

Operating Instructions



F-A770

Filter Weighing Solution

Table of contents

1	Introduction.....	5
2	Start-up	6
2.1	System components and connections.....	6
2.2	Start-up procedure.....	8
3	Configuring the balance control unit	9
3.1	Overview of the XPU balance	9
3.2	Overview of the terminal.....	10
4	Loading the magazine.....	11
4.1	Handling the filter holders	11
4.2	Loading and unloading the magazine.....	12
5	Performing a filter weighing – FilterControl makes it easy	15
5.1	Overview.....	15
5.2	Starting FilterControl, common functions	16
5.3	Password protection.....	17
5.4	Magazine places allocation	17
5.4.1	Magazine positions reserved for reference filters	18
5.4.2	Magazine positions reserved for standard weights	19
5.4.3	Overview of Magazine places allocation	19
5.5	Weighing process settings	20
5.5.1	Overview	20
5.5.2	Setting the process parameters	22
5.6	Report heading	25
5.7	System settings	25
5.7.1	Serial ports	26
5.7.2	Balance settings	26

5.7.3	System defaults	27
5.7.4	Comparator type	27
5.7.5	Barcode reader settings	27
5.8	Starting the weighing process	28
5.9	Monitoring the weighing process.....	28
5.9.1	Overview	28
5.9.2	Weighing process monitor	29
5.10	Using the barcode scanner.....	32
5.10.1	Loading the magazine	32
5.10.2	Unloading the magazine	35
5.10.3	Filter status	36
5.11	Message light tower	36
5.12	Measurement data and report	37
5.12.1	Measurement report	37
5.12.2	Calculations	40
5.13	Daily use of FilterControl	43
5.14	Export data via RS232.....	43
5.15	Remote-controlling FilterControl from a database	44
5.16	Additionally created output files.....	45
5.16.1	The 'central report file'	45
5.16.2	Files for internal use	46
6	Installation site and location change.....	47
6.1	Installation site	47
6.2	Location change	47
7	Maintenance	48
7.1	Weighing chamber, balance, robot hand and filter holders.....	48
7.2	Robot system axes.....	48
7.2.1	Maintenance actions and timetable	48
7.2.2	External inspection	49
7.2.3	Internal inspection	49
7.2.4	Lubrication	50

8	Appendix	52
8.1	Technical data	52
8.2	Dimension drawing	54
8.3	Electrical drawing	55
8.4	Barcode scanner setup	56
8.5	Technical note: FilterControl's interface with database	57
8.5.1	Naming	57
8.5.2	Communication basics	57
8.5.3	Synchronization overview	57
8.5.4	Communication Details	58
8.6	Accessories	62

1 Introduction

In purchasing this filter robot, you have chosen a talented, highly professional weighing machine. Combining METTLER TOLEDO's world-class weighing sensor technology with today's robotic performance.

METTLER TOLEDO F-A770 Filter Robot support the automotive industry in complying with the increasingly strict worldwide limits for Particulate Matter (PM), especially emitted by diesel and direct injection engines. F-A770 Filter Robot guarantees cutting-edge filter measurement performance for emission determination down to 0.1 µg in full compliance with today's and upcoming leading EU and US norms.

The automated weighing process and the filter control software solution simplify and accelerate your workflow as much as possible.

METTLER TOLEDO F-A770 Filter Robot: The turnkey solution for worldwide automotive industry.

To ensure that we can offer you personal service and provide you with the most efficient support, this product is accorded special treatment: not only the complete installation of the filter robot, but also the instruction are handled by a specialist from Mettler-Toledo AG, Greifensee (Switzerland) or by a specialist from your country who has been specially trained.

Besides, please pay careful attention to the following recommendations.



Read carefully through these operating instructions. In particular, the start-up and magazine loading procedures described respectively in Section 2 and 4 must be followed. Besides adjustment and repair work shall be carried out exclusively by the product specialists from Mettler-Toledo AG. You shall never, under no circumstances, undertake any adjustment or repair, unless duly instructed by the above mentioned specialists.



Ensure that the mass comparator is plugged into a grounded power socket. Use only the AC adapters supplied with the mass comparator and make certain that their voltage value matches the local line voltage.



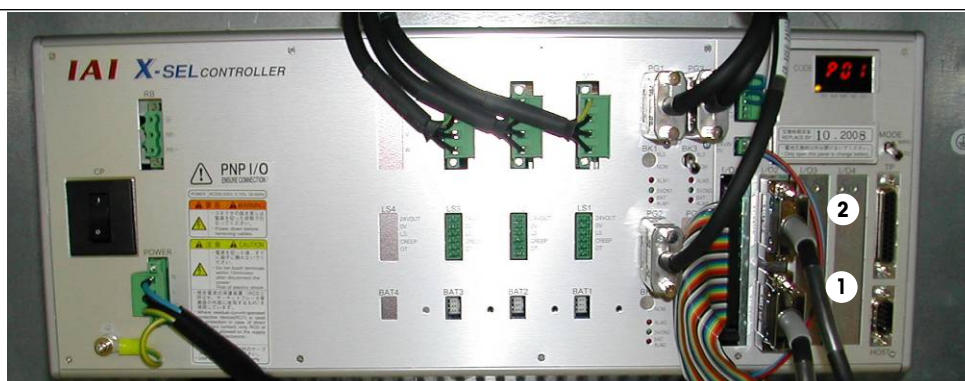
The mass comparator must be installed in a non-hazardous area.

2 Start-up

2.1 System components and connections



Figure 1 Main system components



- 1 Interface cable connecting the robot system control unit to the balance control unit
- 2 Interface cable connecting the robot system control unit to the controller

Figure 2 Serial connections to electrical control rack



Figure 3 Panel with „EMERGENCY“ push-button and „AUTO / HAND“ key-switch

The **F-A770** comprises (see Figure 1):

- The micro-balance with filter kit, XP2U (balance, control unit and AC adapter)
Warning: never use the balance installed with the **F-A770** for manual weighing!
- The 3-axes robot system with its associated control unit, located in the electrical rack
- The 8-row magazine, with 80 filter holders
- The controller with installed Microsoft® Windows® based **FilterControl** software
- The barcode scanner.

Before start-up the system must be fully cabled, i.e.:

- The interface cable connecting the robot system control unit (serial interface channel '1') to the balance control unit ('data I/O')
- The interface cable 2 connecting the controller (serial communication port) to the robot system control unit (serial interface channel '2')
- The interface cable connecting the controller (serial communication port) to the barcode scanner
- The balance cable connecting the balance control unit to the balance
- The balance power cable connecting the balance control unit to the power supply (via the balance AC adapter)
- The robot system power cable connecting the electrical rack to the power supply.

The robot system electrical rack and control unit - serial interface '1' and '2' - can be accessed by opening the electrical rack door (see Figure 2); to do so, simply insert the key into the door locks and turn the key clockwise. In order to access the power plug of the robot system, the left white panel needs to be unscrewed.

2.2 Start-up procedure

After checking that the system is complete and fully cabled, as described in Section 2.1, and both power plugs (balance and robot system) plugged in, the following start-up procedure shall be followed:

- **Prior to any start-up, check that the robot hand and the balance pan are free of any filter holder; ignoring this rule might cause the balance to be damaged**
- Turn the balance on by pressing the 'Set' key
- Switch the robot system on by turning its power switch ('Φ') from position '0' onto position '1' - it is strongly recommended to leave the system on, even while not being operated, in order to ensure optimum weighing conditions -; each axis of the robot system is driven to its respective "home" position (this initialization can take several seconds). The green light of the message light tower is on.
- The sliding door of the weighing chamber can be opened for loading the filter holders onto the magazine as described in Section 4
- If access e.g. to the balance is necessary, unscrew the screw in the left, top corner of the sliding door. During the time the sliding door is not secured thru the screw, the robot system has to be switched off. If access e.g. to the robot hand is necessary, turn the 'AUTO / HAND' key-switch (see Figure 3) from position 'AUTO' onto position 'HAND' so that the weighing chamber swing door can be opened without causing the robot system to be automatically switched off.

3 Configuring the balance control unit

For the optimization of your weighing results, the balance - METTLER TOLEDO XP2U Comparator - offers various setting options. These are found in the Operating Instructions XS Excellence and XP Excellence Plus Micro and Ultra-Micro Balances.

3.1 Overview of the XPU balance



Figure 4 Overview of the XPU balance

3.2 Overview of the terminal



- 1 Terminal
- 2 Display (Touch-sensitive "Touch Screen")
- 3 Operating keys
- 4 SmartSens sensors (terminal type "P" only)
- 5 Control unit
- 6 Type name
- 7 Drawer with weighing tweezers, cleaning brush, and cleaning tweezers

Figure 5 Overview of the terminal

4 Loading the magazine

4.1 Handling the filter holders

The **F-A770** is delivered with an 80-place magazine, equipped with 80 filter holders for filters with diameter 47mm and 40 filter holders for filters with diameter 70mm.

Each filter used during the weighing process needs to be placed into a filter holder (see Figure 6). To do so proceed as follows:

- Open an empty filter holder
- Put the filter with the tweezers into the filter holder. The max. allowed filter curl is visible in Figure 7
- Close the filter holder
- Place a barcode* on the cover of the filter holder (*barcode must individually determined by the user)



Figure 6 Open the filter holder and put the filter into the filter holder

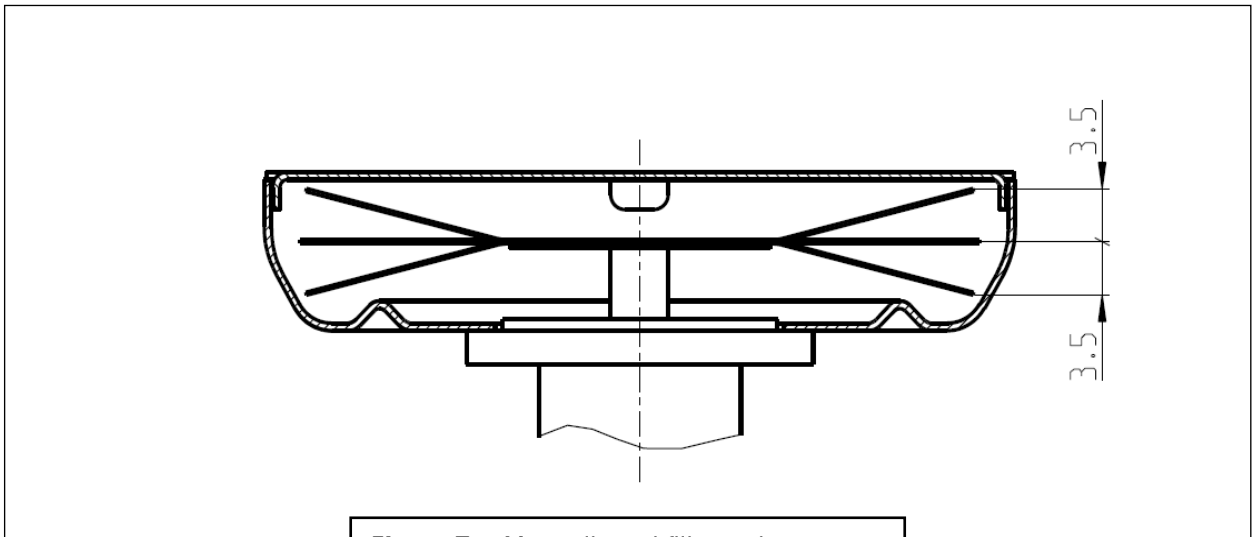


Figure 7: Max. allowed filter curl

4.2 Loading and unloading the magazine

The **FilterControl** software must be started (see Section 5.8).

Before starting to place the filter holders onto their respective magazine position, proceed as follows:

- Open the sliding door of the weighing chamber

Remark: During the time the sliding door is open, the yellow light goes on, but a weighing of a filter will go on, till the moment the robot hand will bring back the filter holder to the magazine. This action will be suspended till the sliding door is closed.

If the sliding door remain open after a loading / unloading action of the magazine, the weighing process will not continue. For this reason, it is crucial to close the sliding door properly after each loading / unloading action.

The magazine comprises (see Figure 8):

- 80 position for filter holders for filters with diameter 47mm. On every second position e.g. a1, a3, a5...b1, b3, b5...it is possible to place a filter holders for filters with diameter 70mm.

Position numbers are:

- a1 to a10,
- b1 to b10,
- c1 to c10,
- d1 to d10,
- e1 to e10,
- f1 to f10,
- g1 to g10,
- h1 to h10,

2 positions reserved for reference filters. Position numbers are: X and Y.

1 position reserved for the standard weight. Position number is: Z



Figure 8 Magazine

You may now start to put the filter holders loaded with filters onto their respective magazine position, as shown in Figure 9.

- Enter the individual filter parameters in **FilterControl**'s weighing process monitor (see section 5.9.2).
- Read the barcode on the cover of the filter holder with the barcode scanner (the barcode scanner confirms with a single "beep" to indicate a successful reading)
- Place the filter holder in a free position of the magazine
- Read the barcode in front of the respective magazine position

Once the magazine is loaded with all filters, close the sliding door of the weighing chamber



Figure 9 Loading the filter holders onto the magazine

After successful weighing, **unload** the filters as follows:

- Open the sliding door of the weighing chamber
- Read the barcode in front of the magazine position which has to be unloaded
- Take out the filter from the respective magazine place
- Read the barcode on the cover of the filter holder

Once all weighed filters are unloaded, close the sliding door of the weighing chamber

To **unload** the filters from the filter holder, proceed as follows (see Figure 10):

- Open the filter holder with the special tweezers
- Place the open filter holder over the filter lifter
- Take out the filter with the special tweezers
- (Remove the barcode from the cover of the filter holder if needed)



Figure 10 Open the filter holder and lift out the filter

5 Performing a filter weighing – FilterControl makes it easy

This section describes the **FilterControl** software and refers to its version 1.27.

5.1 Overview

Program **FilterControl** performs filter weighings in an easy way. Its main characteristics are:

- Filter identification with barcode scanner
- Process parameters include process control with reference filters, and periodic balance checking with standard weights.
- All process parameters can be saved to settings files. This simplifies the daily use: Load a settings file and start measurement (see section 5.13)!
- When loading test filters, individual test filter parameters (like filter acclimatization time, repetition interval, Operator, Notes) can be entered, or pre-defined defaults can be applied.
- Performing direct weighings, as well as ABA- or ABBA-substitution weighings
- Data are saved to reports in .doc and .xls format, and a 'central report file' stores information about all filters ever measured
- Optionally, data can be exported via serial port (RS232) to a host system
- The system can be remote-controlled from a database on a host system: All test filter parameters will be loaded from a database, and measurement results are stored in the database
- A host can import data from serial port, or access the 'central report file' to get filter weighing data, or remote-control the system via the database.

Figure 11 gives a schematic diagram of the system.

