

<b>METROPOLITAN UTILITIES DISTRICT</b>	<b>Construction Standard</b>	No: <b>8.3.3</b>
	<b>Trace Wire, Anode and Test Lead</b>	Page: 1 of 9
Prepared by: Rich Baird	<b>Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	<u>Supersedes:</u> 7-2-20
Approved by: James Bartels		Effective: 2-14-24

The latest revisions can be found at the end of this document

**Scope:** The following procedures cover the various approved methods of attaching anode leads, test leads, and trace wire to steel, ductile iron and cast iron water mains. Other methods may be considered for use with prior approval from the M.U.D. Engineering Department.

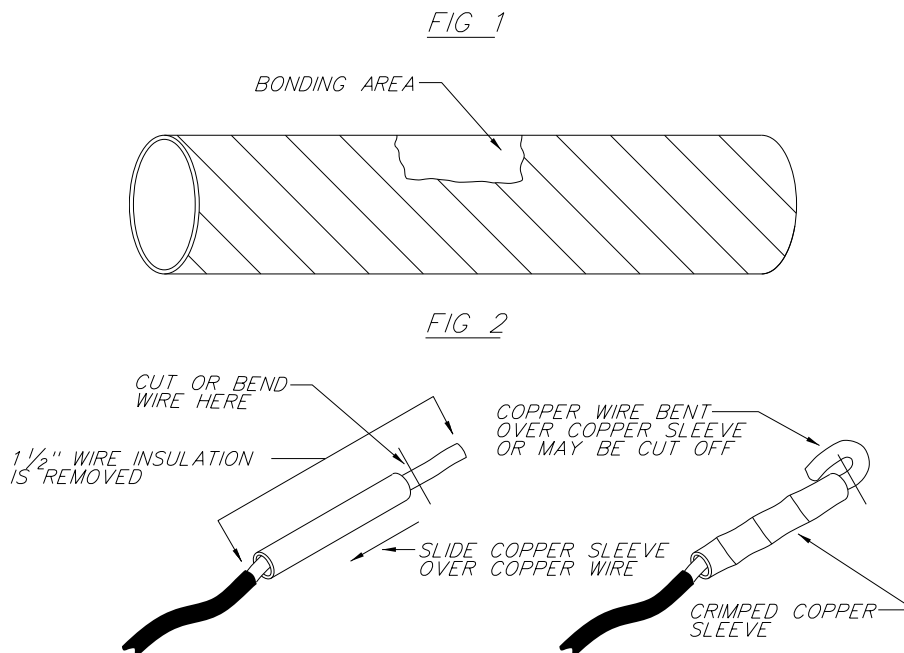
**Note:** Only individuals qualified or directly supervised by qualified individuals are allowed to perform these procedures on water piping.

**Note:** The following procedures for trace wire, anode and test lead attachment methods are for water piping. See Construction Standard 8.3.2 for attachment methods for gas mains.

### THERMITE BONDING (STEEL PIPE)

A thermite bonding kit is used to attach anode leads, test leads, and trace wire to steel pipe and fittings. The kit consists of copper sleeves, metal melting discs, flash powder, crucible (graphite block mold), a flint gun to ignite the powder, and a tool to clean slag from the crucible. The crucible is used to control ignition and the flow of molten metal on top of the test/anode lead to bond it to the steel. **Warning:** Do not perform this procedure if escaping gas is present. A 20 lb. ABC or Purple K fire extinguisher shall be ready for use.

1. Clean a 2" to 3" square on top of the steel pipe, as in Fig 1, and file down to bare steel until it is bright and shiny. Strip off 1 1/2" of insulation from the anode connector wire end. Slide a copper sleeve on to the connector wire end and crimp it. Cut off the remaining wire or bend the end of the connector wire over the sleeve. See Fig 2. Tug on the sleeve to ensure it is tight.



<b>METROPOLITAN UTILITIES DISTRICT</b>	<b>Construction Standard</b>	No: <b>8.3.3</b>
	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page: 2 of 9
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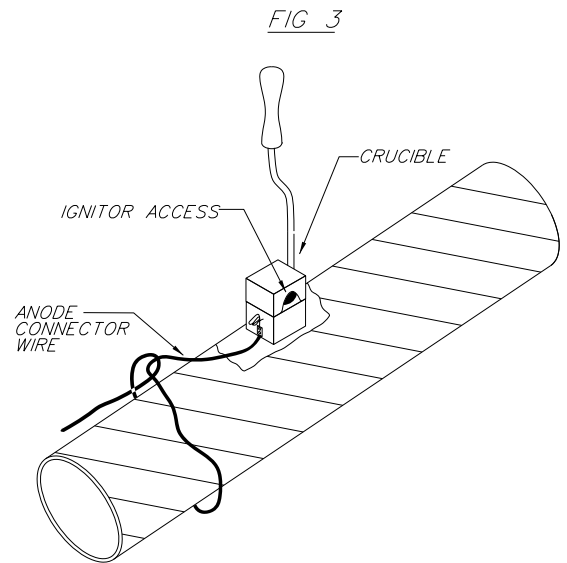
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- Place a metal disc, point down, in the bottom of the crucible and pour the flash powder (gray) on top of the disc. Ensure that the igniter powder (silver) in the very bottom of the plastic container is on top of the powder in the crucible or ignition may not take place. Keep the crucible in an upright position at all times to avoid spilling the powder.

- Center the copper sleeve and connector wire in the bonding area parallel to the pipe.

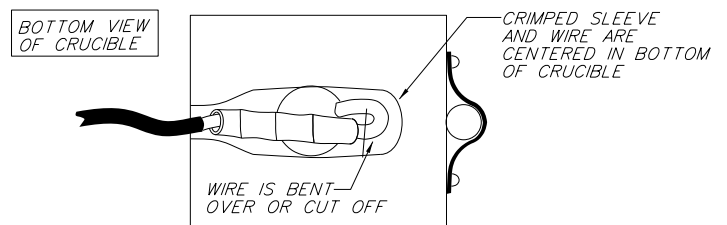
- Place the crucible over the connector wire and hold firmly in an upright position. See Fig 3. The clip on the side of the crucible may be used to hold the wire in place. Fig 4 shows the bottom view of the crucible centered over the connector wire end.

- Gloves and goggles shall be worn and long sleeves recommended during ignition. **Warning:** Make sure that no part of the body or anything flammable is directly under the pipe because molten metal may escape from the crucible and cause serious injury, damage to other pipe and fittings, and/or fire. **Caution:** If molten metal is released from the crucible, pipe coatings and any plastic pipe and fittings in the immediate area should be inspected for damage and repaired as necessary.



