GMP+ International

Performance criteria for GMP+ Registered Laboratories

GMP+ BA 11

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GMP+ Feed Certification scheme

Feed Safety Worldwide

gmpplus.org

Index

History of the document

Revision no. / Date of approval	Amendment	Concerns	Final implementation date
0.0 / 01 – 2018	New document	-	01-07-2019
1.0 / 03- 2019	An important note has been added regarding “Pesticide”	2.6	04-06-2019

1. Introduction

1.1. General

The GMP+ Feed Certification scheme was initiated and developed in 1992 by the Dutch feed industry in response to various more or less serious incidents involving contamination in feed materials. Although it started as a national scheme, it has developed to become an international scheme that is managed by GMP+ International in collaboration with various international stakeholders.

Even though the GMP+ Feed Certification scheme originated from a feed safety perspective, in 2013 the first feed responsibility standard has been published. For this purpose, two modules are created: GMP+ Feed Safety Assurance (focussed on feed safety) and GMP+ Feed Responsibility Assurance (focussed on responsible feed).

GMP+ Feed Safety Assurance is a complete module with standards for the assurance of feed safety in all the links of the feed chain. Demonstrable assurance of feed safety is a 'license to sell' in many countries and markets and participation in the GMP+ FSA module can facilitate this excellently. Based on needs in practice, multiple components have been integrated into the GMP+ FSA standards, such as requirements for a feed safety management system, for application of HACCP principles, for traceability, monitoring, prerequisites programs, chain approach and the Early Warning System.

With the development of the GMP+ Feed Responsibility Assurance module, GMP+ International is responding to requests from GMP+ participants. The animal feed sector is confronted with requests to operate more responsible. This includes, for example, the sourcing of soy and fishmeal which are produced and traded with respect for humans, animals and the environment. In order to demonstrate respon-sible production and trade, a company can get certified for the GMP+ Feed Responsibility Assurance. GMP+ International facilitates via independent certification the demands from the market.

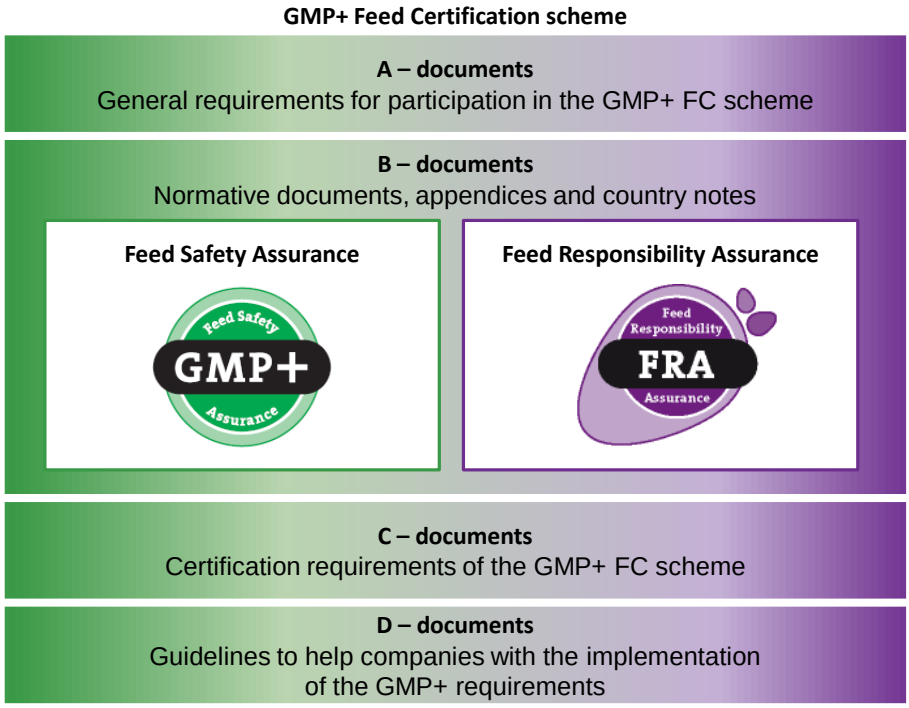
Together with the GMP+ partners, GMP+ International transparently lays down clear requirements in the Feed Certification scheme. Certification bodies are able to carry out GMP+ certification independently.

