MATE

COMAU

MATE-XT

EXOSKELETON

Rel. 1.0

User's handbook

CR00758256-en_00/2021.03

Instruction Handbook

SUMMARY

PREFACE

This chapter contains the following topics:

Documentation storage

All documentation supplied must be stored in the immediate vicinity of the area where the MATE-XT is in use, kept available to all persons working there and kept intact throughout its operational life.

Limits on the handbook contents

The images included in the instruction handbook have the purpose to represent the product
and can differ from what is actually visible on the system.

Glossary

EXOSKELETON	Wearable device. It is understood in the text as a synonym for MATE-XT.
DEVICE	It is understood in the text as a synonym for MATE-XT.
USER	It is understood in the text understood as the person wearing the MATE-XT.

Acronyms

pDOFs	Passive degrees of freedom
pHRi	Physical Human Robot Interface
SVCH	Substances of very High Concern
TGB	Torque Generator Box

Symbols used in the handbook

Below are indicated the symbols that represent: **WARNING**, **CAUTION** and **NOTES** and their meaning.

This symbol indicates operating procedures, technical information and precautions that if are not observed and/or correctly performed may cause injuries to the personnel.

This symbol indicates operating procedures, technical information and precautions that if are not observed and/or correctly performed may cause damage to the equipment.

This symbol indicates operating procedures, technical information and precautions that must be underlined.

The symbol draws the attention to materials disposal that is regulated by the WEEE Directive.

Modification History

The following table shows the history of the Handbook release, with related changes / improvements made.

Date	Edition of the Handbook	Contents
2021/03	00/2021.03	First release of the handbook

1. GENERAL OVERVIEW

This chapter contains the following topics:

1.1 MATE-XT: portable exoskeleton

The device called MATE-XT is a passive (without motors) portable exoskeleton designed to assist the user's upper limbs in flexion-extension movements when lifting objects.

It is a wearable garment made of three different parts of the body: back, waist and arm.

Fig. 1.1 - Example of shoulder flexion-extension movement

The instructions contained in this handbook are sufficient to ensure proper use of the device.

Read the handbook carefully before using the device.

If parts of this user handbook are not clear enough, contact COMAU S.p.A. for assistance.

1.2 Intended use

The device exerts an auxiliary variable torque on the shoulder joint to partially compensate for the gravitational torque created by the weight of the upper limbs.
The purpose of the device is to reduce muscular strain and improve the quality of work in operations that require repetitive movements and with raised arms.
The reaction torques are discharged on the human-robot interface (a system of padding and strings) and distributed around the user waist.

Typical applications of the MATE-XT are:

- Screwing with raised arms;
- Sealing with raised arms;
- Assembly operations performed with raised arms;
- Underbody operations in the automotive sector;
- Cleaning operations performed with raised arms;
- Painting operations performed with raised arms;
- Logistics operations;
- Manual loading/unloading operations;
- Manual collection operations.

In order to use the device correctly and in complete safety, dedicated training is required. Please refer to the documentation provided with the device.

MATE-XT can only be used by people in good physical and psychological health. People affected by the following diseases, or with a medical history involving the following diseases, should consult their doctor before using MATE-XT:

- shoulder arthritis;
- shoulder dislocation;
- vertebral disorders;
- people who have undergone the following interventions:
  - shoulder arthroplasty;
  - shoulder arthroscopy;
  - any type of back surgery.

1.3 Individual use of the MATE-XT

In order to maximise its effectiveness, Comau recommends personal and individual use of the MATE-XT.
However, the MATE-XT can be shared between several workers after sanitisation (see par. 6.1 Sanitisation on page 45) and adjustment (see par. 4. Adjustment on page 23)
In case of doubts about the permitted uses of the MATE-XT, please contact Comau for additional information.

1.4 First use of the MATE-XT

Before wearing the MATE-XT, it is very important to follow the guidelines for choosing the correct size and correct adjustment to maximise the comfort and effectiveness of the device for the user.

In some cases, getting used to the device may take some time; in those cases, it is suggested to start using the MATE-XT gradually. Depending on the user's feeling of comfort and perceived benefit, the usage time can be gradually increased until covering the entire work shift, as required.

If the user feels any discomfort while using the MATE-XT, he/she must remove the device and immediately request Comau's assistance.

1.5 Environmental conditions of use

The MATE-XT can be used in environmental conditions within the temperature range from 0 to 45 °C (from 32 to 113°F). It is recommended using the MATE-XT for 8 hours a day only when the temperature does not exceed 30°C (86°F).

The following temperature operating range must be regarded as indicative.
Contact Comau if you intend to use the MATE-XT at different temperatures.

Wearing the MATE-XT at high temperatures may increase sweating which may be perceived as uncomfortable by the user but does not induce any dangerous condition for the worker. The perception of discomfort may only discourage the use of the MATE-XT for an extended period of time.

1.6 Storage of the MATE-XT

The MATE-XT should be stored in a dry place, preferably hung on a rack.
Do not handle the MATE-XT by its plastic parts. Lift and handle the device by gripping it by the carbon fibre rear frame.

1.7 Unintended uses

All uses that do not fall under the definitions of intended use.

In particular:

– The following categories of people should not use the device under any circumstances:
  • pregnant women;
  • minors.

– Do not use the device when driving a vehicle.

– Do not use the device to lift loads exceeding the legal requirements.

– Do not unlock or move the locking mechanism of the Torque Generator Box if the device is not intended to be used (see par. 3.1.3 Torque Generator Box (TGB) on page 19).

– Do not lift the device by its plastic parts. Grip the device by the carbon fibre rear frame.

– Do not pull the torque generator boxes or try to move them if the locking mechanism is active.

1.8 Warranty

COMAU S.p.A. guarantees the quality of construction and materials of the MATE-XT exoskeleton for a period of 12 months from the date of delivery. This standard warranty does not cover defects attributable to user errors, incorrect use, negligence or willful misconduct or from any other activity excluded from the allowed uses of the device or otherwise contrary to the instructions contained in the Instructions Handbook.

2. SAFETY

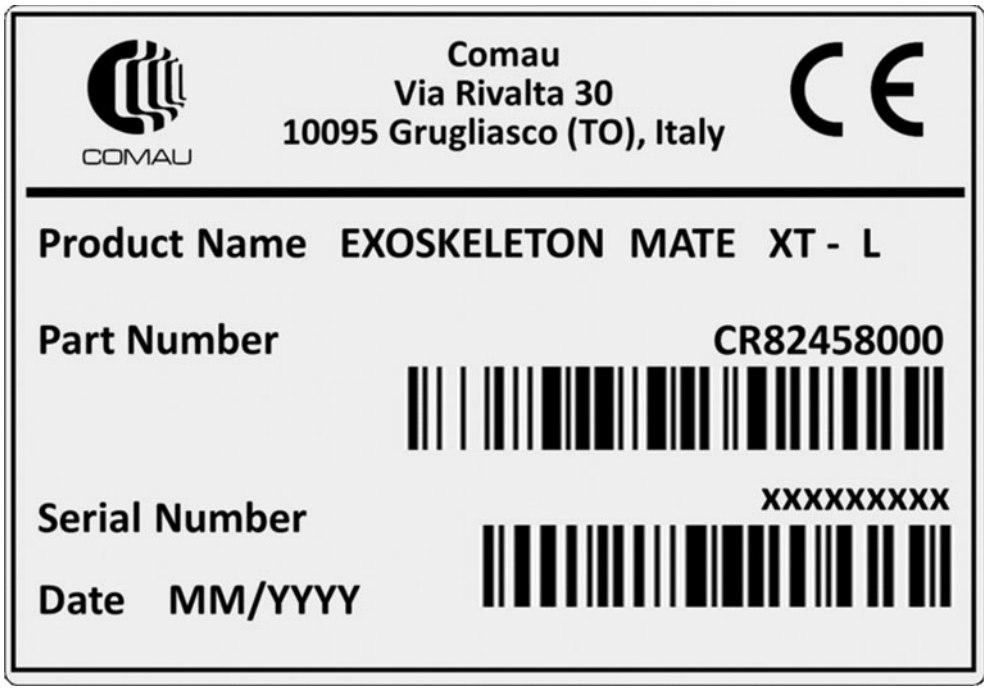
This chapter contains the following topics:

2.1 Device certification

The MATE-XT exoskeleton is a product of Comau S.p.a. Via Rivalta 30, 10095 Grugliasco (TO).

– **Name**: MATE-XT
– **Release**: 1.0
– **Serial number**: found on the product label placed on the inner surface of the exoskeleton
– **Certification**:
  • Machinery Directive 2006/42/EC
  • Standard EN ISO 13482:2014

Fig. 2.1 - Identification plate (example)



The MATE-XT must not be considered a medical device.

Fig. 2.2 - CE Declaration of Conformity

Comau S.p.A.
Sede legale: Via Rivalta, 30
10095 Grugliasco - Torino (Italy)
www.comau.com

Fabbricante (Manufacturer)
Robotics and Automation Products - Business Unit
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CE DECLARATION of CONFORMITY

DICHIARAZIONE **CE DI CONFORMITA'** - Direttiva 2006/42/CE - Allegato IIA	**EC DECLARATION OF CONFORMITY** - DIRECTIVE 2006/42/EC - Annex IIA	DÉCLARATION **CE DE CONFORMITÉ** - Directive 2006/42/CE - Annexe IIA	**EG-KONFORMITÄTSERKLÄRUNG** - Richtlinie 2006/42/EG - Anhang IIA	DECLARACIÓN **CE DE CONFORMIDAD** - DIRECTIVA 2006/42/CE - Anexo IIA
IL FABBRICANTE DICHIARA SOTTO LA SUA RESPONSABILITA' CHE I PRODOTTI	THE MANUFACTURER DECLARES UNDER HIS OWN RESPONSIBILITY THAT THE PRODUCTS	LE FABRICANT DÉCLARE SOUS SA RESPONSABILITÉ QUE LES PRODUITS	DER HERSTELLR ERKLÄRT UNTER IHRER VERANTWORTUNG, DASS DIE PRODUKTE	EL FABRICANTE DECLARA BAJO SU RESPONSABILIDAD QUE LOS PRODUCTOS
commercial name and model/type	**EXOSKELETON MATE XT - L**			
function				year of construction: 2018
code	**CR82458000**	code release:	serial number	

