

28 JULY 1995

BRISBANE CITY COUNCIL  
DEPARTMENT OF WATER SUPPLY AND SEWERAGE  
MECHANICAL AND ELECTRICAL BRANCH  
ELECTROLYSIS SECTION  
EAGLE FARM PUMPING STATION

OPERATING MANUAL  
BILSEN ROAD, GEEBUNG

CATHODIC PROTECTION SYSTEM.

CLIENT:

DEPARTMENT OF WATER SUPPLY AND SEWERAGE  
WATER OPERATIONS BRANCH

## MANUAL CONTENTS

(1.0)	Introduction
(2.0)	Corrosion and Cathodic Protection
(3.0)	Mains Details
(4.0)	Cathodic Protection
(4.1)	Type of System
(4.2)	Cathode
(4.3)	Anodes
(4.4)	Test Points
(4.5)	Associated Drawings
(4.6)	Associated Standards
(4.7)	Government Regulations
(5.0)	Performed Testing
(6.0)	Conclusion
(7.0)	Maintenance

## DRAWINGS

(No Number)	Maintenance Program.
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## **(1.0) INTRODUCTION**

Steel when immersed or covered in water has a tendency to corrode (or rust) as the oxidized form is more stable than the metal.

Because of this, precaution must be taken to stop or minimize the corrosion reaction to an acceptable level consistent with the design life of the structure. This is normally achieved by the use of protective coatings which control the corrosion reaction by isolating the steel from its surrounding environment.

However, it is not practical to achieve a perfect coating and coating damage will always occur with time. Because of this, corrosion may occur at imperfections in the paint coating, causing further deterioration in the coating as well as loss of metal.

As a result of this, the coating defects must be rectified by periodic maintenance or an additional method of protection used to prevent this deterioration and corrosion occurring. This additional protection is achieved by the cathodic protection system.

## **(2.0) CORROSION AND CATHODIC PROTECTION**

Corrosion is an electrochemical process in that it is accompanied by a flow of electrical current.

Corrosion occurs on the surface of metals at active areas known as anodes, which are electrically continuous with less active or passive areas known as cathodes. The electric current flows from the anode through the electrolyte to the cathode, with the circuit being completed by the electrical continuity between the cathode and anode. In practice anodes and cathodes are generally part of the same metallic surface and individual anodic areas may be small.

In applying cathodic protection and external current is applied to the surface so that the entire surface to be protected acts as a cathode. This involves the use of an auxiliary anode and when the current flow from this anode is sufficient, no part of the structure acts as an anode.

While it is the flow of current which achieves the cathodic protection of the surface it is impractical to measure these currents over individual anodic areas to determine when cathodic protection has been achieved. However, with the flow of cathodic protection current, the structure becomes more negative with respect to the surrounding electrolyte. Because of this, it is possible to state values of metal/electrolyte potential at which corrosion does not occur. This metal/electrolyte potential is generally measured against a standard reference electrode which allows a reproducible potential at which corrosion does not occur to be quoted.

(3.0) **MAINS DETAILS**

Size: Dia 300 mild steel cement lined.

Coating: Low density fusion bonded polyethylene outer coating.

Length: approx 38m

Location: CSR Office Building, cnr Bilsen and Ellison Roads Geebung

Construction

Drawings: Not Available

Number N.A

Title W.S. Improvement

Project 317 Bilsen Road Geebung

(4.0) **CATHODIC PROTECTION DETAILS**

(4.1) Type of Cathodic Protection: Sacrificial (Galvanic) System.

(4.2) Cathode: The cathode point is located on the 300 dia. main approx 1metre from the office building on the Bilsen Road side. The cathode point is where the cabling from the sacrificial anode is attached to the structure under cathodic protection.

(4.3) Anodes: One 20 Kg Magnesium anode was installed approximately 4 metres from the trunk mains in a vertical bed. The anodes were firstly packaged with gypsum/bentonite thereby improving anode to ground resistance. The anodes are identified by a marker pit and label. Refer dwg no 2/14.213.

