



Braided Solder Columns for Next Generation Large Heterogeneous 2.5D Packages

***Reduce Mechanical Stress for
Mil/Aero and Commercial Applications***

Braided Column
TopLine®



TopLine Corporation © 2025

April 30, 2025

BLUF:

Bottom Line Up Front

- **Progress is being made – Data available at year-end.**
- *Daisy Chain Test Vehicles are being readied for characterizing and validating Next Generation Braided Solder Columns.*
- *3rd party thermal-cycle testing scheduled at JPL and others.*
 - *Lead Free and Tin-Lead Packages.*
 - *Organic and Ceramic Packages.*
- *VPT Components now qualified to provide QML Class Q, V and Y column attachment services.*

About TopLine:

On shore manufacturing – Supporting A&D for 35 years.

***16 patents in fields of Column Grid Arrays
and P.I.D. Particle Impact Vibration Dampers.***

We manufacture Solder Columns.

***We make all kinds of Daisy Chain Test Packages for
process development projects, including BGA and CGA.***



***Solder Column Technology has not
advanced in over 40 years***

Until Now...

***Braided Solder columns – first major advance
in solder column technology since 1983.***

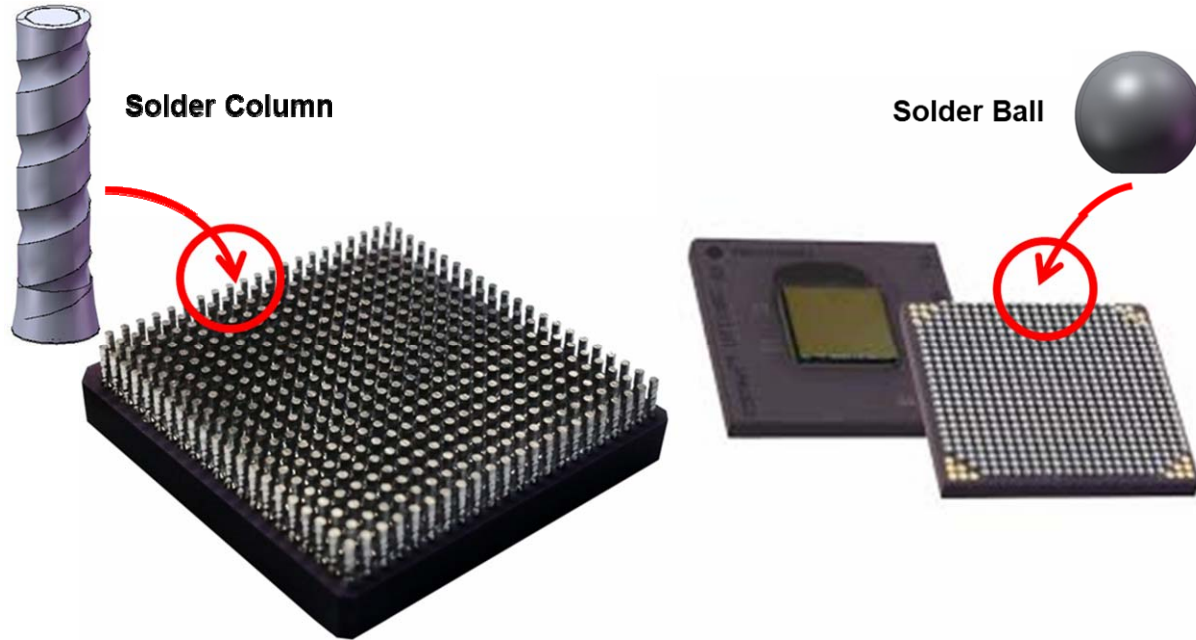
A solution for extreme applications.

History Solder Column Technology:

Year	Description	Inventor	@ TopLine	Image
1975	Tin-Lead Wire Column	IBM	Yes	
1983	Copper Wrap Column	Raychem	Yes	
1994	Solder Ball PBGA	Casio-Motorola	Yes	
2019	Braided Solder Column	TopLine	Yes	
2025	Indium Cryogenic Column	TopLine	Yes	

Solder Columns replace balls to reduce fracture-strain in solder interconnections.

