Miltenyi Biotec

CliniMACS® Plus Applications

User manual



The CliniMACS System components, including Reagents, Tubing Sets, Instruments, and PBS/EDTA Buffer, are designed, manufactured and tested under a quality system certified to ISO 13485. In the EU, the CliniMACS System components are available as CE-marked medical devices for their respective intended use, unless otherwise stated. In the US, the CliniMACS CD34 Reagent System, including the CliniMACS Plus Instrument, CliniMACS CD34 Reagent, CliniMACS Tubing Set TS and CliniMACS Tubing Set LS, and the CliniMACS PBS/EDTA Buffer, is FDA approved as a Humanitarian Use Device (HUD), authorized by U.S. Federal law for use in the treatment of patients with acute myeloid leukemia (AML) in first complete remission. The effectiveness of the device for this indication has not been demonstrated. Other products of the CliniMACS Product Line are available for use only under an approved Investigational New Drug (IND) application, Investigational Device Exemption (IDE) or FDA approval.

Unless otherwise specifically indicated, Miltenyi Biotec products and services are for research use only and not for therapeutic or diagnostic use.

Copyright © 2026 Miltenyi Biotec and/or its affiliates. All rights reserved.

No part of this publication may be reproduced, stored in a retrieval system, transmitted, published, or distributed in any form or by any means, electronically, mechanically, by photocopying, microfilming, recording, or otherwise, without the prior written consent of Miltenyi Biotec; however, notwithstanding the foregoing, the owners of the instrument may make copies solely for purposes of training personnel in the use and servicing of the unit within their business or organization.

CliniMACS Plus Applications
User manual

Software version 3.0

Issued: 2026-10
210-006-209/01

MD CE 0123

Miltenyi Biotec B.V. & Co. KG
Friedrich-Ebert-Straße 68
51429 Bergisch Gladbach
Germany

Miltenyi Biotec Technical Support
+49 2204 8306-3803
technicalsupport@miltenyi.com
www.miltenyibiotec.com

Table of contents

1 About this user manual 9

1.1 Read the manual first 9

1.2 Associated documents 9

1.3 Presentational conventions 10

1.3.1 Text styles 10

1.3.2 Screens and figures 10

2 Safety notes 11

2.1 Hazards 11

2.1.1 Hazard levels 11

2.1.2 Structure of warning messages 11

2.2 Risks related to the process and cell product 13

2.3 CliniMACS Reagents and Biotin Conjugates 14

2.4 Handling of biohazardous material 14

2.5 Starting cell product 15

3 Principles of CliniMACS magnetic cell separation 17

3.1 Labeling of cells with CliniMACS reagents 17

3.2 High-gradient magnetic cell separation 19

3.3 Separation strategies 20

3.3.1 Enrichment strategy 21

3.3.2 Depletion strategies 22

4 About the CliniMACS Plus System 25

4.1 Intended purpose 25

4.2 Regulatory information 25

4.3 CliniMACS Plus Instrument and additional components 26

4.4 CliniMACS Reagents and Biotin Conjugates 26

4.5 CliniMACS Tubing Sets 26

4.6 CliniMACS PBS/EDTA Buffer 26

4.7 CliniMACS Accessories 27

4.8 Additional materials required 27

4.9 Equipment required 28

5 Overview of applications 29

5.1 Four Steps to your target cells 29

5.2 Overview table 30

6 Application-specific overview of Steps 1-4 33

6.1 Enrichment of CD34-positive cells 33

6.1.1 Step 1: Cell preparation and magnetic labeling 33

6.1.2 Step 2: Choice of separation program 35

6.1.3 Step 3: Installation of CliniMACS Tubing Sets 35

6.1.4 Step 4: CliniMACS Plus separation 35

6.2 Enrichment/depletion with the CliniMACS Anti-Biotin Reagent 36

6.2.1 Step 1: Cell preparation and magnetic labeling 36

6.2.2 Step 2: Choice of separation program 39

6.2.3 Step 3: Installation of CliniMACS Tubing Sets 40

6.2.4 Step 4: CliniMACS Plus separation 40

6.3 Enrichment of CD56-positive cells 40

6.3.1 Step 1: Cell preparation and magnetic labeling 40

6.3.2 Step 2: Choice of separation program 42

6.3.3 Step 3: Installation of CliniMACS Tubing Sets 43

6.3.4 Step 4: CliniMACS Plus separation 43

6.4 Depletion of CD3-positive cells 43

6.4.1 Step 1: Cell preparation and magnetic labeling 43

6.4.2 Step 2: Choice of separation program 47

6.4.3 Step 3: Installation of CliniMACS Tubing Sets 47

6.4.4 Step 4: CliniMACS Plus separation 47

6.5 Depletion of CD19-positive cells 47

6.5.1 Step 1: Cell preparation and magnetic labeling 47

6.5.2 Step 2: Choice of separation program 49

6.5.3 Step 3: Installation of CliniMACS Tubing Sets 49

6.5.4 Step 4: CliniMACS Plus separation 50

6.6 Depletion of CD3-positive cells and CD19-positive cells 50
6.6.1 Step 1: Cell preparation and magnetic labeling 50
6.6.2 Step 2: Choice of separation program 52
6.6.3 Step 3: Installation of CliniMACS Tubing Sets 52
6.6.4 Step 4: CliniMACS Plus separation 52
6.7 Enrichment/depletion of CD8-positive cells 53
6.7.1 Step 1: Cell preparation and magnetic labeling 53
6.7.2 Step 2: Choice of separation program 56
6.7.3 Step 3: Installation of CliniMACS Tubing Sets 56
6.7.4 Step 4: CliniMACS Plus separation 56
6.8 Enrichment/depletion of CD25-positive cells 56
6.8.1 Step 1: Cell preparation and magnetic labeling 56
6.8.2 Step 2: Choice of separation program 60
6.8.3 Step 3: Installation of CliniMACS Tubing Sets 60
6.8.4 Step 4: CliniMACS Plus separation 61
6.9 Enrichment/depletion of CD4-positive cells 61
6.9.1 Step 1: Cell preparation and magnetic labeling 61
6.9.2 Step 2: Choice of separation program 64
6.9.3 Step 3: Installation of CliniMACS Tubing Sets 64
6.9.4 Step 4: CliniMACS Plus separation 65
6.10 Depletion of CD4-positive cells and CD8-positive cells 65
6.10.1 Step 1: Cell preparation and magnetic labeling 65
6.10.2 Step 2: Choice of separation program 68
6.10.3 Step 3: Installation of CliniMACS Tubing Sets 68
6.10.4 Step 4: CliniMACS Plus separation 68
6.11 Enrichment of CD1c (BDCA-1)-positive cells – Part 1: Depletion of CD19-positive cells and labeling of CD1c (BDCA-1)-positive cells 68
6.11.1 Step 1: Cell preparation and magnetic labeling 68
6.11.2 Step 2: Choice of separation program 70
6.11.3 Step 3: Installation of CliniMACS Tubing Sets 70
6.11.4 Step 4: CliniMACS Plus separation 71
6.12 Enrichment of CD1c (BDCA-1)-positive cells – Part 2: Flexible Labeling System 71
6.12.1 Step 1: Cell preparation and magnetic labeling 71
6.12.2 Step 2: Choice of separation program 72
6.12.3 Step 3: Installation of CliniMACS Tubing Sets 72

6.12.4 Step 4: CliniMACS Plus separation 73

6.13 Enrichment of CD304 (BDCA-4)-positive cells 73

6.13.1 Step 1: Cell preparation and magnetic labeling 73

6.13.2 Step 2: Choice of separation program 75

6.13.3 Step 3: Installation of CliniMACS Tubing Sets 75

6.13.4 Step 4: CliniMACS Plus separation 75

6.14 Depletion of TCRα/β-positive cells 75

6.14.1 Step 1: Cell preparation and magnetic labeling 75

6.14.2 Step 2: Choice of separation program 77

6.14.3 Step 3: Installation of CliniMACS Tubing Sets 78

6.14.4 Step 4: CliniMACS Plus separation 78

6.15 Depletion of CD45RA-positive cells 78

6.15.1 Step 1: Cell preparation and magnetic labeling 78

6.15.2 Step 2: Choice of separation program 80

6.15.3 Step 3: Installation of CliniMACS Tubing Sets 80

6.15.4 Step 4: CliniMACS Plus separation 80

6.16 Enrichment of human IFN-gamma secreting cells with the CliniMACS Cytokine Capture System (IFN-gamma) 81

6.16.1 Step 1: Cell preparation and magnetic labeling 81

6.16.2 Step 2: Choice of separation program 92

6.16.3 Step 3: Installation of CliniMACS Tubing Sets 92

6.16.4 Step 4: CliniMACS Plus separation 92

7 Detailed explanation of Step 1–4 93

7.1 Step 1: Cell preparation and magnetic labeling 93

7.1.1 First actions required 93

7.1.2 Magnetic labeling of cells 94

7.2 Step 2: Choice of separation program 104

7.2.1 Basic operation 104

7.2.2 Separation planner tool 107

7.2.3 CD34 Selection 1/ CD34 Selection 2 109

7.2.4 Enrichment 1.1 117

7.2.5 Enrichment 3.2 132

7.2.6 Depletion 2.1 140

7.2.7 Depletion 3.1 155

7.3 Step 3: Installation of CliniMACS Tubing Sets 171
7.3.1 CliniMACS Tubing Set and CliniMACS Tubing Set LS 171
7.3.2 Alternative installation of CliniMACS Tubing Sets 198
7.3.3 CliniMACS Depletion Tubing Set 204
7.4 Step 4: CliniMACS Plus Separation 230
7.4.1 CD34 Selection 1/2 230
7.4.2 Enrichment 1.1 235
7.4.3 Enrichment 3.2 240
7.4.4 Depletion 2.1 245
7.4.5 Depletion 3.1 250

8 Troubleshooting 255
8.1 Miltenyi Biotec Technical Support 255
8.2 Error and warning messages 255
8.3 MACS TubeSealer 256
8.4 Barcode scanning 256
8.5 Preparation of the leukapheresis product 256
8.6 CliniMACS Plus Instrument and CliniMACS Tubing Sets 257
8.7 Automated cell separation 258
8.7.1 Emergency program (to be used with enrichment programs only) 258
8.7.2 Unexpected events: All separation programs 260
8.7.3 Unexpected events: Enrichment programs only 263
8.7.4 Unexpected events: CD34 Selection 1/2 263
8.7.5 Unexpected events: Enrichment 1.1 265
8.7.6 Unexpected events: Enrichment 3.2 266
8.7.7 Unexpected events: Depletion 2.1 266
8.7.8 Unexpected events: Depletion 3.1 267
8.8 Cell separation performance 269
8.8.1 Unexpected events: Enrichment programs only 269
8.8.2 Unexpected events: CD34 Selection 1/2 and Enrichment 1.1 270
8.8.3 Unexpected events: CD34 Selection 1/2 270
8.8.4 Unexpected events: Enrichment 1.1 271
8.8.5 Unexpected events: Depletion 2.1 and Depletion 3.1 271

9 Legal notes 273
9.1 Limited warranty 273
9.2 Trademarks 274
10 Glossary 275
10.1 Glossary of symbols 275
10.2 Glossary of terms 275

1

About this user manual

This chapter provides general information about the importance of reading this user manual before using the instrument. It also covers the associated document series and the presentational conventions used in this manual.

This user manual provides instructions, warnings, precautions, and other important information for the use of the CliniMACS Plus Applications.

For further details on the instrument hardware, refer to the CliniMACS Plus Instrument user manual. For further details on the software running on the instrument, refer to the CliniMACS Plus Software user manual.

1.1 Read the manual first

⚠ WARNING

Risk of electrical shock, physical injuries, instrument damage, or malfunction.

Disregard of any instructions, warnings, or cautions at any time can endanger users and others and may compromise the electrical, electronical, electromagnetic, and mechanical safety. Disregard also excludes the manufacturer from any liability.

- The operation of the instrument must be performed by trained users only.
- Pay special attention to all warnings shown on the instrument or provided with consumables and accessories.
- Adhere to all safety information, warnings, precautions, and instructions at all times while the instrument is in operation.
- Retain the user manuals for future reference. They should be kept accessible and readily available together with all other safety and operating documentation during the entire life cycle of the instrument.

1.2 Associated documents

This user manual is part of a series and should only be used in conjunction with the other user manuals of the series.

- CliniMACS Plus Instrument user manual
- CliniMACS Plus Software user manual
- MACS® TubeSealer user manual

1.3 Presentational conventions

The following text styles are used to indicate specific information types in this user manual that are not safety-related. For safety-related information types, see section 'Hazard levels' and section 'Structure of warning messages'.

1.3.1 Text styles

• Bullet point list item with text	Indicates a list-item of an unordered list
1. Numbered list item with text	Indicates a list-item of a step-by-step instruction
Bold, colored text	Indicates a software element (for example a button or tab of the graphical user interface)
See section 'Text styles'	Indicates a reference to the section with the heading 'Text styles'
See Figure 4.2/Table 4.2	Indicates a reference to the second figure/table in chapter four

IMPORTANT:
Advises the user of important practices or information not related to personal injury nor property damage

1.3.2 Screens and figures

The screens and the figures in this manual are only representative screens and may slightly differ from those shown on the instrument.

2

Safety notes

This chapter explains the potential risks associated with the operation of the CliniMACS Plus System. At all times, local working area safety instructions, policies, standards regarding good manufacturing practice, health, safety, and prevention of accidents must be adhered to. For instructions for use, e.g., warnings and precautions, concerning the handling of biohazardous materials and starting cell product, as well as the CliniMACS Plus System components, refer to the relevant sections in the instructions for use of the respective component. Detailed instructions for use regarding the CliniMACS Plus Instrument are described in the CliniMACS Plus Instrument user manual.

Any serious incident that has occurred in relation to this product should be reported to Miltenyi Biotec B.V. & Co. KG – using the contact information provided – and the competent authority of the member state in which the user of this product is established.

2.1 Hazards

2.1.1 Hazard levels

The color and signal word of a warning message depend on the hazard level. The hazard level classifies the hazard as follows:

⚠ WARNING

indicates a hazardous situation that, if not avoided, could result in death or serious injury.

⚠ CAUTION

indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE

indicates a hazardous situation that, if not avoided, could result in property damage. This does not indicate a risk of personal injury.

2.1.2 Structure of warning messages

Warning messages warn of hazardous situations. Warning messages specify the hazard level, the type and source of the hazard, the possible consequences, and the measures to avoid the hazard.

The following examples show the structure of warning messages at the beginning of a chapter or section where a hazard can occur:

⚠ WARNING

Type and source of hazard.

Consequences of noncompliance.

- Measures to avoid the hazard.

⚠ CAUTION

Type and source of hazard.

Consequences of noncompliance.

- Measures to avoid the hazard.

NOTICE

Type and source of hazard.

Consequences of noncompliance.

- Measures to avoid the hazard.

The following examples show the structure of embedded warning messages before an instructional step:

1. **WARNING! Type and source of hazard. Consequences of noncompliance. Measures to avoid the hazard.** Instructional step.

1. **CAUTION! Type and source of hazard. Consequences of noncompliance. Measures to avoid the hazard.** Instructional step.

1. **NOTICE Type and source of hazard. Consequences of noncompliance. Measures to avoid the hazard.** Instructional step.

2.2 Risks related to the process and cell product

⚠ WARNING

Risk of process failure or damage to the instrument.

Risk of process failure or damage to the instrument if procedures are performed by untrained operators.

- All processing procedures must be performed by trained operators only. Operator training will be provided by a qualified Miltenyi Biotec representative.

⚠ CAUTION

Risk of reduced process performance.

Temperatures lower or higher than room temperature may result in less viability, purity and yield of the target cells.

- Perform sample preparation and cell separation at room temperature (+19 °C to +25 °C [+66 °F to +77 °F]).

⚠ CAUTION

Equipment safety may be compromised.

Equipment safety may be compromised if the instrument is not used according to the manufacturer's instructions.

- Fully read and understand the safety information, warnings, precautions, and instructions for proper operation of the CliniMACS Plus System provided in the CliniMACS Plus instructions for use and in any safety-related recommendations issued by Miltenyi Biotec.

- For the manufacturing and use of target cells in humans the national legislation and regulations – e.g., for the EU the Directive 2004/23/EC (human tissues and cells) or the Directive 2002/98/EC (human blood and blood components) – must be followed. Thus, any clinical application of the target cells is exclusively within the responsibility of the user of a CliniMACS Plus System.
- All materials that have come into contact with blood and blood products, must be treated as infectious material. Regulations for the handling of infectious material must be observed.
- All tubing, fittings, valves, the pre-column, and the separation column should be checked thoroughly for leaks during the priming step.
- All bags, including those used in sample preparation, should be preserved until final analysis of the collected cells has been completed and successful separation of the target cells has been confirmed.

2.3 CliniMACS Reagents and Biotin Conjugates

- When the target cell fraction is infused or injected into patients, they may receive traces of murine antibody and iron-dextran.
- Iron-dextran beads and/or murine antibodies may cause allergic or anaphylactic reactions in patients. Intensive care equipment and medication should be available.
- The separation of cells using the CliniMACS Reagents and Biotin Conjugates must be performed by trained users only.
- Users using the CliniMACS Reagents and Biotin Conjugates should have experience in the separation of cells from bone marrow or peripheral blood.
- The non-target cells are not intended for therapeutic use and may not be reinfused into patients.
- The CliniMACS Reagents and Biotin Conjugates are intended for *in vitro* use only and are not designated for therapeutic use or direct infusion into patients.
- The CliniMACS Reagents and Biotin Conjugates are not recommended for use with patients known or suspected to have sensitivity against mouse immunoglobulins or iron-dextran.
- Patients may develop human anti-mouse antibodies (HAMA).
- Do not use after the use-by date printed on the product label.
- Do not use if package is damaged. Use reagent only if vial is undamaged and sealed.

2.4 Handling of biohazardous material

⚠ WARNING

Biological hazard.

Depending on the biological material used, contact may lead to severe personal injury or death.

- Observe the following safety instructions/measures.

- To avoid contamination of the starting cell product, all preparation steps should be performed under sterile conditions using aseptic techniques (for example, in the laminar flow hood).
- The user performing the cell separation must be trained in the proper use of the equipment and in the handling of blood products and bone marrow aspirate.
- The user performing the cell separation should wear appropriate clothing (for example, lab coat, gloves, and eyeglasses or goggles) when working with patient samples and handling potentially biohazardous material.
- All blood products must be treated as a potential biohazard. Leukapheresis product, blood product, bone marrow aspirate, collected cells, used buffer, used tubing set, and other materials that have been in contact with these fluids must be treated as biohazardous materials according to standard hospital or institutional requirements.
- The CliniMACS Plus Instrument should be considered a potential biohazard after each separation run and cleaned according to standard hospital or institutional requirements. Refer to the CliniMACS Plus Instrument user manual for detailed information on cleaning and disinfection of the instrument.
- Disposable materials must be treated as biohazardous materials according to standard hospital or institutional requirements.

2.5 Starting cell product

IMPORTANT:
Labeling and separation of cells should begin as soon as possible after the starting cell product has been collected. The product should not be older than 24 hours when starting the labeling and separation procedure.

- The starting cell product (for example, leukapheresis product) should be collected according to standard hospital or institutional procedures in standard collection bags.
- The container containing the starting cell product should be labeled with patient identification, time, date, and place of collection according to procedures specified for use with the clinical protocol.
- For transportation, the starting cell product should be packed in insulated containers and should be kept at controlled room temperature (+19 °C to +25 °C [+66 °F to +77 °F]) according to standard hospital or institutional blood collection procedures approved for use with the clinical protocol. Do not refrigerate. The cell concentration should not exceed 0.2×10^9 cells per mL during transportation.
- Avoid intensive mixing of the cellular starting material.
- If the starting cell product has to be stored, for example, overnight, it should be kept at controlled room temperature (+19 °C to +25 °C [+66 °F to +77 °F]). During storage, the concentration of leukocytes should never exceed 0.2×10^9 cells per mL.
- Cells should be stored in autologous plasma. If the cell concentration is higher than 0.2×10^9 cells per mL, dilute the starting cell product with autologous plasma.

3

Principles of CliniMACS magnetic cell separation

3.1 Labeling of cells with CliniMACS reagents

MACS magnetic cell separation is a well proven powerful tool for the separation of many cell types, in research laboratories as well as in clinical applications. Cell mixtures are separated in a magnetic field using an immunomagnetic label specific for the cell type of interest, for example, human CD34-positive hematopoietic progenitor cells from heterogeneous hematologic cell populations.

Using the CliniMACS Plus system, cells can be magnetically labeled in three different ways:

1. Directly in a one-way labeling procedure by antigen-specific antibodies conjugated to superparamagnetic iron-dextran beads (see Figure 3.1).

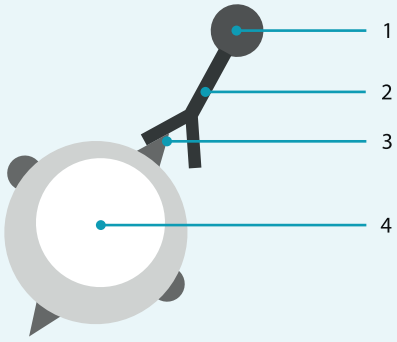


Figure 3.1: Magnetic labeling of cells

1 Magnetic particle
2 Antibody
3 Antigen
4 Cell

2. Indirectly in a two-step labeling procedure called Flexible Labeling System. In a first step cells are labeled with antigen-specific antibodies conjugated to biotin. In a second step these antibodies are labeled with biotin-specific antibodies conjugated to superparamagnetic iron-dextran beads (see Figure 3.2).

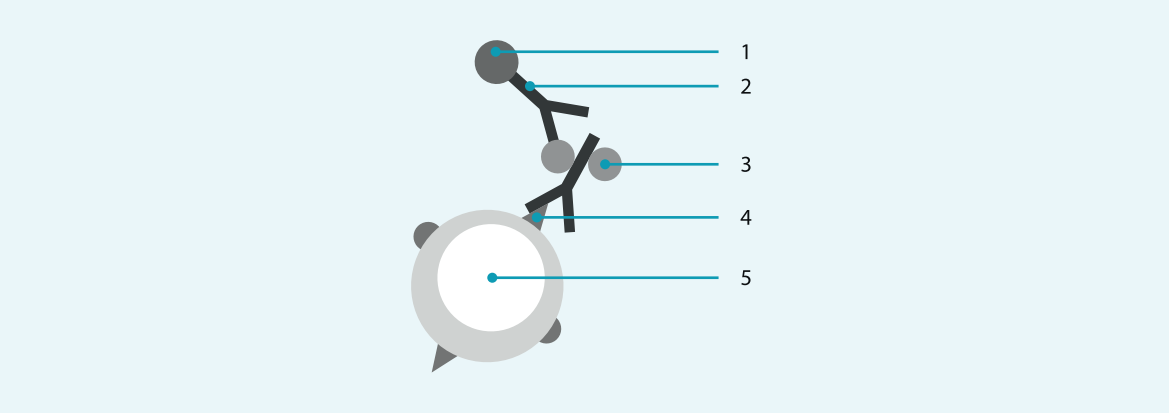


Figure 3.2: Flexible Labeling System

1 Magnetic particle
2 Anti-biotin antibody
3 Biotin molecule
4 Antigen
5 Cell

3. Indirectly in a two-step labeling procedure called CliniMACS Cytokine Capture System (IFN-gamma). First of all, cells are *in vitro* restimulated to secrete the cytokine (for example, IFN-gamma). In a first labeling step the restimulated cells are labeled by a hybrid-molecule consisting of a leucocyte-specific antibody and a cytokine-specific antibody, called the CliniMACS IFN-gamma Catchmatrix Reagent. The cells are then incubated to allow secretion of the cytokine, which is "captured" by the catchmatrix on the cell surface. Subsequently, in a second labeling step the cytokine secreting cells are labeled with cytokine-specific antibodies conjugated to superparamagnetic iron-dextran beads (CliniMACS IFN-gamma Enrichment Reagent), (see Figure 3.3).

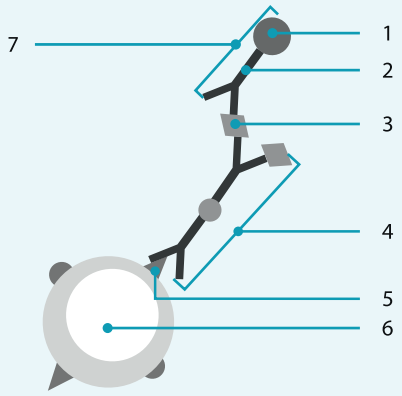


Figure 3.3: CliniMACS Cytokine Capture System (IFN-gamma)

1 Magnetic particle
2 Antibody
3 Cytokine (IFN-gamma)
4 CliniMACS IFN-gamma Catchmatrix Reagent
5 Antigen
6 Cell
7 CliniMACS IFN-gamma Enrichment Reagent

3.2 High-gradient magnetic cell separation

The magnetically labeled cell suspension is loaded onto the CliniMACS Plus Instrument prepared with a tubing set. The magnetic separation unit of the instrument contains a strong permanent magnet which enables the rapid generation of a high gradient magnetic field within the ferromagnetic matrix in the separation column.

The high-gradient field allows the generation of strong magnetic forces and a rapid demagnetization. When small ferromagnetic structures, such as the column matrix, are placed within the magnetic field they disrupt the homogeneity of the field. This results in the generation of high magnetic gradients. In their immediate surrounding, the ferromagnetic structures generate magnetic forces 10,000-fold stronger than in conventional geometries. The high-gradient field attracts labeled cells to the matrix and effectively retains them. After removing the column from the magnet, the rapid demagnetization of the column matrix allows the release of retained cells.

3.3 Separation strategies

The CliniMACS Plus System provides the user with a variety of separation programs. The separation programs can generally be divided into enrichment strategies (CD34 Selection 1 and 2, Enrichment 1.1, and Enrichment 3.2) and depletion strategies (Depletion 2.1 and Depletion 3.1).

Enrichment of magnetically labeled cells

When choosing an enrichment strategy, the magnetically labeled cells (labeled with a CliniMACS Reagent) are retained in the separation column and the unlabeled cells pass through. The labeled cells (target cells) are collected in the Cell Collection Bag and the unlabeled cells (non-target cells) in the Negative Fraction Bag (see Figure 3.4).

Depletion of magnetically labeled cells

The MACS® Technology is also very efficient for depleting specific cell populations. Unwanted cells are specifically labeled with superparamagnetic particles and separated from unlabeled target cells upon passage through the high-gradient magnetic field in the column. In contrast to the enrichment strategy, the unlabeled cells (target cells) are collected in the Cell Collection Bag and the labeled cells (non-target cells) are collected in the Negative Fraction Bag (see Figure 3.5) or in the Non-Target Cell Bag (see Figure 3.6 and Figure 3.7) respectively.

3.3.1 Enrichment strategy

Enrichment of cells using the CliniMACS Tubing Set or CliniMACS Tubing Set LS

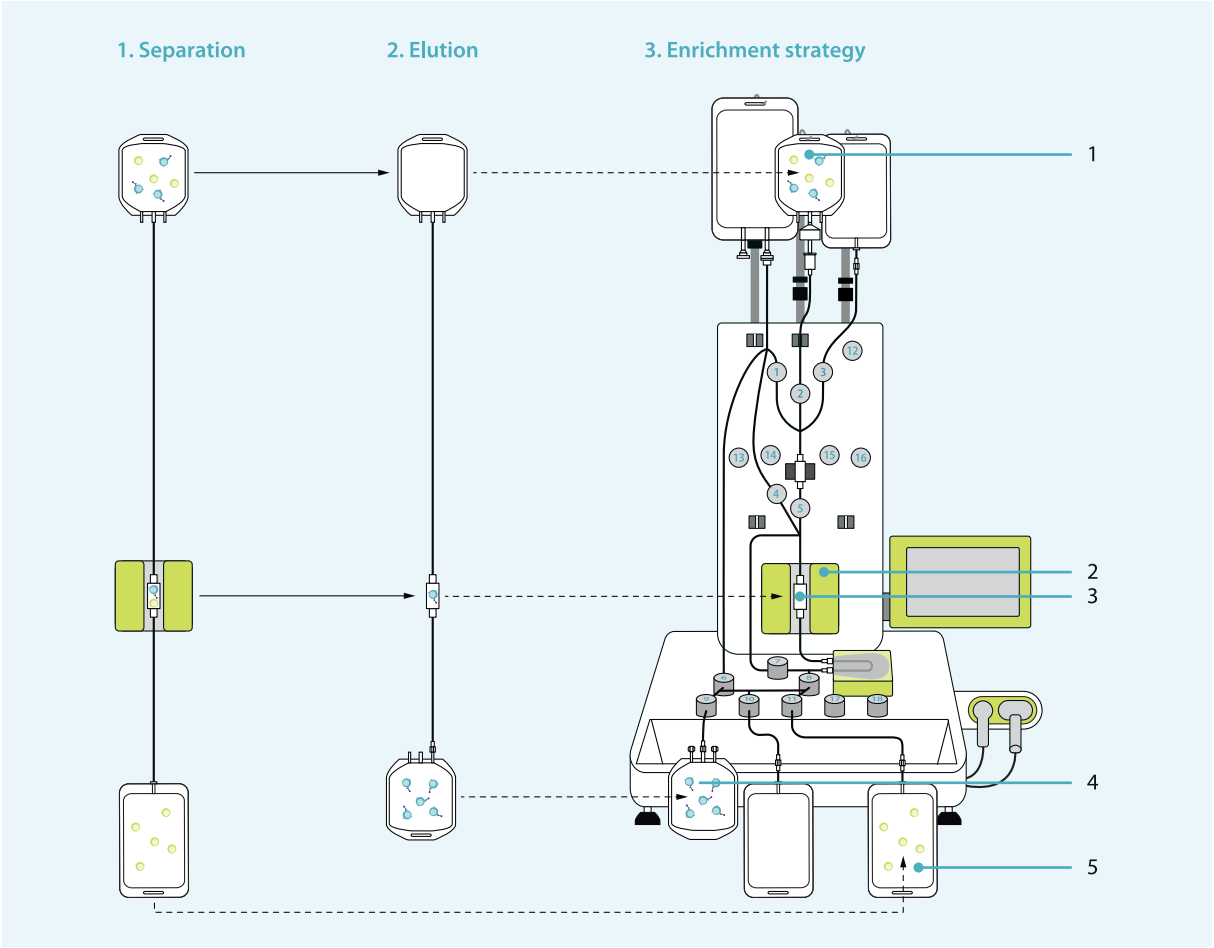


Figure 3.4: Strategy of enrichment programs using the CliniMACS Tubing Set or CliniMACS Tubing Set LS

1 Cell Preparation Bag
2 Magnet
3 Separation column
4 Cell Collection Bag
5 Negative Fraction Bag

1. The magnet is in the "ON"-position. Magnetically labeled cells are held in the separation column, while other unlabeled cells (non-target cells) flow through the column and are collected in the Negative Fraction Bag.
2. The magnet is in the "OFF"-position. The magnetically labeled cells (target cells) are released from the separation column and collected in the Cell Collection Bag.
3. The enrichment program retains the magnetically labeled cells in the separation column, the unlabeled cells (non-target cells) flow through the column and are collected in the Negative Fraction Bag. When the magnet is moved into the "OFF"-position, the magnetically labeled cells (target cells) are released from the column and collected in the Cell Collection Bag.

IMPORTANT:
The target cells are always collected in the Cell Collection Bag.

3.3.2 Depletion strategies

Depletion of cells using the CliniMACS Tubing Set LS: Depletion 2.1

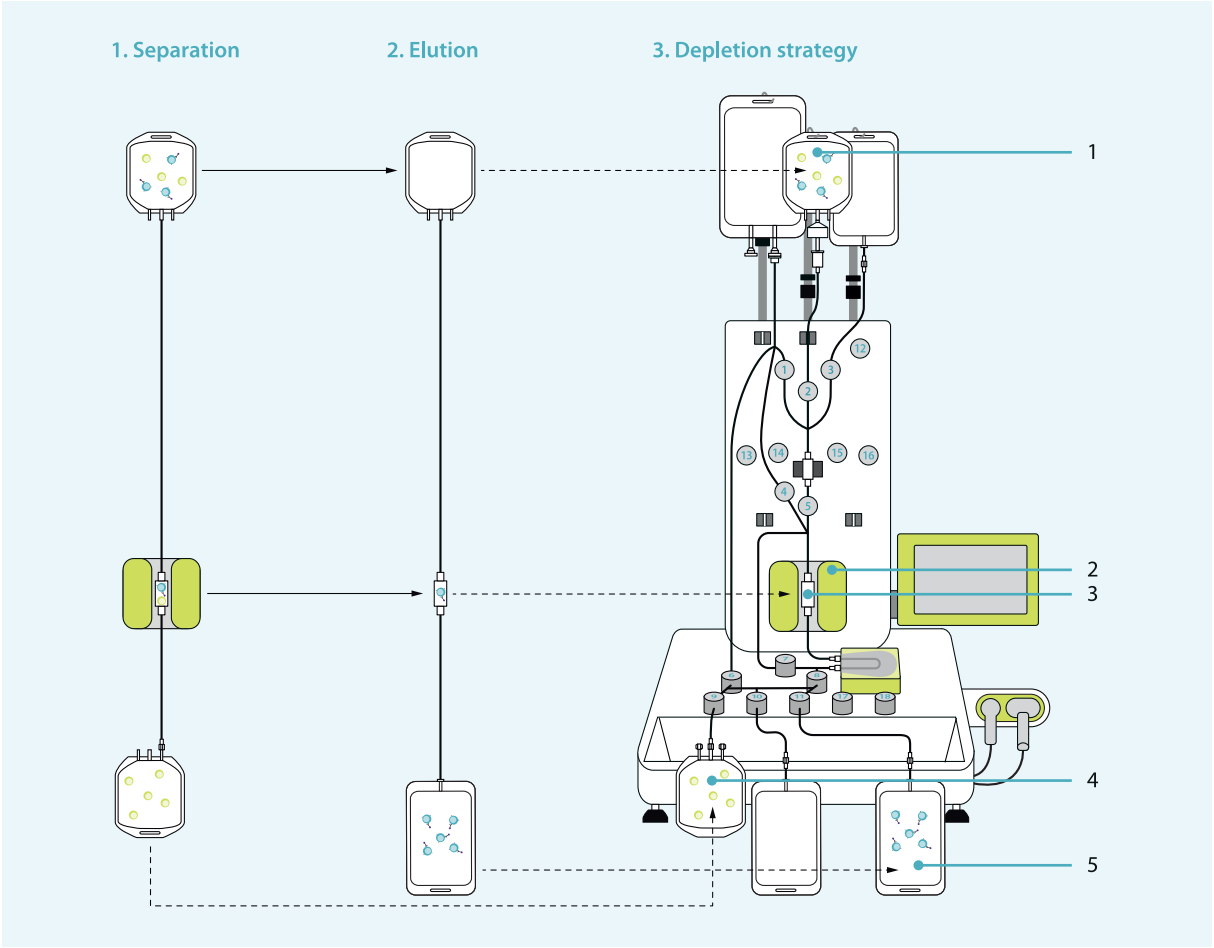


Figure 3.5: Strategy of the depletion program Depletion 2.1 using the CliniMACS Tubing Set LS

1 Cell Preparation Bag
2 Magnet
3 Separation column
4 Cell Collection Bag
5 Negative Fraction Bag

1. The magnet is in the "ON"-position. The magnetically labeled cells are held in the separation column, while the unlabeled cells (target cells) flow through the column and are collected in the Cell Collection Bag.
2. The magnet is in the "OFF"-position. The magnetically labeled cells (non-target cells) are released from the separation column and collected in the Negative Fraction Bag.
3. The depletion program (Depletion 2.1) retains the magnetically labeled cells in the separation column, while the unlabeled cells (target cells) flow through and are collected in the Cell Collection Bag. When the magnet is moved into the "OFF"-position, the magnetically labeled cells (non-target cells) are released from the column and collected in the Negative Fraction Bag.

IMPORTANT:
The target cells are always collected in the Cell Collection Bag.

Depletion of cells using the CliniMACS Depletion Tubing Set: Depletion 3.1 (Part 1: Staged Cell Loading [Bulk Depletion])

Compared to the depletion strategy with the program Depletion 2.1, the depletion strategy with the program Depletion 3.1 and the CliniMACS Depletion Tubing Set consists of a two-step cell loading procedure. This means that the labeled cell suspension is loaded onto the column twice for a thorough and fast depletion of high cell numbers (described in part 1 and part 2).

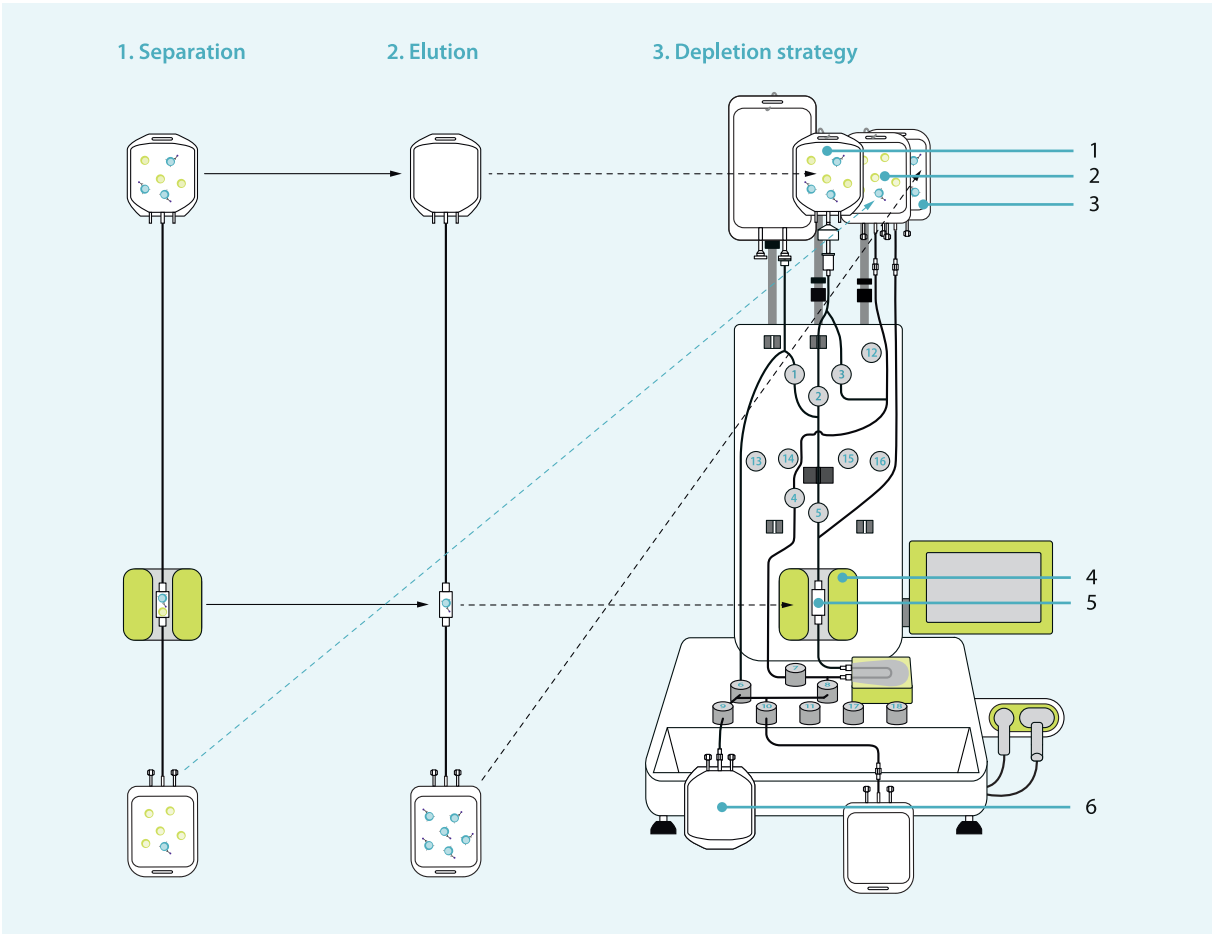


Figure 3.6: Strategy of the depletion program Depletion 3.1 using the CliniMACS Depletion Tubing Set (Part 1)

1 Cell Preparation Bag
2 Reapplication Bag
3 Non-Target Cell Bag
4 Magnet
5 Separation column
6 Cell Collection Bag

1. Staged Cell Loading (Bulk Depletion): The magnet is in the "ON"-position. The magnetically labeled cells are held in the separation column, while the unlabeled cells (target cells) flow through the column and are collected in the Reapplication Bag.
2. The magnet is in the "OFF"-position. The magnetically labeled cells (non-target cells) are released from the separation column and collected in the Non-Target Cell Bag.
3. The depletion program (Depletion 3.1) retains the magnetically labeled cells in the separation column. The unlabeled cells (target cells) flow through the column and are collected in the Reapplication Bag to be reloaded onto the separation column for a second sensitive depletion (see Figure 3.7). When the magnet is moved into the "OFF"-position, the magnetically labeled cells (non-target cells) are released from the column and collected in the Non-Target Cell Bag.

Depletion of cells using the CliniMACS Depletion Tubing Set: Depletion 3.1 (Part 2: Sensitive Cell Loading [Sensitive Depletion])

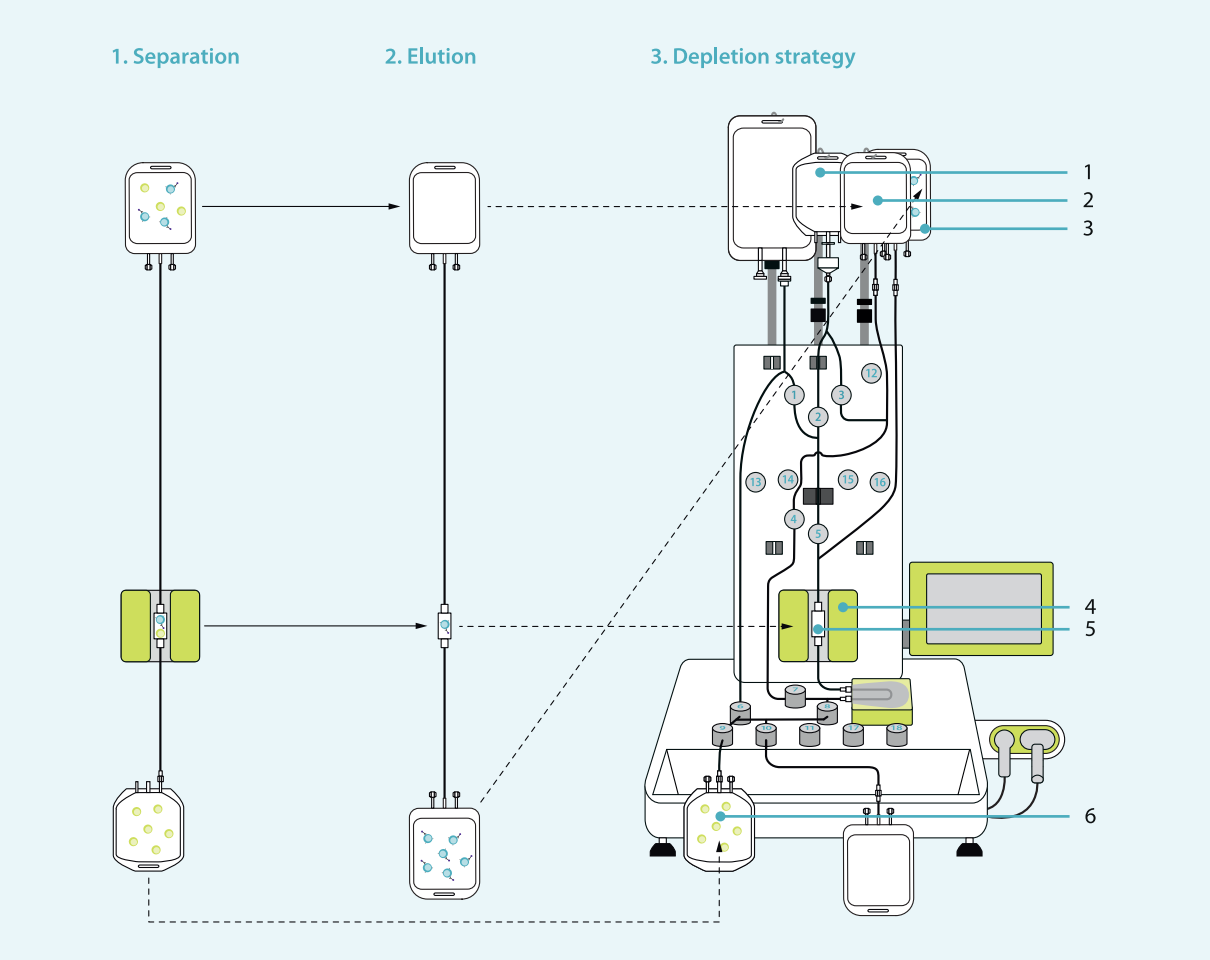


Figure 3.7: Strategy of the depletion program Depletion 3.1 using the CliniMACS Depletion Tubing Set (Part 2)

1 Cell Preparation Bag
2 Reapplication Bag
3 Non-Target Cell Bag
4 Magnet
5 Separation column
6 Cell Collection Bag

1. Sensitive Cell Loading (Sensitive Depletion): The magnet is in the "ON"-position. The cells from the Reapplication Bag are reloaded on the separation column. The few remaining magnetically labeled cells are held in the separation column, while the unlabeled cells (target cells) flow through the column and are collected in the Cell Collection Bag.

2. The magnet is in the "OFF"-position. The magnetically labeled cells (non-target cells) are released from the separation column and collected in the Non-Target Cell Bag.

3. At the end of the separation the labeled cells (non-target cells) are in the Non-Target Cell Bag and the unlabeled cells (target cells) are in the Cell Collection Bag.

IMPORTANT:
The target cells are always collected in the Cell Collection Bag.

4

About the CliniMACS Plus System

The CliniMACS Plus System offers a set of tools making high-quality standard cell separations available for therapeutic applications.

4.1 Intended purpose

The CliniMACS Plus System, consisting of the components CliniMACS Plus Instrument, CliniMACS Reagent(s), CliniMACS Tubing Set, CliniMACS PBS/EDTA Buffer, and further accessories, which must be used in combination, is intended for the *in vitro* separation of specific human cells for clinical applications.

IMPORTANT:
For instructions for use, e.g., warnings and precautions, concerning the CliniMACS Plus System components, refer to the instructions for use provided for the respective component.

The CliniMACS Reagents in combination with the CliniMACS Plus System are intended to separate human cells.

Miltenyi Biotec as the manufacturer of the CliniMACS Plus System does not give any recommendations regarding the use of separated cells for therapeutic purposes and does not make any claims regarding a clinical benefit.

4.2 Regulatory information

The CliniMACS Plus System is based on the magnetic cell separation technology (MACS® Technology) developed by Miltenyi Biotec B.V. & Co. KG. Miltenyi Biotec has made these products available for clinical applications meeting the requirements of European Regulatory Standards.

IMPORTANT:
Before using the CliniMACS Plus System or any components outside the European Economic Area, the regulatory approval of the CliniMACS Plus System or any CliniMACS component in the country must be confirmed.

For the manufacturing and use of target cells in humans the national legislation and regulations – for example, for the EU the Directive 2004/23/EC (human tissues and cells) or the Directive 2002/98/ EC (human blood and blood components) – must be followed. Thus, any clinical application of the target cells is exclusively within the responsibility of the user of a CliniMACS Plus System.

4.3 CliniMACS Plus Instrument and additional components

The CliniMACS Plus Instrument is an electromechanical device incorporating a permanent magnet, a peristaltic pump, pinch valves, electronics, and software.

The CliniMACS Plus Instrument is delivered with additional accessories and components. For further details, refer to the CliniMACS Plus Instrument user manual.

MACS® TubeSealer

The MACS® TubeSealer is used for sealing PVC and EVA tubing of the tubing sets installed on the instrument. A detailed description of the MACS® TubeSealer and relevant safety information are provided in the MACS® TubeSealer user manual.

Barcode reader

The barcode reader is intended to scan barcodes printed on CliniMACS materials required for process execution. The scanned data serve as input of part and lot numbers of the CliniMACS materials required for an application. These numbers and any other process-related parameters may also be entered manually.

External keyboard

The external keyboard is intended to enable administrators to set up user accounts.

IMPORTANT:
DO NOT use the external keyboard when running any of the installed applications on the instrument. The external keyboard must be used for the "User Management" only! The external keyboard must be unplugged from the instrument before starting any application and tool.

Refer to the CliniMACS Plus Software user manual for detailed information on User Management.

4.4 CliniMACS Reagents and Biotin Conjugates

The CliniMACS Reagents are dark colored, non-viscous, colloidal solutions, containing the cell specific antibody conjugates in buffer. The reagents consist of the antibody chemically coupled to superparamagnetic particles.

The CliniMACS Biotin Conjugates are clear and colorless solutions containing antibody covalently linked to biotin in buffer. The antibodies are highly specific, making *in vitro* labeling of rare target cells possible.

4.5 CliniMACS Tubing Sets

The CliniMACS tubing sets are sterile, single-use disposables designed to be used in combination with the CliniMACS Plus Instrument for the *in vitro* enrichment or depletion of human cells from heterogeneous hematologic cell populations.

4.6 CliniMACS PBS/EDTA Buffer

The CliniMACS PBS/EDTA Buffer is a wash and transport fluid to enable the *in vitro* separation of human cells.

IMPORTANT:
The CliniMACS PBS/EDTA Buffer is intended for *in vitro* use only. It is not intended for intravenous infusion or for parenteral applications. It must be exchanged to an infusion solution approved in the country of the user by appropriate means, for example, through centrifugation or buffer exchange.

4.7 CliniMACS Accessories

- **Plasma transfer set:**
  transfer set with two spikes for plasma or fluids, Transfer Set Coupler/Coupler (REF 200-073-902), or equivalent
- **Luer/Spike Interconnector:**
  transfer set with spike and syringe adapter (female luer) for plasma or fluids, Luer/Spike Interconnector (REF 200-073-903), or equivalent

4.8 Additional materials required

In addition to the CliniMACS Products, additional materials may be required for a CliniMACS Plus separation.

- **Cell culture bags, gas-permeable:**
  MACS®GMP Cell Differentiation Bag – 100 mL (REF 170-076-400), or equivalent
- **Transfer bags, suitable for centrifugation:**
  Transfer bag 150 mL, Terumo, or equivalent
  Transfer bag 600 mL, Terumo, or equivalent
  Transfer bag 1,000 mL, Terumo, or equivalent
- **Sampling site coupler:**
  Sampling site coupler, Terumo, or equivalent
- **Pre-system filter:**
  Blood Transfusion Filter, GVS, or equivalent
- **Syringes and needles:**
  Appropriate syringes (5 mL, 10 mL, 20 mL, 50 mL) and hypodermic 20-gauge needles
- **Locking forceps**
- **Sample tubes for quality control**
- **Human serum albumin (HSA)**
  Use HSA of pharmaceutical grade quality only, which is available as approved product in the country of the user.
- **Clinical grade immunoglobulin G:**
  Use IgG of pharmaceutical grade quality only, which is available as approved drug in the country of the user, for example, for Germany: Gamunex® 10%, or equivalent.
- **Cell culture medium:**
  For example, RPMI 1640, or equivalent
- **Application-specific materials:**
  Individual biotinylated cell specific antibody or ligand; AB serum or, alternatively, autologous serum

4.9 Equipment required

- **Uninterruptible power supply (UPS):**
  Recommended UPS: APC Smart-UPS 1500VA USB & Serial 230 V, manufactured by APC (American Power Conversion), or equivalent
- **Laminar flow hood**
- **Sterile tubing connector:**
  Terumo Sterile Connection Device (TSCD®), or equivalent
- **Orbital rotator:**
  Platform shakers, Heidolph Instruments, or equivalent
- **Centrifuge:**
  Centrifuge, Sorvall, or equivalent, and buckets for centrifugation with aerosol containment caps
- **Plasma extractor:**
  Plasma Separation Stand, Terumo Equipment, or equivalent
- **Table top balance:**
  Laboratory Balance, Mettler Toledo, or equivalent, with 1 kg capacity; resolution to 0.1 g
- **Tubing stripper:**
  Tube Stripper, Baxter, or equivalent
- **Biohazard waste containers**

For the CliniMACS Cytokine Capture System (IFN-gamma), additional equipment is required.

- 24 well culture dish Corning™ Costar™ 24 well culture plate, Sigma Aldrich, or equivalent
- MiniMACS™ Separation Unit, Miltenyi Biotec (REF 130-042-102)
- MS Columns, Miltenyi Biotec (REF 130-042-201)
- Pre-Separation Filter, Miltenyi Biotec (REF 130-041-407)
- MACSmix™ Tube Rotator, Miltenyi Biotec (REF 130-090-753)

5

Overview of applications

5.1 Four Steps to your target cells

In the following chapter an overview of the CliniMACS Plus separation is presented. The CliniMACS Plus separation is carried out in four Steps.

Recording of application-related process data may be required. For supporting worksheets, contact Miltenyi Biotec Technical Support.

Step 1: Cell preparation and magnetic labeling

Step 1 describes the preparation of the cell product and the magnetic labeling of the specific cells expressing the respective antigen. Follow the instructions in the applicable section. Continue with Step 2.

Step 2: Choice of separation program

Step 2 describes the selection of a separation program on the CliniMACS Plus Instrument. Depending on cell type and cell number to be separated, the appropriate program must be selected. To determine which program is applicable, refer to the overview table on the next page. Read the respective section for the selected separation program. Follow the instructions given in the applicable section. Continue with Step 3.

Step 3: Installation of CliniMACS tubing sets

Step 3 explains the installation of the tubing set onto the CliniMACS Plus Instrument. Follow the instructions in the applicable section. Continue with Step 4.

Step 4: CliniMACS Plus separation

Step 4 describes the automated CliniMACS Plus separation. The CliniMACS Plus Instrument performs the automated cell separation procedure (chosen in Step 2). Follow the instructions in the applicable section.

5.2 Overview table

The following overview table summarizes information on typical applications of the CliniMACS Reagents. When the separation of a different number of target cells is to be performed, refer to the instructions in the application-specific overview to find information on the maximum capacity of the respective application. Follow the instructions in the application-specific sections and detailed explanations of Steps 1–4.

Application capacity	Reagent vial(s)	Tubing set	Separation program	Application-specific section	Detailed explanation of Steps 1–4 sections			
					Step 1	Step 2	Step 3	Step 4
Anti-Biotin (REF 173-01) – Enrichment								
≤40×10^9 total cells	1× Anti-Biotin Reagent	1× CliniMACS Tubing Set (REF 161-01)	Enrichment 1.1	6.2	7.1	7.2.4	7.3.1	7.4.2
Anti-Biotin (REF 173-01) – Depletion (normal-scale application)								
≤40×10^9 total cells	1× Anti-Biotin Reagent	1× CliniMACS Tubing Set LS (REF 162-01)	Depletion 2.1	6.2	7.1	7.2.6	7.3.1	7.4.4
Anti-Biotin – (REF 173-01) Depletion (large-scale application)								
>40–80×10^9 total cells	2× Anti-Biotin Reagent	1× CliniMACS Tubing Set LS (REF 162-01)	Depletion 2.1	6.2	7.1	7.2.6	7.3.1	7.4.4
CCS (REF 279-01) – Enrichment								
IFN-secreting cells from ≤1×10^9 total cells	1 kit (2 reagent vials)	1× CliniMACS Tubing Set (REF 161-01)	Enrichment 3.2	6.16	7.1	7.2.5	7.3.1	7.4.3
CD1c (BDCA-1)-Biotin (REF 277-01) – Depletion - Part 1 of 2								
≤5×10^9 CD19-positive cells from ≤40×10^9 total cells (WBC)	1× CD19 Reagent and 1× CD1c (BDCA-1)-Biotin	1× CliniMACS Tubing Set LS (REF 162-01)	Depletion 2.1	6.11	7.1	7.2.6	7.3.1	7.4.4
CD1c (BDCA-1)-Biotin (REF 277-01) – Enrichment - Part 2 of 2								
≤0.2×10^9 CD1c (BDCA-1)-positive cells from ≤40×10^9 total cells (WBC)	1× Anti-Biotin Reagent	1× CliniMACS Tubing Set (REF 161-01)	Enrichment 3.2	6.12	7.1	7.2.5	7.3.1	7.4.3
CD3 (REF 273-01) – Depletion (normal-scale application)								
≤15×10^9 CD3-positive cells from ≤40×10^9 total cells	1× CD3 Reagent	1× CliniMACS Tubing Set LS (REF 162-01)	Depletion 2.1	6.4	7.1	7.2.6	7.3.1	7.4.4
CD3 (REF 273-01) – Depletion (large-scale application)								
>15–20×10^9 CD3-positive cells from >40–80×10^9 total cells	2× CD3 Reagent	1× CliniMACS Tubing Set LS (REF 162-01)	Depletion 2.1	6.4	7.1	7.2.6	7.3.1	7.4.4
CD3 (REF 273-01) – Depletion (normal-scale application)								
≤15×10^9 CD3-positive cells from ≤40×10^9 total cells	1× CD3 Reagent	1× CliniMACS Depletion Tubing Set (REF 261-01)	Depletion 3.1	6.4	7.1	7.2.7	7.3.3	7.4.5

Application capacity	Reagent vial(s)	Tubing set	Separation program	Application-specific section	Detailed explanation of Steps 1–4 sections			
					Step 1	Step 2	Step 3	Step 4
CD3 (REF 273-01) – Depletion (large-scale application)								
>15–30×10^9 CD3-positive cells from >40–80×10^9 total cells	2× CD3 Reagent	1× CliniMACS Depletion Tubing Set (REF 261-01)	Depletion 3.1	6.4	7.1	7.2.7	7.3.3	7.4.5
CD4 (REF 276-01) – Enrichment								
≤5×10^9 CD4-positive cells from ≤40×10^9 total cells	1× CD4 Reagent	1× CliniMACS Tubing Set (REF 161-01)	Enrichment 1.1	6.9	7.1	7.2.4	7.3.1	7.4.2
CD4 (REF 276-01) – Depletion								
≤12×10^9 CD4-positive cells from ≤40×10^9 total cells	1× CD4 Reagent	1× CliniMACS Tubing Set LS (REF 162-01)	Depletion 2.1	6.9	7.1	7.2.6	7.3.1	7.4.4
CD8 (REF 275-01) – Enrichment								
≤4×10^9 CD8-positive cells from ≤40×10^9 total cells	1× CD8 Reagent	1× CliniMACS Tubing Set (REF 161-01)	Enrichment 1.1	6.7	7.1	7.2.4	7.3.1	7.4.2
CD8 (REF 275-01) – Depletion								
≤4×10^9 CD8-positive cells from ≤40×10^9 total cells	1× CD8 Reagent	1× CliniMACS Tubing Set LS (REF 162-01)	Depletion 2.1	6.7	7.1	7.2.6	7.3.1	7.4.4
CD4/CD8 combination (REF 276-01/REF 275-01) – Depletion								
≤12×10^9 CD4-positive cells and ≤4×10^9 CD8-positive cells from ≤40×10^9 total cells	1× CD4 Reagent and 1× CD8 Reagent	1× CliniMACS Tubing Set LS (REF 162-01)	Depletion 2.1	6.10	7.1	7.2.6	7.3.1	7.4.4
CD19 (REF 179-01) – Depletion								
≤5×10^9 CD19-positive cells from ≤40×10^9 total cells	1× CD19 Reagent	1× CliniMACS Tubing Set LS (REF 162-01)	Depletion 2.1	6.5	7.1	7.2.6	7.3.1	7.4.4
CD3/CD19 combination (REF 273-01/REF 179-01) – Depletion								
≤15×10^9 CD3-positive cells and ≤5×10^9 CD19-positive cells from ≤40×10^9 total cells	1× CD3 Reagent and 1× CD19 Reagent	1× CliniMACS Depletion Tubing Set (REF 261-01)	Depletion 3.1	6.6	7.1	7.2.7	7.3.3	7.4.5
CD25 (REF 274-01) – Enrichment								
≤0.6×10^9 CD25-positive cells from ≤40×10^9 total cells (WBC)	1× CD25 Reagent	1× CliniMACS Tubing Set (REF 161-01)	Enrichment 3.2	6.8	7.1	7.2.5	7.3.1	7.4.3
CD25 (REF 274-01) – Enrichment								
≤0.6×10^9 highly expressing CD25-positive cells from ≤40×10^9 total cells (WBC)	1× CD25 Reagent	1× CliniMACS Tubing Set (REF 161-01)	Enrichment 3.2	6.8	7.1	7.2.5	7.3.1	7.4.3
CD25 (REF 274-01) – Depletion (normal-scale application)								
≤6×10^9 CD25-positive cells from ≤40×10^9 total cells (WBC)	1× CD25 Reagent	1× CliniMACS Tubing Set LS (REF 162-01)	Depletion 2.1	6.8	7.1	7.2.6	7.3.1	7.4.4

Application capacity	Reagent vial(s)	Tubing set	Separation program	Application-specific section	Detailed explanation of Steps 1–4 sections			
					Step 1	Step 2	Step 3	Step 4
CD25 (REF 274-01) – Depletion (large-scale application)								
>6–12×10^9 CD25-positive cells from >40–80×10^9 total cells (WBC)	2× CD25 Reagent	1× CliniMACS Tubing Set LS (REF 162-01)	Depletion 2.1	6.8	7.1	7.2.6	7.3.1	7.4.4
CD34 (REF 171-01) – Enrichment (normal-scale application)								
≤0.6×10^9 CD34-positive cells from ≤60×10^9 total cells	1× CD34 Reagent	1× CliniMACS Tubing Set (REF 161-01)	CD34 Selection 1	6.1	7.1	7.2.3	7.3.1	7.4.1
CD34 (REF 171-01) – Enrichment (large-scale application)								
>0.6–1.2×10^9 CD34-positive cells from >60–120×10^9 total cells	2× CD34 Reagent	1× CliniMACS Tubing Set LS (REF 162-01)	CD34 Selection 2	6.1	7.1	7.2.3	7.3.1	7.4.1
CD45RA (REF 701-46) – Depletion								
≤20×10^9 CD45RA-positive cells from ≤50×10^9 total cells	1× CD45RA Reagent	1× CliniMACS Depletion Tubing Set (REF 261-01)	Depletion 3.1	6.15	7.1	7.2.7	7.3.3	7.4.5
CD56 (REF 271-01) – Enrichment								
≤5×10^9 CD56-positive cells from ≤40×10^9 total cells	1× CD56 Reagent	1× CliniMACS Tubing Set (REF 161-01)	Enrichment 1.1	6.3	7.1	7.2.4	7.3.1	7.4.2
CD304 (BDCA-4) (REF 278-01) – Enrichment								
≤0.2×10^9 CD304 (BDCA-4)-positive cells from ≤40×10^9 total cells	1× CD304 (BDCA-4) Reagent	1× CliniMACS Tubing Set (REF 161-01)	Enrichment 3.2	6.13	7.1	7.2.5	7.3.1	7.4.3
TCRα/β-Biotin (REF 701-48/REF 173-01) – Depletion								
≤24×10^9 TCRα/β-positive cells from ≤60×10^9 total cells	1× TCRα/β-Biotin and 2× Anti-Biotin Reagent	1× CliniMACS Depletion Tubing Set (REF 261-01)	Depletion 3.1	6.14	7.1	7.2.7	7.3.3	7.4.5

Table 5.1: Overview of available applications with corresponding tubing sets and separation programs

6

Application-specific overview of Steps 1-4

6.1 Enrichment of CD34-positive cells

The CliniMACS Plus CD34 System including the CliniMACS Plus Instrument, the CliniMACS CD34 Reagent, the CliniMACS Tubing Set or the CliniMACS Tubing Set LS, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* enrichment of human CD34-positive hematopoietic progenitor cells from heterogeneous hematologic cell populations.

6.1.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

- **Normal-scale application:** up to 0.6×10^9 CD34-positive cells out of up to 60×10^9 total cells (WBC)
- **Large-scale application:** greater than 0.6×10^9 and up to 1.2×10^9 CD34-positive cells out of up to 120×10^9 total cells (WBC)

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity	Separation program
CliniMACS Plus Instrument	151-01	1	–
CliniMACS CD34 Reagent	171-01	• 1 vial (normal-scale) • 2 vials (large-scale)	–
CliniMACS Tubing Set	161-01	1 tubing set	CD34 Selection 1
CliniMACS Tubing Set LS	162-01	1 tubing set	CD34 Selection 2
CliniMACS PBS/EDTA Buffer	700-25	3×1,000 mL bags[1]	–

[1] Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).

Table 6.1: CliniMACS Materials required for enrichment of CD34-positive cells

Additional materials required

- **Cell Preparation Bag:**
  One 600 mL transfer bag, suitable for centrifugation, as well as one sampling site coupler and two plasma transfer sets, for use during the cell preparation procedure
- **Plasma Waste Bag and Wash Waste Bag:**
  Three 600 mL transfer bags, suitable for centrifugation
- **Cell Collection Bag**:
  One 150 mL transfer bag in combination with a Luer/Spike Interconnector to connect the Cell Collection Bag to the tubing set
- **One pre-system filter**
- **Locking forceps**
- **Appropriate syringes (different sizes) and hypodermic 20 gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Sample tubes for quality control**

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Analysis of starting cell product**
- **Transfer of starting cell product into Cell Preparation Bag**
  If the weight of the starting cell product is more than 200 g, but the number of cells is less than 120×10^9 total cells and 1.2×10^9 CD34-positive cells, centrifuge the sample to reduce the volume to 200 g at the most and then continue with the following steps.
- **Dilution of starting cell product**
  Add buffer using the following equation:
  Weight of buffer to be added = Weight of starting cell product × 2
- **Centrifugation**
  Centrifuge at 200×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
- **Volume adjustment: labeling volume 95 g (±5 g) (normal-scale application) or 190 g (±5 g) (large-scale application)**
  1. Remove supernatant to adjust the cell product using the following equation:
     Weight of supernatant to be removed = Weight of diluted cell product – Labeling volume
  2. Resuspend the cell pellet.

- **Incubation with the CliniMACS CD34 Reagent**
  1. Depending on the required scale, add 1 or 2 vials of CliniMACS CD34 Reagent (see Table 6.1). Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess reagent**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (200×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of three washing steps (instead of only two) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  4. Resuspend the cell pellet.
  5. Fill Cell Preparation Bag with buffer.
  6. Centrifuge (200×g, without brake, 15 minutes, RT).
  7. Remove supernatant as much as possible.
  8. Resuspend the cell pellet.
  9. Adjust Cell Preparation Bag volume to 150 g (normal-scale application) or 275 g (large-scale application).

  Optional: Take a sample after removal of excess reagent for later analysis.

6.1.2 Step 2: Choice of separation program

- **Basic operation**
- **Choosing separation program CD34 Selection 1 or CD34 Selection 2**
  (CliniMACS Tubing Set: CD34 Selection 1)
  (CliniMACS Tubing Set LS: CD34 Selection 2)
- **Entering tubing set parameters**
- **Entering CliniMACS CD34 Reagent parameters**

See section 'CD34 Selection 1/ CD34 Selection 2' in the detailed explanation.

6.1.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Tubing Set and CliniMACS Tubing Set LS**

See section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' in the detailed explanation.

6.1.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'CD34 Selection 1/2' in the detailed explanation.

6.2 Enrichment/depletion with the CliniMACS Anti-Biotin Reagent

The CliniMACS Plus Anti-Biotin System including the CliniMACS Plus Instrument, the CliniMACS Anti-Biotin Reagent, the CliniMACS Tubing Set or the CliniMACS Tubing Set LS, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* enrichment or depletion of human cells previously labeled with biotinylated antibodies.

6.2.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

- **Enrichment:** up to 40×10^9 total cells (WBC)
- **Depletion:**

  Normal-scale application: up to 40×10^9 total cells (WBC)

  Large-scale application: greater than 40×10^9 and up to 80×10^9 total cells (WBC)

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity	Separation program
CliniMACS Plus Instrument	151-01	1	–
CliniMACS Anti-Biotin Reagent	173-01	• 1 vial (normal-scale) • 2 vials (large-scale)	–
CliniMACS Tubing Set	161-01	1 tubing set	Enrichment 1.1
CliniMACS Tubing Set LS	162-01	1 tubing set	Depletion 2.1
CliniMACS PBS/EDTA Buffer	700-25	• 3×1,000 mL bags[1] (normal-scale) • 4×1,000 mL bags[1] (large-scale)	–

[1] The amount of buffer varies depending on the selected separation program and the number of labeled cells (see Table 6.3 to Table 6.6). Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).

Table 6.2: CliniMACS Materials required for enrichment/depletion with the CliniMACS Anti-Biotin Reagent

Additional materials required

- **Cell Preparation Bag**:
  One 600 mL transfer bag, suitable for centrifugation, as well as one sampling site coupler and two plasma transfer sets, for use during the cell preparation procedure
- **Plasma Waste Bag** and **Wash Waste Bag**:
  Two 600 mL transfer bags, suitable for centrifugation
- **Cell Collection Bag:**
  One
  600 mL or one 1,000 mL transfer bag in combination with a Luer/Spike Interconnector to connect the Cell Collection Bag to the tubing set (see Table 6.4 and Table 6.6)
- **If the replacement of the Negative Fraction Bag, the Buffer Waste Bag, and/or the Priming Waste Bag is necessary:**
  Two to three 1,000 mL transfer bags in combination with two Luer/Spike Interconnectors to connect the bags to the tubing set (see Table 6.4 and Table 6.6).
  Replace the Priming Waste Bag using the sterile tubing connector.
- **If more than one liter of buffer is required for the separation:**
  One to two plasma transfer sets to connect the buffer bags (see Table 6.4 and Table 6.6)
- **One pre-system filter**
- **Locking forceps**
- **Appropriate syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Sample tubes for quality control**
- **Individual biotinylated cell-specific antibody or ligand**

Overview of materials required

Cell preparation (Enrichment 1.1)	
Total cells (WBC)	$\leq 40\times10^9$
Number of reagent vials	1
CliniMACS PBS/EDTA Buffer	2,000 mL
Plasma transfer set	2

Table 6.3: Materials required for cell preparation (Enrichment 1.1)

Separation (Enrichment 1.1)		
Labeled cells	≤2×10^9	>2–5×10^9
Negative Fraction Bag	–	Replace original bags of the tubing set with 1,000 mL transfer bags
Buffer Waste Bag	–	
Priming Waste Bag	–	–
Cell Collection Bag	600 mL	600 mL
Luer/Spike Interconnector	1	3
CliniMACS PBS/EDTA Buffer	1,000 mL	2,000 mL
Plasma transfer set	–	1

Table 6.4: Materials required for enrichment (Enrichment 1.1)

Cell preparation (Depletion 2.1)		
Total cells (WBC)	≤40×10^9	>40–80×10^9
Number of reagent vials	1	2
CliniMACS PBS/EDTA Buffer	2,000 mL	2,000 mL
Plasma transfer set	2	2

Table 6.5: Materials required for cell preparation (Depletion 2.1)

Separation (Depletion 2.1)			
Labeled cells	<5×10^9	5–13×10^9	>13–20×10^9
Negative Fraction Bag	–	Replace original bags of the tubing set with 1,000 mL transfer bags	Replace original bags of the tubing set with 1,000 mL transfer bags
Buffer Waste Bag	–		
Priming Waste Bag	–	–	
Cell Collection Bag	600 mL	1,000 mL	1,000 mL
Luer/Spike Interconnector	1	3	4
CliniMACS PBS/EDTA Buffer	1,000 mL	2,000 mL	3,000 mL
Plasma transfer set	–	1	2

Table 6.6: Materials required for depletion (Depletion 2.1)

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Analysis of starting cell product**
- **Transfer of starting cell product into Cell Preparation Bag**
- **Dilution of starting cell product**

  Add buffer using the following equation:

  Weight of buffer to be added = Weight of starting cell product × 2

- **Centrifugation**
  1. Centrifuge at 300×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
  2. Remove supernatant to adjust volume for primary antibody labeling as recommended by the manufacturer of the primary antibody.
  3. Resuspend the cell pellet.
- **Labeling of the cells: incubation with the primary antibody**
  Follow the instructions for use provided by the manufacturer of the primary antibody.
- **Removal of excess conjugate (1st wash)**
  1. Add buffer using the following equation:
     Weight of buffer to be added = 600 g – Weight of cell product
  2. Centrifuge at 300×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
- **Volume adjustment: labeling volume 95 g (±5 g) (normal-scale application) or 190 g (±5 g) (large-scale application)**
  1. Remove supernatant to adjust the sample using the following equation:
     Weight of supernatant to be removed = Weight of diluted cell product – Labeling volume
     Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of two washing steps (instead of only one) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  2. Resuspend the cell pellet.
- **Magnetic labeling of cells: incubation with the CliniMACS Anti-Biotin Reagent**
  1. Add 1 or 2 vials of CliniMACS Anti-Biotin Reagent (see Table 6.3 and Table 6.5). Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess reagent (2nd wash)**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of two washing steps (instead of only one) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  4. Resuspend the cell pellet.
  5. Adjust Cell Preparation Bag volume to 100 g (normal-scale application) or 200 g (large-scale application).

  Optional: Take a sample after removal of excess reagent for later analysis.

6.2.2 Step 2: Choice of separation program

- **Basic operation**
- **Separation planner tool**
- **Choosing separation program Enrichment 1.1** or **Choosing separation program Depletion 2.1**
- **Entering tubing set parameters**
- **Entering starting cell product parameters**

See section 'Enrichment 1.1' or 'Depletion 2.1' in the detailed explanation.

6.2.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Tubing Set and CliniMACS Tubing Set LS**

See section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' in the detailed explanation.

6.2.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Enrichment 1.1' and 'Depletion 2.1'in the detailed explanation.

6.3 Enrichment of CD56-positive cells

The CliniMACS Plus CD56 System including the CliniMACS Plus Instrument, the CliniMACS CD56 Reagent, the CliniMACS Tubing Set, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* enrichment of human CD56-positive cells from heterogeneous hematologic cell populations.

6.3.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

Up to 5×10^9 CD56-positive cells out of up to 40×10^9 total cells (WBC)

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity
CliniMACS Plus Instrument	151-01	1
CliniMACS CD56 Reagent	271-01	1 vial
CliniMACS Tubing Set	161-01	1 tubing set
CliniMACS PBS/EDTA Buffer	700-25	3×1,000 mL bags[1]

[1] See Table 6.8 and Table 6.9. Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).

Table 6.7: CliniMACS Materials required for enrichment of CD56-positive cells

Additional materials required

- **Cell Preparation Bag**:
  One 600 mL transfer bag, suitable for centrifugation, as well as one sampling site coupler and one plasma transfer set, for use during the cell preparation procedure
- **Plasma Waste Bag and Wash Waste Bag:**
  Two 600 mL transfer bags, suitable for centrifugation
- **Cell Collection Bag**:
  One 150 mL or 600 mL transfer bag in combination with a Luer/Spike Interconnector to connect the Cell Collection Bag to the tubing set (see Table 6.9)
- **If the replacement of the Negative Fraction Bag and the Buffer Waste Bag is necessary:**
  Two 1,000 mL transfer bags in combination with two Luer/Spike Interconnectors to connect the bags to the tubing set (see Table 6.9)
- **If more than one liter of buffer is required for the separation:**
  One plasma transfer set to connect the buffer bags (see Table 6.9)
- **One pre-system filter**
- **Locking forceps**
- **Syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Sample tubes for quality control**

Overview of materials required

Cell preparation	
Total cells (WBC)	≤40×10^9
Number of reagent vials	1
CliniMACS PBS/EDTA Buffer	1,000 mL
Plasma transfer set	1

Table 6.8: Materials required for the cell preparation of CD56-positive cells

Separation		
Labeled cells	≤2×10^9	>2–5×10^9
Negative Fraction Bag	–	Replace original bags of the tubing set with 1,000 mL transfer bags
Buffer Waste Bag	–	
Priming Waste Bag	–	–
Cell Collection Bag	150 mL	600 mL
Luer/Spike Interconnector	1	3
CliniMACS PBS/EDTA Buffer	1,000 mL	2,000 mL
Plasma transfer set	–	1

Table 6.9: Materials required for the enrichment of CD56-positive cells

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Analysis of starting cell product**
- **Transfer of starting cell product into Cell Preparation Bag**
- **Dilution of starting cell product**
  Add buffer using the following equation:
  Weight of buffer to be added = 600 g – Weight of starting cell product
- **Centrifugation**
  Centrifuge at 200×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
- **Volume adjustment: labeling volume 95 g (±5 g)**
  1. Remove supernatant completely taking care not to resuspend the cell pellet.
  2. Resuspend the cell pellet carefully after removal of supernatant.
  3. Adjust the weight of the Cell Preparation Bag (CPB) by adding buffer using the following equation:
     Target weight of filled CPB = 95 g + Weight of empty CPB
  4. Resuspend the cells.
- **Incubation with the CliniMACS CD56 Reagent**
  1. Add 1 vial of CliniMACS CD56 Reagent. Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess reagent**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of two washing steps (instead of only one) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  4. Resuspend the cell pellet carefully after removal of supernatant.
  5. Adjust Cell Preparation Bag volume to 150 g.

  Optional: Take a sample after removal of excess reagent for later analysis.

6.3.2 Step 2: Choice of separation program

- **Basic operation**
- **Separation planner tool**
- **Choosing separation program Enrichment 1.1**
- **Entering tubing set parameters**
- **Entering starting cell product parameters**

See section 'Enrichment 1.1' in the detailed explanation.

6.3.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Tubing Set and CliniMACS Tubing Set LS**

See section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' in the detailed explanation.

6.3.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Enrichment 1.1' in the detailed explanation.

6.4 Depletion of CD3-positive cells

The CliniMACS Plus CD3 System including the CliniMACS Plus Instrument, the CliniMACS CD3 Reagent, the CliniMACS Tubing Set LS or the CliniMACS Depletion Tubing Set, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* depletion of human CD3-positive cells from heterogeneous hematologic cell populations.

6.4.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

- **Normal-scale application:** up to 15×10^9 CD3-positive cells out of up to 40×10^9 total cells (WBC) using either the CliniMACS Tubing Set LS or the CliniMACS Depletion Tubing Set
- **Large-scale application:**
  - greater than 15×10^9 and up to 20×10^9 CD3-positive cells out of greater than 40×10^9 and up to 80×10^9 total cells (WBC) using the CliniMACS Tubing Set LS
  - greater than 15×10^9 and up to 30×10^9 CD3-positive cells out of greater than 40×10^9 and up to 80×10^9 total cells (WBC) using the CliniMACS Depletion Tubing Set

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

For high numbers of labeled cells it is recommended to use a CliniMACS Depletion Tubing Set, in order to save processing time on the instrument.

Material	Catalog number	Quantity	Separation program
CliniMACS Plus Instrument	151-01	1	–
CliniMACS CD3 Reagent	273-01	• 1 vial (normal-scale) • 2 vials (large-scale)	–
CliniMACS Tubing Set LS	162-01	1 tubing set	Depletion 2.1
CliniMACS Depletion Tubing Set	261-01	1 tubing set	Depletion 3.1
CliniMACS PBS/EDTA Buffer	700-25	Up to 5×1,000 mL bags[1]	–

[1] See Table 6.11 to Table 6.13. Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).

Table 6.10: CliniMACS Materials required for depletion of CD3-positive cells

Additional materials required

- **Cell Preparation Bag:**
  One 600 mL transfer bag, suitable for centrifugation, as well as one sampling site coupler and two plasma transfer sets, for use during the cell preparation procedure
- **Plasma Waste Bag and Wash Waste Bag:**
  Two 600 mL transfer bags, suitable for centrifugation
- **Cell Collection Bag:**
  One to two 600 mL transfer bags in combination with a Luer/Spike Interconnector to connect the Cell Collection Bag to the tubing set.
  If two Cell Collection Bags are required for the separation, use a plasma transfer set to connect both bags.
  One 600 mL transfer bag is already attached to the CliniMACS Depletion Tubing Set (see Table 6.12 and Table 6.13).
- **If the replacement of the Negative Fraction Bag, the Buffer Waste Bag, and/or the Priming Waste Bag is necessary:**
  Two to three 1,000 mL transfer bags in combination with two Luer/Spike Interconnectors to connect the bags to the tubing set (see Table 6.12 and Table 6.13).
  Replace the Priming Waste Bag using the sterile tubing connector.
- **If more than one liter buffer is required for the separation:**
  One to two plasma transfer sets to connect the buffer bags (see Table 6.12 and Table 6.13)
- **One pre-system filter**
- **Locking forceps**
- **Appropriate syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Clinical grade immunoglobulin G**
- **Sample tubes for quality control**

IMPORTANT:
After input of cell product parameters (Step 2), the CliniMACS Plus Software calculates the volumes that will be collected in the Reapplication Bag, Cell Collection Bag, Non-Target Cell Bag, and Buffer Waste Bag. If the volume of the calculated liquid exceeds the standard volume of 500 mL, replacement of bags is necessary. This will be indicated by the software.

Overview of materials required

Cell preparation		
Total cells (WBC)	≤40×10^9	>40–80×10^9
Labeled cells	≤15×10^9	>15–30×10^9
Number of reagent vials	1	2
CliniMACS PBS/EDTA Buffer	2,000 mL	2,000 mL
Plasma transfer set	2	2
Sample loading volume	150 mL	250–300 mL

Table 6.11: Materials required for the cell preparation of CD3-positive cells

Separation (Depletion 2.1)			
Labeled cells	≤5×10^9	>5–13×10^9	>13–20×10^9
Negative Fraction Bag	–	Replace original bags of the tubing set with 1,000 mL transfer bags	Replace original bags of the tubing set with 1,000 mL transfer bags
Buffer Waste Bag	–		
Priming Waste Bag	–	–	
Cell Collection Bag	600 mL	1–2×600 mL	2×600 mL
CliniMACS PBS/ EDTA Buffer	1,000 mL	2,000 mL	3,000 mL
Luer/Spike Interconnector	1	3	3
Plasma transfer set	–	1–2	3

Table 6.12: Materials required for the depletion of CD3-positive cells (Depletion 2.1)

Separation (Depletion 3.1)		
Labeled cells	≤29×10^9	>29–30×10^9
Non-Target Cell Bag	No bag replacement necessary	
Buffer Waste Bag		
Reapplication Bag		
Cell Collection Bag	–	1×600 mL (additionally)
CliniMACS PBS/EDTA Buffer	1,000 mL	–
Plasma transfer set	–	1

Table 6.13: Materials required for the depletion of CD3-positive cells (Depletion 3.1)

IMPORTANT:

- The materials required for the separation will be determined by the software after entering the cell product parameters (Depletion 2.1 for the CliniMACS Tubing Set LS and Depletion 3.1 for the CliniMACS Depletion Tubing Set). The CliniMACS Plus Software will calculate the required sizes of bags to be connected to the tubing set and the required weight of buffer.
- Before starting a separation program, it is recommended to use the Separation Planner tool to estimate the required materials.

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Analysis of starting cell product**
  Determine the number of all CD3-labeled cells (including unspecific CD3 binding, not only real T cells). Consider this number for application specifications and sample parameter input (see Step 2).
- **Transfer of starting cell product into Cell Preparation Bag**
- **Dilution of starting cell product**
  Add buffer using the following equation:
  Weight of buffer to be added = 600 g – Weight of starting cell product
- **Centrifugation**
  Centrifuge at 200×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
- **Volume adjustment: labeling volume 95 g (±5 g) (normal-scale application) or 190 g (±5 g) (large-scale application)**
  1. Remove supernatant completely taking care not to resuspend the cell pellet.
  2. Resuspend the cell pellet carefully after removal of supernatant.
  3. Adjust the weight of the Cell Preparation Bag (CPB) by adding buffer using the following equation (consider IgG weight):
     Target weight of filled CPB = Labeling volume – IgG weight + Weight of empty CPB
  4. Resuspend the cell pellet.
- **Incubation with clinical grade immunoglobulin**
  1. Add IgG (1.5 mg/mL).
  2. Incubate on orbital rotator (25 rpm) for 5 minutes at RT.
- **Incubation with the CliniMACS CD3 Reagent**
  1. Add 1 or 2 vials of CliniMACS CD3 Reagent (see Table 6.11). Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess reagent**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of two washing steps (instead of only one) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  4. Resuspend the cell pellet.
  5. Adjust Cell Preparation Bag volume to 150 g (normal-scale application) or 250–300 g (large-scale application).

6.4.2 Step 2: Choice of separation program

- **Basic operation**
- **Separation planner tool**
- **Choosing separation program Depletion 2.1** or **Choosing separation program Depletion 3.1** (while using CliniMACS Tubing Set LS or CliniMACS Depletion Tubing Set, respectively)
- **Entering tubing set parameters**
- **Entering starting cell product parameters** (according to analysis of starting cell product [see Step 1])

See section 'Depletion 2.1' or 'Depletion 3.1' in the detailed explanation.

6.4.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Tubing Set and CliniMACS Tubing Set LS**
- **CliniMACS Depletion Tubing Set**

See section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' or 'CliniMACS Depletion Tubing Set' in the detailed explanation.

6.4.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Depletion 2.1' and 'Depletion 3.1' in the detailed explanation.

6.5 Depletion of CD19-positive cells

The CliniMACS Plus CD19 System including the CliniMACS Plus Instrument, the CliniMACS CD19 Reagent, the CliniMACS Tubing Set LS, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* depletion of human CD19-positive cells from heterogeneous hematologic cell populations.

6.5.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

Up to 5×10^9 CD19-positive cells out of up to 40×10^9 total cells (WBC)

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity
CliniMACS Plus Instrument	151-01	1
CliniMACS CD19 Reagent	179-01	1 vial
CliniMACS Tubing Set LS	162-01	1 tubing set
CliniMACS PBS/EDTA Buffer	700-25	2×1,000 mL bags[1]

[1] Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).

Table 6.14: CliniMACS Materials required for depletion of CD19-positive cells

Additional materials required

- **Cell Preparation Bag:**
  One 600 mL transfer bag, suitable for centrifugation, as well as one sampling site coupler and one plasma transfer set, for use during the cell preparation procedure
- **Plasma Waste Bag and Wash Waste Bag:**
  Two 600 mL transfer bags, suitable for centrifugation
- **Cell Collection Bag:**
  One 600 mL transfer bag in combination with a Luer/Spike Interconnector to connect the Cell Collection Bag to the tubing set
- **One pre-system filter**
- **Locking forceps**
- **Appropriate syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Sample tubes for quality control**

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Analysis of starting cell product**
- **Transfer of starting cell product into Cell Preparation Bag**

- **Dilution of starting cell product**
  Add buffer using the following equation:
  Weight of buffer to be added = 600 g – Weight of starting cell product
- **Centrifugation**
  Centrifuge at 200×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
- **Volume adjustment: labeling volume 95 g (±5 g)**
  1. Remove supernatant completely taking care not to resuspend the cell pellet.
  2. Resuspend the cell pellet carefully after removal of supernatant.
  3. Adjust the weight of the Cell Preparation Bag (CPB) by adding buffer using the following equation:
     Target weight of filled CPB = 95 g + Weight of empty CPB
  4. Resuspend the cell pellet.
- **Incubation with the CliniMACS CD19 Reagent**
  1. Add 1 vial of CliniMACS CD19 Reagent. Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess reagent**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of two washing steps (instead of only one) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  4. Resuspend the cell pellet.
  5. Adjust Cell Preparation Bag volume to 100 g.

6.5.2 Step 2: Choice of separation program

- **Basic operation**
- **Separation planner tool**
- **Choosing separation program Depletion 2.1**
- **Entering tubing set parameters**
- **Entering starting cell product parameters**

See section 'Depletion 2.1' in the detailed explanation.

6.5.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Tubing Set and CliniMACS Tubing Set LS**

See section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' in the detailed explanation.

6.5.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Depletion 2.1' in the detailed explanation.

6.6 Depletion of CD3-positive cells and CD19-positive cells

The CliniMACS Plus CD3/CD19 System including the CliniMACS Plus Instrument, the CliniMACS CD3 Reagent, the CliniMACS CD19 Reagent, CliniMACS Depletion Tubing Set, and the CliniMACS PBS/EDTA Buffer is intended for the simultaneous *in vitro* depletion of human CD3-positive cells and human CD19-positive cells from heterogeneous hematologic cell populations.

6.6.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

Up to 15×10^9 CD3-positive cells and up to 5×10^9 CD19-positive cells out of up to 40×10^9 total cells (WBC)

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity
CliniMACS Plus Instrument	151-01	1
CliniMACS CD3 Reagent	273-01	1 vial
CliniMACS CD19 Reagent	179-01	1 vial
CliniMACS Depletion Tubing Set	261-01	1 tubing set
CliniMACS PBS/EDTA Buffer	700-25	3×1,000 mL bags[1]
[1] Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).		

Table 6.15: CliniMACS Materials required for depletion of CD3-positive cells and CD19-positive cells

Additional materials required

- **Cell Preparation Bag:**
  One 600 mL transfer bag, suitable for centrifugation, as well as one sampling site coupler and two plasma transfer sets, for use during the cell preparation procedure

- **Plasma Waste Bag and Wash Waste Bag:**
  Two 600 mL transfer bags, suitable for centrifugation
- **Cell Collection Bag:**
  One to two 600 mL transfer bags in combination with a Luer/Spike Interconnector to connect the Cell Collection Bag to the tubing set
- **One pre-system filter**
- **Locking forceps**
- **Appropriate syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Clinical grade immunoglobulin G**
- **Sample tubes for quality control**

IMPORTANT:
After input of cell product parameters (Step 2), the CliniMACS Plus Software calculates the volumes that will be collected in the Reapplication Bag, Cell Collection Bag, Non-Target Cell Bag, and Buffer Waste Bag. If the volume of the calculated liquid exceeds the standard volume of 500 mL, replacement of bags required is necessary. This will be indicated by the software.

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Analysis of starting cell product**
  Determine the number of all CD3 and CD19 labeled cells (including unspecific CD3 and CD19 bindings, not only real T and B cells). Consider this number for application specifications and sample parameter input (see Step 2).
- **Transfer of starting cell product into Cell Preparation Bag**
- **Dilution of starting cell product**
  Add buffer using the following equation:
  Weight of buffer to be added = 600 g – Weight of starting cell product
- **Centrifugation**
  Centrifuge at 200×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).

- **Volume adjustment: labeling volume 87.5 g (±5 g)**
  1. Remove supernatant completely taking care not to resuspend the cell pellet.
  2. Resuspend the cell pellet carefully after removal of supernatant.
  3. Adjust the weight of the Cell Preparation Bag (CPB) by adding buffer using the following equation (consider IgG weight):
     Target weight of filled CPB = 87.5 g – IgG weight + Weight of empty CPB
  4. Resuspend the cell pellet.
- **Incubation with clinical grade immunoglobulin**
  1. Add IgG (1.5 mg/mL).
  2. Incubate on orbital rotator (25 rpm) for 5 minutes at RT.
- **Incubation with the CliniMACS CD3 Reagent and the CliniMACS CD19 Reagent**
  1. Add 1 vial of CliniMACS CD3 Reagent and 1 vial of CliniMACS CD19 Reagent. Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess reagent**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of two washing steps (instead of only one) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  4. Resuspend the cell pellet.
  5. Adjust Cell Preparation Bag volume to 150 g.

6.6.2 Step 2: Choice of separation program

- **Basic operation**
- **Separation planner tool**
- **Choosing separation program Depletion 3.1**
- **Entering tubing set parameters**
- **Entering starting cell product parameters**
  (according to analysis of starting cell product [see Step 1])

See section 'Depletion 3.1' in the detailed explanation.

6.6.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Depletion Tubing Set**

See section 'CliniMACS Depletion Tubing Set' in the detailed explanation.

6.6.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Depletion 3.1' in the detailed explanation.

6.7 Enrichment/depletion of CD8-positive cells

The CliniMACS Plus CD8 System including the CliniMACS Plus Instrument, the CliniMACS CD8 Reagent, the CliniMACS Tubing Set or the CliniMACS Tubing Set LS, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* enrichment or depletion of human CD8-positive cells from heterogeneous hematologic cell populations.

6.7.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

- **Enrichment:** up to 4×10^9 labeled cells out of up to 40×10^9 total cells (WBC) using the CliniMACS Tubing Set
- **Depletion:** up to 4×10^9 labeled cells out of up to 40×10^9 total cells (WBC) using the CliniMACS Tubing Set LS

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity	Separation program
CliniMACS Plus Instrument	151-01	1	–
CliniMACS CD8 Reagent	275-01	1 vial	–
CliniMACS Tubing Set	161-01	1 tubing set	Enrichment 1.1
CliniMACS Tubing Set LS	162-01	1 tubing set	Depletion 2.1
CliniMACS PBS/EDTA Buffer	700-25	Up to 3×1,000 mL bags[1]	–

[1] See Table 6.17 to Table 6.19. Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).

Table 6.16: CliniMACS Materials required for enrichment/depletion of CD8-positive cells

Additional materials required

- **Cell Preparation Bag:**
  One 600 mL transfer bag, suitable for centrifugation, as well as one sampling site coupler and one plasma transfer set, for use during the cell preparation procedure
- **Plasma Waste Bag and Wash Waste Bag:**
  Two 600 mL transfer bags, suitable for centrifugation
- **Cell Collection Bag:**
  One 600 mL transfer bag in combination with a Luer/Spike Interconnector to connect the Cell Collection Bag to the tubing set (see Table 6.18 and Table 6.19)

- **If the replacement of the Negative Fraction Bag and the Buffer Waste Bag is necessary:**
  Two 1,000 mL transfer bags in combination with two Luer/Spike Interconnectors to connect the bags to the tubing set (see Table 6.18 and Table 6.19)
- **If more than one liter of buffer is required for the separation:**
  One plasma transfer set to connect the buffer bags (see Table 6.18 and Table 6.19)
- **One pre-system filter**
- **Locking forceps**
- **Appropriate syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Sample tubes for quality control**

IMPORTANT:
After input of cell product parameters (Step 2), the CliniMACS Plus Software calculates the volumes that will be collected in the Priming Waste Bag, Cell Collection Bag, Negative Fraction Bag, and Buffer Waste Bag. If the volume of the calculated liquid exceeds the standard volume of 500 mL, replacement of bags is necessary. This will be indicated by the software.

