



International Society of Automation
Setting the Standard for Automation™

STANDARD

American National Standard **ANSI/ISA-75.25.01-2024**

This standard is intended for worldwide use in all industries as applicable.

Test Procedure for Control Valve Response Measurement from Step Inputs

Approved: 8 AUGUST 2024

© 2024 International Society of Automation. This is a copyright document and may not be copied or distributed in any form or manner without the permission of ISA. This copy of the document was made for the sole use of the person to whom ISA provided it and is subject to the restrictions stated in the *Copyright of ISA Standards* policy. It may not be provided to any other person in print, electronic copy or otherwise. Violations of ISA's copyright will be persecuted to the fullest extent of the law and may result in substantial civil and criminal penalties.

Documents
Document Sharing Hub

ANSI/ISA-75.25.01-2024, Test Procedure for Control Valve Response Measurement from Step Inputs

ISBN: 978-1-64331-263-7

Copyright © 2024 by the International Society of Automation (ISA). All rights reserved. Not for resale. Printed in the United States of America. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise), without the prior written permission of the Publisher.

ISA
3252 S. Miami Blvd., Suite 102
Durham, NC 27703 USA

Preface

This preface, as well as all footnotes and annexes, is included for information and is not a normative part of ANSI/ISA-75.25.01-2024.

This document has been prepared as part of the service of ISA toward a goal of uniformity in the field of automation. To be of real value, this document should not be static but should be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms and asks that they be addressed to the Secretary, ISA Standards and Practices Board; standards@isa.org.

It is the policy of ISA to encourage and welcome the participation of all concerned individuals and interests in the development of ISA standards, recommended practices, and technical reports. Participation in the ISA standards-making process by an individual in no way constitutes endorsement by the employer of that individual, of ISA, or of any of the standards, recommended practices, and technical reports that ISA develops.

International System of Units (SI) are the preferred units of measurement in ISA standards.

CAUTION — ISA ADHERES TO THE POLICY OF THE AMERICAN NATIONAL STANDARDS INSTITUTE WITH REGARD TO PATENTS. IF ISA IS INFORMED OF AN EXISTING PATENT THAT IS REQUIRED FOR USE OF THE DOCUMENT, IT WILL REQUIRE THE OWNER OF THE PATENT TO EITHER GRANT A ROYALTY-FREE LICENSE FOR USE OF THE PATENT BY USERS COMPLYING WITH THE DOCUMENT OR A LICENSE ON REASONABLE TERMS AND CONDITIONS THAT ARE FREE FROM UNFAIR DISCRIMINATION.

EVEN IF ISA IS UNAWARE OF ANY PATENT COVERING THIS DOCUMENT, THE USER IS CAUTIONED THAT IMPLEMENTATION OF THE DOCUMENT MAY REQUIRE USE OF TECHNIQUES, PROCESSES, OR MATERIALS COVERED BY PATENT RIGHTS. ISA TAKES NO POSITION ON THE EXISTENCE OR VALIDITY OF ANY PATENT RIGHTS THAT MAY BE INVOLVED IN IMPLEMENTING THE DOCUMENT. ISA IS NOT RESPONSIBLE FOR IDENTIFYING ALL PATENTS THAT MAY REQUIRE A LICENSE BEFORE IMPLEMENTATION OF THE DOCUMENT OR FOR INVESTIGATING THE VALIDITY OR SCOPE OF ANY PATENTS BROUGHT TO ITS ATTENTION. THE USER SHOULD CAREFULLY INVESTIGATE RELEVANT PATENTS BEFORE USING THE DOCUMENT FOR THE USER'S INTENDED APPLICATION.

HOWEVER, ISA ASKS THAT ANYONE REVIEWING THIS DOCUMENT WHO IS AWARE OF ANY PATENTS THAT MAY IMPACT IMPLEMENTATION OF THE DOCUMENT NOTIFY THE ISA STANDARDS AND PRACTICES DEPARTMENT OF THE PATENT AND ITS OWNER.

