



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS M 8108 : 2008

(JFA/JSA)

**Chromium, manganese and
ferruginous manganese ores—
Sampling, sample preparation and
determination of moisture content
and size distribution**

ICS 73.060.20; 73.060.30

Reference number : JIS M 8108 : 2008 (E)

PROTECTED BY COPYRIGHT

Date of Establishment: 1962-08-01

Date of Revision: 2008-10-20

Date of Public Notice in Official Gazette: 2008-10-20

Investigated by: Japanese Industrial Standards Committee
Standards Board
Technical Committee on Iron and Steel

JIS M 8108:2008, First English edition published in 2009-06

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

© JSA 2009

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

PROTECTED BY COPYRIGHT

Contents

	Page
Introduction.....	1
1 Scope.....	1
2 Normative references	2
3 Terms and definitions	2
4 General matters	4
4.1 Summary of sampling and sample preparation	4
4.2 Insurance of safety and preservation of working environment	6
4.3 Handling of sample	6
4.4 Values of average qualities for characteristics of lot.....	7
4.5 Rounding off of numerical values	7
4.6 Other matters	8
5 Sampling methods	8
5.1 Fundamental matters	8
5.2 Overall precision (β_{SDM})	8
5.3 Classification of magnitude of quality variations	10
5.4 Minimum mass of increment	10
5.5 Number of increments	11
5.6 Sampling methods of increments	14
5.7 Manual sampling methods	15
5.8 Mechanical sampling method	17
5.9 Instruments and equipment for sampling and sample preparation	19
6 Sample preparation methods	22
6.1 Preparation of sample.....	22
6.2 Precision of reduction	23
6.3 Arranging method of sample	23
6.4 Crushing of samples.....	26
6.5 Type of reduction	26
6.6 Methods of reduction	27
6.7 Preparation of moisture content test sample	34
6.8 Preparation of particle size test sample	34
6.9 Preparation of composition test sample	35
7 Moisture content determination.....	35
7.1 Summary.....	35
7.2 Measurement precision of moisture content	35
7.3 Sample.....	35
7.4 Apparatus	35

7.5	Operation	36
7.6	Calculation	36
7.7	Tolerance	37
7.8	Representation of results	37
8	Particle size determination method	38
8.1	Summary	38
8.2	Measurement precision of particle size	38
8.3	Sample	38
8.4	Apparatus	39
8.5	Operation	40
8.6	Calculation	41
8.7	Representation of results	42
Annex A (normative)	Experimental method of quality variation investigation and estimating method of sampling precision	43
Annex B (normative)	Experiment for checking sample reduction precision	56
Annex C (normative)	Experimental methods for checking biases of sampling and sample preparation	61
Annex D (normative)	Experimental methods for checking precision for moisture content determination	70
Annex E (normative)	Theoretical formula for obtaining number of increments	75
Annex F (normative)	Method of moisture content determination of a lot sprinkled with water or exposed to precipitation	78
Annex JA (informative)	Method of hatch sampling	81
Annex JB (informative)	Comparison table between JIS and corresponding International Standards	83

Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Ferroalloy Association (JFA)/ Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS M 8108: 1992** is replaced with this Standard.

This **JIS** document is protected by the Copyright Law.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

Chromium, manganese and ferruginous manganese ores—Sampling, sample preparation and determination of moisture content and size distribution

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 4296-1**:1984, **ISO 4296-2**:1983, **ISO 4299**:1989, **ISO 6153**:1989, **ISO 6154**:1989, **ISO 6230**:1989, **ISO 8530**:1986, **ISO 8531**:1986, **ISO 8541**:1986 and **ISO 8542**:1986 with some modifications of the technical contents.

For Annexes of this Standard, Annex A is prepared based on **ISO 8542**, Annex B on **ISO 8530**, Annex C on **ISO 8541**, Annex D on **ISO 8531**, Annex E on a part of **ISO 6153** and a part of **ISO 4296-1** and Annex F on **ISO 4299** Annex B. The portions given sidelines or dotted underlines and Annex JA are the matters in which the contents of the corresponding International Standards have been modified. A list of modifications with the explanations is given in Annex JB.

1 Scope

This Standard specifies the sampling method, sample preparation method, moisture determination method, and particle size determination method to determine the average qualities of chromium ores, manganese ores and ferruginous manganese ores (hereafter referred to as “ores”) of one lot.

NOTE : The International Standards corresponding to this Standard are as follows.

ISO 4296-1:1984 *Manganese ores—Sampling—Part 1: Increment sampling*

ISO 4296-2:1983 *Manganese ores—Sampling—Part 2: Preparation of samples*

ISO 4299:1989 *Manganese ores—Determination of moisture content*

ISO 6153:1989 *Chromium ores—Increment sampling*

ISO 6154:1989 *Chromium ores—Preparation of samples*

ISO 6230:1989 *Manganese ores—Determination of size distribution by sieving*

ISO 8530:1986 *Manganese and chromium ores—Experimental methods for checking the precision of sample division*

ISO 8531:1986 *Manganese and chromium ores—Experimental methods for checking the precision of moisture determination*

ISO 8541:1986 *Manganese and chromium ores—Experimental methods for checking the bias of sampling and sample preparation*

ISO 8542:1986 *Manganese and chromium ores—Experimental methods for evaluation of quality variation and methods for checking the precision of sampling*

(Overall evaluation: MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS M 8100	<i>Particulate materials—General rules for methods of sampling</i>
JIS Z 8401	<i>Guide to the rounding of numbers</i>
JIS Z 8402-1	<i>Accuracy (trueness and precision) of measurement methods and results—Part 1: General principles and definitions</i>
JIS Z 8801-1	<i>Test sieves—Part 1: Test sieves of metal wire cloth</i>
JIS Z 8801-2	<i>Test sieves—Part 2: Test sieves of perforated metal plate</i>
JIS Z 9041-2	<i>Statistical interpretation of data—Part 2: Techniques of estimation and test relating to means and variances</i>

3 Terms and definitions

For the purposes of this Standard, the definitions given in **JIS M 8100** and the following definitions apply.

