

# Direct Steerable Pipe Thrusting

## **Other Titles of Interest**

*Pipeline Design for Installation by Horizontal Directional Drilling, Second Edition*, edited by Eric R. Skonberg and Tennyson M. Muindi (ASCE/Pipelines Division 2014). MOP 108 addresses the design of major pipeline or duct segments to be installed by horizontal directional drilling (HDD) (ISBN 978-0-7844-1350-0).

*Pipe Ramming, Second Edition*, by the Pipe Ramming Task Force of the Trenchless Installation of Pipelines (TIP) Committee; edited by Glenn M. Boyce (ASCE/UESI 2020). MOP 115 presents the latest and best practices for the design and construction of road and railroad crossings using pipe ramming technologies (ISBN 978-0-7844-1560-3).

*Pilot Tube and Other Guided Boring Methods*, by the Task Committee on Pilot Tube and Other Guided Boring Methods (ASCE/UESI 2017). MOP 133 provides a detailed description of the pilot tube and guided boring methods with chapters on project planning, site and geotechnical assessment, shaft design, pipe characteristics and design, contract documents, and construction aspects (ISBN 978-0-7844-1474-3).

Standard Design and Construction Guidelines for Microtunneling, Standard ASCE/CI 36-15. This standard covers the planning, design, materials, and construction for this trenchless method of installing pipelines (ISBN 978-0-7844-1363-0).

*Horizontal Auger Boring Projects*, by the Horizontal Auger Boring Task Force (ASCE/UESI 2017). MOP 106 covers the horizontal auger boring method, providing the instructions for a safe, productive, and efficient installation of pipelines for road crossings (ISBN 978-0-7844-1458-3).

# Direct Steerable Pipe Thrusting

Sponsored by the  
Task Committee on Direct Steerable Pipe Thrusting of the  
Committee on Trenchless Installation of Pipelines of the  
Utility Engineering & Surveying Institute of the  
American Society of Civil Engineers



## Library of Congress Cataloging-in-Publication Data

Names: Robison, Jon, author.

Title: Direct steerable pipe thrusting / Jon Robison, Jeff Scholl, Andrew Sparks, Joachim Engelhardt, Andrew Finney, Norm Joyal, Chris Lamont.

Description: Reston, Virginia : American Society of Civil Engineers, [2023] | Series: ASCE manuals and reports on engineering practice ; no. 155 | Includes bibliographical references and index. | Summary: "MOP 155 details how engineers and construction professionals can utilize the Direct Steerable Pipe Thrusting (DSPT) method to design and install pipelines"-- Provided by publisher.

Identifiers: LCCN 2022059192 | ISBN 9780784416105 (print) | ISBN 9780784484630 (pdf) | ISBN 9780784484647 (epub)

Subjects: LCSH: Underground pipelines--Design and construction. | Pipe-laying machinery. | Trenchless construction. | Boring. | Directional drilling.

Classification: LCC TA660.P55 R63 2023 | DDC 621.8/672--dc23/eng/20230109

LC record available at <https://lccn.loc.gov/2022059192>

Published by American Society of Civil Engineers

1801 Alexander Bell Drive

Reston, Virginia 20191-4382

[www.asce.org/bookstore](http://www.asce.org/bookstore) | [ascelibrary.org](http://ascelibrary.org)

Any statements expressed in these materials are those of the individual authors and do not necessarily represent the views of ASCE, which takes no responsibility for any statement made herein. No reference made in this publication to any specific method, product, process, or service constitutes or implies an endorsement, recommendation, or warranty thereof by ASCE. The materials are for general information only and do not represent a standard of ASCE, nor are they intended as a reference in purchase specifications, contracts, regulations, statutes, or any other legal document. ASCE makes no representation or warranty of any kind, whether express or implied, concerning the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed in this publication, and assumes no liability therefor. The information contained in these materials should not be used without first securing competent advice with respect to its suitability for any general or specific application. Anyone utilizing such information assumes all liability arising from such use, including but not limited to infringement of any patent or patents.

ASCE and American Society of Civil Engineers—Registered in US Patent and Trademark Office.

*Photocopies and permissions.* Permission to photocopy or reproduce material from ASCE publications can be requested by sending an email to [permissions@asce.org](mailto:permissions@asce.org) or by locating a title in the ASCE Library (<https://ascelibrary.org>) and using the "Permissions" link.

**Errata: Errata, if any, can be found at <https://doi.org/10.1061/9780784416105>.**

Copyright © 2023 by the American Society of Civil Engineers.

All Rights Reserved.

ISBN 978-0-7844-1610-5 (print)

ISBN 978-0-7844-8463-0 (PDF)

ISBN 978-0-7844-8464-7 (ePub)

Manufactured in the United States of America.

28 27 26 25 24 23                    1 2 3 4 5

Cover photograph courtesy of Michels Construction.

