

MANUFACTURING GUIDELINES



TRANS-RADIAL PROSTHESIS

Physical Rehabilitation Programme



ICRC



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Foreword

The ICRC polypropylene technology

Since its inception in 1979, the ICRC's Physical Rehabilitation Programme has promoted the use of technology that is appropriate to the specific contexts in which the organization operates, i.e., countries affected by war and low-income or developing countries.

The technology must also be tailored to meet the needs of the physically disabled in the countries concerned.

The technology adopted must therefore be:

- durable, comfortable, easy for patients to use and maintain;
- easy for technicians to learn, use and repair;
- standardized but compatible with the climate in different regions of the world;
- low-cost but modern and consistent with internationally accepted standards;
- easily available.

The choice of technology is of great importance for promoting sustainable physical rehabilitation services.

For all these reasons, the ICRC preferred to develop its own technique instead of buying ready-made orthopaedic components, which are generally too expensive and unsuited to the contexts in which the organization works. The cost of the materials used in ICRC prosthetic and orthotic devices is lower than that of the materials used in appliances assembled from commercial ready-made components.

When the ICRC launched its physical rehabilitation programmes back in 1979, locally available materials such as wood, leather and metal were used, and orthopaedic components were manufactured locally. In the early 1990s the ICRC started the process of standardizing the techniques used in its various projects around the world, for the sake of harmonization between the projects, but more importantly to improve the quality of services to patients.

Polypropylene (PP) was introduced into ICRC projects in 1988 for the manufacture of prosthetic sockets. The first polypropylene knee-joint was produced in Cambodia in 1991; other components such as various alignment systems were first developed in Colombia and gradually improved. In parallel, a durable foot, made initially of polypropylene and EthylVinylAcetate (EVA), and now of polypropylene and polyurethane, replaced the traditional wooden/rubber foot.

In 1998, after careful consideration, it was decided to scale down local component production in order to focus on patient care and training of personnel at country level.

Objective of the manuals

The ICRC's "Manufacturing Guidelines" are designed to provide the information necessary for production of high-quality assistive devices.

The main aims of these informative manuals are as follows:

- To promote and enhance standardization of ICRC polypropylene technology;
- To provide support for training in the use of this technology;
- To promote good practice.

This is another step forward in the effort to ensure that patients have access to high-quality services.

ICRC

Assistance Division/Health Unit

Physical Rehabilitation Programme

Introduction

The aim of this document is to describe a method for producing **trans-radial prostheses with interchangeable sockets**, working with the ICRC polypropylene technology and orthopaedic components used at the Regional Physical Rehabilitation Centre in Battambang, Cambodia.

The casting, rectification and alignment methods used correspond to international prosthetic and orthotic (P&O) standards of practice and are therefore not described in these ICRC manufacturing guidelines.

1

CASTING AND RECTIFICATION

- ▶ Patient assessment, casting and rectification of positive cast impressions are performed in accordance with P&O standards.



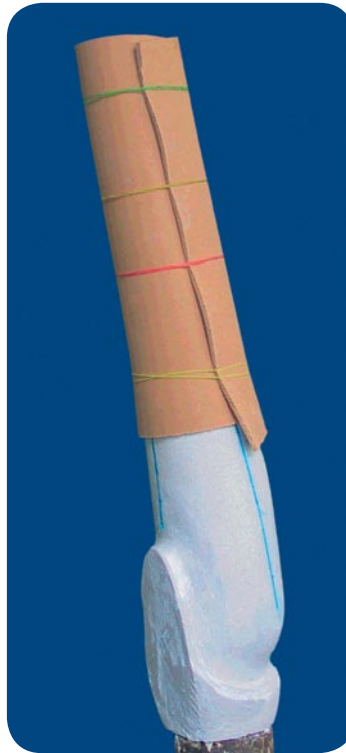
- ▶ Alignment lines antero-posterior and medio-lateral (A-P, M-L) are drawn on the positive mould for proper positioning of the wrist. In most cases this will be along the central axis of the trans-radial stump.

Drive nails into the distal end of the cast to ensure good adherence for the build-up of the plaster extension.



