



Ergonomics approved quality label

Matador E-barrow



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1 Introduction

This report contains the assessment for a vhp ergonomics approved quality label for the Matador E-barrow. During the assessment of the vhp ergonomics mark, the functional and usage aspects of the product are assessed in terms of compliance with the guidelines for physical load from the Physical Load Manual.

The general regulations concerning physical load, including lifting and carrying, apply. Particularly important in this context is: The Government Gazette of 14 May 2012 states that the standard that the loading plus own weight of the wheelbarrow may not exceed 60 kilos. The Inspectorate SZW inspects companies and checks the loading of wheelbarrows against this standard in the Government Gazette.

If the load of wheelbarrows is heavier than 60 kilos, the Inspectorate considers this to be a violation. But the standard used by the Inspectorate does not include the recent innovation of wheelbarrows. A modern wheelbarrow may be able to be loaded much heavier without increasing the physical load for the employee. The weight on the handles determines the lifting force and the pushing force that the user must perform. As long as the weight to be handled on the handles does not exceed 25 kilos, the wheelbarrow complies with the requirement of a maximum of 25 kilos of lifting or pushing force.

2 Product: Matador E-barrow

The Matador E-barrow is the electric version of the Matador Profimax M-151. This is a wheelbarrow where the wheel is placed closer to the load and where the handles are placed high. In addition, the Matador E-barrow contains electric wheel drive. The operation of the electric wheelbarrow is illustrated in this product video: <https://www.youtube.com/watch?v=QIQOq8IMmB4>. The Matador E-barrow has a steel frame and is fitted with a plastic container. The height of the handles is 53 cm. The E-barrow has a weight of 26,6 kg and has a carrying capacity of 200 kg.

The Matador E-barrow avoids initial pushing and pulling and takes slopes and obstacles by using electric drive which can provide up to 600 watts. This makes loading and unloading to and from areas with height differences less strenuous. The battery recharges itself when driving downhill and - depending on use - can be used for an average of 8 hours. The E-barrow has a stepless intuitive speed control and produces low-noise. This is an electric type of wheelbarrow with a leakproof, extra-wide tyre has a 90 litre plastic container made of HDPE (High Density Polyethylene). The motor is incorporated in the rim. The motor is driven in direct manner without gears.

3 Features Matador E-barrow

The Matador E-barrow wheelbarrow has the following ergonomic features compared to a standard wheelbarrow (Matador Profimax):

- A shortened wheelbase. Because of this, the load comes much more positioned above the wheel compared to a traditional wheelbarrow, which leads to a lower lifting strain. To illustrate this: a traditional wheelbarrow with a load of 60 kg weighs 21.3 kg on the handles. On the Profimax M-151 with a load of 60 kg, the lifting weight on the handles is 19.7 kg.
- Compared to the Profimax, the E-barrow is 10 kg heavier in weight. However, the effect of a shortened wheelbase means that the pressure on the handles during use is lower (moment=force times arm effect). By placing the extra weight in the wheel and near the wheel, the load arm effect of the extra weight remains relatively limited and the shortened wheelbase works to the advantage of the user.
- Assuming a maximum of 25 KG of lifting (Dutch Government Gazette), the E-Barrow including its own weight may weigh 76.2 KG in order to achieve a maximum of 25 Kg of force on the hands.

- Higher placed handles. These ensure that the user does not have to bend down as deeply when lifting the load. The force on the lower back is hereby 2600 N (this remains under the NIOSH safe limit of approx. 3400 N, see the Appendix).
- Electric support. Because the E-barrow provides support during horizontal (and angled) movement, the force required to move (push) the wheelbarrow horizontally is drastically reduced. The force that remains is lifting and balancing force only.
- This implicates that the standards imposed by the Government Gazette in fact only relate to lifting and not to pushing and pulling. For pushing and pulling, all peak values (starting up, driving over obstacles, driving up) are provided by the electric drive.
- When working with the E-Barrow, the safe back load for a day's work is a maximum of 33 KG. This has been determined with the 3dSSPS biomechanical calculation model by Chaffin, see the Appendix. Chaffin works on the basis of the NIOSH lifting standard. This limit value is also used in the Netherlands by I SZW (formerly the Labour Inspectorate). The safe weight including load for the E-Barrow is therefore 100.6 KG. The following should be taken into account:
 - Pushing and pulling (starting, driving over obstacles and ramps) is done by using the electric motor;
 - This value only concerns lifting;
 - The handle height is 53 CM;
 - The duration of use per day should be taken into account. When using the Matador E-Barrow regularly (once every 5 minutes), the maximum load weight: up to and including 8 hours per day: 100.6 KG.
 - When working with the E-Barrow, the safe back load for one hour of wheelbarrowing is a maximum of 46 KG.
 - The duration of use per hour must be taken into account. When using the Matador E-Barrow for one hour (once every 5 minutes), the maximum load weight is: up to 1 hour per day: 140.2 KG.

4 Vhp ergonomics approved quality label

The Matador E-barrow has been approved for ergonomic use and has been awarded the vhp ergonomics mark. The Matador E-barrow combines a good working position with responsible use of force when pushing, pulling and lifting the wheelbarrow.

Traditional wheelbarrow (profimax): A maximum wheelbarrow weight of 60 KG is permitted according to the Government Gazette. Without electrical assistance, a maximum weight of 60 KG is allowed on the handles. According to Inspectorate SZW this corresponds to a maximum load of 25 KG.