(4.4) Test Points: Test points are installed on cathodically protected structures to enable testing to ensure full protection of the mains. On these mains two test points have been installed for details see dwg no 2/14.213.

(4.5) Associated Drawings:  
Cathodic Protection Details – 2/14.213  
Cathodic Protection Test Point Details – 2/14.199

(4.6) Associated Standards:  
AS 3000 1986 Australia Wiring Rules  
AS 2832.1 1985 Pipes, Cables, Ducts, Guide to Cathodic Protection,  
Part One.

(4.7) Government Regulations:  
Queensland Electricity Acts and Regulations.

**(5.0) PERFORMED TESTING**

- (1) Natural Potential Survey.
- (2) Testing of Insulated Flanges, Joints.
- (3) Soil Resistance Testing.
- (4) Current Drain Survey.
- (5) Pipe Coating Anomaly Survey.
- (6) Foreign Structure Interference Survey and Mitigation.
- (7) Final Potential Survey and Commissioning.

**NOTE:** Details of above testing have not been included in this manual but are available upon request.

**(6.0) CONCLUSION**

Full Cathodic protection has been achieved on this section of trunk mains. The cathodic protection system is registered with the Queensland Electricity Commission and has approval to operate.

**(7.0) MAINTENANCE**

The cathodic protection system is maintained on a 6 monthly basis after commissioning. These checks involve testing rectifier operation and recording of pipe to soil potentials.

13th October 1992  
Electrical Workshop  
Cathodic Protection

### CPS 6 Monthly Maintenance Details.

#### Required:

- 1/ Notify plant operator and/or sign entry logs where necessary.
- 2/ Have appropriate keying.
- 3/ Set of tools. (Electricians)
- 4/ Multimeter.
- 5/ DC clampmeter.
- 6/ Copper sulphate reference cell and leads.
- 7/ Cleaning equipment.
- 8/ Gatic cover lifters.

#### Labour:

One tradesperson electrical, one laborer, one vehicle.  
Two hours per site.

#### Procedure:

- 1/ Identify system.
- 2/ Check system for operation.
- 3/ Record voltmeter.
- 4/ Record ammeter.
- 5/ Record "on" potentials for all test points.
- 6/ Record "instant off" potentials for all test points.
- 7/ Record "off" potentials for all test points.
- 8/ Perform loop resistance and record.
- 9/ Check and record anode string currents.
- 10/ Comments.
- 11/ Log entry.

13th October 1992  
Electrical Workshop  
Cathodic Protection

### CPS 60 Monthly Maintenance Details.

#### Required:

- 1/ Notify plant operator and/or sign entry logs where necessary.
- 2/ Have appropriate keying.
- 3/ Set of tools. (Electricians)
- 4/ Multimeter.
- 5/ DC clampmeter.
- 6/ Copper sulphate reference cell and leads.
- 7/ Cleaning equipment.
- 8/ Gatic cover lifters.
- 9/ Rectifier load bank.
- 10/ PCS2000 Detection Equipment.

#### Labour:

One tradesperson electrical, one laborer, one vehicle.  
Eight hours per site.

#### Procedure:

- 1/ Identify system.
- 2/ Check system for operation.
- 3/ Record voltmeter.
- 4/ Record ammeter.
- 5/ Record "on" potentials for all test points.
- 6/ Record "instant off" potentials for all test points.
- 7/ Record "off" potentials for all test points.
- 8/ Perform loop resistance and record.
- 9/ Check and record anode string currents.
- 10/ Load test rectifier for 10 minutes.
- 11/ Check all switchboard and testpoint terminals for tightness.
- 12/ Check all switchboard and testpoints are labelled and I.D. tags attached.
- 13/ Check plans are correctly drawn and modify if necessary.
- 14/ Remove and inspect anodes.
- 15/ Recheck all interference (CPS) bleeds.
- 16/ Pipecamp structure if applicable.
- 17/ Apply for "continue to operate" permit if applicable.



