U.S. Department
of Transportation

**Research and
Special Programs
Administration**

400 Seventh Street, S.W.
Washington, D.C. 20590

MAR - 2 1998

Ms. Sharon L. Thompson
Manager-Traffic and Distribution
Elkem Metals Company
Post Office Box 72
Marietta, Ohio 45750-0072

Dear Ms. Thompson:

This is in response to your letter dated October 30, 1997, requesting confirmation that your company's ferrosilicon is not subject to the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180). You state that your product was tested in accordance with the test method described in Appendix E to Part 173, and found it does not meet the definition of a Division 4.3 (Dangerous When Wet) material.

As provided in § 173.22, it is the shipper's responsibility to properly classify a hazardous material. However, based on the test data you provided, we concur that your company's ferrosilicon with 50% ferrosilicon does not meet the definition of a Division 4.3 material. Therefore, if your company's material does not meet any other hazard class definition of Part 173 it is not subject to the HMR.

I hope this satisfies your request.

Sincerely,

Delmer F. Billings
Chief, Standards Development
Office of Hazardous Materials Standards

Elkem

October 30, 1997

Ms. J. Suzanne Hedgepeth
Director
Office of Hazardous Materials
U.S. Department of Transportation
Research & Special Programs Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

Dear Ms. Hedgepath:

In accordance with the rules set forth in U.S. DOT 49 CFR 173, Appendix E, Elkem performed the test as described on our 50% Ferrosilicon to determine if our product met the criteria for classification in Division 4.3. Based on the attached findings, we do not believe our product meets the criteria as it did not spontaneously ignite nor was there any gas evolution observed.

We would appreciate your review of the attached report and confirmation that our product does not meet the 4.3 definition.

Sincerely,

Sharon L. Thompson

Sharon L. Thompson
Manager - Traffic and Distribution

Enclosures

ELKEM METALS COMPANY MARKETING SERVICES; P.O. BOX 72; MARIETTA, OHIO 45750-0072
Telephone: (800) 848-9795 *Fax:* (614) 374-1043

Quality is Our PRIORITY

Results of the tests performed on Elkem's regular 50 % FeSi (50 wt. % Si) using DOT procedures.

(09/29/97)

E. G. Allain, F. X. He, D. G. C. Robertson
Center for Pyrometallurgy
Department of Metallurgical Engineering
University of Missouri-Rolla

Summary

The U.S. DOT procedure, specified in the U.S. DOT 49 CFR 173, appendix E, was used to test Elkem's 50 % ferrosilicon material. The sample was sieved to determine the particle size distribution after handling and transportation. The percentage of particles of less than 500 micrometers was 0.23 %. Therefore, according to the DOT instructions, the material did not need to be ground for testing. Results of the three tests recommended by the U.S. DOT show that no gas evolution or spontaneous ignition was observed when Elkem's 50 % ferrosilicon was put in contact with distilled water.

Aims

The aim of this report is to provide to Elkem the results obtained during the tests of Elkem's 50 % FeSi (50 wt. % Si) in applying rigorously the instructions indicated in the U.S. DOT 49 CFR 173, appendix E, entitled "Guidelines for the Classification and Packing Group Assignment of Class 4 Materials", division 4.3. This division gives the test conditions for the classification of "dangerous when wet" materials.

1. Material

The Elkem's 50 % FeSi material was sent to UMR in a drum. As received, it mainly contained pieces measuring from about one to ten centimeters. However, it also included a relatively low amount of powder. The total weight of this material was 11,362 grams.

2. Tests procedure and results

2. 1. Preliminary sieving test

The U.S. DOT 49 CFR 173, appendix E, division 4.3 gives in section "a). Test method" the following specifications:

"For a solid material, the package should be inspected for any particles < 500 μm diameter. If that powder constitutes more than 1 percent (mass) of the total or if the material is friable, then the whole of the sample should be ground to a powder before testing to allow for a reduction in particle size during handling and transport, otherwise the material should be tested in its commercial state "

Therefore, the totality of the as-received Elkem's 50 % FeSi material was sieved three times, during 10 minutes, using the following equipment:

- A series of 8 sieves of the Tyler Standard Screen Scale (From 3 Mesh to 28 Mesh). The 500 μm opening (32 Mesh Tyler equivalent) sieve was taken from a U S standard sieving series. Openings of these sieves are given in Table I.
- A shaking apparatus model "COMBS gyratory sifting machine", manufactured by Greet Western Mfg. Co., Kansas.

As indicated in Table II, the amount of particles < 500 μm constituted less than 0.23 % of the weight of the as received 50 % FeSi material. It was also found that this material was not friable (at least to handling in the laboratory). Therefore, the further tests recommended by the DOT should be performed in its commercial state.

