Technical Assignment of Škoda Auto a.s.
Part I – 08 Ergonomics

Contents

Abbreviations:

CSN	Czech State Norm/Standard
GR	Government Regulation
PC	Personal computer
PPE	Personal protective equipment

Change History

Status	Date	Description
1.0	01.10.2016	New wording
1.1	01.11.2020	3.1 Upright Workspace – General Requirements
1.1	01.11.2020	3.2 Sitting Workspace – General Requirements
1.1	01.11.2020	4.2 Acceptable Weight Limits
1.1	01.11.2020	6.1 Pushing and Pulling forces
1.1	01.11.2020	6.3 Manipulators
1.1	01.11.2020	6.4 Assembly Actions

1. Workspace Room Requirements

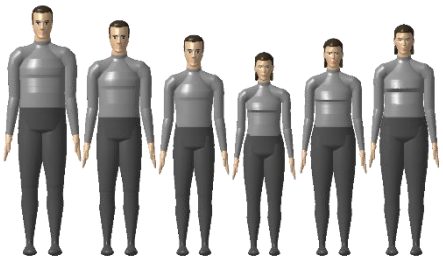
Free floor area for 1 employee – **minimum of 2m^2** except devices and connection paths.
Free area width for motion must under no circumstances be reduced under **1m at any point.**
Placement of machines at least **0.60 m** from fixed obstacles.
One-way workplace pathway at least **0.85 m** wide (1 employee carrying an object).
(According to Government Regulation 361/2007 Coll., on Occupational Safety, Czech State Norms/Standards)

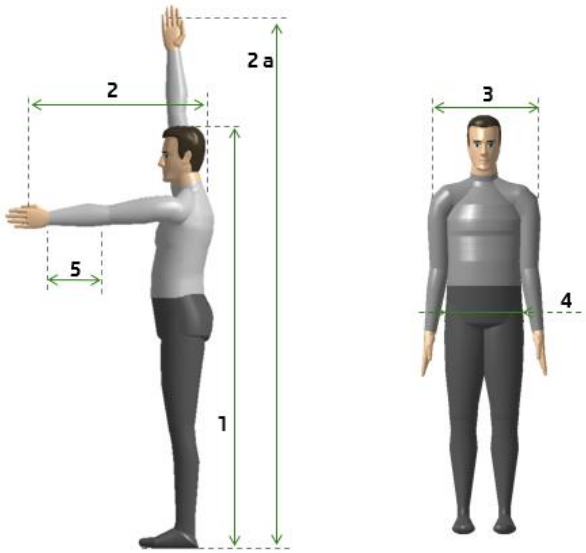
2. Anthropometry

Anthropometry focuses on measuring human dimensions; it is generally used to make sure that dimensions of objects are suitable for the capabilities of humans.

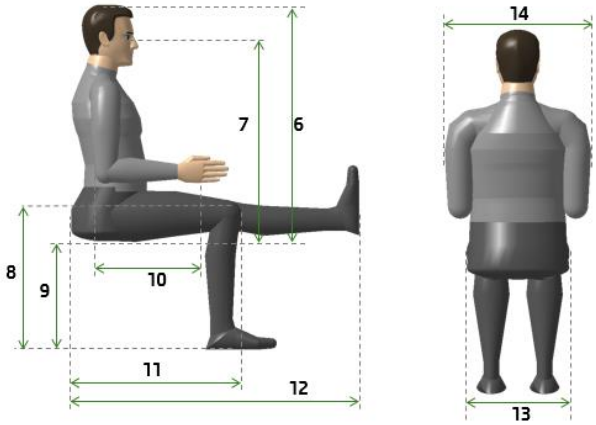
When designing machines, it is necessary to proceed according to human dimensions specified by the standards CSN EN 547-3, CSN EN ISO 4250-1 and CSN EN ISO 14738.

