

Level 1 Certification

Introduction

The British Society for Strain Measurement holds personnel certification examinations leading to the award of the Strain Measurement Certificate, at Level 1 and 2, and the Diploma at Level 3. This booklet gives details of the Level 1 examination. Corresponding details of the Level 2 and 3 examinations are given in booklets CSMP12 and CSMP13 respectively. Full details of the certification scheme are given in CSMP10. All these documents can be viewed at www.bssm.org.

The Level 1 Certificate provides a qualification for engineers and technicians involved in the installation of strain gauges. It shows that the holder has demonstrated a high level of skill in making strain gauge installations, and can install gauges that can be used with confidence to make accurate and reliable measurements.

The Society publishes a Code of Practice CP1 for the installation of electrical resistance strain gauges, a copy of which is issued to everyone registered for the examination. Candidates are expected to observe this code and use it in conjunction with the instruction sheets provided by gauge manufacturers and suppliers. The Society also publishes Installation Record Sheets; copies are provided for use during the examination.

A list of scheduled examinations can be obtained from the Society Office and www.bssm.org. When there are several candidates from the same firm an examination can be held on the firm's premises.

A one-day seminar is normally held about two weeks before each examination, so that candidates can make installations under examination conditions and discuss procedures, techniques and the sample written questions with an experienced engineer. It is normally held at the examination venue.

Entry Requirements

Candidates must have received appropriate training, which should normally include either a 2 day course such as those run by reputable strain gauge suppliers, or a 1 day BSSM workshop and the one-day pre-examination seminar. Also, they should normally have had 2 months of practical experience that includes installations of the type covered by the examination and be familiar with the recommendations of the Code of Practice CP1. All candidates are strongly advised to attend the pre-examination seminar.

The Examination

- (a) The objective of the examination is to enable candidates to demonstrate that they use procedures consistent with the Code of Practice CP1, and are able to install gauges to BSSM standards.

(b) The examination is divided into two parts:

- a practical test
- a short written test

Candidates select one of the two standard installations described on page 6. This must be shown on the registration form. They may also choose to be examined in additional installations from the list without doing further written tests. Separate certificates will be issued for each installation.

- (c) The examination lasts 3.5 hours if only one installation is to be examined. A further 3 hours will be allowed for each additional installation. The examination normally starts at 9 a.m., but candidates are allowed to enter the examination room at 8.45 a.m., so that they can become familiar with the room and the equipment and read through the question papers. A lunch break is taken at around 12.30 p.m. Since the examination is predominantly an assessment of practical skills and understanding, reference books and similar material, excluding the examination question bank, can be taken into the examination room and used in any part of the examination. Personal written material may also be used but must be made available for inspection by the examiner.
- (d) The examiner will provide advice and assistance if this is necessary in order that candidates can fully demonstrate their competence. Problems or any difficulties with the question papers or the materials and equipment should be reported to the examiner as they arise.
- (e) The written test is the minor part of the Level 1 examination. It is allocated 20% of the marks for the whole examination.
- (f) The question paper for the written test contains 20 multiple choice questions, based on general knowledge related to strain measurement and points which can arise during an installation. All questions are allocated equal marks, although they may not take the same time to complete. Answers may come from the candidate's own notes and personal experience, but it may also be necessary to refer to documents such as the Code of Practice CP1 and manufacturers' data sheets. This test should take around 30 minutes to complete.
- (g) Candidates who take a second practical test will not be required to take a second written test.
- (h) The practical test forms the main part of the Level 1 examination. The test for each type of installation is different and may not take the same time to complete, but the time allocated is adequate and each test is allocated 80% of the marks for the whole examination. Full details with diagrams are given on the question paper.

- (i) Candidates taking the examination for the type (a) installation normally install a single-element gauge on two separate test bodies:
- a simple shape which can be handled easily on the bench top
 - a body supported in an inconvenient position
- (j) The practical test for the type (b) installation is done on the bench top. There are normally two activities:
- bonding of two dual-element gauges
 - wiring the gauges into a full bridge
- (k) Candidates should ensure that both tasks have been completed. If an installation is not finished at the end of the standard period of time a further period of up to 30 minutes will be allowed at the discretion of the examiner. The first 10 minutes can be used without penalty, but after that the aggregate mark for the Level 1 examination in that type of installation will be reduced by 10.
- (l) The examiner will assess the quality of the installations, making use of recommendations set out in publications such as the BSSM Code of Practice CP1 and gauge manufacturers' brochures. The following aspects will be covered:

Bonding

- prepared surface - area, finish
- layout lines – clarity, and damage to the prepared surface
- adhesive – under the gauge and around the gauge
- gauge – damage

Protection *

- coating thickness and uniformity; area covered

Gauge Location

- position and orientation

Soldering

- solder deposits - size, shape, surface appearance
- joints - wire/solder/tab contact
- resistance – shorts & potential shorts; dirt/flux/mastic

Wiring

- jumper wires - type, length, configuration, insulation
- intra-bridge wiring - type, length, layout, security
- terminal strips - type, position
- leadwires - size, length, layout, clamping, preparation of ends
- leadwires – identification

Electrical Characteristics

- resistance – insulation, gauge and leads, bridge arms
- output - initial out-of-balance, zero return

Maximum Strain (a) & (c)

- strain at failure
- failure mode

Documentation

- materials - gauges, adhesives, coating, wire
- resistance – insulation, gauges (or IOB); instruments used
- gauge/terminal – position and orientation
- leadwire – layout, clamping and identification

* For type (d) only.

Assessment Regulations

An aggregate mark for the examination will be calculated using 20% of the mark for the written test and 80% of the mark for the practical test. When additional practical tests are examined the aggregate mark will be calculated using the mark for the original written test.

To qualify for the award of the Level 1 Certificate a candidate must obtain an aggregate mark of at least 70%. A candidate who achieves an aggregate mark of 85% or higher will be awarded a pass with Distinction. A separate certificate will be issued for each type of installation.

A candidate who fails to achieve an aggregate mark of 70% may re-take the whole examination.

Marks are awarded by the examiner. Marking Record Sheets, scripts and samples are reviewed by a moderator. The Certification Committee confirms the result of the examination. Candidates are told the result by letter, usually within 5 weeks. The letter sent to candidates who fail will include the main reasons for the failure. A letter will also be sent to the employer.

Renewal of Certification

The award is valid for 5 years.

At the end of each 5 year period practical tests must be undertaken; there is no written examination. Candidates are required to complete tests corresponding to the installations described on page 6, for which they hold certificates, and submit a review of their recent gauge installation experience. The tests will normally be done at the candidate's place of work under the supervision of a senior colleague, who will be required to confirm the candidate's experience and that the installation was done by the candidate. There is no

limit on the time taken. An examiner will assess the test samples and note the type of work normally undertaken. The pass mark for the practical test is 70%.

Registration

All new candidates for the examination must register using Form C111 and provide details of training and experience on form C112. Supporting evidence such as a copy of a certificate should be attached. Application to attend the pre-examination seminar should be made on form C113. Candidates applying to renew their certification should use form C114. The type of installation or installations chosen for the examination must be stated clearly on the form. All forms must be received by the BSSM office at least 5 weeks before the date of the examination.

Registrations are confirmed after a review by the Chairman of the Certification Committee. Each registered candidate is then provided with a copy of the Code of Practice CP1, Installation Record Sheets, a sample practical examination paper, a sample written paper, and the bank of questions for the written examination CSMP11.2.

Materials and Equipment

The strain gauges and adhesives required for installations (a), (b) and (c) will be provided. The gauges must be used. Candidates may use their own adhesive if appropriate curing conditions can be provided and the examiner has agreed.

Candidates are expected to be equipped with all other materials and tools needed for the installations at the examination and the seminar. A list of equipment which may be required is given below. Any candidate who is unable to bring a comprehensive tool kit should advise the BSSM Office at an early date.

- silicone carbide papers (various grades)
- round-pointed rod or empty ball-point pen
- ruler
- degreaser
- cotton buds
- weak acid cleaning solution
- neutralising solution
- gauze sponge or paper tissue
- solder
- rosin solvent
- cellophane tape
- drafting tape
- Mylar tape
- P.T.F.E sheet
- silicone rubber pads
- backing plates
- spring clamps

- protective coating (not required for (a), (b) and (c))
- terminal strips
- lead wire
- single conductor (lacquered)
- scissors
- screwdrivers
- blunt nosed tweezers
- scalpel
- wire cutters
- tools for wire stripping
- temperature-controlled soldering station
- safety glasses, gloves etc.

Types of Installations

Standard Installations

- (a) Foil gauge for quarter-bridge operation at a temperature between 0°C and 50°C.
- (b) Full bridge of foil gauges for long life at a temperature between 0°C and 50°C.

Other Installations

- (c) Foil gauge(s) for quarter-bridge or half-bridge operation at a temperature between -200°C and 250°C.
- (d) Gauges for operation at temperatures above 250°C.