Process Contracting Limited
Human Factors Consultancy

Bridge ergonomics

Some anthropometric considerations for ISO TC8/SC5

May 2004
For use by ISO TC8/SC5 only
N3……

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Summary

This note is an interim expansion of a paper by the author and Denise McCafferty of ABS in Alert! Magazine. It is intended to expand it further as a technical note on anthropometrics for ship design and operation.

At this issue it is concerned with two points about bridge design. Firstly, the need to decide the user population for which bridges should be designed, and secondly to summarise some console dimensions.

The assistance of SIRC in obtaining relevant seafarer population data is gratefully acknowledged.

Author.....Brian Sherwood Jons.....Date.....May 2004....

Version Number.....v1.....

Version history

V1 – new document May 2004

1. Introduction to anthropometrics

Anthropometrics is the branch of ergonomics which deals with body measurements, particularly those of size,strength and physical capacity. Good ergonomic design makes provision for the range of variability to be expected in the user population. 'Improving Operational Design' [1] points out that Korean and Japanese ship designs can assume that the height of seafarers will be about 5'6" rather than 6', and that extra length in bunks and settees may be required for European crews.
Variation in user population can also affect design for safety. ABS has recently updated its ergonomic guidance [2], and gives an example of this. The International Life-Saving Appliance Code [IMO Resolution MSC.48(66)] specifies a seat accomodation of 433 mm. It was later noted [4] that in the Gulf of Mexico offshore workers were too large to fit in lifeboats. Field anthropometric measurements of Gulf of Mexico offshore workers revealed an appropriately clothed hip width of 533 mm – A potential overestimate of maximum lifeboat occupancy for this population by about 20%. A similar difference in average weight (75 kilos vs. 95 kilos) had the potential to affect buoyancy and stability.
There are significant differences in the body dimensions, body shape, weight, and proportions of people living and working in different parts of the world. For example, a design range for 90% of the British for a standing operation would also accommodate 90% of Germans but only 10% of Vietnamese. It has also been shown that even an adjustable safety helmet designed in an industrialized country cannot be fitted properly by 40% of Sri Lankans. Considerable inconvenience, accidents, injuries and low productivity have been shown to be the result of misfits between people and equipment. Workplaces, equipment, tools and protective clothing must fit the physical characteristics of the intended user population. [11].
Lessons to be learned include:

- Subpopulations may vary dramatically from a parent population;
- Where the application of anthropometric data to design can have serious safety implications, field validation studies should be considered (an example of 'honouring the seafarer' by involvement in design decisions).

The application of anthropometry to design establishes limits (or boundary conditions) for sizing equipment for human use. In essence, it defines size limits in design based on the dimensions of the anticipated population of operating and maintenance personnel. By imposing size limits in design (e.g., designing so the shortest expected operator or maintainer can reach all controls), it follows that personnel who are less demanding in their requirements will also be accommodated (e.g., have greater reach than the limiting personnel).
For any body dimension, the 5th percentile value indicates that 5% of the population will be equal to or smaller than that value, and 95% will be larger. On the other hand, the 95th percentile value indicates that 95% of the population will be equal to or smaller than that value, and 5% will be larger. Therefore, use of a design range from the 5th to the 95th percentile (for either male or female populations, but not both) values will theoretically provide coverage for 90% of that (male or female) population using those limiting dimensions, and only those smaller than the 5%, and larger than the 95% will be excluded by design.
Note that the notion of the "average person" is misleading in that an individual will vary among different anthropometric dimensions. For example, individuals who are of average (50%) stature, can be comparatively smaller or larger on other dimensions, such as arm length.

In general, there are four principles of applied anthropometrics in design:
1 Design for the Smallest

This principle applies primarily to application of physical force and vertical and lateral reach distances. For example, the forces required to pull, push, or turn a handle. Usually, the maximum force that can be readily applied by the 5th percentile person for that movement is used as the criterion. Similarly, the reach of the 5th percentile person is often used as the criterion.
2 Design for the Largest
This principle applies primarily to clearances, such as escape hatches, maintenance accesses, lifeboats, walkways, and overhead clearances. Clearances generally are such that at least 95% of the expected population is accommodated. In some cases, persons whose body size exceeds the designed clearances are precluded from selection for the system.
3 Design for the Average
This principle applies to workstations that are not adjustable (e.g. fixed height tables, desks, or other work surfaces). In these situations, designing for the average person better accommodates the entire population.
4 Design for the Range
This principle is applied to determining the amount of adjustability that should be built into such things as variable height work surfaces and workstation seating (e.g., horizontal and vertical adjustability). In general, the dimension criteria used for designing adjustability readily accommodates the middle 90% of the population.
The ABS guidance [2] gives a full worked example of how to calculate headroom.

Figure 1 summarises some of the issues involved in headroom and related topics.

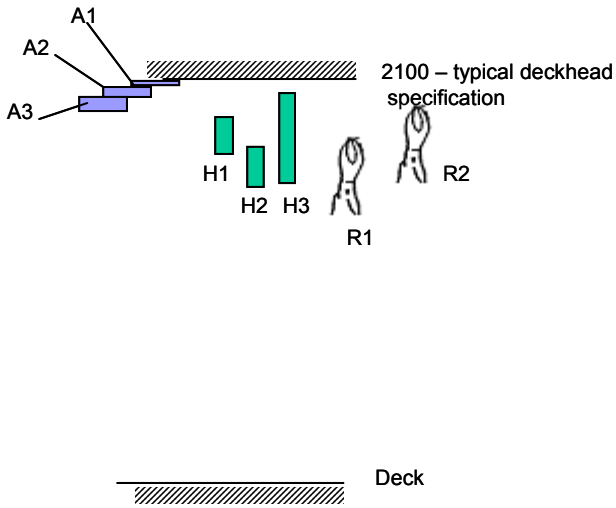


Figure 1. Headroom considerations

Figure 1 shows a typical headroom clearance and some related design factors.
A1, A2, A3 are allowances that may need to be made. A1 is 25 mm for normal footwear, A2 is 50 mm for height change from walking, A3 is 75 mm for a hard hat.
H1, H2, H3 are the variations in height (stature) for three different populations (5%ile to 95%ile). H1 is for N European males [2], and is compatible with the deck height (design for the maximum). H2 is taken from some data for male Philipinos [4]. H3 is a design population developed for the ATOMOS Ship Control Centre [5] and is a range from a small female to a large male for a population up to 2015 – a large range of 475 mm. As can be seen, this is (just) compatible with the deck height but with no hard hat or safety factor allowances. For the SCC to be compatible with 'design for the minimum' required raised chairs and consoles, with a decreased height for the rim of the navigation console.
R1, R2 are 5%ile vertical functional reach heights for different populations. R1 is that of a S. Indian population [6] and R2 is for a UK population [7]. For Europeans, controls over walkways are not quite possible, while for a wider population they are definitely out of reach, headbangers, or both.

2. Seafarer population and dimensions

2.1 Nationality issues

The seafarer population is changing. Figure 2 shows the top ten nationalities in the estimated world fleet –2002 from the SIRC database [8]. Fuller data are included in Section 5.

