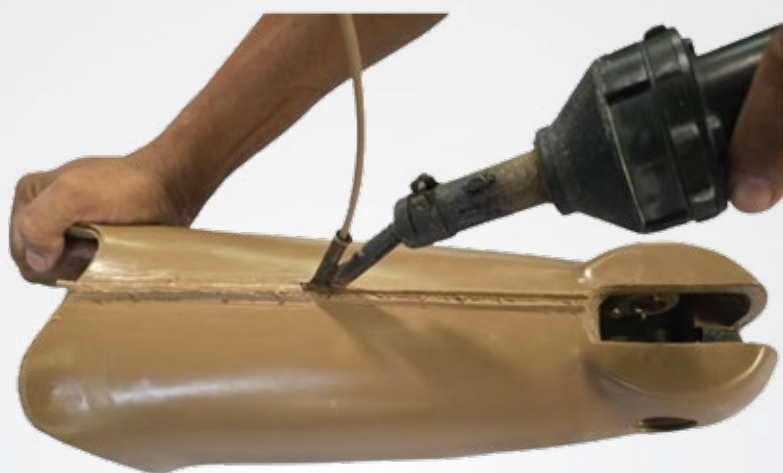


MANUFACTURING GUIDELINES

Polypropylene Welding Techniques for Prosthetics-Orthotics



Promoting
Independent
Lifestyle

Table of contents

Foreword	3
Introduction	4
1. Welding using a welding mirror	5
1.1 Use of the welding mirror	5
1.2 How to weld with the welding mirror?	6
2. Welding using a hot-air welding gun and PP welding rod	8
2.1 Material and equipment for this technique	8
2.2 The different welding operations possible on prostheses	9
2.3 Welding steps with a hot-air welding gun and PP welding rod	11
List of equipment and accessories	14

Foreword

The polypropylene (PP) technology

This technology was created by the International Committee of the Red Cross (ICRC) in 1979. Its use is appropriate to specific contexts i.e., countries affected by war and low-income or developing countries.

The technology has been tailored to meet the needs of the physically disabled in the countries concerned.

The features of this technology are:

- Freedom from the transport and storage restrictions of other materials and no shelf-life constraints;
- Durable, comfortable, easy for service users to use and maintain;
- Its hard cosmetic shell helps the device maintain a good appearance throughout its life;
- Easy for P&O technicians to learn, use and repair;
- Standardized but compatible with the environment in different regions of the world;
- Low-cost but modern and consistent with internationally accepted standards (ISO-certified and CE-marked);
- Does not require expensive machines, tools, and a large setup;
- Easily available.

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

The Rehab'Impulse Brand – owned by ICRC, made by Alfaset

The ICRC registered the Rehab'Impulse trademark in 2019 with the aim of developing a brand identity for its technology. The Rehab'Impulse brand remains under the ownership of ICRC, while the components are manufactured in Switzerland by the Alfaset Foundation, a social enterprise employing persons with disabilities.

Objectives of the manuals

The "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 good practice.
- To provide support for training in the use of this technology.
- To promote and enhance Rehab'Impulse technology.

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

Introduction

This document describes the **polypropylene welding** processes involved in the production of prosthetic and orthotic devices using Rehab'Impulse prosthetic components.

This operation requires the proper techniques and know-how, to achieve good results, it is important to pay particular attention to a number of details.

One of the essential characteristics of a good prosthesis made with polypropylene is its strength and durability, which depends primarily on using proper welding techniques.

The polypropylene prosthesis, regardless of the type, must withstand a significant load (the service user's body weight, but also all the stresses related to the movements and walking). For these reasons, there are certain specific points to consider.

The welding operation, therefore, does not simply consist of hot-wrapping a polypropylene rod around prosthetic components or gluing them together. It is actually a rather delicate operation that has a major impact on the final quality of the prosthesis.

This document is divided into two parts which describe the two main techniques for welding polypropylene components:

- The first, concerns the welding of two components together using a welding mirror.
- The second, explains in detail the welding method using a polypropylene welding rod with the assistance of a hot-air welding gun.

