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Local & Munl. (1898) Department.

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G.O., No. 1967 M

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[Despatch Abstract.]

Madras Steam Boilers & Prime Movers Act, 1893.

Reading Ltr. P.W.D. referring to the Locomotive Superintendent of the Madras Railway and the General Superintendent, Public Works Workshops, for opinion, the rules submitted by the Sanitary Engineer to govt. for placing boilers under the charge of certificated men, & directing, with remarks, that copies of the rule be circulated to the persons concerned.

BACK PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

FURTHER PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

C No 2651 P

GENERAL.
ESTABLISHMENT.

Government {1898} of Madras.

PUBLIC WORKS.

JUDICIAL & LEGISLATIVE DEPT.
DP 3464 11

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Enclosures

Spare copies

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Madras Steam Boilers and Prime Movers Act, 1893

Referring to the Locomotive Superintendent of the Madras Railway and the General Superintendent, Public Works Workshops, for opinion, the rules submitted by the Sanitary Engineer to Government for placing boilers under the charge of certificated men, and directing, with remarks, that copies of the rules be circulated to the persons concerned.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

General.
Establishment.

READ—the following papers:—

From J. A. JONES, Esq., MEM. INST. C.E., F.R.S.E., Sanitary Engineer to Government, to the Secretary to Government, Public Works Department, dated Fort St. George, 19th August 1898, No. 1277

In reply to your memorandum No. 594 D. of 6th July 1898, I have the honour to inform you that I have drawn up in communication with the Boiler Inspector a set of rules which are, I think, a complete reply to your queries Nos. 1—3 and 4 and with reference to these rules forwarded herewith I proffer the following remarks.

2. The rules are based on the Bombay rules but in some few particulars are less stringent. A copy of the Bombay rules is sent for comparison. The rules in many respects have had to be re-drafted owing to officers, different from those in Bombay, administering the Act here, and the rules put forward in this respect are such as seem suitable to the circumstances of Madras Administration; such rules do not, of course, affect the stringency or otherwise of the examinations.

3. The other main points in which the rules differ are (1) in regard to fees, a second chance being given for the same fee to a failed candidate—*vide* rule 11, Madras and 11, Bombay. I think this is desirable looking to the class of men in Madras who are drivers and who are not as a rule too highly paid; (2) in regard to the examination for second-class certificates of competency where conditions (*g*) and (*h*) of rule 28 (Bombay) are transferred to the 1st class (proposed Madras rules), the Boiler Inspector agrees with me in thinking that the amended rules for persons desiring to obtain second-class certificates are stringent enough as we have not here the very large number of well qualified men to be found in Bombay and the Bombay rules apparently refer to sea-going Engineers as well as to Engineers of land engines; (3) in regard to certificate of service [proposed rule No. 44 (*a*)] this has been amended to ensure that a person once having obtained a certificate of service cannot obtain a further one of higher grade but can reach the higher grade by obtaining a certificate of competency on passing the appropriate examination.

4. In other respects the rules are practically those of Bombay and seem suitable to Madras as amended.

5. Referring more particularly to your queries Nos. 1 to 4—

(1) The rules show how the examination will be instituted. I considered whether the examination might not fall into line with the technical examinations of Government, but it appeared to me for many reasons but especially because the rules are framed with reference to an Act administered by this department and observing, moreover, that the licenses must be registered here, that it is advisable to have the examination quite separate.

(2) Provision for the appointment of examiners will be found in rule 1. It will be observed that the Act prohibits the appointment of a Boiler Inspector as examiner and I presume this debars me as Ex-officio Inspector. The persons who would be most suitable for examiners would be Mechanical Engineers, such as—

(*a*) The Locomotive Superintendent, Madras Railway.
(*b*) The Deputy Locomotive Superintendent, Madras Railway.

(*c*) The partners of Messrs. Massey & Co.
(*d*) The Chief Engineers of the Carnatic, Buckingham, Choolay Mills, &c.
(*e*) The Engineer of Messrs. Oakes & Co. The Engineer of Messrs. Borham & Co.
(*f*) The Mechanical Engineer of the Madras Municipality.
(*g*) The Locomotive Foremen, Madras and South Indian Railways.
(*h*) The Mechanical Engineer of the Gun Carriage Factory.
(*i*) The Mechanical Engineer of the Arsenal.

The rules provide for two of the examiners being Mechanical Engineers while the third might be a Public Works or other officer of Government. As however it is proposed that the examiners be appointed annually, names could be submitted from time to time.

(3) The proficiency required for each class is regulated by the proposed rules.

(4) The examination should be made compulsory 18 months after date of issue of rules. This will be no hardship because under rules 23 to 26 certificates of service can be obtained by all those persons who shall have been for three years in charge of engines when these rules began to operate, that is, they must have 18 months' service before the publication of the rules. The former period is much longer than was given in Bombay, the notification appearing in November 1874, and the 1st October 1875 being named as the date after which no person not qualified under the rules should be in charge of a boiler. It is true that such persons have to satisfy the examiners of their capability (*vide* rule 43), but it is evident that this rule must be worked with discretion and leniency because men might otherwise be deprived of making a living by the profession they had adopted and which, previous to the issue of the rules, no person could prevent them from following; practically every one who had been in charge of boiler and engine for the period stated would be granted a certificate unless he showed the most gross ignorance and that his continued employment had been due to good luck and not good guidance.

6. I do not think that I need to further remark in regard to the rules as proposed, but I would add that I deem it a matter to be considered whether the rules should not be extended to the whole Presidency; that portion of the Act relating to the examination of boilers is in force only in the city of Madras and that portion I do not propose should be extended meantime, but it would add immensely to the security of person and property if all persons in charge of boilers within the Presidency were certificated. This is a point for consideration by Government.

7. Meantime, orders for the issue of the notification regarding rules proposed might be obtained, as Government would then be able to observe how the proposed regulations were received in Madras itself; the rules would require slight modification if extended to the mofussil.

ENCLOSURES.

NOTIFICATION.

In exercise of the powers conferred by section 14 of the Madras Steam-boilers and Prime-movers Act III of 1893, His Excellency the Governor in Council proposes to notify that, after a date to be hereafter fixed which will not be less than 18 months from the date of intimation, no boiler shall be used within the city of Madras unless it is in the direct and immediate management and charge of a person certified under the above Act to be competent for the charge thereof, and under section 23, clauses (*c*), (*d*) and (*e*) of the same Act proposes to issue the following rules:—

(1) for regulating under clause (*c*) the grant and record of certificates of competency and of service;

(2) for the conduct under clause (*d*) of examinations for such certificates and for regulating the fees to be charged for admission to the same;

(3) for providing under clause (*e*) for enquiry into an allegation of drunkenness, misconduct or negligence on the part of the holder of a certificate of competency or service.

2. The Government will consider any suggestions made in respect of these rules which may be received on or after the first day of January 1898.

I.—Board of Examiners.

3. The Board of Examiners shall be nominated annually by Government. The examination shall be held at such places as may be notified by Government. Government will nominate not less than three persons to be examiners and shall nominate one of such persons as President of the Board of Examiners; at least two of such examiners shall be Mechanical Engineers in actual practice in the Presidency of Madras.

4. The examiners from time to time nominated above shall receive a fee of Rs. 25 per diem for each examination, but not less than Rs. 50 for each half-yearly examination which he attends from beginning to end.

5. The examiners shall endorse on the printed application of each candidate the result of his examination for a certificate of competency, and shall send to the Sanitary Engineer the application so endorsed.

II.—Examinations.

