

## **Test Report**

**Impact on the airtightness of an air duct brought about  
by the introduction of displacer screws**

valid for

**Self drilling screw for thin sheet metal DBS 4.2x13 mm**

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# Test Report

Test of the impact on the airtightness of an air duct brought about by the introduction of displacer screws

## Self drilling screw for thin sheet metal DBS 4.2x13

Test object

## MÜPRO Services GmbH

Client

## M.78.11.386

Test number

## Europäisches Testzentrum für Wohnungslüftungsgeräte (TZWL) e.V.

Test laboratory

**Dortmund, den 07.02.2023**

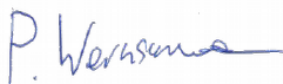
Place and date of issue

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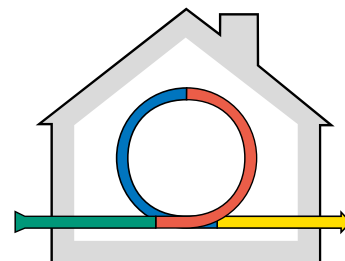
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# 1 Assignment

Airtightness tests are to be conducted on an air duct to determine the extent to which the airtightness of the air duct is impacted by the introduction of thin sheet metal screws into the air duct.

The tests are conducted with the following screws.

## **Self drilling screw for thin sheet metal DBS 4.2x13**

After introduction into the air duct, the screws are tightened with a defined torque of 1.5 Nm. A calibrated torque wrench from the client is used for this purpose. See 6.1. The torque is specified by the client and recommended by him in the product documentation.

### 1.1 Client

Client name: MÜPRO Services GmbH  
Borsigstraße 14  
65205 Wiesbaden

Contact: Herr Dr. Udo Eping  
Tel: +49 6122 808 234

### 1.2 Test Centre

Europäisches Testzentrum für Wohnungslüftungsgeräte e.V.  
Ernst-Mehlich-Str. 4a  
44141 Dortmund  
Deutschland

### 1.3 Test Object

Self drilling screw for thin sheet metal DBS 4.2x13  
4.2 mm x 2.82 mm x 13 mm

Date received: 17 November 2022  
Test period: 12 January.2023 to 13 January 2023



Figure 1.1: Self drilling screw for thin sheet metal DBS 4.2x13

## 2 Test

The test was conducted on the basis of DIN EN 12237:2003 at an overpressure of 2000 Pa in the air duct. 2000 Pa corresponds to the threshold value of airtightness classes C and D pursuant to DIN EN 12237:2003.

In deviation from the standard, a negative pressure measurement was also performed at -2000 Pa.

Table 2.1: Classification of air ducts according to DIN EN 12237:2003

Airtightness classes	Threshold value of static pressure ( $p_s$ ) in Pa		Threshold value of air leakage rate ( $f_{max}$ ) in $m^3 \times s^{-1}m^{-2}$
	Positive	Negative	
A	500	500	$0.027 \times p_t^{0,65} \times 10^{-3}$
B	1.000	750	$0.009 \times p_t^{0,65} \times 10^{-3}$
C	2.000	750	$0.003 \times p_t^{0,65} \times 10^{-3}$
D <sup>a</sup>	2.000	750	$0.001 \times p_t^{0,65} \times 10^{-3}$
<sup>a</sup> air duct system for special applications			

## 2.1 Test Setup

Leakage was determined with the aid of a „DP700” airtightness tester made by „Wöhler”. For this purpose, the entry and exit openings of the air duct were sealed to render them as airtight as possible. The pressure required for the test was generated by the airtightness testing device and maintained by self-regulation. The air volume flow required to generate the test pressure was simultaneously recorded by the airtightness tester. This volume flow corresponds to leakage from the air duct.

