

ANSI/ASSE TR-A1264.3-2007

ANSI/ASSE Technical Report

Using Variable Angle Tribometers (VAT) for Measurement of the Slip Resistance of Walkway Surfaces



American Society of Safety Engineers
1800 East Oakton Street
Des Plaines, IL 60018
www.asse.org

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ANSI Technical Report

Using Variable Angle Tribometers (VAT) for Measurement of the Slip Resistance of Walkway Surfaces

Prepared by the American Society of Safety Engineers

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1800 East Oakton Street

Des Plaines, Illinois 60018-2187

(847) 699-2929 • www.asse.org

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FOREWORD

Subcommittee A1264.2 of the A1264 Accredited Standards Committee *Safety Standards for Floor and Wall Openings, Railings, and Toeboards and Fixed General Industrial Stairs* of the American National Standards Institute developed this technical report to provide guidance for the performance of slip resistance testing of walkway surfaces in situ. The A1264.2 Subcommittee operates under the auspices of the ANSI A1264 ASC and its accredited Standards Development Organization – The American Society of Safety Engineers (ASSE).

This technical report is intended as a companion document to ANSI A1264.2 *Provision of Slip Resistance on Walking/Working Surfaces*. The intent of A1264.2 is to help reduce falls due to preventable conditions by providing guidelines and recommendations for the minimum performance requirements for increased safety on walking/working surfaces. The intent of this technical report is to provide a scientific basis and guidance for certain devices in evaluating walking/working surface slip resistance properties and/or frictional characteristics.

There have been and continue to be a number of standards activities related to the measurement of slip resistance on walkway surfaces. These initiatives tend to be long-term projects that take many years to develop. Therefore, a technical report assembling the scientific, legal, and standards development literature provides timely and much needed guidance.

This technical report complements the objectives of the A1264.2 standard, providing support for the use of slip resistance test instruments.

The standards committee offers this technical report as the state of the art, understanding that development in this area continues, and revisions to this report may be necessary as tribometric science progresses.

There are two appendices at the end of the technical report that provide operating protocols for the two slip resistance testers discussed in this report – the Brungraber Mark II/III Slip Tester and the English XL Tribometer.

Publication of this Registered Technical Report has been approved by the A1264 ASC and registered with ANSI by the American Society of Safety Engineers. This document is registered as a Technical Report series of publications according to the procedures for the Registration of Technical Reports with ANSI. This document is not an American National Standard and the material contained herein is not normative in nature. Comments on the content of this document should be sent to: The Director of Practices and Standards, American Society of Safety Engineers, 1800 East Oakton Street, Des Plaines, IL 60018.

This document is registered as a Technical Report in the A1264 series of publications according to the Procedures for the Registration of ANSI Technical Reports and the ANSI A1264 ASC Operating Procedures.

The A1264 Accredited Standards Committee is composed of the following member organizations:

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Lawrence Oldendorf, P.E., Vice Chairman
Timothy R. Fisher, CSP, ARM, CPEA, Secretary
Jennie Dalesandro, Administrative Technical Support

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	John Rupp, Jr.
	John Shepard
	Keith Vidal, P.E.
	Patrick E. Bush, CUSA

At the time the A1264.2 Standard was approved, the A1264.2 had the following subcommittee members:

Steven Di Pilla (Chairman)	Dale Sowell
Robert Brungraber, Ph.D., P.E.	David Underwood, Ph.D.
William Marletta, Ph.D., CSP	Keith Vidal, P.E.
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Leslie Schwartz	
James D. Smith, CSP	

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ANSI TECHNICAL REPORT TR-A1264.3 USING VARIABLE ANGLE TRIBOMETERS (VAT) FOR MEASUREMENT OF THE SLIP RESISTANCE OF WALKWAY SURFACES

OVERVIEW

Purpose and Scope

This technical report discusses the technical aspects, research, legislation, standards activities, and operation of the widely-used Variable Angle Tribometers (VATs) commercially available for testing of walkway surface slip resistance: The Brungraber Mark II/III and the English XL.

TERMINOLOGY

- *Adhesion*: The tendency of two surfaces in forceful contact to stick together. The resulting increased resistance to slipping may become greater as residence time increases.
- *Sticktion*: A phenomenon in which a liquid film is squeezed out of the interface between the shoe bottom and the walkway surface as a result of residence time. Sticktion can result in slip meter readings that are unexpectedly high under wet conditions.
- *Dwell time (residence time)*: The period of time between initial footwear or test pad contact with the walkway or test surface and the instant that relative motion is initiated. Residence time produces adhesion and sticktion. Slip meters which apply the vertical and horizontal force components simultaneously avoid sticktion on wet or contaminated surfaces and adhesion on dry surfaces.

Apparatus Description and Operating Principles

The phenomena of “adhesion” (involving dry surfaces) and “sticktion” (involving wet surfaces) are associated with slipmeters designed to remain stationary on a surface for some period of time before operating (known as “residence time” or “dwell time”). Dwell times as short as 0.2 seconds are known to be capable of producing this phenomenon. Adhesion and sticktion can result in higher readings than would be obtained on the same surface if testing occurs when the test foot and the walkway surfaces make contact with no dwell time. This difference is especially evident under wet conditions. Devices that avoid sticktion by applying the horizontal and vertical force components simultaneously (thereby avoiding dwell time) are suitable for testing under wet as well as dry conditions.

Variable-angle tribometers use a test foot in motion when it contacts the surface being tested, similar to non-scuffing human ambulation. The ratio of horizontal to vertical force is adjusted by the operator by changing the angle of incidence of the strut holding the test foot until a slip occurs.

The Brungraber Mark II/III and the English XL have been the subject of numerous peer-reviewed publications, collaborative studies, consensus standards development, regulatory adoption, and case law. They are used by many experts as suitable portable devices for measuring slip resistance properties of wet and dry surfaces.

The Brungraber Mark II/III

In the 1980’s, subsequent to the development of the Mark I tribometer, Dr. Brungraber invented the Mark II. A gravity-based articulated strut instrument designed to avoid the “sticktion” problem, the Mark II/III enables users to meter wet surfaces. It does so by eliminating the dwell time between the application of the vertical and horizontal forces. More recently, a spring actuated Mark III version has been developed. This reduces the weight of the tester and makes it independent of gravity so that inclined, even vertical, surfaces can be tested.