TÜVRheinland®
Precisely Right.

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March 2004

Test programme of TÜV Rheinland for conformity with the requirements of the „ERGONOMICS APPROVED“ mark

for

office swivel chairs

Purpose and field of application

This test programme contains the ergonomic requirements and test criteria for office swivel chairs which go beyond the statutory minimum requirements.

If these requirements are fulfilled the quality test mark “ERGONOMICS APPROVED” of TÜV Rheinland may be awarded.

The initial condition for the awarding of the quality mark “ERGONOMICS APPROVED” is compliance with the safety requirements of EN 1335. Such compliance must be proven with the GS mark (Geprüfte Sicherheit - Safety tested)

The test programme contains:

- **Basic requirements („must“-criteria) which have to be met by ergonomically designed office swivel chairs**
- **Description of additional recommendable ergonomic properties**

1. General

1.1 Product description (testing authority)

The office swivel chairs is to be described as supplied, including all parts and features important for identification.

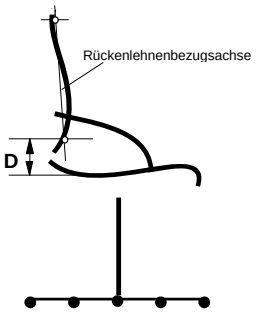
1.2 Intended use (manufacturer)

The manufacturer must describe the intended use of the chair and explain his philosophy and the considerations underlying the design.
Information is to be given as to the users and activities for which the chair is suitable (height, corresponding average weight, use).
(see also 2.7.2.1, Contents and layout of user manual)

2. Testing

2.1 Seat

Measuring the seat requires the definition of a system of reference dimensions, which has a horizontal orientation and contacts the backrest surface in the area of the lower sacrum (110 mm over the seat depressed by the test specimen; dimension D, or adjusted upwards if the posterior space is > 110 mm).



2.1.1 Lifting of seat front edge

Requirement:

The seat front edge must not move up when the backrest tilts back. However, a maximum rise by 20 mm is acceptable.

Recommendation:

The seat front edge is to be designed to move down by 10-20 mm whenever the backrest tilts back.

2.1.2 Seat tilt

Requirement:

In normal position[1] the depressed seat must have a tilt of 0° to 5° related to the horizontal line, a minimum seat tilt of - 2° is tolerable. A synchro mechanism must allow a backward tilt of the seat by minimum 5° - related to the normal position - but the maximum rear tilt of the seat must not exceed 15°. In addition to the rear tilt of the seat caused by the synchro mechanism, there may be the possibility for the seat to tilt forward. In this case the maximum permissible forward tilt of the loaded seat is -4°.

Seat tilt in normal position: α_G

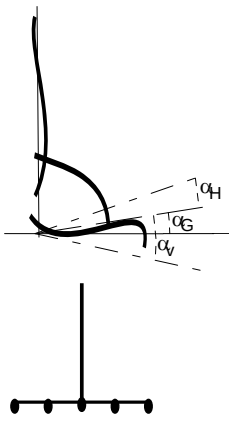
Additional seat tilt in case of backward tilt: α_H

Maximum seat tilt in case of backward tilt: $\alpha_{max} = \alpha_G + \alpha_H$

Additional seat tilt in case of forward tilt: α_V

Maximum seat tilt in case of forward tilt: $\alpha_{min} = \alpha_G + \alpha_V$

Change of seat tilt when sitting posture changes from foremost to rearmost position: $\Delta\alpha = \alpha_{max} - \alpha_{min}$



[1] foremost position of seat and backrest when loaded with sedometer

2.1.3 Seat structure

Requirement:

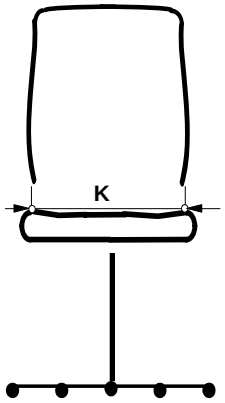
The pressure around the ischial tuberosities must not exceed 3,0 N/cm² under load. (Measuring method: standardized pressure measurement; a device shaped according to the ischial tuberosities with peak pressure sensor).

