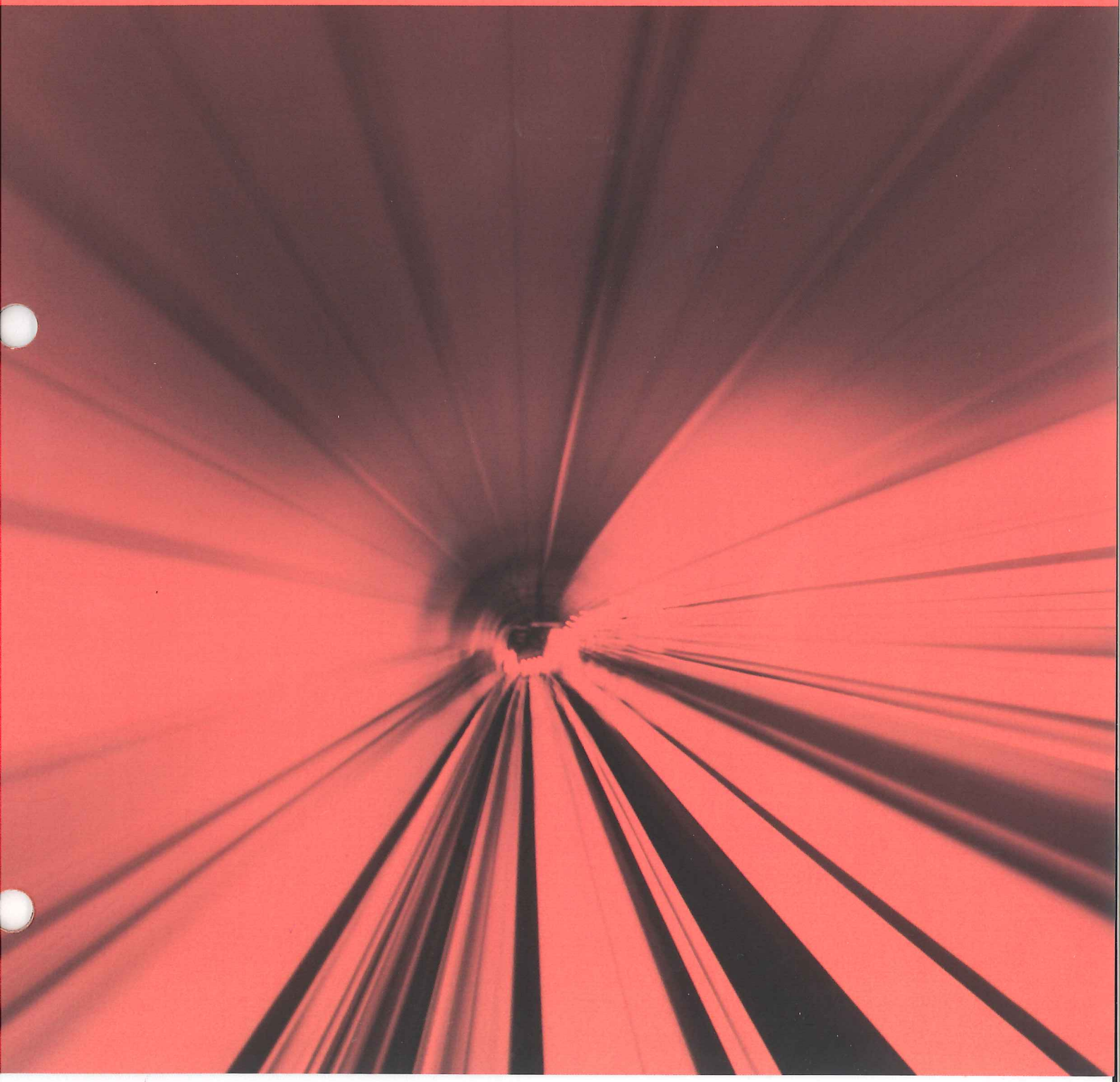
OLS
TUNNEL
VENTILATION
DAMPER



OUR COMMITMENT TO SERVICE EXCELLENCE

OUR MISSION

CREATING PRODUCT & SOLUTION FOR THE MAINTENANCE OF GOOD AND SAFE INDOOR ENVIRONMENTS.