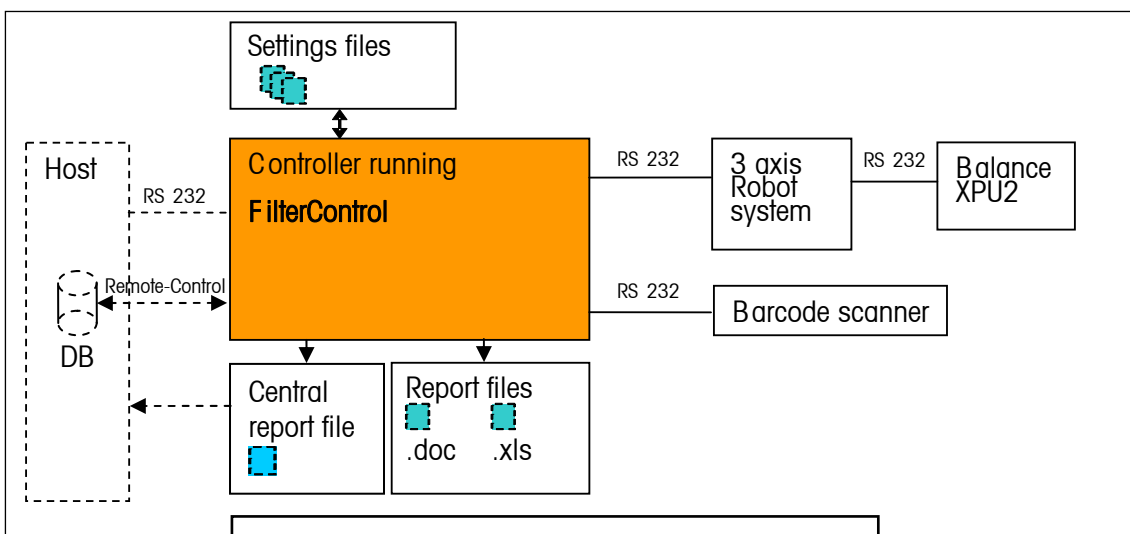


Figure 11 FilterControl – schematic diagram

5.2 Starting FilterControl, common functions

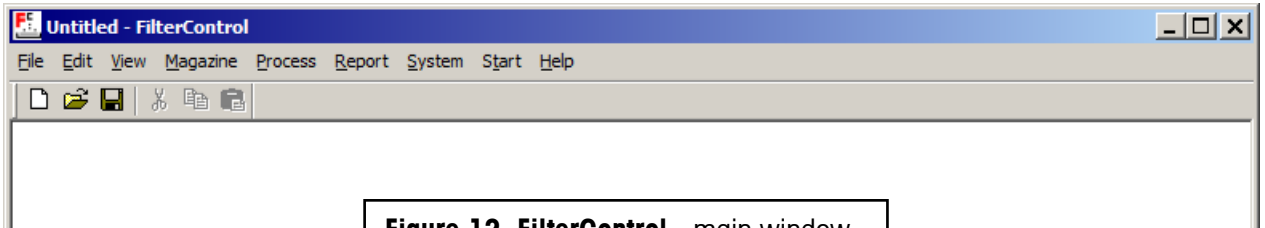


Figure 12 FilterControl - main window

A double mouse-click on the **FilterControl** icon ('FilterControl.EXE') starts the program and opens a new, blank settings file - named 'Untitled.fc' - whose main window is shown in Figure 12. **FilterControl** main menu comprises 9 items, i.e. 'File', 'Edit', 'View', 'Magazine', 'Process', 'Report', 'Adjustment', 'System', 'Start' and 'Help'. ('Edit', 'View' and 'Help' offer functions and options that are standard in common Windows® applications and therefore may not require further description.) 'File' lists the following commands (see Figure 13):

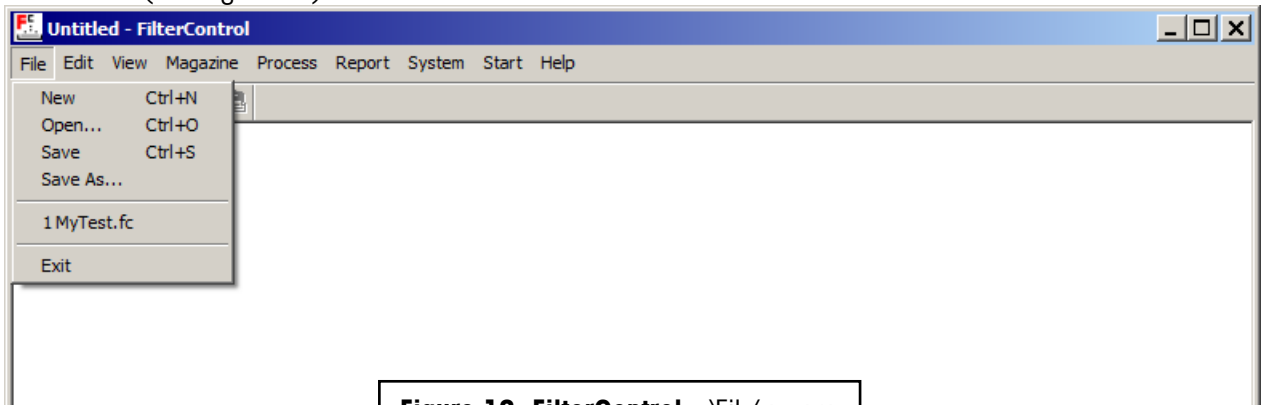


Figure 13 FilterControl - 'File' menu

- **'New'**: closes the current settings file - if changes were made to it, you are prompted to save them - and opens a new, blank file named 'Untitled.fc'
- **'Open...'**: prompts you to select an existing file and, once a particular file is selected, closes the current settings file - if changes were made to it, you are prompted to save them - and opens the file you just selected
- **'Save'**: saves the changes made to the current settings file under the current file name (extension: '.fc')
- **'Save As...'**: prompts you to enter a new file name and saves the current settings file under the name you just entered (extension: '.fc')
- **'Exit'**: prompts you to save the unsaved changes you made, should you have made any, and quits **FilterControl**.

5.3 Password protection

Some input parameters are protected with a password from unauthorized change. **FilterControl** prompts to enter the password (see Figure 14). The default password is '' (empty character string = no character). To change the password, press the 'Change...' command button, and enter, in the 'Change password' window, the current password, the new one and, again, the new one as confirmation. The password is limited to maximum 12 characters.

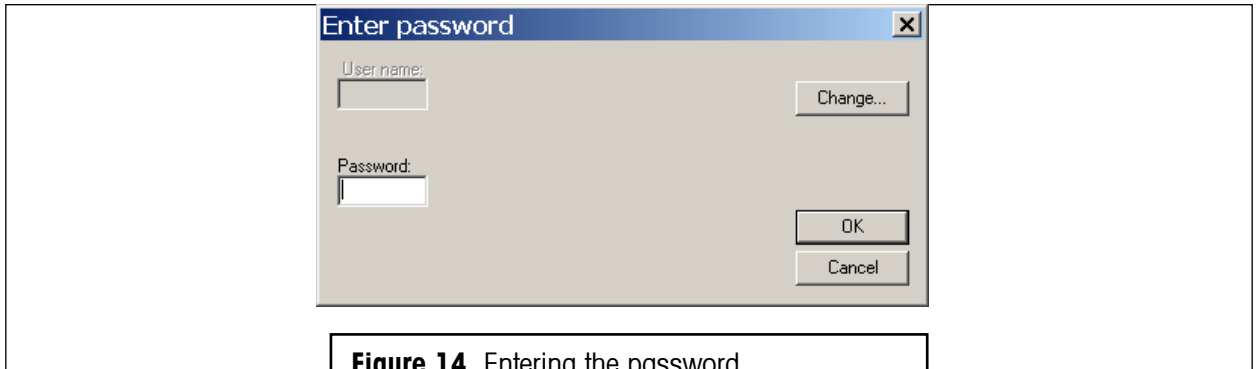


Figure 14 Entering the password

5.4 Magazine places allocation

FilterControl handles three different types of items (see section 5.5.2 for further details):

- **Test filters** are the filters to be measured.
- **Reference filters** are used to control the measurement process.
- **Standard weights** are used to check the measurement process, or as A-weights in substitution weighings.

Each magazine position can hold either a test filter, or a reference filter, or a standard weight.

If you select 'Places allocation' in the 'Magazine'-Menu (see Figure 15), the 'Magazine places allocation' window opens (see Figure 16).

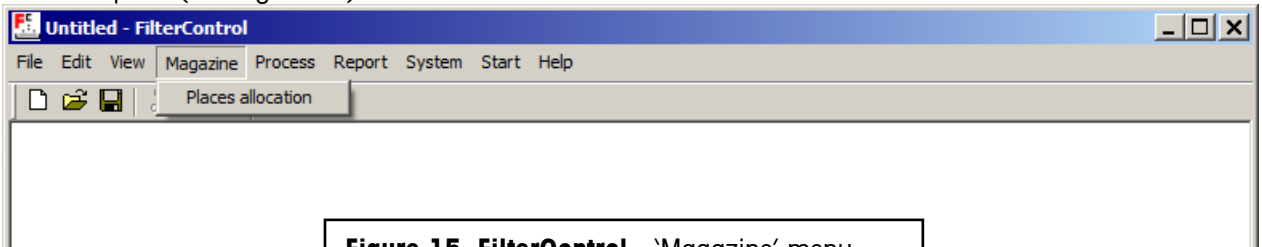


Figure 15 FilterControl - 'Magazine' menu

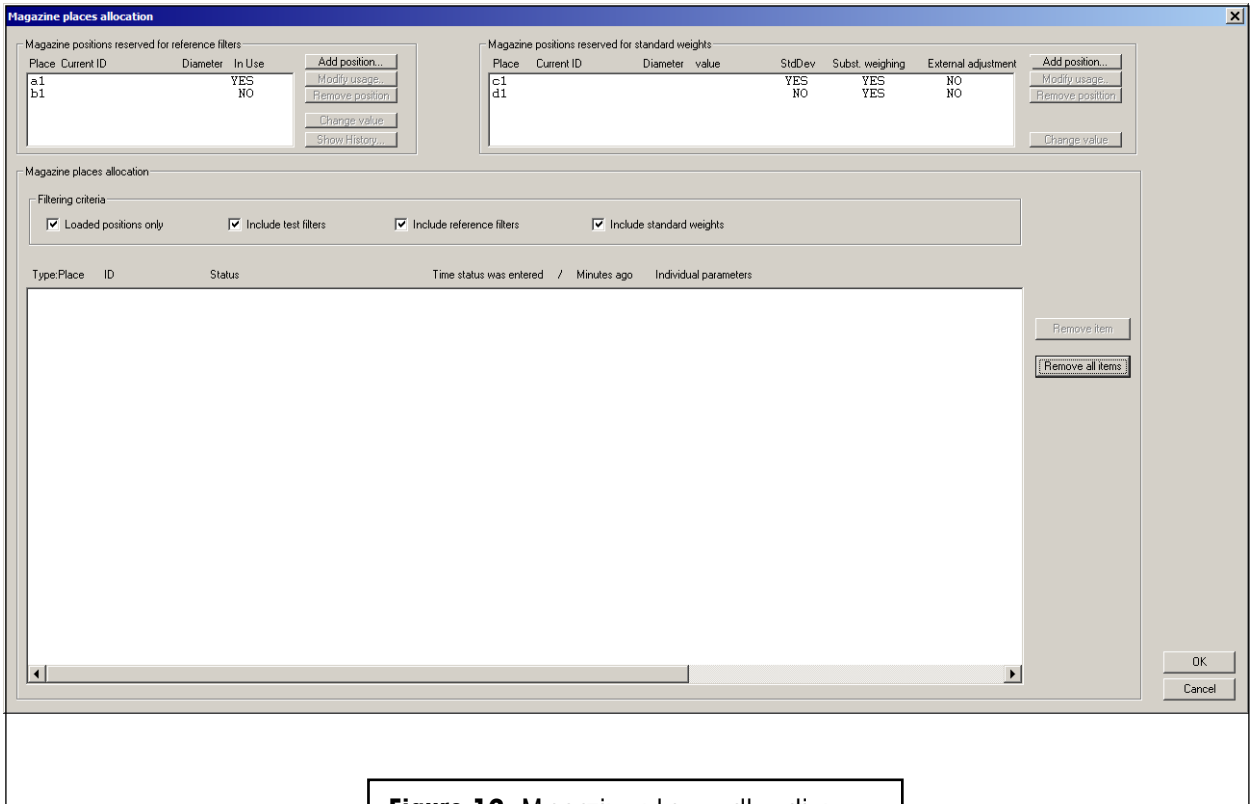


Figure 16 Magazine places allocation

5.4.1 Magazine positions reserved for reference filters

In the upper left section 'Magazine positions reserved for reference filters', you find a list of all the places reserved for reference filters. If an item is placed on such a magazine position, program **FilterControl** assumes that the item is a reference filter.

The following buttons are available:

- **'Add position'** shows all magazine positions currently not loaded with a filter and lets you select a new position for reference filters. The new position is added to the list.
- Select an entry in the list to enable the button **'Modify usage'**. It allows changing the usage of any filter placed on this positions. 'In use'=Yes means: If the current process settings parameters (see section 5.5.2) request a reference filter weighing, the filter placed on this magazine position is included in the measurement.
- Select an entry in the list to enable the button **'Remove position'**: It removes the position from the list. This frees the position to place a test filter on it.
- If you select an entry in the list which is currently loaded with a reference filter, you can use the button **'Change value'** to change the parameters 'Diameter', 'Operator' and 'Notes' which were entered when the reference was loaded onto the magazine position. The button **'Show history'** displays the weighing value of the reference filter's 'first use', 'last use' and 'before last use'. These values are used to calculate the reference drift value: The current drift value is calculated as 'last value' – 'before last value', see section 5.12.2.

5.4.2 Magazine positions reserved for standard weights

In the upper right section 'Magazine positions reserved for standard weights', you find a list of all the places reserved for standard weights. If currently a standard weight is loaded on a position, its 'ID', 'Diameter' and 'Value' are shown.

The 3 parameters 'StdDev', 'Subst. weighing' and 'External adjustment' define the usage of any standard weight placed on this magazine position:

If 'StdDev'=Yes, it can be used for standard deviation checks,

if 'Subst. weighing'=Yes, it can be used as standard weight for substitution weighings (for filters with the same diameter),

if 'External adjustment'=Yes, it can be used as standard weight for external adjustments.

The following buttons are available:

- '**Add position**' shows all magazine positions currently empty and lets you select a new position for reference filters. The new position is added to the list.
- Select an entry in the list to enable the button '**Modify usage**'. It allows changing the usage of any standard weight placed on this positions.
- Select an entry in the list to enable the button '**Remove position**': It removes the position from the list. This frees the position to place a test filter on it.
- If you select an entry in the list which is currently loaded with a standard weight, you can use the button '**Change value**' to change the parameters 'Diameter' 'Value', 'Operator' and 'Notes' which were entered when the reference was loaded onto the magazine.

5.4.3 Overview of Magazine places allocation

In the lower section 'Magazine places allocation', you find a list of all items currently loaded onto the magazine.

Each position has a prefix indicating the type of item to be placed on this position: '**R:**' indicates a position for reference filter, '**S:**' indicates a position for standard weights, '**T:**' indicates a position for test filters

Positions can be included or excluded from the list using filtering criteria.

See section 5.9.2 about details of the data shown in the list.

It might happen that you are forced to unload the magazine quickly, e.g. if the reference filters drift was much too large, indicating some kind of pollution of the weighing room, the currently placed test filters might be judged to have failed and must be removed. Or you have to remove a filter with status 'Acclimating', which cannot be removed with the barcode scanner.

Use the '**Remove item**' button to remove such a filter from the list. This forces **FilterControl** to free the magazine position. However, you must make sure to physically remove the filter from the magazine position, too.

Use 'Remove all items' to remove all items from the list. All magazine positions are ready to be reloaded again.

Press 'OK' to accept any changes (password required), 'Cancel' to ignore them.

5.5 Weighing process settings

5.5.1 Overview

FilterControl performs the weighing of test filters. However, various features are implemented to control the weighing process:

- The weighing parameters 'Stabilisation time' and 'Integration time' can be specified.
- The process can be controlled with **reference filters**: The reference filters can be measured periodically, and the maximum drift (difference to previous measurement) and the maximum standard deviation can be specified.
- **standard weights** can be used as checkweights for periodical balance performance checks: A maximum standard deviation can be specified, and/or as adjustment external weights to adjust the balance.
- If any check fails, the measurement can be forced to stop (abort), or a warning can be generated.

All the relevant information is entered in the 'Process settings' window which opens after selecting 'Settings...' in the 'Process' menu (see Figure 17).

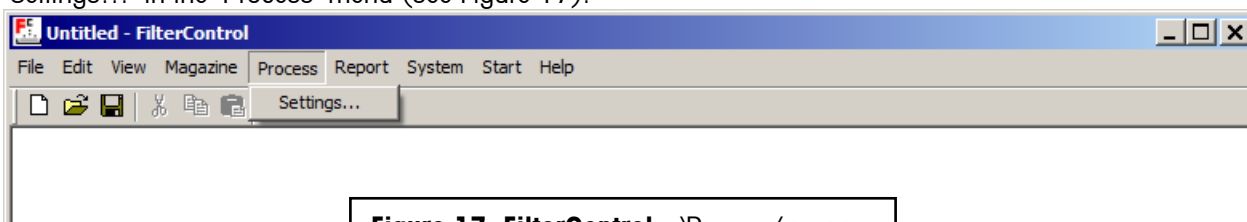


Figure 17 FilterControl - 'Process' menu

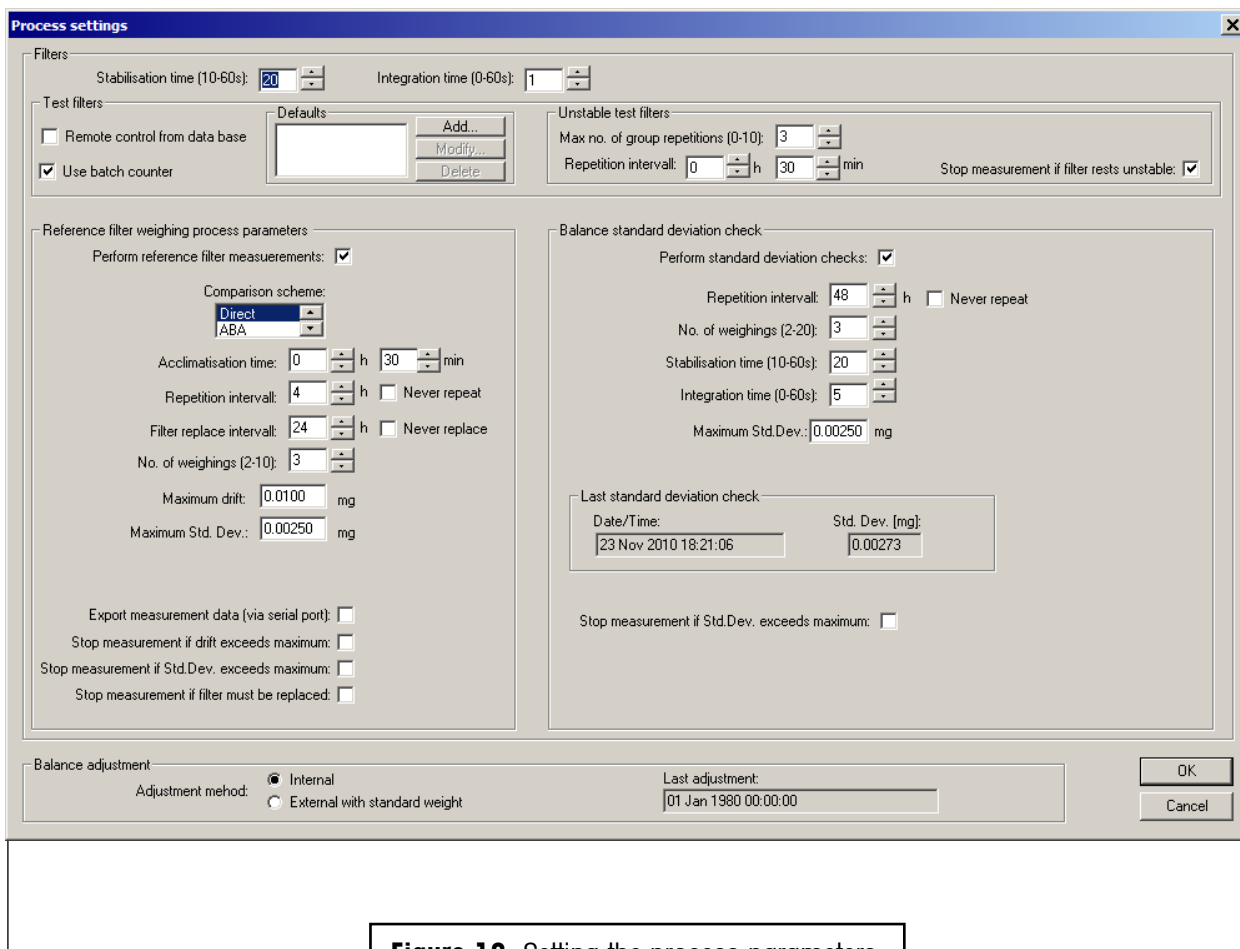


Figure 18 Setting the process parameters

It might be useful at this point to clarify the terminology used to identify the main phases of any weighing process:

- **'Zero-Value'**: The value measured with an empty balance pan, immediately before the pan is loaded.
- **'Value'**: The value measured with a loaded balance pan.
- **'Comparison scheme'**: **FilterControl** performs 'direct weighings', or 'substitution weighings' (ABA or ABBA):
 - 'Direct weighing'**: A direct weighing comprising of the measurement of the Zero-Value and the Value, and the calculation of the difference 'Diff.' = 'Value'-'Zero-Value'.
 - 'Substitution weighing'**: A standard weight A and a test weight B are weighed in a sequence, and the weighing difference is calculated using a formula to eliminate linear drifts. See section 5.12.2 about details on the weighing sequence and calculations for ABA and ABBA substitution weighings.
 - 'Single weighing'**: One direct weighing or one substitution weighing. One single weighing generates one 'Diff' value for weighing difference calculation.
- **'Group'**: sequence of n identical and successive single weighings, whose results are statistically exploited.

5.5.2 Setting the process parameters

After opening the 'Weighing process settings' window (see Figure 18), you may set all parameters. The parameters are split into groups:

Parameter group **'Filters'**: Parameters used for test filters and reference filters

- **'Stabilisation time (10-60 s)'**: time, in seconds, between loading or unloading the balance pan and start of the reading period whose duration is determined under 'Integration time'. (default setting: 20 s)
- **'Integration time (0-60 s)'**: time, in seconds, which runs after the stabilisation time has elapsed and during which the system records one measurement value every second; the average of the recorded values is given as result in the measurement report (default setting: 1 s)

Parameter group **'Test filters'**: Parameters used for test filters only.

- **'Remote control from database'**: Select this checkbox to fully remote control the measurement process from a database. See section 5.15 about remote controlling.
- **'Use batch counter'**: Select this checkbox to enable batch counting of test filters. See selection 5.9.1 for further details.
- **'Defaults'**: Individual test filter parameters will be entered when the test filters will be loaded (see section 5.10.1). These test filter parameters can be pre-defined and saved as defaults. Use the 'Add', 'Modify' and 'Delete' button to add, modify and delete these parameter defaults.

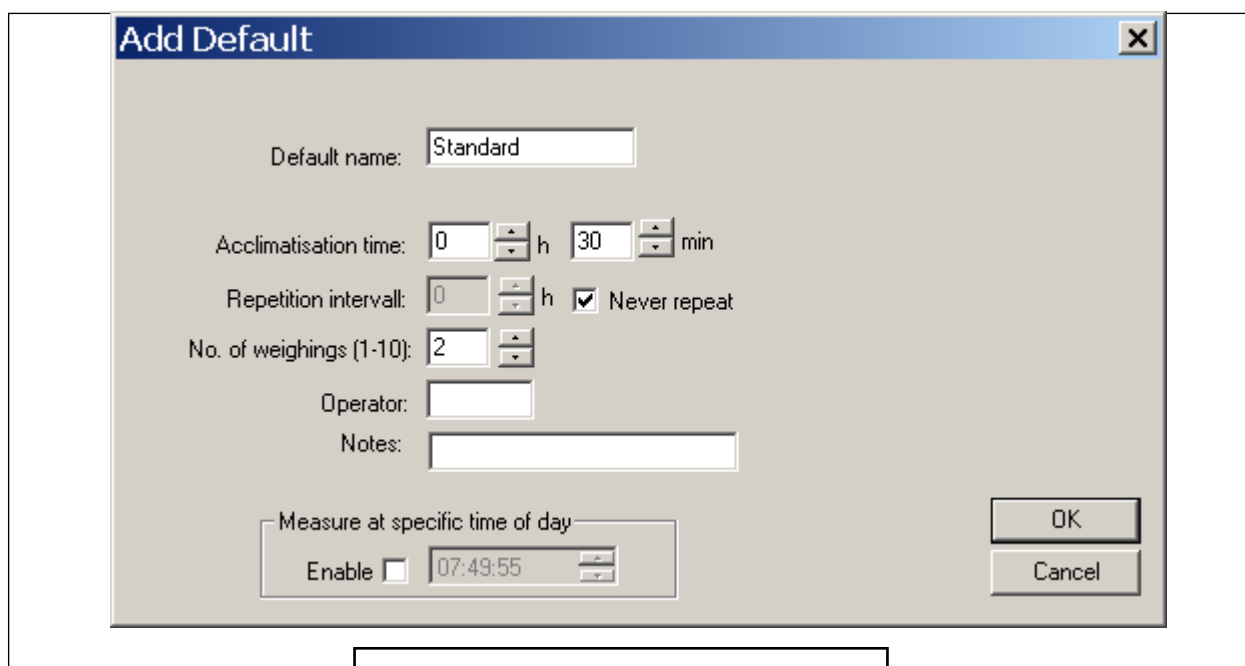


Figure 19 Adding a test filter default

- **'Unstable test filters'**: If a single test filter weighing result in a weighing group is unstable, it will always be repeated, maximum 5 times. If it is still unstable, the test filter group is unstable. However,

the program can try to re-measure the filter after a **'Repetition interval'** has expired (the filter status will be set to *WaitingForRept_U* see section 5.10.3). The maximum number of repetitions can be specified (**'Max. no of group repetitions'**). If **'Stop if filter rests unstable'** is selected, the program will stop (abort) if a test filter rests unstable. If it is not selected, the program will not stop, the filter status is set to *ReadyForUnloading_U* and can be unloaded.

Parameter group **'Reference filters'**: Parameters used for reference filters only.

- **'Perform reference filter measurements'**: Select this checkbox if you want to perform measurements with special reference filters. The measurements will include all reference filters on magazine positions reserved for reference filters which have 'In use'=Yes. See section 5.4.1 for further details.
- **'Comparison scheme'**: Select the comparison scheme used for reference filter measurements.
- **'Acclimatisation time'**: The time the filters are acclimated after loading the filter holders onto the magazine. The filter weighing will start after this time has elapsed. The minimum is 1 Minute (default setting: 30 minutes).
- **'Repetition interval'**: If the reference filter(s) should be measured periodically, you can enter the repetition interval here. Select 'Never repeat', if the reference filter(s) should be measured only once after being loaded, but not repeatedly.
- **'Filter replace interval'**: If the reference filters must be replaced periodically, you can enter the replace interval here. If this interval has expired, either a warning is displayed or the measurement will stop, depending on your selection of 'Stop measurement if filter must be replaced' (see below). Select 'Never repeat', if the program does not have to prompt for reference filter replacement.
- **'No. of weighings (2-20)'**: Number of single weighings in each group. To be able to calculate average and standard deviation, a minimum of 2 weighings is required (default setting is 2).
- **'Maximum drift'**: If the reference filter is measured repeatedly, the drift can be calculated: The difference of 2 successive measurements (see section 5.12.2). The 'Maximum drift' specifies the maximum value of this drift. If the drift exceeds the maximum drift, either a warning is displayed or the program will stop (abort), depending on your selection of 'Stop measurement if drift exceeds maximum' (see below) (default setting is 0.01mg).
- **'Maximum Std.Dev.'**: The reference filter is measured at least twice (the minimum value of 'No. of weighings' entry), and therefore a standard deviation can be calculated (see section 5.12.2). The 'Maximum Std.Dev.' specifies the maximum value of this standard deviation. If the calculated value exceeds the 'Maximum Std.Dev.', either a warning is displayed or the measurement will stop (abort), depending on your selection of 'Stop measurement if standard deviation exceeds maximum' (see below) (default setting is 0.0025mg).
- **'Export measurement data (via serial port)'**: Filter weighing data can be exported via serial port to a host system (see section 5.14). However, you can select here if reference filter data should be sent to the host as well.
- **'Stop measurement if drift exceeds maximum'**: Defines how the program reacts if the reference filter drift exceeds the entered maximum value: Select this checkbox and the program will stop the measurement (abort), deselect it and the program will send a warning, but continue the measurement process.
- **'Stop measurement if standard deviation exceeds maximum'**: Defines how the program reacts if the reference filter standard deviation exceeds the entered maximum value: Select this checkbox and the

program will stop the measurement (abort), deselect it and the program will send a warning, but continue the measurement process.

- **'Stop measurement if filter must be replaced'**: Defines how the program reacts if the reference filter replace interval has expired: Select this checkbox and the program will stop the measurement (abort), deselect it and the program will send a warning, but continue the measurement process.

Parameter group **'Balance standard deviation check'**.

Standard weights can be used to check the balance standard deviation.

- **'Perform standard deviation checks'**: Select this checkbox if you want to perform periodical standard deviation checks with standard weights. The measurements will include all standard weights on magazine positions reserved for standard weights which have 'Std.Dev.'=Yes. See section 5.4.2 for further details.
- **'Repetition interval'**: if the check should be repeated periodically, you can enter the repetition interval here. Select 'Never repeat', if the standard deviation should be checked only once after the standard weight is loaded, but not repeatedly.
- **'No. of weighings (2-20)'**: number of single weighings in each group. To be able to calculate average and standard deviation, a minimum of 2 weighings is required. (default setting is 3).
- **'Stabilisation time (10-60 s)'**: time, in seconds, between loading or unloading the balance pan and start of the reading period whose duration is determined under 'Integration time'. (default setting: 20 s)
- **'Integration time (0-60 s)'**: time, in seconds, which runs after the stabilisation time has elapsed and during which the system records one measurement value every second; the average of the recorded values is given as result in the measurement report (default setting: 5 s)
- **'Maximum Std.Dev.'**: The standard weight is measured at least twice (the minimum value of 'No. of weighings' entry), and therefore a standard deviation can be calculated (see section 5.12.2). The 'Maximum Std.Dev.' specifies the maximum value of this standard deviation. If the calculated value exceeds the 'Maximum Std.Dev.', either a warning is displayed or the measurement will stop, depending on your selection of 'Stop measurement if standard deviation exceeds maximum' (see below) (default setting is 0.0025mg)
- **'Stop measurement if standard deviation exceeds maximum'**: Defines how the program reacts if the standard weight standard deviation exceeds the entered maximum value: Select this checkbox and the program will stop the measurement, deselect it and the program will send a warning, but continue the measurement process.

Parameter group **'Balance adjustment'**:

- The balance can be adjusted either with its built-in adjustment weight (adjustment method 'Internal'), or a standard weight can be used to adjust the balance (adjustment method 'External with standard weight'). The balance has built-in sensors which detect automatically if an adjustment is needed. The adjustment will be done fully automatically whenever it is needed. The program indicates the time the last adjustment did take place.

After all selections were made, press 'OK' to accept the entries (password protected, see section 5.3), or 'Cancel' to ignore the changes.

5.6 Report heading

Before starting the weighing process, the heading contents of the report file can be defined. To do so, select 'Heading...' in the 'Report' menu (see Figure 20).

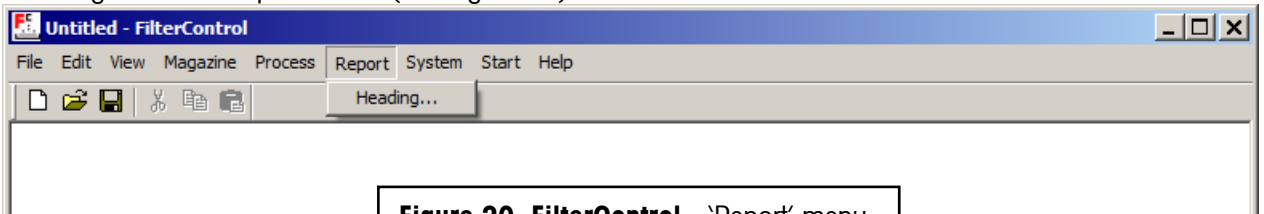


Figure 20 FilterControl - 'Report' menu

The window 'Report heading' displayed in Figure 21 appears and allows you to enter a 'User name' and some 'Notes' (brief description of the process) which will help ensure an easy traceability of your measurement reports.

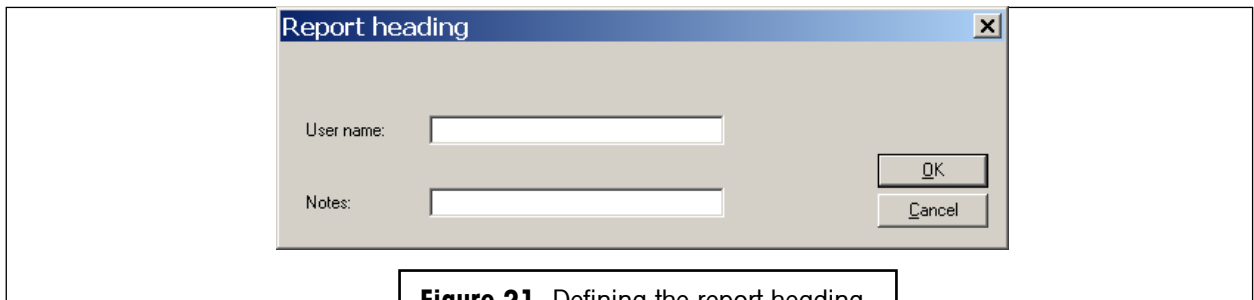


Figure 21 Defining the report heading

5.7 System settings

Before starting the weighing process, several system settings (see Figure 22) needs to be done. All entries are password protected, see section 5.3.

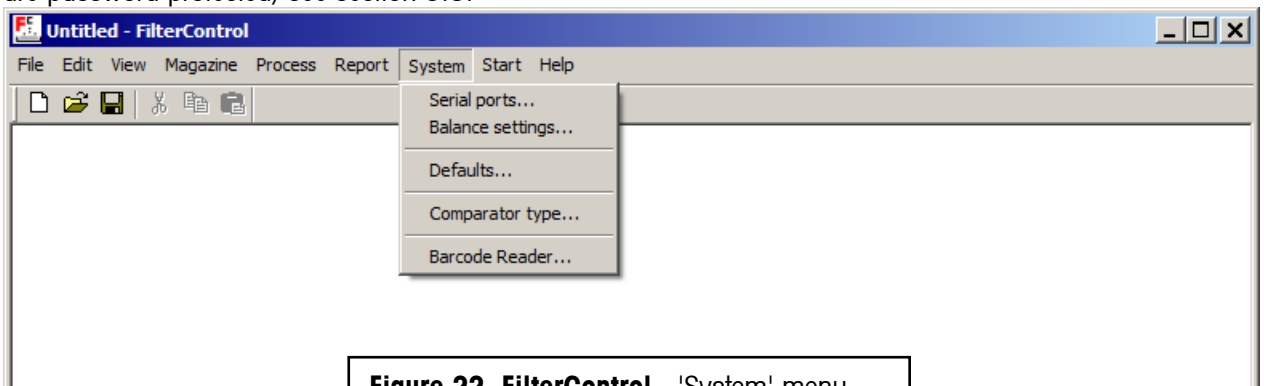


Figure 22 FilterControl - 'System' menu

5.7.1 Serial ports

Select 'Serial ports...' in the 'System' menu (see Figure 22). The window 'Serial ports' displayed in Figure 23 appears and allows you to select the serial ports for robot system, barcode scanner, and export. However, the export can be enabled (checkbox marked) or disabled (checkbox deselected). If export is disabled, no filter weighing data will be exported via serial port, thus no serial port for export is needed.

