H-13-20

INTERNATIONAL STANDARD ISO 4519-1980 (E)/ERRATUM

Published 1981-12-15

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Electrodeposited metallic coatings and related finishes — Sampling procedures for inspection by attributes

ERRATUM

Page 1

3 Definitions

In line 4 of the note, delete "thems", and substitute "items".

Page 2

3.10 percent defective

Replace the equation by the following :

"Percent defective $= \dfrac{\text{number of defectives}}{\text{number of units inspected}} \times 100$"

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International Standard 4519

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Electrodeposited metallic coatings and related finishes — Sampling procedures for inspection by attributes

Dépôts électrolytiques et finitions apparentées — Méthodes d'échantillonnage pour le contrôle par attributs

First edition 1980-07-15

UDC 669.058 : 621.357.7 : 620.113 **Ref. No. ISO 4519-1980 (E)**

Descriptors : metal coatings, electrodeposited coatings, electrodeposition, definitions, sampling, sampling tables (plans), quality control, inspection by attributes.

Price based on 10 pages

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

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 4519 was developed by Technical Committee ISO/TC 107, *Metallic and other non-organic coatings*, and was circulated to the member bodies in March 1979.

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

Bulgaria	Israel	South Africa, Rep. of
Canada	Italy	Spain
Czechoslovakia	Japan	Sweden
France	Korea, Rep, of	Switzerland
Germany, F.R.	Libyan Arab Jamahiriya	Turkey
Hungary	Poland	United Kingdom
India	Romania	USA

The member body of the following country expressed disapproval of the document on technical grounds :

Netherlands

Printed in Switzerland

Electrodeposited metallic coatings and related finishes — Sampling procedures for inspection by attributes

1 Scope and field of application

This International Standard establishes sampling plans and procedures for inspection by attributes of electrodeposited metallic coatings. It may be applied to related finishes by agreement between the supplier and the purchaser. It is based on ISO 2859 (see also Addendum 1 to ISO 2859).

The sampling plans in this International Standard are applicable, but not limited, to the inspection of end items, components, materials in process and finished products in storage. The plans are intended primarily to be used for a continuing series of lots, but they may also be used for the inspection of isolated lots. However, the assurance given for isolated lots is lower than that given for a continuing series of lots.

This International Standard is not applicable to the sampling and testing of mechanical fasteners having electrodeposited metallic coatings or related finishes, in all the circumstances for which procedures for these components are specified in ISO 3269.

The sampling plans given in this International Standard are based on AQLs[1] of 1,5 and 4,0 %. Other AQLs may be used if specified in the product specification, in which case reference should be made to ISO 2859 and its Addendum 1.

It is also possible to formulate sampling plans based on inspection by variables.

2 References

ISO 2859, *Sampling procedures and tables for inspection by attributes.*

ISO 2859/Add. 1, *General information on sampling inspection, and guide to the use of the ISO 2859 tables.*

ISO 3269, *Fasteners — Acceptance inspection.*[2]

ISO 3534, *Statistics — Vocabulary and symbols.*

3 Definitions

NOTE — Some of these definitions are not identical with those in ISO 3534 but have been modified to make them easier to understand by non-statisticians and to make them more readily applicable to electroplated thems.

3.1 inspection : The process of measuring, examining, testing, or otherwise comparing the unit of product (see 3.4) with the requirements.

3.2 attribute : A characteristic or property which is appraised in terms of whether it does or does not exist (for example go or no-go) with respect to a given requirement.

3.3 inspection by attribute(s) : Inspection whereby either the unit of product is simply classified as defective or non-defective, or the number of defects in the unit of product is counted, with respect to one or more given requirements.

3.4 unit of product : The object inspected either to determine its classification as defective or non-defective, or to count the number of defects. It may be a single article, a pair, a set, a length, an area, an operation, a volume, a component of an end item or the end product itself. The unit of product may or may not be the same as the unit of purchase, supply, production, or shipment.

3.5 acceptance number : The maximum number of defects or defective units in the sample that will permit acceptance of the inspection lot.

3.6 rejection number : The minimum number of defects or defective units in the sample that will cause rejection of the inspection lot.

3.7 inspection lot : A collection of coated articles that are of the same kind, that have been produced to the same specifications, that have been coated by a single supplier at one time, or at approximately the same time, under essentially identical conditions and that are submitted for acceptance or rejection as a group.

