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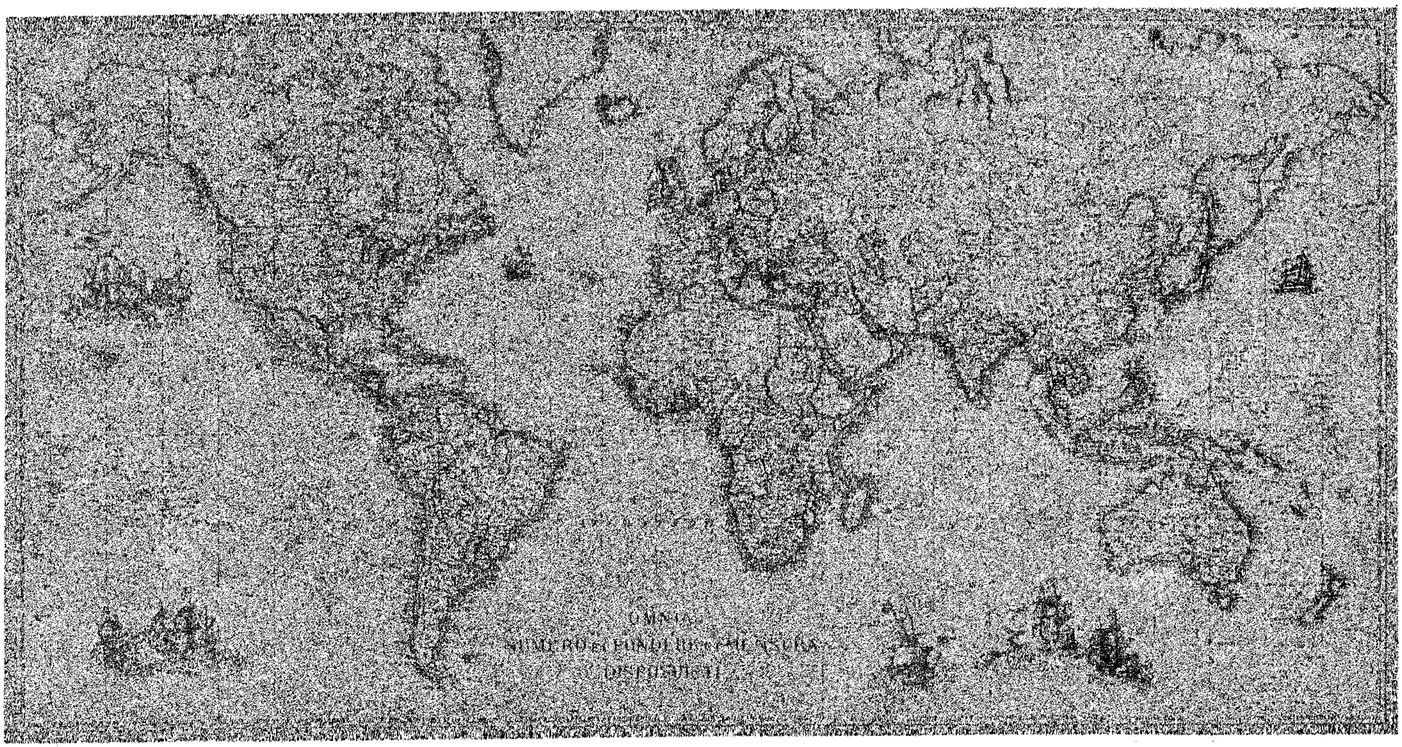

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BULK MATERIAL WEIGHING APPLICATIONS and PROBLEM SOLVING *

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SUMMARY — In all automatic weighing operations of bulk material the effective result depends to a great extent on the installation and loading conditions. The following paper is practically an illustrated course on belt weighing including principles, accuracy and choice of systems according to application as well as the precautions to take at installation and maintenance. The author considers that if all precautions are taken accuracies of ± 0.125 % or better can nowadays be reached.

RESUME — Dans toutes les formes de pesage automatique des produits en vrac le résultat final dépend largement des conditions d'installation et de chargement. L'article suivant constitue en quelque sorte un cours illustré de pesage sur bande comprenant les principes, l'exactitude, le choix de systèmes en fonction de l'application ainsi que les précautions à prendre lors de l'installation et de la maintenance. L'auteur considère que si toutes les précautions sont prises, il est maintenant possible d'atteindre une exactitude de ± 0,125 % ou mieux.

Introduction

Industry in the United States has begun to take a much closer look at the weights produced for bulk materials received and stockpiled, materials used in process, and bulk materials shipped. As an example, the coal-fired power generation industry now needs to know, with accuracy, the amount of coal « as received » and « as fired » in order to determine inventory, and in order to be able to substantiate fuel adjustment charges to its consumers and to State Public Service Commissions.

The cost of bulk raw materials continues to climb, and the price delivered to the plant continues to rise because of increased freight rates. Thus, the need for greater accuracy in measurement of these bulk materials. The word most commonly used today to cover this subject is « accountability ».

In recent years, industry has been following a trend toward automation which has brought about an increase in the use of continuous, automatic processes. In the automatic process, the delays and discontinuities inherent in the batch weighing of bulk materials have been found to be undesirable, and this has led to an increase in the use of continuous weighing conveyor belt scales for bulk material weighing.

Conveyor belt scales are most desirable for industries handling bulk materials, because they require a small amount of space, they are relatively inexpensive, and they permit flow of material without interruption. As industry has increased its use of these products, however, it has often followed the practice of hanging a belt scale on a conveyor as an add-on, essentially after the rest of the material handling

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system has already been designed and, in most instances, installed. This course of action forces the weighing system components into available space, without regard for the effect on its weighing performance.

This common practice of dealing with conveyor belt scales as an afterthought when designing a material handling system, results in the acquisition of a conveying system that incidentally weighs — with questionably accuracy, rather than a weighing system that incidentally conveys — while producing close accuracy.

The performance and reputation of belt scales continues to be questionable and has created apprehension on the part of many users because the actual in-plant performance does not always measure up to the guarantees of the manufacturer or to the expectations of the purchaser. As a result, many belt scales are being used only to produce rough estimates or approximations of material received or used in process, or are no longer used at all in the accountability functions of the plant. In the majority of cases, these disappointing performances could be eliminated if the basic concepts of in-transit weighing were adhered to in the application, installation, and start-up of the equipment, followed by a program of planned maintenance performed by qualified technicians.

To obtain an in-transit weighing system that will produce close accuracy and to eliminate or minimize the problems associated with any system, it is first necessary to understand the major components of a belt conveyor scale system — how the system operates and what parts of the weighing and conveying process are potential sources of trouble.

Major components of a belt conveyor scale system

The basic components of a belt conveyor scale are shown in Figure 1. Their functions are as follows :

- — The scale carriage (scale suspension) transmits the forces resulting from the belt load and directs those forces to the load sensor(s).
- — The load sensor(s) transduces the load force to a form acceptable to the mass totalizer.
- — The belt travel (speed) pickup contacts the belt and transmits belt travel (speed) to the speed sensor.
- — The belt travel (speed) sensor transduces the belt travel (speed) to a form acceptable to the mass totalizer.
- — The mass totalizer (integrator) computes the total mass which has passed over the belt conveyor scale and provides for indicating and recording that value. Typically, the mass totalizer will also provide a mass flow rate indication.

Various designs and technology can be applied to the components of a belt conveyor scale, but basic design considerations are applicable to all.

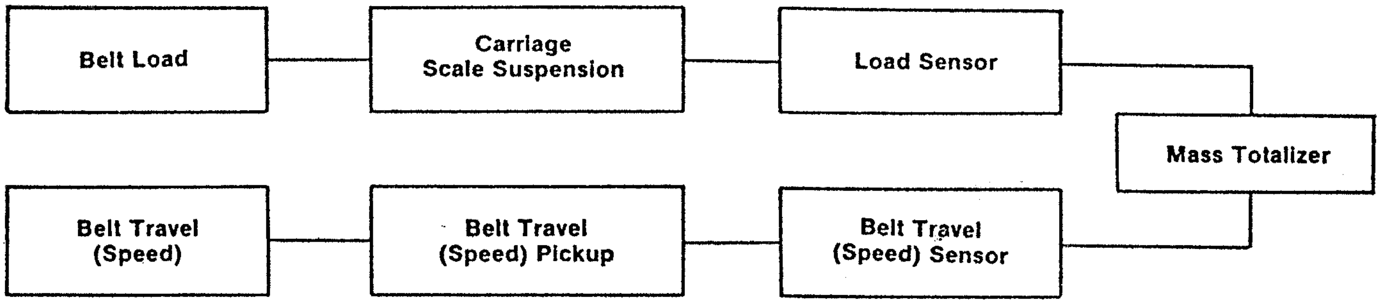


FIGURE 1

Scale Carriage

The scale carriage must transmit the forces resulting from material on the conveyor belt to the load sensor without adding any extraneous forces. It is important that no forces originating from belt travel or belt side travel be converted to a force on the load sensor.

Figure 2 is a sketch of a single weigh idler showing forces in two dimensions. The force F actually is sensed by the idler, but the scale carriage must transmit only force V to the load sensor. Force H, (as well as another force H vertical to the plane of the figure) must not be changed to a force acting on the load cell as a false representation of force V.

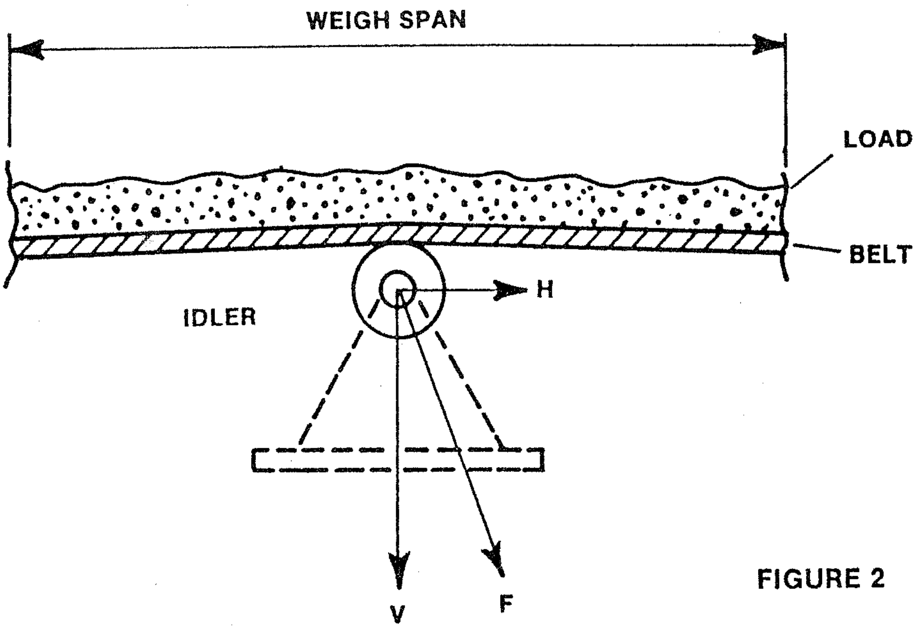
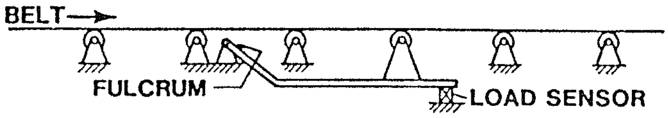


FIGURE 2

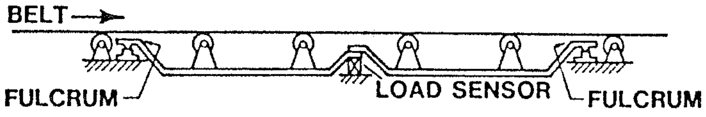
In general, to accomplish this function, the scale carriage must fulfill the following criteria :

1. rigidity, minimal deflection
2. torsional stability
3. elimination of the effects of lateral forces
4. minimize effects of off center belt loading
5. alignment provisions
6. minimize tare weight portion on sensor
7. maximize belt load portion on sensor
8. minimize horizontal surface area for dirt collection
9. unit construction for easy installation
10. frictionless pivot points or fulcrums
11. provisions to accept high temporary overloads without calibration shifts

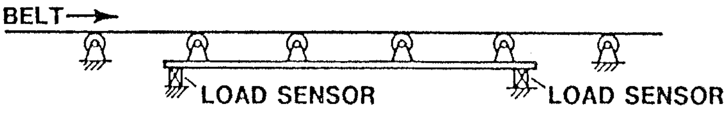
Several common carriage designs are shown schematically in Figure 3.



SINGLE PIVOT CARRIAGE,SINGLE IDLER



DUAL PIVOT CARRIAGE, MULTIPLE IDLER



FULL-FLOATING CARRIAGE, MULTIPLE IDLER

FIGURE 3

Load Sensor

The load sensor(s) receives the force transmitted by the scale carriage and converts the force to a signal usable by the mass totalizer (integrator).

Several means of load sensing have been used in belt conveyor weighing, including mass balance, force balance using buoyance of a displacement float, pneumatic or hydraulic force balance, magnetic force balance, and deflection or spring type transducers which include both strain gauge load cells and LVDT (linear variable differential transformer) load cells.

Each of the above techniques has certain advantages and disadvantages. One important factor for belt conveyor weighing is minimum deflection from no load to full load. Strain gauge load sensors typically have less than .003 inch (.08 mm) deflection as used in conveyor scales and are the most commonly used load sensors. Another important factor is temperature stability. Since most belt conveyor scales are installed outdoors, the load sensor must be able to operate over a wide temperature range without appreciable zero-drift and error due to temperature. Here, again, strain gauge load cells have an advantage over some other types of load sensors.

Belt Speed (Belt Travel) Sensors

Belt speed or belt travel sensing (displacement) is equally important to the accurate measurement of load in the computation of total mass passed over a belt conveyor scale. A one percent error in conveyor speed (travel) measurement will produce a one percent error in the totalized value just as surely as a one percent error in load sensing.

Errors in the accurate measurement of belt travel for belt conveyor weighing can occur from a variety of sources :

1. Slip between the belt travel pickup and the conveyor belt.
2. Belt travel pickup axis not at exactly 90° to the direction of belt travel (narrow wheel type pick-ups).
3. Belt speed varies within the conveyor as a function of tension.
4. Inaccuracies within the speed sensor (speed transducer).

The function of the belt travel pickup is to provide a rotary motion suitable for the belt travel sensor and representative of the actual conveyor belt travel at the load sensing location. Due to changes in belt tensions, differences along the conveyor of 0.3 to 0.5 % have been observed. For this reason, it is preferable that the belt travel pickup be mounted near the scale location. Note that the return portion of the conveyor does not conform to this definition of « near the scale location ».

Some of the most common forms of belt travel (speed) pickup are as follows :

1. The tail pulley.
2. A pickup mounted to ride against the underside of the load carrying portion of the conveyor.
3. A roller mounted to ride against the clean surface of the return portion of the conveyor.
4. A conveyor idler modified to provide speed sensing.

Table 1 provides a summary of some of the advantages and disadvantages for each system.

TABLE 1 — FORMS OF BELT TRAVEL PICKUP

	Advantages	**Disadvantages**
Tail Pulley	1. Large angle of wrap. Low slip. 2. Large diameter - not normally affected by material buildup, small effect from belt thickness variations.	1. If scale is at high tension compared to tail pulley, belt speed will be somewhat higher in scale area.
Underside of Load Carrying Portion of Conveyor	1. Can be mounted near the scale location to avoid speed errors due to tension changes.	1. Very small portion of wrap, has high potential for slip. 2. Often a narrow pulley which can easily be installed with an axis not at 90° to belt travel.
Roller Mounted to Clean Side of Return Portion of Conveyor	1. Usually a full width roller which can readily be installed at 90° to belt travel. 2. If an extra pulley is installed, adequate angle of wrap can be provided.	1. Has even more tension variation than tail pulley location. 2. Requires installation of special roller or rollers. 3. Smaller diameter is affected by belt thickness variations.
Modified Conveyor Idler	1. Can be mounted at the scale location to avoid speed error due to tension changes.	1. Very small angle of wrap, has high potential for slip. 2. Requires special idler.

Belt Travel Sensors

Devices used for sensing belt travel have included d-c generators, a-c generators, mechanical belt or chain drives for mechanical integrators, photo-optical segmented disks, and electromagnetic pulse generators. These devices transduce the belt travel to a signal suitable for the mass totalizer.

With the advent of microprocessors, it has become more appropriate to use a device which provides a pulse for each unit length of belt, as described in the section on mass totalizers.

Mass Totalizers (Integrators)

Outputs from the belt travel (speed) sensor and from the load sensor are combined in the integrator to produce a running total of material passed over the belt conveyor scale. (Both mechanical and electronic integration have been used). Mathematically, there are two classes of integrators which will be referred to as a weight integrator and a rate integrator.

The weight integrator senses load and belt travel. The device then computes the total weight according to the equation :

$$W_T = \int Q dx$$

W_T = Total weight
Q = Weight of material per unit length of belt
dx = Infinitesmal length element of the belt

In the newer digital totalizers, the equation is more correctly stated :

$$W_T = \sum_{o}^{n} Q_i L_i$$

W_T = Total weight
Q_i = Weight on scale at instant i
L = Unit length of belt as utilized by integrator

The rate integrator multiplies the load by the belt speed to get a weight per unit time signal, then integrates :

$$W_T = \int Qv dt$$

W_T = Total weight
Q = Weight per unit length
v = Belt speed

To provide accurate total weight and convenient operation, the integrator should contain such features as :

1. Stability of gain and zero over the operating temperature range, typically — 10 °C to 40 °C or 15 °F to 115 °F. Change across the range should be less than the accuracy statement.
2. Ability to integrate both plus and minus for accurate zeroing.
3. Belt speed compensation.
4. Convenience of operator use for calibration.

