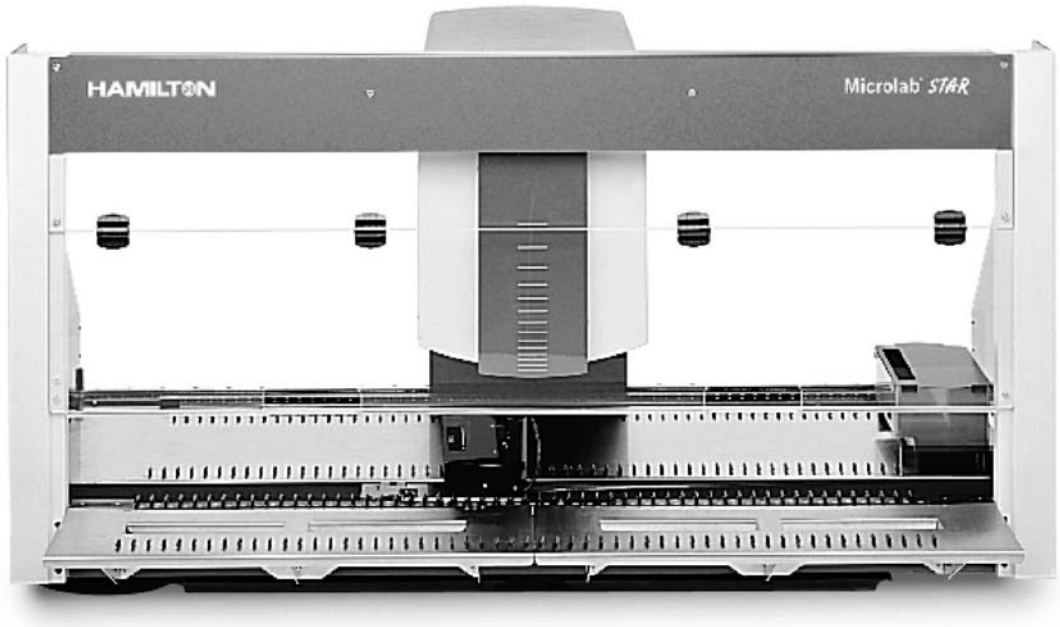
Service Manual

Microlab® STAR



P/N 610 754 / 00

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-
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Table of Contents

1 Introduction

1.1 General Information

This Service Manual is a field service guide and is to be used only by Service Technicians trained and / or authorized by HAMILTON Bonaduz AG.

Repaired units must meet the quality standards set by HAMILTON Bonaduz AG.

No part of this manual may be copied or handed on to a third party. Owners of Service Manuals are registered and only they will be issued with update information such as Service Manual Updates and Service Bulletins.

Attention: You should read User Manual Chapter 1 "General Information" before repairing or servicing the system.

Attention: Never lift a fully assembled instrument (with carriers, racks, etc.) from one work bench to another. First lock pipetting Arm X-movement and channels by using protective covers from packaging.

Check instrument for level position and adjustments after placing on the new work bench.

Attention: Good laboratory practice (GLP) is a must. Protect yourself before working on the Microlab® STAR Instrument - wear safety gloves. Ensure that, where applicable, decontamination has been carried out.

Attention: Be aware of moving Parts inside the Microlab Star Instruments e.g. when ever working inside the Instrument, e.g. if not all covers are closed and the Instrument has to be operated, e.g. via service software.

1.1.1 ML STAR

Descriptions in this Manual often refer to Microlab® STAR instrument with Autoload Option. Disregard such references if the instrument to be serviced is a Manual Load Microlab® STAR.

1.1.2 ML STAR IVD

Additional Information for the Microlab® STAR IVD instrument will be found in each chapter where components, procedures are different from or additional to the basic Microlab® STAR instrument.

However, since the ML STAR IVD is not yet on the market at the time of writing, further changes must be expected.

Once the ML STAR IVD is available, there will be a Service Manual update as well.

1.1.3 ML STAR Extensions

By “Extensions” we mean assemblies such as the Temperatured-Controlled Carrier, Wash Station and iSwap. These components may ordered as an option, or later on as update kits, when there is a need to upgrade an existing ML STAR Instrument in the field.

1.1.4 Description of text icons for special notes

"Attention" notes are included in this manual to emphasize important and critical instructions. They are accompanied by an exclamation mark symbol above the notes and are printed in italics. Here is an example:

Attention: All special problems, warnings or important text will be accompanied by this symbol at the appropriate point in the manual.

Items marked **Note** or **Hint** provide useful additional information. Carefully read these text items as you will find them important for understanding the topic or command in question.

1.2 Structure of this Manual

This Service Manual contains all that the Service Technician requires in order to carry out regular servicing of the Microlab® STAR instrument, and repairs as and when required.

It consists of 12 chapters:

Chapter 1 Introduction

Chapter 2 Microlab® STAR Instrument

Chapter 3 Service Software

Chapter 4 Installation of the instrument

Chapter 5 Disassembly

Chapter 6 Adjustment and Calibration

Chapter 7 Components

Chapter 8 Electronics

Chapter 9 Maintenance

Chapter 10 Troubleshooting and Error Handling

Chapter 11 ML STAR Extensions

Chapter 12 Appendices

- Chapter 1 serves as an introduction to the manual as a whole.
- Chapter 2 serves as an introduction to the Microlab® STAR instrument.
- Chapters 3-10 contain the servicing instructions.
- Chapter 11 contains the servicing instructions for the Temperature-Controlled Carrier, Wash Station and iSwap.
- Chapter 12 contains all appendices.

1.3 Service Manual Updates

As the instrument or parts of the instrument are constantly being improved, this Service Manual will be updated regularly. Each Service Technician will be sent update sets and is responsible for keeping his Service Manual up to date.

Necessary instructions on how to do this will be included in the update set. On receipt of an update, follow the instructions on the cover page and then file the cover page in the appropriate section.

1.4 Service News

Service news are sent to inform the Service Technician of new developments without delay. File the service news in the appropriate section of the Service Manual.

1.4.1 Upgrades

Will be announced via Service News. Basically all information will be found in Service News. After replacing / upgrading of any component refer to section 6.9.3 Verification after replacement, or remounting on page 6-48.

1.4.1.1 Firmware upgrade

Refer to section 1.6.6 Updates on page 1-7.

1.4.1.2 Service Software upgrade

Refer to section 3.1.1 How to Install the Service Software on page 3-1 and section 3.4 Deinstallation of Service Software on page 3-7.

1.4.1.3 User Software upgrade

Refer to section 4.2.4.1 User Software Installation on page 4-14 and section 5.2.7 User Software Deinstallation on page 5-13.

1.5 Manuals Overview

1.5.1 User Manual P/N 610766

The basic reference for the user is the *Microlab® STAR User Manual*. It contains all the information required to operate the instrument, to carry out routine maintenance and to solve the more straightforward problems the user may encounter when operating the instrument.

The *Microlab® STAR User Manual* describes the software used to operate the Instrument. In the *User Manual* will also be found instructions on how to create and run methods.

1.5.2 Operators Manual P/N 610889

For ML STAR IVD Instruments only

1.5.3 Programmers Guide P/N 610888

For ML STAR IVD Instruments only

1.5.4 Service Manual P/N 610754

The basic reference for the Service Technician is the present volume, the *Microlab® STAR Service Manual*.

1.5.5 Firmware Reference Guides

The *Firmware Reference Guide* lists all the commands that can be sent to the firmware of the instrument and lists all the status messages that the firmware returns for a particular module. Firmware commands are used when sending a single instruction to the instrument rather than the series of instructions which constitutes a method. The knowledge of firmware commands is therefore very useful for the Service Technician when testing particular aspects of an instrument‘s performance.

Note: This documentation is not included as an appendix to the present volume. It will be distributed during ML STAR Service Training Courses. Service Technicians trained and / or authorized by HAMILTON Bonaduz AG may request it from Technical Support at Hamilton Bonaduz.

Copies of Firmware reference guides may be filed in Section 12.4.3 Firmware Reference Guides on page 12-19 ff.

1.5.6 Verification Reference Guide

This guide accompanies the Verification Kit, which provides the means to verify instrument function against specific acceptance criteria.

1.6 Software Overview

1.6.1 User Software P/N 911004

This is the software operated by the user when running methods on Microlab Star Instrument.

1.6.2 User Software for Microlab STAR IVD P/N 911039

This is the software operated by the user only when running methods on Microlab Star IVD Instrument.

1.6.3 Service Software P/N 911003

This is the software operated by the Service Technician when testing components of Microlab Star.

1.6.4 Firmware

This is the software stored on ML STAR's Master, Pipetting Channel, Autoload and any Extensions PCB which executes commands sent by the User and Service Software.

Note: For example, Firmware Version 1.9 contains:

File Name	Module	Firmware Address	Version
• GRUALS16.ACH	• Autoload	• AL	• 1.6S
• GRUC0S18.ACH	• Master	• C0	• 1.8S
• GRUPXS17.ACH	• Pipetting Channel	• PX	• 1.7S
• GRUR0S10.ACH	• iSwap	• R0	• 1.0S
• GRUTXS10.ACH	• Temperature-controlled Carrier	• TX	• 1.0S
• GRUWXS13.ACH	• Wash Station	• WX	• 1.3S

1.6.5 Adjustment Macro Programs

These are software programs accompanying the Service Software which help you to adjust the ML STAR Instrument.

1.6.6 Updates

Firmware updates as well as new Adjustment Macro Programs will sent to all Service Technicians registered with HAMILTON.

See the instructions accompanying the Firmware files.

1.7 Service Plan

The Microlab® STAR instrument is installed by the Service Technician according to the instructions in this Service Manual. The user is instructed to maintain the instrument on a regular basis; this maintenance consists largely of surface cleaning and does not require opening up the instrument (i.e. any unscrewing, removing deck, covers etc.).

The Microlab® STAR user is responsible for changing consumable parts (disposable tips, needles, waste bag etc.). Spare parts (PCBs, cables, channels etc.) are generally changed by the Service Technician.

The Service Technician will need to service the instrument in the field at least twice a year (every 6 months). In addition, the Service Technician may be called on by the user to repair a damaged component of the instrument or to resolve a functional problem which the user cannot resolve himself (such as adjusting and calibrating the pipetting channels).

1.8 Part Return Tag

The part return tag has following functions:

- Page 1: part identification, reason for return and description of problem
- Page 2: decontamination declaration (where required).

1.8.1 Return Goods Authorization

Parts of instruments may only be returned to HAMILTON Bonaduz AG with a Return Goods Authorization (RGA).

Ask the Hamilton Order Processing Dept. (OPD) for an RGA number prior to sending any material. This number must be entered in the appropriate blank on the part return tag.

A completed part return tag must be attached to all parts or instruments which are returned to HAMILTON Bonaduz AG. Tags may be ordered free of charge from Hamilton: P/N 612554. See Appendix on page 12-16.

HAMILTON Bonaduz AG reserves the right to refuse any returned parts or instruments which may pose a health hazard due to contamination, and to charge the customer for any expenses incurred.

Please ensure that the tag is filled in correctly. Describe the problem as precisely as possible. Attach all information available such as trace files and technical data for investigation. Either a printout (hardcopy) or files on floppy disc are suitable.

1.9 Feedback

Information from the field is a determining factor for improving Hamilton products. Communicate your observations to Hamilton Bonaduz AG so that we may continue to provide a quality product and service.

Our Hotline will support you on any problems you may encounter.

1.10 Contacting Hamilton

Europe, Africa and Asia:

Hamilton Bonaduz AG
Technical Support
P.O. Box 26
CH-7402 Bonaduz / Switzerland

Phone	+41 81 660 60 60
Fax	+41 81 660 60 70
Hotline	+41 81 660 60 50

E-mail itechsupport@hamilton.ch

Americas, Far East and Pacific Rim:

Hamilton Company
P.O. Box 10030
Reno, NV 89520-0012 USA

Toll Free	+1 (800) 648-5950
Phone	+1 (775) 858-3000
Fax	+1 (775) 856-7259

E-mail tech@hamiltoncompany.com

2 Microlab® STAR Instrument

2.1 Overview

The Microlab® STAR is a **S**equential **T**ransfer and **A**liquoting **R**obot and performs pipetting operations on liquids in containers on the work surface.

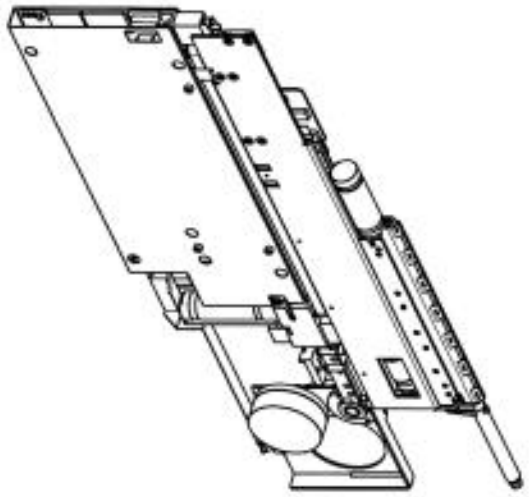
Movable carriers, holding reagent containers, e.g. tubes, microtiter plates, or any other kind of laboratory material are placed on the deck (work surface).

The work surface is divided into 54 tracks (T) of equal width for the purpose of loading carriers. This means the deck has partitions for a maximum of 54 specialized 1-T carriers for sample tubes, or a maximum of 9 6-T carriers for microtiter plates, or a mixture of both. An additional partition is provided for the tip waste station.

The Microlab® STAR is equipped with a pipetting arm containing typically 4, 8, 12 or 16 pipetting channels which work independently. The pipetting arm moves in X-direction, whereas each pipetting channel can move relatively independently both in a Y- and a Z-direction. The Microlab® STAR supports pipetting with disposable tips or with needles.

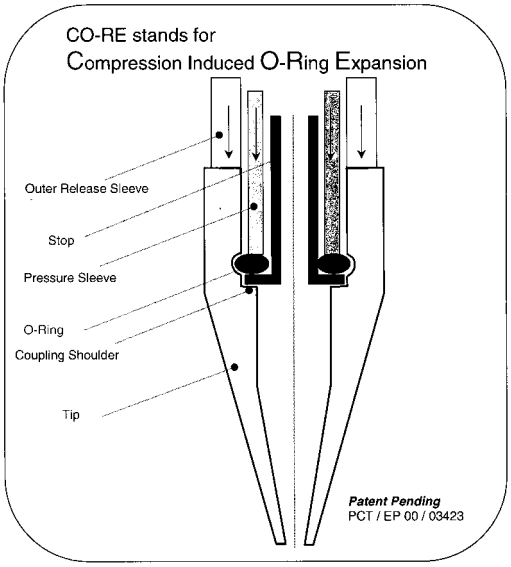
2.1.1 Key Features

Pipetting Channels



- Monitored air displacement
- (No tubing, no system liquid, no pumps)
- Independent pipetting heads with CO-RE (Compression-induced O-Ring Expansion) technology
- Independent Y, Z, volume, and LLD for each pipetting head

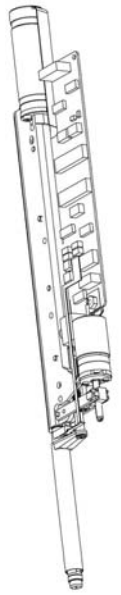
CO-RE Technology



- Tips and needles on the same pipetting head
- Flexible use of tips and needles during the same run
- 300 µl channel:
  low- and standard-volume tips or needles
  when volumes < 5 µl must pipetted.
- 1000 µl channel:
  standard- and high-volume tips or needles
  when volumes > 5 µl must pipetted.
- Soft tip drop-off (minimized aerosol)

Key Features (continued)

Pipetting Heads

	• Pressure and capacitive Liquid Level Detection
	• Totally accessible deck (each head → each well for an 8-channel ML STAR Instrument)
	• Aspiration monitoring
	• 2 types of pipetting heads are available:
	  • 300 µl (0.5-300 µl)
	  and
	  • 1000 µl (5-1000 µl)

Tips and Needles

The types of tips and needles currently available are:

10, 300 and 1000 µl disposable tips with or without filter

and

50, 300 and 1000 µl washable steel needles

For ordering refer to *User Manual*.

General Precautions:

The pipetting channels are the heart of the Microlab® STAR. The instrument will not function properly if these are damaged or are incorrectly adjusted. Therefore you should exercise great care whenever you have to touch the channels - when unpacking or repacking the instrument, dismantling or re-assembling the pipetting arm, replacing channels, etc.

The instrument is provided with a front window. This window is equipped with a sensor that stops any movement immediately and aborts the run when the window is opened.

2.1.2 ML STAR IVD

The Microlab STAR IVD is foreseen to be used in an *in vitro diagnostic* environment, e.g. for blood analyses and DNA analytics.

Typical applications are:

- Sample preparation for ELISA, LIA, RIA, FIA, agglutination and CLIA tests
- Preparation for amplification techniques for DNA detection
- Sample archiving and pooling.

2.1.2.1 Total Aspiration and Dispense Monitoring (TADM)

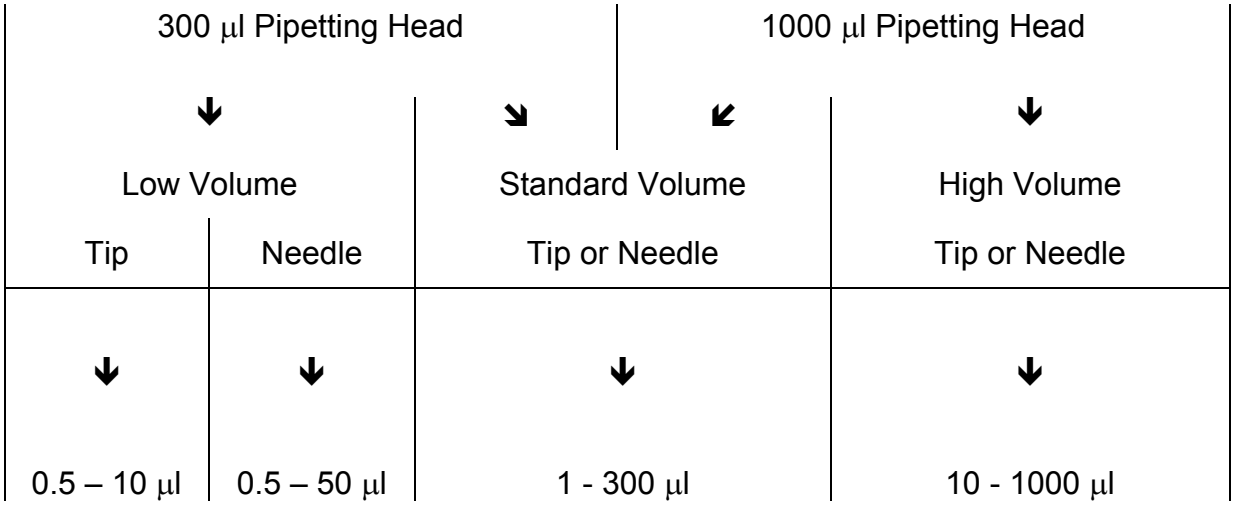
The Microlab STAR IVD is equipped with an additional safety feature, the pressure based Total Aspiration and Dispense Monitoring (TADM), allowing the in process control of aspiration and dispense steps. The principle works as follows: Before tip pickup, the environmental absolute pressure is measured and used as zero base line. When the liquid level is found, the relative pressure of the air volume within the tip is measured every 10 ms during the following aspiration and dispensing. The measurement values are checked on-line if they are lying within a liquid- and volume-specific, predefined tolerance band. If not, the step is stopped with an error message. The TADM enables the detection of leaky or clogged tips, blood clots and foam.

2.1.3 Product variants of Microlab® STAR Instruments

Type of Instrument	Configurations	Extensions
Manual load Auto load	4 to 16 channels 300 µl, or 1000 µl	iSwap Wash station Temperature-controlled carrier Automated vacuum system

2.1.4 Pipetting Head and Tip / Needle Combinations

All pipetting heads mounted on channels are either of 300 or 1000 µl type. A mixture of these two types is not allowable - the user software will not support a configuration with both types of pipetting heads.

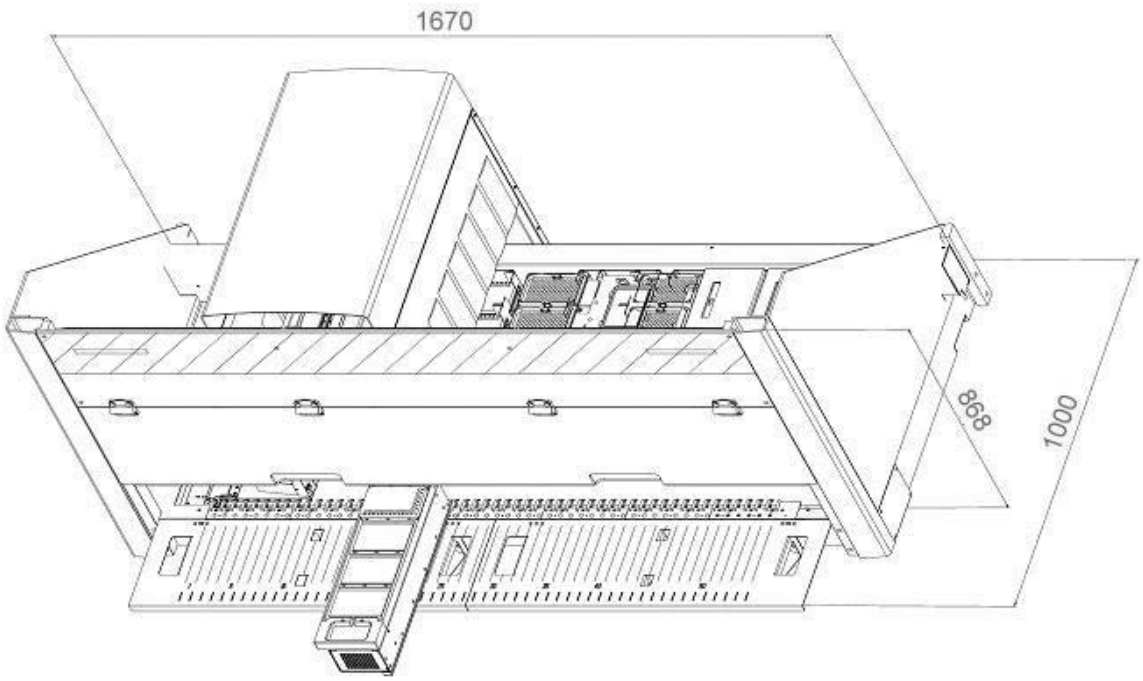


2.2 Technical Specifications

Item	Value
maximum weight of instrument with the Autoload option and trays installed 8 Channel Version: 16 Channel Version: ML STAR Instrument packed for transportation – total weight including shipping crate:	 145 kg 155 kg < 200 kg
electrical requirements maximum power consumption: Voltage: Frequency: Delayed action fuse: 115 V~: 230 V~:	 600W 115 / 230 V~ -15 % + 10 % 50 / 60 Hz ± 5 % 6.3 A 3.15 A
Operating temperature range:	15-35 °C relative humidity 30 – 85 % with no condensation
Storage temperature range:	0 - 55 °C relative humidity at a maximum of 95 % with no condensation

Technical Specifications (continued)

Item	Value
maximum outer dimensions	
Instrument:	Width: 1670 mm Height: 868 mm Depth: 780 mm
Instrument: incl. attached Autoload tray	Depth: 780 +220 mm = 1000 mm
ML STAR Instrument packed for transportation – shipping crate dimensions	Width: 1820 mm Height: 1000 mm Depth: 900 mm



Technical Specifications (continued)

Item	Value
Work area	The Deck has space for 55 Tracks. Track Number 55 (the rightmost Track) is reserved for Waste Station. Therefore: 54 Sample carriers, 9 Plate Carriers, or a mixture of both may be loaded onto the ML STAR Instrument. A ML STAR Instrument with up to 8 Pipetting Channels has full sequential access. This means that every Pipetting Channel reaches any HAMILTON standard Labware. A ML STAR Instrument with up to 16 Pipetting Channels is limited in its Y-direction movements
Movement Increments for x, y, z drives	Refer to Firmware Reference Guides

Technical Specifications (continued)

Criteria	Value
Barcode Types Specification: The following types of bar code symbol can be recognized by the system: See also user software Menu: Tools ➔ ML STAR Configuration Editor ➔ Advanced ➔ Barcode settings	ISBT standard Code 128 (subset B and C) Code 39 Codabar Code 2 of 5 Interleaved UPC A/E JAN/EAN 8
Bar Code Density and Resolution:	Up to 32 characters (excluding start, stop and check characters) can be read and decoded.
Code density, tolerances: The minimum code densities depend on the bar code type and bar code length	Minimum module width (including a print tolerance of 0.0005“) * 0.0065 inches (= 0.1651 mm).
Print Quality:	The bar code print must be of high quality according to USS (Uniform Symbol Specifications) defined by AIM U.S.A. Offset, typographic, intaglio and flexographic printing are suitable. Mechanical dot matrix and thermomatrix printing are not suitable. The label surface may be treated, sealed or plastic-covered.
Print Contrast Signal (PCS):	Minimum contrast between bars and spaces: PCS 80 % (PCS at 632.8 nm Wavelength)
Positioning of Barcode labels: measured from Deck	Range on Tubes: 30 – 110 mm Centerline on Plates: 118 mm

Technical Specifications (continued)

General Note on Drive Specifications[1]:

The User Interface is the Master where all units are 0.1 mm in length and volumes are 0.1 µl.

The master transfers the User's software commands to its slaves and therefore you do not have to know drive resolutions when calculating positions, volumes, etc.

2.2.1 Technical Status of ML STAR Instrument

Technical Status contains all technical data specific to each instrument. It must be updated by the Service Technician whenever any modifications are made.

Technical Status information is stored on the EEPROM of components of ML STAR Instrument and may viewed, changed and printed via service software only.

It is highly recommended that a copy of the current Technical Data Sheet be held by the Service Technician for his own reference.

[1] see in section 12.4.3 Firmware Reference Guides on page 12-19

2.2.2 Computer Requirements

Minimum requirements:

- Compatible with Windows NT™, Windows 2000™ and Windows XP™ Operating Systems.
- CPU with at least 450 MHz Processor, approx. 1 GB HDD and minimum 64 MB of RAM.
- SVGA Monitor (resolution min. 600 * 800)
- Keyboard
- Mouse
- CD-ROM Drive
- 3.5" HD Floppy Drive
- Serial port(s) (at least 1 USB or RS232 for the ML STAR Instrument)

Optional requirement:

- Printer port

2.2.3 Software Requirements

These Operating Systems can be used for the User and Service Software:

- Windows NT™ Version 4.0 (or higher) and Service Pack 5 (or higher),
- Windows 2000™ or
- Windows XP™.

Ongoing updates of User and Service Software may also require Operating System updates.

The Microlab® STAR software installed on one PC controls one Microlab® STAR instrument.

2.3 Service Part Classifications

Spare Part Class (SPC)	Description
I	Instrument
A	Service Technician always has these parts with him.
B	Dealer has parts in stock.
C	Hamilton has parts in stock.
T	Service Tools
V	Consumables
Z	Accessories
	Not a Spare Part

The Spare Part Class (SPC) appears as a column of each part list in this manual.

2.3.1 Service Assemblies

Parts labeled with framed part numbers on the 3D drawings are Service Assemblies and may not disassembled by the Service Technician. If a part of the assembly is defective, the whole assembly must be replaced.
See section 12.6 Appendix F on page 12-38 for a complete List of all available Spare Parts.

2.3.2 Exchange for Parts and Assemblies

Hamilton will exchange assemblies and replace defective Parts with repaired Parts for a reduced price, subject to the defective Part or Assembly being sent to Hamilton Bonaduz AG. To arrange this, contact Hamilton Technical Support (see section 1.10 Contacting Hamilton on page 1-8).

2.4 ML STAR Service Kit P/N 173970[2]

Overview

The Service Case contains all tools required to maintain a Microlab STAR Instrument as well as spare parts, which may be required when servicing the instrument. For your comfort and convenience, the case is equipped with a set of wheels, which makes it easy to carry around at customer sites.

[2] See also section 12.5 Appendix E on page 12-27 for a complete Part List

2.4.1 Service Tool Maintenance

In order to provide best service and maintenance to the components of the Microlab® STAR instrument, the following maintenance procedures should apply to these service tools at the specified intervals:

The torque wrench P/N 239646 must be subject to an annual check and calibration. Calibration may performed by any calibration authority; Hamilton Bonaduz AG offers a calibration service.

The Adjustment Tools, such as the Channel Adjustment Tool P/N 173952 may be returned periodically to Hamilton Bonaduz AG where a check service is offered.

Note: Adjustment Tools can not be calibrated. If an Adjustment Tool is found to be out of range it must be replaced with a new one.

Attention: the Microlab® STAR Special Tools are precision tools and must be handled with due care to provide the best results in adjustment work on the Instrument.

2.5 Disposal of ML STAR Instruments

After the life cycle of the instrument has terminated, the Microlab STAR may be shipped back to Hamilton Bonaduz AG. Otherwise local disposal regulations are to be observed.

3 Service Software

3.1 Overview

The Service Software supports the identification and correction of malfunctions in the ML STAR instrument.

The Service Software

- Configures the Microlab STAR Instrument
- Downloads Firmware
- Updates the Technical Status
- Performs calibration and adjustments (Macro Programs)
- Controls all single movements of the instrument
- Checks Sensor status
- Gathers all Trace information
- Features both Single Commands and Macro Programs
  (refer to firmware reference guide)

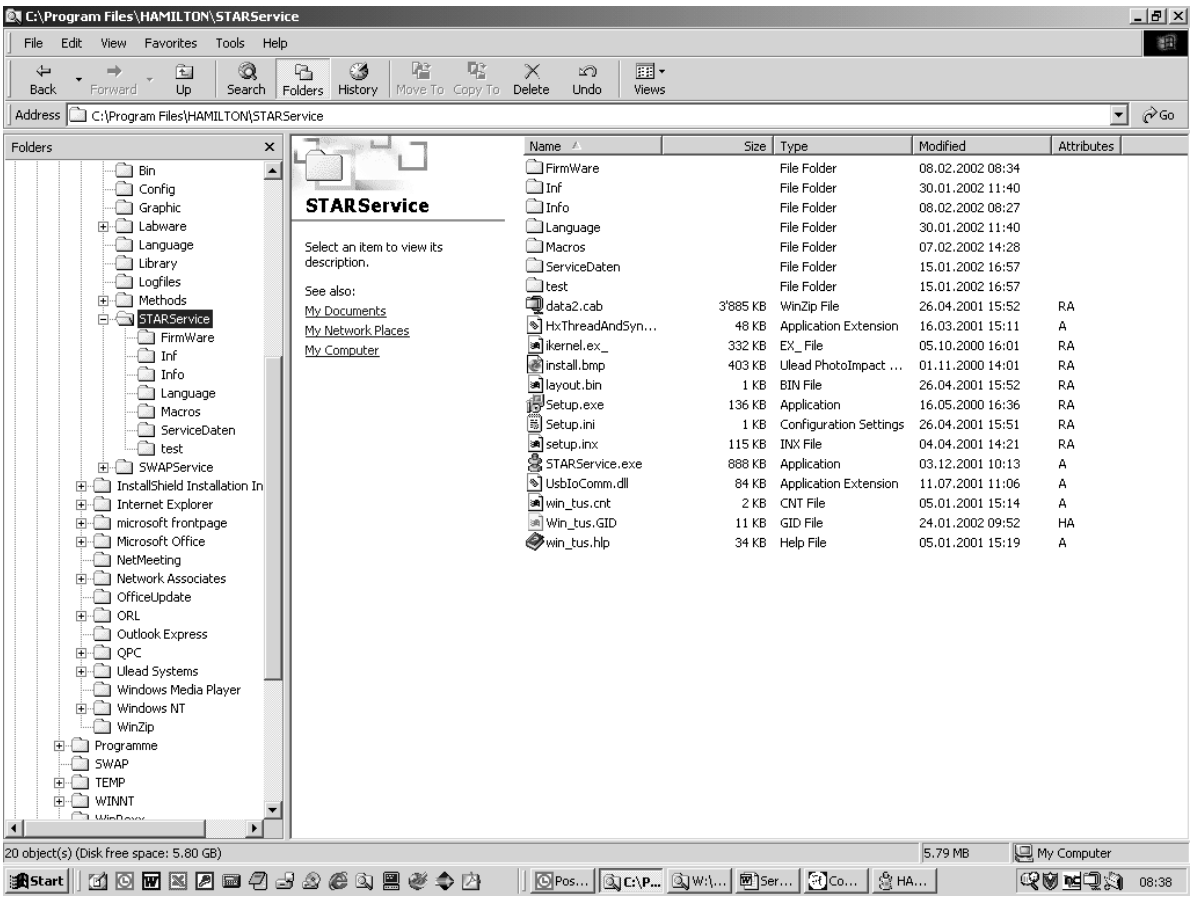
3.1.1 How to Install the Service Software

Attention: Do not install new software version over existing software.
First Back up Macros, Firmware, etc. then remove current software.
After removal of current software the new software version may be installed.

- Put Service Software CD into CD-ROM Drive
- start Setup.exe Program File from the CD-ROM and carefully follow the installation instructions.

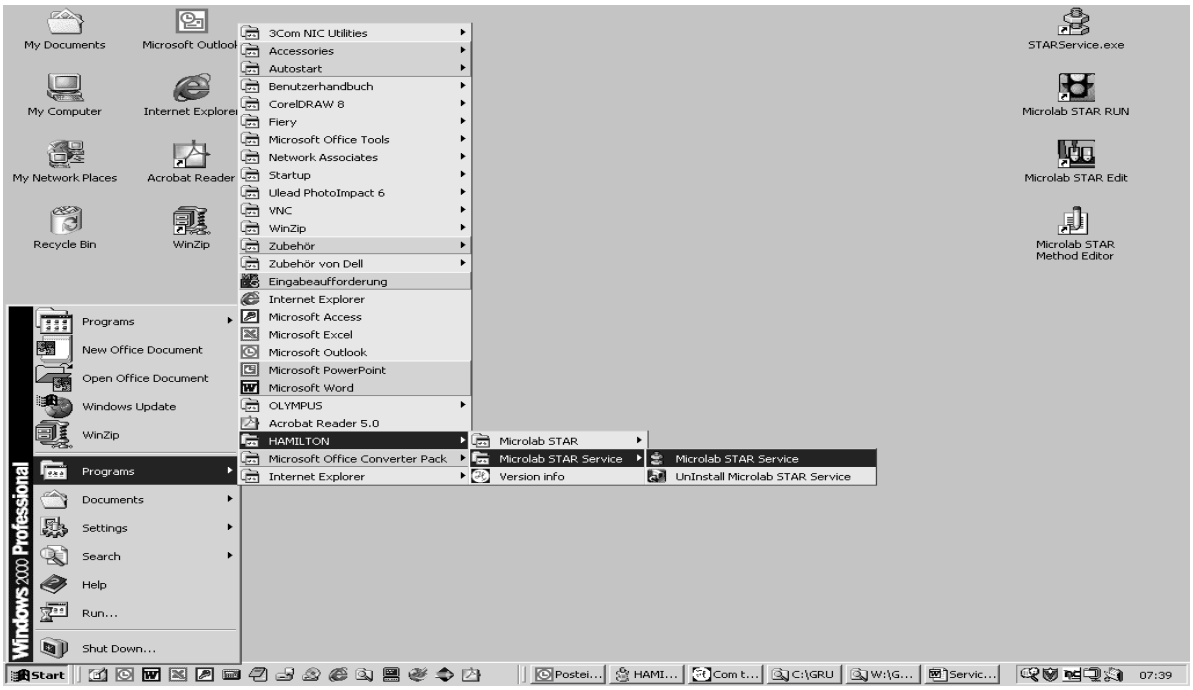
Attention: Do not leave the Service Software installed on a Customer's PC as this will enable any user of that PC to "play" with the system - with potentially damaging results!

3.1.2 Service Software Root Directory structure



3.2 Starting the Service Software

From Start Menu:

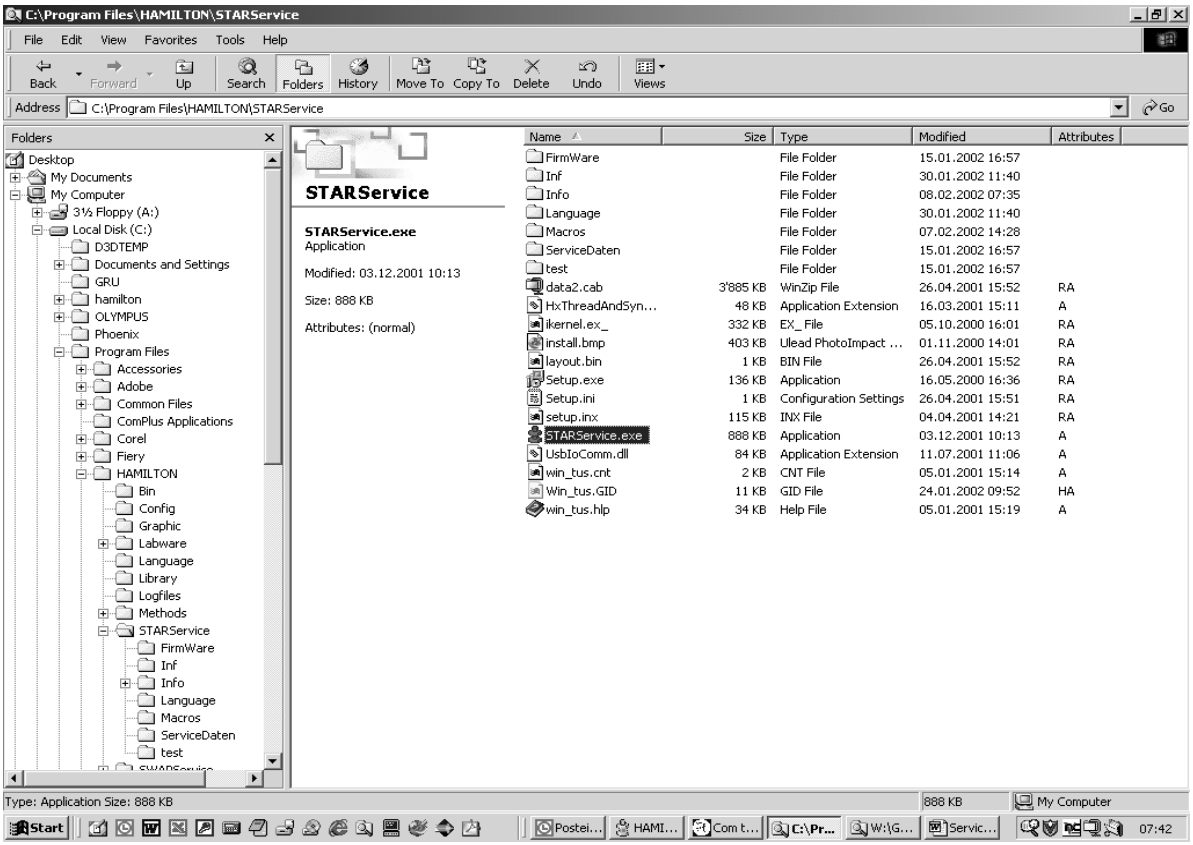


Startup for Service Software:

Start ➔ Programs ➔ HAMILTON ➔ Microlab STAR Service ➔ Microlab STAR Service.

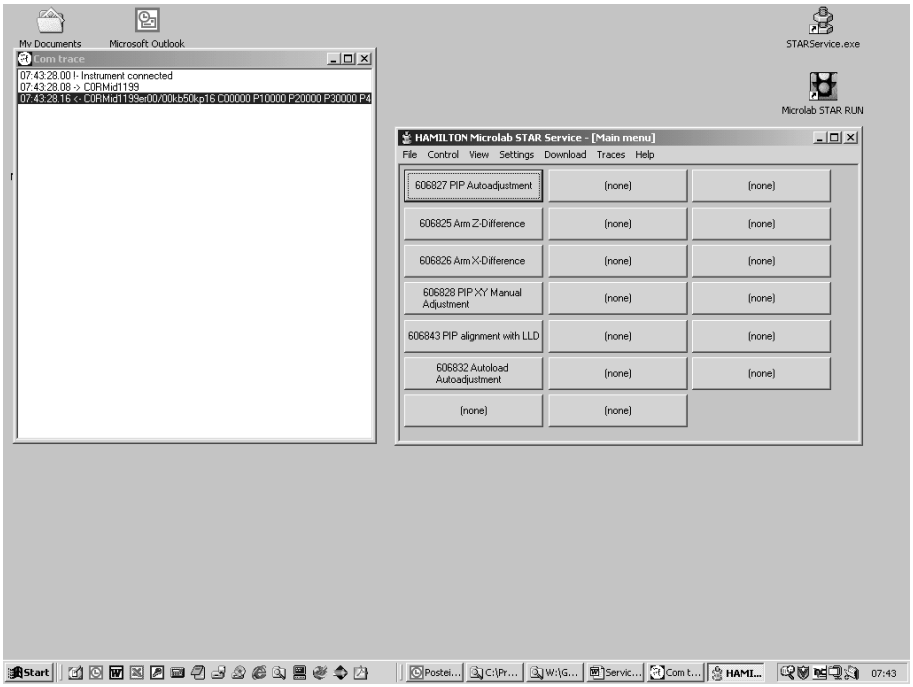
Starting the Service Software (continued):

From Desktop Shortcut:



Service Software may also started from the desktop, if you create a shortcut to the "STARService.exe" program. This will be found in the STARService Folder, e.g. C:\Program Files\HAMILTON\STARService

Starting the Service Software (continued)



By default two windows appear:

COM Trace - and the Main menu window.

The COM trace window starts when “view trace” from the view menu is activated.

It reports all commands sent to and responses received from the ML STAR Instrument.

The arrows after the time format have the following meaning:

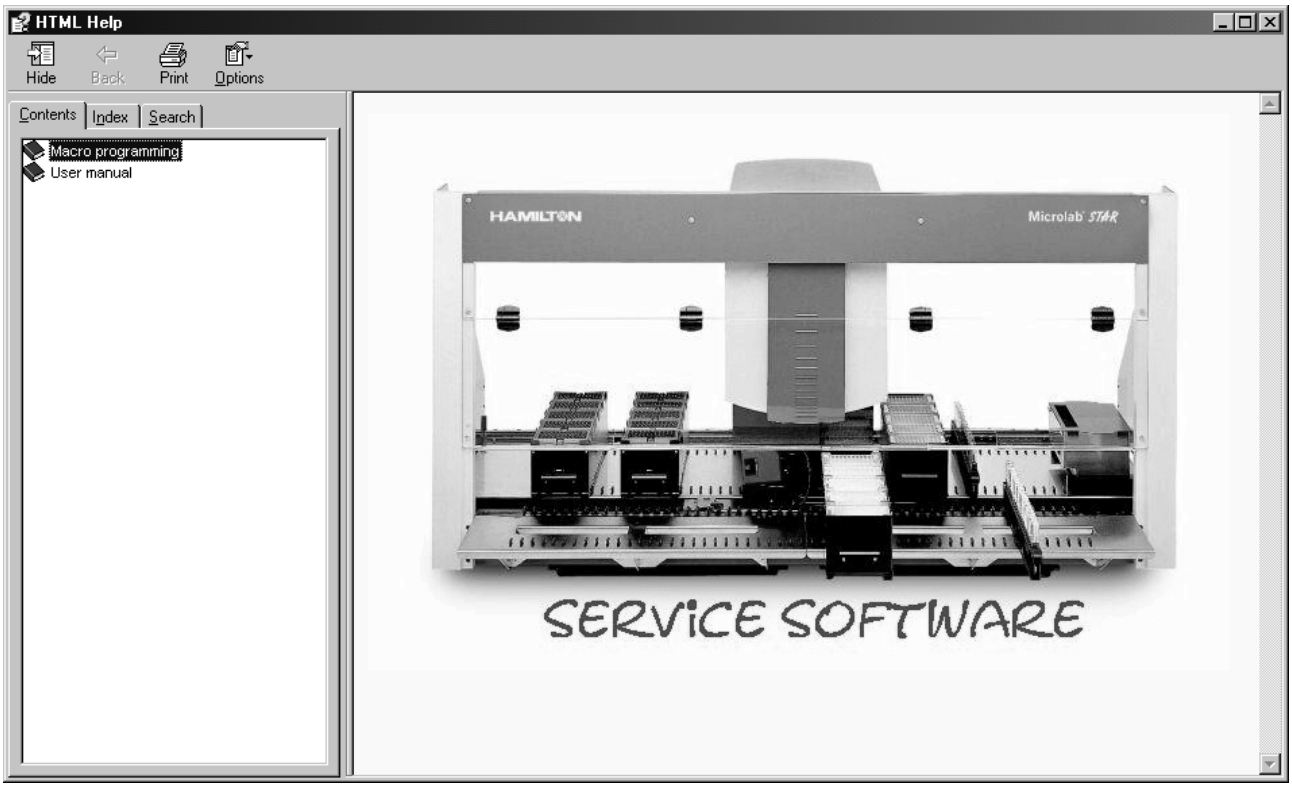
“->” identifies a command from PC to ML STAR Instrument

and

“<-“ identifies a response from ML STAR Instrument to PC after the command has been executed.

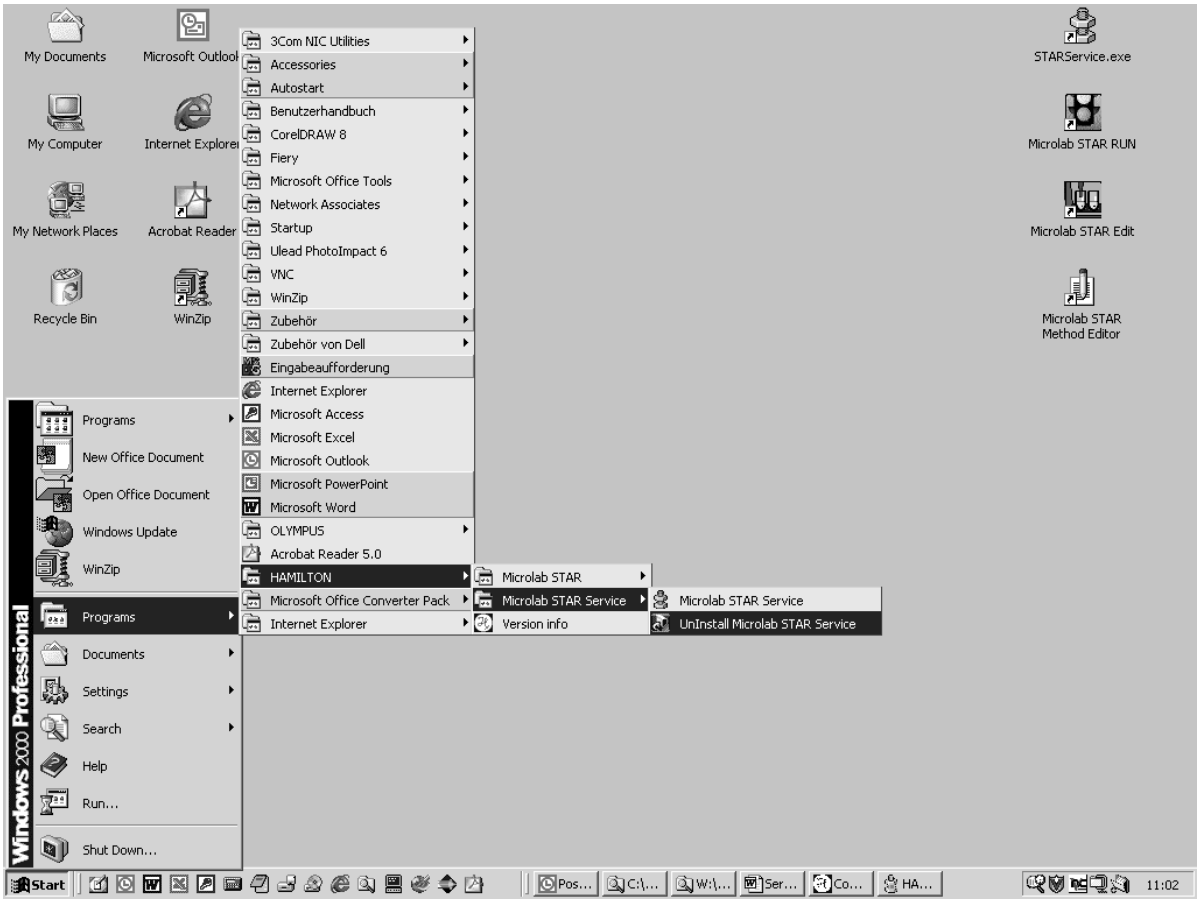
3.3 Help Menu

In this section, all Menu Choices of the Service Software are explained.



3.4 Deinstallation of Service Software

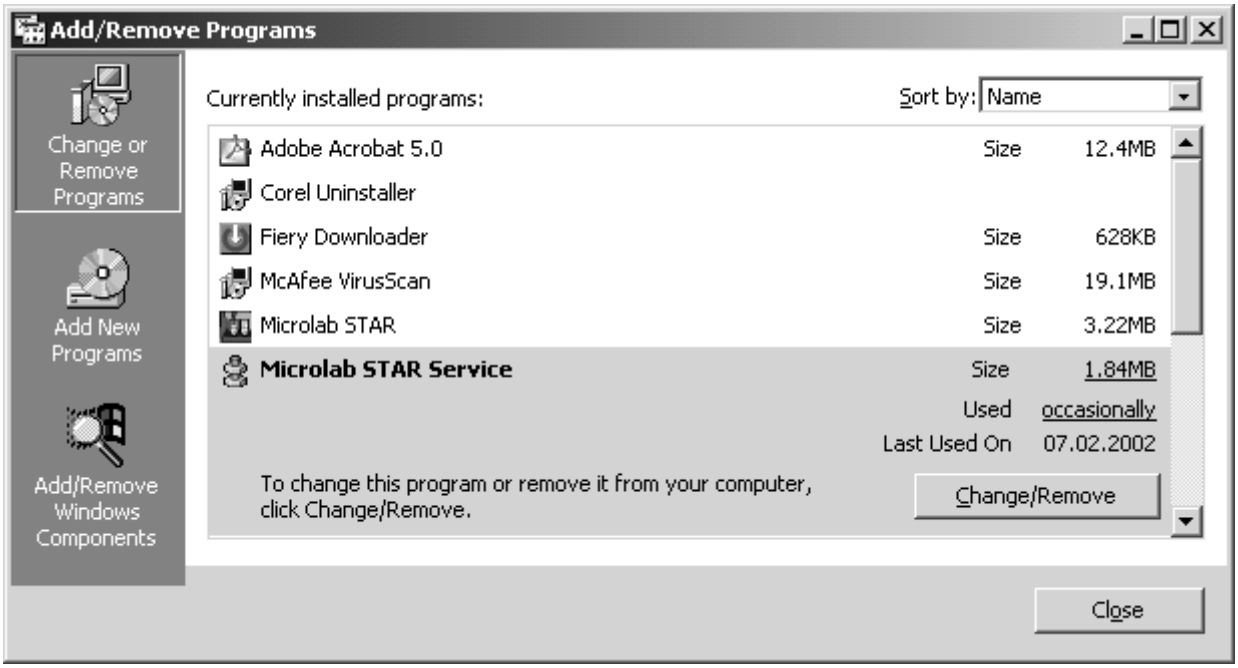
Select Start ➔ Programs ➔ HAMILTON ➔ Microlab STAR Service ➔ UnInstall Microlab STAR Service, then follow the Instructions given in the Program.



Deinstallation of Service Software (continued)

After deinstallation of Service Software ensure that no components are left on the PC.

Select START ➔ SETTINGS ➔ SYSTEM ➔ ADD / REMOVE SOFTWARE and search for ML STAR Service Components, removing them if still present.



4 Installation of the instrument

4.1 Overview

The initial unpacking, installation and setup of the Microlab® STAR may only be carried out by Service Technicians trained and / or authorized by HAMILTON Bonaduz AG. For proper installation follow the order of instructions given in this section.

Deinstallation is described in section 5 Disassembly on page 5-1.

Attention: Exercise great care if touching the Channels when unpacking the Instrument!

4.1.1 Installation Qualification

To ensure a fast and proper installation process, follow the Installation Qualification. For detailed descriptions see the subsequent chapters of this manual.

An Installation Qualification Form may be found in section:

for ML STAR see section 12.2.1.1 IQ Microlab STAR on page 12-7

respectively,

for ML STAR IVD in section 12.2.1.2 IQ Microlab STAR IVD on page 12-9.

Note: depending if a Microlab STAR, or a Microlab STAR IVD is being installed, use the corresponding Installation Qualification Form.

Attention: Do not skip any Chapter as this may lead to an unsuccessful installation!

Note: If any of the steps above can not executed successfully, refer to section 6 Adjustment and Calibration on page 6-1, and section 10 Troubleshooting and Error Handling on page 10-1.

4.1.1.1 Microlab STAR Installation Qualification

HAMILTON
the measure of excellence

Microlab STAR
Installation Qualification (IQ)

Ref. Service Manual: P/N 610754	**Installation Date:**	**Installation Report:** **IR #:** .....
Customer: **Address:**.....	**Contact Person:**.....	**Phone:** ..... **Fax:** ..... **e-Mail:** .....
Service Organization: **Address:**	**Contact Person:**.....	**Phone:** ..... **Fax:** ..... **e-Mail:** .....
ML STAR Software Version: ..... **Serial #:** **Instrument:** ..... **Computer:**	**Extensions Serial #:** **AVS:** ..... **iSWAP:** ..... **TCC 1:** ..... **TCC 2:**	**WS 1:** ..... **WS 2:** .....

Always wear required personal protection equipment!

Work Place Environment

- ❑ Inspect workplace environment for accordance to technical specifications.
- ❑ Inspect table or workbench for supporting the weight of the Microlab STAR and providing the minimum space needed.

Unpacking the Instrument

- ❑ Inspect instrument and accessories for shipping damage or missing parts.
- ❑ Use packing list to verify contents. If any items are missing, contact Customer Service.

Hooking up the Instrument

- ❑ Set up the instrument.
- ❑ Connect communication and power cables.

If included, inspect/install extensions.

iSWAP	Yes ❑	No ❑
AVS	Yes ❑	No ❑
TCC(s)	Yes ❑	No ❑
WS(s)	Yes ❑	No ❑
Recommended Uninterruptible Power Supply (UPS) installed?	Yes ❑	No ❑

Software Installation

- ❑ ML STAR software.
- ❑ Service software.
- ❑ Labware definitions of carriers.

Remote access? Yes ❑ No ❑

Instrument Check Procedure

- ❑ Perform instrument check procedure.

Verification

- ❑ Volume.
- ❑ Print out verification reports.

Service Software

- ❑ Print out instrument configuration.
- ❑ Un-install service software.

Documentation

- ❑ Attach instrument configuration and verification reports to this IQ form.

Customer Summary

- ❑ Explain how to request technical and service assistance.
- ❑ Address any other concerns.

Comments

_____

_____

_____

Customer Acceptance **Date**

Installed by **Date**

P/N 610911/00 HAMILTON Bonaduz AG

4.1.1.2 Microlab STAR IVD Installation Qualification

HAMILTON
the measure of excellence

Microlab STAR IVD
Installation Qualification (IQ)

Ref. Service Manual: P/N 610754 **Ref. Operator's Manual: P/N 610889**	**Installation Date:**	**Installation Report:** **IR #:** .....
Customer: **Address:**.....	**Contact Person:**.....	**Phone:** ..... **Fax:** ..... **e-Mail:** .....
Service Organization: **Address:**	**Contact Person:**.....	**Phone:** ..... **Fax:** ..... **e-Mail:** .....
Serial #: **Instrument:** ..... **Computer:**	**Extensions Serial #:** **AVS:** ..... **iSWAP:**.....	**ML STAR Software Version:** .....

Always wear required personal protection equipment!

Work Place Environment

- ❑ Inspect workplace environment for accordance to technical specifications.
- ❑ Inspect table or workbench for supporting the weight of the Microlab STAR IVD and providing the minimum space needed.

Unpacking the Instrument

- ❑ Inspect instrument and accessories for shipping damage or missing parts.
- ❑ Use packing list to verify contents. If any items are missing, contact Customer Service.

Hooking up the Instrument

- ❑ Set up the instrument.
- ❑ Connect communication and power cables.
  If included, inspect/install extensions.
  iSWAP Yes ❑ No ❑
  AVS Yes ❑ No ❑
- ❑ Install tip waste chute and container.
  Recommended Uninterruptible Power Supply (UPS) installed? Yes ❑ No ❑

Software Installation

- ❑ ML STAR IVD software.
- ❑ Service software.
- ❑ Labware definitions of carriers.
- ❑ Set up user groups.
  Remote access? Yes ❑ No ❑

Instrument Check Procedure

- ❑ Perform instrument check procedure.

Weekly Maintenance (➔ Operator's Manual)

- ❑ Perform Weekly Maintenance procedure.

Verification

- ❑ Volume.
- ❑ Print out verification reports.

Functional Test Run

- ❑ Run demo method (➔ Operator's Manual).

Service Software

- ❑ Print out instrument configuration.
- ❑ Un-install service software.

Documentation

- ❑ Attach instrument configuration and verification reports to this IQ form.

Customer Summary

- ❑ Explain how to request technical and service assistance.
- ❑ Address any other concerns.

Comments

_____

_____

_____

Customer Acceptance **Date**

Installed by **Date**

P/N 610886_05 2002-10-31 HAMILTON Bonaduz AG

4.2 Installation

4.2.1 Workplace environment

The Microlab® STAR is a product which pipettes liquids and dilutions of liquids. Some of these latter may well be temperature-dependent. Therefore, it is important to choose a location in the laboratory where the Microlab® STAR will not be exposed to unusual temperature variations, such as near a window, heating duct or air-conditioning duct.

Depending on the Microlab® STAR configuration used, your Microlab® STAR may weigh up to 155 kg[3]. The Microlab® STAR must be placed on a table or workbench capable of supporting the weight of the Microlab® STAR and providing the minimum space needed. The table or workbench has to be strong enough to support the weight of the instrument, and stable enough to absorb the vibrations caused by the acceleration of the pipetting arm movement.

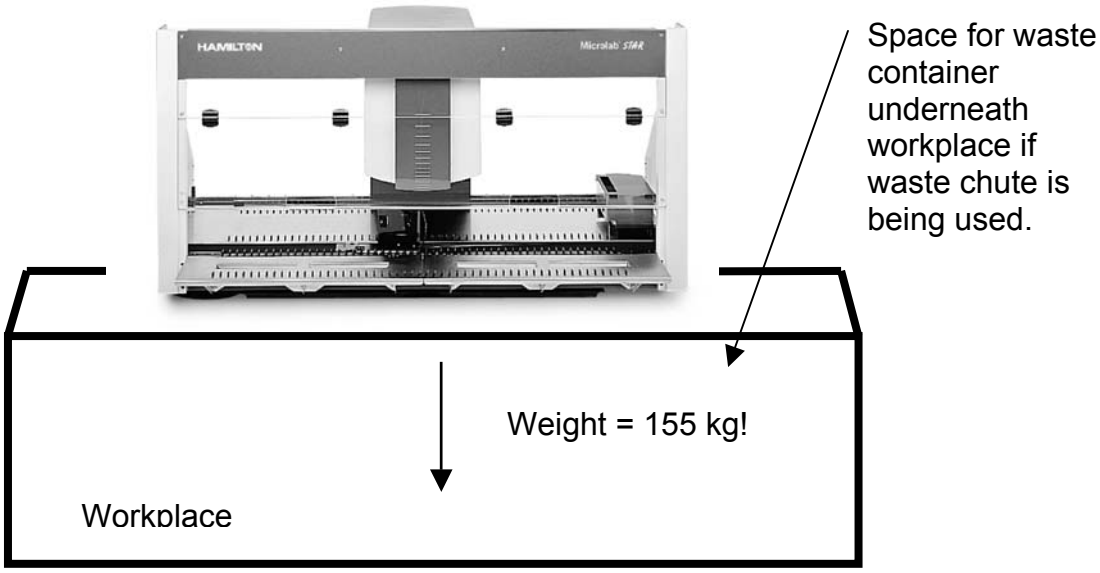
Note: ML STAR IVD uses a tip waste chute. Therefore ensure an appropriate work bench so that a waste container may be placed underneath the waste area of the ML STAR IVD when installing the Instrument.

For proper ventilation, leave at least 5 cm space between the Microlab® STAR and any wall. Ensure that there is collision-free movement of the Pipetting arm.

Access to the mains connector and the mains switch (located on the left hand side of the Microlab® STAR) should not be hindered.

The Microlab® STAR should be located within easy reach of a standard electrical outlet (1 socket for the Microlab® STAR, 1 for the computer, 1 for the monitor and 1 each for any other products daisy-chained to the main one, e.g. UPS).

Other considerations include operator comfort and easy access to needed supplies and equipment. Finally, the position of the Microlab® STAR must not hinder operation or accessibility of other equipment in the work area.