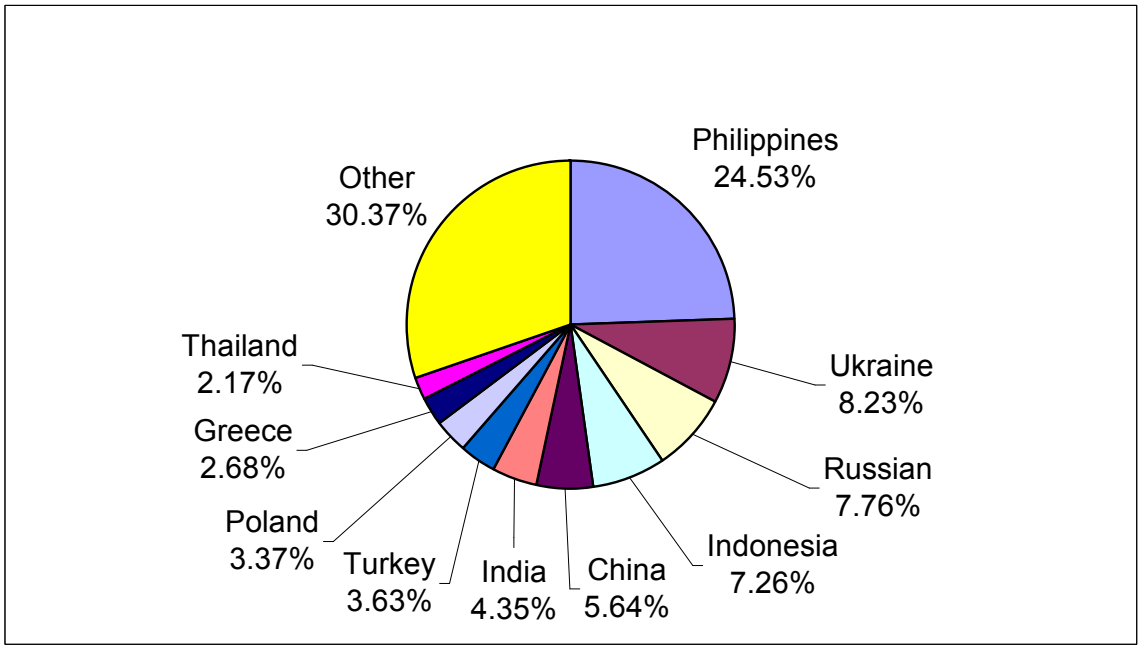
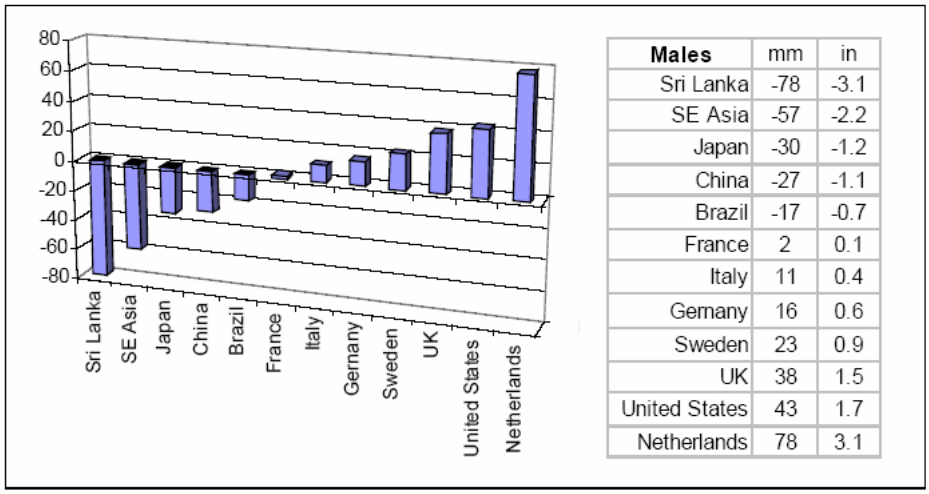


Figure 2 –Seafarer population

Inspection of the fuller data in Section 5 shows that the populations used for determining anthropometric dimensions now make up a very small part of the seafaring population. Some international data are given below. From a literature survey, it would appear that good data on the major parts of the seafarer population are hard to obtain.

Differences in 50th Percentile Male Stature for 12 Regions, in Millimeters, from the Average Stature of 1717 mm (67.6 inches)



Males	mm	in
Sri Lanka	-78	-3.1
SE Asia	-57	-2.2
Japan	-30	-1.2
China	-27	-1.1
Brazil	-17	-0.7
France	2	0.1
Italy	11	0.4
Germany	16	0.6
Sweden	23	0.9
UK	38	1.5
United States	43	1.7
Netherlands	78	3.1

Figure 3 – (From [2])

Essential International Anthropometric Data for Males

Males (mm and inches)	*North America (US)*			*Japan*			*Southeast Asia*†			*Europe**		
	5%	*50%*	*95%*	*5%*	*50%*	*95%*	*5%*	*50%*	*95%*	*5%*	*50%*	*95%*
Stature (floor to top of head)	1644	1760	1876	1593	1687	1781	1530	1630	1720	1604	1728	1847
	64.7	69.3	73.9	62.7	66.4	70.1	60.2	64.2	67.7	63.1	68.0	72.7
Seated Stature (buttocks to top of head)	862	923	984	855	913	970	790	840	900	836	894	959
	33.9	36.3	38.7	33.7	35.9	38.2	31.1	33.1	35.4	32.9	35.2	37.8
Shoulder Breadth (deltoid to deltoid)	449	509	569	413	448	484	380	410	430	420	456	496
	17.7	20.0	22.4	16.3	17.6	19.1	15.0	16.1	16.9	16.5	18.0	19.5
Standing Eye Height	1529	1643	1758	1474	1568	1661				1509•	1613•	1720•
	60.2	64.7	69.2	58.0	61.7	65.4				59.5•	63.4•	67.7•
Seated Eye Height (buttocks to eye)	733	793	853	726	775	832	680	730	780	740‡	796‡	851‡
	28.9	31.2	33.6	28.6	30.5	32.8	26.8	28.7	30.7	29.1‡	31.3‡	33.5‡
Back of Knee Height (approximate maximum seat height)	404	450	496	369	408	447	380	415	445	425	473	521
	15.9	17.7	19.5	14.5	16.1	17.6	15.0	16.3	17.5	16.7	18.6	20.5
Forward functional reach (back of shoulder to fingertips)	842	909	975	758	820	882	730	780	820	711‡	771‡	827‡
	33.1	35.8	38.4	29.8	32.3	34.7	28.7	30.7	32.3	28.0‡	30.4‡	32.6‡
Standing Overhead Reach (floor to tip of extended middle finger)	2067	2237	2407	1959	2121	2282						
	81.4	88.1	94.8	77.1	83.5	89.8						
Arm Length (finger tip to shoulder)	737	796	856	682	735	787				711	771	827
	29.0	31.3	33.7	26.9	28.9	31.0				28.0	30.4	32.6
Hip Breadth	312	372	432	299	328	357				310•	344•	368•
	12.3	14.6	17.0	11.8	12.9	14.1				12.2•	13.5•	14.5•

† Represented by Brunei, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, and Viet Nam. Source: *International Data on Anthropometry*. International Labor Organization, 1990. The data in this source dates to the middle 1960's and may be out of date. For males, regional growth in the area since that time is approximately 29 mm in stature, or an increase of about 2%. Given this, users of the Southeast Asia data for males may consider scaling stature, leg length, and reach dimensions by a factor of 1.02. The data contained in the above table are true to the source document.

* Represented by data from Sweden, Germany, Italy, and France. Source: *ADULTDATA: The Handbook of Adult Anthropometric and Strength Measurements – Data for Design Safety*. Institute for Occupational Ergonomics, University of Nottingham, UK. 1998.

‡ French population data. • German population data.

Figure 4 – from [2]. The (fairly old) ILO reference cited (based on older data again) is still the major source of international data.

The existing ISO 8468 designed for the 2.5%ile to the 97.55ile population. This is good practice. Less good, but also common, is to design for the 5th to 95th %ile range. By designing for the greater range, the standard has stood the test of time in terms of being more able to aocommodate the increasing height of the European population, and the shorter stature of the Pacific population.

Some dimensions extracted from the literature follow:

Source	Short stature	Tall stature	Sitting height
ATOMOS	Short female height: 1551 mm	Tall male height 2026 mm	Short female 830 mm. Tall male 1029.
[6] S Indian	5%ile 1509 mm		
[4] Filipino	5%ile 1550	95%ile 1745	
(ABS) S China male	5%ile 1610 mm		

It has been argued that the Pacific rim population will become taller with increasing industrialisation and better health and nutrition. The author is not able to confirm or deny this assertion, or to find any timescales for when it might reach a comparable state to US or European populations. There has been some publicity lately on the recent findings that the European population is (unlike the US) continuing to get taller, while the US population is getting fatter.

The ATOMOS view was that anthropometric measurements from the year 1988-1989 are outdated when designing a workspace which will be operative until the year 2015. From the year 1989 to 2015 the mean average height for Dutch male is expected to shift from 1810 to 1852 mm (26 x 1.6 mm = 41.6 mm). For the design of workspaces we should take into account extrapolated anthropometric measurements. The ergonomic study for the ATOMOS designs is based on the anthropometric database Antro >95 (Daanen et al., 1997). The database is a survey of measured body dimensions of Dutch high school students in their final year. The results from the survey are also extrapolated to determine the anthropometric measure¬ments of a fully grown young Dutch adult population for the year 2015, and based on a constant secular growth shift.

