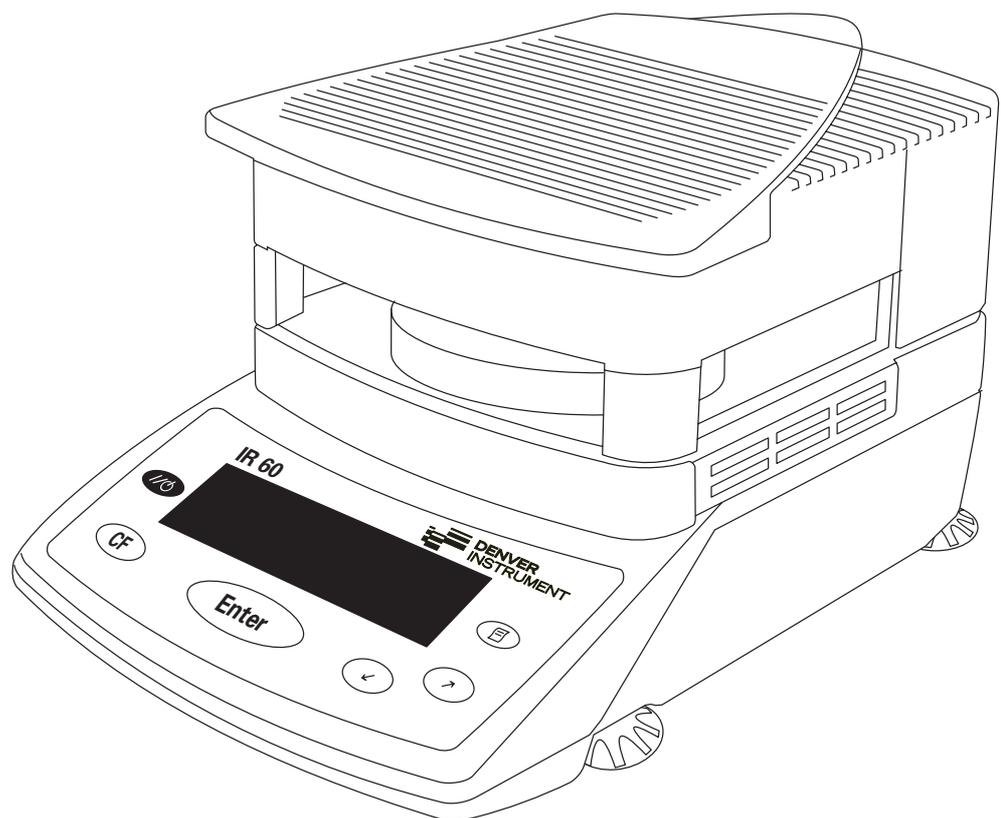


Moisture Analyzer

Model IR-60

Electronic Moisture Analyzer

Operating Instructions



Intended Use

The IR Moisture Analyzer can be used for quick and reliable determination of the moisture content of materials of liquid, pasty and solid substances using the thermogravimetric method.

The moisture analyzer saves work and speeds up your routine procedures through the following features:

- Fast analysis time, high repeatability, and gentle and uniform sample drying due to the round quartz-rod IR heating element
- Choice of fully automatic, semi-automatic or timer modes for shutoff parameters
- Options for storing up to 5 user-defined drying programs

The following features make the moisture analyzer ideal for use as an inspection, measuring and test instrument in process control and incoming inspection:

- Compact design, including base, requires little space
- Hinged sample chamber cover with wide-angle opening for easy access
- Convenient and reliable control of the accuracy of the moisture analyzer according to the DIN/ISO standards by using an external calibration weight and a temperature adjustment set
- ISO/GLP-compliant recording capability with pre-configured formats for printouts of analysis results and records of temperature and weighing system adjustments
- Password-protected drying parameters
- Comprehensive range of accessories, including dust cover for the keypad, glass fiber filters and external printer

The moisture analyzer meets the highest requirements placed on the accuracy and reliability of weighing results through the following features:

- Excellent readability under any lighting conditions; backlit display minimizes reading errors
- Removable pan draft shield makes it easy to clean the sample chamber and protects the weighing system from debris

Symbols

The following symbols are used in these instructions:

- indicates steps you must perform
- indicates steps required only under certain conditions
- > describes what happens after you have performed a certain step
- indicates an item in a list
- ⚠ indicates a hazard

Contents

| | | | |
|----|--------------------------------------------------------------------|----|------------------------------------------------|
| 2 | Intended Use | 24 | Operating the Moisture Analyzer |
| 4 | Warning and Safety Information | 24 | Setting the Drying Parameters |
| 5 | Getting Started | 24 | – Drying Parameters (Overview) |
| 5 | Equipment Supplied | 27 | Example |
| 6 | General View of the Moisture Analyzer | 31 | “isoTEST” Calibration/ Adjustment Functions |
| 7 | Connecting the Moisture Analyzer to AC Power | 31 | Heater Adjustment |
| 8 | Leveling the Moisture Analyzer | 31 | Weighing System Settings |
| 8 | Turning On the Analyzer; Opening and Closing the Sample Chamber | 35 | Hardware Tests |
| 9 | Operating Design | 37 | Data Output |
| 9 | Keys | 37 | Output to the Moisture Analyzer Display |
| 10 | Operation: Analysis and Test Functions | 39 | Interface Port |
| 11 | Menu Operation | 40 | Data Output Format |
| 11 | Data Output | 40 | Data Input Format |
| 12 | Error Codes | 42 | Pin Assignment Chart |
| 12 | Saving Data | 43 | Cabling Diagram |
| 13 | Configuring the Moisture Analyzer | 44 | Error Codes |
| 13 | Setting the Language | 46 | Care and Maintenance |
| 14 | Setting the Device Parameters | 46 | Service |
| 14 | Entering or Changing the Password | 46 | Repairs |
| 17 | Device Parameters (Overview) | 46 | Cleaning |
| 18 | Device Information | 47 | Safety Inspection |
| 19 | Basics of Moisture Analysis | 47 | Instructions for Recycling |
| 21 | Preparation | 48 | Overview |
| 21 | – Adjustment to an Existing Measuring System | 48 | Specifications |
| 22 | – Preparing a Sample | 49 | CE Marking |
| | | 50 | Index |
| | | | Appendix |
| | | | Entering the General Password |
| | | | Brief Instructions |

Warning and Safety Information

This moisture analyzer complies with the European Council Directives as well as international regulations and standards for electrical equipment, electromagnetic compatibility, and the stipulated safety requirements. Improper use or handling, however, can result in damage and/or injury.

To prevent damage to the equipment, read these operating instructions thoroughly before using your moisture analyzer. Keep these instructions in a safe place.

Follow the instructions below to ensure safe and trouble-free operation of your moisture analyzer:

⚠ Use the moisture analyzer only for performing moisture analysis of samples. Any improper use of the analyzer can endanger persons and may result in damage to the analyzer or other material assets

⚠ Do not use this moisture analyzer in a hazardous area/location; operate it only under the ambient conditions specified in these instructions

– The moisture analyzer may be operated only by qualified persons who are familiar with the properties of the sample to be analyzed

⚠ Make sure before getting started that the voltage rating printed on the manufacturer's label is identical to your local line voltage (see the section "Connecting the Moisture Analyzer to AC Power" in the chapter entitled "Getting Started")

– The device comes with a power supply that has a grounding conductor

– The only way to switch the power off completely is to unplug the power cord

– Position the power cord so that it cannot touch any hot areas of the moisture analyzer

– Use only extension cords that meet the applicable standards and have a protective grounding conductor

– Disconnecting the ground conductor is prohibited

– Connect only Denver Instrument accessories and options, as these are optimally designed for use with your moisture analyzer

– Protect the moisture analyzer from contact with liquid

– If there is visible damage to the moisture analyzer or power cord: unplug the equipment and lock it in a secure place to ensure that it cannot be used for the time being

⚠ Clean your moisture analyzer according to the cleaning instructions only (see "Care and Maintenance")

Do not open the analyzer housing. If the seal is broken, this will result in forfeiture of all claims under the manufacturer's warranty.

In case you have any problems with your moisture analyzer:

○ Contact your local Denver Instrument office, dealer or service center



Warning: Severe Burns!

– When setting up the moisture analyzer, leave enough space to prevent heat from building up and to keep your analyzer from overheating:

– leave 20 cm (about 8 inches) around the moisture analyzer
– leave 1 m (3 ft.) above the device

– Do not put any flammable substances on, under or near the moisture analyzer, because the area around the heating unit will heat up

– Be careful when removing the sample from the chamber: the sample itself, the heating unit and the sample pan used can still be extremely hot

– Prevent excessive heat build-up around the analyzer

Hazards for persons or equipment posed by using specific samples:



Fire



Explosion

– Flammable or explosive substances

– Substances that contain solvents

– Substances that release flammable or explosive gases or vapors during the drying process

In some cases, it is possible to operate the moisture analyzer in an enclosed nitrogen atmosphere to prevent the vapor released during drying from coming in contact with oxygen in the surrounding atmosphere. Check on a case-to-case basis whether this method can be used, because installation of the analyzer in too small an enclosed space can affect its functions (for instance, through excessive heat build-up within the analyzer). When in doubt, perform a risk analysis.

The user shall be liable and responsible for any damage that arises in connection with this moisture analyzer.



Poisoning



Caustic burns

– Substances containing toxic or caustic or corrosive components may only be dried under a fume hood. The value for the "lower toxic limit" in a work area must not be exceeded.

Corrosion:

– For substances that release aggressive vapors during the heating process (such as acids), we recommend that you work with small sample quantities. Otherwise, vapors can condense on cold housing parts and cause corrosion.

The user shall be liable and responsible for any damage that arises in connection with this moisture analyzer.

Getting Started

The moisture analyzer consists of a heating unit, a weighing system, and a display and control unit. In addition to the socket for AC power (mains supply), it also has an interface port for connecting peripheral devices, such as a PC, an external printer, etc.

Storage and Shipping Conditions

Allowable storage temperature:
0 ...+40°C (+32°F...+104°F)

Do not expose the moisture analyzer unnecessarily to extreme temperatures, moisture, shocks, blows or vibration.

Unpacking the Moisture Analyzer

- After unpacking the moisture analyzer, check it immediately for any visible damage as a result of rough handling during shipment
- If any sign of damage is visible, proceed as directed in the chapter entitled "Care and Maintenance," under the section on "Safety Inspection"

It is a good idea to save the box and all parts of the packaging until you have successfully installed your moisture analyzer. Only the original packaging provides the best protection for shipment. Before packing your moisture analyzer, unplug all connected cables to prevent damage.

Equipment Supplied

The equipment supplied includes the components listed below:

- Moisture analyzer
- Power cord
- Pan support
- Pan draft shield
- Dust cover for keypad
- 80 disposable aluminum sample pans
- 1 pair of forceps

Installation Instructions

The moisture analyzer is designed to provide reliable results under normal ambient conditions in the laboratory and in industry. When choosing a location to set up your moisture analyzer, observe the following so that you will be able to work with added speed and accuracy:

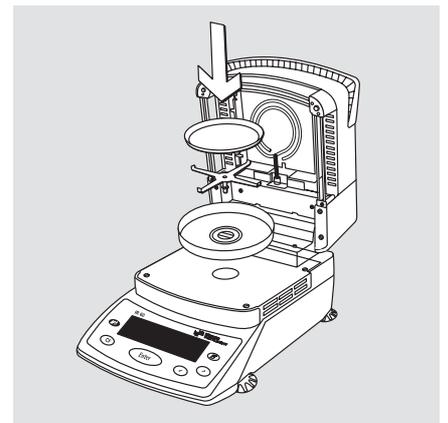
- Set up the moisture analyzer on a stable, even surface that is not exposed to vibrations, and level it using the four leveling feet
- Avoid placing the analyzer in close proximity to a heater or otherwise exposing it to heat or direct sunlight
- Avoid exposing the moisture analyzer to extreme temperature fluctuations
- Protect the moisture analyzer from drafts that come from open windows or doors
- Keep the moisture analyzer protected from dust, whenever possible
- Protect the moisture analyzer from aggressive chemical vapors
- Do not expose the analyzer to extreme moisture
- Make sure to choose a place where excessive heat cannot build up. Leave enough space between the moisture analyzer and materials that are affected by heat.