[3] i.e. without extensions. If you are or will be using extensions with your ML-STAR instrument, we recommend a stronger table or workbench capable of supporting the additional weight.

4.2.2 Unpacking the instrument

The Microlab® STAR comes in a box on a wooden pallet. Examine the packaging for signs of damage. If there is any damage, contact the shipper or your Hamilton representative immediately.

Lift off the top and surrounding cover.

Note: the Form "Unpacking Instructions" will be found inside the ML STAR packaging on top of the Instrument. The Instructions will mainly guide through the unpacking procedure as described below.
The Instructions form describes packing the ML STAR Instrument as well.
For general packing Instructions see section 5 Disassembly on page 5-1.

Remove all Panels from top of accessories boxes, then remove accessory boxes and examine the Instrument and all parts against damage.

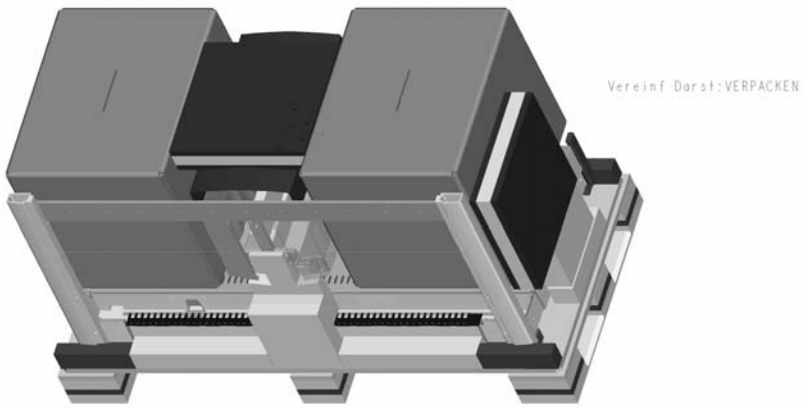
Leave the protective material in place until the Microlab® STAR has been placed in its permanent position.

Attention: Do not turn Barcode Reader by hand as this may damage the DC Motor. If the Barcode Reader must be turned, use the Service Software, or remove the outer covering to access Gear, and turn on cogwheel or belt instead.
See section 7.9 Auto Load drive on page 7-37.

Unpacking the instrument (continued)

Instrument on pallet without top and surrounding covering.

Note: Instrument Panels (such as side and back Panels[4]) are placed on top of Accessories boxes.



To avoid any damage (such as scratches) remove Instrument Panels from top of accessories boxes and store them until they are to be assembled

Remove the two Accessories Boxes and their supporting foam blocks (3 square blocks and 2 z-shaped blocks).

4.2.2.1 Accessory boxes

The contents of these two boxes can vary depending on what the customer ordered. Check the packing list.

The items from these boxes must mounted on the Microlab® STAR Instrument as a part of the installation.

⚠

Attention: Items for ML STAR and ML STAR IVD may vary, therefore ensure correct parts are being used when setting up the Instrument.

[4] Back Panels only for ML STAR IVD Instruments available

4.2.2.2 Accessories

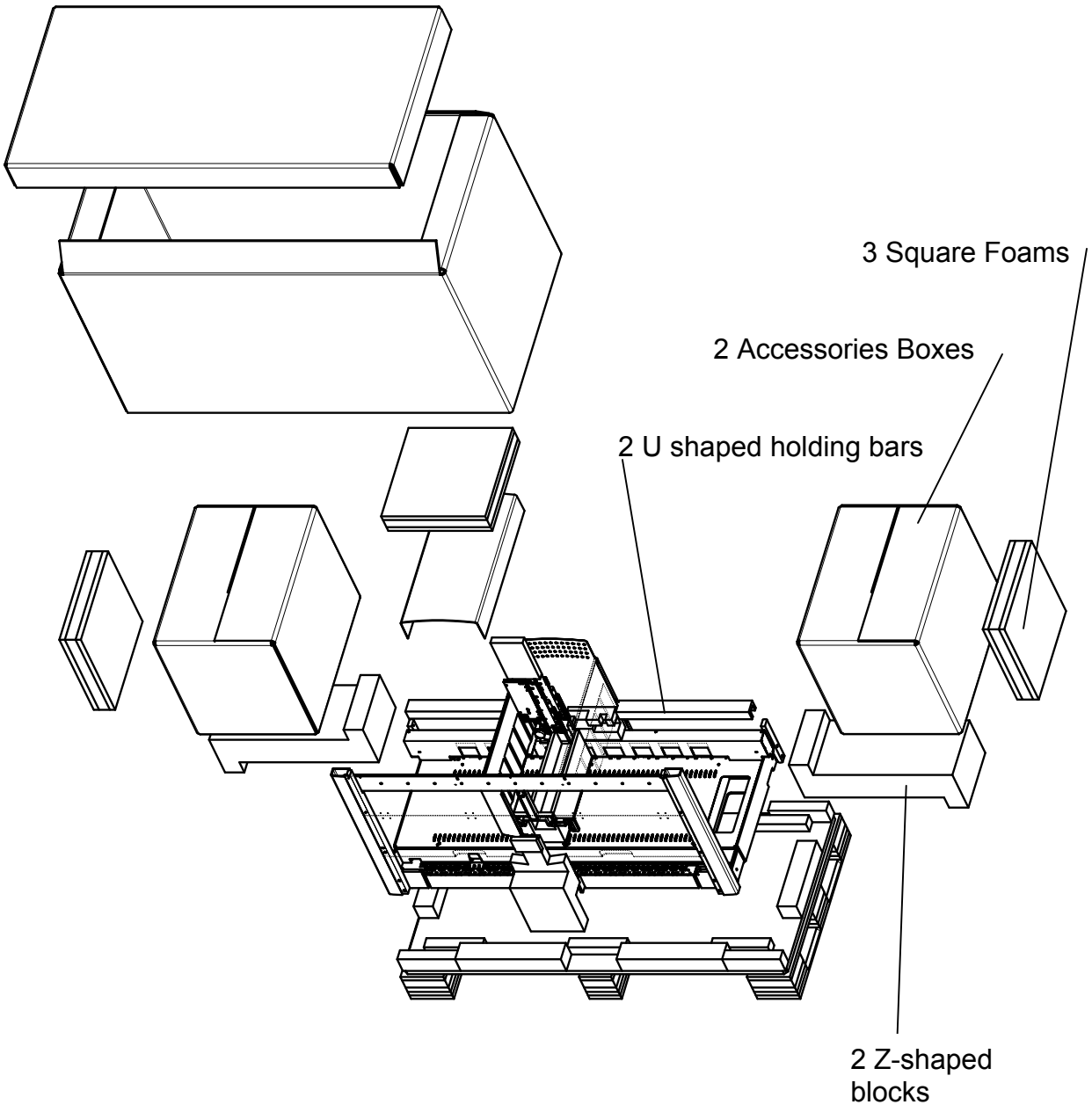
Accessories (i.e. carriers, needles) and Consumables (i.e. tips) must be ordered by the user. For ordering information, refer to the User Manual.

Attention: Accessories for *ML STAR and ML STAR IVD* may vary, therefore refer to the according User Manual (ML STAR or ML STAR IVD).

4.2.2.3 Packing List

The Packing List will be found inside one of the Accessory boxes. Check the contents carefully against it.

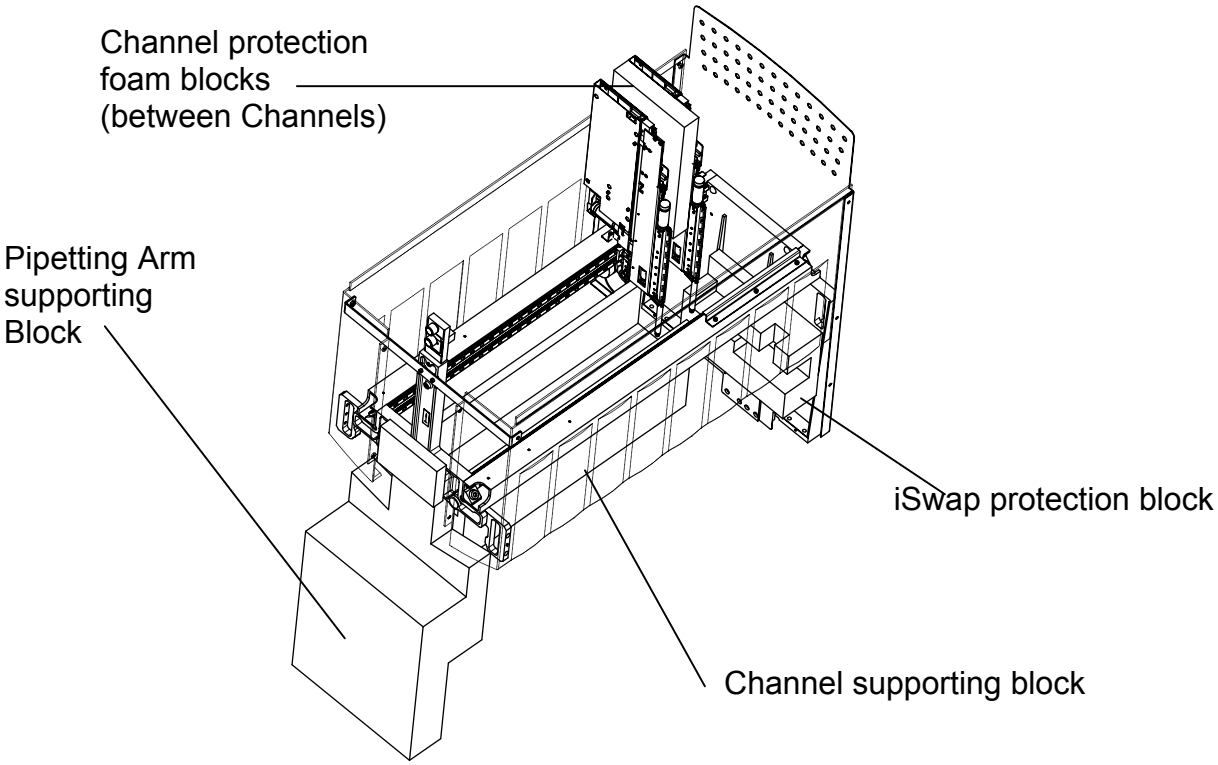
Unpacking the instrument (continued)



Unpacking the instrument (continued)

Initial situation: the ML STAR Instrument is still sitting on the wooden pallet.

Next action is to remove the Pipetting Arm‘s supporting and protective Foam blocks. Therefore untie cords around Pipetting arm housing, then remove Pipetting Arm’s Top and front housing.



1. Carefully remove all protective foam blocks from between channels
2. Remove pipetting arm supporting block from the front
3. Carefully remove channel supporting block from underneath pipetting arm
4. If iSwap is present, untie it from the back of Pipetting arm and carefully remove its protective block.

4.2.3 Hooking up the instrument

4.2.3.1 Putting the Instrument in place

Using the lift points in the Chassis, lift the Microlab® STAR off the pallet and put it on the desired table or workbench in the laboratory. (Refer to section 4.2.1 Workplace environment on page 4-4 when deciding where it should go.)

Attention: Given the weight of the instrument it will take at least 4 people(!) to lift it.

After placing the Instrument in its final position on the workbench or table, check and (if necessary) adjust the feet of the Instrument so that it stands evenly.

It is recommended that you check the Channels' cable connections.

With the Pipetting Arm uncovered (see section 7.4.3 Pipetting Arm on page 7-14), check the cable connections on the Pipetting Arm and Pipetting Channels visually and by hand in case they have become loose during shipment. Check the Y-Motor and communication Cable connection on each Channel for proper fit.

Cover the Pipetting Arm, mount Side Panels, place Spillage Trays, Tip-Waste station and Loading Trays[6] onto the Instrument.

Attach protective front and side shields. ML STAR IVD Instruments have an additional shield toput in place at the back of the instrument.

Attention: Side Panels must be flush with the outer edges of Instrument. After mounting, check to ensure there is collision-free Pipetting Arm movement. Carefully move the Pipetting Arm by Hand!

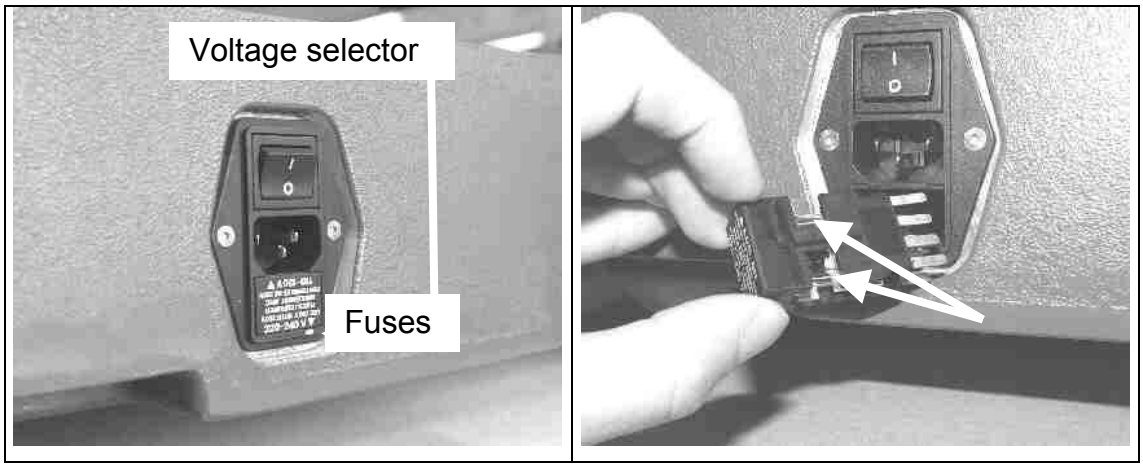
[6] Microlab®-STAR Instrument with Autoload Option only

4.2.3.2 Power / Voltage

Using an Uninterruptible Power Supply (UPS) is highly recommended.

- The mains plug is on the left-hand side of the instrument towards the rear.
- The fuses for the instrument are situated under the mains power switch.
- Plug in the mains cables for the computer and the instrument into the same electrical outlet.

Attention: Connect only to an earth-grounded outlet



Attention: For safety reasons, ensure that the appropriate Fuse is placed into the mains power switch before switching on the instrument.

Fuses:

P/N 363012 Delayed action FUSE 3.15 A for 230 V~

P/N 363013 Delayed action FUSE 6.3 A for 115 V~

See section 2.2 Technical Specifications on page 2-6.

4.2.3.3 Communication

Two different types of serial Interfaces, RS 232 and USB, have been defined since the Microlab® STAR has been on the market.

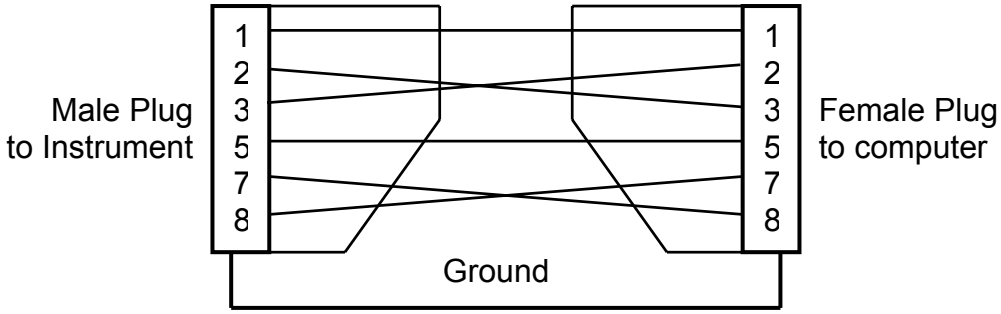
Note: ML STAR IVD Instruments run only with the USB serial Interface.

- Connect the serial cable to the plug on the left-hand side of the instrument and to the corresponding serial interface on your personal computer.

Cables

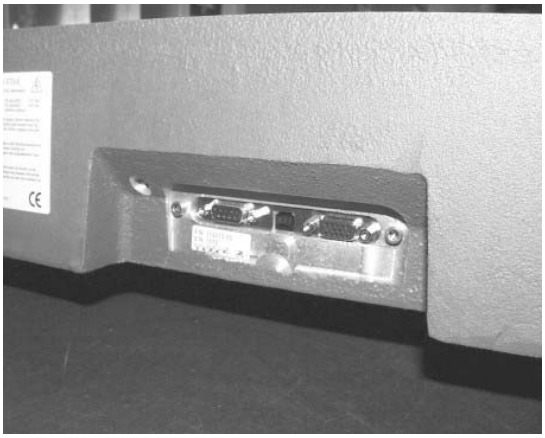
- USB P/N 355130
- RS 232 P/N 173898

Connecting scheme of RS 232 cable



Note: older ML STAR Instruments have RS 232 interface only, if both serial interfaces are available, the USB serial interface should be selected.

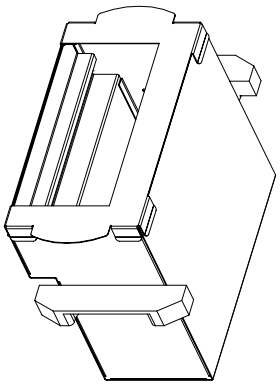
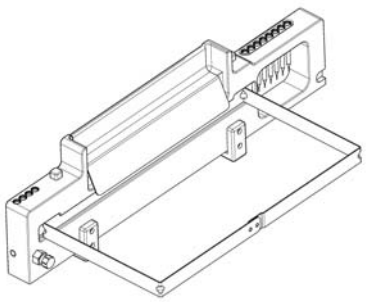
Attention: Do not connect RS 232 and USB together - if both serial interfaces are available, select either one or the other!



4.2.3.4 Tip Waste station

There are two different types of tip waste station.

Regardless which one is being used, Tip waste station is always located on the right side of Instrument and uses the hole / cutout in the deck panel.

Microlab Star	Microlab Star IVD
	
The Microlab Star Tip waste is a container which is placed onto the deck.	The Microlab Star IVD Tip waste must be mounted with its clamps onto the deck.
It is positioned on the deck by placing it through the hole in the deck panel.	It must lie flush with the outermost row of slide blocks on the right and with the carrier stops in the rear.
Plastic Bags (which come with the disposable tips) may be folded around upper rim and fixed with the tip waste lid.	Plastic chute may folded around the metal frame and guided vertically through the instrument. For a complete installation a tip waste container is provided with the instrument witch must placed underneath the tip waste. Guide the Plastic chute into the tip waste container.

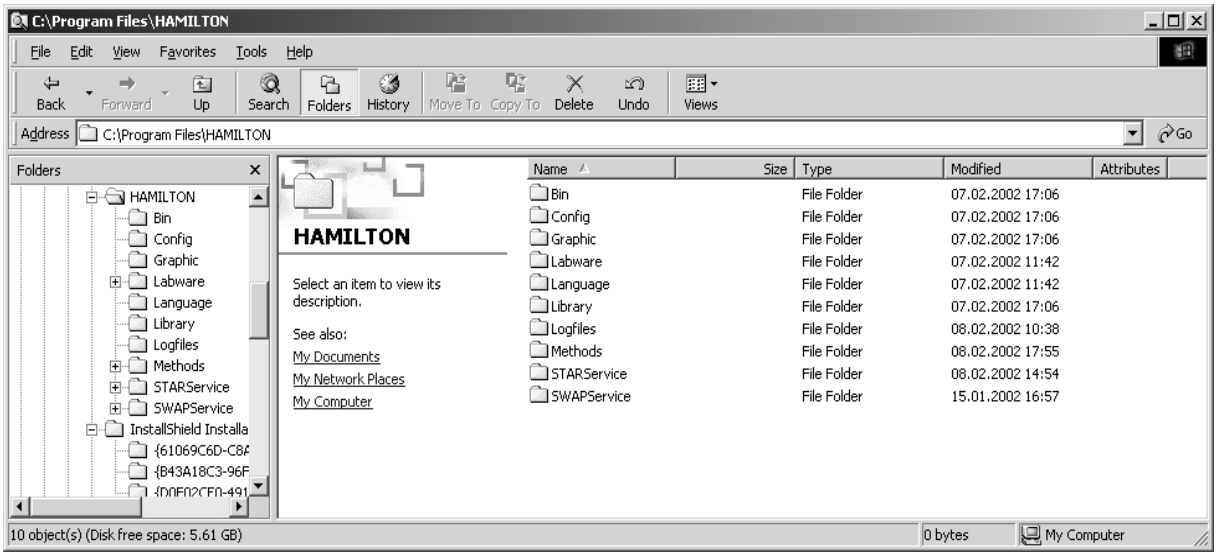
4.2.4 Software Installation

4.2.4.1 User Software Installation

Attention: Do not install new software version over existing software.
First Back up Methods, User-defined Labware, Liquid classes etc. then remove current software.
After removal of current software the new software version may be installed.

- Put CD into CD-ROM-Drive
- Start SETUP.EXE Program File from the CD-ROM and carefully follow the instructions during installation.

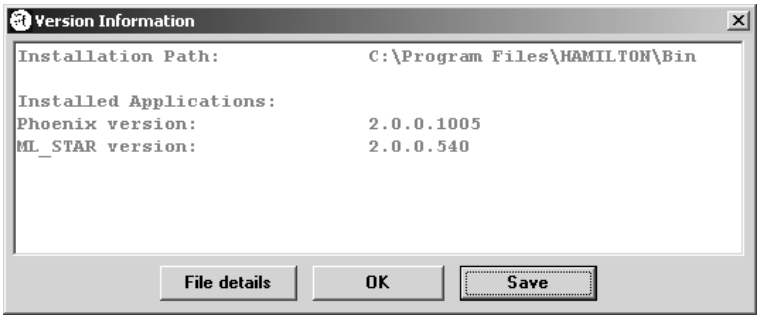
The User Software creates a Root Directory as follows:



Version Information

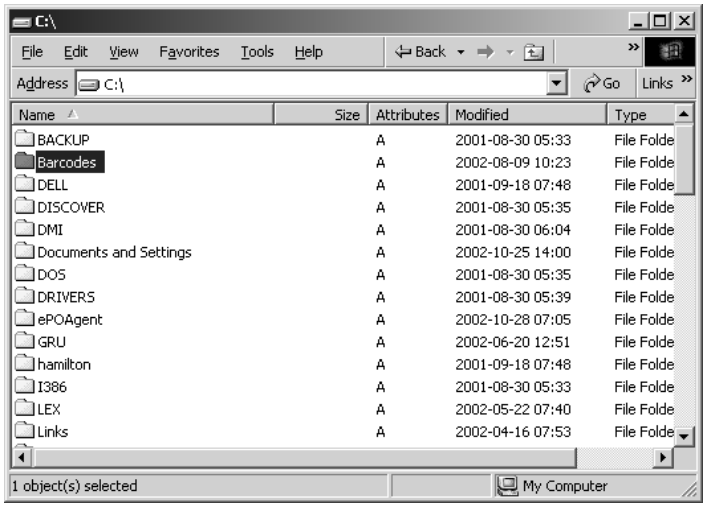
After a successfully installation of user Software a Version Info Program will be found on START ➔ Programs ➔ HAMILTON ➔ Version Info

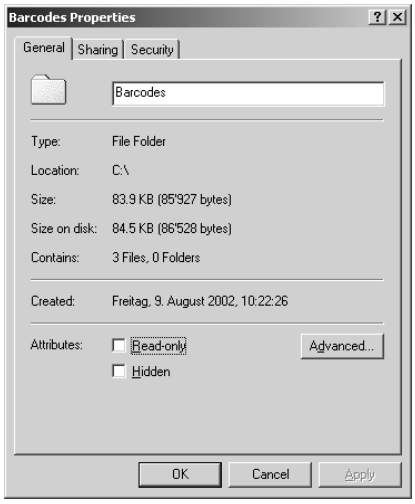
This Tool will provide information about the User Software installed.



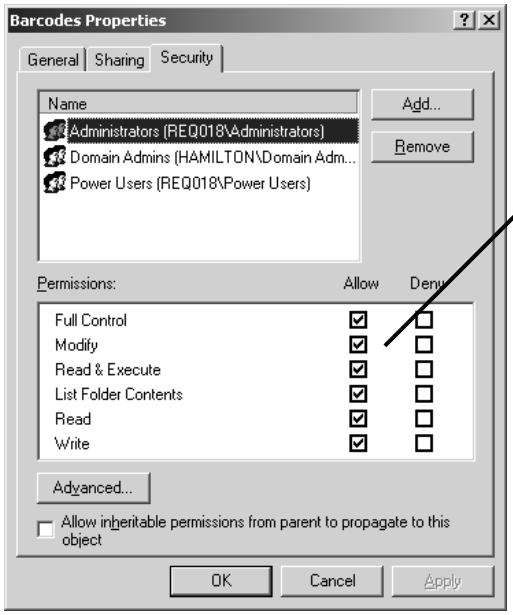
4.2.4.2 Check Access rights for C:\Barcodes

- Open Explorer
- Select Directory C:\Barcodes (if necessary create directory “Barcode” first) and right-click on Properties.





- select Security Tab

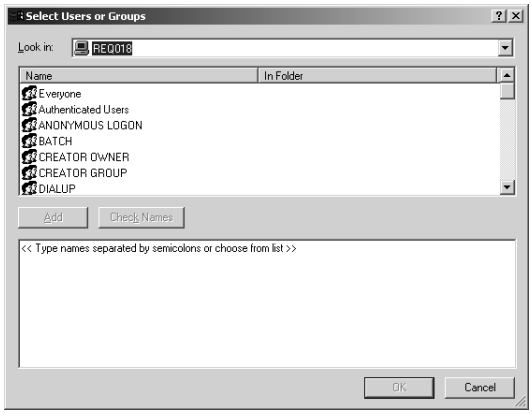


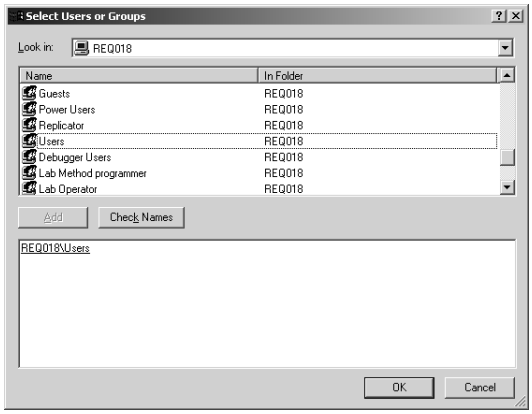
Check if 'Users' have Modify and Read & Execute rights as shown here.

If not, see next page…

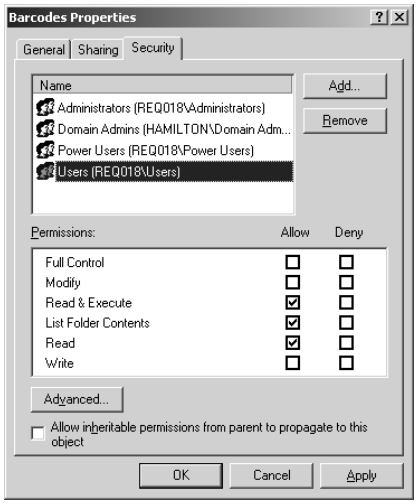
Check Access rights for C:\Barcodes (continued)

- If ‘Users’ do not have the permissions needed, click 'Add'
- Ensure current PC is selected in 'Look in'
- Select 'Users', click 'Add' and then ‘OK’



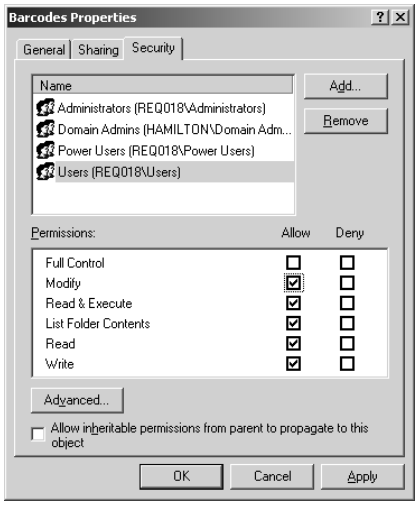


Allow 'Modify' for Group 'Users'



The ‘Permissions’ section of the window should then look like this.

Finally click ‘OK’



4.2.4.3 Accessories Installation (ML STAR IVD)

- Accessories CD comes together with Carrier
- Put CD into CD-ROM-Drive
- start Setup.exe Program File from the CD-ROM and carefully follow the instructions during installation.

4.2.4.4 Service Software Installation

Generally - see section 3 Service Software on page 3-1.

Attention: Do not leave the Service Software permanently installed on a Customer's PC as this will enable any user of that PC to "play" with the system - with potentially damaging results!

4.2.5 Software Presettings

4.2.5.1 Overview

User and Service Software are completely independent of one another. Therefore, settings such as "Com Port settings" must be made for both.

Basically:

- Using the Service Software, you can set the Microlab® STAR Instrument Configurations on the Master Board located inside the Instrument.
- Using the User Software, you can set the Microlab® STAR Instrument Configurations necessary for programming Methods.

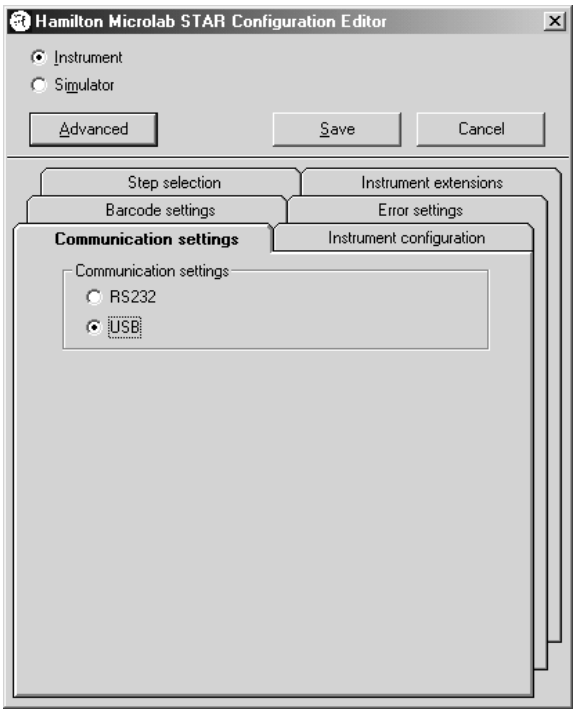
4.2.5.2 Instrument Configuration

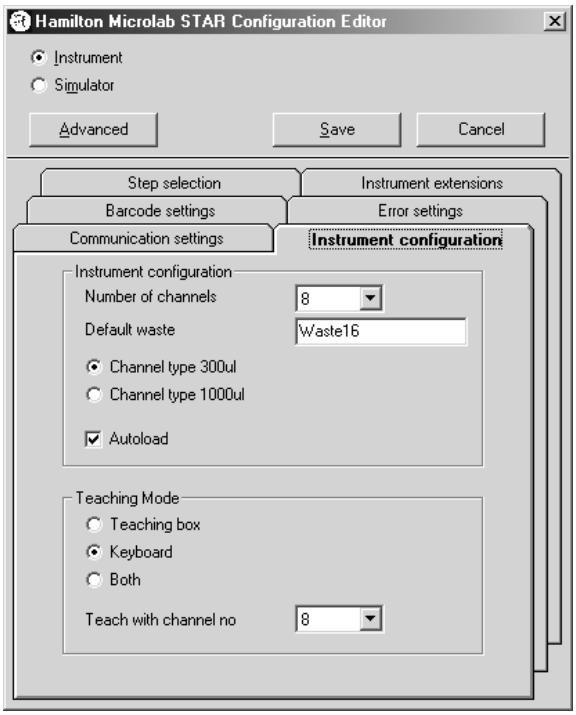
Check the Instrument Configuration by using service software and print out summary.

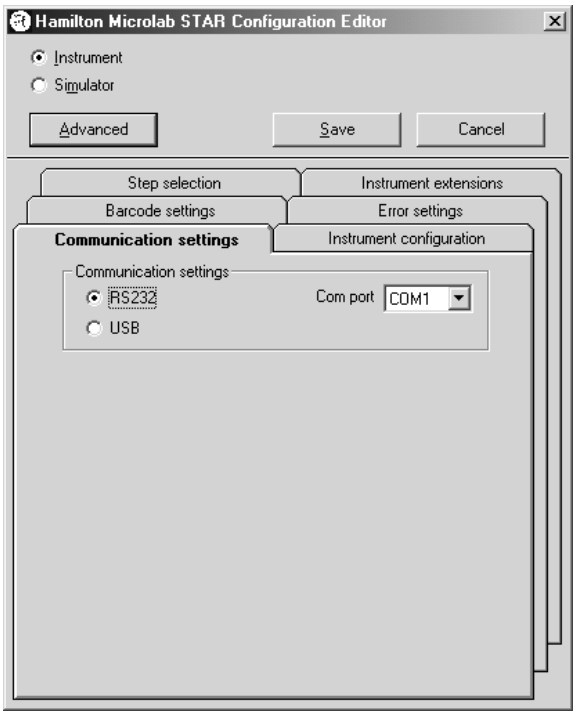
Note: The Instrument and Software Configurations must match. The User Software, during Method parsing, compares the settings of Instrument and User Software.

4.2.5.3 User Software settings

- Select ML STAR
- Menu: Tools ➔ ML STAR Configuration Editor ➔ Advanced

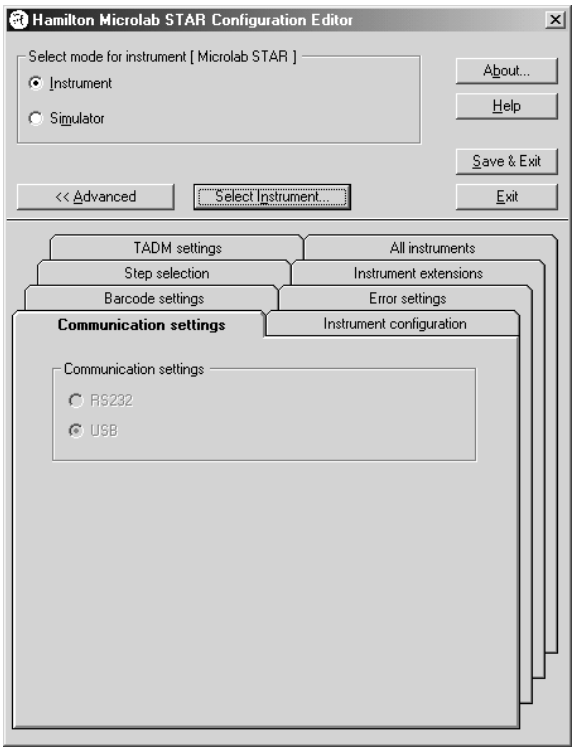


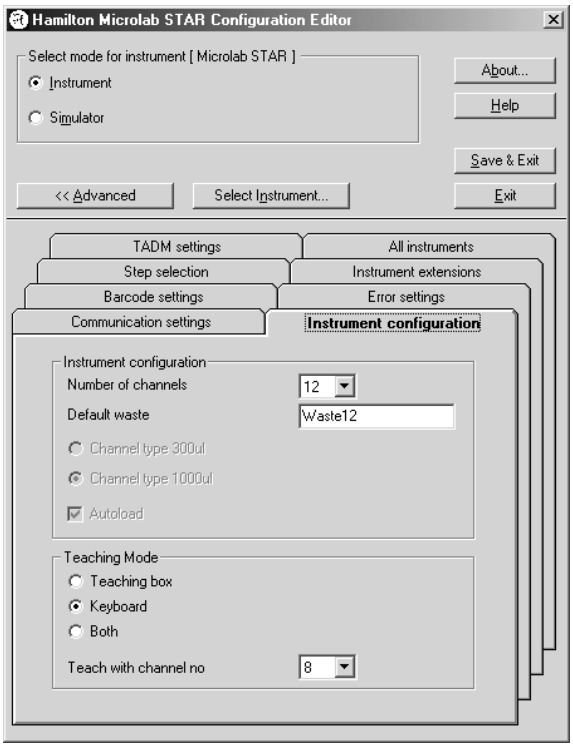


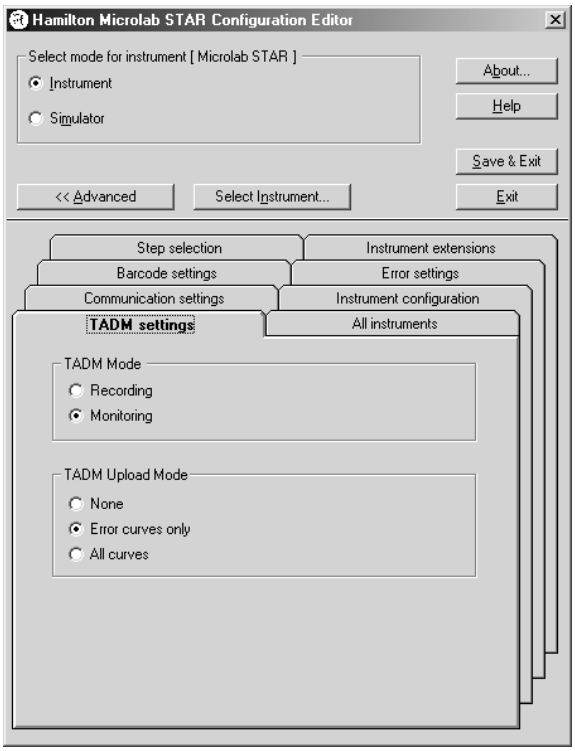


4.2.5.4 User Software settings (ML STAR IVD)

- Select ML STAR
- Menu: Tools ➔ ML STAR Configuration Editor…➔ Advanced







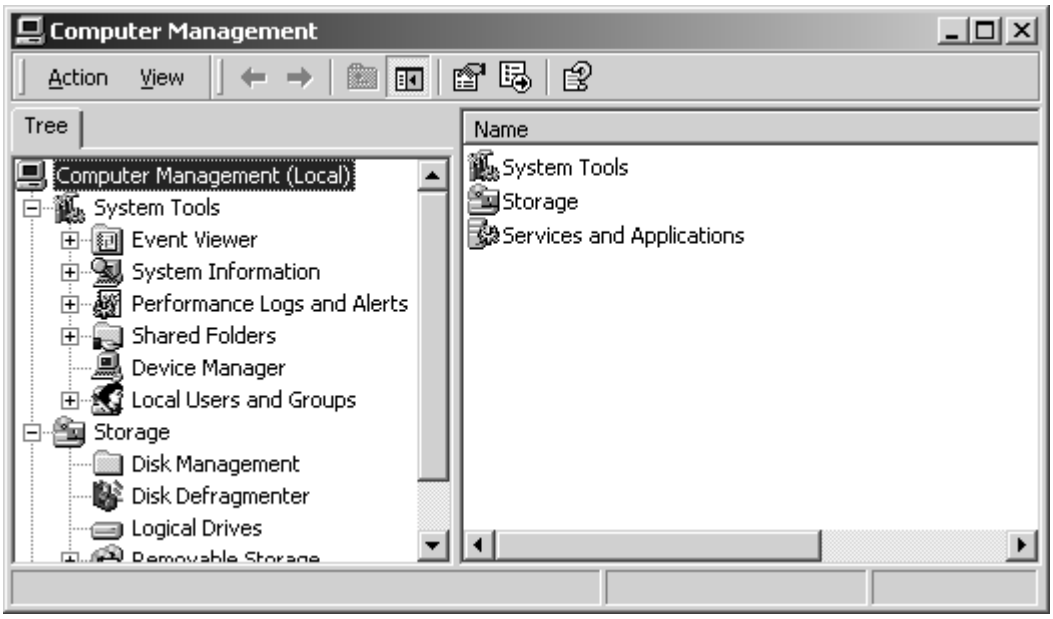
Differences from the ML STAR User Software are:

- Communication only via USB (not selectable)
- Channel Type only 1000 µl (not selectable)
- TADM settings Tab

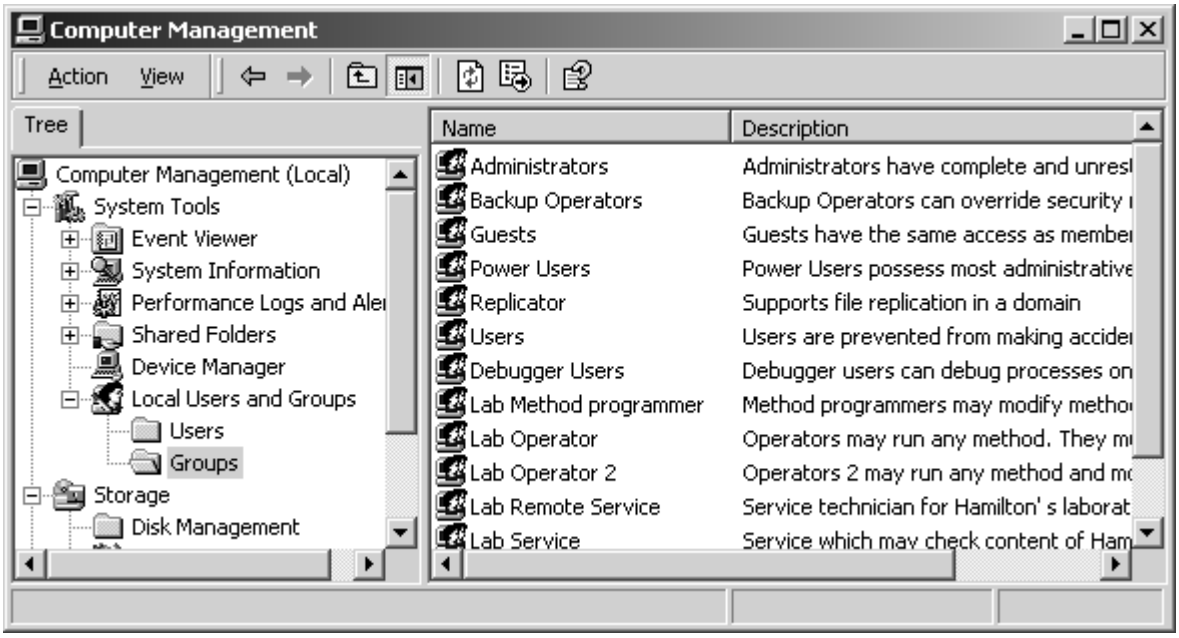
4.2.5.5 Defining Access Rights (ML STAR IVD)

After Installation of ML STAR IVD Software, Users working with the System must be registered. This action can only be done by a PC Administrator.

1. Select ‘My Computer’ and right-click on ‘Manage'.



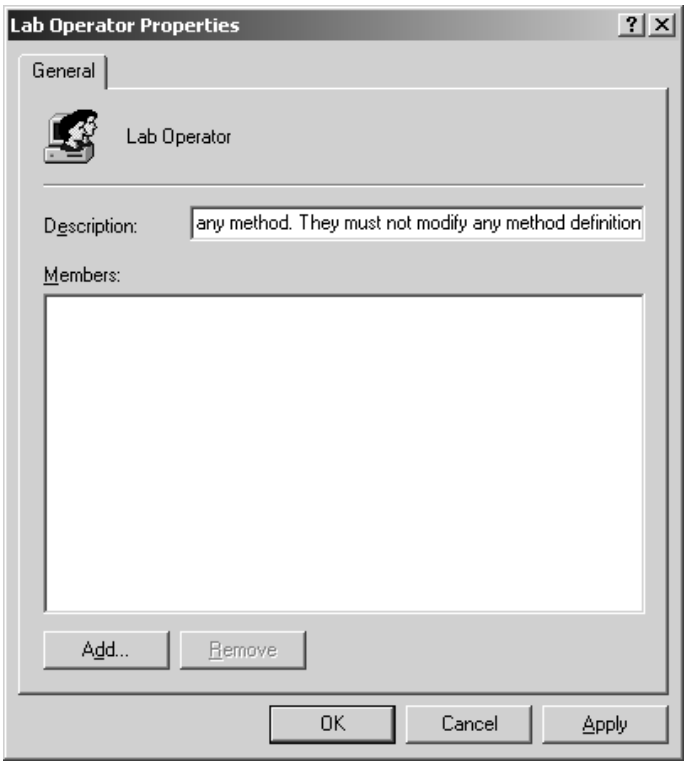
2. Open ‘Local Users and Groups’.
3. Click on ‘Groups’ and see the List of defined Groups.
   You will find groups such as ‘Lab Operator’, ‘Lab Operator2’, ‘Lab Method programmer’, ‘Lab Service’.



Here we want to enter all users who are engaged in routine laboratory work (members of the "Lab Operator" group).

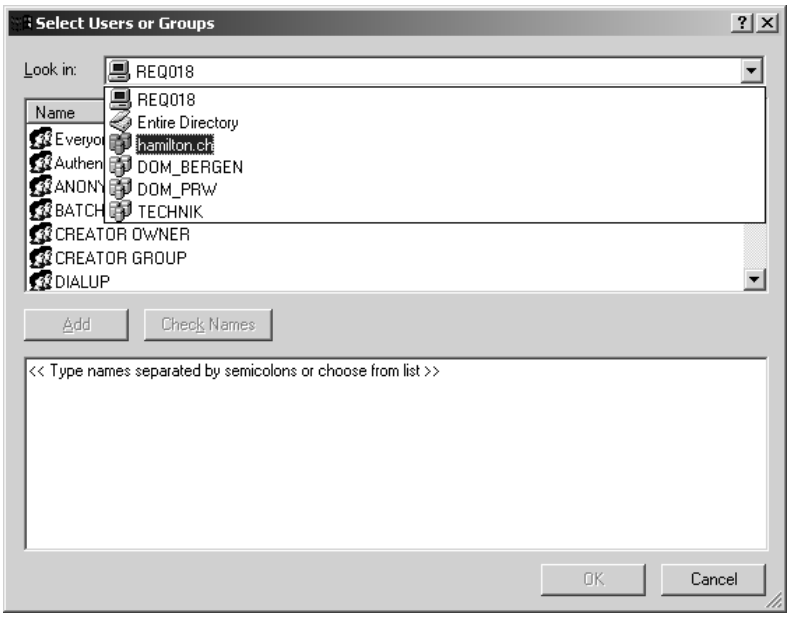
Defining Access Rights (continued)

4. Double-click on ‘Lab Operator’ and click ‘Add’.



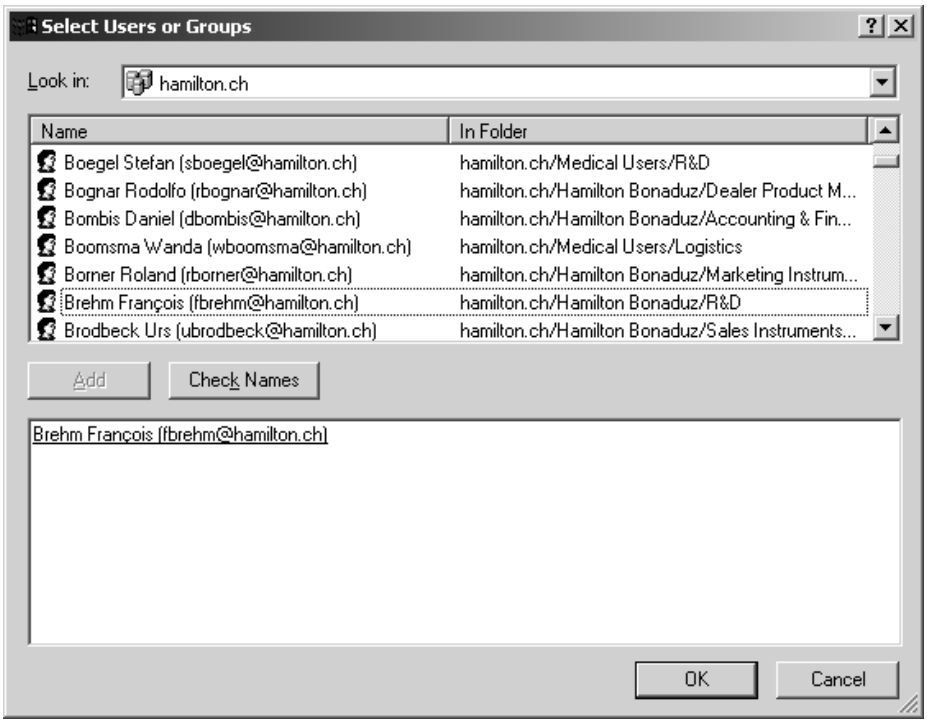
Decide if the User is to be defined only locally or also to a domain (in that case the PC is in a network environment).

5. If so, select the domain out of ‘Look in’ (this step is not necessary for local Users.)

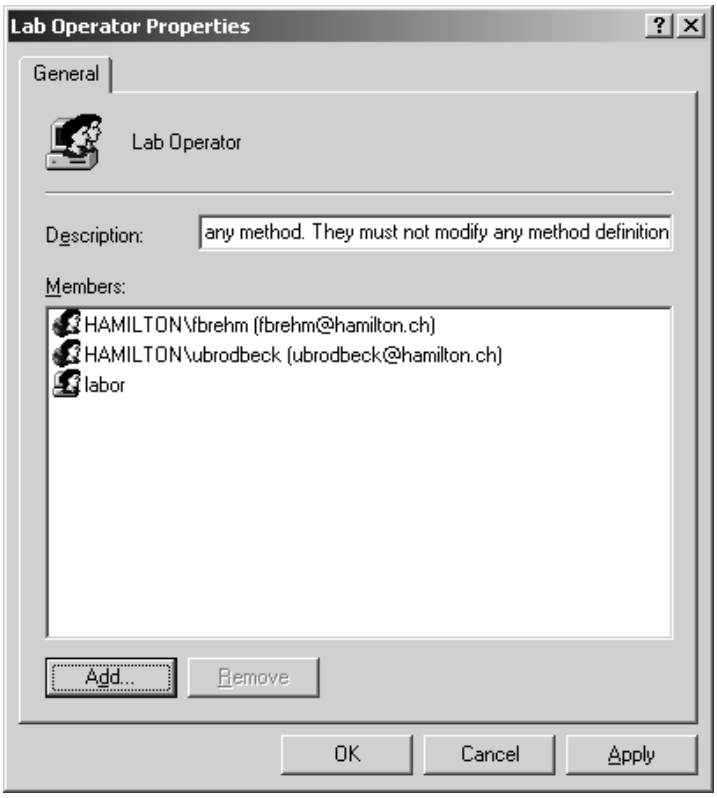


Defining Access Rights (continued)

6. Select ‘User’ from name column and click ‘Add’. The User will then be inserted into list.
   Repeat this Step for all ‘Lab Operator’ Users, then click ‘OK’



7. When the ‘Lab Operator’ List is complete with all ‘Users’ then click ‘OK’ – otherwise click ‘Add’.



Defining Access Rights (continued)

Repeat Steps 4 to 7 for the Users of the following Groups:

Group	User
'Lab Method Programmer'	Method programmer Laboratory Manager
'Lab Service'	Service Engineer

Check the successful installation by logging the specified Users on

*Attention: Users who have not been registered in this way cannot operate the ML STAR IVD Software – not even **LAN-Administrators.** The following error message is displayed in the case of unauthorized access attempts:*

4.2.5.6 Remote Access

It is the Customer's responsibility to prepare the operating PC for remote access. Ensure only read access is enabled.

- **Overview**

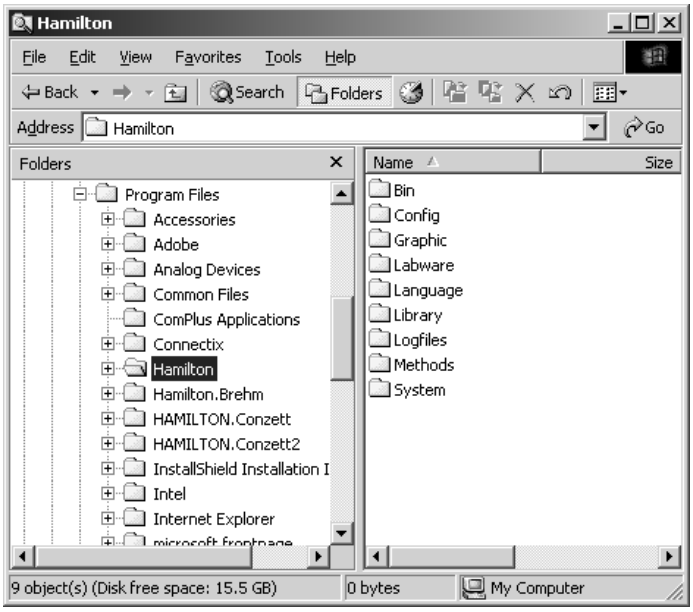
Steps	Responsibility
1. Provide Infrastructure for Remote Access (e.g. RAS-Server).	LAN manager at Customer site
2. Setup Account for Service engineer (e.g. HamService).	LAN manager at Customer site
3. Setup Share on ML STAR IVD PC.	LAN manager at Customer site, or PC Administrator
4. Setup Access rights for Service engineer on ML STAR IVD PC.	LAN manager at Customer site, or PC Administrator
5. Means of Connection (e.g. Telephone number), Account name and Password for Service engineer.	LAN manager at Customer site

- Steps 1 and 2
  are not elsewhere specified, because they are dependent on Network infrastructure at Customer site.
- Step 3
  is described below.
- Step 4
  refer to section 4.2.5.5 Defining Access Rights (ML STAR IVD) on page 4-20 ff. Then Select 'Lab Remote Service' from 'Local Users and Groups.
- Step 5
  must be determined together with the LAN manager.

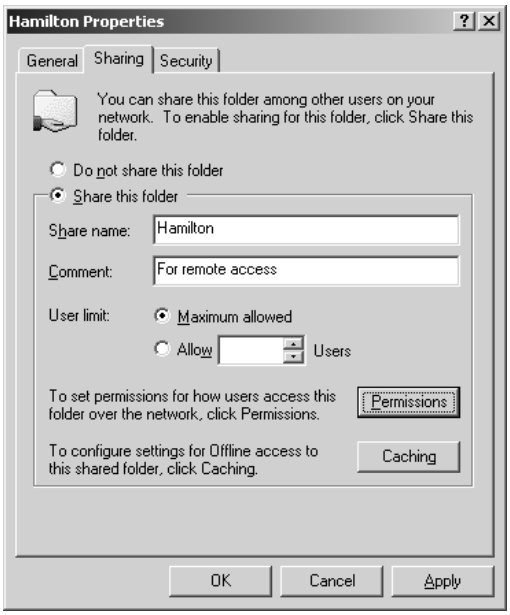
Defining Remote Access (continued)

- Step 3: Setup Share

3.1. Select ‘Hamilton’ (e.g. ‘C:\Program files\Hamilton’) and right-click on 'Sharing...'



3.2. Activate 'Share this folder', define Share name and optional Comment, then click ‘OK’



4.2.6 Adjustment and Calibration

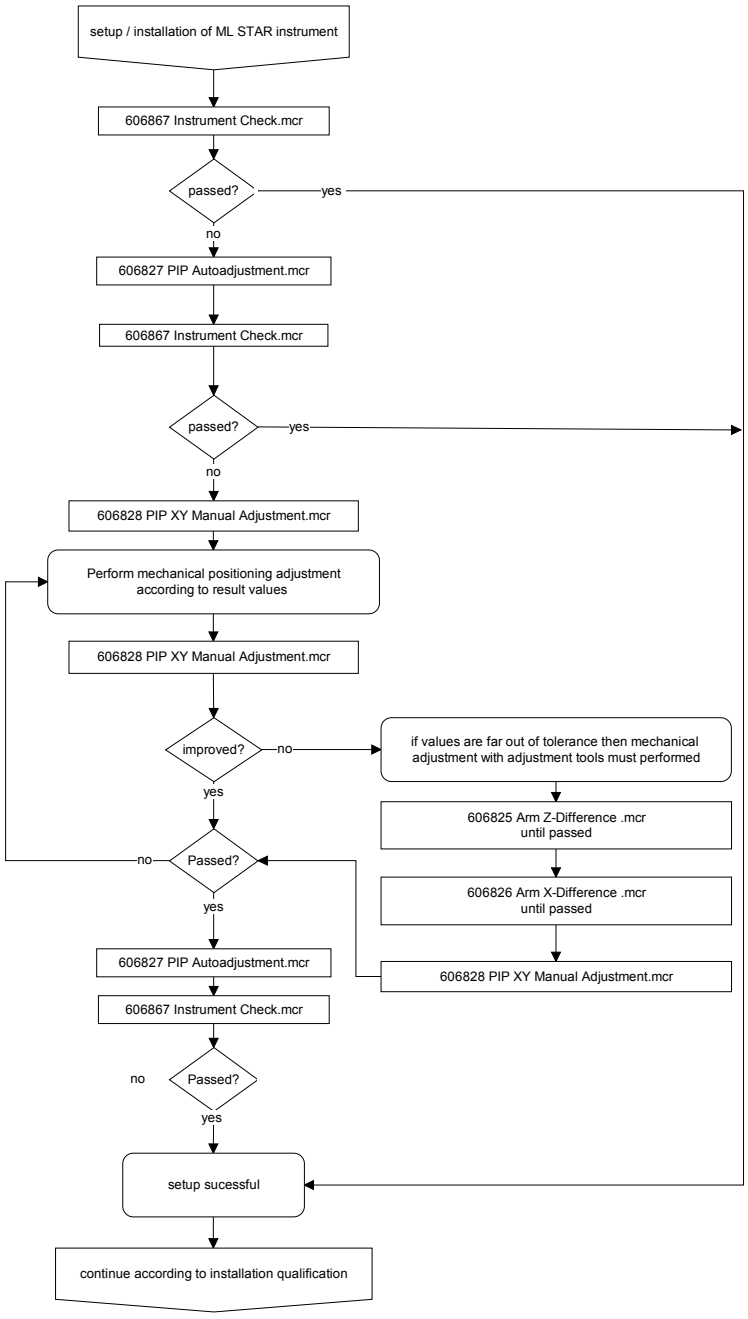
For general information see section 6 Adjustment and Calibration on page 6-1.

It is particularly important and necessary to adjust and calibrate the Pipetting Arm, the Pipetting Channels and the Autoload[7].
Adjustment and Calibration can only be done using the Microlab® STAR Service Software and the special adjustment / calibration tools.

[7] Microlab®-STAR Instrument with Autoload Option only

4.2.6.1 Instrument Check Procedure

Before running any adjustment programs as described in chapter 6 Adjustment and Calibration on page 6-1, perform an Instrument check procedure with Macro Program “INSTRUMENT CHECK.MCR”.



4.2.6.2 Automatic Adjustment

Only if results from instrument check procedure are out of range, perform an automatic Calibration by using the Channel Calibration Tool and Adjustment Program "PIP AUTOADJUSTMENT.MCR". All Calibration values will be newly defined according to the current state of the Instrument. If any corrective action must take place, refer to section 6 Adjustment and Calibration on page 6-1.

4.2.7 Weekly Maintenance (ML STAR IVD)

Run the Weekly Maintenance procedure from User Software.

4.2.8 Verification

Run the Volume verification (Verification Kit).

4.2.9 Performing a test run

For general information on how to create a Method, refer to the User Manual.

Create a Method for Tip Pickup, Aspirating, Dispensing and Tip Eject. Observe the precision of movements especially during Tip Pickup. Decide if the Instrument is ready to run or if any corrective action must take place.

For example, if Tips are not picked up, or only after several tries (Firmware error handling), adjust and calibrate the Pipetting Arm and Channels.

For Instruments with Autoload Option, extend your Method with a loading and unloading Step involving the Tip Rack Carrier.

If, during loading or unloading, the instrument reports any “Steps lost”, calibration must take place.

4.2.10 Service Software Removal

After successful installation remove Service Software from Customers PC

Generally - see section 3.4 Deinstallation of Service Software on page 3-7.

Attention: Do not leave the Service Software permanently installed on a Customer's PC as this will enable any user of that PC to "play" with the system - with potentially damaging results!

5 Disassembly

5.1 Overview

The initial deinstallation and packing of the Microlab® STAR may only be carried out by Service Technicians trained and / or authorized by HAMILTON Bonaduz AG. For proper deinstallation follow the order of instructions given in this section.

Attention: Exercise great care if touching the Channels when packing the Instrument.

5.2 Checklist for Deinstallation

To ensure a fast and proper deinstallation process follow the checklist. For detailed descriptions see the subsequent chapters of this manual.

Attention: Do not skip any of the items in the checklist below as this may lead to an unsuccessful deinstallation.

1. Decontaminate ML STAR Instrument and its components
2. Ensure no Tips or needles are left on Pipetting Channels
   - Remove any still present
   - Dispose of Tips
   - Decontaminate Needles
3. Disconnect ML STAR Instrument
4. Remove all Carriers, Spillage Trays, Loading Trays and the Waste Station from ML STAR Instrument
   - Remove from ML STAR Instrument and decontaminate them
5. Remove ML STAR Instruments Panels
6. Pack ML STAR Instrument into Shipping Crate.
7. Carry out Software deinstallation

Attention: Good Laboratory Practices should be observed when disposing of consumable items such as used plates, disposable tips, steel needles, etc. Exercise care if touching the Channels when repacking the Instrument.