- ▶ Make a conical extension tube using EVA, plastic sheeting or some other suitable material and place it according to the alignment lines for wrist positioning. Tape the cone in place.

Fill the extension cone with plaster up to 5 mm higher than the level of the wrist, so as to leave room for shaping the correct angles of the wrist.



- ▶ Prolong the proximal alignment lines along the plaster extension in order to facilitate positioning of the polypropylene wrist.



- ▶ The measurement from the olecranon to the radial styloid process of the sound side will determine the length of the prosthesis to the distal end of the wrist unit.

The length of the prosthesis may be 1 to 2 cm shorter than the sound side, but never longer.



- ▶ Smooth and shape the build-up so that it is perfectly conical, otherwise it will be difficult to exchange the sockets in this technique.



- ▶ Before draping the polypropylene sheet, pull a stocking over the plaster mould. Cut it at the proximal part of the wrist and fix it with contact glue. Dust the stocking with talcum powder.



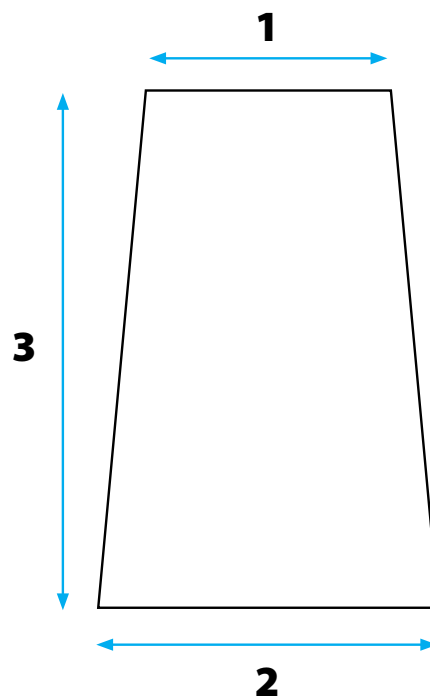
- ▶ Measurement of polypropylene sheet:

1 Wrist circumference + 2 cm

2 Epicondyle circumference + 4 cm

3 Length of plaster cast + 15 cm

Thickness 3 or 4 mm, depending on patient.



- ▶ Heat the polypropylene in an oven for about 20 minutes at 180° C.

Drape the polypropylene over the plaster model and stick the sides together along the posterior side. Tighten the polypropylene around the suction cone or tube using a bicycle inner tube, rope or stocking, then open the vacuum valve.



- ▶ Using scissors or a knife, cut off the leftover polypropylene of the welding seam while it is still hot.

Keep the vacuum on until the plastic has cooled down.



- ▶ Remove the plaster, shape the socket trim lines and grind the posterior welding seam.

Drill a hole (dia. 20 mm) on the medial/distal side for pulling the stump socket.

Flatten the polypropylene on the distal end of the wrist.

Check the socket on the amputee for comfort, suspension and length.



4

PRODUCTION OF SECOND SOCKET

- After the first fitting, fill the socket with plaster again and prepare it for draping the second socket. Pull 4 cotton stockinet tubes and 1 nylon stocking (to obtain a smooth surface) over the first socket.



5

POSITIONING OF CABLE HOUSING

- Draw a line from the proximal to the distal part on the mid-anterior of the socket. **The line must stop at least 5 cm from the wrist.** This indicates the position for the cable housing dummy.



- Take a bicycle brake cable with housing, cut it in accordance with the length of the line and fix it on the stocking with contact glue.



- ▶ Heat a strip of polypropylene and shape it to the socket, 1 cm above the planned trim lines of the 2nd socket to avoid flaring at the trimmed edges of this socket. This will also protect the 1st socket when the second one is being cut.



- ▶ Drape a 3 mm polypropylene sheet over the socket, using the same measurements and draping technique as for the 1st socket.

When the polypropylene is cool, cut it on the strip with an oscillating saw or hacksaw.