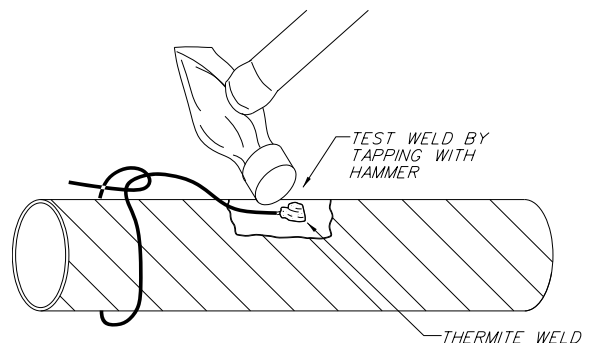
- Close the crucible lid and ignite the powder with the flint gun through the lid opening shown in Fig 3. Hold the crucible in place for 5 seconds.

FIG 4 - BOTTOM VIEW OF CRUCIBLE



- Remove the crucible and clean the slag from the inside and bottom of the crucible. Check the connection by tugging on the connector wire and tapping the weld with a hammer or other suitable tool as in Fig 5.

FIG 5



- Once a successful connection is made, cover the bonding area and connection with Patch-Pad Exothermic Weld Protector, a bitumastic coating or apply primer and cold wrap according to Construction Standard [8.5.2](#).

<b>METROPOLITAN UTILITIES DISTRICT</b>	<b>Construction Standard</b>	No: <b>8.3.3</b>
	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page: 3 of 9
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## CADWELD PLUS WELDING SYSTEM (CAST IRON, DUCTILE IRON OR STEEL PIPE)

The Cadweld Plus welding system replaces the conventional method of using starting material and a flint gun to ignite welding material. This is accomplished by using pre-sealed, drop-in welding material crucible cup packages which are placed into existing molds and using the Cadweld Plus Control Unit to discharge current into a pre-installed crucible cup ignitor strip.

1. Use a file or rasp to clean dirt and rust from a 6" square on top of the steel, cast iron or ductile iron pipe, as shown in Fig 6. Use a file, rasp, or chisel to tap the metal around the cleaned area to find a high pitched \*ting\* sound in order to find optimal Cadweld Plus placement (*Note: this is a very important step to establishing optimal continuity*). Using an angle grinder with a twist-knotted wire wheel attachment, brush a 2" to 3" square down to bare shiny metal. Remove 1 ½" of insulation from the connector wire end. Slide a copper sleeve (see Table 1) on to the connector wire end and crimp it. Cut off the remaining wire. See Fig 7. Tug on the sleeve to ensure it is tight.

FIG 6

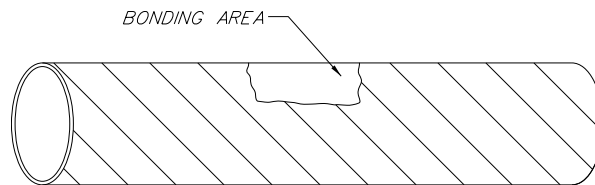
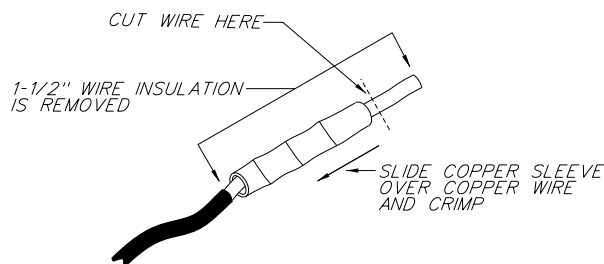


FIG 7



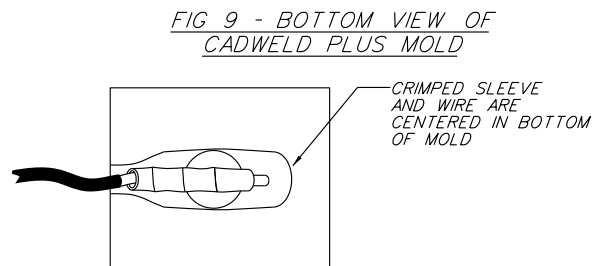
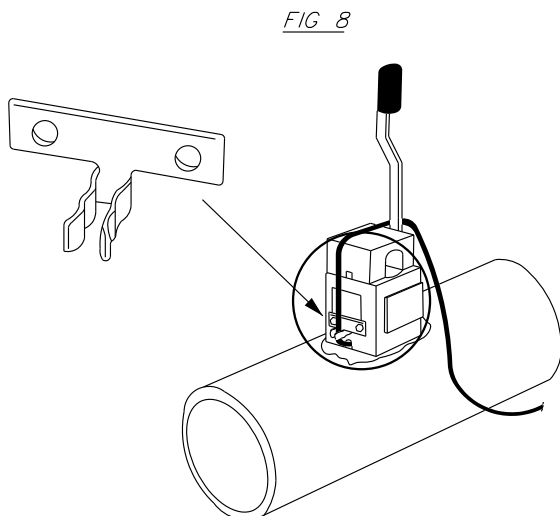
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	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page: 4 of 9
Prepared by: Rich Baird		<u>Supersedes:</u> 7-2-20
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**Table 1**

Pipe Size	Material	Welder Part No. (Mold/Cauldron)	Weld Metal	Wire Size	Copper Sleeve Part No.
≥ 4"	Steel	CAHAA-1G	CA15F-33 (Green Cap)	#14 to #10	CAB-133-1H
6"	Cast/Ductile Iron	CAHBA-1G-6	CA25XF-19 (Orange Cap)	#12	CAB-133-1H
8"	Cast/Ductile Iron	CAHBA-1G-8	CA25XF-19 (Orange Cap)	#12	CAB-133-1H
12"	Cast/Ductile Iron	CAHBA-1G-12	CA25XF-19 (Orange Cap)	#12	CAB-133-1H
≥16"	Cast/Ductile Iron	CAHBA-1G-16	CA25XF-19 (Orange Cap)	#12	CAB-133-1H

- Heat interior of mold with a torch enough to evaporate any residual moisture. . Shake mold cup vigorously until you can hear that the powder inside is well mixed and granular – about 15-20 seconds.
- Place the Cadweld Plus cup into the mold. The ignition strip and termination clip should be positioned perpendicular to the opening in the mold cover to minimize exposure to the reaction. (NOTE: Ensure that the Cadweld Plus cup and mold are specific to the pipe being welded to.)4. On the bottom of the mold, center the copper sleeve and connector wire in the bonding area parallel to the pipe. The mold should fit tightly on top of the main to ensure that the weld metal does not leak out. Pack Cadweld Mold Sealer around the mold if a tight fit is not otherwise possible.
- Place the mold over the connector wire and hold firmly in an upright position. See Fig 8. The clip on the side of the mold may be used to hold the wire in place. Fig 9 shows the bottom view of the mold centered over the connector wire end.



