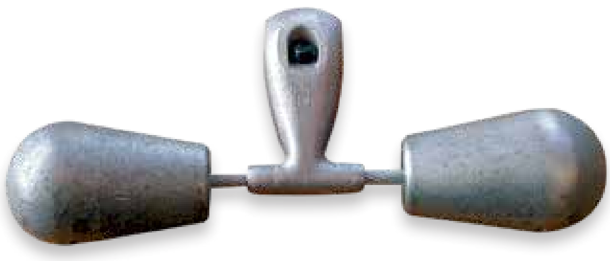
1700AA Series
Asymmetrical Damper
Test Data

1700AA Series Asymmetrical Dampers

Scope

This is a summary of design and testing for the new 1700AA asymmetrical series of stockbridge dampers being offered by AFL for overhead transmission lines. The 1700AA series is intended to be used as an equivalent to the current 1700 series of dampers. As shown below, the 1706AA, 1707AA and 1708AA asymmetrical configurations will be used in place of the previous 1706, 1707 and 1708 symmetrical sizes.



Symmetrical Damper (1700 Series)

Asymmetrical Damper (1700AA Series)

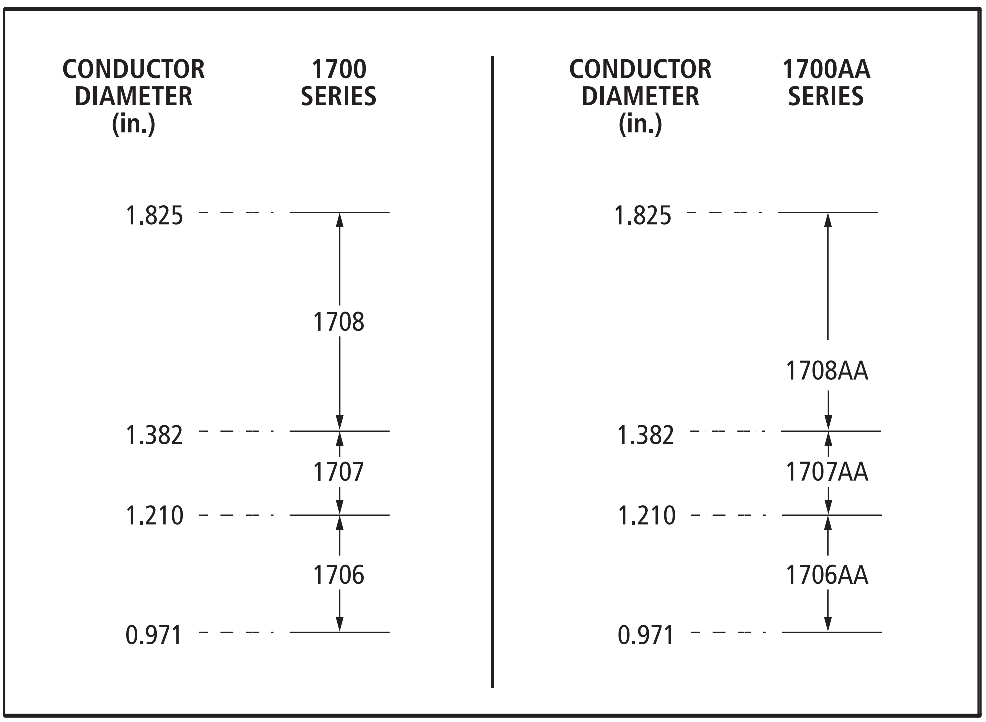


Figure 1—Comparison of diameter ranges

Background

The stockbridge damper was invented in the early 1900s by George H. Stockbridge with Southern California Edison. The stockbridge damper patent was purchased from him in 1925 and began developing the damper and applying it to various conductors. AFL adapted the design over time to new transmission line industry requirements, resulting in the current 1700 series damper, the design of which has not changed significantly for over 30 years. It is known as the B-1700 series of damper and has an excellent reputation for being a solid design, widely used around the country and also used internationally.

Now AFL is again adapting to the needs of the utility market and is releasing a new series of damper, the 1700AA series. This damper, while different in some respects to the 1700 series, is essentially the same from a functional and design standpoint. The components are made from the same materials and the same method and location for assembly of the dampers is used (near Spartanburg, SC). The new damper design takes advantage of AFL's already proven bell-shaped weight design, but is modified to take advantage of asymmetrical messenger cable lengths and differing weights in order to optimize the design further.