5. High resolution for calibration.
6. Non-interacting zero and span adjustments.
   Digital systems are available with no screwdriver adjustments, only keyboard inputs.
7. Compatability with instrumentation and control.
8. Auto zeroing capability.
9. For low accuracy installations, a low load cutout may be convenient.

Most present-day conveyor scales use some form of electronic integrator. They are divided into three categories :

1. Analog mathematics.
2. Frequency counting mathematics.
3. Microprocessor mathematics.

All the components described must function accurately with minimal error for a belt conveyor scale system to perform accurately.

Weighing accuracy

It is important to establish a clear definition of weighing accuracy for belt conveyor scales. Consider the meaning of accuracy as it applies to a platform, truck or hopper scale. The scale is checked for accuracy against a traceable standard weight. For smaller capacities, the weights may be used to full capacity. For larger capacities, a substitution test may be used where standard weights are applied, then removed and material added to that same percent of capacity. In either case, notice the presence of traceable standards of mass which are applied to the scale.

In the case of the belt conveyor scale, this procedure cannot be followed. It is certainly possible to apply traceable weights to the belt conveyor scale, but the procedure has little meaning. The actual mass as seen by the conveyor scale in operation is affected by the conditions of the conveyor belt, as well as by the actual mass passing over the scale. As a result, the only way to test the accuracy of the conveyor scale is to compare the weight of material weighed over the belt conveyor scale to a reference static scale. This immediately raises several other questions :

1. How much mass should be collected ?
2. How accurate is the reference scale ?
3. What if it isn't possible to collect the material ?

National Bureau of Standards Handbook 44 contains a section covering conveyor scales. Paragraph N2 defines the minimum mass to be collected as « not less than » :

(a) 10 minutes duration,
(b) 3 circuits (revolutions) of the belt, and
(c) 500 significant figures on the master weight totalizer.

In addition to defining the minimum mass to be collected, Handbook 44 also requires it be collected at a flow rate between 50 and 100 percent of rated capacity and that a defined zero load test be run prior to the material test.

The rationale for these requirements is based on the properties of a belt conveyor scale. The ten minutes duration is an acknowledgement that the mass measurement in the conveyor scale contains appreciable amounts of process noise and it is necessary to average this noisy signal over some period of time.

Three circuits of the belt is an acknowledgement that the conveyor belting is not perfectly uniform. Some sections of the conveyor belting will be heavier than others. The best test is one in which the test includes an exact unit number of revolutions of the belt.

The requirement for a minimum of 500 significant figures on the master weight totalizer is to provide a minimum resolution of 1 part in 500 in the conveyor scale reading.

These requirements can, in some cases, result in a different quantity of material. For example, a conveyor scale operating at 5 000 tons per hour will yield 833 tons in 10 minutes. If loaded into 100 ton rail cars this is a minimum of 9 cars. This, in turn, requires 9 gross weights and 9 tare weights, each with some error, to establish the reference weight against which the conveyor scale is to be calibrated. It is always important to verify the accuracy of the reference scale prior to any calibration of the conveyor scale.

Accuracy for a conveyor scale is then calculated by :

$$\frac{\text{Reference Scale Value} - \text{Conveyor Scale Value}}{\text{Reference Scale Value}}$$

A WEIGHED MATERIAL LOAD TEST IS THE ONLY WAY TO ESTABLISH TRACEABLE ACCURACY ON A BELT CONVEYOR SCALE.

Other types of tests (referred to as simulated tests) are often used with conveyor scales, such as test chains applied to the carrying surface of the belt, known weights applied to the conveyor scale, or shunt resistors of known value applied to the strain gauge bridge. None of these simulated tests can establish accuracy. In some cases, they may be useful in determining repeatability and stability of the scale electronics.

Often, a simulated calibration test is the only reasonable way to calibrate a belt scale. It may be very difficult in some material handling systems to isolate a sample which can be taken to a certified static scale, especially a sample of large size. The location of the nearest certified track or truck scale could also be a considerable distance away, making it very costly and time consuming to run a material test. One solution is to install a certifiable test weigh bin as part of your material handling system.

Regardless of your installation, it is important to keep in mind what factors contribute to accuracy in a belt scale system and that, because of the dynamic effects of weighing in-motion, a weighed material test is the only way to verify system accuracy as opposed to repeatability.

Electro-mechanical belt scales

The previous discussion has outlined the basic theory of operation, design considerations and concept of weighing accuracy as generally applicable to all types of belt conveyor scales. The three basic types of belt conveyor scales encountered in the field are nuclear, mechanical and electro-mechanical.

Nuclear scales are somewhat unique and have special application considerations. Mechanical scales are representative of older technology and their usage is very limited. Electro-mechanical scales are by far the most widely used type today. Often referred to as electronic belt conveyor scales because data is transmitted and processed electronically, electro-mechanical scales still must mechanically interface with the conveyor itself to measure the mass load on the belt.

Though we refer to an electro-mechanical belt conveyor scale as a type, there is still a great deal of diversity between various electro-mechanical belt conveyor scales on the market. The different manufacturers take varying approaches to the design of the components that comprise their system. Even a single manufacturer may have significant differences between models in their line, varying in capabilities and features. This is evident in all four components that make up a belt conveyor scale system : carriage, load sensor, belt travel (speed) sensor and integrator.

Carriages, for instance, come in a wide variety of designs, but all generally traceable to the three basic types described earlier in Figure 3. The only generalization that can be made about carriages is that the longer multi-idler versions are usually associated with higher performance systems while single-idler carriages are widely used for most general in-plant control and monitoring applications.

The load sensors used on electro-mechanical scales are electronic transducers, usually either LVDT's or strain gauge load cells, the latter being most widely used.

Speed sensors all generate an electronic signal but vary considerably in their design and the point at which a given manufacturer usually applies them. Almost all variations discussed earlier in Table 1 are used by one manufacturer or another.

Finally, integrator/totalizers are electronic but can vary considerably in their design, features and specifications. Both analog and digital designs are offered in the marketplace. Those designs offering the most current technology are microprocessor-based digital units with software that provides simpler calibration and self-diagnostics.

In summary, even among the broadly used electro-mechanical scale type, a wide selection of product designs and features are offered. Each manufacturer will have an argument supporting their own particular design and methods.

Selecting a belt conveyor scale

The process of selecting a belt scale that is best for any given situation should take into consideration all of the following : (1) intended use, (2) accuracy, (3) belt scale design, (4) conveyor, and (5) calibration. The following is a discussion on each of these points.

1. Intended Use

It is generally agreed that people purchase a belt scale for three distinct uses. They are :

a. Fee or custody transfer application. Typically, these scales require accuracies within 1/4 % and require a regulatory agency approval.

b. Process management or control application. These scales are used in process plants to monitor costs, production rates, and blending of material. The accuracy levels desired range between ± 1/4 % and ± 1 %, depending on the situation. Belt conveyor scales rated for ± 1/2 % accuracy are most common for these applications. Typically, they do not require agency approval.

c. Process monitor application. These scales are used in process plants to get an alarm when potentially costly or harmful situation exists, such as too much feed to a crusher. The accuracy levels range between ± 1/2 % and ± 3 %, depending on the situation. Often repeatability is of equal concern as actual weighing accuracy.

2. Accuracy

The accuracy statements printed on the sales literature of each company making belt conveyor scales are different. Some state the accuracy of the instruments and not the complete system. Others give a repeatability statement, meaning simply that it will repeat within certain limits when checked against simulated tests. Still others state that on the installed system, over a specified operating range, the belt conveyor scale system will weigh to a certain accuracy. To a person concerned with weighing, only this latter statement has meaning.

Regulatory agencies such as the Weighing and Inspection Bureaus, require a scale to perform as follows :

> The scale's accuracy must be ± 1/4 of 1 percent maximum error of totalized weight when the scale is operated over a range of 50 to 100 percent of designed capacity.

Governmental agencies, such as State Departments of Weights and Measures, use National Bureau of Standards, Handbook 44. This requires a scale to perform as follows :

> The scale's accuracy must be ± 1/2 of 1 percent maximum error of totalized weight when the scale is operated over a range of 50 to 100 percent of designed capacity.

Note that either type of agency requires material tests to establish the accuracy of a belt scale. Additional criteria are applicable to how the tests are run.

3. Belt Conveyor Scale Design

The belt conveyor scale, as received from the manufacturer, has three major components ; namely, the electronics, the speed sensor and the carriage assembly (which includes the load sensor). The following are things to consider :

a. Electronics — Is it current state-of-the-art ? Is the sum of errors (linearity and temperature stability) considerably less than the system accuracy required ? In other words, the error of the electronics must be small compared to the system accuracy. Do the electronics feature automatic span and zero calibration ? Can the electronics assist in diagnosing and displaying error or operating problems ? Are proper outputs and displays available ? Are output signals isolated ?

b. Carriage Design — Here, two basic designs exist : (1) pivoted type, and (2) full floating platform (refer to Figure 3). The following is a comparison to the two designs :

   (1) Pivoted Design — In the pivoted design, the weight applied to the weigh idler(s) results in the torque about the pivot. This torque is measured by the load cell. The torque and weight will have a linear and stable relationship as long as the pivot is perfect. Pivots made from knife edges and ball bearings develop flat spots with time making them far from a perfect pivot. The result is weighing errors of measurable size.

   (2) Full-Floating Design — In this design, there are 4 load cells to suspend the carriage and sense the weight. No pivots and no torques — only check rods to hold the weighing platform in place. This is the same principle used in accurate static scales.

   For high accuracy weighing microprocessor-based electronics and a full-floating design carriage have proven to be extremely accurate and reliable.

4. Conveyor Design

Review the following « Application » section for conveyor considerations. Remember that for the high accuracy, all suggestions of that section must be addressed.

5. Calibration

The calibration of a belt scale is completely different from a static scale simply because it is a dymamic scale, the material is moving. To calibrate a belt scale involves using a simulated load for initial calibration and followed by a material test. Subsequent calibration checks are normally done with simulated loads.

Application considerations

Assuming you have selected good scale hardware, the application and installation of your belt conveyor scale now becomes all-important in determining how accurately your belt conveyor scale system will perform.

In applying belt conveyor scales one must always consider external influences originating from the material handling system and belt conveyor. Regardless of stated accuracies, these two factors will determine the overall long-term and short-term accuracy you may expect. The guidelines on the last pages of this paper should be adhered to in order to optimize belt scale performance and weighing accuracy.

The application criteria we have recommended simply cannot be followed on every conveyor. On some installations you have to make a few compromises. On typical process monitoring and control applications, the effect on weighing accuracy may not be of great concern. On certified weighing installations, all criteria must be considered important.

Assuming you have selected good belt conveyor scale hardware and applied it in compliance with these guidelines, you should now have an installation that performs reliably and provides the weighing accuracy you expected. On-going performance is, of course, dependent on continuing maintenance.

Continuing maintenance

Inspection of Belt Conveyor Scale Area

Belt Conveyor Scales may be expected to operate satisfactorily and hold calibration for weeks with a minimum of maintenance ; however, if the user wants the full benefit of his belt conveyor scale, maintenance of the conveyor system and belt conveyor scale area should get adequate attention. One of the major problems is lack of good house-keeping. Keeping the belt conveyor scale area clean should be primary consideration, particularly in applications where excessive spillage occurs. The cause of spillage should be investigated and eliminated where possible.

Periodic checking of the weight and speed sensor should be made to see that they are free of material which might impair their performances. Build up on the bend pulley should be kept to a minimum and stabilized. Material build up on the suspension should normally be removed, but in some cases the scale should be rezeroed with material build up left on the suspension, if build up is a normal occurrance. Usually, this build up will reach a certain point and stop. Care should be taken that build up does not interfere with the sensor deflection under load.

With digital electronics, recalibration is not required due to electronic shifts, but more likely due to mechanical misalignment of the weight sensor.

It must be borne in mind that most belt conveyor scale systems are exposed to weather, overloading, etc. Apart from housekeeping, alignment of the troughing rollers should be regularly checked. Normal wear may cause misalignment, but so can the settling of foundations. Proper functioning of the gravity-type takeup should be checked regularly.

Periodic Calibration

Frequent zero calibrations may be impractical, although it is recommended to do a daily zero calibration or empty balance. A change in zero balance can be expected over a long period of time due to material buildup on the carriage. Zero calibration should only be performed by making a whole number of revolutions. Only if whole number of revolutions are used for zero calibration will the belt weight variance be compensated for. Zero shifts in the order of 0.1 to 0.2 % of full scale normally are the result of major weather changes, material buildup on the weighbridge, belt tracking, etc. Zero shifts of a larger magnitude normally are belt conveyor related and should be corrected prior to zero calibration. Most belt conveyor scale weighing errors result from improper zero calibration and lack of understanding of factors causing zero calibration shifts or errors.

Belt conveyor scale systems may need regular zero calibrations ; however, their calibration curve (span) will not change. When a span calibration check reveals a deviation from the span reference constant, its cause is most probably in the mechanical parts of the belt conveyor system. The only way to obtain an accurate span setting is to conduct a material test. Following a material test, a span calibration factor will be applied to one or more simulated span calibration methods for subsequent span checks. No simulated test is known which is equivalent to a material test. Quite often, a material test is not possible and span calibration can only be performed by using a simulated test, where the live load is replaced by using a test chain, test weight, or electronic span.

Accurate record keeping is an important step in any maintenance and calibration program. Without records, severe misalignment and errors due to required mechanical maintenance may go undetected for a lengthy period of time. Accurate history would reveal a problem of this nature during required routine calibrations.

Adherence to this set of standards for the application, installation, and maintenance will solve the majority of problems encountered by industry with in-transit weighing systems.

In conclusion, I would stress that if care has been taken with application and installation of the weighing equipment, the majority of problems encountered are attributable to operating factors within the plant which are inconsistent with the design of the scale, i.e., unsatisfactory feed of material, incorrect rate of flow, and changes in conveyor belt speed or maximum operating capacity. When using a static scale with a maximum capacity of, say, 50 pounds, it is quite obvious that it would not be possible to obtain an accurate weight for an article weighing 75 pounds. This is frequently overlooked when utilizing in-transit weighing devices, and the equipment is ordered to specifications which may, in fact, be considerably different from the actual operating conditions which exist in the plant. Obviously, these differences are compounded because of the dynamics inherent in the system. Close attention should be given to supplying accurate operating information to the manufacturer of the weighing device. If significant changes are made in the underlying operating limits, the scale should be changed (rerated) accordingly.

More and more often, today, management and internal auditors utilize the information gathered from the in-transit weighing systems for critical business planning, and they insist on high accuracy. Certainly, it is possible to consistently obtain accuracies of better than ± 0.125 %, if the ground rules are followed.

A. **Scale Location:**

1. **Tension:**
In all installations it is very important that the belt scale be installed in an area where belt tension and tension variations are minimal. For this reason, the belt scale should be installed near the tail section of the conveyor, but far enough forward so as not to be influenced by infeed skirt boards.

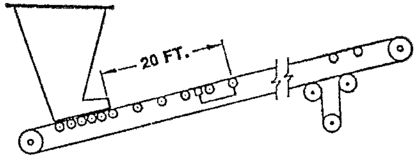


FIGURE 4

2. **Uniform Belt Loading:**
Although in most applications the scale system is capable of operating accurately over a 4 to 1 range, it is desirable that the belt loading be as uniform as possible. To minimize surges or feed variations, hoppers, if possible, should be equipped with depth limiting gate.

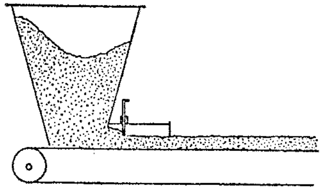


FIGURE 5

3. **Single Load Belt:**
On high accuracy installations, the conveyor should be loaded at one and the same point. This assures constant belt tension at the scale during all loading conditions.

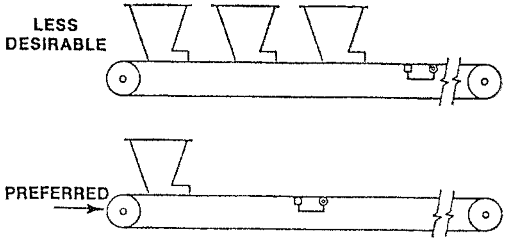


FIGURE 6

4. **Material Slippage:**
The belt scale system processes belt loading and belt travel to arrive at an accurate weight. Product speed must equal belt speed at the scale. For this reason, the conveyor speed and slope should not exceed that at which material slippage occurs.

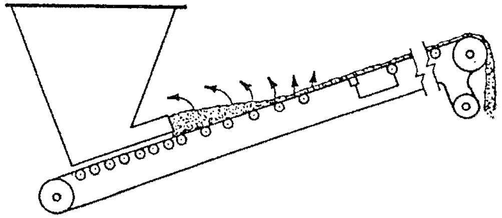


FIGURE 7

5. **Convex Curves:**
Straight conveyors are preferable to curved conveyors. Curves are not recommended between the loading point and the scale. Convex curves are permissible at a distance of 20 feet or a minimum of five idler spaces beyond the scale area idlers.

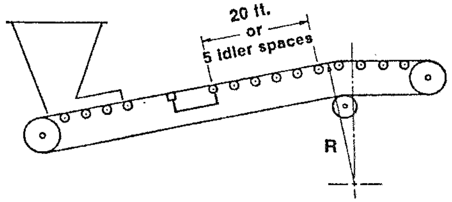


FIGURE 8

6. **Concave Curves:**
The point of tangency on a concave (upward going) curve must be at least 40 feet beyond the scale. If the scale is to be certified under the code outlined in Handbook 44, this dimension must be 70 feet. Regardless of this dimension, if installed on a conveyor with a concave curve, the scale must be installed on a section of the conveyor where the belt is straight and in contact with at least eight idlers to either side of the scale throughout the entire loading range. The belt scale should always be between the infeed and curve, never between curve and head pulley.