GMP+ International supports the GMP+ participants with useful and practical information by way of a number of guidance documents, databases, newsletters, Q&A lists and seminars.

1.2. Structure of the GMP+ Feed Certification scheme

The documents within the GMP+ Feed Certification scheme are subdivided into a number of series. The next page shows a schematic representation of the content of the GMP+ Feed Certification scheme.

All these documents are available via the website of GMP+ International (www.gmpplus.org).



All these documents are available via the website of GMP+ International (www.gmpplus.org).

This document is referred to as GMP+ BA11 *Performance criteria for GMP+ Registered Laboratories* and is part of the GMP+ FSA module.

1.3. Performance criteria for laboratories

In various GMP+ standards it is required that the analysis on some specific critical contaminants in feed must be carried out by a GMP+ Registered Laboratory. A GMP+ Registered Laboratory is a laboratory which has been registered due to compliance with the conditions and requirements as laid down in GMP+ B11 *Protocol for GMP+ registration for laboratories*. One requirement is compliance with the performance criteria as laid down in this document.

This document contains the performance criteria for a GMP+ Registered Laboratory, that analyses critical contaminants in feed for the GMP+ FSA certified companies. It gives the requirements for assuring the reliability and credibility of the laboratory analysis results.

The requirements for GMP+ registration for laboratories are laid down in GMP+ B11 *Protocol for GMP+ registration for laboratories*.

The requirements for GMP+ FSA certified companies for selecting laboratories to perform laboratory testing are laid down in other normative standards like GMP+ B1, GMP+ B1.2, GMP+ B2 and GMP+ B3. In those standards reference is made to GMP+ BA10 where is stated that participants must use a GMP+ Registered Laboratory for the analysis of the critical contaminants for which performance criteria are established in this standard.

2. Performance criteria for laboratory testing

2.1. Introduction

It is necessary to ensure the quality and comparability of analytical results reported by laboratories for enforcement, compliance purposes, as well as for the creation of data for risk assessment purposes. Performance criteria should be achieved by using quality assurance systems and specifically by applying methods that have been validated according to ISO 17025 which meet defined performance criteria, and by ensuring traceability to common standards or standards that are commonly agreed upon. All performance criteria in this document are based upon European legislation and ISO standards.

Maximum limits of the performance criteria for feed materials, feed additives, premixtures and complementary and complete feed are noted in mg/kg (ppm) derived to a moisture content of 12% (88% dry matter), unless mentioned otherwise. References to (inter)national standards or protocols are for information purposes only.

In general, all limits to LOQ's are derived from EU 2002/32 lowered by a factor 5, unless noted otherwise. When clearly not reasonable from results of proficiency testing the limits are adjusted to the lowest achievable level.

Annex I contains a list of definitions of terms used in this document.

2.2. Aflatoxin B1

Guidance
Suitable methods for the analysis of Aflatoxin B1 generally use HPLC, combined with Fluorescence detection or MS detection. All quantitative analytical methods are allowed, provided the set limits are met. When an immuno-affinity column is used for clean up the recovery of Aflatoxin B1 should be higher than 80% and regularly checked for the matrices analysed. Since aflatoxin can absorb to glass the use of acid-rinsed glassware is advised. Semi-quantitative methods like Thin Layer Chromatography (TLC), ELISA and others, can be used for screening purposes, confirmation of suspected non-compliance result is necessary.
NEN-EN-ISO 6498 provides guidelines to the preparation of test samples. For the analysis of mycotoxins the laboratory sample is to be grinded in total.
NEN-ISO 14718 provides a method for the determination of Aflatoxin B1 in animal feeding stuffs by use of HPLC with fluorescence detection after post-column derivatization.

Daylight should be excluded as much as possible during the whole procedure of transport of sample, sample preparation and analysis, since aflatoxin gradually breaks down under the influence of ultraviolet light. As the distribution of aflatoxin is extremely non-homogeneous, samples should be prepared - and especially homogenised - with extreme care e.g. by using the slurry method (ref).

