



ACCREDITATION SCHEME FOR INSPECTION BODIES

TECHNICAL NOTE: IM 01
SPECIFIC REQUIREMENTS FOR THE
ACCREDITATION OF INSPECTION
BODIES FOR INSTRUMENTATION &
MONITORING

Technical Note IM 01, 01 July 2022

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1. INTRODUCTION

- 1.1 The purpose of accreditation of the inspection body for instrumentation & monitoring is to ensure the inspection process of instrumentation & monitoring conforms with standards or other normative documents and/or general requirements.
- 1.2 The scope of instrumentation & monitoring covers drilling, installation, data collection, processing & reporting for instrumentation adopted for civil and engineering construction industry such as Earth Retaining Stabilising Structures (ERSS) and tunnelling works.
- 1.3 This accreditation covers the type of instruments as listed in Appendix 1
- 1.4 This technical note (IM 01) should be read in conjunction with documents listed in the References Section and government regulations where applicable.
- 1.5 Supplementary information for specific areas of inspection may be published as other Technical Notes.

2. EQUIPMENT

- 2.1 Inspectors shall ensure that all equipment, including equipment not under the charge of the inspection body, used for instrumentation and monitoring works are calibrated and traceable to the SI unit. Calibration shall be performed by recognised accredited laboratories¹ or the National Measurement Institute who is a member of the BIPM² MRA where possible.
- 2.2 The inspectors shall ensure that the acceptance of calibration reports be based on the measurement traceability as specified in SAC-SINGLAS 006: Traceability of Measurement.
- 2.3 Where independent calibration facilities are not available, the equipment may be calibrated using in-house facility. The in-house calibration shall be validated using well recognised methods endorsed by the approved signatory.
- 2.4 Each in-house validation report shall be endorsed by the approved signatory.
- 2.5 Table 1 sets out the normal frequencies for calibrations and checks of critical equipment used in the field of instrumentation & monitoring.

¹ Recognised accredited laboratories refer to those accredited by SAC or its MRA partners

² BIPM MRA refers to listing of signatories maintained by the International Bureau of Weights and Measures (BIPM) and publicly available on the BIPM website: <http://www.bipm.fr>

3. INSPECTION PERSONNEL

3.1 INSPECTORS

- 3.1.1 Inspectors shall be suitably qualified and have sufficient relevant experience in their scope of inspection.
- 3.1.2 Inspectors must be familiar with the relevant standards or codes used in the inspection activities.
- 3.1.3 Inspection bodies shall note that qualification requirements of inspectors may be superseded or limited by the regulatory requirements of the countries where the instrumentation and monitoring is carried out.
- 3.1.4 Inspection bodies shall maintain records of inspectors' qualifications, training and experience. The records shall include how and when each inspector is authorised by the inspection bodies to perform specific inspection for I&M firms.

3.2 APPROVED SIGNATORIES

- 3.2.1 All approved signatories shall be assessed by the assessment team prior to award of accreditation. Subsequent assessments will consist of sampling of approved signatories.
- 3.2.2 The assessment team will assess the nominated signatories. Those assessed to be competent in their area of inspection will be submitted to the Council Committee for Inspection for endorsement as approved signatories.

3.3 QUALIFICATION CATEGORIES FOR INSPECTION TEAM

3.3.1 Driller cum Installer

- a. Should meet the following requirements:
 - i) Be able to communicate in basic English; and
 - ii) Possess relevant competencies which are to be assessed and deemed sufficient by the approved signatories; and
- b. Shall possess a valid Skills Evaluation Certificate (Knowledge) [SEC(K)] for Soil Drilling & instrumentation, issued by the Building and Construction Authority.

3.3.2 Instrumentation Supervisor/Engineer

- a. Shall have at least:
 - i) Diploma in Civil Engineering or Geology with at least one year experience in instrumentation & monitoring works; or
 - ii) Five years experience in instrumentation & monitoring works for other qualification levels and
- b. Shall possess a valid Geotechnical Instrumentation for Engineers Certificate issued by Geotechnical Society of Singapore (GeoSS)³

3.3.3 Instrumentation Manager

- a. Shall be a Project Manager with at least:
 - i) Degree in Civil Engineering or Geology with at least five years experience in instrumentation & monitoring works; or
 - ii) Diploma in Civil Engineering or Geology with at least eight years experience in instrumentation & monitoring works and
- b. Shall possess a valid Geotechnical Instrumentation for Engineers Certificate issued by Geotechnical Society of Singapore (GeoSS)³

3.3.4 Approved Signatories

Shall be meeting the following requirements:-

- i. degree in Civil Engineering with at least 8 years experience in instrumentation & monitoring works; and
- ii. possess a valid Geotechnical Instrumentation for Engineers Certificate issued by Geotechnical Society of Singapore (GeoSS)³

³ The certificate can be obtained by registering with GeoSS after the candidate successfully passes the Certification Course for Geotechnical Instrumentation for Engineers conducted by BCA Academy.

