EAGLE LOC 900™

INTERNAL JOINT RESTRAINT SYSTEM

INSTALLATION GUIDE

JM Eagle™

Building essentials for a better tomorrow™

EAGLE LOC 900™

CONTENTS

WARRANTY

J-M Manufacturing Company Inc. (JM Eagle™) warrants that its standard polyvinyl chloride (PVC), polyethylene (PE), conduit/plumbing/solvent weld and Acrylonitrile-Butadiene-Styrene (ABS) pipe products ("Products") are manufactured in accordance with applicable industry specifications referenced on the Product and are free from defects in workmanship and materials. Every claim under this warranty shall be void unless in writing and received by JM Eagle™ within 30 days of the date the defect was discovered, and within one year of the date of shipment from the JM Eagle™ plant. Claims for Product appearance defects, such as sun-bleached pipe etc., however, must be made within 30 days of the date of the shipment from the JM Eagle™ plant. This warranty specifically excludes any Products allowed to become sun-bleached after shipment from the JM Eagle™ plant. Proof of purchase with the date thereof must be presented to the satisfaction of JM Eagle™, with any claim made pursuant to this warranty. JM Eagle™ must first be given an opportunity to inspect the alleged defective Products in order to determine if it meets applicable industry standards, if the handling and installation have been satisfactorily performed in accordance with JM Eagle™ recommended practices and if operating conditions are within standards. Written permission and/or a Return Goods Authorization (RGA) must be obtained along with instructions for return shipment to JM Eagle™ of any Products claimed to be defective.

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JM Eagle's Products should be used in accordance with standards set forth by local plumbing and building laws, codes or regulations and the applicable standards. Failure to adhere to these standards shall void this Limited Warranty. Products sold by JM Eagle™ that are manufactured by others are warranted only to the extent and limits of the warranty of the manufacturer. No statement, conduct or description by JM Eagle™ or its representative, in addition to or beyond this Limited Warranty, shall constitute a warranty. This Limited Warranty may only be modified in writing signed by an officer of JM Eagle™.

1.0 ASSEMBLY INSTRUCTIONS

1.1 INTRODUCTION

Proper assembly of Eagle Loc 900 is much like that of conventional bell-and-spigot PVC pressure pipe. Proper assembly of Eagle Loc 900 requires:

- A clean bell and spigot.
- Application of the recommended lubricant (a container of lubricant is typically provided with each shipment of pipe).
- Maintenance of straight alignment during assembly.
- Inserting the spigot into the bell until the reference mark is even with the lip of the bell.

1.2 CLEAN

As with conventional bell-and-spigot pipe, the gasket and the groove area behind it should be wiped clean. If mud, dirt, silt, or other foreign material is in the sealing area, it may prevent the gasket from sealing against the spigot. In addition to cleaning the gasket area, the restraint hardware needs to be clean. Debris in this area may prevent the hardware from engaging and keep the restraint mechanism from activating.

Figure 1: The sand and grit shown above must be cleaned from the internal-restraint hardware. Dirty hardware may prevent the restraint mechanism from working.

Figure 2: The end plugs keep dirt and other foreign matter out of the bell.

Eagle Loc 900 is easier to install than other options for restraining PVC pipe. To make an easy installation even simpler, the product comes supplied with end plugs. The end plugs make it easier to keep the bell, gasket area and restraining hardware clean. The plugs should be left in place as long as possible. Remove them just prior to assembling the joint.

1.3 LUBRICATE

Lubing the Eagle Loc 900 joint is no different from that of conventional PVC pressure pipe. Typical practice is to lube the spigot from the bevel back to a point approximately midway between the end of the pipe and the insertion line. Lube may also be applied to the gasket surface if desired. Use only lubricant supplied or recommended by JM Eagle.

Figure 3

1.4 ALIGN

Straight alignment is a key element for an easy assembly. Misaligned pipe greatly increases the assembly force required to make the joint. This is especially true for Eagle Loc 900 due to the hardware in the bell of the pipe. Straight alignment is a must. When properly aligned, the pipe joint can be assembled manually using a pry bar.

Figure 4

1.5 ASSEMBLE

PVC pipe is easy to assemble correctly. Just slide the spigot into the bell until the black line is even with the bell. Do not push the spigot farther into the bell as this reduces the rotational flexibility at the joint and causes unnecessary stress on the bell.

Figure 5: Assembly continues until the insertion line is even with the lip of the bell, as shown above.

Figure 6: Assembly has just begun. The spigot has made contact with the grip ring inside the bell.