2.2.1. Feed materials

Matrix	LOQ limit (mg/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Feed materials	0,001	25%	15%	60%

2.2.2. Feed

Matrix		LOQ limit (mg/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Complementary and complete feed with the exception of:		0,005	25%	15%	60%
	Dairy cattle and calves	0,001	25%	15%	60%
	Dairy sheep and lambs	0,001	25%	15%	60%
	Dairy goats and kids	0,001	25%	15%	60%
	Piglets	0,001	25%	15%	60%
	Young poultry animals	0,001	25%	15%	60%
Compound feed for:					
	Cattle (except dairy cattle and calves)	0,004	25%	15%	60%
	Sheep (except dairy sheep and lambs)	0,004	25%	15%	60%
	Goats (except dairy goats and kids)	0,004	25%	15%	60%
	Pigs (except piglet)	0,004	25%	15%	60%
	Poultry (except young animals)	0,004	25%	15%	60%

2.3. Dioxins and DL-PCB's

Guidance
Maximum limits of the performance criteria for feed materials or compound feeds are noted in ng TEQ/kg derived to a moisture content of 12% (88% dry matter).

The EU Commission Regulation 2017/644 for the sampling and analysis of dioxins and dioxin-like PCB's describes in detail precautions and sets standards for laboratories analysing samples for dioxins. The regulation makes a difference between screenings methods and confirmatory methods.

Screening methods are used for selection of those samples with levels of PCDD/Fs and dioxin-like PCBs that exceed the maximum levels or the action thresholds. They shall allow a cost-effective high sample-throughput, thus increasing the chance to discover new incidents with high exposure and health risks to consumers. Screening methods shall be based on bioanalytical or GC-MS methods. Results from samples exceeding the cut-off value to check compliance with the maximum level shall be verified by a full re-analysis from the original sample by a confirmatory method.

Confirmatory methods provide full or complementary information enabling the PCDD/Fs and dioxin-like PCBs to be identified and quantified unequivocally at the maximum or in case of need at the action threshold. Such methods utilise gas chromatography/high resolution mass spectrometry (GC-HRMS) or gas chromatography/triple quadrupole mass spectrometry (GC-MS/MS).

The mass spectrometric method to determine the tetra through octa dioxins should be based on United States Environmental Protection Agency protocols 1613 and the European harmonized protocol EN 16215:2012.
These protocols describe the basis tuning and calibration of the hardware as well as criteria for identification and quantification with isotope dilutions and procedures for quality assurance and quality control. A standard QA programme should be included in the routine procedure e.g. determination of recovery of internal standards, accuracy of spiked samples and blanks.

To express the toxic potency of the mixture of dioxins, the toxic equivalency factor (TEF) approach was used. A TEF value was assigned to the dioxins, which represents their relative toxic potency towards 2,3,7,8-TCDD, the most toxic dioxin congener which TEF value is 1.0. By multiplying the TEF value of each congener with the concentration of that congener in ng/kg product, the toxic value of that congener was calculated (ng TEQ/ kg product). Summarising the TEQ's of all congeners gives the total TEQ value in each sample.

European legislation permits the use of bioanalytical methods such as the CALUX (Chemically Activated LUciferase gene eXpression) assay for screening of feed samples for elevated levels of PCDD/Fs and DL-PCBs. Screening results are compared with a cut-off concentration, enabling the analyst to decide over sample compliance and to identify those samples requiring further investigation by confirmatory analysis. In addition, screening results may give a numerical indication of the PCDD/F- and DL-PCB-TEQ-levels in the sample. Expression of bioanalytical results as BEQs is particularly helpful for the analyst performing the follow-up by a confirmatory method, but mandatory during the initial validation process.

Laboratories applying bioassays within official control, or for other regulatory purposes, must be accredited according to EN ISO/IEC 17025. Methods must be validated thereby providing evidence for compliance with EU legal criteria as given in Commission Regulations (EU) 2017/644 and 152/2009 (including amendments). The proficiency of the laboratory shall be proven by internal and external quality control measures. Continuous and successful participation in interlaboratory studies based on analyses of PCDD/Fs and DL-PCBs in the relevant feed / food matrices is mandatory.