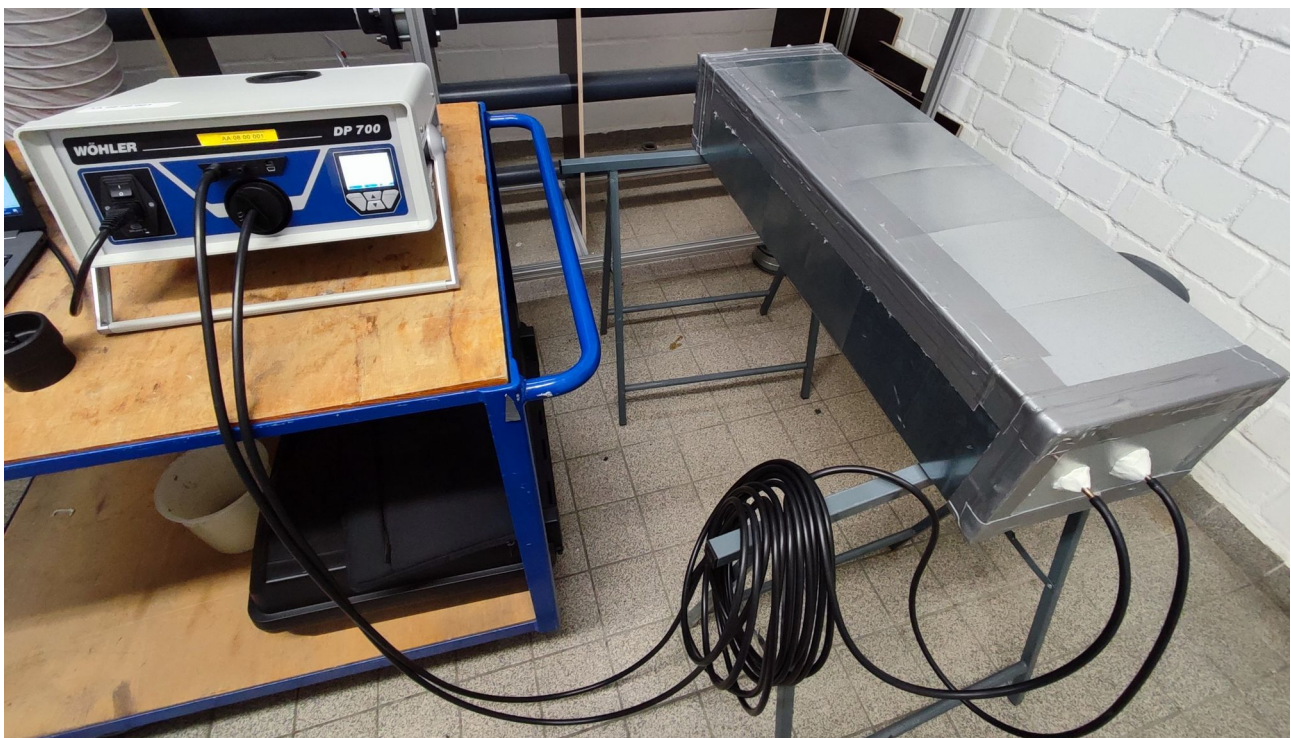


Figure 2.1: Test setup

### 3 Performance of the Tests

To obtain a reference value, a leakage test was performed on an air duct with no screws inserted. For the setup, see 6.2

Table 3.1: Leakage values for reference test **without** screws in the air duct

Pressure	Leakage		Measuring Uncertainty	
[Pa]	[l/s]	[m³/h]	[l/s]	[m³/h]
-2000	0.0309	0.1111	0.0015	0.0056
-1000	0.0218	0.0786	0.0011	0.0039
-400	0.0128	0.0462	0.0009	0.0032
400	0.0162	0.0584	0.0009	0.0032
1000	0.0265	0.0955	0.0013	0.0048
2000	0.0463	0.1668	0.0023	0.0083

After this, screws were inserted into the air duct in a 10\*10 cm grid formation. These were screwed directly into the air duct after punch marking of the sheet metal at a torque of 1.5 Nm. No holes were predrilled.

In Section 4 Results, the leakage values from the reference tests with no screws inserted were subtracted from the values obtained in these measurements, so as to determine the leakages resulting from the introduction of the screws.