5.2.1 Decontamination

Wipe exposed surfaces with desinfectant liquid.

5.2.2 Removing Tips or Needles

- Before Disassembling anything, ensure that there are no Tips or Needles remaining on the Pipetting Channels.
- Assuming the Instrument is working, Tips or Needles may be ejected by starting any Method which must have an initialization at the very beginning. The Method may be aborted after Tip ejection.

  or:

- By using the Service Software Menu Control ➔ Single command ➔ Send command P#MD (where # is the Pipetting Channel Number). A minimum initialization is provided by sending Single Commands P#YI and P#ZI prior to the P#MD Command.

  or:

- By using the Service Software Menu Control ➔ Movement/Sensors ➔ Pipetting Channel ➔ Initializing each squeezer drive.

  or:

- After Instrument has been switched off, turning the squeezer spindle by hand to release the O-Ring coupling.

Attention: Tips or Needles must not pulled away from Channels by Hand as this may cause damage to the O-Ring and the squeezer mechanism of Pipetting head.

5.2.3 Disconnect ML STAR Instrument

Switch off and unplug the Microlab® STAR Instrument. Disconnect it from the PC.

5.2.4 Remove all items on ML STAR Instrument

All Carriers, Tip Waste, Spillage Trays and loading trays[8]. Pack the accessories in the accessory boxes.

5.2.5 Remove Panels

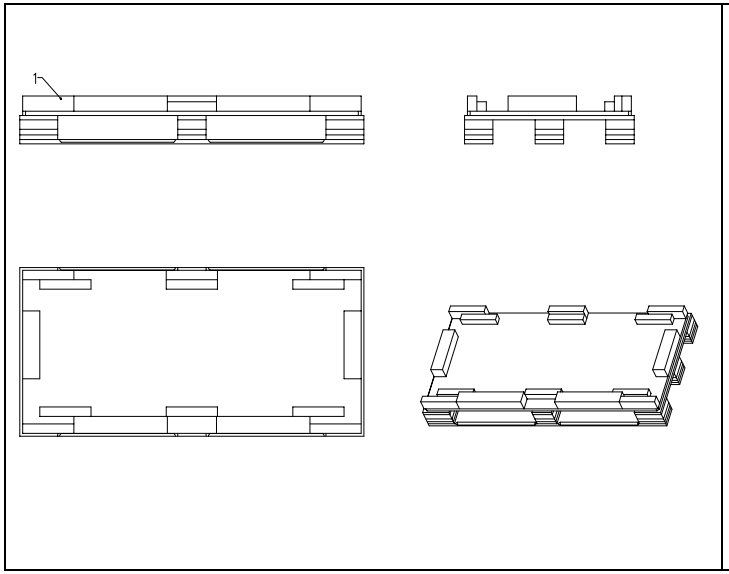
Remove ML STAR instrument's side panels.

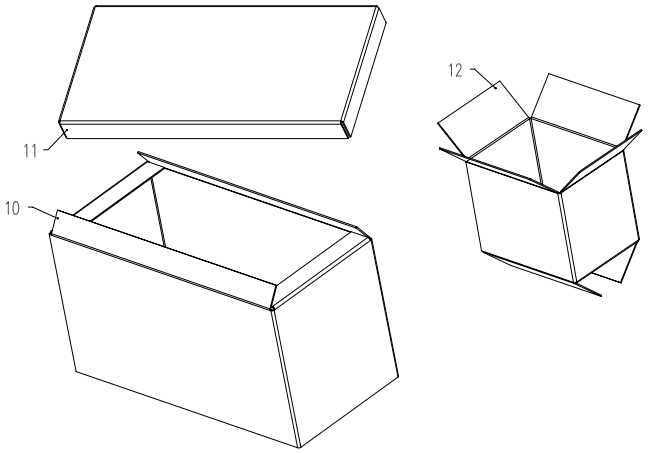
On ML STAR IVD Instruments back cover must be removed as well.

[8] Microlab®-STAR Instrument with Autoload Option only

5.2.6 Packing the ML STAR Instrument

Use ML-STAR PACKAGING P/N 220308 to ensure adequate packing and shipping.





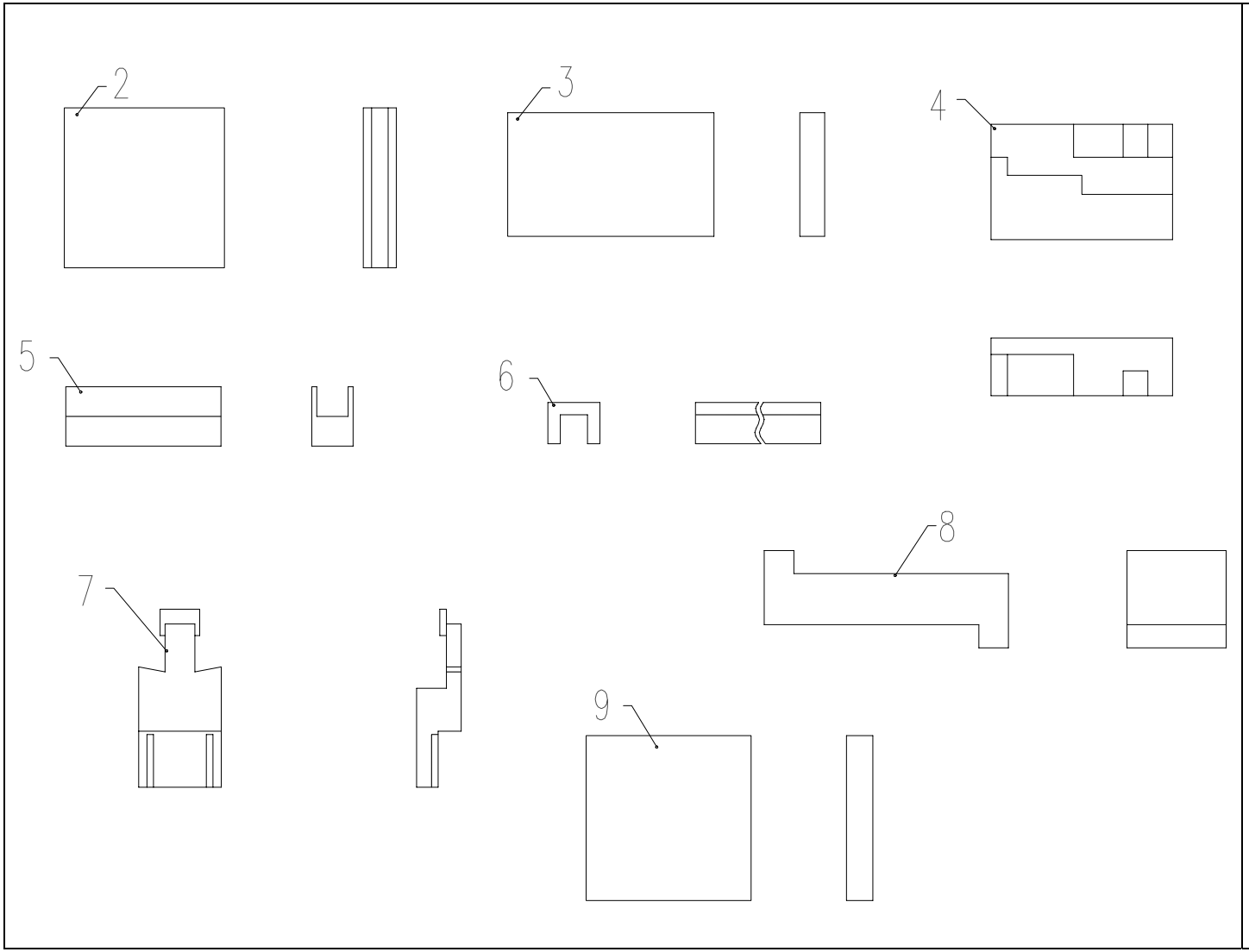
Item:

1 Pallet

10 & 11 Surrounding Cover with Top

12 Accessories Boxes (2 pieces)

Packing the ML STAR Instrument (continued)



Item:

2. Square Foam (1 piece)
3. Channel protection foam blocks (between the Channels) (25 pieces)
4. iSwap protection block (1 piece)
5. Channel supporting block (1 piece)
6. U-shaped holding bars (2 pieces)
7. Pipetting Arm supporting Block (1 piece)
8. Z Profiles block (2 pieces)
9. Square Foam (2 pieces)

ML-STAR packaging (continued):

⚠

Attention: Prior to any transportation or movement, Instrument must be packed with its original supporting and protective foam, placed onto the original Pallet and finally packed into its protective box.

General notes:

The following Procedure is described for a ML STAR Instrument with Autoload option. Disregard these sections if a Manual Load Instrument is to be packed.

When the left or the right side of the ML STAR Instrument is mentioned in these instructions, the point of view is always from the front of the Instrument (the operator's viewpoint).

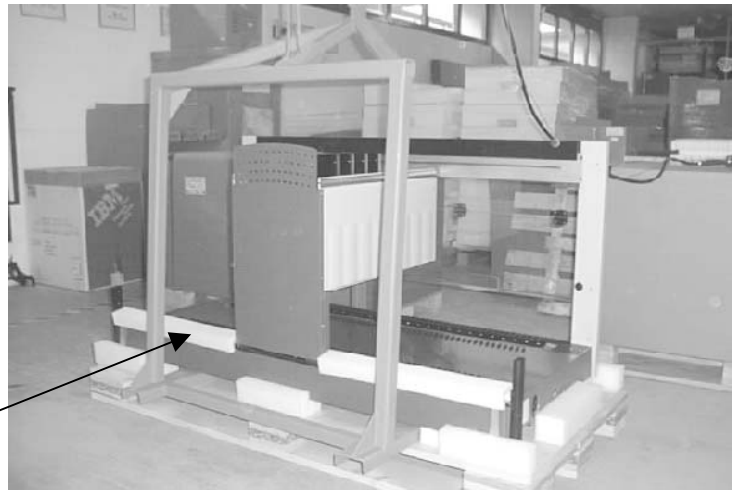
1. Lift Instrument onto Pallet (shown here is Hamiltons ML STAR Fork Lift.

   ⚠

   Attention: Spillage Trays must be removed prior to placing onto pallet.

   Auto Load must be placed / moved either onto the right or left side of the Instrument[9].

   Pipetting arm – U-shaped protective foam bars go on X linear guide.



[9] Microlab®-STAR Instrument with Autoload Option only

ML-STAR packaging (continued):

2. Uncover pipetting arm's top housing and carefully place the protective foam blocks between the channels as shown in picture.

   To insert these protective foam blocks into place, you have to move the channels. Move them gently by hand to the appropriate position and insert the foam blocks between them.

   If an iSWAP is present push it gently towards the rear, protect it with the iSWAP protective block and tie it to the back.

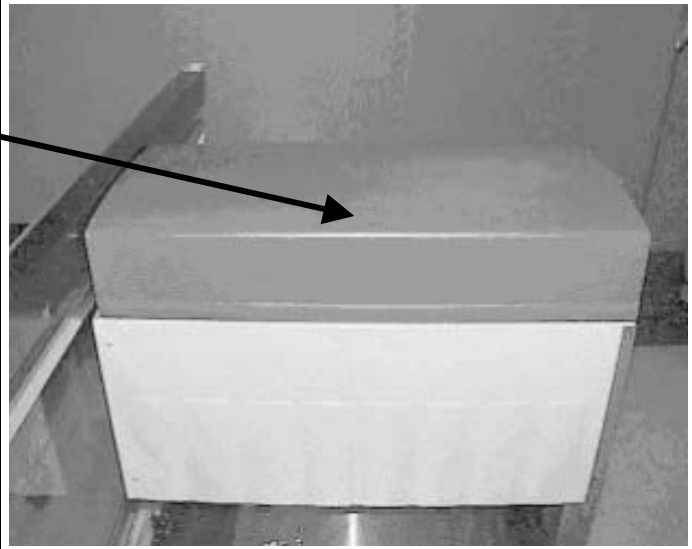
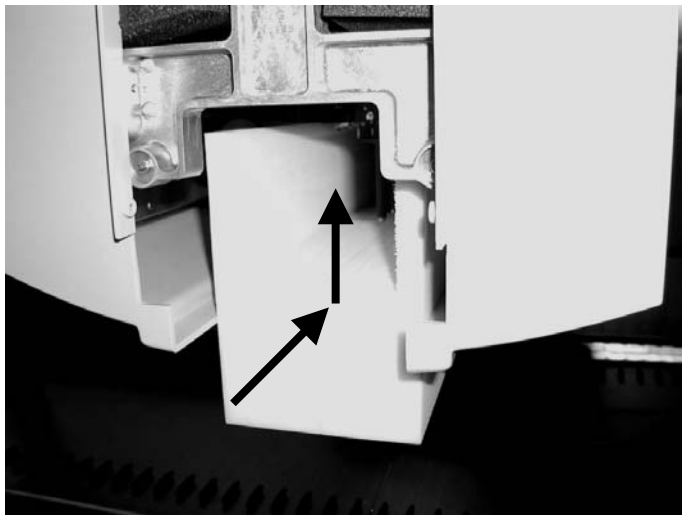
   ⚠

   Attention: Do not use adhesive tape to attach iSWAP to the back as this may damage the paint on the pipetting arm housing.

Packing the ML STAR Instrument (continued)

3. Tie the remaining protective foam blocks for the channels together and place this package into the empty space of the pipetting arm housing. This will help to hold all the channels in place.

Packing the ML STAR Instrument (continued)

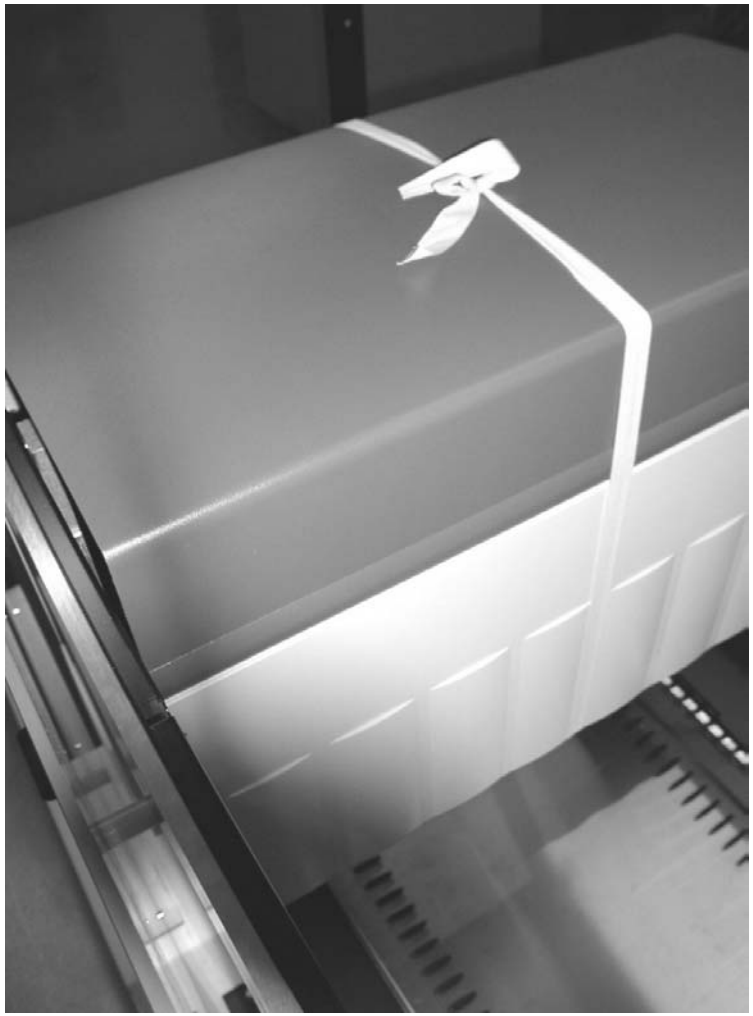
4. Put pipetting arm's top housing in place.	
5. With the pipetting arm's front housing removed, push channel supporting block towards the rear into the pipetting arm housing. Then push it very carefully upwards to the channels.	

Packing the ML STAR Instrument (continued)

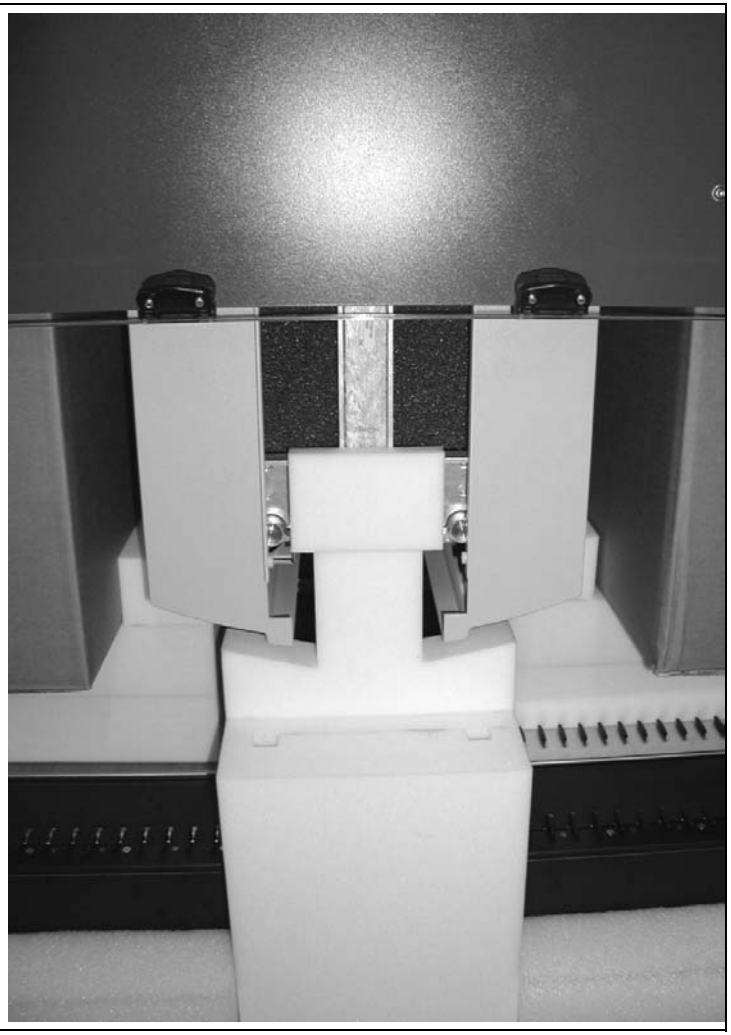
6. Tie channel supporting block onto pipetting arm with a suitable piece of cord.

⚠

Attention: Do not use adhesive tape as this may damage the paint on the pipetting arm housing.



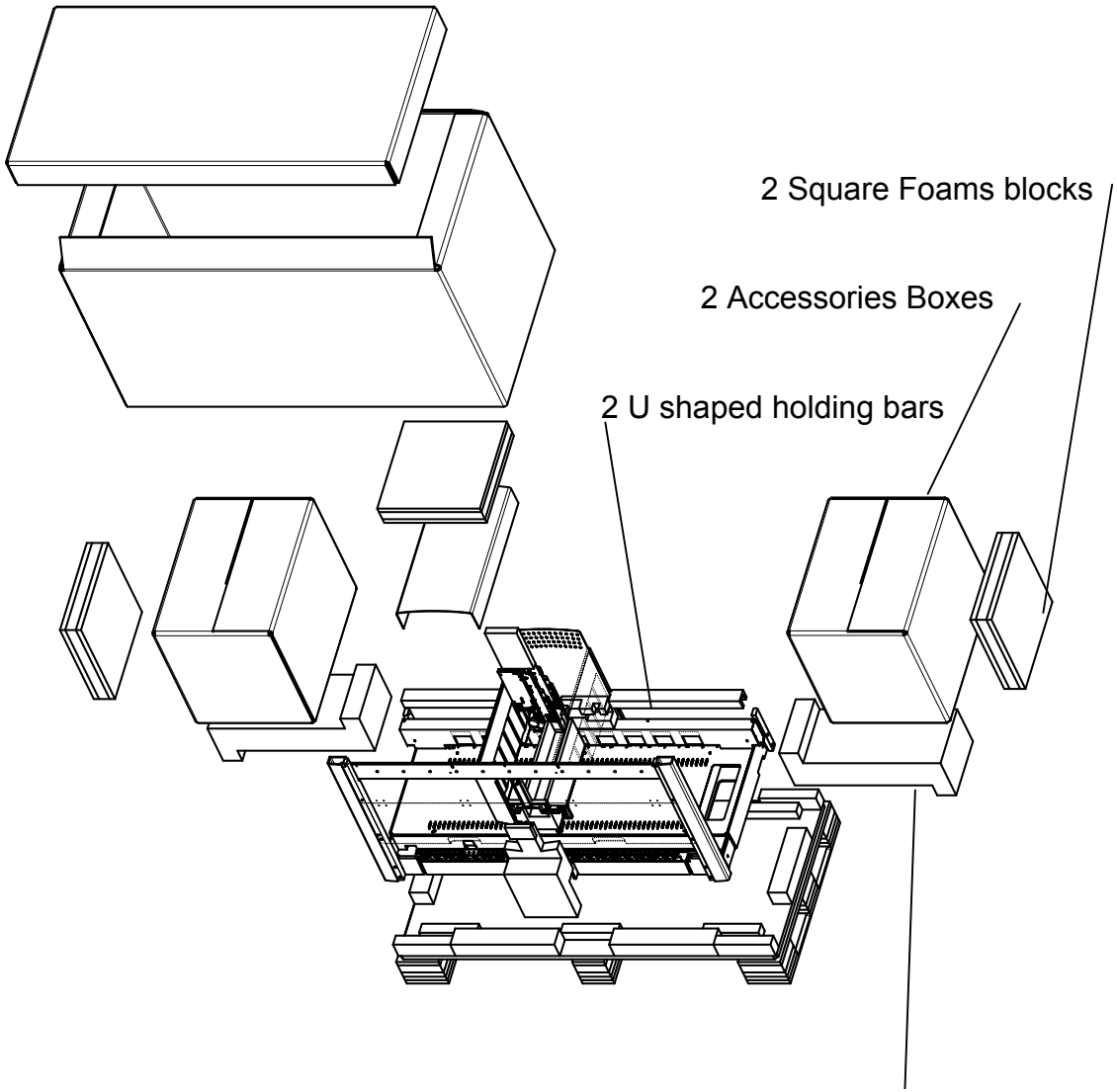
ML-STAR packaging (continued):

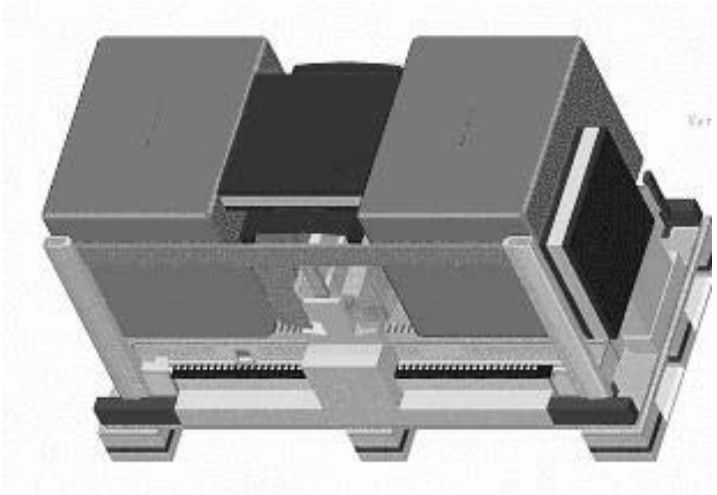
7. Finally place pipetting arm supporting block as shown in picture into the pipetting arm, and re-assemble front housing to pipetting arm.	

ML-STAR packaging (continued):

8. Place all accessories into the accessories boxes. Accessories include: • Wrapped loading trays and waste station. • Carriers in their boxes • Both spillage trays Ensure no movement inside accessories boxes. Fill up empty space with crumpled paper, protection foam etc. Then close accessories Box (use adhesive tape).
9. Place accessories boxes onto the Z-shaped blocks Both Z-shaped blocks go onto instrument's deck panel (left and right beside pipetting arm).
10. Square foam block placed above pipetting arm's top cover serves as a buffer between the two accessory boxes.
11. Lower the packing surround from above onto instrument on pallet.
12. Place additional square foams between accessory boxes and cover of packing surround.
13. Place side panels left and right on top of both accessory boxes.
14. ML STAR IVD instrument's back cover must also placed on top of the two accessory boxes. Avoid scratches on panels and cover.
15. Close instrument packing surround with its top cover and tie up the crate securely.

ML-STAR packaging (continued):



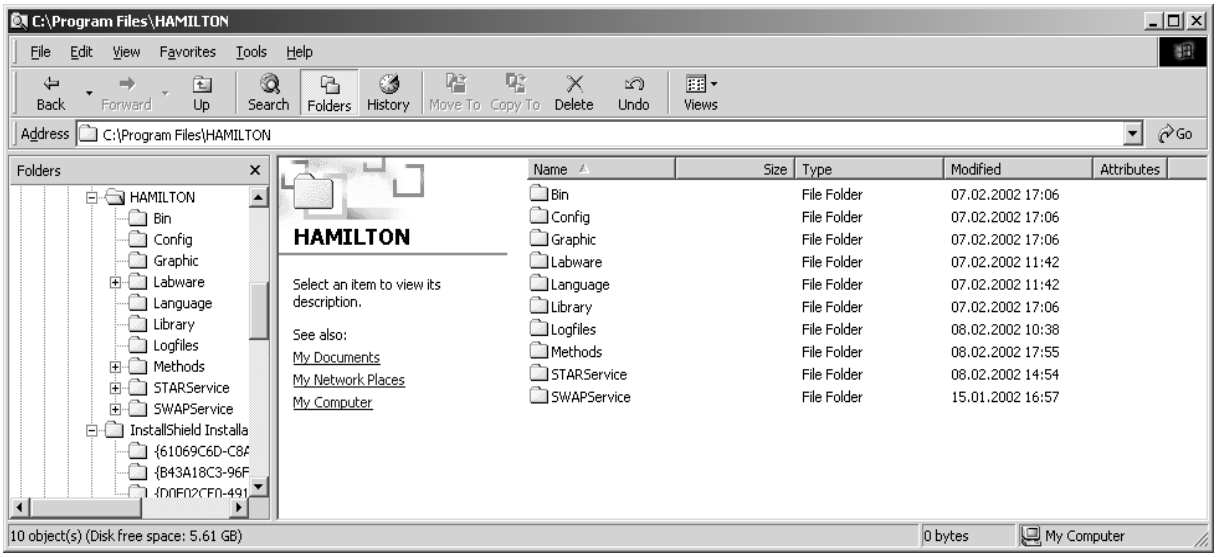


Instrument on pallet without top and surrounding covering

5.2.7 User Software Deinstallation

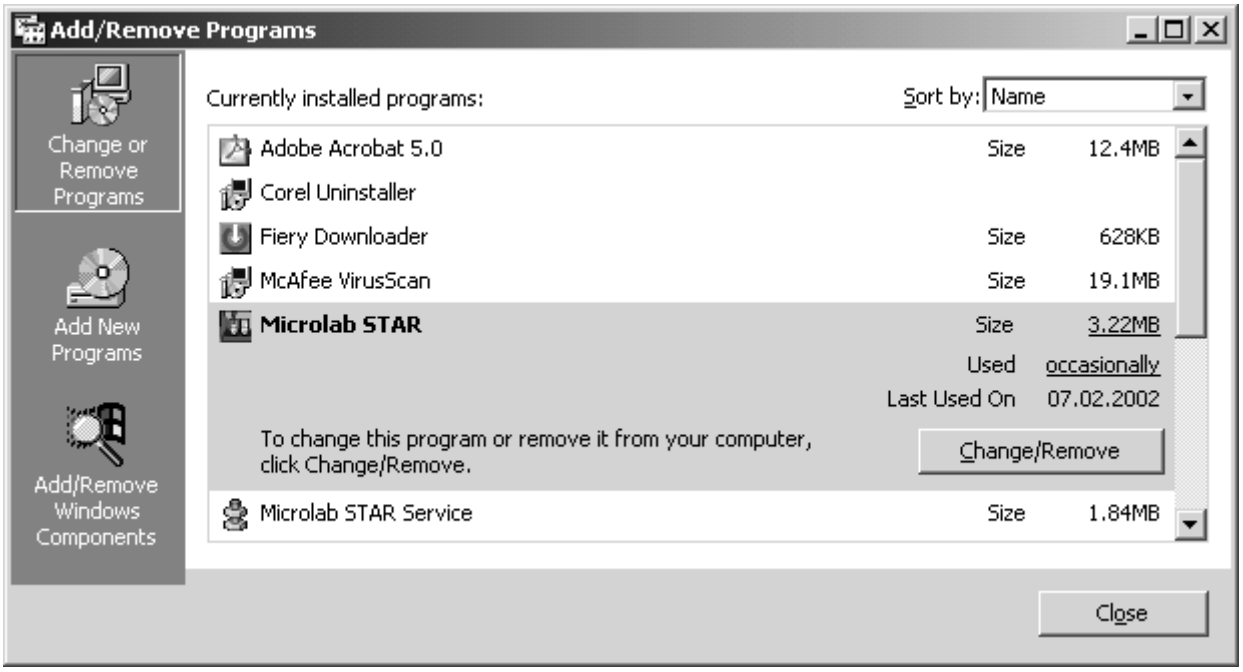
When removing the ML STAR User Software, you will find that no data such as METHODS, LABWARE LOGFILES, etc. are removed. The Software root structure remains the same.

However, it is strongly recommended that you Back up Methods, User defined Labware, Liquid classes etc. before removing current software.



User Software Deinstallation (continued)

Select START ➔ SETTINGS ➔ SYSTEM ➔ ADD / REMOVE SOFTWARE and search for ML STAR - as well as for PHOENIX Components - and remove them if still present.



After deinstallation of User Software ensure that no more components are left on the PC.

If PHOENIX and Microlab STAR Components are not able to be removed then select ‘run’ from ‘start menu’ and type in "regedit" to enter the registry section of the PC's operating system.

Select HKEY_LOCAL MACHINE ➔ SOFTWARE and delete remaining Phoenix and / or Microlab STAR Folder.

6 Adjustment and Calibration

6.1 Overview

Adjustment and calibration are an important part of the installation procedure, and may also be required following maintenance and repair work. The purpose of adjustment and calibration is to ensure that all pipetting channels are using the same set of coordinates and moving in the same space. It guarantees the best performance for tip pick-up and pipetting in very small wells.

Whenever a Pipetting Arm, Pipetting Channel, Pipetting Head, Autoload drive[10] or the Master PCB is removed or replaced, run the appropriate Adjustment Macro Program from the Service Software and decide if any corrective action needs to be undertaken.

After delivery of the instrument, run the check program and only perform an adjustment if values are out of range.

Adjustment and calibration is also needed when problems occur (e.g. in running an application, Channel positioning, Tip pick-up and ejection, or when Steps are Lost) and corrective action is indicated.

After any adjustment and calibration, the functioning of the component concerned must be verified to ensure a properly working Microlab STAR Instrument.

Attention: before starting any Adjustment and Calibration Work empty and decontaminate deck panels (e.g. remove all Carriers and Labware from deck)

Conditions:

All Guides in X-, Y- and Z-Direction must be straight i.e. may not be bent and must ensure a parallel movement to the corresponding axis.

If pipetting heads are replaced, ensure a proper mounting onto channels.

The first three degrees of freedom of the Pipetting Channel must be perfectly adjusted before running any Adjustment Program. Typically when a Pipetting Channel is replaced, or when bad adjustment values indicate the requirement of any corrective actions.

[10] Microlab®-STAR Instrument with Autoload Option only

6.1.1 The Art / Principle of Adjusting

To reach an optimum with adjustment the concept “Degrees of freedom” must be understood:

- Tilting around an axis means rotating or turning around a specific axis.
- Moving on an axis means parallel shift on that specific axis

It is absolutely necessary to follow the order of adjustment and iterate an adjustment procedure until the criteria are met. If iteration is not successful start adjustment again from the very beginning.

6.1.2 Interpretation of correction values

A correction Value of "–7" means a necessary shift of 7 Units away from the direction of the coordinates.

And a correction Value of "16" means a necessary shift of 16 Units in the direction of the coordinates.

For coordinates, refer to section 2.1 Overview on page 2-1.

6.1.3 Order of adjustment and calibration

1. Adjustment of Pipetting Channels and Heads

- Befor running any adjustment program Pipetting Channels with their heads must be properly mounted and adjusted with Channel Adjustment Tool P/N 173952 onto Pipetting Arm.

2. Adjustment of Pipetting Arm

- Adjust Z alignment parallel to deck X- and Y-Axes by moving the front guide bar on the left and right side up or down as appropriate.
- Adjust X alignment to deck perpendicular to Y-Axis by tilting Pipetting Arm (around Z-Axis) on its slides in the back.

3. Calibration of Pipetting Arm with Channels

- After adjustment of Pipetting Channels and Pipetting Arm, all Pipetting Channels and Heads on Pipetting Arm must have the same orientation in X-, Y- and Z-Direction.

4. Adjustment of Autoload[11]:

- Adjustment (synchronization) of Cogwheels

5. Calibration of Autoload[12]:

- Calibration in X, Y and Z, independently from Pipetting Arm with Channels.

See section 6.2 Adjustment Tools and Macro Programs on page 6-5 for a complete list of Tools and Macro Programs.

Note: After adjustment and calibration have been completed, you should perform a Check Run and a verification.

General notes

Always follow the order of adjustment described above and summarized in section 6.2 Adjustment Tools and Macro Programs on page 6-5.

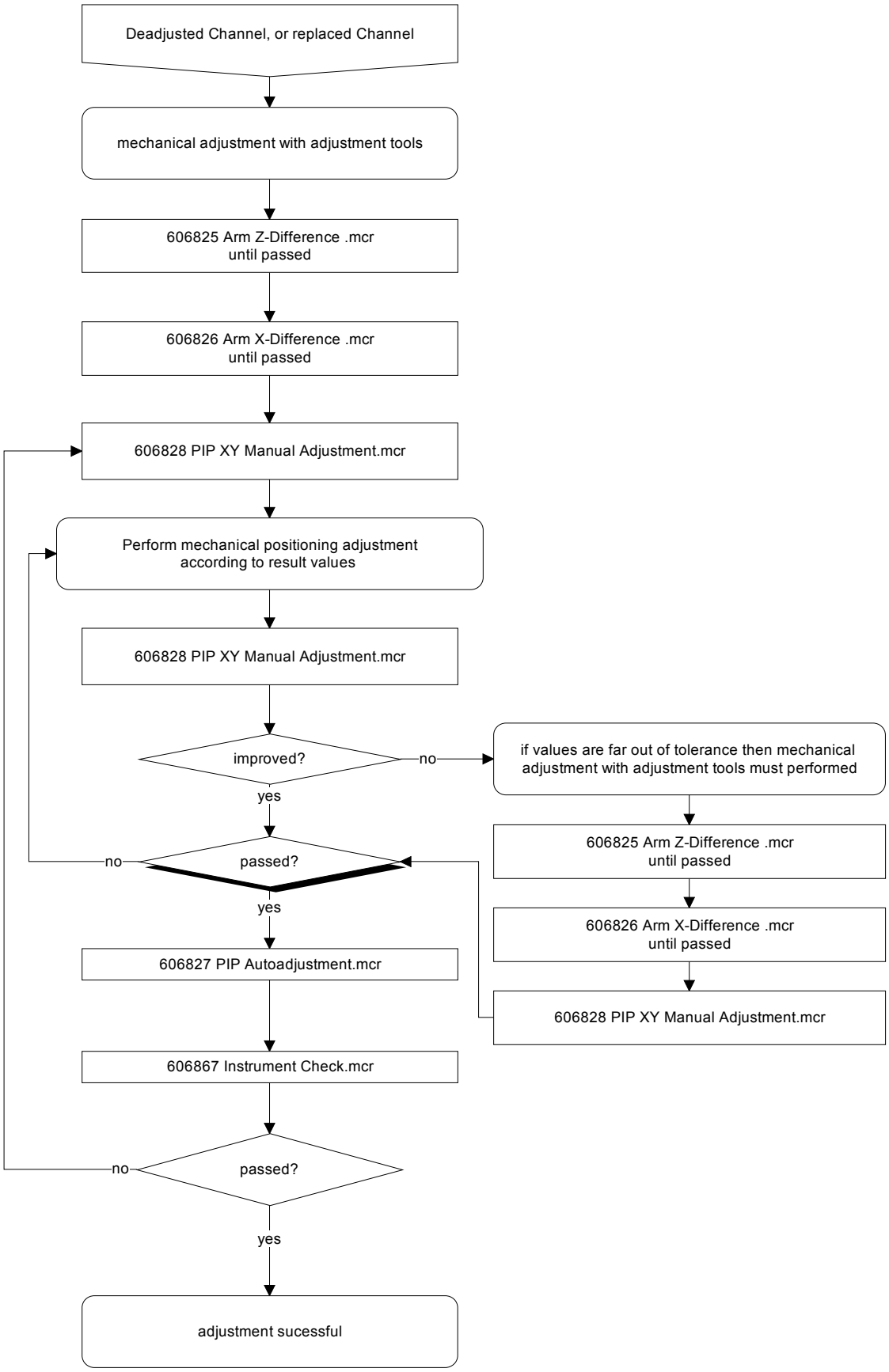
However, for installation and quick check procedures, the Instrument Check Macro Program (INSTRUMENT CHECK.MCR) should be performed to decide if the instrument is ready to operate.

If the values according to the Instrument Check Macro Program are out of range, then the automatic calibration Macro Program (PIP AUTOADJUSTMENT.MCR) must be started to generate new calibration values with the current state of the hardware.

In consequence it may necessary to start a complete adjustment and calibration procedure, following the order already described.

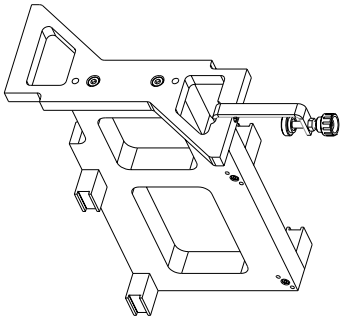
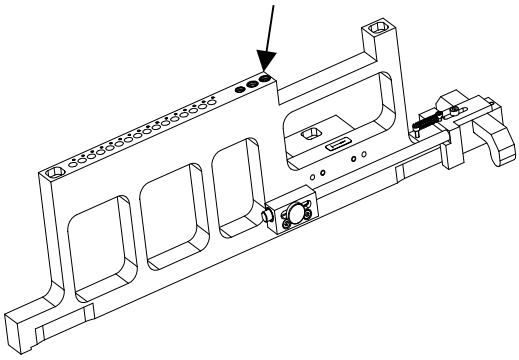
[11] Microlab®-STAR Instrument with Autoload Option only
[12] dito

Order of adjustment and calibration

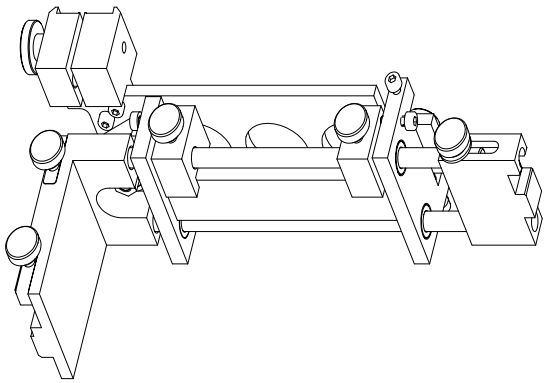


6.2 Adjustment Tools and Macro Programs

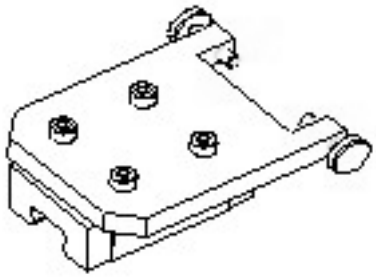
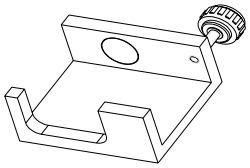
6.2.1 Tools for Pipetting Arm and Channels

Tool	Description
Channel Adjustment Tool P/N 173952 	For mechanical Channel Adjustment on Pipetting Arm. Must be used for preadjustment whenever a Channel is replaced in Order to mount the new channel on the Pipetting Arm. Predefines: • Parallelity (alignment) in Z Direction in functional dependence on X- and Y-Axis. • Linearity (alignment) of all Channels in Y-Axis.
Channel Calibration Tool P/N 173960 Z- Tool P/N 173968 	Reference for Pipetting Arm Alignment / Adjustment and Pipetting Channel Calibration Together with the Adjustment macro programs, ensures perfect alignment of Pipetting Arm and all Channels. All Pipetting Channels must be mounted and adjusted with Channel Adjustment Tool first, then calibration with Channel Calibration Tool can take place. A Pointer (Z Tool P/N 173968) is included with the Channel Calibration Tool. CO-RE Tips for Adjustment P/N 235920 can be used with Macro 'PIP ALIGNMENT WITH LLD.MCR'.

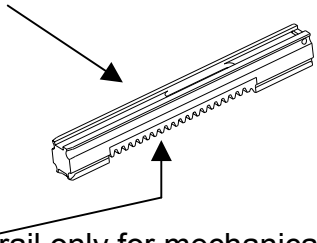
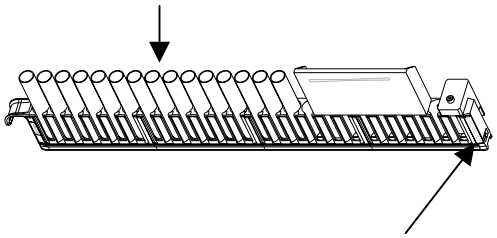
Tools for Pipetting Arm and Channels (continued)

Tool	Description
Channel Positioning Tool P/N 182960 	For mechanical Channel Adjustment on Pipetting Arm. According to the results from the PIP XY MANUAL ADJUSTMENT.MCR, this tool helps in adjusting (fine tuning) channels.

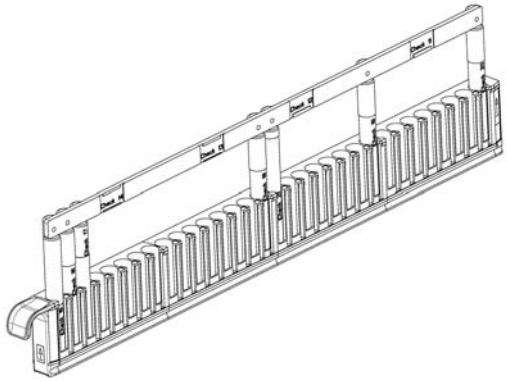
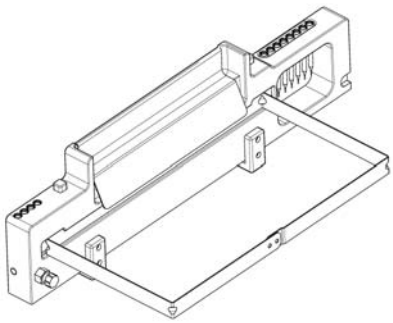
Tools for Pipetting Arm and Channels (continued)

Tool	Description
Pipetting Arm Alignment Tool P/N 173956 	Together with Channel Calibration Tool this facilitates Pipetting Arm alignment in X Direction. Two Pipetting Arm Alignment Tools are placed on the X-Guide, on the left and right sides of the uncovered Pipetting Arm.
Front window Magnet P/N 173950 	Bridges the Front window switch and enables the Microlab® STAR Instrument to be run with Front window open. It is mounted on the left vertical Post. *Hint: The front window may also deselected in the configuration settings (use Service Software).* ⚠ *Attention: Beware of the Pipetting Arm when it is moving on the Instrument.* *Do not forget Front window Magnet on the customer's ML STAR Instrument. This item is intended for use by trained Service Technicians only.* *Alternatively, if you deselected the front window in the configuration settings, be sure to re-select it now.*

6.2.2 Tools for Autoload Adjustment

Tool	Description
Autoload Calibration Tool P/N 173981 Groove for automatic positioning in X, Y and Z Direction of Autoload drive  Cog rail only for mechanical Cog wheel synchronization.	Supports mechanical Cock wheel synchronization and automatically positioning in X, Y and Z Direction of Autoload drive.
Autoload Sensors Adjustment Tool P/N 173980 Reference Barcode Tube Set P/N 173986  Label P/N 173985	Checks Barcode reading, Cup Presence sensor adjustment and the quality of Carrier-loading and -unloading. Reading Height from Deck: • for Plates 118 mm • for Tubes 30 – 110 mm Included with Autoload Sensors Adjustment Tool are: • Label P/N 173985 for Barcode Reader alignment • Reference Barcode Tube Set P/N 173986

6.2.3 Tools for Verification of ML STAR IVD

Tool	Description
Barcode Carrier P/N 185270 	Supports verification of Barcode reading of Autoload drive. This item is part of the ML STAR IVD shipment and the barcode verification may performed by the customer. See the maintenance menu of ML STAR IVD User Software.
Waste Block P/N 185281 	The waste block is a ML STAR IVD Instrument part and besides its main “tip waste” function it is needed for checking tightness and positioning of pipetting heads. These verifications may be performed by the customer as well. Furthermore, for the check and adjustment of Pressure Sensors (of pipetting heads) a coupling section is implemented into the waste block. Toghether with the pressure transmitter and the macro programs: PIP_PRESSURE_SIGNALS_CHECK.MCR and PIP_PRESSURE_SIGNALS_AUTOADJUSTMENT.MCR the Pressure Sensors may be checked and adjusted (necessary for TADM)

Tools for Verification of ML STAR IVD (continued)

Tool	Description
Pressure Transmitter P/N 185380 	The Pressure Transmitter comes together with an RS 232 serial interface and a 0.3 m long silicon tube (P/N 7249057, SILICON TUB. 4X7 TRANSP.)

6.2.4 Adjustment Macro Programs

Ensure all Adjustment macro programs are stored on the same path, i.e. C:\ program files \ HAMILTON \ ML STAR \ services \ macros \.

There are two types of Adjustment Macro Programs:
Measurement and Calibration Macros.

- Measurement Macro Programs do not change any Calibration values. The Software Program provides values which may not exceed the given tolerance.
- Calibration Macro Programs define new calibration values - current values are first deleted by the execute program.

Note: Adjustment Macro Programs must finish completely without errors to confirm that the Instrument is adjusted (Adjustment state 1), initialized and ready to operate.

General notes:

In case of a program interruption (if the program cannot be completed successfully) e.g. due to power failure or user interaction, switch the instrument off and then on again, to reset the macro program action automatically. This action is necessary to avoid the complete loss of calibration values.

If it is not then possible to start or complete any program, ensure that the CO-RE O-Rings do not remain squeezed, as this may reduce their life-time significantly.

Attention: Ensure all Macro Programs once started are correctly completed. Only this will leave the Microlab STAR Instrument within a defined status.

Note: All files from the Adjustment Disk / CD must be installed. The following files are necessary, however must not be started independently (e.g. by the Service Technician):

- ABORT.MCR
- NIX.MCR
- START.MCR

Attention: Pipetting Channels (complete with Pipetting Heads) must be mounted and adjusted properly before running any Adjustment Macro Program.

Adjustment Macro Programs (continued)

This List follows the order of Adjustment and Calibration

File Name	Description
INSTRUMENT CHECK.MCR	With Channel Calibration Tool 173960. checks all calibration values of Pipetting Arm, Channels and Heads. Measurement Macro Program.
ARM Z-DIFFERENCE.MCR	With Channel Calibration Tool 173960. checks Z parallelity of Pipetting Arm to Deck in functional dependence on X- and Y-Axis. Measurement Macro Program.
ARM X-DIFFERENCE.MCR	With Channel Calibration Tool 173960. checks X parallelity of Pipetting Arm to Deck in functional dependence on Y-Axis. Measurement Macro Program.
PIP XY MANUAL ADJUSTMENT.MCR	With Channel Calibration Tool 173960. Shows the linearity and relative positioning of all channels after preadjustment, shipping, etc. Measurement Macro Program.
PIP AUTOADJUSTMENT.MCR	With Channel Calibration Tool 173960. Performs an initial Adjustment and calibrates the pipetting Arm in X Axis and its Channels in Y and Z Axis. Calibration Macro Program.

Adjustment Macro Programs (continued)

This List follows the order of Adjustment and Calibration

File Name	Description
PIP ALIGNMENT WITH LLD.MCR	With Channel Calibration Tool 173960 and Low Volume Tips. Final visual Pipetting Channel check. Checks alignment of all channels with Low Volume Tips picked up. Measurement Macro Program.
AUTOLOAD AUTOADJUSTMENT.MCR	With Autoload Calibration Tool 173975 and Autoload Sensors Adjustment Tool 173980. Calibrates positioning in X, Y and Z Direction automatically after mechanical Cog wheel synchronization. Checks Barcode reading, Cup Presence sensor adjustment and the quality of Carrier loading and unloading. Calibration Macro Program.

Additionally for ML STAR IVD

Tightness check procedure	With waste block 185281 and user Software ML STAR IVD Especially after replacement of CORE O-Rings the tightness of seal on each Pipetting Head may be checked.
PIP_PRESSURE_SIGNALS_CHECK.MCR and PIP_PRESSURE_SIGNALS_AUTOADJUSTMENT.MCR	With waste block 185281 and pressure Transmitter the values for TADM may be checked and adjusted.

6.3 Adjusting Pipetting Channel

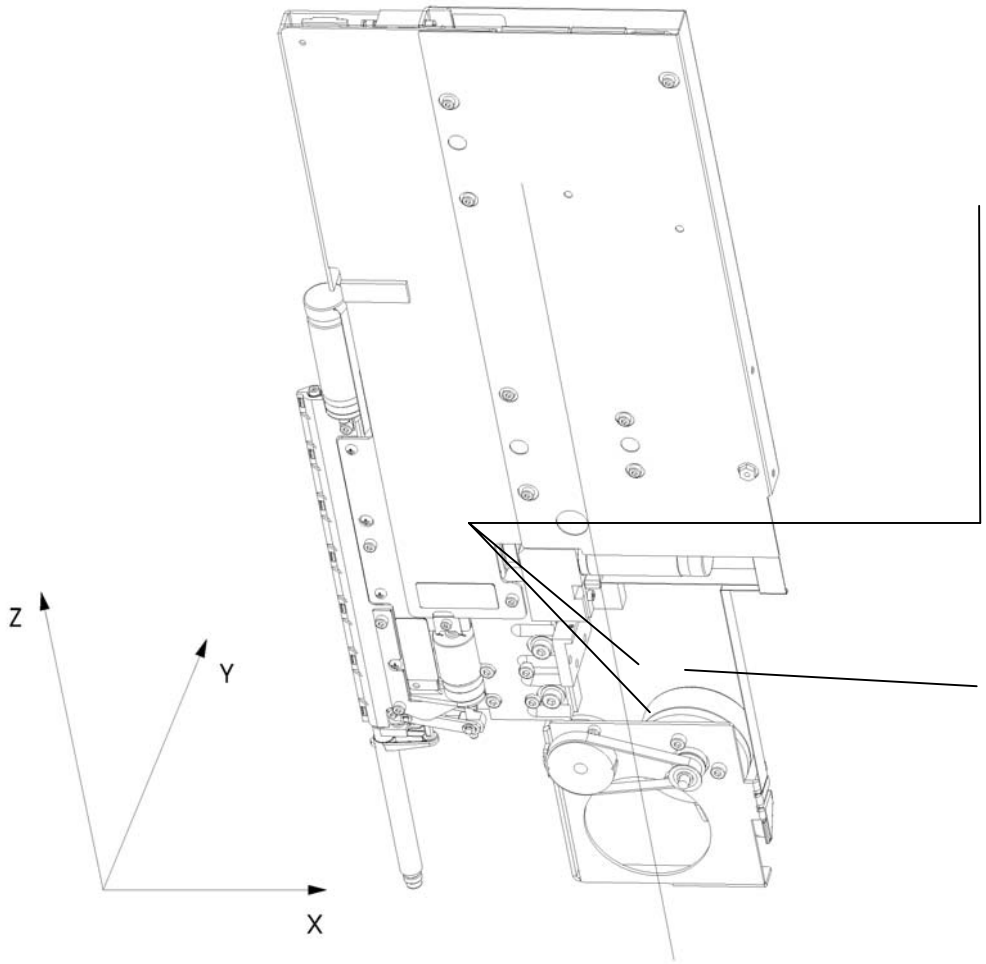
This is to ensure all Channels are aligned towards Y-Axis and are parallel to each other towards Z-Axis.
Using the Channel Adjustment-Tool, you can adjust all Channels after replacement of any parts belonging to Channels (pipetting heads etc.). The Adjustment is of a mechanical nature.

When: a Pipetting Channel is replaced, or due to bad adjustment values Adjustment is required.

The Pipetting Channel with its Pipetting Head has a number of degrees of freedom:

Degree of freedom	Action	Reference
1. Tilting around X-Axis	Channel to Y Slide Fixing Screws	Channel Adjustment Tool
2. Moving in X-Axis	Channel Fixing Screws	Channel Adjustment Tool
3. Tilting around Y-Axis	Channel Fixing Screws	Channel Adjustment Tool
4. Moving in Y-Axis	Position will defined by calibration value which will be determined by automatic adjustment program.	Channel Calibration Tool with Macro Program
5. Tilting around Z-Axis	Adjustment not possible, Position is given through Y-Slide guide.	Pipetting Arm with its Y-Slide and -guide.
6. Moving in Z-Axis	Position will defined by calibration value which will be determined by automatic adjustment program.	Channel Calibration Tool with Macro Program

6.3.1 Pipetting Channels degrees of freedom



Attention: Exercise great care when loosening or tightening the Channel Fixing screws, as excessive torque tension has a direct effect on the ball bearings of the slides and in fact may damage them - then proper positioning is no longer possible.

Channel Fixing Screws:

First loosen both locking set screws which are located just above the upper and underneath the lower fixing screw.

Then slightly loosen the 2 fixing screws for a moving in X-Axis and tilting around Y-Axis.

Torque Tension:

fixing screws M4: 300 cNm, or fixing screws M3: 110 cNm

locking set screws M2: 50 cNm

Channel to Y Slide Fixing Screws:

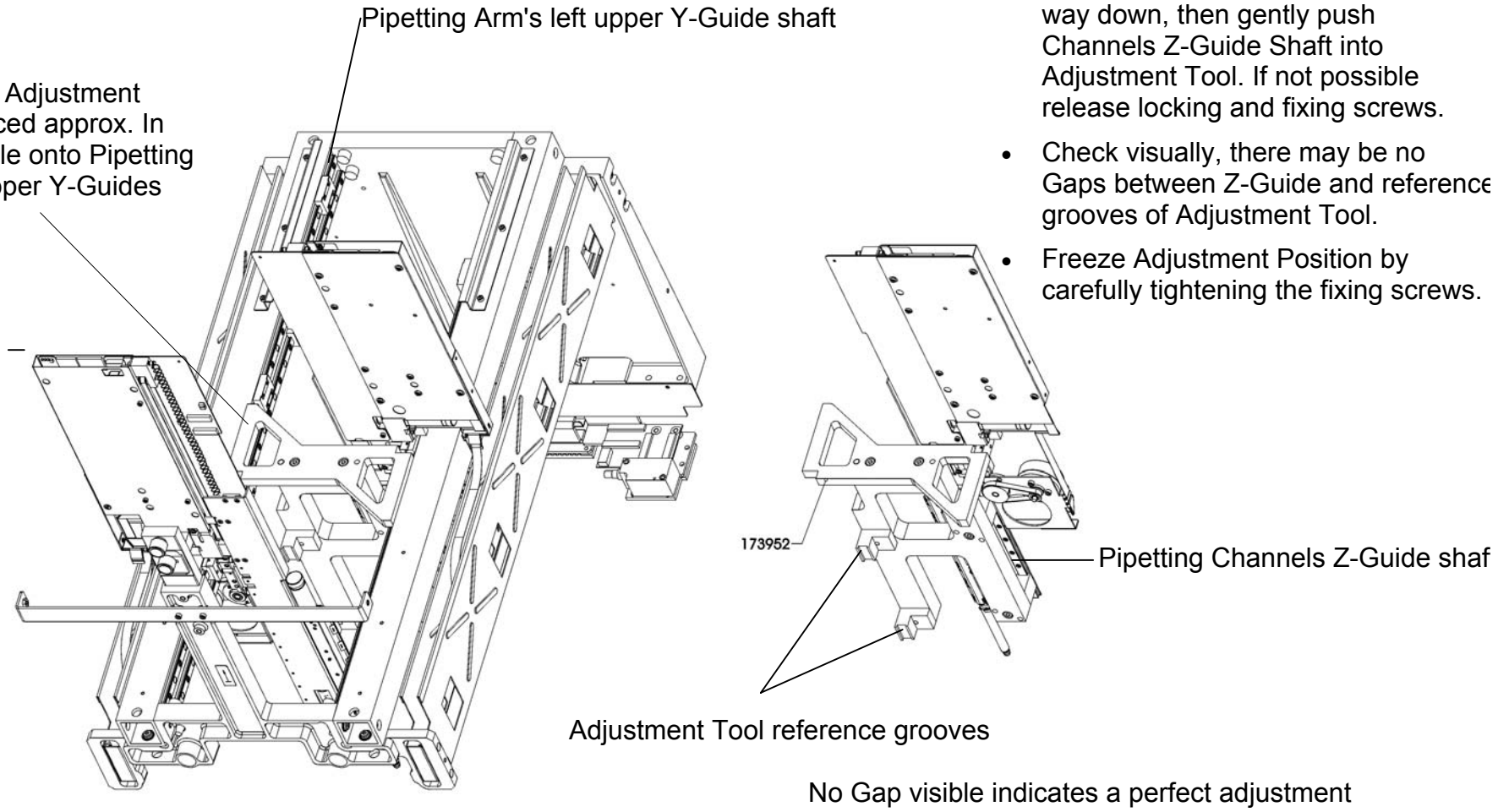
By slightly loosening the 4 fixing screws, tilting around X-Axis is enabled.

Torque Tension fixing screws:

M3 x 8 P/N 420013: 110 cNm, or M2 x 8 P/N 400604: 50 cNm

6.3.2 Pipetting Channel Adjustment Tool

- Remove Y-Spindles first
- Gently drive Pipetting Head all the way down, then gently push Channels Z-Guide Shaft into Adjustment Tool. If not possible release locking and fixing screws.
- Check visually, there may be no Gaps between Z-Guide and reference grooves of Adjustment Tool.
- Freeze Adjustment Position by carefully tightening the fixing screws.



For a better understanding only two Channels with the adjustment Tool are shown here.

6.3.3 Pipetting Channel Alignment

By placing the adjustment Tool once, two channels at a time may be adjusted.
For providing best adjustment results, the Design of the Adjustment Tool is to avoid the need to turn it around which may cause a shift from the theoretical Y-Axis between Channels from the left and the right side of pipetting Arm.

Note: During adjustment use always the same orientation with the adjustment Tool, i.e. left side of adjustment Tool always to left Pipetting Arm's left upper Y-Guide shaft.

Fix the channel adjustment tool in-between the Pipetting Arm's upper Y-Guide shafts with the knurled screw and ensure play-free positioning.

Do not forget to check adjustment tool alignment onto Pipetting Arm's upper Y-Guide shaft

Preliminary actions:

Attention: Exercise care when moving the Pipetting Arm and / or the Pipetting Channels. Move them gently to the desired position.

- To gain access to the Pipetting Channels uncover the Pipetting Arm see section 7.4.3 Pipetting Arm on page 7-14.
  The 2 Panels in the back may remain on the Pipetting Arm.
- Carefully unscrew and remove Y-Spindles P/N 173446 (complete with Washer P/N 173499 and Nut 408006) from Pipetting Arm.
  Refer to section 7.4.3 Pipetting Arm on page 7-14.

Note: The Y-Spindles must be removed due to the fact that too much friction from the Y drive mechanism hinders a proper alignment between the Channel's Z Guide and the Channel Adjustment Tool reference grooves

Pipetting Channel Alignment (continued)

Mechanical Adjustment procedure:

1. Carefully move the Pipetting Arm to a desired position on the deck
2. Uncover Pipetting Arm and remove both Y-Spindles.
3. Place Pipetting Channel Adjustment Tool P/N 173952 as shown onto Pipetting Arm's upper Y-Guide shafts (approximately in the middle of Pipetting Arm).
4. Gently move Pipetting Channel Z-Guide shaft into Adjustment Tool reference grooves.
   If necessary loosen first Pipetting Channels locking set screws and then slightly loosen fixing screws to make it fit.
5. Pipetting Channel Z-Guide shaft must slide into reference grooves without sticking.
6. Check for absolute parallelity between Z-Guide shaft and reference grooves. No Gap should be visible.
7. Freeze adjustment positioning by tightening all loose fixing screws.
8. Verify Adjustment and check again for absolute parallelity between Z-Guide shaft and reference grooves.
9. Finally thighten Pipetting Channels locking set screws.