Conditioning the Moisture Analyzer

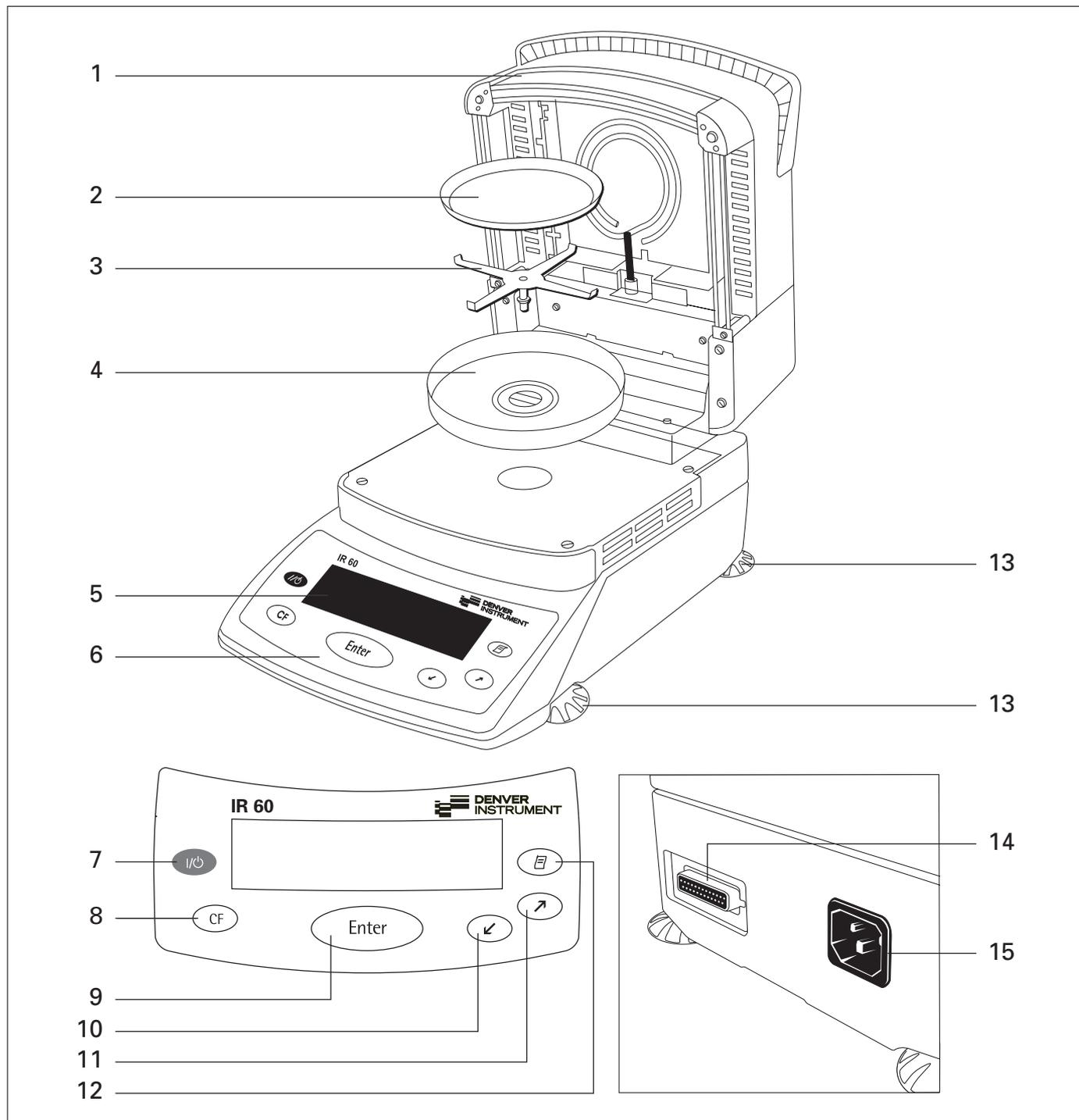
Moisture in the air can condense on the surfaces of a cold moisture analyzer whenever it is brought into a substantially warmer place. If you transfer the moisture analyzer to a warmer area, make sure to condition it for about 2 hours at room temperature, leaving it unplugged from AC power. Afterwards, if you keep the moisture analyzer connected to AC power, the continuous positive difference in temperature between the inside of the moisture analyzer and the outside will practically rule out the effects of moisture condensation.

Setting up the Moisture Analyzer

- Position the components listed below in the order given:
 - Dust cover over the keypad
 - Pan draft shield
 - Pan support; turn to the left or right, press slightly until it stops and snaps into place
 - Disposable sample pan



General View of the Moisture Analyzer



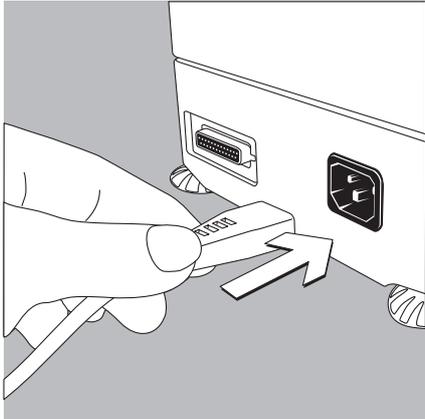
No. Designation

- 1 Hinged cover with heating element
- 2 Disposable sample pan
- 3 Pan support
- 4 Pan draft shield
- 5 Display
- 6 Keypad
- 7 On/off key
- 8 CF key (clear function)
- 9 'Enter' key (confirm)

No. Designation

- 10 'Down/Back' key
- 11 'Up/Forward' key
- 12 Print key
- 13 Leveling foot
- 14 Interface port
- 15 Power socket

Connecting the Moisture Analyzer to AC Power



- The heating unit of the moisture analyzer has been factory-set to 230 V or 115 volts for technical reasons. The voltage has been set as specified on your order. The voltage setting is indicated on the manufacturer's label (see the bottom of the analyzer), for example: – 230 volts: IR...-...**230**..
– 115 volts: IR...-...**115**..
- Check the voltage rating and the plug design
- ⚠ If they do not match your requirements:
Do not operate your moisture analyzer; contact your local Denver Instrument office or dealer.
- Use only
 - Original power cords
 - Power cords approved by a certified electrician/Denver Instrument service technician
 - If you need to connect an extension cord:
Use only a cable with a protective grounding conductor
- Connecting the moisture analyzer, rated to Class 1, to AC power (mains supply): The moisture analyzer must be plugged into a properly installed wall outlet which has a protective grounding conductor (PE)

Note:

This equipment has been tested and found to comply with the limits pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. For information on the specific limits and class of the equipment, please refer to the Declaration of Conformity. Depending on the particular class, you are either required or requested to correct the interference.

If you have a Class A digital device, you need to comply with the FCC statement as follows: "Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at this own expense."

If you have a Class B digital device, please read and follow the FCC information given below:

"However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help."

Before you operate this equipment, check which FCC class (Class A or Class B) it has according to the Declaration of Conformity included. Be sure to observe the information of this Declaration.

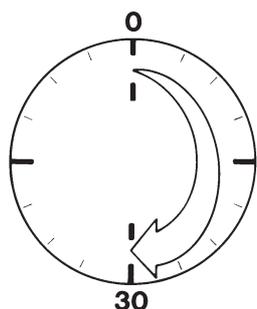
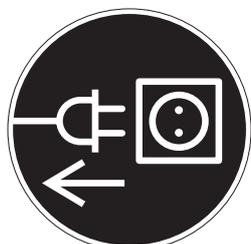
Safety Precautions

If you use an electrical outlet that does not have a protective grounding conductor, make sure to have an equivalent protective conductor installed by a certified electrician as specified in the applicable regulations for installation in your country.

The protective effect must not be negated by using an extension cord without a protective grounding conductor.

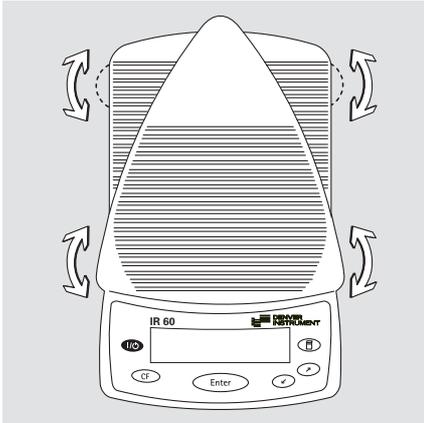
Connecting Electronic Devices (Peripherals)

- Make absolutely sure to unplug the moisture analyzer from AC power before you connect or disconnect a peripheral device (printer or PC) to or from the interface port.



Warmup Time

To deliver exact results, the moisture analyzer must warm up for at least 30 minutes after initial connection to AC power or after a relatively long power outage. Only after this time will the moisture analyzer have reached the required operating temperature.



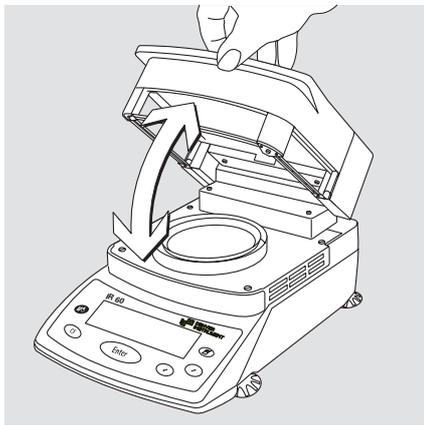
Leveling the Moisture Analyzer

Purpose:

- To compensate for unevenness at the place of installation
- This is necessary especially for testing liquid samples that need to be at a uniform level in the disposable sample pan

Always level the moisture analyzer again any time after it has been moved to a different location.

- Extend or retract the front and/or rear leveling feet as needed to adjust the moisture analyzer



Turning On the Analyzer; Opening and Closing the Sample Chamber

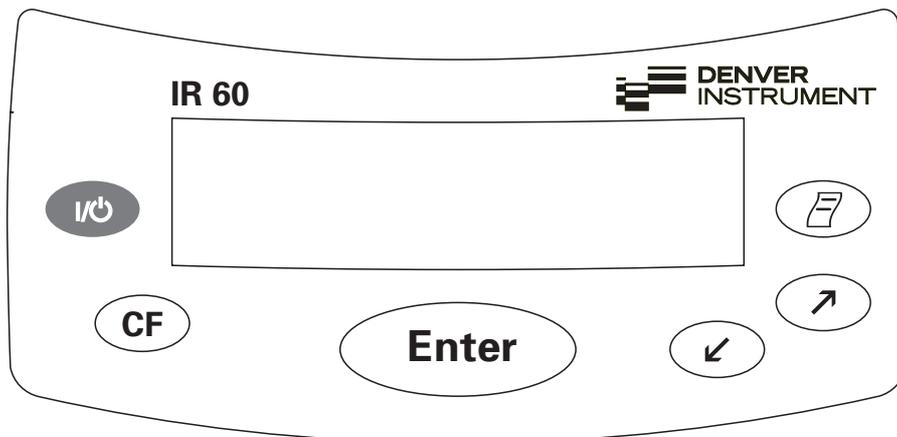
- To turn on the analyzer: Press the  key
- When opening or closing the sample chamber: Do not release the cover until it is in the fully open or fully closed position

Setting the Language

- See "Setting the Language" in the chapter entitled "Configuring the Moisture Analyzer"

Operating Design

Operation of the moisture analyzer follows a standardized "philosophy" which is described below.



Keys

The keys have following functions:

-  **On/off key**
Turns the moisture analyzer on/off. The moisture analyzer remains in standby mode
-  **Clear Function**
Cancels application functions, interrupts calibration/adjustment routines
When the operating menu is active: Closes active submenu and returns to next higher menu level
-  **Enter**
During moisture analysis: Activates the selected function (e.g., tare, start, cancel)
When the operating menu is active: Confirms the setting or input displayed

-  **Down/Back**
When the operating menu is active: Shows the next menu item on the current menu level
When entering alphanumeric characters: Moves the cursor back to the previous character (see the next column for character sequence)
-  **Up/Forward**
When the operating menu is active: Shows the previous menu item on the current menu level
When entering alphanumeric characters: Moves the cursor forward to the next character (see the next column for character sequence)
-  **Print**
Outputs the displayed data or the active data record via the interface port to the external printer

Entering Letters, Special Characters and Numbers:

When the character at the cursor position is blinking, you can use the  and  keys to change the character. The cursor "moves" through the available characters in the following sequence:

```

0 1 2 3 4 5 6 7 8 9 . - + / * =
< > ( ) : ? ! $ & % # @ Z Y X W
U T S R Q P O N M L K J I H G
F E D C B A _ (space)
    
```

To enter a character: Position the cursor as desired and press the  key

To confirm a character string:
After entering the last character, press and hold the  key for at least two seconds

To delete a character: Enter a "space"

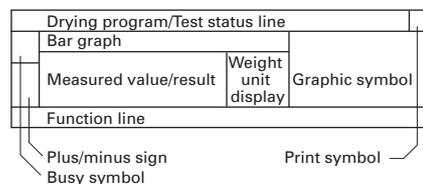
Operation

There are two fundamentally different types of display:

- display for analysis and test functions
- display for menu parameter settings (e.g., Setup or Program menu)

Analysis and Test Functions

This display is divided into nine sections.



