CORROSION ENGINEERING SOLUTIONS

Contract Title:

HOTEL GOTHAM, MANCHESTER. CATHODIC PROTECTION SYSTEM.

Document Title:

INSPECTION AND TEST PLAN

Client:

Marshall Commercial Development Projects Limited
Huddersfield Road
Elland
West Yorkshire
HX5 9BW

Contract / Job No.	CN23-016-J837
Document Ref:	ITP1557
Revision:	0
Date:	7th June 2024
Author:	C. Wozencroft
Checked:	M. Body

THIS INSPECTION AND TEST PLAN SHOULD BE READ IN CONJUNCTION WITH THE FOLLOWING:

Design Report, Extension & Repair Scope: CN23-016-J837-R1558

Installation Drawings: CN23-016-J837- D001 to D032 [at time of publication. Check drawing register each time for latest versions]

INSPECTION AND APPROVAL DETAILS

R - Responsible for undertaking the activity and keeping records. Will issue notification of inspection to other parties [where required], presence is required for the entirety of the activity, can undertake activity and rectify fault before presenting for witness.

W - Right to witness testing is reserved. 72 hours notice of activity must be provided to this party to allow attendance if desired.

Hold point - Approval is required before proceeding past this point. If site testing is involved, 5 working days notice of activity must be provided to this party to allow attendance if desired.

ITEM		DESCRIPTION OF PROCESS OR ACTIVITY	PERSON RESPONSIBLE	FREQUENCY OF TESTING	VERIFICATION			INSPECTION / APPROVAL REQUIRED		
					GOVERNING DOCUMENT AND CLAUSE [WHERE APPLICABLE]	ACCEPTANCE CRITERIA	RECORDS TO BE KEPT	CONTRACTOR	DESIGNER [CES]	CLIENT [MARSHALLS]
1	Pre-Construction	**Equipment Calibration** All of the contractor's test equipment to be used on the project is to hold valid calibration certificates, or documented verification testing.	Contractor's site agent / supervisor	As required by equipment manufacturer		A valid calibration certificate or record of verification test [depending on equipment requirement] submitted to CP specialist.	Photocopies or PDFs of calibration / verification records	R	Hold Point - Approval required prior to proceeding.	
2		**Anode Type and Accelerated Life Test Data** Anode type and manufacturer approval. Proposed anodes to be tested to demonstrate service life as described in NACE TM0294/ISO 19097.	Contractor's site agent / supervisor	Once, prior to order/selection.	NACE Test Method 0294/ISO 19097 - Part A	Test certificate for NACE 0294 testing to be provided in advance of works. CP Specialist to approve proposed anode [type and manufacturer] prior to order.	Test certificate issued by manufacturer/or independent test house	R	Hold Point - Approval required prior to proceeding.	
3		**MMO/Ti Anode Coating Batch Testing** Each batch to be tested under accelerated conditions to demonstrate effectiveness over required service life.	Contractor's site agent / supervisor	Each batch/delivery prior to dispatch	NACE Test Method 0294/ISO 19097 testing - Part B	Anodes to be tested as per test method and no change in drive voltage [as required to generate test current] greater than 2 volts is deemed acceptable. CP specialist to see batch test certificate for first batch and approve prior to proceeding.	Test certificate issued by manufacturer/or independent test house	R	Hold Point - Approval required prior to proceeding.	W
4	Installation	**Initial setting out CP system** The intended position of each CP component is to be marked on the structure to ensure that the designed system can be installed as intended and by the proposed method. Sufficient notice to CP specialist to be given to ensure availability to resolve issues.	Contractor's site agent / supervisor	All items at early stage of project.	CES Installation Drawings	System to be set-out and design reviewed against as-found conditions, positions and dimensions. Any clashes, areas for improvement, redundancies to be recorded and reported to the CP specialist for consideration.	Completed list with associated sketches showing any clashes or errors.	R	Hold Point - Approval required prior to proceeding.	
5		**Inspection of Materials and Documentation** Inspection of materials and associated documentation [and QA data/certificates where appropriate] to ensure conformity.	Contractor's site agent / supervisor	Each delivery at point of delivery	None	All materials to be free from damage [either manufacture or transit]. Product and quantities to be as per purchase order. Each delivery/batch to be in accordance with: 1 - Purchase order information. 2 - Pre-construction information. 3 - Specification/contract requirements. 4 - Provided with required documentation	To be determined by contractor's QA system.	R		
6		**Reference Electrodes - Manufacturer Calibration** Calibration of Reference Electrodes at production stage	Manufacturer	Each electrode prior to dispatch to contractor		Electrodes to be tested against a saturated calomel electrode [SCE] in laboratory conditions. Electrode potential to stable within +/-3mV over a 24 hour period.	Certificate of calibration to be issued with delivery. Receipt of certificate to be recorded on RE life-time record sheet.	R	W	