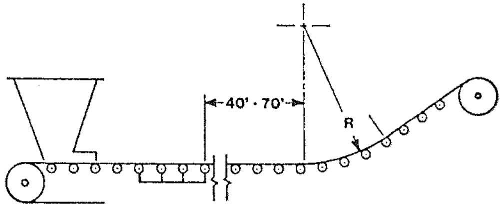


FIGURE 9

7. **Trippers:**
In any installation where weighing accuracy is important, the scale system should not be applied to a conveyor that has a movable tripper. If the scale must be installed on a conveyor with a tripper, then the same rules apply as for an installation in a concave conveyor. The minimum distances outlined in the above paragraph must be adhered to with the tripper in its fully retracted position. It is also of extreme importance that the belt tracks centrally at the scale area for all tripper locations.

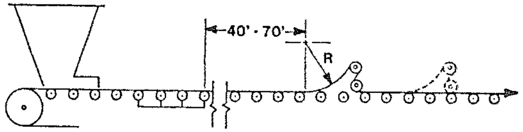


FIGURE 10

B. Conveyor Design:

1. **Wind and Weather Effects:**
   The scale and conveyor at the scale shall be protected from wind and weather effects. Magnitude of weighing errors caused by wind is dependent on wind velocity. A minimum of twenty (20) feet should be enclosed or shielded either side of the scale. A door on one end is recommended.

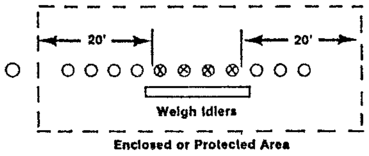


FIGURE 11

2. **Vibration and Deflections:**
   The entire conveyor frame should be isolated from bins, feeders, crushers, and other mechanical equipment. This is to prevent bin loading from causing conveyor deflections and to protect the weighing equipment from vibrations and shocks imposed by mechanical equipment.

3. **Conveyor Support:**
   In the design of the scale system, several deflections are taken into consideration. These are the deflection of the load cells, and the deflection of the supporting conveyor structures. It is of utmost importance that these deflections not be excessive. In the manufacture of the scale, the amount of deflection in the load cells and the carriage assembly is controlled. The only variable is the deflection of the conveyor itself. Therefore, the conveyor stringers suporting the scale and idlers to either side of the scale should be of ample size and be adequately supported to limit the relative deflection between at least the +3 and -3 Idlers to no more than 1 part in 1200 (e.g., ±0.030" over a 36" idler spacing). No conveyor expansion joints or stringer splices should be located in this region of the conveyor.

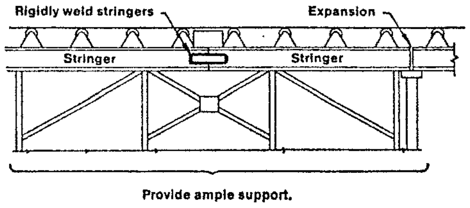


FIGURE 12

4. **Cable Conveyors:**
   Conveyors commonly known as "CABLE" or "ROPE" conveyors are not suitable for electro-mechanical belt conveyor scale weighing

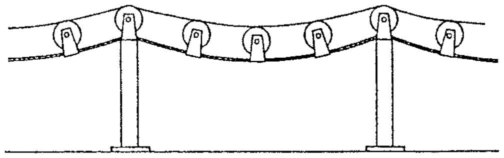


FIGURE 13

5. **Stacking Conveyors:**
   Avoid cable supported conveyors such as stacking conveyors and conveyors that change the angle of elevation between periods of calibration. This application is possible at reduced accuracy.

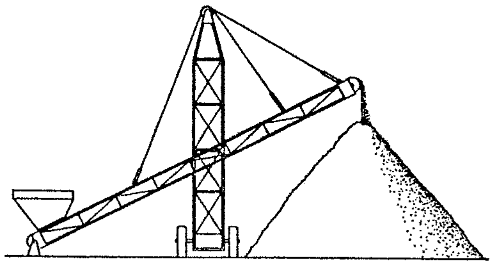


FIGURE 14

6. **Gravity Type Take-Ups:**
   All conveyors over 30 feet in length should be equipped with a gravity type take-up.

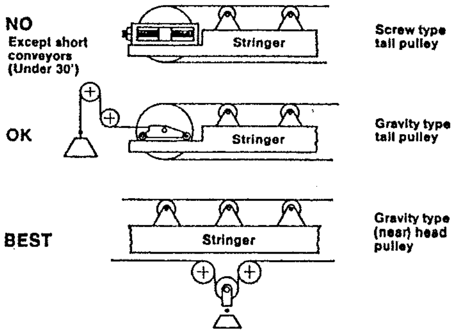


FIGURE 15

7. **Belt Tracking:**
   One problem in attaining optimum belt scale accuracy is the effect of belt tracking from an empty to a fully loaded condition. To enhance belt tracking, the construction of the belting should have the necessary flexibility to assure contact with all scale area idler rolls when the belt is running empty. In addition, this also assures that the conveyed material is being supported by the weighing idlers rather than by the carcass of the conveyor belting.

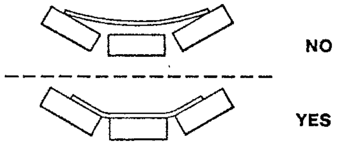


FIGURE 16

C. **Belt Scale Area Idlers:**

1. **Idler Type:**
   The selection of the idlers used within the scale area is extremly important. This pertains not only to the idler type, but the idler construction itself. Since idler alignment plays an extremely important role in the operation of a belt conveyor scale, it is extremely important that all idlers be manufactured as nearly alike as possible. It is also important that certain types be avoided, such as "V" types and rope or cable types.

2. **Scale Service Idlers:**
   Idlers in the weighing area (minimum +3 to -3 idlers and on scale) should be round, uniform and of same make, troughing angle and rating. The top grade idler, manufactured by most of the major idler suppliers, under normal conditions, is an adequate idler for scale service use. It may be required, however, to select a series of idlers that have similar dimensions and troughing angles for scale service.

3. **Idler Troughing Angles:**
   The use of idlers with steep troughing angles causes many problems. Not only does the beam or catenary effect of the belt become more pronounced as the troughing increases, but the effect of idler misalignment is amplified as well. One very important function to perform at the time of installation of the scale system is to check out the alignment of all idlers within the weighing area. This is done to help minimize the extraneous forces introduced into the weighing system caused by changes in belt tension or other external forces as the belt travels across the idlers.
   Troughing angles of 35° or less are preferred for all high accuracy installations. Troughing angles of 45° are acceptable under certain conditions.

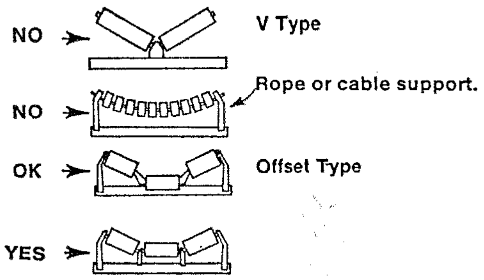


FIGURE 17

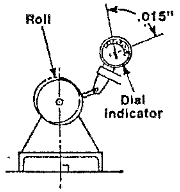
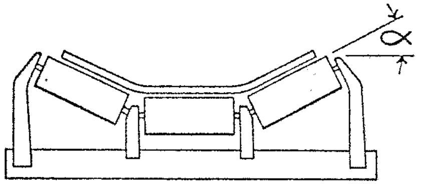


FIGURE 18



α =0°-35° Preferred.
α =45° Acceptable under certain conditions.

FIGURE 19

4. **Training Idlers:**
   It is extremely important that the belt tracks centrally from no load to full load conditions. Training idlers are normally accepted if located at least eleven idler spaces either side of the scale-mounted idlers.

5. **Idler Alignment:**
   The scale mounted idlers and a minimum of three idlers to either side should be dimensionally aligned. It is the installation of these idlers that is the most critical. Good idler alignment throughout the entire conveyor is important to assure adequate and true belt tracking under all load conditions.

ETATS-UNIS D'AMERIQUE

CONSIDERATIONS in TESTING BELT WEIGHER SYSTEMS *

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SUMMARY — In belt weighing installations errors can result from variations in conveyor belt thickness and consequently in mass per unit length. These variations may in certain cases reach ± 3 % and seriously affect the global accuracy when the minimum totalized mass is low and when it corresponds to an uneven number of belt revolutions. In practice this effect can be minimized if the minimum totalized load is defined as a function of the maximum variation (excursion) of totalized value during the zeroing procedure of the belt weigher.

RESUME — Dans les installations de pesage sur bande, des erreurs peuvent résulter des variations d'épaisseur de la bande, donc de sa masse linéique. Ces variations peuvent, dans certains cas, atteindre ± 3 % et sérieusement affecter l'exactitude globale lorsque la masse minimale totalisée est faible et qu'elle ne correspond pas à un nombre entier de révolutions de la bande. En pratique, on pourrait spécifier des valeurs de la masse minimale totalisée en fonction des variations maximales constatées lors de la procédure de réglage du zéro de l'installation.

With the adoption of the OIML International Recommendation RI 50 in the year 1980, an important step was completed toward achieving comparable performance of belt weighers across national boundaries. A number of countries have undertaken revisions in their respective belt weigher codes to bring them into harmonization with RI 50. This paper does not intend to approach the regulatory requirements, but only to discuss the effects of belt mass variation on weighing accuracy within the framework of the existing regulation.

Calibration of an installed belt weigher requires adjustment of both zero and span of the weighing instrumentation. The zero must be accurately set before beginning verification testing to determine proper span settings. RI 50 (and all other regulations with which the author is familiar) requires that the zero adjustment be carried out over a whole number of revolutions of the belt. (Sections 6.4.3.2 and 9.5.2 for example). This is a tacit acknowledgement that the mass per unit length of the conveyor belt is not constant.

Belt mass variation interferes with the value of zero as actually used during weighing. In fact, for any weighing which is not carried out over a unit number of belt revolutions, this variation adds an unknown error. Some effects of that error and some possible means of dealing with it will be discussed.

RI 50 states in section 12.2.1 « the belt should not have more than two parts, each part having the same characteristics ». Mass per unit length is not a characteristic which is controlled by conveyor belt manufacturers. They do control the caliper (thickness) of the belt within some limits. In private communication with two major U.S. conveyor belt manufacturers, one manufacturer gave specific caliper specifications

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* Presented at the OIML Seminar on Testing of Bulk Weighing Installations, Paris 22-25 April 1985.

for 2 ply, 3 ply, and 4 ply belts. In each case, the variation is plus zero and minus approximately 6.5 percent. A second manufacturer did not make specific data available, but stated a typical observed value of approximately half the above number.

Table 1 uses a summary of belt loading data, as supplied by customers when ordering belt weighers. These data are from a limited sample size, and are used for illustration only. Mean loading was calculated for each of the conveyor sizes, and the high and low loadings were noted. On the basis of these data and the variation in belt mass of plus or minus 3.25 percent, the table shows the possible error in apparent net mass per unit length due to belt mass variation. (Note that the minus only tolerance, as stated by the belt manufacturer, has been normalized to a plus and minus value as would be the case with a properly zeroed belt weigher). The real problem is not the mass per unit length, but rather the effect on the minimum totalized load, both in testing and in actual weighing use.

To calculate the effects in actual weighing, it is necessary to make some assumptions as to how the variations in belt mass occur. Because RI 50 allows the belt to be in two parts, one assumption could be that one half the belt has maximum mass per unit length and the other half minimum. Another possible assumption would be that the mass per unit length is a sinusoid completing one complete cycle over one revolution of the belt. Obviously, the real case will be more complex than these, but these two are relatively straightforward to illustrate.

The two part scenario is illustrated in Figure 1. To show the effects in practice, consider that one condition for minimum totalized load in RI 50 section 6.4.1 is one revolution of the belt. This would allow weighing of discrete loads equal to 1.5 revolutions of the belt. Using data from Table 1, with the belt properly zeroed, the error on one half the belt is plus, on the second half is minus, and on the third half is plus again. The error for one half a belt revolution under these conditions can be expressed as :

$$E = e \int_{0}^{0.5} dx = 0.5e$$

or for 1.5 revolutions the integrated error would be :

$$E_i = \frac{0.5e}{n} = \frac{0.5e}{1.5}$$

where E = error integrated for one-half revolution

e = peak error

x = belt length in revolutions

E_i = total integrated error over n revolutions

n = number of belt revolutions

Table 2 accumulates these errors for the several examples of Table 1 and for 1.5, 2.5, and 3.5 revolutions. For these examples, the error from variation in belt weight alone ranges from 0.15 to 1.08 percent. Several of the examples show potential errors well in excess of the total allowable 0.5 percent for a Class I scale. These data are for an approximate worst case scenario.

The sinusoid case is probably the next easiest case to compute, using the following equation :

$$E_i = \frac{e \int_{0}^{n} \sin 2 \pi x \, dx}{\int_{0}^{n} dx}$$

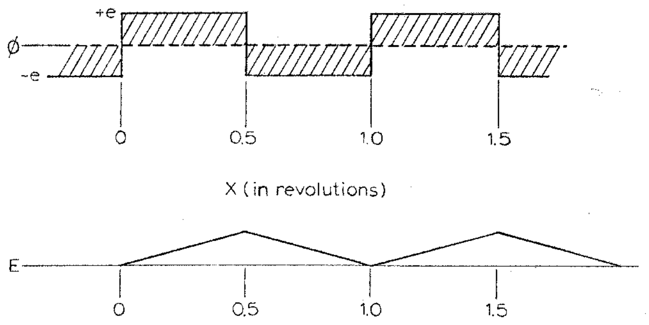

Fig. 1 — Instantaneous error (e) and integrated error (E) for varying belt mass. Belt comprises one-half heavy and one-half light.

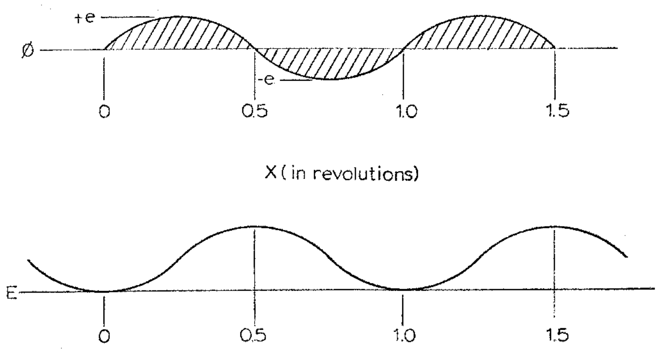

Fig. 2 — Instantaneous error (e) and integrated error (E) for varying belt mass. Variation assumed sinusoidal over one belt revolution.

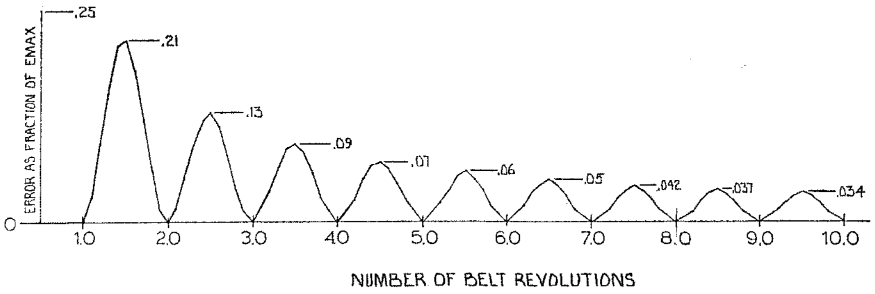

Fig. 3 — Error as a fraction of E_{max} for multiple belt revolutions.

For example, at 1.5 revolutions :

$$E_i = \frac{\dfrac{-e}{2\pi}\left|\cos 2\pi x\right|_{o}^{1.5}}{1.5} = \frac{e}{1.5\,\pi}$$

Table 3 shows error for 1.5, 2.5, and 3.5 belt revolutions using the sinusoid assumption and the data from Table 1. Figure 3 illustrates the effect of additional belt revolutions on the error. The term E max in Figure 3 refers to the maximum value of E in Figure 2 or to the calculated value of E_i for one-half revolution.

Remember that the zero value under discussion is an integrated value. During the zeroing procedure, the totalized value will increase and decrease over each revolution of the belt. When properly zeroed, the totalized value is zero over each revolution of the belt. Because the scale interval of the zero indicator is known in units of mass, the excursion contains information about the magnitude of error which could occur over a partial belt revolution. Specifically, the peak to peak excursion (during zeroing) is the error in units of mass which is possible while accumulating the minimum totalized load over a non-unit number of belt revolutions. In units which integrate a heavily filtered value of mass per unit length or of mass flow rate, this statement may need further examination.

For example, if the zeroing procedure begins with a value of 1 234 kg, advances to 1 236 kg, declines to 1 233 kg, and returns to 1 234 kg at each complete revolution, an error of 3 kg is possible for a fractional revolution. If the minimum totalized load is 1 000 kg accumulated over 1.5 belt revolutions, it could contain an error of 3 kg due to belt mass variation. It is that possibility which is calculated on a theoretical basis in Tables 2 and 3 and which can be observed in field installations as described above.

Both Table 2 and Table 3 show the possibility of unacceptable errors in practice and even in calibration. What are some possible methods to avoid or to minimize this type of inaccuracy ? Several approaches are possible :

1. Require a greater mass ; i.e., more revolutions of the conveyor belt, for the minimum totalized load.
2. Require that all weighings be done over a unit number of belt revolutions.
3. Specify the maximum excursion plus and minus of the integrated value during the zero procedure.
4. Define the minimum totalized load as a function of the excursion of the totalized value during the zero procedure.