4. Format of report

- 4.1 The inspection report shall be an SAC-endorsed report that contains at least all information attached in **Appendix 2** where applicable.
- 4.2 The list attached is not exhaustive and may include requirements as specified by the customer. Non accredited inspection procedures/methods/products are to be clearly shown or identified in the inspection report.

5. INSPECTION METHODS AND PROCEDURES

- 5.1 The inspection body shall have detailed procedures and instructions for the application of the appropriate regulations, codes of practice, standards, specifications, guidance documents and customer requirements.
- 5.2 The instrumentation supervisor/engineer shall not supervise more than two rigs which involve in installation of BH instruments concurrently.
- 5.3 The inspection body which prepares the instrumentation & monitoring works shall be accredited to perform the type of works as listed in Appendix 1. The inspection body shall subcontract those works to an accredited inspection body if it is not accredited for those particular type of works.

6. SAFETY AND ENVIRONMENTAL REQUIREMENT

- 6.1 Staff on-site shall have the requisite personal protection equipment (PPE), example, safety helmet, safety shoes and any other safety equipment as deem necessary by the site safety officer.
- 6.2 The company shall have procedures for safety and ensuring the safety of its staff and the general public.
- 6.3 The company shall ensure that they comply with relevant regulatory requirement with regards of environmental issue.

7. FORMAT OF ACCREDITATION SCOPE

The scope of accreditation is granted only for specific items, materials or systems being inspected. An example of the accreditation scope is attached in Appendix 1.

8. REFERENCE

- a) ISO/IEC 17020:2012 – Conformity Assessment-Requirements for the operation of various types of bodies performing inspection
- b) ILAC P15:06/2014 – Application of ISO/IEC 17020:2012 for the Accreditation of Inspection Bodies
- c) SAC-SINGLAS 006 - Traceability of Measurement
- d) BS EN ISO 18674-1:2015 – Geotechnical Monitoring by Field Instrumentation – General Rules
- e) BS EN ISO 18674-2:2016 – Geotechnical Monitoring by Field Instrumentation - Measurement of Displacement along a line -Extensometers
- f) BS EN ISO 18674-3:2017 – Geotechnical Monitoring by Field Instrumentation – Measurement of Displacement across a line -Inclinometers
- g) BS EN ISO 18674-4:2019 – Geotechnical Monitoring by Field Instrumentation – Measurement of Pore Water Pressure:Piezometers
- h) BS EN ISO 18674-5:2018 - Geotechnical Monitoring by Field Instrumentation – Stress Change Measurements –(By Total Pressure Cells)

Appendix 1

Inspection body: Type A or B or C

Type of Product	Type and Range of Inspection	Inspection Method, Codes or Standards Used
1) Geotechnical Borehole Instrumentation & Monitoring	Measuring Displacement a) BH Extensometer b) Inclinometer Measuring Pressure a) Piezometer b) Total Pressure Cells Measuring Groundwater Level a) Water Standpipes	
2) Instrumentation & Monitoring for Struts	Measuring Force a) Load Cells b) Strain Gauges	

Approved signatories

[Signatory A]

- for item 1 and 2

[Signatory B]

- for item 1

NOTE :

Type A inspection body

The inspection body providing “third party” services.

Type B inspection body

The inspection body which forms a separate and identifiable part of an organisation involved in the design, manufacture, supply, installation, use or maintenance of the item it inspects and has been established to supply inspection services to its parent organisation.

Type C inspection body

The inspection body which is involved in the design, manufacture, supply, installation, use or maintenance of the items it inspects or of similar competitive items and may supply inspection services to other parties not being its parent organisation.