3.1 increment sampling

the method in which the sample consisting of the required number of increments for obtaining the prescribed precision regarding the lot characteristics is taken from the lot

3.2 manual sampling

the method in which the sample consisting of the specified quantity and the number of increments is sampled from a lot using a sampling device such as a scoop capable of being operated manually

3.3 mechanical sampling

the method in which the sample consisting of the specified quantity and number of increments is sampled from a lot using a sampling device capable of being operated mechanically

3.4 subsample

the sample consisting of several increments or that collected after several increments has been prepared individually, as required

3.5 gross sample

the sample which is the aggregation of the whole increments or the whole subsamples sampled from the lot, or the sample which is the aggregation of each increment or each subsample after preparation, as required, for the purpose of obtaining the average quality of the lot

3.6 whole-through sieve size

the particle size expressed in apertures of a sieve through which whole sample passes

3.7 particle size

at the final stage of a screening operation, the size of particles expressed in terms of the sieve apertures being determined whether a part of the sample remains on the sieve or passes through the sieve

3.8 particle size range

the width of particle sizes of the sample or the lot expressed in respective apertures of a pair of sieves

3.9 particle size fraction

a portion of the sample separated by a pair of sieves of x mm and y mm ($x > y$) in aperture

The portion shall be expressed in the ratio [% (mass fraction)] of the amount of $-x$ mm $+y$ mm to the amount of the particle size test sample as to be the particle size fraction yield.

3.10 particle size distribution

the relative frequency of successive particle size fraction yield over the entire particle size range of the sample or the lot

3.11 oversize fraction

a portion of a particle size test sample remaining on the sieve of x mm in aperture indicated by $+x$ mm

This shall be expressed in the ratio [% (mass fraction)] of the amount to the amount of the particle size test sample.

3.12 undersize fraction

a portion of a particle size test sample passing through the sieve of y mm in aperture indicated by $-y$ mm

This shall be expressed in the ratio [% (mass fraction)] of the amount to the amount of the particle size test sample.

3.13 variation within stratum

the quality variation between increments in the ore of partitioned specific mass expressed in the standard deviation σ_w

In a two-stage sampling, it means the quality variation within a truck or a freight car.

3.14 variation between strata

the quality variation between mutual ores of partitioned specific mass expressed in the standard deviation σ_b

In a two-stage sampling, it means the quality variation between trucks or freight cars.

3.15 overall precision (β_{SDM})

the combined precision of sampling, sample preparation and measurement, which is twice of the overall standard deviation (σ_{SDM})

4 General matters

4.1 Summary of sampling and sample preparation

The summary of sampling and sample preparation shall be in accordance with the following.

The summary from **a)** to **j)** shall be given in figure 1 and figure 2.

- a) Determination of an objective lot.
 - b) Determination of the value of the maximum particle size of a lot.
 - c) Determination of the mass of an increment.
 - d) Determination of the classification of sizes of quality variation of a lot.
 - e) Determination of the minimum necessary number of increments.
 - f) Determination of sampling interval of increments or selection interval of primary sampling units.
 - g) Sampling of increments being determined from **c)** to **e)** by a systematic sampling or a two-stage sampling in accordance with **f)** from the selected positions.
 - h) Selection of the arranging method of increments and determination of the manufacturing method of several subsamples or one gross sample.
 - i) Determination of the systems of combined use and dual use of the sample.
 - j) Determination of the total process of preparation and distribution of moisture content test sample, particle size test sample and composition test sample.
- NOTE : Prior to the operations of sampling and sample preparation, it should be preferable to prepare a concrete flow sheet on each brand of ore at each place of business.
- k) Preparation of moisture content test sample, particle size test sample and composition test sample in accordance with **j)**.