6. Examinations shall ordinarily be held in the city of Madras twice a year and at intervals of not more than six months. The first examination shall be held six months after the date of the publication of these rules.

7. Every examination shall be attended by one or more clerks from the office of the Sanitary Engineer to Government or the Inspector of Steam-boilers and Prime-movers, who shall do such clerical work as may be necessary and shall act as interpreter when required to do so by the Board of Examiners.

8. The examinations shall be of three kinds, one for each of the three classes of certificates of competency which the examiners are hereinafter empowered to grant.

III.—Admission of Candidates to the Examinations for Certificates of Competency.

A.—General.

9. Candidates at examinations for certificates of competency shall pay fees at the following rates:—

	RS.
For a 1st-class certificate	20
„ 2nd „ „	10
„ 3rd „ „	5

10. Unsuccessful candidates will not be entitled to a return of any portion of the fees paid by them; but, if applied for, the fee paid by an applicant, who is not admitted to examination, will be returned to him in full, provided that, in the event of a candidate being unavoidably absent from any examination for which he has paid a fee, it shall be in the discretion of the President of the Board of Examiners to allow him to appear at any examination held within one year of the first examination without a second payment of fee.

11. Any candidate after failure may appear at a succeeding examination for the same class of certificate without payment of a further fee on such date as the Board of Examiners shall determine under rule 10.

12. Every applicant for examination must make an application in the form of appendix A. He shall duly fill in all the parts of the said form which are to be filled in by a candidate, and sign the same in the presence of his employer or a municipal tax-payer of not less than Rs. 50 per annum who shall append his signature in token of attestation. The applicant shall then lodge his application at the office of the Sanitary Engineer (Ex-officio Inspector of Steam-boilers and Prime-movers) not later than twenty-one days before the date fixed for the examination, together with—

(*a*) all testimonials of good character, sobriety, experience and ability, together with copies of the same;
(*b*) any other papers required by these rules or the printed form of application;
(*c*) a receipt from a Government treasury for the amount of the fee prescribed in rule 9 for the examination at which he wishes to appear;
(*d*) a letter declaring in what language he desires to be examined; and
(*e*) all previous certificates, if any, issued to the applicant under the Act.

13. Candidates for certificates of competency who are natives of India must prove to the satisfaction of the examiners that they can read their vernacular sufficiently well to perform the duties required of them.

B.—Testimonials.

14. No applicant will be admitted to examination whose testimonials as to sobriety experience and ability do not relate to a period of at least twelve months immediately preceding the date of application to be examined, and are not, in the opinion of the Sanitary Engineer trustworthy and satisfactory.

15. The testimonial for any period during which the candidate acted as a Chief Engineer must be signed by the manager, owner or secretary by or under whom the candidate was employed and for such period as he acted as a second or lower grade Engineer must be signed by the Chief Engineer, to whom the candidate was subordinate; but if, for any sufficient reason, the Chief Engineer's signature is not obtainable, it may be signed by the manager, owner or secretary, but the testimonial must declare that the facts stated therein are either in accordance with the reports of the Chief Engineer, or, if no such reports are available, are within the personal knowledge of the person signing the same.

16. Testimonials relating to service beyond the limits of British India must be countersigned either by the consul, or by some other recognised official authority of the country in which the service was performed or, in the case of the Native State, by the Political Agent: or must be authenticated by the testimony of some credible person on the spot having personal knowledge of the facts required to be established.

17. If the Sanitary Engineer has reason to doubt the truth of any fact stated in any application or testimonial he may make such enquiries as he shall think fit.

18. The applications and copies of the testimonials referred to in rule 10 shall, before the date of the examination, be forwarded by the Sanitary Engineer to the President of the Board of Examiners with a certificate to the effect that the candidate is eligible for examination under the rules. The original testimonials shall be filed in the office of the Sanitary Engineer and shall, at the close of each examination, be returned to the candidates who presented them if they apply for the same.

C.—Age and Training of Candidates.

Training of candidates for third-class certificates.

19. A candidate for a third-class certificate of competency will not be admitted to examination, unless he (*a*) is qualified within the meaning of the rules next following as a candidate for a second-class Engineer's certificate of competency, or unless he (*b*) proves, to the satisfaction of the Sanitary Engineer, that, previous to his application, he has been three years employed as a fireman on engines and boilers, or (*c*) produces satisfactory certificates stating that he has completed a three years' course in the workshops of a recognised college or institute and during that period has been constantly instructed in the management of engines and boilers.

Age and training of candidates for second-class certificates.

20. A candidate for a second-class Engineer's certificate of competency must be not less than twenty-one years of age. No candidate for a certificate of this class will be admitted to the examination, unless he proves to the satisfaction of the Sanitary Engineer that previous to his application—

(*a*) he has served an apprenticeship for not less than three years to an Engineer, and that, during that time, he has been employed on the making or repairing of engines; or
(*b*) he has been employed for not less than three years as a journey-man mechanic in some factory or workshop on the making or repairing of engines; or
(*c*) he has, for not less than two years, fulfilled the requirements either of clause (*a*) or of clause (*b*) as to service or employment, and has, for not less than one year in addition thereto, served as Engineer in charge or Assistant Engineer in some mill or factory with boilers under steam; or
(*d*) having obtained a third-class certificate has since been in independent charge of engines and boilers for a period amounting to at least two years; or
(*e*) unless he produces a satisfactory certificate stating that he has completed in the workshops of a recognised college or institute a three years' course and during that period has been constantly instructed in the management of boilers and engines.

Age and training of candidates for first-class certificates.

21. A candidate for a first-class Engineer's certificate of competency must be not less than twenty-two years of age. No candidate for a certificate of this class will be admitted to the examination unless he proves, to the satisfaction of the Sanitary Engineer, that previous to his application—

(1) he is qualified as is required by rule 20 in the case of a candidate for a second-class Engineer's certificate of competency; and also proves that—

(2) either—

(*a*) he possesses or is entitled to a first-class Engineer's certificate of service; or, if he neither possesses nor is entitled to a first-class certificate of service,

(*b*) that he has served—

(i) for at least one year with boilers under steam as Engineer with a second-class Engineer's certificate of competency, or

(ii) for at least two years with boilers under steam as Engineer with a second-class Engineer's certificate of service, or

(iii) for at least one year with boilers under steam as second Engineer with a second-class Engineer's certificate of service and in addition for at least six months as Chief Engineer with boilers under steam which are by law required to be in the charge of an Engineer holding a certificate:

provided that if an applicant, who is able to satisfy the Sanitary Engineer as to the character of his services, has, in consequence of service abroad, been unable to obtain a second-class certificate of competency or of service, he may be allowed, if the Sanitary Engineer see fit, to be examined for a first-class certificate of competency or of service although he has not obtained a certificate of the lower grade.

22. Any person qualified under the rules hereinbefore contained to appear for examination as a candidate for a certificate of any class other than the third-class may be permitted to appear for examination as a candidate for a certificate of any class inferior to that for which he is so qualified to appear as a candidate.

D.—General Rules regarding service.

23. Every candidate, who applies for a certificate of service (section 18 of the Act), must show by his testimonials that he has been regularly employed in the engine-room as an Engineer of a certain grade.

24. Service with boilers not continuously under steam shall count as service of half the same length with boilers continuously under steam unless the candidate proves that more than half of such service was actually under steam; and the candidate must show by his testimonials whether the boilers with which he has worked were or were not continuously under steam.

25. Service as an Engineer means service in those capacities only which afford opportunities of obtaining practical experience as an Engineer on engines, boilers and their appurtenances; it does not include service as a fire-man, stoker, donkey-man, greaser, winch-man, labourer or Engineer's steward.

