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1.1 CONTROLLED APPLICATIONS

Weights and Measures legislation has, for over a century, required that weighing equipment that is controlled by Regulations and is "in use for trade" should be stamped (verified) before it can be used, and if rejected on inspection, be re-verified before it is brought back into use. The various Weights and Measures Acts that we have seen in the UK have all repeated this legal requirement, the latest being the Weights and Measures Act 1985, and in particular Sections 7 and 11 of that Act.

Often however the term "use for trade" has been difficult to interpret, and in many cases the weighing industry customers have had difficulty in accepting that the equipment they use is really "in use for trade" and for NAWIs the range of controlled applications is wider still. This section discusses both NAWIs and automatic weighing instruments.

Non Automatic Weighing Instruments (NAWIs)
The situation was clouded in 1993 when the Non-Automatic Weighing Instruments (NAWI) Directive came into force. This has since been revised and re- published as the Directive 2009/23/EC. Because it is a European Directive, its scope is not defined by the Weights and Measures Act 1985, and it introduced a number of situations that required the use of verified weighing instruments, some of which went beyond what we in the UK have regarded as trade use in the past. However, as any application that could have been regarded as trade use under the Weights and Measures Act also falls within the controlled applications under the NAWI Directive; the Directive requirements provide the relevant criteria.

The NAWI Directive, and the UK Regulations that implement the Directive (the Non-automatic Weighing Instruments Regulations 2000 (SI 2000/3236)), define six applications that require the use of a verified NAWI. The applications are set out in Article 1.2 (a) of the Directive and are repeated below:

1.2. A distinction is made in this Directive between two categories of instrument use:
(a)

- *(1) Determination of mass for commercial transactions.*
- *(2) Determination of mass for the calculation of a toll, tariff, tax, bonus, penalty, remuneration, indemnity or similar type of payment.*
- *(3) Determination of mass for the application of laws or regulations; expert opinion given in court proceedings.*
- *(4) Determination of mass in the practice of medicine for weighing patients for the purposes of monitoring, diagnosis and medical treatment.*
- *(5) Determination of mass for making up medicines on prescription in a pharmacy and determination of mass in analyses carried out in medical and pharmaceutical laboratories.*
- *(6) Determination of price on the basis of mass for the purposes of direct sales to the public and the making-up of pre-packages.*

Any new NAWI that is brought into use for any of these purposes must be in compliance with the Directive and must be verified.

Categories (1) (2) and (6) correspond to the old definition of "use for trade", whilst categories (3), (4) and (5) were new to UK legislation when the Directive was introduced. Because these were new requirements for these categories, the UK was allowed a 10 year derogation period for these applications, so the requirement to have verified equipment for them did not take effect until 1st January 2003. Up until then, weighing instruments taken into use for these applications did not have to be either Type Approved or verified. It is therefore possible that old weighing instruments that are not verified will be found being used for these applications

for many years to come. Provided that these instruments were in use before 1st January 2003 then they can continue in use indefinitely.

(Article 1.2 (b) of the Directive deals with NAWIs that are not used for any of the purposes set out in Article 1.2 (a) and is there simply to apply the requirements for such NAWIs to be marked with the manufacturer's name and maximum weighing capacity.)

What is the difference between a NAWI and an AWI?
The general difference between the two is that a NAWI requires the intervention of an operator during the weighing process, for example to deposit on or remove from the load receptor the load to be measured and also to obtain the result.

However, it is not always easy from the above brief definition to determine which requirements the instrument has to meet. In these situations, the following interpretation (taken from section 3.1.9 of WELMEC Guide 2, Issue 5) of the definition of a NAWI or an AWI should be used only when doubt exists in applying the definitions contained in EC Directive 2009/23/EC and the relevant OIML recommendations.

> *"An instrument capable of performing consecutive weighing cycles without any intervention of an operator is always regarded to be an AWI. If an instrument needs the intervention of an operator, it is regarded to be an NAWI only in the case where the operator is required to determine or verify the weighing result.*
>
> *Determining the weighing result includes any intelligent action of the operator that affects the result, such as deciding when an indication is stable or adjusting the weight of the weighed product.*
>
> *Verifying the weighing result means making a decision regarding the acceptance of each weighing result on observing the indication. The weighing process allows the operator to take an action which influences the weighing result in the case where the weighing result is not acceptable.*
>
> *Note: the necessity to give an instruction to start the weighing process or to release a load is not relevant in deciding the category of instrument."*

Automatic Weighing Instruments
For automatic weighing instruments, the national legislation, the Weights and Measures Act 1985 still applies.

Section 7 of the Act says:

7. "Meaning of 'use for trade'

(1) In this Act 'use for trade' means, subject to subsection (3) below, use in Great Britain in connection with, or with a view to, a transaction falling within subsection (2) below where –

(a) the transaction is by reference to quantity or is a transaction for the purposes of which there is made or implied a statement of the quantity of goods to which the transaction relates, and

(b) the use is for the purpose of the determination or statement of that quantity.

(2) A transaction falls within this subsection if it is a transaction for—

(a) the transferring or rendering of money or money's worth in consideration of money or money's worth, or

(b) the making of a payment in respect of any toll or duty.

(3) Use for trade does not include use in a case where—
(a) the determination or statement is a determination or statement of the quantity of goods required for dispatch to a destination outside Great Britain and any designated country, and
(b) the transaction is not a sale by retail, and
(c) no transfer or rendering of money or money's worth is involved other than the passing of the title to the goods and the consideration for them."

So any automatic weighing instruments that are used in applications that fall under the definition of use for trade as set out in Section 7 come under the control of the Weights and Measures Act 1985. But do they have to be verified? That all depends on what type of automatic weighing instrument it is. For the verification requirements to apply the weighing instrument must not only be "in use for trade", it must also be "prescribed" by Regulations made under Section 11 of the Weights and Measures Act 1985. If both of these conditions are satisfied, then the automatic weighing instrument must be Type Approved under Section 12 of the Act, and verified under Section 11 of the Act.

A new set of regulations were introduced in 2006 that implement the Measuring Instruments Directive (the MID). The types of automatic weighing instruments that are prescribed remain the same and are as follows:

Equipment type	**Regulation**
Discontinuous totalisers	The Measuring Instruments (Automatic Discontinuous Totalisers) Regulations 2006 SI 2006/1255
Rail-weighbridges	The Measuring Instruments (Automatic Rail-Weighbridges) Regulations 2006 SI 2006/1256
Automatic catchweighers	The Measuring Instruments (Automatic Catchweighers) Regulations 2006 SI 2006/1257
Filling machines	The Measuring Instruments (Automatic Gravimetric Filling Instruments) Regulations 2006 SI 2006/1258
Beltweighers	The Measuring Instruments (Beltweighers) Regulations 2006 SI 2006/1259

The most notable type of automatic weighing instrument that is not "prescribed" i.e. there are no Regulations covering them and therefore they cannot be verified even though they are in use for trade, is automatic checkweighers.

1.2 DIRECT SALES, PRICE COMPUTING AND WEIGH LABELLING

General

Where a weighing instrument is used for direct sales to the public, the relevant mandatory information must be clearly displayed simultaneously to the operator and the customer. It is not uncommon to see a weighing instrument with two displays; the additional, secondary display is generally mounted for the benefit of the customers when it would be impossible for them to see the primary display.

When in use, a weighing instrument must be installed in a manner that ensures that the operator has access to the controls and has clear sight of the weighing platform.

Although the mandatory markings will include a minimum value below which the instrument should not be operated, it is not illegal to carry out transactions below the minimum level when buying or selling products other than precious metals, precious stones or pearls, or drugs and other pharmaceutical products. If it becomes the “norm” to carry out transactions below the minimum capacity then fitness for use should be questioned and consideration given to the use of an instrument of a lower maximum capacity (Max), a smaller scale division (e), and a lower minimum capacity.

It is the responsibility of the operator of a weighing instrument to ensure that it is at zero before each transaction. It is, therefore, essential that the weight display and a zero setting device are available.

Modes of Tare Operation

Tare values, which must correspond to the scale interval of the instrument, are used to remove the weight of the container from the calculation of the price to pay. Consecutive tare operations are permitted. For example, a pre-set tare may be applied with the selection of a PLU then a semi-auto tare may be applied, adding the value of an additional container. A preset tare operation can not be modified or cancelled while any subsequent tare operation is still in use.