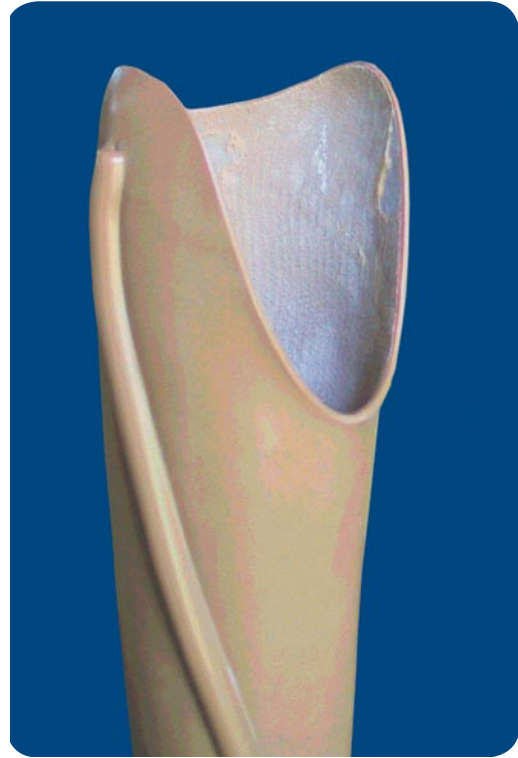
- ▶ Remove the 2nd polypropylene socket and the plaster inside the 1st socket.



- ▼ The trim lines of the 2nd socket should be approximately 3 cm distal to the trim lines of the anterior side of the 1st socket, and should “dip” 6 cm in the posterior to create “ears/wings” on the medial and lateral sides.

This will preserve some flexibility for the 1st socket and prevent rotation of the 2nd socket.

Trim off the distal end by the wrist, leaving it flush with the length of the 1st socket.



- ▶ Remove the cable housing dummy with long flat nose pliers or an awl.



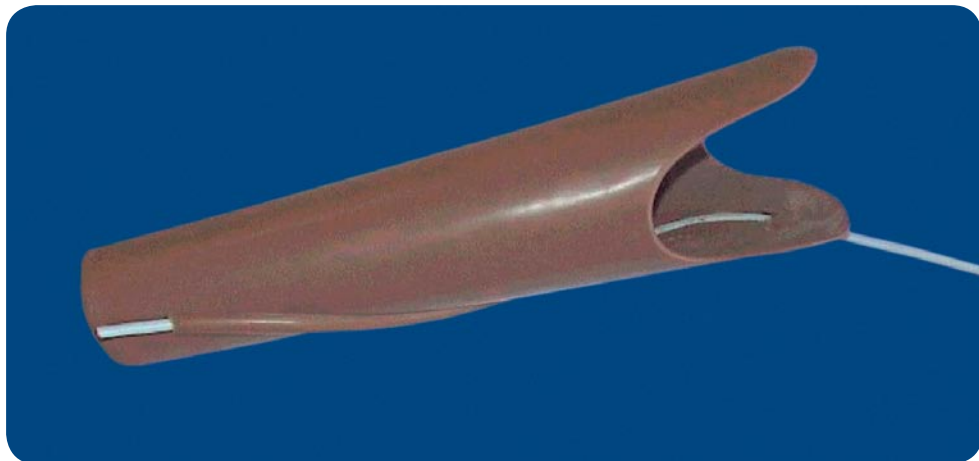
- ▶ Cut and drill openings in the ends of the channel created by the cable housing.



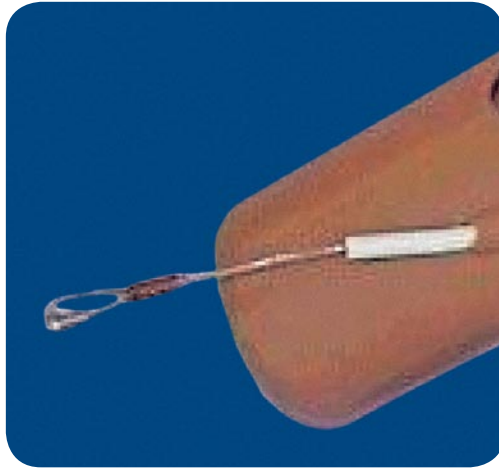
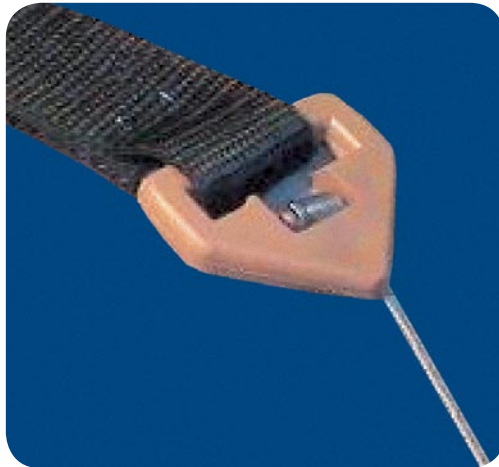
- ▶ Insert the definitive cable housing and push it inside the channel with a riveting bar.



