7. Cathodic Protection
CATHODIC PROTECTION SYSTEM DRAWINGS

DWD C1  Wenner Four Pin Resistivity Test
DWD C2  Barnes Layer Resistivity
DWD C3  Soil Box Resistivity Test
DWD C4  Bond Cables – Metallic Pipe Joints
DWD C5  Bond Cables – Across Fittings on Metallic Pipe
DWD C6  Exothermic Weld
DWD C7  Flush Grade Test Station
DWD C8  CTS – Corrosion Test Station
DWD C9  IJTS – Insulating Joint Test Station
DWD C10 FPTS – Foreign Pipeline Test Station
DWD C11 ATS – Anode Test Station
DWD C12 CATS – Casing Test Station
DWD C13 VATS – Valve Anode Test Station
DWD C14 Valve and Tee Anode Test Station
DWD C15 Fire Hydrant
DWD C16 Metallic Riser
DWD C17 Cross and Valves
DWD C18 Elbow
DWD C19 Double Detector Check Assembly Preventer or Reduced Pressure Backflow Preventer
DWD C20 Double Offset
DWD C21 Cable Identification
DWD C22 Anode at Leak Repair Clamp
DWD C23 Insulating Flange Kit
DWD C24 Copper Water Laterals
DWD C25 Splice Detail
DWD C26 Galvanic Cathodic Protection System Checkout
DWD C27 Impressed Current Cathodic Protection System Checkout (page 1)
DWD C28 Impressed Current Cathodic Protection System Checkout (page 2)
DWD C29 Leak Repair Report
EQUALLY SPACED STEEL PINS IN STRAIGHT LINE CONFIGURATION

RESISTANCE MEASURING INSTRUMENT

WHERE $D =$ SAMPLE DEPTH.

VOLUME OF SOIL INCLUDED IN RESISTANCE MEASUREMENT
VOLUME OF SOIL WITH RESISTANCE $R$ AND RESISTIVITY $\rho$.

VOLUME OF SOIL WITH RESISTANCE $r$ AND RESISTIVITY $\rho$.

GRADE (TYP)

LAYER OF SOIL WITH RESISTIVITY $\rho = \left( \frac{1}{R} - \frac{1}{r} \right) \times \text{(SPACING FACTOR)}$. 
**FLANGED JOINT**

SEE NOTE 18" MINIMUM LENGTH

EXOTHERMIC WELD (TYP)  
SEE DWD C6

**PUSH-ON JOINT**

SEE NOTE 18" MINIMUM LENGTH

EXOTHERMIC WELD (TYP)  
SEE DWD C6

**MECHANICAL JOINT**

SEE NOTE: 24" MINIMUM LENGTH

#8 AWG BOND CABLE

EXOTHERMIC WELD (TYP)  
SEE DWD C6

CAST IRON OR STEEL COUPLING  
EPoxy COATED

**FLEXIBLE COUPLING**

NOTE:
1. USE #8 AWG/HMWPE BOND CABLES FOR BONDING METALLIC FITTINGS ON NON-METALLIC PIPING SYSTEMS.
2. USE #4 AWG/HMWPE BOND CABLES FOR BONDING PIPE JOINTS ON METALLIC PIPING SYSTEMS PER SPECIFICATIONS.
NOTE:
1. ALL BOND 'B' WIRES SHALL BE #4 AWG/HMWPE STRANDED COPPER WIRE.
2. ALL FITTING BOND WIRES 'A' SHALL BE #8 AWG/HMWPE STRANDED COPPER WIRE.
3. USE ONE (1) BOND CABLE 'B' ACROSS EACH FITTING FOR PIPE SIZES 18” IN DIAMETER OR SMALLER.
4. USE TWO (2) BOND CABLES 'B' ACROSS EACH FITTING FOR PIPE SIZES 20” IN DIAMETER OR LARGER.
**STEP 1.** FILE STRUCTURE CONNECTION AREA TO BARE SHINY METAL AND CLEAN.

