Level 3 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 3 examination. Corresponding details of the Level 1 and 2 examinations are given in booklets CSMP11[(2)] and CSMP12[(3)] respectively. Full details of the certification scheme are given in CSMP10[(1)], which is supplied to all registered candidates.

The Level 3 Diploma provides a qualification for engineers and senior technicians having considerable responsibility for strain gauging and strain measurement. It shows that the holder has a broad knowledge of strain measurement methods and component behaviour, and is able to evaluate strain gauge installations and use strain gauges to determine accurate values of stress and the output of strain-gauged sensors.

Level 3 examinations are normally held on two consecutive days in July each year at Oxford Brookes University. A seminar is held one or two weeks before the examination, so that candidates can review measurement procedures and related calculations, assess the quality of a gauge installation, and discuss written questions with an experienced engineer.

Entry Requirements

All candidates must have Level 2 certification. They must also have obtained appropriate training and had an acceptable period of relevant experience. The normal periods of time after certification at Level 2 are given in Table 1.

If the Level 2 certification has expired, it must be renewed.

TABLE 1

Tertiary Education	Training (days)	Experience (months)
Degree/HNC in Engineering or Science	3	9
None	4	18

The Examination

(a) The objective of the examination is to enable candidates to show that they have a broad knowledge of strain measurement methods and component behaviour, can evaluate strain gauge installations made by other personnel, and can make measurements using strain gauges and determine accurate values of stress.

(b) The whole examination takes two days, and has three parts:

- a practical test
- a written test
- an interview

(c) The practical test is held on the first day. It lasts 6 hours. It normally starts at 9.30 a.m. but candidates are allowed into the examination room at 9.15 a.m., so that they can become familiar with the room and the equipment and read the question paper. A lunch break is taken at around 12.15 p.m. Since the examination is predominantly an assessment of practical skills, reference books and similar material can be taken into the examination room. Personal written material may also be used, but this must be made available for inspection by the examiner.

(d) The practical test has three sections:

- a stress analysis task using pre-installed strain gauges
- a load measurement task using pre-installed gauges
- a written evaluation of a strain gauge installation

The time spent on each task is decided by the candidate. The tasks can be done in any order.

(e) The stress analysis exercise is based on measurements using strain gauges already installed on a component. It normally includes the use of rosettes, the correction of raw data, and the determination of principal values and the yield load.

(f) The load measurement task is normally based on a body carrying six gauge grids. Appropriate grids are used in a bridge circuit to achieve relationships between load and the bridge output.

(g) The evaluation task requires the preparation of a short report on a completed installation. This is usually based on an examination of the installation, the original specification for the installation, and the documentation prepared by the installer.

(h) The written test is held during the morning of the second day, and is allocated 2 hours. It starts at 9.00 a.m., but candidates are allowed into the examination room at 8.45 a.m., so that they can read the question papers. Candidates may use reference books and similar material, but not the examination question bank. Personal written material may also be used, but this must be made available for inspection by the examiner.

(i) The written test has two sections:

- a basic section, containing questions based on general knowledge related to (a) component behaviour and (b) methods of strain/stress analysis
- a section containing questions based on the use of strain gauges

(j) The written test contains a total of 45 multiple choice questions consistent with the knowledge base outlined in CSMP10[(1)]. All questions should be attempted. The basic section contains 10 questions based on general knowledge of materials and solid mechanics related to component behaviour, and 15 questions concerned with knowledge of three optional methods of strain/stress analysis chosen by the candidate from the list given on page 6. The strain gauge applications section contains 20 questions dealing with the use of strain gauges either to determine strain and stress or as the measuring elements in a transducer.

All questions are allocated equal marks, although they may not take the same time to complete.

(k) The examiner will provide advice and assistance if this is necessary in order that candidates can fully demonstrate their competence. Problems or difficulties with any of the question papers or the materials and equipment should be reported to the examiner as they arise.