© Corrosion Engineering Solutions Ltd 2024

ITEM		DESCRIPTION OF PROCESS OR ACTIVITY	PERSON RESPONSIBLE	FREQUENCY OF TESTING	VERIFICATION			INSPECTION / APPROVAL REQUIRED		
					GOVERNING DOCUMENT AND CLAUSE [WHERE APPLICABLE]	ACCEPTANCE CRITERIA	RECORDS TO BE KEPT	CONTRACTOR	DESIGNER [CES]	CLIENT [MARSHALLS]
7	Installation	**Reference Electrodes - Site Calibration Check, Pre-Installation** Site testing of Reference electrodes prior to installation. Electrodes to be tested against calibrated portable test electrode of the same type in solution [as specified by manufacturer]. If pre-potting, contractor is to repeat test after striking and add test results to records.	Contractor's CP Level 2 Technician [BSEN15257:2017]	All reference electrodes to be tested, soon after delivery.	BSENISO 12696:2022 Clause 6.3.1	Stable potential reading <10mV difference to portable electrode to be achieved. The value is to be stable and recorded as such over a period of 5 minutes. Monitoring device functionality, variable input impedance test <10mV difference.	Format of record to be determined by contractor. Complete record/traceability from manufacture to commissioning required for each unit.	R	W	W
8		**Electrical Continuity of Metalwork and Ancillary Metalwork** Confirm continuity of steel frame. Locations of masonry repairs can be used.	Contractor's CP Level 2 Technician [BSEN15257:2017]	Testing at each pier where steel/iron is exposed & each negative connection.	BSENISO 12696:2022 Clause 7.1	All metallic items tested are to be ≤1Ω to each other/established negative circuit, excluding test lead/test wire resistance which is to be measured and recorded before each test. Numerous existing metallic exposures are present. These are sufficient for high level of confidence. Testing to be undertaken with an instrument [microohm-meter] of suitable range and resolution.	Format of record to be determined by contractor. One form for whole installation.	R		
9		**Items Detrimental to Cathodic Protection** Locating items detrimental to CP system performance. Visual survey, cover-meter to surface to confirm that no such items are present.	Contractor's CP Level 2 Technician [BSEN15257:2017]	All areas receiving CP as shown on the CES produce zoning drawings.	BSENISO 12696:2022 Clause 7.1	If items are present, these are to be identified and electrically bonded as per specification/approved method.	Survey drawings showing all identified items. One pack of drawing for whole system.	R	Hold Point - Approval required prior to proceeding.	
10		**Stone Chasing Trial** Contractor to demonstrate quality of joint preparation [widening etc] in sample area to set standard for the works. Sample to include a reasonable representation of cases [ashlar, profiled, corners etc]	Principal Contractor / Contractor's Masonry Foreman	Once	CES Installation Drawings	Trial should incorporate representative CP installation to ensure that the finish provided is achievable with embedded cables/anodes present and that components can adequatly encapsulated. Cutting to be neat, with minimal over-cuts and width to be limited to only that needed & previously approved by heritage authority.	Photographs and notes suitable for comparison and review.	R	Hold Point - Approval required prior to proceeding.	Hold Point - Approval required prior to proceeding.
11		**Local Heritage Trial** Contractor to demonstrate quality and finish of external installation [joint widening, re-pointing etc] in sample area to set standard for the works.	Principal Contractor / Contractor's CP Level 2 Technician [BSEN15257:2017]	Once	CES Installation Drawings	Contractor is demonstrate quality and finish will match existing pointing colour, texture, type. Trial should incorporate representative CP installation to ensure that the finish provided is achievable with embedded cables/anodes present and that components can adequatly encapsulated.	Photographs and notes suitable for comparison and review.	R	Hold Point - Approval required prior to proceeding.	Hold Point - Approval required prior to proceeding.
12		**Half-cell Survey** Areas local to sensor positions are to be subject to a half-cell survey prior to anode installation, but after masonry repair. The results are to be shared with the designer to agree exact positioning of monitoring sensors.	Contractor's CP Level 3 Technician [ISO15257:2017]	Once, prior to installation of main anode system.	In accordance with ASTM/CSTR and BRE standards for 1/2 cell surveys.	AgAgcl 0.5M KCl portable reference electrode and high impedance voltmeter to be used to take steel in masonry potential readings on a grid at 500mm centres, reference to the centre line of the elevation. Survey data to be reported in csv. format on a grid that matches the survey grid, with clear and identifiable start and finish positions.	survey data, with referenced positions in CSV format on a grid	R	Hold Point - Approval required prior to proceeding.	
13		**Anode Installation.** Each anode and zone to be tested for isolation from the steel and adjacent anode zones.	Contractor's CP Level 3 Technician [ISO15257:2017]	Completion of section / zone / shift or part-shift as appropriate.	ISO 12696:2022 Clause 7.6	Anode chases to be tested after drilling/racking to confirm no metal is present within 15mm [each hole/chase]. Visual inspection to confirm hole is adequately wetted and free of debris. Anode to cathode isolation, >50Ω and/or 50mV prior to connection to feed wire [each anode]. Anode to adjacent zone isolation, >50Ω and/or 50mV prior to connection to feed wire [each anode]. Anode to interconnecting wire mechanical connection capable of withstanding moderate manual pressure. **Values lower than stated above may be acceptable subject to review and approval by the CP Specialist.**	To be determined by contractor. Each shift, segment, area to recorded as a life-time record with date of completion/testing.	R	W	

