British Standard

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BRITISH STANDARD

BS 2901-5: 1990

Filler rods and wires for gas-shielded arc welding —

Part 5: Specification for nickel and nickel alloys

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Welding Standards Policy Committee (WEE/-) to Technical Committee WEE/39, upon which the following bodies were represented:

Aluminium Federation
Association of Welding Distributors
British Association for Brazing and Soldering
British Compressed Gases Association
British Constructional Steelwork Association Ltd.
British Shipbuilders
British Steel Industry
Electricity Supply Industry in England and Wales
Engineering Equipment and Materials Users' Association
Power Generation Contractors' Association (BEAMA Ltd.)
Process Plant Association
Welding Institute
Welding Manufacturers' Association (BEAMA Ltd.)
Coopted members

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

British Non-ferrous Metals Federation
British Nuclear Fuels Limited
British Railways Board
British Steel Industry (Wire Section)
Stainless Steel Wire Industry Association
United Kingdom Atomic Energy Authority

This British Standard, having been prepared under the direction of the Welding Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 30 September 1990

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Contents

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Foreword

This revision of this Part of BS 2901 has been prepared under the direction of the Welding Standards Policy Committee. BS 2901 is published in Parts covering the following types of consumables.

a) *Part 1: covers ferritic steels*;

b) *Part 2: covers stainless steels*;

c) *Part 3: covers copper and copper alloys*;

d) *Part 4: covers aluminium and aluminium alloys and magnesium alloys*;

e) *Part 5: covers nickel and nickel alloys*.

This Part of BS 2901 supersedes BS 2901-5:1983 which is withdrawn.

In accordance with current practice, in deciding on the dimensions of wires and reels, account has been taken of appropriate ISO (International Organization for Standardization) specifications.

Although the rods and wires specified in this Part of BS 2901 are all suitable for some form of gas-shielded arc welding, certain rods and wires are not suitable for use with particular shielding gases. The chemical composition of the deposited weld metal is not specified because this depends on the shielding gas used and the particular welding conditions. It is necessary, therefore, to ascertain from the supplier whether the rods or wires are suitable for use with a particular shielding gas. Also for some applications a particular chemical composition may need to be selected from the range specified for the appropriate type of rod or wire.

In this revision six additional alloys have been included.

Product certification. Users of this British Standard are advised to consider the desirability of third party certification of product conformity with this British Standard based on testing and continuing surveillance, which may be coupled with assessment of a supplier's quality systems against the appropriate Part of BS 5750.

Enquiries as to the availability of third party certification schemes will be forwarded by BSI to the Association of Certification Bodies. If a third party certification scheme does not already exist, users should consider approaching an appropriate body from the list of Association members.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 6, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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1 Scope

This Part of BS 2901 specifies requirements and chemical compositions for nickel and nickel alloy filler rods and wires for gas-shielded arc welding, i.e. TIG-welding or MIG-welding.

NOTE The titles of the publications referred to in this Part of BS 2901 are listed on the inside back cover.

2 Chemical composition

The rods and wires shall have a chemical composition in accordance with Table 1 for the particular type ordered.

For the purposes of determining compliance with composition limits, any value obtained from the analysis shall be rounded to the same number of decimal places as used in this standard in expressing the specified limit. The following rules shall be used for rounding.

a) When the figure immediately after the last figure to be retained is less than five, then the last figure to be retained shall be kept unchanged.

b) When the figure immediately after the last figure to be retained is either:

1) greater than five; or

2) equal to five and followed by at least one figure other than zero;

then the last figure to be retained shall be increased by one.

c) When the figure immediately after the last figure to be retained is equal to five, and followed by zeros only, then the last figure to be retained shall be left unchanged if even, and increased by one if odd.

In cases of dispute regarding the chemical composition of the rods and wires, sampling and check analysis shall be carried out.

NOTE 1 Some suitable methods are given in BS 6783.
NOTE 2 The purchaser should indicate whether a test certificate for the chemical analysis of rods and wires is required.

3 Diameters and tolerances

The diameters of rods and wires shall be selected from the values given in Table 2 with tolerances appropriate to the specified diameters.