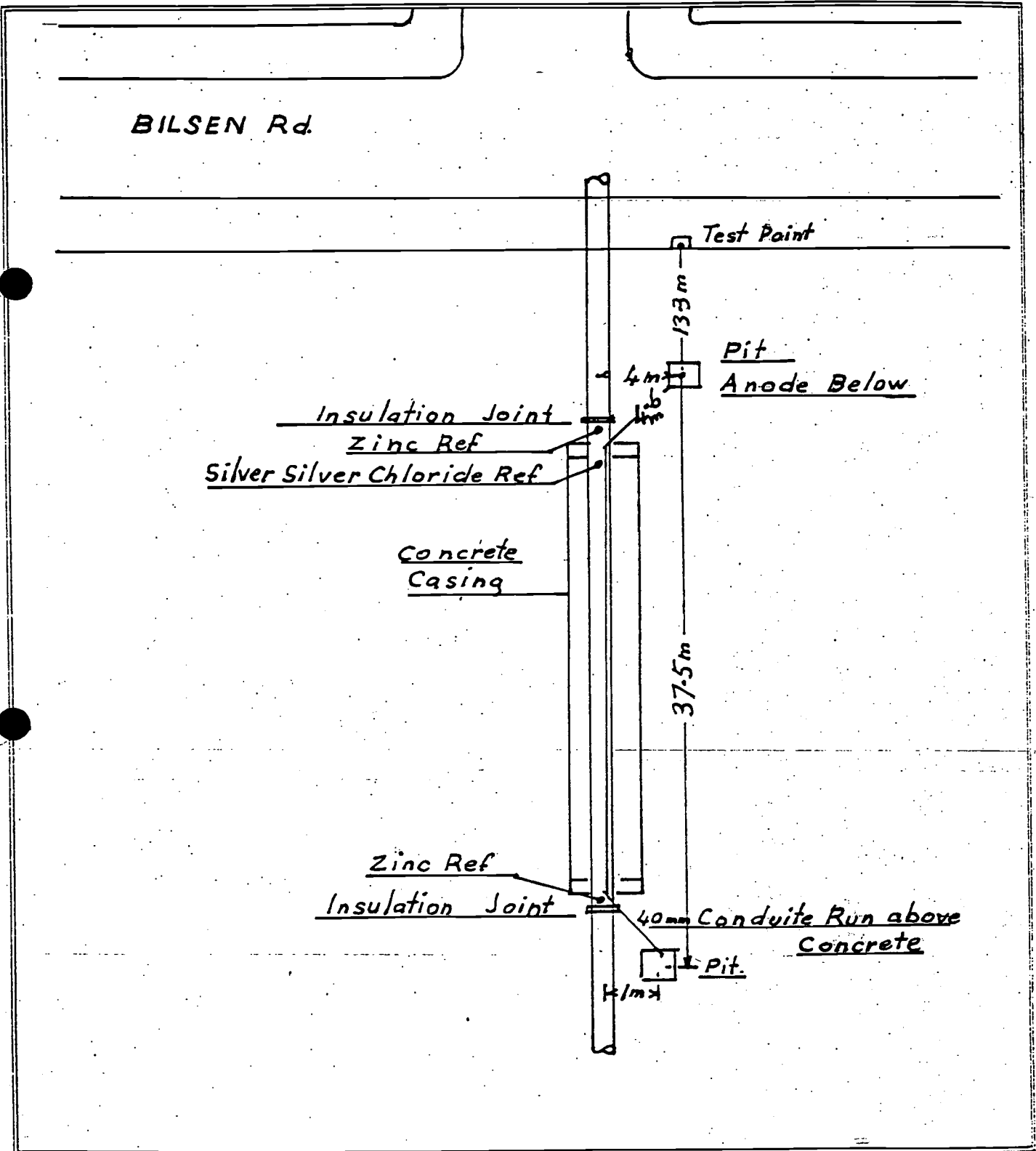
To	File No.	
From	Date 17/11/94	
Subject <i>Bilsen Rd opp Ellison Rd</i> <i>CPS 133 Sacrificial SYS</i>		