Each of these approaches has advantages and disadvantages.

Approach one is simple to implement. With a given installation, the minimum totalized load would be larger, so loading of trucks or other small quantities could require complete conveyor redesign.

Approach two would require either a very elaborate rate-of-flow control system to produce an exact unit number of revolutions, or would require the belt to run empty during a part of a revolution so that the total is always accumulated over a unit number of revolutions.

Approach three allows the maximum error due to zero change from belt mass to be quantified. This appears to be fairly simple to define and may be a workable method.

Approach four is a variation of approach three. Instead of specifying the maximum excursion, the excursion is observed and the minimum totalized load is calculated so as to have a suitably small error due to varying belt mass.

Exploring approach three a little further, it would be feasible to define the excursion of the totalizer during the zero operation in relationship to the minimum totalized load. For a Class I scale, if it were desired to allow half the error to be attributable to this factor, the excursion of the totalizer during the zero operation could be defined as 0.25 percent of the minimum totalized load. Such a requirement would have other ramifications within the regulation, such as the definition of the scale interval of the zero indicator.

As would be expected, the data of Tables 1, 2, and 3 show that this error source is most important at light belt loadings. Appropriate field data must still be acquired and evaluated. As manufacturers, we are beginning to accumulate such data from actual installations. The scenario of loading at 20 percent of capacity for an appropriate belt length to produce the minimum totalized load has not been explored, nor the combinations which might occur as a result of the 2 percent C max and 200 divisions as inter-related with belt revolutions.

This paper has illustrated a potential error source in belt weighers and has suggested a means to quantify this error during testing. Hopefully, the ideas presented here can be expanded by the OIML participants to provide further improvement in belt weigher accuracy.

Table 1

Error due to variation in belt mass expressed as percent of net load.
Mean, light, and heavy belt loadings based on customer data.
Typical belt mass per unit length with variation per manufacturer's specification.

	Loading	Belt Mass (± 3.25 percent)	Belt Mass Variation	Error
600 mm	mean 35 kg/m (24 lbs/ft)	9 kg/m (6 lbs/ft)	± 0.29 kg/m	± 0.82 %
(24 in)	light 8.9 (6)	9 (6)		± 3,26 %
	heavy 67 (45)			± 0.43 %
750 mm	mean 54 (36)	12 (8)	± 0.39 kg/m	± 0.72 %
(30 in)	light 22 (15)	12 (8)		± 1.77 %
	heavy 89 (60)			± 0.44 %
900 mm	mean 80 (54)	18 (12)	± 0.585 kg/m	± 0.73 %
(36 in)	light 45 (30)			± 1.3 %
	heavy 119 (80)			± 0.49 %

Table 2

Errors in percent due to belt mass variation for various conveyor belt loadings.
Mass variation in two parts, heavy and light.

		1.5 rev.	2.5 rev.	3.5 rev.
600 mm	mean (± 0.82)	0.27	0.16	0.12
(24 in)	light (± 3.26)	1.09	0.65	0.46
	heavy (± 0.43)	0.14	0.09	0.06
750 mm	mean (± 0.72)	0.24	0.14	0.10
(30 in)	light (± 1.77)	0.59	0.35	0.25
	heavy (± 0.44)	0.15	0.09	0.06
900 mm	mean (± 0.73)	0.24	0.15	0.10
(36 in)	light (± 1.3)	0.43	0.26	0.18
	heavy (± 0.49)	0.16	0.10	0.07

Table 3

Errors in percent due to belt mass variation for various conveyor belt loadings.
Mass variation is sinusoidal with one cycle equal one belt revolution.

		1.5 rev.	2.5 rev.	3.5 rev.
600 mm	mean (± 0.82)	0.17	0.10	0.07
(24 in)	light (± 3.26)	0.69	0.42	0.30
	heavy (± 0.43)	0.09	0.05	0.04
750 mm	mean (± 0.72)	0.15	0.09	0.06
(30 in)	light (± 1.77)	0.38	0.22	0.16
	heavy (± 0.44)	0.09	0.06	0.04
900 mm	mean (± 0.73)	0.15	0.09	0.07
(36 in)	light (± 1.3)	0.28	0.16	0.12
	heavy (± 0.49)	0.10	0.06	0.04

La NOUVELLE ORGANISATION de la MÉTROLOGIE LÉGALE en FRANCE

par **M. Philippe BERTRAN**
Chef du Service de la Métrologie

Beaucoup d'ingénieurs des services de métrologie des Etats Membres de l'OIML connaissaient le SIM, c'est-à-dire le Service des Instruments de Mesure français, créé en 1946 à la place du Service des Poids et Mesures.

Le SIM (à ne pas confondre avec le Système Interaméricain de Métrologie dont le sigle est également SIM) n'existe plus depuis maintenant deux ans mais bien entendu, les missions qu'il exerçait sont toujours remplies, en particulier dans le domaine de la métrologie légale. Cette nouvelle organisation n'étant pas encore familière à nos collègues étrangers, nous nous proposons de décrire sommairement dans le présent article les causes et la teneur de la réforme ainsi opérée.

1. L'ancienne organisation

En France, la métrologie légale relève depuis plusieurs dizaines d'années du Ministère de l'Industrie. C'est donc au sein de ce ministère qu'avait été créé le SIM.

La figure 1 présente un extrait de l'organigramme du Ministère de l'Industrie avant la réforme qui nous intéresse. Deux choses essentielles caractérisent l'organisation qui était alors en vigueur.

La première est que le SIM était un service relativement autonome possédant son administration centrale et ses services extérieurs, et ayant un budget individualisé à l'intérieur de celui du ministère. Les agents du SIM sur le terrain relevaient du service central du SIM à Paris, aussi bien sur le plan hiérarchique et administratif que sur le plan technique ; le chef du SIM étant le seul membre du service dont le supérieur immédiat ne soit pas un autre agent du SIM. Le SIM était un service où généralement, on faisait toute sa carrière, les possibilités d'intégration d'ingénieurs ou de techniciens venant d'autres services étant quasiment nulles et les cas de départ vers d'autres administrations étant très rares jusqu'à ces dernières années. Le corollaire de cette autonomie était un certain isolement au sein du Ministère de l'Industrie.

La seconde caractéristique de l'organigramme en vigueur jusqu'en 1983 est une conséquence de la première. Le Ministère de l'Industrie possédait, en province, deux services indépendants : d'une part les directions interdépartementales de l'industrie qui avaient en charge toutes les activités relevant du Ministère de l'Industrie sauf la métrologie, d'autre part les circonscriptions métrologiques dont la compétence était limitée à la métrologie légale (avec quelques développements, les dernières années, dans le domaine de la qualité).

Cette organisation, si elle comportait certains avantages, présentait néanmoins des inconvénients importants, tant du point de vue du SIM que de celui du ministère. Pour le SIM, son isolement en avait fait un peu le « parent pauvre » du Ministère de l'Industrie : en effet, la métrologie légale étant une activité marginale par rap-

ANCIENNE ORGANISATION

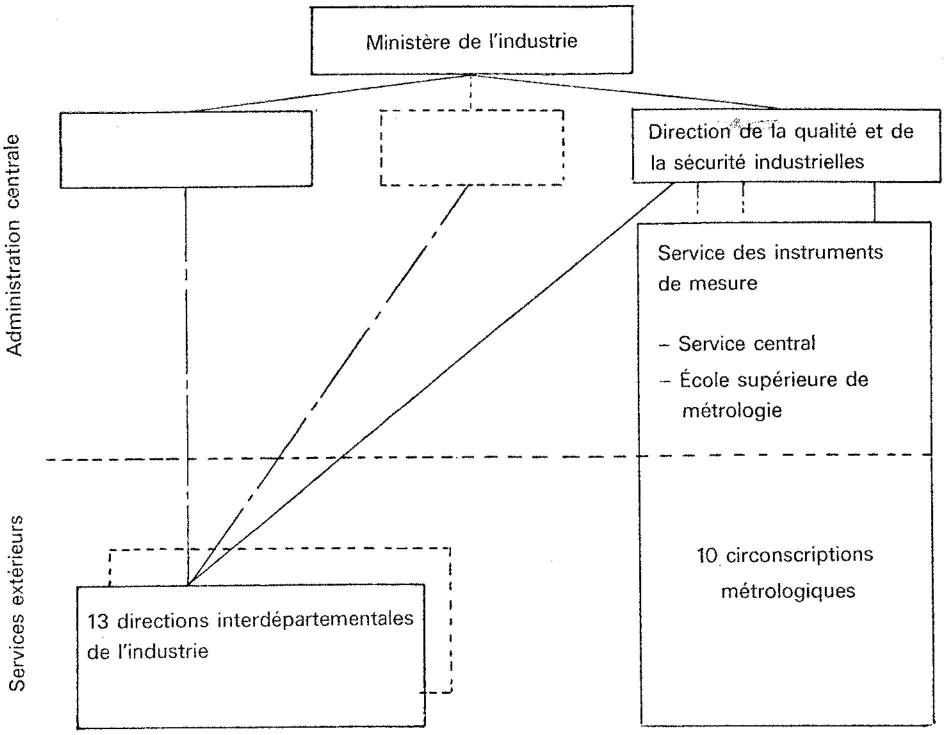

FIGURE 1

port à l'ensemble des missions du ministère, le renforcement des moyens et des effectifs du SIM n'était jamais une priorité. Pour le ministère, il était regrettable de ne pas pouvoir utiliser le remarquable potentiel d'ingénieurs et de techniciens que constituait le SIM pour des actions autres que celles qui relèvent de la métrologie légale.

Ce sont ces considérations qui, en 1983, poussèrent M. Pierre AUBERT, alors chef du SIM, à proposer de fondre les circonscriptions métrologiques dans les nouvelles Directions Régionales de l'Industrie et de la Recherche que le ministre se proposait alors de créer à l'occasion de la réunion de l'Industrie et de la Recherche dans un seul ministère. La proposition fut acceptée et se concrétisa par la nouvelle organisation aujourd'hui en place.

2. La nouvelle organisation

Dans le système qui a été instauré, les fonctions qui étaient exercées par le SIM le sont par trois nouvelles structures comme le montre l'organigramme (figure 2).

Le Service de la Métrologie a pris en charge les missions techniques qui étaient autrefois exercées par le service central du SIM : élaboration de la réglementation, participation aux travaux internationaux, coordination de l'activité métrologique des services extérieurs, gestion de la procédure d'approbation de modèle, etc... Il est à noter que la compétence du service ne se limite pas à la métrologie légale mais s'étend aux autres aspects de la métrologie.

La Direction Générale du Développement Régional et de l'Environnement Industriel et Technologique est chargée, entre autres activités, de la gestion administrative des

Directions Régionales de l'Industrie et de la Recherche. A ce titre, elle gère les personnels et les moyens des anciennes circonscriptions métrologiques, autrefois gérés par le service central du SIM.

Les Directions Régionales de l'Industrie et de la Recherche, enfin, ont repris l'intégralité des missions des circonscriptions métrologiques : vérification primitive, contrôle des instruments en service, etc. Ces directions régionales sont organisées en divisions spécialisées, dont l'une pour les questions de métrologie, de qualité et de normalisation.

Il est important de souligner que cette réforme est un simple redécoupage administratif et ne constitue pas une opération de décentralisation, c'est-à-dire de transfert de compétences de l'Etat au bénéfice de collectivités territoriales : les Directions Régionales de l'Industrie et de la Recherche sont des services du Ministère de l'Industrie, donc de l'Etat, composées de fonctionnaires de l'Etat et non pas des Régions. En cela, notre organisation est très différente de celle de nos voisins de République fédérale d'Allemagne ou du Royaume-Uni.

Bien que la réforme soit récente, les effets bénéfiques escomptés se sont déjà fait sentir : renforcement des moyens malgré un contexte budgétaire difficile, meilleure intégration de la métrologie dans les autres activités du ministère. Cela nous prouve que la voie choisie était la bonne et que nous avons eu raison de faire disparaître ce SIM auquel nous tous, ses membres, mais aussi beaucoup de nos collègues étrangers étions très attachés.

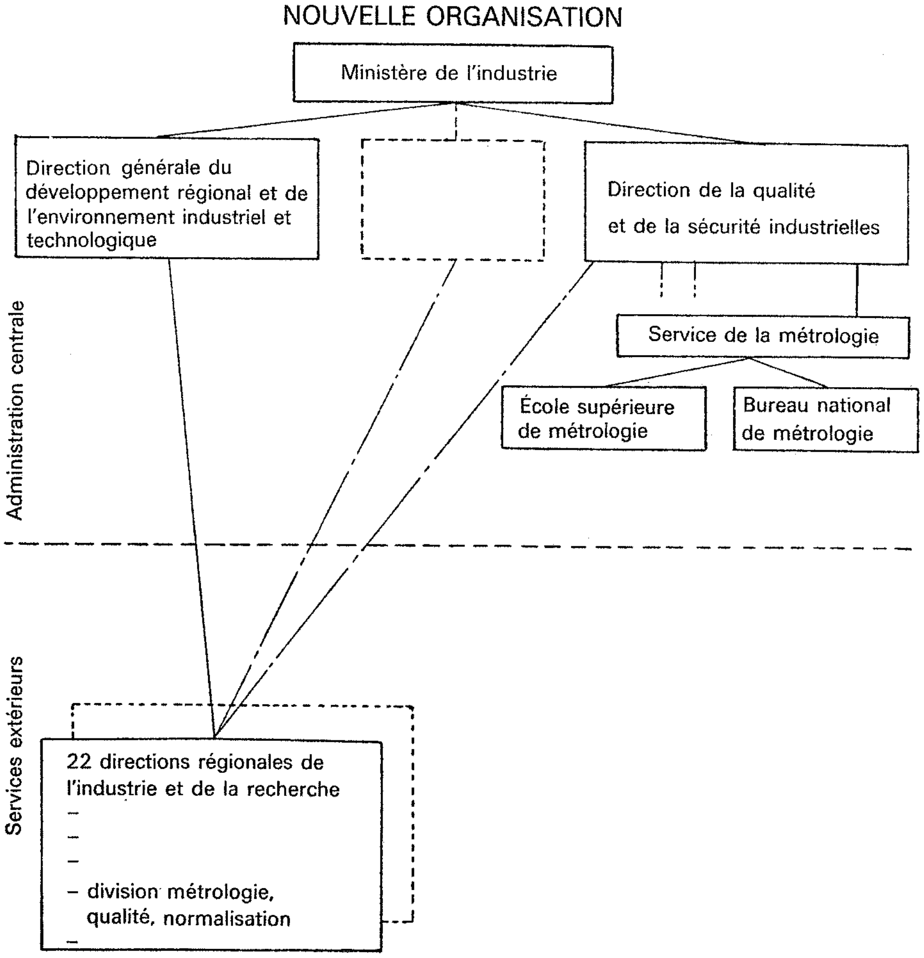

FIGURE 2

U.R.S.S.

EVOLUTION and STANDARDIZATION of the MEANING of some METROLOGICAL TERMS

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SUMMARY — The evolution of the meaning of a number of metrological terms over the last 15 to 20 years and their presentation in international vocabularies and national standards published in English are analysed. It is shown that in some cases the terminologies used in various countries and languages have apparently been drawing nearer though substantial differences still exist.

Suggestions are made that differing viewpoints concerning the meaning and usage of terms should be considered in greater detail in international vocabularies in order to make it easier for specialists in the field to understand existing publications.

Metrological terminology is still at the stage of evolution and this can be evidenced, in particular, by the fact that new terms and modifications in the definitions of well established terms were introduced in the « International Vocabulary of Basic and General Terms in Metrology » (abbreviated VIM) [1] published recently.

The evolution of terminological systems represents a natural development of the respective fields of knowledge and reflects our progress in the cognition of natural phenomena. The task of terminological standardization is to fix a certain stage of the evolution and facilitate mutual understanding among specialists in a given field over a more or less prolonged period of time. Of course, this fixed terminology will eventually cease to meet the requirements of human communication and the necessity to revise it will arise. This process can be traced when considering some metrological terms as typical examples.

First of all we shall consider the term « traceability ». The idea of obtaining worldwide comparable measurement results (having known accuracies or errors) appeared very long ago. The activities of all metrological organizations (and primarily of international bodies) have been aimed at attaining this goal. Nevertheless, the above term was not included neither in the 1969 edition of « Vocabulaire de Métrologie Légale » nor in its bilingual version published in 1978 [2].

For the first time the term « traceability » (as standardized term) appeared in a British standard [3] in 1975. Its definition was rather vague : « Traceability. The concept of establishing a valid calibration of a measuring instrument or measurement standard, by step-by-step comparison with better standards up to an accepted or specified standard.

Note : In general, the concept of traceability implies eventual reference to an appropriate national or international standard. »

Essentially the same definition was given in an Australian standard in 1980 [4]. Meanwhile, at the same period of time B. Belanger [5] analysed another four definitions published elsewhere. He noted that definition 1 was based on an unbroken chain of calibrations of instruments or standards, with the chain ending at a national (or, presumably, international) institution (the same idea was expressed in the definition given in BS 5233).

Definition 2 stresses the need to know the total measurement uncertainty relative to national or other designated standards. B. Belanger shares the latter viewpoint (together with other metrologists).

As to the remaining two definitions, in B. Belanger's opinion, they « occupy an intermediate position between definitions 1 and 2 ». Definition 3 reads : « Traceability means the ability to relate individual measurement results to national standards or nationally accepted measurement systems through an unbroken chain of comparisons ».

For comparison, look at the respective definition in VIM : « The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons ».

Similarity of the two definitions is beyond any doubt. At the same time it is necessary to point out that the quality of measurements depending on their uncertainties is not mentioned in either of the definitions.

Definition 4 implies a capability to quantitatively express the results of a measurement in terms of units that are realized on the basis of accepted reference standards, usually national standards.

