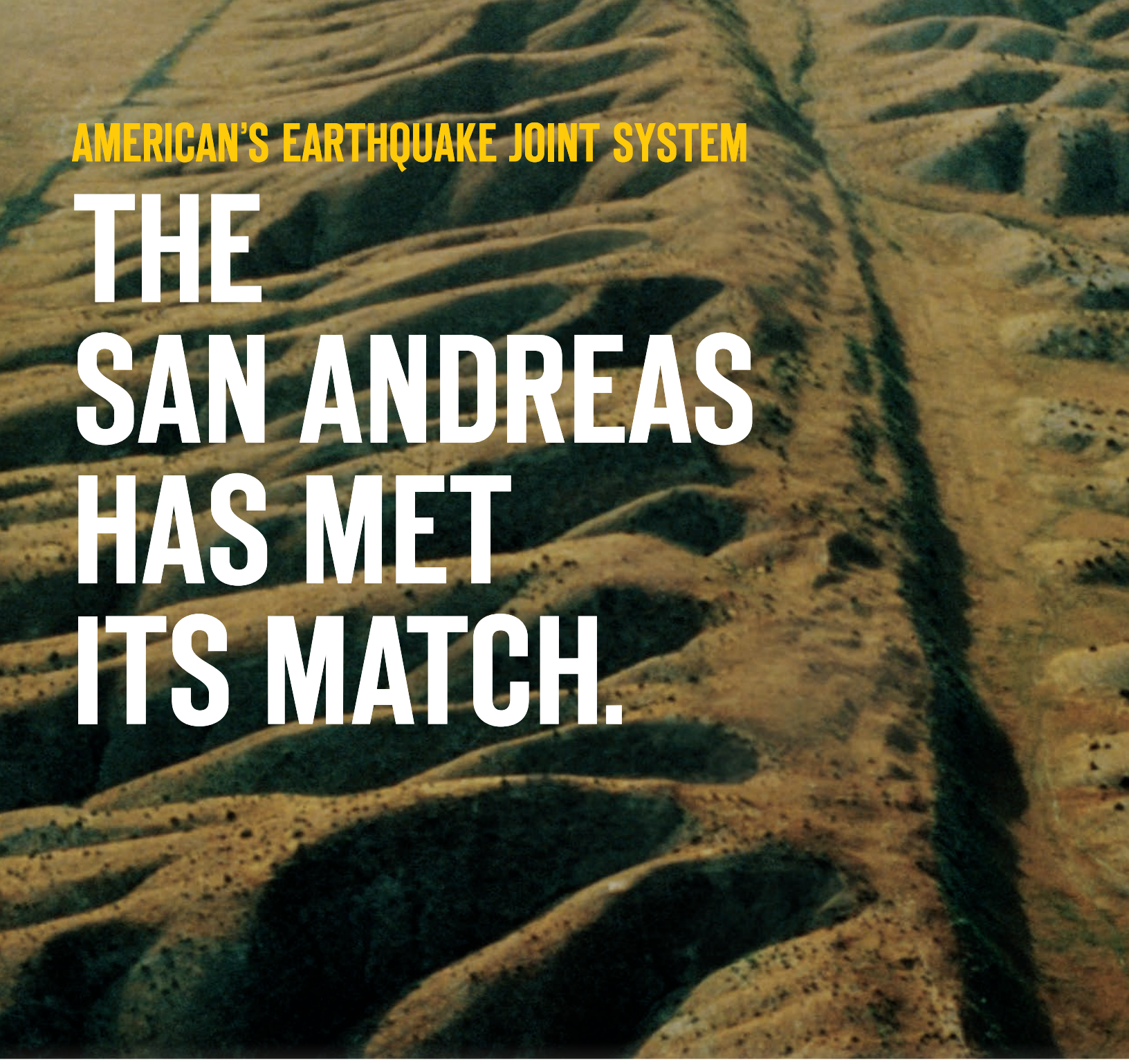


AMERICAN'S EARTHQUAKE JOINT SYSTEM

# THE SAN ANDREAS HAS MET ITS MATCH.

One pipe is built to take it.
Because innovation is at the epicenter of all we do.

AMERICAN
THE RIGHT WAY

DUCTILE IRON PIPE | FLOW CONTROL | INTERNATIONAL | SPIRALWELD PIPE | STEEL PIPE

**RESILIENCE AND SUSTAINABILITY. BY DESIGN.**

Earthquakes. Hurricanes. Landslides. Erosion. When disaster strikes, damage to infrastructure will make a bad situation far, far worse. But the AMERICAN® Earthquake Joint System—along with our Flex-Ring restrained joint pipe—takes the punishment. It expands, contracts, and deflects along with the earth's movement to offer significant range of motion to help your system survive a seismic event or natural disaster. The AMERICAN Earthquake Joint System. American-made, with lower odds of damage for faster recovery.

*So one disaster doesn't lead to another.*

*AMERICAN'S Earthquake Joint System performs under any condition. Even Category 5.*

## TABLE OF CONTENTS

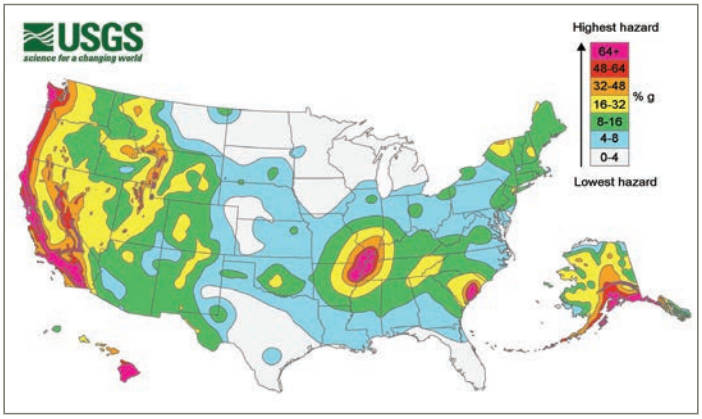
# Seismic and Hazard Resilience. Critical For Public Health and Safety.

The numbers tell the tale: 50% of all Americans are at risk for seismic activity. Another 39% are vulnerable to hurricanes. Yet if water systems fail, more disasters are sure to follow. Firefighters will be unable to fight fires. Then the lack of clean drinking water creates a public health emergency. Protecting water lines is more than a priority. The very safety of our cities depends on it.

When the tremors stop and the winds abate, how can you be sure your water lines are there to help the recovery and not be part of the problem? Are you ready for whatever Mother Nature throws your way?

**DISASTER 101.**

There are three general types of seismic hazards: shaking of the ground, fault displacement or ground surface rupture, and ground failure such as liquefaction or landslides. For each of these dimensions of seismic activity, you need both flexibility and strength for your water grid to survive. Meanwhile, a hurricane may not shake or displace the ground surrounding your pipe, but its heavy rains and washouts can have equally catastrophic effects on infrastructure.