Example: Moisture Analysis:

Drying Program Info/Status Line:

This line shows the following information:

- Selected drying program (e.g., P1)
- Configured drying temperature (e.g., 105°C)
- Criterion for end-point recognition (e.g., Autom.)
- Current temperature
- Elapsed drying time

Busy Symbol:

The  symbol is shown here when the moisture analyzer is processing a function activated by pressing a key.

Plus/Minus Sign:

A plus or minus sign (+ or -) is shown here for the weight value or a calculated value (such as a percentage).

Bar Graph:

The bar graph is shown during moisture analysis if the "Initial Weight" option in the drying program is set to On.

The following symbols may be displayed here:

 Bar graph showing interval markers

- Target value -20%

= Target value

+ Target value +20%

Measured Value:

This section shows the weight or calculated value.

Unit:

When the weighing system reaches stability, the weight unit or calculation unit is displayed here.

Graphic Symbols:

The symbols shown here indicate the current operating status of the moisture analyzer. Example:



Drying in progress

Print Symbol:

During the printout of the analysis results and other data, the following symbol is shown here:

 Printing

Function Line:

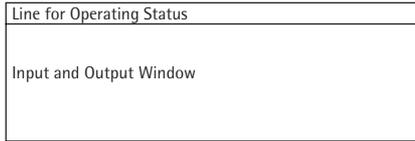
This line indicates the functions that can be activated by pressing "Enter" (e.g., Setup menu, Program menu, "Tare", "Start", or "Cal" (calibration)).



If an error occurs, the resulting error code or message overwrites this line.

Menu Operation

This display is divided into two sections.



Line for Operating Status:

The operating status line indicates the function of the current screen page. In the Setup menu, the current menu path is shown here.

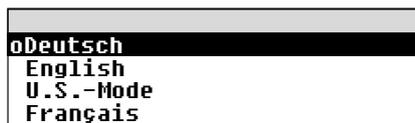
Example for Setup, Language:



Input and Output Window:

This window contains either detailed information (e.g., on the drying program) or a select list. A selected item is displayed inversely (white letters on a black background). You can also enter letters, numbers, and special characters in this window when an input field is active.

Example for Setup, Language:



The following symbol can also appear the input/output window:

- o indicates the currently active menu setting

Parameter Settings

The IR has an operating menu for finding and setting parameters. Each menu has several levels.

Example: Working with the Setup Menu

First of all, you need to find the menu item for the parameter you wish to configure:

- Press the  and  keys until **SETUP** is highlighted, then press  to confirm
- Use the  and  keys to move back and forth between menu items on a given level
- To select an item or open a sub-menu: Press the  key

Parameter Settings:

- Press the  and  keys, repeatedly if needed, until the desired parameter is highlighted (inverse display)
- To select the parameter: Press 

Now you can configure the desired setting.

To select a parameter setting:

- Press the  and  keys, repeatedly if needed, until the desired setting is highlighted (inverse display)

To enter alphanumeric characters:

- Press the  and  keys, repeatedly if needed, until the desired character is displayed (see page 9 for details on alphanumeric input)
- Confirm the setting: Press the  key

To go back to the previous (higher) menu level:

- Press the  key

Exit the Setup menu: Press the  key

Data Output

The IR is equipped with an interface port for connecting either

- a printer, or
- a computer

Printer

The data format for output to an external printer is pre-configured for generating ISO/GLP-compliant printouts.

ISO: International Organization for Standardization

GLP: Good Laboratory Practice

See “Data Output Functions” in the chapter entitled “Operating the Moisture Analyzer” for a detailed description of data output options.

Interface Port

You may choose to connect a computer rather than a printer to the interface port.

See “Data Output Functions” in the chapter entitled “Operating the Moisture Analyzer” for a detailed description of data output options.

Error Codes

If you press a key that has no function, or which is blocked at a certain point in an application program, the error is indicated as follows:

- a double-beep is sounded as an acoustic signal if the key has no function
- an error message indicates invalid input
- an error code or error message indicates incorrect operation

The mode of response to operator errors is identical for all operating modes. See the chapter entitled "Error Codes" for detailed explanations of the error codes and messages.

Saving Data

Storing Parameter Settings

The most recent configurations of Setup menu parameters and drying programs are active when you switch on the moisture analyzer. You also have the option of restoring the factory settings at any time (see below).

Protecting Parameter Settings

You can assign passwords to block access to:

- user-defined drying programs
- the device parameter menu
- isoTEST functions

If no password has been assigned, anyone can access and change the Setup > Device menu and the user-defined drying programs without entering a password.

If you assign a password and then forget what the word is, you can use the General Password (see Appendix) to access these menus.

Configuring the Moisture Analyzer

Purpose

You can configure your moisture analyzer to meet individual requirements by entering user data and setting selected menu parameters in the Setup menu.

The Setup menu is divided into the following sections:

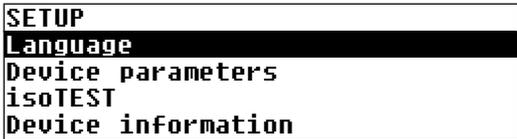
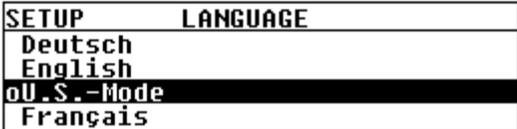
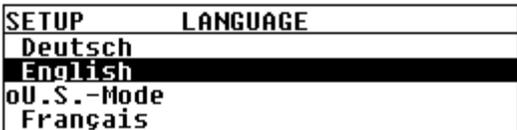
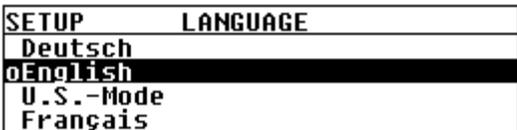
- Language
- Device parameters
- isoTEST
- Device information

Setting the Language

You can choose from 5 languages for the display:

- German
- English
- U.S. Mode:
English with U.S. date/time format (factory setting)
- French
- Italian
- Spanish

Example: Selecting the language: "English"

| Step | Key (or Instruction) | Display/Printout |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1. Select SETUP in the Function line |  or  and confirm |  |
| 2. Confirm Language menu item |  |  |
| 3. Select "English" |  |  |
| 4. Confirm |  |  |
| 5. Exit Setup |   |  |

Setting the Device Parameters (DEVICE)

Purpose

Device configuration, i.e., to meet individual requirements by selecting predefined menu parameters in the Setup menu. You can block access to the menu by assigning a password.

Features

The device parameters are combined in the following groups:

- Password to the Setup menu
- Interface
- Display contrast
- Acoustic signal
- Factory settings

You can display, enter or change the following parameters:

Password

- Password for access to the device parameters and isoTEST functions in the Setup menu, and to drying programs in the Program menu

Interface

- SBI operating mode
Simple record of analysis results for PC or external printer, factory setting for the Denver Instrument printer Format: baud rate, number of data bits, parity, stop bits, handshake
- xBPI operating mode
Function-oriented interface with transparent data transmission
Network address: enter a number from 0 to 31; factory setting: 0

Display contrast

- Contrast/angle of the display (enter a number from 0 to 4; factory setting: 2)

Acoustic signal

- Acoustic signal on or off

Factory Settings

Parameters: The factory-set configurations are identified by an "o" in the list starting on page 17.

Preparation

Display existing device parameters

- Select the Setup menu:
Use the  or  key to select **SETUP** in the Function line and press  to confirm

> SETUP is displayed:

| |
|--------------------|
| SETUP |
| Language |
| Device parameters |
| isoTEST |
| Device information |

- Select Device parameters:
Press the  key and press  to confirm

If no password has been assigned, anyone can access "SETUP: Device parameters" without entering a password

If a password has been assigned:

> The password prompt is displayed

| | |
|-----------------|-------------------------------------------------------------------------------------|
| SETUP | PASSW.CHECK |
| Enter password: |  |

- If the Setup menu is protected by a password: Use the  and  keys to enter the password (see page 9 for details) and press  to confirm
- Confirm the password and display "Device parameters":
Press the  key

> Device parameters are displayed:

| | |
|------------------|--------|
| SETUP | DEVICE |
| Password | |
| Interface | |
| Display contrast | |
| Acoustic signal | |

Entering or Changing the Password

- The password (up to 8 characters) protects the following functions:
 - Setup: Device parameters
 - Program: Drying programs
 - Setup: isoTEST functions

- Display Device parameters (see "Preparation > Display existing device parameters" above)
- Write down the password here for easy reference:

Password =

If you assign a password and then forget what it is:

- Enter the General Password (see Appendix)
- Confirm the password and display device parameters:
Press the  key

> Parameters are displayed (see above)

- Configuring device parameters: Select "Password" (if configured) and confirm: Press the  key

> Password: and any existing password are displayed:

| | | |
|-----------|--------|----------|
| SETUP | DEVICE | PASSWORD |
| Password: | | 12345678 |

- New password: Use the  and  keys to enter the new password (up to 8 characters) and press  to confirm
If no entry is shown under "Password", then no password has been stored
- To confirm your input:
Press the  key
- Exit the Setup menu:
Press the  key twice

Additional Functions

Print out parameter settings:

- If "Device parameters" are displayed: Press the **⏏** key
- > Printout (example)
Lines with more than 20 characters are truncated

```
-----  
SETUP  
      DEVICE  
-----  
Interface  
SBI  
  Baudrate      1200 baud  
Number of data bi  
      7 data bits  
Parity  
                      Odd  
Number of stop bi  
      1 stop bit  
Handshake mode  
Hardware handshake a  
      fter 1 char  
Display contrast      2  
Acoustic signal      0n  
-----
```

Reset the device parameters to the factory settings:

- Select the Setup menu:
Use the **⏏** or **⏏** key to select **SETUP** in the Function line and press **⏏** to confirm
- > SETUP is displayed:

| |
|--------------------|
| SETUP |
| Language |
| Device parameters |
| isoTEST |
| Device information |

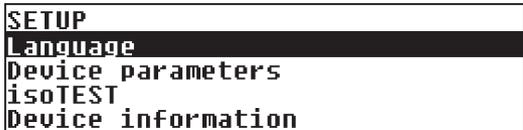
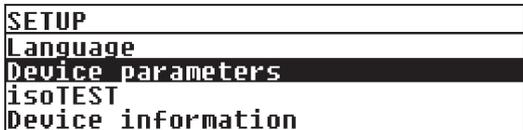
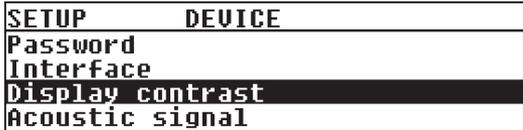
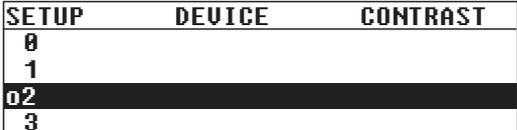
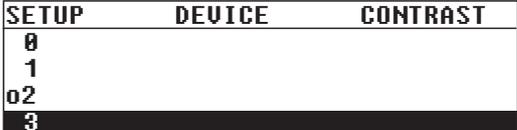
- Select Device parameters:
Press the **⏏** key and press **⏏** to confirm
- If a password has been assigned:
enter the password as described above
- Confirm the password and display "Device parameters":
Press the **⏏** key
- > Device parameters are displayed
- Select **Factory settings**:
Press the **⏏** key 4 times

| | |
|------------------|--------|
| SETUP | DEVICE |
| Interface | |
| Display contrast | |
| Acoustic signal | |
| Factory settings | |

- Confirm **Factory settings**:
Press the **⏏** key
- To cancel the "Reset" operation at this point: Press the **CF** key
- Select **Yes** and confirm.
Press the **⏏** key and then press the **⏏** key
- Exit the Setup menu:
Press the **CF** key three times

