


**AWS D8.6:2005**  
**An American National Standard**



# **Specification for Automotive Resistance Spot Welding Electrodes**



**American Welding Society**



**AWS D8.6:2005  
An American National Standard**

**Approved by the  
American National Standards Institute  
September 20, 2005**

# **Specification for Automotive Resistance Spot Welding Electrodes**

**Supersedes AWS D8.6-77  
SAE HS-J1156**

Prepared by the  
American Welding Society (AWS) D8 Committee on Automotive Welding

Under the Direction of the  
AWS Technical Activities Committee

Approved by the  
AWS Board of Directors

## **Abstract**

This specification outlines the requirements for resistance welding electrodes relating to the automotive welding industry.



**American Welding Society**

550 N.W. LeJeune Road, Miami, FL 33126

International Standard Book Number: 0-87171-008-0  
American Welding Society  
550 N.W. LeJeune Road, Miami, FL 33126  
© 2006 by American Welding Society  
All rights reserved  
Printed in the United States of America

**Photocopy Rights.** No portion of this standard may be reproduced, stored in a retrieval system, or transmitted in any form, including mechanical, photocopying, recording, or otherwise, without the prior written permission of the copyright owner.

Authorization to photocopy items for internal, personal, or educational classroom use only or the internal, personal, or educational classroom use only of specific clients is granted by the American Welding Society provided that the appropriate fee is paid to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, tel: (978) 750-8400; Internet: <[www.copyright.com](http://www.copyright.com)>.

## 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 guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making this standard available, AWS is not 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.

This standard may be superseded by the issuance of new editions. Users should ensure that they have the latest edition.

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.

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

On occasion, text, tables, or figures are printed incorrectly, constituting errata. Such errata, when discovered, are posted on the AWS web page ([www.aws.org](http://www.aws.org)).

Official interpretations of any of the technical requirements of this standard may only be obtained by sending a request, in writing, to the Managing Director, Technical Services Division, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126 (see Annex H). With regard to technical inquiries made concerning AWS standards, oral opinions on AWS standards may be rendered. However, 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 D8 Committee on Automotive Welding. 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 D8 Committee on Automotive Welding 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 D8 Committee on Automotive Welding 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, 550 N.W. LeJeune Road, Miami, FL 33126.

This page is intentionally blank.

## Personnel

### AWS D8 Committee on Automotive Welding

J. C. Bohr, Chair	<i>General Motors North America</i>
W. H. Brafford, 1st Vice Chair	<i>Tuffaloy Products</i>
D. R. Kolodziej, 2nd Vice Chair	<i>Ford Motor Company</i>
A. M. Alonso, Secretary	<i>American Welding Society</i>
F. Armao	<i>The Lincoln Electric Company</i>
G. Armstrong	<i>Dynamic Suspension, Division of Multimatic</i>
J. Dolfi	<i>Consultant</i>
*J. F. Hinrichs	<i>Friction Stir Link, Incorporated</i>
S. H. Lalam	<i>Mittal Steel Company</i>
T. W. Morrissett	<i>Consultant</i>
J. S. Noruk	<i>Servo Robotic Corporation</i>
J. P. Osborne	<i>DeStaCo Industries</i>
M. D. Tumuluru	<i>U.S. Steel Corporation</i>

### AWS D8D Subcommittee on Automotive Resistance Spot Welding

J. C. Bohr, Chair	<i>General Motors North America</i>
W. F. Qualls, 1st Vice Chair	<i>Consultant</i>
H. Zhang, 2nd Vice Chair	<i>University of Michigan</i>
A. M. Alonso, Secretary	<i>American Welding Society</i>
I. Accorsi	<i>DaimlerChrysler</i>
W. H. Brafford	<i>Tuffaloy Products</i>
T. Coon	<i>Ford Motor Company</i>
G. J. Daumeyer	<i>Resistance Welders Equipment and Sales Company</i>
D. P. Kelly	<i>Fusion Welding Solutions</i>
M. Kimchi	<i>Edison Welding Institute</i>
M. Kuo	<i>Mittal Steel Company</i>
A. P. Lee	<i>DOFASCO, Incorporated</i>
T. W. Morrissett	<i>Consultant</i>
T. V. Natale	<i>A K Steel Corporation</i>
C. J. Orsette	<i>RoMan Engineering Services, Incorporated</i>
J. P. Osborne	<i>DeStaCo Industries</i>
E. Pakalnins	<i>DaimlerChrysler</i>
W. Peterson	<i>Edison Welding Institute</i>
N. S. Scotchmer	<i>Huys Industries</i>
T. Sparschu	<i>Candid Logic/Craftline, Incorporated</i>
M. D. Tumuluru	<i>U.S. Steel Corporation</i>
D. J. Walker	<i>Centerline (Windsor) Ltd.</i>

### AWS Task Force for Document Preparation and Revision

W. H. Brafford	<i>Tuffaloy Products</i>
P. Harris	<i>Tuffaloy Products</i>
T. W. Morrissett	<i>Consultant</i>
C. Padden	<i>Ford Motor Company</i>
R. Roberts	<i>General Motors Corporation</i>

\*Advisor

This page is intentionally blank.