The peak pressure is measured at loads corresponding to 5. perc. women, 50. perc. men and 95. perc. men.

2.1.4 Effective seat width

Requirement:

The effective seat width (K) (distance between the contact points of a horizontal line with the upholstery) in the area of the ischial tuberosities must be greater than 430 mm.



Recommendation:

The effective seat width (K) in the area of the ischial tuberosities should be at least 450 mm.

2.1.5 Seat depth

The seat depth is measured with the sedometer.

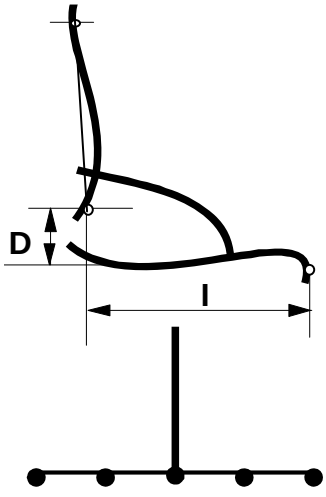
The depth dimensions are related to the sacral/pelvic contact area (D) and with that correlate directly with the dimensions given in EN 894 as anthropometric dimension 2.8 (body depth in sitting posture).

The seat depth should be such that even short persons get sufficient pelvic support by the backrest and tall persons find enough thigh support. It has to be borne in mind that unrestricted support for the back in the lumbosacral area is more important than a seat depth that provides support for the lower part of the thighs.

An adjustable seat depth is not to be equated with a change in seat depth caused by the backward tilt of the backrest.

Requirement:

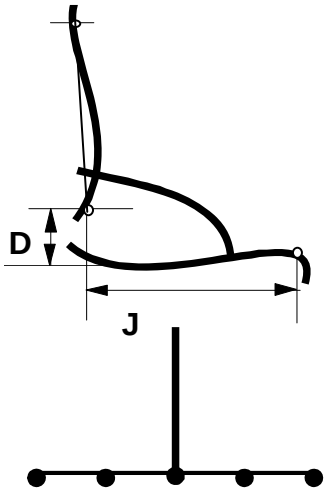
The designed seat depth (l) describes the horizontal distance between the contact area of sacrum/pelvis with the backrest and the seat front edge in the area of the thighs. If the seat depth is not adjustable, the designed seat depth (l) must not exceed 430 mm. This applies to seats with adjustable depth as well, related to the smallest set depth.



In chairs without adjustable seat depth designed for medium-sized and tall users, the designed seat depth must not exceed 490 mm. This applies correspondingly to seats with adjustable depth, related to the smallest set depth. Chairs with a seat depth designed by the manufacturer for medium-sized to tall users must bear a visible hint: (e.g. “for medium-sized to tall users”).

Requirement:

The effective seat depth (J) describes the horizontal distance between the contact area of sacrum/pelvis with the backrest and the beginning of the curve at the seat front edge, taking the depression made by the thighs in consideration. Where the seat depth is not adjustable the effective seat depth (J) must be at least 400 mm. Chairs designed by the manufacturer for short to medium-sized users may have less than 400 mm effective seat depth.



Recommendation:

If the seat depth is adjustable, it should range from effective 400 to 480 mm depending on the target group (5. percentile women, 95. percentile men).

2.1.6 Seat height

The seat height is measured with the sedometer.

The seat height (A) should be designed for short, medium-sized and tall persons.

For fixed-height work desks the seat height is measured in the area of the ischial tuberosities, for the distance between the desk surface and the seat is decisive in this case. Adjustments for the shank length of small users must be made by means of adjustable foot rests.

Requirement:

When loaded with 64 kg (628 N), the seat height in the area of the ischial tuberosities (A_1) must range from 420 mm to 515 mm.