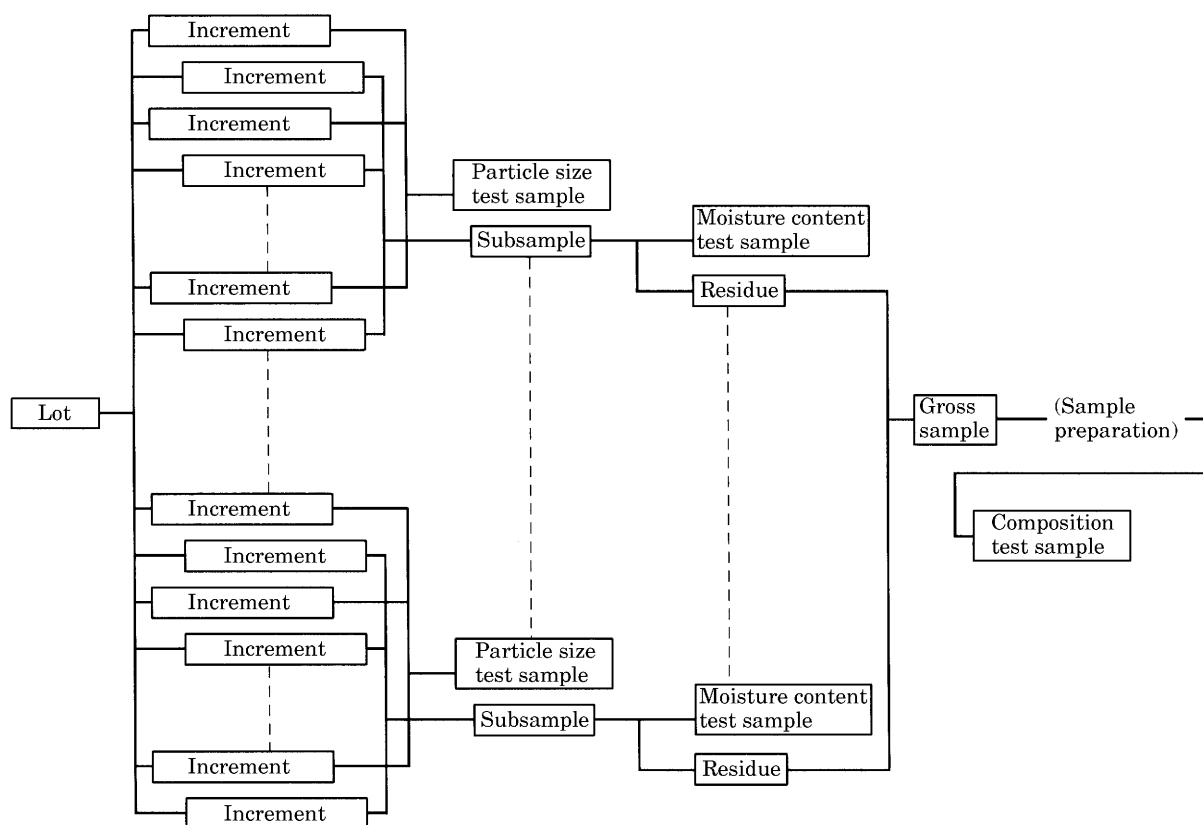


**Figure 1 Summarized diagram of sampling and sample preparation
(An example of systematic sampling)**

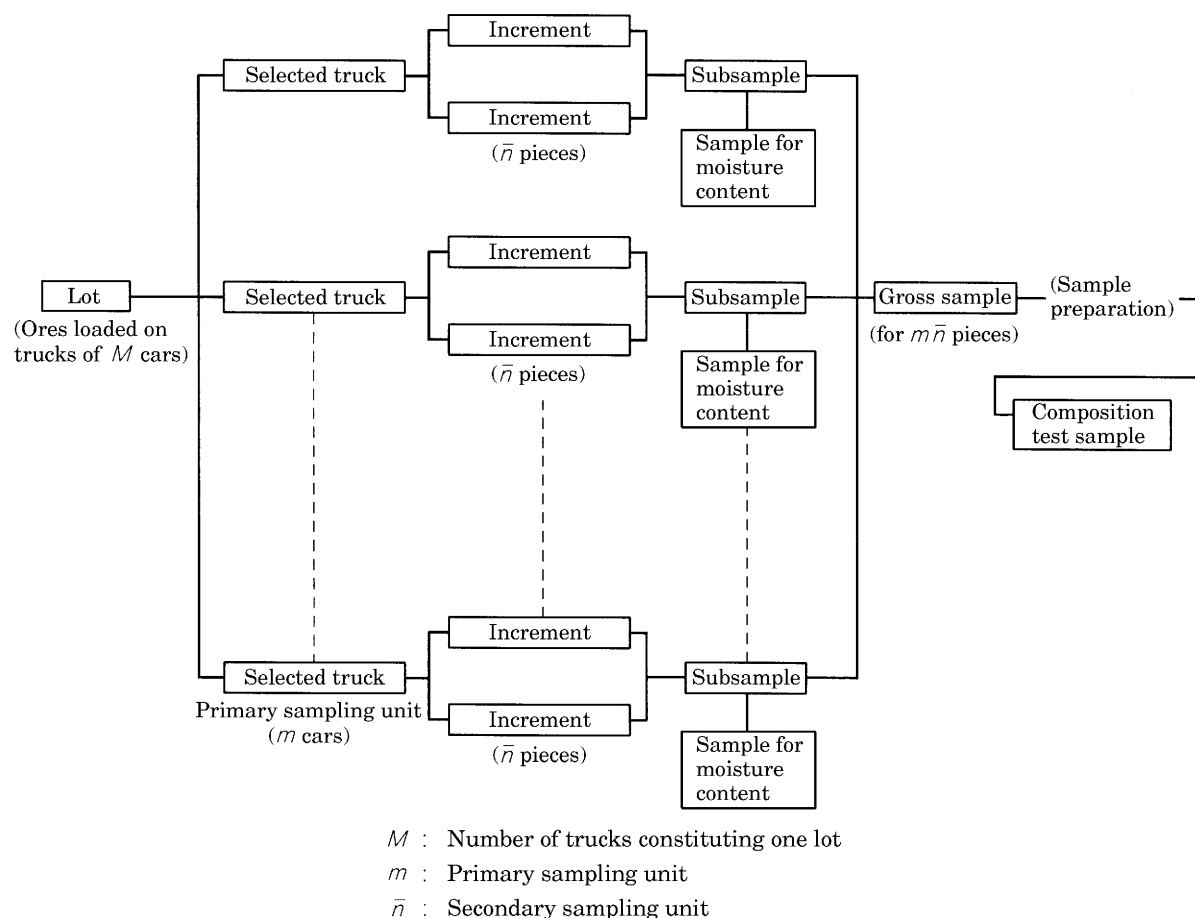


**Figure 2 Summarized diagram of sampling and sample preparation
(An example of two-stage sampling)**

4.2 Insurance of safety and preservation of working environment

Throughout the sampling, preparation of sample and test process, the safety of workers shall be ensured and the working environment shall be preserved.

The safety standards in the running and inspection of the mechanical sampling device and mechanical screening device shall be in accordance with the prescriptions of each place of business.

4.3 Handling of sample

4.3.1 Sample container

The sample container shall be in accordance with the following.

- a) The container to be used for the purposes of the transportation, preservation, etc. of each kind of sample shall be those which are capable of containing the whole volume of the sample, clean and robust, as well as being covered or sealed securely.
- b) Particularly the container of the sample for moisture content shall be airtight and made of the material that is moisture absorption free, and its inner surfaces shall be required to be free from generation of rust and the like.

4.3.2 Package and marking of composition test sample

The composition test sample shall be sent or stored by being tightly sealed in a sample container. The package shall be marked with the following information.

- a) Name of article and name of lot
- b) Name of sample or symbol
- c) Dates of sampling and sample preparation
- d) Name of place of business of sampling and sample preparation
- e) Name of person in charge of sampling and sample preparation

4.3.3 Preservation of sample

The preservation of sample shall be in accordance with the following.

- a) The composition test sample, after preparation and sealing, shall generally be preserved for three months for domestic transactions and for six months for export and import transactions.
- b) For the preserving place of the sample, the place where free from influences of temperature, humidity, direct rays of the sun, etc. shall be selected.

NOTE : In preservation, it shall be sealed tightly, and when the sample is particularly liable to be oxidized, care shall be taken to concern the material of the containers.

4.3.4 Sending of sample

The samples other than composition test sample shall generally be not sent. When these are to be sent inevitably, its method shall be as agreed upon between the purchaser and the supplier.

NOTE : Throughout the sampling, preparation of samples and tests, such measures as to cleanse the machines to be used sufficiently shall be carried out, and care shall be taken so as to prevent the samples from the mingling of foreign substances and the loss thereof, and keep the properties of samples unchanged. In the case where the samples are taken by a mechanical sampling device, sufficient care shall be taken so that the sample for moisture content may not cause any change in a moisture content, and the sample for particle size may not cause any change in particle size distribution due to the collapse of the ore and the like.

4.4 Values of average qualities for characteristics of lot

For the moisture content and particle size of a lot, numerical values obtained in accordance with the methods specified in clause 7 and clause 8 respectively, and for the chemical composition, those obtained in accordance with the analytical method of JIS, shall be the values of average qualities of the respective characteristics of the lot.

4.5 Rounding off of numerical values

The rounding-off of numerical values shall be in accordance with JIS Z 8401.

4.6 Other matters

In the case where part of the prescriptions of this Standard is considered to be difficult to apply, the method as agreed between the purchaser and the supplier may be substituted for the prescription. However, in this case, the precisions and biases shall have been checked in advance by the methods of Annex A to Annex D.

5 Sampling methods

5.1 Fundamental matters

The fundamental matters shall be in accordance with the following.

