

Safe Welding, Cutting, and Hot Work Practices in the Petroleum and Petrochemical Industries

API RECOMMENDED PRACTICE 2009
SEVENTH EDITION, FEBRUARY 2002

REAFFIRMED, MARCH 2020



AMERICAN PETROLEUM INSTITUTE

Safe Welding, Cutting, and Hot Work Practices in the Petroleum and Petrochemical Industries

Safety & Fire Protection

API RECOMMENDED PRACTICE
SEVENTH EDITION, FEBRUARY 2002

REAFFIRMED, MARCH 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.

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Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years.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 the review cycle. This publication will no longer be in effect five years after its publication, unless as an operative API standard or, where an extension has been granted, upon republication. 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 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 API Standards 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 general manager.

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 the Publisher, API Publishing Services, 1220 L Street, N.W., Washington, D.C. 20005.

FOREWORD

This publication provides guidelines for the protection of personnel and property when performing welding, cutting or other hot work in the petroleum and petrochemical industries. This recommended practice distinguishes between normal hot work activities and those which involve hot work on equipment in service. It provides guidance for certain of these special “in-service” activities.

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 federal, state, or municipal regulation with which this publication may conflict.

Suggested revisions are invited and should be submitted to the general manager of the API Standards Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

INFORMATION CONCERNING SAFETY AND HEALTH HAZARDS 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.

CONTENTS

	Page
1 INTRODUCTION	1
1.1 Purpose	1
1.2 Scope	1
1.3 Retroactivity	1
1.4 Concept of Hazard vs Risk	1
1.5 General Hot Work Process	1
2 REFERENCED PUBLICATIONS	3
3 DEFINITIONS	4
4 JOB ANALYSIS	5
4.1 Job Analysis	5
4.2 Review by Qualified Persons	5
5 HAZARD EVALUATION AND RISK REDUCTION	5
5.1 General	5
5.2 Physical Hazards	6
5.3 Potential Acute Health Hazards and Risk Reduction	6
5.4 Potential Chronic Health Hazards and Risk Reduction	6
5.5 Flammable Liquids, Vapors, Solids, or Dust	7
5.6 Combustible Materials	7
5.7 Ignition Sources	7
5.8 Water	8
5.9 Wind	8
5.10 Equipment with Liners, Filters, or Patch Plates	8
5.11 Electrical Hazards to Personnel	8
5.12 Noise	8
6 IMPLEMENTATION OF SAFEGUARDS	9
6.1 General Concepts of Safeguards and Risk Reduction	9
6.2 Equipment Plugging and Ventilation	9
6.3 Protection of Personnel	10
6.4 Safeguards Against Ignition Hazards	11
6.5 Fire Watch Personnel	11
7 TESTING FOR HAZARDS	12
7.1 Flammability Testing	12
7.2 Oxygen Testing	12
7.3 Monitoring for Toxic Substances	12
7.4 Frequency of Monitoring the Atmosphere	12
8 HOT WORK PERMITS	13
8.1 General	13
8.2 Permit Requirements	13
8.3 Issuing and Closing-out the Permit	13
8.4 Interrupted Work	14
8.5 Extending the Permit	14

	Page
9	HOT WORK IN CONFINED SPACES 14
9.1	Confined Space Entry 14
9.2	Oxygen Content in Confined Spaces 14
9.3	Flammable Vapor Concentration 14
9.4	Confined Space Ventilation 14
9.5	Frequency of Monitoring in Confined Spaces 15
9.6	Pyrophoric Iron Precautions 15
10	WORK INSIDE VESSELS, EXCHANGERS, AND TANKS 15
10.1	Preparations 15
10.2	Maintaining a Safe Work Environment 16
10.3	Inspection of Internals 16
11	WORK ON THE EXTERIOR OF VESSELS, EXCHANGERS, AND TANKS NOT IN SERVICE 16
12	WORK ON EQUIPMENT IN SERVICE 16
12.1	Decision Process for Work on Equipment in Service 16
12.2	Hot Work With Hydrocarbons Present 16
12.3	Work on the Exterior of Atmospheric Pressure In Service Vessels 18
12.4	Hot Work on Equipment under Vacuum 18
12.5	Leak Repair 18
13	WORK IN BUILDINGS AND PITS 19
14	WORK ON PIPING 19
14.1	General Considerations for Work on Piping 19
14.2	Piping Isolation 19
14.3	Venting of Piping 20
14.4	Piping Contamination and Coating 20
14.5	Hot Tapping 20
	APPENDIX A BIBLIOGRAPHY 21
	APPENDIX B INSPECTING VESSELS 23
	Figures
1	Typical Hot Work Activity Flow for Equipment Not in Service 2
2	Example Decision Process for Authorization of Work on Equipment in Service 17
	Tables
1	Welding Hazards and Possible Protection 10