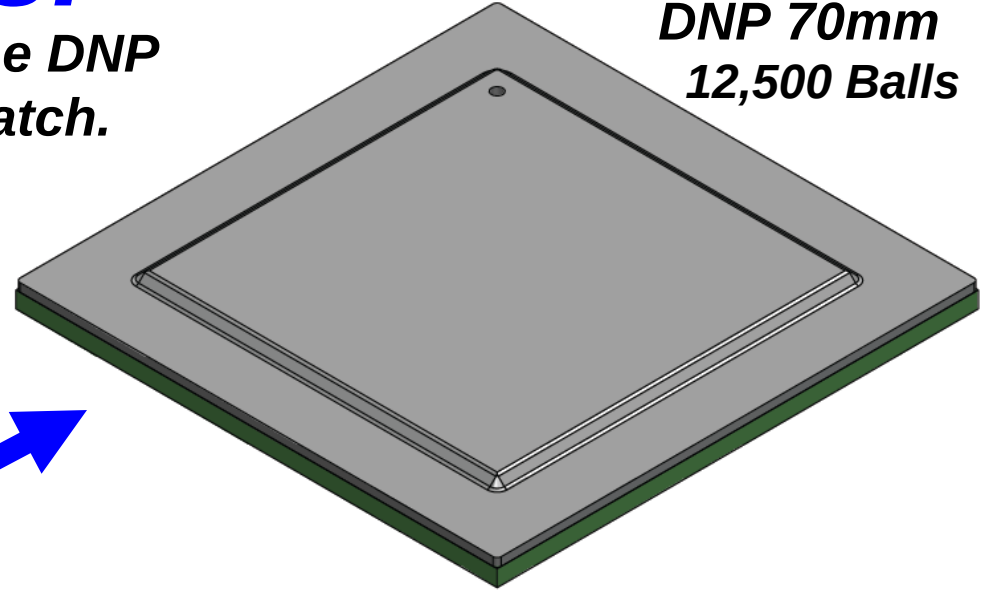
Columns absorb CTE mismatch between the package and boards.



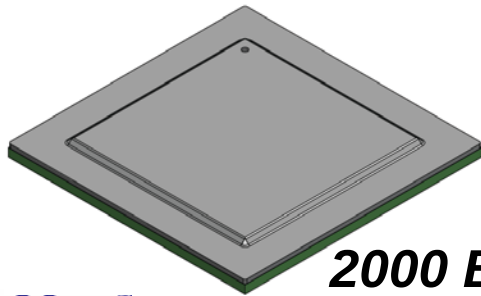
Size Matters!

***Bigger packages increase the DNP
and exacerbates CTE mismatch.***

***Today
100 x 100 mm
DNP 70mm
12,500 Balls***



***10 Years Ago
Size: 45 x 45 mm
DNP 32mm***

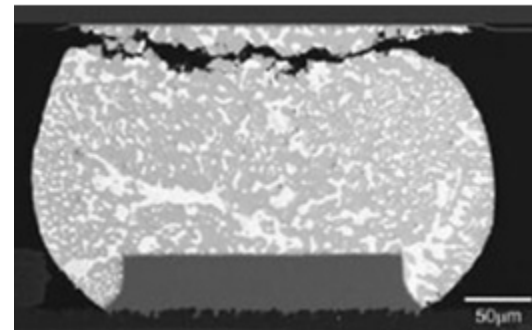


2000 Balls

***Solder Balls are approaching
end of life for reliability for large
organic Heterogeneous 2.5D packages.***

CTE Mismatch can rip balls off your packages.

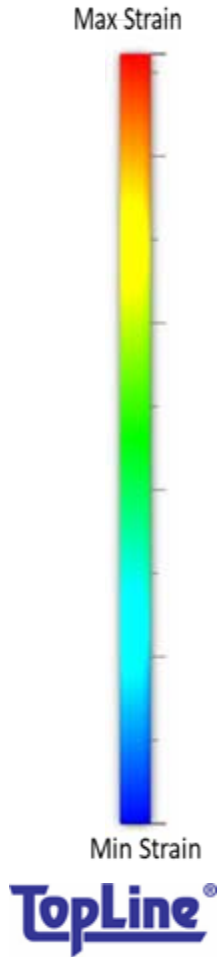
Stress/Strain - Operating Temperature Range				
Module Size	Lead Free Alloys Δ 180°C Swings RoHS		Tin-Lead Alloys Δ 180°C Swings Military Range	
	-55°C	+125°C	-55°C	+125°C
45x45mm DNP 32mm	~50 μ m 2.0 mil		~50 μ m 2.0 mil	
75x75mm DNP 53mm	~90 μ m 3.5 mil		~90 μ m 3.5 mil	
100x100mm DNP 70mm	~140 μ m 5.0 mil		~125 μ m 5.0 mil	