One more definition of the traceability concept is taken from a Soviet industrial standard [6] :

« The state of measurements in which their results are expressed in legal units and measurement uncertainties are known with a specified probability ».

In contrast to all other definitions, the latter one is based on two distinctive features.

In a concise form the results of the above analysis of the definitions of the traceability concept can be tabulated in the following way :

Distinctive features	Definitions						
	1	2	3	4	VIM	BS	GOST
1. Relation of measuring instruments to standards by way of comparisons	×					×	
2. Determination of uncertainties relative to standards		×					×
3. Relation of measurement results to standards by way of comparisons			×		×		
4. Expression of measurement results in legal units				×			×

Legend : 1, 2, 3, 4 are the definitions analysed by B. Belanger.
VIM, BS, GOST - see above.

All distinctive features figuring in the definitions are substantial for the description of the concept of measurement traceability and a definition incorporating all the features listed above would probably be an ideal. However, the authors of the above definitions obviously proceeded from the necessity to emphasize one or another feature at a certain stage of the metrology progress in their respective countries. In particular, in those countries which have no national systems ensuring measurement traceability, it was important to stress the idea of relating all measuring instruments or measurements made with them to national or international standards.

Meanwhile, in the USSR this idea is not a burning issue and in the definition of traceability emphasis is laid on using legal units and well-grounded statement of uncertainties. It may be that in the future, with progress in metrology, the VIM definition will also be modified along the same lines and that the term « traceability » (or a reference to it) will appear in VML.

At present, it should be noted that in VIM the French term « traçabilité » is given as the equivalent of the English term though in an intermediate draft of this vocabulary the term « raccordement » was proposed and now another meaning is ascribed to the latter term in VIM. Thus, both concepts and the terms designating them have been changing.

The concept of measurement traceability is closely associated with the procedure of disseminating units of measurement which are realized using accepted standards. In order to describe this procedure, the French term « schéma d'une hiérarchie des instruments de mesurage » and its English equivalent « block diagram of a hierarchy of measuring instruments » were included in VML. It should be pointed out that the latter term has not been widely used in publications in the English language and it is lacking in VIM. Obviously, the explanation for this is that such hierarchies imply the existence of national systems ensuring measurement traceability (mentioned above) which have not yet been established in many countries. Within the OIML, work is under way for preparation of international recommendations dealing with the establishment of such hierarchies and procedures in a number of measurement fields. In this connection, it might be expected that the above terms will be introduced in metrological practice. However, changes in their form cannot be ruled out as in OIML working documents the terms « schéma de hiérarchie » and « hierarchy scheme » are currently used and sometimes one can come across the terms « traceability chart » and « calibration chart » used in English in the same sense.

It is also necessary to consider the terms « verification » and « calibration ». If one proceeds from the definition of the term « verification » in VML, it can be presumed that this term designates simple tests of measuring instruments after which the latter are stamped. Meanwhile, in many cases even the tests of simple instruments by a metrological organ are followed by the issue of appropriate certificates or some other documents. Furthermore, in the note in the definition of the term « étalon-témoin » in VML the term « verification » is used to describe checks of standards which cannot be considered simple operations.

Evidently for these reasons, the definition of the term « verification » in AS 1514 was written in most general terms : « The testing of measuring instruments, material measures and measurement standards, for conformity with a specification ».

This term was not included in either BS 5233 or VIM. This fact caused certain difficulties because the omission of some, say, English terms in national or international vocabularies does not allow to make a reliable judgement about the usage of these terms, especially when English is rather a means of international communication than a native tongue for the specialists.

As to the term « calibration », in VML its definition includes « determining the values of the errors of a measuring instrument (and if necessary to determine other metrological properties)... with a view to permitting the use of the instrument as a standard ».

If the note in the definition of the term « étalon-témoin », which was discussed above and in which standards were also mentioned, is taken into consideration, the difference between the terms « verification » and « calibration » is substantially blurred.

In contrast to VML, in the definition of the term « calibration » in BS 5233, standards are not mentioned, whereas in AS 1514 the determination of influence quantities is stated in addition to the determination of the errors of « measuring instruments, material measures, and measurement standards ».

A comprehensive definition is given in VIM and it is necessary to quote the whole of it.

« The set of operations which establish, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system, or values represented by a material measure, and the corresponding known values of a measurand.

Notes : 1. The result of a calibration permits the estimation of errors of indication of the measuring instrument, measuring system or material measure, or the assignment of values to marks on arbitrary scales.

2. A calibration may also determine other metrological properties.

3. The results of a calibration may be recorded in a document, sometimes called a calibration certificate or a calibration report.

4. The result of a calibration is sometimes expressed as a calibration factor, or as a series of calibration factors in the form of a calibration curve. »

This all-embracing definition covers the whole of the definitions of the terms « verification » and « calibration » in AS 1514. Its contents is wider than the sum of the meanings of both terms in VML and obviously that is the reason why the term « verification » is missing in VIM. The only point missing in VIM is the statement that all specified operations are to be carried out by an organ of the services of legal metrology (or other legally authorized organizations). With all this in view, the question is still open about the discrimination of the meanings and fields of application of both terms.

It is possible that the respective terms in other languages show more clearly the difference in the two kinds of measurement instrument checking or testing. In particular, the proper use of the French term « étalonnage » seems to be in conjunction with standards only. The two terms in Russian allow to draw easily a line between the two kinds of measuring instrument testing on the basis of the degree of sophistication and the scope of operations involved in calibration of standards or working measuring instruments.

Now we shall turn to terms designating various categories of measuring instruments. In VML it is stated that the French term « instruments de mesurage » covers two categories of measuring instruments — « mesure matérialisée » and « appareil mesureur ». As to the English terminology, voluminous translator's notes were incorporated into Chapter 6 of VML. It was stated there that it is difficult to translate the above French terms into English since, although he French term « instrument de mesurage » corresponds exactly to the English term « measuring instrument », there is no English term corresponding to the French term « appareil mesureur ». For this reason, the term « measuring instrument » was used to translate the latter French term but in this instance the word « active » was added in brackets, for clarification.

In this connection, it seems appropriate to suggest that it would be sufficient to simply state that the English term « measuring instrument » can be used both as a generic term (equivalent to « instrument de mesurage ») and a specific term (equivalent to « appareil mesureur »).

In BS 5233 and AS 1514 these two senses of the term « measuring instrument » were not considered. While in the note in the definition of this term in a VIM draft an attempt was made to distinguish between its two meanings, in the final version of VIM in the preamble to Chapter 4 it is shown by graphical means that the English term corresponds to the two French terms — « appareil de mesure » and « instrument de mesure ».

However, in paragraph 4.01 the term « measuring instrument » is related to the terms « appareil de mesure » and « appareil mesureur ».

A note (applicable to the French text only) is also incorporated in this paragraph. It is stated in the note that the French term « instrument de mesure » embraces the meaning of the terms « appareil mesureur (appareil de mesure) » and « mesure matérialisée » (this fact was also noted in VML) and that it is commonly used in the same sense as the term « appareil mesureur ». Thus, the treatment of the above English and French terms in VIM is not consistent.

Besides the two categories of measuring instruments mentioned above, in some documents measuring transducers (see, for example, VML and GOST 16263-70) and reference materials (see, for example, GOST 16263-70 and 8.315-78 [12]) are also regarded as measuring instruments. In GOST 16263-70 reference materials are placed among other classes of material measures, whereas in GOST 8.315-78 they are ranked as an independent category of measuring instruments. The latter point of view is advocated, for example, by E. Juhasz [7] though he quite justly recognizes that material measures and reference standards have common features. In VML and BS 5233 reference materials are classified as standards but they are not reckoned in any of the above categories of measuring instruments.

The reported analysis has shown that there is no unified approach to the classification of measuring instruments though such a classification would facilitate an improvement in the structure of, say, Chapter 4 in VIM or in the structure of the definitions of terms.

One more group of terms deserving attention is that including the terms that are used when describing measurement errors (or accuracies). In papers published some 20 years ago (see, for example, [8], [9]) the difference in the meanings of the terms « accuracy » and « precision » was discussed. While at the time these terms were treated by many as synonyms, at present the majority of metrologists recognize them as independent terms in line with the statements of the authors referred to above. In contrast to « accuracy », the term « precision » is used to describe the scatter of measurement results or random errors.

Meanwhile, VML, BS 5233 and AS 1514 do not even mention the term « precision » and the authors of VIM limited themselves to stating that « the use of the term « precision » for « accuracy » should be avoided ». This remark cannot be considered as sufficient because it contains no information on the meaning of the term « precision » and its relation, for example, with the meanings of the terms « random error », « repeatability » and « repeatability error » included in VIM. As a result, the readers of this vocabulary cannot get reliable information about one of the terms commonly used in metrological literature and form a correct notion about the contents of publications in which the term « precision » is used but not specifically defined.

As to the French terms given in VML as the equivalents for the terms « accuracy » and « precision », in VIM the term « exactitude » was substituted for « précision » and a specific recommendation was made that the latter term should not be used in this meaning. On this basis, it might be assumed that the French term « précision » is the equivalent for the English term « precision ». If this is the case, all the above considerations concerning the English term « precision » remain valid here (*).

(*) Note by BIML : In French (and in the past sometimes also in English) the word « précision » has commonly been used to designate both degree of repeatability (or reproducibility) and accuracy.

In order to avoid confusion the opinion is generally that the word « précision » in French (and in English as well) should nowadays be avoided in reporting scientific and technical data and that for such purposes use be made of the terms « exactitude », « répétabilité » and « reproductibilité » with the meanings as expressed in VIM.

The word « précision » will probably continue to be used in many common terms such as « instrument de précision » etc.

In VML the term « uncertainty » was defined as « the characteristic of the dispersion of the results of measurement defined by the limits of error ». This may give the impression that this term is mainly associated with random errors.

In the note in the definition of the term « uncertainty » in AS 1514 it is said that this term designates the result of « an appropriate summation of all the residual errors after correction of the result of measurement ». Such interpretation of the term allows ot make the conclusion that it can be used to denote residual systematic errors as well. It is in agreement with the current practice of using the terms « random uncertainty » and « systematic uncertainty » (see, for example, [10], [11]).

The definitions of the term « uncertainty » in BS 5233 and VIM have much in common. It is pointed out in both of them that the estimate may be based on the statistical distribution of the results of series of measurements or on experience or other information. This broad interpretation of the term « uncertainty » does not exclude the possibility of using the terms « random uncertainty » and « systematic uncertainty » whereas the authors of both documents do not list them (although it would be desirable to have them in the vocabulary, in particular, by analogy with the terms « random error » and « systematic error »).

Naturally, there is still a great number of terms which deserve detailed consideration. The terms denoting diverse categories of standards can be mentioned among them. As hierarchy schemes are introduced into metrological practice in various countries, modifications in the definitions of a number of terms may be required because these definitions are of most general character or because the objects described in them have not got fixed positions in the hierarchy of measuring instruments. However, the limits of this paper do not allow to dwell on them.

The examples given above illustrate the evolution of the meanings of a number of terms and their definitions in vocabularies and standards over a period of the last 15 to 20 years. In certain cases the terminologies used in various languages and countries are drawing nearer, though considerable differences still exist.

The authors of the vocabularies cited above have set themselves the task of facilitating communication of metrologists on an international level. Moreover, although national English-language standards are mainly addressed to the readers in respective countries, the results of their authors' work, undoubtedly, influence strongly those English-speaking persons who compile international documents and those specialists from various countries who use English as an international language.

One can fully understand the attitude of the VIM authors who strove to find a consensus or an acceptable compromise and rejected all debatable issues in order to progress quicker in their work on the vocabulary. However, a few comments on this matter seem justified.

Firstly, if the terms actually used are rejected as undesirable and no information is given to the vocabulary readers, the latter are unable to understand those metrologists who use these terms by force of well-established habits or convictions in both national and international communication. For this reason, the suggestion can be made that such information should be included in the text of a vocabulary or a dictionary (as was done, for example in [13]) or in appropriate notes and appendices.

Secondly, the number of terms in VIM appears insufficient. Even the original list of terms intended for this vocabulary was much longer. Any enlargement of the vocabulary due either to a greater number of terms or to more detailed explications will, undoubtedly, serve the purpose of promoting better understanding among specialists.

In conclusion, it seems appropriate to subscribe to the opinion of the joint working group that the imperfections of the vocabulary can be corrected in the future.

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AFRICAN REGIONAL ORGANIZATION
FOR STANDARDIZATION (ARSO)

ORGANISATION REGIONALE AFRICAINE
DE NORMALISATION (ORAN)

ACTIVITIES OF ARSO IN THE FIELD OF METROLOGY (*)

Introduction

The African Regional Organization for Standardization (ARSO) is an African inter-governmental organization open to member States of OAU and ECA. The present membership is 23. ARSO's mandate, which derives from its constitution and the Lagos Plan of Action for the Economic Development of Africa, are to :

(i) promote Standardization, Quality Control, Certification and Metrology activities in Africa ;

(ii) elaborate regional standards of interest to Africa ;

(iii) promote social, industrial and economic development through standardization ; and

(iv) coordinate the views of its member States and their contribution and participation in International standards fora.

In order to achieve the above objectives, ARSO has developed programmes in the following areas :

- Establishment and strengthening of National Standards Bodies ;
- Training ;
- Preparation and issuance of African Regional Standards ;
- ARSO Documentation and Information System (ARSO-DIS) and ARSO-DIS Network (ARSO-DISNET) ;
- Promotional activities ;
- ARSO External relations;
- Quality Control ;
- Testing and applied research for quality improvement ;
- Certification marking ; and
- Metrology

At present only the first six programmes are operational. The activities in metrology under these programme elements are as follows :

Establishment and strengthening of National Standards Bodies

Under this programme element, assistance is provided by ARSO to its member States in the establishment and development of their national machinery for Standardization, Quality Control and Metrology.

A major step was taken under this programme in 1985, when a joint ARSO/UNIDO Project was initiated. Four Consultants were recruited to survey the needs of ARSO member States in the fields of Standardization, Quality Control, Certification and Metrology respectively. It is envisaged that the consultant's report on metrology will form the basis for developing concrete proposals for assistance to member States in this particular field.

Training

In order to upgrade the knowledge and skill of personnel of its member States, ARSO has been operating regular training courses, workshops and seminars on Standardization, Quality Control and Metrology at all levels.

(*) Information distributed at the meeting of the OIML Development Council, 14-15 April 1986.

In 1985, the following two courses were organised :

- an ARSO/UNESCO Basic Training Course on Standardization, Quality Control and Metrology held from 26-30 August 1985, in Abidjan, Ivory Coast for the benefit of francophone member States of ARSO. The International Organization of Legal Metrology (OIML) and the French Government provided resource persons to lecture at this course ;
- an ARSO/UNIDO Regional Training Workshop on Standardization, Quality Control and Metrology held from 28 October - 6 November 1985 in Nairobi, Kenya for anglophone member States of ARSO.

Two specialised courses are planned to be held in 1986 on Metrology and aspects of Standardization and Quality Control for francophone and anglophone member States.

Preparation and issuance of African Regional Standards

The development of African Regional Standards (ARS) is the responsibility of ARSO Technical Committees (ARSO/TCs). The Technical Committee on Basic and General Standards (ARSO/TC1) has under it, a Sub-Committee (SC) on Metrology ARSO/TC1/SC1. This SC has adopted, up to date :

- the International System of Units ; and
- a number of OIML International Recommendations on mass, volume and length measures and measuring instruments.

The Standards adopted by the TCs, upon approval by member States, are published as ARS. The standards on the SI units are expected to be published this year and those on mass, volume and length will be published after approval by member States.

The development of ARS is a continuous process and more OIML International Recommendations are expected to be adopted by ARSO in the future.

ARSO Documentation and Information System (ARSO-DIS) and ARSO DIS Network (ARSO-DISNET)

An ARSO Documentation and Information System (ARSO-DIS) on standards and standards related subjects including metrology has been established at ARSO Headquarters in Nairobi, Kenya. Its activities include :

- collection, storage and dissemination of information ; and
- linkage with the national systems of ARSO member States, and regional and international information systems.

The activities of ARSO-DIS are expected to be instrumental in the initiation and development of national documentation and information systems on standards and standards related subjects including metrology in member States. ARSO-DIS and these national systems will form an ARSO Network of Documentation and Information Systems on Standards (ARSO-DISNET) which will then be linked to other regional and international systems.

A survey to assess the needs of member States in this field was carried out by ARSO with support from the Canadian International Development Research Centre (IDRC). A follow-up workshop was organised in March 1986 on the report and the modalities for formation of ARSO-DISNET.

Promotional Activities

Promotional activities are undertaken to project the image of ARSO in order to secure support from member States, expand membership of ARSO, develop working relations with organizations interested in ARSO activities, safeguarding the interest of member States and strengthening their participation in international standards work.

The above activities are executed through missions, provision of logistic support, dissemination of relevant information, and attendance at meeting and conferences.

ARSO External Relations

ARSO maintains close working relations with a number of regional and International organizations of interest to its work. These include :

- African Intergovernmental Organizations ;
- Regional Standards Organizations ;

— International Standards Organizations ;

— Organizations belonging to the UN System ;

— Other Organizations interested in Standardization ; and

— Donor Governments and Agencies.

Thus, ARSO has developed close working relations with OIML in order to speed up the development of metrology activities in the African region. Practical examples of this collaboration are :

— OIML sponsorship of a resource person to lecture at the ARSO/UNESCO Training Course on Standardization, Quality Control and Metrology held in Abidjan, Ivory Coast in August 1985 ; and

— Attendance of the Director of BIML at the Fifth General Assembly of ARSO held in January 1986 in Cairo, Egypt.