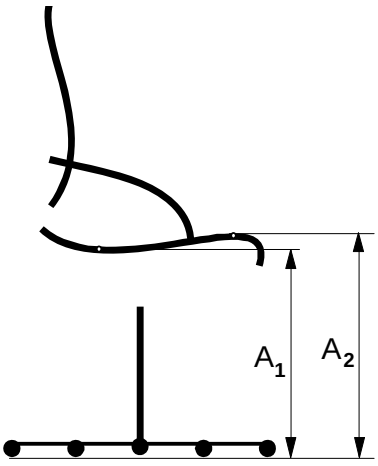
Recommendation:

When loaded with 64kg (628 N), the seat height in the area of the ischial tuberosities (A_1) should range from 400 to 530 mm.

For height-adjustable work desks (setting range approx. 650 to 790 mm) the height of the front seat edge is decisive, as the shank length of the user is considered the principal reference dimension. Consequently, the seat height for height-adjustable work desks is in addition measured at the front, where the thighs are supported (A_2):

Requirement:

When the chair is loaded with 64 kg (628 N) the seat height in the area of thigh support (A_2) must be between 440 and 535 mm. This setting range for the height of the front seat edge (A_2) is a function of the height setting range for the work desk of approx. 650 to 790 mm and covers roughly the scope from 50. percentile women or 5. percentile men up to 95. percentile men. Smaller persons still need foot supports.



Requirement:

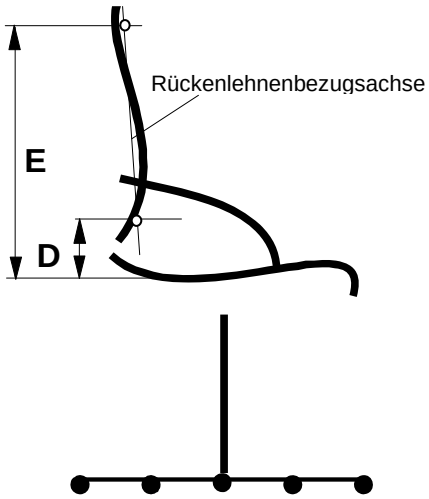
The travel of the spring must be minimum 10 mm even in the lowest position (difference between loaded and unloaded condition, measured as the distance from the supporting base of the seat to the hard level floor).

2.2 Backrest and pelvic support

The reference axis for back rest measurement is defined as follows:

- lower contact point: beginning of the sacral plate (110 mm above depressed seat; dimension D)
- upper contact point: contact point of kyphosis of dorsal vertebrae (approx. 490 mm above depressed seat; dimension E)

To adapt this backrest reference axis to the backrest tilt, the former is turned around a point in the contact area (130 mm before sacrum contact area; 20 mm above depressed seat).



2.2.1 Backrest adjustability

Recommendation:

The backrest should be individually adjustable.
This can be reached through a number of design features (height adjustment of the whole backrest or of parts thereof, e.g. of an adjustable lordisis support).

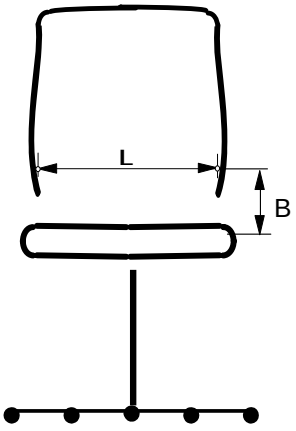
2.2.2 Effective backrest width

Requirement:

Users must find enough lumbar support.
That is why the useful width of the backrest (L) (distance between the contact points of a horizontal line with the upholstery) must be at least 360 mm at the level of the pelvic crest (B).

Recommendation:

The useful width of the backrest (L) at the level of the pelvic crest (B) should be over 400 mm.



2.2.3 Pelvic and lumbar support

The convex lordosis contour is measured with the sedometer.

Requirement:

The pelvis must be supported beginning from the sacral plate to prevent it from tilting back in sitting posture. The support area B extends from 170 to 230 mm over the depressed seat.

As the maximum forward curving of the human spine is not in the supported part of the pelvis but higher - (around the second and third lumbar vertebrae)- the backrest should have its greatest protrusion there (convex lordosis contour).