OUR VISION

TO PLACE EMPHASIS ON CONTINUAL PRODUCT IMPROVEMENT AND EVERY ASPECT OF OUR BUSINESS TO BECOME THE HIGHEST QUALITY PRODUCER IN EVERY MARKET WE SERVE.

CUSTOMER SATISFACTION IS OUR FIRST PRIORITY

- WE TAKE SAFETY PROVIDED BY OUR PRODUCTS VERY SERIOUSLY.
- WE TAKE PRODUCTIVITY AND PLANNING VERY SERIOUSLY SO THAT WE KEEP OUR PROMISE TO OUR CUSTOMERS AND PROVIDE THEM WITH COMPETITIVE PRICE.
- WE TAKE QUALITY OF OUR PRODUCT VERY SERIOUSLY.
- WE INVEST IN MANPOWER AND TRAINING.
- WE INVEST IN MACHINES, EQUIPMENT AND SOFTWARE TOOLS.
- WE PROVIDE TECHNICAL SUPPORT AND HELP CUSTOMERS WITH PROJECT MANAGEMENT.
- IN-HOUSE TESTING FACILITY MAKE US A BETTER SUPPLIER.

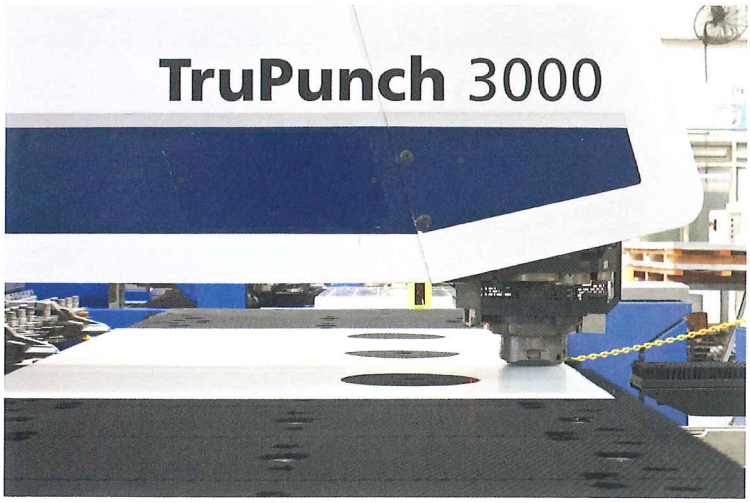
Continual improvement is part of our Quality Management System to ensure improvement in our product design and quality in the manufacturing and administrative processes as we make it our objective to be the highest quality producer in the market that we serve.

