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Viet Nam for its 48th meeting

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José Moyard Imprimeur
8 rue Robert Schuman
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OIML Secretariat

Bureau International de Métrologie Légale (BIML)

11 rue Turgot – 75009 Paris – France

Tel: 33 (0)1 4878 1282
Fax: 33 (0)1 4282 1727
Internet: www.oiml.org or www.oiml.int
www.metrologyinfo.org

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PETER MASON
CIML PRESIDENT

Happy New Year!

When I look forward to 2014, it is with great optimism. Some of the reasons for this are evident in the new website and the refurbished BIML premises in Paris. These are physical signs of the renewal process within the Bureau that has been taking place over the last three years. In addition, policy and procedural changes include a new financial management system, revised Staff regulations and a reform of the way in which we carry out our technical work.

Other reasons for optimism lie in the continued rise in membership of our Organisation and the interest being shown in what we have to offer.

There is an important link between these two items. With increased membership and increased interest come increased expectations. That was clear in a number of the debates we had at last year's CIML, not least the lively discussion at the MAA Seminar. And we are fortunate that as a result of our process of renewal, we are better placed as an Organisation to meet these expectations.

The challenge before us, therefore, is that we make the most of these opportunities. As the work on refurbishment is completed and as our website is finalized, the staff in the Bureau will be able to spend more time on outward-facing tasks. At the same time we need to be aware that most of the resources for the OIML's work come from its Members. Our new systems will make it easier for more representatives from Member Countries to participate; however, we will not draw the full value out of all these changes unless there is actually a greater use of these facilities. But I am confident that we will make good use of them because every time I meet colleagues in the OIML, I see a very high level of personal enthusiasm and commitment, which is the final reason for my optimism.

I look forward to working with you as we explore how we can do more for the worldwide legal metrology community. May I wish all our Members and Readers of the Bulletin a happy new year. ■

Bonne Année !

Quand je regarde l'année 2014, je suis très optimiste. J'ai plusieurs raisons de l'être, à commencer par le nouveau site Internet et la rénovation des locaux du BIML à Paris. Ce sont là des signes matériels du processus de renouveau qui est en cours depuis trois ans au sein du Bureau. S'y ajoutent des changements de politiques et de procédures, parmi lesquels un nouveau système de gestion financière, la révision des Statuts du personnel et une réforme de la façon dont nous menons à bien nos travaux techniques.

D'autres raisons m'invitent à l'optimisme, notamment la progression continue du nombre de Membres de notre Organisation et de l'intérêt porté à ce que nous avons à offrir.

Il existe un lien important entre ces deux aspects. Le nombre de Membres et l'intérêt allant en grandissant, les attentes, elles aussi, grandissent. Un certain nombre de débats que nous avons eus l'année dernière au CIML, en particulier nos échanges animés lors du Séminaire sur le MAA, l'ont clairement montré. Et c'est une chance que d'avoir engagé un processus de renouveau qui permet à notre Organisation d'être mieux outillée pour répondre à ces attentes.

Le défi qui nous attend est donc de tirer le meilleur parti des possibilités ainsi offertes. Maintenant que le travail sur la rénovation des locaux est achevé et que notre site Internet est finalisé, le personnel du Bureau va pouvoir consacrer plus de temps à des tâches orientées vers l'extérieur. Nous devons en même temps être conscients que l'essentiel des ressources nécessaires à l'activité de l'OIML provient de ses Membres. Nos nouveaux systèmes faciliteront la participation de davantage de représentants de Pays Membres ; mais nous ne pourrons pas retirer pleinement les bénéfices de tous ces changements, à moins de faire réellement une plus grande utilisation de ces dispositifs. Je suis cependant convaincu que nous en ferons bon usage, car, chaque fois que je rencontre des collègues de l'OIML, je vois le grand élan d'enthousiasme et de motivation qui les animent : telle est ma dernière raison d'être optimiste.

Je me réjouis à la perspective de travailler avec vous et de réfléchir à ce que nous pouvons faire de plus pour la communauté internationale de métrologie légale. À l'ensemble de nos Membres et des Lecteurs du Bulletin, je souhaite une bonne et heureuse année. ■

CONFORMITY ASSESSMENT

Conformity assessment using Monte Carlo methods

Jos G.M. van der Grinten, NMi EuroLoop and
Alex M. van der Spek, ZDoor B.V.,
The Netherlands

Abstract

Conformity assessment is the activity to determine whether specified requirements relating to a product, process, system, person or body are fulfilled. Often measurements are used to show that the value of the measurand is within (legal) tolerances. Currently analytical methods are available to test whether tolerances are met with a preset level of confidence, e.g. 95 %. The test requires the availability of the overall measurement uncertainty and the statistical distribution of the measurand. In absence of better information this distribution is assumed to be Gaussian.

The new point in this paper is that Monte Carlo methods can be applied directly to perform the conformity assessment. The reason is that the Monte Carlo process generates the cumulative distribution, whereby the (legal) tolerances can be compared directly. The advantage of this process is that the type of distribution does not need to be known and the (worst case) assumption of the distribution being Gaussian can be avoided. Consequently, for a Monte Carlo method the difference between tolerances and acceptance criteria is slightly smaller than for analytical methods.

A test of the Monte Carlo method applied to a calibration of a high-pressure gas meter meeting the maximum permissible errors of the European *Measuring Instruments Directive* (MID) demonstrates the applicability of the method in practice.

Introduction

Conformity assessment is the activity to determine whether specified requirements relating to a product, process, system, person or body are fulfilled. Often measurements are used to show that the measurand falls within (legal) tolerances. Currently analytical methods [3] – [7] are available to test whether tolerances are met with a preset level of confidence, e.g. 95 %. The test requires the availability of the overall measurement uncertainty and the associated probability density function.

The overall uncertainty can be evaluated by analytical methods [1] or Monte Carlo simulation [2]. The probability density is often assumed to be Gaussian. If no exact knowledge of the statistical distribution of the measurand is available, the choice of a Gaussian distribution is the worst case approximation [3], [4].

Monte Carlo methods for uncertainty evaluation prove to be especially useful in cases where a non-linear relationship exists between input quantities and the measurand, where the uncertainty is large compared to the value of the quantity, or where input quantities can only be evaluated numerically by software code.

During verification a measuring instrument is approved or rejected on the basis of maximum permissible errors (mpe) stipulated in legislation. The confidence level of these metrological decisions is affected by the measurement uncertainty. The statistical methods in these publications [3] – [7] have in common that substantial knowledge of statistical testing is required to perform the tests.

At this point the new Monte Carlo Method offers an interesting opportunity. At the same time the uncertainty analysis is made, the statistical testing can be performed. Only a few lines of software code need to be added to the implementation of the Monte Carlo Method.

NMi has developed a Monte Carlo software tool in which this additional feature was implemented. This tool was used to apply the Monte Carlo method on the example of the verification of a high-pressure gas meter that has to meet the mpe of the European *Measuring Instruments Directive* (MID) [8], [9].

Calibration model

The calibration of volume flow gas meters with high pressure natural gas is based on the integral formulation of the mass conservation law applied to a fixed volume V with surface F. The increase in mass per unit time in V equals the mass flow through the surface F

$$\frac{\partial}{\partial t}\iiint\limits_V \rho \, dV = -\iint\limits_F \rho\,(\mathbf{v}\cdot\mathbf{n})\,dF \qquad (1)$$

in which $\mathbf{v}$ is the fluid velocity vector and $\mathbf{n}$ a normal vector of length 1 perpendicular to the surface F pointing outside of V. $(\mathbf{v}\cdot\mathbf{n})$ is the dot product of $\mathbf{v}$ and $\mathbf{n}$, which means that a fluid flow entering V obtains a

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negative sign and a fluid flow leaving V obtains a positive sign.

For the calibration V is the volume between the master meters and the meter under test (MuT). The fluid enters V via the master meters and leaves V via the MuT. Both masters and MuT measure gas in volume units. The volume V having thick steel walls is assumed to be constant in time. As the fluid flows through closed conduits, the fluid velocity times the cross section is the volume flow rate Q. With n parallel master meters equation (1) can now be written as

$$V \frac{\partial \rho_V}{\partial t} = -\rho_2 Q_2 + \sum_{i=1}^{n} \rho_{1i} Q_{1i} \qquad (2)$$

where the index 1 refers to the cross section at the master meters and 2 refers to the MuT.

The density ρ is a function of pressure p, temperature t and the gas composition x:

$$\rho = \rho(p, t, x) \qquad (3)$$

The equation of state used to compute ρ from p, t and the gas composition x is in this example the AGA-8 model [10], which can handle 21 gas components. The AGA-8 algorithm will be evaluated numerically.

The flow rate Q is computed from an integer number of pulses N collected during an interval τ:

$$Q_{si} = \frac{N_{si}}{I_{si}\,\tau_{si}}, \quad Q_m = \frac{N_m}{I_m\,\tau_m} \qquad (4)$$

in which I is the impulse factor of the meter [pulse / m³].

The objective of the calibration is to determine the deviation e_m of the meter under test as a function of the flowrate Q_m indicated by the MuT

$$e_m = \frac{Q_m}{Q_2} - 1 \qquad (5)$$

In the calibration process corrections are applied for all known deviations. For the master meter i the deviation e_{si} depends on the calibration pressure and the flowrate Q_{si} indicated by the master. The correction for this deviation leads to

$$Q_{1i} = \frac{Q_{si}}{1 + e_{si}} \qquad (6)$$

The mass accumulated in V during the calibration time interval τ_V is determined from the volume V and the densities $\rho_{start} = \rho(p_{start}, t_{start}, x)$ at the start and $\rho_{end} = \rho(p_{end}, t_{end}, x)$ at the end of the calibration. The gas composition is assumed to be constant during the calibration time interval τ_V.

Successive substitution of equations (3–6) in equation (2) leads to

$$V \frac{\rho_{end} - \rho_{start}}{\tau_V} = -\frac{\rho_2\, Q_m}{1 + e_m} + \sum_{i=1}^{n} \frac{\rho_{1i}\, Q_{si}}{1 + e_{si}} \qquad (7)$$

from which the deviation e_m can be solved:

$$e_m = \frac{\rho_2\, N_m / I_m\, \tau_m}{\frac{(\rho_{start} - \rho_{end})\, V}{\tau_V} + \sum_{i=1}^{n} \frac{\rho_{1i}\, N_{si}}{I_{si}\tau_{si}(1 + e_{si})}} - 1 \qquad (8)$$

Statistical testing

All statistical tests start with the formulation of a null hypothesis H_0, which in our example is that the gas meter will meet the MID mpe. If the measurand with its associated uncertainty is well within the mpe, H_0 will be accepted. This corresponds to the green points in Figure 1. If the measurand equals the tolerance, there is an equal probability that the measurand will and will not meet the mpe. In that case a decision cannot be made. This corresponds to the blue points.

If the null hypothesis H_0 cannot be accepted it will be possible to test an alternative hypothesis H_1, which states that the measurand is outside the tolerances. If the red points are observed, H_1 will be accepted. If the blue points are found, hypothesis H_1 has to be rejected.

Figure 1 shows that there is a region (blue points) in which both H_0 and H_1 cannot be accepted.

H_0 is typical for conformity assessment where we need to show that meters are conforming. The alternative hypothesis H_1 is typical to inspections where the inspector looks for non-conforming products or the police enforcing the speed limit. A more elaborate discussion on this topic can be found in [3] and [4]. For the case of our gas meter we will only test H_0.

Monte Carlo method

The Monte Carlo process is schematically depicted in Figure 2. The output quantity Y is a function of a vector $\boldsymbol{X}$ of N input quantities X_j, each with its specific probability density function (PDF-j). Now M trials are chosen, e.g. 100 000. Input estimates $x_{j,k}$ are generated for $j = 1..N$ and the output estimate $y = f(x_j)$ is calculated. This process is repeated for each trial $k = 1..M$. The result is a bin with M values of y. The values y_k are sorted in ascending order, which gives the cumulative distribution function (CDF-Y). The probability density

Figure 1 Conforming (green) and non-conforming (red) measurands. The purple points are not conforming and not non-conforming.

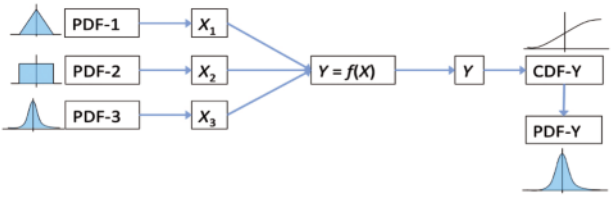

Figure 2 Schematic representation of the Monte Carlo process

function of (PDF-Y) is obtained by differentiation of the CDF-Y.

The estimate of Y is $\bar{y}$ the average of all y_k. The associated standard uncertainty is the experimental standard deviation of all y_k.

In the next step the 95 % coverage interval will be obtained. Figure 3 shows the sorted output estimates. For any value y_q the probability that the value Y will be smaller than the q^{th} estimate of y is $P(Y \leq y_q) = q/M$. For $q = 0$ $P(Y \leq y_q)$ and for $= M$ $P(Y \leq y_q) = 1$. An interval covering 95 % of the output estimates is $[y_q, y_{q+0.95M}]$. This corresponds to the blue cells in Figure 3. The index q can now be chosen such that the interval is symmetric around $\bar{y}$. It is also possible to choose q such that the length of the interval $[y_q, y_{q+0.95M}]$ around $\bar{y}$ is minimal, which may result in a non-symmetrical uncertainty interval.

In general the coverage interval between y_q and y_k is $P(y_q \leq Y \leq y_k) = (q - k)/M$.

Statistical tests using Monte Carlo

Now the coverage interval has been established it is a straightforward procedure to compare the coverage interval with a series of preset tolerances. This is schematically shown in Figure 4. In the upper and middle rows the coverage interval is within the tolerances and the null hypothesis H_0 is accepted. In the lower row the lower tolerance is in the coverage interval and H_0 is rejected.

Based on the acceptance of H_0 the decision is made that the meter complies with the mpe requirements. The use of a 95 % coverage interval means that this decision is made with a confidence level of at least 95 %. By changing the length of the coverage interval the confidence level of the decision changes accordingly.

In the same way the alternative hypothesis H_1 can be tested, i.e. the tolerances are exceeded. This process is schematically shown in Figure 5. If the 95 % coverage interval entirely exceeds the upper tolerance (tol+), H_1 is accepted. If not H_1 is rejected.

For quality control purposes we created the possibility of testing using additional criteria at the same time.