1. Welding using a welding mirror

1.1 Use of the welding mirror

The welding mirror (Fig 1) must be fixed in a horizontal position (Fig 2), and in a safe place in order to avoid accidental burns. Its temperature should be set between **180° C and 200° C** using the heat temperature adjustment as required (Fig 3).



Fig 1



Fig 2



Fig 3

1.2 How to weld with the welding mirror?

Place the PP components (TT concave cylinders, TF conical cups and/or knee-joints) on the welding mirror until a roll of melted PP forms, around 3-5 mm in thickness (from Fig 4 to Fig 7).



Fig 4

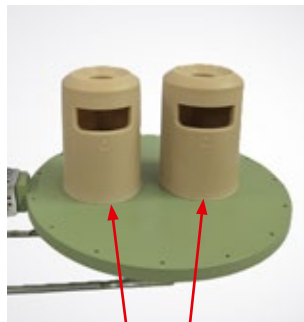


Fig 5

Roll of melted PP



Fig 6



Fig 7

Note:

Do not push on the components during the heating process.

Once a roll of sufficient thickness has formed, carefully bring the two pieces together and apply slight pressure on them. Keep them in an aligned position; both components must be vertical (from Fig 8 to Fig 12).

Let the components cool down completely, before assembling the other parts of the prosthesis.

Trans-Tibial concave cylinders



Fig 8



Fig 9

Trans-Femoral conical cups



Fig 10

Conical cup and knee-joints



Fig 11



Fig 12

Note:

It is not necessary to weld through the area initially welded with the welding mirror as shown in the picture Fig 13.



Fig 13

2. Welding using a hot-air welding gun and PP welding rod

2.1 Material and equipment for this technique

The necessary equipment and material are as follows:

- Polypropylene welding rod (4 mm diameter), Colours: beige, olive or terra (Fig 14)
- Hot-air welding gun (Fig 15)
- Holding nozzle (Fig 16)
- Welding nozzle (Fig 17)
- Welding iron (Fig 18)



Fig 14



Fig 15



Fig 16



Fig 17



Fig 18

2.2 The different welding operations possible on prostheses

The equipment and material described above are used for the various welding operations as follows:

- Connection of the TT socket to the convex disc (Fig 19)



Fig 19

- Connection of the TT convex disc to the concave cylinder (Fig 20)



Fig 20

- Connection of the TT or TF concave cylinder to the convex ankle washer (Fig 21)



Fig 21

- Connection of TF conical cup to the TF total contact socket (Fig 22)



Fig 22

- Connection of the TF conical cup to the convex disc (Fig 23)



Fig 23

- Welding of the cosmetic shells of the Trans-Tibial and Trans-Femoral prosthesis (from Fig 24 to Fig 27).



Fig 24



Fig 25



Fig 26



Fig 27

All the above operations should be carried out without disturbing the required alignment, and knee joint function (for the TF).

2.3 Welding steps with a hot-air welding gun and PP welding rod

- A** Always tack-weld the various parts of the prosthesis with a welding iron to maintain the correct service user alignment before welding (Fig 28 and Fig 29).



Fig 28



Fig 29

- B** Once the correct alignment is confirmed, use the welding iron to make a groove between the two PP parts of the prosthesis to be welded (Fig 30 and Fig 31).



Fig 30



Fig 31

- C** Use the hot-air welding gun with 4 mm welding rod to weld the various parts of the prosthesis, filling the groove that was made earlier. Adjust the temperature to around 180°C using the control knob of the hot-air welding gun (Fig 32).

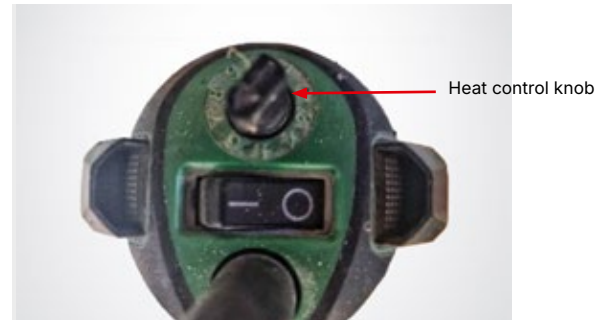


Fig 32 Setting of the hot-air welding gun

The welding rod tip and the surface of the components should both be hot, then slowly pull the hot air gun around both parts of the components. Make 2 or 3 runs depending on the weight of the service user, and the depth of the groove (from Fig 33 to Fig 37).

