

Additively Manufactured Polymer-Based Components for Use in the Petroleum and Natural Gas Industries

API STANDARD 20T
FIRST EDITION, AUGUST 2022



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 document are as follows.

Shall: As used in a standard, “shall” denotes a minimum requirement to conform to the standard.

Should: As used in a standard, “should” denotes a recommendation or that which is advised but not required to conform to the standard.

May: As used in a standard, “may” denotes a course of action permissible within the limits of a standard.

Can: As used in a standard, “can” denotes a statement of 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, Suite 1100, Washington, DC 20001. Requests for permission to reproduce or translate all or any component 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, Suite 1100, Washington, DC 20001.

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

Contents

	Page
1	Scope..... 1
1.1	Purpose 1
1.2	Applicability 1
1.3	Additive Manufacturing Specification Levels (AMSL) 1
2	Normative References 2
3	Terms, Definitions, Acronyms and Abbreviations 4
3.1	Terms and Definitions 4
3.2	Acronyms and Abbreviations 5
4	Requirements for the Additive Manufacturing Process 6
4.1	General 6
4.2	Additive Manufacturer 7
4.3	Feedstock Requirements 9
4.4	Additive Manufacturing Printing Equipment 12
4.5	First Article 13
5	Limits on the Qualification of the Additive Manufacturing Process 19
5.1	General 19
5.2	Essential Additive Manufacturing Variables to be Reported 20
5.3	Essential Additive Manufacturing Variables Not Reported 20
6	Components Production Control..... 20
6.1	General 20
6.2	Manufacturing Process Specification..... 21
6.3	Pre-Build Check..... 21
6.4	Batch Control/Powder Recycling 21
6.5	Process Interruptions 21
6.6	Post-build Processing 22
6.7	Marking and Identification of Production Components 22
7	Quality Control 23
7.1	General 23
7.2	Monitoring and Measuring Equipment 23
7.3	Quality Control Procedures..... 23
7.4	Sampling..... 23
7.5	Quality Control Personnel Requirements 23
8	Production Components Quality Control Requirements 24
8.1	General 24
8.2	Manufacturing Nonconformances..... 24
9	Documentation..... 26
9.1	General 26
9.2	Minimum Documentation and Retention..... 26
9.3	Documentation Provided with the Component(s) 27
10	Handling, Storage, and Shipping 27
	Annex A (informative) Non-essential Additive Manufacturing Variables Guidance..... 28

Contents

	Page
Annex B (informative) Supplemental Documentation Requirements	29
Annex C (informative) Special Requirements.....	30
Bibliography.....	31

Figures

1	Qualification Process Flowchart.	2
---	---------------------------------------	---

Tables

1	Minimum Requirements to be Defined in the Filament Feedstock Specification	10
2	Minimum Requirements to be Defined in the Powder/Granulate Feedstock Specification.....	11
3	Test Requirements for the First Article—MEx	15
4	Test Requirements for the First Article—PBF	16
5	Test Requirements for the First Article—Integrated Substrate.....	17
6	MEx and PBF Essential Additive Manufacturing Variables to be reported (as applicable)	20
7	MEx and PBF Essential Additive Manufacturing Variables Not Reported (as applicable)	20
8	Sampling.....	23
9	Quality Control Requirements for MEx—Production Components	25
10	Quality Control Requirements for PBF—Production Component	26
A.1	Non-Essential Additive Manufacturing Variables	28

Additively Manufactured Polymer-Based Components for Use in the Petroleum and Natural Gas Industries

1 Scope

1.1 Purpose

This standard specifies requirements for qualification of the manufacturing process, production, marking, and documentation of additively manufactured polymer-based components used in the petroleum and natural gas industries when referenced by an applicable API equipment standard or otherwise specified as a requirement for conformance. The qualification process flowchart is shown in Figure 1.

1.2 Applicability

This standard applies to additively manufactured polymer-based components (including composites) produced by material extrusion [also referred to as fused filament fabrication (FFF) or fused deposition modeling (FDM) and fused granulate fabrication (FGF)] and powder bed fusion [also referred to as selective laser sintering (SLS) or multi jet fusion (MJF)].

1.3 Additive Manufacturing Specification Levels (AMSL)

This standard establishes requirements for three additive manufacturing specification levels (AMSL). These three designations—AMSL 1, AMSL 2, and AMSL 3—define increasing levels of additive manufacturing (AM) technical, quality and qualification requirements.

NOTE An AMSL can be assigned to a component by a product specification or standard, the purchaser, or the additive manufacturer.