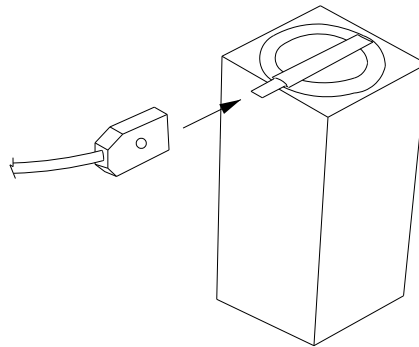
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	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page: 5 of 9
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**Warning:** Always wear protective eyewear and gloves during operation. Be sure OPERATE switch is not being pressed during insertion of ignition strip into Control Unit termination clip.

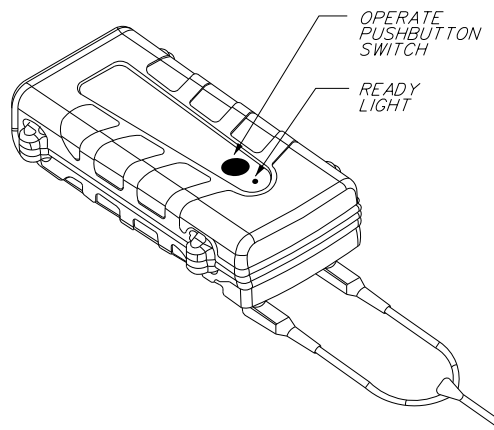
- Connect the Control Unit termination clip to the Cadweld Plus cup ignition strip. See Fig 10. Push the Control Unit termination clip onto the Cadweld Plus cup ignition strip until the end of the termination clip is flush with the black line on the ignition strip. Make sure ignition strip is fully seated inside termination clip. A slight “snap” should be felt.

FIG 10 - CONNECTING CONTROL UNIT



- Press the OPERATE pushbutton switch and hold down with constant pressure. The READY light flashes 5 to 7 times as the Control Unit charges. *Note: If the READY light flashes 12 times or more, the batteries must be replaced.* Once the unit is fully charged, the READY light becomes steady. Initiation of the reaction occurs one second after the READY light is on steady. Maintain constant pressure on the OPERATE switch until the reaction has been initiated. Letting go of the switch before reaction initiation will result in an internal discharge without ignition of the welding material. See Fig 11.

FIG 11



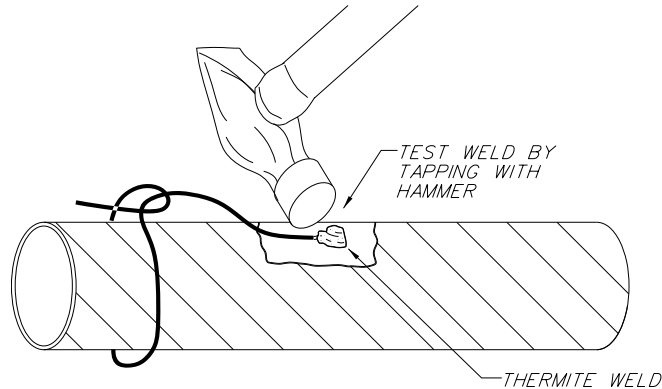
- Allow 30 seconds for the completion of the reaction and the solidification of the molten metal. Remove used Control Unit ignition strip from Control Unit termination clip.

<b>METROPOLITAN UTILITIES DISTRICT</b>	<b>Construction Standard</b>	No: <b>8.3.3</b>
	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page: 6 of 9
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The latest revisions can be found at the end of this document

- Remove the mold and clean the slag from the inside and bottom of the crucible. Check the connection by tugging on the connector wire and tapping the weld with a hammer or other suitable tool as in Fig 12.

FIG 12



- Once a successful connection is made, cover the bonding area and connection with Patch-Pad Exothermic Weld Protector, bitumastic coating or apply primer and cold wrap according to Construction Standard [8.5.2](#).

### ATTACHING ANODES TO CAST IRON OR DUCTILE IRON PIPE USING THE CATHODI-CLAMP (CADWELD PLUS SHALL BE USED UNLESS FIELD CONDITIONS DO NOT PERMIT)

#### Materials:

Cathodi-Clamp  
32# anode  
Wire connector

#### Tools:

Wire brush  
Socket or wrench  
Continuity tester

*Note: For cast iron or ductile iron mains larger than 18", contact the Corrosion Engineer.*

#### Installation of Cathodi-Clamp

- Clean around the pipe surface with a wire brush to remove rust scale and dirt, so the band will lay flat against the pipe. For ductile iron pipe, remove the factory coating and file to smooth the surface where the pigtail connector bolt will contact the pipe surface.

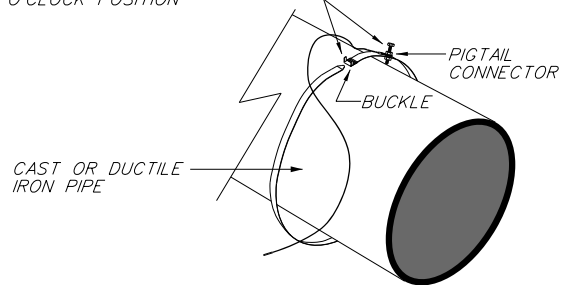
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2. Wrap the band around the pipe with wire pigtail and connector bolt at the 12 o'clock position. See Fig 13.

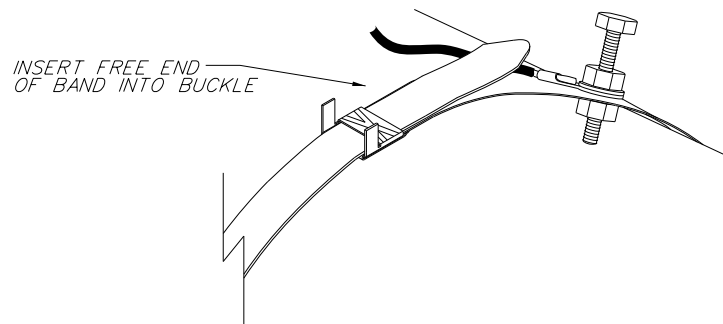
FIG 13

WRAP THE CATHODI-CLAMP AROUND THE PIPE WITH THE PIGTAIL CONNECTOR AND BUCKLE AT THE 12 O'CLOCK POSITION



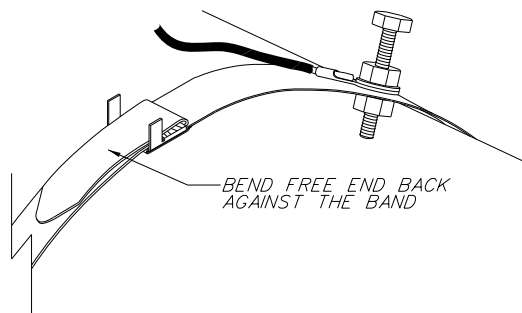
3. Insert the free end of band into buckle, as shown in Fig 14, making sure band is resting flat against pipe surface.