1) AQL = Acceptable Quality Level.

2) At present at the stage of draft.

3.8 Classification of defects and defectives

3.8.1 method of classifying defects : The enumeration of possible defects of the unit of product classified according to their seriousness. A defect is any non-conformance of the unit of product to the specified requirements.

Defects are normally grouped into one or more of the following classes; however, defects may be grouped into other classes or into sub-classes within these classes.

3.8.1.1 critical defect : A defect that judgement and experience indicate is likely to result in hazardous or unsafe conditions for the individual using, maintaining, or depending upon the unit of product which has an electrodeposited metallic coating or related finish. It may also be a defect in the coating that judgement and experience indicate is likely to prevent performance of the primary function of a major end item.

3.8.1.2 major defect : A defect, other than critical, that is likely to result in failure of the finish, or to reduce materially the usability of the unit of product for its intended purpose.

3.8.1.3 minor defect : A defect that is not likely to reduce materially the usability of the unit of product for its intended purpose, or is a departure from established standards having little or no bearing on the effective use or operation of the item which has an electrodeposited coating or related finish.

NOTE — Inspection for detection of critical defects may require non-destructive examination of every unit of product in the lot. In this International Standard, all defects not conforming to the specified requirements in the product item specifications for electrodeposited coatings and related finishes are considered to be major. If specified by the purchaser, the maximum number of defects per hundred items, or the maximum percent defective laid down in this International Standard can be increased for the purpose of sampling inspection of minor defects.

3.8.2 method of classifying defectives : A defective is a unit of product which contains one or more defects.

Defectives are usually classified as follows :

3.8.2.1 critical defective : A defective which contains one or more critical defects, and which may contain major or minor defects.

3.8.2.2 major defective : A defective which contains one or more major defects, and which may contain minor defects but no critical defects.

3.8.2.3 minor defective : A defective which contains one or more minor defects, but no critical or major defects.

3.9 expression of non-conformance : The extent of non-conformance of a product expressed either in terms of percent defective, or in terms of defects per hundred items.

3.10 percent defective : One hundred times the number of defective units of product divided by the total number of units of product inspected, i.e.

$$\text{Percent defective} = \frac{\text{number of units inspected}}{\text{number of defectives}} \times 100$$

4 Product submission

4.1 Lot

An inspection lot shall be a collection of items from which a sample shall be randomly drawn and inspected to determine conformance with the acceptance criteria. It may differ from a collection of units of product designated as a lot for other purposes, such as production, shipment, and storage.

4.2 Formation of lots

The product shall be assembled into identifiable lots, sub-lots, or in such manner as may be prescribed (see 6.3). Each lot shall, as far as practicable, consist of units of product or separate specimens of the same basic material composition, of a single type, grade or class of the coating or finish, and approximately the same size and shape, processed under essentially the same conditions, and at essentially the same time (see 7.2.2).

4.3 Lot size

The lot size is the number of units of product in a lot.

4.4 Presentation of lots

Unless specified by the purchaser in the contract or order, the formation of lots, the lot size and the manner in which the lot is to be presented and identified shall be designated by the supplier.

5 Acceptance and rejection

5.1 Responsibility for tests

Unless otherwise specified in the contract or purchase order, the supplier shall be responsible for performing all the required tests for compliance with the specified inspection requirements, and the supplier may use his own or any other laboratory facilities suitable for performance of the inspection requirements. The purchaser shall have the right to perform any of the inspections detailed in the material document, when such action is deemed necessary to ensure that the electrodeposited metallic coating or the related finish conforms to the prescribed requirements. Reports of the test results shall be available for examination by the purchaser for 1 year from the date of acceptance of the material by him. Copies of the test reports and test details shall be furnished when required by the contract or purchase order.

5.2 Acceptability of lots

Acceptability of a lot shall be determined by the use of a sampling plan.

5.3 Defective items

The purchaser shall have the right to reject any unit of product found defective during inspection, whether that unit of product forms part of a sample or not, and whether the lot as a whole is accepted or rejected. With the approval of, and in the manner specified by the purchaser, rejected items may be repaired or corrected and resubmitted for inspection.

The supplier may be required at the discretion of the responsible authority to inspect every unit of the lot for critical defects. The right is reserved to inspect every unit submitted by the supplier for critical defects and to reject the lot immediately when a critical defect is found. The right is reserved also to sample, for critical defects, every lot submitted by the supplier and to reject any lot if a sample drawn therefrom is found to contain one or more critical defects.

