Fusión: Materias primas

1815 Fundición

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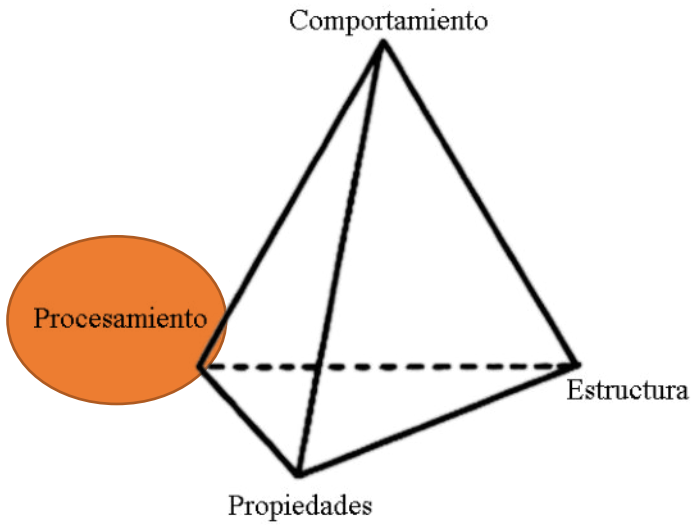
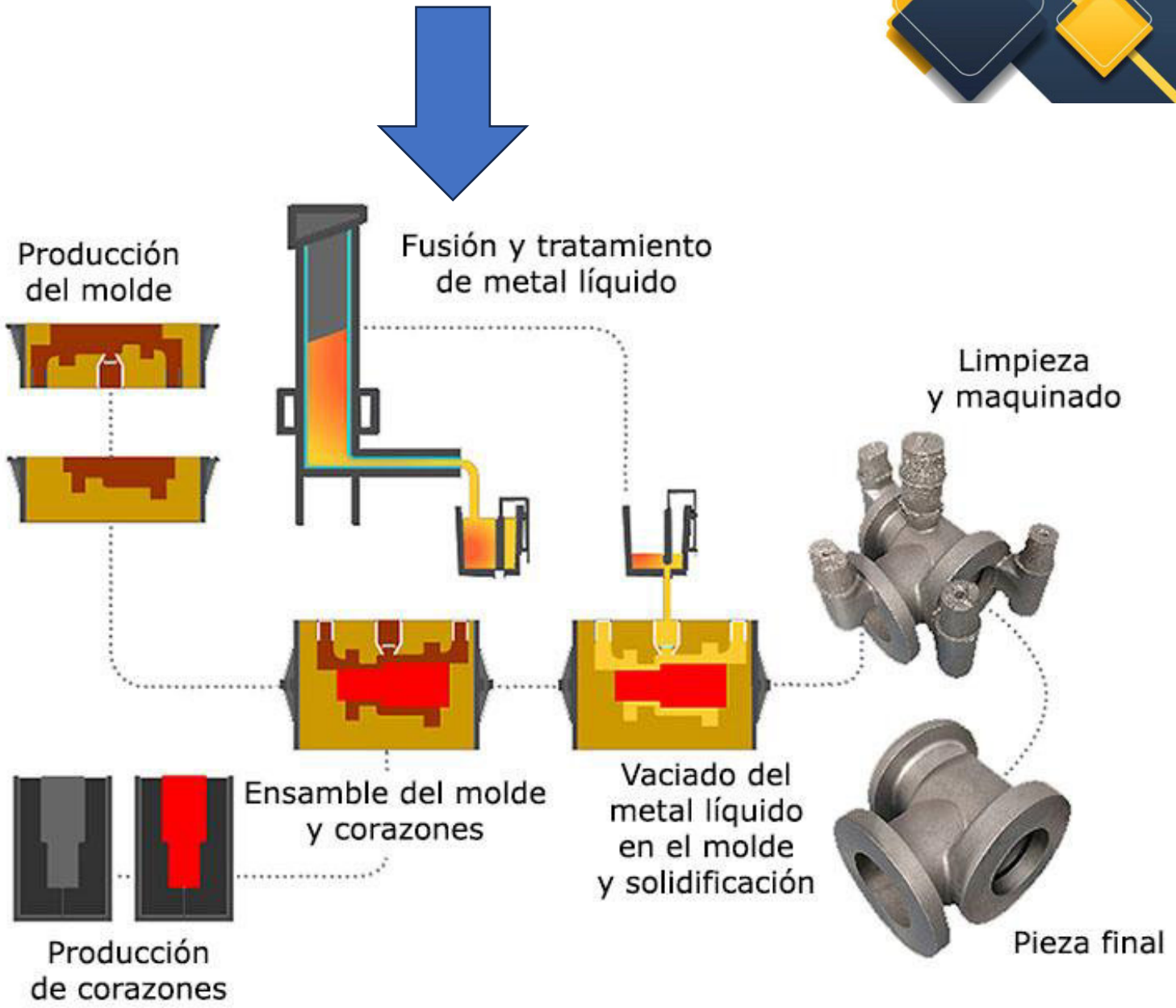


Materias primas para la fusión



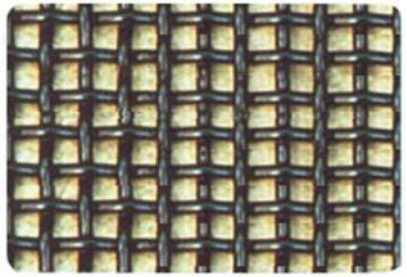
Materias primas para los procesos de Fundición
Fusión de Aleaciones

Chatarras	Piezas falladas o salidas de servicio, o bien subproductos (sobrantes) de procesos de conformado
Retornos	Piezas defectuosas, alimentadores y sistemas de colada (del proceso de fundición)
Arrabios	Materia prima para aleaciones ferrosas
Ferroaleaciones	Para ajuste de carga de aleaciones ferrosas
Aleaciones liga ó aleaciones madre	Para ajuste de carga de aleaciones no ferrosas
Lingotes de metales puros	Para aleaciones no ferrosas, materias de ajuste de carga

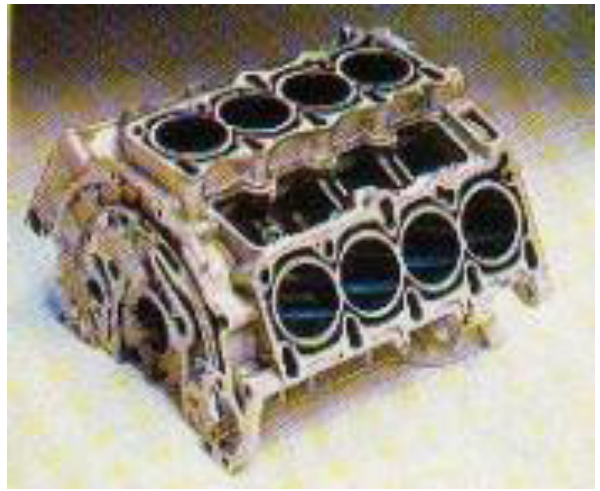
Clasificación de cargas

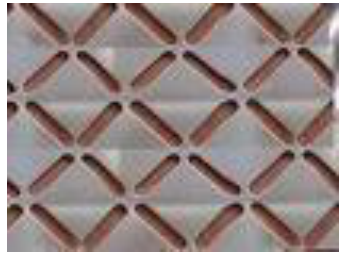
Materia prima (cargas)	Tipo
Chatarras Arrabios Retornos	Materias primas primarias
Ferroaleaciones Aleaciones liga Lingotes de metales puros	Materias primas secundarias (ajuste de carga)
Fundentes	Materias primas auxiliares

Chatarras. Una vez terminada su función o una vez que fallaron



Chatarras. Una vez terminada su función o una vez que fallaron





Chatarras. Una vez terminada su función o una vez que fallaron

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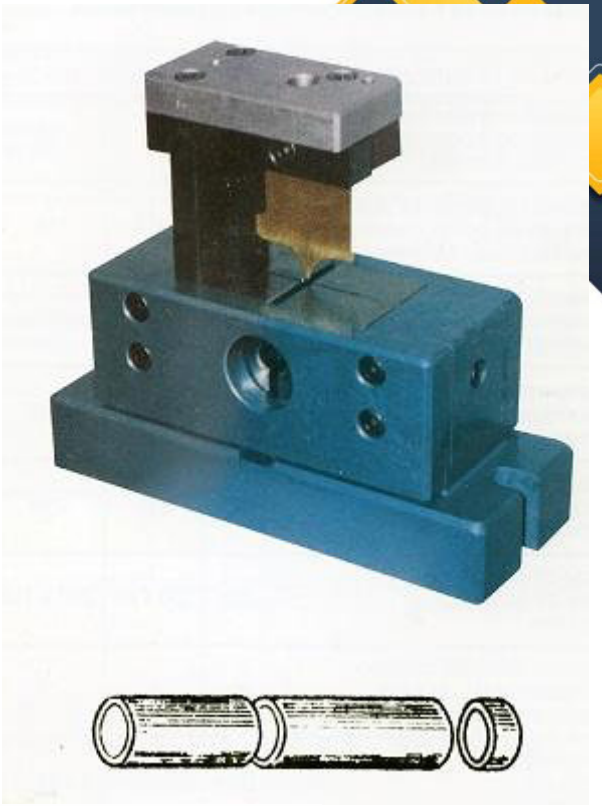


