



# BUREAU OF ANALYSED SAMPLES LTD.

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Certificate No. Q3993

BRITISH CHEMICAL STANDARD CERTIFIED REFERENCE MATERIAL

## CERTIFICATE OF ANALYSIS

### BCS\*/SS§-CRM No. 459/2

## CARBON STEEL (Residual Series)

Prepared under rigorous laboratory conditions and, AFTER CERTIFICATION ANALYSIS IN GREAT BRITAIN issued by the Bureau of Analysed Samples Ltd.

#### CO-OPERATING ANALYSTS AND FIRMS

##### INDEPENDENT ANALYSTS

- KATZ, A.M. and SUTCLIFFE, T.A.,  
Alfred H. Knight International Ltd., St. Helens.
- MOLE, T.H.,  
SGS (UK) Limited, Warley.
- PAGE-GIBSON, J.E., *B.Sc., C.Chem., M.R.S.C.*,  
Ridsdale & Co. Ltd., Middlesbrough.

##### ANALYSTS representing MANUFACTURERS and USERS

- REOCH, G., *B.Sc.*,  
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- FISHER, M.,  
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Sections, Plates and Commercial Steels, Scunthorpe.
- FOX, G.,  
British Steel Engineering Steels, Stocksbridge.
- HUNT, M. and RAW, M.T.,  
British Steel,  
Sections, Plates and Commercial Steels, Redcar.
- SYMONDS, J.,  
British Steel Strip Products, Llanwern Works, Newport.
- SCRIMSHIRE, P.J.,  
IncoTest, Hereford.

#### ANALYSES

Mean of 4 values - mass content in %.

Analyst No.	C	Si	Mn	P	S	Al (Total)	B	Co	Nb	Pb	V	Sb	Zr
1	0.4794	0.6301	0.9261	0.0478	0.0484	...	...	...	...	...	...	...	...
2	0.4560	0.6290	0.9070	0.0486	0.0476	...	...	...	...	...	...	...	...
3	0.4732	0.6447	0.9157	0.0484	0.0471	0.0137	0.0110	0.0906	0.0116	0.0042	0.0585	0.0116	0.0769
4	0.4705	0.6348	0.8950	0.0480	0.0508	...	...	...	...	...	...	...	...
5	0.4652	0.6419	0.9130	0.0485	...	0.0148	0.0117	0.0861	0.0094	0.0045	0.0573	...	...
6	...	...	...	...	...	...	0.0107	0.0902	0.0094	0.0042	0.0593	0.0124	0.0741
7	0.4632	0.6453	0.9125	0.0477	0.0490	0.0155	0.0114	0.0910	0.0097	0.0048	0.0591	0.0127	...
8	0.4720	0.6433	0.9063	0.0501	0.0481	0.0170	...	0.0865	0.0095	...	...	...	...
9	0.4590	0.6523	0.8995	0.0463	0.0459	...	0.0102	0.0893	0.0116	...	0.0585	0.0117	0.0716
$M_M$	<b>0.4673</b>	<b>0.6402</b>	<b>0.9094</b>	<b>0.0482</b>	<b>0.0481</b>	<b>0.0153</b>	<b>0.0110</b>	<b>0.0890</b>	<b>0.0102</b>	<b>0.0044</b>	<b>0.0585</b>	<b>0.0121</b>	...
$s_M$	0.0078	0.0081	0.0097	0.0011	0.0015	0.0014	0.0006	0.0021	0.0011	0.0003	0.0008	0.0005	...
$s_W$	0.0046	0.0071	0.0044	0.0008	0.0010	0.0012	0.0001	0.0007	0.0003	0.0005	0.0004	0.0006	...

$M_M$ : Mean of the intralaboratory means.  $s_M$ : Standard deviation of the intralaboratory means.  $s_W$ : Intralaboratory standard deviation.

#### CERTIFIED VALUES

mass content in %

	C	Si	Mn	P	S	Al (Total)	B	Co	Nb	Pb	V	Sb
$M_M$	<b>0.467</b>	<b>0.640</b>	<b>0.909</b>	<b>0.0482</b>	<b>0.0481</b>	<b>0.015</b>	<b>0.0110</b>	<b>0.0890</b>	<b>0.0102</b>	<b>0.0044</b>	<b>0.0585</b>	<b>0.0121</b>
C(95%)	0.007	0.007	0.008	0.0009	0.0014	0.002	0.0011	0.0022	0.0010	0.0005	0.0021	0.0008

The half-width confidence interval  $C(95\%) = t \times \frac{s_M}{\sqrt{n}}$  where  $t$  is the appropriate Student's  $t$  value and  $n$  is the number of acceptable mean values

For further information regarding the confidence interval for the certified value see ISO Guide 35:1989 section 4.