IT	**EN**	**FR**	**DE**	**ES**
SONO IN CONFORMITA' CON I REQUISITI ESSENZIALI DI SICUREZZA DELLA DIRETTIVA **2006/42/CE.**	ARE IN CONFORMITY WITH ESSENTIAL REQUIREMENTS OF THE DIRECTIVE **2006/42/EC.**	SONT CONFORMES AUX EXIGENCES ESSENTIELLES DE SÉCURITÉ APPLICABLES DE LA DIRECTIVE **2006/42/CE.**	ENTSPRECHEN MIT DEN GRUNDLEGENDEN SICHERHEITS VORSCHRIFTEN DER RICHTLINIE **2006/42/EG.**	ESTÁN DE ACUERDO CON LOS REQUISITOS ESENCIALES DE SEGURIDAD APLICABLES A LA DIRECTIVA **2006/42/CE.**
Sono realizzati in conformità con la seguente principale norma armonizzata: EN ISO 13482:2014 Robots and robotic devices - Safety requirements for personal care robots *(L'elenco delle direttive e delle norme di riferimento f contenuto all'interno del manuale istruzioni).*	Are manufactured in compliance with the following harmonized norms: EN ISO 13482:2014 Robots and robotic devices - Safety requirements for personal care robots *(The list of Declarations and the reference norms is included witihin the instruction manual)*	Ils sont fabriqués en conformité avec les normes harmonisées suivantes: EN ISO 13482:2014 Robots and robotic devices - Safety requirements for personal care robots *(La liste des directives et des normes de référence est contenue dans le manuel d'instructions)*	Sie werden in Übereinstimmung mit den folgenden harmonisierten Normen hergestellt: EN ISO 13482:2014 Robots and robotic devices - Safety requirements for personal care robots *(Die Liste der Richtlinien und Standards der Referenz wird in der Betriebsanleitung enthalten)*	Están realizados de conformidad con el siguiente estándares armonizados: EN ISO 13482:2014 Robots and robotic devices - Safety requirements for personal care robots *(El listado de las directivas y normas de referencia se encuentra en el manual de instrucciones)*
Persona autorizzata a costituire il Fascicolo Tecnico e stabilito nella Comunità Europea è: COMAU S.p.A - BU ROBOTICS AND AUTOMATION PRODUCTS - PRODUCT DEVELOPMENT nome: Maria Teresa Todarello	Person authorized to compile the relevant technical file and established within UE community is: COMAU S.p.A - BU ROBOTICS AND AUTOMATION PRODUCTS - PRODUCT DEVELOPMENT name: Maria Teresa Todarello	Personne autorisée à constituer la dossier technique et établie dans l'Union européenne est: COMAU S.p.A - BU ROBOTICS AND AUTOMATION PRODUCTS - PRODUCT DEVELOPMENT nom: Maria Teresa Todarello	Person berechtigt, die technischen Unterlagen zusammenzustellen und in der Europäischen Union ansässig ist: COMAU S.p.A - BU ROBOTICS AND AUTOMATION PRODUCTS - PRODUCT DEVELOPMENT name: Maria Teresa Todarello	Persona facultada para elaborar el expediente técnico y establecida en la Unión Europea es: COMAU S.p.A - BU ROBOTICS AND AUTOMATION PRODUCTS - PRODUCT DEVELOPMENT nombre: Maria Teresa Todarello
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Luogo (Place) Grugliasco - Torino (Italy)

Data (Date) (dd/mm/yyyy) _____

persona autorizzata a redigere la dichiarazione
(person empowered to draw up the declaration)

POSITION ROBOTICS AND AUTOMATION PRODUCTS BUSINESS UNIT CHIEF OPERATING OFFICER

NAME Pietro Ottavis

SIGNATURE _____

Sede legale: Via Rivalta, 30 - 10095 Grugliasco - Torino (Italy)

Capitale Sociale: € 48;013;959,00 - R;E;!; Torino 474119 - Codice fiscale, Partita IV! e Registro delle Imprese di Torino n; 00952120012 CEE IT 00952120012

2.2 Residual risks

Danger. Pinch point. Keep hands and fingers clear. Keep your hands and fingers free.
Bringing fingers closer to the chain of passive degrees of freedom (pDOFs) or the Torque Generator Box (TGB) while the device is in use may result in pinching of the fingers.
This warning also applies to people who may be around the user of the MATE-XT when the device is in use.

Danger of collision with the TGB
If UNLOCK position is selected when the device is not fixed to the arm, the Torque Generator Box may activate if inadvertently placed in rotation. This activation can generate impacts of parts of the TGB with external objects or people.
Details in par. 3.1.3.1 Operation of the Torque Generator Box locking mechanism on page 20.

3. DESCRIPTION

This chapter contains the following topics:

3.1 Composition of the MATE-XT

The MATE-XT (Fig. 3.1) is composed of:

– **Physical Human-Robot Interface (pHRi)**: all parts that are in direct contact with the user's body;

– **Passive degrees of freedom (pDOFs)**: parts that facilitate the free movement of the user, such as sliding and rotation joints [2];

– **Torque Generator Box (TGB)**: a mechanism capable of storing and transforming the potential mechanical energy of a series of pretensioned springs to create a variable assistive torque for the arm. The assistive torques are maximum for bending angles of about 90° (Fig. 1.1).

Fig. 3.1 - MATE-XT exoskeleton - front view

3.1.1 Physical Human-Robot Interface (pHRi)

The main function of pHRi is to enable and ensure the correct distribution of loads between the device and the user.

The Human-Robot physical interface is made of non-allergenic and non-toxic materials. In particular, materials such as latex, PVC, phthalates, halogenated organic compounds, carcinogens and reproductive toxins according to *"Californian Propositions 65"*, materials on the SVCH list *(Substances of Very High Concern)* and materials of animal origin were not used.

All fabric parts are removable and machine washable (see par. 6.3.1 Washing instructions for fabric parts on page 47).

The device also incorporates some adjustment elements in order to adapt to the different body sizes of the users and facilitate ease of use.
The instructions for a correct wearing are indicated at par. 5.2 Wearing procedure on page 32.

Fig. 3.2 - Physical Human Robot Interface (pHRi) - front view

1. T-structure padding
2. Shoulder straps
3. Arm supports
4. Waist belt
5. Lumbar pad
6. Adjustment straps
7. Adjustable front buckle

– Belt extensions - to be installed if necessary (see par. 5.3 Installation of belt extenders on page 39).

3.1.2 Passive degrees of freedom (pDOFs)

Passive degrees of freedom (Fig. 3.3) allow the correct wearing of MATE-XT and its adaptation to different body sizes. When the device is worn correctly (see par. 5.2 Wearing procedure on page 32) the degree of passive freedom can ensure alignment with the flexion-extension axis of the user's shoulder. They also allow the user to move freely when the device is worn.

Fig. 3.3 - Passive degrees of freedom (pDOFs)

1. Horizontal axis hinge
2. Back elastics
3. Vertical axis hinge
4. Horizontal axis rear sliding elements
5. Arm supports sliding cuffs

3.1.3 Torque Generator Box (TGB)

Fig. 3.4 - Torque Generator Box: overview

1. Structure of the mechanism housing
2. Hexagonal seat for adjusting the assistance level
3. External cover
4. Locking mechanism

3.1.3.1 Operation of the Torque Generator Box locking mechanism

The locking mechanism positioned on the Torque Generator Box is a safety mechanism that prevents the Torque Generator Box from activating when the exoskeleton is not worn (detailed procedure in par. 3.1.3.2 Locking and unlocking the Torque Generator Box on page 21).

Fig. 3.5 - Torque Generator Box in rear home position. This is the only position where the locking mechanism can be activated or deactivated

3.1.3.2 Locking and unlocking the Torque Generator Box

The LOCK position must be selected before the device is removed, while the UNLOCK position must only be selected after locking the TGB to the arm:

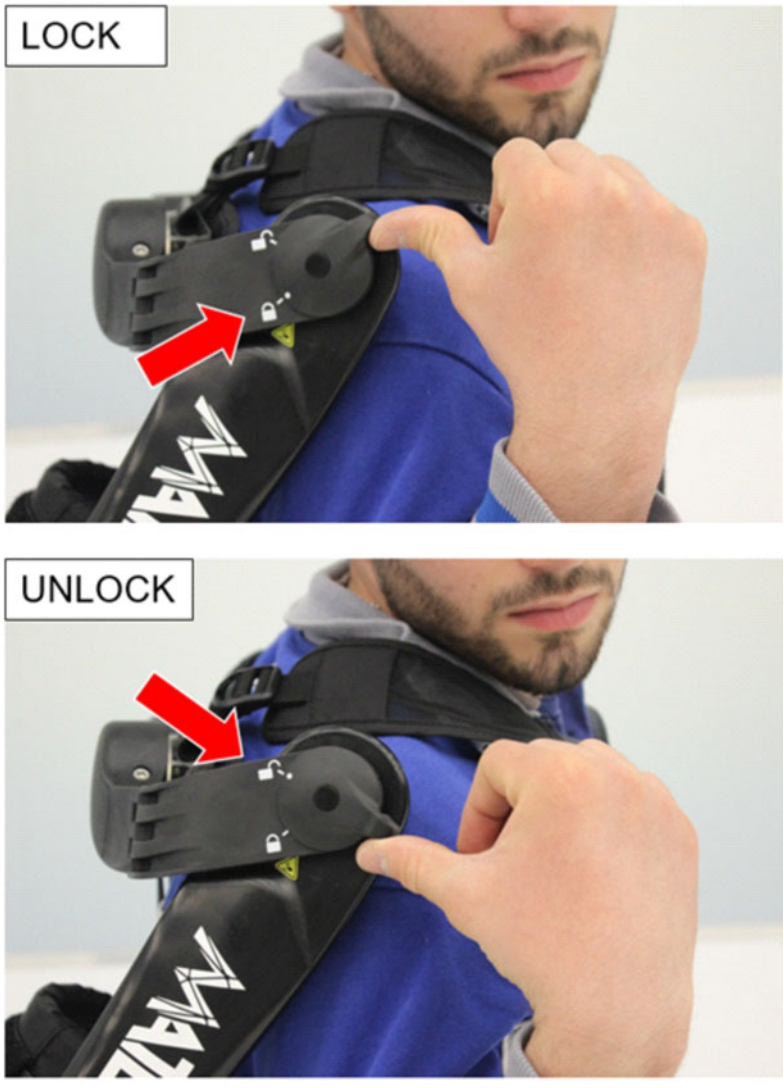
– LOCK position: locked mechanism, rotation not allowed;

– UNLOCK position: unlocked mechanism, rotation free

If the UNLOCK position is selected when the device is not fixed to the arm, the Torque Generator Box may activate if inadvertently placed in rotation. This activation can generate impacts of parts of the TGB with external objects or people.

The locking mechanism can be activated (switching from LOCK position to UNLOCK position and vice versa) only when the Torque Generator Box is in the rear home position (Fig. 3.5).

Fig. 3.6 - Torque Generator Box (TGB): locking mechanism



3.2 Technical features

Feature	Description
Sizes	L
Mass (size L)	3 kg (*6.6 lb*)
Noise	below 70 dB(A)
Operating temperature	from 0 to 45 °C (*from 32 to 113°F*)
Protection degree	IP54 splash-proof and dust-proof
Resistance to ultraviolet light	UV resistant (standard DIN 75220:1992)

4. ADJUSTMENT

This chapter contains the following topics:

- Adjustment of lumbar support;
- Adjustment of shoulder width;
- Adjustment of TGB inclination;
- Adjustment of assistance level.

