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Aldes ME Flash

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Technical Information

Understanding American and European Standards for Fire Dampers

Fire safety products are the key products to ensure safety of building and save lives of people living inside those buildings. As these products are very critical, therefore, certification as per **EN 1366-2** (European standard) or **UL 555** & **UL 555S** (American Standards) is required by the authorities especially in Middle East market. Prior to the release of European standard EN 1366-2, ad-hoc test methods following the methodology of **BS 476: part 20** were used as well but those standards shall not be accepted anymore after issuance of **EN 1366-2.**

European Standard (EN 1366-2)

❶ Before starting burners of the furnace, a **50 cycling test** open/close/open is carried out

→ *The aim is to check availability and efficiency of a fire damper for operational reliability.*

❷ At Tamb AND during the fire resistance test, the **air and smoke leakage is measured** (fire damper in close position) with an under pressure of 500 Pa (200 m3/h/m² => EIS classification).

--> *The aim is to assess the fire damper capacity to stop cold fumes, and then, hot gases and smoke.*

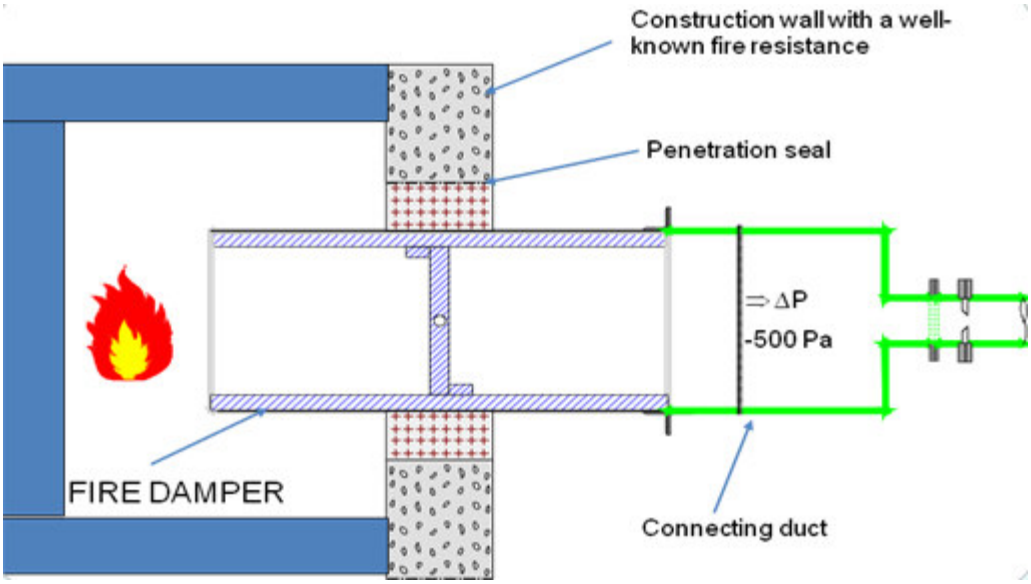
❸ With the fire damper fully open, an exhaust fan is set to produce an **air velocity of 0.15 m/s** across the fire damper opening. Then, ignition of the furnace and the fire damper shall close within 2 minutes.

→ *The aim is to check sensitivity of the fire damper in nominal activation conditions.*

❹ During the test, temperature on the non exposed side of the fire damper is recorded.

Requirement => none of the thermocouples shall exceed **180 °C over Tamb** and the average temperature of the thermocouples shall be less than **140 °C over Tamb**.

→ *The aim is to check fire resistance with integrity, insulation and smoke leakage of the fire damper under fire conditions (under pressure…).*



American Standards (UL 555 & UL 555S)

❶ **Fire endurance & hose stream exposure test (UL 555):**
Dampers are exposed to fire for **1.5hrs or 3hrs** (fire rating) in the intended installation (**vertical or horizontal**) in furnace. After fire exposure, damper is removed from furnace and water jet is applied via hose to the exposed side of damper with 30psi pressure. Then clearances between different components of the damper are checked for the acceptance of test.

→ *The aim is to assess the integrity & rigidity of fire damper through a thermal shock.*

❷ **Salt spray exposure test (UL 555 / UL 555S):**
Dampers are kept in a salt spray chamber in intended installation with salt fog for **5 days** and then **1 day** for drying at ambient temperature. Thermal activation of damper is performed and the blades should close completely. (Note: Dampers can be painted using alkyd base paints to avoid corrosion for this test).

→ *The aim is to simulate dust & debris on components and to check the proper functionality of damper.*

❸ **Cycling test (UL 555 / UL 555S):**
This test is performed on all dampers requiring airflow tests at 3rd party laboratory; **250 cycles** (for curtain fire dampers) **& 20,000 cycles** (for motorized fire & smoke dampers) open/close/open are carried out at client's factory / laboratory.

→ *The aim is to check availability and efficiency of a fire damper for operational reliability.*

❹ **Dynamic closure test (UL 555):**
Dampers installed in a ductwork with elevated temperature air (around 250°F) blowing inside. Blades of dampers are normally opened and they are tested to close against a minimum airflow of 2400fpm @ 4.5" w.g. pressure when the fusible link melts at rated temperature.

→ *The aim is to check the ability of dampers to close against airflow inside ducts.*

❺ **Temperature degradation & operation test (UL 555S):**
Dampers for ambient air leakage & operation tests are kept in oven for 30min at elevated temperature of 250°F or 350°F. Then 3 cycles "open/close" are performed and damper shall not take more than 75s to either open or to close.