*Is your area vulnerable to seismic activity? You may be surprised. (Courtesy, Department of the Interior/USGS)*

**EARTHQUAKE JOINT SYSTEM OVERVIEW**

Ductile iron pipe in general–and its modern joints in particular–are uniquely suited to survive the strains of an earthquake or a hurricane. But AMERICAN takes toughness to entirely new levels. The Earthquake Joint System is designed to withstand disaster-related stresses on pipe joints, valves, and hydrants. Benchmarked against ISO 16134 performance levels and developed for pipe, valves, and hydrants, it uses the proven AMERICAN Flex-Ring® joint as a foundation.

The AMERICAN Flex-Ring® restrained joint provides 5-degrees of deflection in diameters up to 12 inches, providing up to 21 inches of compounding offset


*Designed to take punishment. And to take away your worries.*

*AMERICAN design and quality. Together, they give you greater resilience and confidence when things are at their worst.*

across each 20-foot length of pipe for tremendous deflection capacity. Further, axial displacement is added to deflection for a substantial breakthrough in seismic performance, allowing both expansion and contraction exceeding one percent of each nominal pipe length. Following axial displacement, the AMERICAN Earthquake joint provides the industry's best pull-apart/slip-out resistance.

Altogether, these innovations add up to a system tailor-made to survive some of the most extreme conditions.

## RIGOROUS CONDITIONS. RIGOROUS TESTING.

Don't take our word for it. The Earthquake Joint System passed the toughest tests around at the Geotechnical Lifelines Large-Scale Testing Facility at Cornell University: from deflection to failure, tensile and compressive strength in the axial direction, and compressive load to failure, and a full-scale earthquake fault simulation.

The results are clear. The AMERICAN Earthquake Joint System met requirements for the ratings under ISO 16134 — making AMERICAN the best choice for your seismic and hazard resistant piping needs.

Cornell's consensus? "The fault rupture test confirms that the ductile iron pipes equipped with the AMERICAN Earthquake Joint System are able to sustain, without leakage, large levels of ground deformation through axial displacement and deflection under full-scale conditions of abrupt ground rupture." We think that's one strong endorsement.

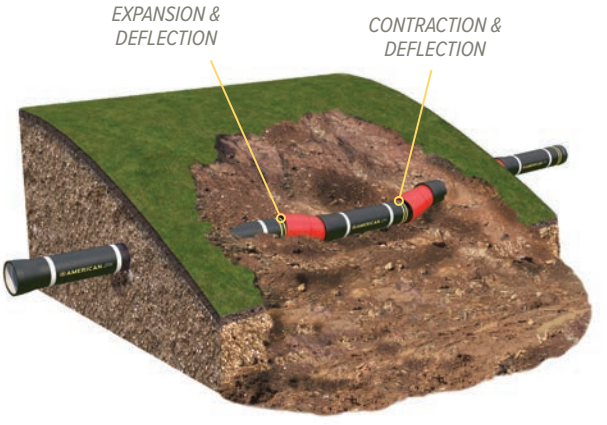
## A PROVEN SYSTEM. FROM A PROVEN NAME.

When you want resilience, you want a company with a long history of solutions. AMERICAN has been there, generation after generation, with innovative design, rigorous testing, and the highest standards

*Will water be there for your firefighters?*

for performance. All to ensure that the pipe you put in the ground stays there for good.

So if you're looking to protect your citizens after a natural disaster, consider AMERICAN and the toughness and resilience of the Earthquake Joint System. After all, while the "Big One" could come at any time, the best way to minimize its damage is available right now.




*In the event of soil failure during a seismic event, AMERICAN's Earthquake Joint System expands, contracts, and deflects to safeguard your water lines.*

We design our products to stand up to earthquakes and hurricanes. At the same time, they're made to measure up to ISO requirements. All so you can install our products with confidence.

In one seismic event after another, ductile iron pipe consistently proves its ability to survive. The reason is simple. The strength of ductile iron means a pipe can resist immense strains that occur during an earthquake. Just as importantly, a ductile iron pipe can be expected to do its job decades after the last aftershocks fade away.

ISO performance standards emphasize three different categories of performance characteristics when it comes to seismic events: Expansion and Contraction Performance, Slip-Out Resistance, and Joint Deflection Angle. In each of these three criteria, the AMERICAN Earthquake Joint System offers high levels of performance, making it the overall best choice for protecting the life and property of your rate payers.

Our products are tested to meet or exceed their indicated levels based on the ISO standard below:

## PERFORMANCE SPECS

| PARAMETER | CLASS | COMPONENT PERFORMANCE |
|---|---|---|
| Expansion/Contraction Performance | S1 | ±1% of L or more |
| | S2 | ± 0.5% to less than ±1% of L |
| | S3 | Less than ±0.5% of L |
| Slip-Out Resistance | A | 3 d kN or more (17,000 d lbs or more) |
| | B | 1.5 d kN to less than 3 d kN (8,500 d lbs - 16,999 d lbs) |
| | C | 0.75 d kN to less than 1.5 d kN (4,250 d lbs - 8,499 d lbs) |
| | D | Less than 0.75 d kN (Less than 4,250 d lbs) |
| Joint Deflection Angle | M1 | $\theta_a$ or more |
| | M2 | $\theta_a/2$ to less than $\theta_a$ |
| | M3 | Less than $\theta_a/2$ |

JOINT DEFLECTION ANGLE TABLE

| Nominal Diameter *d* | 80 to 400 | 450 to 1000 | 1100 to 1500 | 1600 to 2200 | 2400 to 2600 |
|---|---|---|---|---|---|
| | 3 in. - 16 in. | 18 in. - 36 in. | 42 in. - 54 in. | 60 in. - 86 in. | 94 in. - 102 in. |
| Joint deflection angle $\theta_a$ | 8° | 7° | 5°30' | 4° | 3°30' |
| (Ref) Pipe Length[a] | 6 m (19.69 ft) | 6 m (19.69 ft) | 6 m (19.69 ft) | 5 m (16.40 ft) | 4 m (13.12 ft) |

**Key**

L the component length, in millimeters (mm)

d the nominal diameter of pipe, millimeters (mm)

$\theta_a$ the joint deflection angle as shown in joint deflection angle table, in degrees (°)

[a] Ductile iron pipe is available in shorter lengths and, where needed, can be cut during installation to achieve greater pipeline deflection over shorter pipeline lengths.

*See component performance results by diameter on Page 6.*

# A SUMMARY OF CORNELL TESTING–OUR SEISMIC SYSTEM IS SUPERIOR

When we say our Earthquake Joint System can take it, it's no empty claim. One of the world's most respected organizations tested our Earthquake Joint against the same stresses experienced in history's biggest earthquakes. The result? AMERICAN passed with flying colors.