Table I: Characteristics of sieves used to sift the Elkem's 50 % FeSi

Meshes to the inch	Opening (in)	Opening (mm)
3	0.263	6.680
4	0.185	4.699
6	0.131	3.327
8	0.093	2.362
10	0.065	1.651
14	0.046	1.168
20	0.0328	0.083
28	0.0232	0.589
Tyler equivalent 32*	0.0197	0.500*

Sieve taken from a US standard sieving series.

Table II: Size distribution of the as received Elkem's 50 % FeSi

	# Test 1		# Test 2		# Test 3		Average	
Screen Size	**Weight (g)**	**Wt %, retained**	**Weight (g)**	**Wt %, retained**	**Weight (g)**	**Wt %, retained**	**Weight (g)**	**Wt %, retained**
+3 M	11318.60	99.634	11319.38	99.642	11319.39	99.644	11319.12	99.640
-3 M+4 M	6.25	0.055	4.90	0.043	5.470	0.048	5.540	0.049
-4 M+6 M	0.67	0.006	1.25	0.011	0.660	0.006	0.860	0.008
-6 M+8 M	1.400	0.012	1.08	0.010	1.010	0.009	1.163	0.010
-8 M+10 M	1.19	0.010	1.38	0.012	1.470	0.013	1.347	0.012
-10 M+14 M	1.33	0.012	1.28	0.011	1.230	0.011	1.280	0.011
-14 M+20 M	1.53	0.013	1.45	0.013	1.470	0.013	1.483	0.013
-20 M+28 M	1.85	0.016	1.92	0.017	1.840	0.016	1.870	0.016
-28 M+32 M	1.25	0.011	1.24	0.011	1.290	0.011	1.260	0.011
-32 M*	**26.12**	**0.230**	**26.13**	**0.230**	**25.990**	**0.229**	**26.080**	**0.230**
Total	11360.19	100	11360.01	100	11359.82	100	11360.00	100

* < 500 μm

3. Tests to detect spontaneous ignition or gas evolution.

3. 1. Tests Procedure

The U.S. DOT 49 CFR 173, appendix E, division 4.3 specifies four different tests to determine whether the reaction of a material with water leads to the development of a dangerous amount of gases which may be flammable or toxic. The first three tests are described in terms indicated below:

Test (1): "A small quantity (approximately 2mm diameter) of the test material is placed in a trough of distilled water at 20 °C. It is noted whether any gas is evolved and if it spontaneously ignites."

Test (2): "A small quantity of the test material (approximately 2mm diameter) is placed in the center of a filter paper which is floated flat on the surface of distilled water at 20 °C in a 100 mm diameter evaporating dish. The filter paper is to keep the material in one place, under which condition the likelihood of spontaneous ignition of any gas is greatest. It is noted whether any gas is evolved and if it spontaneously ignites."

Test (3): "The test material is made into a pile approximately 2 cm high and 3 cm in diameter with an indentation in the top. A few drops of water are added to the hollow. It is noted whether any gas is evolved and if it spontaneously ignites."

3. 2. Results

3. 2. 1. Test (1)

Three samples of the as-received Elkem's 50 % FeSi material were submitted in triplicate to this test. They were put in a trough containing about 80 cm^3 of distilled water, during 20 minutes. The sample characteristics are the following:

Sample 1: A piece of about 2mm diameter taken from the + 3 Mesh fraction size.

Sample 2: A piece of about 2mm diameter taken from the - 3 Mesh to + 32 Mesh fraction size.

Sample 3: 0.5 gram of the powder from the – 32 Mesh fraction size.

Table III summarizes the results obtained during test (1). It shows that no spontaneous ignition or gas evolution occurred in this test condition.

Table III: Results of test (1)

Sample/Test	N° 1	N° 2	N° 3
Sample 1	N. S. I.* , N.G. E.**	N. S. I., N.G. E.	N. S. I., N.G. E.
Sample 2	N. S. I., N.G. E.	N. S. I., N.G. E.	N. S. I., N.G. E.
Sample 3	N. S. I., N.G. E.	N. S. I., N.G. E.	N. S. I., N.G. E.

* N. S. I.: No Spontaneous Ignition, ** N.G. E.: No Gas Evolution

3. 2. 2. Test (2)

Three samples of the as-received Elkem's 50 % FeSi material were submitted in triplicate to this test. These samples have the same characteristics as those described above for test (1). They were put on a filter paper floating on distilled water contained in a 10-cm diameter evaporating dish, during 20 minutes.