2.2 Gender issues

ILO has pointed out the increasing number of women seafarers [9]. Women represent only 1-2 per cent of the world's 1.25 million seafarers. However, in the cruise line sector, they represent 17-18% of the workforce. Ninety-four per cent of women are employed on passenger ships (with 68% on ferries and 26% on cruise ships) and 6% are employed on cargo vessels (i.e., container ships, oil tankers, etc.). As for jobs, there are women shipmasters and chief engineers, as well as other officers. However, generally, women are working as hotel staff on passenger ships.Of this latter group, 51.2% of women at sea come from OECD countries, 23.6% from Eastern Europe, 9.8% from Latin America and Africa, 13.7% from the Far East, and 1.7% from south Asia and the Middle East.
Using limiting dimensions for males and females (5th percentile female and 95th percentile male) will accommodate approximately 94% of the entire design population (since over 99% of males are larger than the 5th percentile female, and over 99% of females are smaller than the 95th percentile male, so few small males, or large females, are excluded). This was the approach taken, in a European context, by ATOMOS. It is interesting to note that by designing for European females (on equality grounds) they are also going a long way towards designing for the Pacific male population.

3. Console dimensions

Some ATOMOS considerations were:
Work chair (for desk height: 720-750 mm)

Seat Width W	420∀20 mm
Seat Height H (if fixed)	450 mm
Seat Height H (pref.adjust.)	460∀40 mm
Seat Length L	400∀20 mm
Armrest Height A	240∀10 mm
Armrest to SF D	150 mm
Width between Arms S	500 mm
Seat-back Height B	300∀50 mm
Seat-back Angle β	110E - 135E
Seat Angle α	5E - 13E
Back-radius Top R	400 mm
Space O	120 mm

Pedestal chair (for desk height: 750 + X mm)

Seat height H (if fixed)	X+450 mm
Seat Height H (pref.adjust.)	X+460∀40 mm
Footrest Height F	X mm

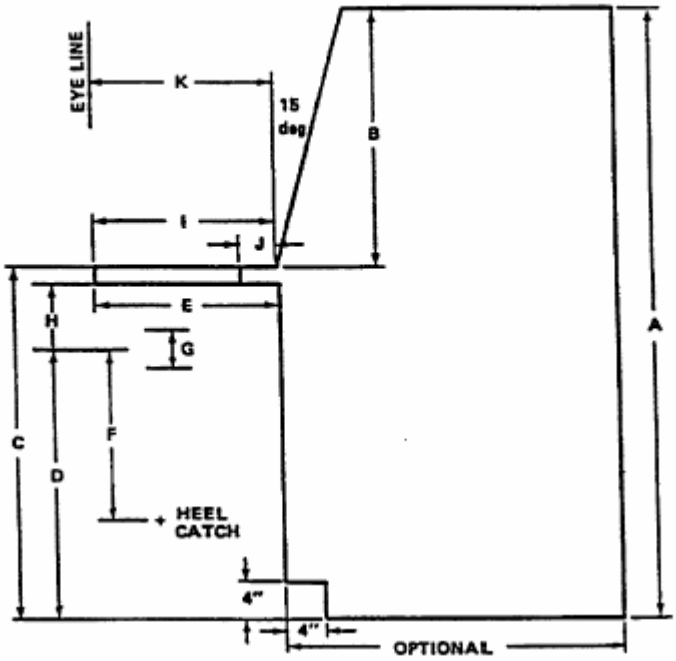
Other dimensions as for work-chair (above).

MIL STD 1472F dimensions

TABLE XIV. Standard console dimensions

	MAXIMUM TOTAL CONSOLE HEIGHT FROM STANDING SURFACE	SUGGESTED VERTICAL DIMENSION OF PANEL (INCLUDING SILLS)	WRITING SURFACE: SHELF HEIGHT FROM STANDING SURFACE	SEAT HEIGHT FROM STANDING SURFACE AT MIDPOINT OF G	MAXIMUM CONSOLE WIDTH (NOT SHOWN)
	A	B	C	D	
1. SIT (WITH VISION OVER TOP)[1]	1.170 m (46 in) 1.335 m (52.5 in) 1.435 m (56.5 in)	520 mm (20.55 in) 520 mm (20.55 in) 520 mm (20.55 in)	650 mm (25.5 in) 810 mm (32 in) 910 mm (36 in)	435 mm (17 in) 595 mm (23.5 in) 695 mm (27.5 in)	1.120 m (44 in) 1.120 m (44 in) 1.120 m (44 in)
2. SIT (WITHOUT VISION OVER TOP)	1.310 m (51.5 in) 1.470 m (58.0 in) 1.570 m (62.0 in)	660 mm (26 in) 660 mm (26 in) 660 mm (26 in)	650 mm (25.5 in) 810 mm (32 in) 910 mm (36 in)	435 mm (17 in) 595 mm (23.5 in) 695 mm (27.5 in)	910 mm (36 in) 910 mm (36 in) 910 mm (36 in)
3. SIT-STAND (WITH STANDING VISION OVER TOP)	1.535 m (60.5 in)	620 mm (24.5 in)	910 mm (36 in)	695 mm (27.5 in)	910 mm (36 in)
4. STAND (WITH VISION OVER TOP)	1.535 m (60.5 in)	620 mm (24.5 in)	910 mm (36 in)	NA	1.120 m (44 in)
5. STAND (WITHOUT VISION OVER TOP)	1.830 m (72 in)	910 mm (36 in)	910 mm (36 in)	NA	910 mm (36 in)

[1]THE RANGE IN "A" IS PROVIDED TO ALLOW LATITUDE IN THE VOLUME OF THE LOWER PART OF THE CONSOLE: NOTE RELATIONSHIP TO "C" AND "D".



KEY	DIMENSIONS	mm	(in.)
A	MAXIMUM TOTAL CONSOLE HEIGHT FROM STANDING SURFACE	SEE TABLE IV	SEE TABLE IV
B	SUGGESTED VERTICAL DIMENSION OF PANEL, INCL SILLS		
C	WRITING SURFACE: SHELF HEIGHT FROM STANDING SURFACE		
D	SEAT HEIGHT FROM STANDING SURFACE AT MIDPOINT OF "G"		
E*	MINIMUM KNEE CLEARANCE	(460)	18
F*	FOOT SUPPORT TO SITTING SURFACE**	(460)	18
G*	SEAT ADJUSTABILITY	(150)	6
H*	MINIMUM THIGH CLEARANCE AT MIDPOINT OF "G"	(190)	7.5
I	WRITING SURFACE DEPTH INCLUDING SHELF	(400)	16
J	MINIMUM SHELF DEPTH	(100)	4
K	EYE LINE-TO-CONSOLE FRONT DISTANCE	(400)	16

*NOT APPLICABLE TO CONSOLE TYPES 4 AND 5 OF TABLE XIV.

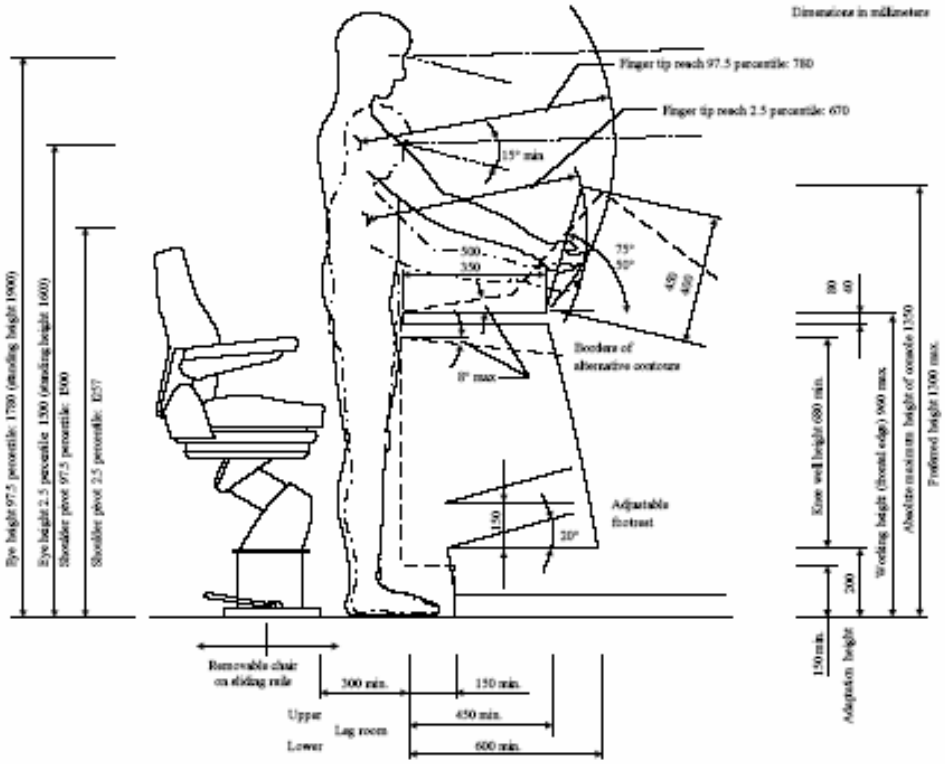
**SINCE THIS DIMENSION MUST NOT BE EXCEEDED, A HEEL CATCH MUST BE ADDED TO THE CHAIR IF "D" EXCEEDS 460 mm (18 in.).

