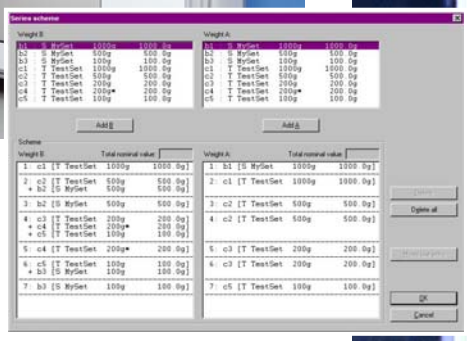
METTLER TOLEDO

Product Outline



a critical step in enhancing your mass standards lab !

METTLER TOLEDO

metrotec

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1 Introduction

Thank you for showing a keen interest in our **a1000**comparator - a smart weighing automaton! Combining METTLER TOLEDO's world-class weighing sensor technology with metrotec's specific, optimized system design, the '**a1000**comparator' - **a**utomated **1000** g mass comparator - gives a new dimension to high-resolution weighing.

Performance and reliability on the one hand, productivity on the other are of concern to metrologists. These aspects were given great attention throughout the development of the **a1000**comparator. This product offers new ways with respect not only to direct comparison, but to down-/upward calibration as well. **a1000**comparator and its smart, versatile **a1000**control software will become in no time indispensable to any mass standards laboratory. (**a1000**control is an original product designed jointly by metrotec engineering and Raillard engineering.)

Among **a1000**comparator's numerous remarkable features, let us highlight the essentials:

- "Turn-key" solution for automated comparison weighing processes
- Enhanced measurement quality (in terms of repeatability and reproducibility) and productivity
- Wide scope of application through large weight magazine (18 places) and advanced software capabilities
- Direct comparison and comparison between combinations of up to three weights
- Rugged design and hassle-free maintenance

We trust this 'Product Outline' will let you realise the tremendous potential which the **a1000**comparator represents to your mass standards laboratory. Should you request greater detail, please do contact us.

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2 System components

The **a1000**comparator comprises (see Figure 1):

- The semi-microbalance, METTLER TOLEDO AT1005 Comparator (balance, control unit and AC adapter)
- The 3-axis robot system with its associated control unit, located in the electrical rack
- The 3-row weight magazine, with 18 weight carriers
- The controller with installed Microsoft® Windows® based **a1000**control software.

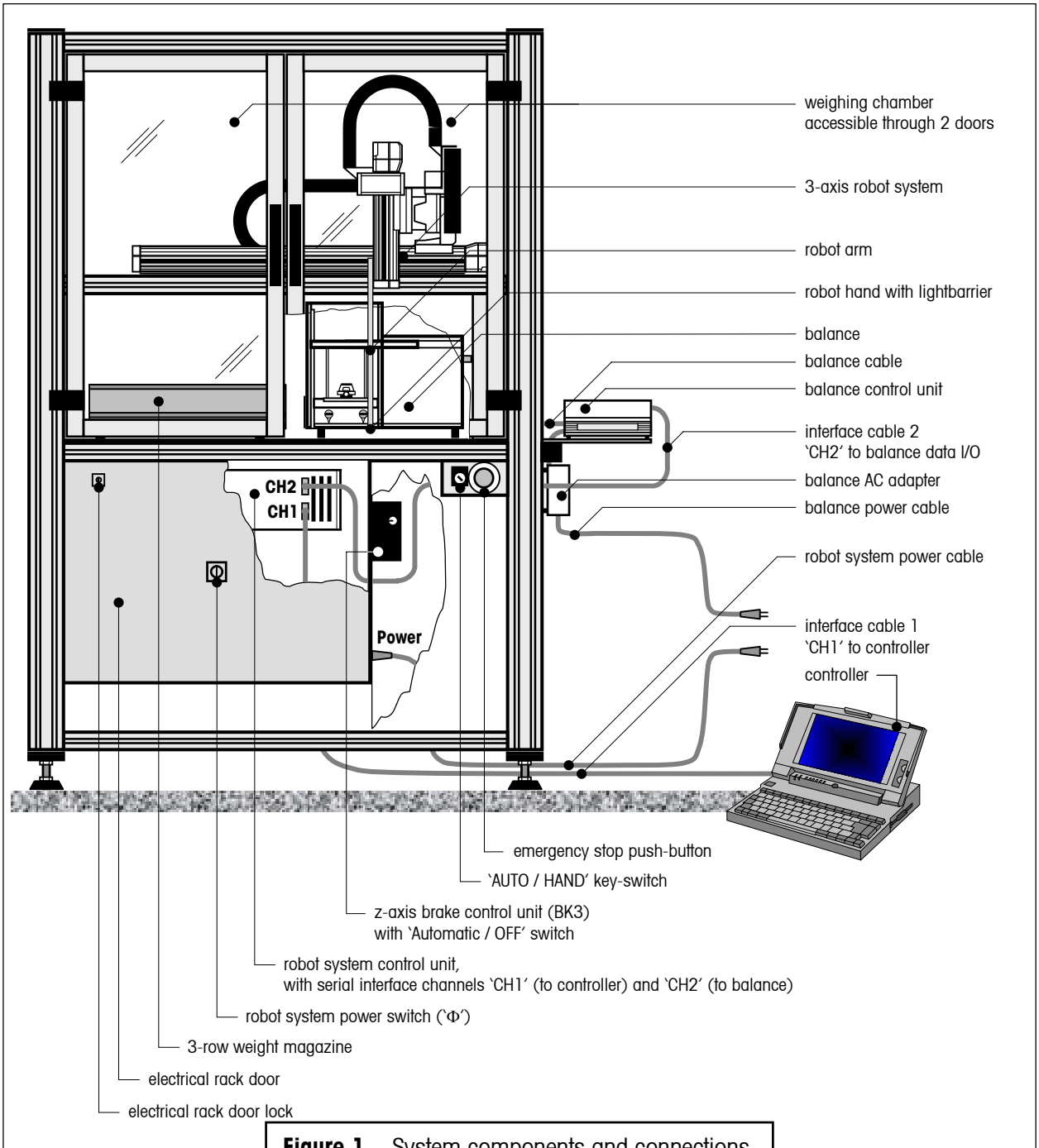


Figure 1 System components and connections

3 18-place weight magazine

The **a1000**comparator is delivered with an 18-place weight magazine, equipped with 18 weight carriers. Each test weight / standard used during the weighing process needs to be placed onto one weight carrier (see Figure 2).

Figure 2 Loading the weights onto the weight carriers, and the weight carriers onto the weight magazine

The selection of the adequate weight carrier type (design 1 or 3 - see Figure 3, 4 and 5) is determined by the weight geometry. Strict rules must be followed when it comes to choose, for each weight, the right carrier type, in order to ensure a trouble-free operation of the **a1000**comparator and to minimize corner load errors. Figures 6, 7 and 8 present the carrier selection criteria.