While it is permissible to increase a tare value by repeated operations of a tare device, a tare value can not be reduced by the same method. Before a lower tare value can be established the instrument must be returned to zero.

In general, the semi-auto tare facility is used for direct sale to the public. It is possible to store a tare value but unless all the items transacted from that instrument have the same container value there is a danger of an incorrect NET weight. This problem is overcome by using a “one shot” tare. An empty container is tared; a full container replaces the empty one without allowing the instrument to see zero. Once the transaction is complete and the scale pan is clear the tare drops out and the instrument returns to zero.

Direct sales to the public can be carried out on two basic types of weighing instruments, price computing, and weight only instruments.

Price Computing Instruments

Price computing instruments are often used in an area some distance from the point of sale so a labelling facility is used to convey the relevant information. Printing must be clear and permanent and the figures must be at least 2mm high. Where transactions are printed the weight, the unit price and the price to pay shall all be printed. Under certain circumstances additional printing features may be used; explanations and conditions can be found in BS EN 45501.

When a weighing instrument is used to generate the price-to-pay based on the weight of an item, the price-to-pay must result from the weight value multiplied by the unit price. At no time is it permissible to calculate and use for trade a unit price by dividing the price-to-pay by the weight or a calculating a weight value by dividing the price-to-pay by the unit price. These practices are commonly referred to as back calculations and often result in price rounding errors and value misunderstandings.

The final calculated value of the price to pay will be influenced by the price rounding regulations of the resident country. In the UK it is normal to use 4/5 rounding, where the calculated value is 0.4p or lower the price to pay is rounded down, and if the calculated value is 0.5p or higher the price to pay is rounded up.

Weight Only Instrument

Almost all weight only instruments are associated with Electronic Point Of Sale (EPOS) devices. In this configuration the instrument only provides weight information, and is not involved in price computation or printing.

All price computation and printing activities are carried out by the EPOS and as these activities are legal metrology relevant an EPOS must have its own certificate. This certificate, usually an EC test certificate, authorises the EPOS to be connected to a non-automatic weighing instrument.

This instrument is regulated in much the same fashion as the price-computing instrument but as a result of differing installation situations additional regulation come into force.

For example, if the product to be weighed is longer than the width of the load receptor the accuracy of weighing will not be affected as long as the over hanging element of the product does not touch any other surface. By the nature of its installation within the checkout furniture the instrument is fitted flush to its surroundings so that it does not interfere with the flow of goods. In this instance a long item would rest on the surrounding surfaces and the weighing transaction would be inaccurate. Where an instrument is less than 10mm above ALL adjacent surfaces, the boundary of ALL adjacent surfaces must be durably marked in a distinctive and contrasting manner with a band at least 15mm in width. This clearly defines the area of use to the operator. If an instrument is below ANY adjacent surface it may not be used for trade.

Another feature unique to some instruments used in an EPOS is the removal of the primary display. The function of the primary has been transferred to the EPOS display, so in effect, it becomes part of the weighing instrument.

References

The Non-automatic Weighing Instruments (EEC Requirements) Regulations 1995
The Weighing Equipment (Non-automatic Weighing Machines) Regulations 2000
The Non-automatic Weighing Instruments Regulations 2000
Price labelling regulations
OIML R76
BS EN 45501

1.3 INTERFACES, PRINTERS AND PERIPHERAL DEVICES

Background
Weighing Instruments, be they non-automatic or automatic, when used for a legally controlled purpose are required to comply with all of the applicable relevant legislation. In legal metrology, the weighing instrument comprises of the weighing element (load cell, load receptor, indicator and all the necessary software and electronics necessary for the weighing operation to be performed) and any other associated equipment connected to it. So for example, an in-store Point of Sale system, comprising of a load receptor, weight display, scanner, printer, cash draw, keyboard, data display and card reader is regarded for legal metrology purposes as a weighing instrument. The Type Approval Certificate for the instrument will detail not only the weighing elements, but also the connected elements and all must satisfy the legal requirements.

If the examination for Type Approval had to cover all of the possible elements of a weighing system, many of which would be common to many different weighing systems, the Type Approval process would be both time consuming and expensive, and the result would be that many elements would be tested over and over again.

Non-automatic Weighing Instruments
Under the NAWI Directive, there has been developed what is known as the “modular” system. The Directive recognised that many elements of a weighing system are common, many can be tested in their own right and different elements can be combined to produce a weighing system.

WELMEC Working Group 2 (WG2) took on board the development of the modular system to enable manufacturers and the Type Approval organisations to understand how the various elements could be tested and to set out some guidance that would illustrate how the modular system could operate. That Guidance is contained in WELMEC Guide 2.5 “Guide for modular approach and testing PCs and other digital peripheral devices”. The Guide, currently at Issue 2 dated September 2000, can be downloaded free of charge from the WELMEC web-site at www.welmec.org.

Definitions
In developing the Guide, WELMEC WG2 soon recognised that there needed to be very clear definitions of what elements of the weighing system can be regarded as modules and what elements are not modules but “peripherals”.

They came up with the following definitions:

> **Module**
> *A module is a part of a NAWI that is necessary for obtaining the weighing result and any primary indication related to it. A module is capable of being tested separately and of having partial error limits p_i assigned to it.*
> *A device connected to a NAWI via a non-protective interface is regarded as a module. The connection needs to be secured and if nothing is connected to it, the interface itself needs to be secured.*
> *Examples of modules of a NAWI: load cell, indicator, display, price-computing POS device, software, weighing module (here they mean a “digitally working instrument including mechanical structures but without a display” which is therefore not a NAWI).*

Peripheral

A peripheral is an additional device to the NAWI, connected externally or built in, which repeats or further processes the weighing result and/or any primary indication without changing the original characteristics as specified in the Type Approval Certificate of the NAWI.
A peripheral shall be connected to the instrument via a protective interface.
Examples of peripherals of a NAWI: printers, supplementary displays, alibi printer, alibi data storage device, personal computer (PC), non-price-computing POS device which receives all primary indications from the NAWI and only prints them on a ticket.

Protective Interface

The following two definitions gave rise to the concept of the "protective" interface, and whilst there is no specific definition of a protective interface the Guide does give advice which is helpful. It describes two types of protective interface:

- *the interface prevents the introduction into the instrument of unauthorised data, parameters or instructions.*
- *the interface provides protection which covers the manner in which data related to primary indications are transmitted to a peripheral device under legal control.*

Modules and Test Certificates

To facilitate the use of modules, WELMEC WG2 developed the concept of Test Certificates (TC). Any module can be submitted for examination and testing to the applicable requirements of the Directive and the European Standard. If the module passes the tests, the Notified Body issues a TC which describes the module and its essential characteristics. Manufacturers can then, with the agreement of the owner of the TC, use that module in their instrument if the Type Approval Certificate (TAC) for the instrument allows the use of modules.

The most common use of TCs in Type Approvals is for load cells. Many load cell manufacturers obtain a TC for their load cells, the weighing instrument manufacturer then applies for the Type Approval for his instrument and asks for a clause to be incorporated into the TAC, allowing the use of any load cell having a TC (or OIML R60 Certificate) issued by a Notified Body.

When using a TC for a load cell, the manufacturer will be required to complete a "Compatibility of Modules" form, which requires him to do some technical checks to ensure that the technical characteristics of the load cell and indicator are such that they will perform together to the accuracy levels required by the TAC. Details of the Compatibility of Modules form can be found in WELMEC Guide 2, "Directive 90/384/EEC, Common Application non-automatic weighing instruments." The Guide also lists websites where spreadsheets can be found which will simplify the completion of the form. (See also section 3.1 on compatibility of modules).

Peripherals

Certain peripheral devices are allowed to be connected to the NAWI without any specific controls. The most common example of this is simple recipient (non-intelligent) printers, i.e. the printer receives data from the weighing instrument and merely prints it onto a label, ticket or receipt without any further processing. In such cases, the only requirement is that the printer bears the CE conformity mark indicating that it meets all of the other applicable EC legislation such as the EMC Directive and the Low Voltage Directive.

At other times peripherals may need a Test Certificate. The simplest example is what is known as an “alibi printer” i.e. a printer that is connected to a weighing instrument to provide a long term record of weighments in systems where the weight data is sent straight to a computer for invoicing purposes or similar. In this case, a simple recipient printer can be used to provide a tally roll record but because this record is a requirement of the Directive, the printer needs to undergo some testing to ensure it meets the essential requirements of the Directive.