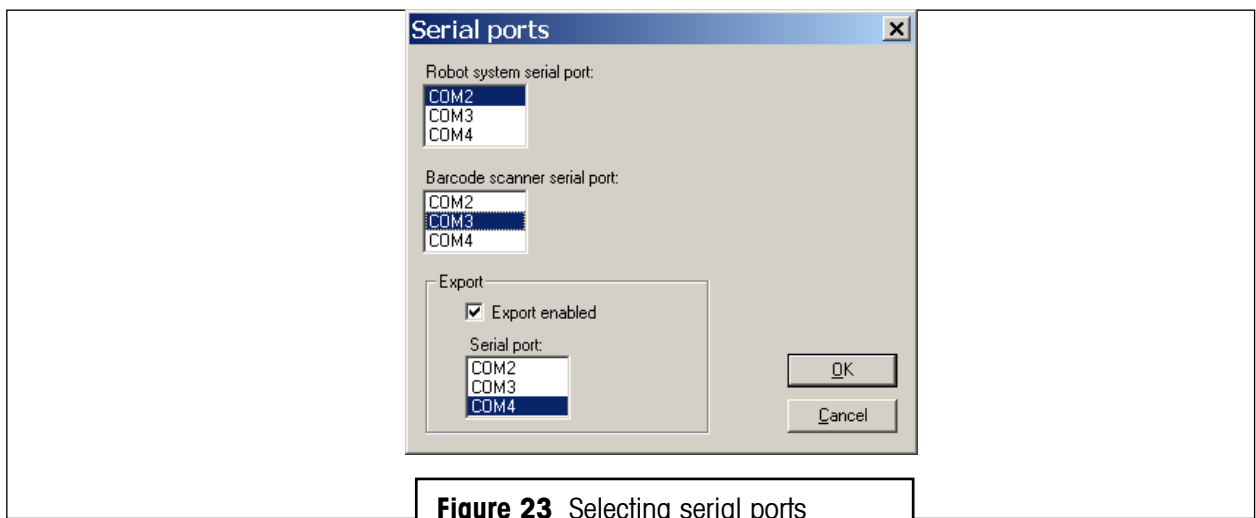


Figure 23 Selecting serial ports

5.7.2 Balance settings

Select 'Balance settings...' in the 'System' menu (see Figure 22). The window 'Balance settings' displayed in Figure 24 appears and allows you set the balance 'value release': (see operating instructions of XPU balance for further details). Default setting is 'fast'.

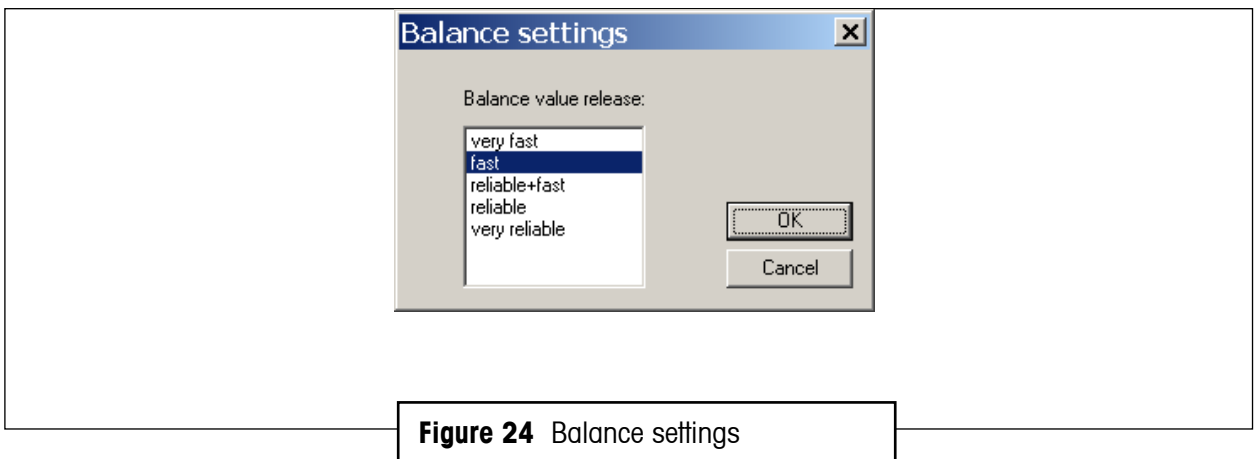


Figure 24 Balance settings

5.7.3 System defaults

Enter the default path for report files. If you have to change the entry, use the browse button to browse to a special directory.

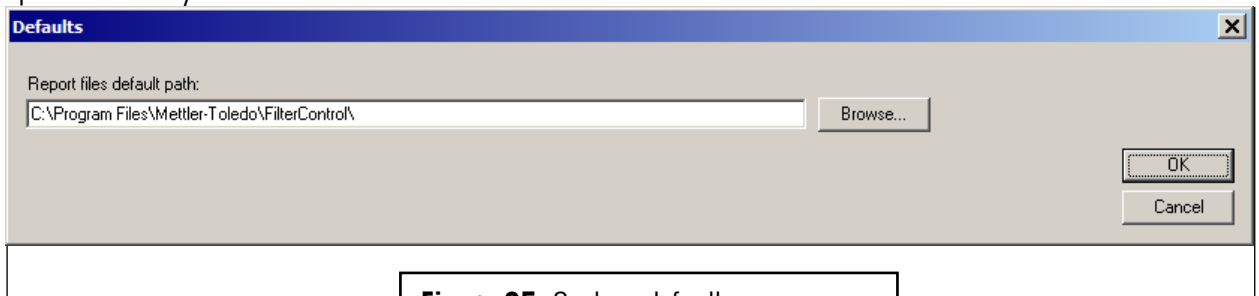


Figure 25 System defaults

5.7.4 Comparator type

Select 'Comparator type...' in the 'System' menu (see Figure 22). The window 'Comparator type' displayed in Figure 26 appears and lets you select the comparator type.

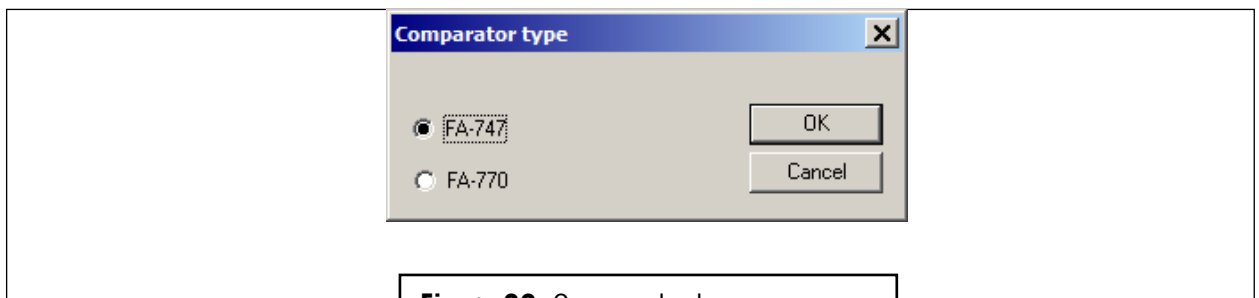


Figure 26 Comparator type

5.7.5 Barcode reader settings

Select 'Barcode reader...' in the 'System' menu (see Figure 22). The window 'Barcode reader settings' displayed in Figure 27 appears and lets you select the barcode reader settings.

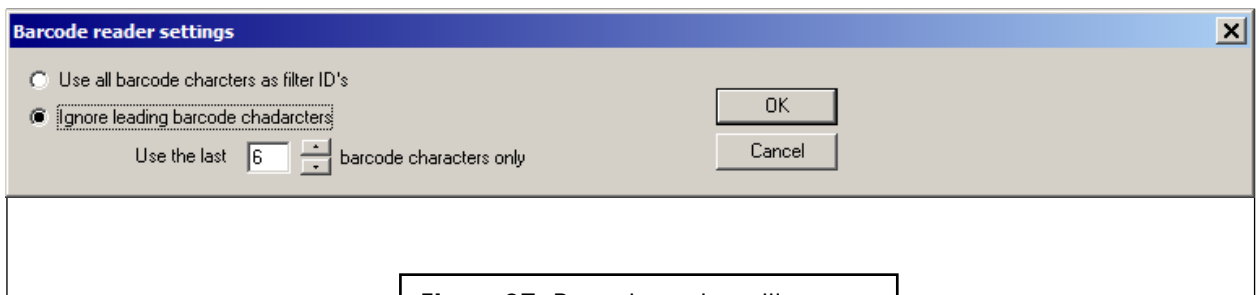


Figure 27 Barcode reader settings

If the barcode contains many characters, it might be useful to ignore some leading barcode characters.

Example:

With the settings shown in Figure 27, the barcode 'ABCDEF1234' will be translated to the FilterID 'EF1234'.

5.8 Starting the weighing process

The start command is given by selecting 'Start measurement' in the 'Start' menu (see Figure 28). Once the process is started, you are prompted to enter the name and location of the measurement report file (see Figure 29); confirm your entry by pressing the 'Save' button (pressing 'Cancel' would abort the process).

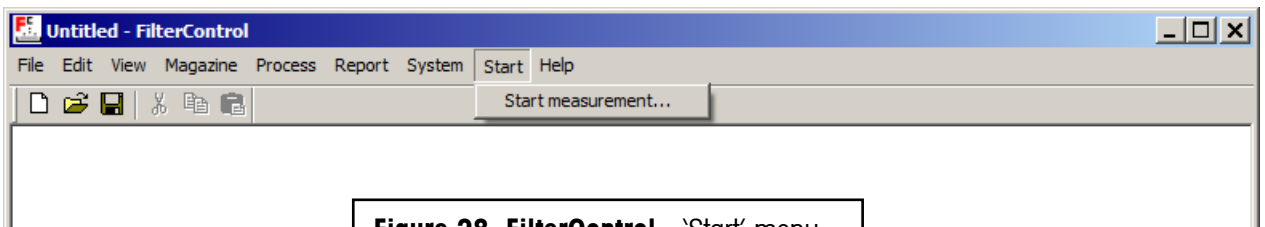


Figure 28 FilterControl - 'Start' menu

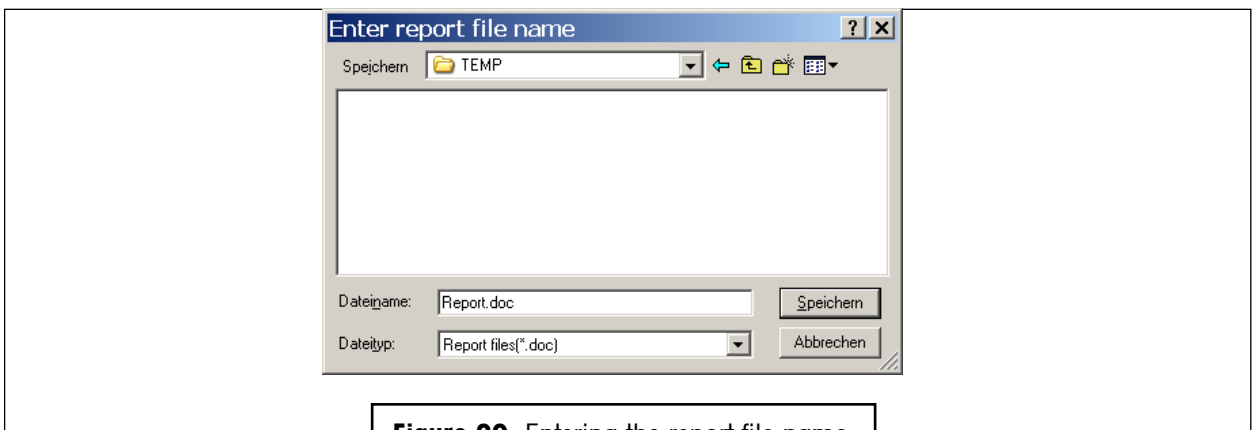


Figure 29 Entering the report file name

5.9 Monitoring the weighing process

5.9.1 Overview

Once the "go" command is given, **FilterControl** displays the 'weighing process monitor' (see Figure 30) which performs the following tasks:

- **User support** for loading and unloading the magazine with filter holders, using a **barcode scanner**.

- **Filter weighing** according to process parameters, and **reporting** of measurement results.
- **Process control** (periodical weighing of reference filter(s) and standard weight, and periodical balance adjustment) according to process parameters.
- **User information:** Lists of filters currently placed in the magazine (and their respective status), barcode commands, measurement data, warnings.

5.9.2 Weighing process monitor

The 'Weighing process monitor' (see Figure 30) is split into different parts, and these parts will be described in detail below. There are several 'View...' buttons placed right of list-boxes, and they can be used to display the current content of the respective list-boxes in a separate window.

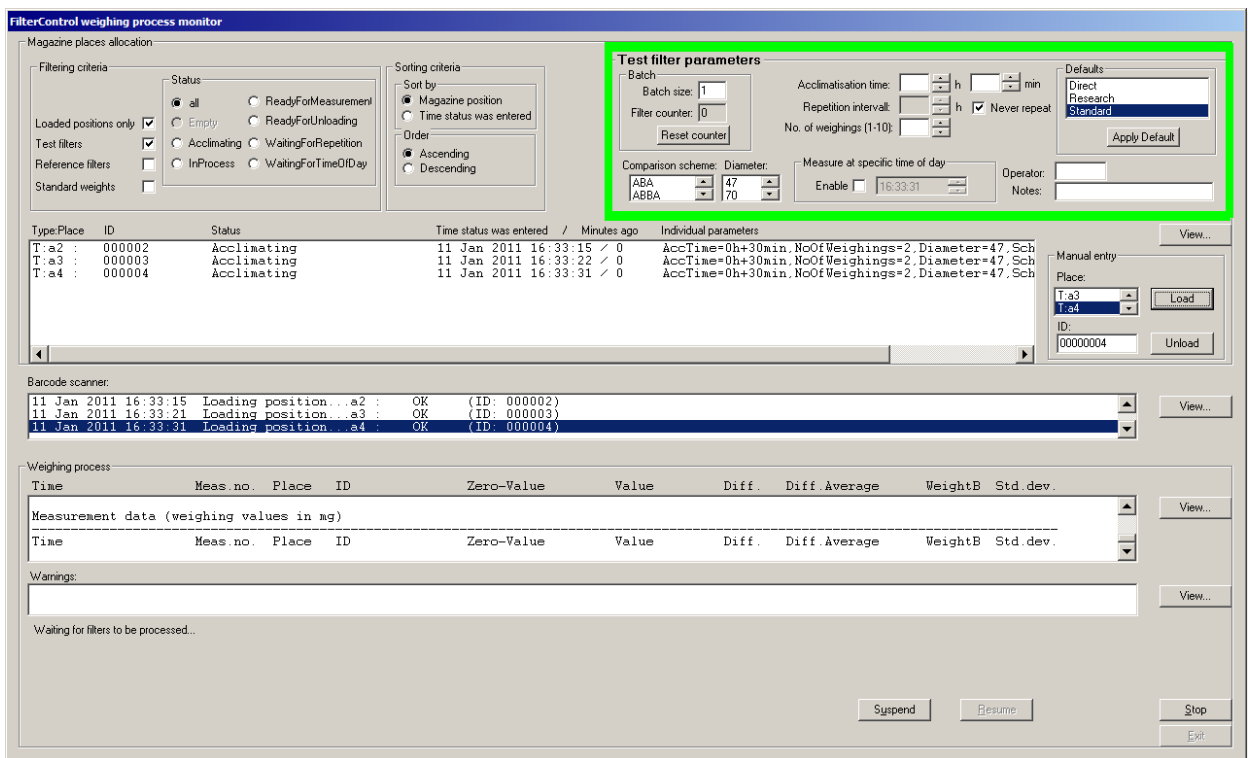


Figure 30 Weighing process monitor

The 'Magazine places allocation' part gives information about the current filters placed in the magazine: The list-box gives the magazine place, the filter ID (barcode), the current status (more about filter status see section 5.10.3), the time the current status was entered and the minutes since the status was entered. You can decide which filters are listed, and you can sort and order the list:

- The 'Filter criteria' specifies which filters are listed in the list-box, by use of a 'Filter criteria': If 'Loaded positions only' is marked, only magazine places having a filter placed on it are listed; If 'Test filters only' is marked, only test filters, but no reference filters nor the standard weight are listed. The 'Status' selection allows to display only filter with a specific filter status (more about filter status see section 5.10.3).

- The 'Test filter parameters' are used to enter the individual test filter parameters when loading filters to the magazine. See section 5.10.1 about loading the magazine.
- The 'Sort criteria' area is used to sort the list either by 'Magazine position' or 'Time status was entered', and to order the list either in ascending or descending order.
- The 'manual entry' area gives the chance to load or unload a magazine position manually, without the use of the barcode scanner: Simply select the magazine position ('Place') and enter the ID, then press the button 'Load' to load the Filter, or 'Unload' to unload it.

Note:

If you double-click on an entry in the listbox of the magazine places allocation area, the corresponding filter place and ID will be copied into the 'Manual entry' area. This gives you the chance to easily unload these filters manually.

- The 'barcode scanner' gives a description of barcode scanner commands. See ... for further details.
- The 'Weighing process' part gives information about the measurement data, a list of warnings, and in the 'status field' (area at the bottom left) useful information on the current action, as well as valuable advice with respect to troubleshooting, should an error be detected.

WARNING Should an error be detected, do pay careful attention to the information given in the process status field and proceed accordingly.