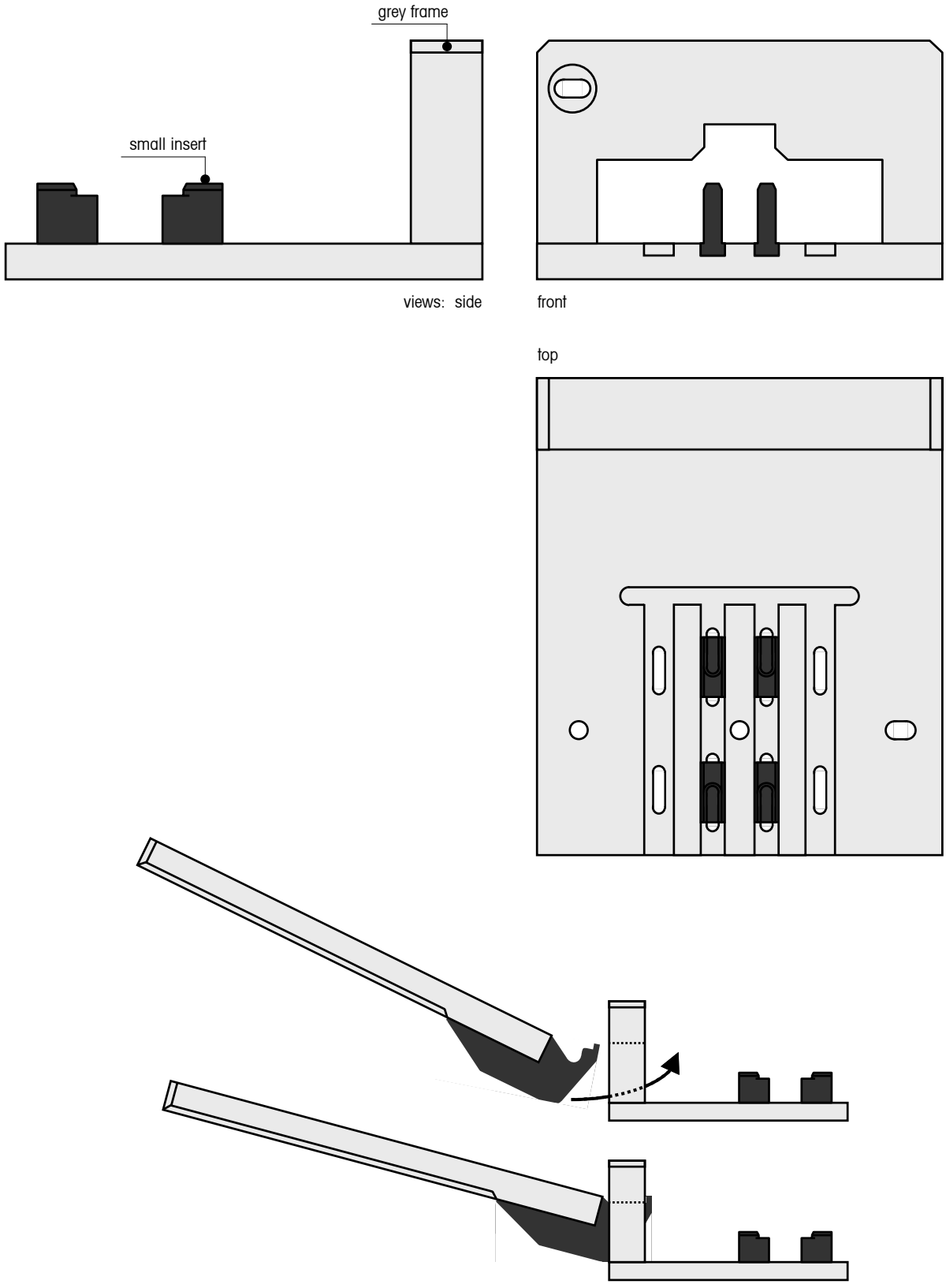


Figure 3 Standard weight carrier design 1, with small, inner inserts

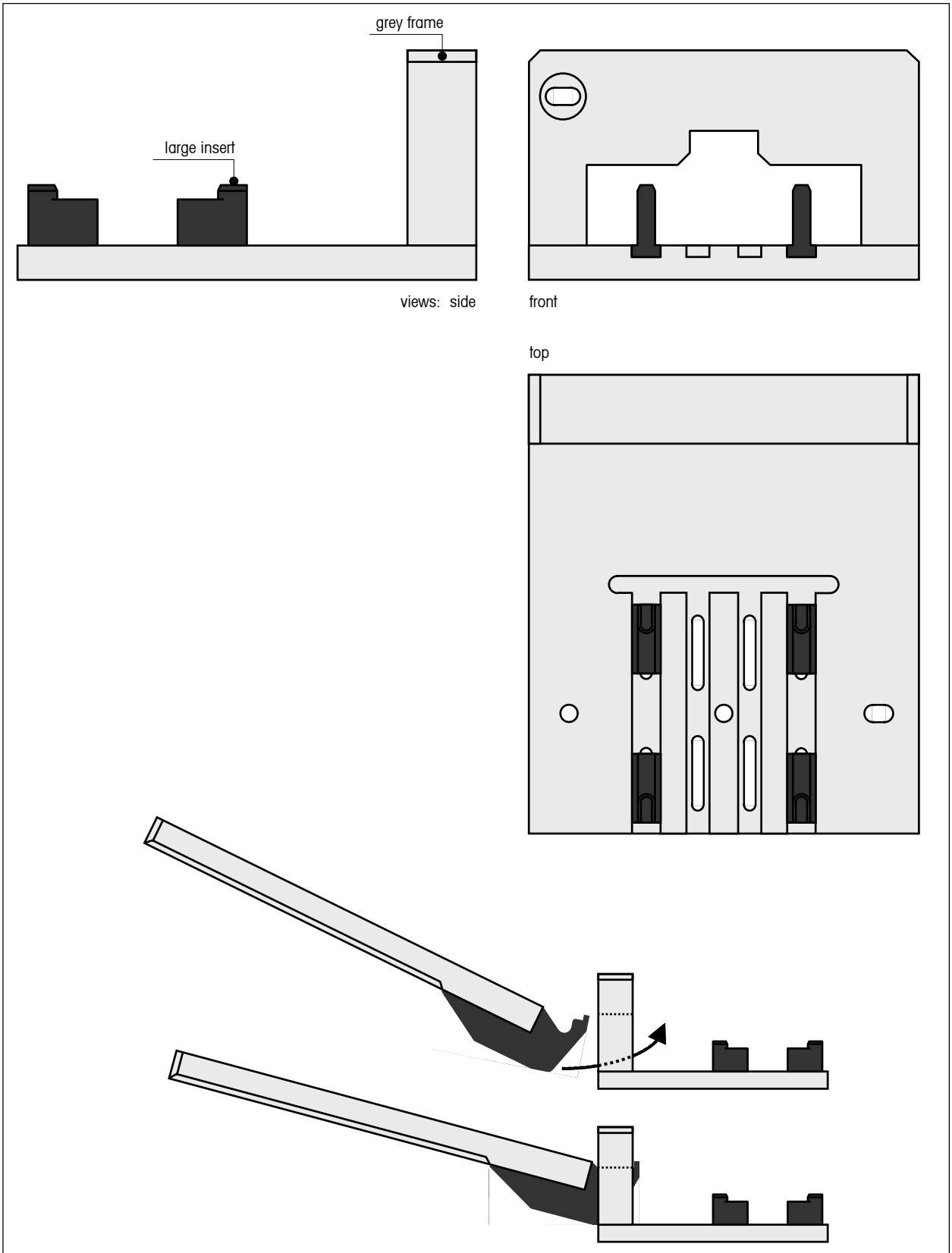


Figure 4 Standard weight carrier design 1, with large, outer inserts

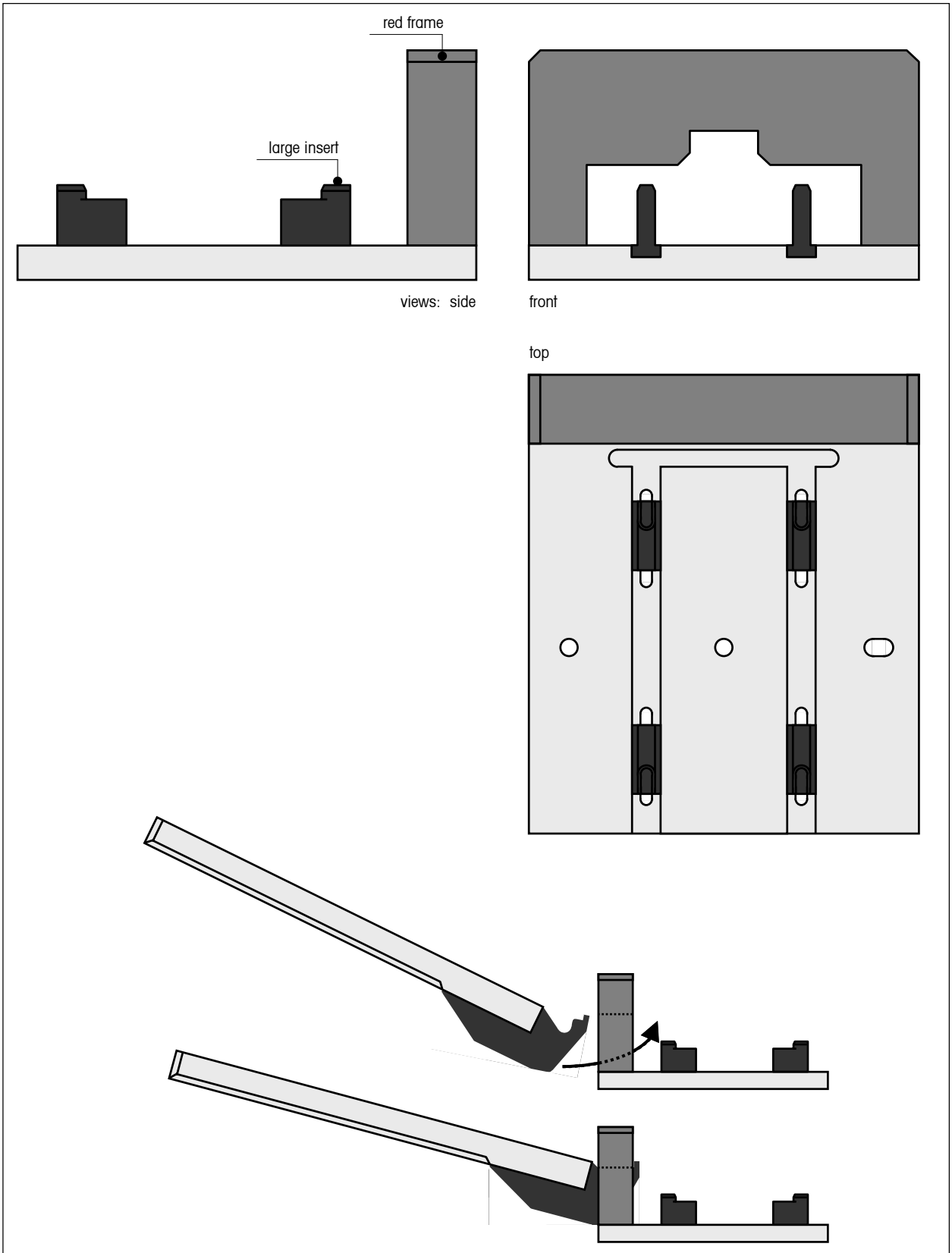
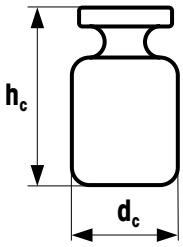
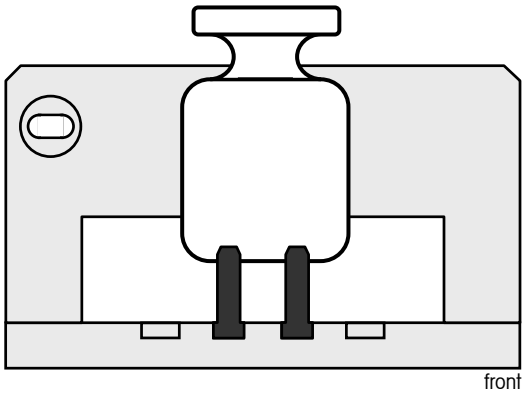
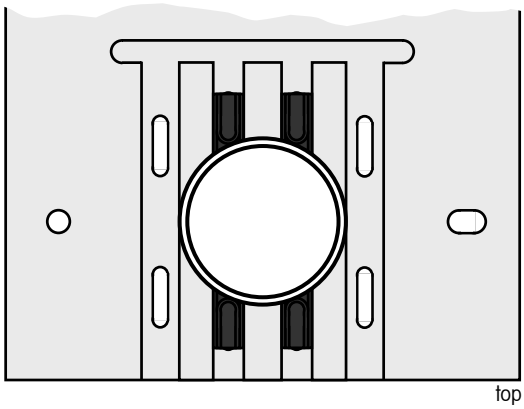


Figure 5 Standard weight carrier design 3, with large inserts

Weight shape	Weight dimensions	Weight carrier and inserts selection
Cylindrical with knob	diameter: **$10 < d_c \leq 30$ mm** height: **$h_c \leq 50$ mm**, if the weight and its carrier are placed on the front magazine row (positions no. a1-a6) **$h_c \leq 85$ mm**, if the weight and its carrier are placed on the middle or back magazine row (positions no. b1-b6, c1-c6)	**design 1, with set of 4 small, inner inserts**





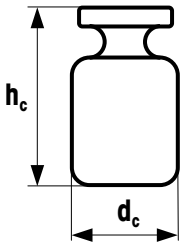


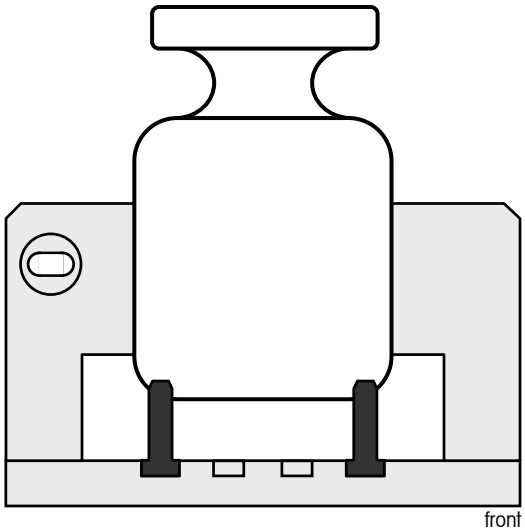
Warning: weights which do not fit in the above categories shall not be loaded on the above carrier.

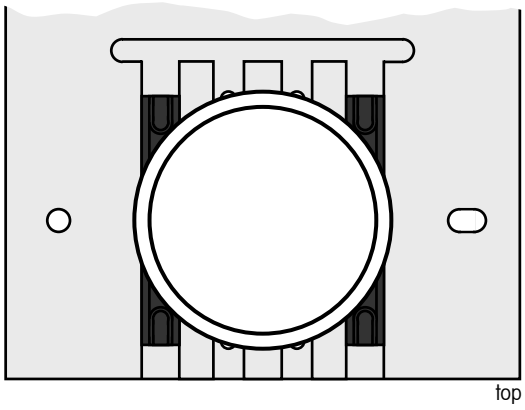
Combinations of up to three weights, placed each on its own carrier of design 1 (see above), can be weighed in the 'down-/upward calibration' mode. If a weight placed on a carrier of design 3 (see Figure 8) is involved in the combination, this is limited to two weights only (3-weight combination forbidden!).