<i>Polarized 7 days</i>	<i>Depolarized 7 days</i>
<i>Cu SO<sub>4</sub> - Pipe - 1420 mV</i>	<i>-486 mV</i>
<i>Cu SO<sub>4</sub> Zn Far - 1182 mV</i>	<i>-1183 mV</i>
<i>Zn Far - Pipe - 242 mV</i>	<i>+697 mV</i>
<i>Cu SO<sub>4</sub> - Pipe - 1452 mV</i>	<i>-487 mV</i>
<i>Cu SO<sub>4</sub> - Zn Near - 1103 mV</i>	<i>-1111 mV</i>
<i>Zn Near - Pipe - 347 mV</i>	<i>+628 mV</i>
<i>Anode Current 24 mA on first Connection</i>	
<i>10.8 mA on Polarizing after 7 days</i>	

Brisbane City Council  
 Dept of Water Supply and Sewerage  
 Eagle Farm Pump Station  
 Electrical Workshop

Date: 10 - 11 - 94

Site Plan for: *Bilsen Rd Opp. Ellison Rd*



To	File No.	
From	Date 10/11/94	
Subject <i>Bilsen Rd. Opp Ellison Rd.</i> <i>Initial Readings</i>		

*CuSO<sub>4</sub> - Pipe - 400 mV Natural Potentials*

*- AG Ref - 45 mV*

*- Zn Ref Near - 928 mV*

*- Zn Ref Far - 926 mV*

*Magnesium Anode 13KG Connected*

*CuSO<sub>4</sub> - Pipe - 848 mV*

*- AG Ref - 45 mV*

*- Zn Ref near - 931 mV*

*- Zn Ref Far - 943 mV*

*Anode - Pipe Voltage 1065 mV*

*Anode - Pipe Current 7 mA*

*Disconnected 10 secs Connected 20 Sec*

*A.G Ref - Pipe - 420 mV - 844 mV*

*Zn Near - Pipe + 426 mV + 65 mV*

*Zn Far - Pipe + 429 mV + 32 mV*

*Zn Far - AG Ref + 896 mV + 896 mV*

*Zn Near - AG Ref + 896 mV + 898 mV*

*Isolated Pipe at FH*

*CuSO<sub>4</sub> - Pipe - 457 mV ON - 457 mV OFF*

*Fence - 458 mV ON - 453 mV OFF*

Cathodic Protection System - Bilsen Road Geebung OM Manual  
DEPARTMENT OF WATER SUPPLY AND SEWERAGE  
MECHANICAL AND ELECTRICAL BRANCH  
METROPOLITAN DIVISION  
EAGLE FARM PUMPING STATION

ELECTRICIAL WORKSHOP

INSULATED JOINT TESTING DETAILS:

DATE

9-11-94

DESCRIPTION

MAINS DETAILS:- 300 MCL - 300 C/CCL Water  
LOCATIONS:- Bilsen Rd. opp. ELLISEN Rd. Geebung  
SIZE:- 300  
MATERIAL:-  
COATING:- PVC  
NUMBER:- 1

IN GROUND TESTING

BOLT TO FLANGE RESISTANCE:- > 200  $\Omega$ s  
NUMBER OF BOLT:- 12  
FLANGE TO FLANGE RESISTANCE:- > 200  $\Omega$ s  
INSULATION CHECKER MODEL 702:- AVO BM 200  
POTENTIAL DIFFERENCE TO REFERENCE CELL  
PROTECTED SIDE:- - 848 mV  
UNPROTECTED SIDE:- - 400 mV

ABOVE TESTING

BOLT TO FLANGE RESISTANCE:-  
NUMBER OF BOLTS:-  
FLANGE TO FLANGE RESISTANCE:-

COMMENTS

TESTED BY

J Taylor

Cathodic Protection System - Bilsen Road Geebung - OM Manual  
DEPARTMENT OF WATER SUPPLY AND SEWERAGE  
MECHANICAL AND ELECTRICAL BRANCH  
METROPOLITAN DIVISION  
EAGLE FARM PUMPING STATION