El **origen de la chatarra** o las chatarras del automóvil presenta tres fuentes diferenciadas

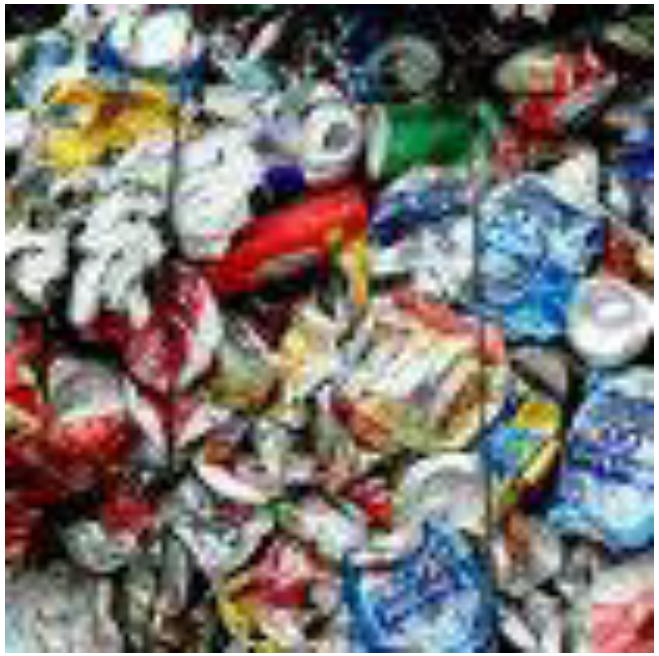
Vehículos dados de baja
por obsolescencia debida al uso

Vehículos dados de baja
debido a accidentes

Vehículos abandonados

CHATARRA

Clasificación y acomodo en “patios de chatarra”



Forma de las chatarras

Las chatarras pueden tener la forma de componentes completos, monoblocks, motores, ollas, sartenes, perfiles, coladeras, tubos, recipientes, contenedores, etc., Componentes fallados o desechados.

O bien pueden tener la forma de laminas, recortes, cilindros, etc., sobrantes de procesos de conformado

Independientemente de su origen pueden tener óxidos, grasas, aceites, productos de corrosión y suciedad anexa.

Tratamiento de las materias primas primarias

Selección

Selección visual	Separación por tipo de metal de forma visual (aluminios, cobres aceros, etc.
Selección magnética	Separación por tipo de metal (material magnético y material no magnética)

Preparación

Limpieza Física Química	Limpieza de grasas, aceites, productos de corrosión, Limpieza suciedad anexa, pinturas, etc

Recorte y /o empaque

Dependiendo de la forma de las chatarras, éstas pueden quedar de igual tamaño al introducirse A los hornos o bien habrá necesidad de cortar y/o empacar a las chatarras

Ejemplos

Virutas de los talleres de procesos de corte. Se deberá, aparte de eliminar grasas y aceites, de empacar para evitar demasiada área superficial, lo que provoca pérdidas excesivas por oxidación durante la fusión.

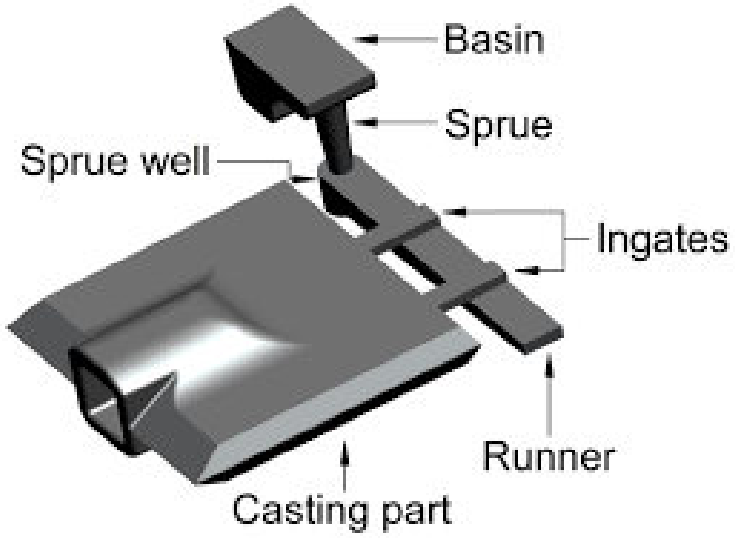
Monoblocks. Si este es demasiado grande para la boca de entrada al horno se deberá de cortar al tamaño adecuado, en dos o más trozos. Es necesario mencionar que se deben de eliminar grasas y aceites

Láminas. Como subproducto de procesos de recorte, estampado, etc. Se deberán de cortar y quizá empacar. De igual manera se deben eliminar grasas y aceites

Pacas

Retornos

Como productos del proceso de fundición (piezas defectuosas, alimentadores, sistemas de colada) principalmente tienen en su superficie arena adherida, la cual se debe eliminar a través de procesos físicos de limpieza (sandblast, airblast y shootblast)



Todas las materias primas, una vez preparadas, deben precalentarse antes de introducirlas a los hornos. Esto con 3 objetivos

•Eliminación de humedad

•Evitar el choque térmico con los refractarios de los crisoles de los hornos

•Aumento de la velocidad de fusión

Generalmente a los arrabios, ferroaleaciones, aleaciones liga y metales puros no se les da tratamiento alguno, ya que se encuentran limpios, pero si se precalientan antes de agregarse al horno.

Los fundentes también deben precalentarse antes de agregarse.

Cargas.



Chatarras



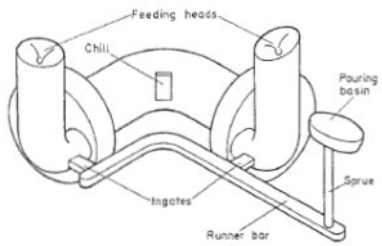


Figure 16.129 Components of a running and feeding system

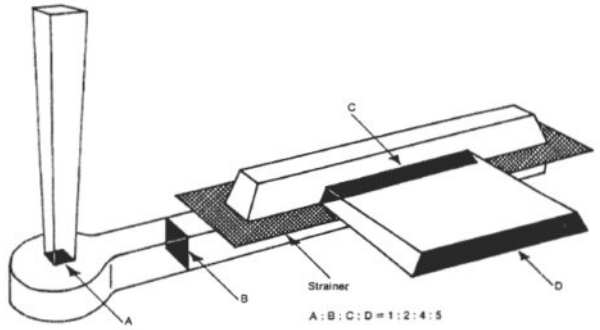
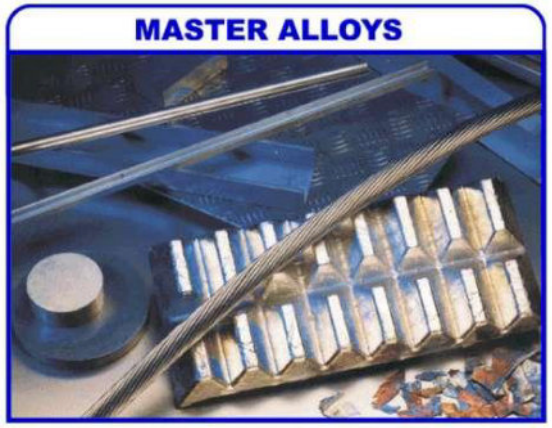


Figure 16.130 Design of gating system for magnesium

Retornos
(del 5% - al 30% de la carga total)