FIG 14



4. Pull on free end to place band in slight tension around pipe.
5. Bend free end back against inside edge of buckle to hold band securely to pipe. See Fig 15.

FIG 15

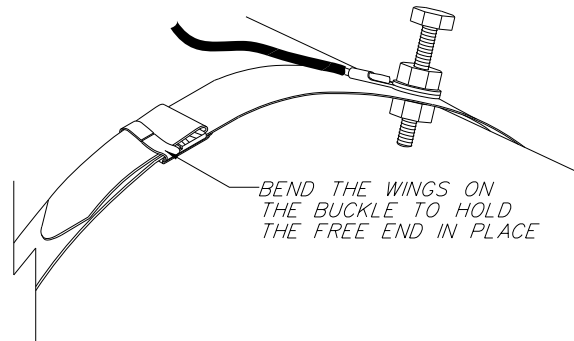


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	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page: 8 of 9
Prepared by: Rich Baird		<a href="#">Supersedes:</a> 7-2-20
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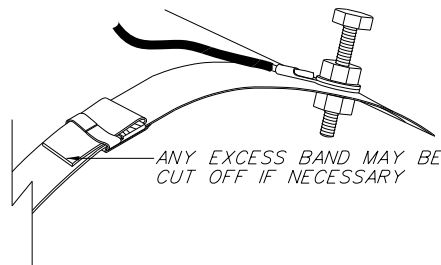
- Lightly strike fastener “wings” of buckle with mallet or hammer holding free end in place as shown in Fig 16.

FIG 16



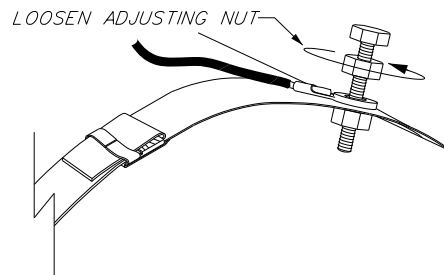
- Excess length of free end of band may be cut with snips (Fig 17) or may remain in place.

FIG 17



- Loosen the adjusting nut on the top of the band. See Fig 18.

FIG 18

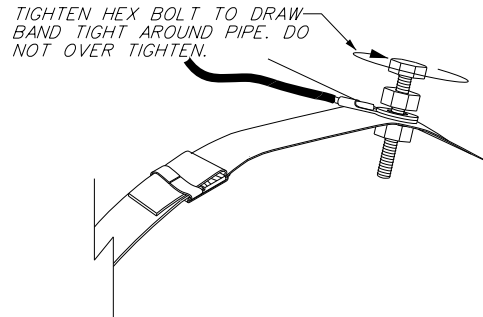


- Using socket or wrench, hand tighten the hex cap bolt to draw the band tight around the pipe. See Fig 19.

<b>METROPOLITAN UTILITIES DISTRICT</b>	<b>Construction Standard</b>	No: <b>8.3.3</b>
	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page: 9 of 9
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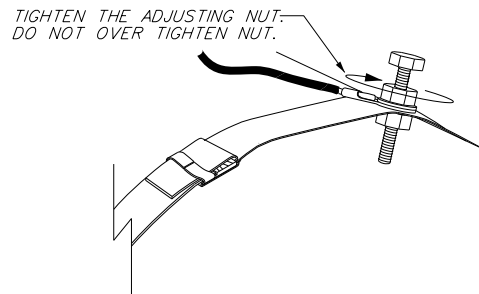
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FIG 19



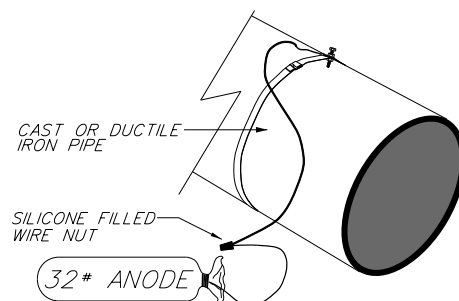
- Hand-tighten the adjusting nut on the top of the band – do not over-tighten the bolt or nut. See Fig 20.

FIG 20



- Verify continuity with continuity tester, one end attached to copper end of wire pigtail, the other end contacting the pipe. **Note:** If there is no continuity, make sure that pipe surface at contact is clean; tighten hex bolt cap ¼ turn at a time until continuity is established.
- Place a 32# anode in the ditch; remove 1” of insulation from the end of anode wire, exposing the copper.
- Hold anode wire end and Cathodi-Clamp® pigtail end together with ends even.
- Screw on connector, pushing wires firmly through the pie shaped cap. No copper wire should be left exposed outside of the connector cap. See Fig 21.

FIG 21





## Revision

The latest revision is detailed on the following page(s).

Pages affected: #1, #2, #3, #4, #5, #6, #7,  
#8, #9, #10 & #11

<b>METROPOLITAN UTILITIES DISTRICT</b>	<b>Construction Standard</b>	No: <b>8.3.3</b>
	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page: 1 of 7 <del>Supersedes: 4-31- 107-2-20</del>
Prepared by: <b>D.J. Satterfield Rich Baird</b>		Effective: <b>7-2-20</b>
Approved by: <b>Jeff Schevane James Bartels</b>		

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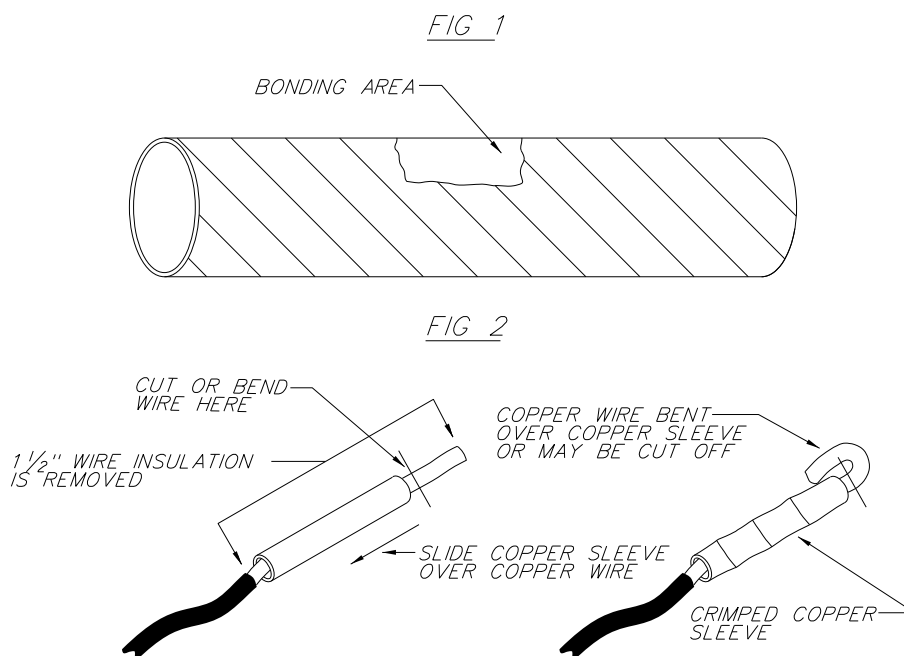
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A thermite bonding kit is used to attach anode leads, test leads, and trace wire to steel pipe and fittings. The kit consists of copper sleeves, metal melting discs, flash powder, crucible (graphite block mold), a flint gun to ignite the powder, and a tool to clean slag from the crucible. The crucible is used to control ignition and the flow of molten metal on top of the test/anode lead to bond it to the steel. **Warning: Do not perform this procedure if escaping gas is present. A 20 lb. ABC or Purple K fire extinguisher shall be ready for use.**

