sartorius

Installation Instructions

Sartorius ScalesNet-M

Product Designation YSN03C, Version 4.x: Climate Database

98646-003-61

Contents

1 Intended Use

ScalesNet-M monitors reference standard weights, climate stations, and their connected sensors. The display shows when calibrations are due.

The user sets the test intervals for the mass comparators, reference standard weights and climate equipment in accordance with the relevant specifications.

The following applications are available:
- Calibration of customer weights
- External calibration of customer weights
- Calibration of reference standard weights
- Calibration with dissemination of mass scale
- Quick comparison of weights
- Calibration of weights with raw data output
- Manual entry of weighing data
- Mass comparator calibration
- Mass comparator adjustment

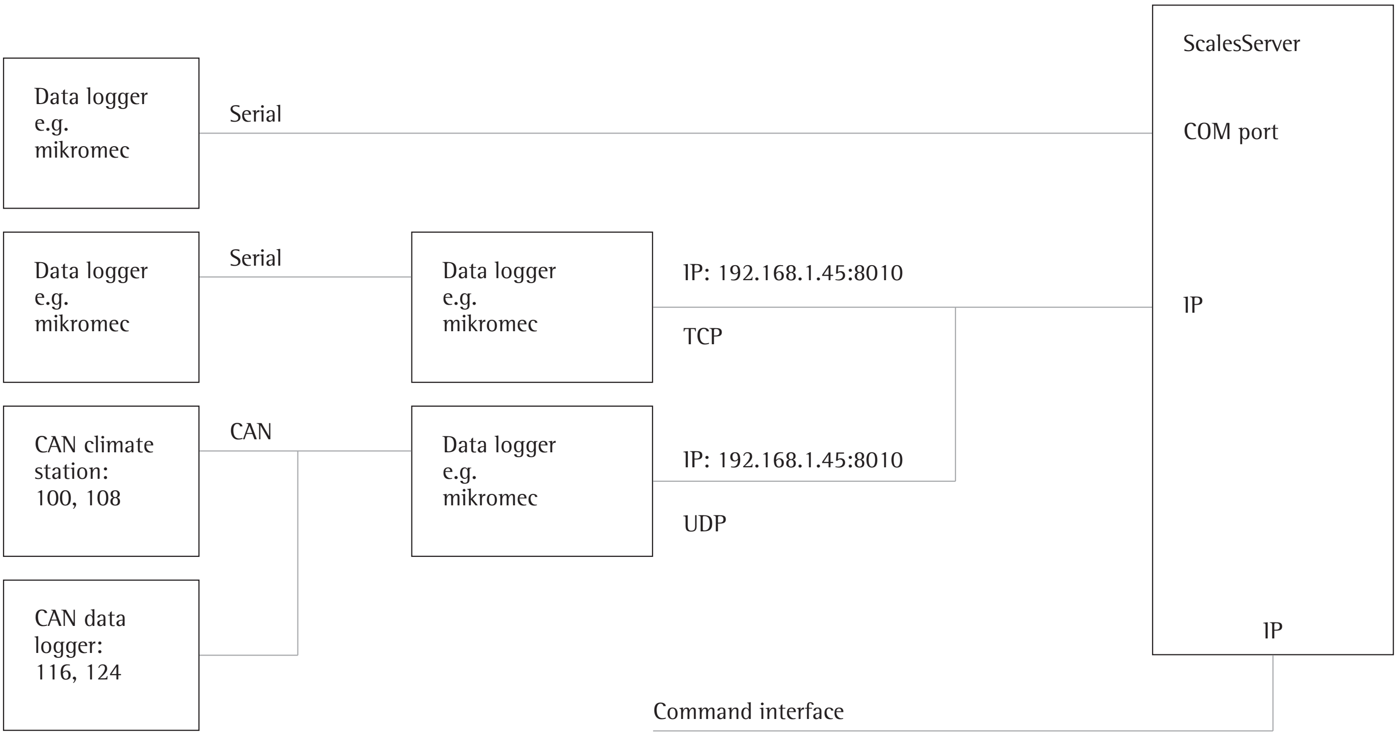
The most important features of ScalesNet-M:
- Central SQL database for storing all acquired measurements and information
- Automatic importing of weighing data via the mass comparator interface. Interface parameters can be generated dependent on the manufacturer
- Automatic acquisition of the room parameters during the weighing cycles
- Number of weighing cycles and weighing type (NPPN or NPN) can be set according to class
- Selection of classes in accordance with OIML R111, ASTM 617 or other national standards
- Simultaneous testing of weights from one set of weights on several mass comparators in the laboratory
- Plausibility testing when selecting the reference standard set and the mass comparator
- Each tested weight is provided with a test report with details of all data acquired during testing (reference standard weight, mass comparator used, temperature, humidity, air pressure, etc.)
- History of every weight tested can be viewed
- User-definable adjustment, test, calibration and DKD certificates using MS Word templates. The data and test results are positioned in the Word template with bookmarks. When printed, these bookmarks are replaced by measurements or data.
  DKD certificates can be generated in two languages
- Automatic generation of inventory lists for the mass comparators and reference standard weights used

Equipment Supplied:
The YSN03C basic package contains 1 CD and one dongle with the following PC licenses:
1 × ScalesServer, SQL database
1 × ScalesMass, laboratory calibration
1 × ScalesDesk, administration
1 × ScalesPrinter, printer control
1 × ScalesPlan, data backup
1 × Hardlock (dongle)
5 × manual mass comparators can be connected
OIML M1, M2, M3, ASTM 5, 6, 7,
NIST Handbooks F, Accept, Maint

Accessories:

PC cable for a Sartorius comparator	YCC01-USBM2
Climate station for E1 & E2	YCM16C
1 license for 1 comparator with load alternator equipment	YSN03AC
1 license for 5 manual comparators	YSN03BC
1 license for climate station	YSN03CC
License: OIML E1, E2, ASTM 0, 1	YSC03EC
License: OIML F1, F2, ASTM 2, 3, 4	YSN03FC
1 license for ScalesMass, for laptop 1 user	YSN03LC
License: mass comparison for E1	YSN03MC
License network	YSN03NC
1 license for 1 robot or CCL1007	YSN03RC
Maintenance & update service	YSN03XC
Training and software instruction	YSN03YC

This program runs on the database server or any other machine.



2 Creating Document Templates

2.1 Preparation
Prerequisite for printing a weighing result is the availability of a Microsoft Word document template.
Microsoft Word must be available for the creation of templates and for printing the documents.

Open a new document in Word and create the desired text. This text in the document should contain only general, non-modifiable formulations.
The positions designed to designate the weighing results, customer's address, shape of weights etc. must be filled by variables. These variables are described in the following documentation.
When a printout is produced using ScalesNet-M, the variables in the document are replaced by the correct weighing data while the document is being printed. The document can be printed and saved. Repeating the printout always generates the data from the database.

A distinction is made between pre-specified and user-definable variables.
The pre-specified variables are defined in order to present the values and definitions required in ScalesNet-M.
The user can enter variables for text passages; for example, a variable with the description "Text 1" is provided with the following texts in the symbol list:

For one weight:	"The weight is"
For two weights:	"The weights are"
For a set of weights:	"The set of weights is"

This dynamic use of variables makes it possible to create a document which takes account of various differences.

2.2 Features

The variables described below are provided by ScalesNet-M. You can use these (or any subset of them) as bookmarks in your own MS Word document template. After registering your template you can print out a report in accordance with this design.

The formation of the bookmarks is subject to certain rules.

As Word does not support multiple bookmarks of the same name within a document, the bookmarks can be distinguished from one another by means of a numbered postfix such as xxx_1, xxx_2 etc. ScalesNet-M does not take account of the numbered postfixes.

When a document template is registered, all the bookmarks defined in the template are imported into the database.
Format descriptions can be defined for most bookmarks.
These format descriptions define the appearance of the output parameter more clearly.
The tables in the next sections indicate whether format descriptions are permissible and, if so, which types.

Important:
A distinction is made between upper case and lower case letters.

The user may define any number of symbols.

Conditions:
- Symbol names must be unambiguous
- The following character sequences are not permissible in symbol names:
  (CUSTOMER, MANUFACTURER, TEST WEIGHT ...)
  To use these designations as symbol names, add "S_" as a prefix.

Symbols with multiple meanings:
The user can create several symbols with the same name (e.g. housing). The designation of symbols that occur repeatedly must be different. All symbols with multiple meanings are combined when a report is compiled.
The individual designations of such symbols with multiple meanings then appear in a selection list alongside the symbol.
Thus the user can define the meaning and thereby the translation of one and the same symbol for each printout.

2.3 Basic Variables
2.3.1 Customer Information

Variable	Meaning
Kunde_ID	Internal ID
Kunde_KNr	CNr
Kunde_Name	Name
Kunde_Strasse	Street
Kunde_PLZ	ZIP
Kunde_Ort	City
Kunde_Gesperrt	Blocked 1 = customer blocked, 0 = customer not blocked
Kunde_MatchCode	MatchCode
Kunde_Name2	Name2
Kunde_PFPLZ	O zip
Kunde_Postfach	PO box
Kunde_Vorwahl	Prefix
Kunde_Telefon	Phone
Kunde_Fax	Fax
Kunde_email	e-mail
Kunde_Internet	Internet
Kunde_Land	Country
Kunde_Landeskennung	CountryCode
Kunde_USTID	TAX ID

Please note:
If multiples of these variables are required in the document, the bookmarks must be extended with an underscore and subsequent text as desired. If, for example, the customer's name is required in four different places the four bookmarks are as follows:

```
Kunde_Name_1
Kunde_Name_2
Kunde_Name_3
Kunde_Name_x
```

The report generator ignores the text following the final underscore. This serves solely to keep the bookmarks different for Word, as two bookmarks with the same name may not be placed in one document.

2.3.2 Manufacturer Information

Variable	Meaning
Hersteller_Nr	Nr
Hersteller_KurzBez	ShortDesc
Hersteller_Name	Name
Hersteller_Strasse	Street
Hersteller_PLZ	ZIP
Hersteller_Ort	City

If multiples of these variables are required in the document, the bookmarks must be extended with an underscore and subsequent text as desired. If, for example, the manufacturer's name is required in four different places the four bookmarks are as follows:

```
Hersteller_Name_1
Hersteller_Name_2
Hersteller_Name_3
Hersteller_Name_QAWDFR
```

The report generator ignores the text following the final underscore. This serves solely to keep the bookmarks different for Word, as two bookmarks with the same name may not be placed in one document.

2.3.3 Test Weight Information

The following variables are available for accessing special values individually:

Non-indexed:

Variable	Meaning
`Pruefling_Count`	Number of test weights in this serial number
`Pruefling_Klasse`	Provides a list of classes of the individual test weights. Each different class is listed only once; i.e., if all 50 test weights under one serial number are of the same class, only one class is shown here.

Indexed:

Variable	Meaning
`Pruefling_0_ID`	Internal
`Pruefling_0_PrNr`	Number of the test weight with the index 0
`Pruefling_0_NennwertWert`	Nominal value
`Pruefling_0_NennwertEinheit`	Unit character only
`Pruefling_0_Nennwert`	Nominal value + unit and prefix where appropriate
`Pruefling_0_DichteWert`	DensityValue
`Pruefling_0_DichteEinheit`	DensityUnit
`Pruefling_0_Dichte`	Density
`Pruefling_0_VolumenWert`	VolumeValue
`Pruefling_0_VolumenEinheit`	VolumeUnit
`Pruefling_0_Volumen`	Volume
`Pruefling_0_DUWert`	DUValue
`Pruefling_0_DU`	DUUnit
`Pruefling_0_DUValue`	Uncertainty of density definition
`Pruefling_0_VUWert`	VUValue
`Pruefling_0_VUEinheit`	VUUnit
`Pruefling_0_VU`	Uncertainty of volume definition
`Pruefling_0_MCPWert`	MCPValue
`Pruefling_0_MCPEinheit`	MCPUnit
`Pruefling_0_MCP`	Conventional weight value
`Pruefling_0_MPWert`	MPValue
`Pruefling_0_MPEinheit`	MPUnit
`Pruefling_0_MP`	Mass
`Pruefling_0_UMCPWert`	UMCPValue
`Pruefling_0_UMCPEinheit`	UMCPUnit
`Pruefling_0_UMCP`	Uncertainty of conventional weight value
`Pruefling_0_UMPWert`	UMPValue
`Pruefling_0_UMPEinheit`	UMPUnit
`Pruefling_0_UMP`	Uncertainty of mass
`Pruefling_0_Status`	Status
`Pruefling_0_Kennzeichnung`	This entry is checked against the list of symbols prior to printing. If a symbol can be found with this name, the text of the symbol is inserted instead of the original text. Example: Designation = . Symbol is defined for: (.) German 1 Punkt English 1 dot The corresponding text is then inserted on the printout instead of (.). Please refer also to 1.5

`Pruefling_0_Bauform`	This entry is checked against the list of symbols prior to the printout. See TestWeight_0_Designation and 1.5
`Pruefling_0_BauformKurz`	This entry is checked against the list of symbols prior to the printout. See TestWeight_0_Designation and 1.5
`Pruefling_0_Klasse`	Class
`Pruefling_0_Werkstoff`	This entry is checked against the list of symbols prior to the printout. See TestWeight_0_Designation and 1.5
`Pruefling_0_WerkstoffKurz`	This entry is checked against the list of symbols prior to the printout. See TestWeight_0_Designation and 1.5
`Pruefling_0_Pruefer`	Tester
`Pruefling_0_DeltaMCPWert`	DeltaMCPValue
`Pruefling_0_DeltaMCPEinheit`	DeltaMCPUnit
`Pruefling_0_DeltaMCP`	DeltaMCP
`Pruefling_0_DeltaMPWert`	DeltaMPValue
`Pruefling_0_DeltaMPEinheit`	DeltaMPUnit
`Pruefling_0_DeltaMP`	DeltaMP
`Pruefling_0_MCPStrich`	MCPDash
`Pruefling_0_MPStrich`	MPDash

The 0 in this case stands for the first test weight. The next test weight is designated 1 etc.
The variable count gives the total number of test weights.
The index therefore runs from 0 to count -1

See Section 1.3 for a table of test weight data

2.3.4 Results Information

Variable	Meaning
`Result_0_MCP`	Prints out the MCP weight value with corresponding unit. The number of digits is determined by the maximum permanent error.
`Result_0_MCPWert`	Gives the result for the calculation of the MCP. The number of digits is 8
`Result_0_MCPEinheit`	The unit of the calculated MCP value
`Result_0_DeltaMCP`	Prints out the DeltaMCP with the corresponding unit. The number of digits is determined by the maximum permanent error.
`Result_0_DeltaMCPWert`	DeltaMCPValue
`Result_0_DeltaMCPEinheit`	DeltaMCPUnit
`Result_0_MP`	Prints out the MP with the corresponding unit. The number of digits is determined by the maximum permanent error.
`Result_0_MPWert`	MPValue
`Result_0_MPEinheit`	MPUnit
`Result_0_DeltaMP`	Prints out the DeltaMP with the corresponding unit. The number of digits is determined by the maximum permanent error.
`Result_0_DeltaMPWert`	DeltaMPValue
`Result_0_DeltaMPEinheit`	DeltaMPUnit
`Result_0_MCPStrich`	MCPDash
`Result_0_MPStrich`	MPDash

The 0 in this case stands for the first test weight. The next test weight is designated 1, etc.

2.3.5 Order Information

Non-indexed variables reproduce the data for the current work order. Indexed variables reproduce the history of a serial number. The order with the highest index corresponds to the current order when a new certificate is created.

Non-indexed:

Variable	Meaning	
`Order_Count`	The total number of orders. This value is > 1 if a serial number has been tested more than once. The highest index represents the last or current order.	
`Order_ID`	The last order in the list (corresponds to Auftrag_Count-1)	
`Auftrag_AuftragsNr`	OrderNr	
`Auftrag_KundenNr`	CustomerNr	
`Auftrag_KundenName`	CustomerName	
`Auftrag_Datum`	Date	
`Order_Status`	0= CASInvalid	For field status in Order.db
	1= CASWaiting	Work order created, no weights tested yet
	2= cASActive	At least 1 test weight tested
	3= cASRunning	At least 1 certificate printed (Serial Nr.)
	4= cASPostprocessing	All certificates printed, grace period running
	5= cASCompleted	Work order completed but not yet archived and can still be opened
	6= cASArchived	Work order has been archived and cannot be opened
	7= cASRemoved	Work order has been removed from the current database and is only available in the backup data
`8=cASSystem`	This order was created by the system administrator and cannot be deleted / modified	

Indexed

Variable	Meaning
`Auftrag_0_ID`	The first order on the list
`Auftrag_0_AuftragsNr`	OrderNr
`Auftrag_0_KundenNr`	CustomerNr
`Auftrag_0_KundenName`	CustomerName
`Auftrag_0_Datum`	Date
`Auftrag_0_Status`	See above
`Auftrag_0_Geloescht`	Deleted

The 0 in this case stands for the first order. The next order is designated 1 etc.
The last order in the list corresponds to the variable without index field.

The data described up to now is available immediately, as it was determined and stored during the weighing of the test weight.
If further data is required (e.g. climate data from an individual weighing operation or an individual weighing result) this is also generally available. However, the object which provides this data must be requested by the user.
On the basis of this request, the object for the corresponding test weight is determined, all relevant data is loaded from the database and the calculations are carried out again. All data that can be found in the calibration record is subsequently available. This process demands considerable resources and reduces the printing speed noticeably as a result. For this reason it is not carried out automatically.

2.3.6 Maximum Permissible Error Information

Non-indexed:

Variable	Meaning

Indexed

Variable	Meaning
`Fehlergrenzen_0_FehlerWert`	The value of the maximum permissible error for the test weight nominal value in the test weight class.
`Fehlergrenzen_0_FehlerEinheit`	ErrorUnit
`Fehlergrenzen_0_Fehler`	Error
`Fehlergrenzen_0_UnsicherheitWert`	The uncertainty value of the maximum permissible error for the test weight nominal value in the test weight class.
`Fehlergrenzen_0_Unsicherheit`	Uncertainty
`Fehlergrenzen_0_UnsicherheitEinheit`	UncertaintyUnit

The index runs from 0 to the number of test weights - 1

2.3.7 General Use

Variable	Meaning
	Parameter
`DocName`	This variable contains the text of the first line of the print dialog. You can use this to enter a certificate number, among other items. If you mark the “Save Certificate” checkbox, the data in this line is used as part of the file name when saving. The name under which the document is saved results from the format description of the INI file. If the Line1 variable remains blank and you select Save, the following file name is generated: <Name of document template>_<8-digit number>.DOC
`Location` `alt: Line2`	Symbol Designates the location where the serial number was placed
`Housing` `alt: Line3`	Symbol Provides a more detailed description of the housing of the set
`HeadOfLab_L1`	Symbol: Text: “Laboratory Manager”
`Deputy`	Symbol Text: “Deputy Laboratory Manager”
`Worker`	Symbol Text; “Worker”
`Sign_1_L1`	The text of the HeadOfLab or Deputy symbol is inserted here in place of this bookmark, depending on the value of the SignedBy parameter SignedBy = 0 → HeadOfLab SignedBy = 1 → Deputy
`Sign_2_L1`	The text of the Worker symbol is recorded in this position.
`Sign_3`	The name of the employee to whom reference is made in the SignatoryID field on the OrderCertificate appears here. Format description: The format description consists of a sequence of characters 0 = First name 1 = First letter of first name only 2 = First two letters of first name only 3 = Surname

Variable	Meaning
	An individual format designation consists of: %X:s % Marks beginning of format designation X Output indicator, in this case 0, 1, 2 or 3 s Data type, in this case string Thus an output is composed as follows: %1:s. %3:s → A. Müller %0:s %3:s → Annette Müller The format description can also contain any desired additional character (such as the . in the above example). This is added to the output character stream. Exception: The underscore "_" serves as a separator and cannot be printed. Default value: %1:s. %3:s
`Sign_4`	The name of the employee to whom reference is made in the MAID field on the OrderCertificate appears here. Format description: The format description consists of a sequence of characters 0 = First name 1 = First letter of first name only 2 = First two letters of first name only 3 = Surname An individual format designation consists of: %X:s % Marks beginning of format designation X Output indicator, in this case 0, 1, 2 or 3 s Data type, in this case string Thus an output is composed as follows: %1:s. %3:s → A. Müller %0:s %3:s → Annette Müller The format description can also contain any desired additional characters (such as the . in the above example). This is added to the output character stream. Exception: The underscore "_" serves as a separator and cannot be printed. Default value: %1:s. %3:s
`ReportNr`	Internal Symbol A unique, system-generated number which can be used for numbering certificates. Extensions such as ReportNr _1 etc. are not permitted. The number is allocated by the system for each certificate created and continuously incremented. The database ensures that the same number never appears more than once. The number created is stored and is available when a new printout of the same certificate is required.

Variable	Meaning
`ActDate`	The date on which the certificate was created. This field remains unchanged if the certificate is loaded in Word at a later time and printed out (in contrast to the corresponding field functions of Word itself). Format description: The format description consists of a sequence of characters 0 = Year, 4 digits 1 = Year, 2 digits 2 = Month 3 = Day 4 = Day of the year, 3 digits 5 = Calendar week, 2 digits 6 = Hour, 24 hour format 7 = Minute 8 = Second An individual format designation consists of: %X:.2d % Marks beginning of format designation X Data to be printed, in this case 0..8 2 Number of places in the output character stream d Number of decimal places Thus an output is composed as follows: %0:.4d-%2:.2d → 2004-05 %1:.2d-%2:.2d → 04-05 The format description can also contain any desired additional characters (such as the - in the above example). This is added to the output character stream. Exception: The underscore "_" serves as a separator and cannot be printed. Default value: %0:.4d-%2:.2d
`ActTime`	Corresponds to the current date ActDate.
`KalibDate`	Indicates the time period of the calibration as a time range. For format description see ActDate Default: %0:.4d-%2:.2d → 2004-05 %3:.2d.%2:.2d.%0:.4d → 01.03.2004
`Expires`	Expiration date of this certificate For format description see ActDate When creating the certificate a CertificateExpires parameter can also be included. This designates the validity period in days. If this parameter is missing the corresponding value from the ScalesPrinter INI file is used. The expiration date of the certificate is calculated from this and from the certificate print date. Default: %1:.2d-%2:.2d → 04-05
`Classes`	Provides a list of the test weight classes
`ProtocolClass`	Internal, indicates the class of the data record
`Smallest`	Nominal value and unit of the smallest weight in the set (even if the set only contains one weight)
`Biggest`	Nominal value and unit of the biggest weight in the set (only if the set contains more than one weight; otherwise a blank string)

Variable	Meaning
`Object` `Alt: Gegenstand`	Parameter The user can specify the object of the test (from within ScalesDesk when creating the report). If this parameter is missing, the program determines the values of the following bookmarks independently: Object Object ObjSmallest Smallest weight of the set ObjTo Up to symbol ObjBiggest Largest weight of the set
`ObjSmallest`	Provides the smallest nominal value in the set if the user has not specified the Object parameter. If there is only one nominal value in the set the printout takes place where appropriate in the form: 4 x 10 g
`ObjBiggest`	Provides the biggest nominal value in the set if the user has not specified the Object parameter. If there is only one nominal value in the set the parameter delivers a blank string.
`ObjTo`	Symbol The separator can be entered here (field: ID). This is only printed out if there are more than 2 different nominal values in the set. It is not necessary to specify translations for different languages.
`FabrikationsNr`	The serial number in the system
`FirstDate`	Date of testing of the first test weight in FabNr For format description see ActDate Default: %3:.2d.%2:.2d.%0:.4d = 01.02.2004
`FirstTime`	Time of testing of the first test weight in FabNr For format description see ActDate Default: %3:.2d.%2:.2d.%0:.4d = 01.02.2004
`LastDate`	Date of testing of the last test weight in FabNr If there is only one test weight this value is a blank string For format description see ActDate Default: %3:.2d.%2:.2d.%0:.4d = 01.02.2004
`LastTime`	Time of testing of the last test weight in FabNr If there is only one test weight this value is a blank string For format description see ActDate Default: %3:.2d.%2:.2d.%0:.4d = 01.02.2004
`AvTemp`	Average value of temperature during the measurement incl. unit without tolerance designation
`AvDruck`	Average value of pressure during the measurement incl. unit without tolerance designation
`AvFeuchte`	Average value of humidity during the measurement incl. unit without tolerance designation
`AvLuftdichte`	Average value of air density during the measurement incl. unit without tolerance designation
`PruefungGueltigDauer`	Validity period of the test in years
`Conformity`	Three different scenarios are possible when creating a declaration of conformity: 1: All test weights meet the requirements of the class 2: No test weight meets the requirements of the class 3: Some test weights meet the requirements of the class and others do not The user defines these bookmarks in the document, creating a symbol of the same name and making the following assignments for the translations: Case 1: Text in the “Single” field e.g. “ ” Case 2: Text in the “Double” field e.g. “not” Case 3: Text in the “Multiple” field e.g. “partly”

2.3.8 Object (of calibration)

The object corresponds to the test weight; however, all the test weights are summarised in one list in accordance with their signature. The following characteristics are included in the signature of a test weight:

Case A: Nominal value + Shape + MaterialShortDescription + Density + UncertaintyofDensity
Case B: Design + MaterialShortDescription + Density + UncertaintyofDensity

If the signature is the same these test weights are consolidated.

The following principles apply:

1. Nominal values with the same signature B are summarized in one table line (DKD Certificate, Page 2, Calibration Object Table).

2. Further selection within a table line is based on the following standard sequences in accordance with the specific Standard (all values in mg).

OIML Standard Sequence

```
1,          2,          5,
10,         20,         50,
100,        200,        500,
1000,       2000,       5000,
10000,      20000,      50000,
100000,     200000,     500000,
1000000,    2000000,    5000000,
10000000,   20000000,   50000000,
100000000,  200000000,  500000000,
1000000000, 2000000000, 5000000000
```

ASTM Standard Sequence

```
2,        4,      5,      6,
20,       40,     50,     60,
200,      400,    500,    600,
2000,     4000,   5000,   6000,
20000,    40000,  50000,  60000,
200000,   400000, 500000, 600000,
1000000,
10000000,
20000000
```

NIST Standard Sequence

```
2,        4,      5,      6,
20,       40,     50,     60,
200,      400,    500,    600,
2000,     4000,   5000,   6000,
20000,    40000,  50000,  60000,
200000,   400000, 500000, 600000,
1000000,
10000000,
20000000
```

3. If there are more than one weight with a particular nominal value (e.g., 20 g), this is printed with the format: 2 × 20 g

4. In the case of two and more different successive nominal values the printout uses the format: 1 g – 20 g.

5. If more than 3 successive nominal values in the sequence are missing the nominal value range must be separated.

   Examples:
   1 g – 10 g, 2 × 2 kg
   1 g – 5 g, 100 g – 1 kg

,

Non-indexed:

Variable	Meaning
`Gegenstand_Caption`	Caption
`Gegenstand_ID`	Internal
`Gegenstand_PrNr`	Number of the test weight with the index 0
`Gegenstand_NennwertWert`	Nominal value
`Gegenstand_NennwertEinheit`	Unit character only
`Gegenstand_Nennwert`	Nominal value + unit and prefix where appropriate
`Gegenstand_DichteWert`	DensityValue
`Gegenstand_DichteEinheit`	DensityUnit
`Gegenstand_Dichte`	Density
`Gegenstand_VolumenWert`	VolumeValue
`Gegenstand_VolumenEinheit`	VolumeUnit
`Gegenstand_Volumen`	Volume
`Gegenstand_DUWert`	DUValue
`Gegenstand_DUEinheit`	DUUnit
`Gegenstand_DU`	Uncertainty of density data
`Gegenstand_VUWert`	VUValue
`Gegenstand_VUEinheit`	VUUnit
`Gegenstand_VU`	Uncertainty of volume data
`Gegenstand_MCPWert`	MCPValue
`Gegenstand_MCPEinheit`	MCPUnit
`Gegenstand_MCP`	Conventional weight value
`Gegenstand_MPWert`	MPValue
`Gegenstand_MPEinheit`	MPUnit
`Gegenstand_MP`	Mass
`Gegenstand_UMCPWert`	UMCPValue
`Gegenstand_UMCPEinheit`	UMCPUnit
`Gegenstand_UMCP`	Uncertainty of the conventional weight value
`Gegenstand_UMPWert`	UMPValue
`Gegenstand_UMPEinheit`	UMPUnit
`Gegenstand_UMP`	Uncertainty of the mass
`Gegenstand_Status`	Status
`Gegenstand_Kennzeichnung`	This entry is checked against the list of symbols prior to the printout. If a symbol can be found with this name the text of the symbol is inserted instead of the original text. Example: Designation = . Symbol is defined for: (.) German 1 Punkt English 1 dot The corresponding text is then inserted on the printout instead of (.). See also 1.5
`Gegenstand_Bauform`	Shape
`Gegenstand_BauformKurz`	ShapeShort
`Gegenstand_Klasse`	Class
`Gegenstand_Werkstoff`	Material
`Gegenstand_WerkstoffKurz`	MaterialShort
`Gegenstand_Pruefer`	Tester
`Gegenstand_DeltaMCPWert`	DeltaMCPValue
`Gegenstand_DeltaMCPEinheit`	DeltaMCPUnit
`Gegenstand_DeltaMCP`	DeltaMCP
`Gegenstand_DeltaMPWert`	DeltaMPValue
`Gegenstand_DeltaMPEinheit`	DeltaMPUnit
`Gegenstand_DeltaMP`	DeltaMP
`Gegenstand_MCPStrich`	MCPDash
`Gegenstand_MPStrich`	MPDash

2.3.9 Extreme Values

Indexed Variable	Meaning
`Extremwert_0_TemperaturVon`	TemperatureFrom
`Extremwert_0_TemperaturBis`	TemperatureTo
`Extremwert_0_TemperaturAvg`	Average temperature during the total weighing of the respective test weight
`Extremwert_0_DruckVon`	PressureFrom
`Extremwert_0_DruckBis`	PressureTo
`Extremwert_0_DruckAvg`	Average value of min. and max.
`Extremwert_0_FeuchteVon`	Extreme value of humidity (minimum) of all cycles of this test weight(0)
`Extremwert_0_FeuchteBis`	HumidityTo
`Extremwert_0_FeuchteAvg`	Average value of min. and max.
`Extremwert_0_LuftdichteVon`	AirPressureFrom
`Extremwert_0_LuftdichteBis`	AirPressureTo
`Extremwert_0_LuftdichteAvg`	Average value of min. and max.
`Extremwert_0_StartDatum`	StartDate
`Extremwert_0_StartZeit`	StartTime
`Extremwert_0_EndeDatum`	EndDate
`Extremwert_0_EndeZeit`	EndTime

The following postfixes can be attached to the room parameter descriptions:

`_Tol`	The printout includes the tolerance range of the sensor
`_NoUnit`	The units are suppressed on the printout
`_NoSign`	Printout takes place without prefix

Examples:	Printout
`ExtremeValue_0_TemperatureAvg_Tol_NoSign`	1003 ± 2.5
`ExtremeValue_0_TemperatureAvg_Tol_NoSign_1`	1003 ± 2.5
`ExtremeValue_0_TemperatureAvg`	1003 mbar
`ExtremeValue_0_TemperatureAvg_NoSign`	1003
`ExtremeValue_0_TemperatureAvg_Tol`	1003 mbar ± 2.5 mbar

Non-indexed Variable	Meaning
`Extremwert_TemperaturVon`	TemperatureFrom
`Extremwert_TemperaturBis`	TemperatureTo
`Extremwert_TemperaturAvg`	Average value of min. and max.
`Extremwert_DruckVon`	PressureFrom
`Extremwert_DruckBis`	PressureTo
`Extremwert_DruckAvg`	Average value of min. and max.
`Extremwert_FeuchteVon`	Extreme value of humidity (minimum) of all test weights of this set
`Extremwert_FeuchteBis`	HumidityTo
`Extremwert_FeuchteAvg`	Average value of min. and max.
`Extremwert_StartDatum`	StartDate
`Extremwert_StartZeit`	StartTime
`Extremwert_EndeDatum`	EndDate
`Extremwert_EndeZeit`	EndTime
`Extremwert_LuftdichteVon`	AirPressureFrom
`Extremwert_LuftdichteBis`	AirPressureTo
`Extremwert_LuftdichteAvg`	Average value of min. and max.

2.3.10 Climate

Indexed Variable	Meaning	
`Klima_0_TempStationID`	TempStationID	%d
`Klima_0_TempStationName`	TempStationName	%s
`Klima_0_TempStationIdentNr`	TempStationIdentNr	%s
`Klima_0_TempStationDevNr`	TempStationDevNr	%s
`[...]`	There is an option to add all further parameters of the climate station here if required.	
`Klima_0_DruckStationID`	PressureStationID	%d
`Klima_0_DruckStationName`	PressureStationName	%s
`Klima_0_DruckStationIdentNr`	PressureStationIdentNr	%s
`Klima_0_DruckStationDevNr`	PressureStationDevNr	%s
`[...]`		
	ditto	
`Klima_0_FeuchteStationID`	HumidityStationID	%d
`Klima_0_FeuchteStationName`	HumidityStationName	%s
`Klima_0_FeuchteStationIdentNr`	HumidityStationIdentNr	%s
`Klima_0_FeuchteStationDevNr`	HumidityStationDevNr	%s
`[...]`		
	ditto	
`Klima_0_TempKanalID`	TempChannelID	%d
`Klima_0_TempKanalName`	TempChannelName	%s
`Klima_0_TempKanalOffsetW`	TempChannelOffsetV	%.2f
`Klima_0_TempKanalOffsetE`	TempChannelOffsetU	%s
`Klima_0_TempKanalOffset`	TempChannelOffset	%s
`Klima_0_TempKanalUnsicherW`	TempChannelUncertV	%.2f
`Klima_0_TempKanalUnsicherE`	TempChannelUncertU	%s
`Klima_0_TempKanalUnsicher`	TempChannelUncert	%s
`[...]`	There is an option to add all further parameters of the climate station here if required.	
`Klima_0_DruckKanalID`	PressureChannelID	%d
`Klima_0_DruckKanalName`	PressureChannelName	%s
`Klima_0_DruckKanalOffsetW`	PressureChannelOffsetV	%.1f
`Klima_0_DruckKanalOffsetE`	PressureChannelOffsetU	%s
`Klima_0_DruckKanalOffset`	PressureChannelOffset	%s
`Klima_0_DruckKanalUnsicherW`	PressureChannelUncertV	%.1f
`Klima_0_DruckKanalUnsicherE`	PressureChannelUncertU	%s
`Klima_0_DruckKanalUnsicher`	PressureChannelUncert	%s
`[...]`	ditto	
`Klima_0_FeuchteKanalID`	HumidityChannelID	%d
`Klima_0_FeuchteKanalName`	HumidityChannelName	%s
`Klima_0_FeuchteKanalOffsetW`	HumidityChannelOffsetV	%.1f
`Klima_0_FeuchteKanalOffsetE`	HumidityChannelOffsetU	%s
`Klima_0_FeuchteKanalOffset`	HumidityChannelOffset	%s
`Klima_0_FeuchteKanalUnsicherW`	HumidityChannelUncertV	%.1f
`Klima_0_FeuchteKanalUnsicherE`	HumidityChannelUncertU	%s
`Klima_0_FeuchteKanalUnsicher`	HumidityChannelUncert	%s
`[...]`	ditto	
`Klima_0_TempSensorID`	TempSensorID	%d
`Klima_0_TempSensorName`	TempSensorName	%s

Variable	Meaning	
Klima_0_TempSensorVonW	TempSensorFromV	%.2f
Klima_0_TempSensorVonE	TempSensorFromU	%s
Klima_0_TempSensorVon	TempSensorFrom	%s
Klima_0_TempSensorBisW	TempSensorToV	%.2f
Klima_0_TempSensorBisE	TempSensorToU	%s
Klima_0_TempSensorBis	TempSensorTo	%s
Klima_0_TempSensorUnsicherW	TempSensorUncertV %.2f	Numerical value only
Klima_0_TempSensorUnsicherE	TempSensorUncertU	The unit
Klima_0_TempSensorUnsicher	TempSensorUncert	Value and unit, from TPhysValue
[...]	There is an option to add all further parameters of the climate station here if required.	
Klima_0_DruckSensorID	PressureSensorID	%d
Klima_0_DruckSensorName	PressureSensorName	%s
Klima_0_DruckSensorVonW	PressureSensorFromV	%.1f
Klima_0_DruckSensorVonE	PressureSensorFromU	%s
Klima_0_DruckSensorVon	PressureSensorFrom	%s
Klima_0_DruckSensorBisW	PressureSensorToV	%.1f
Klima_0_DruckSensorBisE	PressureSensorToU	%s
Klima_0_DruckSensorBis	PressureSensorTo	%s
Klima_0_DruckSensorUnsicherW	PressureSensorUncertV %.1f	Numerical value only
Klima_0_DruckSensorUnsicherE	PressureSensorUncertU	The unit
Klima_0_DruckSensorUnsicher	PressureSensorUncert	Value and unit, from TPhysValue
[...]	There is an option to add all further parameters of the climate station here if required.	
Klima_0_FeuchteSensorID	HumiditySensorID	%d
Klima_0_FeuchteSensorName	HumiditySensorName	%s
Klima_0_FeuchteSensorVonW	HumiditySensorFromV	%.1f
Klima_0_FeuchteSensorVonE	HumiditySensorFromU	%s
Klima_0_FeuchteSensorVon	HumiditySensorFrom	%s
Klima_0_FeuchteSensorBisW	HumiditySensorToV	%.1f
Klima_0_FeuchteSensorBisE	HumiditySensorToU	%s
Klima_0_FeuchteSensorBis	HumiditySensorTo	%s
Klima_0_FeuchteSensorUnsicherW	HumiditySensorUncertV	%.1f
Klima_0_FeuchteSensorUnsicherE	HumiditySensorUncertU	%s
Klima_0_FeuchteSensorUnsicher	HumiditySensorUncert	%s
[...]		

