TC 65

International Standard 4299

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Manganese ores — Determination of moisture content

Minerais de manganèse — Détermination de l'humidité

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4299 was developed by Technical Committee ISO/TC 65, *Manganese and chromium ores*, and was circulated to the member bodies in November 1978.

It has been approved by the member bodies of the following countries :

Australia	Hungary	South Africa, Rep. of
Austria	India	Thailand
Brazil	Italy	Turkey
Bulgaria	Japan	United Kingdom
Czechoslovakia	Korea, Rep. of	USSR
Egypt, Arab Rep. of	Poland	*Yugoslavia*
France	Portugal	
Germany, F. R.	Romania	

No member body expressed disapproval of the document.

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Manganese ores — Determination of moisture content

1 Scope and field of application

This International Standard specifies a method of determining the moisture content of manganese ores, whether natural or processed and including concentrates, pellets and agglomerates.

The method shall be applied at the places of dispatch and/or acceptance of the ores.

2 Definition

For the purpose of this International Standard the following definition applies :

moisture sample : The sample taken for the determination of the moisture content of the consignment or part of the consignment.

3 Principle

Drying of a final moisture sample in an oven at 105 ± 5 °C and determination of the moisture content, as a percentage by mass, from the initial and dried masses.

4 Apparatus

4.1 Pans, made of stainless material (for example, stainless steel or brass), having a smooth surface, free from contamination and capable of accommodating the specified quantity of moisture sample in a layer of less than 30 mm thickness.

4.2 Drying oven, equipped with a temperature controlling device capable of regulating the temperature in the oven to within ± 5 °C.

4.3 Weighing device, having a sensitivity better than 0,05 % and an accuracy which will allow repeatability of the moisture determination at the precision required in clause 8.

5 Sampling[1)]

5.1 After crushing to minus 22,4 mm in size, take a final moisture sample of 5 kg or more.

If no bias due to the loss of moisture during crushing from minus 22,4 mm to minus 10 mm is confirmed by check experiments, a final moisture sample of not less than 1 kg may be obtained by so crushing the sample.

5.2 If one gross sample is obtained from the consignment, four final moisture samples shall be prepared. Two of these shall be submitted for the determination of moisture content and the other two samples shall be reserved as duplicates in case a check determination is required.

5.3 If sub-samples from a consignment are not combined into one gross sample, one final moisture sample shall be prepared from each sub-sample, and each of these shall be submitted for the determination of moisture content.

NOTE — Samples which have been sieved in water for size determination shall not be used for determination of moisture content.

6 Procedure

NOTE — The moisture content of sticky or wet ores shall be determined by the method specified in annex A unless the mass of the sample is not large, in which case the entire mass of the sample may be dried to determine the moisture content by the following procedure.

6.1 Weigh a drying pan (4.1) and record its mass.

6.2 Spread the final moisture sample, prepared as described in clause 5, to a thickness of less than 30 mm in the tared drying pan and weigh. Record the total mass, the mass of the drying pan, the initial mass of the sample and the numerical value of 0,05 % of the initial mass of the sample (see annex B, clause B.2).

1) Sampling of manganese ores will be the subject of a future International Standard.

6.3 Place the drying pan and sample in the drying oven (4.2) at 105 ± 5 °C and maintain at this temperature for not less than 4 h. After the first hour of drying, mix the sample with a metal spatula, ensuring that no material is removed when the spatula is withdrawn.

6.4 Remove the drying pan and sample from the oven and weigh immediately while still hot.

NOTE — The weighing device (4.3) should be protected from the effects of the hot material by an asbestos plate or other suitable heat-resisting material.

6.5 Replace the drying pan and sample in the oven, heat for 1 h, and repeat the weighing.

6.6 Repeat the procedure described in 6.4, until the difference in masses between subsequent determinations becomes less than or equal to 0,05 % of the initial mass of the sample. If, after repeated drying, the mass increases, the mass measured before the last weighing shall be used.

7 Expression of results

7.1 Moisture content of each final moisture sample

The moisture content, M_i, expressed as a percentage by mass, is given by the formula

$$M_i = \frac{m_1 - m_2}{m_1} \times 100$$

where

m_1 is the initial mass, in grams, of the sample;

m_2 is the mass, in grams, of the sample after drying.