5.4 Resubmitted lots

Lots found unacceptable may be resubmitted for reinspection only after all items are re-examined or retested and all defectives are removed or the defects corrected. The purchaser shall state whether reinspection shall include all types or classes of defect, or only the particular type or class of defect which caused initial rejection.

6 Selection of samples (sampling)

6.1 Sample

A sample shall consist of one or more units of product selected at random from a lot submitted for inspection without taking into account their quality. The number of units of product in the sample is the sample size. Defective units shall be neither deliberately included, nor excluded, from the random sample. When selecting the samples, the supplier shall identify all units which are observed to be defective, in order to dispose of or rework them after completion of inspection.

6.2 Representative sampling

When appropriate, the number of units in the sample shall be selected in proportion to the size of sub-lots, or parts of lots, identified by some rational criterion. If representative sampling is used, the units from each part of the lot shall be selected at random. See the annex for methods of drawing samples.

6.3 Lot size

The supplier and purchaser shall agree on a figure which is mutually convenient and which takes into account the nature of the production process. From the point of view of inspection costs there is an advantage in large lots since the sample is a smaller proportion of the lot and discrimination improves. However, large lots should not be formed where to do so would hold up the flow of production and smaller lots could have been sampled separately to maintain the flow. Also, small lots should not be combined if there is doubt that they are of similar quality. Lots should consist of units of product produced under essentially the same conditions.

6.4 Time of sampling

Samples may be drawn after all the units comprising the lot have been assembled, or during assembly of the lot.

7 Sampling plans

7.1 Sampling plan

A sampling plan shall indicate the number of units of product from each lot which are to be inspected (sample size or series of sample sizes) and the criteria for determining the acceptability of the lot (acceptance and rejection numbers). Unless otherwise directed by the purchaser, the sampling plans shall be considered as normal inspection procedures and shall be used from the start of inspection.

7.2 Types of sampling plan

Three sampling plans for normal inspection are given in tables 1, 2 and 3.

7.2.1 Sampling for visual and dimensional examinations and for all non-destructive tests

Sampling for visual examination, dimensional tolerance examination, non-destructive thickness test, and all other non-destructive procedures, shall be conducted in accordance with table 1, unless the units of product were produced by barrel electroplating, in which case, table 2 shall be used as the sampling plan. Unless a need can be demonstrated, separately prepared specimens shall not be used in lieu of production items for non-destructive examinations and tests.

7.2.2 Sampling for all destructive tests

Sampling for each destructive test, such as hydrogen embrittlement, adhesion, corrosion resistance, solderability, etc., shall be conducted for each test in accordance with table 3. If the electroplated or coated articles are of such form, shape, size or value, as to prohibit the use thereof, or are not readily adaptable to the test specified in the contract, purchase order or applicable standard, or if destructive tests of small lot sizes are required, sampling for tests shall be permitted by use of separate specimens processed concurrently with the articles they represent, as detailed in the purchase document or in 4.2. Unless a need can be demonstrated, separately prepared specimens shall not be used in lieu of the production items for thickness measurements.

7.2.3 Alternative sampling plans

If specified in the contract or purchase order, alternative sampling plans may be substituted for those of tables 1, 2 and 3. There are a vast number of different types of sampling plan other than those detailed herein, and, in many instances, any number of alternative sampling schemes may be used for a specific situation involving electrodeposited metallic coatings and related finishes. The selection of a particular type of alter-

native sampling plan is not an easy task, because selection should actually be based upon the following factors :

a) properties of the sampling plan;

b) ease of administering the sampling plan;

c) protection afforded;

d) amount of inspection required;

e) cost of inspection.

In addition to the necessity for appropriately considering the above factors, it should also be recognized that a plan adopted for one type of product may not be the best for another. Furthermore, the past history of the supplier can play an important role in the selection of an alternative sampling plan.

NOTE — General information on procedures for alternative sampling is given in ISO 2859 and its Addendum 1.