# MANUALS AND REPORTS ON ENGINEERING PRACTICE

(As developed by the ASCE Technical Procedures Committee, July 1930, and revised March 1935, February 1962, and April 1982)

A manual or report in this series consists of an orderly presentation of facts on a particular subject, supplemented by an analysis of limitations and applications of these facts. It contains information useful to the average engineer in his or her everyday work, rather than findings that may be useful only occasionally or rarely. It is not in any sense a “standard,” however, nor is it so elementary or so conclusive as to provide a “rule of thumb” for nonengineers.

Furthermore, material in this series, in distinction from a paper (which expresses only one person’s observations or opinions), is the work of a committee or group selected to assemble and express information on a specific topic. As often as practicable, the committee is under the direction of one or more of the Technical Divisions and Councils, and the product evolved has been subjected to review by the Executive Committee of the Division or Council. As a step in the process of this review, proposed manuscripts are often brought before the members of the Technical Divisions and Councils for comment, which may serve as the basis for improvement. When published, each manual shows the names of the committees by which it was compiled and indicates clearly the several processes through which it has passed in review, so that its merit may be definitely understood.

In February 1962 (and revised in April 1982), the Board of Direction voted to establish a series titled, “Manuals and Reports on Engineering Practice” to include the manuals published and authorized to date, future Manuals of Professional Practice, and Reports on Engineering Practice. All such manual or report material of the Society would have been refereed in a manner approved by the Board Committee on Publications and would be bound, with applicable discussion, in books similar to past manuals. Numbering would be consecutive and would be a continuation of present manual numbers. In some cases of joint committee reports, bypassing of journal publications may be authorized.

*A list of available Manuals of Practice can be found at <https://ascelibrary.org/page/books/s-mop>.*



# CONTENTS

<b>PREFACE .....</b>	<b>ix</b>
<b>ACKNOWLEDGMENTS .....</b>	<b>xi</b>
<b>1. INTRODUCTION AND HISTORY .....</b>	<b>1</b>
1.1 Introduction.....	1
1.2 History of Direct Steerable Pipe Thrusting.....	4
1.3 Conclusions .....	18
References .....	19
<b>2. METHOD .....</b>	<b>21</b>
2.1 Introduction.....	21
2.2 Installation Process .....	21
2.3 Equipment .....	25
<b>3. PLANNING .....</b>	<b>37</b>
3.1 Initial Criteria .....	37
3.2 Routing.....	38
3.3 Preliminary Geotechnical Feasibility .....	40
3.4 Preliminary Geometric Design .....	41
3.5 Worksite Layout.....	55
3.6 Preliminary Installation Cost Considerations .....	57
References .....	63
<b>4. DETAILED SITE INVESTIGATIONS AND GEOTECHNICAL ENGINEERING .....</b>	<b>65</b>
4.1 Introduction and Chapter Summary .....	65
4.2 Site Investigation .....	65
4.3 Geotechnical Assessment and Characterization .....	70

4.4	Environmental Conditions .....	77
4.5	Seismic Considerations .....	80
	References .....	80
<b>5.</b>	<b>ENGINEERING DESIGN .....</b>	<b>83</b>
5.1	Introduction .....	83
5.2	Geometric Design .....	83
5.3	Engineering Design Considerations .....	86
	References .....	98
<b>6.</b>	<b>STEEL PIPE DESIGN .....</b>	<b>101</b>
6.1	Introduction .....	101
6.2	Installation-Related Stresses .....	101
6.3	Pipe Buckling Analysis and Considerations .....	104
6.4	Allowable Thrust Force Calculation .....	106
6.5	Operating Stresses .....	107
6.6	Steel Pipe Coating and Lining .....	108
	References .....	110
<b>7.</b>	<b>CONTRACT DOCUMENTS .....</b>	<b>113</b>
7.1	Introduction .....	113
7.2	Contract Forms .....	114
7.3	Geotechnical Risk Allocation .....	118
7.4	Alternative Dispute Resolution .....	120
7.5	Contractor Prequalifications .....	121
	References .....	121
<b>8.</b>	<b>CONSTRUCTION CONSIDERATIONS .....</b>	<b>123</b>
8.1	Introduction .....	123
8.2	Safety .....	123
8.3	Preconstruction Activities and Submittals .....	126
8.4	Layout and Staging .....	129
8.5	Launch Preparation .....	137
8.6	Machine Operation .....	138
8.7	Contingency Measures .....	140
8.8	Construction Documentation and As-Built Submittals .....	144
	References .....	146
	<b>GLOSSARY .....</b>	<b>147</b>
	<b>INDEX .....</b>	<b>155</b>

## PREFACE

This manual of practice was prepared by the Task Committee on Direct Steerable Pipe Thrusting (DSPT) of the ASCE Committee on Trenchless Installation of Pipelines (TIPS), as part of the Utility Engineering & Surveying Institute (UESI). The manual describes the current Direct Steerable Pipe Thrusting method used by engineers and construction professionals in designing and installing pipelines using the DSPT method.

