



Flow properties of coal



This Australian Standard® was prepared by Committee MN-001, Coal and Coke. It was approved on behalf of the Council of Standards Australia on 6 August 2017. This Standard was published on 30 August 2017.

The following are represented on Committee MN-001:

- Australasian Institute of Mining and Metallurgy
 - Australian Coal Industry Reference Samples
 - Australian Coal Preparation Society
 - Australian Energy Council
 - Coalfield Geology Council of NSW
 - CSIRO
 - Department of Natural Resources and Mines, Qld
 - Minerals Council of Australia
 - National Association of Testing Authorities Australia
 - University of Newcastle
 - University of New South Wales
 - University of Queensland
-

This Standard was issued in draft form for comment as DR AS 3880:2016.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

Keeping Standards up-to-date

Australian Standards® are living documents that reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued.

Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments that may have been published since the Standard was published.

Detailed information about Australian Standards, drafts, amendments and new projects can be found by visiting www.standards.org.au

Standards Australia welcomes suggestions for improvements, and encourages readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at mail@standards.org.au, or write to Standards Australia, GPO Box 476, Sydney, NSW 2001.

Australian Standard®

Flow properties of coal

Originated as AS 3880—1991.
Second edition AS 3880:2017.

COPYRIGHT

© Standards Australia Limited

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968.

Published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001, Australia

ISBN 978 1 76035 876 1

PREFACE

This Standard was prepared by the Standards Australia Committee, MN-001, Coal and Coke, to supersede AS 3880—1991, *Bin flow properties of coal*.

The objective of this Standard is to provide laboratory techniques that allow comparison of handleability of different coals. It also seeks to identify the interface between reliable flow and possible limiting or no flow conditions at various critical locations such as bin outlets or chutes. It outlines a series of three tests to identify the flow material characteristics in instantaneous condition and after time storage, depending on specific design requirements:

- (a) Test 1: Measurement of yield locus. This test permits determination of the stress necessary to shear a coal under a given load.
- (b) Test 2: Measurement of wall yield locus. This test concerns the determination of the rate of shear of coal interfacing with a wall lining material.
- (c) Test 3: Bulk density test. This consists in measuring the compressibility of a coal under various consolidation loads.

Although the emphasis of this Standard is on the determination of flow properties in instantaneous conditions, a method is given for determination of flow properties with time consolidation to simulate conditions during storage. This is of particular importance for those materials whose cohesive strength may change after rest. Further tests can be carried out to determine flow properties at different temperatures and under known vibration conditions using the test equipment described in this Standard. While those tests are mentioned for information purpose, they do not form part of this Standard.

While the laboratory techniques presented in this revision are fundamentally the same as in AS 3880—1991 edition, this revision includes more details on the equipment design and set-up. This aims to allow for all Jenike type shear cells to be similar and the scattering in the results obtained from different labs to be reduced. Another focus of the revision has been to clarify the test procedure. While particular attention has been given to include all details relevant to achieve best repeatability between two similar tests and between labs, it is acknowledged that a certain divergence between results will always remain.

It is recognized that the material presented in this Standard represents a lengthy and complex laboratory procedure that could not yet be successfully simplified despite major research effort. Experience has shown that the level of qualification and experience of the personnel practicing the tests have a significant impact on the quality and meaning of the results. While no certification is required to carry out the test, it is strongly recommended that only suitable, competent and properly trained personnel be engaged for both the tests and material preparation. In fact, due to high dependency between flow properties and moisture content, the reliability of the test results also largely depends on material preparation and handling.

Some coals or other particulate materials may fail to give meaningful results with the Jenike type shear cell. This is because they do not reach the critical consolidation state required for the measurements. It cannot be predicted ahead of the test whether a material can be tested with the Jenike shear cell or not. If not, different tests are required to assess suitable design criteria.

The term ‘informative’ has been used in this Standard to define the application of the appendix to which it applies. An ‘informative’ appendix is only for information and guidance.