7.2.4 Switching procedures

At the start of inspection, the acceptance or rejection of lots shall be in accordance with the plans given in tables 1, 2 or 3, as appropriate. Lots found to be unacceptable and rejected shall, after proper remedial treatment in accordance with 5.4, be resampled and inspected as though they were continuing lots. If in the course of sampling a continuing series of lots, two out of five consecutive lots have been rejected, sampling shall be switched as follows :

1) where table 1 was in use, to table 4;

2) where table 2 was in use, to table 5;

3) where table 3 was in use, to a sample size of 20 and acceptance number 1, rejection number 2.

Inspection is now termed tightened inspection. If, as a consequence of switching, tightened inspection is in force, normal inspection (tables 1 and 2, table 3 as shown) may be resumed when five consecutive lots have passed tightened inspection. However, in the event that ten consecutive lots remain on tightened inspection through a failure to meet the requirement for restoring normal inspection, inspection under the provisions of this International Standard should be discontinued pending action to improve the quality of production.

7.2.5 Isolated lots

The sampling plans in tables 1 to 5 are designed for continuing series of lots produced over a period and the safeguard is provided by the switching procedure. If the tables are used to inspect an isolated lot, there is an acceptance risk (or purchaser's risk) that a lot with lower quality may be accepted. If a value is chosen for the acceptance risk, there is a corresponding limiting quality (L.Q.) associated with a given AQL.

Table 6 gives the L.Q. for the two AQLs used in this International Standard and for a 10 % acceptance risk. The L.Q. value is always greater than the AQL and for small samples it is considerably greater. If a lower L.Q. is required for an isolated lot than is given for the 10 % acceptance risk by the sample size shown in tables 1 or 2, then a larger sample size may be selected for the chosen L.Q. from table 6. The acceptance and rejection numbers are given for the sample size in tables 1 or 2, ignoring the lot size in those tables.

8 Determination of acceptability

8.1 Percent defective inspection

To determine acceptability of a lot under percent defective inspection, the application sampling plan shall be used, in accordance with 8.2 as a single sampling plan.

8.2 Single sampling plan

The number of sample units inspected shall be equal to the sample size given in the plan. If the number of defectives found in the sample is equal to or less than the acceptance number, the lot shall be considered acceptable. If the number of defectives is equal to or greater than the rejection number, the lot shall be rejected.

8.3 Single isolated lots

The sample size, acceptance and rejection numbers given in tables 1 to 5 do not give the same assurance of an isolated lot reaching the required quality as is given for the inspection of continuing lots (see table 6).

Table 1 — Sampling of items for non-destructive tests produced by methods other than barrel electroplating[1)]

Number of product items in lot (Lot size)	Number of product items for test (Sample size)	Maximum number of defective products for lot to be accepted (Acceptance No.)	Minimum number of defective products for lot to be rejected (Rejection No.)
91 to 280[2)]	32	1	2
281 to 500	50	2	3
501 to 1 200	80	3	4
1 201 to 3 200	125	5	6
3 201 to 10 000	200	7	8
10 001 and over	315	10	11

1) Based upon ISO 2859, level II, AQL 1,5 %, single sampling, normal inspection.

2) This abridged specification should not be used with lot sizes below 91. Other plans suitable for smaller lots are given in ISO 2859.

Table 2 — Sampling of barrel electroplated items for non-destructive tests[1)]

Number of product items in lot (Lot size)	Number of product items to be tested (Sample size)	Maximum number of defective products for lot to be accepted (Acceptance No.)	Minimum number of defective products for lot to be rejected (Rejection No.)
151 to 500[2)]	13	1	2
501 to 1 200	20	2	3
1 201 to 10 000	32	3	4
10 001 and over	50	5	6

1) Based upon ISO 2859, level S-4, AQL 4 %, single sampling, normal inspection.

2) Not suitable for lot sizes under 151.

Table 3 — Sampling for destructive tests (adhesion, hydrogen embrittlement, corrosion resistance, etc.)[1)]

Number of product items in lot[2)] (Lot size)	151 and over
Number of product items for test (Sample size)	8[3)]
Maximum number of defective products for lot to be accepted (Acceptance No.)	0
Minimum number of defective products for lot to be rejected (Rejection No.)	1

1) Based upon ISO 2859, level S-2, AQL 1,5 %, single sampling, normal inspection.

2) Should not be used for lots under 151 items.

3) Sample size is kept as small as consistent with AQL of 1,5 % in view of destructive tests, but this does entail a probability of 10 % (purchaser's risk) of accepting a lot having 25 % defectives.