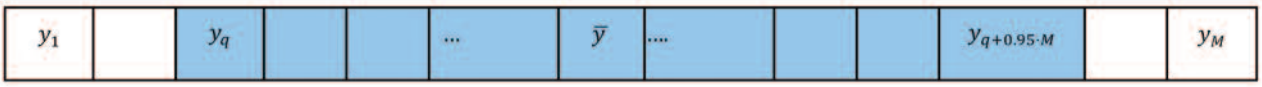

Figure 3 Output estimates y_k, k=1..M in ascending order. The blue cells represent the 95 % coverage interval.

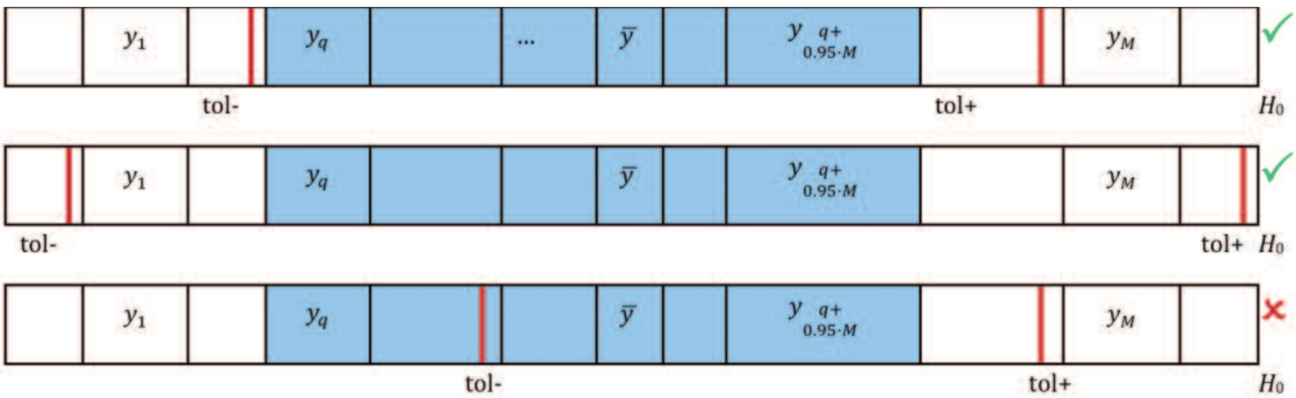

Figure 4: Tolerances (red lines) and coverage intervals around y (blue cells) while testing the null hypothesis H_0. In the upper and middle rows the coverage interval is within the tolerances and H_0 is accepted. In the lower row the lower tolerance is in the coverage interval and H_0 is rejected.

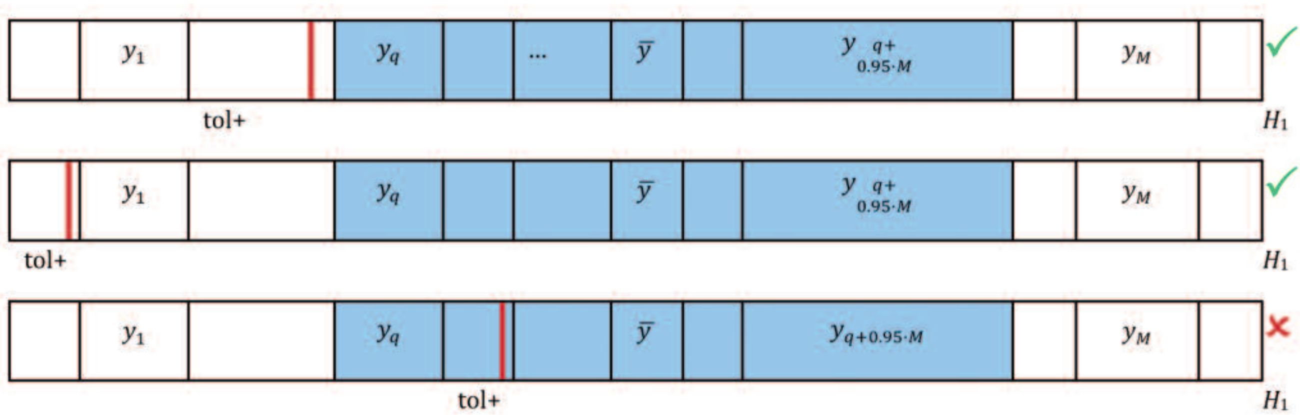

Figure 5: Tolerances (red lines) and coverage intervals around ȳ (blue cells) while testing the alternative hypothesis H_1. In the upper and middle rows the coverage interval is within the tolerances and H_1 is accepted. In the lower row the lower tolerance is in the coverage interval and H_1 is rejected.

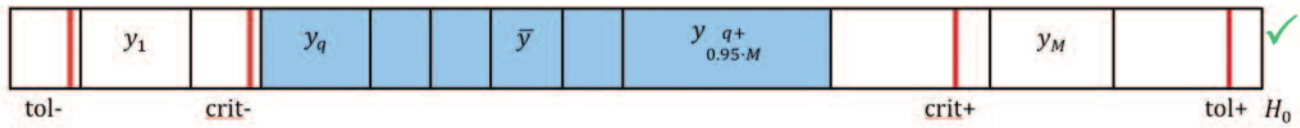

Figure 6: Statistical test with additional criteria crit- and crit+. In the above figure the result y meets both the tolerances tol- and tol+ and the additional criteria crit- and crit+ with 95 % confidence.

Monte Carlo software tool

Thanks to the fact that PCs and laptops have become more and more powerful, Monte Carlo methods have become easily accessible for metrologists. The Monte Carlo software tool developed at NMi was initially an experiment to see whether the method would be feasible in daily metrology practice.

The design choices for the Monte Carlo Method (MCM) software were, from the outset, heavily biased towards the user. It was thought to be essential that the MCM could be used by metrological workers with varying skill levels. In effect widespread use of the MCM was deemed more important than speed, security or implementation details of varying nature. This has led us to develop the MCM tool entirely within Microsoft Excel.

A user can run a Monte Carlo simulation without having to program a single line of code. This is enabled by a feature in VBA (Visual Basic for Applications) not commonly found in other programming languages. VBA allows code to modify itself at runtime. In this case a Set command runs a small piece of dedicated code that replaces the previous code line holding the old model formula with the new model formula.

Validation

Software validation is imperative when developing software tools. The validation of the Monte Carlo simulator was performed by using a series of reference cases:

10 examples of Monte Carlo analysis discussed in the GUM supplement [6]. These resulted in uncertainty values that were in mutual agreement within 1 %.

Cases that have been analyzed analytically. These are the master meter method for calibrations using air for which the analytical uncertainty analysis was described in [11]. The second case was the bending of an aluminum bar due to a force exerted in the middle of the bar.

The last part was a comparison with NPL [13]. Despite entirely different Monte Carlo implementations, different random number generators and different seeding (i.e. the base number for the random number generator), uncertainty results were comparable within 0.5 %.

Verifications using Monte Carlo

The calibration model was implemented in the Monte Carlo Simulator. Table I (see page 10) shows the input variables and their associated standard uncertainties. The uncertainties listed in the column sigma are the root sum square of the uncertainties from the traceability and the process conditions. For a rectangular distribution the lower and upper limits are given in columns a and b. The column on the right hand side of Table I gives the uncertainty contribution of each input quantity to the uncertainty of the output estimate. The root sum square of all these uncertainties is equal to the overall uncertainty shown in Figure 7. The cells are colored: the higher the uncertainty contribution the darker the color. The most important uncertainty source is the traceability of the reference meters, which is fairly common in gas flow metrology.

Figure 7 shows the dashboard of the Monte Carlo Simulator. The green cells are input to the simulator, the purple cells are the output results. The left red box contains the output estimate and the associated standard uncertainty, so the deviation of the meter under test $e_m = -0.18$ %. The expanded uncertainty is twice the standard uncertainty, i.e. 0.29 %. The top right hand box contains in the green cells the criteria (±0.25 %) and tolerances (±1 %). The purple cells give the associated values of the CDF. For the lower criterion 30.46 % of the generated output values is less than –0.25 %. The area between the lower and the upper criterion covers 69.36 % of the observed values. The lower right hand box gives the result of the test based on the stated confidence level. The calibration result meets the tolerances with at least 95 % confidence. The value of the confidence level can easily be changed without the necessity to re-run the simulation. For this case the tolerances are also met at a confidence level of 99.7 %. If a confidence level of less than 69.36 % is specified the result meets the criteria and consequently also the tolerances.

The Cumulative Distribution Function (CDF) and the probability density function are graphically depicted in Figure 8. The 95 % coverage interval is [–0.46 %; +0.11 %]. The same values are obtained by applying analytical means assuming a normal distribution with a mean of –0.175 % and a standard deviation of 0.146 %. A logical result as most of the input distributions were assumed to be Gaussian.

Conclusions

The new point in this paper is that Monte Carlo methods can be applied directly to perform the conformity assessment. The reason is that the Monte Carlo process generates the cumulative distribution, with which the (legal) tolerances can be compared directly. The advantage of this process is that the type of distribution does not have to be known and the (worst case)

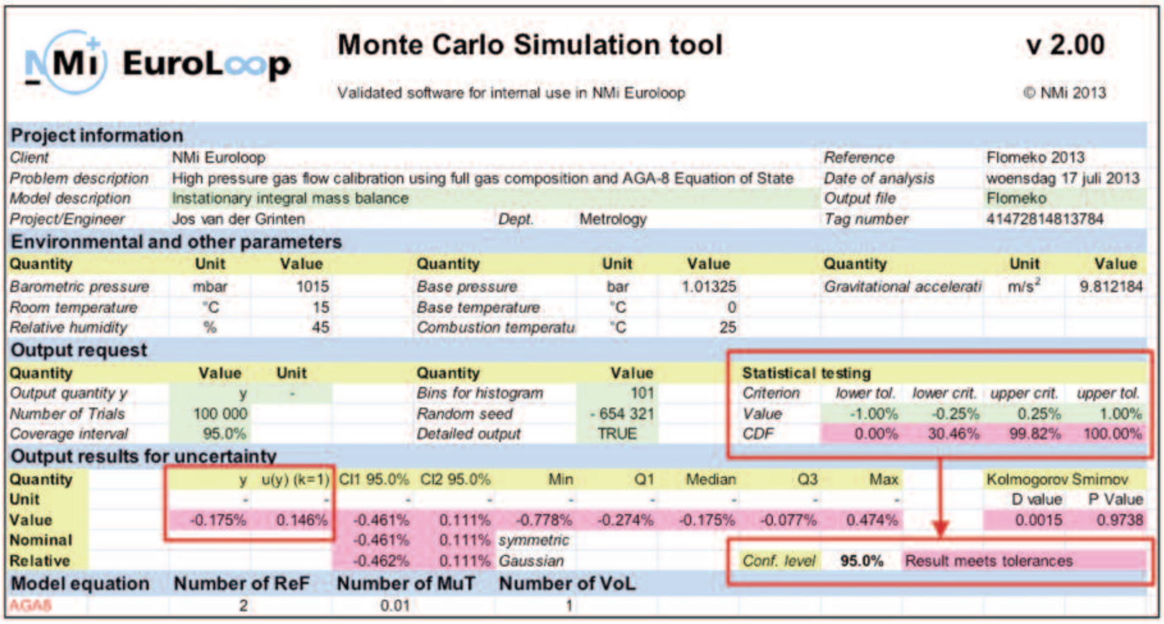

Figure 7: Dashboard of the Monte Carlo Simulator. The left red box contains the output estimate and the associated standard uncertainty. The top right hand box contains in the green cells the criteria and tolerances, the purple cells give the associated values of the CDF. The lower right hand box gives the result of the test based on the stated confidence level.

Table I: Input quantities (first 7 columns) and results (right most column) of Monte Carlo simulation

Quantity	unit	distribution	mu	sigma	a	b	process	traceability	$u(y)$
p_11	bar	Gaussian	59.875	0.00316			0.001	0.003	3.1E-05
t_11	°C	Gaussian	14.12	0.06185			0.015	0.06	1.8E-04
N_s1		Rectangular	14243		14242	14244			2.5E-05
I_s1	m-3	Constant	206.5						0
tau_s1	s	Gaussian	100.5035	0.00014			0.0001	0.0001	7.2E-07
e_s1		Gaussian	0.95%	0.00200				0.20%	1.0E-03
p_12	bar	Gaussian	59.884	0.00316			0.001	0.003	3.0E-05
t_12	°C	Gaussian	14.06	0.06083			0.01	0.06	1.7E-04
N_s2		Rectangular	13452		13451	13453			2.6E-05
I_s2	m-3	Constant	206.5						1.95E-18
tau_s2	s	Gaussian	100.5041	0.00014			0.0001	0.0001	6.8E-07
e_s2		Gaussian	0.69%	0.00200				0.20%	9.7E-04
p_start	bar	Gaussian	59.875	0.00361			0.002	0.003	2.2E-09
t_start	°C	Gaussian	14.06	0.06500			0.025	0.06	1.2E-08
p_end	bar	Gaussian	59.865	0.00361			0.002	0.003	2.2E-09
t_end	°C	Gaussian	14.12	0.06500			0.025	0.06	1.2E-08
V	m3	Gaussian	15.2	0.00000					3.2E-10
tau_V	s	Gaussian	100.5	0.00014			0.0001	0.0001	2.4E-14
p_2	bar	Gaussian	59.844	0.00316			0.001	0.003	6.1E-05
t_2	°C	Gaussian	14.08	0.06083			0.01	0.06	3.5E-04
N_m		Rectangular	53146		53145	53147			1.3E-05
I_m	m-3	Constant	400						0
tau_m	s	Gaussian	100.4992	0.00014			0.0001	0.0001	1.4E-06
X1_C1	molfrac	Gaussian	0.90327	0.00163			0.00157	0.00045	2.7E-08
X2_C2	molfrac	Gaussian	0.04791	0.00050			0.00044	0.00024	9.2E-08
X3_C3	molfrac	Gaussian	0.01297	0.00075			0.00074	0.00006	2.5E-07
X4_iC4	molfrac	Gaussian	0.00191	0.00011			0.00011	0.00001	5.5E-08
X5_nC4	molfrac	Gaussian	0.00276	0.00016			0.00016	0.00002	7.4E-08
X6_iC5	molfrac	Gaussian	0.00063	0.00004			0.00004	0.00000	2.4E-08
X7_nC5	molfrac	Gaussian	0.00054	0.00005			0.00005	0.00000	3.0E-08
X8_C6	molfrac	Gaussian	0.00067	0.00091			0.00091	0.00000	6.7E-07
X9_C7	molfrac	Constant	0						0
X10_C8	molfrac	Constant	0						0
X11_C9	molfrac	Constant	0						0
X12_C10	molfrac	Constant	0						0
X13_CO2	molfrac	Gaussian	0.01099	0.00018			0.00017	0.00006	1.6E-08
X14_N2	molfrac	Gaussian	0.01835	0.00030			0.00029	0.00009	4.2E-08
X15_H2S	molfrac	Constant	0						0
X16_He	molfrac	Constant	0						0
X17_H2O	molfrac	Constant	0						0
X18_O2	molfrac	Constant	0						0
X19_Ar	molfrac	Constant	0						0
X20_H2	molfrac	Constant	0						0
X21_CO	molfrac	Constant	0						0

assumption of the distribution being Gaussian can be avoided. Consequently, for a Monte Carlo method the difference between tolerances and acceptance criteria is slightly smaller than for analytical methods.