A screening method in principle classifies a sample as compliant or suspected to be non-compliant. For this, the calculated BEQ level is compared to the cut-off value. Samples below the cut-off value are declared compliant, samples equal or above the cut-off value as suspected to be non-compliant, requiring analysis by a confirmatory method.

The set limits are applicable for both kind of methods. Confirmatory methods have to be applied in case of results exceeding the standards set in GMP+ BA1. Where individual limits for dioxins or PCB's are set the laboratory has to provide evidence for the different sets of performance criteria.
The laboratory will include lower bound TEQ-values as well as upper bound TEQ-values. A sample exceeding the legal limits is considered confirmed when the difference between the lower bound and upper bound TEQ-value is <20%.

The lot is non-compliant with the maximum level as laid down in Regulation (EC) No 1881/2006, if the upperbound analytical result obtained with a confirmatory method and confirmed by duplicate analysis.
A duplicate analysis is necessary to exclude the possibility of internal cross-contamination or an accidental mix-up of samples. The first analysis, taking into account the measurement uncertainty is used for verification of compliance.
In case the analysis is performed in the frame of a contamination incident, confirmation by duplicate analysis might be omitted in case the samples selected for analysis are through traceability linked to the contamination incident.

Performance criteria as given in Tables below are all based on total TEQ upperbound.

2.3.1. Feed materials (sum of dioxins and DL-PCB's)

Matrix	LOQ limit (ng TEQ/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Feed materials	0,2* limit from GMP+ BA1	15%	20%	50%

2.3.2. Feed additives and premixtures (sum of dioxins and DL-PCB's)

Matrix	LOQ limit (ng TEQ/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Additives and premixtures	0.3	15%	20%	50%

2.3.3. Feed (sum of dioxins and DL-PCB's)

Matrix	LOQ limit (ng TEQ/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Compound feed with the exception of:	0.30	15%	20%	50%
compound feed for pet animals and fish	0.75	15%	20%	50%

2.3.4. Feed materials (dioxins)

Matrix	LOQ limit (ng TEQ/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Feed materials	0,2* limit from GMP+ BA1	15%	20%	50%

2.3.5. Feed additives and premixtures (dioxins)

Matrix	LOQ limit (ng TEQ/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Additives and premixtures	0.2	15%	20%	50%

2.3.6. Feed (dioxins)

Matrix	LOQ limit (ng TEQ/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Compound feed with the exception of:	0.15	15%	20%	50%
Compound feed for pet animals and fish	0.25	15%	20%	50%

2.3.6.1. LOQ for Bioassays

For a bioanalytical screening method, establishment of the LOQ is not an indispensable requirement but the method shall prove that it can differentiate between the blank and the cut-off value. When providing a BEQ- level, a reporting level shall be established to deal with samples showing a response below this level. The reporting level shall be demonstrated to be different from procedure blank samples at least by a factor of three, with a response below the working range. It shall therefore be calculated from samples containing the target compounds around the required minimum level, and not from a S/N ratio or an assay blank. LOQ for Bioassay however should be as such that a BEQ level corresponding to 2/3 of the maximum level may serve as the most suitable cut-off value ensuring a false-compliant rate below 5% and an acceptable rate for false-non-compliant results.

2.3.7. Feed materials (DL-PCB's)

Matrix	LOQ limit (ng TEQ/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Feed materials	0.4	15%	20%	50%

2.3.8. Feed additives and premixtures (DL-PCB's)

Matrix	LOQ limit (ng TEQ/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Additives and premixtures	0.4	15%	20%	50%

2.3.9. Feed (DL-PCB's)

Matrix	LOQ limit (ng TEQ/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Compound feed with the exception of:	0.15	20%	20%	50%
compound feed for pet animals and fish	0,5	10%	20%	45%

2.4. NDL-PCB's

Maximum limits of the performance criteria for feed materials or compound feeds are noted in in µg/kg derived to a moisture content of 12% (88% dry matter).