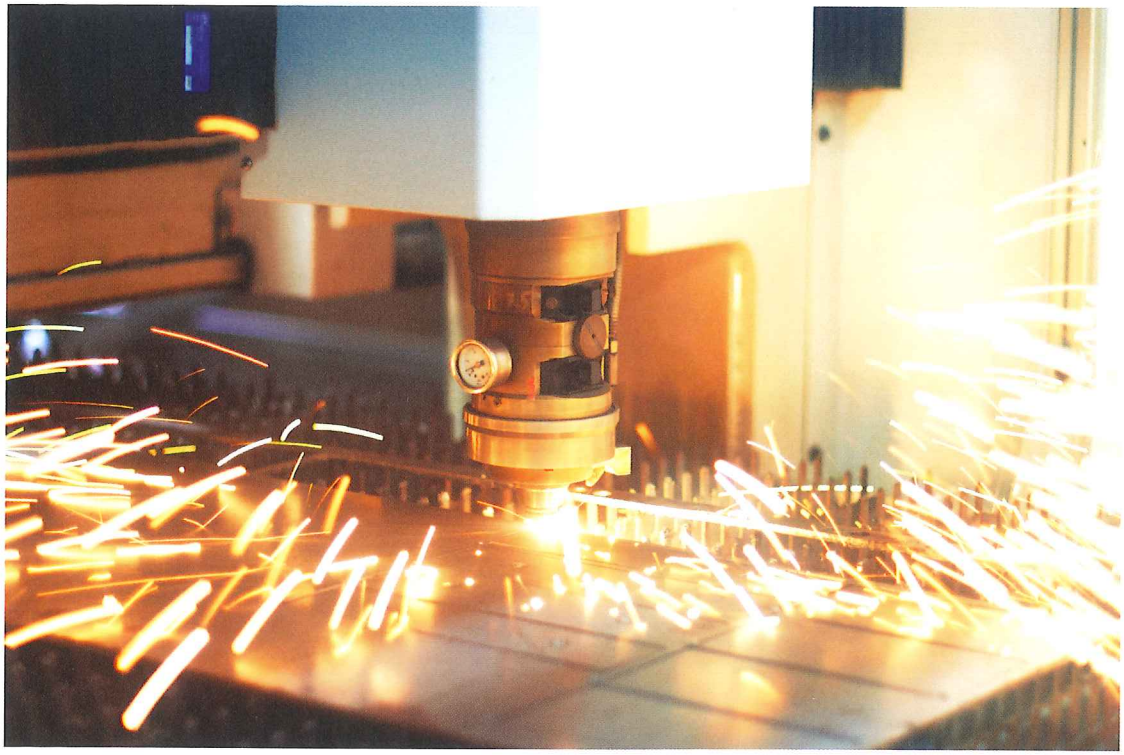
Our philosophy is "We believe helping customers solve problems helps make us a better supplier; we want to solve problem, not just sell products to our customers." The latest CNC machines we use ensure high productivity and highest quality of our products.

In addition, special equipment, jigs and tools are used to ensure high productivity and quality in assembly processes. With our wealth of experience in servicing international contracts, OLS is confident to bring you the highest quality products and the best service to our customers worldwide.

ABOUT OLS

Dedicated to create and develop quality products to cater for the ACMV industry, OLS has placed strong efforts in our Research and Development (R&D) processes. Specially designed for exact applications to meet clients' specifications and statutory regulations, OLS's Tunnel Ventilation Dampers (TVD) are made for the specific use in underground mechanical ventilation system of rail and mass rail transit tunnels, road tunnels, cable tunnels and other underground installations. These underground tunnel ventilation systems usually need heavy duty, high quality and reliable smoke and fire control dampers and OLS's TVD are designed to meet such requirements.





ALL Latest CNC turret and laser cutting equipment used in our production, to enhance productivity and ensure quality.

TYPES OF OLS TVD

SD20

TVD rated for operating pressure up to 1800 Pascal, temperature of 250°C for 2 hours and is suitable for smoke extract/shield function.

Maximum size single module 1500mm x 2400mm.
Maximum size multiple module – Unlimited.

SD60

TVD rated for operating pressure of 3000 Pascal, temperature of 250°C for 2 hours and is suitable for smoke extract/shield function.