2.3.11 Special Characters

As an individual variable

Variable	Meaning
SZ_PlusMinus_n	%
SZ_Celsius_n	°C
SZ_mbar_n	mbar
SZ_hPa_n	hPa
SZ_B_n	-
SZ_Prozent_n (percent)	%
SZ_Gramm_n	G
SZ_Milli_n	Mg
SZ_Kilo_n	kg

In table constructs

The special characters can also be used within table constructs. The syntax is as follows:
Example for test weights: `T0_TestWeight_SZ_PlusMinus_1`

2.3.12 Reference Standards

Indexed

Variable	Meaning	
Standard_0_ID		
Normal_SatzName	SetName	A list of all reference standard sets from which the reference standards used originate, separated by semi-colon
Normal_0_Nennwert	NominalValue	The nominal value of the reference standard including unit character SUM
Normal_0_NennwertWert	NominalValueValue	The numerical value without unit. SUM
Normal_0_NennwertEinheit	NominalValueUnit	The unit character without numerical value SUM
Normal_0_Kennzeichnung	Designation	
Normal_0_KWW	KWW	SUM
Normal_0_KWWWert	KWWValue	SUM
Normal_0_KWWEinheit	KWWUnit	SUM
Normal_0_UKWW	UKWW	SUM
Normal_0_UKWWWert	UKWWValue	SUM
Normal_0_ UKWWEinheit	UKWWUnit	SUM
Normal_0_ Masse	Mass	SUM
Normal_0_ MasseWert	MassValue	SUM
Normal_0_ MasseEinheit	MassUnit	SUM
Normal_0_ UMasse	Umass	SUM
Normal_0_ UMasseWert	UmassValue	SUM
Normal_0_ UMasseEinheit	UmassUnit	SUM
Normal_0_ Volumen	Volume	SUM
Normal_0_ VolumenWert	VolumeValue	
Normal_0_ VolumenEinheit	VolumeUnit	
Normal_0_ UVolumen	Uvolume	SUM
Normal_0_ UvolumenWert	UvolumeValue	
Normal_0_ UvolumenEinheit	UvolumeUnit	
Normal_0_ Dichte	Density	SUM
Normal_0_ DichteWert	DensityValue	
Normal_0_ DichteEinheit	DensityUnit	
Normal_0_ UDichte	Udensity	SUM

Variable	Meaning
`Normal_0_ UdichteWert`	UdensityValue
`Normal_0_ UdichteEinheit`	UdensityUnit
`Normal_0_ Fehlerklasse`	ErrorClass
`Normal_0_ Material`	Material

Postfixes are specified in the table. Their meanings are as follows:
_SUM Delivers the sum of the nominal values
_SEQ Delivers a list of the individual values separated by semi-colon

Non-indexed

Variable	Meaning
`Normal_Von`	The lightest of all reference standards used in the entire set
`Normal_Bis`	The heaviest of all reference standards used in the entire set
`Normal_Saetze`	Prints a list of the reference standard sets used Extendable with _1, _2 etc. The set number precedes the set description. Format description: 0 = Standard Set Nr ASCII 1 = Standard Set Name (*), ASCII 2 = Standard Set ID Nr ASCII 3 = Standard Set Calibration Certificate Nr ASCII 4 = Standard Set Calibration Date ASCII 5 = Standard Set Calibrating Body ASCII Default: 049: GS %0:.3d: %1:s; Cal Nr.: %2:s 001: GS %0:.3d: %1:s; Cal Nr.: %2:s The name of the reference standard set is derived from the symbol table, i.e. a symbol with this name is recorded in the requested translation.
`Normal_Scheine`	Prints a list of the calibration certificates of the reference standard sets used Format description: 0 = Standard Set Calibration Certificate Nr ASCII 1 = Standard Set Calibration Date ASCII 2 = Standard Set Calibration Body ASCII Default: %0:s
`Normal_Klassen`	Lists the classes of the reference standards used

Please note:
When a reference standard set is created or its name is changed, a symbol should be created using the button directly alongside the input field for the name of the set. The symbol then has the same name as the reference standard set. In addition the translations for this name or designation can now be entered against the symbol. These are then referenced when printing out via L1 or L2.

2.3.13 Document Name

A new report can be generated on the basis of a previously registered template under the “Create Report” dialogue. This document’s file name is defined within this dialogue. The path in which the document is stored depends on the setting in ScalesPrinter.ini.
The file name of the new document is formulated as follows:

Y4, Y2, M, T, DOY, W, Nr, P7, P8, P9, P10, P11, P12]

//– 0 : Year, 4 digits	2003	
//– 1 : Year, 2 digits	03	
//– 2 : Month, 2 digits	12	
//– 3 : Day, 2 digits	31	
//– 4 : Day of the year, 3 digits	365	
//– 5 : Calendar week, 2 digits	52	The calendar week begins on Monday and ends on Sunday
//– 6 : Counter, certificate no.	1	The number of digits corresponds to the format description
//– 7 : ScaleNr	1	For mass comparator calibration record
//– 8 : Measurement range no.	2	For mass comparator calibration record
//– 9 : Short name of template	DKD	For a DKD Certificate
//– 10 : Serial no.	ABC123	For a DKD Certificate
//– 11 : Supplement	A123	Line 1 from the print dialogue for a DKD Certificate
//– 12 : Man certificate no.	asdf	Additional parameters from the print dialog for a DKD Certificate, Parameter certificate number

Example: DKD Certificate No.
There is always a number allocated by the system (the counter in this case) and any number entered by the user (ManCertificateNr in this case). The user can now select which number is used to create the file name via the format description.

2.4 Combined Variables

In addition to the symbols described in the previons sections, there are also special constructs which allow the creation of tabular printouts.

Syntax:
Tn_ListType_IndivValue_Language_Modifier_Trailer

n	=	A consecutive number which defines the table. Begins with 1.
List type	=	One element from the following list: [TestWeight | Result | Order | Max Errors | ExtremeValue | Standard | Material List | MatList]
IndivValue	=	One element from the tables described below.
Language	=	[L1 | L2] L1 is the default.
Modifier	=	Modifies the presentation but not the value.
Trailer	=	Any desired postfix which prevents bookmarks of the same name in the template but is not evaluated.

Extension W or "Wert" (Value) means:

Only the numerical value is printed out. The format can be determined via the format description. If no format description is specified the value is printed out in accordance with the designation within the program.
Permissible Modifier: NoSign

Example:

Numerical value	Format	Output
23.12345	%.2f	23.12
0.020		0.020

Extension E or "Einheit" (Unit) means:

Only the unit is printed out. This can be formulated via the format description in the context of a character string.

Example:

String	Format	Output
g	%s	g
g	[%s]	[g]

No extension

The value is printed out including its unit and any negative prefix where appropriate in accordance with the designation within the program.

Example:
A temperature: 23.45 °C

Language:

The following is generally true: L1 is set as the default if no language is specified. However, this is not true for the following characteristics: Shape, ShapeShort, Material, MaterialShort. The following applies in this case:
If a language designation is specified, a search for a translation is made in the symbols. The unmodified designation is used if no translation is found or no language designation is specified.

Modifier:

_NoSign
The output takes place without a prefix

_NoUnit (not yet implemented)
The output takes place without a unit

2.4.1 List: Test Weight

Variable	Meaning	
`ID`	Internal	Format string: %d
`PrNr`	Number of the test weight	Format string: %s
`NennwertWert`	Nominal value	Format string: %.2f
`NennwertEinheit`	Unit character only	Format string: %s
`Nennwert`	Nominal value + unit and any prefix	Format string: %s
`DichteWert`	DensityValue	
`DichteEinheit`	DensityUnit	
`Dichte`	Density	
`VolumenWert`	VolumeValue	
`VolumenEinheit`	VolumeUnit	
`Volumen`	Volume	
`DUWert`	DUValue	
`DUEinheit`	DUUnit	
`DU`	Uncertainty of density definition	
`VUWert`	VUValue	
`VUEinheit`	VUUnit	
`VU`	Uncertainty of volume definition	
`MCPWert`	MCPValue	
`MCPEinheit`	MCPUnit	
`MCP`	Conventional weight value	
`MPWert`	MPValue	
`MPEinheit`	MPUnit	
`MP`	Mass	
`UMCPWert`	UMCPValue	
`UMCPEinheit`	UMCPUnit	
`UMCP`	Uncertainty of conventional weight value	
`UMPWert`	UMPValue	
`UMPEinheit`	UMPUnit	
`UMP`	Uncertainty of mass	
`Status`	Status	
`Kennzeichnung`	Designation	
`Bauform`	TestWeight_0_Shape	
`BauformKurz`	TestWeight_0_ShapeShort	
`Klasse`	Class	
`Werkstoff`	TestWeight_0_Material	
`WerkstoffKurz`	TestWeight_0_MaterialShort	
`Pruefer`	Name of tester	
`DeltaMCPWert`	Value is always specified in mg	
`DeltaMCPEinheit`	Unit is always mg	
`DeltaMCP`	Value is always specified in mg	
`DeltaMPWert`	Value is always specified in mg	
`DeltaMPEinheit`	Unit is always mg	
`DeltaMP`	Value is always specified in mg	
`MCPStrich`	MCPDash	
`MPStrich`	MPDash	

2.4.2 Liste: Result

Individual Value	Meaning
`MCPWert`	MCPValue
`MCPEinheit`	MCPUnit
`MCP`	Conventional weight value
`MPWert`	MPValue
`MPEinheit`	MPUnit
`MP`	Mass
`UMCPWert`	UMCPValue
`UMCPEinheit`	UMCPUnit
`UMCP`	Uncertainty of the conventional weight value
`UMPWert`	UMPValue
`UMPEinheit`	UMPUnit
`UMP`	Uncertainty of the mass
`DeltaMCPWert`	DeltaMCPValue
`DeltaMCPEinheit`	DeltaMCPUnit
`DeltaMCP`	Deviation from the nominal value (conventional weight value)
`DeltaMPWert`	DeltaMPValue
`DeltaMPeinheit`	DeltaMPUnit
`DeltaMP`	Deviation from the nominal value (mass)

This concerns the stored results which were calculated, saved and printed out on the test weight calibration certificates directly following the weighing. A number of settings determine whether the values originate from the stored values or are newly calculated when the test weight values are printed out.

2.4.3 List: Work Order

(not yet implemented)

Individual Value	Meaning
`ID`	Internal

2.4.4 List: Maximum Permissible Errors

Individual Value	Meaning
`Fehlergrenzen_0_FehlerWert`	Value of the maximum permissible error for the nominal value of the test weight in the test weight class.
`Fehlergrenzen_0_FehlerEinheit`	ErrorUnit
`Fehlergrenzen_0_Fehler`	Error
`Fehlergrenzen_0_Unsicherheit`	Value of the uncertainty of the maximum permissible error for the nominal value of the test weight in the test weight class.
`Fehlergrenzen_0_UnsicherheitWert`	UncertaintyValue
`Fehlergrenzen_0_UnsicherheitEinheit`	UncertaintyUnit

2.4.5 List: Extreme Value

Individual Value	Meaning	
`TemperaturVonW`	TemperatureFromV	
`TemperaturVonE`	TemperatureFromU	%s
`TemperaturVon`	TemperatureFrom	%s
`TemperaturBisW`	TemperatureToV	
`TemperaturBisE`	TemperatureToU	%s
`TemperaturBis`	TemperatureTo	%s
`TemperaturAvgW`	TemperatureAvgV	Average temperature during the total weighing of the respective test weight
`TemperaturAvgE`	TemperatureAvgU	%s
`TemperaturAvg`	TemperatureAvg	%s
`DruckVonW`	PressureFromV	
`DruckVonE`	PressureFromU	%s
`DruckVon`	PressureFrom	%s
`DruckBisW`	PressureToV	
`DruckBisE`	PressureToU	%s
`DruckBis`	PressureTo	%s
`DruckAvgW`	PressureAvgV	
`DruckAvgE`	PressureAvgU	%s
`DruckAvg`	PressureAvg	%s
`FeuchteVonW`	HumidityFromV	Extreme value of humidity (minimum) of all cycles of this test weight (0)
`FeuchteVonE`	HumidityFromU	%s
`FeuchteVon`	HumidityFrom	%s
`FeuchteBisW`	HumidityToV	
`FeuchteBisE`	HumidityToU	%s
`FeuchteBis`	HumidityTo	%s
`FeuchteAvgW`	HumidityAvgV	
`FeuchteAvgE`	HumidityAvgU	%s
`FeuchteAvg`	HumidityAvg	%s
`LuftdichteVonW`	AirPressureFromV)	
`LuftdichteVonE`	AirPressureFromU	%s
`LuftdichteVon`	AirPressureFrom	%s
`LuftdichteVonW`	AirPressureFromV	
`LuftdichteVonE`	AirPressureFromU	%s
`LuftdichteBis`	AirPressureTo	%s
`LuftdichteVonW`	AirPressureFromV	
`LuftdichteVonE`	AirPressureFromU	%s
`LuftdichteAvg`	AirPressureAvg	%s
`Start`	dd.mm.yyyy hh:mm	
`StartDatum`	StartDate	dd.mm.yyyy
`StartZeit`	StartTime	Hh:mm
`Ende`	End	dd.mm.yyyy hh:mm
`EndeDatum`	EndDate	dd.mm.yyyy
`EndeZeit`	EndTime	Hh:mm

2.4.6 List: Reference Standard

Individual Value	Meaning
`ID`	Internal

2.4.7 List: Climate

Individual Value	Meaning	
`TempStationID`	TempStationID	%d
`TempStationName`	TempStationName	%s
`TempStationIdentNr`	TempStationIdentNr	%s
`TempStationDevNr`	TempStationDevNr	%s
`DruckStationID`	PressureStationID	%d
`DruckStationName`	PressureStationName	%s
`DruckStationIdentNr`	PressureStationIdentNr	%s
`DruckStationDevNr`	PressureStationDevNr	%s
`FeuchteStationID`	HumidityStationID	%d
`FeuchteStationName`	HumidityStationName	%s
`FeuchteStationIdentNr`	HumidityStationIdentNr	%s
`FeuchteStationDevNr`	HumidityStationDevNr	%s
`TempKanalID`	TempChannelID	%d
`TempKanalName`	TempChannelName	%s
`TempKanalOffsetW`	TempChannelOffsetV	%.2f or blank string The original formatting is used in the case of a blank string.
`TempKanalOffsetE`	TempChannelOffsetU	%s
`TempKanalOffset`	TempChannelOffset	%s
`TempKanalUnsicherW`	TempChannelUncertV	%.2f or blank string The original formatting is used in the case of a blank string.
`TempKanalUnsicherE`	TempChannelUncertU	%s
`TempKanalUnsicher`	TempChannelUncert	%s
`DruckKanalID`	PressureChannelID	%d
`DruckKanalName`	PressureChannelName	%s
`DruckKanalOffsetW`	PressureChannelOffsetV	%.2f or blank string The original formatting is used in the case of a blank string.
`DruckKanalOffsetE`	PressureChannelOffsetU	%s
`DruckKanalOffset`	PressureChannelOffset	%s
`DruckKanalUnsicherW`	PressureChannelUncertV	%.2f or blank string The original formatting is used in the case of a blank string.
`DruckKanalUnsicherE`	PressureChannelUncertU	%s
`DruckKanalUnsicher`	PressureChannelUncert	%s
`FeuchteKanalID`	HumidityChannelID	%d
`FeuchteKanalName`	HumidityChannelName	%s
`FeuchteKanalOffsetW`	HumidityChannelOffsetV	%.2f or blank string The original formatting is used in the case of a blank string.
`FeuchteKanalOffsetE`	HumidityChannelOffsetU	%s
`FeuchteKanalOffset`	HumidityChannelOffset	%s
`FeuchteKanalUnsicherW`	HumidityChannelUncertV	%.2f or blank string The original formatting is used in the case of a blank string.
`FeuchteKanalUnsicherE`	HumidityChannelUncertU	%s
`FeuchteKanalUnsicher`	HumidityChannelUncert)	%s
`TempSensorID`	TempSensorID	%d
`TempSensorName`	TempSensorName	%s
`TempSensorVonW`	TempSensorFromV	%.2f or blank string The original formatting is used in the case of a blank string.
`TempSensorVonE`	TempSensorFromU	%s
`TempSensorVon`	TempSensorFrom	%s
`TempSensorBisW`	TempSensorToV	%.2f or blank string The original formatting is used in the case of a blank string.

Individual Value	Meaning	
TempSensorBisE	TempSensorToU	%s
TempSensorBis	TempSensorTo	%s
TempSensorUnsicherW	TempSensorUncertV	Numerical value only %.2f or blank string The original formatting is used in the case of a blank string.
TempSensorUnsicherE	TempSensorUncertU	The unit
TempSensorUnsicher	TempSensorUncert	Value and unit, from TPhysValue
DruckSensorID	PressureSensorID	%d
DruckSensorName	PressureSensorName	%s
DruckSensorVonW	PressureSensorFromV	%.1f or blank string The original formatting is used in the case of a blank string.
DruckSensorVonE	PressureSensorFromU	%s
DruckSensorVon	PressureSensorFrom	%s
DruckSensorBisW	PressureSensorToV	%.1f or blank string The original formatting is used in the case of a blank string.
DruckSensorBisE	PressureSensorToU	%s
DruckSensorBis	PressureSensorTo	%s
DruckSensorUnsicherW	PressureSensorUncertV	Numerical value only %.1f or blank string The original formatting is used in the case of a blank string.
DruckSensorUnsicherE	PressureSensorUncertU	The unit
DruckSensorUnsicher	PressureSensorUncert	Value and unit, from TPhysValue
FeuchteSensorID	HumiditySensorID	%d
FeuchteSensorName	HumiditySensorName	%s
FeuchteSensorVonW	HumiditySensorFromV	%.1f or blank string The original formatting is used in the case of a blank string.
FeuchteSensorVonE	HumiditySensorFromU	%s
FeuchteSensorVon	HumiditySensorFrom	%s
FeuchteSensorBisW	HumiditySensorToV	%.1f or blank string The original formatting is used in the case of a blank string.
FeuchteSensorBisE	HumiditySensorToU	%s
FeuchteSensorBis	HumiditySensorTo	%s
FeuchteSensorUnsicherW	HumiditySensorUncertV	
FeuchteSensorUnsicherE	HumiditySensorUncertU	%s
FeuchteSensorUnsicher	HumiditySensorUncert	%s

2.4.8 List: Material List

Individual Value	Meaning
ID	Internal

2.5 Symbols:

Symbols are character sequences. When a symbol appears as a bookmark, the character sequence specified by the symbol replaces the text in the report to be created.

Symbol name	This is any desired character sequence. Bookmarks are compared with the symbol name and, if in agreement, the text of the symbol is written to the bookmark.
Language	A translation can be entered in all registered languages for each symbol. The different language versions are then selected via the bookmark extension _L1 or _L2. The languages which can be found under L1 and L2 are defined when the document template is registered.
Single	This text is written in the place of the bookmark if there is exactly 1 test weight in the list of test weights.
Double	This text is written in the place of the bookmark if there are exactly 2 test weights in the list of test weights.
Multiple	This text is written in the place of the bookmark if there are more than 2 test weights in the list of test weights.

Multiple incidences do not make sense in the case of certain replacements. The designation of a test weight can also be managed via the symbols, for example. In such cases the same text must be entered in all three fields.

2.6 Wildcards in Symbols

The following wildcards are defined in symbols: [%]

Wildcard:	%
Meaning:	Stands for an unlimited number of characters. The wildcard must be used as the first or last character. Use as a symbol test is not permissible.
Example:	%.

Such a symbol searches for the dot in the transmitted string. The text of the symbol is then inserted in place of the dot. The text represented by the wildcard also appears unchanged in the output.

Symbol	= %. Symbol text Sprache (Language) 1: [1 dot]
Text	= 2k.
Output in document:	2k[1 dot]

The same applies correspondingly when using the wildcard in the form: .%
In this case the unmodified text appears at the end of the symbol text.
Use in the form "%..%" is not permissible.

Application:

Any desired symbols can be used. The symbol name is inserted into the template in the form of a bookmark. The text assigned to the symbol then appears in place of the bookmark, in the respective language, depending on whether the serial number contains 1, 2 or more than 2 test weights.

In addition, when creating a report in the "zus. Parameter (add. parameter)" register, further parameters can be entered which lead to direct replacement in the document. The parameters are simply written into the text input box in the following form:

```
ParameterName = Text in Sprache1;
                Text in Sprache2
```

This data is stored together with the certificate. If there is a bookmark with the name `ParameterName` in the document, the text specified under `Text in Language1` appears for Language 1, while the text specified under `Text in Language2` is inserted directly for the second language.

The symbol's texts are used if a designation which already exists as a symbol is selected for ParameterName.

2.7 Example of a Test Certificate

This example contains all texts and required bookmarks. The variables are made legible by activating the [Print Draft] button.

Prüfschein / *Test certificate*

Nr. / *No* <ReportNr_1>

<ActDate_2>

Muster ***Kalibrierlaboratorium für Masse***	Silvanerweg 6 D-55559 Bretzenheim	Phone +49(0)671 83999-0 e-mail infol@maro.de

Bearbeiter / Person in Charge: <Sign_4> **Datum** / date: <ActDate_1> **Seite** / page 1 / 1

Gegenstand *object*	**<Object_L1_1> <ObjSmallest_L1_1>** **<ObjTo_L1_1> <ObjBiggest_L1_1>** **<Object_L2_1> <ObjSmallest_L2_1>** **<ObjTo_L2_1> <ObjBiggest_L2_1>**	**Klasse** *class*	**<Classes_1>**
Fab./Ser.-No.	**<FabrikationsNr>**	**Ident. No.**	
Hersteller *manufacturer*	<Hersteller_Name> <Hersteller_Strasse> <Hersteller_PLZ> <Hersteller_Ort>	**Auftraggeber** *customer*	<Kunde_Name> <Kunde_Strasse> <Kunde_PLZ> <Kunde_Ort>
Prüfdatum *date of test*	<KalibDate_1>	**Auftrags-Nr.** *order no.*	<Auftrag_AuftragsNr_1>

Prüfgegenstand / *test object*

Nennwert *nominal value*	**Form** *shape*	**Werkstoff nach Angabe des Herstellers** *material according to the manufacturer*	**Dichte des Werk-stoffes bei 20 °C** *density of the material at 20 °C*	**Unsicherheit der Dichte (k=2)** *uncertainty of density (k=2)*
<T2_Gegenstand_Caption>	<T2_Gegenstand_Bauform_L1>	<T2_Gegenstand_WerkstoffKurz_L1>	<T2_Gegenstand_Dichte>	<T2_Gegenstand_DU>
	<T2_Gegenstand_Bauform_L2>	<T2_Gegenstand_WerkstoffKurz_L2>		

<UGegenstand_L1_1> sich <Housing_L1_1>, <Location_L1_1>

<UGegenstand_L2_1> kept <Housing_L2_1>, <Location_L2_1>

Messergebnisse und Umgebungsbedingungen

Results of measurement and ambient conditions

Nenn-wert *nominal value*	**Kennzeichnung** *marking*	**Konventioneller Wägewert** *conventional mass value*
<T1_Pruefling_Nennwert>	<T1_Pruefling_Kennzeichnung_L1>	<T1_Pruefling_NennwertWert_1> <T1_Pruefling_NennwertEinheit_1> <T1_Pruefling_DeltaMC

Anmerkungen / *remarks*

3 Configuration Files (INI Files)

Purpose
All configuration data for the individual program is managed in text files. These are in the format of INI files, familiar to many from earlier versions of Windows. No data is recorded in the Windows registry. This simplifies the complete backup and transfer of applications to other computers.

Each application within the ScalesNet-M V4 suite has such a configuration file. The file name corresponds to the name of the application and always ends in INI.

There are sections that bear the same name and have the same meaning in all configuration files. These are described below. The application-specific parameters follow.

All sections that begin with [TDlg...] are sections for specific dialog windows. The windows store their last position, size, sort sequence and similar data here. These sections are managed automatically and do not normally require processing. They are not described in this manual.

Common sections for all INI files

Section [Customer]

This section is used in:
[ScalesDesk] [ScalesMass] [ScalesPrinter] [ScalesSvr]

Parameter	Permitted values	Meaning
CompanyName	[A..Z,a..z,0..9,\ ,.]	Company name
Name	[A..Z,a..z,0..9]	Contact person
Street	[A..Z,a..z,0..9,\ ,.]	Street
Postal	[A..Z,a..z,0..9]	PO box
City	[A..Z,a..z,0..9,\ ,.]	City
Country	[A..Z,a..z,0..9]	Country
CustomerID	1..n	CustomerID The customer must register in ScalesNet-M customer administration. The ID which this registration receives in the database must be entered here. This takes place during installation of ScalesNet-M.

Example:
CompanyName=MARO Elektronik
Name=Herr Matzinger
Street= Silvanerweg 6
Postal=55559
City=Bretzenheim
Country=Germany
CustomerID=1

Section [Database]

This section is used in:
[ScalesDesk] [ScalesMass] [ScalesPrinter] [ScalesSvr]

Parameter	Permitted values	Meaning
DatabaseName	[A..Z,a..z,0..9,\ ,.]	The name of the ScalesNet-M database in the format: Host:File **Host** specifies the computer on which the database server runs. It must be a resolvable name, i.e. IP address, DNS name, NetBIOS or WINS name. File is the complete name of the database file including, where appropriate, details of the drive on the database server machine.
UserName	[A..Z,a..z,0..9]	A user who is managed in the database and has the rights to execute the ScalesNet-M applications. This is permanently set up.
Password		Password for logging on to the database applications.

Example:
DatabaseName=server:D:\Database\SNV4_1.gdb
UserName=scalesuser32
Password= mypassword

The applications log on to the database with a fixed ID. The user administration takes place within the application itself. Therefore it is not necessary for users of ScalesNet-M applications to be managed within the database.

It can easily be checked by means of a ping whether a host name, `server` in this example, can be correctly resolved into an address.

Section [Logfile]

This section is used in:
[ScalesDesk] [ScalesMass] [ScalesPrinter] [ScalesSvr]

Parameter	Permitted values	Meaning
FilePath	Valid path name	Specifies the path on which the application log file is created.
FileName	Valid file name	Name of the log file
FileExt	Valid file name extension	Specifies the file name extension.
LogLevel	[1, 2, 3, 4, 99]	Determines the logging level. 1 = everything is logged 2 = certain events only 3 = errors only 4 = serious errors 99 = nothing is logged
Viewer	A program that can display text files	Used when the log file is opened from within the application. The complete path must be specified if the program cannot be located via the search path.

Example:
FilePath =C:\Programme\ScalesNetV4\temp\
FileName =SNV4
FileExt=log
LogLevel=1
Viewer=NOTEPAD.EXE

Section [Configurable]

This section is used in:
[ScalesDesk] [ScalesMass] [ScalesPrinter] [ScalesSvr]

This section contains a list of further sections including information about the type of values these other sections contain. You should only modify the sections described in this chapter if you are requested to do so by the manufacturer.

Parameter	Permitted values	Meanings
Languages	[Values]	Refers to a section with the name “Languages” This section contains individual values with different meanings and a list of the parameter’s values.
Descriptor	[List]	Refers to a section with the name “Descriptor” This section contains a list of the parameter’s values.
Helpfile	[List]	Refers to a section with the name “HelpFile” This section contains a list of the parameter’s values.
DLLFile	[List]	Refers to a section with the name “DLLFile”
Logfile		Refers to a section with the name “LogFile”. This contains information about the log file
Settings	[Values]	Refers to a section with the name “Settings”

Example:
Languages=Values
Descriptor=List
Helpfile=List
DLLFile=List
Logfile=LogFile
Settings=Values

Section [Languages]

This section is used in:
[ScalesDesk] [ScalesMass] [ScalesPrinter] [ScalesSvr]

Parameters	Permitted values	Meaning
MaxLanguage	1..	The number of supported languages. Several files are required for each language. These can be provided when further languages are added
Used	0.. MaxLanguage-1	Specifies the language to be used. The list index begins with 0.
0,1,2,3,...	000...999	Country code of the supported language. The digit corresponds to the list index. All further list indices must be synchronous and must define the same language.

Example:
MaxLanguages=3
Used=0
0=049
1=001
2=009

Section [Descriptor]

This section is used in:
[ScalesDesk] [ScalesMass] [ScalesPrinter] [ScalesSvr]

Parameters	Permitted values	Meaning
0,1,2,3,...	[A..Z,a..z]	The name of the language in the language itself or in English.

Example:
0=German
1=English
2=Portuguese

Section [HelpFile]

This section is used in:
[ScalesDesk] [ScalesMass] [ScalesPrinter] [ScalesSvr]

Parameter	Permitted values	Meaning
0,1,2,3,...	A valid file name	Refers to the Help file in the language which corresponds to the list index.

Example:
0=ScalesNet_049.hlp
1=ScalesNet_001.hlp
2=ScalesNet_009.hlp

Section [DLLFile]

This section is used in:
[ScalesDesk] [ScalesMass] [ScalesPrinter] [ScalesSvr]

Parameters	Permitted values	Meaning
0,1,2,3,...	A valid file name	The ResourcesDLL in the language which corresponds to the list index.

Example:
0=ScalesNet_049.dll
1=ScalesNet_001.dll
2=ScalesNet_009.dll

ScalesDesk.ini

Section [ScalesPrinter]

This section is used in:
[ScalesDesk] [ScalesMass] [ScalesSvr]

The section describes the location of the ScalesPrinter. ScalesDesk does not print any records itself but transmits the print job to the ScalesPrinter. Communication is over TCP/IP. No error message is output to the screen if the parameters are not correctly set or ScalesPrinter does not run. There is only an entry in the log file.

Parameters	Permitted values	Meaning
RemoteAddress	IP address or DNS name	The computer on which ScalesPrinter is running
RemotePort	[1024..65535]	The port on which the ScalesPrinter listens. TCP protocol is used.
Setup Connection Timeout	0..	Timeout monitoring for connection to the ScalesPrinter. If the connection is not made within the time defined here (in ms), the process is broken off with an error message.
SourceName	[A..Z,a..z,0..9]	Any desired name; used to display this computer in the ScalesPrinter tree

Example:
RemoteAddress=192.168.1.5
RemotePort=8092
SetupConnectionTimeout=3000
SourceName='Dolphin'

Section [Format]

This section is used in:
[ScalesDesk] [ScalesPrinter]

This section contains format descriptions that define the path for the locations of individual record types.
Each record type has its own subdirectory in which the ScalesPrinter records are filed.
This single directory for each record type can be understood as the root directory for these records (ProtocolRoot).
Further directories are created in accordance with the following format descriptions. ScalesDesk itself does not create any printouts. For this reason, both the paths for the document templates to be used and the specification of the ProtocolRoot are missing. However, ScalesDesk does allocate document names and for this reason it is necessary to designate the format description. This designation must be synchronous with the [Format] Section in ScalesPrinter.ini.

Parameters	Permitted values	Meaning
PKP_Nr	Format description	A unique, consecutive number for test weight calibration records
PKP_Path	Format description	ProtocolRoot for test weight calibration records
WKP_Nr	Format description	A unique, consecutive number for mass comparator calibration records
WKP_Path	Format description	ProtocolRoot for mass comparator calibration records
VAR_NR	Format description	A unique, consecutive number for variable records, e.g. DKD certificates

The format description is a kind of template. It may contain all characters valid for path names. Certain character sequences have a special meaning (wildcards) and are replaced by valid values on analysis of the format description.
For example, the designation %1 denotes such a wildcard.
It is replaced by the valid year number when running.
The designation :.2d describes the wildcard in more detail and signifies to output a decimal number (d) to two places.
A leading 0 is placed in front when required. The wildcard itself and the formatting add-on define a format within the format description.

The following format elements are defined:

Format element	Meaning	Example
%0:.4d	Year, 4 digits	2004
%1:.2d	Year, 2 digits	04
%2:.2d	Month, 2 digits	12
%3:.2d	Day, 2 digits	31
%4:.3d	Day of the year, 3 digits	365
%5:.2d	Calendar week, 2 digits	52, calendar week begins Monday and ends Sunday
%6:.8d	A counter, e.g. the record number. The number of digits (8 in this case) is supplemented by leading 0's.	
%7:.2d	Number of the mass comparator used (mass comparator calibration record only)	03
%8:.1d	Measurement range number of the mass comparator (mass comparator calibration record only)	1

Additional characters can be included in the format string before, in between and after the format elements. These appear unchanged in the result.

Example (PKP_PATH):
Format string = PKP_%1:.2d_%2:.2d_%6:.8d
Counter = 143
Result = PKP_04_02_00000143

Example (WKP_PATH):
Format string = WKP_%1:.2d_%2:.2d_%6:.6d_W%7:.2d_MB%8:.1d
Number = 123
Mass comparator = 8
Measurement range = 3
Result = WKP_04_02_000123_W08_MB3

Section [Settings]
This section is found in every INI file. Because the parameters it contains can vary, it is described repeatedly in this manual.

Parameter	Permitted values	Meaning
AutoLogOff	00:01:00 .. 23:59:59	The user is logged off after this time has lapsed if there is no interaction (mouse or keyboard).
Debugging	[On|Off]	Switches the debugging mode on or off. Debugging=Off is set if this parameter is missing.
DEFAULTCUSTOMERID	1..	Reference to the customer if a default value is required. Can be set as default value in customer administration.
DEFAULTVENDORID	1..	Reference to a manufacturer if a default value is required.
DEFAULTFORMID	1..	Reference to a shape if a default value is required.
DEFAULTMATERIALID	1..	Reference to a material if a default value is required.
DefaultMaterial	ASCII[3]	Short description of a material, e.g.: SSS
DEFAULTCLASSID	1...	Accuracy class within the specification (pre-setting).
DEFAULTSPECIFICATIONID	1..	Reference to a specification if a default value is required.
DefaultSpecification	[A..Z,a..z,0..9]	Name of the specification which is set as the default value. Default: OIML
DEFAULTMETHOD	[0,1,2]	Measurement method 0 = ABA 1 = ABBA 2 = AB
DEFAULTINTERVAL	1..	Validity interval in days unless specified differently. Default: 360
DEFAULTGRACEPERIOD	1..	Interval in days of the grace period which is granted after expiry of the validity interval before the resource is blocked. Default: 30
DEFAULTSERNRCOUNT	1..	Quantity of serial numbers displayed on opening the “SerNr” dialog. This quantity can be restricted in order to improve the run time response of the dialog.
StationName	[A..Z,a..z,0..9]	A user-definable name which identifies this instance. This name is designed to differentiate all ScalesDesk instances in the network. The name is used when logging on to ScalesSvr and is displayed there.
DEFAULTWIEGEPLAN		DEFAULTWEIGHINGPLAN Dissemination of mass scale: The weighing plan that is set as the default value. Can be changed within the application and serves as pre-selection only.
MaxNormale	1..20 Default: 5	Gives the maximum number of reference standards which can be used within a test weight calibration.
StdDevFactorF	1..1000 Default: 10	Dissemination of mass scale

Example:
AutoLogOff=00:15:00
Debugging=ON
DEFAULTCUSTOMERID=1
DEFAULTVENDORID=1
DEFAULTFORMID=1
DEFAULTMATERIALID=1
DEFAULTCLASSID=2
DEFAULTSPECIFICATIONID=1
DefaultSpecification=OIML
DEFAULTMETHOD=1
DEFAULTINTERVAL=360
DEFAULTGRACEPERIOD=30
DEFAULTSERNRCOUNT=200
StationName=<undefined>

Section [AutomaticLogon]

This section is used in:
[ScalesDesk]

This section facilitates the automatic logon of a user on program start-up and should be removed in operation.