Table 4 — Sampling of items for non-destructive tests, produced by methods other than barrel electroplating, for tightened inspection of continuing lots (see 7.2.4)[1)]

Number of product items in lot (Lot size)	**Number of product items to be tested** (Sample size)	**Maximum number of defective products for lot to be accepted** (Acceptance No.)	**Minimum number of defective products for lot to be rejected** (Rejection No.)
91 to 500[2)]	50	1	2
501 to 1 200	80	2	3
1 201 to 3 200	125	3	4
3 201 to 10 000	200	5	6
10 001 and over	315	8	9

1) Based upon ISO 2859, level II, AQL 1,5 %, single sampling, tightened inspection.

2) Not suitable for lot sizes under 91.

Table 5 — Sampling of barrel electroplated items for non-destructive tests, for tightened inspection of continuing lots (see 7.2.4)[1)]

Number of items in lot (Lot size)	Number of product items to be tested (Sample size)	Maximum number of defective products for lot to be accepted (Acceptance No.)	Minimum number of defective products for lot to be rejected (Rejection No.)
151 to 1 200[2)]	20	1	2
1 201 to 10 000	32	2	3
10 001 and over	50	3	4

1) Based upon ISO 2859, level S-4, AQL 4 %, single sampling, tightened inspection.

2) Not suitable for lot sizes under 151.

Table 6 — Limiting quality for testing isolated lots or batches

Tables 1 to 5 are based upon testing a series of lots from continuing production. With a single lot, there is a finite probability (the "purchaser's risk") that a lot whose quality (the "limiting quality") is lower than the chosen AQL may be accepted. This table gives the limiting quality at 10 % purchaser's risk for the two AQLs used and for the sample sizes used in tables 1 to 5.

NOTE — The meaning of this table is that if a batch is presented with the L.Q. value, there will be a 10 % chance of accepting it.[1)]

Sample size	Limiting quality with 10 % acceptance risk for AQL specified	
	AQL 1,5 %	AQL 4 %
8[2)]	25 %	≈ 35 %
13	–	27 %
30	–	25 %
32	12 %	20 %
50	10 %	18 %
80	8 %	14 %
125	7 %	12 %
200	6 %	10 %
315	5 %	9 %

1) Based upon OC curves of ISO 2859; see also Addendum 1 to ISO 2859 for a discussion of significance of limiting quality.

2) A sample size of 8 is used only with destructive tests.

Annex

Drawing of samples

A.1 Random sampling

A.1.1 Sampling

If the product items in a lot have been thoroughly mixed, sorted or arranged without bias as to quality, a sample drawn anywhere from this lot will meet the requirements of randomness. Although it may not often be practical to mix the items, for example with items stacked in layers, obvious bias will result if the entire sample of the furnished items is drawn only from the top layer. Other bias of sampling, such as drawing units from the same position on a plating rack, selecting units from the output of one plating bath and not from others, or selecting articles which appear to be defective or non-defective, should be avoided.

A.1.2 Selection of random numbers

For selection of random numbers, tables of random numbers may be obtained from books pertaining to statistics. Because these books are generally not available in finishing plants, a table of random numbers, table 7, has been provided in this annex. To use this table, each unit in the lot must be identified by a distinctly different number. This can be done by placing the units in racks or trays where the rows and columns of positions in the racks are distinctly numbered. If the units have serial numbers, these serial numbers can be used.

A.1.3 Example

As an example, let us assume that a lot of 13 product items has to be selected from an inspection lot containing 80 electroplated units numbered from 1 to 80. In selecting random numbers from table 7, one method is to begin by blindly letting a pencil fall on some number in the table, and starting at this point. Toss a coin to decide which way to go : heads, go up; tails, go down. Suppose the pencil falls on column 10, line 11, and the coin falls tails up. The decision is then to read down the column, and to take only the first two digits in each number of 5 digits. The selection of random numbers is made as follows : reject the number 85 because it is over 80, and reject the second number 06 because it has already appeared once. The sample would then consist of the numbers 31, 20, 8, 26, 53, 65, 64, 46, 22, 6, 41, 67, and 14.