6.4 Adjusting Pipetting Arm

This is to ensure the Pipetting Arm is aligned parallel to Deck surface and towards Y-Axis. The Y-Axis is aligned when the rear and the Front of the Pipetting Arm is on the same X Coordinate.
Using the Channel Calibration Tool, the Pipetting Arm Alignment Tool and the appropriate Macro Programs, you can adjust the Pipetting Arm. The Adjustment is of a mechanical nature, The Adjustment Macro Programs provide measurement values.

When: due to bad adjustment values Adjustment is required.

The Pipetting Arm has a number of degrees of freedom:

Degree of freedom	Action	Reference
1. Tilting around X-Axis	is accomplished by raising and lowering the Front Guide Bar of Microlab® STAR Instrument in Z-Axis on the left and the right side.	Channel Calibration Tool with Macro Program
2. Moving on X-Axis	Is the movement Axis of Pipetting Arm	Channel Calibration Tool with Macro Program
3. Tilting around Y-Axis	Adjustment is generally not possible.	
4. Moving on Y-Axis		
5. Tilting around Z-Axis	Movement on the two X slides in the back. is accomplished by turning adjustment screws from Pipetting Arm Alignment Tool.	Channel Calibration Tool and Pipetting Arm Alignment Tool with Macro Program
6. Moving on Z-Axis	is accomplished by moving the Front Guide Bar of Microlab® STAR Instrument along Z-Axis.	Channel Calibration Tool with Macro Program

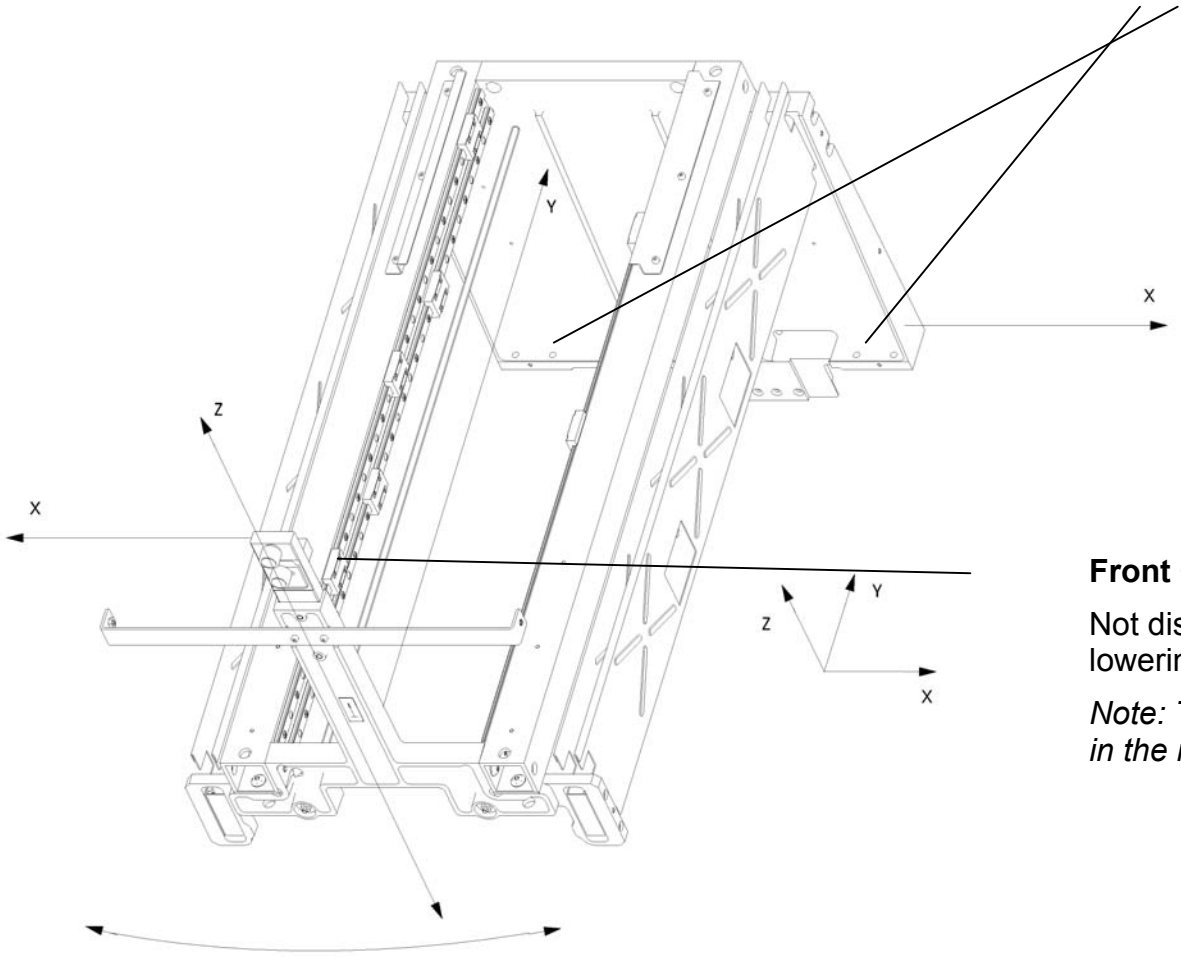
Adjusting Pipetting Arm (continued)

Attention: Guides in X and Y Direction must not be bent and must ensure a parallel movement to the corresponding axis.

The two box section frames of Pipetting Arm, which are the reference to the guides in Y-Direction, must also be straight and parallel together.

Ensure a proper mounting onto its X slides.

6.4.1 Pipetting Arm degrees of freedom



Pipetting Arm Fixing Screws:

When both Pipetting Arm Alignment Tools are in place, loosen 8 fixing screws in the rear for tilting around Z-Axis.

Note: The Z Axis to tilt around will then be in the rear.

This aligns the Pipetting Arm parallel to Y-Axis (the X Coordinate will then be the same for the front and the rear of Pipetting Arm.

Front Guide Bar:

Not displayed here. By slightly lifting and lowering, tilting around X-Axis is enabled.

Note: The X Axis to tilt around will then be in the rear.

Note: the above-mentioned Fixing screws may occur as setscrews with hex nuts and washers.

6.4.2 Pipetting Arm Z Alignment

Overview:

The Pipetting Arm with its channels can be adjusted using the Channel Adjustment Tool with its Steel Needle as Pointer and the Macro Program (Service Software). Adjustment has do be done by hand; the Pipetting Arm Adjustment Program only provides measuring values and helps you to align the Pipetting arm.

Note: The Adjustment may be performed where the Pipetting Channels have been preadjusted.

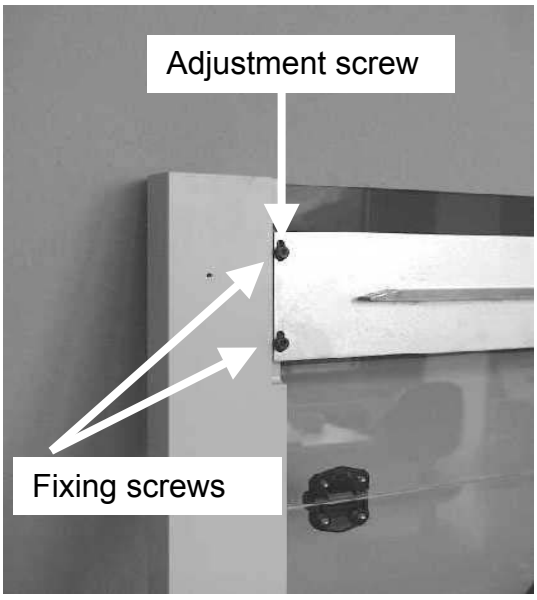
Preliminary actions:

Hint: Run the Adjustment macro Program before removing all Panels of the Instrument. After the first run check the result window. If the values are out of range corrective Action must take place.

- To gain better access to Front guide bar, remove side Panels from Instrument. Refer to section 7 Components on page 7-1.
- Loosen two middle screws front panels, as they are attached to the Front guide bar.

Run the following macro program together with Channel Calibration Tool P/N 173960:

- ARM Z-DIFFERENCE.MCR



Slightly loosen all 4 fixing screws P/N 420564, but do not allow play between vertical post and Front guide bar.

In accordance with Adjustment values, move Front guide bar up or down by turning adjustment screw P/N 420074.

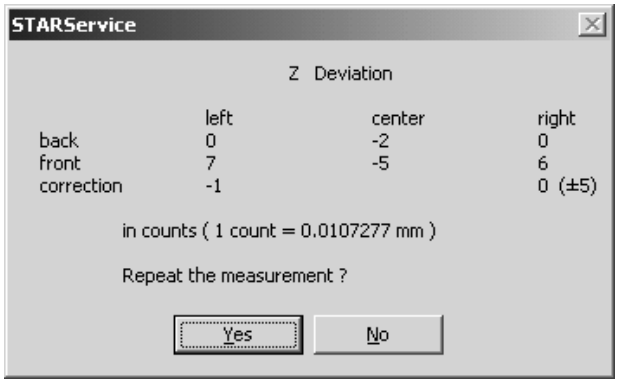
Note: make very small movements (i.e. 1/8 turns) with the adjustment screw, tighten the fixing screws, and check by running adjustment program again.

Pipetting Arm Z Alignment (continued)

Attention: Ensure a completely empty deck before starting macro program. Therefore remove any carriers beforehand.

- Start Adjustment Macro Program "ARM Z-DIFFERENCE.MCR" from Service Software and carefully follow the instructions given in that program.

- Adjustment must performed if difference criteria are not met.



Interpretation of Result of Adjustment procedure:

Adjusting Pipetting Arm in Z-Direction (which would not be necessary in the result window shown above).

Corrective Actions

The Front guide bar may only be lifted or lowered on the left and right side of the Microlab STAR Instrument. In this example, the corrective action would be lowering the Front guide bar on the left side.

- Just loosen 2 fixing screws on each side and lower Front guide bar with adjustment screw according to the values provided by the program, then tighten the fixing screws again (see Picture on previous page).
- Verify the current position by running the Adjustment Program again and iterate if necessary.

6.4.3 Pipetting Arm X-Alignment

Overview:

The Pipetting Arm and Channels can be adjusted using Channel Adjustment Tool as Reference and Adjustment Macro Program (Service Software). Adjustment has to be done by hand - the Adjustment Macro Program only provides measurement values and helps you to align the Pipetting arm.

Note: The Adjustment may be performed once the Pipetting Channels are preadjusted and the Pipetting Arm Z-Alignment is performed.

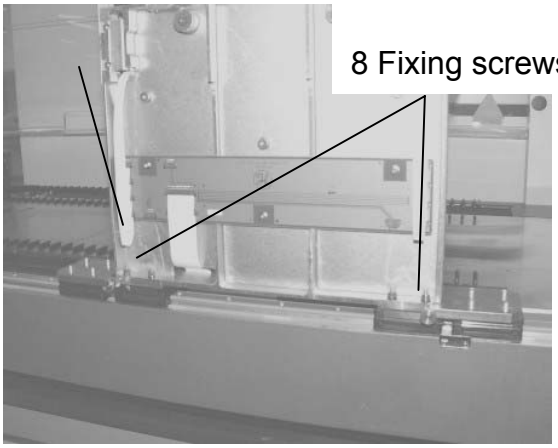
Preliminary actions:

Hint: Run the Adjustment Program before uncovering the Pipetting Arm. After the first run decide if any corrective Action must take place.

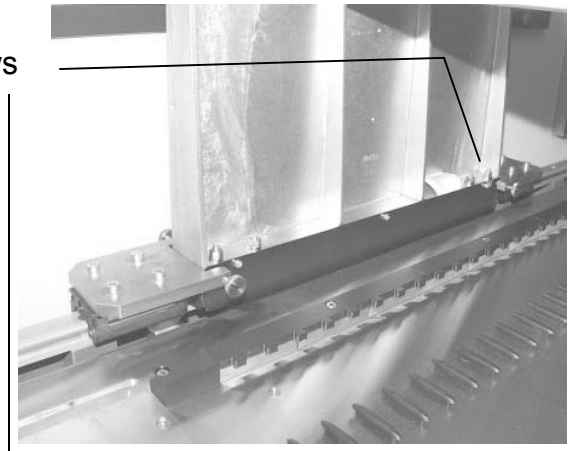
- Uncover the Pipetting Arm completely (see section 7.4.3 Pipetting Arm on page 7-14) to access the 8 fixing screws P/N 400047 in the back.
- First remove side Panels, then both buffers from the ML STAR Instrument Chassis.

Run the following macro program together with Channel Calibration Tool P/N 173960:

- ARM X-DIFFERENCE.MCR



Uncovered Pipetting Arm, view from behind.

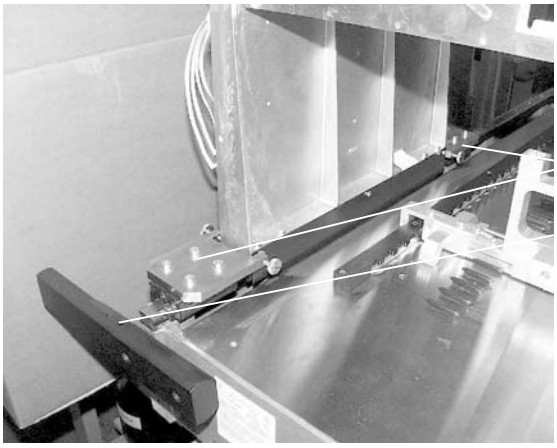
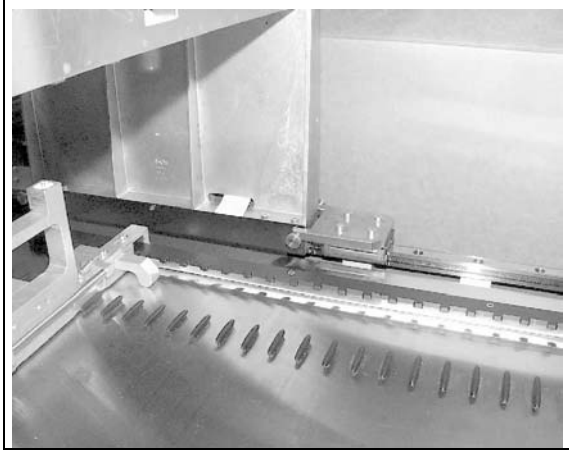


Uncovered Pipetting Arm, view from the front left.

Note: the above-mentioned Fixing screws may occur as setscrews with hex nuts and washers.

Pipetting Arm X-Alignment (continued)

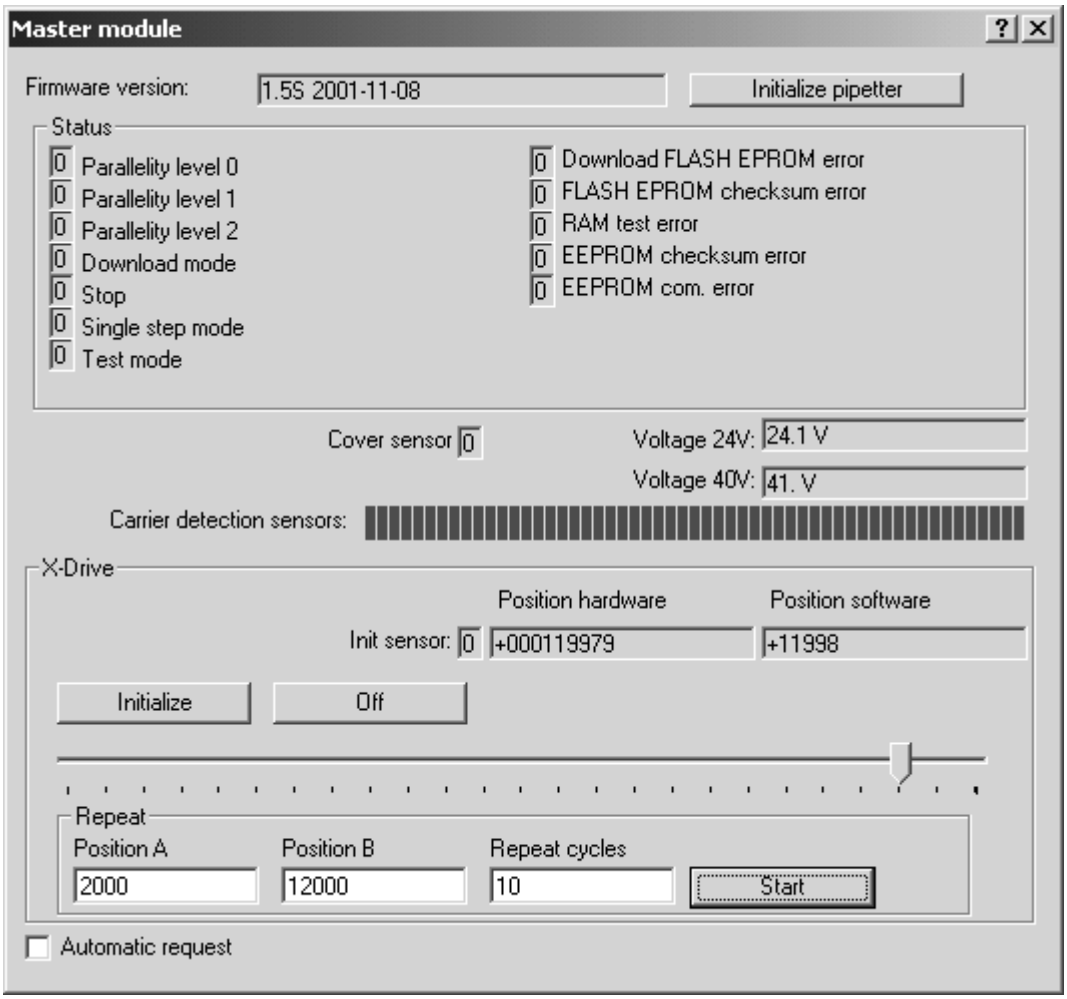
Slide on two Pipetting Arm Alignment Tools P/N 173956 to both sides of Pipetting Arm and gently attach with the adjustment screws. The Pipetting Arm may be slightly tilted around Z-Axis to align in X-Axis. Fixing screws of Pipetting Arm should be slightly loosened beforehand.

	Uncovered Pipetting Arm, view from the front left with Pipetting Arm Alignment Tools P/N 173956 attached. The Stop Bars on both sides of ML STAR Instrument are turned out of their original Positions to enable the Pipetting Arm Alignment Tools P/N 173956 to be slid on the X-Guide
	Uncovered Pipetting Arm, view from the front right. A Pipetting Arm Alignment Tool P/N 173956 attached to the right side of Pipetting Arm.

Pipetting Arm X-Alignment (continued)

Adjustment:

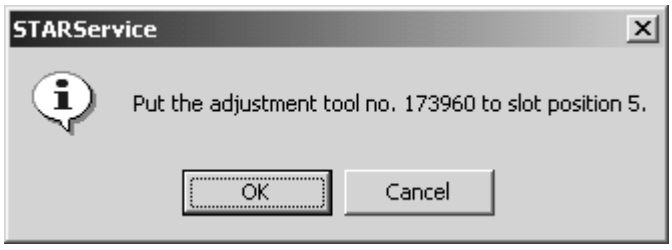
- Before starting the Adjustment Program relieve any stress on the Pipetting Arm by moving it several times in X-Direction
  Use Service Software and let it perform approximately 10 full-length strokes in X- direction to ensure a neutral positioning of Pipetting Arm.



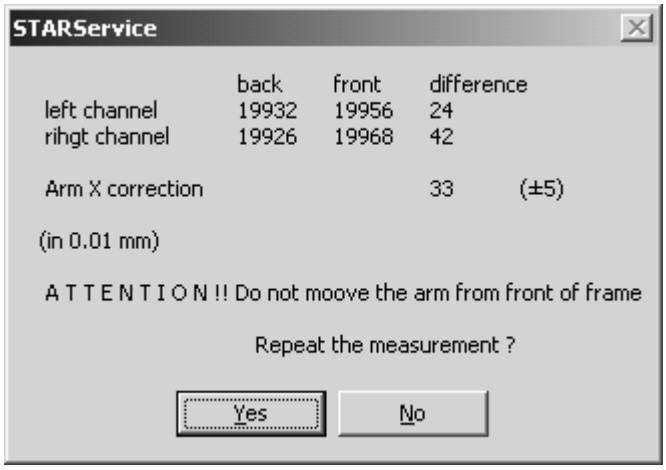
Attention: since any stress on the Pipetting Arm is now relieved do not move it by pushing or pulling it in the front. If the Pipetting Arm must be moved hold it by the rear!

Pipetting Arm X-Alignment (continued)

- Then start "ARM X-DIFFERENCE.MCR" Adjustment Macro Program from Service Software and carefully follow the instructions given in the program.



- Adjustment must performed if difference criteria are not met.

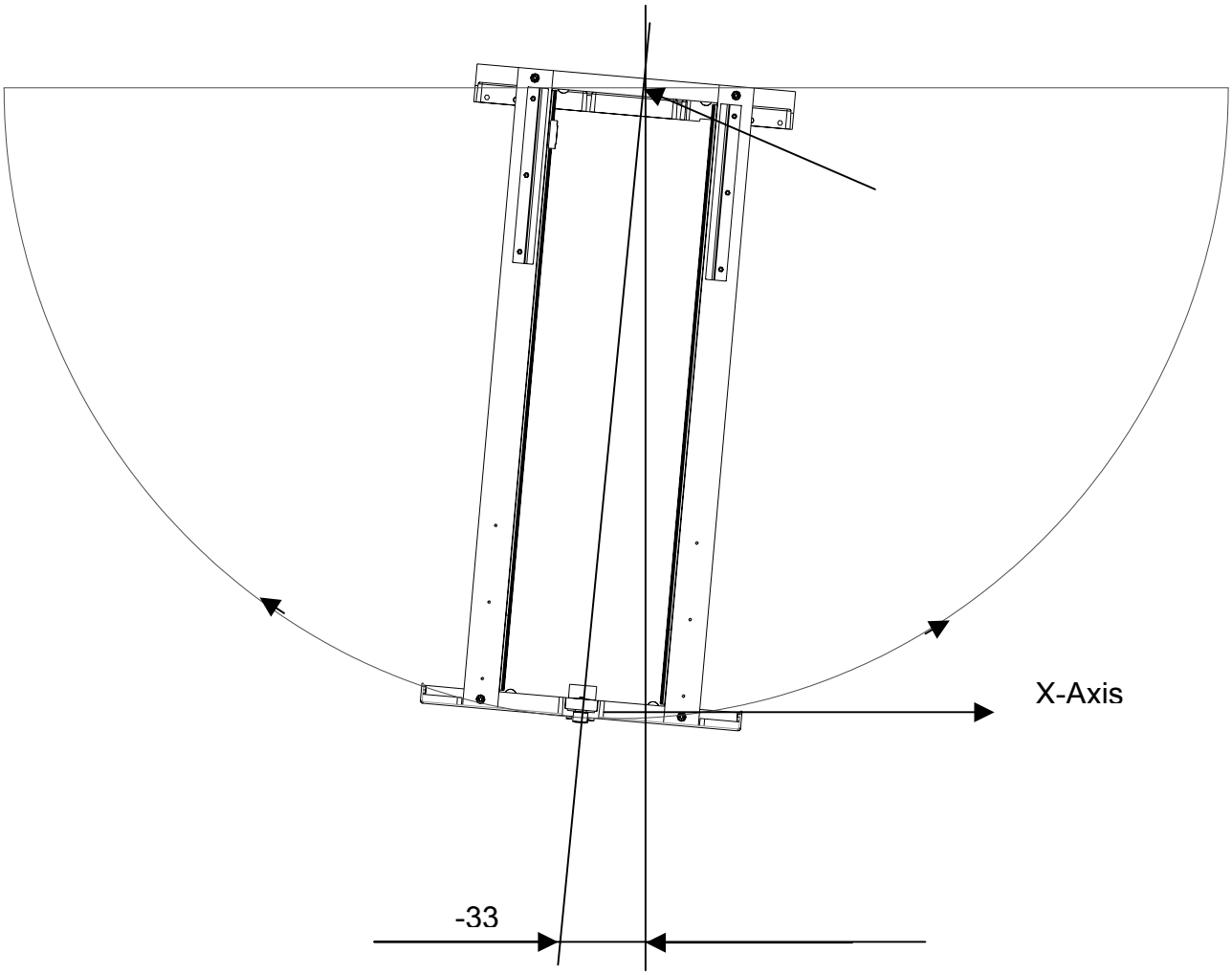


Interpretation of Result of Adjustment procedure:

Adjusting Pipetting Arm in X-Direction (which would be necessary in the result window shown above).

Corrective Actions

Seeing as the back of the Pipetting Arm connected onto the slides as pivot point in Z-Axis, the Pipetting Arm may only turn in X-Direction (counterclockwise). In this example, the corrective action would be turning the Pipetting Arm in positive X-Direction (counterclockwise).



Corrective Actions (continued)

- Just untighten the 8 fixing screws and push or pull the arm by the back to its appropriate position and tighten the 8 fixing screws.

Note: Do not push or pull the Pipetting Arm from the Front to align in X-Direction so as to avoid a shift which could prevent proper adjustment (Hysteresis).

- Verify the current position by running the Adjustment Program again and iterate if necessary.
- After completion of Alignment, check distance between Pipetting Arm Positioning Reader and the Magnetic Tape underneath the deck. Refer to section 7.6 Pipetting Arm X-Drive on page 7-23.

Attention: Ensure Reader is not touching Magnetic Tape. On the other hand, the gap should not be too great.

6.5 Adjusting Pipetting Arm with Channels

Overview:

After readjustment with the Channel Adjustment Tool and Macro programs, only a slight tilting around Y-Axis should be necessary.
By using the upper Fixing screw as a pivot point (open it up just a very little bit), untighten the lower Fixing screw and push or pull the Channel by its Pipetting head around the upper Fixing screw axis.

Now the Pipetting Arm with its channels can be adjusted using the Channel Adjustment Tool and the Macro Program (Service Software). Adjustment has to be done by hand as described above; the Pipetting Arm Adjustment Program only provides measurements and helps you to align the Pipetting Channels on the Pipetting arm.

Note: The Adjustment may be performed where the Pipetting Channels have been preadjusted and the X- and Z- Differernce Macro Procedures are completed succesfully.

Preliminary actions:

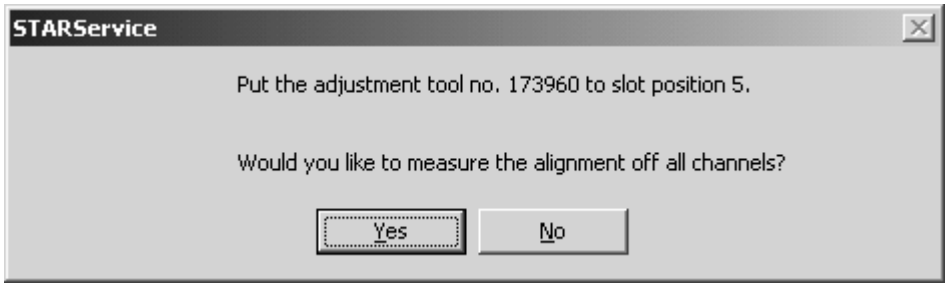
Hint: Run the Adjustment macro Program before removing any Panels of the Instrument. After the first run check the result window. If the values are out of range corrective Action must take place.

Run the following macro program together with Channel Calibration Tool P/N 173960:

- PIP XY MANUAL ADJUSTMENT.MCR

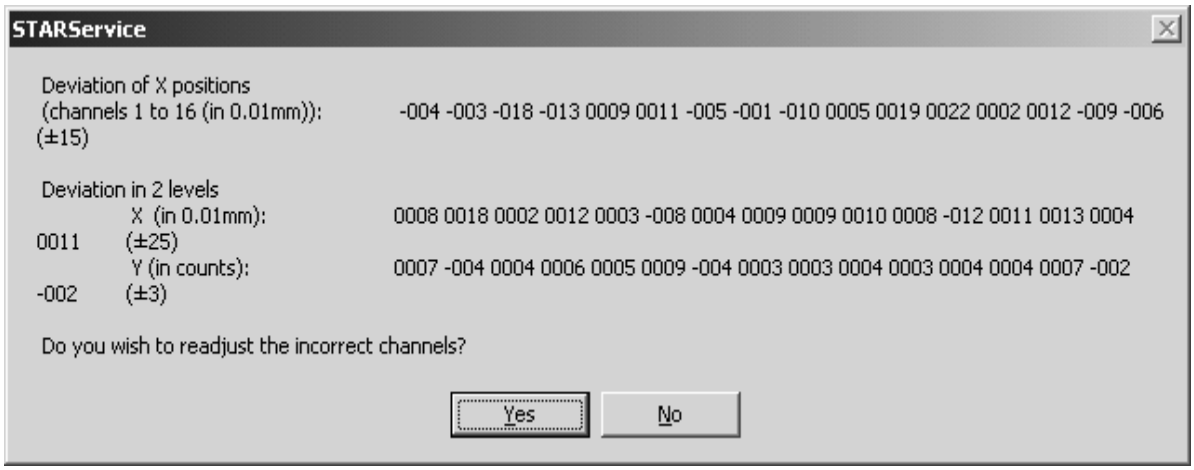
Adjustment:

- Start Adjustment Macro Program "PIP XY MANUAL ADJUSTMENT.MCR" from Service Software and carefully follow the instructions given in that program.



Adjustment: (Pipetting Arm with Channels XY Manual)

- Adjustment must performed if difference criteria are not met.



Interpretion of Results from Adjustment procedure:

Adjusting Pipetting Channels 3, 11 and 12 in X-Direction (which would be necessary in the result window shown above).

The Y Deviation is given by the straightness of the Channel and by the quality of adjustment with the Channel Adjustment Tool P/N 173952, therefore no action can be taken here to improve these values - they are for recognition only.

If the Y Deviation Values are bad or out of Range, start adjusting according to section 6.3 Adjusting Pipetting Channel on page 6-14

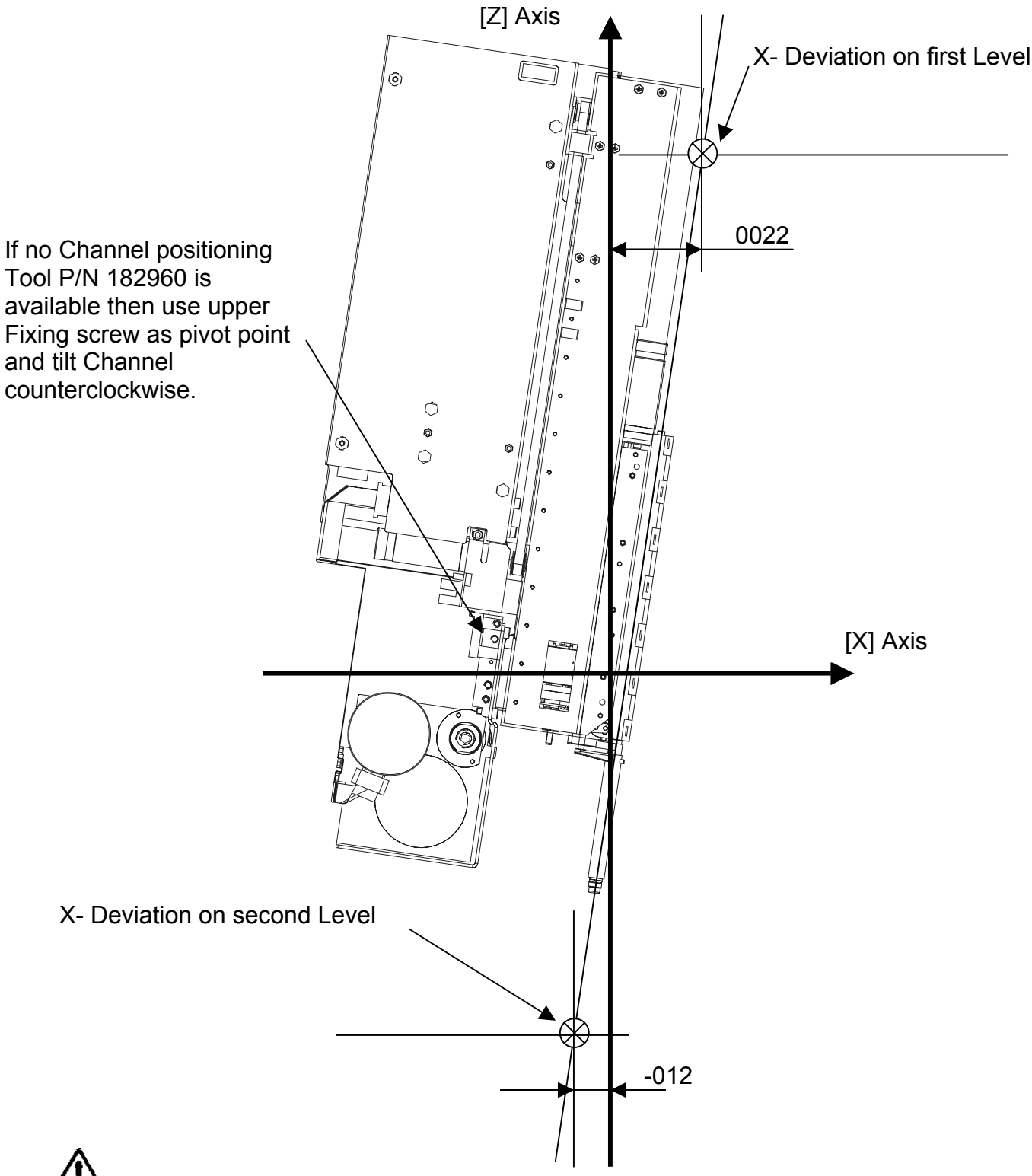
Corrective Actions

Focus only on the Channel with the most deviation, resp. the Channel which is out of range in X-Axis. In this example, this would be Channel 12.

Turn the Channel counterclockwise around its Y Axis to improve the alignment and lower the deviation and run the Adjustment Program again.

Attention: corrective actions take place within the macro adjustment procedure. Therefore focus on Pipetting channel to be corrected. Do not switch off instrument, do not shift Pipetting Arm, etc. The macro will continue after you have corrected the Pipetting channel.

Corrective Actions (continued)

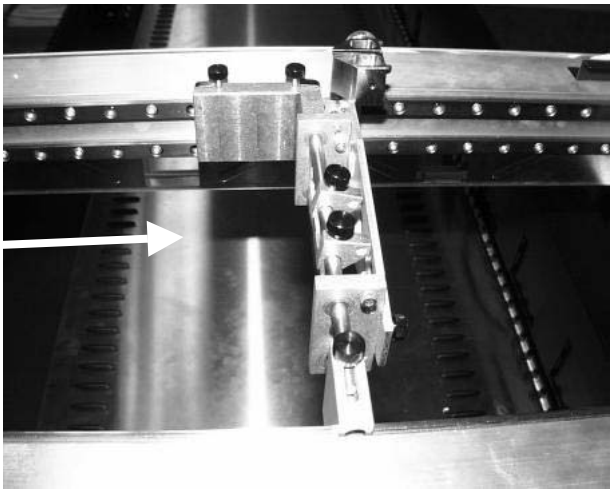
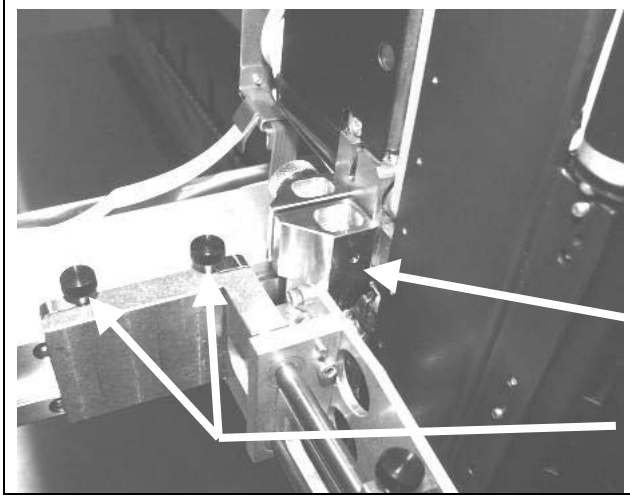


Attention: Do not loosen fixing screws to much, as this would lead to an uncontrolled shift or move. A restart with the Channel Adjustment procedure is then inevitably!

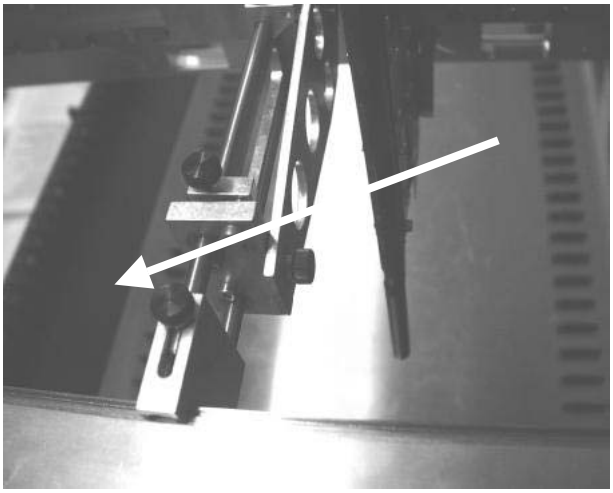
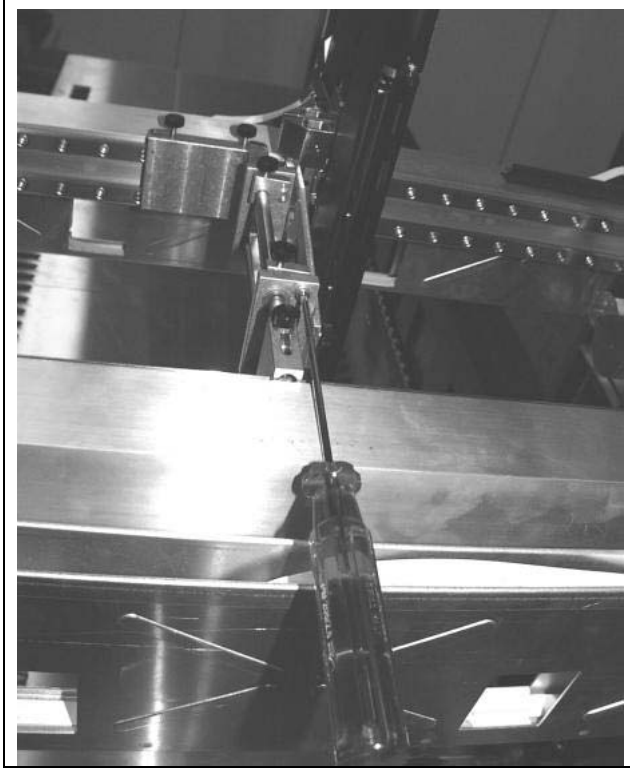
Corrective Actions (continued)

Using the Channel positioning Tool P/N 182960:

Note: Y-Spindle may remain in place.

	Place the Channel positioning Tool onto Pipetting Arm and move it in Y Direction towards the channel to be corrected. The goal is to take over the current position of the channel in question and freeze its position with the Channel positioning Tool.
	After the Channel positioning Tool is attached to the channel, start tightening it. The clamps of the Channel positioning Tool should hold the channel tight, then fix the Channel positioning Tool with the two knurled fixing screws onto the rail. Clamps - and Knurled fixing screws of positioning Tool.

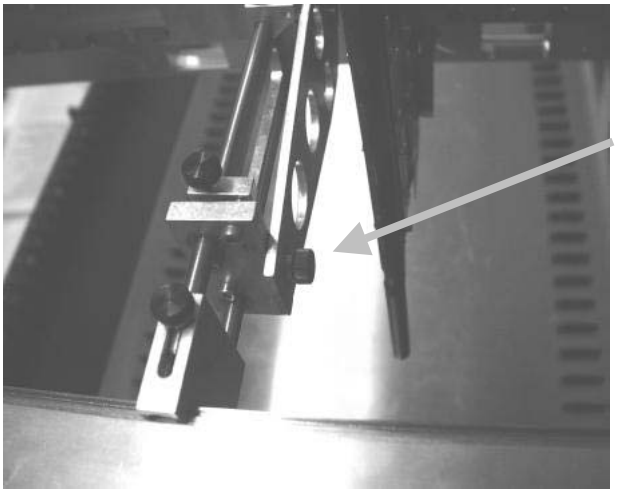
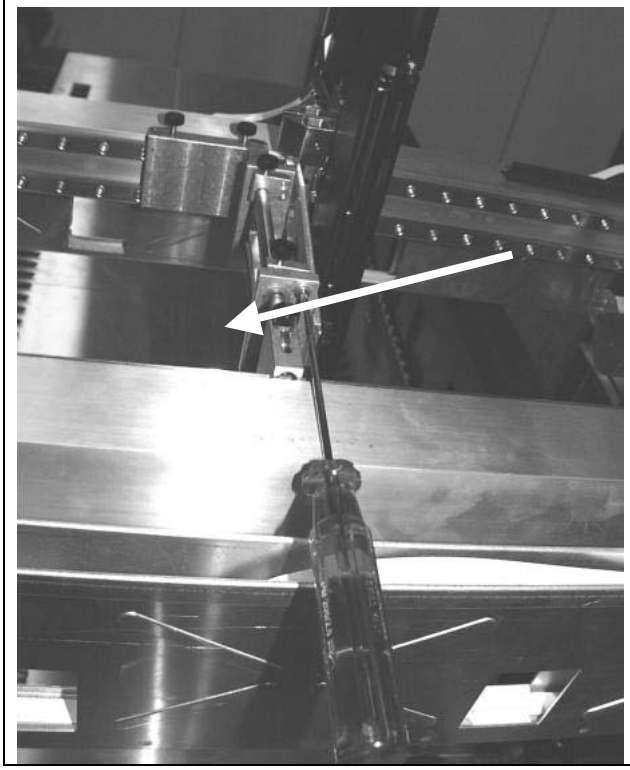
Corrective Actions (continued)

	Stabilize Channel positioning Tool by attaching the bracket onto the opposite side of the pipetting arm. Fix Bracket with the knurled screw.
	Finally tighten the two shift stops on the rod, and use the corresponding adjustment screws to ensure a play-free system ready to tilt and shift the pipetting channel. The two stops on the rod can be fixed by tightening the knurled screws

Since the current position of corresponding pipetting Channel is now “frozen” by the Channel positioning tool, the position of the channel may now be corrected.

The 2 locking and the 2 fixing screws of the Pipetting Channel must loosened first.

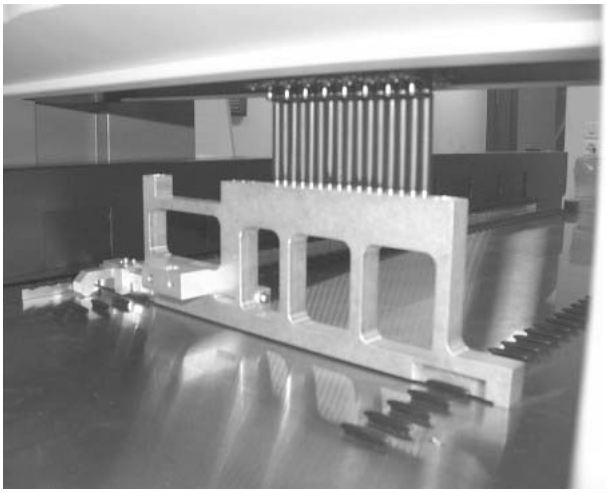
Corrective Actions (continued)

	For tilting the Pipetting Channel around Y Axis: Release lever of channel positioning tool by unscrewing knurled screw, then tilt channel. After the Pipetting Channel is corrected, tighten the lever of channel positioning tool first and then retighten the 2 fixing and the 2 locking screws of the Pipetting Channel. Remove channel positioning tool and continue running the PIP XY MANUAL ADJUSTMENT.MCR to verify improvement of alignment.
	For shifting the Pipetting Channel in X Direction: Choose the appropriate shift stop to shift the pipetting channel, then loosen the opposite shift stop completely. By turning the adjustment screw clockwise, the channel positiong tool will move together with the pipetting channel towards adjustment screw. After the Pipetting Channel is corrected, retighten the 2 fixing and the 2 locking screws of the Pipetting Channel. Remove channel positioning tool and continue running the PIP XY MANUAL ADJUSTMENT.MCR to verify improvement of alignment.

Corrective Actions (continued)

The macro PIP XY MANUAL ADJUSTMENT.MCR continues as follows:

All Pipetting Channels will be placed above calibration Tool and allow a visual check which is prompted with the dialog box below.

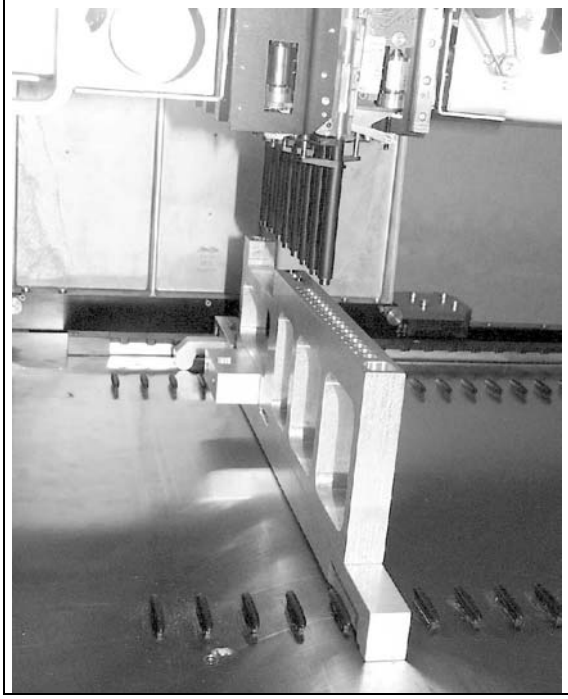


6.6 Calibrating Pipetting Arm with Channels

Run the following macro program together with Channel Calibration Tool P/N 173960:

- PIP AUTOADJUSTMENT.MCR

Automatic Adjustment procedure:

	Channel Calibration Tool P/N 173960 placed onto deck as asked for by the program. (Appropriate Adjustment Program has been started.)

After the successful Adjustment ensure all screws on Pipetting Arm and Pipetting Channels are tight.

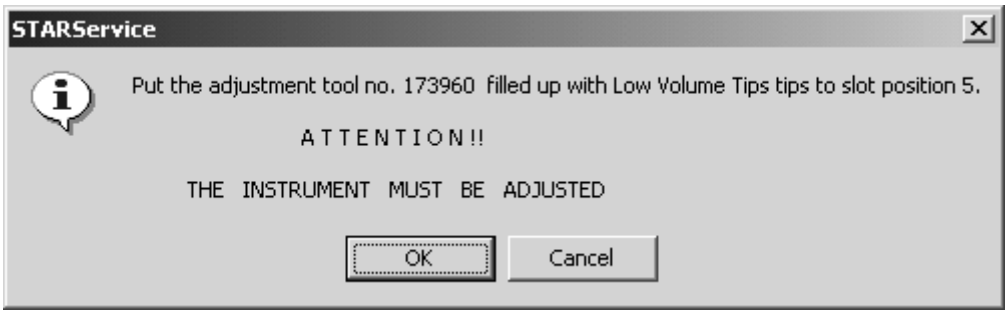
Perform a Check Run.

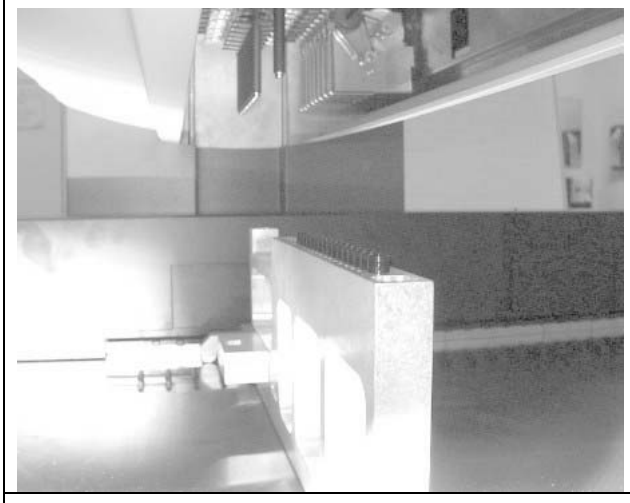
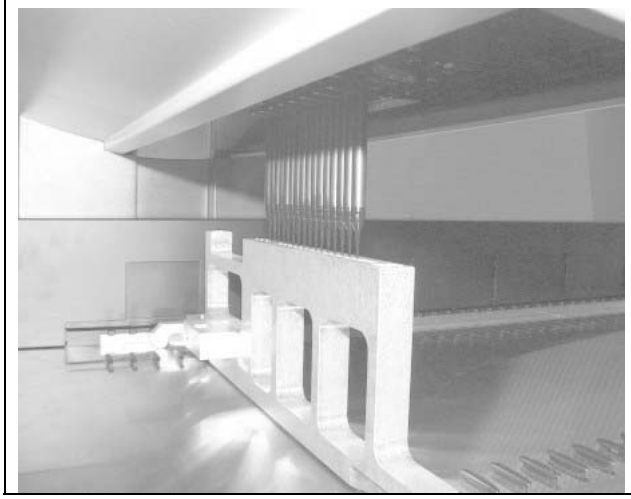
Cover pipetting arm and Instrument.

6.6.1 Pipetting Channel Positioning Check (LLD Check):

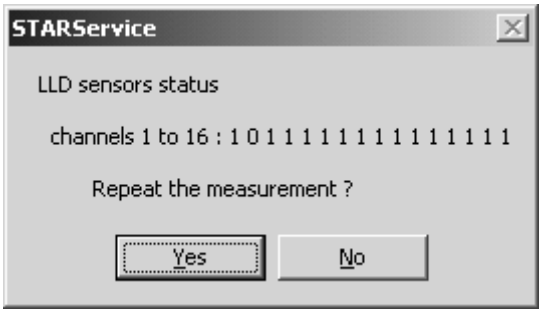
Run the following macro program together with Channel Calibration Tool P/N 173960:

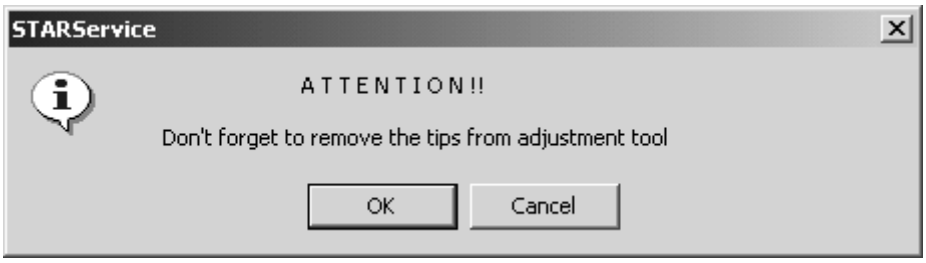
- PIP ALIGNMENT WITH LLD.MCR



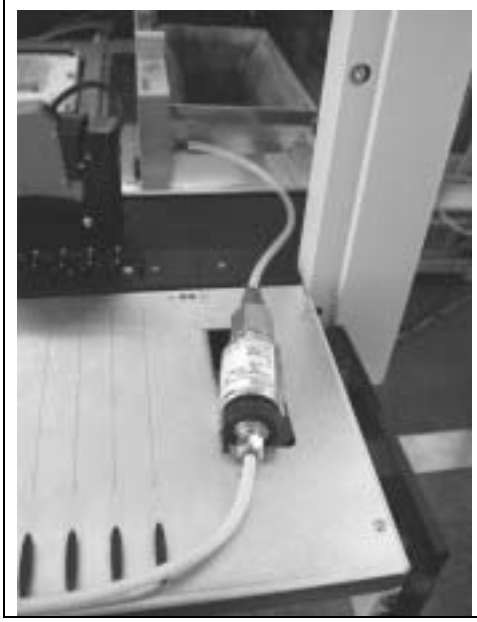
	Calibration Tool filled with Low Volume Tips.
	All Low Volume Tips are picked up and positioned inside the small holes of Calibration Tool.

Pipetting Channel Positioning Check (continued):

	The goal is to have all LLD sensor statuses at 0. This means all Low Volume Tips are absolutely concentrically positioned and have therefore no electronic contact with the calibration tool. Here in the example only Channel 2 actually passed the check procedure.



6.7 Pressure adjustment values of TADM (ML STAR IVD)

	Connect the tubing of the pressure transmitter as shown to the ML STAR IVD tip waste. Connect the RS 232 Cable to the Computer (any Port) where the Service software is installed. PIP_PRESSURE_SIGNALS_CHECK.MCR

6.8 Adjusting Autoload drive[13]

For proper loading and unloading of Carriers and Barcode reading.

By using the Autoload Adjustment-Tool and the Service Program Autoload Calibration.

Loading Tray adjustment, Cog wheel synchronization, Barcode reader and Tube presence Sensor adjustment are of a mechanical nature - adjustment and calibration are totally automatic.

The cogwheel synchronization is of a pure mechanical procedure, therefore no macro program is available for it.

Note: the cogwheels are synchronized with the cog-rail of the tool (P/N 173981)

When using the Autoload Adjustment Program the Cog-rail of this Tool is not used; however, the grooves of the tool must face the Cog Wheels.

The Program asks you during the procedure to put this Tool twice in Track one, both times exactly the same way. The first time the center axis of Track one to the center of the cogwheels is determined; the second time the cog's uppermost position is defined (relative to the cogwheel home sensor).

The Autoload Drive has a number of degrees of freedom:

Degree of freedom	Action
1. Tilting around X-Axis	Adjustment is generally not possible.
2. Moving in X-Axis	Is a movement Axis of Autoload drive and is automatically adjusted / calibrated with the corresponding reference Tool and Macro Program.
3. Tilting around Y-Axis	Adjustment is generally not possible.
4. Moving in Y-Axis	Is a movement Axis of Autoload drive and is automatically adjusted / calibrated with the corresponding reference Tool and Macro Program.
5. Tilting around Z-Axis	Adjustment is generally not possible.
6. Moving in Z-Axis	Is a movement Axis of Autoload drive and is automatically adjusted / calibrated with the corresponding reference Tool and Macro Program.

[13] Microlab®-STAR Instrument with Autoload Option only

Conditions:

Guides in X-Direction must be straight i.e. may not be bent and must ensure a parallel movement to the corresponding axis.

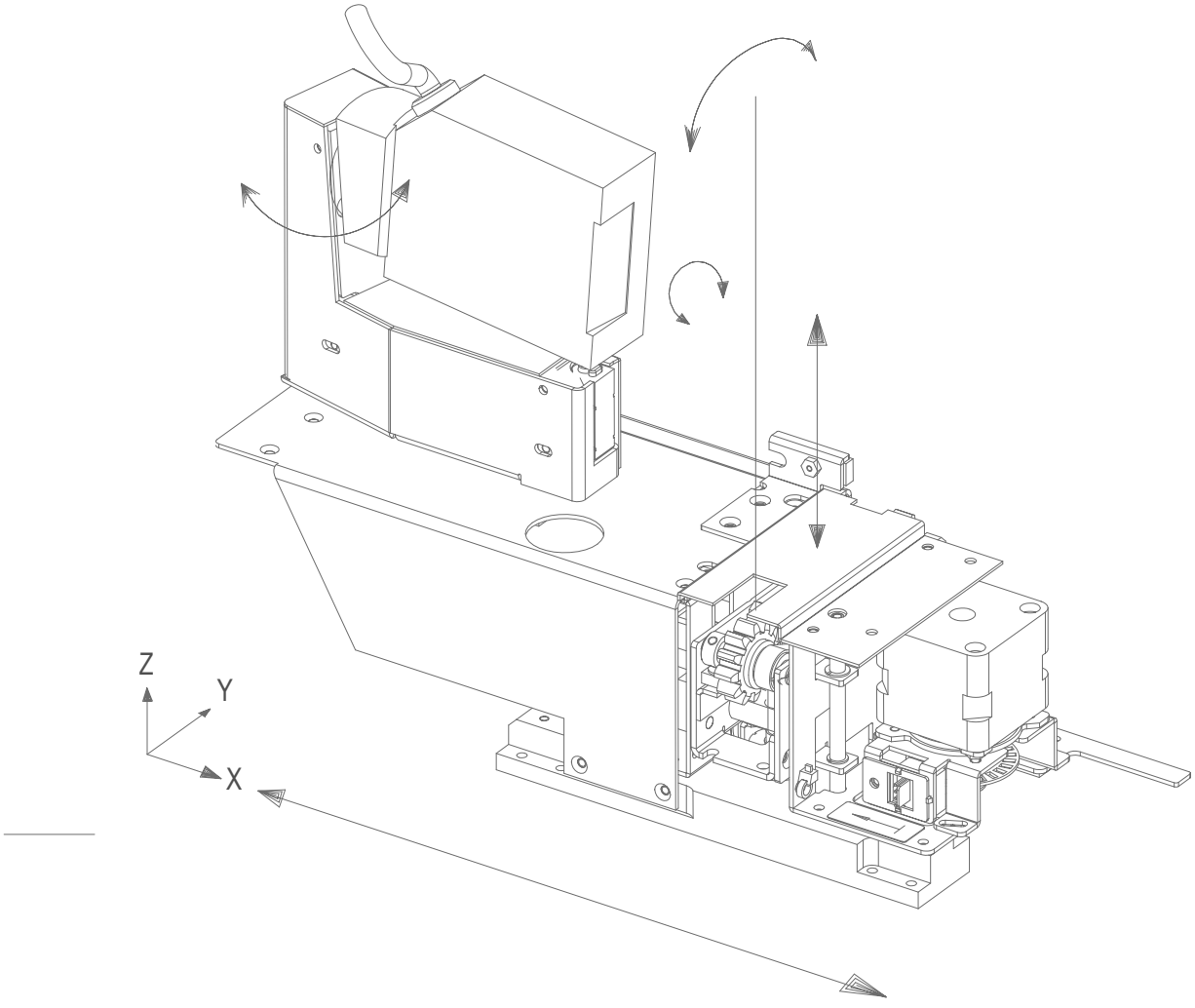
Bad loading and unloading of carriers (Steps lost), or faulty Barcode reading indicates a need for corrective action. Adjustment may solve the problem. If not, the Autoload Drive may need to be replaced.

Order of Adjustment

Follow strictly the order of adjustment

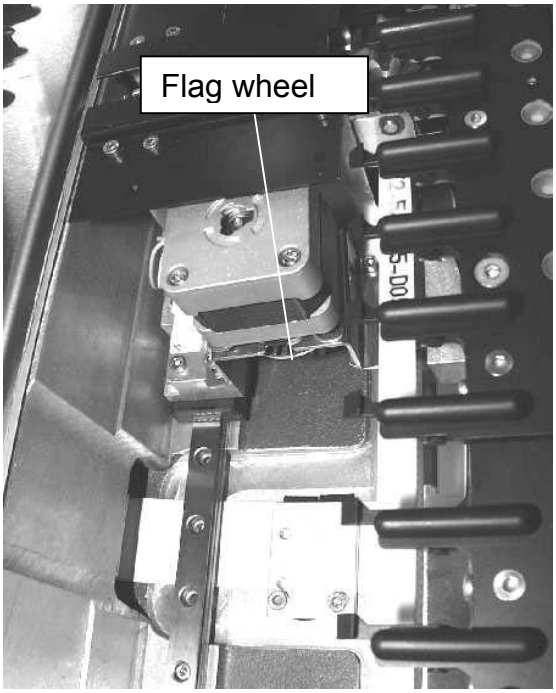
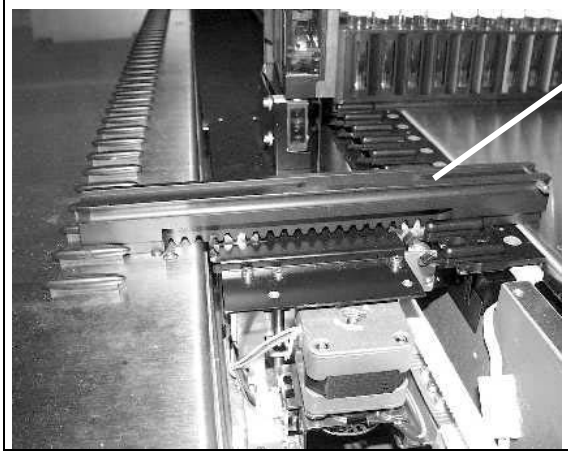
1. Cog wheel synchronization
2. Loading tray adjustment
3. Automatic Autoload Adjustment Procedure

6.8.1 Autoload drive degrees of freedom

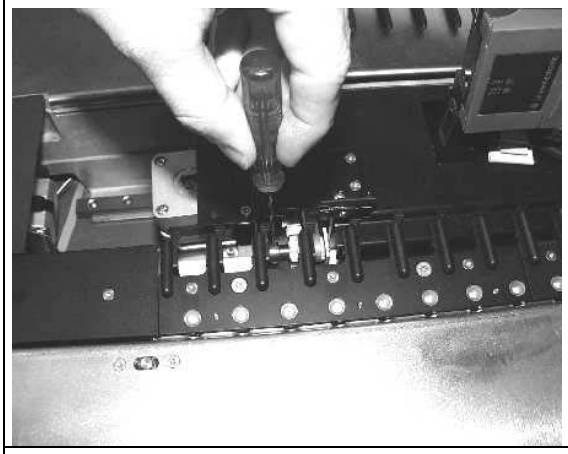
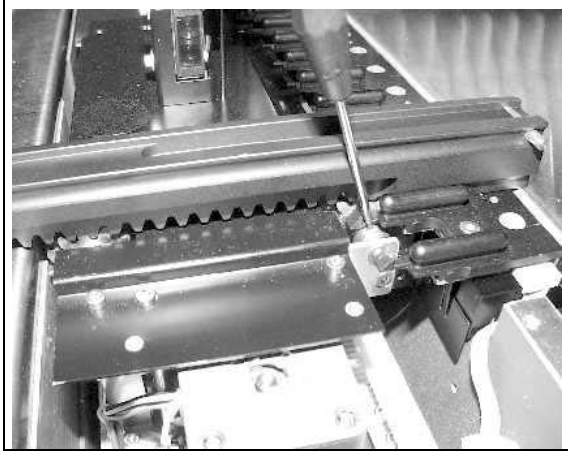


6.8.2 Cog wheel synchronization

To enable loading and unloading, cog wheels must be synchronized

	Remove Ribbon from Autoload Drive to gain access to Flag wheel. Move Autoload drive to a arbitrary Track Position.
	Then place Autoload Calibration Tool cog bar onto the same Track and turn Flag wheel by hand to raise cogwheels up. *Note: If both cogwheels fit perfectly in Autoload Calibration Tool cog bar, no corrective action need take place.*

Cog wheel synchronization (continued)

	With the Autoload Calibration Tool in place, loosen both Set screws from front cogwheel and make cogwheels properly fit into Autoload Calibration Tool cog bar by raising cogwheels up until the Autoload Calibration Tool is just raised.
	Then Tighten both Set screws from front cogwheel before removing Autoload Calibration Tool. Cogwheels are now synchronized.

