vhp human performance b.v.
Huijgensstraat 13a
2515 BD The Hague
The Netherlands
T +31 (0)70 - 38 92 010
F +31 (0)70 - 38 92 413
info@vhphp.nl
www.vhphp.nl

IBAN NL27ABNA0486072894
BIC ABNANL2A
KVK Haaglanden nr. 27259365
VAT NL8121.45.471.B01

Ergonomics approved quality label

Zami stools (Types: SIT, SIT/STAND,BAR)

Date
11-09-2018

Authors
Ir. Bas van Leeuwen
Kees Peereboom MSC, Eur. Erg.

Client
Matador b.v

vhp project number
377 Zami

1 Introduction

This report contains the assessment for a vhp working conditions and ergonomics quality label for the Matador Zami stool range consisting of: Zami-SIT, Zami- SITSTAND and Zami- BAR.

Figure 1 Zami range of products

When assessing the Zami models for the vhp ergonomics quality label, the functional and user-related aspects of the product were assessed in order to access if these meet generally accepted and appropriate ergonomics guidelines. In this case this concerns:

- Physical workload guidelines derived from the Dutch handbook of Physical workload 2015 (7th print). This handbook follows the series CEN standards from the 1005 series and the French industry standard NF X 35-106;
- Guidelines from the Handbook on Ergonomics / Human factors 2015.
- Guidelines from AI magazines 08 'Sitting and standing work' and the general regulations regarding ergonomics, state of affairs and physical load applied there.
- Practice guidelines I SZW (Labor Inspectorate in The Netherlands)

2 .Product: Zami range

The Matador Zami is a stool that seeks to stimulate active sitting. Active sitting means that the musculature is stimulated to balance the body (torso) in a forward-backward direction. The Zami creates a small contact surface around the equilibrium point where the torso rests on the seat bones. The line that can be drawn between the sit bones is from a biomechanical point of view a new axis of movement. The goal is to bring pelvis, back, neck and head forward in a line, as it were. In this position an optimal shape of the spine can be achieved.

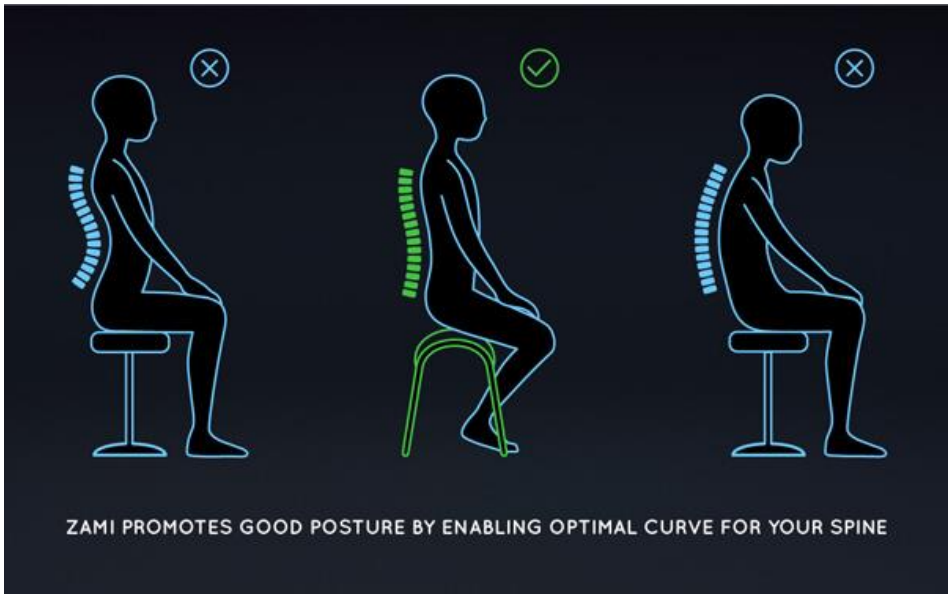


Figure 2 Sitting positions and posture of the spine when sitting on a Zami product (middle)

The posture in the middle figure (Figure 2) coincides with active balancing around the equilibrium position by sitting with the sitting bones just before the top of the bulge of the seat. This automatically leads to better spine positioning and provides "grip" on the seat. This is explained by the parabolic (round) shape of the seat pad that fills the space between the sitting bones. A healthy posture is characterized by a visible ascending cavity forward in the lumbar spine (lordosis, see green stripes middle figure in Figure 2). This posture can only be achieved when the pelvis is in the same position as at is while standing. The Zami allows the legs the possibility to move freely from the hips downward and the position of the legs can be changed freely independently. This makes a favourable spine position possible. The hip angle differs positively from sitting on a standard stool. While using a standard stool (and chair) there is a stronger hip flexion (flexion) which causes the pelvis to tilt backwards. The most relaxed position in position between pelvis and spine is the middle position .