A test of the Monte Carlo method applied to a calibration of a high-pressure gas meter meeting MID mpe demonstrates the applicability of the method in practice. ■

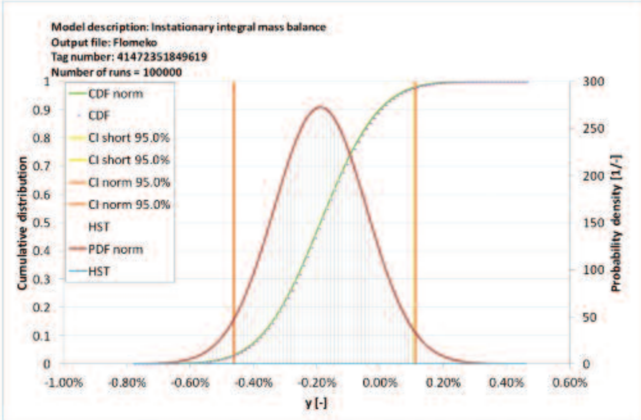

Figure 8: CDF and PDF as a function of the output estimate. The left vertical axis applies to the CDF, the right vertical axis to the PDF. The 95 % coverage interval is marked by two vertical lines.

Abbreviations and symbols

CDF	Cumulative Distribution Function or Distribution Function
MuT	meter under test
PDF	Probability Density Function
tol+	upper tolerance
tol-	lower tolerance
H_0	null hypothesis
H_1	alternative hypothesis

symbols

e	deviation	[%]
I	impulse factor	[1/m³]
N	number of pulses counted during a calibration run	[-]
$\mathbf{n}$	normal vector	[-]
P	probability	[-]
p	absolute pressure	[bar]
Q	volume flowrate	[m³/h]
t	temperature	[°C]
V	volume between master meters and MuT	[m³]
v	fluid velocity	[m/s]
Y	output quantity	
y	output estimate	
$\bar{y}$	average of output estimates	
ρ	density	[kg/m³]
τ	time interval corresponding to an integer number of pulses	[s]

Indices

1	at the position of the master meter
2	at the position of the MuT
i	rank number of the master meter
k	rank number of output estimates y
M	number of trials in the Monte Carlo simulation
m	indicated by the MuT
n	number of parallel master meters
q	rank number of the start of the coverage interval
V	at the volume between masters and MuT

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The Authors

Jos G.M. van der Grinten,
NMi EuroLoop, The Netherlands

Alex M. van der Spek,
ZDoor B.V., The Netherlands

HISTORY OF WEIGHING

Part 11: Weighing loose bulk products

Wolfgang Euler and Werner Braun,
Hennef/Sieg

1 OIML R 107 *Discontinuous totalizing automatic weighing instruments (totalizing hopper weighers)* for receiving and shipping loose bulk products

1.1 Bulk and loose bulk products – introduction

Throughout the world, discontinuous totalizing automatic weighing instruments (known as totalizing hopper weighers) are the most widely used type of weighing instruments for weighing loose bulk products such as cereals, both in the silos of cooperatives and farmers and also in ports before or after their transport. The weight determined is important, since it is used to calculate the value of the product – this value is used as the basis for commercial transactions.

Therefore, the weighing of loose bulk products according to OIML R 107 will be considered first, since everything began with loose products, followed by automatic gravimetric filling instruments ("bagging scales") according to OIML R 61, and later checkweighers and price-indicating scales in accordance with OIML R 51.

There are many mechanical and electronic weighing systems whose type designation contains the word "bulk" (e.g. "Bulk 9" or "Bulk controller"). The term "bulk" designates a granulose or lumpy mixture in a free flowing form. The properties of bulk goods are determined by the grain size and the grain distribution as well as by the bulk density, the dumping angle, the moisture content and the temperature.

Bulk products are primarily foodstuffs such as all types of cereals, rice, sugar, salt, coffee, flour and pellets. Even construction materials such as sand, gravel, cement or raw materials such as ores, coal, etc. can be considered as bulk goods.

1.2 Cereals, flour and rice – the most fundamental and oldest foodstuffs

Cereals, flour and rice are the most important replenishable foodstuffs for mankind and should be available in sufficient quantity for the whole of the world's population. The authors have therefore decided to pay particular attention to this special topic.

1.3 From harvesting the cereals to bread

Farmers all over the world (who, incidentally, are expert nature conservationists) first till the fields, then sow barley, rye, wheat, or oats. From this moment on until harvest time, the fields have to be constantly tended. Of course, also the spring and summer weather plays an important role in the growth of the various types of cereals and, thus, in the success of the harvest. The process is described below.

1 Harvest and transport of the cereals to the cooperatives (e.g. Raiffeisen or BayWa in Germany), farmers or organic farmers and other silos for storage (see Figures 1 to 3).

2 Through a receiving hopper and a weighing instrument (approved and verified), the cereals are conveyed to the cleaning station. The cereals are cleaned by means of scalping sieves, drum screens and grain sieves as well as an air separator, if necessary. The excessive moisture (measured upon arrival) and the impurities (also called "strip waste") are deducted from the total weight of the delivered goods. Non-organic cereals are considerably cleaner than organic cereals on delivery (see Figures 4 and 5).

3 When the cereals have been cleaned thoroughly in all parts of the silos, they are loaded onto ships, trucks or trains via a verified weighing instrument in order to bring them to the mills, malthouses or breweries (see Figure 6).

4 Here, too, the cereals are weighed upon arrival by means of a verified weighing instrument.

5 At the mills, there is a so-called "milling extraction control unit". The milling flour extraction control is determined by means of a number of internal extraction scales which do not necessarily have to be verified. Receiving and shipping scales are used for trade and thus must have a type-approval certificate and have undergone verification.

6 At the mill, the flour extraction rate monitoring system determines how much flour of type A, B or C was produced as well as the bran and impurities incurring. In order to determine all this, the cereals are, at the beginning of the extraction process, weighed using a weighing instrument (the "First Break Weigher").

7 Once the flour has been produced it is loaded into tanker trucks as bulk via a verified weighing instrument. As an alternative, it can also be bagged (e.g. in "big bags" or in open or valve sacks of 10 kg, 25 kg or 50 kg, but also in smaller containers of 250 g or 500 g). The weight is checked by checkweighers. Smaller containers are subject to the ordinance on prepackages.

8 Now as in the past, the flour is taken to the bakeries where of course the bread is baked.

Harvest at the "Demeter" organic farm in Hennef-Dambroich, Germany on 2 August 2013

Fig. 1 Rye field

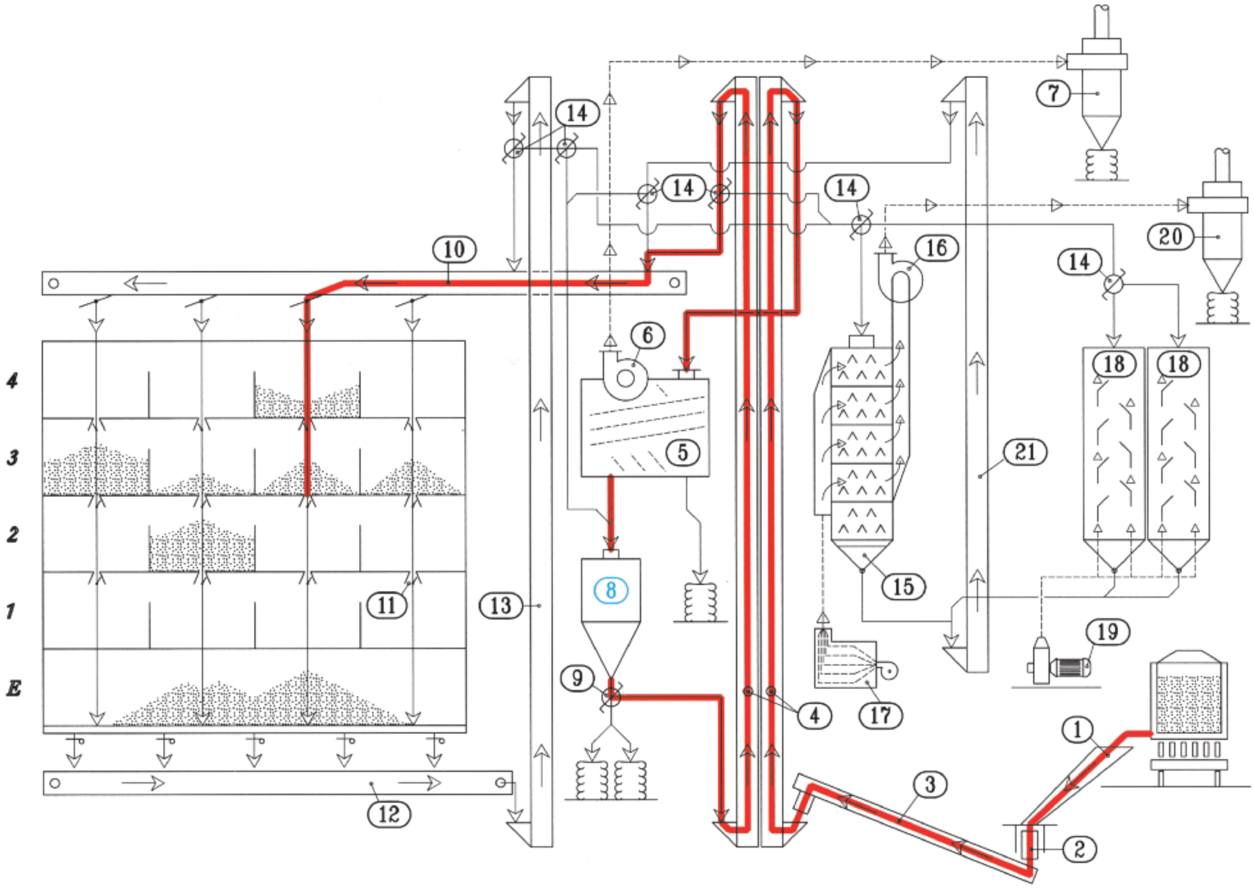
Fig. 2 The combine harvester unloads the grain

Fig. 3 Farmworker at the receiving hopper

Fig. 4 First strip waste of organic grain from the drum screen

Fig. 5 Strip waste from the air separator

Fig. 6 Grain ready to be shipped to the mill

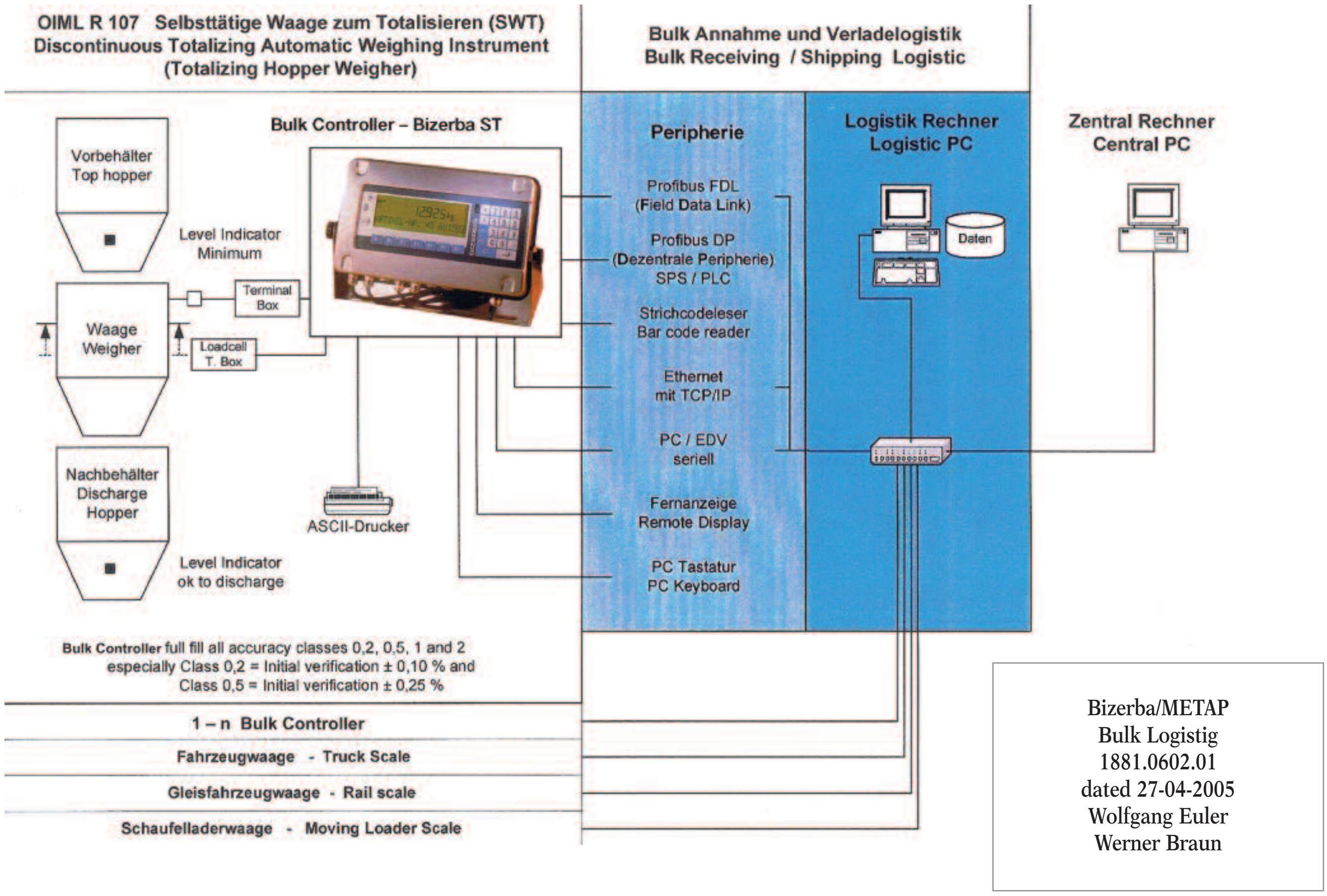


Function scheme of a flat-floor storehouse in Münster-Coerde. Diagram based on a figure from the Farwick-Mühlenbau company

1) Receiving hoppers at the ramp
2) Post-bin drag-chain conveyor
3) Transversal drag-chain conveyor
4) Double elevator, first side: receiving, second side: lifting
5) Cleaning facility with a sieve each for earth clumps, grains and sand
6) Fan
7) Separator for dust from the dryer
8) Grain scales
9) Diverter: towards the elevator (4), or towards the bagging facility
10) Distribution in the storage floor (drag-chain conveyor)
11) Lock diverter to the four bulk storage areas
12) Collecting conveyor in the basement towards the elevator (13)
13) Elevator
14) Diverters either towards: the dryer, the airing cells or the bagging facility
15) Dryer (roof dryer)
16) Dryer blower
17) Drying oven
18) Airing cells
19) Airing blower
20) Separator (cyclone), central aspiration
21) Elevator: once from the dryer to the storage floors or twice from the airing cells to the storage floors or to the bagging facility

In red: Path followed by the cereals from the waggon to the storage floors

Starting from the arrival (1), to the post-bin drag-chain conveyor (2), via the transversal drag-chain conveyor (3) to the double elevator's first side (4), via the cleaning facility (5) to the grain scales (8), via the diverter (9) to the double elevator's second side (4), to the drag-chain conveyor (distribution) (10), to the storage floor distributors.