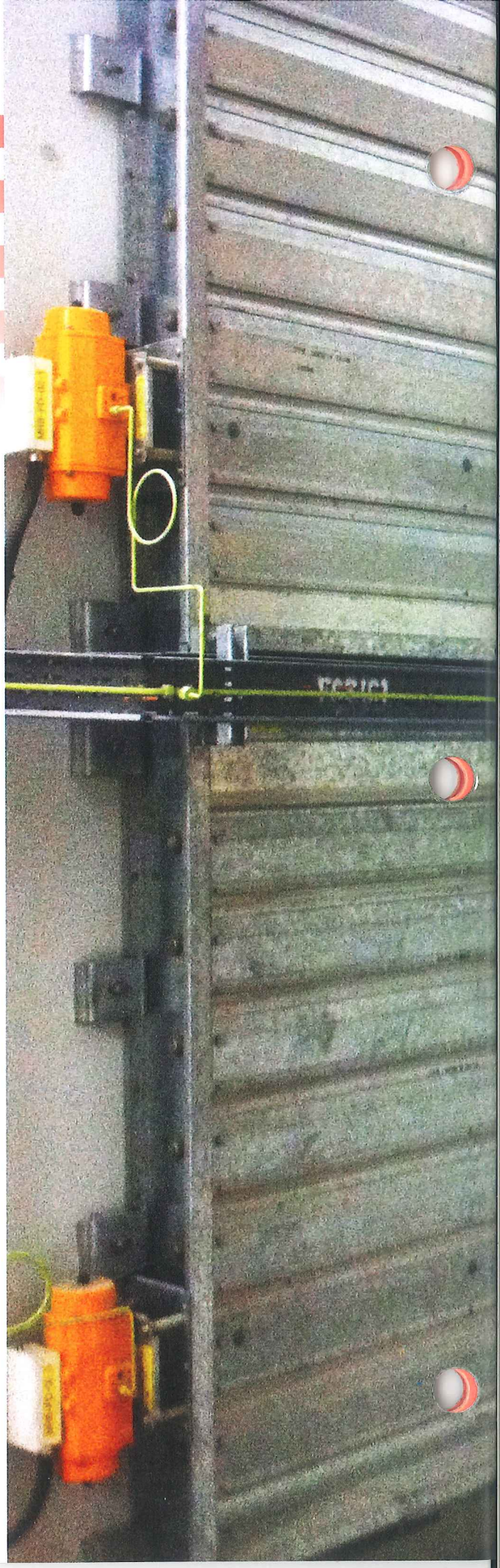
Maximum size single module 1500mm x 2400mm.
Maximum size multiple module – Unlimited.

TFSD460

TVD rated for operating pressure of 3000 Pascal, temperature of 250°C for 2 hours, fire resistance of 4 hours and is suitable for smoke extract/shield function.

Maximum size single module 1000mm x 2400mm without intermediate support, and 2000mm x 2400mm with intermediate support.
Maximum size multiple module – Unlimited.

We are able to provide both standard and customised TVD designs according to your requirements for your projects. Our dedicated team of professional design engineers will ensure close collaboration at all stages during the design development process.



RIGHT 2 by 2 modules TVD damper in close position. Each damper has direct drive mechanism and is pneumatically driven by 4 actuators.

CONSTRUCTION

The main parts of TVD are described as follows.

DAMPER FRAME

Damper frame is constructed from 2.5 mm thick hot-dipped, pre-galvanized steel, 210 mm by 50 mm cold-formed channels for SD60 damper and 220 mm by 50 mm for TFSD460 with fully welded corners for strength. Perimeter and intermediate damper frames are designed to 6000 Pascal pressure.

DAMPER BLADE

The damper blade is constructed of double-skin hot-dip galvanized steel to form an airfoil shape with special edge seals to prevent air leakage across the closed damper at high-pressure differentials. As with the damper frames, the blade is designed to pressure of 6000 Pascal and is strong enough to withstand twisting, hence, ensuring a tight blade closure under high operating pressure.

BLADE BEARING

As a standard, the damper blade pivots on two-part bearings made of phosphor bronze bush with Teflon® insert to ensure smooth cycling. However, to withstand direct fire exposure to over 1100°C, where fire rating is required of the damper, stainless steel bushes are used instead.

BLADE EDGE SEAL

Each damper blade is provided with a stainless steel blade edge seal to prevent air leakage between blades, and between blade and blade stop.

JAMB SEAL

Stainless steel jamb seal is incorporated on the damper vertical frames that significantly reduce air leakage between the blade end and damper frame when the damper is closed.

MOVING PARTS

Stainless steel are used on moving parts whenever necessary to prevent seizure over a prolonged period of operation. Blade linkage bracket is attached to each axle and connected to linkage bar with stainless steel pins outside the air stream so that all blades operate in unison.