2.4.1. Feed materials

Matrix	LOQ limit (µg/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Feed materials	3.33	15%	20%	50%

2.4.2. Feed additives en premixtures

Matrix	LOQ limit (µg/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Additives and premixtures	3.33	15%	20%	50%

2.4.3. Feed

Matrix		LOQ (µg/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Compound feed with the exception of:		3.33	15%	20%	50%
	compound feed for pet animals and fish	10	15%	20%	50%

2.5. Heavy metals and fluorine

Guidance
There are many suitable methods for the analysis of legally regulated heavy metals; Cadmium (Cd), Arsenic (As), Lead (Pb) and Mercury (HG) such as:

- *Inductively coupled plasma atomic emission spectroscopy (ICP-OES)*
- *Inductively coupled plasma mass spectroscopy (ICP-MS)*
- *Graphite furnace atomic absorption spectrometry (GF-AAS)*

For ICP-OES the limit of quantification is in general at the mg/kg, while GF-AAS or ICP-MS for most of the heavy metals the limits of quantification are much lower.
These methods can be applied on in general small amounts of samples which needs to be well homogenized (<0,5mm^2) followed by complete digestion of the matrix with e,g, HNO_3.

In case of ICP-MS it is strongly advised to use the so called collision/reaction cell technology to remove polyatomic Interferences such as ArCl+ which otherwise might result in false positive results.

For the determination of Mercury a specific methods can be used e.g. based on sample thermal decomposition, mercury amalgamation and atomic absorption detection. The limit of quantification using this technique is very low.
As the sample intake is very low mostly up to 0,1 gram the sample should also for this methods well homogenized (<0,5mm^2). From the well homogenized sample a subsample in general 0,1 to 1 gram should be digested in acid or in a muffle furnace . All quantitative analytical methods are allowed, provided the set limits are met. The method detection limit for each method of determination and for each element is dependent on the sample matrix as well as of the instrument and technology used. Fluorine can be determined after treatment with hydrochloric acid using spectroscopy or an Ion Selective Electrode.

In case of a result of analysis above or around the maximum limit it is advised to repeat the analysis using fresh samples and quantification based on "standard addition" bt spiking two subsamples on two different levels e.g. one just 0,5 ML and one 1,5 *ML . By using standard addition the sample specific matrix effects are minimized.*

Although not being a heavy metal LOQs for Fluorine are also taken into account.

2.5.1. Feed materials

Matrix feed materials a.o minerals	LOQ limit (mg/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Arsenic (As) total	0.4	25%	15%	60%
Lead (Pb)	1.0	20%	15%	50%
Cadmium (Cd)	0.2	20%	15%	50%
Mercury (Hg)	0.02	25%	20%	65%
Fluorine (F)	30	10%	15%	35%

2.5.2. Feed additives and premixtures[1]

Matrix feed additives and premixtures	LOQ limit (mg/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Arsenic (As) total	6.0	20%	10%	45%
Lead (Pb)	6.0	15%	10%	40%
Cadmium (Cd)	0.4	15%	10%	40%

1 Because of the absence of product standards, no performance criteria are established for analyzing mercury and fluorine in feed additives and premixtures.

2.5.3. Feed

Matrix Complementary and complete feed	LOQ limit (mg/kg 88% DM)	Reproducibility	Bias	Expanded measurement uncertainty
Arsenic (As) total	0.4	25%	10%	60%
Lead (Pb)	1.0	20%	10%	45%
Cadmium (Cd)	0.1	20%	10%	45%
Mercury (Hg)	0.02	25%	20%	60%
Fluorine (F)	6.0	10%	15%	35%

2.6. Pesticides

NOTE: Due to practical problems with the registration of pesticides, it is decided to postpone the obligation to use a GMP+ registered laboratory for pesticide analyses until further notice. Up to now, a laboratory could become registered if all pesticide analyses he performs comply with the performance criteria.
Read GMP+ D3.21 FAQ *GMP+ Registered Laboratory* for more information.