Ferrroaleaciones y aleaciones liga

FeSiMg



Metales Puros

Cobre cátodo

Estiba de **aluminio** primario

Zinc lingote estibas

Table 9. Typical Compositions of Gray Iron Based on Strength and Section

Type	Composition, % TC	Si	P	S	Mn	Average carbon equivalent(a)	Metal section range, in.	Brinell hardness number	Transverse load, lb	Transverse deflection, in.	Tensile strength, psi
Class 20, light section, 0.875-in. test bar	3.50 to 3.80	2.40 to 2.60	0.20 to 0.80	0.08 to 0.13	0.50 to 0.70	4.56 to ...	Up to 0.50	160 to 200	900 to 1200	0.10 to 0.15	22,000 to 26,000
Class 20, medium section, 1.2-in. test bar	3.40 to 3.60	2.30 to 2.50	0.20 to 0.60	0.08 to 0.80	... to ...	4.34 to ...	½ to 1	160 to 180	1600 to 2200	0.20 to 0.27	18,000 to 24,000
Class 20, heavy section, 2.0-in. test bar	3.10 to 3.30	2.20 to 2.40	0.20 to 0.40	0.08 to 0.13	0.50 to 0.80	3.98 to ...	1 and up	130 to 180	4500 to 6500	... to ...	18,000 to 22,000
Class 25, light section, 0.875-in. test bar	3.30 to 3.50	2.20 to 2.40	0.20 to 0.50	0.08 to 0.13	0.50 to 0.80	4.20 to ...	Up to ½	160 to 180	950 to 1300	0.11 to 0.16	26,000 to 29,000
Class 25, medium section, 1.2-in. test bar	3.20 to 3.40	2.20 to 2.40	0.15 to 0.40	0.08 to 0.12	0.50 to 0.80	4.08 to ...	½ to 1	172 to 207	1800 to 2400	0.22 to 0.28	26,000 to 29,000
Class 25, heavy section, 2.0-in. test bar	3.00 to 3.30	1.90 to 2.20	0.15 to 0.25	0.08 to 0.12	0.50 to 0.80	3.82 to ...	1 and up	179 to 217	6000 to 7800	... to ...	26,000 to 30,000
Class 30, light section, 0.875-in. test bar	3.20 to 3.40	2.10 to 2.30	0.15 to 0.30	0.08 to 0.12	0.50 to 0.80	4.03 to ...	½ to 1	179 to 228	1250 to 1500	... to ...	30,000 to 34,500
Class 30, medium section, 1.2-in. test bar	3.10 to 3.30	2.10 to 2.30	0.15 to 0.25	... to ...	... to ...	3.92 to ...	... to ...	... to ...	.... to	... to ...	..... to .....
Class 30, heavy section, 2.0-in. test bar	2.90 to 3.20	1.70 to 2.10	0.15 to 0.25	0.08 to 0.12	0.45 to 0.70	3.68 to ...	1 and up	207 to 228	6500 to 8200	... to ...	30,000 to 34,500
Class 35, light section, 0.875-in. test bar	3.10 to 3.30	2.00 to 2.20	0.15 to 0.30	0.08 to 0.12	0.45 to 0.70	3.90 to ...	... to ½	179 to 228	1150 to 1450	... to ...	36,000 to 40,000
Class 35, medium section, 1.2-in. test bar	3.00 to 3.25	1.80 to 2.10	0.15 to 0.25	0.07 to 0.12	0.46 to 0.70	3.77 to ...	½ to 1	207 to 228	2300 to 3000	0.25 to 0.35	35,000 to 39,000
Class 35, heavy section, 2.0-in. test bar	2.80 to 3.10	1.60 to 2.00	0.10 to 0.20	0.06 to 0.12	0.45 to 0.70	3.54 to ...	1 and up	183 to 217	7500 to 9000	0.32 to 0.38	35,000 to 38,000
Class 40, light section, 0.875-in. test bar	3.00 to 3.20	1.90 to 2.20	0.10 to 0.25	0.07 to 0.12	0.45 to 0.65	3.77 to ...	... to ½	212 to 241	1275 to 1550	... to ...	42,000 to 46,000
Class 40, medium section, 1.2-in. test bar	2.95 to 3.15	1.70 to 2.00	0.10 to 0.20	0.06 to 0.11	0.45 to 0.70	3.65 to ...	½ to 1	207 to 241	2500 to 3400	0.25 to 0.35	40,000 to 47,000
Class 40, heavy section, 2.0-in. test bar	2.75 to 3.00	1.50 to 1.90	0.07 to 0.15	0.05 to 0.12	0.50 to 0.70	3.42 to ...	1 and up	180 to 217	8400 to 9800	0.30 to 0.38	41,000 to 45,000
Class 50, light section, 0.875-in. test bar	2.90 to 3.10	1.70 to 2.10	0.10 to 0.20	0.06 to 0.12	0.50 to 0.70	3.62 to ...	... to ½	228 to 269	1600 to 1800	... to ...	51,000 to 55,000
Class 50, medium section, 1.2-in. test bar	2.70 to 3.00	1.70 to 2.00	0.10 to 0.20	0.06 to 0.11	0.60 to 0.80	3.45 to ...	½ to 1	228 to 269	3000 to 4000	0.28 to 0.34	50,000 to 57,000
Class 50, heavy section, 2.0-in. test bar	2.55 to 2.85	1.40 to 1.70	0.07 to 0.15	0.06 to 0.11	0.60 to 0.80	3.20 to ...	1 and up	207 to 241	10,000 to 12,500	0.38 to 0.48	50,000 to 54,000
Class 60, light section, 0.875-in. test bar	2.70 to 3.00	1.90 to 2.20	0.10 to 0.20	0.06 to 0.12	0.50 to 0.70	3.51 to ...	... to ...	228 to 272	1750 to 2000	... to ...	60,000 to 65,000
Class 60, medium section, 1.2-in. test bar	2.50 to 2.85	1.90 to 2.10	0.05 to 0.15	0.05 to 0.10	0.70 to 1.00	3.37 to ...	... to ...	248 to 290	3400 to 4500	0.25 to 0.40	60,000 to 65,000
Class 60, heavy section, 2.0-in. test bar	2.50 to 2.80	1.20 to 1.50	0.07 to 0.15	0.05 to 0.12	0.50 to 0.80	3.09 to ...	... to ...	212 to 248	11,500 to 13,500	0.35 to 0.50	60,000 to 64,000

(a) "Carbon equivalent" is calculated as percentage carbon plus 0.3 times the sum of percentage silicon and phosphorus. Some use carbon plus 1/3 silicon. Data in this table from "Handbook of Cupola Operation", AFS, 1946.

Table 1 Compositions for hot-rolled and cold-rolled plain carbon steel sheet and strip

Grade designation	Composition limits, %					
	C	Mn	P(a)	S(a)	Cu(b)	Si
Hot-rolled sheet and strip: heavy thickness coils (ASTM A 635)						
1006	0.08(a)	0.45(a)	0.040	0.050	0.20(c)	...
1008	0.10(a)	0.50(a)	0.040	0.050	0.20(c)	...
1009	0.15(a)	0.60(a)	0.040	0.050	0.20(c)	...
1010	0.08–0.13	0.30–0.60	0.040	0.050	0.20(c)	...
1012	0.10–0.15	0.30–0.60	0.040	0.050	0.20(c)	...
1015	0.12–0.18	0.30–0.60	0.040	0.050	0.20(c)	...
1016	0.12–0.18	0.60–0.90	0.040	0.050	0.20(c)	...
1017	0.14–0.20	0.30–0.60	0.040	0.050	0.20(c)	...
1018	0.14–0.20	0.60–0.90	0.040	0.050	0.20(c)	...
1019	0.14–0.20	0.70–1.00	0.040	0.050	0.20(c)	...
1020	0.17–0.23	0.30–0.60	0.040	0.050	0.20(c)	...
1021	0.17–0.23	0.60–0.90	0.040	0.050	0.20(c)	...
1022	0.17–0.23	0.70–1.00	0.040	0.050	0.20(c)	...
1023	0.19–0.25	0.30–0.60	0.040	0.050	0.20(c)	...
1524	0.18–0.25	1.30–1.65	0.040	0.050	0.20(c)	...

Table 1 Compositions of registered aluminum casting alloys used to cast shapes

Compositions of alloys used to cast primary ingots are not shown.

Alloy	Products[A]	Composition, %[B]											
		Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Sn	Ti	Others	
												Each	Total
201.1	S	0.10	0.15	4.0-5.2	0.20-0.50	0.15-0.55	...	...	...	...	0.15-0.35	0.05[C]	0.10
A201.0	S	0.05	0.10	4.0-5.0	0.20-0.40	0.15-0.35	...	...	...	...	0.15-0.35	0.03[C]	0.10
B201.0	S	0.05	0.05	4.5-5.0	0.20-0.50	0.25-0.35	...	...	...	...	0.15-0.35	0.05[C]	0.15
202.0	S	0.10	0.15	4.0-5.2	0.20-0.8	0.15-0.55	0.20-0.6	...	...	...	0.15-0.35	0.05[C]	0.10
203.0	S	0.30	0.35	4.5-5.5	0.20-0.50	0.10	...	1.3-1.7	0.10	...	0.15-0.25[D]	0.05[E]	0.20
204.0	S, P	0.20	0.35	4.2-5.0	0.10	0.15-0.35	...	0.05	0.10	0.05	0.15-0.30	0.05	0.15
206.0	S, P	0.10	0.15	4.2-5.0	0.20-0.50	0.15-0.35	...	0.05	0.10	0.05	0.15-0.30	0.05	0.15
A206.0	S, P	0.05	0.10	4.2-5.0	0.20-0.50	0.15-0.35	...	0.05	0.10	0.05	0.15-0.30	0.05	0.15
208.0	S, P	2.5-3.5	1.2	3.5-4.5	0.50	0.10	...	0.35	1.0	...	0.25	...	0.50

Table 2 Composition of wrought unalloyed aluminum and wrought aluminum alloys

Grade designation			Composition, wt%													
Aluminum Association	UNS No.	ISO No. R209	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ga	V	Specified other elements	Ti	Unspecified other elements		Al, minimum
															Each	Total	
1035	...	...	0.35	0.6	0.10	0.05	0.05	...	...	0.10	...	0.05	...	0.03	0.03	...	99.35
1040	A91040	...	0.30	0.50	0.10	0.05	0.05	...	...	0.10	...	0.05	...	0.03	0.03	...	99.40
1045	A91045	...	0.30	0.45	0.10	0.05	0.05	...	...	0.05	...	0.05	...	0.03	0.03	...	99.45
1050	A91050	Al 99.5	0.25	0.40	0.05	0.05	0.05	...	...	0.05	...	0.05	...	0.03	0.03	...	99.50
1060	A91060	Al 99.6	0.25	0.35	0.05	0.03	0.03	...	...	0.05	...	0.05	...	0.03	0.03	...	99.60
1065	A91065	...	0.25	0.30	0.05	0.03	0.03	...	...	0.05	...	0.05	...	0.03	0.03	...	99.65
1070	A91070	Al 99.7	0.20	0.25	0.04	0.03	0.03	...	...	0.04	...	0.05	...	0.03	0.03	...	99.70
1080	A91080	Al 99.8	0.15	0.15	0.03	0.02	0.02	...	...	0.03	0.03	0.05	...	0.03	0.02	...	99.80
1085	A91085	...	0.10	0.12	0.03	0.02	0.02	...	...	0.03	0.03	0.05	...	0.02	0.01	...	99.85
1090	A91090	...	0.07	0.07	0.02	0.01	0.01	...	...	0.03	0.03	0.05	...	0.01	0.01	...	99.90

ARRABIO TIPO FUNDICION
ORIGEN: RUSO
L.A.B. VERACRUZ

ANALISIS TIPICO

C	4.0	%
Si	2.3	%
Mn	0.6	%
P	0.1	%
S	0.02	%

PESO 10 KG. MAX.

