

Technical note—test instructions for the technical testing of mono-functional myoelectrically-controlled prosthetic hands. A proposal.

B. INGVARSSON, I. KARLSSON, L-G. OTTOSSON and M. THYBERG.

Department of Rehabilitation Engineering, University Hospital, Linköping, Sweden

Abstract

To get an acceptable standard of prostheses and orthoses in Sweden, the Swedish Institute for the Handicapped is testing this group of aids. One important part of the work is to draw up test instructions.

In response to a request from the Swedish Institute for the Handicapped, the Laboratory of Rehabilitation Engineering at the University Hospital of Linköping in Sweden, has suggested instructions for the technical testing of mono-functional myoelectrically controlled prosthetic hands. These test instructions contain different inspection and control factors which are important for the function of the prosthetic hand.

Introduction

Increasing numbers of technical aids for handicapped people are being put on the market. At the same time these technical aids have the tendency to become more and more complicated and therefore there is a great need to test them in order to ensure that they are functional and durable.

In Sweden there are regular tests of different types of aids. In the field of orthotics and prosthetics several projects are now being carried out drawing up test instructions. At the laboratory of Rehabilitation Engineering at the University Hospital of Linköping, a proposal has been drawn up for technical testing of mono-functional myoelectrically controlled prosthetic hands.

The outline of these test instructions is presented here under the main topics considered.

Description

Information about the manufacturer and the supplier is to be stated as well as the type-

designation, the manufacturing number, the size of the hand, the type of grip, wrist functions, and the way in which the hand is controlled, proportionally or on/off.

Marking

The hand should be clearly and durably marked with the manufacturer's name or trademark, the type-designation and the manufacturing number.

Instructions

It is ascertained that a complete technical description is available and that instructions suitable for the use of patients are included. These must be written in Swedish.

Dimensions and weight

The dimensions identified on Figure 1 are measured.

The distance between the distal end of the wrist unit and the tip of the middle finger (A).

The length of the hand from the distal end of the wrist unit (B).

The length of the middle finger (C).

The maximum circumference when the hand is closed.

The prosthetic hand, including the cosmetic glove, is weighed.

Electronics and mechanics

The hand is inspected to ensure that it performs well. A visual inspection is made of cables, connections, assembly, looseness, etc.

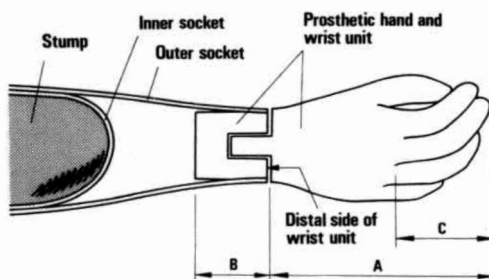


Fig. 1. The figure shows the distances which are noted.

All correspondence to be addressed to Börge Ingvarsson, Department of Rehabilitation Engineering, University Hospital, S-581 85 Linköping, Sweden.

The inner hand and the cosmetic glove

The inner hand and the cosmetic glove are inspected to confirm that they are clearly and durably marked with the manufacturer's name or trade-mark and type-designation. The fitting and the performance are inspected and the cosmetic appearance is examined.

Safety aspects

It is very important to measure the force required to open the hand during an active grip (Fig. 2). One must also inspect that the hand can be voluntarily opened in the normal way when the grip is loaded.

The on/off-switch, if present, must be easy to operate. The danger of fire in the prosthetic hand has to be examined.

Service organization

The address of the supplier's service organization is determined, as well as the time needed for routine servicing and supply of spare parts.

Gripping width

The maximum gripping width of the hand is measured by letting it grasp prisms and cylinders. The hand, which is horizontally placed, should be capable of grasping and then holding these objects without any assistance.

Opening and closing times

The times for the hand to open and to close are measured, i.e. the time from giving a signal to the motor until the hand has reached its maximum extension, after being completely closed, and until it is completely closed after being extended to maximum.

Gripping force

The maximum gripping force and the remaining gripping force after active gripping are measured. These measurements are made when the degrees of opening are 20 per cent, 50 per

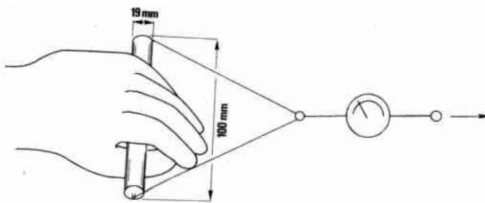


Fig. 2. Method of measuring force required to open the hand.

cent and 80 per cent of the maximum gripping width.

Current consumption

The current required by the prosthetic hand is measured when the hand is on but not moving, during opening and closing, when the hand is completely closed and extended to maximum with applied motor signal and during maximum gripping at the opening degree of 50 per cent.

Noise and vibration measurements

The sound level and the vibration emitted by the hand are measured when the hand is moving and gripping. These measurements are carried out well screened from external noise and vibrations.

Mechanical testing

The prosthetic hand should undergo environmental testing according to IEC Publication 68-2-27, Test Ea: Shock, Second Edition 1972 and according to IEC Publication 68-2-32, Test Ed: Free fall, Second Edition 1975.

Environmental testing

The hand should undergo environmental testing according to IEC Publication 68-2-1, Test A: Cold, Fourth Edition 1974. IEC Publication 68-2-2, Test B: Dry heat, Fourth Edition 1974. IEC Publication 68-2-3, Test Ca: Damp heat, steady state, Third Edition 1969.

Long-term testing

The prosthetic hand is placed in a fixture and driven by external control signals. The complete cycle of operation is: opening for 3 seconds, 1 second pause, closing for 3 seconds and 1 second pause.

After 25,000 cycles and then after every 50,000 cycles the current consumption, the time for opening and closing, the gripping width, the gripping force and the noise level are measured.

Discussion

It is emphasised that this is a proposal for test instructions. The next step is to draw up requirement specifications for myo-electrically controlled prosthetic hands in conjunction with these test instructions. The aim is to compare different prosthetic hands in the hope that this will result in better products.