DRIVE ACTUATOR

Damper may be driven by fast-acting and spring-return electric-powered or pneumatic-powered actuator. Both types of actuator are robust in construction, very reliable and, with proper maintenance, will run

trouble-free for an extremely long time. The pneumatic actuator is extremely reliable, and operates with 5 to 7 bar pressure and has an unlimited choice of torque. This actuator and its switches are designed to operate at 250°C for 2 hours without protection. The fast acting and spring-return electric-powered actuator is also very reliable, but requires protection to operate at 250°C. The actuator may be mounted on the damper frame and connected to the damper drive-shaft for direct-drive configuration, in which case space must be allowed adjacent to the damper for actuator and maintenance. If there is a lack of space next to the damper, the actuator may be mounted on an actuator base for linkage drive configuration, in which case the actuator will be mounted in front of the damper. For large damper with multiple modules construction, more actuators may be needed and the drive may be configured on a one-to-one, one-to-two, one-to-three, or one-to-four actuator-to-damper arrangement depending on preference.

OLS's TVD may be constructed of full stainless steel material upon request.

RIGHT The real view of a multiple module damper in closed position, damper is installed on 200 × 100 hot-dip galvanized steel structural "T" mullion designed for 6 kPa pressure differential.

FEATURES

We understand the importance of Tunnel Ventilation Dampers and how they can help save lives during fires. Thus, we designed our TVD with the following features for everyone's safety in mind.

HIGH PRESSURE RATING

SD60 and TFSD460 dampers including its frames and blades as a whole are designed to pressure of 6000 Pascal. Both are able to withstand constant fluctuating pressures due to passing train indefinitely.

LOW AIRFLOW RESISTANCE

Using an aerodynamic blade design, our dampers present very low resistance to airflow. Pressure loss through the open damper is less than 25 Pa at face velocity of 10 m/s.

RELIABLE & SUPERIOR QUALITY

High quality galvanized steel is used for TVD with stainless steel moving parts to prevent seizures and to withstand adverse environmental conditions.

Stainless steel seal is corrosion-resistant and will permanently retain its spring property, thereby maintaining the leakage performance of the damper perpetually. The stainless steel seal is an excellent seal when compare to rubber and ceramic seals as rubber is unable to withstand high temperature or fire, and ceramic seal does not have the required spring property.

As a standard, the damper blade pivots on two-part bearings made of phosphor bronze bush with Teflon® insert to ensure smooth cycling. These bearings prevent metal-to-metal contact between the blade axle and the bearing preventing wear and tear. Teflon is rated for over 250°C, is chemically inert and has the lowest coefficient of friction among material and, hence, its use minimizes torque and noise as a result of friction between rotating blade axle and bearing. This results in lower operating torque for the actuator. However, to withstand direct fire exposure to over 1100°C stainless steel bushes are used instead.