→ *The aim is to check the reliability of the components (specially actuator) to work at elevated temperature.*

❻ **Leakage test (UL 555S):**
Dampers installed in a ductwork for leakage test at elevated temperature (250°F or 350°F) and ambient temperature. Leakage is tested from upstream as well as downstream side of different sizes of dampers (e.g. min-max, max-min, max-max) against a minimum airflow of 2400fpm @ 4.5" w.g. pressure to be classified as Class I, II or III.

→ *The aim is to check the amount of leakage of cold smoke and fumes in case of fire.*

Comparison between European & American Standards for Fire Dampers

	EN 1366-2	UL 555
1	**Normalization:** • No requirements about the design of fire dampers but high performance requirements.	**Standard:** • Many requirements about the design of fire damper e.g. clearance between adjacent blades, blades & casing, casing & sleeve etc., corrosion.
2	**Intent:** • MAINTAIN FIRE COMPARTMENTS with assessed performances of Integrity (E), Insulation (I) and Smoke Leakage (S).	**Intent:** • RESTRICT only passage of flames.
3	**Fire Test:** • Sample is installed in furnace wall with duct connected to damper → damper + installation is verified. • Time temperature curve: ISO 834-1 curve → **steeper and higher** than the curve used in UL 555. • Fire rating: 2 h or 4 h. • Integrity: **No sustained flames** on unexposed side that can **ignite a cotton pad** (specific test). • Thermal insulation => **temperature is measured on the unexposed side of damper.** - average temp < 140 °C - maximum temp < 180 °C	**Fire Test:** • Sample is installed in furnace wall with no duct connection → only damper construction verified. • Time-temperature curve: as defined in Appendix B of UL 555. • Lower fire rating: 1.5 h or 3 h. • No real integrity: **Flames < 152mm on un-exposed side of damper are acceptable**. • No thermal insulation => no temperature measurement / requirement for the unexposed side of damper.
4	**Hose Stream Test:** • No hose stream test as dampers are non-load bearing elements, and generally located inside false ceiling. But during entire fire test an under-pressure of 300Pa (minimum) is maintained.	**Hose Stream Test:** • Hose stream test on exposed side of the damper after removal from furnace by applying water jet with 30psi.
5	**Smoke Leakage:** • Smoke leakage measurement with suction (300Pa) during the fire test: < 200 m3/h/m² with no cracks and openings => smoke leakage (S)	**Smoke Leakage:** • No smoke leakage measured during the fire test. Note: Only in UL 555S leakage tests are performed in airflow test laboratory on separate samples with ambient & elevated temperature (250°F or 350°F).

Test on UL 555 Classified Fire Damper & EN 1366-2 Certified Fire Dampers

Goal:
To compare the performance between UL & EN fire dampers during a fire test.

Fire Resistance Test Conditions:
Comparative test was performed as per requirements from EN 1366-2.

Installation of Specimens in furnace:
Installation of both fire dampers on the furnace with under-pressure of 300Pa on supporting wall made of aerated concrete blocks (photo given below):

Damper 1 => UL 555 Classified damper (Model: FD 150CH – Aldes Middle East)
Damper 2 => EN 1366-2 Certified damper (Model: ISONE - EM – Aldes France)

Thermocouples were installed on the blades as well as on the casing of each damper to measure temperature during the test.

Results from temperature measurement

The temperatures measured during test are compared in the following table:

Temperature inside The furnace (°C) (ISO 834-1 curve)	Elapsed Time (min)	Temp. on Blade (°C)		Temp. on Casing at 100mm from Wall (°C)		Temp. on Supporting Wall at 20mm From dampers (°C)	
		EN	UL	EN	UL	EN	UL
680	10	36	590	29	300	18	90
785	20	87	672	43	430	26	200
840	30	100	736	57	495	50	300
885	40	130	772	67	510	70	345
920	50	150	800	70	530	80	365

*Note: **EN** refers to ISONE & **UL** refers to FD 150CH*

➞ Analysis of test result:

Temperature:
On blade: The ratio between UL and EN dampers goes from 16 to 5 times with a very big value (590°C) at 10 minutes => **Radiation effect begins significantly at 400 °C within 10 minutes**.

On casing at 100mm from wall: The ratio between UL and EN dampers goes from 10 to 7 times with a big value (300°C) at 10 minutes => **Propagation of fire by heat transfer (conduction) becomes significant by 200°C within 10 minutes with the UL damper.**

Smoke Leakage:
During the test, it was witnessed that smoke passed throughout the UL damper in a very huge quantity. In the meantime, only water vapour passed throughout the EN damper => **Propagation of fire by the smoke extracted by convective effect with the UL damper.**

Fire Propagation:
Pyrolysis of wood begins at **200 °C**.
Pyrolysis products (gases…) start to burn (with flames) between **500 – 700 °C**.

➞ Conclusion:

As per above observations it is evident that the fire compartmentation with **UL 555 classified fire damper** is not preventing any risk of **fire propagation through heat transfer,** and any risk of **smoke inhalation** for the people living or working inside buildings.

- Considering that **smoke inhalation** is the major risk of death inside buildings, smoke leakage should be strictly prevented through efficient fire dampers with rated smoke leakage performances (cf EN 1366-2 or UL555S).

- Considering the risk of **fire propagation**, flames as well as heat transfer should be **strictly prevented** through efficient dampers with rated heat transfer performances (**cf EN 1366-2 only!**).

The level of safety inside buildings can be easily increased with efficient fire dampers in compliance to EN1366-2. These fire dampers will prevent any risks due to smoke leakage and fire propagation by heat transfer.