1.6 PREVENT OVER ASSEMBLY

When the black line goes past the lip of the bell, it is called over assembled or homed.

A properly assembled joint may become over assembled when subsequent joints are made. The force levering together a new joint (Joint B), may cause further insertion of Pipe 2 into the bell of Pipe 1. This may result in the spigot in Joint A being over-inserted. When installing pipe in a ditch, the previously assembled pipe (Pipe 2) can be center loaded with embedment material. The embedment material holds the pipe in place while the new joint is being made.

In an HDD installation when the pipe is joined above ground, it may be necessary to center load Pipe 2 with a piece of equipment in order to prevent over assembly at Joint A.

Alternatively, assembly tools may be used that prevent the assembly forces from moving previously installed pipe. Examples of these tools are shown below.

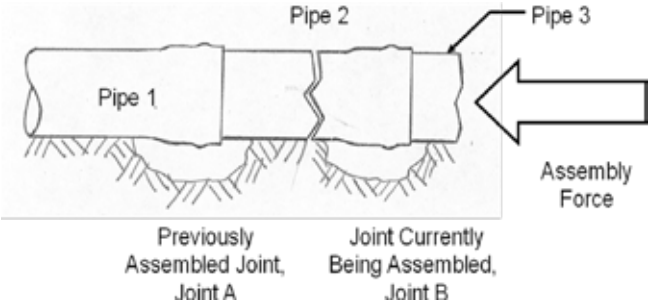

Figure 7

Figure 8: The backhoe's bucket center loads the previosly installed length of pipe to keep it from moving while the new joint is being assembled

Figure 9: This assembly tool is called the Eagle Claw and is available from Pro Pipe Solutions.

Figure 10: This assembly tool uses a chain wrapped around the bell and a lever bar to make the joint.

CHECK THE LIST

- The bell, gasket, gasket groove and restraining hardware are clean.
- Just prior to assembly, the spigot was lubricated with the correct lube.
- Straight alignment was maintained during assembly.
- Assembly stopped when the insertion line was even with the bell.
- Previously assembled pipe did not move when subsequent joints were made.
- Prior to assembly, the grip ring was checked to make sure it was positioned correctly in the casing. If it was not, the grip ring was manually adjusted so that it would sit in the casing properly.

2.0 EAGLE LOC 900 USED WITH A CASING

A casing is often required for utilities installed within the right of way of a major roadway or under a railroad. For the purposes of this instruction, it will be assumed that the utility in question is a water line. The reasons for installing a water line inside a casing are listed below.

- If the water line is being installed under an existing highway or railroad, the installation may be done without interrupting traffic.
- If the water line were to break or leak, the casing re-directs the water beyond the highway or railroad and prevents the embankment from being washed away or undermined.
- If the water line needs to be repaired, a casing installation allows the water line to be slid out of the casing so that repairs can be made without disruption of traffic.

Figure 11 shows a sketch of a casing installed under a road. Note that if the water line were to leak, the water would flow out of the casing at a point that is not underneath the road, which would protect the road's sub-base from erosion.

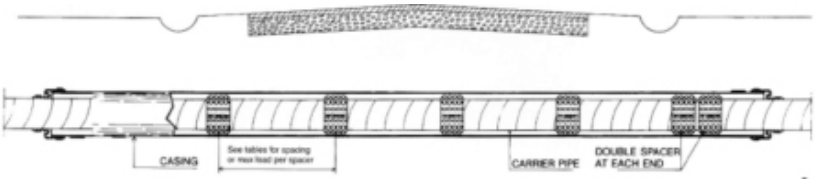

Figure 11: Casing Installed Under A Road.

After the water line is in the casing, there are different schools of thought on what to do about the annular space outside of the water line but inside of the casing. One of the following is done:

- The annular space is grouted. This makes it impossible to repair the water line if it were ever to break or leak.
- Sand is blown into the annular space.
- The annular space is left empty and only the ends of the casing are sealed.

Sealing the ends of the casing is common so that a new drainage pathway is not created and to prevent animals from entering the casing. The ends may be sealed with a spray foam, by grouting the ends, or with end seals. Figure 12 shows an end seal being applied to 12-inch Eagle Loc 900.

Figure 12: One Method of Sealing the Ends of Casing Pipe.