ARRABIO TIPO BASICO
ORIGEN: RUSO
L.A.B. BROWNSVILLE
LOTES T6675-B y T14001-B.
ANALISIS TIPICO

C	4.15	%
Si	0.84	%
Mn	0.037	%
P	0.049	%
S	0.025	%

PESO 12 KG. MAX.

CARBON COKE ABC
ORIGEN ALABAMA
LAB. NUEVO LAREDO

VM	0.38	%
FC	93.06	%
CENIZA	6.56	%
S	0.58	%

Tamaño: 4" x 6"

FERROSILICIO
ORIGEN VENEZUELA
LAB. BROWNSVILLE

Si	75.96	%
Al	1.49	%
C	0.110	%
S	0.003	%
P	0.26	%

Tamaño: 2" x 4"
Y viene en super sacos de 1.5 T.M.

ORIGEN RUSO.
L.A.B. BROWNSVILLE.
LOTES 6272-F y 13854-F
ANALISIS TIPICO

C	3.94	%
Si	2.20	%
Mn	0.64	%
P	0.091	%
S	0.012	%

PESO 12 KG. MAX.

ORIGEN: BRASIL
L.B.A. BROSWNSVILLE.
LOTE: 4255
ANALISIS QUIMICO

C	4.05	%
Si	0.3	%
Mn	0.5	%
P	0.07	%
S	0.02	%

PESO 12 KG. MAX.

ORIGEN RUSO
LAB. VERACRUZ

Si	74.19	%
Al	1.38	%
C	0.08	%
S	0.002	%
P	0.03	%

Tamaño: 0.5" x 3.5"
Y viene en super sacos de 1.5 T.M.

METALS & ALLOYS

SILICON

Silicon Metal	% Si	% Fe	% Ca	% Al
Regular	98.25 Min	.50 Max	.07 Max	.75 Max
	98.00 Min	1.00 Max	.07 Max	.75 Max
	96.75 Min	1.50 Max	.15 Max	.75 Max
High Calcium	97.50 Min	1.00 Max	.40 Max	.75 Max
	96.75 Min	1.50 Max	.40 Max	.75 Max
Chemical	98.00 Min	1.00 Max	.07 Max	.50 Max

Ferrosilicon	% Si	% Al	% Ca	Other
50% Regular	47-51	1.25 Max	—	—
50% High Purity	47-51	.10 Max	.10 Max	C .05 Max
50% Low Aluminum	47-51	.50 Max	.20 Max	—
75% Regular	74-79	1.50 Max	—	—
75% Low Aluminum	74-79	.50 Max	.50 Max	—
75% with Boron	74-79	1.25 Max	—	B .05 Min

MANGANESE

Electrolytic Manganese	% Mn	% C	% Si	% S
	99.95	.01	.001	.05

Ferromanganese	% Mn	% C	% Si	% P
Std. High Carbon	76-79	7.5 Max	1.2 Max	.30 Max
Low Phosphorus	77-79	7.5 Max	1.2 Max	.10 Max
Medium Carbon	80-85	1.5 Max	1.5 Max	.30 Max
Low Carbon	85-90	.75 Max	2.0 Max	.20 Max
Nitrided (4.25% N Min)	75% Min	1.5 Max	1.5 Max	.20 Max

Silicomanganese	% Mn	% C	% Si	% P
	65-68	2.0 Max	16-18.50	.20 Max

CHROMIUM

Electrolytic Chromium Metal	% Cr
	99.9

Ferrochrome	% Cr	% C	% Si
High Carbon	62-72	4-9.5	3.0 Max
Low Carbon (.02% C Grade)	65-72	.025 Max	1.0 Max
Low Carbon (.05 C Grade)	65-72	.05 Max	1.0 Max
Low Carbon (.10 C Grade)	65-72	.10 Max	1.0 Max
Low Carbon (.15 C Grade)	65-72	.15 Max	1.0 Max

SPECIALTY ALLOYS

Ferrovanadium	% V	% Al	% Si	% C	% S	% P
80% Grade	78-82	1.5 Max	1.0 Max	.75 Max	.05 Max	.05 Max

Molybdenum	% Mo	% Cu	% Si	% S	% P
Ferromolybdenum	60-65	.5 Max	1.0 Max	.15 Max	.05 Max
Molybdenum Oxide					
Powder	57 Min	.5 Max	—	.10 Max	.05 Max
Briquette	57 Min	.5 Max	—	.15 Max	.05 Max

Ferrocolumbium	% Cb	% Al	% Si	% C	% S	% P
	60-70	3.0 Max	4.0 Max	.5 Max	.10 Max	.10 Max

Ferrophosphorus	% P	% Si	% Mn	% C
	22-26	1.5-4.0	1.5-2.5	.25 Max

OTHER METALS & ALLOYS

Antimony	% Sb	% Ag	% Fe
	99.0 Min	.05	.10

Copper Chops	% Cu
	99.0

Tin Shot/Bars	% Sn
	99.0

Tungsten Metal	% W
	99.9

Ferrotungsten	% W	% Fe
	80.0	20.0

Silicon Carbide	% SiC	% Free C	% R_2O_3
Metallurgical 90% Grade	88-92	1-3	3.0 Max

Iron Pyrite	% S	% Fe	% SiO_2
	47	42	6

Fluorspar	% CaF_2	% SiO_2	% $CaCO_3$
	88-89	5-5	4-5

PIG IRON

	% C	% Si	% Mn	% P	% S
Basic Grade	3.5-4.5	1.5 Max	1.0 Max	.10 Max	.05 Max
Foundry Grade	3.5-4.5	2.5-3.0	1.0 Max	.10 Max	.05 Max
Nodular Grade	3.5-4.5	.50 Max	.05 Max	.05 Max	.02 Max

FOUNDRY ALLOYS

INOCULANTS

50% Ferrosilicon Foundry Grade		75% Ferrosilicon Foundry Grade		HW-26	
Si	47-51%	Si	74-79%	Si	70-77%
Al	.60-1.25%	Al	.80-1.50%	Al	3.0-4.5%
Ca	.50-1.50%	Ca	.50-1.50%	Ca	.50-1.50%

HW Cubes		INOCARB*		GRAFIDIN (Inolate 10)*	
Si	74-79%	Si	32%	Si	64%
Al	.80-1.50%	Al	.7%	Al	1.3%
Ca	.70-1.50%	Ca	.5%	Ca	2.5%
Available in 20-30 grams, 30-40 grams, 50-60 gram and other sizes in 10 gram increments.		Ba	4.5%	Mn	9%
		C	50%	Ba	4.5%

LMC (Inolate 196)*		HW-5		INOBAR (Inolate 20)*	
Si	66%	Si	70-77%	Si	64%
Al	.8%	Al	.80-1.50%	Al	1.3%
Ca	1.7%	Ca	.80-1.50%	Ca	1%
Ba	.8%	Ba	1.5-2.5%	Ba	9%

HW 50 SR		INOSTRONG (Inolate 30)*		SPHERIX (Inolate 40)*	
Si	47-51%	Si	75%	Si	72%
Al	.60% Max	Al	.5%	Al	.9%
Ca	.10% Max	Ca	.1%	Ca	1.5%
Sr	.70-1.10%	Se	.85%	Bi	1%
				TRE	.5%

INOCAST 125 (Inolate 190)*		ZIRCOGRAF (Inolate 50)*		ZL-80 (Inolate 60)*	
Si	65%	Si	66%	Si	75%
Al	.9%	Al	1.3%	Al	1.4%
Ca	1.1%	Ca	1.5%	Ca	2.5%
Mn	3.5%	Mn	6%	Zr	1.6%
Zr	4%	Zr	6%		
Ba	.2%				

HW Ti CI		HW Ti S		HW 50D	
Si	50-55%	Si	52-59%	Si	46-50%
Al	.9-1.20%	Al	.95-1.35%	Al	1.25% Max
Ca	.5-1.50%	Ca	5.5-8.50%	Ca	.70-1.25%
Ti	10.0-12.0%	Ti	7.0-12.0%	Mg	1.0-1.50%

MOLDINOC 65* In Mold Inserts		MOLDINOC 75* In Mold Inserts	
Si	66%	Si	77%
Al	1%	Al	3%
Ca	1%	Ca	.4%
Mn	.25% Max	Mn	.25% Max
Ba	.15% Max	Ba	.15% Max
MOLDINOC 65 available in 25, 50, 70, 90 or 180 gram sizes.		MOLDINOC 75 available in 20, 40, 60, 80 or 150 gram sizes.	