Parameter	Permitted values	Meaning
Username	A valid user name	Administrator
Password	The associated password	Admin

Example:
Username=Administrator
Password=Admin

Section [System]

Parameter	Permitted values	Meaning
DefaultPassword		
DefaultLoginName		
AUFTRAG_INTERN_P_ID	ORDER_INTERNAL_P_ID	
AUFTRAG_INTERN_N_ID	ORDER_INTERNAL_N_ID	
FABNR_INTERN_P_ID	SERNR_INTERNAL_P_ID	
FABNR_INTERN_N_ID	SERNR_INTERNAL_N_ID	

Example:
DefaultPassword=password
DefaultLoginName=default
AUFTRAG_INTERN_P_ID=1 ORDER_INTERNAL_P_ID=1
AUFTRAG_INTERN_N_ID=2 ORDER_INTERNAL_N_ID=2
FABNR_INTERN_P_ID=1 SERNR_INTERNAL_P_ID=1
FABNR_INTERN_N_ID=2 SERNR_INTERNAL_N_ID=2

ScalesMass.ini

Section [Settings]

Parameter	Permitted values	Meaning
AutoLogOff	00:01:00 .. 23:59:59	The user is logged off after this time has lapsed if there is no interaction (mouse or keyboard).
Debugging	[On|Off]	Switches the debugging mode on or off. Debugging=Off is set if this parameter is missing.
Port	[1..9]	COM port to which the mass comparator is attached. A maximum of COM1..COM9 are supported (Windows 2000 and later).
Jobs	Valid path	Path for the job file The ScalesMass wizard stores the created weighing orders here. The ScalesMass scheduler extracts the jobs from this directory and executes them.
JobSaving	[0|1]	ScalesMass can create a record file in ASCII format for each weighing job. This file contains all the values which were also written in the database. The file names are generated automatically. The directory can be specified using the Jobs parameter. 1 = Job file is created 0 = Job file is not created
DefaultMaterial	ASCII[3]	Short description for the material set as the default. The short description must exist in the list of materials.
MaxZulageWDZ	1..	Number for the max. permitted quantity of standard weights as weighing difference supplement.
MaxZulageEZ	1..	Number for the max. permitted quantity of standard weights as sensitivity supplement.
MaxNormale	1..	Max. number of reference standards that can be used per test weight.
RTSActive	[0|1]	How RTS is to be handled on opening the interface: 0 = Inactive 1 = Activated
DTRActive	[0|1]	How DTR is to be handled on opening the interface: 0 = Inactive 1 = Activated
MaxConnectCount	1..	Number of times ScalesMass attempts to establish a connection to the mass comparator before an error message is output.
ConnectRepeatDelay	1..	
AcknowledgeDelay	1..	Period (in ms) of delay before sending the response to the mass comparator.
AutoStart	[0|1]	Is a defined weighing job to be started immediately or not: 0 = Start manually 1 = Start automatically
DEFAULTSPECIFICATIONID	1..	
DefaultSpecification	ASCII	Name of the specification to be used as a default value.
ShowDelayValueDetails	[0|1]	The time period of each individual weighing is determined. 1 = The values are displayed together with the measurement values. 0 = The values are not shown separately (default: 0).
MultipleClassesPerSerNrAllowed	[0|1]	Defines whether a SerNr or set of reference standards can contain test weights/reference standards with different error classes. 0 = No 1 = Yes
AddClimateValuesInterval	[1..n]	Additional climate data is acquired during a weighing according to this interval in seconds. Thus there is a continuous recording of climate values in addition to the values recorded at the beginning and end of each weighing cycle. Default: 30
AddClimateValuesEnabled	[0|1]	Switches the recording of additional climate values on or off. 0 = Off 1 = On Default: 1
AddClimateValueBeep	[0|1]	Specifies whether an acoustic signal is to be output (1) or not (0) as an acknowledgement of each stored measurement value during recording of the additional climate values.

Example:
AutoLogOff=00:15:00
Debugging=ON
Port=2
Jobs=D:\ Programm\ ScalesNetV4\ jobs
JobSaving=1
DefaultMaterial=SSS
MaxZulageWDZ=3
MaxZulageEZ=3
MaxStandards=5
RTSActive=0
DTRActive=1
MaxConnectCount=15
AcknowledgeDelay=500
AutoStart=0
DEFAULTSPECIFICATIONID=1
DefaultSpecification=OIML

Section [Debug]
This section serves for test purposes only and should be completely removed during operation.

Parameter	Permitted values	Meaning
Usersimulation Manual Balance	[0|1]	Simulates the user's click on OK within the manual weighing process: 0 = User must click 1 = Click is simulated

Example:
UsersimulationManualBalance=1

Section [CMD-Server]
This section describes the connection of ScalesMass to the ScalesSvr. This returns the climate data to the enquiring process, ScalesMass in this case.

Parameter	Permitted values	Meaning
RemoteAddress	IP address	IP address or DNS name of the computer on which ScalesSvr is running
RemotePort	1024..65535	The port on which ScalesSvr waits for incoming commands.
Setup Connection Timeout	1..	Amount of time in ms until timeout on an unsuccessful attempt to connect to the ScalesSvr.
SourceName	[A..Z,a..z,0..9]	Any desired name. Is displayed on the ScalesSvr.

Example:
RemoteAddress=192.168.1.3
RemotePort=8090
SetupConnectionTimeout=3000
SourceName='Penguin'

Section [ScalesPrinter]
This section describes the connection of ScalesMass to the ScalesPrinter. This takes over and executes the print job.

Parameter	Permitted values	Meaning
RemoteAddress	IP address	IP address or DNS name of the computer on which ScalesSvr is running
RemotePort	1024..65535	The port on which ScalesSvr waits for incoming commands.
Setup Connection Timeout	1..	Amount of time in ms until timeout on an unsuccessful attempt to connect to the ScalesSvr.
SourceName	[A..Z,a..z,0..9]	Any desired name. Is displayed on the ScalesSvr.

Example:
RemoteAddress=192.168.1.5
RemotePort=8092
SetupConnectionTimeout=3000
SourceName='Dolphin'

Section [Format]
For a general description of the Format section please refer to ScalesDesk, [Format] Section. Further details are described here.

Parameter	Permitted values	Meaning
--	--	--

Only the path details are required here.

Example:
PKP_Nr=%1:.2d_%2:.2d_%6:.6d
PKP_Path=%0:.4d_%2:.2d
WKP_Nr=%1:.2d_%2:.2d_%6:.6d_W%7:.2d_MB%8:.1d
WKP_Path=%0:.4d_%2:.2d

Section [MovementTimeouts]
Various timeout parameters specified in ms

Parameter	Permitted values	Meaning
TOGeneric		
TOHome		
TOMeasure		

Only the path details are required here.

Example:
TOGeneric=600
TOHome=3000
TOMeasure=864000

Section [Settings]

Parameter	Permitted values	Meaning
AutoLogOff	00:01:00 .. 23:59:59	The user is logged off after this time has lapsed if there is no user interaction (mouse or keyboard).
Debugging	[On|Off]	Switches the debugging mode on or off. Debugging=Off is set if this parameter is missing.
Port	[1..9]	COM port Max. COM1..COM9 are supported (from Win2000).
Climate PollInterval	hh:mm:ss	Specifies the time interval at which the current climate values are to be polled from the connected climate devices.
Climate ValidInterval	hh:mm:ss	Specifies the time period for which measurement values from connected climate devices are to remain valid.

Example:
AutoLogOff=00:15:00
Debugging=ON
Port=2
ClimatePollInterval=00:00:10
ClimateValidInterval=00:02:00

Section [CMD-Server]

Parameter	Permitted values	Meaning
Listener	1024..65535	Specifies the port on which the CMD server within ScalesSvr waits for incoming commands

Example:
Listener=8090

Section [Simulation]
This section serves to create climate values as random values within the specified limits. Real climate devices are no longer required. The values created in this way are handled as real climate values. Mixed operation using both simulated and real devices is not possible. This is designed for development purposes only and it is essential for it to be deactivated in operation.

Parameter	Permitted values	Meaning
Enabled	[0|1]	Activate or deactivate simulation of climate values
TempFrom		
TempTo		
PressureFrom		
PressureTo		
HumidityFrom		
HumidityTo		

Example:
Enabled=0
TempFrom=20.5
TempTo=21.3
PressureFrom=980
PressureTo=1010
HumidityFrom=39
HumidityTo=68

ScalesSvr.ini

Section [Climate recording]

Parameter	Permitted values	Meaning
Enabled	[0|1]	Specifies whether the climate values are to be recorded or not: 0 = Do not record 1 = Record
Interval	hh:mm:ss	Specifies the interval at which the updated climate values are to be registered in the database for the climate history.

Example:
Enabled=1
Interval=00:15:00

[Port0_Template]
Baudrate=8
Databits=4
Parity=0
Stopbits=0
Handshake=0
XON=17
XOFF=19
RTSActive=1
DTRActive=0

[Port1]
Baudrate=8
Databits=4
Parity=0
Stopbits=0
Handshake=0
RTSActive=1
DTRActive=0

[Port2]

[Port3]

[Port4]

[Port5]

[Port6]

[Port7]

[Port8]

[Port9]

ScalesPrinter.ini

Section [Settings]

Parameter	Permitted values	Meaning
Debugging	[On|Off]	Switches the debugging mode on or off. Debugging=Off is set if this parameter is missing.
Listener	1024..65535	Specifies the port on which ScalesPrinter waits for incoming connections and receives print jobs.
AutoStart	[0|1]	0 = Pause mode on program start 1 = Operating mode on program start
Viewer	File name	Specifies the program which is to open the log files, if requested.
SpoolPath	Valid path name	Specifies the path on which ScalesPrinter is to buffer the print job files.
PKP_Path	Valid path name	ProtocolRoot of the test weight calibration records (ProtocolRoot of PKP).
WKP_Path	Valid path name	ProtocolRoot of the mass comparator calibration records (ProtocolRoot of WKP).

Example:
Debugging=ON
Listener=8092
AutoStart=0
Viewer=NOTEPAD.EXE
SpoolPath= D:\Program\ScalesNetV4\Records\Spooler
PKP_Path= D:\Program\ScalesNetV4\Records\PKP
WKP_Path= D:\Program\ScalesNetV4\Records\WKP

Section [Templates]
This section refers to the document templates that form the basis of the individual records.

Parameter	Permitted values	Meaning
PKP	Corresponding to a file name including path	Template for the test weight calibration record
GLW	Corresponding to a file name including path	Template for the equipment list of the mass comparators
GLN	Corresponding to a file name including path	Template for the equipment list of the reference standards
GLK	Corresponding to a file name including path	Template for the equipment list of the climate stations
WKNPN101	Corresponding to a file name including path	Template for the mass comparator calibration record for calibrations with ABA and <= 10 cycles
WKNPN201	Corresponding to a file name including path	Template for the mass comparator calibration record for calibrations with ABA and <= 20 cycles
WKNPPN	Corresponding to a file name including path	Template for the mass comparator calibration record for calibrations with ABBA and <= 10 cycles

Example:
PKP= D:\Program\ScalesNetV4\Templates\PKP.DOT
GLW= D:\Program\ScalesNetV4\Templates\GL_Scales.dot
GLN= D:\Program\ScalesNetV4\Templates\GL_Standards.dot
GLK= D:\Program\ScalesNetV4\Templates\GL_Climate.dot
WKNPN101= D:\Program\ScalesNetV4\Templates\WK_NPN101.dot
WKNPN201= D:\Program\ScalesNetV4\Templates\WK_NPN201.dot
WKNPPN= D:\Program\ScalesNetV4\Templates\WK_NPPN.dot

Section [Format]
For a general description of the Format section please refer to ScalesDesk, [Format] Section.
Further details are described here

Parameter	Permitted values	Meaning
––	––	––

Only the path details are required here.

Example:
PKP_Path=%0:.4d_%2:.2d
WKP_Path=%0:.4d_%2:.2d

ScalesLib.ini
This library is an extension of the Interbase database server.
It administrates among other items the resources (mass comparators, reference standards etc.) in use and the licences.
Use of this application is automatic and cannot be influenced by the user.
There is no specific INI file. However, there are two environment variables which affect the log file:

ScalesLibLogName

ScalesLibLogLevel

ScalesTemplate.ini

Each section of this file describes one mass comparator. The type of the mass comparator is set as the section name in square brackets. The sequence of the subsequent parameters is user-defined.

The file must be located in the same directory as the applications.

Parameter	Meaning	
Hersteller	Name of the mass comparator manufacturer. Sartorius and Mettler are pre-defined	
Print request	Specifies whether a defined command (print command) must be sent to the mass comparator in order to print out the weighing value	
1 = Yes	0 = No	
Waegetoleranz	WeighingTolerance	2
MindestWaegezyklen	MinWeighingCycles	0
COMBaud	COMBaud	300
COMPARITY	COMPARITY	Even
COMDatabits	COMDatabits	7
COMStartbits	COMStartbits	1
COMStopbits	COMStopbits	2
Einheitenzeichen	UnitsCharacters	G
Lastwechsler	LoadAlternator	0
AnzahlPrueflinge	QtyTestWeights	1
Format	Format	+*AAAAAAAAAEEECL
Stillstand	Stability	0
Exzentrizitaet	Eccentricity	0
Sechservergleich	SixWeightComparison	0
JUSTIERINTERVALL	ADJUSTMENTINTERVAL	360
JUSTIERNACHFRIST	ADJUSTMENTGRACEPERIOD	30
JUSTIERUNGINTERN	ADJUSTMENTINTERNAL	1
JUSTIERUNGNENNWERT	The numerical value of the nominal value of the internal adjustment reference standard. A dot is to be used as the decimal separator. No thousands separator. 0..n	
JUSTIERUNGEINHEIT	The unit of the reference standard. One of the valid symbols for units can be used here. Please refer to unit symbols, e.g.: G	
JUSTIERUNGAUFL	Number of significant decimal places of the nominal value. This is important for the display. A value of 20.50 is otherwise displayed as 20.5 0..18	
JUSTIERUNGDICHTE	The density of the internal adjustment reference standard, e.g.: 7900	
JUSTIERUNGDICHTEEINHEIT	Unit of density adjustment reference standard. Please refer to unit symbols kg/m3	
JUSTIERUNGDICHTEAUFL	Number of significant decimal places of the nominal value. This is important for the presentation. A value of 20.50 is otherwise displayed as 20.5 0..18	
VONW	The numerical value of the lower limit of the measurement range of the mass comparator. A dot is to be used as the decimal separator. No thousands separator. 0..n	
VONE	The unit of the lower limit of the measurement range. Please refer to unit symbols G	
VONA	Number of significant decimal places of the nominal value. This is important for the presentation. A value of 20.50 is otherwise displayed as 20.5	
BISW	TOV	20.5
BISE	TOU	G
BISA	TODP	1
TEILW	PARTV	0.001
TEILE	PARTU	Mg
TEILA	PARTDP	3
KLASSE	CLASS	E2

ScalesSvr.ini (Example)

```
[Customer]
CompanyName=MARO Elektronik
Name=Mr Matzinger
Street=Silvanerweg 6
Postal=55559
City=Bretzenheim
Country=Germany
CustomerID=1

[Configurable]
Languages=Values
Descriptor=List
Helpfile=List
DLLFile=List
Logfile=LogFile
Settings=Values

[Database]
LibUserName=SNLIB
LibPassword=snliblib
UserName=SNSERVER
Password=snserver
KeepAliveInterval=5000
DatabaseName=192.168.100.1:D:\Programs\Scales
Net32_V4\db\SNV4_1.gdb

[TDlgLogon]
Height=246
Width=290
Left=265
Top=151

[Languages]
MaxLanguages=3
Used=0
0=049
1=001
2=009

[Descriptor]
0=German
1=English
2=Portuguese

[HelpFile]
0=ScalesNet-M_V4_049.chm
1=ScalesNet_001.hlp
2=ScalesNet_009.hlp
[DLLFile]
0=ScalesNet_049.dll
1=ScalesNet_001.dll
2=ScalesNet_009.dll

[Logfile]
FilePath=D:\Programs\ScalesNet-M_V4\log\
FileName=SNV4Svr
FileExt=log
LogLevel=2
Viewer=NOTEPAD.EXE
SQLMonitoring=0
SyslogServer=192.168.100.13
LocalLogfileEnabled=0

[Settings]
AutoLogOff=00:15:00
Debugging=ON
Port=2
MaxCOMPorts=9
ClimatePollInterval=00:00:10
ClimateValidInterval=00:02:00
SyncEvent=1
ShowRawValues=1

[ScalesPrinter]
PrintJobBufferPath=D:\Programs\ScalesNet-M_V4\
Records\Spooler\

[CMD-Server]
Listener=8090
RemoteAddress=192.168.100.1

[CAN-Transceiver]
IP=192.168.100.201
LocalPort=8099
RemotePort=8099

[Simulation]
Enabled=0
TempFrom=20.9
TempTo=21.3
PressureFrom=999
PressureTo=1005
HumidityFrom=49
HumidityTo=55

[ClimateRecording]
Path=D:\Programs\ScalesNet-M_V4\Temp\
Enabled=1
Interval=00:15:00

[Port1]
Baudrate=8
Databits=4
Parity=0
Stopbits=0
Handshake=0
RTSActive=0
DTRActive=0
```

Example:
ScalesDispatcher.ini

```
[ConfigFile]
ReadOnly=1

[Languages]
MaxLanguages=3
Used=0
0=049
1=001
2=009

[Descriptor]
0=German
1=English
2=Portuguese

[HelpFile]
0=ScalesNet-M_V4_049.chm
1=ScalesNet_001.hlp
2=ScalesNet_009.hlp

[DLLFile]
0=ScalesNet_049.dll
1=ScalesNet_001.dll
2=ScalesNet_009.dll

[Settings]
AsService=0
DEFAULTVENDORINDEX=1
DEFAULTPRINTMODE=0
DefaultMaterial=SSS
FactorCMP=25
DebugMode=OFF
Left=0
Top=600

[Logfile]
LogLevel=1
SyslogServer=192.168.100.13
SQLMonitoring=0

[Database]
DatabaseName=192.168.100.1:D:\Programs\ScalesNet-M_
V4\db\SNV4_1.gdb
UserName=SNMASS
Password=snmass
LibUserName=SNLIB
LibPassword=snliblib

[Format]
PKP_Nr=%6:.6d-%2:.2d-%1:.2d
PKP_Path=%0:.4d_%2:.2d
WKP_Nr=%1:.2d_%2:.2d_%6:.6d_W%7:.2d_MB%8:.1d
WKP_Path=%0:.4d_%2:.2d

[CMD-Server]
RemoteAddress=192.168.100.1
RemotePort=8090
SetupConnectionTimeout=3000
SourceName=ScalesCAN

[CAN-Transceiver]
IP=192.168.100.1
LocalPort=8094
RemotePort=8094
WCPort=8095

[BalanceFormat]
Manual=AAAAAAAAAAAAEEECL
Automatic=AAAAAAAAAAAAEEECL

[ScalesPrinter]
RemoteAddress=192.168.100.21
RemotePort=8092
SetupConnectionTimeout=3000
SourceName='ScalesCAN'
PrintJobBufferPath=D:\Programs\ScalesNet-M_V4\
Records\Spooler

[Preload]
WC1=132
WC2=140
WC4=164
```

Unit symbols

The following symbols can be used in configuration files as symbols for the various units. These texts are not case sensitive.

Symbol	Unit
MG	Milligram
G	Gram
KG	Kilogram
CT	Carat
LB	Pounds
OZ	Ounces
OZT	Troy ounces
TLH	Hong Kong taels
TLS	Singapore taels
TLT	Taiwanese taels
GN	Grams
DWT	Pennyweights
MM^3	Cubic millimetre
CM^3	Cubic centimetre
M^3	Cubic metres
KG/M^3	Kilograms per cubic metre
°C	Degrees Celsius
K	Kelvin
HPA	Hectopascals
MBAR	Millibars
%RH	Percent relative humidity

4.1 Commissioning a COM Transceiver (old version with SC12)

Current version of the program TCP_COM.EXE: V1.01
The version is displayed by entering the command
`tcp_com –h` on the command line (Telnet connection).

IP address: `192.168.1.200`
Port: 8192 –> for application: TCP_COM.EXE

The putty.exe program can be used for a Telnet connection.
User name: tel
Password: tel

The meaning of the individual lines of CHIP.INI is explained in Section 7.

Screen output:

```
A:A:\>tcp_com -h

COM-Transceiver for ScalesNet
Version 1.01
(c) EmTronik

COM [-i -h]
     -i Load default values to CHIP.INI
     -h This helpscreen

Done

A:\>
```

The IP address 192.168.1.200 is configured when the equipment is delivered. If it is necessary to change this address, this can be done as follows:

1. Build a connection to the COM transceiver over FTP (e.g. WS_FTP Lite)
   User name: ftp
   Password: ftp
   and download the CHIP.INI file.
2. Adapt the file to the requirements using your choice of editor (e.g. Notepad). The COM port must be set to the parameters of the datalogger to be connected.
3. Transfer the file back to the COM transceiver using FTP
4. Restart the COM transceiver (switch off and back on again)

The CHIP.INI file can be read and written over FTP even while the TCP_COM.EXE program is executing. However, the parameters are only read from the CHIP.INI file when the device is restarted. There are two ways to restart the device:

1. Send the command “ex” to the COM transceiver using CLIENT.EXE. The TCP_COM program is ended (after expiration of a timeout where appropriate). The console command “reboot” can then be entered via Telnet. The COM transceiver restarts. The Telnet connection is broken at this point and must be rebuilt.
2. Switch the device off and back on again.

4.2 Commissioning a COM Transceiver (new version with XPort)

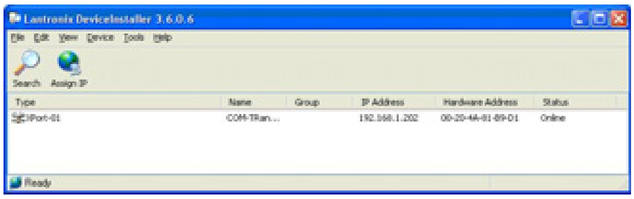
Commissioning takes place in two phases. Each phase is divided into several steps.

4.2.1 Phase 1: DeviceInstaller

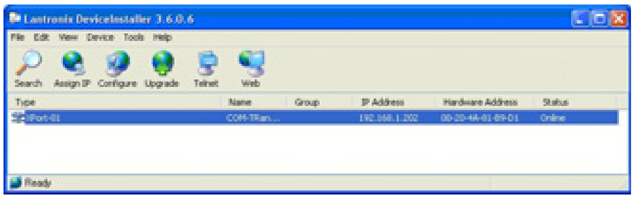
1. Installation of the DeviceInstaller from Lantronix
   This is required only once for each computer which is to communicate with the COM transceivers (usually ScalesSvr).

2. Installation of the Port Redirector from Lantronix
   This is required only once for each computer which is to communicate with the COM transceivers (usually ScalesSvr).

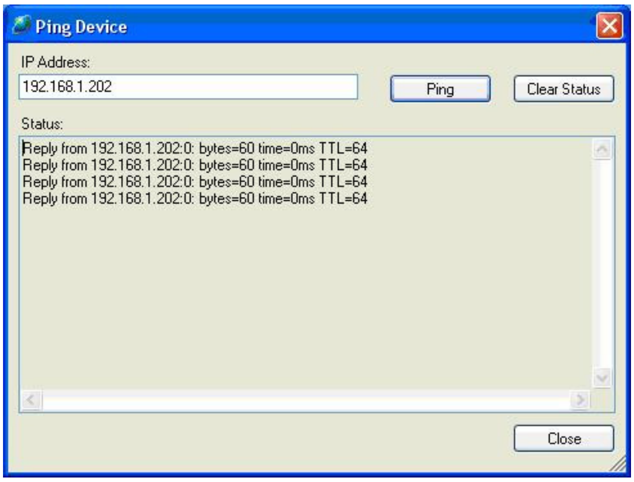
3. Configuration of the COM transceiver with the DeviceInstaller:
– Start the DeviceInstaller
– Click “Search” and wait for a moment. The window lists all accessible devices.



– Select the entry to be processed. Further buttons are displayed.

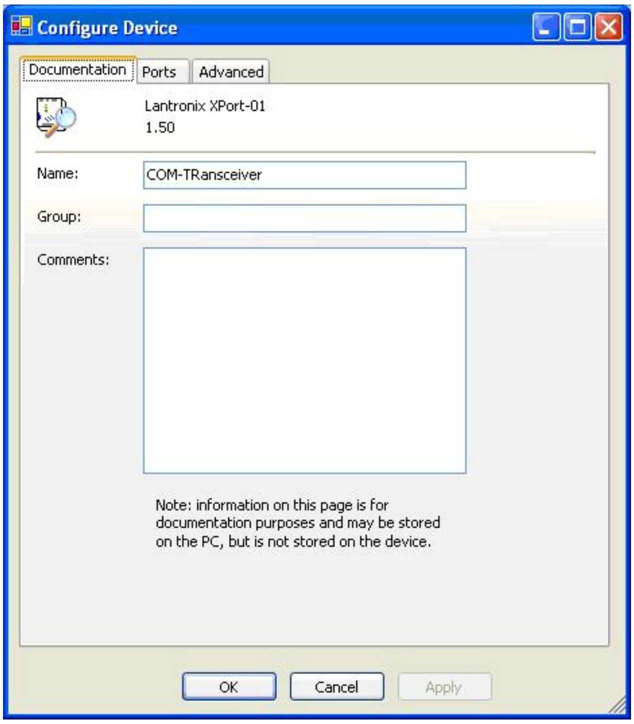


– An IP address is assigned to the device using the AssignIP function. The device can then be accessed under this address from this point onwards. This can be checked using the “ping” command. To do this select “Ping...” from the Tools menu. Clicking on the “Ping” button produces output similar to the following:

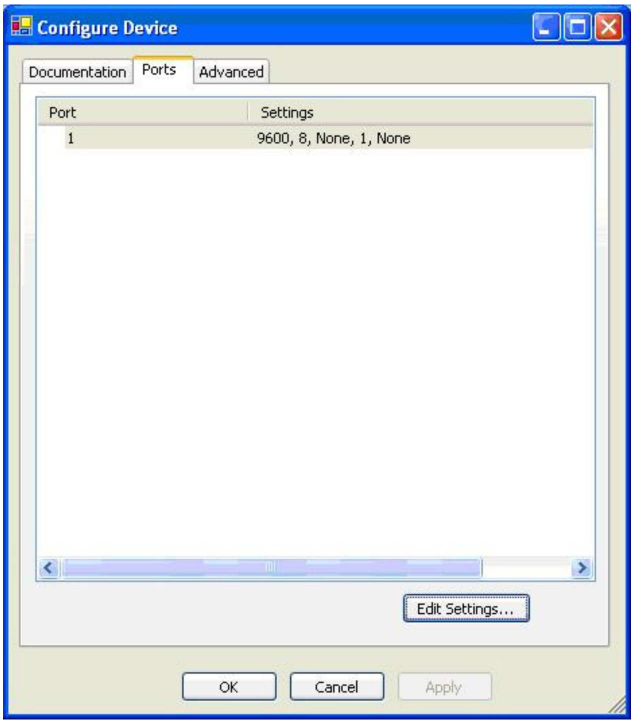


If this output is not displayed there is an error in the address assignment.
Check the settings again.

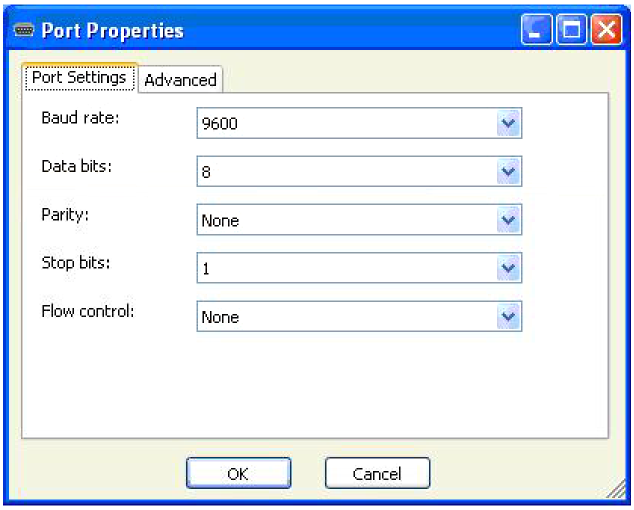
– Click the [Configure] button. The following dialog is displayed:



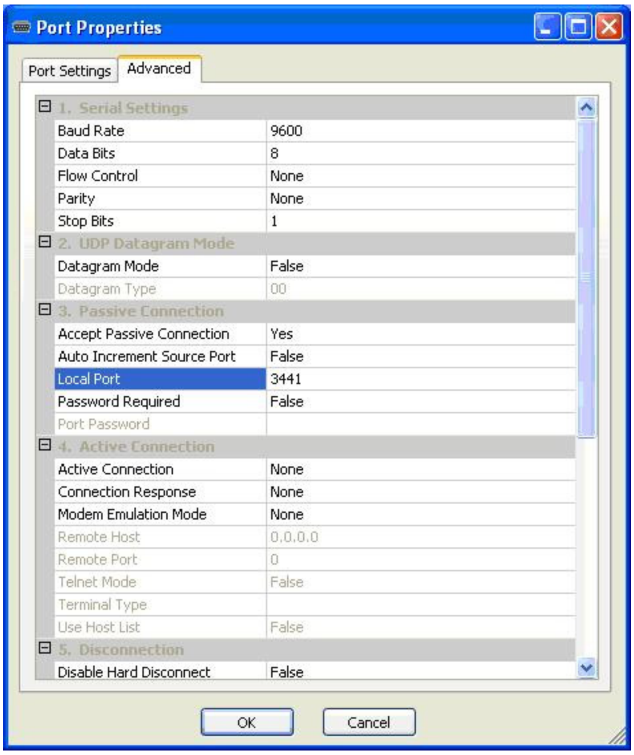
– Enter a designation of your choice under “Name.” For example, you might use the room number.
– On the “Ports” page, check the current setting of the serial interface parameters and adjust with the [Edit Settings] button where necessary.



Edit Settings:



First set the standard parameters for the serial interface on the “Port Settings” page.
There is a further important setting on the “Advanced” page:



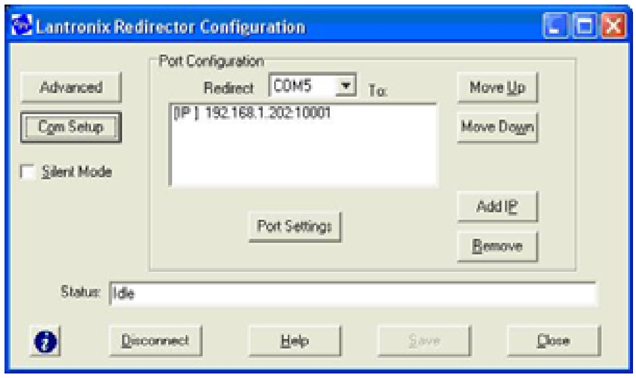
The Local Port setting, 3441 in this case, is important as the COM port redirector requires this data later, in addition to the IP address, in order to build a TCP connection.
Any free port number of the user’s choice can be used as the port number (3441 in this case for testing purposes)
It is recommended to use “10001”.

– Advanced page:
  The functionalities of the 3 control lines can be set here under Pin1 to Pin3. Everything can remain on Inx for the micromec.
  No further settings are required here.

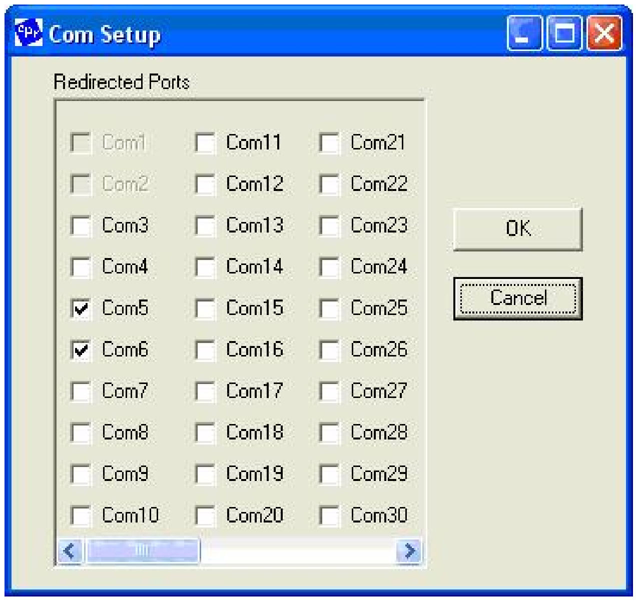
4.2.2 Phase 2: COM Port Redirector

1. Installation of the Port Redirector from Lantronix
   This is required only once for each computer which is to communicate with the COM-transceivers (usually ScalesSvr).

2. Start the configuration tool for the redirector via Start | Programme | Lantronix | Redirector | Configuration:



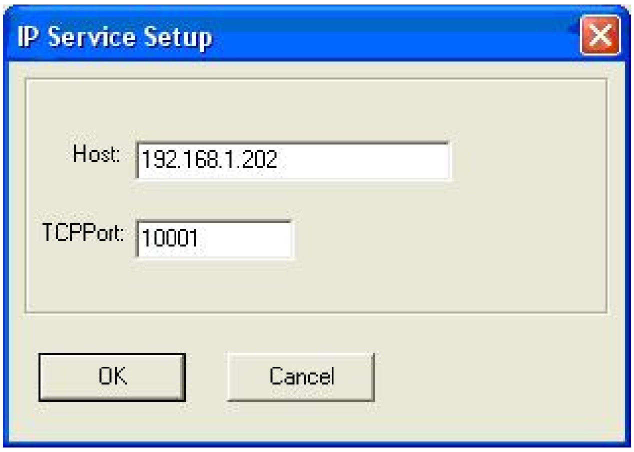
3. First select all COM ports that could be virtual COM ports via the [Com Setup] button. COM ports that are physically available are greyed out (COM1 and COM2 in this case).



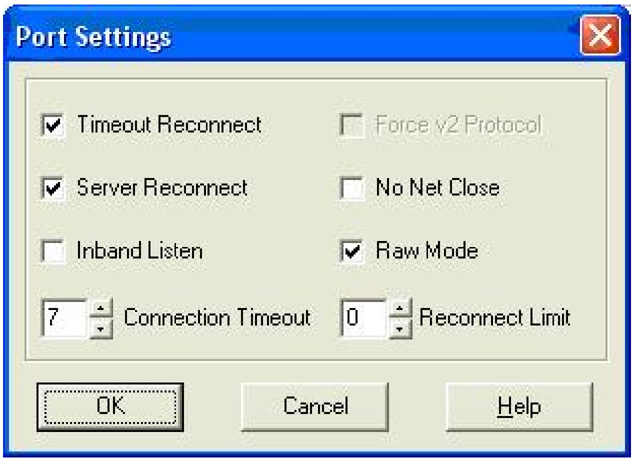
In this setting, COM ports 5 and 6 are designated as virtual COM ports. ScalesSvr can handle COM ports 1 through 9. Therefore all available ports up to and including COM port 9 should be designated here. The COM ports are only prepared here for use as virtual COM ports. It is not compulsory for them to be used as such. Ports which are not marked here cannot be used.
It is necessary to restart the computer after a setting has been modified here.

4. The COM port to be executed is selected using the “Redirect ..... to” drop-down box (COM5 in this case)

5. The IP address and port under which the Xport is accessible can now be assigned to the COM port using the [Add IP] button. This setting was already configured on the Xport in Phase 1, Step 3 (IP address and Local Port).



6. Select the “Raw Mode” setting under “Port Settings”.



The Timeout Reconnect and Server Reconnect settings serve to automatically rebuild a broken connection.

7. The modified settings are stored with “Save.”

8. Hyperterm can only be used to attempt to open this port. An information window is displayed as follows “..connecting to 192.1768...” and the connection is made.
If this test using Hyperterm functions correctly the connection with ScalesSvr will also work perfectly.

4.2.3 Connection with Dataloggers

All dataloggers which are to be connected via such a virtual COM connection are configured in ScalesDesk for operation with a local COM port.

4.3 Mikromec multisens

19,200 baud	Sufficient
8N1	Cannot be modified on the datalogger

The baud rate is set at 9600 at the factory.
This is also sufficient and it is not neccessary to change it.

The datalogger recognises two operating modes:

1. **Permanent data output**
   This is activated as follows:
   Data Output | Simultaneous -> RS 232 | On
   The data is output if the display switches back to the presentation of the measurement data. If “RS 232: EXIT = Abbr.” appears on the display then the interface is not yet open or the RTS signal on Pin 7 has not been activated.
   This operating mode was used in ScalesNet-M V3.

2. **Data output on request**
   This is the operating mode after the device has been switched off.
   The datalogger transmits the data via the interface on request. The RTS signal on Pin 7 must also be activated in this case.
   This operating mode is used by ScalesNet-M V4.

Important:
In order for this datalogger to output data via the serial interface, the RTS control line must be activated. This can be achieved with the setting RTSActive=1. This setting is no longer required when using the new COM-LAN-Transceivers, which are based on the XPort. The transceivers are suitably prepared within the device by means of corresponding coding links.

4.3.1 Operation on COM Port 1 of the ScalesSvr Computer:

Section [Port1] of ScalesSvr.ini:

```
[Port1]
Baudrate=10
Databits=4
Parity=1
Stopbits=2
Handshake=0
RTSActive=1
DTRActive=0
```

4.3.2 Operation on the COM Transceiver (new version with XPort)

From the point of view of ScalesSvr this operating mode is exactly the same as when operating on a local COM port.

4.3.3 Operation on the COM Transceiver (old version with SC12)

Section COM Transceiver of the CHIP.INI file:

```
[COM-TRANSCEIVER]
COMServer_TCPPort=8192
COMServer_SerPort=0
COMServer_Baudrate=19200
COMServer_Parity=0
COMServer_Databits=8
COMServer_Stopbits=1
COMServer_FlowControl=0
TimerSpeed=50
DebugEnable=1
DebugPort=1
```

The SC12 must be restarted after the CHIP.INI has been modified. This can be done by means of the `reboot` command or by simply switching off and back on again.

It is still necessary to set various parameters after the connection has been established over IP:
- Set end characters to $1A
- Replace #13 character by #32
- Replace #10 character by #32

Please refer to:
ScalesDesk | Climate Stations | Extended... |
After Connection Built
The following is entered here:
`sp EOLR=26;st 13=32;st 10=32;cd *iq3;`

Test:

In order to conduct a complete test it is necessary to first build up a connection to COM transceiver using the “client.exe” program. Next the following command lines must be sent in sequence to the COM transceiver:

```
sp EOLR=26
st 13=32
st 10=32
cd *iq3
cd *GMH003F
```

The final command outputs the current measurement values of Channels 1 to 6. For this purpose all channels must be activated on the datalogger.

4.4 Synmet

4.4.1 Condition as delivered

The Synmet interface is set to the parameter 9600 8N1 when delivered.
Changes can only be made by using the manufacturer’s own software (FT50.EXE).

4.4.2 Instructions

Station no:
The FMS 186 must be set to Station Nr 1. ScalesNet-M differentiates between various FMA 186 by means of other mechanisms. The Station no. is not actually used by ScalesNet-M, however it must be set correctly in order for the device to respond to requests from ScalesNet-M. ScalesNet-M always transmits Station Nr 1.