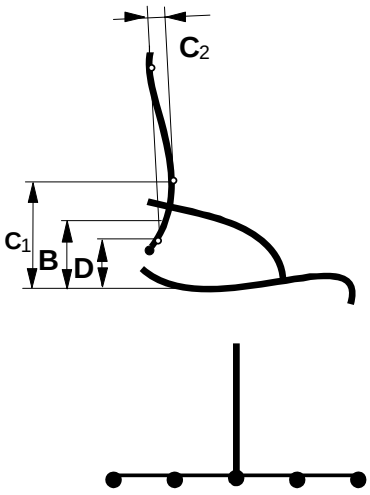
With height-adjustable backrests the convex lordosis contour (C_1) must be at a height of over 210 mm above the depressed seat.

With backrests in which the lordosis height in not adjustable, the height of the convex lordosis contour must be at least 210 mm.

Recommendation:

With height-adjustable backrests or height-adjustable lordosis support the height of the convex lordosis contour should be between 230 and 290 mm.

The lordosis depth (C_2) describes the depth of the backrest convexity measured from the backrest reference axis (straight line connecting the contact points of the sacrum (D) and of the kyphosis of the dorsal vertebrae (E), see above).



Requirement:

Where the lordosis depth (C_2) is not adjustable it must be between 20 and 40 mm.

Recommendation:

Where the lordosis depth (C_2) is adjustable the setting range should be 10 to 50 mm.

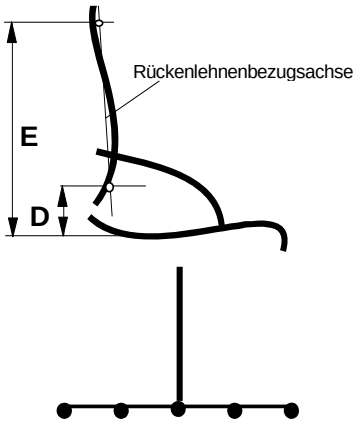
2.2.4 Contact area for the dorsal kyphosis

The height of the contact area for the dorsal kyphosis is measured with the sedometer.

The upper part of the backrest may have a concave shape to fit the dorsal kyphosis.

Requirement:

If a contact area is shaped to fit the dorsal kyphosis, it must be at a height of 460 to 520 mm above the depressed seat if the backrest is not height-adjustable. If the backrest is height-adjustable, the medium position must also be between 460 and 520 mm.
The contact area for the dorsal kyphosis must not have a shape uncomfortable for tall persons, e.g. a swelling in the upper part of the backrest.

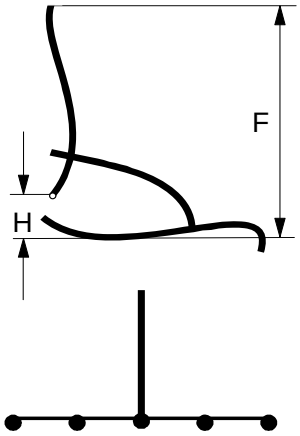


2.2.5 Backrest height

The backrest height is measured with the sedometer.

Requirement:

The height (F) of a fixed-height backrest must be at least 450 mm, measured from the depressed seat.
If the backrest is height-adjustable, its maximum height must be at least 480 mm.



Recommendation:

The backrest height (F) should be adjustable between 500 and 650 mm, measured from the depressed seat.
With fixed-height backrests the minimum height should be 480 mm.

There may be an **open posterior space (H)** between the seat and the lower edge of the backrest.

Requirement:

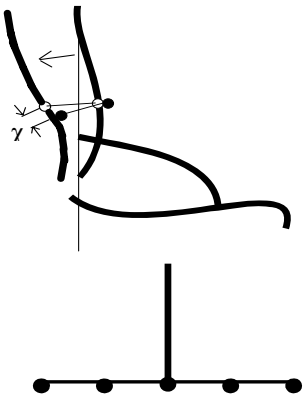
To ensure the required support for the pelvic crest (cf. 2.2.3) in chairs with height-adjustable backrests, the open posterior space must not exceed 130 mm over the depressed seat in the lowest position or 170 mm in the highest position, respectively. Chairs with fixed-heigt backrest may have an open posterior space (H) of maximum 130 mm over the depressed seat.