This manual of practice has been created by a group of engineers, contractors, equipment manufacturers, pipeline owners, and academics fully knowledgeable of the method and its use. This manual considers many of the advances that have occurred since the initial development of the technology. However, the task committee acknowledges that DSPT continues to evolve and contractor and equipment capabilities continue to develop.

Sections of this manual of practice have been written assuming that the reader may be unfamiliar with DSPT methodology. No document can encompass all issues on a particular DSPT project. Improvements in best practices and technology continue to advance so that future use of this manual on any project must consider not only the specific characteristics of the particular project but also further improvements in best practices and technology.

The stakeholders of a pipeline trenchless project are encouraged to consider all trenchless methods before concluding that the DSPT method is the most suitable construction method available. Manuals and reports on engineering practice have been written by ASCE and are available for different construction methods. If the engineer responsible for the pipeline project does not have a strong background in trenchless design, an engineering firm that specializes in trenchless designs should be consulted.



## ACKNOWLEDGMENTS

The American Society of Civil Engineers (ASCE) and the Utility Engineering & Surveying Institute (UESI) acknowledge the work of the Task Committee on Direct Steerable Pipe Thrusting. This group comprises individuals from many backgrounds, including design and consulting engineering, the construction industry, equipment manufacturing, pipeline owners, and academia.

### Principal Authors

Jon Robison, P.E., *MOP Task Committee Chair*—GeoEngineers, Inc.

Jeff Scholl, P.E., *MOP Task Committee Vice Chair*—JD Hair and Associates

Andrew Sparks, P.E., *MOP Task Committee Secretary*—Laney Directional Drilling

Joachim Engelhardt—Herrenknecht, AG

Andrew Finney, P.E.—Jacobs

Norm Joyal, P.E.—McMillen Jacobs Associates

Chris Lamont, P.Eng.—Associated Engineering Alberta Ltd.

Michelle Macauley, P.E.—Macauley Expert Services

Mary Neher, P.E.—Bennett Trenchless Engineers

Matt Smith—Michels

Nic Strater, P.G.—Brierley Associates

Webb Winston, P.E.—Williams

### Other individuals who served and contributed

Abner Chen, Ph.D., P.E.—Purdue University Northwest

Glenn Duyvestyn, Ph.D., P.E., P.Eng.—Orsted

Michael Martens, P.Eng.—TC Energy

Rob Tumbleson—ECI Contracting

Jwala Sharma, Ph.D., P.E.—Michels

Angela Williamson, P.E.—Kinder Morgan

A thank you to the members of the Blue Ribbon Review Committee who reviewed the finished document and provided their comments:

Alan Snider, P.E., *Chair*—The Trenchless Company, LLC

Samuel Ariaratnam, Ph.D., P.E.—Arizona State University

Glenn Boyce, Ph.D., P.E.—McMillen Jacobs Associates

Gerhard Lang—Herrenknecht, AG

A thank you to Julie McCullough (McMillen Jacobs Associates) for providing technical editing, and to James Chae, P.E. (Jacobs) for editorial review.

In addition to acknowledging the support provided by all those companies whose employees participated in the development of this manual, the task committee would like to specially acknowledge the significant support provided by the following companies:

GeoEngineers, Inc.

Herrenknecht, AG

McMillen Jacobs Associates

Michels

Williams

**ASCE UESI Committee on Trenchless Installation of Pipelines (TIPS):**

Jon Robison, P.E., *Chair*

Jeff Boschert, P.E., *ExCom Liaison*

# CHAPTER 1

## INTRODUCTION AND HISTORY

### 1.1 INTRODUCTION

Pipelines of various types, sizes, and purposes are routinely installed below the ground surface in every community around the world. The most common method of pipeline installation is open cut, also known as trenching. However, open-cut installation results in obvious and sometimes significant unwanted ground disturbance. Consequently, numerous trenchless methods of pipeline installation have been developed to reduce surface impacts and public inconvenience (Table 1-1).

Direct steerable pipe thrusting (DSPT) was developed to fill a need for a pipeline installation in ground conditions challenging to other trenchless methods. Direct steerable pipe thrusting is a relatively recent innovation in the trenchless industry combining some of the characteristics of horizontal directional drilling (HDD) and conventional microtunneling. Direct Pipe, developed by Herrenknecht AG (Herrenknecht) in Germany, was the first commercially available system to fall into the DSPT category of trenchless technology. As described in Section 1.2, the first Direct Pipe installation was completed in Germany in 2007; as of 2022, more than 200 installations have been completed worldwide. This Manual of Practice (MOP) reflects the current state of industry development.

#### 1.1.1 Definition of Direct Steerable Pipe Thrusting

Direct steerable pipe thrusting is a near-surface launched, thrusting microtunnel method of pipeline installation that can install a steel pipe in a single pass along both horizontal and vertical curves.