26. Service performed in places where the Act is not in force may be accepted as qualifying service subject to the same rules as those which apply to service performed in places where the Act is in force.

IV.—Subjects of Examination for Certificates of Competency.

Third-class.

27. To be entitled to a third-class certificate of competency a candidate must satisfy the examiners that—

(*a*) he fully understands the working and management of boilers, the use of the best means of firing for the prevention of smoke, and the separate use of gauge glass-cocks, blow-off cocks, scum-cocks and other appliances;

(*b*) he is able to some extent to explain the actual working of engines and the separate uses of feed-pumps, slide-valves, pistons and other appliances;

(*c*) he is able to show what ought to be done in case of the break-down of any portion of the machinery, &c.

28. To be entitled to a second-class certificate of competency a candidate—

(*a*) must give a description of boilers and the methods of staying them together with the use and management of different valves, cocks, pipes and connections;

(*b*) must understand how to correct defects from accident, decay and other causes, and know the means of repairing such defects;

(*c*) must understand the use of the barometer, thermometer, salinometer and the principles on which they are constructed;

(*d*) must know the causes, effects and usual remedies for incrustation and corrosion;

(*e*) must state how a temporary or permanent repair could be effected in case of a derangement of a part of the machinery, or of total break-down;

(*f*) must write a legible hand and understand the first four rules of arithmetic and their application to questions about consumption of stores and capacities of tanks;

29. To be entitled to a first-class certificate of competency, a candidate must be able to—

(*a*) make an intelligible hand sketch or a working drawing of some one or more of the principal parts of a steam engine; and to mark in, without a copy, all the necessary dimensions in figures, so that the sketch or drawing could be worked from; *

(*b*) take off and calculate indicator diagrams;

(*c*) calculate safety-valve pressure and the strength of the boiler shell, stays and revetting;

(*d*) pass a creditable examination as to the various constructions of engines in general use and as to the details of different working parts, external and internal, and the use of each part;

(*e*) state the general proportions borne by the principal parts of the machinery to each other, and calculate the direct stress, tortional stress and the bending stress, in round bars, and the direct stress and the bending stress in rectangular bars with given loads;

(*f*) explain the method of testing and altering the setting of the slide-valves, and sketch approximately what difference any alteration in the slide-valve will make in the indicator diagram, and also explain the method of testing the fairness of shafts, and of adjusting them;

(*g*) possess a knowledge of the prominent facts relating to combustion, heat and steam;

(*h*) explain surface condensation, super-heating and the working of steam expansively, the duty of pumps and the direct strains in engines and boilers;

(*i*) work calculations including the mensuration of superficies and solids and the extraction of the square root, and the application of these rules to questions relating to the power, duty and economy of engines and boilers and to the stresses in rods, shafts and levers of the engine.

V.—Mode of Examination.

Examination to be practical.

30. Every examination shall be of such a nature as to test the practical knowledge of the candidates and to ascertain their competency to manage boilers and prime-movers.

31. The examination for third-class certificate will be conducted *viva voce* in the city of Madras and will be held, if possible, in a workshop, mill or foundry where the candidate's knowledge can be practically tested in the use of the steam, vacuum and water gauges.

First and second class.

32. (1) Each candidate for first and second class certificates will in the first place be called upon to give written answers within a prescribed time to ten of the "elementary questions" appended to these rules. If the candidate's answers are not satisfactory, his examination will cease, and he shall be declared to have failed.

(2) If his answers to the ten questions are satisfactory, the candidate will be called upon—

(*a*) If a candidate for first-class certificate—

(1) to answer within a fixed time, a paper of ten questions in arithmetic as specified in clause (i) of rule 29;

(2) to make within a prescribed time a rough drawing of some part of a boiler or engine;

(3) to answer *viva voce* questions on the subjects specified in clauses (*b*) to (*h*) both inclusive, of rule 29, and on the papers which may have been set to him.

(*b*) If a candidate for second-class certificate—

(1) to answer within a prescribed time a paper of ten questions in arithmetic as specified in clause (*f*) of rule 28;

(2) to answer *viva voce* questions on the subject specified in clauses (*a*) to (*e*), both inclusive, of rule 28 and on the papers which may have been set to him.

(3) Answers to written questions must be worked out in the presence of at least one of the examiners.

(4) Each candidate's answers to written questions must be given up on the expiry of the time prescribed whether his answers are then complete or not.

(5) If, at the expiry of the time prescribed, the candidate has failed to work out the whole of the questions set to him, but the result of the *viva voce* examination, taken in connection with the answers to such of the questions as he has worked out, satisfies the examiners that the candidate is competent to take charge in the case of—

(i) a candidate for first-class certificate of boilers, whatever their nominal horse-power, and in case of

(ii) a candidate for second-class certificate, of boilers not exceeding sixty nominal horse-power

he shall be declared to have passed, otherwise the candidate shall be declared to have failed.

* See Appendix C.

33. When a candidate for a certificate fails to satisfy the Board of Examiners as required by these rules, the Board shall fix a period, after the expiry of which he may again appear for examination and shall inform him thereof; and the candidate shall not be at liberty to appear again for the examination at any place at which an examination is held under the Act until after the expiry of the period so fixed.

VI.—Rules for the Examination Room.

34. The examination in rough working drawing which candidates for first-class certificates have to pass under rule 29 (a) may, at the candidate's option, be applied either to hand sketches clearly dimensioned and complete in the necessary *views* and *sections* or to drawings to a scale. Candidates will have to bring with them any drawing instruments they may require.

35. A candidate discovered (*a*) to have taken into the examination room any book, paper, document or memoranda of any description, or (b) copying from or affording, giving or receiving any assistance or any information to and from, or communicating in any way with another candidate during the time of examination, shall be regarded as having failed in his examination, and will be turned back for six months, in the same manner as if he had failed in the practical part of the examination; but in such case no part of the fees he may have paid for examination will be returned to him.

36. If a candidate leaves the room before answering any question which has been given to him, he cannot afterwards be permitted to answer it, but the examiner may substitute other data, or another question.

VII.—Grant of lower-grade certificates in certain cases.

37. If a candidate allowed under the proviso to rule 21 to be examined for a first-class certificate though he has not obtained a certificate for a lower grade, or if a candidate already in possession of a certificate of service fail to pass the examination for the higher grade but pass the examination for the lower grade, he may receive a certificate for the grade passed, but no part of the fee paid by him will be returned.

38. A candidate who has been permitted to be examined for a first-class certificate of competency under the proviso of rule 21 without first obtaining a second-class certificate of competency or a first-class certificate of service, and who fails in his examination in practical knowledge, shall not be re-examined for a certificate of that grade until he has served 12 months as second Engineer with a second-class Engineer's certificate of competency as required by the rules.

39. If the candidate fails in the examination for the lower as well as for the higher grade of certificate, he may be re-examined for a second-class certificate only subject to the provisions of rule 33.

VIII.—Postponement of grant of certificates in certain cases.

40. (1) If, after a candidate has passed his examination, it is discovered that his services are insufficient to entitle him to a certificate of the grade for which he has passed, such certificate will not be granted to him; but if the Sanitary Engineer is satisfied that the error in the calculation of his services did not occur through any fault or wilful misrepresentation on the candidate's part, the Sanitary Engineer shall report the facts to the President of the Board of Examiners who may direct the certificate to be issued, or may allow the candidate to appear for re-examination without payment of further fee, when he has performed the deficient service.

Short service.