Anyone can claim high performance. AMERICAN can prove it. Our Earthquake Joint was subjected to a series of rigorous tests by the Cornell University School of Civil and Environmental Engineering. Not only was it tested to see how well it withstood the stresses of a seismic event—the Earthquake Joint was tested in conditions that simulated the Loma Prieta, Christchurch, Northridge, and 1906 San Francisco earthquakes.

The results are clear. According to Cornell, "The tests confirm that the ductile iron pipes equipped with the AMERICAN Earthquake Joint System are able to sustain high levels of ground deformation through axial displacement and deflection." In short, the Earthquake Joint took the worst Cornell could throw at it and still performed to spec.

We think that says a lot about our engineering. And how AMERICAN moves heaven and earth to safeguard our cities.

*Our Earthquake Joint System met performance standards even under the most rigorous testing conditions.*

## OUR ADVANTAGES

- Our Earthquake Joint passed the most rigorous tests
- Conditions approximated some of history's strongest seismic events
- High performance in liquefaction and ground deformation
- The strongest possible joint for the worst possible conditions


*Made to last under all conditions for a true long-term solution.*

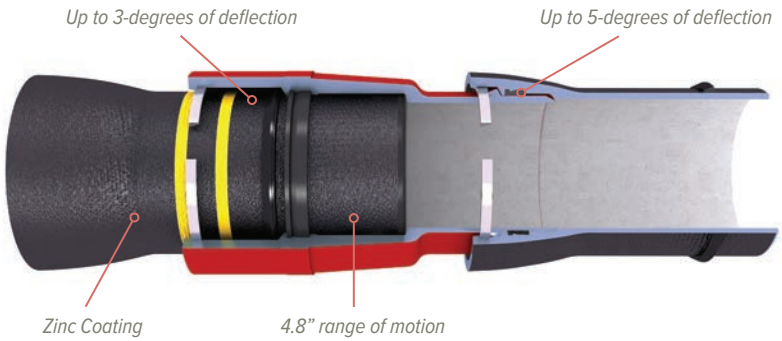
# EARTHQUAKE JOINT SYSTEM

With earthquakes and storms posing a danger to your water grid, a comprehensive solution is needed. The Earthquake Joint System from AMERICAN is designed to give your water grid the highest odds for withstanding whatever Mother Nature sends its way.

Rugged. Tough. Resilient. Those are qualities you should expect from any pipe. But our Earthquake Joint System takes things to a whole new level.

The center of our system is the Earthquake Joint casting, featuring an extended socket depth. With this extended bell, our Flex-Ring joint has an expanded range of motion. Because it's pre-assembled, the Earthquake Joint System means incredible ease of installation. Specially-coated in red for quick identification, the Earthquake Joint offers the deflection, expansion, and contraction needed to survive the stresses of a natural disaster.

Multiple options allow crews to position the joint fully expanded, fully contracted, or at the mid-point which provides 2.4 inches of movement in either direction. With better performance than any other domestic solution, it also easily interfaces with your existing system. That makes it an earthshaking development when it comes to protecting your system.




## OUR ADVANTAGES

- Specifically-engineered for stresses due to seismic events and hurricanes
- Generous deflection and longitudinal expansion
- Standard AWWA inch dimensions
- Coated in red for easy identification
- Casting and Flex-Ring pre-assembled in factory for easy installation

## PERFORMANCE SPECS

| SIZE (IN.) | PIPE JOINT DEFLECTION (DEGREES) | CASTING JOINT DEFLECTION (DEGREES) | COMBINED ASSEMBLY DEFLECTION (DEGREES) | EXPANSION OR CONTRACTION FROM MID-POINT | DEAD-END THRUST RESISTANCE (LBS.) | ISO 16134 RATING |
|---|---|---|---|---|---|---|
| 6 | 5 | 3 | 8 | ± 1.00% (2.40") | 102,000 | A, M1, S1 |
| 8 | 5 | 3 | 8 | ± 1.00% (2.40") | 136,000 | A, M1, S1 |
| 12 | 5 | 3 | 8 | ± 1.00% (2.40") | 204,000 | A, M1, S1 |
| 16 | 3.75 | 3.25 | 7 | ± 1.00% (2.40") | 272,000 | A, M2, S1 |
| 20 | 3.5 | 2.5 | 6 | ± 1.00% (2.40") | 340,000 | A, M2, S1 |
| 24 | 3 | 3 | 6 | ± 1.00% (2.40") | 408,000 | A, M2, S1 |
| 30 | 2.5 | 2.5 | 5 | ± 1.00% (2.40") | 510,000 | A, M2, S1 |

# AMERICAN Earthquake Joint System

## *Assembly Instructions – 6-inch, 8-inch, and 12-inch*

**GENERAL NOTE:** The assembly of the AMERICAN Earthquake Joint System relies on the efficient and proven assembly features of the AMERICAN Flex-Ring joint. This system can be field assembled with various pushing or pulling devices and rigging to provide the nominal Fastite® gasket assembly force of 100-300 lbs. times the outside diameter in inches.

The enhanced strain and deflection capabilities of the Earthquake System should be maximized by careful field positioning of a central ductile iron Earthquake casting bell joint. The design of this joint features an extended socket depth, allowing the extended Flex-Ring weld ring on the Earthquake spigot end an expansive range of motion.

**1.** Ensure the required material to assemble and extend the joint is available. This includes the Flex-Ring locking ring, Fastite gasket, AMERICAN Fastite lubricant, one lever hoist, two choker cables, one hydraulic ram, and one split restraining gland. Prior to joint insertion, remove the full-length strap holding the Earthquake Joint in the contracted position (Figure 1) as well as the packing material holding the split Flex-Ring onto the casting spigot (Figure 2), unless Flex-Rings have been shipped separately.

**2.** Thoroughly clean the pipe socket locking groove, the Fastite gasket recess and casting plain end in accordance with standard 4- to 12-inch Flex-Ring and Fastite joint assembly instructions.

**3.** In accordance with standard Fastite joint assembly instructions, insert the Fastite gasket ensuring the gasket is flush without protrusions. Lubricate the inside surface of the gasket and the red plain end of the casting up to the ring abutment, paying close attention to the beveled nose end of the casting. Ensure the lubricated portion of the casting does not come in contact with the ground to ensure dirt and debris do not contaminate the surface during assembly.

*Figure 1*

*Figure 2*

**4.** With the pipe in essentially straight alignment, assemble the casting spigot end into the Flex-Ring pipe socket until the spigot stripe disappears into the bell. The orientation of the spigot stripe relative to the bell face is an indication of pipe alignment. For the most control and least disturbance of the intended position of the opposite Earthquake Joint and any previously installed joint, assembly of the joint with a lever hoist and two choker slings is recommended. Assemble by installing one choker anchored around/behind the previously installed pipe bell and one anchored around the long bell cylinder of the Earthquake casting with the lever hoist between. Use the lever hoist to apply assembly force needed to position the joint fully homed (Figure 3).