ELECTRICIAL WORKSHOP

INSULATED JOINT TESTING DETAILS:

DATE

9. 11. 94

DESCRIPTION

MAINS DETAILS:- Water  
LOCATIONS:- Bilsen Rd. opp ELLISEN. Rd. Geebung  
SIZE:- 300  
MATERIAL:- C/C L msc L.  
COATING:- PVC  
NUMBER:- 1

IN GROUND TESTING

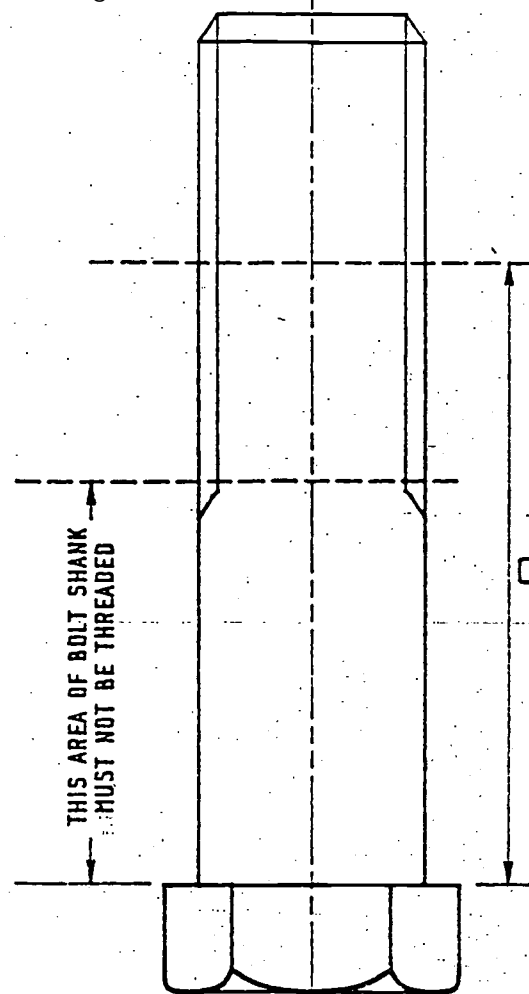
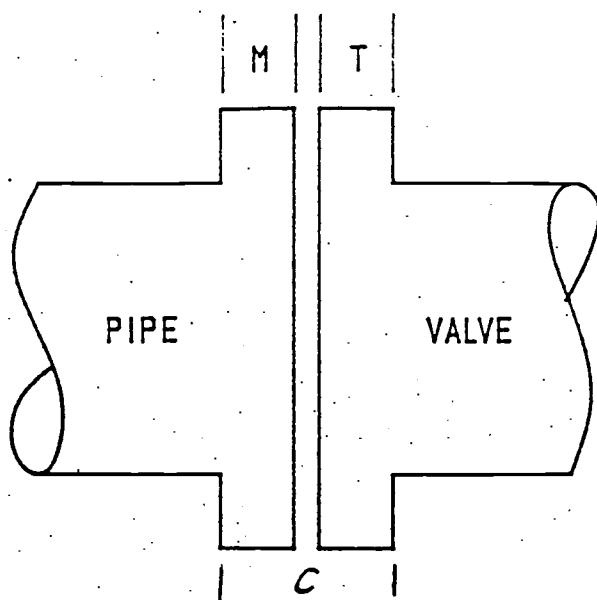
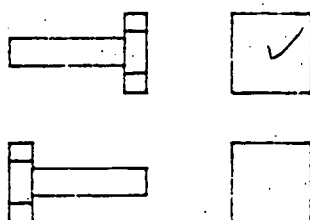
BOLT TO FLANGE RESISTANCE:- > 200  $\Omega$ s  
NUMBER OF BOLT:- 12  
FLANGE TO FLANGE RESISTANCE:- > 200  $\Omega$ s  
INSULATION CHECKER MODEL 702:- AVO BM200  
POTENTIAL DIFFERENCE TO REFERENCE CELL  
PROTECTED SIDE:- - 848 mv  
UNPROTECTED SIDE:- - 400 mv.