Figure 6 Carrier selection guide and weight positioning

Weight shape	Weight dimensions	Weight carrier and inserts selection
Cylindrical with knob	diameter: **$30 < d_c \leq 38$ mm** height: **$h_c \leq 50$ mm**, if the weight and its carrier are placed on the front magazine row (positions no. a1-a6) **$h_c \leq 85$ mm**, if the weight and its carrier are placed on the middle or back magazine row (positions no. b1-b6, c1-c6)	**design 1, with set of 4 large, outer inserts**





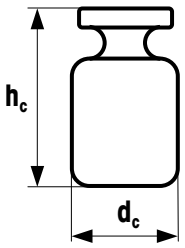


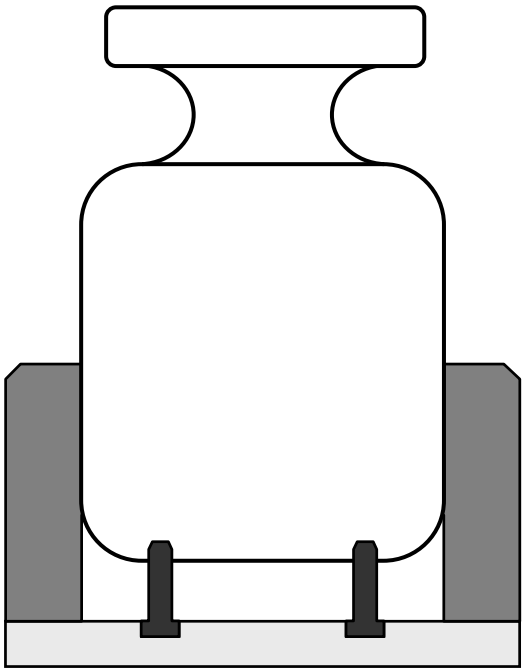
Warning: weights which do not fit in the above categories shall not be loaded on the above carrier.

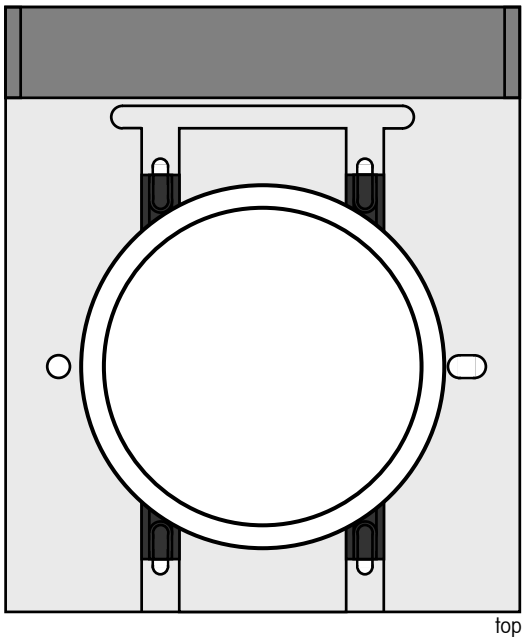
Combinations of up to three weights, placed each on its own carrier of design 1 (see above), can be weighed in the 'down-/upward calibration' mode. If a weight placed on a carrier of design 3 (see Figure 8) is involved in the combination, this is limited to two weights only (3-weight combination forbidden!).

Figure 7 Carrier selection guide and weight positioning (cont'd)

Weight shape	Weight dimensions	Weight carrier and inserts selection
Cylindrical with knob	diameter: **$35 < d_c \leq 60$ mm** height: **$h_c \leq 50$ mm**, if the weight and its carrier are placed on the front magazine row (position no. a1-a6) **$h_c \leq 85$ mm**, if the weight and its carrier are placed on the middle or back magazine row (positions no. b1-b6, c1-c6)	**design 3, with set of 4 large inserts**







Warning: weights which do not fit in the above categories shall not be loaded on the above standard carrier.

Combinations of up to three weights, placed each on its own carrier of design 1, can be weighed in the 'down-/upward calibration' mode. If a weight placed on a carrier of design 3 (see above) is involved in the combination, this is limited to two weights only (3-weight combination forbidden!).

Figure 8 Carrier selection guide and weight positioning (cont'd)

4 Performing a weighing process – a1000control makes it easy

A double mouse-click on the **a1000**control icon (‘a1000control.exe’)

a1000control

starts the program and opens a new, blank process settings file whose main window is shown in Figure 9.

Figure 9 **a1000**control - main window

4.1 Entering and editing the weights data

The ‘Weights’ menu (see Figure 10) gives access to the weights database which contains all relevant data on your standards and test weights. While the data on your test weights are, like other settings,

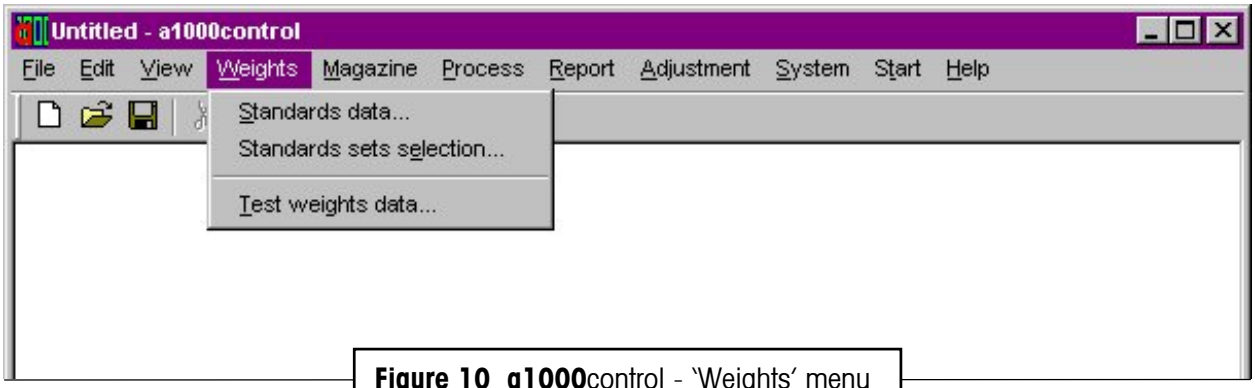


Figure 10 **a1000**control - ‘Weights’ menu

specific to the process and, thus, to the current settings file, the data on your standards are kept in a separate database: these data are specific to your mass standards laboratory, not to the weighing process, and, thus, need to be accessible from any settings file.

After selecting ‘Standards data…’ in the ‘Weights’ menu, the window shown in Figure 11 appears. A list box gives all records - all standards - which have been entered. The access to the standards data is password-protected. Once the password is accepted, you may proceed with modifications, i.e.:

- Adding new standards into the database
- Modifying existing standards
- Deleting one (all) existing standards

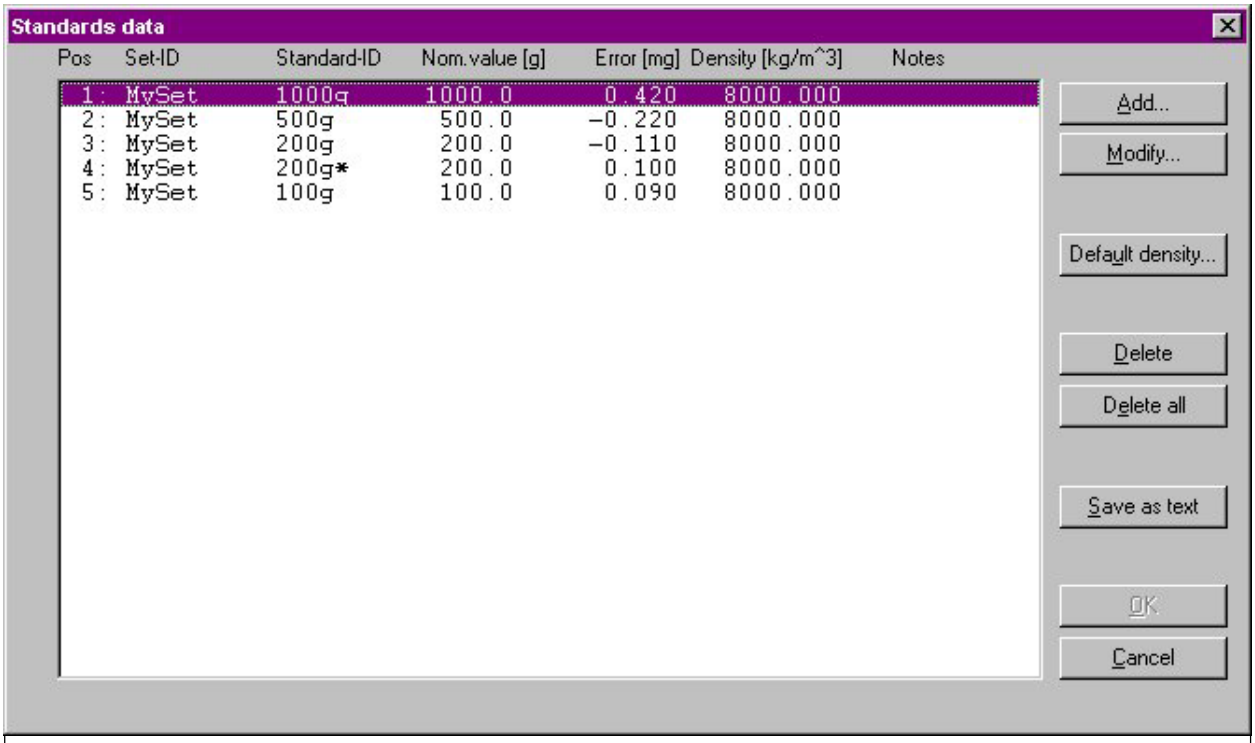


Figure 11 Entering / editing standards data

A window similar to Figure 11 gives access to the test weights database.

4.2 Allocating the weight magazine places

Once standards and test weights are defined in their respective database, their respective position on the weight magazine needs to be identified and registered in **a1000**control. This is done in the 'Allocation of weight magazine places' window shown in Figure 12. The upper list box contains all defined, and, thus, available weights; the lower one shows all available magazine places, identified by their number, from a1 (right) to a6 (left) for the front, lower magazine row, from b1 (right) to b6 (left) for the middle magazine row and from c1 (right) to c6 (left) for the back, upper magazine row.