Women	Men
Small (5%) – **155cm**	X
Medium (50%) – **166cm**	Small (5%) – **167cm**
Large (95%) – **175cm**	Medium (50%) – **177cm**
X	Large (95%) – **187cm**





Dimensions (mm)	Men			Women		
Height distribution of population	**5%.**	**50%.**	**95%.**	**5%.**	**50%.**	**95%.**
1. Standing height	1670	1770	1870	1550	1660	1750
2. Reach with arms raising forward	800	850	890	740	800	840
2a. Height with arms raising upwards	2020	2170	2320	1870	2010	2160
3. Shoulder width	365	400	430	340	365	405
4. Hip width when standing	310	350	375	315	360	410
5. Forearm length	185	200	210	170	185	200
5a. Forearm diameter	105	115	120	100	105	115



Dimensions (mm)		Men			Women		
Height distribution of population		**5%.**	**50%.**	**95%.**	**5%.**	**50%.**	**95%.**
6.	Height when sitting	880	940	980	820	880	930
7.	Eye level height when sitting	740	800	850	700	750	810
8.	Knee level height when sitting	495	550	595	460	500	540
9.	Hough length	420	465	500	390	425	460
10.	Distance elbow – grip	330	360	390	300	325	370
11.	Distance buttock – knee	550	610	660	530	580	630
12.	Distance buttock – foot	985	1070	1150	930	1000	1080
13.	Hip width when sitting	310	365	390	330	400	440
14.	Shoulder width	420	460	490	365	420	465

3. Workspace Dimensions

Working plane height is the point at which working activity is performed most frequently.

Working or handling plane height must take the following into account:

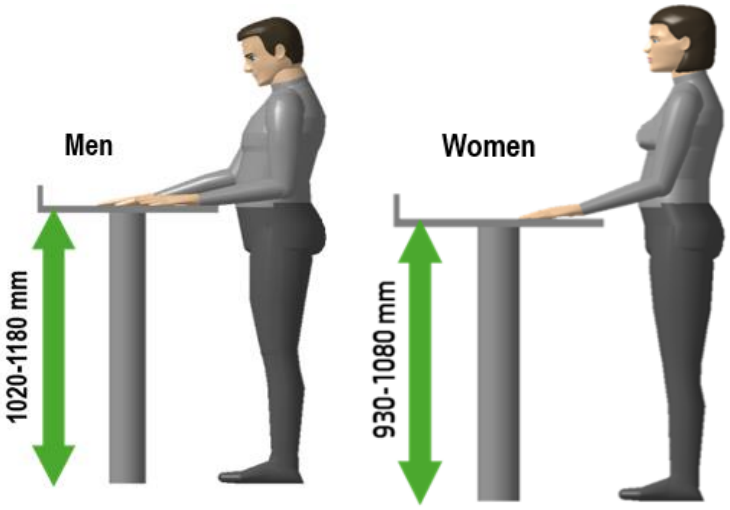
- bodily dimensions of the worker
- basic working position,
- load weight,
- eyesight demands of the work activity,
- required force,
- etc.

The workspace must be arranged so that the working planes, movement spaces and forces applied correspond **with the bodily dimensions and natural movement paths.**

3.1 Upright Workspace – General Requirements

Optimum upright working plane height

Men / Women



When performing a work that is more demanding on eyesight, the working plane height raises by **100–200 mm.**

According to GR 361/2007 Coll., on occupational safety.