A.2 Constant-interval sampling

A.2.1 Sampling

When product items are arranged in an order without regard to quality, such as articles in a tray, a sample can be drawn by using the constant-interval procedure. By this procedure, a constant interval is maintained between the items drawn for the sample. Thus, every 9th, 19th, or 24th unit of a consecutively ordered lot may be selected. The first item to be drawn from the lot could be determined from the table of random numbers. All other items are drawn at a constant interval following the first item. The numerical value of the constant interval is determined by dividing the lot size by the sample size.

A.2.2 Example

As an example, let us assume that a lot of 8 000 items is to be visually examined for freedom from blisters, pits, nodules, staining, and other defects. In accordance with table 1, a sample of 200 items will then have to be drawn. The constant interval will be 40. The first step is to select a random number from 1 to 40 from either table (see A.1.2), or by another appropriate method. After the first item has been taken, the remaining items of the required sample are drawn by selecting every 40th item from the lot, until the total sample size of 200 is reached.

A.3 Stratified sampling (sub-lot sampling)

A.3.1 Sampling

Under certain conditions, it may be necessary to divide the lot into sub-lots, to obtain information about specific parts or strata of the lot. The division of the lot into stratified sub-lots requires considerable knowledge and judgement concerning the characteristics of the product. A sample is then drawn from each sub-lot, as though it were an independent lot, and statistical decisions regarding the acceptance or rejection of product quality can then be made for each sub-lot.

A.3.2 Example

As an example, let us assume that the lot to be visually examined consists of 31 400 mechanically plated articles which were produced in five different lots. All items are of the same material, cadmium plated, of the same size and shape, and processed on different machines during the same production shift. Sampling inspection is used to determine the acceptance or rejection of the product from each lot. The sub-lot size for each lot and the related sample sizes (see table 1) may have been as follows :

Lot number	Sub-lot size	Sample size
1	9 000	200
2	9 500	200
3	6 800	200
4	17 100	315
5	9 000	200
Total	51 400	1 115

