

Substitute  
Fusion Frit

Lead Free Ferro Frits

	SiO2	Al2O3	K2O	Na2O	Li2O	CaO	MgO	ZrO2	SrO	ZnO	B2O3	Total	Expansion	Ratio
F3110	69.80	3.70	2.30	15.30		6.30					2.60	100.00	852.0	32.1
F3124	55.30	9.90	0.70	6.30		14.10					13.70	100.00	471.3	9.5
F3134*	46.50			10.30		20.10					23.10	100.00	628.5	F12
F3195	47.40	11.90		6.20		10.90	0.10				23.50	100.00	323.0	6.8
F3278	56.20			15.30		6.90					21.60	100.00	636.0	F60
F3292	61.10	10.70	3.10	3.00	0.40	10.50	0.70		4.80		5.70	100.00	496.1	9.7
F3185	54.10			7.70							38.20	100.00	97.2	
F3269	49.70	13.20	8.10	11.10		0.10	fluorine	1.60		1.00	15.20	100.00	744.1	6.4

The low expansion rate for B2O3 is only valid for amounts of up to 12% of a glaze.  
Higher expansion/contraction can be expected for amounts over 12%.

Some frits have no silica/alumina ratio because they have no alumina in them.

\* Other substitute frits for Ferro 3134 are Pemco #54 and Hommel #14

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Substitute  
Ferro Frit

	SiO2	Al2O3	K2O	Na2O	Li2O	CaO	MgO	ZrO2	SrO	ZnO	B2O3	Total	Expansion	Ratio
F75	70.00	3.70	2.10	15.30		6.40					2.50	100.00	846.6	32.2
F19	54.50	9.70		7.00		14.20					14.60	100.00	468.2	9.6
F12	45.00	0.80		10.40		20.00					23.80	100.00	626.9	95.6
F2	49.00	13.50	3.70	3.00		10.50					20.30	100.00	351.1	6.2
F60	56.00			15.00		7.50					21.50	100.00	633.9	-
F134	60.50	11.50	1.20	4.90	0.40	11.00			4.50		6.00	100.00	500.8	8.9
F309	24.00	2.50		6.20		18.00	4.30				45.00	100.00	292	11.0
F367	53.80			7.80							38.40	100.00	100.6	-
	SiO2	Al2O3	K2O	Na2O	Li2O	CaO	MgO	ZrO2	SrO	ZnO	B2O3	Total	Expansion	Ratio

Typical Analysis for glaze materials

Oct-12

	SiO2	Al2O3	Fe2O3	K2O	Na2O	Li2O	CaO	MgO	BaO	ZrO2	TiO2	B2O3	P2O5	F2	LOI	Total
Strontium Carbonate									SrO>> 70.27						29.73	100.00
Barium Carbonate									77.66						22.34	100.00
Magnesium Carbonate								47.62							52.38	100.00
Calcium Carbonate	0.20		0.10				55.10	0.25							44.35	100.00
Lithium Carbonate (check solubility)						40.00									60.00	100.00
Colemanite	4.50	0.55	0.28	0.33			25.50	1.75				44.00		0.18	22.31	99.40
Gers Borate 9/97	11.73	1.63	0.48	1.38	4.29		19.06	4.19				27.68			29.35	99.79
Gerstley Borate (Laguna 2011)	14.80	0.98	0.43	0.40	3.95		19.40	3.54			0.05	26.80	0.05		29.50	99.90
CadyCal 100 (no longer available)	0.73	0.15	0.06	0.01	0.10		25.67	0.26	SrO>> 0.03			46.49			24.70	98.20
Gillespie Borate	11.81	1.70		0.01	3.77		23.02	3.89	SrO>> 0.45			24.48			30.87	100.00
Laguna Borate	18.75	8.07	0.07	1.42	3.97		18.86	2.26			0.07	27.52			19.00	99.99
Dolomite (Pfizer Dolocron)	1.05	0.56	0.40	0.07	0.08		31.41	20.77							45.53	99.87
Dolowhite	0.50	0.05	0.14				31.20	20.80							47.00	99.69
Talc - Natal (no longer available)	55.20	0.31	0.16		0.34		8.42	30.00							5.41	99.84
Talc - Amtal C98 (Texas talc) also sold as #'s 2882, 92, 88 & 300	54.50	0.50	0.50	0.30			3.50	29.50			0.10				11.00	99.90
Talc Imerys sierralite (* high Al2O3)	32.00	21.00	0.23				0.04	34.00							12.60	99.87
Silica (Flint)	99.80	0.13	0.06													99.99
Wollastonite (Vansil W)	51.91	1.82	0.37		0.27		42.10	1.49							2.04	100.00
Bone Ash	0.27	0.51		0.30	0.35		53.80	1.10					42.50		1.17	100.00
Bell Dark Ball	58.30	27.70	1.00	0.40	0.10		0.30	0.20			1.50				10.50	100.00
Old Mine #4 Ball	55.20	27.90	1.10	1.00	0.30		0.30	0.40			1.20				12.60	100.00
E.P.K.	46.08	37.46	0.69	0.40	0.04		0.13	0.12			0.30		0.12		14.66	100.00
Kaolin (Calcined) Glomax LL	52.80	44.60	0.40	0.10	0.30		0.05	0.04			1.60					99.89
Bentonite	55.44	20.14	3.67	0.60	2.76		0.49	2.49							13.50	99.09
Molochite	54.50	42.50	0.75	1.75	0.10		0.10	0.10			0.08					99.88
Alumina Hydrate	0.02	64.80	0.01		0.35										34.80	99.98
Calcined Alumina	0.01	99.80	0.01		0.15											99.97
Zircopax	34.28						0.22			64.88						99.38
	SiO2	Al2O3	Fe2O3	K2O	Na2O	Li2O	CaO	MgO	BaO	ZrO2	TiO2	B2O3	P2O5	F2	LOI	Total