LOW LEAKAGE

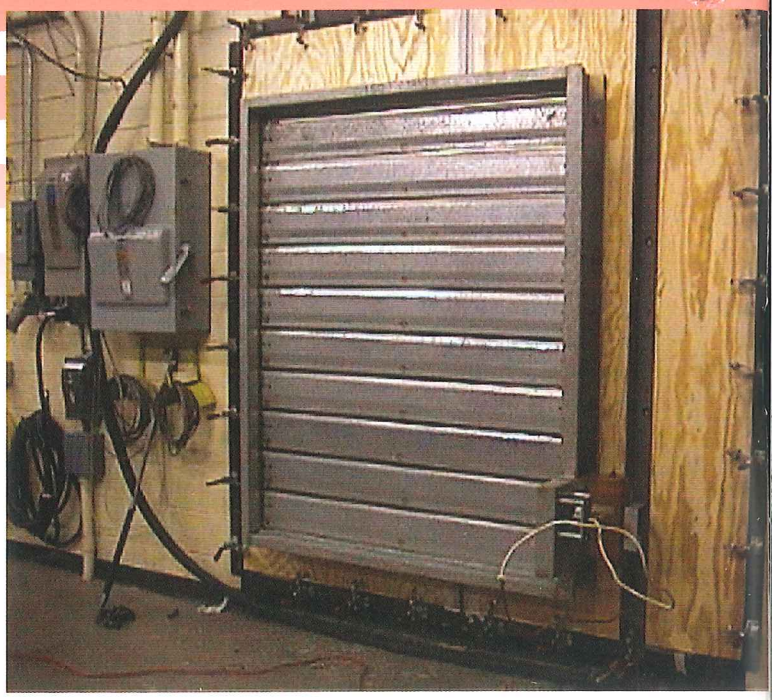
It is essential for subway tunnels to control movement of airflow and toxic smoke to prevent loss of lives during fire emergency. Thus, OLS's TVD are designed to effectively seal openings when closed. The damper blade is constructed of double-skin hot-dip galvanized steel to form an airfoil shape with special edge seals to prevent air leakage across the closed damper at high-pressure differentials. As with the damper frames, the blade is designed to the pressure of 6000 Pascal and is strong enough to withstand twisting, ensuring a tight blade closure under high operating pressure. The stainless steel blade edge seal is able to handle hot gases much more than 300°C without damage. Test at AMCA showed that the damper is still able to seal 99.7% (leakage of 0.3% based on approach velocity of 10.2 m/s) of the airflow at a pressure differential of 1000 Pa across the closed damper after it has been subject to 250°C for 2 hours. Even at 2000 Pascal pressure test shows that there is absolutely no leak between damper blades when closed. Stainless steel seal is corrosion-resistant and will permanently retain its spring property, thereby maintaining the leakage performance of the damper perpetually. The stainless steel seal is an excellent material when compare to rubber and ceramic seals as rubber ignites when hot and is unable to withstand temperature of 250°C when tested to UL555s. On the other hand, the ceramic seal does not have the required spring property to provide a consistent seal on repeated cycling.

PERFORMANCE TESTED

OLS's TVD and actuators have been rigorously tested according to UL555s (Leakage Rated Dampers for use in Smoke Control System) for its reliability, temperature resistance, air tightness and ability to operate under dynamic conditions. It has been repeatedly tested to 250°C with electric and pneumatic actuator without fail. Additionally our TFSD460 damper have been tested to BS 476 Parts 20 and 22 for 4 hours of fire resistance.

Note: If the required temperature rating is higher than 250°C, please consult our factory.

PERFORMANCE TESTING



The reliability and proper functioning of TVDs in underground tunnel ventilation system is of paramount importance as the lives and safety of personnel and passengers in the case of vehicular system depend on it to control and direct toxic smoke out of the tunnel during a fire. Smoke can spread very rapidly in the tunnel and, if not controlled, smoke will spread in all directions, will overwhelmed operation personnel, passengers and fire fighting personnel. For this reason, it is imperative that TVDs be properly tested to ensure its quality and reliability as a fire and/or smoke control damper.

OLS's SD20, SD60 and TFSD460 dampers have been repeatedly subject to a series of quality assurance tests according to ULS555s for its performance and reliability as a life support component in underground tunnel ventilation system. Additionally, the TFSD460 has been tested to BS476 Parts 20 and 22 for fire resistance.

Our dampers has been subject to the following tests:

- 200,000 continual cycling test
- Temperature resistant test to 250°C for 2 hours to UL555s in single and double module construction, with pneumatic and electric actuator
- Air leakage test to UL555s Class I damper
- Operation test to UL555s Class I damper
- AMCA pressure loss test
- Fire resistant test to BS 476 Parts 20 and 22 with installation simulating the site conditions
- Pressure test to 6000 Pa
- Temperature shock test from minus 10°C to plus 250°C
- Operating torque test