Automatic Weighing Instruments

When the Measuring Instrument Directive was being drafted and adopted, it was assumed by everyone that the modular approach, which was by then well established for non-automatic weighing instruments, would also be applicable for automatic weighing instruments. Unfortunately, no one realised that the Directive itself was drafted in such a way that the modular approach was not allowed. This has been recognised as an error but one that cannot be corrected until the Directive is reviewed which will probably not be for a number of years.

The modular approach has, however, been accepted and for the purposes of the MID and the rules outlining this can be found in the WELMEC Guide 8.8 (http://www.welmec.org/latest/guides/88.html).

The OIML are also looking at adopting a Recommendation on the Modular Approach, and once this is done, then the hope is that it can be adopted by the EC as a “Normalised Document” under the MID thus allowing full use of the modular approach for all measuring instruments covered by the MID .

Detailed requirements

The whole question of modules, peripherals and interfaces is one which arises frequently in WELMEC and perhaps the only real answer is to say that in any case of doubt guidance should be sought from the Notified Body who are/will be responsible for issuing the Type Approval Certificate. Readers who are considering using the modular approach for NAWI manufacture should consult WELMEC Guide 2.5; and for AWI the WELMEC Guide 8.8 for the specific details of the tests that will be applied and the requirements that apply.

1.4 APPROVAL AND VERIFICATION OF WEIGHING INSTRUMENTS

Weighing instruments used for controlled applications need to satisfy the essential requirements of the relevant directives and associated UK regulations.

In general terms, a particular model of instrument will require a type approval and then each unit will require initial verification when it is put in to service. Alternatively, an instrument can undergo unit verification which effectively combines the two processes and would be the typical approach for a one-off installation. Once an instrument has obtained type approval, the manufacturer must provide an EC declaration of type conformity to declare that individual units have been manufactured in conformity with the approval type and satisfy the provisions of the relevant directive.

Verification can be performed by an approved third party (typically a local authority) or by the manufacturer, if approved to do so (known as self-verification).

If a unit undergoes modification or repair then it will require re-verification to the appropriate standards before being put back in to service. Any unit may also be subject to in-service inspection by a trading standards officer.

For the differentiation between automatic and non-automatic weighing, see section 1.1 on controlled applications.

Non-Automatic Weighing Instruments (NAWIs)
Prior to regulations implementing the NAWI Directive, non-automatic weighing machines were controlled under national approval and regulations emanating from the Weights and Measures Act 1985. During the transition period between 1st January 1993 and 1st January 2003 national type approvals that had not expired due to time could continue to be used for the manufacture and verification of machines, however, new designs of machines could only be approved and verified under the regulations implementing the NAWI Directive. Any national approval that was still in force at 1st January 2003 was deemed to have expired on that date.

Equipment that was verified under the national regulations can continue in use and can be repaired and re-verified even though the national type approval has now expired. The appropriate regulations are the Weighing Equipment (Non-Automatic Weighing Machines) Regulations 2000 (SI 2000 No. 932).

Since 1st January 2003, all equipment put in to service comes under the NAWI directive 2009/23/EC (previously 90/384/EC). This is implemented into UK law by the Non-Automatic Weighing Instruments Regulations 2000 (SI 2000 No. 3236). The most common route for ensuring that the Essential Requirements of the Directive are met is through the application of the European Standard EN 45501. If the weighing instrument complied with EN 45501 then it automatically satisfies the essential requirements and will be eligible for an EC Type Approval. The standard covers both the type approval and verification.

Automatic Weighing Instruments
From 30th October 2006, the Measuring Instruments Directive governs new designs of automatic weighing instruments. (Instruments already in service will continue to be controlled by the national regulations under which they are initially type approved and verified. National Type Approvals that were in force on 30th October will remain valid until their normal expiry date and can be used for national verification of the instruments to which they apply.)

The EU Commission has published in the Official Journal C269 dated 4th November 2006 (2006/C 269/01) the references to the Normative Documents with respect to the OIML recommendations. These can be found on the Commission website.

The Normative Documents address al the provision of the MID, i.e. both the general and instrument specific requirements, in tabular form, in relation to the relevant paragraphs of the respective OIML recommendations and makes comments, in general terms only, of any differences. The range of AWIs regulated in the UK together with the regulations that apply and the relevant OIML recommendation are as follows:

Regulation	**OIML Recommendation**
The Measuring Instruments (Automatic Discontinuous Totalisers) Regulations 2006 SI 2006/1255	R107 Discontinuous totalising automatic weighing instruments (totalising hopper weighers)
The Measuring Instruments (Automatic Rail-Weighbridges) Regulations 2006 SI 2006/1256	R106 Automatic rail-weighbridges
The Measuring Instruments (Automatic Catchweighers) Regulations* 2006 SI 2006/1257	R51 Automatic catchweighing instruments
The Measuring Instruments (Automatic Gravimetric Filling Instruments) Regulations 2006 SI 2006/1258	R61 Automatic gravimetric filling instruments
The Measuring Instruments (Beltweighers) Regulations 2006 SI 2006/1259	R50 Continuous totalising automatic weighing instruments (belt weighers)

**Automatic checkweighers and weight-graders, although designated as catchweighers, are not prescribed in the UK, and consequently, do not require type approval. However, to enable manufacturers to distribute to other member states, The NMO can issue approval documentation.*

The MID will offer manufacturers alternative conformity assessment modules as shown below (for electronic systems or systems containing software):

B + F (type approval plus “third-party verification”
B + D (type approval plus “self-verification”)
G (unit verification)
H1 (full quality system approval plus design examination)

The NMO is a Notified Body for each of these conformity assessment modules, with the exception of module F.

Notified bodies
A full list of all notified bodies for type approval and verification of non-automatic and automatic weighing instruments is given on the Nando (New Approach Notified and Designated Organisations) website:

http://ec.europa.eu/enterprise/newapproach/nando

1.4.1 TYPE APPROVAL OF WEIGHING INSTRUMENTS

Under the NAWI and Measuring Instruments Directives, EC-Type examination certificates can only be issued by Notified Bodies who have been designated in their Member State for this task. The National Measurement Office (NMO) is the designated Notified Body in the UK for issuing EC TACs for both non-automatic and automatic weighing instruments. Member States of the EC are obliged to accept type-approval certificates issued by Notified Bodies of other Member States.

To grant an approval, the examining body must assess the equipment against the essential requirements of the associated directive. In general, the examining body will refer to harmonised standards, OIML normative documents (MID only) and WELMEC guidelines. If the equipment satisfies the related harmonised standard(s) or normative document then it is presumed to conform to the applicable essential requirements of the directive. WELMEC guidelines give interpretations from a legal metrological point of view.

Alternatively, a manufacturer can request to have an instrument assessed against the essential requirements of the associated directive independently of the standards, normative documents and guidelines. However, the manufacturer will need to demonstrate how the instrument satisfies the essential requirements.

Non Automatic Weighing Instruments (NAWIs)
The harmonised standard for non-automatic weighing instruments is EN45501 which is based on OIML recommendation R76. This details the test procedures and criteria to be met.

The following WELMEC guidelines may be relevant:

2	Directive 90/384/EEC: Common Application
2.1	Guide for Testing Indicators
2.2	Guide for Testing Point of Sale Devices
2.3	Guide for Examining Software
2.4	Guide for Load Cells
2.5	Guide for Modular Approach and Testing of PCs and other Digital Peripheral Devices
4.1	Guide for Notified Bodies performing Conformity Assessments f Measuring Instruments
7	Guidelines for Examination and Testing of Interfaces and Peripheral Equipment
9	WELMEC Type Approval Agreement
10.3	Guide for the use of an alibi recording device (printer or memory) in Measuring Systems for Liquids other than Water

To reduce the amount of examination and testing needed to approve a NAWI, it is possible to test modules of a NAWI separately and issue them with individual Test Certificates (TC). These TCs can then be quoted in Type Approval Certificates (TACs), rather than examining and testing the entire NAWI. This method is known as the modular approach. TCs can be issued for modules such as indicators, load cells and point of sale devices, as well as for peripheral devices such as computers and printers.