4 Condition of rods and wires

4.1 Finish

Rods and wires shall have a smooth finish, free from surface imperfections, corrosion products, grease or other foreign matter which would adversely affect the quality of the weld or the operation of the welding equipment.

4.2 Cast and helix of wire

The cast of spooled filler wire shall be such that one complete loop or circle of wire taken from the spool, when laid on a flat surface without restraint, shall form a circle or part thereof with maximum and minimum diameters as given in Table 3.

The vertical separation between any part of the loop used to determine the cast and the flat surface on which it is laid shall not exceed the value for helix given in Table 3.

NOTE Although cast and helix have been specified it should be noted that other factors which cannot be quantified also affect the feeding of a wire.

5 Spools of wire

The size of spool on which the particular diameter of wire is to be supplied shall conform to the appropriate dimensions and mass given in Figure 1 and Table 4 and Table 5.

NOTE 1 It is necessary for the purchaser to designate the size at the time of placing the order.

The flanges of spools shall be sufficiently robust to avoid becoming deformed in normal usage.

NOTE 2 The barrel diameter for spools should be as large as possible to permit satisfactory feeding of the wire.

6 Spooling conditions

The wire shall be wound on the spool in one continuous length and shall be free from kinks, waves, sharp bends or twists, so that it is free to unwind without restriction.

The outer layer of wire shall be not closer than 3 mm to the flange periphery on spools having a flange diameter of 100 mm and not closer than 10 mm to the flange periphery on spools having other flange diameters.

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Table 1 — Chemical compositions for nickel and nickel alloys (percentage by mass)

