AWS C2.19/C2.19M:2013
An American National Standard

Specification for the Application of Thermal Spray Coatings to Machine Elements for OEM and Repair

American Welding Society®

Approved American National Standard
ANSI

AWS C2.19/C2.19M:2013
An American National Standard

Approved by the
American National Standards Institute
July 29, 2013

Specification for the Application of Thermal Spray Coatings to Machine Elements for OEM and Repair

1st Edition

Prepared by the
American Welding Society (AWS) C2 Committee on Thermal Spray

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard defines requirements for thermal spray coating systems for OEM and repair applications. Included are HVOF (High Velocity Oxygen Fuel) coatings that can be used as an alternative to hard chrome plating. The essential equipment, procedures for surface preparation, and the application of specific thermal spray coatings and sealers are detailed with in-process quality control checkpoints. This standard also presents management requirements and procedures for qualification, procedure approval, and documentation. Also covered are approved applications for thermal spray processes used for OEM and repair of machinery components along with minimum training requirements for thermal spray operators and inspectors. This specification has several annexes including annexes on safety, protocols for the U.S. Navy shipboard machinery, bend testing, and bond testing.

American Welding Society®

Statement on the Use of American Welding Society Standards

All standards (codes, specifications, recommended practices, methods, classifications, and guides) of the American Welding Society (AWS) are voluntary consensus standards that have been developed in accordance with the rules of the American National Standards Institute (ANSI). When AWS American National Standards are either incorporated in, or made part of, documents that are included in federal or state laws and regulations, or the regulations of other governmental bodies, their provisions carry the full legal authority of the statute. In such cases, any changes in those AWS standards must be approved by the governmental body having statutory jurisdiction before they can become a part of those laws and regulations. In all cases, these standards carry the full legal authority of the contract or other document that invokes the AWS standards. Where this contractual relationship exists, changes in or deviations from requirements of an AWS standard must be by agreement between the contracting parties.

AWS American National Standards are developed through a consensus standards development process that brings together volunteers representing varied viewpoints and interests to achieve consensus. While AWS administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in its standards.

AWS disclaims liability for any injury to persons or to property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this standard. AWS also makes no guarantee or warranty as to the accuracy or completeness of any information published herein.

In issuing and making this standard available, AWS is neither undertaking to render professional or other services for or on behalf of any person or entity, nor is AWS undertaking to perform any duty owed by any person or entity to someone else. Anyone using these documents should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances. It is assumed that the use of this standard and its provisions is entrusted to appropriately qualified and competent personnel.

This standard may be superseded by new editions. This standard may also be corrected through publication of amendments or errata, or supplemented by publication of addenda. Information on the latest editions of AWS standards including amendments, errata, and addenda is posted on the AWS web page (www.aws.org). Users should ensure that they have the latest edition, amendments, errata, and addenda.

Publication of this standard does not authorize infringement of any patent or trade name. Users of this standard accept any and all liabilities for infringement of any patent or trade name items. AWS disclaims liability for the infringement of any patent or product trade name resulting from the use of this standard.

AWS does not monitor, police, or enforce compliance with this standard, nor does it have the power to do so.

Official interpretations of any of the technical requirements of this standard may only be obtained by sending a request, in writing, to the appropriate technical committee. Such requests should be addressed to the American Welding Society, Attention: Managing Director, Technical Services Division, 8669 NW 36th St, #130, Miami, FL 33166 (see Annex G). With regard to technical inquiries made concerning AWS standards, oral opinions on AWS standards may be rendered. These opinions are offered solely as a convenience to users of this standard, and they do not constitute professional advice. Such opinions represent only the personal opinions of the particular individuals giving them. These individuals do not speak on behalf of AWS, nor do these oral opinions constitute official or unofficial opinions or interpretations of AWS. In addition, oral opinions are informal and should not be used as a substitute for an official interpretation.

This standard is subject to revision at any time by the AWS C2 Committee on Thermal Spray. It must be reviewed every five years, and if not revised, it must be either reaffirmed or withdrawn. Comments (recommendations, additions, or deletions) and any pertinent data that may be of use in improving this standard are required and should be addressed to AWS Headquarters. Such comments will receive careful consideration by the AWS C2 Committee on Thermal Spray and the author of the comments will be informed of the Committee's response to the comments. Guests are invited to attend all meetings of the AWS C2 Committee on Thermal Spray to express their comments verbally. Procedures for appeal of an adverse decision concerning all such comments are provided in the Rules of Operation of the Technical Activities Committee. A copy of these Rules can be obtained from the American Welding Society, 8669 NW 36th St, #130 Miami, FL 33166.

Dedication

"The C2 Committee on Thermal Spray, humbly dedicates this edition of AWS C2.19/C2.19M: 2013 *Specification for the Application of Thermal Spray Coatings to Machine Elements for OEM and Repair* to Elliot Sampson and Bob Sulit in recognition of their longstanding dedication to the C2A Sub and C2 Main committee and their efforts in the advancement of the art and science of thermal spray technology. Sampson and Sulit were active members of the C2A subcommittee since its creation and were instrumental in the migration of the MIL-STD-1687A(SH), *Thermal Spray Processes for Naval Ship Machinery Applications*, to this C2.19 document, an ANSI approved AWS Standard."

