BRITISH STANDARD

BS EN 14137:2003

Postal services — Quality of service — Measurement of loss of registered mail and other types of postal service using a track and trace system

The European Standard EN 14137:2003 has the status of a British Standard

ICS 03.240

BSi

British Standards

National foreword

This British Standard is the official English language version of EN 14137:2003.

The UK participation in its preparation was entrusted to Technical Committee SVS/4, Postal services, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

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EUROPEAN STANDARD

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EN 14137

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English version

Postal services - Quality of service - Measurement of loss of registered mail and other types of postal service using a track and trace system

Services postaux - Qualité du service - Mesure de la perte du courrier recommandé et d'autres types de services postaux par un système de traçabilité et de repérage

Postalische Dienstleistungen - Dienstqualität - Messung des Verlusts registrierter Sendungen und anderer Postdienste mit Hilfe eines "track and trace" -Systems

This European Standard was approved by CEN on 12 June 2003.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This document (EN 14137:2003) has been prepared by Technical Committee CEN/TC 331, "Postal services", the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2004, and conflicting national standards shall be withdrawn at the latest by March 2004.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

Annex A is normative. Annex B is informative.

This document includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

In the Green paper on postal services [1992] the European Commission emphasised the need to establish common rules for the development of community postal services and the improvement of quality of service. The Commission identified requirements for quality of service measurement that included the reliability of services and treatment of problems of loss, theft and damage.

CEN was asked to draw up standards related to the methodology for the measurement of loss of mail at reasonable cost for some mail types within the universal service.

This standard refers to a number of principles and minimum requirements to be applied for the measurement of the level of loss of domestic and cross-border registered letter mail.

1 Scope

This European Standard specifies methods for measuring the level of loss and substantial delay of domestic and cross-border registered letter mail, collected, processed and delivered by postal service providers. The resulting overall figure for loss and substantial delay is expressed as a percentage of the total posted registered mail collected or received by the postal service providers.

This European Standard is applicable only to those service providers which have a measurement system in place which

— records each item as it is posted,

— records each item as it is delivered,

— can, by comparing these records, count the number of items which have been posted and not delivered.

This European Standard can be used if appropriate to measure the level of loss of other types of postal items for which such a measurement system is in operation.

This European Standard specifies requirements for the design and operation of the measurement system and for other procedures to allow the level of loss to be calculated.

This European Standard does not specify technical requirements for the design and operation of a registered letter service, except for purposes of measurement. It does not deal with the technical requirements of a track and trace system.

This European Standard includes specifications for the quality control of the measurement system and for the reporting of loss of mail.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 13850   2002   *Postal services – Quality of service – Measurement of the transit time of end-to-end services for single piece priority mail and first class mail.*

EN 14012   *Postal services – Quality of service – Measurements of complaints and redress procedures.*

ISO 19011   *Guidelines for quality and/or environmental management systems auditing.*

UPU S2[1]   *Barcode Symbology for Postal Items.*

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[1] UPU documents are available from the Universal Postal Union International Bureau:

Case Postale 13, CH 3000 Berne 15, Switzerland
Tel: +41.31.350.3111; Fax: +41.31.350.3110;
URL: http://www.upu.int

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1
complainant
any natural or legal person who makes a complaint [EN 14012]

3.2
complaint
communication from a complainant about something that does not meet his or her expectations about the postal service or the "Customer Charter" [EN 14012]

NOTE 1 In relation with complaints, the expression "postal service" includes claimed or proposed service levels, specific requirements of the postal service, service regulations, and delivery conditions.

NOTE 2 Suggestions, communications, service enquiries, and requests for information are not considered as complaints.

NOTE 3 A "Customer Charter" is a statement published by the service provider containing commitments to customers or users.

3.3
item arriving late
postal item delivered to the recipient in a time longer than the service provider's promised service standard but within a specified period of time

NOTE The specified period is defined in 4.2 of this European Standard.

cf. **lost or substantially delayed (3.5)**

3.4
justified complaint
complaint regarding a subject for which the service provider, after investigation if necessary, recognises that it may not have fulfilled its obligations in whole or in part [EN 14012]

NOTE   Examples of the obligations of the service provider are its general terms and conditions and its regulatory and legal requirements.

