

BlowerDoor GmbH
MessSysteme für Luftdichtheit

Bau.Tools BlowerDoor

All-season testing procedure for detecting leakages with BlowerDoor and thermography



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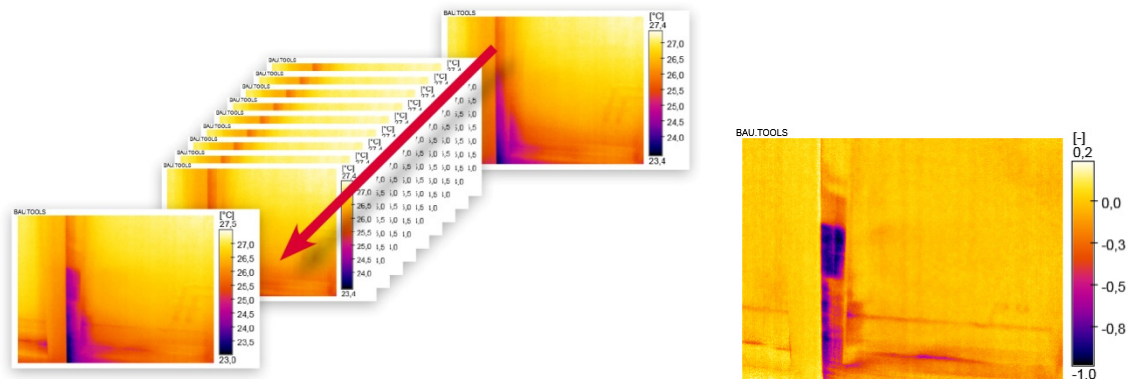
1 Introduction

1.1 Measuring principle

Bau.Tools BlowerDoor is a testing procedure for analyzing air leakages and backflows with BlowerDoor and thermography that can be used year-round.

This innovative testing method, developed especially for the use of a Minneapolis BlowerDoor and FLIR Systems thermography camera, works even at only the slightest difference in temperature and can usually be used year-round. Air leakages and backflows can be detected accurately and visualized.

FLIR thermography cameras have a thermal resolution of 0.03 to 0.08 Kelvin. A fivefold of the lowest resolving capacity already provides accurately reproducible results in order to detect air leakages and backflows. Bau.Tools BlowerDoor makes temperature differences of 0.15 to 0.4 Kelvin in the thermogram visible. The computer-aided sequential analysis particularly brings out and visualizes those minimal differences that can barely be perceived in a standard thermogram.



*Fig. 1.1: With the sequential analysis, the changes in all thermograms in a sequence are evaluated.
Right: The sequential analysis shows the changes over the testing period.*

The BlowerDoor Measuring System and the FLIR thermography camera are controlled by a laptop that also saves the thermograms and the pressure curve for the report. The constantly newly generated sequential analysis can be observed live on the computer. Based on the images shown, the user decides when to save the measurement.

1.2 Overview device setup

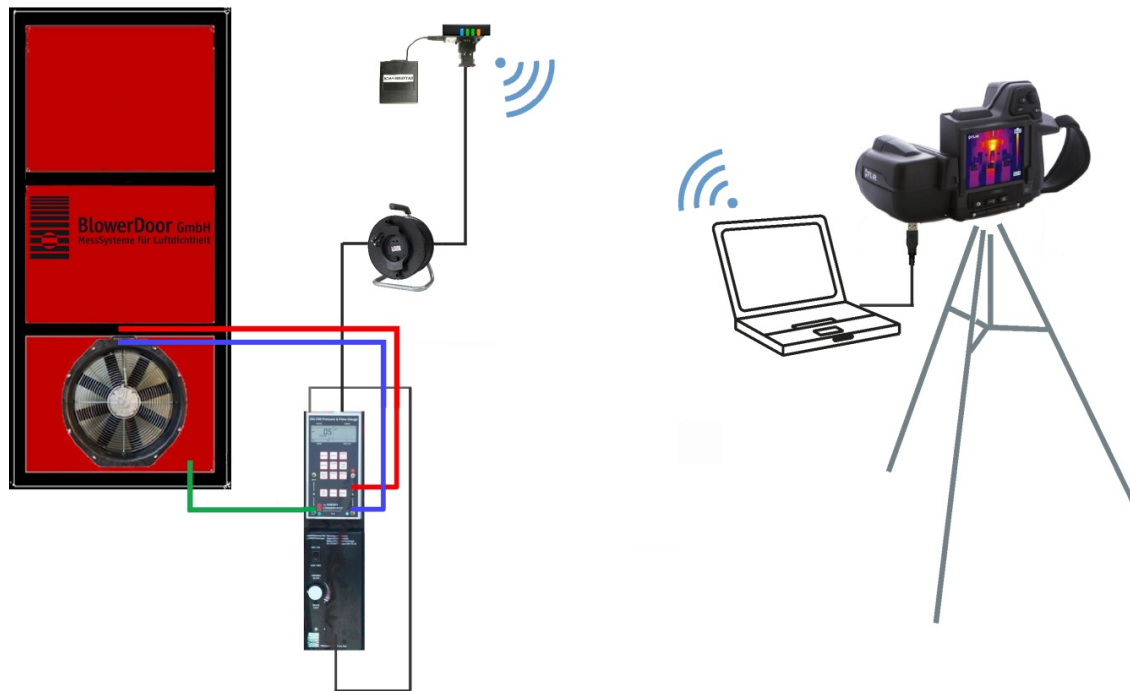


Fig. 1.2: Recommended setup of the equipment for the measurement with Bau.Tools BlowerDoor

Set up the BlowerDoor Measuring System as usual in an exterior door. Following the setup in Fig. 1.2 the speed controller as well as the DG-700 should be placed at mounting frame. DG-700 and laptop computer are connected wireless with TEC WiFi Link. FLIR camera and laptop computer are connected by cable.

The TEC WiFi Link can be plugged directly on the serial port of DG-700. If the distance between TEC WiFi Link (DG-700) and laptop computer is too large, or the shielding is too strong, we recommend using a serial data cable (50 m on cable drum) between DG-700 and TEC WiFi Link to reduce the distance. The power supply of TEC WiFi Link is supplied by an external battery box.

For alternatives setups please contact the BlowerDoor GmbH.