Table 7 — Random numbers

Line \ Column	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	10480	15011	01536	02011	81647	91646	69179	14194	62590	36207	20969	99570	91291	90700
2	22368	46573	25595	85393	30995	89198	27982	53402	93965	34095	52666	19174	39615	99505
3	24130	48360	22527	97265	76393	64809	15179	24830	49340	32081	30680	19655	63348	58629
4	42167	93093	06243	61680	07856	16376	39440	53557	71341	57004	00849	74917	97758	16379
5	37570	39975	81837	16656	06121	91782	60468	81305	49684	60672	14110	06927	01263	54613
6	77921	06907	11008	42751	27756	53498	18602	70659	90655	15053	21916	81825	44394	42880
7	99562	72905	56420	69994	98872	31016	71194	18738	44013	48840	63213	21069	10634	12952
8	96301	91977	05463	07972	18876	20922	94595	56869	69014	60045	18425	84903	42508	32307
9	89579	14342	63661	10281	17453	18103	57740	84378	25331	12566	58678	44947	05585	56941
10	85475	36857	53342	53988	53060	59533	38867	62300	08158	17983	16439	11458	18593	64952
11	28918	69578	88231	33276	70997	79936	56865	05859	90106	31595	01547	85590	91610	78188
12	63553	40961	48235	03427	49626	69445	18663	72695	52180	20847	12234	90511	33703	90322
13	09429	93969	52636	92737	88974	33488	36320	17617	30015	08272	84115	27156	30613	74952
14	10365	61129	87529	85689	48237	52267	67689	93394	01511	26358	85104	20285	29975	89868
15	07119	97336	71048	08178	77233	13916	47564	81056	97735	85977	29372	74461	28551	90707
16	51085	12765	51821	51259	77452	16308	60756	92144	49442	53900	70960	63990	75601	40719
17	02368	21382	52404	60268	89368	19885	55322	44819	01188	65255	64835	44919	05944	55157
18	01011	54092	33362	94904	31273	04146	18594	29852	71585	85030	51132	01915	92747	64951
19	52162	53916	46369	58586	23216	14513	83149	98736	23495	64350	94738	17752	35156	35749
20	07056	97628	33787	09998	42698	06691	76988	13602	51851	46104	88916	19509	25625	58104
21	48663	91245	85828	14346	09172	30168	90229	04734	59193	22178	30421	61666	99904	32812
22	54164	58492	22421	74103	47070	25306	76468	26384	58151	06646	21524	15227	96909	44592
23	32639	32363	05597	24200	13363	38005	94342	28728	35806	06912	17012	64161	18296	22851
24	29334	27001	87637	87308	58731	00256	45834	15398	46557	41135	10367	07684	36188	18510
25	02488	33062	28834	07351	19731	92420	60952	61280	50001	67658	32586	86679	50720	94953
26	81525	72295	04839	96423	24878	82651	66566	14778	76797	14780	13300	87074	79666	95725
27	29676	20591	68086	26432	46901	20849	89768	81536	86645	12659	92259	57102	80428	25280
28	00742	57392	39064	66432	84673	40027	32832	61362	98947	96067	64760	64584	96096	98253
29	05366	04213	25669	26422	44407	44048	37937	63904	45766	66134	75470	66520	34693	90449
30	91921	26418	64117	94305	26766	25940	39972	22209	71500	64568	91402	42416	07844	69618
31	00582	04711	87917	77341	42206	35126	74087	99547	81817	42607	43808	76655	62028	76630
32	00725	69884	62797	56170	86324	88072	76222	36086	84637	93161	76038	65855	77919	88006
33	69011	65795	95876	55293	18988	27354	26575	08625	40801	59920	29841	80150	12777	48501
34	25976	57948	29888	88604	67917	48708	18912	82271	65424	69774	33611	54262	85963	03547
35	09763	83473	73577	12908	30883	18317	28290	35797	05998	41688	34952	37888	38917	88050
36	91567	42595	27958	30134	04024	86385	29880	99730	55536	84855	29080	09250	79656	73211
37	17955	56349	90999	49127	20044	59931	06115	20542	18059	02008	73708	83517	36103	42791
38	46503	18584	18845	49618	02304	51038	20655	58727	28168	15475	56942	53389	20562	87338
39	92157	80634	94824	78171	84610	82834	09922	25417	44137	48413	25555	21246	35509	20468
40	14577	62765	35605	81263	39667	47358	56873	56307	61607	49518	89656	20103	77490	18062
41	98427	07523	33362	64270	01638	92477	66969	98420	04880	45585	46565	04102	46880	45709
42	34914	63976	88720	82765	34476	17032	87589	40836	32427	70002	70663	88863	77775	69348
43	70060	28277	39475	46473	23219	53416	94970	25832	69975	94884	19661	72828	00102	66794
44	53976	54914	06990	67245	68350	82948	11398	42878	80287	88267	47363	46634	06541	97809
45	76072	29515	40980	07391	58745	25774	22987	80059	39911	96189	41151	14222	60697	59583
46	90725	52210	83974	29992	65831	38857	50490	83765	55657	14361	31720	57375	56228	41546
47	64364	67412	33339	31926	14883	24413	59744	92351	97473	89286	35931	04110	23726	51900
48	08962	00358	31662	25388	61642	31072	81249	35648	56891	69352	48373	45578	78547	81788
49	95012	68379	93526	70765	10592	04542	76463	54328	02349	17247	28865	14777	62730	92277
50	15664	10493	20492	38391	91132	21999	59516	81652	27195	48223	46751	22923	32261	85653
51	16408	81899	04153	53381	79401	21438	83035	92350	36693	31238	59649	91754	72772	02338
52	18629	81953	05520	91962	04739	13092	97662	24822	94730	06496	35090	04822	86774	98289
53	73115	35101	47498	87637	99016	71060	88824	71013	18735	20286	23153	72924	35165	43040
54	57491	16703	23167	49323	45021	33132	12544	41035	80780	45393	44812	12515	98931	91202
55	30405	83946	23792	14422	15059	45799	22716	19792	09983	74353	68668	30429	70735	25499

Table 8 — Random numbers (*concluded*)