Besides, the following command buttons are available:

- **'Suspend'** and **'Resume'**: the 'Suspend' command interrupts temporarily the weighing process and allows access to the weighing chamber from the right-hand door, provided the 'AUTO / HAND' key-switch has been turned onto 'HAND' position; if the 'Resume' command is given, **FilterControl** pursues the process, provided the 'AUTO / HAND' key-switch has been turned back onto position 'AUTO'

Note: However, even with a suspended weighing process, the filters can still be loaded/unloaded. While the weighing process is suspended, the yellow light of the message light tower (see Figure 1) goes on.

- **'Stop'**: the 'Stop' command aborts the weighing process; you are prompted to choose between aborting the process immediately, and aborting the process after the robot system has brought the filter holder, which is being determined, back to the magazine - N.B.: the process can be abruptly aborted at any time, should the need arise, by pressing the emergency stop push-button (see Figure 3). Should the process be aborted, the measurement results gathered up to this point are nevertheless documented in the report file.
- **'Exit'**: closes the weighing process monitor and returns to the main window.

The program starts with a measurement initialization:

- ID and 'loading time' of all filters currently placed in the magazine are read from a file (where they were saved when the measurement was stopped). The new filter status is calculated for each filter(see section 5.10.3 about filter status).

- The serial communication is established
- The robot hand is free of any filter (holder)
- The balance deadload - weight (force) generated by the electromagnetic balance sensor, when the balance pan is free of any weight - has kept stable within an acceptable range since the last process start
- Some parameters of the barcode scanner's configuration are set, which is indicated by a barcode scanner **'multi-beep'** (see section 5.10)

WARNING If the barcode scanner does not send a 'multi-beep', it might be configured badly. See Appendix 8.4 about barcode scanner setup.

After successful initialization, the program's error handler is initialized: A program failure will now be marked with the red light of the message light tower being switched on, see section 5.11.

The program checks if the process configuration includes the usage of reference filter(s) or the standard weight(s). If one of these items is included, it checks if it is currently placed in the magazine. If it is missing, a warning message is generated ('Startup condition failed'), and the user is prompted to load the item(s). Use the barcode scanner to load the appropriate items (see section 5.10.1 about loading an item onto the magazine). **FilterControl** will automatically continue the measurement process if all missing items are loaded.

The measurement process is an (infinite) loop of the following actions, depending on the process settings:

- A balance adjustment is performed if the balance requests an adjustment,
- Any reference weight will be measured if it is in use and
 - a) it was placed recently and its filter acclimatization time has expired, or
 - b) it is measured repeatedly and the reference filter repetition interval has expired.
- A balance standard deviation check is performed if the process settings request a standard deviation check, and
 - a) No standard deviation check has been performed yet, and any standard weight which is used for standard deviation checks has been placed at least 1 hour ago (1 hour is the fix acclimatization time for standard weights), or
 - b) Standard deviation checks have already been performed, the standard deviation check repetition interval has expired, and any standard weight which is used for standard deviation checks has been placed longer than 1 hour ago.
- If any test filter has the status 'ReadyForMeasurement' (indicating that the acclimatisation time has expired, see section 5.10.3), it will be measured.

The program loops to check if there is any action to be performed. If no action can be performed, the status field indicates 'Status: Waiting for filters to be replaced'.

5.10 Using the barcode scanner

The barcode scanner is used to load the filters into the magazine, and to unload them again when there are measured. The manual operation of loading an unloading the magazine is described in section 4.2. The barcode scanner can be configured, e.g. its volume (loudness) can be set. See appendix 8.4 for further details.

The barcode scanner is also used to inform the user if he is going to perform an **'illegal action'**. Illegal actions are:

- The user attempts to load a magazine position which is already loaded (it might be currently looking empty, if it is the magazine place of the filter currently measured!)
- The user attempts to unload a filter which is not ready to be unloaded, because it was not measured yet.
- The user loads a filter, but a filter with the same ID is already loaded in the magazine
- The user unloads a filter from a magazine place, but the filter ID indicates that this filter was placed on a different magazine place (the user might have unloaded the wrong magazine place)
- The user loads a test filter, and a filter parameter is missing.
- The user has loaded a reference filter or a standard weight, and the input box to enter additional parameters is still shown on screen.

Note

If you fail to unload a test filter with the barcode scanner due to a wrong filter status, you can try to force to unload it using the 'Unload' button in the 'Manual entry' area. However, reference filters and standard weights cannot be unloaded with this method. Stop the measurement process and select 'Magazine/Places allocation' (see section 5.4) to force the program to remove these filters.

FilterControl implements the following barcode scanner interface:

- If any barcode is scanned, the scanner sends a single beep, and a green light replaces the red laserbeam.
- If the barcode indicates an 'illegal action' (see above), the scanner will send a **'multi-beep'**, (a fast sequence of 4 single-beeps), ca. 0.3 sec after the single beep.

If a multi-beep is sent, the user can check the 'Barcode scanner'-listbox of the 'Weighing process monitor' to get more information about the 'illegal action', see figure 30.

5.10.1 Loading the magazine

Condition: Measurement started, program shows 'Weighing process monitor', see section 5.9.

5.10.1.1 Entering individual filter parameters

If you load an item onto a certain magazine position, **FilterControl** detects the items type automatically: The type of each magazine position was defined in the section 'Magazine places allocation', see section 5.4.

When loading reference filters or standard weights to the magazine, most of the filter parameters are defined in the weighing process settings (see section 5.5.2): The number of weighings, the repetition interval etc. If you load reference filters or standard weights, special popup boxes will appear and let you enter the individual parameters.

Individual parameters for reference filters:

- **'Diameter'**: Choose the filters diameter.
- **'Operator'**: This text entry is used to identify the operator.
- **'Notes'**: Enter any description text here.

Individual parameter for standard weights:

- **'Diameter'**: Due to mechanical limitations, even the standard weights for substitution weighings of 70mm reference and test filters could be placed in 47mm filter holders. However, standard weights and reference or test filters must have equal diameter settings to be comparable in substitution weighings. Therefore, enter 70mm as 'Diameter' value for these standard weights, even if their filter case diameter is 47mm!
- **'Value [mg]'**: The weighing value of the standard weight, according to its calibration certificate, in mg. This value is used in substitution weighings to calculate the test filters value, as well as for balance adjustment, if 'Adjustment method: External with standard weight' is selected in the process settings window, see section 5.5.2.
- **'Operator'**: This text entry is used to identify the operator.
- **'Notes'**: Enter any description text here.

Test filters have more individual parameters when loaded onto the magazine. All parameter can be entered in the 'Test filter parameter' section of the weighing process window (see Figure 30). These individual parameters can be entered manually into the edit boxes, or parameter defaults can be used: Select a default from the list and press 'Apply' (or simply double-click onto the entry in the list). The default values will be loaded into the appropriate input boxes.

Individual parameters for test filters

- **'Filter acclimatisation time'**: The time the filters are acclimated after loading the filter holders onto the magazine. The filter weighing will start after this time has elapsed. The minimum is 1 Minute.
- **'Repetition intervall'**: if the check should be repeated periodically, you can enter the repetition interval here. Select 'Never repeat', if the standard deviation should be checked only once after the standard weight is loaded, but not repeatedly.
- **'No. of weighings (1-20)'**: number of single weighings in each group (default setting is 1: only 1 measurement per filter, no average nor standard deviation can be calculated).
- **'Comparison scheme'**: Choose the comparison scheme. See section 5.5.1 about definition of available comparison schemes.
- **'Diameter'**: Choose the filters diameter.

- ‘**Masure at specific time of day**’:If the filter should be measured at a specific time of day, the time can be entered here.
- ‘**Operator**’: This text entry is used to identify the operator.
- ‘**Notes**’: Enter any description text here.

5.10.1.2 Load batches of test filters

If the ‘Use batch counting’ is enabled in the weighing process parameters window (see section 5.5), the user can enter the ‘Batch size’ in the ‘Test filter parameter’ area. When the first filter of the batch is loaded, all input parameters in the ‘Test filter parameter’ area are frozen, the green frame turns yellow, and the ‘filter counter’ gives the number of successfully loaded filters (see figure 31). Continue to load all filters of the batch, until the frame turns green again (and the input parameters will be cleared), or simply press the ‘Reset counter’ button to stop the batch loading procedure.

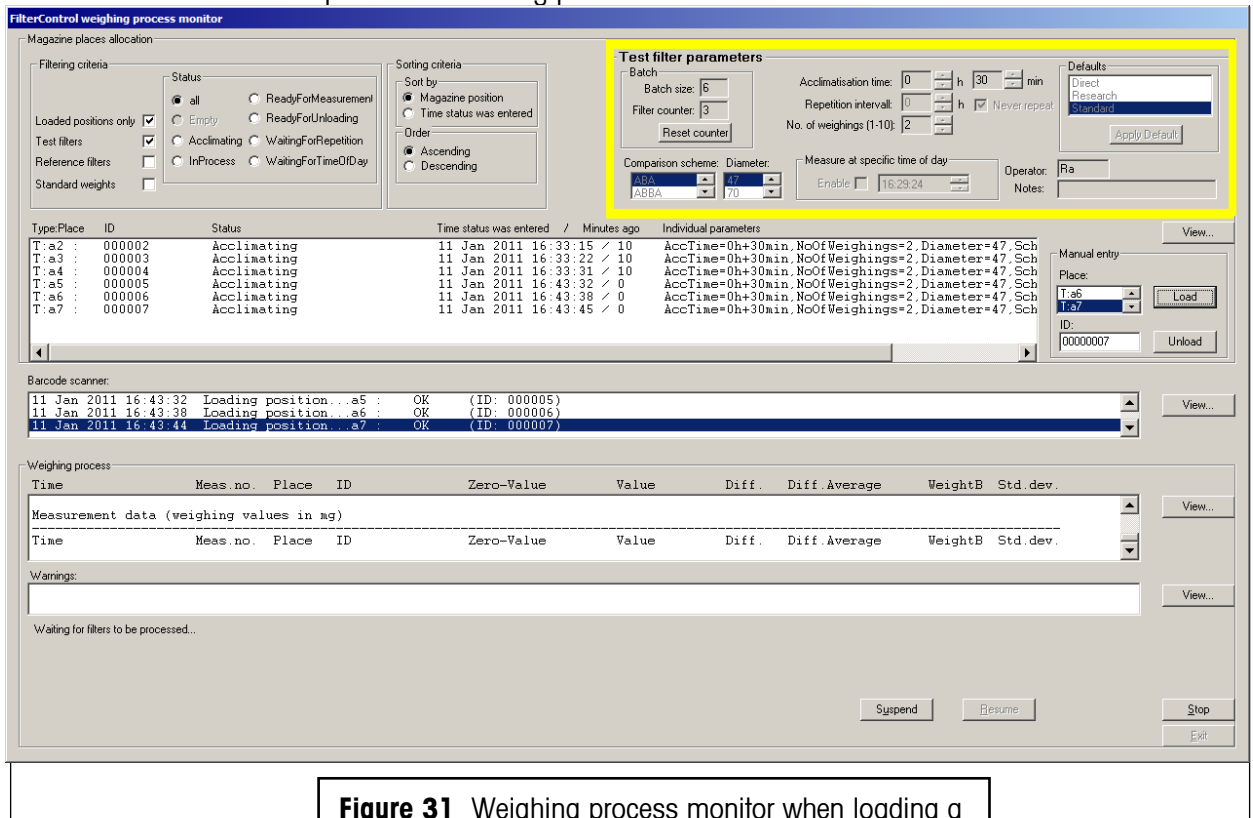


Figure 31 Weighing process monitor when loading a batch of test filters (3 of 6 filters loaded)

Note:

If batch counting is enabled and ‘Batch size’=1 (default settings), the program will automatically clear all input parameters after each filter loading. However, if batch counting is disabled, the input parameters will never be cleared automatically.

5.10.1.3 Detailed procedure to load the magazine

Loading the magazine is performed using the barcode scanner (see Figure 8):

Step	Action	What to do if Barcode scanner sends multi-beep:
If batch counter is enabled	Enter 'Batch size': Number of test filters to load having all equal individual parameters.	
Enter individual filter parameters for test filters	For test filters only: Select a 'Default' from the list and press 'Apply', and/or enter the test filter parameters individually.	
Prepair for loading	Open sliding door; If robot is moving towards magazine: Wait till robot has ended its movement;	
Read Filter ID	Read the barcode (filter ID) on the cover of the filter holder with the barcode scanner	Read filter-ID again
Load the filter onto the magazine	Place the filter holder in a free position of the magazine	
Read magazine position ID	Within 15 seconds after reading the filter ID, read the barcode in front of the respective magazine position.	Unload the filter from the magazine.
End loading	Close the sliding door.	
Enter individual parameters for reference filters or standard weights	For reference filters or standard weights: Enter the parameters in special popup boxes.	

5.10.2 Unloading the magazine

Condition: Measurement started, program shows 'Weighing process monitor', see section 5.9.

Unloading the magazine is performed using the barcode scanner:

Step	Action	What to do if Barcode scanner sends multi-beep:
Prepair for unloading	Open sliding door; If robot is moving towards magazine: Wait till robot has ended its movement	
Read magazine position ID	Read the barcode in front of the respective magazine position.	Magazine position cannot be unloaded, do not unload it!
Unload the filter	Remove the filter holder from the magazine	
Read Filter ID	Within 15 seconds after reading the position ID, read the barcode (filter ID) on the cover of the filter holder with the barcode scanner	Put filter back onto the same magazine place! Check carefully if you have removed filter from a wrong place! Try to prepair for unloading again.
End unloading	Close the sliding door.	

5.10.3 Filter status

The program gives a status to every filter (holder) to keep track of its processing. The filter status is displayed in the 'magazine places allocation' part of the weighing process monitor (see section 5.9.2).

The following table gives a short description of all status values:

Status name	Description	Remarks
Acclimating	Filter was loaded onto the magazine, and the acclimatization interval has not expired yet.	
ReadyForMeasurement	The filter is ready to be measured: The acclimatization time (or repetition interval) has expired.	
InProcess	The filter is currently measured.	
ReadyForUnloading	The measurement was successfully completed.	Filter can be unloaded
ReadyForUnloading_U	The test filter rests unstable even after repeating the group measurement 'Max no of group repetitions' times.	Filter can be unloaded, Filter could not be measured successfully.
ProcessAborted	The measurement was aborted.	
WaitingForRepetition	Repetition requested, and the repetition interval has not expired yet.	Filter can be unloaded
WaitingForRept_U	The test filter was unstable and will be measured again after the 'Repetition interval' for unstable test filters has expired.	
WaitingForTimeOfDay	The test filter parameter 'Measure at specific time of day' was enabled and the time was entered for this test filter. The filter is waiting for the specific time of day. If repetition was enabled, the filter will enter this status again after successful measurement. If not, it will be set to ReadyForUnloading.	
StdWeightNotReady	The test filter is ready to be measured, but it needs a standard weight to perform substitution weighings. The appropriate standard weight is not ready (it is acclimating).	

Remark:

Filter can be unloaded with the barcode scanner only if their status is 'ReadyForUnloading', 'ReadyForUnloading_U', or 'WaitingForRepetition', i.e. if they have been measured successfully. The program can be forced to unload test filters of any other status using the 'Unload' button in the 'Manual entry' area (see section 5.9.2). However, reference filters and standard weights of any other status cannot be unloaded the 'Unload' button in the 'Manual entry' area. To unload them, stop the measurement process and select 'Magazine/Places allocation' (see section 5.4) to force the program to remove these filters.

5.11 Message light tower

The meaning of the green, red, and yellow light of the message light tower (see Figure 1) is as follows:

Green:

- The robot system was successfully started. No error condition could be detected.

Red:

- A failure has been detected. Follow the instructions in **FilterControl**.

Yellow:

- **Yellow 'On':** The user has opened the sliding door in the front of the robot system to access the magazine, and/or the weighing process was suspended.
- **Yellow 'Off':** The sliding door is closed and the weighing process is not suspended.

5.12 Measurement data and report

5.12.1 Measurement report

The Figures 32 shows a report generated by **FilterControl** while weighing 7 test filters.

It shows the report heading, comprising the report file name (`.doc`), the name of the settings file (`.fc`), the process start date and start time, as well as the user identification and some notes.