Collaboration between ARSO and OIML has further been strengthened by conclusion of a formal Agreement on Cooperation between the two organizations. The Agreement was signed by Mr. Bernard Athané, Director of BIML and Mr. Zawdu Felleke, Secretary-General of ARSO, at a Ceremony during the Fifth General Assembly of ARSO in Cairo. The Agreement provides for collaboration in the following areas :

— development of African Regional Standards ;

— participation in OIML technical work ;

— assistance to member States ;

— training ;

— information exchange ; and

— invitations to meetings.

Conclusion

There is no doubt that the modest activities described herein will increase in tempo with the launching of the substantive programme of ARSO in metrology in the near future. Under the programme, assistance will be sought for the development of metrology activities at the national and regional levels. It is hoped that OIML and other interested organizations and Governments will provide the required support to ARSO and its member States in order to develop metrology activities in Africa.

REP. FED. D'ALLEMAGNE

PAYS EN DEVELOPPEMENT

LA COOPERATION DE LA REPUBLIQUE FEDERALE D'ALLEMAGNE

Le but de la politique de développement du Gouvernement de la RFA est d'améliorer la situation économique et sociale des gens dans les pays en voie de développement et d'activer leur habileté créatrice.

Il est à cet effet disposé à soutenir des efforts dans l'établissement d'une économie efficace et la création d'une infrastructure relative à un système de mesurage, de normalisation, de contrôle et d'assurance de qualité (MNPQ) *.

Le développement de cette infrastructure doit être parallèle au développement général d'un pays pour

- — assurer la capacité compétitive des produits du pays,
- — créer les conditions techniques nécessaires pour l'industrie et l'économie du pays,
- — protéger la population et l'environnement contre les conséquences négatives éventuelles de la technologie, assurer un échange équitable des marchandises, des produits et des prestations de services et défendre les intérêts des consommateurs.

La compétitivité d'un produit dépend non seulement de son prix mais aussi de sa qualité. Les meilleurs machines et ensembles de production ne valent rien si la qualité est erratique. Pour cette raison, la création de systèmes pour assurer la qualité est importante pour le succès économique. La métrologie et la normalisation sont des éléments essentiels pour l'assurance de qualité.

C'est la tâche de l'Etat de former un cadre technique par les lois et les directives qui doivent régler par exemple les unités légales dans la métrologie, leur représentation et leur transmission ainsi que la nature obligatoire des normes et d'autres prescriptions techniques.

Il est nécessaire d'avoir des institutions et des organisations correspondant au besoin du pays dans les domaines spéciaux de mesure, d'étalonnage et de contrôle, qui développent le système national de normalisation et qui garantissent le suivi des réglementations légales dans les domaines concernés (environnement, lieu de travail, produits alimentaires, transports, protection des consommateurs, médecine, métrologie).

Sur ordre du Gouvernement Fédéral, la PTB assiste 12 pays dans la création de leur système de métrologie et s'occupe de la coordination des projets du système MNPQ en collaboration avec d'autres institutions spécialisées allemandes (Bundesanstalt für Materialprüfung/BAM, Deutsche Technische Akademie/DTA, Deutsches Institut für Normung/DIN, Technische Überwachungsvereine/TÜV, Deutsche Gesellschaft für Qualität/DGQ).

Le financement était en 1985 de plus de 10 millions DM, et il augmentera en 1987 à presque 20 millions DM par an.

Les différents projets comportent les activités suivantes :

1. Enseignement dispensé dans les institutions suivantes :

- — Physikalisch-Technische Bundesanstalt (PTB) à Braunschweig et à Berlin.
- — Académie Technique Allemande (DTA) à Helmstedt (établie en 1985), lieu de perfectionnement surtout pour les boursiers des pays en développement. L'extension aux systèmes de normes, de contrôle et de l'assurance de qualité est en cours.

  La DTA offre des cours de base et avancés, partiellement en langue étrangère. Les conditions d'entrée et les programmes de perfectionnement sont adaptés aux besoins des pays en voie de développement.

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* En allemand : Mess-, Normen-, Prüf- und Qualitätssicherungswesen (MNPQ).

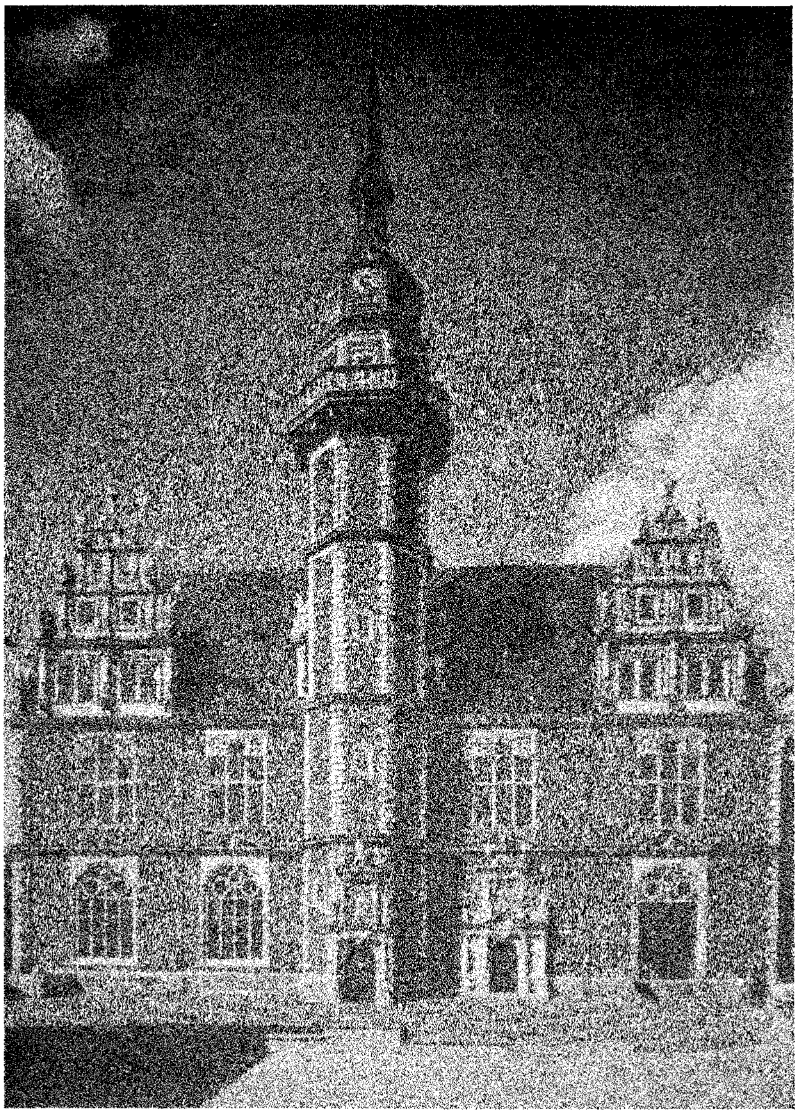
— L'école allemande de vérification à Munich pour le système de la métrologie légale.

Le perfectionnement professionnel est complété par l'enseignement dans les services de vérification, d'étalonnage et de contrôle et par l'enseignement par les fabricants et par les utilisateurs d'instruments de mesure.

La durée de l'apprentissage, en République Fédérale, est :

— à long terme : en général jusqu'à 12 mois pour le stage spécial d'application et 5 mois pour les études linguistiques qui commencent normalement déjà dans le pays en voie de développement en coopération avec des institutions de langue allemande, par exemple avec un « Goethe Institut ».

— à court terme : moins de 3 mois pour les programmes de spécialisation, la formation continue et les séminaires (partiellement en langue étrangère) destinés à mettre à jour les connaissances ou pour des participants ayant déjà des connaissances étendues dans les domaines concernés.



Le Juleum - bâtiment principal de l'Université de Helmstedt (1576 à 1810) réouverte en 1985 pour constituer l'Académie technique allemande DTA.

2. Consultation par des experts allemands

La durée de leur travail peut être à court ou à long terme selon les besoins spécifiques. La consultation commence déjà au stade de planification de l'organisation partenaire à assister.

Celle-ci comprend notamment :

- la collaboration à la planification de la construction et à l'équipement des laboratoires,
- les problèmes d'institution et d'infrastructure,
- la consultation lors de l'introduction d'un système de normalisation ou de réglementation,
- l'approvisionnement, la mise en œuvre et l'étalonnage des instruments de mesure et de contrôle et l'instruction pour leur utilisation,
- l'installation des experts étrangers qui ont reçu une formation dans la République Fédérale dans leurs tâches.

3. Construction de laboratoires

Consultation lors de la construction et de l'achèvement d'un institut central métrologique, responsable pour la conservation des étalons des unités de mesure et qui réunit un ensemble d'instruments de mesure ayant une exactitude suffisante pour les clients potentiels dans le pays en voie de développement.

4. Equipements de mesure et de contrôle

La fourniture des équipements constitue une part importante de la contribution de la République Fédérale afin d'assurer l'activité pratique après le retour dans leur pays des experts ayant suivi la formation.

5. Documentation et traduction

Mise à la disposition des pays en développement des documents relatifs à la technique de mesure et de contrôle ainsi que des normes qui peuvent servir comme base pour élaborer de propres normes ou qui peuvent être utilisés pendant le travail de tous les jours.

La traduction dans la langue du pays de la littérature technique rend possible un meilleur rapprochement sur le plan international.

6. Maintien du contact

Le contact entre les institutions coopérantes est maintenu par l'échange de publications et d'informations, la participation à des cours de perfectionnement, etc.

En plus de l'assistance indiquée ci-dessus, il faut mentionner le soutien (par exemple par l'envoi d'experts) aux activités de l'ONUDI, l'UNESCO, l'ISO, la CEI et la Communauté Economique Européenne.

FRANCE

PAYS EN DEVELOPPEMENT
LA COOPERATION FRANÇAISE

Cet exposé, sur l'aide aux pays en développement en matière de métrologie, essais de laboratoire, normalisation et contrôle de la qualité, a été présenté par la délégation française au Conseil de Développement de l'OIML, les 14 et 15 avril 1986.

Avant de parler à vrai dire des actions de coopération, il convient de dire quelques mots sur les modifications qui sont intervenues dans les services chargés de la métrologie en France.

Dans le but d'une amélioration constante du système et de façon à mieux répondre aux besoins de l'industrie et à favoriser le développement des technologies et également pour améliorer la précision des mesures, un certain nombre de réformes ont été introduites dans l'organisation de la métrologie en France. On peut citer brièvement la réforme du Service des Instruments de Mesure qui a évolué sous la forme d'un Service de Métrologie et de services régionaux (*), une concentration de la métrologie légale et industrielle par la tutelle exercée par le Service de Métrologie sur le Bureau National de Métrologie, également une série de réfexions qui sont en cours sur les relations que doivent entretenir les laboratoires primaires du Bureau National de Métrologie et enfin, et c'est le plus important, les actions qui sont menées pour sensibiliser l'industrie à la métrologie et à son apport essentiel à l'amélioration de la qualité. Plus particulièrement, on peut signaler la création d'un département « Métrologie » à l'Ecole Nationale Supérieure des Techniques Industrielles et des Mines de Douai (**), à laquelle a été rattachée l'Ecole Supérieure de Métrologie et où sont créés des cours de métrologie de qualité destinés à former des ingénieurs civils et des ingénieurs fonctionnaires. Ce pôle de métrologie devrait permettre de donner dans des conditions excellentes les techniciens compétents en métrologie et en qualité.

La tradition française de coopération technique va se poursuivre et de façon à l'améliorer on a été amené à créer un groupement d'intérêt économique appelé CERLAB, c'est le Centre interlaboratoires d'études et de réalisations, qui est un organisme qui regroupe les organismes suivants : l'Association Française de Normalisation, le Laboratoire National d'Essais, le Laboratoire Central des Industries Electriques et l'Institut de Recherche de Chimie Appliquée ainsi que le Ministère de l'Industrie.

Compte tenu de l'étroite complémentarité de la métrologie, des essais et de la normalisation, pour mettre en œuvre une politique de qualité, il est apparu souhaitable de créer un tel organisme afin de présenter une offre cohérente des prestations dans ce domaine.

En outre, CERLAB offre la garantie, pour les pays qui font appel à ses services, de répondre à chaque instant de la manière la plus efficace possible à des besoins nécessairement évolutifs, les prestations techniques étant assurées par le membre le plus compétent du groupement, voire par des organismes extérieurs si cette compétence n'existe pas en son sein.

En outre, ces prestations peuvent se faire en trois langues : en langue française, langue anglaise et langue espagnole.

Alors, pour citer les plus récentes actions de coopération en métrologie, on peut signaler d'abord les actions permanentes d'assistance à travers les réunions dans les groupes de travail de l'OIML et de l'ISO et deuxièmement des actions de formation de fonctionnaires des services des poids et mesures. La France a formé plus de 200 ingénieurs et techniciens au

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* Voir article de Ph. Bertran dans ce Bulletin.

** Voir information dans le Bulletin de l'OIML N° 102, p. 36.

cours de ces 25 dernières années, ingénieurs et techniciens des pays en voie de développement. On peut citer parmi ces pays : l'Algérie, l'Afghanistan, le Bénin, le Burkina Faso, le Cambodge, le Cameroun, Chypre, la Côte d'Ivoire, Djibouti, le Gabon, l'Indonésie, le Liban, Madagascar, le Mali, le Maroc, la Tunisie et le Togo.

La France a également organisé des formations de courte durée, d'une semaine à trois mois, pour les fonctionnaires des services des poids et mesures. On peut citer parmi les pays qui ont fait appel à cette formation : l'Argentine, le Brésil, le Venezuela, le Maroc, la Tunisie, le Sénégal, le Cameroun, la Côte d'Ivoire, le Mali, le Kenya, le Burkina Faso, l'Inde, la Chine, le Vietnam, l'Indonésie, Singapour, la République de Corée.

Ces stages ont porté en particulier sur les disciplines du pesage, des mesures de longueur, du mesurage des volumes de liquides, des mesures électriques, du conditionnement ou bien, d'une façon plus générale, sur l'organisation d'un service de métrologie. Troisième forme d'aide : une assistance technique. Des missions d'identification des besoins ont été réalisées à la demande de certains pays. On peut citer l'Argentine, le Maroc, la Tunisie, l'Indonésie. Ces missions permettent aux pays en voie de développement de s'entourer de conseils avant de prendre les décisions qui leur incombent. Elles débouchent le cas échéant sur des contrats d'équipements de laboratoires, de formation de personnel, etc.

Enfin, des actions diverses, des actions ponctuelles telles que la préparation de séminaires de métrologie ont été organisées.

Une des caractéristiques communes de ces actions est que l'on ne cherche pas à plaquer une solution toute faite sur un problème rencontré dans un pays en voie de développement. De la même manière que sur le plan national, il est recherché une amélioration constante de l'efficacité. On tente d'apprécier les besoins réels du pays en voie de développement, afin de proposer des solutions les plus adaptées aux problèmes qui sont rencontrés.

Pour les actions futures, nous souhaitons pouvoir faire bénéficier le plus grand nombre de pays en voie de développement des formations dispensées à l'Ecole Supérieure de Métrologie de Douai et qui permettraient par exemple la délivrance d'un diplôme d'ingénieur ou tout simplement la formation d'auditeurs libres. Nous entendons sensibiliser et au-delà aider nos partenaires des pays en voie de développement à se doter de systèmes efficaces de métrologie dans le but de contribuer à améliorer la politique de la qualité, à permettre de contrôler les importations et les exportations et à permettre la qualification des produits nationaux.

Sur le marché intérieur et à l'exportation, c'est le maillon qui est indispensable pour la tutelle des organismes de contrôle et d'essai. Enfin c'est un élément essentiel d'une politique de maintenance industrielle permettant de fabriquer des produits de qualité.

L'organisation CERLAB permet également à ceux qui font appel à ses services de rechercher les sources de financement permettant de mener à bien ces orientations, ces recherches pouvant se faire auprès des organismes qui dispensent les aides bilatérales et qui sont soit les Ministères des Affaires Etrangères ou de la Coopération ou les Ministères du Commerce Extérieur. Ce peut être aussi les organismes d'aide multilatérale comme la CEE, l'ONUDI, l'UNESCO, la Banque Mondiale et les banques régionales de crédit et de développement.

Une plaquette publiée par CERLAB indique comme exemples les activités suivantes :

PAYS DU PACTE ANDIN : évaluation des niveaux de qualité de laboratoires d'essais et élaboration d'un projet de réseau régional de laboratoires d'essais.

VENEZUELA : formation de quatre ingénieurs du Service National de Métrologie en vue de la mise en place d'un service de métrologie industrielle.

TUNISIE : assistance technique auprès de l'Institut National de la Normalisation et de la Propriété Industrielle (INNORPI) en organisation générale, normalisation et certification.

MALI : étude préliminaire du laboratoire central du service de métrologie.

CAMEROUN — COTE D'IVOIRE — SENEGAL : cycle de formation sur la gestion de la qualité de douze ingénieurs destinés à intervenir comme conseillers en qualité dans les industries de ces pays.

