

Recommended Practices for Testing Sand Used in Hydraulic Fracturing Operations

**API RECOMMENDED PRACTICE 56
SECOND EDITION, DECEMBER 1995**



Recommended Practices for Testing Sand Used in Hydraulic Fracturing Operations

Exploration and Production Department

**API RECOMMENDED PRACTICE 56
SECOND EDITION, DECEMBER 1995**



SPECIAL NOTES

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

API is not undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations under local, state, or federal laws.

Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer or supplier of that material, or the material safety data sheet.

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. Sometimes a one-time extension of up to two years will be added to this review cycle. This publication will no longer be in effect five years after its publication date as an operative API standard or, where an extension has been granted, upon republication. Status of the publication can be ascertained from the API Authoring Department [telephone (202) 682-8000]. A catalog of API publications and materials is published annually and updated quarterly by API, 1220 L Street, N.W., Washington, D.C. 20005.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API *standard*. Questions concerning the interpretation of the content of this standard or comments and questions concerning the procedures under which this standard was developed should be directed in writing to the director of the Exploration and Production Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to ensure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any federal, state, or municipal regulation with which this publication may conflict.

API standards are published to facilitate the broad availability of proven, sound engineering and operating practices. These standards are not intended to obviate the need for applying sound engineering judgment regarding when and where these standards should be utilized. The formulation and publication of API standards is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

All rights reserved. No part of this work may be reproduced, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact API Publications Manager, 1220 L Street, N.W., Washington, D.C. 20005.

CONTENTS

1	SCOPE	1
2	REFERENCES	1
	2.1 Standards	1
	2.2 Other References	1
3	RECOMMENDED SAND SAMPLING PROCEDURE	1
	3.1 Description	1
	3.2 Equipment	1
	3.3 Number of Required Samples	1
	3.4 Sampling	1
4	RECOMMENDED SAND SAMPLES HANDLING AND STORAGE	1
	4.1 Sample Reduction (Sacked Material)	1
	4.2 Sample Splitting	2
	4.3 Sample Retention and Storage	2
5	RECOMMENDED FRAC SAND SIEVE ANALYSIS	2
	5.1 Sieve Analysis	2
	5.2 Recommended Sand Size	4
6	FRAC SAND SPHERICITY AND ROUNDNESS	4
	6.1 General	4
	6.2 Sphericity	4
	6.3 Roundness	5
	6.4 Recommended Sphericity and Roundness	5
	6.5 Sand Grain Clusters	5
	6.6 Alternate Method for Determining Average Sphericity and Roundness	5
7	EVALUATION OF SAND SOLUBILITY IN ACID	6
	7.1 Description	6
	7.2 Acid Solubility Test Equipment and Materials	6
	7.3 Acid Solubility Test Procedure	7
	7.4 Recommended Maximum Acid Solubility	8
8	RECOMMENDED SILT TEST	8
	8.1 Method I: Turbidity Measurement of Silt- and Clay-size Particulate Matter	8
	8.2 Method II: Field On-site Turbidity Test	9
	8.3 Method III: Centrifugal Measurement of Clay and Soft Particle Content	10
9	RECOMMENDED FRAC SAND CRUSH RESISTANCE TEST	10
	9.1 General	10
	9.2 Equipment and Materials	10
	9.3 Recommended Test Procedure	10
	9.4 Suggested Fines	11
10	RECOMMENDED SAND MINERALOGICAL ANALYSIS	11
	10.1 Test Procedure	11
	10.2 Reported Results	12

Figures

1	—Example Box Sampling Device	2
2	—Example Sample Reducer Equipment	3
3	—Example Sample Splitter Equipment	4
4	—Testing Sieve Shaker and Nest of Six U.S.A. Sieves Plus Pan	5
5	—Chart for Visual Estimation of Sphericity and Roundness	7
6	—Example Prescription Bottle	9
7	—Example Test Cell Frac Sand Crush Resistance Test	12

Tables

1—Recognized Frac Sand Sizes	6
2—Recommended Maximum Acid Soluble Material Content in Frac Sand	8
3—Stress to Be Applied and Suggested Maximum Fines for Frac Sand Crush Resistance Tests	11

FOREWORD

These recommended practices were prepared by the Task Group on Evaluation of Hydraulic Fracturing Sand under the API Subcommittee on Evaluation of Well Completion Materials. They have been reviewed for content and accuracy by the Subcommittee on Evaluation of Well Completion Materials and by the API Executive Committee on Drilling and Production Practices. This publication is under jurisdiction of the Executive Committee on Drilling and Production Practices, American Petroleum Institute's Exploration and Production Department.