In a later article the detailed costs will be discussed of the very long and intensive process of producing bread (sowing, harvesting, grinding, baking). The results obtained will then be compared with the costs involved in producing and processing 100 L of petroleum to obtain fuel.

Another report on the further processing of cereals into flour, the loading of flour as bulk and the bagging into bags and smaller containers will be published in due course.

2 Cereal storage technology and cereal treatment

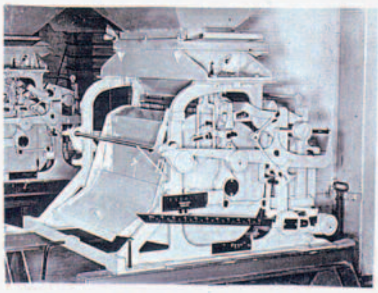
The function chart/diagram below shows the main functions in a grain storage silo which formerly used to be carried out at a so-called "mimic panel". Today, grain storage silos are operated with SPS controls.

The general sequences in the grain silos (or similar) are clearly depicted in the function diagram. No. 8 stands for the integrated grain balance – previously a Chronos balance was normally used which needed no energy of its own for weight determination. The weighing process relied on the gravitational force (gravimetric principle) exerted by the bulk product. As Wolfgang Euler's grandson, Patrick, recently said while visiting Becker's "Demeter" organic farm: "Grandpa, that means that the grain is the electricity for the scales". Today, electronic balances are usually used as receiving scales – or as shipping weighers, if necessary – in this place (no. 8 in the diagram). No. 9 in the diagram shows the diverter which can be set to "bagging". This "bagging" configuration is no longer used in this way today.

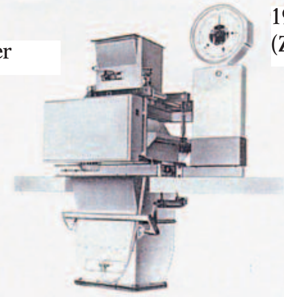
3 Receiving/shipping bulk logistics today

The diagram of the receiving/shipping bulk logistics first shows, on the left, the mechanical part of the totalizing automatic weighing instrument in accordance with OIML R 107, consisting of a storage hopper, the weigher and a discharge hopper. The weight is then determined analogically via load cells which are located in or on the bulk weigher. In certain load cells (for more details on load cells, please refer to "Mühle + Mischfutter", Issues No. 17 and 18 (Parts 7 and 8) and to the OIML Bulletin

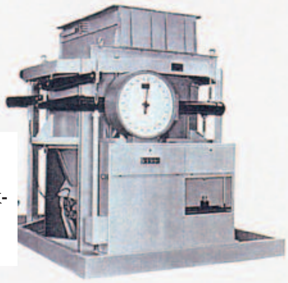
1883-2000: G balance. Here: G100 with residue weigher



1962-1971: Automatic bench scales with (ZBF) double-pendulum mechanism

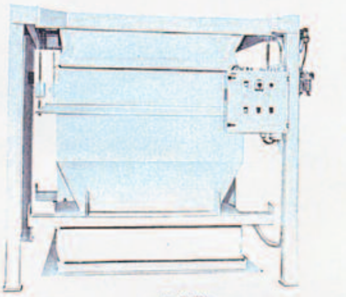


1972-1981: Receiving/shipping scales with automatic bench scales (spring mechanism) 1st design with decimal checkweigher and shock-mount frame for mobile receiving lift at the pier

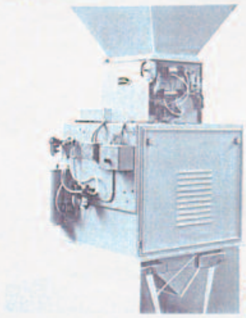


Small cereal silo in Canada with G100

Hopper scales for receiving and loading bulk goods receiving/shipping scales 101/501

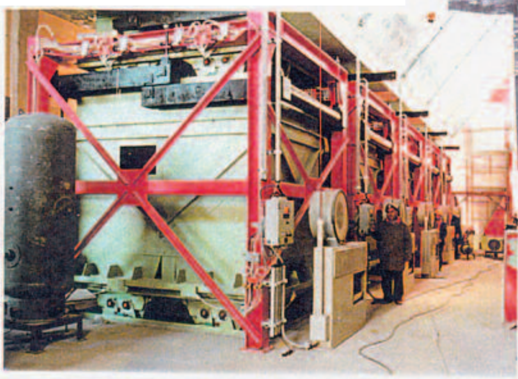


Receiving/shipping scales up to 10 000 kg Hopper scales for receiving and loading bulk goods



Since 1981 receiving/shipping scales in full load-cell design. Output: up to 1 550 t/h heavy cereals

Silo facility of the J. Müller company in Brake-Unterweser

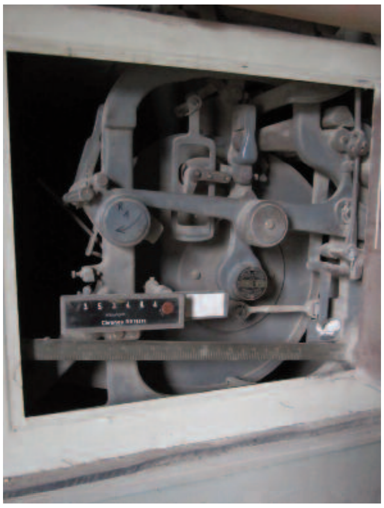


1981: 5 receiving/shipping scales 10 000 kg in Rio Grande

Right: 3 of 4 mobile lifts in Rio Grande

OIML R 107 *Discontinuous totalizing automatic weighing instruments (totalizing hopper-weighers)*. Receiving and shipping through the ages.





Chronos G 100 at the Demeter Biohof in Hennef-Dambroich (100 kg damping weight).
Note that when closed (center picture) it can be locked by key to protect against unauthorized intervention.

Parts 7 and 8 (OIML Bulletin, April 2013, pp. 17–23), the analogue signal of the measured value is directly converted into a digital value. In our example (as is most frequently the case), however, the analogue measured value is transmitted to an electronic weighing unit whcih contains the A/D (analogue-to-digital) converter.

The control elements located on the automatic bulk weigher – such as the sensors for the gats / flap inlet or the outlet monitoring (door open/closed), the pressure monitoring unit, the solenoid valves, the silo detector, etc. – are connected in a terminal box and, from there, conducted to the electronic weighing unit. The bulk controller needs this to control the complete flow.

The accuracy classes presently valid and also the maximum permissible errors on initial verification in accordance with OML R 107 are listed in the figure on the previous page.

On the right, the receiving/shipping bulk logistics diagram shows the necessary options for connecting the bulk controller to the so-called "peripheral devices".

Via the direct serial connection or as a participant of the customer's Ethernet or profibus network, it is possible to transmit, on the one hand, the parameters required for the controlling process from the customer's IT system to the electronic weighing unit. On the other hand, these connections also allow all the weighing results to be transmitted to the customer's computer in order to issue shipping orders and invoices and to save the data to the databases. As a general rule, the shipping order for the customer is issued directly via the printer that is connected to the weighing terminal.

This article will be continued under the title "Fundamental technological setup and function of totalizing automatic weighing instruments, including function description, requirements with regard to type approval and verification in accordance with OIML R 107, and description of the dynamic verification test in automatic operation". ■

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EMC TESTING

NMIJ test facility for immunity to radiated electromagnetic interference used for type approval testing of measuring instruments in conformity with international requirements

Tomoko Fukuzaki, Katsuhiko Harada
Shinsuke Mikura, Kazuo Neda
NMIJ/AIST, Japan

Abstract

In 2006, the National Metrology Institute of Japan (NMIJ) renovated its facility for electromagnetic immunity testing used in the type approval procedure. The facility was originally developed in 1995 based on IEC 801-3 (1984)[1]. The aim of the renovation was to meet the new specifications with an extension of the maximum testing frequency from 1 to 2 GHz in accordance with the updated standard IEC 61000-4-3 Second Edition (2002-3)[2] as well as to improve the efficiency of the test procedure. In this renovation, the anechoic chamber for the immunity test was upgraded in order to maintain a uniform electromagnetic field in the extended frequency range. A new wideband antenna was also employed to generate an electromagnetic field to meet the requirements. Consequently, the renovation of the test facility has achieved its goals by confirming the conformity to the relevant IEC standards.

Since this renovation there have been other achievements in NMIJ, and the relevant IEC standards have since been further updated. However, this report is provided as useful information for OIML Members who may be planning to renovate an old electromagnetic immunity testing facility at limited expense.

1 Introduction

The National Metrology Institute of Japan (NMIJ) within the National Institute of Advanced Industrial Science and Technology (AIST) is an issuing authority for type approval certificates utilized in Japan. NMIJ is also an OIML issuing authority as well as a testing laboratory in the framework of both the Basic certificate system and the OIML MAA (Mutual Acceptance Arrangement).

Recently, electromagnetic compatibility (EMC) has become a critical requirement in designing electric instruments. The concept of EMC encompasses both the emission of electromagnetic wave and immunity to electromagnetic interference. In the type approval test of the specified measuring instruments under legal metrology, immunity to electromagnetic fields is the most important characteristic to be tested in order to prevent intentional or incidental interference to the instrument. The purpose of this test is to prevent a measuring instrument from delivering an incorrect measurement result by ensuring it can withstand electromagnetic interference or by preventing the measurement from being made if the instrument is affected by the interference. In recent years, certain international standards (e.g. IEC standards) have been largely revised to extend the target frequency range in order to accommodate recent advances in electronics and wireless telecommunications.

NMIJ conducts electromagnetic environment testing for specified measuring instruments with electronic circuits; this was introduced when the Measurement Act was revised in 1993. NMIJ renovated its facility for radiated electromagnetic interference test in 2006 to meet the new specifications with an extension of the maximum testing frequency from 1 to 2 GHz in accordance with IEC 61000-4-3 Second Edition 2002-3 [2] (hereafter "Second ed."), which was a revised edition of IEC 801-3 [1], as well as to improve the efficiency of the test procedure. As a result, the renovation of the NMIJ test facility has achieved its goal by proving conformity to the relevant IEC standards in regard to the uniformity of the electromagnetic field radiated in the extended frequency ranges.

2 Trends in the revision of IEC Standards

IEC standards have been revised recently and the frequency ranges for testing accordingly tend to be extended higher. Following these revisions, OIML D 11 (*General requirements for electronic measuring instruments*) [3] was revised in 2004 and again in 2013,

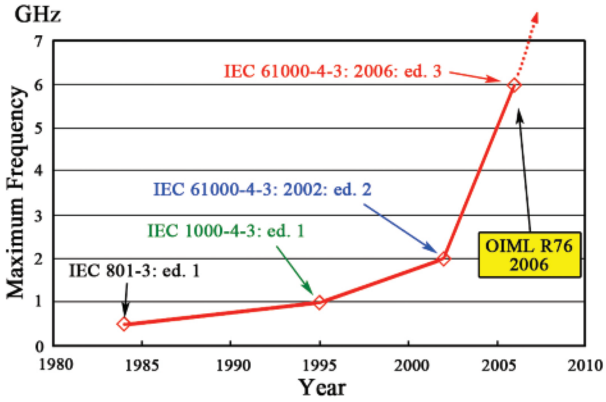

Figure 1 Increase in the maximum testing frequency according to revisions of IEC standards

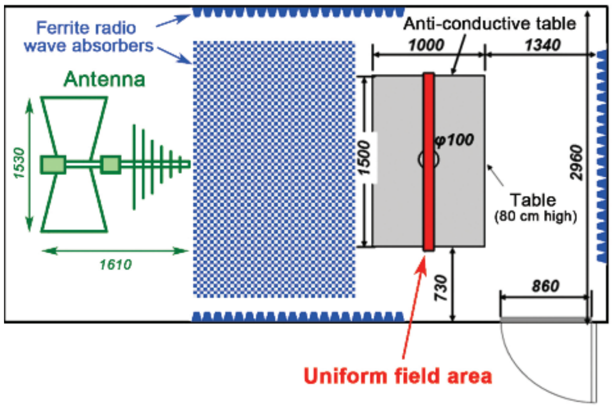

Figure 2 Horizontal layout of the equipment in the anechoic chamber

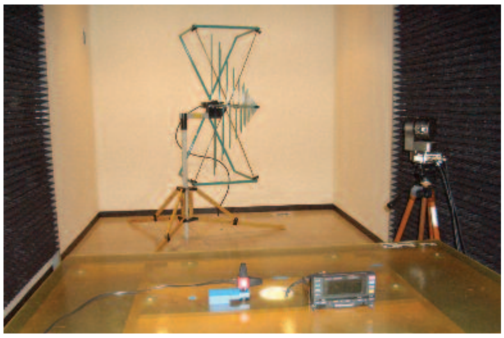

Figure 3 Inside the anechoic chamber with a table for the EUT and an antenna

Figure 4 Control system of the renovated electromagnetic environment test facility (NMIJ)

amongst other reasons to extend the frequency ranges. As a result of the revisions of both the IEC standards and OIML D 11, the OIML Recommendation for non-automatic weighing instruments (R 76) was also revised in 2006 to accommodate the extended frequency ranges. These revisions created a necessity to renovate the NMIJ test facility.