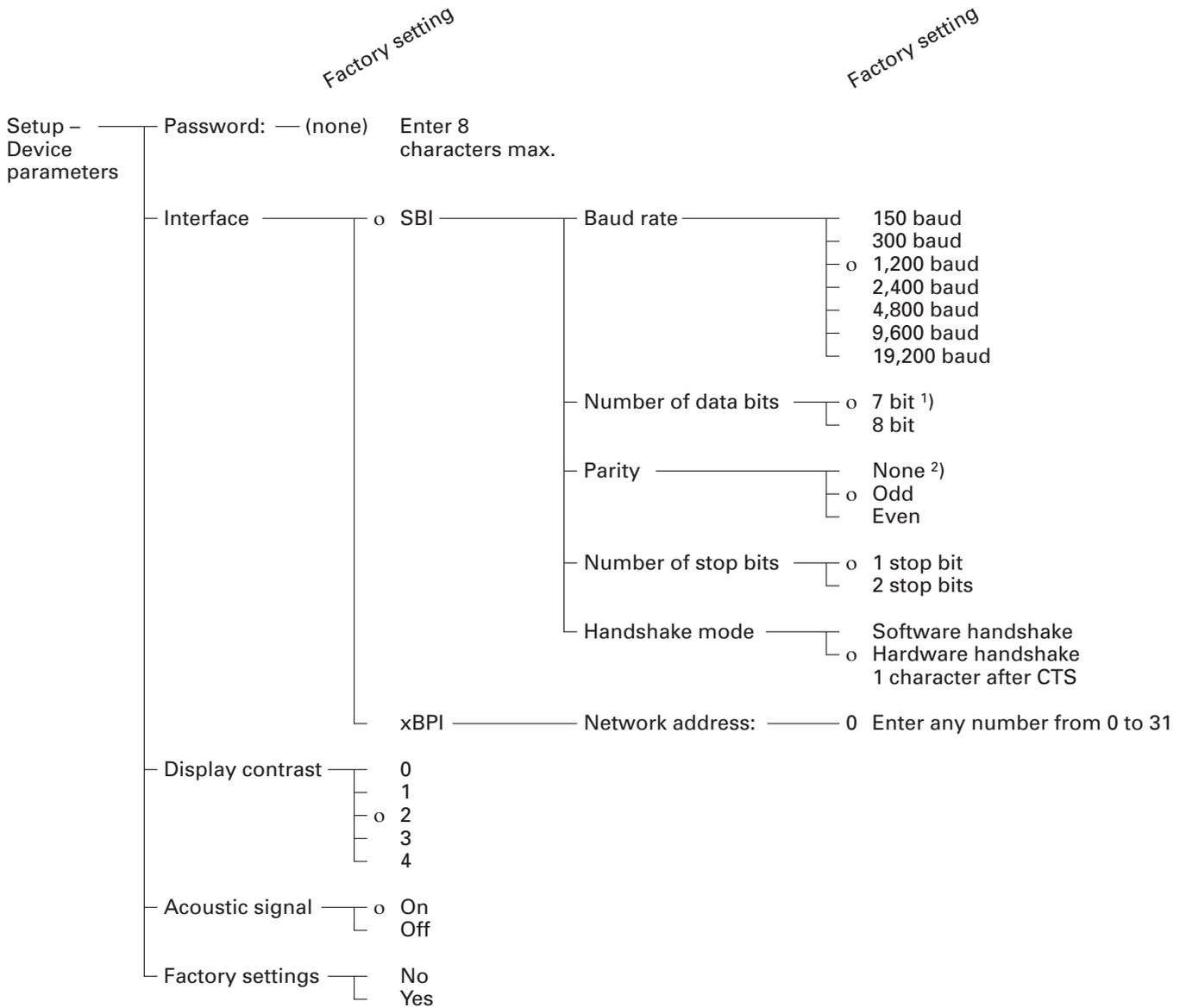
Example:

Set the display contrast to "3"

| Step | Key (or Instruction) | Display/Printout |
|-----------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------|
| 1. Select SETUP in the Function line | ↗ or ✓ |  |
| 2. Confirm SETUP | Enter |  |
| 3. Select Device parameters | ✓ |  |
| 4. Confirm Device parameters | Enter |  |
| 5. Select Display contrast | 2 × ✓ |  |
| 6. Confirm Display contrast | Enter |  |
| 7. Select setting 3 | ↗ or ✓ (repeatedly, if necessary) |  |
| 8. Store setting | Enter |  |
| 9. Exit the Setup "Device parameters" menu | CF three times |  |

Device Parameters (Overview)

- o Factory setting
- √ User-defined setting



¹⁾ not if parity is set to "None"
²⁾ only with 8 (not 7) data bits

Device Information

Purpose

Display of device information

Display Device Information

- Select the Setup menu:

Use the  or  key to select **SETUP** in the Function line and press  to confirm

> SETUP is displayed:

| |
|--------------------|
| SETUP |
| Language |
| Device parameters |
| isoTEST |
| Device information |

- Select **Device information**:

Press the  key three times and press  to confirm

> Device information is displayed

| SETUP | INFO |
|--------------|----------|
| Version no.: | 01-43-10 |
| W.sys.ver.#: | 00-25-03 |
| Model: | IR60 |
| Serial no.: | 90706913 |

- Exit the Setup menu:

Press the  key twice

- Print device information:

Press the  key

> Printout (Example)

```
-----  
13.06.2004      13:02  
Model   IR60-000230V  
Ser. no.   13206969  
Ver. no.   01-43-10  
(Operating program version)  
ID
```

```
-----  
SETUP  
      INFO  
-----  
Version no. :  
              01-43-10  
(Operating program version)  
W.sys.ver.# :  
              00-25-03  
(Wgh.sys.program version)  
Model :  
          IR60-000230V  
Serial no. :  
              13206969  
-----
```

- Return to Setup menu:

Press the  key

- Exit the Setup menu:

Press the  key twice

> Previous status is restored

Basics of Moisture Analysis

Purpose

The IR moisture analyzer can be used for quick and reliable determination of the moisture content of materials of liquid, pasty and solid substances using the thermogravimetric method.

Material

The moisture of a material is often mistakenly equated with its water content. In fact, the moisture of a material includes of all the volatile components which are given off when the sample is heated, no matter the kind of material. Among such volatile substances are:

- water
- fats
- oils
- alcohols
- organic solvents
- flavorings
- products of decomposition (when a sample is overheated)

There are many methods for determining the moisture content of a substance. Basically, these methods can be divided into two categories: absolute and deductive methods.

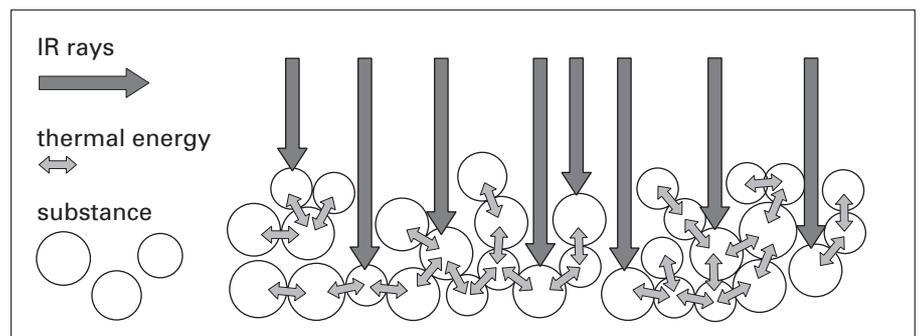
When absolute methods are used, the moisture content is directly determined (for example, as a weight loss registered during the drying routine). These methods include oven drying, infrared drying, and microwave drying. All three of these methods are thermogravimetric.

When deductive methods are used, the moisture content is indirectly determined. A physical property related to the moisture in the substance is measured (e.g., absorption of electromagnetic rays). These methods include Karl-Fischer titration, infrared spectroscopy, microwave spectroscopy, etc.

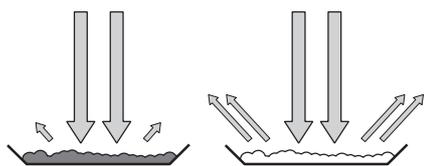
Thermogravimetry is the process of determining the loss of mass that occurs when a substance is heated. In this process, the sample is weighed before and after being heated, and the difference between the two weights determined is calculated.

In a conventional drying oven, circulating hot air warms the sample from the outside toward the inside. Efficiency is lost during drying because as the moisture evaporates, it cools the sample surface.

By contrast, infrared rays (IR rays) penetrate a sample without being impeded. Having reached the interior of a sample, they are converted into heat energy, which stimulates evaporation, thus drying the sample.



A small part of the IR rays is reflected from the surface of the substance. The quantity of reflected IR rays depends to a great extent on whether the substance is light or dark-colored.

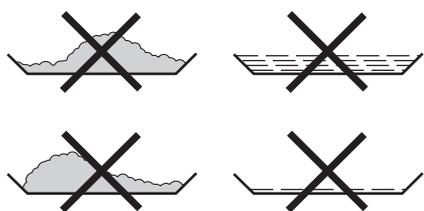


Dark Substance
Low Reflection

Light Substance
High Reflection

How the rays penetrate the sample depends on the sample's light-transmitting capacity. If the light-transmitting capacity is low, the rays can penetrate only the uppermost layers of the sample. The heat conductivity of the sample dictates the degree to which the heat can be transmitted to the underlying layers. The higher the conductivity, the faster and more uniformly the substance is heated.

The substance should be applied to the sample pan in a thin, even layer. A height of approximately 2 – 5 mm for 5 – 15 g substance weight has proved to be ideal. Otherwise, the sample will not be dried completely or the analysis time will be unnecessarily extended, a crust/skin will form on the surface of the sample or the sample will scorch, and the analysis results obtained will not be reproducible, and therefore cannot be used.



Incorrect Application of a Sample

When preparing a substance for analysis, you should use methods that do not generate heat so that the sample does not lose moisture before it is analyzed.

Perform initial analysis of a new substance to test how the IR rays are absorbed by the sample and converted into heat. A printout of the intermediate values of the drying process (see page 25) provides you with this information at an early stage.

Experience has shown that the temperature setting selected for infrared drying is usually lower than the temperature setting used when working with a drying oven.

In many cases, the fully automatic shutoff mode will meet your requirements. If the final result is higher or lower than expected, try varying the temperature setting before resorting to a different shutoff parameter.

When analyzing samples that lose their moisture only very slowly or when operating a cold moisture analyzer, the fully automatic mode may end the drying routine too early, if it does not detect any analyzable progress in the drying routine under these conditions. In this case, preheat the moisture analyzer for 2–3 minutes before starting the drying routine, or select a different shutoff parameter.

Preparation

Before drying a sample, you must carry out the following preparations:

- Adjustment to the available measuring system (if required)
- Sample preparation
- Setting the drying program parameters

Adjustment to an Existing Measuring System

A moisture analysis method often replaces another drying method (e.g., oven drying method), because it is simple to use and requires shorter analysis time. In this case, you should adapt this method to that of the moisture analyzer in order to obtain values comparable to those yielded by your standard reference method.

- Perform parallel measurements: take a fresh sample and divide it in half
- Determine the moisture content of the first half using your standard method of analysis
- Analyze the second half of the sample in the moisture analyzer. Use the following settings:
 - fully automatic mode for the shutoff parameter
 - lower temperature settings than for the oven drying method
 - temperature setting for organic substances: 80–100°C
 - temperature setting for inorganic substances: 140–160°C
- If the result of the second analysis does not correspond to that of the first:
 - first, repeat the analysis using a different temperature setting
 - then use the semi-automatic mode for the shutoff parameter (for example, with a different loss rate per 24 s)
- Vary the shutoff parameter, if required:
 - Increase end-point recognition: set the parameter to 2 mg / 24 s or 1 mg / 24 s
 - Decrease end-point recognition: set the parameter to 10 mg / 24 s or 20 mg / 24 s

Preparing a Sample

Selecting a Sample

- Select a representative part of the whole substance as a sample
 - a representative number of individual samples for quality control
 - samples which indicate a trend are sufficient for in-process control
- Homogenize the product before a sample is taken, if required, by:
 - mixing or stirring,
 - taking several samples from different areas of the product, or
 - taking several samples at defined intervals
- Take only one sample at a time for a given analysis and prepare it as quickly as possible. In this way, it will not lose or gain moisture as a result of the ambient conditions.
- If you need to analyze several samples at a time, the samples must be sealed in air-tight containers, in order to ensure that the storage conditions do not alter the state or condition of the samples:
 - Warm or highly volatile substances lose their moisture very quickly.
 - If you store the samples in a container, the moisture can condense on the walls of the container.
 - If the container is too big and not filled completely, the sample can exchange its moisture with the air remaining in the container.
- Mix the condensed moisture back in with a sample, if necessary.

Preparing a Sample

- When crushing a sample, avoid any contact with heat: heat results in moisture loss.
- Crush a sample with
 - a pestle
 - a shredder (see below)

For liquids containing solids, use

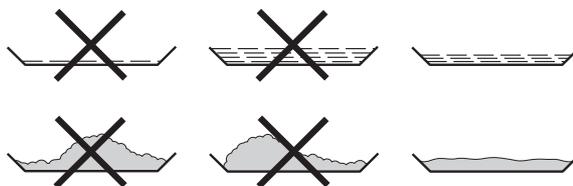
- a glass stirrer,
 - a spoon, or
 - a magnetic stirrer.
- Use an appropriately designed tool for shredding a sample.

