# WHITE PAPER | SILICONE JAMB SEALS - 2018 UPDATE

## Longevity & Performance at 1,000,000 Cycles

Dane Carey, Director of Engineering | JUNE 2018



27 IBER ROAD, STITTSVILLE, ONTARIO, CANADA, K2S 1E6
800-561-3449 | WWW.TAMCODAMPERS.COM

We are often asked whether the silicone jamb seals TAMCO uses will endure the thousands of cycles that our air control dampers are subjected to over the course of their service life *(well over 20 to 30 years)*.

## The Question

We are often asked whether the silicone jamb seals TAMCO uses will endure the thousands of cycles that our air control dampers are subjected to over the course of their service life *(well over 20 to 30 years)*. This is an important question, because damper air leakage has a significant effect on the cost of operating a building, be it the day the damper is installed, or after twenty years of operation. Lower air leakage equals cost savings. High air leakage translates into increased operating costs.

Jamb seals (also commonly referred to as frame or side seals) are used to prevent air from leaking between the blades and damper side frames when the damper is in the fully closed position. Blade and jamb seals are the two principal elements that influence a control damper's leakage rates.

Jamb seals are in constant contact with blades, whether they are at rest or rotating between the open and closed positions. This quite naturally leads those who use air control dampers to be concerned about jamb seal material and its ability to resist friction and hold up to many years of blade cycling.

In order to determine the longevity of TAMCO silicone jamb seals, TAMCO has been conducting extensive testing. These tests were designed to measure the effects of prolonged cycling, under a variety of conditions, on the jamb seal's physical appearance, durability, and air leakage performance.

Since our initial findings were recorded, TAMCO has continued cycling, testing and inspecting these same dampers. On January 30, 2018 we reached one million cycles with our Series 1000 opposed blade and parallel blade dampers and exceeded the one million mark with our Series 1000 SM dampers.

In addition, we began cycle testing a competitor's damper to introduce some comparative data for a product similar to the TAMCO Series 1000.

# The Facts

## Test Objectives:

The test objective was to determine the effect of prolonged cycle testing on the physical appearance and leakage rates of TAMCO dampers:

1. Constructed according to normal TAMCO production standards.
2. Constructed with blades that were slightly longer than normal TAMCO production standards. This was done to introduce additional force and friction.
3. Assembled out of square. This was done to introduce additional force and friction, applied unequally to the jamb seals. Leakage testing was not conducted for this damper, given that leakage rates would be artificially elevated due to out of square construction.

The secondary test objective was to determine the effect of prolonged cycle testing on the physical appearance and leakage rates of a competitor's damper :

1. Considered an industry equivalent to the TAMCO Series 1000.
2. Constructed according to normal competitor's production standards.

## Test Methodology:

*The actuators installed on each damper were connected to a timed electronic cycler.*

This study originated during the Underwriter Laboratories (UL) certification process for TAMCO's Series 1000 SM, UL/ULC Approved Smoke Damper. Cycle testing simulated normal wear and tear under fair to good conditions in a clean air environment.

Based on the excellent results we achieved at UL, TAMCO undertook further in-house cycle testing to see if our other damper model jamb seals would perform as well. We first followed with the standard Series 1000 dampers and then the 1000 dampers with the (SW) Salt Water Resistance Option. For this reason we have the most cycle data for Series 1000 SM, followed by the other two models. In November of 2015, we began conducting identical cycle testing on a competitor's damper, for the purpose of comparing its performance to that of TAMCO dampers.

Prior to cycling, a leakage test was conducted for all the test dampers, to establish base point leakage rates. Leakage was tested with airflow in both directions. Leakage tests were then conducted at 30,000 cycle intervals, and the dampers were inspected for physical signs of wear and damage. Changes in leakage rates at each cycle interval were compared to base test results.

*TAMCO Leakage Test Chamber*

### The following dampers were tested:

All TAMCO test dampers measured:
24" x 24" *(610 mm x 610 mm)*

- *Series 1000 Damper*
  opposed blade, normal production as per TAMCO specifications.
- *Series 1000 Damper*
  parallel blade, normal production as per TAMCO specifications.
- *Series 1000 SM Damper*
  parallel blade, blades constructed $^{1}/_{32}$" *(0.83 mm)* longer than normal production.
- *Series 1000 Damper – SW Option*
  opposed blade, blades constructed $^{1}/_{16}$" *(1.60 mm)* longer than normal production.
- *Series 1000 Damper – SW Option*
  opposed blade, assembled with frame forced $^{11}/_{16}$" *(17.50 mm)* out of square.