Versions of the device
There are various versions of the device. The version provided to us in the first instance is a version adapted for Sartorius. For this reason this variant of the device is designated as Synmet (Sartorius) within ScalesNet-M.

However, a more detailed examination of the two protocols revealed that there are no differences between the two versions at the protocol level. The difference appears to be in the precision of the sensors. Thus it is no longer necessary to differentiate between the two variants, Synmet (Sartorius) and Synmet.

Synmet does not require an active RTS line and can be operated with the R×D, T×D and GND signals.

4.4.3 Operation on COM Port 1 of the ScalesSvr Computer

Section [Port1] of the ScalesSvr.ini file:

```
[Port1]
Baudrate=8
Databits=4
Parity=0
Stopbits=0
Handshake=0
RTSActive=0
DTRActive=0
```

4.4.4 Operation on the COM Transceiver (new version with XPort)

From the point of view of ScalesSvr this operating mode is exactly the same as when operating on a local COM port.

4.4.5 Operation on the COM Transceiver (old version with SC12)

Section COM Transceiver of the CHIP.INI

```
[COM-TRANSCEIVER]
COMServer_TCPPort=8192
COMServer_SerPort=0
COMServer_Baudrate=9600
COMServer_Parity=0
COMServer_Databits=8
COMServer_Stopbits=1
COMServer_FlowControl=0
TimerSpeed=50
DebugEnable=1
DebugPort=1
```

The SC12 must be restarted after the CHIP.INI has been modified. This can be done by means of the `reboot` command or by simply switching off and back on again.

No further parameters must be set after the connection has been made over IP. The input fields under
ScalesDesk | Climate Stations | Extended... |
After Connection Built
and
ScalesDesk | Climate Stations | Extended... |
Before Disconnection
remain blank.

Test:
In order to conduct a complete test it is necessary to first build up a connection to COM transceiver using the “client.exe” program. Next the following command line can be sent to the COM transceiver:

```
cd $0201$1bA
```

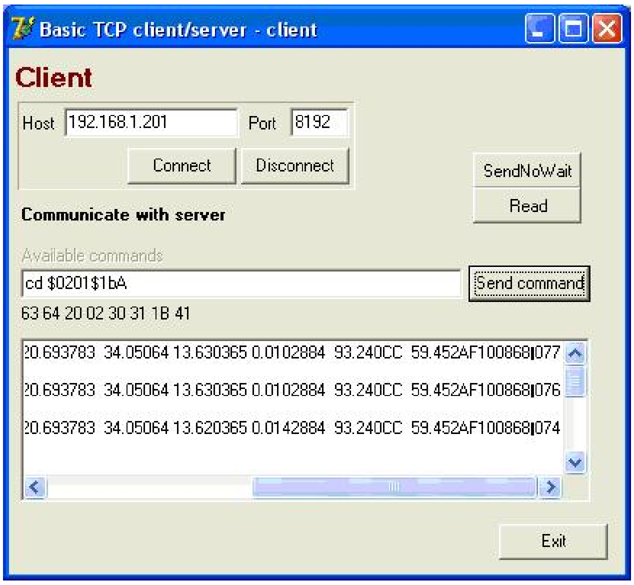
The datalogger thereupon outputs the currenty active values. Non-printable characters are not output on the COM transceiver console. Therefore only `cd 01` can be seen.

Instructions about client.exe
The Synmet datalogger expects the following lines in order to request the current values:
<STX>01<ESC>A<CR>

The STX and ESC characters are special characters which cannot be entered via the keyboard directly.

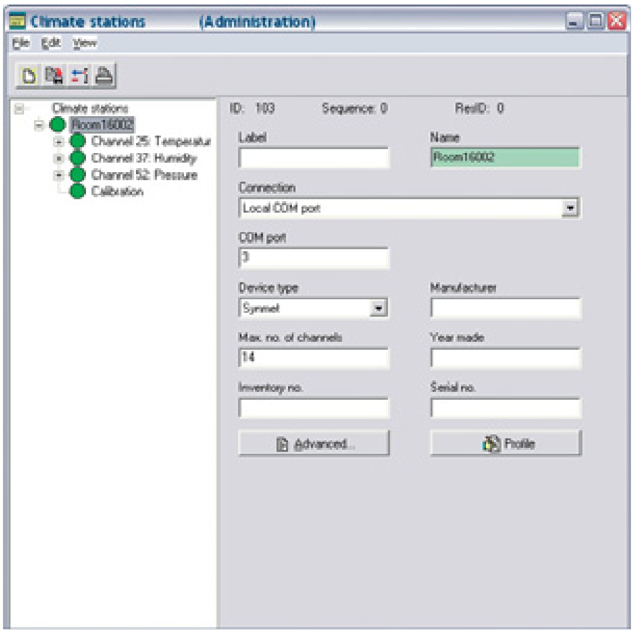
STX = 02 or hexadecimal $02
ESC = 27 or hexadecimal $1

However, in order to send such characters from client.exe, these special characters can be entered directly as hexadecimal values identified with the prefix $. Directly under the input line, client.exe again displays the byte string, which is sent by clicking on the [Send command] button. Thus whenever a $ appears in the input character stream the two subsequent bytes are interpreted as a hexadecimal representation of an individual character.



4.4.6 Steps for setting up Synmet for ScalesNet-M

1. First of all configure Synmet with the help of the programs supplied (e.g. FT50.EXE) in accordance with the Synmet manual and your own requirements.
2. Set up a new climate station of type Synmet under ScalesDesk. Enter 16 as the number of channels. You do not need to set up the channels and sensors yet. ScalesNet-M sets up one sensor for each of the parameters of temperature, pressure and humidity in accordance with pre-settings.



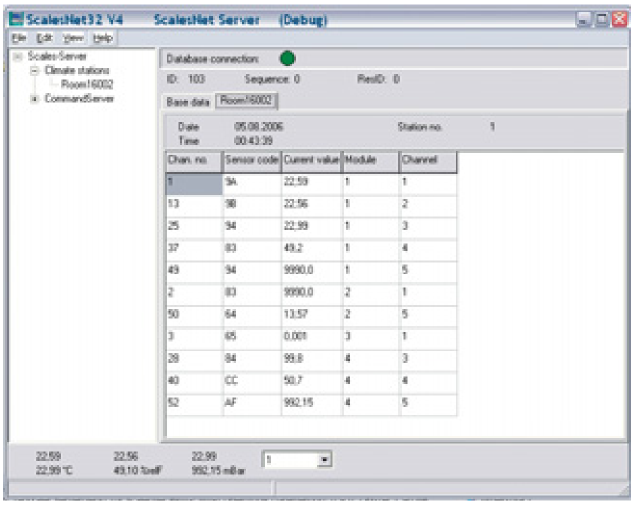
In the example the datalogger is connected to the local COM port 1 of the computer on which ScalesSvr.EXE is running.

3. Adjusting the ScalesSvr.ini configuration:
   Connect the Synmet to COM port 1 of the computer on which ScalesSvr.exe is running. Open the ScalesSvr.ini file with an editor. There is a [Port1] section there.
   Check the setting and adjust to the Synmet setting if necessary. The configuration setting shown below is applicable to the Synmet factory setting: 9600 8N1

   [Port1]
   Baudrate=8
   Databits=4
   Parity=0
   Stopbits=0
   Handshake=0
   RTSActive=1
   DTRActive=0

   Save the file.

4. Start ScalesSvr:
   The program builds up the connection to Synmet and shows the configured channels on the Synmet summary page.
   This summary page appears when you click on the Synmet branch of the Climate Stations tree.
   The display is updated in accordance with the request interval. In the basic setting of ScalesSvr this interval is 10 seconds. If necessary wait a moment for the update.

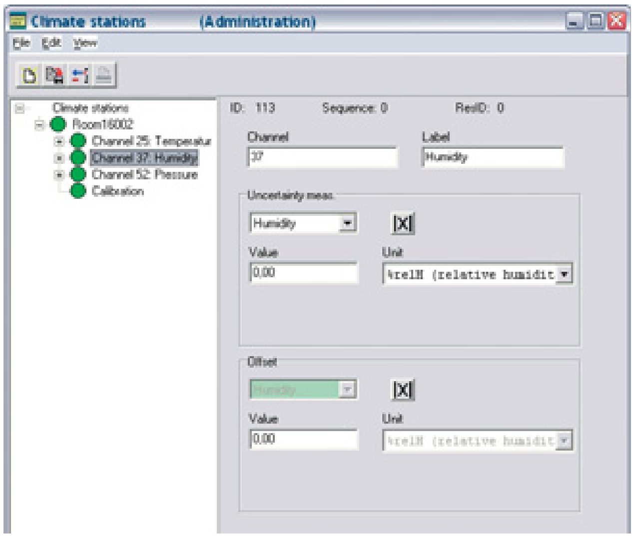


The Station no. is always 1. This must be set on the Synmet. The Synmet clock setting indicates the date and time. ScalesNet-M does not use this time. It inserts the system time of the computer on which ScalesSvr is running. The Synmet time is only given here for information purposes.
The data for ScalesNet-M can be found in the Chan. no. column. Enter these channel numbers as the channel number in the climate station (ScalesDesk) base data. You do not need to configure all the channels in ScalesDesk. It is sufficient to configure the ones you want to use.

Important:
Only the channels that have been configured in ScalesDesk are listed permanently.

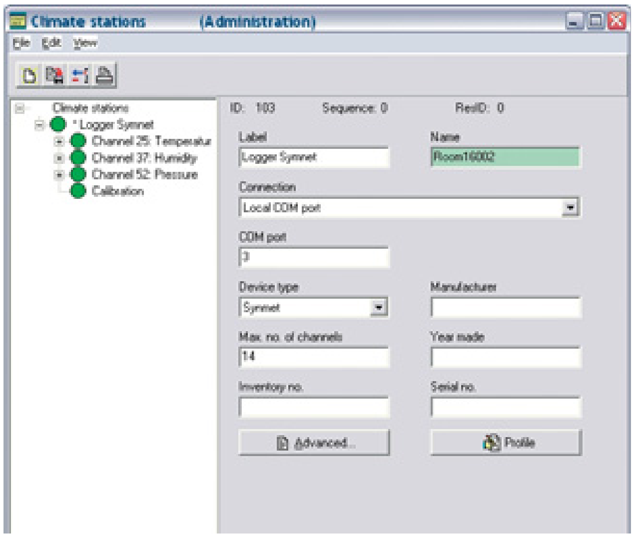
Example:
1 = Temperature
37 = Humidity
52 = Air pressure

The display for the humidity channel appears as follows:



Add channels as necessary and set the Chan no. in the same way. Save the adjusted settings in ScalesDesk. You must restart ScalesSvr in order for the amended settings to take effect.

5. ScalesSvr now displays the measurement data of the set channels.



The datalogger is now ready for operation and can be used for weighing.

4.4.6.1 WST9001 (MARO Elektronik)

4.4.7 Direct Operation on COM Port 1 of the ScalesSvr Computer:

Section [Port1] of the ScalesSvr.ini:

```
[Port1]
Baudrate=8
Databits=4
Parity=0
Stopbits=0
Handshake=0
RTSActive=0
DTRActive=0
```

4.4.8 Operation on the COM Transceiver (new version with XPort)

From the point of view of ScalesSvr this operating mode is exactly the same as when operating on a local COM port.

5 Database Connection

The logon account is:
Username: SNSERVER
Password: snserver

List of access rights to the various database objects.
This ID does not have access to objects which are not listed.

The rights to the individual database objects are listed in the “MANUAL.DOC” document.

The ScalesSvr application works internally with the EmployeeID=2. The “blocked” profile is assigned to this ID. In addition it is marked as deleted.

6 Climate Data

This application collects the climate data from the climate stations managed by ScalesNet and writes the data in a database table to present details of the measurements over time. In addition, this application communicates at regular intervals with the climate stations in order to maintain current data for the weighing operations. The mass comparator controller or ScalesMass application for their part then only request the current climate data from this server application. Thus the mass comparator controller or ScalesMass do not communicate with the climate stations directly.

6.1 Mode of operation

The interface for requesting data through the mass comparator controller or ScalesMass is separate from the climate station data request through ScalesSvr. ScalesSvr requests the current climate data from the climate stations at regular intervals and holds this data ready in internal buffers together with a timestamp of the last climate data request.

The requests from the mass comparator controller or ScalesMass are answered by ScalesSvr directly and are not forwarded to the climate station.

The interval at which the data is collected from the climate stations can be set in seconds and the default value is 10 seconds.
Once collected the data remains valid for a user-definable period of time (default = 120 seconds).

6.2 Climate station

There are three climate station and datalogger versions: IP interface, CAN interface and serial interface. The devices with CAN interface are operated on the CAN transceiver such that there is no difference from the point of view of ScalesNet-M. The devices with serial interface are likewise operated via an IP to serial converter (COM transceiver).

The climate devices have two address fields in their basic data. Their meanings are as follows:

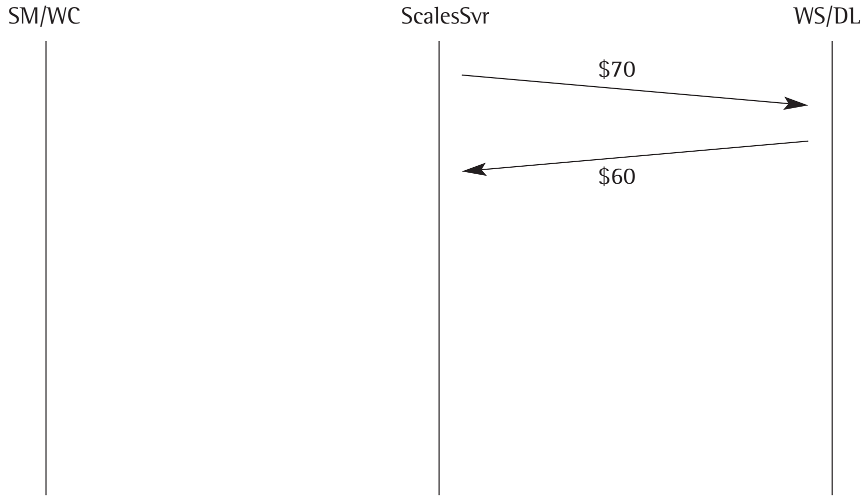
CANID	The address of the device on the CAN bus. Only the following values are possible here:
0	= Device does not require CANID (connection by COM transceiver)
1	= Device is connected via a COM port. This is the first COM port of the machine on which ScalesSvr is running (local connection)
2 through 9	= as 1, but for COM2 through COM9
100	= Climate Station 1
108	= Climate Station 2
116	= Datalogger 1 (old ScalesNet-M version)
124	= Datalogger 2 (old ScalesNet-M version)
IP-Address	The IP address of the CAN transceiver, COM transceiver or climate station direct. The IP address or a valid DNS name can be specified. The port is attached by means of a colon separator, e.g. 192.168.1.200:8012 cantransceiver.maro.de:8012

If local COM ports are used (CANID = 1 through 9) the COM port configurations (baud rate, handshake etc.) can be found in ScalesSvr.INI in the Sections [COM1] to [COM9].

6.2.1 Requesting the current climate data, protocol version 3

Protocol version 3 is based on CAN telegrams. These have a reference data range of 8 bytes. As this is not sufficient for all the data of a request, the request and its response are distributed across several telegrams. The first byte within a CAN telegram represents the function code. Thus it describes the meaning of the subsequent 7 bytes and is designated as a symbol in the message flow diagrams.

Message flow



Direction: ScalesSvr → climate station
Meaning: Require room parameters

Byte	1	2	3	4	5	6	7	8
Value	$70	$00	$00	$00	$00	$00	$00	$00

Direction: Climate station → ScalesSvr
Meaning: Current room parameters

Byte	1	2	3	4	5	6	7	8
Value	$60		T0	T1	F0	F1	D0	D1

T0 BCD representation of temperature – before decimal point
HighNibble = Tens
LowNibble = Units

T1 BCD representation of temperature – after decimal point
HighNibble = 1 / 10
LowNibble = 1 / 100

The decimal point is not shown.

F0 BCD representation of humidity – before decimal point
HighNibble = Tens
LowNibble = Units

F1 BCD representation of humidity – after decimal point
HighNibble = 1 / 10
LowNibble = 1 / 100

The decimal point is not shown.

D0	BCD representation of pressure	
	HighNibble	= Hundreds
	LowNibble	= Tens
D1	BCD representation of pressure	
	HighNibble	= Units
	LowNibble	= 1 / 10

The offset of 900 is added to the value formed in this way.

Examples:

T0 = $20	T1 = $35	→	corresponds to 20.35°C
F0 = $53	F1 = $21	→	corresponds to 53.21% relative humidity
D0 = $09	D1 = $45	→	corresponds to 094.5 + 900 = 994.5 mbar

6.2.2 Requesting the current climate data, protocol version 3 via RS232

The WST9001 climate station with modified software outputs the climate data via the RS232 at 10 second intervals.

Output protocol:

Pressure : 1000.76 Humidity : 42.50 Temp : 21.83

```
44 72 75 63 6B 20 3A 20 31 30 30 30 2E 36 36 20 20 46 65 75 63 68 74 65 20 3A 20 34 32 2E 35
37 20 20 54 65 6D 70 20 3A 20 32 31 2E 38 35 0D 0A
 0  0  0  0  0  0  0  0  1  0  0  0  ,  6  6  0  0  0  0  0  0  0  0  0  0  0  0  4  2  ,  5
 7  0  0  0  0  0  0  0  0  0  2  1  ,  8  5
```

00000000222222200000000000003333300000000011111
000000001000,6600000000000042,5700000000021,85 Definition of the FormatString
Pressure Humidity Temp

6.3 Datalogger

6.3.1 Requesting the current climate data, protocol version 3: Please refer to 6.2.1

6.4 Ring memory request including verification, Protocol version 3

Climate data is now always recorded unless the climate station is deactivated.
Climate data continues to be recorded even if the climate station is activated but the calibration has expired.

6.5 Requests from generic climate stations

The “Generic Datalogger” device type was created to avoid the necessity of executing a program modification for each climate station / datalogger. In this case the communication profile is described by a set of parameters, called a profile.
A number of profiles can be defined. These profiles are initially independent of any specific climate station. They are assigned to a climate station. Modifications made to a profile are effective on all climate stations that use this profile.

Profiles are defined in the CLIMATESOURCEPROFILE table.

Structure of the

Column	Data type	Meaning
ID	INTEGER	Primary key
PROFIL	VARCHAR(100)	Name of the profile
NAME	VARCHAR(100)	Name of the parameter
VALUE	VARCHAR(100)	Value of the parameter
VALUETYPE	INTEGER	Type of the parameter
		0 = string[100] 1 = integer 2 = float 3 = character (hexadecimal presentation) 4 = segmented string 5 = undefined
LOGID	INTEGER	internal
PRIOR	INTEGER	internal
NEXT	INTEGER	internal
DELETED	INTEGER	internal

A profile consists of the parameters listed below:

arameter	Type	Meaning
SOLSend	3	Start Of Line Send The character that must precede a line to be sent
SOLRec	3	Start Of Line Receive The character that precedes a received line
EOLSend	3	End Of Line Send The character required at the end of a line
EOLRec	3	End Of line Receive The character at the end of a line
SepChar	3	Separator within a block of parameters
BlockChar	3	Separator of blocks of parameters
NVLSep	3	Separator between values in a list
FormatChannels	0	Format description
FormatValues	0	No meaning at present
Print	0	Command which prompts the datalogger to output a data set
Version	0	Command to output the version number of the datalogger
Offset_x	2	x = the channel number, beginning with 1 The designated value is added to the transferred value (default=0)
MaxChannels	1	The number of channels available. 1..cMaxChannel (default=3)
MinValue_x	2	x = the channel number, beginning with 1 Sets the smallest valid value for this channel. (default = 0)
MaxValue_x	2	x = the channel number, beginning with 1 Sets the highest valid value for this channel. (default = 2000)

Format description:
This is a sequence of digits and upper case letters (masking characters).
The corresponding characters for each digit and each letter are taken from the data stream and allocated to a channel.
The masking channel determines the channel concerned (1 = Channel 1, 5 = Channel 5, A = Channel 10 ...)

Example
Datalogger transmits: (temperature, humidity, time, pressure, battery voltage)
```
----21.05----49.5-----14:25:10----998.5----11.9----
```

If the datalogger is configured under ScalesNet-M as follows:
Channel 1 = Temperature
Channel 2 = Humidity
Channel 3 = Pressure

then the format description for the FormatChannels parameter must be:
```
000011111000022220000000000000000033333000000000000
```

More specifically:
```
----21.05----49.5-----14:25:10----998.5-----11.9---
000011111000022220000000000000000033333000000000000
```

All characters with a masking character that contains a 0 are ignored.
All characters having the same masking character are transmitted for further processing. The information required in the datastring is allocated to the channel numbers accordingly.

In this way both the number of digits and the position in the data telegram can be defined.

Conditions:
- The datalogger always transmits an identical telegram, automatically or on request
- The data telegram is not longer than 100 characters
- The datalogger has no more than 35 channels

6.5.1 Default values of some dataloggers

6.5.1.1 Climate Station
```
Pressure : 1059.98  Humidity : 99.99  Temp : 25.00
000000003333333000000000002222200000000011111
```

Parameter	Type	Meaning
SOLSend	3	0
SOLRec	3	0
EOLSend	3	0D
EOLRec	3	0A
SepChar	3	20
BlockChar	3	0
NVLSep	3	3B
FormatChannels	0	0000000002222220000000000003333300000000011111
FormatValues	0	<zero>
Print	0	<zero>
Version	0	<zero>

6.5.1.2 Micromec V1

Parameter	Type	Meaning
SOLSend	3	0
SOLRec	3	0
EOLSend	3	0D
EOLRec	3	1A
SepChar	3	20
BlockChar	3	0
NVLSep	3	3B
FormatChannels	0	
FormatValues	0	
Print	0	*GMH0007
Version	0	*iq3

6.5.1.3 Micromec V2

Parameter	Type	Meaning
SOLSend	3	0
SOLRec	3	0
EOLSend	3	0D
EOLRec	3	1A
SepChar	3	20
BlockChar	3	0
NVLSep	3	3B
FormatChannels	0	
FormatValues	0	
Print	0	*GMH0007
Version	0	*iq3

6.5.1.4 Micromec V3

Parameter	Type	Meaning
SOLSend	3	0
SOLRec	3	0
EOLSend	3	0D
EOLRec	3	1A
SepChar	3	20
BlockChar	3	0
NVLSep	3	3B
FormatChannels	0	
FormatValues	0	
Print	0	*GMH0007
Version	0	*iq3

6.5.1.5 Dostmann P600 Series, Equipment Type P655

Humidity and Temperature

Parameter	Type	Meaning
SOLSend	3	0
SOLRec	3	0
EOLSend	3	0
EOLRec	3	0A
SepChar	3	0D
BlockChar	3	0D
NVLSep	3	;
FormatChannels	0	00011111000022222
FormatValues	0	<zero>
Print	0	ü
Version	0	<zero>

[Port1]
Baudrate = 6
Databits = 4
Parity = 0
Stopbits = 2
Handshake = 0
RTSActive = 1
DTRActive = 0

6.5.1.6 Vaisala Pressure Sensor PTB 220 AA

Pressure

Parameter	Type	Meaning
SOLSend	3	0
SOLRec	3	0
EOLSend	3	0D
EOLRec	3	0A
SepChar	3	0
BlockChar	3	0
NVLSep	3	0
FormatChannels	0	11111110000000
FormatValues	0	<zero>
Print	0	r
Version	0	<zero>

[Port1]
Baudrate = 8
Databits = 3
Parity = 2
Stopbits = 0
Handshake = 0
RTSActive = 1
DTRActive = 0

Please note:
The sensor only requires the Print command (r) once. It then prints out data permanently provided that the supply voltage is not switched off. However, regular execution of the Print command does not disturb the datalogger.

6.5.1.7 Climate Simulation

Temperature, Humidity, Pressure

Parameter	Type	Meaning
SOLSend	3	0
SOLRec	3	0
EOLSend	3	0D
EOLRec	3	0A
SepChar	3	0
BlockChar	3	0
NVLSep	3	0
FormatChannels	0	001111100000022220000000033333330000000
FormatValues	0	<zero>
Print	0	r
Version	0	<zero>

7 Printing

7.1 [Labels] Section

General:
As of Version 4.0.42.4, ScalesPrinter supports the printing of labels on special label printers. The following printer types are supported:

- Brother P-touch 2700
- Brother P-touch 9200 DX
- Brother P-touch 9500 PC

An additional “Labels Barcode” tab has been added to the “Print report...” window in ScalesDesk.

Implementation supports two categorically different formats, which are referred to in the following as Type A and Type B.

Example for Type A labels

ScalesDesk sends the text itself as a print job. The layout (which text will appear where and how big) is controlled by the following parameters in ScalesPrinter.ini.

Parameter	Permitted Values	Meaning
LabelPrinter	Name of a Windows printer	Name of the label printer as set up in Windows, e.g. P-touch 2700

7.1.1 [Type_A] Section

All values specified here refer to a continuous label roll measuring 24 mm in width.
The length of the printed label is 70 mm.
The resolution of the printer in use – P-touch 2700 – is 180 dpi.

Parameter	Permitted Values	Meaning
Width	Integer	Width of printable area in pixels (437)
Height	Integer	Height of printable area in pixels (125)
dpi	Integer	Resolution of printer in use, in dpi (180)
HeaderSize	Integer	Height of header in pixels (35)
HeaderText	ASCII	The text to be printed Care Pac Certificate
HeaderFont	Section	Reference to a section which contains descriptions for the font, see [Font Description] Section Font_A1
HeaderTextXPos	Integer	Distance of text from left edge in pixels (70)
BarCodeTyp	[0..]	
BarcodeHeight	Integer	Height of barcode in pixels, including the plain text lines directly under the barcode (70)
BarcodeFont	Section	Reference to a section which contains descriptions for the font, see [Font Description] Section Font_BCA

Meaning of Symbols:

7.1.2 [Type_B] Section
All values specified here refer to a continuous label roll measuring 24 mm in width.
The length of the printed label is 70 mm.
The resolution of the printer in use – P-touch 2700 – is 180 dpi.

Parameter	Permitted Values	Meaning
Width	Integer	Width of printable area in pixels (437)
Height	Integer	Height of printable area in pixels (125)
dpi	Integer	Resolution of printer in use, in dpi (180)
HeaderSize	Integer	Height of header in pixels (35)
HeaderText	ASCII	The text to be printed MARO ELEKTRONIK
HeaderFont	Section	Reference to a section which contains descriptions for the font, see [Font Description] Section Font_B1
HeaderTextXPos	Integer	Distance of text from left edge in pixels (126)
HeaderTextYPos	Integer	Distance of text from top edge in pixels (1)
SubHeaderText	ASCII	The text to be printed
Silvanerweg 6, 55559 Bretzenheim, Germany		
SubHeaderFont	Section	Reference to a section which contains descriptions for the font, see [Font Description] Section Font_B2
SubHeaderTextXPos	Integer	Distance of text from left edge in pixels (64)
SubHeaderTextYPos	Integer	Distance of text from top edge in pixels (22)
BarCodeTyp	[0..]	
BarcodeHeight	Integer	Height of barcode in pixels, including the plain text lines directly under the barcode (42)
BarcodeFont	Section	Reference to a section which contains descriptions for the font, see [Font Description] Section Font_BCB
BarcodeXPos	Integer	Distance of barcode from left edge in pixels. Optional. Default = horizontally centered in the body of the text (74)
BarcodeYPos	Integer	Distance of barcode from top edge in pixels. Optional. Default = 5 pixels below HeaderSize
BarcodeLabelFont	Section	Reference to a section which contains descriptions for the font, see [Font Description] Section Font_B3
BarcodeLabel	ASCII	Text to be printed Serial no.
BarcodeLabelXPos	Integer	Distance of barcode label from left edge in pixels. Optional. Default = 10 (10)
BarcodeLabelYPos	Integer	Distance of barcode from top edge in pixels. Optional. Default = 5 pixels + HeaderSize (83)
BarcodeCleartextXPos	Integer	Distance of barcode label from left edge in pixels. Optional. Default = BarcodeLabelXPos + width (BarcodeLabel) + 10 (109)

Parameter	Permitted Values	Meaning
Param1Font	Section	Reference to a section which contains descriptions for the font, see [Font Description] Section Font_B4
Param1NameXPos	Integer	Distance of barcode label from left edge in pixels. Optional. Default = 10 (10)
Param1NameYPos	Integer	Distance of barcode from top edge in pixels. Optional. Default = BarcodeLabelYPos + height (BarcodeLabel) (101)
Param1ValueXPos		Distance of barcode label from left edge in pixels. Optional. Default = Param1NameXPos + width (BarcodeLabel) + 10 (64)
Param1ValueYPos		Distance of barcode from top edge in pixels. Optional. Default = Param1NameYPos (101)
Param2xx.. Param5xx	Analog	

7.1.3 [Font Description] Section

As many sections of this type as desired can be created. The names of these sections must all be different. Referencing is carried out using the section names.

Parameter	Permitted Values	Meaning
Font	Name of a character set	Name of a Windows character set available on this machine Arial
Size	Integer	Font size
Style	[bold, italic, underline, strikeout]	Font style. Any combination of all these styles is possible. The list items are separated with a comma.

8 Command Interface

8.1 General

This function represents an interface to various functions of ScalesSvr. A client can send requests to the server in the form of simple character strings and receive a corresponding response. The construction of the requests and the responses sent by the server correspond to simple character strings. The character string begins with a command word which informs the server of the function required. Parameters which belong to the corresponding command word then follow, separated from each other and from the command word by a 'space' character in each case. These parameters are transmitted in the form Name=Value.

On start up, ScalesServer connects to all network cards registered in the system as a listener process on TCP port 8090. This port can be designated to ScalesSvr in the INI file.

All commands are case-sensitive and it is therefore essential that they are used in the notation described here.

8.2 Commands

8.2.1 Permitted requests and their parameters:

Command: getServerStatus
Function: Requests various parameters from the server
Response: setServerStatus

Parameter	Meaning
version=0	Requests the version number of the server
uptime=0	Requests how long the server has been running
welcome=0	Sends the same text as when opening the connection. Can be used for testing.

Command: getClimate
Function: Requests climate data for the weighing process. Either the current data or 0.0 is returned
Response: setClimate

Parameter	Meaning
tsid=n	n = ChannelID of the temperature sensor. ScalesSvr returns the measurement value of the sensor without offset correction.
tkid=n	n = ChannelID of the temperature sensor. ScalesSvr returns the measurement value of the channel which corresponds to the measurement value of the sensor including offset correction.
fsid=n	Corresponds to humidity
fkid=n	Corresponds to humidity
dsid=n	Corresponds to air pressure
dkid=n	Corresponds to air pressure

"tsid" and "tkid" request a temperature in each case.
The parameter which is named first is used. Subsequent requests for temperature are ignored. The same applies to the other measurement values.

Command: getClimateBuffer
Function: Requests climate data from the climate buffers. This is required for the subsequent allocation of the climate values to specific timestamps.
Response: setClimateBuffer

Parameter	Meaning
source	Designation of the climate station from which data is requested
date	Date portion of the timestamp requested
time	Time portion of the timestamp requested

ScalesSvr records all the climate values delivered by the climate stations in climate buffers. The recording level is 7 days. Older values are deleted. Recording is pre-set to take place every 10 seconds.

Command: getClientInfo
Function: Allows the client to send various data to the server for identification purposes
Response: setClientInfo

Parameter	Meaning
sourceName	Any desired name under which the connection is displayed in the list of active server connections
userName	Name of employee or user logged on to the client

Command: getUpdate
Function: Allows the client to inform the server about a change in the configuration of specific objects. The server acknowledges this information with "ok" only and downloads the corresponding objects from the database.
Response: setUpdate

Parameter	Meaning
object	One of the following keywords: [ClimateStation | ClimateChannel | ClimateSensor]
objectIDold	Integer value, 1.. The old primary key of the above object in the database 0 = invalid
objectIDnew	Integer value, 1.. The new primary key of the above object in the database 0 = invalid
action	One of the following keywords: [add | update | remove | reload] **Meaning:** add — The climate station with the ID designated in objectIDnew is added update — The climate station which was identified by objectIDold until now is replaced by the station designated under objectIDnew remove — Removes the station designated under objectIDold from the list reload — All climate stations are reloaded from the database This may take a few seconds

Delete in this case does not mean delete from the database. ScalesServer loads the global objects on start up. If there should be any change to this relatively static data, ScalesServer can update this list from the database against a corresponding "getUpdate" instruction as described above.

8.2.2 Permitted responses and their parameters:

Response: setServerStatus
Function: Delivers the requested parameter

Parameter	Meaning
version=mm.ss	Version number of the server software mm=main version, nn=ancillary version
uptime=d	Timestamp since the beginning of the last server start up Format: YYYY-MM-DD HH:MM:SS

Response: setClimate
Function: Delivers the requested climate data back to the requester. Only the currently active values requested by the requester are delivered.

Parameter	Meaning
temp=nn.nn	Current value of temperature in the unit of the channel / sensor
humidity=nn.nn	Current value of humidity in the unit of the channel / sensor
pressure=nnn.nn	Current value of pressure in the unit of the channel / sensor
air density = n.nnnnn	The air density is calculated by ScalesSvr from the parameters transmitted. If the climate values come from several stations the air density is not identical to the values of the climate recordings per station.

Response: setClimateBuffer

Parameter	Meaning
source=	Designation of the climate station from which data is requested
time=	Timestamp of the climate data
Kn (Cn)=	Channel number of the climate station and the numerical value of the measurement without the unit. These entries occur once per channel
result=	Integer value with the following meaning 0 = Valid data –1 = Requested timestamp too old –2 = Requested timestamp too new

Response: setClientInfo
Function: Only sends "OK" or an error text but no parameters

8.3 ScalesSrv ↔ COM transceiver communication

Communication takes place on the basis of character strings. The character string begins with a command code followed by one parameter in each case. Commands and parameters are separated from each other by blank characters. The parameters themselves consist of a pair of values in the form Name=Value. The name of the parameter (always 4 characters in length, with the exception of st), the equal sign and the value itself follow on directly with no further blank characters or separators. The end of a line is designated by the CR / LF characters. The CR / LF characters thus belong to the communication between ScalesSvr and TCP_Com and therefore must not appear again in the command sequences. If the device connected to the serial port likewise requests a CR/LF, this must be added by TCP_Com.
Please refer also to the EOLS parameter.

The following characters are permitted as characters for parameter names: [A..Z,a..z,0..9]
Parameter names must begin with a letter.
Parameter names are case sensitive.

The following characters are permitted as characters for values: [A..Z,a..z,0..9]
Numbers are always decimal as a character string.

Example:

```
sp EOLS=23<CR><LF>
sp TO01=3000<CR><LF>
cd *iq3<CR><LF>
```

8.3.1 List of the defined commands and their meanings

8.3.1.1 Direction: ScalesSvr → COM Transceiver

Command	Meaning

sp	Set Parameter
	Passes important communication parameters for the communication between TCP-Com and the datalogger to TCP_Com.
	All parameters have default values which can be modified by means of sp. The current setting can be requested by means of qp.
	General:
	`sp <Parametername>=<Wert><CR><LF>`
	Example:
	`sp EOLS=23<CR><LF>`

qp	Query Parameter Request set parameter values. The format of the response corresponds to the sp command. Example: `qp EOLS<CR><LF>`
st	Set Translation General: tt src=dst<CR><LF> Example: tt 13=32<CR><LF> Designates the src character code which is to be replaced by a different character code – dst. The characters sent by the datalogger are given via a translation table. In this way each byte can be exchanged for a replacement character. The table receives all ASCII characters by default so that changes do not occur. This translation becomes important when the characters #13 and/or #10 are contained in the data stream. These must be replaced, as they have a separate meaning in the communication between ScalesSvr and COM transceiver.
qt	Query Translation Request set values. The format of the response corresponds to the “st” command Example: `qt 13<CR><LF>`

cd	Command
	The subsequent string is to be sent to the device which is connected to the serial port. In this process, the command itself (the first 3 characters) and the <CR><LF> at the end of the line are removed and the character stored in EOLS as the end of line identifier for the datalogger is attached to the remaining line.
	General:
	`cd [befehlsstring für den Logger]<CR><LF>`
	Example:
	`cd *iq3<CR><LF>`
	Character sequence sent to the datalogger: `*iq3<EOLS>`

ex	Ends the program on the COM transceiver and is for development purposes only. Does not require any parameters.

8.3.1.2 Direction: COM transceiver → ScalesSvr

The response from COM transceiver to ScalesSvr always takes place on every request (with an error message on timeout if necessary).

General format:

```
[ok|er] <Befehl> <Antwort vom Logger|Fehlermeldung><CR><LF>
```

Example: (response to command)

Command	Meaning
ok	There is a valid acknowledgement from the datalogger.
er	An error message from the datalogger or the TCP_Com server

8.3.2 Examples:

Commands to COM transceiver	Responses from COM transceiver
`sp EOLS=23<CR><LF>`	`ok sp EOLS=23<CR><LF>`
`qp EOLS<CR><LF>`	`ok qp EOLS=23<CR><LF>`
`cd *iq3<CR><LF>`	`ok cd <Antwort vom Logger><CR><LF>`

8.3.3 Definition of the Parameters and their Permitted Values

All parameters have default values. These default values are defined in CHIP.INI. The respective default value for the individual parameters is identified by the designation: **default=xxx**. Parameters which are sent to TCP_Com by the sp command overwrite these default values. Therefore only the parameter which differs from the default value has to be transmitted.
A parameter always consists of 4 letters (case-sensitive).