NOTE: A SHELF THICKNESS OF 25 mm (1 in.) IS ASSUMED. FOR OTHER SHELF THICKNESS, SUITABLE ADJUSTMENTS SHOULD BE MADE.

ABS dimensions

FIGURE 1

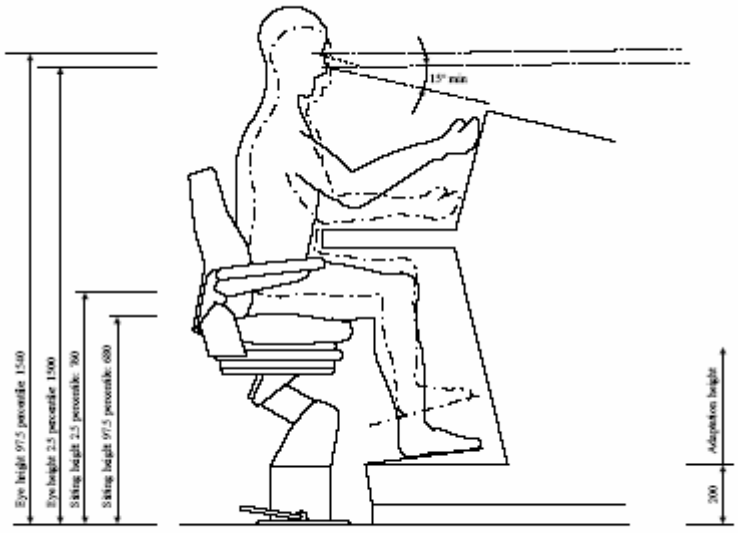
Console Configuration and Dimensions for Standing Positions



Note: The intention of this figure is only to demonstrate solutions based on ergonomic principles.

FIGURE 2

Console Configuration and Dimensions for Sitting Positions



Notes:

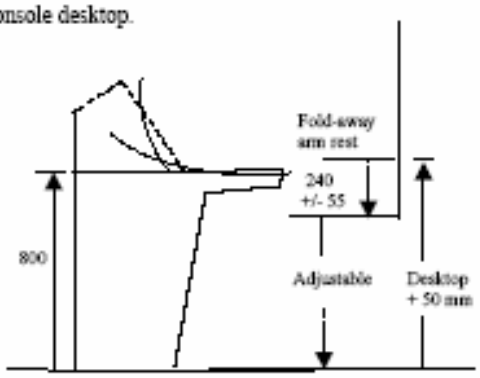
1 The intention of this figure is only to demonstrate solutions based on ergonomic principles.

2 Preferred knee well width for sitting position is 600 mm, minimum 500 mm.

3 The height measurements of consoles for only a sitting position shall be reduced by the adaptation height of 200 mm.

BDEAP dimensions

Guidance note:
To provide a functional reach from standing position, the height of console desktops above bridge deck surface should be 800 mm and not less than 750 mm. The sitting height is governed by the elbow height in relation to console desktop.



To provide a functional reach of equipment and easy operation of controls from sitting position, the elbow height of the operator should preferably be 50 mm higher than the console desktop and not less than the height of the desktop.

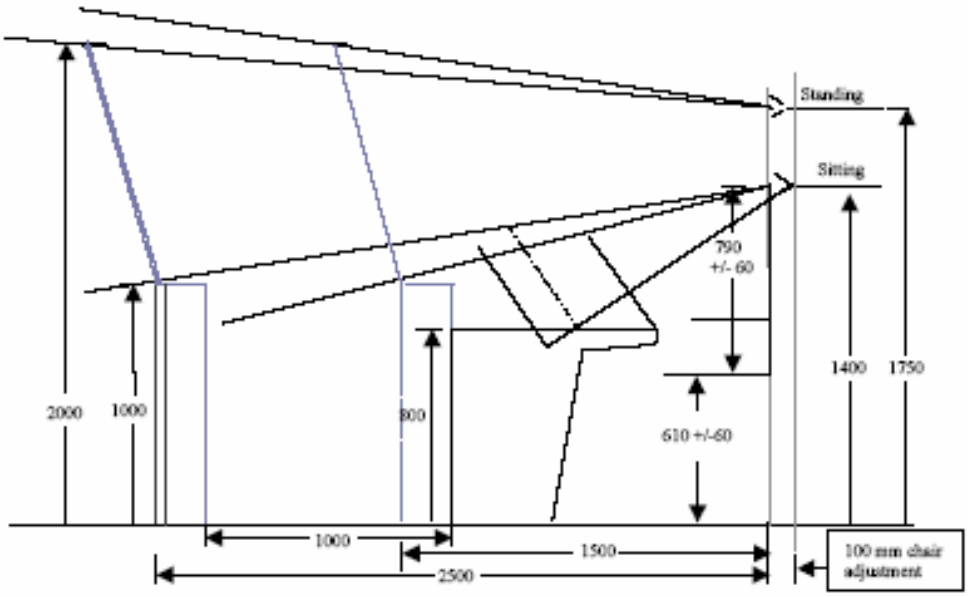
To provide the elbow height required for persons of different size and build in relation to the console desktop, it should be possible to adjust the height of the seat to allow an elbow height of 240 mm +/- 55 mm above the seat. It should be possible to adjust chair armrests accordingly, if installed, and to fold the armrests away.

B 7.5 The console in front of a seated working position shall provide sufficient leg room.

Guidance note:
The leg room should have a depth of 450 mm and not less than required for a person sitting at a working position 350 mm from the console (chair backrest 440 mm from the edge of the console, requiring a leg room depth of at least 230 mm.)

B 7.6 The consoles forming the front workstations shall not be higher than required for efficient use in standing position and shall not obstruct the fields of vision over the lower edge windows in front of the workstation from sitting position.

Guidance note:
The console height should not exceed 1200 mm. This console height may be accepted for installation at a distance of 350 mm or more from the window, also if it interferes with the line of sight from an eye height of 1400 mm, providing the height of the chair can be adjusted to compensate for the interference.



Note: See B6.3 for eye heights at standing position

B 7.7 Consoles within the required fields of vision aft of the front workstation consoles shall not obstruct the horizontal line of sight from the sitting eye height.

Guidance note:
The height of the consoles should be 100 mm lower than the horizontal line of sight and should not exceed 1300 mm.

B 7.8 When a chair is installed at a workplace for operations in both standing and seated position, it shall be fastened to rails allowing fore and aft movement of the seat to enable easy reach of equipment when seated and sufficient room to stand in front of the console when the chair is pushed back. It shall be possible to adjust the height of the seat to suit users of different heights for optimum view and reaching distance and armrests, if provided, shall be of fold away type and preferably adjustable in height.

Guidance note:
The seat height of the chair should be adjustable from 550 to 670 mm above the deck surface. The movement in fore-aft direction should allow the front edge of the seat to be positioned at the edge of the front console and to allow a free space of at least 700 mm between the chair and console when moved in aft direction. Armrests should preferably be adjustable from 185 and 295 mm above the seat if installed.

MSC/Circ. 982 dimensions

5.3.1.4 Console Height

The top of the consoles should not exceed a height of 1200 mm.

5.3.1.5 Console Leg Room

The upper leg room of the console should have a minimum of 450 mm in depth and the lower leg room a minimum of 600 mm in depth.