- a) The sampling shall be executed during transferring of the ores.
- b) The sampling shall be executed in accordance with the increment sampling method.
- c) The mass of increment shall be determined according to the maximum particle size of the lot.
- d) The number of increments to be sampled from one lot shall be determined according to the sections of the size of lot, classification of the magnitudes of quality variation of ores, and the prescribed sampling precisions.
- e) In the case where the particle size measurement of a lot is carried out, the sample for particle size shall generally be sampled separately from other samples.
- f) Each kind of sampling method shall be confirmed that no bias is included in accordance with Annex C.

5.2 Overall precision (β_{SDM})

The overall precision of chromium oxide content in chromium ores, moisture content and particle size corresponding to the mass of a lot shall be in accordance with table 1. Also, the overall precision of manganese content in manganese ores and ferrous manganese ores, moisture content and particle size corresponding to the mass of a lot shall be in accordance with table 2.

Higher precision may be adopted upon the agreement between the purchaser and the supplier, the case of which shall be in accordance with Annex 5 of **JIS M 8100**.

Table 1 Overall precisions for chromium ores (β_{SDM})

Unit: % (mass fraction)

Mass of lot (t)		Chromium oxide content	Moisture content	Particle size Under sieve content (-10 mm)
Over	Or under			
30 000	45 000	0.61	0.39	3.3
15 000	30 000	0.64	0.43	3.7
5 000	15 000	0.65	0.44	3.9
2 000	5 000	0.67	0.47	4.2
1 000	2 000	0.75	0.59	5.5
500	1 000	0.80	0.64	6.0
	500	0.85	0.70	6.7

NOTE 1 As regards $\beta_{SDM} = 2\sqrt{\sigma_w^2/n + \sigma_D^2 + \sigma_M^2/2}$ of chromium oxide content, $\sigma_D = 0.25$ % (mass fraction) and $\sigma_M = 0.10$ % (mass fraction) have been applied.

NOTE 2 As regards $\beta_{SDM} = 2\sqrt{\sigma_w^2/n + \sigma_{DM}^2/2}$ of moisture content, $\sigma_{DM} = 0.15$ % (mass fraction) has been applied.

NOTE 3 As regards $\beta_{SDM} = 2\sqrt{\sigma_{wDM}^2/n}$ of particle size, $\sigma_{wDM} = 15.0$ % (mass fraction) (-10 mm) has been applied.

where, β_{SDM} : overall precision expressed by confidence section
 σ_w : variation within stratum expressed by standard deviation
 σ_D : reduced precision expressed by standard deviation
 σ_M : measuring precision expressed by standard deviation
 σ_{DM} : reduction and measuring precision expressed by standard deviation
 σ_{wDM} : reduction and measuring precision within stratum expressed by standard deviation

Table 2 Overall precisions for manganese ores and ferruginous manganese ores (β_{SDM})

Unit: % (mass fraction)

Mass of lot (t)		Manganese content	Moisture content	Particle size Under sieve content (-10 mm)
Over	Or under			
45 000	60 000	0.60	0.40	2.2
30 000	45 000	0.62	0.41	2.3
15 000	30 000	0.64	0.42	2.4
5 000	15 000	0.65	0.44	2.6
2 000	5 000	0.67	0.47	2.8
1 000	2 000	0.69	0.50	3.0
500	1 000	0.75	0.58	3.6
	500	0.88	0.74	4.7

NOTE 1 As regards $\beta_{SDM} = 2\sqrt{\sigma_w^2/n + \sigma_D^2 + \sigma_M^2/2}$ of manganese content, $\sigma_D = 0.25$ % (mass fraction) and $\sigma_M = 0.10$ % (mass fraction) have been applied.

NOTE 2 As regards $\beta_{SDM} = 2\sqrt{\sigma_w^2/n + \sigma_{DM}^2/2}$ of moisture content, $\sigma_{DM} = 0.15$ % (mass fraction) has been applied.

NOTE 3 As regards $\beta_{SDM} = 2\sqrt{\sigma_{wDM}^2/n}$ of particle size, $\sigma_{wDM} = 15.0$ % (mass fraction) (-10 mm) has been applied.

5.3 Classification of magnitude of quality variations

The classification of magnitude of quality variations shall be in accordance with the following.

- a) The quality variation of ore (in the systematic sampling, it is expressed by σ_w , and in the two-stage sampling, by σ_b and σ_w) shall be obtained by taking composition and moisture content as the characteristics both for chromium ore and manganese ore.
- b) For each brand or brand group of ores, the estimated values of its quality variations shall be obtained in accordance with Annex A and be classified into the magnitude (large, medium and small) of quality variations specified in table 3. To the magnitude of the quality variations of ferruginous manganese ore, the medium of the standard deviations on manganese ore applies.
- c) For the brand of ore of which estimated values relating to quality variations have not been obtained, it shall be classified into the largest one in magnitude. In this case, it should be preferable to obtain the magnitude of quality variation by carrying out investigation in accordance with Annex A.
- d) As regards the magnitude of quality variations of ores, these shall be checked periodically, and when these have changed remarkably, the classification of magnitude thereof shall be as agreed between the purchaser and the supplier.
- e) In the case where a sample is used in combination or dually, it shall be in accordance with the classification of magnitude of quality variations whichever larger one determined among the characteristics of each ore.

Table 3 Classification of magnitude of quality variations

Unit: % (mass fraction)

Kind of ore	Characteristics	Standard deviations on characteristics (σ_w and σ_b)		
		Large	Medium	Small
Chromium ore	Chromium oxide content	$\sigma \geq 1.0$	—	$\sigma < 1.0$
	Moisture content			
Manganese ore	Manganese content	$\sigma \geq 2.0$	$2.0 > \sigma \geq 1.0$	$\sigma < 1.0$
	Moisture content			

5.4 Minimum mass of increment

The minimum mass of each increment shall be specified in table 4 according to the maximum particle size of a lot.

Table 4 Minimum mass of increment of each ore

Unit: kg

Maximum particle size mm		Minimum necessary number of increments		
		Chromium ore	Manganese ore	Ferruginous manganese ore
Over	Or under			
150		30	25	25
100	150	30	25	25
50.0	100	15	13	13
22.4	50.0	5	4	4
10.0	22.4	2	2	2
2.80	10.0	0.5	0.5	0.5
	2.80	0.2	0.2	0.2

5.5 Number of increments

The number of increments in the systematic sampling and two-stage sampling shall be in accordance with the following and also Annex E.