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2. Place a metal disc, point down, in the bottom of the crucible and pour the flash powder (gray) on top of the disc. Ensure that the igniter powder (silver) in the very bottom of the plastic container is on top of the powder in the crucible or ignition may not take place. Keep the crucible in an upright position at all times to avoid spilling the powder.

3. Center the copper sleeve and connector wire in the bonding area parallel to the pipe.

4. Place the crucible over the connector wire and hold firmly in an upright position. See Fig 3. The clip on the side of the crucible may be used to hold the wire in place. Fig 4 shows the bottom view of the crucible centered over the connector wire end.

5. Gloves and goggles shall be worn and long sleeves recommended during ignition. **Warning:** Make sure that no part of the body or anything flammable is directly under the pipe because molten metal may escape from the crucible and cause serious injury, damage to other pipe and fittings, and/or fire. **Caution:** If molten metal is released from the crucible, pipe coatings and any plastic pipe and fittings in the immediate area should be inspected for damage and repaired as necessary.

6. Close the crucible lid and ignite the powder with the flint gun through the lid opening shown in Fig 3. Hold the crucible in place for 5 seconds.

7. Remove the crucible and clean the slag from the inside and bottom of the crucible. Check the connection by tugging on the connector wire and tapping the weld with a hammer or other suitable tool as in Fig 5.

8. Once a successful connection is made, cover the bonding area and connection with Patch-Pad Exothermic Weld Protector, a bitumastic coating or apply primer and cold wrap according to Construction Standard 8.5.2.

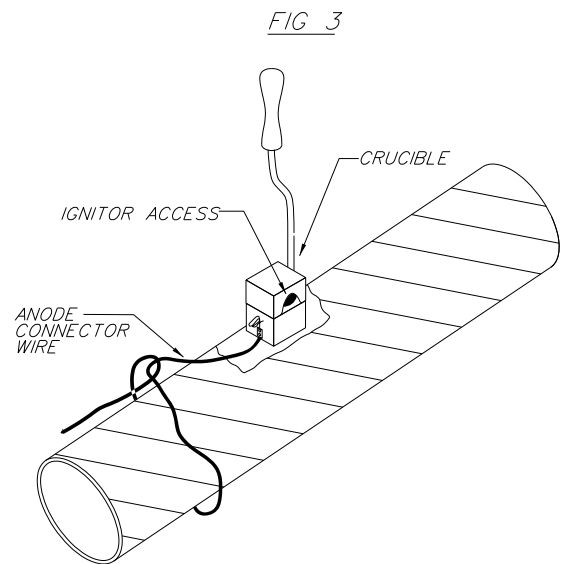


FIG 4 - BOTTOM VIEW OF CRUCIBLE

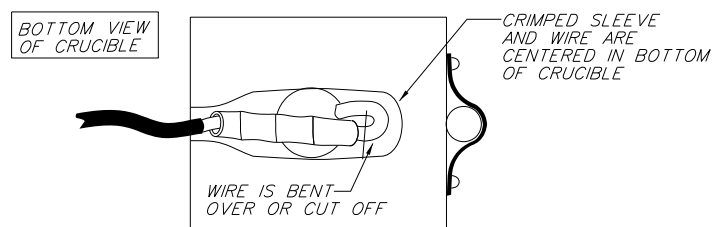
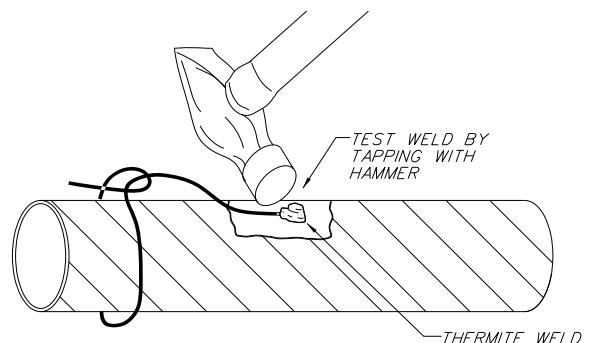


FIG 5



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	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page:	3 of 7
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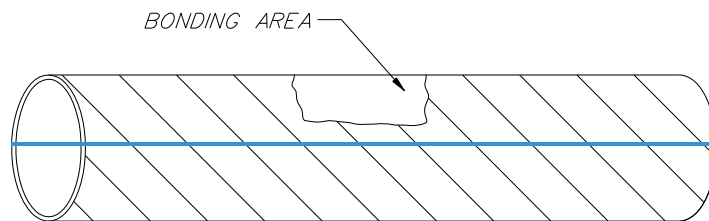