**5.** Tap the split retaining ring into the bell's Flex-Ring socket beginning with one end of the split retaining ring and progressing around the joint (Figure 4). This operation is made easier by holding one end of the split retaining ring inside the bell as the remainder of the ring is tapped into the socket. Correct seating is generally indicated by a snapping noise as the split retaining ring springs into position. Visually confirm the ring is fully in position (the split retaining ring is painted yellow to aid in this inspection). (Note: When a visual inspection to determine the split retaining ring position is not practical, such as underwater installations, a feeler gauge may be used to verify the correct positioning of the split retaining ring in the socket locking groove. It may be necessary to move the entering pipe slightly to improve alignment if the ring does not readily spring into the socket locking groove).

*Figure 3*

*Figure 4*


*Figure 5*


*Figure 6*

**6.** When the fully contracted position is not desired, extension can be performed with the use of a split restraining gland and one hydraulic ram to extend the Earthquake casting to the desired position. Install the split restraining gland on the Earthquake spigot with the leading edge facing away from the bell face. Distance should be sufficient to install hydraulic ram (Figure 5). Once installed in straight alignment per manufacturer's instructions, place the hydraulic ram between the split restrained gland and Earthquake casting bell face (Figure 6). Ensure consistent force is applied by the hydraulic ram until the desired placement is reached as indicated by paint stripes.

**7.** Once the Earthquake stripe location has been reached, remove the hydraulic ram and split restraining gland. After removal of restraining gland, ensure the pipe coating has not been damaged during extension. If coating damage has occurred during extension, repair coating per the AMERICAN coating repair procedure. The completed joint pictured in Figure 7 is in the intermediate position* as previously described, with the first assembly stripe of the opposite Earthquake Joint fully inserted and flush with the bell face, and the second stripe is fully exposed.

*Figure 7*

# AMERICAN Earthquake Joint System

## *Assembly Instructions – 16-inch, 20-inch, 24-inch, and 30-inch*

**GENERAL NOTE:** The assembly of the AMERICAN Earthquake Joint System relies on the efficient and proven assembly features of the AMERICAN Flex-Ring joint. This system can be field assembled with various pushing or pulling devices and rigging to provide the nominal Flex-Ring joint assembly force of 200-500 lbs. times the outside diameter in inches.

The enhanced strain and deflection capabilities of the Earthquake System should be maximized by careful field positioning of a central ductile iron Earthquake casting bell joint. The design of this joint features an extended socket depth, allowing the Flex-Ring weld ring on the Earthquake spigot end an expansive range of motion.

**1.** Ensure the required material to assemble and extend the joint is available. This includes the Fastite gasket, AMERICAN Fastite lubricant, two lever hoists, four choker cables, two hydraulic rams, and one split restraining gland). Remove the full-length strap, holding the Earthquake Joint in the fully contracted position (Figure 1).

**2.** Thoroughly clean the pipe socket locking groove, the Fastite gasket recess area, and the casting plain end in accordance with standard 14- to 54-inch Flex-Ring and Fastite joint assembly instructions.

**3.** In accordance with 14- to 54-inch Flex-Ring joint assembly instructions, place the rubber-backed restraining segments in the socket restraining groove in gasket-like fashion. Ensure the yellow restraining segments are oriented toward the entering spigot and evenly spaced.

**4.** In accordance with standard Fastite joint assembly instructions, insert the Fastite gasket ensuring it is flush without protrusions. Lubricate the inside surface of the gasket (Figure 2) and the red plain end of the casting up to the ring abutment, paying close attention to the beveled nose end of the casting. There is no need to lubricate the rubber-backed restraining segments. Ensure the lubricated portion of the casting does not come in contact with the ground to make certain dirt and debris do not contaminate the surface during assembly.

*Figure 1*

*Figure 2*

**5.** With the pipe in essentially straight alignment, assemble the casting plain end into the Flex-Ring pipe socket until the spigot stripe disappears into the bell. The orientation of the ring abutment and spigot stripe relative to the bell face is an indication of pipe alignment. Correct assembly is generally indicated by an audible snap of the Flex-Ring segments into the correct position; however, if any segment should not come down firmly on the casting, deflect the entering assembly slightly in that direction, allowing the segment to seat itself correctly.

Verify the correct positioning of the yellow Flex-Ring segments by visual inspection or feeler gauge if conditions are limiting. The ring abutment is in the proper assembled position when it is fully beyond the yellow Flex-Ring segments and all segments are fully against the casting. For the most control and least disturbance of the intended position of the opposite Earthquake Joint and any previously installed Earthquake castings, assembly of this joint using two lever hoists and four reasonably short choker slings is recommended. Assembly using two choker slings anchored around/behind the previously installed pipe bell and two anchored around the long bell cylinder of the Earthquake casting with the two lever hoists between, is best for applying the assembly force needed (Figure 3). Ensure even distribution of assembly force by tightening both lever hoists at the same rate.

**6.** When the fully contracted position is not desired, it is necessary to use a split restraining gland and two hydraulic rams to extend the Earthquake casting to the desired position. Install the split restraining gland on the Earthquake spigot with the leading edge facing away from the bell face at a distance sufficient to install hydraulic rams (Figure 4). Once installed in straight alignment per manufacturer's instructions, place the hydraulic rams between the split restraining gland and Earthquake casting bell face. Ensure even and consistent force is applied by the hydraulic rams until the desired placement is reached as indicated by paint stripes (Figure 5).


*Figure 3*

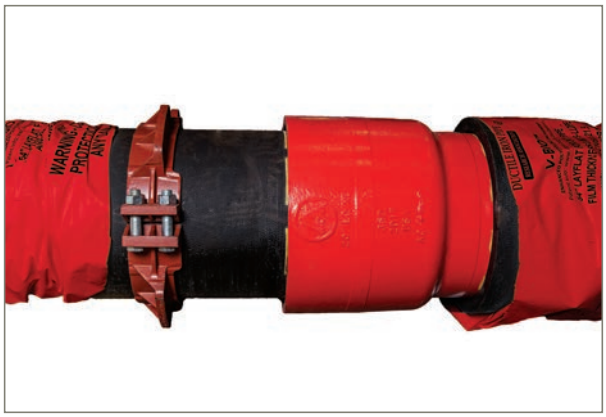


*Figure 4*

*Figure 5*

*Figure 6*

**7.** Once the Earthquake pipe location has been reached, remove the hydraulic rams and split restraining gland. After removal of the restraining gland, ensure the pipe coating has not been damaged during extension. If coating damage has occurred during extension, repair coating per the AMERICAN coating repair procedure. The completed joint pictured in Figure 6 is in the intermediate position*, as previously described, with the first assembly stripe of the opposite Earthquake Joint fully inserted and flush with the bell face, and the second stripe is fully exposed.