(2) If, in such a case, the applicant's services are sufficient to entitle him to receive a certificate of a lower grade provided as aforesaid he has not wilfully misrepresented the amount of his services, a certificate of such lower grade may be granted to him, but the difference between the fee paid by him for the superior certificate and the fee payable for the inferior certificate shall not be refunded.

(3) In such a case, when the applicant has by further service made up the time in which he was found to be deficient, he may be required, before he can receive the higher certificate, to be re-examined in all the subjects.

Re-examination.

IX.—Surrender of lower-grade certificates.

41. No certificate of the first or second class shall be granted to the holder of the certificate of a lower grade unless and until the holder has surrendered to the Sanitary Engineer the certificate of the lower grade.

Holder of lower-grade certificate to surrender it before grant of first or second grade certificate.

42. Every certificate of competency granted under section 15 of Act III of 1893 to a person in possession of a certificate entitling him thereto under the said section shall be in the form in this behalf provided in Appendix B, and shall be endorsed on the certificate of competency by virtue of which such person is so entitled as aforesaid.

X.—Certificates of Service.

43. In order (1) to ascertain that a candidate for a certificate under section 18 of the Act is possessed of competent skill for the charge and management of a boiler, and (2) to determine what class of certificate he is qualified to hold, the Board of Examiners shall subject him to such practical examination as they in each case think fit.

Examination to be practical.

44. Applicants for certificates of service will be charged fees at the following rates:—

	Rs.
First class	10
Second class	5
Third class	3

44-A. A person having once received a certificate of service shall not be granted a further certificate of service of higher grade, but may obtain a certificate of competency of higher grade under rules 28 to 33.

XI.—Form of Certificates.

45. Certificates of competency and of service shall be in the forms given in Appendix B, respectively, or to the like effect.

46. Applications under section 17 of the Act for certificates of competency corresponding to foreign certificates in the possession of the applicants, shall be in the form of Appendix A. Each applicant shall duly fill in the form, and together with copies of the original foreign certificates in his possession, shall lodge the form with the Sanitary Engineer at least 10 days before a half-yearly examination.

Certificates under section 17.

47. Holders of certificates of the first class shall be deemed capable, as first-class Engineers, to have charge of boilers attached to prime-movers of any horse-power.

Capabilities of holders of certificates.

48.* Holders of certificates of the second class shall be deemed capable, as second-class Engineers, to have charge of boilers attached to prime-movers not exceeding 60 horse-power nominal.

49.* Holders of certificates of the third class shall be deemed capable as third-class Engineers to have charge of boilers attached to prime-movers not exceeding 20 horse-power nominal.

50. Written applications for duplicates under section 20 of the Act shall be lodged with the Sanitary Engineer together with a declaration of the loss of the certificate and other documents relied upon by the applicant.

Duplicate certificates how to be obtained.

51. Duplicates of all certificates granted under the Act shall be recorded in the Boiler Inspector's office, Madras.

Record of duplicates.

XII.—Misconduct of Holders of Certificates.

52. Should it come to, or be brought to, the notice of the Sanitary Engineer, that any person holding any certificate under Act III of 1893, has, when on duty, been drunk, or has misconducted himself, or been negligent in respect to his duties, the Superintending Engineer shall, if he deems it necessary, report the facts to Government in order that the matter may be dealt with under section 19 of Act III of 1893. On any such enquiry having been ordered by Government the holder of the certificate about whose conduct the enquiry is instituted shall be called on to surrender his certificate to the Sanitary Engineer to be retained by him until Government pass orders on the result of such enquiry and should such certificate not be surrendered within three days from date of receipt of such call, the provisions of clause 2 of section 19 of the Act will be enforced.

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* NOTE.—For the purpose of the above rules the following formulæ shall be used to determine the nominal H.P.—

For single cylinder engines condensing or non-condensing, $\frac{S}{10}$.

Where S = the square of the diameter in inches of the cylinder.

For compound engines, $\frac{S}{32}$.

For triple expansion engines, $\frac{S}{22}$.

Where S = Sum of the squares of the diameters in inches of all the cylinders of an engine.

APPENDIX A.

MADRAS ACT III OF 1893.

APPLICATION for an Engineer's certificate of competency under section ____

Rotation No.

(a) Name, &c., of Applicant.

Names at full length.	Surname.	Permanent address, stating town, street, and number of house and name of person (if any), with whom residing.
1	2	3

Date of birth.			Where born.	
Day.	Month.	Year.	Town.	Country.
4	5	6	7	8

(b) Particulars of all previous Certificates (if any) whether issued in British possessions or elsewhere.

Number.	Competency or service.	Grade.	Where issued.	Date of issue.	If at any time suspended or cancelled, state by what court or authority.	Date.	Cause.
9	10	11	12	13	14	15	16

(c) Certificate now required.

Grade.	Competency or service.	Address to which it is to be sent.
17	18	19

Certified that the applicant is eligible under the rules for examination.

Sanitary Engineer to Government.

To The President, Board of Examiners.

(d) If applicant has failed in a previous examination for the certificate now required, he must here state when and where. If he has not failed, he must state so in writing across this division.

Day.	Month.	Year.	Town.	Subjects in which he failed.
20	21	22	23	24

(e) Declaration to be made by Applicant.

(Take notice).—Any person who makes, procures to be made, or assists in making, any false representation for the purpose of obtaining for himself or any other person, a certificate either of competency or service *will be criminally* prosecuted.

I do hereby declare that the particulars contained in divisions (*a*), (*b*), (*c*), (*d*) and (*f*) of this Form are correct and true to the best of my knowledge and belief; and that the papers enumerated in division (*f*) and sent with this Form are true and genuine documents, given and signed by the persons whose names appear on them. I further declare that the statement (*f*) contains a true and correct account of the whole of my services without exception.

And I make this declaration conscientiously believing the same to be true.

Dated at this day of 189 .

Signed in the presence of

Signature of applicant.

Present address.

(f) List of Testimonials and Statement of Service.

(The testimonials to be numbered consecutively according to the number given in column 25 below) :—

Number of testimonials (if any).	Where employed.	Horse-power of engines.	Style of Factory.	Service of applicant.						Remarks.	Initials of verifier.
				Capacity.	Date of commencement.	Date of termination.	Time employed in this service.				
							Years.	Months.	Days.		
25	26	27	28	29	30	31	32	33	34	35	36
						Total Service ..					
						Time served for which certificates are now produced ..					
						Time served for which no certificates are produced ..					

(g) Certificate of Examiner.

NOTE.—The Examiner should fill up divisions (*g*) and (*h*) and in all cases, as soon as possible, forward this paper to the Sanitary Engineer. If the applicant passes, his testimonials and previous certificates, if any, must be sent with this paper. The certificate and the testimonials will be delivered to the applicant at the office of the Sanitary Engineer.

Date and place of Examination.		Insert passed or failed in each column.		Rank for which passed.
Date.	Place.	In working out the questions.	In the *viva-voce* examination.	
37	38	39	40	41

(h) Personal Description of Applicant.

Height.		Complexion.	Finger marks, personal marks and peculiarities.	Colour of	
Feet.	Inches.			Hair.	Eyes.
42	43	44	45	46	47

I hereby certify that the particulars contained in divisions (*g*) and (*h*) are correct.

This form and the testimonials are returned to the Sanitary Engineer.

This day of 189 .

Signature of Examiner.

To

The Sanitary Engineer and

(Ex-officio) Inspector of Steam-boilers and Prime-movers, Madras.

APPENDIX B.

(SEE RULES 42 AND 45.)