FIG 1

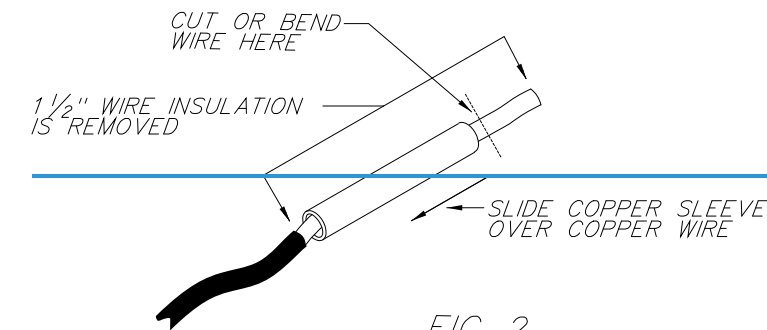
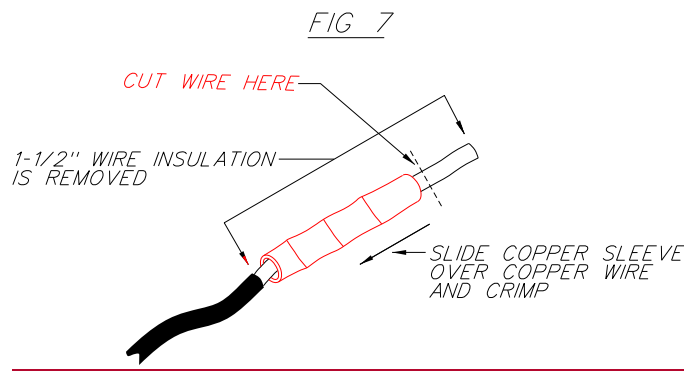
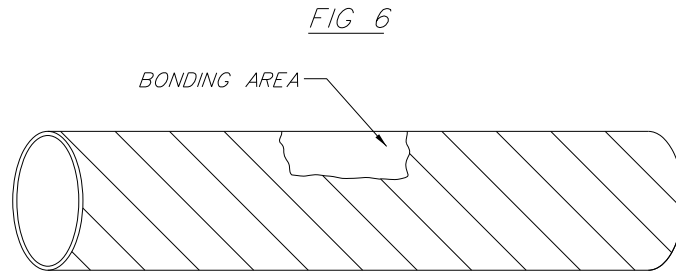


FIG 2

<b>METROPOLITAN UTILITIES DISTRICT</b>	<b>Construction Standard</b>	No: <b>8.3.3</b>
	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page: 4 of 7
Prepared by: <u>D.J. Satterfield</u> <u>Rich Baird</u>		<u>Supersedes:</u> <del>1-31-</del> <del>107-2-20</del>
Approved by: <u>Jeff Schevane</u> <u>James Bartels</u>		Effective: <u>7-2-20</u>



**Table 1**

<u>Pipe Size</u>	<u>Material</u>	<u>Welder Part No. (Mold/Cauldron)</u>	<u>Weld Metal</u>	<u>Wire Size</u>	<u>Copper Sleeve Part No.</u>
<u>&gt; 4"</u>	<u>Steel</u>	<u>CAHAA-1G</u>	<u>CA15F-33 (Green Cap)</u>	<u>#14 to #10</u>	<u>CAB-133-1H</u>
<u>6"</u>	<u>Cast/Ductile Iron</u>	<u>CAHBA-1G-6</u>	<u>CA25XF-19 (Orange Cap)</u>	<u>#12</u>	<u>CAB-133-1H</u>
<u>8"</u>	<u>Cast/Ductile Iron</u>	<u>CAHBA-1G-8</u>	<u>CA25XF-19 (Orange Cap)</u>	<u>#12</u>	<u>CAB-133-1H</u>
<u>12"</u>	<u>Cast/Ductile Iron</u>	<u>CAHBA-1G-12</u>	<u>CA25XF-19 (Orange Cap)</u>	<u>#12</u>	<u>CAB-133-1H</u>
<u>&gt;16"</u>	<u>Cast/Ductile Iron</u>	<u>CAHBA-1G-16</u>	<u>CA25XF-19 (Orange Cap)</u>	<u>#12</u>	<u>CAB-133-1H</u>

- \*2. ~~Clean and wipe bonding area using a clean rag and heat the area until the moisture evaporates from the pipe.~~ Heat interior of mold with a torch enough to evaporate any residual moisture. ~~to dry the mold also.~~ Shake mold cup vigorously until you can hear that the powder inside is well mixed and granular – about 15-20 seconds.

\* ~~Revised Text~~

\*\* ~~Revised Drawing~~



<b>METROPOLITAN UTILITIES DISTRICT</b>	<b>Construction Standard</b>	No:	<b>8.3.3</b>
	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page:	5 of 7
Prepared by: <b>D.J. Satterfield Rich Baird</b>		<u>Supersedes:</u>	<del>1-31- 10</del> 7-2-20
Approved by: <b>Jeff Schevane James Bartels</b>		Effective:	7-2-20

- \*3. Place the Cadweld ADWELD Plus LUS Cup into the mold. The ignition strip and termination clip should be positioned perpendicular to the opening in the mold cover to minimize exposure to the reaction. (NOTE: Ensure that the CADWELD adweld PLUS lus Cup and mold are specific to the pipe being welded to.)
- \*4. On the bottom of the mold, center the copper sleeve and connector wire in the bonding area parallel to the pipe. The mold should fit tightly on top of the main to ensure that the weld metal does not leak out. Pack Cadweld Mold Sealer around the mold if a tight fit is not otherwise possible.
- \*5. Place the mold over the connector wire and hold firmly in an upright position. See Fig 38. The clip on the side of the mold may be used to hold the wire in place. Fig 49 shows the bottom view of the mold centered over the connector wire end.

\*\*\*

FIG 8

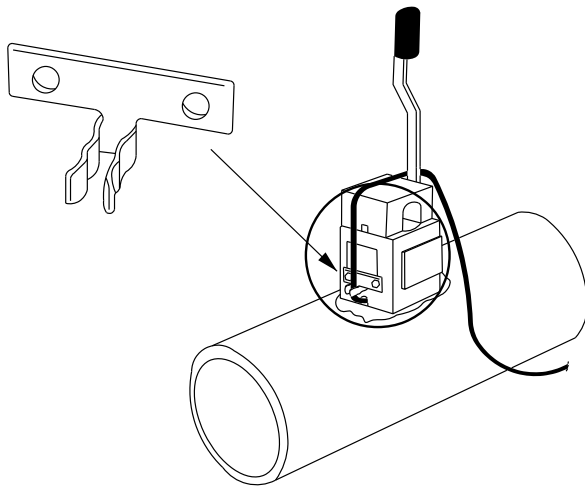
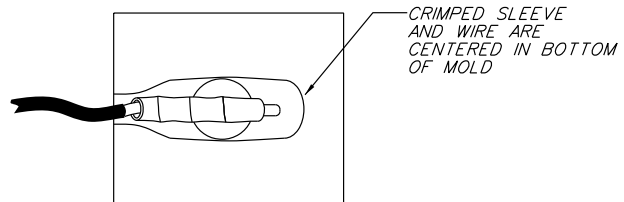


FIG 9 - BOTTOM VIEW OF  
CADWELD PLUS MOLD



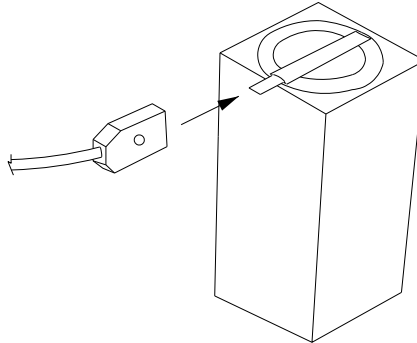
- \*6. **Warning:** Always wear protective eyewear and gloves during operation. Be sure OPERATE switch is not being pressed during insertion of ignition strip into Control Unit termination clip.