The double curved seat (without back support) ensures that the weight of the torso is transferred to the seat bones (tuber ossis isschii). This has the advantage that legs then contribute less to the support of the upper body and as a result will become less statically loaded. Sitting on the Zami, however, results in a higher point load on the sitting bones itself, which are protected against this by bursa. A relative disadvantage of Zami is that an active sitting posture cannot be sustained for an entire working day. This is taken care of by the natural automatism to move or to get up for a while (this is a learning and habituation process).

From the AI magazine 08 'Sitting and standing work' it follows that a stool is in fact a sitting shape somewhere in between a work chair and the standing support. Stools are particularly suitable for workplaces where a higher degree of mobility is required (a lot of standing up and walking), this compared to a fixed sitting workplace (sitting on an (office) chair).

The Zami is also intended for workplaces:

- where little thigh and knee space is present under the work surface or the machine,
- with widely varying working heights
- where the arm force used is relatively small.

The content of the range of tasks to be performed determines the possibilities for sedentary work and the requirements to be imposed on the various parts of the workplace, in particular the chair (see Appendix 1).

3 Usage characteristics Zami stool

Working with Zami stools involves sitting, sitting / standing and / or standing. No specific useful guideline has been included for this in the Working Conditions Act (Dutch Law on occupational safety and health). vhp human performance therefore verified at I SZW (SZW Inspectorate, formerly Labour Inspectorate) which principles it applies in practice in this type of matters (mid-September 2018).

Principles I SZW:

- Limit working while standing to one hour uninterrupted and up to a4 hours maximum per day;
- Limit sitting when possible to a 5 hour maximum a day, but avoid sitting continuously for longer than 2 hours at the same time;
- For screen work (VDU work), the guideline is a maximum of 6 hours per day, of which a maximum of 2 hours are continuous. The Dutch practice guideline for computer work also recommends a maximum of 4 hours for working seated at a monitor when working intensively and continuously with either a keyboard and/or a computer mouse.
- Alternate screen work after 2 hours with different work or a 10 minute break;

From the selection scheme in Figure 1 (derived from Appendix 1) it follows that the different Zami types can be applied for different types of tasks and working conditions. Zami stools are suitable for longer seated work and for work places where while seated pedals need to be operated.
:

Type	Type of workstation	Preferred usage	Time of use	Additional remarks
Zami-SIT 48 cm sitting height	Sedentary work (standing up < 10 p/h)	For variety purposes or as a choice to replace a (desk) chair	2 hours uninterrupted and in total a maximum of max 6 hours sitting on a working day	• When there is little or no mobility needed • Combine with table / work surface height of 70-75 cm
Zami-SIT/STAND 65 cm sitting height	Working combined sedentary and standing (standing up > 10 p/h)	Working part of the working time standing and working while seated mostly	For the standing part: 1 hour uninterrupted and a total of 4 hour maximum on a working day	• In case of limited mobility • Combine with table / work surface height of 90-95 cm
Zami-BAR, 75 cm sitting height	Being very mobile on the job	As an alternative to standing	For the standing part: 1 hour uninterrupted and a total of 4 hour maximum on a working day	• When being very mobile • Set working height / worktop 10 cm lower than compared to working while standing

Table 1: Recommended choice schedule application per type of Zami

The recommended limits for duration of use as these can be seen in Table 1 have been determined on the basis of the practical guidelines of I SZW, Arbo magazine 8 Seated and Standing Work (AI 8) and research by Nachemson[1].

[1] Guideline Dutch labor inspectorate:
http://www.arbokennisnet.nl/images/dynamic/Dossiers/RSI_Beelschermwerk/D_Beeldschermwerk.pdf
A. Nachemson (1965) The Effect of Forward Leaning on Lumbar Intradiscal Pressure, Acta Orthopedics Scandinavica, 35: 1-4, 314-328, DOI: 10.3109 /

Research by Nachemson (see also Appendix 4) shows that if a lordosis is not assumed in the lumbar spine (i.e. slightly hollow back while seated), the load on the intervertebral discs increases strongly. However, this lordosis is automatically obtained with an active seated position when the sitter does not support against a backrest. This effect is enhanced by a non-horizontal thigh position, which is especially the case with the Zami SITSTAND and the Zami BAR. The lordosis position of the lower back is achieved more easily then because of the (slightly) lowered upper legs. For the Zami SIT, the same provisions apply as for working with an office chair with the addition that when working with the Zami it is essential to continue to keep sitting in an active manner, this should be emphasized in the instruction (see appendix 2). When working with the Zami, passive sitting like this so often occurs in a regular (office) chair is prevented.

