

Product Evaluation, Application, and Testing of Stage Cementing Collars

API RECOMMENDED PRACTICE 10G
FIRST EDITION, AUGUST 2020



American
Petroleum
Institute

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. The use of API publications is voluntary. In some cases, third parties or authorities having jurisdiction may choose to incorporate API standards by reference and may mandate compliance.

Neither API nor any of API's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure 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 authorities having jurisdiction with which this publication may conflict.

API publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be used. The formulation and publication of API publications 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, translated, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001-5571.

Foreword

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.

The verbal forms used to express the provisions in this specification are as follows:

- the term “shall” denotes a minimum requirement to conform to the standard;
- the term “should” denotes a recommendation or that which is advised but not required to conform to the standard;
- the term “may” is used to express permission or a provision that is optional;
- the term “can” is used to express possibility or capability.

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 publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 200 Massachusetts Avenue NW, Suite 1100, Washington, DC 20001. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually by API, 200 Massachusetts Avenue NW, Suite 1100, Washington, DC 20001.

Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue NW, Suite 1100, Washington, DC 20001, standards@api.org.

Contents

	Page
1	Scope..... 1
2	References 1
3	Terms, Definitions, and Abbreviations..... 1
3.1	Terms and Definitions 1
3.2	Abbreviations 3
4	Purpose and Applications of Stage Cementing Collars 4
4.1	General 4
4.2	Cementing Across a Potential Loss Zone 4
4.3	Two-stage Cementing 5
4.4	Three-stage Cementing or More Stages 7
4.5	Discontinuous Cement Intervals 7
4.6	Reducing Post-cementing Annular Flow Potential..... 7
4.7	Off-bottom Cementing above Open Hole Completions..... 8
4.8	Placing Specialty Fluids in the Top Section of the Annular Space 8
4.9	Contingency Cementing 8
5	Operating Types of Stage Cementing Collars..... 8
5.1	General 8
5.2	Non-workstring Operated Tools 9
5.3	Workstring Operated Tools 9
5.4	Special Features or Performance Tools..... 9
5.5	Purchasing Guidelines 12
6	Manufacturing and Quality Considerations 13
6.1	Quality Management System Guidelines..... 13
6.2	Design Verification 13
6.3	Design Validation Considerations 14
6.4	Field Operations 15
6.5	Factors Affecting Stage Collar Life Span 15
7	Relationship to Well Integrity 16
8	Job Planning Considerations 17
8.1	Simulations 17
8.2	Cement Properties 18
8.3	Tool inside Pass-through Geometries 18
8.4	Tool installation 19
8.5	Stage Collar Selection 21
8.6	Operating Plugs Selection 21
8.7	Cement Job Procedure 22
8.8	Compatibility with Other Casing Equipment (If Present)..... 29
8.9	Review Potential Failure Modes and Contingency Planning 30
9	Operational Considerations 30
9.1	On-site Job Review 30
9.2	Non-workstring Operated Cementing Stage Collars..... 32
9.3	Additional Workstring Operated Stage Cementing Collar Considerations..... 36

Contents

	Page
10	Post-job Review for Multiple-stage Cementing Operations 37
11	Prevention and Investigation of Potential Tool Failures and Operational Issues 39
11.1	Prevention and Investigation 39
11.2	Non-workstring Operated Tools 39
11.3	Additional Considerations for Workstring Operated Tools 46
	Annex A (informative) Stage Cementing Collar Plug Set Options 49
	Bibliography..... 53

Figures

1	Formation Fracture during Single-stage Primary Cement Job 5
2	Preventing Formation Fracture with Two-stage Primary Cement Job 6
3	Example of Off-bottom Cementing above an Uncemented Completion 8
A.1	Examples of Landing Seats 49
A.2	Examples of First-stage Top Plugs 50
A.3	Examples of Opening Devices..... 50
A.4	Examples of Second-stage Top Plugs 51
A.5	Examples of Stage Cementing Bottom Plugs 51
A.6	Example of Cancellation Plug 52
A.7	Example of Stage Cementing Sub-surface Release Plugs and Darts 52

Tables

1	Opening Device Not Landing, or Taking Excessive Volume or Time to Land 40
2	Leaking during Opening Operations 40
3	High Opening Pressure 41
4	Premature Opening or Low Opening Pressure 41
5	Failure to Open 42
6	Closing Device not Landing or Taking Excessive Volume to Land 43
7	Closing Device or Dart, or Both, Leaking..... 43
8	High Closing Pressure 43
9	Failure to Close..... 44
10	Pressure Leak (Casing to Annulus or Annulus to Casing) or Casing Pressure Build-up after Closing 45
11	Drillout Issues 45
12	Leaking after Drillout (Casing to Annulus or Annulus to Casing) 45
13	Fluid Bypassing Plugs 45
14	High Opening Force..... 46
15	Failure to Open 47
16	High Closing Force 47
17	Failure to Close..... 48
18	Pressure Leak (Casing to Annulus or Annulus to Casing) or Casing Pressure Build-up after Closing 48

Product Evaluation, Application, and Testing of Stage Cementing Collars

1 Scope

This document provides requirements, guidelines, and recommended practices for stage cementing collars used in cementing applications in the petroleum and natural gas industry. Information is included on the types, application, specification, validation, manufacturing, job planning and execution, and preventing and diagnosing problems. Use of stage cementing collars for non-cementing applications or annulus casing packers, or both, are outside the scope of this document.

Products covered under another API or international specification are not included. This document does not cover the connections to the well conduit.

2 References

This document contains no normative references. For a listing of other articles associated with this publication, refer to the bibliography.

3 Terms, Definitions, and Abbreviations

3.1 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1 annulus

The space between the open hole and tubulars, or between tubulars, where fluid can flow.

NOTE The annulus designation between the production tubing and production casing is the "A" annulus. Outer annuli between other strings are designated B, C, D, etc. as the pipe sizes increase in diameter.

3.1.2 baffle plate

A landing seat wholly contained within a tubular string and placed at a predetermined location for the purpose of landing a shutoff or bypass plug.

3.1.3 ball

A spherical device used to actuate downhole tools or release sub-surface darts or plugs.

3.1.4 bypass plug

Device designed to allow fluid to flow through or around itself once landed on a seat.

3.1.5 cancellation device cancellation plug

A device dropped through the casing to fully cycle the stage collar from the run-in position to the closed position in a single operation.

3.1.6 cementing plug plug

A device used to separate fluids and wipe the internal surface of the pipes as it is pumped from one location in the pipe to another or to operate downhole tools, or both.