- a) **In the case of systematic sampling** The minimum necessary number n of increments necessary for obtaining the prescribed sampling precision sampled from one lot shall be obtained in accordance with the following formula.

$$n = \left(2 \frac{\sigma_w}{\beta_s} \right)^2$$

where, n : minimum necessary number of increments sampled

σ_w : variation within stratum expressed by standard deviation

β_s : sampling precision expressed by confidence section

The minimum necessary number n of increments by the manual sampling (see **5.7.2**) and hatch sampling (see Annex JA) from a belt conveyor shall be in accordance with table 5 for chromium ores and with table 6 for manganese ores and ferruginous manganese ores.

Table 5 Minimum necessary number of increments (*n*) of chromium ore

Mass of lot <i>t</i>		β_s	Minimum necessary number of increments	
Over	Or under		Large quality variation	Small quality variation
30 000	45 000	0.33	85	20
15 000	30 000	0.37	65	15
5 000	15 000	0.39	60	13
2 000	5 000	0.42	50	11
1 000	2 000	0.55	30	7
500	1 000	0.60	25	6
	500	0.65	20	5

NOTE 1 β_s shall be the sampling precision expressed by a confidence section.

NOTE 2 As regards σ_w , it has been calculated, when the quality variation is large, as 1.5 % (mass fraction), and when it is small, as 0.7 % (mass fraction).

Table 6 Minimum necessary number of increments (*n*) of manganese ore and ferruginous manganese ore

Mass of lot <i>t</i>		β_s	Minimum necessary number of increments		
Over	Or under		Large quality variation	Medium quality variation	Small quality variation
45 000	60 000	0.33	165	70	13
30 000	45 000	0.35	145	60	12
15 000	30 000	0.37	130	55	11
5 000	15 000	0.39	120	50	9
2 000	5 000	0.42	100	40	8
1 000	2 000	0.46	85	35	7
500	1 000	0.55	60	25	5
	500	0.70	40	15	3

NOTE 1 β_s shall be the sampling precision expressed by a confidence section.

NOTE 2 As regards σ_w , it has been calculated as 2.10 % (mass fraction), when the quality variation is large, as 1.35 % (mass fraction) when it is medium, and as 0.60 % (mass fraction) when it is small.

- b) **In the case of two-stage sampling** In the case of sampling from a truck or freight car (5.7.3), the minimum necessary number (number of cars) *m* of the primary sampling unit (truck or freight car) shall be in accordance with table 7 for chromium ore, and with table 8 for manganese ore and ferruginous manganese ore.

Table 7 Minimum necessary number of primary sampling units of chromium ore (*m* cars)

Mass of lot t		Number of cars of truck or freight car constituting a lot <i>M</i>	β_S	Quality variation σ_b	Primary sampling units (<i>m</i> cars)		Sampling number of increments $\bar{n}$
Over	Or under				Quality variation σ_w large	Quality variation σ_w small	
30 000	45 000	3 000	0.33	Large Small	121 59	90 27	2
15 000	30 000	2 000	0.37	Large Small	96 47	71 22	
5 000	15 000	1 000	0.39	Large Small	84 42	62 19	
2 000	5 000	334	0.42	Large Small	67 36	49 17	
1 000	2 000	134	0.55	Large Small	37 21	27 10	
500	1 000	67	0.60	Large Small	28 17	21 8	
	500	34	0.65	Large Small	20 14	15 7	
NOTE 1	The loading capacity of truck or freight car constituting a lot has been taken as 15 t. In the case where it differs from 15 t remarkably, see 5.7.3 c) 2.2) .						
NOTE 2	As regards σ_b , it has been calculated as 1.5 % (mass fraction) when quality variation is large, and as 0.7 % (mass fraction) when it is small.						

Table 8 Minimum necessary number of primary sampling units of manganese ore and ferruginous manganese ore (*m* cars)

Mass of lot t		Number of cars of truck or freight car constituting a lot <i>M</i>	β_S	Quality variation σ_b	Primary sampling units (<i>m</i> cars)			Sampling number of increments $\bar{n}$	
Over	Or under				Quality variation σ_w large	Quality variation σ_w medium	Quality variation σ_w small		
30 000	45 000	3 000	0.35	Large	235	204	166	2	
				Medium	177	146	106		
				Small	83	68	28		
15 000	30 000	2 000	0.37	Large	207	180	146		
				Medium	157	129	94		
				Small	74	61	25		
5 000	15 000	1 000	0.39	Large	177	153	124		
				Medium	137	112	82		
				Small	66	55	22		
2 000	5 000	334	0.42	Large	128	112	91		
				Medium	104	87	63		
				Small	56	46	19		
1 000	2 000	134	0.46	Large	84	73	59		
				Medium	74	61	45		
				Small	45	37	15		
500	1 000	67	0.55	Large	54	44	36		
				Medium	47	38	28		
				Small	31	25	10		
	500	34	0.70	Large	28	25	20		
				Medium	27	22	16		
				Small	19	15	6		
NOTE 1 The loading capacity of truck or freight car constituting a lot has been taken as 15 t. In the case where it differs from 15 t remarkably, see 5.7.3 c) 2.2) .									
NOTE 2 As regards σ_b , it has been calculated as 2.25 % (mass fraction) when quality variation is large, as 1.75 % (mass fraction) when it is medium and as 0.75 % (mass fraction) when it is small.									
NOTE 3 No actual record for over 45 000 t to and including 60 000 t has been reported.									

5.6 Sampling methods of increments

The sampling methods of increments shall be in accordance with the following.

- Individual increments shall be sampled by one motion of a specified sampling tool. However, in the case where it is difficult to sample it by one motion, it may be sampled by several motions from the same position.
- The increments to be sampled shall be approximately constant in mass (variation coefficient $CV \leq 20\%$). In the case where the increments can not be sampled approximately constant, and these are to be arranged into a subsample or gross sample, after individual increment has been reduced to a constant mass at an appropriate stage of sample preparation, these are collected to make up a subsample or gross sample. In the case where the particle size measurements are carried out over its total quantity of respective increments which have been sampled from a lot, the mass of increments may not be necessarily constant.

- c) The sampling interval of increment shall be at each constant mass (mass basis) over the total quantity of one lot, and this shall not be changed during sampling. The sampling interval of increment shall be selected rather smaller so that the number of increments will not become smaller than the minimum necessary number n . When the cargo handling rate of a lot is considered to be practically uniform, the sampling interval of increment may be determined as its constant interval (time basis). However, the time interval shall be regulated according to the variations of this cargo handling rate. When the sampling interval of increment has been altered inevitably, the increments before and after alteration shall be discriminated to prepare a subsample or gross sample allocating these by cargo handling mass ratio at an appropriate stage of each sample preparation, or the correction shall be carried out by the method as agreed on between the purchaser and supplier, when the characteristic values of the lot are calculated.
- d) When the cargo handling is still continued, after the number of increments preliminarily determined have been finished completely, the sampling of increments shall be continued by the same sampling interval as the foregoing until completion of the cargo handling of one lot.
- e) In the case where the mass of sample to be taken is liable to become less than the necessary mass for test sample, the mass of increment shall preliminarily be increased, or the number of increments shall be increased.