Testing commenced with a single screw in the middle of a 10x10cm grid, see 6.3.

Table 3.2: Leakage values for the test **with 1** screw

Pressure	Leakage		Measuring Uncertainty	
[Pa]	[l/s]	[m³/h]	[Pa]	[l/s]
-2000	0.0561	0.2018	0.0028	0.0101
-1000	0.0330	0.1187	0.0016	0.0059
-400	0.0197	0.0710	0.0010	0.0036
400	0.0225	0.0811	0.0011	0.0041
1000	0.0414	0.1489	0.0021	0.0074
2000	0.0624	0.2246	0.0031	0.0112



In the next step, 5 screws were inserted into the 10x10cm grid. See 6.4.

Table 3.3: Leakage values for the test with 5 screws

Pressure	Leakage		Measuring Uncertainty	
[Pa]	[l/s]	[m³/h]	[Pa]	[l/s]
-2000	0.0872	0.3139	0.0044	0.0157
-1000	0.0563	0.2028	0.0028	0.0101
-400	0.0308	0.1108	0.0015	0.0055
400	0.0311	0.1118	0.0016	0.0056
1000	0.0610	0.2196	0.0031	0.0110
2000	0.0932	0.3355	0.0047	0.0168

In the final test series, 25 screws were introduced into the 10x10cm grid. See 6.5

Table 3.4: Leakage values for the test with 25 screws

Pressure	Leakage		Measuring Uncertainty	
[Pa]	[l/s]	[m³/h]	[Pa]	[l/s]
-2000	0.3700	1.3320	0.0185	0.0666
-1000	0.1702	0.6128	0.0085	0.0306
-400	0.0937	0.3373	0.0047	0.0169
400	0.0944	0.3397	0.0047	0.0170
1000	0.1756	0.6322	0.0088	0.0316
2000	0.3633	1.3080	0.0182	0.0654

## 4 Results of tests

Table 4.1: Leakage values with 1 screw

Pressure	Leakage (Difference to reference value)		Measuring Uncertainty	
[Pa]	[l/s]	[m³/h]	[Pa]	[l/s]
-2000	0.025	0.091	0.004	0.016
-1000	0.011	0.040	0.003	0.010
-400	0.007	0.025	0.002	0.007
400	0.006	0.023	0.002	0.007
1000	0.015	0.053	0.003	0.012
2000	0.016	0.058	0.005	0.020

Table 4.2: Leakage values with 5 Screws

Pressure	Leakage (Difference to reference value)		Measuring Uncertainty	
[Pa]	[l/s]	[m³/h]	[Pa]	[l/s]
-2000	0.056	0.203	0.006	0.021
-1000	0.035	0.124	0.004	0.014
-400	0.018	0.065	0.002	0.009
400	0.015	0.053	0.002	0.009
1000	0.034	0.124	0.004	0.016
2000	0.047	0.169	0.007	0.025

Table 4.3: Leakage values with 25 Screws

Pressure	Leakage (Difference to reference value)		Measuring Uncertainty	
[Pa]	[l/s]	[m³/h]	[Pa]	[l/s]
-2000	0.339	1.221	0.020	0.072
-1000	0.148	0.534	0.010	0.035
-400	0.081	0.291	0.006	0.020
400	0.078	0.281	0.006	0.020
1000	0.149	0.537	0.010	0.036
2000	0.317	1.141	0.020	0.074

## 5 Summary

The highest leakage rates of all the conducted measurements occurred in the air duct with 25 inserted screws. The maximum leak volume flow was  $1.221 \text{ m}^3/\text{h}$ . In these cases, the measuring uncertainty of the leakage test instrument was  $0.072 \text{ m}^3/\text{h}$ .

Since the maximum air leak rate for all measurements performed was less than  $4.19556788 \times 10^{-4} \text{ m}^3 \times \text{s}^{-1} \times \text{m}^{-2}$ , all of the test objects, as measured, can be categorised as being of airtightness class C according to DIN EN 12237:2003.