Appendix 2

The following information is to be included in the inspection report (as applicable)

[A] Quality Manual containing the following information:

1. Specifications for all instrument sensors and recording equipment.
2. Valid calibration certificates for all instrument sensors and recording equipment, where applicable.
3. Details of automated monitoring system and wireless data transmission protocols.
4. Method statements for the installation and monitoring of all instruments, including backfilling grout mix ratios and strength results for borehole instruments.
5. Organisation chart and contact numbers for all personnel, including any sub-contractors engaged.
6. Flowchart showing detailed workflow for:
 - a. dissemination of monitoring results
 - b. action taken when review levels are breached
 - c. action taken when abnormal reading trends are detected
7. Sample installation and monitoring report.

[B] Installation Reports containing the following information:

1. Owner of project.
2. Name and location of project.
3. Name of I&M company.
4. Date of submission of report.
5. Name and signature of the person(s) (Approved Signatories) responsible for the monitoring project.
6. The installation record for individual instruments shall incorporate a graphical illustration of the instrument installation and shall include the following:
 - a. Instrument number and location
 - b. Names of personnel responsible for installation
 - c. Time and date of commencement and completion of installation
 - d. Details of instrument installation (grouting, fixings etc).
 - e. Instrument readings during installation, calibration and immediately after installation are completed (where applicable).
 - f. Location of any instrument terminals, housings and cable routing.
 - g. Details of any splices, numbers of casings or joints.
 - h. Details of any breakdowns or delays.
 - i. Details of any instrument protection.
 - j. Borehole instruments shall also include the following:
 - i) As-built co-ordinates and reduced level(s) for sensor(s) or tip(s)
 - ii) Borehole log according to SAC Technical Note SI-01 depicting ground conditions encountered during installation
 - iii) Measurement and trend plot to indicate initial readings and establishment of stable base readings

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[C] Monitoring Reports containing the following information:

1. A summary highlighting:
 - a. Readings that have breached review levels
 - b. Readings that exhibit abnormal reading trends
 - c. Instruments not read due to damage or obstruction
 - d. Instruments that have been re-initialised and reasons for doing so [Approval from Qualified Person for Supervision (QPS) shall be sought and attached in the report before the re-initialisation]
 - e. Any other areas of concern observed during monitoring worksAny instrument or reading highlighted shall include a brief description of nearby construction activities.
2. Monitoring zone, reporting period and date of report submission.
3. Name and signature of the person(s) (Approved Signatories) responsible for the monitoring project.
4. Instrument number and location.
5. Instrument co-ordinate and reduced level(s) for borehole instruments.
6. Baseline, previous, current readings and review levels in relation to construction stages.
7. Colored graphical plots of measured parameters vs appropriate variables, for example, settlement vs. time, horizontal deflections vs. time, load vs. depth of excavation, settlement vs. location of tunnel / depth of excavation etc. The plots shall also indicate the review levels for the respective instruments and the stage of construction/excavation.
8. As-built instrumentation plans shall be prepared in accordance to the following requirements:
 - a. appropriately color coded to clearly illustrate all instruments
 - b. endorsed by the resident surveyor (if applicable)
 - c. updated and submitted monthly or whenever there is a change in instrument status on site, **whichever later.**
 - d. Include the review levels for each type of instruments, and for the various excavation stages, where appropriate
 - e. include the outline of structure being built
 - f. include other details such as instrument installation depth, strut layout, annotation, etc. where appropriate
9. Any changes or modifications that may affect readings shall be clearly highlighted and documented, for example:

- a. corrections to any readings, for example: due to twist or spiral in inclinometers
- b. calibration, maintenance, repair or reinstallation performed on instruments, readout units, data loggers, etc

TABLE 1 RECOMMENDED EQUIPMENT CALIBRATION AND CHECK INTERVALS

S/N	TYPE OF TEST/MEASUREMENT	FREQUENCY OF CALIBRATION OR CHECK	EQUIPMENT/PARAMETERS TO BE CHECKED	GENERAL PROCEDURES AND COMMENTS
1.	Force Measurement : a) Load Cell b) Strain Gauges	Annual Calibration Annual Calibration	a) Read-Out Unit b) Read-Out Unit	
2.	Displacement Measurements a) Inclinometers b) BH Extensometers	Annual Calibration Annual Calibration	a) Read-Out Unit b) Read-Out Unit	
3.	Pore Pressure Measurements a) Piezometers	Annual Calibration	a) Read-Out Unit	
4.	Earth Pressure Measurements a) Total Pressure Cell	Annual Calibration	a) Read-Out Unit	
5.	Groundwater Level Measurement a) Water Standpipes	Annual Calibration	a) Read-Out Unit	

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