# Typical Analysis for Feldspars and Spodumenes

## Potash Feldspars

	SiO2	Al2O3	Fe2O3	K2O	Na2O	Li2O	CaO	MgO	MnO2	TiO2	P2O5	LOI	Total
G 200 Spar (K2O = 10.67, Na2O = 3.01) (no longer available)	66.84	18.39	0.08	10.57	3.01		0.81					0.16	99.86
70% G200HP + 30% Minspar 200 = Old G200 (what the mine used to do)													
G 200 HP Spar (high potassium)	65.90	18.20	0.09	13.20	1.52		0.75					0.16	99.82
Custer Spar (K2O=10.08, Na2O= 3.02) what Custer was years ago	68.90	17.11	0.15	10.08	3.02		0.30					0.30	99.86
Custer Spar (K2O = 7.5, Na2O = 3) average of 6 lab analysis	72.26	15.29	0.21	7.57	3.17		0.28	0.07			0.19	0.64	99.68
Kingman Spar (no longer available)	66.00	18.70	0.10	12.00	2.80		0.10					0.20	99.90
Buckingham spar (no longer available)	66.30	18.39	0.06	11.81	2.70		0.40					0.30	99.96
Norfloat spar (Norway)	65.90	18.60	0.07	11.80	2.90		0.30					0.20	99.77
Cornwall Stone (K2O & Na2O equal!) no longer available	72.53	15.87	0.14	3.68	3.68		1.99			0.07	0.50	1.48	99.94
Cornwall Stone replacement from Hammil & Gillespie	77.00	14.06	0.20	3.34	3.56		0.42	0.05		0.05	0.22	1.03	99.93

## Soda Feldspars

F4 Spar (no longer available) - use Min spar	66.74	19.55	0.04	4.80	6.90		1.70					0.20	99.93
C6 Spar	68.40	18.48	0.07	5.20	6.87		0.70					0.21	99.93
NC 4 Spar	68.70	18.65	0.07	3.92	6.65		1.60					0.12	99.71
Min Spar 200 (formerly called NC4)	68.60	18.50	0.06	4.10	6.50		1.50					0.30	99.56
Forshammar (Norway?)	75.70	14.10	0.15	3.80	5.00		0.30	0.10		0.02		0.50	99.67
Neph Syenite (not really a spar but used like one)	60.70	23.30	0.07	4.60	9.80		0.70	0.10				0.70	99.97

## Spodumenes (sources of lithium)

Footo Spodumene (note high iron)	63.00	24.80	2.28	1.18	0.60	5.78						0.20	97.84
Tanko Spodumene (Canada)	66.00	25.50	0.09	0.25	0.23	7.20			0.04		0.25	0.42	99.98
Gwalia Spodumene (Australia)	64.46	26.45	0.06	0.10	0.23	7.57	0.03		0.03	0.01	0.14	0.20	99.28
Cabot Spodumene - 200 mesh (Canada)	65.40	26.00	0.15	0.30	0.30	7.00			0.05		0.40	0.20	99.80
Petalite (from South Africa may not be available - expensive)	76.70	17.50		0.25	0.25	4.30						0.70	99.70
Lithium Carb. (a little soluble)						40.00						60.00	100.00
See also frits - some have lithium													

	SiO2	Al2O3	Fe2O3	K2O	Na2O	Li2O	CaO	MgO	MnO2	TiO2	P2O5	LOI	Total
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