



TECHNICAL BULLETIN NUMBER 101

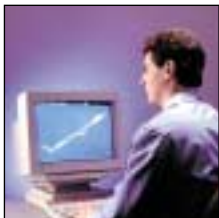


SPHERICAL JOINT SYSTEM

CUSTOM-ENGINEERED SOLUTIONS IN KNITTED WIRE MESH

For forty years, Metex design, development, and manufacturing engineers have been producing engineered components that take maximum advantage of the unique characteristics and robust nature of knitted wire mesh. Its interlocked looped structure, which offers excellent resiliency, memory—even when subjected to high temperatures as well as high-tensile or compressive stress—and strength, make knitted wire the ideal choice in materials when both performance and cost are paramount.

Metex products now meet a wide range of critical needs—from providing flexible, yet durable, seals and joints to noise attenuation, thermal insulation, and filtration—in some of the most demanding industrial applications and environments.



Complete in-house design, R&D, and test facilities



Flexibility in manufacturing for JIT requirements

A New, Low-Cost, Spherical Joint Design for Automotive Exhaust Systems

The Metex Spherical Joint System combines breakthrough innovation and global best practices of the classic spring-loaded ball joint in a turnkey system to assure consistent superior performance for the life of the vehicle. Using a system approach, the proven durable ball joint technology has been optimized to provide near “zero leak” performance at a fraction of the cost of bellows-based systems, while meeting the stringent durability and customer satisfaction needs of major automotive manufacturers worldwide.

The self-supporting design can support the weight of the exhaust system in either the vertical or horizontal direction, eliminating need for additional hangers. In addition, the system displays stable, consistent, dynamic behavior throughout the life of the vehicle.

The Metex spherical-loaded joint system offers the following performance characteristics:

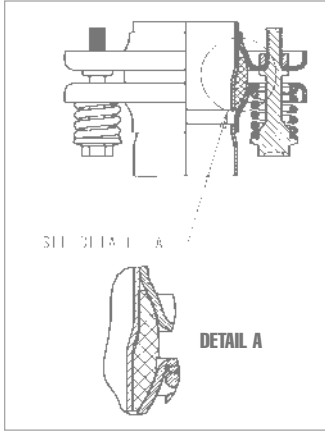
- Operating temperatures up to 700° C (flange surface)
- Less than 1.0 standard liters per minute leakage at pressures up to 34kPa when new
- Less than 2.0 standard liters per minute leakage at pressures up to 34kPa after vehicle durability tests
- Pipe outside diameters from 38 mm to 76 mm

The Metex spherical joint system is a complete “turnkey” spring-loaded ball joint for use in the exhaust systems of internal combustion engines. The system was developed to provide a joint with “near-zero” leakage performance in automotive exhaust systems, while acting as a:

- **Decoupling point** to isolate the vibrations of the engine from the remainder of the exhaust system and the passenger compartment. This is extremely important in automobiles where any reduction in noise, vibration, and harshness (NVH) will improve ride quality.
- **Pivot point** to stop the exhaust system from moving when the engine exhibits large amplitude rolling motion. This is most important in front wheel drive (FWD) vehicles with transverse mounted engines. In these cases, the roll axis of the engine is perpendicular to the axis of the exhaust system. With no pivot point, the exhaust will slam into the vehicle underbody, or the ground, when the engine rolls upon gear changes and acceleration/deceleration.

US Patent 5,683,119 and Foreign Patents





PRODUCT BENEFITS

- **Sealing Ability**—The unique “turnkey” system design maximizes sealing ability and virtually eliminates leakage.
- **Competitive Price**—Lower cost alternative to flex couplings.
- **Compact Size**—Easier packaging. Minimizes heat loss.
- **Self Supporting**—Can support weight of exhaust systems in horizontal or vertical direction. Eliminates extra support hangers.
- **Torsional Degree of Freedom**—Capable of accommodating relative twist between upstream and downstream portions of the joint.
- **Stable, Consistent Performance**—Unlike flex couplings, whose damping and support members change over time, this system displays consistent dynamic performance.



Mechanical Oscillator Test

Evolutionary Design for Spherical Joint Systems to Reduce Vibration and Enhance Product Quality

The Metex Spherical Joint System represents evolutionary refinements to the classic automotive ball joint combined with the best practices and a unique static sealing surface that results in a near-zero leak joint. These improvements include:

- Spring design, which minimizes loss of load due to spring relaxation.
- True spherical radius flange and offset seal radius leads to high sealing stress
- Spherical static sealing surface creates “wedging” effect, dramatically improving sealing ability
- Stamped flanges offer extremely smooth sealing surfaces, uninterrupted by weld seams typically found in flared pipes.

Sealing surfaces of the flanges resist oxidation, which could lead to increased leakage and squeak. Since traditional ball-joint-based systems only provide three rotational degrees of freedom (bending up-down, bending side-side, and twisting) the joint will not accommodate axial motion due to vibration or thermal expansion. The Metex automotive spherical joint system can eliminate this problem by using multiple joints in series. The combined effect of the multiple joints is a six-degree-of-freedom system. Due to this unique, double-joint configuration, thermal expansion and other axial movements can be easily accommodated.