When using Zami stools the following approach should be followed:

1. Follow table 1 to make a model choice.
2. Not suitable for work where force over 40 N (4 KG) has to be applied with the upper extremities.
3. Not suitable for work with foot pedal operation where force has to be applied (eg when working with industrial machines). It is suitable for control pedals (for example in activities similar to piano, organ and carillon playing). In the case of operating pedals, the heel usually rests on the floor level. No more than 30 N (3 KG) of force is supplied with foot pedal operation.
4. Instruct users. This instruction has been drawn up by vhp human performance and is attached in Appendix 2. In this context, emphasize a dynamic and active position while seated.

4 vhp human performance ergonomics approved quality label

The Matador Zami stool range (SIT, SITSTAND, BAR) has been approved and is provided with the vhp health and safety label.

This quality mark is only valid if the following approach is being applied:

1. Follow table 1 for use and choice of Zami type;
2. The Zami stool is not suitable for work where more than 40 N (4 KG) force is applied with the upper extremities (arms);
3. The Zami stool is not suitable for work with foot pedal operation in industrial setting where more than 30 N (3 KG) force is applied;
4. Supply users with the (Zami) sit instruction as included in Appendix 2;
5. The seating instructions are included with each product.

In addition, it should be taken into account that the Zami is not adjustable in height; An ideal height setting is therefore not possible for every user. Customization is recommended for users shorter than 165 cm body length and users over 190 cm body length.