MAGNESIUM FERROSILICON TREATMENT ALLOYS

Rare Earth Free Grades	% Mg	% Si	% Ca	% Al
HW-MAG 3	2.90-3.40	44.0-48.0	.80-1.35	1.25 Max.
HW-MAG 5	5.50-6.50	44.0-48.0	.80-1.35	1.25 Max.
MAG 910*	9.00	46.0	1.20	0.80

Cerium Bearing Grades	% Mg	% Si	% Ca	% Al	% Ce
HW-MAG 5L	5.50-6.50	44.0-48.0	.80-1.35	1.25 Max.	.30-.40
HW-MAG 5M	5.50-6.50	44.0-48.0	.80-1.35	1.25 Max.	.45-.70
HW-MAG 5MHP	5.50-6.50	44.0-48.0	.30 Max.	.30 Max.	.45-.70
HW-MAG 5H	5.50-6.50	44.0-48.0	.80-1.35	1.25 Max.	.90-1.25

Blended Rare Earth Grades	% Mg	% Si	% Ca	% Al	Total Rare Earth
HW-MAG 3LA	3.00-3.80	44.0-48.0	.80-1.35	1.25 Max.	1.50-2.20
HW-MAG 3LAFT	3.00-3.80	44.0-48.0	.80-1.35	1.25 Max.	1.30-1.80
HW-MAG 5LA	5.50-6.50	44.0-48.0	.80-1.35	1.25 Max.	.50-.85
HW-MAG 5LB	5.50-6.50	44.0-48.0	.80-1.35	1.25 Max.	.75-1.10
HW-MAG 5LC	5.50-6.50	44.0-48.0	.80-1.35	1.25 Max.	1.25-1.75

Calcium Modified Grades	% Mg	% Si	% Ca	% Al	Other
HW-MAG 4LBHC	4.5-5.5	44.0-48.0	1.80-2.25	1.25 Max.	TRE .50-.85
HW-MAG 5LBHC	5.5-6.5	44.0-48.0	1.80-2.25	1.25 Max.	TRE .50-.85

In Mold Treatment	% Mg	% Si	% Ca	% Al	Other
SIMAF*	5.7	46.0	.40	1.0	TRE .40

*Trademark of Pechiney Electrometallurgie

Inoculants are available in standard ladle sizes, injection sizes or in cored wire form. Inolate is a designation for late inoculation size.

Magnesium Ferrosilicon treatment alloys are available in standard industry sizes including stream treatment applications.

METALS & ALLOYS

INCO NICKEL PRODUCTS

	% Ni	%C	% Fe	Other
Electrolytic Nickel 4" x 4" Cathodes 2" x 2" Cathodes	99.8 Min	.01	.002	Cu .005
Nickel Briquettes 1-1/2" x 5/8"	99.9 Min	.01	.015	Cu .01
Nickel Pellets* 1/4" x 1/2"	99.9 Min	.01	.002	Cu .005
F Nickel Shot*	91-95	.2-.4	2-3	5-5.5 Si
Nickel Oxide Sinter* 40 x 65 Mesh	74-76	—	3-5	Cu .65-.90 Co .8-1.0 Balance Oxygen
Nickel Powder* Type 123	99.7 Min	.1	.01	.15 Oxygen
Incomag Alloy 1* 4" x 1/4"	82-86	1.0	.05	Mg 14-16
Incomag Alloy 3LC* 3lb. pig	95-96	.025	.05	Mg 4-6
Incomag Alloy 4* 3lb. pig	58-62	1.6-1.8	34	Mg 4-5
Incocal Alloy 10* 3lb. pig	93-95	.02-.04	.02	Ca 4.5-5.5

*Trademark of the INCO family of companies.

GALT ALLOYS

Boron-Titanium

	% B	% Ti	% Al	% Zr	% Si	% Mn	% Fe
Bortal 5*	0.5	20.0	13.0	4.0	5.0	8.0	Balance
Bortal X*	2.25	47.0	8.0	5.0	4.0	6.0	Balance

*Trademark of Galt Alloys, Inc.

Ferroaluminum

	% Al	% Si	% Mn	% Cu	% C	% Fe	
65% Grade	65.0-68.0	0.6 Max	0.5 Max	0.2 Max	0.1 Max	Balance	
40% Grade	38.0-42.00	0.6 Max	0.5 Max	0.2 Max	0.1 Max	Balance	
35% Grade	30.0-33.0	0.6 Max	0.5 Max	0.2 Max	0.1 Max	Balance	

40% Ferrotitanium

	% Ti	% Al	% V	% Si	% C	% S	% N_2
Std. Grade	38.0-43.0	2.65 Max	1.75 Max	0.75 Max	0.50 Max	0.04 Max	0.30 Max
HP Grade	38.0-43.0	0.40 Max	0.20 Max	0.10 Max	0.10 Max	0.02 Max	0.25 Max

70% Ferrotitanium

	% Ti	% Al	% V	% Si	% C	% S	% N_2
Std. Grade (LC)	68.0-73.0	5.00 Max	3.00 Max	0.25 Max	0.20 Max	0.02 Max	0.40 Max
HP Grade	68.0-73.0	0.50 Max	0.25 Max	0.10 Max	0.15 Max	0.02 Max	0.30 Max

Titanium Pucks

	% Ti	% Al	% V	% C	% Sn	% Cr	% Ni
Ti-Pucks 85	85.0-88.0	6.5 Max	4.5 Max	0.5 Max	2.5 Max	1.0 Max	1.0 Max
Ti-Pucks 90	87.0 Min	8.0 Max	4.5 Max	0.15 Max	0.25 Max	1.5 Max	1.5 Max

Silicon-Titanium

	% Si	% Ti	% Fe				
STI 50	47.0-50.0	47.0-50.0	Balance				

Powdered Alloys
- Aluminum
- Boron

Specialty Alloys
- Ferroboron
- Ferrosilicon/Zirconium
- Nickel Titanium
- Nickel Zirconium

BRIQUETTED ALLOYS

Silicon	Alloy Content	Total Weight
Si B4-50	2 lbs. Silicon	4 lbs.
Si B6-50	3 lbs. Silicon	6 lbs.
Si B20-50	10 lbs. Silicon	20 lbs.-segmented
Si B40-50	20 lbs. Silicon	40 lbs.

Manganese	Alloy Content	Total Weight
Mn B3	2 lbs. Manganese	3 lbs.
Mn B10	6.5 lbs. Manganese	10 lbs.
Mn B15	10 lbs. Manganese	15 lbs.-segmented
Mn B30	20 lbs. Manganese	30 lbs.-segmented

Chromium	Alloy Content	Total Weight
Cr B8	45% Chromium	8 lbs.
FeCr/Si13	25% Chromium 15% Silicon	13 lbs.-segmented

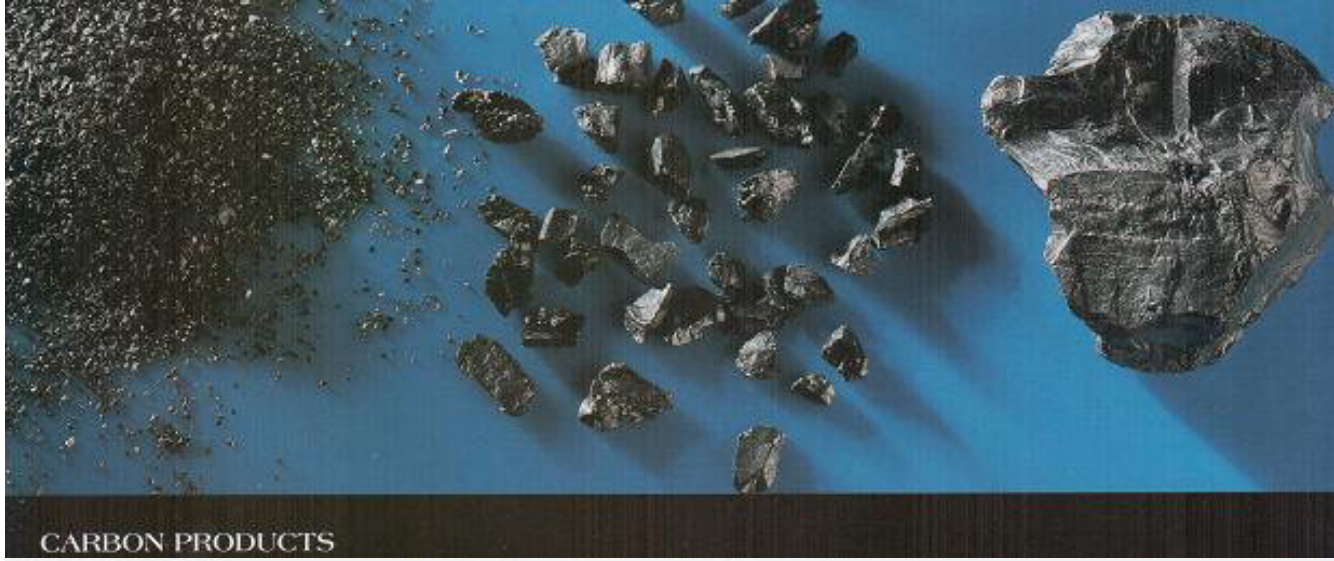
Silicon Carbide	Alloy Content	Total Weight
Si C5	65%/3.25 lbs. Si C	5 lbs.
Si C15	65%/9.75 lbs. Si C	15 lbs.-segmented
Si C30	65%/19.5 lbs. Si C	30 lbs.