To allocate one magazine place to one particular weight, simply:

- Select the weight by clicking on the proper record in the upper list box
- Select the magazine place you want to be allocated to the weight you just selected
- Press the 'Place' button

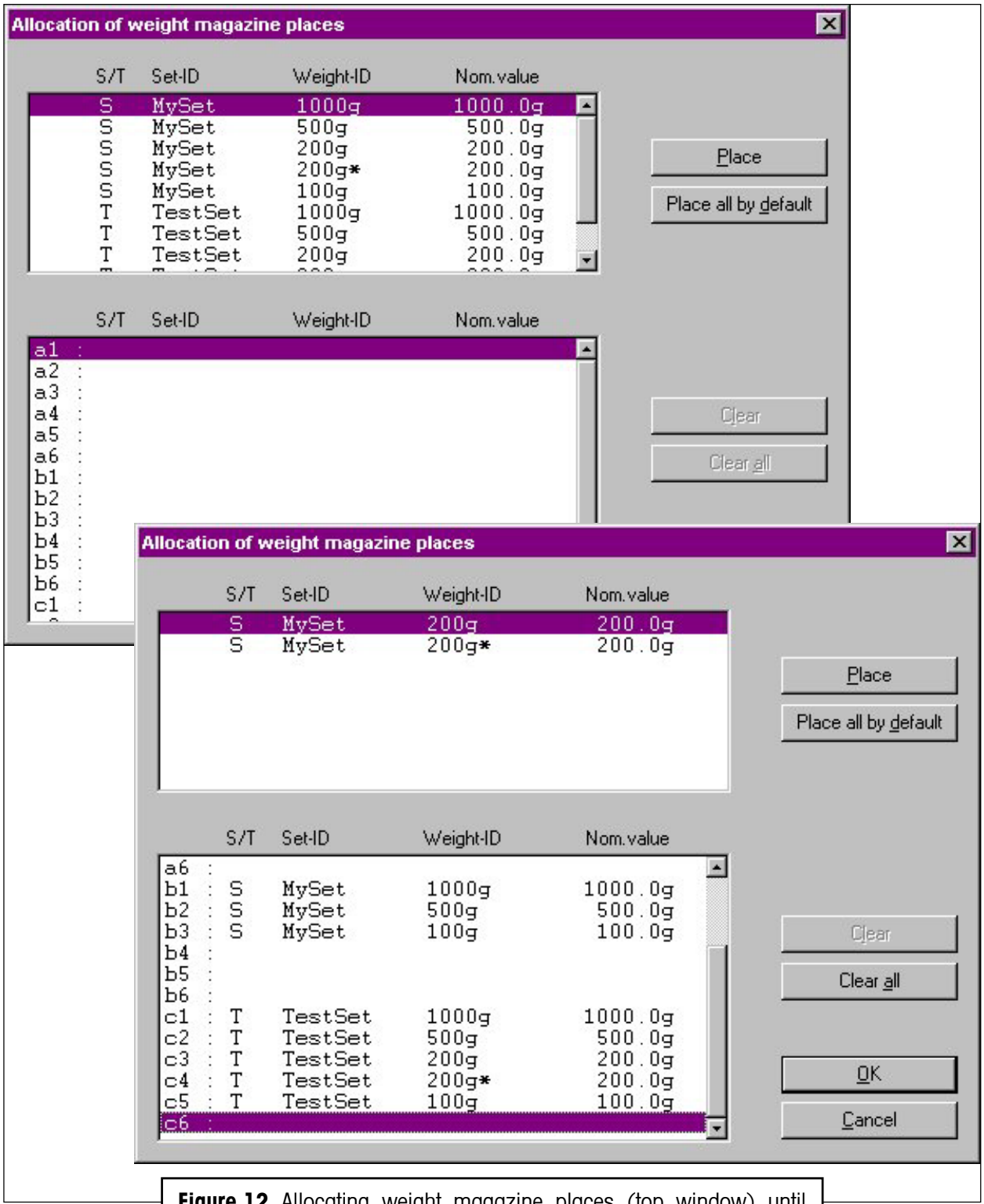


Figure 12 Allocating weight magazine places (top window) until all weights used during the process have got a magazine position assigned to them (bottom window)

4.3 Determining the weighing process settings and series scheme

After defining standards and test weights and determining on which magazine place each of these weights is located, the comparisons, of which the weighing process shall consist, as well as their precise timing and sequence are to be set. As shown in Figure 13, various parameters serve to determine the process, such as, in particular:

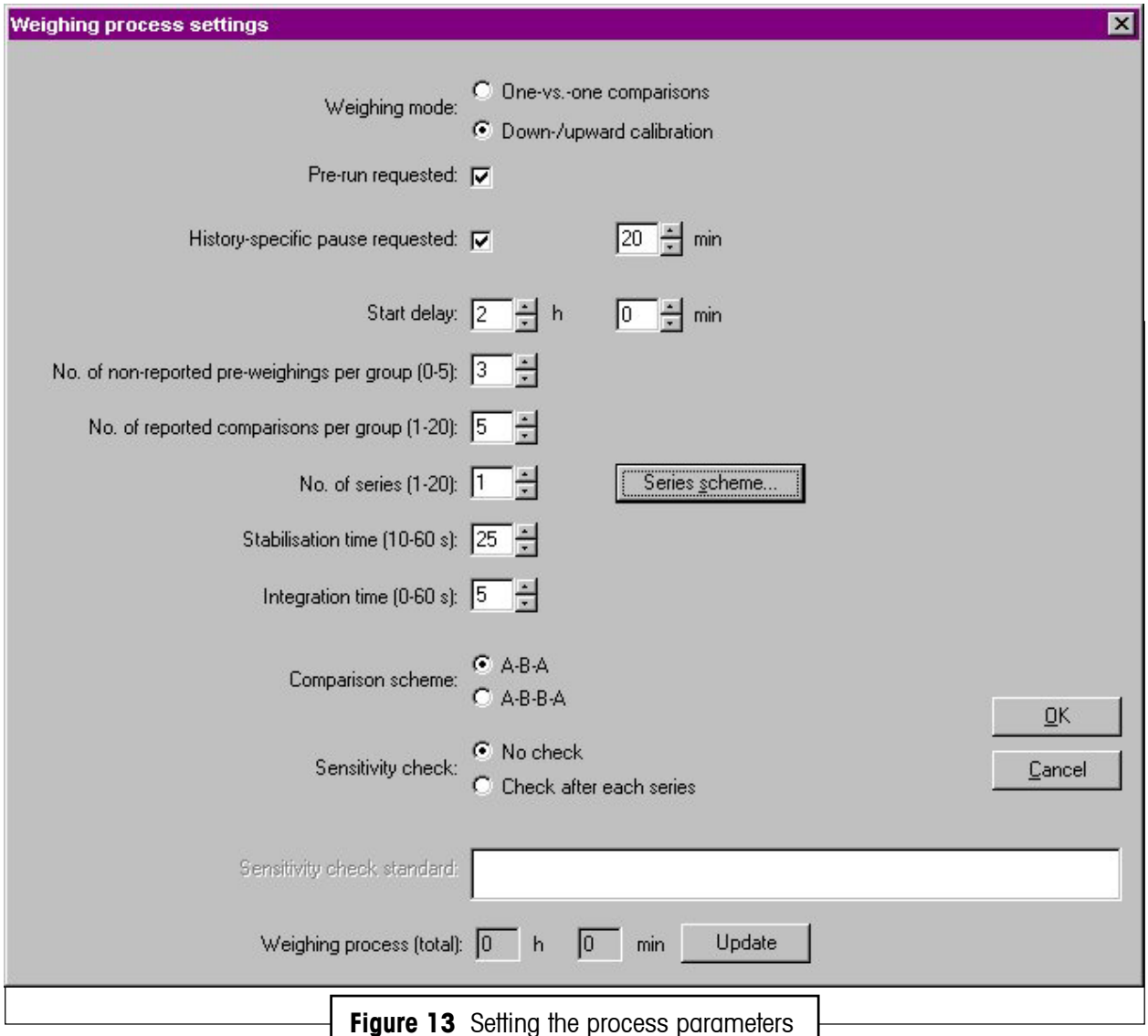


Figure 13 Setting the process parameters

- '**Weighing mode**': 'One-vs.-one comparisons' – direct comparisons, between a single weight B and a single weight A - or 'Down-/upward calibration' - comparison between two combinations of up to three weights each - (professional software edition; optional); the 'standard' software allows 'One-vs.-one comparisons' only
- '**Comparison scheme**': you may choose either the 'A-B-A' or 'A-B-B-A' scheme
- '**Sensitivity check**': should you wish to monitor the balance "sensitivity" during the weighing process, you may select 'Check after each series'; the sensitivity check - determination of the value of the check standard (to be selected) - will be performed before the first series starts and at the end of each series.

After setting these parameters, it remains to determine the series scheme (design), i.e. which comparisons shall be performed and in which sequence. A separate window ('Series scheme', see Figure 14) makes it as easy as it can possibly be. The upper list boxes 'Weight B:' and 'Weight A:' both contain all available weights, i.e. all test weights and all standards to which one magazine place is allocated. The series scheme, displayed in the lower list boxes ('Scheme - Weight B:' and 'Scheme - Weight A:'), consists of a list of comparisons between two combinations of up to three weights each. Each comparison is entered as follows:

- Select first the weight B by clicking on the proper record in the upper 'Weight B:' list box
- Press the 'Add B' button: the selected weight B is entered in the 'Scheme - Weight B:' list box
- If you wish to enter a combination of more than one weight, repeat the previous two steps (the symbol '+' in the 'Scheme' list boxes indicates that a combination is entered - see Figure 14 - and the total nominal value of the combination is displayed on the top of the 'Scheme' list boxes)
- Once the (combination of) weight(s) B is entered, select the weight A by clicking on the proper record in the upper 'Weight A:' list box
- Press the 'Add A' button: the selected weight A is entered in the 'Scheme - Weight A:' list box
- If you wish to enter a combination of more than one weight A, repeat the two previous steps.