All the adjustments described below are intended to increase the comfort of use of the device. Sub-optimal adjustments do not compromise the efficiency of the device and its possibility of use; however, it is recommended to follow in detail the procedure described below.

4.1 Adjustment of lumbar support

The lumbar support of the MATE-XT can be adjusted in six different levels.

The most suitable level is the one that allows the lumbar pad to be placed on the lumbar curve of the spine (so that the MATE-XT can lie on the iliac crest) and the upper part of the rear support can touch the shoulder blades. Fig. 4.1 shows how to adjust the device.

The following table can help the user during the initial wearing of the exoskeleton.

Tab. 4.1 - Choice of lumbar support level

	Height [cm]	Level to be set
Size L	Up to 179	1
	179-183	2
	183-187	3
	187-190	4
	190-194	5
	Over 194	6

Adjust the rear support when the device is not worn.

1. Open the protective panel on the back of the device.
2. Pull the spring button back.
3. Remove the Velcro fastener on the underside of the T.
4. Slide the metal support inside the plastic panel until it reaches the level chosen in the table above.
5. Release the spring button in position and close the protective panel to bring it back to its original configuration.

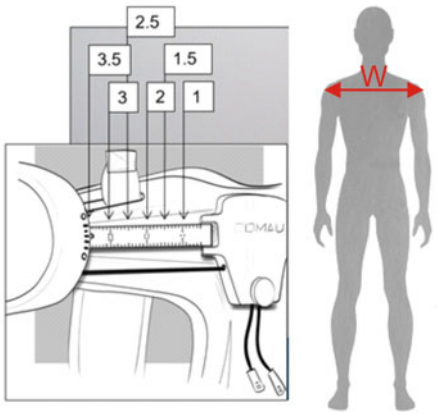
Fig. 4.1 - Adjustment of the rear support

4.2 Adjustment of shoulder width

The table below provides guidance on how to choose the correct adjustment. First measure the width of the shoulders without wearing the device, then adjust the lengths of the rear elastic straps by pulling or loosening them as necessary as shown in Fig. 4.2.

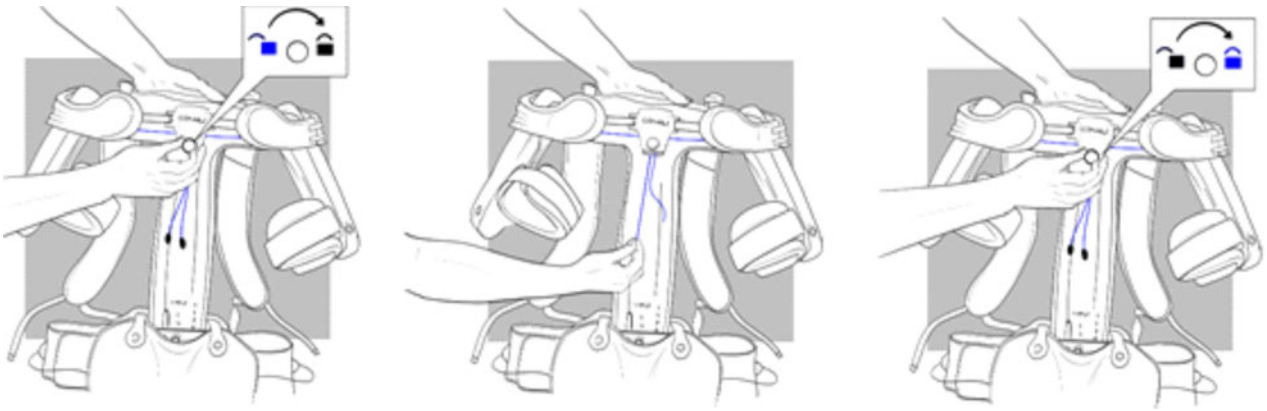
Tab. 4.2 - Choice of shoulder fit level

Shoulder width (bilateral) W [cm].	Level to be set
Up to 31	1
From 31 to 35	1.5
From 35 to 40	2
From 40 to 45	2.5
From 45 to 49	3
From 49	3.5



Adjust the rear support when the device is not worn.

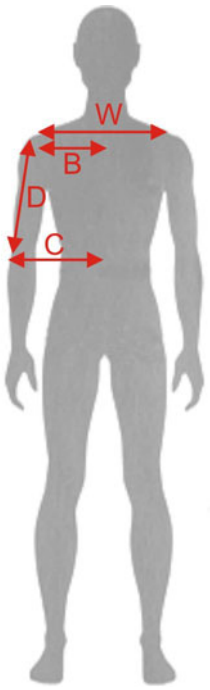
Fig. 4.2 - Rear elastic straps adjustment modes



4.3 Adjustment of TGB inclination

Tab. 4.3 - Matrix for inclination adjustment

		D [cm]							
		Less than 31	From 31 to 34	From 34 to 38	From 38 to 41	From 41 to 44	From 44 to 47	From 47 to 50	From 50 to 53
C-B [cm]	Less than 1	1	1	1	1	1	1	1	1
	From 1 to 2	1	1	1	1	1	1	1	1
	From 2 to 3	2	2	1	1	1	1	1	1
	From 3 to 4	2	2	2	2	1	1	1	1
	From 4 to 5	2	2	2	2	2	2	1	1
	From 5 to 6	3	3	2	2	2	2	2	2
	From 6 to 7	3	3	3	2	2	2	2	2
	From 7 to 8	4	3	3	3	2	2	2	2
	From 8 to 9	4	4	3	3	3	3	2	2
	From 9 to 10	4	4	4	3	3	3	3	3
	More than 10	4	4	4	4	3	3	3	3

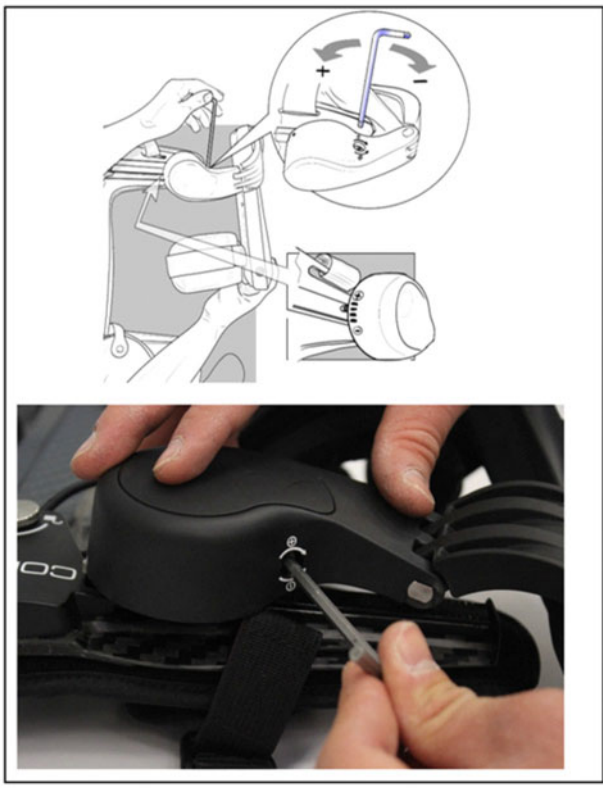


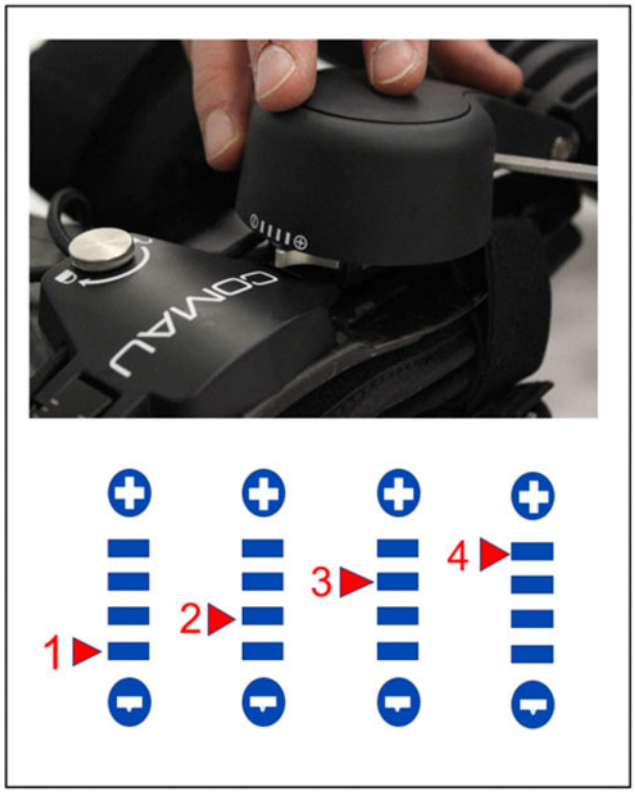
Dimension B is half the width of the shoulders (W), C is half the distance between the elbows and D is the length between the shoulder and the elbow.

Equipment required:

– 4 mm Allen wrench

1. Position the Allen wrench in the hex seat on top of the passive degrees of freedom.
2. Turn the wrench so that the adjustment level indicator corresponds to the level chosen in the table above.





4.4 Adjustment of assistance level

Different assistance levels can be set on the MATE-XT. The value of the assistance level must be chosen by the user by looking at Tab. 4.4. This table was created by taking into account parameters such as height and body mass of the potential user group.

The use of an incorrect assistance level may cause discomfort but no harm to the user.

The Torque Generator Box can offer eight different and increasing levels of assistance from 1 to 8.

The assistance level value is a parameter that can be changed depending on the user who is wearing the device. The adjustment of the assistance level can also be carried out when the device is worn and during routine work.

Tab. 4.4 - Range of assistance levels in relation to height and weight of the user

		Weight										
		50	55	60	65	70	75	80	85	90	95	100
Height	150	1	1	1	1	2	3	4	5	5	6	7
	155	1	1	1	1	3	3	4	5	6	7	7
	160	1	1	1	2	3	4	5	5	6	7	8
	165	1	1	1	3	3	4	5	6	7	7	8
	170	1	1	1	3	4	5	5	6	7	8	8
	175	1	1	2	3	4	5	6	7	8	8	8
	180	1	1	3	4	4	5	6	7	8	8	8
	185	1	1	3	4	5	6	7	8	8	8	8
	190	1	2	3	4	5	6	7	8	8	8	8
	195	1	3	4	5	6	6	7	8	8	8	8
	200	1	3	4	5	6	7	8	8	8	8	8

Fig. 4.3 - Close view of the adjustment seat on the Torque Generator Box and the assistance level indicator

Required instruments:

– 6 mm Allen wrench

1. Position the Allen wrench in the hex seat on the Torque Generator Box.
2. Turn the wrench so that the adjustment level indicator (Fig. 4.3) corresponds to the needed assistance level.

A sub-optimal adjustment of the assistance level may cause discomfort but no harm to the user.