3.2 Sitting Workspace – General Requirements

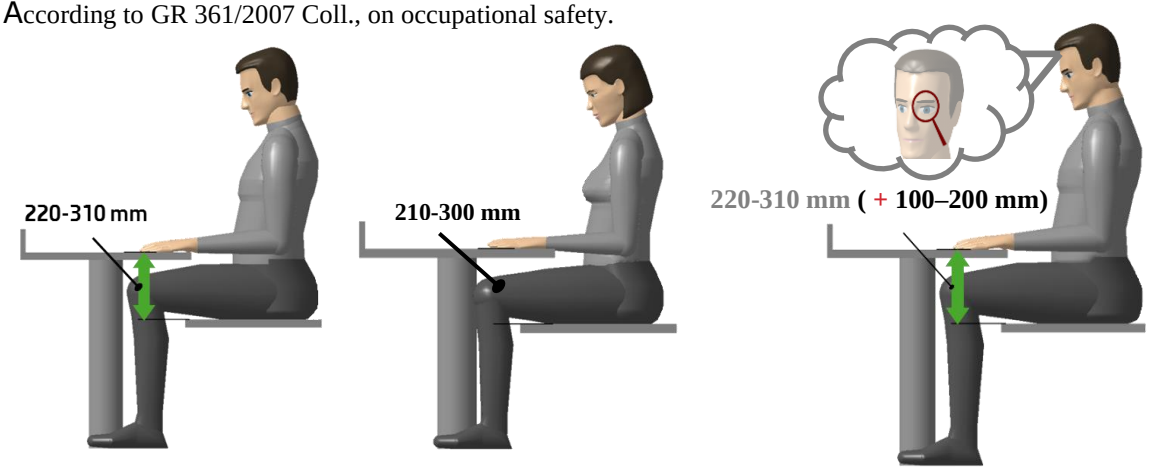
The seat must be stable with easy adjusting option for the seat squab height and the back rest angle.

Requirements regarding free movement space for legs:

- Minimum height above floor 600 mm
- Minimum total width 500 mm
- Minimum depth from the front side of the table or device 500 mm
- Optimum depth from the front side of the table or device 700 mm
- Minimum distance of the seat plane from the bottom table plane 200 mm

Working chairs or stools are selected according to the working plane height and activity performed.

According to GR 361/2007 Coll., on occupational safety.



When working with increased demands on eyesight, the height of the working plane increases by approximately 100 - 200 mm.



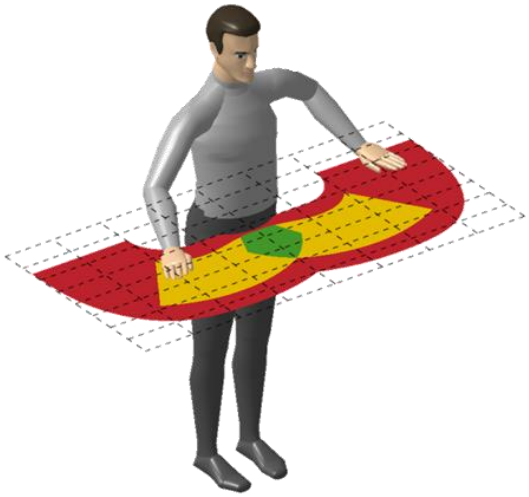

3.3 Workspace Dimensions

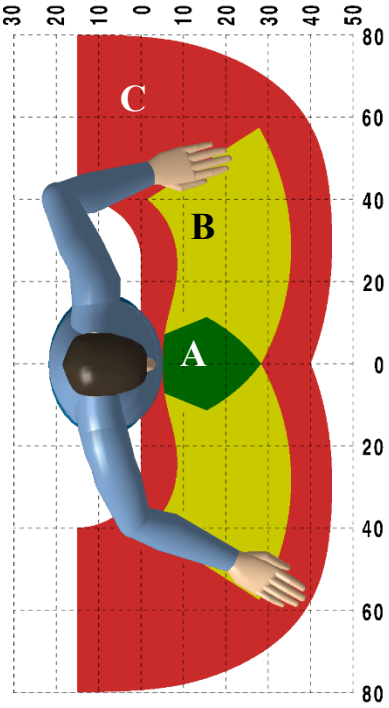
Arm reach in the horizontal plane for the small pre-assembly workstation:

Area A – optimum space
- Frequent and accurate movement
- Pre-assembly activities themselves

Area B – suitable space
- Movement of both forearms without having to change the basic posture
- Placement of tools and parts