Overview of materials required

Cell preparation	
Total cells	$\leq 40\times10^9$
Labeled cells	$\leq 4\times10^9$
Number of reagent vials	1
CliniMACS PBS/EDTA Buffer	1,000 mL
Plasma transfer set	1
Sample loading volume	100 mL

Table 6.17: Materials required for the cell preparation of CD8-positive cells

Separation (Enrichment 1.1)		
Labeled cells	$<2\times10^9$	$2–4\times10^9$
Negative Fraction Bag	–	Replace original bags of the tubing set with 1,000 mL transfer bags
Buffer Waste Bag	–	
Priming Waste Bag	–	–
Cell Collection Bag	600 mL	600 mL
CliniMACS PBS/EDTA Buffer	1,000 mL	2,000 mL
Luer/Spike Interconnector	1	3
Plasma transfer set	–	1

Table 6.18: Materials required for the enrichment of CD8-positive cells

Separation (Depletion 2.1)	
Labeled cells	≤4×10^9
Negative Fraction Bag	No bag replacement necessary
Buffer Waste Bag	
Priming Waste Bag	
Cell Collection Bag	600 mL
CliniMACS PBS/EDTA Buffer	1,000 mL
Luer/Spike Interconnector	1

Table 6.19: Materials required for the depletion of CD8-positive cells

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Analysis of starting cell product**
- **Transfer of starting cell product into Cell Preparation Bag**
- **Dilution of starting cell product**
  Add buffer using the following equation:
  Weight of buffer to be added = Weight of starting cell product × 2
- **Centrifugation**
  Centrifuge at 300×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
- **Volume adjustment: labeling volume 95 g (±5 g)**
  1. Remove supernatant completely taking care not to resuspend the cell pellet.
  2. Resuspend the cell pellet carefully after removal of supernatant.
  3. Adjust the weight of the Cell Preparation Bag (CPB) by adding buffer. Calculate the target weight of the CPB filled with diluted cell product using the following equation:
     Target weight of filled CPB = 95 g – Weight of empty CPB
  4. Resuspend the cell pellet.
- **Incubation with the CliniMACS CD8 Reagent**
  1. Add 1 vial of CliniMACS CD8 Reagent. Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess reagent**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of two washing steps (instead of only one) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  4. Resuspend the cell pellet.
  5. Adjust Cell Preparation Bag volume to 100 g.

6.7.2 Step 2: Choice of separation program

- **Basic operation**
- **Separation planner tool**
- **Choosing separation program Enrichment 1.1** or **Choosing separation program Depletion 2.1**
- **Entering tubing set parameters**
- **Entering starting cell product parameters**

See section 'Enrichment 1.1' or 'Depletion 2.1' in the detailed explanation.

6.7.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Tubing Set and CliniMACS Tubing Set LS**

See section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' in the detailed explanation.

6.7.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Enrichment 1.1' and 'Depletion 2.1'in the detailed explanation.

6.8 Enrichment/depletion of CD25-positive cells

The CliniMACS Plus CD25 System including the CliniMACS Plus Instrument, the CliniMACS CD25 Reagent, the CliniMACS Tubing Set or the CliniMACS Tubing Set LS, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* enrichment or depletion of human CD25-positive cells – preferably CD25-high cells – from heterogeneous hematologic cell populations.

6.8.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

- **Enrichment:** CD25-positive or CD25-high cells: up to 0.6×10^9 labeled cells out of up to 40×10^9 total cells (WBC) using the CliniMACS Tubing Set
- **Depletion:**
  Normal-scale application: up to 6×10^9 CD25-positive cells out of up to 40×10^9 total cells (WBC) using the CliniMACS Tubing Set LS
  Large-scale application: greater than 6×10^9 and up to 12×10^9 CD25-positive cells out of greater than 40×10^9 and up to 80×10^9 total cells (WBC) using the CliniMACS Tubing Set LS

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity	Separation program
CliniMACS Plus Instrument	151-01	1	–
CliniMACS CD25 Reagent	274-01	• 1 vial (normal-scale) • 2 vials (large-scale)	–
CliniMACS Tubing Set	161-01	1 tubing set	Enrichment 3.2
CliniMACS Tubing Set LS	162-01	1 tubing set	Depletion 2.1
CliniMACS PBS/EDTA Buffer	700-25	Up to 4×1,000 mL bags[1]	–

[1] See Table 6.21 to Table 6.24. Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).

Table 6.20: CliniMACS Materials required for enrichment/depletion of CD25-positive cells

Additional materials required

- **Cell Preparation Bag:**
  One 600 mL transfer bag, suitable for centrifugation, as well as one sampling site coupler and one to two plasma transfer sets, for use during the cell preparation procedure
- **Plasma Waste Bag and Wash Waste Bag:**
  Two 600 mL (or two 1,000 mL) transfer bags, suitable for centrifugation
- **Cell Collection Bag**
  One 150 mL or one to two 600 mL transfer bags in combination with a Luer/Spike Interconnector to connect the Cell Collection Bag to the tubing set.
  If two Cell Collection Bags are required for the separation, use a plasma transfer set to connect both bags (see Table 6.22 and Table 6.24).
- **If the replacement of the Negative Fraction Bag and the Buffer Waste Bag is necessary:**
  Two 1,000 mL transfer bags in combination with two Luer/Spike Interconnectors to connect the bags to the tubing set (see Table 6.22 and Table 6.24)
- **If more than one liter of buffer is required for the separation:**
  One plasma transfer set to connect the buffer bags (see Table 6.22 and Table 6.24)
- **One pre-system filter**
- **Locking forceps**
- **Appropriate syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Sample tubes for quality control**

IMPORTANT:
After input of cell product parameters (Step 2), the CliniMACS Plus Software calculates the volumes that will be collected in the Priming Waste Bag, Cell Collection Bag, Negative Fraction Bag, and Buffer Waste Bag. If the volume of the calculated liquid exceeds the standard volume of 500 mL, replacement of bags is necessary. This will be indicated by the software.

Overview of materials required

Cell preparation (Enrichment 3.2)		
Application	**Enrichment of CD25-positive cells**	**Enrichment of CD25-high cells**
Total cells (WBC)	≤40×10^9	≤40×10^9
Labeled cells	≤0.6×10^9	≤0.6×10^9
Number of reagent vials	1	1
CliniMACS PBS/EDTA Buffer	1,000–2,000 mL	2,000 mL
Plasma transfer set	1–2	2
Labeling volume	190 mL	380 mL
Labeling temperature	Room temperature	+4 °C to +8 °C (+39 °F to +46 °F)

Table 6.21: Materials required for the cell preparation of CD25-positive/highly expressing cells (Enrichment 3.2)

Separation (Enrichment 3.2)		
Application	**Enrichment of CD25-positive cells**	**Enrichment of CD25-high cells**
CliniMACS PBS/EDTA Buffer	1,000 mL	1,000 mL
Negative Fraction Bag	No bag replacement necessary	
Buffer Waste Bag		
Priming Waste Bag		
Cell Collection Bag	150 mL	150 mL
Luer/Spike Interconnector	1	1

Table 6.22: Materials required for enrichment CD25-positive/highly expressing cells (Enrichment 3.2)

Cell preparation (Depletion 2.1)		
Total cells (WBC)	≤40×10^9	>40–80×10^9
Labeled cells	≤6×10^9	>6–12×10^9
Number of reagent vials	1	2
CliniMACS PBS/EDTA Buffer	1,000–2,000 mL	1,000–2,000 mL
Plasma transfer set	1–2	1–2
Labeling volume	95 mL	190 mL
Labeling temperature	Room temperature	Room temperature

Table 6.23: Materials required for the cell preparation of CD25-positive cells (Depletion 2.1)

Separation (Depletion 2.1)		
Total cells (WBC)	≤40×10^9	>40–80×10^9
CliniMACS PBS/EDTA Buffer	1,000 mL for <5×10^9 labeled cells	2,000 mL for 5–12×10^9 labeled cells
Negative Fraction Bag	–	Replace original bags of the tubing set with 1,000 mL transfer bags
Buffer Waste Bag	–	
Priming Waste Bag	–	–
Cell Collection Bag	600 mL	2×600 mL
Luer/Spike Interconnector	1	3
Plasma transfer set	–	2

Table 6.24: Materials required for the depletion of CD25-positive cells (Depletion 2.1)

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

IMPORTANT:

- Store the buffer for cell preparation for the enrichment or depletion of CD25-positive cells at +19 °C to +25 °C (+66 °F to +77 °F).
- Magnetic labeling during the cell preparation for the enrichment of CD25-high cells has to be performed using cold buffer (+4 °C to +8 °C [+39 °F to+46 °F]). Lower or higher temperature may result in less purity and yield of the target cells.

- **Analysis of starting cell product**
- **Transfer of starting cell product into Cell Preparation Bag**
- **Dilution of starting cell product**
  Add buffer using the following equation:
  Weight of buffer to be added = Weight of starting cell product × 2
- **Centrifugation**
  Centrifuge at 300×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).

- **Volume adjustment: labeling volume for**
  enrichment of CD25-positive cells: 190 g (±5 g)
  enrichment of CD25-high cells: 380 g (±5 g)
  depletion of CD25-positive cells (normal-scale application): 95 g
  depletion of CD25-positive cells (large-scale application): 190 g

  IMPORTANT:
  The magnetic labeling for the enrichment of CD25-high cells has to be performed using cold buffer (+4 °C to +8 °C [+39 °F to +46 °F]).

  1. Remove supernatant completely taking care not to resuspend the cell pellet.
  2. Resuspend the cell pellet carefully after removal of supernatant.
  3. Adjust the weight of the Cell Preparation Bag (CPB) by adding buffer using the following equation:
     Target weight of filled CPB = labeling volume + Weight of empty CPB
  4. Resuspend the cell pellet.

- **Incubation with the CliniMACS CD25 Reagent**
  1. Add 1 or 2 vials of CliniMACS CD25 Reagent (see Table 6.21 and Table 6.23). Mix contents gently.
  2. Incubate on orbital rotator (25 rpm):
     1. enrichment or depletion of CD25-positive cells: 30 minutes at RT
     2. enrichment of CD25-high cells: 15 minutes at +4 °C to +8 °C (+39 °F to +46 °F)

- **Removal of excess reagent**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of two washing steps (instead of only one) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  4. Resuspend the cell pellet.
  5. Adjust Cell Preparation Bag volume to 100 g (normal-scale application) or 200 g (large-scale application).

6.8.2 Step 2: Choice of separation program

- **Basic operation**
- **Separation planner tool**
  (not for Enrichment 3.2)
- **Choosing of separation program Enrichment 3.2** or **Choosing separation program Depletion 2.1**
- **Entering tubing set parameters**
- **Entering starting cell product parameters**
  (not for Enrichment 3.2)

See section 'Enrichment 3.2' or 'Depletion 2.1' in the detailed explanation.

6.8.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Tubing Set and CliniMACS Tubing Set LS**

See section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' in the detailed explanation.

6.8.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Enrichment 3.2' or 'Depletion 2.1' in the detailed explanation.

6.9 Enrichment/depletion of CD4-positive cells

The CliniMACS Plus CD4 System including the CliniMACS Plus Instrument, the CliniMACS CD4 Reagent, the CliniMACS Tubing Set or the CliniMACS Tubing Set LS, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* enrichment or depletion of human CD4-positive cells from heterogeneous hematologic cell populations.

6.9.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

- **Enrichment:** up to 5×10^9 labeled cells out of up to 40×10^9 total cells (WBC) using the CliniMACS Tubing Set
- **Depletion:** up to 12×10^9 labeled cells out of up to 40×10^9 total cells (WBC) using the CliniMACS Tubing Set LS

IMPORTANT:
If the number of calculated cells exceeds the application capacity, split the cell product and continue with each cell product separately, using a new tubing set for every CliniMACS Plus Instrument run.

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Materials	Catalog number	Quantity	Separation program
CliniMACS Plus Instrument	151-01	1	–
CliniMACS CD4 Reagent	276-01	1 vial	–
CliniMACS Tubing Set	161-01	1 tubing set	Enrichment 1.1
CliniMACS Tubing Set LS	162-01	1 tubing set	Depletion 2.1
CliniMACS PBS/EDTA Buffer	700-25	Up to 4×1,000 mL bags[1]	–

[1] See Table 6.26 to Table 6.29. Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).

Table 6.25: CliniMACS Materials required for enrichment/depletion of CD4-positive cells

Additional materials required

- **Cell Preparation Bag:**
  One 600 mL transfer bag, suitable for centrifugation, as well as one sampling site coupler and one plasma transfer set, for use during the cell preparation procedure
- **Plasma Waste Bag and Wash Waste Bag:**
  Two 600 mL (or two 1,000 mL) transfer bags, suitable for centrifugation
- **Cell Collection Bag**
  One 150 mL or one to two 600 mL transfer bags in combination with a Luer/Spike Interconnector to connect the Cell Collection Bag to the tubing set.
  If two Cell Collection Bags are required for the separation, use a plasma transfer set to connect both bags (see Table 6.27 and Table 6.29).
- **If the replacement of the Negative Fraction Bag, the Buffer Waste Bag is necessary:**
  Up to three 1,000 mL transfer bags in combination with two Luer/Spike Interconnectors to connect the bags to the tubing set (see Table 6.27 and Table 6.29).
  Replace the Priming Waste Bag using the sterile tubing connector.
- **If more than one liter of buffer is required for the separation:**
  One to two plasma transfer sets to connect the buffer bags (see Table 6.27 and Table 6.29)
- **One pre-system filter**
- **Locking forceps**
- **Syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Sample tubes for quality control**

IMPORTANT:
After input of cell product parameters (Step 2), the CliniMACS Plus Software calculates the volumes that will be collected in the Priming Waste Bag, Cell Collection Bag, Negative Fraction Bag, and Buffer Waste Bag. If the volume of the calculated liquid exceeds the standard volume of 500 mL, replacement of bags is necessary. This will be indicated by the software.

Overview of materials required

Cell preparation (Enrichment 1.1)	
Total cells (WBC)	≤40×10^9
Labeled cells	≤5×10^9
Number of reagent vials	1
CliniMACS PBS/EDTA Buffer	1,000 mL
Plasma transfer set	1

Table 6.26: Materials required for cell preparation of CD4-positive cells (Enrichment 1.1)

Separation (Enrichment 1.1)		
Labeled cells	≤2×10^9	>2–5×10^9
CliniMACS PBS/EDTA Buffer	1,000 mL	2,000 mL
Negative Fraction Bag	–	Replace original bags of the tubing set with 1,000 mL transfer bags
Buffer Waste Bag	–	
Priming Waste Bag	–	–
Cell Collection Bag	150 mL	600 mL
Luer/Spike Interconnector	1	3
Plasma transfer set	–	1

Table 6.27: Materials required for the enrichment of CD4-positive cells (Enrichment 1.1)

Cell preparation (Depletion 2.1)	
Total cells (WBC)	≤40×10^9
Labeled cells	≤12×10^9
Number of reagent vials	1
CliniMACS PBS/EDTA Buffer	1,000 mL
Plasma transfer set	1

Table 6.28: Materials required for cell preparation of CD4-positive cells (Depletion 2.1)

Separation (Depletion 2.1)		
Labeled cells	<5×10^9	5–12×10^9
CliniMACS PBS/EDTA Buffer	1,000 mL	2,000 mL
Negative Fraction Bag	–	Replace original bags of the tubing set with 1,000 mL transfer bags
Buffer Waste Bag	–	
Priming Waste Bag	–	–
Cell Collection Bag	1×600 mL	1–2×600 mL
Luer/Spike Interconnector	1	3
Plasma transfer set	–	1–2

Table 6.29: Materials required for depletion of CD4-positive cells (Depletion 2.1)

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Analysis of starting cell product**
- **Transfer of starting cell product into Cell Preparation Bag**
- **Dilution of starting cell product** Add buffer using the following equation:
  Weight of buffer to be added = Weight of starting cell product × 2
- **Centrifugation**
  Centrifuge at 300×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
- **Volume adjustment: labeling volume 95 g (±5 g)**
  1. Remove supernatant to adjust the sample using the following equation: Weight of supernatant to be removed = Weight of diluted cell product – 95 g
  2. Resuspend the cell pellet.
- **Incubation with the CliniMACS CD4 Reagent**
  1. Add 1 vial of CliniMACS CD4 Reagent. Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess reagent**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of two washing steps (instead of only one) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  4. Resuspend the cell pellet.
  5. Adjust Cell Preparation Bag volume to 100 g.

6.9.2 Step 2: Choice of separation program

- **Basic operation**
- **Separation planner tool**
- **Choosing separation program Enrichment 1.1** or **Choosing separation program Depletion 2.1**
- **Entering tubing set parameters**
- **Entering starting cell product parameters**

See section 'Enrichment 1.1' or 'Depletion 2.1' in the detailed explanation.

6.9.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Tubing Set and CliniMACS Tubing Set LS**

See section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' in the detailed explanation.

6.9.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Enrichment 1.1' and 'Depletion 2.1'in the detailed explanation.

6.10 Depletion of CD4-positive cells and CD8-positive cells

The CliniMACS Plus CD4/CD8 System including the CliniMACS Plus Instrument, the CliniMACS CD4 Reagent, the CliniMACS CD8 Reagent, the CliniMACS Tubing Set LS, and the CliniMACS PBS/EDTA Buffer is intended for the simultaneous *in vitro* depletion of human CD4-positive and CD8-positive cells from heterogeneous hematologic cell populations.

6.10.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

Up to 12×10^9 CD4-positive cells and up to 4×10^9 CD8-positive cells out of up to 40×10^9 total cells (WBC)

IMPORTANT:
If the number of calculated cells exceeds the application capacity, split the cell product and continue with each cell product separately, using a new tubing set for every CliniMACS Plus Instrument run.

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity
CliniMACS Plus Instrument	151-01	1
CliniMACS CD4 Reagent	276-01	1 vial
CliniMACS CD8 Reagent	275-01	1 vial
CliniMACS Tubing Set LS	162-01	1 tubing set
CliniMACS PBS/EDTA Buffer	700-25	Up to 4×1,000 mL bags[1]

[1] See Table 6.31 and Table 6.32. Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).

Table 6.30: CliniMACS Materials required for depletion of CD4-positive cells and CD8-positive cells

Additional materials required

- **Cell Preparation Bag:**
  One 600 mL transfer bag, suitable for centrifugation, as well as one sampling site coupler and one plasma transfer set, for use during the cell preparation procedure
- **Plasma Waste Bag and Wash Waste Bag:**
  Two 600 mL (or two 1,000 mL) transfer bags, suitable for centrifugation
- **Cell Collection Bag:**
  One to two 600 mL transfer bags in combination with a Luer/Spike Interconnector to connect the Cell Collection Bag to the tubing set.
  If two Cell Collection Bags are required for the separation, use a plasma transfer set to connect both bags (see Table 6.32).
- **If the replacement of the Negative Fraction Bag, the Buffer Waste Bag, and/or the Priming Waste Bag is necessary:**
  Up to three 1,000 mL transfer bags in combination with two Luer/Spike Interconnectors to connect the bags to the tubing set (see Table 6.32).
  Replace the Priming Waste Bag using the sterile tubing connector.
- **If more than one liter of buffer is required for the separation:**
  One to two plasma transfer sets to connect the buffer bags (see Table 6.32)
- **One pre-system filter**
- **Locking forceps**
- **Syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Sample tubes for quality control**

IMPORTANT:
After input of cell product parameters (Step 2), the CliniMACS Plus Software calculates the volumes that will be collected in the Priming Waste Bag, Cell Collection Bag, Negative Fraction Bag, and Buffer Waste Bag. If the volume of the calculated liquid exceeds the standard volume of 500 mL, replacement of bags is necessary. This will be indicated by the software.

Overview of materials required

Cell preparation	
Total cells (WBC)	$\leq 40\times10^9$
Labeled cells	$\leq 12\times10^9$ CD4-positive cells and $\leq 4\times10^9$ CD8-positive cells
Number of reagent vials	1 vial CliniMACS CD4 Reagent and 1 vial CliniMACS CD8 Reagent
CliniMACS PBS/EDTA Buffer	1,000 mL
Plasma transfer set	1

Table 6.31: Materials required for cell preparation of CD4-positive and CD8-positive cells

Separation			
Labeled cells	$<5\times10^9$	$5–13\times10^9$	$>13–16\times10^9$
CliniMACS PBS/ EDTA Buffer	1,000 mL	2,000 mL	3,000 mL
Negative Fraction Bag	–	Replace original bags of the tubing set with 1,000 mL transfer bags	Replace original bags of the tubing set with 1,000 mL transfer bags
Buffer Waste Bag	–		
Priming Waste Bag	–	–	
Cell Collection Bag	1× 600 mL	1–2× 600 mL	2× 600 mL
Luer/Spike Interconnector	1	3	3
Plasma transfer set	–	1–2	3

Table 6.32: Materials required for depletion of CD4-positive and CD8-positive cells

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Analysis of starting cell product**
- **Transfer of starting cell product into Cell Preparation Bag**
- **Dilution of starting cell product**
  Add buffer using the following equation:
  Weight of buffer to be added = Weight of starting cell product × 2
- **Centrifugation**
  Centrifuge at 300×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F])
- **Volume adjustment: labeling volume 88 g (±5 g)**
  1. Remove supernatant to adjust the sample using the following equation: Weight of supernatant to be removed = Weight of diluted cell product – Labeling volume
  2. Resuspend the cell pellet.
- **Incubation with the CliniMACS CD4 Reagent and the CliniMACS CD8 Reagent**
  1. Add 1 vial of CliniMACS CD4 Reagent and 1 vial of CliniMACS CD8 Reagent. Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess reagent**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of two washing steps (instead of only one) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  4. Adjust Cell Preparation Bag volume to 100 g.

6.10.2 Step 2: Choice of separation program

- **Basic operation**
- **Separation planner tool**
- **Choosing separation program Depletion 2.1**
- **Entering tubing set parameters**
- **Entering starting cell product parameters**

See section 'Depletion 2.1' in the detailed explanation.

6.10.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Tubing Set and CliniMACS Tubing Set LS**

See section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' in the detailed explanation.

6.10.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Depletion 2.1' in the detailed explanation.

6.11 Enrichment of CD1c (BDCA-1)-positive cells – Part 1: Depletion of CD19-positive cells and labeling of CD1c (BDCA-1)-positive cells

The CliniMACS Plus CD1c (BDCA-1)-Biotin System including the CliniMACS Plus Instrument, the CliniMACS CD1c (BDCA-1)-Biotin, the CliniMACS CD19 Reagent, the CliniMACS Anti-Biotin Reagent, the CliniMACS Tubing Set LS, the CliniMACS Tubing Set, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* enrichment of human CD1c (BDCA-1)-positive cells from heterogeneous hematologic cell populations after depletion of CD19-positive cells.

6.11.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

Depletion of up to 5×10^9 CD19-positive cells and labeling of up to 0.2×10^9 CD1c (BDCA-1)-positive cells out of up to 40×10^9 total cells (WBC)

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity
CliniMACS Plus Instrument	151-01	1
CliniMACS CD1c (BDCA-1)-Biotin	277-01	1 vial
CliniMACS CD19 Reagent	179-01	1 vial
CliniMACS Tubing Set LS	162-01	1 tubing set
CliniMACS PBS/EDTA Buffer	700-25	2×1,000 mL bags[1]
[1] Before use, supplement buffer with HSA to a final concentration of 0.5% (w/v).		

Table 6.33: CliniMACS Materials required for depletion of CD1c (BDCA-1)-positive cells (Part 1)

Additional materials required (for Part 1 and Part 2)

- **Cell Preparation Bag:**
  Two 600 mL transfer bags suitable for centrifugation as well as two sampling site couplers and three plasma transfer sets, for use during the cell preparation procedures
- **Plasma Waste Bags and Wash Waste Bags:**
  Five 600 mL transfer bags suitable for centrifugation
- **Cell Collection Bag (Part 1):**
  One 600 mL transfer bag suitable for centrifugation in combination with a Luer/Spike Interconnector to connect the Cell Collection Bag to the tubing set
- **Cell Collection Bag (Part 2):**
  One 150 mL transfer bag suitable for centrifugation in combination with a Luer/Spike Interconnector to connect the transfer bag to the tubing set
- **Two pre-system filters**
- **Locking forceps**
- **Syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Sample tubes for quality control**

Magnetic labeling of cells (Part 1)

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Analysis of starting cell product**
- **Transfer of starting cell product into Cell Preparation Bag**

- **Dilution of starting cell product**
  Add buffer using the following equation:
  Weight of buffer to be added = Weight of starting cell product × 2
- **Centrifugation**
  Centrifuge at 200×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
- **Volume adjustment: labeling volume 90 g (±5 g)**
  1. Resuspend the cell pellet carefully after removal of supernatant.
  2. Adjust the weight of the Cell Preparation Bag Part 1 (CPB) by adding buffer using the following equation:
     Target weight of filled CPB Part 1 = 90 g + Weight of empty CPB
  3. Resuspend the cell pellet.
- **Incubation with the CliniMACS CD19 Reagent and the CliniMACS CD1c (BDCA-1)-Biotin**
  1. Add 1 vial of CliniMACS CD19 Reagent and 1 vial of CliniMACS CD1c (BDCA-1)-Biotin. Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess reagent**
  1. Fill Cell Preparation Bag Part 1 with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of two washing steps (instead of only one) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  4. Resuspend the cell pellet.
  5. Adjust Cell Preparation Bag volume to 100 g.

6.11.2 Step 2: Choice of separation program

- **Basic operation**
- **Separation planner tool**
- **Choosing separation program Depletion 2.1**
- **Entering tubing set parameters**
- **Entering starting cell product parameters**

See section 'Depletion 2.1' in the detailed explanation.

6.11.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Tubing Set and CliniMACS Tubing Set LS**

See section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' in the detailed explanation.

6.11.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Depletion 2.1' in the detailed explanation.

6.12 Enrichment of CD1c (BDCA-1)-positive cells – Part 2: Flexible Labeling System

The CliniMACS Plus CD1c (BDCA-1)-Biotin System including the CliniMACS Plus Instrument, the CliniMACS CD1c (BDCA-1)-Biotin, the CliniMACS CD19 Reagent, the CliniMACS Anti-Biotin Reagent, the CliniMACS Tubing Set LS, the CliniMACS Tubing Set, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* enrichment of human CD1c (BDCA-1)-positive cells from heterogeneous hematologic cell populations after depletion of CD19-positive cells.

6.12.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

Up to 0.2×10^9 CD1c (BDCA-1)-positive cells out of up to 40×10^9 total cells (WBC)

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity
CliniMACS Plus Instrument	151-01	1
CliniMACS Anti-Biotin Reagent	173-01	1 vial
CliniMACS Tubing Set	161-01	1 tubing set
CliniMACS PBS/EDTA Buffer	700-25	3×1,000 mL bags[1]

[1] Before use, supplement buffer with HSA to a final concentration of 0.5% (w/v).

Table 6.34: CliniMACS Materials required for enrichment of CD1c (BDCA-1)-positive cells (Part 2)

Additional materials required

Refer to part 1 for the additional materials required.

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells (CD19 depleted cell product (Part 2))

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Transfer of CD19 depleted starting cell product into Cell Preparation Bag Part 2**
- **Dilution of CD19 depleted starting cell product**
  Add buffer using the following equation:
  Weight of buffer to be added = 600 g – Weight of CD19 depleted starting cell product
- **Centrifugation**
  Centrifuge at 300×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
- **Volume adjustment: labeling volume 95 g (±5 g)**
  1. Remove supernatant to adjust the sample using the following equation:
     Weight of supernatant to be removed = Weight of diluted cell product – Labeling volume
  2. Resuspend the cell pellet.
- **Incubation with the CliniMACS Anti-Biotin Reagent**
  1. Add 1 vial of CliniMACS Anti-Biotin Reagent. Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess reagent**
  1. Fill Cell Preparation Bag Part 2 with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible.
  4. Resuspend the cell pellet.
  5. Fill Cell Preparation Bag Part 2 with buffer.
  6. Centrifuge (300×g, without brake, 15 minutes, RT).
  7. Remove supernatant as much as possible.
  8. Resuspend the cell pellet.
  9. Adjust Cell Preparation Bag volume to 100 g.

6.12.2 Step 2: Choice of separation program

- **Basic operation**
- **Choosing of separation program Enrichment 3.2**
- **Entering tubing set parameters**

See section 'Enrichment 3.2' in the detailed explanation.

6.12.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Tubing Set and CliniMACS Tubing Set LS**

See section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' in the detailed explanation.

6.12.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Enrichment 3.2' in the detailed explanation.

6.13 Enrichment of CD304 (BDCA-4)-positive cells

The CliniMACS Plus CD304 (BDCA-4) System including the CliniMACS Plus Instrument, the CliniMACS CD304 (BDCA-4) Reagent, the CliniMACS Tubing Set, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* enrichment of human CD304 (BDCA-4)-positive cells from heterogeneous hematologic cell populations.

6.13.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

Up to 0.2×10^9 CD304 (BDCA-4)-positive cells out of up to 40×10^9 total cells (WBC)

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity
CliniMACS Plus Instrument	151-01	1
CliniMACS CD304 (BDCA-4) Reagent	278-01	1 vial
CliniMACS Tubing Set	161-01	1 tubing set
CliniMACS PBS/EDTA Buffer	700-25	4×1,000 mL bags[1]

[1] Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).

Table 6.35: CliniMACS Materials required for enrichment of CD304 (BDCA-4)-positive cells

Additional materials required

- **Cell Preparation Bag:**
  One 600 mL transfer bag suitable for centrifugation as well as one sampling site coupler and three plasma transfer sets, for use during the cell preparation procedures
- **Plasma Waste Bags and Wash Waste Bags:**
  Five 600 mL transfer bags suitable for centrifugation

- **Cell Collection Bag:**
  One 150 mL transfer bag in combination with a Luer/Spike Interconnector to connect the Cell Collection Bag to the tubing set
- **One pre-system filter**
- **Locking forceps**
- **Syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Sample tubes for quality control**

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Analysis of starting cell product**
- **Transfer of starting cell product into Cell Preparation Bag**
- **Dilution of depleted starting cell product**
  Add buffer using the following equation:
  Weight of buffer to be added = 600 g – Weight of starting cell product
- **Centrifugation**
  Centrifuge at 200×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
- **Repeat steps 'Dilution of starting cell product' and 'Centrifugation' twice**
  1. Fill up one transfer bag to 600 g
  2. Centrifuge at 300×g without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
  3. Remove supernatant.
- **Volume adjustment: labeling volume 95 g (±5 g)**
  1. Remove supernatant completely taking care not to resuspend the cell pellet.
  2. Resuspend the cell pellet carefully after removal of supernatant.
  3. Adjust the weight of the Cell Preparation Bag (CPB) by adding buffer using the following equation:
     Target weight of filled CPB = 95 g + Weight of empty CPB.
  4. Resuspend the cell pellet.
- **Incubation with the CliniMACS CD304 (BDCA-4) Reagent**
  1. Add 1 vial of CliniMACS CD304 (BDCA-4) Reagent. Mix contents gently.
  2. Incubate on orbital rotator (25rpm) for 30 minutes at RT.

- **Removal of excess reagent**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible.
  4. Resuspend the cell pellet.
  5. Adjust Cell Preparation Bag volume to 100 g.

6.13.2 Step 2: Choice of separation program

- **Basic operation**
- **Choosing of separation program Enrichment 3.2**
- **Entering tubing set parameters**

See section 'Enrichment 3.2' in the detailed explanation.

6.13.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Tubing Set and CliniMACS Tubing Set LS**

See section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' in the detailed explanation.

6.13.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Enrichment 3.2' in the detailed explanation.

6.14 Depletion of TCRα/β-positive cells

The CliniMACS Plus TCRα/β-Biotin System including the CliniMACS Plus Instrument, the CliniMACS TCRα/β-Biotin, the CliniMACS Anti-Biotin Reagent, the CliniMACS Depletion Tubing Set, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* depletion of human TCRα/β-positive cells from heterogeneous hematologic cell populations.

6.14.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

Up to 24×10^9 TCRα/β-positive cells out of up to 60×10^9 total cells (WBC)

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity
CliniMACS Plus Instrument	151-01	1
CliniMACS TCRα/β-Biotin	701-48	1 vial
CliniMACS Anti-Biotin Reagent	173-01	2 vials
CliniMACS Depletion Tubing Set	261-01	1 tubing set
CliniMACS PBS/EDTA Buffer	700-25	Up to 4×1,000 mL bags[1]
[1] Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).		

Table 6.36: CliniMACS Materials required for depletion of TCRα/β-positive cells

Additional materials required

- **Cell Preparation Bag:**
  One 600 mL transfer bag suitable for centrifugation as well as one sampling site coupler and two plasma transfer sets, for use during the cell preparation procedure
- **Plasma Waste Bags and Wash Waste Bags:**
  Four 600 mL (or 1,000 mL) transfer bags suitable for centrifugation
- **Cell Collection Bag:**
  One 600 mL Cell Collection Bag is already assembled to the CliniMACS Depletion Tubing Set.
- **One pre-system filter**
- **Locking forceps**
- **Syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Sample tubes for quality control**

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Analysis of starting cell product**
  Determine the percentage/total number of all TCRα/β-labeled cells (including unspecific TCRα/β binding, not only real TCRα/β-positive cells). Consider this number for application specifications and cell product parameter input (see Step 2).

- **Transfer of starting cell product into Cell Preparation Bag**
- **Dilution of starting cell product**
  Add buffer using the following equation:
  Weight of buffer to be added = Weight of starting cell product × 2
- **Centrifugation**
  1. Centrifuge at 200×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
  2. Remove supernatant.
- **Volume adjustment: labeling volume 95 g (±5 g)**
  1. Remove supernatant completely taking care not to resuspend the cell pellet.
  2. Resuspend the cell pellet carefully after removal of supernatant.
  3. Adjust the weight of the Cell Preparation Bag (CPB) by adding buffer using the following equation:
     Target weight of filled CPB = 95 g + Weight of empty CPB
  4. Resuspend the cell pellet.
- **Labeling of the cells: incubation with the CliniMACS TCRα/β-Biotin**
  1. Add 1 vial of CliniMACS TCRα/β-Biotin. Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess conjugate: repeat this step**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible.
  4. Resuspend the cell pellet and adjust the weight to 190 g after the second wash.
- **Magnetic labeling of the cells: incubation with the CliniMACS Anti-Biotin Reagent**
  1. Add 2 vials of CliniMACS Anti-Biotin Reagent. Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess reagent**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of two washing steps (instead of only one) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  4. Resuspend the cell pellet.
  5. Adjust Cell Preparation Bag volume to 150 g. A maximum WBC concentration of 0.4×10^9 WBC/mL is recommended.

6.14.2 Step 2: Choice of separation program

- **Basic operation**
- **Separation planner tool**
- **Choosing separation program Depletion 3.1**
- **Entering tubing set parameters**
- **Entering starting cell product parameters**

See section 'Depletion 3.1' in the detailed explanation.

6.14.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Depletion Tubing Set**

See section 'CliniMACS Depletion Tubing Set' in the detailed explanation.

6.14.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Depletion 3.1' in the detailed explanation.

6.15 Depletion of CD45RA-positive cells

The CliniMACS Plus CD45RA System including the CliniMACS Plus Instrument, the CliniMACS CD45RA Reagent, the CliniMACS Depletion Tubing Set, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* depletion of human CD45RA-positive cells from heterogeneous hematologic cell populations.

6.15.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

Up to 20×10^9 CD45RA-positive cells out of up to 50×10^9 total cells (WBC)

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity
CliniMACS Plus Instrument	151-01	1
CliniMACS CD45RA Reagent	701-46	1 vial
CliniMACS Depletion Tubing Set	261-01	1 tubing set
CliniMACS PBS/EDTA Buffer	700-25	3×1,000 mL bags[1]

[1] Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).

Table 6.37: CliniMACS Materials required for depletion of CD45RA-positive cells

Additional materials required

- **Cell Preparation Bag:**
  One 600 mL transfer bag suitable for centrifugation as well as one sampling site coupler and two plasma transfer sets, for use during the cell preparation procedure
- **Plasma Waste Bags and Wash Waste Bags:**
  Two 600 mL transfer bags suitable for centrifugation
- **Cell Collection Bag:**
  One 600 mL Cell Collection Bag is already assembled to the CliniMACS Depletion Tubing Set.
- **One pre-system filter**
- **Locking forceps**
- **Syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Sample tubes for quality control**

IMPORTANT:
An alternative starting cell source can be the non-target cell fraction after a CliniMACS Plus CD34 Separation. The use of the CliniMACS CD45RA Reagent is only recommended for starting cell products containing CD45RA-positive cells within the normal frequency range (up to 80%). Higher frequencies have been observed in a few donors where CD45RA is expressed by almost all PBMC due to a rare mutation within the CD45 gene. In such cases, the depletion efficiency and/or recovery may become inadequate.

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

Magnetic labeling of cells

Refer to section 'Magnetic labeling of cells' (Detailed explanation of Step 1–4) for a detailed description of the following steps.

- **Analysis of starting cell product**
  Determine the percentage/total number of all CD45RA-labeled cells (including unspecific CD45RA binding, not only real CD45RA-positive cells). Consider this number for application specifications and sample parameter input (see Step 2).
- **Transfer of starting cell product into Cell Preparation Bag**
- **Dilution of depleted starting cell product**
  Add buffer using the following equation:
  Weight of buffer to be added = Weight of starting cell product × 2
- **Centrifugation**
  Centrifuge at 200×g, without brake, 15 minutes, room temperature (RT: +19 °C to +25 °C [+66 °F to +77 °F]).
  If the non-target cell fraction of a CliniMACS CD34 Separation is used as alternative starting cell source, the dilution step can be skipped. Continue with the centrifugation step and centrifuge the cells at 300×g (without brake) for 15 minutes at RT.

- **Volume adjustment: labeling volume 95 g (±5 g)**
  1. Remove supernatant completely taking care not to resuspend the cell pellet.
  2. Resuspend the cell pellet carefully after removal of supernatant.
  3. Adjust the weight of the Cell Preparation Bag (CPB) by adding buffer using the following equation: Target weight of filled CPB = 95 g + Weight of empty CPB
  4. Resuspend the cell pellet.
- **Incubation with the CliniMACS CD45RA Reagent**
  1. Add 1 vial of CliniMACS CD45RA Reagent. Mix contents gently.
  2. Incubate on orbital rotator (25 rpm) for 30 minutes at RT.
- **Removal of excess reagent**
  1. Fill Cell Preparation Bag with buffer.
  2. Centrifuge (300×g, without brake, 15 minutes, RT).
  3. Remove supernatant as much as possible. Recommendation: Remove at least 500 g of supernatant. If the supernatant removed is less than 500 g, a total of two washing steps (instead of only one) is recommended. Otherwise, the removal of unbound reagent may be insufficient.
  4. Resuspend the cell pellet.
  5. Adjust Cell Preparation Bag volume. Calculate the weight of buffer necessary to adjust the weight of the cell suspension to approximately 125 g. Cell concentration should not exceed 0.4×10^9 WBC/mL: Weight of buffer to be added (g) = 125 g – Weight of cell product after the wash (g)

6.15.2 Step 2: Choice of separation program

- **Basic operation**
- **Separation planner tool**
- **Choosing separation program Depletion 3.1**
- **Entering tubing set parameters**
- **Entering starting cell product parameters**

See section 'Depletion 3.1' in the detailed explanation.

6.15.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Depletion Tubing Set**

See section 'CliniMACS Depletion Tubing Set' in the detailed explanation.

6.15.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Depletion 3.1' in the detailed explanation.

6.16 Enrichment of human IFN-gamma secreting cells with the CliniMACS Cytokine Capture System (IFN-gamma)

The CliniMACS Plus CCS (IFN-gamma) System including the CliniMACS Plus Instrument, the CliniMACS Cytokine Capture System (IFN-gamma), the CliniMACS Tubing Set, and the CliniMACS PBS/EDTA Buffer is intended for the *in vitro* enrichment of human IFN-gamma secreting cells from heterogeneous hematologic cell populations.

6.16.1 Step 1: Cell preparation and magnetic labeling

First actions required

Refer to section 'First actions required' (Detailed explanation of Step 1–4) for a detailed description of the first actions required.

Application capacity

IFN-gamma-secreting cells out of up to 1×10^9 total cells (WBC)

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

CliniMACS Materials required

Material	Catalog number	Quantity
CliniMACS Plus Instrument	151-01	1
CliniMACS Cytokine Capture System (IFN-gamma)	279-01	1 set
CliniMACS Tubing Set	161-01	1 tubing set
CliniMACS PBS/EDTA Buffer	700-25	3×1,000 mL bags[1]

[1] Before use, supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v).

Table 6.38: CliniMACS Materials required for enrichment of human IFN-gamma secreting cells

IMPORTANT:
Store the buffer for cell preparation cold at +2 °C to +8 °C (+36 °F to +46 °F). Lower or higher ambient temperature may result in less purity and yield of the target cells.

Additional materials required

- **Cell Preparation Bags:**
  Two 600 mL transfer bags suitable for centrifugation as well as two sampling site couplers and two plasma transfer sets, for use during the cell preparation procedures
- **Plasma Waste Bags and Wash Waste Bags:**
  Nine 600 mL transfer bags suitable for centrifugation
- **Medium bag:**
  Eight 600 mL transfer bags suitable for centrifugation

- **Cell Collection Bag (Part 2):**
  One 150 mL transfer bag suitable for centrifugation in combination with a Luer/Spike Interconnector to connect the transfer bag to the tubing set
- **One 100 mL gas-permeable cell culture bag**
- **One pre-system filter**
- **Locking forceps**
- **Syringes (different sizes) and hypodermic 20-gauge needles**
- **Human serum albumin (HSA)** to be added to the CliniMACS PBS/EDTA Buffer to a final concentration of 0.5% (w/v)
- **Sample tubes for quality control**
- **120 mL of AB serum or, alternatively, autologous serum**, as a supplement for the media used
- **1,000 mL of cell culture medium (RPMI 1640)**, +4 °C (+39 °F)
- **1,100 mL of cell culture medium (RPMI 1640)**, +37 °C (+99 °F) supplemented with 10% (v/v) of AB serum or, alternatively, autologous serum
- **500 mL of cell culture medium (RPMI 1640)**, +4 °C (+39 °F) supplemented with 2% (v/v) of AB serum or, alternatively, autologous serum

Equipment required

Find information regarding equipment required for a CliniMACS Plus Separation in section 'Equipment required'.

Additional equipment required for an application using the CliniMACS Plus CCS (IFN-gamma) System:

- 24 well culture dish
- MiniMACS Separation Unit
- MS Columns
- Pre-separation filter (only for MS Columns)
- MACSmix Tube Rotator

Preparation of bags

Determine the weight of the empty Cell Collection Bag and Cell Preparation Bag as described in section 'First actions required' (Detailed explanation of Step 1–4).

IMPORTANT:
Pre-cool the centrifuge to +4 °C (+39 °F). After the secretion phase, a third Cell Preparation Bag is required to recombine the cell suspensions. Therefore, label one of the four 600 mL transfer bags (prepared with 125 mL of medium (RPMI) supplemented with 10% AB serum) as **Cell Preparation Bag No. 3 (Separation)**.

Preparation of starting cell product

The following sections describe the recommended in-bag procedure for the preparation of the starting cell product using the sterile tubing connector.

- The user must be familiar with the operation and use of the sterile tubing connector.
- Before starting the cell labeling and separation procedure, ensure that all needed supplies and equipment are available.

Transfer of starting cell product into Cell Preparation Bag No. 1

1. Record the date and the start time before beginning to prepare the starting cell product.
2. Determine the volume of the original starting cell product by estimating 1 mL of original product as equivalent to 1 g (1 g ≙ 1 mL).
3. Holding the bag containing the starting cell product with both hands, mix the contents thoroughly by using a gentle rotating motion.
4. Using the sterile tubing connector, connect the Cell Preparation Bag No. 1 to the bag containing the starting cell product.
5. Open the locking forceps to transfer the appropriate weight of the starting cell product (containing a maximum of 1×10^9 cells, according to the frequency of leukocytes determined before) into the Cell Preparation Bag No. 1. Visually control (by monitoring the scale) that the appropriate weight has been transferred. Close the locking forceps next to the Cell Preparation Bag.
6. Seal off the tubing and separate the bags, leaving at least 15 cm of tubing on the Cell Preparation Bag No. 1 for further connections (see Figure 6.1). Use the MACS TubeSealer to produce three adjacent seals in the tubing, with a distance of at least 1 cm between each seal. Make sure the seals are thoroughly established. Sever at the center seal. Keep the bag which contained the starting cell product until the separation and final analysis of all cells have been accomplished.

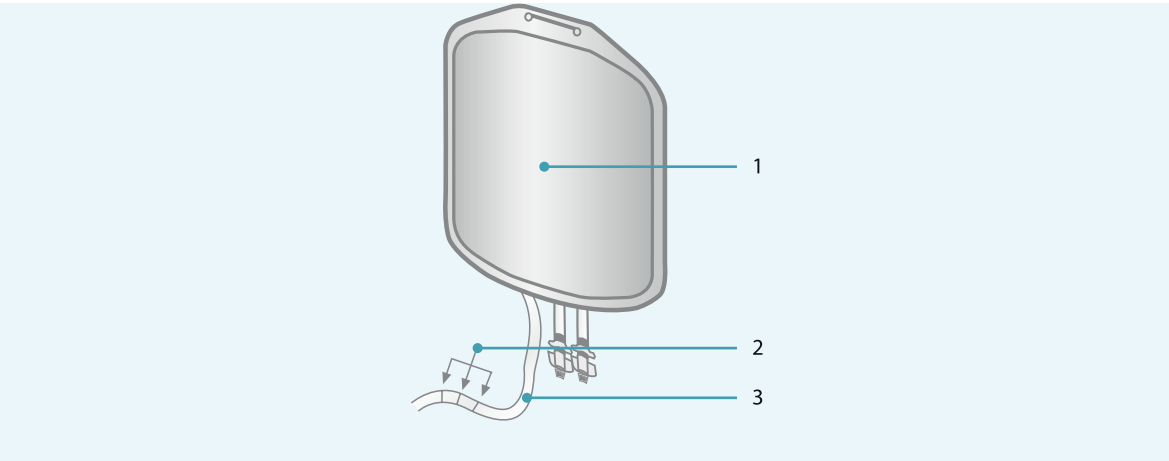


Figure 6.1: Sealing a bag

1 Bag
2 Hermetic seals
3 Tubing

7. Tare the balance. Lay the filled Cell Preparation Bag No. 1 on the balance, let the tubing lie on the table. Record the weight of the filled Cell Preparation Bag No. 1.
8. Determine the weight of the starting cell product by subtracting the weight of the empty Cell Preparation Bag No. 1 from the weight of the Cell Preparation Bag No. 1 filled with the original starting cell product. Record the calculated weight.
   Weight of starting cell product (g) = Weight of filled Cell Preparation Bag No. 1 (g) – Weight of empty Cell Preparation Bag No. 1 (g)

Dilution of starting cell product

The starting cell product must be diluted with culture medium. Dilute the product with cold medium (+2 °C to +8 °C [+36 °F to +46 °F]) to a total volume of 500 mL. Calculate the weight of medium to be added using the following equation and record it.

Weight of medium to be added (g) = 500 g – Weight of diluted starting cell product (g)

1. Take one of the medium bags and connect it to the Cell Preparation Bag No. 1 using the sterile tubing connector.
2. Place the Cell Preparation Bag No. 1 on the balance and tare the balance. Hang the medium bag on a bag hanger.
3. Open the locking forceps next to the Cell Preparation Bag No. 1. By visually monitoring the scale on the balance, transfer the calculated weight of medium to the Cell Preparation Bag No. 1.
4. When the appropriate weight of medium has been transferred, close the locking forceps next to the Cell Preparation Bag No. 1 to stop the liquid flow.
5. Using the MACS TubeSealer, seal off the tubing leaving at least 15 cm of tubing on the Cell Preparation Bag No. 1 for further connections. Disconnect the medium bag.
6. Holding the Cell Preparation Bag No. 1 with both hands, mix the contents thoroughly by using a gentle rotating motion. Avoid intensive mixing of the cells.
7. Tare the balance and weigh the filled Cell Preparation Bag No. 1. Record the weight.
8. Determine the weight of the diluted starting cell product by subtracting the weight of the empty Cell Preparation Bag No. 1 from the weight of the filled Cell Preparation Bag No. 1. Record the calculated weight.
   Weight of diluted starting cell product (g) = Weight of filled Cell Preparation Bag No. 1 (g) – Weight of empty Cell Preparation Bag No. 1 (g)

⚠ WARNING

Risk of contamination.

If the bags are not suitable for cell preparation or not placed correctly into the centrifuge bucket, there is the risk of contamination due to bag damage.

- Use suitable bags, fold any loose parts of the bags or tubing downwards, taking care not to impair bag integrity and place the bags securely in the centrifuge bucket.

⚠ CAUTION

Risk of lower cell separation performance.

If the bags are not placed correctly into the centrifuge bucket, there is the risk of cell loss during supernatant removal.

- Fold any loose parts of the bags or tubing downwards and place the bags securely in the centrifuge bucket.

Centrifugation

1. Using the sterile tubing connector, connect the empty Plasma Waste Bag No. 1 to the Cell Preparation Bag No. 1.
2. Fold any loose parts of the Cell Preparation Bag No. 1 or tubing downwards. Place the two bags securely in the centrifuge bucket.
3. Balance the loaded bucket with a suitable weighed bucket. It is essential that the centrifuge is balanced accurately.
4. Centrifuge the cells at 200×g (without brake) for 10 minutes at room temperature (+19 °C to +25 °C [+66 °F to +77 °F]).
5. Remove the bags from the centrifuge, taking care not to disturb the cell pellet. Load the Cell Preparation Bag No. 1 onto the plasma extractor.
6. Open the locking forceps next to the Cell Preparation Bag No. 1. Remove the supernatant completely, taking care not to resuspend the cell pellet during removal of the supernatant. When the supernatant has been removed, close the locking forceps next to the Cell Preparation Bag No. 1 to stop the liquid flow.
7. Using the MACS TubeSealer, seal off the tubing leaving at least 15 cm of tubing on the Cell Preparation Bag No. 1 for further connections. Disconnect the Plasma Waste Bag No. 1.
8. Repeat dilution and centrifugation using the second medium bag prepared with cold medium and the Plasma Waste Bag No. 2.
9. Keep the Plasma Waste Bags until the separation and final analysis of all cells have been accomplished.

Volume adjustment

1. For *in vitro* restimulation of the cells, the volume of the cell sample must be adjusted to 100 mL. When the supernatant has been removed, resuspend the pellet carefully.
2. Adjust the weight of the Cell Preparation Bag No. 1 by adding culture medium. Calculate the weight of medium to be added using the following equation:
   Weight of filled Cell Preparation Bag No. 1 after volume adjustment (g) = 100 g + Weight of empty Cell Preparation Bag No. 1 (g)
3. Using the sterile tubing connector, connect the Cell Preparation Bag No. 1 to the prepared Medium Bag 10% (containing 600 mL pre-warmed culture medium supplemented with 10% AB serum). Hang the Medium Bag 10% on a bag hanger.
4. Tare the balance. Place the Cell Preparation Bag No. 1 with the cell pellet on the balance.
5. Open the locking forceps next to the Cell Preparation Bag No. 1. Fill the Cell Preparation Bag No. 1 with medium until the calculated "Weight of filled Cell Preparation Bag No. 1 after volume adjustment" is reached. Close the locking forceps next to the Cell Preparation Bag No. 1 to stop the liquid flow.
6. Using the MACS TubeSealer, seal off the tubing leaving at least 15 cm of tubing on the Cell Preparation Bag for further connections. Disconnect the Medium Bag 10%.
7. Using the sterile tubing connector, connect the filled Cell Preparation Bag No. 1 to a 100 mL gas-permeable culture bag. Open the locking forceps next to the Cell Preparation Bag No. 1 and completely transfer the content.

⚠ CAUTION

Risk of lower performance.

If the bags are not suitable for cell preparation, there is the risk of contamination due to bag damage.

- Use gas-permeable culture bags suitable for cell preparation.

Labeling of cells

One CliniMACS Cytokine Capture System (IFN-gamma), consisting of two vials (7.5 mL each), is ready to use and sufficient for one application as described below. The reagents are not for parenteral administration.

Target sample and control sample

The protocol describes the labeling procedure of the "target sample" and the "control sample". Both samples are processed in parallel, the control sample being treated exactly the same as the target sample, but without addition of antigen. Therefore, the analysis of the control sample gives information on spontaneous cytokine secretion.

In vitro restimulation

IMPORTANT:

- A small negative control sample (control sample), treated exactly the same as the antigen-stimulated target sample but without addition of antigen, should be included as a measure of spontaneous cytokine secretion.
- For *in vitro* restimulation the optimal cell density is 0.5–1×10^9 cells/cm^2 and 1×10^9 cells/mL.

1. Using a sterile syringe (1 mL) with a 20-gauge needle, take a small aliquot (e.g., 1 mL = appr. 1×10^9 cells) of the cells to serve as **control sample (unstimulated)**.
2. Culture the aliquot under optimal conditions in one well of a 24 well culture dish.
3. Inject the antigen to the cells in the gas-permeable cell culture bag (**target sample**) at predetermined concentration via one of the ports using a syringe.
4. Incubate both samples at +37 °C (+99 °F) and 5–7.5% CO^2 for an appropriate time in the incubator. When proteins or cell lysates are used as antigens, the incubation time is between 4 and 16 hours. For peptides the incubation time is 3 to 6 hours. As the optimal stimulation time is influenced by specific characteristics of the antigen, Miltenyi Biotec recommends to perform dedicated validation procedures in order to gain the best result.

Labeling with the CliniMACS IFN-gamma Catchmatrix Reagent

Record the lot number and use-by date of the CliniMACS IFN-gamma Catchmatrix Reagent.

Target sample

IMPORTANT:
For the secretion phase, the vessel of choice must be of sufficient size to allow the addition of at least 1 volume of cold buffer at the end of the secretion phase. The cell density must not exceed 1×10^6 cells/mL. Therefore, 1×10^9 cells must be incubated for secretion in a total of 1,000 mL of warm culture medium.

1. Use the sterile tubing connector to connect the culture bag to the Cell Preparation Bag No. 2 (Secretion) and transfer the cells. Ensure the complete transfer of the cells into the Cell Preparation Bag No. 2. Close the locking forceps next to the Cell Preparation Bag No. 2 to stop the liquid flow.
2. Use the MACS TubeSealer to seal off the tubing leaving at least 15 cm of tubing on the Cell Preparation Bag No. 2 for further connections. Disconnect the empty culture bag.
3. Use the sterile tubing connector to connect the prepared Medium Bag 2% (containing 500 mL cold (+2 to +8 °C [+36 °F to +46 °F]) culture medium supplemented with 2% AB serum) to the Cell Preparation Bag No. 2.
4. Open the locking forceps next to the Cell Preparation Bag No. 2. Fill the Cell Preparation Bag No. 2 up to 600 mL. When the appropriate weight of medium has been transferred, close the locking forceps next to the Cell Preparation Bag No. 2 to stop the liquid flow.
5. Use the MACS TubeSealer to seal off the tubing leaving at least 15 cm of tubing on the Cell Preparation Bag No. 2 for further connections. Disconnect the Medium Bag 2%.
6. Use the MACS TubeSealer to connect the empty Wash Waste Bag No. 1 to the Cell Preparation Bag No. 2.
7. Fold any loose parts of the bag or tubing downwards. Place the two bags securely in the centrifuge bucket.
8. Balance the loaded bucket with a suitably weighed bucket. It is essential that the centrifuge is balanced accurately.
9. Centrifuge cells at 300×g (without brake) for 10 minutes at +4 °C to +8 °C (+39 °F to +46 °F).
10. Place the Cell Preparation Bag No. 2 on the plasma extractor. Open the locking forceps next to the Cell Preparation Bag No. 2. Remove the supernatant completely, taking care not to disturb the cell pellet. Close the locking forceps next to the Cell Preparation Bag No. 2 to stop the liquid flow.
11. Use the MACS TubeSealer to seal off the tubing leaving at least 15 cm of tubing on the Cell Preparation Bag No. 2 for further connections. Disconnect the Wash Waste Bag No. 1.
12. Resuspend the cell pellet in the residual volume after removal of the supernatant.
13. Attach a sampling site coupler to the Cell Preparation Bag No. 2 and disinfect the septum. Use an appropriate sterile syringe and needle to remove 7.425 mL from the CliniMACS IFN-gamma Catchmatrix Reagent vial. A 10 mL syringe is sufficient to remove the contents of one reagent vial. The syringe should be equipped with a 20-gauge needle.
14. Holding the Cell Preparation Bag No. 2 with both hands, mix the contents thoroughly by using a gentle rotating motion.
15. Using the injection port on the sampling site coupler, inject the entire volume of the reagent into the Cell Preparation Bag No. 2. Take care not to puncture the bag.
16. Resuspend the cells and incubate them for 5 minutes on ice. Record the incubation time.

Control sample (unstimulated)

1. Transfer the cells to a 15 mL closable tube.
2. Add cold (+2 °C to +8 °C [+36 °F to +46 °F]) culture medium supplemented with 2% AB serum up to 15 mL.
3. Centrifuge cells at 300×g (without brake) for 10 minutes at +4 °C to +8 °C (+39 °F to +46 °F) and carefully remove supernatant completely.
4. Resuspend cell pellet in 100 µL of cold (+2 °C to +8 °C [+36 °F to +46 °F]) culture medium supplemented with 2% AB serum.
5. Add the remaining 75 µL of the CliniMACS IFN-gamma Catchmatrix Reagent and incubate the suspension for 5 minutes on ice.

Secretion phase

Target sample

1. Take the four pre-filled transfer bags (including the labeled Cell Preparation Bag No. 3) containing 125 mL of warm (+37 °C [+99 °F]) culture medium supplemented with 10% AB serum.
2. Using the sterile tubing connector, connect the Cell Preparation Bag No. 2 to the prepared Medium Bag 10% (containing pre-warmed (+37 °C [+99 °F]) culture medium supplemented with 10% AB serum).
3. Add 500 mL of the pre-warmed culture medium to the cell sample in the Cell Preparation Bag No. 2. Immediately start measuring the 45 minutes incubation time.
4. Distribute 125 mL of the resulting cell suspension in each of the four transfer bags by serial attachment of the transfer bags to the Cell Preparation Bag No. 2 using the sterile tubing connector. By visually monitoring the scale on the balance, transfer the appropriate weight of cell suspension. This procedure results in a total of 250 g of cell suspension in each of the four transfer bags. After transfer, seal off the tubing to disconnect the transfer bags using the MACS TubeSealer.
5. Incubate the cells at +37 °C (+99 °F) for the remainder of the 45 minutes with continuous slow rotation (max 50 rpm) until the end of incubation time. Record the incubation time.
6. Take a plasma transfer set and ensure that the clamp is in the closed position. Insert the spike of the plasma transfer set into a port of the buffer bag.
7. After the 45 minutes, connect the buffer bag to the Cell Preparation Bag No. 3 using the sterile tubing connector. Add cold (+2 °C to +8 °C [+36 °F to +46 °F]) buffer to each of the four transfer bags (at least one volume, i.e., 250 mL each) by serial attachment of the transfer bags to the buffer bag. Allow the cells to cool down by placing the bags on ice for 10 minutes.
8. Using the sterile tubing connector connect one Wash Waste Bag (Wash Waste Bags Nos. 2 to 5) to each of the four transfer bags.
9. Centrifuge cells at 300×g (without brake) for 10 minutes at +4 °C (+39 °F). Using the plasma extractor, completely remove supernatant of all bags.
10. Using the MACS TubeSealer, seal off the tubing of each bag. Disconnect the Wash Waste Bags.
11. Take a plasma transfer set and ensure that the clamp is in the closed position. Insert the spike of the plasma transfer set into a port of a buffer bag.
12. Using the sterile tubing connector, connect the buffer bag to the Cell Preparation Bag No. 3.

13. Slide the clamp on the plasma transfer set to the open position and fill the Cell Preparation Bag No. 3 with 200 mL of buffer.
14. When the appropriate weight of buffer is transferred, slide the clamp on the plasma transfer set to the closed position to stop the liquid flow.
15. Using the MACS TubeSealer, seal off the tubing leaving at least 15 cm of tubing on the Cell Preparation Bag No. 3. Disconnect the buffer bag.
16. Using the sterile tubing connector, attach one of the other three transfer bags containing the cells to the Cell Preparation Bag No. 3 and recombine both suspensions.

IMPORTANT:
The divided samples have to be recombined in the Cell Preparation Bag No. 3 before centrifugation.

17. Repeat this procedure until the cell suspensions from all four transfer bags are recombined in the Cell Preparation Bag No. 3.
18. After the cells have been recombined, connect the buffer bag to the Cell Preparation Bag No. 3 using the sterile tubing connector.
19. Slide the clamp on the plasma transfer set to the open position. Fill the Cell Preparation Bag with buffer up to 500 mL.
20. When the appropriate weight of buffer is transferred, slide the clamp on the plasma transfer set to the closed position to stop the liquid flow. Close the locking forceps next to the Cell Preparation Bag No. 3.
21. Using the MACS TubeSealer, seal off the tubing between both clamps leaving at least 15 cm of tubing on the Cell Preparation Bag No. 3 for further connections. Disconnect the buffer bag.
22. Using the sterile tubing connector, connect the empty Wash Waste Bag No. 6 to the Cell Preparation Bag No. 3.
23. Fold any loose parts of the Cell Preparation Bag No. 3 or tubing downwards. Place the two bags securely in the centrifuge bucket.
24. Balance the loaded bucket with a suitably weighed bucket. It is essential that the centrifuge is balanced accurately.
25. Centrifuge cells at 300×g (without brake) for 10 minutes at +4 °C (+39 °F).

Control sample (unstimulated)

1. Add warm (+37 °C [+99 °F]) culture medium supplemented with 10% AB serum to dilute the sample to a maximum of 1×10^6 cells/mL, that is, a total volume of 10 mL must be used for 1×10^9 cells.
2. Incubate the cells in a closed tube for 45 minutes at +37 °C (+99 °F) under slow continuous rotation using the MACSmix Tube Rotator (max. 50 rpm).
3. After 45 minutes, fill up the tube with cold (+4 °C [+39 °F]) buffer and place the tube on ice for 5–10 minutes.
4. Centrifuge cells at 300×g (without brake) for 10 minutes at +4 °C to +8 °C (+39 °F to +46 °F).

Magnetic labeling of cells with the CliniMACS IFN-gamma Enrichment Reagent

Record the lot number and use-by date of the CliniMACS IFN-gamma Enrichment Reagent.

Target sample

1. After the centrifugation step, carefully remove supernatant, using the plasma extractor, as described above, and resuspend in residual volume. Close the locking forceps next to the Cell Preparation Bag No. 3 after removal.
2. Use the MACS TubeSealer to seal off the tubing leaving at least 15 cm of tubing on the Cell Preparation Bag No. 3 for further connections. Disconnect the Wash Waste Bag No. 6.
3. Attach a sampling site coupler to the Cell Preparation Bag No. 3 and disinfect the septum. Use an appropriate sterile syringe and needle to remove 7.425 mL from the CliniMACS IFN-gamma Enrichment Reagent vial. A 10 mL syringe is sufficient to remove the contents of one reagent vial. The syringe should be equipped with a 20-gauge needle.
4. Using the injection port on the sampling site coupler, inject the reagent into the Cell Preparation Bag No. 3. Take care not to puncture the bag. Immediately start counting the incubation time of 15 minutes. Record the incubation start time.
5. Holding the Cell Preparation Bag with both hands, mix the contents thoroughly by using a gentle rotating motion.
6. Incubate the cells for 15 minutes on ice. Record the incubation stop time.
7. Using the sterile tubing connector, connect the buffer bag to the Cell Preparation Bag No. 3.
8. Open the locking forceps next to the Cell Preparation Bag No. 3. Slide the clamp on the plasma transfer set to the open position. Fill the Cell Preparation Bag No. 3 up to 500 mL with cold (+2 °C to +8 °C [+36 °F to +46 °F]) buffer.
9. When the appropriate weight of buffer has been transferred, slide the clamp on the plasma transfer set to the closed position. Close the locking forceps next to the Cell Preparation Bag No. 3. Using the MACS TubeSealer, seal off the tubing between both clamps. Disconnect the buffer bag.
10. Using the sterile tubing connector, connect the empty Wash Waste Bag No. 7 to the Cell Preparation Bag No. 3.
11. Fold any loose parts of the bag or tubing downwards. Place the two bags securely in the centrifuge bucket.
12. Balance the loaded bucket with a suitably weighed bucket. It is essential that the centrifuge is balanced accurately.
13. Centrifuge at 300×g (without brake) for 10 minutes at +4 °C (+39 °F).
14. Carefully remove the supernatant as described above and resuspend the cells in 100 mL of cold (+2 °C to +8 °C [+36 °F to +46 °F]) buffer.
15. Disinfect the septum of the sampling site coupler. Insert a needle with an appropriate syringe into the sampling site coupler of the Cell Preparation Bag and remove a volume of 0.5 mL of the labeled product. Take care not to puncture the bag. Transfer the sample into a sample tube. Label the tube as ORIGINAL TARGET SAMPLE (should include patient identification).

    IMPORTANT:
    Ensure that the cells are mixed thoroughly before taking the sample. In order to get a representative sample, use a syringe with a capacity of at least 5 mL.

16. Retain the cell sample for cell analysis stored in the cold (+2 °C to +8 °C [+36 °F to +46 °F]).

Control sample (unstimulated)

1. After the centrifugation carefully remove supernatant.
2. Resuspend the cells in 100 µL of cold buffer (+2 °C to +8 °C [+36 °F to +46 °F]).
3. Add 75 µL of the remaining CliniMACS IFN-gamma Enrichment Reagent.
4. Incubate the cells for 15 minutes on ice.
5. Fill the vessel with cold buffer (+2 °C to +8 °C [+36 °F to +46 °F]) and centrifuge at 300×g (without brake) for 10 minutes at +4 °C (+39 °F).
6. Carefully remove the supernatant and resuspend the cells in 1 mL of cold (+2 °C to +8 °C [+36 °F to +46 °F]) buffer.
7. Remove a small sample (appr. 100 µL) of the cell suspension and transfer it into a tube, labeled as ORIGINAL CONTROL SAMPLE fraction before separation. Store in the cold until analysis.

Magnetic separation

Target sample

The magnetic separation of the target sample is performed using the CliniMACS Plus Instrument. After the separation procedure, process the control sample as described below.

Control sample (unstimulated)

1. Prepare two MS Columns by rinsing them with 500 µL of cold (+2 °C to +8 °C [+36 °F to +46 °F]) buffer and discard the effluent.
2. Place the first column into the magnetic field of the MiniMACS Separator.
3. Pass the cells through a pre-separation filter to remove clumps.
4. Apply the cell suspension onto the column.
5. Collect the total effluent (containing the unlabeled cell fraction). Wash the column by adding 500 µL of cold buffer onto the column. Perform a total of three washing steps by successively applying 500 µL of buffer onto the column once the column reservoir is empty.
6. Remove the column from the separator, place the second column into the separator, and put the first column on top of the second one.
7. Pipette 1 mL of cold buffer onto the first column. Immediately flush out the fraction with the magnetically labeled cells by firmly applying the plunger, supplied with the column, directly onto the second column.
8. Collect the unlabeled cells that pass through and wash the column with 500 µL of cold buffer. Perform a total of three washing steps by successively applying 500 µL of buffer onto the column, once the column reservoir is empty.
9. Remove the second column from the separator and place the column on a suitable collection tube labeled as positive fraction.
10. Pipette 0.5 mL of cold buffer onto the column. Immediately flush out the fraction with the magnetically labeled cells by firmly applying the plunger, supplied with the column.
11. Keep the target cell fraction in the cold until analysis.

6.16.2 Step 2: Choice of separation program

- **Basic operation**
- **Choosing of separation program Enrichment 3.2**
- **Entering tubing set parameters**

See section 'Enrichment 3.2' in the detailed explanation.

6.16.3 Step 3: Installation of CliniMACS Tubing Sets

- **CliniMACS Tubing Set and CliniMACS Tubing Set LS**

See section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' in the detailed explanation.

6.16.4 Step 4: CliniMACS Plus separation

- **Separation procedure**
- **Disconnecting bags and removing tubing set**
- **Shutting down and cleaning the instrument**
- **Analysis of cells**

See section 'Enrichment 3.2' in the detailed explanation.

7

Detailed explanation of Step 1–4

7.1 Step 1: Cell preparation and magnetic labeling

This chapter gives the detailed explanations of the procedures that are needed for cell separation using the CliniMACS Plus System.

7.1.1 First actions required

For the materials required for a particular application, refer to the application-specific section (see section 'Overview table').

Preparation of the CliniMACS PBS/EDTA Buffer (process buffer)

Supplement the CliniMACS PBS/EDTA Buffer with HSA to a final concentration of 0.5% (w/v). The supplemented buffer is henceforth referred to as "process buffer".

Preparation of bags

Refer to the application-specific section for the bags needed:

- **Cell Preparation Bag:**

  Insert a sampling site coupler (or equivalent) into the outside port of the Cell Preparation Bag. Place a locking forceps on the tubing close to the bag and close the locking forceps. Weigh the empty Cell Preparation Bag with the locking forceps positioned close to the bag and the tubing hanging on the table next to the balance. Record the weight.

  IMPORTANT:
  Since the length of the tubing can vary during the preparation procedure, be careful when determining the weight of the Cell Preparation Bag. To acquire an accurate reading confirm the locking forceps are always positioned close to the bag and are lying on the balance and the rest of the tubing is lying on the table next to the balance.

- **Cell Collection Bag:**

  - CliniMACS Tubing Set/CliniMACS Tubing Set LS: Insert a Luer/Spike Interconnector (or equivalent) into the outside port of the Cell Collection Bag. Place a locking forceps on the tubing close to the bag and close the locking forceps. Weigh the empty Cell Collection Bag with the locking forceps positioned close to the bag and the tubing hanging on the table next to the balance. Record the weight.

  - CliniMACS Depletion Tubing Set: One Cell Collection Bag is already attached to the tubing set. Insert a Luer/Spike Interconnector (or equivalent) into the outside port of the Cell Collection Bag. Place a locking forceps on the tubing close to the bag and close the locking forceps. Weigh the empty Cell Collection Bag with locking forceps positioned close to the bag and the tubing hanging on the table next to the balance. Record the weight.

7.1.2 Magnetic labeling of cells

The following sections describe the recommended in-bag procedure for the preparation of the cell product using the sterile tubing connector.

- The user must be familiar with the operation and use of the sterile tubing connector.
- Before starting the cell labeling and separation procedure, ensure that all needed supplies and equipment are available.

IMPORTANT:

- All bag handling should be done in a sterile environment (for example, laminar flow hood) using aseptic techniques. The connection of tubing using the sterile tubing connector may be performed outside the laminar flow hood.
- Perform sample preparation and cell separation at the temperature conditions defined in the application-specific section. Lower or higher ambient temperature will result in less purity and yield of the target cells.

In short, the magnetic labeling of the cell product is performed by the following steps:

1. Analysis of starting cell product
2. Transfer of starting cell product into Cell Preparation Bag
3. Dilution of the starting cell product
4. Centrifugation
5. For the CliniMACS Plus Anti-Biotin System and CliniMACS Plus TCRα/β-Biotin System only: labeling of the cells (incubation with the primary antibody/CliniMACS TCRα/β-Biotin) and removal of excess conjugate (1st wash)
6. Volume adjustment
7. For the CliniMACS Plus CD3 and CD3/CD19 Systems only: incubation with clinical grade immunoglobulin
8. Magnetic labeling of the cells (incubation with CliniMACS Reagent)
9. Removal of excess reagent
10. Volume adjustment for cell separation

Analysis of starting cell product

Before starting the preparation of the starting cell product, determine the following parameters:

- Total number of leukocytes
- Percentage of cells to be labeled
- Total number of leukocytes to be labeled
- Viability

Ensure working within the application specification.

Recheck the parameters after the labeling procedure. This is necessary for the staged-loading programs (Enrichment 1.1/Depletion 2.1/Depletion 3.1), as the following three sample parameters have to be entered in the software during the setup of the CliniMACS Plus Instrument prior to loading the tubing set onto the instrument:

- Concentration of leukocytes per mL
- Percentage of labeled cells
- Final volume of the cell product (cell product loading volume)

Other tests might be required depending on the intended use of the cells (for example, number of T cells, phenotype). Record all data.

Transfer of starting cell product into Cell Preparation Bag

1. Record the date and the start time before beginning to prepare the starting cell product.
2. Determine the volume of the starting cell product by assuming 1 mL of starting cell product as equivalent to 1 g (1 g ≙ 1 mL).
3. Holding the starting cell product bag with both hands, mix the contents thoroughly by using a gentle rotating motion.
4. Using the sterile tubing connector, connect the Cell Preparation Bag to the original starting cell product bag.
5. Open the locking forceps to transfer the starting cell product into the Cell Preparation Bag. Use a tubing stripper to clear the tubing from any remaining blood. Close the locking forceps on the tubing as close to the bag as possible.

6. Seal off the tubing and separate bags, leaving at least 15 cm of tubing on the Cell Preparation Bag for further connections (see Figure 7.1. Use the MACS TubeSealer to produce three adjacent seals in the tubing, with a distance of at least 1 cm between each seal. Make sure the seals are thoroughly established. Sever at the center seal. Keep the original leukapheresis/cellular starting bag until the separation and final analysis of all cells have been accomplished.

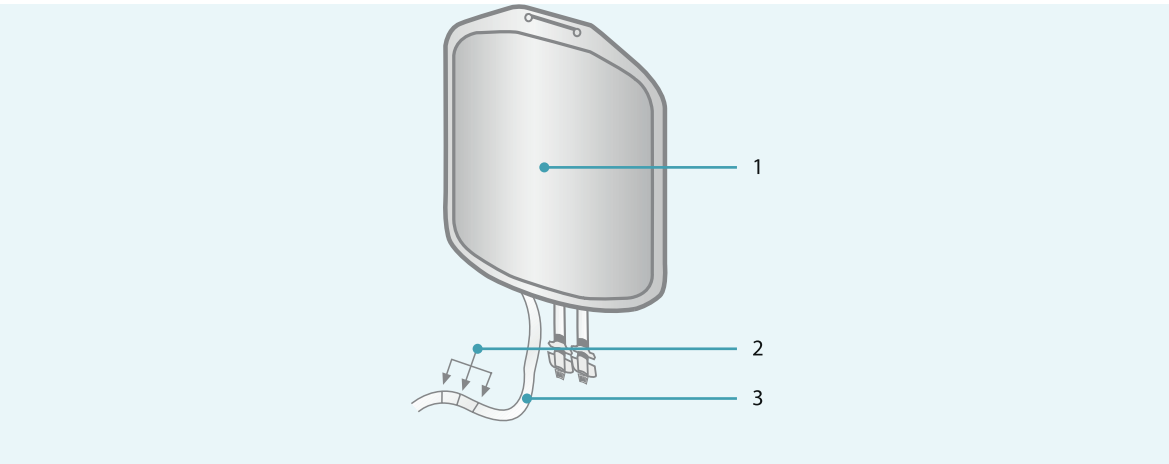


Figure 7.1: Sealing a bag

1 Bag
2 Hermetic seals
3 Tubing

7. To take a sample, disinfect the septum of the sampling site coupler. Mix the contents of the bag. Insert a needle with an appropriate syringe into the sampling site coupler of the Cell Preparation Bag and remove a volume of 0.5 mL. Transfer the sample into a sample tube. Label the tube as LEUKAPHERESIS/starting cell product (should include patient identification) and retain for cell analysis.

IMPORTANT:
Ensure that the starting cell product is mixed thoroughly before taking the sample. In order to get a representative sample, use a syringe with a capacity of at least 5 mL.

8. Tare the balance. Lay the filled Cell Preparation Bag on the balance, let the tubing lie on the table. Record the weight.

9. Determine the weight of the starting cell product by subtracting the weight of the empty Cell Preparation Bag from the weight of the Cell Preparation Bag filled with starting cell product. Record the calculated weight.
Weight of starting cell product (g) = Weight of filled Cell Preparation Bag (g) – Weight of empty Cell Preparation Bag (g)

Dilution of starting cell product

Refer to the application-specific section for the dilution ratio needed.
The starting cell product must be diluted with CliniMACS PBS/EDTA Buffer (supplemented with HSA to a final concentration of 0.5% [w/v]) before magnetic labeling. Calculate the weight of buffer to be added using either of the following equations (1 or 2) depending on the application and record it.

1. Weight of buffer to be added (g) = 600 – Weight of starting cell product (g)
2. Weight of buffer to be added (g) = Weight of starting cell product (g) × 2

1. Take a plasma transfer set and make sure that the clamp is in the closed position. Insert the spike of the plasma transfer set into a port of the buffer bag.

2. Using the sterile tubing connector, connect the buffer bag to the Cell Preparation Bag. Make sure to position the buffer bag higher than the Cell Preparation Bag.
3. Place the Cell Preparation Bag on the balance and tare the balance.
4. Open the locking forceps next to the Cell Preparation Bag. Slide the clamp on the plasma transfer set to the open position. By visually monitoring the scale on the balance, transfer the calculated weight of buffer to the Cell Preparation Bag.
5. When the appropriate weight of buffer has been transferred, slide the clamp on the plasma transfer set to the closed position to stop the liquid flow. Close the locking forceps on the tubing as near to the bag as possible.
6. Use the MACS TubeSealer to seal off the tubing between the clamp and the locking forceps leaving at least 15 cm of tubing on the Cell Preparation Bag for further connections. Disconnect the buffer bag.
7. Holding the Cell Preparation Bag with both hands, mix the contents thoroughly by using a gentle rotating motion. Avoid intensive mixing of the cells.
8. Tare the balance and weigh the filled Cell Preparation Bag. Record the weight.
9. Determine the weight of the diluted starting cell product by subtracting the weight of the empty Cell Preparation Bag from the weight of the filled Cell Preparation Bag. Record the calculated weight.
   Weight of diluted starting cell product (g) = Weight of filled Cell Preparation Bag (g)
   – Weight of empty Cell Preparation Bag (g)

Centrifugation

⚠ WARNING

Risk of contamination.

If the bags are not suitable for cell preparation or not placed correctly into the centrifuge bucket, there is the risk of contamination due to bag damage.

- Use suitable bags, fold any loose parts of the bags or tubing downwards, taking care not to impair bag integrity and place the bags securely in the centrifuge bucket.

⚠ CAUTION

Risk of lower cell separation performance.

If the bags are not placed correctly into the centrifuge bucket, there is the risk of cell loss during supernatant removal.

- Fold any loose parts of the bags or tubing downwards and place the bags securely in the centrifuge bucket.

1. Using the sterile tubing connector, connect the empty Plasma Waste Bag to the Cell Preparation Bag.
2. Fold any loose parts of the Cell Preparation Bag or tubing downwards. Place the two bags securely in the centrifuge bucket.
3. Balance the loaded bucket with a suitably weighed bucket. It is essential that the centrifuge is balanced accurately.

4. Centrifuge the cells at conditions defined in the application-specific section. Record the centrifugation conditions.
5. Remove the bags from the centrifuge, taking care not to disturb the cell pellet. Load the Cell Preparation Bag onto the plasma extractor and the connected Waste Bag on the table top balance.

Volume adjustment

For magnetic labeling of the cells, the optimal weight of the cell product varies depending on the application. Refer to the application-specific section for the labeling volume.

Depending on the application, it may be necessary either to only remove some amount of the supernatant to reach the labeling volume (tailored supernatant removal) or remove the supernatant completely and add buffer to reach the labeling volume (complete supernatant removal). Refer to the application-specific section for the applicable option and continue accordingly.

IMPORTANT:

- Using the plasma extractor, maintain constant control of the extractor release handle and ensure that the locking forceps next to the Cell Preparation Bag and the sterile welding between Cell Preparation Bag and Waste Bag are open before beginning the transfer. Release the extractor handle slowly.
- During removal of supernatant, be careful not to lose cells.

Tailored supernatant removal

Calculate the weight of supernatant to be removed to adjust the sample to the labeling volume using the following equation: Weight of supernatant to be removed (g) = Weight of cell product after the wash (g) – Labeling volume (g)
Record the weight of supernatant to be removed.

1. Place the empty Plasma Waste Bag or Wash Waste Bag No. 1 on the balance and tare the balance.
2. Open the locking forceps next to the Cell Preparation Bag. By visually monitoring the scale on the balance, remove the supernatant using the plasma extractor. Carefully press out excess supernatant until the calculated "weight of supernatant to be removed" is reached.
3. When the appropriate weight of supernatant is removed, close the locking forceps next to the Cell Preparation Bag to stop the liquid flow. Record the weight of the supernatant removed.
4. Using the MACS TubeSealer, seal off the tubing leaving at least 15 cm of tubing on the Cell Preparation Bag for further connections. Disconnect the Plasma Waste Bag or Wash Waste Bag No. 1.
5. Resuspend the cells in the Cell Preparation Bag carefully. Avoid intensive mixing of the cells. Ensure that all cells are resuspended.
6. Tare the balance and weigh the filled Cell Preparation Bag. Record the weight.
7. Determine the weight of the cell product after volume adjustment by subtracting the weight of the empty Cell Preparation Bag from the weight of the filled Cell Preparation Bag. Record the calculated weight.
   Weight of cell product after volume adjustment (g) = Weight of filled Cell Preparation Bag (g) – Weight of empty Cell Preparation Bag (g)
8. Keep the Plasma Waste Bag or Wash Waste Bag until the final separation and analysis of all cells have been accomplished.

Complete supernatant removal

1. Open the locking forceps next to the Cell Preparation Bag.
2. Remove the supernatant completely using the plasma extractor, taking care not to resuspend the cell pellet during removal of supernatant.
3. When the supernatant has been removed, close the locking forceps next to the Cell Preparation Bag to stop the liquid flow.
4. Using the MACS TubeSealer, seal off the tubing leaving at least 15 cm of tubing on the Cell Preparation Bag for further connections.
5. Disconnect the Plasma Waste Bag.
6. Resuspend the pellet carefully.
7. Adjust the weight of the Cell Preparation Bag by adding buffer. Calculate the target weight of the Cell Preparation Bag (CPB) filled with diluted cell product using the following equation:
   Target weight of CPB filled with washed cell product (g) = Labeling volume (g) + Weight of empty CPB (g)
8. Insert the spike of a plasma transfer set to a port of a buffer bag. Confirm the clamp on the plasma transfer set is in the closed position.
9. Using the sterile tubing connector, connect the buffer bag to the Cell Preparation Bag. Hang the buffer bag on a bag hanger.
10. Tare the balance. Place the Cell Preparation Bag with the cell pellet on the balance.
11. Open the locking forceps next to the Cell Preparation Bag. Slide the clamp on the plasma transfer set to the open position. Fill the Cell Preparation Bag with buffer until the calculated "Target weight of Cell Preparation Bag filled with washed cell product" is reached. Slide the clamp on the plasma transfer set to the closed position to stop the liquid flow. Close the locking forceps next to the Cell Preparation Bag.
12. Using the MACS TubeSealer, seal off the tubing leaving at least 15 cm of tubing on the Cell Preparation Bag for further connections. Disconnect the buffer bag.
13. Resuspend the cells in the Cell Preparation Bag carefully. Avoid intensive mixing of the cells. Ensure that all cells are resuspended.
14. Tare the balance and weigh the filled Cell Preparation Bag. Record the weight.
15. Determine the weight of the cell product after volume adjustment by subtracting the weight of the empty Cell Preparation Bag from the weight of the filled Cell Preparation Bag. Record the calculated weight.
    Weight of cell product after volume adjustment (g) = Weight of filled Cell Preparation Bag (g) – Weight of empty Cell Preparation Bag (g)
16. Keep the Plasma Waste Bag until the separation and final analysis of all cells have been accomplished.

Labeling of the cells (for the CliniMACS Plus Anti-Biotin System and CliniMACS Plus TCRα/β-Biotin System only)

Incubation with the CliniMACS TCRα/β-Biotin

The CliniMACS TCRα/β-Biotin vial is ready to use and sufficient for the application as described below. The conjugate is not for parenteral administration.

Store the conjugate at +2 °C to +8 °C (+36 °F to +46 °F). DO NOT freeze. The conjugate must be used cold directly from the refrigerator. DO NOT warm up before use. The lot number and use-by date of the conjugate is printed on the vial label. DO NOT use the conjugate after the use-by date.

1. Record the lot number and use-by date of the CliniMACS TCRα/β-Biotin.
2. Disinfect the septum of the sampling site coupler. Use an appropriate sterile syringe and needle to remove the entire volume from one vial (7.5 mL). A 10 mL syringe is sufficient to remove the content of one vial. The syringe should be equipped with a 20-gauge needle.
3. Using the injection port on the sampling site coupler, inject the entire volume of conjugate into the Cell Preparation Bag (optionally, transfer the content of the Cell Preparation Bag into a new transfer bag to ensure high depletion efficiency). Immediately start the incubation period of 30 minutes.
4. Holding the Cell Preparation Bag with both hands, mix the contents thoroughly by using a gentle rotating motion. Record the incubation start time.
5. Place the Cell Preparation Bag flat on the orbital rotator, set to a speed of approximately 25 rpm, and ensure that the bag is not creased or bent. Incubate the bag for a total of 30 minutes at controlled room temperature (+19 °C to +25 °C [+66 °F to +77 °F]). Record the incubation stop time.

Incubation with the primary antibody (biotinylated antibody of another manufacturer)

1. Resuspend cell pellet and label cells with primary biotinylated antibody at time and titer recommended by the manufacturer of the antibody. Ensure that all cells are resuspended. (The primary antibody should be used at its optimal titer, i.e., with optimal staining intensity and no background staining. Follow the instructions for use, provided by the manufacturer of the primary antibody.)
2. Incubate the Cell Preparation Bag on an orbital shaker at 25 rpm. Follow the instructions for use, provided by the manufacturer of the primary antibody.

Removal of excess conjugate (1st wash) (for the CliniMACS Plus Anti-Biotin System and CliniMACS Plus TCRα/β-Biotin System only)

Dilute the cell product with buffer to a total weight of 600 g. Calculate the weight of buffer to be added using the following equation and record it.
Weight of buffer to be added (g) = 600 g – Weight of labeled cell product (g)

1. Dilute the cell product following the steps described in the step "Dilution of starting cell product" (steps 1–8) to a total weight of 600 g.
2. Determine the weight of cell product after the removal of excess conjugate (1st wash) wash by subtracting the weight of the empty Cell Preparation Bag from the weight of the filled Cell Preparation Bag. Record the calculated weight.
   Weight of cell product after removal of excess conjugate (1st wash) (g) = Weight of filled Cell Preparation Bag (g) – Weight of empty Cell Preparation Bag (g)
3. Using the sterile tubing connector, connect the empty Wash Waste Bag to the Cell Preparation Bag.
4. Fold any loose parts of the Cell Preparation Bag or tubing downwards. Place the two bags securely in the centrifuge bucket.
5. Balance the loaded bucket with a suitably weighed bucket. It is essential that the centrifuge is balanced accurately.
6. Centrifuge the cells under conditions defined in the application-specific section.

7. Remove the bags from the centrifuge, taking care not to resuspend the cell pellet. Load the Cell Preparation Bag onto the plasma extractor and the connected Wash Waste Bag on the table top balance.
8. For the required number of washes, see the application-specific section.
9. Adjust the weight of the cell suspension as described in the section "Volume adjustment" to approximately 190 g for magnetic labeling of the cells with the CliniMACS Anti-Biotin Reagent.

Incubation with clinical grade immunoglobulin (for the CliniMACS Plus CD3 or CD3/CD19 Systems only)

IMPORTANT:
Note that human IgG is not a component of the CliniMACS System. Use only pharmaceutical grade human IgG approved in your country. Carefully read the package insert of the human IgG used; in particular the section regarding hypersensitivity reactions and the risk of infection that human IgG as a blood derived product brings to all patients. All risks arising from these materials must be evaluated by the user.

Disinfect the septum of the sampling site coupler of the Cell Preparation Bag. Use an appropriate sterile syringe and needle to add 1.5 mg human IgG per mL cell product (e.g., 1.6 mL of Gamunex 10% for 95 mL cell product). Mix the contents thoroughly. Incubate for 5 minutes at controlled room temperature by using a gentle rotating motion (e.g., 25 rpm on orbital rotator).

Magnetic labeling of the cells: incubation with the CliniMACS Reagent

The CliniMACS Reagent vials are ready to use and sufficient for the application as described below. The reagents are not for parenteral administration.
Store the reagents at +2 °C to +8 °C (+36 °F to +46 °F). DO NOT freeze. The reagents must be used cold directly from the refrigerator. DO NOT warm up before use. The lot number and use-by date of the reagents are printed on the vial label. DO NOT use the reagents after the use-by date.

1. Record the lot number and use-by date of the CliniMACS Reagent(s).
2. Disinfect the septum of the sampling site coupler. Use an appropriate sterile syringe and needle to remove the entire volume from a) one vial or b) two vials (7.5 mL each). A 10 mL syringe is sufficient to remove the contents of one vial, or respectively, a 20 mL syringe is sufficient to remove the contents of two reagent vials. The syringe should be equipped with a 20-gauge needle.
3. Using the injection port of the sampling site coupler, inject the entire volume of the reagent into the Cell Preparation Bag (optionally, in depletion applications transfer the content of the Cell Preparation Bag into a new transfer bag to ensure high depletion efficiency). The incubation time starts at this point.
4. Holding the Cell Preparation Bag with both hands, mix the contents thoroughly by using a gentle rotating motion.
5. Place the Cell Preparation Bag flat on the orbital rotator, set to a speed of approximately 25 rpm, and ensure that the bag is not creased or bent. Incubate the bag in the conditions and duration defined in the application-specific section.

Removal of excess reagent

To remove the unbound reagent after incubation is completed, washing the cells is required. Refer to the application-specific section for the required number of washes.

1. Insert the spike of a plasma transfer set to a port of a buffer bag containing at least 500 mL of buffer. Confirm the clamp on the plasma transfer set is in the closed position.

2. Using the sterile tubing connector, connect the buffer bag to the Cell Preparation Bag. Hang the buffer bag on a bag hanger.
3. Place the Cell Preparation Bag on the balance and tare the balance.
4. Open the locking forceps next to the Cell Preparation Bag. Slide the clamp on the plasma transfer set to the open position. Fill the Cell Preparation Bag with buffer to 600 mL. Slide the clamp on the plasma transfer set to the closed position to stop the liquid flow. Close the locking forceps next to the Cell Preparation Bag. Record the weight of the filled Cell Preparation Bag.
5. Seal off the tubing between both clamps leaving at least 15 cm of tubing on the Cell Preparation Bag for further connections. Disconnect the buffer bag.
6. Holding the Cell Preparation Bag with both hands, mix the contents thoroughly with a gentle rotating motion.
7. Using the sterile tubing connector, connect the empty Wash Waste Bag to the Cell Preparation Bag.
8. Fold any loose parts of the bags or tubing downwards. Transfer the Cell Preparation Bag and Wash Waste Bag securely to the centrifuge bucket.
9. Centrifuge the cells in the conditions and duration defined in the application-specific section.
10. Taking care not to disturb the cell pellet, remove the bags from the centrifuge.
11. Carefully hang the Cell Preparation Bag on the plasma extractor.
12. Place the Wash Waste Bag on the balance and tare the balance.
13. Open the locking forceps next to the Cell Preparation Bag, and open the sterile welds between the bags, if not yet done. Using the plasma extractor, remove as much supernatant as possible from the Cell Preparation Bag taking care not to remove cells. Close the locking forceps next to the Cell Preparation Bag to stop the liquid flow.
14. Using the MACS TubeSealer, seal off the tubing leaving at least 15 cm of tubing on the Cell Preparation Bag for further connections. Disconnect the Wash Waste Bag.
15. Keep the Wash Waste Bag until the separation and final analysis of all cells have been accomplished.
16. Resuspend the cell pellet in the Cell Preparation Bag. Avoid intensive mixing of the cells. Ensure that all cells are resuspended.
17. If more washes are required (for example, for enrichment of CD34-positive cells), repeat steps 1–16.
18. Tare the balance and weigh the filled Cell Preparation Bag. Record the weight.
19. Determine the weight of the cell product after the wash by subtracting the weight of the empty Cell Preparation Bag from the weight of the filled Cell Preparation Bag. Record the calculated weight.
    Weight of cell product after the wash (g) = Weight of filled Cell Preparation Bag (g) – Weight of empty Cell Preparation Bag (g)

20. Adjust sample loading volume: Calculate the weight of buffer necessary to adjust the weight of the cell suspension to the appropriate sample loading volume according to the application using the following equation. For loading the labeled and washed cells on the tubing set, a maximum cell concentration of 0.4×10^9 cells per mL is recommended.
    Weight of buffer to be added (g) = Sample loading volume (according to application) – Weight of cell product after the wash (g)

21. Using the sterile tubing connector, connect the buffer bag to the Cell Preparation Bag. Hang the buffer bag on a bag hanger.
22. Place the Cell Preparation Bag on the balance and tare the balance.
23. Open the locking forceps next to the Cell Preparation Bag. Slide the clamp on the plasma transfer set to the open position. By visually monitoring the scale on the balance, transfer the calculated weight of buffer to the Cell Preparation Bag.
24. When the appropriate weight of buffer has been transferred, slide the clamp on the plasma transfer set to the closed position to stop the liquid flow. Close the locking forceps next to the Cell Preparation Bag.
25. Using the MACS TubeSealer, seal off the tubing between both clamps. Disconnect the buffer bag.
26. Resuspend the cell pellet in the Cell Preparation Bag. Avoid intensive mixing of the cells. Ensure that all cells are resuspended.
27. Disinfect the septum of the sampling site coupler. Insert a needle with an appropriate syringe into the sampling site coupler of the Cell Preparation Bag and remove a volume of 0.5 mL of the labeled product. Transfer the sample into a sample tube. Label the tube as ORIGINAL (should include patient identification) and retain for analysis.
28. Tare the balance and weigh the filled Cell Preparation Bag. Record the weight.
29. Determine the weight of the cell product after the addition of buffer (sample loading volume) by subtracting the weight of the empty Cell Preparation Bag from the weight of the filled Cell Preparation Bag. Record the calculated weight.
    Weight of cell product after addition of buffer (g) = Weight of filled Cell Preparation Bag (g) – Weight of empty Cell Preparation Bag (g)

Proceed to Step 2.

DO NOT connect the Cell Preparation Bag to the tubing set until instructed by the screen.