5. USE

This chapter contains the following topics:

5.1 Precautions for use

Before starting to use the device, check the integrity of the wearable interface and the cleaning of the exposed mechanical parts that make up the pDOFs and the Torque Generator Box.
In particular, in order to avoid malfunctions, check that the sliding elements on the Torque Generator Box and on the pDOFs are free of dust and debris.
For the most suitable cleaning procedure, refer to par. 6.2 Cleaning of rigid parts on page 46.

5.2 Wearing procedure

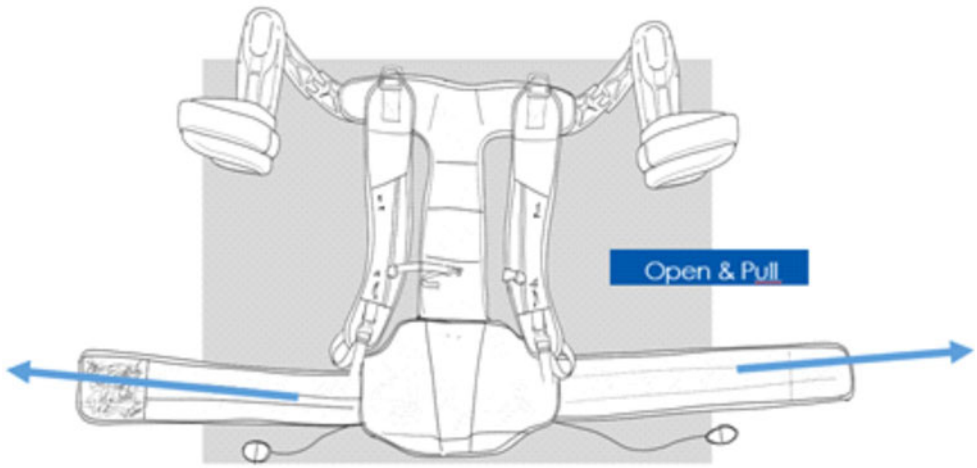
The MATE-XT is designed to be worn and undressed by a person independently. During the first wearing it is necessary to be helped by a trained person who can speed up the understanding of the process, and help to find the best combination of the available adjustments.

Try to wear and undress the device independently for 3 times in the presence of a trained person in order to become familiar with the procedure.

Preliminary instructions

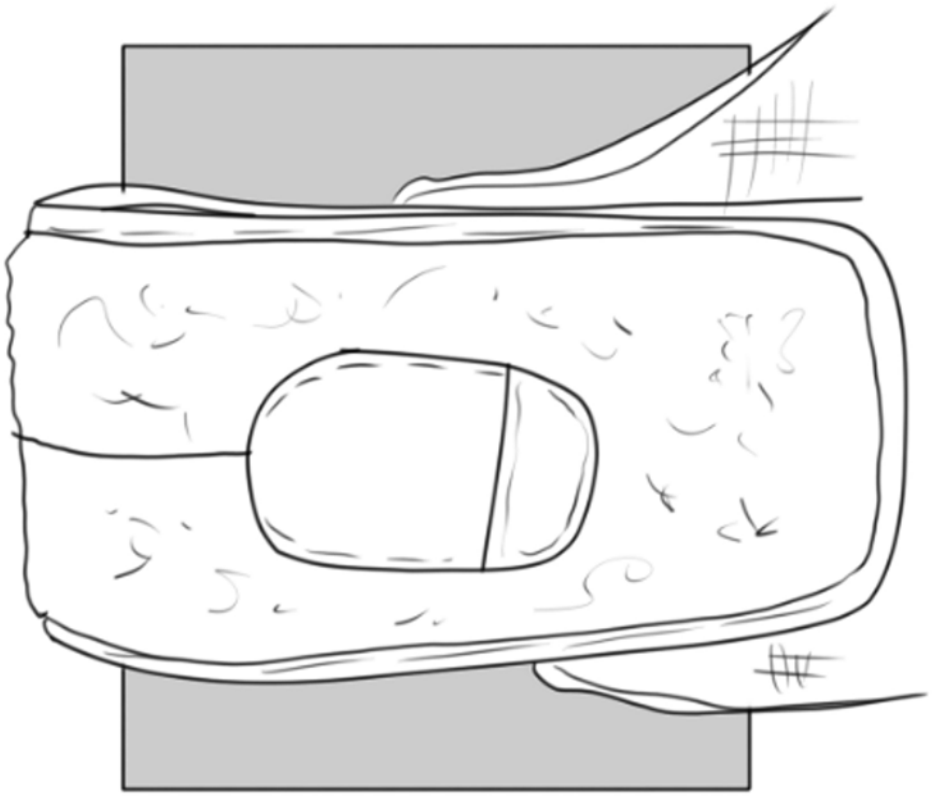
- Do not wear the device in direct contact with the skin, and make sure that clothing is appropriate: do not wear too loose-fitting or too tight clothes. We recommend the use of a well-close-fitting cotton t-shirt or shirt.
- Ensure that the **locking** mechanism on the TGB is in the **LOCK** position.
- Make sure the Velcro belt is open, as well as the adjusting straps (component 6 in Fig. 3.2).
- Pull the Velcro belt from both ends to get its maximum length.

Fig. 5.1 - Opening and extending the ends of the Velcro belt



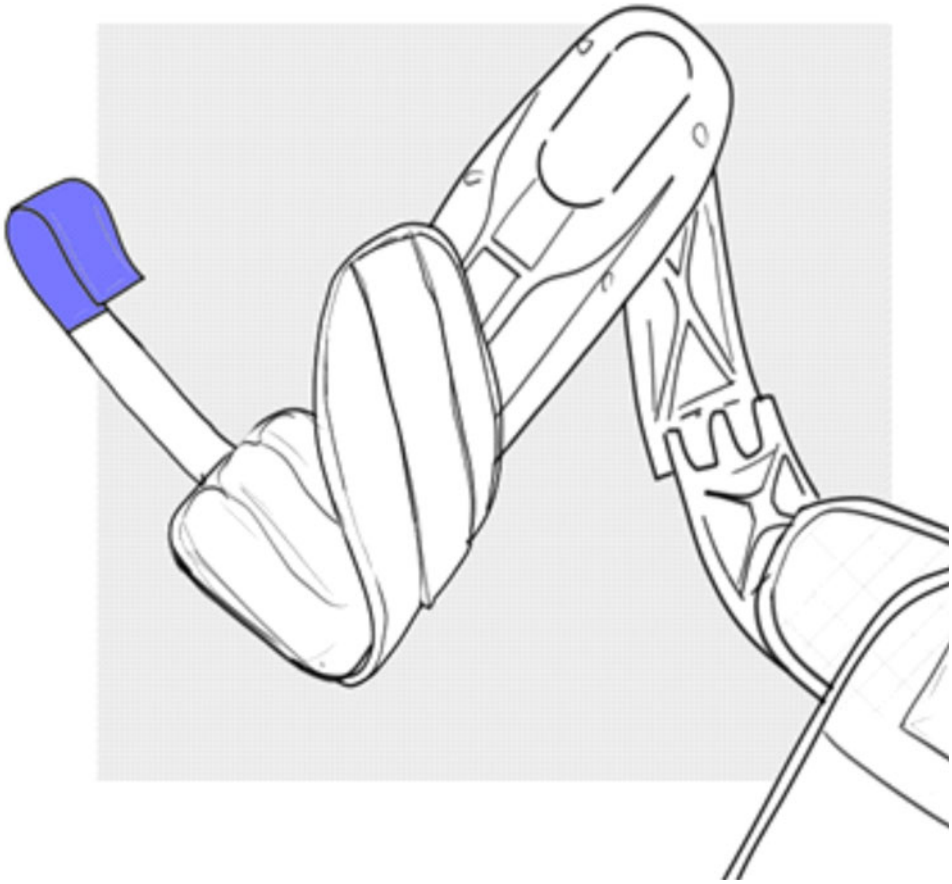
- Adhere the Velcro ends of the adjusting straps to the Velcro belt.

Fig. 5.2 - Velcro end positioned on the Velcro belt



- Open the straps of the arm supports.

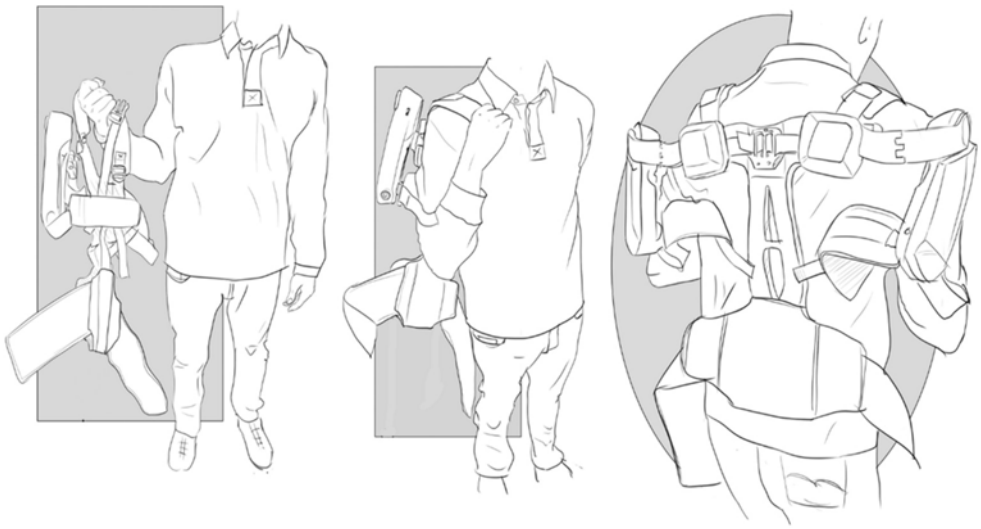
Fig. 5.3 - Opening of the arm support strap and momentary fixing of the strap on itself



Wearing

1. Lift the MATE-XT by gripping it from a shoulder strap and wear it as a backpack.

Fig. 5.4 - First phase of wearing the MATE-XT

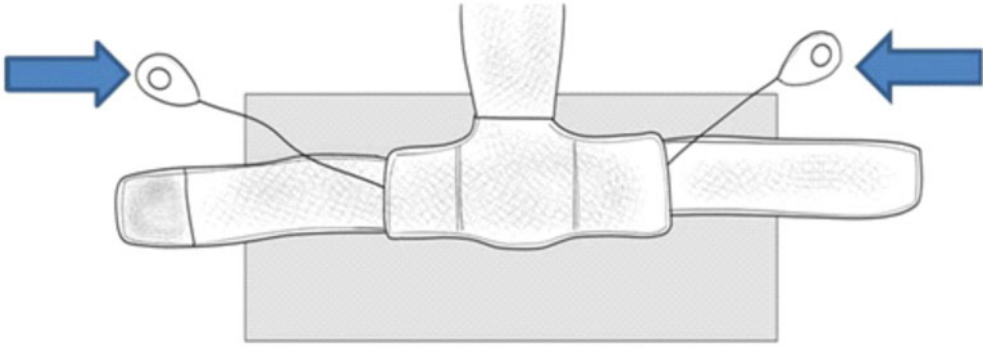


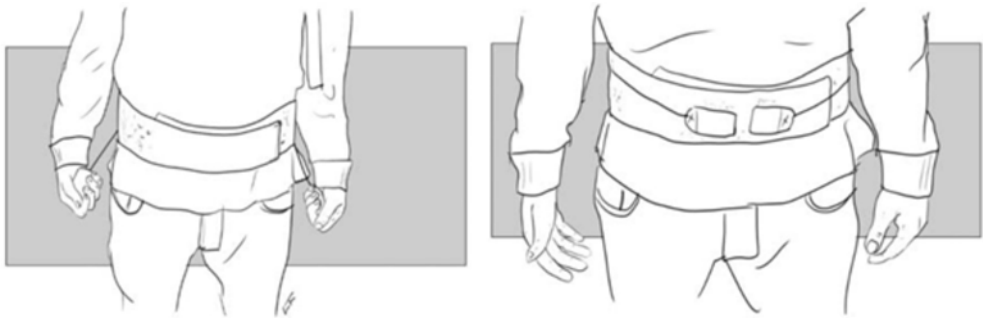
2. Fasten the Velcro belt.