Phosphorus	Alloy Content	Total Weight
FeP-3 (Foundry)	16.0% P/2.5% Si	3.0 lbs.
FeP (Steel)	22.0% P/No Si	Pillow Briquette

Ilmenite	Alloy Content	Total Weight
IL-25	8 lbs. TiO_2	25 lbs.-segmented
IL-8	2.5 lbs. TiO_2	8 lbs.-segmented
IL-3	1.0 lb. TiO_2	3 lbs.

Fluorspar	Alloy Content	Total Weight
	75% Fluorspar	5 lbs.

Flowable bricks of all the above alloys can be produced to meet specific requirements.



CARBON PRODUCTS

ANTHRACITE COAL

Typical Analysis

Product	Size	% Moisture	% Ash (Dry Basis)	% Volatile (Dry Basis)	% Fixed Carbon (Dry Basis)	% Sulfur (Dry Basis)
Egg	2-7/16" x 3-1/4"	5.0	8-10	4.0-4.5	84-88	.55
Stove	2-7/16" x 1-5/8"	5.0	9-11	4.0-4.5	84-88	.55
Nut	1-5/8" x 13/16"	5.0	9-11	4.0-4.5	84-88	.55
Pea	13/16" x 9/16"	5.0	9-11	4.0-4.5	84-88	.55
Buckwheat	9/16" x 5/16"	5.0	10-12	4.0-4.5	84-88	.55
Rice	5/16" x 3/16"	5.0	11-13	4.0-4.5	84-88	.55
Barley	3/16" x 3/32"	8.0	11-13	4.5-5.0	82-85	.60
Buckwheat #4	3/64" x 3/32"	9.0	12-14	4.5-5.0	80-83	.60
Buckwheat #5	3/64" x 0	10.0	13-15	4.5-5.0	80-83	.60

Anthracite products are also available dried to less than 1% moisture. The above sizes may be supplied blended as needed to meet customer requirements.

METALLURGICAL COKE

Screened By-Product Coke

Typical Analysis

Product	Size	% Moisture	% Ash (Dry Basis)	% Volatile (Dry Basis)	% Fixed Carbon (Dry Basis)	% Sulfur (Dry Basis)
Smelter Coke	4" x 2"	6-8	6-8	1-1.5	91.5-93	.65
Blast Furnace Coke	4" x 1"	5-10	7-8	1.5-2	90-91.5	.75
Nut Coke	1 1/2" x 3/4"	10-13	8-10	1-2	88-91	.6-.8
Buckwheat Coke	3/4" x 1/4"	10-13	9-11	1-2	87-90	.6-.8
Coke Breeze	1/4" x 0	10-13	9-13	1-3	84-90	.6-.8

By-product coke is screened and processed in Hickman, Williams & Company owned facilities.

TECHNI-CARB CARBON PRODUCTS

Dried Metallurgical Coke

Typical Analysis

Product	Size	% Moisture	% Ash	% Volatile	% Fixed Carbon	% Sulfur
Buckwheat	3/4" x 1/4"	5.0 Max.	10-13	1.6-2.5	86-88	.60-.70
Coarse Grade	3/8" x 10 Mesh	1.5 Max.	10-13	1.6-2.5	86-88	.60-.75
Fine Grade	8 Mesh x 0	1.5 Max.	10-13	2.0-2.5	85-88	.60-.75
Regular Grade	3/8" x 100 Mesh	1.5 Max.	10-13	2.0-2.5	85-88	.60-.75
Extra Fine Grade	40 Mesh x 200 Mesh	1.0 Max.	10-13	2.0-2.5	85-88	.60-.75
Flour Grade	200 Mesh x 0	1.0 Max.	16-22	6.0-8.0	70-75	.70-1.25

Techni-Carb products are available in bulk for pneumatic or dump truck delivery. Packaging is also available in 50 lb. bags or bulk bags.
Techni-Carb products are manufactured and sold exclusively by Hickman, Williams & Company.

BLACK DIAMOND DIA CARB PRODUCTS

Calcined Petroleum Coke

Typical Analysis

Product	Size	% Moisture	% Ash	% Volatile	% Fixed Carbon	% Sulfur
Dia Carb 45-55	3/8" x 100 Mesh	.05 Max.	.30 Max.	.50 Max.	99.20 Min.	.20-.30
Dia Carb 044	20 Mesh x 100 Mesh	.05 Max.	.30 Max.	.50 Max.	99.20 Min.	.40-.60
Dia Carb G	3/8" x 100 Mesh	.05 Max.	5.0 Max.	1.75 Max.	93.00 Min.	.75-.95
Dia Carb 1	4 Mesh x 100 Mesh	.05 Max.	.75 Max.	.75 Max.	98.50 Min.	1.0-1.2
Dia Carb 15	4 Mesh x 100 Mesh	.05 Max.	.75 Max.	.75 Max.	98.50 Min.	1.4-1.6
Dia Carb 4	4 Mesh x 100 Mesh	.05 Max.	.75 Max.	.75 Max.	98.50 Min.	1.8-2.0
Dia Carb 4AN	4 Mesh x 100 Mesh	.05 Max.	.75 Max.	.75 Max.	98.50 Min.	2.1-2.3
Dia Carb 4A	4 Mesh x 100 Mesh	.05 Max.	.75 Max.	.75 Max.	98.50 Min.	2.6-2.8
Dia Carb 7F	4 Mesh x 100 Mesh	.05 Max.	.75 Max.	.75 Max.	98.50 Min.	3.4-4.0
Dia Carb 7	4 Mesh x 100 Mesh	.05 Max.	.75 Max.	1.0 Max.	98.00 Min.	4.5-4.8

Dia Carb Products are available in 50 lb. bags or bulk bags. Black Diamond Dia Carb Products are manufactured exclusively by Black Products Division of Hickman, Williams & Co.

GRAPHITE

Techni-Graph Synthetic Graphite

Product	Size	% Moisture	% Ash	% Volatile	% Fixed Carbon	% Sulfur
Techni-Graph 99	3/8" x 0, 20 Mesh x 0	1 Max.	.5	.5	99.0 min.	.05 Max.

Available in 50 lb. bags and bulk bags.

SUPER G®*

Product	Size	% Moisture	% Ash	% Volatile	% Fixed Carbon	% Sulfur
Super G 9165	3/8" x 65 Mesh	.35 Max.	.5 Max.	.2 Max.	99.5 Min.	.1 Max.
Super G 9130	3/8" x 65 Mesh	.4 Max.	.5 Max.	.25 Max.	99.5 Min.	.18 Max.

Super G products can be custom blended to meet customer sulfur requirements.
*Trademark of Superior Graphite Co.

DESULCO®*

% Moisture	% Ash	% Volatile	% Fixed Carbon	% Sulfur	% Nitrogen	% Hydrogen	% Oxygen
0.2 Max.	0.5 Max.	0.2 Max.	99.7 Min.	.03 Max.	42 ppm	10 ppm	128 ppm

Grade	Size
9001	3/8" x 65 Mesh
9005	3/8" x 12 Mesh
9012	6 Mesh x 28 Mesh
9018	20 Mesh x 80 Mesh

Available in 50 lb. bags and bulk bags. The purest form of carbon additive available.
*Trademark of Superior Graphite Co.

CARBON PRODUCTS FOR ALL APPLICATIONS:

- Foundry
- Steel
- Charge Carbon
- Ladle Addition
- Slag Foaming
- Cupola Tuyere Injection for Superior Carbon Control
- Ladle Furnace Desulco® Injection as an Economical Alternative to Wire Feeding