3.5
lost or substantially delayed (item)
postal item not delivered, in whole or in part, to the recipient within a specified period of time

NOTE 1 The specified period is defined in 4.2 of this European Standard.

NOTE 2 Items that can neither be delivered to the intended receiver nor returned to sender, because, for example, they are incorrectly addressed, should not be counted as lost for the purposes of this European Standard.

cf. **item arriving late (3.3)**

3.6
on-time performance
proportion of items with transit times meeting the specification [EN 13850]

Formal definition: $\dfrac{1}{N(t)}\sum_{i=1}^{N(t)} X_i$ *where* $N(t)$ *is the total number of postal items inducted during the period,*

and $X_i = 1$ *if postal items* i *fulfils the specification and otherwise* $X_i = 0$

3.7
registered item, registered letter
letter-post item for which the sender has paid for delivery against signature and is paid compensation in the case of loss, rifling, or theft

NOTE   Registered items for the purposes of this European Standard can include both services where a compensation is paid and services where it is not.

3.8
service standard
standard that specifies requirements to be fulfilled by a service to establish its fitness for purpose [EN 45020]

NOTE 1 In this standard, the service standard is the number of working days within which time an item should normally be delivered.

NOTE 2 The service standard is sometimes expressed in the form J + n, where n is the number of working days. For example, a service standard of J + 1 means that an item should normally be delivered on the next working day after posting.

3.9
user
any natural or legal person benefiting from postal services

NOTE A sender or recipient of a postal item is a user.

4 Measurement

4.1 General

Registered items are recorded when they are posted and when they are delivered, and systems shall also be in place so that it can be confirmed whether or not an item has been posted and delivered.

A monitoring system shall be in operation to allow posting and delivery records to be compared for all items. It shall be possible to count the number of items which were posted in a period and the number of these which were actually delivered.

Statistical checks shall be made for the following types of recording errors.

— items without a record of delivery in the monitoring system but which have actually been received.

— items with a record of delivery in the monitoring system but which have not actually been received.

— items which are missing from the monitoring system.

The level of recording errors of each type shall be compared with the specified control limits and corrections shall be made to the level of loss, according to the requirements of 5.2, 5.3 and 5.4 of this European Standard.

NOTE   The statistical control checks require a link to the complaints handling system.

4.2 Minimum period before an item is considered to be lost or substantially delayed

At a given moment, it is impossible in practice to distinguish between items that will never arrive and items that have been delayed for an exceptionally long time. It is therefore necessary to define a minimum period after which an item that has been sent can be treated as if it has been lost for the purposes of this measurement.

For the purposes of measurement, an item shall be classified as lost or substantially delayed if the item has not been received within the number of days shown in Table 1.

Table 1 — Definition of substantial delay

	Service Standard			
	J + 1	J + 2	J + 3	Over J + 3 or no standard
Domestic mail	7	13	20	27
Cross-border mail	10	20	30	40[a]
NOTE In Table 1, J + n means an on-time service standard of delivery within n working days after the date of posting.				
[a] Exceptionally, for cross-border mail on routes where delays of 40 days or more are not unusual, a longer period than 40 days may be used to define substantial delay.				

As the figures in Table 1 show, the minimum period required is related to the service standard, e.g. J+1 for domestic first class mail. The column headed "Over J+3" should be used for postal items for which no service standard has been defined.

In determining substantial delay, non-functioning of the service provider and days of strikes or industrial disputes shall not be deducted from the period of delivery. However, in the case of "force majeure", the deduction of the corresponding period may be considered in agreement with the regulator and shall be indicated in reports.

The postal service provider shall specify and publish the period for each type of service after which the postal service provider will consider an item to be lost or substantially delayed. This period may be different for domestic and cross-border mail.