In the tests performed with up to 5 inserted screws, the maximum air leak rate overall was less than  $1.398522627 \times 10^{-4} \text{ m}^3 \times \text{s}^{-1} \times \text{m}^{-2}$ . This means that an air duct with up to 5 inserted screws can still be categorised as Airtightness Class D according to DIN EN 12237:2003.

Overall, it can thus be assessed that the insertion of the screws causes leakages that are significantly above the measurement uncertainty of the Wöhler DP 700 leakage test instrument used. The occurrence of leakages accumulates on insertion of further screws. When 25 screws are inserted in the air duct, the requirements of the maximum Airtightness Class D (air duct system for special applications) are no longer fulfilled, such cases then being categorised as Airtightness Class C. For measurements with up to 5 inserted screws, Airtightness Class D is still fulfilled.

In conclusion, it should be taken into consideration that the insertion of more than 25 screws would further impair the airtightness of the air duct and that this would result in a further downward reclassification of the airtightness class.

## 6 Appendix

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## 6.1 Technical Specifications of the Leakage Test Instrument

Table 6.1: Device Specifications

Product:	Wöhler DP 700
Serial number:	5044
Supply voltage:	230V, 50 to 60Hz
Current consumption:	Max. 9 A
Operating temperature:	5°C to 40°C
Storage temperature:	-20°C to 50°C
Dimensions:	33 x 36 x 15 cm
Weight:	9,5 kg

Table 6.2: Pressure measurement

Measuring principle:	Piezoresistive semiconductor sensor
Measuring range:	$\pm 7000$ Pa
Resolution:	0.1 Pa to $\pm 900$ Pa, afterwards 1 Pa
Precision:	$\pm 0.5$ Pa or $\pm 2.5\%$ of measurement value, depending on which value is greater

Table 6.3: Volume flow

Measuring principle:	Hot-film anemometer
Measuring range:	0,0000 to 55,00 l/s
Resolution:	0.0001 l/s to 0.3000 l/s, 0.001 l/s to 3.000 l/s 0.01 l/s from 3.00 l/s
Precision:	$\pm 0.0009$ l/s or $\pm 5\%$ of measurement value, depending on which value is greater