The tests recommended herein have been developed to improve the quality of frac sand delivered to the well site. They are for use in evaluating certain physical properties of sand used in hydraulic fracturing operations. These suggested tests will enable users to compare the physical characteristics of various sands tested under the described conditions and to select materials most useful for application in hydraulic fracturing operations.

The recommendations presented in this publication are not intended to inhibit the development of new technology, materials improvements, or improved operational procedures. Qualified engineering analysis and judgment will be required for their application to fit a specific situation.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to ensure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any federal, state, or municipal regulation with which this publication may conflict.

Suggested revisions are invited and should be submitted to the director of the Exploration and Production Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

Recommended Practices for Testing Sand Used in Hydraulic Fracturing Operations

1 Scope

The objective of these recommended practices is to provide control of frac sand quality at the well site. As a first step in accomplishing this objective, the recommended tests should be applied at the basic point of supply where quality control is first exercised.

2 References

2.1 STANDARDS

Unless otherwise specified, the most recent editions or revisions of the following standards shall, to the extent specified herein, form a part of this standard.

ASTM¹

E 11-95 *Specifications for Wire-Cloth Sieves for Testing Purposes*

2.2 OTHER REFERENCES

Krumbein, W.C. and Sloss, L.L., *Stratigraphy and Sedimentation*, Second Edition, 1963, W.N. Freeman and Co., New York, NY.

3 Recommended Sand Sampling Procedure

3.1 DESCRIPTION

The sampling procedure should provide a representative sample of the frac sand supplied by the sand supplier to the service company or by the service company to the user. This sample is to be compiled from a flowing stream of sand as opposed to material sampled at rest.

3.2 EQUIPMENT

The following equipment should be used to compile representative sand samples and conduct physical tests:

- Box sampling device approximately 8 inches × 6 inches × 4 inches with a 1/2-inch opening. Refer to Figure 1.
- Sample reducer (of appropriate size for handling sack-size samples and reducing in one pass to 1/16 original weight). Refer to Figure 2.

¹ASTM, 100 Bar Harbor Drive, West Conshohocken, Pennsylvania 19428-2959.

- Sample splitter of appropriate size. Refer to Figure 3.
- Set of recently calibrated sieves, complying with requirements of the U.S.A. Sieve Series, 8-inch diameter. Refer to *ASTM E 11-95: Specifications for Wire-Cloth Sieves for Testing Purposes*. Refer to Figure 4.
- Testing sieve shaker. Refer to Figure 4.
- Scale (minimum of 100 gram capacity with precision of 0.1 gram or better).

3.3 NUMBER OF REQUIRED SAMPLES

A minimum of nine samples per rail car load and three samples per truck load should be obtained, combined, and tested. For material sampled at the fracturing job site, a minimum of five samples should be obtained per 100,000 pounds of sand or fraction thereof. These on-site samples should be combined and used as a single sample for subsequent testing operations.

3.4 SAMPLING

The sampling device, with its longitudinal axis perpendicular to the flowing sand stream, should be passed at a uniform rate from side to side through the full stream width of moving sand as the sand falls from a conveyor belt into a blender, truck, or rail car. Sand should be allowed to flow for at least 2 minutes after initial flow prior to taking the first sample. Several samples should be extracted at approximately uniform intervals through the body of sand to ensure a representative sample for analysis. The number of samples taken should comply with the requirements of 3.3. During sampling, the sampling receptacle should be swung completely across the moving sand stream in a brief interval of time so as to take all of the stream part of the time. Under no circumstances should the sampling receptacle be allowed to overflow.

4 Recommended Sand Samples Handling and Storage

4.1 SAMPLE REDUCTION (SACKED MATERIAL)

Place the contents of an entire sack of frac sand (approximately 100 pounds) in the sample reducer (refer to Figure 2). Obtain a reduced sample of approximately 6 pounds (approximately 1/16 of the original weight of the total sack's contents).