

**Pressure testing of the airtightness of buildings and sound level measurement with respect to the surroundings – sub-project under Technology procurement for heat recovery systems in existing apartment blocks.**

**Background**

Bengt Bergqvist of Energianalys has carried out air permeability tests and sound measurements in apartment blocks for Åsa Wahlström of CIT Energy Management.

**Airtightness tests**

The air permeability tests were performed in accordance with Swedish Standard SS-EN 13829 during March and April 2010 in a total of 16 apartments in nine apartment blocks.

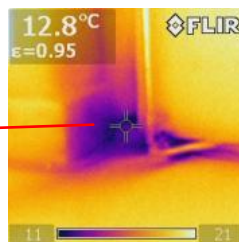
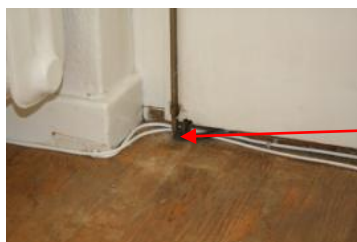
Air inlet vents, air exhaust vents and cooker hood ducts were sealed with plastic and tape before the tests began. Traps in floor gullies, washbasins, WC-pans and sinks were filled with water.

In two apartments which had an open fireplace, measurements were performed both with the fireplace unsealed but with the damper closed and with the fireplace sealed and the damper closed.



Figure 1. The pressure testing fan was installed in the balcony door opening or in the front door opening. The speed of the fan was adjusted to maintain a negative pressure of -50 Pa and the air flow across the inlet nozzle was measured.

When the leakage air flow had been determined, a systematic search of all rooms was undertaken to locate leaks in the shell of the building, in partition walls between apartments and in floors.



Figures 2a and 2b. The leakage flows through the shell were located and documented with a FLIR i50 thermal imaging camera.



Figure 3. Leakage flows from neighbouring apartments and other areas were located by feeling with a hand and with smoke bottles (RFA) and air velocity meters (TSI).

### **Sound level measurements**

Sound level measurements with respect to the surroundings were performed in order to determine the degree of sound insulation of the external walls. These tests comprised sound level measurement in rooms with a balcony and outdoors on the balcony. Measurements were carried out in accordance with SS 025267, with and without weighting filters: A-, B- and C-filters.

Unwanted sources of noise, such as wall clocks were located and stopped before measurements were made. Measurement could then proceed.



Figure 4. Sound level meter, Quest model 155.

### **Measuring equipment**

“Minneapolis blower door”, Model 4, pressure testing equipment.

Pressure/air velocity meter TSI Model 8360-M-S VelociCalc, serial no. 409062.

Swema 3000 pressure gauge/air velocity meter with probe SWA 31.

Quest precision sound level meter Model 155 with octave band filter.

### Tested apartment blocks

Airtightness tests and sound measurements were performed on the following properties and apartments.

Fastighetsägare	Adress	Täthetsprovning	Ljudmätning
Helsingborgshem	Rosenbergsgatan 24 A (apartment 1)	X	X
Helsingborgshem	Rosenbergsgatan 24 A (apartment 2)	X	-
Hyresbostäder i Växjö	Sandviksvägen 38 B (apartment 1)	X	X
Hyresbostäder i Växjö	Sandviksvägen 38 B (apartment 2)	X	X
Huge Fastigheter	Kommunalvägen 20 (apartment 1)	X	X
Huge Fastigheter	Kommunalvägen 20 (apartment 2)	X	X
Stockholmshem	Åmänningevägen 64	X	-
Stockholmshem	Åmänningevägen 68	X	X
Stockholmshem	Skattungsvägen 23	X	X
Familjebostäder	Spångavägen 72 (apartment 1)	X	-
Familjebostäder	Spångavägen 72 (apartment 2)	X	X
Familjebostäder	Spångavägen 74	X	X
Familjebostäder	Saltvägen 10 (apartment 1)	X	X
Familjebostäder	Saltvägen 10 (apartment 2)	X	X
Örebrobostäder	Tallrisvägen 43 L	X	X
Örebrobostäder	Granrisvägen 1G	X	X

### Results

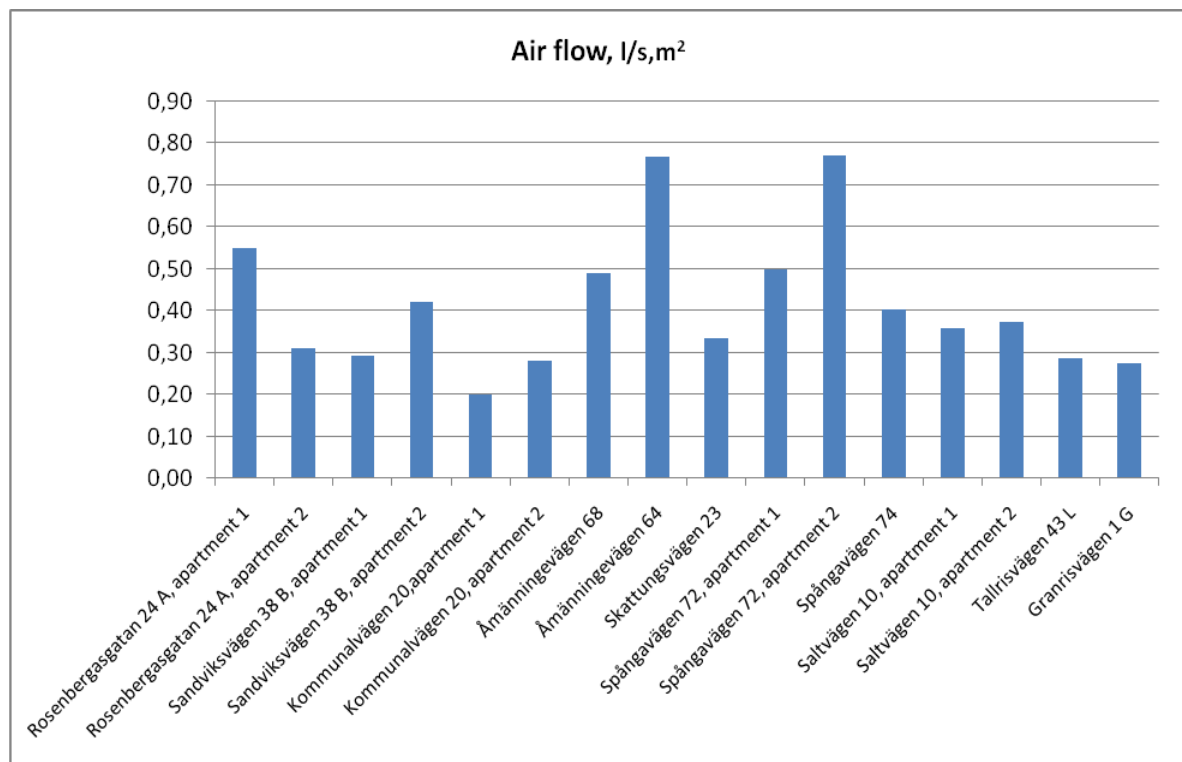


Figure 5. Results of airtightness testing

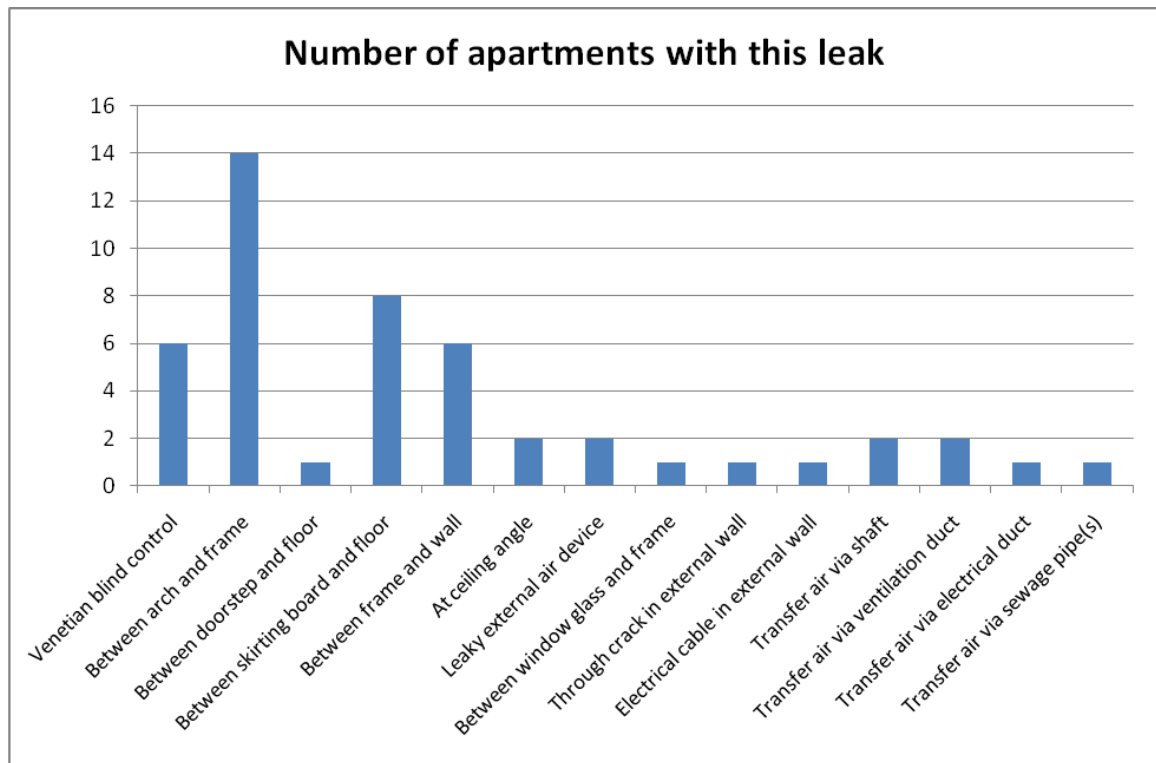


Figure 6. Number of apartments with this leak. 14 of 16 apartments studied have leaks between sash and frame and/or between door and frame. In six apartments there are leaks between frame and external wall. In eight apartments there are leaks at the floor through the external wall.

#### Comments

Rosenberggatan 24 A apt 1, Helsingborg has major leakage between window sash and frame in the bathroom.

Spångavägen 72 (apt 2), Spångavägen 74 in Spånga and Åmänningevägen 64 in Årsta have major leakage between balcony door and frame/threshold.

Tallrisvägen 43 and Granrisvägen 1 in Örebro have an old supply air system which is no longer in use but which is connected to other apartments in the building. About 50% of all leakage air is in the form of transfer air from other apartments.

Saltvägen 10, apt 1 and apt 2, Farsta, have a leaky shaft as a result of the replacement of main services. There have been complaints about problems with the spread of tobacco smoke between apartments, for example.