## 6.2 Photo Documentation



Figure 6.1: Calibrated torque wrench

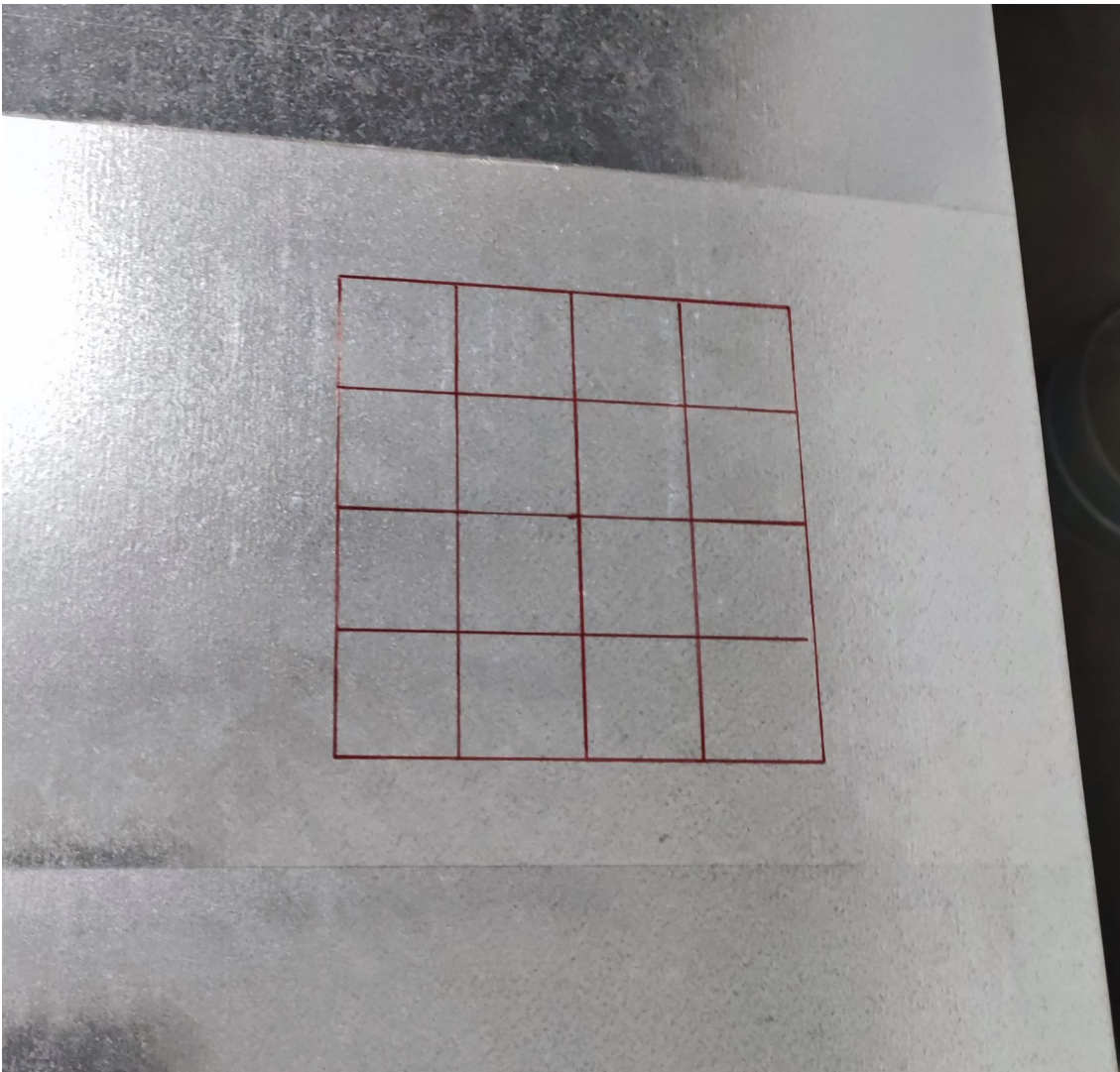


Figure 6.2: Grid without screws