Metex factory-trained application engineers are always available to assist you with your special applications, either by phone or at your site.

Applications

System design is based on spherical seal technology which has been used since the mid 1970s. Spherical seals are used by nearly every major automotive, truck and recreational vehicle manufacturer in the world. Typical applications include:

- Automotive, Truck, Construction, Agricultural, Motorcycles, ATVs/Recreational Vehicles Exhaust Systems
- Any location in the system where a compensating joint or serviceable joint is required due to misalignment
- Any location in the system where a decoupling joint is required
- Can replace any existing static joint in a system to dramatically improve dynamic performance

Durability Testing

High-Temperature Oscillator Testing

- Mechanical sinusoidal inputs up to 10 Hz
- Hydraulic sinusoidal, square, and triangle wave inputs up to 45 Hz
- Gas temperatures up to 1200°C

High-Temperature Corrosion Oscillator Testing

- As above, with engine-roll simulation, with automatic salt spray or mud/salt solution

On Vehicle Testing

- High mileage dedicated fleet testing

Engine-Roll Simulation

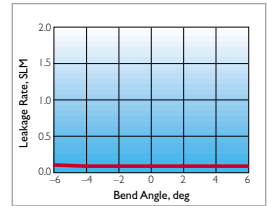
- Engine and manifold roll movements with full or partial exhaust system
- Gas temperatures up to 1200°C
- Automatic salt spray or mud/salt solution

Noise Screening Testing

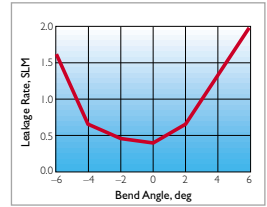
- Hand oscillator evaluations
- Room temperature screening
- High temperature screening

Leak Testing

- Static measurements
- Dynamic measurements



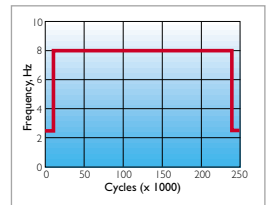
Average leakage values for spherical joint system prior to durability testing. (34 kPa internal pressure)



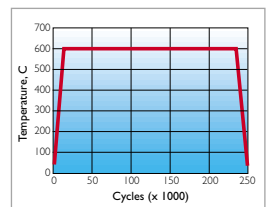
Average leakage values for spherical joint system after durability testing. (34 kPa internal pressure)



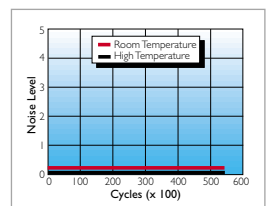
High-temperature durability test of Spherical Joint System



Test frequency for high-temperature corrosion durability test



Temperature profile for high-temperature corrosion durability test



Typical noise levels recorded during durability testing

High-Temperature Durability

- Total of 555,000 cycles for a test time of approximately 20 hours
- The test is broken down into 10 blocks with each block containing 50,000 cycles +/- 2° at 8 Hz/5,000 cycles +/- 4° at 6 Hz/500 cycles +/- 6° at 4 Hz
- The test temperature on the outer face surface is 600-625° C, with one out of every five blocks run at room temperature

High-Temperature Corrosion Durability

- This test consists of oscillating a joint +/- 3° for 500,000 cycles between room temperature and an operating temperature
- During ramp up and ramp down of the temperature cycles, the oscillating frequency will be 2.5 Hz
- During the steady state portion, the oscillating frequency is 8 Hz
- A salt solution is applied to the joint for 15 seconds every 15 minutes
- The profiles shown are repeated twice for a test time of approximately 20 hours

Noise Screening & Evaluation

Subjective Noise Screening Performed During Testing

LEVEL	DESCRIPTION
0.0	No noise
0.5	Noticeable noise is confirmed by using a tube
1.0	Noticeable noise is confirmed within 200 mm from joint
2.0	Noticeable noise is confirmed within 1 m from joint
3.0	Noticeable noise is confirmed with 3 m from joint
4.0	Noticeable noise is confirmed within 10 m from joint
5.0	Noticeable noise is confirmed with 20 m from joint



Metex Knitted Wire Mesh Products Solve Problems Cost Effectively

Metex knitted wire mesh is manufactured from an “endless” wire that is formed into loops and subsequently networked, providing elasticity and resilience not found with woven wire or powdered metal products.

The diversity and versatility of wire mesh enables Metex to produce products for a wide variety of applications, including:

- Seals
- Breathers
- Coalescers
- Gaskets
- Heat Shields
- Navin Rings
- Catalytic Converter Support Mesh
- Heat Wicks
- Noise Attenuators
- Mufflers
- Air Filters
- Electronic Shielding
- Ball Joint Seal Systems
- Air Gap Rings
- Filters
- Shock Absorbers
- Protective Coverings
- Exhaust Seals
- Catalytic Converter End Rings
- Flame Arrestors

Our **Spherical Joint System** continues a longstanding Metex tradition of integrating the right designs, materials, and manufacturing methods to meet customer needs for optimal performance at lowest possible cost.



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