For countries outside of the EU, the NAWI or module can be approved in accordance with the relevant OIML Recommendation (R60 for load cells and R76 for complete NAWIs and other modules). An OIML Certificate of Conformity and Test Report will be issued which may then be used to assist in the gaining of approvals in other countries.

Automatic Weighing Instruments (AWI)
Until harmonised standards have been developed, notified bodies will refer to normative documents (derived from OIML recommendations) and WELMEC guides. The OIML recommendations for the various types of AWI are listed in section 1.4.

The WELMEC guides that may apply include the following:

- 2.6 Guide for the testing of automatic catchweighing instruments
- 7.2 Software Guide (Measuring Instruments Directive 2004/22/EC)
- 8.1 Terms and definitions in MID and their relation to terms defined in other international metrologically relevant documents
- 8.16.1 Guide for Measuring Instruments Directive 2004/22/EC Automatic Catchweighers Corresponding Tables OIML R 51-1 – MID-006
- 8.16.2 Guide for Measuring Instruments Directive 2004/22/EC Automatic Gravimetric Filling Instruments Corresponding Tables OIML R 61-1 2004 – MID-006 III
- 8.16.3 Guide for Measuring Instruments Directive 2004/22/EC Discontinuous Totalisers Corresponding Tables OIML R 107-1 1997– MID-006 IV
- 8.16.4 Guide for Measuring Instruments Directive 2004/22/EC Continuous Totalisers Corresponding Tables OIML R 50-1 1997– MID-006 V
- 8.16.5 Guide for Measuring Instruments Directive 2004/22/EC Automatic Rail Weighbridges Corresponding Tables OIML R 106-1 1997– MID-006 VI

Type Approval typically involves testing and examination of the AWI to ensure that the instrument satisfies the essential requirements. Testing covers the environmental (temperature and humidity) and electrical (immunity to disturbances) performance of the instrument, as well as a range of other weighing performance checks, e.g. span stability. The examination stage is used to check the functionality of the instrument. Unlike NAWIs, there is normally a requirement for on-site testing of a complete instrument at the type approval stage. Due to the physical size or mode of operation it is normally not feasible to test the complete instrument in the laboratory.

In addition, part of the approval process requires the determination of the accuracy class of the instrument when weighing actual material or vehicles (as appropriate). Therefore, laboratory testing is usually undertaken on a simulator, with the on-site testing of a complete instrument then performed. N.B. this tends not to apply to catchweighers (e.g. weigh-price labellers) as the complete instrument can normally be tested in the laboratory.

1.4.2 VERIFICATION

Under the current legislation, verification by a Trading Standards Officer (TSO) from a Notified Body, or by a self-verifier are equally valid and the process is generally the same no matter who carries out the verification. In cases where the manufacturer can demonstrate to the satisfaction of his assessment body that he has controlled procedures and operations in his production process that negate the need for specific tests to be carried out on the completed instrument, then he need not carry out all the tests that a TSO would. The actual verification process will depend on the type of equipment being verified.

Non-automatic weighing instruments (NAWIs)
NAWIs come under The Non-automatic Weighing Instruments Regulations 2000. The weights used to test the equipment must meet several requirements of the regulations; these are found in regulation 8 of the 2000 regulations. With the advent of modular equipment, not only will you need a Type Approval Certificate (TAC) but also possibly the relevant Test Certificate (TC) for such things as a cash register, indicator or PC.

Regulation 8 requires that the accuracy class of the weights used for verification is related to the accuracy class of the instrument being verified. Most verification is carried out on Class III instruments, and the regulation permits weights meeting the tolerance requirements for OIML Class M1 weights to be used. However, where a Class III instrument has more than 5000 scale intervals, the regulations require that the tolerance on the weights used does not exceed half of that permitted for M1 weights. This reduced tolerance may mean that these weights should be calibrated more frequently than is normal for M1 weights. The recently revised OIML Recommendation on weights, R111, specifies tolerances for standard weights and test weights up to 1000kg.

The International Organisation of Legal Metrology OIML drafted a standard in 2006 (OIML recommendation R76) to cover specifications and testing of NAWIs, this became European Norm EN45501 that was later adopted in this country as British Standard BS EN 45501. The regulations in force today are derived from the above and linked directly to them..

Section 8.3 of EN 45501 / OIML R76 details the assessment required for initial verification (i.e. when the unit is put in to service). This refers to several of the sub-sections of the standard for the specific tests to be performed. The tests can be summarised as follows:

- Checking of a declaration of conformity.
- Visual inspection of basic metrological characteristics (e.g. Min, Max, e, d, etc), markings and suitability of use.
- Errors on loading and unloading; gross, net and tare weighing (sections 3.5.1, 3.5.3, 4.6.2, 4.7.3; appendices A4.4 – A.4.6)
- Accuracy of zero setting and tare setting (A.4.2.3 & A.4.6.2)
- Repeatability tests (section 3.6.1 and appendix A.4.10)
- Eccentric loading tests (section 3.6.2 and appendix A.4.7)
- Discrimination tests (section 3.8 and appendix A.4.8)

Other tests may be performed in special cases and if the instrument is to be used in a different location then any difference in gravity shall be considered, if appropriate.

Automatic weighing instruments
The regulations in force depend on the type of instrument to be verified and the verification procedures will be outlined in the associated OIML recommendation.

In general the verifier will have to:

- Ensure that the unit under test complies with the type approval certificate
- Check the markings on the instrument
- Test the unit with the product or equipment to be processed and from the test results determine the accuracy class
- Ensure that the errors are within the appropriate maximum permissible limits

In addition to test weights verification may require a separate control instrument for comparative static reference tests.

1.4.3 VERIFICATION BY A TRADING STANDARDS OFFICER

A local authority may be a notified body to be able to verify a weighing instrument. A Trading Standards Officer (TSO) will perform the actual verification testing as described in section 1.4.2 but the submitter will have to prepare for the verification and is responsible for ensuring that various matters are addressed.

A hard copy of the Type Approval Certificate (TAC) must be available on site plus any test certificates, if required. The TSO is entitled to ask to see a copy of the documentation prior to the test.

The equipment must be complete and working prior to the appointment time. It would be advisable to calibrate and/or check it as well, because if it fails the TSO will charge a fee and may well leave the site with another appointment to be made. The checks should include that the necessary inscriptions and any company seals are in place.

The submitter should ensure that the inspector is aware of any issues specific to the site, for example health and safety requirements such as a site induction.

The TSO will want to check the calibration status of the weights used to test the instrument, if hiring in a test unit for weighbridge verification then the submitter must ensure that a current calibration certificate is available.

A problem that is occurring more often now is that not all local Trading Standards Services are Notified Bodies under the NAWI regulations, or the regulations applying to the type of AWI, which means that their TSOs cannot verify this type of equipment. This is due to resource pressures within local government. If this occurs then it may be necessary to bring in an outside TSO to verify the equipment; check that their insurance is valid and they can verify the type of instrument.

The TSO will test the equipment and must fill in a test report form which shows the results of all tests applied to that instrument, which may be required in any future dispute. Upon passing they will then deliver a Certificate of Conformity to the submitter, or if the equipment fails, a notice of refusal to verify.

1.4.4 SELF-VERIFICATION

European Self-verification or UK Weights and Measures Act 1985 Self-verification?
The term "self-verification" has become the colloquial expression for the process whereby an organisation that is suitably accredited/authorised can carry out the conformity assessment and performance testing on weighing instruments that it has manufactured or, in certain circumstances, has repaired, installed or distributed. In contrast, "verification" is the term used when weighing equipment undergoes performance testing and conformity assessment carried out by a Notified Body such as a Trading Standards Department or an accredited third party organisation.

There are now three types of self verification:

- UK national self verification, which has its origins under the Weights and Measures Act 1985
- EC Declaration of Type Conformity which has its origins in the Non-Automatic Weighing Instruments Directive (NAWI) 2009/23/EC
- Declaration of Conformity to Type based on quality assurance of the production process, with its origin in the Measuring Instruments Directive (MID) 2004/22/EC

In practice, there is little difference between the last two, and the obligations that have to be met by the manufacturer are very similar. It should be noted, however, that there is a subtle difference in the way these requirements have been implemented in UK legislation. A manufacturer who is accredited as a "self-verifier" under the NAWI Directive is also allowed to carry out re-verification of the products that he can initially verify, because the NAWI concerned do not fall under the control of the Weights and Measures Act 1985 after they have been placed on the market and taken into service. However, the MID has been implemented in the UK on a different basis; Automatic Weighing Instruments (AWI) that are subject to the MID do become subject to the Weights and Measures Act 1985 once they have been placed on the market and taken into service, therefore re-verification can be carried out either by a Notified Body or by a manufacturer, repairer, installer or distributor that is accredited under the UK national self-verification system. A table showing who can verify is given at the end of this document.