The increase in the maximum frequency for electromagnetic interference tests specified in the successive editions of IEC standards [1, 2, 5] is shown in Figure 1.

As Figure 1 shows, the maximum frequency for testing electromagnetic immunity has risen over 20 years from 500 MHz in 1983 to 2 GHz in 2002 and 6 GHz in 2006. The maximum frequency is expected to rise continuously in the future, one example being the growing individual use of radio waves due, for example, to cell phones which emit strong radio waves at higher frequencies.

3 Renovation of the NMIJ electromagnetic environment test facility

The NMIJ test facility for immunity to radiated electromagnetic fields was built in 1995. It consists of an anechoic chamber, an antenna and a control system, however the specifications did not initially comply with the Second ed. [2] because the maximum capabilities were 1 GHz for frequency and 10 V/m for field strength. As previously mentioned, the main purpose of this renovation was to increase the upper limit of the testing frequency to 2 GHz to perform immunity tests in compliance with the revised IEC standard. To meet this requirement, the following improvements were conducted:

- shield performance of the anechoic chamber evaluated in the frequency range from 1 to 3 GHz,
- radio-wave absorbers on the anechoic chamber walls upgraded, and
- field-generating antenna upgraded to extend the frequency range.

Figure 2 shows a horizontal layout of the upgraded anechoic chamber. Figures 3 and 4 show the inside of the anechoic chamber and the control system, respectively. After the renovation, the conformity of the test facility with the Second ed. [2] was evaluated since it was a crucial requirement in the immunity test for type approval. In addition, the efficiency of the test procedure was improved in order to conduct the immunity test in the minimum duration. The details of the renovation and its results are reported below.

3.1 Shield performance

Shield performance of the anechoic chamber is an important factor for the safety of the operator since strong electromagnetic waves are radiated in the chamber to realize the specified field strength. The shield performance of the anechoic chamber was maintained with a structure composed of welded or soldered metal plates. Considering the sound structure of the chamber, the shield performance was considered to be maintained within the entire frequency range of operation even after an extension to 2 GHz. However, there was a possibility of leakage of electromagnetic waves near the entrance. Therefore, a practical evaluation of the shield performance was conducted only in the entrance area. In this evaluation, a procedure in compliance with the MIL-STD-285 [4] was employed based on the following steps:

- the intensity of the electromagnetic field outside the chamber was measured using a constant electromagnetic wave with the door open,
- another level at the same point was measured with the door closed, and
- an attenuation coefficient between the two levels was calculated.

The frequency used for the evaluation was scanned from 1 to 3 GHz with a step of 0.1 GHz. The result of this procedure showed that the attenuation coefficient achieved with the shield was at least 80 dB. Therefore, it was concluded that there were no particular safety concerns.

3.2 Extension of frequency range and improvement in efficiency

3.2.1 Radio-wave absorbers in the anechoic chamber

Before the renovation, the frequency range was 26 MHz to 1 GHz in compliance with IEC 801-3 [1]. This performance was realized with the aid of flat-tile shape ferrite radio-wave absorbers covering the entire wall inside the chamber. As mentioned in 3.1, it had already been confirmed that the shield performance of the anechoic chamber satisfied the safety requirement in the frequency range up to 3 GHz. It was therefore decided to keep the original basic structure, and to add wedge-shaped radio-wave absorbers in order to accommodate the extended frequency range of operation elevated up to 2 GHz.

In practice, the absorbers were placed on the walls between the table on which the equipment under test (EUT) is placed and the antenna. The radio-wave absorbers employed were wedge-shaped and about 80 mm high. The principal material of the absorbers was ferric oxide with a high absorption coefficient in the frequency range approximately from 30 MHz to 3 GHz. On the ceiling between the table and the antenna, other pyramid-shaped absorbers made of polypropylene foam mixed with carbon were attached. The absorbers were effective in the higher frequency range over 3 GHz even if the frequency range is extended in the future. By locating these absorbers mainly on the ceiling, walls and floor, where a contribution to the reflections of radio waves is expected, the electromagnetic characteristics in a uniform field area inside the chamber (see Figures 2 and 3) were improved within the frequency range up to 2 GHz.

3.2.2 Field generating antenna and signal generator

In the test facility before the renovation, the lower frequency range below 200 MHz was covered by a biconical antenna and the high frequency range up to 1 GHz was covered by another log-periodic antenna. In order to respond to the requirement of extending the frequency range, an additional antenna operating in the frequency range from 1 to 2 GHz was required. It was easy to install the additional antenna, however it was decided to employ a totally new antenna that covered the entire range for the reasons detailed below.

Before the renovation cabling for the two antennas, which covered different frequency ranges respectively, was switched manually using connectors. This switching method was employed in order to minimize power loss due to limitation of the output power of the amplifier. However, loose connections or other failures were often caused as a result of damage to the connectors. Moreover, the total duration of the immunity test was excessive due to the need for frequent cable switching, which led to inefficiency in the test procedure. To meet these requirements, a new single antenna was therefore installed that covered the entire frequency range from 26 MHz to 2 GHz.

These improvements have led to a more uniform electromagnetic field in the uniform field area that

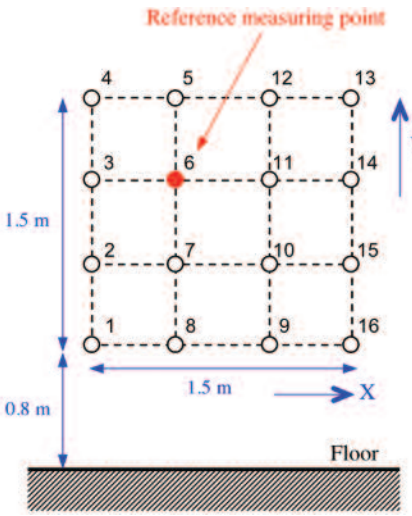

Figure 5 Two-dimensional arrangement of measuring points in the uniform field area (also see Figure 2). The EUT is placed in this area.

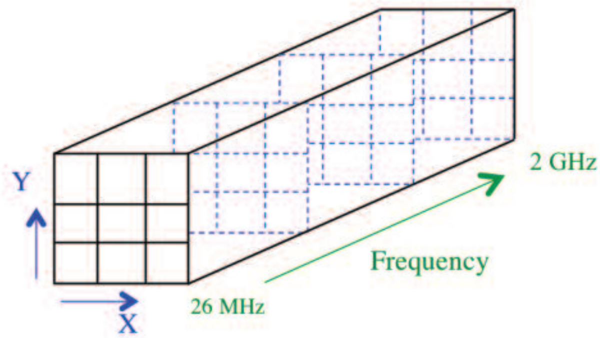

Figure 6 Schematic illustration of a virtual three-dimensional space consisting of the uniform field area (x and y) and frequency. The assessment was conducted in the entire range of this space.

complies with the immunity test requirement. In addition, these improvements have substantially decreased the total time duration required for the immunity test.

4 Improvement in distribution of field strength for testing and evaluation

An important technical requirement for immunity testing, which is specified in IEC 61000-4-3 Third Edition 2006-3 [5] (hereafter "Third ed."), is to ensure the uniformity of field strength in the uniform field area. This IEC standard stipulates a procedure to measure field strength at two or more measuring points in the uniform field area to evaluate the uniformity of the electromagnetic field. With this procedure, the capability of the anechoic chamber after the renovation was assessed.

4.1 Measurement and adjustment methods of field strength to evaluate uniformity

In the present measurement of field strength in the uniform field area (see Figure 2), the method recommended in the Third ed. [5], clause 6.2.2 *Constant field strength calibration method* was selected. In this method, the field strength in the area is measured with a field sensor placed at one of the 16 measuring points shown in Figure 5 while maintaining constant forward power. The uniformity in the area is measured and evaluated repeatedly at discrete frequency points in the target frequency range (26 MHz – 2 GHz). In other words, the present measurement covers a virtual three-dimensional space consisting of the uniform field area and frequency as shown in Figure 6.

The most important condition to achieve uniformity of the field strength stipulated by the Third ed. [5] is that the measured strength shall be within a range of dispersion equal to or less than 6 dB (hereafter referred to as the "6 dB tolerance") for the measuring points not less than 75 % (12 points) out of the 16 points. In order to satisfy this condition, 12 appropriate measuring points are carefully selected. When this condition is achieved, the entire uniform field area is evaluated as appropriate for the immunity test even if there are some measuring points with field strengths that are outside the 6 dB tolerance.

In addition, the strength of the radio wave emitted by the antenna generally varies with frequency because the gain of the antenna is not constant and the amplifier is switched between different frequency ranges. Therefore, the forward power of the radio waves at each

Table 1 Measurement conditions for the distribution of field strength

Items	Condition
Frequency range for the measurement	26 MHz – 2 GHz (the frequency point was increased with a step of 1 %, and the total number of measuring points was 438.)
Target field strength	5 V/m
Antenna polarization	Horizontal and vertical
Area in which field distribution is evaluated	Shown in Figures 2 and 5
Irradiation distance	3 m (between the tip of the antenna and the center of the uniform field area)

frequency point needs to be adjusted so that the measured field strength becomes closer to the target field strength. The practical conditions applied in the measurement of field strength are shown in Table 1.

The size of the field sensor was approximately 50 mm × 50 mm × 50 mm, and it was calibrated by a testing laboratory which complies with ISO/IEC 17025. The expanded uncertainty (k = 2) of the field strength measured with the sensor was 0.7 dB, and it was almost one-tenth of the 6 dB tolerance.

4.2 Practical measurement procedures for field strength in the uniform field area recommended by the IEC

The practical methods and procedures to measure field strength in the uniform field area are given by the following procedures in accordance with the Third ed. [5].

1) Choose an arbitrary point, which is fixed regardless of the frequency, and set the field sensor at this point. Hereafter, this point is referred to as the "reference measuring point" (No. 6 in Figure 5). Then adjust the forward power so that the field strength at the reference measuring point becomes closer to the target field strength. Repeat this adjustment procedure by scanning the frequency at all frequency points (438 points) in the frequency range (26 MHz – 2 GHz). Record the measurement results of field strength and the settings of forward power at all of the frequency points.
2) Move the field sensor from the reference measuring point (No. 6) to another point (usually No. 1) in Figure 5. Measure and record the field strength at this point at all of the frequency points, setting the forward power to the value obtained in procedure 1.
3) By moving the field sensor to the remaining 14 points sequentially, repeat procedure 2 for all of the frequency points. As a result of procedures 1–3, a set of measurement results of field strength, which corresponds to the 16 measuring points and all of the frequency points (438 points), is obtained. One typical example of the result at a frequency point is given in Table 2a.
4) At each frequency point, sort the values of field strength measured at the 16 measuring points into ascending order. An example of the sorted values is given in Table 2b. Check if a group of 12 smaller deviations is within the 6 dB tolerance. If not, select the next smaller 12 points and repeat the procedure

Table 2a An example of field strength measured in the uniform field area at a frequency point. Relative deviations are given in respect to the reference measuring point (marked with *).

Point No.	**Field strength (V/m)**	**Relative deviation (dB)**
1	4.0	–1.9
2	6.0	1.6
3	3.0	–4.4
4	3.5	–3.1
5	3.8	–2.4
6*	5.0	0.0
7	10.2	6.2
8	7.0	2.9
9	3.1	–4.2
10	4.2	–1.5
11	4.8	–0.4
12	3.8	–2.4
13	1.3	–11.7
14	4.2	–1.5
15	3.5	–3.1
16	3.8	–2.4

Table 2b Sorted field strengths of Table 2a. 12 points within the 6 dB tolerance and deviations after the power adjustment (step 8 in 4.2) are also shown for the IEC (4.2) and NMIJ (4.5) methods.

Field strengths of Table 2a sorted in ascending order			Within the 6 dB tolerance?		Deviation after power adjustment (dB)	
No.	Strength (V/m)	Deviation (dB)	IEC	NMIJ	IEC	NMIJ
13	1.3	–11.7			–7.3	–8.6
3	3.0	**–4.4**^{i}	Y		**0.0i**	–1.3
9	3.1	–4.2	Y		0.2	–1.1
4	3.5	**–3.1**^{n}	Y	Y	1.3	**0.0**^{n}
15	3.5	–3.1	Y	Y	1.3	0.0
5	3.8	–2.4	Y	Y	2.0	0.7
12	3.8	–2.4	Y	Y	2.0	0.7
16	3.8	–2.4	Y	Y	2.0	0.7
1	4.0	–1.9	Y	Y	2.5	1.2
10	4.2	–1.5	Y	Y	2.9	1.6
14	4.2	–1.5	Y	Y	2.9	1.6
11	4.8	–0.4	Y	Y	4.0	2.7
6*	**5.0**	**0.0**^{i}	Y	Y	**4.4**^{i}	3.1
2	6.0	1.6		Y	6.0	4.7
8	7.0	**2.9**^{n}		Y	7.3	**6.0**^{n}
7	10.2	6.2			10.6	9.3
Constant adjustment factor (dB)					**+4.4**	**+3.1**

* Reference measuring point
i/n Minimum and maximum deviations within the 6 dB tolerance in the IEC/NMIJ method.

until all of the 12 consecutive points are within the tolerance. In this example, 12 smaller consecutive points starting from point 13 are not within the 6 dB tolerance. By selecting the points starting from No. 3, the criterion of 6 dB tolerance has been satisfied as indicated by "Y" in the column "IEC". This means that the distribution of the field strength in the entire area is evaluated as appropriate at this frequency point.

5) Repeat procedure 4 for all of the frequency points. The selected 12 points are generally different at each frequency point.

6) When it is not possible to choose 12 measuring points at all of the frequency points, repeat the measurement of field strength (procedures 1–3). If it is still not possible to choose the points even after the repetition, the condition of the anechoic chamber, including the reflections of the electromagnetic field inside the chamber, need to be examined.

7) After the 12 measuring points are successfully determined at all the frequency points, estimate the forward power at each frequency that brings the minimum field strength within the 12 points (point 3 in Table 2b) to the target field strength (5 V/m in this study). Confirm if the radio-wave generator has an extra capacity to increase the forward power to elevate the field strength.