© Corrosion Engineering Solutions Ltd 2024

ITEM		DESCRIPTION OF PROCESS OR ACTIVITY	PERSON RESPONSIBLE	FREQUENCY OF TESTING	VERIFICATION			INSPECTION / APPROVAL REQUIRED		
					GOVERNING DOCUMENT AND CLAUSE [WHERE APPLICABLE]	ACCEPTANCE CRITERIA	RECORDS TO BE KEPT	CONTRACTOR	DESIGNER [CES]	CLIENT [MARSHALLS]
14	Installation	**Installation of System and Test Negatives** Negative Connections [test and power].	Contractor's CP Level 2 Technician [BSEN15257:2017]	Each connection	BSENISO 12696:2022 Clause 7.3	Cathode feed continuity, <1Ω [both polarities] and/or <1mV. TR end of cable to be tested against at least one other connection or area of exposed steel/iron. Location sketch and information [including photographs where appropriate] to be included.	To be determined by contractor. Photographs and/or location sketches sufficient to locate after completion.	R		
15		**Installation of System Positive Connections** Positive connections [copper wire to titanium connections].	Contractor's CP Level 2 Technician [BSEN15257:2017]	Each connection	BSENISO 12696:2022 Clause 7.7 CES installation Drawings	Anode feeder wire to copper cable, <1Ω and/or 1mV. Micro ohm-meter to be used. Mechanical strength of connection to withstand moderate manual pressure. Visual inspection to ensure integrity of all aspects.	To be determined by contractor. Photographs and/or location sketches sufficient to locate after completion.	R		
16		**Testing of Installed Reference Electrodes** Testing of installed reference electrodes and location of reference electrodes. Variable input impedance testing of electrodes.	Contractor's CP Level 2 Technician [BSEN15257:2017]	Each reference electrode	BSENISO 12696:2022 Clause 7.10 & 8.2.	4 hour wet down to be witnessed and checked. Native potential readings for steel to be stable [+/-1mV] over a period of 5 minutes. Variation in reading, between high & low input impedance, to be <10mV. Location sketch and information [including photographs where appropriate] to be included.	To be determined by contractor. A single sheet/record for each unit, or all units in a single zone is expected.	R		
17		**Testing of Completed Zones** On completion of each zone, all circuits and components are to be tested for conformance and functionality.	Contractor's CP Level 2 Technician [BSEN15257:2017]	On completion of each zone, at intervals not exceeding one week thereafter until initial energisation or after major works to structure in this zone.	BSENISO 12696:2022 Clause 8	Anode to cathode isolation, >100Ω and/or 50mV Anode feed continuity, <5Ω [both polarities] and/or <5mV Anode to adjacent zone isolation, >100Ω and/or 50mV Cathode feed continuity, <1Ω and/or <1mV [both polarities] Monitoring device stability, +/-1mV in 1 minute. Monitoring device functionality, variable input impedance test <10mV difference. All cables properly labelled within junction boxes and or TR as appropriate.	To be determined by contractor. A single sheet is expected to be completed for each zone on completion.	R	W	
18		**Pre-Commissioning** Pre-commissioning testing of all circuits and installed components	Contractor's Engineer - Level 3 [BSEN15257:2017]	Once, when all components are installed but access remains in place	BSENISO 12696:2022 Clause 8	Anode to cathode isolation, >100Ω and/or 50mV Anode feed continuity, <5Ω and/or <5mV [both polarities] Anode to adjacent zone isolation, >100Ω and/or 50mV Cathode feed continuity, <1Ω and/or <1mV [both polarities] Monitoring device stability, +/-1mV in 1 minute. Monitoring device functionality, variable input impedance test <10mV difference. Cables properly labelled within junction boxes and or TR as appropriate.	To be determined by contractor. A single sheet is expected to be completed for each zone on completion.	R	W	
19		**On/Off Testing** Instant-off versus Off potential using portable reference electrode, of each member and section of member, to demonstrate effective protection throughout façade. System to be energised to 6V.	Contractor's Engineer - Level 3 [BSEN15257:2017]	Once, when all components are installed but scaffold access remains in place	BSENISO 12696:2022 Clause 8	Demonstrable negative potential shift, consistent with applied voltage/current at circa 1m intervals along protected areas.	To be determined by contractor. Marked up drawings to be submitted to CP Specialist for review.	R	**Hold Point - Approval required prior to proceeding.**	W