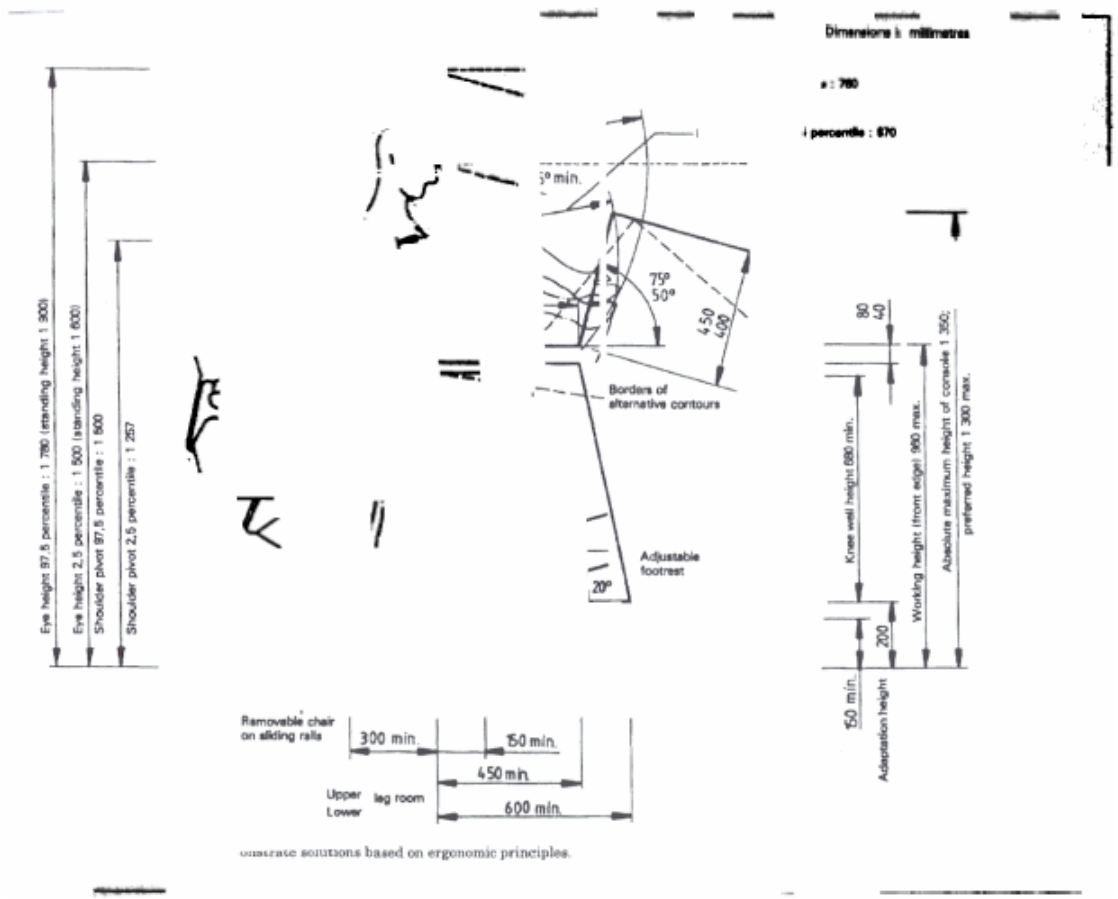
5.3.1.6 Chart Table Dimensions

The chart table should be large enough to accommodate all chart sizes normally used internationally for navigation.

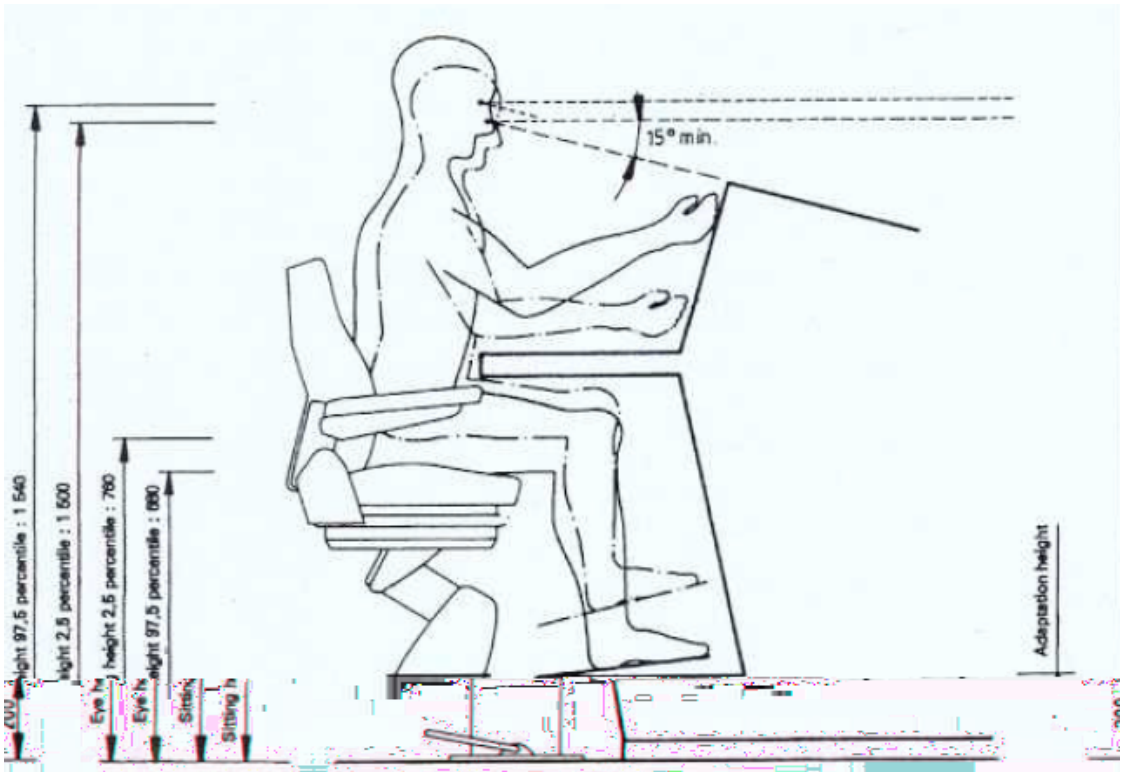
5.3.1.7 Chair Design

Chairs at workstations designed for a sitting position should be capable of rotating with the foot rest being arrested, adjustable in height, and capable of being arrested on the floor. Chairs should be movable out of the operating area.

ISO 8468 dimensions



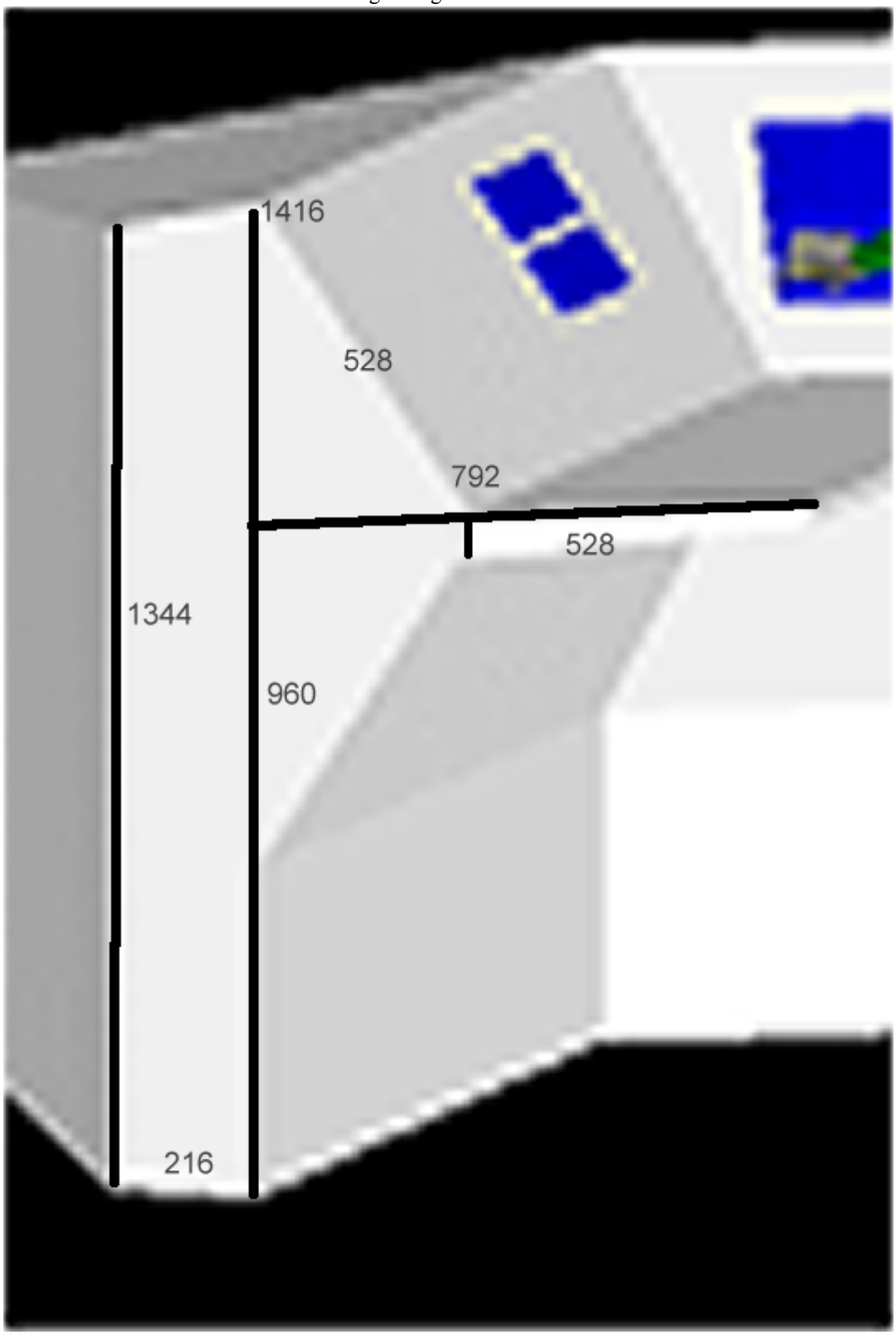
illustrate solutions based on ergonomic principles.