Report the moisture content to the second decimal place.

7.2 Moisture content of the consignment

The moisture content of the consignment or lot, M, expressed as a percentage by mass, shall be calculated as follows and reported to the second decimal place :

a) *when the determination of moisture content is conducted on a gross sample from the consignment or lot*, from the arithmetic mean of the two results obtained from the two moisture samples as given by the formula

$$M = \frac{M_1 + M_2}{2}$$

where M_1 and M_2 are, respectively, the moisture contents, expressed as percentages by mass, of moisture samples 1 and 2.

b) *when the determination of moisture content is conducted on each sub-sample,* from the weighted mean of the results for all sub-samples, considering the number of increments in each sub-sample as given by the formula

$$M = \frac{\sum_{i=1}^{k} N_i M_i}{\sum_{i=1}^{k} N_i}$$

where

k is the number of sub-samples;

N_i is the number of increments in the i-th sub-sample;

M_i is the moisture content, expressed as a percentage by mass, of the i-th sub-sample.

NOTE — If it is impracticable to sample the consignment or lot as a whole or desirable to sample a consignment or lot in separate parts of unequal mass, the moisture content of each part should be determined independently and the weighted mean moisture content of the consignment or lot calculated from the individual results using the formula

$$M = \frac{\sum_{i=1}^{k} m_i M_i}{\sum_{i=1}^{k} m_i}$$

where

k is the number of parts in the consignment or lot;

m_i is the mass of the i-th part;

M_i is the moisture content, expressed as a percentage by mass, of the i-th part.

c) *when the determination of moisture content is conducted on each increment*, from the arithmetic mean of the results obtained as described in 7.1 for all increments, as given by the formula

$$M = \frac{\sum_{i=1}^{n} M_i}{n}$$

where

n is the number of increments;

M_i is the moisture content, expressed as a percentage by mass, of the i-th increment.

8 Precision

The following precision requirements relate to the precision in determining the values of moisture content in a final moisture

sample when moisture determinations are made in the same laboratory. The method is designed so as to obtain the values of precision, with 95 % probability, shown in the following table.

Table — Precision and maximum permissible tolerance between results of duplicate determinations