- ▶ The cable housing should extend at least 2 cm outside the distal channel opening to protect the cable wire from bending and breaking, and to allow enough room for the cable to open the hook fully.



- ▶ Insert the bicycle brake cable into the housing. On the proximal part, fix a polypropylene webbing hanger with a screw clamp. On the distal part, make a loop with the cable and secure it with a small metal tube (clamp sleeve), which is flattened (pressed) around the cable.



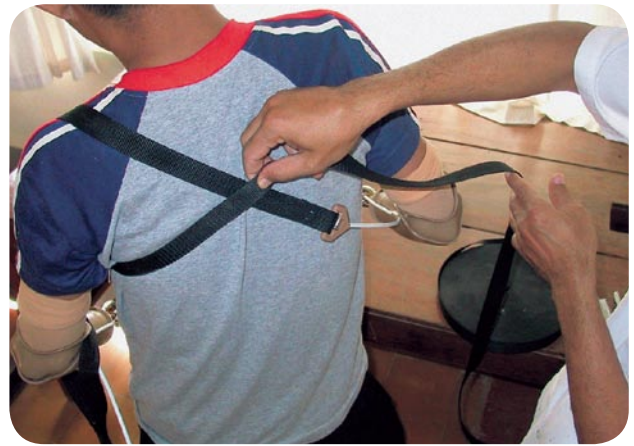
- ▶ The most simple type of harness for operating the hook is the “figure of eight” suspension.

Staple or clamp a nylon belt (30 mm wide) on the webbing hanger.



- ▶ Fold the nylon belt around the opposite shoulder.

The connection should be adjusted in the middle of the back (spine).



- ▶ Staple or clamp the harness together. When cutting the belt, leave it a little longer so that it can be readjusted.

Check with the amputee that the cable control system functions properly in different arm positions.

To open the hook, the patient moves his shoulder on the sound side (opposite side for double amputees) or the prosthesis forward.



- ▼ Once the harness has been adjusted so that amputee feels comfortable with it, sew the belt connection and the fixation onto the webbing hanger.



- ▶ To prevent fraying, melt the fibres at the end of the belt with a welding iron.



- ▶ Finished prosthesis with interchangeable socket.



- ▶ The first socket can be used with a cosmetic hand, a working ring or other tools not requiring the cable control system.



- ▶ Check with the amputee that the second socket slides easily over the first.



- Teach the patient how to use the interchangeable trans-radial sockets and how to connect and use the harness and the cable-operated hook.



List of components, CR Equipments SA (CRE)