**Note: The expansion/contraction position can be varied as desired by the positioning of the two assembly stripes of the bell joint of the Earthquake casting. When a position other than midpoint is desired, the stripe position can be adjusted by moving/telescoping the spigot of the Earthquake joint in or out the amount desired.*

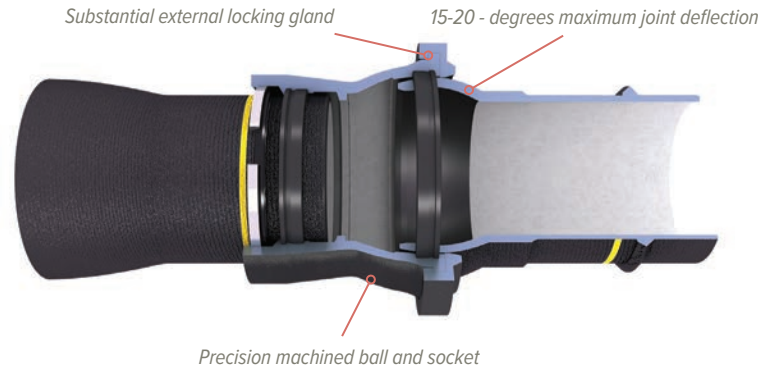
# AMERICAN FLEX-LOK® BALL JOINT

During an earthquake or hurricane, your pipes are subjected to unimaginable stress. AMERICAN Flex-Lok® Pipe has the design and rugged construction you need to withstand the most difficult conditions.

With a highly flexible ball-and-socket joint, our Flex-Lok joint is tailor-made to endure the worst conditions. A superb record of performance and reliability, along with the engineering you expect from AMERICAN, and small wonder it's the pipe of choice when conditions demand it.

Cast of ductile iron, the spherical socket of the AMERICAN Flex-Lok joint offers extraordinary strength accurately machined to accommodate the ball of the adjoining pipe. Its thick wall and bell section ensure minimized stresses resulting from installation and service conditions.

Further, the boltless Flex-Lok joint is made for easy assembly, a 15-degree or greater range of motion, and positive restraint. All to give you unshakeable confidence.




*AMERICAN Flex-Lok wall pipe in combination with Flex-Ring pipe and fittings is an excellent choice in seismic applications to allow for extreme movement.*

## FLEX-LOK ADVANTAGES

- Ideal for joints adjacent to structures and areas subject to significant displacement
- Boltless joint designed for 15-degree or greater universal deflection
- Ductile iron means full service life, even after seismic event
- Environmentally safe, operationally proven
- Adapters available for easy connection to other joints

*See page 14 for AMERICAN Flex-Ring ISO qualifications.*

*Consult Section 10 of the AMERICAN Pipe Manual for additional Flex-Lok information.*

# FLEX-LOK® BALL JOINT PIPE PERFORMANCE SPECIFICATIONS

We design our products to stand up to earthquakes and hurricanes. At the same time, they're made to measure up to ISO requirements. All so you can install our products with confidence.

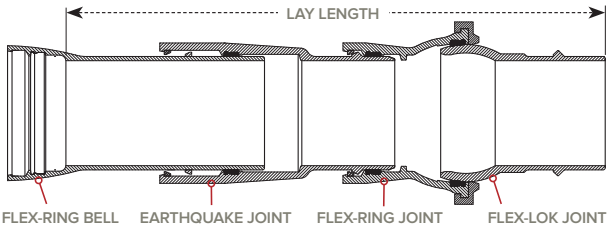
## PERFORMANCE SPECS - AMERICAN FLEX-LOK® JOINT EARTHQUAKE CAPACITY

| SIZE (IN.) | NOMINAL LAY LENGTH (IN.) | RADIUS OF CURVATURE (LINEAR FT.) | MINIMUM PULL APART RESISTANCE (LBS.) | JOINT DEFLECTION (DEGREES) | ELONGATION AT FULL INSERTION ASSEMBLY | ISO 16134 DESIGNATION |
|---|---|---|---|---|---|---|
| 4 | 258 (21'-6") | 48 | 68,000 | 25.00 | +0.68% (1.75") | A, M1, S3 |
| 6 | 259 (21'-7") | 49 | 102,000 | 25.00 | +0.68% (1.75") | A, M1, S3 |
| 8 | 260 (21'-8") | 49 | 136,000 | 25.00 | +0.68% (1.75") | A, M1, S3 |
| 10 | 259.63 (21'-7.63") | 49 | 170,000 | 25.00 | +0.68% (1.75") | A, M1, S3 |
| 12 | 260.63 (21'-8.63") | 49 | 204,000 | 25.00 | +0.68% (1.75") | A, M1, S3 |
| 14 | 246 (20'-6") | 78 | 238,000 | 15.00 | +0.10% (0.25") | A, M1, S3 |
| 16 | 247.25 (20'-7.25") | 52 | 272,000 | 22.50 | +1.10% (2.75") | A, M1, S2 |
| 18 | 246 (20'-6") | 78 | 306,000 | 15.00 | +0.10% (0.25") | A, M1, S3 |
| 20 | 247.25 (20'-7.25") | 53 | 340,000 | 22.00 | +1.10% (2.75") | A, M1, S2 |
| 24 | 246 (20'-6") | 55 | 408,000 | 21.00 | +1.80% (4.50") | A, M1, S2 |
| 30 | 259 (21'-7") | 61 | 510,000 | 20.00 | +1.74% (4.50") | A, M1, S2 |
| 36 | 265 (22'-1") | 66 | 612,000 | 19.00 | +1.70% (4.50") | A, M1, S2 |

*Larger diameters are available. Please consult your AMERICAN representative for more details.*

## PERFORMANCE SPECS - COMBINED ALLOWABLE DEFLECTION

| DIAMETER (IN.) | WORKING PRESSURE (PSI) | COMBINED ALLOWABLE DEFLECTION (DEGREES) | NORMAL MIDPOINT LAY LENGTH | MINIMUM MIDPOINT LAY LENGTH | COMBINED CONTRACTION OR ELONGATION AT MIDPOINT ASSEMBLY (IN.) | MINIMUM PULL APART RESISTANCE (LBS.) | ISO 16134 DESIGNATION |
|---|---|---|---|---|---|---|---|
| 6 | 250 | 28.0 | 23'-1.81" | 6'-9" | ±3.65 | 102,000 | A, M1, S1 |
| 8 | 250 | 28.0 | 23'-3.16" | 6'-10" | ±3.65 | 136,000 | A, M1, S1 |
| 12 | 250 | 28.0 | 23'-5.48" | 7'-2" | ±3.65 | 204,000 | A, M1, S1 |
| 16 | 250 | 25.5 | 24'-2.23" | 8'-5" | ±4.4 | 272,000 | A, M1, S1 |
| 20 | 250 | 25.0 | 24'-3.60" | 8'-7" | ±4.4 | 340,000 | A, M1, S1 |
| 24 | 250 | 24.0 | 24'-11.50" | 9'-3" | ±5.28 | 408,000 | A, M1, S1 |



# FLEX-RING® RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

Using the sealing features of our proven gasket, as well as a boltless restrained connection, the Flex-Ring® restrained joint ductile iron pipe assures flexibility and joint strength/slip-out resistance due to ground strain.

