

EBAA IRON Connections™

TECHNICAL DATA FOR THE WATER & WASTEWATER PROFESSIONAL

FT - 06

Design and Installation Considerations for the FLEX-TEND® and EX-TEND® Family of Products

The FLEX-TEND family of products is a very versatile product line that allows designers to place pipeline connection protection into locations that are subjected to settlement, frost heave, seismic activity, thermal changes, and many other situations. One of the most frequent questions that arises with the implementation of these products is how should they be installed. There are several considerations that go into answering this question and this spotlight will highlight several of them.

There are many variations of the FLEX-TEND family of products. The variations have different protection capabilities, and the designer needs to carefully consider what kind of differential motion could occur

- Double Ball FLEX-TEND (FT)
- Single Ball FLEX-TEND (SBFT)
- EX-TEND® (ET)
- FLEX-900® (Flex-900)
- Force Balanced FLEX-TEND® (FBFT)
- Force Balanced Single Ball FLEX-TEND (FBSBFT)
- Force Balanced EX-TEND® (FBET)
- DWV FLEX-TEND® (DWVFT)

Product	Offset	Expansion	Deflection	Thrust Force
FT	Yes	Yes	Yes	Yes
SBFT	No	Yes	Yes	Yes
ET	No	Yes	No	Yes
FLEX-900	No	No	Yes	No
FBFT	Yes	Yes	Yes	No
FBSBFT	No	Yes	Yes	No
FBET	No	Yes	No	No
DWVFT	Yes	Yes	Yes	N/A

Best Location

The best location for the FLEX-TEND product to be installed is as close to the point of maximum differential motion as possible. This is, often times, as a pipe leaves a structure and enters the soil or as the pipe transitions between two structures. It is also important that one end of the unit is supported by the structure that will move in one direction and the other end of the unit supported by the soil or structure that will move in the other direction.

Thrust Force

One very important thing that must be considered is the thrust force that is generated when a standard FLEX-TEND is pressurized (see table above). Below ground installations often have the benefit of soil friction to hold that thrust force in check. However, above

ground installations, especially if fittings are involved, can be damaged if this thrust force is not accommodated in some manner. This force is generated at the expansion joint of the FLEX-TEND or Ex-Tend (like all conventional expansion joints) and simply restraining the pipe joints does not keep this force in check.

For waterlines, use of the Force Balanced FLEX-TEND will eliminate the thrust force at the expansion joint and simplify the design and future function of the pipeline.

Find out more about thrust force by reading the following Connections Bulletins: [FT-04 How does the Force Balanced FLEX-TEND® Product Work?](#) and [FT-05 Bridge Crossings and The Proper use of EX-TEND, FLEX-TEND](#)

While FT-05 address bridge crossings the concepts described can be applied to many different, above ground applications.

Important note- DO NOT use standard FLEX-TEND family units in the same pipeline with Force Balanced FLEX-TEND family units. The Force Balanced units are thrust neutral and the thrust that develops at the standard unit will cause the Force Balanced unit to compress. The units in the red box can be used together and the units in the green box can be used together. Here are the units that can be used in the same pipeline. The units in the red box are standard units and the units in the green box are force balanced units.

Double Ball FLEX-TEND
Single Ball FLEX-TEND
EX-TEND
FLEX-900
Force Balanced FLEX-TEND
Force Balanced Single Ball FLEX-TEND
Force Balanced EX-TEND
DWV FLEX-TEND

For more installation information see: [Installation Instructions FLEX-TEND® Family of Pipeline Protection Products](#)

Connecting Piping

The pipe connected to the FLEX-TEND unit must be restrained, and it must be strong enough to transfer differential motion to the FLEX-TEND so that it can protect the piping as intended.

It must be restrained. It does absolutely no good for the FLEX-TEND to be in place if the differential motion causes an unrestrained pipe joint to separate. How much of the piping must be restrained? It is totally dependent upon how much piping is subject to the differential motion. Once the piping is well away from that area it can be possible to switch to unrestrained pipe.

Especially for above ground piping, when using factory installed restrained joint pipe, be sure to pull any slack out of the joint before pressurizing as instructed by the pipe manufacturers. Like the standard FLEX-TEND, the slack in a restrained joint is an

unrestrained joint until the restraint is fully engaged. As such it will exert a thrust force that can cause a multitude of problems.

If the piping is not strong or stiff enough to transfer motion to the FLEX-TEND it is possible for the piping to break or collapse. Again, if this occurs the FLEX-TEND will not be able to protect the pipeline connection as intended.

You can find out more about what kind of piping is and isn't appropriate by reading the [FLEX-TEND Installation Instructions](#). The [FLEX-TEND Torque Curves](#) show the moment loads required to cause the ball joint components of the FLEX-TEND to deflect.

Additional FLEX-TEND Family Design Information

In addition to the torque curve information listed above there are other elements that may be needed by the designer.