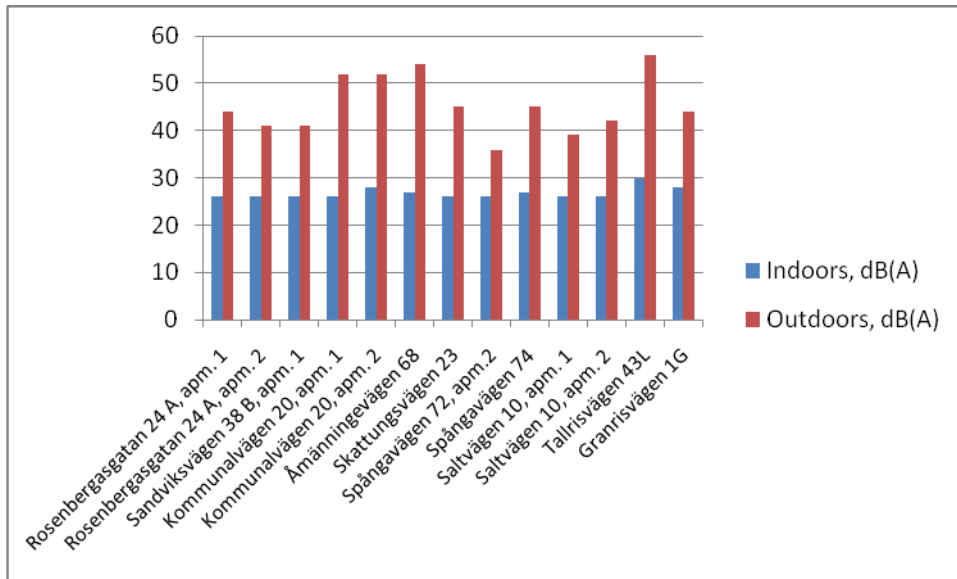


Figure 6. Sound level measurement with weighting filter A. (Readings below 26 dB(A) are reported as 26 dB(A) since this the lower measuring limit of the meter.)

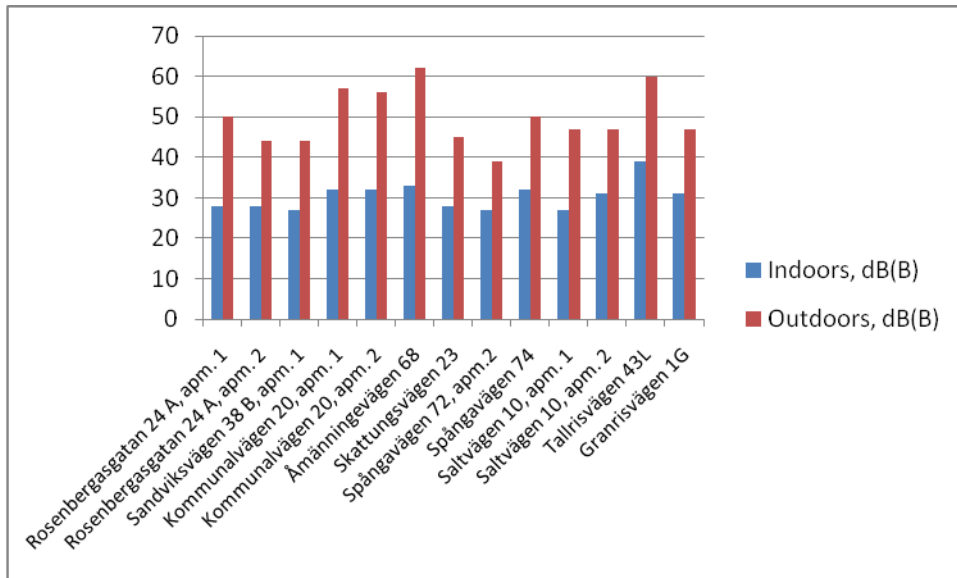


Figure 7. Sound level measurement with weighting filter B.

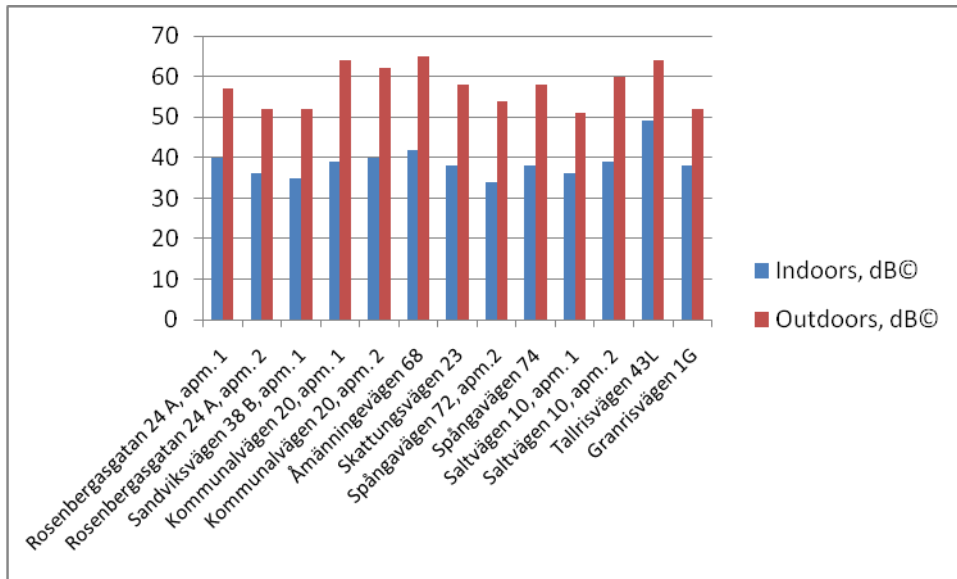


Figure 8. Sound level measurement with weighting filter C.

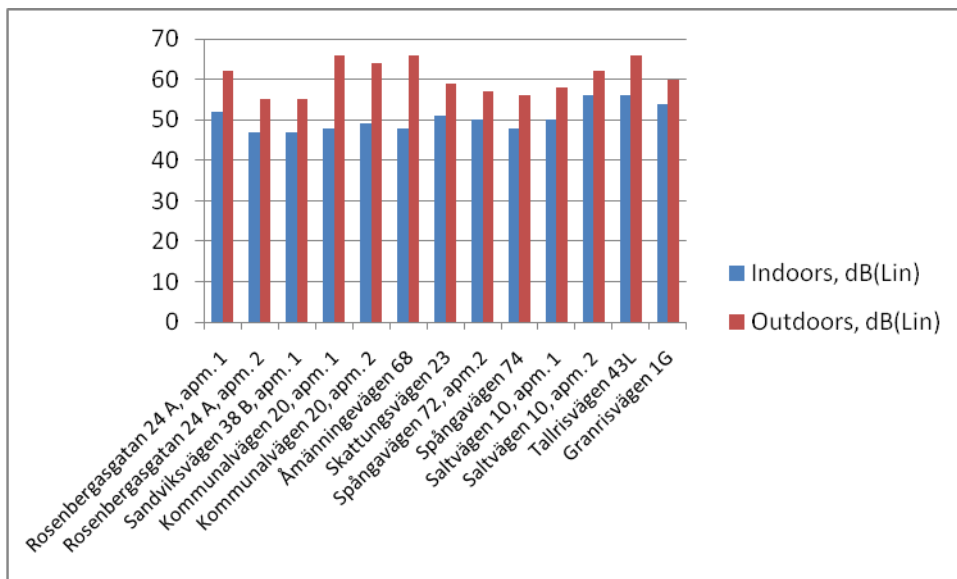


Figure 9. Sound level measurement without weighting filter.

Comments

During the sound level measurements, occasional higher sound levels from, for example, passing lorries and trains and from crows were not included. Only the "normal basic noise" was measured.

However, at Tallrisvägen 43 an excavator was working continuously outside the apartment, so the noise levels are higher for that apartment. Similarly, the noise levels at the apartment at Granrisvägen 1 G are slightly higher as a result of children playing in a sandpit outside the apartment.

2010-04-19  
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**Appendix:**  
Illustration appendices with photos.



**Rosenborgsgatan 24A, gable apartment no 1.**



Figure 1a. Rosenborgsgatan 24 A, entrance.



Figure 1b. Rosenborgsgatan 24 A, balcony side.



Figure 2a. At air tightness tests was the hood temporarily tightened.



Figure 2b. At air tightness tests were external air devices and exhaust air devices temporarily tightened.



Figure 3a. The Blower Door was placed at the balcony opening.

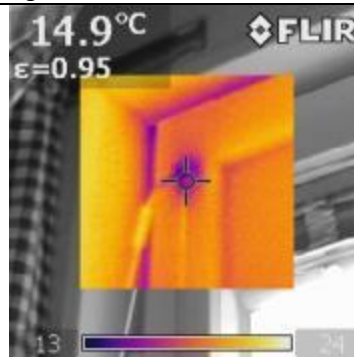


Figure 3b. Leakages through bushings for venetian blind control in kitchen.





Figure 4a. Kitchen.

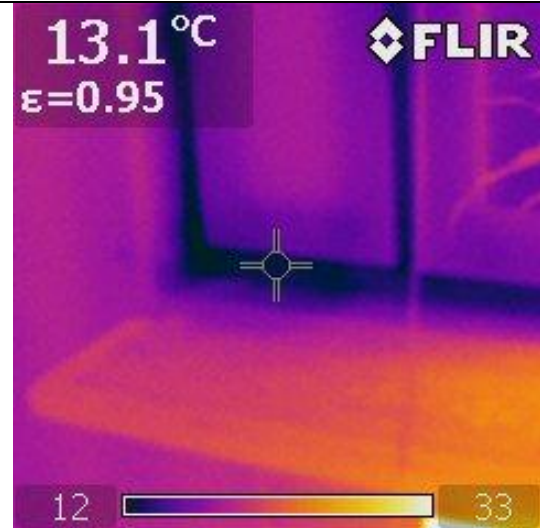


Figure 4b. Leakage between window frame and arch.



Figure 5a. Kitchen.

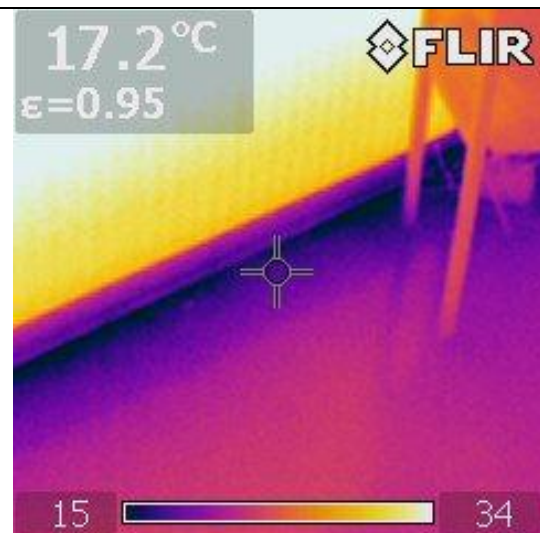


Figure 5b. Leakages between skirting-board and floor.



Figure 6a. Living room.

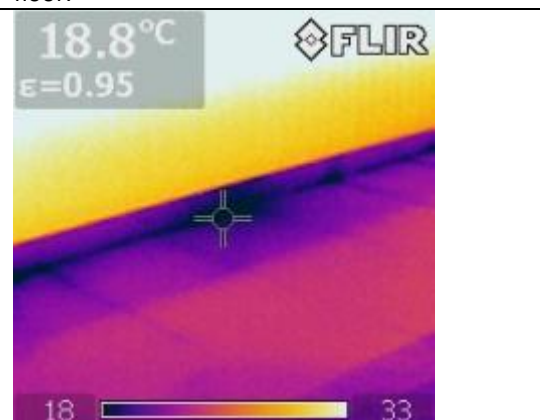


Figure 6b. Leak through external wall between skirting-board and floor.