The calculation of the transit time (as defined in EN 13850:2002, 4.2.3) shall take into account the treatment of items which cannot be delivered at the first attempt or which are waiting to be claimed.

— If an item cannot be delivered at the first attempt, the transit time should be calculated from the date of posting to the date when the first attempt was made to deliver the item or the recipient was advised that the item was waiting to be claimed.

— If an item is delivered via a pick-up location, e.g. a PO Box if acceptable, to await collection, the transit time should be calculated from the date of posting to the date when the item was placed in the pick-up location to await collection.

— If an item, which has not already been substantially delayed, is returned to sender, the delay should be recalculated taking the date of posting to be the date when the item is sent back to the sender and using the service standard which the postal service provider has specified for items which are returned to sender. Time spent waiting for the item to be collected by a recipient shall be ignored in the calculation.

4.3 Calculation of number of lost or substantially delayed items

Let: K be the total number of items,

   L be the total number of items which are lost or substantially delayed (according to the approved definition),

   P be the proportion of items which are lost or substantially delayed.

then: $$K = N + M$$

   $$L = A - B + C + D$$

   $$P = L / K$$

where N is the total number of items recorded as posted by the monitoring system,

   A is the number of items recorded as lost or substantially delayed by the monitoring system,

   B is the number of items recorded as lost by the monitoring system which have actually been delivered,

   C is the number of items recorded as delivered by the monitoring system but which were actually lost,

   M is the total number of items missing from the monitoring system,

   D is the number of items missing from the monitoring system and which were lost.

Statistics A and N are known from the monitoring system itself. Statistics B, C, M and D have to be estimated as described in clause 5.

An item shall only appear once in calculating the total number of items (N) recorded as posted by the monitoring system. Thus N is not increased if an item is returned to sender.

Annex B provides an example of how to calculate the percentage of items which are lost or substantially delayed.

4.4 Information to be recorded for domestic mail

The following information shall be recorded for each domestic mail item:

— When the item is posted:

  — Identification number or code of the item

  — Date of posting

  — Place of posting

  — Place of first record in the monitoring system

  — Product or service

— When the item is delivered:

  — Identification number or code of the item

  — Place of delivery

  — Date of first attempt at delivery

  — Date of successful delivery (if applicable)

— When the item is waiting to be claimed:

  — Place where waiting to be claimed

  — Date when the item is claimed (if applicable)

— When the item is returned to sender:

  — Place from which item is returned

  — Date when item was sent back to sender

  — (or) Record that the item cannot be delivered to the address on the item

4.5 Information to be recorded for cross-border mail

If information on cross-border mail is shared between the postal service providers responsible for posting and delivery, the following information shall be recorded for each cross-border mail item:

— When the item is posted:

  — Identification number or code of the item

  — Country of posting

  — Date of posting

  — Place of posting

  — Place of first record in the monitoring system.

  — Product or service

  — Country of delivery

— When the item is delivered:

  — Identification number or code of the item

  — Place of delivery

  — Date of first attempt at delivery

  — Date of successful delivery (if applicable)

— When the item is waiting to be claimed:

   — Place where waiting to be claimed

   — Date when the item is claimed (if applicable)

— When the item is returned to sender:

   — Place from which item is returned

   — Date when item was sent back to sender

   — (or) Record that the item cannot be delivered to the address on the item

The postal service provider with which the item was posted shall record the information required when the item is posted, and the remaining information shall be recorded by the postal service provider responsible for delivery.

If information on cross-border mail is not shared between the postal service providers responsible for posting and delivery, the following information shall be recorded for each cross-border mail item:

The postal service provider with which the item was posted shall record:

— Identification number or code of the item

— Date of posting

— Place of posting

— Place of first record in the monitoring system

— Place of despatch (normally the office of exchange) to another service provider

— Date of despatch to another service provider

— Country of delivery

— Product or service

The postal service provider responsible for the delivery of the item shall record:

— When the item is received from the other service provider:

   — Identification number or code of the item

   — Country of posting

   — Place where the item was first recorded in the monitoring system (normally the office of exchange)

   — Date when the item was first recorded in the monitoring system

   — Product or service

   — Country of delivery

— When the item is delivered:

   — Identification number or code of the item

   — Place of delivery

   — Date of first attempt at delivery

   — Date of successful delivery (if applicable)

— When the item is waiting to be claimed:

    — Place where waiting to be claimed

    — Date when the item is claimed (if applicable)

— When the item is returned to sender:

    — Place from which item is returned

    — Date when item was sent back to sender

    — (or) Record that the item cannot be delivered to the address on the item

5 Methodology

5.1 Monitoring system

The monitoring system shall satisfy the following requirements.