During welding, apply slight pressure on the welding nozzle located at the end of the hot-air welding gun, so that the PP rod is well embedded. It is recommended to perform a test run on a waste piece of PP sheet before attempting the actual weld.

Welding of a TF socket on a conical cup



Fig 33

Welding of a TF conical cup on a convex disc



Fig 34

Welding of concave cylinder on convex disc welding gun



Fig 35

Welding of a concave cylinder on a convex ankle washer



Fig 36

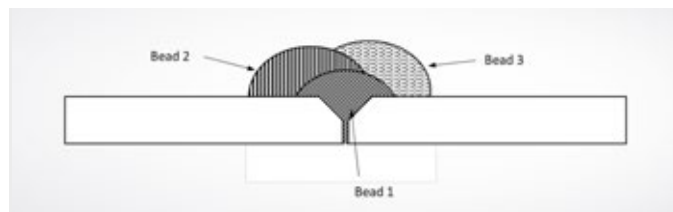


Fig 37

Various welds required for TT and TF prosthesis cosmetic shells

TF socket cosmetic shell



Fig 38



Fig 39

TF cosmetic shank



Fig 40

Ankle cosmetic area



Fig 41

TT proximal area

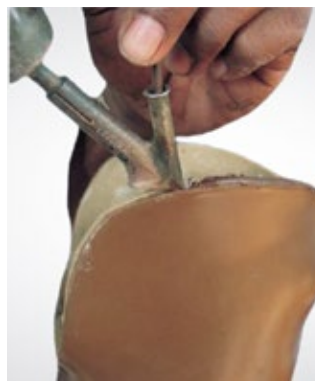


Fig 42

TF proximal area

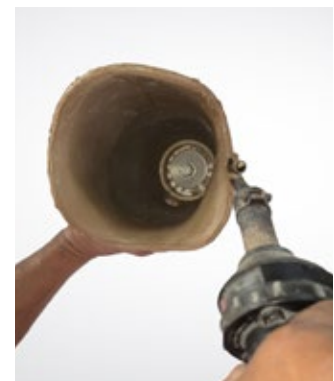


Fig 43

Note:

Getting a good, clean, and strong weld is crucial for the prosthesis's durability. So, it is important to do this operation at a moderate speed (not too fast or too slow), and at the right temperature (180°–200°C). In the two pictures on the right, Fig 44 shows a good quality weld, unlike Fig 45 which shows a bad one.



Fig 44



Fig 45

List of equipment and accessories

Rehab'Impulse Code	Item Description	Used for
74-01223	Welding "mirror" - Diam. 280 mm	Welding
74-01222	Hot-air welding gun, Leister Triac "S", 230V	Welding
74-01351	Welding Iron, electrical 150W, curved nozzle, for PP plastic	Welding
74-01177	(Welder Triac S) Holding nozzle, Diam. 32 mm, mod. 100.303	Welding
74-01179	(Welding "hot air") Welding nozzle, Diam 4 mm	Welding
74-01176	(Welder Triac S) Heating element, type 33, 1550W	Welder Hot Air Leister Triac S maintenance

Acknowledgements

Didier Cooreman
Jean François Gallay
Pierre Gauthier
Denver Graham
Leo Grasser
Franck Joumier
Anil Kumar Singh
Jacques Lepetit
Marc Liandier
Madeshanaika
Mamta Kumari
Bernard Matagne
Joel Nininger
Guy Nury
Peter Poetsma
Prasithy Prom (PWDF Battambang PRC)
Hmayak Tarakhchyan

and all prosthetists-orthotists who have worked in ICRC-assisted physical rehabilitation centres.



Rehab'Impulse
Rue des Terreaux 48
CH-2300 La Chaux-de-Fonds
Switzerland

Tél + 41 32 967 96 50
info@rehabimpulse.org

rehabimpulse.org