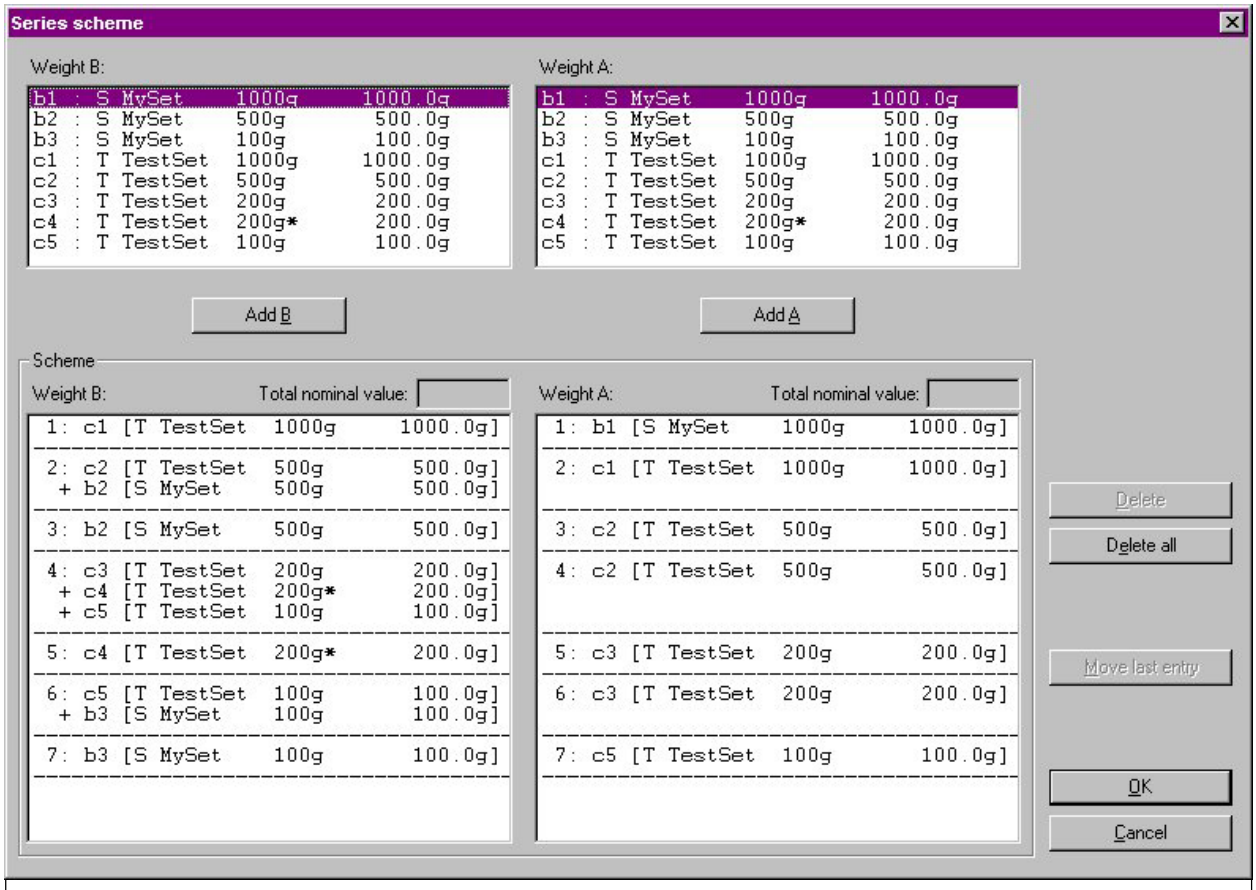


Figure 14 Complete series scheme in mode 'Down-/upward calibration'

4.4 Choosing the report contents

The weighing process is now defined: **a1000**control has registered which standards and test weights are involved in this process, where on the magazine these weights are located, it has registered the timing which has to be followed throughout the process and the scheme which defines all comparisons and their sequence. All parameters are set.

Before starting the weighing process, the contents of the report file can be defined, by selecting the information blocks you want to get reported:

- Weighing process settings
- Magazine places allocation
- Series scheme
- Balance settings
- Measurement data
- Summary of results.

4.5 Starting and monitoring the weighing process

The start command is given by selecting 'Start measurement' in the 'Start' menu. **a1000**control then displays some information on the process timing (see Figure 15). Once the "go" command is given, the weighing process monitor (see Figure 16) allows you to follow the process on-line, step by step. The two upper boxes 'Weight B:' and 'Weight A:' show which comparison is currently being carried out. The large text box records every single process step and displays the detailed measurement data, in a format which is similar to the report format. Furthermore, it provides in the 'status field' useful information on the current action, as well as valuable advice with respect to troubleshooting, should an error be detected.