By adjusting the lengths of messenger cable on either side of the damper and using differing weights on each side, the damper can now cover a wider frequency range with lighter components. But as with any new damper to be used on electric utility transmission lines, testing is very important. This document highlights three very important tests used to confirm the performance of a stockbridge damper: efficiency, fatigue and corona. Also included is a drawing for the 1700AA series.

Design

As noted, the design of the new 1700AA series is very similar to the already existing 1700 series. The basic components are shown below and the materials used are listed in the following table.

Component Materials

COMPONENT	MATERIAL	FINISH
Clamp Body and Keeper	Aluminum Alloy	Cast and finished
Clamp Bolt	Aluminum Alloy	Anodized bolt head and lubricated threads
Messenger Cable	Steel	Galvanized
Damper Weights	Cast Iron	Hot-Dip Galvanized

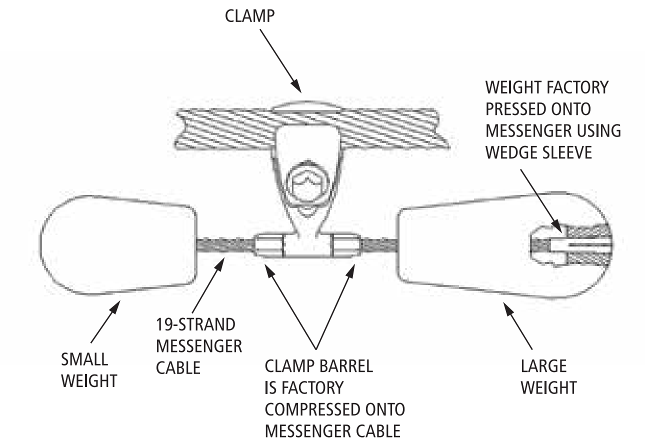


Figure 2—1700AA Series Construction

Damper Specifications by Size

WEIGHT CONFIGURATION	APPLICABLE DIAMETER RANGE (IN.)	APPROXIMATE WEIGHT OF ASSEMBLY (LBS)*	APPROXIMATE LENGTH OF ASSEMBLY (IN.)*
1706AA	0.971 - 1.210	9.3	15
1707AA	1.211 - 1.382	10.1	16
1708AA	1.383 - 1.825	17.6	19

* Weight and length may vary slightly according to clamp size used.

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Efficiency Testing

General

Dampers are required to dissipate the required amount of vibrational energy from overhead conductors. Several factors dictate the amount of required energy dissipation, including conductor tension, span length, geographic terrain and prevailing winds. Therefore, laboratory testing must be applied appropriately to field installations so as not to require more energy dissipation than the damper can provide.

Test Setup

A length of cable is attached at both ends to concrete abutments through the use of fittings and/or other hardware. The cable is tensioned to a value normally used in overhead transmission lines. The cable is then vibrated over a range of frequencies corresponding to what is expected to occur in field installations. During these vibrations, the power dissipated by the damper is measured by determining various amplitudes of vibration present in the vibrating cable. Theory and calculations for this type of test are listed in IEEE Std. 664, IEEE Guide on the Measurement of the Performance of Aeolian Vibration Dampers for Single Conductors. The results can be plotted in the form of damping efficiency, which gives a measure of the power dissipation of the damper (reference Figure 5, IEEE Std. 664). The tests listed here were all performed at one of AFL's vibration spans located in Duncan, SC.

Results

Interpretation

Dampers are matched to cables in large part by what is known as the cable's characteristic impedance, or Z_0. This impedance, which is dependent on cable tension and unit mass, ranges from low to high as the cable's tension and weight change. For conventional aluminum-based conductors, this impedance generally increases as the conductor diameter increases, within the same cable type (ACSR, AAC, ACAR, ACSS, etc.).

As dampers are intended to cover cables of varying diameters, they also need to be tested over a range of impedances as well. Included here are results of efficiency testing on various cable sizes, showing that various sizes have been tested to demonstrate the damper's ability to perform across a range of cables.

Data

Cables were efficiency tested to determine the damper performance across a range of cables. These cable sizes included those listed below, in order of increasing diameter. Graphs follow below also, including a comparison between the old symmetrical style damper and new asymmetrical style damper.