Correct wearing requires that the lumbar pad is positioned on the lumbar curve of the spine (so that the MATE-XT can lie on the iliac crest), and that the upper part of the back support rests on the shoulder blades.

3. Adjust the tension of the Velcro belt by pulling the adjustment mechanism. Attach the Velcro ends to the belt to block it from slipping.

Fig. 5.5 - Closure of the Velcro belt and adjustment of its tension



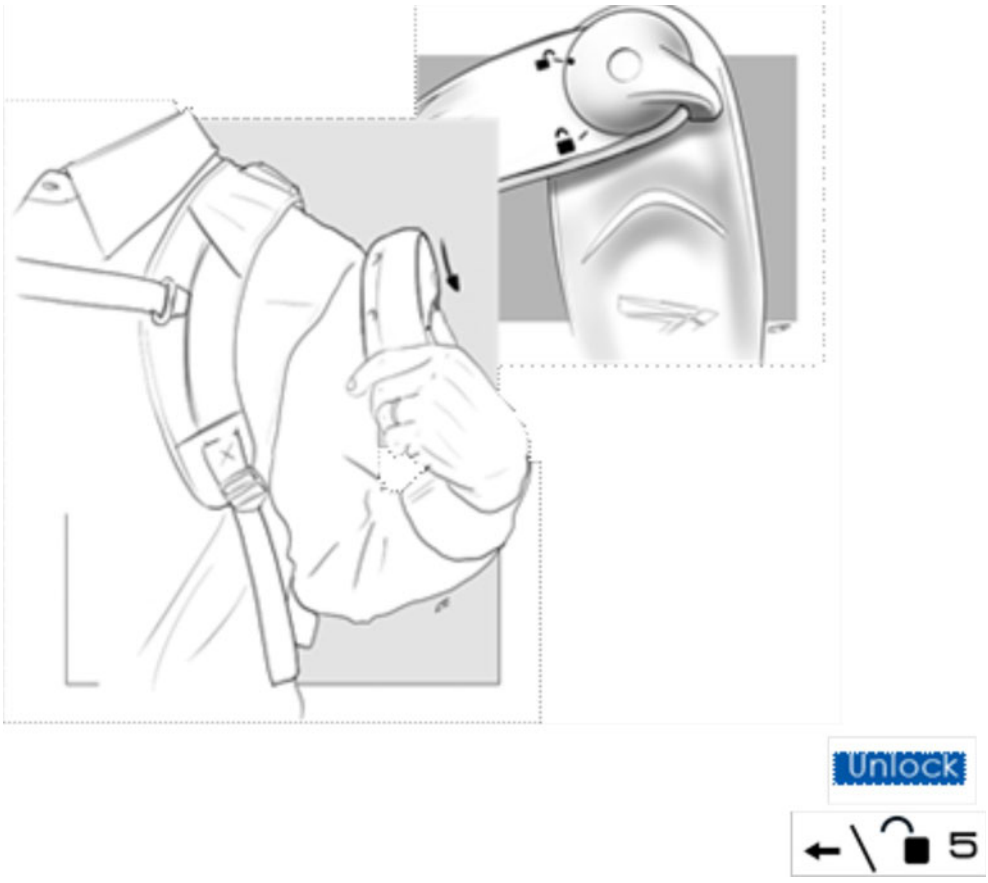


The Velcro tensioning belt is adjusted by pulling the laces with the Velcro ends visible in Fig. 5.5. By pulling and loosening them, it is possible to adjust the tightness of the belt for different users and body sizes.

4. Repeat the following steps for each arm:

a. Unlock the locking mechanism of the Torque Generator Box.

Fig. 5.6 - Unlocking the locking mechanism of the Torque Generator Box



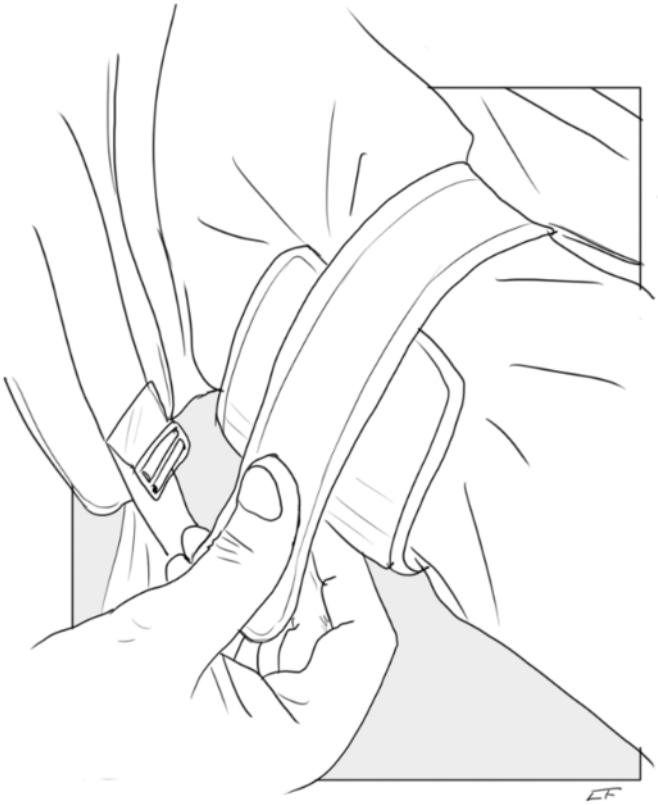
b. Bring an arm into contact with its support

c. Rotate the torque generator box so that it supports the arm.

Fig. 5.7 - Torque Generator Box activation procedure

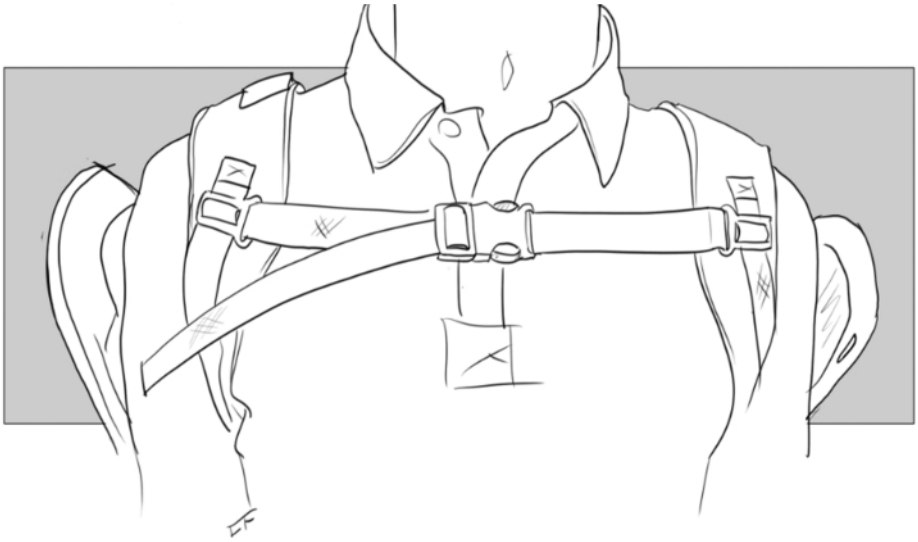
d. Close the arm support strap.

Fig. 5.8 - Closing the arm support strap



5. Close and tighten the front buckle.

Fig. 5.9 - Closing the central buckle



5.3 Installation of belt extenders

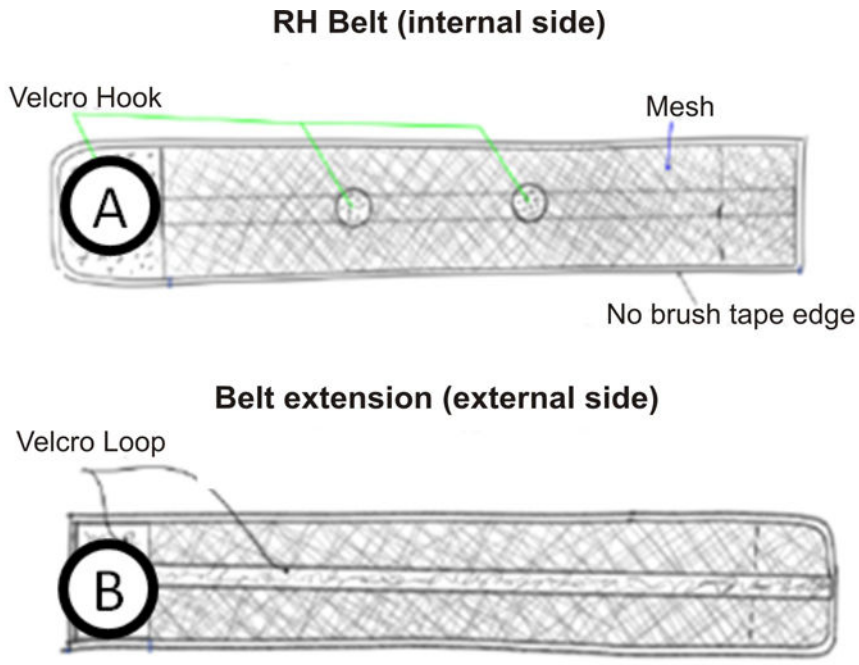
The MATE-XT is supplied with a Velcro belt extenders to be installed if required, depending on the circumference.