The postal service provider shall ensure that:

— Every item shall have a unique identification number or code. Barcodes on items shall comply with UPU S2 or other relevant technical standard.

— Every item shall be recorded by the monitoring system either

  — at the point and time it is received by the postal service provider or its franchisee or

  — at a point and time so close to hand-over that there is little risk (taking into account the requirements of 5.5) that losses can occur before recording.

— Every item shall be recorded by the monitoring system at the time it is delivered to the recipient, received at a pick-up location (waiting to be claimed), or despatched to another postal service provider.

— It shall be possible to compare the date of posting and the date of delivery for every item by means of the identification number or code, and thus to identify which items have not been delivered.

Information about all items, as described in 4.4, shall be stored in a database so that the information can be used to provide statistics about the mail handled including, in particular:

— The total number of items recorded as posted in a particular period (N).

— The total number of these items recorded as lost or substantially delayed (A).

The system shall also be able to provide lists of the items recorded as lost or substantially delayed.

The system may also record reasons why items cannot be delivered: unknown addresses, unclaimed items, items refused by the recipient, and so on.

5.2 Items not reported as delivered

A statistical sample survey shall be undertaken to estimate the number of items (B) recorded as lost by the monitoring system which have actually been delivered.

Items which have been waiting to be claimed for a long time, as defined by the postal service provider, shall be included in this survey in order to check whether they are still waiting to be claimed.

A sample of items shall be taken from the list of all items recorded as lost (according to the approved definition) in the monitoring system.

The survey shall cover the whole year. Separate samples shall be drawn for each month using simple random sampling or other permitted survey designs.

An investigation shall be made of each sampled item to discover whether there is evidence of delivery held by the postal service provider outside the monitoring system and whether the recipient has actually received the item or not. Following investigation the item shall be classed as a genuine loss or a recording error.

The postal service provider shall produce written instructions for the operation of the survey including a description of investigations to be undertaken. The results of each investigation shall be documented.

The number of items (B) that have actually been delivered shall be estimated as follows:

$$B = A \cdot P_1$$

$$P_1 = X / n$$

where n is the total number of items in the sample,

X is the number of items in the sample which were actually delivered,

P_1 is the probability that an item is delivered although it has been recorded as lost.

The number of items (B) that have actually been delivered shall be calculated separately for domestic and for cross-border mail. Separate figures may be calculated if appropriate for different categories of mail within these two types.

The size of the sample, n, shall be sufficient to meet the accuracy requirements specified in 5.5.

If P_1 is known to be small (less than 0,1) it is permissible to assume that $B = 0$. In that case the sample survey is not required.

5.3 Items incorrectly recorded as delivered

The extent to which the monitoring system fails to record items that are actually lost, shall be estimated from the complaints handling system. The complaints handling system shall be compliant with the European Standard for measurement of complaints and redress procedures (EN 14012).

Complaints to be included in the analysis are those which have been received during the reporting period. Any complaints received after the end of the reporting period may be ignored.

In every case where a complaint about loss or substantial delay of an item has been accepted as justified or is still under investigation 40 calendar days after the complaint was received, the item shall be checked against the monitoring system and a record made of the category into which the complaint falls.

Table 2 — Categories of complaints

Category 1	Complaint about an item that does not appear in the monitoring system.
Category 2	Complaint about an item that appears in the monitoring system but is recorded as having been delivered.
Category 3	Complaint about an item that appears in the monitoring system and is recorded as not having been delivered.