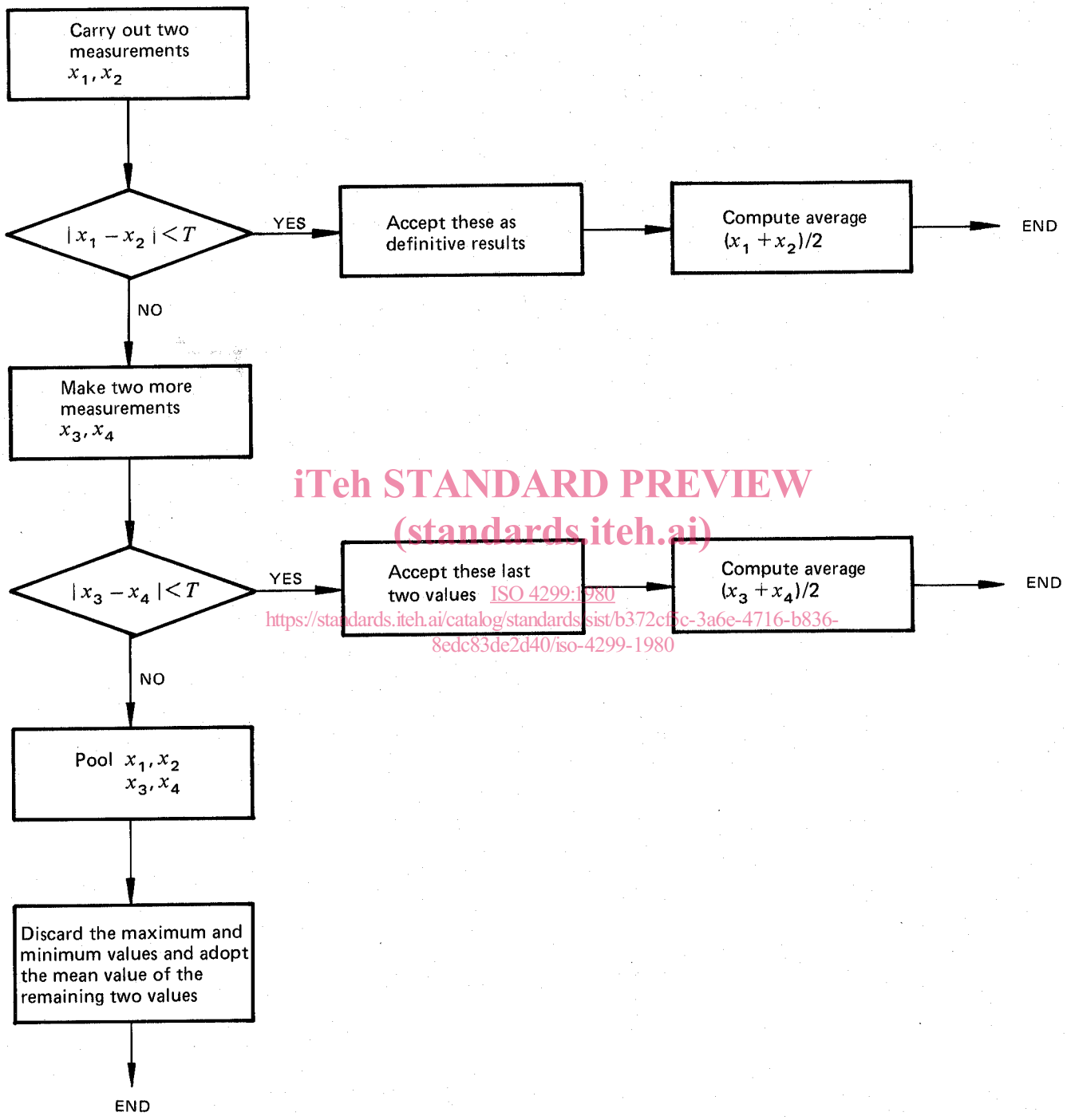
Moisture content (%)		Precision (absolute %)	Maximum permissible tolerance (absolute %)
>	⩽		
–	5	± 0,4	0,5
5	10	± 0,5	0,7
10	15	± 0,7	1,0
15	–	± 0,8	1,2

If the values of precision and maximum tolerance obtained exceed those given in the table, the moisture determination shall be repeated.

NOTE — When two duplicate determinations are carried out, the final result shall be obtained as shown in the flow chart.

9 Test report

Examples of suitable test reports are given in annex B.



Flow chart — Procedures for processing the results of moisture determinations

NOTE — T is the maximum permissible tolerance given in the table.

Annex A

Determination of moisture content of wet manganese ores

A.1 If the sample is difficult to sieve, crush and divide owing to it being sticky or very wet, it should be pre-dried until preparation can be conducted satisfactorily.

In this case, the pre-drying moisture content shall be determined by the following procedure.

A.1.1 Determine the initial mass of the sample, spread it to a uniform thickness and dry by air-drying or in a drying apparatus at not more than 105 °C. After drying, again determine the mass of the sample.

A.1.2 Calculate the pre-drying moisture content, M_p, expressed as a percentage by mass, from the formula

$$M_p = \frac{m'_1 - m'_2}{m'_1} \times 100$$

where

m'_1 is the initial mass, in grams, of the sample;

m'_2 is the mass, in grams, of the sample after drying.

Record the pre-drying moisture content to the second decimal place.

A.2 Prepare the final moisture sample from the pre-dried sample by the method specified in clause 5. Determine the loss of mass on drying of the final moisture sample by the method specified in clause 6 and calculate the moisture content as specified in 7.1.

A.3 Calculate the total, as-received moisture content, M, expressed as a percentage by mass, from the formula

$$M = M_p + \frac{100 - M_p}{100} \times M_i$$

where

M_p is the pre-drying moisture content, expressed as a percentage by mass, calculated as specified in A.1.2;

M_i is the moisture content, expressed as a percentage by mass, calculated as specified in 7.1.