Whether the water line should be restrained when installed inside the casing depends on which school of thought subscribed to. If the water line is grouted inside the casing, there is no need to restrain the joints when installing the pipe inside the casing. With sand in the annular space, or when the annular space is left empty, restraining the gasketed bell-and-spigot joints make sense. Common reasons for requiring restrained joints:

- The ROW owner requires that the water line be capable of being isolated in the event of a failure. To isolate that section of pipe, a valve must be installed near the casing at both ends. When the valve is closed,

end thrust is generated by the water pressure. The water line must be restrained so that the valve does not blow off when closed.

- If there is a break, one can not count on being able to push the unbroken sections out of the casing. One will need to pull the unbroken sections from each end of the casing. One cannot pull a gasketed bell-and-spigot joint if it is not restrained.
- If there is a leak, but not a break, one may not be able to count on having easy access at both sides of the casing. To be able to remove the line from either side, one must have restrained joints.

In those instances where the utility uses restrained joint water pipe inside a casing, Eagle Loc 900 offers some clear advantages. The greatest advantage is that Eagle Loc 900's restrained joint allows a smaller casing pipe to be used. See Figure 13.

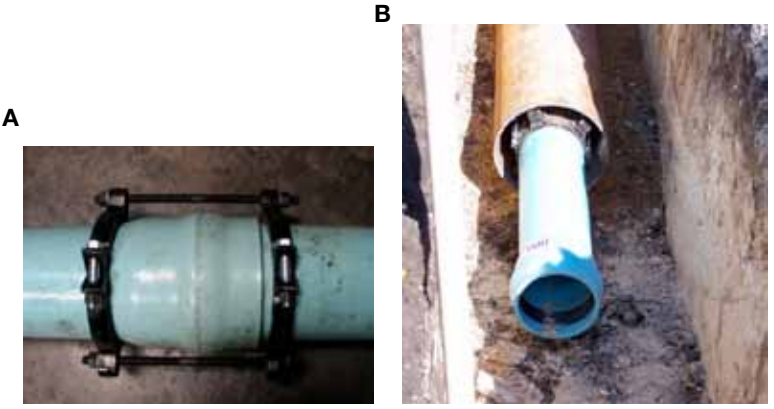

Figure 13: Installing Restrained Joint PVC Pipe Inside a Casing.
A: The Traditional External Restraint Harness. B: Eagle Loc 900.

By their design, an external harness has to be larger than the outside diameter of the PVC pipe bell. Eagle Loc 900 puts the joint restraint inside the PVC pipe bell, which allows for a smaller diameter casing. Table 1 lists the outside diameters of various bell harnesses for AWWA C900 pipe and compares them to the outside diameter of the Bulldog bell.

CLEARANCE DIMENSIONS DRIVING CASING DIAMETER					
NOMINAL PIPE SIZE (INCHES)	**OD OF AWWA C900 PIPE** (INCHES)	**APPROXIMATE OD OF THE BULLDOG BELL** (INCHES)	**APPROXIMATE OD OF THE UNI-FLANGE SERIES 1350** (INCHES)	**APPROXIMATE OD OF THE STAR SERIES 1000** (INCHES)	**APPROXIMATE OD OF THE EBAA SERIES 1600** (INCHES)
4	4.800	6.50	9.125	9.12	9.25
6	6.900	9.25	11.875	11.12	11.25
8	9.050	11.75	14.625	14.75	14.75
10	11.100	14.25	16.625	16.82	16.85
12	13.200	16.75	19.25	19.46	19.45

Table 1

By putting the restraint inside the PVC pipe bell, a smaller diameter casing may be used. A smaller casing means a smaller auger bit, less spoil, and less time required for jacking and boring the casing into place. This adds up to lower costs and higher profit margins.

A 2009 Texas Department of Transportation project quantifies the cost savings potential from using a smaller casing. The average bid cost per linear foot of installed steel casing pipe is listed in Table 2.

AVERAGE COST BID PER LINEAR FOOT OF STEEL CASING PIPE INSTALLED	
DIAMETER OF CASING INSTALLED	**AVERAGE COST BID**
12" Steel Casing	$166 / Linear Foot
16" Steel Casing	$191 / Linear Foot
24" Steel Casing	$284 / Linear Foot

Table 2

The contractor will also save time installing the joint restraint device. With Eagle Loc 900, there are no nuts, bolts and tie rods to assemble and tighten. Moreover, if the utility is concerned about corrosion and requires polyethylene encasement of the joint restraint harness, the contractor will have to add up to $50 per harness for the time and material of installing the polyethylene encasement.