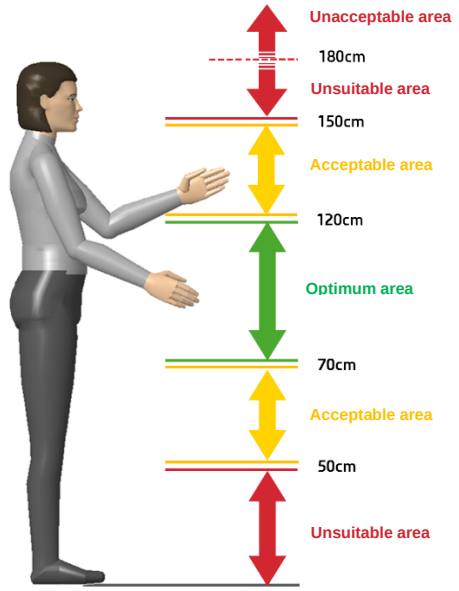
Area C – unsuitable space
- Maximum reach – less frequent and slower movement, torso turning
- Positioning via auxiliary preparative and measuring equipment





Dimensions are in cm

Arm reach in the vertical plane for work activity:



4. Manual Object Handling

4.1 Main Rules of Handling

Main Rules of Handling:

- **Exclude** redundant and physically demanding manual handling
- **Facilitate** unavoidable manual handling by via suitable handling devices (manipulators or lifting equipment
- **Objects should be moved**
  – in the most suitable elevation
  – along the shortest possible path
  – smoothly, with no sudden moves
- **Objects should not be lifted or moved**
  – directly off the ground
  – under the knee level or above the shoulder level
  – with the object obstructing the handler's view

4.2 Acceptable Weight Limits

	Maximum acceptable object weight for occasional handling **(<30min./shift)**	Maximum acceptable object weight for frequent handling **(<30min./shift)**	Limit In sitting position
Women	**20** kg	**15** kg	**3** kg
Pregnant women	**7.5** kg	**5** kg	**3** kg
Men	**50** kg	**30** kg	**5** kg

Limits of cumulative (total manipulated) weight per shift.
(under optimal working conditions)

	Men	Women
8 hour shift	10 000 kg	6 500 kg
12 hour shift	11 500 kg	7 500 kg

If the handling is not performed under optimum working conditions (reaching distance, handling elevation, walking distance etc.), proceed according to CSN EN 1005-2 (calculation of physical load for object handling).
Request-based calculation is to be performed by the ordering party.

According to GR 361/2007 Coll., on occupational safety.

5. Working Postures

When operating machines, devices and manipulators, the employees may not assume non-physiological postures that could damage the locomotor system.
The limits are defined in GR 361/2007 Coll., on occupational safety.

Fundamental non-physiological working postures:

Torso
- Torso angle greater than 60°
- Leaning back without a full body rest
- Leaning sideways significantly or torso turned by more than 20°

Arms
- Unsuitable arm position (extreme arm rotation, lifting, bending backwards..)
- Reaching upwards or outwards in a greater angle than 60°

Head, neck
- Head leaning forward by more than 25° with no support
- Head leaning back with no support
- Leaning sideways or rotation by more than 15°

6. Pushing and Pulling forces

6.1 Limits for Hand Trolleys

Limits for Hand Trolleys:

		Women	Men
Pulling force (N)	Acceleration	**260 N**	**330 N**
	Traversing	**220 N**	**280 N**
Pushing force (N)	Acceleration	**300 N**	**370 N**
	Traversing	**250 N**	**310 N**

Pushing the truck and lifting the load with both hands, according to the principles of ergonomic behaviour.

6.2 Operating Conditions

Operating Conditions:

- Before pushing, it is necessary to align the turning wheels with the direction of travel.
- Accelerate by applying gradual pressure onto the handles or pallet edges.
- Handle diameter should be 20–40 mm.
- Handle/cut-out width should be at least 125 mm.
- There should be a room of at least 70 mm above the fingers.

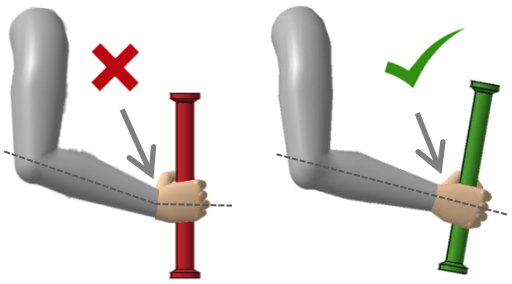
According to GR 361/2007 Coll., on occupational safety, the Ergonomic Standard of ŠKODA AUTO.