2 Requirements

2.1 Requirements for the BlowerDoor Measuring System

- Minneapolis BlowerDoor Measuring System (BlowerDoor Standard, BlowerDoor MiniFan, or BlowerDoor MultipleFan) with pressure gauge DG-700

Recommended additional equipment

- Laptop rack
- TEC WiFi Link for wireless connection between BlowerDoor Measuring System and notebook
- External battery box for TEC WiFi Link
- Serial data cable on cable drum (2x RS-232 / 50 m)
- **For BlowerDoor airtightness measurements of buildings with TEC WiFi Link you will need:**
Software TECTITE Express version 4.1 or up

2.2 Requirements for the thermography camera

FLIR®-infrared camera with USB, WLAN, or Gigabit Ethernet connection, and with tripod.
Contact BlowerDoor GmbH for a full selection of supported FLIR®-cameras.

2.3 General computer equipment requirements

For optimal software functioning, you will need a laptop that meets the following minimum requirements:

- Current INTEL / AMD CPU
- Full version of one of the following operating systems:
Windows Vista, Windows 7, Windows 8, and Windows 10
- Microsoft FRAMEWORK 4.0
- 512 MB RAM

- 75 MB free storage space on the hard disk for the program
- Storage space on the hard disk for saving the infrared images (depending on the number of infrared images to be saved)
- 1024 x 768 screen resolution
- Internet connection for product activation/product update
- The connected computer is required to comply with IEC 60950-1 or equivalent standards on data port electrical safety isolation.

3 Software installation and activation

In order to install the Bau.Tools BlowerDoor software correctly, you must have administrator rights on your computer.

- Depending on your operating system please download the installation file of 32-bit or 64-bit version via the website link which has been sent to you by e-mail.

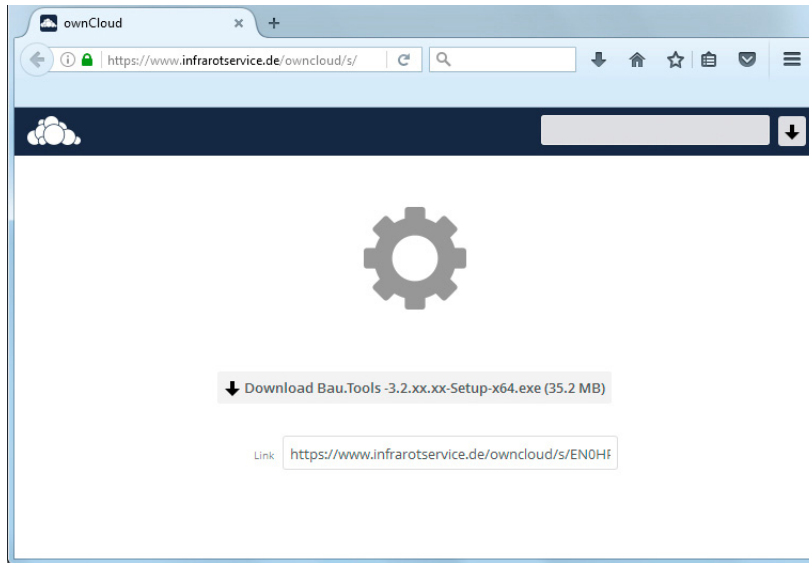


Fig. 3.1

Before installing Bau.Tools BlowerDoor

- Make sure that all programs are closed.
- Uninstall older versions of Bau.Tools BlowerDoor including their components.
- Make sure that your computer runs on an updated operating system. If not, you must do a Windows Update.

Step-by-step instructions

- After the complete download please start the installation file by double-clicking on “BauTools_ *version* _Setup.exe”.
- Select the language desired for the setup and start setup with “OK”.

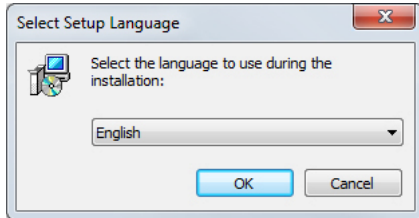


Fig. 3.2

- Carefully read the licensing agreement. Only select “I accept the agreement” if you expressly agree to the licensing agreement. Click on “Next” to continue with the setup.

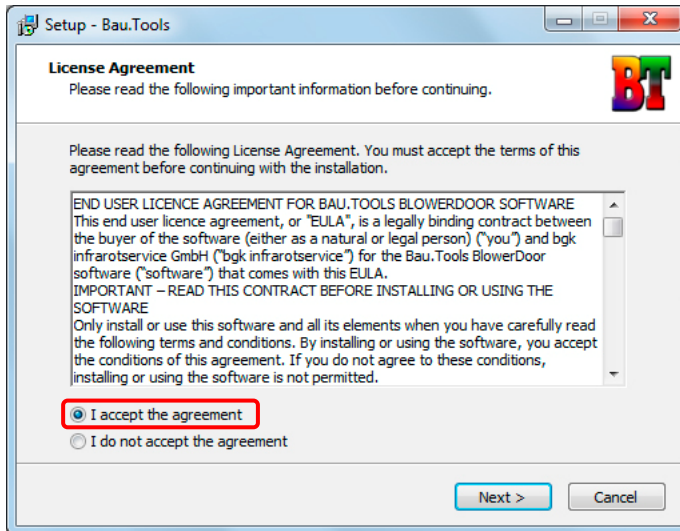


Fig. 3.3

- Selecting the installation directory and start menu folder: The installer suggests a standard directory. If you want to select a different directory or folder, use “Browse...”. Click on “Next” to continue with the setup.

