

# Building airtightness for renovations Leaflets (Germany)

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## SUMMARY

The WTA-Leaflets (International Association for Science and Technology of Building Maintenance and Monuments Preservation", (WTA)) provide recommendations on how a defined quality of building airtightness can be achieved when renovating existing buildings. These recommendations are guidelines that support planners, builder and quality inspectors involved in construction in their implementation.

The leaflet series consists of 3 parts:

- Part 1 (WTA-Leaflet 6-9) defines the required level of airtightness for renovated buildings and building elements. Moreover, basic planning rules are formulated.
- Part 2 (WTA-Leaflet 6-10) gives information about planning details, sources of errors, construction options as well as methods to check the quality.
- Part 3 (WTA-Leaflet 6-11) focuses on suitable methods for airtightness testing with leak detection of existing and renovated buildings, including the building preparation and the best times for testing.

The leaflets are expected to be published at the end of 2024 / beginning of 2025.

## KEYWORDS

Airtightness, existing buildings, refurbishment, planning, air permeability test, quality control, airtightness concept

## 1 AIRTIGHTNESS IN EXISTING BUILDINGS

In Germany, the requirements for the airtightness of buildings are widely accepted and are applied to new buildings. In comparison, this is rarely the case when renovating existing buildings, although there is significant potential for saving energy.

A good airtightness of the building envelope protects the construction against condensation due to convection, reduces energy consumption due to uncontrolled air exchange and increases comfort by preventing draughts.

The current revision of the WTA leaflet series from 2015 [Vogel] is intended to help focus attention once again on the need for a defined quality of airtightness, even in existing buildings. The developments of recent years in the field of processing and new airtightness materials will be brought up to date. The leaflets are scheduled to be published at the end of 2024 or beginning of 2025.

The aim is to achieve an airtightness after a renovation or extension of existing buildings that is comparable to that of a new building. In cases where the "new building standard" cannot be achieved, the aim is to achieve the best possible quality. Controlled mechanical ventilation is also taken into consideration for a demand-oriented air exchange rate in order to prevent, among other things, the entry of humid indoor air into the construction via individual leaks in the air barrier.

These leaflets have been updated to the best of the knowledge and belief by experts with many years of experience in the areas of planning, production and measurement in the field of airtightness in new and existing buildings, without any claim to completeness.

The leaflet series consists of three parts:

- Part 1: General principles of planning (WTA Leaflet 6-9)
- Part 2: Detailed planning and execution (WTA Leaflet 6-10)
- Part 3: Measuring Procedure (WTA Leaflet 6-11)

### 1.1 Part 1: General principles of planning (WTA-Leaflet 6-9)

In Part 1, methods are presented for determining a level for the airtightness for an existing building or building component in the case of renovation and basic planning rules are explained.

To ensure that a building renovation is successful in improving the thermal insulation and airtightness of the building envelope, it is essential to first analyze the existing building. In addition to the building inspection, an airtightness measurement (single-point measurement) with leak detection is recommended. Based on this, an airtightness requirement for the renovated building can be defined and the air barrier planned.

To assess the quality of the airtightness of the existing building envelope, the air permeability  $q_{E50}$  is used as the key value, because it is independent of the surface/volume ratio of the building. It is used to describe the leakage rate at 50 Pa in relation to one square meter of building envelope.

The primary goal when making changes to the building envelope is to improve the quality of the air barrier. In order to be able to set requirements (target value or limit value) for the air permeability, four cases (Figure 1) are considered:

Figure 1: (1) Existing building (2) Partial renovation (3) Extension to existing building (4) Complete renovation  
(note on the graphic: lines with dots = not renovated; solid line = refurbished or new)



#### *Case 1: Checking the airtightness of the existing building (Figure 1, Case 1)*

The air permeability of the existing building envelope is determined by a single-point measurement. This is the basis for further decisions and planning.

#### *Case 2: Renovation parts of the building envelope (Figure 1, Case 2)*

In the case of partial renovation of the building envelope, the target air permeability for the entire building is determined using a calculation formula based on the measured permeability for the unrenovated envelope areas and the air permeability at new-build level for the renovated envelope areas.

#### *Case 3: Extension of the heated building volume (Figure 1, Case 3)*

For newly added parts of the building, the aim is to achieve the level of a new building. The target air permeability for the entire building is determined using a calculation formula based

on the measured permeability for the unrenovated envelope areas and the desired air permeability for the new envelope areas.

*Case 4: Full renovation (Figure 1, Case 4)*

If the building is completely renovated, the requirements of new buildings will be applied.

Components (e.g. windows or doors) that are to be retained for historical reasons are treated separately.

It is clearly stated that a ventilation concept is required when improving the airtightness of a building so that a defined air exchange can take place and, among other things, indoor air humidity can be extracted in a controlled way.

The leaflet lists data from previous experience for the air permeability and air exchange rates of existing buildings. It also presents specific target values / limit values for full renovations, depending on the desired building quality (e.g. Building Energy Act standard or passive house standard).

## **1.2 Part 2: Detailed planning and execution (WTA- Leaflet 6-10)**

Part 2 provides information on planning details, sources of errors, execution options and methods for verifying the quality achieved. It is based on the basic planning principles of Part 1.

Detailed information is provided on the planning and execution of the air barrier of the heat-transferring building envelope such as roof surfaces, exterior walls and basement ceilings, among others. Different constructions (masonry, timber construction, etc.), the position of the air barrier, e.g. in the roof construction or stairwells to unheated basements, are presented based on current developments and risks during implementation are examined in detail. The installation of the air barrier when replacing windows and external doors is shown, as well as the handling of bonding and sealings, taking into account the nature of new and existing bases. Reference is also made to the need for quality assurance and quality control during the installation of the air barrier.

## **1.3 Part 3: Measuring Procedure (WTA- Leaflet 6-11)**

Part 3 explains suitable methods for measuring the airtightness of existing buildings, including a description of the preparation of the building and the best times to do tests.

In addition to the "final measurement" with measurement of the air permeability after completion of the renovation, two further testing times are suggested: the first test before and the second during the renovation.

*Measurement 1: Before the renovation as a status analysis*

This inspection is important in order to obtain an overview of the existing air permeability of the building envelope and the qualities of the individual air barriers. The focus is on leakage detection at approx. 50 Pa negative pressure, so a simple single-point test with an estimate of the air permeability  $q_{E50}$  is sufficient. This investigation is the essential basis for planning the air barrier.

*Measurement 2: During the renovation - quality controls*

This inspection at a negative pressure of approx. 50 Pa during the renovation process is used to check the planned air barrier for defects. If leaks are detected, they can be eliminated quickly and easily at this phase of construction and plans and installations can be adapted if problems arise. With a simple single-point measurement, it is possible to document the air permeability at the time of measurement.

*Measurement 3: After the renovation - final measurement*

After finishing the building envelope, the final measurement is carried out according to DIN EN ISO 9972. The test result is compared with the target air permeability. At the time of this measurement, the air barriers are often covered and no longer accessible. Improvement is only possible at an extremely high effort.

This leaflet provides further information on, among other things, guard zone tests that prevent internal airflows between adjacent building sections, as well as on sectional measurements for large buildings or buildings that cannot be measured as a single unit due to their complexity or the construction process.

## 2 REFERENCES

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