Follow the reference table:

Tab. 5.1 - References for belt extender installation

Waist circumference	Number of extenders
Less than 98 cm (*3.21 ft*)	not necessary
from 98 cm to 135 cm (*from 3.21 ft to 4.43 ft*)	1

Fig. 5.10 - Illustration of the installation of the belt extenders on the Velcro belt



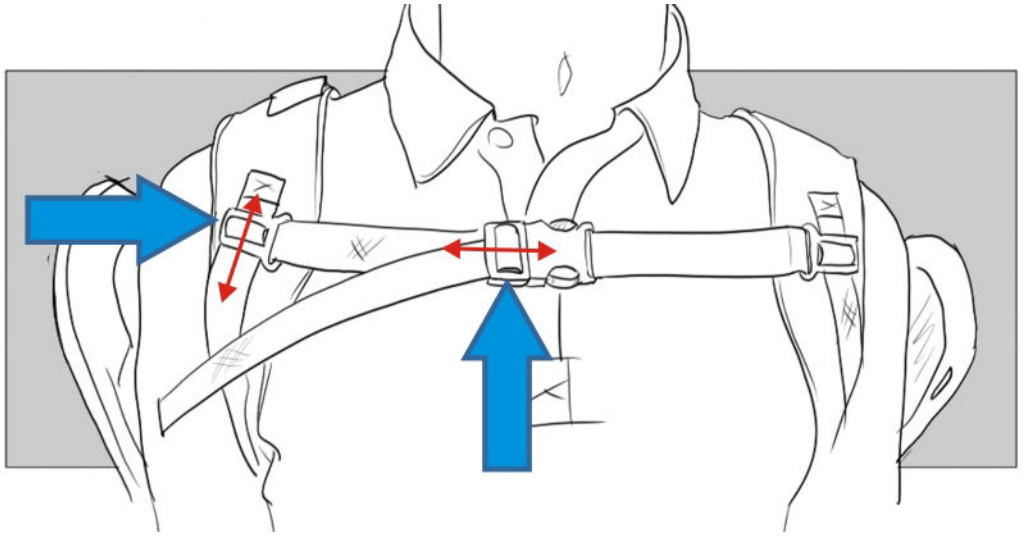
To install the belt extender, attach the Velcro end “A” of the belt to the end of the belt extender “B”, making sure that the two parts overlap completely.

5.4 Adjusting the front buckle

Further adjustment of the height and length of the front buckle may be necessary. Bringing the shoulder straps together and away prevents the possibility of relative slippage between the shoulder straps and the user's arms.

The position of the front buckle can be adjusted according to the various body shapes by sliding it on the padded shoulder straps. Even its length can be adjusted making it more or less tight to the user's chest.

Fig. 5.11 - Adjusting the front buckle



5.5 Undressing procedure

The following operations must be repeated for both arms separately.

1. Open the support strap of one of the two arms and attach it on itself as shown in Fig. 5.12.

Fig. 5.12 - Opening the arm support strap

2. Move the corresponding arm backwards.

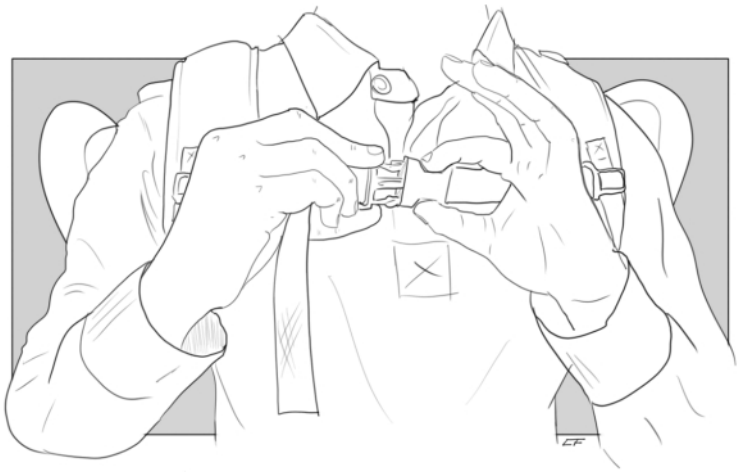
Fig. 5.13 - Arm in back position

3. Lock the locking mechanism of the corresponding Torque Generator Box.

Fig. 5.14 - Locking the TGB locking mechanism

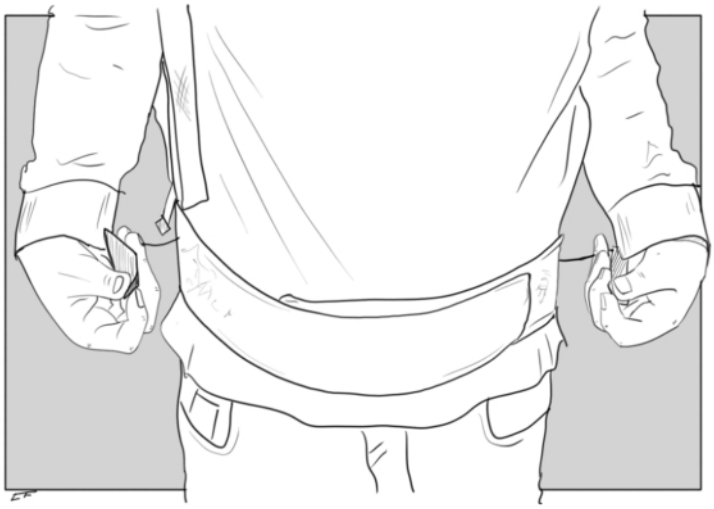
4. Open the front buckle.

Fig. 5.15 - Opening the front buckle



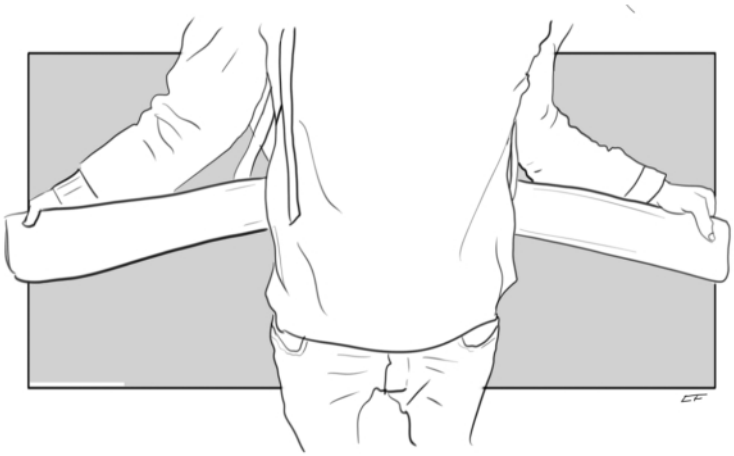
5. Detach the Velcro ends of the adjustment straps, and attach them laterally to the Velcro belt.

Fig. 5.16 - Opening the adjustment straps of the Velcro belt



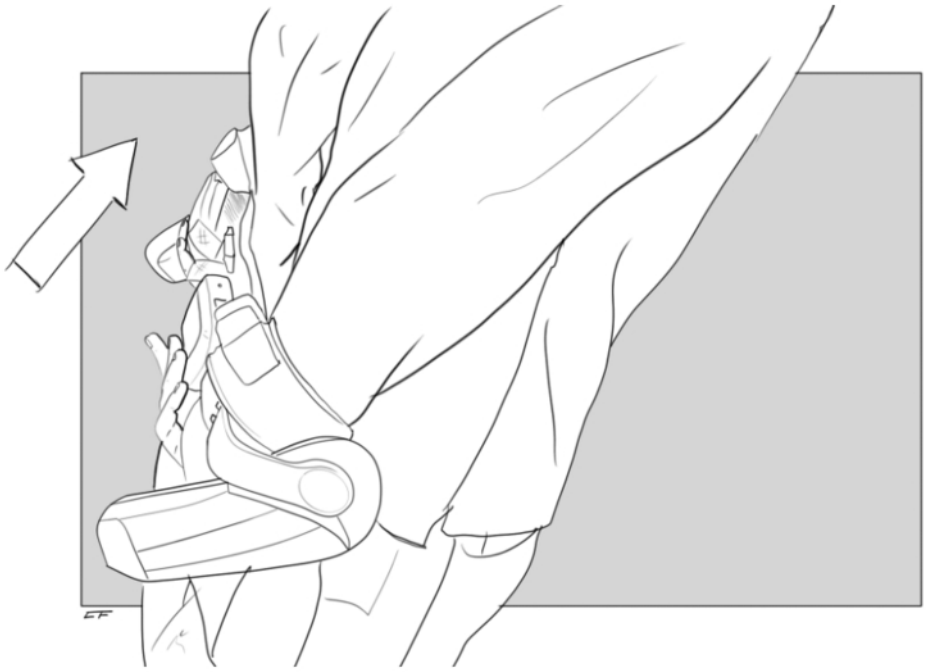
6. Open the Velcro belt.

Fig. 5.17 - Opening the Velcro belt.



7. Remove the MATE-XT by pulling it out by the padded shoulder straps.

Fig. 5.18 - Last phase of the MATE-XT undressing



6. CLEANING AND MAINTENANCE OF THE DEVICE

This chapter contains the following topics:

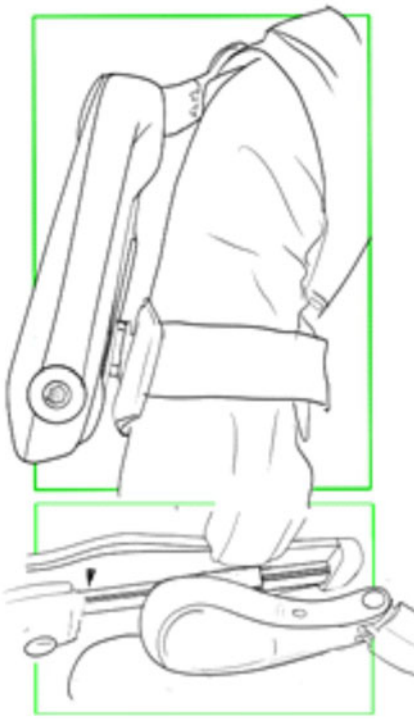
6.1 Sanitisation

– To sanitise the MATE-XT parts, we recommend the use of a spray with max. 60% alcohol concentration.
– Sanitisation can also be carried out on a daily basis.

6.2 Cleaning of rigid parts

- Clean the rigid parts and exposed mechanical components of the MATE-XT device using a dry or lightly soaked with water cloth and neutral soap.
- Do not use aggressive cleaning agents, gases, alcohol or diluents.
- Any grease escaping from the enclosures is a sign of deterioration of gaskets. As it is a food-grade grease, it can be removed without special precautions, but more careful maintenance should be carried out promptly.
- Check that the sliding elements on the Torque Generator Box and on the pDOFs are free of dust and debris.