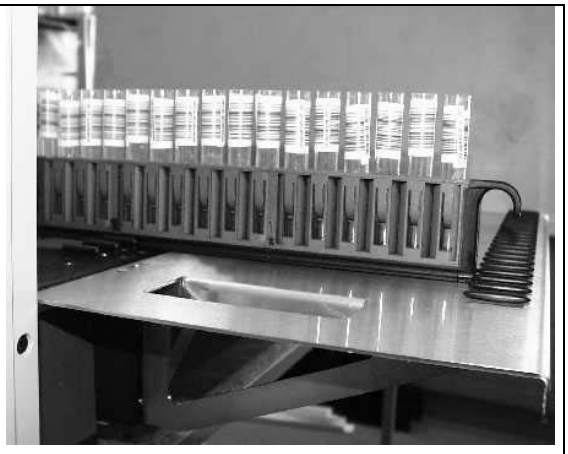
6.8.3 Loading tray adjustment

For a proper loading and unloading of Carriers.

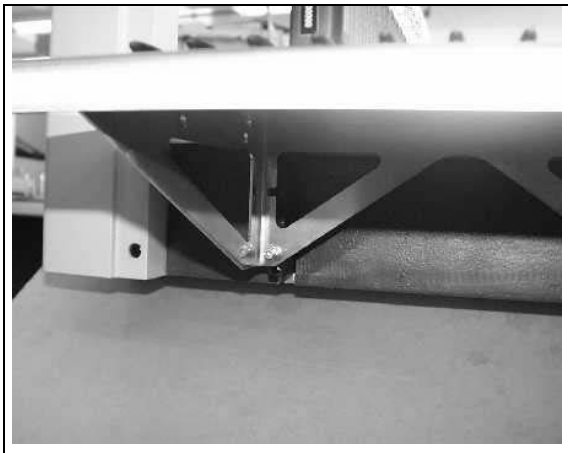
Adjustment

By using a Sample Carrier (or any other carrier) check for height and parallelity to deck.

Procedure:

	
Place the Carrier onto the deck and mount only one loading tray (say, the left one) onto the Instrument.	Pull the carrier out to the loading tray and check for height and parallelity between carrier and tray. A parallel gap indicates an ideal adjusted loading tray.

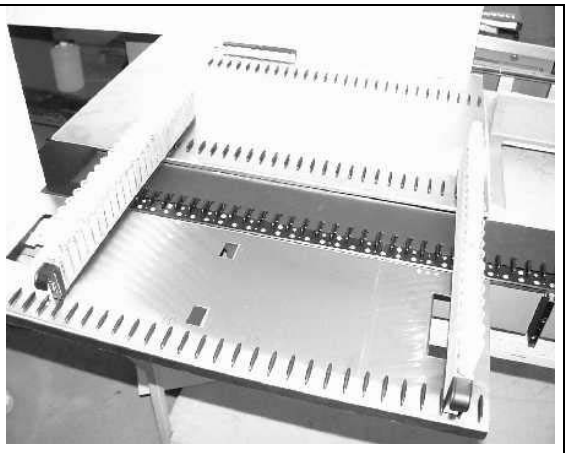
Loading tray adjustment (continued)



Adjust loading trays in height and angle to deck underneath.

Height Adjustment: remove loading tray and raise or lower black table adapter

Angle Adjustment: with the loading tray mounted and the Carrier placed as shown in picture, turn screw underneath loading tray in or out and fix it then with the hex nut.



Perform this procedure at least on the outer edges of the loading tray to ensure proper loading and unloading of carriers.

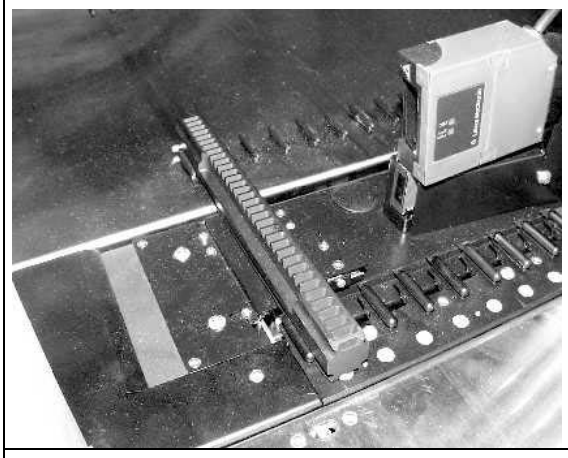
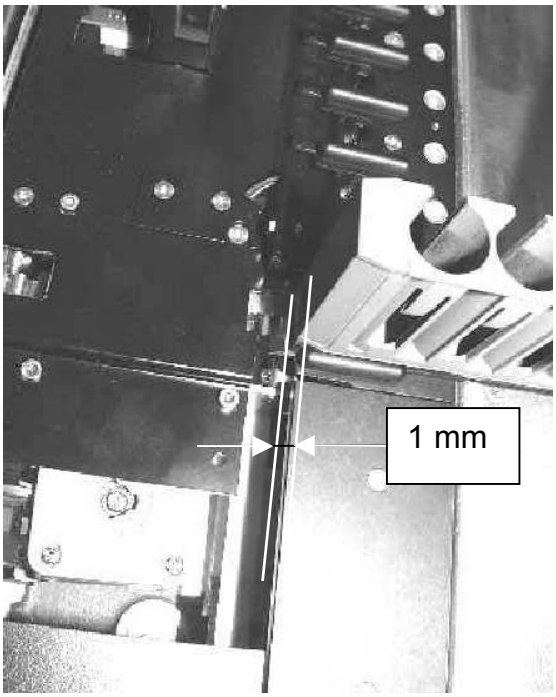
Replace the loading tray by the other one and follow the instructions above.

Finally with both Loading trays mounted, ensure both are adjusted onto the same height. Especially check for Track 28 (in the Middle of the Instrument) and perform an automatic loading and unloading step, using the Software.

6.8.4 Automatic Autoload Adjustment Procedure

Positioning of Cog wheels in X, Y and Z Direction and Sensors Adjustment: Start Macro Program “AUTOLOAD AUTOADJUSTMENT.MCR” from Service Software and carefully follow the instructions given in the program.

Follow exactly the instructions given in the adjustment program.

	When the program asks for the Autoload Calibration Tool to be placed from the back onto Track position 1, Ensure the cog rail is facing upwards and push the Tool gently from inside the ML STAR Instrument outwards until the pin from the Tool attaches to the slide block.
	At the end of adjustment procedure, after the Autoload Sensors Adjustment Tool is unloaded, ensure a gap of approx. 1 mm between Stop Hook and the Carrier.

6.9 Verification

6.9.1 Volume Verification

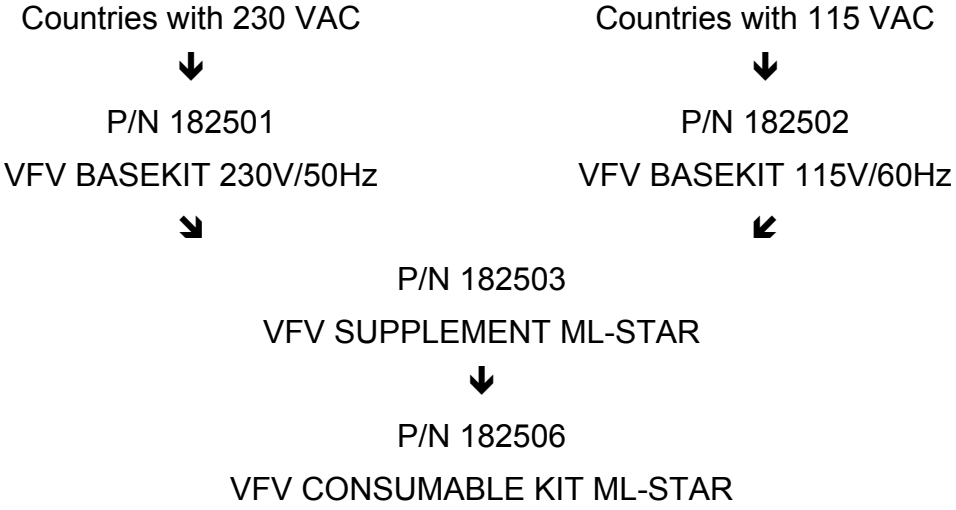
The Verification Kit provides the means to verify instrument functions against specific acceptance criteria. The gravimetric verification procedure consists of an easy-to-follow program called from the user Software.

The Pipetter's Accuracy and Precision will be verified.

6.9.2 Verification Kit's

The Verification Kit consists of 3 parts:

- A Basekit witch may be used for several Hamilton Instruments next to the ML STAR Instrument, however it is current depending for Countries with either 115 VAC or 230 VAC.
- An Instrument specific "SUPPLEMENT" Kit witch contents ML STAR Instrument specific items.
- A "CONSUMABLE KIT" which contains verification fluid, disposables Tips, etc.



6.9.3 Verification after replacement, or remounting

Described below are the necessary actions (such as adjustments, verification and functional check), which have to be undertaken after replacement, or remounting for each component.

"x" indicates a necessary adjustment, volume verification and/or functional check. Components which are not listed below do not need any action to be undertaken.

Instrument Components	Adjustment			Volume Verification	Functional check
	Instrument Check	Auto adjustment	Autoload adjustment		
Side Panels of ML STAR Instrument	-	-	-	-	• Check Collision free movement of Pipetting Arm
Front window	-	-	-	-	x
Cover Switch	-	-	-	-	• check locking function (ML STAR IVD) • check stop functionality when opened while method is running
Carrier Stops	-	-	-	-	• Perform loading of carriers
Deck Panels	x	-	-	-	• Perform loading of carriers
Docking Station	-	-	-	-	• Check Collision free movement of Pipetting Arm • No collision while carriers are loaded
Waste station	-	-	-	-	x

Verification after replacement, or remounting (continued)

Pipetting Arm Components	Adjustment			Volume Verification	Functional check
	Instrument Check	Auto adjustment	Autoload adjustment		
Covers of Pipetting Arm	-	-	-	-	• Check Collision free movement of Pipetting Arm • Check Collision free movement of Channels
Pipetting Arm	x	x	-	-	x
Pipetting Arm X-Drive	x	x	-	-	x
EC Pipetting Arm X-Position	x	x	-	-	x
P-Arm Flag	x	x	-	-	x
Channel	x	x	-	-	x
Pipetting Head	x	x	-	x	x
Stop Disk	x	x	-	x	x
CO-RE O-Ring	x	x	-	x	x

Verification after replacement, or remounting (continued)

Autoload Components	Adjustment			Volume Verification	Functional check
	Instrument Check	Auto adjustment	Autoload adjustment		
Autoload drive Incl. all of its components	-	-	x	-	x
Autoload X-drive	-	-	x	-	x
Insertion Guides	-	-	-	-	x
Loading Trays	-	-	-	-	x

Verification after replacement, or remounting (continued)

Electronically Components	Adjustment			Volume Verification	Functional check
	Instrument Check	Auto adjustment	Autoload adjustment		
Master PCB	x	x	-	-	x
Autoload PCB	-	-	x	-	x
Main Switch	-	-	-	-	x
Power distribution Board	-	-	-	-	x
Extension Board	-	-	-	-	x
Power supply	-	-	-	-	x
Fan	-	-	-	-	x
Cables	-	-	-	-	x

7 Components

7.1 Overview

All mainly mechanical Components of the Microlab® STAR are listed below. In this section will be found a description of functions, how to replace Assemblies or single parts, and a list of part numbers.

Before starting the replacement of assemblies the instrument has to be uncovered. Disconnect the instrument first from the main power. Then follow the instructions below.

This section has the character of a top down structure and starts with uncovering of panels.

Attention: Never switch on an ML STAR Instrument while any electrical cables are not plugged in (e.g. a pipetting head not mounted onto its channel) as this may destroy an electronic component such as a complete Channel.

7.2 Replacement of Components

Update Data with service Software, when one or more of the following Assemblies / Components are being replaced:

- 300 and 1000 µl Pipetting Head
- A & B Channel
- Autoload Drive
- Extensions such as iSwap, washing station, temperature-controlled carrier.

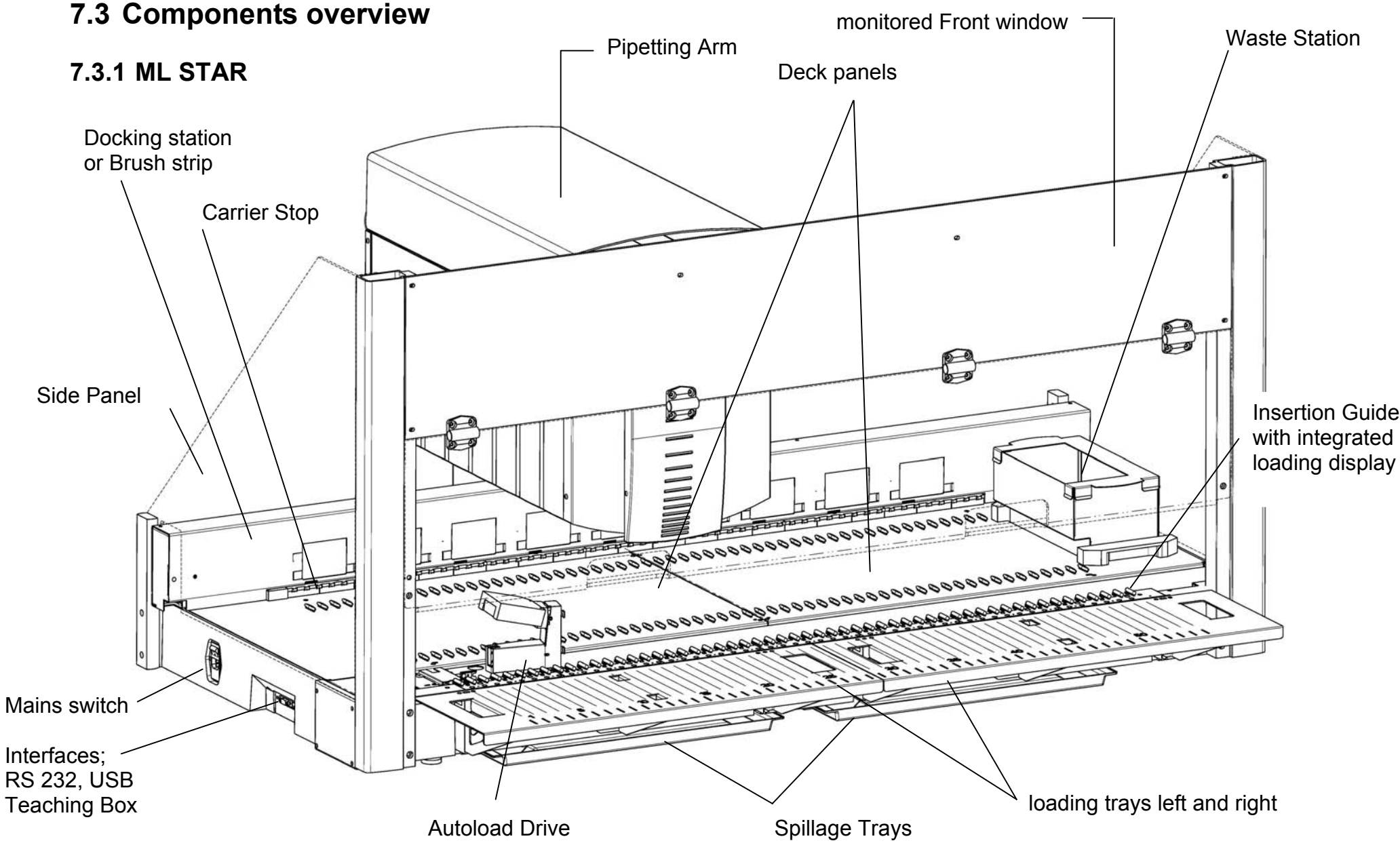
For Data input, refer to section 3 Service Software on page 3-1 ff

After replacement, update or upgrade run an installation qualification according to section 4 Installation of the instrument on page 4-1to verify the functionality of the ML STAR Instrument.

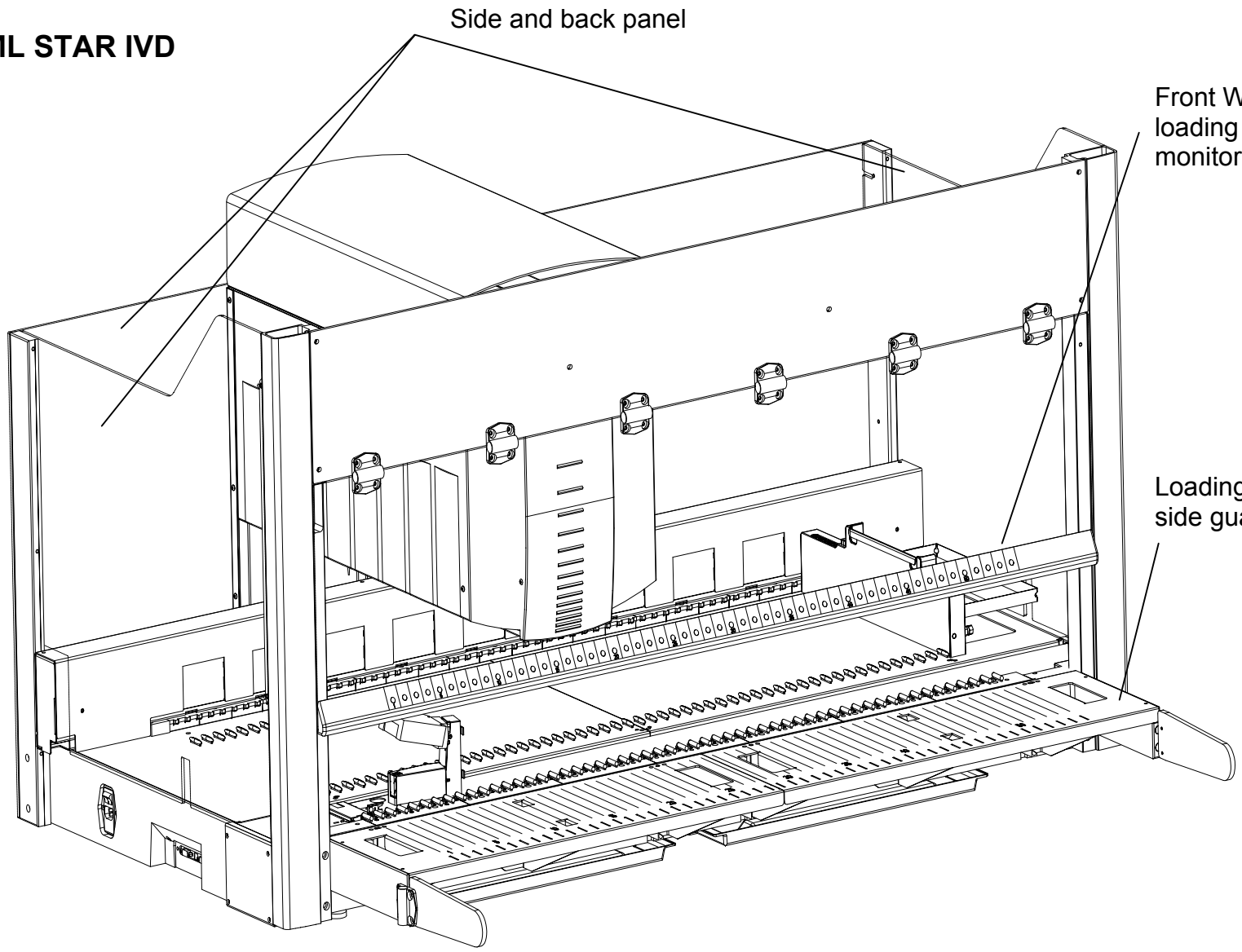
Note: file / store technical data with Service Software before replacing any part. When sending a defective part for repair to Hamilton Bonaduz AG attach a copy of its technical data for investigation.

7.3 Components overview

7.3.1 ML STAR



7.3.2 ML STAR IVD

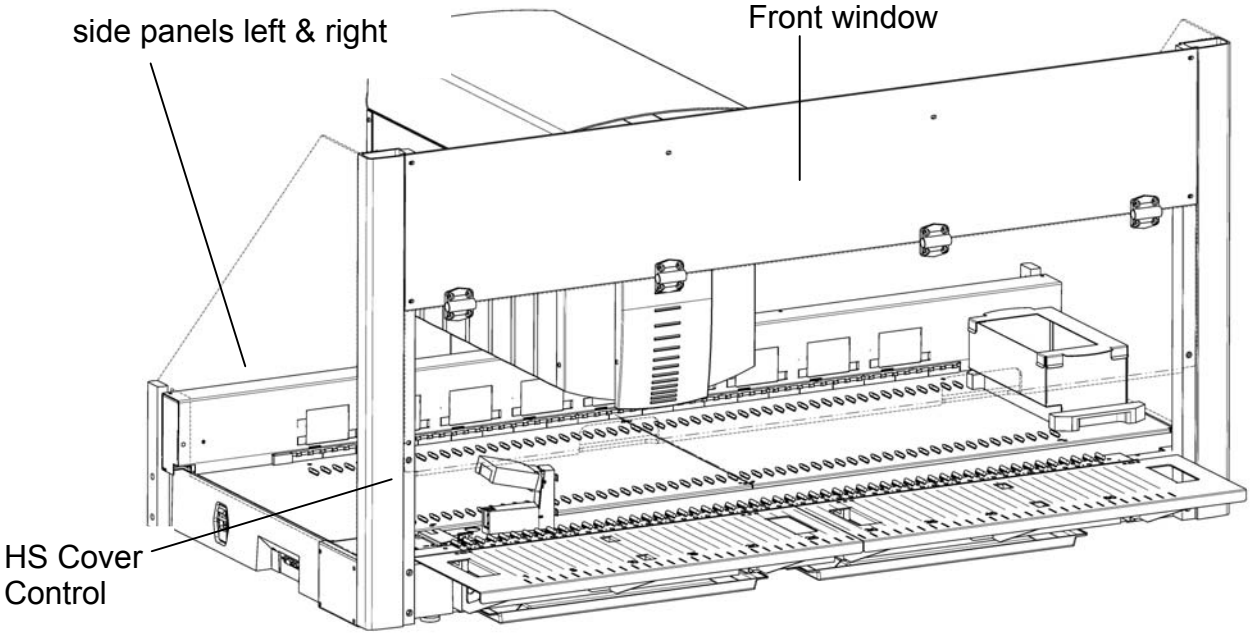


7.4 Covers of the Microlab® STAR

- Front window
- Panels left and right side
- Deck Panels
- Pipetting Arm housing

- for the Autoload Drive Ribbon refer to section 7.9 Auto Load drive on page 7-37.

7.4.1 Front Window and Panels left & right side



7.4.1.1 Part List

P/N	Description	SPC
173712	SIDE PANEL LEFT	C
173713	SIDE PANEL RIGHT	C
173774	FRONT WINDOW	C
173860	HS COVER CONTROL	A
281401	COVERING CAP D=25.5 PA	A
400047	CYL-SCR M5X16 DIN912	A
400619	CYL-SCR M2.5X8 DIN912	A
420560	SCREW M4x10 A2 ISO7380	A
420561	TORX SCREW M5x12	A

7.4.1.2 Function

The Front window and side Panels left & right protect the user from the moving Pipetting Arm and from any contamination inside the instrument.

A Cover Control switch located inside the left vertical post controls the closed Front window and will stop any movement of the instrument and also will abort a started Method if the Front window is opened during a Run. However, it is still possible to access all Carriers, loading and unloading, with the Front window closed. Opening is necessary for maintenance Tasks i.e. deck surface cleaning, access to waste station etc.

The Microlab® STAR Instrument can be run without side Panels when the optional ML STAR Plate Handler and / or the ML SWAP require access to the deck.

7.4.1.3 Replacement

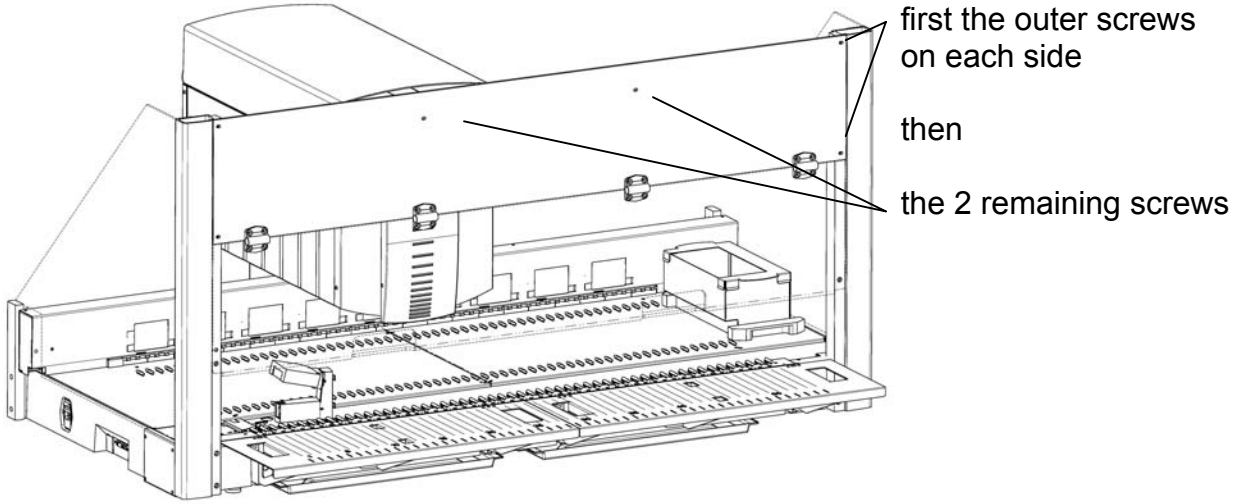
this section describes the replacement of:

- Front window
- Cover Switch
- Panels left & right side

Attention: Handle with care to avoid scratches on cover and panels.

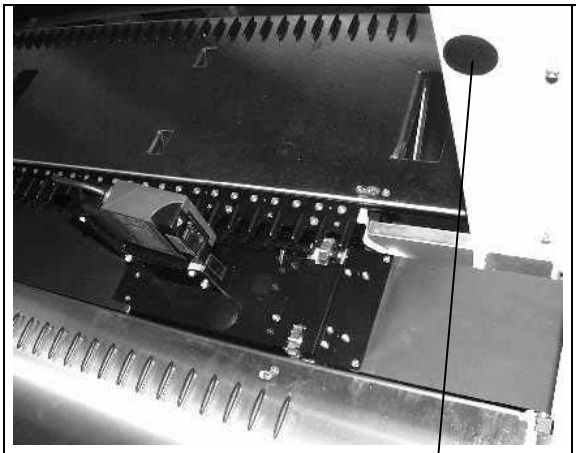
- **Front window**

  Remove 6 screws P/N 420561:
  First remove outer screws, then, holding the Front window by hand, the two remaining screws in middle. Carefully lift Front window away and store on appropriate surface.
  A black sheet metal to protect the front guide bar from dust is located behind the Front window, fixed with screws P/N 400047.



Replacement (continued)

- **Cover Switch**



Remove Covering Cap P/N 281401 by hand on left vertical post to access HS Cover Control.

To replace Cover Control it is necessary to remove left Deck Panel and Autoload ribbon[14]. See section 7.4.2 Deck Panels on page 7-7 and section 7.9 Auto Load drive on page 7-37.

- **side Panels**

  Simply loosen 6 screws P/N 420560 per Panel and gently move them out of their sockets. It is not necessary to remove any screw at all.

Attention: To avoid any damage to Panels do not use extensive force during removing or mounting them. Handle with care!

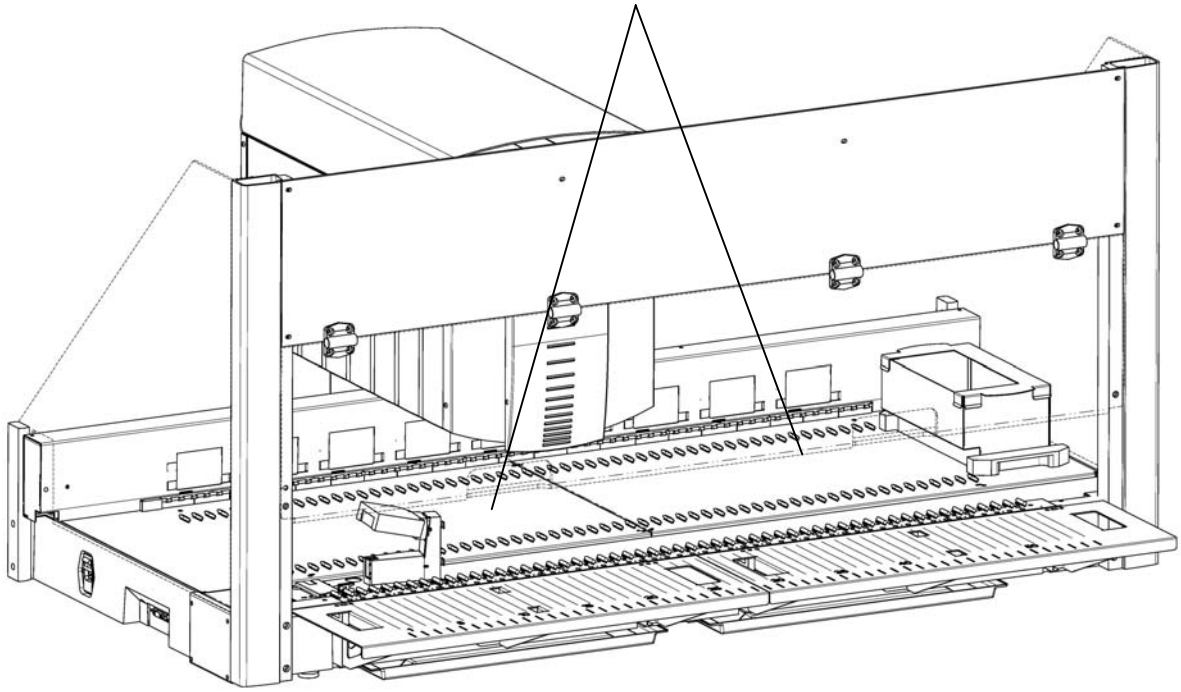
Covering:

Instructions are the reverse of uncovering. Take care to avoid scratches.

[14] Microlab®-STAR Instrument with Autoload Option only

7.4.2 Deck Panels

Deck Panels left and right



7.4.2.1 Part List

P/N	Description	SPC
173378	CAP	C
173288	CONTACT PLATE	C
173600	SLIDE BLOCK	A
173602	SLIDE BLOCK WEDGE	A
173833	CARRIER SENSOR BOARD	A
173858	CABLE SSC	A
182114	REPLACE. DECK AL RIGHT	C
182115	REPLACE. DECK AL LEFT	C
182118	REPLACE. CARRIER STOP	C
182283	DOCKING STATION FOR ML STAR	C
400302	CYL-SCR M4X8 DIN912 A2	A
403491	C-SUNK SCR M 4X8 DIN7991	A
420010	CYL-SCR M2,5X8 DIN912 A4	A
420074	CYL-SCR M4X16 DIN912 A2	A

7.4.2.2 Function

The Deck Panels provide the reference grid for Carriers as well as Pipetting Channels. Using Slide Blocks and Carrier Stops, the Working area is divided into 55 Tracks. These components are responsible for correct and precise positioning, and smooth transport of all Carriers.

The Carrier Stops in the rear detect presence of carriers and that they have snapped into place. The stops also ground Carrier to Instrument.

The Docking Station (in place of the Brush Strip) enables customers to extend the ML STAR Instrument with options such as Wash Station, temperature-controlled Carriers, Automated Vacuum System etc.

A Brush Strip located between the Carrier Stops and the X Guide Shaft covers over the trough and prevents dust and e.g. disposable Tips from falling into ML STAR Instrument.

7.4.2.3 Replacement

Described in this section is the replacement of:

- Docking Station, or Brush Strip
- Carrier Stops
- Deck Panels
- Slide Blocks

Attention: All Carrier Stops and Docking Station / Brush Strip must removed before Deck Panels can be removed.

- **Docking Station / Brush Strip**

  Remove either Docking Sation P/N 182283 or Brush Strip P/N 173194 with its sheet-metal (whatever the configuration of the ML STAR Instrument is) by removing 4 screws P/N 400302 from Deck Panels.

Replacement (continued)

- **Carrier Stops**

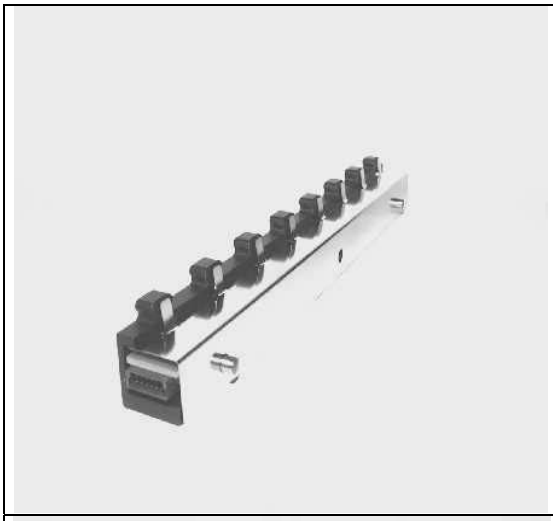
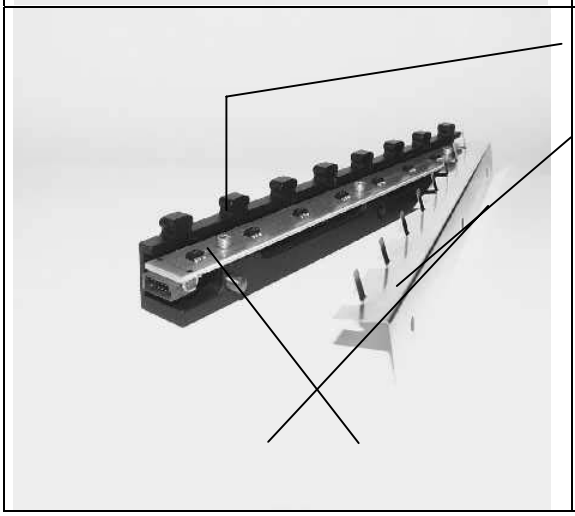
	Unscrew and remove Plug Cap P/N 173354 (Screw P/N 420074) on the left hand side of Carrier Stops, disconnect Cable P/N 173858 from Carrier Sensor Board and push Cable with Plug through the hole in the deck.

- Then completely unscrew and carefully remove all Carrier Stops in the rear (Screws P/N 420074).

Attention: Do not break any plugs from Carrier Sensor Board located on Carrier Stops while removing Carrier Stops from Deck Panel.

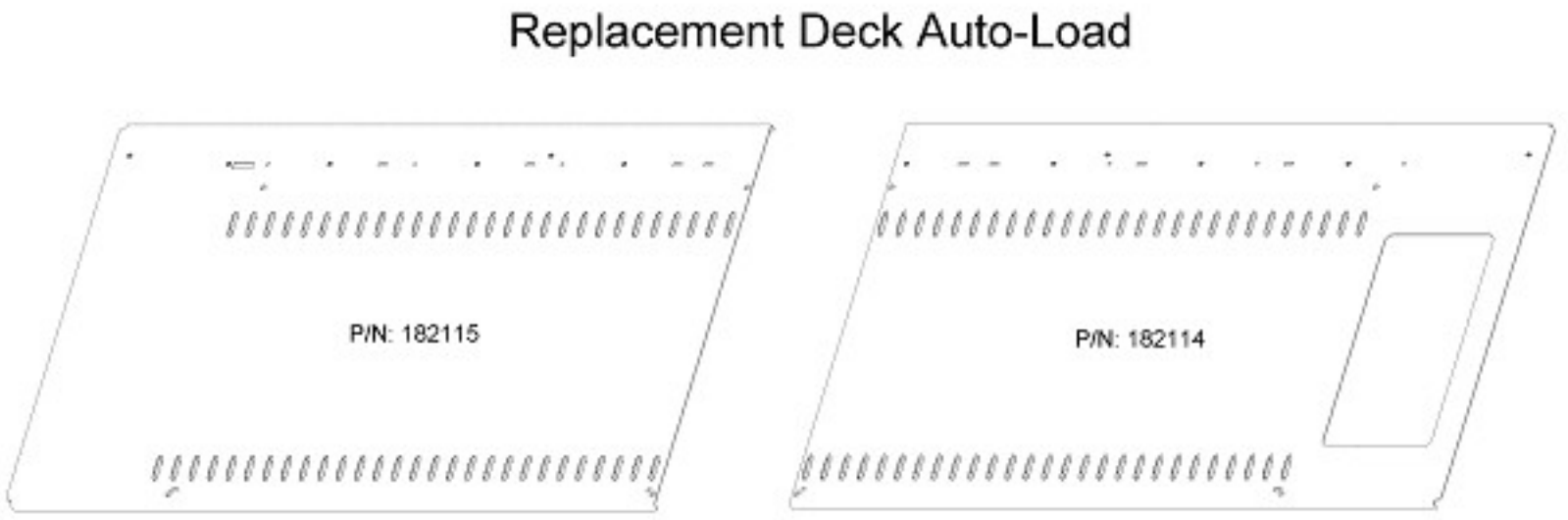
Start removing Carrier Stops from left to right!

Replacement (continued)

	• Do not bend any parts of Contact Plate (sheet metal). • "Tongues" of Contact Plate must be as close as possible to Replace. Carrier Stop (solid piece).
	• Replace. Carrier Stop P/N 182118 (solid piece) • Contact Plate P/N 173288 (sheet metal) • Carrier Sensor board P/N 173833 • 3 Screws P/N 420010 holding Carrier Sensor board on Replace. Carrier Stop.

Replacement (continued)

- **Deck Panels**



Note: only Deck Panels for ML STAR Instruments with Autoload Option may ordered as replacement parts

Replacement (continued)

Unscrew Deck Panels (4 screws P/N 403491 each panel) and remove them.

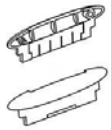
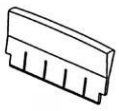
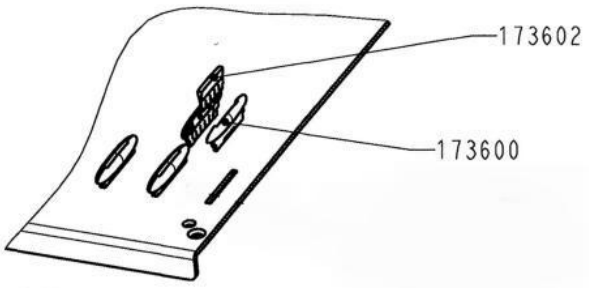
Attention: Before removing Left deck Panel, note presence of of Carrier Sensor Board Cable.

Note: Store Deck Panels on appropriate surface and prevent from damage, i.e. protect slide blocks.

- **Slide Blocks**

  Note: Deck Panels must removed before Slide Blocks can be replaced. First it must be ensured that no broken parts have fallen inside instrument and second, proper remounting is only possible when Deck Panels are placed onto appropriate supports.

  Remove damaged or broken Slide blocks and replace with new ones. Connect two Slide Blocks together, push them into square hole in deck and finally push a Slide Blocks Wedge to wedge the replaced parts into position.
  A rubber Hammer may be used to gently tap the Slide blocks into place.

	Slide Blocks P/N 173600
	Slide Block wedge P/N 173602
	Preassembled Slide blocks with wedge.

Attention: Deck Panels may damaged (warped) if they are not placed onto appropriate supports when remounting slide blocks. Avoid bending during mounting slide blocks - e.g. by using a rubber hammer.

Covering of deck panels:

Instructions are the reverse of those for uncovering. Remember to guide Carrier Sensor Board Cable through left deck panel first.

Guide deck panels as well as Carrier Stops into their positioning pins or holes as required.

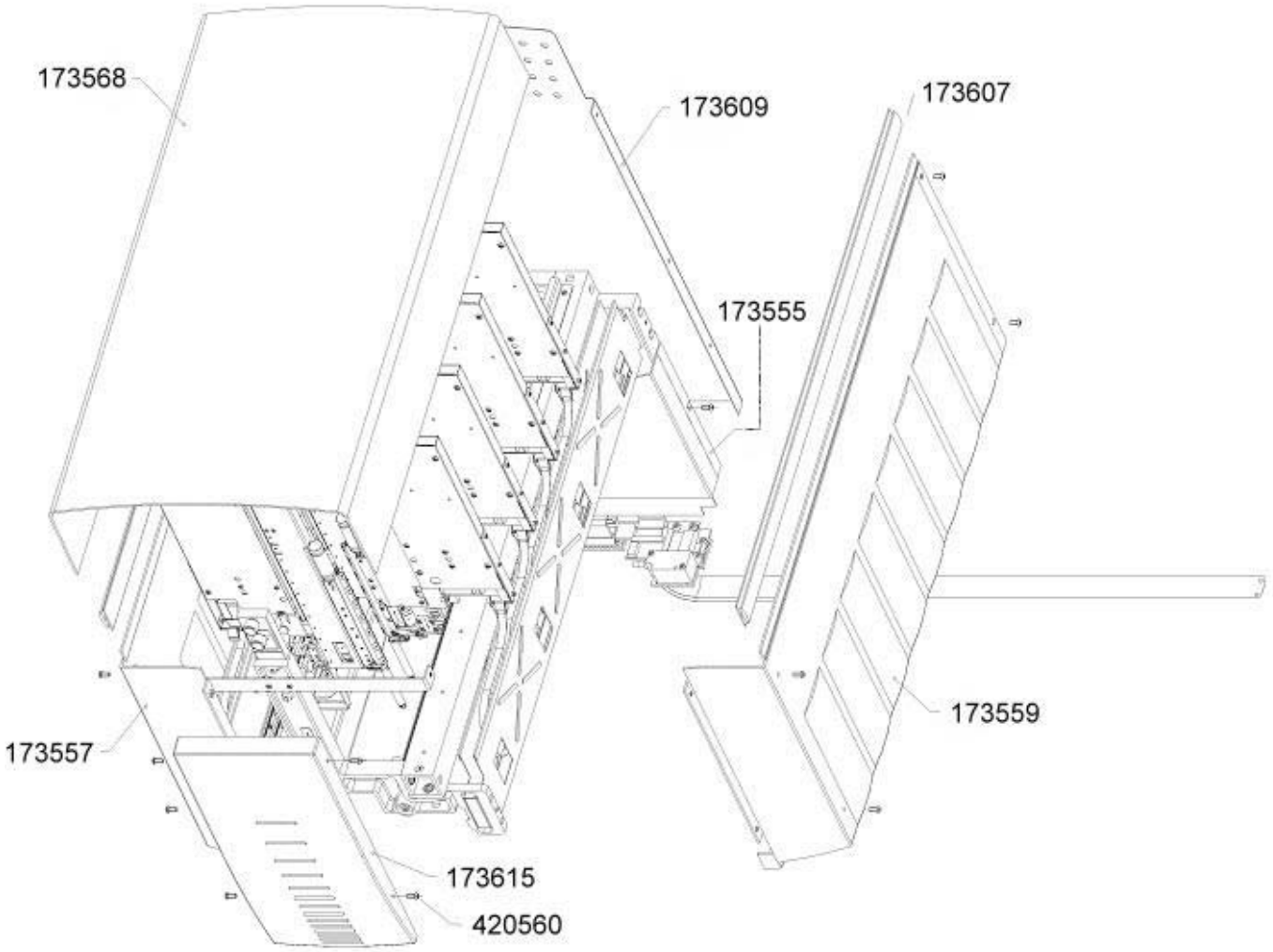
Attention: Do not bend sheet metal tongues of the Carrier Stops in the rear - otherwise Carriers won't snap in correctly. See section 7.4.2.3 Replacement on page 7-8.

Note: Start put Carrier Stops in place on Deck Panels, working from right to left. Carefully connect them together so as to preserve them from any damage.

Plug in and fold Cable, remount cable cap and brush strip or docking station as the case may be.

Attention: Do not push cable into whole of deck panel, due to avoid damage through X-Arm drive.

7.4.3 Pipetting Arm housing



7.4.3.1 Part List

P/N	Description	SPC
173555	PANEL	C
173557	SIDE PANEL LEFT	C
173559	SIDE PANEL RIGHT	C
173568	TOP COVER	C
173607	H PROFILE	C
173609	BACK PANEL	C
173615	FRONT PANEL	C
420560	SCREW M4X10 A2 ISO7380	A

7.4.3.2 Function

The function of the Pipetting Arm:

- Pipettes Liquids
- Accommodates the Channels with the Pipetting Heads
  - from 4 up to 12 Channels
- Enables Y-Movement for the Channels
- Carries a Cover which:
  - Protects the Channels, guide shafts and spindles from dust.
  - Security for the user prevents physical contact with the channels
- Moves in X-Direction driven by the Pipetting Arm X-Drive

7.4.3.3 Replacement

- Lift Top Cover P/N 173568 off Side panels (P/N 173557 & 173559). Top Cover, Side panels and H-bars P/N 173607 fit snugly into place together. H-bars may remain on Side panels or on Top Cover.
- Remove Front panel P/N 173615 by unscrewing 4 Screws P/N 420560.

  Hint: Front panel may be used as screw holding place for further actions.

- Side panels are removed by unscrewing 8 Screws P/N 420560 (currently 2 screws per panel, front and rear).

  Hint: If no more uncovering is needed, do not remove side panel's lower screw at the back since there are matching indents to join the side panel with the back panel.

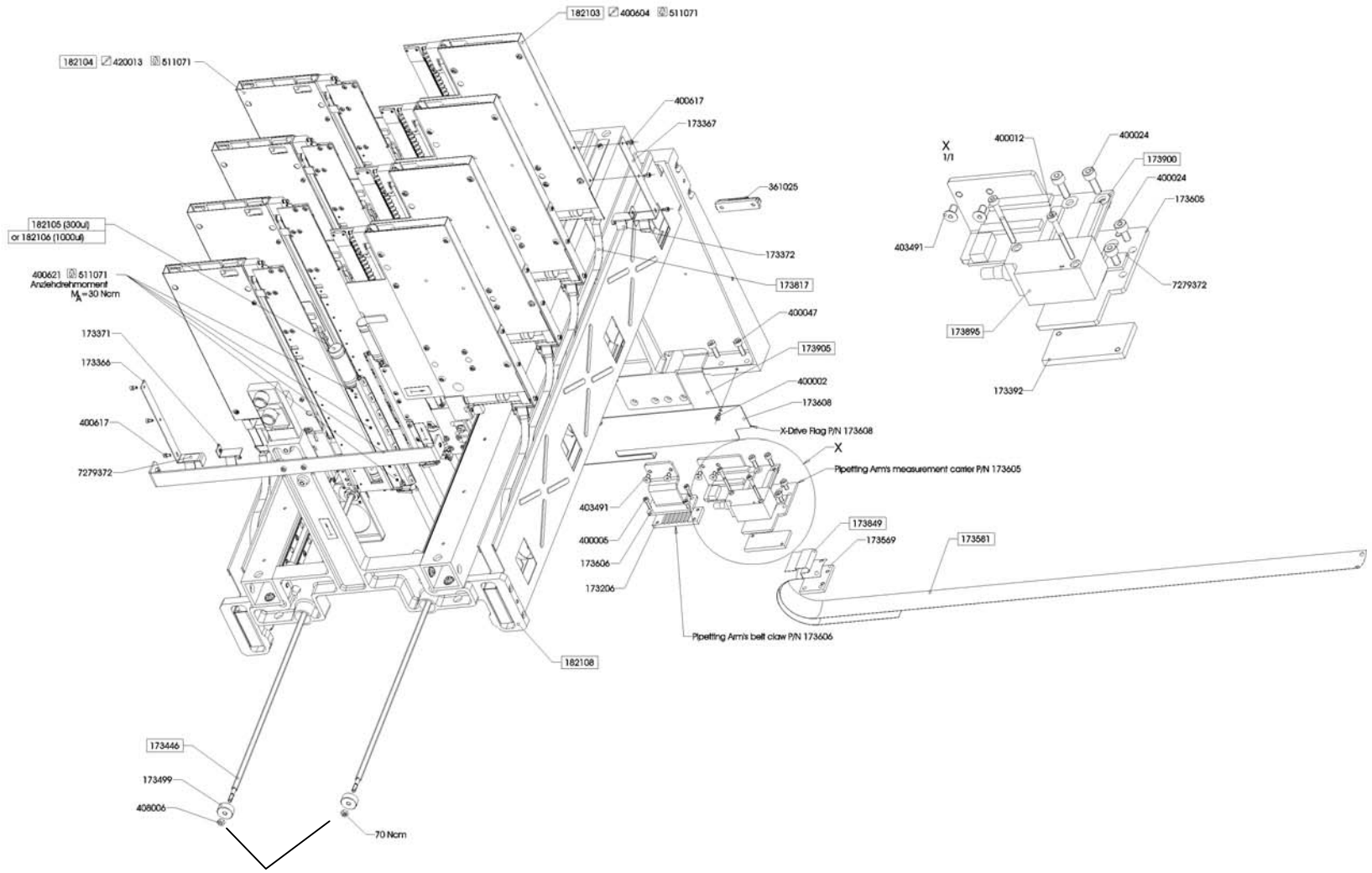
- Unscrew the 2 remaining screws and remove Back panel P/N 173609 and Panel P/N 173555 in the rear.

  Hint: If it is all right for the Back panel to remain on the Pipetting Arm, do not remove lowest screws since there are indents in Panel to join it with back panel.

Covering:

- Instructions are the reverse of those for uncovering. Ensure shadow gaps and collision-free mounting for Pipetting Channels and X-Movement of Pipetting Arm.
- Join Panel and Back panel at the rear and place screws loosely in Back panel - do not tighten them yet.
- Join Side panels to Back panel and fix them with screws.
- Reassemble Front Panel with 4 screws.
- Tighten all screws.
- Snap Top Cover onto H-bars and Side panels.

7.5 Pipetting Arm



Torque tension of the M4 Hex Nut 60 cNm. (P/N 408006)

7.5.1 Part List

P/N	Description	SPC
173206	CLAMP AT5	C
173366	CABLE GUIDE PLATE LEFT	C
173367	CABLE GUIDE PLATE RIGHT	C
173371	HOLDING PLATE LEFT	B
173372	HOLDING PLATE RIGHT	B
173392	HOLDING BAR	C
173446	Y-SPINDLE	C
173499	Y-SPINDLE BEARING	C
173569	BRIDE FLAT CABLE	C
173581	STEEL BAND	C
173605	CLAMPING BRACKET	C
173606	P-ARM LINK	C
173608	P-ARM FLAG	C
173817	CABLE X-ARM –P-CHANNEL BOARD	A
173849	X-MOVEMENT CABLE	A
173895	EC PIPETTING ARM X-POSITION	A
173900	X-ARM CONNECTOR	A
173905	CABLE X-ARM CONNECTOR 8C	A
173906	CABLE X-ARM CONNECTOR 16C	A
182103	REPLACEMENT CHANNEL A	A
182104	REPLACEMENT CHANNEL B	A
182105	REPLACE. PIPETTING HEAD 300ul [15]	A
182106	REPLACE. PIPETTING HEAD 1000ul [16]	A
182108	REPL. FRAME PIP. ARM 8-CHANNEL	C
361025	FCC-2A CABLE GUIDE	A
400002	CYL-SCR M3X6 DIN912	A
400005	CYL-SCR M3X12 DIN912	A
400012	CYL-SCR M3X30 DIN912	A
400024	CYL-SCR M4X8	A
400047	CYL-SCR M5X16 DIN912	A
400604	CYL-SCR M2x8 DIN912	A
400617	CYL-SCR M2.5X5 DIN912	A
400621	CYL-SCR M2.5X12	A
403491	SUNK SCREW M4X8	A
408006	HEX SCREW M 4 DIN934	A
420013	CYL-SCR M3X8 DIN912	A
511071	OMNI FIT 15M	A
7279372	ADHESIVE TAPE 1-SIDED D=2 B=12	A

[15] Depending on instrument configuration
[16] ditto

7.5.2 Main Components

- Pipetting Arm Replacement Frame P/N 182108
- A & B Channels
- Pipetting Heads 300 µl
- Pipetting Heads 1000 µl
- iSwap[17]

7.5.3 Replacement

Preliminary tasks:

- Uncover Pipetting Arm and remove all Pipetting Channels and iSwap (if installed). Refer to section 7.7 Pipetting Channels on page 7-26.

Attention: store and handle Pipetting Channels and iSwap (if available) with care.

Remove left deck panel - see section 7.4.2 Deck Panels on page 7-7.

For the following removals Refer to section 7.6 Pipetting Arm X-Drive on page 7-23.

- X-Drive Flag P/N 173608
- Pipetting Arm belt claw P/N 173606
- Pipetting Arm measurement carrier P/N 173605. Disconnect Cable first.

Attention: Do not bend or kink X-Movement Cable.

- Unscrew 8 fixing screws (P/N 400047) from carriage main guide in the back, and then carefully remove Pipetting Arm from instrument.

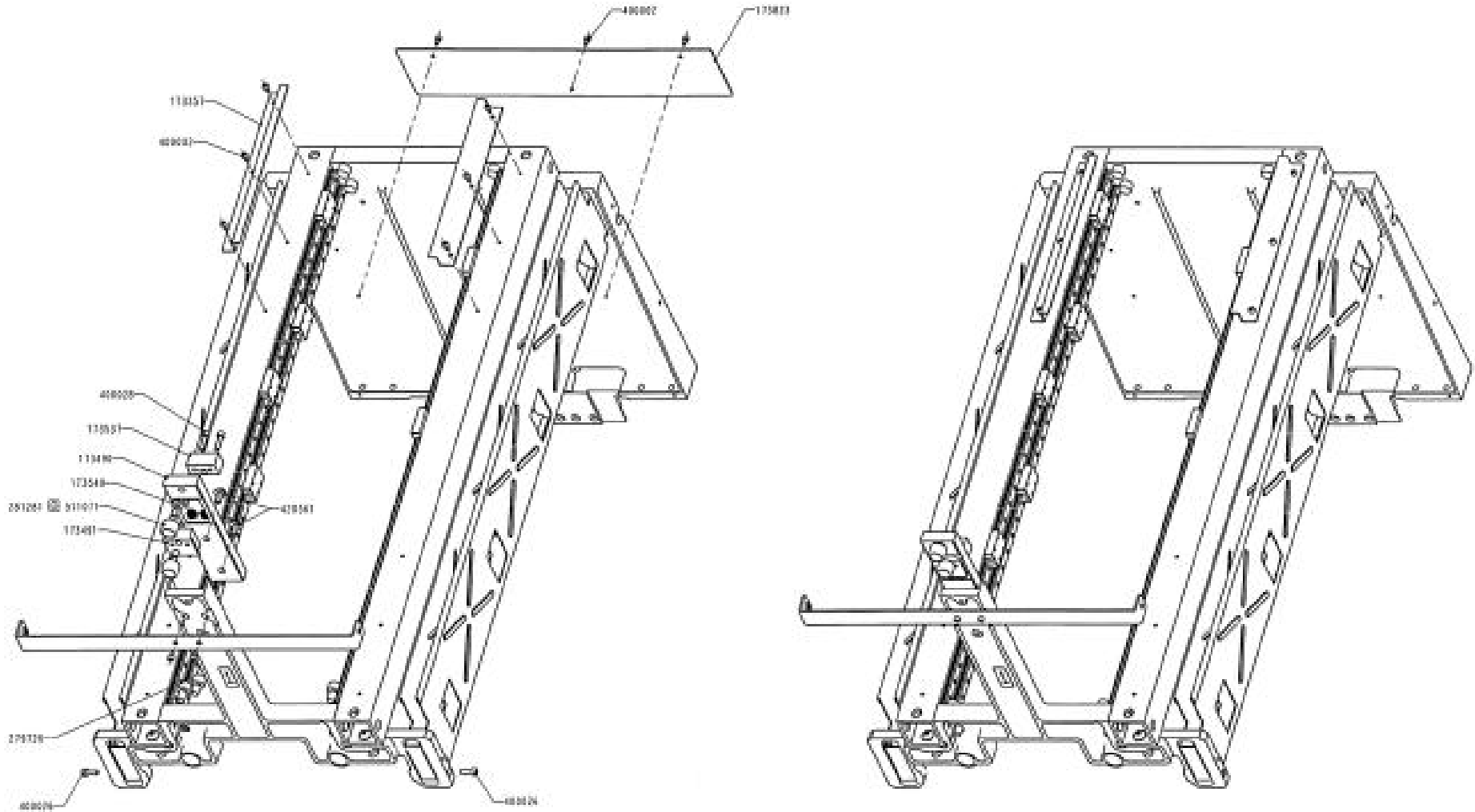
Note: the 8 fixing screws may occur as setscrews with hex nuts and washers. Setscrew P/N 405092, hex nut P/N 173459, washer P/N 173458.