Example Solder Ball Fracture

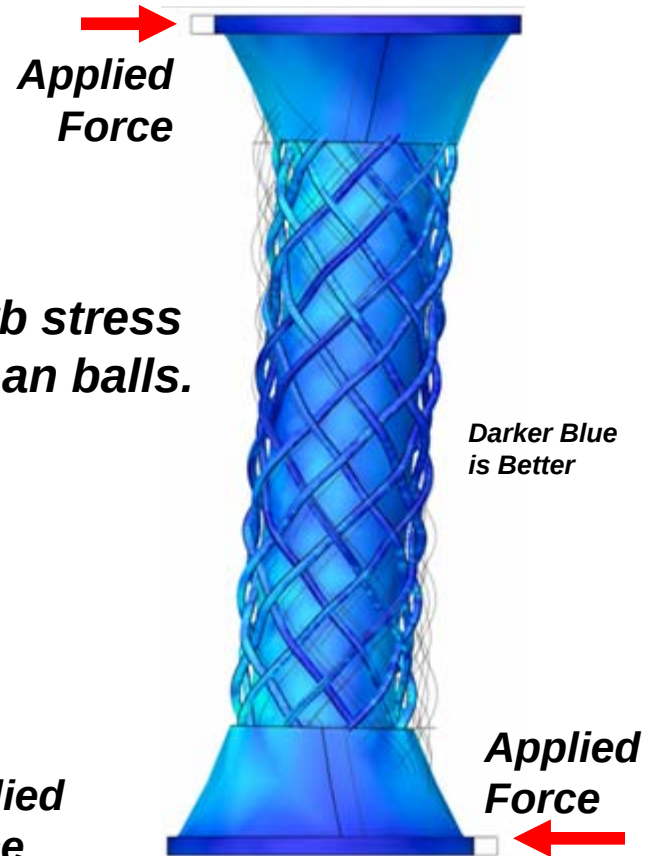
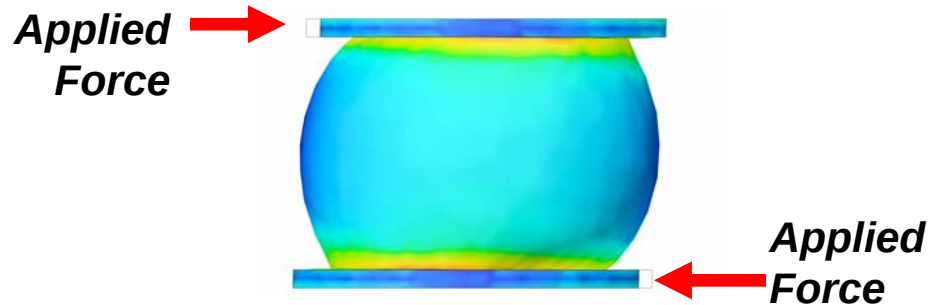
Braided Columns are Drop-in Replacement for Solder Balls

Columns provide reduced mechanical stress.



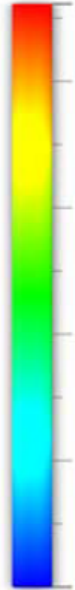
Finite Element Analysis Comparison Bend Strain Ball vs Column