Type		C	Si	Mn	P	S	Ag	Al	B	Bi	Co	Cr	Cu	Fe	Mo	Ni	Pb	Ti	V	W	Zr	Al + Ti	Nb + Ta
NA 32	min.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	93.0[a]	—	2.0	—	—	—	—	—
	max.	0.15	0.75	1.0	0.030	0.015	—	1.5	—	—	1.0	—	0.25	1.0	—	—	—	3.5	—	—	—	—	—
NA 33	min.	—	—	3.0	—	—	—	—	—	—	—	—	—	—	—	62.0[a]	—	1.5	—	—	—	—	—
	max.	0.15	1.25	4.0	0.020	0.015	—	1.25	—	—	1.0	—	Rem.[c]	2.5	—	69.0[a]	—	3.0	—	—	—	—	—
NA 34	min.	—	—	—	—	—	—	—	—	—	—	18.0	—	—	—	—	—	—	—	—	—	—	—
	max.	0.26	0.5	1.2	0.030	0.015	—	—	—	—	1.0	21.0	0.2	0.5	—	Rem.[a]	—	—	—	—	—	—	—
NA 35[b]	min.	—	—	2.5	—	—	—	—	—	—	—	18.0	—	—	—	67.0[a]	—	—	—	—	—	—	2.00
	max.	0.10	0.5	3.5	0.030	0.015	—	—	—	—	1.0	22.0	0.5	3.0	—	—	—	0.8	—	—	—	—	3.00
NA 36[d]	min.	—	—	—	—	—	—	1.0	—	—	15.0	18.0	—	—	—	—	—	2.0	—	—	—	—	—
	max.	0.13	1.0	1.0	0.015	0.015	0.0005	2.0	0.020	0.0001	21.0	21.0	0.2	1.5	—	Rem.	0.0020	3.0	—	—	0.15	—	—
NA 37[d]	min.	—	—	—	—	—	—	1.7	—	—	12.0	16.0	—	—	6.0	—	—	1.5	—	—	—	—	—
	max.	0.07	0.5	0.5	0.015	0.010	0.0005	2.5	0.005	0.0001	16.0	20.0	0.2	1.0	8.0	Rem.	0.0020	3.0	—	—	0.06	—	—
NA 38[d]	min.	0.04	—	—	—	—	—	0.3	—	—	19.0	19.0	—	—	5.6	—	—	1.9	—	—	—	2.4	—
	max.	0.08	0.4	0.6	0.015	0.007	0.0005	0.6	0.005	0.0001	21.0	21.0	0.2	0.7	6.1	Rem.	0.0020	2.4	—	—	—	2.8	—
NA 39[d]	min.	—	—	2.0	—	—	—	—	—	—	—	14.0	—	—	—	67.0[a]	—	2.5	—	—	—	—	—
	max.	0.08	0.35	2.7	0.030	0.015	—	—	—	—	1.0	17.0	0.5	8.0	—	—	—	3.5	—	—	—	—	—
NA 40	min.	0.05	—	—	—	—	—	—	—	—	0.5	20.5	—	17.0	8.0	—	—	—	—	0.2	—	—	—
	max.	0.15	1.0	1.0	0.015	0.015	—	—	0.010	—	2.5	23.0	0.5	20.0	10.0	Rem.	0.0050	—	—	1.0	—	—	—
NA 41	min.	—	—	—	—	—	—	—	—	—	—	19.5	1.5	22.0	2.5	38.0[a]	—	0.6	—	—	—	—	—
	max.	0.05	0.5	1.0	0.030	0.030	—	0.2	—	—	2.0	23.5	3.0	—	3.5	46.0[a]	—	1.2	—	—	—	—	—
NA 42[d]	min.	0.04	—	—	—	—	—	1.1	—	—	—	15.5	—	—	2.8	42.0[a]	—	1.1	—	—	0.01	—	—
	max.	0.08	0.5	0.2	0.020	0.015	0.0005	1.3	0.0050	0.0001	2.0	17.5	0.5	Rem.	3.8	45.0[a]	0.0015	1.3	—	—	0.04	—	—
NA 43	min.	—	—	—	—	—	—	—	—	—	—	20.0	—	—	8.0	58.0[a]	—	—	—	—	—	—	3.15
	max.	0.10	0.5	0.5	0.015	0.015	—	0.4	—	—	1.0	23.0	0.5	5.0	10.0	—	—	0.4	—	—	—	—	4.15
NA 44	min.	—	—	—	—	—	—	—	—	—	—	—	—	—	26.0		—	—	—	—	—	—	—
	max.	0.02	0.10	1.0	0.040	0.030	—	—	—	—	1.0	1.0	0.5	2.0	30.0	Rem.[a]	—	—	—	0.1	—	—	—
NA 45	min.	—	—	—	—	—	—	—	—	—	—	14.0	—	—	14.0	—	—	—	—	—	—	—	—
	max.	0.015	0.08	1.0	0.040	0.030	—	—	—	—	2.0	18.0	0.5	3.0	18.0	Rem.[a]	—	0.7	—	0.50	—	—	—

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Table 1 — Chemical compositions for nickel and nickel alloys (percentage by mass)

Type		C	Si	Mn	P	S	Ag	Al	B	Bi	Co	Cr	Cu	Fe	Mo	Ni	Pb	Ti	V	W	Zr	Al + Ti	Nb + Ta
NA 46	min.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	99.0[a]	—	—	—	—	—	—	—
	max.[e]	0.15	0.35	0.35	0.030	0.015	—	—	—	—	2.0	—	0.25	0.40	—		—	0.1	—	—	—	—	—
NA 47	min.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	52.0[a]	—	—	—	—	—	—	—
	max.	0.15	0.5	1.0	0.030	0.020	—	—	—	—	2.0	—	0.5	Rem.	—	60.0[a]	—	—	—	—	—	—	—
NA 48	min.	—	—	—	—	—	—	—	—	—	—	14.5	—	4.0	15.0		—	—	—	3.0	—	—	—
	max.	0.02	0.08	1.0	0.040	0.030	—	—	—	—	2.5	16.5	0.5	7.0	17.0	Rem.[a]	—	—	0.35	4.5	—	—	—
NA 49	min.	—	—	—	—	—	—	1.0	—	—	—	21.0	—	—	—	58.0[a]	—	—	—	—	—	—	—
	max.	0.10	0.5	1.0	0.030	0.015	—	1.7	—	—	1.0	25.0	1.0	Rem.	—	63.0[a]	—	—	—	—	—	—	—
NA 50	min.	0.05	—	—	—	—	—	0.8	—	—	10.0	20.0	—	—	8.0	—	—	—	—	—	—	—	—
	max.	0.15	1.0	1.0	0.030	0.015	—	1.5	—	—	15.0	24.0	0.5	3.0	10.0	Rem.	—	0.6	—	—	—	—	—
NA 51[d]	min.	—	—	—	—	—	—	0.2	—	—	—	17.0	—	—	2.8	50.0[a]	—	0.6	—	—	—	—	4.75
	max.	0.08	0.35	0.35	0.015	0.015	—	0.8	0.006	—	1.0	21.0	0.3	Rem.	3.3	55.0[a]	—	1.2	—	—	—	—	5.50