You need pipe and fittings that can take punishment. That's the idea behind the AMERICAN Flex-Ring® restrained joint ductile iron pipe. It's made to take the stresses of seismic events or loss of backfill.

Flex-Ring takes the pressure, too–up to 350 psi working pressure for sizes 4" to 24" and up to 250 psi in sizes 30" and 54". Further, the ring is factory tested to withstand dead-end thrust at twice those pressures.

Best of all, Flex-Ring pipe and fittings are designed for easy, boltless installation. After the Flex-Ring end is assembled into the Flex-Ring bell, the split ring is inserted into the socket locking groove. Assembly requires nothing more than a single ring or rubber-backed assembly. For large diameter sizes, the rubber-backed restraining segment is used instead of a split restraining ring. Resilience has never been this simple.

14" THROUGH 54" FLEX-RING PIPE AND FITTING DESIGN

*Made for quick assembly in the field.*

## OUR ADVANTAGES

- The strength of ductile iron. The flexibility of AMERICAN design
- Innovation to take the stress of seismic events and erosion
- Working pressure up to 350 psi for 4" - 24", 250 psi for 30" - 54"
- Up to 5-degrees compounding deflection, depending on diameter
- Tested for dead-end thrust up to twice working pressure
- Boltless connection means fast and efficient installation

*See page 16 for AMERICAN Flex-Ring ISO qualifications.*

*Consult Section 9 of the AMERICAN Pipe Manual for additional Flex-Ring information.*

# FLEX-RING® RESTRAINED JOINT DUCTILE IRON PIPE PERFORMANCE SPECIFICATIONS

Whatever the size, the AMERICAN Flex-Ring® joint is made to take the strain. Below are the performance specifications for all available sizes.

## PERFORMANCE SPECS - AMERICAN FLEX-RING® JOINT EARTHQUAKE CAPACITY

| SIZE (IN.) | NOMINAL LAY LENGTH (IN.) | RADIUS OF CURVATURE (LINEAR FT.) | MINIMUM PULL APART RESISTANCE (LBS.) | JOINT DEFLECTION (DEGREES) | ELONGATION AT FULL INSERTION ASSEMBLY | ISO 16134 DESIGNATION |
|---|---|---|---|---|---|---|
| 4 | 239 (19'-11") | 230 | 68,000 | 5.00 | +0.31% (0.75") | A, M2, S3 |
| 6 | 239 (19'-11") | 230 | 102,000 | 5.00 | +0.31% (0.75") | A, M2, S3 |
| 8 | 239 (19'-11") | 230 | 136,000 | 5.00 | +0.31% (0.75") | A, M2, S3 |
| 10 | 238 (19'-10") | 230 | 170,000 | 5.00 | +0.32% (0.75") | A, M2, S3 |
| 12 | 238 (19'-10") | 230 | 204,000 | 5.00 | +0.32% (0.75") | A, M2, S3 |
| 14 | 238 (19'-10") | 285 | 238,000 | 4.00 | +0.53% (1.25") | A, M2, S3 |
| 16 | 237.5 (19'-9.5") | 305 | 272,000 | 3.75 | +0.53% (1.25") | A, M2, S3 |
| 18 | 237 (19'-9") | 305 | 306,000 | 3.75 | +0.53% (1.25") | A, M2, S3 |
| 20 | 237 (19'-9") | 327 | 340,000 | 3.50 | +0.53% (1.25") | A, M2, S3 |
| 24 | 237 (19'-9") | 380 | 408,000 | 3.00 | +0.53% (1.25") | A, M3, S3 |
| 30 | 236.75 (19'-8.75") | 458 | 510,000 | 2.50 | +0.53% (1.25") | A, M3, S3 |
| 36 | 236.75 (19'-8.75") | 570 | 612,000 | 2.00 | +0.53% (1.25") | A, M3, S3 |
| 42 | 236.75 (19'-8.75") | 570 | 714,000 | 2.00 | +0.53% (1.25") | A, M3, S3 |
| 48 | 235.75 (19'-7.75") | 570 | 816,000 | 2.00 | +0.53% (1.25") | A, M3, S3 |
| 54 | 235.75 (19'-7.75") | 570 | 918,000 | 1.50 | +0.53% (1.25") | A, M3, S3 |

# SMALL DIAMETER FIELD FLEX-RING (4-12 INCHES)

There are times when you need to make adjustments. Our Field Flex-Ring gives you the ability to create restrained connections—without a factory fabricated spigot—when field cuts are required.

The world doesn't always come in standard sizes. So when you need to cut a pipe, you need an easy way to maintain restraint. The Field Flex-Ring joint delivers, letting installers restrain joints with any suitable ductile iron plain end or cut pipe.

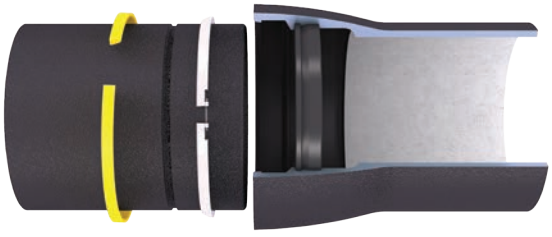
The Field Flex-Ring provides the same working pressures, deflection capability, and slip-out resistance as the standard Flex-Ring Joint. It's also factory tested to withstand dead-end thrusts of up to twice rated working pressure.

And, with boltless installation, it's an easy and fast method for restraining field connections without a factory or field weldment, a huge boost to your crew's productivity. With AMERICAN engineering, you have confidence that it's designed to stand up to the most challenging environments.

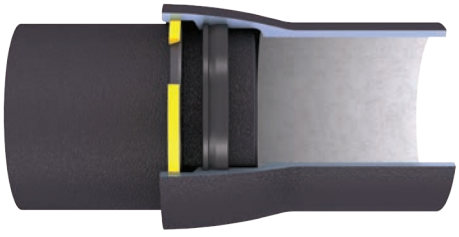
*Preparing the pipe for installation of small diameter Field Flex Ring.*

## OUR ADVANTAGES

- Adaptability on installation sites for field cuts
- The same rating as our standard Flex-Ring restrained joint
- Factory tested to withstand dead-end thrusts twice rated working pressure
- Restraint without weld beads