Name	Value range	Meaning
EOLS	0 to 255	Designates the line end character for data lines which are to be sent to the datalogger. Default = 13 (carriage return)
EOLR	0 to 255	Designates the line end character sent by the datalogger. Default = 13 (carriage return)
TO01	0 to 65535	Designates how long TCP_Com is to wait for a response from the datalogger which is connected via the serial interface. TCP_Com reports a timeout to ScalesSvr when this time has expired. The designation takes place in **50 ms** steps. Default = 200 (corresponds to 10 seconds)

9 Data Output and Format Descriptions

Format description of the data output of a mass comparator

The mass comparators output character strings followed by a CR/LF. These character strings have a fixed construction.
The construction is defined in the type of format description with the characters shown below. The position of the character in the format string corresponds to the position of the character.
Automatic mass comparators usually output 2 values with one datagram. The two values are separated by a separator in the format description.

Character	Position
+	Prefix
*	Blank character
A	Display character including decimal separator The decimal separator can be a dot or a comma.
E	Unit designation of the mass comparator
C	Carriage return
L	Line feed
K	Designation
Y	Separator if there is more than 1 value. The separator separates the individual values from each other. The first separator marks the position of the separation and does not stand for any character position. If it is also necessary for the separator to occupy character positions then it must be repeated for each character. Thus n separators mark the position of the separation and represent n-1 characters there.
N,P	These characters are placed at the end of the format description. They designate the allocation when the mass comparator transmits more than 1 measurement value. N=Standard P=Test weight These characters only apply to mass comparators which deliver several measurement values in a string (automatic mass comparators). These characters can be omitted for manual mass comparators.
Q	Stability display (Quiet) This position contains the display concerning whether or not the mass comparator is in stability. Stability is displayed by means of the letter S in the weighing string.

Sartorius mass comparators:

16 digit designation: +*AAAAAAAAAEEECL

22 digit designation: KKKKKK+*AAAAAAAAAEEECL

Several values
in one datagram: +AAAAAAAAAYY+AAAAAAAAACNP
(e.g. Sartorius automatic mass comparator)

First value = Normal
Second value = Test weight
The first Y character marks the position at which the input datastream is to be separated. The number of following Y's designates the number of characters which separate the two values from each other (in this case: 1). The character which is used as a separator in the input datastream is immaterial. The output string of the mass comparator ends with CR/LF. In the format description, the designation concerning which transmitted measurement value belongs to which weight then follows. The reference standard is output first, followed by the test weight.

Stability display:
0 = Stability when the unit character is shown (Sartorius)
1 = Stability display by means of an S in the weighing string (Mettler)

Mettler-Toledo

Of all the possible output commands of these mass comparators only the response to the following commands is evaluated:
S – Send stable weight value
SI – Send weight value immediately (PrintRequest = True)
No further commands or their possible responses are currently supported.

Output formats:

`S_S______-0.00_g`	Measurement value stable
`S_D_______1.23_g`	Measurement value unstable
`S_D_0000000000_g`	General format
`KKQ*AAAAAAAAAAEECL`	Format description

Simple mass comparators from the B-S product range
– AB-S
– PB-S
do not recognise SI commands. They are to be configured in such a way that they permanently output the weighing value autonomously.

Configuration of these mass comparators:
Host
S.cont
S.SICS
Baud 19200
8Bit, No Parity
HS Off

ScalesController
The ScalesController sits between the ScalesNet-M_V4 server and the mass comparator. The ScalesController transmits the measurement values in the header data at the end of the weighing. Each measurement consists of a string with a length of 20 characters.

Permitted space in the header data of the ScalesController:
```
xxxxxxxxxxxxxxxxxxxx
```

<u>Example:</u>
```
A1 01 2B 31 30 30 32 2E
A2 30 31 36 32 20 67 20
A3 20 20 20 20 20 20 20
```

is recomposed to:

```
2B 31 30 30 32 2E 30 31 36 32 20 67 20 20 20 20 20 20 20 20
+  1  0  0  2  .  0  1  6  2  _  g  _  _  _  _  _  _  _  _
A  A  A  A  A  A  A  A  A  A  A  E  E  E
```

(i.e. left-justified)

The ScalesController from ScalesNet-M copies the number of characters which correspond to the format description without CL into a receive buffer, beginning with the first character of the header data. The total length of the format description without CL, in theory, must be only 20 characters. However, at the same time it is important that the length of the area marked by A's, which describes the positions, does not project beyond the units character, because the area of characters marked with A is converted into a number. This conversion fails in the case of non-numeric characters such as kg, g or mg and the number value is set to =0.

```
B1 01 2B 31 30 30 32 2E
B2 30 31 36 37 20 67 20
B3 20 20 20 20 20 20 20
```

is recomposed to:

```
2B 31 30 30 32 2E 30 31 36 37 20 67 20 20 20 20 20 20 20 20
```

(i.e. left-justified)

Format strings for name allocation

```
//------------------------------------------------------------------------------
//-- These functions expect a format string, e.g. from the INI file
//-- The sequence of parameters is as follows:
//--  0 : Year, 4 digits                        2003
//--  1 : Year, 2 digits                          03
//--  2 : Month, 2 digits                         12
//--  3 : Day,   2 digits                         31
//--  4 : Day of the year, 3 digits              365
//--  5 : Calendar week, 2 digits                 52    Calendar week begins on Monday and ends on Sunday
//--  6 : Counter -- number of digits according to format  1
//--  7 : MassComparatorNr                         1    for MassComparatorCalibrationRecord
//--  8 : MeasurementRangeNr                       2    for MassComparatorCalibrationRecord
//--  9 : Short name of the template            DKD1    for DKD Certificate
//-- 10 : SerNr                            dwiu4rcc2    for DKD Certificate
//-- 11 : Add-on                                mib1    Line 1 from the Print dialogue for DKD Certificate
//--
//-- Delivers a WKP number for the WKP record
//--
//-- Example:
//-- Format string =  WKP_%1:.2d_%2:.2d_%6:.6d_W%7:.2d_MB%8:.1d
//-- No.            =  123
//-- result        =  WKP_04_02_000123_W08_MB3
//--
```

The format strings are used in the INI file of the respective application. The meanings of the respective indicators do not change in this process. However, depending on the application, various identifiers are without meaning or function.

For PKP-protocol

```
//------------------------------------------------------------------------------
//-- These functions expect a format string, e.g. from the INI-file
//-- The sequence of parameters is as follows:
//-- 0 : Year, 4 digits                         2003
//-- 1 : Year, 2 digits                           03
//-- 2 : Month, 2 digits                          12
//-- 3 : Day,   2 digits                          31
//-- 4 : Day of the year, 3 digits               365
//-- 5 : Calendar week, 2 digits                  52    Calendar week begins on Monday and ends on Sunday
//-- 6 : Counter – number of digits according to format  1
//-- Delivers a PKP number for the PKP record
//--
//-- Example:
//-- Format string =  PKP_%1:.2d_%2:.2d_%6:.8d
//-- Nr            =  143
//-- Result        =  PKP_04_02_00000143
//--

//------------------------------------------------------------------------------
```

Format description of the data output of a datalogger

The dataloggers designate character strings followed by an end identifier. It is not essential for this end identifier to be CR/LF. These character strings have a fixed construction.
This construction is defined in the type of format description with the characters shown below. The position of the character in the format string corresponds to the position of the character. Dataloggers return 1..n values in a string.
The `FormatChannels` field exists next to the `FormatValues` field in order that the values can be allocated to channels.
This field describes which position in the format string belongs to which channel.

FormatChannels
The input data is read from left to right. All characters which belong to a channel are extracted and added to a new string for this channel in the sequence in which they appear. This newly created string is interpreted as the measurement value for this string in accordance with the designations in `FormatValues`.
The digits 1 through 9 and upper case letters A through Z are defined as descriptions for the channel numbers. This allows 35 channels to be differentiated, which should be sufficient for ScalesNet-M.

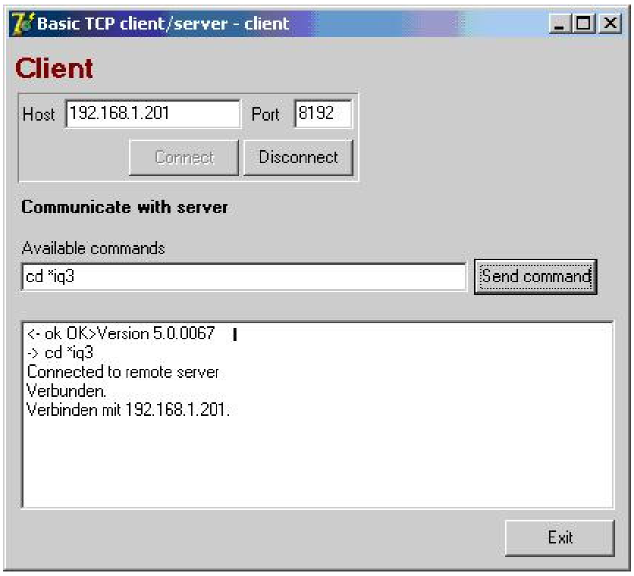
Character	Position
0	Position has no meaning and is not considered in the evaluation.
1	Position belongs to Channel 1
2	Position belongs to Channel 2
3	Position belongs to Channel 3
...	...
A	Position belongs to Channel 10
B	Position belongs to Channel 11
...	...
Z	Position belongs to Channel 35

FormatValues:
For the purposes of simplicity this structure follows the construction of the format string for mass comparator data.

Character	Position
+	Prefix
*	Blank character
A	Display character including decimal separator The decimal separator can be a dot or a comma.
E	Unit designation of the channel
C	Carriage return
L	Line feed

10 CLIENT.EXE Test Program

The function of the connection between TCP_COM (SC12) and datalogger can be checked using the Client.exe test program.
It is not suitable for the new version (XPort).



To conduct this test, the IP address of the COM transceiver is entered under Host and the port on which the COM transceiver listens is entered under Port. Both parameters are registered in the CHIP.INI of the SC12.
Click on [Connect] to build up the connection to the COM transceiver. Next it is necessary to transfer various parameters, depending on the device connected. In the example of the mikromec multisense this would be the end designation $1A.
`sp EOLR=26`
Thus $1A is defined as the end ID of micromec telegrams (the pre-setting is $0D)

It is then possible to communicate directly with the connected device. In doing so the commands naturally depend on the device itself. In the case of mikromec, the software version of the device is requested with the `*iq3` command.
The command to the COM-transceiver is thus:
`cd *iq3`
The required CR/LF automatically attaches the Client program.

11 CHIP.INI

```
[IP]
DHCP=0
ADDRESS=192.168.1.201
NETMASK=255.255.255.0

[COM-TRANSCEIVER]
COMServer_TCPPort=8192
COMServer_SerPort=0
COMServer_Baudrate=19200
COMServer_Parity=0
COMServer_Databits=8
COMServer_Stopbits=1
COMServer_FlowControl=0
TimerSpeed=50
DebugEnable=1
DebugPort=1
```

12 ScalesSvr.INI

In ScalesDesk, a local COM port of the computer on which ScalesSvr is running can be selected for a climate station. However, the interface parameters are not stored in the database but in ScalesSvr.ini. As ScalesNet-M supports up to a maximum of 49 COM ports, the parameters of these 49 interfaces are defined in the [Port1] through [Port49] sections.

12.1 Section [Port0_Template]

This section is a template for the definition of sections [Port1] through [Port9].
The parameters and their permitted values are identical in all these sections.

The interface to be used for a climate station is defined in the CAN-ID field, if the value lies in the range 1 through 9 (corresponding to COM1 through COM9).
The further parameters of this interface are then defined in the Configfile of the ScalesSvr in the [Port1] through [Port9] sections. The allocations designated below are applicable:

Parameter	Meaning / Permitted Values		
Baudrate	0	=	50 Bd
	1	=	110 Bd
	2	=	150 Bd
	3	=	300 Bd
	4	=	600 Bd
	5	=	1,200 Bd
	6	=	2,400 Bd
	7	=	4,800 Bd
	8	=	9,600 Bd
	9	=	14,400 Bd
	10	=	19,200 Bd
	11	=	38,400 Bd
	12	=	56,000 Bd
	13	=	57,600 Bd
	14	=	115,200 Bd
	15	=	128,000 Bd
	16	=	230,400 Bd
	17	=	256,000 Bd
	18	=	460,800 Bd
	19	=	921,600 Bd
Default: 8			
Data bits	0	=	4 data bits
	1	=	5 data bits
	2	=	6 data bits
	3	=	7 data bits
	4	=	8 data bits
	Default: 4		

Parameter	Meaning / Permitted Values		
Parity	0	=	none
	1	=	odd
	2	=	even
	3	=	mark
	4	=	space
	Default: 0		
Stopbits	0	=	1 stop bit
	1	=	1.5 stop bits
	2	=	2 stop bits
	Default: 1		
Handshake	Bit field		
	Bit 0:		1= RTS/CTS hardware activated 0= RTS/CTS hardware deactivated
	Bit 1:		1= DTR/DSR hardware activated 0= DTR/DSR hardware deactivated
	Bit 2:		1= XON / XOFF software activated 0= XON / XOFF software deactivated
	Bit 3 through 15:		not defined
	Default: 0 (no handshake)		
XON	Characters for XON if software handshake is to be used Default: #17		
XOFF	Characters for XOFF if software handshake is to be used Default: #19		
RTSActive	1:		RTS line is activated when the interface is opened
	0:		RTS line is not activated when the interface is opened
	Default: 1		
DTRActive	1:		DTR line is activated when the interface is opened
	0:		DTR line is not activated when the interface is opened
	Default: 0		

To illustrate the entire procedure of presenting a mass scale in ScalesNet32, all steps will be presented and explained in the following using an example.

First, the job is realistically defined.
Determination of masses β_2 to β_8 for weights with nominal values M_2 to M_8 within Class E1 accuracies.
$M_1 = M_2 = 1000g$, $M_3 = M_4 = 500g$, $M_5 = M_6 = 200g$, $M_7 = M_8 = 100g$

Calculation of expanded standard uncertainties $U(\beta_2)$ to $U(\beta_8)$ for the masses of the weights.

The measurements were taken in the Häfner calibration laboratory. Upon explanation of measuring equipment and known sizes, the individual steps are then presented in ScalesNet32 for determining the measured values. From this, the masses and uncertainties are calculated.

Measuring Equipment

Fully Automatic Weighing Robot for Mass Scale Weight Comparisons

ScalesNet32 exchanges data directly with the robot via a TCP/IP interface.

Type CCR 10-1000
An electronic mass comparator, the Sartorius CCE 10-GWA, is used for determining the differences in weight:
Maximum load 1002 g, resolution d = 0.0001 mg
Weighing range 1: 10 g–200 g (s_P value = 0.0035 mg)
Weighing range 2: 500 g–1002 g (s_P value = 0.0048 mg)

Room Climate Detection and Monitoring System

A room climate detection and monitoring system with measurement sensors is available as a measuring device for determining the density of the air:
mikromec logger MLm 1624n
<u>Connected sensors:</u>
6 temperature sensors, type: Pt 100
1/10 DIN B (at 0°C) according to DIN EN 60751, measuring range: -50 to 200°C, resolution: 0.01 K
2 humidity sensors, type: Hygroclip S3
Measuring range: 0–100% rel. humidity, resolution: 0.1%
1 atmospheric pressure sensor, type: PTB 101C
Measuring range: 900–1100 hPa, resolution: 0.01 hPa

1.1 Nominal Values of the Mass Scale

$M_1 = M_2 = 1000g$, $M_3 = M_4 = 500g$, $M_5 = M_6 = 200g$, $M_7 = M_8 = 100g$

Hence: $M = (1000 \quad 1000 \quad 500 \quad 500 \quad 200 \quad 200 \quad 100 \quad 100)^T * 10^3 mg$

1.2 Reference Comparison Standard

All reference weight data are transferred from the calibration certificate to the ScalesNet32 database:

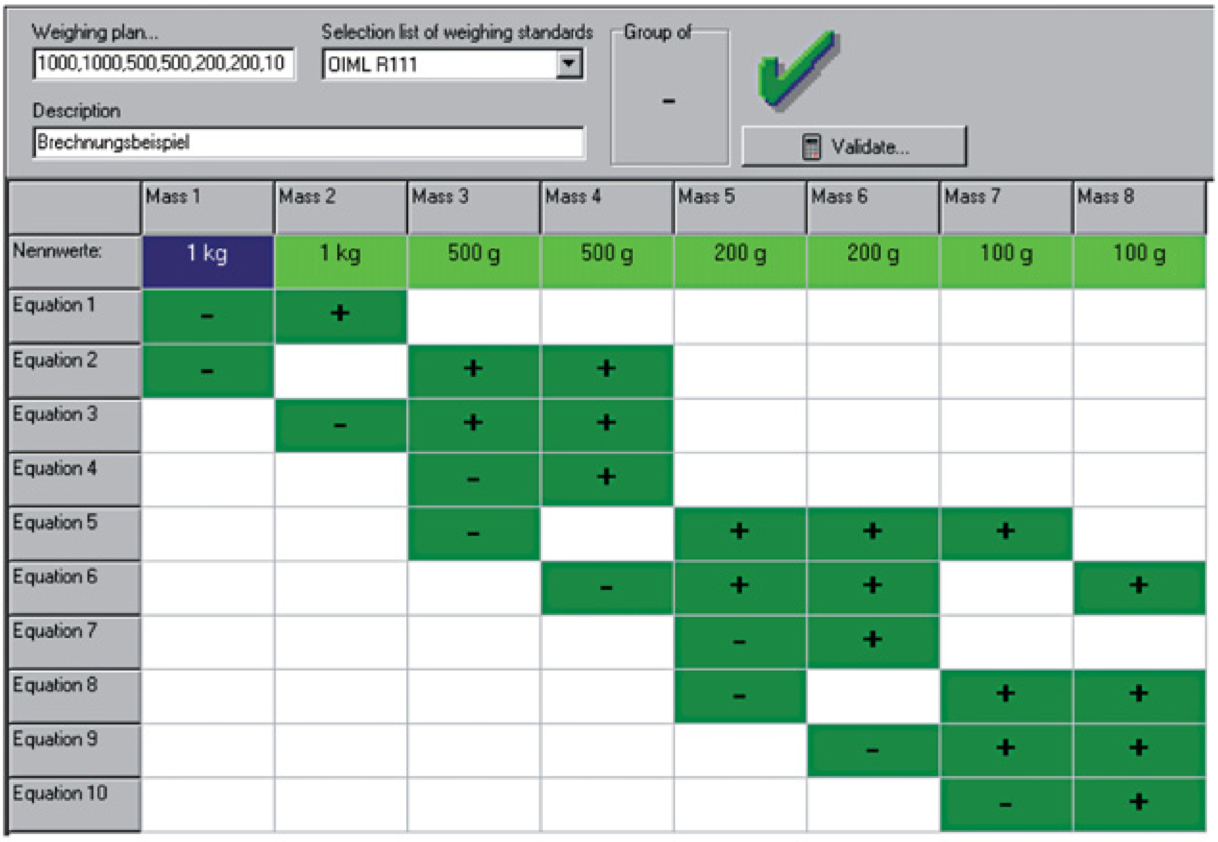
$m_N = \beta_1 = 1kg - 0.81mg = 999999.19mg$

1.3 Expanded Uncertainty of Reference Comparison Standard

From the calibration certificate: $U_{k=2}(m_N) = 0.050mg$

1.4 Weighing Plan in ScalesNet32

The weighing plan, defined in ScalesNet32, meets the specifications of our example



	Mass 1	Mass 2	Mass 3	Mass 4	Mass 5	Mass 6	Mass 7	Mass 8
Nennwerte:	1 kg	1 kg	500 g	500 g	200 g	200 g	100 g	100 g
Equation 1	-	+						
Equation 2	-		+	+				
Equation 3		-	+	+				
Equation 4			-	+				
Equation 5			-		+	+	+	
Equation 6				-	+	+		+
Equation 7					-	+		
Equation 8					-		+	+
Equation 9						-	+	+
Equation 10							-	+

1.5 Weighing Matrix Created from the Weighing Plan

Determination of k=8 weights with n=10 equations

$$\overline{X} = \begin{pmatrix} -1 & +1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & +1 & +1 & 0 & 0 & 0 & 0 \\ 0 & -1 & +1 & +1 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & +1 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & +1 & +1 & +1 & 0 \\ 0 & 0 & 0 & -1 & +1 & +1 & 0 & +1 \\ 0 & 0 & 0 & 0 & -1 & +1 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 & +1 & +1 \\ 0 & 0 & 0 & 0 & 0 & -1 & +1 & +1 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & +1 \end{pmatrix}$$

1.6 Number of Cycles per Weighing Equation

l = 6 cycles (m_i^- - m_i^+ - m_i^+ - m_i^- for each)

All of these parameters are contained in the ScalesNet32 database or must be completed when the job is entered.

1.7 Balance Exchange Error for the Weighing Equations

$f_T = f_{T_i} = 0.0003mg$ for $i = 1,...,10$

1.8 Balance Sensitivities for the Weighing Equations

$E_J = E_{J_i} = 0.99999800$ for $i = 1,...,10$

1.9 Densities of Balance Adjustment Comparison Standards for Weighing Scheme

$\rho_J = \rho_{J_i} = 8010.33 \; kg \; m^{-3}$ for $i = 1,...,10$

1.10 Air Densities during Balance Adjustment for Weighing Scheme

$\rho_{a,J} = \rho_{a,J\,i} = 1.1478 \; kg \; m^{-3}$ for $i = 1,...,10$

1.11 Weight Heights

$z_M = (80.8 \quad 80.6 \quad 64.4 \quad 64.4 \quad 47.4 \quad 47.4 \quad 38.5 \quad 39.2)^T \, mm$

1.12 Volume Expansion Coefficients for Weights to Be Determined

$\gamma_j = 46.5 * 10^{-6} \; K^{-1}$ for all weights to be determined

1.13 Uncertainties during Air Density Measurement

1.13.1 Temperature Sensor Uncertainty

$u(t) = 0.1K$

1.13.2 Pressure Sensor Uncertainty

$u(p) = 0.5mbar = 50Pa$

1.13.3 Humidity Sensor Uncertainty

$u(h) = 0.025$

1.13.4 Uncertainty of the Proportion of CO_2 in Häfner Laboratory Weights

$u(x_{CO_2}) = 0.00004$

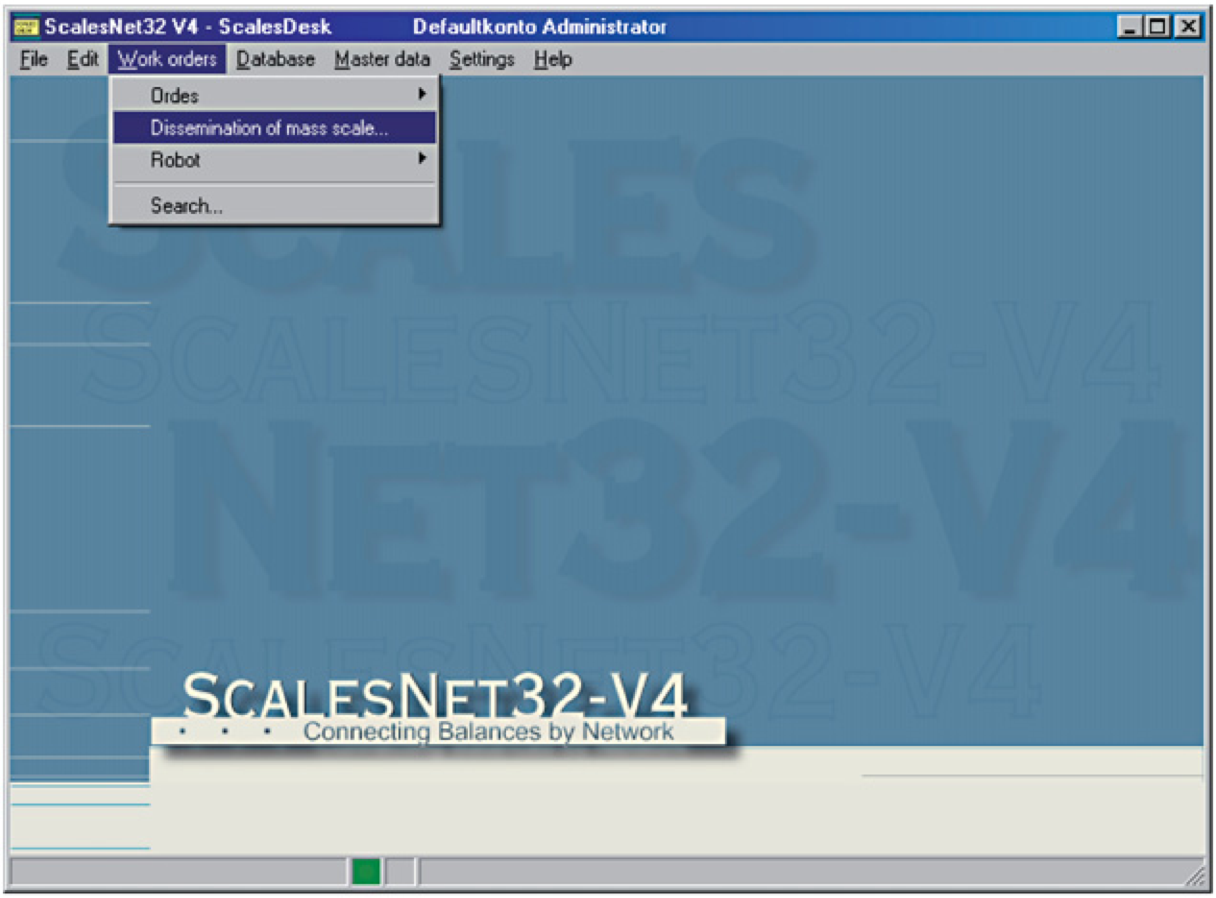
1.14 Balance Resolution

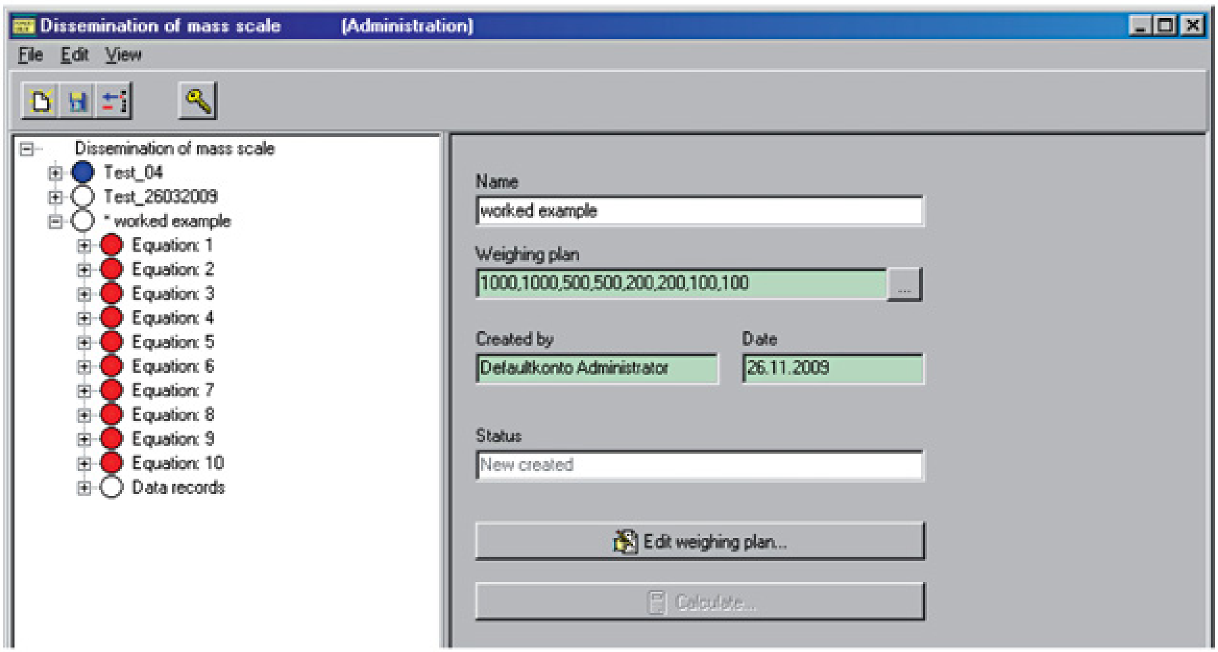
$$V_S = \begin{pmatrix} 0.003603 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0.002526 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.038677 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.021700 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.009830 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.010067 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.003344 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.002300 \end{pmatrix} mg^2$$

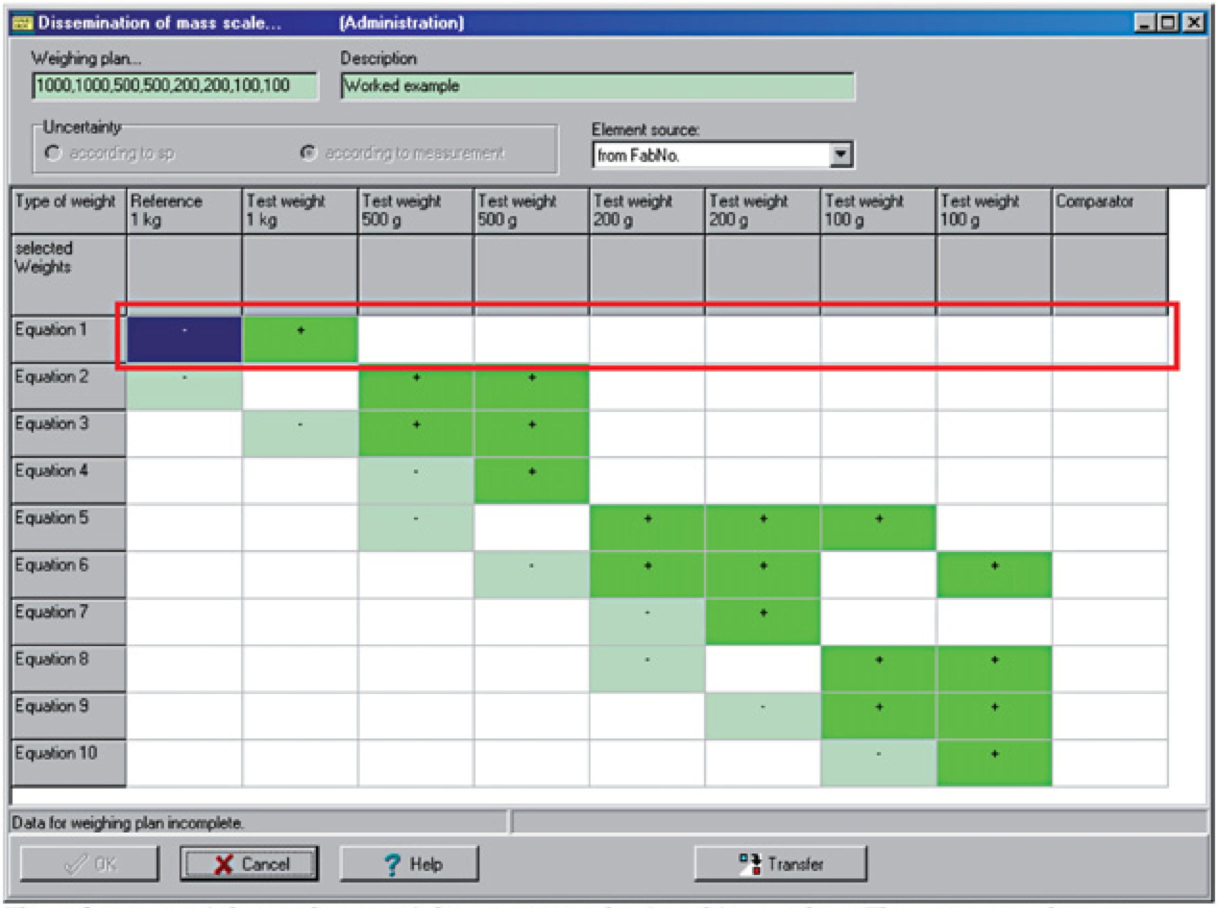
for all i = 1,...,10

2 Job Definition

The job is created in ScalesDesk from menu option <Dissemination of mass scale...>

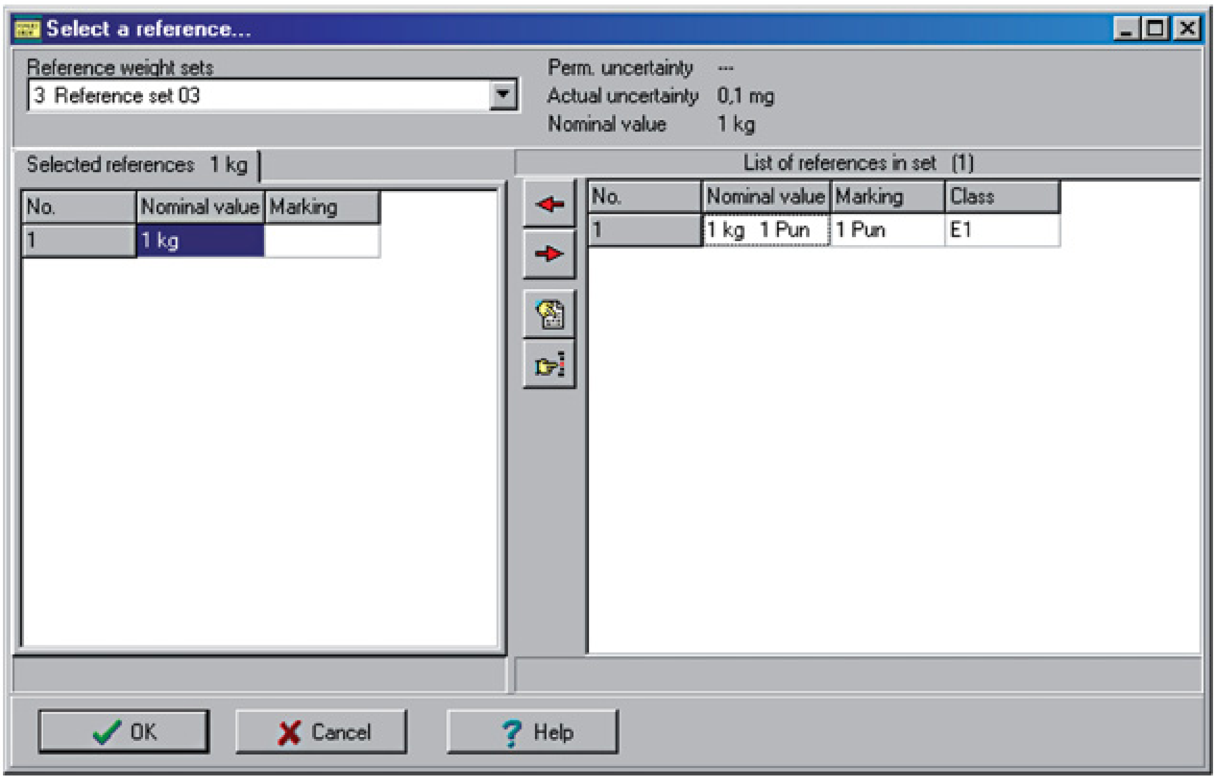






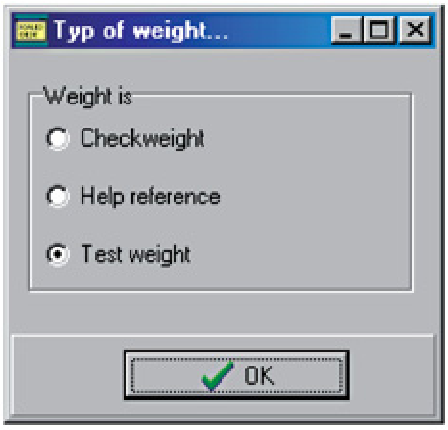
The reference weights and test weights are entered using this template. The entry templates are opened by double-clicking in the corresponding cell within the red box.