The weighing process settings, and the balance settings are documented as well, followed by the measurement data. Each table line consists of the 10 following fields:

- **'Time'**: measurement date and time recorded in the format `day month year hours:minutes:seconds`
- **'Meas.no.'**: measurement number, numbers from `01` to `No. of weighings`.
- **'Place'**: indicates the magazine place of the filter.
- **'ID'**: The barcode on the filter cover of the filter holder.
- **'Zero-Value'** (only for comparison scheme = `Direct`): The value measured with an empty balance pan, immediately before the pan is loaded, in mg. This value is the calculated average of all values collected during the integration time (see section 5.5.1) and shows therefore an extra decimal place. If any of these values were collected while that the balance was unstable, it will be marked with a `*`.
- **'Value'**: The value measured with a loaded balance pan, in mg. This value is the calculated average of all values collected during the integration time (see section 5.5.1) and shows therefore an extra decimal place. If any of these values were collected while the balance was unstable, it will be marked with a `*`.
- **'Diff'**: One single weighing result. The calculation depends on the comparison scheme (see section 5.12.2).
- **'Diff.average'**: indicates for each group the calculated average of all differences (see section 5.12.2)
- **'Std.dev.'**: indicates for each group the calculated standard deviation of the difference average (see section 5.12.2)

Remark:

If either the `Zero-Value` or the `Value` was collected while the balance was unstable, the affected single weighing will be repeated, and therefore it will be excluded from the calculation of the difference average. However, if 5 successive single weighings are unstable, the program will

- immediately abort, if the filter is a reference filter or the standard weight.
- If the filter is a test filter, the behavior depends on the weighing process settings entries 'Parameters for unstable test filters' (see section 5.5).

```

FilterControl v1.25a - measurement report

File: C:\Program Files\Mettler-Toledo\FilterControl\Report-sz_02.doc

FilterControl settings defined in: C:\Program Files\Mettler-Toledo\FilterControl\test.fc

Start date                26 Nov 2010   User
Start time                10:27:53   Notes

Filter process settings
-----
Stabilisation time [s]    20
Integration time [s]      1

Unstable test filter process settings
-----
Max no. of repetitions    2
Repetition intervall [h:min] 00:30
Stop measurement if filter rests unstable  yes

Reference filter process settings
-----
Reference filter comparison scheme: Direct
Reference filter acclimatisation time [h:min] 00:15
Reference filter on position a1: in use
Reference filter on position b1: not in use
Repetition intervall [h] 4
Replace intervall        never
No. of weighings         3
Maximum drift [mg]       0.0100
Maximum Std.Dev. [mg]    0.00250
Send measurement data (via serial port) no
Stop measurement if drift exceeds maximum no
Stop measurement if filter must be replaced no

Standard weight(s) process settings for standard deviation checks
-----
Repeat intervall [h]      1
Standard weight on position c1: in use ID:00074 Value: 105.8635mg
Standard weight on position d1: not in use
No. of weighings         6
Stabilisation time [s]   15
Integration time [s]      5
Maximum Std.Dev. [mg]    0.00250
Stop measurement if Std.Dev. exceeds limit no

Standard weight(s) used for substitution weighings
-----
Standard weight on position c1: in use ID:00074 Value: 105.8635mg
Standard weight on position d1: not in use

Balance settings
-----
Environment                unstable
Value release              fast

Balance adjustment
-----
Adjustment method          Internal
Last adjustment            26 Nov 2010 09:03:22

Measurement data (weighing values in mg)
-----
Time           Meas.no.  Place  ID           Zero-Value  Value      Diff.  Diff.Average  Std.dev.
26 Nov 2010 12:51:14  01 R:a1 : abcdefgh  0.00050  98.72090  98.72040
26 Nov 2010 12:52:19  02 R:a1 : abcdefgh  0.00090  98.72100  98.72010
26 Nov 2010 12:53:24  03 R:a1 : abcdefgh  0.00100  98.72115  98.72015  98.72022  0.00016
26 Nov 2010 10:56:21  01A S:c1 : 00074  105.86930
26 Nov 2010 10:57:35  01B T:a6 : 00000006  84.81160
26 Nov 2010 10:58:47  01B T:a6 : 00000006  84.81150
26 Nov 2010 11:00:01  01A S:c1 : 00074  105.86920  -21.05770  84.80580
26 Nov 2010 12:59:59  01 T:a7 : 00000007  0.00170  95.00200  95.00030  95.00030
26 Nov 2010 13:01:20  01 T:a8 : 00000008  0.00200  97.12780  97.12580  97.12580
26 Nov 2010 13:02:42  01 T:b9 : 00000009  0.00210  67.86370  67.86160  67.86160
26 Nov 2010 14:54:54  01 R:a01: abcdefgh  0.00320  98.72340  98.72020
26 Nov 2010 14:56:00  02 R:a01: abcdefgh  0.00315  98.72340  98.72025
26 Nov 2010 14:57:05  03 R:a01: abcdefgh  0.00300  98.72330  98.72030  98.72025  0.00005
    
```

Figure 32 Example of a Report

5.12.2 Calculations

The calculated difference '**Diff**' is the result of a single weighing. The calculation depends on the comparison scheme:

Comparison scheme 'Direct': '**Diff**'='Value'-'Zero-Value'.

For substitution weighings (Comparison scheme 'A-B-A' or 'A-B-B-A'), the '**Diff**' calculation compensates a linear drift of the weighing values.

Figure 33 schematically represents the reported measurement data and the differences B-A calculated during a weighing process, whose comparison scheme was set to A-B-A and A-B-B-A respectively.

The differences B-A are reported in the column '**Diff.**' (see Figure 32) and, if the comparison scheme A-B-A was selected, calculated as follows (see Figure 33, top diagram):

$$\text{Diff}_{01} = \frac{(\text{Val_B}_{01} - \text{Val_A}_{01}) + (\text{Val_B}_{01'} - \text{Val_A}_{01'})}{2}$$

$$\text{Diff}_{02} = \frac{(\text{Val_B}_{02} - \text{Val_A}_{02}) + (\text{Val_B}_{02'} - \text{Val_A}_{02'})}{2}$$

$$\text{Diff}_{03} = \frac{(\text{Val_B}_{03} - \text{Val_A}_{03}) + (\text{Val_B}_{03'} - \text{Val_A}_{03'})}{2}$$

etc.

If the comparison scheme A-B-B-A was selected, the differences B-A, reported in the column '**Diff.**', are calculated as follows (see Figure 33, bottom diagram):

$$\text{Diff}_{01} = \frac{(\text{Val_B}_{01} + \text{Val_B}_{01'}) - (\text{Val_A}_{01} + \text{Val_A}_{01'})}{2}$$

$$\text{Diff}_{02} = \frac{(\text{Val_B}_{02} + \text{Val_B}_{02'}) - (\text{Val_A}_{02} + \text{Val_A}_{02'})}{2}$$

etc.

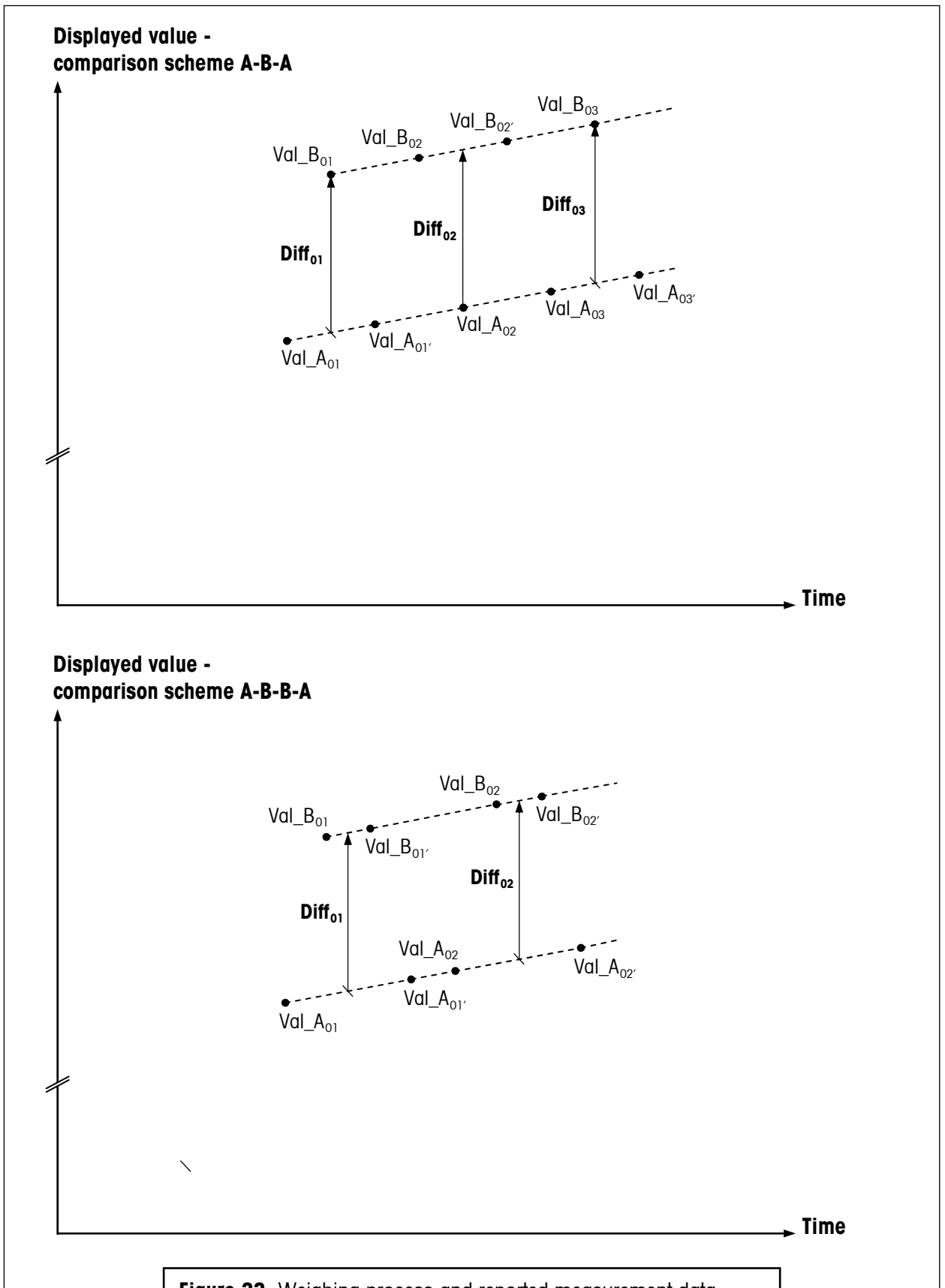


Figure 33 Weighing process and reported measurement data - top diagram: A-B-A, bottom diagram: A-B-B-A scheme

The difference average is reported, for each group, in the column '**Diff.Average**', and calculated as follows:

$$\text{Diff.average} = (1 / n) \sum_{i=01}^n \text{Diff}_i$$

If the 'No. of weighings' n is greater than 1, the standard deviation of the difference average is reported, for each group, in the column '**Std.dev.**', and calculated as follows:

$$\text{Std.dev.} = \sqrt{[1 / (n-1)] \sum_{i=01}^n (\text{Diff}_i - \text{Diff.average})^2}$$

The 'Reference drift' is the difference of two successive reference filter weighings of the same reference filter: For a reference filter, we have 'Diff.average_1' as the difference average of a measurement, and 'Diff.average_2' as the difference average of the next measurement, then we calculate the drift value 'Drift':

$$\text{Drift} = \text{Diff.average}_2 - \text{Diff.average}_1$$

The drift exceeds the entered maximum drift, if

$$| \text{Drift} | > \text{Max_Drift}$$

5.13 Daily use of FilterControl

Once you have set the process parameters according to your needs and saved them to a settings file, which you should write-protect, your everyday work will be reduced to the following tasks:

- Start **FilterControl** (double-click on its program icon) and load the setting file (use menu 'File/Open')
- Start the measurement: Select menu 'Start/Start measurement', select an appropriate report file name, indicating the current date, and the type of measurement
- Load the test filters onto the magazine using the barcode scanner
- In the 'Magazine places allocation' part of the 'Weighing process monitor' (see section 5.9.2), set the 'filter criteria' to get information about which filters are ready to be unloaded: Select Status 'ReadyForUnloading'.
- Unload the measured test filters using the barcode scanner,
- Replace the reference filters, if the program requests to do so.
- Check for warnings regularly,
- It is recommended to stop the measurement and restart it, choosing a new report file name, at least once a week.

5.14 Export data via RS232

Program **FilterControl** can replace a balance in an existing, host-controlled filter weighing application: The program will send the Filter-ID followed by the (averaged) filter weight ('WeightB'), formatted as the balance would format it, via the export serial port selected in section 5.7.1. The user can select if the weights of reference filters should be exported via serial port as well, see parameter 'Export measureremt data (via serial port)' in section 5.5.2.

Serial port settings:

The serial port settings must be set to 9600baud, 8 data bits, no parity

Example:

Filter ID:	123456789012 (max. 12 characters)
No of weighings:	3
Weighing results:	65.1015mg, 65.1018mg, 65.1025mg
Average:	65.1019mg

Data sent:

```
123456789012<CR><LF>
S S    65.1019 mg<CR><LF>
```

Where <CR> and <LF> indicate the characters 'Carriage Return' and 'Line Feed', respectively. These two lines are sent without any substantial delay between the lines.

5.15 Remote-controlling FilterControl from a database

FilterControl can be remote-controlled from a database: When a filter is loaded onto the magazine position, **FilterControl** automatically gets the appropriate filter parameters from the database. After a successful filter measurement, the measured data is stored in a database table.

A detailed description of the interface between **FilterControl** and the database can be found in Appendix 8.5.

If you want to remote-control **FilterControl** from a database, you must

- Setup a database according to the interface description, see section 8.5.
- Install an ODBC-datasource named 'FilterControl' on the controller-PC running application **FilterControl** to access the database (read- and write-access).
- Start **FilterControl**, select 'Remote control from database' in the 'Process settings' Window (see section 5.5.2).
- Start the measurement, the 'weighing process monitor' will be shown in a special mode (see Figure 34): The 'test filter parameter' area will be disabled, except the 'Batch size' and the 'Operator'-entries. However, before loading a test filter, you still have to enter the 'Operator'-value, and you can use the 'Batch size' feature to re-use this input for a batch of test filters.
- The 'weighing process monitor' shows an additional 'Database status'-bar. If the database access creates any problem, this status will show a red bar, if everything is OK, the bar is green. If an error occurs, additional information can be found either in the 'barcode scanner' listbox or in the status line.

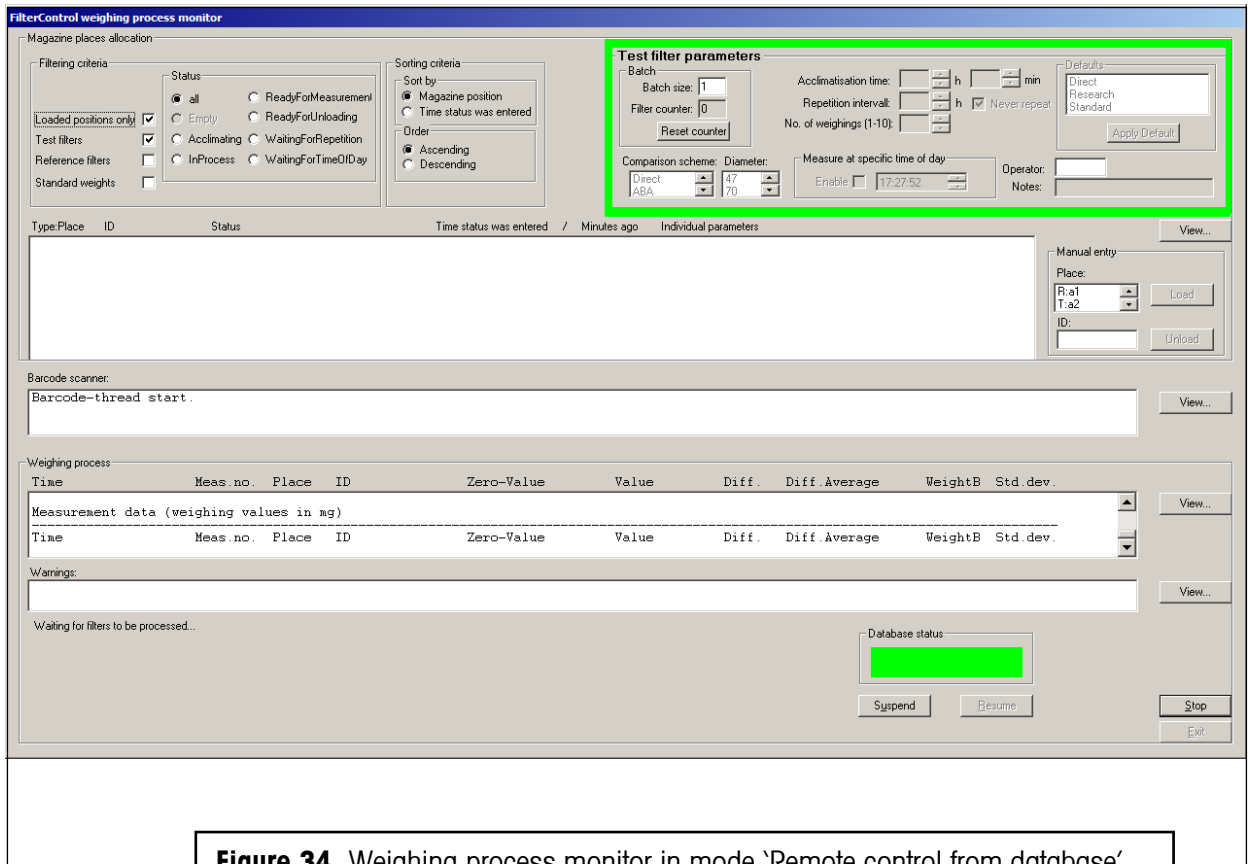


Figure 34 Weighing process monitor in mode 'Remote control from database'

5.16 Additionally created output files

5.16.1 The 'central report file'

FilterControl creates two report files, where all the process parameters and measurement data are stored. However, **FilterControl** creates an additional 'central report file', where it stores data of all filters ever measured (new data will be appended to the file).