Using Disposable Sample Pans

- Use only Denver Instrument disposable sample pans (inner diameter = 92 mm). Reusing sample pans leads to poor reproducibility of results for several reasons:
 - after cleaning, sample residues can still remain on the pan
 - residues from cleaning agents can evaporate during the next moisture analysis
 - if scratches and grooves are inflicted during cleaning, the hot, rising air produced during the drying process acts on these surfaces, resulting in a more pronounced buoyancy

Applying a Sample to the Sample Pan

- Apply the sample to the sample pan in a thin, even layer (height: 2 to 5 mm, weight: 5 to 15 g); otherwise:
 - a sample applied unevenly will result in a non-uniform distribution of heat
 - a sample will not be dried completely
 - the analysis time will be unnecessarily extended
 - the sample burns or a crust/skin forms on its surface as a result of a very thick layer
 - the crust makes it difficult or impossible for moisture to escape from the sample during the drying process
 - uncertain and unknown quantity of moisture remains in the sample



- Apply liquid samples, pasty samples or samples that can melt to a glass fiber filter; you will obtain the following advantages:
 - uniform distribution due to the capillary effect
 - liquids prevented from beading together and forming drops
 - with larger surfaces, the moisture can evaporate faster
 - considerably more convenient than the “sea-sand method”

When drying samples containing sugar, a crust or skin can form and seal the surface.

A glass fiber filter is especially helpful in such cases. The moisture can evaporate downwards through the surface of the filter. You can prevent or limit the crust/ skin formation if you place the glass fiber filter on top of the sample.

- Cover solid, heat-sensitive samples with a glass fiber filter; you will obtain the following advantages:
 - gentle heating, because of the sample surface is shielded from excessive heat
 - higher temperature setting can be selected
 - uniformity of the sample surface
 - fast evaporation of the moisture
 - excellent reproducibility for samples containing fat

Avoiding the Formation of Crust/Skin

You can add “solvents” to the sample to prevent the formation of crust/skin during the analysis runs. The weight of a solvent you apply to the sample will not influence the final result of an analysis.

- Once you have closed the sample chamber, open it again within 2 seconds after you hear a beep tone.
- Apply a solvent to the sample
- Close the sample chamber and start the analysis run as usual

Operating the Moisture Analyzer

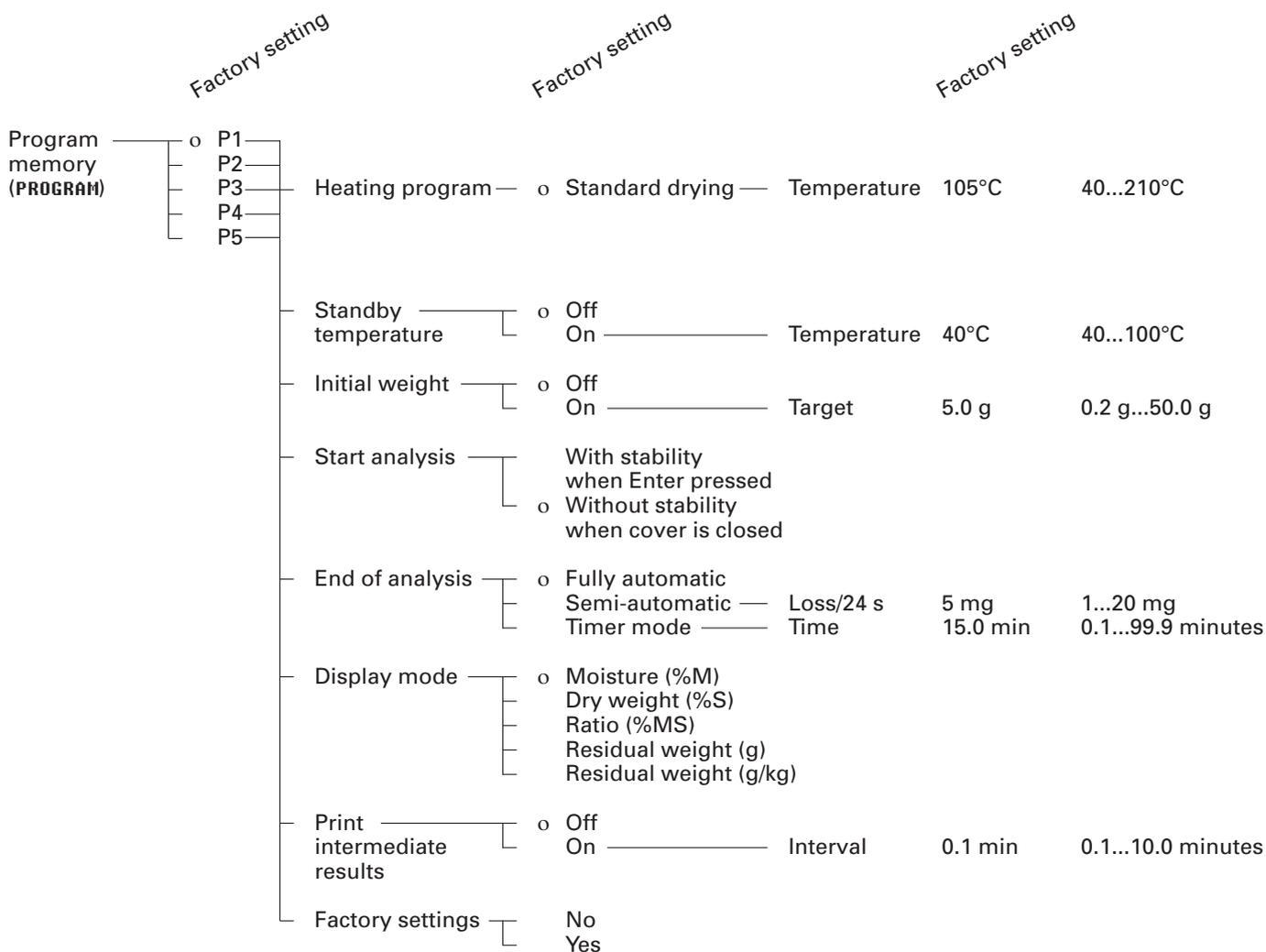
Setting the Drying Parameters

Purpose

Adapt the moisture analyzer to the special requirements of products. Parameters can be configured individually for each program.

Drying Parameters (Overview)

- Factory setting
- √ User-defined setting



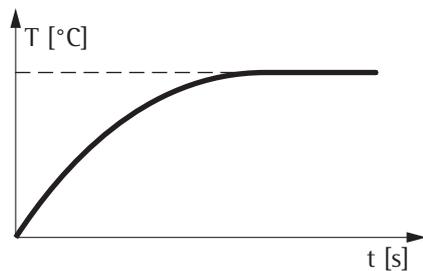
Features

Number of Drying Programs:
5 programs

Programs are listed according to program number.

Heating Programs

Standard drying:
With the standard program, you need to enter the final temperature.



Standby Temperature

- Temperature set to defined value when the sample chamber is closed

Initial Weight

You can select a weight to be used as a guide for applying a sample to the analyzer. This value is stored as a target weight and is not used as a start condition for the drying program. Tolerance limits of $\pm 20\%$ are displayed.

Start of Analysis

- With stability after the **Enter** key is pressed:

When **START** is shown in the Function line and you press **Enter** to confirm, the initial weight is stored at stability regardless of whether the cover is open or closed.

- Without stability after the cover is closed:
A symbol shown in the graphic symbol display prompts you to close the cover once the initial weight condition is met.

The initial weight is stored without stability as soon as the sample chamber is closed.

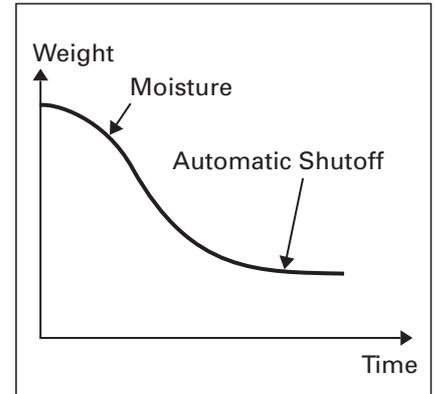
The analysis starts as soon as you close the cover and a 2-second delay has elapsed.

End of Analysis with Shutoff Parameters

- fully automatic mode
- semi-automatic (absolute)
- timer-mode

Fully Automatic Mode:

The analysis ends as soon as the weight loss per 24 s is below an automatically detected threshold.



Semi-automatic, absolute:

The analysis ends as soon as the weight loss per 24 s is lower than a user-defined threshold (set in milligrams).

Timer Mode:

The analysis ends as soon as the specified time has elapsed.

Display Mode

The following units can be selected for displaying analysis results:

- Moisture %M
- Dry weight %S
- Ratio %MS
- Residual weight g
- Residual weight g/kg

Print Intermediate Results

Intermediate results can be printed either at user-definable time intervals or by pressing the **Print** key.

Factory Settings

The drying programs can be reset to the factory settings.

Printout of the Analysis Parameters

- When the desired program is displayed: Press the  key
- > Parameters are printed (see example on the right)
Lines with more than 20 characters are truncated.

Additional Functions

The following functions are available in the program memory:

- Display programs
- Change program settings
- Save changes

```
-----  
13.06.2004      13:06  
Model   IR60-000230V  
Ser. no.   13206969  
Ver. no.   01-43-10  
ID  
-----  
PROGRAM  
          P1  
-----  
          Heating program  
          Standard drying  
          Temperature:  
              105 °C  
          Standby temperatur  
              Off  
          Bar graph for weig  
          Activated  
          Target wght:  
              5.0 g  
          Start analysis  
Without stability, a  
              fter close  
          End of analysis  
              Automatic  
          Display mode  
Moisture      (%M)  
          Print intermediate  
              Off  
-----
```

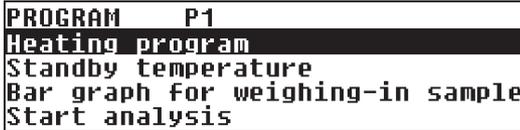
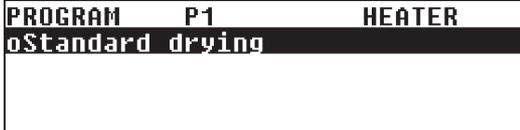
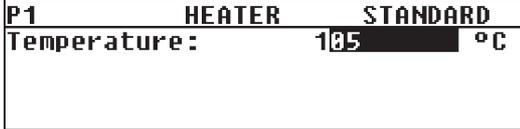
Example: Standard Drying with Fully Automatic Shutoff Mode

The moisture content of 2 g of corn starch is to be analyzed. The sample can scorch if overheated, but it is not particularly heat sensitive. The analysis is to be ended automatically as soon as a constant weight is reached.