5.7 Manual sampling methods

5.7.1 Classification of manual sampling

The manual increment sampling shall be one of the following, according to the transportation means of ores, cargo handling equipment and sampling place of increments.

- a) Manual sampling from a belt conveyor
- b) Manual sampling from a truck or freight car

As regards one lot, either one of these methods may be used or these may be used jointly. Also as regards the method of hatch sampling, Annex JA should be referred to.

5.7.2 Manual sampling from belt conveyor

The manual sampling from a belt conveyor shall be in accordance with the following.

- a) In the case where increments are sampled manually by stopping the belt conveyor for sampling, it shall be carried out at a specific position of the belt conveyor.
- b) Individual increments shall be sampled from the part of 3 times or over the length of the maximum particle size over the total width and total thickness of the ores on the belt conveyor. Since the manual sampling of increments from the belt conveyor during running is very dangerous and also liable to introduce bias in the sample, it should preferably be avoided.

For the ores of 22.4 mm or under in the maximum particle size, when it has been confirmed that no bias is introduced in the sample in accordance with the check experiment given in Annex C, in the case where no problem exists in safety, the increments of the specified mass or over may be sampled from a part randomly selected on all such occasions in the flow of ores on the belt conveyor or at its chute.

- c) The sampling interval of increment shall be calculated from the following formula to an integer by discarding the fraction thereof.

$$T = \frac{Q}{n}$$

where, T : sampling interval of increment (t)

Q : mass of one lot (t)

n : the minimum necessary number of increments to be sampled which has been selected in accordance with table 5 and table 6

5.7.3 Manual sampling from truck or freight car

The manual sampling from a truck or freight car shall be in accordance with the following.

- a) Increments shall generally be sampled from the ores in a truck or freight car during cargo handling. Sampling shall not be carried out as loaded condition of ores and only from the surfaces thereof.
- b) The individual increment shall generally be sampled from the randomly selected place of the fresh surface of the ores exposed during cargo handling.
- c) The sampling method shall be in accordance with either of the following methods, whether the number (M) of cars or freight cars constituting one lot is smaller or larger than the minimum necessary number (n) of increments of table 5 or table 6.
- 1) **Stratified sampling** In the case where the number of trucks or freight cars constituting one lot is not more than the minimum necessary number of increments of table 5 or table 6 ($M \leq n$), the number of increments which has been raised to an integer by calculating from the following formula shall be sampled for whole trucks or freight cars.

$$\bar{n}_3 = \frac{n}{M}$$

where, $\bar{n}_3$: number of increments to be sampled from each truck or each freight car

n : the minimum necessary number of increments to be sampled which has been selected in accordance with table 5 or table 6

M : number of trucks or freight cars constituting one lot

NOTE : As regards the stratified sampling, **JIS M 8100** should be referred to.

2) Two-stage sampling

- 2.1) In the case where the loading capacity of truck or freight car constituting one lot is approximately 15 t, and its number of cars exceeds the minimum necessary number of increments of table 5 or table 6 ($M > n$), the trucks or freight cars of the minimum necessary number of cars (m) specified in table 7 or table 8 shall be calculated. Next, each two increments ($\bar{n} = 2$) shall be sampled from each one truck or freight car which has been selected.

- 2.2) In the case where the loading capacity of truck or freight car is different from 15 t remarkably and its number of cars exceeds the minimum necessary number of increments of table 5 or table 6 ($M > n$), the minimum necessary number of trucks or freight cars and the minimum necessary number of increments shall be calculated from the following formula. However, the calculated values shall be raised to integer.

$$m' = m \sqrt{\frac{15}{c}}$$

and

$$\bar{n}' = 2 \sqrt{\frac{c}{15}}$$

where, m : the minimum necessary number of trucks or freight cars specified in table 7 and table 8

m' : the minimum necessary number of cars to be selected of truck or freight car of which loading capacity differs from 15 t remarkably

c : loading capacity of truck or freight car (t)

$\bar{n}'$: number of increments to be sampled from each truck or each freight car of which loading capacity differs from 15 t remarkably

- 2.3) The minimum necessary number of trucks or freight cars (m or m') necessary for achieving the prescribed sampling precision shall be selected from trucks or freight cars constituting one lot (M) at a fixed mass interval (mass basis) by a systematic sampling according to a random start. The selecting interval shall be calculated from the following formula to obtain the integer number of cars of which fractions have been discarded.

$$S = \frac{M}{m}$$

or

$$S' = \frac{M}{m'}$$

where, S and S' : selecting interval of trucks or freight cars (number of cars)

M : number of trucks or freight cars constituting one lot

m and m' : in accordance with 2.2)

5.8 Mechanical sampling method

The mechanical sampling method shall be in accordance with the following.

- a) **Mean mass of increment** The mean mass of increments for the primary sampling sampled at the chute of a belt conveyor shall be obtained from the following formula.

$$W = \frac{CA}{3.6 V}$$

where, W : mean mass of increment (kg)
 C : mean flow rate of ore being sent by belt conveyor (t/h)
 A : width of opening of primary sampler (m)
 V : travelling speed of primary sampler (m/s)

- b) **Sampling interval of increment** The interval, in the case where the increments are sampled in accordance with mass basis, shall be calculated from the following formula to obtain the integer value of which fractions have been discarded.

$$T_m = \frac{Q}{n}$$

where, T_m : sampling interval of increments in accordance with mass basis (t)
 Q : mass of lot (t)
 n : necessary minimum number of increments selected in accordance with table 5 or table 6

In the case where the flow of ores is regular, the corresponding time interval may be substituted for the mass interval.

For the interval of time basis, the interval shall be calculated from the following formula to obtain the integer value of which fractions shall be discarded.

$$T_r = \frac{60 \times Q}{q_m \times n}$$

where T_r : sampling interval of increments in accordance with time basis (min)
 Q : mass of lot (t)
 q_m : mean flow rate (t/h)

In order to secure the minimum necessary number of prescribed increments, the sampling interval of increments shall be made smaller than the calculated value.