2.2.6 Relative movement between back and backrest

The swivelling axis should be in such a position as to avoid the „shirt-push effect” and to prevent excessive tilting of the pelvis when the user leans back.

Requirement:

When the user shifts from the foremost to the rearmost sitting posture, the relative movement (χ) between backrest and back must not exceed 1,5 mm / 1° aperture angle.



Recommendation:

When the user shifts from the foremost to the rearmost sitting posture, the relative movement (χ) between backrest and back should not exceed 0,5 mm / 1° aperture angle.

2.2.7 Backrest resiliency when tilted back

Requirement:

The resiliency of the mechanism must be adjustable according to the weight of the user, so that any user (ranging from 5. percentile women to 95. percentile men) can use the whole range of movement. As a precondition, the spring power of the backrest must be adjustable in such a manner that the movement mechanism can be used by small, light-weight persons (5. perc. women) without problems and, on the other hand, taller and heavier persons (95. perc. men) find sufficient support.

This is to be checked with appropriate test persons. For that purpose the test persons sit on the office swivel chairs in normal sitting posture (upper body in vertical position, pelvis in contact with the backrest, thighs in horizontal position, shanks in vertical position, feet supported by the floor or by a foot rest) and test the resiliency setting range by shifting from the foremost to the rearmost sitting posture.

2.2.8 Backrest tilt

Requirement:

The angle between the backrest and the horizontal line must never be smaller than 80°, whichever the setting of seat and backrest may be. In normal position this angle must be between 90° and 95°, when the user shifts from foremost to rearmost sitting posture, the backrest tilt must increase by minimum 15°.

The normal backrest tilt is defined as the tilt of the backrest reference axis (straight line connecting the contact point of the sacrum (D) with the contact point of the kyphosis of the dorsal vertebrae (E), see above) in relation to the horizontal line, and it is measured with the sedometer. The forward and backward change of the backrest tilt is determined with the help of test persons.

Backrest tilt in normal position: β_G

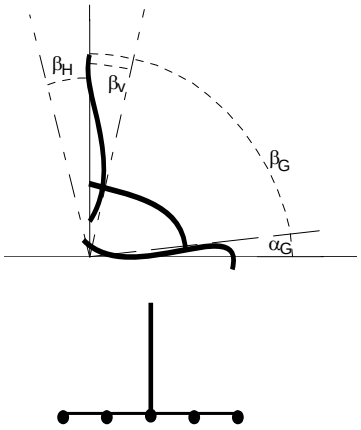
Additional backrest tilt in case of backward tilt: β_H

maximum backrest tilt: $\beta_{max} = (\beta_G + \beta_H)$

Additional backrest tilt in case of forward tilt: β_V

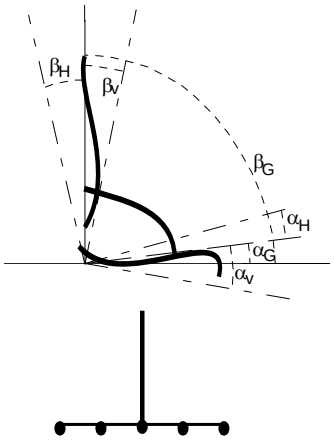
minimum backrest tilt: $\beta_{min} = (\beta_G - |\beta_V|)$

Change of backrest tilt when user shifts from foremost to rearmost sitting posture: $\Delta\beta = \beta_{max} - \beta_{min}$



2.3 Seat / backrest movement

2.3.1 Aperture angle



Requirement:

In normal position, the aperture angle between backrest and seat must be between 90° and 95°. In the foremost sitting posture, the aperture angle must not be under 84°.

When the backrest tilts back (shift from foremost to rearmost sitting posture) the aperture angle must increase by at least 10°.