Appendix 1 Choice schedule for working standing up or seated

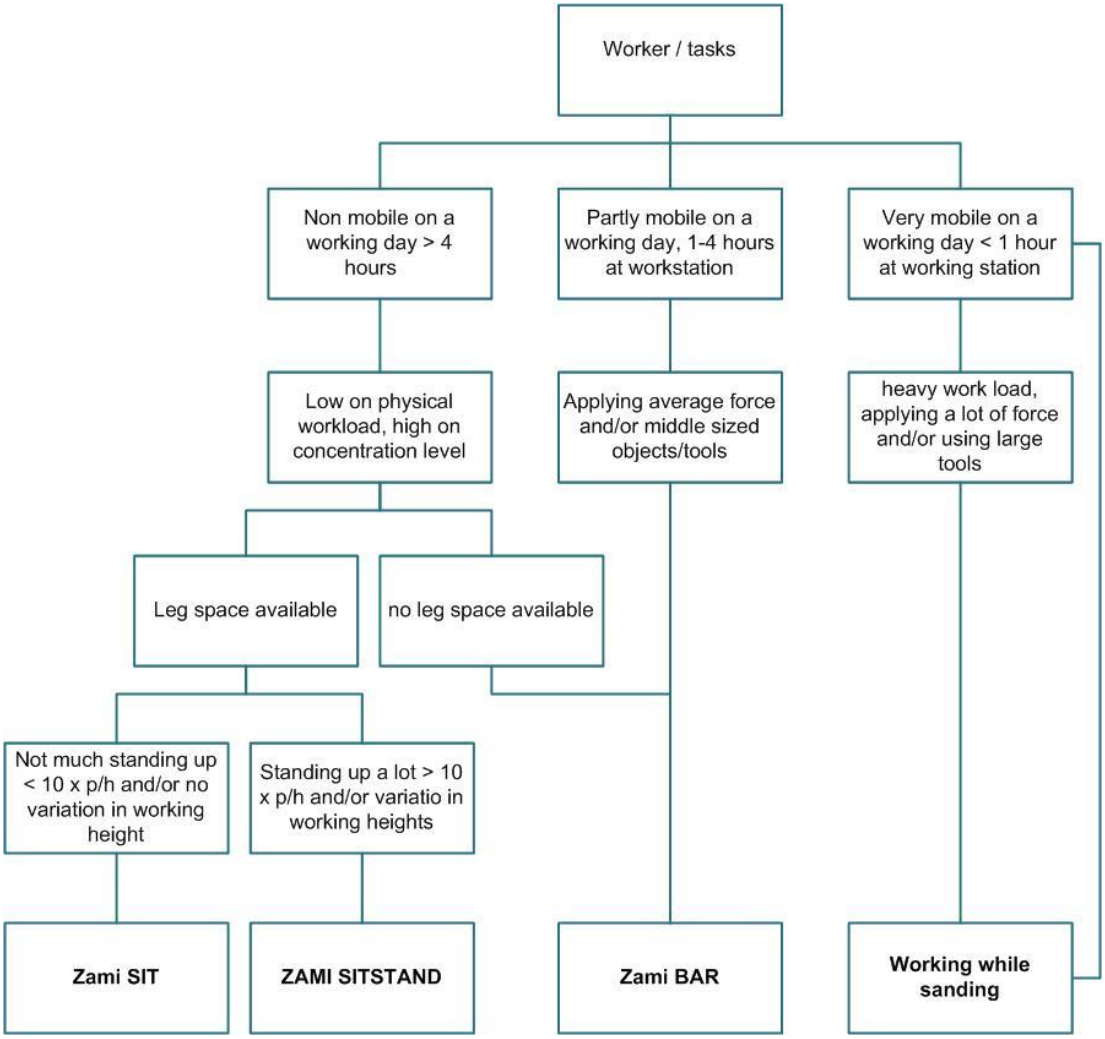
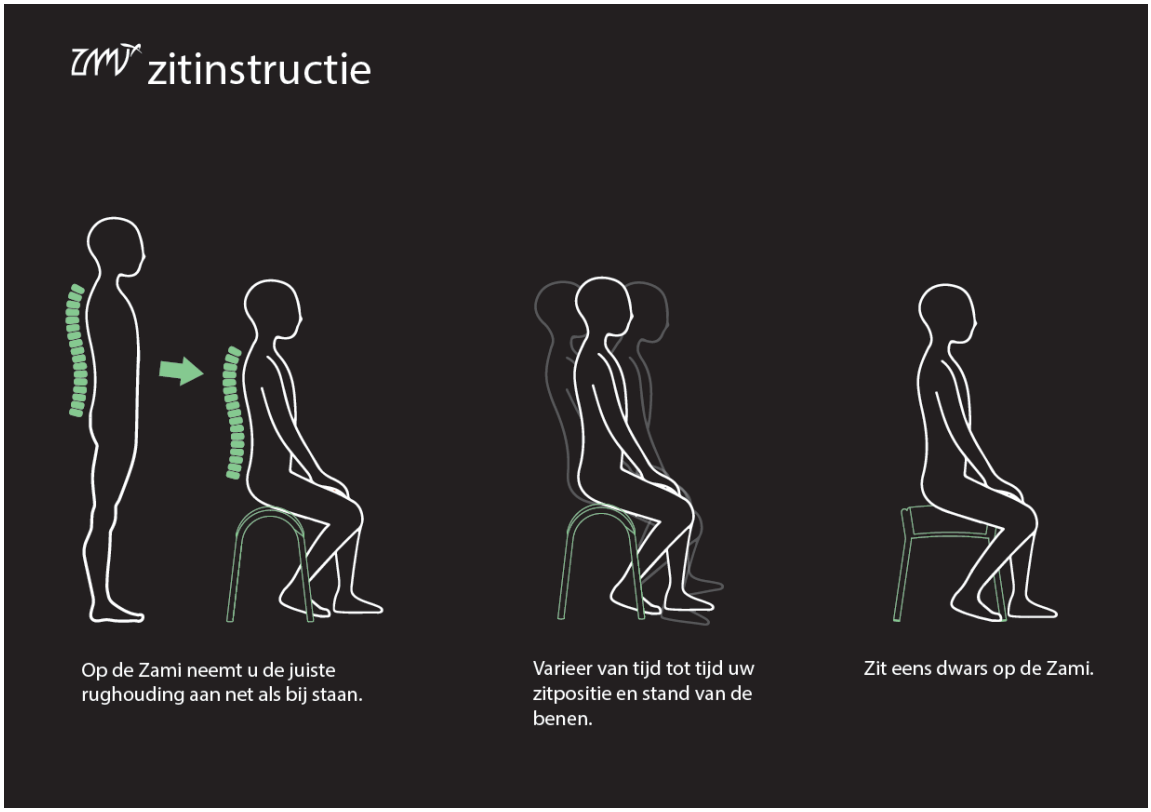


Figure 3 Diagram choice work sitting and/or standing. (KJ Peereboom, 2009, Sdu Publishers)

Appendix 2 Zami instruction



First figure: Zami allows you to obtain the right back position just like in standing up

Second figure: Vary your sitting position and the position of your legs from time to time