- c) **Sampling method of increment** The increment shall be sampled so as a sampler to cut across the total flow width of the ores during cargo handling by one motion. The sampling time of the first increment shall be determined randomly within the first sampling interval after the start of cargo handling. Hereafter, increments shall be sampled at a defined interval until completion of the cargo handling of a lot.

In the case of the mass basis a sampler for either constant speed or variable speed shall be used, and in the case of the time basis, the constant speed sampler shall be used.

5.9 Instruments and equipment for sampling and sample preparation

5.9.1 Instrument and equipment of manual system

The instrument and equipment of manual system shall be in accordance with the following.

- An instrument capable of sampling the increments of specified mass and one set of equipment capable of performing manual sample preparation which conforms to the reduction standard specified in 6.6 shall be used.
- The scoop for increment sampling shall generally be that of larger than the capacity specified in table 9 according to the maximum particle sizes of lots. The opening part shall be 3 times or over the maximum particle size.

An example of the dimensions of scoop for increment sampling is given in figure 3.

Table 9 Example of capacity and dimension of scoop for increment sampling

Scoop number	Maximum particle size mm	Dimension mm								b/c	Capacity ml
		a	b	c	d	e	f	g	Thickness of material		
150	150	450	190	450	380	170	As appropriate	As appropriate	3	0.42	Approx. 35 000
125	125	380	160	380	320	150			3	0.42	Approx. 21 000
100	100	300	130	300	260	120			3	0.43	Approx. 11 000
70	71	200	100	200	170	80			2	0.50	Approx. 3 700
50	50	150	75	150	130	65			2	0.50	Approx. 1 600
40	40	110	65	110	95	50			2	0.59	Approx. 730
30	31.5	90	50	90	80	40			2	0.56	Approx. 380
20	22.4	80	45	80	70	35			2	0.56	Approx. 270
15	16	70	40	70	60	30			2	0.57	Approx. 180
10	10	60	35	60	50	25			1	0.58	Approx. 120
5	5	50	30	50	40	20			1	0.60	Approx. 70
3	2.8	40	25	40	30	15			0.5	0.62	Approx. 35
1	1	30	20	30	25	12			0.5	0.67	Approx. 16
0.25D ^{a)}	0.25	15	10	15	12	0			0.3	0.67	Approx. 2

Note ^{a)} When using the scoop of this type for the increment reduction, the one without triangular edge ($e = 0$) shall be used by appending D at the right side of the scoop number.

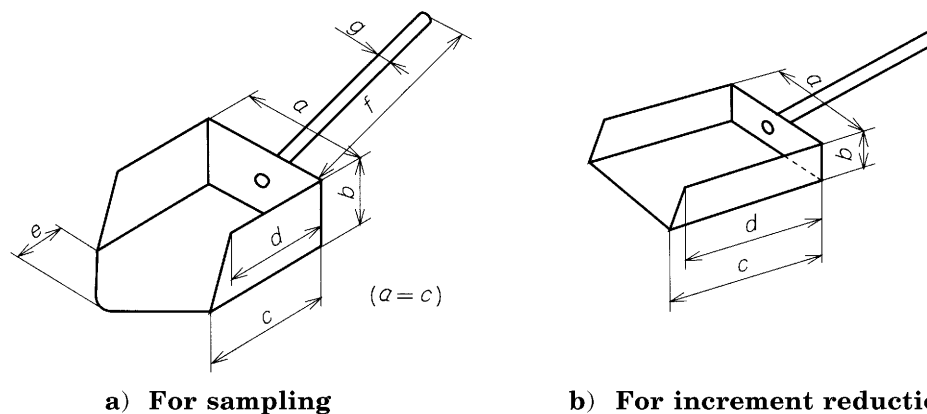


Figure 3 Example of dimension of scoop for increment sampling

5.9.2 Equipment of mechanical sampling

The equipment of mechanical sampling shall be in accordance with the following.

- a) The equipment of mechanical sampling may be whichever the integrated one with sample preparation equipment or the separated one.

The equipment may be used in common or separately for the lump ore and the fine ore.

- b) The equipment shall be of durable construction so that it will always exhibit the prescribed functions during operation, and be one suitable to each kind of ore.
- c) The sampling equipment shall be one capable of sampling twice or more of total number of increments for the purpose of check experiments (see Annex A to Annex D) to be executed as required.

As required, the sampling equipment shall function so that it will be capable of sampling a gross sample constituting of n pieces only for particle size measurement separately from those for other characteristics.

- d) The material and construction shall be those which prevent the sample from introducing bias, and the parts of equipment getting in touch with the sample do not cause change on properties of the sample. The equipment shall be such that the ore which is not sampled as the increment may not be mingled with the sample, and that the discarded portion may not be mingled with the sample after reduction during sample preparation. The equipment shall be so constructed that any part can be easily checked, maintained and cleaned.
- e) Prior to the sampling from a lot, ore of a necessary amount sampled from the lot shall be passed through the equipment to wash with the common material.

In addition, after completion of the sampling, the equipment shall be washed with fresh water, compressed air or the like.

- f) When the equipment has become unusable in the half-way, it shall be changed over to the manual sampling method and manual sample preparation given in **5.7** and **6.1** as agreed between the purchaser and the supplier.
- g) When the equipment has been newly installed or remodelled, prior to use of this, check experiment (Annex A to Annex D) or the method as agreed between the

purchaser and the supplier shall be carried out and as regards the precision and bias, it shall be confirmed if the requirements of **5.2** and Annex C are satisfied or not.

5.9.3 Primary sampler

The primary sampler shall be in accordance with the following.

- The primary sampler which samples increments from a lot mechanically shall be installed at the place through which the total quantity of lot passes. The primary sampler should preferably be installed at the chute of ore flow of a belt conveyor, as near as possible, where the unloading or loading of the ore is carried out.
- The example of the type of the primary sampler shall be given in figure 4.
The opening part shall be so constructed as to cut out the whole section of ore flow quantity at the chute.
- The width of the opening part shall be approximately 3 times or over the maximum particle size of the ores (dimension A of figure 4).
- The capacity of the sample container shall be that of holding the total quantity of increments, as well as not overflowing from this.