ABOVE TESTING

BOLT TO FLANGE RESISTANCE:-  
NUMBER OF BOLTS:-  
FLANGE TO FLANGE RESISTANCE:-

COMMENTS

TESTED BY

**BOLT DIRECTION (TICK)****VALVE TYPE:-**

NOMINAL DIAMETER		M	T	$\phi$	C	NO. OF BOLTS PER FLANGE	NUMBER OF FLANGES	TOTAL NO. OF BOLTS TO BE COATED	NO. OF DELRIN WASHERS REQUIRED
BOLT	FLANGE								
22	25	25	25	22	52	12	2	12	12

M - THICKNESS OF MILD STEEL FLANGE

T - THICKNESS OF VALVE FLANGE

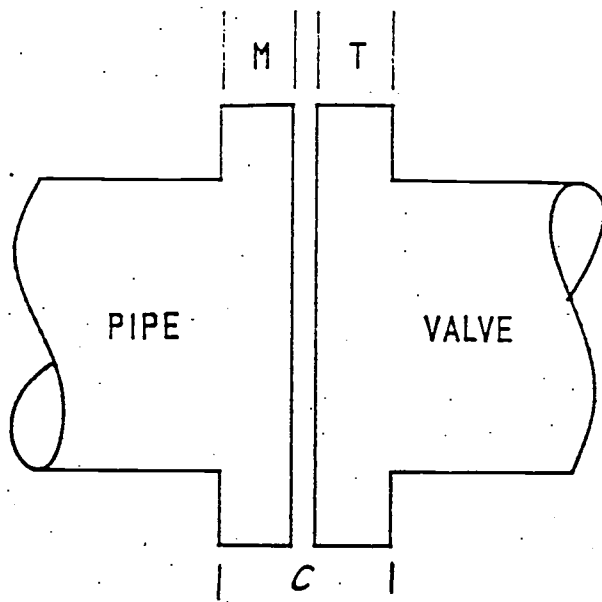
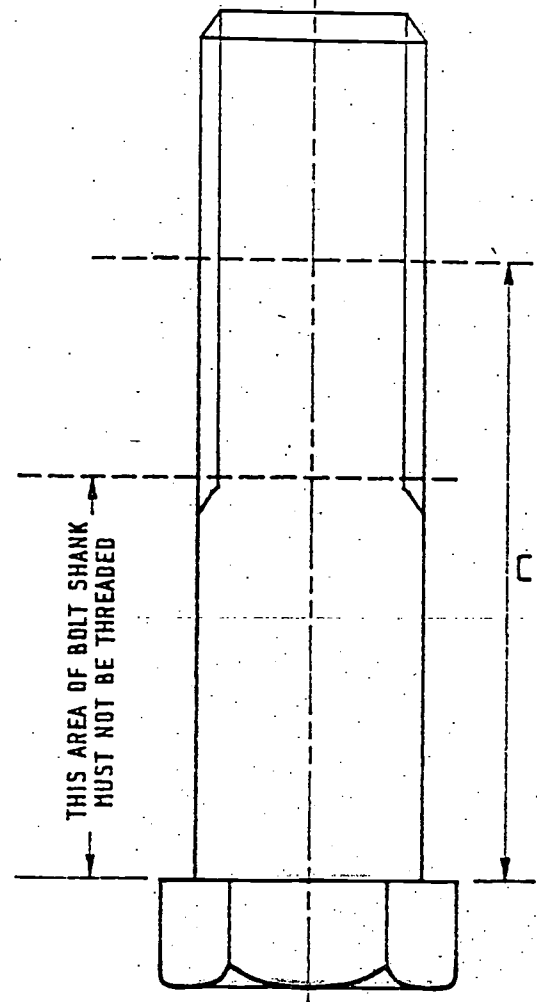
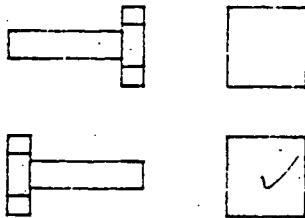
 $\phi$  - DIAMETER OF BOLT