ADDITIONALLY, THE USE OF THIS DOCUMENT MAY INVOLVE HAZARDOUS MATERIALS, OPERATIONS OR EQUIPMENT. THE DOCUMENT CANNOT ANTICIPATE ALL POSSIBLE APPLICATIONS OR ADDRESS ALL POSSIBLE SAFETY ISSUES ASSOCIATED WITH USE IN HAZARDOUS CONDITIONS. THE USER OF THIS DOCUMENT MUST EXERCISE SOUND PROFESSIONAL JUDGMENT CONCERNING ITS USE AND APPLICABILITY UNDER THE USER'S PARTICULAR CIRCUMSTANCES. THE USER MUST ALSO CONSIDER THE APPLICABILITY OF ANY GOVERNMENTAL REGULATORY LIMITATIONS AND ESTABLISHED SAFETY AND HEALTH PRACTICES BEFORE IMPLEMENTING THIS DOCUMENT.

THE USER OF THIS DOCUMENT SHOULD BE AWARE THAT THIS DOCUMENT MAY BE IMPACTED BY ELECTRONIC SECURITY ISSUES. THE COMMITTEE HAS NOT YET ADDRESSED THE POTENTIAL ISSUES IN THIS VERSION.

ISA (www.isa.org) is an international professional association that sets the standard for those who apply engineering and technology to improve the management, safety, and cybersecurity of modern automation and control systems used across industry and critical infrastructure. Founded in 1945, ISA develops widely used international standards for industrial automation, safety, and cybersecurity; certifies industry

professionals; provides education and training; publishes books and technical articles; hosts conferences and events; and provides networking and career development programs for its members and customers around the world.

ISA owns Automation.com, a leading online publisher of automation-related content. In addition, through a wholly owned subsidiary, ISA bridges the gap between standards and their implementation with the ISA Security Compliance Institute (www.isasecure.org) and the ISA Wireless Compliance Institute (www.isa100wci.org).

The following people served as active members of the ISA75.25 Working Group for ANSI/ISA-75.25.01-2024:

NAME	AFFILIATION
J. Beall, <i>Chair</i>	Enero Solutions
C. Langford, <i>Co-Chair</i>	Consultant
S. Boyle	Retired
J. Broyles	Control Valve Science
M. Coughran	Emerson Automation Solutions
B. Dahme	Emerson – Fisher Controls
J. Davis	SofTek Engineering
J. Dufresne	Samson Controls Inc.
K. Enos	REXA, Inc.
J. Faramarzi	Control Components Inc.
M. Fontaine	Emerson Process Management – Fisher Valves
F. Gonzalez	Flowserve
M. Hamid	QatarEnergy LNG
C. Hergert	Kellogg Brown & Root (KBR)
S. Houston	Eastman Chemical Company
B. Janvier	Enero Solutions
S. Kratzer	Emerson Automation Solutions
G. Liu	Retired
J. Lowery	Eastman Chemical Company
D. Martin	Valve Solutions Co.
P. Maurath	The Procter & Gamble Company
G. McMillan	Retired
S. Rashid	Petronas
G. Wang	Easytork Automation
J. Young	The Dow Chemical Co.

The following people served as voting members of the ISA75 Committee and approved ANSI/ISA-75.25.01-2024:

NAME	AFFILIATION
V. Mezzano, <i>Managing Director</i>	Fluor Corp
J. Young, <i>Chair</i>	The Dow Chemical Co.
H. Baumann	H B Services Partners LLC
J. Beall	Enero Solutions
S. Boyle	Retired
J. Broyles	Control Valve Science
J. Dufresne	Samson Controls Inc.
J. Faramarzi	Celeros Flow Technology
C. Hergert	Kellogg Brown & Root (KBR)
J. Kiesbauer	University of Applied Sciences Darmstadt
C. Langford	Consultant

A. Libke	DeZURIK
G. Liu	Retired
T. Loudin	Valmet Flow Control
L. Miller	Emerson
A. Sahraei	Nutrien
S. Samy	IMI Critical Engineering
J. Scalise	Bechtel

This standard was approved by the ISA Standards and Practices Board on 5 August 2024.