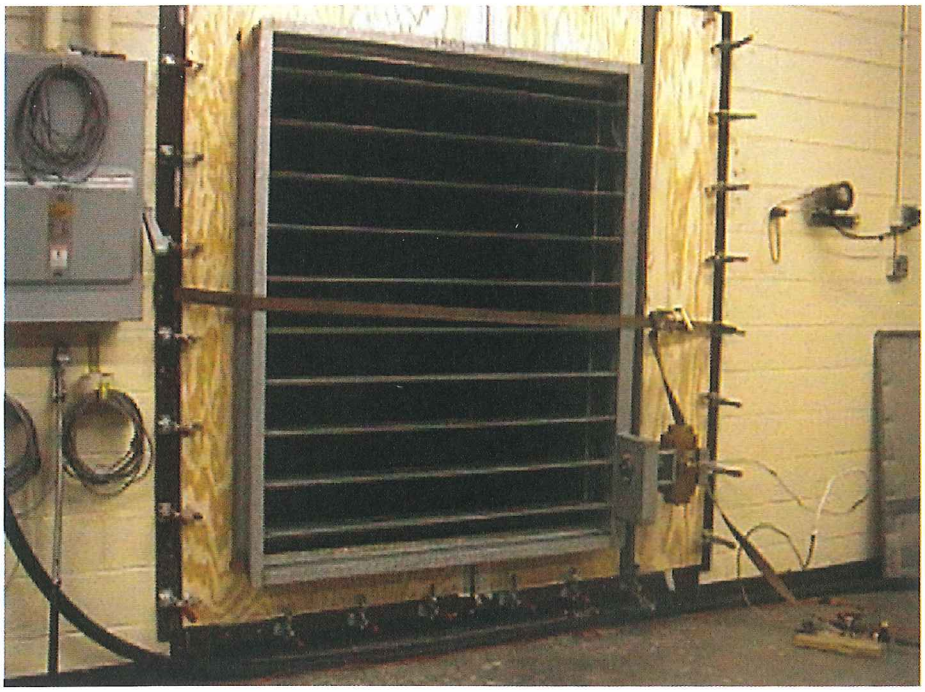
Many of these tests are quality assurance tests that are carried in prescribed sequence. This test procedure gives more evidence on the reliability and quality of the damper.

Examples of such a test sequence are:

- 200,000 continual cycling test followed by temperature resistant test to 250°C for 2 hours
- 20,000 cycling test followed by temperature resistant test and then air leakage test
- 5000 cycling test followed by heat resistant test, then air leakage test, then operation test and pressure loss test
- Temperature shock test from minus 10 to plus 250°C followed by the 2 hour at 250°C heat resistant test.

Similarly when a TVD is tested to UL555s standard the damper has to undergo the following sequence of test:

- Cycling testing
- Temperature degradation cycling test
- Air leakage test
- Operation test



Note: An air leakage test alone to UL555s leakage criteria does not constitute a test to UL555s Standard. The test according to UL555s require the damper to undergo preconditioning cycling test first, followed by temperature degradation cycling test before the air leakage and operation test. The main thing to note is if the damper is exposed to high temperature, the damper blade seals and the actuators/switches may become damaged and fail to perform in the subsequent air leakage and operation test. Failure of any component in the test sequence implies failure in compliance to UL555s standard.

Temperature degradation and cycling tests should be carried out with the appropriate laboratory set-up to simulate the condition onsite where dampers are installed in the tunnel or plenum without connection to metal ductwork. Under this condition, the damper and actuator are both exposed to smoke in case of fire. The test should be carried out with equipment that is able to maintain constant temperature all round the damper and actuator throughout the period of the test. Test in a furnace designed for a fire test will result in grossly inaccurate performance due to uneven temperature distribution across the damper.