© Corrosion Engineering Solutions Ltd 2024

ITEM		DESCRIPTION OF PROCESS OR ACTIVITY	PERSON RESPONSIBLE	FREQUENCY OF TESTING	VERIFICATION			INSPECTION / APPROVAL REQUIRED		
					GOVERNING DOCUMENT AND CLAUSE [WHERE APPLICABLE]	ACCEPTANCE CRITERIA	RECORDS TO BE KEPT	CONTRACTOR	DESIGNER [CES]	CLIENT [MARSHALLS]
20	Commissioning	**Initial Energisation** Recording of natural potentials and initial powering and assessment of the CP zones.	Contractor's Engineer - Level 3 [BSEN15257:2017] In the presence of the Client's CP Engineer - Level 4 [BSEN15257:2017]	Once, after all site work is complete.	BSENISO 12696:2022 Clause 8	Native [natural] potentials to be recorded on both control system & manually. Output to be set and recorded. Outputs to be checked against manual measurements. Output settings to be stable and controllable within sensible ranges. Reference electrode potentials to shift according to variations in output. Current to be measured once drive voltage is applied. Manual testing to be undertaken to compare and confirm the values recorded by the control equipment.	CP specialist's standard format	R	Hold Point - Approval required prior to proceeding.	W
21		**Intermediate Performance Verification** 15 day system test [remote]	Client's CP Engineer - Level 4 [BSEN15257:2017] **N.B. Outside of contractor's scope**	Once, at 15 days after energisation	BSENISO 12696:2022 Clause 8	As found values to be similar to as-left setting s from previous testing. Potential decay to indicate negative shift on majority of reference electrodes. Results to indicate protection is possible, within system capacity. Adjustments to be made as necessary.	CP specialist's standard format		R	W
22		**Performance Verification - Completion of Commissioning** 45 day system test [remote]		Once, at 45 days after energisation	BSENISO 12696:2022 Clause 8	As found values to be similar to as-left setting s from previous testing. Potential decay or instant-off to meet criteria on approximately 50% of reference electrodes in zone. Results to indicate protection is likely / within system capacity. Adjustments to be made as necessary.	CP specialist's standard format		R	W
23	Post-installation / Operation	**Monthly Function Checks** Monthly check of the system functionality [remote].		Monthly from date of commissioning	BSENISO 12696:2022 Clause 10	As found values to be similar to as-left setting s from previous testing. Reference electrode instant-off values to be within parameters, and similar to expectations. Adjustments to be made as necessary.	CP specialist's internal monitoring procedure.		R	W
24		**Quarterly Performance Monitoring** Performance assessment and adjustment of system [remote].		Quarterly from date of commissioning	BSENISO 12696:2022 Clause 10	As found values to be similar to as-left settings from previous testing. Potential decay or instant-off to meet criteria on majority of reference electrodes in each zone. Adjustments to be made as necessary.	CP specialist's internal monitoring procedure. End of period monitoring report.		R	W
25		**End of Period Inspection** Site visit to inspect protected structure, equipment and test values against recorded data.		Once - 12 months from commissioning	BSENISO 12696:2022 Clause 10	Values measured on site to match those recorded by system. Protected structure to be free from corrosion related damage or anode staining. Reference electrodes to be tested for accuracy and stability. All DC commissioning tests to be repeated and compared.	End of period monitoring report.	W	Hold Point - Approval required prior to proceeding.	Hold Point - Approval required prior to proceeding.

© Corrosion Engineering Solutions Ltd 2024