So far, the memo has described the benefits Eagle Loc 900 offers the contractor. The ROW owner also benefits. External restraint harnesses prevent

the joints from separating, but they are uni-directional. They do not prevent over assembly of the spigot into the bell. Thus, a restrained PVC system that uses external restraints at the bell, along with casing spacers, will only be allowed to be pulled. If pulled, the harnesses will grab onto the spigot and keep it from being pulled out of the bell. If pushed, the harnesses will not prevent the spigot from being over inserted into the pipe bell.

An Eagle Loc 900 restrained system, with casing spacers, allows the pipe to be pushed or pulled if the spacers are installed on either side of the gasketed joint. The spacer installed at the insertion line on the spigot prevents the spigot from being over inserted into the pipe bell. (See Figure 14.) Thus, Eagle Loc 900 offers the ROW owner the option of either pushing or pulling the pipe at any future point in time.

Figure 14: By using Eagle Loc, pipe may be pushed or pulled into the casing.

As our ROW's become more crowded, installing smaller diameter casings results in less congestion or allows more utilities to be installed in the same amount of space.

Figure 15: Casing spacers should be installed just behind the insertion line to prevent over insertion.

Using Eagle Loc 900 for casing installations helps all the stakeholders. The contractor has a product that saves time and money. For the ROW owner, the installation leaves a smaller footprint and simplifies maintenance of the line. The engineer and the utility owner have a joint restraint system that is stronger and that is less likely to be installed incorrectly.

3.0 INSTALLATION CONSIDERATIONS FOR PVC PRODUCTS EMPLOYING THE EAGLE LOC 900™ INTERNAL JOINT RESTRAINT SYSTEM.

The superior strength of Eagle Loc 900 makes it suitable for even the most challenging trenchless applications. Strong enough to withstand pullback in the ground, even at greatly extended lengths, Eagle Loc 900 allows for placement in areas with high water tables and acidic soils; fits in tight, hard-to-reach areas where other utility lines are present; does away with labor-intensive and expensive digging and trenching; and eliminates the need to pre-fuse the entire length of pipe.

3.1 TENSILE STRENGTH

Testing confirms that Eagle Loc 900 has sufficient joint tensile strength for installation via horizontal directional drilling. Table 4 summarizes the results of the test.

DR18 EAGLE LOC 900 JOINT TENSILE STRENGTHS	
NOMINAL DIAMETER (inches)	**LOAD AT FAILURE** (pounds)
4	20,358*
6	36,952*
8	54,215*
10	72,700
12	110,100

**average of two tests*

Table 4

3.2 ENTRY ANGLES

Typical entry angles (6 to 15 degrees) used for other HDD products may also be used with Eagle Loc 900 as long as:

- The pipe is not bent tighter than the allowable bending radius.
- The pipe's maximum unsupported length is not exceeded.

Meeting these requirements is simple. It just takes a little planning to dig an entry pit that will allow these requirements to be met.

The minimum bending radius recommended for AWWA C900 pipe is 250 times the pipe's outside diameter. This recommendation is given in the AWWA installation standard for PVC pipe, which is AWWA C605. Table 5 lists the minimum bending radii for AWWA C900 product and the allowable offset. Figure 1 has a sketch describing these two dimensions. The maximum allowable offset is based on a 20-foot length of pipe, which is the standard laying length for C900.

MINIMUM BENDING RADII AND OFFSETS FOR AWW C900 PIPE		
NOMINAL DIAMETER (inches)	**MINIMUM BENDING RADIUS** (feet)	**MAXIMUM ALLOWABLE OFFSET** (in)
4	100	24
6	144	17
8	189	13
10	232	10
12	275	9

Table 5

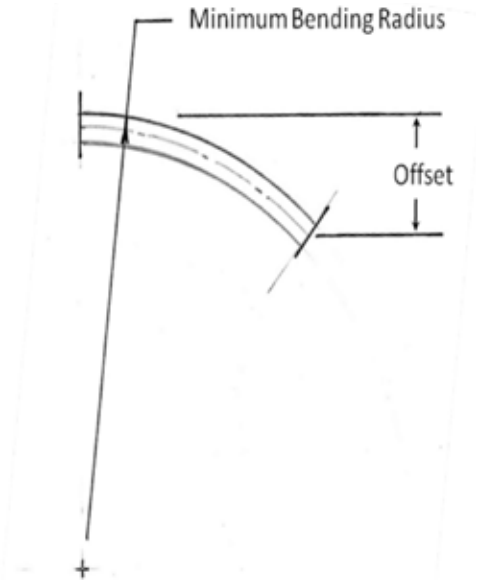

Figure 16: Sketch showing a bending radius and the resulting offset for a length of pipe.