Form of Certificate of Competency.

CERTIFICATE of Competency of the class granted under the Madras Act III of 1893.
No. of 189 .

A.B., aged about , at present residing at , having satisfied the Board of Examiners appointed under the above Act, of his competency to have charge of a boiler attached to prime-movers of any horse-power (*or* not exceeding 60 or 20 horse-power nominal, *as the case may be*), is granted under section 15 of the said Act this certificate of competency of the first (or second or third, *as the case may be*) class.

The of 189 .

(Signed) ,
Board of Examiners.

Duplicate of this certificate has been recorded in the office of the Inspector of Steam-boilers and Prime-movers this day of 189 .

(Signed) ,
Inspector of Steam-boilers and Prime-movers.

Form of Certificate to be granted under section 17 of the Act.

No. of 189 .

Whereas Mr. , at present residing at , has produced before us a certificate of the class issued to him by the , we, in accordance with the provisions of the Madras Act III of 1893, section 17, hereby authorize him to be in charge of boilers attached to prime-movers of horse-power on the production of this certificate.

The of 189 .

(Signed) ,
Board of Examiners.

Duplicate of this certificate has been recorded in the office of the Inspector of Steam-boilers and Prime-movers this day of 189 .

(Signed) ,
Inspector of Steam-boilers and Prime-movers.

Form of Certificate of Service.

CERTIFICATE of service of the class granted under section 18 of Madras Act III of 1893.
No. of 189 .

A.B., aged about , at present residing at , having satisfied the Board of Examiners appointed under the above Act at , that he has served for a period of not less than three years prior to the day of (the date on which the rules under the said Act published in *Fort St. George Gazette* of came into force) as Engineer in actual charge and management of a boiler, and that he is possessed of competent skill for the charge of a boiler attached to prime-movers of any horse-power (*or* not exceeding 60 or 20 horse-power nominal, *as the case may be*), is granted under section 18 of the said Act this certificate of *service* of the first (or second or third, *as the case may be*) class.

The of 189 .

(Signed) ,
Board of Examiners.

Duplicate of this certificate has been recorded in the office of the Inspector of Steam-boilers and Prime-movers this day of 189 .

(Signed) ,
Inspector of Steam-boilers and Prime-movers.

APPENDIX C.

Examination in rough working drawing for a first-class Engineer's certificate of competency.

1. Rules in regard to the qualifications of a candidate for a first-class Engineer's certificate of competency specify that—

"He must be able to make rough working drawings of the different parts of the engines and boilers;

"He must be able to state the general proportions borne by the principal parts of the machinery to each other."

2. In accordance with these clauses a candidate for a first-class certificate is required to make a rough working drawing of the parts specified below:—

Fine drawing is not expected and in the proportions of the parts a wide margin will be allowed; grossly inaccurate dimensions will be failure in practical knowledge. The drawing must, however, be practically a working drawing, giving a sufficient number of views to show the parts fully—sections, plans, or elevations—just as the candidate would require to be supplied to him if he had to make the parts to the design of another person.

3. A clear hand sketch showing the construction completely and fully dimensioned will be accepted if the candidate prefers this alternative.

4. A portion only of the parts specified may be accepted in place of the whole, if that portion is sufficient to show that the candidate has a good practical idea of the construction of the parts and a fair notion of their general proportions or dimensions.

5. Candidates are hereby cautioned to put on paper nothing which they have not fully considered and understood.

6. The candidate is advised not to begin more than he can clearly finish in the time allowed. An important object in this part of the examination is to ascertain whether the candidate can be trusted to mark all necessary dimensions upon a sketch or a drawing. The test of this is practically the making of the part from the sketch without having to supply additional dimensions and without measuring the drawing. To prove his ability the candidate must fully dimension the parts shown in his sketch or drawing notwithstanding that the parts may be correctly drawn to scale. A drawing is fully dimensioned when no part of it is left to the option of the party who is to work the drawing.

7. The candidate is not expected to design anything; he has merely to sketch or draw something with which he is already familiar.

8. All the dimensions, the figures, and the darts must be inked in; employ the remaining time in examining the drawing and in inking in any figures which may have been before overlooked and in checking the dimensions.

9. There should be sufficient room on the sheet to show all the necessary views. Another sheet of paper can be had if necessary. All the paper used must be forwarded with the drawing.

Fill in and sign the following statement:—

Subject for Examination in Rough Working Drawings.

Specimen Questions.

A common slide valve with its spindle? Show also an outline section of the parts at the cylinder face? Show the provision for connecting the slide valve to the spindle?

The candidate is requested to fill up the following and to attach this paper to his drawing:—

Statement by the Candidate.

The accompanying drawing, made by me this day, without referring to any document and without the assistance of any person is intended by me to be sufficient for the new construction of the parts above described to fit the place of similar parts which are to be removed. The construction is similar to what I am familiar with in the . Factory, Mill or Workshops , but the dimensions may be different.

Specimen notes on Drawing.

The diameter of the cylinder is .
The stroke of the piston is .
The stroke of the valve is .

The cover at top end on steam side is
The cover at bottom end on steam side is
The lead at top is intended to be
The lead at bottom is intended to be
The inside cover is or
The thickness of the face of valve is
The thickness of the body of valve is
The greatest opening for steam will be
That gives an area equal to one
The opening for exhaust when the crank is on the top centre is
That gives an area equal to th of piston.
The length of the connecting rod is
The valve will cut off steam on the down stroke at
The valve will cut off steam on the upstroke at } The candidate may omit this part if he chooses.
The parts fully dimensioned, in ink, are

Dated at
this day of 189 .
Applicant.
.....

APPENDIX D.

Instructions to Examiners.

Examiners shall require all candidates to fill up a form of which a copy is attached, and they shall forward the same to the Sanitary Engineer along with the reports of the examination (Appendix A).

For the present the questions for candidates for first-and second-class Engineer's certificates will be taken from the book of "Elementary Questions"; and candidates are expected to show their superiority by giving answers more complete than those of the other candidates.

The numbers of the questions for each examination are not to be communicated to the candidate until his examination commences.

The questions themselves need not be written, only the answers to them.

Form of Preliminary questions to be answered by the first-and second-class candidates.

City.	Class for which examined.
Date.	Candidate's name.

(*a*) Where and how long did you serve in works at the making or at the repairing of engines and in what capacities?

(*b*) How long have you served as fireman or driver?

(*c*) How long have you served in an engine-room and in what capacities?

(*d*) With what descriptions of engines have you served—jet condensing, surface condensing, or non-condensing engines, compounds, triples, inverted cylinders, or horizontal engines? What size were the engines?

(*e*) With what descriptions of boilers have you served—Lancashire, marine, multi-tubular, sectional or locotype boilers?

(*f*) What engine defects have come under your notice, what caused these defects, and how were they remedied? Give the names of the factory for verification.

(*g*) What boiler defects have come under your notice, what caused these defects, and how were they remedied? Give the names of the factory for verification.

ELEMENTARY QUESTIONS.