Third figure: try sitting crosswise on the Zami once in a while

Appendix 3 Working surface height related to body length

Table height / surface height related to body length

	A	B	C	D	E	F	G
	Length(P50)	Sitting height	Table height	Sitting height / 10 degree hip angle	Table height / 10 degree hip angle	Sitting height / 10 degree hip angle	Table height / 20 degree hip angle
Male 20-60 jr N- Europe	181,0	44,8	77,0	+ 8,4 =53,2	+ 8,4 = 85,4	+16,4 = 61,2	+16,4 = 93,4
Female 20-60 jr N-Europe	169,0	42,0	71,0	+ 7,9=49,9	+ 7,9= 78,9	+15,4= 57,4	+15,4= 86,4
Male 20-60 jr M- Europe	171,0	42,2	72,5	+8,0= 50,7	+8,0= 80,5	+15,5=57,7	+15,5= 88,0
Female 20-60 jr M-Europe	166,0	40,7	69,9	+7,8= 48,5	+7,8= 77,7	+15,2=55,9	+15,2= 85,1
Male 20-60 jr N- USA	179,0	44,2	76,0	+8,3= 52,5	+8,3= 84,3	+16= 60,2	+16= 92,0
Female 20-60 jr N-USA	165,0	40,7	69,2	+7,8= 48,5	+7,8= 77,0	+15,2=55,9	+15,2= 84,4

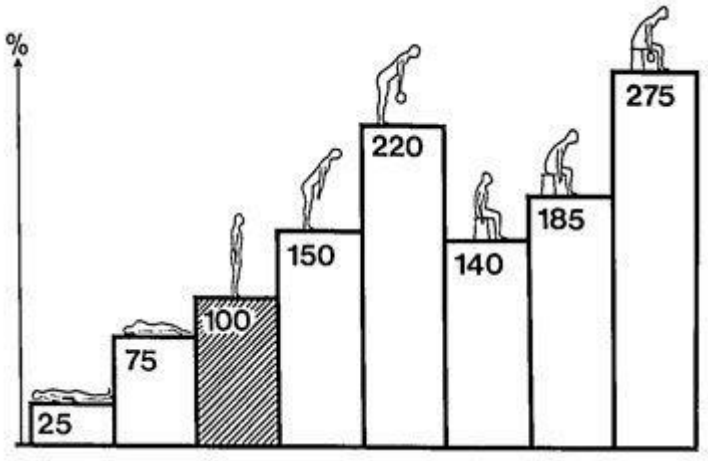
A = P50 (= average length Dutch male DINED 2004)
B = Seat height according to Dreyfuss (barefoot sitting on a kitchen chair with upper leg bent 90 degrees in knee and hip joint)
C = Table height according to Dreyfuss sitting on a kitchen chair without shoes
D = Approximate seat height with upper legs - 10 degrees compared to horizontal
E = Approximate table height with upper legs - 10 degrees compared to horizontal
F = Approximate seat height with upper legs 20 degrees from horizontal
G = Approximate table height with upper legs - 20 degrees to horizontal
N = North, M = Middle

Table height / surface height related to body length combined with a 35 degree hip angle

	A	B	C	H	I
	Length(P50)	Sitting height	Table height	Sitting height / 35 degree hip angle	Table height / 10 degree hip angle
Male 20-60 jr N- Europe	181,0	44,8	77,0	+27,7=72,5	+ 27,7=104,7
Female 20-60 jr N-Europe	169,0	42,0	71,0	+26,9= 68,9	+ 26,9=97,9
Male 20-60 jr M- Europe	171,0	42,2	72,5	+26,42= 68,62	+26,42=98,92
Female 20-60 jr M-Europe	166,0	40,7	69,9	+25,77=66,47	+25,77= 95,67
Male 20-60 jr N- USA	179,0	44,2	76,0	+27,42=71,62	+27,42=103,42
Female 20-60 jr N-USA	165,0	40,7	69,2	*+25,77=66,47*	*+25,77=94,97*

Because people wear footwear/shoes it is recommended to add 2.5 cm sole height for all sizes

Appendix 4 Back load (research by Nachemson)



The figure shows the relative measured pressure between the lower (lumbar) intervertebral discs in different postures compared to standing up straight where the standing up value is defined as 100. It can clearly be seen that the pressure increases when bending forward (185 compared to 140) and that when an additional weight is being lifted that the intervertebral pressure increases more strongly (275 compared to 140 and 100).

Sources ,

- Nachemson AL, Journal Spine (Phila Pa 1976), 1981 Jan-Feb;6(1):93-7;
- A. Nachemson (1965) The Effect of Forward Leaning on Lumbar Intradiscal Pressure, Acta Orthopaedica Scandinavica, 35:1-4, 314-328, DOI: 10.3109/17453676508989362