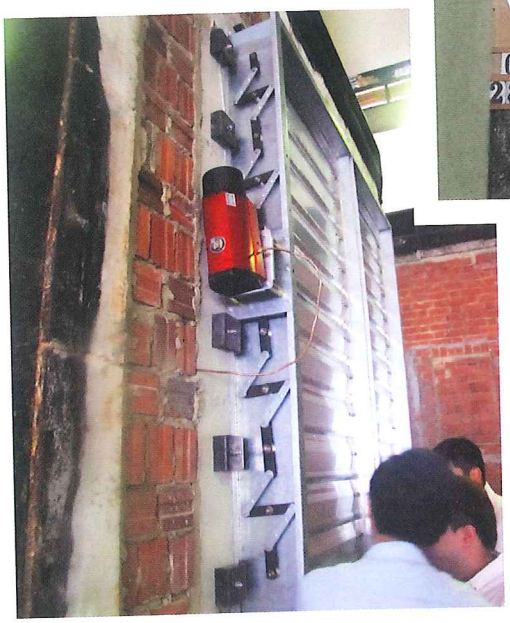
ABOVE A tunnel damper undergoing leakage test to UL555s at AMCA Laboratory in Chicago immediately after the temperature test of 250°C.

RIGHT A tunnel damper undergoing operation test to UL 555s to 2700 Pa and pressure loss test at AMCA Laboratory in Chicago immediately after the temperature test of 250°C.

PERFORMANCE TESTING

FIRE TEST TO BS476 PARTS 20 AND 22

TOP View of the unexposed side of wall mounted damper 4 hours and 20 minutes into the fire test.



LEFT View of the exposed side of wall mounted damper before commencement of fire test.

RIGHT, BOTTOM View of the unexposed side of wall mounted damper before testing.

LEFT, TOP Smaller single module floor mounted damper undergoing fire test to BS476 Part 20 and 22.

RIGHT, BELOW
View of unexposed smaller single module floor mounted damper before testing.

RIGHT BOTTOM
View of the unexposed side of a larger single module damper with intermediate frame, damper is floor mounted and is 4 hours and 10 min into the fire test.

MULTIPLE MODULE ASSEMBLY + INSTALLATION

Due to the large air volume that is required for mechanical ventilation of underground installation for normal operation and especially during emergency, the damper required is normally very large in size. Planning for the design of damper assembly and installation method is needed to handle this airflow. It is also crucial to consider the pressure and temperature to which the damper may be exposed. Our team at OLS is able to assist with your requirements if such a need arises.

Maximum single module size of our SD20 and SD60 damper is 1500 X 2000 mm without intermediate support. Maximum single module size of our TFSD460 damper is 1000 X 2000 mm without intermediate support and 2000 X 2000 mm with intermediate support. Large dampers are of multiple module construction and assembled on the prescribed site location by our customer. Dampers as large as 10,000 X 10,000 mm have been supplied by OLS consisting of 30 modules. Large dampers as such are driven by many actuators which can be direct or linkage driven with or without jackshaft. The picture on the right of this page shows a very large damper with direct drive actuator on the side modules and linkage drive actuator for intermediate modules.

The actuators are easily installed on site with 4 bolts and the damper are easily installed with our installation clamps holding them to the wall or floor with high temperature gasket to prevent leakage at the frame. For two or multiple module damper, heavy duty mullion such as channel, "T" bar or hollow steel frame should be installed to support the damper between modules to withstand the design pressure specified. The picture on page 5 shows a real view of OLS damper with 4 modules supported on "T" designed for 6 kPa pressure. The picture on page 2 and 4 shows two sets of damper each of 4 module construction, with each module direct-driven by one pneumatic actuator. Cable or piping may run between modules to the actuator in between modules as shown on picture on the right of this page.

ACTUATOR

Heavy duty pneumatic and fully electric actuator with spring return feature are the standard actuator we recommend for tunnel damper application due to its high reliability. The pneumatic actuator is more versatile due to the wide torque range available. Further pneumatic actuators are much more compact in size, easier to install and require less maintenance space. Electric actuators are much more expensive in cost and are difficult to justify the use of one actuator per module of damper. Pneumatic actuators operate with 6 to 7 bar compressed air and electric actuator requires 110 or 230 VAC supply. Both types of actuators that we supply are able to meet requirement of 250°C for 2 hours.

RIGHT a very large damper customised to suit the space constraint on site, damper are driven with pneumatic actuator with direct or leakage mechanism, damper modules are mounted on the wall and floor with standard clamp.

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