Line \ Column	1	2	3	4	5	6	7	8	9	10	11	12	13	14
56	16631	35006	85900	98275	32388	52390	16815	69298	82732	38480	73817	32523	41961	44437
57	96773	20206	42559	78985	05300	22164	24369	54224	35083	19687	11052	91491	60383	19746
58	38935	64202	14349	82674	66523	44133	00697	35552	35970	19124	63318	29686	03387	59846
59	31624	76384	17403	53363	44167	64486	64758	75366	76554	31601	12614	33072	60332	92325
60	78919	19474	23632	27889	47914	02584	37680	20801	72152	39339	34806	08930	85001	87820
61	03931	33309	57047	74211	63445	17361	62825	39908	05607	91284	68833	25570	38818	46920
62	74426	33278	43972	10119	89917	15665	52872	73823	73144	88662	88970	74492	51805	99378
63	09066	00903	20795	95452	92648	45454	09552	88815	16553	51125	79375	97596	16296	66092
64	42238	12426	87025	14267	20979	04508	64535	31355	86064	29472	47689	05974	52468	16834
65	16153	08002	26504	41744	81959	65642	74240	56302	00033	67107	77510	70625	28725	34191
66	21457	40742	29820	96783	29400	21840	15035	34537	33310	06116	95240	15957	16572	06004
67	21581	57802	02050	89728	17937	37621	47075	42080	97403	48626	68995	43805	33386	21597
68	55612	78095	83197	33732	05810	24813	86902	60397	16489	03264	88525	42786	05269	92532
69	44657	66999	99324	51281	84463	60563	79312	93454	68876	25471	93911	25650	12682	73572
70	91340	84979	46949	81973	37949	61023	43997	15263	80644	43942	89203	71795	99533	50501
71	91227	21199	31935	27022	84067	05462	35216	14486	29891	68607	41867	14951	91696	85065
72	50001	38140	66321	19924	72163	09538	12151	06878	91903	18749	34405	56087	82790	70925
73	65390	05224	72958	28609	81406	39147	25549	48542	42627	45233	57202	94617	23772	07896
74	27504	96131	83944	41575	10573	08619	64482	73923	36152	05184	94142	25299	84387	34925
75	37169	94851	39117	89632	00959	16487	65536	49071	39782	17095	02330	73401	00275	48280
76	11508	70225	51111	38351	19444	66499	71945	05422	13442	78675	84081	66938	93654	59894
77	37449	30362	06694	54690	04052	53115	62757	95348	78662	11163	81651	50245	34971	52924
78	46515	70331	85922	38329	57015	15765	97161	17869	45349	61796	66345	81073	49106	79860
79	30986	81223	42416	58353	21532	30502	32305	86482	05174	07901	54339	58861	74818	46942
80	63798	64995	46583	09785	44160	78128	83991	42865	92520	83531	80377	35909	81250	54238
81	82486	84846	99254	67632	43218	50076	21361	64816	51202	88124	41870	52689	51275	83556
82	21885	32906	92431	09060	64297	51674	64126	62570	26123	05155	59194	52799	28225	85762
83	60336	98782	07408	53458	13564	59089	26445	29789	85205	41001	12535	12133	14645	23541
84	43937	46891	24010	25560	86355	33941	25786	54990	71899	15475	95434	98227	21824	19585
85	97656	63175	89303	16275	07100	92063	21942	18611	47348	20203	18534	03862	78095	50136
86	03299	01221	05418	38982	55758	92237	26759	86367	21216	98442	08303	56613	91511	75928
87	79626	06486	03574	17668	07785	76020	79924	25651	83325	88428	85076	72811	22717	50585
88	85636	68335	47539	03129	65651	11977	02510	26113	99447	88645	34327	15152	55230	93448
89	18039	14367	61337	06177	12143	46609	32989	74014	64708	00533	35398	58408	13261	47908
90	08362	15656	60627	36478	65648	16764	53412	09013	07832	41574	17639	82163	60859	75567
91	79556	29068	04142	16268	15387	12856	66227	38358	22478	73373	88732	09443	82558	05250
92	92608	82674	27072	32534	17075	27698	98204	63863	11951	34648	88022	56148	34925	57031
93	23982	25835	40055	67006	12293	02753	14827	23235	35071	99704	37543	11601	35503	85171
94	09915	96306	05908	97901	28395	14186	00821	80703	70426	75647	76310	88717	37890	40129
95	59037	33300	26695	62247	69927	76123	50842	43834	86654	70959	79725	93872	28117	19233
96	42488	78077	69882	61657	34136	79180	97526	43092	04098	73531	80799	76536	71255	64239
97	46764	86273	63003	93017	31204	36692	40202	35275	57306	55543	53203	18098	47625	88684
98	03237	45430	55417	63282	90816	17349	88298	90183	36600	78406	06216	95787	42579	90730
99	86591	81482	52667	61582	14972	90053	89534	76036	49199	43716	97548	04379	46370	28672
100	38534	01715	94964	87288	65680	43772	39560	12918	86537	62738	19636	51132	25739	56947