**STEP 2.** STRIP INSULATION FROM WIRE. ATTACH SLEEVE REQUIRED ON #6 AWG WIRE OR SMALLER

**STEP 3.** HOLD MOLD FIRMLY WITH OPENING AWAY FROM OPERATOR AND IGNITE WITH FLINT GUN.

**STEP 4.** REMOVE SLAG FROM CONNECTION AND PEEN WELD FOR SOUNDNESS.

**STEP 5.** SPRAY PRIMER ON BARE METAL.

**STEP 6.** COVER CONNECTION AND EXPOSED STRUCTURE SURFACE WITH PLASTIC CAP & BITUMASTIC

**NOTE:**
PROCEDURE SHOWN ABOVE IS TO BE USED AS A GENERAL GUIDE ONLY. CONSULT MANUFACTURER’S LITERATURE FOR SPECIFIC INSTALLATION INSTRUCTIONS.
NOTES:
1. INSTALL 2" PVC PIPE IN CLEAN NATIVE SOIL. FILL PIPE WITH CLEAN SOIL, FREE FROM ROCKS & DEBRIS.
2. INSTALL 18" LENGTH OF 3/4" PVC PIPE TO ENSURE THAT THE TERMINAL BOX WILL REMAIN IN THE UPRIGHT POSITION. POSITION THE PIPE SO THAT THE TERMINAL BOX WILL BE AS HIGH AS POSSIBLE WITH THE CAST IRON LID STILL CLOSING PROPERLY.
CTS TERMINAL BOX

NOTE:
IDENTIFY CABLES PER DRAWING DWD C21.

DIABLO WATER DISTRICT  STANDARD DRAWING
CTS - CORROSION TEST STATION

DESIGNED  MA  DRAWN  SC  APPROVED  JDH  DATE  DECEMBER 2013  DWG. NO. DWD C8
**IJTS TERMINAL BOX**

- **(2) #10 AWG/THHN TEST CABLES**
  - WHITE – PROTECTED
  - RED – UNPROTECTED

- **(2) #8 AWG/THHN BOND CABLES**
  - WHITE – PROTECTED
  - RED – UNPROTECTED

**CABLE IDENTIFICATION**

SEE DWD C21

---

**NOTE:**
IDENTIFY CABLES PER DRAWING DWD C21.
(1) #10 AWG/THHN TEST CABLE (RED) TO FOREIGN PIPE

NICKEL-PLATED BRASS BINDING POST W/BRASS SET SCREW (TYP)

(1) #10 AWG/THHN TEST CABLE (WHITE) TO PROTECTED PIPE

(1) #8 AWG/THHN BOND CABLE (WHITE) TO PROTECTED PIPE

(1) #12 AWG/THHN REF. CELL CABLE (YELLOW)

(2) #10 AWG/THHN ANODE CABLES (BLACK)

TERMINAL BOX (COVER NOT SHOWN FOR CLARITY)

COPPER BONDING STRAP

FPTS TERMINAL BOX

TERMINAL BOX SEE ABOVE

TEST STATION SEE DWD C7

(1) #12 AWG/THHN REF. CELL CABLE (YELLOW)

(2) #10 AWG/THHN-USE ANODE CABLES (BLACK)

#10 & #8 AWG/THHN CABLES (RED)

FOREIGN PIPELINE

PROTECTED PIPELINE

EXOTHERMIC WELD (TYP) SEE DWD C6

12"(TYP.)

