
International Standard



4519

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

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

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 4519:1980](#)

<https://standards.iteh.ai/catalog/standards/sist/1245287f9c00-4aff-aaac-b539f0228bfe/iso-4519-1980>

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

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 AQLs¹⁾ 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 items.

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-

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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 electroplating¹⁾

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.

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Table 2 – Sampling of barrel electroplated items for non-destructive tests¹⁾

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 lot²⁾ (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.

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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.