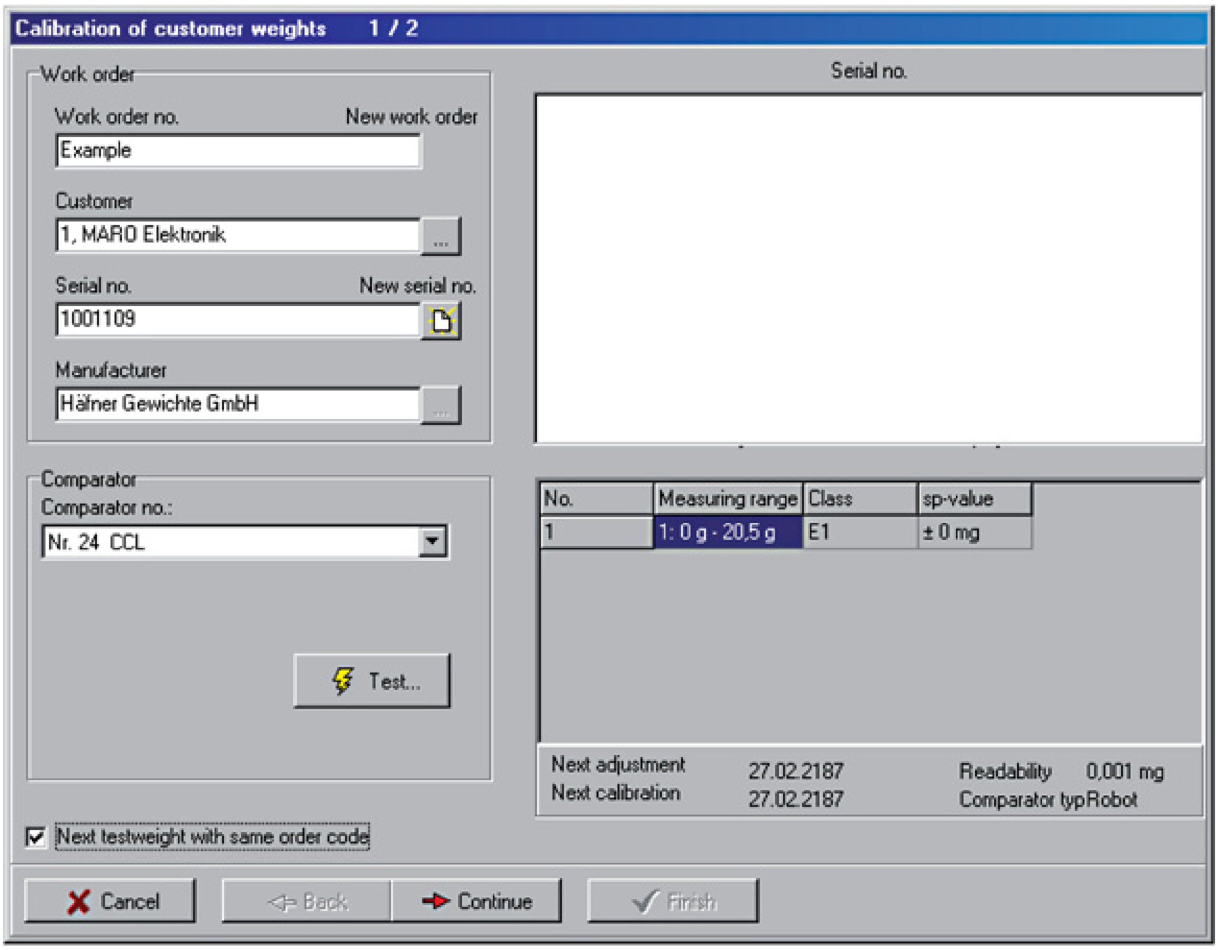
Double-clicking in the first cell within the red box opens the entry template for reference weights.



After the reference weights are selected, the entry template is closed by clicking OK.

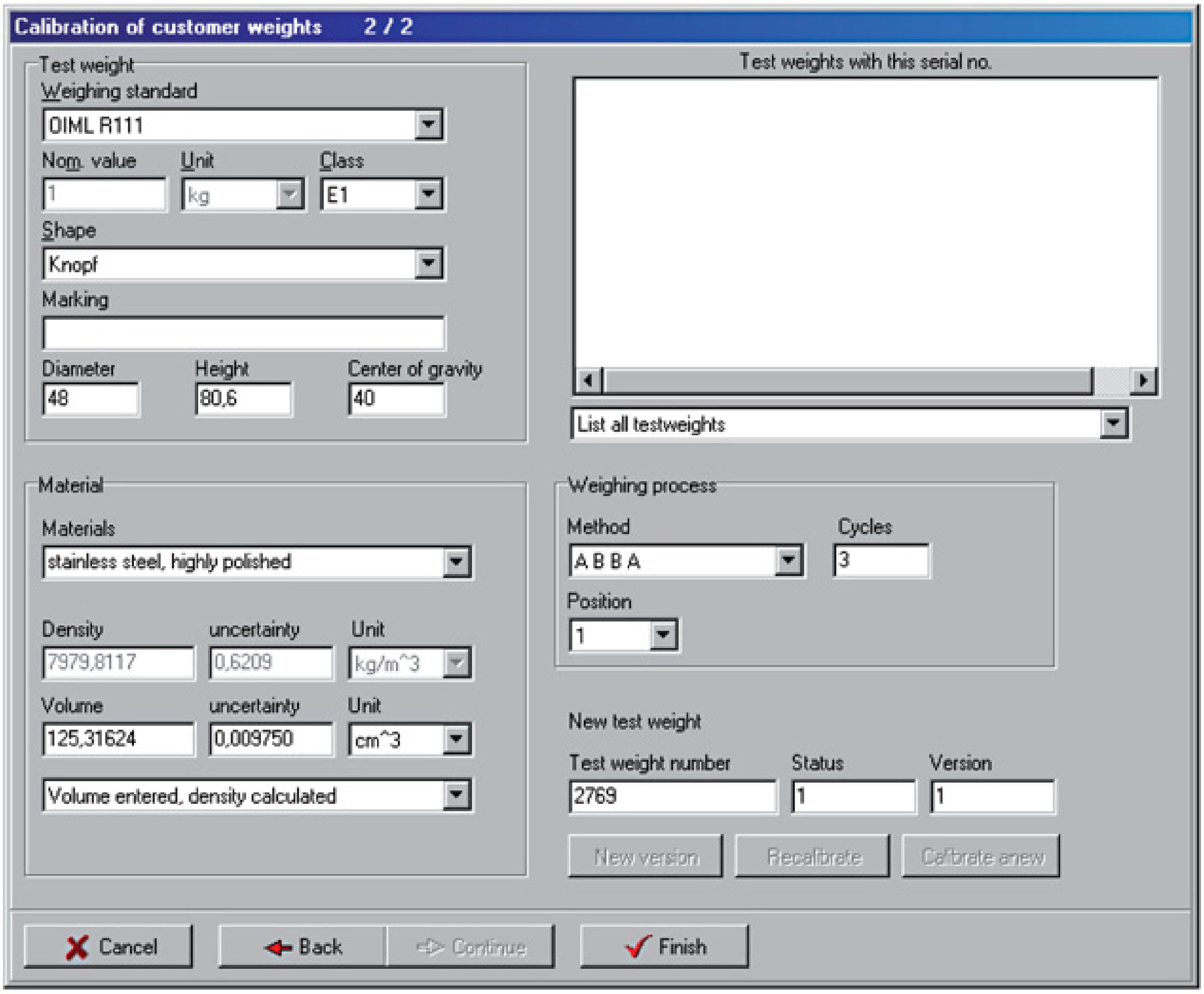
Double-clicking in the next cell within the red box opens a selection window
<Type of weight>





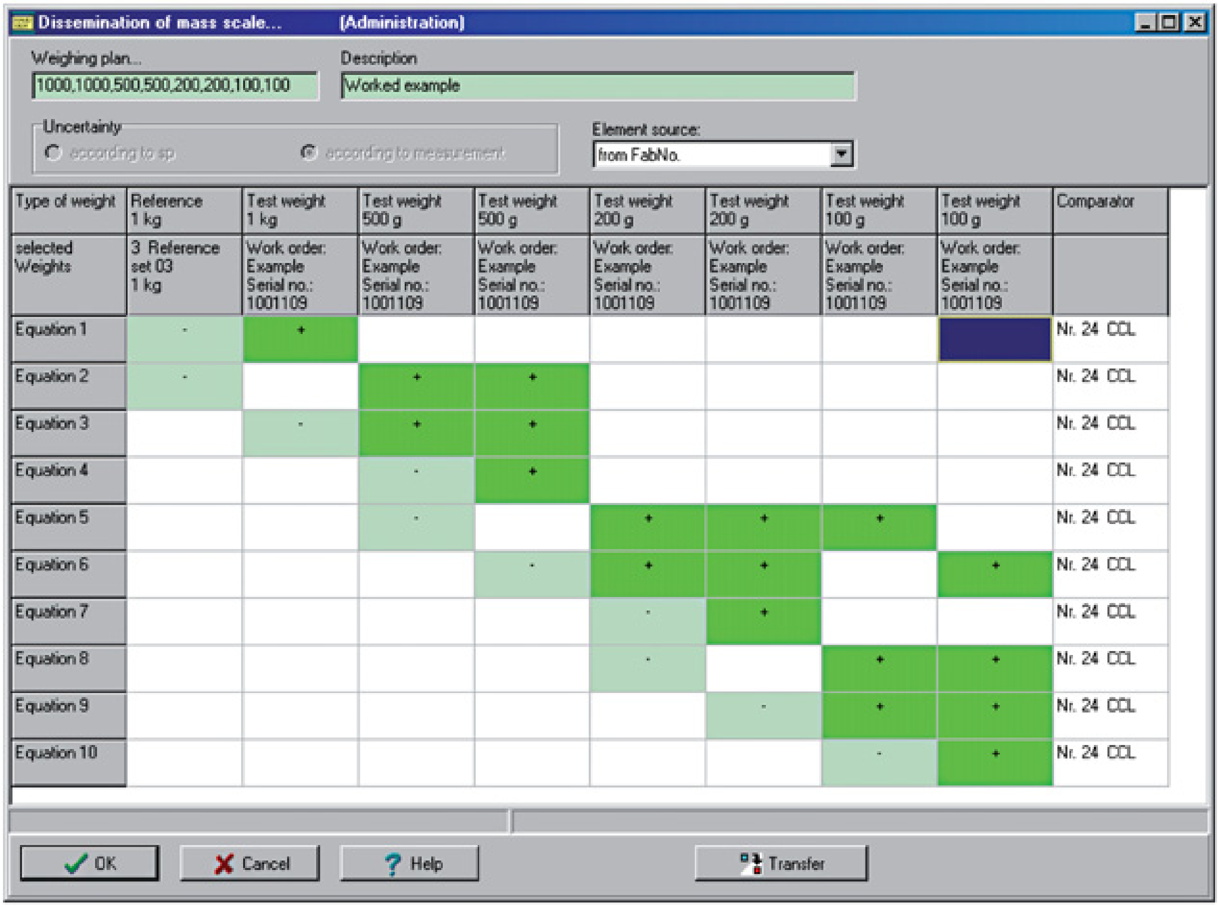
The fields should be completed as work order specifications require.

In this example, dissemination is carried out on a CCL robot. However, a manual comparator or load alternator can also be selected.



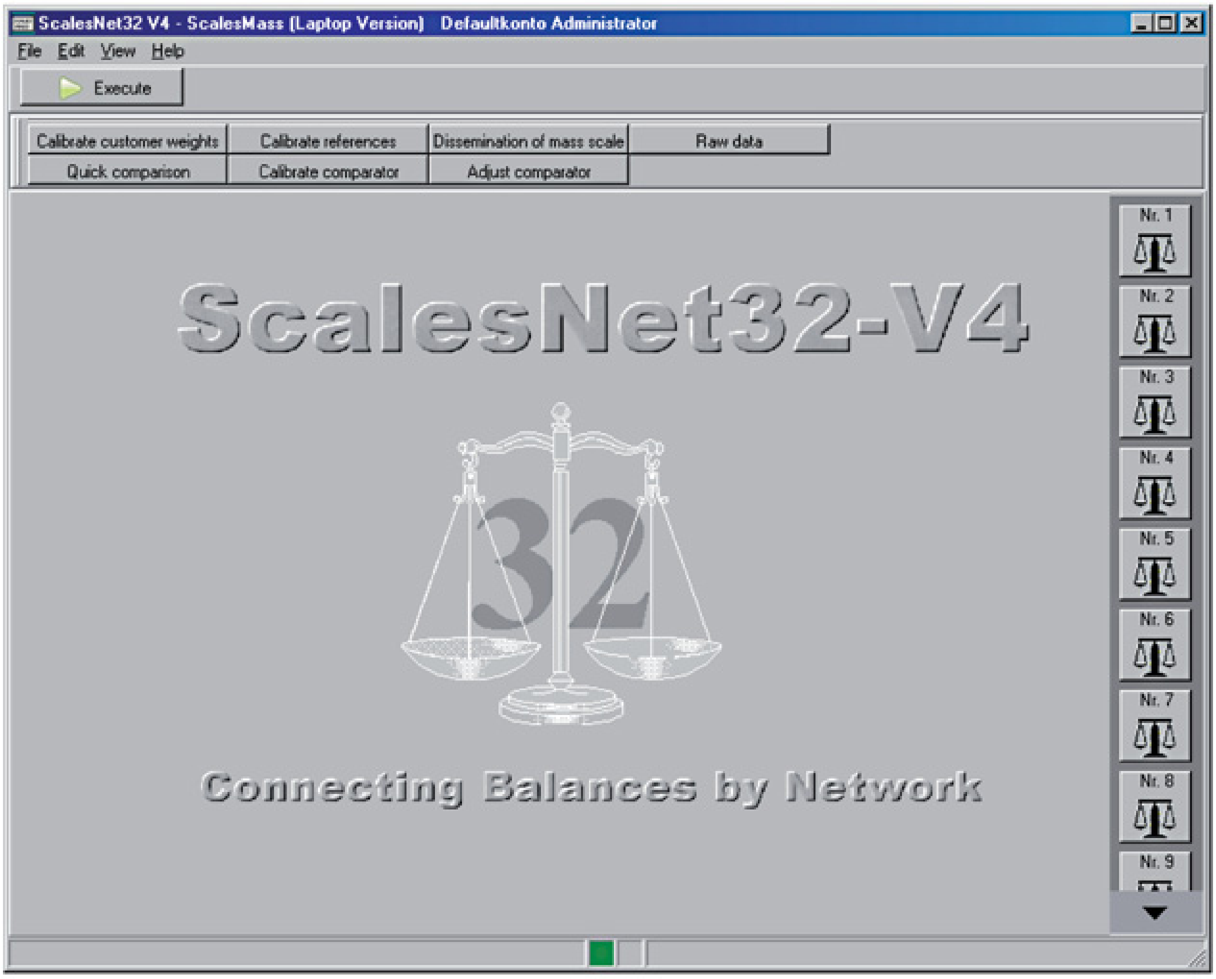
For the first customer weight of the work order, the weighing standard and class are indicated. The weighing standard and class cannot be changed for all other weights in this work order. Diameter, height, and center of gravity are mandatory fields for dissemination.

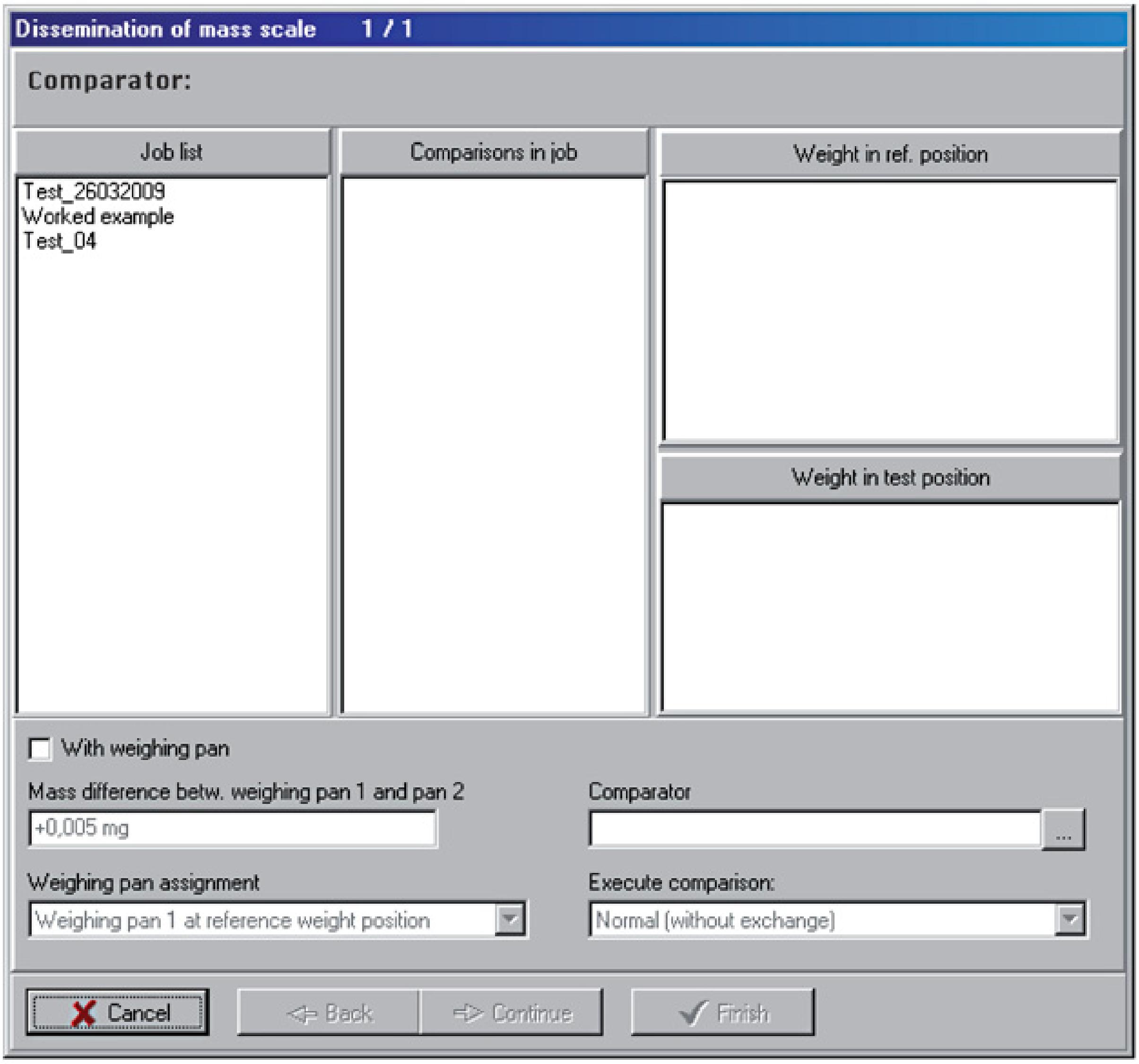
Other fields are completed as job specifications require.



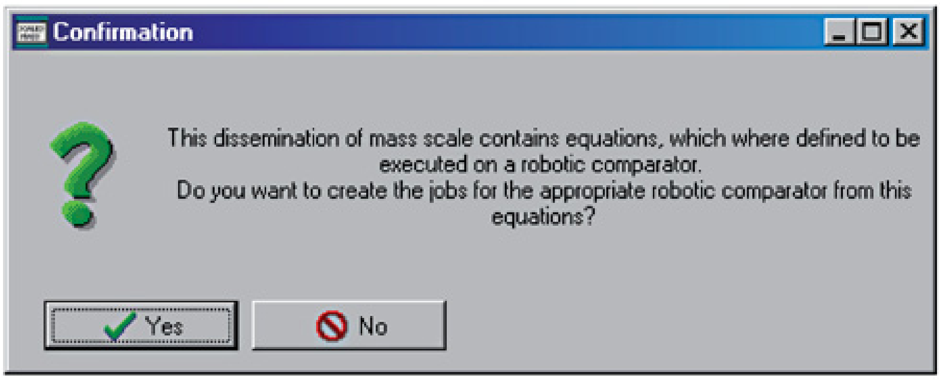
All test weights are assigned to a work order, and the job is saved by clicking OK. To execute a job, ScalesMass must then be started.

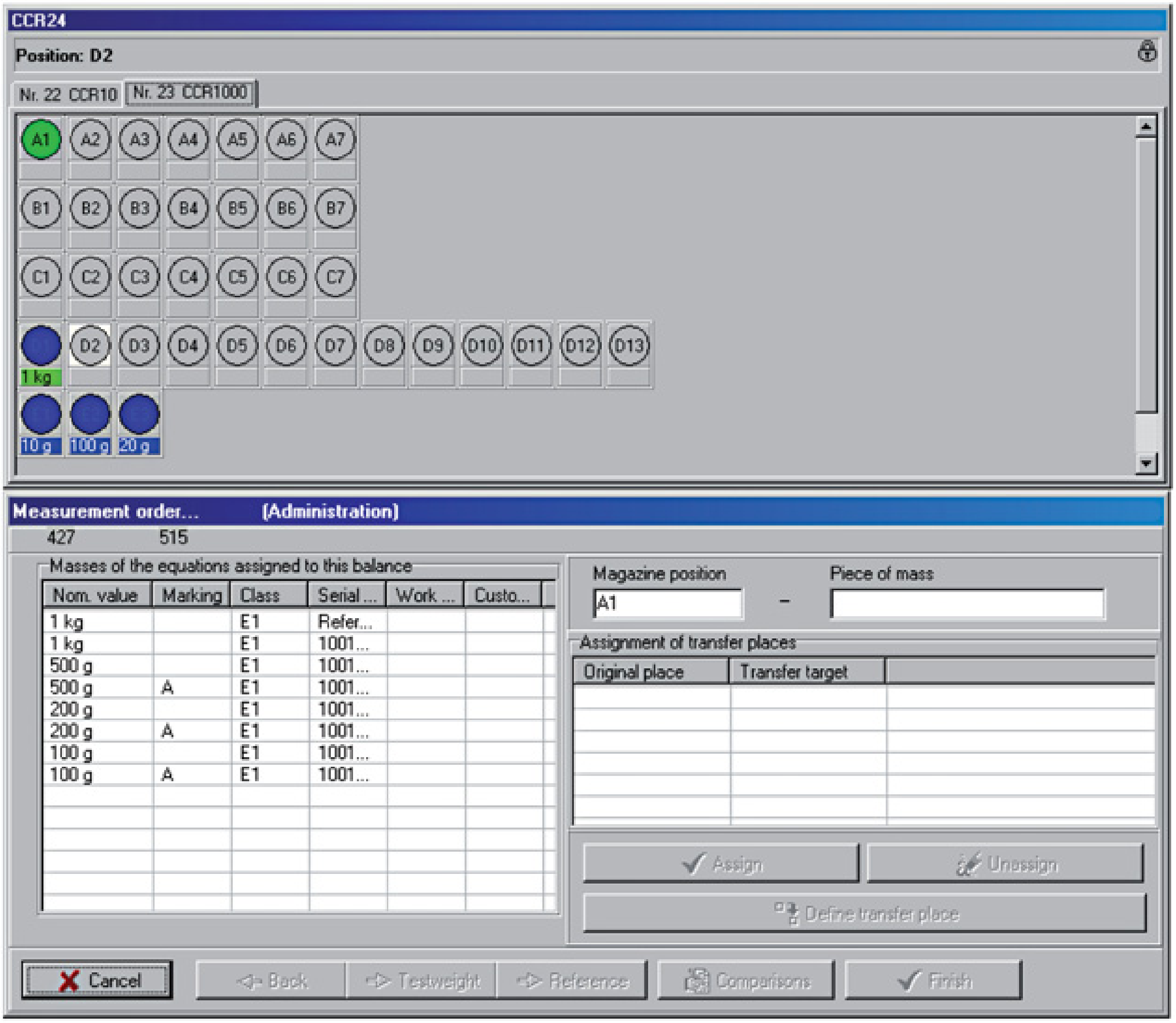
In ScalesMass, the button <Dissemination of mass scale> is selected to open the job list.



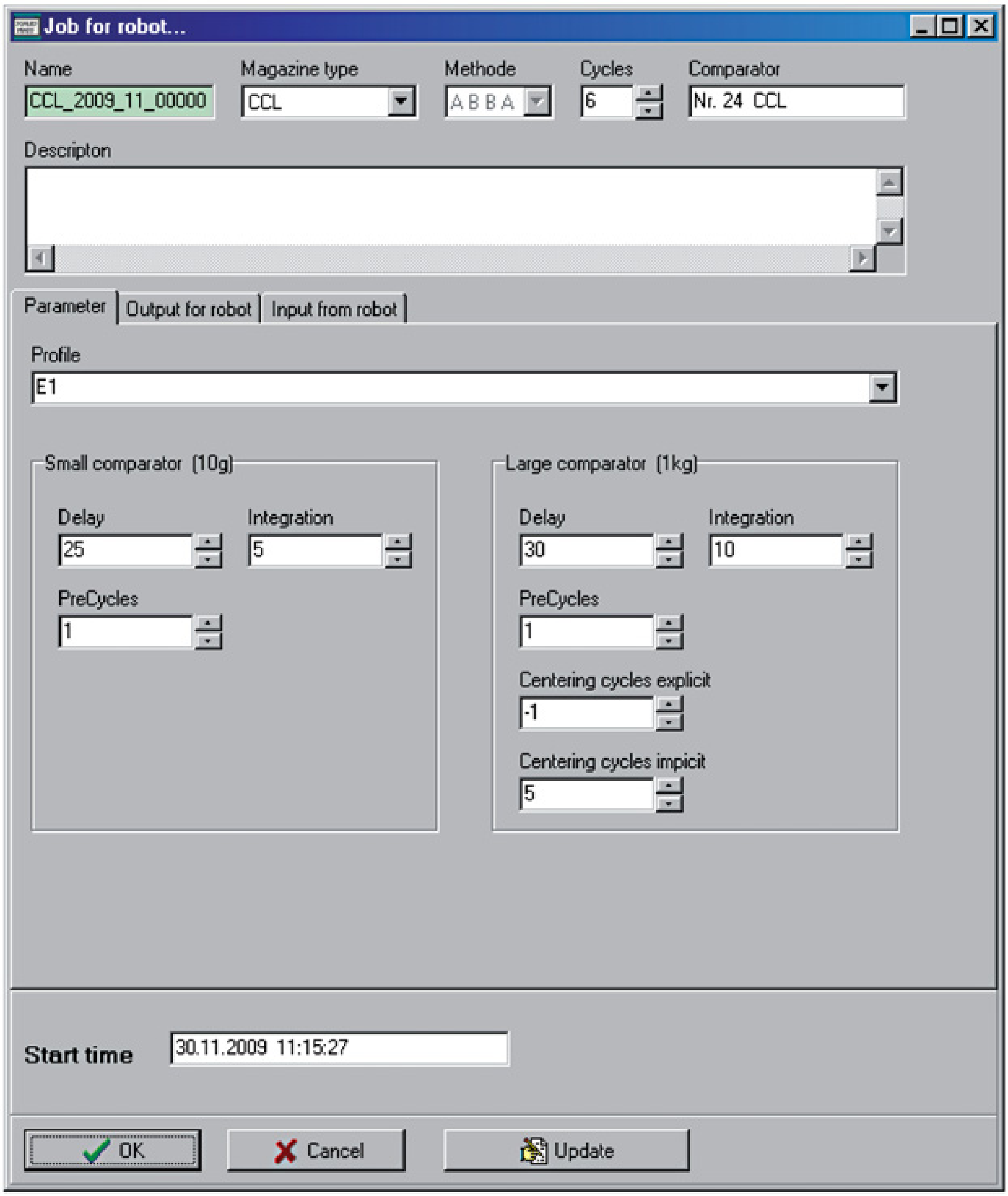


The job that was just defined is selected from the job list.



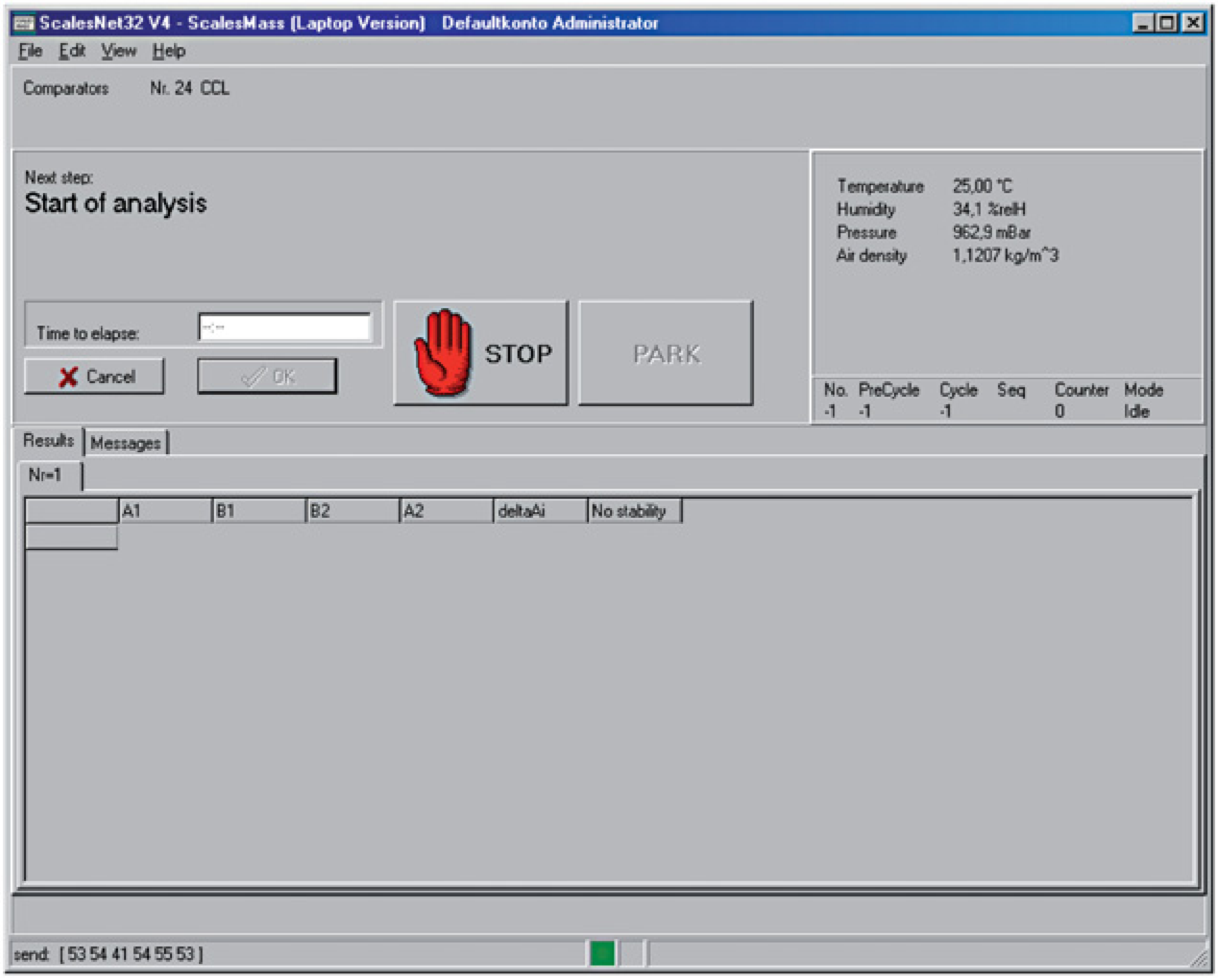


The weights must now be placed in their correct positions in the magazine.
The magazine positions shown in ScalesMass are exactly the same as the actual magazine positions in the robot.
First, the weight's position is selected in ScalesMass to correspond to its position in the magazine. Then the weight that has been assigned to that position is selected in the table. This choice is confirmed by clicking <Assign>. The nominal value then appears under the magazine position labeled in green, and the weight is removed from the table. Each weight must be assigned to a position. Weights in green represent test weights, auxiliary comparison standards, or control weights, and weights in blue are reference weights.
Once all weights are positioned, the <Finish> button is clicked, and the next window opens.

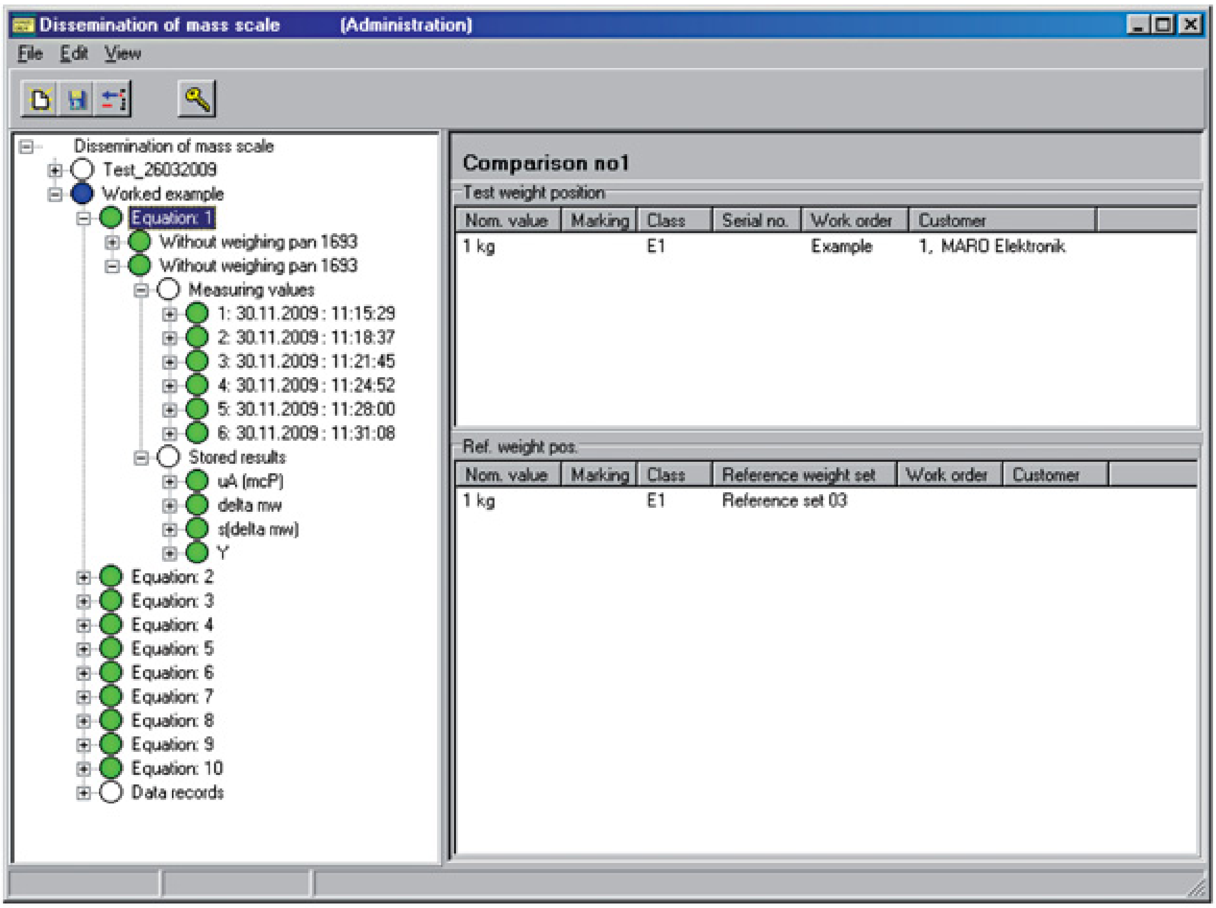


In this window, the parameters for the number of cycles and for the robot are indicated. Different work orders and classes may be entered in one job. The cycles set in this window ensure that all classes receive the same number of cycles in the job. However, it is not possible for the set number of cycles for the highest class in the job to fall below its minimum number of cycles. For example: there are two work orders for classes E1 and E2 in the job, and class E1 is set to six cycles (Specifications -> Methods/Class), while class E2 is set to three cycles. Six cycles is the minimum number permitted for class E1 and thus cannot be reduced to three.

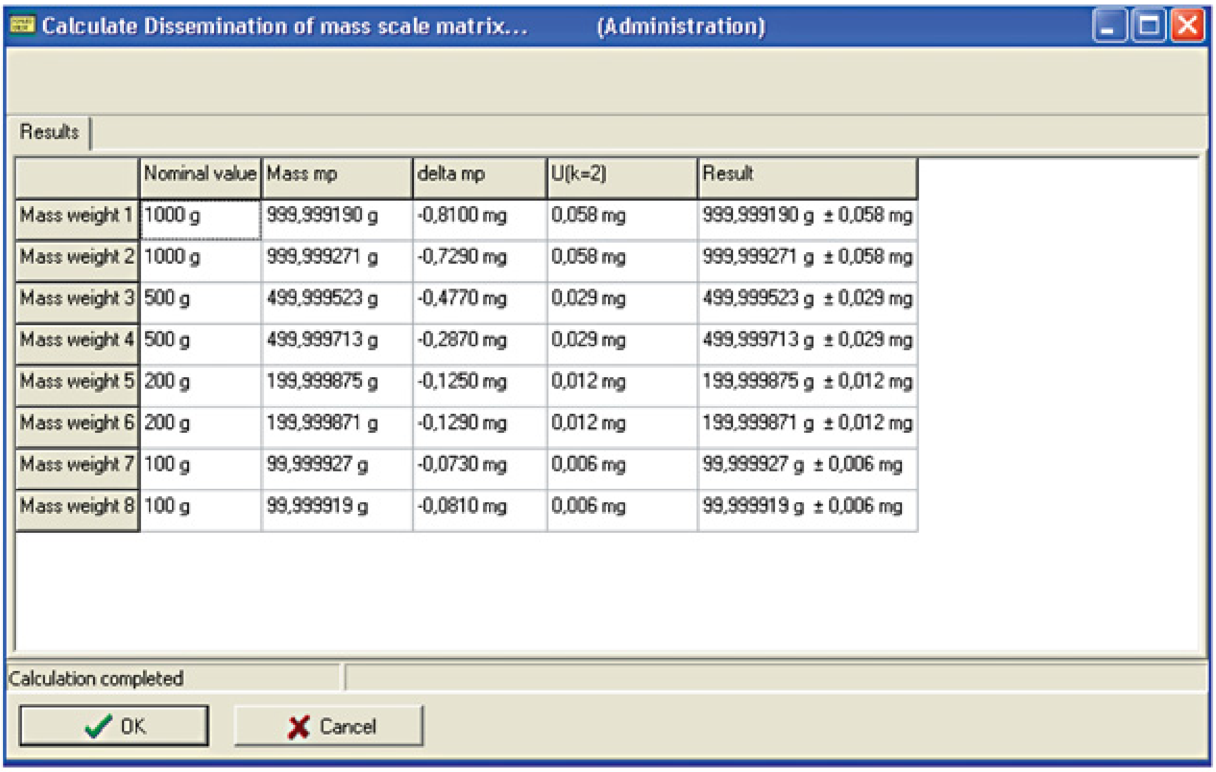
The robot settings, which can be adjusted as required, are found in the Parameter tab.
The <Update> button generates the command list that will be sent to the robot. This list is displayed in the <Output for robot> tab. The <OK> button generates the command list for the robot without displaying it in the <Output for robot> tab. Instead, the ScalesMass default window appears. The <Execute> button starts the measurement on the robot.