The competitor's test damper measured:
23.75" x 23.75" *(603 mm x 603 mm)*

- opposed blade, stainless steel jamb seal, normal production as per competitor's specifications.

**20,000** cycles is equivalent to **20** years

UL estimates that 20,000 cycles of life safety dampers is equivalent to 20 years of service *(2.8 full cycles/day)*.

## Test Results:

| Maximum Leakage Rates (CFM/ft²) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **SERIES 1000** Normal TAMCO Production Standard | | | | | | | | |
| **STATIC PRESSURE** (INCHES W.G.) | **OPPOSED BLADE DAMPER** | | | | **PARALLEL BLADE DAMPER** | | | |
| | 0 CYCLES | 158,337 CYCLES | 406,672 CYCLES | 1,000,000 CYCLES | 0 CYCLES | 158,337 CYCLES | 406,672 CYCLES | 1,000,000 CYCLES |
| 1.00 | 1.44 | 1.52 | 1.46 | 1.68 | 1.72 | 1.49 | 1.80 | 2.03 |
| 4.00 | 3.21 | 3.26 | 2.90 | 3.14 | 3.02 | 3.20 | 3.57 | 3.71 |
| 8.00 | 4.35 | 4.66 | n/a | 3.94 | 4.73 | 4.53 | n/a | 4.55 |

These dampers were cycled for the equivalent of 1000 years, by UL standards.

The maximum increase in leakage rate from 0 cycles to 158,337 cycles for the opposed blade damper was 5% *(at 8" w.g.).* In the case of the parallel blade damper, air leakage actually decreased by almost 10% at 8" w.g. and 13% at 1" w.g. The jamb seals showed some scuff marks and slight wear on the outside finger. There were no tears at all in the silicone jamb seals.

After simulating 1000 years of use, both dampers' leakage rates stayed well below AMCA's maximum allowable leakage rate for Class 1A certification. The jamb seals' fingers were worn in a few places, and did have several superficial tears. However, none of the jamb seals were perforated or torn through. The entire length of each seal remained intact and firmly secured within the channels in the frame extrusions.

*Appearance of damper seals after cycle testing*

*Series 1000 OB*

*Series 1000 PB*

**1000 years**
**Series 1000 Dampers** were cycled for the equivalent of

| Maximum Leakage Rates (CFM/ft²) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **SERIES 1000 SM** Blades 1/32" *(0.83 mm)* longer than normal production | | | | **SERIES 1000 – SW OPTION** Blades 1/16" *(1.60 mm)* longer than normal production | | | |
| **STATIC PRESSURE** (INCHES W.G.) | **OPPOSED BLADE DAMPER** | | | | **Parallel Blade Damper** | | | |
| | 0 CYCLES | 256,846 CYCLES | 501,181 CYCLES | 1,082,059 CYCLES | 0 CYCLES | 70,387 CYCLES | 314,722 CYCLES | 912,050 CYCLES |
| 1.00 | 1.43 | 1.12 | 1.42 | 1.27 | 1.93 | 2.09 | 1.38 | 1.47 |
| 4.00 | 3.15 | 2.38 | 2.33 | 2.57 | 3.31 | 3.26 | 2.88 | 2.92 |
| 8.00 | n/a | 3.44 | n/a | 3.39 | 4.13 | 4.14 | n/a | 3.91 |

The Series 1000 SM damper was cycled for the equivalent of 1082 years and the SW Option Series 1000 damper was cycled for the equivalent of 912 years.

As with the standard construction Series 1000 dampers, the jamb seal fingers on the Series 1000 SM and the Series 1000 with SW Option did have some superficial tears, but none of the seals were torn through or loosened in any way from within the frame channels. The leakage rates at all static pressures showed very little change over the duration of the test period. What is truly remarkable is that the leakage rates at over one million and over 900,000 cycles respectively, remained lower than they had been at the outset.

Although the longer blade does settle into the jamb seal, reducing air leakage over time, there is a caveat. Blades that are longer than recommended require more torque to operate. Increased torque requirements will necessitate larger actuators. It is also possible that since the actuator has to work harder, the internal actuator gears may fail sooner and will need to be replaced more often.

*Appearance of damper seals after cycle testing*

*Series 1000 SM*

*Series 1000 SW*

**1082 years**
**Series 1000 SM Damper** was cycled for the equivalent of
**912 years**
**Series 1000 SW Damper** was cycled for the equivalent of

## Test Results:

### TAMCO Series 1000 Damper with SW Option assembled with frame forced $^{11}/_{16}$" *(17.50 mm)* out of square.

This test damper's frame was forced out of square to simulate a "worst case" condition. Being out-of-square caused only a portion of each blade edge to come into contact with the jamb seal. All of the force that would have been distributed evenly across the entire blade edge was concentrated in a much smaller contact area, effectively increasing the friction applied to the jamb seals.