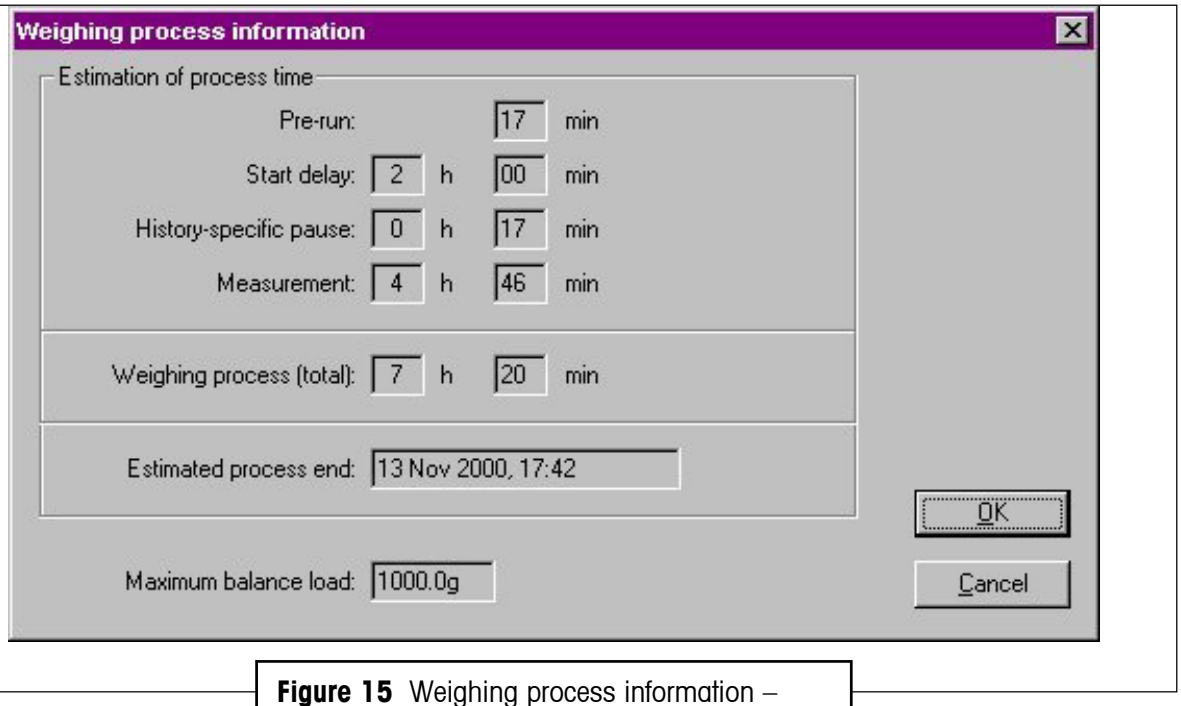


Figure 15 Weighing process information – Timing and maximum balance load

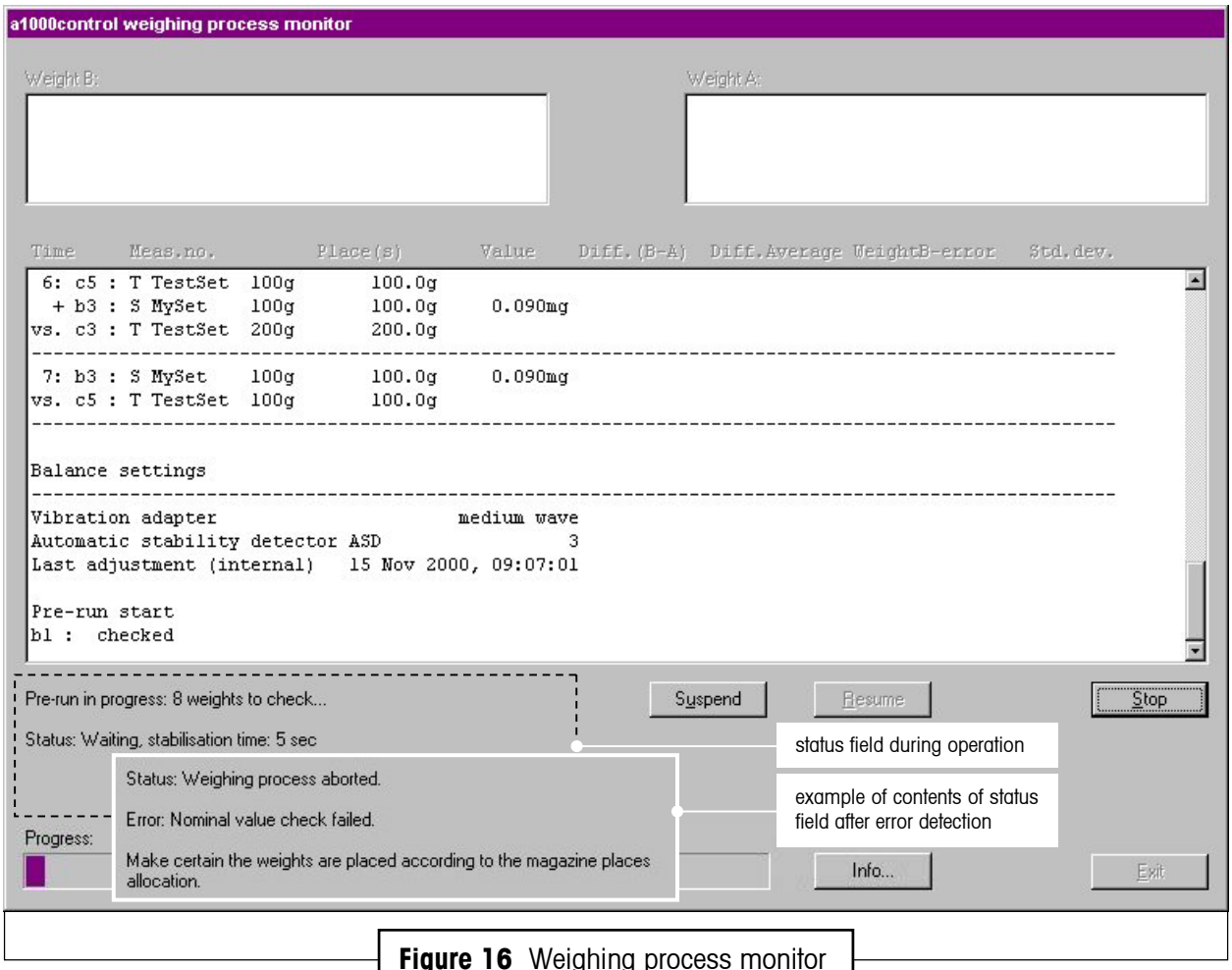


Figure 16 Weighing process monitor

4.6 Measurement report

The Figures 17, 18 and 19 show a report generated by **a1000**control after running a weighing process consisting of one series of 7 groups of 5 A-B-A comparison weighings. The selected weighing mode is 'Down-/upward calibration'. Figure 17 presents the report heading, Figure 18 the measurement data and Figure 19 the results summary table from which you get, at a glance, the essentials in a compact, but explicit format. Should the process consist of more than one series, the summary table indicates, in addition, the average of the difference averages.

```
a1000control v4.5 - measurement report

File: D:\metrotec\a1000comparator\a1000control\a1000control reports\TestReport.doc

a1000control settings defined in: D:\metrotec\a1000comparator\a1000control\1000g-100g.1e3

Start date                              15 Nov 2000    User                 metrotec engineering ag
Start time                                 18:09:33    Notes   determination of TestSet 1000g - 100g
Weighing process time [h:min]                 7:25

Weighing process settings
-------------------------------------------------------------------------------------------------
Pre-run done                                   Yes
History-specific pause enabled [min]            20
Start delay [h:min]                          02:00
No. of non-reported pre-weighings per group      3
No. of reported comparisons per group            5
No. of series                                    1
Comparison scheme                            A-B-A
Stabilisation time [s]                          25
Integration time [s]                             5
Sensitivity check done                         Yes   b3 : S MySet    100g       100.0g      0.090mg  8000.000kg/m^3

Magazine places allocation
-------------------------------------------------------------------------------------------------------------------------
    b1 : S MySet    1000g     1000.0g      0.420mg  8000.000kg/m^3
    b2 : S MySet    500g       500.0g     -0.220mg  8000.000kg/m^3
    b3 : S MySet    100g       100.0g      0.090mg  8000.000kg/m^3
    c1 : T TestSet  1000g     1000.0g               8000.000kg/m^3
    c2 : T TestSet  500g       500.0g               8000.000kg/m^3
    c3 : T TestSet  200g       200.0g               8000.000kg/m^3
    c4 : T TestSet  200g*      200.0g               8000.000kg/m^3
    c5 : T TestSet  100g       100.0g               8000.000kg/m^3

Series scheme (B vs. A)
-------------------------------------------------------------------------------------------------------------------------
 1: c1 : T TestSet  1000g     1000.0g               8000.000kg/m^3
vs. b1 : S MySet    1000g     1000.0g      0.420mg  8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------------
 2: c2 : T TestSet  500g       500.0g               8000.000kg/m^3
  + b2 : S MySet    500g       500.0g     -0.220mg  8000.000kg/m^3
vs. c1 : T TestSet  1000g     1000.0g               8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------------
 3: b2 : S MySet    500g       500.0g     -0.220mg  8000.000kg/m^3
vs. c2 : T TestSet  500g       500.0g               8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------------
 4: c3 : T TestSet  200g       200.0g               8000.000kg/m^3
  + c4 : T TestSet  200g*      200.0g               8000.000kg/m^3
  + c5 : T TestSet  100g       100.0g               8000.000kg/m^3
vs. c2 : T TestSet  500g       500.0g               8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------------
 5: c4 : T TestSet  200g*      200.0g               8000.000kg/m^3
vs. c3 : T TestSet  200g       200.0g               8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------------
 6: c5 : T TestSet  100g       100.0g               8000.000kg/m^3
  + b3 : S MySet    100g       100.0g      0.090mg  8000.000kg/m^3
vs. c3 : T TestSet  200g       200.0g               8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------------
 7: b3 : S MySet    100g       100.0g      0.090mg  8000.000kg/m^3
vs. c5 : T TestSet  100g       100.0g               8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------------

Balance settings
-------------------------------------------------------------------------------------------------------------------------
Mass comparator ID                          AX1005
Environment                               very stable
Value release                               very fast
Last adjustment (internal)   13 Nov 2000, 17:13:25

Climate data
-------------------------------------------------------------------------------------------------------------------------
Climate data input                           online
Climate measuring instrument              Klimet A30
```

Figure 17 Report - Part 1: heading and process settings

Day/Time	Meas.no.	Place(s)	Value	Diff.(B-A)	Diff.average	WeightB-error	Std.dev.	Press.[hPa]	rel.Hum.[%]	T1[degr.C]	T2[degr.C]	T3[degr.C]	T4[degr.C]
15/20:28:51	00 sc	0	-0.260					972.213	37.94	22.658	22.315	22.691	22.710
15/20:30:03	00 sc	b3	99999.850					972.213	37.94	22.658	22.315	22.691	22.710
15/20:31:15	00 sc	0	-0.230	100000.095	100000.095			972.177	37.64	22.668	22.336	22.695	22.714
15/20:42:17	010101A	b1	-654.770					972.213	37.94	22.658	22.315	22.691	22.710
15/20:43:52	010101B	c1	-654.230					972.213	37.94	22.658	22.315	22.691	22.710
15/20:45:27	010101A	b1	-654.770	0.540				972.177	37.64	22.668	22.336	22.695	22.714
15/20:47:01	010102B	c1	-654.220					972.177	37.64	22.668	22.336	22.695	22.714
15/20:48:36	010102A	b1	-654.770					972.203	37.46	22.677	22.348	22.697	22.714
15/20:50:11	010102B	c1	-654.230	0.545				972.203	37.46	22.677	22.348	22.697	22.714
15/20:51:46	010103A	b1	-654.770					972.207	37.31	22.679	22.353	22.685	22.704
15/20:53:20	010103B	c1	-654.220					972.146	37.16	22.683	22.356	22.678	22.699
15/20:54:55	010103A	b1	-654.760	0.545				972.146	37.16	22.683	22.356	22.678	22.699
15/20:56:29	010104B	c1	-654.220					972.138	37.11	22.687	22.363	22.677	22.700
15/20:58:04	010104A	b1	-654.760					972.138	37.11	22.687	22.363	22.677	22.700
15/20:59:38	010104B	c1	-654.210	0.545				972.104	36.97	22.691	22.371	22.680	22.702
15/21:01:13	010105A	b1	-654.760					972.036	36.90	22.706	22.402	22.712	22.731
15/21:02:48	010105B	c1	-654.220					972.036	36.90	22.706	22.402	22.712	22.731
15/21:04:23	010105A	b1	-654.758	0.539	0.543	0.827	0.003	972.038	36.73	22.716	22.417	22.717	22.739
15/21:26:41	010201A	c1	-654.170					972.213	37.94	22.658	22.315	22.691	22.710
15/21:28:56	010201B	c2 + b2	-656.755					972.213	37.94	22.658	22.315	22.691	22.710
15/21:31:11	010201A	c1	-654.160	-2.590				972.177	37.64	22.668	22.336	22.695	22.714
15/21:33:26	010202B	c2 + b2	-656.760					972.177	37.64	22.668	22.336	22.695	22.714
15/21:35:41	010202A	c1	-654.158					972.203	37.46	22.677	22.348	22.697	22.714
15/21:37:55	010202B	c2 + b2	-656.747	-2.596				972.203	37.46	22.677	22.348	22.697	22.714
15/21:40:09	010203A	c1	-654.140					972.207	37.31	22.679	22.353	22.685	22.704
15/21:42:24	010203B	c2 + b2	-656.745					972.146	37.16	22.683	22.356	22.678	22.699
15/21:44:38	010203A	c1	-654.148	-2.601				972.146	37.16	22.683	22.356	22.678	22.699
15/21:46:52	010204B	c2 + b2	-656.750					972.138	37.11	22.687	22.363	22.677	22.700
15/21:49:06	010204A	c1	-654.150					972.138	37.11	22.687	22.363	22.677	22.700
15/21:51:21	010204B	c2 + b2	-656.730	-2.590				972.104	36.97	22.691	22.371	22.680	22.702
15/21:53:34	010205A	c1	-654.130					972.036	36.90	22.706	22.402	22.712	22.731
15/21:55:50	010205B	c2 + b2	-656.720					972.036	36.90	22.706	22.402	22.712	22.731
15/21:58:04	010205A	c1	-654.110	-2.600	-2.595		0.005	972.038	36.73	22.716	22.417	22.717	22.739
15/22:09:25	010301A	c2	-589.180					972.213	37.94	22.658	22.315	22.691	22.710
15/22:11:01	010301B	b2	-591.010					972.213	37.94	22.658	22.315	22.691	22.710
15/22:12:37	010301A	c2	-589.180	-1.830				972.177	37.64	22.668	22.336	22.695	22.714
15/22:14:12	010302B	b2	-591.010					972.177	37.64	22.668	22.336	22.695	22.714
15/22:15:48	010302A	c2	-589.170					972.203	37.46	22.677	22.348	22.697	22.714
15/22:17:23	010302B	b2	-591.003	-1.836				972.203	37.46	22.677	22.348	22.697	22.714
15/22:18:58	010303A	c2	-589.170					972.207	37.31	22.679	22.353	22.685	22.704
15/22:20:35	010303B	b2	-591.000					972.146	37.16	22.683	22.356	22.678	22.699
15/22:22:10	010303A	c2	-589.165	-1.832				972.146	37.16	22.683	22.356	22.678	22.699
15/22:23:46	010304B	b2	-591.003					972.138	37.11	22.687	22.363	22.677	22.700
15/22:25:22	010304A	c2	-589.180					972.138	37.11	22.687	22.363	22.677	22.700
15/22:26:57	010304B	b2	-591.010	-1.826				972.104	36.97	22.691	22.371	22.680	22.702
15/22:28:32	010305A	c2	-589.178					972.036	36.90	22.706	22.402	22.712	22.731
15/22:30:08	010305B	b2	-591.010					972.036	36.90	22.706	22.402	22.712	22.731
15/22:31:43	010305A	c2	-589.160	-1.841	-1.833		0.006	972.038	36.73	22.716	22.417	22.717	22.739
15/22:54:50	010401A	c2	-589.132					972.213	37.94	22.658	22.315	22.691	22.710
15/22:57:54	010401B	c3 + c5 + c4	-580.110					972.213	37.94	22.658	22.315	22.691	22.710
15/23:00:55	010401A	c2	-589.130	9.021				972.177	37.64	22.668	22.336	22.695	22.714
15/23:03:59	010402B	c3 + c5 + c4	-580.110					972.177	37.64	22.668	22.336	22.695	22.714
15/23:07:00	010402A	c2	-589.136					972.203	37.46	22.677	22.348	22.697	22.714
15/23:10:04	010402B	c3 + c5 + c4	-580.110	9.026				972.203	37.46	22.677	22.348	22.697	22.714
15/23:13:05	010403A	c2	-589.130					972.207	37.31	22.679	22.353	22.685	22.704
15/23:16:08	010403B	c3 + c5 + c4	-580.110					972.146	37.16	22.683	22.356	22.678	22.699
15/23:19:09	010403A	c2	-589.120	9.015				972.146	37.16	22.683	22.356	22.678	22.699
15/23:22:11	010404B	c3 + c5 + c4	-580.110					972.138	37.11	22.687	22.363	22.677	22.700
15/23:25:11	010404A	c2	-589.130					972.138	37.11	22.687	22.363	22.677	22.700
15/23:28:14	010404B	c3 + c5 + c4	-580.112	9.019				972.104	36.97	22.691	22.371	22.680	22.702
15/23:31:16	010405A	c2	-589.130					972.036	36.90	22.706	22.402	22.712	22.731
15/23:34:19	010405B	c3 + c5 + c4	-580.110					972.036	36.90	22.706	22.402	22.712	22.731
15/23:37:20	010405A	c2	-589.120	9.015	9.019		0.005	972.038	36.73	22.716	22.417	22.717	22.739

Figure 18 Report - Part 2: measurement data

```
Series scheme (B vs. A) and summary of results (in mg)                        Diff.average WeightB-error   Std.dev.
-------------------------------------------------------------------------------------------------------------------
 1: c1 : T TestSet  1000g     1000.0g              8000.000kg/m^3  Series 1:         0.543         0.827      0.003
vs. b1 : S MySet    1000g     1000.0g      0.420mg 8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------
 2: c2 : T TestSet  500g       500.0g              8000.000kg/m^3  Series 1:        -2.595                    0.005
  + b2 : S MySet    500g       500.0g     -0.220mg 8000.000kg/m^3
vs. c1 : T TestSet  1000g     1000.0g              8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------
 3: b2 : S MySet    500g       500.0g     -0.220mg 8000.000kg/m^3  Series 1:        -1.833                    0.006
vs. c2 : T TestSet  500g       500.0g              8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------
 4: c3 : T TestSet  200g       200.0g              8000.000kg/m^3  Series 1:         9.019                    0.005
  + c4 : T TestSet  200g*      200.0g              8000.000kg/m^3
  + c5 : T TestSet  100g       100.0g              8000.000kg/m^3
vs. c2 : T TestSet  500g       500.0g              8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------
 5: c4 : T TestSet  200g*      200.0g              8000.000kg/m^3  Series 1:         6.090                    0.007
vs. c3 : T TestSet  200g       200.0g              8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------
 6: c5 : T TestSet  100g       100.0g              8000.000kg/m^3  Series 1:         3.653                    0.004
  + b3 : S MySet    100g       100.0g     0.090mg  8000.000kg/m^3
vs. c3 : T TestSet  200g       200.0g              8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------
 7: b3 : S MySet    100g       100.0g     0.090mg  8000.000kg/m^3  Series 1:        -3.539                    0.004
vs. c5 : T TestSet  100g       100.0g              8000.000kg/m^3
-------------------------------------------------------------------------------------------------------------------
sc: b3 : S MySet    100g       100.0g     0.090mg  8000.000kg/m^3     Start:    100000.095
                                                                   Series 1:    100000.095
-------------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------------
```