The central report file has a fixed name: 'FilterControl_Results.xls', it is placed in the folder of the application program (**FilterControl**), and it contains one line of data for each successful measurement. It can be read to import data to a host system for any further calculations, like filter gross weight calculations or reference filter drift analysis.

Example of central report file content:

Time	ID	No of Meas.	Diff.Average [mg]	Std.dev. [mg]	Individual parameters
26.11.2010 12:53	abcdefgh	3	98.72022	0.00016	Diameter=47,Operator=Alain
26.11.2010 12:55	1	1	98.8317		AccTime=0h+30Min, NoOfWeighings=2,Diameter=70, Scheme=ABA,Operator=Alain

26.11.2010 12:56	2	1	87.4807		AccTime=0h+30Min, NoOfWeighings=2,Diameter=47, Scheme=Direct,Operator=Alain
26.11.2010 12:57	3	1	96.2962		AccTime=0h+30Min, NoOfWeighings=2,Diameter=47, Scheme=Direct,Operator=Alain
26.11.2010 12:59	4	1	97.341		AccTime=0h+30Min, NoOfWeighings=2, Diameter=47, Scheme=Direct,Operator=Alain
26.11.2010 13:00	5	1	95.0003		AccTime=0h+30Min, NoOfWeighings=2, Diameter=47, Scheme=Direct,Operator=Alain
26.11.2010 13:01	6	1	97.1258		AccTime=0h+30Min, NoOfWeighings=2, Diameter=47, Scheme=Direct,Operator=Alain
26.11.2010 13:03	7	1	67.8616		AccTime=0h+30Min, NoOfWeighings=2, Diameter=47, Scheme=Direct,Operator=Alain
26.11.2010 14:57	abcdefgh	3	98.72025	0.00005	Operator=Alain

and so on...

There is one header line, and the data are tabulator-separated.
The last column gives all the individual filter parameters specified for this filter.

5.16.2 Files for internal use

There are some files for internal use, placed in the folder of the application program (**FilterControl**):

- 'FilterControl_log.txt' contains information about error messages, warnings, and report names.
- 'FilterControl_System.std' stores the current system settings. Delete this file to force the program to use system defaults (i.e. restore factory settings).
- 'FilterControl_Placing.std' stores the current magazine places allocation: Filter ID and loading time of all filters currently placed in the magazine.

6 Installation site and location change

6.1 Installation site

The **F-A770** comprises the robot system and the micro-balance, which are both to be attached separately to the floor. For this purpose, the balance is installed on a separate bench, attached to the floor by 2 screws; the robot system itself needs, to be properly attached, 2 screws as well. This work will be done by the specialist from Mettler-Toledo AG.

Besides, you need to ensure that at least 30 cm free space is available on the left sides and at the back of the **F-A770**; in the front and on the right side at least 70 cm free space is needed.

The **weighing room** should ideally

- be as insensitive as possible to shocks and vibrations
- have only one door (drafts)
- be as free from drafts as possible (important with air conditioning systems)
- be in the basement
- be well insulated
- contain as few heat sources as possible (it is better to locate all computers and other peripherals in an anteroom).

The **room temperature** should be between 17 and 27°C. Temperature fluctuations within minutes should be kept as small as possible. The air temperature should not change by more than $\pm 0.5^{\circ}\text{C}$ over twelve hour. Relatively large, long-term fluctuations (summer/winter) are entirely permissible.

The **relative humidity** should be between 45 and 60%. Relatively large, long-term fluctuations (summer/winter) are entirely permissible.

6.2 Location change

Please contact Mettler-Toledo AG before changing the location of the mass comparator. Improperly moving the weighing system will lead to damages for which the supplier refuses any liability.

Warning: In addition, we wish to draw your attention to the fact that you are not allowed to carry the mass comparator. Its weight (290 kg) exceeds the acceptable limit, in accordance to the applicable regulations.

7 Maintenance

7.1 Weighing chamber, balance, robot hand and filter holders

The weighing chamber of the **F-A770** should be free from dust. Keep the doors of the weighing chamber closed. Use a soft cloth to clean the weighing chamber.

The balance weighing chamber and the balance pan can be cleaned by using extremely cautiously a soft brush. Touch the weighing pan very gently. Make sure the position of the balance remains absolutely unchanged.

Only clean and dust-free filter holders should be used.

In case of a malfunction of the robot hand light barrier, it must be cleaned by means of a soft brush. Do not use any solvent or ethanol.

7.2 Robot system axes

Please contact Mettler-Toledo AG before proceeding maintenance actions about which you are not trained, because improperly maintenance can lead to damages for which the supplier refuses any liability. Alternatively METTLER TOLEDO AG offers Service Contracts to ensure the productivity and accuracy during its lifetime.

7.2.1 Maintenance actions and timetable

Do perform the maintenance actions according to the following timetable. The operating time of the **F-A770** is assumed to be 8 hours per day. If it is longer, the maintenance intervals need to be shortened accordingly.

Robot maintenance timetable	External inspection	Internal inspection	Lubrication
Start of operation	◆		
After 1 month of operation	◆		
After 6 months of operation	◆	◆	
After 1 year of operation		◆	◆
Twice a year thereafter	◆		
Once a year thereafter		◆	◆

7.2.2 External inspection

- Is there any loose assembling screws? If so, tighten them
- Is there any damaged cable or connector? If so, contact your supplier
- Is any unusual noise or vibrations noticeable? If so, contact your supplier
- **Cleaning:** clean the exterior surfaces; wipe off dust and dirt with a soft (moist) cloth
Warning: do not blow compressed air on the robot axes, nor use petroleum-based solvents.

7.2.3 Internal inspection

For all 3 axes, follow the procedure below:

- Turn the robot system off; unscrew the spindle cover by means of a 1.5 mm hexagonal wrench; four

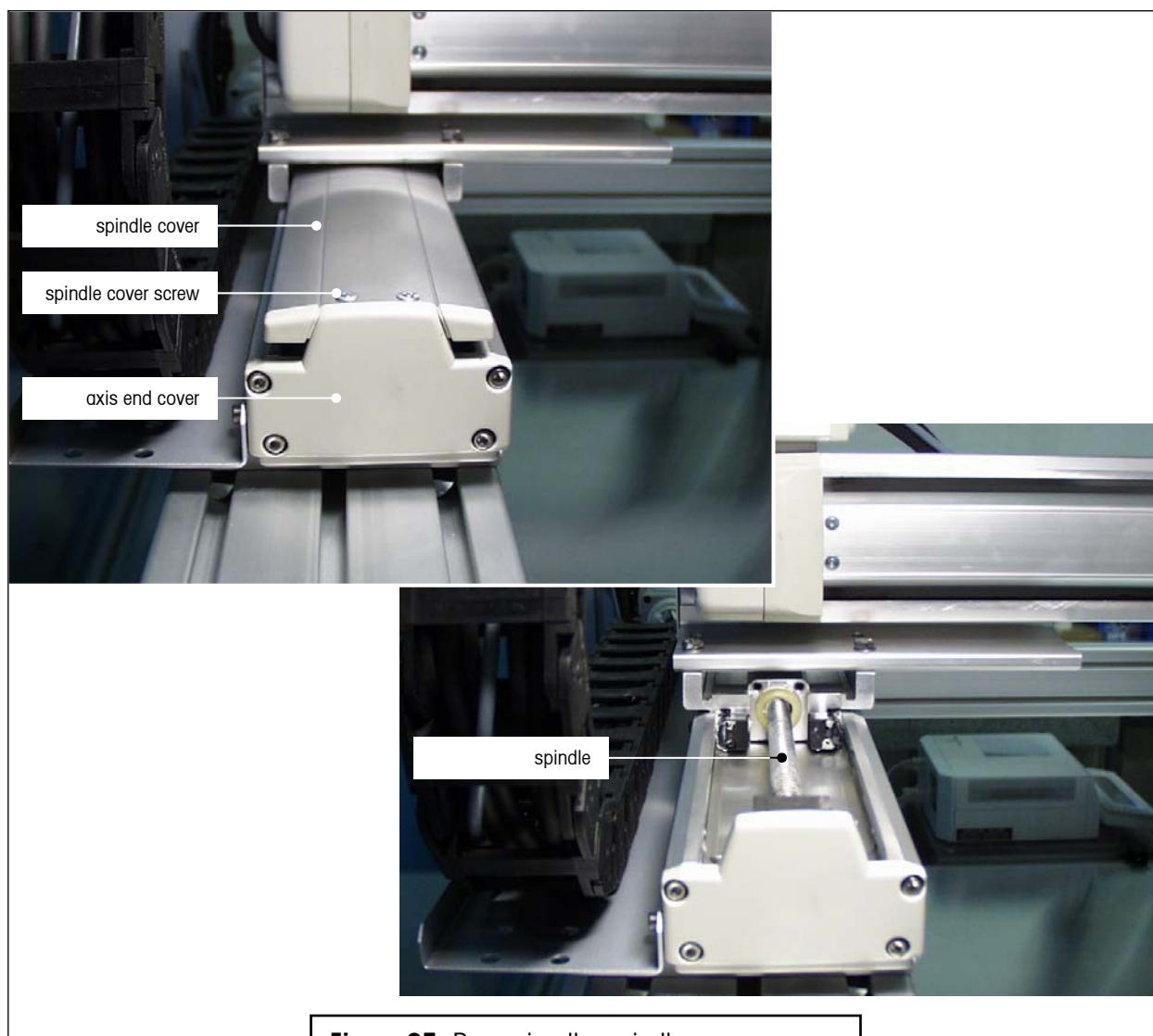


Figure 35 Removing the spindle cover – do not touch the axis end cover!

screws need to be removed on each spindle cover (see Figure 35) - **Warning:** Do not remove any axis end cover since it supports the ball bearing and the axis positioning device (see Figure 35)

- Check the inside, i.e. its cleanliness and the state of the lubricant - the spindle must be shiny, indicating that the lubricant is evenly distributed and in sufficient quantity; if the inside is dirty, use a soft cloth to wipe off the dirt – do not blow compressed air, nor use neutral detergents, petroleum-based solvents or alcohol -; if the grease becomes dirty and dull or if the grease has worn away due to intensive operation, then follow the steps described under lubrication
- Screw the cover back.

7.2.4 Lubrication

Use only lithium grease no. 2., such as 'Idemitsu Kosan Daphne Exponex Grease No. 2'. Similar greases - e.g. 'Showa Shell Oil Albania Grease No. 2', 'Mobil Oil Mobilux 2', 'Molykote Longterm W 2' - can be used as well.

Lubricating the x- and y-axes (horizontal axes)

- Turn the robot system off; unscrew the spindle cover by means of a 1.5 mm hexagonal wrench; four screws need to be removed (see Figure 35)
- Remove the first screw plug (see Figure 36) and insert the lubrication nipple
- Squirt the grease in the nipple with a grease gun (see Figure 36)
- Remove the lubrication nipple and screw the plug back
- Repeat the above 3 steps with the second screw plug
- Move the slider back and forth several times by hand; wipe off the excess grease
- Screw the cover back.

Lubricating the z-axis (vertical axis)

- The z-axis can be moved by hand only if its brake is deactivated; to do so, turn the robot system on and then turn the 'Automatic / OFF' switch, located on the z-axis brake control unit (see Figure 1), onto position 'OFF' (to get access to this switch, unscrew the front panel of the robot system)
- Unscrew the spindle cover by means of a 1.5 mm hexagonal wrench; four screws need to be removed (see Figure 35)
- Remove the first screw plug (see Figure 36) and insert the lubrication nipple
- Squirt the grease in the nipple with a grease gun (see Figure 36)
- Remove the lubrication nipple and screw the plug back
- Repeat the above 3 steps with the second screw plug
- Move the slider up and down several times by hand; wipe off the excess grease
- Clean the spindle by means of a soft cloth; apply some grease on the spindle with your finger and spread it out by moving the slider up and down; after this, wipe off any excess grease
- Screw the cover back

- Turn the z-axis brake switch back onto position 'Automatic'
- Restart the robot system.

WARNING After lubricating the slider, remove the grease nipple immediately. If you restart the robot system without removing the grease nipple you may damage the robot system.

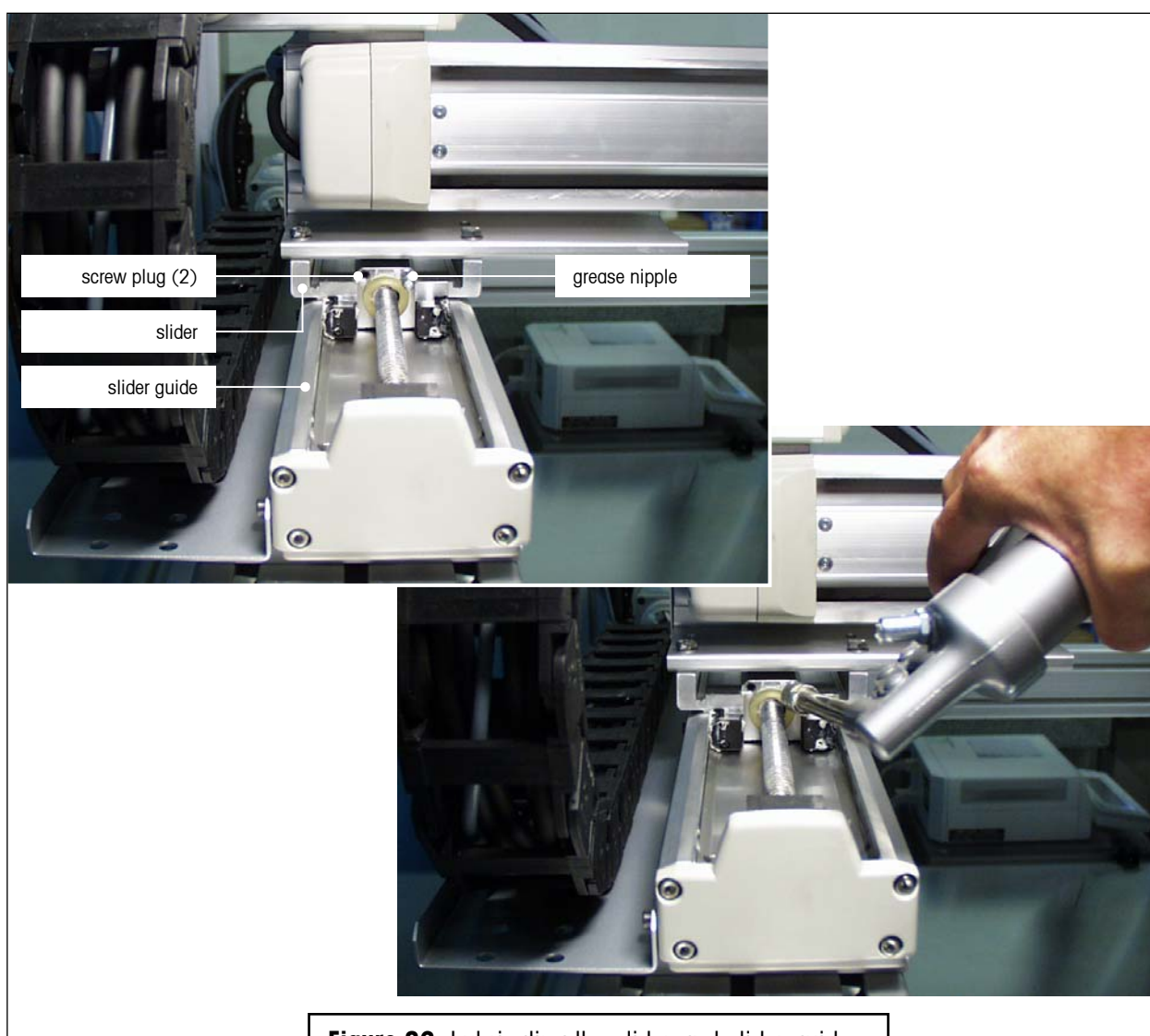


Figure 36 Lubricating the slider and slider guides

8 Appendix

8.1

Technical data

Balance - METTLER TOLEDO XP2U

Readability	0.1 µg
Maximum load	2.1 g
Repeatability	0.25µg with (47mm Pall TX40) 0.35µg with (70mm Pall TX40)
Linearity	1.5 µg
Stabilization time (typical)	16 s
Adjustment	Motorized adjustment of the electrical range (built-in 2 x 1 g adjustment weights) or adjustment by means of an external selectable adjustment weight

Automated weight handler

Weight handler	For automatic determination of filters with a diameter of 47mm and 70mm
Measuring time (typical)	60 sec. for one filter measurement
Weight magazine	80 places / max. 40 places for 70mm filters
Control software	Microsoft® Windows® -based FilterControl , compatible with Windows®95, Windows®98, WindowsNT® , WindowsXP®, WindowsVista® and Windows7®
Data interface	RS232C to controller

Technical data (cont'd)**Admissible ambient conditions**

Temperature	17 - 27 °C (±1°C max/min peaks)
Relative humidity	45 - 60 % (±1% RH max/min peaks)
Vibrations	A set-up in a "vibration-free" room

AC adapter

Voltage

- Balance control unit	100-240V (-15%/+10 %), 2.25A
- Robot system control unit	115 V or 230 V (-20% - +15 %)