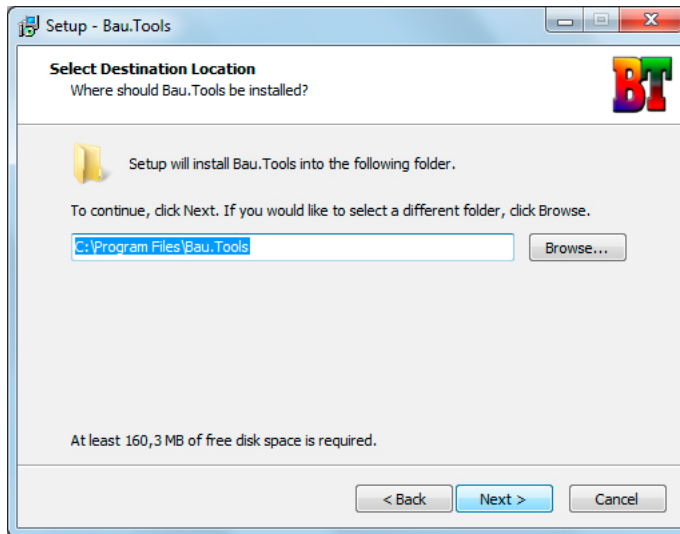


Fig. 3.4

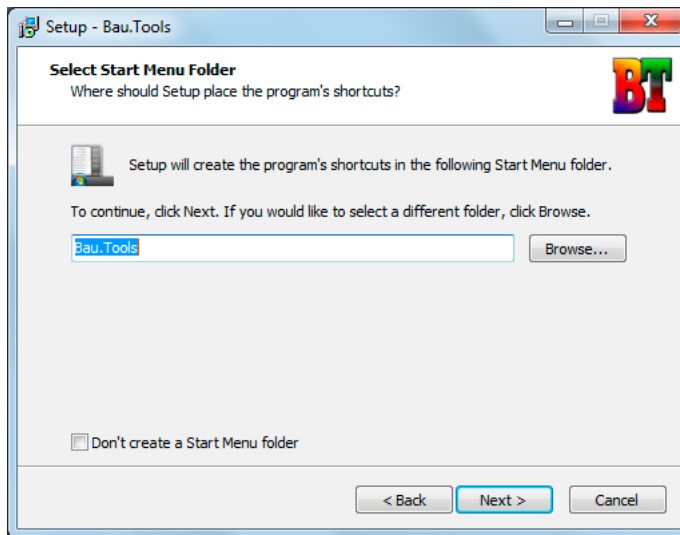


Fig. 3.5

- Select whether you want a start symbol on your desktop or in the quick launch bar. Click on “Next” to continue with the setup.

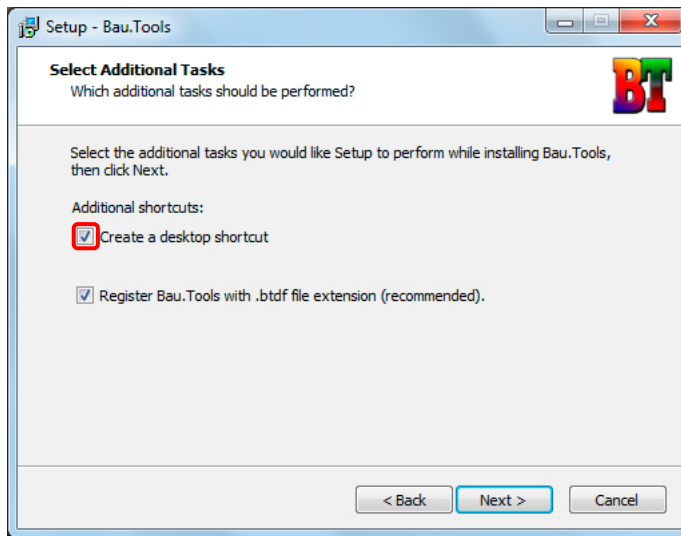


Fig. 3.6

- Click on “Install” to copy all necessary data onto your computer.

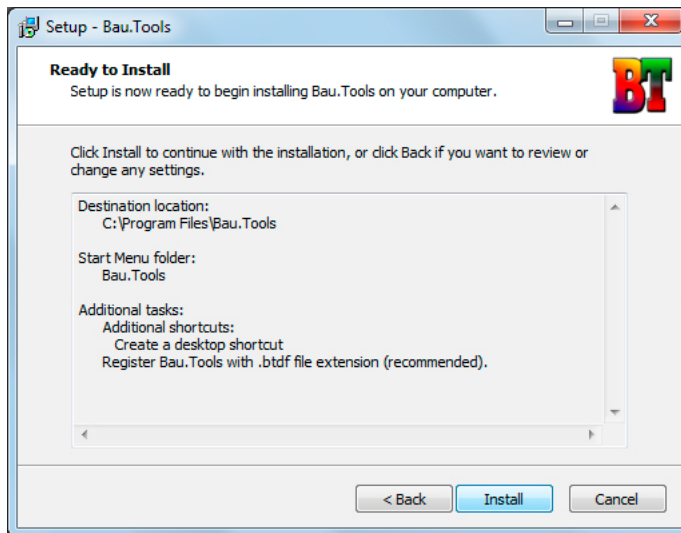


Fig. 3.7

- The installation has been successfully completed. Click on “Next” to close the setup file.

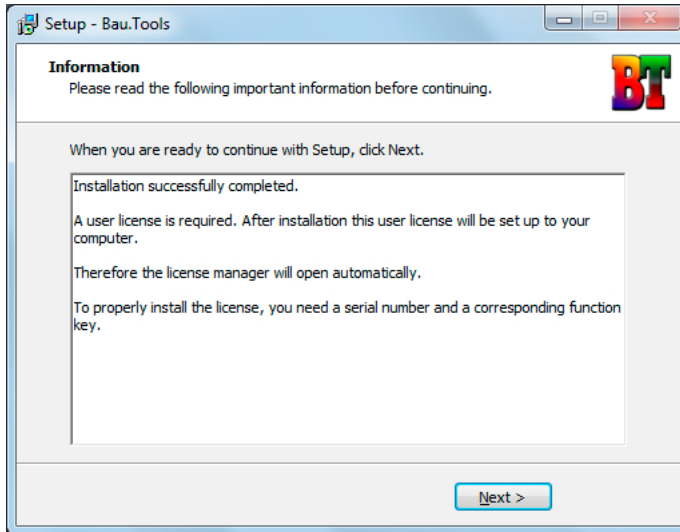


Fig. 3.8

- To activate the software the Bau.Tools License Manager will start automatically once the setup is finished. Click on “Finish”.

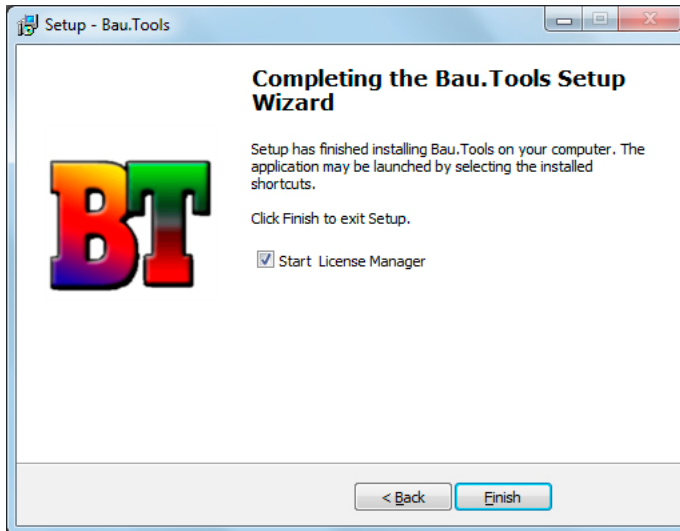





Fig. 3.9

- Fill in the marked fields, enter your serial number and click on “Check input data”.