[17] Extension

Remounting:

- Instructions are the reverse of those for disassembly.
- lead caster onto front guide bar and mount Pipetting Arm with 8 fixing screws to rail slides.
- remount Pipetting Channels, iSwap (if available)
- Adjust Pipetting Arm according to section 6.4 Adjusting Pipetting Arm on page 6-19.
- Adjust Pipetting Channels according to section 6.3 Adjusting Pipetting Channel on page 6-14.
- Cover Pipetting Arm

7.5.4 Pipetting Arm Replacement Frame P/N 182108



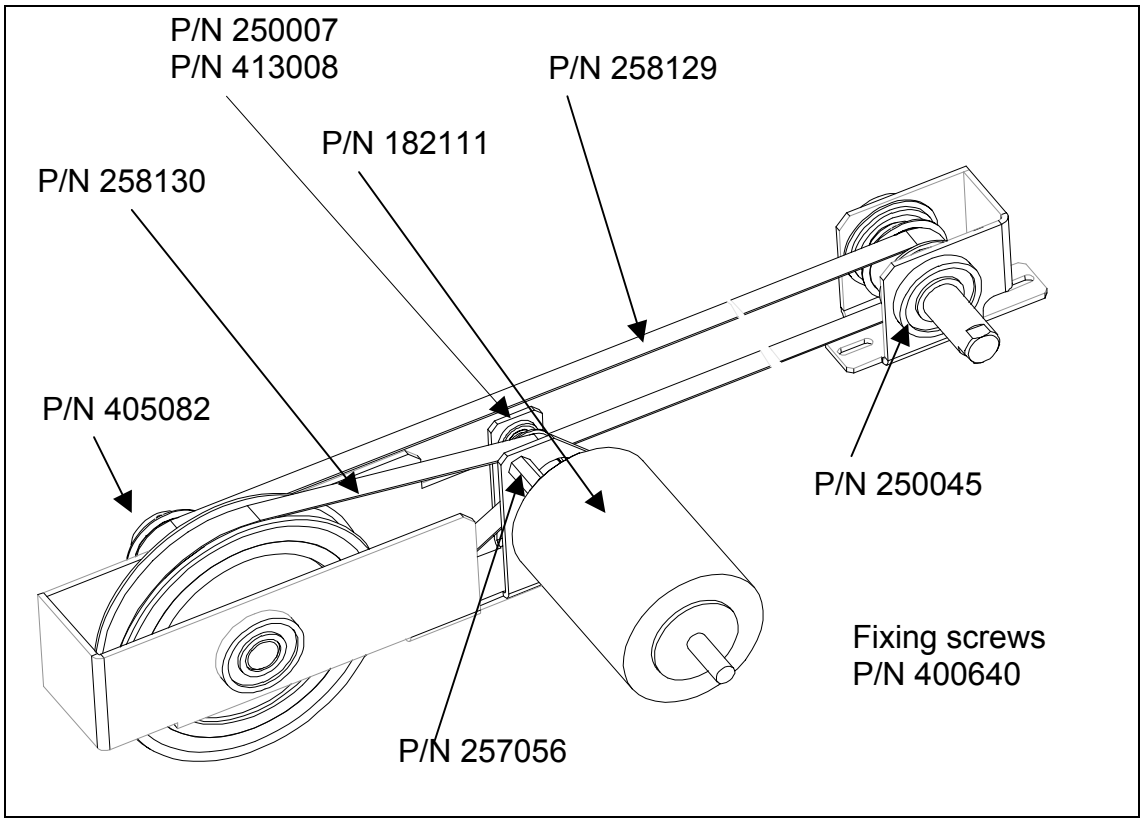
7.5.4.1 Part List

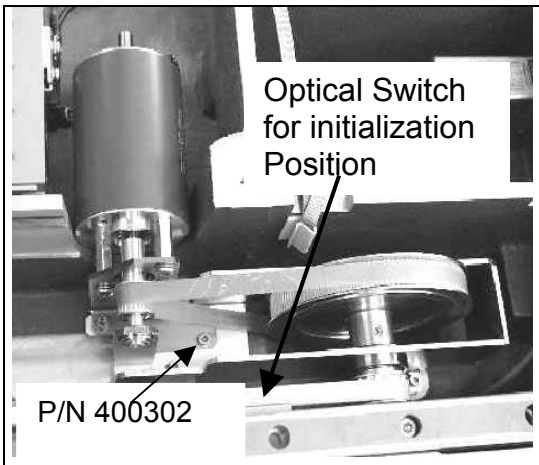
P/N	Description	SPC
173239	CABLE GUIDE COMPLETE	C
173357	Y-FLAG	C
173490	ROLL HOLDER	C
173491	GUIDE	C
173536	REINFORCING ANGLE BRACKET	C
173537	PAWL	C
173538	PROTECTIVE RING	C
173549	GAP DISC	C
173823	PIPETTING ARM CONNECTOR	A
254087	O-RING ID8.00X2.00 NIT 70SH	C
256141	PRESSURE SPRING	A
281281	TRACK ROLLER D=16	B
281457	BUTTON BUFFER D=12 F=4 d=8	C
361004	CABLE GUIDE CFCC-4 ½"	A
400002	CYL-SCR M3X6 DIN912	A
400026	CYL-SCR M4X12	A
400028	CYL-SCR M4X16 DIN912	A
420561	TORX SCREW M5x12	A
511006	LOCTITE 222	A

Attention: Remove or replace only those Parts which are labeled as Spare Parts.

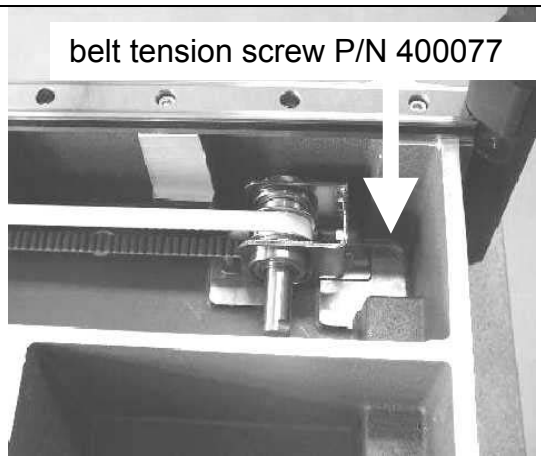
The Pipetting Arm Replacement Assembly is an adjusted assembly which is not intended to be serviced in the field, so do not loosen any screws or parts which are not labeled on the drawing.

7.6 Pipetting Arm X-Drive





Primary Drive



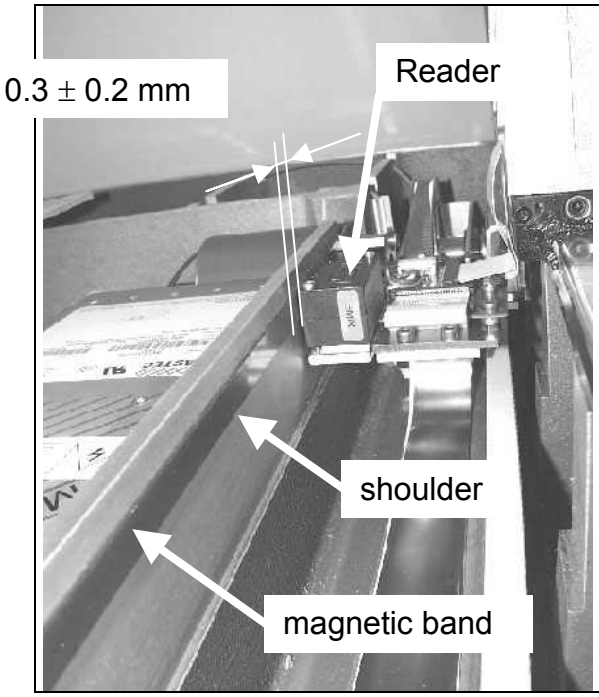
Secondary drive belt tension unit.

Belt tension:

Tighten Belts, however do not over-tighten them (do not use excessive force).

Optical Switch for initialization Position:
Sheet metal P/N 173380 with Screws P/N 400025
OS PIPETTING ARM - X-INIT P/N 173864 with Screws P/N 400262

Pipetting Arm X-Drive (continued):



Measurement system.

Gap between Reader P/N 173895 and magnetic band P/N 396011 must be at least 0.3 ± 0.2 mm.

Magnetic band is self-adhesive and is positioned on the shoulder in the chassis.

7.6.1 Part List

P/N	Description	SPC
173380	OS-HOLDER	C
173864	OS PIPETTING ARM – X-INIT	A
182111	REPLACEMENT X-MOTOR	B
250007	BALL BEARING ID= 8 AD=16/18 B=6	A
250045	BALL BEARING ID=15 AD=35 B=11	A
257056	SPACER PINS M5x20 I/O	A
258129	COG BELT 10AT5/2875	A
258130	COG BELT 10T2.5/480	A
396011	MAGN. MEASURING TAPE	B
400025	CYL-SCR M4X10 DIN912	A
400026	CYL-SCR M4X12 DIN912	A
400077	CYL-SCR M6X60 DIN912	C
400262	CYL-SCR M3X6 DIN912 A2	A
400302	CYL-SCR M4X8 DIN912 A2	A
405082	SET SCR M5X5 DIN913	A
413008	LOCK DISC 7 DIN6799	A
420561	TORX SCREW M5x12	A

7.6.2 Function

- Moves Pipetting Arm in X-Direction.
- Driven by a DC Motor and controlled by a magnetic measurement system and an optical switch.

7.6.3 Replacement

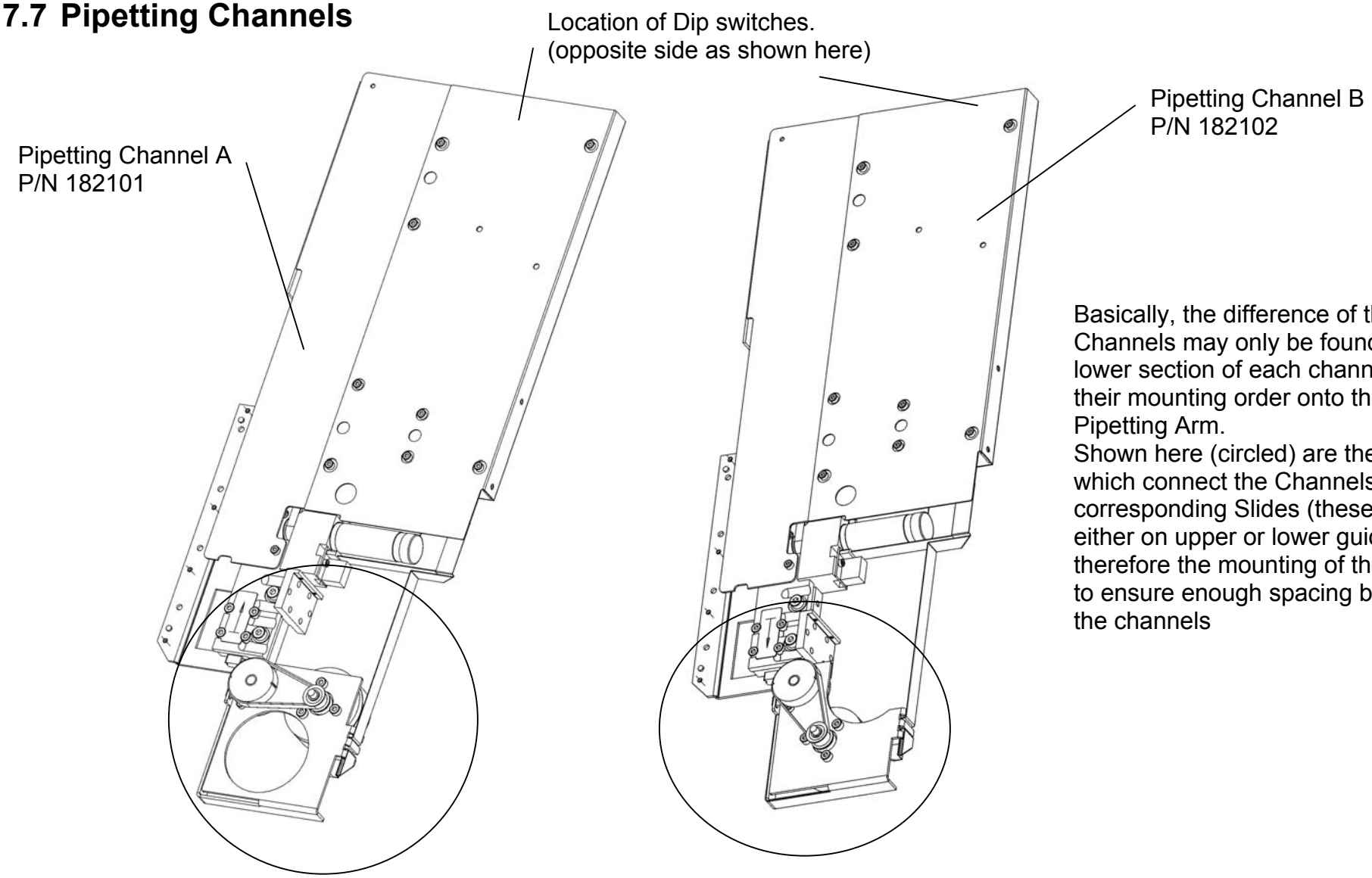
Preliminary actions:

Remove deck panels - see section 7.4.2 Deck Panels on page 7-7.

Hint: remove left deck panel first and right side deck panel only if necessary.

Item	Description
Replace X-Motor P/N 182111	Loosen Belt Tension of secondary drive, disconnect DC Motor cable from Master PCB and then remove Primary Drive Assembly (2 screws M4 x 8, P/N 400025). Loosen Belt Tension of primary drive (2 screws M3 x 6, P/N 400262), remove security washer from DC Motor axis and then remove DC Motor from sheet metal (3 screws I6R M5x12, P/N 420561).
Primary drive belt Cog belt SYN-FLEX 10T2.5/480 P/N 258130	See DC-Motor Additionally loosen 2 set screws (P/N 405082) from large cogwheel, remove axle and large cogwheel.
Secondary drive belt Cog belt Breco P/N 258129	Loosen Belt Tension of secondary drive, and remove belt from Pipetting arm claw
Magnetic Band	See picture on previous side.

7.7 Pipetting Channels



Basically, the difference of the Channels may only be found in the lower section of each channel due to their mounting order onto the Pipetting Arm.
Shown here (circled) are the brackets which connect the Channels to their corresponding Slides (these run either on upper or lower guides), and therefore the mounting of the Y-Motor to ensure enough spacing between the channels

7.7.1 Part List

Pipetting Channels

P/N	Description	SPC
182103	Replacement Channel A Package containing: • 1 Channel A P/N 182101 (without Pip. Head) • Mounting accessories	A
182104	Replacement Channel B Package containing: • 1 Channel B P/N 182102 (without Pip. Head) • Mounting accessories	A

Note: Replacement Channels come without Pipetting Heads. These must ordered separately.

The mounting accessories are 2 types of screws and washers for both types of slides available on ML STAR Instruments. For Slides with small threads, the small screws CYL-SCR M2X8 P/N 400604 must be mounted with washers, otherwise use CYL-SCR M3X8 (P/N 420013).

Nothing may replaced or repaired on Channels - if any drive or function is defective replace the Channel.

7.7.2 Function

To reach a grid pattern of 9 mm, two different Channels A & B are used in the Microlab® STAR.

All A Channels use the upper guide shafts and therefore all B Channels use the lower guide shafts on the pipetting arm.

Note: The left and the right side of the Pipetting Arm have each upper and lower Y-guides for the Pipetting Channels to travel on.

The Pipetting Channel carries the pipetting head which performs all Pipetting Steps. The following features are implemented in the channel:

- Independent Z and Y movements
  The limitations in Y direction are due to the neighbouring Channel
- Carries both types of Pipetting heads (300 and 1000 µl)
- All A- and all B Pipetting Channels are universal and may be individually addressed with dip switches (see section 8.1.6 Node settings on page 8-5). Each channel has its own µController and its own CAN Address, which may individually set.

Note: This means every A Pipetting Channel may be placed onto every A-, and every B Pipetting Channel may be placed onto every B Position.

Attention: As mentioned before and after:
Handle with care when servicing (touching, handling) the pipetting Channels!
Avoid applying any direct or indirect force to any guides.

Special attention must be given to when the channel fixing screws must be loosened, or tightened for adjustment reasons, as this may damage the Y slide of Pipetting Arm.

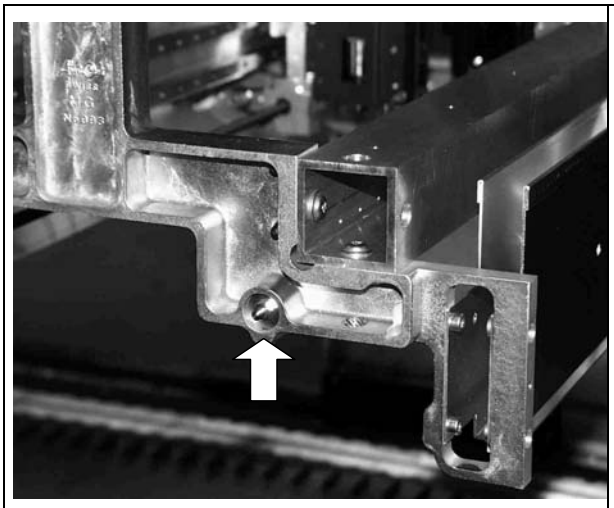
When the channels are stored temporarily e.g. into the Microlab STAR Service Kit. Unsecured storage may bend the Z guide irreparably out of shape.

(The same could happen during crashes, where movements of the Pipetting Arm in X and / or Movements of the Channels in Y collide with an obstacle, eg.due to imprudent use of Service Software.)

7.7.3 Replacement

Before a Pipetting Channel is replaced all data from the channel should be printed out, or saved to a file. Use the Service Software for this printout (see section 3 Service Software on page 3-1).

- Uncover Pipetting Arm (see section 7.4.3 Pipetting Arm on page 7-14).
- Remove Y-Spindle P/N 173446.



- Remove M4 Hex nut.
- Turn Y-Spindle out by Hand.
  If it is too tight use an adjustable wrench to get it loose. Cross flats will be found on the front of the Spindle.
- Carefully remove Y-Spindle from Pipetting Arm.
  Take care not to scratch coated thread.

- Remove Cable holders on desired Channel, since these will be used again.
- Disconnect and remove 2 Cables (Y-motor and communication cable) on desired Channel.
- Loosen the 4 screws which connect channel with Y-Slide
- Carefully remove Channel from Pipetting Arm.

Attention: Whenever it is necessary to move Channels on Pipetting Arm, move them gently by pushing close to their Y-Slide. Never force them as this may lead to damage.

Hint: If Possible switch on Instrument as this will result in a smoother motion when Channels have to be moved on Pipetting Arm.

However, do this only if all cables are plugged in correctly and no short circuit is possible.

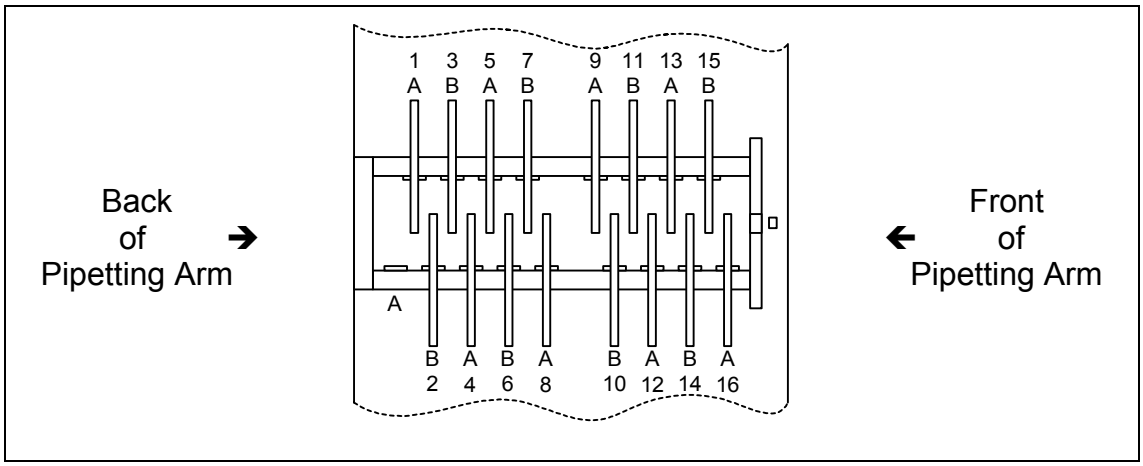
Remounting:

- Instructions are basically the reverse of disassembly instructions.
- Turn Y-Spindle completely in by hand not using much force.
- Using a Torque wrench, tighten the M4 Hex Nut with 60 cNm.

Attention: Check for correct Dip Switch setting on new channels. Refer to section 8.1.6 Node settings on page 8-5. Also, check for correct Firmware Version, because all Pipetting Channels must using the same Firmware Version.

- If necessary, download the latest firmware onto the new Pipetting Channel.
- Adjust Channel according to section 6 Adjustment and Calibration on page 6-1.

Order of Pipetting Channel placement



Shown above are the location of all Channels and their numbering.

7.7.4 Part Numbers for original and replacement Parts

Note: Microlab® STAR instruments when shipped carry Channels with the following Part Numbers (Label on Channels):

P/N 173301 = CHANNEL A with 300ul PIPETTING Head

P/N 173302 = CHANNEL B with 300ul PIPETTING Head

P/N 173305 = CHANNEL A with 1000ul PIPETTING Head

P/N 173306 = CHANNEL B with 1000ul PIPETTING Head

Ordering:

The replacement Channels must ordered with Part Numbers as follows:

P/N 182103 is a Channel A without Pipetting Head

P/N 182104 is a Channel B without Pipetting Head

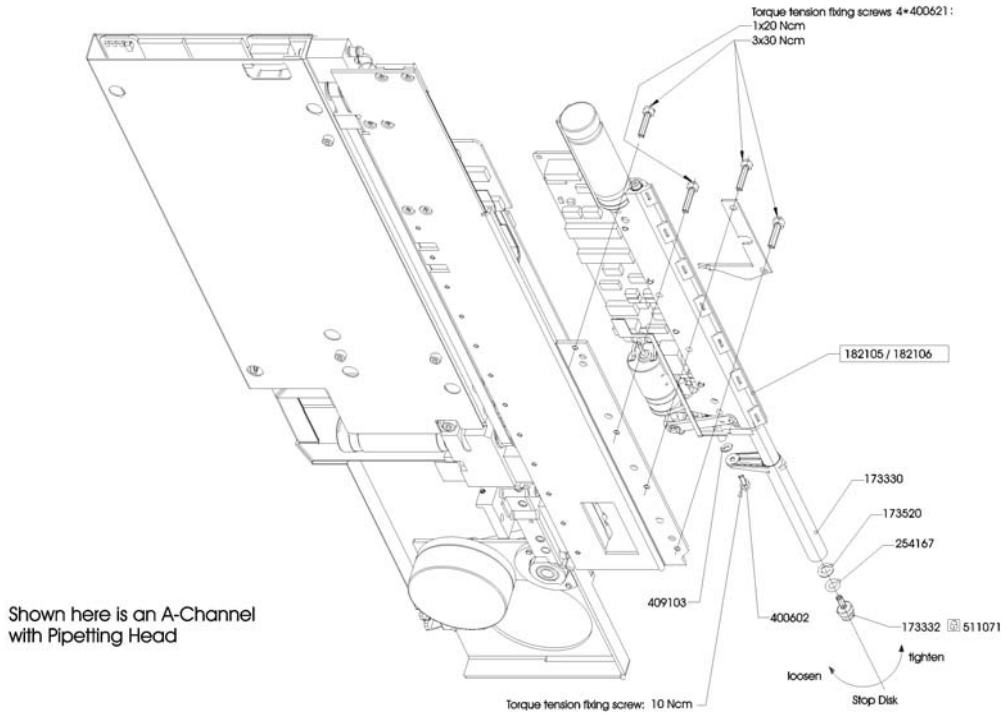
The Label on replacement Channels will show:

Part Number 182101 for Channel A

Part Number 182102 for Channel B.

7.8 Pipetting Heads

Two different Pipetting heads of 300 & 1000 µl are available for the Microlab® STAR.
Due to their absolutely identical outer geometry you need to refer to the Label to identify them as a 300 or 1000 µl Pipetting Head.



7.8.1 Part List

P/N	Description	SPC
173330	TIP EJECTOR	A
173332	STOP DISK	A
173520	DISC 2	A
182105	REPLACE. PIPETTING HEAD 300ul	A
182106	REPLACE. PIPETTING HEAD 1000ul	A
254167	O-Ring ID3.6x1.45	A
400602	CYL-SCR M2x5 DIN912	A
400621	CYL-SCR M2.5x12 DIN912	A
409103	DISC M2 DIN125A	A
511071	OMNI FIT 15M	A
173310	GREASE 100 GR TOPAS AK50	A

7.8.2 Function

The following features are implemented in the Pipetting Head:

- Tip coupling with CO-RE technology.
- Tip presence is registered.
- Capacitive Liquid Level Detection (for Aspiration and Dispensing).
- Pressure Liquid Level Detection (for Aspiration only, by using a new disposable Tip for each aspiration step).
- MAD (Monitored Air Displacement), which monitors aspiration.
- Aspiration and dispensing of liquid
- Tip ejection with CO-RE technology

ML STAR IVD additionally features

- TADM (Total Aspiration and Dispense Monitoring), where aspiration and dispensing are monitored.

7.8.3 Replacement

Preliminary actions:

Uncover Pipetting Arm see section 7.4.3 Pipetting Arm on page 7-14.

Channels should remain on Pipetting Arm. Otherwise refer to section 7.7 Pipetting Channels on page 7-26.

Hint: Remove Y-Spindles for better access to channels and Pipetting Heads.

Attention: Never switch on ML STAR Instrument while cables such as those between Channel and Pipetting Head are not plugged in when replacing Pipetting Heads as short circuits are possible.

Removal:

Removal of Pipetting Head:

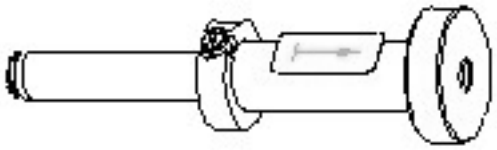
(see Drawing above)

Carefully push Pipetting Head on Channel's Z-Drive all the way down. Then unscrew and remove the 4 screws of Pipetting Head and carefully draw it out of the Channel to access the 2 cables and disconnect them.

The items listed below may removed with Pipetting Head installed.

Item	Description
Stop Disk P/N 173332	Loosen and remove Stop Disk. Use Stop Disk Mounting Tool P/N 173953 If Pliers are used to unscrew Stop Disk, ensure no damage (e.g. scratches) during removal Check for any scratches or blocked bore hole on Stop Disk, replace if any damage is visible.
CO-RE O-Ring P/N 254167	See above, loosen and remove Stop Disk. Replace CO-RE O-Ring

Tool for Stop disk removal

STOP DISC MOUNTING TOOL P/N 173953	 ⚠ *Attention: Use this tool only for loosening the stop disk. Tighten stop disks always by hand!*

⚠

Attention: Do not mistakenly tighten Stop Disk when loosening is intended. This may damage the Pipetting Head.

Note: Replace Stop disk, rather than reusing it, if pliers were used to unscrew it. Even if only small scratches are visible, replace Stop disk

Removal (continued):

A disposable tip gripped with a pair of pliers may also used to open the stop disk. The diposable Tip prevents any scratches to the stop disk. After removal of the Stop disk throw used disposable tip away.

Nothing more than the above mentioned items may replaced or repaired. If any drive or other function are defective replace the Pipetting Head.

Reassembly:

Instructions are basically the reverse of disassembly instructions.

- Carefully tighten the Stop Disk by hand. Do not use any Tool e.g. Pliers and do not use excessive force, just turn it into place.
- As per Drawing above, tighten 3 screws with 30 cNm and one screw with 20 cNm (the second from above).

Attention: Check for appropriate Dip Switch setting on channels (300, or 1000 µl Pipetting Heads). Refer to section 8.1.6 Node settings on page 8-5.

Adjustment:

After replacment run the necessary Adjustment procedures as described in section 6 Adjustment and Calibration on page 6-1.

7.8.4 Part Numbers for original and replacement Parts

Note: Original equipped Microlab® STAR instruments carry Pipetting Heads with the following Part Numbers (Label on Pipetting Heads):

P/N 173303 = 300 µl PIPETTING Head

P/N 173304 = 1000 µl PIPETTING Head

Ordering:

The replacement Pipetting Heads must ordered by Part Number as follows:

P/N 182105 is a 300 µl Pipetting Head

P/N 182106 is a 1000 µl Pipetting Head

The Label on replacement Channels will show:

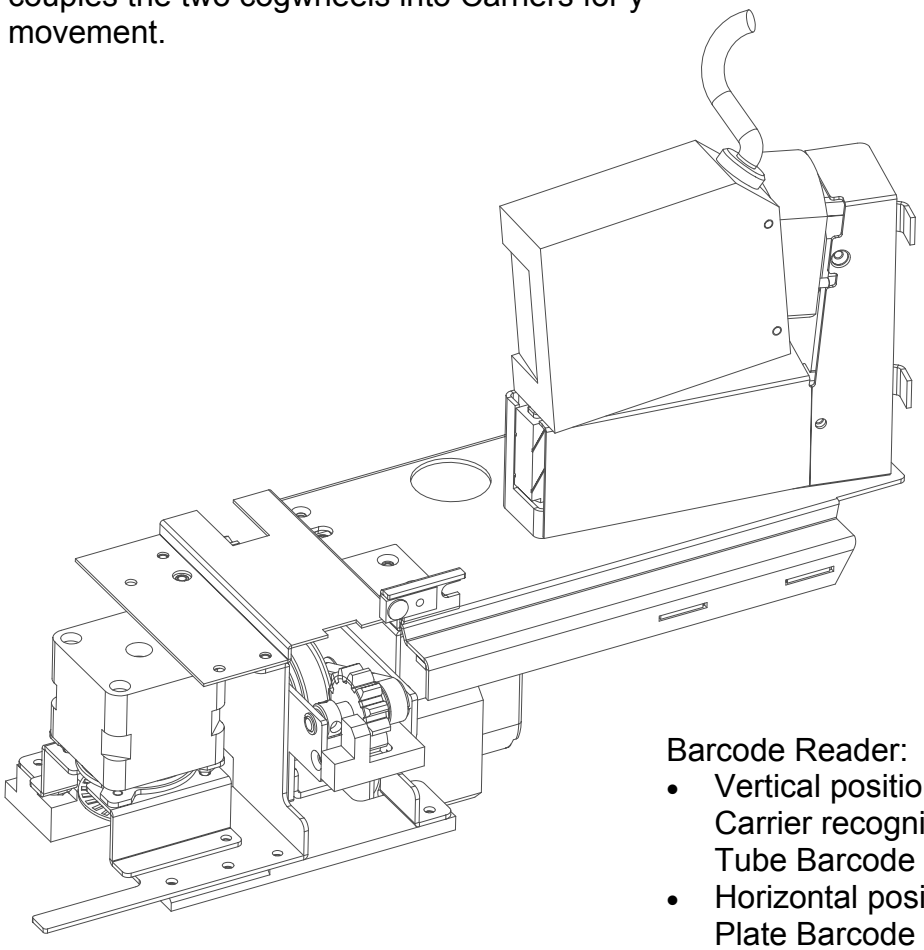
Part Number 173303 for 300 µl Pipetting Head

Part Number 173304 for 1000 µl Pipetting Head

7.9 Auto Load drive[18]

Drives:

- X Drive:
  positions the Autoload drive to the Track
- Y Drive:
  The two Cogwheels load and unload Carriers.
- Z-Drive:
  couples the two cogwheels into Carriers for y-movement.

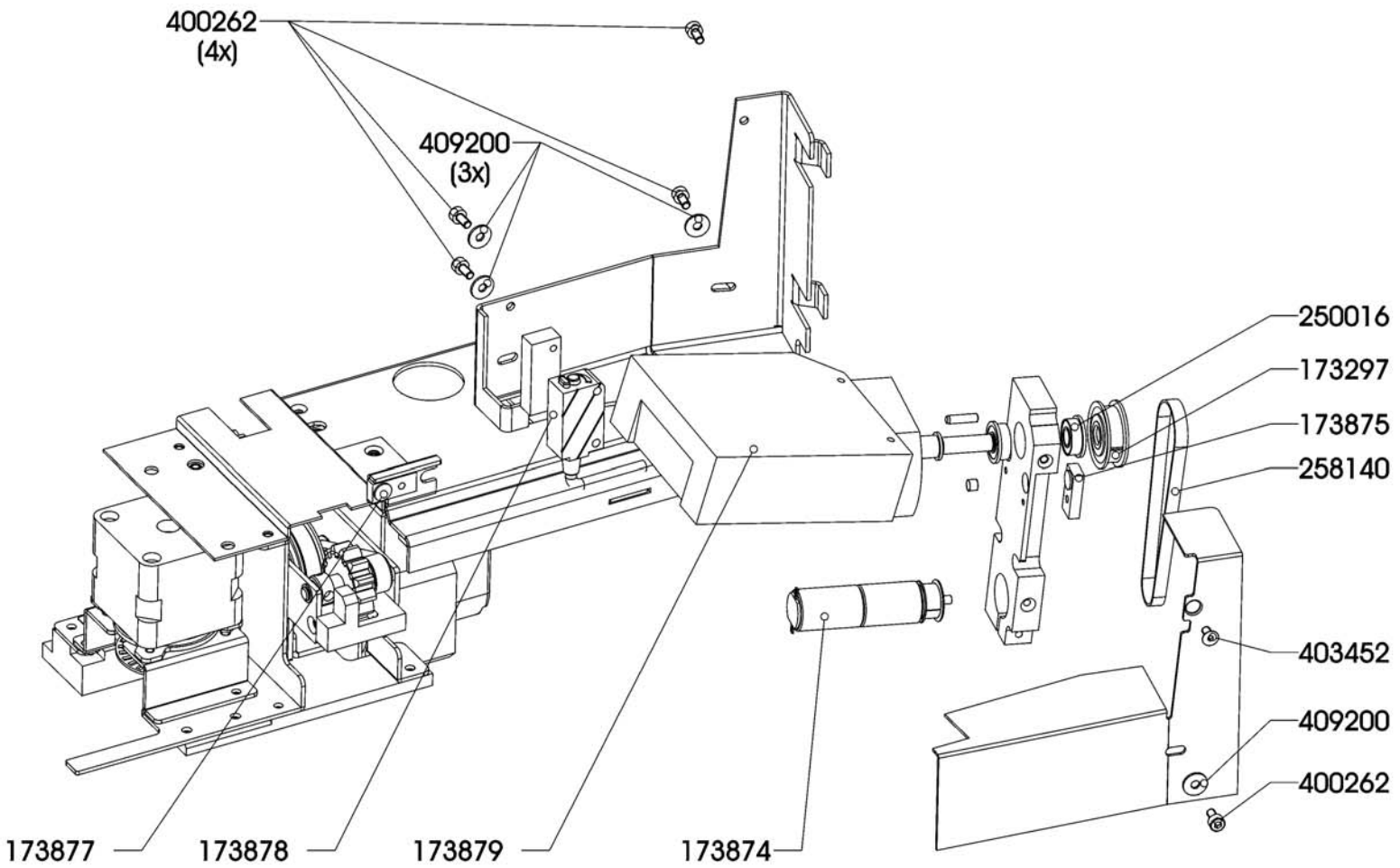


Barcode Reader:

- Vertical position for Carrier recognition and Tube Barcode Reading
- Horizontal position for Plate Barcode Reading

[18] Microlab® STAR Instrument with Autoload Option only

Auto Load drive (continued):



7.9.1 Part List

P/N	Description	SPC
173297	PINION MXL Z=32	C
173845	LOAD X – CONNECTOR	A
173849	CABLE X-MOVEMENTS	A
173874	DM ROTATOR DRIVE	A
173875	HS H/V POSITION	A
173877	HS LOAD DETECT	A
173878	OS TUBE DETECT	A
173879	SCANNER	B
182107	REPL. AUTO LOAD DRIVE	C
182119	REPL. GUIDE ROLLER	C
182120	REPL. RIBBON	C
182263	BLACK COVER RIGHT	C
182264	BLACK COVER LEFT	C
182266	COVER LEFT	C
182274	COVER RIGHT	C
250016	BALL BEARING ID=6 OD=13/15	C
258140	COG BELT MXL Z= 90X3/16"	A
281401	COVERING CAP	A
400262	SCREW M3X6	A
403452	SUNK SCREW M3X6 DIN7991	A
403453	SUNK SCREW M3X8	A
403499	SUNK SCREW M4x30	A
409200	DISC M3	A

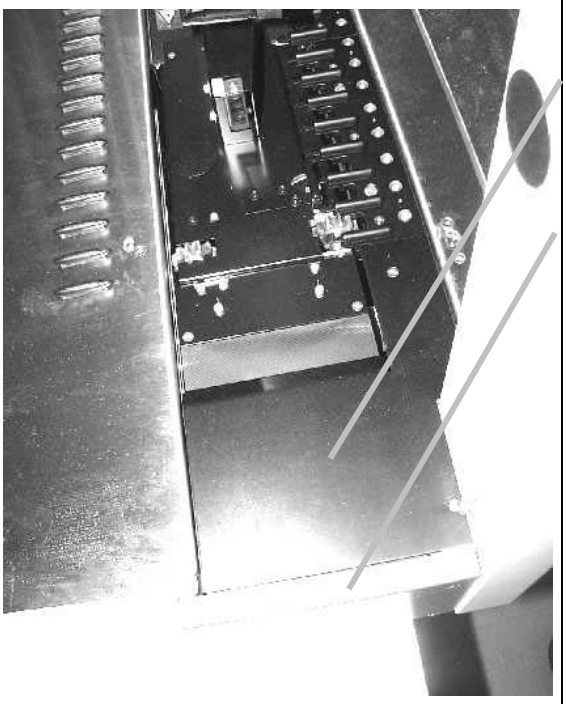
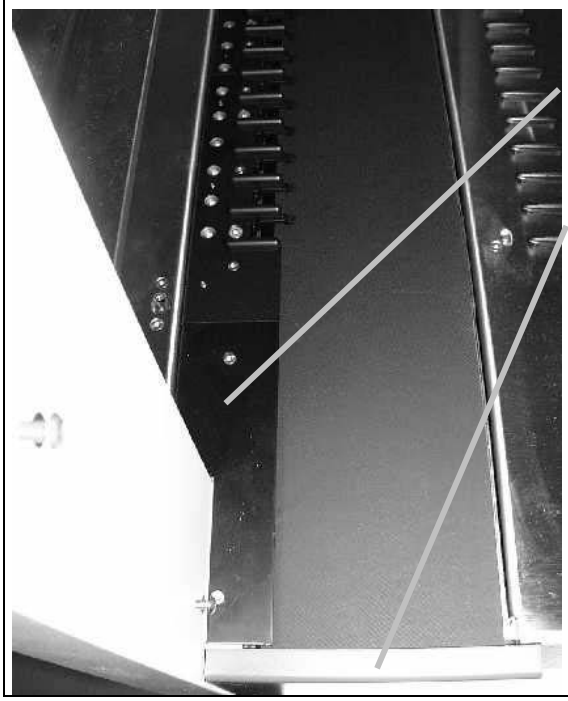
7.9.2 Function

The Autoload component

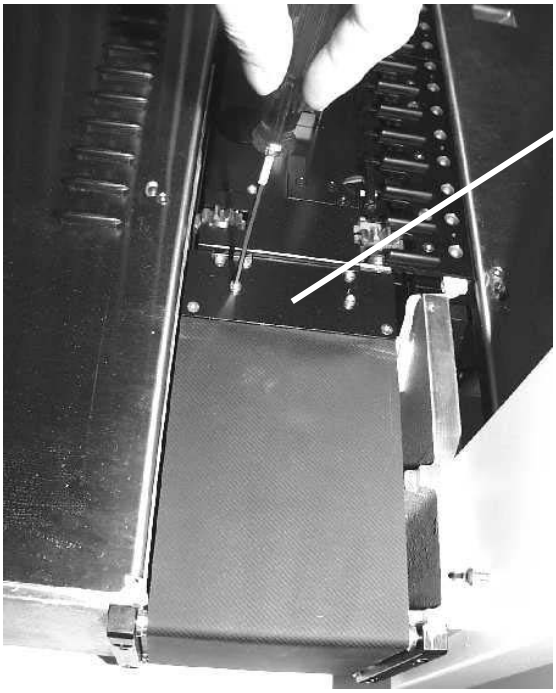
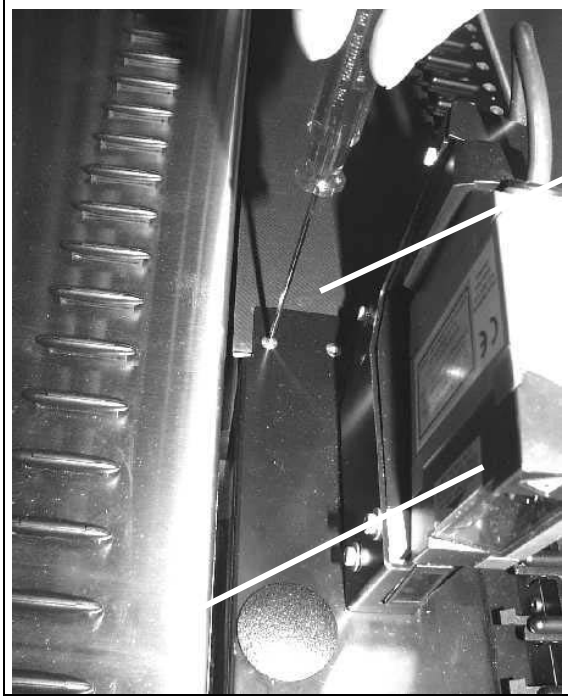
- loads and unloads all Types of Carriers automatically
- Recognizes the presence of carriers ready to load
- While loading:
  - Recognizes Carrier Type
  - Reads Carrier Barcodes
  - Recognizes Plate or Tube Barcodes
  - Recognizes the presence (or absence) of Tubes.

Removal

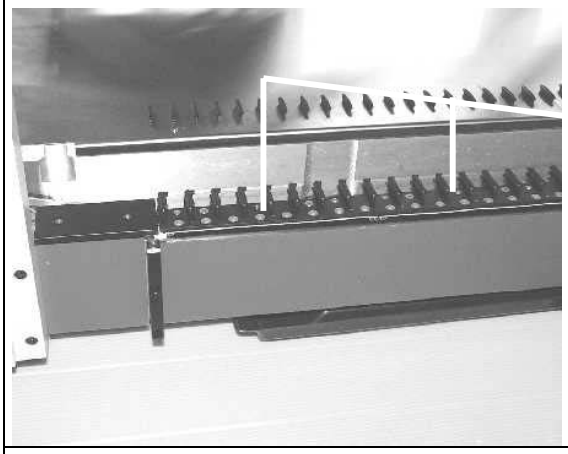
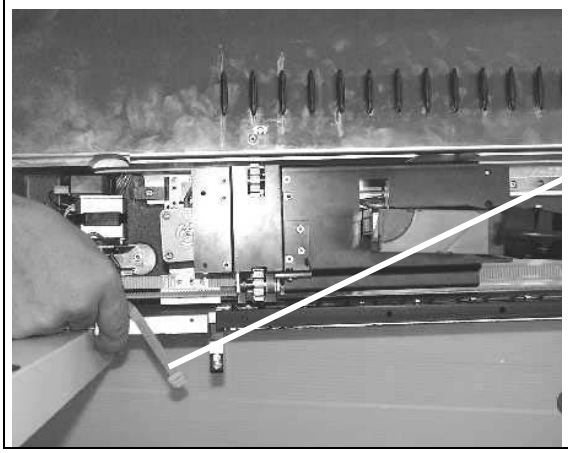
Attention: Never switch on ML STAR Instrument while cables such as those to Autoload drive are not plugged in when replacing Autoload drive as short circuits are possible.

	Unscrew and remove: 182264 BLACK COVER LEFT (Screws 2 x 403453) and 182266 COVER LEFT (Screws 4 x 403453).
	Unscrew and remove: 182263 BLACK COVER RIGHT (Screws 2 x 403453) and 182274 COVER RIGHT (Screws 4 x 403453).

Removal (continued)

	Detach: ribbon P/N 182120 (Screws 2 x 400262) on the left side of Autoload Drive
	Detach: Ribbon (Screws 2 x 403453) on the right side of Autoload Drive Remove Covering Cap 281401

Removal (continued)

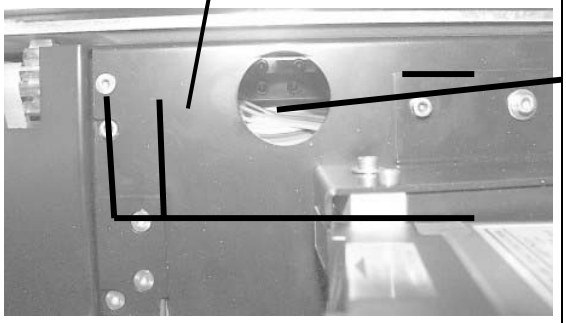
	Unscrew and remove the first two Insertion Guides on the left side and disconnect cable (screws P/N 403499).
	View from above: Removed Insertion Guides and disconnected cable to gain access to Autoload drive.

Removal (continued)

View from above:

The Autoload drive is connected with a total of 6 screws P/N 400632 onto 2 sliding carriages.
4 screws onto the right,
and 2 screws onto the left sliding carriage.

The belt clamp is mounted with 2 screws P/N 400010 onto the autoload drive and must be disconnected as well.
3 screws are involved, however the middle screw is to remain in place.



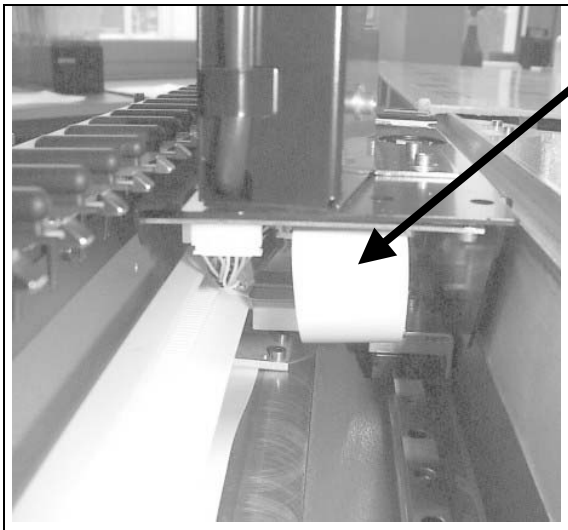
Through the hole unscrew:

two screws P/N 400653 holding sheet metal and removing it, then unscrew four slide screws P/N 400632 underneath sheet metal.

Sheet metal away from aluminum block

2 of the 4 slide screws

Removal (continued)



Finally unplug:

cable P/N 173874 from Autoload drive and carefully lift assembly out of instrument.

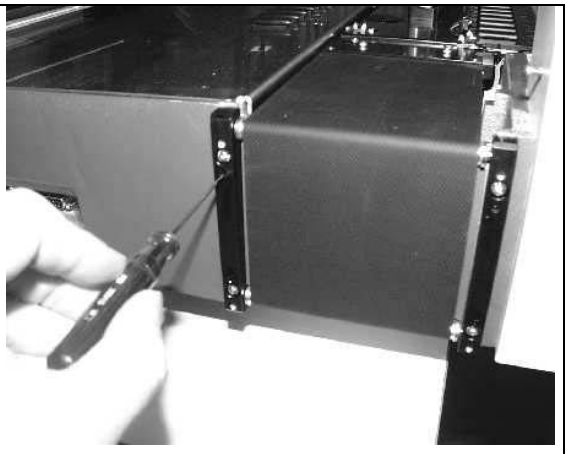
View from right to left, underneath Autoload drive.

Hint: carefully lift Autoload drive assembly a little bit in the rear to gain better access to the cable plug.

Reassembly

Instructions are basically the reverse of those for disassembly.

	*Hint: for easier removal of covering caps, modify them.* Cut away two spring catches (1 per side) as shown here on the left covering cap. The cap when mounted, will then fit snugly on the Autoload drive The covering cap shown here on the right is before modification.

	
The ribbon on the right side of Autoload drive is to be mounted as shown above. *Note: the aluminum thread bar is wrapped by the ribbon.*	Tighten and align the ribbon by turning in set crews P/N 400262. Carefully move the Autoload drive by hand from side to side and adjust ribbon for a proper movement. Service Software for Autoload drive movement may also be used.

Attention: Do not overtighten the ribbon as this may lead to autoload x-movement steps lost.

Adjustment:

After replacement run the necessary Adjustment procedures as described in section 6 Adjustment and Calibration on page 6-1.

7.9.3 Part Numbers for original and replacement Parts

Note: Original equipped Microlab® STAR instruments Autoload drive comes with the following Part Number (Label on Autoload drive):

P/N 173309

Ordering:

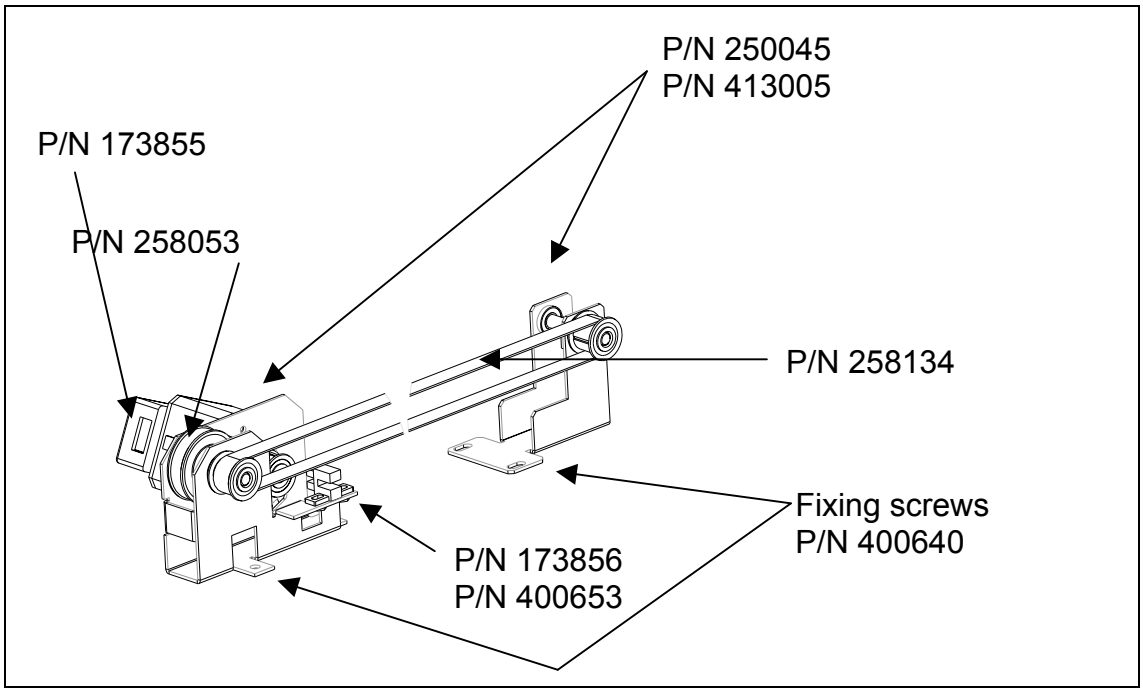
The replacement *Autoload drive* must ordered by Part Number:

P/N 182107

The Label on replacement *Autoload drive* will show:

Part Number 173309

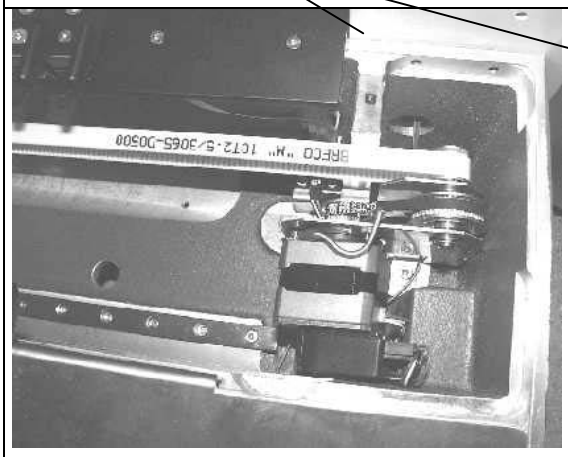
7.10 Auto Load X-Drive[19]



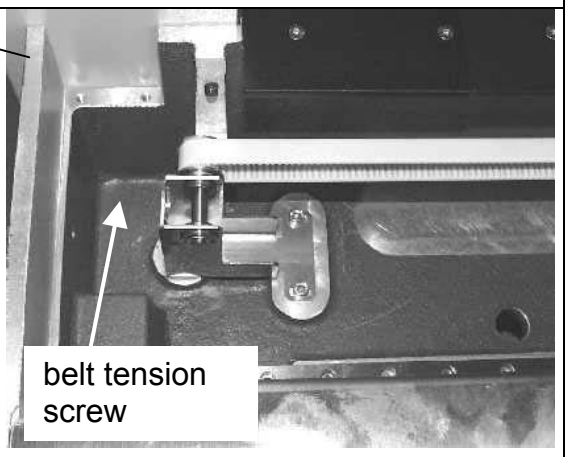
[19] Microlab® STAR Instrument with Autoload Option only

Auto Load X-Drive (continued)

Viewpoint is here from inside ML STAR Instrument to the back of the vertical posts.



Primary drive



Secondary drive with belt tension screw P/N 420580.

Belt tension:

Tighten Belts, however do not over-tighten them (do not use excessive force).

7.10.1 Part List

P/N	Description	SPC
173855	SM Auto Load X-Drive	C
173856	OS Auto Load X-Init	C
250016	BALL BEARING ID=6 OD=13/15	C
250045	BALL BEARING ID=15 OD=35	C
258053	COG BELT MXL Z= 83 X 3/16"	A
258134	COG BELT 10T2.5 3065	A
400640	CYL-SCR M4x10 DIN912 TUFLOK	A
400653	CYL-SCR M3X6 DIN912 A2 TUFLOK	A
405445	SET SCR M3x8 DIN916	A
413005	LOCK DISC 4 DIN6799	A
420580	CYL-SCR M4X50 DIN912 TUFLOK	C

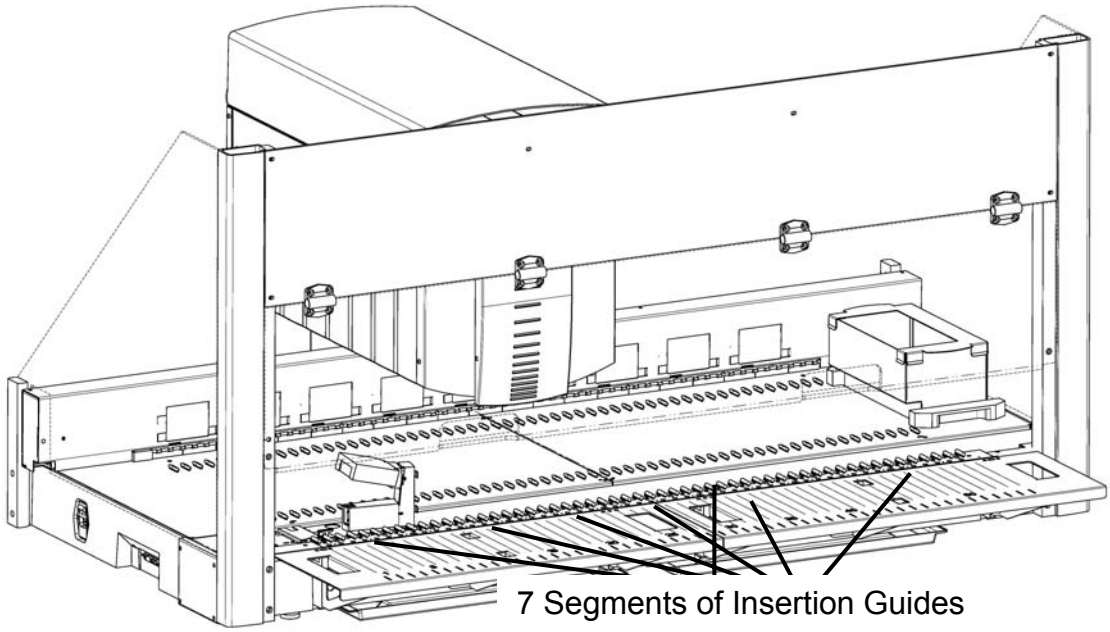
7.10.2 Function

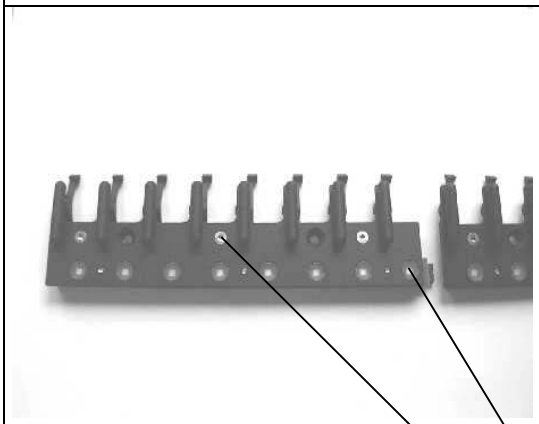
- Carriers the Autoload and moves it in X-Direction

7.10.3 Replacement

Item	Description
DC Motor P/N 173855	Loosen Belt of secondary drive, disconnect DC Motor cable from Autoload PCB and then remove Primary Drive Assembly (3 screws M4 x 10, P/N 400640). Loosen Belt of primary drive (2 screws M3 x 6, P/N 400653) and remove DC Motor from sheet metal
Primary drive belt Cog belt MXL Z= 83 x 3/16" P/N 258053	See DC Motor Additionally loosen 2 set screws (P/N 405445) from big cock wheel, remove lock disc P/N 413005, then remove axle and large cog wheel.
Secondary drive belt Cog belt SYN-FLEX 10 T2.5 3065 P/N 258134	Loosen Belt secondary, and remove belt from Autoload drive claw.

7.11 Insertion Guides [20]





7 Segments of Insertion Guides are connected together. LEDs in the front display user where to load carrier.

2 Types of Insertion Guides are applicable:

- The one outermost right:
  Insertion Guide End P/N 173729

  and

- 6 to the left:
  Insertion Guide P/N 173292

Both types of segments including:

- P/N 173300 disk (7x)
- Screw P/N 403452 (3x)

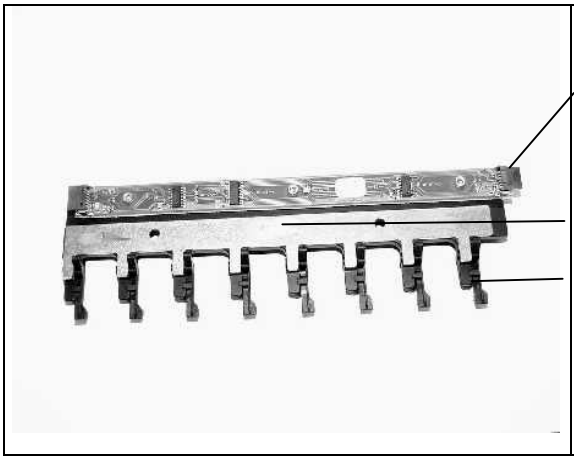
[20] Microlab® STAR Instrument with Autoload Option only

7.11.1 Part List

P/N	Description	SPC
173292	INSERTION GUIDE	C
173293	STOP HOOK	A
173299	SHEET METAL	C
173300	DISK	A
173729	INSERTION GUIDE - END	C
173747	SPRING STRIP	C
173843	LOAD DISPLAY BOARD	B
400617	CYL-SCR M2.5X5 DIN912	A
403452	SUNK SCREW M3X6 DIN7991	A

7.11.2 Function

- LEDs guide the user as to where to load carriers.
- Entry and exit positioning for carriers to be loaded and unloaded.



Bottom view:

- Load display board P/N 173843 (1x) is mounted with 3 screws P/N 400617.
- Sheet Metal P/N 173299 (1x)
- Stop Hook P/N 173293 (8x)

Not shown here is Spring Strip P/N 173747 which is mounted on Chassis and pushes the Stop Hooks up.

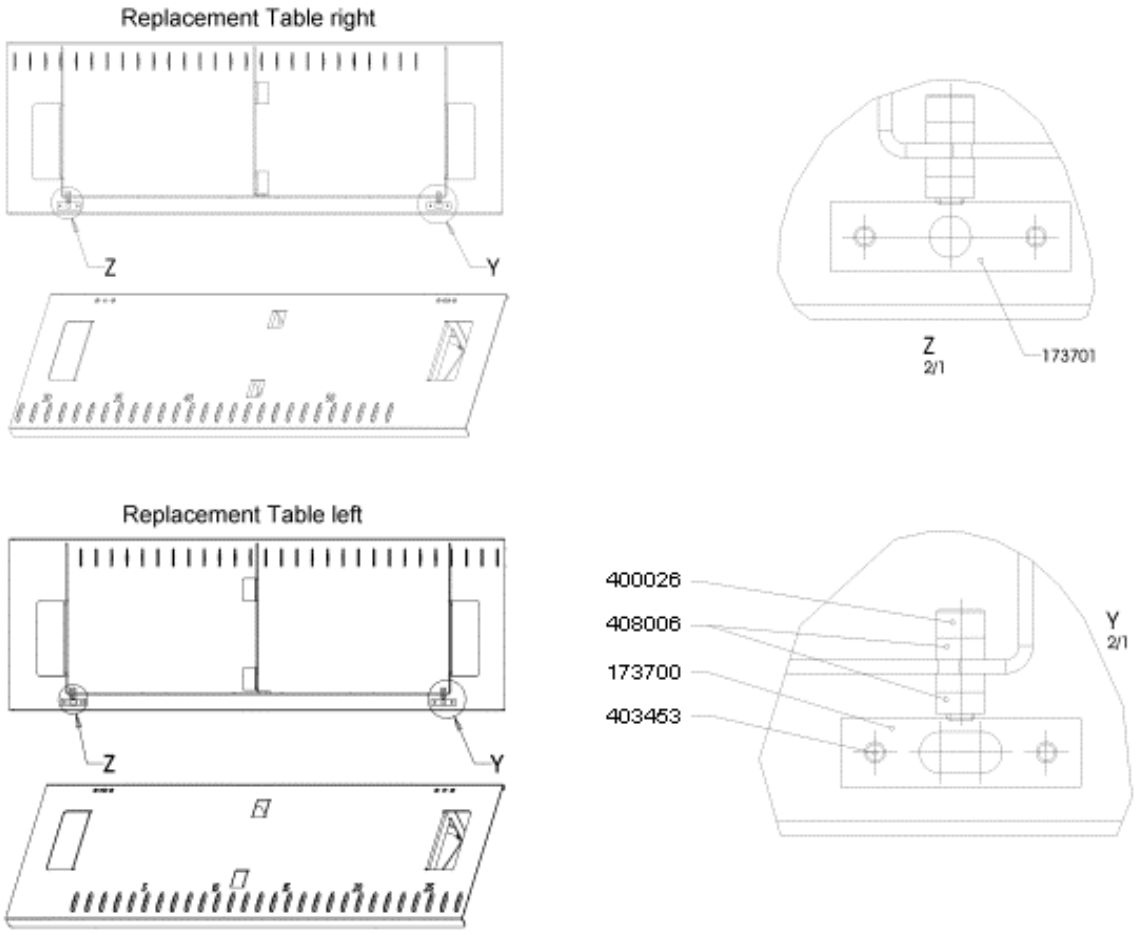
7.11.3 Replacement

- See section 7.10 Auto Load X-Drive on page 7-46. Due to its plug design, start removing from left to right.
- Replace Stop Hook by removing Load display board and sheet metal.
- Remove Load display board by loosening three screws and replace with a new one.
  Disk is located between Insertion Guides and Load display board.