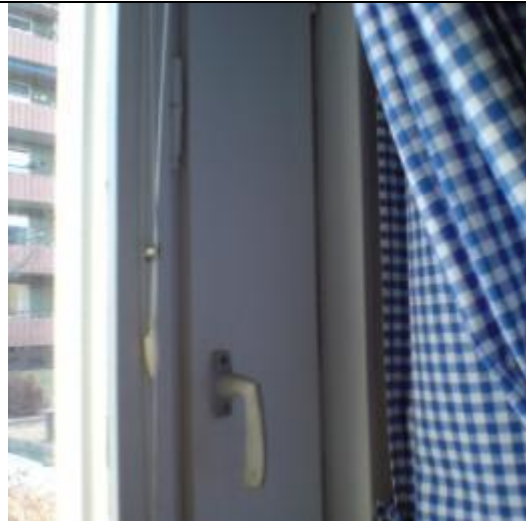


Figure 7a. Kitchen.

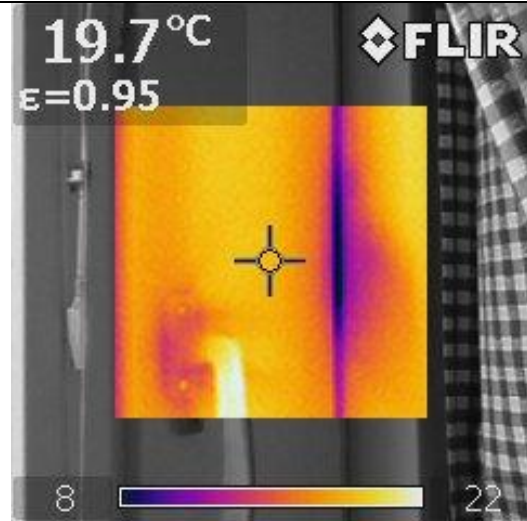


Figure 7b. Leakage between window frame and arch.



Figure 8a. Bath room.

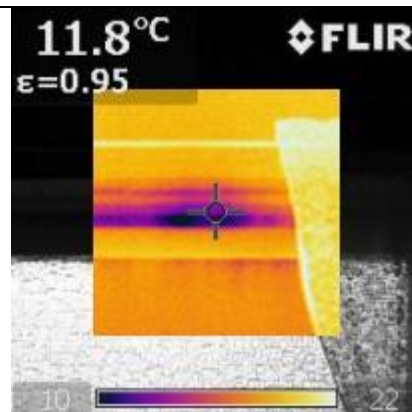


Figure 8b. Leakage between window frame and arch.



Figure 9a. Living room. Crack between window frame and external wall.

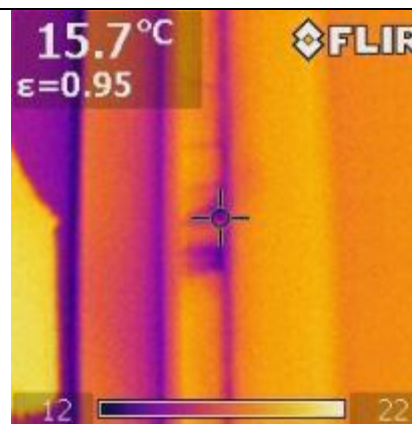


Figure 9b. Leakage through crack between window frame and external wall.

**Rosenbergsgatan 24A, Apartment no 2, entrance floor.**



Figure 1a. Rosenbergsgatan 24 A, entrance.



Figure 1b. Rosenbergsgatan 24 A, balcony side.



Figure 2a. The Blower Door was mounted at the balcony door opening.



Figure 2b. Living room. Leakage was registered through splice between external wall and floor.



Figure 3a. Living room.

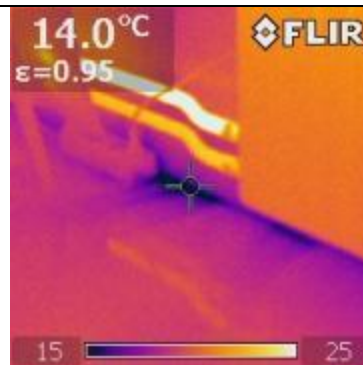


Figure 3b. Leakage through external wall between skirting-board and floor.



Figure 4a. Living room.

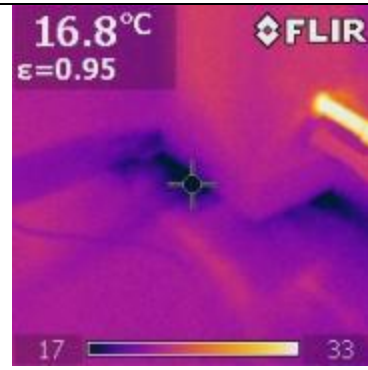


Figure 4b. Leakage through external wall between skirting-board and floor.

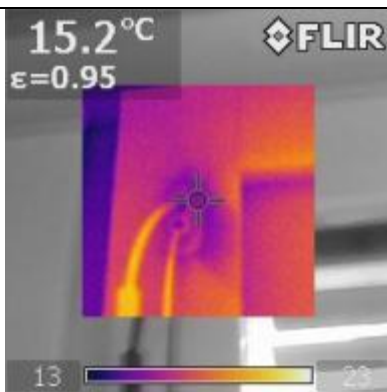


Figure 5a. A small leak through bushings for venetian blind control.

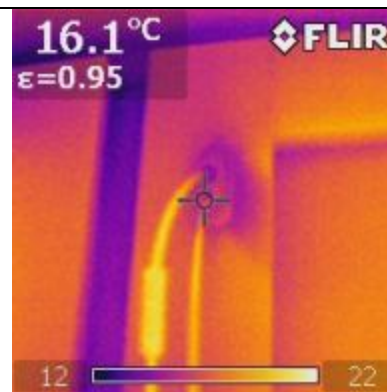


Figure 5b. A small leak through bushings for venetian blind control.



**Sandviksvägen 38 B, Växiö, Lägenhet, 1 tr.**



Bild 1a. Sandviksvägen 38 B. Entrésida mot gård.



Bild 1b. Sandviksvägen 38 B. Balkongsida mot Sandviksvägen.



Bild 2a. Uteluftsdon bakom radiator tätades provisoriskt under provningen.



Bild 2b. Uteluftsdon bakom radiator tätades provisoriskt under provningen.



Bild 3a. Vardagsrum.

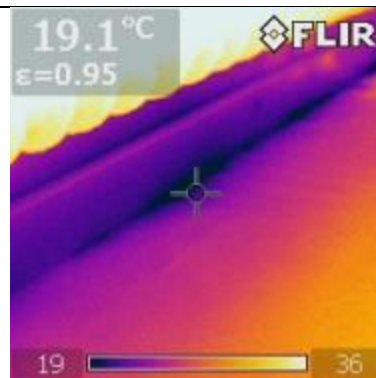


Bild 3b. Läckage genom yttervägg, i skarv mellan golvsockel och golv.



Bild 4a. Sovrum.

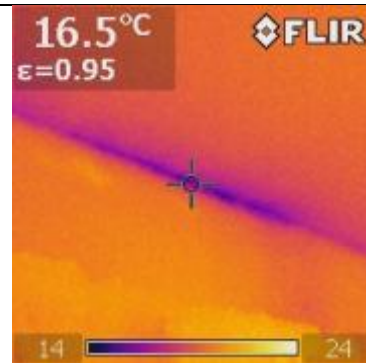


Bild 4b. Läckage genom yttervägg, i takvinkel.



Bild 5a. Sovrum.



Bild 5b. Läckage genom yttervägg, i skarv mellan golvsockel och golv.



Bild 6a. Sovrum.

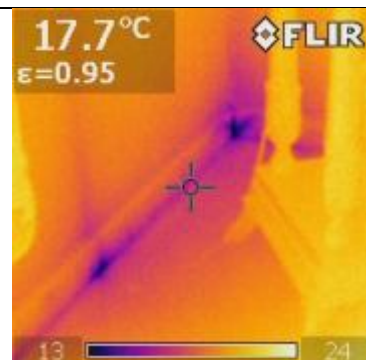


Bild 6b. Läckage genom yttervägg, i skarv mellan golvsockel och golv.



Bild 7a. Kök.

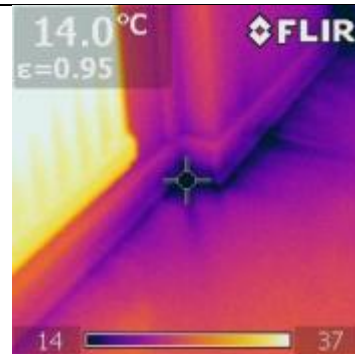


Bild 7b. Läckage genom yttervägg, i skarv mellan golvsockel och golv.



Bild 8a. Kök.

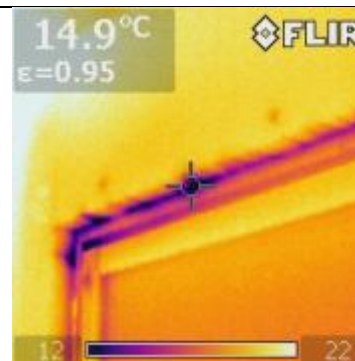


Bild 8b. Läckage i skarv mellan fönsterkarm och yttervägg.



**Sandviksvägen 38 B, Apartment no 2, third floor.**



Figure 1a. Sandviksvägen 38 B. Entrance.



Figure 1b. Sandviksvägen 38 B. Balcony side.



Figure 2a. Living room.

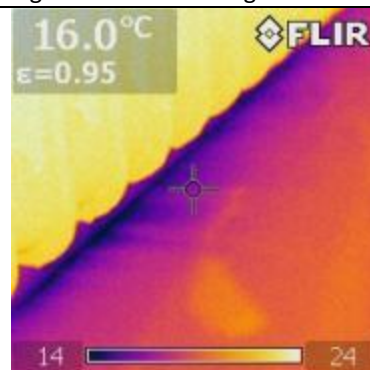


Figure 2b. Leak through external wall between skirting-board and floor.



Figure 3a. Living room.

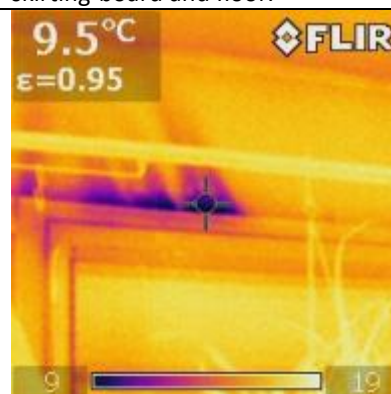


Figure 3b. Leak between window frame and external wall.



Figure 4a. Bed room.

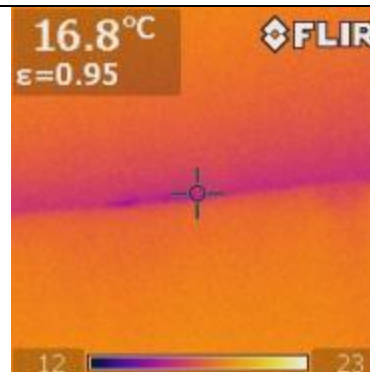


Figure 4b. Leak through external wall, in ceiling angle.



Figure 5a. Kitchen, kitchen cupboard.