8) In the practical test on the EUT, forward power is adjusted at each frequency point according to the values estimated in procedure 7. For the example of Table 2b, the constant adjustment factor becomes +4.4 dB. After the adjustment, the deviations of the field strengths at the 12 points become within a range from 0 dB to +6 dB in reference to the target strength as shown in Table 2b.

4.3 Measurement results of field strength (two-dimensional distribution)

In accordance with the procedures described in 4.2, a series of measurements of field strength was conducted. Figures 7 to 9 show the two-dimensional distributions of field strength measured in the uniform field area. The figures illustrate the relative distributions where the minimum value corresponds to 0 dB. In the frequency range used in this evaluation procedure, the measured distributions of field strength were almost within the 6 dB tolerance, and no significant inhomogeneity beyond the tolerance was observed. The basic pattern of the distributions did not change significantly even if the forward power was changed.

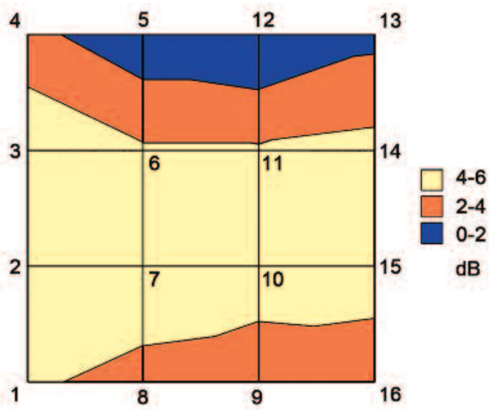

Figure 7 Two-dimensional distribution of field strength in the uniform field area at 26 MHz

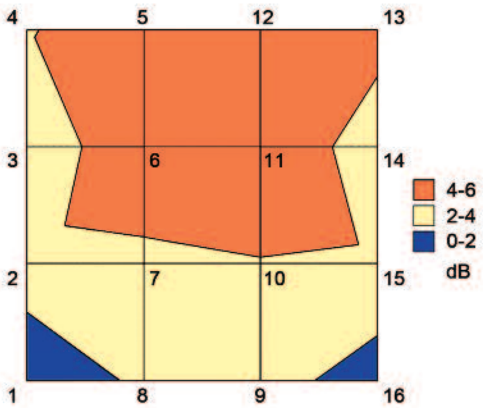

Figure 8 Two-dimensional distribution of field strength in the uniform field area at 500 MHz

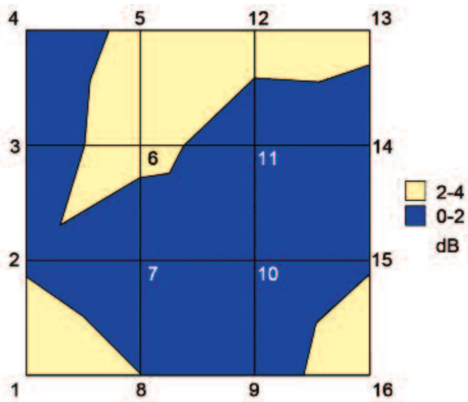

Figure 9 Two-dimensional distribution of field strength in the uniform field area at 2 GHz

4.4 Measurement results of field strength (frequency dependence)

As reported in 4.3, no significant change was observed in the two-dimensional distributions regardless of the differences in the measuring frequency and forward power. Therefore, it was concluded that the forward power was the only parameter which should be adjusted

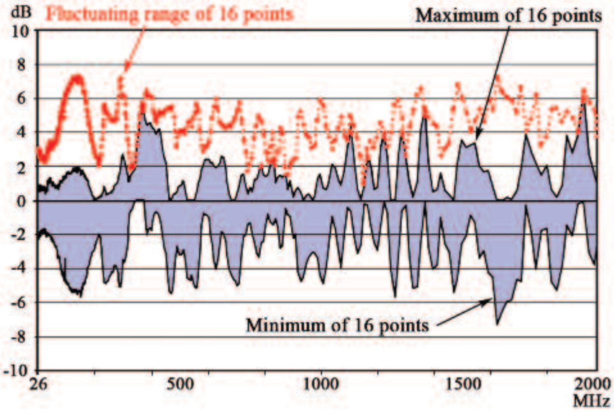

Figure 10 Maximum and minimum values of deviations of field strength at the 16 measuring points in the uniform field area at each frequency point

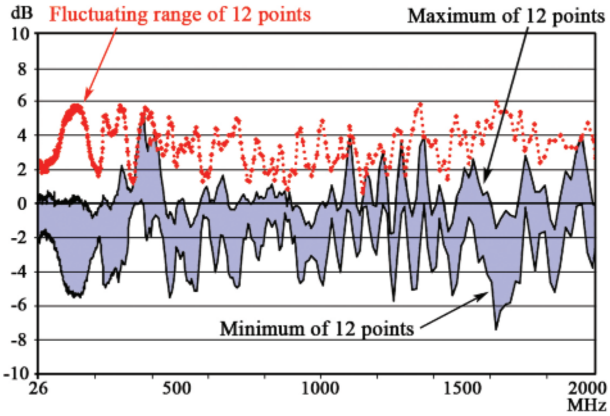

Figure 11 Maximum and minimum values and the magnitudes of fluctuating range of field strength at the 12 measuring points chosen according to the IEC standard

at each frequency in order to realize a constant field strength regardless of frequency. In order to find out an appropriate forward power at each frequency, the relationship between the field strength in the uniform field area and frequency was analyzed.

The measured values of field strength are shown in Figures 10 to 12 with the measuring frequency on the abscissa. Figure 10 shows the maximum and minimum values of the field strength measured at the 16 measuring points in the uniform field area. Figure 10 also shows the magnitude of a fluctuating range that corresponds to a difference between the maximum and the minimum values of field strength. The ordinate axis corresponds to the deviations of the measured field strengths from the value at the fixed point selected arbitrary regardless the frequency.

Figure 11 shows another result similar to Figure 10. However, Figure 11 shows the deviations only for the 12 points within the 6 dB tolerance, which were chosen in accordance with procedure 4 in 4.2. In contrast to the result in Figure 10, the maximum values as well as the magnitudes of the fluctuating range decreased. This result proved that the values of the field strength measured at the selected 12 measuring points were within the 6 dB tolerance.

The difference of results between Figures 10 and 11 shows that the field strength at the four measuring points other than the 12 chosen points exceeds the upper limit of the 6 dB tolerance. This is because the 12 points are chosen based on the minimum value through procedure 4 in 4.2, and the rest usually have higher values than those of the 12.

4.5 Original test method proposed by NMIJ

The actual immunity tests, however, are not conducted only at the selected 12 points. The entire uniform field area is generally utilized for the tests. In reality, the field strength at a measuring point, which originally has a higher value, could be elevated further as a result of power adjustment following procedure 4 in 4.2. This procedure may cause a problem in which an unnecessarily strong electromagnetic field may be irradiated locally to the EUT.

Therefore, the authors examined a new test method (NMIJ method) to find a possibility to avoid such a problem, although it is different from the method recommended by the IEC (see 4.2).

This new method is based on a sorting process in descending order of the field strength measured at the 16 measuring points in contrast to the IEC method. Then, 12 consecutive points starting from the highest value are sought and chosen in descending order within the 6 dB tolerance. The forward power of the radio wave is adjusted accordingly so that the minimum value within the 12 points becomes closer to the target field strength (5 V/m in this study). An example of the results with the NMIJ method is also shown in Table 2b in comparison with the results of the IEC method.

In Table 2b, the deviations of the field strengths of the 12 points chosen according to the NMIJ method were also within the 6 dB tolerance. A fundamental difference between the NMIJ and IEC methods is the procedure to adjust the forward power. In the IEC method, where the minimum value is referred to, it is highly likely that the field strengths at the points out of the 6 dB tolerance (No. 2, 7 and 8 in Table 2b) are higher than those of the 12. In the NMIJ method, where the maximum value is referred to, the field strengths at the points out of the 6 dB tolerance (No. 3, 9 and 13 in Table 2b) are more likely to be lower than those of the 12. Furthermore, the magnitude of the constant adjustment factor in the NMIJ method (+3.1 dB), which is required to bring the minimum field strength to the target strength, is smaller than that of the IEC method (+4.4 dB).

Therefore, the probability in which a strong electromagnetic field exceeds the target strength would be irradiated to the EUT, is expected to be small in the NMIJ method. Consequently, a test that meets the requirement of 6 dB tolerance shall be realized without applying an unnecessarily strong electromagnetic field.

5 Conclusions

The NMIJ test facility was renovated to accommodate the extended frequency range specified in the Second ed. [2]. In addition, the functions of the test facility were upgraded in order to save the total time required for immunity test.

Following the adjusting method recommended in the Second ed. [2], it was proven that the distribution of the field strength satisfies the requirements in the IEC standards with the antenna radiating both in the horizontal and vertical polarizations. It was also proven that the requirements were satisfied in the extended frequency range over 1 GHz. In addition, the possibility of a new test method that would meet the 6 dB tolerance without applying unnecessarily high electromagnetic field was examined.

As a proposal for the future, it will be necessary to consider a new scheme for measuring the distribution of field strength in anechoic chambers and to review the equivalence of the test conditions in different chambers for the purpose of ensuring the mutual confidence in the test results.

The target of the scheme could be the chambers used by the national/public testing laboratories worldwide, which conduct tests on measuring instruments for conformity assessment procedures including type approvals. This proposal arises from the fact that the characteristics of the electromagnetic field achieved in different anechoic chambers differ slightly due to the differences in their condition and/or structures including inner reflections of the radio wave. These differences are likely to lead to significant inconsistency in the final test results for conformity assessments.

In addition to the performance of the test facility, more practical standardization in practical methods for testing is required. For example, there is a concern that the arrangement of the EUT cable in an immunity test may affect the test result significantly. If we disregard such practical precautions, this would reduce the reproducibility of the test results. To eliminate such potential factors that may affect the test results, the establishment of a uniform test procedure for immunity testing, which specifies practical procedures in detail is necessary. Accordingly, an internationally harmonized approach is required to reduce the inconsistency in the practical test procedures in order to secure confidence in the results of conformity assessments. Ultimately, a new conformity assessment method, which takes account of the major sources of uncertainty involved in the immunity tests, is required.

In Japan, a standard has been developed in order to standardize practical procedures for electromagnetic environment tests to complement international standards such as the IEC standards and OIML D 11. If this standard could fully complement the requirements in international standards, the test results of conformity assessment would be more reliable. We believe that this standard will be a useful tool in support of the international requirements by establishing the practical procedure.

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[5] IEC 61000-4-3 Third edition 2006-2: *Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test*

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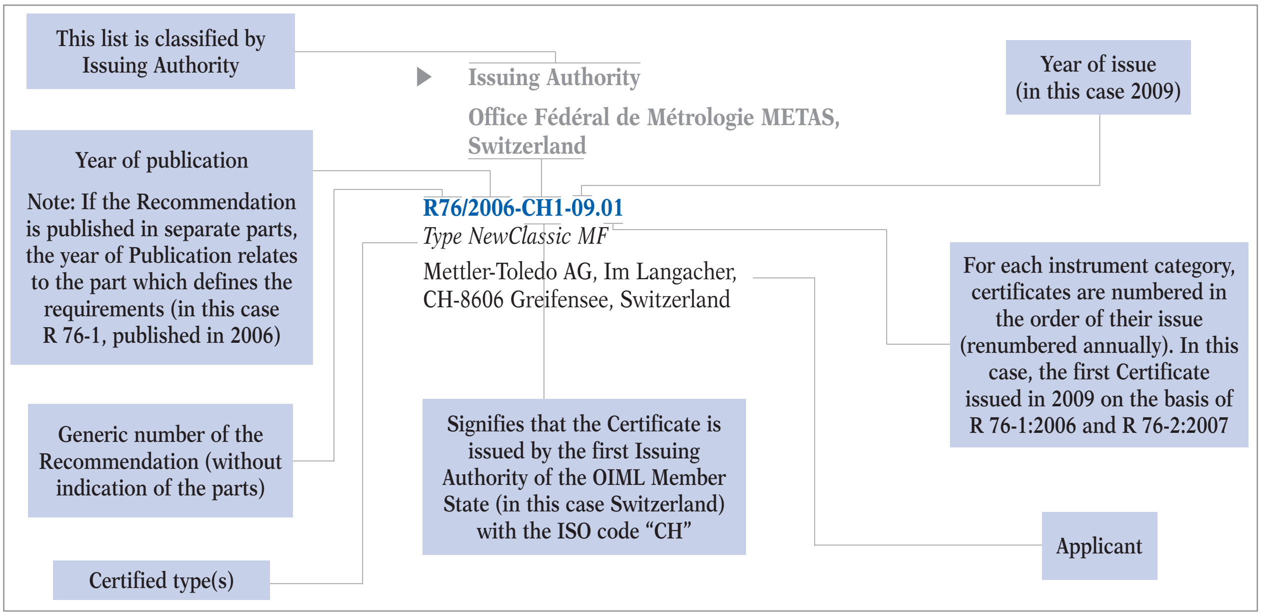
The aim of the MAA is for the participants to accept and utilize MAA Evaluation Reports validated by an OIML MAA Certificate of Conformity. To this end, participants in the MAA are either Issuing Participants or Utilizing Participants.

For manufacturers, it avoids duplication of tests for type approval in different countries.

