MATERION BRUSH PERFORMANCE ALLOYS
TECHNICAL TIDBITS

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Twice as nice or twice the hassle? – A comparison of one-piece and two-piece construction for female terminal (socket) contacts.

One-Piece vs. Two-Piece Terminal Contacts

This series of six or so editions of Technical Tidbits will discuss various types of springs used in electrical contacts or sensors, and group them into six broad categories of similar function (cantilever beams, simply supported beams, torsion bars, Belleville washers, coil springs, and bellows & diaphragms). This month we will pause and do a comparison/contrast of several spring types.

In keeping of the spirit of this month's theme, we are also providing two comparisons in one issue. The first is a comparison of cantilever, simply supported, and torsion beam contacts as used in connectors. The second is a comparison of one-piece and two piece socket designs.

Figure 1. Comparison of the unit spring used for socket contacts. From left, cantilever beam, simply supported (arch) beam, torsion bar (louvered spring) contacts.

- **Cantilever Beam**
- **Simply Supported (Arch) Beam**
- **Torsion Bar**
- **Louvered Contact**

Table 1 below compares the spring performance of the three spring types. Figure 2 shows a graphical comparison of the spring performance of all 3 types, where each spring has the same width, thickness, length, and height above flat. Do not be concerned with the absolute numbers, we are focusing on the relative performance of the 3 spring types.

Spring Type	Contact	Spring Rate Comparison	Comments
Cantilever Beam	Line contact - minimum wipe	Most flexible – lowest force, greatest deflection	Simple, allows one-piece design. Longer conducting path means greater temperature rise
Torsion (Louvered) Beam	Point contact - moderate wipe	Stiffest – highest force, least deflection	High insertion force, good durability
Simply Supported (Arch) Beam	Line contact - minimum wipe	Much stiffer than cantilever, slightly less stiff than torsion beam	More linear spring rate than torsion beam

Table 1. Comparison of Spring Performance.

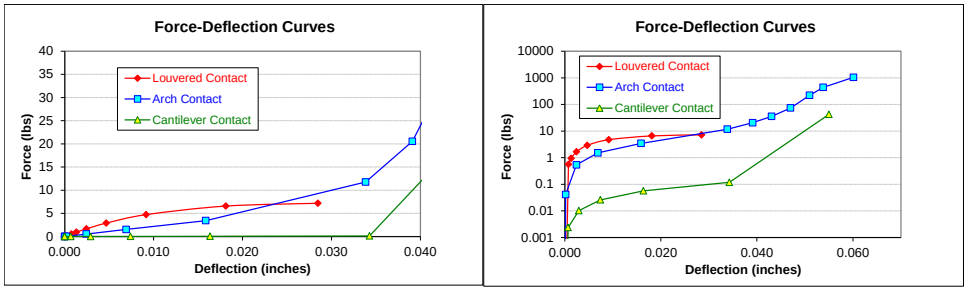

Figure 2. Comparison of Spring Performance. All 3 spring types have same length, width, thickness, and height above flat. The cantilevered beam is the least stiff, and the louvered spring is the stiffest, but least linear of the three.

The next issue of Technical Tidbits will continue the discussion on various spring types, focusing on spring washers.

One Piece vs Two Piece Female Socket Contacts (continued)

Figure 2 below compares a two piece female socket contact with an arch beam spring two a one piece socket contact with a cantilever spring. (In the two piece design, the arch beam is shown without plating to differentiate it from the crimped part of the socket that houses it. The advantages and disadvantages of each design are compared in Table 2 below. The two piece design is more expensive to fabricate, but may have performance advantages over the one piece design that would justify the additional cost, such as savings in area that needs to be plated, and increased stiffness allowing for a smaller contact (and less metal to buy, stamp, and plate).

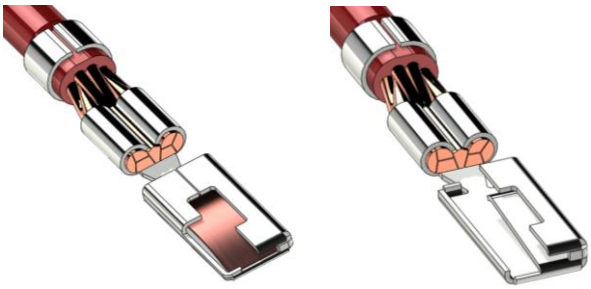

Figure 2. Cutaway views Comparing 2 piece (left) and 1 piece (right) socket contacts.
The two piece design requires that the crimped and spring part of the socket be stamped separately and then assembled. When the spring and the crimped part are stamped from one piece, there are stringent formability requirements.

Two Piece Socket	One Piece Socket
Separate, high strength spring inserted into soft, crimpable housing.	Socket, spring, and crimp area stamped out of one piece of metal.
As much strength and reliability in contact area as you want. As much formability in housing and ductility in the crimping area as you want.	Requires tradeoff between high strength in contact area and ductility/ formability in housing and crimp zone.
Requires two independent stamping operations and one assembly step.	Requires one stamping operation.
Multiple contact beams possible.	Typically only one contact beam.
Spring elements can be arch, torsion, or cantilever beam.	Spring element is typically cantilever beam.
More efficient coverage of plating	Less efficient use of plating

Table 2. Comparison of 1 piece and 2 piece socket contacts.
The one-piece design is easier to stamp and has no additional assembly cost, while the two piece design is more complicated but typically has better performance. The one-piece design also forces a greater strength/formability tradeoff in the base metal.

Written by Mike Gedeon of Materion Performance Alloys Marketing Department. Mr. Gedeon's primary focus is on electronic strip for the automotive, telecom, and computer markets with emphasis on application development.

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Materion Performance Alloys
6070 Parkland Blvd.
Mayfield Heights, OH 44124

Sales	+1.216.383.6800	800.321.2076	BrushAlloys@Materion.com
Technical Service	+1.216.692.3108	800.375.4205	BrushAlloys-Info@Materion.com

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