Figure 19 Report - Part 3: summary of results

Indication of corner load error

a1000control automatically handles the comparison of two weight combinations in such a way (placing sequence) that the remaining corner load error is minimized. In the case of a comparison '200 g + 200 g + 100 g' vs. '500 g', the combination entered as '200 g + 200 g + 100 g' will be placed onto the balance pan in the sequence '200 g + 100 g + 200 g': the center of gravity of the weights combination is located on the same vertical axis as the 500 g weight and, consequently, the remaining corner load error equals zero. However, in certain cases, in particular when non OIML weights are involved in a combination (e.g. '300 g + 200 g' vs. '500 g'), a certain error due to corner load remains. Knowing the measured corner load error, **a1000**control calculates for each comparison the remaining error due to corner load and, if not zero, indicates it under 'CrLd-err' in the results summary table of the measurement report (see Figure 20).

```
Series scheme (B vs. A) and summary of results (in mg)          Diff.average WeightB-error   Std.dev.
-------------------------------------------------------------------------------------------------------
 1: b10: T TestSet  300g       300.0g              Series 1:         0.460         0.240      0.005
  + b9 : T TestSet  200g       200.0g              Series 2:         0.458         0.238      0.004
vs. b8 : S MySet    500g       500.0g     -0.220mg Average :         0.459         0.239
                                                 CrLd-err:        -0.060
-------------------------------------------------------------------------------------------------------
```

Figure 20 Indication of corner load error

4.7 "Remote-controlling" the a1000comparator

The weighing process settings may need to be generated by a central laboratory information management system, such as for instance the 'Automated Mass Measurement System' (AMMS) supplied by Measurement Technology Laboratories (Minneapolis, USA), and imported from this system into **a1000**control. Furthermore certain commands may need to be sent to **a1000**control from this central system, in order to let this system "remote-control" the **a1000**comparator. **a1000**control offers such an interface which fully meets these requirements.

4.7.1 Generating a file importable into a1000control as settings file

As above mentioned, the ability of **a1000**control to import a settings file generated by a central information management system is indispensable to certain laboratories. To achieve this, a text file needs to be produced by this central system according to well-defined format rules, so that it becomes convertible into a regular, **a1000**control-compatible settings file (see Figure 22 and following table). Figure 21 presents an example of such a text file, named 'ImportDemo.imp' and containing all necessary settings.

```
JOB: ImportDemo
a1000control 3
HEADER:
<This is an optional 3-line text block which appears in a message box
when the new settings file (imported and converted into a1000control)
is loaded>
END HEADER
PROCESS:
1 1 2 0 3 5 1 A-B-A 25 5 b3 20
END PROCESS
MAGAZINE:
b1 S MySet 1000g 1000 0.42 8000.0
b2 S MySet 500g 500 -0.22 8000.0
b3 S MySet 100g 100 0.09 8000.0
c1 T TestSet 1000g 1000
c2 T TestSet 500g 500
c3 T TestSet 200g 200
c4 T TestSet 200g* 200
c5 T TestSet 100g 100
END MAGAZINE
SCHEME:
c1 VS. b1
c2+b2 VS. c1
b2 VS. c2
c3+c4+c5 VS. c2
c4 VS. c3
c5+b3 VS. c3
b3 VS. c5
END SCHEME
REPORT:
metrotec engineering ag
C:\Programs\a1000control\DemoOutput
END REPORT
END JOB ImportDemo
```

Figure 21 Example of a text file convertible into a settings file by **a1000**control

```
JOB: strJobID<CR LF>
strAppName intDocVersion<CR LF>
[HEADER:<CR LF>
strHeaderLine<CR LF>
[strHeaderLine<CR LF>
[strHeaderLine<CR LF>]]
END HEADER]
PROCESS:<CR LF>
blnWeighingMode blnPreRun intStartDelayHours intStartDelayMinutes
intNonReportedPreweighings intReportedComparisons intSeries
strComparisonScheme intStabilisationTime intIntegrationTime
strSensitivityCheck intHistorySpecificPause<CR LF>
END PROCESS<CR LF>
MAGAZINE:<CR LF>
strPosID strWeightType strSetID strWeightID decNominal[ decError]<CR LF>
[…]
END MAGAZINE<CR LF>
SCHEME:<CR LF>
strCombination VS. strCombination<CR LF>
[…]
END SCHEME<CR LF>
REPORT:<CR LF>
strUserName<CR LF>
strFileName<CR LF>
END REPORT<CR LF>
END JOB strJobID<CR LF>
```

Figure 22 Format of a text file convertible into an **a1000**control settings file (<CR LF> means 'carriage return linefeed' and [ ] optional)

Parameter designation	Value (range)	Description
strJobID	<no limitation>	string of characters used as job identification
strAppName	'a1000control'	designation of control software used
intDocVersion	3	document version used as internal reference to the settings definition and its history
strHeaderLine	<no limitation>	text appearing in a message box when loading the imported and converted settings file
blnWeighingMode	0 | 1	'0' = 1 vs. 1 comparisons, '1' = down-/upward calibration
blnPrerun	0 | 1	'0' = pre-run not requested, '1' = pre-run requested
intStartDelayHours	0 – 99	integer, number of hours in time requested as start delay
intStartDelayMinutes	0 – 59	integer, number of minutes in time requested as start delay
intNonReportedPreweighings	0 – 5	integer, number of non-reported pre-weighings per group

Parameter designation	**Value (range)**	**Description** (cont'd)
intReportedComparisons	1 – 20	integer, number of reported comparisons per group
intSeries	1 – 20	integer, number of series
strComparisonScheme	'A-B-A' | 'A-B-B-A'	comparison scheme
intStabilisationTime	10 – 60	integer, stabilisation time in seconds
intIntegrationTime	0 – 60	integer, integration time in seconds
strSensitivityCheck	strPosID | 'NO'	mag. place of sens. check standard if check done, 'NO' if not
intHistorySpecificPause	0 – 60	integer, duration of history-specific pause in minutes
strPosID	'a' | 'b' | 'c' & '1' | '2' | …| '6'	magazine position number: a1 to a6, b1 to b6, c1 to c6
strWeightType	'S' | 'T'	'S' = standard, 'T' = test weight
strSetID	<maximum 8 characters>	string of maximum 8 characters, weight set identification
strWeightID	<maximum 8 characters>	string of maximum 8 characters, weight identification
decNominal	0 – 1109	number (with decimal), weight nominal value in g
decError	<no limitation, in principle>	number (with decimal), error in mg given for standards only (i.e. strWeightType = 'S')
strCombination	strPosID[+strPosID [+strPosID]]	string consisting of up to 3 different magazine positions, separated by the '+' sign
strUserName	<maximum 54 characters>	string of maximum 54 characters (including spaces), user identification
strFileName	<file location path and name>	name of report file, without extension, and its location on disk

Meaning of the symbols used in the above table

'< >' delimits a comment on the value of a parameter, '–' means 'up to', ' \| ' stands for 'or', '[ ]' delimits an optional block and '&' indicates the concatenation of two strings of characters.

The file generated according to the above rules (extension '.imp') can now be imported into **a1000**control and converted into a settings file. Before doing so, you need to choose the data import mode between importing from file (accessible locally on disk or via local area network) and importing via a serial communication port. Should the latter be selected, a second serial communication port has to be available - in addition to the port used for communication to the **a1000**comparator weighing machine.

4.7.2 Communicating via the serial port

As mentioned earlier on, the `.imp' text file generated by the laboratory information management system (LIMS) can be imported into **a1000**control via a serial communication port.

The communication protocol is fixed: 2400 baud, 7 data bits, 1 stop bit, parity even; besides, a fixed time out of 3 seconds is defined during which the reply to a request for data must be sent. To ensure a smooth exchange of information between the LIMS and **a1000**control, the following set of commands is available:

Task, description	**Command a1000**control ➔ **LIMS**	**Command LIMS ➔ a1000**control
Requesting list of pending jobs, pressing 'Get job list' button	JOB ?<CR LF>	
Sending list of pending jobs (empty list if none available)		JOB[strJobID[strJobID[…]]]<CR LF>
Requesting one particular job, pressing 'Load job' command button	JOB strJobID<CR LF>	
Sending one particular job		<text file as described in Section 4.7.1>
Accepting job (file syntax and consistency o.k.), saving job as settings file	JOB strJobID OK<CR LF>	
Rejecting job (file syntax and consistency not o.k.)	JOB strJobID DENIED<CR LF>	
Advising of job start and estimated duration, before pre-run/centering starts	JOB strJobID STARTS DURATION: intHours:intMinutes<CR LF>	
Advising of job end, after job successfully completed	JOB strJobID SUCCESSFULLY ENDED<CR LF>	
Advising of job end due to program failure, after program aborted	JOB strJobID ABORTED<CR LF>	
Advising of job end due to 'Abort' command given by user	JOB strJobID ABORTED BY USER<CR LF>	

The output data, i.e. the measurement results, can be sent out via the serial communication port and processed on line by the LIMS. While the weighing process is running, **a1000**control sends out the measurement data - without heading -, contained in the first four columns ('Time', 'Measurement number', 'Place(s)' and 'Value') of the measurement data block of the report presented in Figure 18, for example:

```
20:28:51  00   sc              0       -0.260<CR LF>
20:30:03  00   sc             b3     99999.850<CR LF>
20:31:15  00   sc              0       -0.230<CR LF>
20:42:17  010101A              b1      -654.770<CR LF>
20:43:52  010101B              c1      -654.230<CR LF>
20:45:27  010101A              b1      -654.770<CR LF>
...
01:44:46  01   sc              0        0.040<CR LF>
01:45:57  01   sc             b3   100000.140<CR LF>
01:47:09  01   sc              0        0.050<CR LF>
```

After the weighing process is successfully completed, **a1000**control sends out via the serial port a final data block containing the corner load error, in mg, calculated for each measurement group. The block format is as follows:

```
CORNERLOAD decCrLd_err1[ decCrLd_err2[ decCrLd_err3[ …]]]<CR LF>
```

where 'decCrLd_err1' is the corner load error calculated for the first measurement group, 'decCrLd_err2' the corner load error calculated for the second measurement group etc. Should the error calculated for a particular group equal zero or not have been measured, the value indicated for the error is 'NO' or 'UNKNOWN' respectively. An example of a complete block is given below, advising of the following corner load errors: 0 for the first group, 0.060 mg for the second group, -0.050 mg for the third group and 'unknown' because not measured for the fourth and last group.

```
CORNERLOAD NO 0.060 -0.050 UNKNOWN<CR LF>
```

4.7.3 Upgrading a1000control

To upgrade (see Figure 23) the **a1000**control to the 'professional' one (optional; Down/-upward calibration), or to enable online climate data input (optional; Temperature, Relative humidity, Pressure), you need to purchase the software options separately.

