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**TNO report**

**2006-CVB-R0191**

Determination of the resistance to fire, according to the Dutch standard NEN 6077 in conjunction with the European standard NEN-EN 1366-2, of a circular and a rectangular fire damper, type ISONE FDP, mounted in a wall construction

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Date March 2006  
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Copy no  
No. of copies  
Number of pages 17  
Number of appendices 5 (A to E)

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Project name resistance to fire  
Project number 006.45902.01.01

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### Appendices

- A Observations
- B Measured gastemperatures and pressure in the furnace
- C Measured temperatures and leakage
- D Gap widths around the damper blades
- E Photos

## 1 Subject

Two ventilation ducts, one fitted with a circular fire damper and one fitted with a rectangular fire damper, both mounted in a wall construction. The fire dampers were manufactured by ALDES and were of the type ISONE FDP.

## 2 Investigation

Resistance to fire according to the Dutch standard NEN 6077:2001 in conjunction with the European standard NEN-EN 1366-2:2001.

## 3 Sponsor

Aldes  
20, Boulevard Joliot Curie  
69694 Vénissieux Cedex  
France

## 4 Location and date for the investigation

The investigation took place in the laboratory of the Centre for Fire Research of TNO in Rijswijk, the Netherlands.  
The dampers were mounted in the wall construction in week 6 of 2005.  
The fire test was carried out on 8 March 2005.

## 5 Date and number of the report

March 2006, 2006-CVB-R0191

## 6 Construction under investigation

### 6.1 Fire damper

#### 6.1.1 General

The fire dampers consisted of a damper blade mounted in a damper housing and were activated by a drive mechanism with a fusible link, see figures 1 to 5.  
The components are described below.

## 6.1.2 Components of the fire damper

### 6.1.2.1 Damper housing (see figures 1 to 4)

	Rectangular damper	Circular damper
Material	1.5 mm galvanised steel	0.8 mm galvanised steel
External dimensions	798 x 598 mm	Diameter 313 mm
Commercial dimensions	800 x 600 mm	Diameter 315 mm
Number of parts	2	2
Length of the parts	250 and 150 mm	238 and 152 mm
Insulation between parts	Supalux M (2 x 25 mm)	Supalux M (2 x 25 mm)
Landing angle	Supalux-M	Supalux-M

### 6.1.2.2 Damper blade (see figures 1 to 4)

	Rectangular damper	Circular damper
Material	Supalux-M	Supalux-M
Thickness	50 mm (2 x 25 mm)	50 mm (2 x 25 mm)
External dimensions	753 x 278 mm (one side) 713 x 258 mm (other side)	Ø 135.5 mm (one side) Ø 150.5 mm (other side)

### 6.1.2.3 Bearing of the damper blade (see figure 1 and 2)

	Rectangular damper	Circular damper
Shaft	Steel Ø 10 mm, length 340 mm	Steel Ø10 mm , Length 340 mm
Number of shafts	2	1 (through the blade)
Bearing	Bronze, outside diameter 20 mm, inside diameter 10 mm	Bronze, outside diameter 20 mm, inside diameter 10 mm

### 6.1.2.4 Drive mechanism (see figures 1 to 5)

See parts list for components and figures 1 to 5 for assembly.

### 6.1.2.5 Fusible link (see figure 5)

See parts list for components and figure 5 for assembly.

### 6.1.2.6 Intumescent material (see figure 3)

– Pyrostrip 500, 20 x 2 mm, 2 strips between the damper blade and the end stop.

## 6.2 Mortar

The mortar to fill the gap between the damper housing and the aperture in the aerated concrete wall was standard glue for aerated concrete blocks. The gap between the damper housings and the supporting construction was 25 mm wide for both dampers.

## 6.3 Supporting construction

The supporting construction consisted of aerated concrete blocks with a thickness of 150 mm. The aerated concrete wall construction was mounted in a steel test frame with inner dimensions of 4 x 3 meters. In this frame the following apertures were made:

- 900 x 700 mm for the rectangular damper;
- diameter 415 mm for the circular damper.

# 7 Sampling and manufacturing of the construction

Centre for Fire Research TNO in Rijswijk : wall construction and mounting of the dampers.

Aldes : delivery of the dampers and the ventilation duct.

# 8 Method of investigation

## 8.1 Verification of the test specimen

### 8.1.1 General

The dampers were delivered by the sponsor and mounted by TNO. TNO was not involved in the selection of the dampers from production.

## 8.2 Conditioning

After delivery the dampers were stored in the laboratory of the Centre for Fire Research of TNO Building and Construction Research with ambient conditions  $20 \pm 5$  °C temperature and  $50 \pm 10$  % relative humidity.