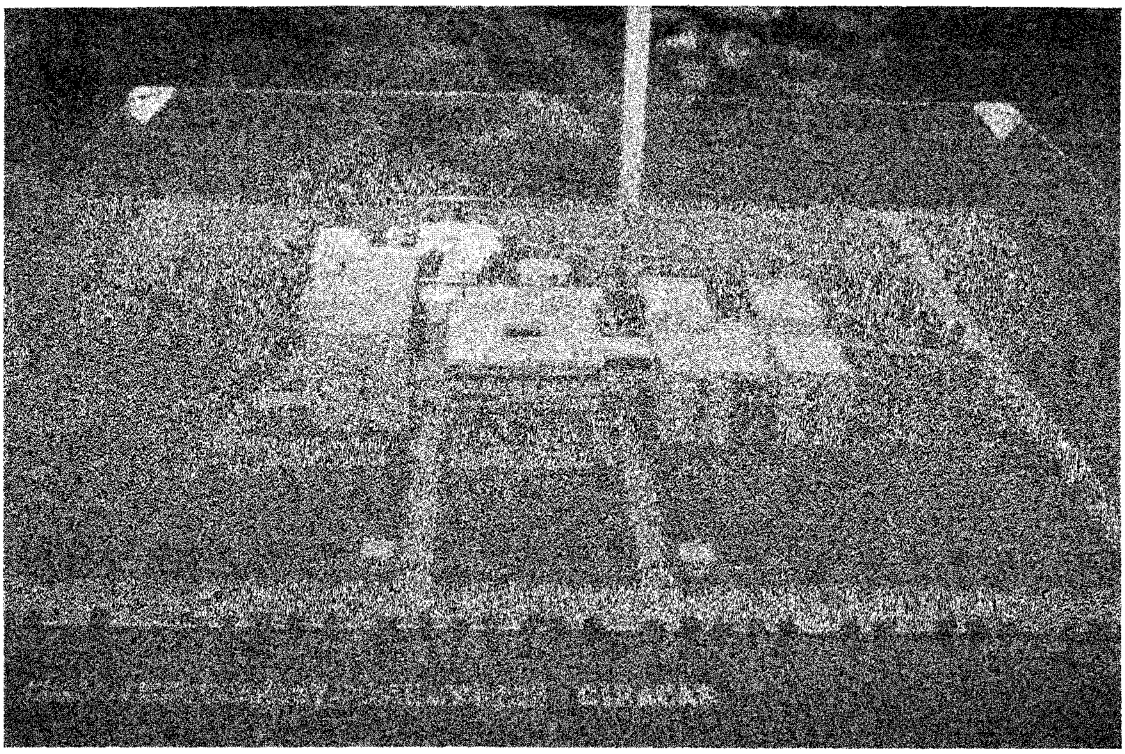
SINGAPOUR : séminaire sur la métrologie dans l'industrie dans le cadre du SISIR (Singapore Institute of Standards and Industrial Research).

INDONESIE : études et assistance au maître d'ouvrage pour l'extension aux produits industriels de l'activité du Centre d'Essai et de Contrôle de la Qualité (PPMB) à Jakarta (voir illustration).

— assistance technique auprès du Ministère du Commerce pour définir et mettre en œuvre une politique d'amélioration de la qualité des produits non pétroliers destinés à l'exportation.

D'autres informations peuvent être obtenues en s'adressant à

CERLAB, 1, rue Gaston Boissier, 75015 PARIS, Tél. (33) (1) 48 56 86 96



JAPAN

DEVELOPING COUNTRIES
JAPANESE ASSISTANCE IN METROLOGY (*)

The program « Institute for Transfer of Industrial Technology (ITIT) » was established in 1973 to coordinate and promote scientific and technological cooperation with developing countries in the field of mining and industrial technology. This program is conducted by the 16 national research institutes operated by the Agency of Industrial Science and Technology (AIST) of the Ministry of International Trade and Industry (MITI).

The activities of ITIT comprise joint research projects with developing countries, invitation of managers and other staff to visit specialized institutes in Japan, sending of Japanese specialists to developing countries and the organization of international symposia.

Joint research on specific subjects

There were on the whole a total of 23 international joint research and development projects currently under way in 1985 and approximately 80 researchers are exchanged each year under the ITIT program. Out of this great number of joint research projects several are devoted to metrology.

The National Research Laboratory of Metrology (NRLM) Japan is cooperating with the Korea Standards Research Institute and the National Industrial Research Institute, Korea in the field of technology for the transfer of force standards, including development of portable transfer devices and intercomparison of proving rings.

Another project concerns the study on the accuracy of mass standards and interlaboratory comparisons between NRLM and the Directorate of Metrology, Indonesia, and the National Institute of Science and Technology, Philippines.

The Electrotechnical Laboratory (ETL) of Japan has also under this programme cooperated with the Thailand Institute of Scientific and Technological Research with the view of establishing a calibration system for radio frequency measurements (power and voltage) in Thailand.

International Symposia

International Symposia are held to aid in the solution of problems which are common to developing countries. The presentations which are published contain therefore to a large extent country reports explaining the situation in the various countries.

International Symposia in Metrology, abbreviated ISMET were held in 1978, 1981 and 1984. On the mean there were 13 invited participants from developing countries in these symposia.

The next ISMET is planned to be held in 1987.

Training courses

Group training courses are held annually at research institutes operated by the Agency of Industrial Science and Technology in cooperation with the Japan International Cooperation Agency (JICA).

The group training course in metrology and measurement standards is one of them and it has been conducted at NRLM since 1978. During the period 1978-1985, 173 metrologists from 34 countries participated in the course. This year (1986) sees 14 participants from 11 countries (Brazil, China, Dominican Republic, Indonesia, Mexico, Nepal, Pakistan, Philippines, Solomon Islands, Thailand, Turkey) and the course lasts six months from June to December. In addition,

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(*) Summarized account of presentation at the meeting of the OIML Development Council 14-15 April 1986.

individual trainees are occasionally accepted for a specialized subject at NRLM and ETL on request by their countries or by JICA and the United Nations.

Textbooks in the various fields of metrology were specially written or translated into English for the group training course and a number of video tapes were prepared for this purpose.

Technical Cooperation Project in Malaysia

A JICA project for the establishment of the National Metrology Laboratory of Malaysia was implemented from 1981 to 1985 with 25 Japanese experts involved and 12 Malaysian metrologists trained in Japan. The training activities of the Japanese experts concerned mainly the measurements of length, mass, volume, temperature and electrical quantities. Calibration equipment amounting to 1.7 million US dollars was donated by the Government of Japan.

Other technical cooperation with NRLM

In addition to the extensive project in Malaysia the National Research Laboratory of Metrology sent during the period 1981 to 1985 experts to assist the following countries :

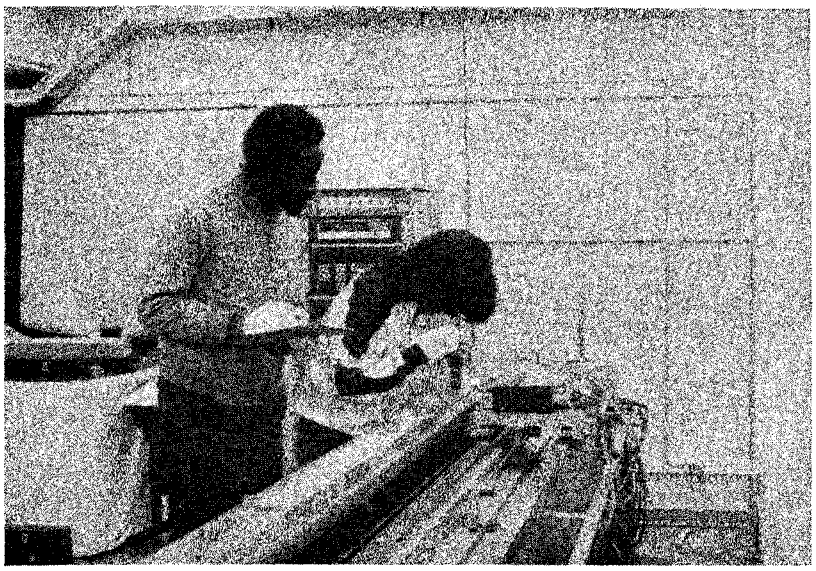
Brazil	Measurement System (2 experts)
China	Thermal Radiation (1), Laser Frequency (1), Reference Materials (1), Force (1)
India	Pressure (1)
Indonesia	Pressure (2), Mass (4)
Korea	Mass (1), Viscosity (1), Force (2)
Philippines	Temperature (2), Mass (4)

Conclusion

Japanese technical assistance in metrology for developing countries will be continued and strengthened in such forms as those stated before : sending of Japanese experts, training of the counter-part staff either in group (JICA) or individually, and supplying metrological apparatus (JICA project only).

For any further information, please contact the address below :

National Research Laboratory of Metrology
1-1-4 Umezono, Sakura-mura, Niihari-gun,
Ibaraki 305, Japan



Training in length metrology

ROYAUME-UNI **UNITED KINGDOM**

TRAINING IN METROLOGY

1 — The National Weights and Measures Laboratory (NWML) offers a 3-week training course in May each year, subject to demand. The course includes the theory and practice of length, mass and volume measurement, visits to equipment manufacturers and other laboratories, including NPL and BSI. The cost of the 3-week course is £600.

2 — The National Engineering Laboratory (NEL) offers one-week courses in the theory and practice of flow measurement. The courses are usually in May and October each year and cost £380 + 15 % VAT.

3 — The British Standards Institution (BSI) offers a 5-week course for standards officers. The cost of the 5-week course is approximately £750.

4 — The South West Provincial Council Trading Standards Unit (SWPC) arranges a 3-year Diploma course for Trading Standards Officers and is prepared to arrange shorter (3 months) residential courses on demand. These courses include training attachments to local authorities and the NWML 3-week course.

Financial assistance for potential students may be sought through local representatives of United Nations agencies.

Countries with United Nations Industrial Development (UNIDO) grants may spend part of their grant on training in metrology.

Commonwealth countries may apply for a grant under the UK Overseas Aid programme through the British Embassy or High Commission in their country.

Application forms to attend the courses are available from :

1. The course co-ordinator
   NWML
   26 Chapter Street
   London SW1P 4NS
2. Conference Section
   NEL
   East Kilbride
   Glasgow G75 OQU
3. Education Section
   BSI
   2 Park Street
   London W1A 2BS
4. The course director
   SWPC
   Daunceys
   Claremont Crescent
   Weston-super-Mare BS23 2EE

FORMATION EN METROLOGIE

1 — Le Laboratoire national des poids et mesures (National Weights and Measures Laboratory, ou NWML) assure chaque année en mai un cours de formation d'une durée de 3 semaines, à condition qu'il y ait une demande. Ce cours porte sur la théorie et la pratique de la mesure des longueurs, des masses et des volumes et comprend la visite des locaux d'un certain nombre de fabricants d'équipements et autres laboratoires, y compris le NEL et le BSI. Le cours de 3 semaines coûte £600.

2 — Le Laboratoire technique national (National Engineering Laboratory, ou NEL) offre des cours d'une semaine portant sur la théorie et la pratique de la mesure des débits. Les cours sont généralement organisés chaque année en mai et en octobre et coûtent £380 + 15 % TVA.

3 — L'Institut britannique de normalisation (British Standards Institution, ou BSI) offre un cours de 5 semaines à l'intention des personnels des services responsables des normes. Le cours de 5 semaines coûte environ £750.

4 — La Section qui s'occupe de l'application de la réglementation sur le commerce du Conseil provincial du Sud-Ouest (South West Provincial Council Trading Standards Unit, ou SWPC) organise un cours de 3 ans sanctionné par un diplôme et peut organiser sur demande des cours moins longs (3 mois) avec logement des étudiants. Ces cours comprennent des stages pour les personnes détachées auprès des collectivités locales et le nouveau cours de 3 semaines du NWML.

Les étudiants éventuels peuvent chercher à obtenir une assistance financière en s'adressant aux représentants locaux des agences des Nations Unies.

Les pays bénéficiant de subventions des Nations Unies pour le développement industriel (UNIDO) peuvent consacrer une partie de leur subvention à la formation en métrologie.

Les pays du Commonwealth peuvent faire une demande de subvention dans le cadre du Programme britannique d'aide aux pays d'outre-mer en s'adressant à l'Ambassade ou au Haut-Commissariat britannique dans leur pays.

Les formulaires de demande d'inscription aux cours peuvent être obtenus auprès des adresses indiquées dans la version anglaise de cette information.

L'OIML A TRAVERS LA PRESSE

Un aperçu des informations sur l'OIML publiées dans la presse technique a paru dans le Bulletin OIML N° 92 en septembre 1983. Nous donnons ci-après une compilation nouvelle des publications sur notre Organisation, s'étendant sur les années 1983-1985.

Mentionnons d'abord trois journaux techniques qui publient beaucoup d'informations sur l'OIML :

PTB — Mitteilungen (R.F. d'Allemagne) publie régulièrement un compte rendu de tous les événements touchant l'OIML. Les changements dans le CIML, rapports sur les réunions et séminaires, annonce des publications nouvelles de l'OIML, sont publiés dans presque chaque numéro du journal. Les traductions en allemand des Recommandations Internationales N^os^ 17, 51, 53, 57, 60, 61 en parallèle avec les textes officiels français, ont été publiées pendant ces trois dernières années. Dans PTB-Mitteilungen 5/85, le texte intégral du discours du Président du CIML, M. K. Birkeland, sur les exigences de la société et de la technologie envers la métrologie légale et sur les moyens de satisfaire ces exigences nationales et internationales a été publié. Parallèlement, les volumes de *PTB Jahresberichte* (Rapport annuel de PTB) donnent aussi un aperçu détaillé de l'activité des Secrétariats OIML.

Standardization, le Bulletin officiel de l'Organisation Arabe pour la Normalisation et la Métrologie (ASMO) suit également tous les travaux de l'OIML. Une part importante du programme de travail du Comité C.T.8. Métrologie est la traduction en arabe des RI (par exemple N^os^ 3, 4, 16, 33, 47) et des DI (N^os^ 5, 6), ainsi que du Vocabulaire de Métrologie Légale.

Le journal australien *The Institute of Trading Standards Review* réimprime souvent des articles complets parus dans le Bulletin OIML, qui sont d'intérêt spécial pour les agents techniques australiens. On peut ainsi citer les articles écrits par MM. Haegstad, Strecker, Driel, Šindelâř, Hoerlein, Gögge, Humpert, Wunsche. Des nouvelles brèves donnent régulièrement un aperçu des travaux des organes dirigeants de l'OIML.

Izmeritelnaya teknika (1983-N° 2) (URSS) a fait un reportage sur la réunion du SP 31 tenue à Odessa.

Muwassafat (Tunisie) publiait dans le N° 11-1984 un article intitulé « Faites connaissance avec l'OIML ». Un « calendrier international » indique souvent les réunions OIML.

Československá standardizace a commémoré le 30ème anniversaire de notre Organisation (N° 12-1985). Le Document International N° 6 « Documentation pour les étalons et les dispositifs d'étalonnage » est le sujet d'un article paru dans le N° 1-1984.

Dans le journal néerlandais *Metrovisie*, M. Korenhoff a publié des rapports sur deux réunions : SP 7-Sr 2 à Alexandria (N° 6-1983) et SP 2-Sr 6 à Copenhague (N° 2-1985). Ces rapports ne concernent pas uniquement le côté technique des réunions, mais donnent aussi quelques impressions personnelles sur les endroits visités pendant le voyage. Une réunion du SP 5D est décrite dans le N° 4-1985.

Un rapport sur la réunion du SP 2-Sr 4 à Paris a été publié dans le *JEMIC Technical Report* Vol. 19 N° 4 au Japon.

La revue *INFOVRAC* (N° 19-1985, Paris) publiait un article rappelant « L'importance de la métrologie légale ».

Aux Etats-Unis, NBS publiait en juin 1984 un bulletin « *OIML News* » avec rapports sur les réunions et activités en cours. Le journal *Weights and Measures Today* (Nov. 1984) faisait un rapport sur la 7ème Conférence Internationale de Métrologie Légale. Chaque volume des rapports de la *Réunion Annuelle de la « National Conference on Weights and Measures »* comporte un chapitre sur les travaux de l'OIML.

Standarti i Catchestvo (Bulgarie, N° 6-1985) donne un rapport détaillé sur la visite de M. Athané à Sofia, avec une série de questions sur l'OIML et les réponses du Directeur du BIML.

La Septième Conférence a été le sujet d'articles parus dans *Eich- und Vermessungsmagazin* (N° 45, Autriche) et *Standardisierung und Qualität* (N° 7-1983, RDA). Ce journal a aussi publié des rapports sur les réunions du 19ème CIML et du SP 21.

On peut encore rappeler qu'il est fait mention de notre Organisation à deux reprises dans des publications inhabituelles. Les Etats membres du GATT envoient au Secrétariat des notifications sur des changements de prescriptions techniques, conformément à l'Accord dit « Code des normes du GATT ». Ce changement peut être la conséquence de l'harmonisation des prescriptions par l'OIML. Par exemple, la Notification 85.129 de la Suisse (26 juillet 1985) fait part d'un amendement de l'Ordonnance sur l'approbation et la vérification des compteurs de chaleur et d'eau chaude, en conséquence de la mise en application de la RI N° 72.

Deux normes de la République de Cuba réglementent les méthodes de la coopération avec l'OIML, ainsi que la mise en application des RI à Cuba.

Ce bref aperçu est basé sur les publications disponibles au Centre de Documentation du BIML. Les rapports parus dans les Bulletins internes aux Services nationaux de métrologie ne sont pas inclus.

F.P.

OIML IN THE PRESS

A survey of information on OIML to be found in the technical press was published in the OIML Bulletin No. 92, September 1983. A new compilation of publications on OIML, for the years 1983-1985, is given below.

Three journals should be mentioned first, as they publish most of the news on OIML :

PTB — Mitteilungen (F.R. Germany) is regularly publishing reports on all aspects of OIML activity. Changes in the CIML, reports on meetings and seminars, announcements of new OIML publications appear in almost each number of this journal. German translations of International Recommendations No's 17, 51, 53, 57, 60, 61 in parallel with the official French texts, were published during these three years. In PTB-Mitteilungen 5/85, the integral text of a paper by the CIML-President Mr. K. Birkeland, on the demands of society, and the technology concerning legal metrology and the ways and means of satisfying these national and international requirements, was published. Similarly, the volumes of *PTB Jahresberichte* (Annual Reports of the PTB) give a detailed account of the activity of OIML Secretariats.