***Observation: Braided Columns absorb stress
and distribute the load more evenly than balls.***



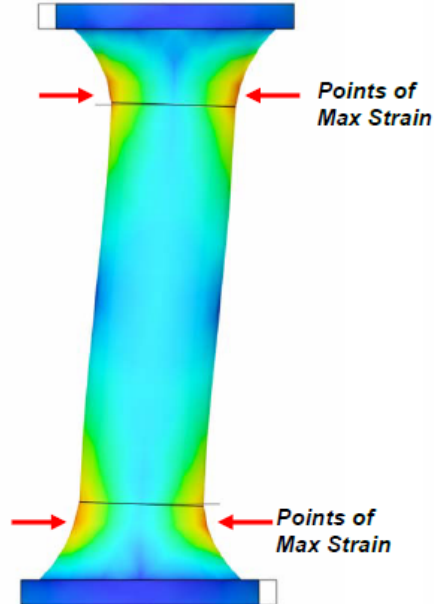
Comparative Stress in Different Columns

Max Strain



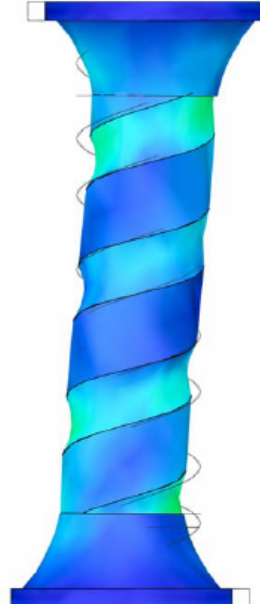
Min Strain

**1975 Original
IBM Column**



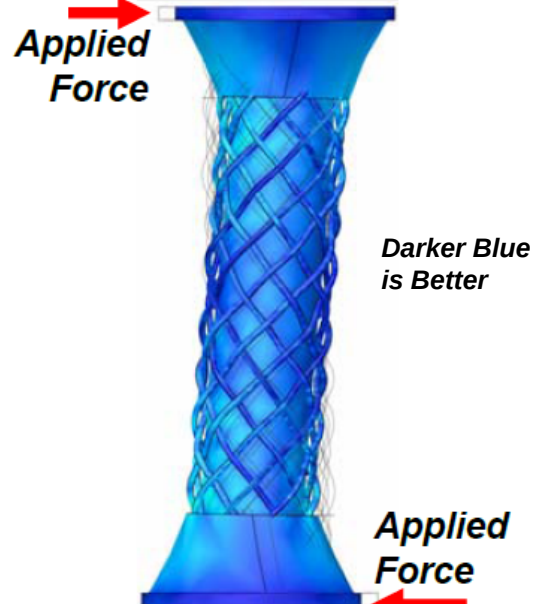
More stress = Orange/Yellow

**1990 Wrapped
Six Sigma Column**



Moderate stress = Light Blue

**2020 Braided
TopLine Column**



Less stress = Dark Blue

***TopLine is working with 3rd parties
to characterize and validate
next generation braided solder
columns for use in large packages.***

DUT Solder Column Materials:



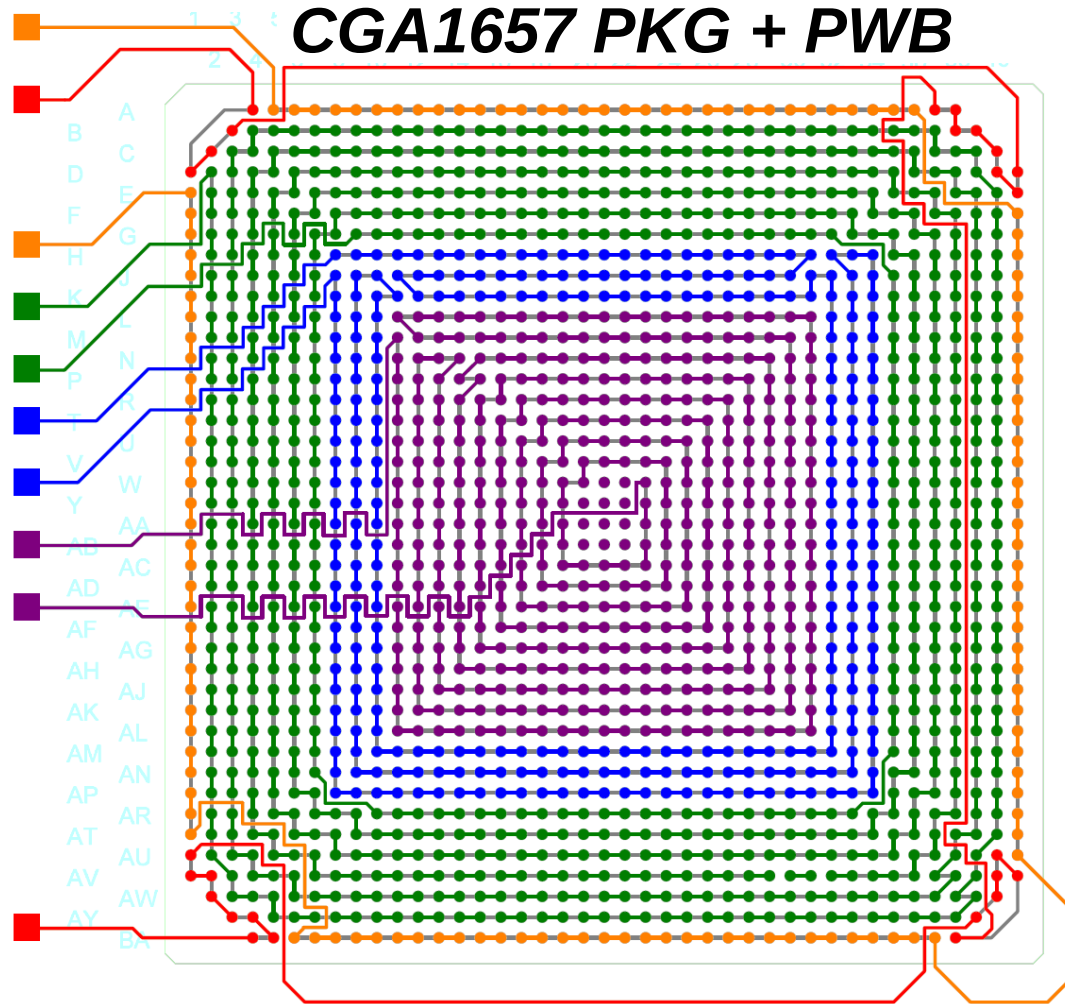
**Braided Solder
Column**

Construction Device Under Test	Lead Free -55°C to +125°C	Military -55°C to +125°C
Solder Core	Sn91.5/Sb8.5	*Pb80 / Sn20
Coating	Sn90/Ag3.5/Bi.5/In6	Sn63 / Pb37
Braid Be-Cu	C172	C172
PKG Fillet	Sn90/Ag3.5/Bi.5/In6	Sn63 / Pb37

*** Also available Pb90/Sn10**

Thermal Cycle Test Schedule:

Phase 1 Base Line Tin-Lead	Phase 2 Lead Free
-55°C to +125°C	-55°C to +125°C
Solder Column Pb80/Sn20	Solder Column Sn91.5/Sb8.5
PWB 370 HR Test Vehicle HASL	PWB 370 HR ENIG Test Vehicle
CGA1657 Ceramic Daisy Chain Package	Organic 1657 Daisy Chain Package
JPL Summer 2025	JPL TBD



Daisy Chain Test Loops:

- 1. Corners of PKG***
- 2. Perimeter PKG***
- 3. Die Outline***
- 4. Outside Die***
- 5. Under Die***



**Solder Column
relative size**

**Braided
Solder
Column**

**16x BeCu wire braid.
Non-collapsible**

**Shown before
Solder Coating**



**Shown After
Solder Coating**



**Length
1.0mm
~2.2mm**

Pitch: 0.65mm ~ 1.27mm



Planarized Braided Solder Columns Near Zero Coplanarity

TopLine®

Patents:

US 10,477,698 B1

CN 111882289 B

QML Column Attach Services for class Q, V and Y performed by VPT Components.



DLA Certification MIL-PRF-38535; FSC5962

VQ(VQC-24-038593); CN: 087625

Effective April 16, 2024

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Summary

Braided Solder Columns for Large Ceramic & Organic Packages.

- 1. Braided Columns absorb CTE mismatch.***
- 2. Exo-skeleton braided sleeve provides mechanical support.***
- 3. Life cycle test data for characterization and validation ready by year-end.***
- 4. Underfill not required for columns.***
- 5. Braided Columns potentially better than Copper Wrap Columns.***
- 6. Column Attach Services for Class Q, V, and Y available now.***

**BRAIDED
SOLDER
COLUMNS**

**GREAT
FOR SPACE**

US PATENT 10,477,698

**CONNECTS
CHIPS
TO PCB**

**BETTER THAN
BALLS**

TopLine®

Let's Explore

Think Large 2.5D Packages

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TopLine®