FERROALEACIONES

NOMBRE	ELEMENTO % Min.	C % Max.	Si % Max.	S % Max.			TAMAÑO 90% Min.
ALUMINIO	Al 95.00	-	-	-			BARRA 1 KG, GRANALLA, 1/2 ESFERA
ANTIMONIO	Sb 99.20						LINGOTES
CALCIO SILICIO	Ca 28.00	0.554	70.00	0.027			(7x20) y (8x0)
COBALTO	Co 99.0	-	-	-			BARRA 18-25 KG, POLVO
COBRE CATODICO	Cu 99.99	-	-	-			CATODOS
CROMO ELECTROLITICO	Cr 99.00	-	-	-			1½" x 10 Mesh
ESTAÑO	Sn 99.80	-	-	-			LINGOTES, GRANALLA Y BARRA-1 KG
ESTAÑO GRADO A	Sn 99.65	-	-	-			LINGOTES
FERROBORO	B 17.5	0.05	3.00	0.030			2" x D
FERRONIOBIO (FERROCOLUMBIO)	Nb 65.0	0.07	1.30	0.008			10 x 30 mm
FERROCROMO ALTO CARBON	Cr 62.0	7.00	3.00	0.040			3" x 1", 2" X ½", 4" X2", FINOS
FERROCROMO BAJO CARBON	Cr 65.0	0.05	0.75	0.025			2" x 1/2", 3" X ½"
FERROMANGANESO ALTO CARBON	Mn 72.00	1.40	0.05	0.007			3" x ½", 4" X 2", 3/8 X 12M
FERROMANGANESO MEDIO CARBON	Mn 80.0	1.40	0.05	0.007			3" x ½"
FERROMOLIBDENO	Mo 60.0	0.04	1.50	0.050			(-3") y (-1½"x ½"), FINOS
FERROFOSFORO	P 23.0	-	3.20	-			10 x 50 mm
FERROSILICIO 75%	Si 75.0	0.05	-	0.005			(25 x 75 mm), (10 X 50mm) (3/8" x 12 Mesh
FERROSILICIO-ULTRA BAJO ALUMINIO	Si 75.0	0.10	0.10	0.003	Al	0.05	25 X 75mm
FERROSILICIO MAGNESIO	Si 43.0	0.05	-	0.005	Mg	8.41	3/4" x 5 Mesh
FERROSILICIO ZIRCONIO	Si 51.98	0.15	-	-	Zr	35.02	3/8" x 12 Mesh
FERROTITANIO	Ti 68.0	0.15	0.20	0.05	Al	5.00	(2" x ½") y (3/4" x D)
FERROTUNGSTENO	W 75.0	0.60	1.00	0.10			10 x 125 mm, ½" x D
FERROVANADIO	V 80.0	1.00	0.35	0.10	Al	1.00	2" x D, 2" X 1/2"
FOSFURO DE COBRE	Cu 85.0	-	-	-	P	15.00	WAFFLE / GRANALLA
FERROBORO	B 18.0	0.50	1.00	0.01	P	0.05	POLVO, 15 X 75
INOCULANTE	Mn10.0	0.06	63.5	-	Ca	2.00	3/8" x 8 Mesh
MAGNESIO PURO	Mg 99.5	-	-	-			LINGOTE
MANGANESO ELECTROLITICO	Mn 99.0	0.01	0.003	.030			HOJUELAS
NIQUEL	Ni 99.9	0.002	N/A	0.001			(4"x 4") , (1"x 1"), PELLETS, BRIQUETA
OXIDO FERRICO (HEMATITA)	Fe_2O_3 97.0	0.10	0.20	-	Cl	0.30	POLVO
SILICIO METALICO	Si 99.0	-	-	-			10 x 100 mm
SILICO MANGANESO	Mn 65.0	2.00	15.0	0.03			3" x ½"
TITANIO BORO ALUMINIO 5/1	Ti 4.5	-	0.20	-			VARILLA
TRIOXIDO DE MOLIBDENO	Mo 58.0	0.05	-	0.05			POLVO
ZINC	Zn 99.5	-	-	-			SEMIESFERA, LINGOTE
BENTONITA SODICA	RESIST. EN VERDE 12.0 PSI HINCH 26 CC GELACION 40 SEG						200 Mesh
FLUORITA GRADO METALURGICO	CaF_2 80.0		$CaCO_3$ 7.0		SiO_2	7.0	½" x 1/8"
FLUORITA GRADO ACIDO (SECO)	CaF_2 97.0		$CaCO_3$ 1.0		SiO_2	1.0	100 x 325 Mesh
PIRITA	Pureza (FeS_2) 99 % Min. Hierro 45-47%, Azufre 53-55 %						- 200 Mesh

PRODUCTOS DE CARBON

NOMBRE	CARBON FIJO % Min.	M. VOLATIL % Max.	CENIZA % Max.	AZUFRE % Max.	TAMAÑO 90% Min.
CARBOOSTER 50 LS	98.50	0.50	0.50	1.00	3/8" x 12 Mesh
CARBOOSTER XS	98.00	1.20	0.50	4.00	3/8" x 12 Mesh
CARBOOSTER XLS	98.00	1.00	0.50	0.03	3/8" x 60 Mesh
CARBOOSTER AIMCHG	92.00	3.00	5.00	1.00	3" x ¼"
CARBOOSTER AIMINS	96.00	2.40	1.20	1.10	10 x 200 Mesh
CARBON MARINO	92.00	35.00	-	-	70 Mesh
ANTRACITA	80.00	4.00	16.0	0.65	3" x ½" y ¼" x 0
COQUE METALURGICO (CBA)	84.00	2.00	13.0	0.60	3" x 6"

Master Alloys for the Aluminium Industry

Colour Code	Product	Name	Percentage of Alloying Element	Available as					
				10 mm Rod	Cut Rod	0,5 kg ContiCast	2,5 kg ContiCast	7 kg Waffle	Others/ Remarks
Grain Refiners									
Green Brown	Titanium-Boron	AlTiB	3% Ti-1% B	¥	¥	¥	¥	¥	
Green Grey	Titanium-Boron	AlTiB	3% Ti-0.4% B	¥	¥	¥	¥		
Green Purple	Titanium-Boron	AlTiB	3% Ti-0.2% B	¥	¥	¥	¥		
Green	Titanium-Boron	AlTiB	5% Ti-1% B	¥	¥	¥	¥	¥	
Green Yellow	Titanium-Boron	AlTiB	5% Ti-0.6% B	¥	¥	¥	¥		
Green Black	Titanium-Boron	AlTiB	5% Ti-0.2% B	¥	¥	¥	¥	¥	
Green Red	Titanium-Boron	AlTiB	5% Ti-0.1% B	¥	¥	¥	¥		
Green Orange	Titanium-Boron	AlTiB	6% Ti-0.4% B	¥	¥	¥	¥		
Green White	Titanium-Boron	AlTiB	10% Ti-1% B					¥	
Green Dark Blue	Titanium-Boron	AlTiB	10% Ti-0.4% B	¥	¥	¥	¥		

Hardeners

No Code	Antimony	AlSb	8 or 16%					¥	
Purple / Yellow	Bismuth	AlBi	3 or 6%					¥	
No Code	Cadmium	AlCd	10%					¥	
Orange / White	Calcium	AlCa	10%					¥	
Purple	Chromium	AlCr	5, 10, or 20%					¥	
Light Blue / Orange	Cobalt	AlCo	10%					¥	
Orange	Copper	AlCu	20, 33, 50 or 54%					¥	¥
Orange / Black	Iron	AlFe	5, 10, 15, 20, 25 or 45%	¥				¥	Splatter
No Code	Lithium	AlLi	5%					¥	
Purple / White	Magnesium	AlMg	10, 20, 25, or 50%					¥	¥
Brown	Manganese	AlMn	10, 20, 25, 30 or 60%					¥	Splatter
Grey	Nickel	AlNi	10, 20, 25 or 50%	¥				¥	¥
White	Silicon	AlSi	20, 22, 25, 30 or 50%	¥				¥	
White / Black	Silicon-Magnesium	AlMgSi	20% Si - 20% Mg					¥	
Black	Vanadium	AlV	5 or 10%					¥	
Red	Titanium	AlTi	6%	¥	¥	¥	¥	¥	
Red / Black	Titanium	AlTi	10%	¥	¥	¥	¥	¥	
Dark Blue	Zirconium	AlZr	6 or 10%					¥	

Special Alloys

Red / Yellow	Beryllium	AlBe	5%						¥
Yellow	Boron	AlB	3, 4 or 5%	¥	¥	¥	¥	¥	
No Code	Molybdenum	AlMo	10%					¥	
No Code	Silver	AlAg	10%					¥	
Light Blue	Strontium	AlSr	3.5, 5, 10 or 15%	¥	¥			¥	
No Code	Ytrium	AlY	8%					¥	

Silicon Containing Alloys

	% Si	% Al	% Ca	OTHER
50% FeSi - Reg. Grade	47-51	1.25 max.	0.30 max.	------
50% FeSi - Low Al	47-51	0.50 max.	0.20 max.	------
50% FeSi - High Purity	47-51	0.10 max.	0.10 max.	0.03 max. Ti
75% FeSi - Reg. Grade	74-79	1.50 max.	0.50 max.	------
75% FeSi - Low C	74-79	---------	--------	0.02 max. C
75% FeSi - Low Al	74-79	0.50 max.	0.30 max.	------
75% FeSi - High Purity	74-79	0.10 max.	0.10 max.	0.040 max. Ti

APPLICATION: Ferrosilicon is used primarily as a deoxidizer. It readily combines with the oxygen in the molten metal. Sometimes used as a degasifer because of its affinity for undesirable gases. Used as a source of silicon in cast iron.