If all comparisons in the job are processed (or "worked"), the dissemination can be concluded in ScalesDesk (<Work Order->Dissemination of mass scale>).
The node for the processed work order is then marked in blue and the nodes for all equations in green. Nodes for equations that have not been executed are marked in red.
The number of nodes under the <Measuring values> subitem is equal to the number of cycles, and each of these nodes, when selected, displays the measured values, climate data, and start and end date for each measurement cycle. The most important results are displayed under the <Stored results> subitem.



If all equation nodes are marked in green, the job has been completely processed and the calculation can be concluded. If the job node is selected, the <Calculate> button can then be clicked. If measurements must be repeated, the <Cancel> button stops the calculation.



Individual equations can then be selected, and the measurements repeated.
This procedure can be repeated as desired until the calculation is concluded using the <OK> button.
When the calculation is concluded, the results are printed out and repeating the measurements is no longer possible.

The following calculations correspond to the formulae, which are implemented in ScalesNet32.

3 Determined Measurement Categories [MC1]

Balance Display Values for the Weighing Equations

The measured values are automatically transferred from ScalesMass during the weighing process

The weight values are determined using the Sartorius robot CCL 10-1000.
CCL1000 balance displays $A^-_{\alpha_i,1}$, $A^+_{\alpha_i,1}$, $A^+_{\alpha_i,2}$, and $A^-_{\alpha_i,2}$ (α_i =1,...,l , i=1,...,n).

The measured values for weighing equations i=1,...,10 are given in the following (in mg):

	Equation i=1 **M1 = 1 kg | M2 = 1 kg**				**Equation i=2** **M1 = 1 kg | M3 = 500 g, M4 = 500 g**			
Cycle	$A^-_{\alpha_i,1}$	$A^+_{\alpha_i,1}$	$A^+_{\alpha_i,2}$	$A^-_{\alpha_i,2}$	$A^-_{\alpha_i,1}$	$A^+_{\alpha_i,1}$	$A^+_{\alpha_i,2}$	$A^-_{\alpha_i,2}$
1	22.439	22.401	22.401	22.440	22.444	22.385	22.385	22.444
2	22.441	22.402	22.402	22.441	22.444	22.385	22.385	22.444
3	22.441	22.403	22.403	22.442	22.444	22.385	22.385	22.444
4	22.442	22.403	22.403	22.442	22.443	22.385	22.385	22.444
5	22.442	22.403	22.403	22.442	22.443	22.385	22.385	22.444
6	22.442	22.404	22.404	22.443	22.444	22.385	22.385	22.444

	Equation i=3 **M2 = 1 kg | M3 = 500 g, M4 = 500 g**				**Equation i=4** **M3 = 500 g | M4 = 500 g**			
Cycle	$A^-_{\alpha_i,1}$	$A^+_{\alpha_i,1}$	$A^+_{\alpha_i,2}$	$A^-_{\alpha_i,2}$	$A^-_{\alpha_i,1}$	$A^+_{\alpha_i,1}$	$A^+_{\alpha_i,2}$	$A^-_{\alpha_i,2}$
1	22.406	22.385	22.386	22.405	22.247	22.056	22.056	22.246
2	22.406	22.386	22.385	22.405	22.246	22.056	22.056	22.246
3	22.406	22.386	22.386	22.405	22.246	22.056	22.056	22.247
4	22.405	22.386	22.385	22.405	22.246	22.056	22.056	22.246
5	22.405	22.386	22.386	22.405	22.247	22.057	22.056	22.247
6	22.405	22.386	22.385	22.405	22.247	22.057	22.057	22.247

	Equation i=5 **M3 = 500 g | M5 = 200 g, M6 = 200 g, M7 = 100 g**				**Equation i=6** **M4 = 500 g | M5 = 200 g, M6 = 200 g, M8 = 100 g**			
Cycle	$A^-_{\alpha_i,1}$	$A^+_{\alpha_i,1}$	$A^+_{\alpha_i,2}$	$A^-_{\alpha_i,2}$	$A^-_{\alpha_i,1}$	$A^+_{\alpha_i,1}$	$A^+_{\alpha_i,2}$	$A^-_{\alpha_i,2}$
1	22.251	22.121	22.121	22.251	22.061	22.129	22.129	22.061
2	22.251	22.121	22.121	22.250	22.061	22.129	22.128	22.061
3	22.251	22.120	22.121	22.250	22.060	22.128	22.128	22.060
4	22.250	22.121	22.121	22.251	22.060	22.128	22.128	22.060
5	22.251	22.121	22.120	22.250	22.060	22.128	22.128	22.060
6	22.251	22.121	22.121	22.251	22.060	22.128	22.128	22.060

Equation i=7
M5 = 200 g | M6 = 200 g

Cycle	$A^{-}_{\alpha_i,1}$	$A^{+}_{\alpha_i,1}$	$A^{+}_{\alpha_i,2}$	$A^{-}_{\alpha_i,2}$
1	22.207	22.211	22.211	22.206
2	22.207	22.211	22.211	22.206
3	22.207	22.211	22.211	22.206
4	22.206	22.211	22.211	22.207
5	22.207	22.211	22.211	22.207
6	22.207	22.212	22.212	22.207

Equation i=8
M5 = 200 g | M7 = 100 g, M8 = 100 g

Cycle	$A^{-}_{\alpha_i,1}$	$A^{+}_{\alpha_i,1}$	$A^{+}_{\alpha_i,2}$	$A^{-}_{\alpha_i,2}$
1	22.208	22.212	22.211	22.208
2	22.208	22.211	22.211	22.208
3	22.208	22.211	22.211	22.208
4	22.208	22.211	22.211	22.208
5	22.208	22.211	22.211	22.208
6	22.208	22.211	22.211	22.208

Equation i=9
M6 = 200 g | M7 = 100 g, M8 = 100 g

Cycle	$A^{-}_{\alpha_i,1}$	$A^{+}_{\alpha_i,1}$	$A^{+}_{\alpha_i,2}$	$A^{-}_{\alpha_i,2}$
1	22.210	22.208	22.208	22.209
2	22.209	22.207	22.207	22.209
3	22.209	22.207	22.207	22.208
4	22.208	22.207	22.207	22.208
5	22.208	22.207	22.207	22.208
6	22.209	22.207	22.206	22.208

Equation i=10
M7 = 100 g | M8 = 100 g

Cycle	$A^{-}_{\alpha_i,1}$	$A^{+}_{\alpha_i,1}$	$A^{+}_{\alpha_i,2}$	$A^{-}_{\alpha_i,2}$
1	22.321	22.328	22.328	22.321
2	22.321	22.328	22.328	22.321
3	22.321	22.328	22.328	22.321
4	22.322	22.328	22.328	22.322
5	22.322	22.329	22.329	22.321
6	22.322	22.329	22.328	22.322

3.1 Climate Data (Temp., Pressure, and Humidity) during Weighing [MC2]

The measured values are automatically transferred from ScalesMass during weighing and organized according to the measured value of the weights

When a room climate detection system is used, the measured values are determined for temperature ($t^{-}_{\alpha_i,1}$, $t^{+}_{\alpha_i,1}$, $t^{+}_{\alpha_i,2}$, and $t^{-}_{\alpha_i,2}$), for pressure ($p^{-}_{\alpha_i,1}$, $p^{+}_{\alpha_i,1}$, $p^{+}_{\alpha_i,2}$, and $p^{-}_{\alpha_i,2}$) and for relative humidity ($h^{-}_{\alpha_i,1}$, $h^{+}_{\alpha_i,1}$, $h^{+}_{\alpha_i,2}$, and $h^{-}_{\alpha_i,2}$). (α_i =1,...,l , i=1,...,n.)

The measured values for equations i=1,...,10 are given in the following (t in °C, p in mbar, h in %):

Equation i=1 **M1 = 1 kg | M2 = 1 kg**

Cycle	$t^{-}_{\alpha_i,1}$	$p^{-}_{\alpha_i,1}$	$h^{-}_{\alpha_i,1}$	$t^{+}_{\alpha_i,1}$	$p^{+}_{\alpha_i,1}$	$h^{+}_{\alpha_i,1}$	$t^{+}_{\alpha_i,2}$	$p^{+}_{\alpha_i,2}$	$h^{+}_{\alpha_i,2}$	$t^{-}_{\alpha_i,2}$	$p^{-}_{\alpha_i,2}$	$h^{-}_{\alpha_i,2}$
1	21.24	974.7	55.3	21.25	974.8	55.3	21.25	974.8	55.3	21.25	974.8	55.3
2	21.26	974.8	55.3	21.25	974.8	55.3	21.26	974.8	55.3	21.26	974.8	55.3
3	21.26	974.9	55.3	21.26	974.9	55.3	21.26	974.9	55.3	21.26	974.9	55.3
4	21.26	974.9	55.3	21.26	975.0	55.3	21.26	975.0	55.3	21.26	974.9	55.3
5	21.26	974.9	55.3	21.26	974.9	55.3	21.25	975.0	55.3	21.26	975.0	55.3
6	21.26	975.0	55.3	21.26	975.1	55.3	21.26	975.1	55.3	21.26	975.1	55.3

Equation i=2 M1 = 1 kg | M3 = 500 g, M4 = 500 g

Cycle	$t^{-}_{\alpha_i,1}$	$p^{-}_{\alpha_i,1}$	$h^{-}_{\alpha_i,1}$	$t^{+}_{\alpha_i,1}$	$p^{+}_{\alpha_i,1}$	$h^{+}_{\alpha_i,1}$	$t^{+}_{\alpha_i,2}$	$p^{+}_{\alpha_i,2}$	$h^{+}_{\alpha_i,2}$	$t^{-}_{\alpha_i,2}$	$p^{-}_{\alpha_i,2}$	$h^{-}_{\alpha_i,2}$
1	21.28	976.1	54.7	21.28	976.1	54.7	21.28	976.1	54.7	21.28	976.1	54.7
2	21.28	976.0	54.7	21.28	976.0	54.7	21.28	976.0	54.7	21.27	976.1	54.7
3	21.28	976.1	54.7	21.28	976.1	54.6	21.28	976.1	54.6	21.28	976.1	54.6
4	21.28	976.0	54.6	21.28	976.0	54.6	21.28	976.0	54.6	21.28	976.0	54.6
5	21.28	976.0	54.6	21.28	976.0	54.6	21.28	976.0	54.6	21.28	976.0	54.6
6	21.28	976.0	54.6	21.28	975.9	54.6	21.28	975.9	54.6	21.28	976.0	54.6

Equation i=3 M2 = 1 kg | M3 = 500 g, M4 = 500 g

Cycle	$t^{-}_{\alpha_i,1}$	$p^{-}_{\alpha_i,1}$	$h^{-}_{\alpha_i,1}$	$t^{+}_{\alpha_i,1}$	$p^{+}_{\alpha_i,1}$	$h^{+}_{\alpha_i,1}$	$t^{+}_{\alpha_i,2}$	$p^{+}_{\alpha_i,2}$	$h^{+}_{\alpha_i,2}$	$t^{-}_{\alpha_i,2}$	$p^{-}_{\alpha_i,2}$	$h^{-}_{\alpha_i,2}$
1	21.28	975.9	54.6	21.28	975.9	54.6	21.29	975.9	54.6	21.28	975.9	54.6
2	21.29	975.9	54.6	21.28	975.9	54.6	21.29	975.9	54.6	21.29	976.0	54.6
3	21.28	975.9	54.6	21.28	976.0	54.6	21.28	976.0	54.6	21.28	976.0	54.6
4	21.29	976.0	54.6	21.28	976.0	54.6	21.28	976.0	54.6	21.28	976.0	54.6
5	21.29	976.0	54.6	21.28	976.0	54.6	21.28	976.0	54.6	21.29	976.0	54.6
6	21.29	976.0	54.6	21.29	976.0	54.6	21.28	976.0	54.6	21.28	976.0	54.7

Equation i=4 M3 = 500 g | M4 = 500 g

Cycle	$t^{-}_{\alpha_i,1}$	$p^{-}_{\alpha_i,1}$	$h^{-}_{\alpha_i,1}$	$t^{+}_{\alpha_i,1}$	$p^{+}_{\alpha_i,1}$	$h^{+}_{\alpha_i,1}$	$t^{+}_{\alpha_i,2}$	$p^{+}_{\alpha_i,2}$	$h^{+}_{\alpha_i,2}$	$t^{-}_{\alpha_i,2}$	$p^{-}_{\alpha_i,2}$	$h^{-}_{\alpha_i,2}$
1	21.17	976.5	55.1	21.16	976.5	55.1	21.17	976.5	55.0	21.16	976.5	55.0
2	21.17	976.6	55.0	21.17	976.7	55.0	21.17	976.7	55.0	21.17	976.6	55.0
3	21.17	976.5	55.0	21.18	976.5	55.0	21.17	976.4	55.0	21.18	976.5	55.0
4	21.18	976.5	55.0	21.18	976.5	55.0	21.18	976.5	55.0	21.18	976.6	55.0
5	21.18	976.6	55.0	21.18	976.6	55.0	21.18	976.6	54.9	21.18	976.6	54.9
6	21.18	976.6	54.9	21.18	976.7	54.9	21.18	976.7	54.9	21.18	976.7	54.9

Equation i=5 M3 = 500 g | M5 = 200 g, M6 = 200 g, M7 = 100 g

Cycle	$t^{-}_{\alpha_i,1}$	$p^{-}_{\alpha_i,1}$	$h^{-}_{\alpha_i,1}$	$t^{+}_{\alpha_i,1}$	$p^{+}_{\alpha_i,1}$	$h^{+}_{\alpha_i,1}$	$t^{+}_{\alpha_i,2}$	$p^{+}_{\alpha_i,2}$	$h^{+}_{\alpha_i,2}$	$t^{-}_{\alpha_i,2}$	$p^{-}_{\alpha_i,2}$	$h^{-}_{\alpha_i,2}$
1	21.31	976.4	54.7	21.30	976.4	54.6	21.30	976.4	54.6	21.31	976.5	54.6
2	21.30	976.4	54.6	21.31	976.5	54.6	21.30	976.5	54.6	21.30	976.5	54.6
3	21.30	976.5	54.7	21.30	976.5	54.7	21.30	976.4	54.6	21.30	976.5	54.6
4	21.30	976.6	54.6	21.30	976.5	54.6	21.30	976.5	54.6	21.30	976.5	54.6
5	21.30	976.6	54.6	21.30	976.6	54.6	21.30	976.5	54.7	21.30	976.6	54.6
6	21.31	976.6	54.6	21.30	976.5	54.6	21.30	976.5	54.6	21.30	976.6	54.6

Equation i=6 M4 = 500 g | M5 = 200 g, M6 = 200 g, M8 = 100 g

Cycle	$t^-_{\alpha_i,1}$	$p^-_{\alpha_i,1}$	$h^-_{\alpha_i,1}$	$t^+_{\alpha_i,1}$	$p^+_{\alpha_i,1}$	$h^+_{\alpha_i,1}$	$t^+_{\alpha_i,2}$	$p^+_{\alpha_i,2}$	$h^+_{\alpha_i,2}$	$t^-_{\alpha_i,2}$	$p^-_{\alpha_i,2}$	$h^-_{\alpha_i,2}$
1	21.31	976.6	54.6	21.31	976.6	54.7	21.31	976.6	54.6	21.31	976.6	54.6
2	21.31	976.6	54.6	21.31	976.6	54.6	21.31	976.6	54.6	21.31	976.6	54.6
3	21.31	976.6	54.6	21.30	976.6	54.7	21.31	976.6	54.6	21.31	976.6	54.6
4	21.31	976.6	54.6	21.31	976.6	54.6	21.31	976.6	54.6	21.31	976.6	54.6
5	21.31	976.6	54.7	21.31	976.6	54.6	21.31	976.6	54.6	21.31	976.6	54.6
6	21.31	976.6	54.6	21.31	976.6	54.7	21.31	976.6	54.7	21.31	976.6	54.7

Equation i=7 M5 = 200 g | M6 = 200 g

Cycle	$t^-_{\alpha_i,1}$	$p^-_{\alpha_i,1}$	$h^-_{\alpha_i,1}$	$t^+_{\alpha_i,1}$	$p^+_{\alpha_i,1}$	$h^+_{\alpha_i,1}$	$t^+_{\alpha_i,2}$	$p^+_{\alpha_i,2}$	$h^+_{\alpha_i,2}$	$t^-_{\alpha_i,2}$	$p^-_{\alpha_i,2}$	$h^-_{\alpha_i,2}$
1	21.23	976.8	54.8	21.23	976.8	54.8	21.24	976.8	54.8	21.24	976.8	54.8
2	21.24	976.8	54.8	21.24	976.8	54.8	21.24	976.7	54.8	21.24	976.8	54.8
3	21.24	976.8	54.8	21.24	976.7	54.8	21.24	976.7	54.8	21.24	976.7	54.8
4	21.24	976.7	54.8	21.24	976.7	54.8	21.24	976.7	54.8	21.24	976.7	54.8
5	21.24	976.6	54.8	21.24	976.7	54.8	21.24	976.7	54.8	21.24	976.7	54.8
6	21.24	976.7	54.8	21.24	976.7	54.8	21.24	976.7	54.8	21.24	976.6	54.8

Equation i=8 M5 = 200 g | M7 = 100 g, M8 = 100 g

Cycle	$t^-_{\alpha_i,1}$	$p^-_{\alpha_i,1}$	$h^-_{\alpha_i,1}$	$t^+_{\alpha_i,1}$	$p^+_{\alpha_i,1}$	$h^+_{\alpha_i,1}$	$t^+_{\alpha_i,2}$	$p^+_{\alpha_i,2}$	$h^+_{\alpha_i,2}$	$t^-_{\alpha_i,2}$	$p^-_{\alpha_i,2}$	$h^-_{\alpha_i,2}$
1	21.32	976.4	54.6	21.32	976.4	54.6	21.32	976.4	54.6	21.32	976.3	54.6
2	21.32	976.3	54.6	21.32	976.3	54.6	21.32	976.3	54.6	21.32	976.3	54.6
3	21.32	976.3	54.6	21.31	976.3	54.6	21.32	976.3	54.6	21.32	976.3	54.6
4	21.32	976.3	54.6	21.32	976.3	54.6	21.32	976.3	54.6	21.32	976.3	54.6
5	21.32	976.2	54.7	21.32	976.2	54.7	21.32	976.2	54.6	21.32	976.2	54.6
6	21.33	976.2	54.6	21.32	976.1	54.6	21.33	976.1	54.6	21.33	976.1	54.6

Equation i=9 M6 = 200 g | M7 = 100 g, M8 = 100 g

Cycle	$t^-_{\alpha_i,1}$	$p^-_{\alpha_i,1}$	$h^-_{\alpha_i,1}$	$t^+_{\alpha_i,1}$	$p^+_{\alpha_i,1}$	$h^+_{\alpha_i,1}$	$t^+_{\alpha_i,2}$	$p^+_{\alpha_i,2}$	$h^+_{\alpha_i,2}$	$t^-_{\alpha_i,2}$	$p^-_{\alpha_i,2}$	$h^-_{\alpha_i,2}$
1	21.37	976.0	54.7	21.37	976.1	54.7	21.37	976.1	54.7	21.37	976.1	54.7
2	21.37	976.0	54.7	21.37	976.0	54.7	21.38	976.0	54.7	21.38	976.0	54.7
3	21.38	976.0	54.7	21.38	976.0	54.7	21.38	976.0	54.7	21.38	976.0	54.7
4	21.38	976.0	54.7	21.38	976.0	54.7	21.38	976.0	54.7	21.38	976.0	54.7
5	21.39	976.0	54.7	21.39	976.0	54.7	21.39	976.0	54.7	21.39	976.0	54.7
6	21.39	976.0	54.7	21.39	976.0	54.7	21.39	976.0	54.7	21.40	976.0	54.7

Equation i=10 M7 = 100 g | M8 = 100 g

Cycle	$t^-_{\alpha_i,1}$	$p^-_{\alpha_i,1}$	$h^-_{\alpha_i,1}$	$t^+_{\alpha_i,1}$	$p^+_{\alpha_i,1}$	$h^+_{\alpha_i,1}$	$t^+_{\alpha_i,2}$	$p^+_{\alpha_i,2}$	$h^+_{\alpha_i,2}$	$t^-_{\alpha_i,2}$	$p^-_{\alpha_i,2}$	$h^-_{\alpha_i,2}$
1	21.40	976.4	54.8	21.40	976.5	54.8	21.40	976.4	54.8	21.40	976.5	54.8
2	21.40	976.4	54.8	21.40	976.3	54.8	21.40	976.3	54.8	21.40	976.3	54.8
3	21.40	976.3	54.8	21.40	976.2	54.8	21.40	976.3	54.8	21.40	976.3	54.8
4	21.40	976.3	54.8	21.40	976.3	54.8	21.40	976.3	54.8	21.40	976.3	54.8
5	21.40	976.3	54.8	21.40	976.3	54.8	21.40	976.3	54.8	21.40	976.4	54.8
6	21.40	976.4	54.8	21.40	976.4	54.8	21.40	976.4	54.8	21.41	976.3	54.8

4 Calculation for Solving the Weighing Scheme

4.1 (C1)Calculation for Mass Differences in Weighing Equations, $\bar{y}_i$

$\Delta A_{\alpha_i} = (-A^-_{\alpha_i,1} + A^+_{\alpha_i,1} + A^+_{\alpha_i,2} - A^-_{\alpha_i,2})/2$ display differences

$\Delta A_{T,\alpha_i} = \Delta A_{\alpha_i} - f_{T_i}$ display differences (corrected for exchange errors)

$\Delta m_{\alpha_i} = \dfrac{\Delta A_{T,\alpha_i}}{E_{J,i}}$ mass differences in individual cycles

$\Delta m_{\alpha_i}' = \Delta m_{\alpha_i}(1-\rho_o/\rho_c)\cdot\dfrac{1-\rho_{a,J_i}/\rho_{J\,i}}{1-\rho_o/\rho_{J\,i}}$ mass differences in individual cycles (corrected)

$\bar{y}_i = \dfrac{1}{l}\sum_{\alpha_i=1}^{l}\Delta m_{\alpha_i}'$ mass differences in the i th equation

When the above calculation is carried out with the measured values from MC1, the result for equations i=1,...,10 is the vector of the mass differences $\bar{y}$:

$$\bar{y} = \begin{pmatrix} -38.838 \\ -58.788 \\ -19.718 \\ -190.249 \\ -129.594 \\ 67.846 \\ 4.678 \\ 3.373 \\ -1.460 \\ 6.884 \end{pmatrix} mg$$

4.2 (C2)Calculation of Air Densities, $\rho_{a,i}$

For air densities during a single weighing process, $\rho^{-}_{\alpha_i,1}$ and the average air density in an equation, $\rho_{a,i}$, apply:

$$\rho^{-}_{\alpha_i,1} = 3.483740 \frac{p^{-}_{\alpha_i,1}}{Z(273.15K + t^{-}_{\alpha_i,1})}(1 - 0.3780 x_v)$$ density for one measurement

$$p_{sv} = e^{\left(A(273.15+t^{-}_{\alpha_i,1})^2 + B(273.15+t^{-}_{\alpha_i,1}) + C + \frac{D}{(273.15+t^{-}_{\alpha_i,1})}\right)} * 1Pa$$ saturation vapor pressure of humid air

$$f = \alpha + \beta\ p^{-}_{\alpha_i,1} + \gamma\ {t^{-}_{\alpha_i,1}}^2$$ incremental factor

$$x_v = h^{-}_{\alpha_i,1}\ f \frac{p_{sv}}{p^{-}_{\alpha_i,1}}$$ proportion of water vapor

$$Z = 1 - \frac{p^{-}_{\alpha_i,1}}{273.15K + t^{-}_{\alpha_i,1}}\left(a_0 + a_1 t^{-}_{\alpha_i,1} + a_2 {t^{-}_{\alpha_i,1}}^2 + (b_0 + b_1 t^{-}_{\alpha_i,1}) x_v + (c_0 + c_1 t^{-}_{\alpha_i,1}) x_v^2\right)$$
$$+ \frac{{p^{-}_{\alpha_i,1}}^2}{(273.15K + t^{-}_{\alpha_i,1})^2}(d + e\ x_v^2)$$

compressibility factor

For constants A, B, C, D, α, β, γ, a_0, a_1, a_2, b_0, b_1, c_0, c_1, d, and e, see section 3.3.

$$\rho_{a,i} = \frac{1}{4l}\sum_{\alpha_i=1}^{l}\left(\rho^{-}_{\alpha_i,1} + \rho^{+}_{\alpha_i,1} + \rho^{+}_{\alpha_i,2} + \rho^{-}_{\alpha_i,2}\right)$$ air density in the i-th equation

When the above calculation is carried out with the measured values from MC2, the result is the densities $\rho_{a,i}$ for equations i=1,...,10:

$$\rho_a = \begin{pmatrix} 1.1478 \\ 1.1491 \\ 1.1490 \\ 1.1501 \\ 1.1495 \\ 1.1496 \\ 1.1500 \\ 1.1492 \\ 1.1486 \\ 1.1489 \end{pmatrix} \frac{kg}{m^3}$$

4.3 (C3)Volumes of Weights under Standard Conditions, $v_{0,j}$

Under the assumption that the average temperature, taken when the volume is determined in this process, is somewhere between the average temperatures taken when weighing in air and in liquid, the volume of the weights under standard conditions, $v_{0,j}$, can be calculated.

$t_{P_j} = \frac{1}{2}\left(t_{a_j} + t_{Fl_j}\right)$ average temperature when volume is determined

$v_{0,j} = \left(1 + \gamma_j \left(t_{P_j} - t_0\right)\right)^{-1} \; v_{P_j}$ volumes of the weights under standard conditions

$$t_P = \begin{pmatrix} 20.699 & 20.774 & 20.701 & 20.717 & 20.694 & 20.727 & 20.637 & 20.745 \end{pmatrix}^T \; K$$

Vector of the volumes of the weights under standard conditions, v_0:

$$v_0 = \begin{pmatrix} 124.846 \\ 124.882 \\ 62.418 \\ 62.418 \\ 24.979 \\ 24.979 \\ 12.478 \\ 12.478 \end{pmatrix} cm^3$$

4.4 (C4)Matrix of Center of Gravity Heights for Weights in the Weighing Scheme, Z

Because this example involves customary cylindrical weights, which do not need to be stacked, half of each weight's height can be used as its center of gravity height. The following thus applies:

$z_j = z_{S,j} = \frac{1}{2} z_{M,j}$ center of gravity heights referring to weighing pan

Matrix of center of gravity heights, Z:

$$Z = \begin{pmatrix} 80.8 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 80.6 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 64.4 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 64.4 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 47.4 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 47.4 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 38.5 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 39.2 \end{pmatrix} 10^{-3}\ m$$

4.5 (C5)Air Buoyancy Correction

The term $P_a * \Delta v$ represents air buoyancy correction.

4.5.1 (C5.1)Matrix of Air Densities, P_a

The result from C2 results in the following for the matrix of air densities, P_a:

$$P_a = \begin{pmatrix} 1.1478 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1.1491 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1.1490 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1.1501 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1.1495 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1.1496 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1.1500 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.1492 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.1486 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.1489 \end{pmatrix} \frac{kg}{m^3}$$

4.5.2 (C5.2)Volume Differences, Δv

The volume differences, Δv , can be calculated using the results from C3 and the average temperatures taken during weighing in the mass scale from C2.

Taking expansion of volumes into consideration:

Volume differences,

$$\Delta t_i = \frac{1}{4l}\sum_{\alpha_i=1}^{l}\left(t^-_{\alpha_i,1} + t^+_{\alpha_i,1} + t^+_{\alpha_i,2} + t^-_{\alpha_i,2}\right) - 20°C$$ average temperatures

$$\Delta t = \begin{pmatrix} t_1 - 20°C & \cdots & 0 \\ \vdots & t_i - 20°C & \vdots \\ 0 & \cdots & t_n - 20°C \end{pmatrix}$$ matrix of average temperatures

$$\gamma = \begin{pmatrix} \gamma_1 & \cdots & 0 \\ \vdots & \gamma_j & \vdots \\ 0 & \cdots & \gamma_k \end{pmatrix}$$ matrix of volume expansion coefficients

$$\overline{X_V} = \overline{X} + \Delta t \overline{X} \gamma$$ volume expansion matrix

$$\Delta v = \overline{X_V} v_0$$ volume differences

$$\Delta v = \begin{pmatrix} -0.036305 \\ 0.009608 \\ 0.0045912 \\ 0.0000161 \\ -0.018965 \\ -0.018573 \\ 0.0000172 \\ 0.022765 \\ 0.022748 \\ 0.000408 \end{pmatrix} cm^3$$

4.6 (C6)Combined Mass Differences and Weighing Matrix

4.6.1 (C6.1)Combined Weighing Matrix, X

$$X = \overline{X} - 3*10^{-7} m^{-1} * \overline{X} * Z$$

$$X=\begin{pmatrix}
1-1.2*10^{-8} & -1+1.2*10^{-8} & 0 & 0 & 0 & 0 & 0 & 0 \\
1-1.2*10^{-8} & 0 & -1+1.0*10^{-8} & -1+1.0*10^{-8} & 0 & 0 & 0 & 0 \\
0 & 1-1.2*10^{-8} & -1+1.0*10^{-8} & -1+1.0*10^{-8} & 0 & 0 & 0 & 0 \\
0 & 0 & 1-1.0*10^{-8} & -1+1.0*10^{-8} & 0 & 0 & 0 & 0 \\
0 & 0 & 1-1.0*10^{-8} & 0 & -1+0.7*10^{-8} & -1+0.7*10^{-8} & -1+0.6*10^{-8} & 0 \\
0 & 0 & 0 & 1-1.0*10^{-8} & -1+0.7*10^{-8} & -1+0.7*10^{-8} & 0 & -1+0.6*10^{-8} \\
0 & 0 & 0 & 0 & 1-0.7*10^{-8} & -1+0.7*10^{-8} & 0 & 0 \\
0 & 0 & 0 & 0 & 1-0.7*10^{-8} & 0 & -1+0.6*10^{-8} & -1+0.7*10^{-8} \\
0 & 0 & 0 & 0 & 0 & 1-0.7*10^{-8} & -1+0.6*10^{-8} & -1+0.6*10^{-8} \\
0 & 0 & 0 & 0 & 0 & 0 & 1-0.6*10^{-8} & -1+0.6*10^{-8}
\end{pmatrix}$$

4.6.2 (C6.2)Combined Mass Differences, y

$$y = P_a \ \Delta v + \overline{y}$$

$$y = \begin{pmatrix} -0.081 \\ -0.048 \\ 0.033 \\ -0.191 \\ -0.152 \\ 0.046 \\ 0.004 \\ 0.029 \\ 0.024 \\ 0.007 \end{pmatrix} mg$$

4.7 (C7)Weighting

4.7.1 (C7.1)Weight Matrix, W

The weighing scheme is weighted as described in section 2.4 with the weight matrix, W. Since six weighing cycles are conducted, the s_W values can be used in this example.

$$s_i = s_{W,i} = \sqrt{\frac{1}{l-1} \sum_{\alpha_i=1}^{l} \left(\Delta m_{\alpha_i}' - y_i\right)^2}$$ empirical standard deviations of mass differences

$$\sigma_0^{\ 2} = \frac{1}{\sum_{i=1}^{n} 1/s_i^{\ 2}}$$ standardization factor

$$W = \sigma_0^{\ 2} \begin{pmatrix} 1/s_1^{\ 2} & 0 & \cdots & 0 \\ 0 & 1/s_i^{\ 2} & & \vdots \\ \vdots & & \ddots & 0 \\ 0 & \dots & 0 & 1/s_n^{\ 2} \end{pmatrix}$$ weight matrix

The results of the calculations are as follows:

Standardization factor, $\sigma_0^{\ 2}$:

$$\sigma_0^{\ 2} = 7.6443 * 10^{-9}$$

Weight matrix, W:

$$W = \begin{pmatrix} 0.102190 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0.114964 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.054101 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.102190 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.114964 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.183943 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.076643 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.183943 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.038321 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0{,}028741 \end{pmatrix}$$

4.7.2 (C7.2)Weighted Weighing Matrix, X'

$$X' = \sqrt{W}X$$

$$X' = \begin{pmatrix} 0.31967 & -0.31967 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.33906 & 0 & -0.33906 & -0.33906 & 0 & 0 & 0 & 0 \\ 0 & 0.23260 & -0.23260 & -0.23260 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.31967 & -0.31967 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.33906 & 0 & -0.33906 & -0.33906 & -0.33906 & 0 \\ 0 & 0 & 0 & 0.42889 & -0.42889 & -0.42889 & 0 & -0.42889 \\ 0 & 0 & 0 & 0 & 0.27684 & -0.27684 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.42889 & 0 & -0.42889 & -0.42889 \\ 0 & 0 & 0 & 0 & 0 & 0.19576 & -0.19576 & -0.19576 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.16953 & -0.16953 \end{pmatrix}$$

4.7.3 (C7.3)Weighted Mass Differences, y'

$$y' = \sqrt{W}y$$

$$y' = \begin{pmatrix} -0.026 \\ -0.016 \\ 0.008 \\ -0.061 \\ -0.052 \\ 0.020 \\ 0.001 \\ 0.012 \\ 0.005 \\ 0.001 \end{pmatrix} mg$$

4.8 (C8)Matrix Expansions Using the Lagrange Method

The weighing scheme is expanded to allow for the fact that the Lagrange method involves side conditions. The result of this mathematical conversion is the expanded, weighted solution matrix, L_e', and the vector of the expanded, weighted differences in mass.