- 1706AA: ACSR Dove (0.927"), AAC Arbutus (1.026"), ACSR Drake (1.108"), ACSR Rail (1.165"), ACSR Cardinal (1.196").
- 1707AA: ACSS Bluejay (1.259"), ACSR Bunting (1.302")
- 1708AA: ACSR Chukar (1.602")

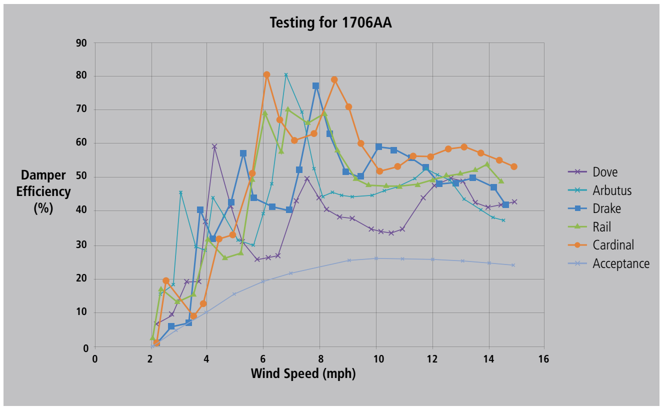

Figure 3—Efficiency Test Results—1706AA

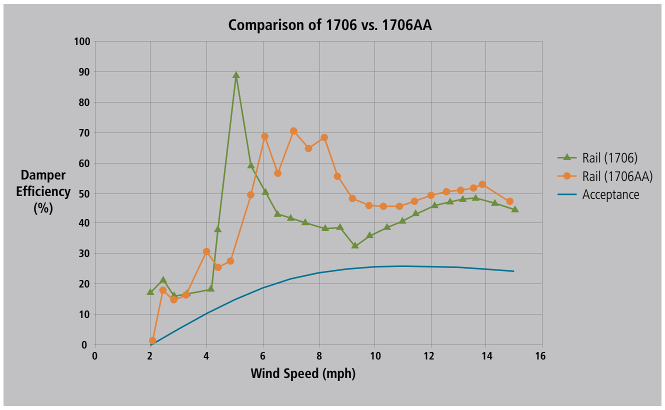

Figure 4—Comparison for 1706, 1706AA

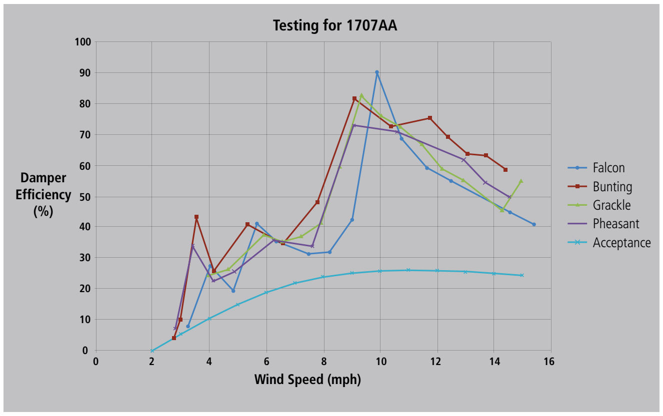

Figure 5—Efficiency Test Results—1707AA

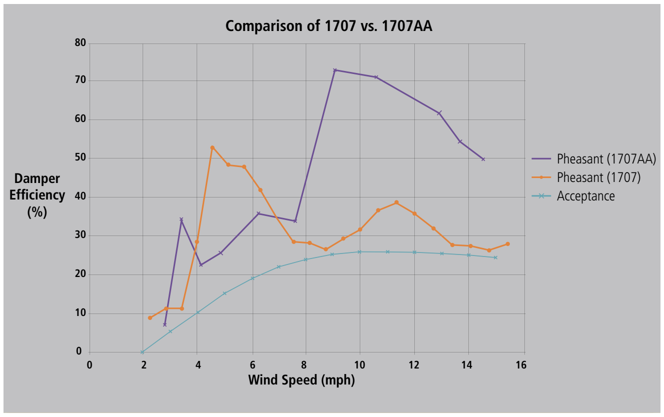

Figure 6—Comparison Graph—1707, 1707AA

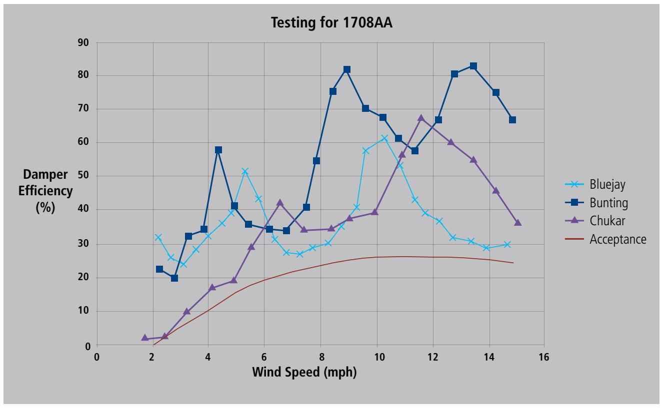

Figure 7—Efficiency Test Results—1708AA

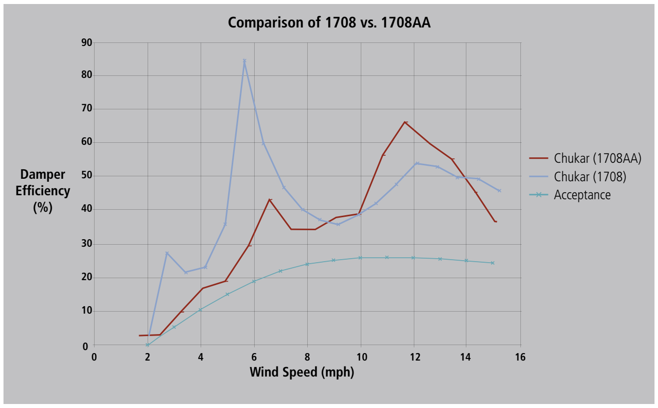

Figure 8—Comparison Graph—1708, 1708AA

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Fatigue Testing

A common test for stockbridge dampers is to vibrate them for a large number of cycles to check the durability of the damper. Even though the damper is required to damp vibration in field situations to a manageable level, it is important that the damper can withstand a certain level of vibration. A common test procedure uses 10 million cycles.