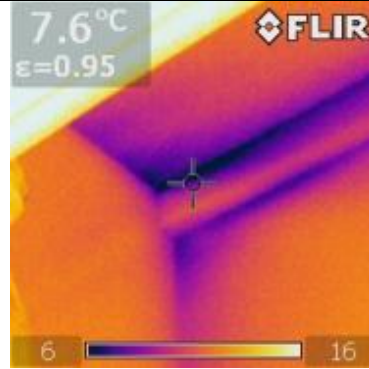


Figure 5b. Leak through external wall in ceiling angel inside kitchen cupboard.



Figure 6a. Kitchen, airing window.

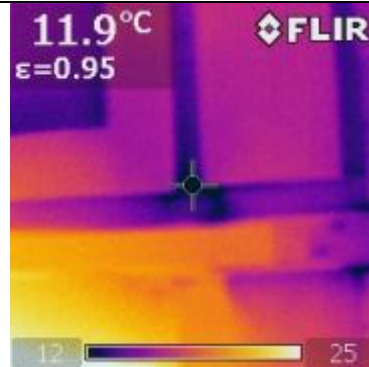


Figure 6b. Leak between window frame and arch.



Figure 7a. Kitchen.

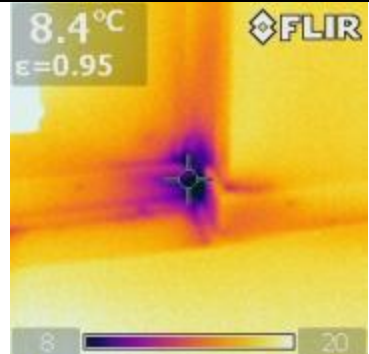


Figure 7b. Leak through external wall, at skirting-board.



Figure 8a. Kitchen.

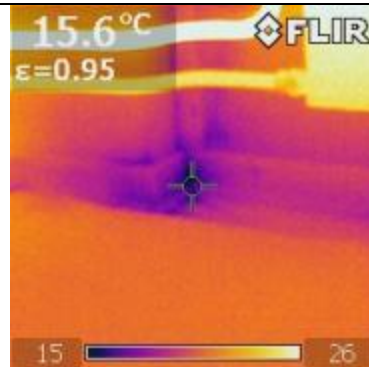


Figure 8b. Leak through external wall, at skirting-board.

**Kommunalvägen 20, Huddinge, Apartment no 1, 6<sup>th</sup> floor.**



Figure 1a. Kommunalvägen 20, Entrance towards west.



Figure 1b. Kommunalvägen 20. Facades towards east and north.



Figure 2a. Living room, leak trough window frame and arch.



Figure 2b. Living room, leak trough window frame and arch.



Figure 3a. Bed room, leak trough window frame and arch.

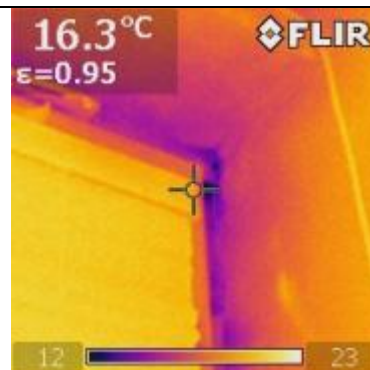


Figure 3b. Bed room, leak trough window frame and arch.



Figure 4a. Leak trough window frame and arch.

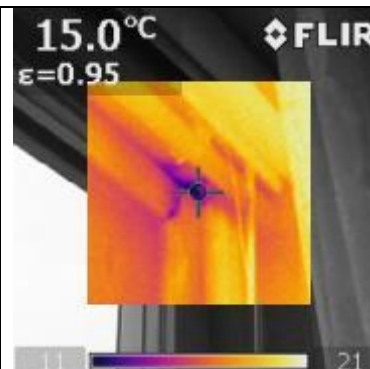


Figure 4b. Leak trough window frame and arch.





Figure 5a. Bed room, leak trough window frame and arch.

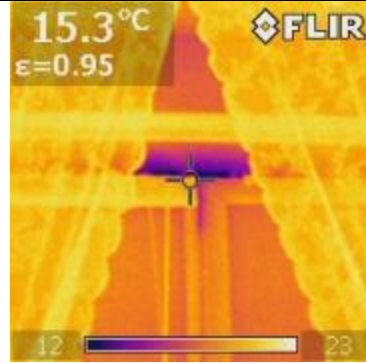


Figure 5b. Bed room, leak trough window frame and arch.



Figure 6a. Bed room, leak trough window frame and arch.



Figure 6b. Bed room, leak trough window frame and arch.



Figure 7. Air tightness testing were performed both with sealed stove and unsealed stove. No measurable difference in air flows were registered. The smoke damper, which was closed in both measurements, is obviously air tight.

**Kommunalvägen 20, Huddinge, Apartment no 2, third floors.**



Figure 1a. Kommunalvägen 20, Entrance towards west.



Figure 1b. Kommunalvägen 20. Facades towards east and north.



Figure 2a. Living room.



Figure 2b. Living room. Blower Door placed in opening for balcony door.



Figure 3a. Bed room, leak trough window frame and arch.

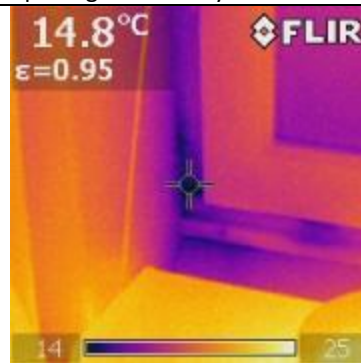


Figure 3b. Bed room, leak trough window frame and arch.



Figure 4a. Kitchen, leak between skirting-board and floor.

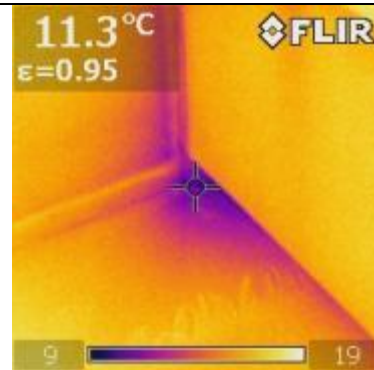


Figure 4b. Kitchen, leak between skirting-board and floor.

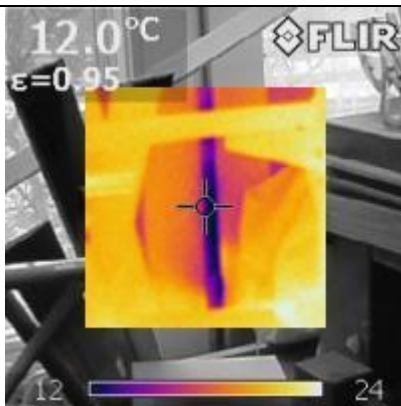


Figure 5a. Bed room, leak trough window frame and arch.

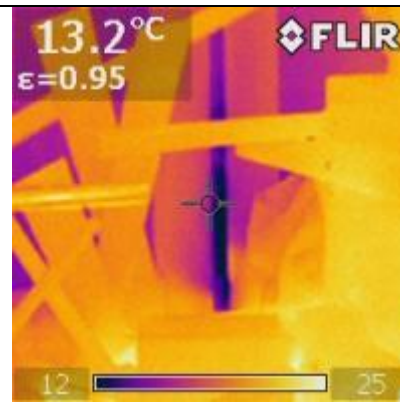


Figure 5b. Bed room, leak trough window frame and arch.

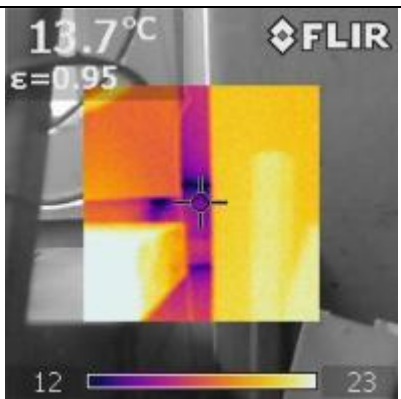


Figure 6a. Bed room, leak trough window frame and arch.

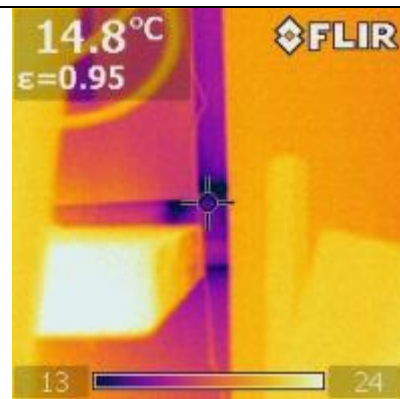


Figure 6b. Bed room, leak trough window frame and arch.

**Åmänningevägen 68, Årsta, Apartment no 1, second floor**



Figure 1a. Åmänningevägen, Entrance



Figure 1b. Åmänningevägen.



Figure 2a. Bed room, leak trough window frame and arch.

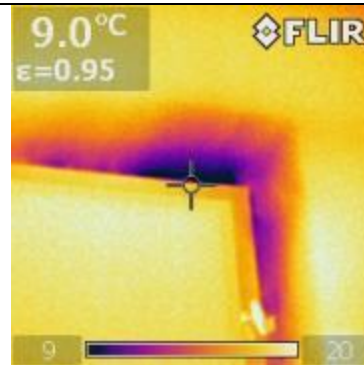


Figure 2b. Bed room, leak trough window frame and arch.



Figure 3a. Bath room, leak trough window frame and arch.

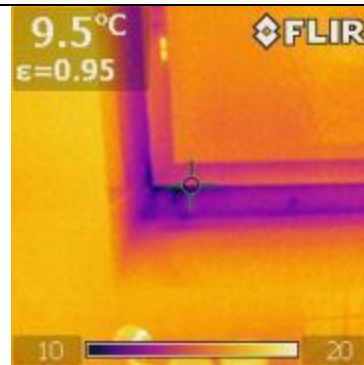


Figure 3b. Bath room, leak trough window frame and arch.





Figure 4a. Kitchen, leak trough window frame and arch.

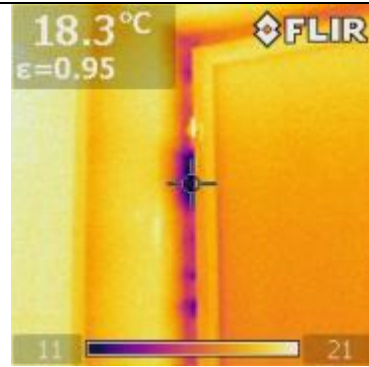


Figure 4b. Kitchen, leak trough window frame and arch.



Figure 5. Leak trough window frame and arch.

**Åmänningevägen 64, Årsta, Apartment no 2, Second floor**



Figure 1a. Åmänningevägen 64. Entrance



Figure 1b.



Figure 2a. Leak between windowframe and arch.

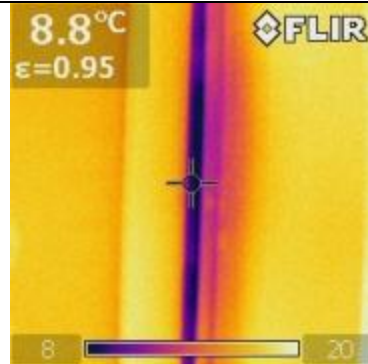


Figure 2b. Leak between windowframe and arch.



Figure 3a. Leak between windowframe and exterior wall.