Frequency

- Balance control unit	50 Hz / 60 Hz
- Robot system control unit	50 Hz / 60 Hz

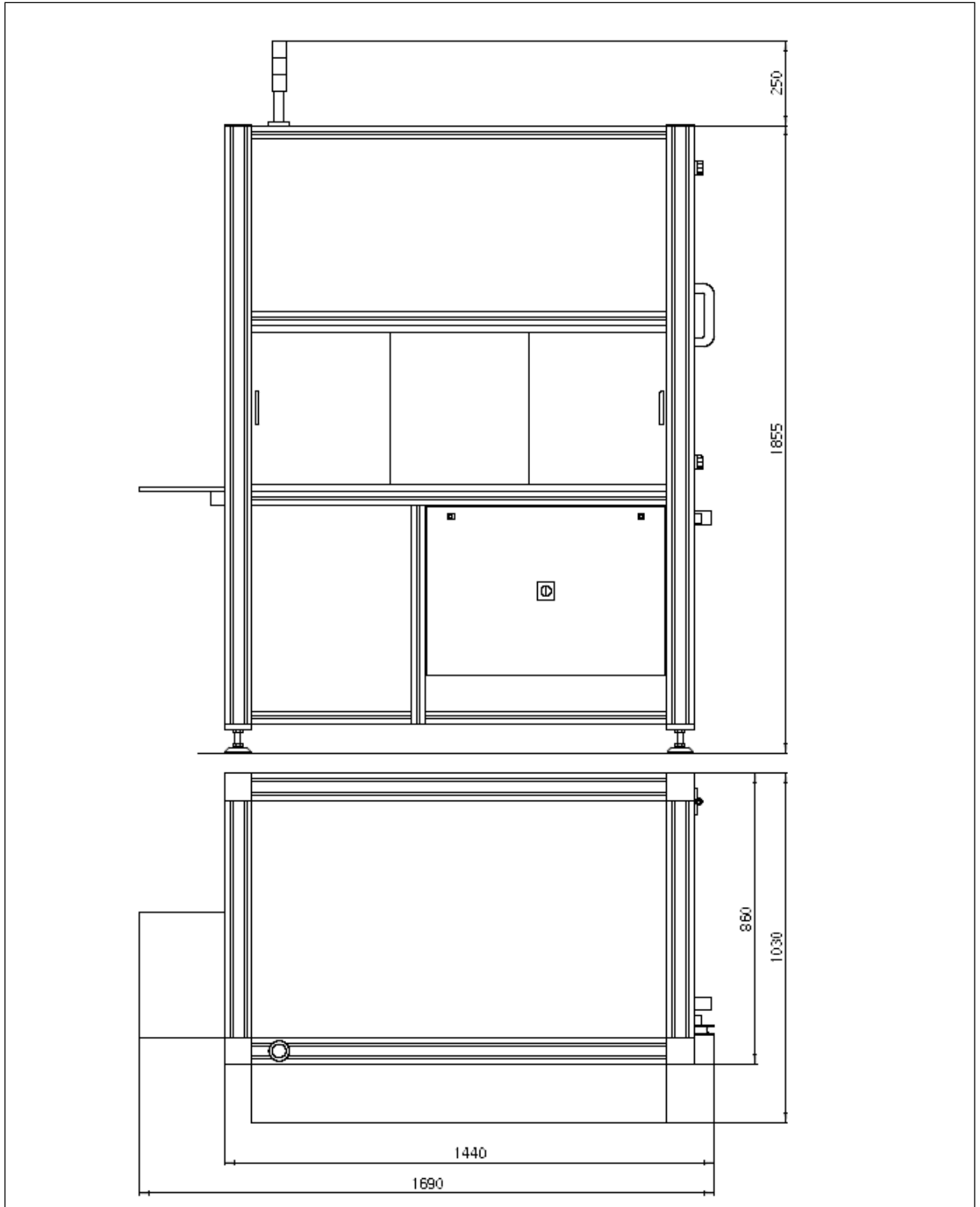
Power consumption

- Handler	150 VA max.
-----------	-------------

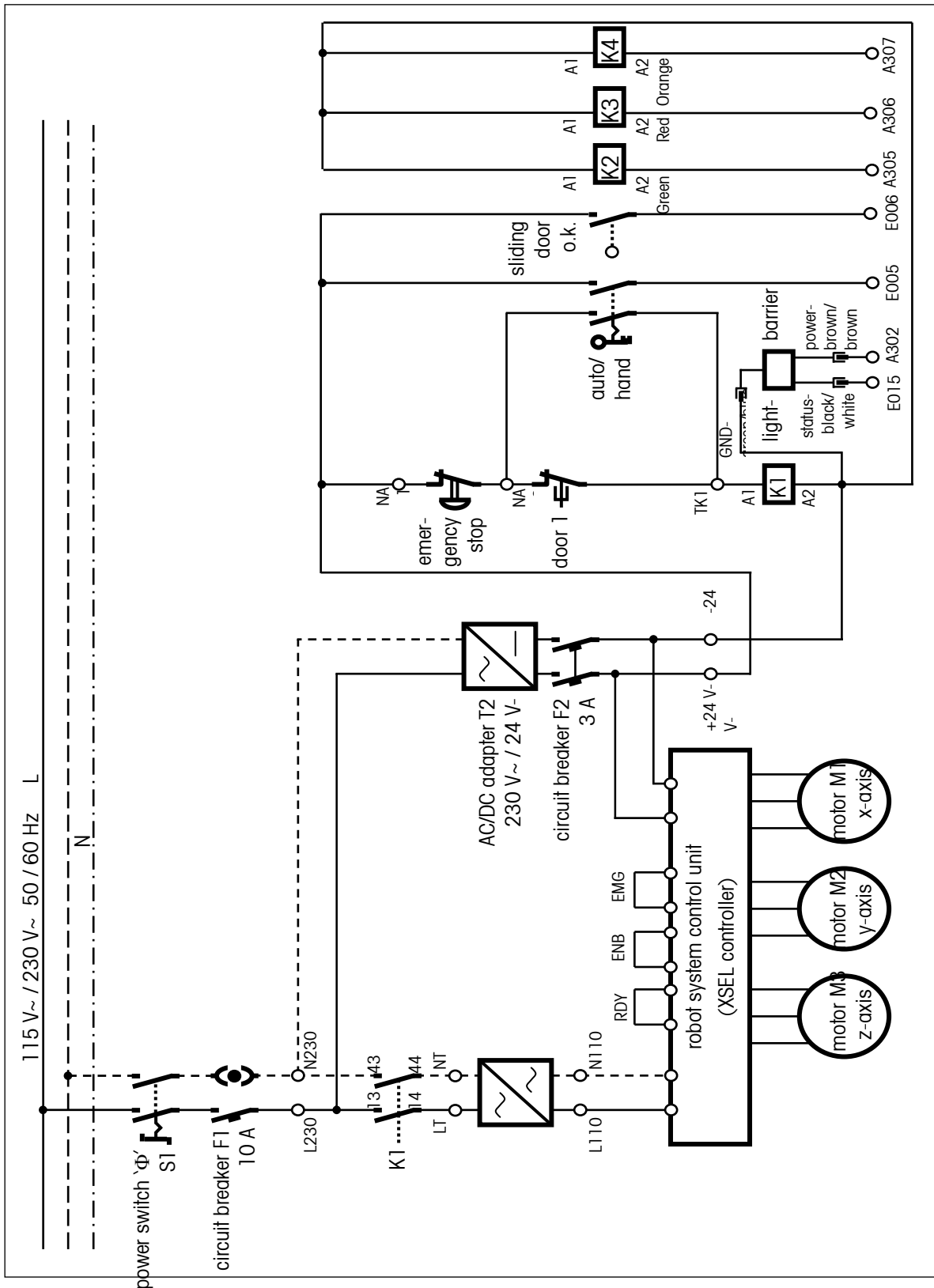
Dimensions (w x d x h) / net weight

Handler and balance	1690 x 1030 x 1855 mm / 400 kg
----------------------------	--------------------------------

8.2 Dimension drawing



8.3 Electrical drawing



8.4 Barcode scanner setup

The barcode scanner can be configured to read various barcode types. There is a user guide for the barcode scanner included in the delivery. However, you must make sure the scanner's RS232 interface is enabled. The communication settings must be set to 9600baud, 8 data bits, no parity, which are the default settings.

Some parameters of the scanner's interface will be configured during the startup procedure of the **FilterControl** measurement (see section 5.9.2). If the configuration was done successfully, the scanner will send a 'multi-beep'. If this beep is missing, the barcode scanner might be configured badly. Use the 'Restore default' and the 'RS232 Interface'-Command of the scanner's user guide (p. 15), and make sure the barcode scanner connects to the controller's serial port selected in section 5.7.1.

8.5 Technical note: FilterControl's interface with database

8.5.1 Naming

- **'Controller-PC'**: Computer running application **FilterControl** V1.26 or higher version.
- **'Database'** : Customers database with information about filters and measurement values.

8.5.2 Communication basics

- Application **FilterControl** communicates with the database via an **ODBC-source** named 'FilterControl'.
- **FilterControl** executes certain queries on the ODBC-source to perform a variety of tasks. The details of these queries and tasks will be described in this document.
- For many parameters (such as Filter-ID's, or acclimatization time), application **FilterControl** defines limits for length or value ranges. These limits are valid for corresponding database parameters, too. See section 5.5.2 and section 5.9.2 for further details.
- Date/Time values will be saved in current local time, detected on the Controller-PC.

Notes:

- However, it is the duty of the customer to set up an ODBC-source named 'FilterControl' properly on the controller-PC , and to guarantee that the Controller-PC has read- and write-access to this data source.
- The customer must implement all the queries and tables in the database mentioned in this document. They must be accessible via the ODBC-source 'FilterControl'.
- The following descriptions use a parameter type naming of C++ source code. However the customer must choose appropriate and compatible parameter types in his database.

8.5.3 Synchronization overview

- When a filter is loaded onto the magazine, the Barcode reader detects the FilterID. Application **FilterControl** reads the corresponding filter parameters from the database query '*qryFilterParameters*'.
- Before a filter is measured, application **FilterControl** reads the status from query '*qryRobotStatus*' to check if the measurement can be started. It waits till the robot status indicates OK. This feature can be used to temporary pause the robot if conditions like climate parameter ranges are out of limits.
- Before a filter is measured, **FilterControl** reads a new measurement number called **LFD-number** from '*qryLFD*'. This LFD-number will be used to mark all measurement data of the next measurement group.
- When filters are measured, one or many single weighings are performed to produce a measurement group. The results of each single weighing are stored in the '*tblMeasurement_Single*'. Unstable measurement data will not be transferred to the database.
- After a filter is successfully measured, the measurement group (1 or more single measurements) is statistically analyzed, and the group data is written to the table '*tblMeasurement_Group*'.

8.5.4 Communication Details

8.5.4.1 Reading filter parameters from the database

When a filter is loaded onto the magazine, the Barcode reader detects the FilterID. Application **FilterControl** executes the database query **'SELECT qryFilterParameters.* FROM qryFilterParameters WHERE FilterID=<Barcode>'** to receive the filter's parameters from the database.

All items (test filters, reference filters, standard weights) must have an entry in this table.

qryFilterParameter

Field name	Type (C++)	Meaning	Notes	Mandatory for
FilterID	String	Filters barcode-ID		
FilterJobNo	Integer	Unique job number to identify the filter	Important if barcode-IDs have a small range and therefore will repeat after some time.	All items.
FilterType	Integer	Type of filter	0=Testfilter, 1=Reference filter, 2=Standard weight	All items
AcclimatisationTime_h	Integer	Acclimatisation hours	Total acclimatisation time: AcclimatisationTime_h hours + AcclimatisationTime_min minutes.	Testfilters only.
AcclimatisationTime_min	Integer	Acclimatisation minutes		
RepetitionIntervall_h	Integer	Repetition interval in hours	-1 indicates 'Never'	Testfilters only
NoOfWeighings	Integer	Number of direct- or substitution weighings.	>=1 AND <=10	Testfilters only.
ComparisonScheme	Integer	Comparison scheme	0=Direct weighing, 1=ABA-Substitution weighing, 2=ABBA-Substitution weighing	Testfilters only.
Notes	String	Free text		
DiameterCode	Integer	Diameter code of filter	0=Diameter 45mm, 1=Diameter 70mm.	All items.

Important note:

The reading of the filter parameters must complete within 0.25sec.

It is the customer's duty to guarantee this access time limit under all conditions.

8.5.4.2 Temporary pause the measurement process

Before a filter is measured, application **FilterControl** executes the query ``SELECT Status FROM qryRobotStatus'` to check if the measurement can be started. It waits till the robot status indicates OK. This feature can be used to temporary pause the robot if conditions like climate parameter ranges are out of limits.

qryRobotStatus

Field name	Type (C++)	Meaning	Notes	Mandatory
Status	Integer	0=OK, 1=Stop		Yes

8.5.4.3 Query of unique measurement number (LFD)

Before a filter is measured, **FilterControl** executes ``SELECT LFD FROM qryLFD'` once to get a new measurement number called LFD. This LFD-number will be used to mark all measurement data of the next measurement group.

It is up to the user to implement `qryLFD` to return a new, unique number for each query call. However, `qryLFD` may return the same number for all calls as well.

qryLFD

Field name	Type (C++)	Meaning	Notes	Mandatory
LFD	Integer	(Unique) measurement number		Yes

8.5.4.4 Store individual single measurements

When filters are measured, one or many single weighings are performed to produce a measurement group. The results of each single weighing are stored in the ``tblMeasurement_Single'`. Unstable measurement data will not be transferred to the database.

The user can choose between the comparison schemes

- **Direct weighings** comprising of a 'O'-weighing (balance pan empty) and a 'B'-weighing (Item loaded onto balance pan),
- **ABA- and ABBA-substitution weighings**, comprising of A-weighings (standard weight on balance pan) and B-weighings (test filter on balance pan).

A direct weighing therefore generates 2 entries in the table (one with Type='O', one with Type='B'), an ABA-substitution weighing 3 entries (two with Type='A' and one with Type='B') and an ABBA-substitution-weighing 4 entries (two with Type='A' and two with Type='B').

tblMeasurement_Single

Field name	Type (C++)	Meaning	Notes
LFD	Integer	Unique number	According to query 'qryLFD', see above
CurrentTime	Date/Time	Local measurement time (including date).	Local on controller PC
Type	String	'0', 'A' or 'B'	Indicates the type of measurement, see above for details.
FilterID	String	Barcode-ID	A-weighings: Barcode-ID of standard weight, B-weighings: Barcode-ID of testfilter, 0-weighings: Barcode-ID of testfilter
FilterJobNo	Integer	Unique job number to identify the filter.	A-weighings: FilterJobNo of standard weight, B-weighings: FilterJobNo of testfilter, 0-weighings: FilterJobNo of testfilter
N	Integer	Index of measurement	
WeighingValue	Double	Weighing value	In mg.
Operator	String	'Operator'-Entry in Application FilterControl	Operator

8.5.4.5 Store group measurement results

When filters are measured, N single weighings are performed to produce a measurement group. An average and a standard deviation are calculated from these N single results. The data are saved in 'tblMeasurement', one record for each measurement group.

tblMeasurement

Field name	Type (C++)	Meaning	Notes
LFD	Integer	Unique number	According to query 'qryLFD', see above
CurrentTime	Date/Time	Local measurement time (including date).	Local on controller PC
StdID	String	Barcode-ID of standard weight	„“ if direct weighing
StdJobNo	Integer	Unique job number to identify the standard weight	FilterJobNo of standard weight, -1 of direct weighing.
TestID	String	Barcode-ID of testfilter	
TestJobNo	Integer	Unique job number to identify the testfilter	

N	Integer	Number of direct- or substitution weighings.	Missing if Status=1=Abort.
DiffAverage	Double	Average of N weighings	0.0 if Status=1=Abort
WeightB	Double	Weighing value of weight B	Direct weighing: =DiffAverage Substitution weighing: =DiffAverage +Value of Standard-weight A. 0.0 if Status=1=Abort..
StdDev	Double	Standard deviation of N weighings	0.0 if Status=1=Abort OR N=1
Status	Integer	0=OK, Filter weighing was successfully completed. 1=Weighing Aborted.	

Note: What happens if the measurement was aborted?

The weighing process can abort due to many reasons, for instance communication problems or a user stop. The measurement group currently in process will be aborted: A data record will be saved to table tblMeasurement, with Status=1=Weighing aborted, and the calculated numerical data (DiffAverage, WeightB, StdDev) will be set to 0.0.

If the database finds entries with Status=1 and the LFD-number is unique for each measurement group (see section 8.5.4.3), it can ignore all entries in tblMeasurement_Single with corresponding LFD-number.

8.6**Accessories**

Antistatic Ionizer in front of magazine	Order Nr: 11116995
Filter holder 47mm, per piece	Order Nr: 11116993
Filter holder 70mm, per piece	Order Nr: 30008635
Weight 100mg F_Line	Order Nr: 30008280
Weight 200mg F_Line	Order Nr: 30008281
Tweezers Filter Robot	Order Nr: 11116999

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Mettler-Toledo AG, Business Area Metrology, CH-8606 Greifensee, Switzerland
Phone: +41-44-944 22 11, Fax: +41-44-944 23 70, E-mail: metrology@mt.com, Internet: <http://www.mt.com>