[a] This includes cobalt.
[b] Cobalt to be 0.12 maximum when specified. Tantalum to be 0.30 maximum when specified.
[c] Rem. is an abbreviation for remainder.
[d] To obtain normal parent metal mechanical properties precipitation treatment is required.
[e] Magnesium is 0.20 maximum.

Table 2 — Diameters and tolerances

Form	Diameter	Tolerance
	mm	mm
Wire	0.5	+ 0.01 – 0.03
	0.6	
	0.8	+ 0.01 – 0.04
	0.9	
	1.0	
	1.2	
Wire or rod	1.6	
Rod	**2.0**	+ 0.01 – 0.07
	2.4	
	2.5	
	3.2	
	4.0	
	5.0	

NOTE The values printed in bold type are the sizes normally manufactured.

Table 3 — Cast and helix of wire

Diameter of spool	Cast		Helix
	max.	min.	
mm	mm	mm	mm
300	760	380	25
100	230	65	13

7 Lengths of rods[1)]

The length of rod supplied shall be one of the following:

a) 500 mm or 1 000 mm for rods of less than 2.5 mm diameter;

b) 1 000 mm for rods of 2.5 mm diameter and larger;

c) a length as stated at the time of placing the order.

NOTE Options **7** a) and **7** b) are the preferred lengths.

The tolerance on each length shall be ± 5 mm.

8 Packing

Rods and spools of wire shall be suitably packed to guard against damage, contamination or deterioration during storage and transportation.

NOTE If special conditions apply, e.g. transportation to a tropical region, the purchaser should state them at the time of placing the order.

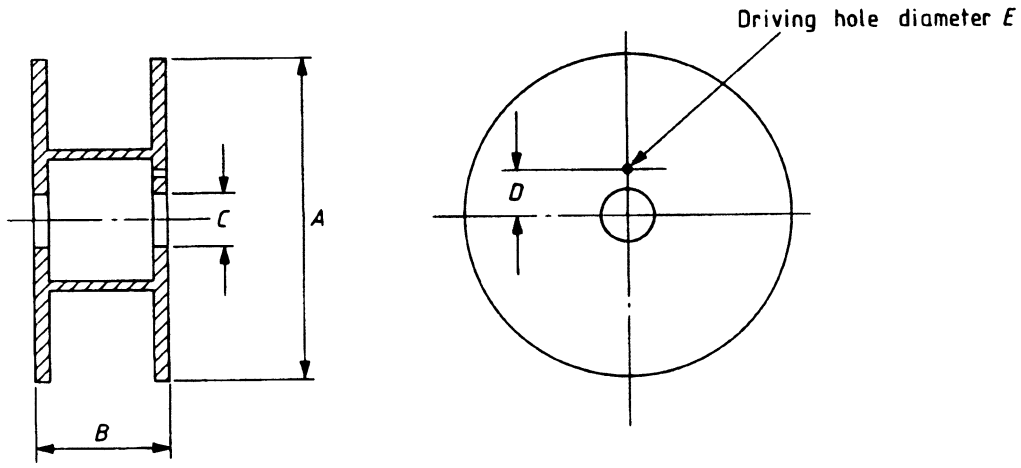

Figure 1 — Spool

[1)] The lengths specified in **7** a) and **7** b) are in accordance with ISO 544:1989.