C - LENGTH OF COATING TO BE APPLIED FOR C.I. AND M.S. FLANGE AND PIPE

**NOTES**

1. - BOLTS TO BE INSTALLED AND COATED IN ACCORDANCE WITH DRG NO. 2/13.351 (STEEL WATER MAINS INSULATED BOLT COATING REQUIREMENTS)
2. - M&E SECTION TO BE PRESENT DURING INSTALLATION TO ENSURE ELECTRICAL ISOLATION OF FLANGES.

REVISIONS	DRAWN	B.C.C. W.S.&S.	DWG.No			
	L.O.S.	MECHANICAL & ELECTRICAL BRANCH				
	SCALE	INSULATION OF EXISTING TRUNKMAINS VALVES	JE02.112			
	N.T.S.					
	DATE					
	17.4.86	BOLT DETAILS	A	B	C	D

**BOLT DIRECTION (TICK)****VALVE TYPE:-**

NOMINAL DIAMETER		M	T	$\varnothing$	C	NO. OF BOLTS PER FLANGE	NUMBER OF FLANGES	TOTAL NO. OF BOLTS TO BE COATED	NO. OF DELRIN WASHERS REQUIRED
BOLT	FLANGE								
22	25	25	25	22	52	12	2	12	12

M - THICKNESS OF MILD STEEL FLANGE

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 $\varnothing$  - DIAMETER OF BOLT

C - LENGTH OF COATING TO BE APPLIED FOR C.W. AND M.S. FLANGE

**NOTES**

1. - BOLTS TO BE INSTALLED AND COATED IN ACCORDANCE WITH ORG NO. 2/13.351 (STEEL WATER MAINS INSULATED BOLT COATING REQUIREMENTS)
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REVISIONS		DRAWN	B.C.C. W.S.&S.	DWG.No
		L.O.S.		
		SCALE	MECHANICAL & ELECTRICAL BRANCH	JE02.112
		N.T.S.		
		DATE	INSULATION OF EXISTING TRUNKMAINS VALVES	A B C D
		17.4.86		
			BOLT DETAILS	