## Foreword

This foreword is not a part of AWS D8.6:2005, *Specification for Automotive Resistance Spot Welding Electrodes*, but is included for informational purposes only.

This specification is designed to supplement RWMA Bulletin 16, *Resistance Welding Equipment Standards*.

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, AWS D8 Committee on Automotive Welding, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

Official interpretation of any of the technical requirements of this standard may only be obtained by sending a request, in writing, to the Managing Director, Technical Services Division, American Welding Society. A formal reply will be issued after it has been reviewed by the appropriate personnel following established procedures.

This page is intentionally blank.

# Table of Contents

	<b>Page No.</b>
<i>Personnel</i> .....	v
<i>Foreword</i> .....	vii
<i>Table of Contents</i> .....	ix
<i>List of Tables</i> .....	xi
<i>List of Figures</i> .....	xii
<b>1. Scope</b> .....	1
<b>2. Normative References</b> .....	1
<b>3. Terms and Definitions</b> .....	1
<b>4. Materials</b> .....	2
4.1 Wrought and Forged Materials.....	2
4.2 Material Structure.....	2
4.3 Chemical Composition.....	2
4.4 Physical Requirements.....	2
<b>5. Dimensions and Specifications</b> .....	2
5.1 Contact Surfaces.....	2
5.2 Water Passages.....	2
5.3 Bent Electrodes.....	2
<b>6. Identification</b> .....	2
6.1 Markings.....	2
6.2 Electrode Identification Systems for AWS RSW Straight and Bent Electrodes.....	2
6.3 Electrode Identification System for AWS RSW Cap Electrodes.....	2
6.4 Electrode Identification System for AWS RSW Cap-Adaptor Shanks.....	2
<b>7. RWMA Tapered and Straight Shank Electrodes</b> .....	2
7.1 Standard Tapered Electrodes.....	2
7.2 Standard Straight Electrode Noses.....	2
<b>8. RWMA Electrode Caps and Cap-Adaptor Shanks</b> .....	5
8.1 Male Cap Electrodes.....	5
8.2 Cap-Adaptor Shanks for Male Cap Electrodes.....	5
8.3 Female Cap Electrodes.....	5
8.4 Cap-Adaptor Shanks for Female Cap Electrodes.....	5
<b>9. Single-Bend Electrodes</b> .....	5
9.1 Dimensions for Single-Bend Electrodes.....	5
9.2 Dimensions for Water Tubes in Single-Bend Electrodes.....	5
<b>10. Double-Bend Electrodes</b> .....	5
10.1 Dimensions for Double-Bend Electrodes.....	5
10.2 Dimensions for Water Tubes in Double-Bend Electrodes.....	5
<b>11. Special-Faced Electrodes</b> .....	5
<b>12. Single- and Double-Bend Adaptor Shanks for Standard Electrode Caps</b> .....	5
12.1 Single-Bend Adaptor Shanks for Standard Electrode Caps.....	5

12.2 Double-Bend Adaptor Shanks for Standard Electrode Caps .....5

**13. Engineering Information .....5**

Annex A (Informative)—Recommended Electrode Materials for Spot Welding Dissimilar and Similar Metals ..... 31

Annex B (Informative)—Standard Gauges for Confirmation of RWMA “Standard Electrode Tapers” .....35

Annex C (Informative)—Standard Gauges for Confirmation of RWMA “Standard Male Cap Electrode Tapers” .....37

Annex D (Informative)—Standard Gauges for Confirmation of RWMA “Standard Female Cap Electrode Tapers” .....39

Annex E (Informative)—Recommended Sizes of Stock RWMA Electrode Numbers and Welding Face Diameters for Use at Various Welding Force Ranges .....41

Annex F (Informative)—Cap Electrodes and Cap Electrode Adaptor Conventions in Common Usage by Automotive Companies.....43

Annex G (Informative)—Female Cap Electrodes and Adaptor Conventions in Common Usage by Automotive Companies.....71

Annex H (Informative)—Guidelines for the Preparation of Technical Inquiries .....81