European Self-verification (EC Declaration of Type Conformity under NAWI Directive 2009/23/EC)
Non Automatic Weighing Instruments (NAWI's), (weighing instruments that require the action of gravity to determine the mass and require the intervention of an operator during weighing), which are first placed on the EU market and put into use in EU member states must comply with the NAWI Directive.

NAWI's used for controlled applications must have gone through EC type-examination and been given an EC Type Approval Certificate. They must be manufactured in conformity with the EC Type Approval Certificate and must be labelled and CE marked in accordance with the NAWI Directive and other applicable directives.

These NAWI's must be subject to initial conformity assessment (verification) procedures whereby either:

- a NAWI notified body examines and tests the instrument and applies the conformity assessment mark (i.e. TSO Verification) or
- a manufacturer who has in place a quality system which has been approved by a NAWI notified body as complying with the Directive gives his own EC Declaration of Type Conformity and applies the conformity assessment mark (i.e. self-verification)

Getting Quality System approval to make EC Declarations of Type Conformity
An organisation, in the EU or outside it, who is the "manufacturer" of NAWI's can apply in writing to a European Commission Notified Body that has NAWI Directive Annex II(2) approval to assess their quality management system, as complying with the Annex II paragraph 2.3 of the Directive. In the UK, these notified bodies include:

BSI Management Systems
SGS UK Ltd
NMO

The "manufacturer" must undertake to carry out the obligations arising from the approved quality system and to maintain the approved quality system to ensure its continuing suitability and effectiveness. They must make available all relevant information including the documentation of the quality system presented in a systematic and orderly manner in the form of written rules, procedures and instructions with a view to ensuring a proper understanding of the quality programmes, plans, manuals and records and the "design documentation" of the instruments.

The Notified Body will evaluate the quality system to determine whether it satisfies the requirements referred to in paragraph 2.3.2 of Annex II to the NAWI Directive. If it does, the Notified Body will grant to the "manufacturer" an approval of the quality system; which then permits the "manufacturer" to make EC Declarations of Type Conformity.

Making EC Declarations of Type Conformity
Providing the "manufacturer" adequately implements the approved quality system; carries out all the examinations and tests consistent with his obligations in the quality system and is satisfied that the instruments conform with the Type Approval Certificate and meet the requirements of the NAWI Directive, he can apply the CE marking including the green M and the identification number of the notified body that approved the quality system. If the manufacturer has appointed authorised representatives within an EU Member State then they may also carry out these functions, provided that they are operating under the manufacturers control and approved quality system. The manufacturer or his authorised representative shall draw up a written declaration of conformity detailing compliance with the NAWI Directive and any other applicable directives.

Note: the Directive uses terminology that is sometimes confusing and this is a good example:

"EC Declaration of Type Conformity" is the process whereby the approved manufacturer carries out the activities defined in his quality system, and applies the CE mark, the green M and the Notified Body number

"Declaration of Conformity" is the document that identifies the model type and declares that it complies with all the relevant identified directives.

Keeping the approval to make EC Declarations of Type Conformity
Notified Bodies that have approved the quality systems carry out what is known as EC surveillance. They periodically carry out audits in order to ensure that the manufacturer is maintaining and applying the quality system and provide the manufacturer with an audit report. They carry out visits at the places of manufacture, inspection, testing and storage. They can carry out full or partial audits, announced or unannounced. The "manufacturer" is required, in respect of each instrument, to keep available for inspection the documentation of the quality system; the design documentation of the instrument; and all related quality records. The manufacturer is also required to inform the notified body of any changes in his quality system.

Self-verifying repaired NAWI Directive Instruments
Once a NAWI Directive weighing instrument has had its first conformity assessment, i.e. EC Declaration of Type Conformity or EC Verification (see section 1.4.2) and has been put into use, it ceases to come under the full first-placed-on-the-market arrangements detailed above. If it has undergone any repair or maintenance process which has affected its

metrological integrity or accuracy it should be submitted for re-qualification. Manufacturers who have an approved quality system can also re-qualify any instruments included in the scope of their approval that have been rejected by an authorised officer and repaired, or that underwent significant repair such that they should be re-qualified before being placed back into use.

They follow the same basic process for examination and conformity assessment but finish the process by applying a re-qualification crown and alongside it the notified body number of the notified body that approved their system. Additionally they are not required to issue a declaration of conformity.

Definition of a manufacturer

Unfortunately, the scope of the legislation for EC self-verification is significantly different to that for UK national self-verification as the EC system is limited to only manufacturers, whereas the UK system included installers and repairers (and therefore the distinction is less of an issue). It will be up to the notified body that assesses the company for self-verification to determine whether it qualifies as a manufacturer for a range of instruments and hence be eligible for approval.

When a company has the design, component production and instrument assembly all completely under their direct control then it is more than likely that they will be considered a manufacturer. However, the situation has become blurred from both sides in that traditional manufacturer's contract out many services and, especially with the modular approach, an organisation may well be able to assemble an instrument from components without actually being the manufacturer.

To satisfy an assessor that they qualify as a manufacturer, the company will have to show that they have exercised control over the design of the instrument, even if they have assembled an indicator sourced from another manufacturer holding the TAC to a platform with load cells from another manufacturer holding test certificates. In any case, they will have to show that they have the full support of the component manufacturers in attaining approval for self-verification so that they can demonstrate that they will be able to keep the necessary information up to date. Other actions that will support qualification as a manufacturer include:

- labelling the instrument under the companies own name or own brand
- holding the type approval certificate or test certificate (either as the manufacturer or as a parallel approval)
- making the full CE declaration of conformity and hence taking full legal responsibility for compliance with all applicable EC directives

European Self-Verification (Declaration of conformity to type based on quality assurance of the production process under MID 2004/22/EC)

Automatic Weighing Instruments that are used for applications that come under the heading "Use for Trade", as defined in Section 7 of the Weights and Measures Act 1985, must either be type approved under Section 12 of that Act and be stamped either by a Weights and Measures Inspector or an authorised self-verifier under Section 11 of the Act; or be manufactured under a European Type Approval granted under the MID and then be initially verified either by a Notified Body or an accredited manufacturer.

The process and requirements for a manufacturer to become accredited under the MID are essentially the same as those under the NAWI Directive. The same rules relating to documentation of the Quality System, record keeping, auditing, training and so on apply. The accreditation to be a self-verifier under this Directive however does not extend to the re-verification of instruments that have been repaired following either rejection by a Trading Standards Officer or failure such that a repair was necessary that could have impacted on the metrological performance of the instrument. (See the Table "Who can verify?")

Who can verify?

	INITIAL VERIFICATION				REVERIFICATION			
	TSO	Notified Body	Manufacturer	Repairer, Installer or adjuster	TSO	Notified Body	Manufacturer	Repairer Installer or adjuster
Any Weighing Instrument Type Approved under Sec 12 of the Weights and Measures Act 1985	Yes	No, unless the Notified Body is also a Trading Standards Department in which case they act as a TSD and not as a Notified Body	Yes if he is an "authorised verifier" under Section 11A of the Weights and Measures Act 1985	Yes if he is an "authorised verifier" under Section 11A of the Weights and Measures Act 1985	Yes	No, unless the Notified Body is also a Trading Standards Department in which case they act as a TSD and not as a Notified Body	Yes if he is an "authorised verifier" under Section 11 of the Weights and Measures Act 1985	Yes if he is an "authorised verifier" under Section 11 of the Weights and Measures Act 1985
Non-automatic weighing instrument Type Approved under the NAWI Directive	No	Yes	Yes, if accredited for that purpose by a Notified Body	No	No	Yes	Yes, if accredited for initial verification by a Notified Body	No
Automatic Weighing Instrument Type Approved under the Measuring Instruments Directive	No	Yes	Yes, if accredited for that purpose by a Notified Body	No	Yes	No, unless accredited as an "authorised verifier" under Sec 11 of the Weights and Measures Act 1985	No, unless he has an accreditation as an "authorised verifier" under Sec 11 of the Weights and Measures Act 1985	No, unless he has an accreditation as an "authorised verifier" under Sec 11 of the Weights and Measures Act 1985

1.5.1 AVERAGE WEIGHT REGULATIONS

General
Packaged goods may be produced by weight or by volume as appropriate, these notes only consider quantity checking by weight. With the proper conversions, goods packed by volume may be checked by weight but the conversion factors used are the responsibility of the packer.