- 6. Connect the Control Unit termination clip to the CADWELD adweld PLUS lus cup ignition strip. See Fig 510. Push the Control Unit termination clip onto the CADWELD adweld PLUS lus cup ignition strip until the end of the termination clip is flush with the black line on the ignition strip. Make sure ignition strip is fully seated inside termination clip. A slight “snap” should be felt.

\*\*\*

<b>METROPOLITAN UTILITIES DISTRICT</b>	<b>Construction Standard</b>	No: <b>8.3.3</b>
	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page: 6 of 7
Prepared by: <b>D.J. Satterfield Rich Baird</b>		<del>Supersedes: 1-31- 107-2-20</del>
Approved by: <b>Jeff Schevane James Bartels</b>		Effective: <b>7-2-20</b>

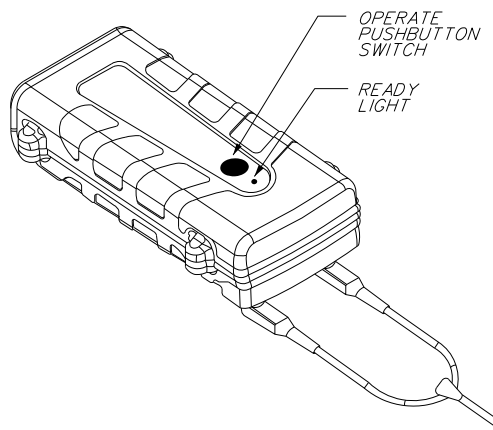
FIG 10 - CONNECTING CONTROL UNIT



\*  Revised Text  
 \*\*\*  New Drawing

- \*7. Press the OPERATE pushbutton switch and hold down with constant pressure. The READY light flashes 5 to 7 times as the Control Unit charges. *Note: If the READY light flashes 12 times or more, the batteries must be replaced.* Once the unit is fully charged, the READY light becomes steady. Initiation of the reaction occurs one second after the READY light is on steady. Maintain constant pressure on the OPERATE switch until the reaction has been initiated. Letting go of the switch before reaction initiation will result in an internal discharge without ignition of the welding material. See Fig [611](#).

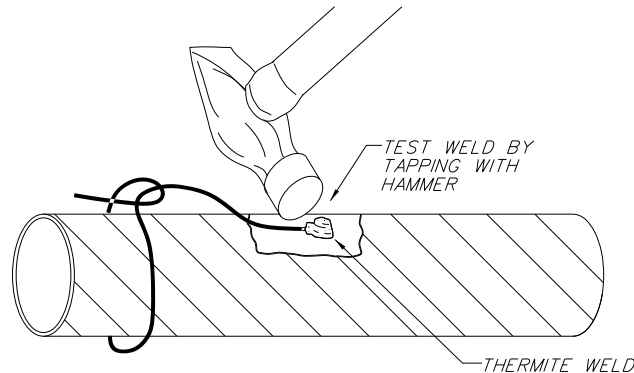
FIG 11



- \*\*8. Allow 30 seconds for the completion of the reaction and the solidification of the molten metal. Remove used Control Unit ignition strip from Control Unit termination clip.
- \*\*\*
- \*\*9. Remove the mold and clean the slag from the inside and bottom of the [mold crucible](#). Check the connection by tugging on the connector wire and tapping the weld with a hammer or other suitable tool as in Fig 12.

<b>METROPOLITAN UTILITIES DISTRICT</b>	<b>Construction Standard</b>	No: <b>8.3.3</b>
	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page: 7 of 7 <del>Supersedes: 4-31- 107-2-20</del>
Prepared by: <del>D.J. Satterfield</del> Rich Baird		Effective: 7-2-20
Approved by: Jeff Schevane James Bartels		

FIG 12



- \*10. Once a successful connection is made, cover the bonding area and connection with Patch-Pad Exothermic Weld Protector, bitumastic coating or apply primer and cold wrap according to Construction Standard [8.5.2](#).

\* ~~Revised Text~~

\*\* ~~Added Text~~

\*\*\* ~~New Drawing~~

**\*ATTACHING ANODES TO CAST IRON OR DUCTILE IRON PIPE USING THE CATHODI-CLAMP® (CADWELD PLUS SHALL BE USED UNLESS FIELD CONDITIONS DO NOT PERMIT)**

\*\*\*\*

**Materials:**

Cathodi-Clamp®

32# anode

Wire connector

**Tools:**

Wire brush

Socket or wrench

Continuity tester

*Note: For cast iron or ductile iron mains larger than 18", contact the Corrosion Engineer.*

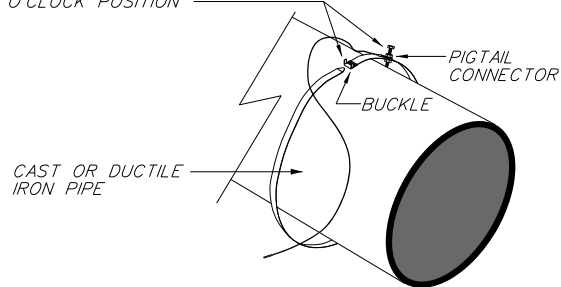
**Installation of Cathodi-Clamp®**

- \*1. Clean around the pipe surface with a wire brush to remove rust scale and dirt, so the band will lay flat against the pipe. For ductile iron pipe, remove the factory coating and file to smooth the surface where the pigtail connector bolt will contact the pipe surface.
2. Wrap the band around the pipe with wire pigtail and connector bolt at the 12 o'clock position. See Fig [713](#).

<b>METROPOLITAN UTILITIES DISTRICT</b>	<b>Construction Standard</b>	No: <b>8.3.3</b>
	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page: 8 of 7
Prepared by: <b>D.J. Satterfield</b> <b>Rich Baird</b>		<u>Supersedes:</u> <del>1-31- 107-2-20</del>
Approved by: <b>Jeff Schevane</b> <b>James Bartels</b>		Effective: <b>7-2-20</b>

FIG 13

WRAP THE CATHODI-CLAMP AROUND THE PIPE  
WITH THE PIGTAIL CONNECTOR AND BUCKLE  
AT THE 12 O'CLOCK POSITION



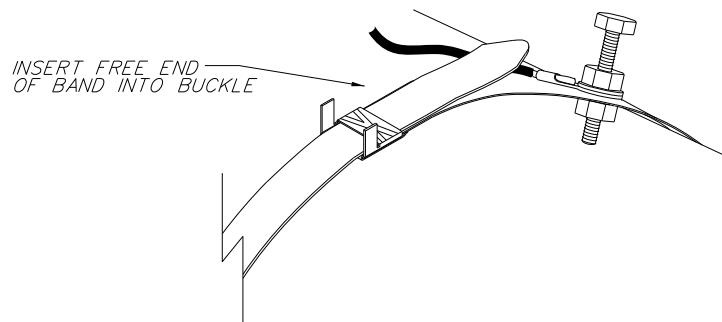
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Revised Text