Table IV shows the results obtained during this test. It indicates that no spontaneous ignition or gas evolution occurred during the three tests.

Table IV: Results of test (2)

Sample/Test	N° 1	N° 2	N° 3
Sample 1	N. S. I.* , N.G. E.**	N. S. I., N.G. E.	N. S. I., N.G. E.
Sample 2	N. S. I., N.G. E.	N. S. I., N.G. E.	N. S. I., N.G. E.
Sample 3	N. S. I., N.G. E.	N. S. I., N.G. E.	N. S. I., N.G. E.

* N. S. I.: No Spontaneous Ignition, ** N.G. E.: No Gas Evolution

3. 2. 3. Test (3)

Two samples of the as-received Elkem's 50 % FeSi material were submitted in triplicate to this test. The sample characteristics were the following:

Sample 1: A piece of about 2 cm high and 3 cm large taken from the + 3 Mesh fraction size of the Elkem's 50 % FeSi material. A hollow of about 3-mm depth was drilled at the top of this piece. Then, some drops of water were added.

Sample 2: Some pieces of the Elkem's 50 % FeSi material were ground.to <80 µm The resulting powder was packed into a small refractory crucible of 2 cm high and 2 cm. A hollow of about 3-mm depth was made at the top of this pile. Then, some drops of water were added.

Table V groups the results obtained during Test (3). It shows that no spontaneous ignition or gas evolution occurred during the three tests.

Table V: Results of Test (3)

Sample/Test	N° 1	N° 2	N° 3
Sample 1	N. S. I.* , N.G. E.**	N. S. I., N.G. E.	N. S. I., N.G. E.
Sample 2	N. S. I., N.G. E.	N. S. I., N.G. E.	N. S. I., N.G. E.

* N. S. I.: No Spontaneous Ignition, ** N.G. E.: No Gas Evolution

3. 2. 4. Test (4)

Test (4): "Water is put into the dropping funnel and enough of the material (up to a maximum weight of 25 g) to produce between 100 cm^3 and 250 cm^3 of gas is weighed and placed in a conical flask. The tap of the dropping funnel is opened to let the water into the conical flask and a stop - watch is started. The volume of gas evolved is measured by any suitable means. The time taken for all the gas to be evolved is noted and, where possible, intermediate readings are taken. The rate of evolution of gas is calculated over seven hours at 1-hour intervals. If the rate of evolution is erratic or is increasing after 7 hours, the measuring time should be extended to a maximum time of 5 days. The 5 day test may be stopped if the rate of evolution becomes steady or continually decreases and sufficient data has been established to assign a packing group to the material or to determine that the material should not be classified in Division 4.3. If the chemical identity of the gas is unknown, the gas should be tested for flammability and toxicity."

The samples taken for this test weighed 25g of ground material. The experimental apparatus used to measure the volume of gas that could evolve from the 50 % FeSi consisted in a flask of 500 cm^3 connected to a U-tube having a 1/16-inch ID. This U-tube was filled with water colored by the addition of a small amount of red ink. From the results of previous tests the gas volume was expected to be very low or even equal to zero. So, the change of the liquid position in the U-tube, due to the variation of the pressure in the flask was expected to indicate us the gas volume evolved as function of the time.

As specified by the DOT 49 CFR 173, the 25 grams 50 % FeSi Material were put into contact with water in the flask. No ignition or gas evolution were observed. As reported in table VI no variation of the water height was noticed in the U-tube, from the beginning of the experiment through 7 hours. Hence, as recommended by DOT specifications, the measurements were stopped.

Table VI: Results of Test (4)

Time (hours)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Δh^* (mm)	0	0	0	0	0	0	0
Gas volume (mm^3)	0	0	0	0	0	0	0

* Variation of the colored water height in the U-tube.

3. 2. 5. Chemical analysis

A sample weighing about 200 grams was taken from the as received 11.4 kg Elkem's 50 % FeSi. This sample was ground and sieved to a powder of less than 80 micrometers. Then, four samples of five grams each were taken and sent to the MINTEK Laboratories, Randburg, South Africa (See Appendix I). The four samples were analyzed by emission spectroscopy to measure their Fe, Si, Al, Ca and Mg contents. Results are given below in Table VII and in Appendix I.

Table VII: Results of chemical analysis of Elkem's 50 % FeSi.