CONTENTS

	<i>Page</i>
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE.....	5
1.2 REFERENCED DOCUMENTS.....	5
1.3 DEFINITIONS.....	6
1.4 NOTATION.....	7
SECTION 2 SAMPLING	
2.1 GENERAL.....	9
2.2 SAMPLE PREPARATION.....	9
SECTION 3 APPARATUS	
3.1 GENERAL.....	10
3.2 TESTER	10
3.3 SPECIFICATIONS.....	11
SECTION 4 INSTANTANEOUS SHEAR TEST	
4.1 GENERAL.....	14
4.2 PROCEDURE.....	14
4.3 INSTANTANEOUS YIELD LOCUS	19
4.4 COMPLETE FAMILY OF INSTANTANEOUS YIELD LOCI.....	21
4.5 INSTANTANEOUS FLOW FUNCTION.....	23
4.6 ACCEPTANCE OF RESULTS.....	24
4.7 REPORTING AND PRESENTATION OF RESULTS	25
4.8 PRECISION.....	25
SECTION 5 ADDITIONAL SHEAR TESTS	
5.1 GENERAL.....	27
5.2 HIGH-PRESSURE YIELD LOCUS	27
5.3 TIME YIELD LOCUS.....	27
5.4 TEMPERATURE YIELD LOCUS	28
5.5 VIBRATION YIELD LOCUS.....	28
SECTION 6 WALL SHEAR TESTS	
6.1 GENERAL.....	29
6.2 TEST PROCEDURE	29
6.3 WALL YIELD LOCUS	31
6.4 WALL FRICTION ANGLE.....	31
6.5 STATIC ANGLE OF WALL FRICTION	33
6.6 PRECISION OF DETERMINATION.....	33
SECTION 7 BULK DENSITY/COMPRESSIBILITY	
7.1 GENERAL.....	34
7.2 APPARATUS	34
7.3 TEST PROCEDURE	35
7.4 DETERMINATION OF BULK DENSITY.....	36
7.5 PRECISION OF DETERMINATION.....	36

APPENDICES

A	OVERVIEW OF APPLICATION OF FLOW PROPERTY RESULTS IN INDUSTRY	37
B	GUIDE FOR DETERMINATION OF ‘WORST CASE’ MOISTURE CONTENT ON THE BASIS OF SATURATED DRAINED MOISTURE CONTENT	39
C	GUIDE FOR THE SELECTION OF CONSOLIDATION STRESS FOR SHEARING AND EQUIVALENCE BETWEEN MASS, FORCE AND STRESS	41
D	EXAMPLE OF YIELD LOCUS RAW TEST RESULTS FOR 10% MOISTURE COAL.....	42

STANDARDS AUSTRALIA

Australian Standard Flow properties of coal

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out a series of tests to characterize the flow properties of coal as the basis for designing equipment to achieve reliable flow at the desired flowrate. Not all the tests described have to be carried out on a material. The selection of the relevant tests depends on the information sought:

- (a) Test 1: Yield locus, covers the measurement of the stress necessary to shear a coal under a given load. From this, the coal flow function can be established, which gives indication of the material cohesive strength. This test also gives output of material characteristics such as internal friction angle, which are required for design calculations and computer simulation purpose.
- (b) Test 2: Wall yield locus, consists of determining the angle of wall friction that describes the interactions between a coal and a selected wall material.
- (c) Test 3: Bulk density, describes the determination of coal bulk density and compressibility. The bulk density is of particular relevance in assessing the flow properties of a bulk material as often, the cohesive strength of a material will depend on its consolidation state reflected by its bulk density.

This Standard is nominally for coal. However, the principles and apparatus may be used for coke and other semi-cohesive particulate materials when a knowledge of flow properties is required.

This Standard also provides some guidance on the presentation of the test results for analysis and design. However, it does not cover the application of the results to industrial design.

NOTE: Appendix A for more information on application of flow properties results.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

- | | |
|--------|--|
| 1038 | Methods for the analysis and testing of coal and coke |
| 1038.1 | Part 1: Coal and coke—Analysis and testing—Higher rank coal—Total moisture |
| 3774 | Loads on bulk solids container |
| 3881 | Higher rank coal—Size analysis |
| ISO | |
| 13909 | Hard coal and coke—Mechanical sampling (series) |