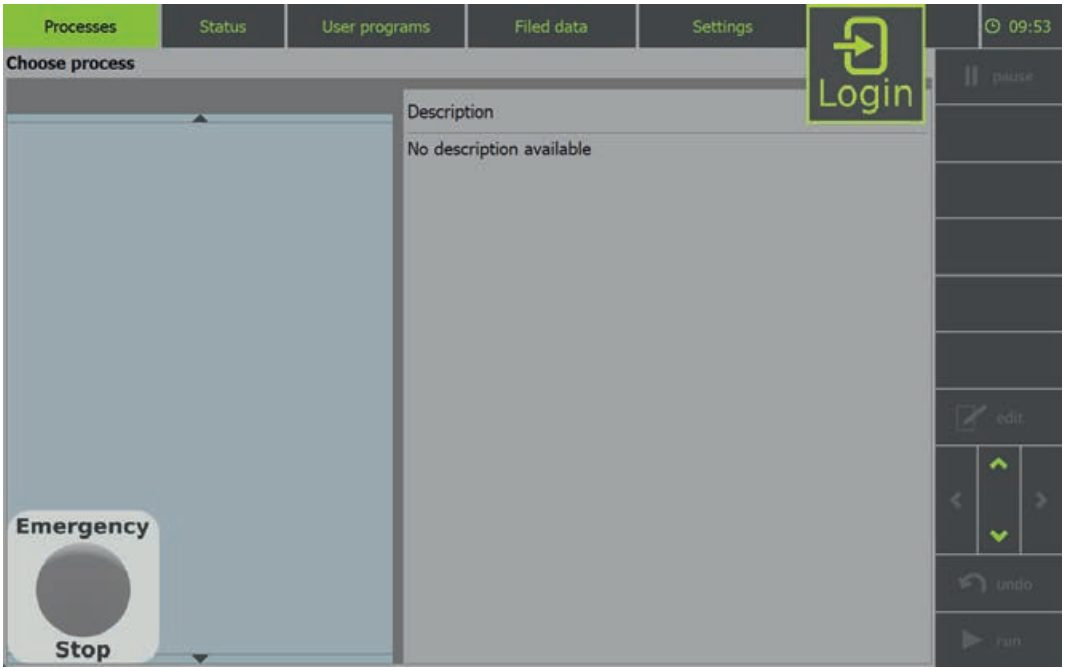
7.2 Step 2: Choice of separation program

7.2.1 Basic operation

This section describes the basic instrument operations required before and after the execution of a separation
program. For information on additional instrument operations and software functions, refer to the CliniMACS Plus Software user manual.

Switching on the instrument

1. Plug the power cable of the instrument into a grounded electrical outlet.
2. Switch on the CliniMACS Plus with the power switch located on the rear side of the instrument.
   The start screen appears and shows the current software version. During the initialization, the instrument performs self-checking procedures. After the initialization process, a locked screen appears and only the Login button is active.



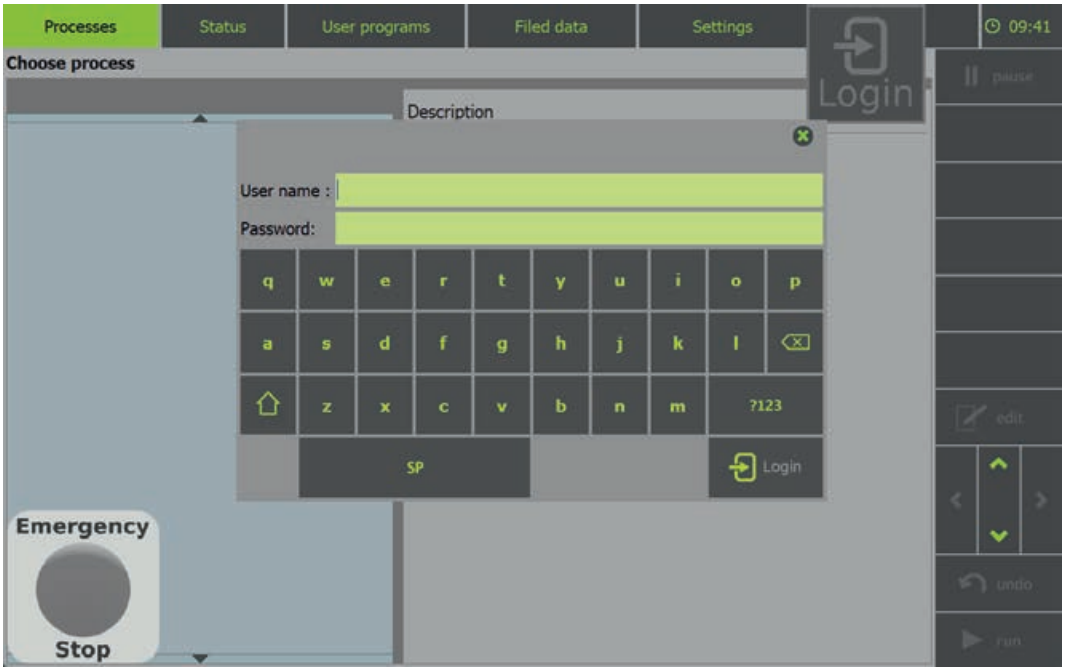
   If the instrument does not start up, switch off the instrument by using the power switch and disconnect it from the power supply. Check the power port. Then switch on the instrument again. If the instrument does not start correctly or the window shows an error message, note the error message number, switch off the instrument, and contact Miltenyi Biotec Technical Support.

Login

IMPORTANT:

- The username and password should be set up before login (refer to the CliniMACS Plus Software user manual for details).
- Maxing out the login attempts locks the user completely. There is no option to reset the password, also not by Miltenyi Biotec Technical Support.
- In case of login failure, refer to the CliniMACS Plus Software user manual.

1. To open the login window, tap **Login** in the upper right corner of the locked screen.
   A pop-up window appears, allowing the user to enter the user credentials:



2. Enter username and password and tap **Login** within the pop-up window.

Logout

IMPORTANT:
After 20 minutes (default) without interaction with the software, the user is logged out automatically.

1. Tap (**quick access menu**) and select **Logout** from the list.
2. To confirm the logout, tap **ok** in the pop-up window.

Shutting down the instrument

1. To shut down the instrument, choose one of the following options:
   - Tap (**quick access menu**) and select **Shutdown** from the list or
   - navigate to **Settings** > **Tools** > **Shutdown** and tap **run**.
2. In the pop-up window, confirm with **shutdown**.
3. Wait for the shutdown process to finish and switch off the instrument using the power switch located at the rear side of the instrument.

Navigating to the processes menu

To view the standard processes, navigate to the Processes menu (see Figure 7.2).

Tap Processes in the menu bar.
The left-hand side of the screen shows a list of the available processes. The right-hand side of the screen shows a description of the selected process.

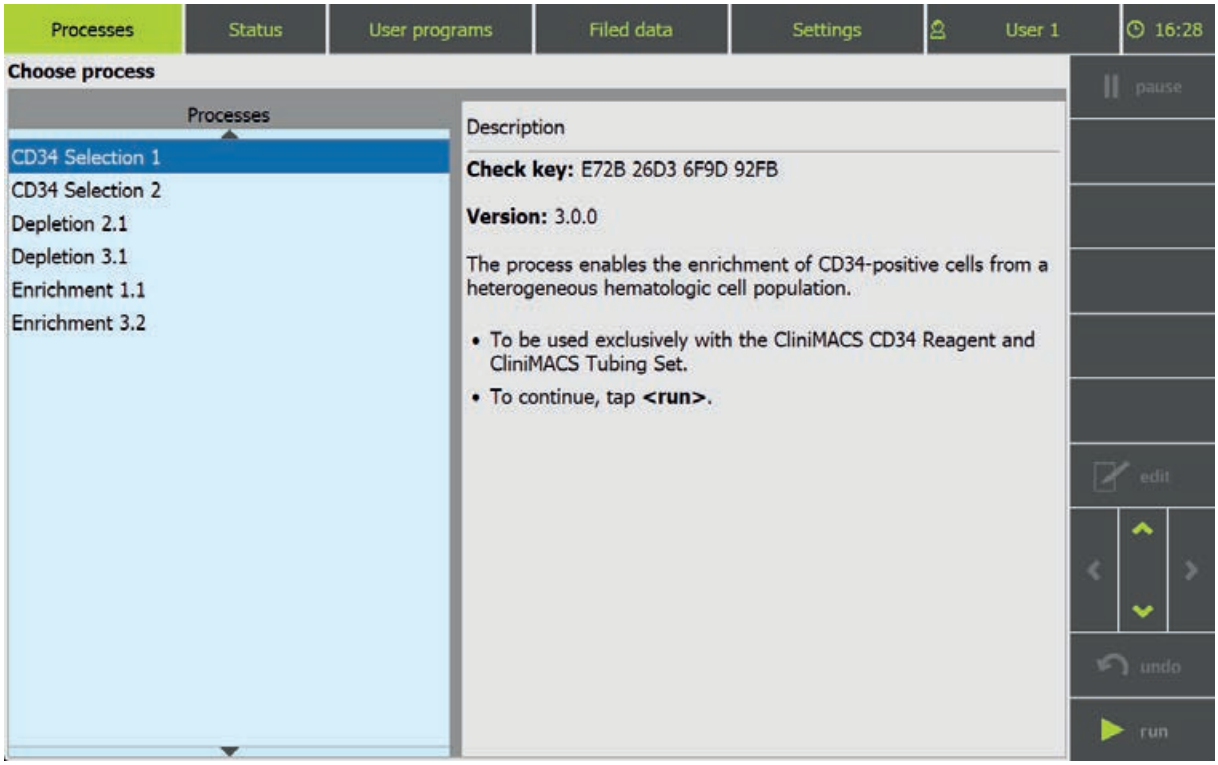


Figure 7.2: Processes menu

Parameter input

Multiple parameters must be entered for the process either with the barcode reader connected to the CliniMACS Plus or the keyboard shown on the screen. Optional parameters are indicated as such and can be skipped. Tap ok to confirm each entry. All entered parameters are saved in the process-related protocol.

If unexpected events occur during barcode scanning, refer to section 'Barcode scanning' in the Troubleshooting chapter for information on corrective actions.

IMPORTANT:

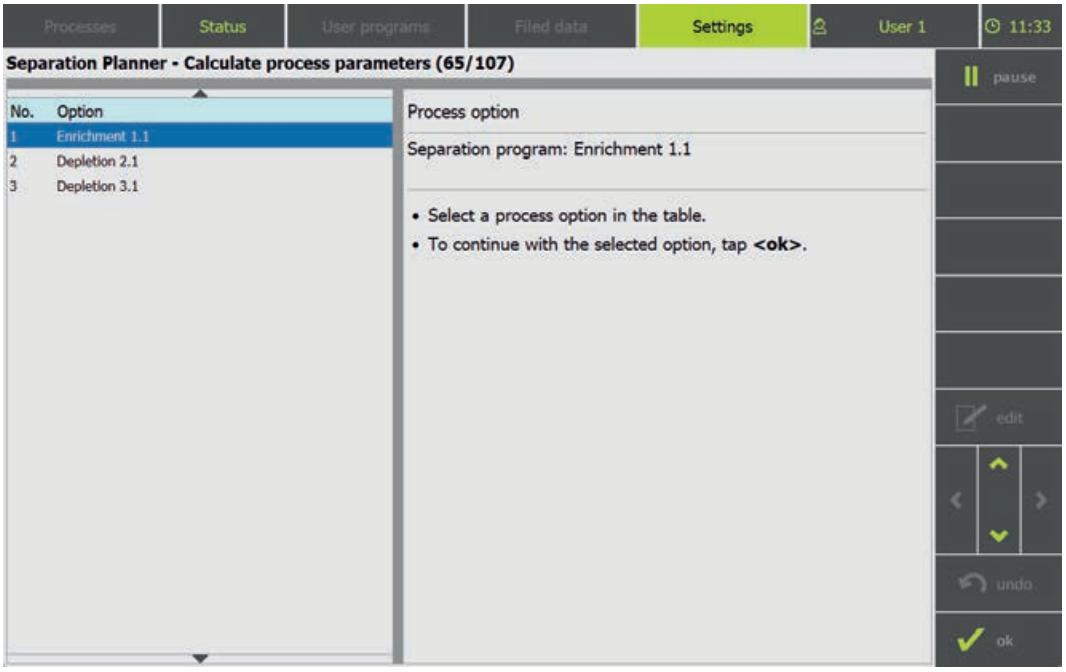
- The user interface shows screens with instructions and images to guide the user through the entire procedure. Use the touchscreen functionality and buttons on the menu bar and tool bar to operate the CliniMACS Plus Instrument. For details, refer to the CliniMACS Plus Software user manual.
- DO NOT use the external keyboard when running any of the installed applications on the instrument. The external keyboard must be used for the "User Management" only! The external keyboard must be unplugged from the instrument before starting any application and tool.

7.2.2 Separation planner tool

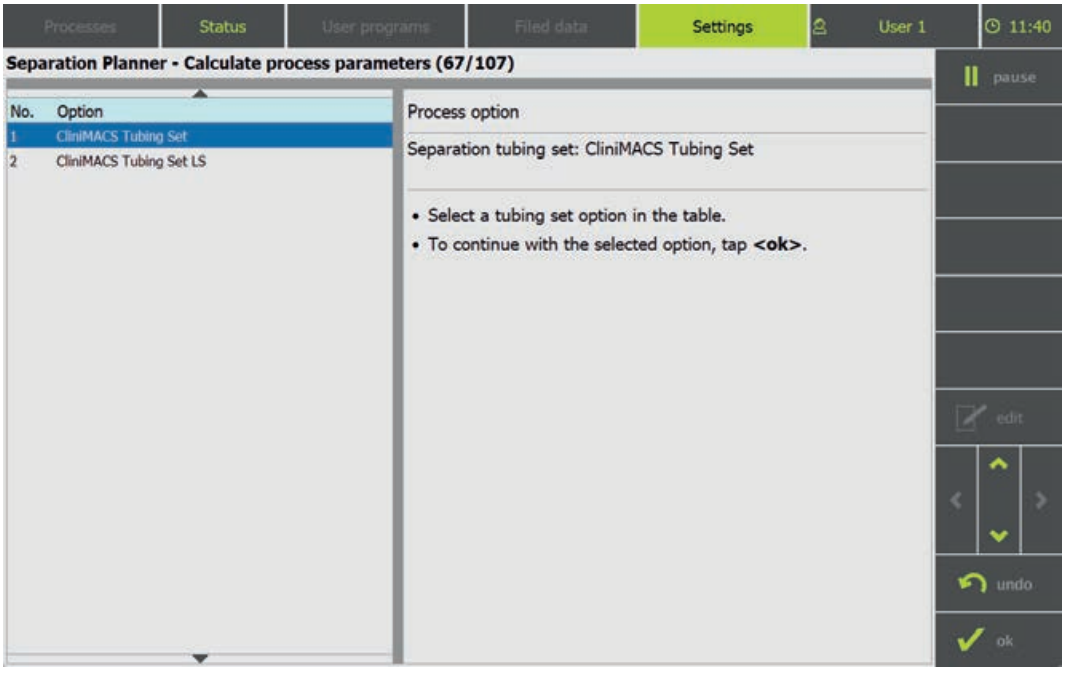
The Separation planner tool allows the user to calculate and estimate process parameters for Enrichment 1.1, Depletion 2.1, and Depletion 3.1 based on entered starting cell product parameters.

IMPORTANT:
Before starting a separation program, use the Separation Planner tool to support the planning and preparation of the separation run.

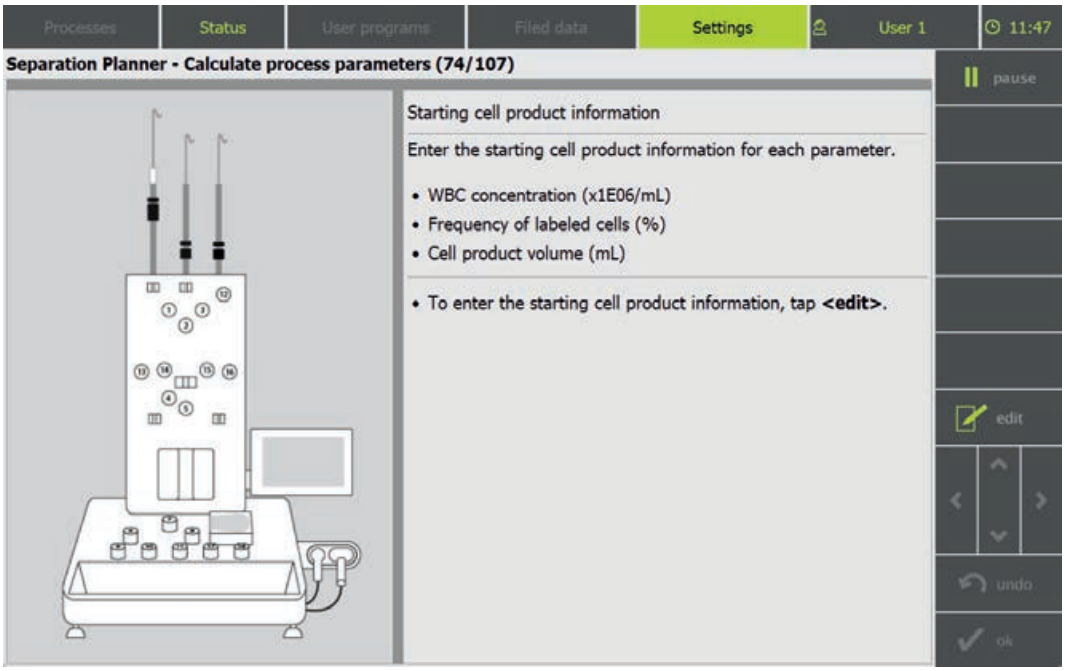
1. To start the separation planner, navigate to **Settings** > **Tools** > **Separation Planner** and tap **run**.
2. To choose a separation program from the list, use the navigation buttons ⌄ and ⌃ or tap on the program name. To continue, tap **ok**.



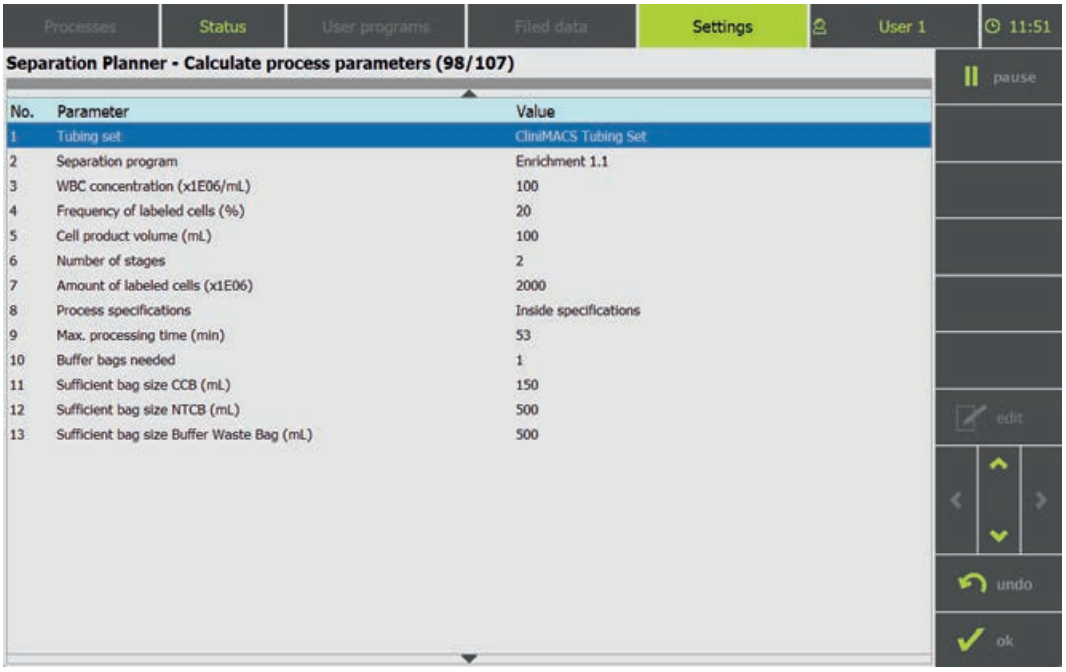
3. Choose a tubing set from the list. To continue, tap **ok** and confirm choice. To return to the list, tap **undo**.



4. To enter the required starting cell product parameters, tap **edit**. To change an entered parameter, tap **edit**. To continue tap **ok**.



5. Review the calculated process parameters. The estimated process parameters can be used for preparation of the planned separation procedure.



7.2.3 CD34 Selection 1/ CD34 Selection 2

CD34 Selection 1 and CD34 Selection 2 are optimized for the enrichment of CD34-positive cells.

The separation program CD34 Selection 1 must only be used in combination with the CliniMACS Tubing Set (REF 161-01). The separation program CD34 Selection 2 must only be used in combination with the CliniMACS Tubing Set LS (REF 162-01). Ensure that the tubing set is correct before the installation on the instrument.

Screen prompts and diagrams serving as procedure guides will appear on the screen.

- Perform and check each step according to the manual and software instructions before proceeding to the next step.
- To correct a mistake during data input, tap **undo** (refer to the CliniMACS Plus Software user manual for more details on the toolbar).

Choosing separation program CD34 Selection 1 or CD34 Selection 2

Depending on the application, choose CD34 Selection 1 or CD34 Selection 2 (see Figure 7.3).

The screenshots in the following sections may show either CD34 Selection 1 or CD34 Selection 2 in the title bar. Depending on the selected separation program, the program name shown in the software may differ from that shown in the screenshots in this user manual.

1. To select CD34 Selection 1/2 from the list, highlight the name of the program by using the navigation buttons ⌄ and ⌃ or by tapping on the program name.
2. To continue with the selected program, tap **run**.

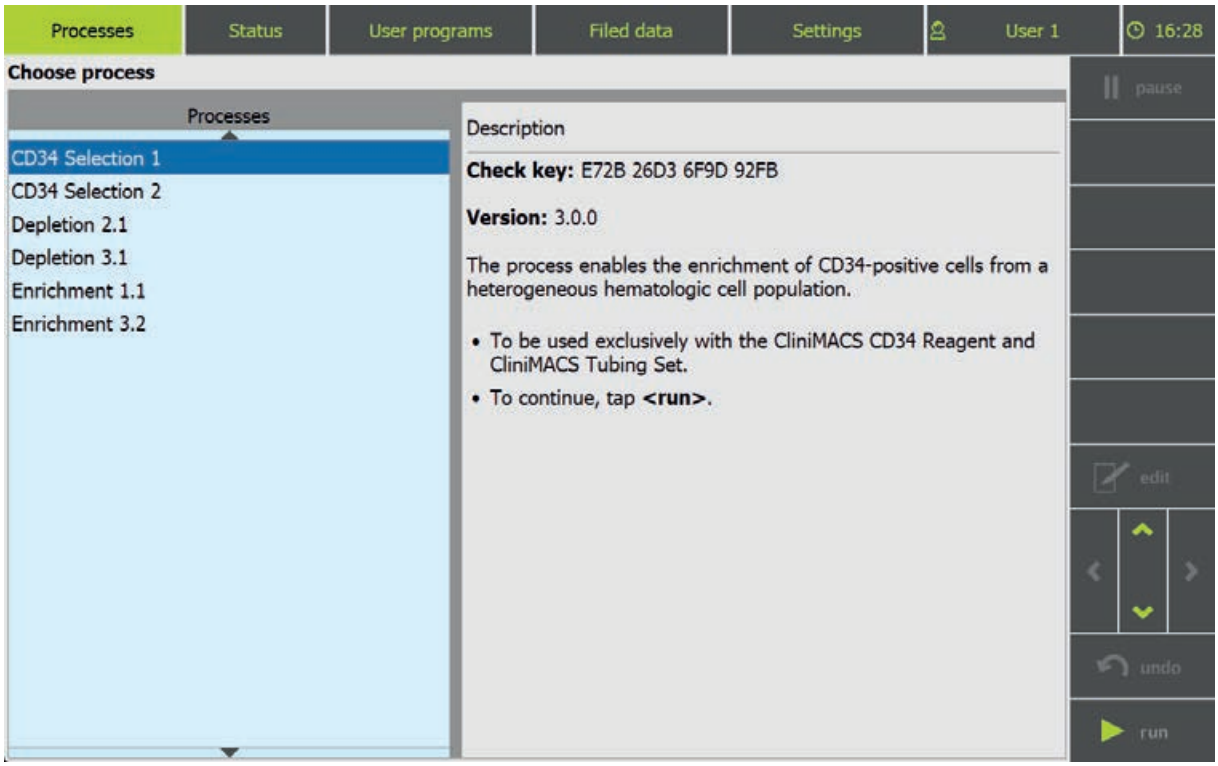


Figure 7.3: Choice of separation program CD34 Selection 1/2

Entering Run ID (optional)

The user can enter a Run ID for the process. To enter a Run ID, tap **edit**. To continue without any entry, tap **ok**.

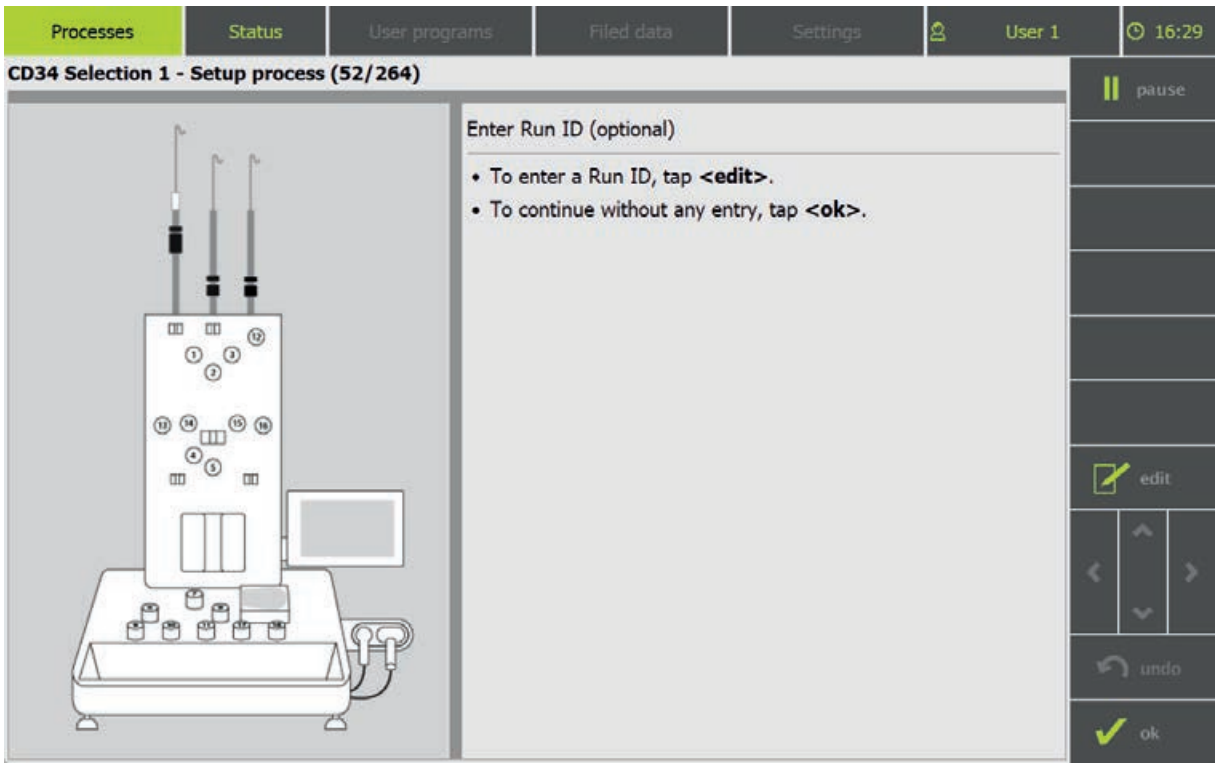


Figure 7.4: Entry of Run ID

Entering tubing set parameters

1. Use the barcode reader to scan the barcode label on the tubing set packaging.
2. Alternatively, enter the part number (P/N), LOT number, and use-by date manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.

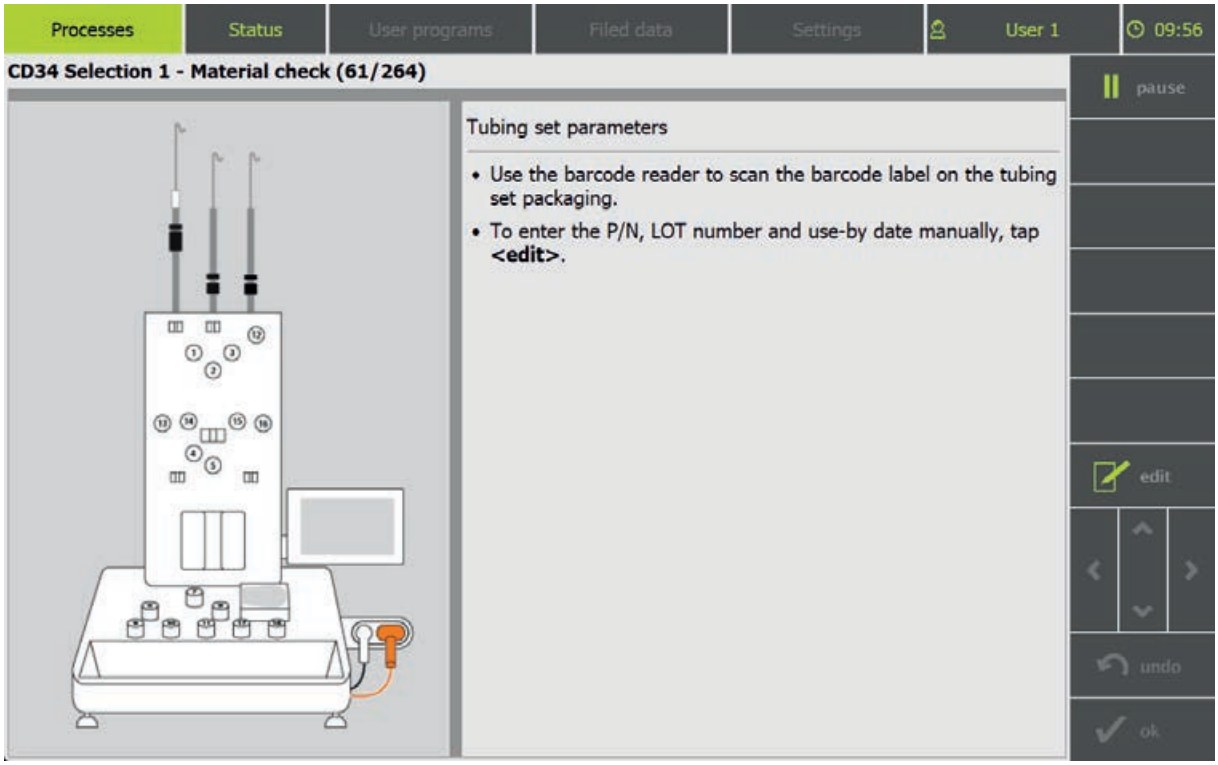


Figure 7.5: Entry of tubing set parameters

Entering starting cell product information (optional)

1. Use the barcode reader to scan the barcode label on the cell product.
2. Alternatively, enter the information manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm each entry, tap **ok**.

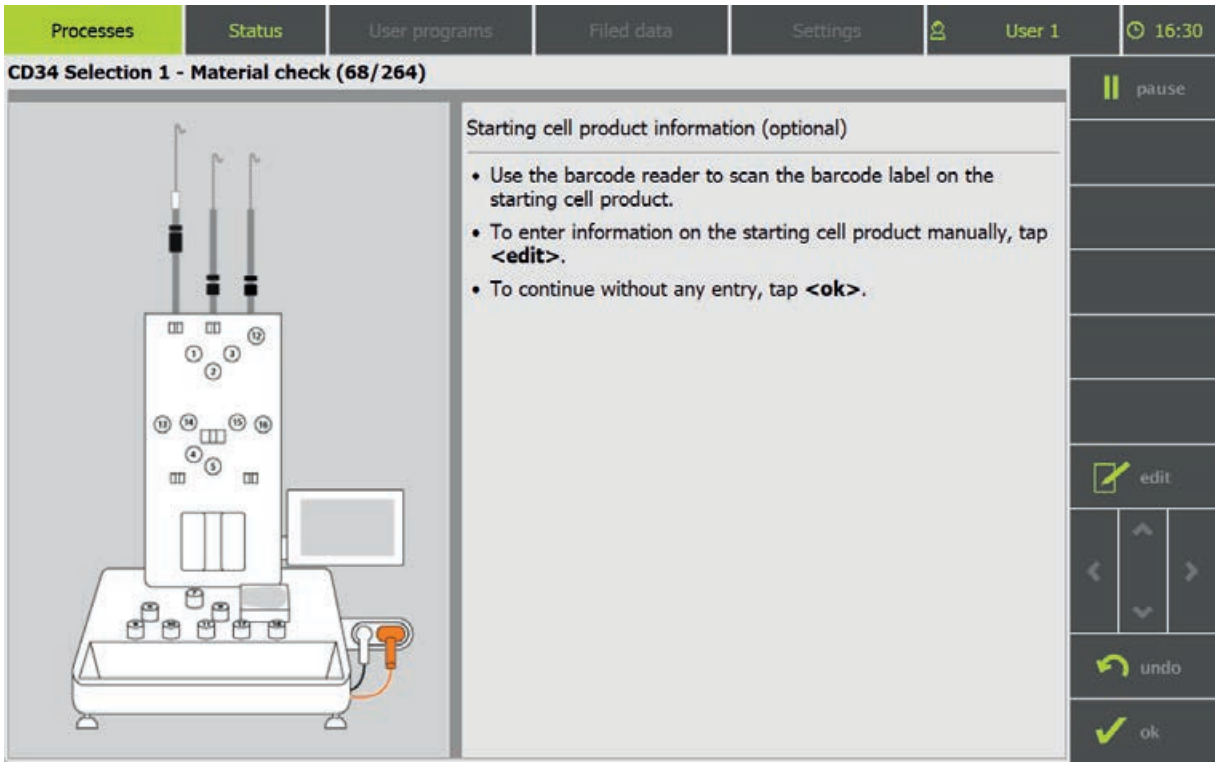


Figure 7.6: Entry of starting cell product information

Entering CliniMACS CD34 Reagent parameters

If CD34 Selection 1 has been started, enter the parameters for one reagent vial. If CD34 Selection 2 has been started, enter the parameters for two reagent vials.

1. Use the barcode reader to scan the barcode label on the CliniMACS CD34 Reagent.
2. Alternatively, enter the part number (P/N), LOT number, and use-by date manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm each entry, tap **ok**.

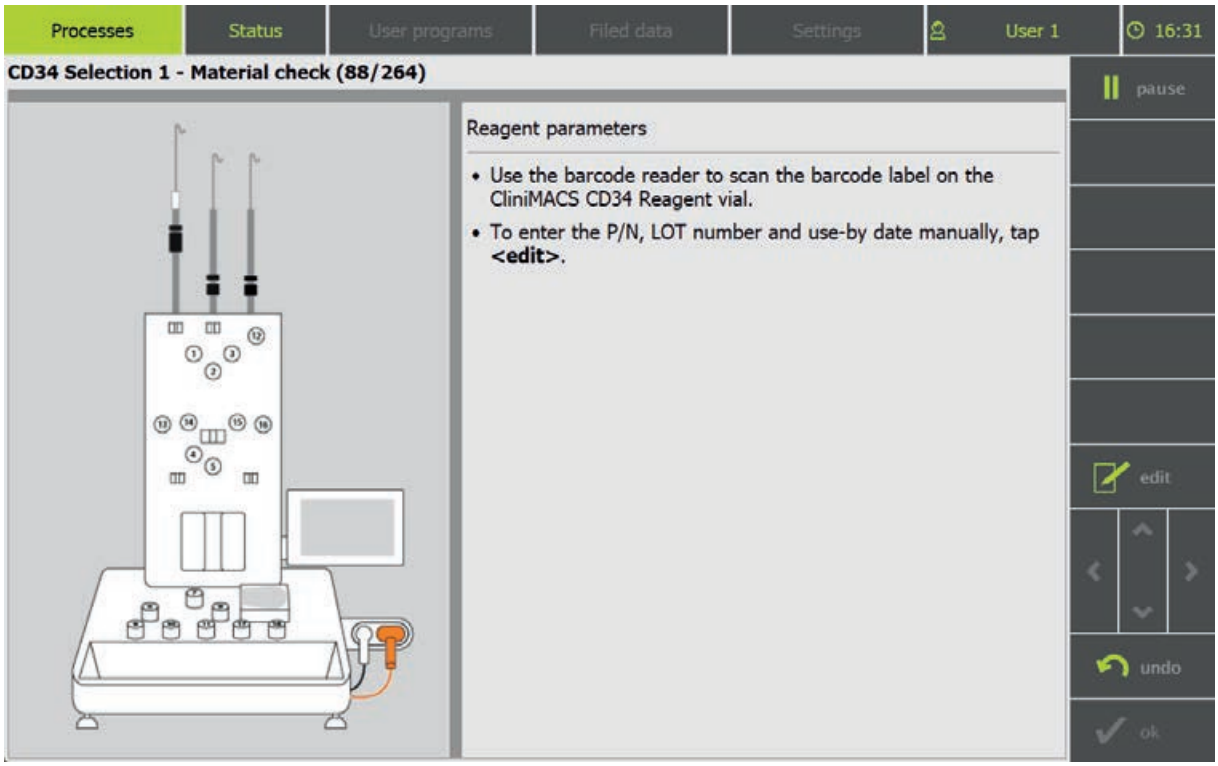


Figure 7.7: Entry of CliniMACS CD34 Reagent parameters

Entering process buffer parameters (optional)

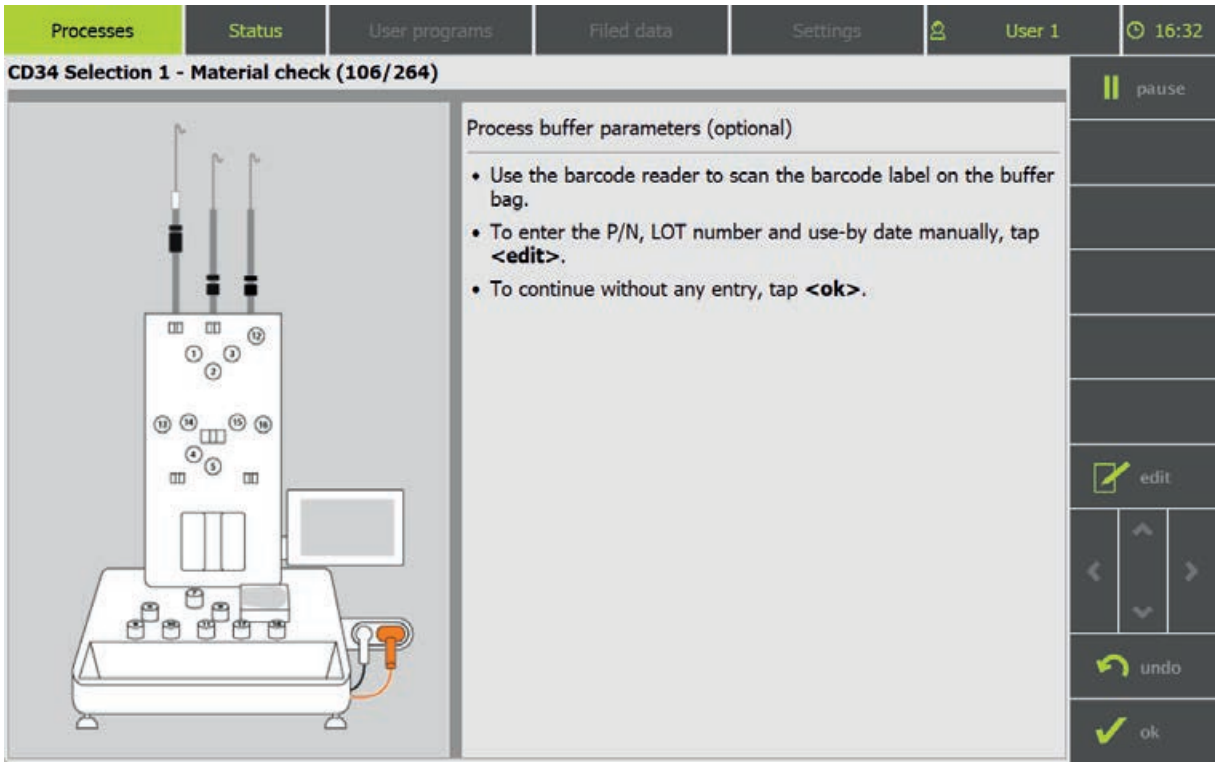


Figure 7.8: Entry of process buffer parameters

1. To enter the process buffer parameters, scan the barcode label on the buffer bag using the barcode reader.
2. Alternatively, enter the parameters manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
3. To continue without any entry, tap **ok**.

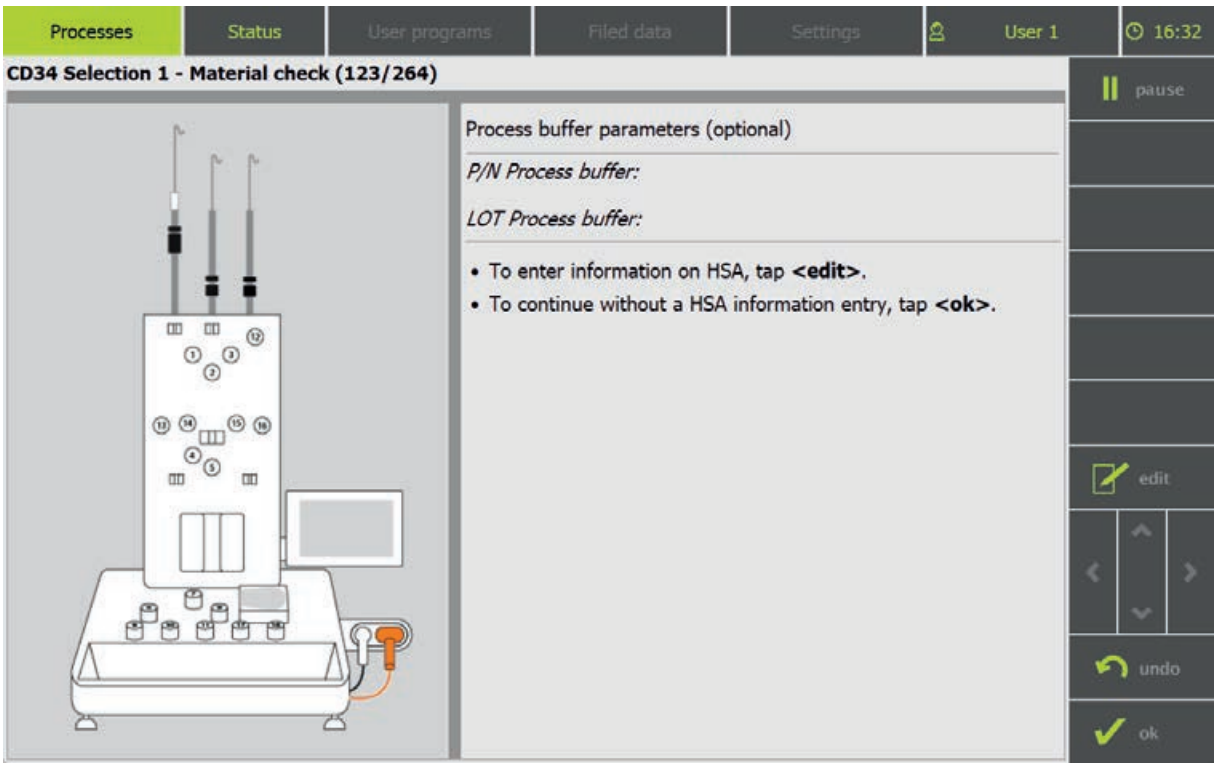


Figure 7.9: Entry of HSA information for the process buffer

Additionally, the user can enter HSA information for the process buffer.

1. To enter HSA information, tap **edit**. To continue without any entry, tap **ok**.

Entering information for additional materials (optional)

If multiple additional materials are used, repeat the following steps for each entry.

1. To enter the item name and information of the additional material, tap **edit**. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
2. To continue without any entry, tap **ok**.

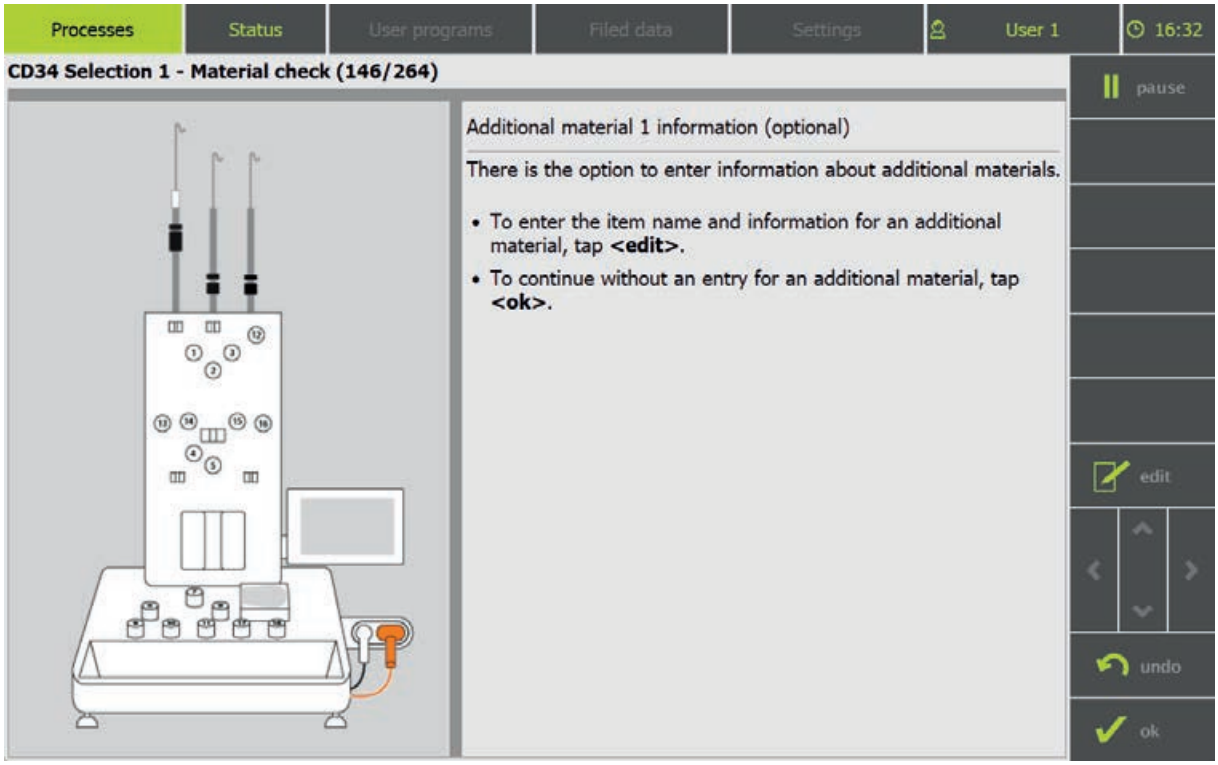


Figure 7.10: Entry of additional material information

Continue with the installation of the tubing set (see section 'Step 3: Installation of CliniMACS Tubing Sets').

7.2.4 Enrichment 1.1

The separation program Enrichment 1.1 must only be used in combination with the CliniMACS Tubing Set (REF 161-01) or the CliniMACS Tubing Set LS (REF 162-01). Ensure that the tubing set is correct before the installation on the instrument.

Screen prompts and diagrams serving as procedure guides will appear on the screen.

- Perform and check each step according to the manual and software instructions before proceeding to the next step.
- To correct a mistake during data input, tap **undo** (refer to the CliniMACS Plus Software user manual for more details on the toolbar).

IMPORTANT:
Before starting Enrichment 1.1, it is recommended to use the Separation Planner tool to plan and prepare for the actual separation run (see section 'Separation planner tool').

Choosing separation program Enrichment 1.1

1. To select Enrichment 1.1 from the list (see Figure 7.11), highlight the name of the program by using the navigation buttons ⌄ and ⌃ or by tapping on the program name.
2. To continue with the selected program, tap **run**.

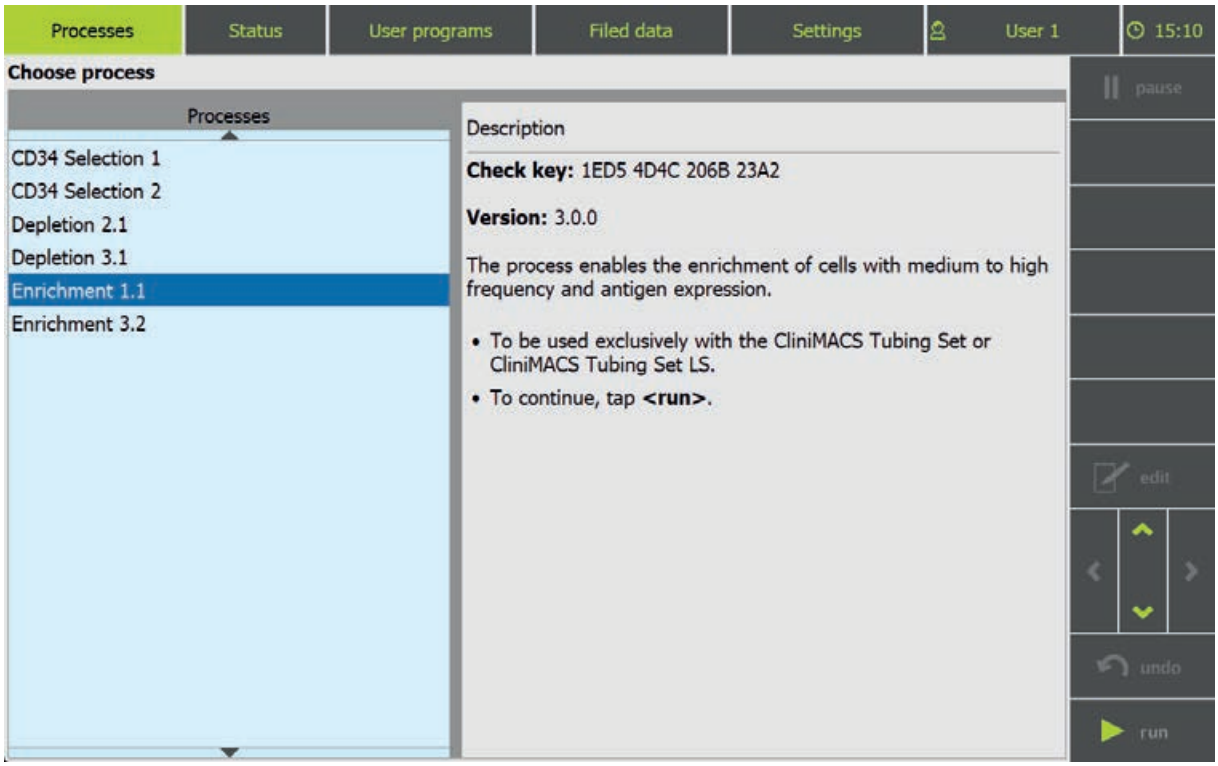


Figure 7.11: Choice of separation program Enrichment 1.1

Entering Run ID (optional)

The user can enter a Run ID for the process. To enter a Run ID, tap **edit**. To continue without any entry, tap **ok**.

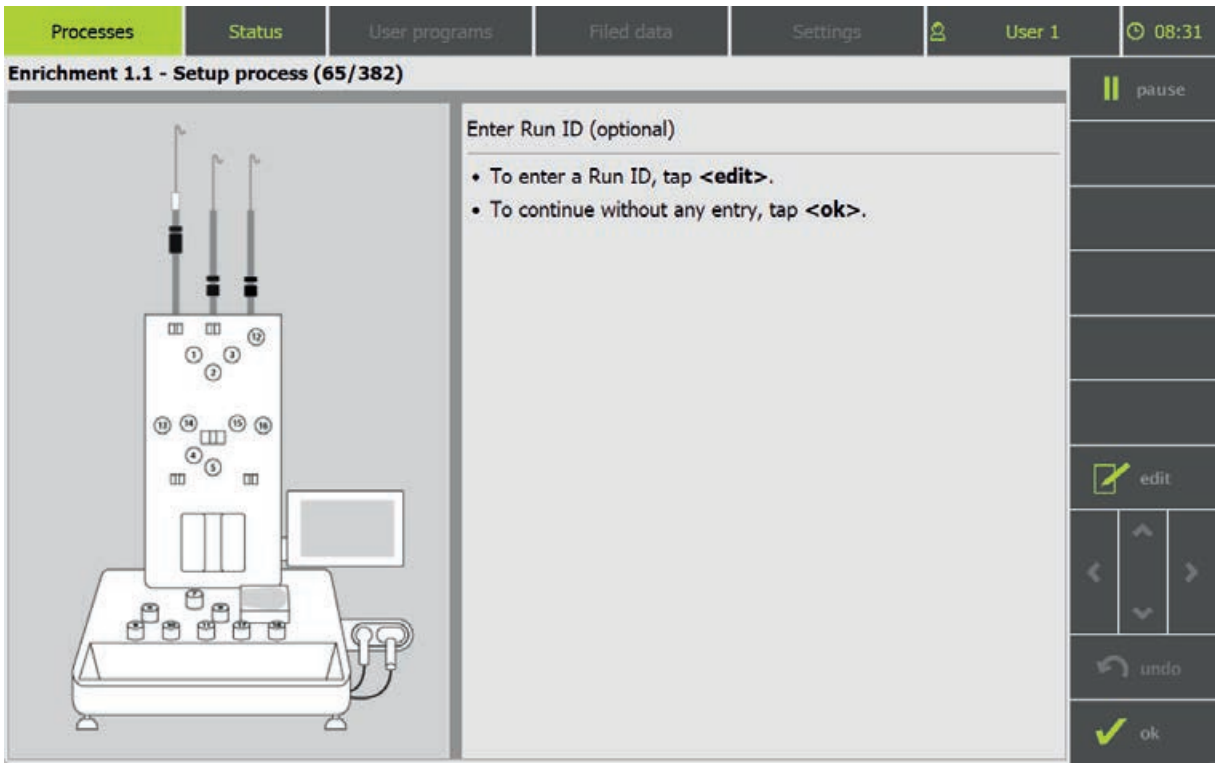


Figure 7.12: Entry of Run ID

Entering tubing set parameters

1. Use the barcode reader to scan the barcode label on the tubing set packaging.
2. Alternatively, enter the part number (P/N), LOT number, and use-by date manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.

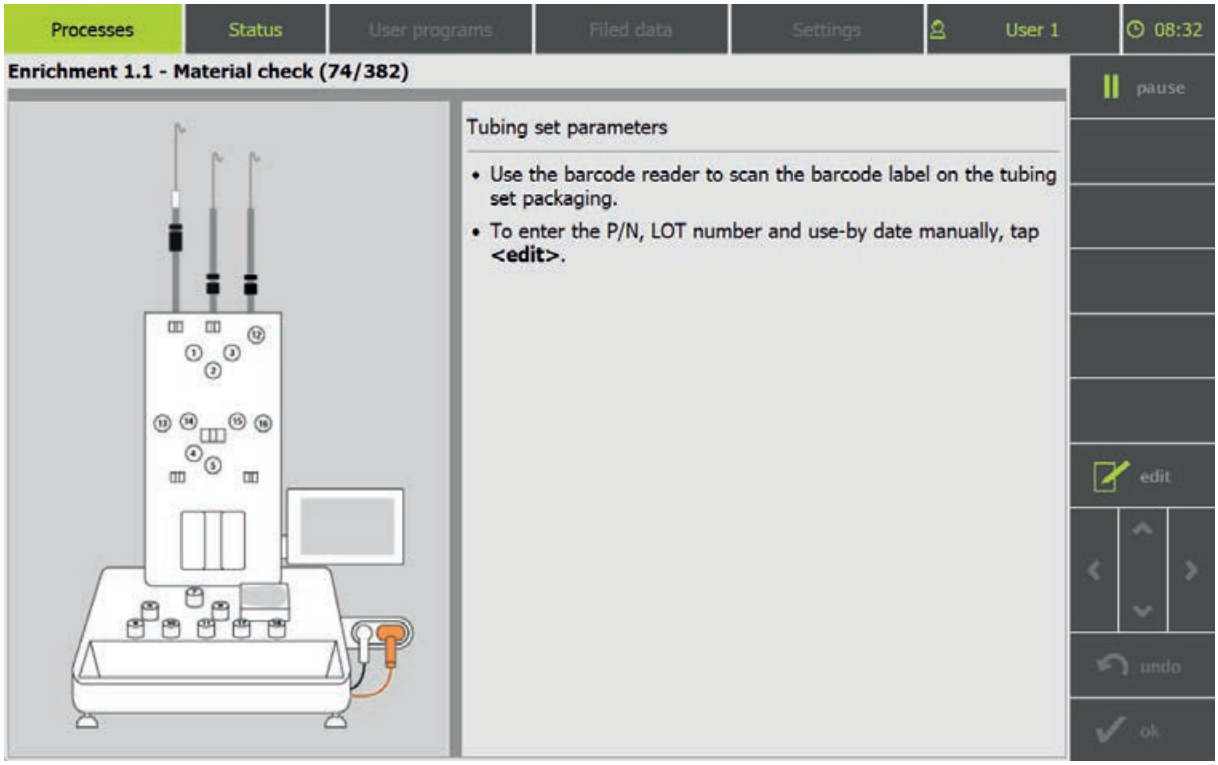


Figure 7.13: Entry of tubing set parameters

Entering starting cell product information (optional)

1. Use the barcode reader to scan the barcode label on the cell product.
2. Alternatively, enter the information manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm each entry, tap **ok**.

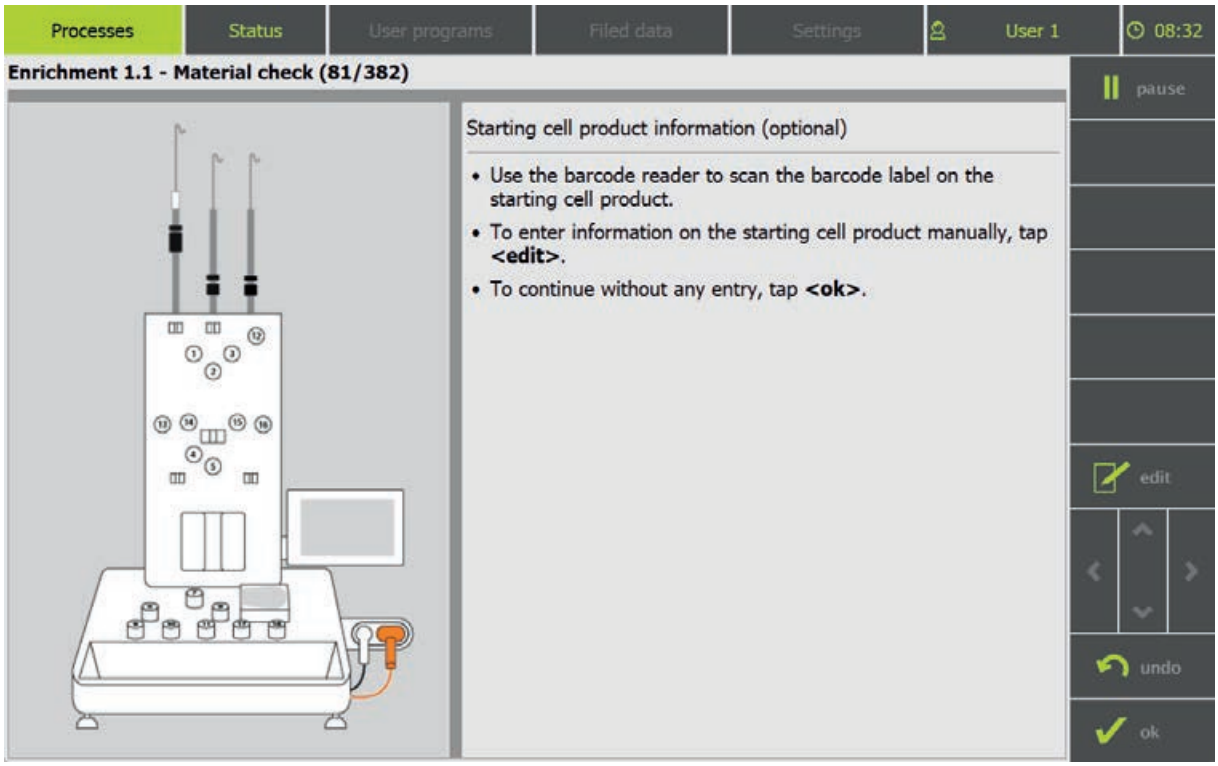


Figure 7.14: Entry of starting cell product information

Entering starting cell product parameters

Enter the starting cell product parameters (see Figure 7.15). The starting cell product parameters are necessary to adjust the separation to each individual cell product and to provide the user with important information about the required buffer and bag volumes.

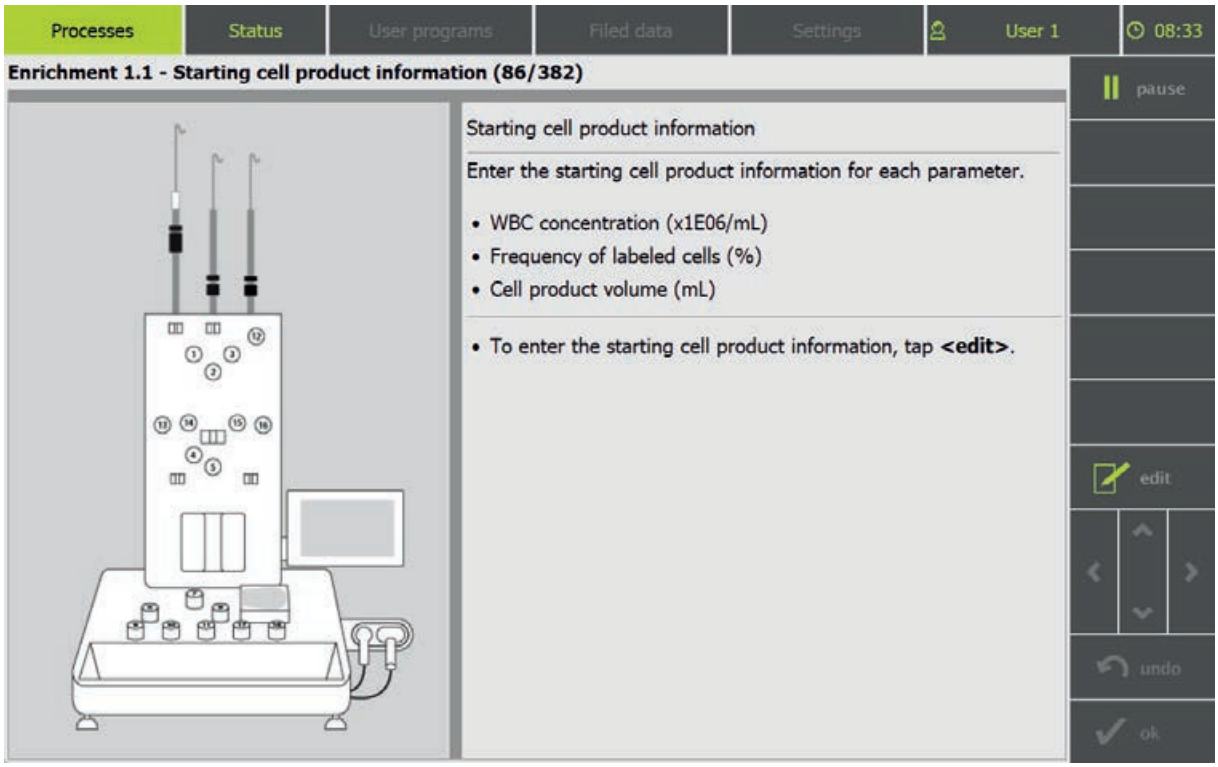


Figure 7.15: Entry of starting cell product parameters

⚠ CAUTION

Specifying wrong parameters may result in non-optimal cell product processing and may increase the risk of target cell loss.

Entering values for WBC concentration and/or percentage of labeled cells which are lower than the actual cell product values may result in cell loss due to the system being overloaded. Entering a lower cell product volume may result in cell loss due to overloading or even to incomplete cell product processing. If the specification of any of the three parameters is too high, this will result in increased processing time and enlarged volume of the target cell fraction.

- Always ensure to enter the correct parameters.

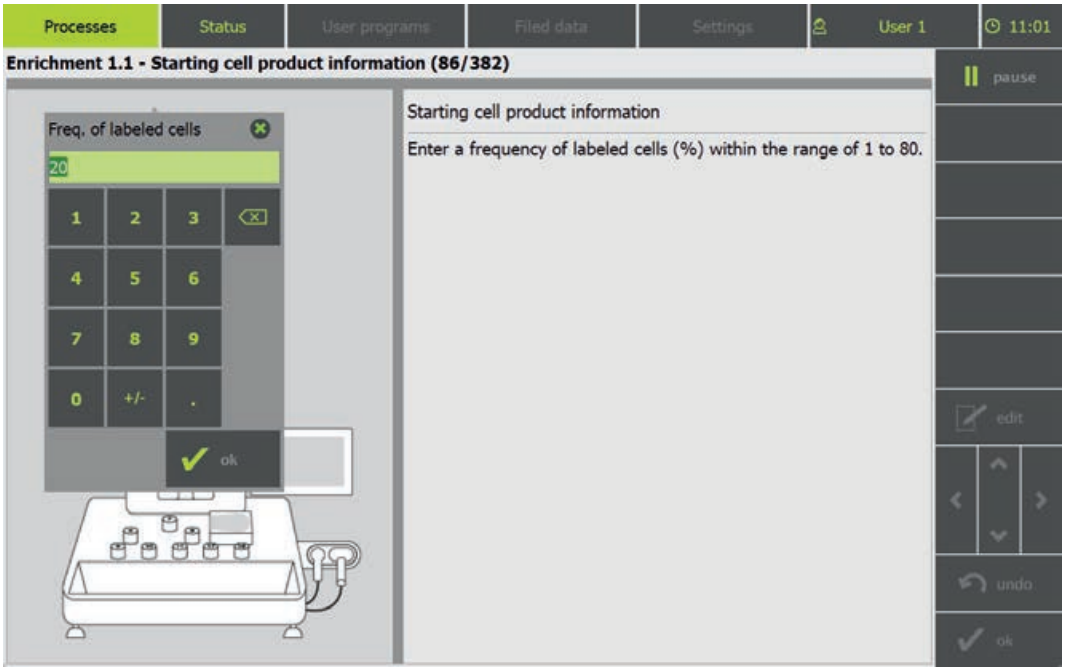
IMPORTANT:
All cell product parameters required refer to the cell product after the cell labeling and washing procedure. The allowed range shown on the right-hand side of the screen always takes into account the previous input. After each input, the software calculates and adjusts the accepted range of the next query.

To enter the starting cell product parameters, tap **edit**.

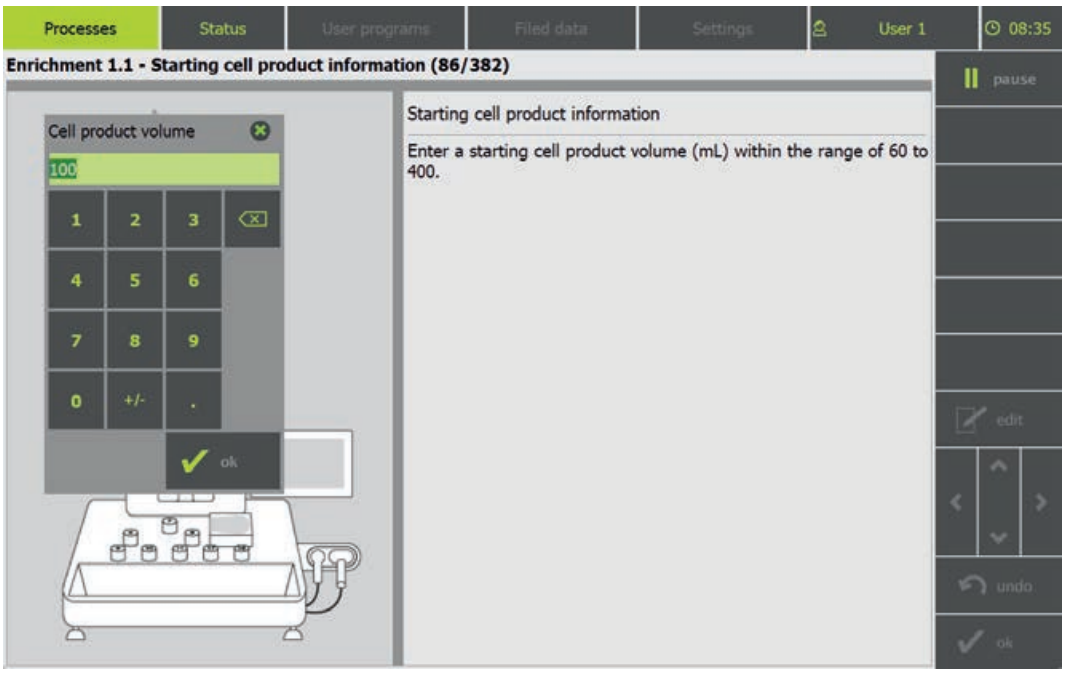
1. Enter the WBC concentration of the starting cell product. The allowed range is shown on the right-hand side of the screen. Ensure that the value entered reflects the value of the cell product. Otherwise cell product processing may not be optimal. To continue with the next input, tap **ok**.



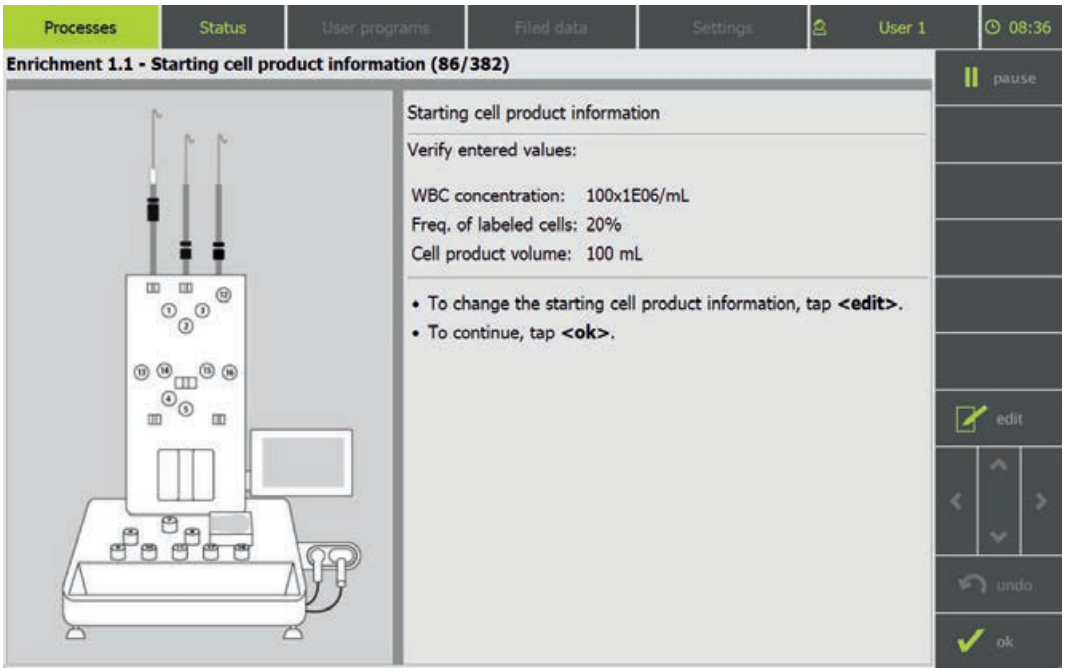
2. Enter the percentage of labeled cells. Ensure that the value entered reflects the value of the cell product. Otherwise cell product processing may not be optimal. To continue with the next input, tap **ok**.



3. Enter the volume of the cell product to be attached to the tubing set. Ensure that the value entered reflects the value of the cell product. Otherwise cell product processing may not be optimal. To continue, tap **ok**.



4. Verify the entered values. To correct an entry, tap **edit** and re-enter the values as described in steps 1 to 3. To continue, tap **ok**.



Checking the calculated cell number

After verifying the entered values, the CliniMACS Plus Software calculates the total number of labeled cells to check whether the separation capacity is sufficient.

If the result is within the system specifications, the screen shows Figure 7.16.

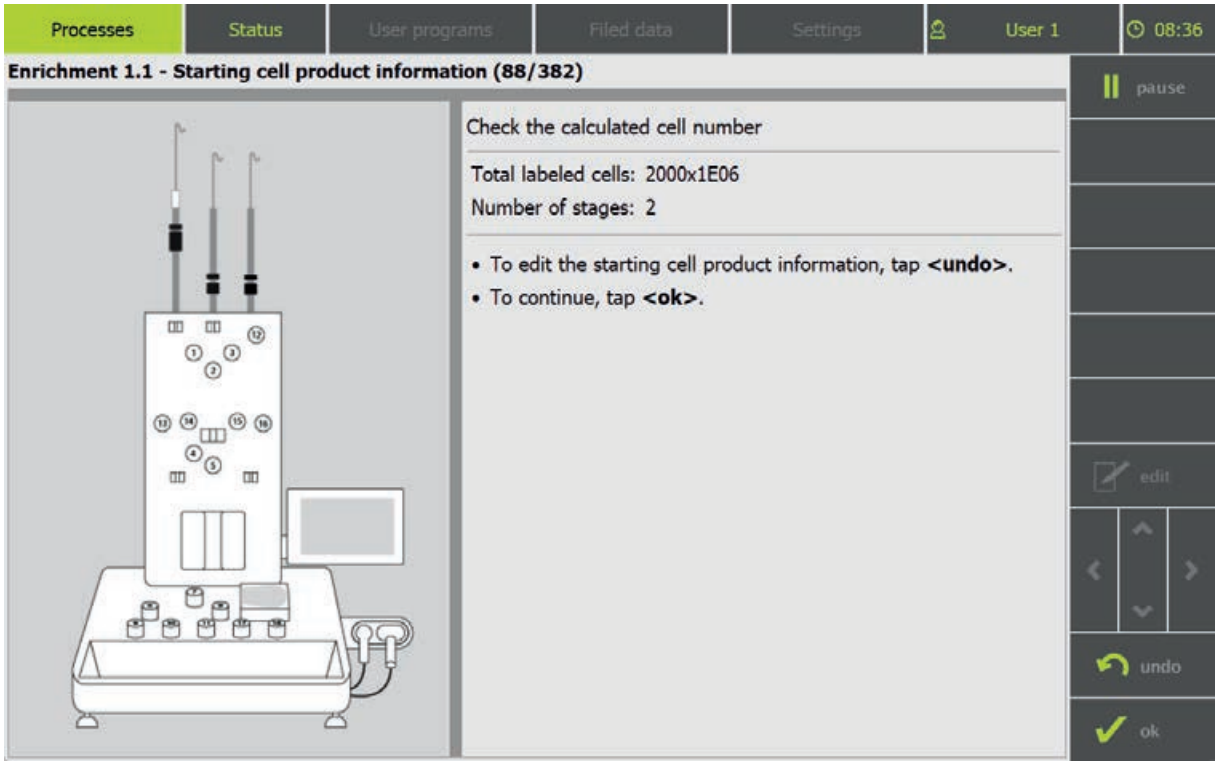


Figure 7.16: Calculation - Labeled cell number is within separation capacity

1. Ensure that the correct cell product parameters have been entered and the calculated number of cells is correct. To edit the entered values and return to Figure 7.15, tap **undo** > **edit**. To continue, tap **ok**.

If the result exceeds the standard separation capacity, the screen shows Figure 7.17.

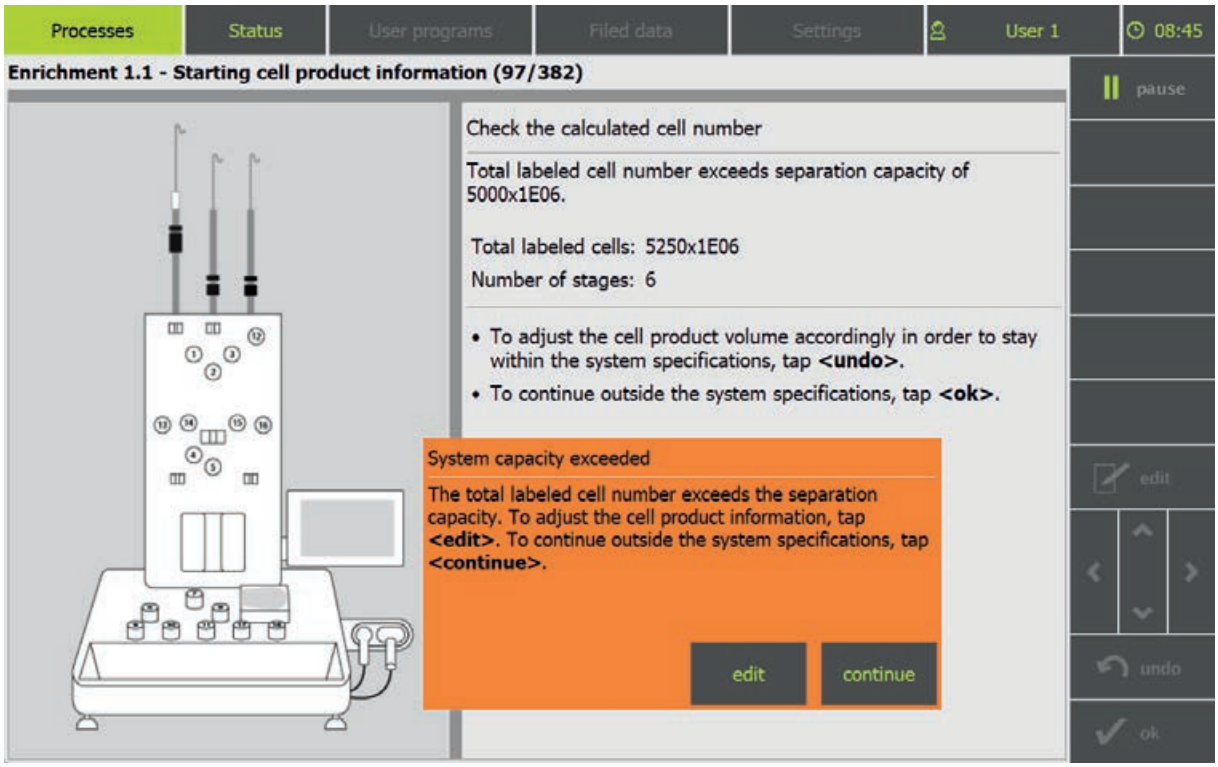


Figure 7.17: Calculation - Labeled cell number exceeds separation capacity

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

1. Ensure that the correct cell product parameters have been entered and the calculated number of cells is correct. To edit the entered values and return to Figure 7.15, tap **undo** > **edit**. To continue outside the system specifications, tap **ok** > **continue**.
2. To avoid overloading the system, split the cell product and determine the volume of each portion. To return to the previous screen (see Figure 7.15), tap **undo**.
    a. Enter the cell product parameters for the first aliquot of the cell product and continue with the separation of this portion.
    b. After the separation is finished, start a second separation for the second aliquot using a new tubing set.
    c. To continue, tap **ok**.

Checking the required buffer and bag volumes

From the total number of labeled cells (see section 'Checking the calculated cell number'), the software calculates the number of separation stages, the amount of process buffer needed for the entire separation and the liquid volumes that will be collected in Negative Fraction Bag, Buffer Waste Bag, and Cell Collection Bag.

The standard values are the following:

- Process buffer: 1000 mL
- Cell Collection Bag: 150 mL
- Negative Fraction Bag: 500 mL
- Buffer Waste Bag: 500 mL

If the calculated values are within the system specifications, the screen shows Figure 7.18. Prepare the required amount of buffer. Connect the appropriate bags to the tubing set when instructed.

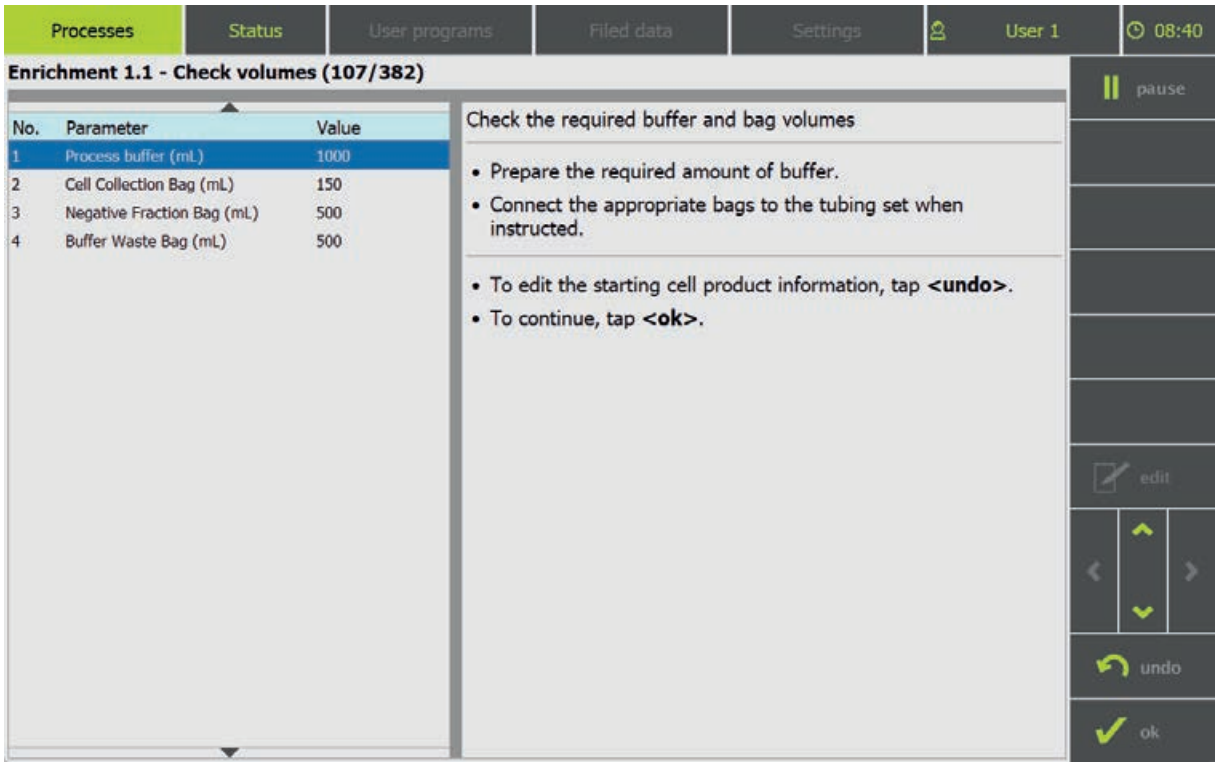


Figure 7.18: Check required buffer and bag volumes

If one of the calculated values exceeds these standard values, Figure 7.19 appears to inform about the amount of liquid that will be required and accumulated during the separation process. If replacement of bags is necessary, replace the bags delivered with the tubing set (capacity approximately 500 mL) by alternative bags of appropriate size.

- The bags originally attached to the tubing set are connected by luer connections.
- Bags that replace the original bags should have a female luer connector.

Standard bags can be connected by a Luer/Spike Interconnector.

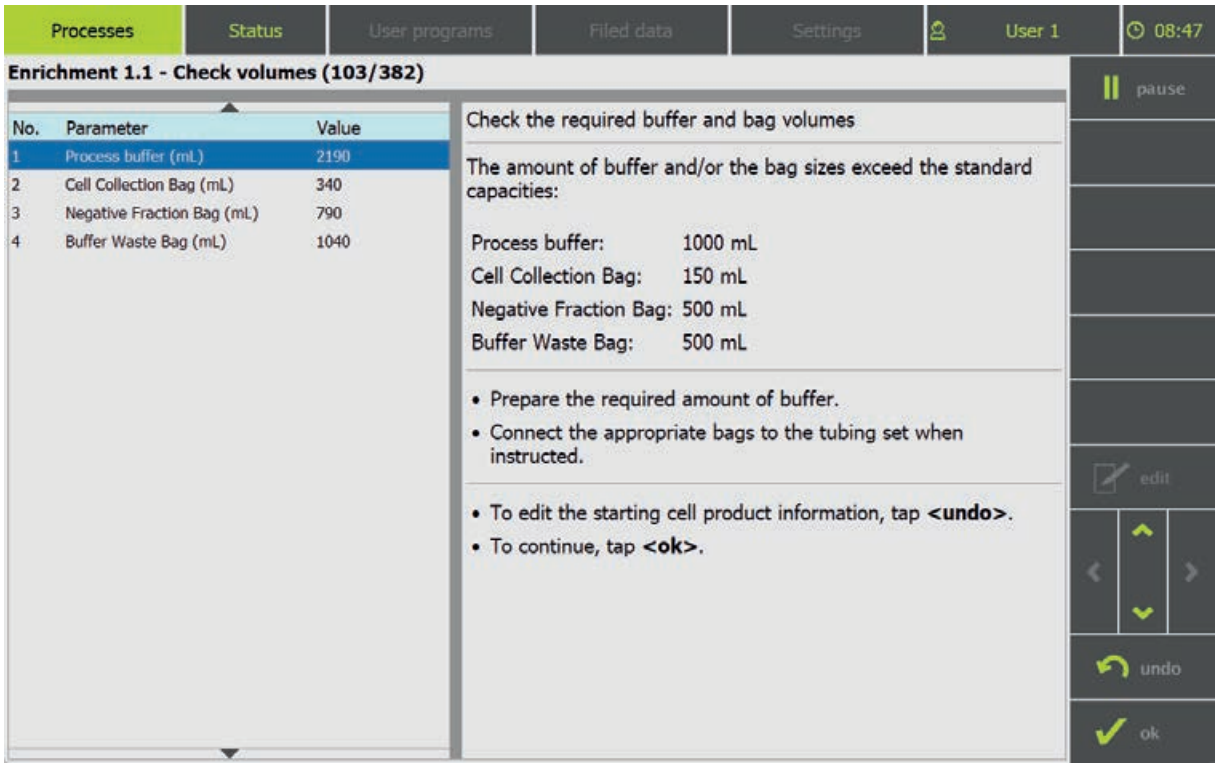


Figure 7.19: Separation capacity exceeded

⚠ WARNING

Risk of personal injury and infection.

Overloading the bag hangers can cause the instrument to tip over. Falling or damaged bags may become contaminated. Contaminated solution may lead to infection if used.

- Do not overload the bag hangers. The carrying capacity of a single bag hanger is 5 kg.

1. Ensure that the requested amount of buffer is available. DO NOT attach more than five liters of buffer on the bag hanger.
2. If necessary, open the tray of the tubing set under sterile conditions and replace the original bags with larger ones. Ensure unrestricted flow to these bags.
3. Attach a Cell Collection Bag of sufficient size to the free luer connector. If not specified in Figure 7.19, the maximum elution volume of the target cell fraction is 150 mL. Ensure that unrestricted flow to the Cell Collection Bag is possible.

IMPORTANT:

- Ensure that the required amount of buffer is available and the volume of the bags listed in Figure 7.19 is sufficient. Otherwise the performance of the separation will be compromised.
- Any modifications of the CliniMACS Tubing Sets should be performed under sterile conditions, for example, in the laminar flow hood.
- For further analysis or cell processing, note that the volumes listed in Figure 7.19 are not the exact volumes but volumes within the safety requirements.

4. Ensure that the Luer lock connections on the columns are undamaged. DO NOT tighten or manipulate the Luer lock connections on the columns.

To continue, tap **ok**.

Entering reagent parameters (optional)

1. To choose whether to enter reagent parameters or to continue without any entry, tap **ok**. A pop-up window appears.
2. Depending on the number of reagent vials used, tap **1 vial** or **2 vials**.
3. Use the barcode reader to scan the barcode label on the reagent vial.
4. Alternatively, enter the part number (P/N), LOT number, and use-by date manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
5. To continue without any entry, tap **continue**.

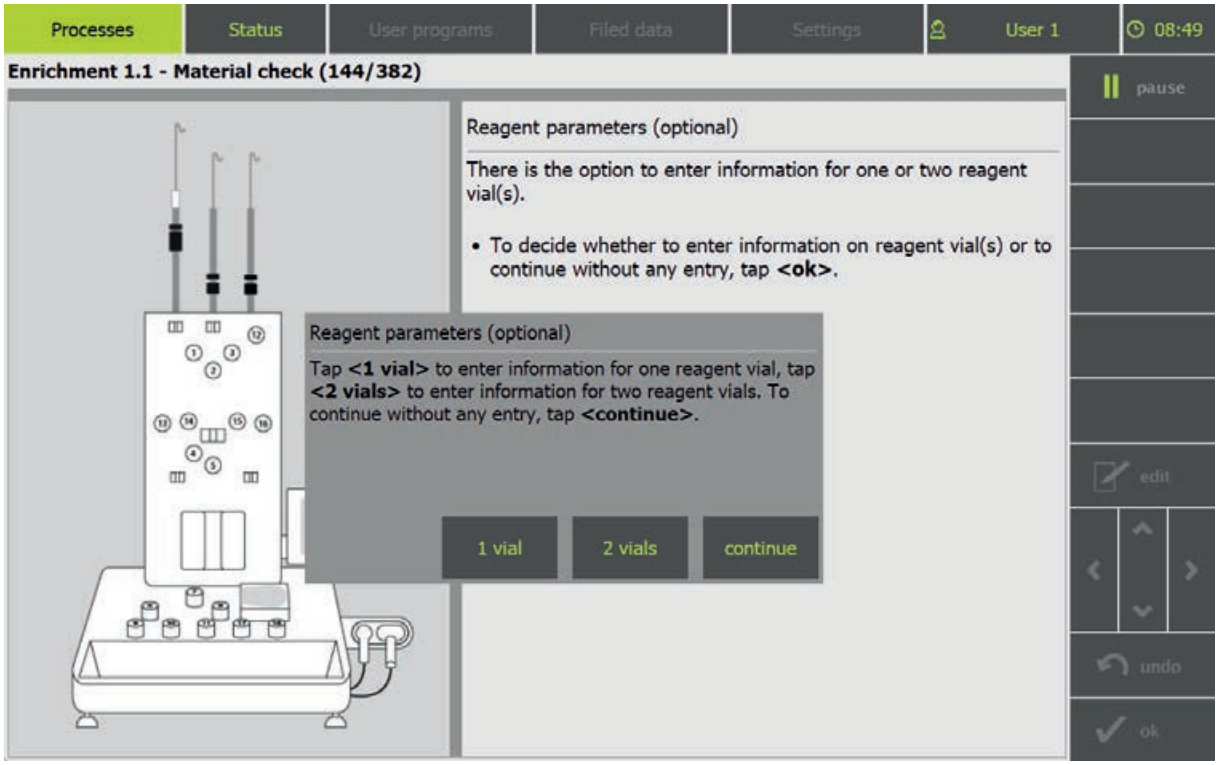


Figure 7.20: Choice of reagent parameter entry

Entering process buffer parameters (optional)

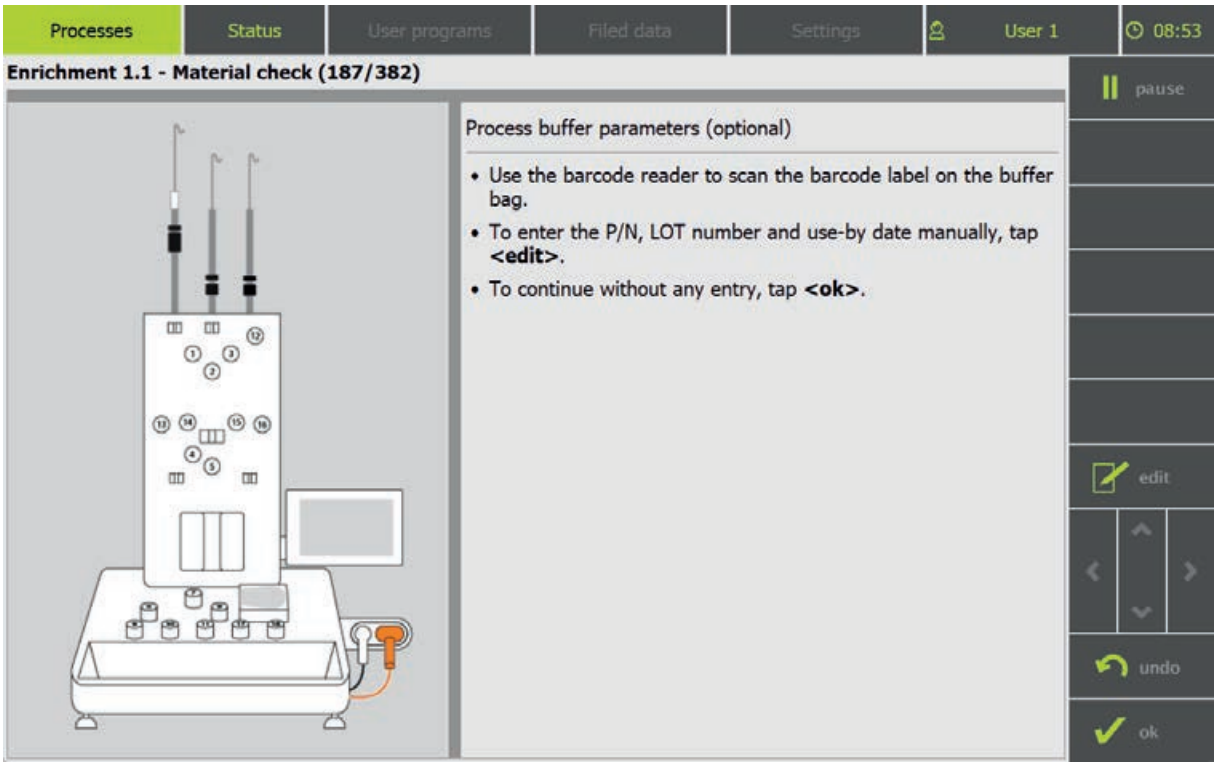


Figure 7.21: Entry of process buffer parameters

If more than one buffer bag is used, repeat the following steps for each buffer bag.

1. To enter the process buffer parameters, scan the barcode label on the buffer bag using the barcode reader.
2. Alternatively, enter the parameters manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
3. To continue without any entry, tap **ok**.