PRE-ASSEMBLED VIEW



ASSEMBLED VIEW

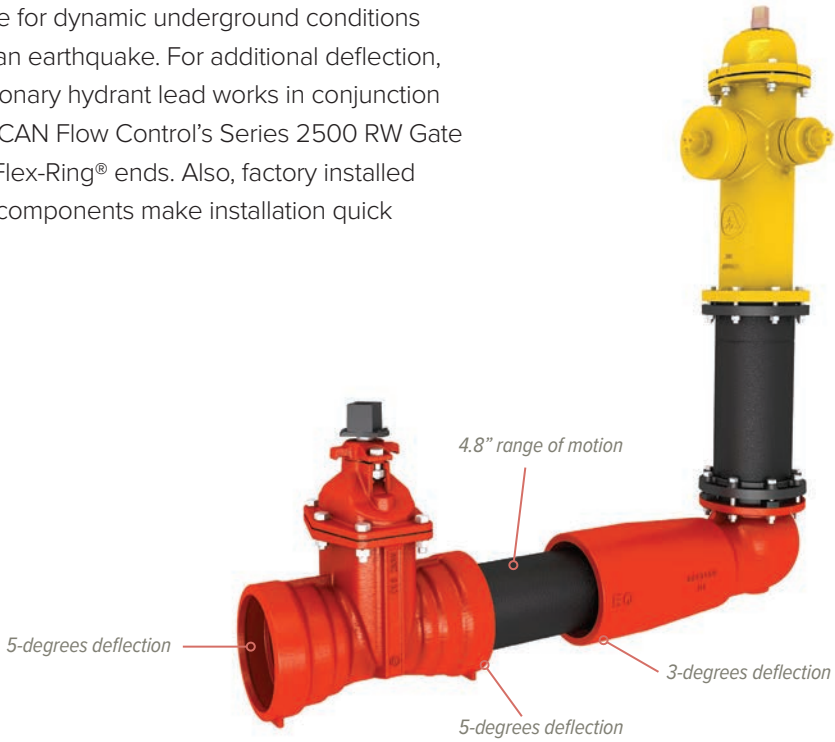
Our 5-1/4” American-Darling® B-84-B-5 Fire Hydrant is uniquely resilient, well-suited to withstand the stresses of seismic events and hurricanes. That means emergency crews have the water they need–when they need it.

The AMERICAN Earthquake Joint System offers an unmatched solution for guarding against seismic events. And the 5-1/4” American-Darling B-84-B-5 hydrant assembly with the AMERICAN Earthquake Joint System hydrant base is the ideal complement to create the greatest degree of resilience.

The Earthquake Joint System base allows the inlet pipe up to 3-degrees deflection as well as ± 2.4” contraction or expansion. This unique inlet can compensate for dynamic underground conditions caused by an earthquake. For additional deflection, this revolutionary hydrant lead works in conjunction with AMERICAN Flow Control’s Series 2500 RW Gate Valve with Flex-Ring® ends. Also, factory installed restraining components make installation quick and easy.

All in all, the hydrant assembly will have 4.8” range of motion and 13-degrees deflection with more than 100,000 pounds of pull-out thrust.

That means your system can maintain water pressure, conserve water, and help ensure crucial fire protection after a seismic event.




## OUR ADVANTAGES

- Up to 3-degrees universal deflection at the 6” hydrant base
- An additional 5-degrees deflection on each side of the 6” isolation valve
- The AMERICAN Earthquake Joint System hydrant lead is designed to withstand more than 100,000 lbs. of pull-out thrust
- Flex-Ring valves available in 6” and 16” - 60” diameters.
- +/- 2.4” of longitudinal expansion or contraction
- A uniquely designed drain ring helps prevent water loss in the event of upper barrel separation
- Meets the requirements of ISO 16134 for expansion/contraction performance, slip-out resistance, and joint deflection angle

# PLANT YARD PIPING–STRUCTURE SETTLEMENT AND ATTACHMENT TO STRUCTURES

When disaster strikes, half measures won't do. AMERICAN has the complete system to avoid disruption. And keep the water flowing.

Water networks are complex. In seismically active zones and coastal communities, they are at even greater risk of disruption.

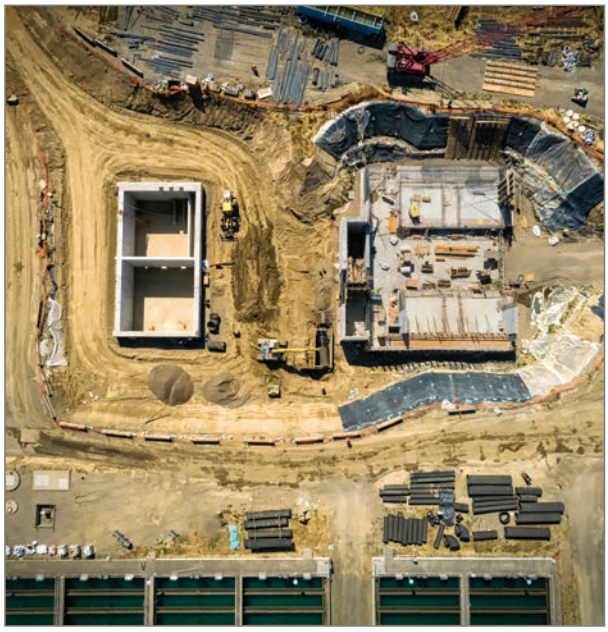
Much like the heart in our cardiovascular system, a water treatment plant plays a critical role in a city's life. Through it, water is purified and pumped to the people, factories, hospitals, and farmers who rely on it. From intake structures at the raw water source, to purification and pumping facilities, water treatment and wastewater treatment plant complexes are vulnerable to seismic damage.

Yet the use of tough and resilient ductile iron pipe in general–and the conscientious use of certain joints in particular–increases the odds that your treatment and pumping facilities are part of the solution in the aftermath of a disaster.

Settlement or displacement at structures can be addressed by the use of the exceptionally robust AMERICAN Flex-Lok® joint, offering 15-degrees of universal deflection and up to 25-degrees when combined with the AMERICAN Flex-Ring®. Away from the structure, use of the Flex-Ring joint with up to 5-degrees universal deflection is recommended. Nearer the structure and within the piping array, include the AMERICAN Earthquake Joint with a range of longitudinal expansion or contraction of 4.8 inches. Further, the use of Flex-Ring joints throughout the yard piping between structures provides a flexible underground web of piping capable of deflecting, resisting thrust and, with the EQ joint, expanding or contracting.

In all, with Flex-Lok at the structure, Flex-Ring with some earthquake joints nearby, and Flex-Ring between structures, you have a restrained, flexible, expanding-or-contracting system of tough and resilient ductile iron pipe. That means you keep the water running, making us your very best choice when it comes to the worst-case scenario.

*AMERICAN's wide variety of robust joints provides a resilient solution for every need with plant yard piping.*



*Overhead view of water treatment plant utilizing AMERICAN Earthquake Joint System.*

When specifying your AMERICAN Earthquake Joint System, be sure to include the following information.