Settings (changes in the factory settings required for this example):

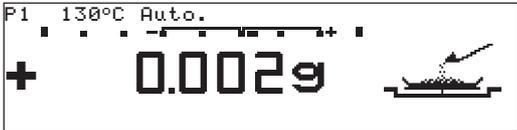
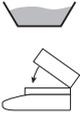
- Program number: 1
- Final temperature: 130°C
- Start of analysis: With stability after “Enter” key is pressed
- End of analysis: automatic (factory setting)

Part A: Configuring the Drying Parameters

| Step | Key (or Instruction) | Display/Printout |
|----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1. Turn on the moisture analyzer |  | Denver Instrument logo is displayed Self-test runs |
| 2. Select the PROGRAM function |  or  |  |
| 3. Confirm the PROGRAM function |  |  |
| 4. Select P1 program |  |  |
| 5. Select Heating program |  |  |
| 6. Select Standard drying |  |  |
| 7. Enter the temperature: 130 |  3 x   5 x   |  |

| Step | Key (or Instruction) | Display/Printout |
|--------------------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------|
| 8. Confirm the temperature | Enter | <pre>PROGRAM P1 HEATER Standard drying</pre> |
| 9. Select the Initial weight parameter | CF 2 x ↵ | <pre>PROGRAM P1 Heating program Standby temperature Bar graph for weighing-in sample Start analysis</pre> |
| 10. Confirm the Initial weight parameter | Enter | <pre>PROGRAM P1 BAR GRAPH Inactivated Activated</pre> |
| 11. Select the On setting and confirm | ↵ Enter | <pre>P2 BAR GRAPH ACTIVATED Target wt: 5.0 g</pre> |
| 12. Enter the target weight 2.0 | 3 x ↵ ↵ | <pre>P2 BAR GRAPH ACTIVATED Target wt: 2.0 g</pre> |
| 13. Confirm the target weight | Enter | <pre>PROGRAM P1 BAR GRAPH Inactivated Activated</pre> |
| 14. Select the Start of analysis parameter | CF ↵ | <pre>PROGRAM P1 Heating program Standby temperature Bar graph for weighing-in sample Start analysis</pre> |
| 15. Confirm the Start of analysis parameter | Enter | <pre>PROGRAM P2 START With stability, after ENTER key W/o stability, after closing</pre> |
| 16. Select the With stability, after ENTER key setting and confirm | ↵ Enter | <pre>PROGRAM P2 START With stability, after ENTER key W/o stability, after closing</pre> |
| 17. Exit the PROGRAM function | 3 x CF | |

Part B: Performing the Analysis

| Step | Key (or Instruction) | Display/Printout |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Turn on the moisture analyzer |  | Denver Instrument logo is displayed Self-test runs  |
| 2. Prepare the sample: not necessary for corn starch | | |
| 3. Open the sample chamber and position a new sample pan |  | |
| 4. Tare the sample pan: Select the TARE function and confirm |  or  as needed  |  |
| 5. Spread approx. 2 g of corn starch uniformly on the sample pan Close the sample chamber |  |  |
| 6. Start the drying program |  |  |
| After 2 seconds' delay the header for the moisture analysis is printed (see next page) | |  |

| Step | Key (or Instruction) | Display/Printout |
|------|----------------------|------------------|
|------|----------------------|------------------|

```

-----
13.06.2004      16:01
Model   IR60-000230V
Ser. no. 13206969
Ver. no. 01-43-10
ID
-----

```

The current moisture loss is displayed after the data is printed.

```

-----
Prg. 1
Heating      STANDARD
Fin. temp.   130 'C
Stdby temp.  OFF
Start        W/STABIL.
End          AUTOMATIC
IniWt +     2.036 g
-----

```

P1 130°C Auto. 37°C 0.8min
 + 0.05%M CANCEL

The drying program shuts off automatically once no further weight loss is detected (in this example, after 5.2 minutes)

P1 130°C Auto. 128°C 5.2min
 + 10.90%M END
 NEXT

Then the footer of the analysis record is printed

```

-----
FinWt +     1.814 g
  5.2+     10.90 %M
Name:
-----

```

“isoTEST” Calibration/Adjustment Functions

The following functions are available in the **SETUP** menu, under the **isoTEST** menu item:

- Weighing system:
 - Calibration/adjustment
 - Weighing only
- Hardware tests
 - Test interfaces
 - Heater test

When the sample pan and the pan support are removed from the sample chamber, you have access to the following functions:

- Heater adjustment
 - 2-point temperature adjustment
 - 1-point temperature adjustment

Heater Adjustment

Using 1-point and 2-point temperature adjustment and the temperature adjustment set (available as an accessory) you can calibrate and adjust temperature settings of the drying unit.

Weighing System Settings

Calibration, Adjustment Purpose

Calibration is the determination of the difference between the weight readout and the true weight (mass) of a sample. Calibration does not entail making any changes within the weighing system.

Adjustment is the correction of the difference between the measured value displayed and the true weight (mass) of a sample, or the reduction of the difference to an allowable level within maximum permissible error limits.

Features

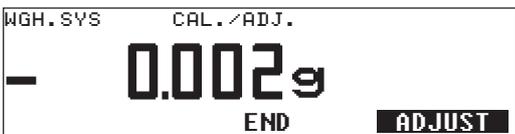
Calibration is performed externally with the following weight values: 50 g (accuracy class E2)

You can have calibration and adjustment results documented as a ISO/GLP-compliant printout; see the next page.

External Calibration/Adjustment with a Factory-Defined Weight

Externally calibrate and adjust the weighing system using a 50-g calibration weight

| Step | Key (or Instruction) | Display/Printout |
|---------------------------------------------|----------------------|------------------|
| 1. Select SETUP in the Function line | or | |
| 2. Confirm SETUP | | |
| 3. Select isoTEST | 2 x | |
| 4. Confirm isoTEST | | |
| 5. Confirm Weighing system settings | | |
| 6. Confirm Calibration/adjustment | | |
| 7. Unload and tare the weighing system | | |
| 8. Select the CAL. function | | |
| 9. Start calibration | | |

| Step | Key (or Instruction) | Display/Printout |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The weighing system is prepared for the calibration procedure When the system is ready, the display shows</p> | |  |
| <p>10. Place the weight on the weighing system (in this example, 50.000 g) Minus sign: weight too low Plus sign: weight too high No sign: weight ok</p> | <p>Apply 50-g calibration weight</p> |  |
| <p>At the end of calibration, the display shows</p> | |  |
| <p>11. If no adjustment is required, select END in the function line and confirm</p> | <p> </p> | <pre> ----- 13.06.2004 16:15 *) Model IR60-000230V Ser. no. 99992581 Ver. no. 01-43-10 ID ----- External calibration W-ID Nom. + 30.000 g Diff. - 0.002 g ----- 13.06.2004 16:16 *) Name: ----- </pre> |
| <p>12. If necessary, adjust the weighing system</p> | <p></p> |  |
| <p>At the end of adjustment, the display shows</p> | |  |

and a report is printed (see next page)

| Step | Key (or Instruction) | Display/Printout |
|-------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Printout following adjustment: | | <pre> ----- 13.06.2004 16:15 *) Model IR60-000230V Ser. no. 13206969 Ver. no. 01-43-10 ID ----- External calibration W-ID Nom. + 50.000 g Diff. - 0.002 g External adjustment completed Diff. 0.000 g ----- 13.06.2004 16:16 *) Name: ----- </pre> |
| *) Date and time shown only when using a printer from Denver Instrument | | |
| 13. Unload the weighing system | | |

Hardware Tests

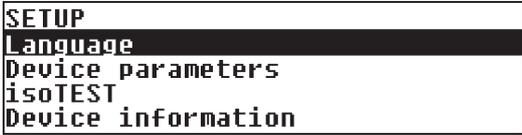
Purpose

Hardware tests are performed to check whether the system communication with internal and external devices functions properly. These tests are not elementary hardware tests.

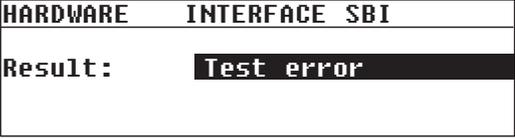
The following device elements can be tested:

- SBI communication
- Heater

Activating Hardware Tests

| Step | Key (or Instruction) | Display/Printout |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1. Select SETUP in the Function line and confirm |  or   |  |
| Select isoTEST and confirm | 2 x   |  |
| 3. Select Hardware Tests and confirm |   |  |

Testing SBI Communication

| Step | Key (or Instruction) | Display/Printout |
|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1. Prepare the test connector for the RS-232 port (see "Pin Assignment Chart") | Connect TxD (pin 2) with RxD (pin 3) | |
| 2. Select "Hardware tests" | see above | |
| 3. Select "Test interfaces" function and confirm |  |  |
| 4. Confirm "SBI communication test" function |  |  |
| At the end of the test, the result is displayed: Test error or: Test OK (in this case, Test error) (the test is repeated continuously) | |  |
| 5. Exit "Test SBI communication" | 2 x  | |

Testing the Heater

| Step | Key (or Instruction) | Display/Printout |
|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 1. Select "Hardware tests" | see the previous page | |
| 2. Select "Heater test" and confirm |   |  |
| 3. Start the heater test: Select the START function |  |  |
| After initialization, the current temperature (in this case: 123°C) and test time (in this case: 1.5 min) are displayed | | |
| If the sample chamber is opened, the test stops until the sample chamber is closed again. | | |
| After a brief time interval, the device reaches the nominal temperature. | | |
| 4. Exit the heater test |  |  |

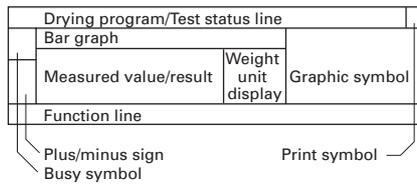
Data Output

There are three options for data output:

- Output to the moisture analyzer
- Output to an external Denver Instrument printer
- Output to a peripheral device (e.g., a computer) via the interface port

Output to the Moisture Analyzer Display (Weights and Calculated Values)

The display is divided into 9 sections. Information about the weighing system, the application being used and the sample weighed is output in the following sections:



- Drying program/Test status line
- Print symbol
- Bar graph
- Busy symbol
- Plus/minus sign
- Measured value/result
- Weight unit display
- Graphic symbol
- Function line

Drying Program/Test Status

This line shows information on the drying program:

- | | |
|-------------------|----------------------------------------|
| P1 | - Program number |
| 105°C | - Temperature data |
| Auto. | - Shutoff parameter |
| 85°C 5.4min | - Current temperature and elapsed time |
| HEATER TEST 160°C | - Active test function with parameters |



Print Symbol

The print symbol is shown in this section when the key is pressed or at the start and end of moisture analysis.

Bar Graph (Overview Display)

The bar graph shows the target weight with tolerance values (-20%, +20%).



The bar graph is displayed if you have selected **0N** for the "Initial weight" parameter in the drying program.



Busy Symbol

The "Busy" symbol is shown here when the moisture analyzer is processing a function activated by pressing a key.



Plus/Minus Sign

Any plus or minus sign required for a displayed value is shown here.

Measured Value/Result

This line shows:

5.234

– the current weight unit

17.23

– calculated values (e.g., % moisture)

Weight Unit Display

This section shows:



– the current weight unit (e.g., g)



– the drying temperature unit



– the unit for calculated values (e.g., % moisture)



Graphic Symbols

There are a number of different graphic symbols that can be displayed here; for example, to prompt the next user action ("Close cover"), to indicate the current function (sample pan with evaporating moisture) or to show that the current internal operation will take some time (hourglass).

SETUP

PROGRAM

TARE

Function Line

This line indicates the functions that can be activated by pressing "Enter" (e.g., Setup menu, Program menu, "Tare", "Start", or "Cal" (calibration)).

If an error occurs, the resulting error code or message overwrites this line.

Interface Port

Purpose

The moisture analyzer has an interface port for connecting an external printer or computer (or other peripheral device).

External Printer

You can use an external printer to generate printouts and to document settings.

Computer

Analyses and calculated values can be transmitted to a computer for further evaluation and recording.

Warning When Using Pre-wired

RS-232 Connecting Cables

RS-232 cables purchased from other manufacturers often have incorrect pin assignments for use with Denver Instrument weighing systems. Be sure to check the pin assignments against the chart on page 42 before connecting the cable, and disconnect any lines marked "Internally Connected" (e.g., pin 6). Failure to do so may damage or even completely ruin your weighing system and/or peripheral device.

Available Features

| | |
|---------------------------------|--------------------------------------------------------|
| Type of interface: | Serial interface |
| Interface operating mode: | Full duplex |
| Standard: | RS-232 |
| Transmission rates: | 150; 300; 600; 1,200; 2,400; 4,800; 9,600; 19,200 baud |
| Number of data bits | 7, 8 bit |
| Parity: | None, odd, even |
| Number of stop bits: | 1 or 2 stop bits |
| Handshake mode: | Software, hardware 1 character |
| Operating mode: | SBI, xBPI ¹⁾ |
| Network address ²⁾ : | 0, 1, 2, [...], 30, 31 |
| Data output format with SBI: | 20 characters + CR LF |

¹⁾ xBPI operating mode: 9600 baud, 8 bits, odd parity, 1 stop bit

²⁾ Network address is valid only in the xBPI mode

Factory Settings for the SBI Operating Mode Parameters:

| | |
|----------------------|----------------------|
| Transmission rate: | 1,200 baud |
| Number of data bits: | 7 bits |
| Parity: | Odd |
| Stop bits: | 1 stop bit |
| Handshake: | Hardware 1 character |
| Operating mode: | SBI |

Preparation

- See pages 42 and 43 for the pin assignment chart and cabling diagram.

Data Output Format

You can output the values, displayed in the corresponding line for moisture analysis values, and the weight unit with or without a data ID code.

Example: With Data ID code
N + 3.4253 g

20 characters per line are output.