The Weights and Measures (Packaged Goods) Regulations 2006 came into force on 6th April 2006. The previous legislation, contained in Part V of the Weights and Measures Act 1985 and The Weights and Measures (Packaged Goods) Regulations 1986, was repealed by these new Regulations. The 2006 regulations apply to all packages made up in quantities of 5g to 25kg, where the packer intended all the packages to be of the same nominal quantity, whereas the old regulations specified Prescribed Goods which were subject to the regulations, whilst other goods not in the prescribed list could be packed to the average system on a voluntary basis. The new regulations therefore have a much wider scope than the previous legislation.

Types of checkweigher
The type of checkweigher used following a packing operation may be automatic or manual.

Automatic checkweighers are capable of checking every package at high speed and they have the advantage that they can be integrated into the filling operation to provide feedback of the accuracy of the fill, this will allow for any drift in the dispensing operation. Any packages which are outside the tolerances can be automatically rejected to ensure that no under tolerance packs enter the supply chain. These checkweighers will usually have an integrated statistical package so that production records can be automatically produced to demonstrate compliance with the legislation.

Manual checkweighers are used where samples of the production process are checked using a non-automatic instrument. Data collection systems, either stand-alone or integrated, can be used with manual checkweighers to simplify the task of analysing the data.

The law for packers
The Weights and Measures (Packaged Goods) Regulations 2006 (SI 2006 No 659) contains the requirements that packers have to meet. The regulations cover the making up and marking of packages. Previous regulations defined the type of weighing equipment that could be used for making up and checking packages, this has now been replaced with a simplified requirement that packers use equipment which is suitable for the purpose. An additional change is to remove the distinction that previously existed between equipment used for making up packages and that is used for checking them. Under the old legislation, packers had to use prescribed and verified equipment for making up packages but could use unverified equipment for checking; now any equipment used for making up or checking packages must comply with all relevant weights and measures legislation, including European Directives such as the Non-automatic Weighing Instruments Directive and the Measuring Instruments Directive. However, packers who were legitimately using unverified equipment for checking packages before these regulations were introduced can continue to use that equipment without the need to have it verified.

Guidance

A document entitled "Code of Practical Guidance for packers and importers No1" was produced to provide guidance on the previous regulations to packers and importers. Certain parts of the Code were given statutory effect by means of references in the regulations, this has not been reproduced in the 2006 regulations and many parts of the Code are now irrelevant. However, the Code still contains reference material, particularly in the Appendices that may be helpful in understanding of average quantity control in general. The Guidance provided on the 1986 regulations is, however, no longer relevant. BIS have published Guidance Notes to the 2006 regulations which can be downloaded from the BIS website.

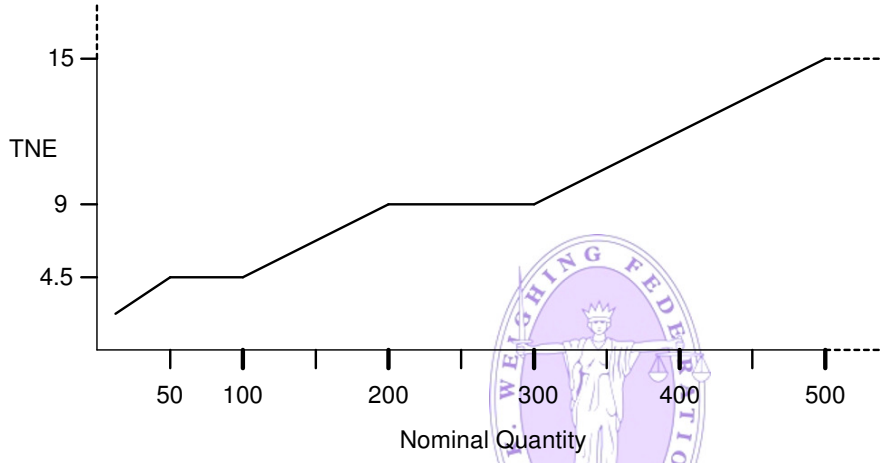
When a packer is using an automatic checkweigher the necessary records are usually part of the operation of the system. When using a non-automatic weighing instrument, the packer will need to have a documented sampling scheme and must maintain records of the samples. The guidance document makes recommendations about the sampling plans which can be used when samples are taken from production and also shows how the data can be analysed.

It is the duty of the packer to ensure that the equipment used for making up and checking packages remains accurate at all times.

It is accepted that for any given filling process there will always be some deviation of the pack to pack fill value. The legislation sets limits on these small deviations to ensure that they are within acceptable limits. An important concept is the 'Tolerable Negative Error' or TNE, which is calculated from the nominal quantity being packed; see table below from schedule 3 of the 2006 Regulations.

Nominal quantity in grams or millilitres	Tolerable Negative Error (TNE)	
	As a percentage of nominal quantity	g or ml
5 to 50	9	-
from 50 to 100	-	4.5
from 100 to 200	4.5	-
from 200 to 300	-	9
from 300 to 500	3	-
from 500 to 1,000	-	15
from 1,000 to 10,000	1.5	-
from 10,000 to 15,000	-	150
above 15,000	1	-

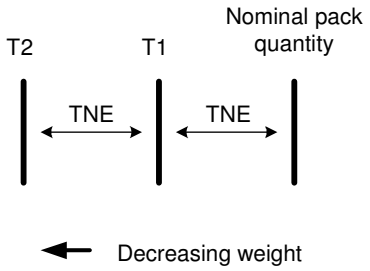
It can be seen from the table that as the nominal quantity increases, the banding of the TNE alternates between a fixed value and a percentage of the nominal weight. The graph below shows the effect of the banding over the 5g to 500g range.



When calculating the values for the percentage bands, the TNE should be rounded up to the nearest 0.1g

Given a nominal quantity and a TNE the tolerance limit, 'T1' and the absolute tolerance limit, 'T2' can be calculated.

Any package whose contents are less that the nominal quantity minus the TNE is referred to as a 'non-standard package'.

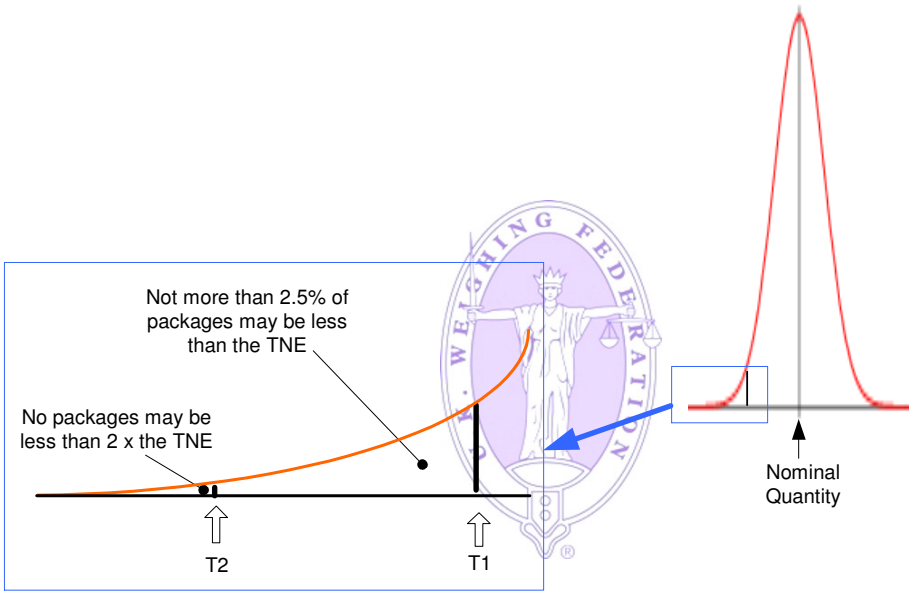


The three packers' rules (taken from regulation 4 of the 2006 regulations) are:

(1) the contents of the packages shall not be less on average than the nominal quantity;
(2) the proportion of packages having a negative error greater than the tolerable negative error shall be sufficiently small for batches of packages to satisfy the requirements specified in Schedule 2 [of the Regulations];
(3) no package shall have a negative error greater than twice the tolerable negative error.