Fig. 6.1 - Detail on the sliding elements of the TGB and the pDOFs



6.3 Cleaning of fabric parts

All fabrics and padded parts can be disassembled and washed.
After a daily use of the device, we recommend a cleaning frequency of approximately once a month, following these instructions and procedures:

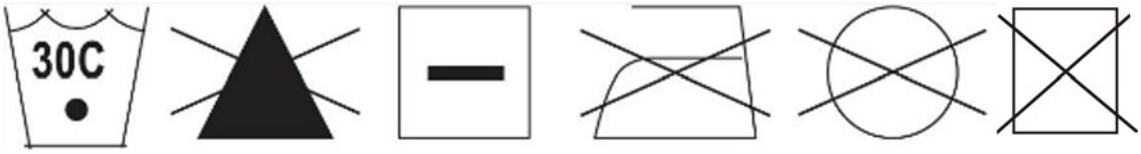
– Washing instructions for fabric parts.

6.3.1 Washing instructions for fabric parts

Use the instructions described in par. 6.4 Procedure for removing the fabric parts on page 48 to disassemble the washable parts from the device.

Use the following directions to wash the fabric parts of the wearable interface:

– Machine wash cold;
– Do not bleach;
– Dry flat;
– Do not iron;
– Do not dry clean;
– Do not tumble dry;
– Use delicate soaps, do not use fabric softeners.



Wash the various components individually using a laundry bag, making sure that the Velcro connections are closed.

Once washed and dried, use the procedure in par. 6.5 Procedure for reassembling the fabric parts on page 51 to reassemble the wearable parts on the device.

It is also possible to wash the soft parts directly on the MATE-XT without disassembling the device, using a fabric sanitiser spray (see par. 6.1 Sanitisation on page 45).

6.4 Procedure for removing the fabric parts

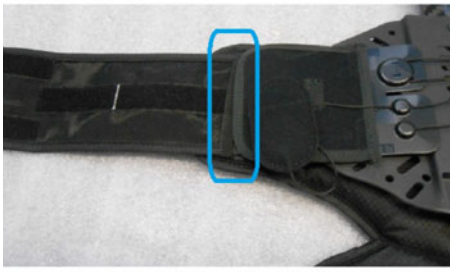
Removing the fabric parts requires separating the parts from constraints such as Velcro and buckles.
The necessary steps are shown figuratively in the following procedure.

Step **1**:
– remove the right shoulder strap.

Step **2**:
– remove the adjustment strap from the buckle.

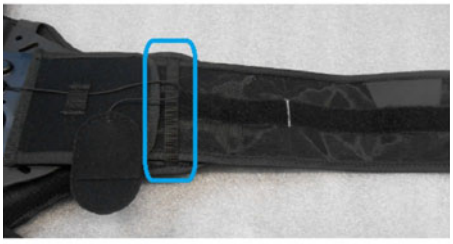
Step **3**:
– release the aluminium buckle.

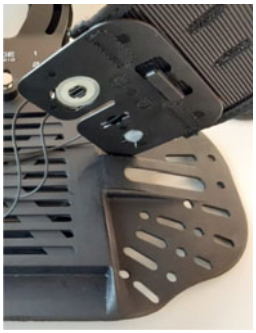
Step **4**:
– open the lumbar pad using the 2 press-fit buttons.



Step **5**:

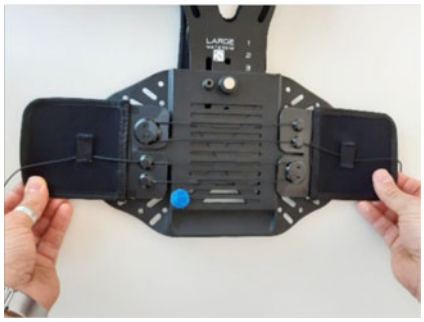
– remove the lumbar straps from the structure using the Velcro parts;
– separate the Velcro parts from the ones present on the movable parts of the lumbar support.

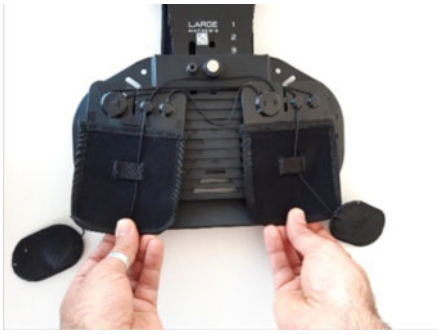


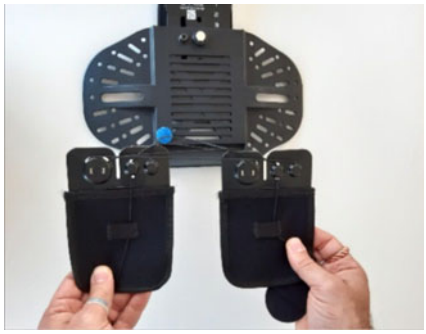


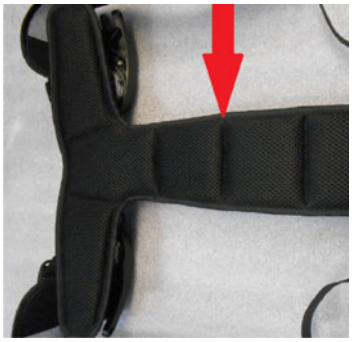
Step **6**:

– separate the Velcro parts from the ones present on the movable parts of the lumbar support.







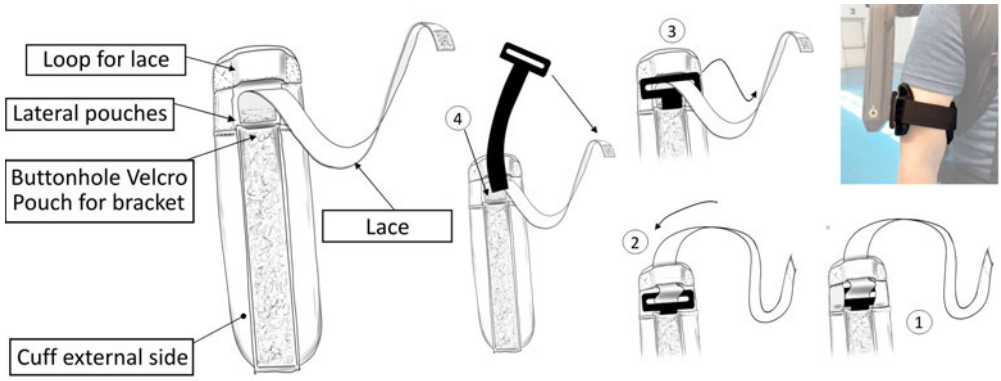


Step **7**:

– remove the padding from the T-structure attached by Velcro.

Step **8**:

– release the Velcro strip from the loop and the slot of the aluminium support;
– remove the fabric arm support by pulling it out of the housing;
– repeat the operation on the right and left sides.

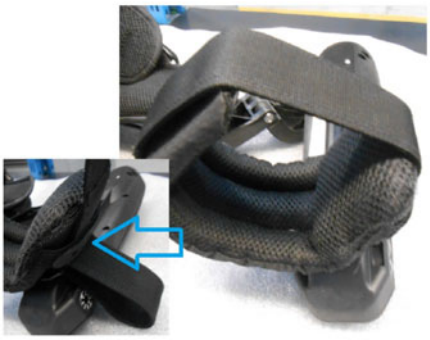


6.5 Procedure for reassembling the fabric parts

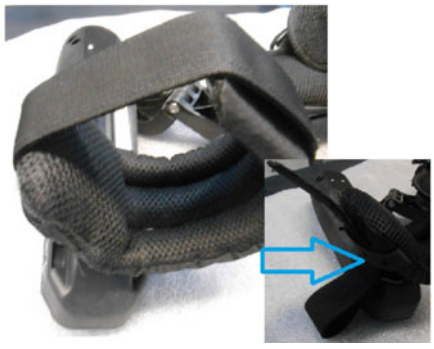
Reassembling the fabric parts requires joining the parts with constraints such as Velcro and buckles.
The necessary steps are shown figuratively in the following procedure.

Step **1**:
– insert the right-side arm supports.

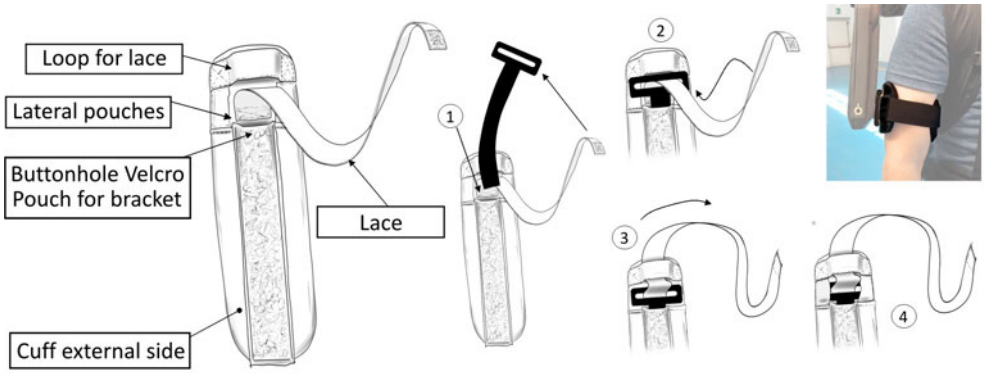
Step **2**:
– insert the left-side arm supports.



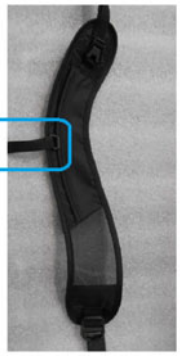
Step **3**:
– pass the Velcro strip through the slot in the aluminium support and then through the loop in the fabric arm support;
– close on the other part of the Velcro present (right side).



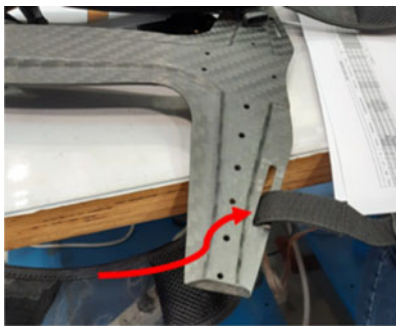
Step **4**:
– pass the Velcro strip through the slot in the aluminium support and then through the loop in the fabric arm support;
– close on the other part of the Velcro present (left side).



Left shoulder strap



Right shoulder strap



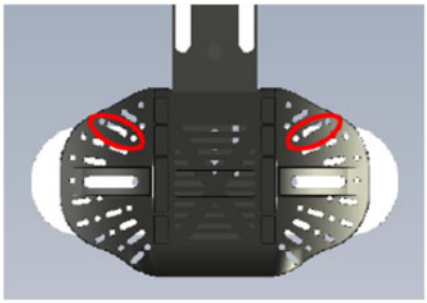
Step **5**:

– insert the strap into the slot on the carbon structure, passing it from the inside to the outside;
– turn it back towards the plastic buckle.

Step **6**:
– insert the straps of the right and left shoulder into the T-structure;
– then insert them into the buckles as in step 1 and step 2.

The white mark of the strap must be visible towards the plastic ring.