6.3 Manipulators

Basic data:

Traversal pushing forces	max. 80 N
Acceleration pushing forces	max. 80 N
Manipulator handles	Ø 20–40 mm
Hauling device handles	Ø 20–40 mm

Note: placement and angle must eliminate limit positions of joints and limbs.



The handle surface must be protected by a thermal insulator for allergy reasons **No black rubber**.

According to the ergonomic standard of ŠKODA AUTO.

6.4 Assembly Actions

a) Palm and individual fingers

Part of the limb	Direction of movement	Limit (N)
Palm / Arm	Front	80
Thumb	Pushing	40
Index finger	Pushing	25

b) Finger combination

Thumb against index finger	40
Thumb against side of index finger	50
Three-finger pressure	45
Fingers against palm	80
two thumbs right next to each other	55

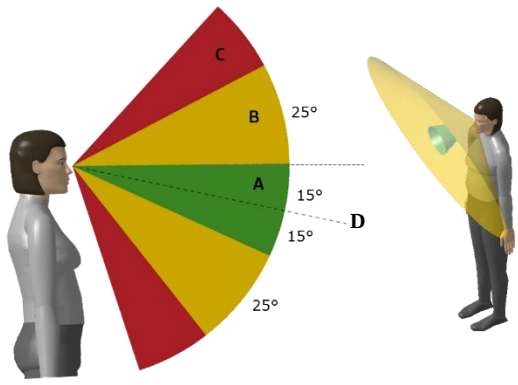
c) Arm

Arm pressure straight forward	80
Arm pressure towards the body	80
Arm pressure to the side	80
Arm pushing upwards / downwards	80

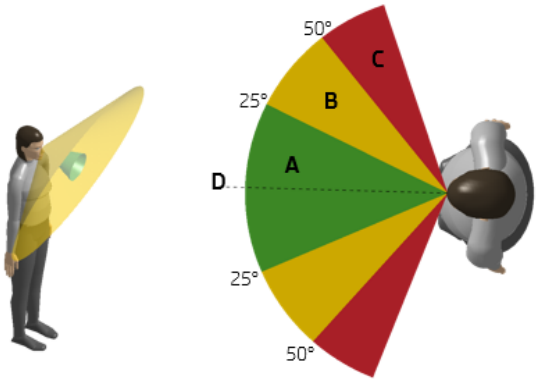
7. Field of View

Field of view for communicator placement

Vertical



Horizontal



A – recommended angle of view
B – acceptable angle of view
C – unsuitable angle of view
D – normal (middle) angle of view

8. Controllers

The controllers must be at optimum range (within 50 cm from the shoulder joint), but maximum of a forward reaching arm. When designing controllers, it is necessary to adhere to the anthropometric human dimensions, including the addition for PPE.
For the controls, it is also necessary to take hand muscular strength into account.

Controller types	**Control frequency**	**Control method**	
		Max. forces	
Hand lever	Often	Forward and backwards	60 N
		Sideways	40 N
	Seldom	Forward and backwards	120 N
		Sideways	80 N
		Upwards and downwards	300 N
Button		One finger	8 N
		Palm	50 N

Explanatory notes:
“Frequently used controllers” refers to controller that are used 20 to 40 times per an eight-hour shift.
“Seldom used controllers” refers to controllers that are used less frequently than 20 times per an eight-hour shift.

According to GR NV 361/2007 Coll., on occupational safety

9. Control Centres

When designing control centres, you need to account for ergonomic rules, recommendations and requirements according to CSN EN ISO 11064 (Ergonomic Design of Control Centres – Parts 1 to 7).
When designing and creating projects, it is necessary to focus on arrangements of control centres, arrangement and dimensions of workstations, communicators, controllers and environmental requirements.

For workstations with PC, you also need to meet further requirements according to GR 361/2007 Coll., on occupational safety, and the internal regulations of ŠKODA AUTO.