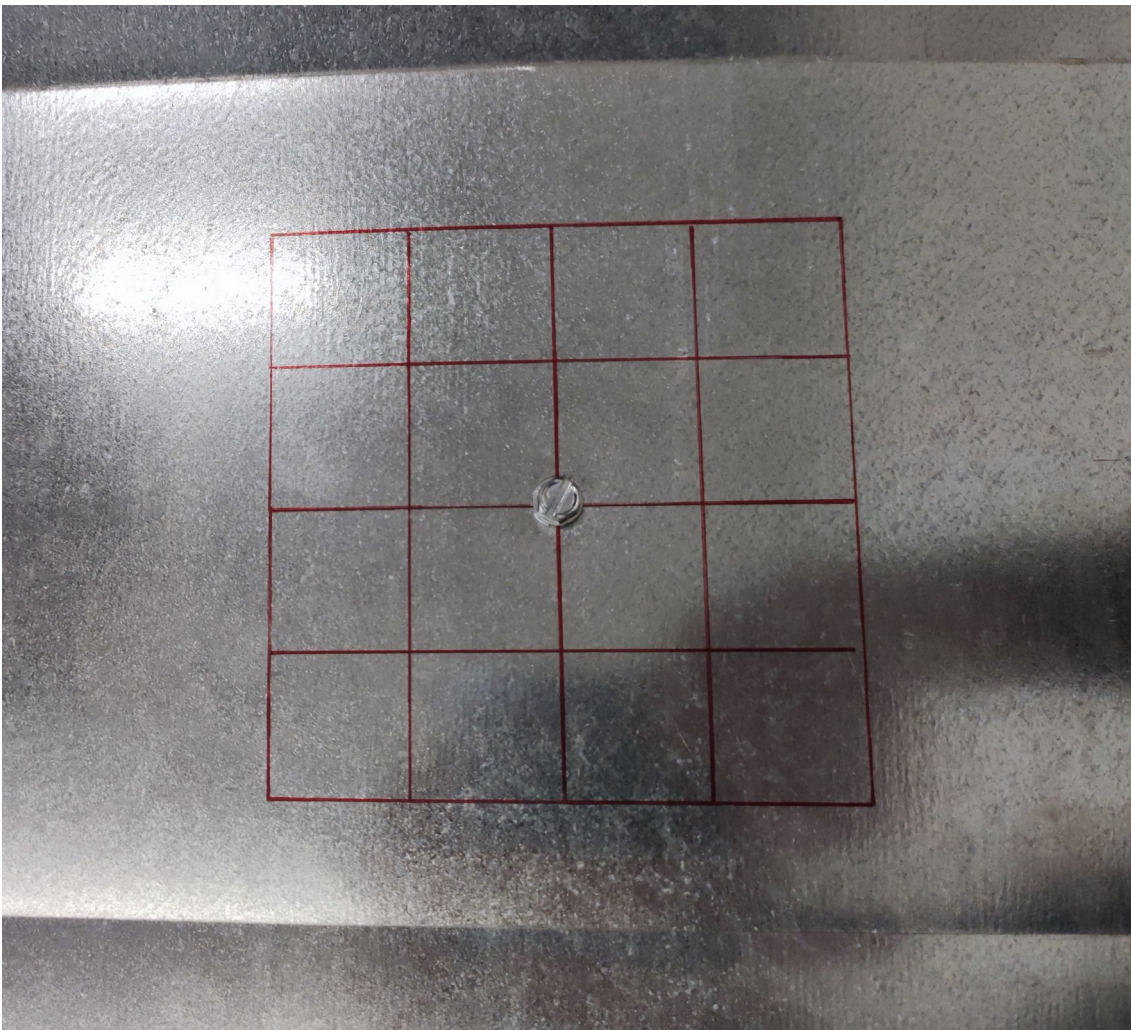


Figure 6.3: Grid with one screw inserted

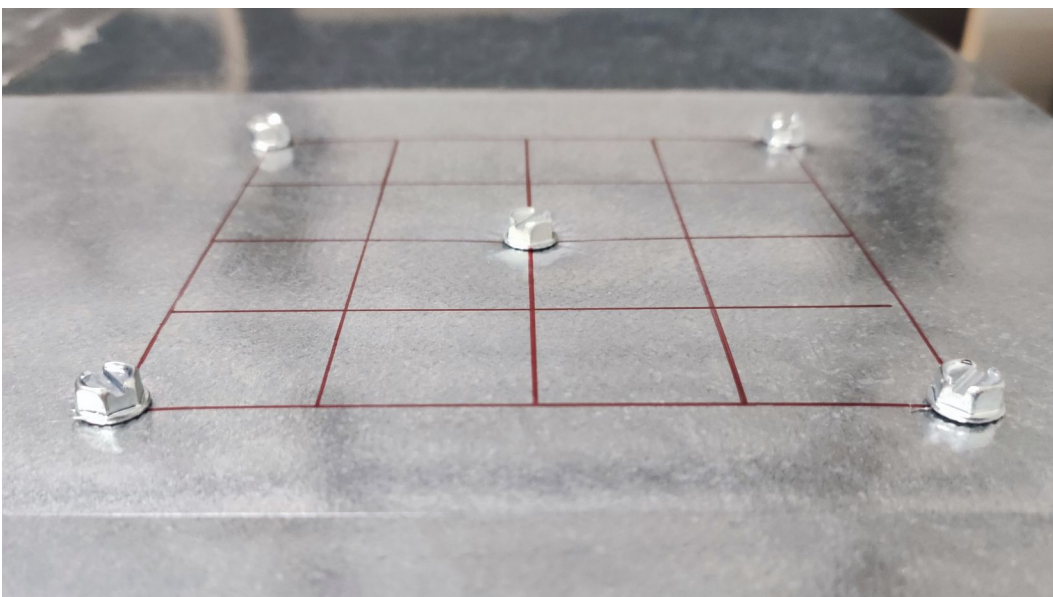