ICRC Code	Description	Unit of measure	Quantity
OCPOWRISKIA OCPOWRISLIA OCPOWRISERA	PP wrist unit, adult, with M10 T-nut (dia. 45 mm) and 4 pan head Phillips framing screws, 8 x 3 mm <i>* Wrist units are available in 3 different colours. Choose ICRC code according to colour **</i> <i>** Beige colour</i> <i>** Olive colour</i> <i>** Terra colour</i>	Each	1
OCPOHOOKAL	Hook, adult, left, stainless steel, M10 thread <i>According to side of amputation</i>	Each	1
OCPOHOOKAR	Hook, adult, right, stainless steel, M10 thread <i>According to side of amputation</i>	Each	1
KORTHOOKSP	Spare parts for hook: Rubber washer, D30x d10x H6 mm Stainless steel spring	Each	10
		Each	10
OCPOHOOKKRT	<i>* Working round ring tool, stainless steel with rubber washer</i> <i>* On request by amputee</i>	Each	1
OCPOHANDERML OCPOHANDERMR OCPOHANDERWL OCPOHANDERWR	Terra colour: Hand, man, left, terra colour	Each	1
	Hand, man, right, terra colour	Each	1
	Hand, woman/child, left, terra colour	Each	1
	Hand woman/child, right, terra colour	Each	1
OCPOHANDKIML OCPOHANDKIMR OCPOHANDKIWL OCPOHANDKIWR	Beige colour: Hand, man, left, beige colour	Each	1
	Hand, man, right, beige colour	Each	1
	Hand, woman/child, left, beige colour	Each	1
	Hand, woman/child, right, beige colour	Each	1
OCPOHANDLIML OCPOHANDLIMR OCPOHANDLIWL OCPOHANDLIWR	Olive colour: Hand, man, left, olive colour	Each	1
	Hand, man, right, olive colour	Each	1
	Hand, woman/child, left, olive colour	Each	1
	Hand, woman/child, right, olive colour	Each	1

List of other manufacturing materials

ICRC Code	Description	Unit of measure	Quantity
For first TR socket:			
MDREBANDP10	Plaster bandages 10 cm	Each	According to stump dimension
MDREBANDP12	or Plaster bandages 12 cm		
OMIS	Plaster of Paris		According to cast dimension
OMIS	Nails	Each	2
OPLAEVAFERA03 OPLAEVAFKIN03 OPLAEVAFLIV03	EVA 3 mm, plastic sheet or other for extension tube	Each	1, dimensions according to extension length
OMIS	Tubular nylon stocking, 60 or 80 mm for PP draping	Each	1, length according to prosthesis
OPLAPOLYCHOC03 OPLAPOLYCHOC04	Polypropylene 3 mm or 4 mm according to patient size: Polypropylene 3 mm, terra brown Polypropylene 4 mm, terra brown	Each	Dimension explained in PP draping
OPLAPOLYSKIN03 OPLAPOLYSKIN04	Polypropylene 3 mm, beige Polypropylene 4 mm, beige		
OPLAPOLYLIV03 OPLAPOLYLIV04	Polypropylene 3 mm, olive Polypropylene 4 mm, olive		
For second TR socket:			
MDREBANDP10	Plaster bandage 10 cm	Each	According to first socket size
OMIS	Plaster of Paris		According to first socket size
ODROSTOCOT60	Cotton stockinet 60 mm for PP draping	Each	4, length according to prosthesis
OMIS	Nylon stocking for PP draping	Each	1, length according to prosthesis
OMIS	Bicycle brake cable housing dummy	Each	1, cut according to socket length
OPLAPOLYCHOC03 OPLAPOLYSKIN03 OPLAPOLYLIV03	Polypropylene 3 mm for trim line strip: Polypropylene 3 mm, terra brown Polypropylene 3 mm, beige Polypropylene 3 mm, olive	Each	1, width: 20 mm, according to circumference
OPLAPOLYCHOC03 OPLAPOLYSKIN03 OPLAPOLYLIV03	Polypropylene 3 mm for 2nd socket Polypropylene 3 mm, terra brown Polypropylene 3 mm, beige Polypropylene 3 mm, olive	Each	Dimensions explained in PP draping of 2nd socket
OMIS	Definitive bicycle brake cable housing	Each	1, cut according to socket length
OMIS	Bicycle brake cable	Each	1, length according to patient size
OMIS	PP webbing hanger or other fixation method	Each	1
OSBOVSB24	Nylon (or Perlon) belt for harness, width 25 mm	Each	1, length according to patient size

MISSION

The International Committee of the Red Cross (ICRC) is an impartial, neutral and independent organization whose exclusively humanitarian mission is to protect the lives and dignity of victims of war and internal violence and to provide them with assistance. It directs and coordinates the international relief activities conducted by the Movement in situations of conflict. It also endeavours to prevent suffering by promoting and strengthening humanitarian law and universal humanitarian principles. Established in 1863, the ICRC is at the origin of the International Red Cross and Red Crescent Movement.

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