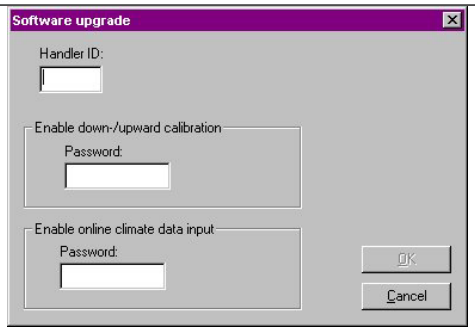


Figure 23 Upgrading the **a1000**control software

5 Installation site

The **a1000**comparator comprises the robot system and the 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. Figure 22 shows the footprint of the **a1000**comparator and defines the position of the holes which need to be drilled in the floor.

Besides, you need to ensure that at least 30 cm free space is available on both sides and at the back of the **a1000**comparator; in the front the two doors which give access to the weighing chamber need at least 60 cm free space to open.

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 +/- 0.5°C over one hour. Relatively large, long-term fluctuations (summer/winter) are entirely permissible.

The relative humidity should be between 40 and 70%. The relative humidity should not change by more than +/- 5% over one hour. Relatively large, long-term fluctuations (summer/winter) are entirely permissible.

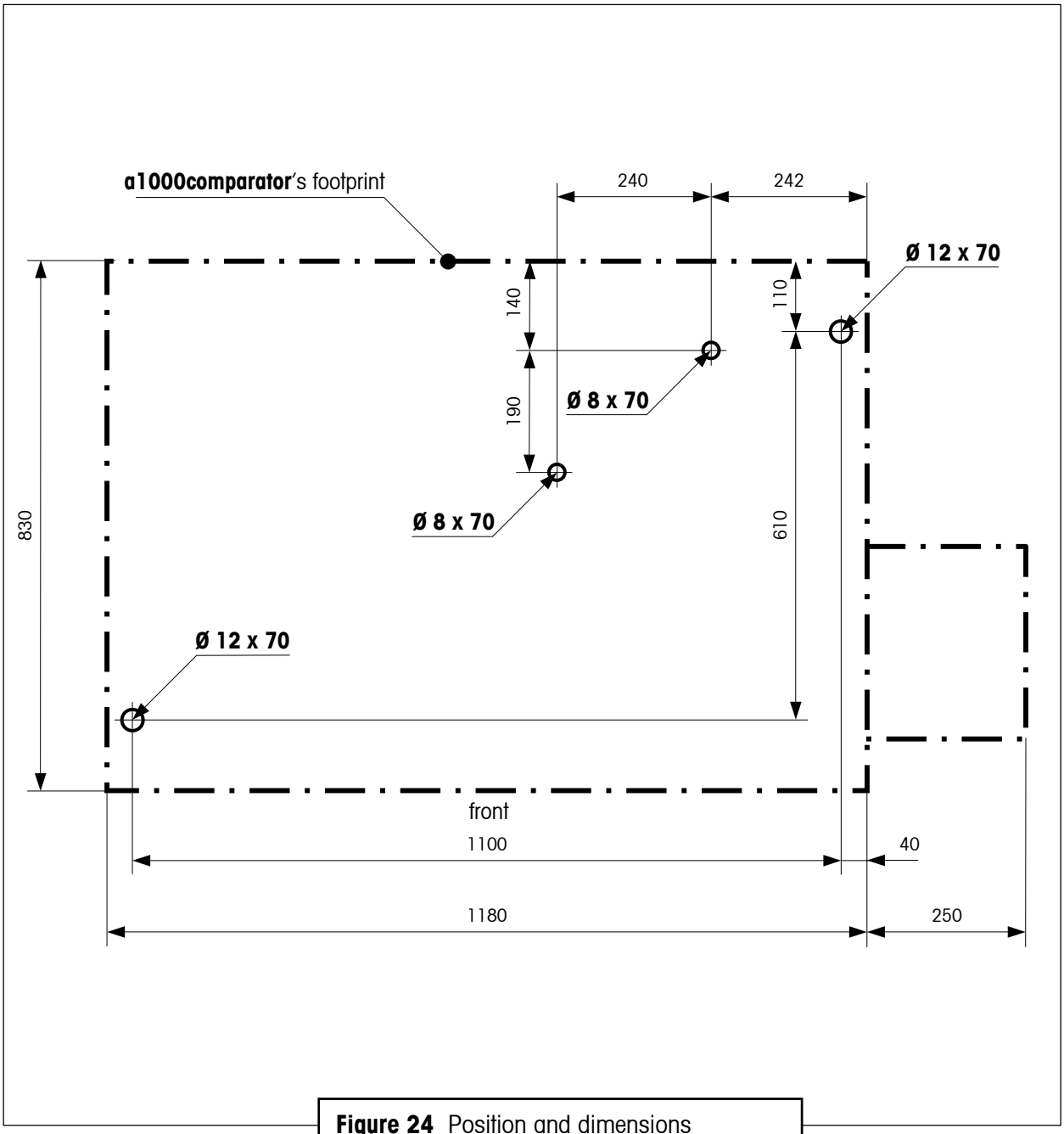


Figure 24 Position and dimensions of the holes for floor attachment

6 Technical data

Balance - METTLER TOLEDO AX1005 Comparator

Readability	0.01 mg
Maximum capacity	1109 g
Electrical weighing range	109 g
Repeatability	Determined as standard deviation of 10 'one-vs.-one' comparative weighings, after drift elimination: $s \leq 0.01$ mg - typical value: 0.005 mg
Linearity	± 0.12 mg
Stabilisation time	10...20 s
Adjustment	Motorized adjustment of the electrical range at a keystroke (built-in 2 x 100 g adjustment weights)

Automated weight handler

Weight handler	For automatic determination of test weights, by direct comparison of one test weight with one standard, or, as an option, by down- / upward calibration - comparison between combinations of up to three weights, as described in 'Weight carrier selection guide', Section 3
Measuring time (typical)	15 min. for a series of 5 'one-vs.-one' A-B-A comparative weighings, 30 min. for a series of 5 'three-vs.-one' A-B-A comparative weighings
Test weights / standards	Cylindrical, knob-shaped weights with a nominal value of 10 g - 1000 g and geometry as follows (see Section 3): • single weight and 2-weight combination: 10≤weight diameter≤60 mm, height≤85 mm • 3-weight combination: 10≤weight diameter≤38 mm, height≤85 mm
Weight magazine	18 places
Control software	Microsoft® Windows®-based **a1000**control, compatible with Windows®95, Windows®98, WindowsNT® and WindowsXP®
Data interface	RS232C to controller

Technical data (cont'd)

Admissible ambient conditions

Temperature	17 - 27 °C (± 0.5 °C / hour)
Relative humidity	40 - 70 % (± 5 %)
Vibrations	A set-up in a "vibration-free" room is recommended
Overvoltage category	Class II
Degree of pollution	2

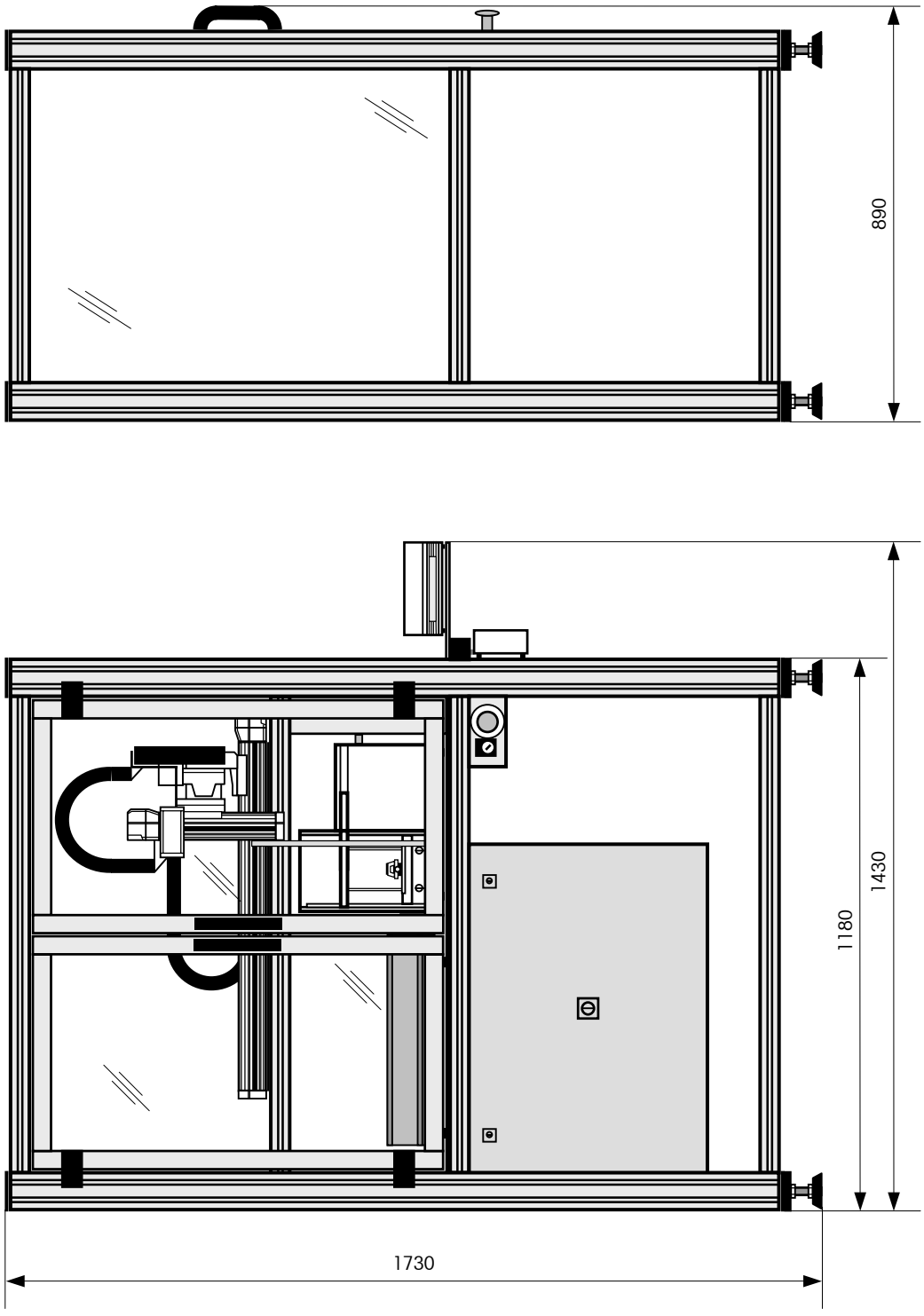
AC adapter

Voltage	
- Balance control unit	100-240V (-15%/+10 %), 0.7A
- 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	1430 x 890 x 1730 mm / 308 kg

7 Dimension drawing



This document (version 3.4, July 2003) is subject to technical changes.