Table 5 has been developed to simplify getting the information needed for digging an entry pit of sufficient length and depth. The table has been developed for common entry angles, and it assumes that the existing grade is flat. Using a similar approach, entry pit dimensions can be easily calculated for other entry angles and surface grades.

Figure 17 shows the dimensions and angles for the entry pit.

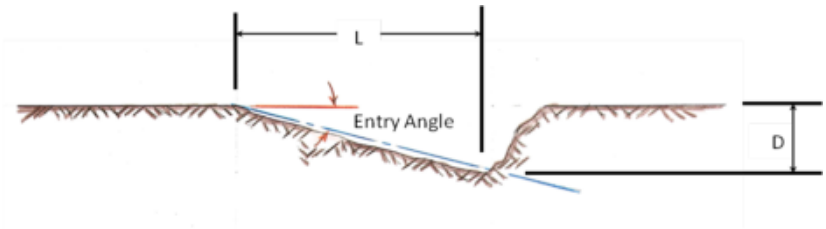

Figure 17

ENTRY PIT DIMENSIONS			
NOMINAL DIAMETER (inches)	**ENTRY ANGLE** (degrees)	**PIT DEPTH** (feet)	**PIT LENGTH** (feet)
4	6	0.5	10.5
	7	0.7	12.2
	8	1.0	13.9
	9	1.2	15.6
	10	1.5	17.4
	11	1.8	19.1
	12	2.2	20.8
	13	2.6	22.5
	14	3.0	24.2
	15	3.4	25.9
6	6	0.8	15.0
	7	1.1	17.5
	8	1.4	20.0
	9	1.8	22.5
	10	2.2	25.0
	11	2.6	27.4
	12	3.1	29.9
	13	3.7	32.3
	14	4.3	34.8
	15	4.9	37.2
8	6	1.0	19.7
	7	1.4	23.0
	8	1.8	26.2
	9	2.3	29.5
	10	2.9	32.7
	11	3.5	36.0
	12	4.1	39.2
	13	4.8	42.4
	14	5.6	45.6
	15	6.4	48.8
10	6	1.3	24.2
	7	1.7	28.2
	8	2.3	32.2
	9	2.8	36.2
	10	3.5	40.2
	1	4.2	44.1
	12	5.1	48.1
	13	5.9	52.0
	14	6.9	55.9
	15	7.9	59.9
12	6	1.5	28.7
	7	2.0	33.5
	8	2.7	38.3
	9	3.4	43.0
	10	4.2	47.8
	11	5.1	52.5
	12	6.0	57.2
	13	7.0	61.9
	14	8.2	66.5
	15	9.4	71.2

Table 6

Recommendations for the maximum unsupported length have also been developed for PVC pipe. The applications in which this information is helpful are casing projects or above ground installations where the pipe is suspended by pipe hangers. Recommendations for the maximum unsupported length may be found in *The Handbook of PVC Pipe: Design and Construction.* The upper limit for the unsupported length is the laying length of the product, which is 20 feet for AWWA C900 pipe. We recommend this maximum unsupported length for HDD applications. Figure 18 shows an entry pit for a 12-inch diameter pipe string which is being installed with a 15-degree entry angle. The length and depth recommended in Table 6 were followed, but the pipe string will have an unsupported length of approximately 72 feet, which far exceeds the allowable of 20 feet. Thus, the entry pit shown in Figure 18 is unacceptable. Pipe stands with rollers would be needed to support the pipe string and reduce the span length to below 20 feet.

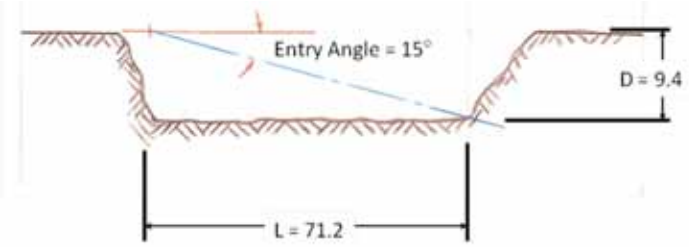

Figure 18: Installing the 12-inch diameter pipe string in this entry pit would violate the permissible unsupported length.

Figure 19 shows an example of an entry pit that allows the pipe string to be installed without exceeding either the allowable bending radius or the maximum unsupported length. Making such a pit is simple if the dimensions provided in this memo are observed.

LOOKING AWAY FROM THE INSERTION POINT.

LOOKING TOWARDS THE INSERTION POINT.

Figure 19: Example of a proper entry pit.

NOTES:

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