As indicated in the product literature, the product is coated with fusion bonded epoxy and that is the only coating option we provide. The maximum operating temperature for that coating is 180° F. We can also provide chemical resistance information for the coating.

When utilizing a FLEX-TEND unit in a pipeline design, and performing flow modeling, we recommend using the same value as a 90° bend for the unit. An Ex-Tend unit should be treated as a straight run of pipe.

The force required to move the expansion chamber, as with the bending moments, is a function of friction. This force, however, does not change with pressure. For a standard FLEX-TEND/EX-TEND expansion section the force required to move that is approximately 10 psi multiplied by the cross-sectional area of plain end portion of the expansion chamber. For example, in the six-inch size, the cross-sectional area is 37.4 sq. in. Therefore, the force required to move the expansion portion is about 374 lbf. For a Force Balanced FLEX-TEND/EX-TEND product, the force required to move the expansion portion is twice that of the standard unit – approximately 20 psi. As a result, that force for a six-inch size is about 748 lbf. Cross-sectional areas needed to make this calculation can be found on the back page of the [standard Flex-Tend brochure](#).

Finally, when using software to perform stress analysis on a piping system, the software will often require a “stiffness” value for expansion joints and deflection joints. In US customary units, this constant is expressed in pounds force per inch of deflection, lbf/in. This requirement is based on the performance of bellows type joints and rubber expansion joints. When either of those joints is deflected or expanded/contracted, a spring force is developed and when the force used to move the joint is removed, the joint will attempt to move back to its original orientation. The more the joint moves, the more force that is required to move it further. This is, essentially, a spring constant.

FLEX-TEND products do not have a “stiffness” or “spring constant” value. As mentioned above, the movement of the joint is resisted by friction. When the joint is moved there is a certain amount of force required to cause that movement to occur. Once the unit orientation has been changed, however, it remains in that changed position until another force acts on the unit to move it further. Therefore, the US customary unit for causing deflection or expansion of the FLEX-TEND family products is simply pounds force, lbf.

Buried Applications

FLEX-TEND products can be used in buried applications. It must

be remembered that the FLEX-TEND is most effective in protecting connections from damage as a result of differential motion when it is most free to move. It is for this reason that the backfill around a FLEX-TEND should be as loose as possible and that friction from the backfill material be as small as possible.

As an extreme example, if the FLEX-TEND is encased in concrete the unit will be fine, but it will not be able to move and protect. The same reasoning applies to high compaction of the soil. The designer must determine what an appropriate compaction should be based on the specifics of the application.

Regarding friction, a good low friction backfill material is pea gravel. Also, every FLEX-TEND unit is shipped with a polyethylene sleeve. Installing this sleeve also helps to reduce the friction acting on the unit and provides more freedom for the unit to move and protect.

Deep Bury Applications

Will FLEX-TEND units be damaged in deep bury applications? There is a simple answer, but the answer is really much more involved.

The simple answer is that the soil compaction resulting from the deep bury will not damage the FLEX-TEND unit in the same way that it will not damage fittings used along the pipeline.

The involved answer is that it is important to remember why the FLEX-TEND is being used. It is being used to provide strain relief for connections that will be subjected to differential motion. If the connection is subjected to high soil compaction, can the FLEX-TEND move and protect in response to the differential motion? The FLEX-TEND is best able to protect a pipeline connection when 1) it is free to move, 2) it is connected to a restrained pipeline so that all movement of that pipeline can be transferred to the FLEX-TEND, and 3) it is placed at (or as near as physically possible) to the point maximum differential motion.

It has been suggested that a way to remove the soil load is to place the unit in a vault. This can be done but the designer must make sure that the pipe openings for the vault are large enough to accommodate the anticipated differential motion. If the openings are too small then the units cannot move as needed.

Above-Ground Applications

As mentioned above, the more freedom that a FLEX-TEND unit has to move the better able it is to provide the intended protection. As a result, an above ground installation should be most free to move. This is not the case, however, if bracing used to support the unit and/or connected piping limit the ability to move. This also is not the case, for example, if the unit is placed right against a wall and is therefore limited in its ability to travel in one direction and the intention is for protection against differential motions in every direction is intended.

Lateral support for exposed pipelines (think bridge crossings) is very important. Simply supporting the pipe vertically is not enough. If the pipeline starts to move and there is no lateral support the pipeline could deflect to the side and never transmit the movement to the product that is intended to provide protection. Remember, the goal is always to force differential motion to the FLEX-TEND so that it can provide strain relief and protect the pipeline connection.

This is one more reason to feel comfortable relying on EBAA Iron products, and specifically EBAA Iron Flex-Tends, in your system.



This is one in a series of Connections reports addressing design and application subjects. If you would like additional copies of other reports or a listing of available reports contact your EBAA Iron representative or call EBAA Iron Sales at 800.433.1716 or fax 254.629.8931. EBAA's engineering group can be reached at 800.633.9190 or fax 254.629.2079. Copyright© 1995 Ebaa Iron Sales, Inc.

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