Figure 6.4: Grid with 5 screws inserted

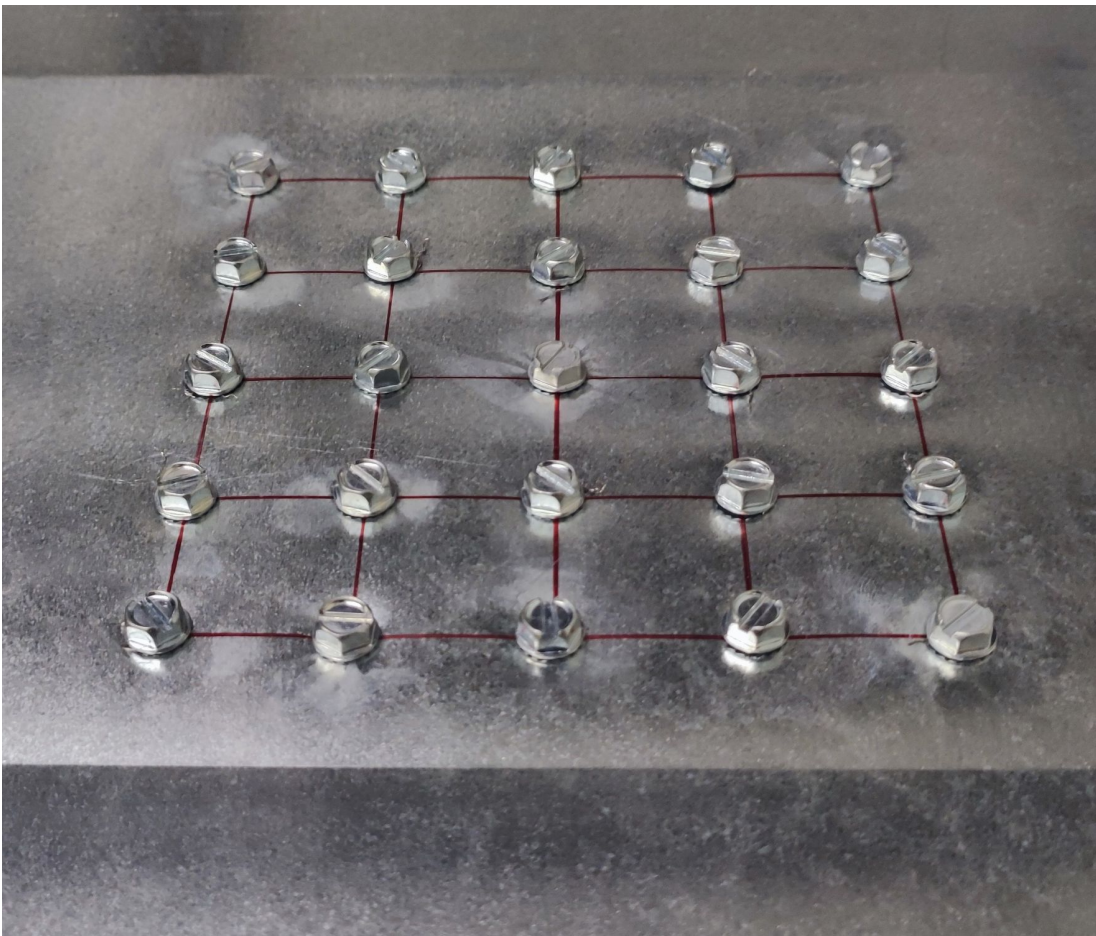


Figure 6.5: Grid with 25 screws inserted