

AEROSPACE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

SAE ARP890

REV.
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Spark Plug Rating Calibration

FOREWORD

This revision contains editorial/format changes only.

INTRODUCTION

It has been found that the cooling rate of spark plugs in comparison with the indicated mean effective pressure on the piston can vary greatly between one cylinder head and another. Also, on occasions, a wide variation in ratings was found between those taken at one time in comparison with those taken at another time on the same cylinder head. These differences were due to many conditions, some of them controllable and some uncontrollable. Accordingly, it is necessary to arrive at a means of correction for these variables so that comparable results can be obtained at all times. This is necessary in order to establish acceptable standards for use in development work and in the application of production quality control.

After considerable work on the investigation of rating correction means, it has been decided that carefully made spark plugs offer the best method of detecting and compensating for engine and operating variables. The spark plug models which have been determined as satisfactory for this purpose are listed in AS889.

As a result of the research program, the following procedure is recommended for the use of calibration spark plugs.

1. SCOPE:

Procedure for obtaining the corrected heat-rating values (indicated mean effective pressure, IMEP) of spark plugs rated in the SAE 17.6 cubic inch rating engine (SAE AS840).

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2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. In the event of conflict between the text of this specification and references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AS840 Manual for the SAE 176..6 Cubic Inch Spark Plug Rating Engine, Including Maintenance and Overhaul

AS889 Calibration Spark Plugs

3. RECOMMENDED PROCEDURE FOR USE OF CALIBRATION SPARK PLUGS:

3.1 Master Calibration Spark Plugs:

Obtain three specially selected uniform, prerated spark plugs of the model required for calibration purposes (see AS889). These shall be considered as master calibration spark plugs.

3.2 Working Calibration Spark Plugs:

Obtain an appropriate number of the same model spark plugs as in paragraph 3.1. These will be known as working calibration spark plugs.

3.3 Determination of Standard Rating of Working Calibration Spark Plugs:

3.3.1 Rate the three master calibration spark plugs (M_1 , M_2 , M_3) three times, alternating these ratings, in the same rating engine with those in paragraph 3.3.2.

3.3.2 Rate as many working calibration spark plugs (W_1 ----- W_n) as are desired. It is recommended that at least ten working calibration spark plugs be available for use at all times.

3.3.3 Calculate the standard rating of each of the working calibration spark plugs as follows in Equation 1:

$$\text{Rating of } W_1 = \frac{\left(\text{Avg. of the 3 ratings obtained for } W_1 \right) \times \left(\text{Avg. of the assigned ratings}^1 \text{ of } M_1, M_2, M_3 \right)}{\text{Avg. of the 9 ratings obtained for } M_1, M_2, M_3} \quad (\text{Eq. 1})$$

¹ As assigned by the supplier through prerating or as previously determined by the recommended procedure (paragraph 3.3.5).

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3.3.4 Mark this rating figure on the hexagon of the spark plug.

3.3.5 Preserve and store the master calibration spark plugs and use only for: (1) future reference, (2) the establishment of new working standards, or (3) the establishment of new master calibration spark plugs. To preserve the original master calibration spark plugs they should be used as sparingly as possible. Additional calibration spark plugs with sensibly the same rating as the master spark plugs can be selected from the working calibration spark plugs and used as needed.

3.4 Determination of Engine Calibration Factor:

3.4.1 On a new cylinder head or after a major engine overhaul, rate three working calibration spark plugs three times each.

3.4.2 On routine calibration checks, rate three working calibration spark plugs once, alternating these spark plugs with the test spark plug during the test. If test requires more than 8 hour shift, the calibration spark plugs should be used again, once each shift during the test.

3.4.3 Calculate the Engine Calibration Factor (ECF) as follows in Equation 2:

$$ECF = \frac{\text{Avg. of the standard rating value of } W_1, W_2, \text{ and } W_3 \text{ (Marked on spark plug hex)}}{\text{Avg. of observed ratings of } W_1, W_2, \text{ and } W_3} \quad (\text{Eq. 2})$$

3.5 Determination of Corrected Rating of Test Spark Plugs:

3.5.1 Rate test spark plugs in conjunction with paragraph 3.4.2.

3.5.2 Calculate corrected rating of test spark plugs as follows in Equation 3:

$$\text{Corrected Rating} = \text{Observed Rating} \times ECF \quad (\text{Eq. 3})$$

NOTE: When calibration spark plugs are used as above, all comparative ratings are made at the same spark advance. If the spark plugs and engine are to be calibrated at both 30 and 40 deg spark advance, the calibration procedure should be followed for both 30 and 40 deg spark advance. The identical calibration spark plugs may be used for both spark settings but the rating figure marked on the plug hex should be coded to indicate whether it is a 30 or 40 deg rating.

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4. DISCUSSION:

The procedure outlined above for calibrating the SAE 17.6 rating engine is based upon the following premises:

1. That standard uniform spark plugs can be made or selected.
2. That these spark plugs remain uniform in their rating over a reasonable number of tests.
3. That the rating assigned to the master calibration spark plugs by the supplier designated in AS889 were obtained in line with the recommended procedure above. In following the recommended procedures above, if any one plug has a rating which is noticeably out of line with the other similar plugs with which it was rated, its value should not be used in the averages used for calibration purposes. If the discrepancy in rating is repeated, the plug should be discarded.

If any laboratory prefers to use its own production spark plug as a working standard, this is satisfactory for internal use. In cases of a contractual or comparative nature, the laboratory using its own production item shall offer substantiating evidence that the working standard produces a satisfactory calibration of the engine.

5. EXAMPLE:

The following is an example of the use of the calibration procedures: (The paragraphs listed refer to the action described in Section 3.)

- 5.1 Rate three master calibration spark plugs three times each. Paragraph 3.3.1. (For the example, master calibration spark plugs of 250 psi assigned rating, each, have been selected to calibrate the working spark plugs of comparable rating.)

	Observed Ratings		
M ₁	257	255	257
M ₂	253	257	261
M ₃	252	258	255

Avg. of the 9 ratings = 256