A.4 Calculate the moisture content of the consignment, expressed as a percentage by mass, as specified in 7.2.

Annex B

Test reports

B.0 Introduction

The test report shall be adapted according to the method of sampling and the method of calculation. Examples of suitable reports are given in clauses B.1, B.2 and B.3.

B.1 Example of a test report for determination of the moisture content of each sample

Type and grade of manganese ore :				
Identity and quality of consignment :				
Sample No. :	Mass of sample : 5 kg	Particle size of sample : − 22,4 mm		Date :
Total mass before drying (g)		(1)		6 021
Mass of drying pan (g)		(2)		896
Initial mass of sample (g)		(3) = (1) − (2)		5 125
Value of 0,05 % of initial mass of sample (g)		$(4) = \frac{(3)}{2\,000}$		2,56
			mass	**difference***
Total mass after 4 h drying (g)		(5)	5 592	
Total mass after 1 h drying (g)		(6)	5 583	(5) − (6) = 9
Total mass after another 1 h drying (g)		(7)	5 581	(6) − (7) = 2
Final loss on drying (g)		(8) = (1) − (7)		440
Moisture content (M_i) (%)		$(9) = \frac{(8)}{(3)} \times 100$		8,59
Remarks :				
Assayer :				

* The difference (5) − (6) was 9 g and exceeded (4), so another 1 h drying was conducted. The difference (6) − (7) became 2 g and was less than (4). Therefore, the drying of this sample was terminated.

B.2 Example of a test report for determination of the moisture content of a gross sample

(Duplicate determinations)

Type and grade of manganese ore :							
Identity and quality of consignment :							
Sample No. :	Mass of sample : 1 kg		Particle size of sample : − 10 mm			Date :	
Total mass before drying (g)		(1)	1 228,4			1 220,9	
Mass of drying pan (g)		(2)	204,1			196,0	
Initial mass of sample (g)		(3) = (1) − (2)	1 024,3			1 024,9	
Value of 0,05 % of initial mass of sample (g)		$(4) = \frac{(3)}{2\,000}$	0,51			0,51	
			mass	**difference**		**mass**	**difference**
Total mass after 4 h drying (g)		(5)	1 169,6			1 167,0	
Total mass after 1 h drying (g)		(6)	1 161,9	(5) − (6) = 7,7		1 158,6	(5) − (6) = 8,4
Total mass after another 1 h drying (g)		(7)	1 161,7	(6) − (7) = 0,2		1 158,3	(6) − (7) = 0,3
Final loss on drying (g)		(8) = (1) − (7)	66,7			62,6	
Moisture content of each sample (%)		$(9) = \frac{(8)}{(3)} \times 100$	6,51			6,11	
Difference between two determinations (%)			0,4				
Maximum permissible tolerance (%)			0,7				
Moisture content (%)			6,31				
Remarks :							
Assayer :							

B.3 Example of a test report for determination of the moisture content of a consignment

Sample No. :					Mass of sample : 5 kg			Particle size of sample : − 22,4 mm	
Date :		Type and grade of manganese ores :			Name of consignment :			Assayer :	
Sub-sample No.	(1) No. of increments	(2) Total mass before drying (g)	(3) Total mass after drying (g)	(4) Mass of drying pan (g)	(5) Initial mass of sample (g)	(6) Mass of dried sample (g)	(7) Loss on drying (g)	(8) Moisture content (M_i) (%)	(9) (1) × (8)
1	6	1 344,8	1 306,1	236,1	1 108,7	1 070,0	38,7	3,49	20,94
2	6	1 369,3	1 340,4	270,0	1 099,3	1 070,4	28,9	2,62	15,72
3	6	1 335,5	1 299,4	253,0	1 082,5	1 046,4	36,1	3,33	19,98
4	5	1 395,8	1 356,5	249,3	1 146,5	1 107,2	39,3	3,43	17,15
5	5	1 387,4	1 359,4	264,6	1 122,8	1 094,8	28,0	2,49	12,45
Total	28	Moisture content (M) (%) $= \frac{\Sigma\,(9)}{\Sigma\,(1)} = \frac{86,24}{28} = 3,08$							86,24

Final result : 3,08 %