Sample	Si %	Fe %	Al %	Ca %	Mg %	Σ % *
1	50.5	47.9	0.65	< 0.2	< 0.1	99.35
2	50.2	47.7	0.62	< 0.2	< 0.1	98.82
3	50.7	47.6	0.61	< 0.2	< 0.1	99.21
4	50.1	47.6	0.62	< 0.2	< 0.1	98.62
Average	50.4	47.7	0.63	< 0.2	< 0.1	99.03

* Total assuming that Ca = 0.2 % and Mg = 0.1 %

4. Conclusion

Elkem's 50 % FeSi material was tested following the U.S. DOT method procedure, specified in the U.S. DOT 49 CFR 173, appendix E. Test results lead to the following conclusions:

The percentage of particles of less than 500 micrometers in the as-received material was 0.23 %,

No gas evolution or spontaneous ignition were observed when small quantity of Elkem 50 % FeSi is placed in a trough of distilled water at 20 °C,

No gas evolution or spontaneous ignition were observed when a small quantity of Elkem 50 % FeSi is placed in the center of a filter paper which is floated flat on the surface of distilled water at 20 °C,

No gas evolution or spontaneous ignition were observed when few drops of water were added at 20 °C into a hollow made in the top of a piece of Elkem 50 % FeSi,

No gas evolution could be measured or even detected when water was put in contact with a weight of 25 g of Elkem 50 % FeSi in a conical flask at 20 °C.

The chemical analysis of the Elkem 50 % FeSi give an average content of 50.4 % Si, 47.7% Fe, 0.63 %Al, less than 0.2 % Ca and less than 0.1 % of Mg.

APPENDIX I

TELEFAX MESSAGE

Analytical Science Division

MINTEK

Facsimile (011)-792-6650 (Local)
(2711)-792-6650 (Int'l)
Telephone (011)-709-4111
Private Bag X3015, Randburg,
2125 South Africa

Faksimilee (011)-793-2413 (Plaas)
(2711)-792-6650 (Int'l)
Telefoon (011)-709-4111
Privaatsak X3015, Randburg,
2125 Suid-Afrika

Date: 97/09/25

To: UNIVERSITY OF MISSORI - ROLLA Fax No: 091 (573) 341 6934

For attention: DAVID ROBERTSON

Please find attached results for the ferrosilicon samples submitted for analysis.

Please acknowledge receipt of this fax.

Kind regards
Sheena Maharaj

Sheet No. / Staat Nr. K739

Project No. / Projek Nr. 131 89701

MINTEK
Specialists in mineral and metallurgical technology

Section / Seksie: EMISSION SPECTROSCOPY / EMISSIE-SPEKTROSKOPIE

Report No. / Verslag Nr. S 002819 C

ATT: DAVID ROBERTSON

Technique/Plate No. / Tegniek/Plaat Nr. SF002 — as received

Results reported in / Resultate gerapporteer in: %

Date started / Datum begin: 97/09/01

Date reported / Datum gerapporteer: 97/09/22

	Mg	Al		Ca	Fe									
1	<0.1	0.65		<0.2	47.9									
2	↓	0.62		↓	47.7									
3	↓	0.62 / 0.59		↓	47.6 / 47.6									
4	↓	0.62		↓	47.6									
5														
6														
7														
8														
9														
10														
sample/Verw. monster: A167					50.1									
value/Aanv. waarde					50.05									
sample/Verw. monster														
value/Aanv. waarde														

Analyst / Analis
1. S. Marland
2. [signature]

Time / Tyd
1. ....Hrs/uur
2. ....Hrs/uur

No of determinations / Getal bepalings: 20

Total time: Hrs / Totale Tyd: uur

Checked by / Nagesien deur: [signature]

Approved by / Goedgekeur deur: Maharaj

Worksheet no. / Werkstaat nr. AK739 ATT DAVID ROBERTSON

MINTEK

Group— CHEMISTRY

Report No. C 012934

Results reported in / Resultate gerapporteer in %

Project / Projek 13189701

Date received / Datum begin 97/9/01 23

Date reported / Datum gerapporteer 97/9/23

Checked by / Nagesien deur RJ

Sample / Monster	Si													COMMENTS/OPMERKINGS
1	49,8	50,3												
2	50,2													
3	50,7													ANALYSIS CARRIED OUT
4	50,1													~~ON SAMPLES AS RECEIVED~~
5														
6														
7														
8														
9														
10														
Technique / Tegniek														
Lab method / Lab metode	W64													

Analyst / Analis

1 A. VAN LIENDEN

2

3

4

Time / Tyd h

1

2

3

4

Total time / Totale tyd

No. of determinations / Aantal bepalings

Ref. sample / Verwysingsmonster	Constituent / Bestanddeel	Results / Resultate	Acc. value / Aanv. waarde
A167	Si	48,07	48,1

Approved / Goedgekeur Maharaj

MINTEK 66/C