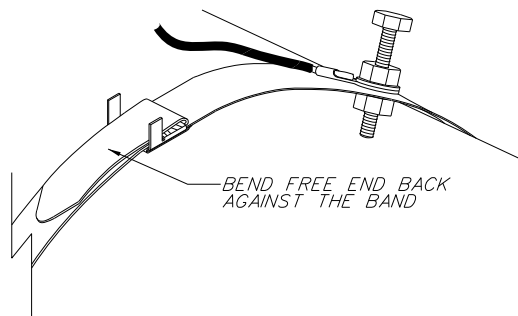
- 3 Insert the free end of band into buckle, as shown in Fig ~~8~~14, making sure band is resting flat against pipe surface.

FIG 14



- 4 Pull on free end to place band in slight tension around pipe.
- 5 Bend free end back against inside edge of buckle to hold band securely to pipe. See Fig ~~9~~15.

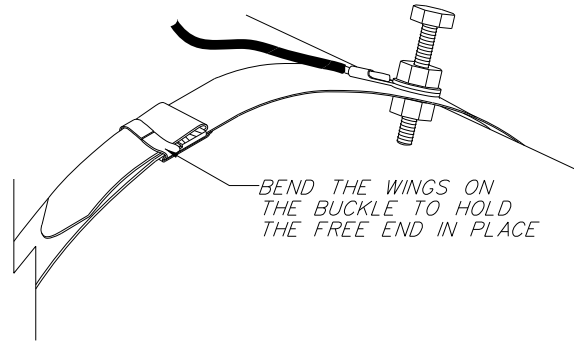
FIG 15



- 6 Lightly strike fastener "wings" of buckle with mallet or hammer holding free end in place as shown in Fig ~~10~~16.

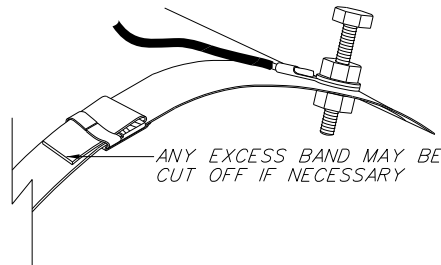
<b>METROPOLITAN UTILITIES DISTRICT</b>	<b>Construction Standard</b>	No:	<b>8.3.3</b>
	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page:	9 of 7
Prepared by: <b>D.J. Satterfield Rich Baird</b>		<u>Supersedes:</u>	<del>1-31- 10</del> 7-2-20
Approved by: <b>Jeff Schevane James Bartels</b>		Effective:	7-2-20

FIG 16



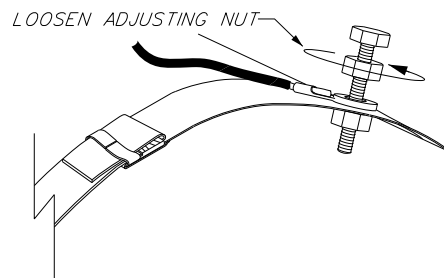
7. Excess length of free end of band may be cut with snips (Fig 17) or may remain in place.

FIG 17



8. Loosen the adjusting nut on the top of the band. See Fig 18.

FIG 18

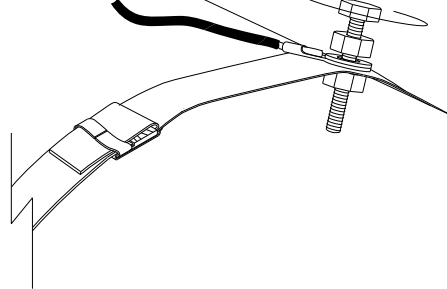


9. Using socket or wrench, hand tighten the hex cap bolt to draw the band tight around the pipe. See Fig 19.

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FIG 19

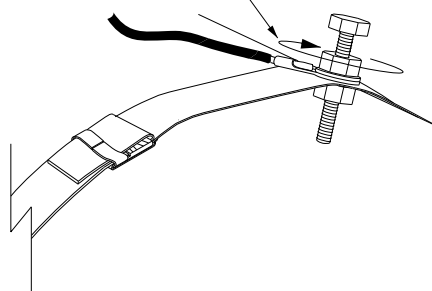
TIGHTEN HEX BOLT TO DRAW BAND TIGHT AROUND PIPE. DO NOT OVER TIGHTEN.



10. Hand-tighten the adjusting nut on the top of the band – do not over-tighten the bolt or nut. See Fig [1420](#).

FIG 20

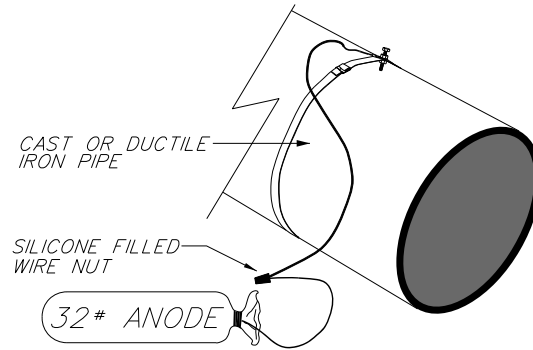
TIGHTEN THE ADJUSTING NUT. DO NOT OVER TIGHTEN NUT.



- \*11. Verify continuity with continuity tester, one end attached to copper end of wire pigtail, the other end contacting the pipe. **Note:** *If there is no continuity, make sure that pipe surface at contact is clean; tighten hex bolt cap ¼ turn at a time until continuity is established.*
12. Place a 32# anode in the ditch; remove 1” of insulation from the end of anode wire, exposing the copper.
13. Hold anode wire end and Cathodi-Clamp® pigtail end together with ends even.
14. Screw on connector, pushing wires firmly through the pie shaped cap. No copper wire should be left exposed outside of the connector cap. See Fig [1521](#).

<b>METROPOLITAN UTILITIES DISTRICT</b>	<b>Construction Standard</b>	No: <b>8.3.3</b>
	<b>Trace Wire, Anode and Test Lead Attachment Methods For Steel, Ductile Iron And Cast Iron Water Mains</b>	Page: 11 of 7
Prepared by: <b>D.J. Satterfield Rich Baird</b>		<u>Supersedes:</u> <del>1-31- 10</del> <b>7-2-20</b>
Approved by: <b>Jeff Schevane James Bartels</b>		Effective: <b>7-2-20</b>

FIG 21



\*



Revised Text