As required on the project plans and in these specifications, in high-risk areas subject to earthquakes, flooding, hurricanes, and other threats, a ductile iron system shall be provided that delivers joint deflection and longitudinal expansion and contraction. This system shall be the AMERICAN Earthquake Joint System, or a system equal to or exceeding each of these performance criteria:

## PERFORMANCE SPECS – SEISMIC AND HAZARD RESISTANT PIPE SYSTEMS

| SIZE (IN.) | PIPE JOINT DEFLECTION[1] (DEGREES) | CASTING JOINT DEFLECTION (DEGREES) | COMBINED ASSEMBLY DEFLECTION (DEGREES) | EXPANSION OR CONTRACTION FROM MID-POINT | DEAD-END THRUST RESISTANCE[2] (LBS.) | ISO 16134 RATING |
|---|---|---|---|---|---|---|
| 6 | 5 | 3 | 8 | ± 1.00% (2.40") | 102,000 | A, M1, S1 |
| 8 | 5 | 3 | 8 | ± 1.00% (2.40") | 136,000 | A, M1, S1 |
| 12 | 5 | 3 | 8 | ± 1.00% (2.40") | 204,000 | A, M1, S1 |
| 16 | 3.75 | 3.25 | 7 | ± 1.00% (2.40") | 272,000 | A, M2, S1 |
| 20 | 3.5 | 2.5 | 6 | ± 1.00% (2.40") | 340,000 | A, M2, S1 |
| 24 | 3 | 3 | 6 | ± 1.00% (2.40") | 408,000 | A, M2, S1 |
| 30 | 2.5 | 2.5 | 5 | ± 1.00% (2.40") | 510,000 | A, M2, S1 |

[1] This deflection is available from the mid-point, in full insertion, or from fully extended positions.
[2] Ultimate dead-end thrust resistance is in straight alignment and with special thickness class 53 wall.

Ductile iron earthquake and hazard resistant pipe shall meet all applicable requirements of **AWWA C150** (design), **AWWA C151** (manufacture), **AWWA C104** (lining), **C111** (joints), **AWWA C153** (fittings), **AWWA C105** (polyethylene encasement), and **AWWA C600** (installation). The ductile iron pipe shall be sized in inches, and be special thickness class 53.

The piping shall meet defined classifications detailed below as shown in **ISO 16134 Earthquake Resistant Ductile Iron Pipe and Subsidence-Resistant Design**. The seismic design shall be verified by an independent seismic lab such as Cornell University or an owner-approved institution.

**1.** All ductile iron pipe and fitting joints shall meet or exceed **3dKN pull-out strength or category A**.

**2.** Designated Earthquake System piping shall meet or exceed a minimum deflection of **8 degrees for category M1** for sizes 6" - 12", between **4 degrees to 8 degrees for category M2** for 16", and between **3.5 degrees to 7 degrees for category M2** for 20" and above, whether in the mid-point, fully inserted, or fully extended positions.

**3.** Designated ductile iron Earthquake System piping will have a minimum **expansion/contraction of plus or minus 1% or category S1**.

**As a designation, the minimum requirements would be A-M1-S1 per ISO 16134 for sizes 6" - 12" and A-M2-S1 for sizes 16" and above, unless otherwise shown on plans and specifications**.

The network of ductile iron pipe connected to the Earthquake Joint System shall have the exterior of the pipe coated with a layer of arc-sprayed zinc. The mass of the zinc applied shall be a minimum of 200 g/m$^2$ of pipe surface area, and the coating system shall conform in every respect to **ISO 8179-1, "Ductile Iron Pipes - External Zinc-Based Coating - Part 1: Metallic Zinc with Finishing Layer,"** second edition 2004-06-01. The zinc shall have a top coat of approved materials. (Component pieces and field touch up may require the use of a zinc-rich coating 85% zinc per **ISO-8179-part 2**).

The Earthquake System piping will be installed in the fully extended, fully contracted, or mid-point position per project criteria. To facilitate determining field joint alignment, the expansion spigot in the assembly shall have a minimum of two assembly stripes–one indicating fully contracted and one indicating the mid-point of assembly. Full extension can be achieved by pulling out the completed joint until the joint stops movement.

In addition, the connected network of ductile iron pipe shall be encased in 8-mil **V-Bio polyethylene encasement** meeting the requirements of **AWWA C105** concerning both materials and installation.

The pipeline will be installed with a **locator tape** that identifies the buried line as an earthquake resistant pipeline. The tape will be a minimum 2 inches in width and red in color labeled, "Earthquake Resistant Ductile Iron Pipeline Below."

*Joint assembly can be readily performed by two workers in a trench and one worker on the backhoe.*

Corrosion can prove as damaging as any storm or seismic event. That's why AMERICAN protects pipes and joints with unique protective layers in order to keep your water grid in peak condition.

We begin with cement mortar lining for improved flow and protection against tuberculation. Then, to the exterior, we first apply zinc coating, proven to inhibit corrosion. Add to that a top coat for even greater protection and longer service life. Even then, we're not done. We add V-Bio, the latest advancement in corrosion control. An enhanced polyethylene encasement, colored red, to denote earthquake resilience, V-Bio also utilizes an inhibitor to arrest microbiologically influenced corrosion.

And we ensure resilience of the earthquake casting with cement lining, galvanic zinc primer, and red polyurethane top coat to withstand the toughest environments.

In short, we put everything into our pipes and joints to resist corrosion so you can rely on our products over the long haul.

*Metallized arc-spray application of zinc coating.*


*Red V-Bio enhanced polyethylene encasement.*

## OUR ADVANTAGES

- Multiple layers of protection for your water grid
- Earthquake casting has a zinc base coat with a red top coat to withstand the toughest environment
- Cement mortar lining for sustained flow
- V-Bio polyethylene wrap, red for easy identification

*Consult Section 11 of the AMERICAN Pipe Manual for additional coatings and lining information.*

# Additional Information

## AMERICAN EARTHQUAKE JOINT NOMENCLATURE

**EQ Joint** – AMERICAN Earthquake Joint
**FR Joint** – Small Diameter Flex-Ring Joint
**XR** – Large Diameter Flex-Ring Joint
**XE** – Flex-Ring End
**FFR** – Field Flex-Ring Joint
**FST** – Fastite Plain End
**FLX** – AMERICAN Flex-Lok Joint
**GR** – Grooved Joint

Retro-fitting existing water systems, connecting to existing installations, and other tie-ins are each unique concerning joint type, configurations, and other factors. Consult your AMERICAN professional with any questions and solutions related to these specialized matters.

To learn more about the AMERICAN Earthquake Joint System, as well as our many other solutions, contact us today at **1-205-325-7701** or **EQJoint@american-usa.com**.

AMERICAN

THE RIGHT WAY

AMERICAN-USA.COM
1-205-325-7701
EQJOINT@AMERICAN-USA.COM

DUCTILE IRON PIPE FLOW CONTROL INTERNATIONAL SPIRALWELD PIPE STEEL PIPE

02/2023

Patent 10,436,367