The image to the right shows the jamb seals of this damper after 912,050 cycles. Even under these extreme conditions, the seals held fast within the integral slots in the aluminum frame extrusion. None of the seals were torn away. The only changes in appearance observed, were a number of surface tears in the jamb seal fingers.

*Appearance of damper seals after cycle testing*

*Series 1000 SW assembled out of square*

**912 years**

**Series 1000 SW Damper** was cycled for the equivalent of

### Competitor's Damper Equivalent to TAMCO Series 1000

| Maximum Leakage Rates (CFM/ft²) | | | | | |
|---|---|---|---|---|---|
| **OPPOSED BLADE DAMPERS** Normal Production Standard | | | | | |
| **STATIC PRESSURE** (INCHES W.G.) | **COMPETITOR'S DAMPER** | | **TAMCO SERIES 1000** | | |
| | 0 CYCLES | 474,436 CYCLES | 0 CYCLES | 406,672 CYCLES | 1,000,000 CYCLES |
| 1.00 | 3.60 | 17.21 | 1.72 | 1.80 | 2.03 |
| 4.00 | 8.73 | 31.93 | 3.02 | 3.57 | 3.71 |
| 8.00 | 12.03 | n/a | 4.73 | n/a | 4.55 |

This competitor's damper is manufactured with stainless steel jamb seals, and was cycled a total of 474,436 times.

The image to the right shows where the damper blades have scraped against the jamb seals. As the blades rotated repeatedly across the jamb seals, the blade edges were worn away. Evidence of this wear can be seen on the stainless steel jamb seals in the form of accumulated dust particles. This dust mixes with the moisture in the air to produce a hardened residue that affects jamb seal function. We also observed heavy wear on linkage components that affected blade operation adversely. This was the major contributing factor to the pronounced increase in leakage, as the damaged linkage prevented blades from closing properly.

After being cycled 474,376 times, the competitor's damper leakage rate more than quadrupled to 17.21 CFM/ft² at 1" w.g. of static pressure and more than tripled to 31.93 CFM/ft² at 4" w.g. When this damper left the factory, its leakage rate placed it on the cusp between AMCA's Leakage Class 1 and 2. At the end of the cycling period, the leakage rate deteriorated, placing it well within the Leakage Class 3 range.

In comparison, after one million cycles, the TAMCO damper leakage rates were still far below the upper limits set by AMCA for Leakage Class 1A at 1" w.g. and Leakage Class 1 at 4" w.g. and 8" w.g. of static pressure.

*Competitor's Damper*

*Appearance of damper seals after cycle testing*

*Accumulation of blade fragments*

**474 years**

**Competitor's Damper** was cycled for the equivalent of

## The Solution

After one million cycles, the leakage test results confirm that TAMCO dampers are the unequivocal solution wherever consistent leakage performance and jamb seal longevity are a priority! TAMCO silicone jamb seals are specifically engineered through design and special chemical composition to resist wear that may result from normal day to day operation.

Cycle testing proved the resilience and durability of TAMCO's silicone jamb seals. All the TAMCO jamb seals showed minimal evidence of wear under normal operating conditions, and stayed firmly inserted within the integral slots in the aluminum frames. None of the seals failed, nor did our damper blades cause any puncture or perforation of the jamb seal material, even under extremely unfavorable conditions. The durability of our product makes TAMCO dampers a highly attractive and cost effective choice.

Unlike many industry standard dampers, TAMCO dampers will not need to be replaced after a few short years, because TAMCO silicone seals will not fail. The competitor's damper that underwent identical cycle testing demonstrated significant jamb seal and linkage component wear, as well as degradation of the blade material. This deterioration caused leakage rates to increase to more than three to four times what they had been before testing began!

In addition to superior jamb seal integrity, TAMCO dampers' leakage rates changed very little over the course of cycle testing. Some test dampers demonstrated minimal increases and remarkably, some of the test damper's leakage performance improved! Consistent low leakage rates translate into energy savings over the entire service life of the damper.

The bottom line is, TAMCO damper reliability, consistent performance, and longevity add up to significant savings. TAMCO dampers can be relied on to provide consistent ultra-low leakage performance from the day they are installed, and for decades of dependable service life.

TAMCO dampers are the unequivocal solution wherever consistent leakage performance and jamb seal longevity are a priority!

### *Ongoing Cycle Testing:*

*We may have hit a major milestone at one million cycles, but TAMCO will continue cycle testing in order to measure the long-term effects on jamb seal material, on overall damper operation, and on leakage rates.*