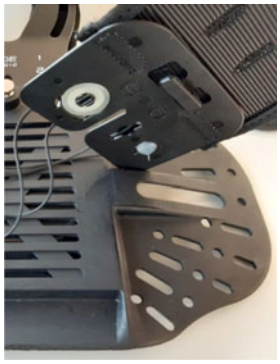
Step **7**:
– on the right side, insert the aluminium buckle into the second slot from the top of the plastic lumbar structure.



Lumbar structure

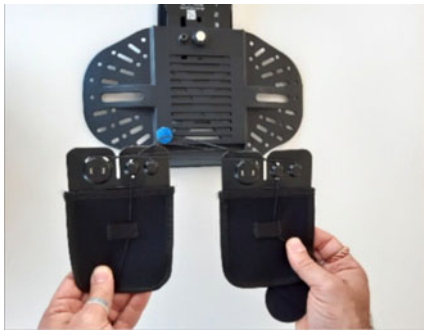
Step **8**:
– by means of Velcro, place the Soft Cover back (CR82458605) on the carbon T-structure.

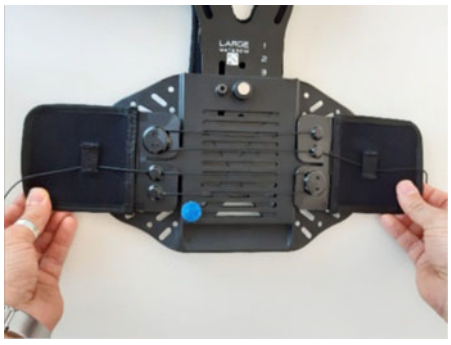
Be careful when aligning the Soft Cover with the carbon T.



Step **9**:

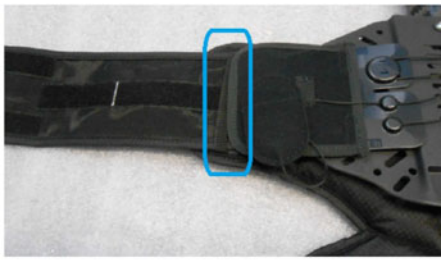
– mount the movable parts on the lumbar support by inserting them into the appropriate slots and turning them outwards to fix them.



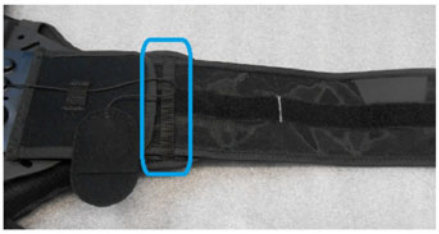


Step **10**:

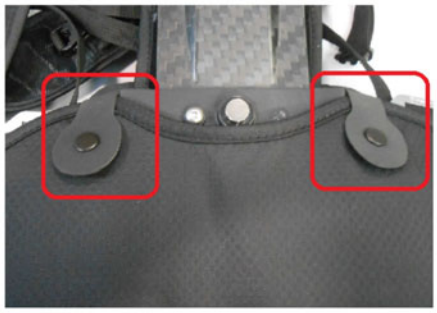
– insert the lumbar pad into the plastic holder.



Step **11**:
– mount the lumbar straps by matching their Velcro parts to the floating parts of the plastic structure of the lumbar support.



Step **12**:
– repeat on the right side.



Step **13**:
– close the lumbar pad fastening it with the 2 press-fit buttons.

6.6 Scheduled maintenance

Scheduled maintenance carried out at the specified intervals will ensure long and reliable operation of the MATE-XT.

Frequency	Required activity	Reference
Every year	Inspection of the fabric parts (pHRI)	par. 6.6.1
	Inspection of the mechanical parts (TGB and pDOF)	par. 6.6.2

6.6.1 Inspection of the fabric parts (pHRI)

Check the integrity of the fabric parts annually.
After one year of daily use of the device it may be necessary to replace some of the fabric parts of the pHRi.

To remove the worn-out fabric part, proceed as usual for cleaning and washing operations (see Procedure for removing the fabric parts) and replace the damaged part with the original spare part listed in par. 6.7 Spare parts list on page 57.

6.6.2 Inspection of the mechanical parts (TGB and pDOF)

The frequency of scheduled maintenance interventions depends on the working conditions of the device.
However, it is advisable to always carry out a scheduled maintenance operation when the 12 months of use are reached.

Please refer to COMAU for technical assistance and scheduled maintenance (www.comau.com/mate).

6.7 Spare parts list

For the maintenance of the MATE-XT, use only original spare parts.
Do not use spare parts for different purposes than those indicated.

In the following tables are indicated:

– Spare fabric parts, size L
– TGB spare parts

Tab. 6.1 - Spare fabric parts, size L

Position	Comau Part No.	Description	Quantity
1	**CR82458605**	T-structure padding	1
2	**CR82458606**	Lumbar pad	1
3	**CR82458607**	Right belt	2
4	**CR82458608**	Left belt	1
5	**CR82458601**	Arm supports	2
6	**CR82458603**	Right shoulder strap	1
7	**CR82458604**	Left shoulder strap	1

Tab. 6.2 - TGB spare parts

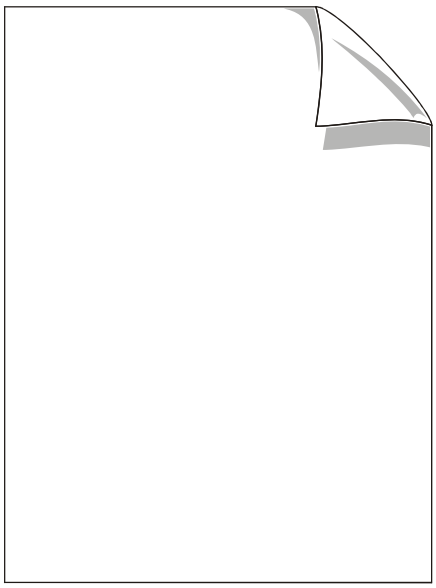
Position	Comau Part No.	Description	Quantity
1	**CR82458200**	Right Torque Generator Box	1
2	**CR82458300**	Left Torque Generator Box	1

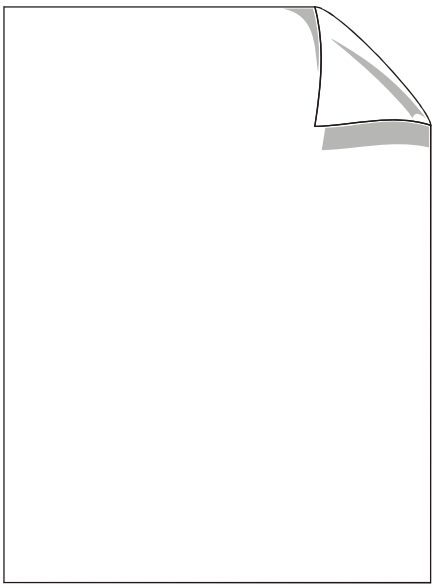
7. PARTS DISPOSAL

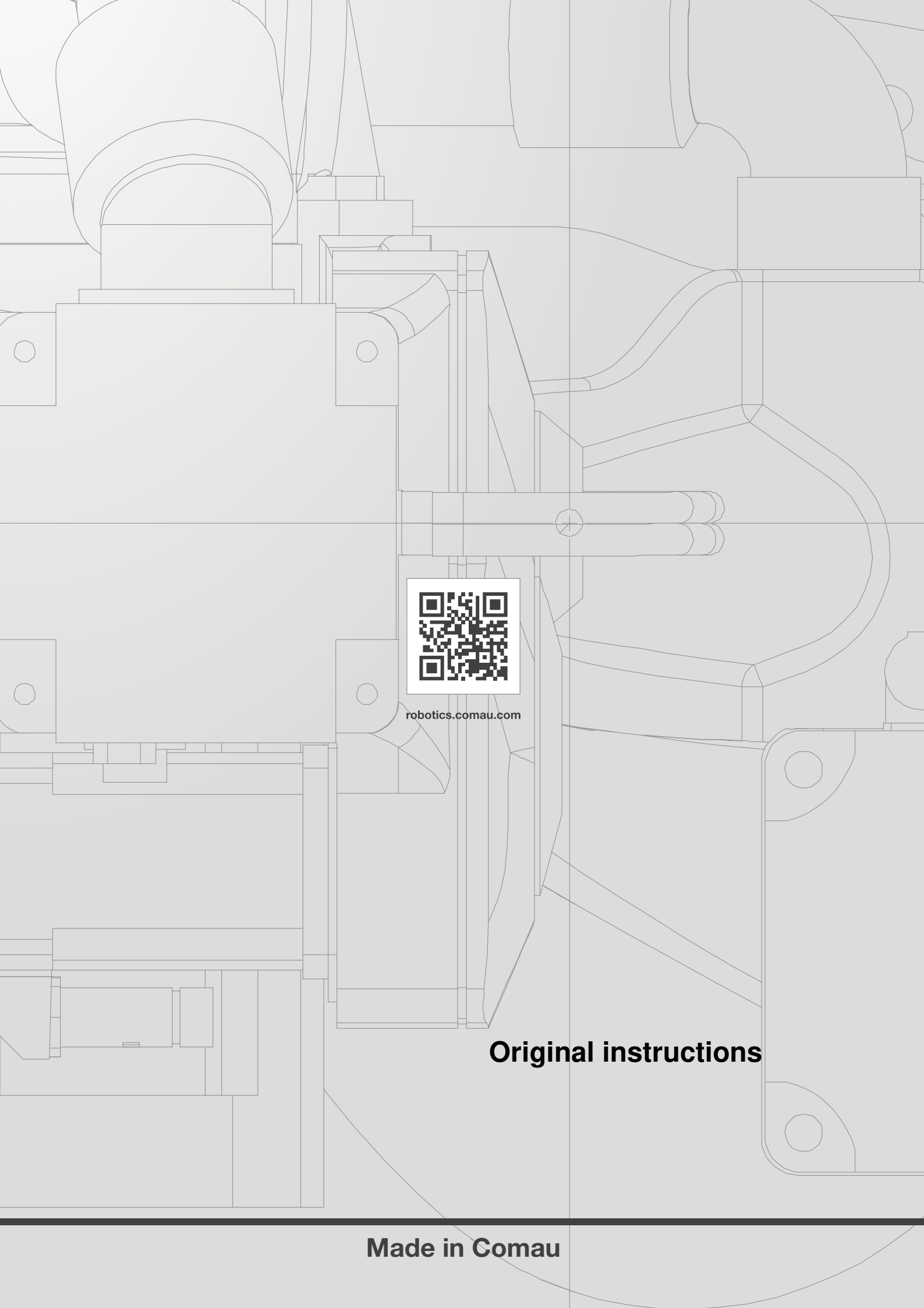
– If partial or total disposal of the MATE-XT is necessary, a separate collection of the parts to be disposed of (e.g. iron with iron and plastic with plastic) must be carried out.

The disposal operations must be carried out in compliance with the law in force in the country where the MATE-XT is used.

The plastic parts of which the MATE-XT is composed are of type 7, according to European Directive 97/129/EC.







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Original instructions

Made in Comau