Participants (Issuing and Utilizing) declare their participation by signing a Declaration of Mutual Confidence (Signed DoMCs). ■



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CATÉGORIE D'INSTRUMENT

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R049/2006-FR2-2008.04 Rev. 1
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Electromagnetic flow meter for water metering, ISOMAG Family Model MS2500 DN 25 up to DN 250 with ML255 Model
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R049/2006-IT1-2013.02
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Slovak Legal Metrology (Banska Bystrica), Slovakia

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Family of mechanical volumetric (rotary piston) water meters for metering of cold water - Type: PD-A…, PD-AP…
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Automatic catchweighing instrument - Type: AB C
Mettler-Toledo Garvens GmbH, Kampstr. 7, 31180 Giesen, Germany

INSTRUMENT CATEGORY
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Metrological regulation for load cells (applicable to analog and/or digital load cells)
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R 60 (2000)

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R060/2000-CN1-2013.01 (MAA)
Load Cell - Type: SLB615D

Mettler-Toledo (Changzhou) Precision Instruments Ltd., 5, Middle HuaShan Road, Xinbei District, 213022 ChangZhou, Jiangsu, P.R. China

► Issuing Authority / *Autorité de délivrance*

NMi Certin B.V.,
The Netherlands

R060/2000-NL1-2013.20 (MAA)
*A single point load cell, with strain gauges. Type: BM8H-C-xx-xx-xx Series Type: CC010-**T-C3 (with ** the capacity in t)*

Zhonghang Electronic Measuring Instruments Co. Ltd (ZEMIC), Xinyuan Road, The North Zone of EDZ, Hanzhong, P.O. Box 2, 723000 Hanzhong- ShaanXi, P.R. China

R060/2000-NL1-2013.20 Rev. 1 (MAA)
A shear beam load cell, with strain gauges. Type: BM8H-Cx-xx-xx-xx Series

Zhonghang Electronic Measuring Instruments Co. Ltd (ZEMIC), Xinyuan Road, The North Zone of EDZ, Hanzhong, P.O. Box 2, 723000 Hanzhong- ShaanXi, P.R. China

R060/2000-NL1-2013.21 (MAA)
A single point load cell, with strain gauges. Type: H8Q-Cx-xx-xx-xx Series

Zhonghang Electronic Measuring Instruments Co. Ltd (ZEMIC), Xinyuan Road, The North Zone of EDZ, Hanzhong, P.O. Box 2, 723000 Hanzhong- ShaanXi, P.R. China

R060/2000-NL1-2013.21 Rev. 1 (MAA)
A shear beam load cell, with strain gauges. Type: H8Q-Cx-xx-xx-xx Series

Zhonghang Electronic Measuring Instruments Co. Ltd (ZEMIC), Xinyuan Road, The North Zone of EDZ, Hanzhong, P.O. Box 2, 723000 Hanzhong- ShaanXi, P.R. China

R060/2000-NL1-2013.22 (MAA)
A single point load cell, with strain gauges. Type: L6P-Cx-xx-xx-xx Series

Zhonghang Electronic Measuring Instruments Co. Ltd (ZEMIC), Xinyuan Road, The North Zone of EDZ, Hanzhong, P.O. Box 2, 723000 Hanzhong- ShaanXi, P.R. China

R060/2000-NL1-2013.22 Rev. 1 (MAA)
A beaming beam load cell, with strain gauges. Type: L6P-Cx-xx-xx-xx Series

Zhonghang Electronic Measuring Instruments Co. Ltd (ZEMIC), Xinyuan Road, The North Zone of EDZ, Hanzhong, P.O. Box 2, 723000 Hanzhong- ShaanXi, P.R. China

R060/2000-NL1-2013.23 (MAA)
A single point load cell, with strain gauges. Type: L6P1-Cx-xx-xx-xx Series

Zhonghang Electronic Measuring Instruments Co. Ltd (ZEMIC), Xinyuan Road, The North Zone of EDZ, Hanzhong, P.O. Box 2, 723000 Hanzhong- ShaanXi, P.R. China

R060/2000-NL1-2013.23 Rev. 1 (MAA)
A bending beam load cell, with strain gauges. Type: L6P1-Cx-xx-xx-xx Series

Zhonghang Electronic Measuring Instruments Co. Ltd (ZEMIC), Xinyuan Road, The North Zone of EDZ, Hanzhong, P.O. Box 2, 723000 Hanzhong- ShaanXi, P.R. China

R060/2000-NL1-2013.24 (MAA)
Tension load cell, with strain gauges - Type: G4-SB series

Group Four Transducers Inc., 22 Dear Park Drive, East Longmeadow, MA 01028, United States

► Issuing Authority / *Autorité de délivrance*

Physikalisch-Technische Bundesanstalt (PTB), Germany

R060/2000-DE1-2013.02 (MAA)
Load cell - Type Z16A

Hottinger Baldwin Messtechnik GmbH, Im Tiefen See 45, 64293 Darmstadt, Germany

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Nonautomatic weighing instruments
Instruments de pesage à fonctionnement non automatique

R 76-1 (1992), R 76-2 (1993)

Issuing Authority / *Autorité de délivrance*

National Measurement Office (NMO), United Kingdom

R076/1992-GB1-2013.03 (MAA)
Flintec M300 - Infant Scale
Flintec UK Ltd., W4/5 Capital Point, Capital Business Park, Wentloog Avenue, Cardiff CF3 2PW, United Kingdom

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Non-automatic weighing instruments
Instruments de pesage à fonctionnement non automatique

R 76-1 (2006), R 76-2 (2007)

Issuing Authority / *Autorité de délivrance*

Laboratoire National de Métrologie et d'Essais, Certification Instruments de Mesure, France

R076/2006-FR2-2013.01 Rev. 0 (MAA)
Module data processing type WT-12 for non automatic weighing instruments.
Arpege Master-K, 38 Avenue des Frères Montgolfier, BP 186, 69686 Chassieu Cedex, France

R076/2006-FR2-2013.02 Rev. 0 (MAA)
Terminal module type IDTB for non automatic weighing instruments
Arpege Master-K, 38 Avenue des Frères Montgolfier, BP 186, 69686 Chassieu Cedex, France

Issuing Authority / *Autorité de délivrance*

NMi Certin B.V., The Netherlands

R076/2006-NL1-2011.12 Rev. 1 (MAA)
Indicator, tested as part of a non-automatic weighing instrument. Type: IND245 / IND246
Mettler-Toledo (Changzhou) Measurement Technology Ltd., N° 111, West TaiHu Road, ChangZhou XinBei District, 213125 Jiangsu, P.R. China

R076/2006-NL1-2013.19 (MAA)
Indicator - Type: ORION PLUS / Cyber Plus
Grupo Epelsa S.L., c/Punto Net, 3, Polígono Industrial TECNOALCALÁ, 28805 Alcalá de Henares (Madrid), Spain,

R076/2006-NL1-2013.21 (MAA)
Indicator - Type: 8442-F610
Mettler-Toledo (Changzhou) Measurement Technology Ltd., N° 111, West TaiHu Road, ChangZhou XinBei District, 213125 Jiangsu, P.R. China

R076/2006-NL1-2013.22 (MAA)
Non automatic weighing instrument - Type: 8442 (Tiger P)
Mettler-Toledo (Changzhou) Measurement Technology Ltd., N° 111, West TaiHu Road, ChangZhou XinBei District, 213125 Jiangsu, P.R. China

R076/2006-NL1-2013.31 (MAA)
Non-automatic weighing instrument - Type: MS-2xxx, MS-3xxx, MS-4xxx, MS-5xxx, MS-6xxx, MBF-5xxx, MBF-6xxx, MS21-NEOxx
Charder Electronic Co., Ltd., No. 103, Kuo Chung Road, Dah Li City, TW-Taichung Hsien 41262, Chinese Taipei

R076/2006-NL1-2013.32 (MAA)
Non-automatic weighing instrument - Type: Serie LX/LS
Precisa Gravimetrics A.G., Moosmattstrasse 32, 8953 Dietikon, Switzerland

R076/2006-NL1-2013.35 (MAA)
Indicator of digital processing device - Type: IND245/IND246
Mettler-Toledo (Changzhou) Measurement Technology Ltd., N° 111, West TaiHu Road, ChangZhou XinBei District, 213125 Jiangsu, P.R. China

R076/2006-NL1-2013.37 (MAA)
Non-automatic weighing instrument. Type: XPE,XSE and XVE
Mettler-Toledo GmbH, Im Langacher 44, 8606 Greifensee, Switzerland

R076/2006-NL1-2013.38 (MAA)
Non-automatic weighing instrument. Type: SM-5600
Teraoka Weigh-System PTE Ltd., 4 Leng Kee Road, #05-03/04/05 & 11, SIS Building, 159088 Singapore

R076/2006-NL1-2013.39 (MAA)
Indicator Type: 500, 500-SW and D-900 Series
Dibal S.A, Astinze Kalea, 24-Pol. Ind. Neinver, 48160 Derio (Bilbao-Vizcaya), Spain

R076/2006-NL1-2013.40 (MAA)
Non automatic weighing instrument - Type: RM-5800..
Shanghai Teraoka Electronic Co., Ltd., Tinglin Industry Developmental Zone, Jin Shan District, 201505 Shanghai, P.R. China

R076/2006-NL1-2013.43 (MAA)
Indicator - Type: W8 Explorer
Bascules Robbe N.V., Noordlaan 7, 8820 Torhout, Belgium

R076/2006-NL1-2013.44 (MAA)
Non-automatic weighing instrument - Type: SM-5000, SM-5400, SM-5500, SM-5500H
Teraoka Weigh-System PTE Ltd., 4 Leng Kee Road, #05-03/04/05 & 11, SIS Building, 159088 Singapore

R076/2006-NL1-2013.45 (MAA)
Non-automatic weighing instrument - Type: SM-100.., SM-5100..
Shanghai Teraoka Electronic Co., Ltd., Tinglin Industry Developmental Zone, Jin Shan District, 201505 Shanghai, P.R. China

R076/2006-NL1-2013.46 (MAA)
Non-automatic weighing instrument - Type: RM-50..
Shanghai Teraoka Electronic Co., Ltd., Tinglin Industry Developmental Zone, Jin Shan District, 201505 Shanghai, P.R. China

▶ **Issuing Authority / *Autorité de délivrance***

National Measurement Office (NMO), United Kingdom

R076/2006-GB1-2009.02 Rev. 1 (MAA)
WPI-700
Digi Europe Ltd., Digi House, Rookwood Way, Haverhill, Suffolk CB9 8DG, United Kingdom

R076/2006-GB1-2013.02 (MAA)
Marsden M-300 - Baby Scale
Marsden Weighing Machine Group Ltd., Unit 7, Centurion Business Park, Coggin Mill Way, Rotherham S60 1FB, United Kingdom

R076/2006-GB1-2013.05 (MAA)
NCR 7812-5XXX series, where XXX denotes alternative approved models
NCR Corporation, 2651 Satellite Blvd, Duluth 30096, Georgia, United States

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Automatic level gauges for fixed storage tanks
Jaugeurs automatiques pour les réservoirs de stockage fixes

R 85 (2008)

▶ **Issuing Authority / *Autorité de délivrance***

Czech Metrology Institute (CMI), Czech Republic

R085/2008-CZ1-2013.05
Magnetostrictive level gauge - TSP-LL2-XXX / TSP-LL2-XXX-I probes and Colibri series console unit (models CL6, TS-CL6)
Franklin Fueling Systems / Intelligent Controls Inc., 34 Spring Hill Rd., Saco ME 04072, United States

R085/2008-CZ1-2013.06
Magnetostrictive level gauge - TSP-LL2-XXX / TSP-LL2-XXX-I probes, TS-5XXXX series console unit (models TS-5, TS-550/500evo, TS-5000/5000evo; expansion boxes TS-EXPC, TS-EXPC2)
Franklin Fueling Systems / Intelligent Controls Inc., 34 Spring Hill Rd., Saco ME 04072, United States

▶ **Issuing Authority / *Autorité de délivrance***

NMi Certin B.V., The Netherlands

R085/2008-NL1-2013.02
Automatic level gauge for measuring the level of liquid in stationary storage tanks. Type: Smartradar Flexline XP and Smartradar Flexline HP, with antennas F06, F08, W06, H04, S06, S10 and S12
Enraf B.V., Delftechpark 39, 2628 XJ Delft, The Netherlands

▶ Issuing Authority / *Autorité de délivrance*

National Measurement Office (NMO), United Kingdom

R085/2008-GB1-2013.01

Digital microwave tank gauge

Motherwell Tank Gauging, 1 St. Michaels Road, Lea Green Industrial Estate, St. Helens, Merseyside WA9 4WZ, United Kingdom

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Fuel dispensers for motor vehicles
Distributeurs de carburant pour véhicules à moteur

R 117 (1995) + R 118 (1995)

▶ Issuing Authority / *Autorité de délivrance*

International Metrology Cooperation Office, National Metrology Institute of Japan (NMIJ) National Institute of Advanced Industrial Science and Technology (AIST), Japan

R117/1995-JP1-2009.01 Rev. 2

Fuel dispenser for motor vehicles, Tatsuno Sunny-G II series and Tatsuno Sunny-XE series.

Tatsuno Corporation, 2-12-13, Shibaura Minato-ku, 108-8520 Tokyo, Japan

▶ Issuing Authority / *Autorité de délivrance*

NMi Certin B.V., The Netherlands

R117/1995-NL1-2009.03 Rev. 3

A fuel dispenser for motor vehicles - Type: Quantium XXXX

Tokheim Group S.A.S., Paris-Nord 2, 5 rue des Chardonnerets, BP 67040 Tremblay en France, 95971 Roissy Ch de Gaulle Cedex, France

INSTRUMENT CATEGORY
CATÉGORIE D'INSTRUMENT

Multi-dimensional measuring instruments
Instruments de mesure multidimensionnels

R 129 (2000)

▶ Issuing Authority / *Autorité de délivrance*

National Measurement Office (NMO), United Kingdom

R129/2000-GB1-2012.01

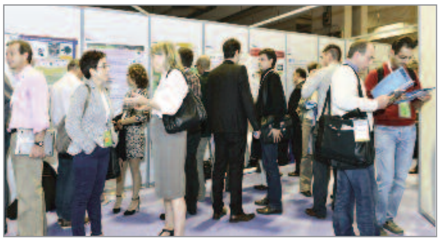
Multi-dimensional measuring instrument for measuring square or rectangular boxes only.

Cube Logic Systems Pty Ltd., Office 1 384 Forest Road, NSW 2220 Hurstville, Australia

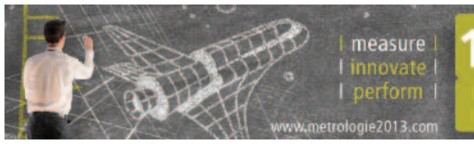
R129/2000-GB1-2013.01

Multidimensional measuring instrument designated QubeVu® for measuring square or rectangular boxes only

Postea Inc, 2750 Prosperity Ave, Suite 450, Fairfax VA 22031, United States



Pour son 30° anniversaire, le Congrès International de Métrologie confirme sa bonne santé …



Le Congrès s'est tenu à la Porte de Versailles à Paris du 7 au 10 octobre dernier, conjointement avec le salon Enova. Avec la maturité liée aux trente premières années, les organisateurs s'appuient sur 3 grands axes pendant la préparation de cet événement :

- une **ouverture constante sur toutes les sensibilités**, tous les pays et tous les secteurs d'activité,
- le souci de la **nouveauté** et de la **compétence technique** et technologique,
- la volonté acharnée de favoriser les rencontres entre des mondes différents : le fameux **transfert** …

Ainsi le Congrès 2013 a proposé pendant 3 jours et demi un large choix : 180 conférences techniques, 6 tables rondes industrielles, 3 visites en entreprise et une exposition liée au salon Enova, dans la partie Mesurexpovision. Mais l'objectif est aussi de suivre les évolutions de tous et de répondre aux attentes d'un maximum de participants : le monde change et personne ne travaille aujourd'hui comme il y a 5 ans. Quelques grandes nouveautés ont de ce fait été affichées pendant cette édition :

- une session sur **l'intérêt des métiers liés à la mesure** en ouverture du Congrès,
- deux programmes européens de recherche en métrologie sont venus présentés l'avancement de leur travaux,
- des sujets sur l'agro-alimentaire, les défis énergétiques et les nano-technologies.