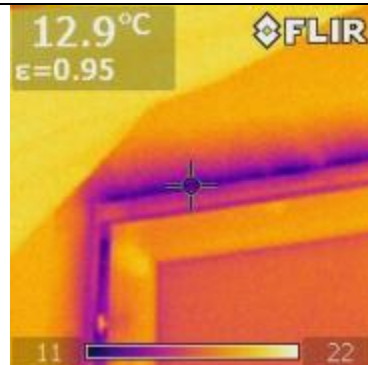


Figure 3b. Leak between windowframe and exterior wall.



Figure 4a. Leak between window frame and arch.



Figure 4b. Leak between window frame and arch.



Figure 5a. Leak between windowframe and arch.

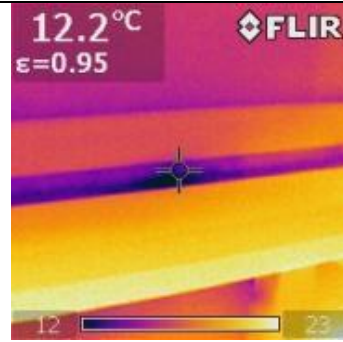


Figure 5b. Leak between windowframe and arch.



Figure 6a. Balcony door.

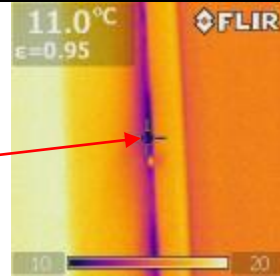


Figure 6b. Leak through crack in door frame.



Figure 6c. Crack in door frame.

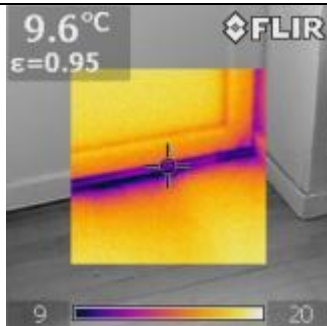


Figure 7a. Balcony door, leak between doorstep and floor.



Figure 7b. Balcony door, leak between doorstep and floor.



Figure 8a. Kitchen, leak trough window frame and arch.

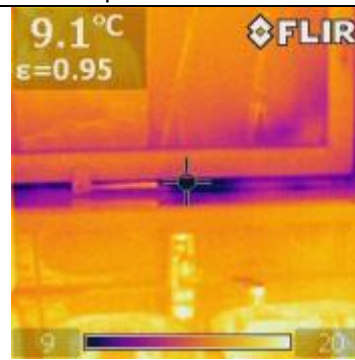


Figure 8b. Kitchen, leak trough window frame and arch.

**Skattungsvägen 23, Årsta, Gable apartment on second floor**



Figure 1a. Skattungsvägen 23. Entrance.



Figure 1b. Skattungsvägen 23. Balcony side.

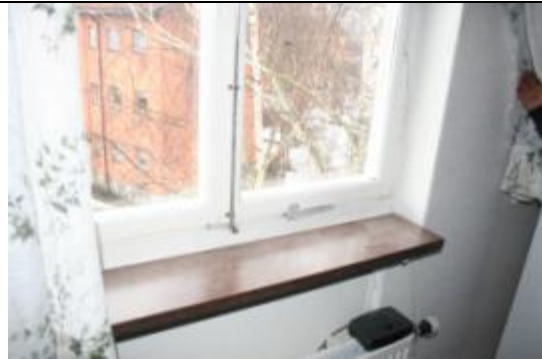


Figure 2a. Leak trough window frame and arch.

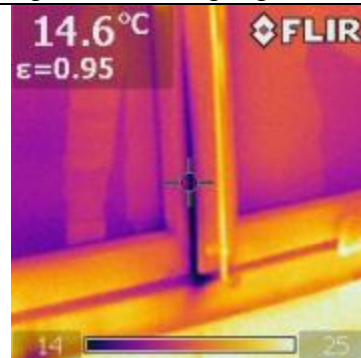


Figure 2b. Leak trough window frame and arch.



Figure 3a. Läckage vid genomföring för persiennstyrning.

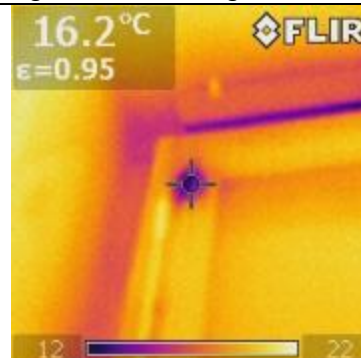


Figure 3b. Läckage vid genomföring för persiennstyrning.



Figure 4a. Leak trough window frame and arch.

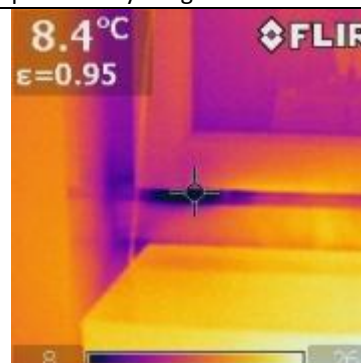


Figure 4b. Leak trough window frame and arch.





Figure 5a. Leak through window frame.

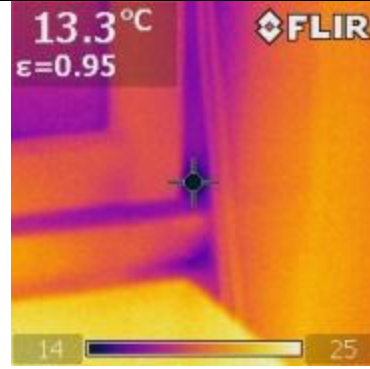


Figure 5b. Leak through window frame.



Figure 6a. Balcony door, living room

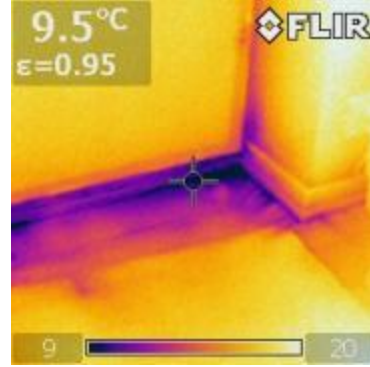


Figure 6b. Leak between skirting-board and floor.



Figure 7a. Balcony door, living room

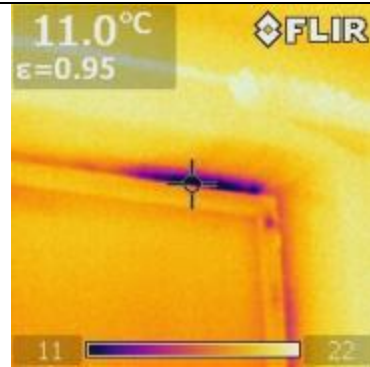


Figure 7b. Leak between door frame and arch.



Figure 8a. Leak trough crack in window frame.

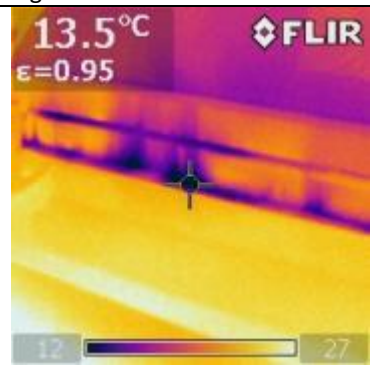


Figure 8b. Leak trough crack in window frame.

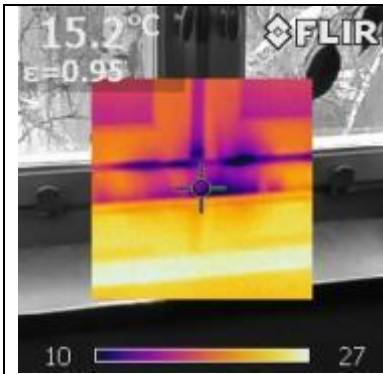


Figure 9a. Leak trough crack in window frame and between window frame and arch.

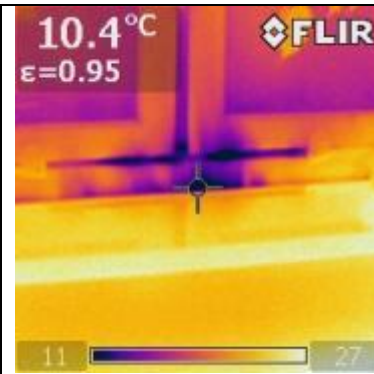


Figure 9b. Leak trough crack in window frame and between window frame and arch.



Figure 10a. Leak trough window frame and arch.



Figure 10b. Leak trough window frame and arch.

**Spångavägen 72, Apartment no 1, first floor.**



Figure 1. Spångavägen 72. Entrance



Figure 2a. Leak at balcony door.

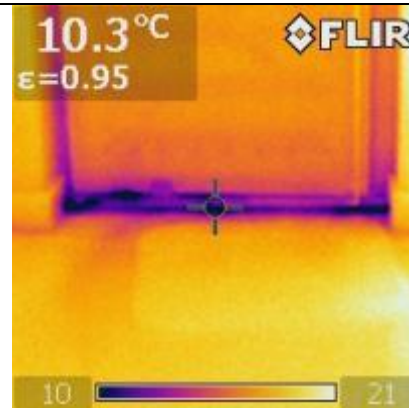


Figure 2b. Leak at balcony door.



Figure 3a. Leak trough window frame and arch.



Figure 3a. Leak trough window frame and arch.



Figure 4a. Leak trough window glas and arch and between frame and arch.



Figure 4b. Leak trough window glas and arch and between frame and arch.





Figure 5a. Leak trough window frame and arch.

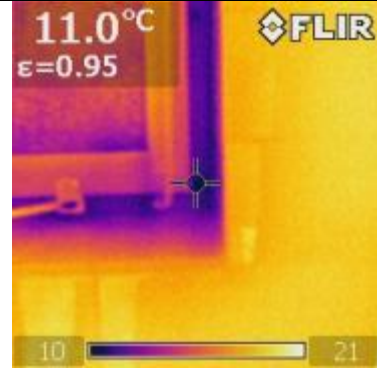


Figure 5b. Leak trough window frame and arch.



Figure 6a. Leak trough window frame and arch.

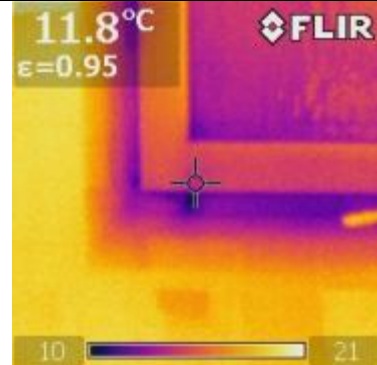


Figure 6b. Leak trough window frame and arch.

**Spångavägen 72, Apartment no 2, first floor.**



Figure 1. Spångavägen 72.



Figure 2a. Leak trough window frame and arch.

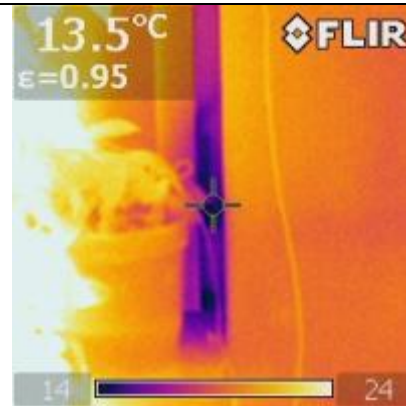


Figure 2a. Leak trough window frame and arch.



Figure 3a. Leak through balcony door (between arch and frame/ doorstep).

