

CERTIFICATE OF ANALYSISReference Material Type HIGH SPEED STEEL (CAST)Catalogue Section: 14 X Sample No: 14946 Batch No: DCertified Values

ELEMENT	C	Si	S	P	Mn	Ni
%	0.85	0.46	0.048	0.051	0.53	1.06
ELEMENT	Cr	Mo	Cu	Co	W	V
%	5.06	0.21	0.25	0.44	16.9(7)	1.03

Form and Size: Disc 40mm diameter x 15mm thickness

Supplied by: MBH Analytical Limited

Produced by: Willan Metals Limited

Date of Certification: 22 December 1994

Intended Use: With Optical Emission and X-Ray Fluorescence Spectrometers.

Recommended Method of Use: Steels are generally prepared by finishing (avoiding contamination with abrasives), milling or turning on a lathe (avoiding the use of lubricants) or lapping (using a suitable polishing media). However, users are recommended to follow the calibration and sample preparation procedures specified by the relevant instrument manufacturer. Preparation should be the same for reference materials and the samples for test. When using O.E. a minimum of three consistent replicate analyses is recommended to optimise precision and accuracy. Users are advised to check against possible bias between reference materials and production samples due to difference in metallurgical history and be aware of possible inter-element effect.

MBH ANALYTICAL LIMITED 

V.A.T REGISTERED No. GB 421 3295 82

Registered in England. Registered No. 1875653

Directors: D.Moore D.F. Morgan

Registered Office: Regency House, 33 Wood Street, Barnet, Herts. EN5 4BE

CERT. No.
0524

Method of Preparation: This Reference Material was produced from pure metals ferro alloys and master alloys. The discs are the product of one melt poured into a single mould with a feeding system designed to ensure sound discs. Metal was removed from the cast surface of the discs to minimise surface effect.

Sampling: Samples were taken relative to the top and the bottom of the mould. Two discs were used for chemical analysis and were checked for homogeneity

Chemical Analysis Data:

Sample	C	Si	S	P	Mn	Ni
1	0.86	0.44	0.045	0.050	0.55	1.08
2	0.85	-	0.046	-	-	1.07
3	0.842	0.455	0.052	0.056	0.52	1.05
4	-	0.48	-	0.048	0.51	1.03

Mean: 0.851 0.458 0.048 0.051 0.527 1.058

Standard Deviation: 0.009 0.020 0.003 0.004 0.020 0.018

Sample	Cr	Mo	Cu	Co	W	V
1	5.05	0.20	0.25	0.45	17.1	1.01
2	5.12	-	-	-	-	1.05
3	5.05	0.214	0.252	0.405	16.80	1.04
4	5.03	0.21	0.25	0.45	17.0	1.02

Mean: 5.063 0.208 0.251 0.435 16.967 1.03

Standard Deviation: 0.039 0.007 0.001 0.025 0.152 0.018

Homogeneity: Discs were taken relative to the top and bottom of the composite mould and each disc was checked on the face and back using an Optical Emission Spectrometer.

Multiple sparkings were made on each surface and averaged

The mean value of the material was then calculated from these averages.

The difference between the average for each step and the overall mean value is tabulated below in % concentration for each element.

Disc from Top of Mould

Position	C	Si	S	P	Mn	Ni
Face	-0.01	0.00	-0.001	-0.002	0.00	-0.02
Back	0.00	-0.01	+0.001	+0.002	-0.01	0.00
Avg	0.00	-0.01	0.000	0.000	-0.01	-0.01

Position	Cr	Mo	Cu	Co	W	V
Face	-0.02	+0.01	0.00	0.00	-0.075	-0.01
Back	+0.03	0.00	+0.01	-0.01	+0.025	+0.01
Avg	+0.01	0.00	0.00	0.00	-0.025	0.00

Disc from Bottom of Mould

Position	C	Si	S	P	Mn	Ni
Face	0.00	+0.02	+0.001	0.000	+0.02	+0.01
Back	0.00	-0.01	-0.001	0.000	-0.01	+0.01
Avg	0.00	+0.01	0.000	0.000	+0.01	+0.01

Position	Cr	Mo	Cu	Co	W	V
Face	-0.02	0.00	0.00	0.00	+0.025	+0.01
Back	0.00	0.00	0.00	0.00	+0.025	-0.01
Avg	-0.01	0.00	0.00	0.00	+0.025	0.00

Participating Laboratories:

J B Elds Limited	Stoke-on-Trent, England	NAMAS Approval 1173
Metals Tech (Testing) Ltd	Sheffield, England	NAMAS Approval 0963
Willan Metals Limited	Rotherham, England	NAMAS Approval 0014
Commercial Test. Services Ltd	Sheffield, England	NAMAS Approval 0638

Analytical Methods Used:

Carbon		Combustion	(IRD)
Silicon	(a)	Atomic Absorption	
Sulphur		Combustion	(IRD)
Phosphorus	(a)	Colorimetric	
Manganese	(a)	Atomic Absorption	
Nickel	(a)	Atomic Absorption	Volumetric
Chromium	(a)	Volumetric	
Molybdenum	(a)	Colorimetric	Atomic Absorption
Copper	(a)	Atomic Absorption	
Cobalt	(a)	Atomic Absorption	
Tungsten	(a)	Gravimetric	Atomic Absorption
Vanadium	(a)	Atomic Absorption	

NOTE :

1. Some cast materials may exhibit shrinkage cavities on the back engraved surface of the discs. This does not effect the certified portion.
2. (a) overchecked by XRF
3. Confidence Limits

These are the upper and lower values between which the actual measurements will fall with a certain probability to a gaussian distribution

68.3% of the results will fall within ± 1 x Standard Deviation of the mean

95.4% of the results with fall within ± 2 x Standard Deviation of the mean

99.7% of the results will fall within ± 3 x Standard Deviation of the mean

The material to which the Certificate of Analysis refers is supplied subject to our general conditions of sale