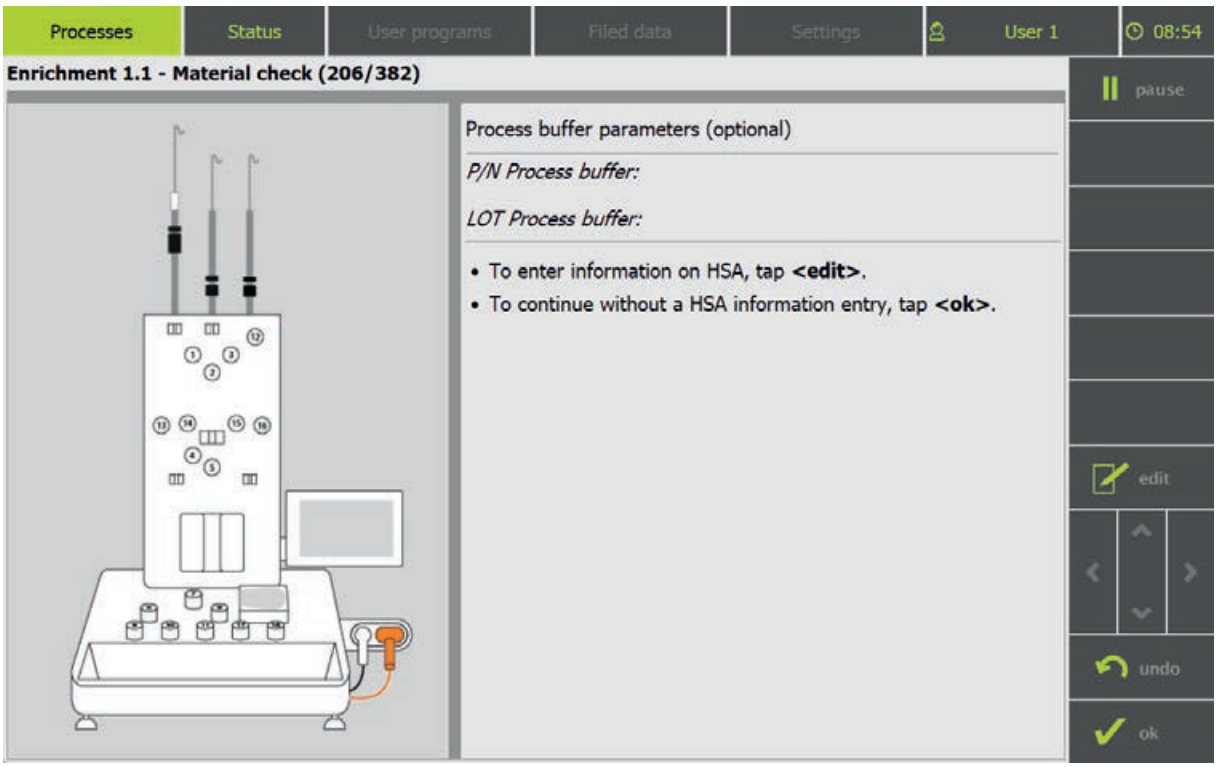


Figure 7.22: Entry of HSA information for the process buffer

Additionally, the user can enter HSA information for the process buffer.

1. To enter HSA information, tap **edit**. To continue without any entry, tap **ok**.

Entering information for additional materials (optional)

If multiple additional materials are used, repeat the following steps for each entry.

1. To enter the item name and information of the additional material, tap **edit**. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
2. To continue without any entry, tap **ok**.

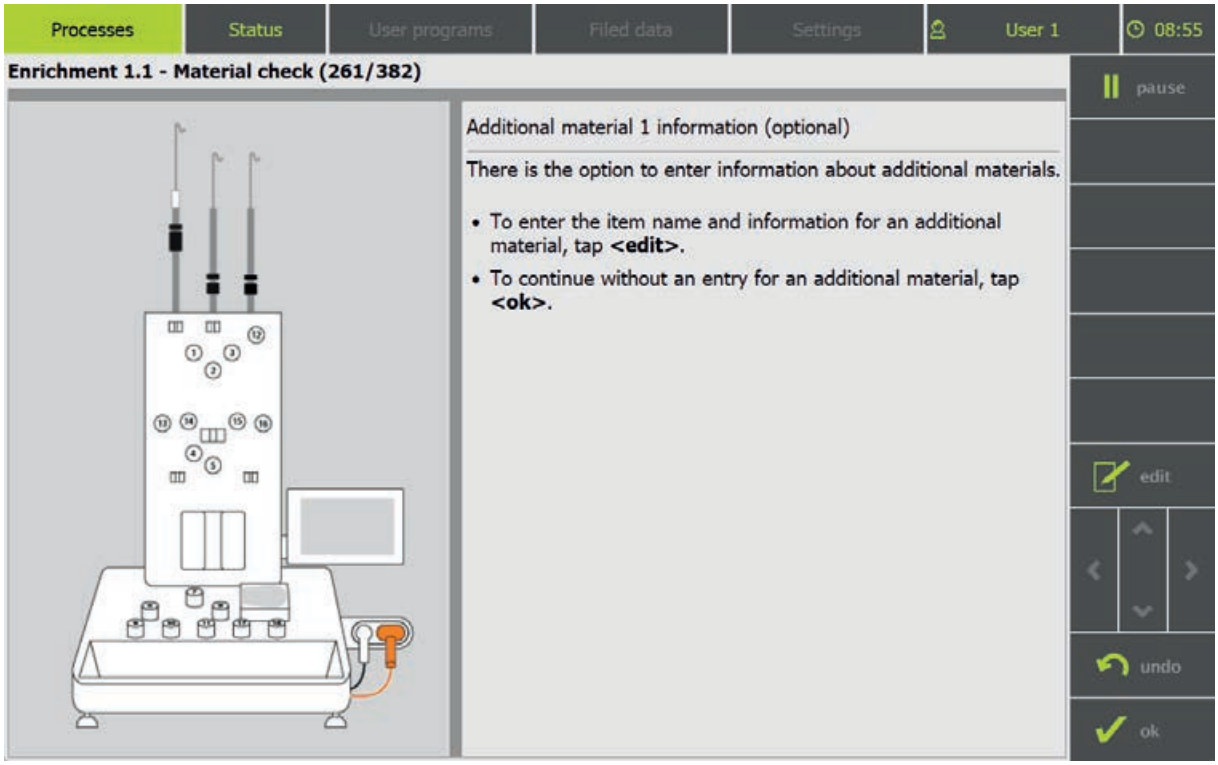


Figure 7.23: Entry of additional material information

Continue with the installation of the tubing set (see section 'Step 3: Installation of CliniMACS Tubing Sets').

7.2.5 Enrichment 3.2

The separation program Enrichment 3.2 must only be used in combination with the CliniMACS Tubing Set (REF 161-01) or the CliniMACS Tubing Set LS (REF 162-01). Ensure that the tubing set is correct before the installation on the instrument.

Screen prompts and diagrams serving as procedure guides will appear on the screen.

- Perform and check each step according to the manual and software instructions before proceeding to the next step.
- To correct a mistake during data input, tap **undo** (refer to the CliniMACS Plus Software user manual for more details on the toolbar).

Choosing of separation program Enrichment 3.2

1. To select Enrichment 3.2 from the list (see Figure 7.24), highlight the name of the program by using the navigation buttons ⌄ and ⌃ or by tapping on the program name.
2. To continue with the selected program, tap **run**.

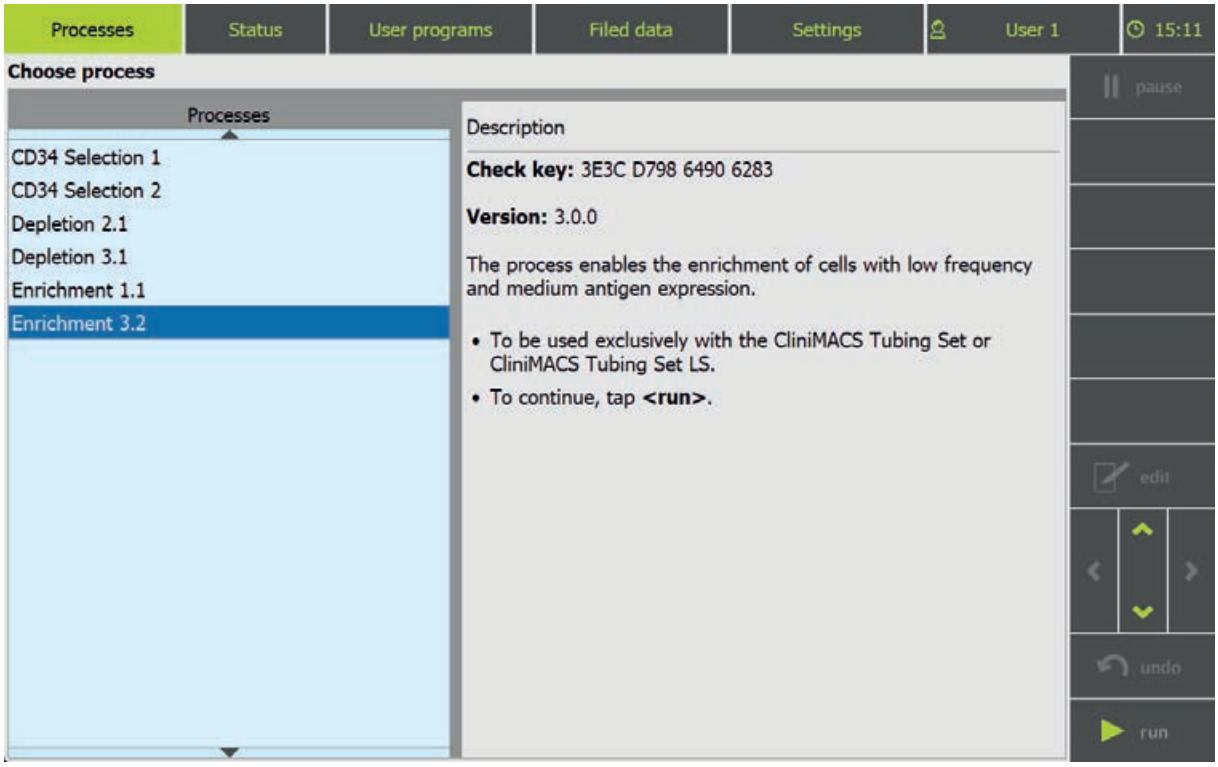


Figure 7.24: Choice of separation program Enrichment 3.2

Entering Run ID (optional)

The user can enter a Run ID for the process. To enter a Run ID, tap **edit**. To continue without any entry, tap **ok**.

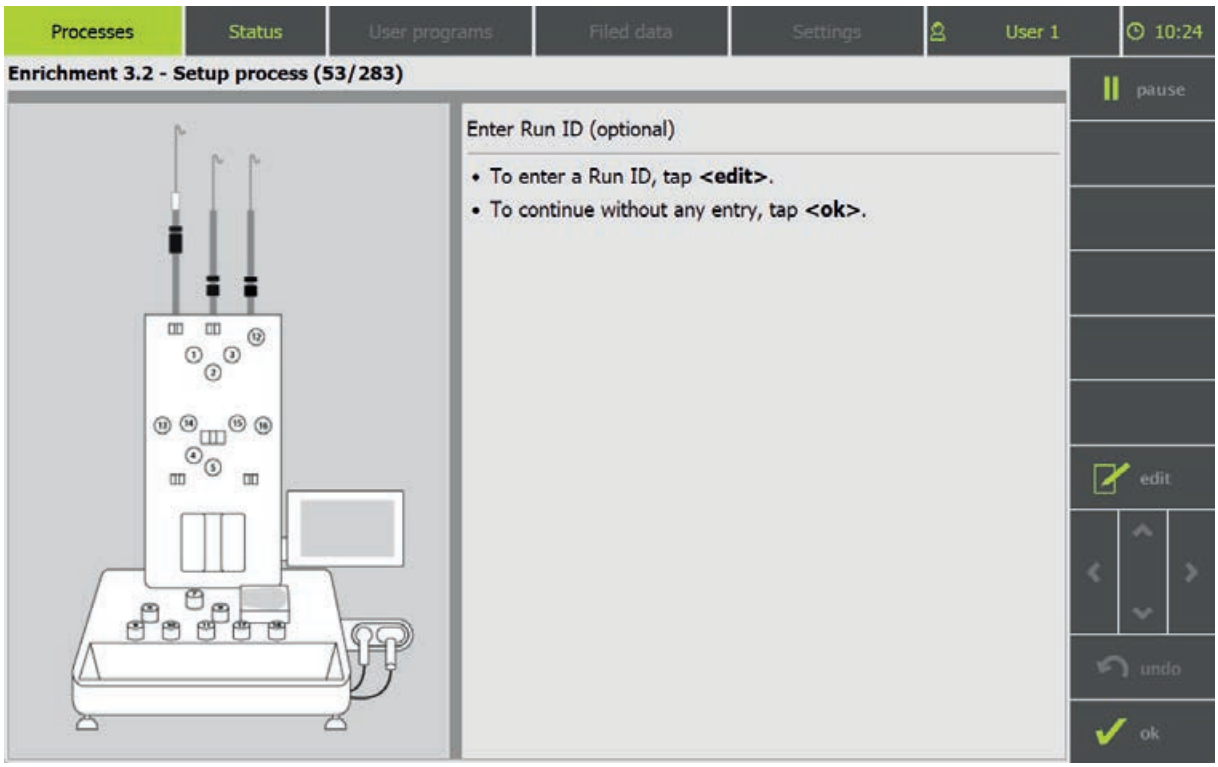


Figure 7.25: Entry of Run ID

Entering tubing set parameters

1. Use the barcode reader to scan the barcode label on the tubing set packaging.
2. Alternatively, enter the part number (P/N), LOT number, and use-by date manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.

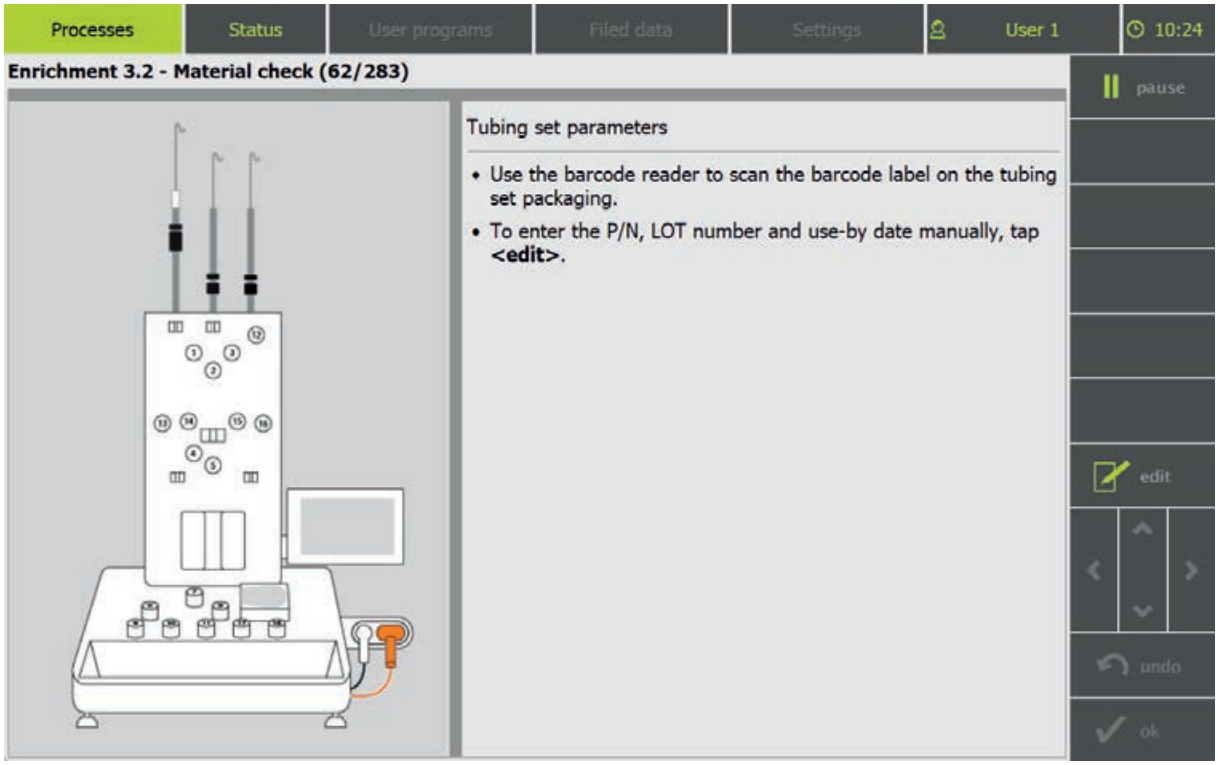


Figure 7.26: Entry of tubing set parameters

Entering starting cell product information (optional)

1. Use the barcode reader to scan the barcode label on the cell product.
2. Alternatively, enter the information manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm each entry, tap **ok**.

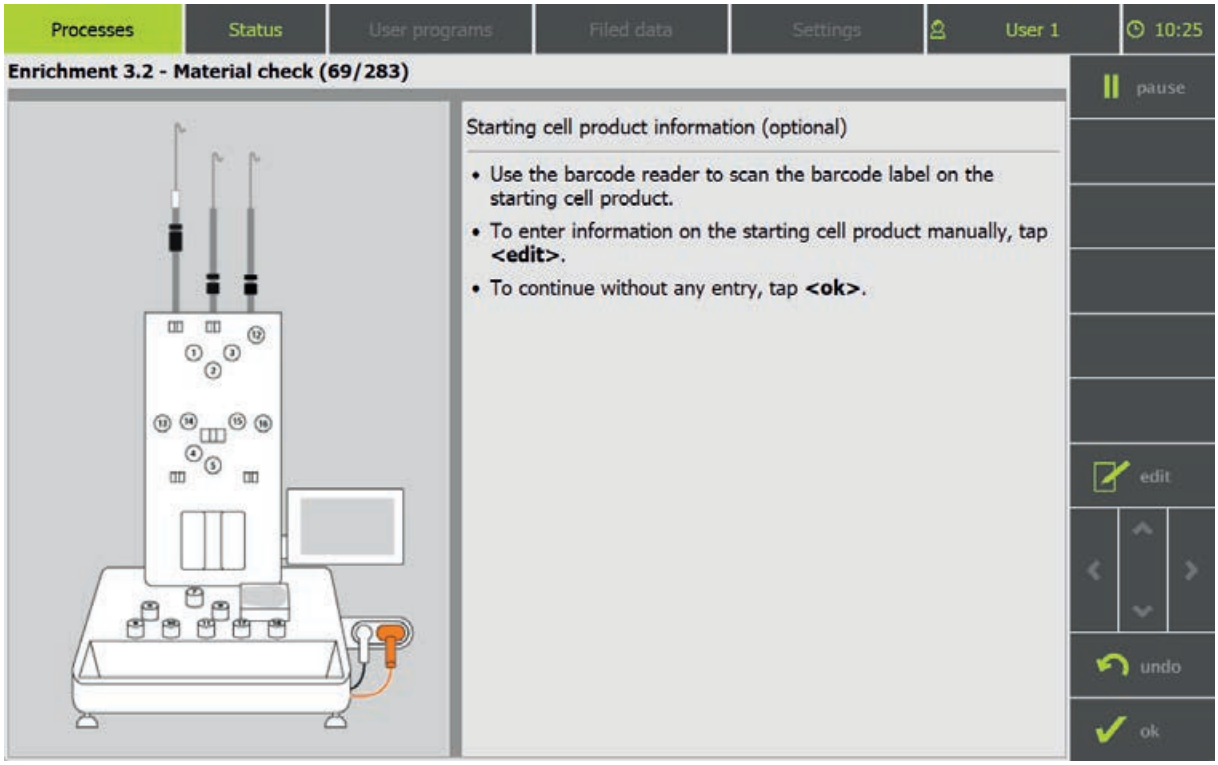


Figure 7.27: Entry of starting cell product information

Entering reagent parameters (optional)

1. To choose whether to enter reagent parameters or to continue without any entry, tap **ok**. A pop-up window appears.
2. Depending on the number of reagent vials used, tap **1 vial** or **2 vials**.
3. Use the barcode reader to scan the barcode label on the reagent vial.
4. Alternatively, enter the part number (P/N), LOT number, and use-by date manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
5. To continue without any entry, tap **continue**.

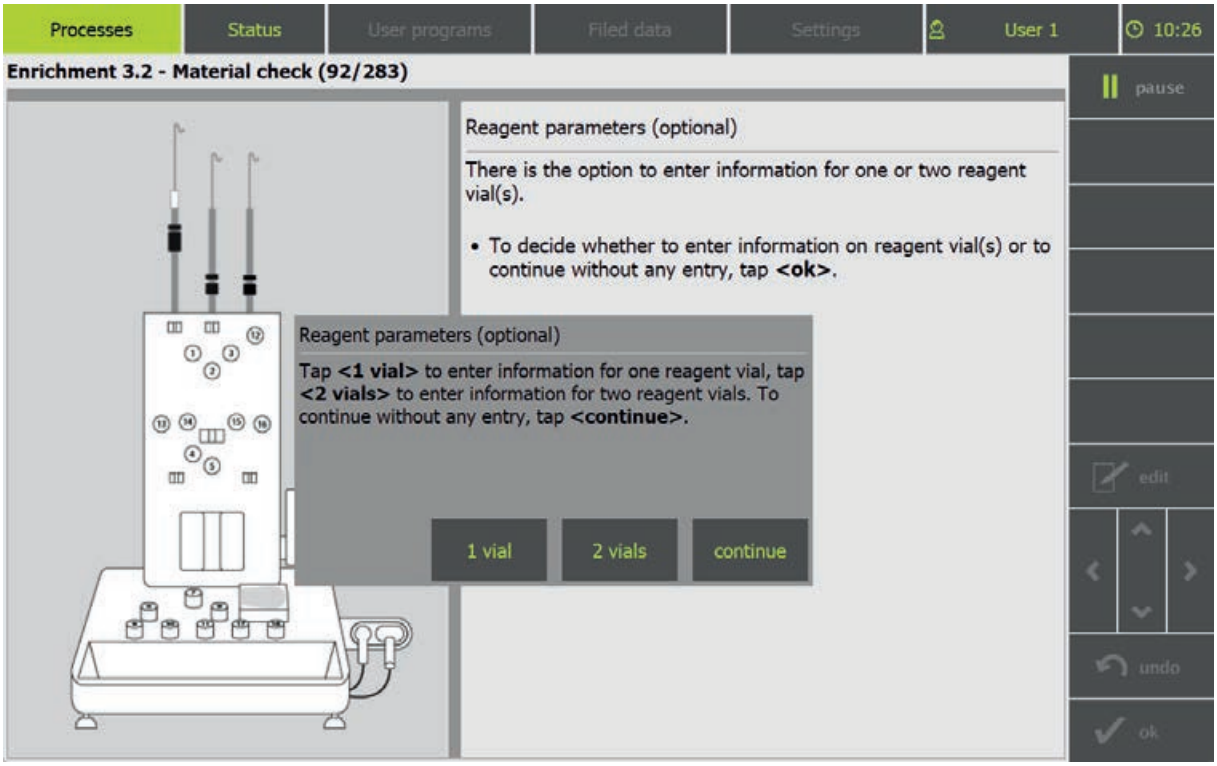


Figure 7.28: Choice of reagent parameter entry

Entering process buffer parameters (optional)

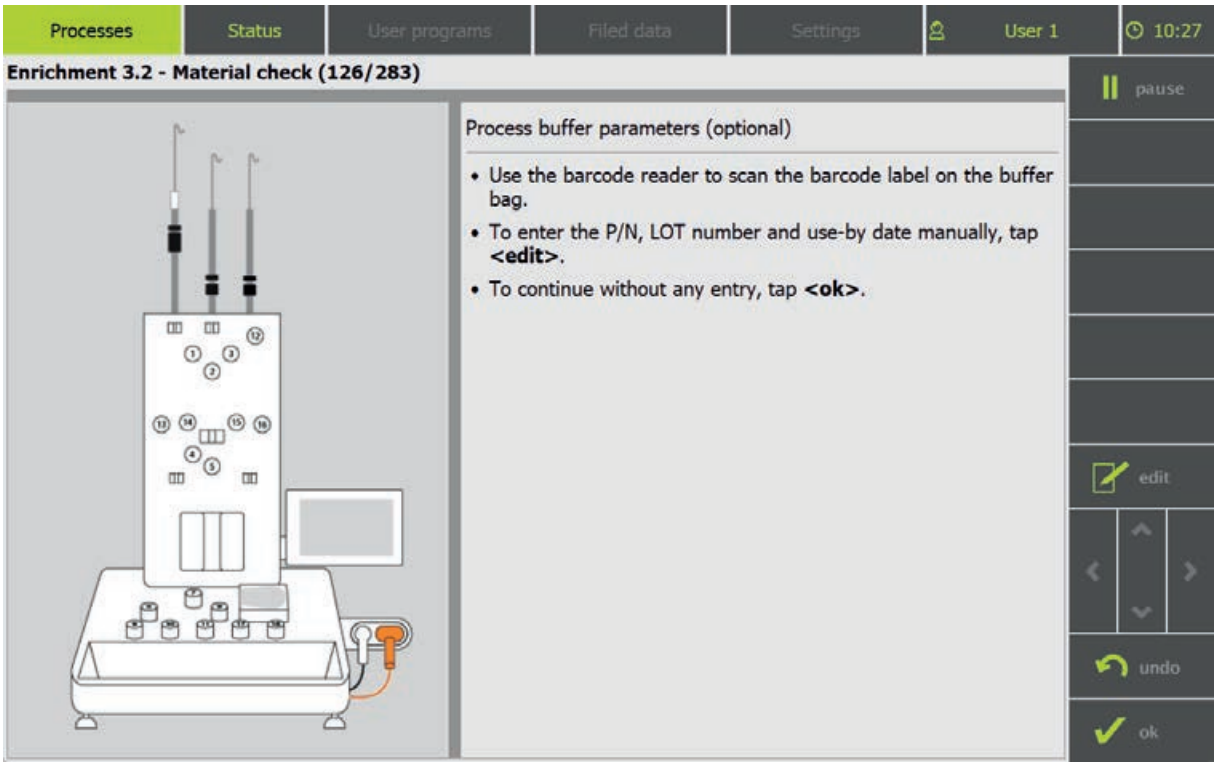


Figure 7.29: Entry of process buffer parameters

1. To enter the process buffer parameters, scan the barcode label on the buffer bag using the barcode reader.
2. Alternatively, enter the parameters manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
3. To continue without any entry, tap **ok**.

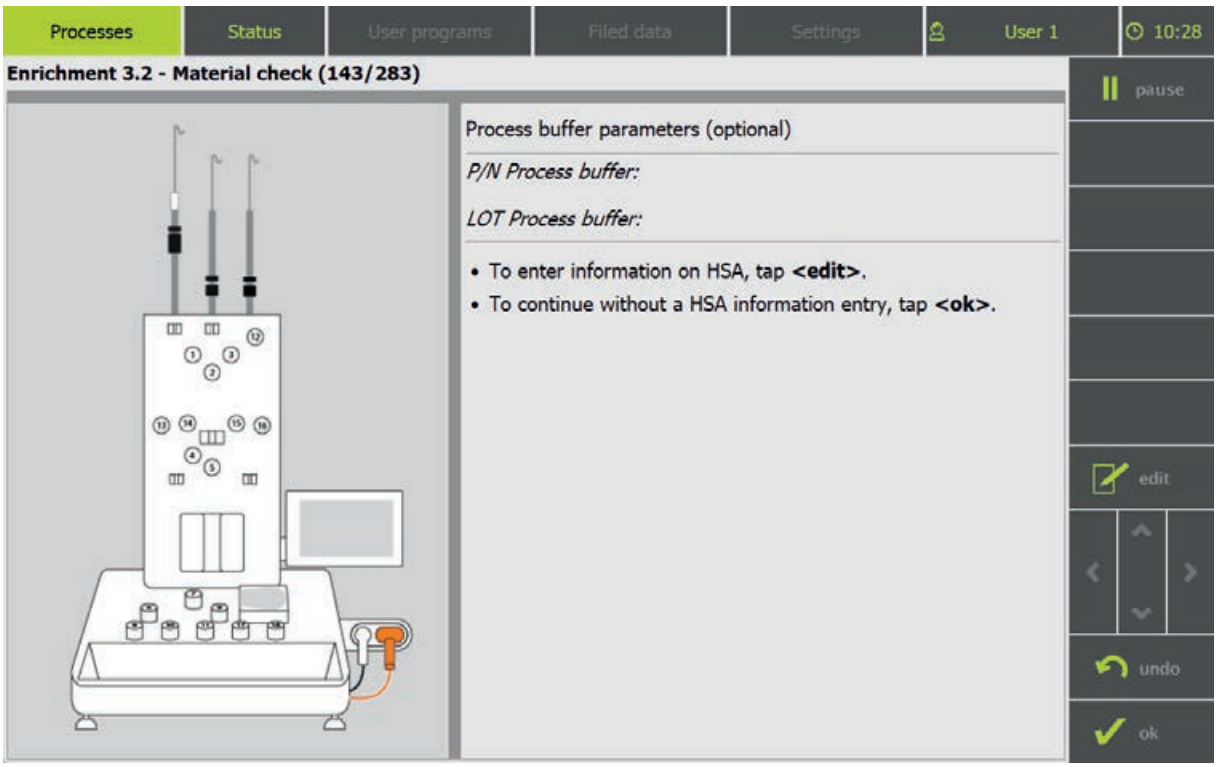


Figure 7.30: Entry of HSA information for the process buffer

Additionally, the user can enter HSA information for the process buffer.

1. To enter HSA information, tap **edit**. To continue without any entry, tap **ok**.

Entering information for additional materials (optional)

If multiple additional materials are used, repeat the following steps for each entry.

1. To enter the item name and information of the additional material, tap **edit**. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
2. To continue without any entry, tap **ok**.

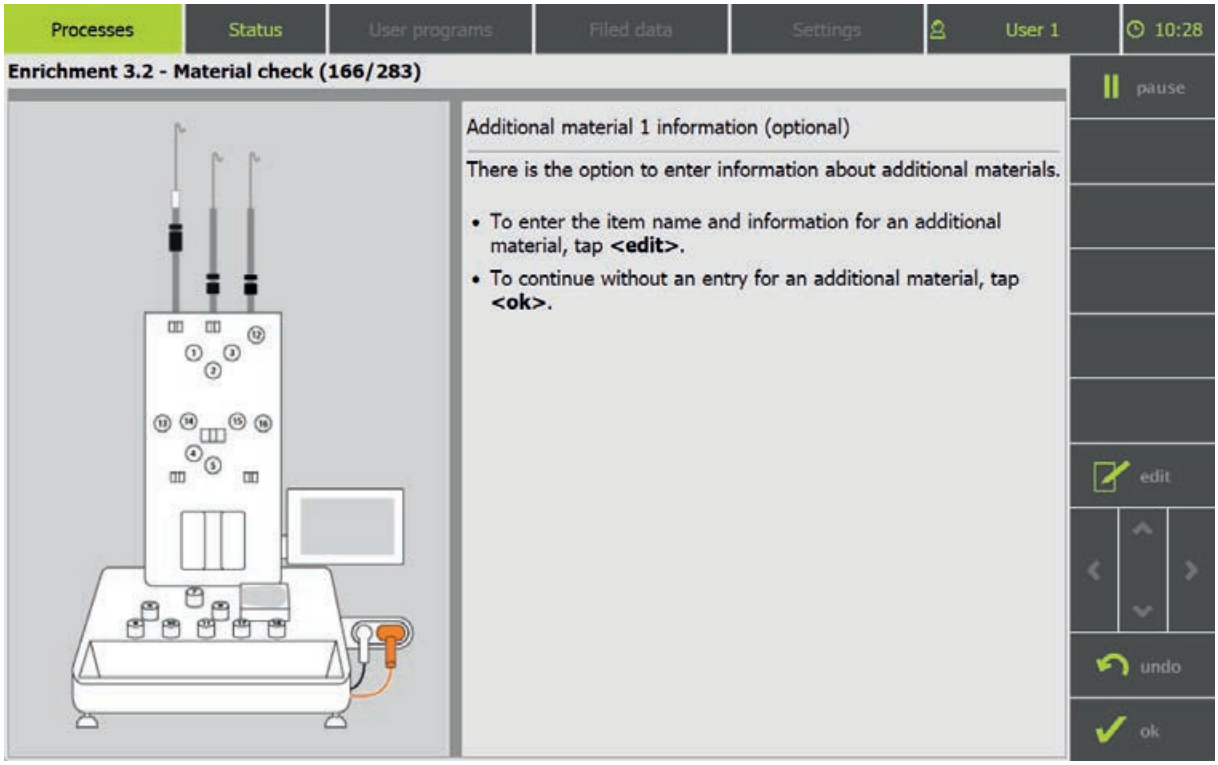


Figure 7.31: Entry of additional material information

Continue with the installation of the tubing set (see section 'Step 3: Installation of CliniMACS Tubing Sets').

7.2.6 Depletion 2.1

The separation program Depletion 2.1 must only be used in combination with the CliniMACS Tubing Set LS (REF 162-01). Ensure that the tubing set is correct before the installation on the instrument.

Screen prompts and diagrams serving as procedure guides will appear on the screen.

- Perform and check each step according to the manual and software instructions before proceeding to the next step.
- To correct a mistake during data input, tap **undo** (refer to the CliniMACS Plus Software user manual for more details on the toolbar).

IMPORTANT:
Before starting Depletion 2.1, it is recommended to use the Separation Planner tool to plan and prepare for the actual separation run (see section 'Separation planner tool').

Choosing separation program Depletion 2.1

1. To select Depletion 2.1 from the list (see Figure 7.32), highlight the name of the program by using the navigation buttons ⌄ and ⌃ or by tapping on the program name.
2. To continue with the selected program, tap **run**.

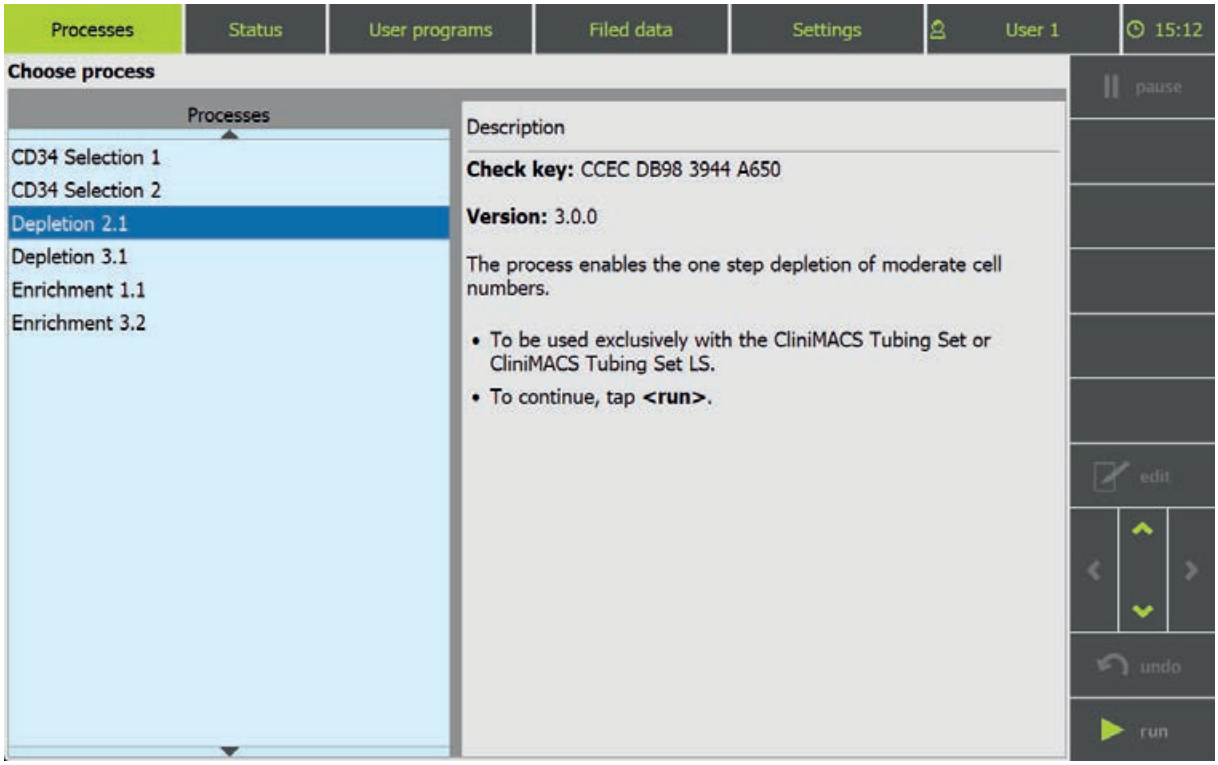


Figure 7.32: Choice of separation program Depletion 2.1

Entering Run ID (optional)

The user can enter a Run ID for the process. To enter a Run ID, tap **edit**. To continue without any entry, tap **ok**.

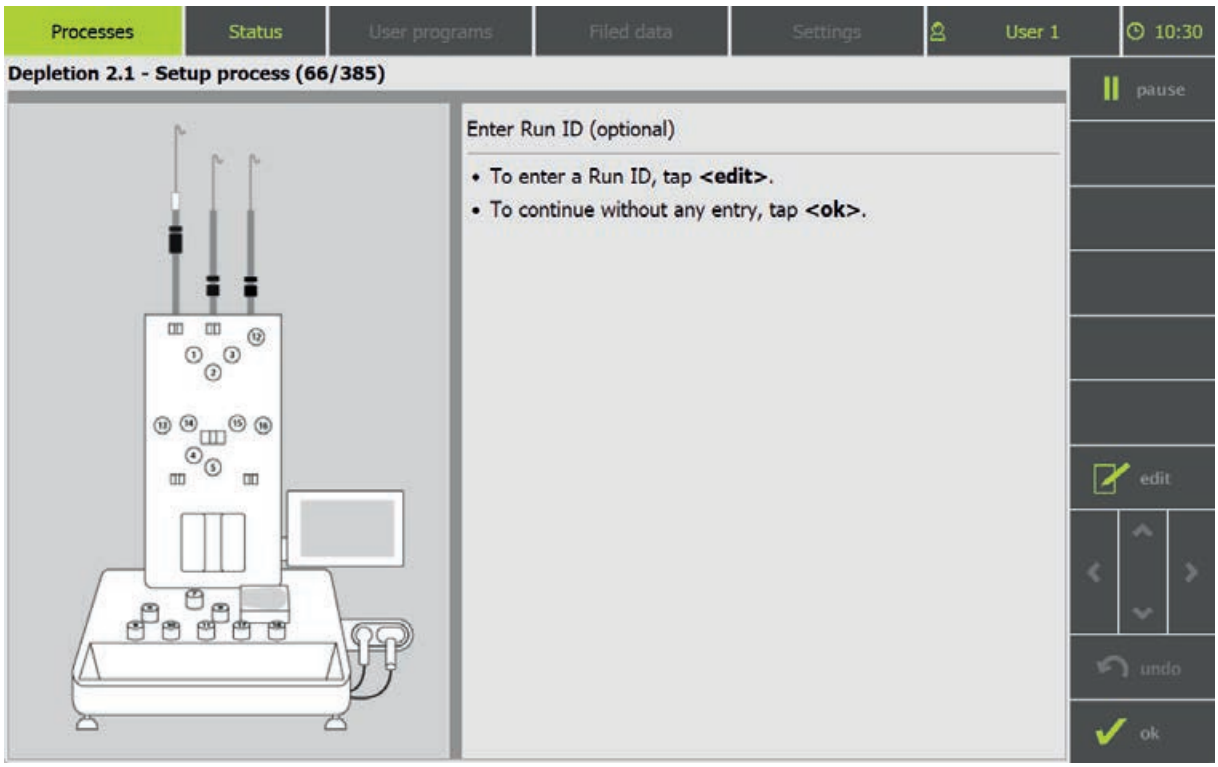


Figure 7.33: Entry of Run ID

Entering tubing set parameters

1. Use the barcode reader to scan the barcode label on the tubing set packaging.
2. Alternatively, enter the part number (P/N), LOT number, and use-by date manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.

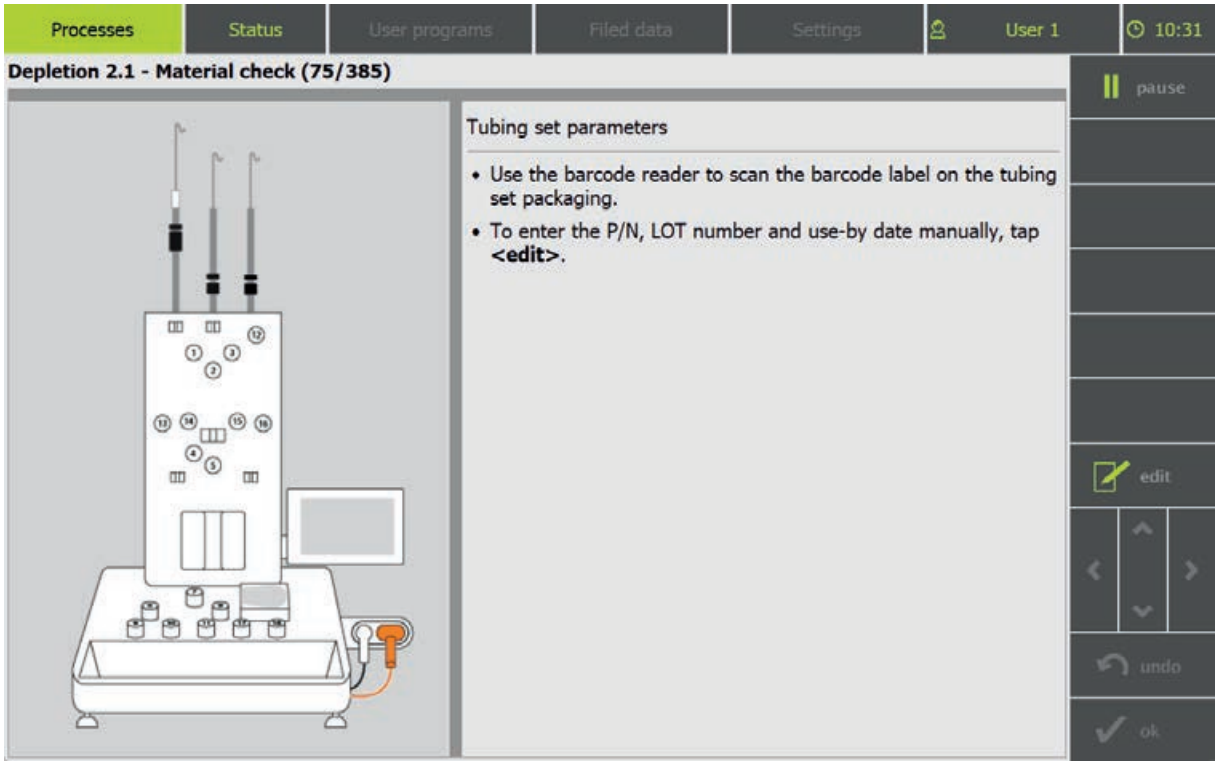


Figure 7.34: Entry of tubing set parameters

Entering starting cell product information (optional)

1. Use the barcode reader to scan the barcode label on the cell product.
2. Alternatively, enter the information manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm each entry, tap **ok**.

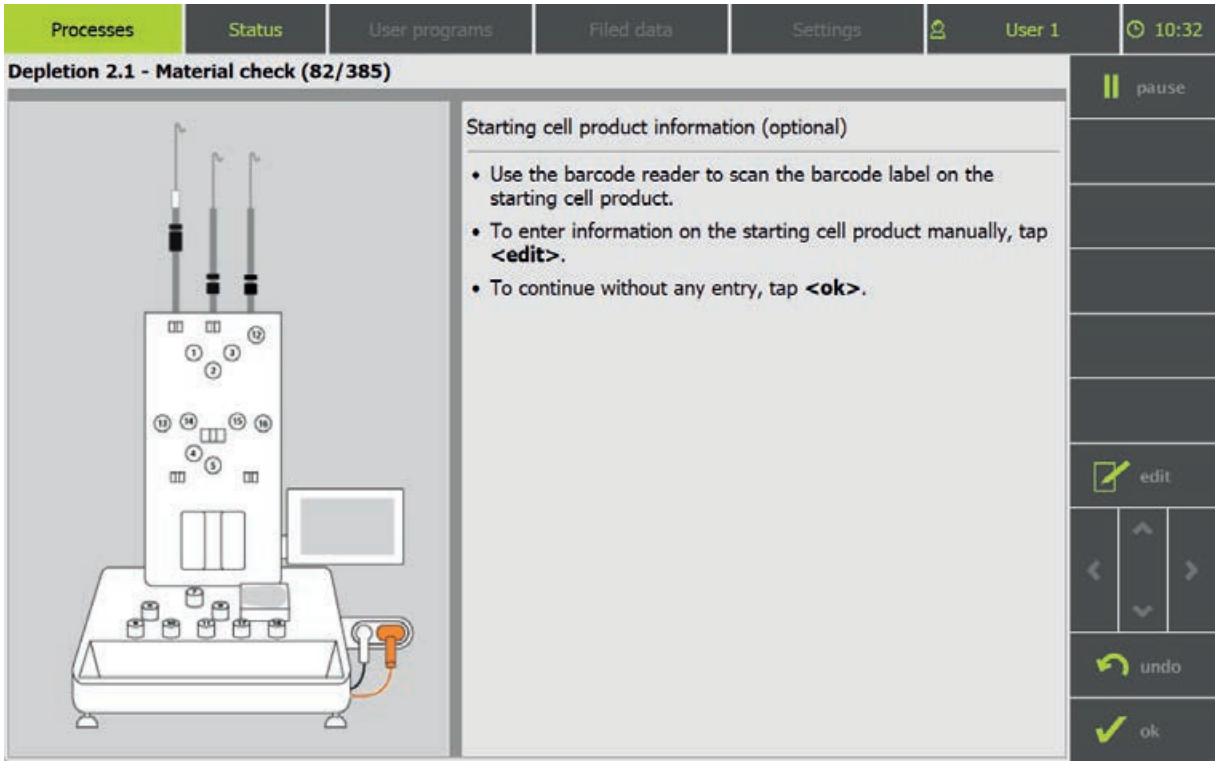


Figure 7.35: Entry of starting cell product information

Entering starting cell product parameters

Enter the starting cell product parameters (see Figure 7.36). The starting cell product parameters are necessary to adjust the separation to each individual cell product and to provide the user with important information about the required buffer and bag volumes.

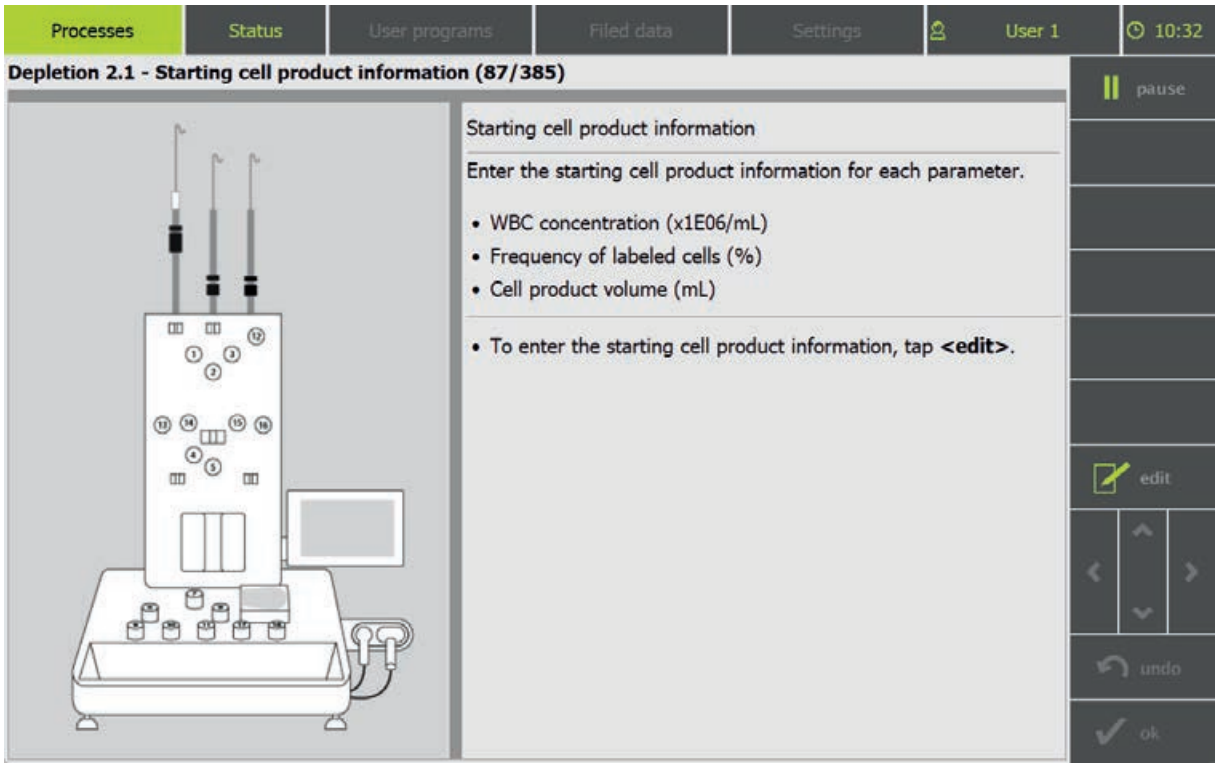


Figure 7.36: Entry of starting cell product parameters

⚠ CAUTION

Specifying wrong parameters may result in non-optimal cell product processing and may increase the risk of target cell loss.

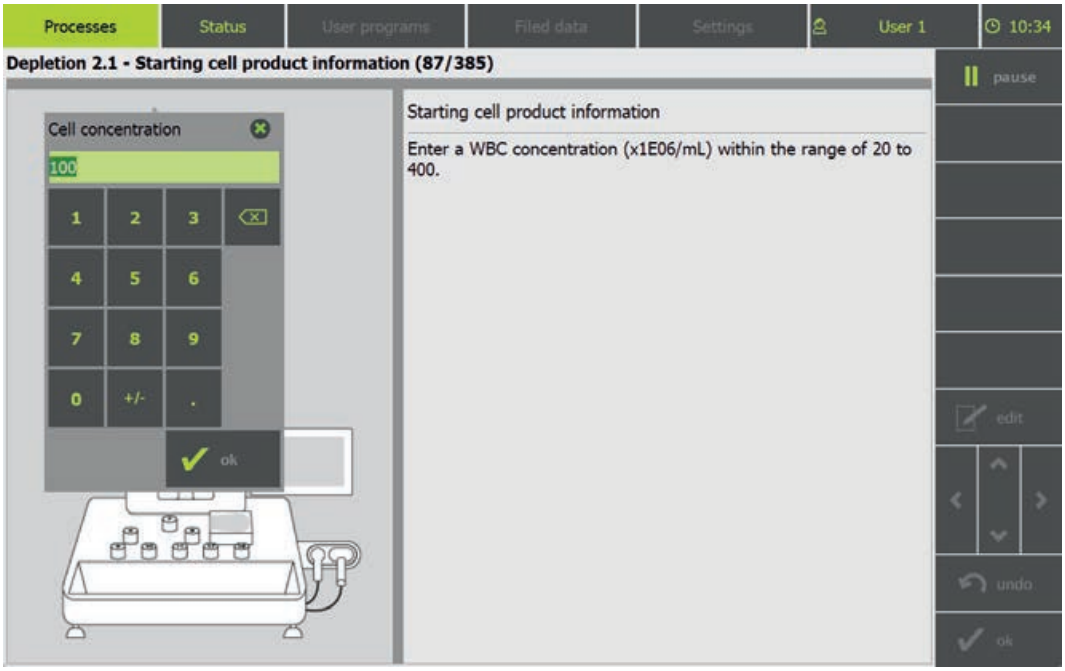
Entering values for WBC concentration and/or percentage of labeled cells which are lower than the actual cell product values may result in cell loss due to the system being overloaded. Entering a lower cell product volume may result in cell loss due to overloading or even to incomplete cell product processing. If the specification of any of the three parameters is too high, this will result in increased processing time and enlarged volume of the target cell fraction.

- Always ensure to enter the correct parameters.

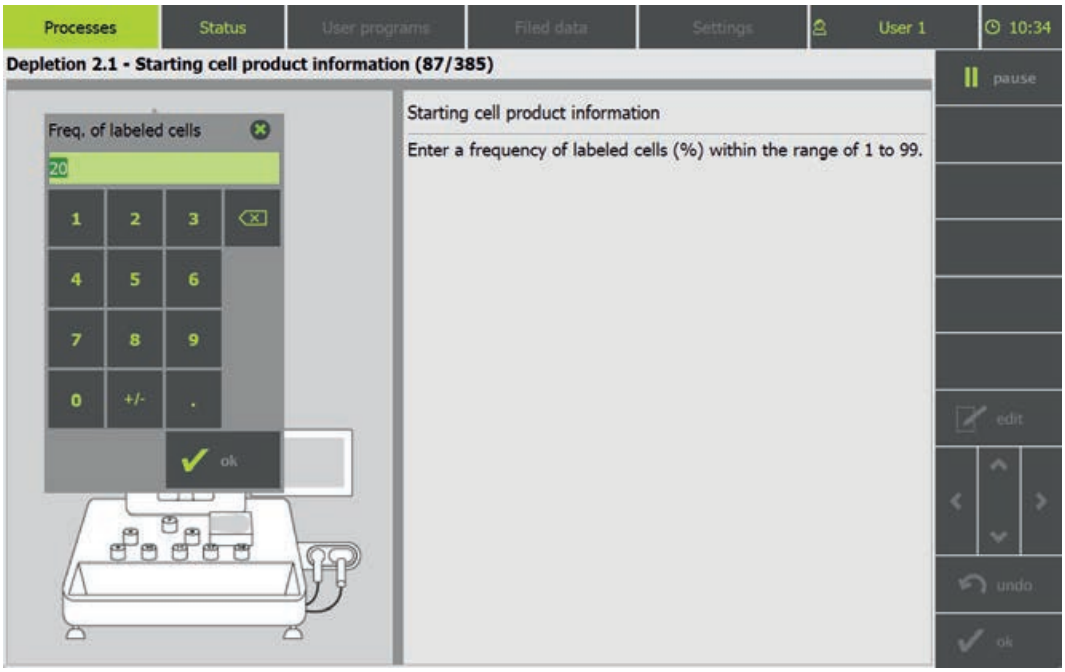
To enter the starting cell product parameters, tap **edit**.

IMPORTANT:
All cell product parameters required refer to the cell product after the cell labeling and washing procedure. The allowed range shown on the right-hand side of the screen always takes into account the previous input. After each input, the software calculates and adjusts the accepted range of the next query.

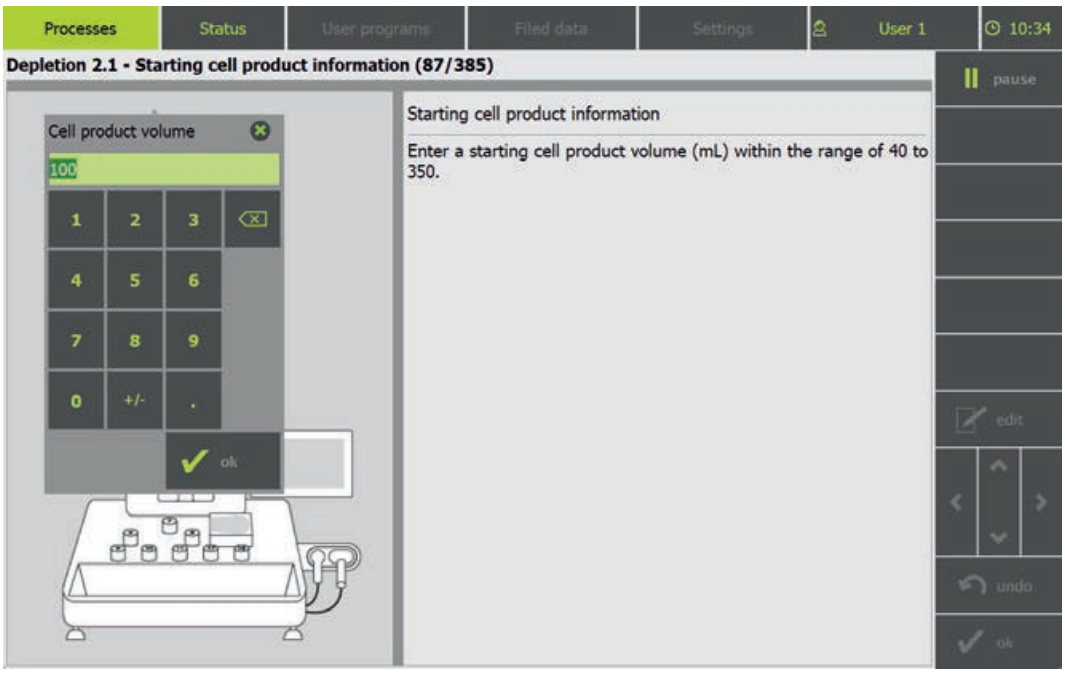
1. Enter the WBC concentration of the starting cell product. The allowed range is shown on the right-hand side of the screen. Ensure that the value entered reflects the value of the cell product. Otherwise cell product processing may not be optimal. To continue with the next input, tap **ok**.



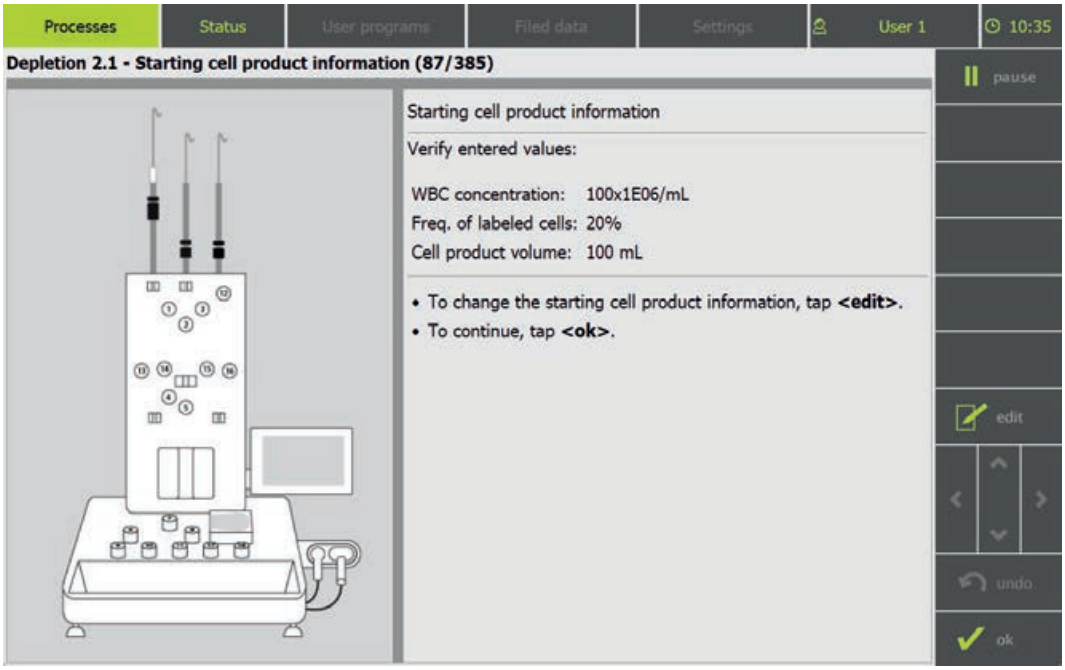
2. Enter the percentage of labeled cells. Ensure that the value entered reflects the value of the cell product. Otherwise cell product processing may not be optimal. To continue with the next input, tap **ok**.



3. Enter the volume of the cell product to be attached to the tubing set. Ensure that the value entered reflects the value of the cell product. Otherwise cell product processing may not be optimal. To continue, tap **ok**.



4. Verify the entered values. To correct a wrong input, tap **edit**. To continue, tap **ok**.



Checking the calculated cell number

After verifying the entered values, the CliniMACS Plus Software calculates the total number of labeled cells to check whether the separation capacity is sufficient.

If the result is within the system specifications, the screen shows Figure 7.37.

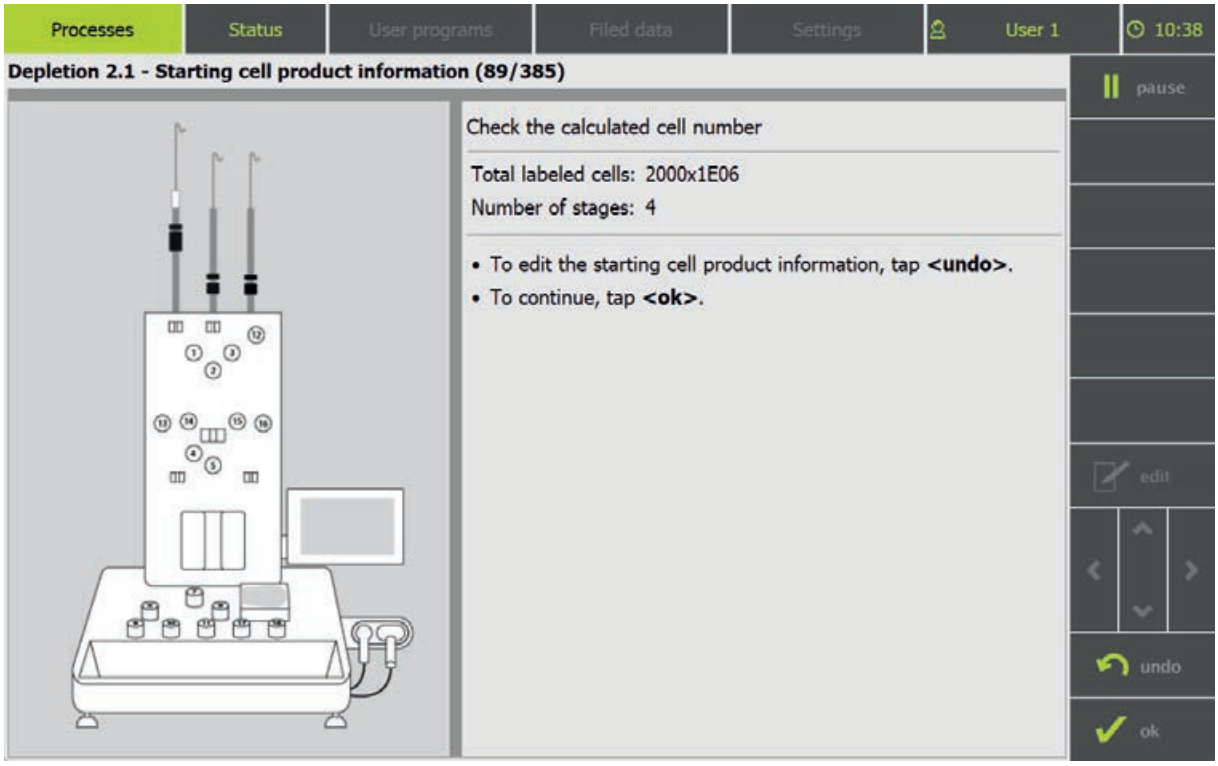


Figure 7.37: Calculation - Labeled cell number is within separation capacity

1. Ensure that the correct cell product parameters have been entered and the calculated number of cells is correct. To edit the cell product information, tap **undo**. To continue, tap **ok**.

If the result exceeds the standard separation capacity, the screen shows Figure 7.38.

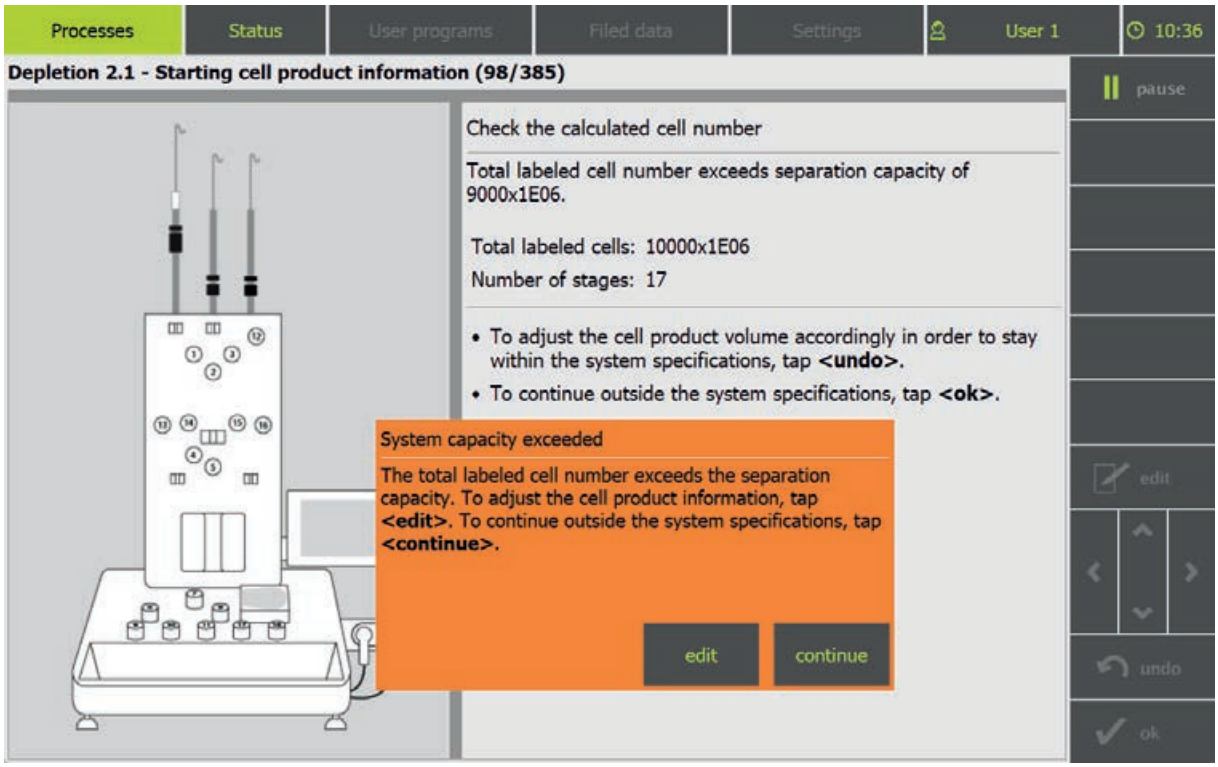


Figure 7.38: Calculation - Labeled cell number exceeds separation capacity

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

1. Ensure that the correct cell product parameters have been entered and the calculated number of cells is correct. To edit the entered values and return to Figure 7.36, tap **undo** > **edit**. To continue outside the system specifications, tap **ok** > **continue**.
2. To avoid overloading the system, split the cell product and determine the volume of each portion. To return to the previous screen (see Figure 7.36), tap **undo**.
    a. Enter the cell product parameters for the first aliquot of the cell product and continue with the separation of this portion.
    b. After the separation is finished, start a second separation for the second aliquot using a new tubing set.
    c. To continue, tap **ok**.

Checking the required buffer and bag volumes

From the total number of labeled cells (see section 'Checking the calculated cell number'), the software calculates the number of separation stages, the amount of process buffer needed for the entire separation and the liquid volumes that will be collected in Negative Fraction Bag, Buffer Waste Bag, and Cell Collection Bag.

The standard values are the following:

- Process buffer: 1000 mL
- Cell Collection Bag: 150 mL
- Negative Fraction Bag: 500 mL
- Buffer Waste Bag: 500 mL
- Priming Waste Bag: 500 mL

If the calculated values are within the system specifications, the screen shows Figure 7.39. Prepare the required amount of buffer. Connect the appropriate bags to the tubing set when instructed.

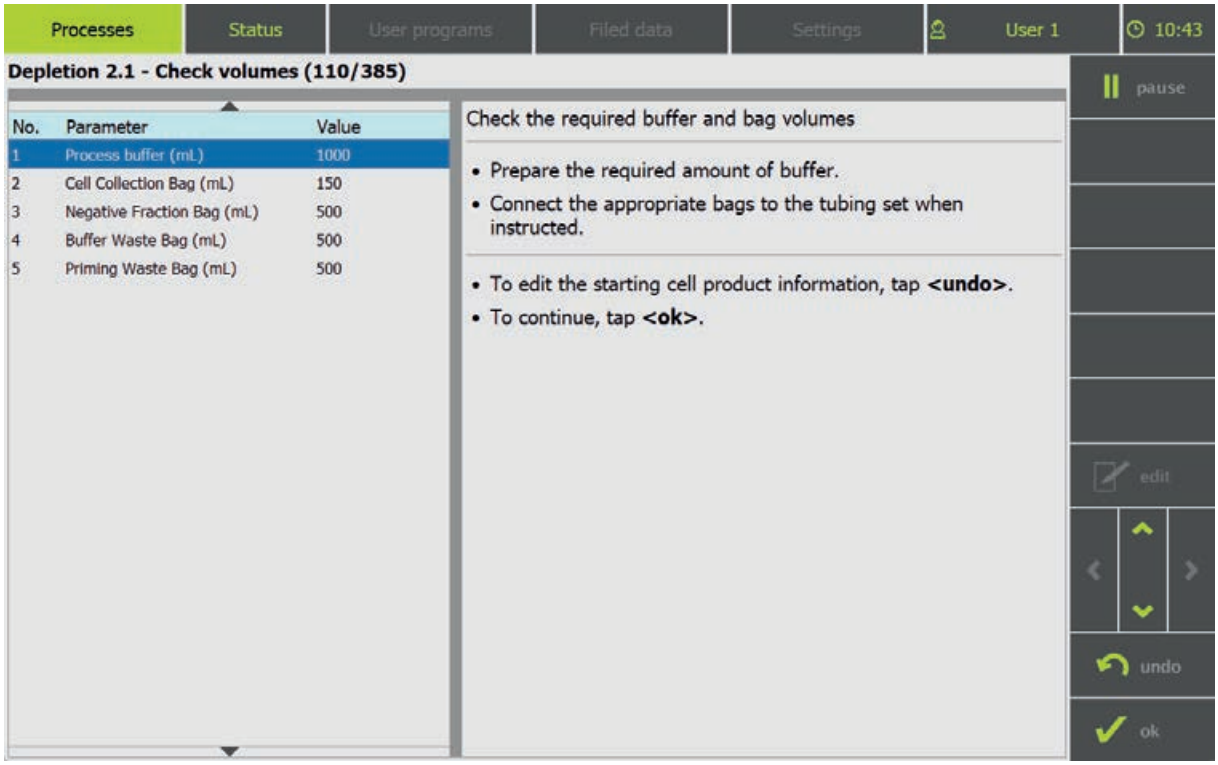


Figure 7.39: Checking the required buffer and bag volumes

If one of the calculated values exceeds these standard values, Figure 7.40 appears to inform about the amount of liquid that will be required and accumulated during the separation process. If replacement of bags is necessary, replace the bags delivered with the tubing set (capacity approximately 500 mL) by alternative bags of appropriate size.

- The bags originally attached to the tubing set are connected by luer connections.
- Bags that replace the original bags should have a female luer connector.

Standard bags can be connected by a Luer/Spike Interconnector.

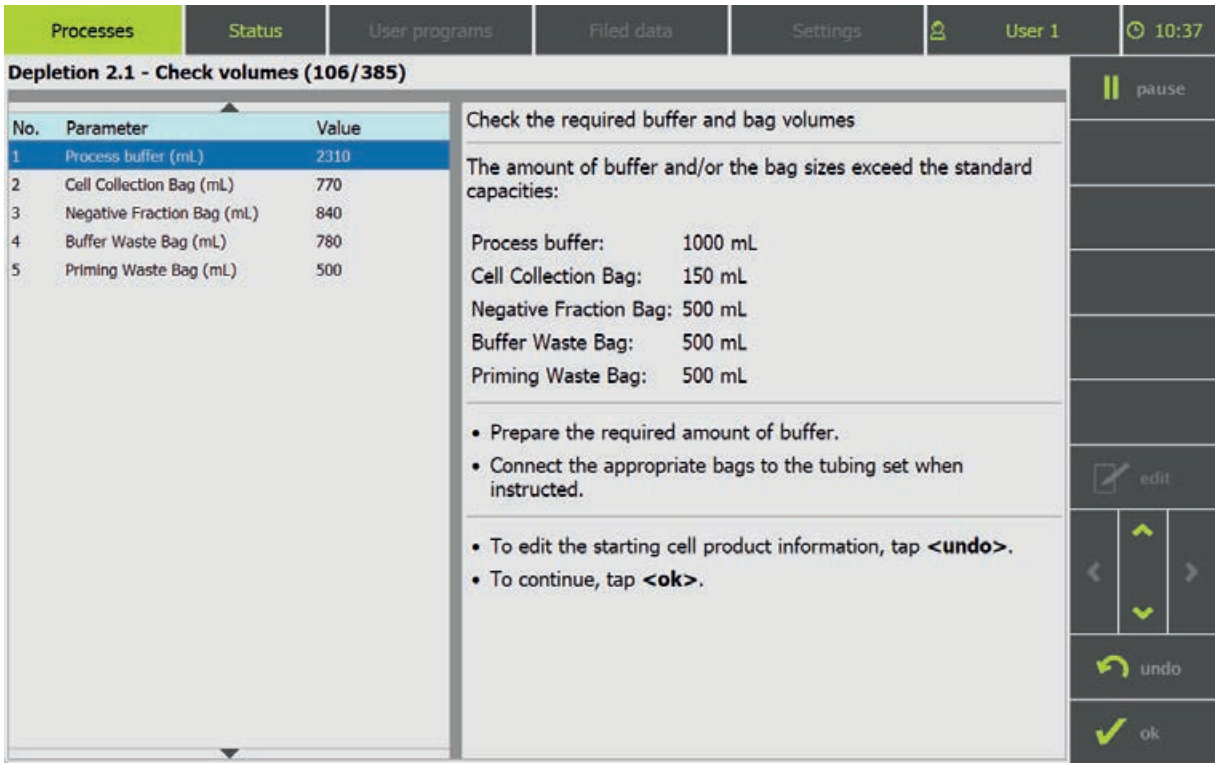


Figure 7.40: Checking the required buffer and bag volumes - Standard capacities exceeded

⚠ WARNING

Risk of personal injury and infection.

Overloading the bag hangers can cause the instrument to tip over. Falling or damaged bags may become contaminated. Contaminated solution may lead to infection if used.

- Do not overload the bag hangers. The carrying capacity of a single bag hanger is 5 kg.

1. Ensure that the requested amount of buffer is available. DO NOT attach more than five liters of buffer on the bag hanger.
2. Open the tray of the tubing set under sterile conditions and replace the original bags with larger ones if necessary. Ensure unrestricted flow to these bags.
3. Attach a Cell Collection Bag of sufficient size to the free luer connector. If not specified on Figure 7.40, the maximum elution volume of the target cell fraction is 150 mL. Ensure that unrestricted flow to the Cell Collection Bag is possible.

IMPORTANT:

- Ensure that the required amount of buffer is available and the volume of the bags listed in Figure 7.40 is sufficient. Otherwise the performance of the separation will be compromised.
- Any modifications of the CliniMACS Tubing Sets should be performed under sterile conditions, for example, in the laminar flow hood.
- For further analysis or cell processing, note that the volumes listed in Figure 7.40 are not the exact volumes but volumes within the safety requirements.

4. Ensure that the Luer lock connections on the columns are undamaged. DO NOT tighten or manipulate the Luer lock connections on the columns.

To continue, tap **ok**.

Entering reagent parameters (optional)

1. To choose whether to enter reagent parameters or to continue without any entry, tap **ok**. A pop-up window appears.
2. Depending on the number of reagent vials used, tap **1 vial** or **2 vials**.
3. Use the barcode reader to scan the barcode label on the reagent vial.
4. Alternatively, enter the part number (P/N), LOT number, and use-by date manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
5. To continue without any entry, tap **continue**.

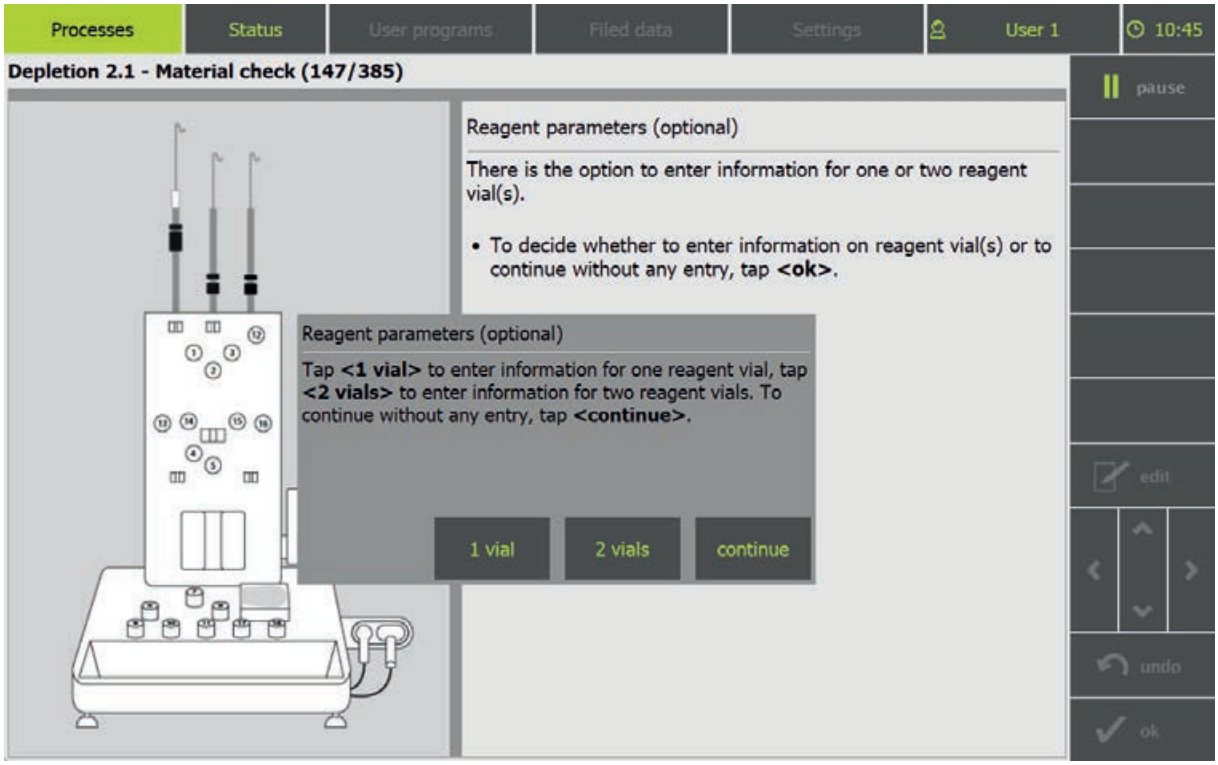


Figure 7.41: Choice of reagent parameter entry

Entering process buffer parameters (optional)

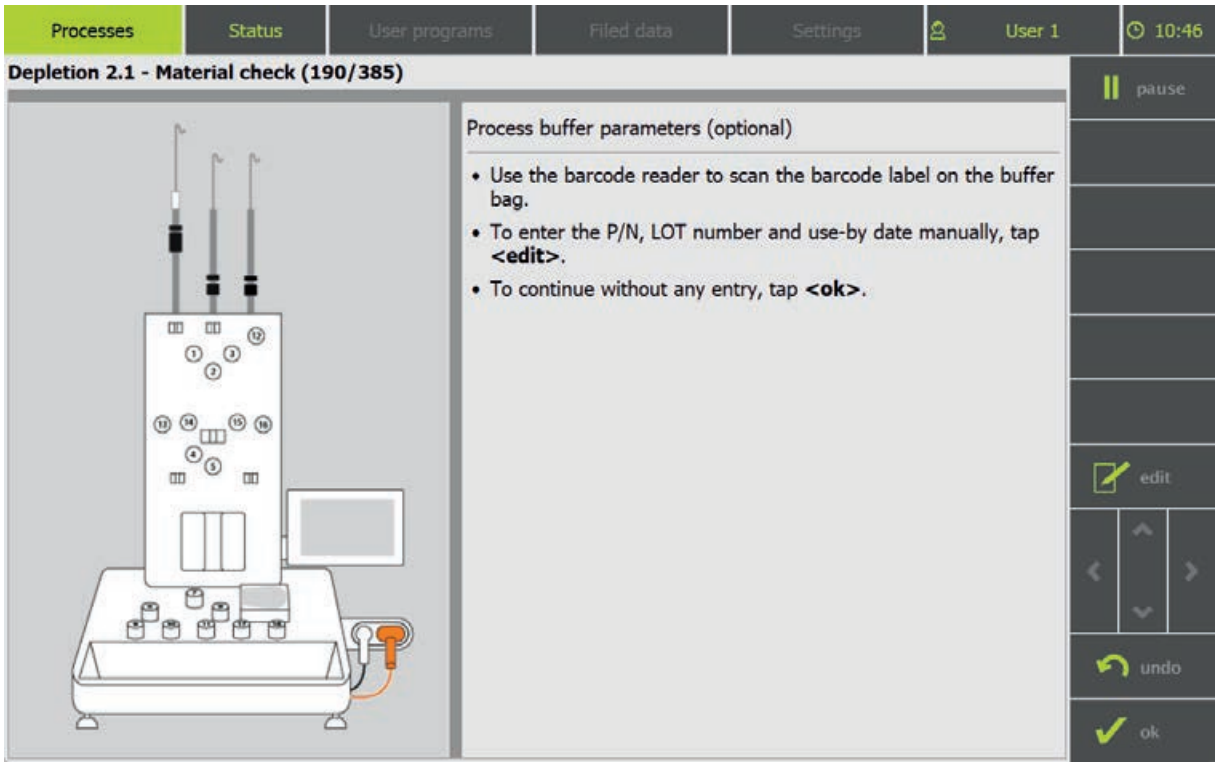


Figure 7.42: Entry of process buffer parameters

If more than one buffer bag is used, repeat the following steps for each buffer bag.

1. To enter the process buffer parameters, scan the barcode label on the buffer bag using the barcode reader.
2. Alternatively, enter the parameters manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
3. To continue without any entry, tap **ok**.

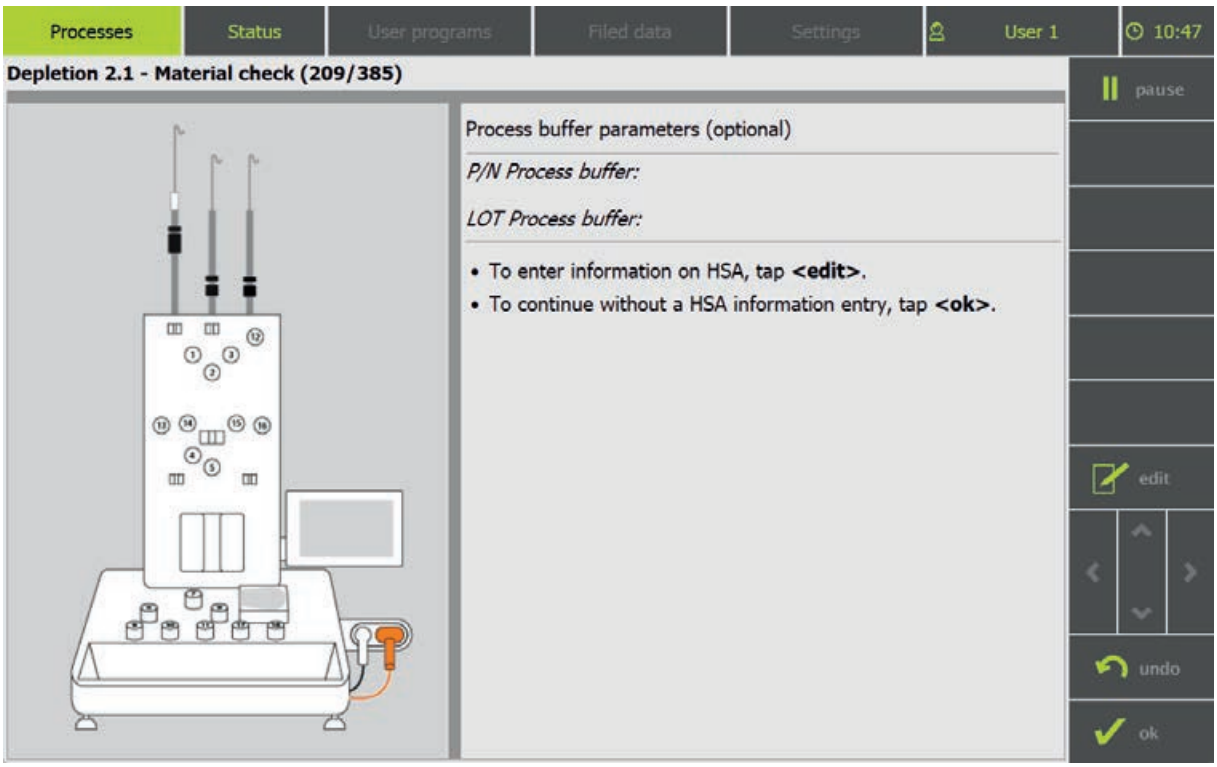


Figure 7.43: Entry of HSA information for the process buffer

Additionally, the user can enter HSA information for the process buffer.

1. To enter HSA information, tap **edit**. To continue without any entry, tap **ok**.

Entering information for additional materials (optional)

If multiple additional materials are used, repeat the following steps for each entry.

1. To enter the item name and information of the additional material, tap **edit**. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
2. To continue without any entry, tap **ok**.

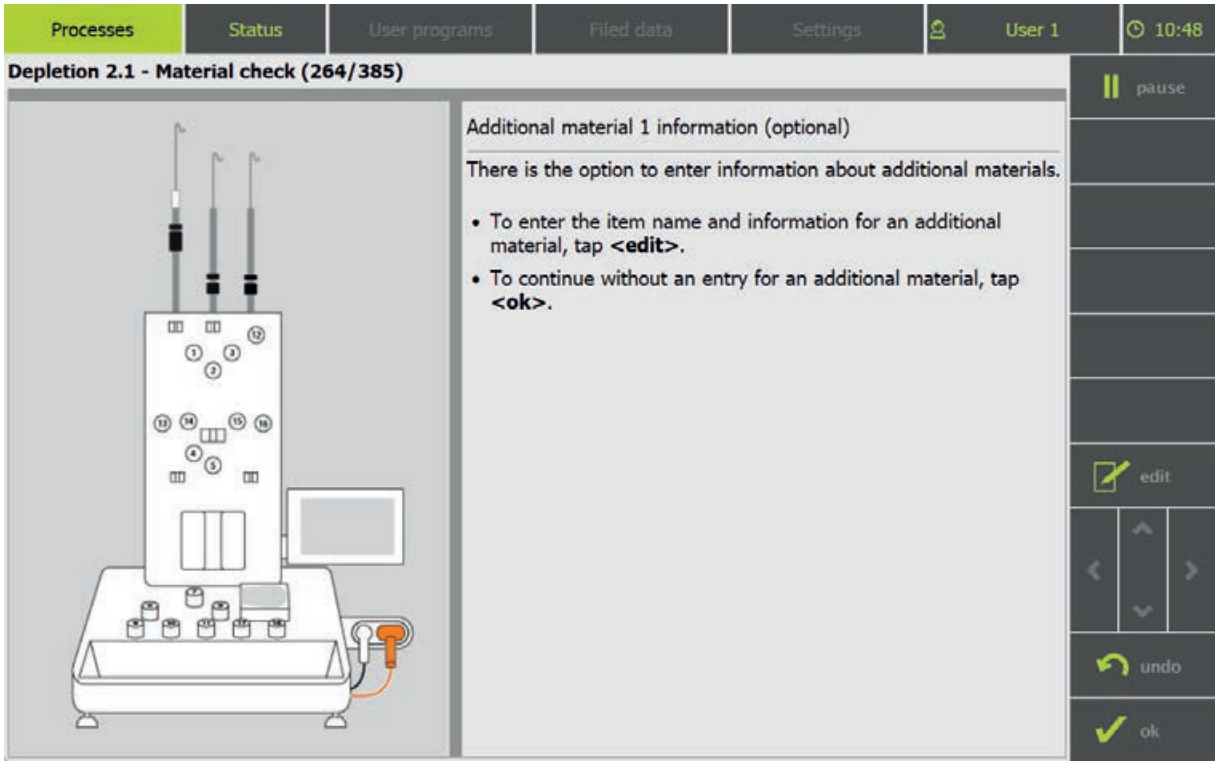


Figure 7.44: Entry of additional material information

Continue with the installation of the tubing set (see section 'Step 3: Installation of CliniMACS Tubing Sets').

7.2.7 Depletion 3.1

The separation program Depletion 3.1 must only be used in combination with the CliniMACS Depletion Tubing Set (REF 261-01). Ensure that the tubing set is correct before the installation on the instrument.

Screen prompts and diagrams serving as procedure guides will appear on the screen.

- Perform and check each step according to the manual and software instructions before proceeding to the next step.
- To correct a mistake during data input, tap **undo** (refer to the CliniMACS Plus Software user manual for more details on the toolbar).

IMPORTANT:
Before starting Depletion 3.1, it is recommended to use the Separation Planner tool to plan and prepare for the actual separation run (see section 'Separation planner tool').

Choosing separation program Depletion 3.1

1. To select Depletion 3.1 from the list (see Figure 7.45), highlight the name of the program by using the navigation buttons ⌄ and ⌃ or by tapping on the program name.
2. To continue with the selected program, tap **run**.

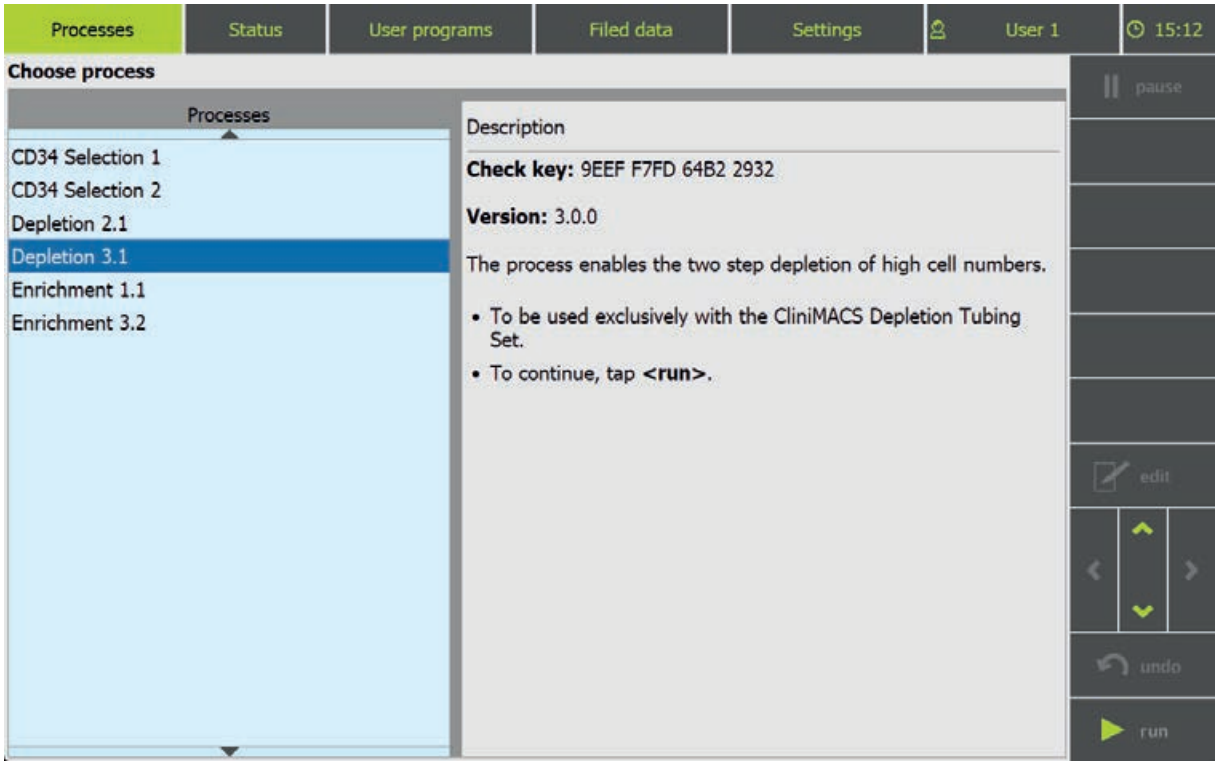


Figure 7.45: Choice of separation program Depletion 3.1

Entering Run ID (optional)

The user can enter a Run ID for the process. To enter a Run ID, tap **edit**. To continue without any entry, tap **ok**.

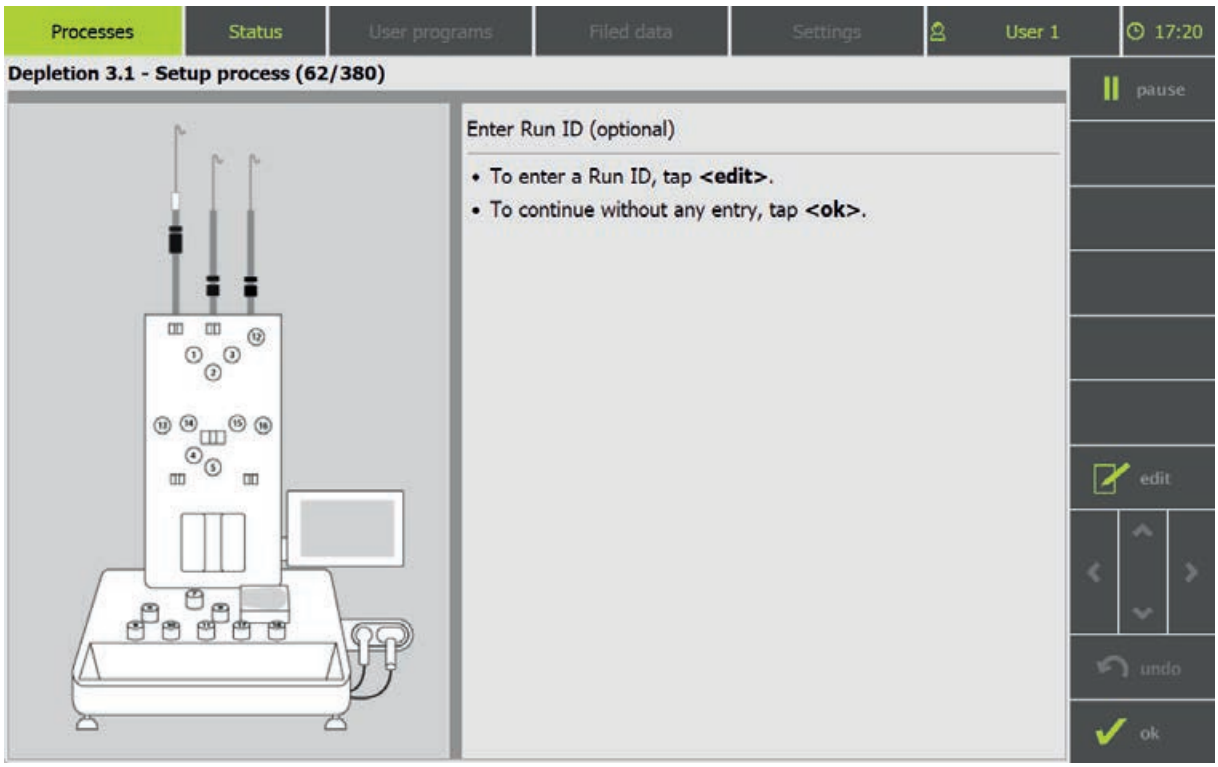


Figure 7.46: Entry of Run ID

Entering tubing set parameters

1. Use the barcode reader to scan the barcode label on the tubing set packaging.
2. Alternatively, enter the part number (P/N), LOT number, and use-by date manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.