(l) Interviews are held after the written examination on the second day. The interview is conducted by three members of the Certification Committee and lasts around half an hour. It is concerned with:

- education and training
- experience in the analysis of strain and stress
- understanding and breadth of knowledge of strain measurement and stress analysis methods
- responsibility for gauge installations and test programmes
- supervisory experience

The candidate is expected to submit a summary of relevant work done over a period of around two years. At the interview candidates normally use additional supporting material such as photographs, drawings, graphs, models, samples and components.

Assessment Regulations

An aggregate mark for the examination will be calculated using 30% of the mark for the written test and 70% of the mark for the practical test. A mark will be awarded for the interview, but it will not be included in the aggregate.
The mark for the practical test will be determined by allocating:

- 40% for the stress analysis task
- 30% for the load measurement task
- 30% for the report on the installation

To qualify for the Diploma a candidate must obtain a mark of at least 70% for the interview and an aggregate mark of at least 70%, with at least 60% in the written test and 60% in the practical test.

A pass with Distinction will be awarded to a candidate who achieves an aggregate mark of 85% or higher.

A candidate who fails to obtain the minimum aggregate mark, but has achieved the required mark for the written test and the practical test may be re-tested once in one of these elements. A candidate who obtains the required aggregate mark, but scores less than 70% in the interview or less than 60% in one of the other elements of the examination may retake that one element once, but the mark awarded will not exceed the minimum pass mark. If a pass is not achieved in this way the candidate may repeat 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, certification can be renewed by either completing a practical test and submitting a review of recent strain measurement and related experience, or using the Credit Scheme.

The practical test will include design of tests and gauge installations, inspection of gauge installations, measurements, calculations, and the consideration of alternative methods. Candidates will normally do the tasks at their workplace, under the supervision of a senior colleague, who will be required to confirm the candidate's experience and that the renewal tasks were done by the candidate. There will not be a limit on the time taken to do the tasks.

An examiner will assess the test samples and documentation, and note the type of work normally undertaken. The pass mark for the practical test is 70%.

Candidates using the Credit Scheme will be required to show that they have accumulated 30 points based on Table 2. The claims for credit will be assessed by an examiner.

TABLE 2

Activity (1)	Points awarded for each activity	Maximum points per year
Attendance at a conference, seminar or course (per day)	1	3
Attendance at a meeting of a committee or working group	1	3
Authorship of a technical report or publication	1-3	6
Experience as a training instructor (per 3 hours)	1	6
Experience as an examiner	1	6
Total activity	-	10

(1) Concerned with strain measurement/stress analysis

Registration

All new candidates for the examination must register using Forms C131 and C132. Candidates applying to renew their certification should use Form C133; those making use of the credit scheme should also complete Form C134. All forms must be received by the BSSM office at least 5 weeks before the date of the examination.

Registrations for examination are confirmed after a review by the Chairman of the Certification Committee. Each registered candidate is then provided with a sample practical examination paper, a sample written paper, and the bank of questions for the written examination CSMP13.2[(5)].

Materials and Equipment

Candidates are expected to have calculators. All the other equipment required for the Level 3 examination and seminar will be provided.

Optional Strain/Stress Analysis Methods

- Mechanical, inductive and strain-gauged beam extensometers
- Capacitance strain gauges
- Vibrating wire strain gauges
- Semiconductor strain gauges
- Transmission photoelasticity
- Photoelastic coatings
- Residual stress determination
- Finite element analysis

References

(1) BSSM, Certification of Strain Measurement Personnel, CSMP10:2005

(2) BSSM, Certification of Strain Measurement Personnel, Level 1 Examination, CSMP11:2005

(3) BSSM, Certification of Strain Measurement Personnel, Level 2 Examination, CSMP12:2005

(4) BSSM, Code of Practice for the Installation of Electrical Resistance Strain Gauges, CP1:2005

(5) BSSM, Questions for Written Examinations in Strain Measurement, Level 3, CSMP13.2:2005