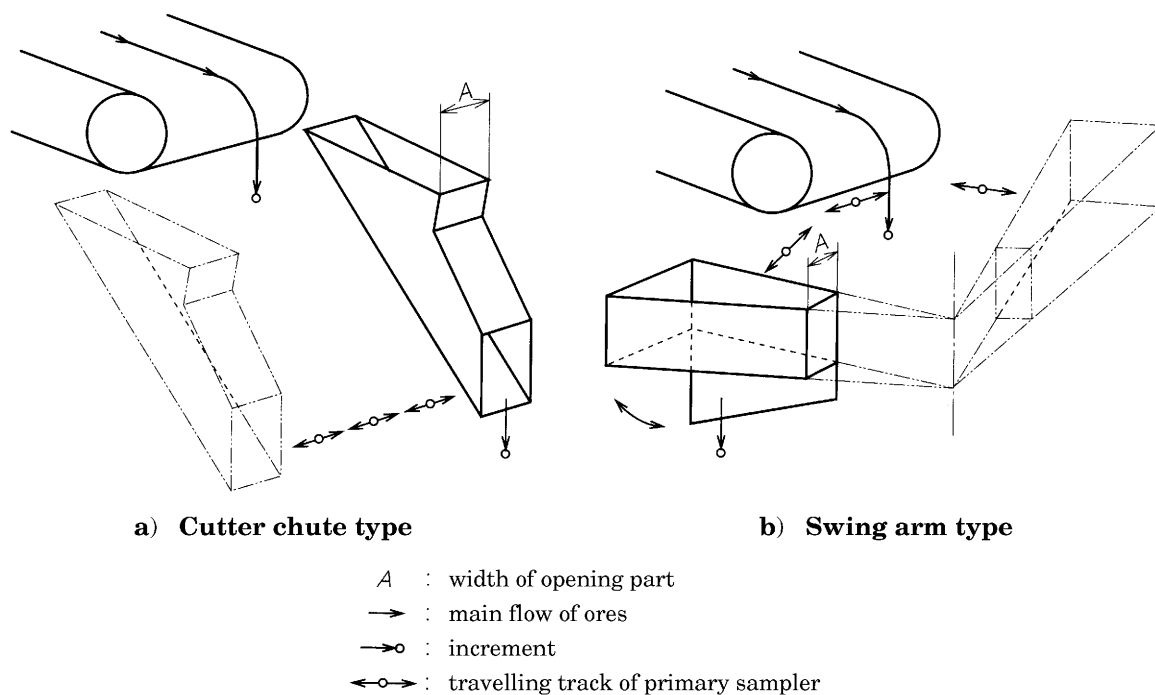


Figure 4 Example of types of primary sampler

5.9.4 Sampling method of reference increment

The increment to be taken for reference in the experiment to check the bias of a mechanical type sampling device in accordance with Annex C shall be the increment to be sampled manually after stopping a belt conveyor. The sampling method of the reference increment shall be in accordance with the following.

- a) The individual reference increment shall be sampled by stopping the belt conveyor at the specific position on all such occasions. The mass of one reference increment shall be the minimum mass or over specified in table 4, and all of the ore within the section of the full section of the ore on the belt conveyor over the length 3 times or over the maximum particle size of ore in travelling direction of the belt conveyor shall be sampled.
- b) The sampling frame of which end face having the depth of belt width or over of the belt conveyor and the height of the maximum thickness or over the ore and having the partitioning length over the length 3 times or over the maximum particle size of ore shall be prepared (see figure 5).

This sampling frame shall be inserted to the bottom of the ore at the specific position specified in **a)**, all of the ore within both end faces shall be sampled using a scoop, brush or the like and be put in a container, and this shall be considered to be one reference increment.

When inserting the sampling frame into the ore, in the case where the insertion is interfered because the plates at both ends are blocked by ores, those on the left side of the plate viewed from the sampling person shall be included in the increment, and those on the right shall be discarded.

- c) The container for the reference increment shall be capable of holding its total quantity, and of which material and construction shall bring no change in the moisture content.

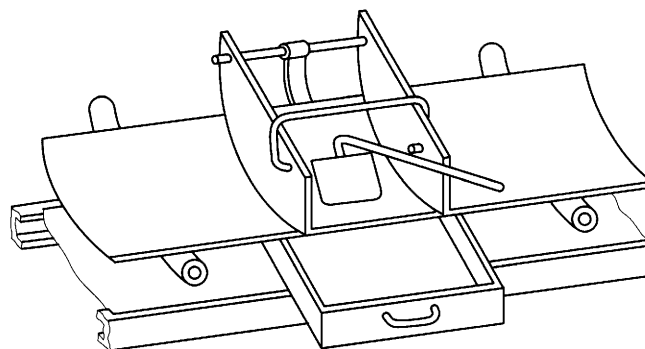


Figure 5 Example of sampling frame

6 Sample preparation methods

6.1 Preparation of sample

The sample preparation shall be in accordance with the following.

- a) The increments sampled in accordance with clause **5** shall be collected to be a subsample or a gross sample, or, as required, after each increment or subsample has been reduced or crushed and reduced, these shall be collected to be a subsample or gross sample.
- b) According to the purposes, the test sample shall be prepared for any of each gross sample, subsample or increment.

- c) The crushing of sample shall be carried out by an appropriate crusher, and the total quantity of sample shall be crushed to the prescribed particle size, taking care so that the sample may not deteriorate.
- d) The reduction of sample shall be carried out in accordance with the reduction standard by either of the manual or mechanical method, or the combination of both methods.
- e) During the preparation of sample, sufficient care shall be taken so that part of sample may not be scattered, and the dusts of surroundings and other foreign substances may not be mingled.

6.2 Precision of reduction

When the overall precision (see 5.2) is to be prescribed, the reduction precision (β_D) or combined precision of reduction and measurement (β_{DM}) shall be in accordance with table 10.

Table 10 Reduction precision and combined precision of reduction and measurement

Unit: % (mass fraction)

Kind of ore	Characteristics		Reduction precision β_D	Combined precision of reduction and measurement β_{DM}
Chromium ore	Chromium oxide content		0.5	—
	Moisture content	Over 10	—	0.4
		Over 6 up to and incl. 10	—	0.3
		Over 3 up to and incl. 6	—	0.2
		3 or under	—	0.2
	Undersize fraction (–10 mm) content		—	3.5
Manganese ore	Manganese content		0.5	—
	Moisture content	Over 10	—	0.3
		Over 6 up to and incl. 10	—	0.2
		Over 3 up to and incl. 6	—	0.2
		3 or under	—	0.2
	Undersize fraction (–10 mm) content		—	3.5
Ferruginous manganese ore	Manganese content		0.5	—
	Moisture content		—	0.3
	Undersize fraction (–10 mm) content		—	3.5

The experiment for the purpose of checking β_D or β_{DM} of table 10 shall be in accordance with Annex B and Annex D.

6.3 Arranging method of sample

The arranging method of sample shall be in accordance with the following.