The amplitude of vibration for the test is commonly the number 1 divided by the frequency of vibration in Hz. The fatigue tests for the 1706AA, 1707AA and 1708AA style dampers were tested at their highest corresponding resonances for 10 million cycles with no resulting damages observed. Additionally, these samples were then subjected to a weight pull-off strength test which resulted in more than 800 lbs withstand strength. Figure 9 shows a damper mounted in the fatigue testing machine at AFL's facility.

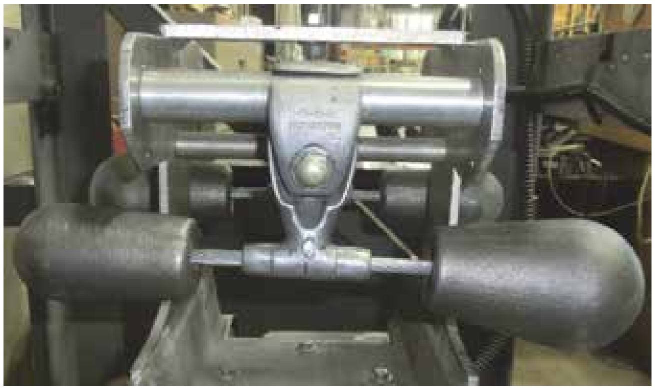


Figure 9—Fatigue Tester

Corona Testing

Dampers must be designed to minimize corona discharge in situations where the conductor is at a high electric potential (i.e. Extra High Voltage, or "EHV" applications). In the vicinity of EHV overhead transmission lines, electric field levels can be high enough to induce corona discharge on the conductor, attachment fittings and even dampers if they are not properly designed and applied. The voltage gradients (electric field strengths) for EHV installations vary widely, but some estimated values are as follows for 345 kV and 500 kV applications:

CONDUCTOR DIAMETER (IN.)	BUNDLE SPACING (IN.)	VOLTAGE LEVEL IN KV (RMS)	MINIMUM VOLTAGE GRADIENTS OF SOME TYPICAL LINES AT NOMINAL SYSTEM VOLTAGES
1.125"	18	345 kV	16.69 kV/cm
1.50"	18	500 kV	18.03 kV/cm