Cu/CuSO4 REFERENCE CELL

ANODE

NOTES:
1. IDENTIFY CABLES PER DRAWING DWD C21.
2. INSTALL THE REFERENCE CELL BETWEEN THE TWO PIPELINES.
3. PERMISSION MUST BE OBTAINED FROM THE FOREIGN PIPELINE OWNER PRIOR TO ATTACHMENT OF TEST WIRES.
ATS TERMINAL BOX

NOTES:
1. NUMBER AND SIZE OF ANODES SHALL BE DETERMINED BY THE PROJECT CORROSION ENGINEER.
2. THE ANODES SHALL BE INSTALLED A MINIMUM OF 3 FT. OFF THE WALL OF THE WATER PIPE.
3. BOND ALL PIPE JOINTS PER DRAWING DWD C6.
4. IDENTIFY CABLES PER DRAWING DWD C21.
CATS TERMINAL BOX

NOTE:
1. NUMBER AND SIZE OF ANODES SHALL BE DETERMINED BY THE PROJECT CORROSION ENGINEER.
2. CARRIER PIPE & CASING ARE TO BE ELECTRICALLY ISOLATED VIA CASING INSULATORS.
3. IF CARRIER PIPE IS NON–METALLIC DELETE WHITE CABLES AND EXOTHERMIC WELDS.
4. BOND ALL PIPE JOINTS PER DRAWING DWD C6.
5. IDENTIFY CABLES PER DRAWING DWD C21.
ATS TERMINAL BOX

NOTE:
1. Install anode a minimum of 3-feet from valve.
2. Identify cables per drawing DWD C21.
ATS TERMINAL BOX

EXOTHERMIC WELD (TYP)
SEE DWD C6

NONMETALLIC PIPE

PLAN

TERMINAL BOX
SEE ABOVE

TEST STATION
SEE DWD C7

3/4" PVC CONDUIT

VALVE STEM CASING

#10 AWG/THHN (WHITE)
TEST & DRAIN CABLE

#8 AWG BOND CABLE

#10 AWG/THHN (BLACK)
ANODE CABLE

NONMETALLIC PIPE

PROFILE

NOTES:
1. INSTALL ANODE A MINIMUM OF 3- FEET FROM THE VALVE & TEE.
2. IDENTIFY ALL CABLES PER DRAWING DWD C21.

DIABLO WATER DISTRICT  STANDARD DRAWING
VALVE AND TEE ANODE TEST STATION

DESIGNED MA  DRAWN SC  APPROVED JDH  DATE DECEMBER 2013  DWG. NO. DWD C14
NOTES:
1. IDENTIFY ALL CABLES PER DRAWING DWD C21.
2. INSTALL TEST STATION IN COMMON CONCRETE SLAB WITH F.H. RISER.

DIABLO WATER DISTRICT

STANDARD DRAWING

FIRE HYDRANT

| DESIGNED | MA | DRAWN | SC | APPROVED | JDH | DATE          | DECEMBER 2013 | DWG. NO. | DWD C15 |
ATS TERMINAL BOX

INSTALL INSULATING FLANGE KIT DWD C25

TERMINAL BOX SEE ABOVE

TEST STATION SEE DWD C7

#10 AWG/THHN (WHITE) TEST & DRAIN CABLE

METALLIC RISER

EXOTHERMIC WELD (TYP) SEE DWD C6

#8 AWG BOND CABLE

#10 AWG/THHN (BLACK) ANODE LEAD CABLE

METALLIC FITTING

NONMETALLIC PIPE

NOTE:
1. IDENTIFY ALL CABLES PER DRAWING DWD C21.

DIABLO WATER DISTRICT

STANDARD DRAWING METALLIC RISER

DESIGNED MA DRAWN SC APPROVED JDH DATE DECEMBER 2013 DWG. NO. DWD C16
ATS TERMINAL BOX

TEST STATION (SEE DWD C7) & TERMINAL BOX (SEE ABOVE)

#8 AWG BOND CABLE (TYP)

NONMETALLIC PIPE

#10 AWG/THHN (WHITE) TEST & DRAIN CABLE

NONMETALLIC PIPE

VALVE (1 TO 4 TYP)