Magnesium Containing Alloys

	% Mg	% Si*	% Ca	% Ce	% T.R.E.	% AL**
Noduloy ®3	3.5-4.2	43-48	0.8-1.3	--------	--------	1.2 max.
Noduloy 5	5.5-6.5	43-48	0.8-1.3	--------	--------	1.2 max.
Noduloy 9	8.5-10	43-48	1.0-1.5	--------	--------	1.2 max.
Noduloy 5LC	5.5-6.5	43-48	0.8-1.3	0.3-0.4	--------	1.2 max.
Noduloy 5C	5.5-6.5	43-48	0.8-1.3	0.5-0.75	--------	1.2 max.
Noduloy 5C1	5.5-6.5	43-48	0.8-1.3	0.9-1.2	--------	1.2 max.
Noduloy 3R	3.5-4.2	43-48	0.8-1.3	[0.9-1.2]	1.5-2.0	1.2 max.
Noduloy 5R-1	5.5-6.5	43-48	0.8-1.3	0.3-0.45	[0.5-0.85]	1.2 max.
Noduloy 5R-2	5.5-6.5	43-48	0.8-1.3	0.45-0.6	[0.75-1.15]	1.2 max.
Noduloy 5R-3	5.5-6.5	43-48	0.8-1.3	0.85-1.0	[1.45-2.0]	1.2 max.
Noduloy 5R-2+	6.0-7.0	43-46	1.7-2.3	0.45-0.6	[0.75-1.15]	1.2 max.
Noduloy 9R	8.5-10	43-48	0.8-1.3	0.35-0.5	[0.6-1.0]	1.2 max.
Noduloy 3R	3.5-4.2	43-48	0.8-1.3	[0.9-1.2]	1.5-2.0	1.2 max.

[] = Typical Range
*For certain Noduloy-Alloys a silicon level of 40-42% available. More utilization of returns possible, because of the lower silicon-addition during the magnesium treatment.
**For certain Noduloy-Alloys 0.5% maximum aluminum available.

High calcium, high magnesium alloys are available to minimize alloy addition; also, low aluminum and low calcium alloys are available for pressure pouring applications.

Inoculant

	% Si	% Al	% Ca	% Ba	% Ce	% T.R.E.	% Ti	% Mn	% Fe
Calsifer®50	46-50	0.5-1.4	0.6-1.0	------	-----	------	----	----	-----
Calsifer 75	74-79	0.75-1.5	0.5-1.0 1.0-1.5	------	-----	------	----	----	-----
APPLICATION: Specially sized and of proper composition for the inoculation of gray and ductile cast irons.									
Inoculoy®63	60-65	0.8-1.5	1.5-3.0	4-6	-----	-----	-----	7-12	------
SB5	65-72	0.8-1.5	0.8-1.5	1.5-2.5	-----	-----	-----	----	------
APPLICATION: Powerful inoculant for gray and ductile cast irons. High efficiency permits use of small additions. Provides excellent chill reduction in gray cast irons.									

Inoculant (cont.)

	% Si	% Al	% Ca	% Ba	% Ce	% T.R.E.	% Ti	% Mn	% Fe
InocuChrome ™	6-11	0.5 max.	0.5 max.	------	------	2-3	------	------	------
APPLICATION: (46-50% Chrome) Inoculant for gray cast irons for increasing mechanical properties.									
CFS - 10®	36-40	------	-----	------	9-11	10.5-15.0	------	------	-----
APPLICATION: For reducing chill and providing proper graphite structure for optimum mechanical properties in gray cast iron. A source of cerium and rare earths for gray and ductile cast iron. Economical and flexible source of cerium for the production of ductile iron. Used in conjunction with magnesium ferrosilicon.									
	% Si	% Al	% Ca	% Ba	% Ce	% T.R.E.	% Ti	% Mn	% Sr
Graphidox®	50-55	------	5-7	------	------	------	9-11	------	-----
APPLICATION: Highly effective in supplementary deoxidation of steel for castings. Improves quality of steel castings and increases yield strength, ductility, and low temperature impact toughness properties.									
Low Calcium Graphidox®	50-55	------	0.5-1.5	------	------	------	9-11	------	------
APPLICATION: Highly effective proprietary inoculant designed for effective, economical inoculation of both gray cast iron and compacted graphite irons. This titanium bearing ferroalloy is highly efficient as both a graphidizer and deoxidizer. In addition, titanium in LOW CALCIUM GRAPHIDOX reacts with nitrogen in iron to reduce chances of nitrogen porosity.									
SRF-50	44-48	0.5 max.	0.10 max.	------	-----	------	------	------	0.8-1.2
SRF-75	74-79	0.5 max.	0.10 max.	------	-----	------	------	------	0.8-1.2
APPLICATION: Proprietary inoculant containing strontium, the most potent element for reducing chill and promoting type A graphite structure in gray iron. Offer good machinability while keeping tensile strength and hardness to a minimum. *Lower silicon values are possible with sizes of 8M and finer.									

ESM Desulfurizers

X-1	Calcium oxide used with continuous porous plug cupola runner application.
S-1	Calcium fluoride used with continuous porous plug cupola runner applications.
LoSul B-1050	Bagged calcium oxide base product used in foundry ladle desulfurization applications.

APPLICATION: Environmentally acceptable alternatives to calcium carbide for the desulfurization of cast iron in the production of ductile iron; can be applied to continuous or batch processing; cupola or electric base iron; sulfur levels below .010% are obtainable.

Specialty Metals and Alloys

	% Cr	% Fe	% Si	% Al	% C	% S	% O_2	% N_2
A. T. Chromium Metal	99 min.	0.20 max.	0.10 max.	0.10	0.03 max.	0.01 max.	0.10 max.	0.015 max.
	% Mo	% C	% S	% P	% Si	% Cu	--------	--------
Ferro Molybdenum	60-70	0.10 max.	0.15 max.	0.05 max.	1.00 max.	0.5 max.		
Moly Oxide	57 min.	------	0.10 max.	0.05 max.	--------	0.50 max.		

APPLICATION: These metals and alloys are used in the production of low and high alloy steels, tool and high speed steels, and cast irons. Other applications are stainless and heat resisting alloys, welding and hardfacing alloys, air and vacuum melted superalloys, and aluminum alloys.

Calcium Containing Alloys

	% Ca	% Si	% Ba	% Mn	% Al
CaSi	29-33	59-63		--------	1.75 max.
BaCaSi	14-18	55-62	14-18	--------	1.75 max.

APPLICATION: Calcium silicon is available in lump, powder and cored wire form. It is a universal deoxidizing and desulfurizing agent in the production of high grade steels. In combination with aluminum, it is used where very high demands are made on the castability, degree of purity and surface quality of steel.

Cored Wire

APPLICATION: Available in the following alloys: (CaSi, CaSiBa, CaC_2, FeB, FeTi, C, Pb, Sulfur); other filling material available on request. Alloys for desulfurization, Mg treatment, and inoculation of cast iron also available.

Manganese Containing Alloys

	% Mn	% Si	% C	% P
Silico Manganese	65-68	16-18.5	2.0 max.	0.20 max.
M. C. FeMn	80-85	1.00 max.	1.5 max.	0.30 max.
Std. FeMn	70 min.	1.20 max.	6-8	0.30 max.

APPLICATION: Manganese gives strength to steel, counteracts the embrittling effect of sulfur, and increases nitrogen solubility.

Chromium Containing Alloys

	% Cr	% Si	% P	% C
FeCrSi	34-40	39-43	0.030 max.	0.05 max.
HCFeCr	60-70	3.0 max.	0.030 max.	5 - 9
LCFeCr	65-75	1.0 max.	0.030 max.	0.05 max.

APPLICATION: Chrome addition conveys hardenability, corrosion resistance, high strength, and high temperature stability. It also produces a fine crystalline structure.

Welding Products and Powdered Alloys

	MESH	% Si	% C	% P	% S
Ferrosilicon 50% Grade, Unstablized	40 x 325	47.0 min.	0.12 max.	0.04 max.	0.02 max.
Ferrosilicon 50% Grade, Stabilized	40 x 325	47.0 min.	0.12 max.	0.04 max.	0.02 max.

APPLICATION: Stabilized and unstabilized Ferrosilicon is used in fluxes for both welding electrodes and core wire.

Typical Field Sample Testings of Carbon Additives

Carbon Type	Carbon	Ash	Vol.	Moist.	Sulphur	Nitrogen ppm	Hydrogen ppm	Oxygen ppm
Desulco	**99.8**	**.10**	**.10**	**NIL**	**.008**	**13**	**5**	**7**
Scrap Electrode Graphite	99.0	.40	.15	.15	.009	33	72	1400
Mexican Natural Graphite	69.4	26.80	3.10	.10	.570	750	2200	141400 (14.14%)
Low Sulphur Calcined Petroleum Coke	99.2	.10	.25	.25	.090	200	600	275
Calcined Petroleum Coke	98.4	.22	.50	TR	.850	18560 (1.85%)	1185	1180
Metallurgical Coke	87.2	10.80	.80	NIL	1.150	9090	2980	70600 (7.06%)

Comparative Chemistry	Desulco	Crushed Electrode Scrap Graphite*
Carbon	99.8%	99.0%
Ash	0.1	0.7
Volatiles	<0.1	0.2
Moisture	nil	0.1
Sulphur	0.015	0.050
Size	−6M+20M	−4M+20M

*Note: Chemistry of crushed electrode scrap graphite was inconsistent, therefore above is average of several tests.

Carbon Recovery Results Over 34 Heats		
Amount of carbon added	14,118 lbs.	14,220 lbs.
Carbon recovery (average)	94.5%	84.3%
Solution rate	45.0 lbs./min.	32.9 lbs./min.

Conclusions:

- Desulco generated an average of 10.2% greater carbon recovery than crushed electrode scrap graphite.
- Desulco dissolved 12 lbs./min. faster than crushed electrode scrap graphite.
- Desulco's reduced range of variation in carbon recovery increased precision of achieving aim analysis.
- Desulco's performance was more consistent and dependable due to its quality and purity.