1. What parts of an engine are generally made of wrought iron?
2. What parts of an engine are generally made of cast iron?
3. For what part of an engine is steel sometimes used?
4. What parts of an engine are generally made of brass or gun metal?
5. Where is "white metal" sometimes used? On account of what property possessed by it is it adopted? What objection is there to its more general use?
6. For what parts is Muntz Metal sometimes used? Is it malleable? For what properties is it valued?
7. What difference is there in the composition of cast iron, of wrought iron, and of steel?
8. How can cast iron, wrought iron, and steel be distinguished from each other?
9. What are the different properties of cast iron, of wrought iron, and of steel?
10. What is meant by the terms "breaking stress," "proof stress," "safe working stress"?
11. What is the cohesive strength, or breaking stress, of good ordinary wrought iron?
12. Tempering steel; how is it done, and in what order do the colours come?
13. What is case-hardening?
14. Which of the common metals or alloys can be forged, and which of them are brittle or "short"?
15. What is meant by "welding"? Which of the common metals can be welded?
16. The expansion of metals by heat; give examples of this in the engine and in the boiler.
17. In the construction of cylindrical boilers, what parts of the plates have to be worked hot? When the material is steel, what precautionary treatment of the plates is afterwards necessary?
18. What is "double rivetting"? In what parts of cylindrical boilers is double rivetting employed? In which of the shell seams is it most necessary?
19. What is "caulking," and how are seams prepared for caulking?
20. Describe the different ways of staying the ends of a cylindrical boiler? What are the merits of and objections to the different plans?
21. What strain per square inch is allowed on boiler stays?
22. Describe a rivetted stay, and state where such stays are commonly used?
23. Where are thin plates to be looked for in a boiler as it wears, and how is the thinness to be detected?
24. How are boiler tubes fixed? What are "stay tubes," and how are they secured?
25. Where is it generally that boiler tubes leak? How is this defect repaired? What are the causes of this leaking?
26. What are the causes of cracked tube-plates? Where are the cracks situated? How are they repaired?
27. What is the difference between a "flash flue," a "split draft," and a "wheel draft"? What classes of boilers are each peculiar to?
28. What is meant by a "fuel economiser"? What is its construction? What valves and cocks are on it? What is the pressure per square inch in it, in comparison with the pressure in the boilers to which it is joined?
29. What parts of the "Loco. type" boilers are first injured by shortness of water?
30. Where are angle irons used in the construction of a Cornish or Lancashire boiler? And where are flanged plates used?
31. Priming; to what causes is it attributed? What means are applied to prevent it? What evils may be produced by it?
32. What causes, and what checks furnace draft, with an ordinary factory boiler?
33. Black smoke is sometimes seen at the top of a factory chimney; what is the cause of this? Is it beneficial or detrimental? Give reasons.
34. A "blast pipe" is fitted to Loco. type boilers, what is its construction? Where is it placed? For what is it used?
35. How is a blow-off cock fitted to Lancashire and Cornish boilers? Why is it not fitted direct on to the boiler shell?
36. Blow-off cocks are sometimes fitted with a double gland; for what purpose is this? Describe how the double gland is formed?

37. Test cocks or water-gauge cocks; where are they placed? At what heights? Must the cocks themselves be at those heights? What provision is made for cleaning these cocks should they ever become choked? When there are no test cocks, how is the height of the water ascertained?

38. What is a "dead-weight" safety valve? Of what are the rubbing surfaces formed? What are its advantages and faults compared with the common lever and weight valve?

39. About what area of safety valve is now required by the Board of Trade? What area was formerly required, and on what ground has that been altered? What is the effect of suddenly opening a safety valve when steam is up? To about what extent do safety valves rise when blowing off without being eased by hand?

40. Spring-loaded safety valves; what advantages have they that are not possessed by dead weight valves? What are the disadvantages as compared with dead-weight valves?

41. Of what pieces does a glass water-gauge mounting consist? How does it act? Where is it placed? At what height? Is it liable to derangement? How is its working tested?

42. Glass water-gauges are sometimes fitted in duplicate; what is the object sought?

43. Describe a Bourdon steam-gauge. Some gauges have an inverted syphon pipe below them; what is its use?

44. On Lancashire and Cornish boilers the steam pressure gauge mounting has usually a small branch closed by a screwed cap; what is this branch for?

45. Do steam-gauges indicate the total pressure of the steam, or only a portion of that pressure? What is the pressure measured from?

46. What is meant by the salting of the boiler? How is this prevented? What is the density of ordinary sea water? How is the density ascertained? What is the difference between the formation of scale and the salting of the boiler?

47. Scum cocks and pipes; how are they arranged? Where are they placed? At what height in the boiler? When are they used? When must they be shut? Neglect of these cocks lead to what dangers?

48. Scale; of what does it consist? Where is it most objectionable? How is it removed? How is its formation prevented? What evil effects are produced by it?

49. What is a salinometer? Of what does it consist? How does it act? How is it graduated? Can it be used at any temperature indiscriminately?

50. What harm may be done through the check valve of one of a set of boilers being defective? How would you work to avoid this harm?

51. How is the leak from a split tube stopped in a Loco. type boiler while under steam? Describe the operation.

52. What is the use of dampers? Where are they fitted to Loco. type, Cornish, Lancashire, and Vertical boilers?

53. If no dampers were fitted to a Cornish boiler, how could the draft be regulated? What inconvenience would arise from the want of dampers?

54. Describe the piston of a steam cylinder, with its different rings and their uses.

55. Cylinder drain cocks; what is their use? There is sometimes a valve upon each cock; what purpose does it serve?

56. Cylinder escape valves; of what do they consist? How protected? How regulated? When are they most needed? To what danger do they expose the engineer? What precaution is sometimes used to obviate this danger?

57. What is a "compound engine"? What different kinds are there used in mills and factories, in respect to the number and arrangement of their cranks and cylinders? What is a triple expansion engine?

58. What is "link motion"? What are some of its advantages? What motion is sometimes used in its stead?

59. What is a separate expansion valve? Why is it not fitted to all engines? What effect has an expansion valve upon the starting and upon the reversing of the engine?

60. What arrangement is applied to reduce the friction of a slide valve? To what is the friction due?

61. Describe a "variable-eccentric"? How does it act? In what class of engine is it used?

62. What is the travel of the eccentric? How is it measured on the eccentric? What is the travel of the slide valve when the link motion is in mid gear, and the engine still moving?

63. What are "double beat valves"? Why are they not generally used for safety valves? Are they ever used instead of the slide valve? What objections are there to their use?

64. What is a circulating pump? Is it always worked by the main engine? Give an example from the last factory you worked in, of the three water temperatures generally noted by careful engineers.

65. An air valve is sometimes fitted to a circulating reciprocating pump; what purpose does it serve?

66. What is the difference between a bucket air-pump, a piston air-pump and a plunger air-pump?

67. Whether are double acting air-pumps, made with plungers, with pistons or with buckets?

68. What is an air-pump trunk? When is it necessary? How is it attached to the bucket?

69. What class of air-pump requires both foot and delivery valves, and in what other class can either of these valves be in some cases dispensed with?

70. When working at ordinary speed, when the air-pump bucket is at top of its stroke, at what height is the water in the condenser?

71. With a surface condenser and a single acting air-pump, what is the effect of a leaky foot valve, and what is the effect of a leaky bucket when there is also a foot valve?

72. Air-pump pet cock or valve; where is it placed? How does it act? What is its object? Does it in every case reduce the effective capacity of the pump? Is it equally applicable to double acting pump?

73. At what temperature is the hot well worked? What is the effect of higher temperatures? What is the effect of lower temperatures? What limits the lowness of temperature? Has a very low temperature any disadvantages?

74. Jet fittings to the surface condensers; what are required? When to be used? What precautions are necessary?

75. With surface condensers, what takes the place of the injection? To what is the connexion made? How is its valve formed? Why is this necessary?

76. What are the practical guides to the proper amount of opening of the inlet valve for the circulating pump?

77. Feed-pump pet cock or valve; where is it placed? What is its use? How does it act? Is it always a necessary fitting?

78. What are some of the ways of fastening the ends of surface condenser tubes? About what size and about what thickness are condenser tubes? What parts of a surface condenser are made of brass?