EXOTHERMIC WELD (TYP) SEE DWD C6

#10 AWG/THHN (BLACK) ANODE CABLE

NONMETALLIC PIPE

ANODE

3'

PLAN

NOTE:
1. IDENTIFY ALL CABLES PER DRAWING DWD C21.
ATS TERMINAL BOX

TERMINAL BOX (COVER NOT SHOWN FOR CLARITY)

#10 AWG/THHN (WHITE) TEST & DRAIN CABLES

NICKEL-PLATED BRASS BINDING POST W/BRASS SET SCREW (TYP)

0.01 OHM-6 AMP SHUNT

#10 AWG/THHN (BLACK) ANODE CABLE(S)

CABLE IDENTIFICATION SEE DWD C21

EXOTHERMIC WELD (TYP) SEE DWD C6

#8 AWG BOND CABLE

METALLIC ELBOW

TEST STATION (SEE DWD C7) & TERMINAL BOX (SEE ABOVE)

(2) #10 AWG THHN (WHITE) TEST LEADS

ANODE

#10 AWG THHN (BLACK) ANODE CABLE

NONMETALLIC PIPE (TYP)

PLAN

NOTE:
1. IDENTIFY ALL CABLES PER DRAWING DWD C21.
ATS TERMINAL BOX

NOTES:
1. INSTALL ANODE A MINIMUM OF 3—FEET FROM RISER.
2. IDENTIFY ALL CABLES PER DRAWING DWD C19.

DIABLO WATER DISTRICT

STANDARD DRAWING
DOUBLE DETECTOR CHECK ASSEMBLY PREVENTER
OR REDUCED PRESSURE BACKFLOW PREVENTER

DESIGNED _______ MA _________ DRAWN _______ SC _________ APPROVED _______ JDH _________ DATE ___________ DECEMBER 2013 _________ DWG. NO. _______ DWD C19
NOTE:
1. THIS DETAIL MAY BE USED FOR ALL UNDERGROUND SECTIONS OF DUCTILE IRON PIPE INCLUDING CROSSING UNDER OR OVER A PIPE, BRIDGE AND SHORT RUNS OF DUCTILE IRON PIPE. IN ALL CASES A MINIMUM OF ONE ANODE SHALL BE INSTALLED ON EACH END OF A DUCTILE IRON PIPE SEGMENT.
2. THE ANODE SHALL BE INSTALLED VERTICALLY OR HORIZONTALLY WITH THE TOP OF THE ANODE 5 FT. BELOW GRADE AND 3 FT. BELOW PIPE.
3. THE BOND CABLES MAY NOT BE REQUIRED IF IT IS DETERMINED DURING TESTING THAT THE DUCTILE IRON PIPE SEGMENT IS ELECTRICALLY CONTINUOUS FROM END TO END.

DIABLO WATER DISTRICT

STANDARD DRAWING
DOUBLE OFFSET

DESIGNED MA DRAWN SC APPROVED JDH DATE DECEMBER 2013 DWG. NO. DWD C20
PERMANENT NYLON MARKING TAG

WIRE INSULATION STRIPPED TO FIT TERMINAL BINDING POST

W-6

ABBREVIATIONS
AN - ANODE
BO - BLOW OFF
CA - CASING
DR - DRAIN CABLE
DW - DOMESTIC WATER
EL - ELBOW
FH - FIRE HYDRANT
FP - FOREIGN PIPELINE
RE - REFERENCE ELECTRODE
RW - RAW WATER

NUMBER
PIPE DIA. (INCHES)
#10 AWG THHN (BLACK) ANODE LEAD CABLE WRAPPED AROUND MAIN

CONNECT WIRE TO COUPLING BOLT USING CRIMP ON LUG

STAINLESS STEEL LEAK REPAIR CLAMP

EXISTING METALLIC MAIN

ANODE

2' MIN

5' MAX

NOTES:
1. INSTALL ANODE A MINIMUM OF 2-FEET BELOW PIPE DEPTH IN NATIVE SOIL.
2. MAXIMUM HORIZONTAL DISTANCE FROM ANODE TO LEAK REPAIR CLAMP IS 5-FEET.
BELOW GRADE INSULATING JOINT COATING