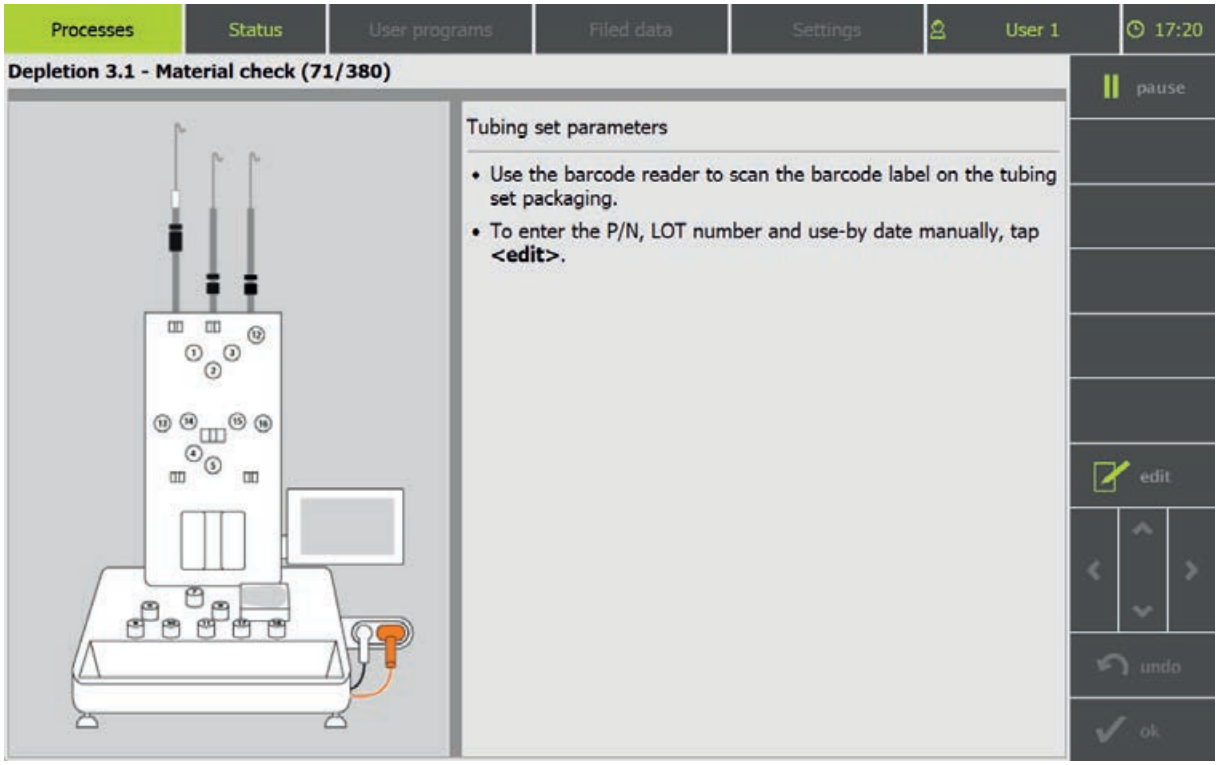


Figure 7.47: Entry of tubing set parameters

Entering starting cell product information (optional)

1. Use the barcode reader to scan the barcode label on the cell product.
2. Alternatively, enter the information manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm each entry, tap **ok**.

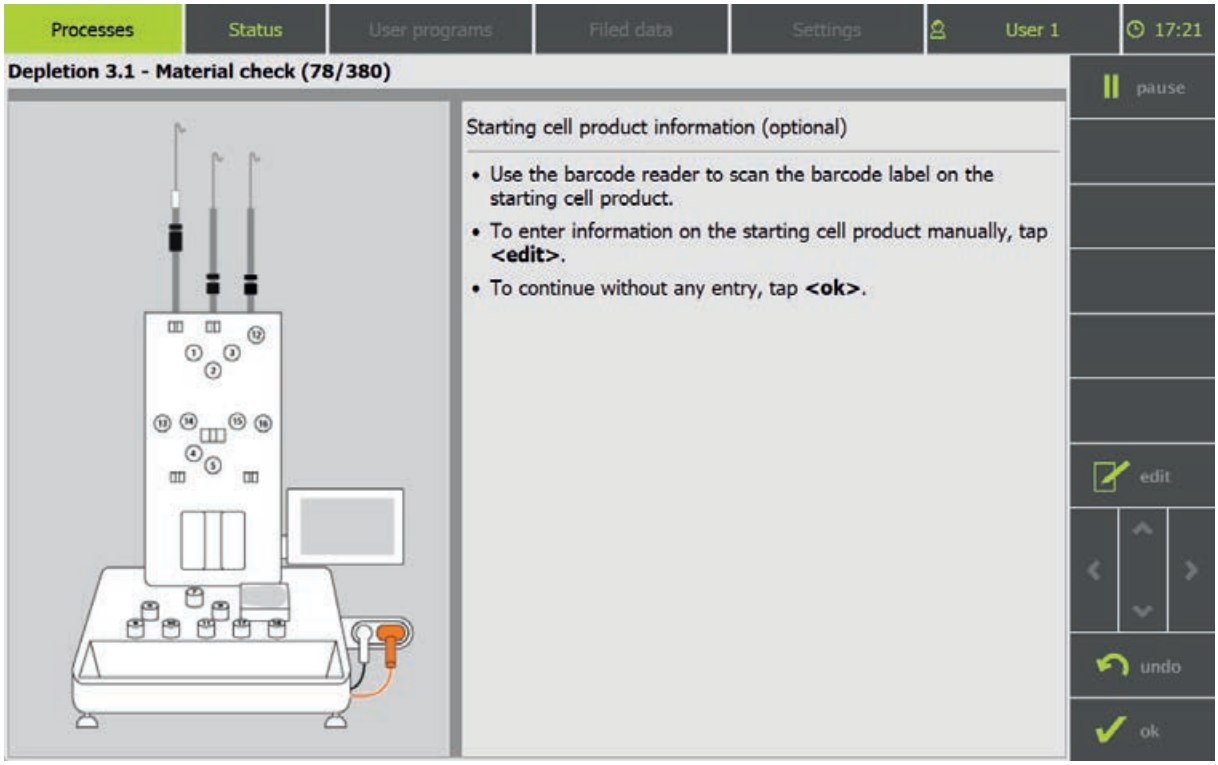


Figure 7.48: Entry of starting cell product information

Entering starting cell product parameters

Enter the starting cell product parameters (see Figure 7.49). The starting cell product parameters are necessary to adjust the separation to each individual cell product and to provide the user with important information about the required buffer and bag volumes.

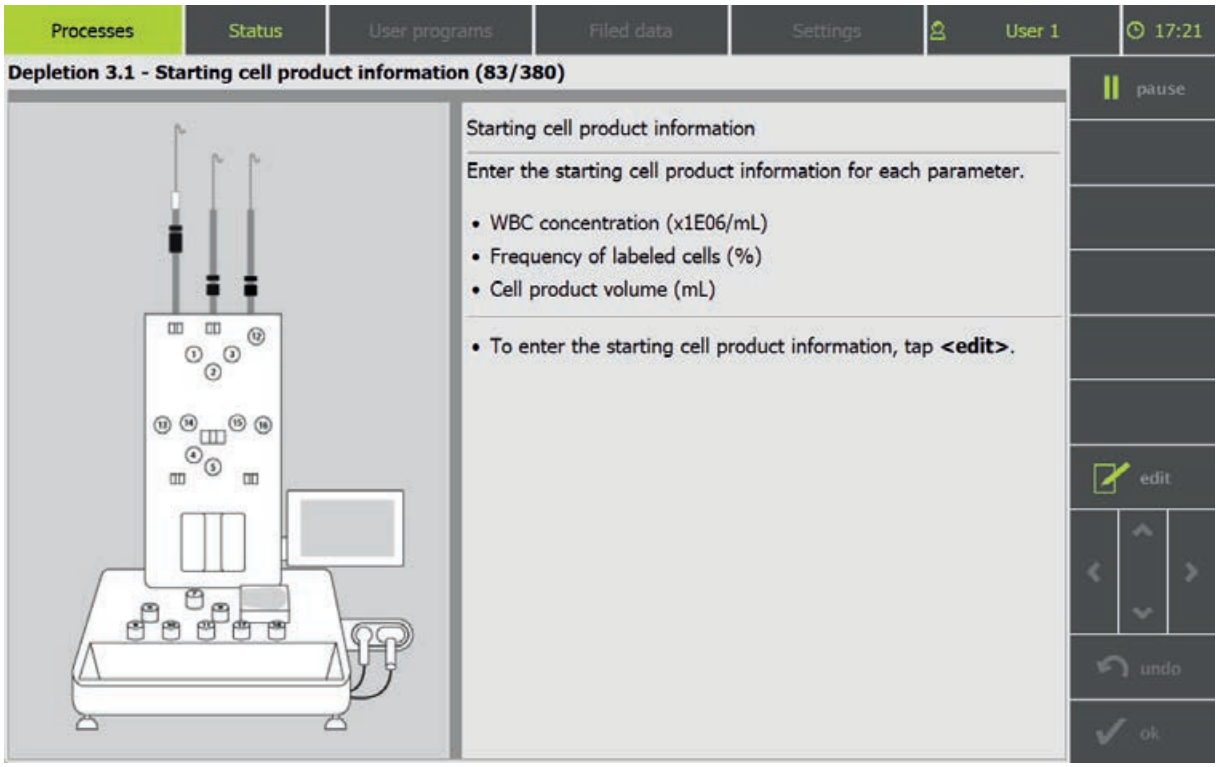


Figure 7.49: Entry of starting cell product parameters

⚠ CAUTION

Specifying wrong parameters may result in non-optimal cell product processing and may increase the risk of target cell loss.

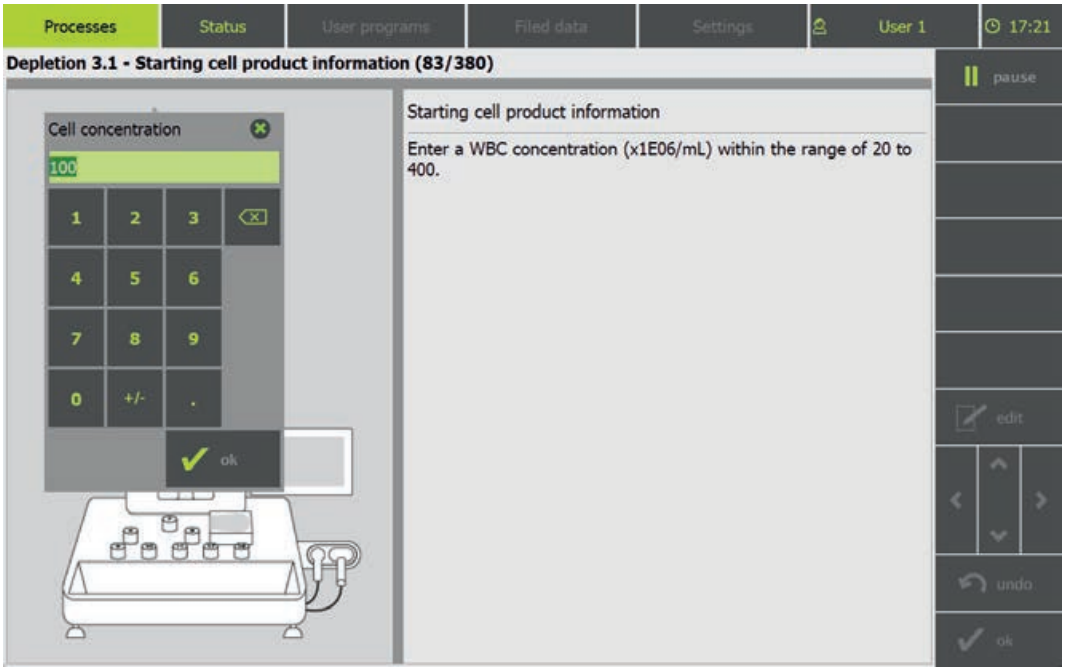
Entering values for WBC concentration and/or percentage of labeled cells which are lower than the actual cell product values may result in cell loss due to the system being overloaded. Entering a lower cell product volume may result in cell loss due to overloading or even to incomplete cell product processing. If the specification of any of the three parameters is too high, this will result in increased processing time and enlarged volume of the target cell fraction.

- Always ensure to enter the correct parameters.

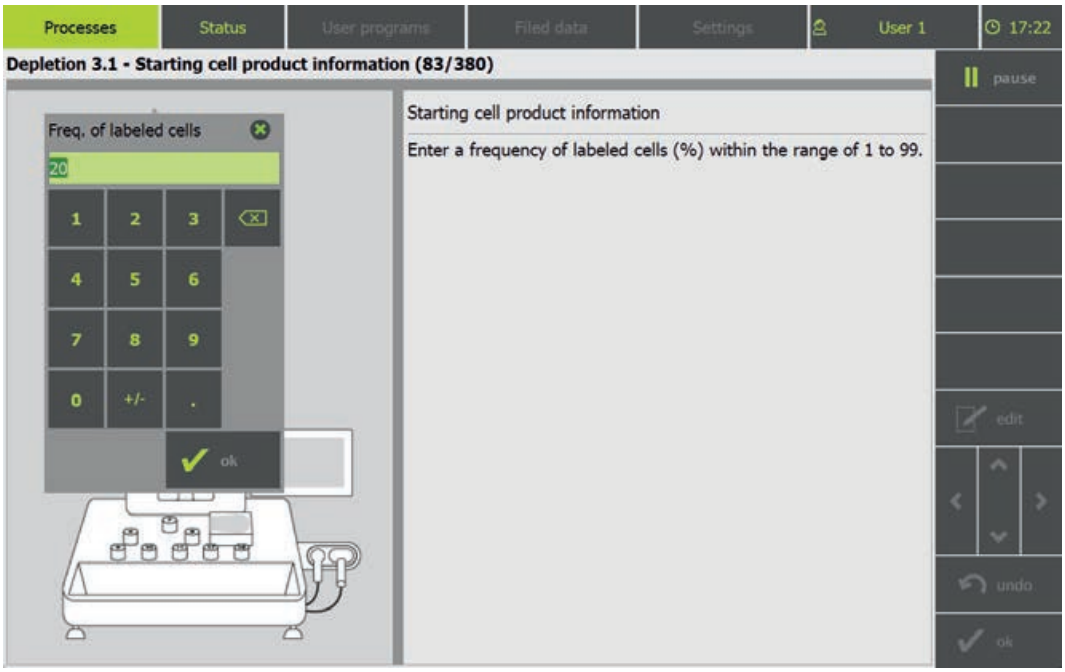
To enter the starting cell product parameters, tap **edit**.

IMPORTANT:
All cell product parameters required refer to the cell product after the cell labeling and washing procedure. The allowed range shown on the right-hand side of the screen always takes into account the previous input. After each input, the software calculates and adjusts the accepted range of the next query.

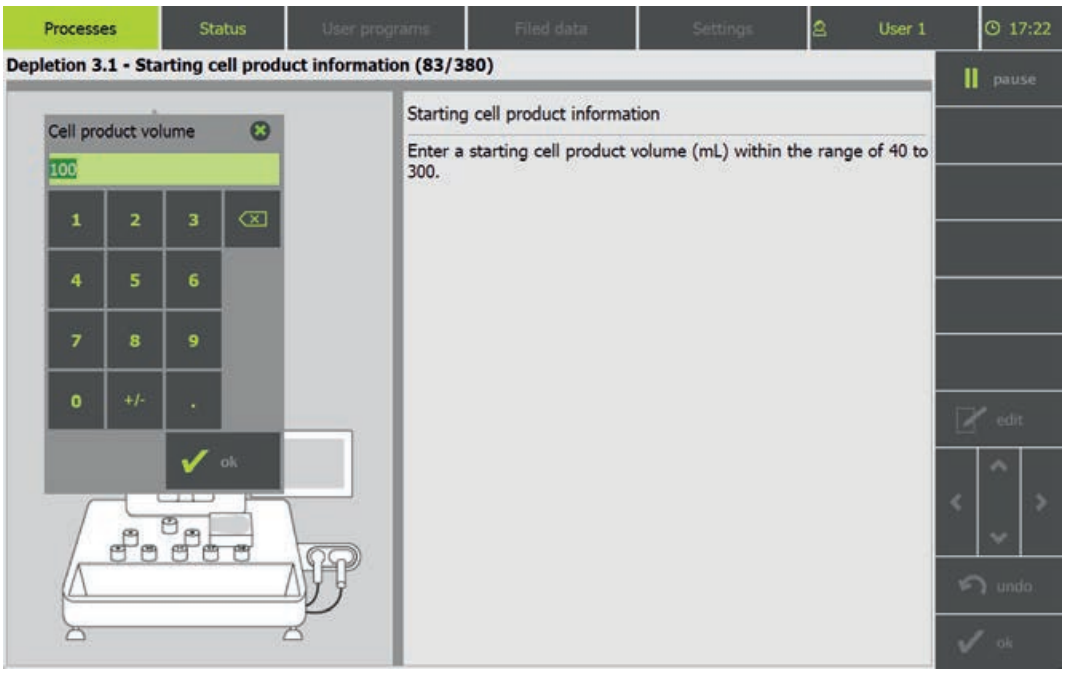
1. Enter the WBC concentration of the starting cell product. The allowed range is shown on the right-hand side of the screen. Ensure that the value entered reflects the value of the cell product. Otherwise cell product processing may not be optimal. To continue with the next input, tap **ok**.



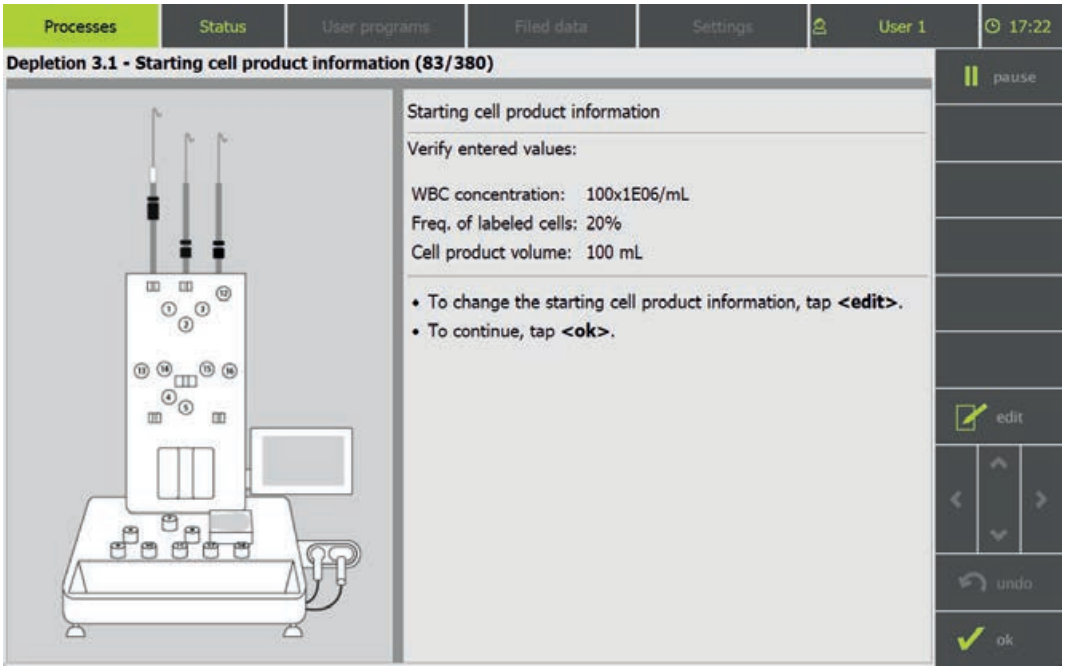
2. Enter the percentage of labeled cells. Ensure that the value entered reflects the value of the cell product. Otherwise cell product processing may not be optimal. To continue with the next input, tap **ok**.



3. Enter the volume of the cell product to be attached to the tubing set. Ensure that the value entered reflects the value of the cell product. Otherwise cell product processing may not be optimal. To continue, tap **ok**.



4. Verify the entered values. To correct a wrong input, tap **edit**. To continue, tap **ok**.



Checking the calculated cell number

After verifying the entered values, the CliniMACS Plus Software calculates the total number of labeled cells to check whether the separation capacity is sufficient.

If the result is within the system specifications, the screen shows Figure 7.50.

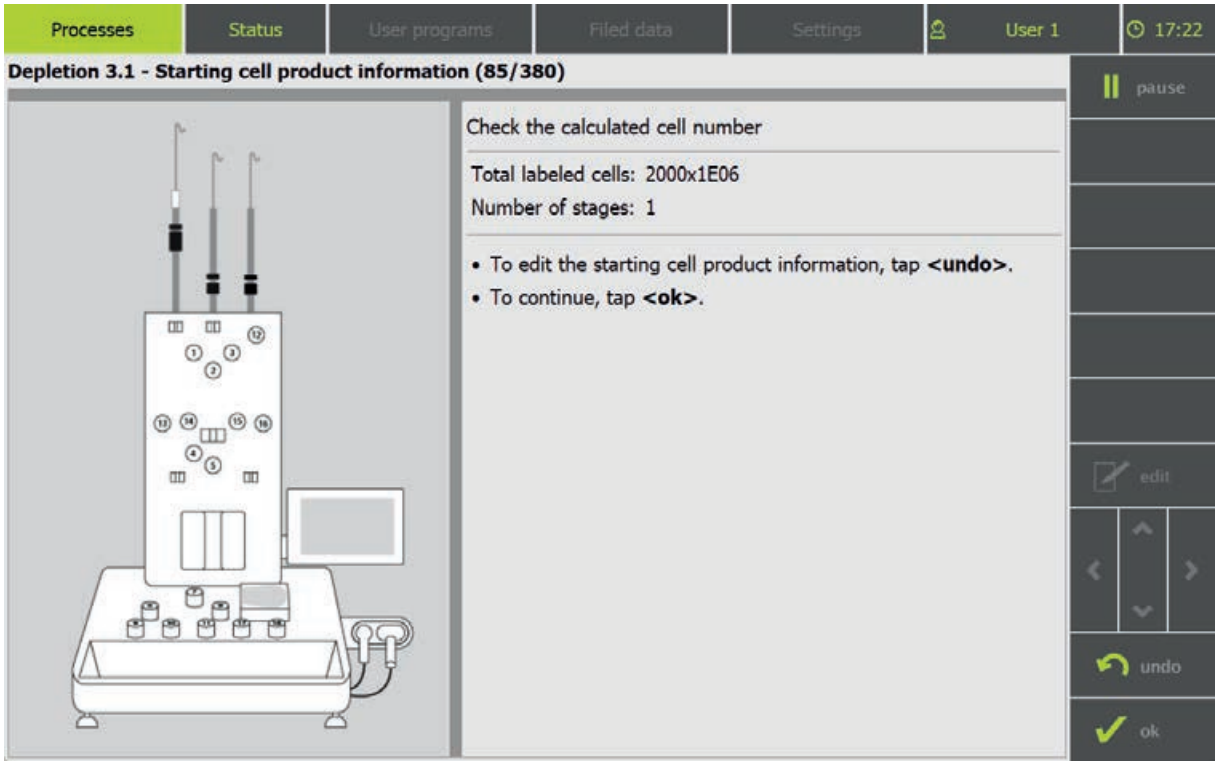


Figure 7.50: Calculation - Labeled cell number is within separation capacity

1. Ensure that the correct cell product parameters have been entered and the calculated number of cells is correct. To edit the cell product information, tap **undo**. To continue, tap **ok**.

If the result exceeds the standard separation capacity, the screen shows Figure 7.51.

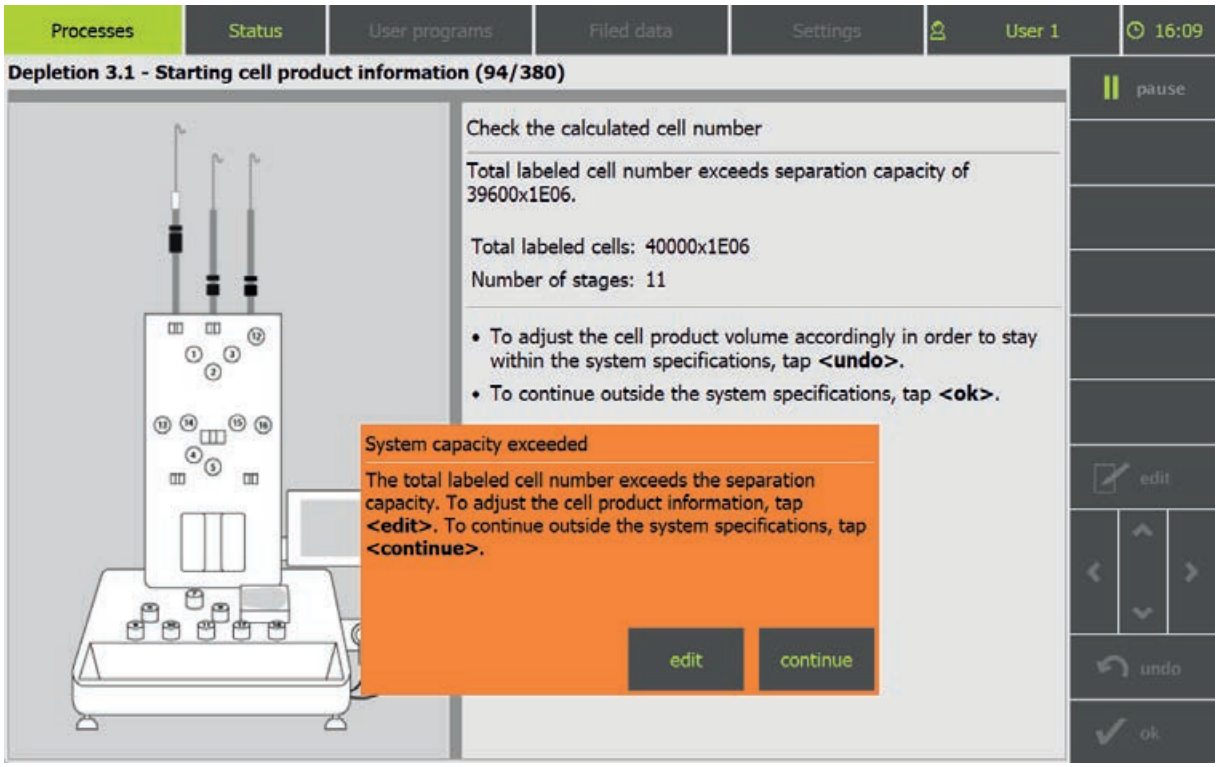


Figure 7.51: Calculation - Labeled cell number exceeds separation capacity

⚠ CAUTION

Risk of insufficient separation performance of labeled cells.

If the application specifications are exceeded, there is the risk of insufficient specific labeling.

- Use the required amount of cells and reagent as described for the respective application.

1. Ensure that the correct cell product parameters have been entered and the calculated number of cells is correct. To edit the entered values and return to Figure 7.49, tap **undo** > **edit**. To continue outside the system specifications, tap **ok** > **continue**.
2. To avoid overloading the system, split the cell product and determine the volume of each portion. To return to the previous screen (see Figure 7.49), tap **undo**.
    a. Enter the cell product parameters for the first aliquot of the cell product and continue with the separation of this portion.
    b. After the separation is finished, start a second separation for the second aliquot using a new tubing set.
    c. To continue, tap **ok**.

Checking the required buffer and bag volumes

From the total number of labeled cells (see section 'Checking the calculated cell number'), the software calculates the number of separation stages, the amount of process buffer needed for the entire separation and the liquid volumes that will be collected in the Cell Collection Bag, Non-Target Cell Bag, and Reapplication Bag.

The standard values are the following:

- Process buffer: 1000 mL
- Cell Collection Bag: 600 mL
- Non-Target Cell Bag: 600 mL
- Buffer Waste Bag: 600 mL
- Reapplication Bag: 600 mL

IMPORTANT:

- Negative Fraction Bag corresponds to Non-Target Cell Bag.
- Priming Waste Bag corresponds to Reapplication Bag.

If the calculated values are within the system specifications, the screen shows Figure 7.52. Prepare the required amount of buffer. Connect the appropriate bags to the tubing set when instructed.

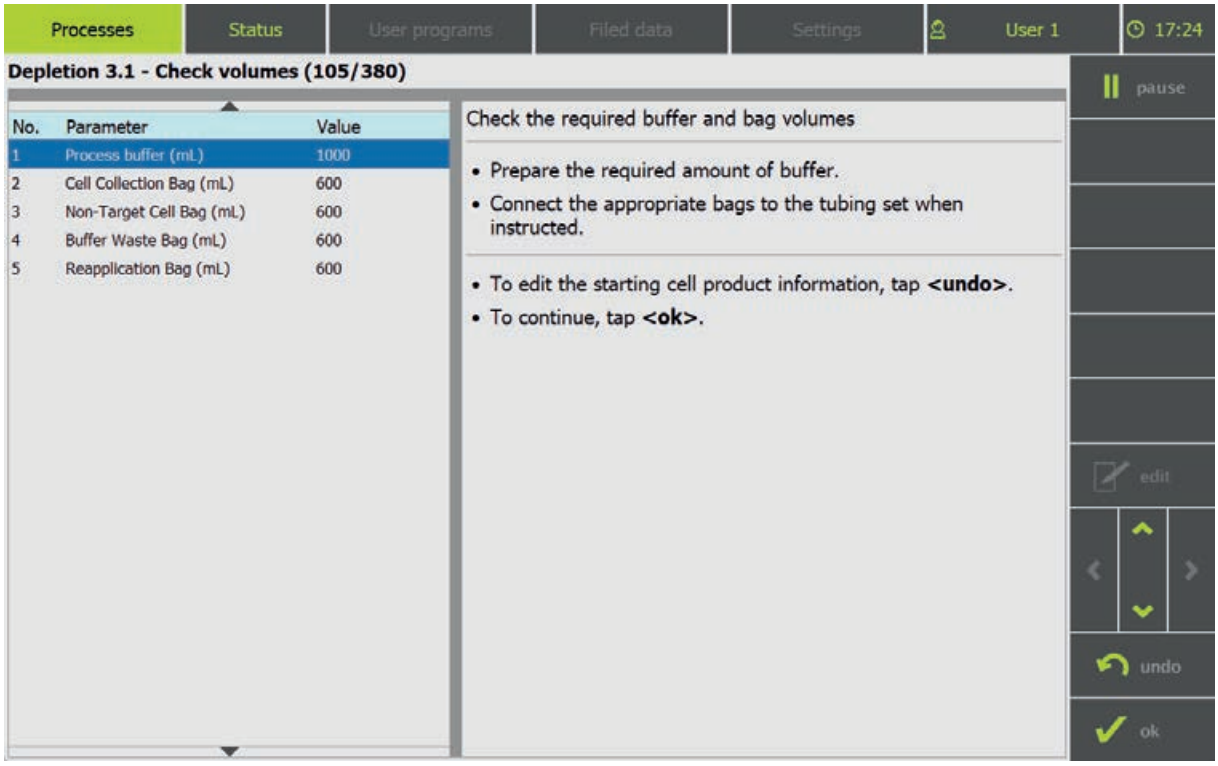


Figure 7.52: Checking the required buffer and bag volumes

If one of the calculated values exceeds these standard values, Figure 7.53 appears to inform about the amount of liquid that will be required and accumulated during the separation process. If replacement of bags is necessary, replace the bags delivered with the tubing set (capacity approximately 500 mL) by alternative bags of appropriate size.

- The bags originally attached to the tubing set are connected by luer connections.
- Bags that replace the original bags should have a female luer connector.

Standard bags can be connected by a Luer/Spike Interconnector.

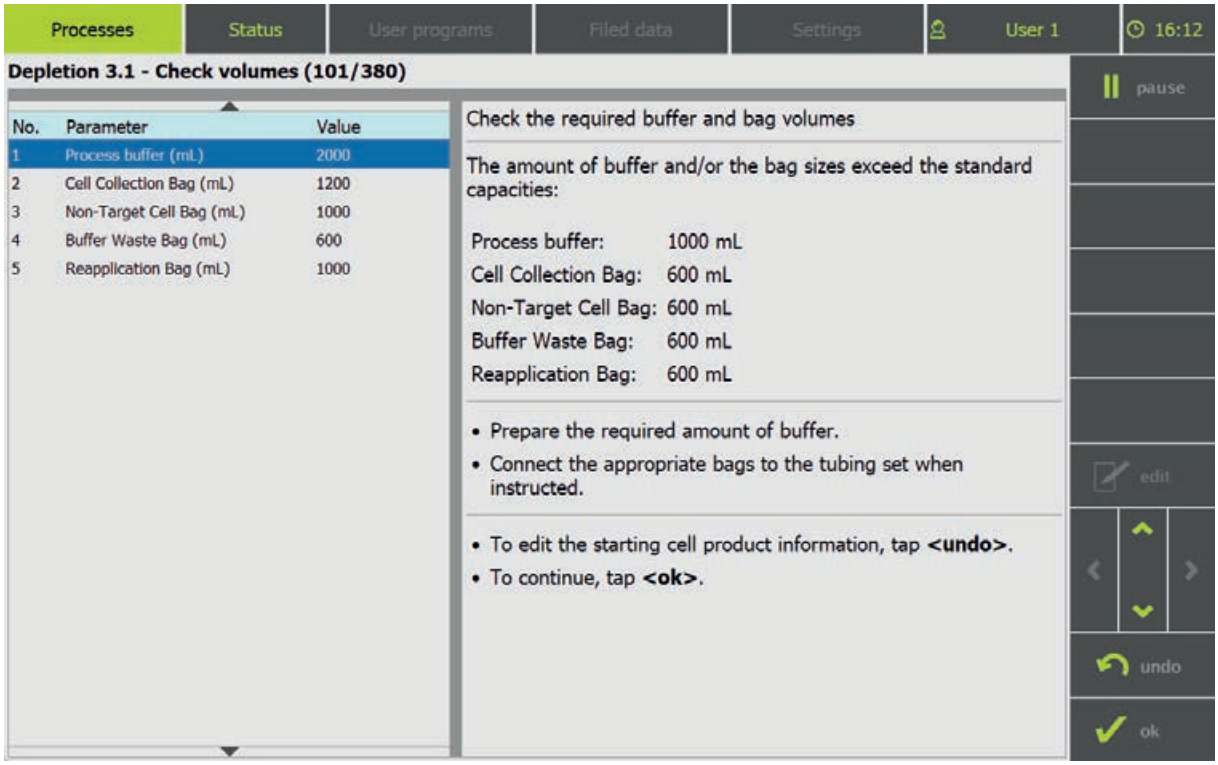


Figure 7.53: Checking the required buffer and bag volumes - Standard capacities exceeded

⚠ WARNING

Risk of personal injury and infection.

Overloading the bag hangers can cause the instrument to tip over. Falling or damaged bags may become contaminated. Contaminated solution may lead to infection if used.

- Do not overload the bag hangers. The carrying capacity of a single bag hanger is 5 kg.

1. Ensure that the requested amount of buffer is available. DO NOT attach more than five liters of buffer on the bag hanger.
2. Open the tray of the tubing set under sterile conditions and replace the original bags with larger ones if necessary. Ensure unrestricted flow to these bags.
3. If replacement is necessary, replace the Cell Collection Bag of the tubing set with a transfer bag of sufficient size. Determine the weight of the new, empty Cell Collection Bag and record it. Ensure that unrestricted flow to the Cell Collection Bag is possible. Alternatively, attach an additional 600 mL transfer bag to the first Cell Collection Bag, for example, by using a plasma transfer set.

IMPORTANT:

- Ensure that the required amount of buffer is available and the volume of the bags listed in Figure 7.53 is sufficient. Otherwise the performance of the separation will be compromised.
- Any modifications of the CliniMACS Tubing Sets should be performed under sterile conditions, for example, in the laminar flow hood.
- For further analysis or cell processing, note that the volumes listed in Figure 7.53 are not the exact volumes but volumes within the safety requirements.

4. Ensure that the Luer lock connections on the columns are undamaged. DO NOT tighten or manipulate the Luer lock connections on the columns.

To continue, tap **ok**.

Entering reagent parameters (optional)

The user can enter reagent parameters for one or more reagent vials (see Figure 7.54). Repeat the following steps for each reagent vial.

1. To enter the reagent parameters, scan the barcode label on the reagent vial with the barcode reader.
2. Alternatively, enter the parameters manually by tapping **edit**. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
3. To continue without any entry, tap **ok**.

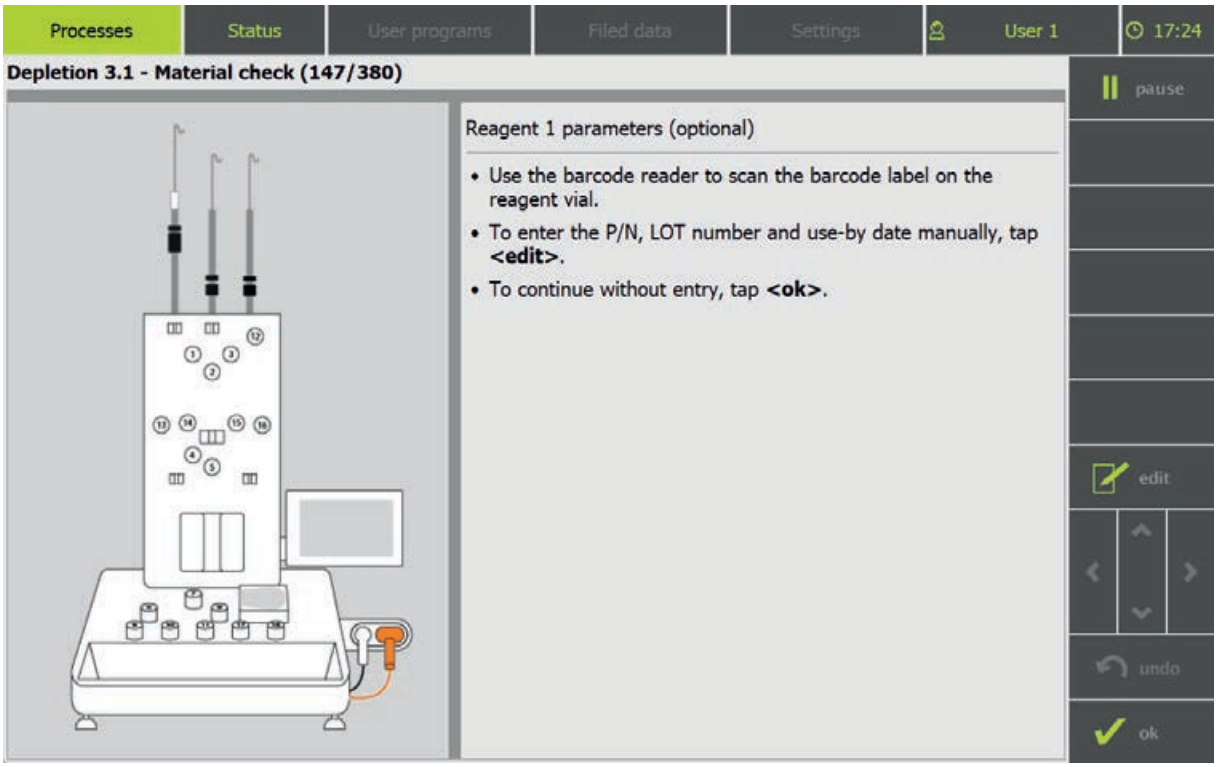


Figure 7.54: Entry of reagent parameters

Entering process buffer parameters (optional)

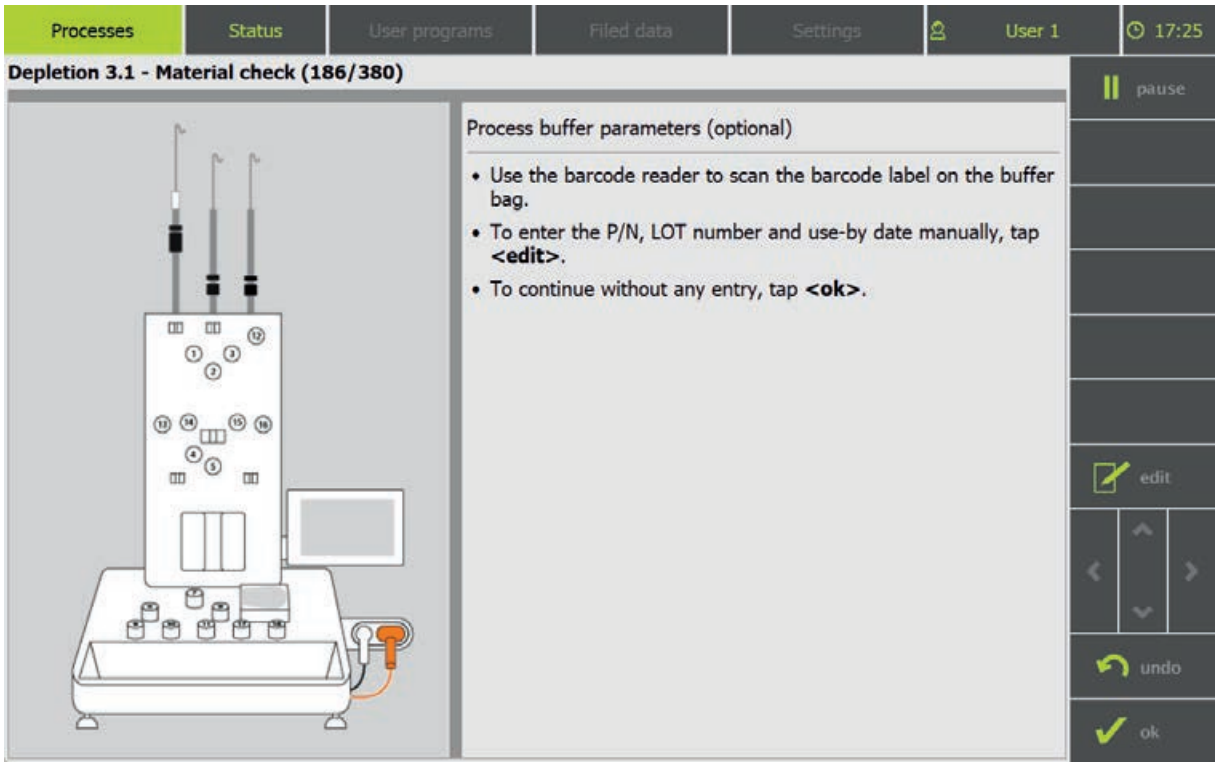


Figure 7.55: Entry of process buffer parameters

1. To enter the process buffer parameters, scan the barcode label on the buffer bag using the barcode reader.
2. Alternatively, enter the parameters manually by tapping **edit** and using the keyboard shown on the screen. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
3. To continue without any entry, tap **ok**.

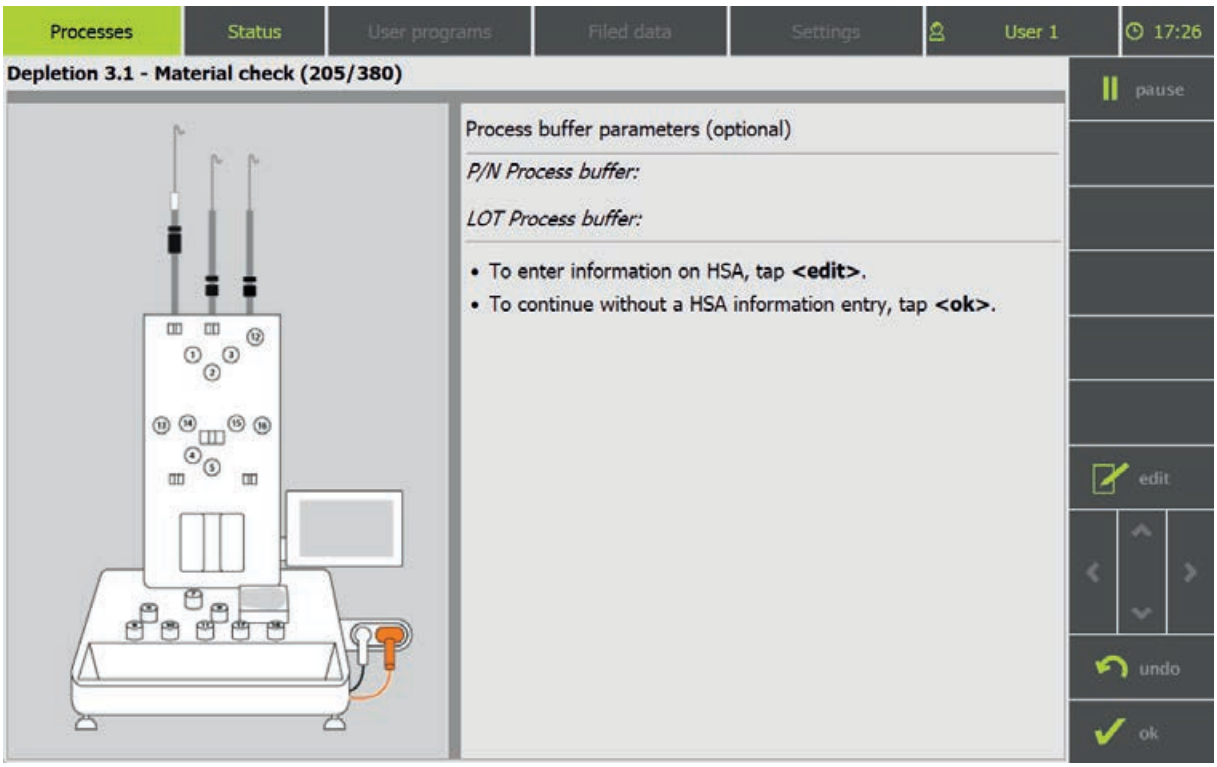


Figure 7.56: Entry of HSA information for the process buffer

Additionally, the user can enter HSA information for the process buffer.

1. To enter HSA information, tap **edit**. To continue without any entry, tap **ok**.

Entering information for additional materials (optional)

If multiple additional materials are used, repeat the following steps for each entry.

1. To enter the item name and information of the additional material, tap **edit**. An input field appears for each entry. To confirm the entry in the input field, tap **ok**.
2. To continue without any entry, tap **ok**.

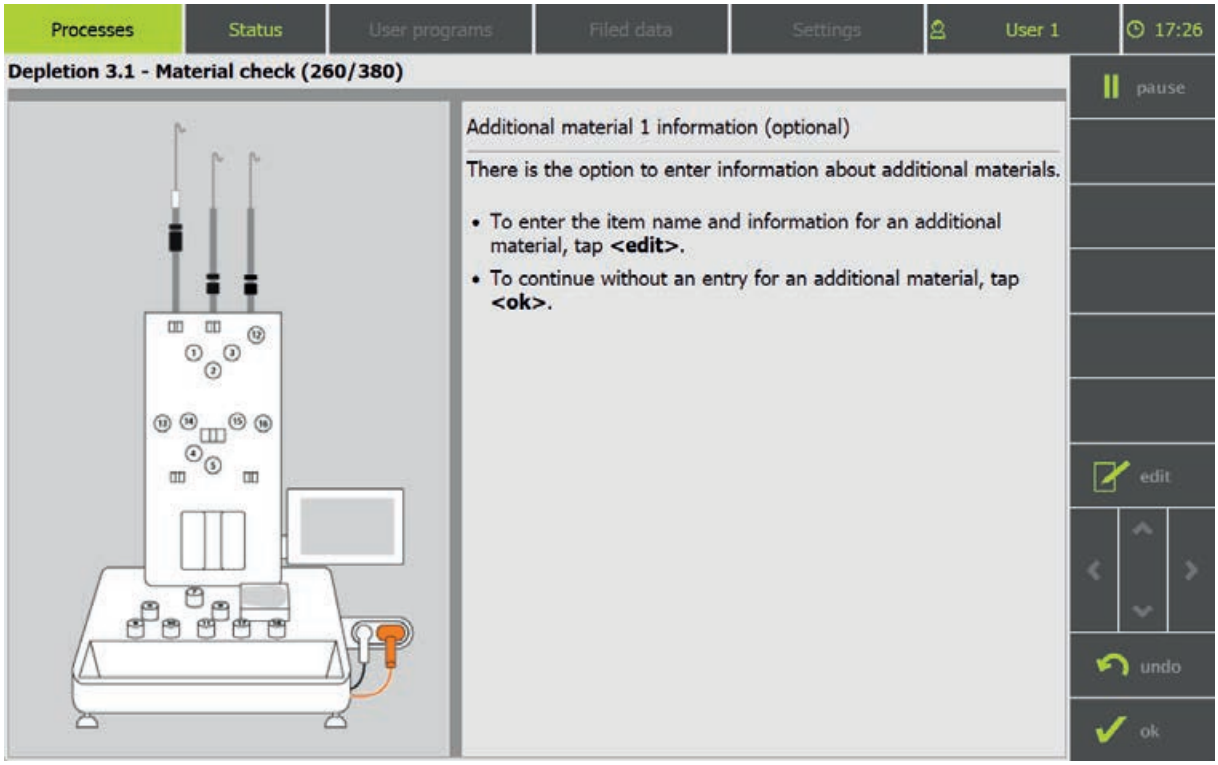


Figure 7.57: Entry of additional material information

Continue with the installation of the tubing set (see section 'Step 3: Installation of CliniMACS Tubing Sets').

7.3 Step 3: Installation of CliniMACS Tubing Sets

This chapter contains instructions and precautions for the installation of the CliniMACS tubing sets. Depending on the selected separation program, the program name shown in the software may differ from that shown in the screenshots in this user manual.

7.3.1 CliniMACS Tubing Set and CliniMACS Tubing Set LS

The CliniMACS Tubing Set and the CliniMACS Tubing Set LS are each provided in sealed, sterilized packages. Each tubing set is for single use and contains preassembled tubing and columns for one separation, providing a sterile fluid path (see Figure 7.58).

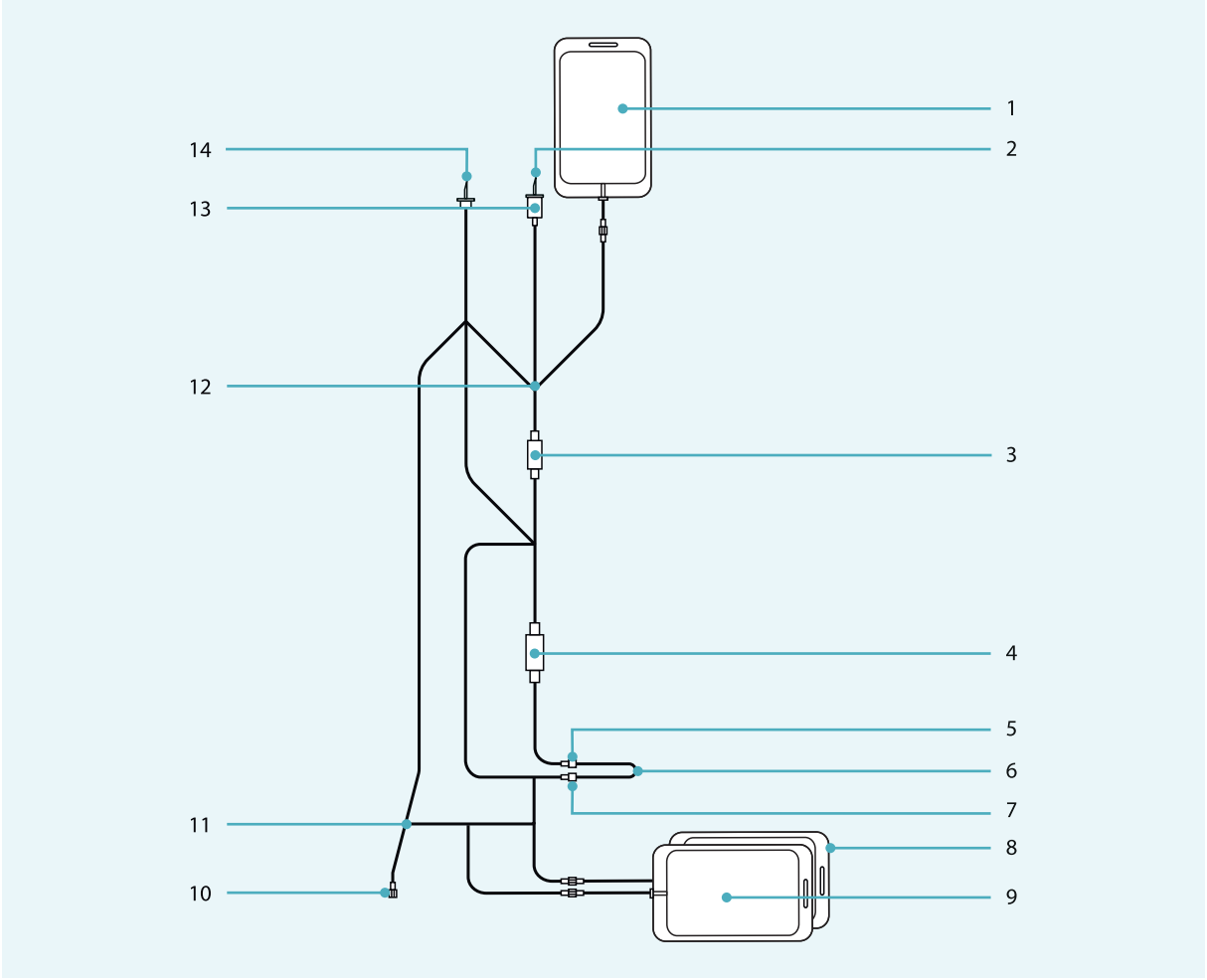


Figure 7.58: General construction of a CliniMACS Tubing Set (for example, CliniMACS Tubing Set)

1 Priming Waste Bag
2 Bubble trap spike
3 Pre-column
4 Separation column
5 Upper retaining ring
6 Pump tubing
7 Lower retaining ring
8 Negative Fraction Bag
9 Buffer Waste Bag
10 Luer connector
11 T-fitting
12 4-way fitting
13 Bubble trap
14 Buffer spike

Handling of preconnected process buffer and Cell Preparation Bag

After Step 2 is complete, the screen shows Figure 7.59. The instruction is shown on the right, and a diagram corresponding to the instruction on the left-hand side of the screen. The orange blinking features on the screen indicate the areas of attention.

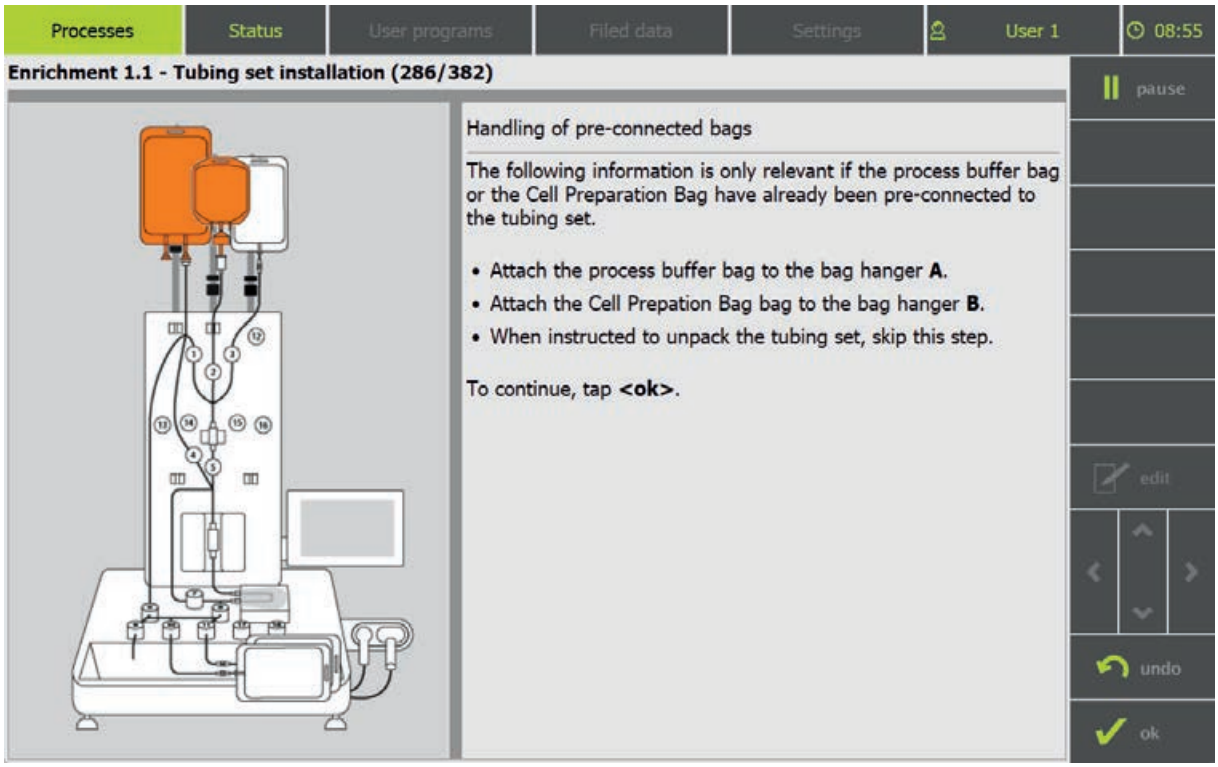


Figure 7.59: Handling of preconnected process buffer and Cell Preparation Bag

1. If the process buffer bag(s) or the Cell Preparation Bag are already connected to the tubing set, follow the instructions on the screen.
    a. Ensure that the clamps beneath the process buffer bag(s) and the Cell Preparation Bag are closed.
    b. Continue by tapping ok.
2. If the the bags are not preconnected to the tubing set, skip this step by tapping ok.

Unpacking the tubing set, connecting the Cell Collection Bag, attaching the Priming Waste Bag, and inserting the pre-column

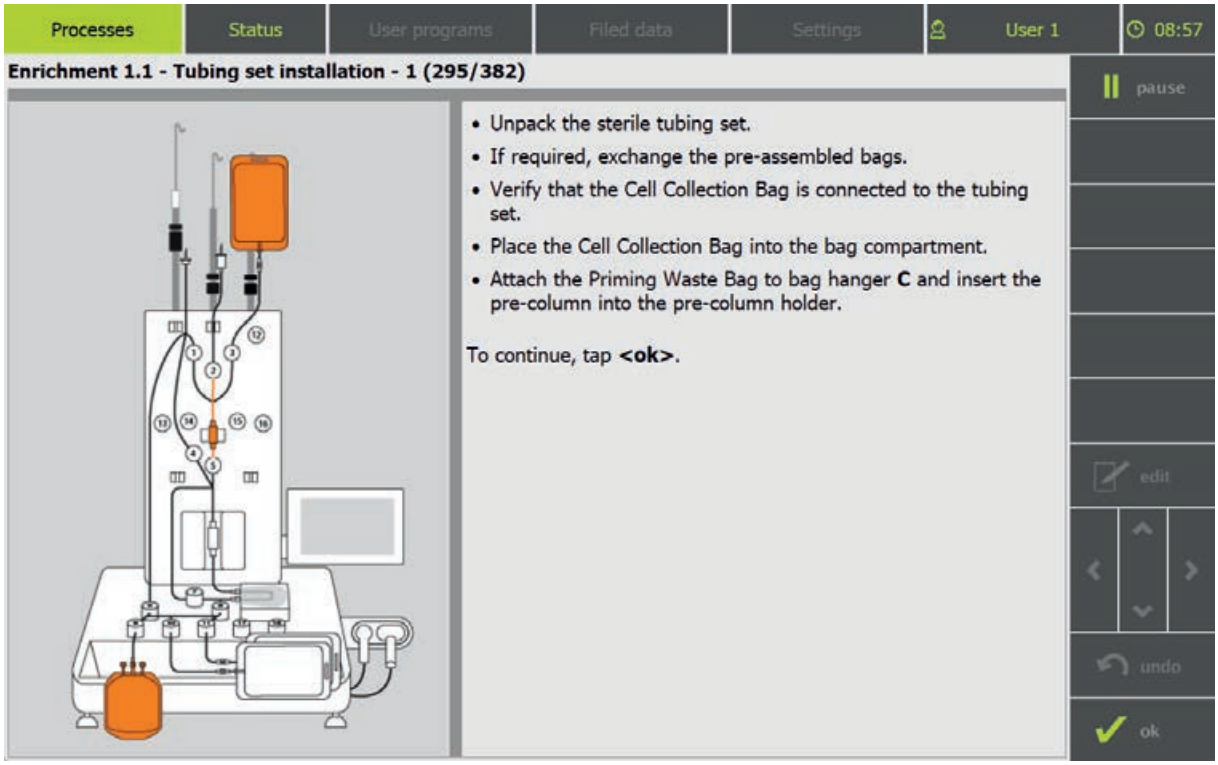


Figure 7.60: Unpacking of the tubing set, connection of the Cell Collection Bag, attachment of the Priming Waste Bag, and insertion of the pre-column

⚠ WARNING

Risk of contamination.

Damaged packaging indicates that the tubing set may no longer be sterile and therefore must not be used.

- Carefully inspect the packaging for damage, puncture or tears.
- Use the tubing set only if package is undamaged and sealed.

⚠ WARNING

Risk of injury.

If the separation column is inserted or removed while the magnet unit is switched on, there is the risk of personal injury.

- Only insert or remove the separation column when the magnet unit is switched off.

Unpacking tubing set

1. Unpack the sterile tubing set under sterile conditions (if not done in a clean room, for example, in a laminar flow hood).

2. CliniMACS Tubing Set LS: Before installing the tubing set, remove the pinch clamps used for the secure packaging of the columns. The pinch clamps are labeled with "Remove before assembly to CliniMACS Plus Instrument".
3. Ensure that the Luer lock connections to the bags are closed tightly. DO NOT tighten or manipulate the Luer lock connections on the columns.
4. If necessary, exchange the preassembled bags.

Connection of the Cell Collection Bag to the tubing set

1. Note the weight of the empty Cell Collection Bag(s).
2. In an aseptic environment, remove caps and attach the sterile Cell Collection Bag equipped with a Luer/ Spike Interconnector to the tubing set before installing the tubing set onto the CliniMACS Plus Instrument.
3. Ensure that the original tubing of the Cell Collection Bag is either clamped or sealed off.
4. If more than one Cell Collection Bag is necessary for a separation, connect the bags using a plasma transfer set. Make sure that all connections are closed tightly.
5. Ensure that an unrestricted flow to the Cell Collection Bag is possible.
6. If the instrument is used in a clean room, continue with the installation of the tubing set according to the procedure in the following sections. If the instrument is not used in a clean room, install the tubing under sterile conditions as described in section 'Alternative installation of CliniMACS Tubing Sets'.

Attaching Priming Waste Bag and inserting pre-column

1. Ensure that the Cell Collection Bag is connected to the tubing set.
2. Attach the Priming Waste Bag to bag hanger C (see Figure 7.61).
3. Adjust the height of the bag hanger. Raise or lower the bag hanger to accommodate the height to the size of the Priming Waste Bag. Ensure that it is positioned high enough to prevent severe bending of the tubing that could restrict the flow, and that it is low enough to avoid the tubing or connections being stretched.
4. Place the pre-column into the pre-column holder (see Figure 7.61).

To continue, tap **ok**.

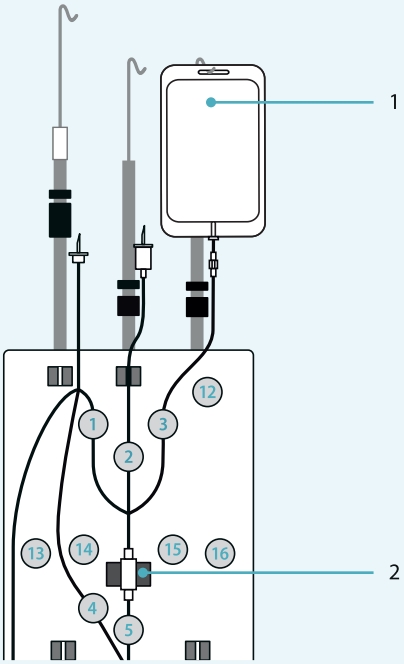


Figure 7.61: Attach Priming Waste Bag to bag hanger C

1 Priming Waste Bag

2 Pre-column holder

Inserting the separation column and loading valve 5

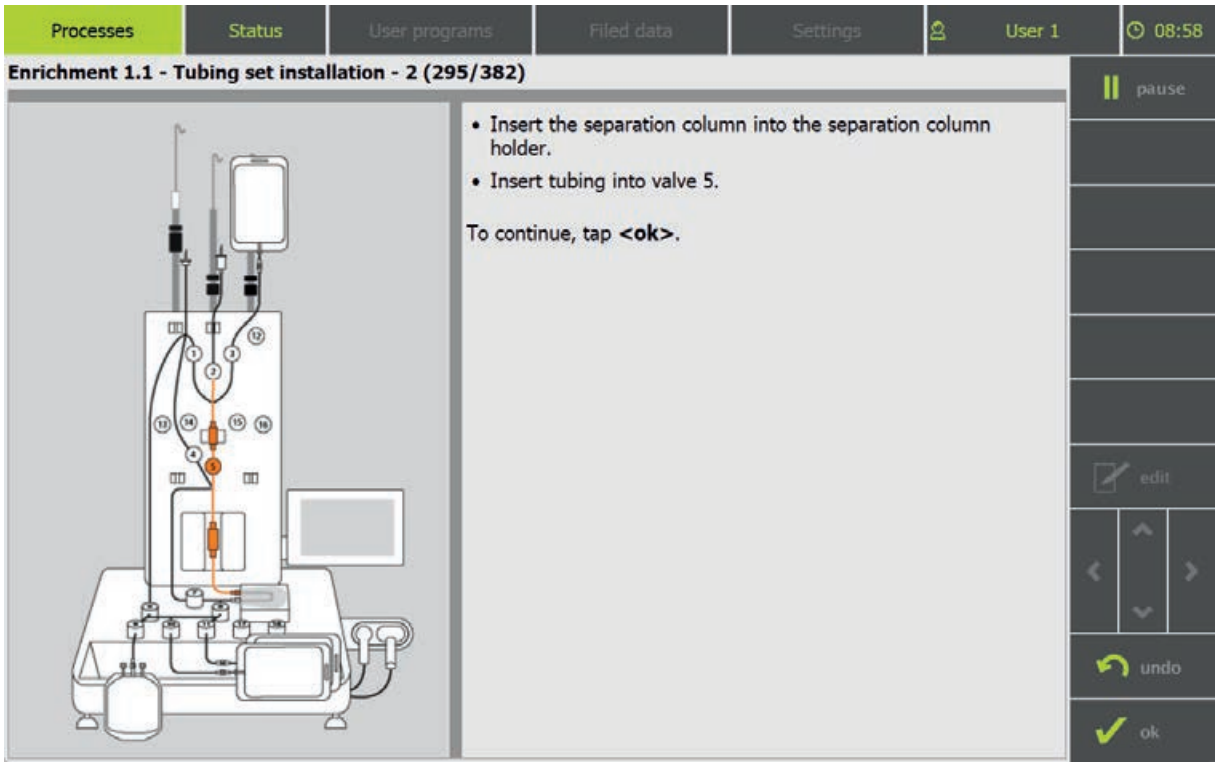


Figure 7.62: Insertion of separation column and loading of valve 5

⚠ WARNING

Risk of injury.

If the separation column is inserted or removed while the magnet unit is switched on, there is the risk of personal injury.

- Only insert or remove the separation column when the magnet unit is switched off.

The valve indicated in orange on the screen will open automatically to facilitate the tubing insertion.

1. Insert the separation column into the separation column holder (see Figure 7.63).
2. Insert the tubing into valve 5 (see Figure 7.64).

IMPORTANT:

- As each step is performed, check all tubing and attachments for any kinks or severe bending that could restrict the flow of liquid through the tubing. Check all valves to ensure that the tubing is correctly seated.
- Only insert the tubing set into open valves (when button is pushed inwards). If the tubing is inserted into a closed valve, the tubing will not fit correctly.
- To adjust the tubing after a valve closes, press the valve button to open the valve before pulling the tubing (see Figure 7.64).

To return to the previous screen (see Figure 7.60), tap **undo**. To continue, tap **ok**.

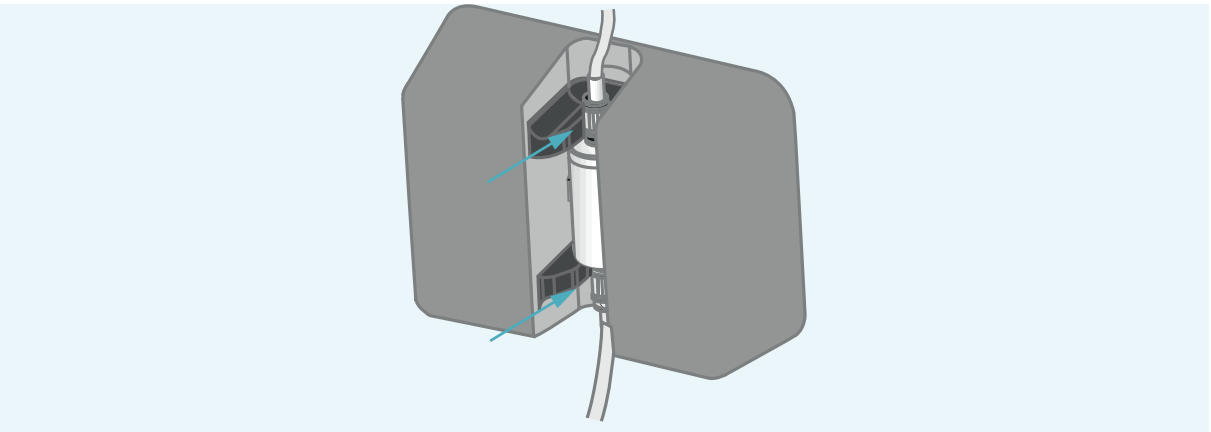


Figure 7.63: Separation column in separation column holder

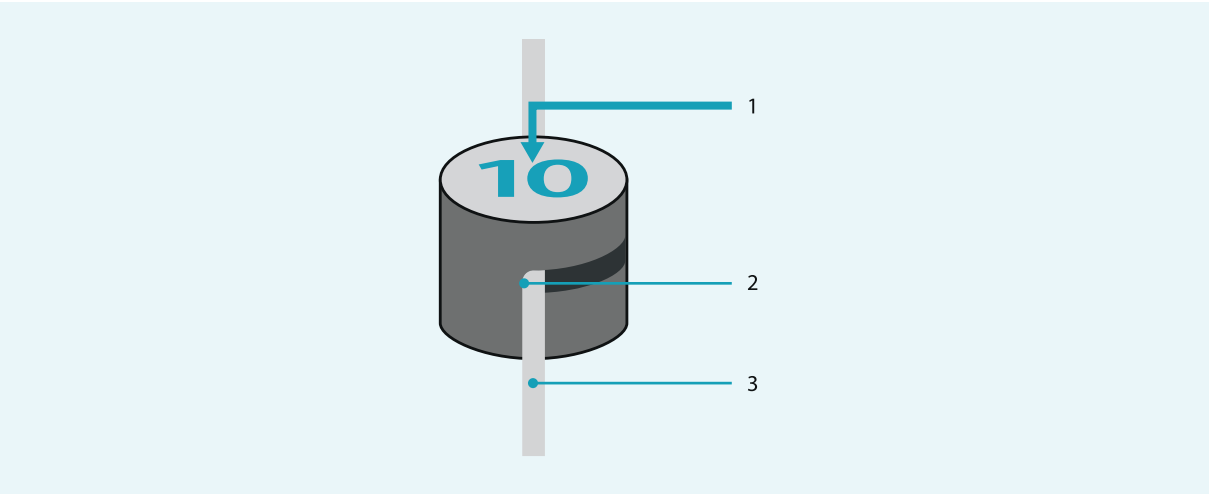


Figure 7.64: Correct insertion of the tubing into a valve

1 Press button to open valve
2 Inner end of slot
3 Tubing

Loading valves 1, 2, 3, and 4

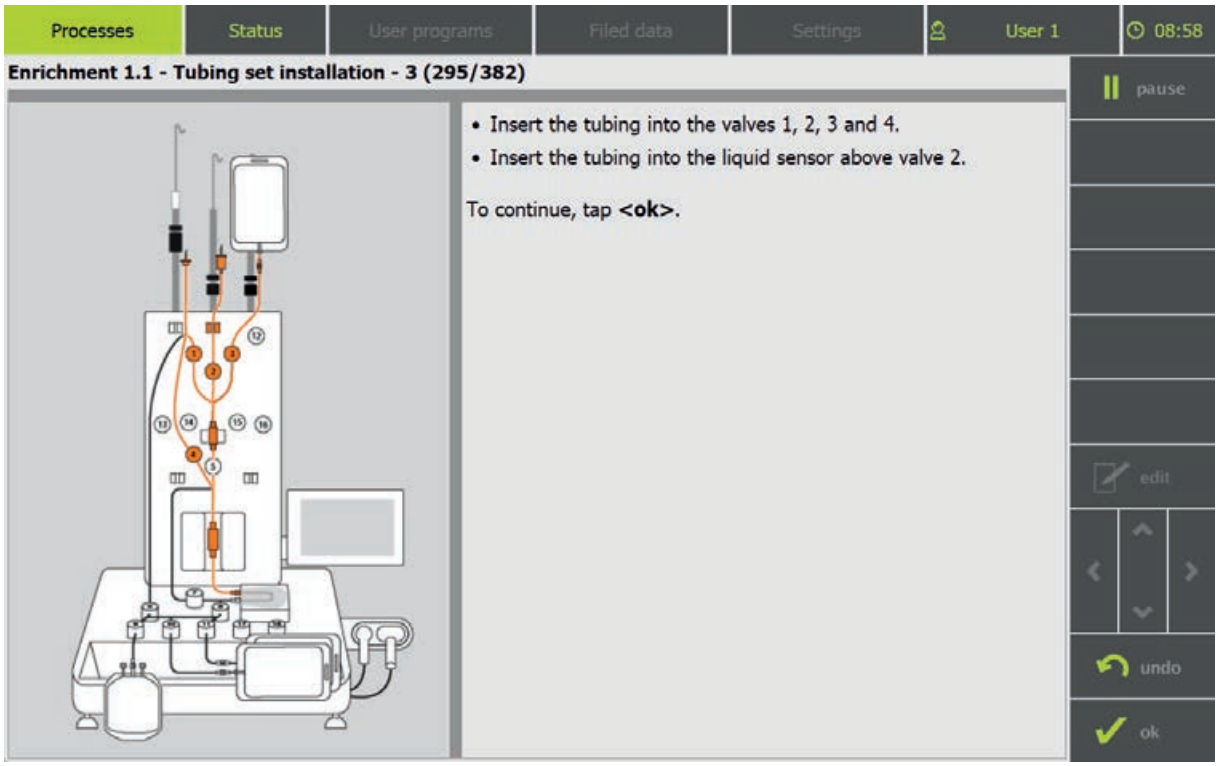


Figure 7.65: Insertion of tubing into valves 1, 2, 3, 4, and liquid sensor

1. Insert the tubing into valve 4. Ensure that the tubing is inserted correctly in the valve opening (see Figure 7.64). Pay particular attention to the area between valves 4 and 5 (see Figure 7.66) and keep the four-way fitting upright.
2. Insert the tubing into valve 1.
3. Position the 4-way fitting just below valve 2. Pay particular attention to the area below valve 2.
4. Insert the tubing into valves 2 and 3.
5. Insert the tubing into the liquid sensor between valve 2 and the bubble trap. Ensure that the tubing is inserted correctly into the sensor fitting.

   IMPORTANT:
   To ensure proper operation, both the liquid sensor and the tubing being inserted must be dry. Carefully inspect both. If any liquid is present, dry the area with a soft, lint-free cloth.

To continue, tap **ok**.

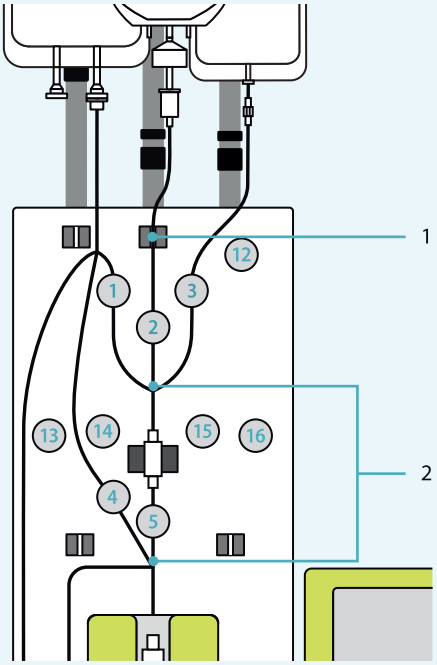


Figure 7.66: Tubing in valves - Liquid sensor and critical areas between valves 4 and 5 and below valve 2

1 Liquid sensor

2 Important areas between valves 4 and 5 and below valve 2

Inserting the pump tubing into the pump

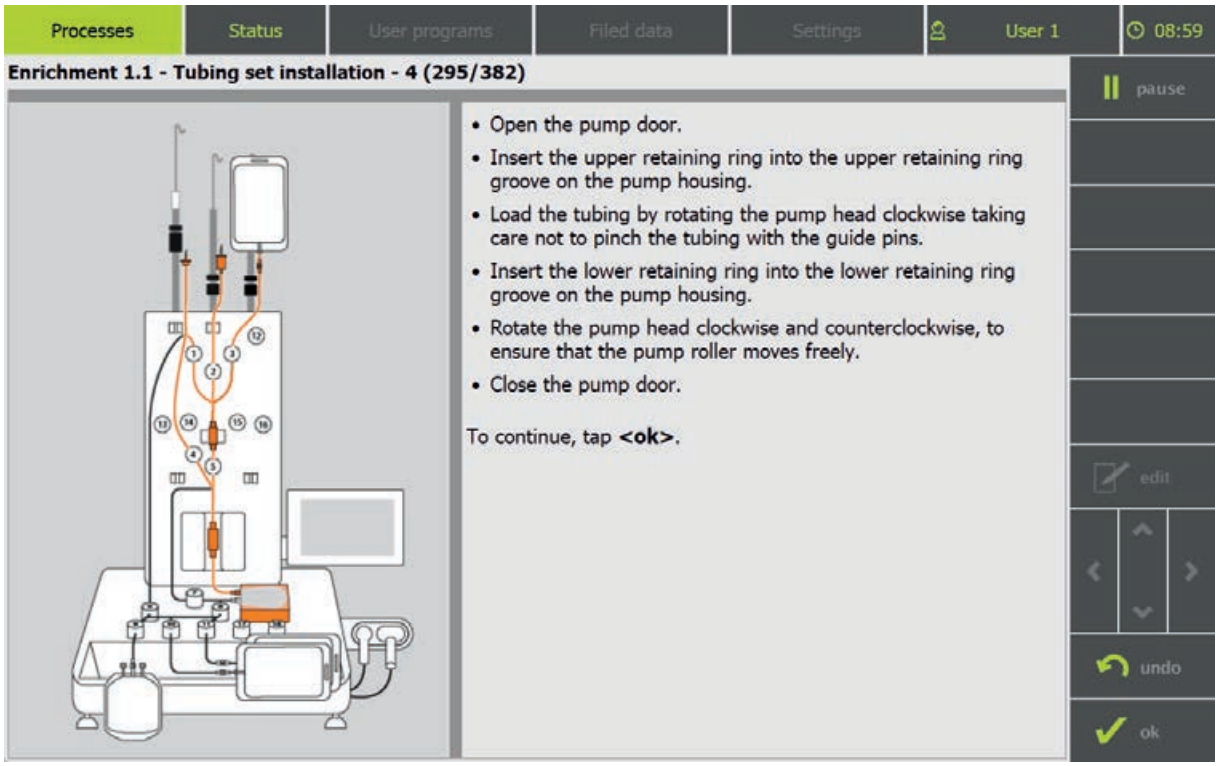


Figure 7.67: Insertion of the pump tubing into the pump

1. Open the pump door by lifting up at the left-hand edge.
2. Insert the upper retaining ring of the pump tubing into the retaining ring groove on the pump housing (see Figure 7.68).
3. Rotate the pump roller clockwise until the tubing is threaded between both sets of the tubing guide pins and fits snugly around the pump roller. Ensure that the tubing is not pinched at the end of the guide pins. If adjustment of the tubing inside the pump is necessary, remove the tubing by lifting the lower end and turning the pump roller counterclockwise.
4. Insert the lower retaining ring of the pump tubing into the retaining ring groove on the pump housing.
5. To ensure that the pump roller moves freely, rotate the pump roller clockwise and counterclockwise.
6. Close the pump door.

IMPORTANT:
If the pump door is opened during the cell separation program, the instrument run will immediately stop.

To continue, tap **ok**.

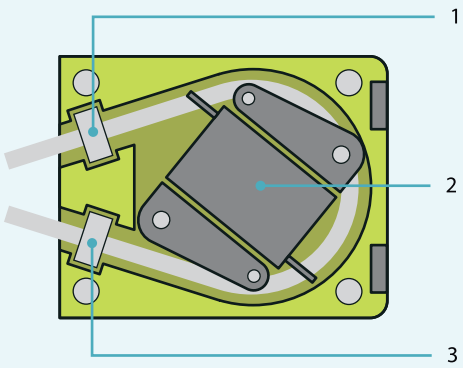


Figure 7.68: Insert pump tubing

1 Upper retaining ring
2 Pump roller
3 Lower retaining ring

Loading valves 7 and 8

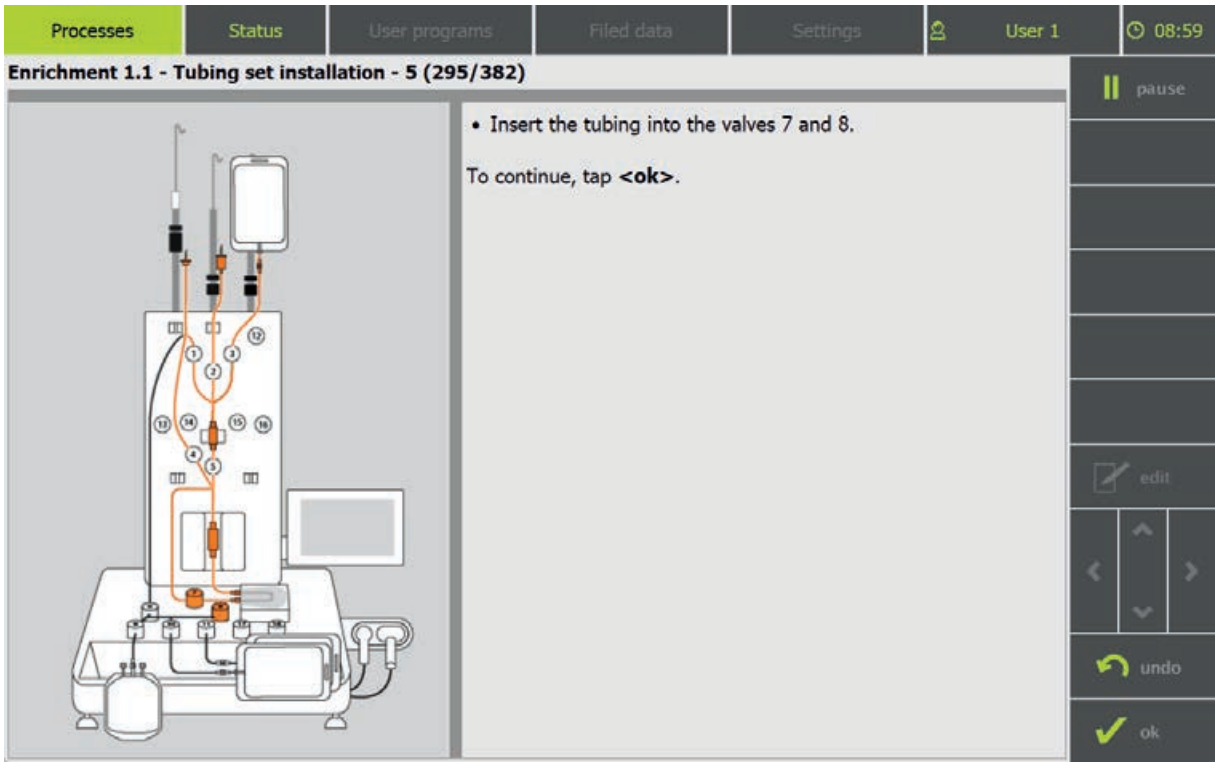


Figure 7.69: Loading of valves 7 and 8

Insert the tubing into the valves 7 and 8. To continue, tap ok.

Loading valves 6, 9, 10, and 11

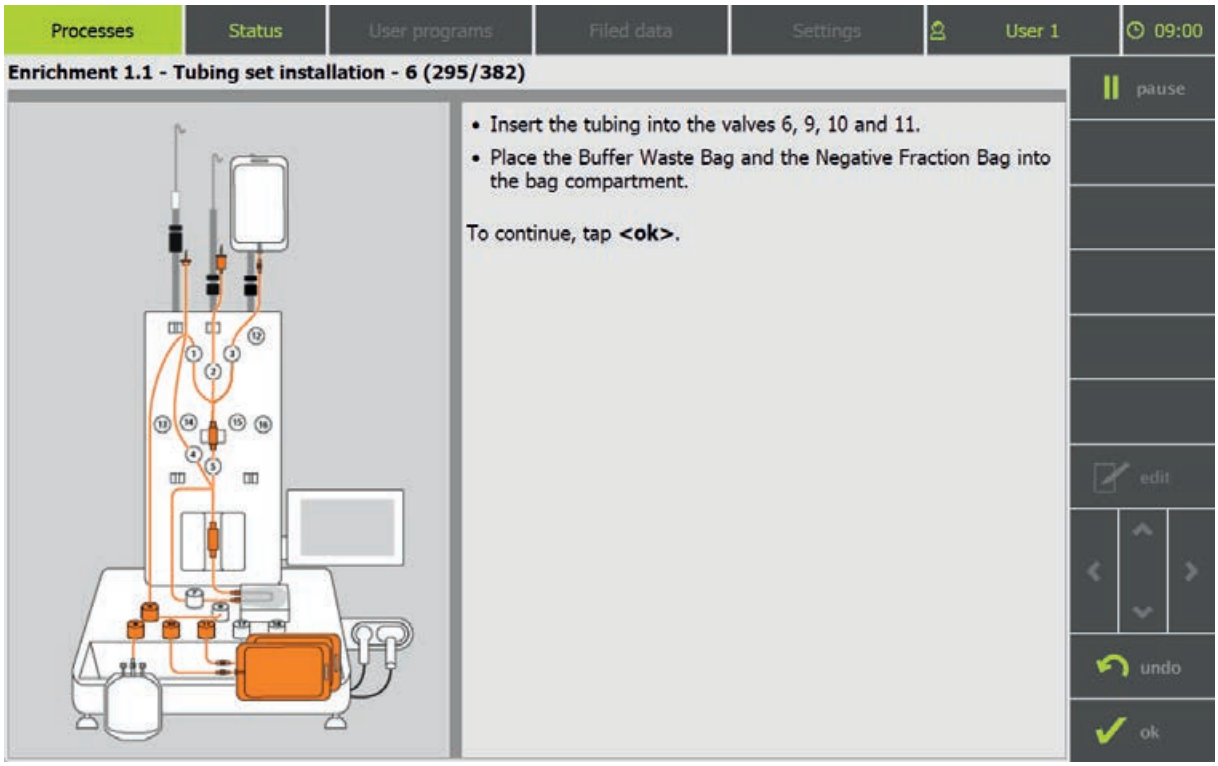


Figure 7.70: Load valves 6, 9, 10, and 11

1. Insert the tubing into valves 6, 9, 10, and 11.
2. Place the Negative Fraction Bag and the Buffer Waste Bag in the bag compartment.

To continue, tap **ok**.

Rechecking all tubing and attachments

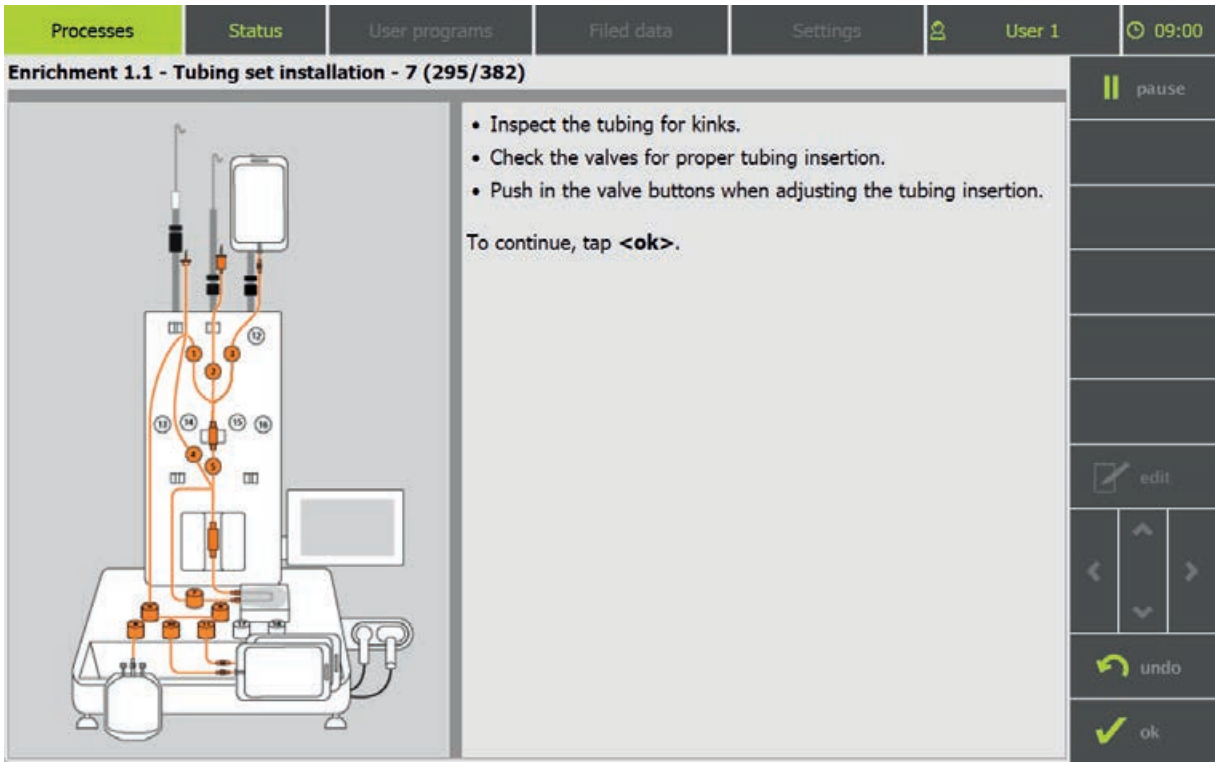


Figure 7.71: Recheck of all tubing and attachments

Before beginning the cell separation, recheck all tubing and attachments.

- Check all valves for proper tubing insertion. Ensure that the tubing is spaced uniformly, and that there are no kinks or stretched areas in the tubing.
- Pay particular attention to the pre-column area and the area between the pump and valves 7 and 8 (see Figure 7.72) and between valves 4 and 5 (see Figure 7.66).

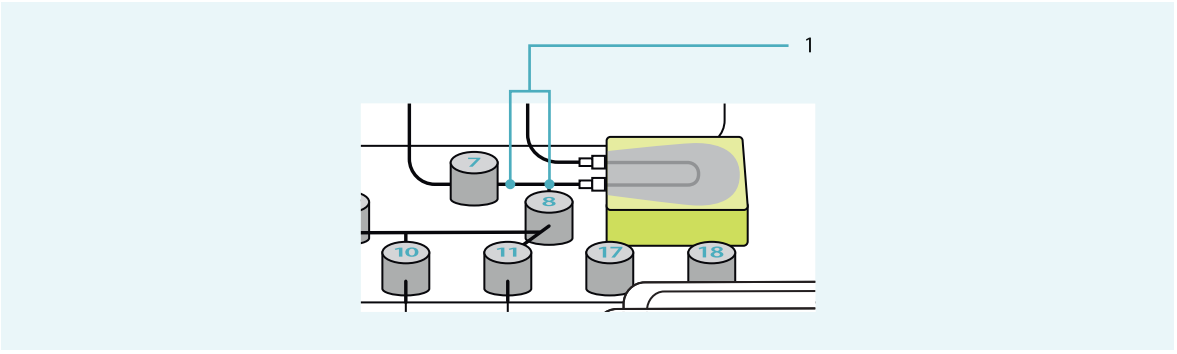


Figure 7.72: Tubing in valves - Critical area between valves 7 and 8

- If the tubing has to be adjusted after a valve is closed, do not pull the tubing without pressing the valve button to open the valve.
- If a tubing has been adjusted, it is necessary to press the corresponding valve buttons firmly twice.

To continue, tap **ok**.

Seating of valves

To ensure the proper fit of the tubing in the valves, the instrument will operate all of the valves in sequence twice. Watch and listen to ensure that all valves are working properly. If any valve does not operate correctly, refer to section 'Troubleshooting'. The magnet drive will also be tested during this check sequence.