79. What is a blow-through valve or cock? To what is it attached? There is sometimes a valve that when opened admits steam from the slide valve casing to the exhaust port; what is its use? To which cylinder is it fitted?

80. What is a "Hopkinson valve"? What is its use? Where is it fixed? How is it set? Can it be set too low or too high?

81. What connections are generally fitted to the donkey pump, and to what services can it be applied?

82. When the engines are stopped with steam up, what are to be shut and what are to be opened?

83. How is an engine heated up before starting? What precautionary examinations are made before starting?

84. What is an interceptor or catch-water? Where is it fixed, what is its construction, how does it act, and what attention does it require?

85. Describe an air-pump bucket, with its valve or valves and its packing. Of what are the valves generally made?

86. Of what materials are air-pump rods made? Why so?

87. What is meant by "unsteady driving"? Mention instances. What danger attaches to it? What is done to prevent it?

88. What are governors? What is their general construction? How do they act on "Corliss valves"?

89. What is meant by "spur driving," "rope driving," and "pelt driving"?

90. Explain the difference between a right hand and a left hand engine?

91. What is meant by the "Slip" of a belt or a rope on a driving pulley?

92. Which of the valves about engines and boilers have to be worked by hand, which of them work self-actingly, and which are worked by the motion of the engine?

93. Why is soda sometimes put into a boiler, and how is it put in? What is the kind of soda used?

94. Tallow cups for cylinders were sometimes made with two small cocks, or with only one small cock, or with one large hollow plug cock, or with one small cock and a valve; which of these is suitable for a high pressure cylinder, and which for the cylinder of a condensing engine? Describe how the cup with only one small cock is used? What is now generally used instead of these? How has this change come about?

95. Does a cylinder escape valve, self-acting, allow all the water to escape, if not, how much is left in the cylinder?

96. What is a "sight feed" lubricator? Explain its action. To what part of an engine is it generally attached? Whether will throwing cold water over it, make it work faster or slower? Describe one you have worked.

97. A common spur driving wheel; what is the boss made of? How are the arms fastened into the boss? How are the weight segments, and the toothed segments fastened?

98. Why have some of the weight segments of a spur wheel hollow spaces in them, while others are solid? With what class of engines is this unevenness most required? In what part of the circumference is the heaviest segment put?

99. With what class of compound engine is a "receiver" required between the high and low pressure cylinder, and with what class of compound engine is such a receiver unnecessary? State reasons in each case.

100. Explain the terms, "spur gearing," "bevil gearing," "mortise gearing," and "friction gearing," stating in what cases each is used.

101. What is meant by "staking" a wheel or drum? And what is meant by the term "hung on keys"?

102. What is meant by "pitch line" of a toothed wheel? What is meant by "pitch," length and width of teeth on spur wheels?

103. Explain the terms "spring pinion" and "split drum," why are they so made?

104. What valve motion is used for regulating the admission of steam to the cylinders of mill-engines? Explain the principle of its action.

105. What are expansion joints? Where are they necessary? What attention do they require? Of what should the working surfaces be made?

106. What omission in the construction of expansion joints may lead to a serious accident when steam is first applied? Where are such joints most required? Describe several forms of expansion joints.

107. Describe an oil cup with a syphon worsted. How is the worsted arranged? How is it cleaned? How far down the tubes does it extend?

108. Describe a main shaft bearing (with its system of adjustment and lubrication) of a rope driving mill engine, compound cranks at right angles, to indicate 1,000 H.P.

109. What is the usual speed of ropes, and what indicated H.P. does each rope usually drive, in ropes $5\frac{1}{2}$ inches circumference driving spinning mills?

110. Describe a Jacketted "Corliss" cylinder with all necessary fittings.

111. In mill-gearing, what is meant by a "foot step"? Where are such used?

112. How are heavy wheels fixed to their shafts? What prevents them working loose?

113. Where are injection valves placed in jet condensing factory engines? From what position is this valve usually worked? Why so? What attention does it require?

114. In an ordinary factory, fitted with compound engines and Lancashire boilers, what cocks and valves are in the engine room, and what are in the boiler house?

115. Describe the necessary fittings of a Lancashire boiler, including an Injector.

116. With a surface condensing engine, what cocks or valves are opened some time before the engine is started so as to be ready for starting whenever the order is given?

117. What is a steamjacket? What cocks are on it? In what engines are jackets most generally used? Do they require to be felted?

118. What parts of an engine or its fittings should be felted or otherwise protected from radiation?

119. The work of the air pump in a mill engine is usually done, driving one stroke of the engine; which stroke is so burdened, and why?

120. Name the principal pipes about the engines and boilers of a cotton mill, and state to what the ends of such pipes are connected.

121. Through what cocks or valves, pipes and chambers does the water pass on its way from the "jack well" to the water space in the boilers with a jet condenser engine?

122. Through what cocks or valves, pipes, and chambers does the circulating water of a surface condenser pass?

123. Through what cocks or valves, pipes and chambers does the steam pass from the boiler until it is in the form of water in the hot well?

124. Name the pieces of the engine through which the pressure of the steam is transmitted from the piston to the driving gear in an ordinary factory engine?

125. What is an air vessel? How does it act? At what parts of an engine or of its fittings are air vessels generally applied?

126. What is the construction of an injection pipe "foot valve," such as are fitted in jack wells of mill engines? What is their object? Why is the rose fitted below them?

127. What is a "barring engine"? Why are they fitted?

128. What is an oscillating engine? Where are they used? Why? Why are they not used on land?

129. What "reversing motion" is fitted to portable engines having no link motion?

130. What is "Cowburns group" dead-weight safety valve? What are its advantages over the common dead-weight valve?

131. Where are "expansion-couplings" required in shafting? Describe one.

132. Describe a "gusset stay;" show how they are secured to both shell and end plate; state what you know for and against their use in Lancashire boilers.

133. About how much fuel per indicated horse power per hour is required by modern steam engines, common, compound, and triple expansion?

134. What is the explanation of the economy of the surface condenser?

135. What is the construction of a surface condenser? Of what are its tubes made? How are they fixed? How are they kept tight? What is done with a split tube?

136. Where do surface condensers foul? How are they cleaned?

137. What non-conducting substances are employed to prevent radiation, and how are they applied?

138. With "portable engines," what provision is made to prevent ashes and sparks injuring adjacent property?

139. How can the formation of black smoke be prevented? Describe smoke preventing apparatus.

140. What is meant by "circulation" in a boiler, and what are the results of defective circulation?

141. What means are sometimes adopted to improve the circulation in a boiler?

142. How can extra heating surface be gained in Lancashire and Cornish boilers? Is it on the whole advantageous?

143. What "fittings" are usually on a steam receiver between a high pressure and low pressure cylinder?

144. What is the construction of a feed escape valve, to what is its discharge connected, and how is its loading regulated?

145. When there is no feed escape valve, what is the arrangement of the feed valves or cocks?

146. What is the measure of a horse power? How is indicated horse power ascertained?

147. Has "nominal horse power" a fixed meaning? What is the use of this expression? What is generally taken as the measure of one horse power nominal?

148. What is meant by "back-pressure" in a cylinder? About how much was it the last engine you were with? Is excessive cushioning ever a trouble under certain conditions in modern engines? Say when and why, and in which cylinder this occurs.

149. What is meant by "piston-speed," and about how much is it in mill-engines, and how much in non-condensing factory engines?