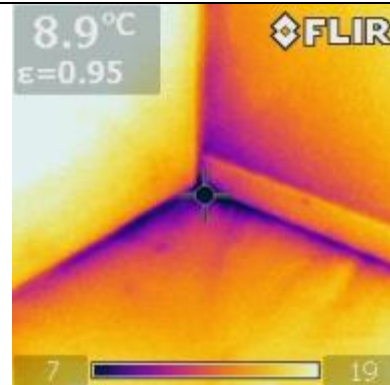


Figure 3b. Leak through balcony door (between arch and frame/ doorstep).



Figure 4a. Leak between skirting-board and floor.

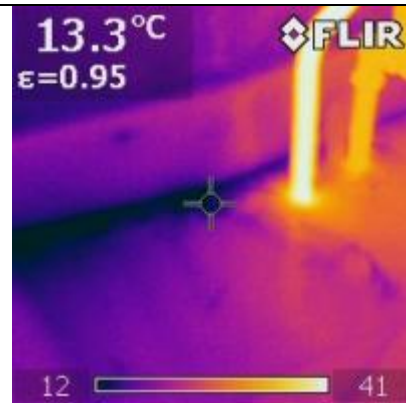


Figure 4b. Leak between skirting-board and floor.

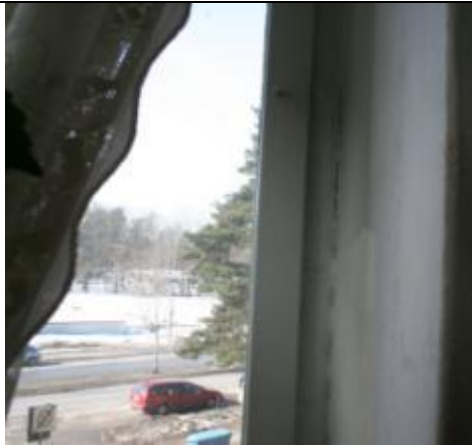


Figure 5a. Leak trough window frame and arch.

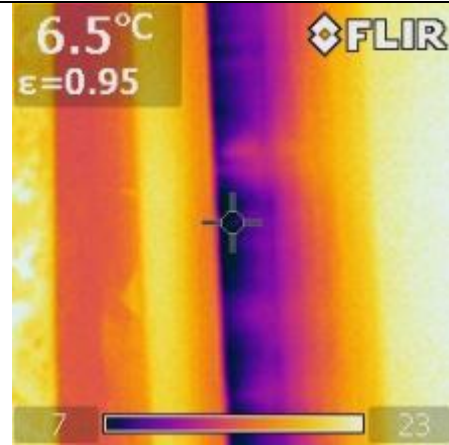


Figure 5b. Leak trough window frame and arch.



Figure 6a. Leak trough window frame and arch.

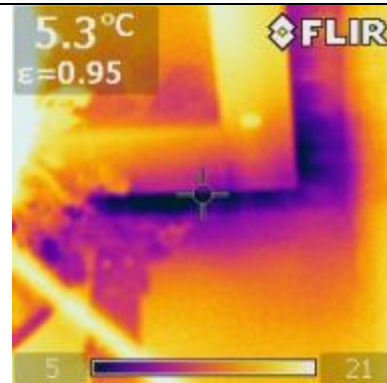


Figure 6a. Leak trough window frame and arch.



Figure 7a. Leak trough window frame and arch.

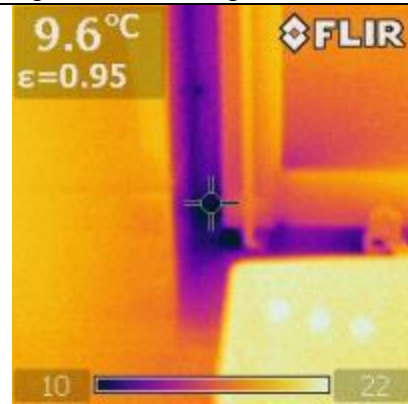


Figure 7b. Leak trough window frame and arch.

**Spångavägen 74, Apartment on second floor.**



Figure 1. Spångavägen 74.



Figure 2a. Leak at balcony door, between arch and door frame/step.

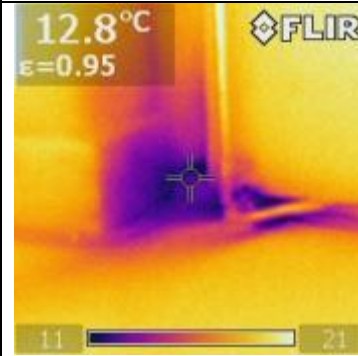


Figure 2b. Leak at balcony door, between arch and door frame/step.



Figure 3a. Bath room, leak trough window frame and arch.



Figure 3b. Bath room, leak trough window frame and arch.





Figure 4a. Leak between external air device and window arch.



Figure 4b. External air device (type Biobe)



Figure 5a. Air tightness testing were performed both with sealed stove and unsealed stove. The smoke damper was closed in both measurements.



Figure 5b. No measurable difference in air flows were registered between sealed and unsealed stove.

**Saltvägen 10, Apartment no 1, first floor.**



Figure 1. Saltvägen 10.

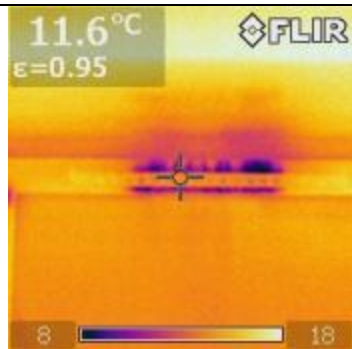


Figure 2a. Leak through crack between external air device and window arch.



Figure 2b. Leak through crack between external air device and window arch.

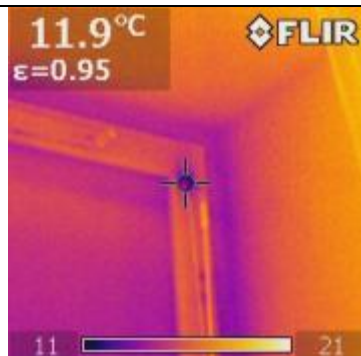


Figure 3a. Leak through bushings for venetian blind control.

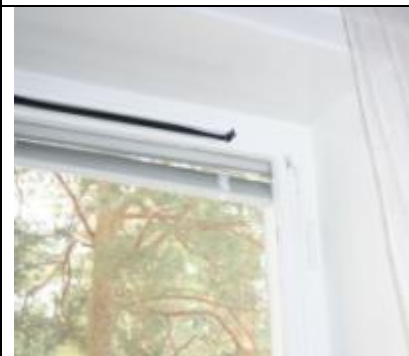


Figure 3b. Leak through bushings for venetian blind control.

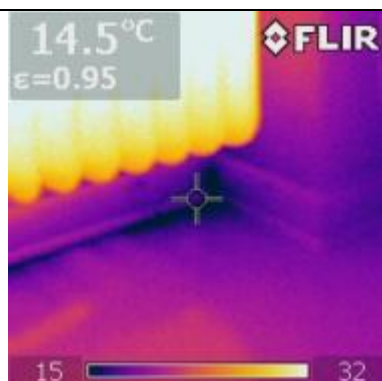


Figure 4a. Bed room, leak between skirting-board and floor.

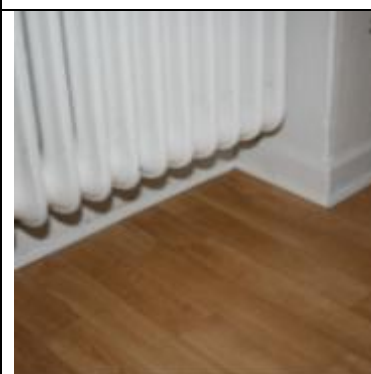


Figure 4b. Bed room, leak between skirting-board and floor.

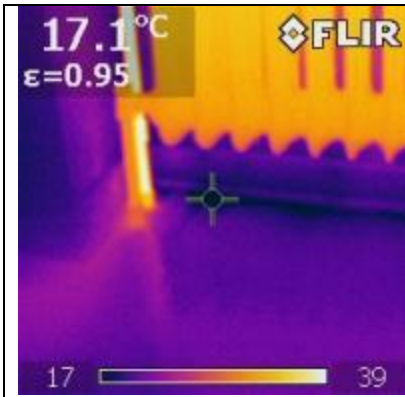


Figure 5a. Bed room, leak between skirting-board and floor.



Figure 5b. Bed room, leak between skirting-board and floor.

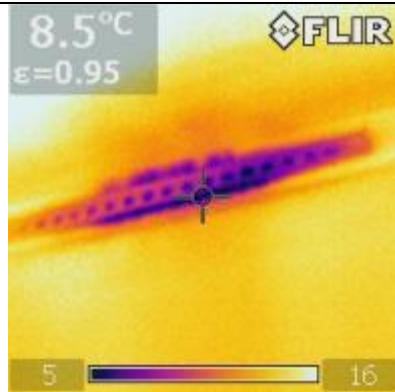


Figure 6a. Leak between external air device and window arch.



Figure 6b. Leak between external air device and window arch.



Figure 7a. Leak between skirting-board and floor.

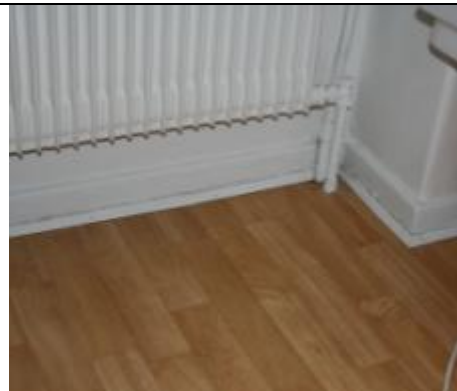


Figure 7b. Leak between skirting-board and floor.



Figure 8a. Leak between window frame and arch.



Figure 8b. Leak between window frame and arch.



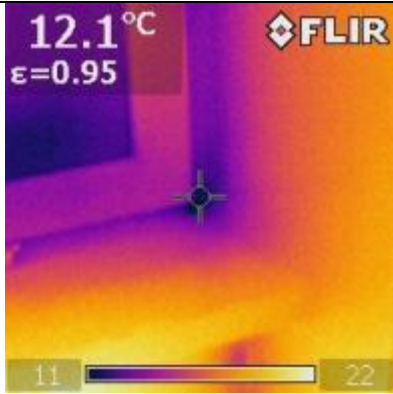


Figure 9a. Leak between window frame and arch.



Figure 9b. Leak between window frame and arch.



Figure 10a. The biggest leak was found at mounting for water pipes. Probably is fire tightening between pipe and structure untight and air may be overflow between apartments. The tenant has problem with smell of smoke from the neighbor.



Figure 10b. In crack to ducts was air speeds measured around 1m/s that probably depend on leaking air from the neighbor. Under pressure in the apartment was constant at -50 Pa during this measurement. (Water pipes were changed in 2005)



**Saltvägen 10, Apartment no 2, 6<sup>th</sup> floor.**



Figure 1. Saltvägen 10.

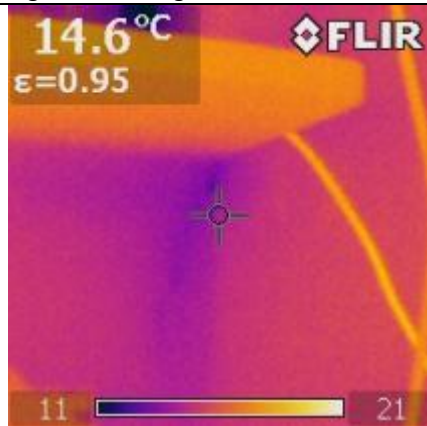


Figure 2a. Leak through crack in exterior wall.