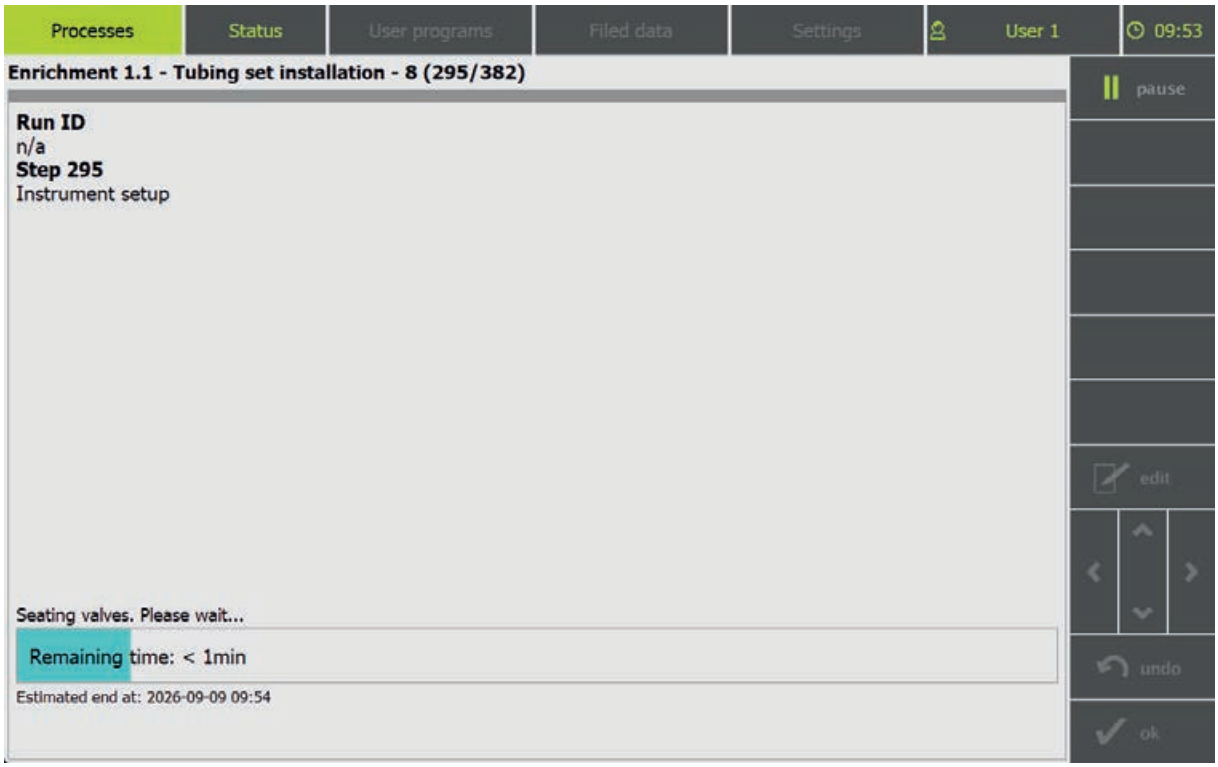


Figure 7.73: Seating of valves

Attaching the process buffer bag

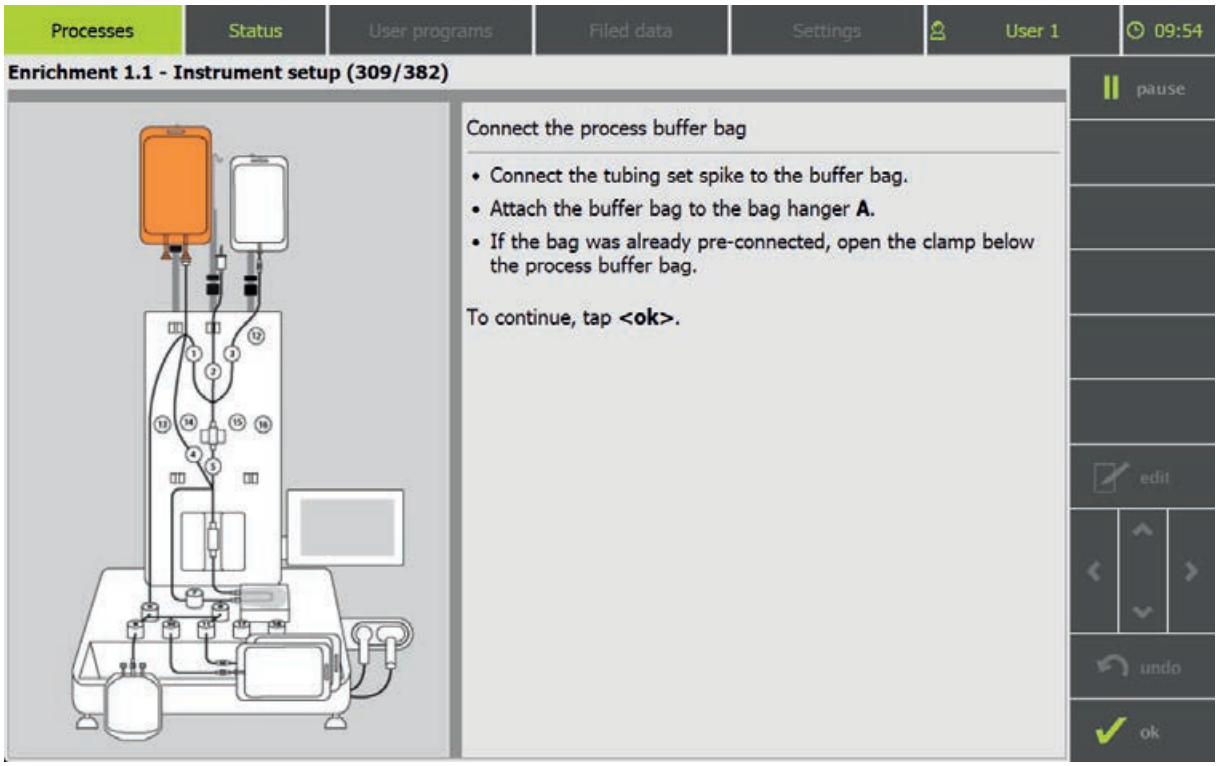


Figure 7.74: Attachment of the buffer bag

The prescribed process buffer for the CliniMACS Plus separations is CliniMACS PBS/EDTA Buffer supplemented with HSA to a final concentration of 0.5% (w/v).

1. Using aseptic techniques, remove the cap from the buffer spike on the tubing set (see Figure 7.58) and connect it to the buffer bag.
    a. Ensure that the septum is punctured, allowing free flow of liquid.
    b. Gently squeeze the bag to confirm that the spike has penetrated the bag.
2. If more than one liter of buffer is necessary for a separation, connect two buffer bags using a plasma transfer set.
3. Attach the buffer bag to the buffer bag hook on the bag hanger A (see Figure 7.75).

⚠ WARNING

Risk of personal injury and infection.

Overloading the bag hangers can cause the instrument to tip over. Falling or damaged bags may become contaminated. Contaminated solution may lead to infection if used.

- Do not overload the bag hangers. The carrying capacity of a single bag hanger is 5 kg.

4. Adjust the height of the buffer bag hanger.
    a. Raise or lower the bag hanger to accommodate the height to the size of the buffer bag.
    b. Ensure that it is positioned high enough to prevent severe bending of the tubing that could restrict the flow, and that it is low enough to avoid the tubing or connections being stretched.

To continue, tap **ok**.

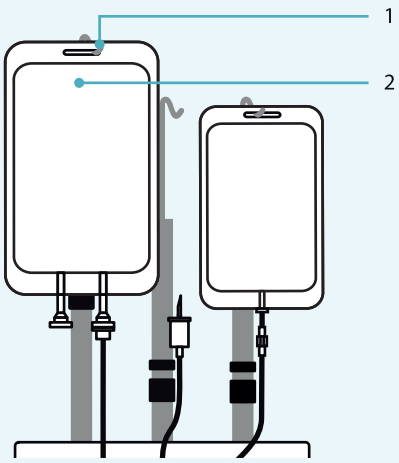


Figure 7.75: Attachment of the buffer bag to bag hanger A

1 Bag hanger hook

2 Process buffer

Priming of the tubing set

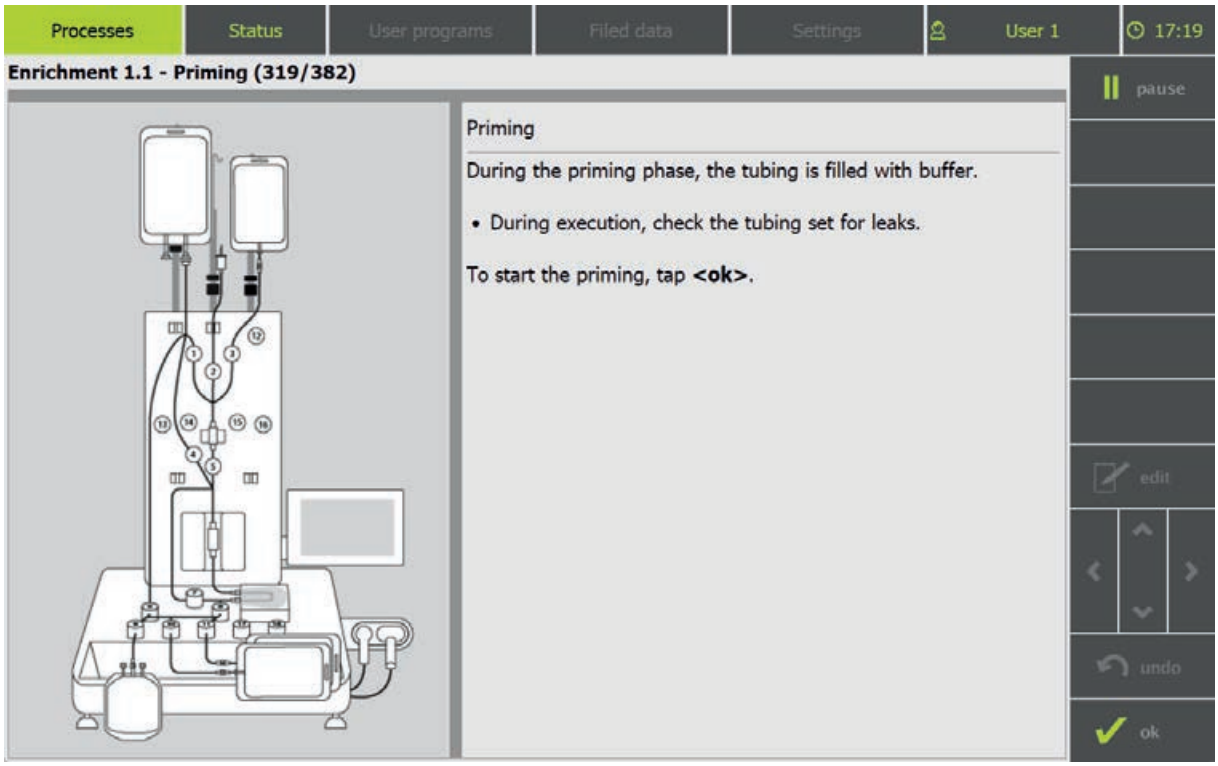


Figure 7.76: Priming of the tubing set

IMPORTANT:
Once priming has started, it is not possible to return to the instrument set-up procedure.

To start the priming, tap ok. The priming phase will take approximately 1 minute. The priming status is shown on the screen.

- During the priming phase, the tubing set is filled with the process buffer. The buffer will circulate through the tubing set including both the pre-column and the separation column.
- Priming waste is collected in the Priming Waste Bag and the Buffer Waste Bag (see Figure 7.58).
- The priming cycles continue, repeating a series of steps.
- During the priming phase, check all tubing, fittings, valves, and columns for the appearance of any leaks or the presence of any folds that may block fluid flow.

Final check of all tubing and attachments

After the priming is completed, the screen shows Figure 7.77.

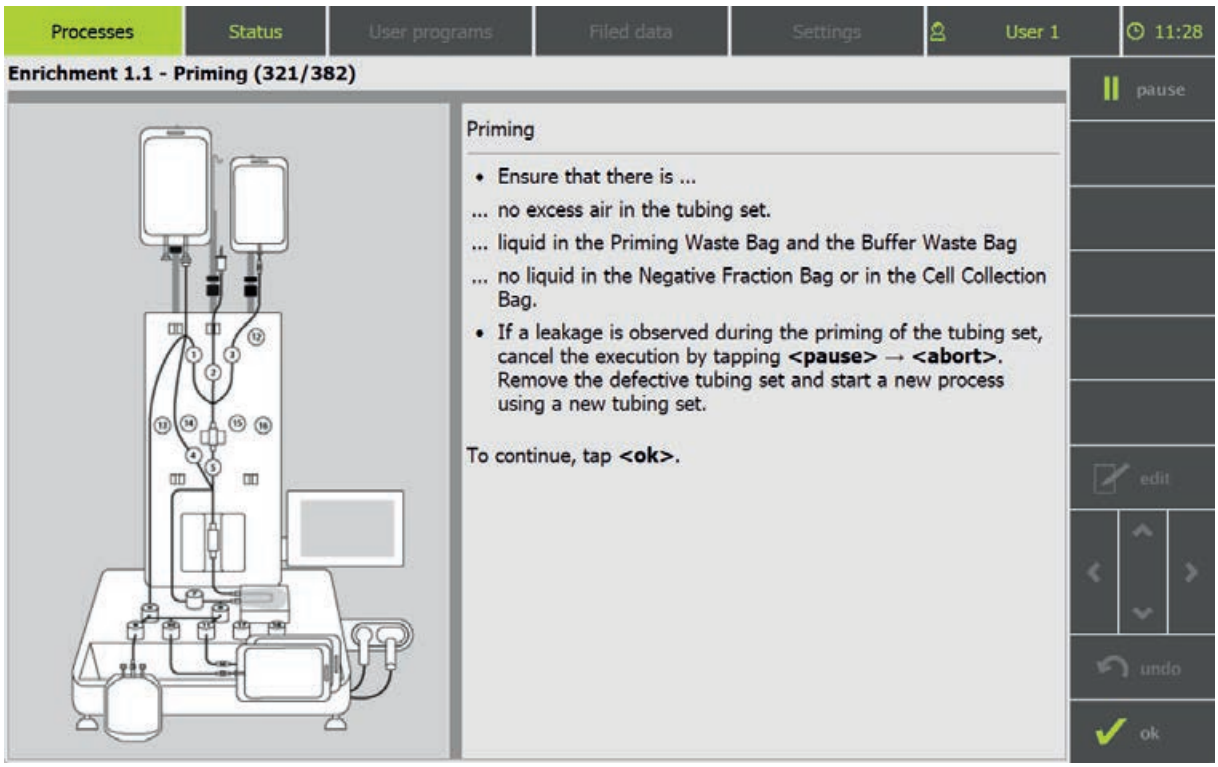


Figure 7.77: Final check of tubing

Before continuing the program, ensure the following:

- Liquid in all parts of the tubing set (except the pre-system filter)
- No excess air in the tubing set
- Fluid in the Priming Waste Bag and the Buffer Waste Bag
- No fluid in the Negative Fraction Bag or in the Cell Collection Bag

If leaks or malfunctions are observed, stop the run.

- To stop the run, tap **pause** > **abort**.
- If the tubing set is defective, remove the tubing set and start a new process using a new tubing set.

To continue, tap **ok**.

Integrity test

For additional safety, it is recommended to perform an integrity test to check the tubing set for leaks. The test sequence consists of two automated subsequences, which allow both the upper and the lower parts of the tubing set to be pressurized and observed separately. To continue with the integrity test, tap **ok** > **continue**. To skip the integrity test, tap **ok** > **skip**.

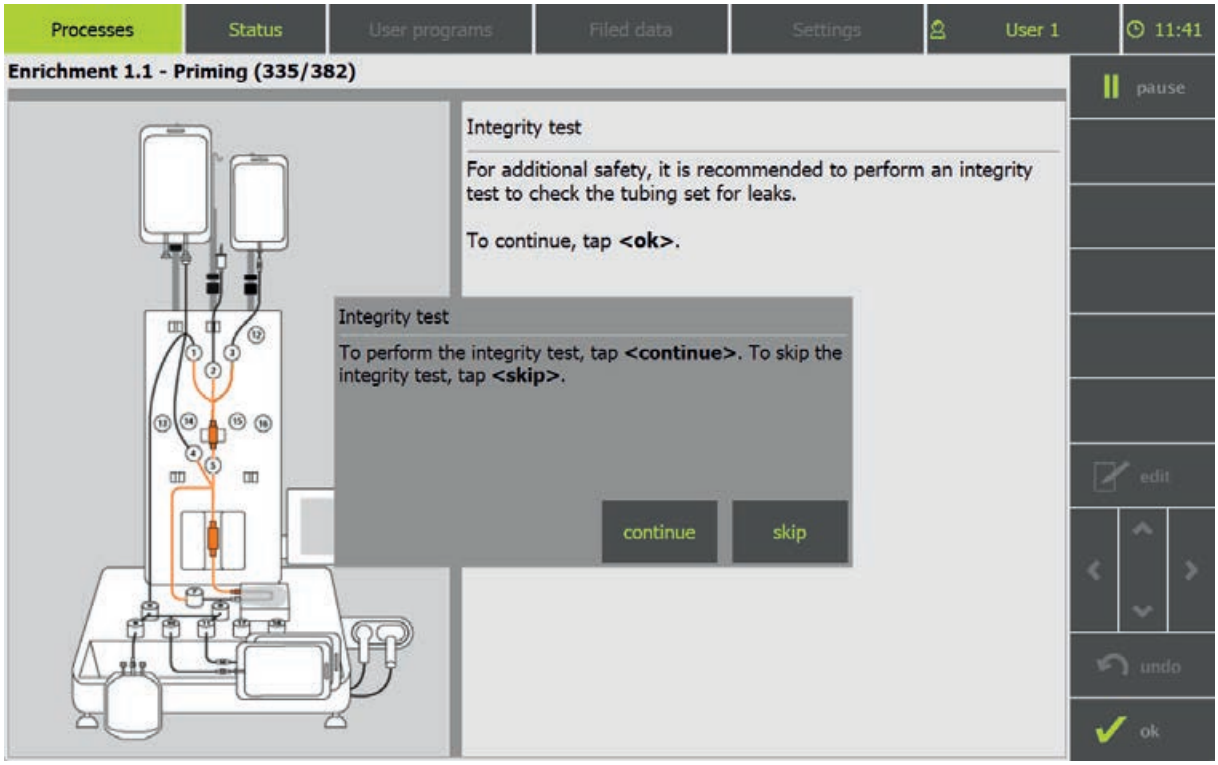


Figure 7.78: Integrity test

Integrity test for the upper part of the tubing set

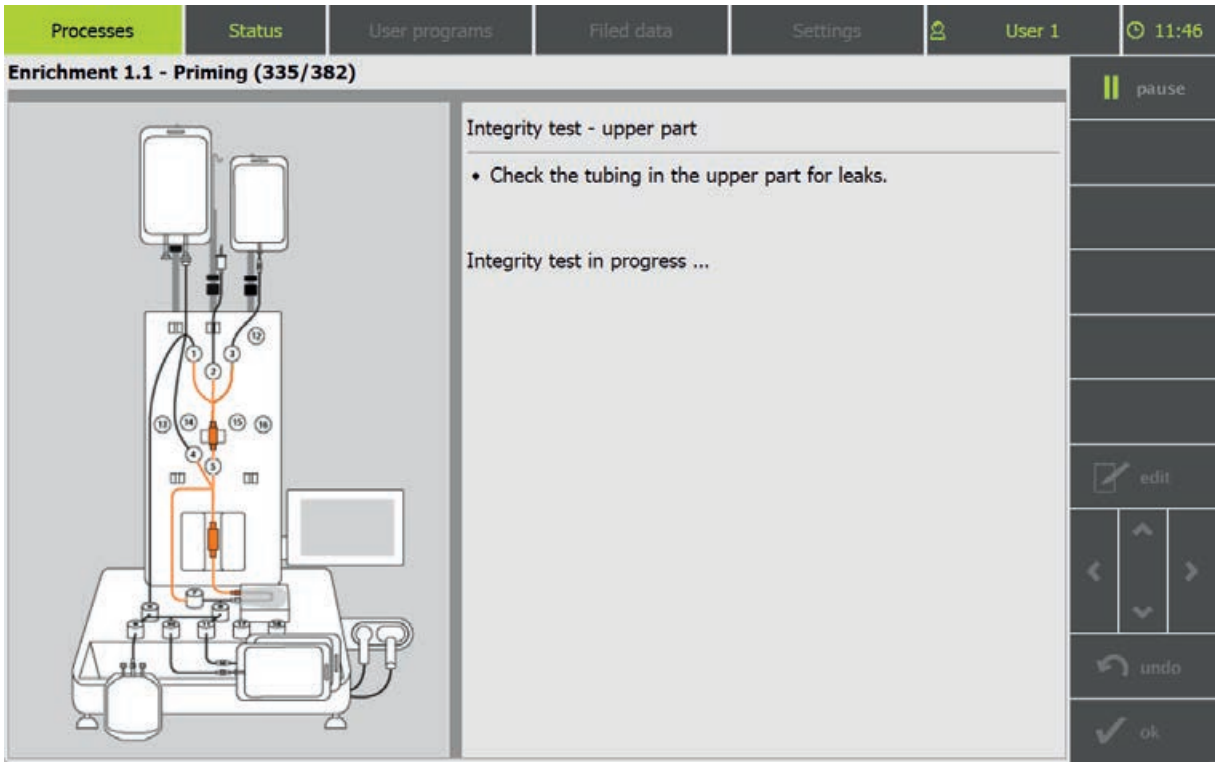


Figure 7.79: Integrity test for the upper part in progress

After tapping **continue**, the instrument starts the automated test sequence for the upper part of the tubing set (see Figure 7.79). Overpressure will be created and held for two minutes.

1. During this time, the user should watch all the connections above the upper pump tubing connection.

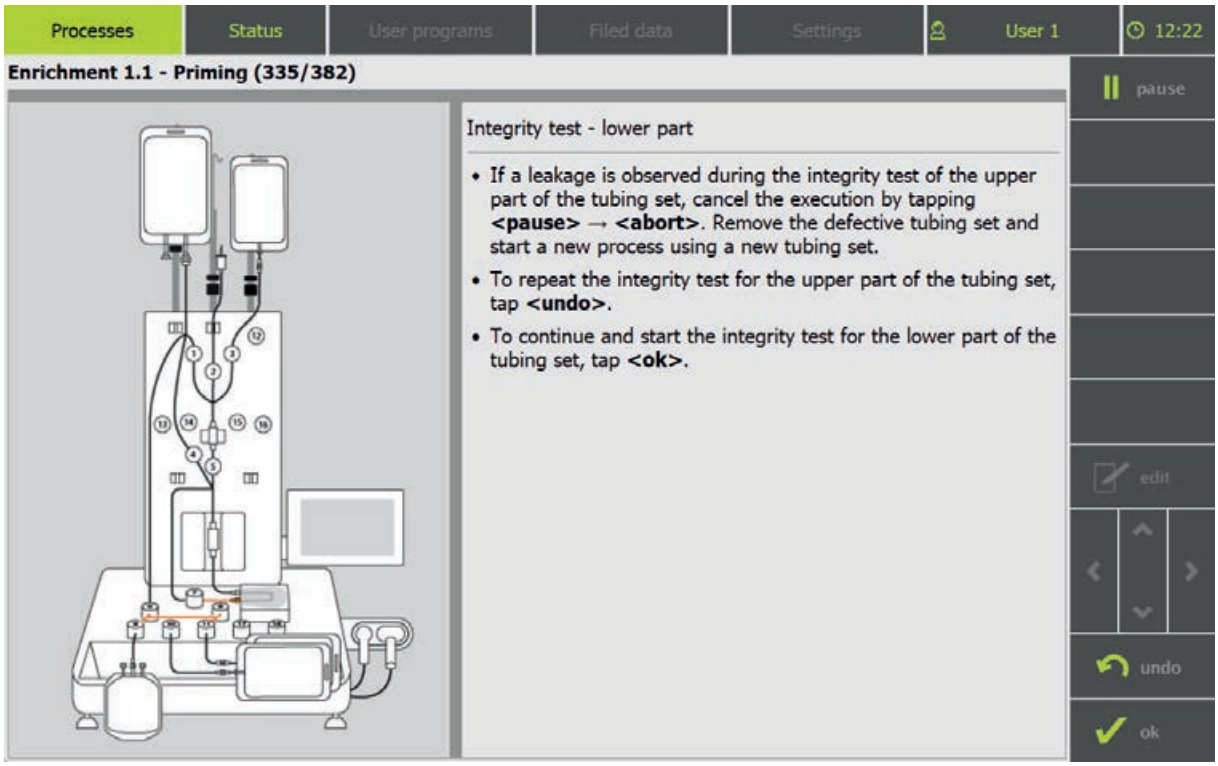


Figure 7.80: Integrity test for the upper part completed

After two minutes, the pressure is automatically released (see Figure 7.80).

1. Check if any leaks have occurred during the test sequence. If leakage is observed at any connection of the tubing set, stop the run and replace the defective tubing set with a new one.
    a. To stop the run, tap **pause** > **abort**.
    b. Remove the defective tubing set from the instrument and replace it with a new one. Start a new process with the new tubing set. Contact Miltenyi Biotec Technical Support for instructions regarding the return of the defective tubing set.
2. To repeat the integrity test of the upper part of the tubing set, tap **undo** > **repeat**. If no leaks are observed, continue with the integrity test of the lower part of the tubing set by tapping **ok**.

Integrity test for the lower part of the tubing set

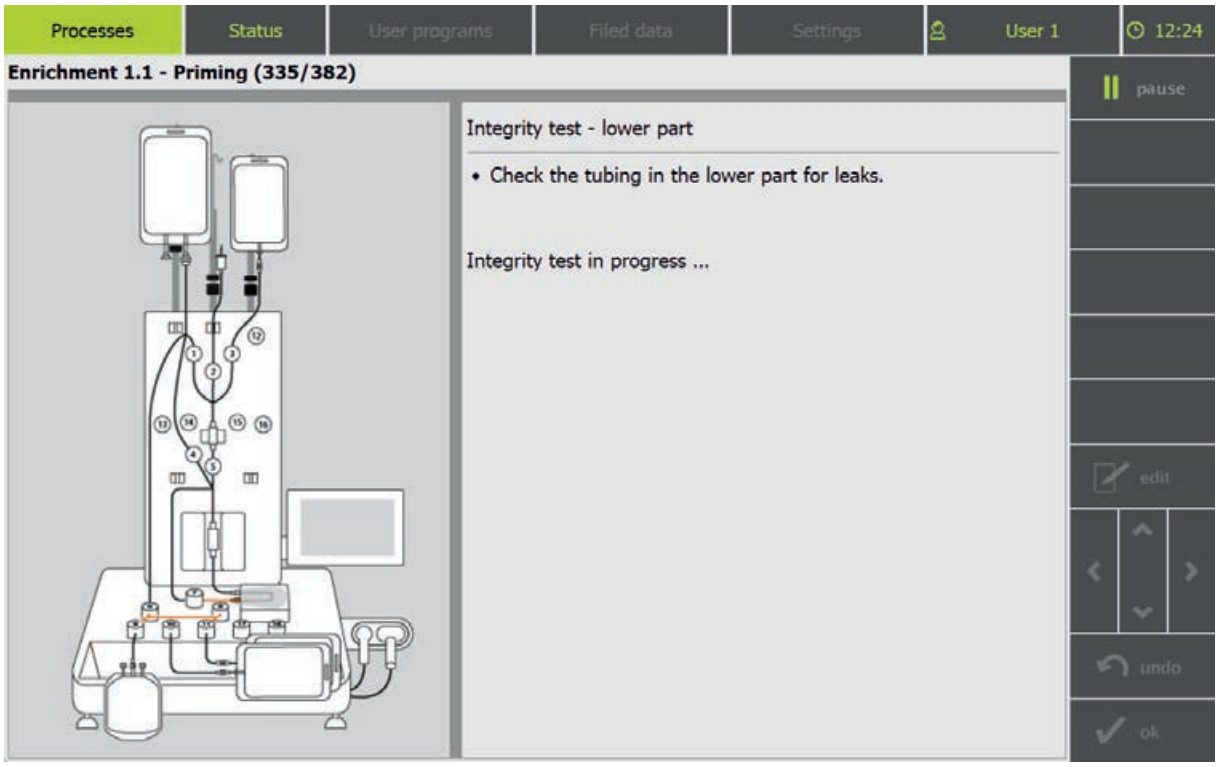


Figure 7.81: Integrity test for the lower part in progress

After tapping **ok**, the instrument starts the automated test sequence for the lower part of the tubing set (see Figure 7.81). Overpressure will be created and held for 30 seconds.

1. During this time, the user should watch the lower pump tubing connection and the T-fittings between valves 6, 8, 9, 10, and 11.

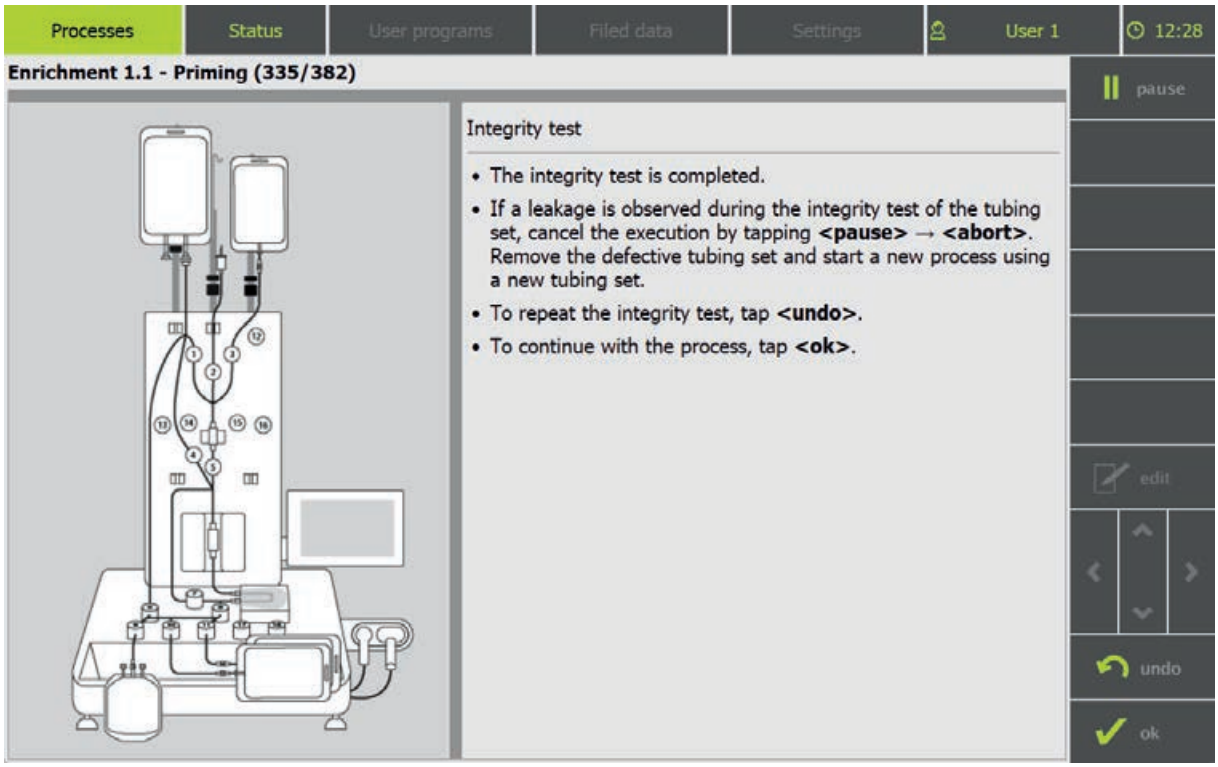


Figure 7.82: Integrity test for the lower part completed

After 30 seconds, the pressure is automatically released.

1. Check if any leaks have occurred during the test sequence. If leakage is observed at any connection of the tubing set, stop the run and replace the defective tubing set with a new one.
    a. To stop the run, tap **pause** > **abort**.
    b. Remove the defective tubing set from the instrument and replace it with a new one. Start a new process with the new tubing set. Contact Miltenyi Biotec Technical Support for instructions regarding the return of the defective tubing set.
2. To repeat the integrity test, tap **undo**. If no leaks are observed, continue with the process by tapping **ok**.

Connecting the Cell Preparation Bag

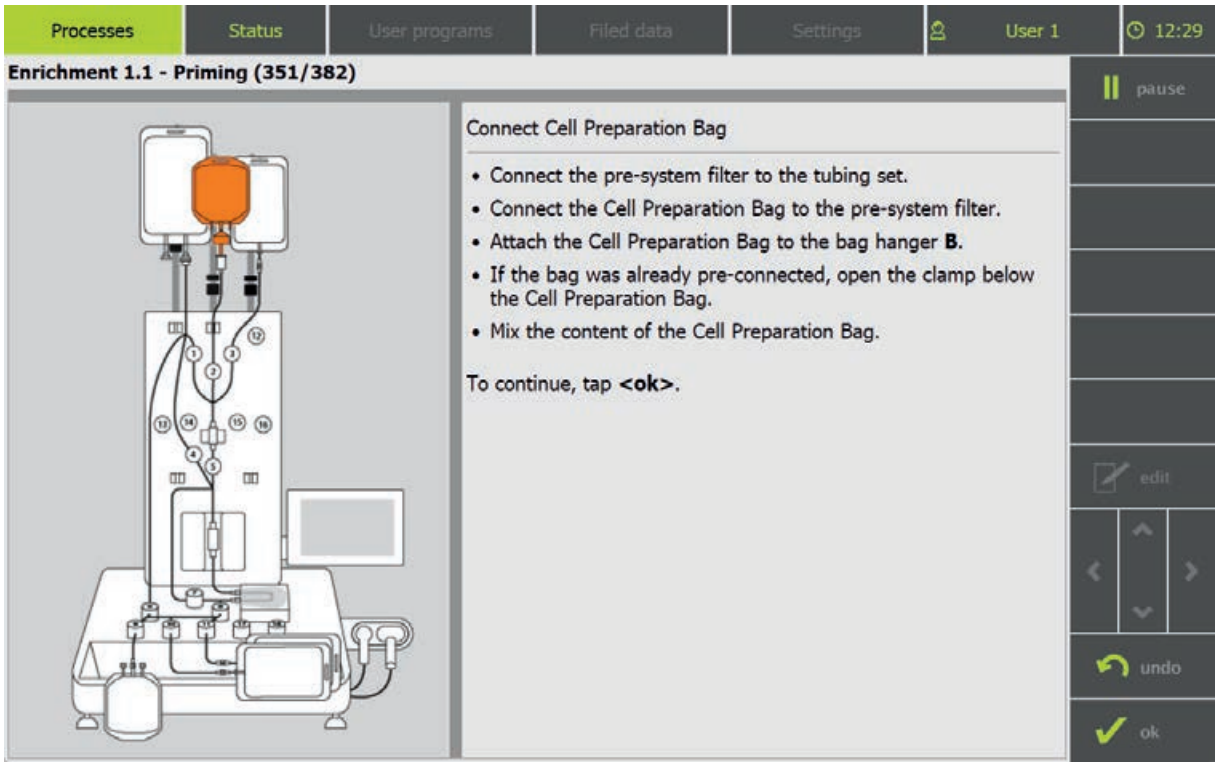


Figure 7.83: Connect Cell Preparation Bag

Connect the Cell Preparation Bag containing the labeled cell product to the tubing set.

1. Remove the cap from the bubble trap spike of the tubing set (see Figure 7.58).
2. Remove the cap from the blunt end of the pre-system filter. Firmly insert the spike into the pre-system filter (see Figure 7.85).
3. Remove the cap from the pre-system filter spike.
4. Spike the pre-system filter into an unused port of the Cell Preparation Bag ensuring that the septum is punctured, allowing free flow of liquid. Gently squeeze the bag to confirm that the spike has penetrated the bag.
5. Carefully check the connection between the pre-system filter and the tubing set to ensure that the connection is secure.
6. Hang the Cell Preparation Bag on the bag hanger B.
7. If the bag was already pre-connected, open the clamp below the Cell Preparation Bag.
8. Mix the content of the Cell Preparation Bag.
9. Adjust the bag hanger for the Cell Preparation Bag to hold the Cell Preparation Bag in an upright position.

To continue, tap **ok**.

Final check of the liquid sensor

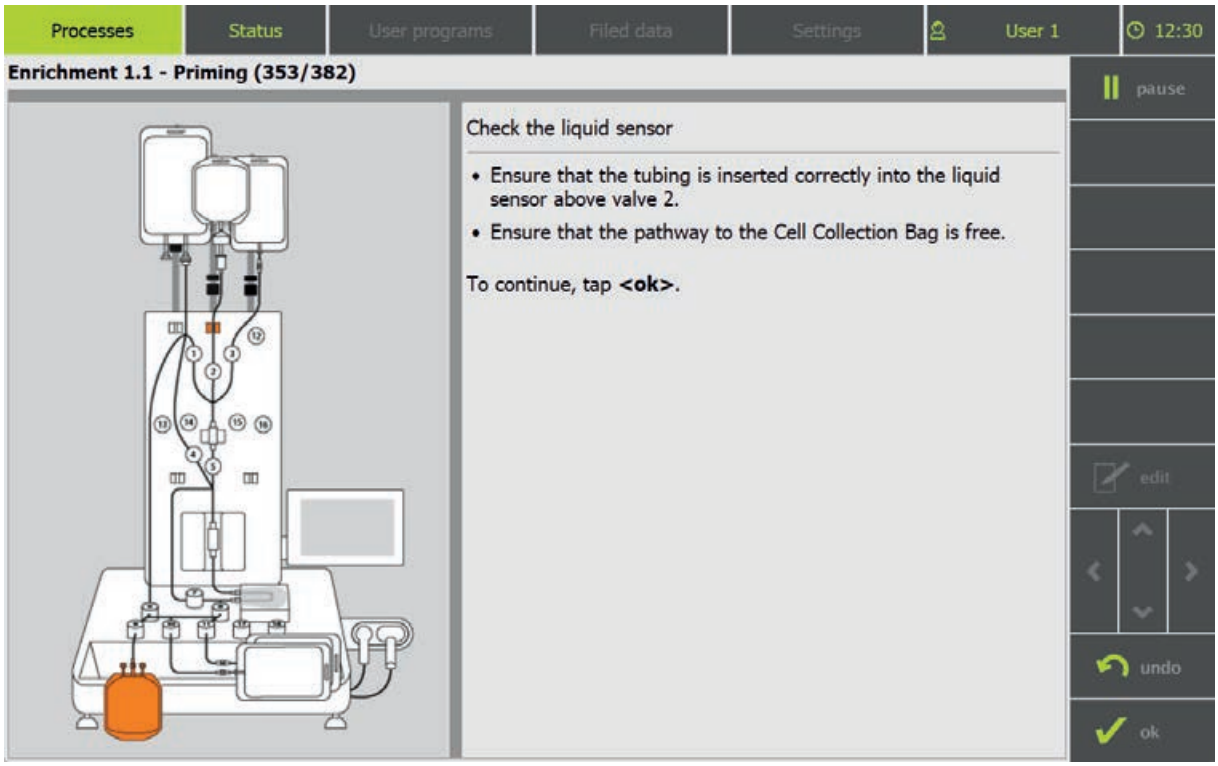


Figure 7.84: Final check of the liquid sensor

1. Check the liquid sensor tubing. Ensure that the tubing is properly inserted, that it is free of any external liquid and has not been dislodged during the loading procedure.
2. Ensure that the unrestricted flow to the Cell Collection Bag is possible (for example, open clamp below valve 9).

To continue with the separation (Step 4), tap ok.

Figure 7.85 shows the CliniMACS Plus Instrument with the CliniMACS Tubing Set, process buffer, Cell Preparation Bag, and Cell Collection Bag.

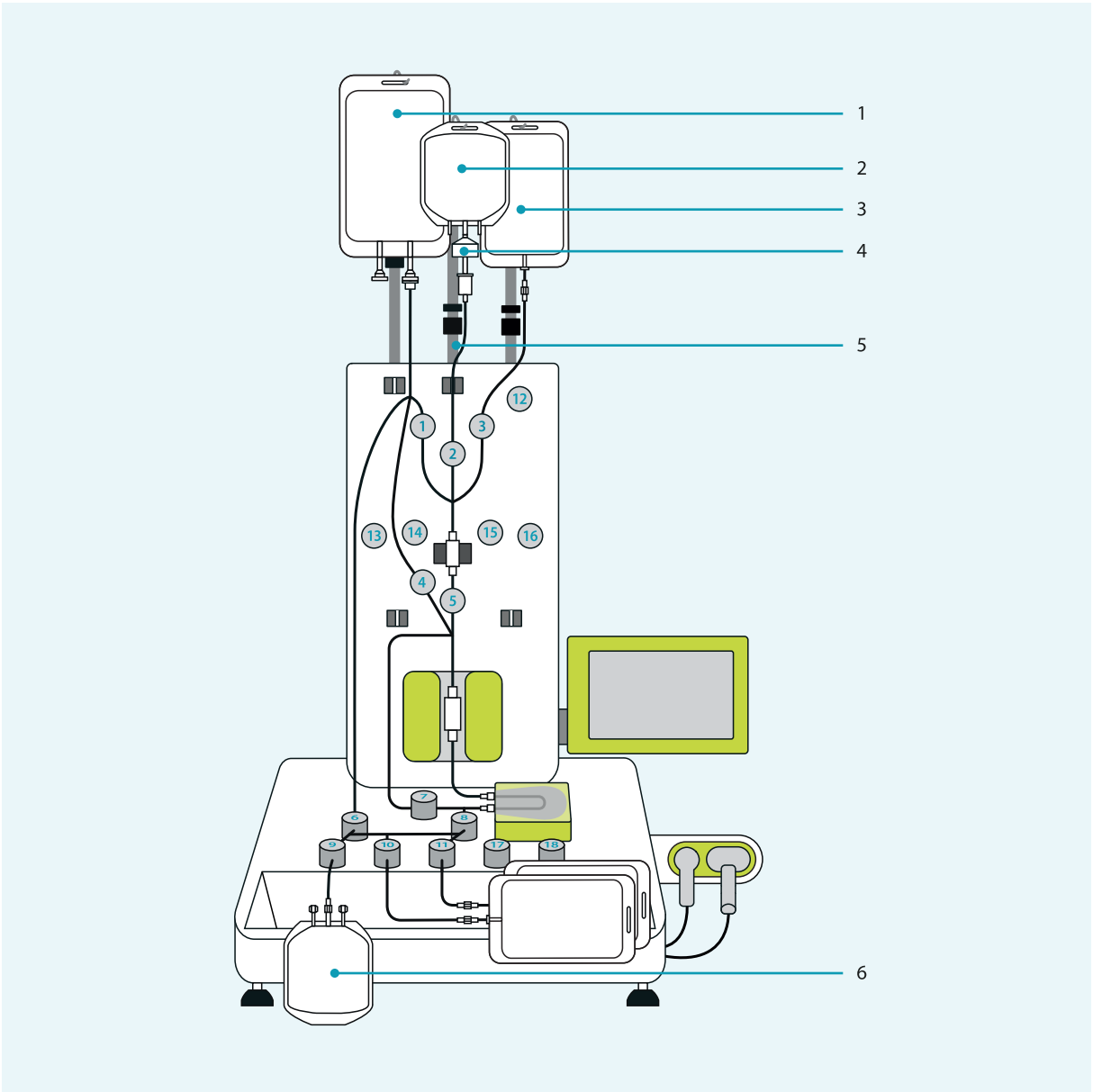


Figure 7.85: CliniMACS Plus Instrument with CliniMACS Tubing Set, process buffer, Cell Preparation Bag, and Cell Collection Bag

1 Process buffer
2 Cell Preparation Bag
3 Priming Waste Bag
4 Pre-system filter
5 Bag hanger B for Cell Preparation Bag
6 Cell Collection Bag

7.3.2 Alternative installation of CliniMACS Tubing Sets

The instructions in Step 3 and the screens shown by the CliniMACS Plus Instrument describe the installation of the CliniMACS tubing sets in a clean room.

The CliniMACS Plus System itself is a closed system which does not necessarily need to be operated in a clean room. However, if operated outside a clean room, the installation procedure of the tubing set needs to be adapted in order to ensure that the sterility of the cell separation process is guaranteed.

The sterility of the cell separation process may be compromised during the attachment of the Cell Collection Bag, the process buffer, the pre-system filter, and the Cell Preparation Bag. To ensure that the system remains sterile, these components must be attached to the tubing set under sterile conditions (for example, laminar flow hood). When the components are attached to the tubing set before installation onto the CliniMACS Plus Instrument, the order of the instructions provided by the instrument and the instructions in Step 3 must be changed and further actions taken.

When operating the CliniMACS Plus Instrument outside a clean room, follow the following additional instructions, altering the instructions in Step 3.

Preparation for tubing set installation

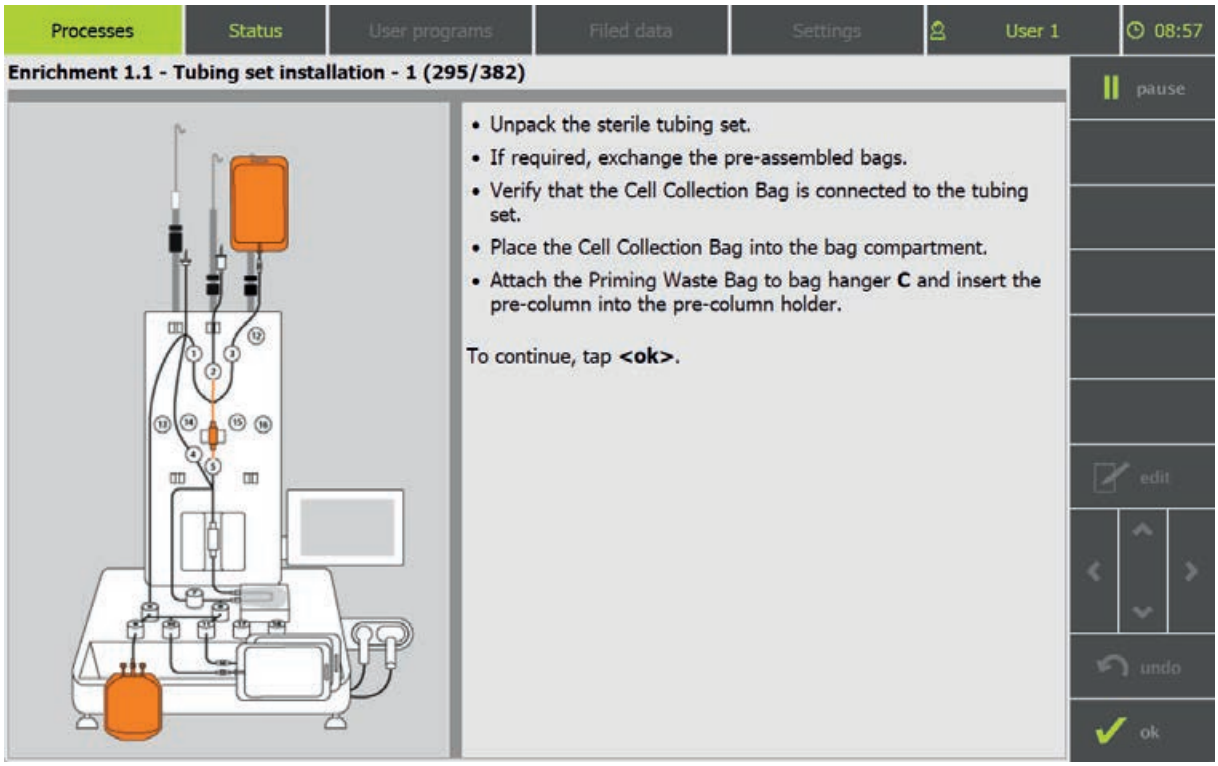


Figure 7.86: Unpacking the tubing set

As described, the Cell Collection Bag, the process buffer, the pre-system filter, and the Cell Preparation Bag must be attached to the tubing set before installing the tubing set onto the instrument under sterile conditions.

Unpack the tubing set under sterile conditions and attach the following components under sterile conditions as described in section 'Connection of the Cell Preparation Bag'.

Attachment of the process buffer

IMPORTANT:
To prevent the buffer from flowing into the tubing set prior to installation, clamp the tubing below the buffer spike with a locking forceps before connecting the process buffer to the tubing set (see clamp 1, Figure 7.89).

- Using aseptic techniques, remove the cap from the buffer spike on the tubing set and connect it to the process buffer bag.
- Ensure that the septum is punctured, allowing free flow of liquid.
- Gently squeeze the bag to ensure that the spike has penetrated the bag.

Attachment of the pre-system filter

Remove the cap from the spike of the bubble trap. Remove the cap from the lower opening of the pre-system filter.

Firmly insert the spike into the pre-system filter. DO NOT remove the top cap of the pre-system filter. Close the tubing just below the bubble trap using a locking forceps (see clamp 2 Figure 7.89). This prevents the prepared cell suspension in the Cell Preparation Bag from entering pre-system filter and tubing set.

Attachment of the Cell Preparation Bag

Connect the Cell Preparation Bag containing the magnetically labeled and washed cells to the tubing set. Spike the Cell Preparation Bag with the pre-system filter ensuring that the septum is punctured, allowing free flow of liquid. Gently squeeze the bag to ensure that the spike has penetrated the bag.

Installation on the CliniMACS Plus Instrument

Hang the process buffer bag on bag hanger A, the Cell Preparation Bag on the bag hanger B, and the Priming Waste Bag on bag hanger C on the instrument.

To continue, tap **ok**. Refer to section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' for a detailed description of the following steps:

- **Attaching Priming Waste Bag and inserting the pre-column**
- **Inserting the separation column and loading valve 5**
- **Loading valves 1, 2, 3, and 4**
- **Inserting the pump tubing into the pump**
- **Loading valves 7 and 8**
- **Loading valves 6, 9, 10, and 11**
- **Rechecking all tubing and attachments**
- **Seating of valves**

Attachment of the CliniMACS PBS/EDTA Buffer

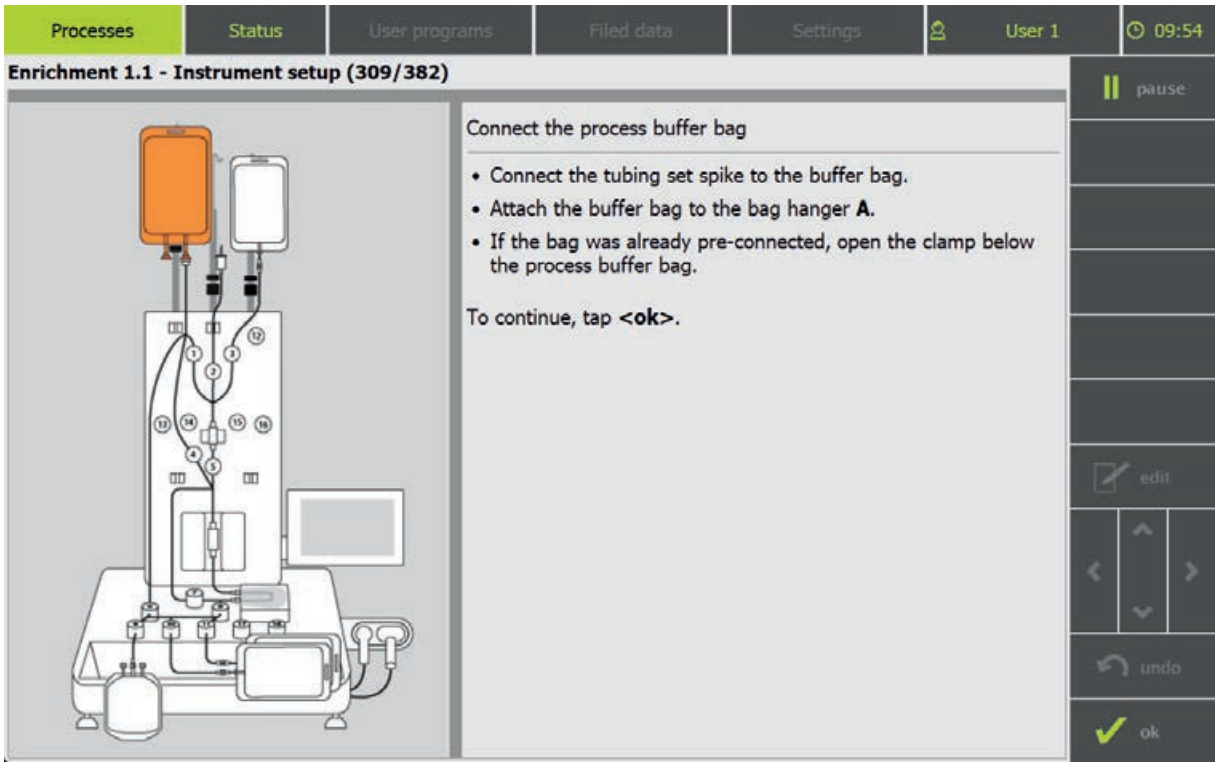


Figure 7.87: Attachment of process buffer bag

1. The buffer bag was attached during 'Preparation for tubing set installation'. Therefore, only the height of the buffer bag hanger may need to be adjusted. Raise or lower the hanger to accommodate the size of the buffer bag, ensuring that the height allotted is high enough to prevent the tubing from severe bending that could restrict the liquid flow, and low enough to avoid stretching the tubing or connections.

2. Remove the locking forceps from the tubing just below the buffer spike.

To continue, tap ok. Refer to section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' for a detailed description of the following steps:

- **Priming of the tubing set**
- **Final check of all tubing and attachments**
- **Integrity test**

Connect Cell Preparation Bag (and pre-system filter)

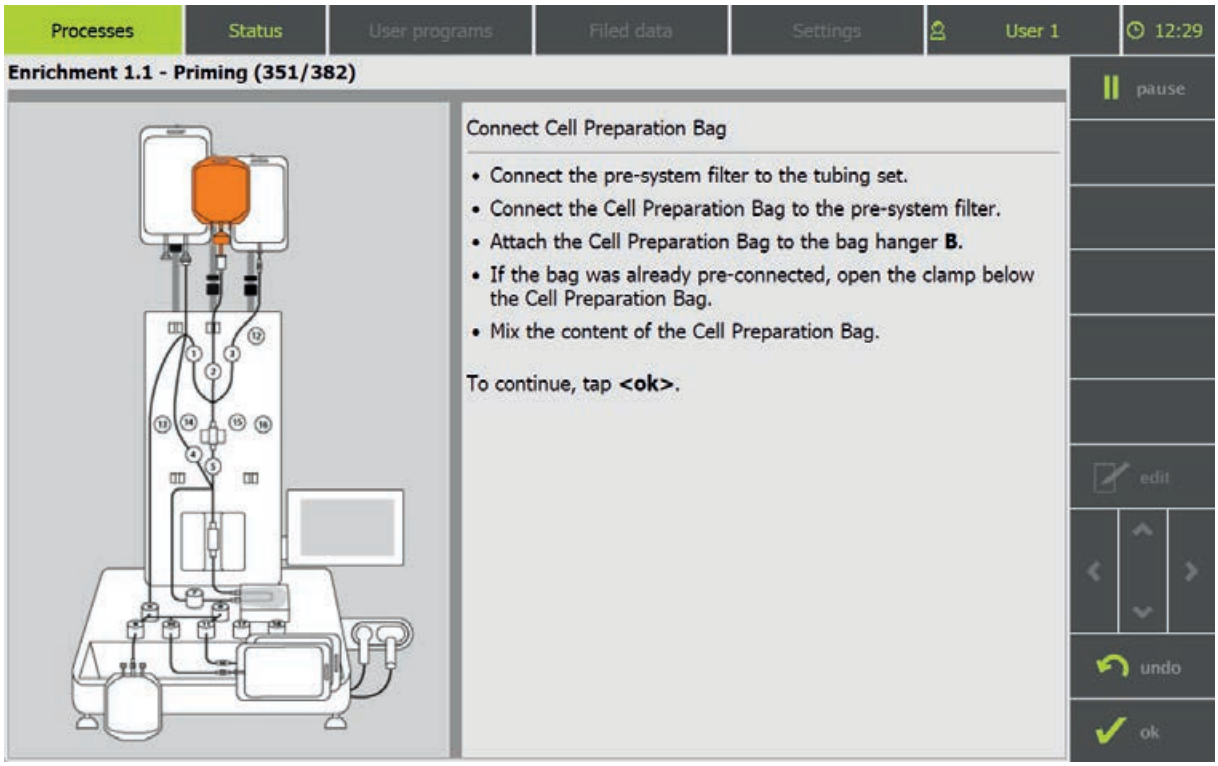


Figure 7.88: Connection of the Cell Preparation Bag

1. The Cell Preparation Bag and the pre-system filter were attached during 'Preparation for tubing set installation'.
2. Remove the locking forceps below the bubble trap (see Figure 7.89).

To continue, tap ok. Refer to section 'CliniMACS Tubing Set and CliniMACS Tubing Set LS' for a detailed description of the following step:

- **Final check of the liquid sensor**

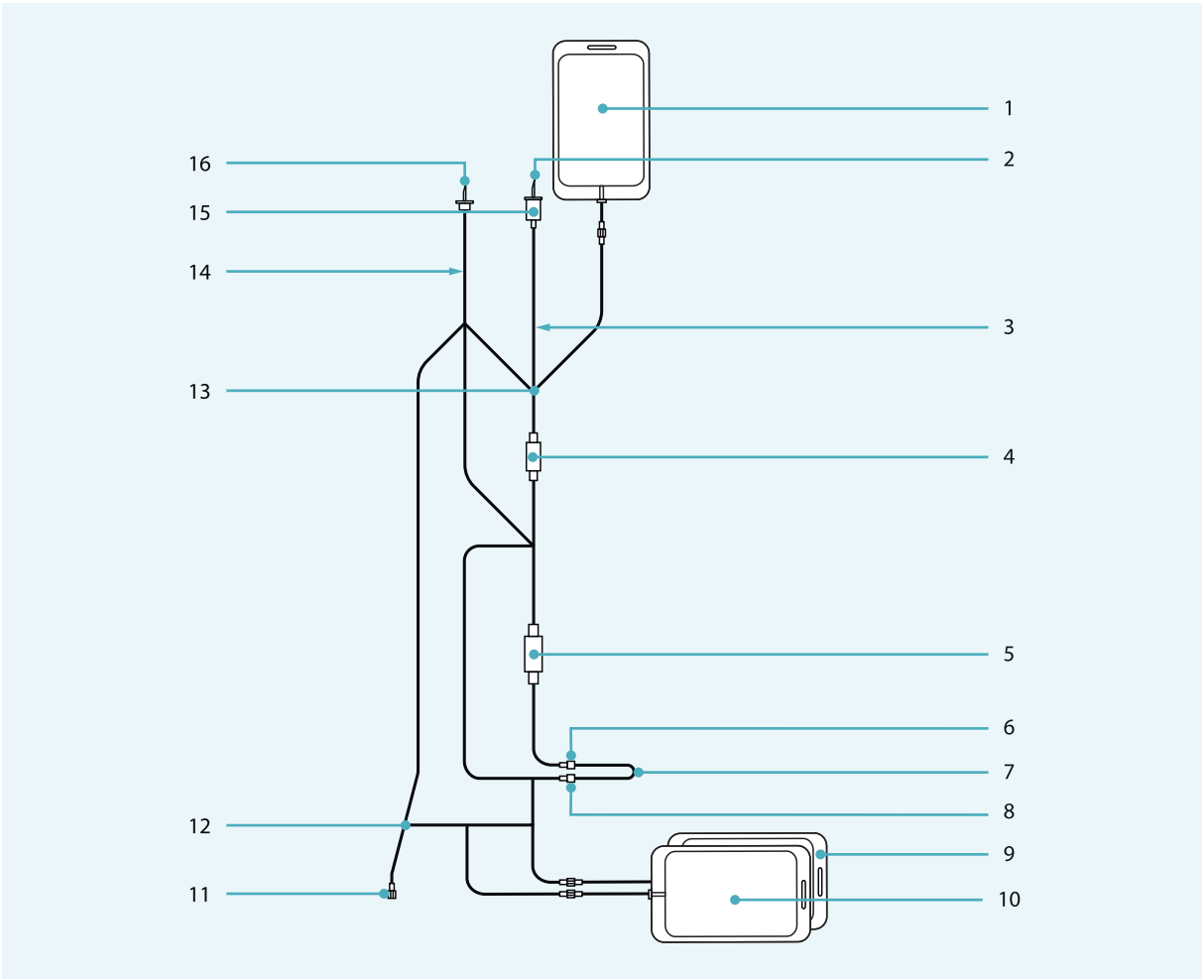


Figure 7.89: General construction of a CliniMACS Tubing Set (for example, CliniMACS Tubing Set) with clamping positions 1 and 2

1 Priming Waste Bag
2 Bubble trap spike
3 Clamp 2 here
4 Pre-column
5 Separation column
6 Upper retaining ring
7 Pump tubing
8 Lower retaining ring
9 Negative Fraction Bag
10 Buffer Waste Bag
11 Luer connector
12 T-fitting
13 4-way fitting
14 Clamp 1 here
15 Bubble trap
16 Buffer spike

7.3.3 CliniMACS Depletion Tubing Set

The CliniMACS Depletion Tubing Set is provided in a sealed, sterilized package. The tubing set contains preassembled tubings, a column, and bags for one cell separation, providing a sterile fluid path (see Figure 7.90).

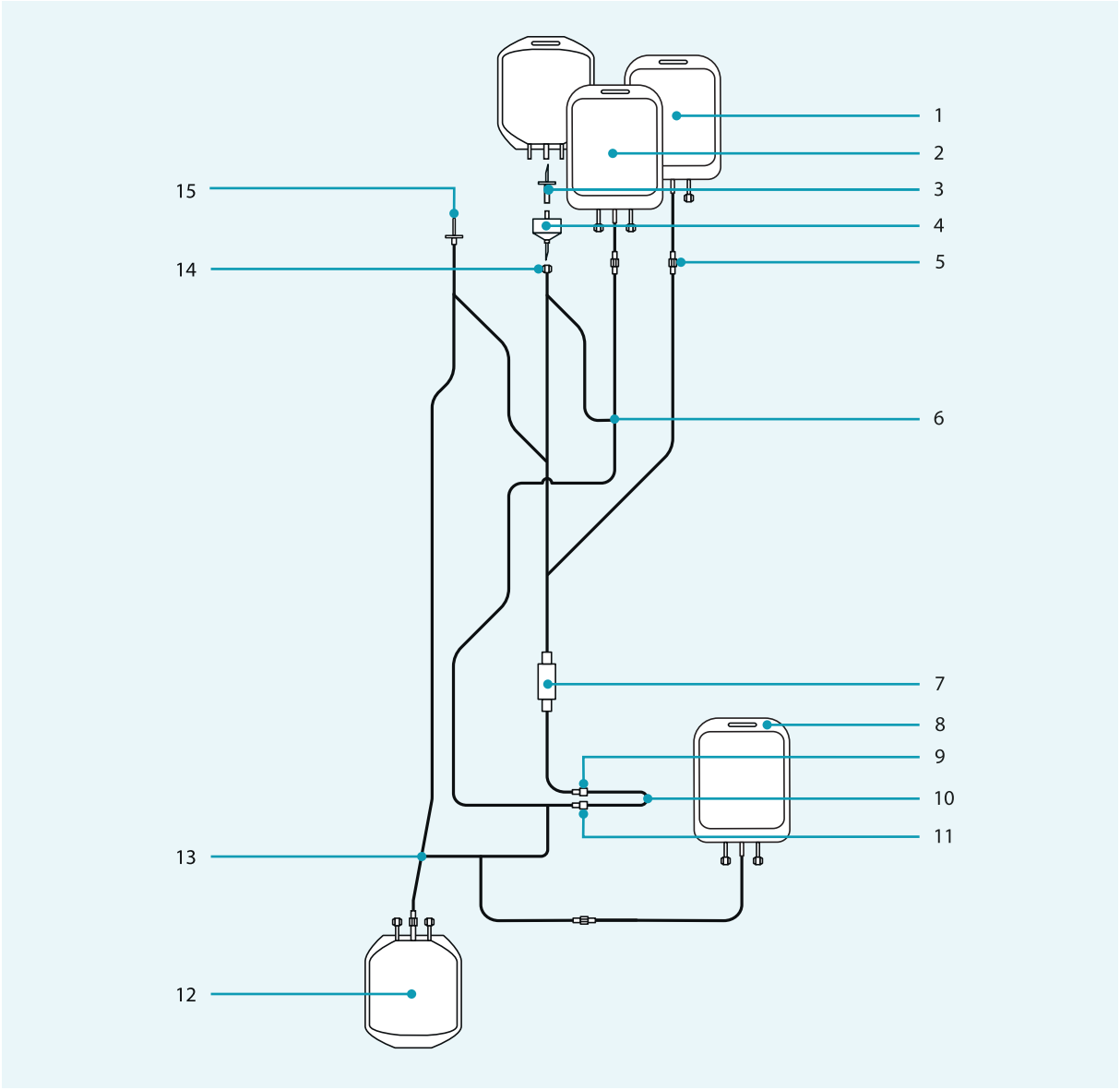


Figure 7.90: General construction of a CliniMACS Depletion Tubing Set

1 Non-Target Cell Bag
2 Reapplication Bag
3 Spike connector
4 Pre-system filter
5 Check valve
6 Y-fitting
7 Separation column
8 Buffer Waste Bag
9 Upper retaining ring
10 Pump tubing
11 Lower retaining ring
12 Cell Collection Bag
13 T-fitting
14 Twist off cap
15 Buffer spike

Handling of preconnected process buffer and Cell Preparation Bag

After Step 2 is complete, the screen shows Figure 7.91. The instruction is shown on the right, and a diagram corresponding to the instruction on the left-hand side of the screen. The orange blinking features on the screen indicate the areas of attention.

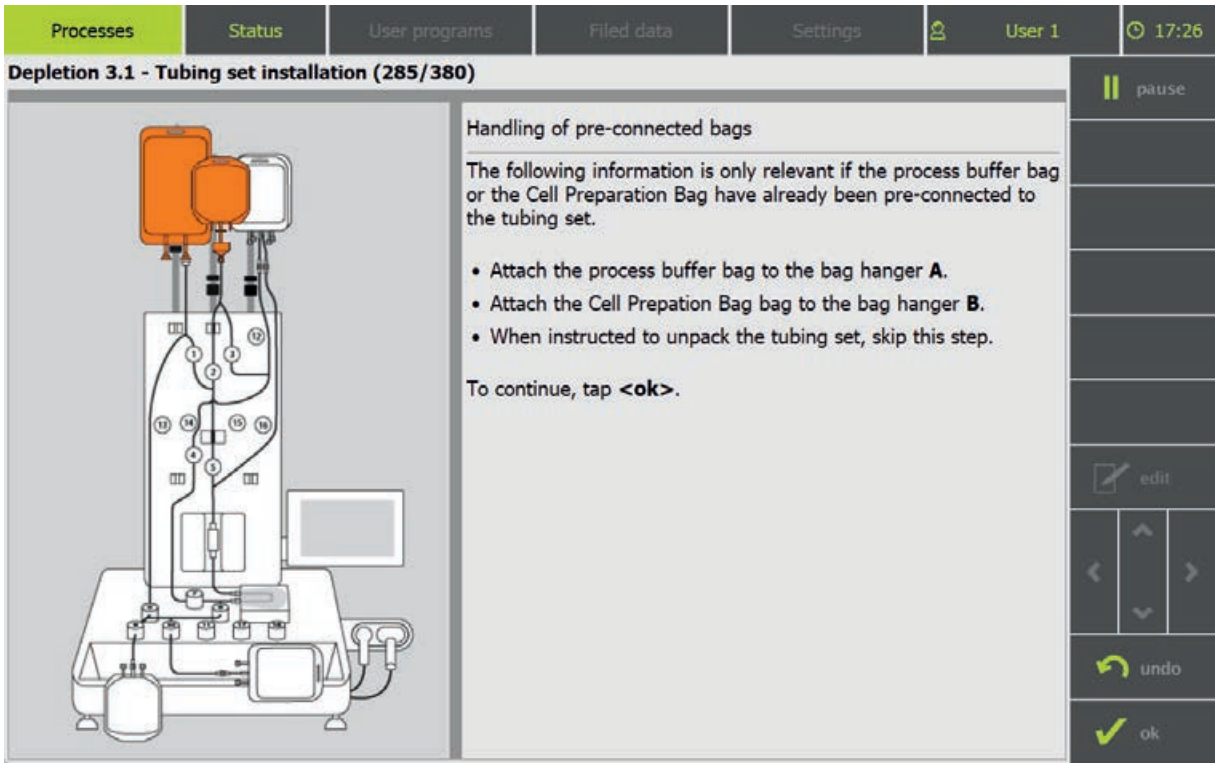


Figure 7.91: Handling of preconnected process buffer and Cell Preparation Bag

1. If the process buffer bag(s) or the Cell Preparation Bag are already connected to the tubing set, follow the instructions on the screen.
    a. Ensure that the clamps beneath the process buffer bag(s) and the Cell Preparation Bag are closed.
    b. Continue by tapping ok.
2. If the the bags are not preconnected to the tubing set, skip this step by tapping ok.

Unpacking the tubing set, attaching the Non-Target Cell Bag and Reapplication Bag, and inserting the separation column

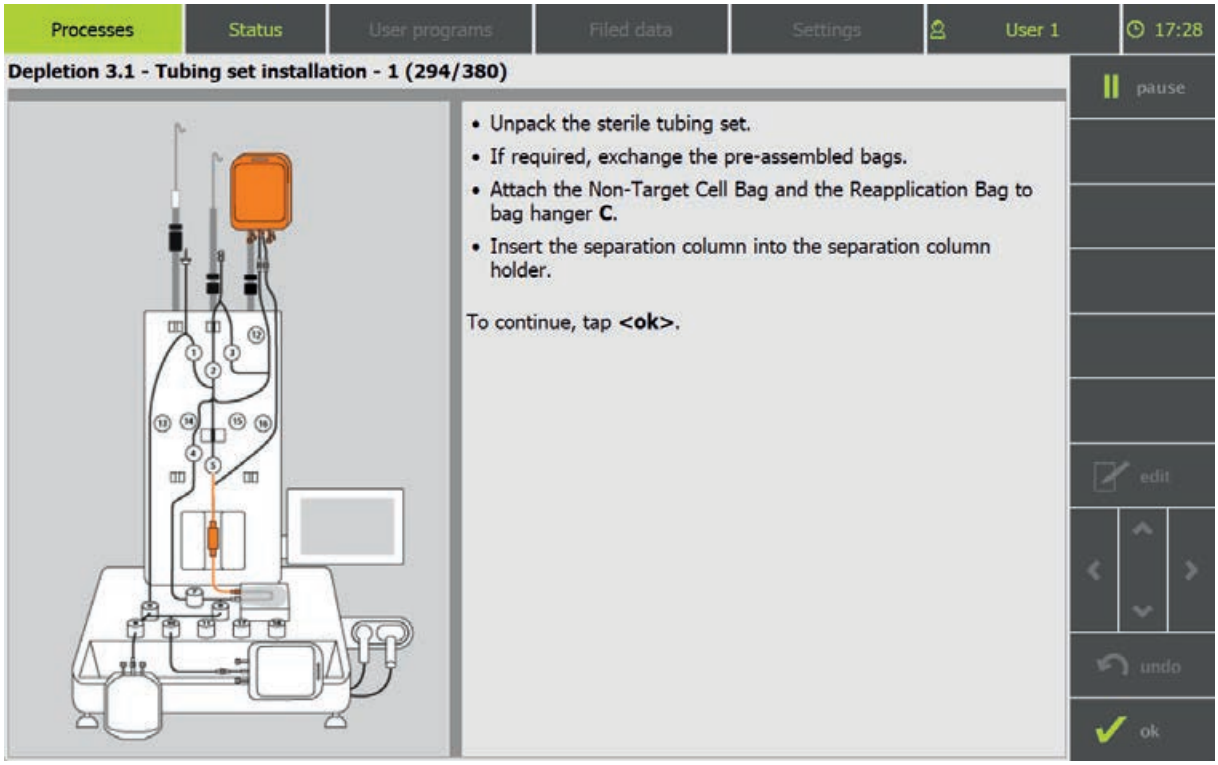


Figure 7.92: Unpacking of the tubing set, connection of the Cell Collection Bag, attachment of the Priming Waste Bag, and insertion of the pre-column

⚠ WARNING

Risk of contamination.

Damaged packaging indicates that the tubing set may no longer be sterile and therefore must not be used.

- Carefully inspect the packaging for damage, puncture or tears.
- Use the tubing set only if package is undamaged and sealed.

⚠ WARNING

Risk of personal injury and infection.

Overloading the bag hangers can cause the instrument to tip over. Falling or damaged bags may become contaminated. Contaminated solution may lead to infection if used.

- Do not overload the bag hangers. The carrying capacity of a single bag hanger is 5 kg.

⚠ WARNING

Risk of injury.

If the separation column is inserted or removed while the magnet unit is switched on, there is the risk of personal injury.

- Only insert or remove the separation column when the magnet unit is switched off.

Unpacking tubing set

1. Unpack the sterile tubing set under sterile conditions (if not done in a clean room, for example, in a laminar flow hood).
2. Before using the tubing set, remove the pinch clamp used for the secure packaging of the CliniMACS Depletion Tubing Set. The pinch clamp is labeled with "Remove before assembly to CliniMACS Plus Instrument".
3. Ensure that the Luer lock connections to the bags are closed tightly. DO NOT tighten or manipulate the Luer lock connections on the columns.
4. If necessary, exchange the preassembled bags.

Preassembled Cell Collection Bag

1. The CliniMACS Depletion Tubing Set is provided with an attached Cell Collection Bag. Note the weight of the empty Cell Collection Bag.
2. If more than one Cell Collection Bag is necessary for a separation, connect the bags using a plasma transfer set.
3. Ensure that all connections are closed tightly.
4. Note the weight of the empty Cell Collection Bag(s).

Attaching the Non-Target Cell Bag and Reapplication Bag

1. Attach the Non-Target Cell Bag and the Reapplication Bag to bag hanger C on the instrument (see Figure 7.93).
2. Adjust the height of the bag hangers.
    a. Raise or lower the bag hangers to accommodate the height to the size of the Non-Target Cell Bag and Reapplication Bag.
    b. Ensure that they are positioned high enough to prevent severe bending of the tubing that could restrict the flow, and that it is low enough to avoid the tubing or connections being stretched.
3. Insert the separation column into the separation column holder (see Figure 7.94).

To continue, tap **ok**.

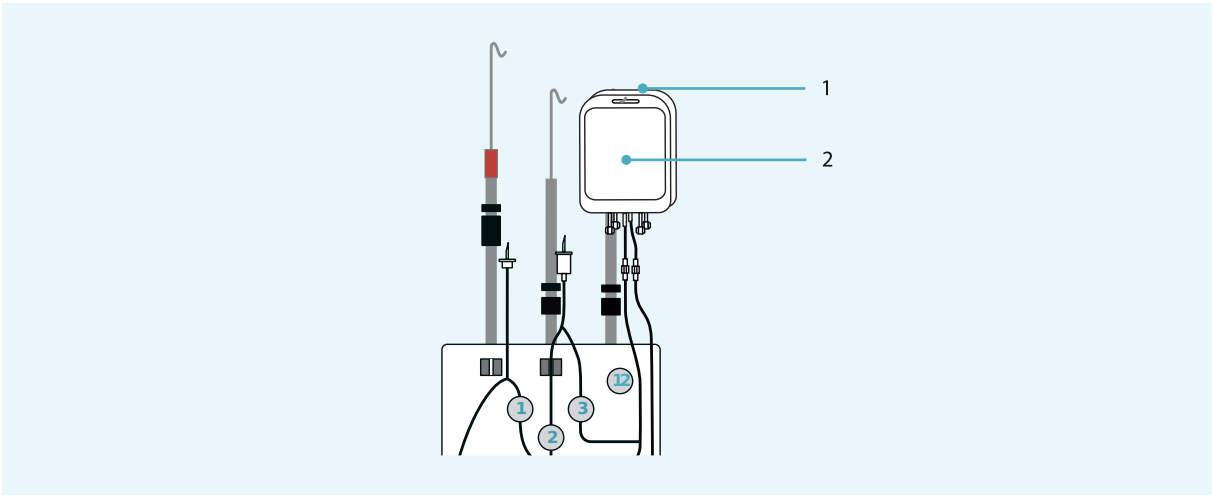


Figure 7.93: Attach Non-Target Cell Bag and Reapplication Bag

1 Non-Target Cell Bag

2 Reapplication Bag

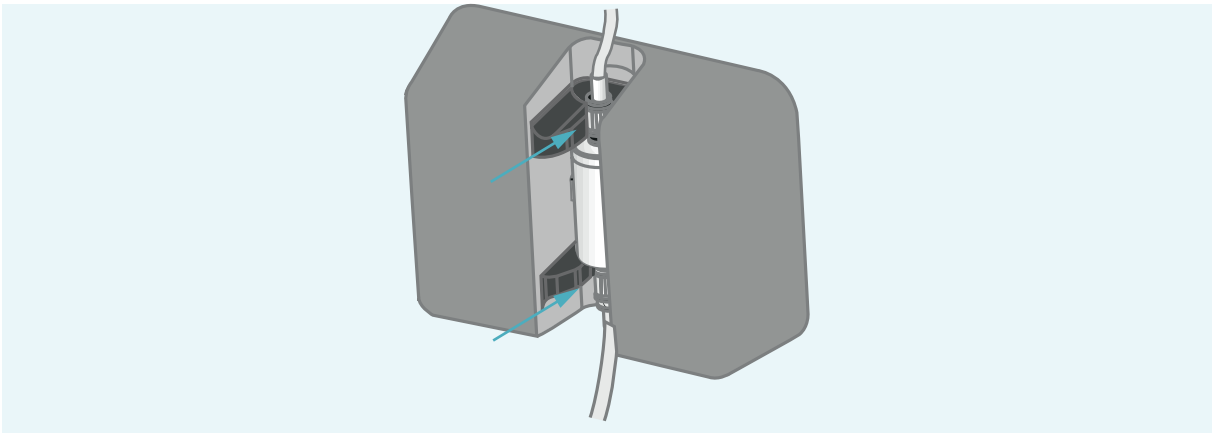


Figure 7.94: Separation column in separation column holder

Loading valves 1, 2, 3, 4, and 5

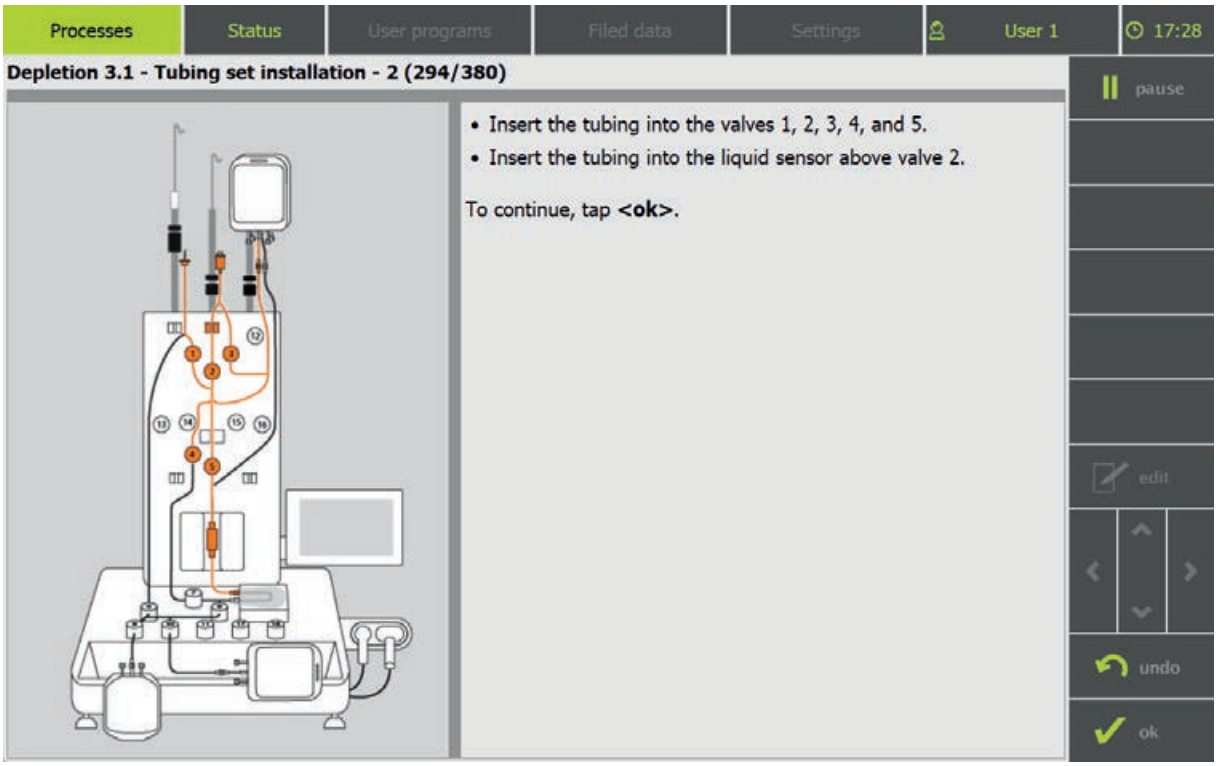


Figure 7.95: Insertion of tubing into valves 1, 2, 3, 4, and 5

The valve indicated in orange on the screen will open automatically to facilitate the tubing insertion.

1. Insert the tubing into valves 1, 2, 3, 4, and 5. Ensure that the tubing is placed securely in the valve opening (see Figure 7.64).
2. Insert the tubing into the liquid sensor above valve 2.

IMPORTANT:

- To ensure proper operation, both the liquid sensor and the tubing being inserted must be dry. Carefully inspect both. If any liquid is present, dry the area with a soft, lint-free cloth.
- As each step is performed, check all tubing and attachments for any kinks or severe bending that could restrict the flow of liquid through the tubing. Check all valves to ensure the tubing fits snugly.
- Only insert the tubing set into open valves (when button is pushed inwards). The tubing will not fit correctly if inserted into a closed valve.
- If the tubing has to be adjusted after a valve has been closed, do not pull the tubing without pressing the valve button to open the valve (see Figure 7.96)

To continue, tap ok.

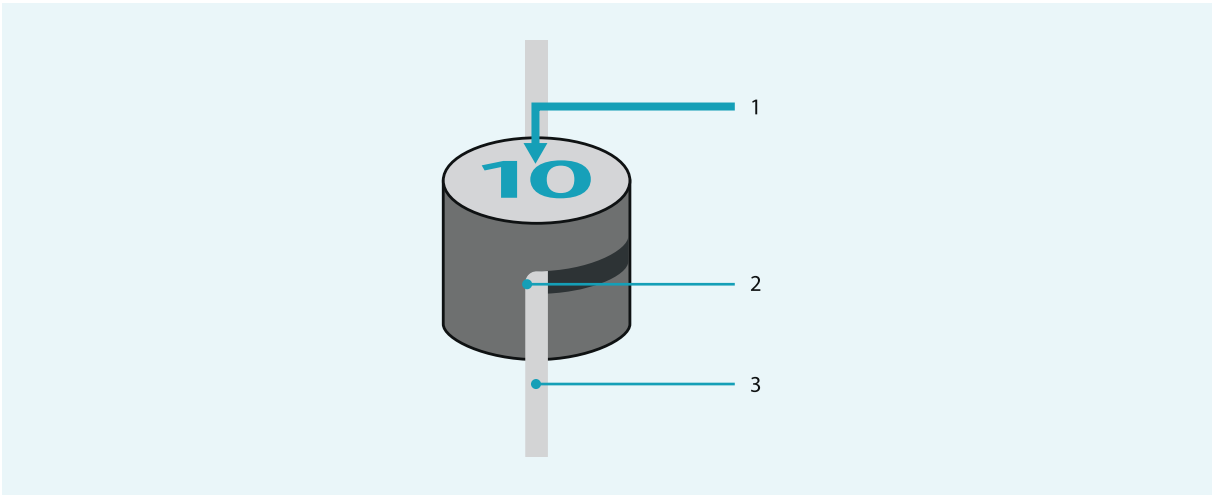


Figure 7.96: Correctly inserted tubing

1 Press button to open valve
2 Inner end of slot
3 Tubing

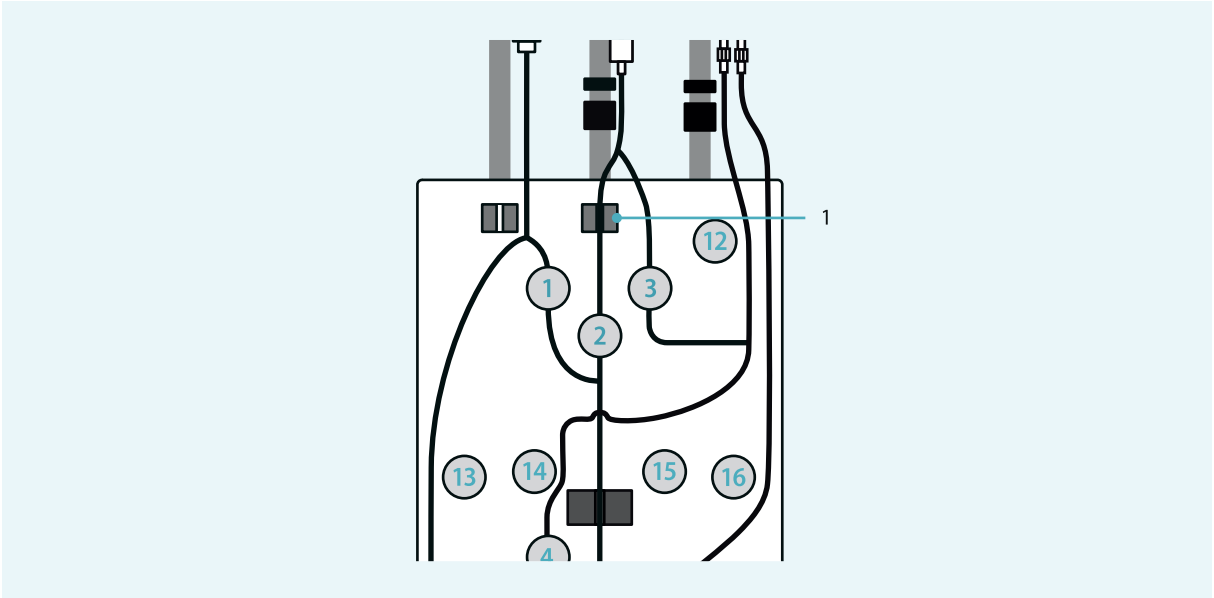


Figure 7.97: Tubing in valves

1 Liquid sensor

Inserting the pump tubing into the pump

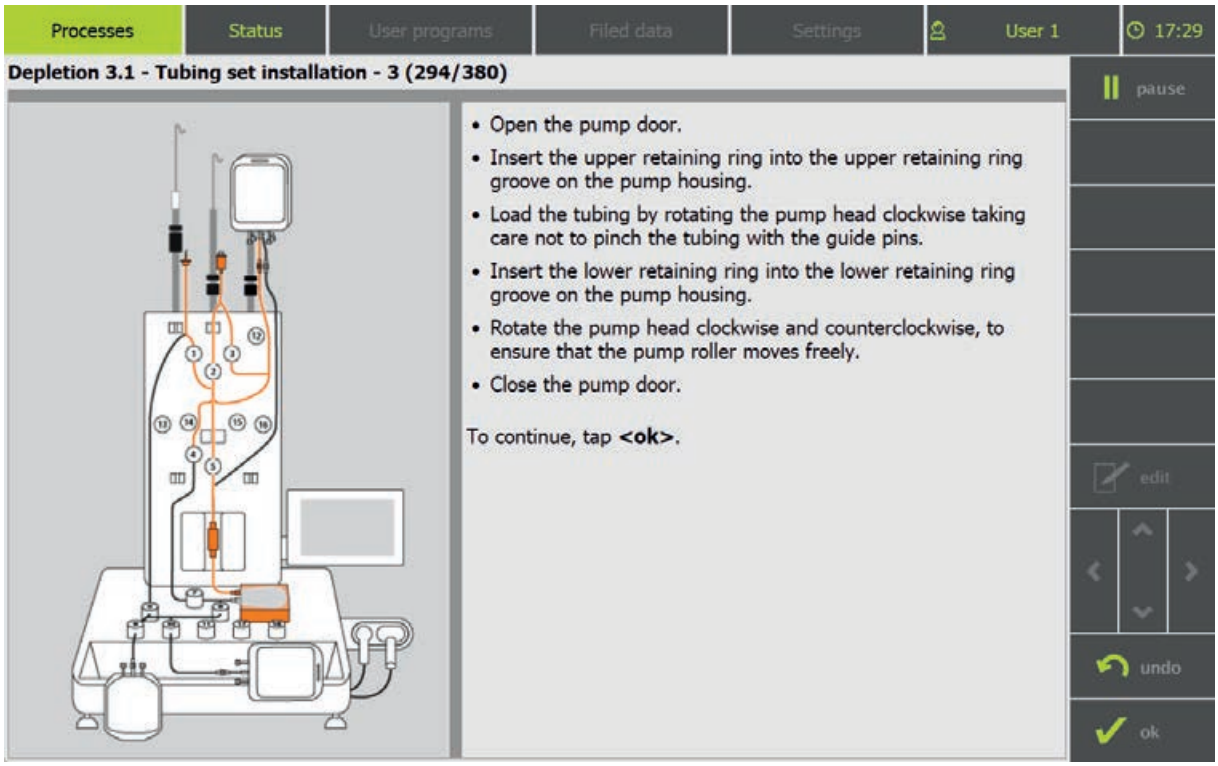


Figure 7.98: Insertion of the pump tubing into the pump

1. Open the pump door by lifting up at the left-hand edge.
2. Insert the upper retaining ring on the pump tubing into the retaining ring groove on the pump housing (see Figure 7.99).
3. Rotate the pump roller clockwise until the tubing is threaded between both sets of the tubing guide pins and the tubing fits snugly around the pump roller.
    a. Ensure that the tubing is not pinched at the end of the guide pins.
    b. If adjustment of the tubing inside the pump is necessary, the tubing can be unloaded by lifting the lower end and turning the pump roller counterclockwise.
4. Insert the lower retaining ring on the pump tubing into the retaining ring groove on the pump housing.
5. Rotate the pump roller clockwise and counterclockwise, to ensure that the pump roller moves freely.
6. Close the pump door.

IMPORTANT:
If the pump door is opened during the cell separation program, the instrument run will immediately stop.

To continue, tap **ok**.

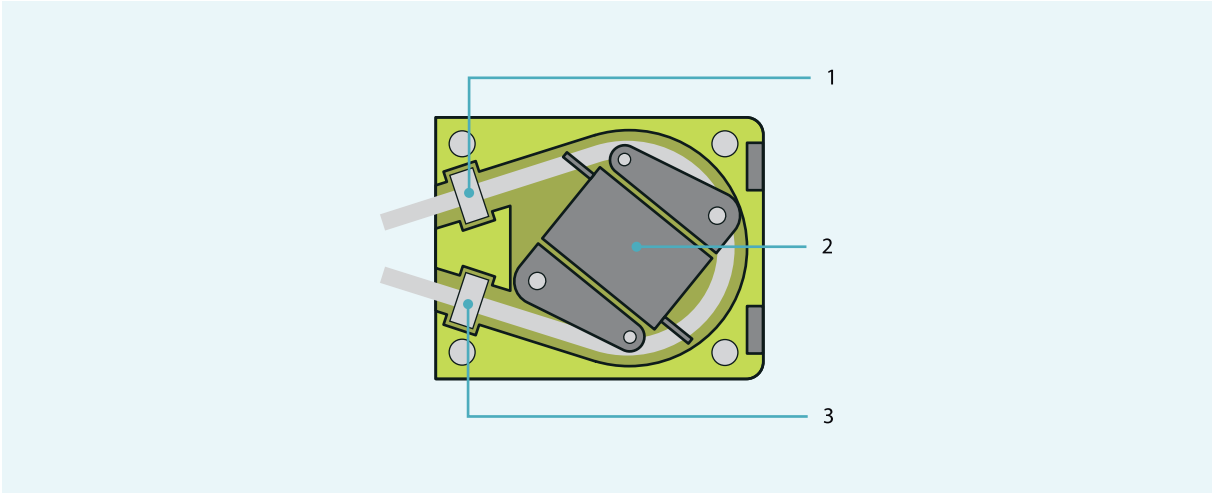


Figure 7.99: Load pump tubing

1 Upper retaining ring
2 Pump roller
3 Lower retaining ring

Loading valves 6, 7, 8, 9, and 10

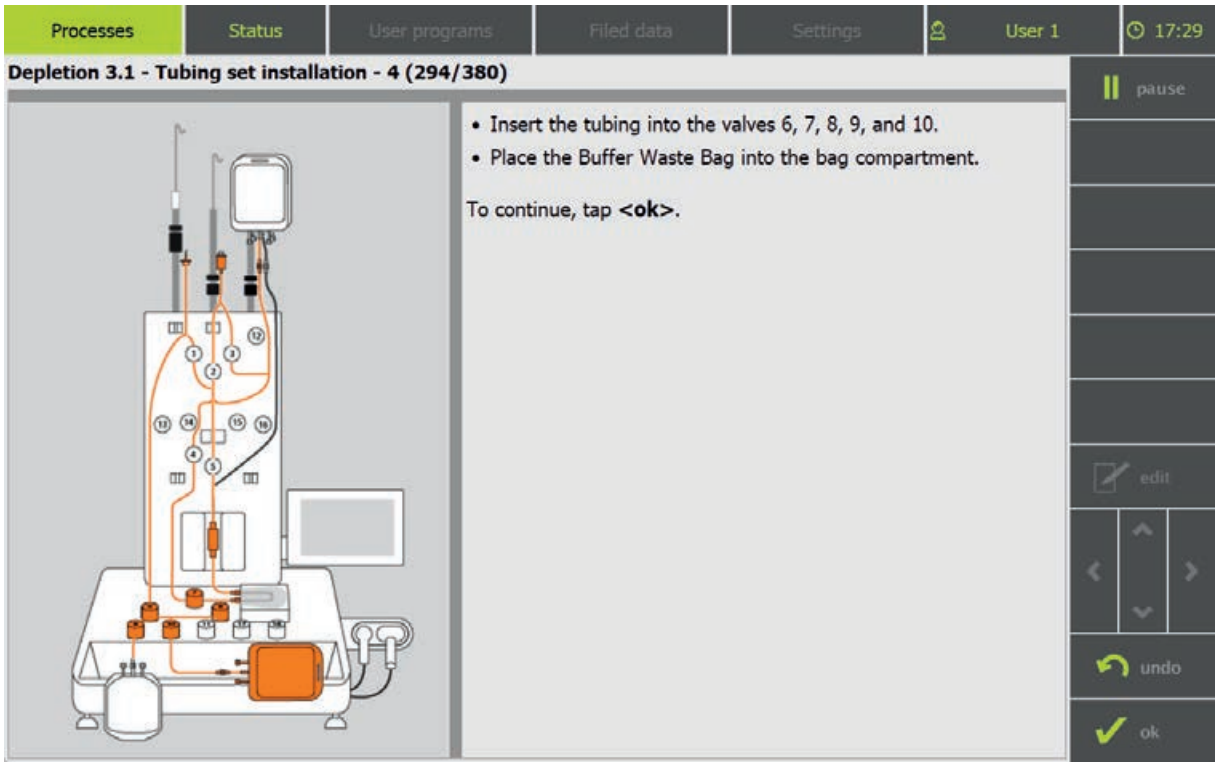


Figure 7.100: Insertion of the tubing into valves 6, 7, 8, 9, and 10

1. Insert the tubing into valves 6, 7, 8, 9, and 10. Ensure that the tubing is placed securely in the valve opening.
2. Place the Buffer Waste Bag in the bag compartment.
3. Ensure that unrestricted flow to the Cell Collection Bag is possible.