Maximum Residue Levels (MRL) for Pesticides which needs to be checked in animal feed can be found in EU Pesticides database (see: http://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=homepage&language=EN). The Community legislation regarding the maximum permitted levels of residues concerns Regulation (EC). 396/2005. It is stated that MRLs set for food are also applicable to both feed for food producing animals and nonfood producing animals. In general MRLs are set for single products. In case of a compound feed or a derived product the MRL has to be recalculated among others based on product group and composition.

Guidance
In GMP+ BA1 Specific Feed Safety Limits a questionnaire is given in order to find the correct MRL. Also GMP+ D3.19 FAQ Pesticides residues can be consulted in this respect. This document describes and answers the questions from participants about the requirements in the GMP+ FC scheme regarding the applicable MRLs for pesticides in feed.

The majority of the pesticides to be controlled can be analyzed using the so called QuEChERS (Quick Easy Cheap Effective Rugged Safe) method. This method is based on extraction with acetonitrile in the presence of water followed by a separation, controlled by a mixture of MgSO4 and NaCl, of the water-phase. Subsequently the acetonitrile phase can be analyzed using GC-MS and LC-MS/MS covering a wide range of pesticides with different physical and chemical properties.
For some pesticides a specific method (single compound) is needed e.g. dithiocarbarmates. For very polar compounds specific methods based on the so called QuPPe (Quick Polar Pesticides Method).
See also :
(http://www.crl-pesticides.eu/docs/public/tmplt_article.asp?CntID=887&LabID=200&Lang=EN).

For pesticides with a MRL of 0.05 mg/kg in general LOQs can be achieved as low as 0.01 mg/kg. For pesticides with a MRL higher than 0.05 mg/kg at least, in order to achieve good quality results, LOQs should be 1/10 of the appropriate MRL.

Furthermore an expanded measurement uncertainty with a maximum of 50% is general accepted as being realistic (SANCO 12495/2011) allowing a reproducibility of max. 20% and a bias of max 15%.

2.7. Antibiotics (in progress)

The development of performance criteria for the analysis of antibiotics in feed products is in progress. This chapter will be finalized once the standards for antibiotics have been established on EU level.

3. Improvement

3.1. General

GMP+ Registered Laboratories participate in proficiency tests to proof their daily competence.

Proficiency testing determines the performance of individual laboratories for specific tests or measurements and is used to monitor laboratories' continual performance.

Proficiency testing is already part of the laboratory's quality management system, but must comply at least with the requirements in the sections 3.2 – 3.5.

3.2. Proficiency testing program

The (applicant) GMP+ Registered Laboratory annually takes part in a proficiency testing program for each analysis for which the laboratory is registered. The provider of the proficiency test conducts the proficiency test in accordance with** ISO 17043.

In case no proficiency test is available, the performance of the analysis is demonstrated on basis of a certified reference material or, if this is not available, a reference material from past proficiency tests or a spiked sample.

*** This means the provider does not have to accredited, but must conduct the proficiency test in line with ISO 17043.*

3.3. Planning

Each year the laboratory makes a plan in which proficiency tests it will participate. This plan is recorded.

3.4. Administration

The laboratory's results of a proficiency test are retained and archived for a minimum of 3 years. The laboratory's result is expressed into a 'z-score'. This score reflects (a) the actual accuracy achieved (the difference between the laboratory's result and the accepted true or consensus value) and (b) the judgement of the provider of the proficiency test of what degree of accuracy is fit for purpose.

3.5. Interpretation of proficiency testing results

The GMP+ Registered Laboratory interprets the results of the proficiency test based on the limits in table 1.

Table 1 Determination of performance

Z-score	**Assessment**
Z ≤ 2	Satisfactory
2 < Z < 3	Questionable
Z ≥ 3	Unsatisfactory

In case the z-score is assessed as questionable or unsatisfactory, the GMP+ Registered Laboratory must:

- investigate the probable cause(s) of deviation,
- implement corrective action, and
- verify that the corrective action lead to a satisfactory performance.