Figure 2b. Leak through crack in exterior wall.

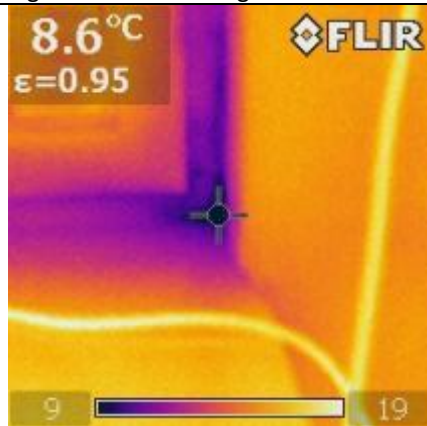


Figure 3a. Leak through window frame and arch.



Figure 3b. Leak through window frame and arch.

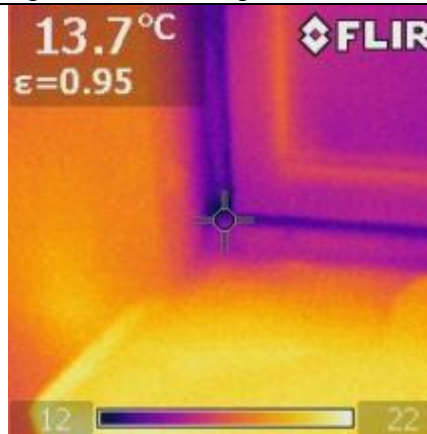


Figure 4a. Leak through window frame and arch.



Figure 4b. Leak through window frame and arch.

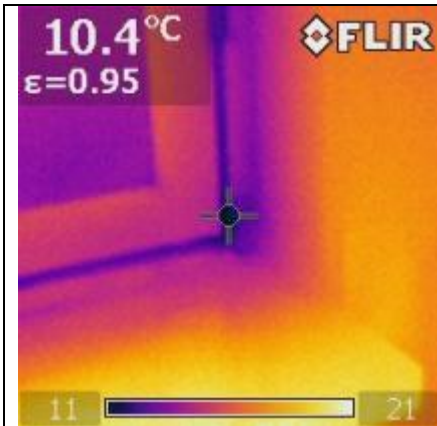


Figure 5a. Leak through window frame and arch.



Figure 5b. Leak through window frame and arch.

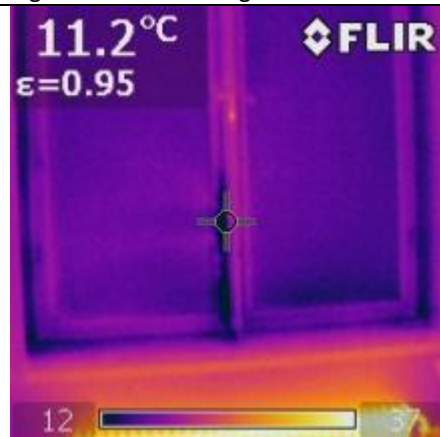


Figure 6a. Leak through window frame and between frame and arch.



Figure 6b. Leak through window frame and between frame and arch.



Figure 7a. An air leakage was measured with hot wire anemometer through opening of cover to the WC shaft. 0.3 m/s was indicated.



Figure 7b. A smaller air leakage was indicated within the electrical control unit.

**Additional observation**



Figure 8a. The apartment has, exhaust air devices both in bath room and living room.



Figure 8b. Exhaust air device in bath room and horizontal duct to exhaust air device in living room.



**Tallrisvägen 43, ground floor.**



Figure 1. Tallrisvägen 43 (upper apartment)



Figure 2. Blower Door placed in opening for front door, gives the under pressure -50 Pa during testing.



Figure 3a. Living room



Figure 3b. Leak between window frame and arch.



Figure 4a. Living room

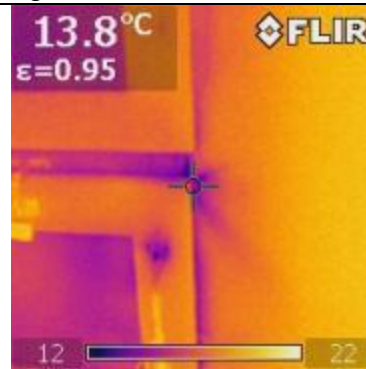


Figure 4b. Leak between window frame and arch, and through bushings for venetian blind control.

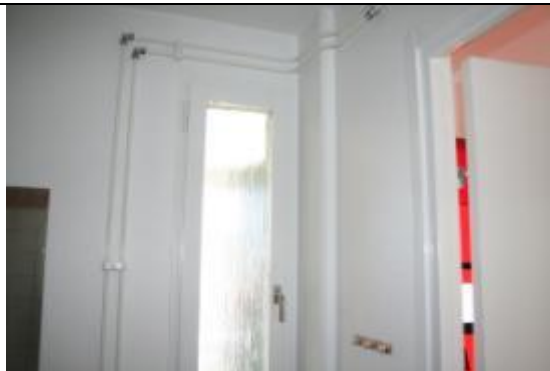


Figure 5a. Bath room

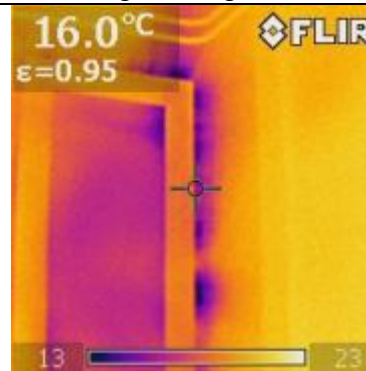


Figure 5b. Leak between window frame and arch.



Figure 6a. Hall.



Figure 6b. Leak between window and floor.



Figure 7a. Kitchen

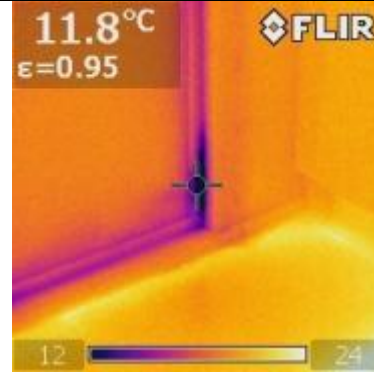


Figure 7b. Leak between window frame and arch.



Figure 8a. Hall.



Figure 8b. Leak throgth bushing for electrical cable.



Figure 9a. Original balanced mechanical ventilation with supply air devices ("Elephant foot") in floor have been changed with exhaust air ventilation with exterior air devices (Biobe) in window frame. The old supply air system is not sealed and it is possible for air change between apartments. The measurements showed an air change between apartments of about 33 l/s, ( 9+9+15=33 l/s).



Figure 9b. In bed room was air speeds of 2 m/s measured in supply air opening (air from the other apartment). 2 m/s correspond to about 9 l/s in the opening.



Figure 10a. In living room were 2 m/s measured in the opening, corresponding to about 9 l/s.



Figure 10b. In the second floor opening in the living room was an air speed of 3,4 m/s measured, corresponding to about 15 l/s.

**Additional observations**



Figure 11a. Clothes cupboard.

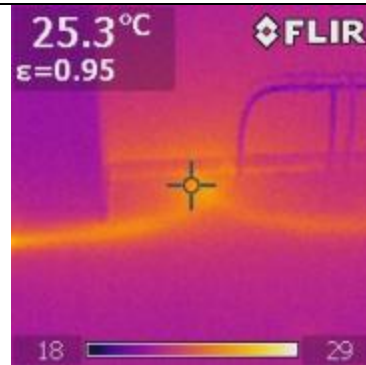


Figure 11b. Heat losses from heat pipes to radiators.



Figure 12a. Sleeping room

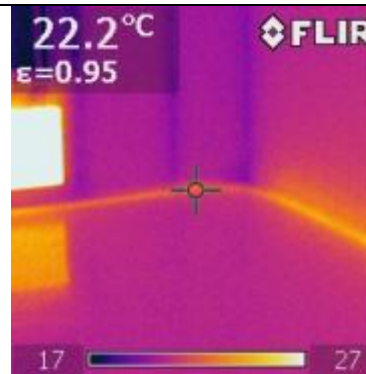


Figure 12b. Heat losses from heat pipes to radiators.

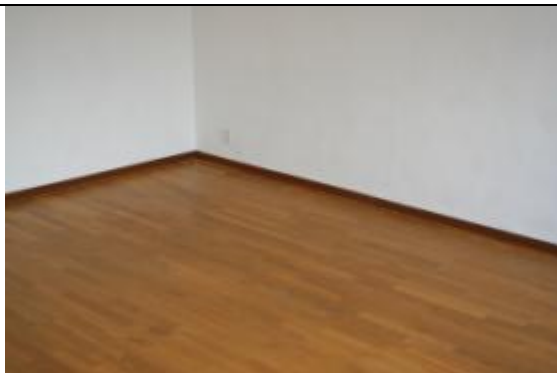


Figure 13a. Living room.

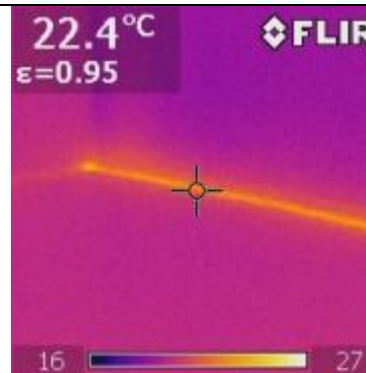


Figure 13b. Heat losses from heat pipes to radiators.

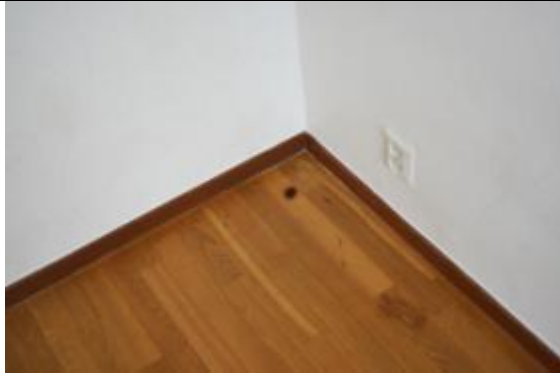


Figure 14a. Living room.

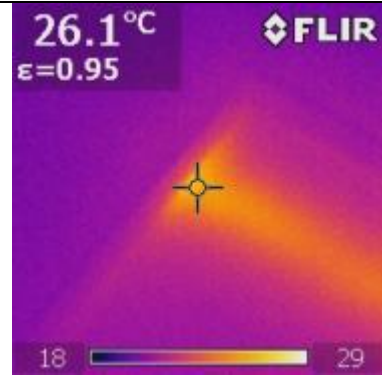


Figure 14b. Heat losses from heat pipes to radiators.



**Granrisvägen 1G, Örebro, Vacant apartment.**



Figure 1. Granrisvägen 1G (upper apartment)



Figure 2a. Living room. Installation of new floor hides two supply air openings from an old supply air system. Now its renovated to anexhhaust air system.