Please enter the activation data:

Change Language   

Salutation male female not applicable

First Name

Last Name (x)

Company

Address

Postal Code

City

State


E-Mail Address (x)

Serial Number (x)

Online Activation was successful.

Fig. 3.10

After successful verification (OK) click on “Activate now!”.

After successful activation close the window via .

4 Installing the TEC WiFi Link for wireless communication with BlowerDoor measuring system



Fig. 4.1

Requirement: TEC WiFi Link

For wireless communication between BlowerDoor measurement system and laptop computer a TEC WiFi Link needs to be installed at DG-700.



Fig. 4.2: DG-700 with TEC WiFi Link

Connection of TEC WiFi Link

Plug the TEC WiFi Link into the serial port of the DG-700. Tighten both set screws onto the TEC WiFi Link. Attach the power connector cable between the TEC WiFi Link and the DG-700.

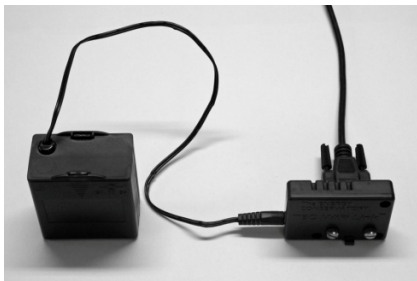


Fig. 4.3: TEC WiFi Link with external battery box

A serial cable could be installed between DG-700 and TEC WiFi Link to reduce the distance between TEC WiFi Link and laptop computer (Access Point).

The power supply of TEC WiFi Link is supplied by an external battery box.

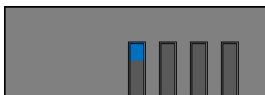


Fig. 4.4

The blue indicator light No. 1 on the TEC WiFi Link shows that the TEC WiFi Link is supplied with power.

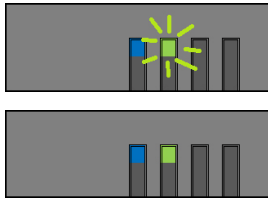


Fig. 4.5

Turn on the DG-700 using the On/Off button.

The green indicator light No. 2 on the TEC WiFi Link will blink at first.

As soon as it becomes constant, access (Wireless Access Point) to the wireless network provided by the TEC WiFi Link is possible.

As long as the green indicator light No. 2 is lit, manual control via the keypad of the DG-700 is no longer possible. The DG-700 display remains on.

On your laptop, select the TEC WiFi Link wireless network and connect to it.

The network is called “DG700-SN” (SN stands for the serial number of the measuring gauge). When first connecting to this network, you will be asked for a password. Enter the default password **tecwifi12**.

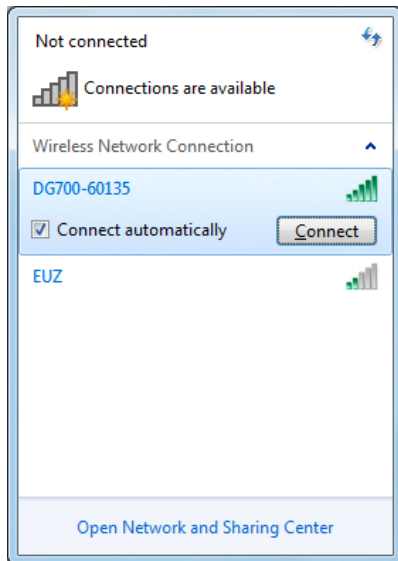


Fig. 4.6

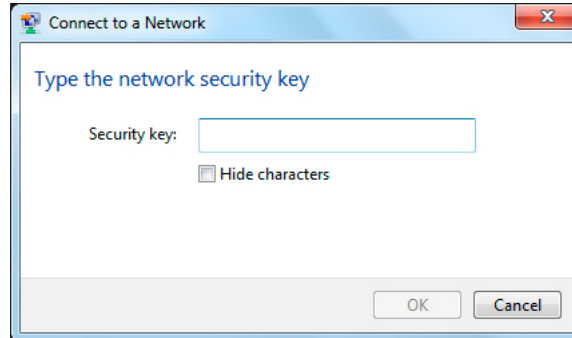


Fig. 4.7

Note:

If your laptop is already connected to another wireless network, you must disconnect from this network before establishing the connection to the TEC WiFi Link network. The DG-700 must be on in order for the TEC WiFi Link network to be visible on your laptop.



For further information about other operating modes of TEC WiFi Link please see the reference guides BlowerDoor Standard and/or BlowerDoor MiniFan.

5 Setting up, device connection and software default settings

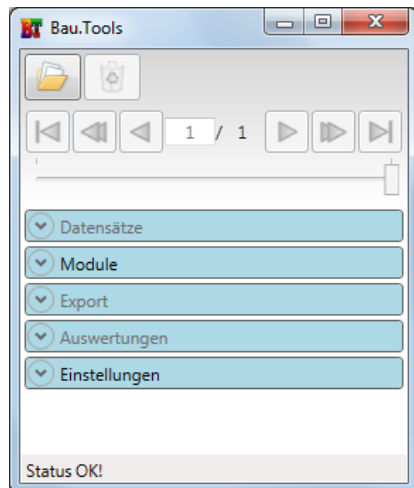
5.1 Setting up the measuring equipment

Set up the BlowerDoor Measuring System as usual. For detailed information on the setup of the equipment, please consult your manual. The current instruction manuals for measurement system BlowerDoor Standard, BlowerDoor MiniFan, and BlowerDoor MultipleFan are available for download at www.blowerdoor.com.

Switch on the DG-700. Before starting the measurement, make sure that the speed controller is on and the turning switch is set to minimum.

The thermography camera and the BlowerDoor Measuring System are controlled via a laptop and the Bau.Tools BlowerDoor software. We recommend connecting the DG-700 wireless to the laptop via TEC WiFi Link. Position the FLIR-infrared camera on a tripod, connect the camera to the laptop (see Figure 1.2) and switch it on.

5.2 Starting the software and setting the language



- **Start the Bau.Tools BlowerDoor software by clicking on the icon on your desktop.**

The window **Bau.Tools** will open (Menu window).

Default language at first use is German.

Fig. 5.1: Menu window Bau.Tools

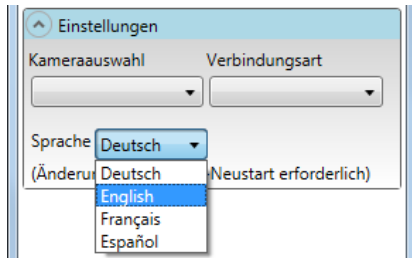


Fig. 5.2: Settings/Languages

- **Language selection in the menu *Einstellungen (Settings)***

Select the desired language in the *Settings* menu.