NAME	AFFILIATION
D. Lee, <i>Chair</i>	UCDS
D. Brandl, <i>Chair-Elect</i>	BR&L Consulting
D. Bartusiak	Collaborative Systems Integration
P. Brett	Honeywell
E. Cosman	OIT Concepts
J. Federlein	Federlein & Associates
S. Fluchs	admeritia GmbH
J.-P. Hauet	KB Intelligence
G. Lehmann	NextEra Energy
T. McAviney	Consultant
V. Mezzano	Fluor
C. Monchinski	Automated Control Concepts
D. Reed	Rockwell Automation
H. Sasajima	FieldComm Group
I. Verhappen	Willowglen Systems
D. Visnich	Burns & McDonnell
W. Weidman	Consultant
J. Weiss	Applied Control Solutions
M. Wilkins	Yokogawa
D. Zetterberg	Consultant

This page intentionally left blank.

Contents

1	Scope and limitations	9
2	Purpose and limitations	9
3	Terms and definitions	9
4	General test procedures	13
4.1	Test system	13
4.2	Measurement instrumentation requirements	14
4.3	Process variable	14
4.4	Nominal test positions	15
4.5	Examples of step response	15
5	Tests specified for each of the three test environments	17
5.1	Bench tests	17
5.2	Laboratory tests	18
5.3	In-process tests	18
6	Detailed test procedures	19
6.1	Baseline test	19
6.2	Small step test	20
6.3	Response time test	21
7	Presentation of test results	23
7.1	General information	23
7.2	Test results	24
8	Specification parameters for valve response from step inputs	26
9	References (latest versions)	26
	Annex A – Sliding friction measurement	27

Figures

Figure 1	– Dead band and resolution	10
Figure 2	– Typical step change and response without overshoot	16
Figure 3	– Step response with some overshoot	17
Figure 4	– Example step and response during baseline test	20
Figure 5	– Signal sequence for small step test	21
Figure 6	– Sample signal step sequence for response time tests	22
Figure 7	– Sample data from small step test ($\Delta s = 0.13\%$) performed in a process loop	25
Figure 8	– Sample plot showing step response, T_{86} , versus step size for four valves	25

This page intentionally left blank.

1 Scope and limitations

This document defines how to test, evaluate, and report the response of a control valve to a step input change. This document is intended for use with throttling control valves in closed or open loop control applications. It may apply to other types of final control elements (for example, dampers, variable speed drives). The “control valve,” hereinafter called “valve,” in the context of this document includes the complete, ready-to-use assembly of the control valve body, actuator, and any required accessories.

It was developed to address problems with automatic control caused by the response of control valves or other final control elements. The focus of this document is on the HOW to test. For the WHY to test and other background information, please refer to technical report ISA-TR75.25.02, *Control Valve Response Measurement from Step Inputs*.

If this document is used for evaluation or acceptance testing, the parties may agree to documented variations from these requirements.

This document does not define acceptable control valve performance for process control, nor does it restrict the selection of control valves for any application.

This document defines methods and criteria for performing, evaluating, and reporting valve response tests for any environment: bench testing, laboratory testing, and in-process testing. “Bench testing” is testing without flow, probably in a plant shop. “Laboratory testing” is testing with flow in a laboratory. “In-process” testing is testing of a valve installed in the plant with process conditions and flow rate noted in the test report.

2 Purpose and limitations

The purpose of this document is to define how to test, measure, and report valve response characteristics. This information can be used for process control applications to determine how well and how fast the control valve responds to the control valve input signal. It does not define acceptable process control, or restrict the selection of valves to any application, since process requirements and user objectives vary widely.

The information is specifically applicable to closed loop feedback control but may also be applicable to some open loop control applications.

3 Terms and definitions

The technical report ISA-TR75.25.02 explains applicable terms and explores control valve static and dynamic response characteristics important for process control. That information will aid with correct interpretation and application of the test results obtained from the tests defined in this document. Other relevant standards are listed in Clause 9.

This standard and ISA-TR75.25.02 make use of terms as defined in ISA-51.1, *Process Instrumentation Terminology*, and some of the essential terms are repeated here for convenience. In the specific area of nonlinear dynamics, some terms defined in ISA-51.1 lack the precision desired, while others are inconsistent with the accepted definitions used in nonlinear control literature. A common set of definitions is used in this standard and ISA-TR75.25.02.