Safe Welding, Cutting, and Hot Work Practices in the Petroleum and Petrochemical Industries

SECTION 1—INTRODUCTION

1.1 PURPOSE

Gas and electric welding and cutting operations are important activities to support petroleum and petrochemical operations. Personnel engaged in these operations should have a thorough understanding of the duties they are to perform and the potential hazards associated with the activity and materials involved. This recommended practice provides information to assist welding, cutting and other hot work activities to be done safely in petroleum and petrochemical operations. The understanding of potential hazards, and application of this knowledge, can help reduce the probability and severity of incidents.

1.2 SCOPE

This recommended practice provides guidelines for safely conducting welding, cutting or other hot work activities in refineries, gas plants, petrochemical plants and other facilities in the petroleum and petrochemical industries. It includes specific guidance to evaluate procedures for certain types of work on equipment in service.

Not included in the scope are:

- Guidance for compliance with regulations or codes.
- Hot tapping (it is the subject of API Recommended Practice 2201 *Procedures for Hot Tapping on Equipment in Service*).
- Welding techniques, craft skills or qualification of welders.
- Normal “safe work” practices such as fall protection, PPE, slip/trip/fall, etc.
- Entry or work in inert environments (see API 2217A).

The principles and resources provided in this document are widely applicable. Some activities (such as oil drilling or offshore operations) may be subject to specific regulations or unique work requirements which should be considered when developing welding and hot work programs.

While personnel doing welding and other hot work require a high degree of skill and shall be qualified for the work they are doing, the qualification of personnel falls outside the scope of this document.

API 2009 intends to maintain consistency and compatibility with ANSI/AWS Z49.1 which provides much more detail on welding equipment, PPE and certain procedures and NFPA 51B that focuses on fires and explosions with guidance

covering a broad spectrum of applications including structures. Additional guidance relating to welding equipment, techniques, processes and testing used in the chemical, oil, gas and pipeline industries is provided by API RP 582, API Std 1104 and API RP 1107.

1.3 RETROACTIVITY

Any provisions in this publication related to procedures or design are intended for new projects, reference such as revising procedures or designing new facilities, or when considering major revisions or expansions. It is not intended that any recommendations in this publication be applied retroactively to existing facilities or evaluation of prior practice. This recommended practice should provide useful guidance when there is a desire or need to review programs or facilities.

1.4 CONCEPT OF HAZARD VS RISK

Hazards are properties of materials with the inherent ability to cause harm. Flammability, toxicity, corrosivity, and stored chemical or mechanical energy all are hazards associated with various industrial materials. Risk requires exposure. A hot surface or material can cause thermal skin burns or a corrosive acid can cause chemical skin burns, but these can occur only if there is contact exposure to skin. There is no risk when there is no potential for exposure.

Determining the level of risk involves understanding hazards and estimating the probability and severity of exposure that could lead to harm. While the preceding examples relate hazards to the risk to people, the same principles are valid for evaluating property risk. For instance, hydrocarbon vapors in a flammable mixture with air can ignite if exposed to a source of ignition resulting in a fire that could damage property.

1.5 GENERAL HOT WORK PROCESS

The discussion of safe “hot work” in this publication follows the process flow chart shown in Figure 1. This chart shows a typical flow sequence for welding activities in the petroleum and petrochemical industries. Sections of this document that discuss those steps are indicated. Other facilities may have alternative work flow processes, or may combine some steps.