150. What is "atmospheric pressure"? What is its average amount? What instrument tells this amount?

151. What is "gross pressure" or "absolute pressure"? What pressure is it that is shown by the steam gauge?

152. What is meant by "cutting off" steam? How is it done? What part of the valve regulates the cut off?

153. What is a "Corliss valve"? Describe its construction. Why has it superseded the slide valve for mill engines? What is its great defect?

154. What fixes the time of closing the exhaust? After the exhaust is closed and before the port opens for steam, what becomes of the steam that is in the cylinder?

155. What is the "lead" of the valve? What is its object? About what amount is it?

156. What is the "cover" or "lap" of the valve? What is its object? About what proportion of the stroke of the valve is it made?

157. What is the "exhaust cover" of a slide valve? What is its effect upon the cushioning and upon exhaust?

158. What is "minus cover" or "minus lap" on the exhaust? What is its effect upon the exhaust and upon cushicning?

159. What is "cushioning" or "compression" in a steam cylinder? How is it affected by the amount of cover or of minus cover there may be upon the exhaust? How is it affected by the exhaust pressure?

160. What is "mean effective pressure"? How is its amount ascertained?

161. What is a dial vacuum gauge? What is its construction? For what is it used? About what amount should it show when the engine is working all right? What effect has the variations it indicates on the performance of the engine?

162. Does the vacuum gauge enable you to tell what pressure there is in the condenser, or must you have recourse also to the barometer to arrive at that? How would you ascertain the actual amount of back pressure there is in the condenser?

163. What is a barometer? What is its construction? Is a barometer sometimes used instead of a vacuum gauge? In what respect does the weather barometer differ from the vacuum gauge barometer?

164. The common vacuum gauge and the common steam gauge, in which of them are the graduations marked from atmospheric pressure? Does either of them tell what is the true actual pressure in the boiler or in the condenser?

165. Do steam and vacuum gauges vary with the variations of the weather barometer? When the weather barometer varies from 29 to 31, how much will the vacuum gauge vary, and how will that affect the working of the engine? Why so?

166. Vacuum is generally stated as so many inches. What is meant by, say, 20 inches vacuum? What does that tell us about the absolute pressure of the vapour then in the condenser?

167. From what depth will a pump draw water? Is there any limit? Why?

168. What is vacuum? Can any vacuum move a position? When the temperature of the water in the condenser is 2120, what is the greatest degree of vacuum there can then be in the condenser?

169. What is a thermometer, its construction? What is the property of matter that is the principle of its construction? What temperatures are regularly noted by careful engineers?

170. What is the temperature of (1) melting ice, (2) of boiling water, (3) of steam about 60 lb. pressure by the steam gauge, (4) of steam about 100 lb., and (5) of steam about 150 lb., also (6) of smoke in the funnel, and (7) of water in the hot well?

171. What is meant by the "conduction" of heat? Give examples of it in the boiler and in the engine.

172. What is meant by the "convection" of heat? Give examples of it in the boiler and in the engine.

173. What is meant by "radiation" of heat? Give examples of it in the boiler and in the engine.

174. Which is convection, which is radiation, and which is conduction in the following cases:—(1) Heat from the glowing fuel to the furnace crown. (2) Heat passing from one side of the furnace crown plate to the other. (3) Heat passing from the steam pipes in the engine room. (4) The heat of evaporation?

175. What are the "effective heating surfaces" of a "Lancashire boiler," a "Loco. type boiler," and a "Vertical boiler"?

176. What is the average difference between the temperature of the feed water on entering and leaving an ordinary mill fuel economiser?

177. What is the general temperature of the gases at the base of the chimney attached to a range of boilers in a cotton mill?

178. State as many ways as you can by which a boiler might not get its full speed; that is, a boiler, or one of a set of boilers, gets short of water although the feed valve is open its proper amount; to what causes might this be due?

179. Of what are furnace bars generally made? About what thickness are they at top? About what space is between them? Whether are the bars put further apart for Newcastle coal or for Welsh coal?

180. Which burns faster, Newcastle coal or Welsh coal? Which is the flaming coal? Which makes most smoke?

181. About how many tons of steam coal will be burnt per day in four furnaces, each 3′ 0″ wide, and of about the usual length? On what grounds do you say so?

182. About how many tons of coal will be burnt per day with good compound engines indicating 1,000 H.P.? On what grounds do you say so? What percentage of coal would be required with the same load if the piston speed was augmented five per cent.?

183. About how many tons of steam coal will be burnt per day with a good compound engine, surface condensers, the low pressure cylinder 70 inches diameter doing average work? On what grounds do you say so?

184. A pair of inverted cylinder direct acting engines, there is a liner half an inch thick between the head eccentric rod and the eccentric strap, in overhauling the engine this piece is lost and forgotten; what difference will its omission make in the working of the engine, on the admission, on the cut-off, and on the exhaust of the steam? Which will take place earlier and which later, distinguishing between the up stroke and down stroke?

185. With a horizontal engine with the fly wheel running in the usual direction, which crosshead guide gets the most strain? And on which stroke is the strain greatest? Sketch your meaning.

186. The "toothed segments" in a spur driving wheel are getting loose; how will this show in the engine room?

187. How can you prove whether the main shaft is true with a line through the cylinder?

188. How can the fairness of a pair of bevil wheels be tested? Explain how they are adjusted.

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From the Sanitary Engineer to Government, dated 4th October 1898, No. 1429.

ORDER—No. 2702 W., dated 17th October 1898.

Section 14 of the Madras Steam Boilers and Prime Movers Act, 1893, provides that, from a duly specified date and within any defined local area, no boiler shall be used unless it is in the direct and immediate management of a person certified under the Act to be competent for the charge thereof. The Government having directed inquiry to be made as to how best these provisions could be brought into effect, the Sanitary Engineer now submits detailed proposals with draft rules under sections 14 to 20 and 23 (*c*) (*d*) of the Act.

2. These rules, which are based on those in force in Bombay, provide for three classes of certificates, the lowest of which will be granted on passing a *viva voce* examination of a very elementary character. The second or intermediate certificate requires a somewhat more advanced standard of competency, while to obtain a first-class certificate the candidate must have a well-grounded knowledge of the construction and working of steam engines, and of other allied subjects, including mathematics.

3. It is proposed to make the examinations compulsory eighteen months after the issue of the rules, and the question is raised whether the rules should not be extended to the whole Presidency. The Sanitary Engineer does not recommend that the provisions of the Act relating to the *examination* of boilers should be so extended; but only that the boilers in the mofussil should, equally with those in the town of Madras, be in charge of certificated men.

4. The question as to whether the provisions of the Act relating to the examination of boilers should be extended to the mofussil is being separately considered. Meanwhile, the proposed rules for the grant of certificates of competency, as amended in a few verbal particulars, will be referred to the Locomotive Superintendent of the Madras Railway and General Superintendent, Public Works Workshops, for opinion. Copies of the rules will also be communicated to the Collectors of districts for circulation, through owners of boilers, to the men affected. The Sanitary Engineer will arrange for a similar distribution at Madras.

5. The replies will be considered on or after the 1st January next.

6. A copy of these proceedings will be published in the Fort St. George and District Gazettes for general information.

(True Extract.)

A. C. Russell.

Under Secretary to Government.

To all Collectors.
" the Judicial Department.
" the Local and Municipal Department.
" the Sanitary Engineer.
" the Locomotive Superintendent, Madras Railway.
" the General Superintendent, Public Works Workshops.
" the Superintendent, Government Press.

Exd. S. J. Pereira.

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