.18	0.68	22.12	0.63
65	10	2	24	-14.11	0.92	0.32	0.71	17.65	0.72
65	10	3	24	-13.86	0.88	0.34	0.76	15.34	0.35
65	10	4	24	-17.36	0.94	-6.78	0.74	13.83	0.43
65	10	8	24	2.39	0.76	-7.51	0.92	3.98	0.61
65	10	9	24	17.03	0.85	-5.52	1.45	14.05	0.53
65	10	10	24	17.88	1.36	-7.81	1.63	10.15	1.45
65	10	11	24	19.48	1.41	-7.03	1.73	12.03	1.60
65	20	1	23	-16.26	1.24	0.10	0.51	22.33	0.73
65	20	2	23	-14.94	0.99	0.21	0.49	17.83	0.76
65	20	3	23	-14.71	0.79	0.24	0.57	15.64	0.39
65	20	4	23	-18.41	0.84	-6.87	0.61	14.07	0.62
65	20	8	23	1.38	0.64	-7.64	1.26	4.17	0.70
65	20	9	23	15.80	0.64	-5.48	1.31	14.93	0.45
65	20	10	23	16.70	1.35	-7.74	1.56	11.16	1.48
65	20	11	23	18.08	1.47	-7.16	1.80	12.66	1.73

Top of Knee Position for 5th to 95th Percentile as a Function of Seat Configuration for Foot Position 1

Coordinates	I	II	III	IV	V	Percentile
	20.09	18.88	17.53	16.99	15.69	95th
X	18.44	17.44	16.28	15.65	14.49	50th
	16.79	16.00	15.03	14.32	13.29	5th
	17.10	16.86	16.65	17.02	17.07	95th
Z	16.01	15.90	15.79	15.73	16.26	50th
	14.92	14.94	14.93	14.44	14.45	5th
Displacement						
		-1.21	-2.56	-3.10	-4.40	95th
X		-1.00	-2.16	-2.79	-3.95	50th
		-.79	-1.76	-2.47	-3.50	5th
		-.24	-.45	-.08	-.03	95th
Z		-.11	-.22	-.28	-.25	50th
		.02	.01	-.48	.53	5th