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*(in part)* 1620.16

# Australian Standard 1038, Part 9-1977

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**METHODS FOR THE ANALYSIS AND  
TESTING OF COAL AND COKE**

## **Part 9-PHOSPHORUS IN COAL AND COKE**



**STANDARDS ASSOCIATION OF AUSTRALIA**

*Incorporated by Royal Charter*



THE FOLLOWING SCIENTIFIC, INDUSTRIAL AND GOVERNMENTAL ORGANIZATIONS and departments were officially represented on the committee entrusted with the preparation of this standard:

Associated Chambers of Manufactures of Australia  
Australasian Institute of Mining and Metallurgy  
Bureau of Steel Manufacturers of Australia  
Department of Minerals and Energy  
Department of Mines, N.S.W.  
Electricity Supply Association of Australia  
Institution of Engineers, Australia  
Joint Coal Board  
Mines Department, Queensland  
Mines Department, Victoria  
Queensland Coal Board  
Royal Australian Chemical Institute  
Universities

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This standard, prepared under the direction of Committee CH/15, Coal and Coke, was approved on behalf of the Council of the Standards Association of Australia on 15 April 1977, and was published on 1 September 1977.

In order to keep abreast of progress in industry, Australian standards are regularly reviewed. Suggestions for improvement to published standards, addressed to the head office of the Association, are welcomed.

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**AUSTRALIAN STANDARD**

**METHODS FOR THE  
ANALYSIS AND TESTING OF  
COAL AND COKE**

**Part 9**  
**PHOSPHORUS IN COAL  
AND COKE**

**AS 1038, Part 9-1977**

First published (as AS K152, Part 9)	..	1965
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## PREFACE

This standard was prepared by the Association's Committee on Coal and Coke as the revision of AS K152, Part 9—1965, which it accordingly supersedes. AS K152, Part 9 was the endorsement of BS 1016:Part 9:1960, and this revision is based on BS 1016:Part 9:1971.\* It differs only where BS 1016, Part 9 does not apply to Australian practices and conditions. The need for revision became apparent following continued work by the committee concerned, and international discussion under the aegis of the International Organization for Standardization's Technical Committee 27, Solid Mineral Fuels.

Knowledge of the phosphorus content of coal or coke is of importance in steelmaking, since the presence of more than small amounts of phosphorus in the coke used in the production of acid pig iron makes it unsuitable for making low-phosphorus steels.

Since the volumetric method of determination given in AS K152, Part 9, appears to have been entirely superseded by the colorimetric method, it has been omitted from this revision. In the colorimetric method now specified, the phosphorus may be brought into solution either by dry oxidation of the coal or coke (ashing) followed by acid extraction of the ash,† or by a wet oxidation procedure. Previously, either of two reducing agents (hydrazine sulphate or stannous chloride) was permitted for colour development. Recent work‡ has indicated that ascorbic acid is a more convenient reducing agent and its use is specified here.

Although the values for between-laboratory tolerance given in AS K152, Part 9, were based on the results of inter-laboratory investigations carried out at that time, subsequent experience with the methods has indicated that they were too stringent, particularly for some coals and cokes having high phosphorus content. The values given in this revised standard differ from those previously specified and should now be applicable to all samples of coal or coke.

In the relevant ISO Recommendations, the analysis sample is specified as being 'ground to pass a 0.2 mm sieve'; in this standard reference is made to a 212  $\mu\text{m}$  AS test sieve,§ this being the nearest metric equivalent to the original 72 mesh sieve and to the ISO requirements.

Alternative procedures are described for taking the phosphorus into solution; it may be extracted from the coal ash or coke ash by acid, or the coal or coke may be submitted to a 'wet oxidation' which yields a solution containing all the phosphorus from the sample. After either procedure, a blue coloration is produced in the solution by addition of a single reagent solution. The intensity of the blue coloration, which is proportional to the concentration of phosphorus, is measured using a suitable optical instrument.

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\* Subsequently superseded by BS 1016, Part 9:1977.

† R. Belcher, *Fuel*, 1950, 29, 232.

‡ J. Murphy and J. P. Riley, *Anal. Chim. Acta*, 1962, 27, 31.

§ AS 1152, Test Sieves.

This standard makes reference to the following published standards:

- AS 1038 Methods for the Analysis and Testing of Coal and Coke  
Part 16 — Reporting of Results
- AS 1152 Test Sieves
- AS 1676 Methods for the Sampling of Hard Coal
- AS 1898 Methods for the Sampling of Coke
- AS K152 Methods for the Analysis and Testing of Coal and Coke  
Part 3 — Proximate Analysis of Coal  
Part 4 — Moisture, Volatile Matter and Ash in the  
Analysis Sample of Coke
- AS CK19 Code of Recommended Practice for the Chemical Analysis  
of Materials by Ultraviolet/Visible Spectroscopy
- AS R20 One-mark Volumetric Flasks
- BS 572 Interchangeable Conical Ground Glass Joints
- BS 3875 Optical Spectrometric Cells
- BS 4237 Report on Reproducibility of Methods of Chemical Analysis  
Used in the Iron and Steel Industry.

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## STANDARDS ASSOCIATION OF AUSTRALIA

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**Australian Standard Methods**  
**for**  
**ANALYSIS AND TESTING OF**  
**COAL AND COKE**

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**PART 9 — PHOSPHORUS IN COAL AND COKE**

**1 SCOPE.** This standard describes procedures for determining the phosphorus content of coal or coke.

**2 DEFINITIONS.** For the purpose of this standard the following definitions apply:

**2.1 Coke**—the vesicular solid material resulting from coal particles fusing together during carbonization.

**2.2 Total moisture**—free moisture, plus moisture in air dried coal, expressed as percentages of the sample as received.

**2.3 Moisture in the analysis sample\* of coal or coke**—the moisture which is retained by the 'through 212  $\mu\text{m}$  AS† sieve' sample of coal or coke after it has reached equilibrium with the laboratory atmosphere.

**2.4 Ash**—the inorganic matter remaining after the coal or coke has been burned in air to constant mass under standard conditions.

**2.5 Repeatability (within-laboratory tolerance)**—the maximum acceptable difference between duplicate determinations carried out at different times in the same laboratory by the same operator with the same apparatus on two parts from the same sample after the last stage of the reduction process.

**2.6 Reproducibility (between-laboratory tolerance)**—the maximum acceptable difference between the means of the determinations carried out by different laboratories on representative samples taken from the same bulk sample after the last stage of the reduction process.

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\* AS K152, Part 3—Proximate Analysis of Coal: Part 4—Moisture, Volatile Matter and Ash in the Analysis Sample of Coke.

† AS 1152, Test Sieves.