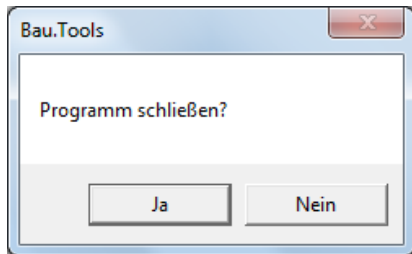



Fig. 5.3: Close the program?

Any change of language requires a restart of the software. Close the Bau.Tools software by the  button and click in the next window on "Ja" (Yes).

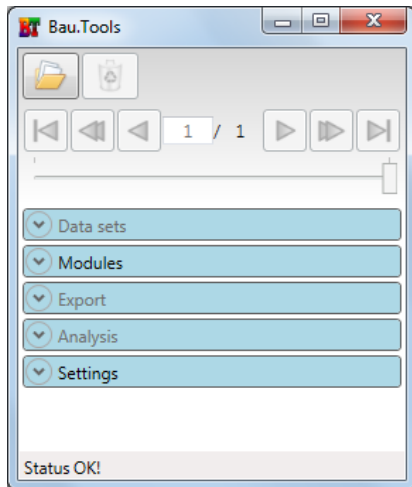


Fig. 5.4: Bau.Tools menu window in English.

- **Restart the software**

The menu window will open in the selected language.

5.3 Connecting the devices to the software

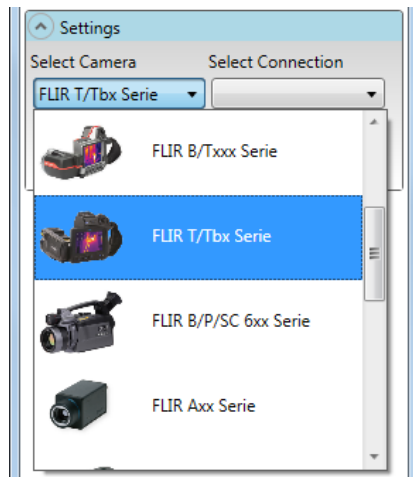


Fig. 5.5

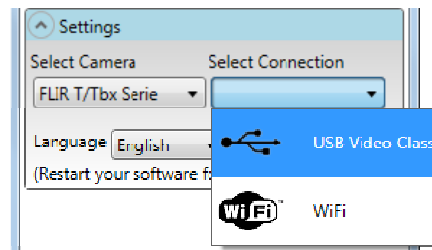


Fig. 5.6

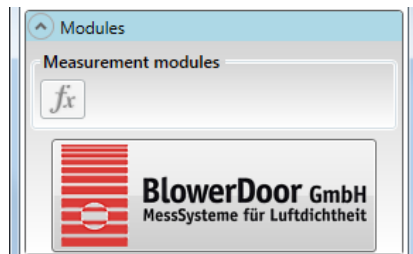


Fig. 5.7: Connecting DG-700

- Connecting the FLIR camera in the **Settings** menu

In the **Bau.Tools** window in the **Settings** menu, select the thermography camera connected and the type of connection.

The camera and type of connection selected last will be saved as default.

Note:

The fastest connection via USB Video Class (USB cable) is recommended!

- Connecting DG-700 and FLIR camera with the software via the **Modules** menu.

Click on the **BlowerDoor** button, and the **Bau.Tools BlowerDoor** window for conducting a measurement will open. The link connection to the thermography camera and the DG-700 is started. The live infrared image is displayed in the measurement window as soon as the connection is established (see Fig. 5.8).

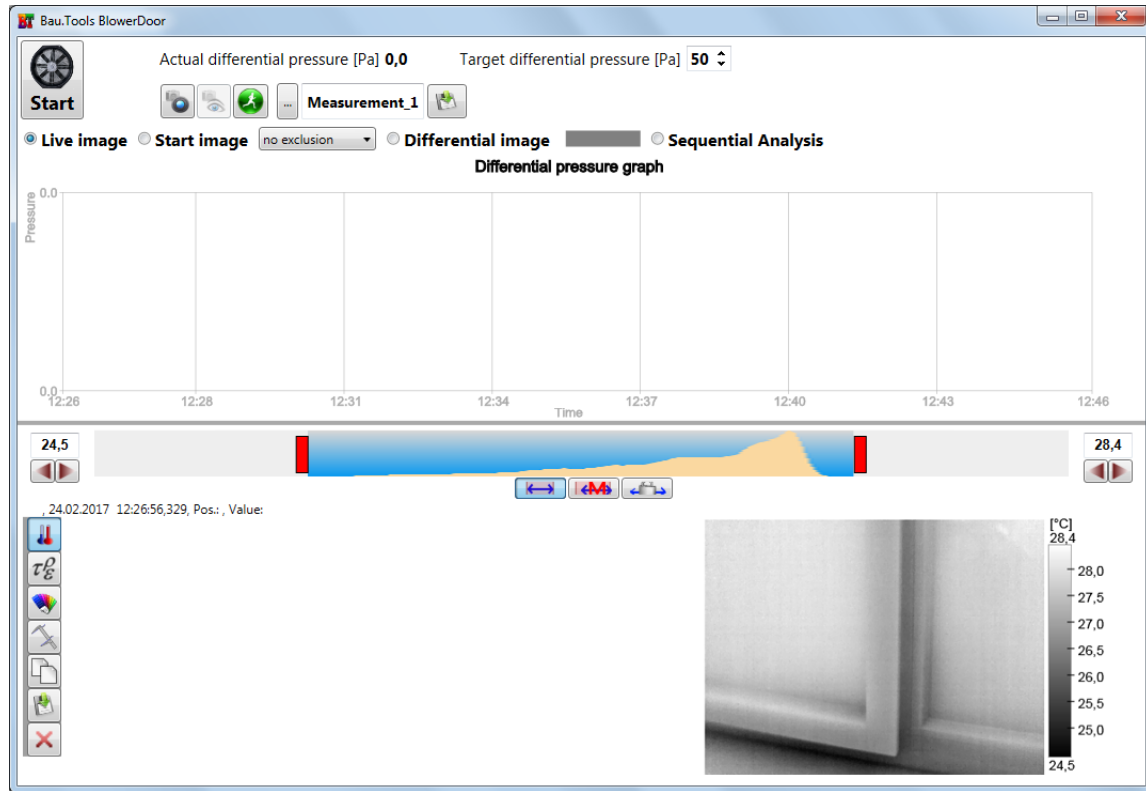
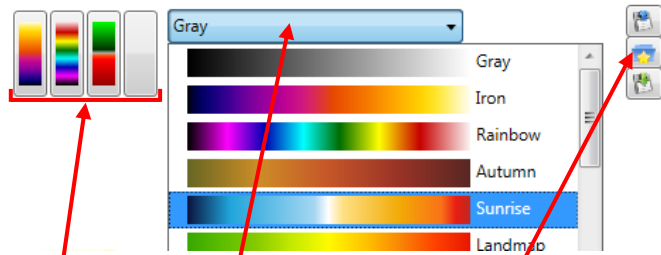