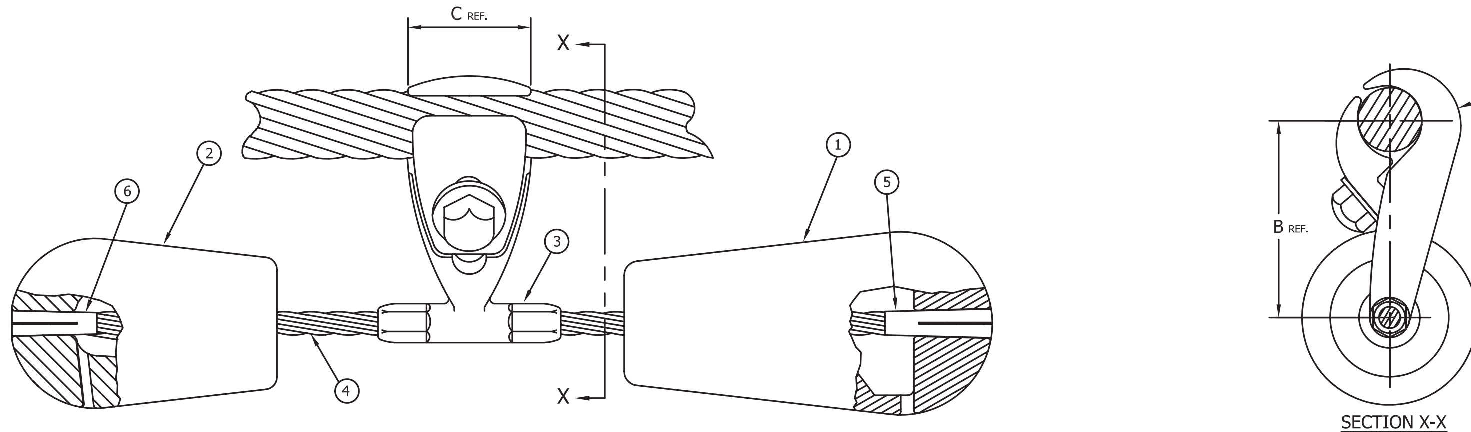
Samples for both 1706AA and 1708AA were tested at Kinectrics High Voltage Laboratory to investigate the use of the weight configurations used. The performance of these samples exceeded the corona requirements easily and the results are shown below. As reference, the "extinction" value is the point at which all corona disappears from the sample under test.

Corona Test Results

DAMPER SAMPLE DESIGNATION	GROUND PLANE HEIGHT (FT)	CORONA EXTINCTION GRADIENT (KV/CM)	COMMENTS	PASS/FAIL
1706AA	11	21.0	Value easily exceeds minimum of 16.69 kV/cm	Pass
1707AA	15	26.4	Value easily exceeds minimum of 16.69 kV/cm	Pass
1708AA	15	23.6	Value easily exceeds minimum value of 18.03 kV/cm	Pass

BILL OF MATERIAL

ITEM	DESCRIPTION	MATERIAL	DETAIL DWG. & ITEM	REQ'D	REMARKS
1	DAMPER WEIGHT	CAST IRON	SEE TABLE	1	
2	DAMPER WEIGHT	CAST IRON	SEE TABLE	1	
3	CLAMP ASSEMBLY	ALUMINUM	SEE TABLE	1	
4	PREFORMED STEEL STRAND	GALV. STEEL	SEE TABLE	1	
5	TAPERED SLEEVE	ALUMINUM	SEE TABLE	1	
6	TAPERED SLEEVE	ALUMINUM	SEE TABLE	1	



ASSEMBLY CATALOG NUMBER	REPLACES CATALOG NUMBER	BARE CONDUCTOR DIAMETER RANGE FOR ASSEMBLY		DIMENSIONS (IN.)			APPROX. WEIGHT LBS.
		MIN.	MAX.	B	C	CLAMP BOLT DIA.	
1706AA-9	1706-9	.971	1.090	3.78	2.12	.50	9
1706AA-10	1706-10	1.091	1.210	3.78	2.12	.50	9
1707AA-11	1707-11	1.211	1.330	3.78	2.12	.50	18
1707AA-13	1707-13	1.331	1.382	4.31	2.50	.62	18
1708AA-14	1708-14	1.487	1.643	4.31	2.50	.62	18
1708AA-15	1708-15	1.644	1.780	4.31	2.50	.62	18
1708AA-16	1708-16	1.781	1.825	4.50	2.50	.62	19

SUPERSEDES: SUPERSEDED BY:

DAMPERS - CATALOG 1700AA SERIES

SINGLE LEG CLAMP TYPE

WITH 19 STRAND DAMPER CABLE

DESIGN DRAWN CHECK

SCALE DATE APPR

SHEET REVISION PA

ARN

Figure 10—Drawing for several 1700AA sizes

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