\*British Chemical Standard - chips graded 1700-250  $\mu\text{m}$  (10-60 mesh) for chemical analysis.

§Spectroscopic Standard - discs 38mm dia. x 19mm thick for spectroscopic analysis.

N.B. Due to slight segregation of certain elements an area 6mm in diameter in the centre of the disc sample should be avoided for emission spectrometry.

# BCS/SS - CRM No. 459/2

## CARBON STEEL (Residual Series)

### NOTES ON METHODS USED

#### CARBON

All analysts, except Nos. 3 and 5 determined carbon using high frequency combustion and infrared absorption. Analysts Nos. 3 and 5 used non-aqueous titration according to BS 6200:3.8.2:1991.

#### SILICON

Analysts Nos. 1, 2, 3, 4, 5 and 8 used gravimetric methods. All analysts, except No. 4, after dehydration with perchloric acid according to BS 6200:3.26.1:1995 (ISO 439-1994). Analyst No. 4 after dehydration with nitrosulphuric acid. Analysts Nos. 7 and 9 determined silicon by ICP-OES.

#### MANGANESE

Analysts Nos. 1, 2, 7, 8 and 9 determined manganese using ICP-OES. Analysts Nos. 3 and 5 determined manganese photometrically after oxidation with periodate according to BS 6200:3.18.2:1985 (ISO 629-1982). Analyst No. 4 used FAAS.

#### PHOSPHORUS

Analysts Nos. 1, 2, 7, 8 and 9 determined phosphorus using ICP-OES. Analysts Nos. 3 and 5 determined phosphorus photometrically as phosphovanadomolybdate according to BS EN 10184:1992. Analyst No. 4 used a titrimetric method after precipitation as phosphomolybdate.

#### SULPHUR

All analysts, except No. 3 determined sulphur using high frequency combustion and infrared absorption. Analyst No. 3 determined sulphur gravimetrically as barium sulphate.

#### ALUMINIUM (TOTAL)

All analysts, except No. 3, determined total aluminium using ICP-OES. Analyst No. 3 used FAAS according to BS 6200:3.1.4:1990 (ISO 9658-1990).

Analyst No. 8 also determined acid soluble aluminium and obtained a mean value of 0.013%.

#### BORON

Analysts Nos. 3, 5 and 6 determined boron photometrically with curcumin according to BS EN 10200:1992. Analysts Nos. 7 and 9 used ICP-OES.

#### COBALT

All analysts, except No. 3, determined cobalt using ICP-OES. Analyst No. 3 used FAAS according to BS 6200:3.11.3:1997 (ISO 11652-1997).

#### NIOBIUM

All analysts, except No. 3, determined niobium using ICP-OES. Analyst No. 3 used a photometric method with PAR after separation with phenylarsonic acid according to BS EN 10178:1989.

#### LEAD

Analysts Nos. 3 and 6 determined lead using FAAS. Analysts Nos. 5 and 7 used ICP-OES.

#### VANADIUM

All analysts, except No. 3, determined vanadium using ICP-OES. Analyst No. 3 used a photometric method with N-benzoylphenyl-hydroxylamine according to BS 6200:3.34.2:1989 (ISO 4942:1988).

#### ANTIMONY

Analyst No. 3 determined antimony using FAAS. Analyst No. 6 also used FAAS after separation of antimony with hydride generation. Analysts Nos. 7 and 9 used ICP-OES.

#### ZIRCONIUM

All analysts, except No. 3, determined zirconium using ICP-OES. Analyst No. 3 used a photometric method with arsenazo III.

#### Abbreviations:

FAAS: Flame Atomic Absorption Spectrometry.

ICP-OES: Inductively Coupled Plasma-Optical Emission Spectrometry.

PAR: 4-(2-pyridylazo) resorcinol.

NEWHAM HALL,  
MIDDLESBROUGH,  
ENGLAND.

For BUREAU OF ANALYSED SAMPLES LTD.  
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Chairman.