To continue, tap ok.

Rechecking all tubing and attachments

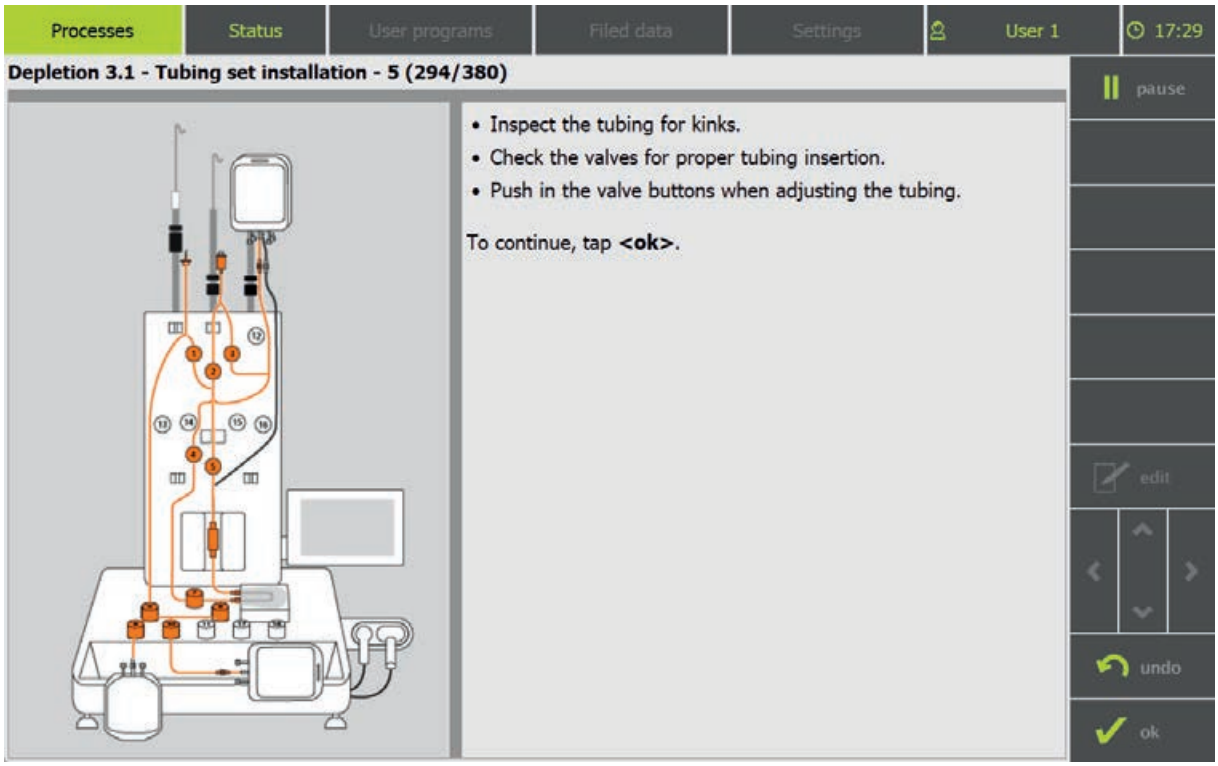


Figure 7.101: Recheck all tubing and attachments

1. Beginning with valve 1, ensure that the tubing fits properly and is positioned in each valve correctly.
    a. Reinspect the tubing in each valve.
    b. Ensure that the tubing enters and leaves each valve through the enlargement at the inner end of the slot (see Figure 7.96).
2. Ensure that the tubing is not kinked or twisted.

IMPORTANT:
If the tubing has to be adjusted after a valve has been closed, do not pull the tubing. Instead, press the valve button to open the valve first.

To continue, tap **ok**.

Seating of valves

To ensure the proper fit of the tubing in the valves, the instrument will operate all of the valves in sequence twice. Watch and listen to ensure that all valves are working properly. If any valve does not operate correctly, refer to section 'Troubleshooting'. The magnet drive will also be tested during this check sequence.



Figure 7.102: Seating of valves

Attaching the process buffer bag

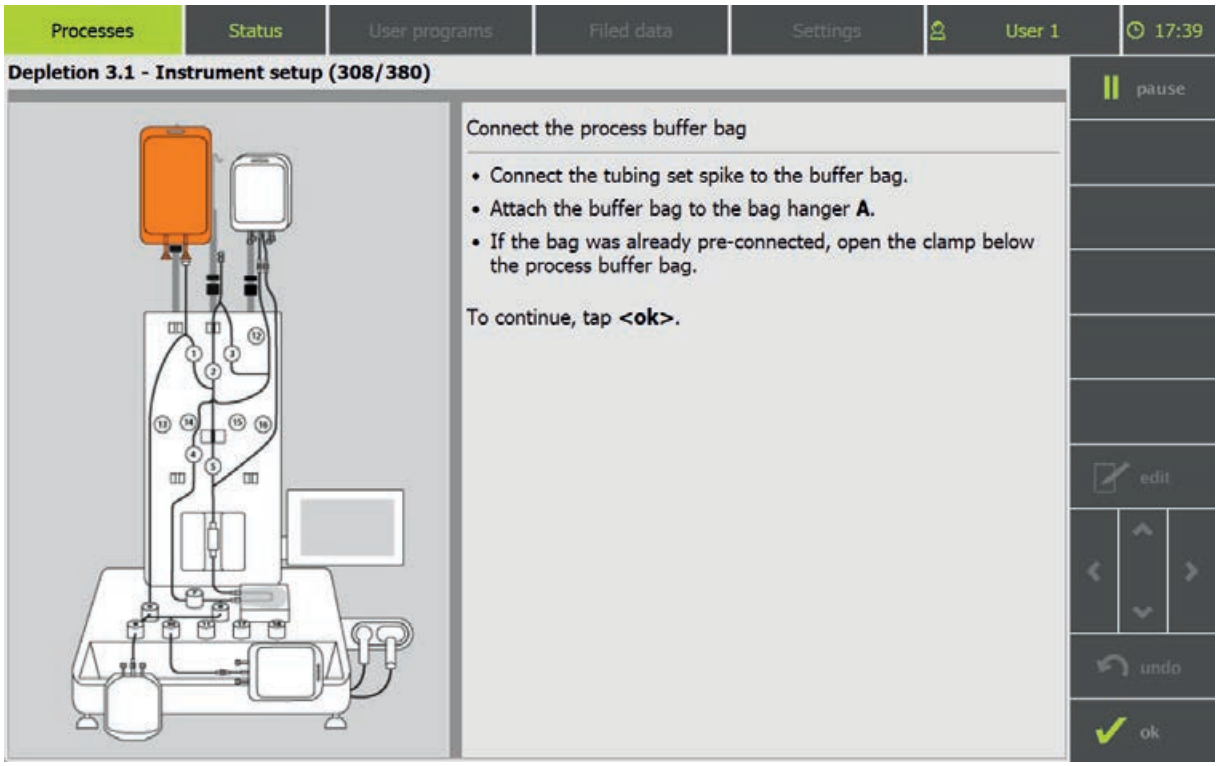


Figure 7.103: Attachment of the process buffer bag

⚠ WARNING

Risk of personal injury and infection.

Overloading the bag hangers can cause the instrument to tip over. Falling or damaged bags may become contaminated. Contaminated solution may lead to infection if used.

- Do not overload the bag hangers. The carrying capacity of a single bag hanger is 5 kg.

The prescribed buffer for CliniMACS Plus separations is CliniMACS PBS/EDTA Buffer supplemented with HSA to a final concentration of 0.5% (w/v).

1. Using aseptic techniques, remove the cap from the buffer spike on the tubing set (see Figure 7.90) and connect it to the process buffer bag.
    a. Ensure that the septum is punctured, allowing free flow of liquid.
    b. Gently squeeze the bag to ensure that the spike has penetrated the bag without external leakage.
2. Attach the process buffer bag to the buffer bag hook on bag hanger A (see Figure 7.104).
3. Adjust the height of the buffer bag hanger.
    a. Raise or lower the bag hanger to accommodate the height to the size of the process buffer bag.
    b. Ensure that it is positioned high enough to prevent severe bending of the tubing that could restrict the flow, but low enough to avoid the tubing or connections being stretched.

IMPORTANT:
Due to several gravimetric priming and rinsing steps, it is essential that the process buffer bag is positioned as high as possible, ensuring that it is higher than the Reapplication Bag and the Non-Target Cell Bag (see Figure 7.114).

To continue, tap **ok**.

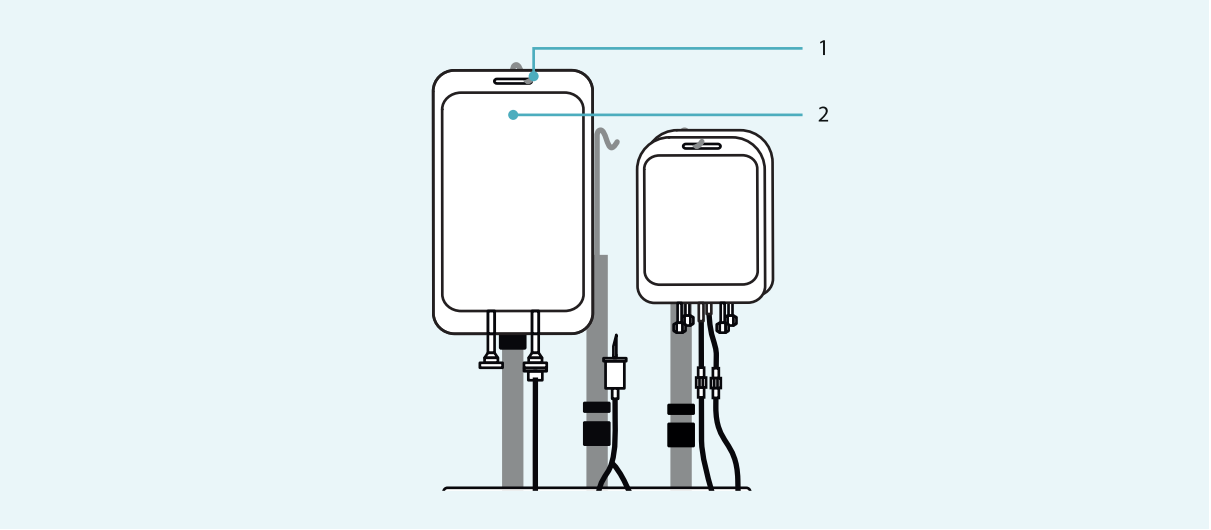


Figure 7.104: Attach buffer bag

1 Bag hanger hook
2 Process buffer

Priming of the tubing set

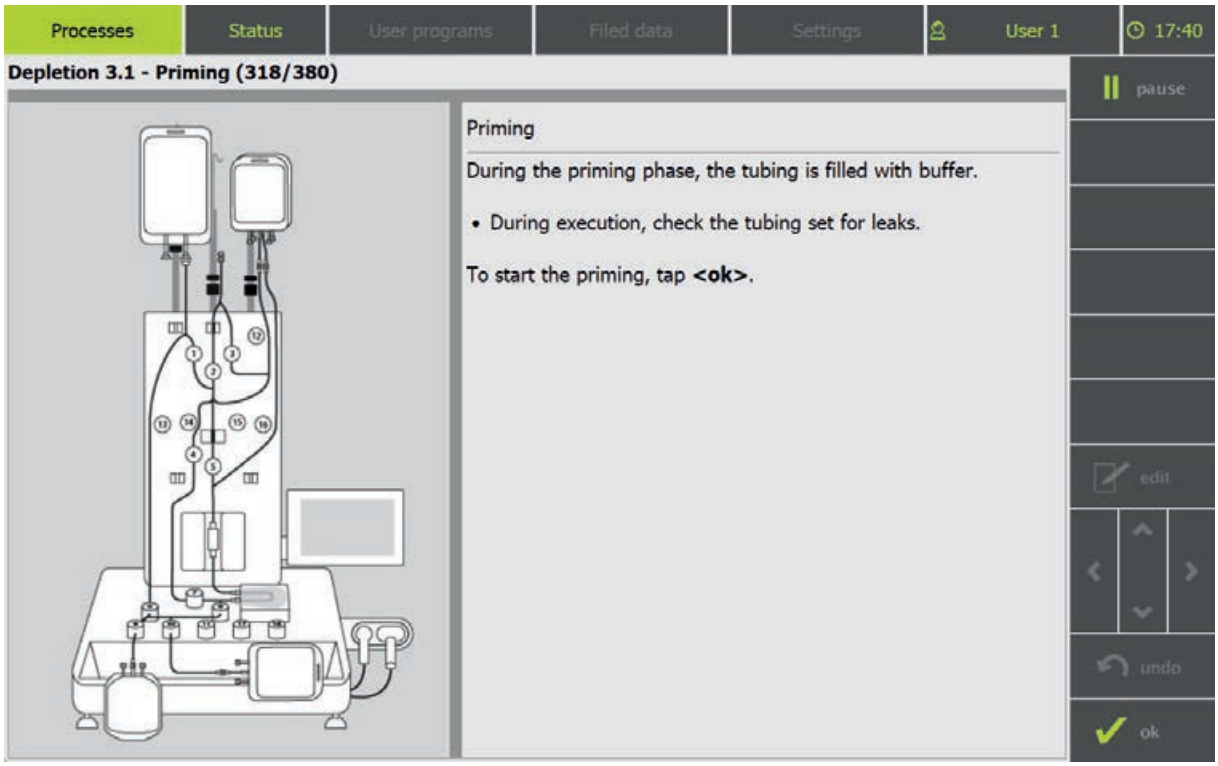


Figure 7.105: Priming of the tubing set

IMPORTANT:
Once priming has started, it is not possible to return to the instrument set-up procedure.

To start the priming, tap ok. The priming phase will take approximately 2.5 minutes. The priming status is shown on the screen.

- During the priming phase, the tubing set is filled with the process buffer. The buffer will be circulated through the tubing set including the separation column.
- Priming fluid is collected in the Buffer Waste Bag, Reapplication Bag, and the Non-Target Cell Bag whereas the Cell Collection Bag remains empty (see Figure 7.90).
- The priming cycles will continue, repeating a series of steps.
- During the priming phase, check all tubing, fittings, valves, and columns for the appearance of any leaks or the presence of any folds that may block fluid flow.

Final check of all tubing and attachments

After the priming is completed, the screen shows Figure 7.106.

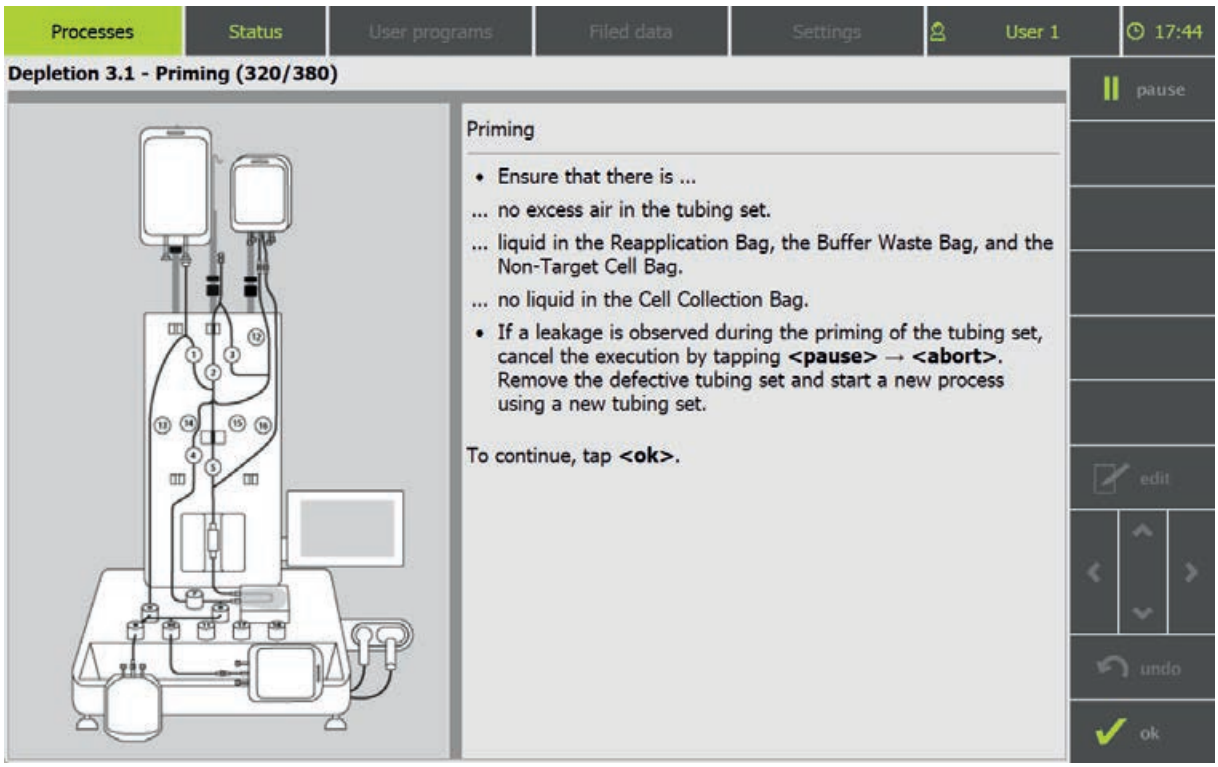


Figure 7.106: Final check of tubing and attachments

Before continuing the program, check the following:

- fluid in all parts of tubing set except for tubing above valves 2 and 3
- no excess air in tubing set
- fluid in Reapplication Bag, Buffer Waste Bag, and Non-Target Cell Bag
- no fluid in the Cell Collection Bag

If leaks or malfunctions are observed, stop the run.

- To stop the run, tap **pause** > **abort**.
- If the tubing set is defective, remove the tubing set and start a new process using a new tubing set.

To continue, tap **ok**.

Integrity test

For additional safety, it is recommended to perform an integrity test to check the tubing set for leaks. The test sequence consists of two automated sequences, which allow both the upper and the lower parts of the tubing set to be overpressurized and tested separately.

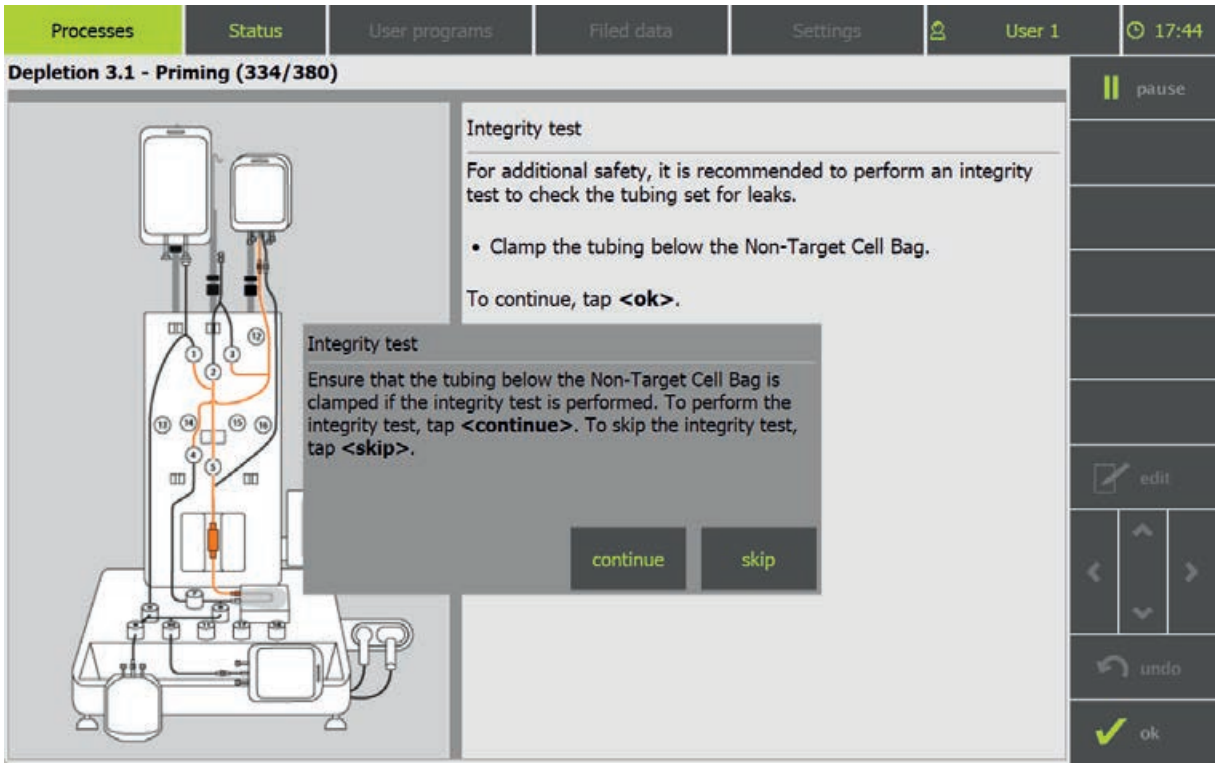


Figure 7.107: Integrity test

⚠ CAUTION

Risk of process delay.

If the clamp below the Non-Target Cell Bag has not been removed after completion of the integrity test, non-target (labeled) cells could not be removed from the separation column during elution. Further retention of non-target cells is then impossible. The separation procedure needs to be repeated.

- Remove the clamp after completion of the integrity test.

IMPORTANT:
The integrity test will only work properly if the tubing below the Non-Target Cell Bag is clamped.

1. Before starting the integrity test, clamp the tubing below the Non-Target Cell Bag (see Figure 7.108).

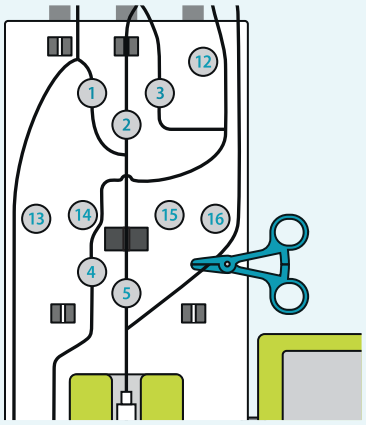


Figure 7.108: Preparation for the integrity test

2. To continue, tap **ok** > **continue**.
3. To skip the integrity test, tap **ok** > **skip**.

Integrity test for the upper part of the tubing set

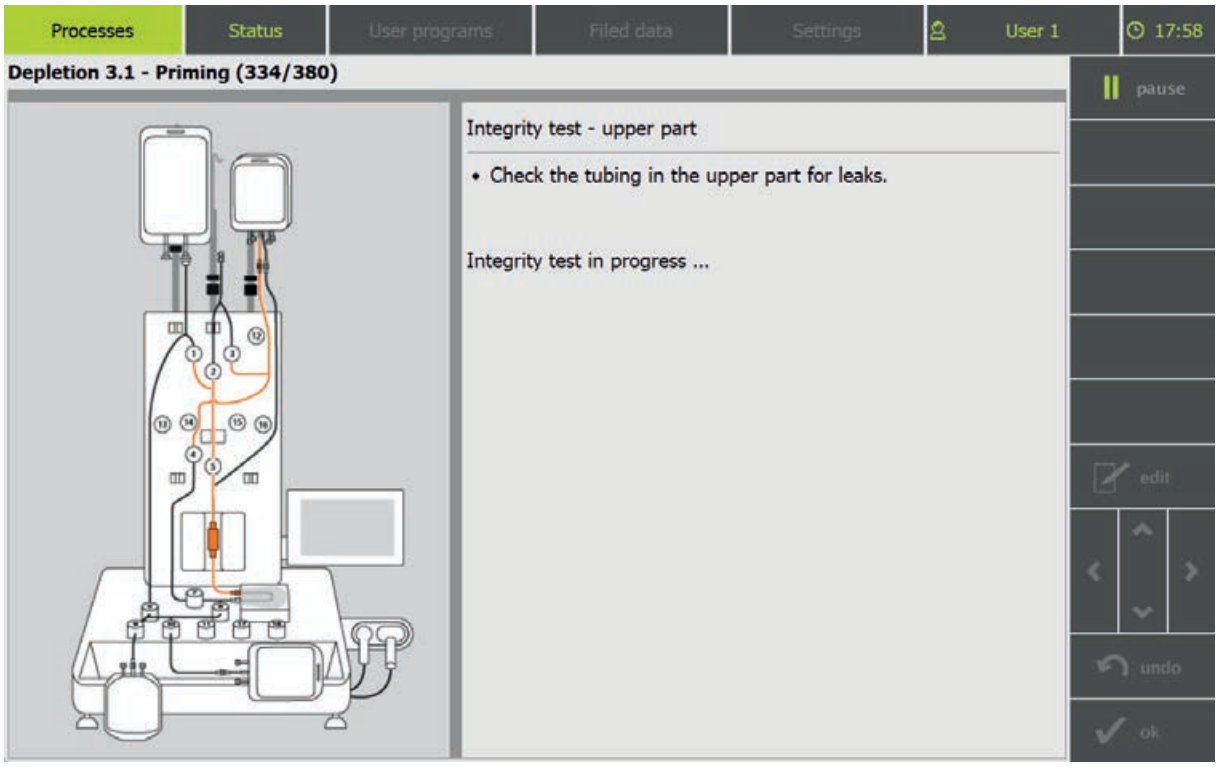


Figure 7.109: Integrity test for the upper part in progress

After tapping **continue**, the instrument starts the automated test sequence for the upper part of the tubing set (see Figure 7.109). Overpressure will be created and held for two minutes.

1. During this time the user should watch all the connections above the upper pump tubing connection.

After two minutes, the pressure is automatically released (see Figure 7.110).

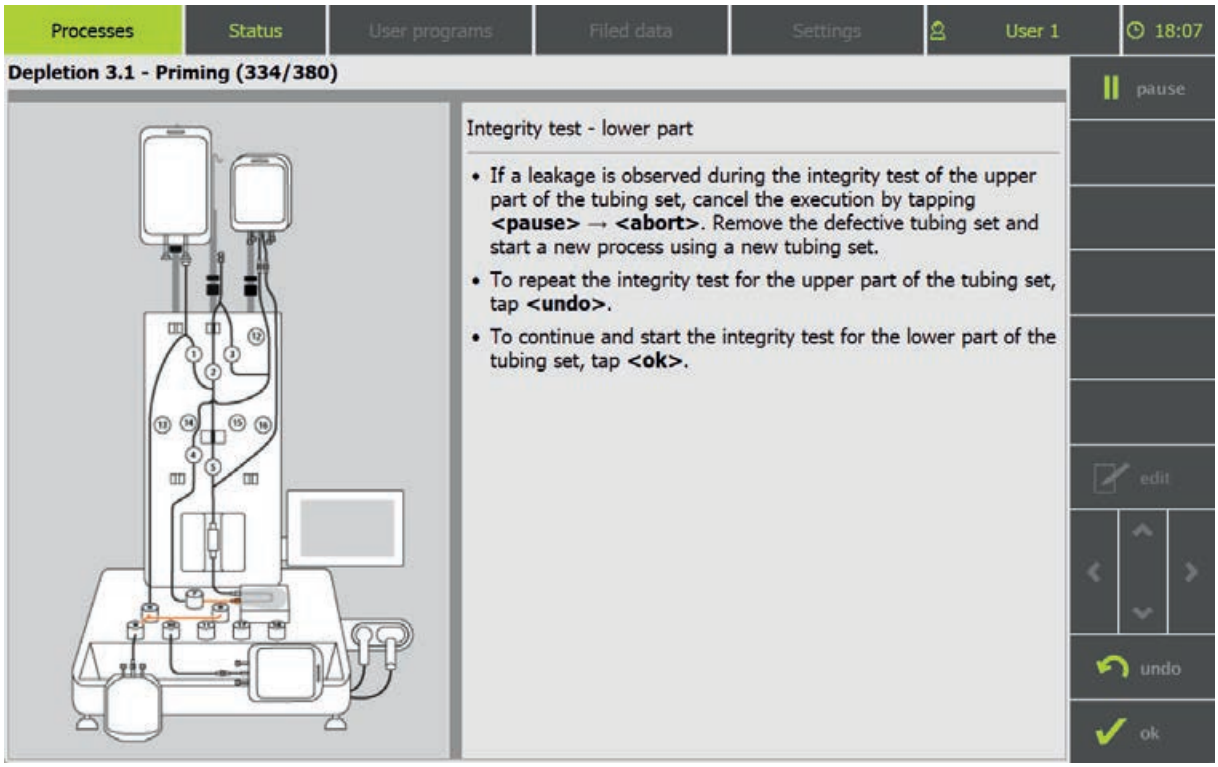


Figure 7.110: Integrity test for the upper part completed

1. Check if any leaks have occurred during the test sequence. If leakage is observed at any connection of the tubing set, stop the run and replace the defective tubing set with a new one.
    a. To stop the run, tap **pause** > **abort**.
    b. Remove the defective tubing set from the instrument and replace it with a new one. Start a new process with the new tubing set. Contact Miltenyi Biotec Technical Support for instructions regarding the return of the defective tubing set.
2. To repeat the integrity test of the upper part of the tubing set, tap **undo** > **repeat**. If no leaks are observed, continue with the integrity test of the lower part of the tubing set by tapping **ok**.

Integrity test for the lower part of the tubing set

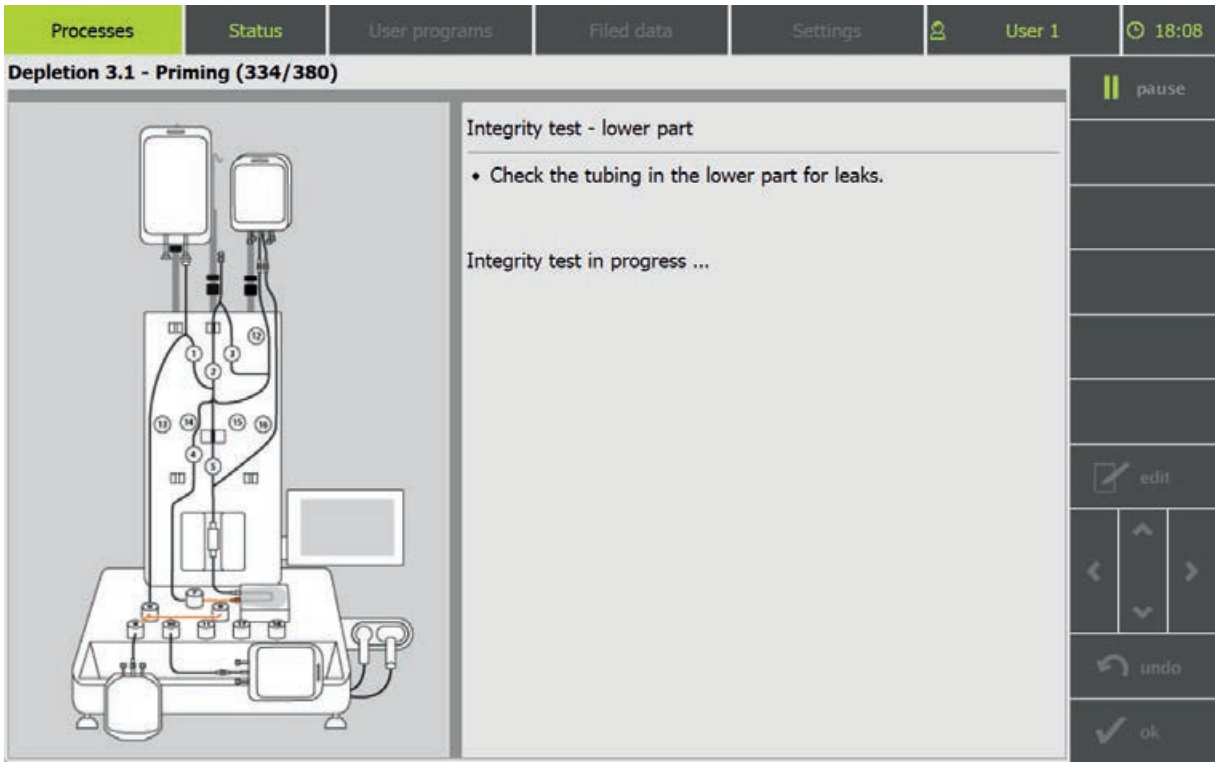


Figure 7.111: Integrity test for the lower part in progress

After tapping **ok**, the instrument starts the automated test sequence for the lower part of the tubing set (see Figure 7.111). Overpressure will be created and held for 30 seconds.

1. During this time, the user should watch the lower pump tubing connection and the T-fittings between valves 6, 8, 9, and 10.

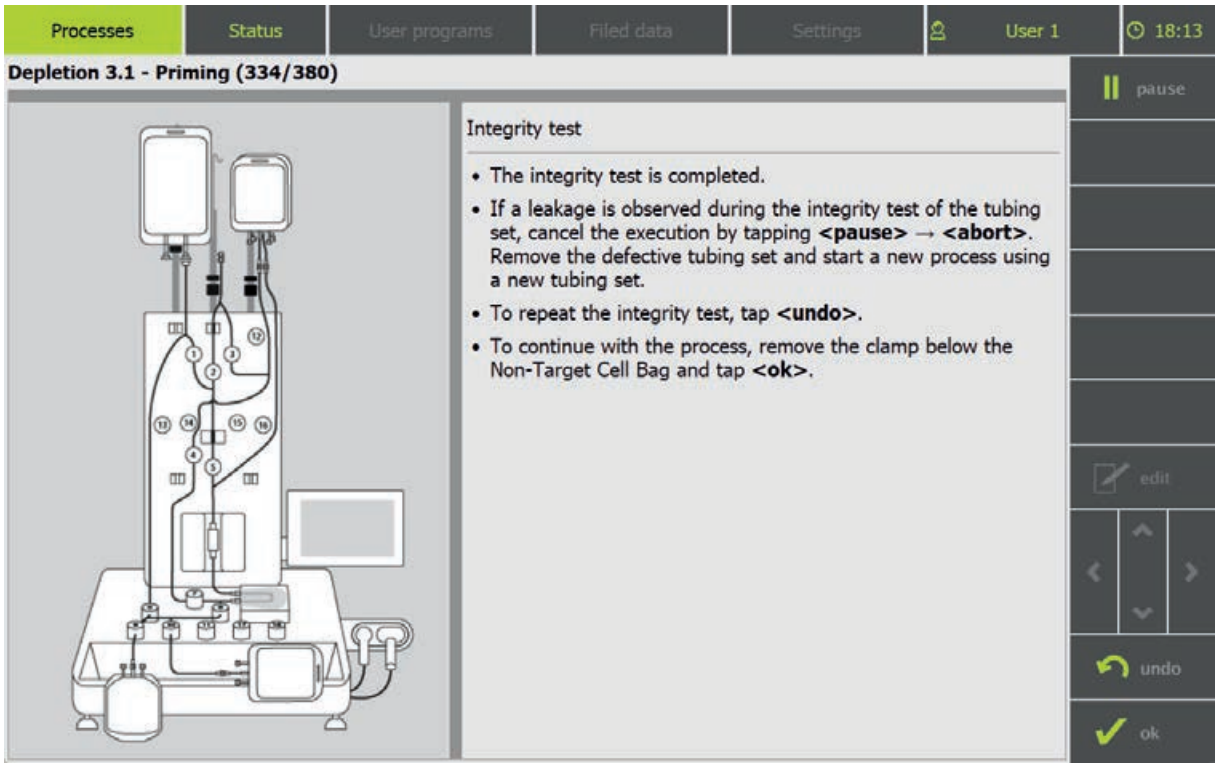


Figure 7.112: Integrity test for upper part completed

After 30 seconds, the pressure is automatically released (see Figure 7.112).

1. Check if any leaks have occurred during the test sequence. If leakage is observed at any connection of the tubing set, stop the run and replace the defective tubing set with a new one.
    a. To stop the run, tap **pause** > **abort**.
    b. Remove the defective tubing set from the instrument and replace it with a new one. Start a new process with the new tubing set. Contact Miltenyi Biotec Technical Support for instructions regarding the return of the defective tubing set.
2. To repeat the integrity test, tap **undo**. If no leaks are observed, continue with the process by tapping **ok**.
3. Open the pathway to the Non-Target Cell Bag by removing the clamp underneath the check valve.

Connecting the Cell Preparation Bag

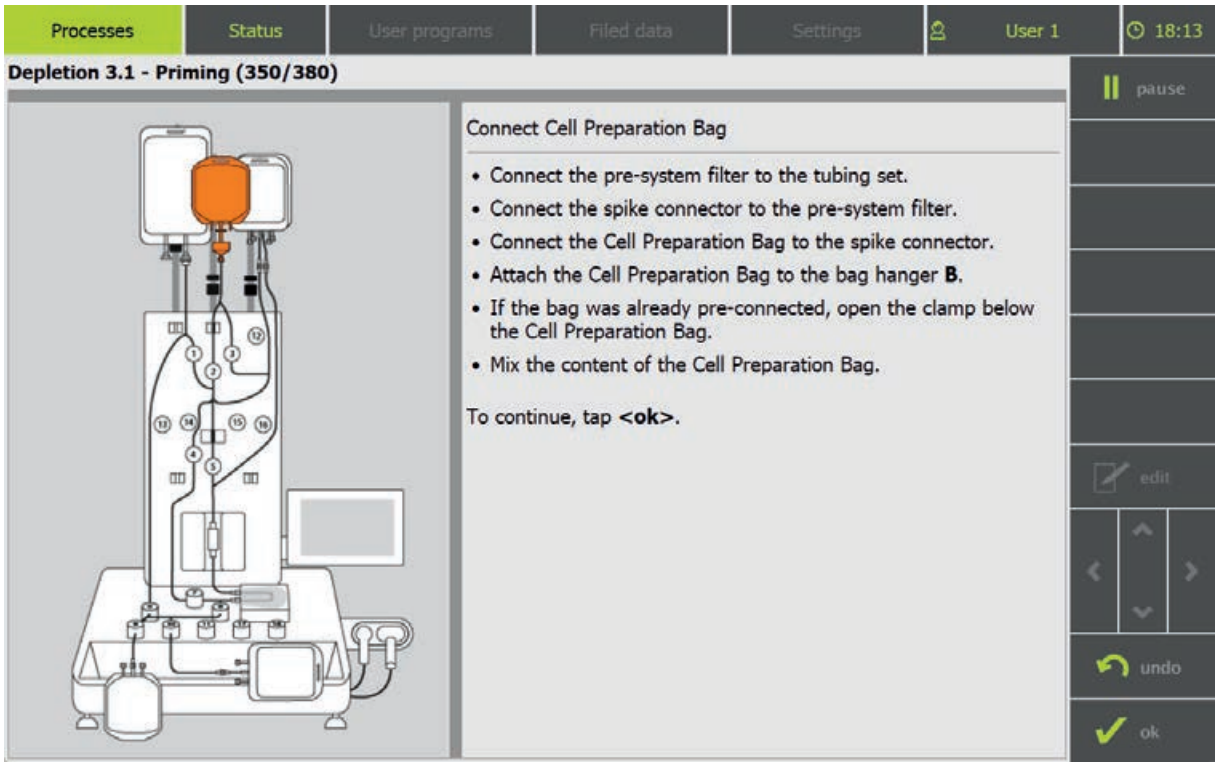


Figure 7.113: Connection of the Cell Preparation Bag

Connect the Cell Preparation Bag (containing the magnetically labeled cells) with the tubing set:

1. Remove the twist-off cap from the tubing set (see Figure 7.90).
2. Remove the cap from the spike of the pre-system filter. Firmly insert the spike of the pre-system filter into the tubing set, ensuring the septum is punctured.
3. Remove the caps from the pre-system filter and the blunt end of the spike connector and connect both parts to each other.
4. Remove the other cap from the spike connector and connect the spike to the Cell Preparation Bag ensuring that the septum is punctured, allowing free flow of liquid. Gently squeeze the bag to ensure that the spike has penetrated the bag.
5. Check the connection between the Cell Preparation Bag, spike connector, the pre-system filter and the tubing set to confirm that the connection is secure.
6. Hang the Cell Preparation Bag on the bag hanger (see Figure 7.116).
7. Ensure that the bags and tubings attached to the bag hanger are neither stretched nor bent.
8. Due to the gravimetric priming and rinsing steps performed during the automated separation, it is very important that the bags are leveled correctly.
9. Also, to ensure the complete processing of the cell product, it is crucial to place the Reapplication Bag and Non-Target Cell Bag higher than Cell Preparation Bag (see Figure 7.114):
   - **Highest position:** Process buffer bag
   - **Middle position:** Reapplication Bag and Non-Target Cell Bag
   - **Lowest position:** Cell Preparation Bag

To continue, tap **ok**.

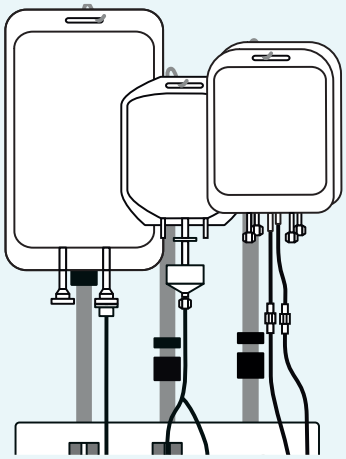


Figure 7.114: Correctly leveled bags

Final check of the liquid sensor

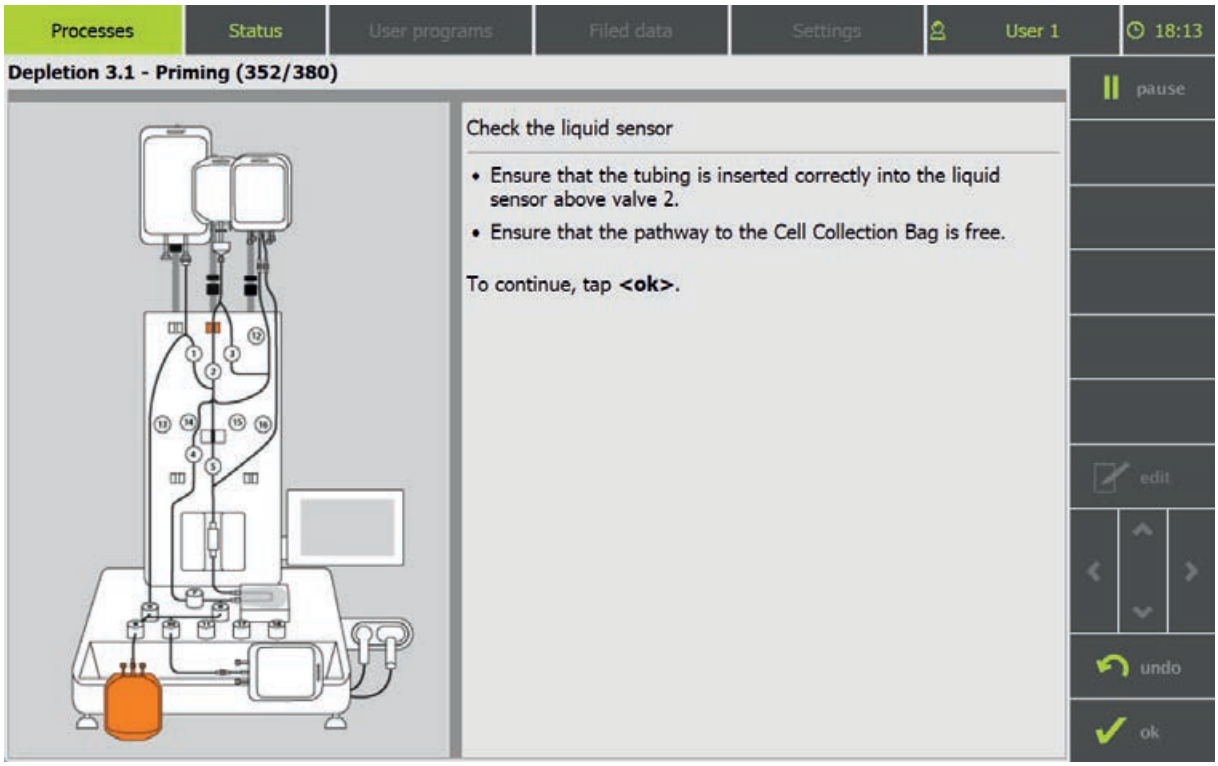


Figure 7.115: Final check of the liquid sensor

1. Check the liquid sensor tubing. Ensure that the tubing has been properly inserted, that it is free of any external liquid, and has not been dislodged during the loading procedure.
2. Ensure that the unrestricted flow of fluid to each bag is possible.

To continue, tap ok.

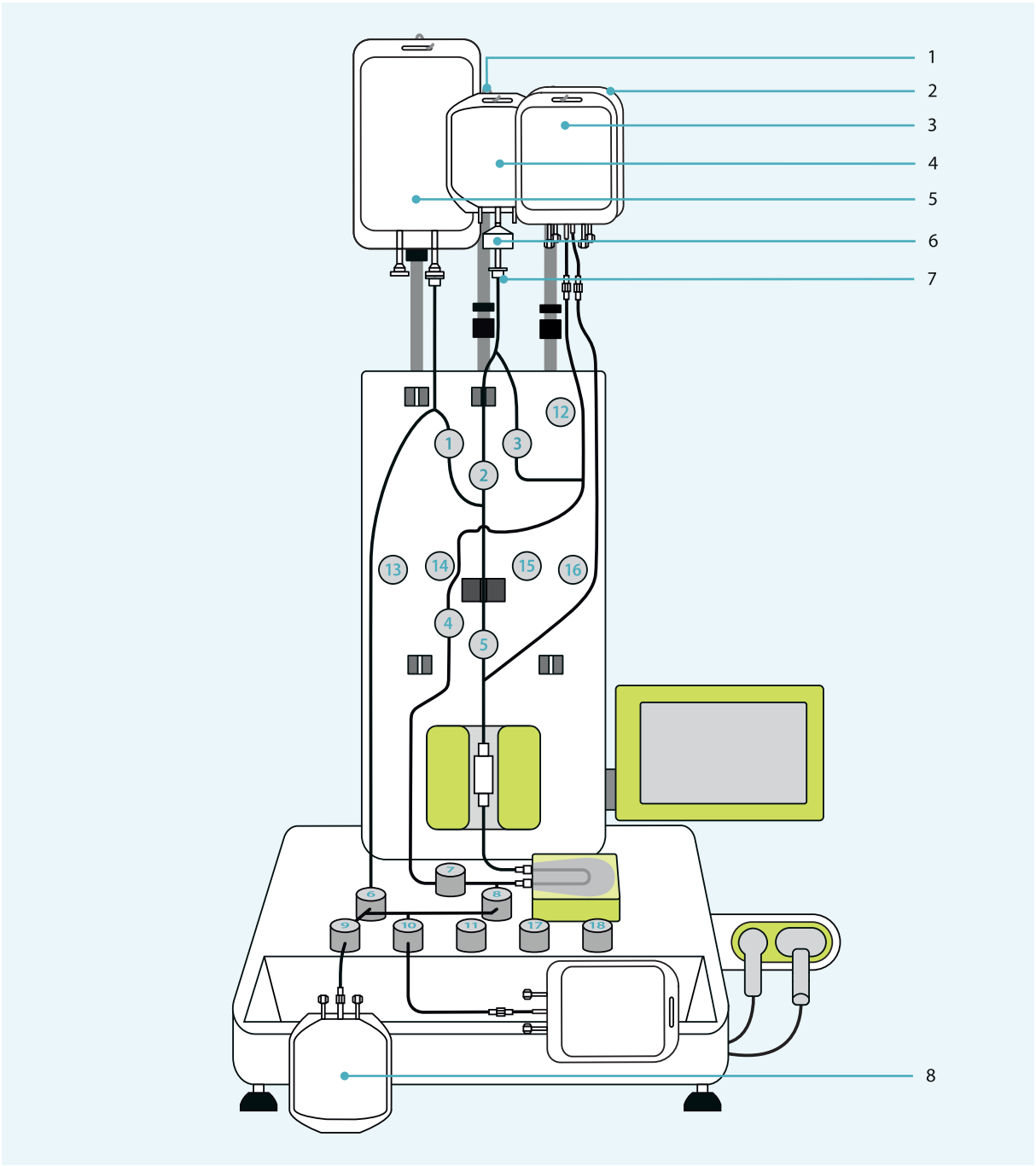


Figure 7.116: CliniMACS Plus Instrument with CliniMACS Depletion Tubing Set, CliniMACS PBS/EDTA Buffer, Cell Preparation Bag, and Cell Collection Bag

1 Bag hanger for Cell Preparation Bag
2 Non-Target Cell Bag
3 Reapplication Bag
4 Cell Preparation Bag
5 CliniMACS PBS/EDTA Buffer
6 Pre-system filter
7 Spike connector
8 Cell Collection Bag

7.4 Step 4: CliniMACS Plus Separation

7.4.1 CD34 Selection 1/2

Starting the separation program

Once the final check is completed, the CliniMACS Plus Instrument is ready to begin the separation (see Figure 7.117).

IMPORTANT:
The screen may show a different program name depending on the chosen separation program (CD34 Selection 1 or CD34 Selection 2).

1. To start the separation program, tap **ok**. The instrument will automatically perform the chosen separation procedure. At the beginning of the separation, buffer is pumped upwards towards the Cell Preparation Bag to fill the pre-system filter.
2. Tap the side of the filter gently several times to remove any bubbles which might be trapped in the filter.
3. To view the current step of the separation procedure, tap **Status** in the menu bar. The name of the current step is shown on the right-hand side of the screen.

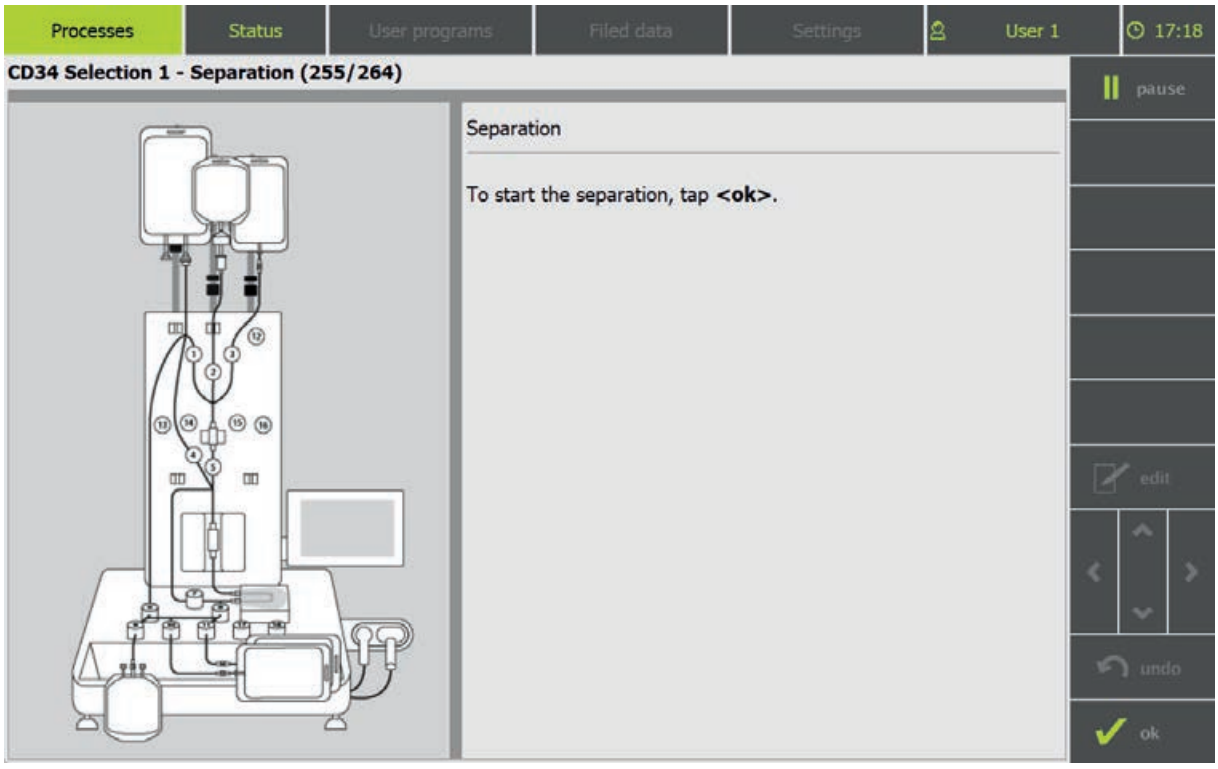


Figure 7.117: Starting the separation

The following section 'Separation procedure' describes the individual steps of the separation procedure. If a warning or error message appears during the separation process, refer to chapter 'Troubleshooting' for information on corrective actions.

Separation procedure

Loading cells

The separation procedure starts with the filling of the pre-system filter to remove remaining air from the pre-system filter.

Then the separation of the labeled cells begins. The pump draws the contents of the Cell Preparation Bag into the tubing set and loads the cell product via the pre-column on the separation column. The magnetically labeled cells (target cells) are retained in the separation column, placed in the magnetic field, while the unlabeled cells (non-target cells) are passed through and collected in the Negative Fraction Bag. When the Cell Preparation Bag is empty (detected automatically by the liquid sensor) the pre-system filter is rinsed twice with buffer.

Column wash I

The pre-column and separation column are washed extensively to remove all unlabeled cells. Wash buffer is collected in the Buffer Waste Bag. When 'Column Wash I' starts, the total remaining time until the end of the separation procedure is shown.

Release of cells I

The magnet is moved to the rear of the instrument ("OFF" position). The retained cells are released at a high speed flow, but the cells remain within an internal tubing cycle.

Reloading of cells I

The magnet is moved into the "ON" position again to magnetize the separation column and the cells are reapplied onto the separation column.

Column wash II

Reloading of the cells is followed by a second washing step to remove remaining unlabeled cells. Also all tubings are rinsed several times.

Release of cells II, reloading of cells II, column wash III

The cells are released and reapplied on the separation column for a second time in order to remove any unlabeled cells that unspecifically stick to the column matrix. Afterwards, the separation column is washed again.

Release of cells III, reloading of cells III, column wash IV

Additionally, the separation program CD34 Selection 2 includes a third release and reapplication step.

Final elution of the cells

The magnet is moved into the "OFF" position and the magnetically labeled cells are released from the separation column and collected in the attached Cell Collection Bag.

Disconnecting bags and removing tubing set

When the separation is completed, the screen shows Figure 7.118.

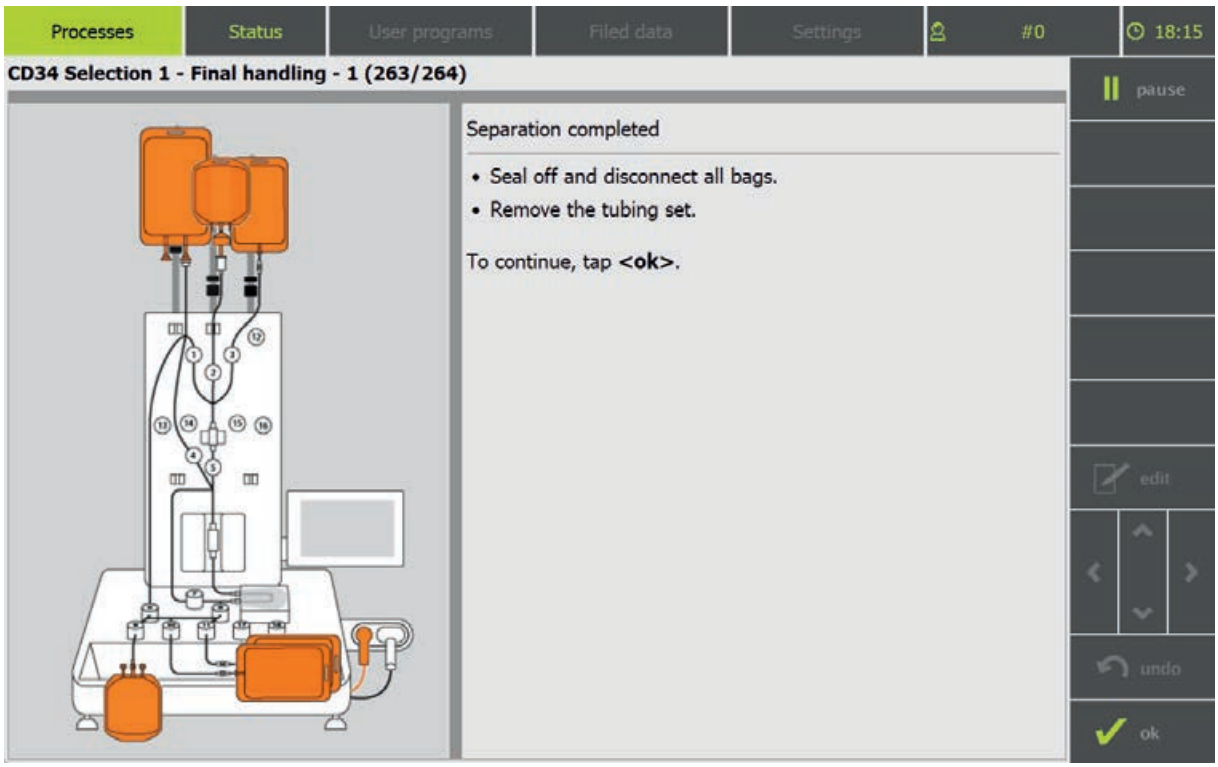


Figure 7.118: Separation completed - Sealing off bags and removing the tubing set

⚠ WARNING

Risk of infection and loss of cell product.

Multiple seals made closer than the recommended distance may result in rupture of the sealed tubing segment and leakage of the cell product. Leakage may expose the user to biological material, potentially resulting in infection, and may lead to loss of the cell product.

- Maintain a minimum distance of at least 1 cm between adjacent seals.

1. Clamp or seal the tubing above the luer lock connecting the Cell Collection Bag to the tubing set (see Figure 7.119).
    a. Make three hermetic seals in the tubing directly below valve 9, with a distance of at least 1 cm between each seal.
    b. Carefully sever the middle seal to disconnect the Cell Collection Bag from the tubing set.
2. Weigh the filled Cell Collection Bag. Record the weight.
    a. Determine the weight of the target cell fraction by subtracting the weight of the empty Cell Collection Bag from the weight of the Cell Collection Bag containing the target cells.
    b. Record the weight.
3. Mix the target cell suspension thoroughly by rotating the bag. Take a suitable amount, for example, 0.5 mL, and retain for analysis.

4. Using the MACS TubeSealer, seal off the tubing above the luer lock of the Negative Fraction Bag.
    a. Make three hermetic seals in the tubing, with a distance of at least 1 cm between each seal.
    b. Sever the center seal to disconnect the Negative Fraction Bag.
5. Disconnect the Buffer Waste Bag in the same way.
6. Remove the Negative Fraction Bag and Buffer Waste Bag.
7. Keep all bags until final analysis of all cells has been accomplished.
8. Remove the tubing set in the following order:
    a. Beginning with valves 6, 9, 10, and 11, and working upwards, press on the valves and release the tubing from the liquid sensor and from the valves.
    b. Release the columns from the column holders.
    c. Dispose the tubing set as a biohazard, according to standard hospital procedures.

The target cells can now be processed in accordance with clinical protocols. To continue, tap **ok**.

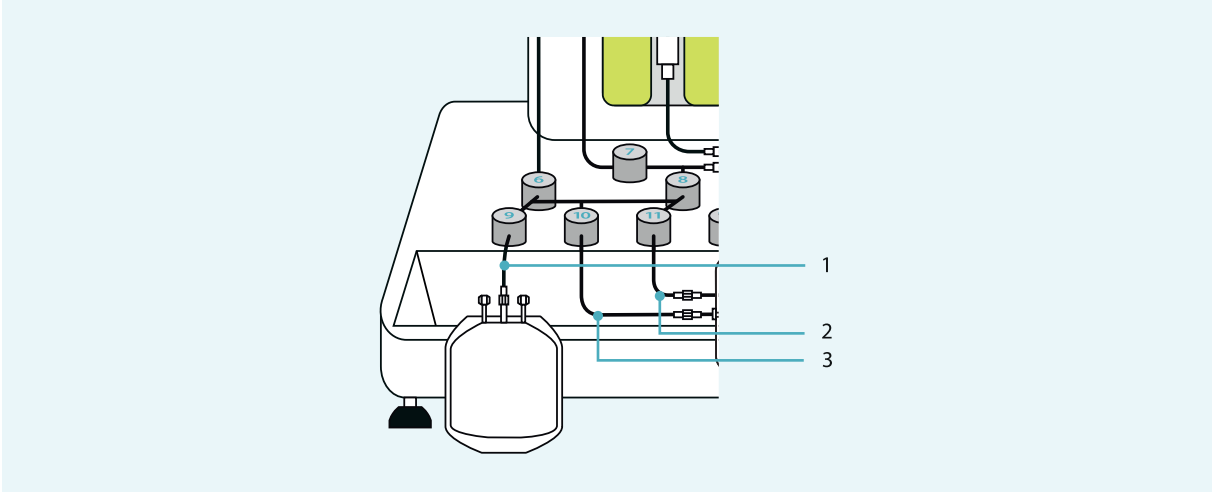


Figure 7.119: Sealing off bags

1 Seal off Cell Collection Bag
2 Seal off Negative Fraction Bag
3 Seal off Buffer Waste Bag

Shutting down and cleaning the instrument

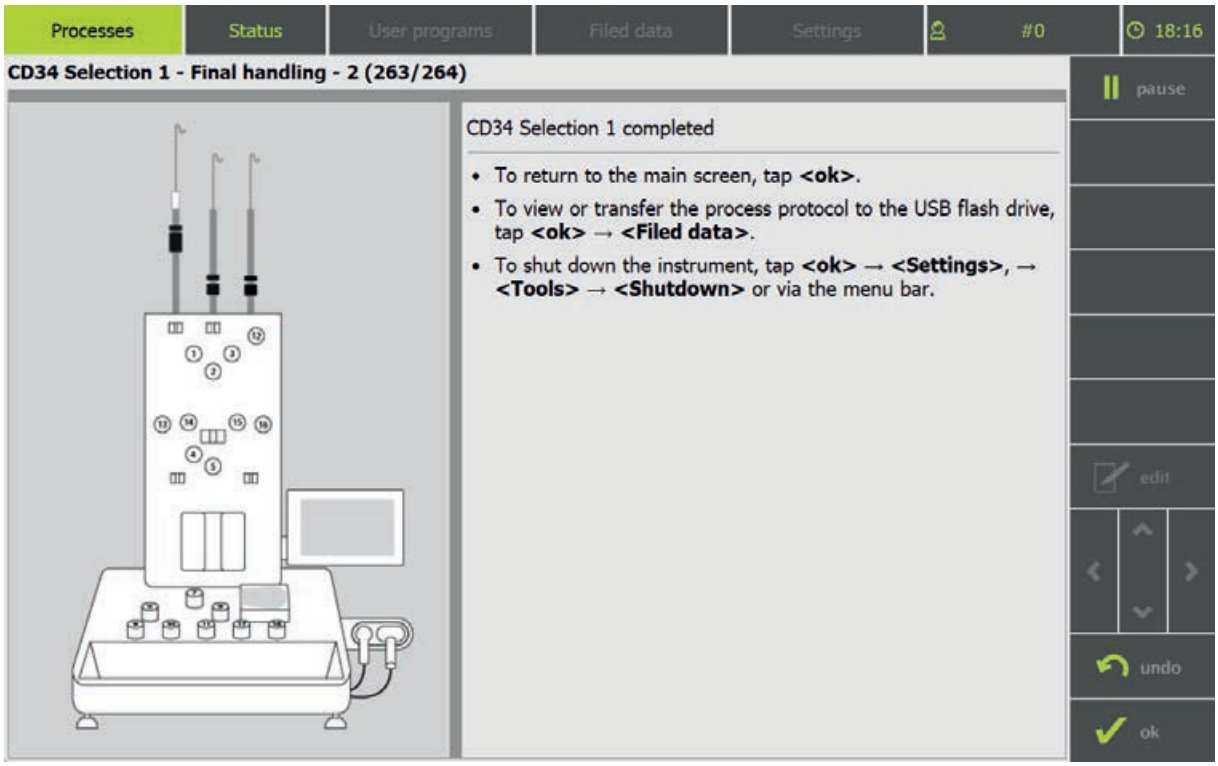


Figure 7.120: Completion of the separation program CD34 Selection 1/2

1. After the completion of the separation program, the user can choose one of the following options:
   - To return to the main screen, tap ok.
   - To view the process protocol or to transfer it to a storage device, tap ok > Filed data.
   - To shut down the instrument, tap ok > Settings > Tools > Shutdown.
2. Clean the instrument according to cleaning instructions as described in the CliniMACS Plus Instrument user manual. Follow the standard procedures for the treatment of infectious material.

Analysis of cells

⚠ CAUTION

Risk of reduced quality of target cells.

The target cells must be analyzed and confirmed to meet user requirements, otherwise the suitability for clinical application can be compromised.

- Examine the target cells regarding quality and quantity according to their intended use.

This must include the following parameters:

- total number of leukocytes
- viability and total number of target cells
- purity (depletion efficiency) and recovery of target cells

It is also recommended to determine the total number of leukocytes and the viability of the non-target cell fraction. The list is an example and other tests should be included based on the intended use and clinical protocols. Record the analysis data.

7.4.2 Enrichment 1.1

Starting the separation program

Once the final check is completed, the CliniMACS Plus Instrument is ready to begin the separation (see Figure 7.121).

1. To start the separation program, tap **ok**. The instrument will automatically perform the chosen separation procedure. At the beginning of the separation, buffer is pumped upwards towards the Cell Preparation Bag to fill the pre-system filter.
2. Tap the side of the filter gently several times to remove any bubbles which might be trapped in the filter.
3. To view the current step of the separation procedure, tap **Status** in the menu bar. The name of the current step is shown on the right-hand side of the screen.

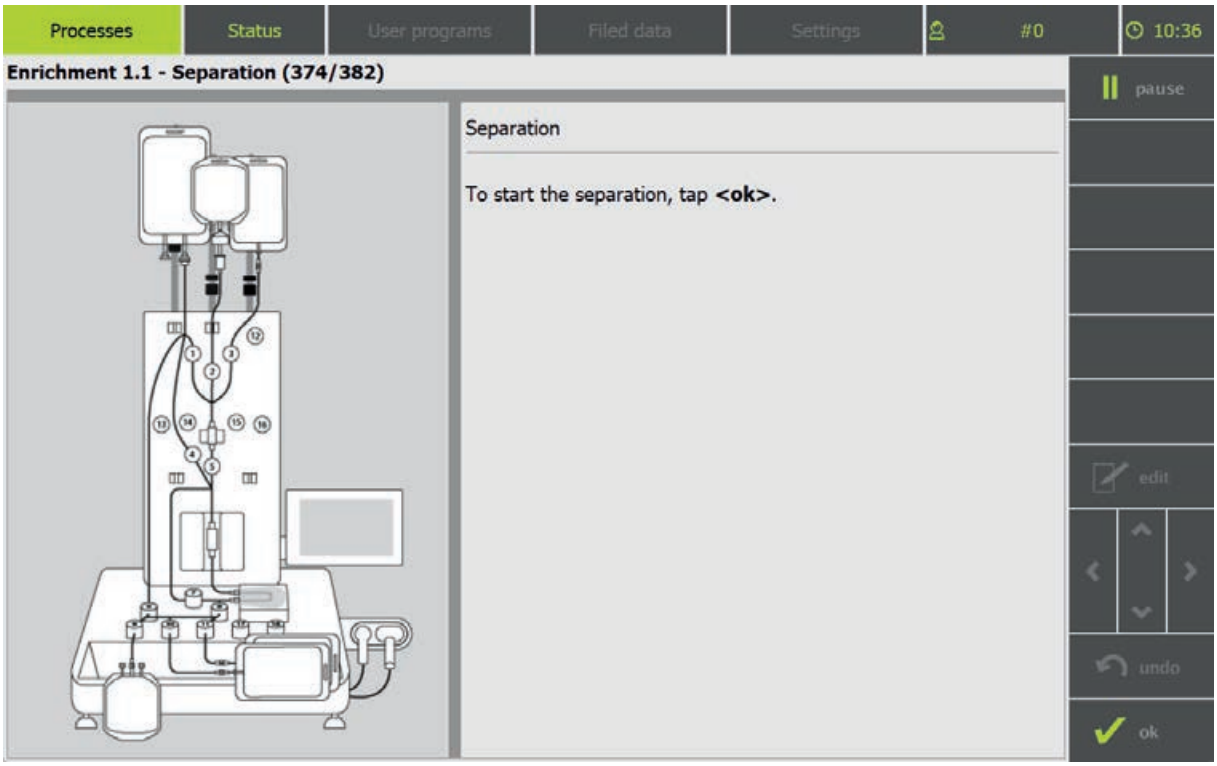


Figure 7.121: Starting the separation

The following section 'Separation procedure' describes the individual steps of the separation procedure. If a warning or error message appears during the separation process, refer to chapter 'Troubleshooting' for information on corrective actions.

Separation procedure

Loading cells

The separation procedure starts with the filling of the pre-system filter to remove remaining air from the pre-system filter.

Then the separation of the labeled cells begins. The pump draws the contents of the Cell Preparation Bag into the tubing set and loads the cell product via the pre-column on the separation column. The magnetically labeled cells (target cells) are retained in the separation column, placed in the magnetic field, while the unlabeled cells (non-target cells) are passed through and are collected in the Negative Fraction Bag.

If the number of magnetically labeled cells (calculated by the CliniMACS Plus Software) exceeds the binding capacity of the separation column, the separation program automatically loads and separates the cell product in suitable portions ("staged loading"). The loading will be stopped when the capacity of the separation column is reached, and the separation program will proceed to the next step of the separation. After the last step (final elution of the cells) has been completed, the next portion of the sample will be loaded onto the column and processed accordingly.

Column wash I

The pre-column and separation column are washed extensively to remove all unlabeled cells. Wash buffer is collected in the Buffer Waste Bag.

Release of cells

The magnet is moved to the rear of the instrument ("OFF" position). The retained cells are released at a high speed flow, but remain within an internal tubing cycle.

Reloading of cells

The magnet is moved into the "ON" position again to magnetize the separation column and the cells are reapplied onto the separation column.

Column wash II

Reloading of the cells is followed by a second column washing sequence to remove remaining unlabeled cells. Also, all tubing is rinsed several times.

Final elution of the cells

The magnet is moved into the "OFF" position and the magnetically labeled cells (target cells) are released from the separation column and collected in the Cell Collection Bag.

Disconnecting bags and removing tubing set

When the separation is completed, the screen shows Figure 7.122.

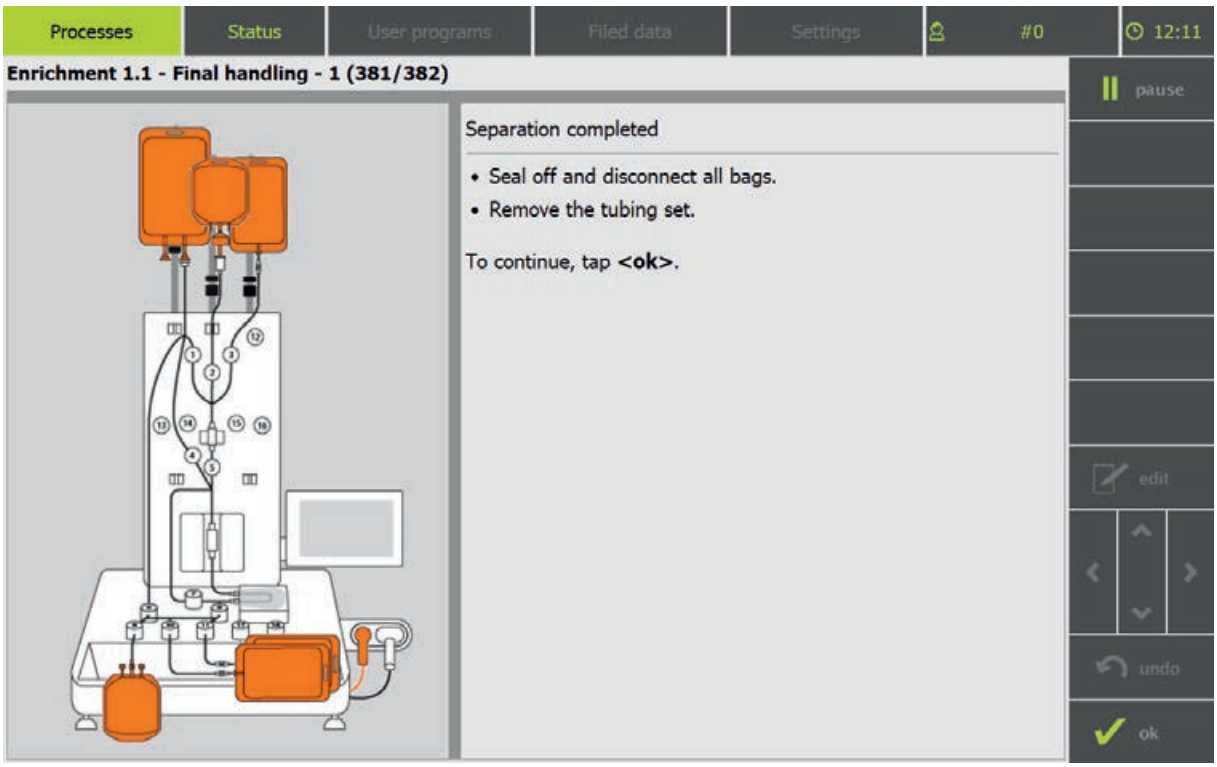


Figure 7.122: Separation completed - Sealing off bags and removing the tubing set

⚠ WARNING

Risk of infection and loss of cell product.

Multiple seals made closer than the recommended distance may result in rupture of the sealed tubing segment and leakage of the cell product. Leakage may expose the user to biological material, potentially resulting in infection, and may lead to loss of the cell product.

- Maintain a minimum distance of at least 1 cm between adjacent seals.

1. Clamp or seal the tubing above the luer lock connecting the Cell Collection Bag to the tubing set (see Figure 7.123).
    a. Make three hermetic seals in the tubing directly below valve 9, with a distance of at least 1 cm between each seal.
    b. Carefully sever the middle seal to disconnect the Cell Collection Bag from the tubing set.
2. Weigh the filled Cell Collection Bag. Record the weight.
    a. Determine the weight of the target cell fraction by subtracting the weight of the empty Cell Collection Bag from the weight of the Cell Collection Bag containing the target cells.
    b. Record the weight.
3. Mix the target cell suspension thoroughly by rotating the bag. Take a suitable amount, for example, 0.5 mL, and retain for analysis.

4. Using the MACS TubeSealer, seal off the tubing above the luer lock of the Negative Fraction Bag.
    a. Make three hermetic seals in the tubing, with a distance of at least 1 cm between each seal.
    b. Sever the center seal to disconnect the Negative Fraction Bag.
5. Disconnect the Buffer Waste Bag in the same way.
6. Remove the Negative Fraction Bag and Buffer Waste Bag.
7. Keep all bags until final analysis of all cells has been accomplished.
8. Remove the tubing set in the following order:
    a. Beginning with valves 6, 9, 10, and 11, and working upwards, release the tubing from the liquid sensor and from the valves by pressing on the valves.
    b. Release the columns from the column holders.
    c. Dispose the tubing set as a biohazard, according to standard hospital procedures.

The target cells can now be processed in accordance with clinical protocols. To continue, tap **ok**.

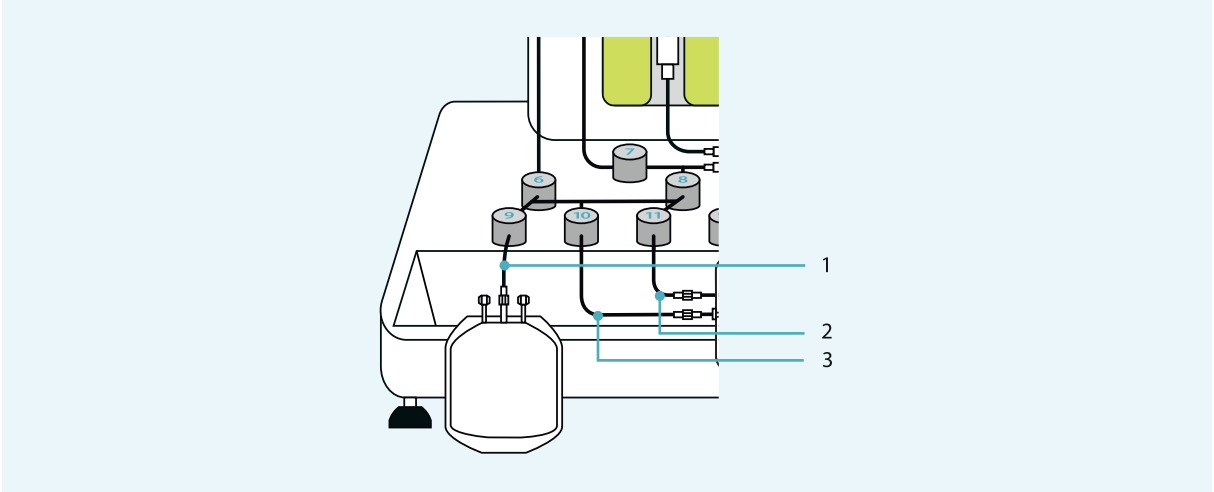


Figure 7.123: Seal off bags

1 Seal off Cell Collection Bag
2 Seal off Negative Fraction Bag
3 Seal off Buffer Waste Bag

Shutting down and cleaning the instrument

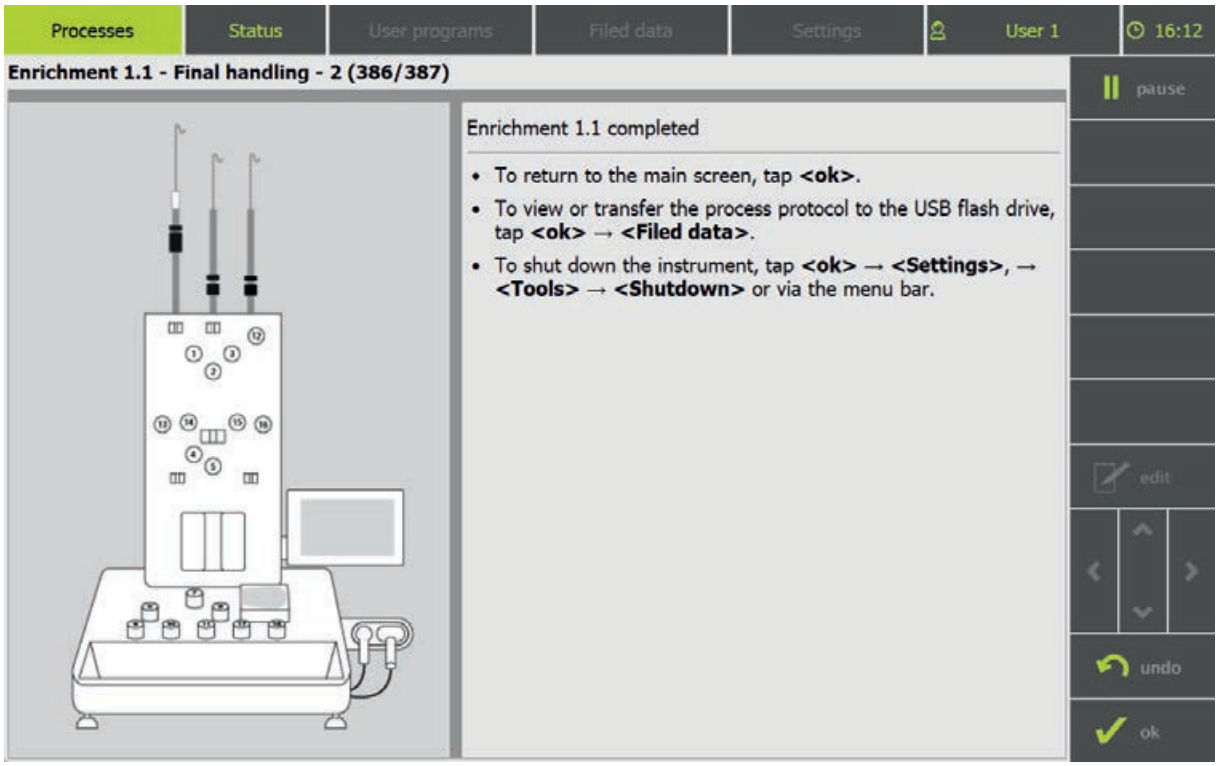


Figure 7.124: Completion of the separation program Enrichment 1.1

1. After the completion of the separation program, the user can choose one of the following options:
   - To return to the main screen, tap ok.
   - To view the process protocol or to transfer it to a storage device, tap ok > Filed data.
   - To shut down the instrument, tap ok > Settings > Tools > Shutdown.
2. Clean the instrument according to cleaning instructions as described in the CliniMACS Plus Instrument user manual. Follow the standard procedures for the treatment of infectious material.

Analysis of cells

⚠ CAUTION

Risk of reduced quality of target cells.

The target cells must be analyzed and confirmed to meet user requirements, otherwise the suitability for clinical application can be compromised.

- Examine the target cells regarding quality and quantity according to their intended use.

This must include the following parameters:

- total number of leukocytes
- viability and total number of target cells
- purity (depletion efficiency) and recovery of target cells

It is also recommended to determine the total number of leukocytes and the viability of the non-target cell fraction. The list is an example and other tests should be included based on the intended use and clinical protocols. Record the analysis data.

7.4.3 Enrichment 3.2

Starting the separation program

Once the final check is completed, the CliniMACS Plus Instrument is ready to begin the separation (see Figure 7.125).

1. To start the separation program, tap **ok**. The instrument will automatically perform the chosen separation procedure. At the beginning of the separation, buffer is pumped upwards towards the Cell Preparation Bag to fill the pre-system filter.
2. Tap the side of the filter gently several times to remove any bubbles which might be trapped in the filter.
3. To view the current step of the separation procedure, tap **Status** in the menu bar. The name of the current step is shown on the right-hand side of the screen.

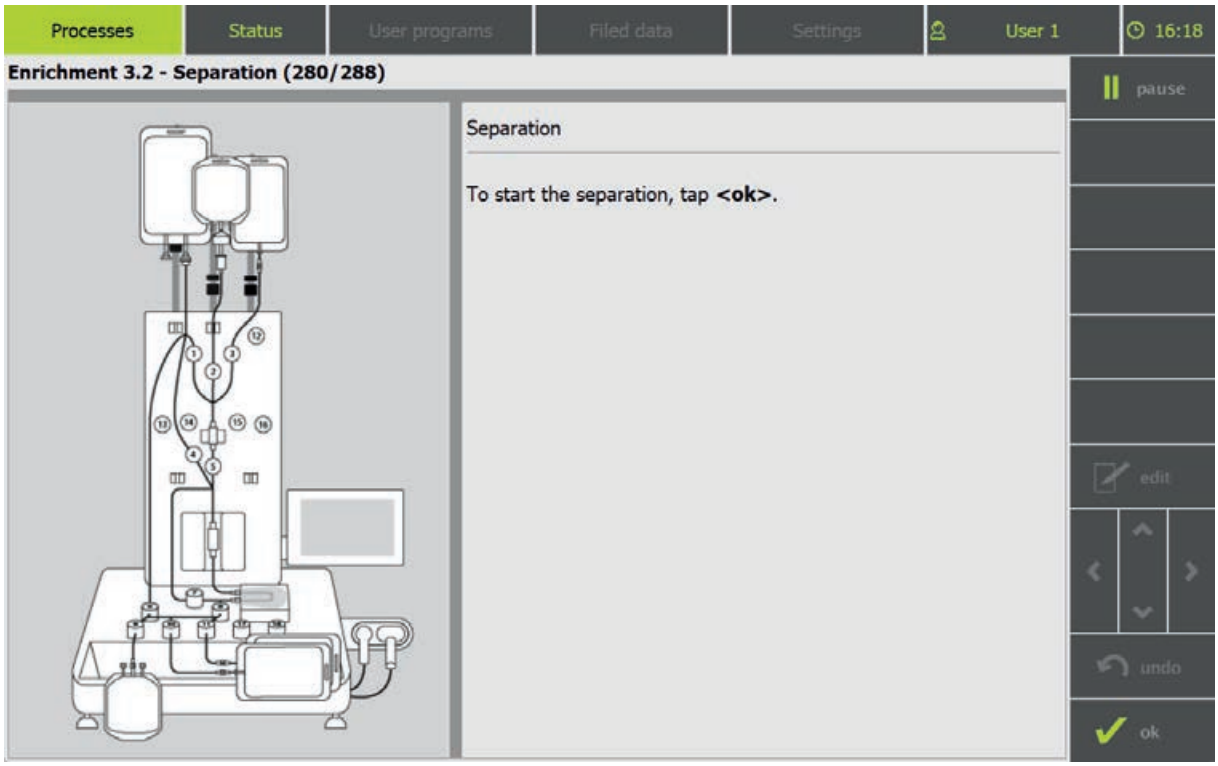


Figure 7.125: Starting the separation

The following section 'Separation procedure' describes the individual steps of the separation procedure. If a warning or error message appears during the separation process, refer to chapter 'Troubleshooting' for information on corrective actions.

Separation procedure

Loading cells

The separation procedure starts with the filling of the pre-system filter to remove remaining air from the pre-system filter. Then the separation of the labeled cells begins. The pump draws the contents of the Cell Preparation Bag into the tubing set and loads the cell product via the pre-column on the separation column. The magnetically labeled cells (target cells) are retained in the separation column, placed in the magnetic field, while the unlabeled cells (non-target cells) are passed through and are collected in the Negative Fraction Bag. When the Cell Preparation Bag is empty (detected automatically by the liquid sensor), the pre-system filter is rinsed twice with buffer.

Column wash I

The pre-column and separation column are washed extensively to remove all unlabeled cells. Wash buffer is collected in the Buffer Waste Bag.

Release of cells I

The magnet is moved to the rear of the instrument ("OFF" position). The retained cells are released at a high speed flow, but the cells remain within an internal tubing cycle.

Reloading of cells I

The magnet is moved into the "ON" position again to magnetize the separation column and the cells are reapplied onto the separation column.

Column wash II

The reloading of the cells is followed by a second washing step to remove remaining unlabeled cells. Also, all tubing is rinsed several times.

Release of cells II, reloading of cells II, column wash III

The cells are released and reapplied onto the separation column for a second time in order to remove any unlabeled cells sticking unspecifically to the column matrix. Afterwards the separation column is washed again.

Final elution of the cells

The magnet is moved into the "OFF" position and the magnetically labeled cells (target cells) are released and collected in the Cell Collection Bag.

Disconnecting bags and removing tubing set

When the separation is completed, the screen shows Figure 7.126.

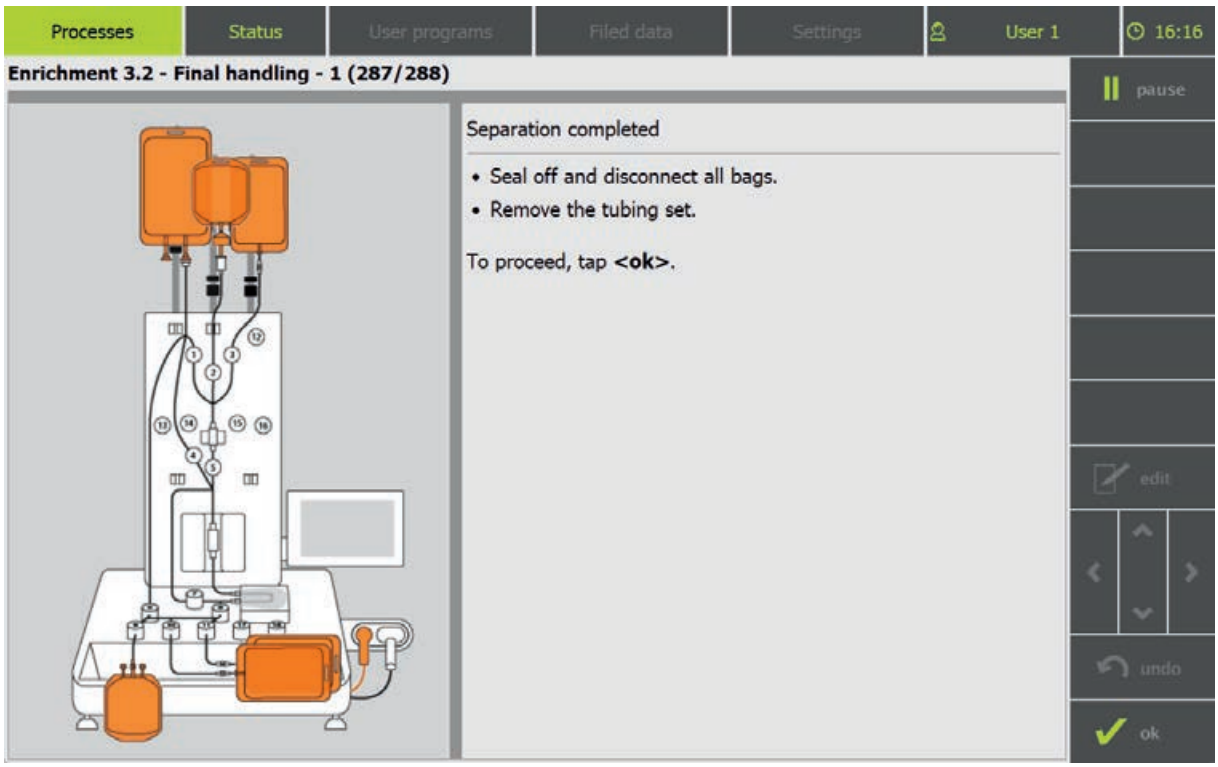


Figure 7.126: Separation completed - Sealing off bags and removing the tubing set

⚠ WARNING

Risk of infection and loss of cell product.

Multiple seals made closer than the recommended distance may result in rupture of the sealed tubing segment and leakage of the cell product. Leakage may expose the user to biological material, potentially resulting in infection, and may lead to loss of the cell product.

- Maintain a minimum distance of at least 1 cm between adjacent seals.

1. Clamp or seal the tubing above the luer lock connecting the Cell Collection Bag to the tubing set (see Figure 7.127).
    a. Make three hermetic seals in the tubing directly below valve 9, with a distance of at least 1 cm between each seal.
    b. Carefully sever the middle seal to disconnect the Cell Collection Bag from the tubing set.
2. Weigh the filled Cell Collection Bag. Record the weight.
    a. Determine the weight of the target cell fraction by subtracting the weight of the empty Cell Collection Bag from the weight of the Cell Collection Bag containing the target cells.
    b. Record the weight.
3. Mix the target cell suspension thoroughly by rotating the bag. Take a suitable amount, for example, 0.5 mL, and retain for analysis.

4. Using the MACS TubeSealer, seal off the tubing above the luer lock of the Negative Fraction Bag.
    a. Make three hermetic seals in the tubing, with a distance of at least 1 cm between each seal.
    b. Sever the center seal to disconnect the Negative Fraction Bag.
5. Disconnect the Buffer Waste Bag in the same way.
6. Remove the Negative Fraction Bag and Buffer Waste Bag.
7. Keep all bags until final analysis of all cells has been accomplished.
8. Remove the tubing set in the following order:
    a. Beginning with valves 6, 9, 10, and 11, and working upwards, press on the valves and release the tubing from the liquid sensor and from the valves.
    b. Release the columns from the column holders.
    c. Dispose the tubing set as a biohazard, according to standard hospital procedures.

The target cells can now be processed in accordance with clinical protocols. To continue, tap **ok**.