4.8.1 (C8.1)Expanded, Weighted Solution Matrix, L_e'

$$\left(X'^T X'\right)_e = \begin{pmatrix} X'^T X' & 1 \\ 1 & 0 \end{pmatrix}$$

$$X_e'^T = \begin{pmatrix} X'^T & 0 \\ 0 & 1 \end{pmatrix}$$

$$L_e' = \left(X'^T X'\right)_e^{-1} X_e'^T$$ expanded, weighted solution matrix

The following values result from the analysis:

$$\left(X'^T X'\right)_e = \begin{pmatrix}
0.21715 & -0.10219 & -0.11496 & -0.11496 & 0 & 0 & 0 & 0 & 1 \\
-0.10219 & 0.15629 & -0.05410 & -0.05410 & 0 & 0 & 0 & 0 & 0 \\
-0.11496 & -0.05410 & 0.38622 & 0.06687 & -0.11496 & -0.11496 & -0.11496 & 0 & 0 \\
-0.11496 & -0.05410 & 0.06687 & 0.45520 & -0.18394 & -0.18394 & 0 & -0.18394 & 0 \\
0 & 0 & -0.11496 & -0.18394 & 0.55949 & 0.22226 & -0.06898 & 0 & 0 \\
0 & 0 & -0.11496 & -0.18394 & 0.22226 & 0.41387 & 0.07664 & 0.14562 & 0 \\
0 & 0 & -0.11496 & 0 & -0.06898 & 0.07664 & 0.36597 & 0.19352 & 0 \\
0 & 0 & 0 & -0.18394 & 0 & 0.14562 & 0.19352 & 0.43495 & 0 \\
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}$$

$$X_e'^T = \begin{pmatrix}
0.31967 & 0.33906 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-0.31967 & 0 & 0.23260 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -0.33906 & -0.23260 & 0.31967 & 0.33906 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -0.33906 & -0.23260 & -0.31967 & 0 & 0.42889 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & -0.33906 & -0.42889 & 0.27684 & 0.42889 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & -0.33906 & -0.42889 & -0.27684 & 0 & 0.19576 & 0 & 0 \\
0 & 0 & 0 & 0 & -0.33906 & 0 & 0 & -0.42889 & -0.19576 & 0.16953 & 0 \\
0 & 0 & 0 & 0 & 0 & -0.42889 & 0 & -0.42889 & -0.19576 & -0.16953 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1
\end{pmatrix}$$

$$L_e' = \begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
-2.30015 & -0.78070 & 1.13805 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
-0.36802 & -1.12767 & -0.50580 & 1.30342 & 0.24577 & -0.19430 & 0 & 0 & 0 & 0.49155 & 0.5 \\
-0.36802 & -1.12767 & -0.50580 & -1.30342 & -0.24577 & 0.19430 & 0 & 0 & 0 & -0.49155 & 0.5 \\
-0.14721 & -0.45107 & -0.20232 & -0.03476 & -0.55709 & -0.49223 & 1.11007 & 0.68243 & -0.47346 & 0.06554 & 0.2 \\
-0.14721 & -0.45107 & -0.20232 & -0.03476 & -0.55709 & -0.49223 & -1.44486 & 0 & 1.02167 & 0.06554 & 0.2 \\
-0.07360 & -0.22553 & -0.10116 & 0.90950 & -1.15241 & 0.44474 & 0.33478 & -0.68243 & -0.54821 & 1.23434 & 0.1 \\
-0.07360 & -0.22553 & -0.10116 & -0.94425 & 0.59532 & -0.93697 & 0.33478 & -0.68243 & -0.54821 & -1.23434 & 0.1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}$$

4.8.2 (C8.2)Expanded, Weighted Differences in Mass

$$y_e' = \begin{pmatrix} y' \\ m_N \end{pmatrix}$$

$$y_e' = \begin{pmatrix} -0.026 \\ -0.016 \\ 0.008 \\ -0.061 \\ -0.052 \\ 0.020 \\ 0.001 \\ 0.012 \\ 0.005 \\ 0.001 \\ 1000000 \end{pmatrix} \text{mg}$$

4.9 (C9)Masses of the Weights, β

$$\beta_e = L_e' \; y_e'$$

$$\beta_e = \begin{pmatrix} \beta \\ \lambda \end{pmatrix}$$

Masses of the weights, β:

$$\beta_e = \begin{pmatrix} 999999.190 \\ 999999.271 \\ 499999.523 \\ 499999.713 \\ 199999.875 \\ 199999.871 \\ 99999.927 \\ 99999.919 \\ 6.94 * 10^{-11} \end{pmatrix} mg \qquad \beta = \begin{pmatrix} 999999.190 \\ 999999.271 \\ 499999.523 \\ 499999.713 \\ 199999.875 \\ 199999.871 \\ 99999.927 \\ 99999.919 \end{pmatrix} mg$$

5 Calculation of Uncertainties

5.1 (U1)Uncertainty of Masses Due to the Weighing Procedure, $u_{\beta,y}$

$$V_{\beta,y} = \frac{1}{nl-k+1} \sum_{i=1}^{n} \left(\sigma_0^{\,2}(l-1) + (y'-X'\beta)^2 \right) C$$

$$\sigma_0^{\,2} = \frac{1}{\sum_{i=1}^{n} 1/s_i^{\,2}}$$ standardization factor

$$\begin{pmatrix} C & h \\ h' & 0 \end{pmatrix} = \left(X'^T X' \right)_e^{-1}$$ matrix C

Matrix C:

$$C = \begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 7.19534 & 1.15125 & 1.15125 & 0.46050 & 0.46050 & 0.23025 & 0.23025 \\
0 & 1.15125 & 3.70160 & -0.37576 & 0.61080 & 0.61080 & 1.75513 & -1.14433 \\
0 & 1.15125 & -0.37576 & 3.70160 & 0.71953 & 0.71953 & -1.08996 & 1.80949 \\
0 & 0.46050 & 0.61080 & 0.71953 & 2.74634 & -1.26340 & 0.77088 & 0.38429 \\
0 & 0.46050 & 0.61080 & 0.71953 & -1.26340 & 3.95526 & -0.43840 & -0.82499 \\
0 & 0.23025 & 1.75513 & -1.08996 & 0.77088 & -0.43840 & 4.82145 & -2.45940 \\
0 & 0.23025 & -1.14433 & 1.80949 & 0.38429 & -0.82499 & -2.45940 & 4.43486
\end{pmatrix}$$

Variance–covariance matrix of masses due to the weighing procedure, $V_{\beta,y}$:

$$V_{\beta,y} = \begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 6.92 & 1.11 & 1.11 & 0.44 & 0.44 & 0.22 & 0.22 \\
0 & 1.11 & 3.56 & -0.34 & 0.59 & 0.59 & 1.69 & -1.10 \\
0 & 1.11 & -0.34 & 3.56 & 0.69 & 0.69 & -1.05 & 1.74 \\
0 & 0.44 & 0.59 & 0.69 & 2.64 & -1.22 & 0.74 & 0.37 \\
0 & 0.44 & 0.59 & 0.69 & -1.22 & 3.81 & -0.42 & -0.79 \\
0 & 0.22 & 1.69 & -1.05 & 0.74 & -0.42 & 4.64 & -2.37 \\
0 & 0.22 & -1.10 & 1.74 & 0.37 & -0.79 & -2.37 & 4.27
\end{pmatrix} 10^{-9}\ mg^2$$

Uncertainty of masses due to the weighing procedure, $u_{\beta,y}$:

$$u_{\beta,y} = \begin{pmatrix} 0 \\ 8.319 \\ 5.967 \\ 5.967 \\ 5.140 \\ 6.168 \\ 6.810 \\ 6.531 \end{pmatrix} 10^{-5}\ mg$$

5.2 (U2)Verification of the Weighing Results:

Comparison of Non-Weighted Residuals, $\hat{e}_i$, with Empirical Standard Deviations, s_i

$$e = (e_i) = y - \hat{y} = y - X\beta \qquad \text{non-weighted residuals}$$

$$s_i = \sqrt{\frac{1}{l-1} \sum_{\alpha_i=1}^{l} \left(\Delta m_{\alpha_i}' - y_i\right)^2} \qquad \text{empirical standard deviations}$$

The result is as follows:

$$e = \begin{pmatrix} 6.435 \\ -5.721 \\ 12.156 \\ 11.090 \\ -9.857 \\ 6.161 \\ -11.595 \\ 4.831 \\ -23.190 \\ 39.430 \end{pmatrix} 10^{-5}\ mg \qquad s = \begin{pmatrix} 27.386 \\ 25.820 \\ 37.639 \\ 27.386 \\ 25.820 \\ 20.412 \\ 31.623 \\ 20.412 \\ 44.721 \\ 51.640 \end{pmatrix} 10^{-5}\ mg$$

All residuals are smaller than the corresponding empirical standard deviations. This indicates that the weighing results are accurate.

5.3 (U3)Uncertainty of Masses Due to the Standard Comparison, u_{β,m_N}

For the uncertainty of the standard comparison, the uncertainty data on the calibration certificate is referred to [cf. known size (3)].
Since no knowledge of previous calibration with the standard comparison exists, the formula for the worst case scenario is adopted to determine the uncertainty for the instability of the standard comparison (see section 4.2).

$$u_{inst}(m_N) = \frac{U_{k=2}}{2\sqrt{3}} \qquad \text{uncertainty for instability of the standard comparison}$$

$$u_c(m_N) = \sqrt{\left(\frac{U_{k=2}(m_N)}{k}\right)^2 + u_{inst}^2(m_N)} \qquad \text{combined standard uncertainty of the comparison standard}$$

$$h_j = \frac{M_j}{M_N} \qquad \text{quotients from the nominal values}$$

$$V_{\beta,m_N} = u_c^{\,2}(m_N)\ h^2 = u_c^{\,2}(m_N) \begin{pmatrix} h_1^{\,2} & 0 & \cdots & 0 \\ 0 & h_j^{\,2} & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & h_k^{\,2} \end{pmatrix}$$

Uncertainty for the instability of the standard comparison:

$$u_{inst}(m_N) = 0{,}028868$$

Quotients from the nominal values:

$h = (1 \quad 1 \quad 0.5 \quad 0.5 \quad 0.2 \quad 0.2 \quad 0.1 \quad 0.1)^T$

Variance-covariance matrix of masses due to the standard comparison, V_{β,m_N} :

$$V_{\beta,m_N} = \begin{pmatrix} 0.00083333 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0.00083333 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.00020833 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.00020833 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.00003333 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.00003333 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.00000833 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.00000833 \end{pmatrix} mg^2$$

Uncertainty of masses due to the standard comparison, u_{β,m_N} :

$$u_{\beta,m_N} = \begin{pmatrix} 0.0289 \\ 0.0289 \\ 0.0144 \\ 0.0144 \\ 0.0058 \\ 0.0058 \\ 0.0029 \\ 0.0029 \end{pmatrix} mg$$

5.4 (U4)Uncertainty of Masses Due to Measurement of the Air Density (Type A), $u_{\beta,P_a,A}$

The uncertainties for the measurements of the air density (type A), $u_{\beta,P_a,A}$, are determined from the corresponding standard deviations (see section 4.3).
For the variance-covariance matrix of the weights related to the standard uncertainties for the measurement of the air density (type A), $V_{\beta,P_a,A}$, the following applies (cf. measured values from MC2):

$u_A^2(\rho_{a,i}) = \frac{1}{l-1} \sum_{\alpha_i=1}^{l} (\rho_{a,\alpha_i} - \rho_{a,i})^2$ standard uncertainties for the measurement of the air density (type A)

$V_{P_a,A} = (u_A^2(\rho_{a,i}))E$ matrix of standard uncertainties for the measurement of the air density

$\Delta V = \begin{pmatrix} \Delta v_1 & \cdots & 0 \\ \vdots & \Delta v_j & \vdots \\ 0 & \cdots & \Delta v_k \end{pmatrix}$ matrix of volume differences

$$V_{\beta,P_a,A} = CX^T W \, \Delta V \, V_{P_a,A} \, (CX^T W \, \Delta V)^T$$

Variance–covariance matrix of weights due to the measurement of the air density (type A):

$$V_{\beta,P_a,A} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 108.29 & 14.51 & 14.51 & 5.81 & 5.81 & 2.90 & 2.90 \\ 0 & 14.51 & 4.61 & 4.25 & 1.37 & 1.37 & 0.04 & 1.33 \\ 0 & 14.51 & 4.25 & 4.61 & 2.17 & 2.17 & 1.73 & 0.44 \\ 0 & 5.81 & 1.37 & 2.17 & 7.58 & 1.22 & -3.27 & -6.13 \\ 0 & 5.81 & 1.37 & 2.17 & 1.22 & 2.56 & 1.76 & -1.10 \\ 0 & 2.90 & 0.04 & 1.73 & -3.27 & 1.76 & 10.14 & 4.13 \\ 0 & 2.90 & 1.33 & 0.44 & -6.13 & -1.10 & 4.13 & 7.28 \end{pmatrix} 10^{-13}\ mg^2$$

Uncertainty of weights due to the measurement of the air density (type A):

$$u_{\beta,P_a,A} = \begin{pmatrix} 0 \\ 32.908 \\ 6.790 \\ 6.790 \\ 8.709 \\ 5.057 \\ 10.071 \\ 8.532 \end{pmatrix} 10^{-7}\ mg$$

5.5 (U5)Uncertainty of Masses Due to Measurement of the Air Density (Type B), $u_{\beta,P_a,B}$

The individual measurements of temperature, pressure, and relative humidity are not completely accurate due to measurement sensor inaccuracies.

As described in section 4.4, type B uncertainties for air density, $V_{\beta,P_a,B}$, are calculated as follows.

Known sizes (12.1) to (12.4) are used for this purpose:

$u(t) = 0.1K$

$u(p) = 0.5mbar = 50Pa$

$u(h) = 0.025$

$u(x_{CO_2}) = 0.00004$

Calculation:

$$u_t\left(\bar{\rho}_{a,\alpha_{i,1}}\right) = 4*10^{-3}K^{-1}u(t)\bar{\rho}_{a,\alpha_{i,1}}$$

$$u_p\left(\bar{\rho}_{a,\alpha_{i,1}}\right) = 10^{-5}Pa^{-1}u(p)\bar{\rho}_{a,\alpha_{i,1}}$$

$$u_h\left(\bar{\rho}_{a,\alpha_{i,1}}\right) = 9*10^{-3}u(h)\bar{\rho}_{a,\alpha_{i,1}}$$

$$u_{x_{CO2}}\left(\bar{\rho}_{a,\alpha_{i,1}}\right) = 0.4u(x_{CO_2})\bar{\rho}_{a,\alpha_{i,1}}$$

$$u_B^2\left(\bar{\rho}_{a,\alpha_{i,1}}\right) = u_t^2\left(\bar{\rho}_{a,\alpha_{i,1}}\right) + u_p^2\left(\bar{\rho}_{a,\alpha_{i,1}}\right) + u_h^2\left(\bar{\rho}_{a,\alpha_{i,1}}\right) + u_{x_{CO2}}^2\left(\bar{\rho}_{a,\alpha_{i,1}}\right) + u_R^2\left(\bar{\rho}_{a,\alpha_{i,1}}\right)$$

$$u_R\left(\bar{\rho}_{a,\alpha_{i,1}}\right) = 22*10^{-6}\bar{\rho}_{a,\alpha_{i,1}}$$

$$u_B^2(\rho_{a,i}) = \left(\frac{1}{4l}\right)^2 \sum_{\alpha_i=1}^{l} u_B^2\left(\rho^-_{a,\alpha_{i,1}}\right) + u_B^2\left(\rho^+_{a,\alpha_{i,1}}\right) + u_B^2\left(\rho^+_{a,\alpha_{i,2}}\right) + u_B^2\left(\rho^-_{a,\alpha_{i,2}}\right)$$

$$V_{P_a,B} = \begin{pmatrix} u_B^2(\rho_{a,1}) & 0 & \cdots & 0 \\ 0 & u_B^2(\rho_{a,i}) & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & u_B^2(\rho_{a,n}) \end{pmatrix}$$

$$V_{\beta,P_a,B} = CX^T W \, \Delta V \, V_{P_a,A} \, \left(CX^T W \, \Delta V\right)^T$$

Variance–covariance matrix of weights due to the measurement of the air density (type B):

$$V_{\beta,P_a,B} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 93.40 & 6.21 & 6.21 & 2.48 & 2.48 & 1.24 & 1.24 \\ 0 & 6.21 & 7.10 & 6.04 & 2.67 & 2.67 & -0.54 & 3.21 \\ 0 & 6.21 & 6.04 & 7.10 & 2.58 & 2.58 & 3.17 & -0.59 \\ 0 & 2.48 & 2.67 & 2.58 & 9.36 & 3.06 & -2.34 & -2.03 \\ 0 & 2.48 & 2.67 & 2.58 & 3.06 & 6.33 & 0.69 & 1.01 \\ 0 & 1.24 & -0.54 & 3.17 & -2.34 & 0.69 & 12.98 & -0.22 \\ 0 & 1.24 & 3.21 & -0.59 & -2.03 & 1.01 & -0.22 & 13.29 \end{pmatrix} 10^{-11} \; mg^2$$

Uncertainty of weights due to the measurement of the air density (type B):

$$u_{\beta,P_a,B} = \begin{pmatrix} 0 \\ 30.562 \\ 8.424 \\ 8.424 \\ 9.677 \\ 7.954 \\ 11.391 \\ 11.528 \end{pmatrix} 10^{-6} \; mg$$

5.6 (U6)Uncertainty of Masses Due to the Measurement of the Volume, $u_{\beta,V}$

The uncertainties from determining the volumes are calculated from the variance–covariance matrix for the measurement of the volume, V_V, which is obtained from the volume comparator software (see section 4.5).

$$V_V = \begin{pmatrix} u^2(v_{0,1}) & u(v_{0,1}, v_{0,2}) & \cdots & u(v_{0,1}, v_{0,k}) \\ u(v_{0,2}, v_{0,1}) & u^2(v_{0,2}) & \ddots & \vdots \\ \vdots & \ddots & \ddots & \vdots \\ u(v_{0,k}, v_{0,1}) & \cdots & \cdots & u^2(v_{0,k}) \end{pmatrix}$$

$$V_{\beta,V} = CX^T W \, P_a \overline{X_V} \; V_V \; \left(CX^T W \, P_a \overline{X_V}\right)^T$$

Variance–covariance matrix of weights due to the measurement of the volume:

$$V_{\beta,V} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 73.01 & 36.11 & 36.11 & 14.45 & 14.45 & 7.22 & 7.22 \\ 0 & 36.11 & 90.43 & 18.04 & 7.22 & 7.22 & 3.62 & 3.60 \\ 0 & 36.11 & 18.04 & 18.23 & 7.23 & 7.23 & 3.61 & 3.61 \\ 0 & 14.45 & 7.22 & 7.23 & 20.68 & 2.89 & 1.45 & 1.45 \\ 0 & 14.45 & 7.22 & 7.23 & 2.89 & 3.18 & 1.45 & 1.45 \\ 0 & 7.22 & 3.62 & 3.61 & 1.45 & 1.45 & 18.50 & 0.72 \\ 0 & 7.22 & 3.60 & 3.61 & 1.45 & 1.45 & 0.72 & 0.97 \end{pmatrix} 10^{-17}\ mg^2$$

Uncertainty of weights due to the measurement of the volume:

$$u_{\beta,V} = \begin{pmatrix} 0 \\ 2.702 \\ 3.007 \\ 1.350 \\ 1.438 \\ 0.564 \\ 1.360 \\ 0.311 \end{pmatrix} 10^{-8}\ mg$$

5.7 (U7)Uncertainty of Masses Due to the Balance, $u_{\beta,ba}$

5.7.1 (U7.1)Uncertainty of Masses Due to Adjustment of the Balance (Sensitivity), $u_{\beta,S}$

$$V_{\beta,S} = \begin{pmatrix} {u_{\beta,S,1}}^2 & 0 & \cdots & 0 \\ 0 & {u_{\beta,S,j}}^2 & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & {u_{\beta,S,k}}^2 \end{pmatrix}$$

$$u_{\beta,S} = \left(u_{\beta,S,j}\right) = \left(\frac{u(k_J)}{k_J}\right) \left(\left|\overline{X}\right| \ M\right)^T \Phi^{-1} \left|\overline{y}\right|$$

$$M = \begin{pmatrix} M_1 & 0 & 0 \\ 0 & M_j & 0 \\ 0 & 0 & M_k \end{pmatrix}$$ matrix of nominal values for weights

$$\phi = (\phi_i) = \left(\left|\overline{X}\right| \ M\right) \begin{pmatrix} 1 \\ \vdots \\ 1 \end{pmatrix}$$ vector ϕ of sums from each of the nominal values concerned

$$\Phi = \begin{pmatrix} \phi_1 & 0 & \cdots & 0 \\ 0 & \phi_i & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & \phi_n \end{pmatrix}$$ diagonal matrix with entries from the vector ϕ

$$\frac{u(k_J)}{k_J} = 5*10^{-4}$$ approximate value with regularly adjusted electronic balance

The result:

$$\left|\overline{X}\right| = \begin{pmatrix} 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \end{pmatrix}$$

$$M = \begin{pmatrix} 1000 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1000 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 500 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 500 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 200 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 200 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 100 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 100 \end{pmatrix}$$

$$\Phi = \begin{pmatrix} 2000 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 2000 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 2000 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1000 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1000 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1000 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 400 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 400 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 400 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 200 \end{pmatrix}$$

$$V_{\beta,S} = \begin{pmatrix} 6.02 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 2.17 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 81.06 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 55.37 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 4.63 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 4.53 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.76 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.31 \end{pmatrix} 10^{-10} \ mg^2$$

5.7.2 (U7.2) Uncertainty of Masses Due to the Resolution of the Balance, $u_{\beta,d}$

$$V_{\beta,d} = \begin{pmatrix} {u_{\beta,d,1}}^2 & 0 & \cdots & 0 \\ 0 & {u_{\beta,d,j}}^2 & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & {u_{\beta,d,k}}^2 \end{pmatrix}$$

$$u_{\beta,d} = \left(u_{\beta,d,j}\right) = \frac{1}{12}\left(\left|\overline{X}\right| \;\; M\right)^T \Phi^{-1} d$$

$d = \left(d_i\right)$ resolution of the balance

Calculation:

$d = 0.0001mg$ for all d_i, i=1,...,n

$$V_{\beta,d} = \begin{pmatrix} 6.94 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 6.94 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 15.63 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 15.63 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 13.61 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 13.61 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 8.40 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 8.40 \end{pmatrix} 10^{-11} mg^2$$

5.7.3 (U7.3) Uncertainty of Masses Due to the Balance, $u_{\beta,ba}$

$$V_{\beta,ba} = V_{\beta,S} + V_{\beta,d}$$

$$V_{\beta,ba} = \begin{pmatrix} 6.72 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 2.86 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 82.63 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 56.93 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 5.99 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 5.89 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1.60 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.15 \end{pmatrix} 10^{-10} \; mg^2$$

$$V_{\beta,ba} = \begin{pmatrix} 2.592 \\ 1.693 \\ 9.090 \\ 7.545 \\ 2.448 \\ 2.426 \\ 1.265 \\ 1.074 \end{pmatrix} 10^{-5}\ mg$$

5.8 (U8) Composite Uncertainty of the Weighing Scheme

5.8.1 (U8.1) Composite Uncertainty of Type A, $u_{\beta,A}$

$$V_{\beta,A} = V_{\beta,y} + V_{\beta,P_a,A}$$

$$V_{\beta,A} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 69.32 & 11.09 & 11.09 & 4.44 & 4.44 & 2.22 & 2.22 \\ 0 & 11.09 & 35.61 & -3.61 & 5.88 & 5.88 & 16.88 & -11.01 \\ 0 & 11.09 & -3.61 & 35.61 & 6.92 & 6.92 & -10.48 & 17.41 \\ 0 & 4.44 & 5.88 & 6.92 & 26.43 & -12.15 & 7.41 & 3.69 \\ 0 & 4.44 & 5.88 & 6.92 & -12.15 & 38.05 & -4.22 & -7.94 \\ 0 & 2.22 & 16.88 & -10.48 & 7.41 & -4.22 & 46.39 & -23.65 \\ 0 & 2.22 & -11.01 & 17.41 & 3.69 & -7.94 & -23.65 & 42.67 \end{pmatrix} 10^{-10}\ mg^2$$

$$u_{\beta,A} = \begin{pmatrix} 0 \\ 8.326 \\ 5.968 \\ 5.968 \\ 5.141 \\ 6.169 \\ 6.811 \\ 6.532 \end{pmatrix} 10^{-5}\ mg$$

5.8.2 (U8.2) Composite Uncertainty of Type B, $u_{\beta,B}$

$$V_{\beta,B} = V_{\beta,m_N} + V_{\beta,P_a,B} + V_{\beta,P} + V_{\beta,ba}$$

$$V_{\beta,B} = \begin{pmatrix} 8.33*10^{-4} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 8.33*10^{-4} & 6.21*10^{-11} & 6.21*10^{-11} & 2.48*10^{-11} & 2.48*10^{-11} & 1.24*10^{-11} & 1.24*10^{-11} \\ 0 & 6.21*10^{-11} & 2.08*10^{-4} & 6.04*10^{-11} & 2.67*10^{-11} & 2.67*10^{-11} & -0.54*10^{-12} & 3.21*10^{-11} \\ 0 & 6.21*10^{-11} & 6.04*10^{-11} & 2.08*10^{-4} & 2.58*10^{-11} & 2.58*10^{-11} & 3.17*10^{-11} & -0.59*10^{-12} \\ 0 & 2.48*10^{-11} & 2.67*10^{-11} & 2.58*10^{-11} & 3.33*10^{-5} & 3.06*10^{-11} & -2.34*10^{-11} & -2.03*10^{-11} \\ 0 & 2.48*10^{-11} & 2.67*10^{-11} & 2.58*10^{-11} & 3.06*10^{-11} & 3.33*10^{-5} & 6.94*10^{-12} & 1.01*10^{-11} \\ 0 & 1.24*10^{-11} & -0.54*10^{-12} & 3.17*10^{-11} & -2.34*10^{-11} & 6.94*10^{-12} & 8.33*10^{-6} & -2.21*10^{-12} \\ 0 & 1.24*10^{-11} & 3.21*10^{-11} & -0.59*10^{-12} & -2.03*10^{-11} & 1.01*10^{-11} & -2.21*10^{-12} & 8.33*10^{-6} \end{pmatrix} mg^2$$

$$u_{\beta,B} = \begin{pmatrix} 0.029 \\ 0.029 \\ 0.014 \\ 0.014 \\ 0.006 \\ 0.006 \\ 0.003 \\ 0.003 \end{pmatrix} mg$$

5.8.3 (U8.3) Composite Uncertainty of the Weighing Scheme, $u_{\beta,c}$

$$V_{\beta,c} = V_{\beta,y} + V_{\beta,m_N} + V_{\beta,P_a,A} + V_{\beta,P_a,B} + V_{\beta,P} + V_{\beta,ba}$$
$$u_c(\beta_j) = \sqrt{v_{\beta,c,jj}}$$

$$V_{\beta,c} = \begin{pmatrix} 8.33*10^{-4} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 8.33*10^{-4} & 1.17*10^{-9} & 1.17*10^{-9} & 4.68*10^{-10} & 4.68*10^{-10} & 2.34*10^{-10} & 2.34*10^{-10} \\ 0 & 1.17*10^{-9} & 2.08*10^{-4} & -3.01*10^{-10} & 6.14*10^{-10} & 6.14*10^{-10} & 1.68*10^{-9} & -1.07*10^{-9} \\ 0 & 1.17*10^{-9} & -3.01*10^{-10} & 2.08*10^{-4} & 7.18*10^{-10} & 7.18*10^{-10} & -1.02*10^{-9} & 1.73*10^{-9} \\ 0 & 4.68*10^{-10} & 6.14*10^{-10} & 7.18*10^{-10} & 3.33*10^{-5} & -1.18*10^{-9} & 7.18*10^{-10} & 3.49*10^{-10} \\ 0 & 4.68*10^{-10} & 6.14*10^{-10} & 7.18*10^{-10} & -1.18*10^{-9} & 3.33*10^{-5} & -4.15*10^{-10} & -7.84*10^{-10} \\ 0 & 2.34*10^{-10} & 1.68*10^{-9} & -1.02*10^{-9} & 7.18*10^{-10} & -4.15*10^{-10} & 8.33*10^{-6} & -2.37*10^{-9} \\ 0 & 2.34*10^{-10} & -1.07*10^{-9} & 1.73*10^{-9} & 3.49*10^{-10} & -7.84*10^{-10} & -2.37*10^{-9} & 8.33*10^{-6} \end{pmatrix} mg^2$$

$$u_C(\beta_j) = \begin{pmatrix} 0.029 \\ 0.029 \\ 0.014 \\ 0.014 \\ 0.006 \\ 0.006 \\ 0.003 \\ 0.003 \end{pmatrix} mg$$

5.9 (U9) Expanded Uncertainty of Masses, $U(\beta)$

With expansion factor k=2, the following applies:

$$U(\beta_j) = 2\ u_c(\beta_j)$$

$$U(\beta) = \begin{pmatrix} 0.058 \\ 0.058 \\ 0.029 \\ 0.029 \\ 0.012 \\ 0.012 \\ 0.006 \\ 0.006 \end{pmatrix} mg$$

14 List of Equations

Symbol	Description/Explanation	Unit
A_i	Display value when determining density with loading i=A,B,C	kg
$A^+_{\alpha_i}$	Scale display for + group in α_i-th cycle	kg
$A^-_{\alpha_i}$	Scale display for - group in α_i-th cycle	kg
ΔA_{α_i}	Display difference for α-th cycle in equation i	kg
$\Delta A_{T,\alpha_i}$	Exchange-corrected display difference for α-th cycle in equation i	kg
c_J	Adjustment constant for volume comparator scales	kg/N
d	Scale interval	
e_i	Residual for equation i: $e_i = y_i - \hat{y}_i$	kg
e	Vector of residuals for equations i=1,...,n	kg
E	Unit matrix	-
$E_{J,i}$	Sensitivity in equation i	-
f_{T_i}	Exchange error in equation i	kg
g	Vector for the sums of the nominal values in the individual equations	kg
G	Diagonal matrix for the sums of the nominal values in the individual equations: $P \in R^{kxk}$	kg
g_0	Gravitational acceleration for volume comparator at the height of the weighing pan z_0	N/kg
g_1	Gravitational acceleration for volume comparator at the height of the upper level of the hanger z_1	N/kg
g_2	Gravitational acceleration for volume comparator at the height of the lower level of the hanger z_2	N/kg
$h_{\alpha_{i,1}}$	Relative humidity at beginning of α-th cycle in equation i	%
$h_{\alpha_{i,1}}$	Relative humidity at end of α-th cycle in equation i	%
L_{erw}'	Expanded solution matrix for weighted weighing scheme	-
m_i^+	Sum of the masses of all weights in + group for equation i	kg
m_i^-	Sum of the masses of all weights in - group for equation i	kg
m_N	Mass of reference comparison standard	kg
Δm_{α_i}	Mass difference for α-th cycle in equation i	kg
$\Delta m_{\alpha_i}'$	Corrected mass difference for α-th cycle in equation i	kg
m_{P_j}	Mass of a test weight when determining density	kg
m_{N_j}	Mass of reference comparison standard during determination of density for weight comparison in air	kg
$\Delta m_a'$	Corrected mass difference during determination of density for weighing in air	kg
$\Delta m_{Fl}'$	Corrected mass difference during determination of density for weighing in liquid	kg
m_{Geh}	Mass of volume comparator hanger for determination of density	kg

Symbol	Description/Explanation	Unit
m_{Ni}	Mass of comparison standard N_i when determining density, $i = 0,1,2,3,4$	kg
$\Delta m_{\rho_{Fl}}'$	Corrected mass difference when determining density in liquid	kg
M_j	Nominal value of weight j	kg
M	Matrix for nominal values for weights: $P \in R^{kxk}$	kg
$p_{\alpha_{i,1}}$	Pressure at beginning of α -th cycle in equation i	mbar
$p_{\alpha_{i,2}}$	Pressure at end of α -th cycle in equation i	mbar
P	Diagonal matrix for densities: $P \in R^{kxk}$	kg/m³
P_0	Matrix for densities under standard conditions: $P_0 \in R^{kxk}$	kg/m³
P_a	Diagonal matrix for air densities: $P_a \in R^{nxn}$	kg/m³
$Q_{y,erw}$	Expanded Jacobian matrix for weighted results	-
$Q_{m_N,erw}$	Expanded Jacobian matrix for weighted results	-
$Q_{P_a,erw}$	Expanded Jacobian matrix for air densities	-
$Q_{P,erw}$	Expanded Jacobian matrix for densities of weights	-
s^2	Group variance: approximate value for variance of weighted mass differences σ^2	kg^2
s_i	Empirical standard deviation for equation i	kg
s_i^2	Empirical variance for equation i	kg^2
$s_{W,i}$	s_W value for equation i	kg
$s_{P,i}$	s_P value for equation i	kg
$t_{\alpha_{i,1}}$	Temperature at beginning of α -th cycle in equation i	°C
$t_{\alpha_{i,2}}$	Temperature at end of α -th cycle in equation i	°C
t_i	Average temperature in equation i	°C
t_0	Standard temperature of $t_0 = 20\ °C$	°C
t_V	Average temperature during measurement with volume comparator	°C
Δt_i	Temperature difference from standard temperature in equation i: $\Delta t_i = t_i - t_0$	K
Δt	Matrix for temperature differences from standard temperature: $\Delta t \in R^{nxn}$	K
$u_c(m_N)$	Combined standard uncertainty of reference comparison standard	kg
$u_{inst}(m_N)$	Uncertainty caused by instability of comparison standard	kg
$u_A(\rho_{a,i})$	Type A uncertainty of air density in equation i	kg/m³
$u_B(\rho_{a,i})$	Type B uncertainty of air density in equation i	kg/m³
u_d	Vector of resolution uncertainties	
u_F	Uncertainty of approximate formula for determining air density	kg/m³

Symbol	Description/Explanation	Unit
$u(p_{\alpha_{i,1}})$	Uncertainty of pressure when determining air density	mbar
$u(t_{\alpha_{i,1}})$	Uncertainty of temperature when determining air density	K
$u(h_{\alpha_{i,1}})$	Uncertainty of relative humidity when determining air density	%
$u(k_J)/k_J$	Relative uncertainty of adjustment constants k_J	-
u_E	Uncertainty due to excentric loads	-
u_{ma}	Uncertainty due to magnetic forces	-
u_S	Vector of standard uncertainties for adjustment of scales	kg
$U(m_j)$	Expanded uncertainty of weight j	kg
$v_{Geh,a}$	Volume of the volume comparator hanger component that is in air at both times when a load is placed on the scales	m^3
$v_{Geh,Fl}$	Volume of volume comparator hanger component that is in liquid at both times when a load is placed on the scales	m^3
$v_{\Delta Geh}$	Volume of volume comparator hanger component that is in air when load A is placed on the scales and in liquid when load B is placed on the scales	m^3
v_j	Volumes of weight j	m^3
v	Vector of volumes of weights j=1,...,k	m^3
$v_{0,j}$	Volumes of weight j under standard conditions	m^3
v_i^+	Sum of the volumes of all weights in + group for equation i	m^3
v_i^-	Sum of the volumes of all weights in - group for equation i	m^3
v_{Ni}	Volumes of comparison standard N_i when determining density, $i = 0,1,2,3,4$	m^3
$v_{0,Ni}$	Volumes of comparison standard N_i when determining density under standard conditions, $i = 0,1,2,3,4$	m^3
$V_{y,erw}$	Expanded variance-covariance matrix for weighted results	kg^2
V_{m_N}	Variance-covariance matrix for comparison standard	kg^2
$V_{P_a,A,erw}$	Variance-covariance matrix for determination of type A air density	kg^2
$V_{P_a,B,erw}$	Variance-covariance matrix for determination of type B air density	kg^2
$V_{P,erw}$	Variance-covariance matrix for densities of weights	kg^2
V_S	Variance-covariance matrix related to sensitivity	kg^2
V_d	Variance-covariance matrix related to resolution	kg^2
V_E	Variance-covariance matrix related to excentric loads	kg^2
V_{ma}	Variance-covariance matrix related to magnetic forces	kg^2
$V_{\beta,y,erw}$	Expanded variance-covariance matrix for masses related to the standard uncertainty of the weighing process	kg^2
V_{β,m_N}	Variance-covariance matrix for masses related to the standard uncertainty of the comparison standard	kg^2
$V_{\beta,P_a,A,erw}$	Variance-covariance matrix for weights related to the standard uncertainties for measuring type A air density	kg^2

Symbol	Description/Explanation	Unit
$V_{\beta,P_a,B,erw}$	Variance-covariance matrix for weights related to the standard uncertainties for measuring type B air density	kg^2
$V_{\beta,P,erw}$	Variance-covariance matrix for masses related to the standard uncertainties of the densities	kg^2
$V_{\beta,ba}$	Variance-covariance matrix related to inaccuracy of the scales	kg^2
$V_{\beta,A}$	Variance-covariance matrix for all type A proportions	kg^2
$V_{\beta,B}$	Variance-covariance matrix for all type B proportions	kg^2
$V_{\beta,c}$	Complex variance-covariance matrix for weights	kg^2
V_{β}	Expanded variance-covariance matrix for weights	kg^2
W	Matrix for standardized weighting (weight matrix): $W \in R^{nxn}$	$1/kg^2$
$(\overline{x}_{ij})$	Element of weighing matrix: $(\overline{x}_{ij}) \in \{-1;0;1\}$	-
$\overline{X}$	Weighing matrix: $\overline{X} \in R^{nxk}$	-
$\lvert\overline{X}\rvert$	Weighing matrix with the amounts of the entries	-
$\overline{X_V}$	Volume expansion matrix: $\overline{X_V} = \overline{X} + \Delta t \overline{X} \gamma$	-
y_i	Measured value of (corrected) mass difference in equation i	kg
y	Vector of mass differences for equations i=1,...,n	kg
$\hat{y}_i$	Estimate of mass difference in equation i	kg
$\hat{y}$	Vector of estimates for weighted mass differences in equations i=1,...,n	kg
y_i'	Measured value of weighted mass difference in equation i	kg
y'	Vector of weighted mass differences for equations i=1,...,n	kg
$\hat{y}_i'$	Estimate of weighted mass difference in equation i	kg
$\hat{y}'$	Vector of estimates for weighted mass differences in equations i=1,...,n	kg
z_j	Center of gravity height of weight j related to the height of weighing pan $h_0 = 0$	m
Z	Diagonal matrix for center of gravity heights of weights: $Z \in R^{kxk}$	m
$z_{S,j}$	Center of gravity height of weight j related to its underside	m
z_i^+	Center of gravity height of + group in equation i	m
z_i^-	Center of gravity height of - group in equation i	m
α_g	Approximate value for relative gradients of gravitational acceleration of $\alpha_g \approx -3\ 10^{-7} m^{-1}$	m^{-1}
β_j	Mass of weight j	kg
β	Vector of masses of weights j=1,...,k	kg
γ_j	Volume expansion coefficient of weight j	m^3/K
γ	Diagonal matrix for volume expansion coefficients of weights: $P \in R^{kxk}$	m^3/K

Symbol	Description/Explanation	Unit
γ_{Ni}	Volume expansion coefficient of comparison standard N_i when determining density, $i = 0,1,2,3,4$	m³/K
γ_P	Volume expansion coefficient of test weight P when determining density,	m³/K
ρ_j	Density of weight j	kg/m³
$\rho_{0,j}$	Density of weight j under standard conditions	kg/m³
$\rho_{a,\alpha_{i,1}}$	Air density at beginning of α -th cycle in equation i	kg/m³
$\rho_{a,\alpha_{i,2}}$	Air density at end of α -th cycle in equation i	kg/m³
ρ_{a,α_i}	Average air density at beginning and end of α -th cycle in equation i	kg/m³
$\rho_{a,i}$	Air density in equation i	kg/m³
ρ_0	Conventional base value for air density of 1.2 kg/m³	kg/m³
ρ_c	Conventional base value for material density of 8000 kg/m³	kg/m³
ρ_{a,J_i}	Air density during adjustment of scales with adjustment comparison standard J_i	kg/m³
$\rho_{J\,i}$	Density of adjustment comparison standard J_i for the scales used to execute equation i	kg/m³
$\rho_{P,j}$	Density of test weight j when determining density	kg/m³
$\rho_{N,j}$	Density of reference comparison standard during determination of density for weight comparison in air	kg/m³
ρ_{Sub_j}	Fictional density derived from substitution weight difference when determining density	kg/m³
ρ_{a,ε_j}	Air density of weight j during weighing in air for determination of density	kg/m³
ρ_{a,η_j}	Air density of weight j during determination of liquid density with volume comparator	kg/m³
ρ_{Fl_j}	Liquid density determined when weighing in liquid	kg/m³
σ^2	Variance of weighted mass differences	kg²
$\sigma_0{}^2$	Standardization factor when weighting mass differences	kg²

15 Abbreviations

SM = ScalesMass
SV = ScalesServer
SD = ScalesDesk

Abbreviations used in English translation:

DKD = Deutscher Kalibrierdienst
(German Calibration Service)
DL = Datalogger
MCP = Conventional Weight Value
MP = Mass
PKP = Test Weight Calibration Record
SS = Sensitivity Supplement
UMCP = Uncertainty of Conventional Weight Value
WC = Scales Controller
WDS = Weighing Difference Suplement
WKP = Mass Comparator Calibration Record
WS = Climate Station

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