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Table 4 — Dimensions of spools

A		*B*		*C*		*D*		*E*	
Diameter	**Tolerance**	**Width**	**Tolerance**	**Diameter**	**Tolerance**	**Distance between axes**	**Tolerance**	**Diameter**	**Tolerance**
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
100	+ 2 – 2	45	+ 0 – 2	16	+ 1 – 0	—	—	—	—
300	+ 5 – 5	103	+ 0 – 3	50.5	+ 2.5 – 0	44.5	+ 0.5 – 0.5	10	+ 1 – 0
NOTE The dimensions specified are in accordance with ISO 864:1988 and are shown in Figure 1.									

9 Marking

Each package of rods and each spool of wire and its outer packing shall be clearly marked with the following information.

a) The name of the supplier.

b) The designation of the material type.

NOTE If individual identification of rods is required this is to be agreed between the purchaser and supplier at the time of placing the order.

c) The size and quantity or mass of rod or wire.

d) The identification number for traceability.

e) A health warning (see Appendix A) consisting of the general warning sign (**A.2.9** of BS 5378-1:1980) accompanied by the following.

FUMES AND GASES CAN BE DANGEROUS TO YOUR HEALTH. ARC RAYS CAN INJURE EYES AND BURN SKIN. ELECTRIC SHOCK CAN KILL.

READ AND UNDERSTAND THE MANUFACTURER'S INSTRUCTIONS AND YOUR EMPLOYER'S SAFETY PRACTICES.

Table 5 — Maximum masses for wire on spools

Wire diameters	**Masses for wire on spools having flange diameters of**	
	100 mm	**300 mm**
	kg	kg
All	1.1	18

10 Supplier's certificate

The supplier shall provide a certificate stating that the rods or wires comply with BS 2901-5:1990[2)].

[2)] Marking BS 2901-5:1990 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

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Appendix A References to health and safety publications

The following references about health and safety are available.

The Facts About Fume, The Welding Institute, Abington 1986

Welding Fume, The Welding Institute, Abington 1981

Health and Safety in Welding, The Welding Institute, Abington, 1983

Health and Safety Executive Guidance Note EH 40 *Occupational Exposure Limits*

Department of Employment Guidance Note MS 15 *Welding*

American Standard ANSI Z 49.1 *Safety in Cutting and Welding*, American Welding Society 1973

Health Hazards of Welding, Dr H T Doig, British Safety Council

Welding Manufacturers' Association, Publication No. 237 *The Arc Welder at Work*

BS 679 *Specification for filters, cover lenses and backing lenses for use during welding and similar operations*

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Publication(s) referred to

BS 679, *Specification for filters, cover lenses and backing lenses for use during welding and similar operations.*

BS 2901, *Filler rods and wires for gas-shielded arc welding*[3)].

BS 2901-1, *Ferritic steels.*

BS 2901-2, *Specification for stainless steels.*

BS 2901-4, *Specification for aluminium and aluminium alloys and magnesium alloys.*

BS 5378, *Safety signs and colours.*

BS 5378-1, *Specification for colour and design.*

BS 6783, *Sampling and analysis of nickel, ferronickel and nickel alloys.*

ISO 544, *Filler materials for manual welding — Size requirements.*

ISO 864, *Arc welding — Solid and tubular cored wires which deposit carbon and carbon manganese steel — Dimensions of wires, spools, rims and coils.*

The Facts About Fume, The Welding Institute, Abington 1986.

Welding Fume, The Welding Institute, Abington 1981.

Health and Safety in Welding, The Welding Institute, Abington 1983.

Health and Safety Executive Guidance Notes EH 40 Occupational Exposure Limits.

Department of Employment Guidance Note MS 15 Welding.

American Standard ANSI Z 49.1 Safety in Cutting and Welding, American Welding Society 1973.

Health Hazards of Welding, Dr H T Doig, British Safety Council.

Welding Manufacturers' Association, Publication No. 237 The Arc Welder at Work.

[3)] Referred to in the foreword only.

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