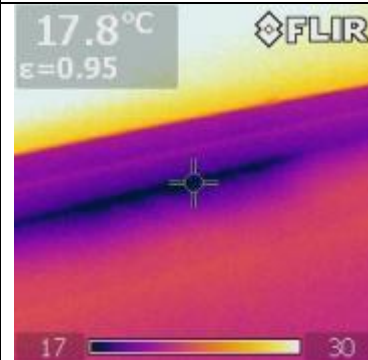


Figure 2b. Leak, probably by air from neighbor apartment through the old supply air sysem under the new floor.



Figure 3a. Living room.

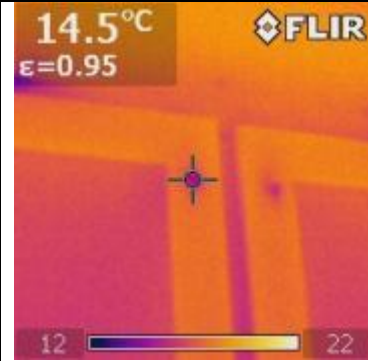


Figure 3b. Leak throgth bushing for control of ventian blinds.

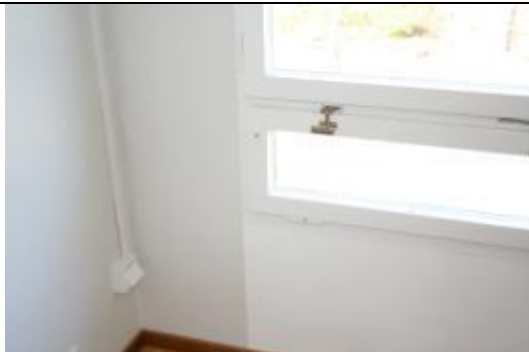


Figure 4a. Living room, Leak between window farme and arch.

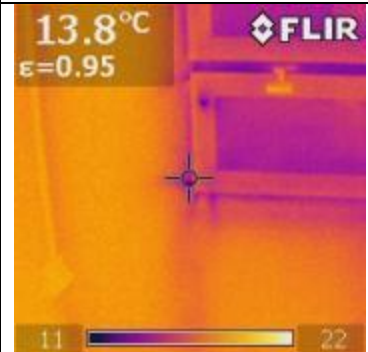


Figure 4b. . Living room, Leak between window farme and arch.



Figure 5a. . Living room, leak in corner between skirting-board and floor.

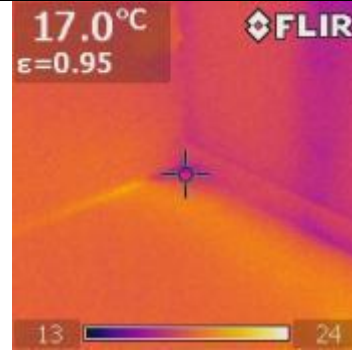


Figure 5a. . Living room, Leak in corner between skirting-board and floor.



Figure 6a. Two cut offed pipes in the ceiling in cloths cupboard.



Figure 6b. Two cut offed pipes in the ceiling in cloths cupboard.



Figure 7a. The pipes were temporarily sealed with glass wool.

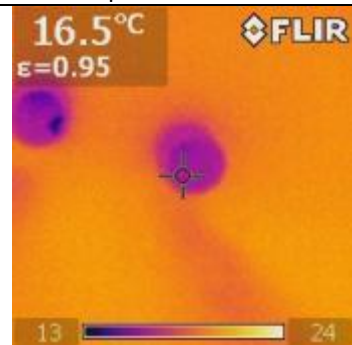


Figure 7b. Measurements without glass wool gives relatively high speeds of under tempered air.



Figure 8a. Air speeds about 5 m/s was measured in pipe opening at an under pressure of 50 Pa. Air temperatures was measured to +14°C, which indicates that it is outdoor air and not air from neighbor apartment.

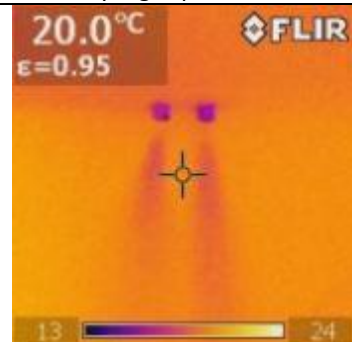


Figure 8b. Air speeds about 5 m/s was measured in pipe opening at an under pressure of 50 Pa. Air temperatures was measured to +14°C, which indicates that it is outdoor air and not air from neighbor apartment.



Figure 9a. Bed room, leak in corner between skirting-board and floor.

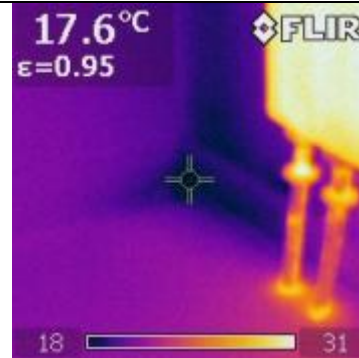


Figure 9b. Bed room, leak in corner between skirting-board and floor.



Figure 10a. Bed room, leak in corner between skirting-board and floor.

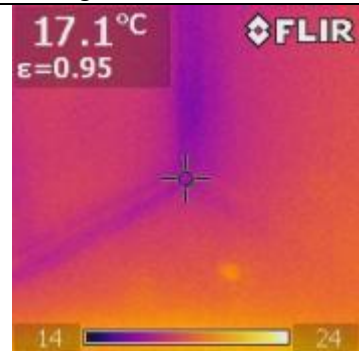


Figure 10b. Bed room, leak in corner between skirting-board and floor.



Figure 11a. Supply air device in bed room was temporary sealed with glass wool and foam plastic. Without sealing was an air speed of 4 m/s measured in the opening and an air temperature of +20°C, which indicates that it is air from neighbor apartment.



Figure 11a. Supply air device in bed room was temporary sealed with glass wool and foam plastic. Without sealing was an air speed of 4 m/s measured in the opening and an air temperature of +20°C, which indicates that it is air from neighbor apartment.



Figure 12a. Kitchen. Large leak between balcony door and door frame.

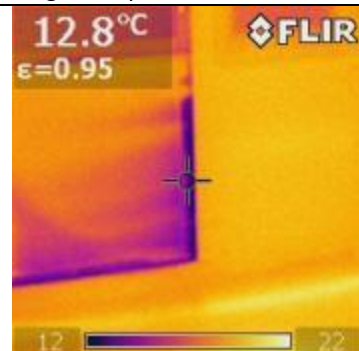


Figure 12b. Kitchen. Large leak between balcony door and door frame.

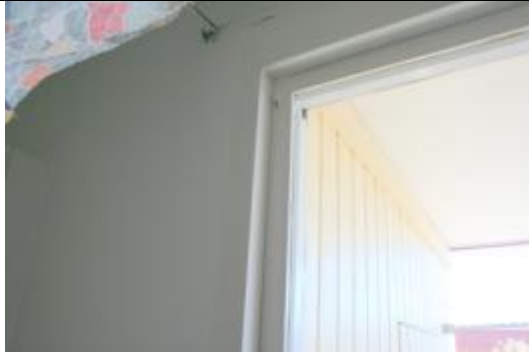


Figure 13a. Kitchen. Leak between balcony door and door frame.

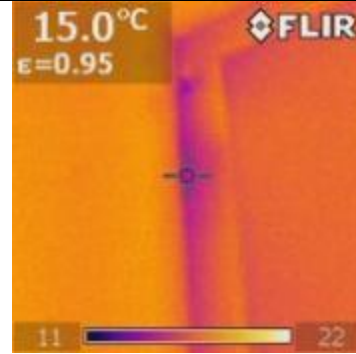


Figure 13ba. Kitchen. Leak between balcony door and door frame.



Figure 14a. Kitchen. Leak between window frame and arch.

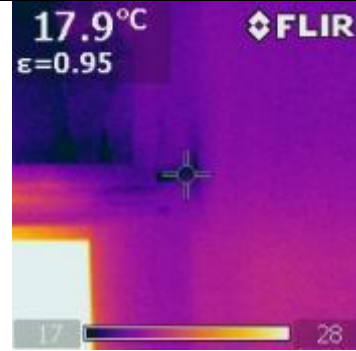


Figure 14b. Kitchen. Leak between window frame and arch.



Figure 15a. Kitchen. Leak between window frame and arch.

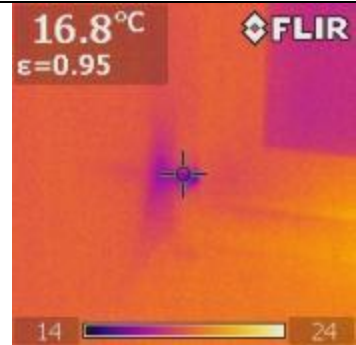


Figure 15b. Kitchen. Leak between window frame and arch.



Figure 16a. Bath room. Leak through sewage pipe from washbasin and sewage pipe in joists. This is probably the reason for sewage smell in the bath room since water seal was full with water.



Figure 16b. Bath room. Leak through sewage pipe from washbasin and sewage pipe in joists. This is probably the reason for sewage smell in the bath room since water seal was full with water.





Figure 17. Front door. Leak through broken weather strip.

**Additional observations**

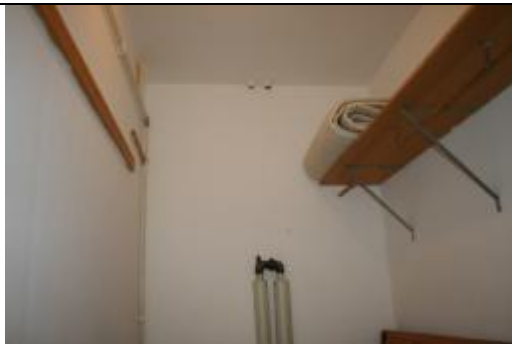


Figure 18a. One pipe heating system inside concrete joists is distributed through the clothes cupboard.

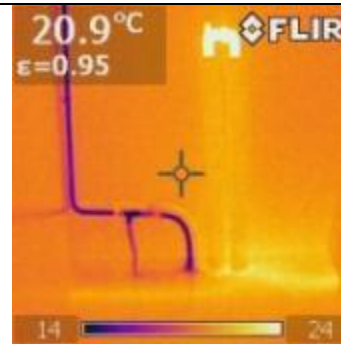


Figure 18b. One pipe heating system inside concrete joists is distributed through the clothes cupboard



Figure 19a. Even though supply water temperatures is relatively low could surface temperatures of floor be measured to 23,5°C, due to heat losses from water pipes.

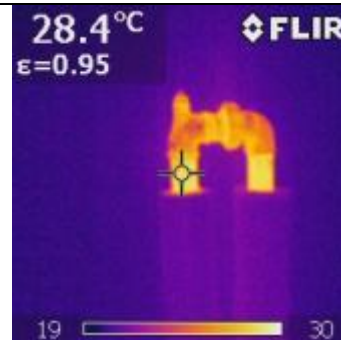


Figure 19b. Supply water temperature is about +30°C at an outdoor temperatur of +8°C.



Figure 20a. Heat losses from one-pipe coil to the radiator.

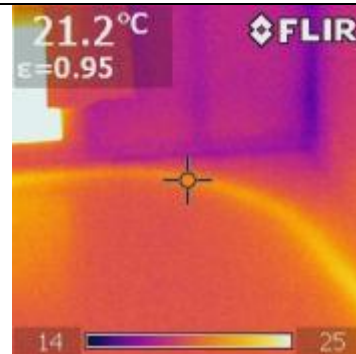


Figure 20b. Heat losses from one-pipe coil to the radiator.