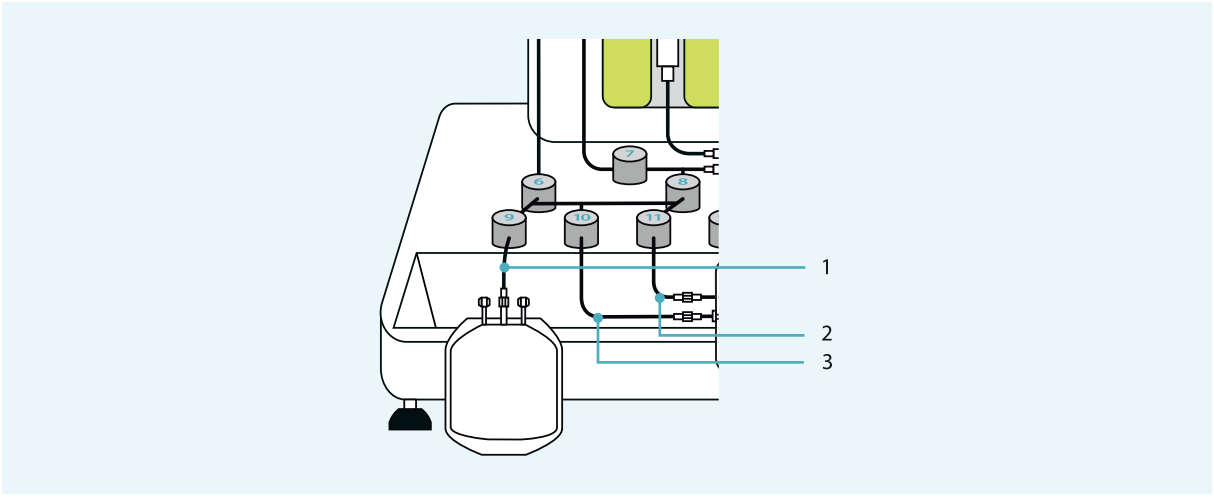


Figure 7.127: Seal off bags

1 Seal off Cell Collection Bag
2 Seal off Negative Fraction Bag
3 Seal off Buffer Waste Bag

Shutting down and cleaning the instrument

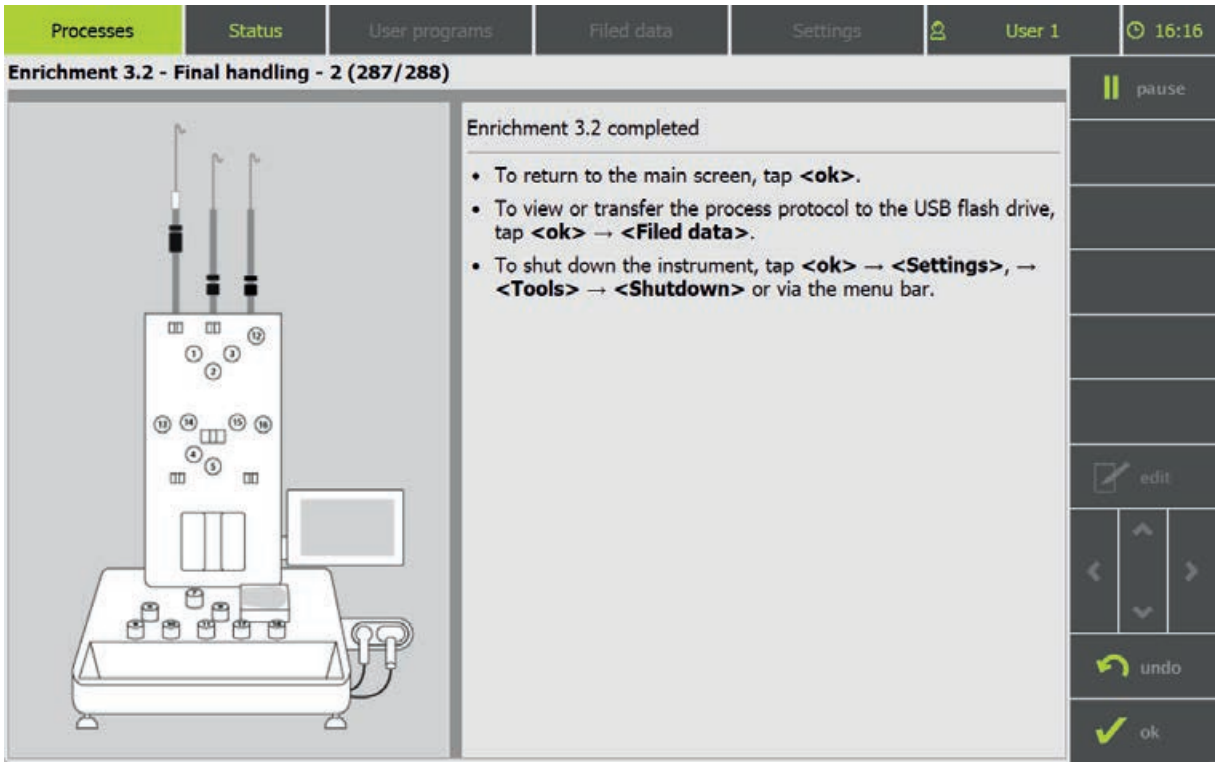


Figure 7.128: Completion of the separation program Enrichment 3.2

1. After the completion of the separation program, the user can choose one of the following options:
   - To return to the main screen, tap ok.
   - To view the process protocol or to transfer it to a storage device, tap ok > Filed data.
   - To shut down the instrument, tap ok > Settings > Tools > Shutdown.
2. Clean the instrument according to cleaning instructions as described in the CliniMACS Plus Instrument user manual. Follow the standard procedures for the treatment of infectious material.

Analysis of cells

⚠ CAUTION

Risk of reduced quality of target cells.

The target cells must be analyzed and confirmed to meet user requirements, otherwise the suitability for clinical application can be compromised.

- Examine the target cells regarding quality and quantity according to their intended use.

This must include the following parameters:

- total number of leukocytes
- viability and total number of target cells
- purity (depletion efficiency) and recovery of target cells

It is also recommended to determine the total number of leukocytes and the viability of the non-target cell fraction. The list is an example and other tests should be included based on the intended use and clinical protocols. Record the analysis data.

7.4.4 Depletion 2.1

Starting the separation program

Once the final check is completed, the CliniMACS Plus Instrument is ready to begin the separation (see Figure 7.129).

1. To start the separation program, tap **ok**. The instrument will automatically perform the chosen separation procedure. At the beginning of the separation, buffer is pumped upwards towards the Cell Preparation Bag to fill the pre-system filter.
2. Tap the side of the filter gently several times to remove any bubbles which might be trapped in the filter.
3. To view the current step of the separation procedure, tap **Status** in the menu bar. The name of the current step is shown on the right-hand side of the screen.

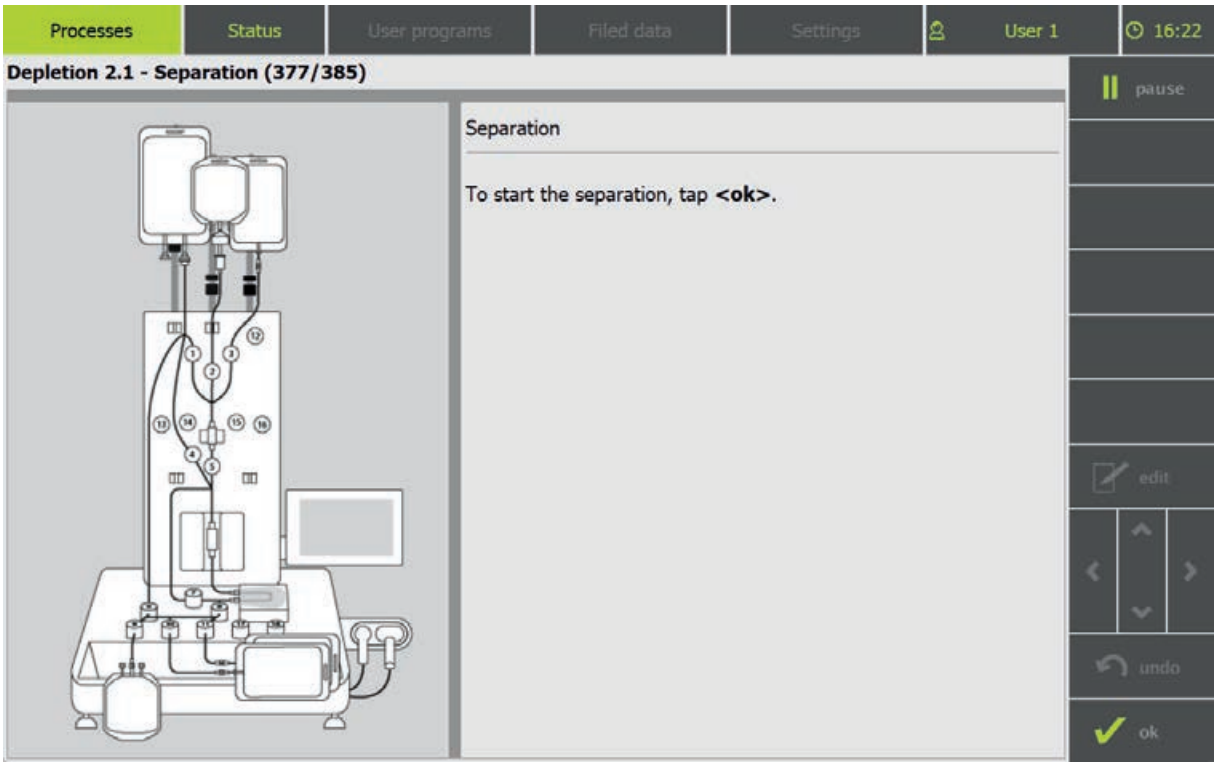


Figure 7.129: Starting the separation

The following section 'Separation procedure' describes the individual steps of the separation procedure. If a warning or error message appears during the separation process, refer to chapter 'Troubleshooting' for information on corrective actions.

Separation procedure

Loading cells

The separation procedure starts with the filling of the pre-system filter to complete the priming of the system. Then the separation of the labeled cells begins. The pump draws the contents of the Cell Preparation Bag into the tubing set. The magnetically labeled cells (non-target cells) are retained in the separation column, placed in the magnetic field, while the unlabeled cells (target cells) are passed through and collected in the Cell Collection Bag.

Rinsing pre-system filter

After the cell sample has been completely loaded onto the tubing set, the pre-system filter is rinsed twice with buffer to reduce cell loss in the filter.

If the number of magnetically labeled cells (calculated by the CliniMACS Plus Software) exceeds the binding capacity of the separation column, the separation program automatically loads and separates the cell sample in smaller portions ("staged loading"). The loading will be stopped when the capacity of the separation column is reached and the separation program will proceed to the next step of the separation. After the last step (final elution of the cells) has been completed, the next portion of the sample will be loaded onto the column.

Column wash

The pre-column and separation column are washed extensively to remove all unlabeled cells. Wash buffer is collected in the Buffer Waste Bag.

Final elution of the cells

The magnet is moved into the "OFF" position. At first the magnetically labeled cells are eluted to the Priming Waste Bag. Only after the last loading stage has been finished, all magnetically labeled cells (non-target cells) are released from the separation column and collected in the Negative Fraction Bag to reduce carryover with labeled cells in the pump tubing.

Disconnecting bags and removing tubing set

When the separation is completed, The screen shows Figure 7.130.

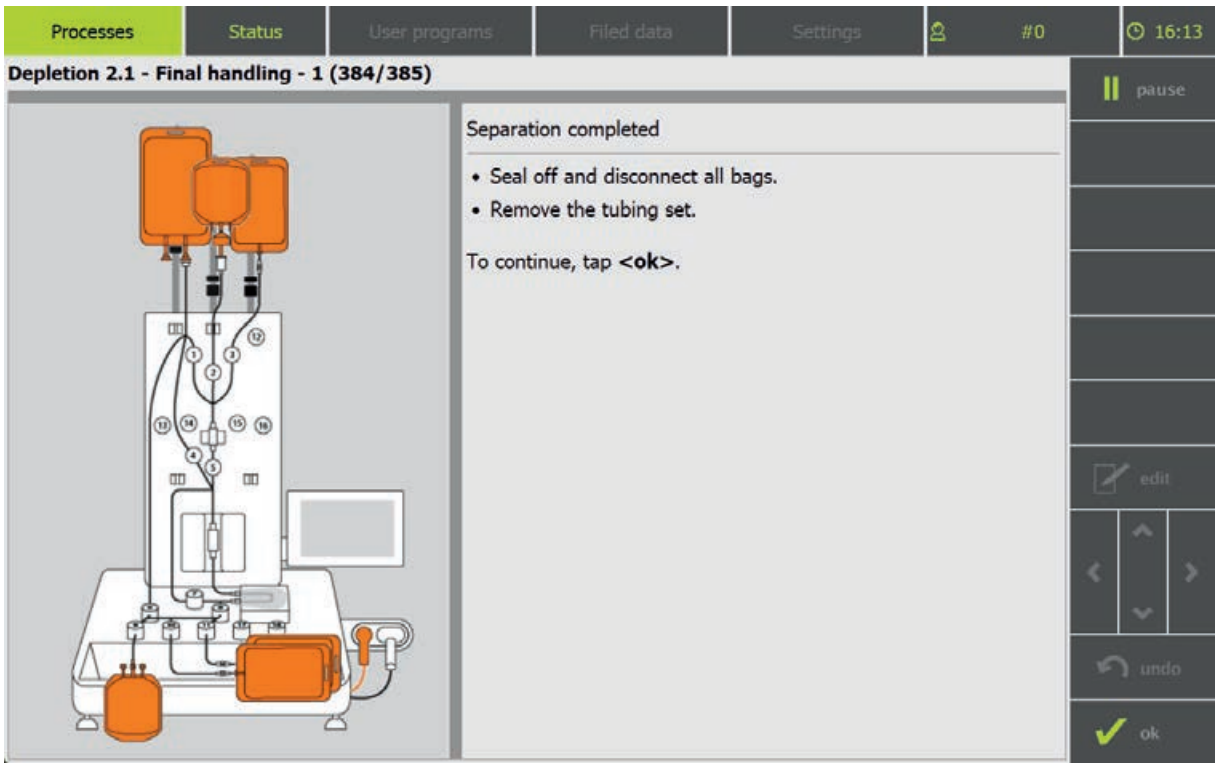


Figure 7.130: Separation completed - Sealing off bags and removing the tubing set

⚠ WARNING

Risk of infection and loss of cell product.

Multiple seals made closer than the recommended distance may result in rupture of the sealed tubing segment and leakage of the cell product. Leakage may expose the user to biological material, potentially resulting in infection, and may lead to loss of the cell product.

- Maintain a minimum distance of at least 1 cm between adjacent seals.

1. Clamp or seal the tubing above the luer lock connecting the Cell Collection Bag to the tubing set (see Figure 7.131).
    a. Make three hermetic seals in the tubing directly below valve 9, with a distance of at least 1 cm between each seal.
    b. Carefully sever the middle seal to disconnect the Cell Collection Bag from the tubing set.
2. Weigh the filled Cell Collection Bag. Record the weight.
    a. Determine the weight of the target cell fraction by subtracting the weight of the empty Cell Collection Bag from the weight of the Cell Collection Bag containing the target cells.
    b. Record the weight.
3. Mix the target cell suspension thoroughly by rotating the bag. Take a suitable amount, for example, 0.5 mL, and retain for analysis.

4. Using the MACS TubeSealer, seal off the tubing above the luer lock of the Negative Fraction Bag.
    a. Make three hermetic seals in the tubing.
    b. Sever the center seal to disconnect the Negative Fraction Bag.
5. Disconnect the Buffer Waste Bag in the same way.
6. Remove the Negative Fraction Bag and Buffer Waste Bag.
7. Keep all bags until final analysis of all cells has been accomplished.
8. Remove the tubing set in the following order:
    a. Beginning with valves 6, 9, and 10, and working upwards, press on the valves to release the tubing from the liquid sensor and from the valves.
    b. Release the column from the column holder.
    c. Dispose the tubing set as a biohazard, according to standard hospital procedures.
9. Switch off the CliniMACS Plus Instrument.

The target cells can now be processed in accordance with clinical protocols. To continue, tap **ok**.

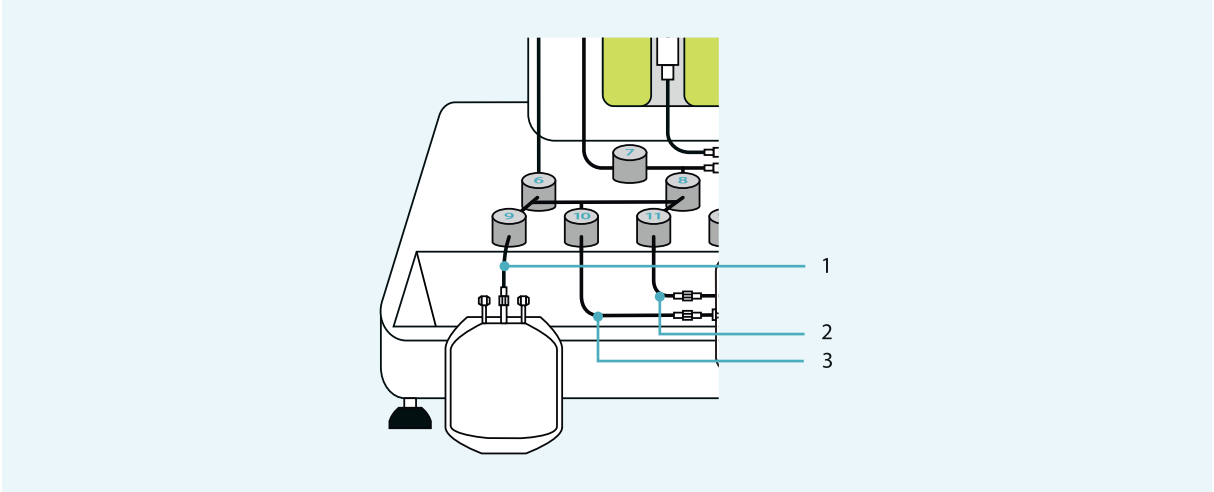


Figure 7.131: Seal off bags

1 Seal off Cell Collection Bag
2 Seal off Negative Fraction Bag
3 Seal off Buffer Waste Bag

Shutting down and cleaning the instrument

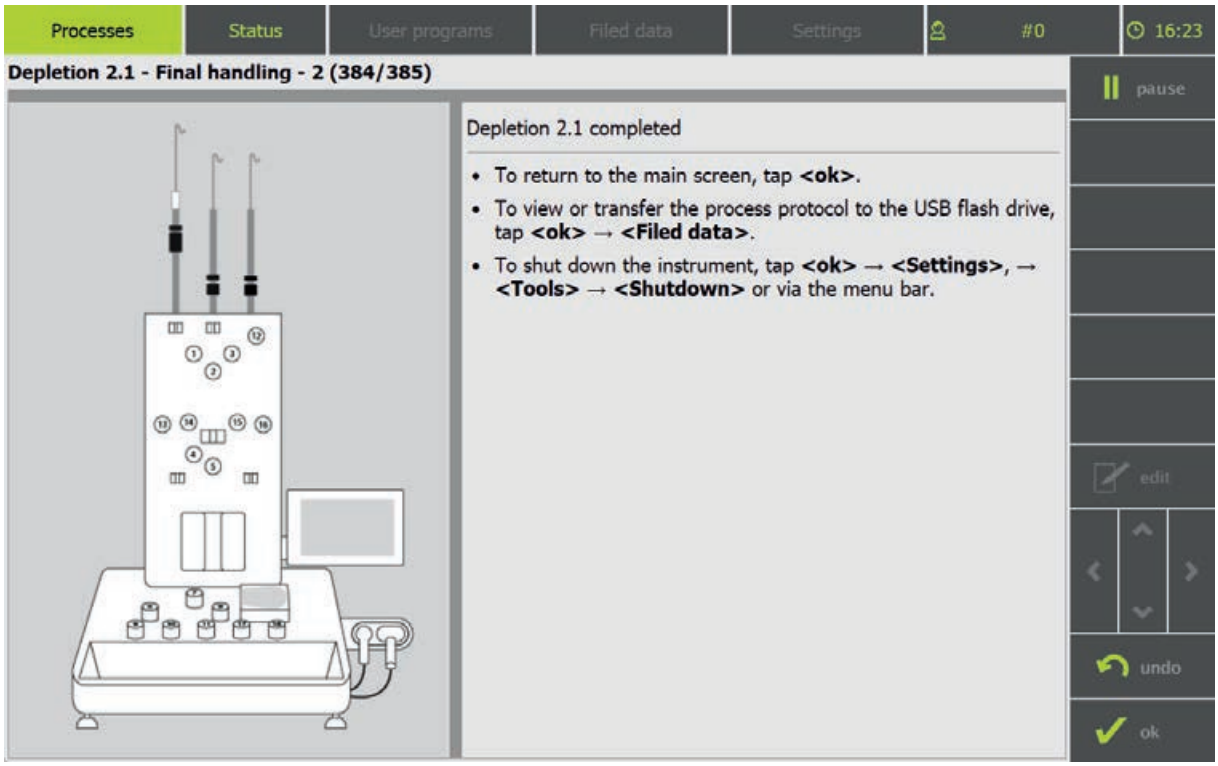


Figure 7.132: Completion of the separation program Depletion 2.1

1. After the completion of the separation program, the user can choose one of the following options:
   - To return to the main screen, tap ok.
   - To view the process protocol or to transfer it to a storage device, tap ok > Filed data.
   - To shut down the instrument, tap ok > Settings > Tools > Shutdown.
2. Clean the instrument according to cleaning instructions as described in the CliniMACS Plus Instrument user manual. Follow the standard procedures for the treatment of infectious material.

Analysis of cells

⚠ CAUTION

Risk of reduced quality of target cells.

The target cells must be analyzed and confirmed to meet user requirements, otherwise the suitability for clinical application can be compromised.

- Examine the target cells regarding quality and quantity according to their intended use.

This must include the following parameters:

- total number of leukocytes
- viability and total number of target cells
- purity (depletion efficiency) and recovery of target cells

It is also recommended to determine the total number of leukocytes and the viability of the non-target cell fraction. The list is an example and other tests should be included based on the intended use and clinical protocols. Record the analysis data.

7.4.5 Depletion 3.1

Starting the separation program

Once the final check is completed, the CliniMACS Plus Instrument is ready to begin the separation (see Figure 7.133).

1. To start the separation program, tap **ok**. The instrument will automatically perform the chosen separation procedure. At the beginning of the separation, buffer is pumped upwards towards the Cell Preparation Bag to fill the pre-system filter.
2. Tap the side of the filter gently several times to remove any bubbles which might be trapped in the filter.
3. To view the current step of the separation procedure, tap **Status** in the menu bar. The name of the current step is shown on the right-hand side of the screen.

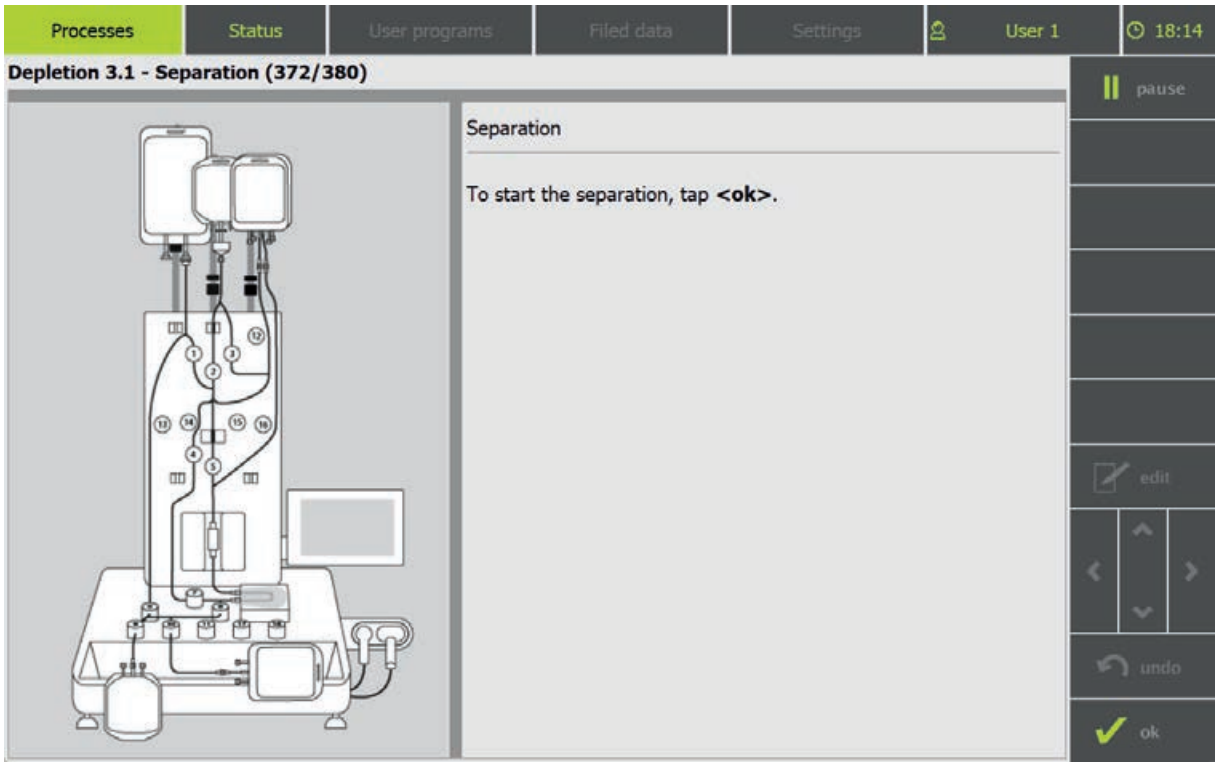


Figure 7.133: Starting the separation

The following section 'Separation procedure' describes the individual steps of the separation procedure. If a warning or error message appears during the separation process, refer to chapter 'Troubleshooting' for information on corrective actions.

Separation procedure

Depletion 3.1 is a two-step depletion program, that is the cells are applied onto the separation column twice.

- **Staged Cell Loading (Bulk Depletion):** In the first part of the process, the bulk of labeled cells is depleted.
- **Sensitive Cell Loading (Sensitive Depletion):** In the second part of the process, the few remaining labeled cells are depleted.

If the number of magnetically labeled cells (calculated by the CliniMACS Plus Software) exceeds the binding capacity of the separation column, the separation program automatically loads and separates the cell sample

in smaller portions (“staged loading”). Between each loading stage, the separation column is washed to remove all labeled cells. The labeled cells will be eluted and held in the Non-Target Cell Bag. The wash buffer is collected in the Reapplication Bag.

Staged cell loading (Bulk Depletion)

The separation procedure starts with the filling of the pre-system filter to complete the priming of the system. Then the separation of the labeled cells begins. The pump draws the contents of the Cell Preparation Bag into the tubing set. The magnetically labeled cells (non-target cells) are retained in the separation column, placed in the magnetic field, while the unlabeled cells (target cells) are passed through and collected in the Reapplication Bag.

Sensitive cell loading (Sensitive Depletion)

For further depletion the cells in the Reapplication Bag are reloaded to the separation column at a lower speed. While the few remaining labeled cells are now retained on the column, the unlabeled cells (target cells) flow through the magnetic field and are collected in the Cell Collection Bag.

Rinsing pre-system filter and Reapplication Bag

After the cell sample has completed both bulk and sensitive depletion, the pre-system filter and the Reapplication Bag are rinsed with buffer twice to reduce cell loss in the system.

Removal of non-target cells

The magnet is moved into the “OFF” position. The magnetically labeled cells (non-target cells) are released from the separation column and collected into the Non-Target Cell Bag after each loading stage.

Disconnecting bags and removing tubing set

When the separation is completed, the screen shows Figure 7.134.

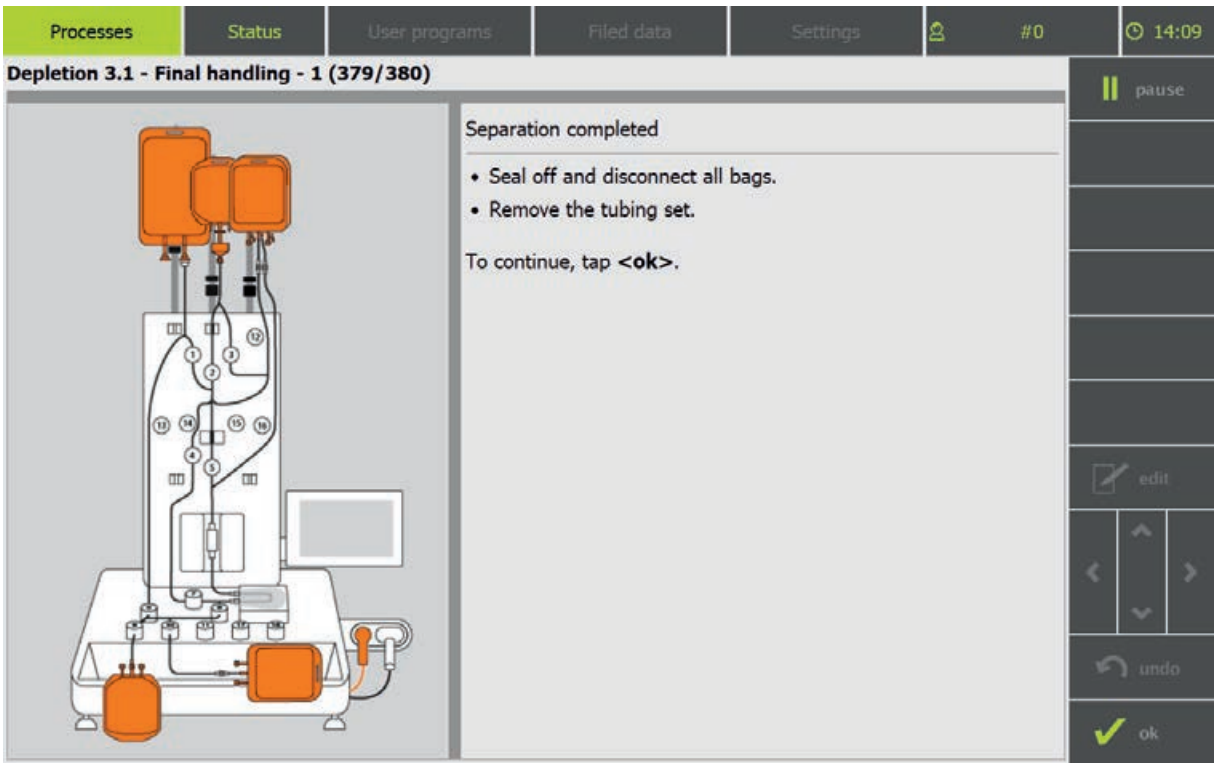


Figure 7.134: Separation completed - Sealing off bags and removing the tubing set

⚠ WARNING

Risk of infection and loss of cell product.

Multiple seals made closer than the recommended distance may result in rupture of the sealed tubing segment and leakage of the cell product. Leakage may expose the user to biological material, potentially resulting in infection, and may lead to loss of the cell product.

- Maintain a minimum distance of at least 1 cm between adjacent seals.

1. Clamp or seal the tubing above the luer lock connecting the Cell Collection Bag to the tubing set (see Figure 7.135).
    a. Make three hermetic seals in the tubing directly below valve 9, with a distance of at least 1 cm between each seal.
    b. Carefully sever the middle seal to disconnect the Cell Collection Bag from the tubing set.
2. Weigh the filled Cell Collection Bag. Record the weight.
    a. Determine the weight of the target cell fraction by subtracting the weight of the empty Cell Collection Bag from the weight of the Cell Collection Bag containing the target cells.
    b. Record the weight.
3. Mix the target cell suspension thoroughly by rotating the bag.
    a. Take a suitable amount, for example, 0.5 mL, and retain for analysis.

4. Using the MACS TubeSealer, seal off the tubing above the luer lock of the Buffer Waste Bag.
    a. Make three hermetic seals in the tubing, with a distance of at least 1 cm between each seal.
    b. Sever the center seal to disconnect the Buffer Waste Bag.
5. Disconnect the Non-Target Cell Bag in the same way.
6. Remove the Non-Target Cell Bag and Buffer Waste Bag.
7. Keep all bags until final analysis of all cells has been accomplished.
8. Remove the tubing set:
    a. Beginning with valves 6, 9, and 10, and working upwards, press on the valves to release the tubing from the liquid sensor and from the valves.
    b. Release the column from the column holder.
    c. Dispose the tubing set as a biohazard, according to standard hospital procedures.
9. Switch off the CliniMACS Plus Instrument.

The target cells can now be processed in accordance with clinical protocols. To continue, tap **ok**.

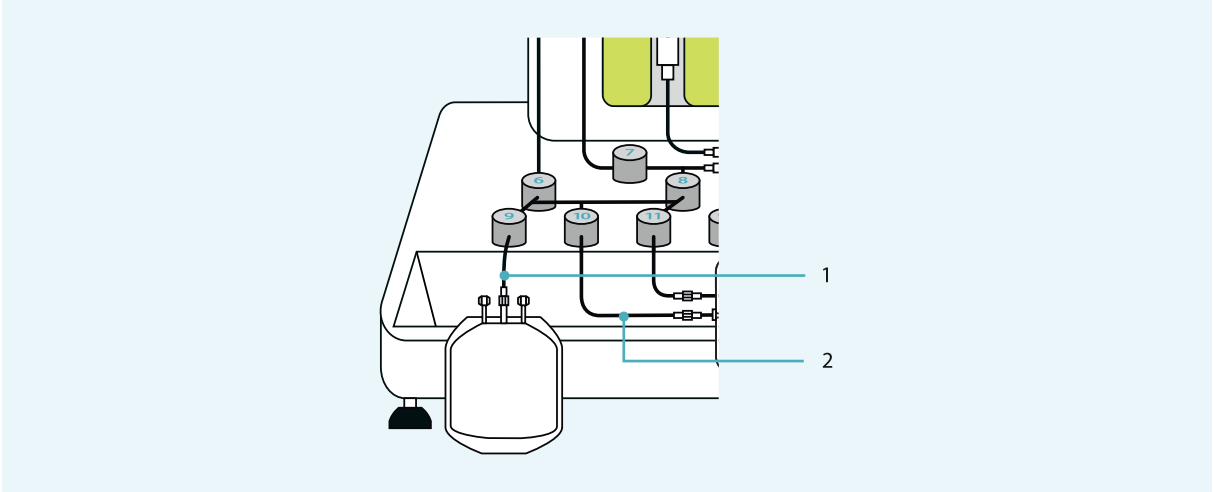


Figure 7.135: Seal off bags

1 Seal off Cell Collection Bag
2 Seal off Buffer Waste Bag

Shutting down and cleaning the instrument

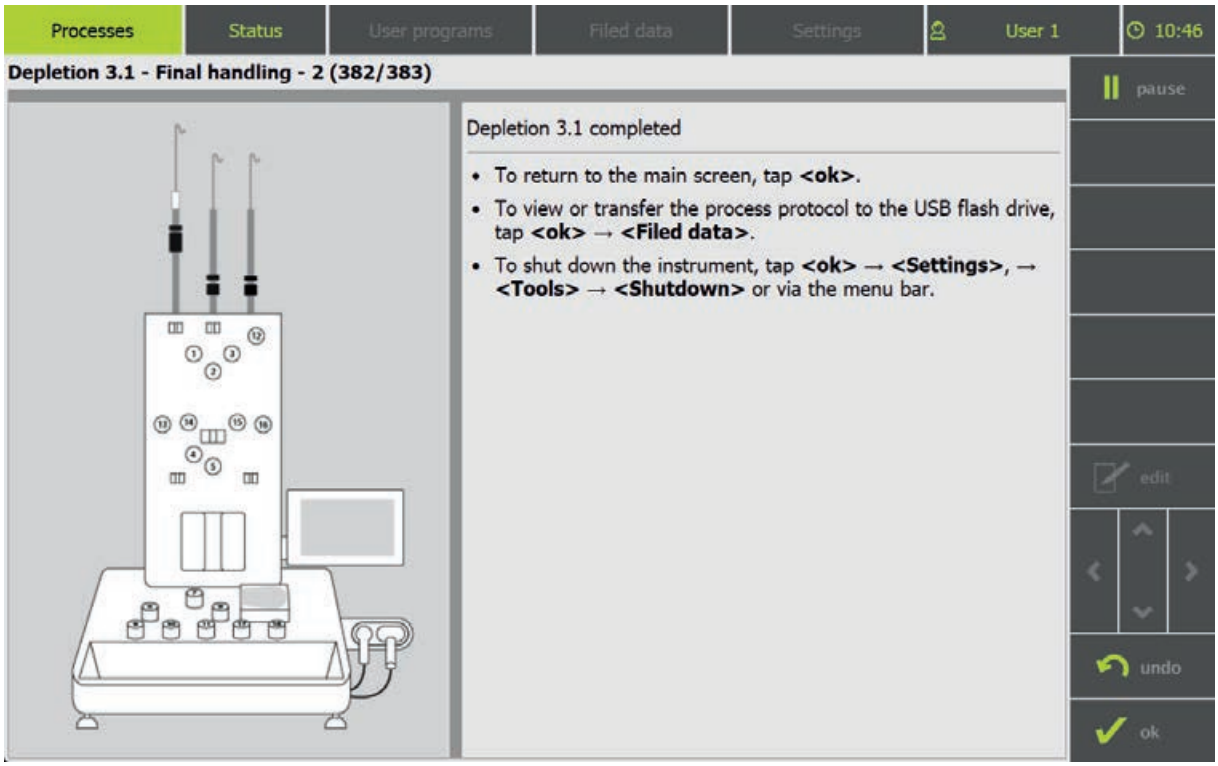


Figure 7.136: Completion of the separation program Depletion 3.1

1. After the completion of the separation program, the user can choose one of the following options:
   - To return to the main screen, tap ok.
   - To view the process protocol or to transfer it to a storage device, tap ok > Filed data.
   - To shut down the instrument, tap ok > Settings > Tools > Shutdown.
2. Clean the instrument according to cleaning instructions as described in the CliniMACS Plus Instrument user manual. Follow the standard procedures for the treatment of infectious material.

Analysis of cells

⚠ CAUTION

Risk of reduced quality of target cells.

The target cells must be analyzed and confirmed to meet user requirements, otherwise the suitability for clinical application can be compromised.

- Examine the target cells regarding quality and quantity according to their intended use.

This must include the following parameters:

- total number of leukocytes
- viability and total number of target cells
- purity (depletion efficiency) and recovery of target cells

It is also recommended to determine the total number of leukocytes and the viability of the non-target cell fraction. The list is an example and other tests should be included based on the intended use and clinical protocols. Record the analysis data.

8

Troubleshooting

This chapter is intended as a reference to provide information about possible unexpected events that might occur and to suggest appropriate corrective action. For information not covered in the following chapter, contact Miltenyi Biotec Technical Support as soon as possible.

The order of this chapter follows the actual sequence of a separation.

8.1 Miltenyi Biotec Technical Support

In any case of instrument malfunction or a process failure that cannot be corrected by the user, contact the Miltenyi Biotec Technical Support team:

+49 2204 8306-3803

technicalsupport@miltenyi.com

Visit www.miltenyibiotec.com for local Miltenyi Biotec Technical Support contact information.

8.2 Error and warning messages

The instrument and software can have malfunctions. Error and warning messages are shown on the screen and marked as such. If the error or warning cannot be corrected by the user, record the number shown in the message panel and contact Miltenyi Biotec Technical Support as soon as possible. One possible error message and warning message is shown in Figure 8.1 and Figure 8.2.

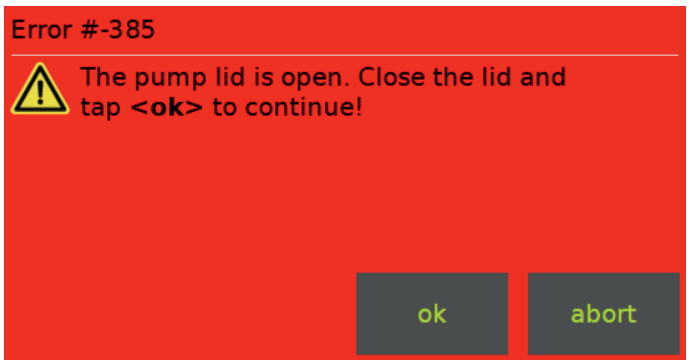


Figure 8.1: Error message

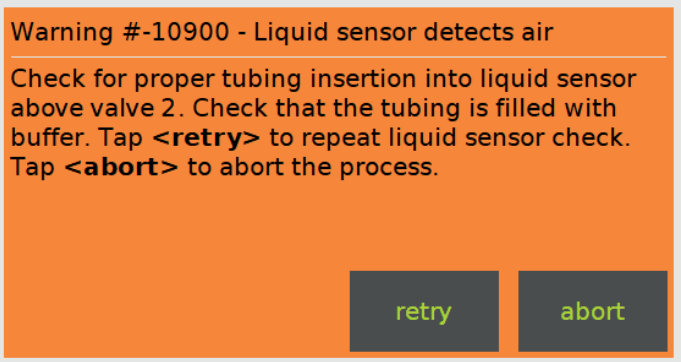


Figure 8.2: Warning message

8.3 MACS TubeSealer

For troubleshooting information about possible unexpected events related to tube sealing with the MACS TubeSealer, refer to chapter 'Troubleshooting' of the MACS TubeSealer user manual.

8.4 Barcode scanning

A barcode label cannot be scanned correctly.

Incorrect material scanned

- Ensure that the material is specified for the current separation program.
- Use the barcode reader to scan the barcode label again.

Barcode scanner does not scan the barcode label

- Make sure that the barcode label is clean, undamaged, and fully visible to the barcode reader.
- Use the barcode reader to scan the barcode label again.
- If the barcode cannot be scanned, enter the information manually.

Barcode is missing

To enter the material information manually, tap edit and enter the information in the input fields shown on the screen.

8.5 Preparation of the leukapheresis product

The cell product received is diluted

Ideally, magnetic labeling is performed in diluted leukapheresis product. Adjust the leukapheresis product to a final dilution of approximately 1:3.

- If the cell product received is more diluted than 1:3, or if the user does not exactly know the concentration of plasma in the cell product, add immunoglobulin to the cell product before the addition of the reagent. The recommended concentration of immunoglobulin in the labeling volume is 1.5 mg/mL.
- It is important to have a certain amount of immunoglobulin in the cell product during the labeling in order to minimize non-specific binding of the reagent.

The number of target cells in the leukapheresis product is low

The mobilization of stem cells was insufficient. Check analysis of the leukapheresis product.

Poor viability of cells in the leukapheresis product

The leukapheresis product may have been harvested, stored, or transported inappropriately.

To ensure better sample quality, the preparation and separation of the leukapheresis product should be performed immediately after leukapheresis.

- Keep the leukapheresis product at a leukocyte concentration of less than 0.2×10^9 per mL.
- If necessary, dilute the leukapheresis product with autologous plasma.
- The leukapheresis product should not be older than 24 hours when starting the labeling and separation procedure.
- If the leukapheresis product has to be stored, for example, overnight, it should be kept at controlled room temperature (+19 °C to +25 °C [+66 °F to +77 °F]).

8.6 CliniMACS Plus Instrument and CliniMACS Tubing Sets

8.6.1 Loading and priming of the tubing set

IMPORTANT:
Contact Miltenyi Biotec Technical Support for instructions on returning a defective tubing set.

Valve does not open when user is instructed to insert tubing into a valve

The valves are designed to work properly once the tubing is inserted.

- Press the valve manually to open it.
- Watch the valve carefully during the seating of valves.

If the valve does not depress during the seating of valves, see 'Valve does not depress during seating of valves'.

Valve does not depress during seating of valves

Ensure that tubing is correctly inserted. Ensure that the valves are cleaned thoroughly. Any valve that is contaminated by fluid has to be exchanged.
Contact Miltenyi Biotec Technical Support.

Buffer is leaking from tubing set during priming

Tubing set is defective.

1. Abort the program by tapping **pause** > **abort**.
2. Remove the defective tubing set.
3. Restart the separation program using a new tubing set and sufficient new buffer.

Excessive air occurs in tubing set after priming

Buffer bag is not spiked properly.

1. Abort the program by tapping **pause** > **abort**.

2. Remove the defective tubing set.
3. Restart the separation program using a new tubing set and sufficient new buffer.

Ensure that the septum of the buffer bag is properly punctured.

Unexpected volume of buffer in bags after priming. After priming, liquid should only be in the Priming Waste Bag and Buffer Waste Bag

Tubing set is not installed correctly.
If the tubing set is not installed correctly or the valves are not functioning properly, liquid can leak behind the valves. This may result in a poor performance of the CliniMACS Plus separation.

1. Abort the program by tapping **pause** > **abort**.
2. Remove the defective tubing set.
3. Restart the separation program using a new tubing set and sufficient new buffer.

Pump motor stalls during priming

Pump tubing is not inserted correctly.

1. Abort the program by tapping **pause** > **abort**.
2. Restart the separation program.
3. During the tubing set installation, clamp the tubing below the process buffer with a locking forceps and correct the position of the pump tubing.
4. Before starting the priming sequence, remove the locking forceps.

8.7 Automated cell separation

8.7.1 Emergency program (to be used with enrichment programs only)

If a run terminates irreversibly before the target cells are eluted from the separation column, the **Emergency Program** can be run to elute the cells from the separation column. The Emergency program is designed only for use with all enrichment programs together with either a CliniMACS Tubing Set (REF 161-01) or a CliniMACS Tubing Set LS (REF 162-01).

IMPORTANT:

- The Emergency program must not be used with any depletion programs.
- The Emergency program will elute approximately 75 mL of fluid. Ensure that a suitable Cell Collection Bag is connected to the tubing set.

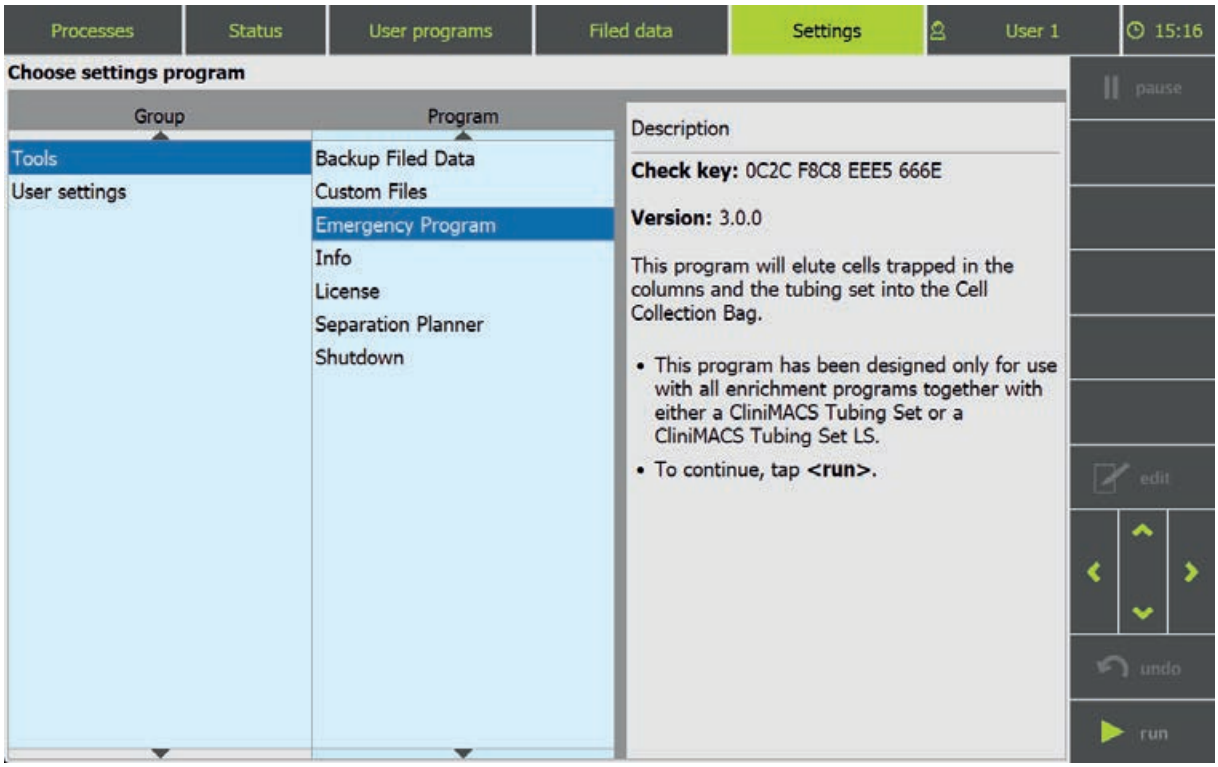


Figure 8.3: Selection of Emergency Program

1. Navigate to the emergency program by tapping **Settings** > **Tools** > **Emergency Program**. To start with the elution of the trapped cells, tap **run**.
    a. The magnet will be withdrawn from the magnetic separation unit. Refer to the CliniMACS Plus Instrument user manual for more information on the magnetic separation unit.
    b. Check if the magnet is withdrawn by holding a small magnetizable item to the magnetic separation unit. If the magnet is not withdrawn, or if there is an ongoing power failure, contact Miltenyi Biotec Technical Support.
2. Transfer the eluted cells collected in the Cell Collection Bag to a new 600 mL transfer bag.
3. Pool the remaining cells in the Cell Preparation Bag with the cells eluted by the emergency program.
4. Start a new separation procedure using a new tubing set and sufficient new buffer.

8.7.2 Unexpected events: All separation programs

Run is aborted before completion of cell separation program

- Pump door opened: For safety reasons, the separation in progress will automatically stop if the pump door is opened during the instrument run. An error message appears on the screen (see Figure 8.4).

  Close the pump door and tap retry.

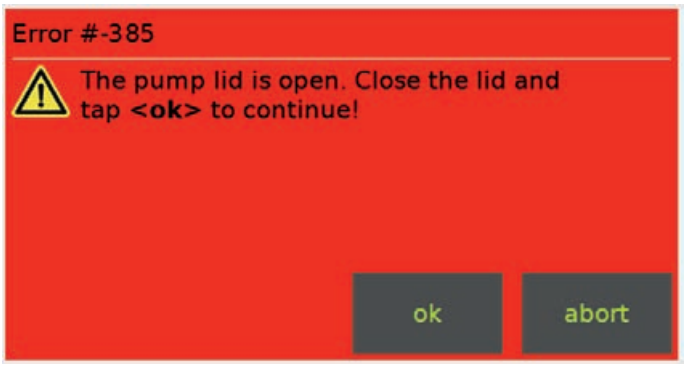


Figure 8.4: Error message no. 385

- Power failure: A power failure results in the termination of the CliniMACS Plus separation. Once terminated, the cell separation will not resume even if the power supply is restored. Contact Miltenyi Biotec Technical Support.
  - **Enrichment programs:** Recover as much of the cell product as possible from the tubing set by running the Emergency program (see section 'Emergency program (to be used with enrichment programs only)').

Liquid sensor detects air

If the liquid sensor is not able to detect liquid in the tubing, warning message no. 10900 will appear during the starting phase of the cell loading process. As the pre-system filter is rinsed with buffer prior to the cell loading, there must be liquid in the tubing at this point.

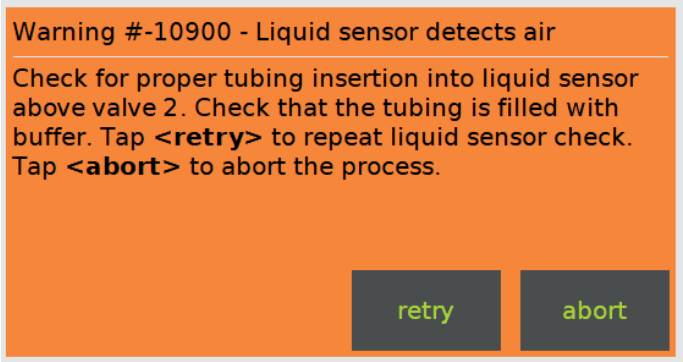


Figure 8.5: Warning message no. 10900 - Liquid sensor detects air

Check the following points:

1. Is the tubing inserted correctly into the liquid sensor above valve 2? If not, do so.
2. Is the tubing filled with buffer? If not, see point 3.

3. If the tubing is not filled with buffer, proceed as follows:
    a. Inspect the tubing for kinks blocking the buffer flow upwards into the pre-system filter and Cell Preparation Bag.
    b. Adjust the position of the tubing set. If necessary, raise or lower the bag hangers using the bag hanger clamps.
    c. Adjust the position of the tubing in the valves. To alter the position of the tubing, open the valve by manually pressing the button.
    d. Ensure that the tubing is not kinked, twisted, or taut.
4. Is the Cell Preparation Bag spiked properly? Ensure that the pre-system filter spike penetrates the septum of the Cell Preparation Bag port.
5. Is the tubing set completely filled with buffer? If not, ensure that the buffer spike of the tubing set penetrates the buffer bag. For corrective action, see 'Loading and priming of the tubing set'.

After the corrective action, continue the separation by tapping **retry**. If warning message no. 10900 appears again after each of the possible causes listed above have been ruled out, the liquid sensor may be defect. Contact Miltenyi Biotec Technical Support.

Cells move to wrong part of tubing set. Liquid is leaking past valves

- Tubing set is not properly inserted.
  If the instrument run is ongoing, tap **pause** and clamp the affected tubing with a locking forceps. Depress the appropriate valve by pushing the valve in and adjust the tubing. Remove the locking forceps and tap **resume** to continue the separation.
- Valve is not functioning properly.
  Tap **pause**. Clamp the affected tubing with a locking forceps. Depress the valve manually several times to unstick the stuck valve. Remove the locking forceps and continue the separation by tapping **resume**. If the valve cannot be unstuck, contact Miltenyi Biotec Technical Support.
- Wrong separation program used.
  Check the screen for the name of the program currently used. Abort the run by tapping **pause** > **abort** and immediately contact Miltenyi Biotec Technical Support.

Magnet does not move

Magnet drive is not functioning due to a failure.

An error message appears on the screen (see section 'Error and warning messages'). Record the number of the error message and contact Miltenyi Biotec Technical Support.

Pump motor stalls during cell separation

Pump tubing is not inserted correctly, so the pump might be unable to rotate. In this case, the error shown in Figure 8.6 will appear on the screen.

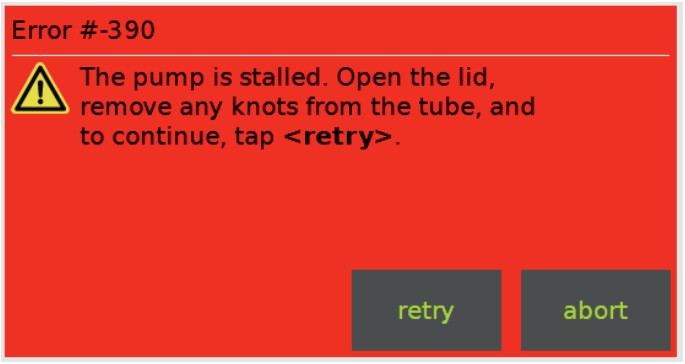


Figure 8.6: Error message no. 390

1. Carefully remove the pump tubing from the pump.
2. Remove any knots from the pump tubing and ensure that the tubing is not damaged by incorrect insertion.
    a. If the pump tubing is leaking, save the cells retained on the column by clamping the tubing above and below the separation column, then contact Miltenyi Biotec Technical Support.
    b. If the pump tubing is not damaged, it can be reinserted into the pump housing.
3. To continue with the separation, tap retry.

If the pump tubing is flat and collapsed, the separation column may be clogged. In this case, contact Miltenyi Biotec Technical Support.

Cell loading does not stop even though the Cell Preparation Bag and the pre-system filter are empty

The liquid sensor may not function correctly if the tubing surface inside the sensor is wet.

1. Tap pause to pause the separation.
2. Remove tubing from the liquid sensor.
3. Dry the tubing and the contact area using a lint-free cloth.
4. Reinsert the tubing into the liquid sensor and tap resume.

If the liquid sensor cannot be activated, skip cell loading and continue the separation by tapping Skip cell load > skip.

IMPORTANT:

- The Skip cell load function is not available for Depletion 3.1.
- Skipping the cell loading cannot be undone.

8.7.3 Unexpected events: Enrichment programs only

Run is aborted before completion of cell separation program

- Pump door opened: For safety reasons, the separation in progress will automatically stop if the pump door is opened during the instrument run. An error message appears on the screen (see Figure 8.7).

  Close the pump door and tap **retry**.

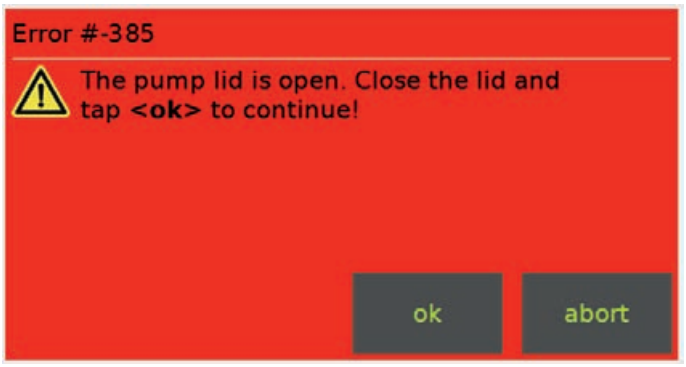


Figure 8.7: Error message no. 385

- Power failure: A power failure results in the termination of the CliniMACS Plus separation. Once terminated, the cell separation will not resume even if the power supply is restored. Recover as much of the cell product as possible from the tubing set by running the Emergency program (see section 'Emergency program (to be used with enrichment programs only)').

8.7.4 Unexpected events: CD34 Selection 1/2

Cell loading stopped before complete cell product is loaded onto the columns

The pre-system filter is clogged due to a large amount of cell debris or incomplete filling of the filter.

The continued pumping created a vacuum which led to the generation of air bubbles, thus triggering the liquid sensor. As a result, the separation process continued with the column washes before the complete cell product could be loaded. A part of the cell product remains in the Cell Preparation Bag after the separation is finished.

IMPORTANT:
It is not possible to restart the cell loading once the loading sequence has stopped.

1. Allow the CliniMACS Plus Instrument to finish the separation program. DO NOT abort the current run, as this may result in unnecessary cell loss.
2. After the separation procedure is finished, filter the remaining cell product with a 200 µm in-line blood filter and transfer it into a new transfer bag.
3. Immediately perform a second separation using a new tubing set and sufficient new buffer.

Pump tubing collapsed and/or excessive air appeared in tubing set below pre-column during cell loading

The pre-column is clogged due to large amount of cell debris in the Cell Preparation Bag.

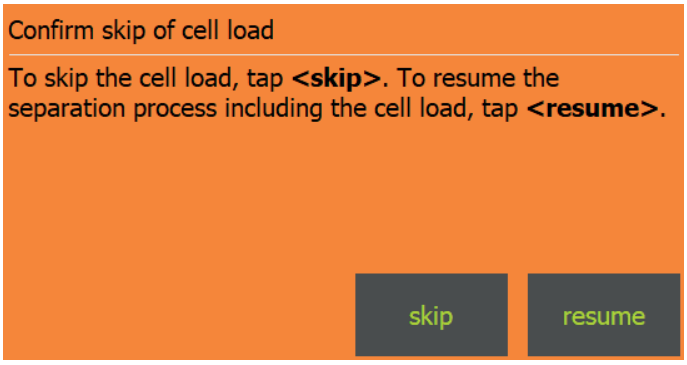
It is necessary to skip the loading of the remaining cell product manually and to continue the separation with the cells that have already been loaded onto the system.

IMPORTANT:
Skipping the cell loading cannot be undone.

1. To skip the cell loading process, tap **Skip cell load** on the right-hand side of the screen.

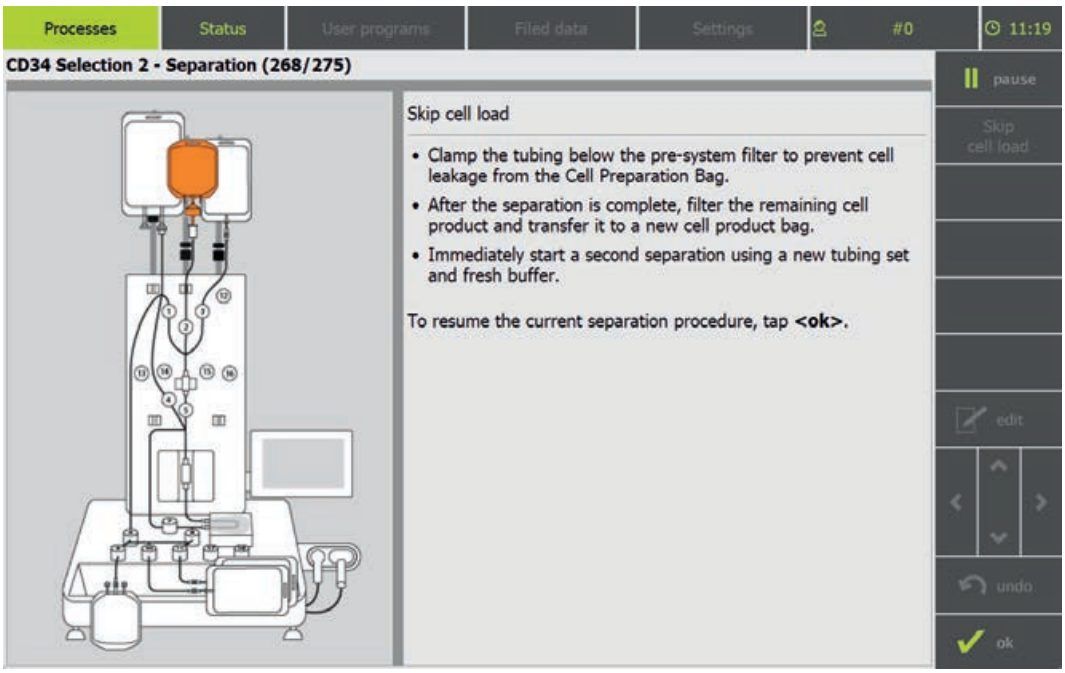


2. An orange pop-up window will appear for confirmation. To stop the cell loading and continue with the column washes, tap **skip**.



3. Clamp the tubing below the pre-system filter to prevent cells from leaking out of the Cell Preparation Bag into the tubing set.
4. After the separation procedure is finished, filter the remaining sample with a 200 µm in-line blood filter and transfer it into a new transfer bag.

5. Immediately perform a second separation with a new tubing set and sufficient new buffer.



8.7.5 Unexpected events: Enrichment 1.1

Cell loading stopped before complete cell product is loaded onto the columns

The pre-system filter is clogged due to a large amount of cell debris or incomplete filling of the filter.

The continued pumping created a vacuum which led to the generation of air bubbles, thus triggering the liquid sensor. As a result, the separation process continued with the column washes before the complete cell product could be loaded. A part of the cell product may remain in the Cell Preparation Bag after the separation is finished.

IMPORTANT:
It is not possible to restart the cell loading once the loading sequence has stopped.

1. Allow the CliniMACS Plus Instrument to finish the separation program. DO NOT abort the current run, as this may result in unnecessary cell loss.
2. Determine the total cell number, percentage of target cells, and the remaining cell product volume in the Cell Preparation Bag. Enter actual cell product parameters during the parameter input (Step 2).
3. After the separation procedure has been finished, filter the remaining cell product with a 200 µm in-line blood filter and transfer it into a new transfer bag.
4. Immediately perform a second separation with a new tubing set and sufficient new buffer.

Wrong cell product parameter values were entered

The entered cell product volume was lower than the actual volume in the attached Cell Preparation Bag.

1. Allow the CliniMACS Plus Instrument to finish the separation program. DO NOT abort the current run, as this may result in unnecessary cell loss.
2. Determine the total cell number, percentage of target cells, and the remaining cell product volume in the Cell Preparation Bag. Enter actual cell product parameters during the parameter input (Step 2).

3. Process remaining cell product with a new tubing set, a new pre-system filter, and sufficient new buffer.

Pump motor stalls during elution of target cells into Cell Collection Bag

The locking forceps next to the Cell Collection Bag is not open during the elution sequence. Therefore, the pathway to the Cell Collection Bag is blocked.

Tap **pause** and open the locking forceps next to the Cell Collection Bag. Open the pump door and check whether the pump tubing is inserted correctly. Close the pump door and tap **retry** to restart the elution sequence.

8.7.6 Unexpected events: Enrichment 3.2

Cell loading stopped before complete cell product is loaded onto the columns

The pre-system filter is clogged due to a large amount of cell debris or incomplete filling of the filter.
The continued pumping created a vacuum which led to the generation of air bubbles, thus triggering the liquid sensor. As a result, the separation process continued with the column washes before the complete cell product could be loaded. A part of the cell product remains in the Cell Preparation Bag after the separation is finished.

Allow the CliniMACS Plus Instrument to finish the separation program. Do not abort the current run, this may result in unnecessary cell loss.
After the separation procedure has been finished, filter the remaining sample with a 200 µm in-line blood filter and transfer it into a new transfer bag. Immediately perform a second separation with a new tubing set and sufficient new buffer.

Pump motor stalls during elution of target cells into Cell Collection Bag

The locking forceps next to the Cell Collection Bag is not open during the elution sequence. Therefore, the pathway to the Cell Collection Bag is blocked.

Tap **pause** and open the locking forceps next to the Cell Collection Bag. Open the pump door and check whether the pump tubing is inserted correctly. Close the pump door and tap **retry** to restart the elution sequence.

8.7.7 Unexpected events: Depletion 2.1

Target cells do not reach the Cell Collection Bag

Pump is unable to load the cell product from the Cell Preparation Bag because the clamp next to the Cell Collection Bag is not open during the cell loading sequence. Tap **pause** and open clamp next to Cell Collection Bag. Continue the depletion process by tapping **resume**.

1. Allow the CliniMACS Plus Instrument to finish the separation program. DO NOT abort current run, as this may result in unnecessary cell loss.
2. If a part of the cell product remains in the Cell Preparation Bag after the depletion procedure is finished, process the remaining cells with a new tubing set, a new pre system filter, and sufficient new buffer.
3. Determine the total cell number, percentage of labeled cells, and cell product volume. Enter actual cell product parameters during the parameter input (Step 2) and start the new depletion.

Cell loading stopped before complete cell product has been loaded onto the columns

Loading stopped before complete cell product has been loaded onto the columns

1. Abort the current run and check total cell number and depletion efficiency of the cells in the Cell Collection Bag. If necessary, process the remaining cell product with a new tubing set, a new pre-system filter and sufficient new buffer.
2. Determine the total cell number, percentage of labeled cells, and cell product volume. Enter actual cell product parameters during the set-up of the instrument (Step 2) and start the new depletion.

8.7.8 Unexpected events: Depletion 3.1

Cell loading stopped during Staged Cell Loading, before complete cell product has been loaded onto the columns

- Pre-system filter inserted wrong way around.
  The drip chamber function is not available and air bubbles may pass the liquid sensor directly causing the termination of the cell loading before the complete cell product has been applied. The instrument continues the depletion process by directly beginning the next step. It is not possible to restart the cell loading once it has stopped.
- Pre-system filter is clogged due to large amount of cell debris or due to incomplete filling of the filter.
  The continued pumping created a vacuum which led to the generation of air bubbles, thus triggering the liquid sensor. As a result, the separation process continued with the column washes before the complete cell product could be loaded. A part of the cell product may remain in the Cell Preparation Bag after the separation is finished.

1. Abort the current run and pool the contents of the Reapplication Bag and the Cell Preparation Bag.
2. Process the remaining cells with a new tubing set, a new pre-system filter, and sufficient new buffer.

Loading stopped during Sensitive Cell Loading (Sensitive Loading Stage)

The Reapplication Bag is hanging lower than the Cell Preparation Bag.

During the sensitive cell loading step, the Cell Preparation Bag runs empty before the Reapplication Bag volume is completely loaded. It is therefore possible that an air bubble triggers the liquid sensor before the cell product is completely loaded from the Reapplication Bag after the depletion procedure is finished.

IMPORTANT:
It is not possible to restart the cell loading once the loading sequence has stopped.

1. Allow the CliniMACS Plus Instrument to finish the separation program. DO NOT abort current run, as this may result in unnecessary cell loss.
2. Process the remaining cell product with a new tubing set, pre-system filter, and sufficient new buffer.
3. Determine the total cell number, percentage of labeled cells, and cell product loading volume.Enter actual cell product parameters during the parameter input (Step 2).
4. Consider the obligatory need of three large bag hangers for the program Depletion 3.1 and refer to installation instructions for appropriate bag heights (see Figure 7.114 in section 'CliniMACS Depletion Tubing Set').

Target cells (unlabeled cells) do not reach Reapplication Bag during Staged Cell Loading Bulk (Loading Stage)

Wrong tubing is inserted in valve 3 (right branch of Reapplication Bag tubing instead of left branch (Y-fitting) of tubing).

1. Tap **pause** and remove the wrong tubing from valve 3.
2. Manually insert the correct tubing (left branch of Reapplication Bag tubing) into valve 3 as described in the installation instructions.
3. To continue the depletion procedure, tap **resume**.
4. Allow the CliniMACS Plus Instrument to finish the separation program. DO NOT abort the current run, as this may result in unnecessary cell loss.
5. Check the depletion efficiency of the target fraction in the Cell Collection Bag. If the depletion efficiency is not sufficient, repeat the depletion procedure with a new tubing set, a new pre-system filter, and sufficient new buffer.
6. Determine the total cell number, percentage of labeled cells, and cell product loading volume. Enter actual cell product parameter values during parameter input (Step 2) and start the new depletion.

Cells flow into process buffer bag during gravimetric rinsing steps

Buffer bag is hanging too low (lower than Cell Preparation Bag).

1. Tap **pause** and adjust buffer bag hanger to correct position.
2. Ensure that three large bag hangers are installed for the program Depletion 3.1 and refer to installation instructions for appropriate bag heights (see Figure 7.114 in section 'CliniMACS Depletion Tubing Set').
3. If the cells have not reached the buffer bag, it is sufficient to manually open valves 1 and 2 to allow a short backflushing of cells into Cell Preparation Bag. After the buffer bag tubing is clear again, close valves 1 and 2 and tap **resume** to continue the depletion procedure.
4. If the cells have already reached the buffer bag, exchange the buffer bag, manually open valves 1 and 2 for a short flushing of the buffer bag tubing, and tap **resume** to continue with the depletion procedure. If necessary, process the remaining cell product in the buffer bag (if the volume exceeds 300 mL, transfer the cell product into a centrifugable bag for volume reduction first) using a new tubing set, a new pre-system filter, and sufficient new buffer.

Pump motor stalls during first elution of labeled cells into Non-Target Cell Bag

- Locking forceps has not been removed after integrity test.
  Tap **pause** and remove the locking forceps. Open the pump door and check whether the pump tubing is correctly inserted. Close the pump door and tap **resume** to restart elution sequence.
- Wrong tubing is inserted in valve 3 (Non-Target Cell Bag tubing instead of left branch (Y-fitting) of Reapplication Bag tubing).
  Tap **pause** and remove the Non-Target Cell Bag tubing from valve 3. Manually insert the correct tubing (left branch of Reapplication Bag tubing) into valve 3 as described in the installation instructions. Tap **resume** to restart elution sequence.

8.8 Cell separation performance

8.8.1 Unexpected events: Enrichment programs only

The yield of target cells is low

- Target cells were poorly labeled with the reagent:
  - Reagent is expired. Check the use-by date. DO NOT use any reagent after the use-by date.
  - Reagent was not stored properly. Check the storage temperature. DO NOT use any reagent that has been stored improperly (see instructions for use of the reagent).
  - Recommended labeling procedure has not been followed. Refer to cell product preparation and separation procedure sections in the user manual.
- Cells were lost during the preparation steps.
  - Cells were removed with the supernatant into Plasma Waste Bag and Wash Waste Bags due to incomplete sedimentation or too early resuspension of the cells, for example, when the bag was removed from the centrifuge. Compare leukocyte content of the unlabeled cell product and the labeled cell product. Check the centrifugation settings for proper centrifugation. Determine cell counts from all waste bags.
  - Buffer did not contain HSA. Supplement the buffer with HSA to a final concentration of 0.5% (w/v), (see section 'CliniMACS Materials required' of the respective application).
  - Centrifuge settings were suboptimal. Check the centrifugation settings.
  - Centrifuge imbalance or use of brake or asymmetrical loading of centrifuge.
- Analysis was incorrect.
  - Sampling error occurred. Check cell suspension for clumped or settled cells. Confirm that representative samples have been taken and repeat analysis.
  - Staining error occurred. Check flow cytometry reagents. Repeat staining.
  - Flow cytometer settings were improper. Check the instrument settings.

The purity of target cells is low.

- The cell product was stored inappropriately. Preparation and separation of the cell product should be performed immediately after leukapheresis. Keep the cell product at a leukocyte concentration of less than 0.2×10^9 per mL. If necessary, dilute the cell product with autologous plasma. The cell product should not be older than 24 hours when starting the labeling and separation procedure. If the cell product has to be stored, for example, overnight, it should be kept at controlled room temperature (+19 °C to +25 °C [+66 °F to +77 °F]).
- The magnetic labeling protocol has not been followed (for example, incorrect volumes during magnetic labeling). Follow the instructions given for the magnetic labeling (see Step 1 in the section of the respective application). For troubleshooting purposes, determine the leukocyte subsets (B cells, T cells, monocytes, granulocytes as well as platelets) contaminating the target cell fraction and contact Miltenyi Biotec Technical Support for advice.
- High numbers of granulocytes contaminated the start product (suboptimal apheresis setting). Dying granulocytes will then bind the CliniMACS Reagent non-specifically which may lead to decreased purity of the target cells.

- Valve malfunction occurred. Eluted target cell fraction has been contaminated by part of the non-target fraction or buffer waste fraction. Inspect the tubing placement within the valves to ensure proper functioning. Assess target cell content of the non-target cell fraction and buffer waste. If necessary, pool the target and non-target cell fraction, reduce to a suitable volume, and repeat the separation with a new tubing set and sufficient new buffer.

Non-specific retention of dead cells from cell product or high non-specific cell losses throughout the procedure

- Buffer does not contain HSA. Supplement the buffer with HSA to a final concentration of 0.5% (w/v), (see section 'CliniMACS Materials required' of the respective application).
- The cell product may have been stored inappropriately. The preparation and separation of the cell product should be performed immediately after leukapheresis. Keep the cell product at a leukocyte concentration of less than 0.2×10^9 per mL. If necessary, dilute the leukapheresis with autologous plasma. The cell product should not be older than 24 hours when starting the labeling and separation procedure. If the cell product has to be stored, for example, overnight, it should be kept at controlled room temperature (+19 °C to +25 °C [+66 °F to +77 °F]).
- Incomplete cell product loading due to clogging of separation column, pre-system filter, or pre-column. Check the total cell number and depletion efficiency of the remaining cells.

8.8.2 Unexpected events: CD34 Selection 1/2 and Enrichment 1.1

The purity of the target cells is low

Elution from the separation column was incomplete.

- Separation program was aborted. Check screen for error message. Continue with section 'Run is aborted before completion of cell separation program'.
- Pump failure or valve failure occured. Recover cells from the tubing set following the emergency program described in section 'Emergency program (to be used with enrichment programs only)'. Check volumes of all fractions. Assess target cell content of Buffer Waste Bag and Negative Fraction Bag.
- Tubing to Cell Collection Bag is blocked. Check tubing set for closed clamps, occlusions or kinks.
- Capacity of reagent and/or tubing set was exceeded. Refer to capacity limit of the relevant application.
- Tubing is not properly inserted. Check all valves for proper tubing insertion.

8.8.3 Unexpected events: CD34 Selection 1/2

The purity of the target cells is low

Non-target cells were retained.

- Mobilization of target cells was poor. Very low number of target cells has occurred. Therefore, a low number of contaminating non-target cells (for example, granulocytes, monocytes, platelets) may lead to decreased purity.
- Insufficient plasma or immunoglobulins were present during magnetic labeling. Follow the instructions given for the magnetic labeling (see Step 1 of the respective application).
  If a final concentration of about 30% autologous plasma in the cell product during magnetic labeling cannot be guaranteed, add immunoglobulin to the cell product. A final concentration of 1.5 mg/mL is recommended for the efficient blocking of non-specific reagent binding during magnetic labeling.

8.8.4 Unexpected events: Enrichment 1.1

The yield of the target cells is low

Incorrect cell product parameter input. Cross-check the parameter input with the analysis results.

8.8.5 Unexpected events: Depletion 2.1 and Depletion 3.1

The depletion efficiency is low

If the depletion efficiency is insufficient, process the remaining cell product with a new tubing set and sufficient new buffer. A new labeling of the cells to be depleted should be considered. Determine the cell count and percentage of cells to be depleted and enter actual sample parameters during set-up of the instrument (Step 2). If visible clumps occur, it may be helpful to filter the cells prior to a new run. Consider that cells may be lost due to clumping and additional filtration.

- Capacity of reagent and/or tubing set was exceeded. Refer to capacity limit of the relevant application.
- Incorrect determination of cells to be labeled by the reagent.
- Incorrect cell product parameter input. Cross-check the parameter input with the analysis results.
- Reduced viability of the cells. Dead cells can bind non-specifically to separation column thereby reducing the labeling capacity of the column, potentially resulting in lower depletion efficiency. Ensure better cell product quality and process product as fresh as possible. Stored products that are older than 24 hours should not be used. If storage is necessary, cell product should be kept at controlled room temperature (+19 °C to +25 °C [+66 °F to +77 °F]). The cell concentration should not exceed 0.2×10^9/mL. If necessary, dilute the cell product with autologous plasma to achieve optimal cell concentration.

9

Legal notes

9.1 Limited warranty

Except as stated in a specific warranty statement, which may accompany this Miltenyi Biotec product, or unless otherwise agreed in writing by a duly authorized Miltenyi Biotec representative, Miltenyi Biotec's warranty for products purchased directly from Miltenyi Biotec shall be subject to the terms and conditions of sale under which it was provided to you by the respective Miltenyi Biotec sales organization. These terms and conditions are available on request or at www.miltenyibiotec.com. The applicable terms and conditions of sale may vary by country and region. Nothing herein should be construed as constituting an additional warranty.

For products purchased from third-party retailers or resellers (e.g., purchased from an Authorized Distributor of Miltenyi Biotec), different terms and conditions may apply.

To determine the warranty that came with your product, see your packing slip, invoice, receipt or other sales documentation. Some components of a product combination you purchased may have a shorter warranty than that listed on your packing slip, invoice, receipt or other sales documentation (e.g., goods subject to shelf life and obsolescence).

Miltenyi Biotec's warranty for this product only covers product issues caused by defects in material or workmanship during normal use. It does not cover product issues caused by any other reason, including but not limited to product issues due to use of the product in a manner other than specifically described in this manual, for example: inappropriate or improper use; incorrect assembly or installation by an operator or a third-party; reasonable wear and tear; negligent or incorrect operation, handling, storage, servicing, or maintenance; non-adherence to the operating instructions; unauthorized modification of or to any part of this product; or use of inappropriate consumables, accessories, or work materials.

Miltenyi Biotec's warranty does not cover products sold AS IS or WITH ALL FAULTS or consumables. Nothing herein should be construed as constituting an additional warranty.

Miltenyi Biotec must be informed immediately if a claim is made under such warranty. If a material or manufacturing defect occurs within the warranty period Miltenyi Biotec will take the appropriate steps to restore the full usability of the instrument.

Limitation on damages

Miltenyi Biotec shall not be liable for any incidental or consequential damages for breach of any express or implied warranty or condition on this product.

Some countries/states or jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty statement gives you specific legal rights and you may have other rights, which vary from state to state or jurisdiction to jurisdiction.

9.2 Trademarks

CliniMACS, MACS, MACSmix, the Miltenyi Biotec logo, and MiniMACS are registered trademarks or trademarks of Miltenyi Biotec B.V. & Co. KG and/or its affiliates in various countries worldwide. All other trademarks mentioned in this document are the property of their respective owners and are used for identification purposes only.

10

Glossary

10.1 Glossary of symbols

An overview of symbols used for the CliniMACS Plus System is provided in the CliniMACS Plus Instrument user manual. The glossary of symbols depicts the symbols used in the user manuals and labeling of the CliniMACS Products.

10.2 Glossary of terms

Apheresis	The method of collecting blood in which whole blood is withdrawn, a desired component selected and retained, and the remainder of the blood returned to the donor
Anti-biotin antibody	This antibody recognizes cells which have previously been labeled with an appropriate biotinylated antibody or ligand
Bag compartment	Compartment of the CliniMACS Plus Instrument in which the Negative Fraction Bag and Buffer Waste Bag are placed
Bag hanger	Support on the CliniMACS Plus Instrument to mount the Cell Preparation Bag, Non-Target Cell Bag, Priming Waste Bag, Reapplication Bag, and buffer bag
BDCA	Blood Dendritic Cell Antigen
Buffer Waste Bag	Waste bag to collect buffer during cell separation using the CliniMACS Plus Instrument
CD1c (BDCA-1) antigen	CD1c is part of a CD1 gene cluster that is believed to be related to the MHC. The CD1 genes are clustered within a 170 000 bp region of human chromosome 1q23.1. The proteins encoded therein (CD1a-e) are expressed as heterodimers composed of CD1 heavy chain non-covalently paired with ß2-microglobulin. CD1c is involved in antigen presentation of microbial glycolipids or lipopeptide antigens to T lymphocytes. In human peripheral blood, CD1c (BDCA-1) is expressed on myeloid dendritic cells type-1 (MDC1) and on a subset of B lymphocytes. They can be found in lymph node, mantle zones and, germinal centers, in marginal zone of spleen, and in fetal and adult human peripheral blood

CD3 antigen	The CD3 antigen is present on mature human T cells, thymocytes, and a subset of NK cells. It is associated with the T cell receptor (TCR) and is responsible for the signal transduction of the TCR. The CD3 antigen is a complex of five invariable chains: γ, δ, ε, ζ and η. The CD3 antibody recognizes all T cells, i.e. it reacts with 70-80% of human peripheral blood lymphocytes and with 65- 85% of thymocytes. The epitope recognized by the antibody is located on the ε-chain of the CD3 complex
CD4 antigen	The CD4 antigen is expressed on most thymocytes and approximately two-thirds of peripheral blood T cells; it is also expressed on monocytes and macrophages. CD4 is an accessory molecule in the recognition of foreign antigens in association with MHC class II. Additionally, CD4 is a receptor for HIV-1
CD8 antigen	The CD8 antigen is a disulfide-linked dimer, which exists either as a CD8 α homodimer or as a CD8 α/β heterodimer. CD8 is strongly expressed on CD8 positive T cells and thymocytes and on a subset of NK cells and CD8 positive γ/δ T cells. CD8 acts as a co-receptor with MHC class I-restricted T cell receptors in antigen recognition
CD19 antigen	The CD19 antigen is a critical signal transduction molecule that regulates B lymphocyte development, activation, and differentiation. As a B cell lineage marker, CD19 is expressed from the early pro-B cell stage to the B cell lymphoblast stage but the expression is downregulated upon B cell maturation to plasma cells. The CD19 antigen is further expressed on most malignant B cells and a subset of follicular dendritic cells
CD25 antigen	The CD25 antigen, the low affinity interleukin-2 receptor alpha chain (IL-2Rα), is expressed on activated T and B cells, NK cells, and monocytes, as well as on regulatory CD4 positive T cells. The CD25 antigen shows three epitope regions A, B, and C. The antibody of the CliniMACS CD25 Reagent recognizes epitope A of the CD25 molecule
CD34 antigen	The CD34 antigen is a highly glycosylated 115 kDa type 1 integral membrane protein of unknown function which is expressed on 1% to 4% of normal bone marrow cells and less than 0.2% of normal peripheral blood leukocytes, on subsets of bone marrow stromal cells, and on small vessel endothelium of various tissues
CD45RA antigen	The CD45RA antigen is expressed on naive CD4 and CD8 positive T cells, as well as on subsets of B cells, NK cells, and monocytes. It is an isoform of the common leukocyte antigen CD45, a transmembrane protein tyrosine phosphatase
CD56 antigen	The CD56 antigen is a member of the NCAM-family (Neural Cell Adhesion Molecule-family) which is expressed within the hematopoietic system on NK, NKT cells
CD304 (BDCA-4) antigen	The CD304 (BDCA-4) antigen is a 130-140 kDa cell surface glycoprotein expressed in fresh blood and bone marrow exclusively on plasmacytoid dendritic cells
Cell Collection Bag	Bag in which the purified target cells are accumulated after separation

Cell Preparation Bag	Bag into which cell product is transferred and in which magnetic labeling and washing of cells are performed
CliniMACS Anti-Biotin Reagent	Reagent for magnetic labeling of cells primarily labeled with biotinylated antibodies or ligands
CliniMACS CD1c Biotin (BDCA-1)	Biotinylated antibody for labeling of human cells expressing the CD1c (BDCA-1) antigen prior to the magnetic labeling with the CliniMACS Anti-Biotin Reagent
CliniMACS CD3 Reagent	Reagent for magnetic labeling of cells expressing the CD3 antigen
CliniMACS CD4 Reagent	Reagent for magnetic labeling of cells expressing the CD4 antigen
CliniMACS CD8 Reagent	Reagent for magnetic labeling of cells expressing the CD8 antigen
CliniMACS CD19 Reagent	Reagent for magnetic labeling of cells expressing the CD19 antigen
CliniMACS CD25 Reagent	Reagent for magnetic labeling of cells expressing the CD25 antigen
CliniMACS CD34 Reagent	Reagent for magnetic labeling of cells expressing the CD34 antigen
CliniMACS CD45RA Reagent	Reagent for magnetic labeling of cells expressing the CD45RA antigen
CliniMACS CD56 Reagent	Reagent for magnetic labeling of cells expressing the CD56 antigen
CliniMACS CD304 (BDCA-4) Reagent	Reagent for magnetic labeling of cells expressing the CD304 (BDCA-4) antigen
CliniMACS Cytokine Capture System (IFN-gamma)	Combination of reagents, consisting of the CliniMACS IFN-gamma Catchmatrix Reagent and the CliniMACS IFN-gamma Enrichment Reagent. With the CliniMACS Cytokine Capture System (IFN-gamma), IFN-gamma secreting cells can be enriched after in vitro restimulation
CliniMACS Depletion Tubing Set	Set of tubing, connectors, columns, and bags through which the magnetically labeled cell suspension is processed and in which the magnetic cell separation takes place, especially designed for the specific depletion needs
CliniMACS IFN-gamma Catchmatrix Reagent	Component of the CliniMACS Cytokine Capture System (IFNgamma) for surface labeling leukocytes with IFN-gamma specific antibodies
CliniMACS IFN-gamma Enrichment Reagent	Component of the CliniMACS Cytokine Capture System (IFNgamma) for magnetic labeling of IFN-gamma bound to the CliniMACS IFN-gamma Catchmatrix Reagent on the IFN-gamma secreting cells
CliniMACS PBS/EDTA Buffer	Buffer used for cell preparation and cell separation with the CliniMACS Plus System: PBS (phosphate buffered saline), supplemented with 1 mM EDTA, pH 7.2. Before use, CliniMACS PBS/EDTA Buffer must be supplemented with pharmaceutical grade HSA to a final concentration of 0.5% (weight/volume, i.e., 5 g HSA per liter buffer)
CliniMACS Plus Instrument	Magnetic cell separation instrument based on the MACS Technology
CliniMACS TCRα/β-Biotin	Biotinylated antibody for labeling of human cells expressing the TCRα/β antigen prior to the magnetic labeling with the CliniMACS Anti-Biotin Reagent

CliniMACS Tubing Set, CliniMACS Tubing Set LS	Set of tubing, connectors, columns, and bags through which the magnetically labeled cell suspension is processed and in which the magnetic cell separation takes place
EDTA	Ethylene-diamine-tetra-acetic acid
×g	Multiples of the earth's gravitational acceleration
Hematopoietic progenitor cells	Progenitor cells of lymphoid, myeloid, and erythroid lineages
HSA	Human serum albumin
Human serum albumin	Pharmaceutical grade HSA approved in the country of the user is necessary as a buffer supplement when used with the CliniMACS Plus System
IgG	Immunoglobulin G
In-bag procedure	Sterile processing and transferring the cells in the closed environment of transfer bags
Labeling	Reaction of cells with magnetic labeling reagent, e.g., CliniMACS CD34 Reagent to CD34-positive cells
Leukapheresis	Apheresis collecting leukocytes
Liquid sensor	Component of the CliniMACS Plus Instrument that detects liquid in the tubing
Luer connector	Screw coupling, part of the tubing set
Luer/Spike Interconnector	Transfer set with piercing pin (spike) and syringe adapter (female luer) for plasma or fluids
Magnetic antibody	A super-paramagnetically labeled antibody
MACS TubeSealer	Heat sealer used for sealing PVC and EVA tubes of the tubing sets installed on the instrument
MDC	Myeloid dendritic cells
Monoclonal antibodies	A single type of antibody that is directed against a specific epitope (antigen, antigenic determinant) and is produced by a single clone of B cells or a single hybridoma cell line, which is formed by the fusion of a lymphocyte cell with a myeloma cell. Some myeloma cells synthesize single antibodies naturally
Negative Fraction Bag	Bag of the CliniMACS Tubing Set and CliniMACS Tubing Set LS containing the non-target cell fraction
Non-Target Cell Bag	Bag of the CliniMACS Depletion Tubing Set containing the non-target cell fraction
Orbital rotator	Device used to mix cell product during the reaction with CliniMACS Reagents
PBMC	Peripheral Blood Mononuclear Cell
Peristaltic pump	Tubing pump used in the CliniMACS Plus Instrument to control the flow rate of fluid in the tubing set

Plasma extractor	Device used to extract liquid from the Cell Preparation Bag after cell washing
Plasma transfer set	Transfer set with two piercing pins (spikes) for plasma or fluids
Plasma Waste Bag	Waste bag to collect excess plasma prior to the labeling procedure
Pre-column	First column in the CliniMACS Tubing Set and the CliniMACS Tubing Set LS, serves as filter to trap cells having non-specific interactions with the column matrix
Pre-column holder	Support mounted on the CliniMACS Plus Instrument that holds the pre-column in place
Pre-system filter	40 µm filter device between Cell Preparation Bag and precolumn used to trap clumps and cell debris
Priming	Step prior to cell separation in which buffer is flushed through the tubing set
Priming Waste Bag	Bag in which buffer from priming step is collected
Pump safety switch	Sensor that prevents pump operation when the pump door is open
Reapplication Bag	Bag of the CliniMACS Depletion Tubing Set in which the unlabeled cells are collected temporarily during the separation. The unlabeled cells from the Reapplication Bag are applicated onto the separation column twice, to ensure high purity of the target cells
Retaining ring	Part of a tubing set that enables the pump tubing to remain in its proper location
rpm	Revolutions per minute
Sampling site coupler	Injection port, e.g., for removal of samples or addition of CliniMACS Reagents to the Cell Preparation Bag
Separation column	Column in which magnetically labeled cells are separated when exposed to the magnetic field
Separation column holder	Molded guides in the magnet housing that holds the separation column in place
Separation program	Software program designed for the enrichment or depletion of magnetically labeled cell subsets from a mixed cell population. Choose from a menu of separation programs depending on the intended separation
Separation reagent	Reagent for magnetic labeling of cells, e.g., CliniMACS CD34 Reagent
T-fitting	T-shaped fitting on a tubing set where three tubing meet
TCRα/β antigen	The TCRα/β is the T cell receptor heterodimer composed of two transmembrane glycoprotein chains, α and β. Both chains are members of the Ig superfamily and consist of a constant and a polymorphic variable region. The variable region of the TCRα/β is involved in recognition of antigenic peptides presented by the MHC complex of antigen presenting cells. The TCRα/β antigen is expressed on the majority of peripheral blood T cells

Transfer bag	Bag with a tubing and a spike at the end
Wash Waste Bag	Collection bag in which the wash supernatant is collected by separation from the sedimented cell suspension after centrifugation steps during sample preparation
WBC	White blood cells
Starting cell product	Cell-containing product used as starting material for the CliniMACS Plus separation process, e.g., leukapheresis harvest, PBMCs, or bone marrow

Miltenyi Biotec

Germany/Austria
Miltenyi Biotec B.V. & Co. KG
Friedrich-Ebert-Straße 68
51429 Bergisch Gladbach
Germany
+49 2204 8306-0
+49 2204 85197
macsde@miltenyi.com

USA/Canada
Miltenyi Biotec, Inc.
1201 Clopper Road
Gaithersburg, MD 20878
USA
800 FOR MACS
+1 866 811 4466
+1 877 591 1060
macsus@miltenyi.com

Australia
Miltenyi Biotec Australia Pty. Ltd.
Unit 11, 2 Eden Park Drive
Macquarie Park NSW 2113
Australia
+61 2 8877 7400
+61 2 9889 5044
macsau@miltenyi.com

Benelux
Miltenyi Biotec B.V.
Dellaertweg 9C
2316 WZ Leiden
The Netherlands
macsnl@miltenyi.com
Customer service for:
The Netherlands
0800 4020120
0800 4020100
Belgium
0800 94016
0800 99626
Luxembourg
800 24971
800 24984

China
Miltenyi Biotec Technology & Trading (Shanghai) Co., Ltd.
Room A401, 4/F
No. 1077, Zhangheng Road
Pudong New Area
201203 Shanghai
P.R. China
+86 21 6084 0210
+86 21 6235 0953
macscn@miltenyi.com.cn

France
Miltenyi Biotec SAS
10 rue Mercoeur
75011 Paris
France
+33 1 56 98 16 16
macsfr@miltenyi.com

Hong Kong
Miltenyi Biotec Hong Kong Ltd.
Unit 301, Lakeside 1
No. 8 Science Park West Avenue
Hong Kong Science Park
Pak Shek Kok, New Territories
Hong Kong
+852 3751 6698
+852 3619 5772
macshk@miltenyi.com.hk

India
Miltenyi Biotec India Pvt. Ltd.
Vatika Business Centre,
Floor No. 6
Divya Sree Omega
Kondapur, Serilingampally
K.V. Rangareddy
Telangana 500084
India
+91 040 45175910
macsin@miltenyi.com

Italy
Miltenyi Biotec S.r.l.
Via Paolo Nanni Costa, 30
40133 Bologna
Italy
+39 051 6460 411
+39 051 6460 499
macsit@miltenyi.com

Japan
Miltenyi Biotec K.K.
NEX-Eitai Building 5F
16-10 Fuyuki, Koto-ku
Tokyo 135-0041
Japan
+81 3 5646 8910
+81 3 5646 8911
macsjp@miltenyi.com

Nordics and Baltics
Miltenyi Biotec Norden AB
Medicon Village
Scheeletorget 1
223 81 Lund
Sweden
macsse@miltenyi.com
Customer service for:
Sweden
0200 111 800
+46 280 72 99
Denmark
80 20 30 10
+46 46 280 72 99
Norway, Finland, Iceland, and Baltic countries
+46 46 280 72 80
+46 46 280 72 99

Singapore
Miltenyi Biotec Asia Pacific Pte Ltd.
438B Alexandra Road, Block B
Alexandra Technopark
#06-01
Singapore 119968
+65 6238 8183
+65 6238 0302
macssg@miltenyi.com

South Korea
Miltenyi Biotec Korea Co., Ltd.
Donggeuk 7F
562 Nonhyeon-ro
Gangnam-gu
Seoul 06136
South Korea
+82 2 555 1988
+82 2 555 8890
macskr@miltenyi.com

Spain
Miltenyi Biotec S.L.
C/Virgilio 2, Edificio II, Planta –1
28223 Pozuelo de Alarcón, Madrid
Spain
+34 91 512 12 90
+34 91 512 12 91
macses@miltenyi.com

Switzerland
Miltenyi Biotec Swiss AG
Soodstrasse 52
8134 Adliswil
Switzerland
+41 32 623 08 47
+49 2204 85197
macsch@miltenyi.com

United Kingdom
Miltenyi Biotec Ltd.
Almac House, Church Lane
Bisley, Surrey GU24 9DR
United Kingdom
+44 1483 799 800
+44 1483 799 811
macsuk@miltenyi.com

www.miltenyibiotec.com

Miltenyi Biotec provides products and services worldwide. Visit **www.miltenyibiotec.com/local** to find the nearest Miltenyi Biotec contact.

210-006-209/01 | Issued: 2026-10