List of AWS Documents on Automotive Welding.....83

## List of Tables

Table	Page No.
1	Chemical Compositions of RWMA Materials.....3
2	Minimum Mechanical and Physical Properties for RWMA Copper Alloys .....4
3	Coding for Standard Straight Electrodes .....7
4	Coding for Single-Bend Electrodes .....8
5	Coding for Double-Bend Electrodes.....9
6	Coding for Standard Male Cap Electrodes .....10
7	Coding for Standard Female Cap Electrodes.....11
8	Coding for Straight Cap-Adaptor Shanks for Male Electrode Caps.....12
9	Coding for Single-Bend Adaptor Shanks for Male Electrode Caps .....13
10	Coding for Double-Bend Adaptor Shanks for Male Electrode Caps.....14
11	Coding for Straight Cap-Adaptor Shanks for Female Electrode Caps .....15
12	Coding for Single-Bend Adaptor Shanks for Female Electrode Caps.....16
13	Coding for Double-Bend Adaptor Shanks for Female Electrode Caps .....17
14	Standard Dimensions for Straight Electrodes, Tapers, and Water Holes .....18
15	Standard Dimensions for Standard Straight Electrode Noses.....20
16	Standard Dimensions for Male Cap Electrodes .....21
17	Standard Dimensions for Straight Cap-Adaptor Shanks for Male Cap Electrodes .....23
18	Standard Dimensions for Female Cap Electrodes.....25
19	Standard Dimensions for Straight Cap-Adaptor Shanks for Female Cap Electrodes.....27
20	Water Tube Specifications for Tubes Inserted in Single- and Double-Bend Electrodes (not part of RWMA standards) .....29
21	Double-Bend Electrodes Listed by the RWMA .....29
F.1	Standard for Male Cap Electrodes .....47
F.1M	Standard for Male Cap Electrodes .....47
F.2	Standard for Male Cap Electrode and Adaptor Shank.....54
F.2M	Standard for Male Cap Electrode and Adaptor Shank.....55
F.3	Standard for Increased Water Flow Male Cap Electrodes.....63
F.3M	Standard for Increased Water Flow Male Cap Electrodes.....63
F.4	Standard for Female Cap Electrodes.....67
F.4M	Standard for Female Cap Electrodes.....67
F.5	Standard for Straight Adaptors for Type “F” Female Cap Electrodes.....70
F.5M	Standard for Straight Adaptors for Type “F” Female Cap Electrodes.....70
G.1	Standard for Straight Adaptor for Female Cap Electrodes .....74
G.1M	Standard for Straight Adaptor for Female Cap Electrodes .....74
G.2	Standard for Straight Adaptors for RWMA #4 Female Cap Electrodes and #1 Special Tapers .....76
G.2M	Standard for Straight Adaptors for RWMA #4 Female Cap Electrodes and #1 Special Tapers .....76
G.3	Standard for Straight Adaptors for RWMA #6 Female Cap Electrodes .....78
G.3M	Standard for Straight Adaptors for RWMA #6 Female Cap Electrodes .....78