Aperture angle (δ)

Aperture angle in normal position: $\delta_G = \beta_G - \alpha_G$

Aperture angle in foremost sitting posture: $\delta_V = \delta_G + |\alpha_V| - |\beta_V|$

Additional aperture angle in case of backward tilt: $\delta_H = \beta_H - \alpha_H$

2.3.2 Synchronous adjustment

Requirement:

The chair must have a mechanism for the synchronous adjustment of seat and backrest, or provide the same seating comfort with other design features, i.e. dynamic sitting must be provided for.
The synchrony ratio is a function of the setting ranges of backrest tilt related to seat tilt in the synchronous movement. The synchrony ratio must be between 1:1,5 and 1:3,5.

$$\text{Synchrony ratio} = 1 : \left(\frac{\beta_H + |\beta_V|}{\alpha_H + |\alpha_V|} \right)$$

Recommendation:

The synchrony ratio should be between 1:2 and 1:3.

2.4 Armrests

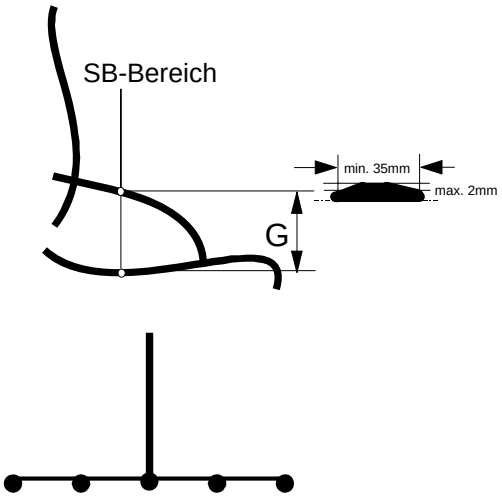
Requirement:

If armrests exist, the effective width of their supporting surface (measured at 2mm curve depth) must be 35 mm at least.

The clear span between the armrests must be 470 mm at least.

For height-adjustable armrests, the setting range of armrest height (G) must be 220 to 280 mm.

For fixed-height armrests, the armrest height (G) must be between 220 and 280 mm.



Recommendation:

The effective width of the supporting surface should be 40 to 60 mm.
To fit the normal posture, the armrests should have a forward slope (ca. 10° to 15° related to the horizontal line) and be rounded at the front (wrist area).

The height (G) of the armrests should be adjustable over the full range of 220 to 280 mm.

The clear span between the armrests should be over 490 mm.

2.5 Upholstery

2.5.1 Upholstery cloth and moulded backrest elements

***Requirement*:**

The cloth must not be glued together with the upholstery over the whole surface, and there must not be any layer barring water vapour.
The moulded seat and backrest elements must permit water vapour transmission.

2.6 Controls

***Requirement*:**

All controls must be easily accessible, functional, ergonomically shaped and easy to handle.
The actuating powers must be in accordance with EN 894.
Power flux must be straight wherever possible.

2.7 Content and layout of instructions for use

The instructions for use are inspected with respect to form and to comprehensibility of the contents.

***Requirement*:**

The instructions for use / reference material must be attached to the supplied product and clearly visible.

2.7.1 Check of formal requirements

2.7.1.1 The reference material has to be in German. If more languages are available, each language should form an independent unit of the reference material.

2.7.1.2 Reference material consisting of several pages must be bound.

The pages of the reference material must be easy to handle.

2.7.1.3 Technical terms, foreign words and abbreviations must be explained unless they are generally known.

2.7.1.4 Texts and graphic charts must be easily comprehensible.

2.7.1.5 Safety information and warnings must stand out from the normal text.

2.7.1.6 The reference material must include the following information:

- **manufacturer**
- **model or type name**
- **description of the product and the supplies (if any)**
- **scope of function and application**
- **performance features**
- **additional supplies**
- **information about warranty conditions**
- **warning to have repairs made by experts only**

2.7.2 Check of completeness of content

2.7.2.1 The intended use of the chair must be described. Particulars must be given as to the persons for whom the chair is suitable (height and corresponding average weight[2], use).

2.7.2.2 Technical and ergonomic features must be described in a comprehensible manner.

2.7.2.3 All controls must be described. The handling and setting of the controls must be documented in a simple and practicable manner.

2.7.2.4 A name or an address must be given which provides quick help for the user in case of problems.

2.7.2.5 There should be information about the general conditions of warranty.

2.7.2.6 Recommendations regarding the ergonomic adjustment of the seat should be given.

[2] average weight (kg) ≙ height (cm) -100