ABOVE GRADE INSULATING JOINT COATING

NOTE:
1. Gasket shall be for water service and be of the same pressure rating as the flange.
NOTES:
1. IF WATER MAIN IS METALLIC, PLACE INSULATING COUPLING BETWEEN COPPER WATER LATERAL AND WATER MAIN.
2. MAINTAIN A MINIMUM CLEARANCE OF 2 FEET BETWEEN THE ANODE AND THE LATERAL.
3. TOP OF ANODE SHALL BE 5 FEET MINIMUM FROM THE GROUND SURFACE.
## Galvanic Cathodic Protection System Checkout

**DIABLO WATER DISTRICT**

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<th>Station</th>
<th>Anode Potential (mV)</th>
<th>Structure Potential Disconnected (mV)</th>
<th>Structure Potential Connected (mV)</th>
<th>Shift in Potential (mV)</th>
<th>Shunt Measurement (A)</th>
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DIABLO WATER DISTRICT
Impressed Current Cathodic Protection System Checkout

Date: ____________  Data Sheet No. ____________
Job. No. ____________  Job Title: ______________________
Rectifier No. ____________  Location: ______________________
Engr.: ____________  Structure: ______________________

RECTIFIER DATA:

Input (AC): ____________  Volts: ____________  Amps: ____________
Phase: ____________  Cycles: ____________
Rated Output (DC): ____________  Volts: ____________  Amps: ____________
Coarse: ____________  Fine: ____________
Date Energized: ____________

DC OUTPUT:

By Panel Meter: Volts: ____________  Amps: ____________
By Volt Meter: Volts: ____________  Amps: ____________
Shunt Potential Measured: ____________
Shunt Rating: Amps: ____________  per mV: ____________
Current Calculated: ____________ Amps

ANODE DATA:

Anode Description: ________________________  No. ________
Size: ____________ X ____________ Long ________  Lbs. ________
Shunt Rating: ____________ mV

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<th>Anode No.</th>
<th>Reading (mV)</th>
<th>Amps</th>
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DWD C27
## DIABLO WATER DISTRICT
### Impressed Current Cathodic Protection System Checkout

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<th>Station</th>
<th>Structure Potential Rectifier &quot;On&quot; (mV)</th>
<th>Structure Potential Rectifier &quot;Off&quot; (mV)</th>
<th>Comments</th>
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Date: ___________________________  Data Sheet No. ________________

Job. No. ________________________  Job Title: ________________________

System No.: __________  Location: ________________________

Engr.: ________________________  Structure: ________________________

DWD C28
Date: ___________________________  Data Sheet No.  ______
Job. No. ___________________________  Location: ___________________________

Structure Description:  Type of Pipe: ______________________________________
Pipe Diameter: ______________________________________
Year Installed: ______________________________________
Internal Lining: ______________________________________
Exterior Coating: ______________________________________
Polywrap: ______________________________________
Cathodic Protection: ___________________________  Yes: ________  No: ________

What Part of the Main was damaged? ______________________________________

Describe the Leak: Approximate Size: ______________________________________
Orientation on Pipe: ______________________________________
Photographs: ___________________________  Yes: ________  No: ________

Describe backfill around pipe: ______________________________________

Does damage appear to be mechanical or corrosion related? ___________________________

What type of corrosion damage: _______ No corrosion damage
_________ Pitting
_________ General corrosion
_________ Graphitized cast or ductile iron (looks okay but cuts easily)

If corrosion related, collect soil sample for chemical analysis!

Describe the condition of the pipe adjacent to the failure: __________________________

Describe repairs made: ______________________________________

Materials used: ______________________________________