Note that previous regulations have given an explicit limit of 2.5% in rule 2 for the proportion of packages below T1, whereas the 2006 regulations give varying limits depending on the method of sampling and the sample size. However, in all cases in schedule 2, the acceptable limits equate to a value greater than 2.5%.

A graphical illustration of the T1 and T2 tolerance levels is given below. This shows the classic normal distribution of package weights from a filling system.



Equipment

Equipment used for making up packages, or for checking them after making up, must be suitable for the purpose and must comply with other relevant metrology legislation.

The 2006 regulations differ from the previous legislation in that there is no detailed description in the type of equipment that is permitted to be used. The determination of whether a particular piece of equipment is suitable will depend on the circumstances of the case and the nominal quantity of the product being packed. The size and capacity of the equipment must bear a sensible relationship in respect of the scale interval to the quantity being packed. The NMO guidance notes state that equipment that enables the quantity to be determined to 0.2 TNE will be appropriate. Less sensitive equipment can be used but greater allowance should then be given compensate for errors so leading to higher "give away" by the packer to compensate for those possible errors.

Using the recommended minimum scale division of 0.2 TNE, the following table can be derived:

Min scale division	Min TNE	Pack size
0.1g	0.5g	> 5.5g
0.2g	1g	> 11g
0.5g	2.5g	> 28g
1g	5g	> 112g
2g	10g	> 334g
5g	25g	> 1667g
10g	50g	> 3334g
20g	100g	> 6667g

Glossary

Nominal quantity, Q_n	The quantity marked on the container.
Negative error	The amount by which the actual contents fall short of the nominal.
Tolerable negative error, TNE	The negative error in relation to a particular nominal quantity, as defined by the regulations.
Tolerance limit, T_1	The nominal quantity minus the tolerable negative error, i.e. $T_1 = Q_n$ - TNE
Absolute tolerance limit, T_2	The nominal quantity minus twice the tolerable negative error, i.e. $T_2 = Q_n - 2*TNE$
Non-standard package	A package whose contents are less than the tolerance limit, T_1
Inadequate package	A package whose contents are less than the absolute tolerance limit, T_2
Target quantity, Q_t	The average contents which an operation is intending to produce.
Tolerance Under T_u	Packers in-house limit for under fill
Tolerance Over T_o	Packers in-house limit for overfill
Minimum target quantity Q_t (min)	The lowest level a packer can aim the average contents if he is to ensure compliance
Range	Difference between min. and max. in process unit.
Standard deviation	Describes the scattering of the individuals of the sample or long term.
Drift	Describes the scattering of the individuals of the sample or long term like standard deviation. Dimension is %. So this is a product independent value about the process-machine capability.
Batch	Number of packages of the same type forming a homogeneous collection for QC purposes.
Group	A number of packages of the same type and production run, forming the subject of the test.
Dimension	The used process unit (i.e. g, ml or kg, l).

References

The Code of Practical Guidance for Packers & Importers
The Weights and Measures (Packaged Goods) Regulations 2006
The Weights and Measures (Packaged Goods) Regulations 2006 – Guidance Note dated 6th April 2006, reference no URN 06/1087 – available from NMO

1.5.2 USE OF AUTOMATIC CHECKWEIGHERS

Whichever method of quality control is employed, it is essential that records are kept of all sampling checks and, in the case of checkweighers, that the average weight of all production batches is recorded. These records must be saved for at least one year or possibly longer depending upon the shelf life of the product. In addition, recording adjustment changes to filling machines will be included in the records, this has been mandatory since April 2006.

Automatic Checkweighers

Checkweighers have evolved over time from the simple grading checkweighers, which simply accepted or rejected packs on the basis of a single set point, to average recording checkweighers which calculate and display statistical information about the production process.

Grading checkweighers may still be used for packages that have a minimum weight requirement. They may also be used to remove inadequate packs on a product line complying with average weights, but control by sampling will still be required to ensure that the average weight is maintained, and that non-standard packs are properly controlled. Counting checkweighers introduced in the late 70s may still be used to ensure compliance with average weight requirements, providing that product assessment is carried out to establish a suitable target weight.

The majority of automatic checkweighers produced today are average recording checkweighers. These machines inspect every pack and remove non-standard and inadequate product, calculate and record the average weight for a given batch size, and operate a suitable alarm if the average weight falls below the nominal net weight. Many checkweighers can be set to always enable the packer to maintain the 3 Packers rules. With optional features such as automatic mean weight correction they can prevent a defective batch by controlling the average weight.

The same Average Recording Checkweighers may also be configured to inspect packages to minimum weight requirements.

Certification or pattern approval

In the UK, automatic checkweighers do not have to be certified or approved. Due to the requirements of the 1979 Weights & Measures Act the onus is on the packer to ensure that the machine in use is suitable for the application. Therefore, the packer must assess the performance of the machine by off line sampling, and then decide if an allowance is necessary due to the error of measurement.

Since October 2006, checkweighers fall under the control of the MID (Measuring Instruments Directive). The regulations implementation in the UK uses the optionality of the European Directive to keep Checkweighers as non-prescribed devices and therefore, there is no change from the former legislation above. Checkweighers for use in the UK market do not need to be approved. In doing this, the UK are taking advantage of the optionality of the Directive, which enables member States to choose whether to regulate instruments and to prescribe specific measurement tasks for which they must be used. This means that, as is currently the case, different member States may regulate different instruments and for different purposes than is the case in the UK.

A manufacturer wishing to export an instrument not prescribed in the UK to a member state, where such instruments are prescribed, would need to have the instrument assessed for Conformity.

Since the accuracy of an automatic checkweigher is highly dependent upon the package and the environmental conditions, the packer must assess the performance for all package types and sizes. If the error calculated for a given package is greater than 1/4 TNE (Tolerable Negative Error) for that nominal net pack weight, then the packer must increase the T1 & T2 set points by an amount equal to 1/2 the error minus 1/8 of the TNE. If the variation in packaging weight (the tare weight) is excessive then a further allowance will be required. Where the standard deviation of the

tare weight exceeds 1/10 TNE then the packer must add an allowance of 0.85 times the standard deviation of the tare weight.

Having established the accuracy of the checkweigher after installation, the packer must perform frequent checks on the machine to ensure that performance is maintained. The Code of Practical Guidance suggests that tests are initially carried out every hour or every 10,000 packs, until the performance and stability of the checkweigher has been established. The checks may then be relaxed to once per shift or once per day. If re-calibration is found to be necessary, then the frequency of testing must be increased once again until the problem is cleared and the machine performance stabilizes.

Many packers prefer to carry out checks every hour, so that if a problem occurs it can be rectified quickly. Many checkweighers have a check mode, a simple but effective check may be performed by passing a normal production pack over the machine 20 times. The checkweigher will then display the mean weight and give an indication of variance or deviation. By also weighing this test pack on standard bench scales, the mean error is calculated by finding the difference between the actual weight and the checkweigher average weight reading. The calibration process is designed to minimize mean error, so if this is excessive simply re-calibrate.

With the use of proven software connected to checkweighers, the accuracy of the checkweigher can be monitored and functions such as drift from nominal and standard deviation can be seen in real time and therefore allowing the checkweigher monitoring to be simplified.

The variation from one reading to another gives an indication of the random error. This is often expressed as 1, 4 or 6 times the sample standard deviation (although officially the zone of indecision is based upon 6 times the sample standard deviation). The random error is influenced by checkweigher repeatability; the stability, size & shape of the package and any disturbances such as vibration and air currents. Therefore, the random error cannot be improved by re-calibrating the machine. If the random error is higher than normal, check for sources of vibration (both internal to the checkweigher and externally generated), and check the condition of the transport components.

The reject mechanism should also be checked by passing an out of tolerance pack at regular intervals.

Summary

After installing a checkweigher, introducing a new package size to an existing line, or major service or repair to a machine, carry out checks to establish the mean & random error and record these values.