Fig. 5.8: Bau.Tools BlowerDoor measurement window


5.4 Color palette settings



Preselecting field, dropdown menu, color palette as standard

Fig. 5.9: Settings for color palette

- Choose color palette and declare as standard type

Using the button  and the menu **Change color palette** opens. Select a color palette from the drop-down menu for the image display and declare it as standard type. The color palette is preset for all windows.

6 Conducting a measurement

Aim the FLIR thermography camera at the building detail to be analyzed and focus the image. With autofocus cameras and USB connection to the laptop, you can focus by triggering the **camera autofocus** button. To shutter, use the **camera shutter** button.



All of the software's buttons are provided with clear short explanations of their functions (Tooltips). To access them hover your cursor over the buttons without clicking.

The following describes the most important operating steps for recording and saving a sequential analysis with Bau.Tools BlowerDoor.

6.1 Settings before starting an infrared image sequence



Measurement_1

- **Setting the path for measurement data and the folder names for measurements**

It is useful to determine the path and the folder names for the measurement data to be saved before recording the infrared image sequence.

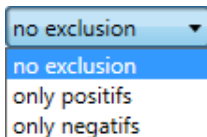
If no individual path is set, the program will automatically save the infrared images in the folder "Measurement_1" on C:\My Pictures.

Target differential pressure [Pa] 50

- **Setting the desired target pressure differential**

- Live image
- Sequential Analysis**

- **Recommended:**
Select Live image and Sequential Analysis



- **Select the desired display of changes in temperature**
Details see chapter 8.

6.2 Recording an infrared image sequence



- **Starting the BlowerDoor Fan and setting starting image**

Before starting the fan, make sure that the speed controller is on and the knob is set to minimum.

Click on the **Start** button and the BlowerDoor fan will be started. The starting image is set. The target building pressure differential is adjusted. If the target pressure is not achieved, you need to change the flow ring (see manual for BlowerDoor measurement system).

- **Observing the live displayed sequential analysis**

While the target building pressure differential is adjusted, you should observe the sequential analysis on the Live Display in (almost) real time to evaluate whether you have achieved a meaningful result. Once a clear result is achieved, save the sequence of infrared images.



- **Saving the infrared image sequence**

The infrared images of the measurement recorded thus far are saved at the previously determined path by clicking on the **Save as ...** button.
(For details, see Chapter 6.3).



Determine a folder name (e.g. measurement_1, measurement_2 ...) for each individual measurement. If you save again to the same folder, the previously saved infrared images will be overwritten and are therefore deleted.

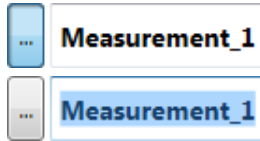


- **Stopping the BlowerDoor fan**

Once you have achieved a measurement result, stop the fan by clicking on the **Start/Stop** button.

6.3 Saving an infrared image sequence

- **Setting the path for the measurement data and the folder name for the measurement**



By clicking on the *Set path for saving* button, you can set a project-based path for saving. In the input field next to it enter the folder name for the respective measurement

Note:

You will have to enter a new folder name for each individual measurement, so that the data will be recorded in a separate folder. If you save to the same folder, the previously saved infrared images will be overwritten and can no longer be restored.

If no other path is set for the measurement to be saved, the program will automatically save the infrared images to the folder “*Measurement_1*” on C:\My Pictures.



- **Saving the measurement**

With click on the *Save as ...* button to save the actual infrared image.

The storage of measurement will be confirmed with a message.

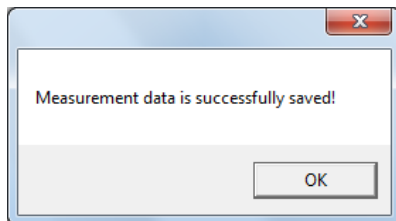


Fig. 6.1

If the folder already exists, a warning appears!

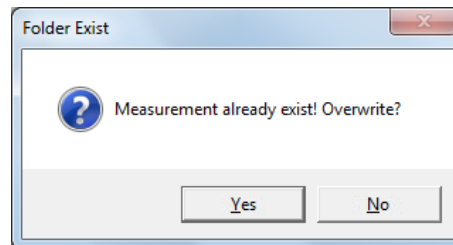


Fig. 6.2

The infrared images will be saved as .BTDF files.

The differential pressure curve is saved as a .png file (see Fig. 6.3) and can, for example, be integrated into the reporting file.

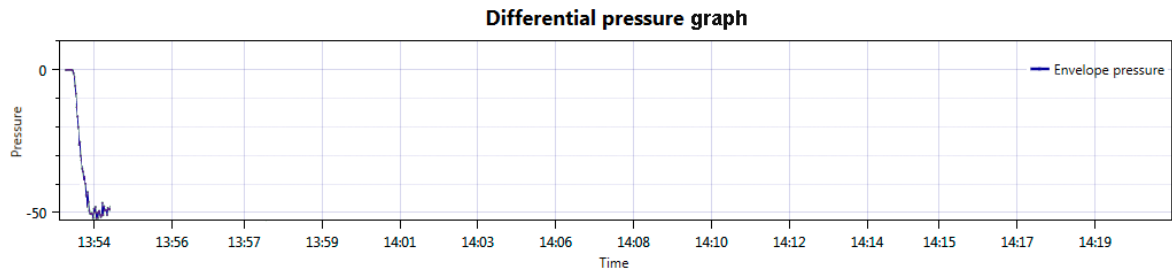


Fig. 6.3: Differential pressure curve of the building pressure

7 Evaluating infrared image sequences

7.1 Loading and viewing infrared images

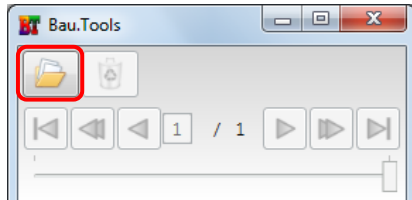


Fig. 7.1: Load infrared image(s)

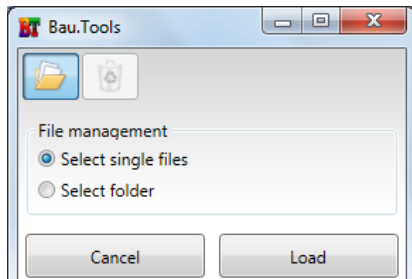


Fig. 7.2

Loading infrared images

With the button **Load infrared image(s)**, you can select single images of a sequence (.BTDF files), or all images of a folder will be load into the program.