Matador E-Barrow: a maximum weight (including own weight of 26.6 KG) of 100.6 KG is allowed. This weight is higher than for a traditional wheelbarrow because:

- Pushing and pulling/turning is done by the electric motor, only lifting is done manually;
- The handle height of the Matador E-barrow is higher, this leads to a lower back compression value;
- The wheelbase of the Matador E-barrow is shorter, this leads to less back strain;
- Based on these starting points, the maximum load for an average man is determined with a biomechanical calculation model based on the NIOSH standards (see Appendix).

This starting point has been determined based on the application of internationally accepted ergonomic health limits.

NOTE> The approval for the ergonomic approved quality label only applies when these conditions are met:

Spread weight evenly between both handles, a maximum lifting weight per hand of 16.5 KG is allowed.

This corresponds to a maximum lifting weight of 100.6 kg from a standing position (minus own weight of 26.6 KG = 80 KG as a maximum load). The conditions during use of the E-barrow required for the award of the quality mark are as follows:

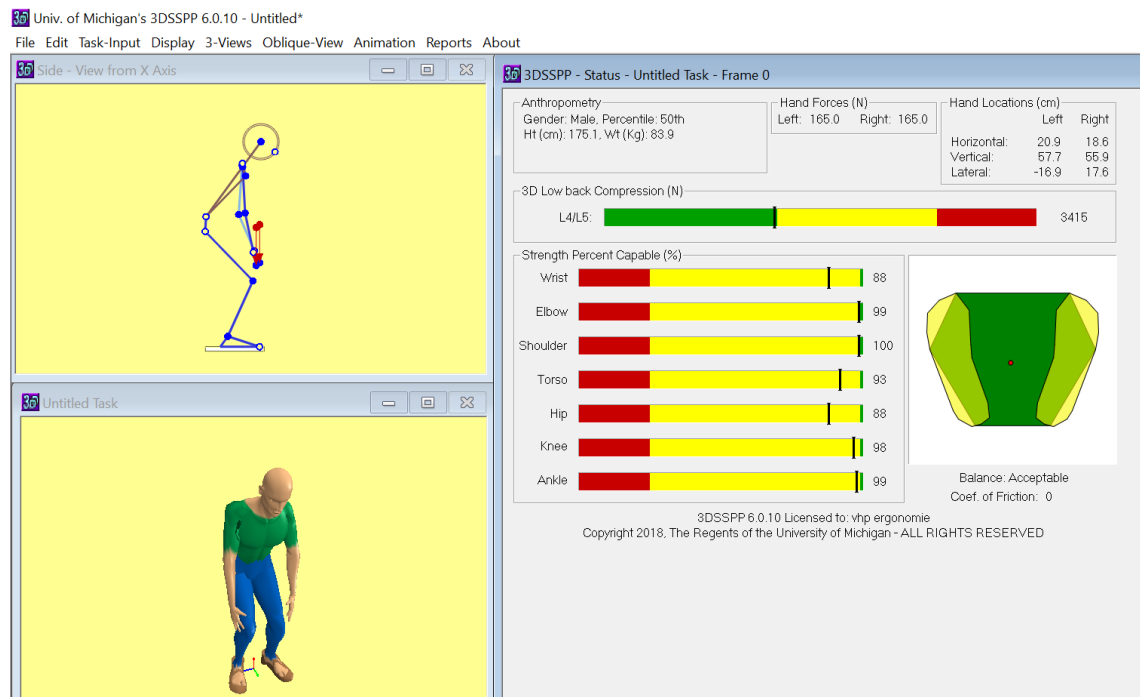
- Pushing and pulling (starting, driving over obstacles and ramps) are done by using the electric motor;
- The user only uses force for lifting and not for pushing and pulling;
- The handle height is 53 CM;

5 Appendixes

5.1 Appropriate Standards

NEN-EN 1005-1:2001+A1:2008 en	Safety of machinery - Human physical performance - Part 1: Terms and definitions
NEN-EN 1005-2:2003+A1:2008 en	Safety of machinery - Human physical performance - Part 2: Manual handling of machinery and component parts of machinery
NEN-EN 1005-3:2002+A1:2008 en	Safety of machinery - Human physical performance - Part 3: Recommended force limits for machinery operation
NEN-EN 1005-4:2005+A1:2008 en	Safety of machinery - Human physical performance - Part 4: Evaluation of working postures and movements in relation to machinery
Mital , A. et al: 1997	A Guide to Manual Materials Handling, Taylor & Francis, London.
Dutch official Government Gazette	The Government Gazette of February 25, 2012 states: A fine will be imposed by the Inspectorate SZW in cases where one handles a wheelbarrow heavier than 25 kilograms. The Government Gazette of May 14, 2012 states the standard that the load plus the own weight of the wheelbarrow should not exceed 60 kilograms.

5.2 Low back compression



The green area L4/L5 marks the completely safe area for back loading (3415 N value). In the figure this is shown for an average man (175.1 cm and weighing 83.9 KG). The hand forces are 165 Newtons per hand when lifting (because wheelbarrowing is actually lifting), this equals 330 Newtons and this equals a total of 33 KG of force. The yellow area L4/L5 marks the acceptable area for back strain. The red area should be avoided.