## 8.3 Density<sup>1</sup> and equilibrium moisture content<sup>2</sup>

### Damper blade (Supalux-M)

- Density : 744 kg/m<sup>3</sup>
- Moisture content : 3.0 %

### Mortar

- Density : 1509 kg/m<sup>3</sup>
- Moisture content : 6.7 %

<sup>1</sup> Determined before drying

<sup>2</sup> Determined after drying for 24 hours at 105°C

## **8.4 Fire test**

### *8.4.1 Conditions*

The investigation was carried out according to NEN-EN 1366-2:2001 in conjunction with NEN 6077:2001. The ambient temperature and the air speed in the laboratory were within the specified limits.

### *8.4.2 Measurements*

During the test the following measurements were taken:

- Gastemperatures in the furnace;
- Pressure in the furnace at half height of the dampers;
- Surface temperatures on the non exposed side of the dampers and the supporting construction;
- Surface temperatures on the mechanisms inside the plastic cover boxes on the unexposed side;
- Pressure difference over the damper blades;
- Leakage over the damper blades.

## **9 Observations**

### **9.1 Before heating**

The dampers were opened and closed 50 times. No damage was visible after this.

### **9.2 During heating**

See annex A.

### **9.3 After heating and cooling**

No significant damage was visible.

## **10 Measurements**

### **10.1 Leakage of the test setup**

The leakage of the test setup including the damper (closed with foil) and the connecting ducts was below the required  $12 \text{ m}^3/\text{h}$ .

The results of both the determination of the system leakage and of the cold leakage of the damper are given in the table below.

	Pressure difference over the damper blade in Pa				
	100	200	300	400	500
Damper					
- Cold leakage in m <sup>3</sup> /h					
- rectangular	67	87	107	124	145
- round	11.5	15	18	21	23
Damper covered with foil					
- Leakage in m <sup>3</sup> /h					
- Rectangular	8.3	10.7	11.3	12.4	12.5
- round	6.9	13.2	14.3	21.1	19.6

## 10.2 Fire test

The measurements are presented in the figures B1 to B4 and C3 to C16.

The fire test was wrongfully started with an underpressure in the duct of 300 Pa. After 40 minutes of heating the underpressure was raised to 500 Pa, which was required by the sponsor. We assumed the test at 500 Pa underpressure to have started at 40 minutes after the start of the test and have reported the results for both 300 and 500 Pa underpressure.

The air speed and the temperature in the laboratory were within the specifications given in NEN-EN 1363-1.

## 10.3 Uncertainty of measurement

Due to the nature of fire resistance testing, in which several non-linear effects are present in both the test configuration and the test specimen, which influence each other, it is at this moment not yet possible to give a stated degree of uncertainty of measurement.

## 11 Summary

In table 1 the most important results of the investigation are given.

Table 1: summary of the results

Criterion	Time from the start of heating during which the criterion was just fulfilled [minutes]			
	Rectangular		round	
	NEN 6077	EN 1366-2	NEN 6077	EN 1366-2
<b>Integrity based on sealing</b>				
<b>300 Pa underpressure</b>				
- cotton pad *	220	220	220	220
- gap gauge *	220	220	220	220
- sustained flaming *	220	220	220	220
<b>500 Pa underpressure</b>				
- cotton pad **	180	180	180	180
- gap gauge **	180	180	180	180
- sustained flaming **	180	180	180	180
<b>Thermal insulation based on temperature</b>				
<b>300 Pa underpressure</b>				
- average temperature rise 140°C *	220	220	220	220
- maximum temperature rise 180°C *	170	170	220	220
<b>500 Pa underpressure</b>				
- average temperature rise 140°C **	180	180	180	180
- maximum temperature rise 180°C **	130	130	180	180
<b>Leakage *</b>				
<b>300 Pa underpressure *</b>	220	220	220	220
<b>500 Pa underpressure **</b>	180	180	180	180

\* criterion not reached after 220 minutes of heating.

\*\* criterion not reached after 180 minutes of heating

## 12 Conclusion

The resistance to fire, according to NEN 6077:2001 and NEN-EN 1366-2, with regard to the separating function of the ventilation duct including the fire dampers mentioned in this report is:

- Rectangular damper :
  - At 300 Pa underpressure : 170 minutes
  - At 500 Pa underpressure : 130 minutes
- Round damper :
  - At 300 Pa underpressure : 220 minutes
  - At 500 Pa underpressure : 180 minutes

## 13 Field of application

The conclusions mentioned in this report are valid for:

- circular dampers of the same type as investigated with a maximum cross sectional diameter of 315 mm;
- rectangular dampers of the same type as investigated with a maximum cross sectional area across the airflow of 800 x 600 mm;
- the maximum gap width between damper blade and damper housing shall be 6 mm (see annex D);
- the dampers may be mounted in a wall construction with a thickness of at least 150 mm and a density of at least 630 kg/m<sup>3</sup>;
- The mortar between the damper housing and the supporting construction shall be aerated concrete glue with a width of maximum 25 mm.

## 14 Extended field of application

Based on NEN-EN 1366-2 the conclusions are also valid if the actuating mechanism is situated on the exposed side of the wall.

Based on the measured temperatures on the mechanisms inside the plastic cover boxes it is concluded that the result is also valid if the dampers are mounted without the plastic cover boxes over the mechanism.



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