Reassembly

Instructions are basically the reverse of those for disassembly.

7.12 Loading tray[21]



[21] Microlab® STAR Instrument with Autoload Option only

7.12.1 Part List

P/N	Description	SPC
173600	SLIDE BLOCK	A
173602	SLIDE BLOCK WEDGE	A
173700	HOLDER W OVAL BORE	C
173701	HOLDER W ROUND BORE	C
182112	REPLACEMENT TABLE RIGHT	C
182113	REPLACEMENT TABLE LEFT	C
400026	CYL-SCR M4X12 DIN912	A
403453	C-SUNK SCR M3X8 DIN7991	A
403453	SUNK SCR M3X8 DIN7991	A
408006	HEX NUT M4 DIN934	A

7.12.2 Function

- holds carriers ready for transfer to Autoload.
- Positions carriers in relation to deck.

7.12.3 Replacement

Slide Blocks with Slide Blocks Wedges. See section 7.4.2 Deck Panels on page 7-7.

7.13 Additional Instrument Components

7.13.1 Tip Waste

P/N	Description	SPC
173736	TIP WASTE CONTAINER	C
173737	TIP WASTE LID	C
173738	TIP WASTE HANDLE	C
420561	TORX SCREW M5x12	A

7.13.2 Spillage Trays

P/N	Description	SPC
173195	SPILLAGE TRAY LEFT	C
173196	SPILLAGE TRAY RIGHT	C
147683	FAME AIR FILTER	B
148248	FAME VELCRO	B

7.13.3 Instrument Parts

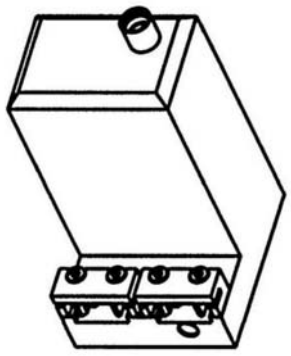
P/N	Description	SPC
281111	FOOT M10x50 W CAP	C
173508	STOP BAR	C
173509	FENDER BAR	C

7.13.4 Teaching Box

P/N	Description	SPC
173861	TEACHING BOX	C

Additional Instrument Components (continued)

7.13.5 Teaching Station



P/N	Description	SPC
182174	TEACHING STATION	C
182176	TEACHING NEEDLE	C

7.14 Accessories

Accessories such as Carriers, Disposables, Needles, etc. are described in User Manual.

8 Electronics

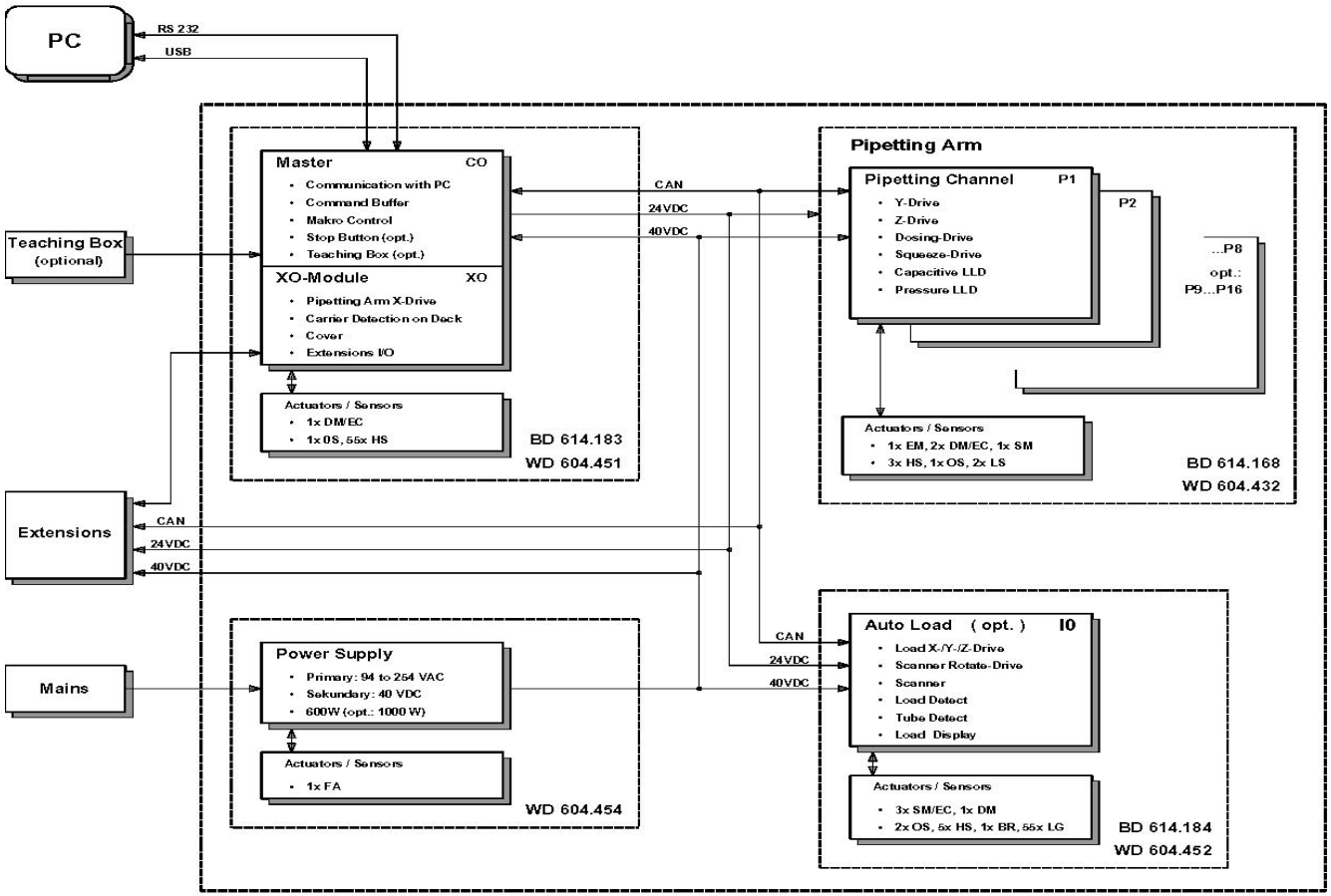
8.1 Overview

This section describes the electronics architecture and electrical Components such as PCBs and cables.

General note:

When removing PCBs such as Master-, Autoload, or Pipetting Channels, perform automatic adjustment according to section 6 Adjustment and Calibration on page 6-1.

8.1.1 Functional Overview



Actuators		Sensors	
EM	= EC-Motor	BR	= Barcode Reader
DM	= DC-Motor	EC	= Encoder
FA	= Fan (Ventilator)	FS	= Force Sensor
HE	= Heating Element	HS	= Hall Sensor
LB	= LED blue	LS	= Liquid Level Sensor
LG	= LED green	MS	= Micro-Switch
LR	= LED red	OS	= Optical Sensor
LY	= LED yellow	PS	= Pressure Sensor
SM	= Stepper Motor	TS	= Temperature Sensor
SN	= Solenoid	VS	= Volume Sensor

8.1.2 Functional Description

8.1.2.1 Interfaces:

- PC is User Interface. Either a RS 232 or an USB Interface connects PC to the Master PCB of ML STAR Instrument.
- Optionally, a teaching Box connected to the ML STAR Instrument may used as an additional User interface, when recognized by the User software (PC).
- Mains is connected to Power supply of ML STAR Instrument.

8.1.2.2 ML STAR Instrument communication architecture:

The Master-Slave architecture is designed as follows:

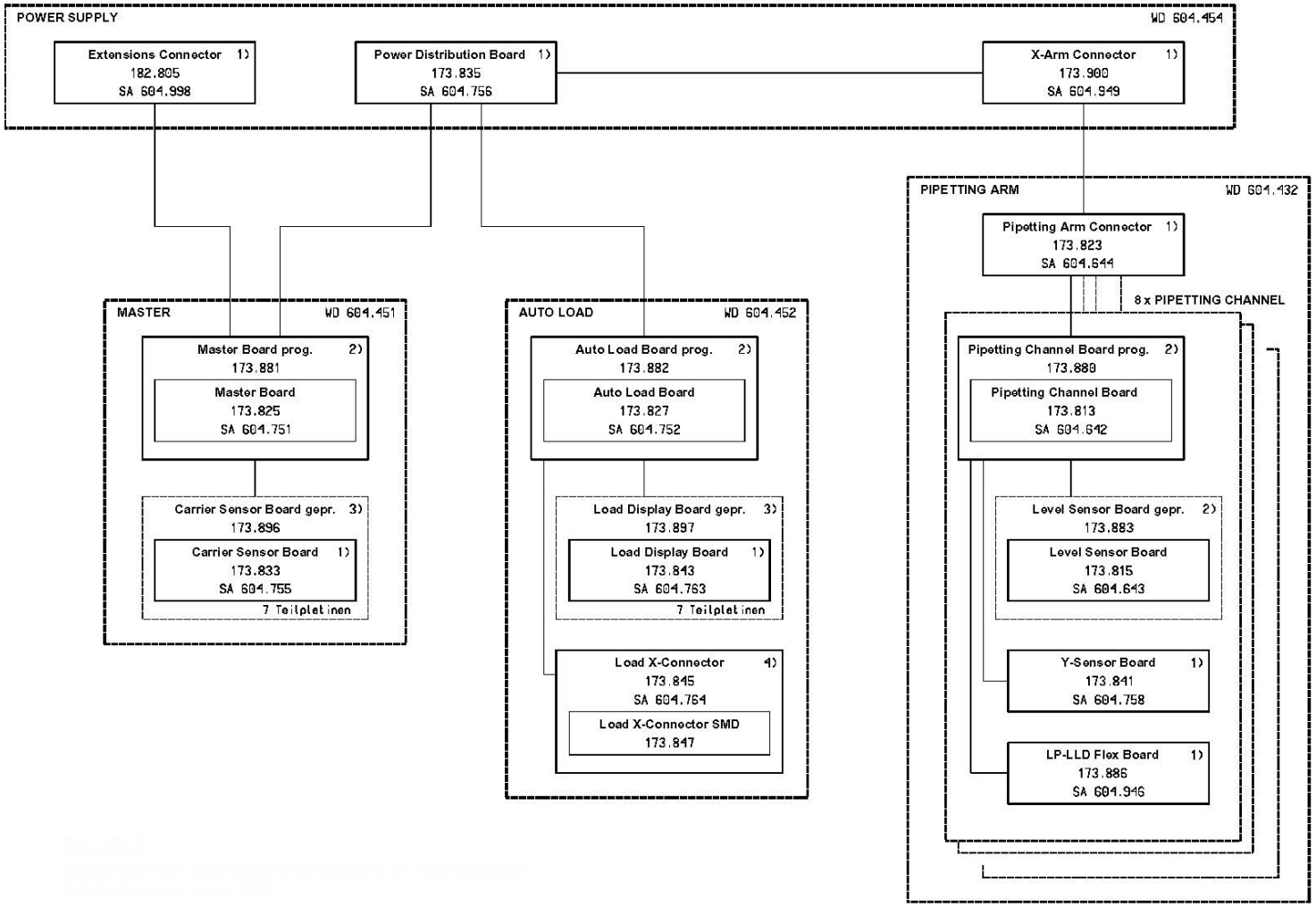
- The Master PCB controls its slaves which are Pipetting Arm X Movement (physically located on the Master PCB), Pipetting channels, Autoload PCB and ML STAR extensions.
- The Power supply provides power to connected modules such as Master PCB, Pipetting Arm, Pipetting channels, Autoload PCB and ML STAR extensions.

8.1.2.3 Firmware and Data

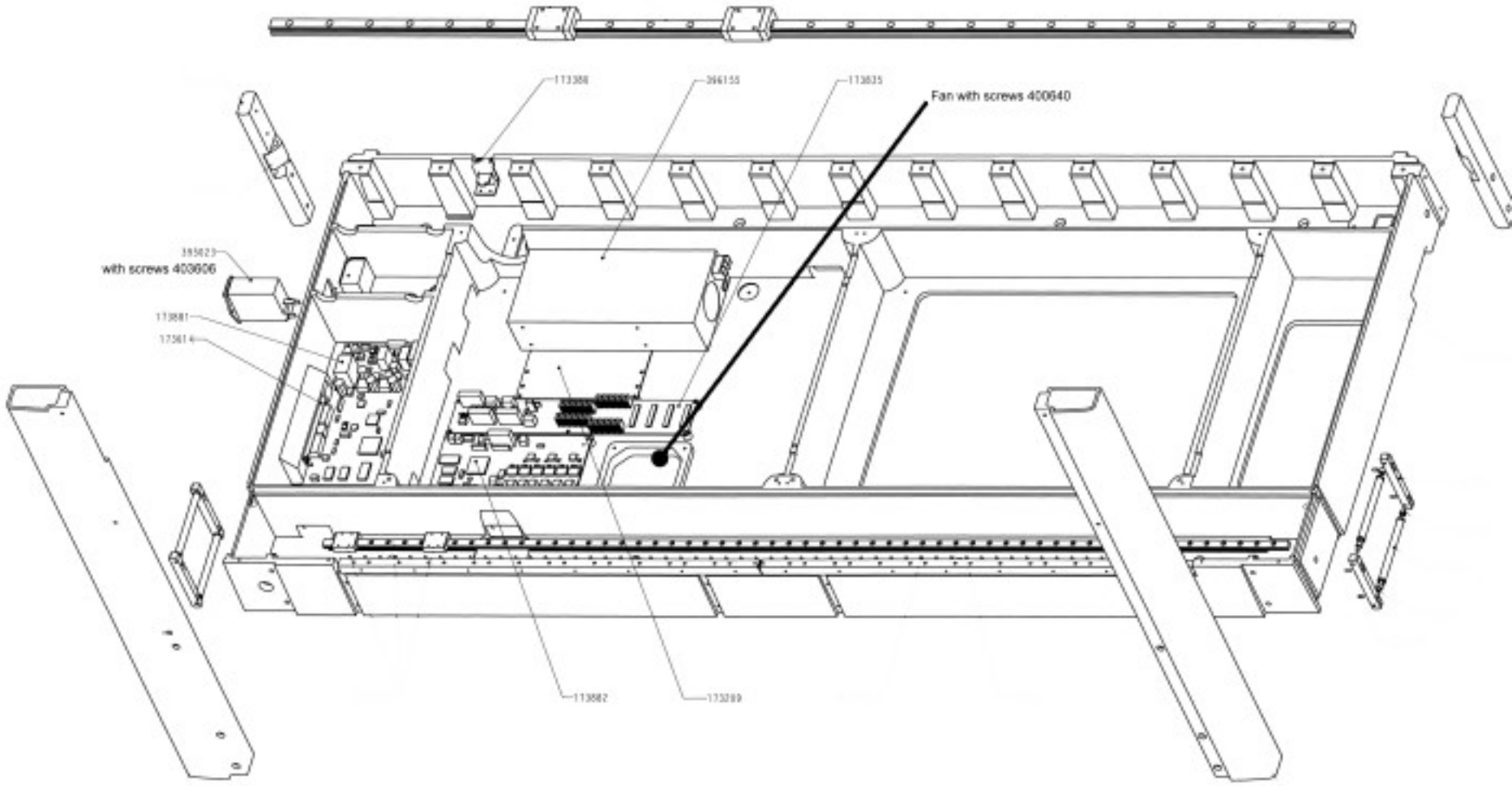
The following PCBs carry Flash Memory which contain the necessary Firmware.

- Master C0 Module on Master PCB
- The Pipetting Arm's X Drive is the X0 Module which is a virtual slave on the Master PCB
  (Note: It does not have its own Flash Memory - it is controlled by the Master and therefore has no Firmware of its own).
- Pipetting Channel PX Module on Pipetting Channel PCB (X stands for the channel number)
  (Note: Pipetting Channel Board carries Flash Memory; Pipetting heads do not have Flash Memorys but are controlled by their associated Channel).
- Pipetting Heads are passive elements and have therefore no memory of their own.
- Autoload I0 Module on Autoload PCB.
- For Extensions, see chapter 11 ML STAR Extensions.

8.1.3 Boards Overview



8.1.4 Location of electronically components

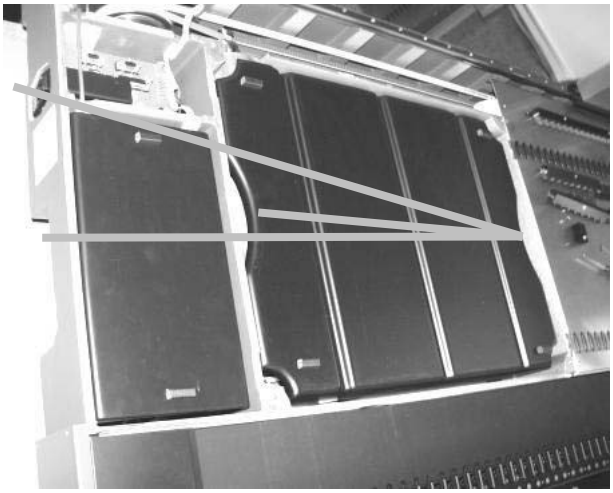


8.1.4.1 Part List

P/N	Description	SPC
146242	FAME ELECTRONIC RACK FAN	C
173614	INTERFACE METAL PLATE	C
173835	POWER DISTRIBUTION BOARD	A
173881	MASTER BOARD PROG	A
173882	AUTO LOAD BOARD PROG.	A
395023	LINE FILTER	B
396155	POWER SUPPLY 41V 600W	B
400640	CYL-SCR M4x10 DIN912 TUFLOK	A
403606	C-SUNK SCR M3X8 DIN7991 A2 TUFLOK	A

Attention: when replacing a Master Board without an USB Interface, the Interface metal plate P/N 173614 must be ordered as well. This is because all Master PCBs contain RS 232 as well as USB COM Ports.

8.1.5 Covers over electronics

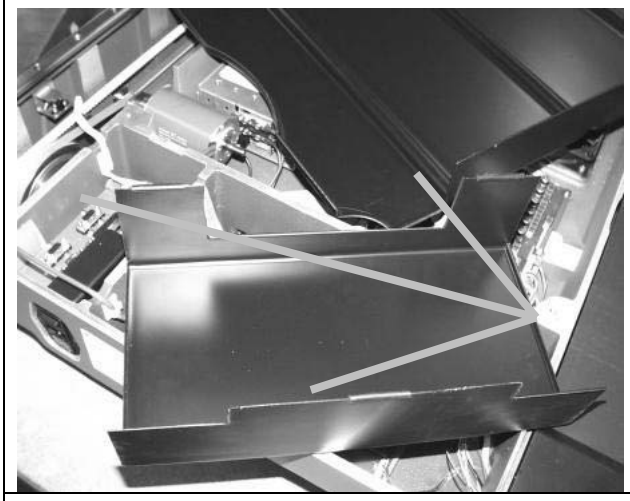
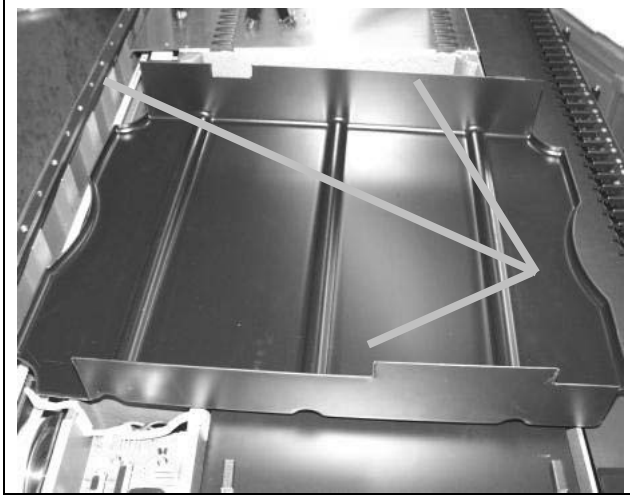


There are three covers, which protect the electronic components against any liquid which may drop from the deck if liquids are spilled.

The covers are over the Line filter, Master and Power compartment.

To stabilize them the self-adhesive gasket P/N 7369085 must be placed as shown over the covers (6 items, each 3 cm long).

Covers over electronics (continued)

	To prevent any vibration of the covers, the bottom line of the Master and the power compartment cover must equipped with rubber edge protective strips (6 items, each 2 cm long). 3 rubber edge protective strips
	3 rubber edge protective strips

Covers over electronics to prevent against liquid falling onto components.

P/N	Description	SPC
173743	EL-COVER LINE FILTER	C
173748	EL-COVER MASTER	C
173750	EL-COVER POWER	C
7279443	EDGE PROTECTION SECTION	C
7369085	SELF ADHESIVE GASKIT	C

8.1.6 Node settings / Dip Switches

The node settings address multiple components / modules via the CAN Bus system.

CAN	Module		switch 6	switch 5	switch 4	switch 3	switch 2	switch 1
Node	Abbrev.	Name	Type	Address				
0.	C0	Master	(b)	Off	Off	Off	Off	Off
1.	X0	X- Motor	(b)	Off	Off	Off	Off	**ON**
2.	I0	Auto Load	(b)	Off	Off	Off	**ON**	Off
3.	W1	Wash station 1-3	(b)	Off	Off	Off	**ON**	**ON**
4.	W2	Wash station 4-6	(b)	Off	Off	**ON**	Off	Off
5.	T1	Temperature carrier 1	(b)	Off	Off	**ON**	Off	**ON**
6.	T2	Temperature carrier 2	(b)	Off	Off	**ON**	**ON**	Off
7.	R0	iSwap	(b)	Off	Off	**ON**	**ON**	**ON**
8.	P1	Pipetting channel 1	(a)	Off	**ON**	Off	Off	Off
9.	P2	Pipetting channel 2	(a)	Off	**ON**	Off	Off	**ON**
10.	P3	Pipetting channel 3	(a)	Off	**ON**	Off	**ON**	Off
11.	P4	Pipetting channel 4	(a)	Off	**ON**	Off	**ON**	**ON**
12.	P5	Pipetting channel 5	(a)	Off	**ON**	**ON**	Off	Off
13.	P6	Pipetting channel 6	(a)	Off	**ON**	**ON**	Off	**ON**
14.	P7	Pipetting channel 7	(a)	Off	**ON**	**ON**	**ON**	Off
15.	P8	Pipetting channel 8	(a)	Off	**ON**	**ON**	**ON**	**ON**
16.	P9	Pipetting channel 9	(a)	**ON**	Off	Off	Off	Off
17.	PA	Pipetting channel 10	(a)	**ON**	Off	Off	Off	**ON**
18.	PB	Pipetting channel 11	(a)	**ON**	Off	Off	**ON**	Off
19.	PC	Pipetting channel 12	(a)	**ON**	Off	Off	**ON**	**ON**
20.	PD	Pipetting channel 13	(a)	**ON**	Off	**ON**	Off	Off
21.	PE	Pipetting channel 14	(a)	**ON**	Off	**ON**	Off	**ON**
22.	PF	Pipetting channel 15	(a)	**ON**	Off	**ON**	**ON**	Off
23.	PG	Pipetting channel 16	(a)	**ON**	Off	**ON**	**ON**	**ON**

(a) The Pipetting channel is defined with Dip switch 6 where OFF = 300ul and ON = 1000ul.

(b) Not currently used.

8.2 Power

8.2.1 Function

- Provides the power needed to run the Microlab® STAR Instrument with all its applications.
- Through operation of the Net filter / Mains power switch the current is distributed to the Power Supply (Primary circle). On the secondary circle 41 V= are available.
- Feeds Current through the Power distribution board to all Modules
- Each Module has its own self-resetting Fuses (multi Fuses).
- The Master Board additionally generates 24V=. This is also distributed to specific Modules.
- Each Module then generates locally its own voltages depending on their necessary digital and analog circuits.

8.2.2 Power Components

- Line Filter P/N 395023
  - Function:
    Mains Cable Interface and Fuse
- Power supply P/N 396155
  - Function:
    transforms Alternating voltage 230 / 115 VAC to 41 VDC
- Power Distribution Board P/N 173835
  - Function:
    Distributes Power between Power Supply, Master Board, Pipetting Arm, and Autoload Board[22].
- Extension PCB P/N 182805
  - Function:
    Cable Interface between Master PCB and Extensions such as Wash station and Temperature Controlled Carrier

[22] Microlab®-STAR Instrument with Autoload Option only

8.2.3 Replacement

- Remove Left Deck Panel for access. See section 7.4.2 Deck Panels on page 7-7.

- Line Filter
  - Disconnect all cables, then unscrew Line Filter and replace.
    Screw P/N 400301 3 x
    Screw P/N 257062 2 x
    Screw P/N 400301 2 x
    Lock Disc P/N 411002 2 x

- Power supply:
  - Disconnect all cables, unscrew sheet metal from chassis, then unscrew Power supply from sheet metal and replace Power supply.
    Screw P/N 400656 4 x
    The sheet metal is mounted with Screw P/N 400301 4 x to Power supply

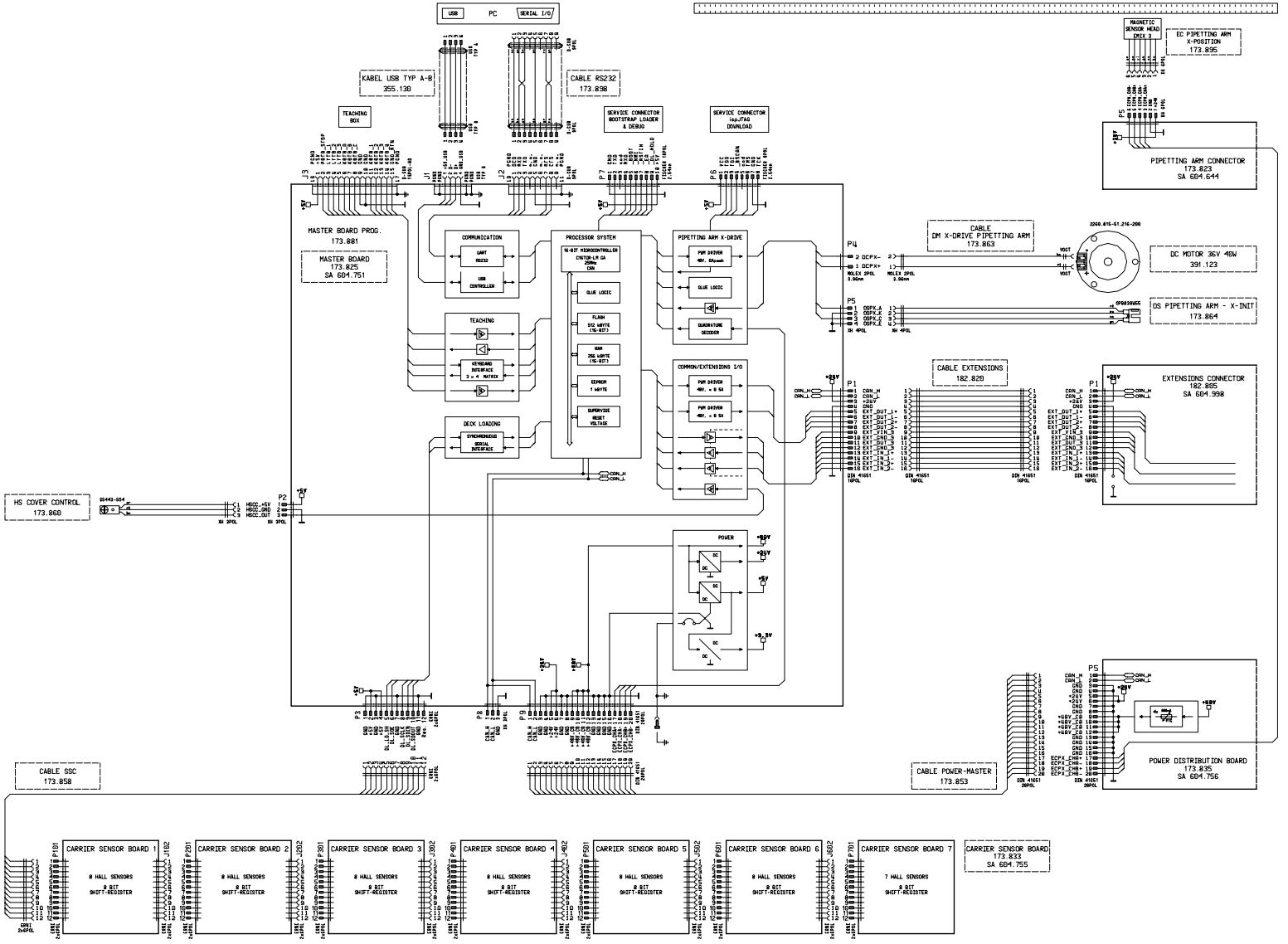
- Power Distribution Board
  - Disconnect all cables, then unscrew Power Distribution Board and replace Power Distribution Board.
    Screw P/N Screw P/N 400656 6 x

- Extension PCB
  - Disconnect all cables, then unscrew Extension PCB and replace.
    Screw P/N 403606 2 x

8.2.4 Reassembly

- Instructions are basically the reverse of those for disassembly.

8.2.5 Wiring Diagram Power / Master



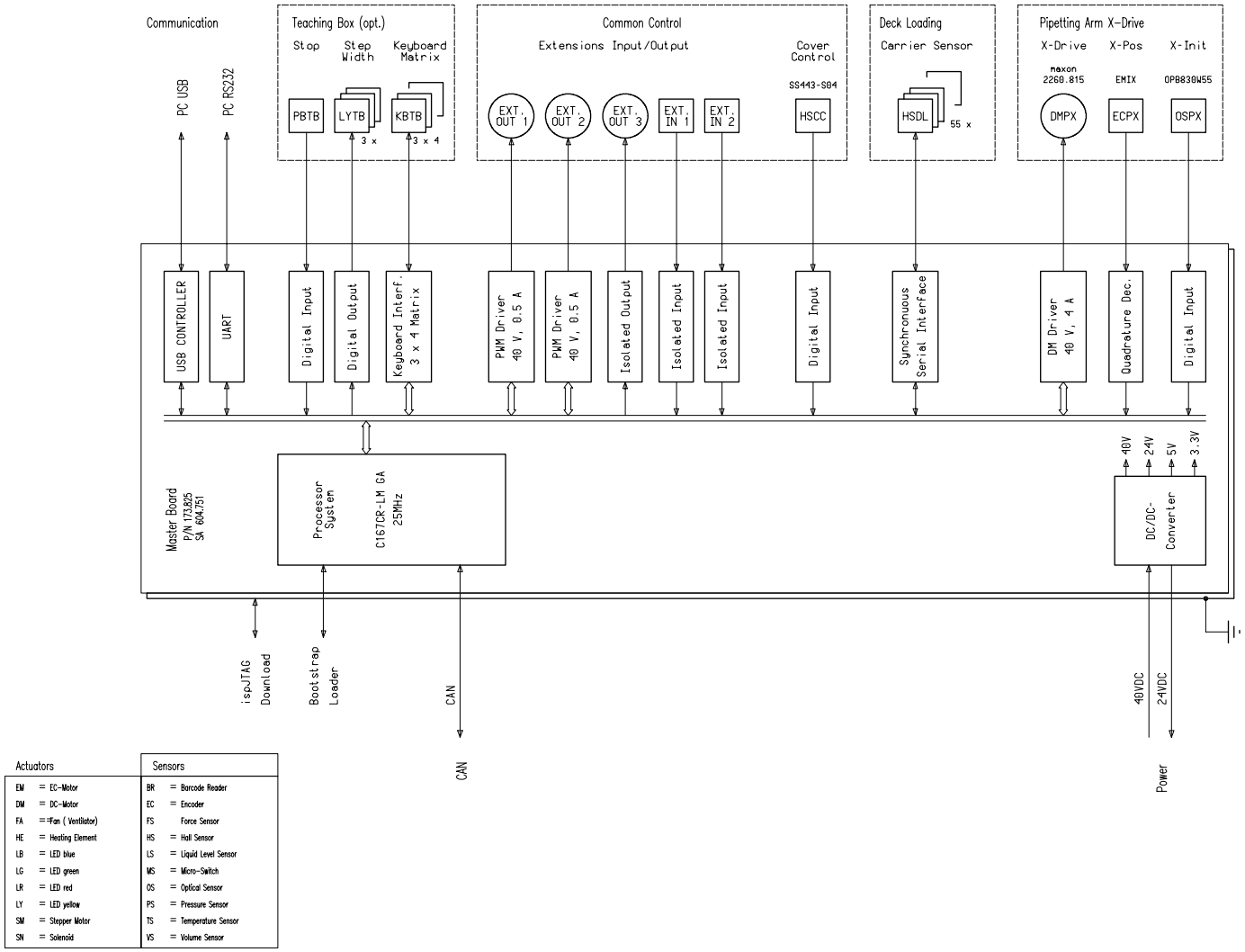
8.3 Master

8.3.1 Function

- Controls such actions as:
  - Communication with PC
  - Communication with teaching box
  - Controlling Pipetting-Arm X-Movement
  - Controlling pipetting channels
  - Controlling Autoload Function
  - Controlling all extensions (e.g. iSwap, Wash station, Temperature-controlled carrier)
  - Storing Technical Status, Adjustment Values, Download Status, Cycle Counting and Firmware.

The Master ensures coordination and synchronization of all commands between Service and User software and the ML STAR Instrument.

8.3.2 Master Block Diagram



Actuators		Sensors	
EM	= EC-Motor	BR	= Barcode Reader
DM	= DC-Motor	EC	= Encoder
FA	= Fan (Ventilator)	FS	= Force Sensor
HE	= Heating Element	HS	= Hall Sensor
LB	= LED blue	LS	= Liquid Level Sensor
LG	= LED green	MS	= Micro-Switch
LR	= LED red	OS	= Optical Sensor
LY	= LED yellow	PS	= Pressure Sensor
SM	= Stepper Motor	TS	= Temperature Sensor
SN	= Solenoid	VS	= Volume Sensor

8.3.3 Replacement

- Remove Left Deck Panel to access Master Board, see section 7.4.2 Deck Panels on page 7-7.
- Before the Master Board is replaced, print a hard copy of all Data from the Board by using Service Software, and keep on file.
- Disconnect all cables and unscrew Master Board.
  Screw P/N 400656 5 x
  Screw P/N 400632 1 x
  INTERFACE METAL PLATE P/N 173614 1 x
  WASHER P/N 369026 1 x
  ISOLATING TAPE P/N 369061 1 x

8.3.4 Remounting:

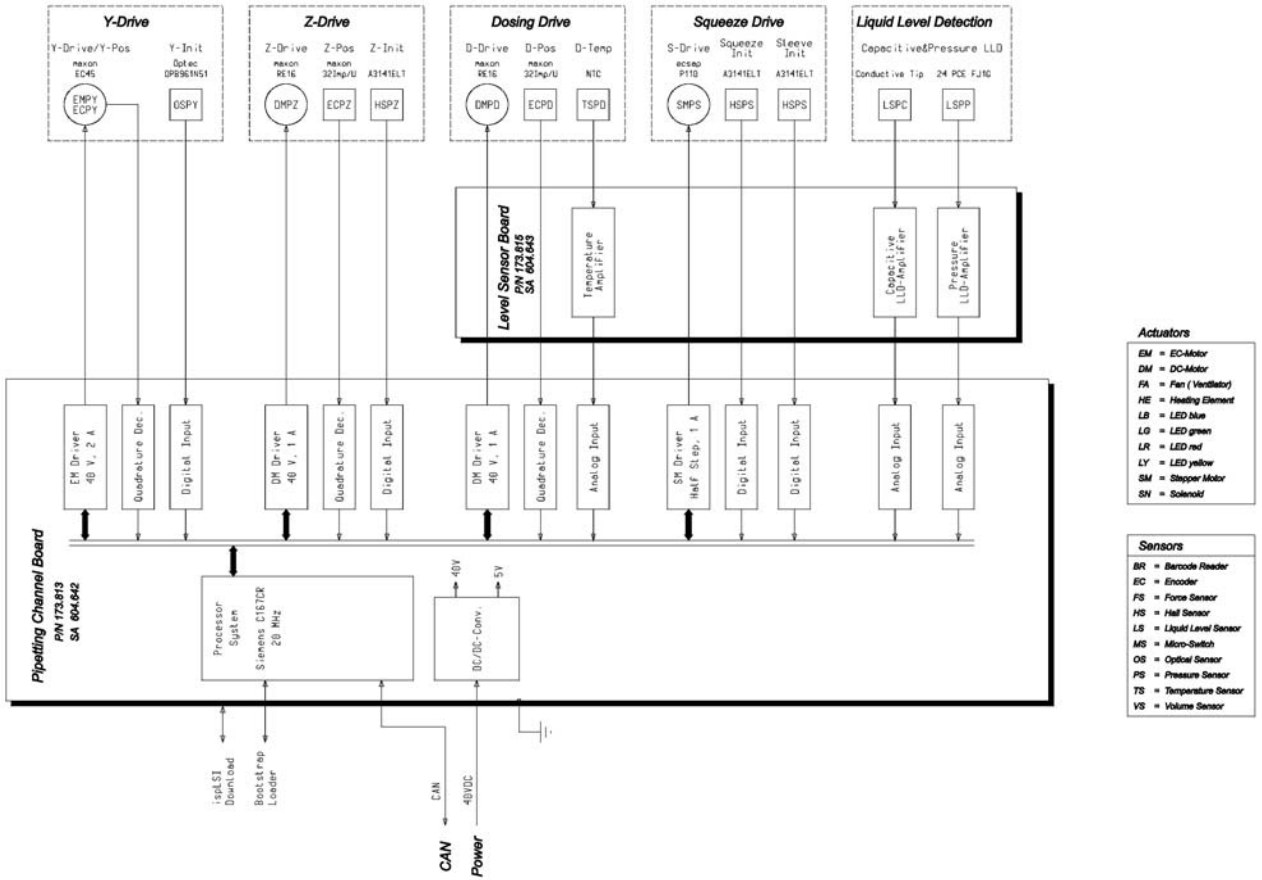
- Instructions are basically the reverse of those for disassembly.
- By using Service Software
  - Data may restored (if copied from replaced Master PCB).
  - Check Master settings
  - Check for correct Firmware

8.3.5 Adjustment

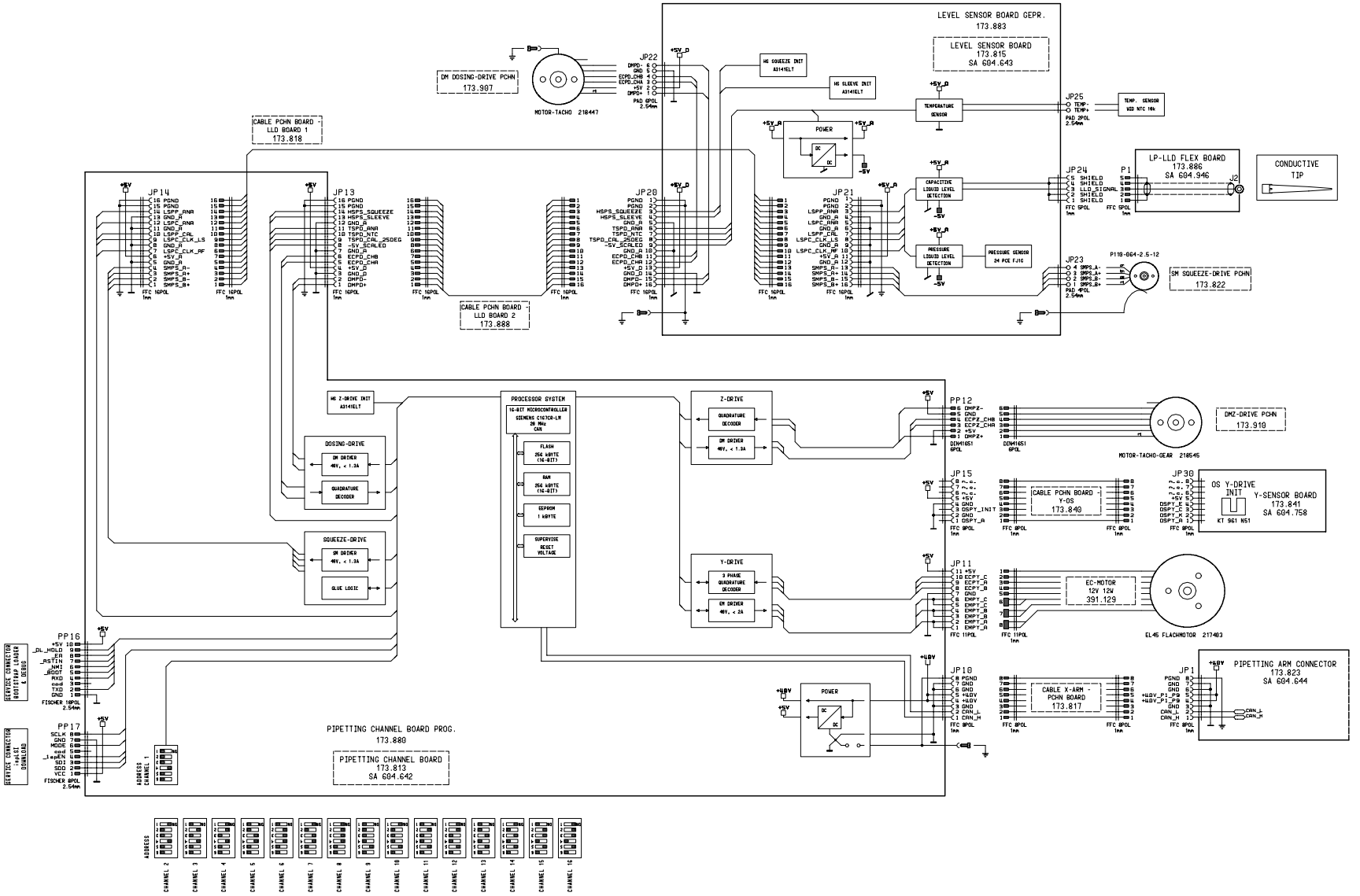
- It is highly recommended that you run the autoadjustment (PIP AUTOADJUSTMENT.MCR) to generate new calibration values for X-Drive Pipetting Arm.

8.4 Pipetting Channel

8.4.1 Pipetting Channel Block Diagram



8.4.2 Pipetting Channel Wiring Diagram



8.4.3 Replacement

See section 7.7 Pipetting Channels on page 7-26.

- Before a Pipetting Channel is replaced, print a hardcopy of all Data from the Channel by using Service Software.

8.4.4 Remounting:

- Instructions are basically the reverse of those for replacement. See section 7.7 Pipetting Channels on page 7-26.
- With Service Software:
  - Check Pipetting Channel settings
  - Check for accurate Firmware

8.4.5 Adjustment

- It is absolutely necessary to run the PIP AUTOADJUSTMENT.MCR to generate new calibration values for the Pipetting Channel.

Attention: Do not restore any Data to Pipetting Channel (if previously copied from replaced Pipetting Channel). The Calibration values are no longer valid since the Pipetting Channel is physically replaced by another one.

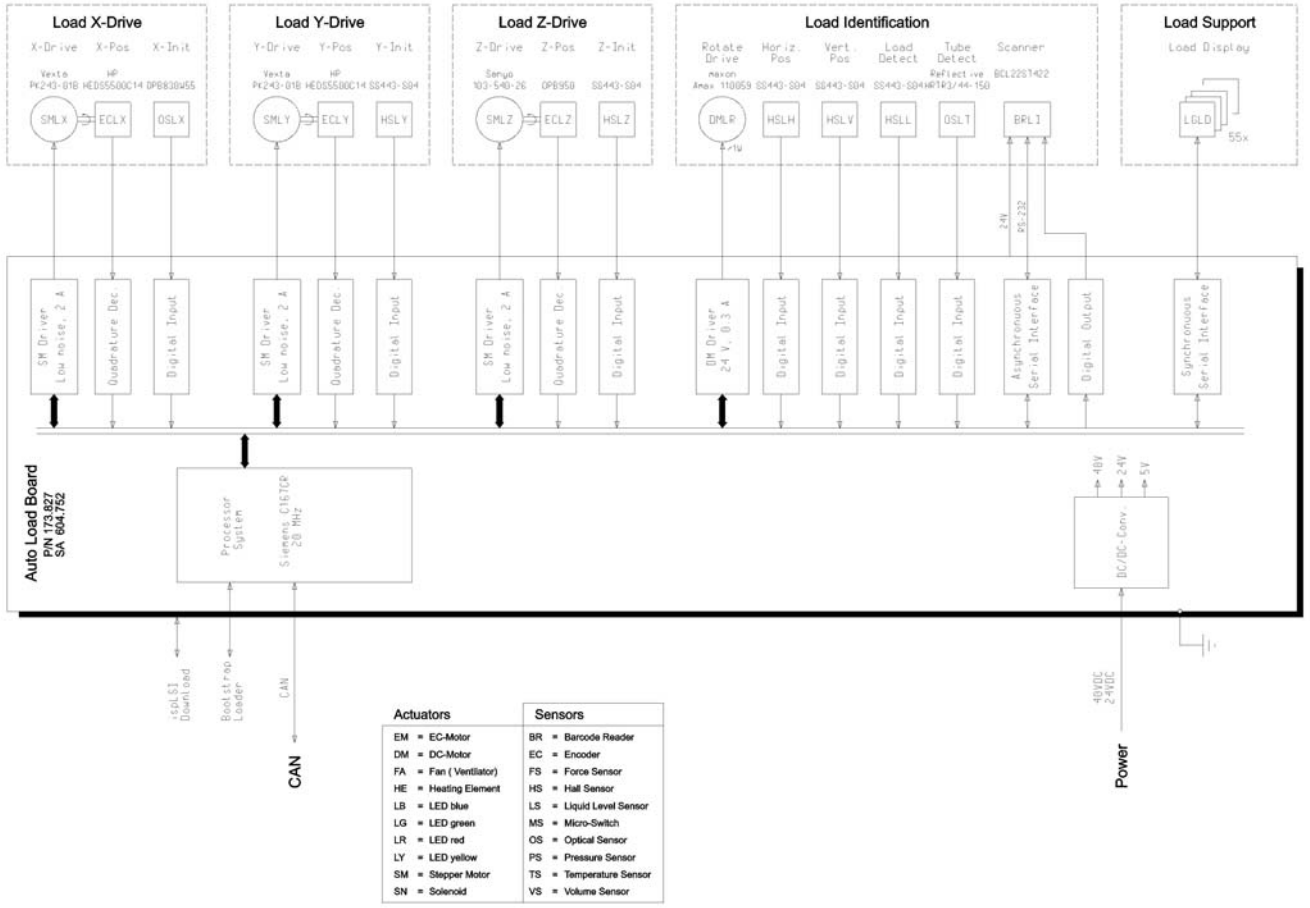
8.5 Autoload[23]

8.5.1 Function

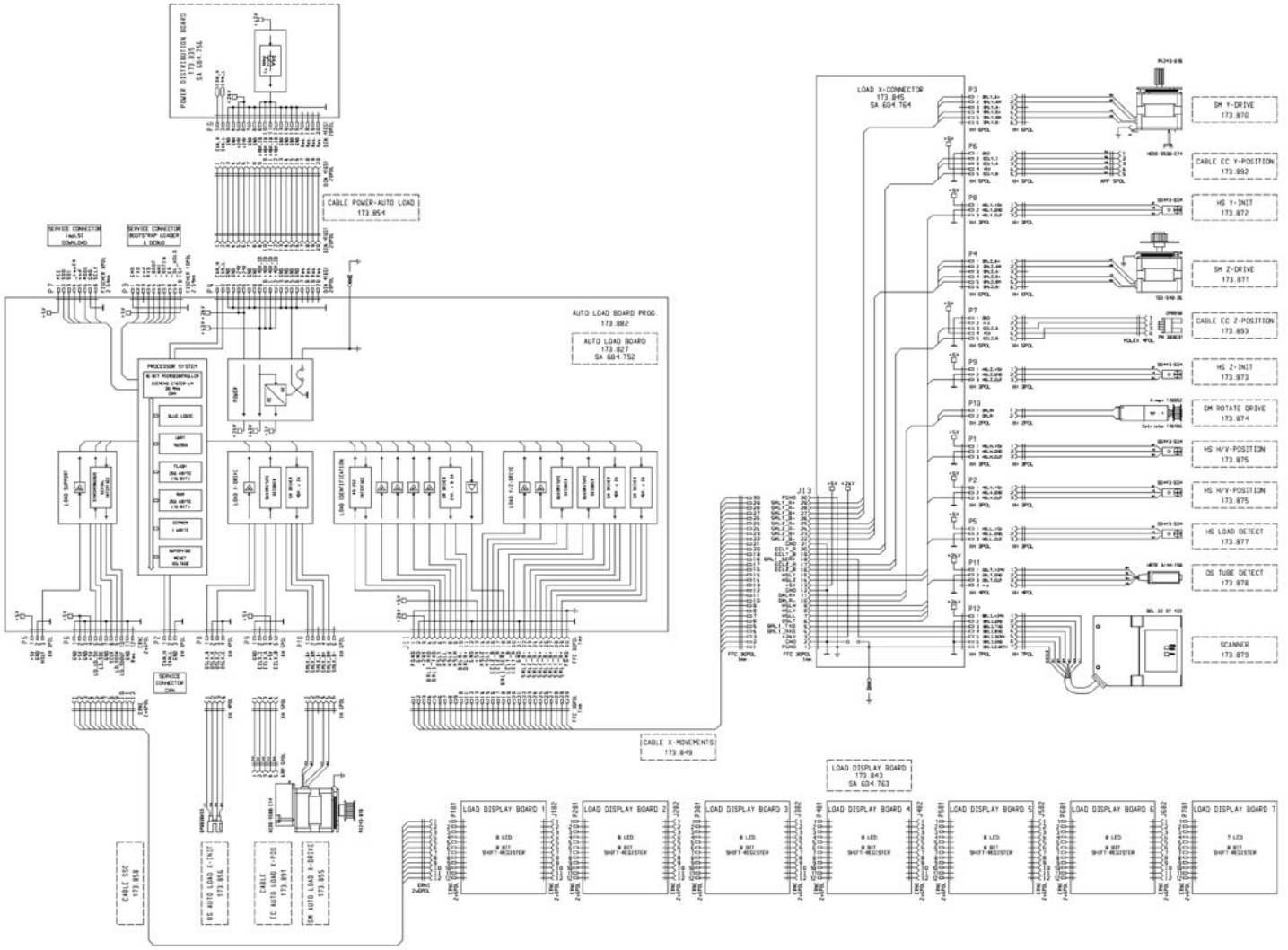
- Controls Autoload Function
- Stores Technical Status, Adjustment Values, Download Status, Cycle Counting and Firmware.

[23] Microlab®-STAR Instrument with Autoload Option only

8.5.2 Autoload Block Diagram



8.5.3 Autoload Wiring Diagram



8.5.4 Replacement

- Remove Left Deck Panel to access Autoload Board, see section 7.4.2 Deck Panels on page 7-7.
- Before the Autoload Board is replaced, print a hardcopy of all Data from the Board by using Service Software.
- Disconnect all cables and unscrew Autoload Board.
  Screw P/N 400656 5 x

8.5.5 Remounting:

- Instructions are basically the reverse of those for disassembly.
- Data may restored (if copied from replaced Autoload PCB).
- With Service Software:
  - Check Autoload settings
  - Check for correct Firmware

8.5.6 Adjustment

- It is highly recommended that you run the AUTOLOAD AUTOADJUSTMENT.MCR to generate new calibration values for Autoload drive.

8.6 Cables

Cables are generally replaced in their previous position. If necessary fold the new cable to fit.

8.6.1 Location of cables

Refer to the block diagrams in this chapter.

8.6.2 Cables Part list

P/N	Description	SPC
146355	CABLE W65	A
173817	CABLE X-ARM - PCHN BOARD	A
173849	CABLE X-MOVEMENTS	A
173850	CABLE FILTER-POWER SUPPLY	A
173851	CABLE POWER SUPPLY-40VDC	A
173852	CABLE POWER SUPPLY-GND	A
173853	CABLE POWER-MASTER	A
173854	CABLE POWER-AUTO LOAD	A
173858	CABLE SSC	A
173863	CABLE DM X-DRIVE PIPETTING ARM	A
173890	CABLE POWER SUPPLY-EARTH	A
173891	CABLE EC AUTO LOAD X-POSITION	A
173898	CABLE RS232	A
173905	CABLE X-ARM CONNECTOR 8C	A
173906	CABLE X-ARM CONNECTOR 16C	A
173911	CABLE FILTER-EARTH	A
182820	CABLE MASTER-EXTENSIONS	A
355130	CABLE USB TYPE A-B 3M	A

Mains cables for different countries:

P/N	Description	SPC
235062	POWER CABLE GB	C
355008	POWER CABLE SWISS	C
355009	POWER CABLE US	C
355010	POWER CABLE GERMANY, FRANCE	C

9 Maintenance

9.1 Overview

As well as the routine maintenance by the user (described in the User Manual), the Service Technician carries out an in-depth maintenance at least twice a year. This chapter provides a checklist of things to do as part of that in-depth maintenance.

Note: The preventive Maintenance for Microlab Star IVD Instruments must carried out every 6 months!

In order to ensure error-free operation of the instrument, the content of the maintenance and verification procedures, and the intervals at which these are to be carried out, must be adhered to, and the work must be documented.

Attention: The preventive maintenance must only be done by an authorized Service Technician.

Service Technicians as well as laboratory personnel should be aware of the danger of infection where instruments are used to sample biohazardous materials. In such cases the instrument or parts of it are said to be contaminated. As Service Technician you should be aware if an instrument you are servicing has been contaminated in this way. Contaminated parts to be touched while repairing should be cleaned and sterilized – a precautionary measure of the greatest importance. Only after cleaning and disinfecting should repairs be carried out.

Attention: Wear Gloves before repairing the Instrument and decontaminate Microlab® STAR prior to taking any action.

Attention: before executing any preventive Maintenance empty and decontaminate deck panels.

Attention: The following Parts may have sharp edges where infringements are possible when not enough attention is paid:

- *Decks under side ➔ where slide Blocks are pushed through deck*
- *Electronic covers Cutaways ➔ above PCB's, Fan, etc.*
- *Magnet Band edges ➔ Position Reader Pipetting Arm X-Drive*

9.2 Items Needed

Description	P/N
• Microlab™ Detergent & Disinfectant Kit	281242
• Microlab™ Disinfectant Spray Kit	281243
• Microlab™ Disinfectant Starter Kit	281245

• Service Kit Microlab® STAR:
  • Tools, e.g. Adjustment Tools
  • Grease
  • Cleaning Paper / Towels
	173970

• Microlab™ STAR Verification Kit	182501 or 182502 with 182503 and 182506

9.2.1 Duration

For an 8-channel Microlab® STAR it will take approximately 4 to 6 hours to perform a complete maintenance as described below.

Refer to section 12.2.2 Maintenance Checklist on page 12-11 for a list of items which the Service Technician has to check on the instrument being serviced.

9.2.2 Tasks

Refer to section 9.5 Half-yearly Maintenance on page 9-5 for each Task that should be carried out.

9.3 Decontamination

Spray Carriers and Waste Station with Microlab™ Disinfectant and wipe them off.

Clean Deck and loading trays[24] the same way.

Carefully clean Pipetting Heads (Tip Coupling, Ejection Tubes) with a cloth soaked with Microlab™ Disinfectant.

Attention: Do not spray directly onto the Channels or inside the Pipetting Arm Cover as this may damage the Instrument.

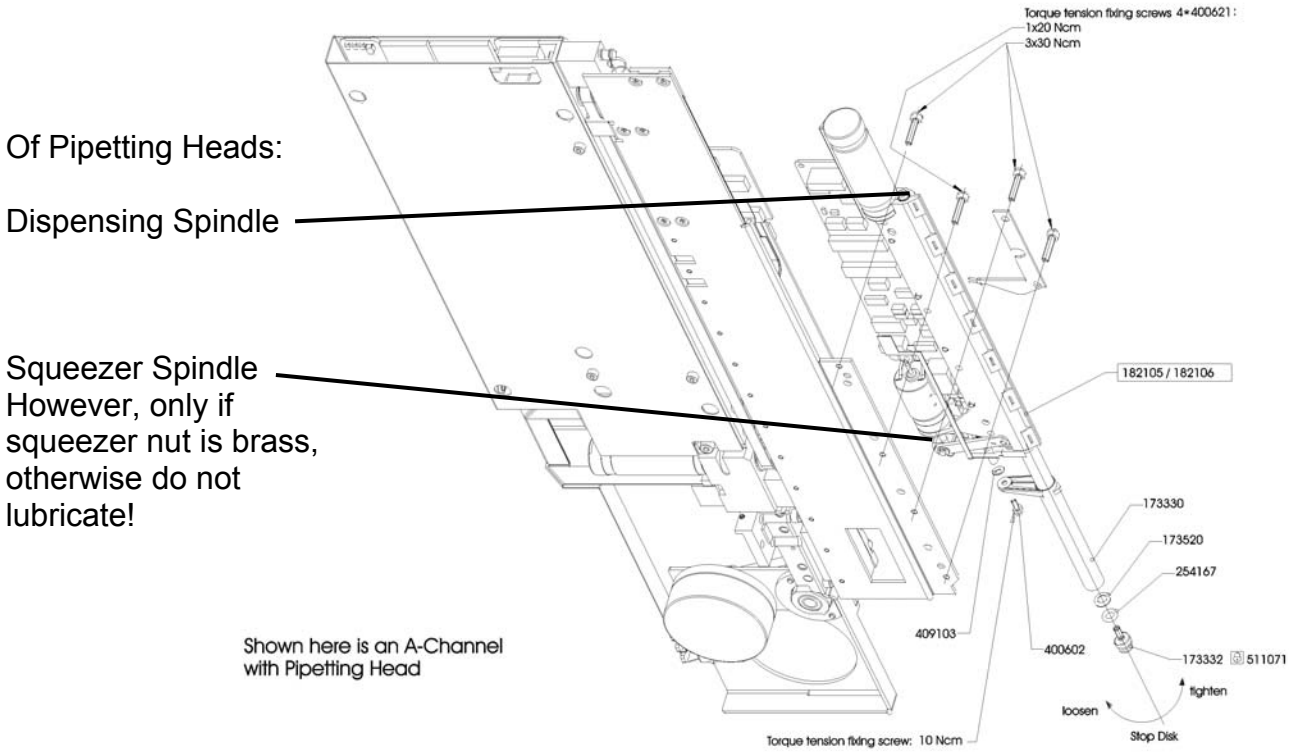
The Covers of the Microlab® STAR may by cleaned either by spraying Microlab™ Disinfectant directly onto surfaces, or by wiping them with a cloth soaked with Microlab™ Disinfectant.

Attention: Transparent Covers will become stained and clouded if they come into contact with Liquids containing propyl alcohol.

[24] Microlab®-STAR Instrument with Autoload Option only

9.4 Lubrication

Generally: lubricate as sparingly as possible. Avoid the possibility of grease falling from the spindles as this can badly affect the samples.



Procedure is as follows: set the spindle moving up and down (using Service Software), then use a paper or cloth to wipe off old grease.

Attention: Do not use any liquids such as Acetone or alcohols, as these may damage the Pipetting Head Housing.

Attention: Touch Spindles gently!

Ensure spindles are completely dry, and then apply a thin layer of Topas Grease.

9.5 Half-yearly Maintenance

	Action	Available Program
1.	Decontaminate and clean exposed Surfaces • Deck • Docking Station • Loading trays[25] • Instrument Covers • Pipetting Arm housing • Autoload ribbon[26] • Spillage Trays • Air filter, replace if necessary.	N/A

Attention:

- *Do not grease Y-Spindles Pipetting Arm*
- *Do not use any Cleaning liquids other than on Spindles to remove old grease. Avoid any contact with the CO-RE O-Ring as this may shorten its life span.*

2.	Uncover Pipetting Arm • Check Cable connections onto Pipetting Channels. • Check and clean Y- Spindle on Pipetting Arm. Spindle must not be greased at all. If needed, e.g. when step losses in Y occurs, Silicon oil may used to apply a thin layer onto the Y-Spindle.	N/A
3.	On Pipetting Heads: • Replace CO-RE O-Rings • Check Stop Disk(s) check for any scratches, blocked bore, or visible damage, and replace if such is the case. • Check Tip ejection Tube(s) check against contamination and damage. Ensure it glides smoothly.	For replacement Procedures refer to section 7.8 Pipetting Heads on page 7-32.