Standardization, the official Bulletin of the Arab Organization for Standardization and Metrology (ASMO) also keeps up with OIML activities. An important part of the work of the Committee C.T.8 Metrology is the translation into Arabic of the RI's (e.g. No's 3, 4, 16, 33, 47) and of DI's (No's 5, 6), and of the Vocabulary of Legal Metrology.

The Institute of Trading Standards Review of Australia is often reprinting complete articles published in OIML Bulletin, which may be of interest to the Australian technical personnel.

Among these one may mention the articles by Messrs Haegstad, Strecker, Driel, Sindelář, Hoerlein, Gögge, Humpert, Wünsche. Short news items give a regular survey of the work of the leading bodies of OIML.

Izmeritelnaya teknika (1983-No. 2, USSR) reported on the meeting of SP 31 held in Odessa.

Muwassafat (Tunisia) published in No. 11-1984 an article entitled « Get acquainted with OIML ». An « International Calendar » often gives dates of OIML meetings.

Československá standardizace commemorated the 30th anniversary of our Organization (No. 12-1985). The International Document No. 6 « Documentation for measurement standards and calibration devices » was discussed in a paper published in No. 1-1984.

In the Dutch journal *Metrovisie*, Mr. Korenhoff published reports on two meetings : SP 7-Sr 2 in Alexandria (No. 6-1983) and SP 2-Sr 6 in Copenhagen (No. 2-1985). These reports cover not only the technical aspects of the meeting but give also some personal impressions on the places visited during the journey. The meeting of SP 5D was described in No. 4-1985.

A report on the meeting of SP 2-Sr 4 in Paris appeared in *JEMIC Technical Report* Vol. 19 No. 4 in Japan.

The journal *INFOVRAC* (No. 19-1985, Paris) published an article on « The importance of Legal Metrology ».

In the United States of America, NBS published, in June 1984, a bulletin « *OIML News* » with information on meetings and current activities. The paper *Weights and Measures Today* (Nov. 1984) gave an account of the 7th International Conference on Legal Metrology. Each volume of the *Reports of the Annual Meetings of the National Conference on Weights and Measures* contains a chapter on OIML activities.

Standarti i Catchestvo (Bulgaria, No. 6-1985) gave a detailed report on the visit of Mr. Athané to Sofia, with a series of questions on OIML, followed by the answers of the Director of the BIML.

The Seventh Conference was the subject of articles published also in *Eich- und Vermessungsmagazin* (No. 45, Austria) and *Standardisierung und Qualität* (No. 7-1983, GDR). This journal published also articles on the meetings of the 19th CIML and of SP 21.

One should also point out that our Organization was mentioned in two unusual publications. Member States of GATT are sending Notifications on changes in technical regulations to the Secretariat in conformity with the GATT Standards Code. Such a change may be the consequence of harmonization of the requirements by OIML. For example, the Notification 85.129 of Switzerland (26 July 1985) which announced a modification of the Regulation on the approval and verification of heat meters and hot water meters, a consequence of the implementation of RI 72.

Two standards of the Republic of Cuba regulate the methods of co-operation with OIML and of the implementation of RI's in Cuba.

This brief survey is based on publications available in the BIML Documentation Center. The reports published by metrological services in Bulletins of restricted distribution were not taken into consideration.

F.P.

INFORMATIONS

MEMBRES DU COMITE

AUSTRALIE — Monsieur J. BIRCH, Executive Director de la National Standards Commission, a été désigné pour représenter son Pays au CIML, en remplacement de Monsieur T.J. PETRY (Monsieur F. HARVEY avait provisoirement rempli les fonctions de Membre du Comité à l'occasion de la 21ème réunion du CIML en avril 1986).

REPUBLIQUE POPULAIRE DEMOCRATIQUE DE COREE — Le nouveau membre du Comité est Monsieur TCHEU HWA TCHOUN qui remplace Monsieur KIM HI SANG, appelé à d'autres fonctions.

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COMMITTEE MEMBERS

AUSTRALIA — Mr J. BIRCH, Executive Director, National Standards Commission, has been designated to represent his country on the CIML in the place of Mr T.J. PETRY (Mr F. HARVEY acted provisionally as the CIML Member during the 21st meeting of the CIML, April 1986).

DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA — The new Committee Member is Mr TCHEU HWA TCHOUN. He replaces Mr KIM HI SANG who is taking up another position.

REUNIONS

	Groupes de travail	Dates	Lieux
SP 12 - Sr 8	Compteurs d'énergie thermique	30 sept.-1er oct. 1986	BRAUNSCHWEIG R.F. D'ALLEMAGNE
SP 17 - Sr 1	Mesure des pollutions de l'air	20-22 oct. 1986	BERLIN-OUEST
SP 5D - Sr 3	Compteurs d'eau	23-24 oct. 1986	BERLIN-OUEST
SP 23	Méthodes et moyens d'attestation des dispositifs de vérification	27-31 oct. 1986	PRAGUE TCHECOSLOVAQUIE
et SP 23 - Sr 1, 2, 3, 4 et 5			
SP 7 - Sr 4	Instruments de pesage à fonctionnement non automatique	3-7 nov. 1986	PARIS FRANCE
SP 6 - Sr 1	Compteurs de gaz à parois déformables	20-21 nov. 1986	WASHINGTON, D.C. USA
SP 6 - Sr 2	Compteurs de gaz à pistons rotatifs Compteurs de gaz non volumétriques		
SP 5D - Sr 1	Compteurs et ensembles de mesure de liquides autres que l'eau à chambres mesureuses ou à turbine	25-27 nov. 1986	PARIS FRANCE
SP 5D - Sr 8	Compteurs électromagnétiques		
SP 5D - Sr 9	Compteurs vortex		
SP 5S - Sr 8	Réservoirs de stockage	8-12 déc. 1986	DELFT PAYS-BAS
SP 5S - Sr 9	Camions et wagons citernes		
SP 5S - Sr 10	Péniches et navires citernes		
SP 5S - Sr 11	Dispositifs de repérage des niveaux de liquides dans les réservoirs		
SP 14	Acoustique et vibrations	6-7 avril 1987	BIML PARIS
SP 14 - Sr 1	Sonomètres		
SP 14 - Sr 2	Audiomètres		
SP 14 - Sr 3	Vibrations mécaniques et chocs		
SP 10 - Sr 1	Mesure de la vitesse des véhicules	avril 1987 *(provisoire)*	SUISSE
SP 12 - Sr 7	Thermomètres médicaux	5-8 mai 1987	BRAUNSCHWEIG R.F. D'ALLEMAGNE

Séminaire sur la vérification des installations de mesure de liquides	11-15 mai 1987	ARLES FRANCE

PUBLICATIONS

— Vocabulaire de métrologie légale
Vocabulary of legal metrology

— Vocabulaire international des termes fondamentaux et généraux de métrologie
International vocabulary of basic and general terms in metrology

RECOMMANDATIONS INTERNATIONALES

INTERNATIONAL RECOMMENDATIONS

RI N°

1 — Poids cylindriques de 1 g à 10 kg (de la classe de précision moyenne)
Cylindrical weights from 1 g to 10 kg (medium accuracy class)

2 — Poids parallélépipédiques de 5 à 50 kg (de la classe de précision moyenne)
Rectangular bar weights from 5 to 50 kg (medium accuracy class)

3 — Réglementation métrologique des instruments de pesage à fonctionnement non automatique
Metrological regulations for non automatic weighing instruments

4 — Fioles jaugées (à un trait) en verre
Volumetric flasks (one mark) in glass

5 — Compteurs de liquides autres que l'eau à chambres mesureuses
Meters for liquids other than water with measuring chambers

6 — Prescriptions générales pour les compteurs de volume de gaz
General specifications for volumetric gas meters

7 — Thermomètres médicaux (à mercure, en verre, avec dispositif à maximum)
Clinical thermometers (mercury-in-glass, with maximum device)

9 — Vérification et étalonnage des blocs de référence de dureté Brinell
Verification and calibration of Brinell hardness standardized blocks

10 — Vérification et étalonnage des blocs de référence de dureté Vickers
Verification and calibration of Vickers hardness standardized blocks

11 — Vérification et étalonnage des blocs de référence de dureté Rockwell B
Verification and calibration of Rockwell B hardness standardized blocks

12 — Vérification et étalonnage des blocs de référence de dureté Rockwell C
Verification and calibration of Rockwell C hardness standardized blocks

14 — Saccharimètres polarimétriques
Polarimetric saccharimeters

15 — Instruments de mesure de la masse à l'hectolitre des céréales
Instruments for measuring the hectolitre mass of cereals

16 — Manomètres des instruments de mesure de la tension artérielle (sphygmomanomètres)
Manometers for instruments for measuring blood pressure (sphygmomanometers)

17 — Manomètres, vacuomètres, manovacuomètres indicateurs
Indicating pressure gauges, vacuum gauges and pressure-vacuum gauges

18 — Pyromètres optiques à filament disparaissant
Optical pyrometers of the disappearing filament type

19 — Manomètres, vacuomètres, manovacuomètres enregistreurs
Recording pressure gauges, vacuum gauges, and pressure-vacuum gauges

20 — Poids des classes de précision E_1 E_2 F_1 F_2 M_1 de 50 kg à 1 mg
Weights of accuracy classes E_1 E_2 F_1 F_2 M_1 *from 50 kg to 1 mg*

21 — Taximètres
Taximeters

22 — Tables alcoométriques internationales
International alcoholometric tables

23 — Manomètres pour pneumatiques de véhicules automobiles
Tyre pressure gauges for motor vehicles

24 — Mètre étalon rigide pour agents de vérification
Standard one metre bar for verification officers

25 — Poids étalons pour agents de vérification
Standard weights for verification officers

26 — Seringues médicales
Medical syringes

27 — Compteurs de volume de liquides (autres que l'eau). Dispositifs complémentaires
Volume meters for liquids (other than water). Ancillary equipment

28 — Réglementation technique des instruments de pesage à fonctionnement non-automatique
Technical regulations for non-automatic weighing machines

29 — Mesures de capacité de service
Capacity serving measures

30 — Mesures de longueur à bouts plans (calibres à bouts plans ou cales-étalons)
End standards of length (gauge blocks)

31 — Compteurs de volume de gaz à parois déformables
Diaphragm gas meters

32 — Compteurs de volume de gaz à pistons rotatifs et compteurs de volume de gaz à turbine
Rotary piston gas meters and turbine gas meters

33 — Valeur conventionnelle du résultat des pesées dans l'air
Conventional value of the result of weighing in air

34 — Classes de précision des instruments de mesurage
Accuracy classes of measuring instruments

35 — Mesures matérialisées de longueur pour usages généraux
Material measures of length for general use

36 — Vérification des pénétrateurs des machines d'essai de dureté
Verification of indenters for hardness testing machines

37 — Vérification des machines d'essai de dureté (système Brinell)
Verification of hardness testing machines (Brinell system)

38 — Vérification des machines d'essai de dureté (système Vickers)
Verification of hardness testing machines (Vickers system)

39 — Vérification des machines d'essai de dureté (systèmes Rockwell B, F, T - C, A, N)
Verification of hardness testing machines (Rockwell systems B, F, T - C, A, N)

40 — Pipettes graduées étalons pour agents de vérification
Standard graduated pipettes for verification officers

41 — Burettes étalons pour agents de vérification
Standard burettes for verification officers

42 — Poinçons de métal pour agents de vérification
Metal stamps for verification officers

43 — Fioles étalons graduées en verre pour agents de vérification
Standard graduated glass flasks for verification officers

44 — Alcoomètres et aréomètres pour alcool et thermomètres utilisés en alcoométrie
Alcoholometers and alcohol hydrometers and thermometers for use in alcoholometry

45 — Tonneaux et futailles
Casks and barrels

46 — Compteurs d'énergie électrique active à branchement direct (de la classe 2)
Active electrical energy meters for direct connection (class 2)

47 — Poids étalons pour le contrôle des instruments de pesage de portée élevée
Standard weights for testing of high capacity weighing machines

48 — Lampes à ruban de tungstène pour l'étalonnage des pyromètres optiques
Tungsten ribbon lamps for calibration of optical pyrometers

49 — Compteurs d'eau (destinés au mesurage de l'eau froide)
Water meters (intended for the metering of cold water)

50 — Instruments de pesage totalisateurs continus à fonctionnement automatique
Continuous totalising automatic weighing machines

51 — Trieuses pondérales de contrôle et trieuses pondérales de classement
Checkweighing and weight grading machines

52 — Poids hexagonaux. Classe de précision ordinaire de 100 g à 50 kg
Hexagonal weights. Ordinary accuracy class, from 100 g to 50 kg

53 — Caractéristiques métrologiques des éléments récepteurs élastiques utilisés pour le mesurage de la pression. Méthodes de leur détermination
Metrological characteristics of elastic sensing elements used for measurement of pressure. Determination methods

54 — Echelle de pH des solutions aqueuses
pH scale for aqueous solutions

55 — Compteurs de vitesse, compteurs mécaniques de distances et chronotachygraphes des véhicules automobiles - Réglementation métrologique
Speedometers, mechanical odometers and chronotachographs for motor vehicles. Metrological regulations

56 — Solutions-étalons reproduisant la conductivité des électrolytes
Standard solutions reproducing the conductivity of electrolytes

57 — Ensembles de mesurage de liquides autres que l'eau équipés de compteurs de volumes. Dispositions générales
Measuring assemblies for liquids other than water fitted with volume meters. General provisions.

58 — Sonomètres
Sound level meters

59 — Humidimètres pour grains de céréales et graines oléagineuses
Moisture meters for cereal grains and oilseeds

60 — Réglementation métrologique des cellules de pesée
Metrological regulations for load cells

61 — Doseuses pondérales à fonctionnement automatique
Automatic gravimetric filling machines

62 — Caractéristiques de performance des extensomètres métalliques à résistance
Performance characteristics of metallic resistance strain gages

63 — Tables de mesure du pétrole
Petroleum measurement tables

64 — Exigences générales pour les machines d'essai des matériaux
General requirements for materials testing machines

65 — Exigences pour les machines d'essai des matériaux en traction et en compression
Requirements for machines for tension and compression testing of materials

66 — Instruments mesureurs de longueurs
Length measuring instruments

67 — Ensembles de mesurage de liquides autres que l'eau équipés de compteurs de volumes. Contrôles métrologiques
Measuring assemblies for liquids other than water fitted with volume meters. Metrological controls

68 — Méthode d'étalonnage des cellules de conductivité
Calibration method for conductivity cells

69 — Viscosimètres à capillaire, en verre, pour la mesure de la viscosité cinématique
Glass capillary viscometers for the measurement of kinematic viscosity.

70 — Détermination des erreurs de base et d'hystérésis des analyseurs de gaz
Determination of intrinsic and hysteresis errors of gas analysers

71 — Réservoirs de stockage fixes. Prescriptions générales
Fixed storage tanks. General requirements

72 — Compteurs d'eau destinés au mesurage de l'eau chaude
Hot water meters

73 — Prescriptions pour les gaz purs CO, CO_2, CH_4, H_2, O_2, N_2 et Ar destinés à la préparation des mélanges de gaz de référence
Requirements concerning pure gases CO, CO_2, CH_4, H_2, O_2, N_2 and Ar intended for the preparation of reference gas mixtures

74 — Instruments de pesage électroniques (*)
Electronic weighing instruments (*)

DOCUMENTS INTERNATIONAUX

INTERNATIONAL DOCUMENTS

DI N°

1 — Loi de métrologie
Law on metrology

2 — Unités de mesure légales
Legal units of measurement

3 — Qualification légale des instruments de mesurage
Legal qualification of measuring instruments

4 — Conditions d'installation et de stockage des compteurs d'eau froide
Installation and storage conditions for cold water meters

5 — Principes pour l'établissement des schémas de hiérarchie des instruments de mesure
Principles for the establishment of hierarchy schemes for measuring instruments

6 — Documentation pour les étalons et les dispositifs d'étalonnage
Documentation for measurement standards and calibration devices

7 — Evaluation des étalons de débitmétrie et des dispositifs utilisés pour l'essai des compteurs d'eau
The evaluation of flow standards and facilities used for testing water meters

8 — Principes concernant le choix, la reconnaissance officielle, l'utilisation et la conservation des étalons
Principles concerning choice, official recognition, use and conservation of measurement standards

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(*) Projet à sanctionner par la Huitième Conférence Internationale de Métrologie Légale - octobre 1988
Draft to be sanctioned by the Eighth International Conference of Legal Metrology - October 1988.

9 — Principes de la surveillance métrologique
Principles of metrological supervision

10 — Conseils pour la détermination des intervalles de réétalonnage des équipements de mesure utilisés dans les laboratoires d'essais
Guidelines for the determination of recalibration intervals of measuring equipment used in testing laboratories

11 — Exigences générales pour les instruments de mesure électroniques
General requirements for electronic measuring instruments

12 — Domaines d'utilisation des instruments de mesure assujettis à la vérification
Fields of use of measuring instruments subject to verification

13 — Conseils pour les arrangements bi- ou multilatéraux de reconnaissance des : résultats d'essais - approbations de modèles - vérifications
Guidelines for bi- or multilateral arrangements on the recognition of : test results - pattern approvals - verifications

14 — Qualification du personnel en métrologie légale
Qualification of legal metrology personnel

15 — Principes du choix des caractéristiques pour l'examen des instruments de mesure usuels
Principles of selection of characteristics for the examination of measuring instruments

Note — Ces publications peuvent être acquises au / *These publications may be purchased from*
Bureau International de Métrologie Légale, 11, rue Turgot, 75009 PARIS.

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