Avec ce mélange de thèmes classiques et de nouveautés, les volumes enregistrés pour ce congrès sont exceptionnels et place cette manifestation au premier rang mondial **:**

- **850 participants et exposants**, avec accès complet à tout le Congrès, sont venus, soit 6 % de plus que pour l'édition 2011,
- **36 pays différents** étaient représentés, et **35 % des participants sont issus de l'étranger**, européens principalement mais aussi Amérique du Nord et Amérique du Sud, Afrique, Moyen-Orient, Asie,
- 53 sociétés étaient installées sur le **Village Métrologie** situé au sein du Salon : le lieu de rassemblement des moments de convivialité du Congrès : pauses, posters, cocktail et apéritif, …
- le **niveau scientifique et technique** du Congrès est jugé excellent ou satisfaisant pour 87 et 90 % des participants,
- **l'intérêt industriel** ressort comme excellent ou satisfaisant dans 83 % des sondages,
- la soirée de gala à la Tour Eiffel a rassemblé près de 200 congressistes et partenaires de tous les horizons,
- en complément, **5 900 personnes ont visité le salon Enova** dédié aux sujets électronique, mesure, optique et radio fréquence. Ce visitorat est en hausse par rapport à l'édition précédente et les organisateurs notent le retour à un « climat d'affaires positif ».

Le Congrès confirme aussi qu'il rassemble tous les publics et acteurs du secteur de la mesure :

- **68 % sont des industriels** : utilisateurs de moyens de mesure dans tout type de secteur, laboratoires d'analyses, laboratoires de métrologie ou fabricants de matériels, …
- **11 % sont issus des grands organismes nationaux et internationaux** : laboratoire national des grands pays européens, Ministères, organisme d'accréditation, organisations internationales, …
- **13 % des universitaires ou des chercheurs**,
- 8 % des participants sont d'origines diverses : hôpitaux, organisme de formation, consultant, presse, ..

Le Collège Français de Métrologie, porteur de l'événement, souhaite remercier chaleureusement tous ceux qui étaient présents et l'ensemble des partenaires du Congrès :

- les membres du Comité d'Organisation : Acac, BEA Métrologie, BIPM, Cetiat, EDF, Hexagon Metrology, IMQ, INSA de Lyon, LNE, Metas, NIST, NPL, Novartis, OIML, Peugeot Citroën Automobiles, Trescal,
- les sponsors et partenaires : A+ Métrologie-Apave, Carl Zeiss, Hexagon Metrology, et Implex,
- les soutiens institutionnels : Ministère du Redressement Productif et DGCIS, Ministère de la Culture.

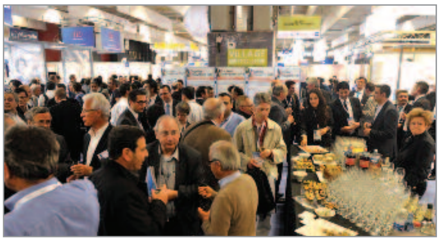
Information presse :

04.67.06.20.36

info@cfmetrologie.com

www.metrologie2013.com

On its 30th anniversary, the International Congress of Metrology confirms its excellent health...



The Congress took place at the Porte de Versailles in Paris between 7 and 10 October in association with the Enova exhibition. With the maturity gained from the first thirty years, the organisers focused on three main priorities in preparing for the event:

- **permanent openness to all areas of interest**, all countries and all activity sectors,
- a concern for **innovation** and both **technical and technological skill**,
- an unfailing ambition to promote encounters between different worlds: the famous **transfer**…

The 2013 Congress offered three and a half days of very wide choice: 180 technical presentations, six industrial round-table discussions, three company tours and an exhibition in the Mesurexpovision section of the Enova trade fair. But the goal was also to follow the evolutions in participants' working lives and meet the needs of as many visitors as possible: the world is changing, and no-one is still working in the same way as five years ago. Several innovations were introduced during this year's Congress:

- a session on **the benefits of measurement-related careers** at the opening of the Congress,
- two European metrology research programmes came to present their progress,
- subjects such as food processing, energy challenges and nano-technology.

With this blend of standard themes and new areas, the visitor numbers recorded for this Congress were exceptional, placing the event in a world-leading position:

- **850 participants and exhibitors**, with full access to the whole Congress, 6 % more than in 2011,
- **36 different countries** were represented, and **35 % of participants came from abroad**, mainly from Europe but also from North and South America, Africa, the Middle East and Asia,
- 53 companies had a presence in the **Metrology Village** at the heart of the event, the gathering place for friendly downtime at the Congress: breaks, poster sessions, cocktails and aperitifs,
- the **scientific and technical level** of the Congress was judged excellent or satisfactory by 87 and 90 % of participants respectively,
- **the industrial benefits** are seen as excellent or satisfactory in 83 % of survey responses,
- the gala evening at the Eiffel Tower attracted nearly 200 congress attendees and partners from all backgrounds,
- in addition, **5,900 people visited the Enova exhibition** dedicated to electronics, measurement, optics and RF technology. These visitor numbers are higher than the previous year, and the organisers noted a return to a "positive business climate".

The Congress also confirmed that it appeals to all audiences and stake-holders in the field of measurement:

- **68 % of participants are industrial users** of measurement in all types of sectors: analysis and metrology laboratories, equipment manufac-turers etc.
- **11 % are representatives of major national and international organisations**: the national laboratories of the large European countries, ministries, accreditation bodies, international organisations, etc.
- **13 % are academics or researchers**,
- 8 % come from other backgrounds: hospitals, training organisations, consultants, the press, etc.

The Collège Français de Métrologie, the organiser of the event, wishes to extend its warm thanks to everyone who attended and all the partners of the Congress:

- the members of the Organising Committee: Acac, BEA Métrologie, BIPM, Cetiat, EDF, Hexagon Metrology, IMQ, INSA de Lyon, LNE, Metas, NIST, NPL, Novartis, OIML, Peugeot Citroën Automobiles, Trescal,
- the event's sponsors and partners: A+ Métrologie-Apave, Carl Zeiss, Hexagon Metrology and Implex,
- the institutional supporters: the Ministry for the Productive Recovery and the DGCIS (Department of Competitiveness, Industry and Services), the Ministry of Culture.

Press information:

+33 4.67.06.20.36

info@cfmetrologie.com

www.metrologie2013.com

9th International Symposium: Metrology 2014

12–13 June 2014
International Conference Center
Havana, Cuba

The National Bureau of Standards (NC) and the Ministry of Science, Technology and the Environment (CITMA) are organizing Metrology 2014 to promote the exchange of experience among metrologists, academicians, business people, managers, manufacturers, technologists, and importers and marketers of measuring instruments and systems, as well as any metrology related staff.

Organizing Committee

Chairperson	Dr. Sc. Nancy Fernández Rodríguez
Vice chairperson	Eng. Fernando Arruza Rodríguez
Executive Secretary	Lic. Teresa Infante Frómeta
Scientific Committee Chairperson	Eng. Antonio López Maidique
Member	Lic. Elina González Labrada
Professional Congress Organizer	Lic. Alicia García González

Topics

- Legal metrology and its fields of application
- Traceability and uncertainty of measurements
- Metrology and quality
- Measurements in the field of energy
- Measurements in the field of health
- Measurements in industry
- Nuclear measurements and technologies
- Training in metrology
- Chemical metrology

In parallel with the Symposium, workshops and exchange panels related to the above topics will be organized during which selected papers will be presented and daily plenary sessions will be held. The official languages will be Spanish and English (simultaneous interpretation will be provided in the main and other sessions). All Abstracts and Papers should be submitted in English or Spanish by January 31, 2014 (Abstracts) or March 15, 2014 (Full Papers). Please enquire for detailed specifications. Pre event courses are also planned on current developments in legal metrology and general metrology. The course fee is 100.00 CUC (Cuban peso) and the registration fee for the main event is 250.00 CUC which includes participation in the event and all related social activities, documents, name badge and certificate of attendance.

Contacts

Lic. Teresa Infante Frómeta
Secretaria Ejecutiva del Comité Organizador
Oficina Nacional de Normalización
Calle E, No. 261, entre 11 y 13, Vedado,
La Habana
Tel.: (537) 830 0022
E mail: nc@ncnorma.cu
Web: www.nc.cubaindustria.cu

Dr. C. Ysabel Reyes Ponce
Vicepresidenta del Comité Científico
Consulado 206, e/ Animas y Trocadero
Centro Habana, La Habana
Tel.: (537) 864 3360
E mail: ysabel@inimet.cu
Web: www.inimet.cubaindustria.cu

Lic. Alicia García González
Organizadora Profesional de Congresos
Palacio de Convenciones de La Habana
Tel.: (537) 208 5199; 202 6011 ext. 1510
E mail: aliciagarcia@palco.cu
Web: www.eventospalco.com

48th Meeting of the International Committee of Legal Metrology

Ho Chi Minh City, Viet Nam
8–10 October 2013

Speech by Dr. Tran Viet Thanh, Deputy Minister of Science and Technology, Viet Nam

Dear Mr. Peter Mason, CIML President,
Distinguished CIML Members,
Distinguished guests,

On behalf of the Minister of Science and Technology, I would like to welcome Mr. Peter Mason, CIML President, and all of you to the 48th Meeting of the International Committee of Legal Metrology and related events in Ho Chi Minh City, Viet Nam. It is a great honor for us to hold the most important annual meeting of the International Organization of Legal Metrology, this influential worldwide organization with the number of State Members now covering 96 % of the global economy.

Ladies and gentlemen, Viet Nam has always been aware of the significance of legal metrology and government administration. On January 20th 1950, President Ho Chi Minh promised to use Ordinance 8 to unify the units of measurement in Viet Nam in conformity with the metric system. To mark this historic measure, in 2001 the Government of Viet Nam promulgated that day as Viet Nam Metrology Day. Every year to celebrate Metrology Day, our Metrological Office and experts around the country gather together in order to recap and access results of metrological activities and establish the agenda of action for the coming years.

During the last 20 years Viet Nam – with the Directorate of Standards, Metrology and Quality from the Ministry of Science and Technology as the official representative – has been actively involved in international and regional metrology organizations. Viet Nam became a full member of the Asia Pacific Metrology Program in 1995, of the Asia Pacific Legal Metrology Forum in 1996 and of the OIML in 2003. In 2002 with the responsibility of the State Member we successfully organized the 18th APMP conference and the 9th APLMF meeting.

This year – and for the first time – we have the honor to host the CIML meeting in Ho Chi Minh City, one of the most dynamic cities in Asia renowned for industrial manufacturing, tourism and having foreign interests with business opportunities.

As you may know, Viet Nam became an official member of the World Trade Organization in 2007. One of the highest priorities is the regulatory framework, including that for legal metrology, and ensuring that it meets international and regional expectations. In this context, the Law of Metrology of Viet Nam was approved in the National Assembly in November 2011, which marked the introduction of the highest legal document governing metrological activities in Viet Nam. This law is a combination of years of cooperation with international and regional organizations in metrology, in particular the OIML, whose Documents and Recommendations are a primary foundation of our national regulation system, not only for the domestic environment but which are compatible with international practice as well.

Taking this opportunity on behalf of the Government of Vietnam, I would like to express our sincere thanks to the international metrological experts and organizations that contributed recommendations and practical ideas to this law. The Ministry of Science and Technology always supports STAMEQ to the best of our ability for its great involvement in and contribution to international and regional cooperation in metrology.

Ladies and gentlemen, Viet Nam truly appreciates the success and the efforts made by the OIML, the CIML, and the BIML during the preparations for the CIML meeting. We actively cooperate with other Member States in their dedication to developing a global measurement system for the benefit of Members' legal metrology systems. We hope that all the ideas at this meeting will greatly contribute in promoting cooperation and mutual recognition between legal metrological organizations from all Member States, bringing our common goals to reality in creating a global measurement system.

On behalf of the host country I wish the 48th CIML Meeting and related events every success. I wish President Peter Mason, delegates and guests health and happiness. I also hope that everyone will enjoy their stay in this dynamic and friendly country of Viet Nam. Thank you for your attention. ■

The fifth *OIML Award for Excellent Achievements in Legal Metrology in Developing Countries* was awarded to the Tanzania Weights and Measures Agency, represented by Mrs. Magdalena Chuwa

Dr. Miki (Japan) was elected CIML Second Vice-President

◀ Opera House

City Hall ▼

Technical visit to Nhon Hoa Scale Co., Ltd. ▼

The resolutions of the 48th CIML Meeting are available under the Structure/ CIML section of the OIML web site

The OIML is pleased to welcome the following new

CIML Members

- **Albania: Mr. Petrit Rama**
- **Hungary: Mr. Ferenc Monus**
- **Iran: Mr. Adel Banaei**

Bulletin online:

Did you know that the OIML Bulletin is now available online free of charge?

oiml.org/en/publications/bulletin

OIML Meetings

March 2014

TC 9 Project Group meeting to discuss p1 (Revision of R 60).
17-18 March, Gaithersburg, MD, USA

Joint CPRs meeting - Intermediate DoMC reviews.
18-19 March, Gaithersburg, MD, USA

MAA Ad hoc group meeting.
20-21 March, Gaithersburg, MD, USA

April 2014

TC 8/SC 3 Project Group meeting
to discuss p2 and p3 (Revision of R 117).
Chicago, USA - Date and venue to be finalized.

September 2014

TC 6 Project Group meetings
to discuss p2 (Revision of R 79) and p3 (Revision of R 87).
Seoul, Rep. Korea - Date and venue to be finalized.

Committee Drafts

Received by the BIML, 2013.10 – 2013.12

Revision of OIML R 79: Labelling requirements for prepackages	E	5 CD	TC 6	ZA
R 117-2: Dynamic measuring systems for liquids other than water. Part 2: Metrological controls and performance tests	E	2 CD	TC 8/SC 3	US/DE

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