Let C_1 be the sum of complaints in category 1.

C_2 be the sum of complaints in category 2.

C_3 be the sum of complaints in category 3.

The number of items recorded as delivered by the monitoring system but which were actually lost (C) is estimated by:

$$C = (A - B) \cdot C_2 / C_3$$

This calculation takes into account that some users may not complain about items that are lost.

The estimate (C) shall be calculated separately for domestic and for cross-border mail. Separate figures may be calculated if appropriate for different classes of domestic and cross-border mail.

5.4 Items not recorded on the monitoring system

Some items may not appear in the monitoring system at all. The complaints handling system should provide evidence if this is happening because complaints will occur about items which are not in the recording system.

The information from 5.2 shall be used to estimate the degree of under-recording by the monitoring system. This is obtained from the ratio (R) of items not recorded in the monitoring system to those that are:

$$R = C_1 / (C_2 + C_3)$$

The total number of items missing from the monitoring system (M) is estimated by:

$$M = N \cdot R$$

The number of items missing from the monitoring system which were lost (D) is estimated by:

$$D = (A - B + C) \cdot R$$

The estimates (C, D and M) shall be calculated separately for domestic and for cross-border mail. Separate figures may be calculated if appropriate for different classes of domestic and cross-border mail.

5.5 Accuracy requirements

Accuracy limits for the percentage (P) of lost mail shall be calculated as described in annex A.

Of the statistics used to calculate P, A and N are known exactly. Uncertainty is introduced by the estimates B and C. Mathematically, if D and M are estimated as described in 5.4, they do not affect the value of P.

B is obtained from a properly constructed sample survey and its accuracy can be calculated.

C is estimated from the complaints handling process. Its accuracy is not computable directly but some assessment shall be made by treating it as if it comes from a simple random sample.

The accuracy required per year is:

accuracy (P) / P < 0,1   for domestic mail

accuracy (P) / P < 0,4   for cross-border mail

where confidence limits for P are { P - accuracy (P), P + accuracy (P)} with 95 % confidence.

In addition the ratio of items missing from the monitoring system to items recorded by the monitoring system (R) shall not be more than 0,2.

6 Reporting

6.1 General

Reports on the loss rate for registered mail, or other type of postal service, shall be provided at a minimum once a year based on the calendar year. The reports shall be issued not later than 3 months following the end of the period to which the report relates.

Loss and substantial delay shall be reported as a percentage: the statistic (P) defined in 4.3.

All reports shall include as a minimum the following information:

— results, as specified in 6.1 and 6.2.

— categories of mail covered by the results.

— period of the measurement.

— methodology used, by reference to the standard.

— accuracy of the results (5.5).

— failures, if any, to meet accuracy requirements or other standard requirements.

— definition of loss or substantial delay used (4.2).

6.2 Domestic mail

A single figure shall be reported for domestic mail. This figure shall be the proportion of items that are lost (P) as defined in 4.3.

6.3 Cross-border mail

Separate figures shall be reported for posted and delivered cross-border mail within the European Union.

— For posted cross-border mail within the European Union a single figure shall be reported.

— For delivered cross-border mail within the European Union a single figure shall be reported. Separate figures may also be reported for cross-border mail received from each country, provided that the accuracy of the loss rate can be calculated within the accuracy requirements set out in 5.5 of this European Standard.

A correction for items recorded as lost, which have actually been delivered, shall be made in the following way:

— For posted cross-border mail, no correction shall be made since the information will not be available for many service providers.

— For delivered cross-border mail, the correction shall be made in the following way:

  — Calculate statistics A and B for all delivered cross-border mail.

  — Calculate the ratio $Q_B = B / A$.

  — Calculate A_C the number of lost items posted in country c.

  — Calculate B_C from the formula:

$$B_C = A_C \cdot Q_B$$

  If separate figures are reported for each cross-border country-to-country route, statistics A, N, B, and B_C shall be calculated separately for each country.