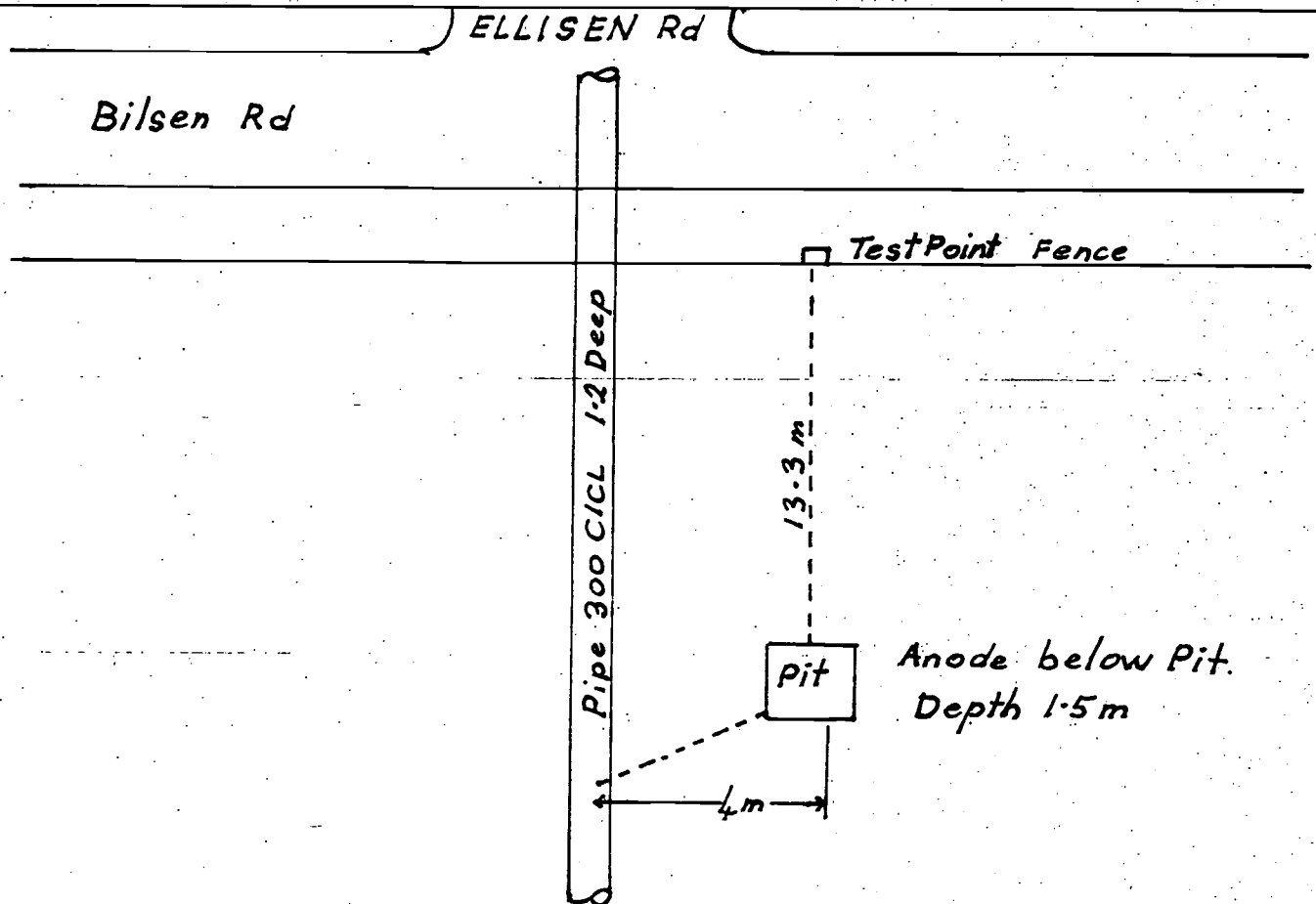
Brisbane City Council  
 Dept. W.S. & S.  
 Metropolitan Division  
 Eagle Farm Pump Station

Electrical Workshop

### Cathodic Protection Anode Bed Testing

Date: 9-11-94	Structure: 300 mscl water main		
Anode material: Magnesium	Anode size/weight: 18 kg.		
Packaging: Ref bag	Burial: Direct		
Depth: 1.5 m	Resistivity:		
Test Point type: Special	Signage: Brass plate on Pit Lid. Above Anode		
Resistance to ground:			
Anode 1	Anode 2	Anode 3	Anode 4
Tested by:	Total:		Anode 5

Locality Plan:





Brisbane City Council  
 Dept Of W.S & S.  
 Mechanical and Electrical Branch  
 Eagle Farm Pump Station  
 Electrical Workshop

16 November 1994

### 317 Bilsen Rd 300 dia MSCL Retic Main Cathodic Protection

Potentials	Natural	Off	On
Cu So4 to Pipe	-400		-848
CuSo4 to Zn (near)	-928		-931
Zn to Pipe (near)			
Cu So4 to Pipe			
CuSo4 to Zn (far)	-926		-943
Zn to Pipe (far)			

### Soil Resistivity

Pin spacings	2 metres
Meter reading	5 ohms
Resistivity	62.8 ohm.metres

Note: Tested near far test point

### Anode Details

Anode material	Magnesium
Anode mass	18 kg
Anode current	7 mA
Anode O/C pot.	1065 mV