NOTE 1 The intention of this figure is only to demonstrate solutions based on ergonomic principles.
NOTE 2 Preferred knee well width for sitting position is 600 mm, absolute minimum 500 mm.
NOTE 3 The height measurements of consoles for only a sitting position shall be reduced by the adaptation height of 20

Figure 9 — Console for combined standing/sitting position — Example of sitting posi

Inferred dimensions from ATOMOS bridge design



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11. McCafferty (2000)

5. SIRC data

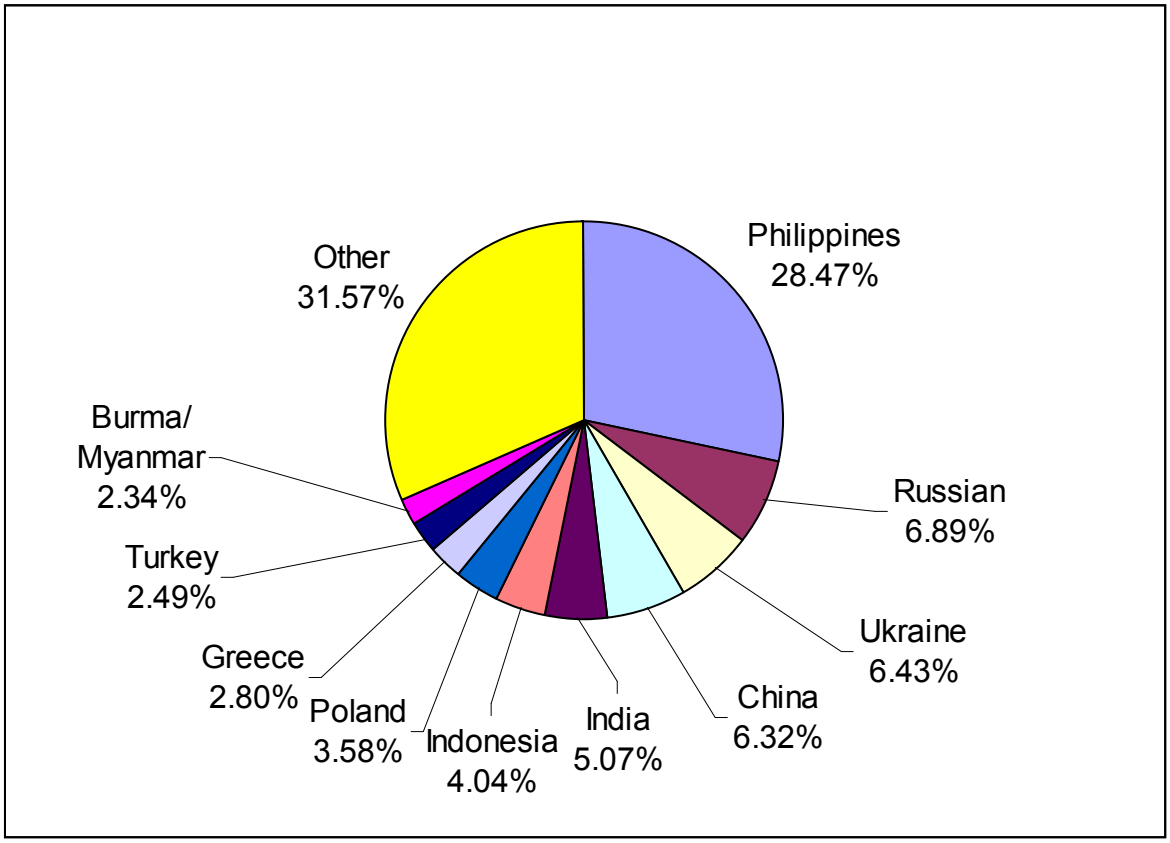
Frequency of seafarers in the SIRC sample by nationality - 2002

Nationality	Frequency	Percent	Valid Percent	Cumulative Percent
Philippines	27734	28.0	28.5	28.5
Russian	6715	6.8	6.9	35.4
Ukraine	6265	6.3	6.4	41.8
China	6156	6.2	6.3	48.1
India	4941	5.0	5.1	53.2
Indonesia	3935	4.0	4.0	57.2
Poland	3484	3.5	3.6	60.8
Greece	2728	2.8	2.8	63.6
Turkey	2421	2.4	2.5	66.1
Burma/ Myanmar	2280	2.3	2.3	68.4
Latvia	2073	2.1	2.1	70.6
Bulgaria	1905	1.9	2.0	72.5
Romania	1767	1.8	1.8	74.3
Croatia	1711	1.7	1.8	76.1
Korea, South	1669	1.7	1.7	77.8
Taiwan	1607	1.6	1.6	79.4
Germany	1307	1.3	1.3	80.8
Syria	1306	1.3	1.3	82.1
Netherlands	1042	1.1	1.1	83.2
Italy	1024	1.0	1.1	84.3
United States	1019	1.0	1.0	85.3
Malaysia	972	1.0	1.0	86.3
Thailand	934	.9	1.0	87.3
United Kingdom	852	.9	.9	88.1
Egypt	791	.8	.8	88.9
Denmark	770	.8	.8	89.7
Norway	733	.7	.8	90.5
Bangladesh	556	.6	.6	91.1
Spain	514	.5	.5	91.6
Viet Nam	488	.5	.5	92.1
Pakistan	487	.5	.5	92.6
Japan	458	.5	.5	93.1
Lithuania	443	.4	.5	93.5
Sweden	407	.4	.4	93.9
Kiribati	305	.3	.3	94.2
Sri Lanka	277	.3	.3	94.5
Iran	255	.3	.3	94.8

Yugoslavia	242	.2	.2	95.0
Georgia	231	.2	.2	95.3
France	226	.2	.2	95.5
South Africa	215	.2	.2	95.7
Brazil	199	.2	.2	95.9
Cuba	196	.2	.2	96.1
Ecuador	194	.2	.2	96.3
Azerbaijan	193	.2	.2	96.5
Estonia	187	.2	.2	96.7
Chile	185	.2	.2	96.9
Finland	178	.2	.2	97.1
Tuvalu	174	.2	.2	97.3
Israel	172	.2	.2	97.4
Belgium	167	.2	.2	97.6
Maldives	153	.2	.2	97.8
Cape Verde	145	.1	.1	97.9
Portugal	115	.1	.1	98.0
Singapore	107	.1	.1	98.2
Ghana	105	.1	.1	98.3
Honduras	104	.1	.1	98.4
Peru	98	.1	.1	98.5
Morocco	96	.1	.1	98.6
Hong Kong	91	.1	.1	98.7
Panama	79	.1	.1	98.7
Algeria	75	.1	.1	98.8
Iceland	75	.1	.1	98.9
Tunisia	69	.1	.1	99.0
Australia	63	.1	.1	99.0
El Salvador	62	.1	.1	99.1
Canada	53	.1	.1	99.1
Slovenia	48	.0	.0	99.2
Nicaragua	40	.0	.0	99.2
Czech Rep	38	.0	.0	99.3
Hungary	35	.0	.0	99.3
Lebanon	33	.0	.0	99.3
Libya	33	.0	.0	99.4
Ireland	30	.0	.0	99.4
Belarus	28	.0	.0	99.4
British Virgin Islands	28	.0	.0	99.5
Colombia	28	.0	.0	99.5
Ethiopia	25	.0	.0	99.5
Senegal	24	.0	.0	99.5
Argentina	23	.0	.0	99.6
Korea, North	23	.0	.0	99.6
Malta	21	.0	.0	99.6
Uruguay	20	.0	.0	99.6
Cote d Ivoire (Ivory Coast)	18	.0	.0	99.7
New Zealand	18	.0	.0	99.7
Guinea	17	.0	.0	99.7
Nigeria	16	.0	.0	99.7
Sierra Leone	16	.0	.0	99.7
Cyprus	15	.0	.0	99.7
Palestinian Territory	15	.0	.0	99.8
Slovakia	15	.0	.0	99.8
Tanzania	15	.0	.0	99.8