For posted and delivered cross-border mail, corrections shall be made, as described in 5.3 and 5.4, for items incorrectly recorded as delivered by the monitoring system and for items not recorded by the monitoring system at all. These corrections shall be made separately for posted and delivered mail but not for each country (since the correction might have low accuracy if calculated separately for each country).

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It is only possible to compute losses for mail known to a single postal service provider, unless information is shared between the postal service providers responsible for posting and delivery.

Results and statistical indicators may vary from year to year as track-and-trace services are introduced for new countries, and more service providers share information, bringing the cross-border service monitored from that within the control of one service provider to total end-to-end service. Trends in the level of loss and substantial delay may therefore be difficult to follow and analyse.

7 Quality control

Quality assurance procedures should be applied through all phases and activities of the measurement system, including relevant parts of the process for tracking mail, according to rules laid down in EN ISO 9001.

The measurement system and the reports produced shall be able to be audited according to rules laid down in ISO 19011.

Annex A
(normative)

Calculation of accuracy

Section 5.5 of this European Standard sets out requirement for the accuracy of the proportion (P) of lost or severely delayed mail. This annex describes how accuracy limits for P shall be calculated.

A.1   Calculation of loss rate

According to 4.3 of this European Standard:

$$P = (A - B + C + D) / (N + M)$$

where: N is the total number of items recorded by the monitoring system,

A is the number of items recorded as lost by the monitoring system,

B is the number of items recorded as lost by the monitoring system which have actually been delivered,

C is the number of items recorded as delivered by the monitoring system but which were actually lost,

M is the total number of items missing from the monitoring system,

D is the number of items missing from the monitoring system and which were lost.

Mathematically, if D and M are estimated as described in 5.4, they do not affect the value of P and the formula for P can be simplified to:

$$P = (A - B + C) / N$$

Uncertainty is introduced into the calculation of P by the estimates B and C, since A and N are known exactly.

The number of items (B) that have actually been delivered is estimated as:

$$B = A \cdot P_1$$

where P_1 is the probability that an item is delivered although it has been recorded as lost. P_1 is estimated from a sample of size n.

The number of items recorded as delivered by the monitoring system but which were actually lost (C) is estimated by:

$$C = (A - B) \cdot Q_1$$

$$Q_1 = C_2 / C_3$$

where: C_2 is the number of justified complaints where the item appears in the monitoring system and is recorded as having been delivered.

C_3 is the number of justified complaints where the item appears in the monitoring system and is recorded as having been lost.

Thus P can be expressed as:

$$P = A \cdot (1 - P_1) \cdot (1 + Q_1) / N \qquad\qquad (1)$$

A.2 Accuracy of the loss rate

If X and Y are statistically independent random variables it can be shown that :

$$V(X \cdot Y) = E(Y)^2 \cdot V(X) + E(X)^2 \cdot V(Y) + V(X) \cdot V(Y)$$

where E( ) represents the expectation and V( ) the variance.

Thus from equation (1), if we let $X = 1 - P_1$ and $Y = 1 + Q_1$, the variance of P will become:

$$V(P) = A^2 \cdot (E(Y)^2 \cdot V(X) + E(X)^2 \cdot V(Y) + V(X) \cdot V(Y)) / N^2 \qquad (2)$$

A.2.1 Items not reported as delivered

If P_1 is estimated from a simple random sampling of size n, the variance of X is easily shown to be:

$$V(X) = V(P_1) = P_1 \cdot (1 - P_1) / n$$

The formula can be modified in the appropriate way if a more complex acceptable statistical survey is used.

A.2.2 Items incorrectly recorded as delivered

Q_1 is estimated using information from the complaints handling process. It is not possible to estimate its accuracy exactly, since the information does not come from a statistical survey. However, for the purposes of this European Standard, the accuracy shall be estimated by treating it as if it comes from a simple random sample.