## List of Figures

Figure		Page No.
1	Electrode Types .....	7
2	Single-Bend Electrode Terminology .....	8
3	Double-Bend Electrode Terminology.....	9
4	Male Cap Electrode Types.....	10
5	Female Cap Electrode Types .....	11
6	Straight Cap-Adaptor Shank for Male Cap .....	12
7	Single-Bend Cap-Adaptor Shank for Male Cap .....	13
8	Double-Bend Cap-Adaptor Shank for Male Cap.....	14
9	Straight Cap-Adaptor Shank for Female Cap.....	15
10	Single-Bend Cap-Adaptor Shank for Female Cap.....	16
11	Double-Bend Cap-Adaptor Shank for Female Cap.....	17
12	Standard for Straight Electrodes.....	19
13	Nose Configurations for Standard Straight Electrodes.....	20
14	Standard Male Cap Electrodes.....	22
15	Cap-Adaptor Shanks for Male Cap Electrodes.....	24
16	Standard Female Cap Electrodes .....	26
17	Cap-Adaptor Shanks for Female Cap Electrodes .....	28
F.1	Male Cap Electrodes—Ordering Codes .....	44
F1.M	Male Cap Electrodes—Ordering Codes .....	45
F.2	Male Cap Electrode Dimensions .....	46
F.2M	Male Cap Electrode Dimensions .....	46
F.3	Male Cap Electrode Nose Descriptions.....	48
F.3M	Male Cap Electrode Nose Descriptions.....	49
F.4	Male Cap Electrode Adaptor Shanks—Ordering Codes .....	50
F.4M	Male Cap Electrode Adaptor Shanks—Ordering Codes .....	51
F.5	Male Cap Electrode Adaptor Shanks—Dimensional Specifications.....	52
F.5M	Male Cap Electrode Adaptor Shanks—Dimensional Specifications.....	53
F.6	3/4 in Increased Water Flow Male Cap Electrodes—Ordering Codes.....	57
F.6M	19 mm Increased Water Flow Male Cap Electrodes—Ordering Codes.....	59
F.7	3/4 in Increased Water Flow Male Cap Electrodes—Nose Design.....	60
F.7M	19 mm Increased Water Flow Male Cap Electrodes—Nose Design.....	61
F.8	3/4 in Increased Water Flow Male Cap Electrodes—Dimensions .....	62
F.8M	19 mm Increased Water Flow Male Cap Electrodes—Dimensions .....	62
F.9	Type “F” Female Cap Electrodes—Ordering Codes.....	64
F.10	Type “F” Female Cap Electrodes—Description.....	65
F.10M	Type “F” Female Cap Electrodes—Description.....	66
F.11	Straight Adaptor for Type “F” Female Cap Electrodes—Ordering Codes .....	68
F.12	Straight Adaptor for Type “F” Female Cap Electrodes—Description .....	69
F.12M	Straight Adaptor for Type “F” Female Cap Electrodes—Description .....	69
G.1	Nomenclature for Straight Adaptors and Assemblies for Female Cap Electrodes with RWMA #5 Taper .....	72
G.1M	Nomenclature for Straight Adaptors and Assemblies for Female Cap Electrodes with RWMA #5 Taper .....	73
G.2	Nomenclature for Straight Adaptors and Assemblies for Female Cap Electrodes with RWMA #4 Cap and RWMA #4 Tapers .....	75

<b>Figure</b>		<b>Page No.</b>
G.2M	Nomenclature for Straight Adaptors and Assemblies for Female Cap Electrodes with RWMA #4 Cap and RWMA #4 Tapers .....	75
G.3	Nomenclature for Straight Adaptors and Caps for Female Cap Electrodes with RWMA #6 Taper.....	77
G.3M	Nomenclature for Straight Adaptors and Caps for Female Cap Electrodes with RWMA #6 Taper.....	77
G.4	Nomenclature for Female Electrode Caps .....	79
G.4M	Nomenclature for Female Electrode Caps .....	80

This page is intentionally blank.

# Specification for Automotive Resistance Spot Welding Electrodes

## 1. Scope

This specification outlines the requirements for resistance spot welding electrodes, hereafter referred to as AWS RSW electrodes or simply RSW electrodes.

RSW electrodes shall comply with Resistance Welder Manufacturers' Association (RWMA) standards in addition to the specifications and requirements of this specification. In case of any conflict between RWMA standards and AWS standards, the AWS specification shall govern. Examples of several widely used commercially available standard automotive industrial type caps and shanks are shown in the informative annexes.

This specification makes sole use of U.S. Customary Units. Approximate mathematical equivalents in the International System of Units (SI) are provided for comparison in parentheses or in appropriate columns in tables and figures.

Safety and health issues and concerns are beyond the scope of this specification, and therefore are not fully addressed herein. Safety and health information is available from other sources, including, but not limited to, ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*, and applicable federal and state regulations.

## 2. Normative References

The following standard contains provisions which, through reference in this text, constitute provisions of this AWS standard. For undated references, the latest edition of the referenced standard shall apply. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply.

1. RWMA Bulletin 16, *Resistance Welding Equipment Standards*, Section 1<sup>1</sup>; and

<sup>1</sup>RWMA standards are published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

2. AWS A3.0, *Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying*.<sup>2</sup>

## 3. Terms and Definitions

The definitions given here are the names and descriptions of the various types, shapes, and configurations used to identify resistance spot welding electrodes. All other terms used herein are defined by AWS A3.0, *Standard Welding Terms and Definitions*.

For the purposes of this document, the following terms and definitions apply:

**resistance spot welding (RSW) electrodes.** The component of a resistance welding machine through which the welding current and, in most cases, pressure are applied directly to the work.

**electrode shapes.** The various forms of RSW electrodes covered by this standard are as follows:

1. Straight electrodes with tapered shanks
2. Straight electrodes with straight shanks
3. Electrode caps and cap-adaptor shanks
4. Single-bend electrodes
5. Double-bend electrodes
6. Special-faced electrodes

The RSW **electrode tapers** and **straight shanks** are shown and defined in Figure 12 (see Clause 7) of this specification.

**nose configurations.** The following nose styles are shown and defined in Figure 13 (see 7.2) of this specification.

1. Type A—Pointed

<sup>2</sup>AWS standards are published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.