Austria	14	.0	.0	99.8
Benin	14	.0	.0	99.8
Guyana	14	.0	.0	99.8
Papua New Guinea	13	.0	.0	99.8
Sudan	12	.0	.0	99.9
Venezuela	12	.0	.0	99.9
Togo	9	.0	.0	99.9
Tonga	9	.0	.0	99.9
Albania	8	.0	.0	99.9
Barbados	8	.0	.0	99.9
Costa Rica	8	.0	.0	99.9
Kuwait	8	.0	.0	99.9
Switzerland	7	.0	.0	99.9
Mexico	6	.0	.0	99.9
Samoa	6	.0	.0	99.9
Iraq	5	.0	.0	99.9
Mali	5	.0	.0	99.9
Fiji	4	.0	.0	100.0
Jordan	4	.0	.0	100.0
Burkina Faso	3	.0	.0	100.0
Cayman Islands	3	.0	.0	100.0
Faeroe Islands	3	.0	.0	100.0
Kenya	3	.0	.0	100.0
Bosnia and Herzegovina	2	.0	.0	100.0
Gambia	2	.0	.0	100.0
Guatemala	2	.0	.0	100.0
Madagascar	2	.0	.0	100.0
Namibia	2	.0	.0	100.0
Moldova Rep	2	.0	.0	100.0
Sao Tome and Principe	2	.0	.0	100.0
Saudi Arabia	2	.0	.0	100.0
Trinidad and Tobago	2	.0	.0	100.0
Uganda	2	.0	.0	100.0
Angola	1	.0	.0	100.0
Brunei Darussalam	1	.0	.0	100.0
Congo DR	1	.0	.0	100.0
Kazakhstan	1	.0	.0	100.0
Liberia	1	.0	.0	100.0
Mauritius	1	.0	.0	100.0
Monaco	1	.0	.0	100.0
Oman	1	.0	.0	100.0
Qatar	1	.0	.0	100.0
Saint Lucia	1	.0	.0	100.0
Yemen	1	.0	.0	100.0
Total	**97411**	**98.3**	**100.0**	
Missing - System	1695	1.7		
Total	**99106**	**100.0**		

5.1.1 Top 10 Nationalities in the SIRC Sample -2002



Frequency of seafarers in the estimated world fleet by nationality -2002

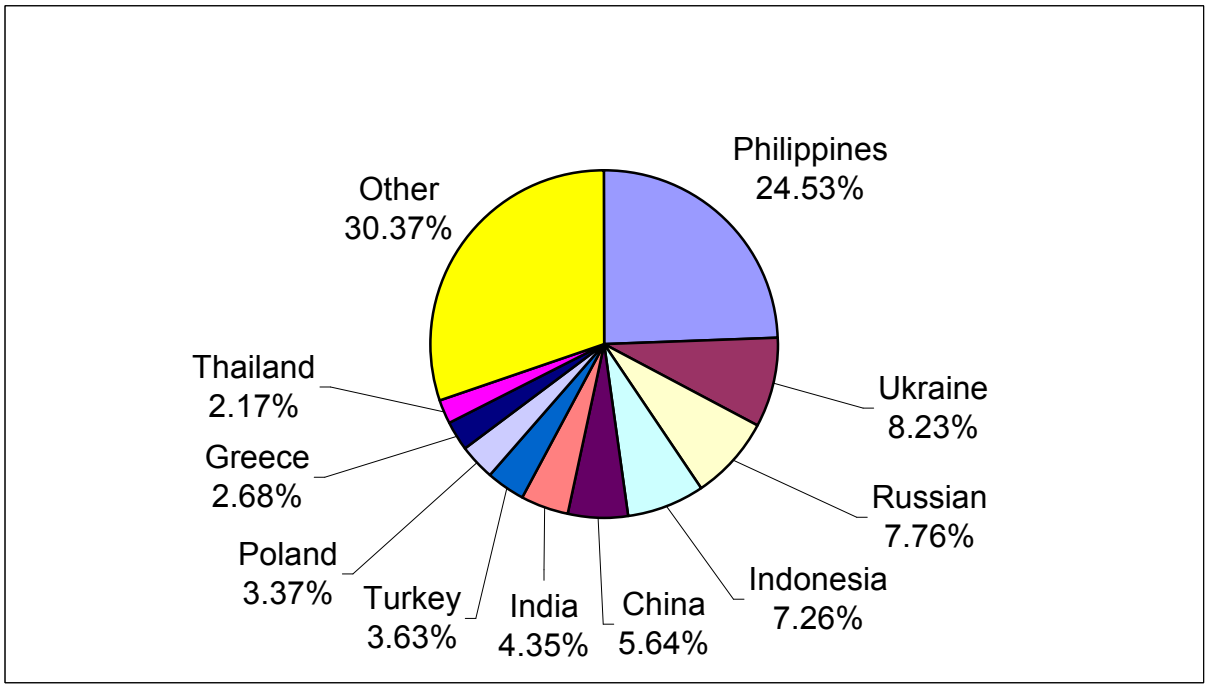
5.2 Nationality	Frequency	Percent	Valid Percent	Cumulative Percent
Philippines	134664	22.6	24.5	24.5
Ukraine	45178	7.6	8.2	32.8
Russian	42623	7.2	7.8	40.5
Indonesia	39839	6.7	7.3	47.8
China	30937	5.2	5.6	53.4
India	23892	4.0	4.4	57.8
Turkey	19953	3.4	3.6	61.4
Poland	18528	3.1	3.4	64.8
Greece	14707	2.5	2.7	67.5
Thailand	11924	2.0	2.2	69.6
Burma/ Myanmar	11670	2.0	2.1	71.8
Syria	10492	1.8	1.9	73.7
Romania	10485	1.8	1.9	75.6
Latvia	9552	1.6	1.7	77.3
Bulgaria	9502	1.6	1.7	79.0
Croatia	8507	1.4	1.5	80.6

Korea, South	6476	1.1	1.2	81.8
Egypt	5922	1.0	1.1	82.9
Malaysia	5459	.9	1.0	83.8
Italy	5122	.9	.9	84.8
Taiwan	4737	.8	.9	85.6
Germany	4714	.8	.9	86.5
Netherlands	4387	.7	.8	87.3
United Kingdom	4183	.7	.8	88.1
Norway	3868	.6	.7	88.8
Bangladesh	3738	.6	.7	89.4
United States	3438	.6	.6	90.1
Denmark	3393	.6	.6	90.7
Spain	3200	.5	.6	91.3
Pakistan	3180	.5	.6	91.9
Lithuania	3089	.5	.6	92.4
Viet Nam	3028	.5	.6	93.0
Sweden	2353	.4	.4	93.4
Japan	2134	.4	.4	93.8
Tunisia	1583	.3	.3	94.1
Iran	1484	.2	.3	94.3
Estonia	1441	.2	.3	94.6
Sri Lanka	1343	.2	.2	94.8
Yugoslavia	1295	.2	.2	95.1
Azerbaijan	1270	.2	.2	95.3
Finland	1220	.2	.2	95.5
Georgia	1199	.2	.2	95.8
Ecuador	1137	.2	.2	96.0
France	1134	.2	.2	96.2
Cape Verde	1097	.2	.2	96.4
Maldives	1073	.2	.2	96.6
Brazil	1041	.2	.2	96.8
Portugal	1036	.2	.2	96.9
Chile	994	.2	.2	97.1
Kiribati	886	.1	.2	97.3
Ghana	884	.1	.2	97.4
Cuba	836	.1	.2	97.6
Honduras	727	.1	.1	97.7
Colombia	687	.1	.1	97.9
Morocco	684	.1	.1	98.0
Belgium	666	.1	.1	98.1
Algeria	628	.1	.1	98.2
Nicaragua	625	.1	.1	98.3
Peru	620	.1	.1	98.4
Panama	570	.1	.1	98.5
Tuvalu	540	.1	.1	98.6
South Africa	469	.1	.1	98.7
Canada	448	.1	.1	98.8
Israel	425	.1	.1	98.9
Singapore	406	.1	.1	99.0
Hong Kong	382	.1	.1	99.0
El Salvador	362	.1	.1	99.1
Slovenia	352	.1	.1	99.2
Iceland	301	.1	.1	99.2
Lebanon	284	.0	.1	99.3
Ethiopia	223	.0	.0	99.3
Czech Rep	217	.0	.0	99.4
Hungary	197	.0	.0	99.4