Output Format with 20 Characters + CR LF

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| | | | | | | + | * | D | D | D | D | D | D | D | * | U | U | U | CR | LF | |
| * | * | * | * | * | - | | . | . | . | . | . | . | . | . | | * | * | * | | | |
| | | | | | * | | * | * | * | * | * | * | * | * | | | | | | | |

- I: ID code character
- U: Unit symbol
- *: Space
- CR: Carriage return
- D: Digit or letter
- LF: Line feed

Error Codes

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| S | t | a | t | * | * | * | * | * | E | R | R | * | # | # | # | * | * | * | * | CR | LF |

- *: Space
- H: Overload
- L: Underload
- ###: Error code number

Data Input Format

If you have a computer connected to the interface port on the moisture analyzer, you can send the commands "Esc P CR LF" to generate a printout.

Synchronization

During data communication between the moisture analyzer and an on-line device (computer), messages consisting of ASCII characters are transmitted via the interface. For error-free data communication, the parameters for baud rate, parity, handshake mode and character format must be the same for both units.

You can adapt your moisture analyzer by setting corresponding parameters in the Setup menu.

If you do not connect a peripheral device to the analyzer's interface port, this will not generate an error message.

Handshake

The moisture analyzer interface has transmit and receive buffers. You can define the handshake parameter in the Setup menu:

- Hardware handshake (CTS/DTR)
- Software handshake (XON, XOFF)

Hardware Handshake

With a hardware handshake, 1 more character can be transmitted after CTS ("clear to send").

Software Handshake

The software handshake is controlled via XON and XOFF. When a device is switched on, XON must be transmitted to enable any connected device to communicate.

When the software handshake is configured in the Setup menu, the hardware handshake becomes active after the software handshake.

The data transmission sequence is as follows:

| | | |
|-----------------------------------------|-----------|-----------------------------|
| Moisture analyzer (transmitting device) | — byte —> | Computer (receiving device) |
| | — byte —> | |
| | — byte —> | |
| | <— XOFF — | |
| | — byte —> | |
| | — byte —> | |
| | ... | |
| | (Pause) | |
| | ... | |
| | <— XON — | |
| | — byte —> | |

Transmitting Device:

Once XOFF has been received, it prevents further transmission of characters. When XON is received, it re-enables the transmitting device to send data.

Receiving Device:

To prevent too many control commands from being received at one time, XON is not transmitted until the buffer is almost empty.

Activating Data Output

You can define the data output parameter so that output is activated either when a print command is received, or automatically and synchronously with the analyzer display.

Data Output by Print Command

The print command can be transmitted by pressing  or by sending a software command (Esc P).

Pin Assignment Chart

Female Interface Connector:

25-position D-Submini (DB25S) with screw lock hardware for cable gland

Male Connector Used:

(please use connectors with the same specifications):

25-pin D-Submini (DB25S) with shielded cable clamp assembly (Amp type 826 985-1C) and fastening screws (Amp type 164 868-1)

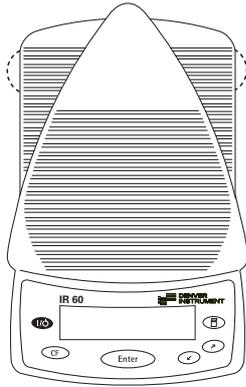
Pin Assignment Chart:

Pin 1: Signal ground
Pin 2: Data output (TxD)
Pin 3: Data input (RxD)
Pin 4: Signal return (TxD/RxD)
Pin 5: Clear to send (CTS)
Pin 6: Internally connected
Pin 7: Internal ground
Pin 8: Internal ground
Pin 9: Reset _ In*)
Pin 10: -12 V
Pin 11: +12 V
Pin 12: Reset _ Out*)
Pin 13: + 5 V
Pin 14: Internal ground
Pin 15: Internally connected
Pin 16: Internally connected
Pin 17: Internally connected
Pin 18: Internally connected
Pin 19: Internally connected
Pin 20: Data terminal ready (DTR)
Pin 21: Supply voltage ground
"COM"
Pin 22: Not connected
Pin 23: Not connected
Pin 24: +10 V
Pin 25: +5 V

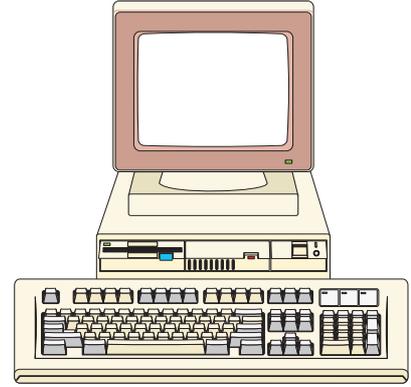
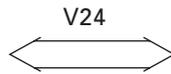
*) = Hardware restart

Cabling Diagram

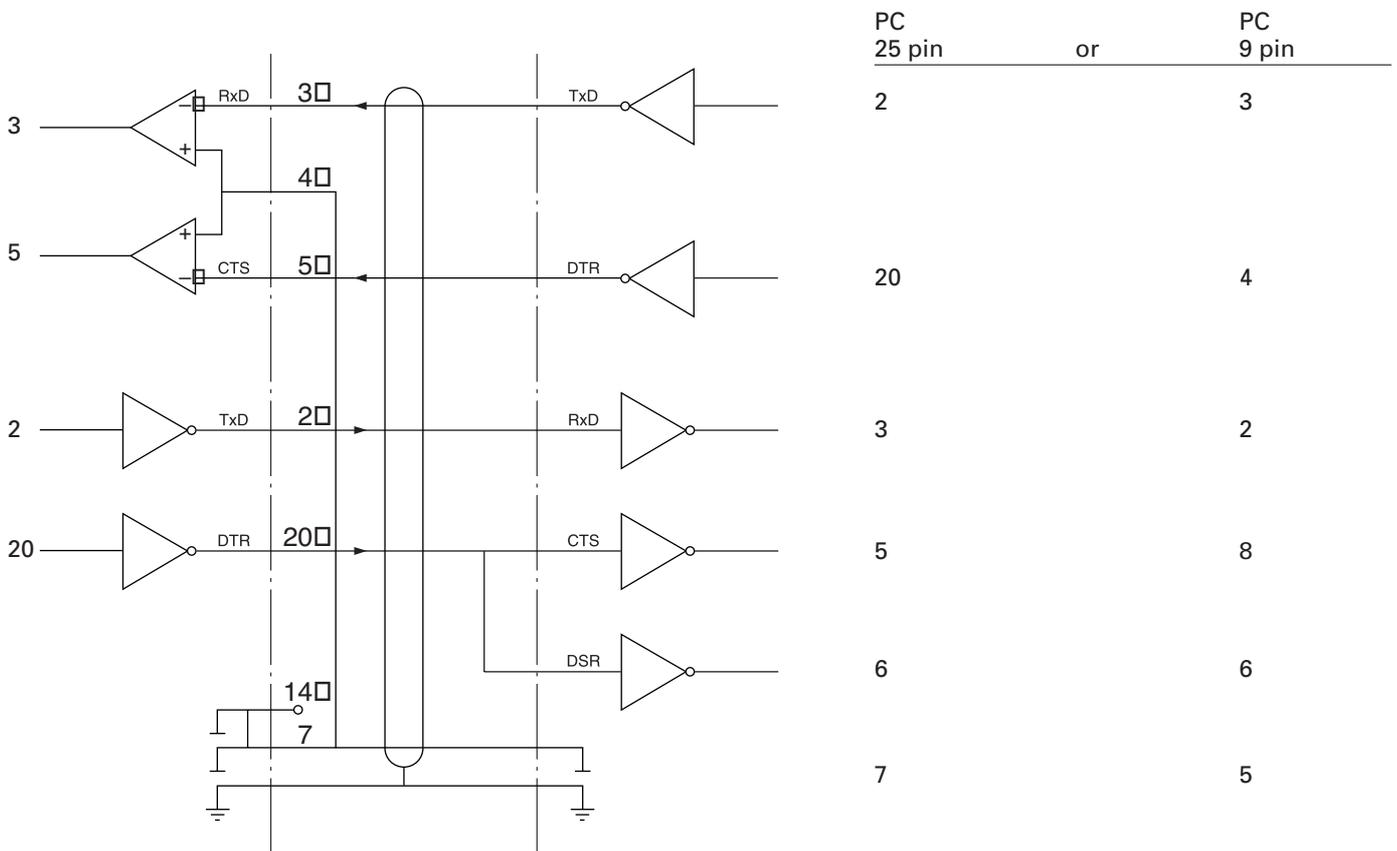
- Diagram for interfacing a computer or other peripheral device to the moisture analyzer using the RS-232/V24 standard and cables up to 15 m (50 ft.) long



Moisture analyzer



Peripheral device



Type of cable: AWG 24 specification

Error Codes

Error codes are displayed in the main display or text line for 2 seconds.
The program then returns automatically to the previous status.

| Display | Cause | Solution |
|---------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| No segments appear on the display | No AC power is available The power cord is not plugged in Fuses are defective | Check the AC power supply Plug in the power cord Replace the fuses |
| H | The load exceeds the weighing capacity | Unload the pan support |
| L or ERR 54 | The pan support is not in place | Place the pan support on the weighing system |
| ERR 01 > Display range | Data output not compatible with output format | Change the configuration in the Setup menu |
| ERR 02 Cal. n. possible | Calibration/adjustment condition not met, e.g., – not tared – the pan support is loaded | Calibrate only when zero is displayed Press the TARE function key Unload the moisture analyzer |
| ERR 03 up Cal/adj. interrupt | Calibration/adjustment could not be completed within a certain time | Allow the moisture analyzer to warm up again and repeat the adjustment process |
| ERR 30 Print fct. blocked | Interface port for printer output is blocked | Have the port setting changed by Denver Instrument Customer Service |
| ERR 31 Print fct. blocked | External device not ready to send (interface handshake interrupted; XOFF, CTS) | Transmit XON, then CTS |
| ERR 53 No meas. value | No temperature compensation Adjustment disk missing (during heater adjustment) | Contact the Denver Instrument Service Center Position the disk in the sample chamber |
| ERR 101 "Checkerboard" pattern displayed continuously | Key is stuck Key pressed when switching on the moisture analyzer ⓔ key was pressed when turning on the moisture analyzer, or is stuck | Release key or contact your local Denver Instrument Service Center |
| ERR 320 | Operating program memory is wrong | Contact your local Denver Instrument Service Center |
| ERR 340 | Operating parameter (EEPROM) is wrong | Contact your local Denver Instrument Service Center |
| ERR 342 | Operating parameter (EEPROM) is wrong except for adjustment parameters | Contact your local Denver Instrument Service Center |
| NO WP | Weighing system is defective | Contact your local Denver Instrument Service Center |
| blocked | Function blocked | None |
| xxxxx too low xxxxx too high | Input wrong (with any application program) | Follow the instructions for the application programs |

Troubleshooting: see next page

| Problem | Cause | Solution |
|---------------------|---------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| What can I do if... | The selected temperature is too high and the sample oxidizes | <ul style="list-style-type: none"> - Reduce the temperature - Put a glass fiber filter on top of the sample |
| | Sample boils or scorches and the splashes continuously change the sample weight | <ul style="list-style-type: none"> - Reduce the sample quantity or apply the sample more evenly - Select a semi-automatic shutoff parameter or select the timer mode |
| | Analysis time is too long | <ul style="list-style-type: none"> - Increase the temperature - Reduce the sample quantity - Preheat the unit by running it for 2 or 3 minutes with an empty sample pan |
| | Sample loses weight before it is analyzed | <ul style="list-style-type: none"> - Remove the sample pan and apply the sample outside the sample chamber |
| | Sample is liquid or pasty | <ul style="list-style-type: none"> - Use a glass fiber filter |
| | Sample contains too little moisture | <ul style="list-style-type: none"> - Increase the sample quantity |
| | Insufficient heat output | <ul style="list-style-type: none"> - Clean the protective glass or temperature sensor |
| | Place of installation exposed to interfering factors (vibration, etc.) | <ul style="list-style-type: none"> - Change the place of installation |

If any other errors occur, please contact your local Denver Instrument Service Center

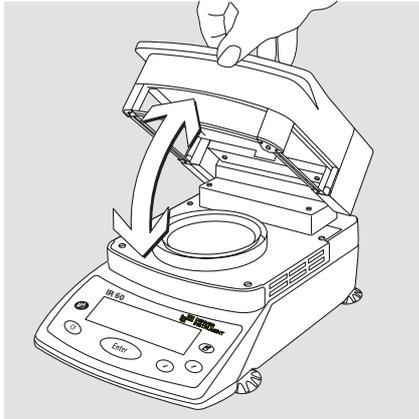
Care and Maintenance

Repairs

Repair work must be performed by trained service technicians. Any attempt by untrained persons to perform repairs may lead to hazards for the user.

