TNO Built Environment and Geosciences

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TNO report

2005-CVB-R0129

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 EM, mounted in a wall construction

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Number of appendices 5 (A to E)

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Project name resistance to fire
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Contents

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 EM.

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
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4 Location and date for the investigation

The investigation took place in the laboratory of the Centre for Fire Research of TNO Building and Construction Research in Rijswijk, the Netherlands.
The dampers were mounted in the wall construction in week 34.
The fire test was carried out at 30 September 2004.

5 Date and number of the report

May 2005, 2005-CVB-R0129.

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 was activated by a drive mechanism with a fusible link.
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 498 mm
Commercial dimensions	800 x 600 mm	Diameter 500 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	712 x 502 mm	Diameter 439 mm

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 ,
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 2 to 5)*

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

The mechanism of the rectangular damper was also fitted with:
- A re-arming motor (EHOP) supplied by either 24 V or 48 V AC/DC;
- An electro-magnetic tripping system – set off by a 48 V signal;
- Start and end of travel contacts.

The mechanism of the circular damper was also fitted with:
- A manual tripping device.

6.1.2.5 *Fusible link (see figure 6)*

See parts list for components and figure 6 for assembly.

6.1.2.6 *Intumescent material (see figure 4)*

- 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 where made:
- 850 x 650 mm for the rectangular damper;
- round 550 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 ± 5 °C temperature and 50 ± 10 % relative humidity.

8.3 Density[1] and equilibrium moisture content[2]

Damper blade (Supalux-M)
- Density : 744 kg/m^3
- Moisture content : 3.0 %

Mortar

[1] Determined before drying
[2] Determined after drying for 24 hours at 105°C

- Density : 1509 kg/m^3
- Moisture content : 6.7 %

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:
- Gas temperatures 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;
- 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 set up

The leakage of the test set up including the damper (closed with foil) and the connecting ducts was below the required 12 m^3/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^3/h rectangular round	 28.3 3.8	 38.4 8.2	 50.6 11.3	 60.9 14.0	 72.1 17.9
Damper covered with foil (system leakage) Leakage in m^3/h Rectangular * - round	 0.3 3.5	 0.7 8.0	 1.2 11.3	 2.0 12.6	 2.8 16.0

* even when the damper was covered with foil the system leakage was higher than 12 m^3/h, this could not be solved by taping the connections because most of the leakage seemed to come from the actuating mechanism. In order to be able to determine system leakage the measuring system the connecting flange to the ventilation duct was disconnected and closed. Now the real system leakage could be determined. This was only done for the rectangular since the system leakage on the circular damper falls within the requirements.

10.2 Fire test

The measurements are presented in the figures C3 t/m C14.

The air speed and the temperature in the laboratory where 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			
	Rectangular		round	
	NEN 6077	EN 1366-2	NEN 6077	EN 1366-2
Integrity based on sealing				
- cotton pad **	135	135	135	135
- gap gauge **	135	135	135	135
- sustained flaming **	135	135	135	135
Thermal insulation based on temperature				
- average temperature rise 140°C **	135	135	135	135
- maximum temperature rise 180°C **	135	135	135	135
Leakage **	135	135	135	135

** criterion not reached after 135 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 : **135 minutes;**
- Round damper : **135 minutes.**

A formal classification according to EN 13501-2 can be given in a separate document.

13 Field of application

The conclusions mentioned in this report are valid for :
- circular dampers of the same type as investigated with a blade diameter of maximum 439 mm;
- rectangular dampers of the same type as investigated with blade dimensions of maximum 712 x 502 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^3.

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.

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