Note:

Each sequence consists of 15 to 30 individual thermograms regardless of how long the recording time was. Additional thermograms are deleted regularly and permanently.

After loading, the window **Images** will open. The first image of the sequence will be displayed.

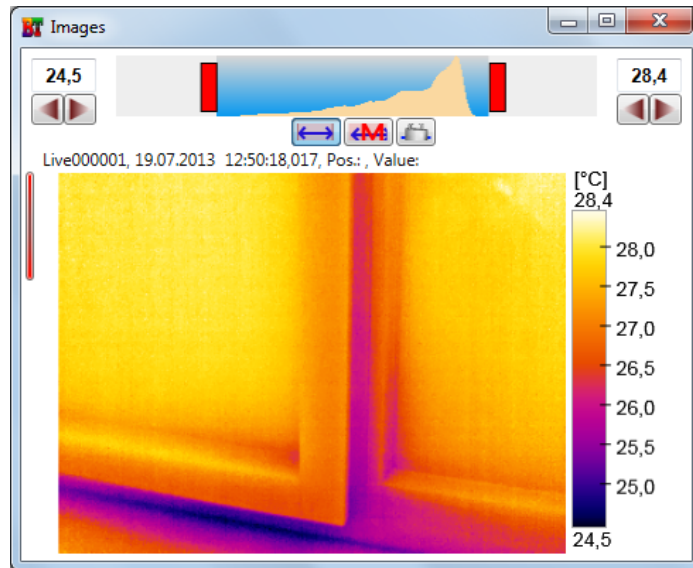


Fig. 7.3: Starting thermogram



Fig. 7.4

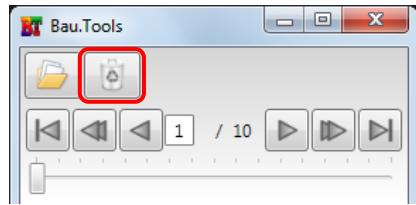



Fig. 7.5: Button Clear all

Using the **cursor** buttons or the **slider**, you can go forward or back within the sequence of images and watch the images individually or as a movie.

Load further image sequences

Before loading another image sequence for the next evaluation, delete the previously loaded infrared images by clicking on the button **Clear all**. The window **Images** as well as all evaluation windows that may have been opened are now closed. The infrared images will remain in your folder.

By closing the window **Images** with the  button, all loaded thermograms are removed from the selection.

7.2 Evaluating infrared images

The software Bau.Tools BlowerDoor generates the best possible and reproducible sequential analysis from a thermography series of 15 to 30 images.

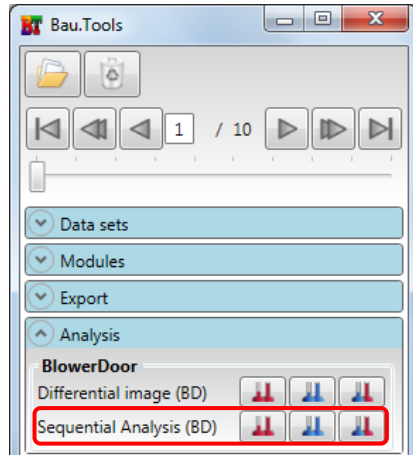


Fig. 7.6: Menu Analysis/Sequential analysis

Evaluating the sequential analysis

To evaluate the entire sequence, click on one of the *Sequential analysis* button.



Display of positive and negative changes in temperature of the analyzed images.

The window *SeqCCF_Images* will open. This image corresponds to the sequential analysis observed live when the measurement was finished and saved.



Display of **positive** changes in temperature of the analyzed images



Display of **negative** changes in temperature of the analyzed images

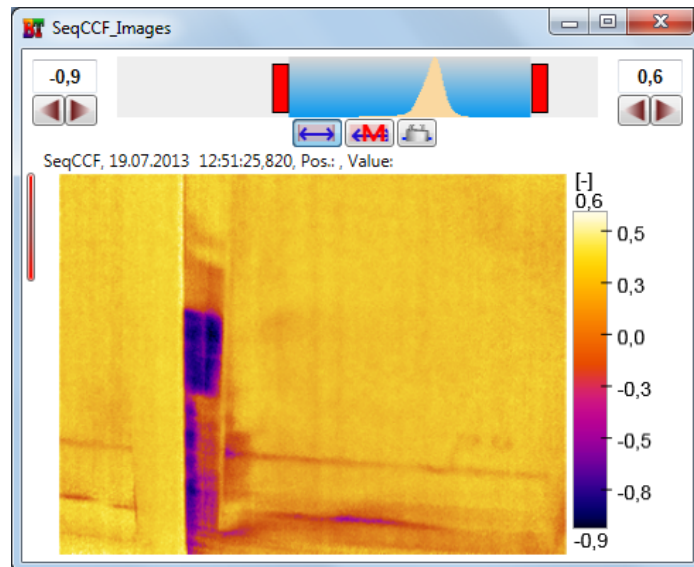


Fig. 7.7: Sequential analysis

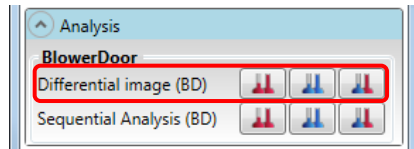


Fig. 7.8: Menu Analysis/Differential image

Evaluating the BlowerDoor differential image

To evaluate the differential image click on one of the **Differential image** button depending on the desired temperature range.

The window **Diff_Images** will open.

You will now first see the unicolored differential image 1 of 1 (starting image of the starting image). With the **cursor** keys, you can click through the individual differential images.

7.3 Settings and tools for editing infrared images

In the measurement window **Bau.Tools BlowerDoor** (see Fig. 5.8) as well as in all other windows for viewing and evaluating thermograms (e.g., the window **SeqCCF_Images**) you can edit, label, and save the images by using different tools.

These functions may already be used during the recording process.