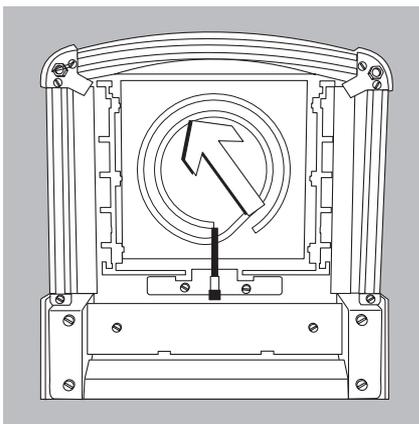
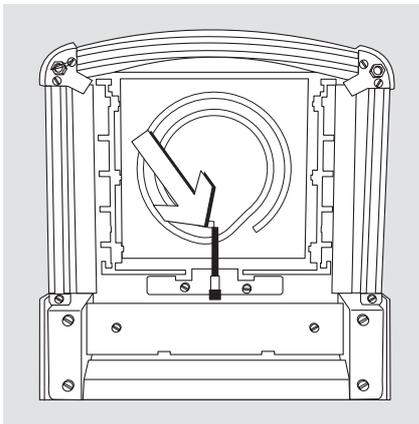
Cleaning

- ⚠ Make sure that no dust or liquid enters the moisture analyzer housing
- ⚠ Do not use any aggressive cleaning agents (solvents, abrasive cleaning agents, etc.); clean the moisture analyzer using a piece of cloth which has been wet with a mild detergent (soap) only
- Unplug the power cord from the wall outlet (mains supply)
If you have a cable connected to the interface, unplug it from the moisture analyzer
- The pan draft shield and the pan support can be removed for cleaning
- Carefully remove any sample residue/spilled powder using a brush or a hand-held vacuum cleaner
- After cleaning, wipe down the analyzer with a soft, dry cloth



Cleaning the Heating Unit and Temperature Sensor

- Open the hinged cover
- ⚠ **Danger:** The terminals of the heating unit are under live current
- **To disconnect from AC power, unplug the power cord from the wall outlet (mains).**
If you have a cable connected to the interface port, disconnect it from the moisture analyzer
- Carefully remove any residue from the temperature sensor
- Use a commercially available glass cleaner to clean the protective glass on the quartz-rod radiator.



Safety Inspection

If there is any indication that safe operation of the moisture analyzer is no longer warranted:

- Turn off the power and disconnect the equipment from the wall outlet immediately
- > Lock the equipment in a secure place to ensure that it cannot be used for the time being

Safe operation of the moisture analyzer is no longer ensured when:

- there is visible damage to the moisture analyzer or power cable
- the moisture analyzer no longer functions properly
- the moisture analyzer has been stored for a relatively long period under unfavorable conditions
- the moisture analyzer has been exposed to rough handling during shipment

In this case, notify your nearest Denver Instrument Service Center. Maintenance and repair work may be performed only by service technicians who are authorized by Denver Instrument and who:

- have access to the required maintenance manuals
- have attended the relevant service training courses

We recommend that the moisture analyzer be inspected according to the following checklist by a qualified Denver Instrument service technician:

- Resistance of the protective grounding conductor < 0.2 ohm measured with a commercially available multimeter
- Insulation resistance > 2 megohms measured with a constant voltage of at least 500 volts at a 500 kohm load

The duration and number of measurements should be determined by a qualified Denver Instrument service technician according to the particular ambient and operating conditions. However, such inspection must be performed at least once a year.

Instructions for Recycling the Packaging

To ensure adequate protection for safe shipment, your moisture analyzer has been packaged to the extent necessary using environmentally friendly materials. After successful installation of the moisture analyzer, you should return this packaging for recycling because it is a valuable source of secondary raw material. For information on recycling options, including recycling of old weighing equipment, contact your municipal waste disposal center or local recycling depot.

Overview

Specifications

| | |
|------------------------------------------------------------------|---------------------------------------------------------------------------|
| Model | IR-60 |
| Dryer functions: | |
| Heating element | Quartz-rod IR heater |
| Temperature range | 40 – 210°C |
| Temperature increments | adjustable in 1°C increments |
| Temperature adjustment | with temperature adjustment set |
| Weighing Functions: | |
| Weighing capacity | 60 g |
| Readability | 1 mg, 0.01% moisture content |
| Repeatability, average (%) | sample weight 1–5 g: 0.2% sample weight 5 g: 0.05% |
| External calibration weight (with an accuracy of at least...) | 50 g (E2) |
| Sample pan dimensions | Ø 90 mm |
| Drying parameters: | |
| Drying programs | Standard |
| Drying time | 0.1 to 99.9 minutes |
| Number of programs | 5 |
| Shutoff criteria | Fully automatic, semi-autom. (1 – 20 mg/24 s), timer mode (1 × 99.9 Min.) |
| Display of analysis results | Moisture, dry weight, RATIO, residual weight (g or g/kg) |
| Minimum sample weight | 0.100 g |
| Analyzer (hardware): | |
| Dimensions (W × D × H) | 213 × 320 × 181 mm |
| Net weight, approx. | 5.1 kg |
| Voltage | 230 V or 115 V (depending on model), –15% ... +10% |
| Frequency | 48 – 60 Hz |
| Fuses | 2 (neutral conductor/phase), 6.3 AT, 5 × 20 mm (internal) |
| Operating temperature range | +10 ... +30°C |
| Power consumption | 700 VA max. |
| Built-in interface | RS-232C |
| Format: | 7 bit ASCII, 1 start bit, 1 or 2 stop bits |
| Parity: | Odd or even |
| Transmission rates: | 150 to 19,200 baud |
| Handshake: | Software or hardware |

CE Marking

The CE marking affixed to the equipment indicates that the equipment meets the requirements of the following Directive(s) issued by the Council of the European Union:

**Council Directive 89/336/EEC
“Electromagnetic compatibility
(EMC)”**

1. Electromagnetic Compatibility
1.1 Reference to 89/336/EEC:

Official Journal of the European
Communities, No. 2001/C 105/03

EN 61326-1 Electrical equipment for
measurement, control
and laboratory use
EMC requirements

Part 1: General requirements
Defined immunity to
interference: Industrial
areas, continuous non-
monitored operation
Limitation of
emissions:
Residential areas,
Class B

Important Note:

The operator shall be responsible for any modifications to Denver Instrument equipment and for any connections of cables or equipment not supplied by Denver Instrument and must check and, if necessary, correct these modifications and connections. On request, Denver Instrument will provide information on the minimum operating specifications (in accordance with the Standards listed above for defined immunity to interference).

73/23/EU “Electrical equipment
designed for use within
certain voltage limits”

Applicable European Standards:

EN 60950 Safety of information
technology equipment
including electrical
business equipment

EN 61010 Safety requirements
for electrical equipment
for measurement,
control and laboratory
use
Part 1: General
requirements

If you use electrical equipment in installations and under ambient conditions requiring higher safety standards, you must comply with the provisions as specified in the applicable regulations for installation in your country.

Index

| | Page | | Page |
|--------------------------------------------|----------------------------------|-----------------------------------------|-----------------------------|
| Acoustic signal | 14, 17 | Keypad | 2, 5 |
| Adjustment to an existing measuring system | 21 | Keys: description | 9 |
| Adjustment | 31, 44 | Language: setting | 8, 13 |
| Alphanumeric input | 9 | Leveling the moisture analyzer | 8 |
| Basics | 19 | Maintenance | 46 |
| € marking | 49 | Numeric input | 9 |
| Cabling diagram | 43 | On/off | 8, 27, 29, 41, 44 |
| Calibration | 31, 38 | Operating design | 9 |
| Care and maintenance | 46 | Operating the moisture analyzer | 24 |
| Cleaning | 2, 4, 8, 22, 46 | Password | 2, 12, 14, 53 |
| Configuring the moisture analyzer | 13, 27 | Password: enter, change | 14 |
| Connection to power | 6 | Pin assignments | 42 |
| Contents | 3 | Power connection | 6 |
| Contrast of the display | 14 | Preparing samples | 21 |
| Crust development on samples | 23 | Print intermediate results | 25 |
| Data input format | 40 | Printer | 2, 5, 7, 11, 14, 33, 37, 39 |
| Data output format | 40 | Printing | 15, 18, 20, 26, 29, 34 |
| Data output | 11, 37, 41, 44 | Programs | 2, 12, 14, 25, 38, 48 |
| Date: setting | 8 | Recycling the packaging | 47 |
| Device information | 18 | Repairs | 46 |
| Device parameters | 14 | Replacing a fuse | 44, 48 |
| Display contrast | 14 | Results: display mode | 24, 48 |
| Display | 2, 6, 9, 14, 37, 41 | Safety information | 4, 8 |
| Drying parameters | 2, 24, 48 | Safety inspection | 47 |
| Drying programs | 12, 14, 25, 38 | Safety precautions | 7 |
| Drying temperature | 10, 38, 45 | Sample chamber | 8, 23, 25, 29, 31, 36 |
| End criteria | 25 | Samples: crust, skin development | 23 |
| End of analysis | 24 | Samples: preparing | 21 |
| Entering letters/numbers | 9 | Shutoff parameters | 20, 37, 45 |
| Equipment supplied | 5 | Software handshake | 17, 41 |
| Equipment: general overview | 6 | Specifications | 48 |
| Error codes | 12, 41, 44 | Standard drying | 24 |
| Examples | 10, 13, 15, 16, 18, 26, 40 | Standby temperature | 25 |
| Factory settings | 12, 17, 24, 27, 39 | Start of analysis | 24 |
| Frequency | 5, 7, 46, 48 | Storage and shipping conditions | 5, 47 |
| Fuses | 44 | Synchronization | 41 |
| General overview of the equipment | 6 | Technical advice on applications | 2 |
| General password | 12, 14, 53, Appendix | Testing the heater | 31, 35, 36 |
| Getting started | 4 | Testing the interface port | 31, 35 |
| Handshake | 14, 17, 39, 41, 44, 48 | Time: output on printouts | 33 |
| Hardware test | 31, 35 | Time: setting | 8 |
| Heater adjustment | 31 | Unpacking the equipment | 5 |
| Heater | 4, 7, 46 | Warmup time | 7, 44 |
| Heater: test | 36 | Warning and safety information | 4 |
| Heating programs | 2, 11, 24, 48 | Weighing system settings | 31 |
| Initial weight | 10, 24, 37, 48 | | |
| Installation | 5 | | |
| Intended use | 2 | | |
| Interface port | 6, 7, 11, 37, 39, 44 | | |
| Interface port test | 5, 9, 11, 14, 31, 35, 39, 44, 48 | | |
| Interface | 12, 18, 31 | | |
| isoTEST | 12, 18, 31 | | |

General Password

Enter/Change Password

- Select the Setup menu:
Use the  or  key to select **SETUP** in the Function line and press  to confirm
- Press the  key
- > **SETUP** is displayed with submenus
- Select a submenu (in this example, "Device parameters"): Press the  key and press  to confirm
- > Password prompt is displayed.

| | |
|-----------------|--------------------|
| SETUP | PASSW.CHECK |
| Enter password: | ██████████ |

- Use the  and  keys to enter the password (see page 9 for details on alphanumeric input) and press  to confirm each digit
- Press  to confirm password
- Display device parameters:
Press the  and  keys
- > Device parameters are displayed

- Select the password function:
Press the  key
- > Password prompt is displayed, together with current password
- Enter a new password: Use the  and  keys to enter the password and press  to confirm
- To delete the password, enter a "space" and press the  key to confirm
- Exit the Setup menu:
Press the  key twice
- > Restart your application

| |
|---------------------------------------|
| General Password: 40414243 |
|---------------------------------------|

Copyright by Denver Instrument GmbH, Goettingen, Germany. All rights reserved. No part of this publication may be reprinted or translated in any form or by any means without the prior written permission of Denver Instrument GmbH.

The status of the information, specifications and illustrations in this manual is indicated by the date given below. Denver Instrument GmbH reserves the right to make changes to the technology, features, specifications, and design of the equipment without notice.

Status:
June 2004, Denver Instrument GmbH,
Goettingen, Germany

Europe, Asia and Australia:
**Denver Instrument GmbH
Robert-Bosch-Breite 10
37079 Goettingen, Germany
Tel: +49-551-20977-30
Fax: +49-551-20977-39**

Internet:
www.denverinstrument.com

U.K. and Ireland:
**Denver Instrument Company
Denver House, Sovereign Way
Trafalgar Business Park
Downham Market
Norfolk PE38 9SW England
Tel: +44-136-63862-42
Fax: +44-136-63862-04**

North and South America:
**Denver Instrument Company
6542 Fig Street
Arvada, Colorado 80004
1-800-321-1135
Tel: +1-303-431-7255
Fax: +1-303-423-4831**