[25] Microlab®-STAR Instrument with Autoload Option only
[26] dito

Half-yearly Maintenance (continued)

Action		Available Program
4.	On Pipetting Heads clean and only slightly grease: • Squeezer Spindle only with brass nuts • Dispensing Spindle	Service Software: Single Commands or Movements Sensors
5.	Clean and slightly grease guide shafts: • X-Guide Pipetting Arm front and rear • X-Guide Autoload[27]	Service Software: Single Commands or Movements Sensors
6.	Remove Deck Panels and check: • For signs of liquid spillage underneath deck and inside electronic chamber. • If necessary: decontaminate and clean surfaces of deck underneath and electronic chamber cover. • Clean Flat Band Cables Groove and ensure collision free movement of Flat Band Cables. • All belts, drives and cables for any damage - or loose screws • Distance of X-measurement Reader on Pipetting Arm to magnetic Band	N/A
7.	Remove Autoload ribbon[28] and check: • For signs of liquid spillage underneath. • If necessary: decontaminate and clean surfaces of Autoload ribbon underneath. • Clean Flat Band Cables Groove and ensure collision free movement of Flat Band Cables. • All belts, drives and cables for any damage, or loose screws.	N/A

[27] Microlab®-STAR Instrument with Autoload Option only
[28] dito

Half-yearly Maintenance (continued)

Action		Available Program
8.	Recover: • Autoload ribbon[29] • Deck Panels • Pipetting Arm	N/A
9.	Check and Adjust: • Pipetting Arm • Pipetting Channels • Autoload[30] • Verify instrument with verification kit • Perform a test run	Adjustment is done in accordance with section 6 Adjustment and Calibration on page 6-1. Verification Program N/A
10.	Check all available Carriers: • For signs of liquid spillage and damage • If necessary: decontaminate and clean Carriers. • Ensure smooth gliding on Deck Panels and Loading Trays. • Replace damaged carriers.	N/A
11.	Check Needles if available: • For signs of damage. • If necessary: decontaminate and clean Needles • Replace damaged Needles	N/A

Attention: Items for ML STAR and ML STAR IVD may vary, therefore ensure correct parts are being used on the Instrument.

[29] Microlab®-STAR Instrument with Autoload Option only
[30] dito

Half-yearly Maintenance (continued)

	Action	Available Program
12.	Removal of old files • Together with the Laboratory Supervisor check for trace files witch may deleted from the Operating PC. • Check for Traces files such as method / system trace files communication trace files • Check for old methods which may be removed from PC • Back them up if necessary, else delete • Check for available disk space onto hard drive, 500 MB minimum are needed	N/A

ML STAR IVD additionally:

13.	• Test tightness of seal for all Pipetting Heads.	Maintenance Procedure according to ML STAR IVD Operators Manual
14.	• Check the pressure adjustment values of TADM.	PIP_PRESSURE_SIGNALS_ CHECK.MCR

10 Troubleshooting and Error Handling

10.1 Overview

This chapter is about how to respond to problems and errors identified by the software which the user himself cannot resolve. The solution of the problem may require the Service Technician to open up a component of the instrument.

This chapter takes the form of a list of such errors, and instructions how to handle them.

Problems reported by the User Software

See User Manual. It contains all software-reported problems that the user himself cannot solve. In the User Manual, the user is instructed to make a service call whenever one of these problems occurs and there is not an obvious solution he can implement himself. The last column, recommended action, is the action to be taken by the Service Technician when called in by the user.

10.1.1 Version Information

For User Software a Version Info Program will be found on START ➔ Programs ➔ HAMILTON ➔ Version Info

For Service Software see section 3.3 Help Menu on page 3-6.

10.2 Trace Files

Trace Files can be of great help to the Service Technician with error investigation. Typically when an undetected error occurs on the customer site - e.g. a damaged or contaminated tip ejection tube which hinders a proper functioning of the Tip presence sensor - checking these Files first for possible Hardware errors may help to solve the problem very quickly. 2 Types of trace files are available:

10.2.1 Communication Trace files

A record of every single Firmware command sent to - and acknowledged by - the ML Star Instrument.

Every Day when any method is started, a new Trace File is created and named for the current day; it will be found in C:\ Program Files \ HAMILTON \ Logfiles \.

E.g. 20010112.trc which is the date format JJJJJMMDD, 12th of January 2001

10.2.2 System Trace files

A record of every step in the method executed, from information supplied by the run editor.

Each Method started creates a Trace File which is named with the name of the Method plus the extension "trc". It will be found in C:\ Program Files \ HAMILTON \ Methods \ *.trc

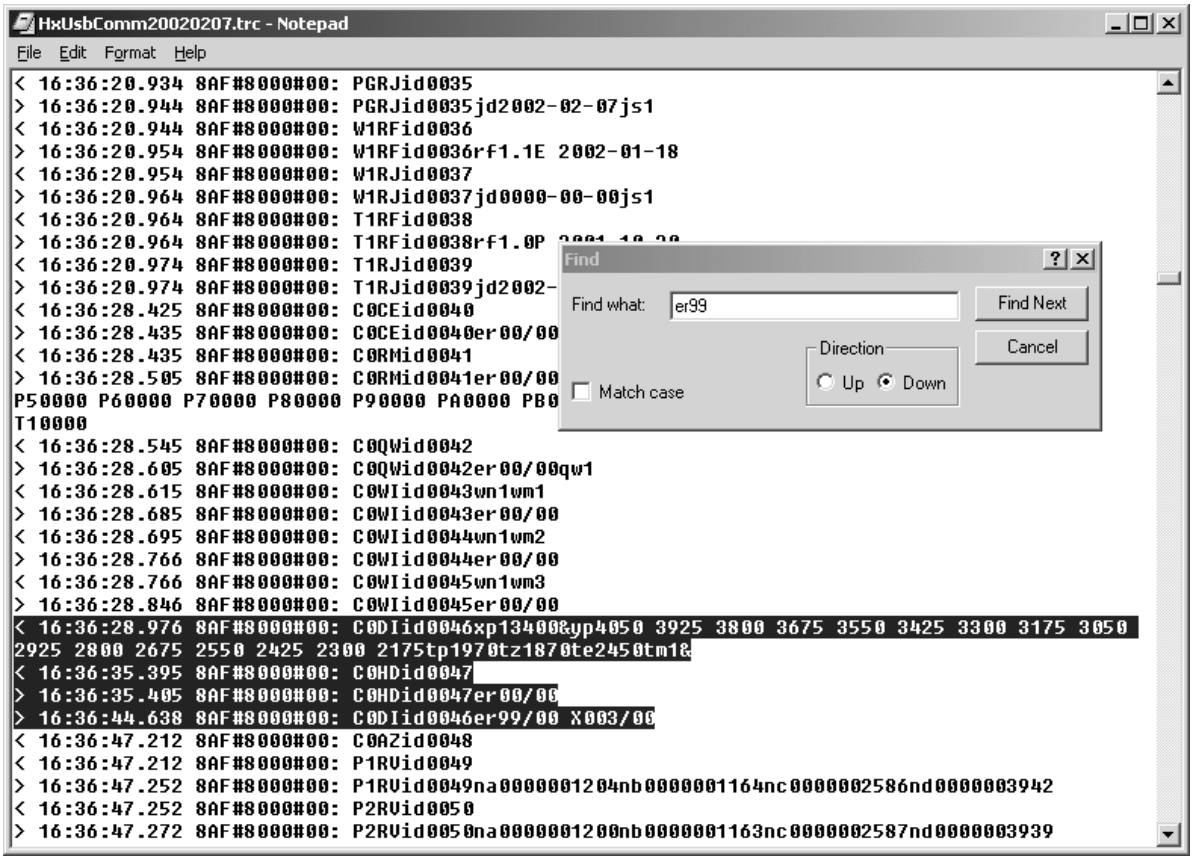
Example: If Method name is "DNASEC", Trace File will appear as "DNASEC.trc"

Every time the Method is started, an already existing Trace file will be opened (otherwise it will be created) and information will be appended to the last entries. Accordingly, it may be helpful to delete Trace files from time to time simply to avoid large files on the hard drive.

10.2.3 Investigation of Errors with Trace files

When an Error with the instrument has occurred Open the COM Trace - e.g. ComTrace20010612.trc (a file from the 12th June 2001) - with an Editor e.g. NotePad.

Due to the Master-Slave Architecture always search for "er99" which indicates an SLAVE error. However, every possible Error reported by the Firmware may be found this way.



Refer also to section 12.4.3.2 X0 Module Command Specification on page 12-21 for further information.

Investigtation of Errors with Trace files (continued):

Focusing on the higlighted section of the above window, we can see the following:

As seen from the editor	Commands
< 16:36:28.976 8AF#8000#00: C0DIid0046xp13400&yp4050 3925 3800 3675 3550 3425 3300 3175 3050 2925 2800 2675 2550 2425 2300 2175tp1970tz1870te2450tm1&	Command from PC to Instrument: C0DI a typical Initialize command
< 16:36:35.395 8AF#8000#00: C0HDid0047	Command from PC to Instrument: C0HD
> 16:36:35.405 8AF#8000#00: C0HDid0047er00/00	Return Message from Instrument to PC: C0HDid0047er00/00
> 16:36:44.638 8AF#8000#00: C0DIid0046er99/00 X003/00	Return Message from Instrument to PC: C0DIid0046er99/00 X003/00

Note: Always check for the complete command, which may include several lines in the Trace File Editor, to gather all information.

In this case the Master (C0) has sent a general Initialize Command (DI) for his Slaves (refer to Firmware reference Guide "Command Specifications Master Module").

Disregard any Identification Number e.g. id0081

While initializing a Halt command has been sent, which interrupted the initialize command.

The Slave is Pipetting Arm X Drive (X0) with Error 03 which is "Command not completed" (refer to Firmware reference Guide "Command Specifications X0 Module").

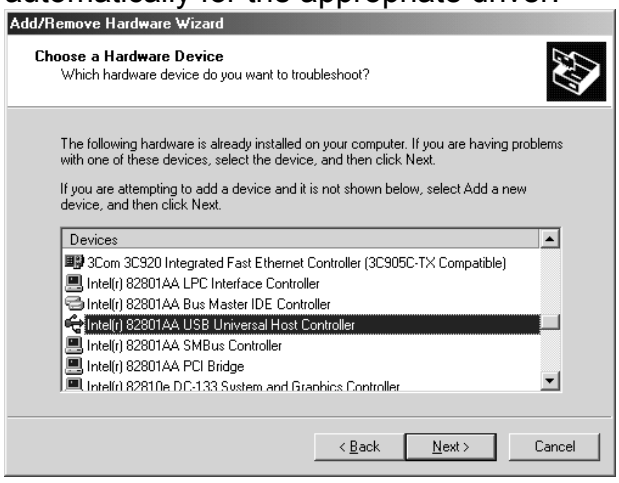
In this case the method could have been aborted by the user e.g. by selecting the ABORT Button in the Run Screen, or by opening the front window while running the method, which has the same effect.

This Information could be found in the System Trace File, by checking the same time, when the Error occurred.

10.3 Error Handling

The following listing of activities will help you to locate defective parts. It is recommended that Service Technicians make an in-depth examination of the assemblies before replacing any parts.

Also, check the Versions of Firmware, Adjustment Macro Programs, Service – and User Software. Ensure the latest / current Versions are being used!

Incident	Corrective Action
No communication	1. Check if Power switch is on Listen for the Fan working inside Microlab® STAR instrument. 2. Check Power - and Interface Cables, Fuses (e.g. does the PC work on the same electrical outlet?). Are all cables plugged in correctly? Cables may not be damaged (e.g. broken lines)! 3. Check the COM Port in the Configuration Settings in Service and User Software and physically on the PC. Is USB being used or the RS 232 Interface? 4. If RS 2323 Interface is being used: Is the original Microlab® STAR Interface Cable being used (RS 232)? Check the Lines according to section 4.2.3 Hooking up the instrument on page 4-10. 5. If USB Interface is being used: Check USB Controller in the Add / Remove Hardware Wizard (start ➔ settings➔ control panel) You may delete the ML STAR USB driver, switch then off and on again the ML STAR Instrument. The System is then looking automatically for the appropriate driver. 

Error Handling (continued)

Incident	Corrective Action
No communication	6. Compare physical Configuration with settings first in Service and then in user Software. 7. Switch off ML STAR Instrument and shut down Service Software. Then restart service software and switch on Instrument. 8. Replace Master PCB P/N 173881 After replacement, remember to check Firmware Versions and perform Auto-adjustments.
Flash Memory errors	1. Switch ML STAR Instrument off and on. 2. Check for correct node settings (dip switches) 3. Start Download again if need be. 4. Check all cables are plugged in properly 5. Perform Auto Adjustment, then switch off ML STAR Instrument, shut down Service Software and wait at least 10 sec. Then switch on ML STAR Instrument and start up Service Software. 6. Start Download again if need be. 7. Switch off ML STAR Instrument, shut down Service Software and wait at least 10 sec. Then switch on ML STAR Instrument and start up Service Software. 8. The EPROM is defective. Assembly (e.g. PCB, or Channel) where Flash Eprom is built in must be replaced.
E^2EPROM errors	1. Ensure all Parameters are defined such as cycles, adjustment status, technical status, etc
Flash EPROM, E^2EPROM errors (typically after download of new firmware) Pipetting Channels:	1. Run Macro “SET_EEPROM_PX_DATA.MCR”.

Error Handling (continued)

Incident	Corrective Action
Flash EPROM, E^2EPROM errors (typically after download of new firmware) Autoload Drive:	1. Run Macro “SET_EEPROM_I0_DATA.MCR”.
Flash EPROM, E^2EPROM errors Note:	After running of the above mentioned Macros switch ML STAR Instrument OFF and then ON!
Method on PC runs without any action on instrument	1. Check Configuration Settings in user Software and switch from simulation to instrument mode
Configuration mismatch on starting any method	1. Check the physical Configuration of Microlab® STAR instrument: Autoload, number of channels, channel type, etc. 2. Compare physical Configuration with settings first in Service and then in user Software.

Error Handling (continued)

Incident	Corrective Action
Pipetting Arm Step Loss	1. Ensure no crash has caused the Pipetting Arm to lose steps, e.g. a crash involving Pipetting Channels and Carriers. 2. Ensure the Pipetting Arm Cover is not touching the Front guide Bar anywhere. 3. Uncover Deck Panels see section 7.4.2 Deck Panels on page 7-7. 4. Check X-Motor and Belt Tensions. 5. Especially the Belt from the primary Drive must not be damaged. Check for signs of anything worn out, broken inlays, teeth, etc. 6. Ensure proper collision-free movement by carefully pushing the Pipetting Arm by hand all the way from the left to the right. 7. Ensure the X-Position Reader is not touching the Magnetic band anywhere, see section 7.6 Pipetting Arm X-Drive on page 7-23. 8. Check the gap between Reader and Magnetic Band. 9. Ensure the X-Flag (black sheet-metal cover) is not loose; tighten the screws if necessary. 10. Check tightness of fit between X drive belt and Pipetting Arm (check for loose screws). 11. Check Cables to pipetting Arm for any signs of damage or disconnection. 12. By using Service Software; Check Init Sensor movement, check voltage, check Hardware positioning counter. 13. Perform a Pipetting Arm Auto-adjustment

Error Handling (continued)

Incident	Corrective Action
Pipetting Channels Step loss. Dispensing Drive:	In General, try to run the specific drive with service software to determine the degree of malfunction. 1. Ensure the Pipetting Head fixing screws are mounted with the exact torque tension defined in section 7.8 Pipetting Heads on page 7-32. 2. Clean Dispensing Spindle by removing all old grease, and slightly grease it with new grease. *3.* By using Movement Sensors / Pipetting Channel Menu from Service Software, perform a whole stroke run-in (approx. 10 times). Use Service Software CONTROL ==> MOVEMENTS/SENSORS ==> PIPETTING CHANNEL and RUN in Dispensing Drive from corresponding Channel 4. If dispensing Drive is blocked at its lower end: Dispensing Spindle is not visible, the spindle is down - then send single command: P#DSds00500dv05000dr200dw7dt0 The Spindle must come up, otherwise no recovery is possible. *Note: when the Spindle is down, not visible, then parameter “dt0” must be used.* 5. If dispensing Drive is blocked on its upper end: Dispensing Spindle is visible, the spindle is up - then send single command: P#DSds00500dt1dv05000dr200dw7 The Spindle must go down, otherwise no recovery is possible. *Note: when the Spindle is up, visible, then parameter “dt1” must be used.* 6. After sending these comands use P#AI which resets the Firmware to its default values - this is absolutely necessary. 7. If no improvement, replace Pipetting Head.

Error Handling (continued)

Incident	Corrective Action
Pipetting Channels Step loss. Squeezer Drive:	1. Clean Dispensing Spindle by removing all old grease and slightly grease it with new grease. Using Movement Sensors Menu from Service Software, perform a whole stroke run-in (approx. 10 times). Perform an Auto-adjustment. If no improvement, replace Pipetting Head
Z-movement:	1. Ensure no crash has caused the Pipeting Channel to lose steps, e.g. a crash involving Pipetting Channels and Carriers / Labware. 2. Check if the Spring is still in place (e.g. after transportation). 3. Check if the Belt is still in place. 4. Check all the cable connections of the channel, focussing on z-motor cable. 5. Check the z movement manually by gently pushing or pulling the Channel up or down. Do not forget to switch off current to z motor beforehand. 6. In the absence of visible Hardware collision with other components, no corrective action is possible and the Channel must be replaced.

Error Handling (continued)

Incident	Corrective Action
Y-Movement:	1. Check visually the elastic sheet metal holding the Y-Motor Drive. The Y-Nut Bore must be rectangular to the Channel (no signs of bending). A bent sheet metal indicates too much friction between Y-Spindle and nut which may lead to steps lost. 2. The Y-Motor metal plate nose must fit into the groove. If not, too much friction between Y-Spindle and Nut which may lead to step lost. 3. Check if the Belt is still in place. 4. Check all the cable connections of the channel, focussing on y-motor cable. 5. Perform an Auto-adjustment and check visually the linearity of all Channels. Turning the Y-Motor by hand, no hardware-based friction is recognized e.g. signs of damaged bearing, broken parts inside etc. (except the electromechanical resistant). If no improvement, check Y-Spindle for possible damage and replace Channel. Decide if Y-Spindle should be replaced as well
Pipetting Head loss of seal	1. Ensure Stop Disk has no scratches - the smallest scratches may lead to an loss of seal. If there are scratches, replace Stop Disk. 2. Check CO-RE O-Ring for signs of wear and tear. Black abrasions may be found around O-Ring and Stop disk - if so replace O-Ring.

Error Handling (continued)

Incident	Corrective Action
Pipetting Head cLLD problems	1. Ensure conductive liquid is used. 2. Run the PIP AUTOADJUSTMENT.MCR 3. Check if the O-Ring is squeezed when the program is started. 4. Using Service Software 1. squeeze CO-RE O-Ring: menu ➔ movements sensors ➔ pipetting channels ➔ squeezer drive. 2. perform a cLLD measurement: menu ➔ control ➔ single commands, send PXALal1lc0, then connect stop disk of Pipetting Channel X with ground for a short moment (e.g. use a conductive cable between stop disk and deck). Then send command PXRN, the response should then be PXRNid####rn1 ==> LLD detected. 3. If it is PXRNid####rn0 then the Squeezer does not squeeze enough, or the O-ring may be worn out, or else the pipetting head or Channel is defective. 4. Switch Pipetting Heads and repeat procedure. If this eliminates the problem on that specific position, replace the Pipetting Head. If no Improvement, it may indicate that the Channel is defective and must be replaced.
Pipetting Head pLLD problems	1. Ensure disposables Tips are not being reused. 2. Run a method with a Tip pickup, an aspirating step and Tip eject. Check then the LLD Trace files from Service Software. 3. Switch Pipetting Heads and repeat procedure. If this eliminates the problem on that specific position, replace the Pipetting Head. If no Improvement, it may indicate that the Channel is defective and must be replaced.

Error Handling (continued)

Incident	Corrective Action
Pipetting outside volume specifications	1. Run Volume Verification
Autoload Step loss	In General, try to run the specific drive with service software to determine the degree of malfunction. 1. Ensure Deck, Carriers and Slide Blocks are not contaminated. Clean them if necessary 2. Check for damaged Slide Blocks on Deck and loading trays and replace them if necessary 3. Load and unload Carriers (move them by Hand). Check that they glide smoothly. Clean the guides of Carriers. 4. Replace those Carriers which don't move smoothly. 5. Check Synchronisation of both Cog Wheels 6. Perform an Autoload Auto-adjustment
Autoload rattles, sticks and slips while loading carriers	Generally see Autoload Step loss 1. Lower calibration value of Z-Drive Autoload Use Service Software Menu "Settings" "Inst. Configuration" "read Instrument data" and change existing Carrier Z value. E.g. current Carrier Z value is –037, change to –057. Keep lowering until improvement. 2. Shift the cogwheel angle position forwards or backwards, whatever suits better. E.g. current Carrier Y value is +003 +8913, change to +006 +8913. Keep shifting until improvement. 1st Value defines angle position of Cogwheel. 2nd Value defines the number of steps to load a carrier

Error Handling (continued)

Incident	Corrective Action
Barcode reading Problems	1. Ensure all Barcode Specifications are met according to technical Specifications in User Manual. E.g. print contrast signal, density of barcode, code type, quiet zone, label position on tubes and plates etc. 2. Check Barcode Reader settings in User Software. 3. Perform an Autoload Adjustment, answer "Would you like to setup the barcode scanner parameters?" with *yes* and check the laser beam positions with the autoload sensors adjustment tool. 4. Ensure no external light source is affecting the Barcode Reader while it is reading barcodes. 5. If no improvement, replace Barcode reader
No Carrier Presence detected	1. Carriers do not move completely to carrier Stop. Perform an autoload adjustment. 2. Carrier's Magnet is defective, broken, wrongly mounted, or lost. Replace Carrier. 3. The Carrier Sensor Board is defective. Check for loose Plugs in any of the 7 segments and replace.

10.4 Firmware Error Codes

See section 12.4.3 Firmware Reference Guides on page 12-19 ff. for the firmware error codes.

11 ML STAR Extensions

Here the ML STAR Extensions Manual may be filed.

12 Appendices

Generally: Copy checklist lists and forms for multiple use

12.1 Appendix A

12.1.1 Glossary

Access Right
the specific permission needed by a user to carry out a certain function with the ML STAR software.

Accuracy
a quality which characterises the closeness of an indicated value of a measuring instrument to the corresponding true value

Adjustment
Detailed positional setting for the hardware

Alignment
the condition of being in satisfactory adjustment and having the parts in proper relative position.

Aspirate
Aspirate is the activity of sucking up liquid by a pipetting device.

Autoload
Autoload is an assembly enabling automatic loading and identification of carriers onto the Microlab® STAR.

Autoload tray Hardware unit. On it the carriers can be placed and held outside the Microlab STAR IVD. The loading tray is attached to the Microlab STAR IVD, to support the automatic loading and unloading process.

AVS
Automated Vacuum System.

Barcode Mask
The barcode mask defines the basic structure of a barcode. It is a pattern to which a barcode must conform. The assignment of a specific labware item can be done this way. The barcode mask can require a barcode to contain specific strings at fixed positions. It can contain wildcards, too.

Barcode Reader
Part of the Autoload unit.

Calibration
all operations for the purpose of determining the values of a deviation from a theoretical axis.

Glossary (continued)

Carrier
A carrier is a template describing a discrete number of positions for locating labware items such as racks or containers.
A carrier is the only labware item that can be placed directly on the deck.

Container
A container is a vessel for holding fluid, including tubes, microwells, reagent containers, etc.

Container identification
Barcode for identification of containers. Serves for unambiguous identification of the vessel, e.g. a sample test tube.

CO-RE
Compression induced O-Ring Expansion.

Cover
The cover shelters the whole Microlab® STAR, leaving user access for loading and unloading of the racks onto their respective carriers. All activities must be suspended before the cover is opened. The cover should always be closed while the Microlab® STAR is in use.

Deck
The deck is the physical work surface used by the Microlab® STAR. It includes discrete bounded sites for locating carriers.

Dispense
To distribute quantities of liquid from a pipetting device.

EEPROM
also known as E^2PROM. Non volatile ROM for non volatile Data.

Firmware
Programs (sequences of commands) which are carried out on the processors of the Microlab STAR.

Flash Memory
Code Memory

FW
Firmware

Front, Side and Rear Windows
Covering for the Microlab STAR IVD in such a way that it is shielded from user intervention. At the same time, it protects the user from the movements of the Microlab STAR. It is made of transparent plexiglass.

GLP
Good Laboratory Practice

GUID
Globally unique identifier.

Glossary (continued)

Hardware error
Type of error which depends exclusively on faulty functioning of the hardware.

HSL
HAMILTON Standard Language.

Instrument
Hardware of the Microlab STAR (Mechanics, Electronics, and Firmware).

IVD
In vitro diagnostic

iSwap
Internal Swivel Arm Plate Handler.
Is a mechanical device that can pick up, hold, and release microtiterplates, and that can transfer them between different locations on the deck of the Microlab® STAR.

Labware
Refers to movable items to be placed on the Microlab STAR IVD deck, such as carriers, containers, or racks.

LED
Light Emitting Diode.

LIMS
Higher-level data processing system, generally known as Laboratory Information Management System, also LMS.

Liquid
Includes all kinds of liquids, among which are included reagents, controls, standards.

LLD
Liquid Level Detection. Detection of liquid surface which may be achieved either by pressure or capacitive signal detection.

Loading, unloading
The process by which carriers are brought on to the work surface of the Microlab STAR. This happens automatically by means of the Autoload unit.

Method
The method contains all instructions as to how the content of the source vessels is to be processed. The assignment of the vessels to positions happens "virtually", however, in the deck layout definition.

MAD
Monitored Air displacement, means Aspiration is monitored

Microlab STAR
The Microlab STAR instrument with pipetting arm, deck Autoload and optional extensions such as iSwap, Washing Station, and temperature-controlled Carrier. The Number of Pipetting Channels may vary from 4 up to 16.

Glossary (continued)

Microlab STAR IVD
The Microlab STAR IVD has additionally to the Microlab STAR instrument e.g. a locked front window, a panel in the back, a different waste station, either 8 or 12 Pipetting Channels and special carriers. It runs only with the IVD User Software.

ML STAR software
user software which controls the Microlab STAR instrument.

ML STAR IVD software
user software which controls the Microlab STAR IVD instrument.

MTP
Microtiter plate. The terms 'Microplate' and 'Microtiter plate (MTP)' mean the same and are also referred to simply as 'plate'. In general we assume a plate with 96 wells (8 x 12).

Pause
Interruption of processing. The current processing steps are completed. The processing can be continued.

PC
Personal Computer.

Pipetting
Transfer of liquids from one container to another.

Pipetting arm
Assembly consisting of pipetting channels, as well as the common X-drive and arm housing.

Pipetting channel
Hardware part, which moves onto pipetting arm in Y- and Z-direction and carries pipetting head.

Pipetting head
Pipetting device on pipetting channel.

P/N
Part Number.

Programmer
The user programming the methods for the Microlab STAR IVD instrument.*Precision* repeatability and reproducibility of e.g. Pipetting

Rack
A rack is a template describing a discrete number of positions for the containment of containers or tips. Examples of racks include a tube rack, a microtiterplate, a microtiter strip, a deep-well plate, and tip racks.

Glossary (continued)

Rack identification
Barcode for rack identification.

Sample
Refers to a liquid in an unambiguously identified container which is to be processed.

Service Technician
Trained and authorized service engineer.

STAR
Sequential Transfer and Aliquoting Robot.

The System
Refers to the Microlab STAR instrument together with the PC running the ML STAR software and the serial cable connecting the two together.

SSW
Service Software

TADM
Total Aspiration and Dispense Monitoring.

Tip
Disposable tip for dispensing.

Tip rack
Frame that holds tips together; used to store a set of tips for access by pipetting channel.

Tip waste station
An opening in the Microlab STAR deck to direct used disposable tips via a plastic chute into a laboratory-supplied waste container below the working area.

Trace
Note of a status during a processing.

Tube
A tube is a narrow container for liquid, usually showing a circular cross-section, and a cylindrical length-section.

User
The user actually operating the Microlab STAR instrument and the ML STAR software.

USW
User Software

Verification Kit
Aid to check the functions of the Microlab STAR IVD.

Glossary (continued)

Waste Container
The Waste Container is a device on the Microlab® STAR deck to collect used disposable tips.

Well
The individual hollow in the MTP.

Well type
Geometrical shape of the well, such as U, V, or flat.

Work area
The area on the Microlab STAR IVD, to which access is provided during processing. Elements to be pipetted can be placed in this area.

Work list
Information sent from outside the system, as to what method(s) is or are to be executed on the Microlab STAR IVD, and with what liquid.

12.2 Appendix B

12.2.1 Installation Qualification

12.2.1.1 IQ Microlab STAR

HAMILTON
the measure of excellence

Microlab STAR
Installation Qualification (IQ)

Ref. Service Manual: P/N 610754	**Installation Date:**	**Installation Report:** **IR #:** .....
Customer: **Address:**.....	**Contact Person:**.....	**Phone:** ..... **Fax:** ..... **e-Mail:** .....
Service Organization: **Address:**	**Contact Person:**.....	**Phone:** ..... **Fax:** ..... **e-Mail:** .....
ML STAR Software Version: ..... **Serial #:** **Instrument:** ..... **Computer:**	**Extensions Serial #:** **AVS:** ..... **iSWAP:** ..... **TCC 1:** ..... **TCC 2:**	**WS 1:** ..... **WS 2:** .....

Always wear required personal protection equipment!

Work Place Environment

- ❑ Inspect workplace environment for accordance to technical specifications.
- ❑ Inspect table or workbench for supporting the weight of the Microlab STAR and providing the minimum space needed.

Unpacking the Instrument

- ❑ Inspect instrument and accessories for shipping damage or missing parts.
- ❑ Use packing list to verify contents. If any items are missing, contact Customer Service.

Hooking up the Instrument

- ❑ Set up the instrument.
- ❑ Connect communication and power cables.

If included, inspect/install extensions.

iSWAP	Yes ❑	No ❑
AVS	Yes ❑	No ❑
TCC(s)	Yes ❑	No ❑
WS(s)	Yes ❑	No ❑
Recommended Uninterruptible Power Supply (UPS) installed?	Yes ❑	No ❑

Software Installation

- ❑ ML STAR software.
- ❑ Service software.
- ❑ Labware definitions of carriers.

Remote access? Yes ❑ No ❑

Instrument Check Procedure

- ❑ Perform instrument check procedure.

Verification

- ❑ Volume.
- ❑ Print out verification reports.

Service Software

- ❑ Print out instrument configuration.
- ❑ Un-install service software.

Documentation

- ❑ Attach instrument configuration and verification reports to this IQ form.

Customer Summary

- ❑ Explain how to request technical and service assistance.
- ❑ Address any other concerns.

Comments

_____

_____

_____

Customer Acceptance **Date**

Installed by **Date**

P/N 610911/00 HAMILTON Bonaduz AG

12.2.1.2 IQ Microlab STAR IVD

HAMILTON
the measure of excellence

Microlab STAR IVD
Installation Qualification (IQ)

Ref. Service Manual: P/N 610754 **Ref. Operator's Manual: P/N 610889**	**Installation Date:**	**Installation Report:** **IR #:** .....
Customer: **Address:**.....	**Contact Person:**.....	**Phone:** ..... **Fax:** ..... **e-Mail:** .....
Service Organization: **Address:**	**Contact Person:**.....	**Phone:** ..... **Fax:** ..... **e-Mail:** .....
Serial #: **Instrument:** ..... **Computer:**	**Extensions Serial #:** **AVS:** ..... **iSWAP:**.....	**ML STAR Software Version:** .....

Always wear required personal protection equipment!

Work Place Environment

- ❑ Inspect workplace environment for accordance to technical specifications.
- ❑ Inspect table or workbench for supporting the weight of the Microlab STAR IVD and providing the minimum space needed.

Unpacking the Instrument

- ❑ Inspect instrument and accessories for shipping damage or missing parts.
- ❑ Use packing list to verify contents. If any items are missing, contact Customer Service.

Hooking up the Instrument

- ❑ Set up the instrument.
- ❑ Connect communication and power cables.
  If included, inspect/install extensions.
  iSWAP Yes ❑ No ❑
  AVS Yes ❑ No ❑
- ❑ Install tip waste chute and container.
  Recommended Uninterruptible Power Supply (UPS) installed? Yes ❑ No ❑

Software Installation

- ❑ ML STAR IVD software.
- ❑ Service software.
- ❑ Labware definitions of carriers.
- ❑ Set up user groups.
  Remote access? Yes ❑ No ❑

Instrument Check Procedure

- ❑ Perform instrument check procedure.

Weekly Maintenance (➔ Operator's Manual)

- ❑ Perform Weekly Maintenance procedure.

Verification

- ❑ Volume.
- ❑ Print out verification reports.

Functional Test Run

- ❑ Run demo method (➔ Operator's Manual).

Service Software

- ❑ Print out instrument configuration.
- ❑ Un-install service software.

Documentation

- ❑ Attach instrument configuration and verification reports to this IQ form.

Customer Summary

- ❑ Explain how to request technical and service assistance.
- ❑ Address any other concerns.

Comments

_____

_____

_____

Customer Acceptance **Date**

Installed by **Date**

P/N 610886_85 2002-10-31 HAMILTON Bonaduz AG

12.2.2 Maintenance Checklist

Decontamination and cleaning of all exposed surfaces:	OK	REMARKS
Deck	☐	_____
Docking Station	☐	_____
Loading trays[31]	☐	_____
Instrument Covers	☐	_____
Pipetting Arm housing	☐	_____
Autoload ribbon[32]	☐	_____
Spillage trays	☐	_____
Air filter, replace if necessary	☐	_____

Uncover Pipetting Arm		
Check Cable connections	☐	_____
Check and clean Y- Spindles	☐	_____

On Pipetting Heads:		
Replace CO-RE O-Rings	☐	_____
Check Stop Disk's	☐	_____
Check Tip ejection Tubes	☐	_____

On Pipetting Heads clean and only slightly grease:		
Squeezer Spindle[33]	☐	_____
Dispensing Spindle	☐	_____

Clean and slightly grease guide shafts of:		
X-Guides Pipetting Arm	☐	_____
X-Guide Autoload[34]	☐	_____

[31] Microlab®-STAR Instrument with Autoload Option only
[32] dito
[33] only with brass nuts
[34] Microlab®-STAR Instrument with Autoload Option only

Maintenance Checklist (continued):

Remove Deck Panels and check:	**OK**	**REMARKS**
For signs of liquid spillage underneath deck and inside electronic chamber.	☐	_____
If necessary: decontaminate and clean surfaces of deck underneath and electronic chamber cover.	☐	_____
Clean Flat Band Cables Groove and ensure collision free movement of Flat Band Cables.	☐	_____
All belts, drives and cables for any damage - or loose screws	☐	_____
Distance of X-measurement Reader on Pipetting Arm to magnetic Band	☐	_____

Remove Autoload ribbon[35] and check:		
For signs of liquid spillage underneath.	☐	_____
If necessary: decontaminate and clean surfaces of Autoload ribbon underneath.	☐	_____
Clean Flat Band Cables Groove and ensure collision free movement of Flat Band Cables.	☐	_____
All belts, drives and cables for any damage, or loose screws.	☐	_____

Recover:		
Autoload ribbon[36]	☐	_____
Deck Panels	☐	_____
Pipetting Arm	☐	_____

[35] Microlab®-STAR Instrument with Autoload Option only
[36] dito

Maintenance Checklist (continued):

Check all available Carriers:	OK	REMARKS
For signs of liquid spillage and damage	☐	_____
If necessary: decontaminate and clean Carriers.	☐	_____
Ensure smooth gliding on Deck Panels and Loading Trays.	☐	_____
Replace damaged carriers.	☐	_____
Autoload[37]	☐	_____

Check Needles if available:		
For signs of damage.	☐	_____
If necessary: decontaminate and clean Needles	☐	_____
Replace damaged Needles	☐	_____

Check and Adjust:		
Pipetting Arm	☐	_____
Pipetting Channels	☐	_____
Autoload[38]	☐	_____
Verify instrument	☐	_____
Perform a test run	☐	_____

[37] Microlab®-STAR Instrument with Autoload Option only
[38] dito

Maintenance Checklist (continued):

Removal of Trace files	OK	REMARKS
Together with the Laboratory Supervisor check for trace files witch may deleted from the Operating PC.	☐	_____
Check for Traces files such as method / system trace files communication trace files	☐	_____
Check for old methods which may be removed from PC	☐	_____
Back them up if necessary, else delete	☐	_____
Check for available disk space onto hard drive, 500 MB minimum are needed	☐	_____

ML STAR IVD additionally:		
Test tightness of seal for all Pipetting Heads.	☐	_____
Check the pressure adjustment values of TADM.	☐	_____

12.3 Appendix C

12.3.1 Service news

	Subject	Date

12.3.2 Parts return tag

A Tag P/N 612554 should be found here.

12.3.3 Problem report form

Name:	Date:
Company:	Operating System:
User Software version:	PC RAM
PC Processor:	PC Hard drive size / free space:
Brief description:	
Symptom:	
❑ User software hangs ❑ System error, Abort ❑ System error, Continue ❑ Exit	❑ Initialization fault ❑ Verification fault ❑ Processing fault ❑ Window / dialog box fault
❑ Instrument hangs ❑ Pipetting Arm fault ❑ Channel fault ❑ Pipetting Head fault ❑ Autoload fault	❑ …… ❑ …… ❑ …… ❑ …… ❑ ……
Detailed description of problem:	
Attached: ❑ Method Trace …… ❑ Com Trace …… ❑ Method …… ❑ Other ……	

Please sign and return to Hamilton[39]
Date:
Signed:

[39] Refer to section 1.10 Contacting Hamilton on page 1-8

12.4 Appendix D

12.4.1 Microlab® STAR Firmware Addresses:

- Master Module: C0 where 0 is the number zero
- X- drive Pipetting Arm Module: X0 where 0 is the number zero
- Pipetting Channel: P# where # is 1 to 9 and A to G
- Auto Load Module: I0 where 0 is the number zero
- Temperatured Controlled Carrier: T# where # is 1 or 2
- Wash station: W# where # is 1 or 2
- iSwap R0 where 0 is the number zero

12.4.2 Microlab® STAR Firmware Files:

Firmware file	Description
• GRUC0S##.ACH	Firmware for Master Module (Pipetting Arm X drive Module included)
• GRUPXS##.ACH	Firmware for Pipetting Channels
• GRUALS##.ACH	Firmware for autoload drive
• GRUTXS##.ACH	Firmware for Temperatured Controlled Carrier
• GRUWXS##.ACH	Firmware for Wash station
• GRUR0SE##.ACH	Firmware for iSwap

Where ## is the current Version of firmware

12.4.3 Firmware Reference Guides

12.4.3.1 Master Module Command Specification

File the corresponding Firmware reference guide after this page.

12.4.3.2 X0 Module Command Specification

File the corresponding Firmware reference guide after this page.

12.4.3.3 Pipetting Channel Module Command Specification

File the corresponding Firmware reference guide after this page.

12.4.3.4 Auto Load Module Command Specification

File the corresponding Firmware reference guide after this page.

12.4.3.5 Wash Station Module Command Specification

File the corresponding Firmware reference guide after this page.

12.4.3.6 Temperature Controlled Carrier Module Command Specification

File the corresponding Firmware reference guide after this page.

12.4.3.7 iSwap Module Command Specification

File the corresponding Firmware reference guide after this page.

12.5 Appendix E

12.5.1 Microlab® STAR Service Kit

All items listed below come in the Microlab® STAR Service Kit P/N 173970.

Note: The Service Kit Microlab® STAR contains items such as parts and Tools.

12.5.1.1 Parts

P/N	Description	Quantity	Spare Part class
146355	FAME CABLE W65	1	A
173293	STOP HOOK	20	A
173300	DISC	10	A
173310	GREASE 100 GR TOPAS AK50	1	A
173330	TIP EJECTOR	16	A
173332	STOP DISK	16	A
173520	U-DISC 2	16	A
173600	SLIDE BLOCK	30	A
173602	SLIDE BLOCK WEDGE	15	A
173817	CABLE X-ARM -PCHN BOARD	16	A
173823	PIPETTING ARM CONNECTOR	1	A
173833	CARRIER SENSOR BOARD	1	A
173835	POWER DISTRIBUTION BOARD	1	A
173843	LOAD DISPLAY BOARD	1	A
173845	LOAD X-CONNECTOR	1	A
173849	CABLE X-MOVEMENTS	2	A
173850	CABLE FILTER-POWER SUPPLY	1	A
173851	CABLE POWER SUPPLY-40VDC	1	A
173852	CABLE POWER SUPPLY-GND	1	A
173854	CABLE POWER-AUTO LOAD	1	A
173856	OS AUTO LOAD X-INIT	1	A
173858	CABLE SSC	2	A
173860	HS COVER CONTROL	1	A
173863	CABLE DM X-DRIVE PIP ARM	1	A
173864	OS PIPETTING ARM – X-INIT	1	A
173874	DM ROTATE DRIVE	1	A
173875	HS H/V POSITION	2	A
173877	HS LOAD DETECT	1	A
173878	OS TUBE DETECT	1	A
173881	MASTER BOARD PROG	1	A
173882	AUTO LOAD BOARD PROG.	1	A
173890	CABLE POWER SUPPLY-GND	1	A
173891	CABLE EC AUTO LOAD X-POS	1	A
173895	EC PIPETTING ARM X-POSITION	1	A
173898	CABLE RS232	1	A

Microlab® STAR Service Kit

Parts (continued)

P/N	Description	Quantity	Spare Part class
173900	X-ARM CONNECTOR	2	A
173905	CABLE X-ARM CONNECTOR 8C	2	A
173906	CABLE X-ARM CONNECTOR 16C	2	A
173911	CABLE FILTER-GND	1	A
182103	REPLACEMENT CHANNEL A	1	A
182104	REPLACEMENT CHANNEL B	1	A
182105	REPL. PIPETTING HEAD 300ul	1	A
182106	REPL. PIPETTING HEAD 1000ul	1	A
182805	EXTENSIONS CONNECTOR	1	A
182820	CABLE MASTER-EXTENSIONS	1	A
254167	O-RING ID=3.6x1.45	16	A
256141	PRESSURE SPRING	2	A
257056	SPACER PINS M5x20 I/O	3	A
257062	SPACER PINS M4X40 I/O	5	A
258053	COG BELT MXL Z= 83 X 3/16"	1	A
258129	COG BELT 10AT5/2875	1	A
258130	COG BELT 10T2.5/480	1	A
258134	COG BELT 10T2.5 3065	1	A
258140	COG BELT MXL Z= 90X3/16	1	A
281401	COVERING CAP D=25.5 PA	2	A
281457	BUTTON BUFFER D=12 F=4 d=8	8	A
355130	CABLE USB TYPE A-B 3M	1	A
361004	CABLE CLAMP CFCC-4 1/2"	10	A
361025	CABLE CLAMP FCC-2A	5	A
361036	CABLE CLAMP	10	A
363012	FUSE 3.15 AT	4	A
363013	FUSE 6.3 AT	4	A
400002	FLAT HEAD SCREW M 3 X 6 DIN912	10	A
400005	FLAT HEAD SCREW M 3 X12 DIN912	10	A
400012	FLAT HEAD SCREW M 3 X30 DIN912	10	A
400024	FLAT HEAD SCREW M 4 X 8	10	A
400025	FLAT HEAD SCREW M 4 X10 DIN912	10	A
400026	FLAT HEAD SCREW M 4 X12 DIN912	10	A
400028	FLAT HEAD SCREW M 4 X16 DIN912	10	A
400047	FLAT HEAD SCREW M 5 X16 DIN912	10	A
400262	FLAT HEAD SCREW M 3X 6 DIN912 A2	10	A
400301	FLAT HEAD SCR M4X6 DIN912	10	A
400650	FLAT HEAD SCR M4X16 DIN912	10	A
400302	FLAT HEAD SCREWM 4X 8 DIN912 A2	10	A
400602	FLAT HEAD SCREWM2X 5 DIN912	40	A
400604	FLAT HEAD SCREWM2X 8 DIN912	50	A
400617	FLAT HEAD SCREWM2.5X 5 DIN912	50	A

Microlab® STAR Service Kit

Parts (continued)

P/N	Description	Quantity	Spare Part class
400619	FLAT HEAD SCREWM2.5X 8 DIN912	50	A
400621	FLAT HEAD SCREWM2.5X12 DIN912	50	A
400632	FLAT HEAD SCREWM3X 8 DIN912	50	A
403452	SUNK SCREW M 3X 6 DIN7991	10	A
403453	SUNK SCREW M 3X 8 DIN7991	10	A
403491	SUNK SCREW M 4X 8 DIN7991	10	A
403499	SUNK SCREW M4x30	10	A
405082	SET SCREW M 5X 5 DIN913	10	A
405445	SET SCREW M3 X 8 DIN916	10	A
408006	HEX NUT M 4 DIN934	10	A
409103	U-DISC M 2 DIN125A	20	A
409200	U-DISC M 3 DIN9021B	10	A
413005	LOCK DISC 4 DIN6799	10	A
413008	LOCK DISC 7 DIN6799	10	A
420010	ZYL-SCHR.M2,5X8 DIN912 A4	10	A
420013	FLAT HEAD SCREW M 3 X 8 DIN912	10	A
420074	FLAT HEAD SCREWM 4X16 DIN912 A2	10	A
420560	SCREW M4x10 A2 ISO7380	20	A
420561	TORX SCREW M5x12	10	A
420564	PASSCHULTERSCHRAUBE 6x20/M5	4	A
511000	LOCTITE 222 10 ML	1	A
511071	OMNI FIT 15M	1	A
7249025	PVC TUBING 3 X 5 TRANSP	0.5 m	A
7279372	TAPE D= 2 B= 12	0.5 m	A

Microlab® STAR Service Kit (continued)

12.5.1.2 Tools

P/N	Standard Tools	Size
239511	ALLEN SCREW DRIVER WITH GRIP	1.5 mm
239512		2 mm
239012		2.5 mm
239010		3 mm
239544	PHILLIPS SCREW DRIVER	0-60
239643	ANGLED ALLAN SCREW DRIVER SET	1.5, 2, 2.5, 3, 4 mm
239644	TORX SREW DRIVER	T 25
239596	ADJUSTABLE WRENCH	0 ÷ 10 mm
239563	FORK / RING WRENCH	7 mm
239564		8 mm
239573		17 mm
239646	TORQUE WRENCH ¼" SNAP ON	10 ÷ 60 cNm
239647	ALLAN BIT's ¼"	1.5 mm
239648	(snap on for Torque wrench ¼")	2 mm
239649		2.5 mm
239650	HEX NUT BIT (snap on for Torque wrench ¼")	7 mm
239651	ADAPTER PIECE ¼" (for Hex Nut bit)	¼"
239652	ADAPTER PIECE ¼" (for Allan bit's ¼")	¼" - 6.3 MM
239028	FLAT PLIERS	120 mm
239035	BRUSH	L=135
239034	PELIKAN BRUSH	25-1
235414	GLOVES	10 pairs
239631	SCALE L=300	
239015	VERNIER GAUGE	

Microlab® STAR Service Kit

Tools (continued)

P/N	Microlab® STAR Special Tools
173950	FRONT WINDOW MAGNET
173956	PIPETTING ARM ALIGMENT TOOL (2 pieces)
	Pipetting Channel Adjustment Tool Set
173952	CHANNEL ADJUSTMENT TOOL
173960	CHANNEL CALIBRATION TOOL
	Autoload Adjustment Tool Set
173981	AUTOLOAD CALIBRATION TOOL
173980	AUTOLOAD SENSOR TOOL
173953	STOP DISC MOUNTING TOOL

P/N	Microlab® STAR Disposables
235920	CO-RE TIPS FOR ADJUSTMENT

One each of the Microlab® STAR Standard and Special Tools is required – except in the case of the PIPETTING ARM ALIGMENT TOOL, where 2 of them are necessary.

12.5.2 ML STAR Verification Kit

P/N	Microlab® STAR Special Tools
182501	VFV BASEKIT 230V/50Hz
182502	VFV BASEKIT 115V/60Hz
182503	VFV SUPPLEMENT ML-STAR
182506	VFV CONSUMABLE KIT ML-STAR

12.6 Appendix F Part List Summery

12.6.1 Instrument Cover Part List

P/N	Description	SPC
173712	SIDE PANEL LEFT	C
173713	SIDE PANEL RIGHT	C
173774	FRONT WINDOW	C
173860	HS COVER CONTROL	A
281401	COVERING CAP D=25.5 PA	A
400047	CYL-SCR M5X16 DIN912	A
400619	CYL-SCR M2.5X8 DIN912	A
420560	SCREW M4x10 A2 ISO7380	A
420561	TORX SCREW M5x12	A

12.6.2 Covers over electronics

P/N	Description	SPC
173743	EL-COVER LINE FILTER	C
173748	EL-COVER MASTER	C
173750	EL-COVER POWER	C
7279443	EDGE PROTECTION SECTION	C
7369085	SELF ADHESIVE GASKIT	C

12.6.3 Deck Panel Part List

P/N	Description	SPC
173378	CAP	C
173288	CONTACT PLATE	C
173600	SLIDE BLOCK	A
173602	SLIDE BLOCK WEDGE	A
173833	CARRIER SENSOR BOARD	A
173858	CABLE SSC	A
182114	REPLACE. DECK AL RIGHT	C
182115	REPLACE. DECK AL LEFT	C
182118	REPLACE. CARRIER STOP	C
182283	DOCKING STATION FOR ML STAR	C
400302	CYL-SCR M4X8 DIN912 A2	A
403491	C-SUNK SCR M 4X8 DIN7991	A
420010	CYL-SCR M2,5X8 DIN912 A4	A
420074	CYL-SCR M4X16 DIN912 A2	A

12.6.4 Pipetting Arm Cover Part List

P/N	Description	SPC
173555	PANEL	C
173557	SIDE PANEL LEFT	C
173559	SIDE PANEL RIGHT	C
173568	TOP COVER	C
173607	H PROFILE	C
173609	BACK PANEL	C
173615	FRONT PANEL	C
420560	SCREW M4X10 A2 ISO7380	A

12.6.5 Pipetting Arm Part List

P/N	Description	SPC
173206	CLAMP AT5	C
173366	CABLE GUIDE PLATE LEFT	C
173367	CABLE GUIDE PLATE RIGHT	C
173371	HOLDING PLATE LEFT	B
173372	HOLDING PLATE RIGHT	B
173392	HOLDING BAR	C
173446	Y-SPINDLE	C
173499	Y-SPINDLE BEARING	C
173569	BRIDE FLAT CABLE	C
173581	STEEL BAND	C
173605	CLAMPING BRACKET	C
173606	P-ARM LINK	C
173608	P-ARM FLAG	C
173817	CABLE X-ARM –P-CHANNEL BOARD	A
173849	X-MOVEMENT CABLE	A
173895	EC PIPETTING ARM X-POSITION	A
173900	X-ARM CONNECTOR	A
173905	CABLE X-ARM CONNECTOR 8C	A
173906	CABLE X-ARM CONNECTOR 16C	A
182103	REPLACEMENT CHANNEL A	A
182104	REPLACEMENT CHANNEL B	A
182105	REPLACE. PIPETTING HEAD 300ul [40]	A
182106	REPLACE. PIPETTING HEAD 1000ul [41]	A
182108	REPL. FRAME PIP. ARM 8-CHANNEL	C
361025	FCC-2A CABLE GUIDE	A
400002	CYL-SCR M3X6 DIN912	A
400005	CYL-SCR M3X12 DIN912	A

[40] Depending on instrument configuration
[41] ditto

Pipetting Arm Part List (continued)

P/N	Description	SPC
400012	CYL-SCR M3X30 DIN912	A
400024	CYL-SCR M4X8	A
400047	CYL-SCR M5X16 DIN912	A
400604	CYL-SCR M2x8 DIN912	A
400617	CYL-SCR M2.5X5 DIN912	A
400621	CYL-SCR M2.5X12	A
403491	SUNK SCREW M4X8	A
408006	HEX SCREW M 4 DIN934	A
420013	CYL-SCR M3X8 DIN912	A
511071	OMNI FIT 15M	A
7279372	ADHESIVE TAPE 1-SIDED D=2 B=12	A

12.6.6 Replacement Frame Pipetting Arm P/N 182108 Part List

P/N	Description	SPC
173239	CABLE GUIDE COMPLETE	C
173357	Y-FLAG	C
173490	ROLL HOLDER	C
173491	GUIDE	C
173536	REINFORCING ANGLE BRACKET	C
173537	PAWL	C
173538	PROTECTIVE RING	C
173549	GAP DISC	C
173823	PIPETTING ARM CONNECTOR	A
254087	O-RING ID8.00X2.00 NIT 70SH	C
256141	PRESSURE SPRING	A
281281	TRACK ROLLER D=16	B
281457	BUTTON BUFFER D=12 F=4 d=8	C
361004	CABLE GUIDE CFCC-4 ½"	A
400002	CYL-SCR M3X6 DIN912	A
400026	CYL-SCR M4X12	A
400028	CYL-SCR M4X16 DIN912	A
420561	TORX SCREW M5x12	A
511006	LOCTITE 222	A

12.6.7 Pipetting Arm's X Drive Part List

P/N	Description	SPC
173380	OS-HOLDER	C
173864	OS PIPETTING ARM – X-INIT	A
182111	REPLACEMENT X-MOTOR	B
250007	BALL BEARING ID= 8 AD=16/18 B=6	A
250045	BALL BEARING ID=15 AD=35 B=11	A
257056	SPACER PINS M5x20 I/O	A
258129	COG BELT 10AT5/2875	A
258130	COG BELT 10T2.5/480	A
396011	MAGN. MEASURING TAPE	B
400025	CYL-SCR M4X10 DIN912	A
400026	CYL-SCR M4X12 DIN912	A
400077	CYL-SCR M6X60 DIN912	C
400262	CYL-SCR M3X6 DIN912 A2	A
400302	CYL-SCR M4X8 DIN912 A2	A
405082	SET SCR M5X5 DIN913	A
413008	LOCK DISC 7 DIN6799	A
420561	TORX SCREW M5x12	A

12.6.8 Pipetting Channels Part List

P/N	Description	SPC
182103	Replacement Channel A	A
182104	Replacement Channel B	A

12.6.9 Pipetting Head Part List

P/N	Description	SPC
173330	TIP EJECTOR	A
173332	STOP DISK	A
173520	DISC 2	A
182105	REPLACE. PIPETTING HEAD 300ul	A
182106	REPLACE. PIPETTING HEAD 1000ul	A
254167	O-Ring ID3.6x1.45	A
400602	CYL-SCR M2x5 DIN912	A
400621	CYL-SCR M2.5x12 DIN912	A
409103	DISC M2 DIN125A	A
511071	OMNI FIT 15M	A
173310	GREASE 100 GR TOPAS AK50	A

12.6.10 Autoload Part List

P/N	Description	SPC
173297	PINION MXL Z=32	C
173845	LOAD X – CONNECTOR	A
173849	CABLE X-MOVEMENTS	A
173874	DM ROTATOR DRIVE	A
173875	HS H/V POSITION	A
173877	HS LOAD DETECT	A
173878	OS TUBE DETECT	A
173879	SCANNER	B
182107	REPL. AUTO LOAD DRIVE	C
182119	REPL. GUIDE ROLLER	C
182120	REPL. RIBBON	C
182263	BLACK COVER RIGHT	C
182264	BLACK COVER LEFT	C
182266	COVER LEFT	C
182274	COVER RIGHT	C
250016	BALL BEARING ID=6 OD=13/15	C
258140	COG BELT MXL Z= 90X3/16"	A
281401	COVERING CAP	A
400262	SCREW M3X6	A
403452	SUNK SCREW M3X6 DIN7991	A
403453	SUNK SCREW M3X8	A
403499	SUNK SCREW M4x30	A
409200	DISC M3	A

12.6.11 Autoload's X Drive Part List

P/N	Description	SPC
173855	SM Auto Load X-Drive	C
173856	OS Auto Load X-Init	C
250016	BALL BEARING ID=6 OD=13/15	C
250045	BALL BEARING ID=15 OD=35	C
258053	COG BELT MXL Z= 83 X 3/16"	A
258134	COG BELT 10T2.5 3065	A
400640	CYL-SCR M4x10 DIN912 TUFLOK	A
400653	CYL-SCR M3X6 DIN912 A2 TUFLOK	A
405445	SET SCR M3x8 DIN916	A
413005	LOCK DISC 4 DIN6799	A
420580	CYL-SCR M4X50 DIN912 TUFLOK	C

12.6.12 Insertion Guide Part List

P/N	Description	SPC
173292	INSERTION GUIDE	C
173293	STOP HOOK	A
173299	SHEET METAL	C
173300	DISK	A
173729	INSERTION GUIDE - END	C
173747	SPRING STRIP	C
173843	LOAD DISPLAY BOARD	B
400617	CYL-SCR M2.5X5 DIN912	A
403452	SUNK SCREW M3X6 DIN7991	A

12.6.13 Loading tray Part List

P/N	Description	SPC
173600	SLIDE BLOCK	A
173602	SLIDE BLOCK WEDGE	A
173700	HOLDER W OVAL BORE	C
173701	HOLDER W ROUND BORE	C
182112	REPLACEMENT TABLE RIGHT	C
182113	REPLACEMENT TABLE LEFT	C
400026	CYL-SCR M4X12 DIN912	A
403453	C-SUNK SCR M3X8 DIN7991	A
403453	SUNK SCR M3X8 DIN7991	A
408006	HEX NUT M4 DIN934	A

12.6.14 Tip Waste Part List

P/N	Description	SPC
173736	TIP WASTE CONTAINER	C
173737	TIP WASTE LID	C
173738	TIP WASTE HANDLE	C
420561	TORX SCREW M5x12	A

12.6.15 Spillage Trays Part List

P/N	Description	SPC
173195	SPILLAGE TRAY LEFT	C
173196	SPILLAGE TRAY RIGHT	C
147683	FAME AIR FILTER	B
148248	FAME VELCRO	B

12.6.16 Instrument Parts

P/N	Description	SPC
281111	FOOT M10x50 W CAP	C
173508	STOP BAR	C
173509	FENDER BAR	C

12.6.17 Teaching Station

P/N	Description	SPC
182174	TEACHING STATION	C
182176	TEACHING NEEDLE	C

12.6.18 Teaching Box

P/N	Description	SPC
173861	TEACHING BOX	C

12.6.19 Boards Part List and accessories

P/N	Description	SPC
146242	FAME ELECTRONIC RACK FAN	C
173614	INTERFACE METAL PLATE	C
173835	POWER DISTRIBUTION BOARD	A
173881	MASTER BOARD PROG	A
173882	AUTO LOAD BOARD PROG.	A
182805	EXTENSIONS CONNECTOR	A
257062	SPACER PINS M4X40 I/O	C
369026	WASHER	C
369061	ISOLATING TAPE	C
395023	LINE FILTER	B
396155	POWER SUPPLY 41V 600W	B
400640	CYL-SCR M4x10 DIN912 TUFLOK	A
400301	CYL-SCR.M4X6 DIN912	A
400632	CYL-SCR.M3X8 DIN912	A
400656	CYL-SCR M4X8 DIN912 A2 TUFLOK	C
403606	C-SUNK SCR M3X8 DIN7991 A2 TUFLOK	A
411002	LOCK DISC M4	C

12.6.20 Cables Part list

P/N	Description	SPC
146355	CABLE W65	A
173817	CABLE X-ARM - PCHN BOARD	A
173849	CABLE X-MOVEMENTS	A
173850	CABLE FILTER-POWER SUPPLY	A
173851	CABLE POWER SUPPLY-40VDC	A
173852	CABLE POWER SUPPLY-GND	A
173853	CABLE POWER-MASTER	A
173854	CABLE POWER-AUTO LOAD	A
173858	CABLE SSC	A
173863	CABLE DM X-DRIVE PIPETTING ARM	A
173890	CABLE POWER SUPPLY-EARTH	A
173891	CABLE EC AUTO LOAD X-POSITION	A
173898	CABLE RS232	A
173905	CABLE X-ARM CONNECTOR 8C	A
173906	CABLE X-ARM CONNECTOR 16C	A
173911	CABLE FILTER-EARTH	A
182820	CABLE MASTER-EXTENSIONS	A
355130	CABLE USB TYPE A-B 3M	A

12.7 Index

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