Temperature curve

The curve shows the qualitative distribution of temperature points in the thermogram displayed.



The three controllers below the temperature curve allow you to control the range.

-  Automatic range settings (preselected)
-  Manual range control
-  Parallel range adjustment



Object parameters

$\varepsilon =$ $d =$ $\phi_{Hum} =$
 $T_{Ref} =$ $T_{Atm} =$ $\tau_{Atm} =$

Use object parameter for all images



Color palette – Settings

You may pre-set up to four color palettes for the display. Just select the color palette in the drop-down menu (center) and save it in one of the pre-selection fields by clicking your **right** mouse button.



Create histogram



Reversing color palette



Mark Overflow on/off



Add Isotherm



Mark Underflow on/off



Delete Isotherm



Load additional color palette



Actual color palette as standard



Save color palette



Marking tools (dot, line, rectangle)

With the different marking tools, you can label areas in one of the infrared images. The markings will be displayed on all opened infrared images (normal thermograms, sequential analysis, etc.). This facilitates interpretation of the test results.



Copy image/duplicate image



Save image as...

To save a snapshot during the measurement, the thermograms can be saved as different image formats (e.g., .jpg). The images are then available for, e.g., reporting.



Closing tool palette




Opening/showing tool palette

When moving the cursor over the narrow vertical red bar, the image editing menu will open.

8 Function buttons and displays in the measurement window Bau.Tools BlowerDoor

A few seconds after connecting the Minneapolis BlowerDoor and the infrared camera, the program will start to record infrared images. The images are displayed live in the measurement window (see Figure Fig. 5.8) and saved to the internal memory.


 **All of the software's buttons are provided with clear short explanations of their functions (Tooltips). To access them hover your cursor over the buttons without clicking.**



Start/Stop button to trigger the measuring fan.
The click on Start will automatically set the starting image.

Actual differential pressure [Pa] **0,0**

Display of actual pressure differential between the inside and the outside

Target differential pressure [Pa] **50** 

Field for entering desired pressure differential for the measurement



Triggering camera shutter



Triggering camera autofocus

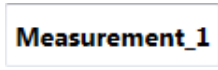


Manually setting a starting image and resetting the internal image memory



Path for the file location of the measurement data

Unless you change the path and the folder name, all measurement data will be saved to C:\My Pictures.



Input field for assigning a name to the folder for the measuring data

The path and folder name for the measurement data to be saved should be set before recording the infrared image sequence!



Saving the measurement data (details see Chapter 6.3)

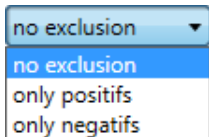
- Live image**
- Start image**
- Differential image**
- Sequential Analysis**

Display mode in the measurement window

It is possible to display live the continuously generated Differential image or the Sequential analysis. For this purpose, Live image is selected together with one of the evaluations.



Process of sequence of infrared images



Options for image display: Display of positive and negative changes in temperature of the analyzed images (no exclusion), exclusive display of positive changes in temperature, exclusive display of negative changes in temperature.

Display areas in the window Bau.Tools BlowerDoor (measurement window)

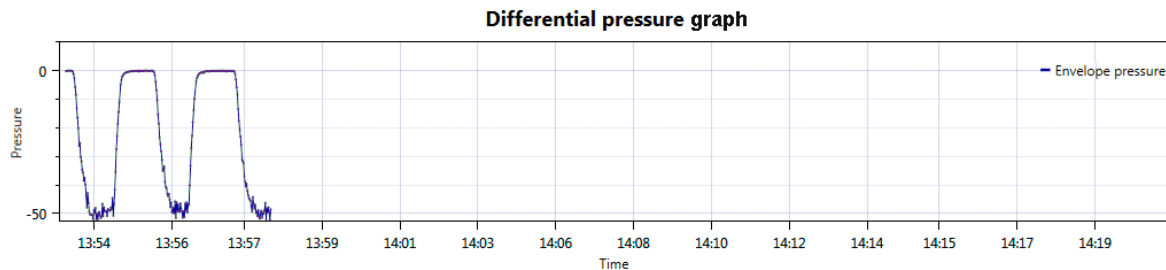


Fig. 8.1: Differential pressure curve of the building pressure after several measurements.

When saving the sequence, the entire pressure curve since starting the program will be saved.

Our service offer

Calibration of your BlowerDoor Measurement Systems

At $\pm 4\%$ (flow rings A – C resp. flow rings 1-4) and $\pm 5\%$ (flow rings D + E), both the accuracy of the BlowerDoor testing flow rings as well as that of the pressure gauge DG-700 at $\pm 1\%$ clearly exceed the legal minimum requirements.

To maintain the high measuring accuracy of the BlowerDoor Measurement System, we recommend ensuring regular calibration according to the manufacturer's specifications: The accuracy of the BlowerDoor testing fan should be checked by calibration every four years. A previous fan check forms part of each fan calibration.

BlowerDoor GmbH not only offers regular fan calibration, but also manufacturer's calibration of pressure gauges at favorable prices. Details are available on www.blowerdoor.com.

Seminars and in-house training

In addition to the extensive seminar program covering aspects of an airtight building envelope offered by the Energie- und Umweltzentrums am Deister, BlowerDoor GmbH and its contract partners also provide individual training on site or on-demand webinars. Contact us for more information!

Service at your construction site

If required, we will lend our competence to support you in conducting a BlowerDoor measurement at your construction site. Contact us for an offer tailored to your needs!

Listing in the directory of providers of BlowerDoor measurements

As a BlowerDoor testing team, your listing in our online database is free of charge. Contact us at info@blowerdoor.com if you would like an address entry, including a link to your email address and website in our directory of BlowerDoor test providers.

CompetenceCenter

All BlowerDoor testing teams receive access to our virtual Center of Competence at www.blowerdoor.com free of charge, where we regularly provide you with news and offer interesting information for download. Contact us if you have not yet received your client number and access data from BlowerDoor GmbH.

Advertising material for BlowerDoor testing teams

Upon request, we support BlowerDoor testing teams with professional printable files on BlowerDoor measurements free of charge. The material will feature your own contact data and company logo. (View a sample at www.blowerdoor.com.) If interested, send us an e-mail with your complete address and your company logo as a jpg file in printable resolution to info@blowerdoor.com.

Tech Support

If you require support or technical solutions when installing or using the Bau.Tools BlowerDoor software, please contact **bgk infrarotservice GmbH**. It offers its technical support generally free of charge (during working hours). For inquiries by e-mail please write to post@infrarotservice.de, with the subject line: Bau.Tools BlowerDoor.



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