The total size of the "sample" is $C_2 + C_3$. Let P_2 be the proportion where the item was recorded as lost on the monitoring system. Then

$$P_2 = C_3 / (C_2 + C_3)$$

$$V(P_2) = P_2 \cdot (1 - P_2) / (C_2 + C_3)$$

It can also be shown that $Y = 1 + Q_1 = (C_2 + C_3)/C_3 = 1 / P_2$. Provided that Y is not too large, the variance of Y can be found approximately from the formula:

$$V(Y) = V(P_2) / E(P_2)^2$$

$$= Q_1 / (C_2 + C_3)$$

A.3 Estimation of accuracy

The accuracy of P is estimated by using the observed values of P_1 and Q_1 in equation (2). Approximate accuracy limits (with 95 % confidence) are then calculated using equation (3):

$$\text{Accuracy } (P) = 1{,}96 \cdot (A / N) \cdot \sqrt{[(1 + Q_1)^2 \cdot V_X + (1 - P_1)^2 \cdot V_Y + V_X \cdot V_Y]} \qquad (3)$$

Where:

$$V_X = P_1 \cdot (1 - P_1) / n$$

$$V_Y = Q_1 / (C_2 + C_3)$$

The accuracy should be estimated separately for domestic and for cross-border mail. Separate figures may be calculated if appropriate for different categories of mail within these two types.

Equation (3) may be an inadequate approximation if the number of justified complaints about loss is small. In these circumstances more exact statistical methods should be used (In the worst case, where $C_3 = 0$, equations (1), (2) and (3) cannot be used and the results should regarded as failing to meet the accuracy requirements of 5.5.).

The formula for V_X assumes that B is estimated using simple random sampling, and should be modified in the appropriate way if a more complex acceptable statistical survey is used.

Annex B
(informative)

Calculation of loss of registered mail

This annex provides an example of how to calculate the percentage of lost registered items. The calculation would be similar for other types of postal services.

Details of the calculation are given in 4.3, 5.2, 5.3 and 5.4 of this European Standard. The figures used are for illustration only.

— According to the monitoring system 2 000 000 registered items were posted during the year and 2 000 letters were not recorded as having been delivered.

Therefore, from 4.3:

$$N = 2\ 000\ 000$$

$$A = 2\ 000$$

— A sample of 300 items were chosen from the 2 000 recorded as not delivered. On investigation it was found that 60 of these items had actually been delivered.

Therefore, from 5.2:

$$n = 300$$

$$X = 60$$

$$P_1 = 60 / 300 = 0,20$$

$$B = 0,20 \cdot 2\ 000 = 400$$

— There were 460 complaints about lost registered items where the postal service provider accepted that the item was lost. 60 of these items were not recorded at all in the monitoring system, and 50 were recorded by the monitoring system as having been delivered.

Therefore, from 5.3:

$$C_1 = 60$$

$$C_2 = 50$$

$$C_3 = 460 - 60 - 50 = 350$$

The number of registered items recorded as delivered by the monitoring system but which were actually lost (C) is calculated as:

$$C_2 / C_3 = 50 / 350 = 0,143$$

$$A - B = 2\ 000 - 400 = 1\ 600$$

$$C = 0,143 \cdot 1\ 600 = 229$$

— The overall loss rate (P) can be calculated from 4.3 and A.1 using the formula:

$$P = (A - B + C) / N$$

$$P = (2\ 000 - 400 + 229) / 2\ 000\ 000 = \underline{0,091\ 5\ \%}$$

Accuracy limits for L should be of the order of 140 items with 95 % confidence.

NOTE The percentage of lost items can also be calculated taking into account the letters which are not recorded by the monitoring system but the result is the same as if M and D were ignored.

The proportion of registered items which were not recorded by the monitoring system is calculated from 5.4 as:

$C_1 / (C_2 + C_3) = 60 / (50 + 350) = 0,15$

$M = 0,15 \cdot 2\ 000\ 000 = 300\ 000$

$A - B + C = 2\ 000 - 400 + 229 = 1\ 829$

$D = 0,15 \cdot 1\ 829 = 274$

$P = (2\ 000 - 400 + 229 + 274) / 2\ 300\ 000 = 2\ 103 / 2\ 300\ 000 = 0,091\ 4\ \%$

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