Personnel Page

AWS C2 Committee on Thermal Spray

D.A. Lee, Chair	*Kennametal Stellite*
A.P. Yanski, Vice Chair	*Praxair TAFA*
E.H. Abrams, Secretary	*American Welding Society*
D. Beneteau	*Centerline Ltd*
M. Froning	*The Boeing Company*
L.F. Grimenstein	*Nation Coating Systems Inc.*
J.O. Hayden	*Hayden Corp*
W. Medford	*Consultant*
B. Mosier	*Polymet Corp*
K. Sampath	*Chart Industries*
C. Sauer	*NAVAIR In-Service Support Center*
K.L. Sender	*Sulzer Metco (US) Inc.*
M.F. Smith	*Sandia National Laboratories*
S. Szapra	*Naval Surface Warfare Center*
R.Unger	*Polymet Corp*
R.J. Wong	*Naval Surface Warfare Center*

Advisors to the C2 Committee on Thermal Spray

C.C. Berndt	*Swinburne University of Technology*
M.R. Dorfman	*Sulzer Metco (US) Inc.*
A.J. Grubowski	*DDL OMNI*
D. Guillen	*INEEL*
A. Roy	*Quality Calibration & Consulting*
T.H. Via	*Via Technologies*
M. Weinstein	*Wall Colmonoy Corporation*

AWS C2A Subcommittee on Machine Element Repair

J.O. Hayden, Chair	*Hayden Corp*
E.H. Abrams, Secretary	*American Welding Society*
D. Beneteau	*Centerline Ltd*
A. Roy	*Quality Calibration & Consulting*
C. Sauer	*NAVAIR In-Service Support Center*
J.P. Stricker	*St Louis Metallizing Co*
S. Szapra	*Naval Surface Warfare Center*
A.P. Yanski	*Praxair TAFA*
R.J. Wong	*Naval Surface Warfare Center*

Advisors to the C2A Subcommittee on Machine Element Repair

J.T. Butler	*Joseph T Butler Inc.*
J.J. DeLoach	*Naval Surface Warfare Center*
B.J. Rampolla	*Alion Science & Technology Inc.*
E.F. Rybicki	*The University of Tulsa*

Foreword

This foreword is not part of AWS C2.19/C2.19M:2013 *Specification for the Application of Thermal Spray Coatings to Machine Elements for OEM and Repair*, but is included for informational purposes only.

This first edition of AWS C2.19/C2.19M:2013, *Specification for the Application of Thermal Spray Coatings to Machine Elements for OEM and Repair*, was developed pursuant to a request from the U.S. Naval Sea System Command to migrate MIL-STD-1687A(SH), *Thermal Spray Processes for Naval Ship Machinery Applications*, to an ANSI approved AWS Standard.

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, AWS C2A Committee on Thermal Spray, American Welding Society, 8669 NW 36th St, #130 Miami, FL 33166.

Table of Contents

List of Figures

Figure **Page No.**

List of Tables

Table **Page No.**

Specification for the Application of Thermal Spray Coatings to Machine Elements for OEM and Repair

1. General Requirements

1.1 Scope. This specification covers thermal spray processes for original equipment manufacturers (OEMs) and the repair of machinery components. The scope includes (1) recommended applications, (2) management and engineering requirements, (3) equipment and facility requirements, (4) feedstock materials, and (5) application processes for thermal spray coatings.

The thermal spray processes covered by this standard are combustion and high velocity oxygen fuel powder, electric arc, and plasma processes that use either powder or wire as feedstock.

Development of this standard was initiated at the request of the U.S. Navy to replace MIL-STD-1687A (SH), Thermal Spray Processes for Naval Ship Machinery Applications. It contains Annex B that the Navy may still use as their guide for surface ship applications. Annex B also lists Navy applications that are permitted and those that are prohibited, including the certification, approval requirements and protocols for handling U.S. Navy components.

Others may use this standard and annexes as a guide to establishing contract document requirements between equipment owners (purchaser) and thermal spray coating contractors where they may choose to invoke all or only a portion of this specification's requirements as fits the needs of their work.

1.2 Units of Measure. This standard makes use of both U.S. Customary Units and the International System of Units (SI). The latter are shown within brackets ([ ]) or in appropriate columns in tables and figures. The measurements may not be exact equivalents; therefore, each system must be used independently.

1.3 Safety. Safety and health issues and concerns are beyond the scope of this standard; some safety and health information such as Personal Protective Equipment is provided in clause 6, but such issues are not fully addressed herein. Annex A provides more comprehensive safety and health information specific to thermal spray.

Safety and health information is available from the following sources:

American Welding Society:

(1) ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*

(2) AWS Safety and Health Fact Sheets

(3) Other safety and health information on the AWS website

Material or Equipment Manufacturers:

(1) Material Safety Data Sheets supplied by materials manufacturers

(2) Operating Manuals supplied by equipment manufacturers