Belarus	195	.0	.0	99.4
Australia	194	.0	.0	99.5
Libya	149	.0	.0	99.5
Ireland	138	.0	.0	99.5
Palestinian Territory	135	.0	.0	99.5
Korea, North	122	.0	.0	99.6
Nigeria	122	.0	.0	99.6
Kuwait	117	.0	.0	99.6
Guinea	113	.0	.0	99.6
British Virgin Islands	112	.0	.0	99.6
Cote d Ivoire (Ivory Coast)	110	.0	.0	99.7
Sudan	100	.0	.0	99.7
Barbados	99	.0	.0	99.7
Argentina	98	.0	.0	99.7
Sierra Leone	90	.0	.0	99.7
Tanzania	90	.0	.0	99.7
Benin	89	.0	.0	99.8
Senegal	89	.0	.0	99.8
Tonga	83	.0	.0	99.8
Slovakia	82	.0	.0	99.8
Malta	78	.0	.0	99.8
Cyprus	74	.0	.0	99.8
Guyana	71	.0	.0	99.9
Austria	59	.0	.0	99.9
Venezuela	57	.0	.0	99.9
Papua New Guinea	56	.0	.0	99.9
Albania	53	.0	.0	99.9
Uruguay	53	.0	.0	99.9
Togo	53	.0	.0	99.9
New Zealand	46	.0	.0	99.9
Mali	36	.0	.0	99.9
Mexico	34	.0	.0	99.9
Faeroe Islands	32	.0	.0	99.9
Costa Rica	32	.0	.0	99.9
Switzerland	29	.0	.0	100.0
Jordan	22	.0	.0	100.0
Burkina Faso	21	.0	.0	100.0
Mauritius	18	.0	.0	100.0
Iraq	16	.0	.0	100.0
Cayman Islands	15	.0	.0	100.0
Fiji	15	.0	.0	100.0
Kenya	14	.0	.0	100.0
Uganda	13	.0	.0	100.0
Trinidad and Tobago	13	.0	.0	100.0
Oman	12	.0	.0	100.0
Samoa	12	.0	.0	100.0
Guatemala	12	.0	.0	100.0
Madagascar	10	.0	.0	100.0
Gambia	10	.0	.0	100.0
Moldova Rep	10	.0	.0	100.0
Bosnia and Herzegovina	7	.0	.0	100.0
Yemen	7	.0	.0	100.0
Liberia	6	.0	.0	100.0
Congo DR	6	.0	.0	100.0
Monaco	6	.0	.0	100.0

Saint Lucia	5	.0	.0	100.0
Angola	5	.0	.0	100.0
Saudi Arabia	5	.0	.0	100.0
Brunei Darussalam	4	.0	.0	100.0
Namibia	3	.0	.0	100.0
Kazakhstan	3	.0	.0	100.0
Qatar	2	.0	.0	100.0
Total	**548999**	**92.2**	**100.0**	
Missing - System	46477	7.8		
Total	**595476**	**100.0**		

5.2.1 Top 10 Nationalities in the estimated world fleet -2002

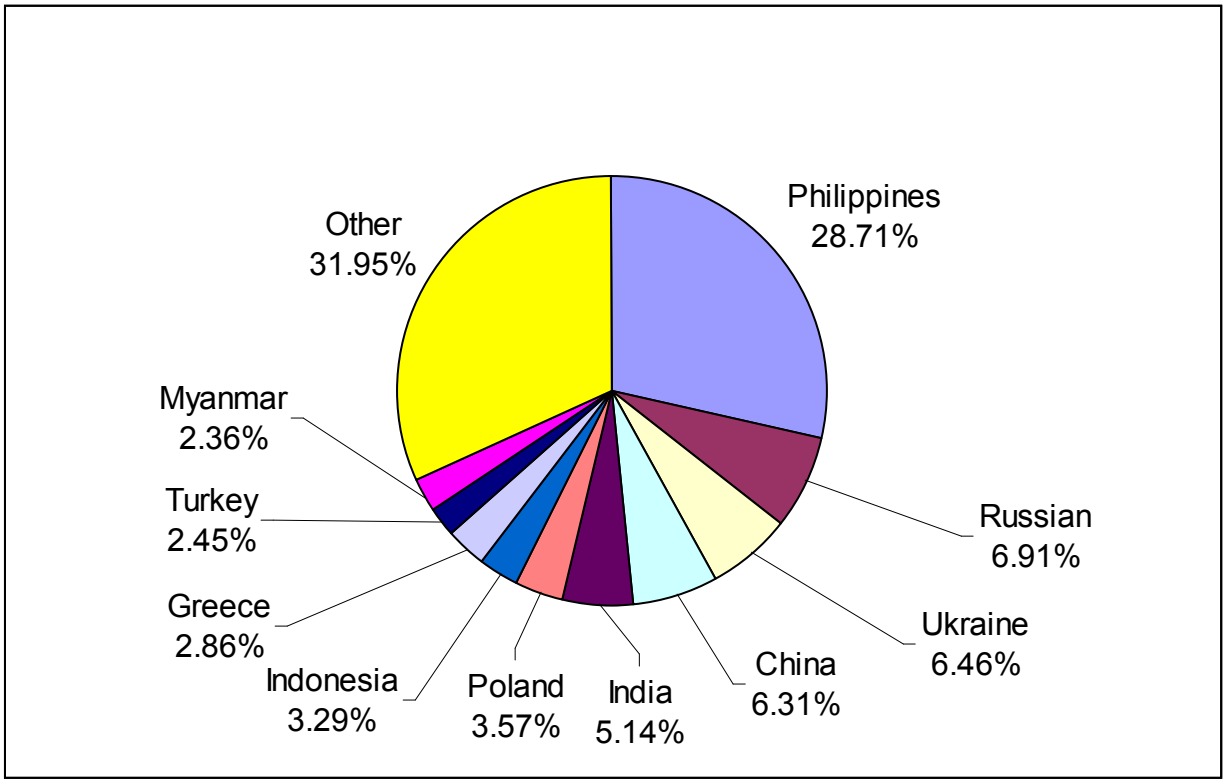


Frequency of seafarers in the SIRC sample by nationality - 2000

Nationality	N	% of Total N
Philippines	27355	28.7
Russian	6586	6.9
Ukraine	6150	6.5
China	6013	6.3
India	4893	5.1
Poland	3398	3.6
Indonesia	3133	3.3
Greece	2724	2.9

Turkey	2330	2.4
Myanmar	2246	2.4
Latvia	2057	2.2
Bulgaria	1900	2.0
Romania	1747	1.8
Croatia	1666	1.7
Korea, South	1611	1.7
Germany	1275	1.3
Italy	1023	1.1
Netherlands	765	0.8
Denmark	748	0.8
United Kingdom	736	0.8
Norway	651	0.7
Spain	492	0.5
Lithuania	417	0.4
Sweden	399	0.4
France	226	0.2
Estonia	182	0.2
Finland	178	0.2
Portugal	112	0.1
Belgium	101	0.1
Slovenia	48	0.1
Czech Rep	36	0.0
Hungary	35	0.0
Ireland	29	0.0
Malta	19	0.0
Cyprus	15	0.0
Slovakia	15	0.0
Austria	14	0.0
Other	13941	14.6
Total	95266	100

5.2.2 Top 10 Nationalities in the SIRC Sample -2000


Philippines
28.71%
Russian
6.91%
Ukraine
6.46%
China
6.31%
India
5.14%
Poland
3.57%
Indonesia
3.29%
Greece
2.86%
Turkey
2.45%
Myanmar
2.36%
Other
31.95%