



American National Standard
for

Rotodynamic Pumps - Guideline for Effects of Liquid Viscosity on Performance



6 Campus Drive
First Floor North
Parsippany, New Jersey
07054-4406
www.Pumps.org

American National Standard for

Rotodynamic Pumps - Guideline for Effects of Liquid Viscosity on Performance

Sponsor
Hydraulic Institute
www.Pumps.org

Approved September 16, 2015
American National Standards Institute, Inc.



American National Standard

Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgement of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this standard. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

Published By

**Hydraulic Institute
6 Campus Drive, First Floor North
Parsippany, NJ 07054-4406**

www.Pumps.org

Copyright © 2015 Hydraulic Institute
All rights reserved.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without prior written permission of the publisher.

Printed in the United States of America

ISBN 978-1-935762-43-0

Contents

Page

Foreword	v	
9.6.7	Guideline for effects of liquid viscosity on pump performance	1
9.6.7.1	Summary	1
9.6.7.2	Introduction	1
9.6.7.3	Fundamental considerations	2
9.6.7.3.1	Viscous correction factors	2
9.6.7.3.2	Methods for determining correction factors	3
9.6.7.4	Synopsis of Hydraulic Institute method	3
9.6.7.4.1	Generalized method based on empirical data	3
9.6.7.4.2	Viscous liquid performance correction limitations	4
9.6.7.4.3	Symbols and definitions used for determining correction factors	4
9.6.7.4.4	Overview of procedure to estimate effects of viscosity on pump performance	5
9.6.7.4.5	Instructions for determining pump performance on a viscous liquid when performance on water is known	8
9.6.7.4.6	Instructions for preliminary selection of a pump for given head, rate of flow, and viscosity conditions	15
9.6.7.5	Further theoretical explanations	18
9.6.7.5.1	Scope	18
9.6.7.5.2	Power balance and losses	18
9.6.7.5.3	Method for estimating net positive suction head required (NPSH3)	21
9.6.7.6	Additional considerations	25
9.6.7.6.1	Mechanical considerations	25
9.6.7.6.2	Sealing issues	25
9.6.7.6.3	Sealless pumps	27
9.6.7.7	Bibliography	27
9.6.7.8	Notation	28
Appendix A	Conversion of kinematic viscosity units	31
Appendix B	Index	33

Figures

9.6.7.3.1	— Modification of pump characteristics when pumping viscous liquids	3
9.6.7.4.4a	— Flowchart to establish if the procedure is applicable	5
9.6.7.4.4b	— Flowchart to determine pump performance on a viscous liquid when performance on water is known	6
9.6.7.4.4c	— Flowchart to select a pump for given head, rate of flow, and viscous conditions	7
9.6.7.4.5a	— Chart of correction factors for C_Q and C_H	9
9.6.7.4.5b	— Chart of correction factors for C_η	10
9.6.7.4.5c	— Example performance chart of a single-stage pump (metric units)	12
9.6.7.4.5d	— Example performance chart of a single-stage pump (US customary units)	15
9.6.7.5.2a	— Ratio of disk friction losses to useful power	20
9.6.7.5.2b	— Influence of disk friction losses on viscosity correction factor for efficiency	20

9.6.7.5.3a — Example NPSH3 chart (metric units)	23
9.6.7.5.3b — Example NPSH3 chart (US customary units)	24
9.6.7.6.1 — Example speed versus torque curve	26

Tables

9.6.7.4.5a — Example calculations (metric units)	12
9.6.7.4.5b — Example calculations (US customary units)	14
9.6.7.5.3a — Example calculations (metric units)	23
9.6.7.5.3b — Example calculations (US customary units)	24