Annex I Definitions and calculations

1. Definitions

In addition to the definitions mentioned in GMP+ A2 *Definitions and Abbreviations* the following definitions[2] apply:

Term	Definition
Bias	The difference between the expectation of the test result and an accepted reference value.
Combined standard uncertainty	Standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or co-variances of these other quantities weighted according to how the measurement result varies with changes in these quantities.
Confirmatory Methods	Are methods that provide full or complementary information enabling the substance to be unequivocally identified and if necessary quantified at the level of interest.
Expanded measurement uncertainty	Quantity defining an interval about the result, at the M(R)L, of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand.[3] [4] [5]
GMP+ Registered Laboratory	A laboratory which has been registered due to compliance with the conditions and requirements laid down in this document.
Measurement Uncertainty	A parameter associated with the result, at the M(R)L, of a measurement, that characterises the dispersion of the values that could reasonably be attributed to the measurand".
Laboratory	A facility where analyses regarding quality or safety of feed are performed by qualified personal and with adequate equipment.

[2] Derived from EU regulation 2002/657/EC.
[3] The fraction may be viewed as the coverage probability or level of confidence of the interval.
[4] To associate a specific level of confidence with the interval defined by the expanded uncertainty requires explicit or implicit assumptions regarding the probability distribution characterized by the measurement result and its combined standard uncertainty. The level of confidence that may be attributed to this interval can be known only to the extent to which such assumptions may be justified.
[5] The expanded measurement uncertainty is determined at the level of interest, i.e. the M(R)L.

Term	Definition
Laboratory analysis	The identification and measurement of the physical or chemical constituents of a substance, specimen or microbe.
LOQ	The lowest amount or concentration of measurand in a sample that can be reliably quantified with an acceptable level of precision and accuracy.
Measurand	Particular subject or quantity subject to measurement.
MRPL	Minimum required performance limit (MRPL) means minimum content of an analyte in a sample, which at least has to be detected and confirmed.
Performance characteristic	Functional quality that can be attributed to an analytical method, i.c. specificity, accuracy, trueness, precision, repeatability, reproducibility, recovery, detection capability and ruggedness.
Performance criteria	Requirements for a performance characteristic according to which it can be judged that the analytical method is fit for the purpose and generates reliable results.
Registration Agreement	A written agreement concluded between certification body and a Laboratory.
Repeatability	Closeness of the agreement between the results of measurements of the same measurand carried out under the same conditions of measurement (i.e. duplicate analysis in the same series).
Reproducibility	Closeness of the agreement between the results of measurements of the same measurand carried out under changed conditions of measurement (within the laboratory).[6] [7]
Screening methods	Are methods used to detect the presence of a substance or class of substances at the level of interest. These methods have the capability for a high sample throughput and are used to sift large numbers of samples for potential non-compliant results. They are specifically designed to avoid false compliant results.

[6] The changed conditions may include:
a. observer
b. measuring instrument
c. reference standard
d. location
e. conditions of use
f. time.

[7] Reproducibility may be expressed quantitatively in terms of the dispersion characteristics of the results.

2. Calculations

The following calculations regarding the performance criteria apply:

Performance criteria[8]	**Calculation**
Limit of detection (LOD)	$LOD = 3 \times s_R$
Limit of quantification (LOQ)	$LOQ = 6 \times s_R$
Reproducibility	$R = \sqrt{\frac{\sum_{i=1}^{n}(x_{i1} - x_{i2})^2}{2n}}$
Bias	$\delta = \bar{x} - c_{ref}$
Epanded measurement uncertainty	$U = 2 \times \sqrt{{s_R}^2 + \delta^2}$

s_R	the standard deviation in blanc samples under reproducibility circumstances
R	Reproducibility (determined in this standard at MRL level)
δ	bias
U	expanded measurement uncertainty
n	number of analysis
x	concentration of the component
$\bar{x}$	mean concentration of the component analysed in the reference material
c_{ref}	the assigned value of the component in reference material

The average bias of the method is obtained from certified reference material or from materials from proficiency tests with an assigned (consensus) value. Bias based on addition is acceptable when interference with the matrix is not expected. Addition to at least eight different sample matrices is used when calculating the bias from the calculated recovery (accuracy).

[8] Definitions and calculations are derived from NEN 7777: Prestatiekenmerken van meetmethoden and NEN 7779: Meetonzekerheid

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