Check whether the zone of indecision (equal to 6 times the standard deviation) exceeds 1/4 TNE (make allowances to T1 & T2 set points if necessary).

During production, check the performance of the checkweigher & the reject device on an hourly basis. Compare results to limits established during initial assessment.

Document test procedures to ensure that all staff checks the equipment at the same frequency, in a consistent manner.

Record the results of all tests and the time, date and person who carried them out.

For average weight operation, ensure that the checkweigher produces a production batch report every hour or every 10,000 packs.

Save batch reports (or summary data from batch reports) for 12 months.

Discuss your methods & procedures with the local Trading Standards Officer.

1.6.1 STATIC VEHICLE WEIGHING

Weighbridges are the work horses of modern weighing, providing valuable weight data from a diverse range of vehicle activities and having a major impact on overall efficiency, safety and profitability. The increased use of modern instrumentation, user-friendly software and communication technology is rapidly increasing the scope of weighbridges, thereby expanding their operational and data collection capabilities.

Certification
Weighbridges are classed as non-automatic weighing instruments (NAWIs) and if the weight data is used as part of any commercial or legislative transaction* they require approval to European weights and measures standards in accordance with directive 2009/23/EC. This Directive is implemented in the UK through the Non-automatic Weighing Instruments Regulations 2000 (SI 2000 No. 3236). Some users insist their weighbridges are weights and measures approved, even if they are not used for commercial transactions. This ensures that the weighbridges are maintained and certified for optimum precision.

**This includes checking vehicles for overloading. Weighbridges are also widely used at ports and terminals to ensure ships and ferries are correctly loaded.*

Statistics show that the average value of transactions conducted over weighbridges typically ranges from £200 for general waste and aggregate, up to £20,000 for chemicals and metals. Errors in weighbridge equipment can therefore have important financial implications for businesses. For example, based on 50 weighings per day, an error of just one 20 kg weight increment per transaction can cost between £10 and £300 per day.

Most weighbridges in the UK are approved to either 1 part in 2,500 (e.g. 50,000 kg with a minimum verification interval of 20 kg) or 1 part in 3,000 (60,000 kg with minimum verification interval of 20 kg). Higher resolution weighbridges are produced (e.g. 20,000 kg x 5 kg or 60,000 kg x 10 kg) but these are usually limited to indoor use because of the adverse affects of influence factors such as wind. For outdoor NAWIs, the OIML (R76) give a strong recommendation that *'a value of n = 3 000 should not be exceeded' with further recommendations that for 'road or rail weighbridges the verification scale interval should not be less than 10 kg'.*

This limit should also apply to each weighing range of combinations of instruments or of multiple range instruments or to each partial weighing range of multi-interval instruments.

Multi-range instruments are useful where weighbridges are used to weigh a range of vehicle types from cars or small vans up to trucks. A typical example would be where a 60,000 kg weighbridge provides a minimum verification interval of 10 kg for the first 30,000 kg after which the instrument automatically switches to an interval of 20 kg for the remainder of the range. This allows both smaller and larger vehicles to be weighed with the same proportional accuracy.

Once a weighbridge has been installed and verified, there is no legal requirement for the weighbridge to be reverified unless any repairs involve critical components such as load cells or weigh indicators. However, weighbridges are subject to inspection by Local Trading Standards Officers. These inspections involve full weight testing for linearity, hysteresis and eccentric loading. Checks are also made to ensure the weighbridge has not been replaced and that critical parts of the measuring chain are still 'as they were' at the last inspection. The frequency of the inspections is determined from a risk analysis study, which takes into account how and where a particular weighbridge is operated. Typically inspections will take place every two to three years. Those installations designated as public weighbridges are inspected more frequently - usually at 6-8 month intervals. (Public weighbridges are those where the owner makes the weighbridge available for use by the general public and other businesses, usually on payment of a fee. In these circumstances, the weighbridge operator needs a certificate of competence which is issued by the

local Trading Standards Office following an examination and test of the operators' competence. There are also specific requirements about record keeping.)

Calibration
Refer to section 3.3 of the Technical Articles.

Choice
Weighbridges come in a wide range of sizes and designs, manufactured from steel, steel-concrete composite and pre-stressed concrete. Designs include pit mounted, surface mounted, modular and portable. Typical capacities range from 30 to 100 tonnes, in lengths of 9, 15 and 18 metres. Widths typically vary from 3 to 4.5 metres. The common factor for all these variants is that they need to be robust, accurate and reliable. The majority of weighbridges are verified for trade use. Whether this is to check the weight of goods purchased or despatched, for onsite check for overloading or law enforcement. The choice for a particular application will depend on factors including maximum vehicle sizes and weights, available space, usage and, of course, budget. Most weighbridges are operated in a drive-through manner. In other words, the vehicles drive on at one end and off at the other. However, in applications where space is at a premium, vehicles may go on and off from the same end. For plants where vehicles are weighed in and out, the obvious choice is to operate two separate weighbridges. Not only does this streamline traffic flow, but it also gives the opportunity to service one bridge whilst keeping the other operational. However, this is clearly a more expensive option and in many applications one weighbridge is sufficient.

Load cells
Most mechanical weighbridges have now given way to fully electronic versions where the weighbridge deck or deck sections are supported on a number of strain gauge load cells, connected to weight instrumentation. Load cell types include traditional analogue and digital versions of column cells, double ended shear beams and cantilever beams. Digital load cells are growing in popularity, offering a number of installation and operational advantages. Load cell capacities must be selected so that they can support not just the deck and maximum weighing capacity, but also cope with overloaded vehicles, shock loads and excess loads when vehicles come onto or leave the weighbridge (including braking and acceleration forces). Load cell approvals (R60) specify a minimum verification interval v_{min} for particular models. The value of v_{min} divided by the square root of the number of load cells in the weighbridge, must be less than the minimum scale interval 'd'.
The mounting of load cells is crucial to ensure correct load introduction under all operating conditions and to prevent damage to the cells.

Weighbridge Types
Pit mounted weighbridges have weigh decks that are flush with the ground. As a result, they pose no restrictions to vehicle movement on site. Mechanical weighbridges were installed in pits so when these are upgraded or replaced, the new pit mounted weighbridges provide a very cost effective answer.

Surface weighbridges offer one of the strongest designs and the side frames ensure vehicles always drive centrally through the bridge. Approach and departure ramps can either be of steel construction or pre-cast in concrete on-site. Removable steel ramps have the advantage of being able to be moved with the bridge if relocation is required, leaving the site level.

Portable weighbridges have special load cell assemblies and feet, allowing temporary installation with minimum foundation preparation. Steel ramps provide vehicle access. Careful consideration must be given to the integrity and flatness of the mounting surface.
Concrete weighbridges can offer advantages for certain applications, for instance where corrosive liquids may be present or to avoid problems from spillages of oil based substances. Pour-on-site composite versions provide a cost effective solution for medium use operations. These consist of a steel outer frame, inner strengthening beams and reinforcing mesh. Once the unit is assembled on site, the ready mixed concrete is poured in and when the deck has cured, the load cells are fitted. Alternatively, the complete weighbridge can be constructed at the factory and delivered to site.

Weighbridges with modular or multiple decks are growing in popularity, especially as steel prices continue to increase. Although they incorporate more load cells than single piece bridges, this cost is more than offset by the reduction in steel costs. Furthermore, because the modules are constructed in lighter steel they are easier to handle, transport and install.

Environmental Considerations

Weighbridges are expected to operate in the harshest of environments, fully open to the elements. Therefore, a well structured finishing procedure is essential to provide optimum longevity. In a typical coating process, all steel is shot-blasted to remove mill scale and surface imperfections prior to painting. This ensures maximum adhesion of the surface coating applications. In parallel, sound design principles ensure a well drained deck and no hidden traps underneath where corrosion can occur. For maximum protection, the underside of the weighbridges should be coated in a proprietary self-sealing water repellent coating. Hot dip galvanised steel work offers the best protection for applications in particularly harsh environments.

Load cells should be weld sealed with glass to metal cable entry to provide sealing to IP67 minimum. Cables should be protected against abrasion, heat and rodent damage.

Lightning can cause serious damage to weighbridge components, with the deck acting as an ideal receptor for the huge voltages generated during electric storms. Damage can be limited by using load cells with built-in lightning protection and implementing a good earthing regime in and around the weighbridge.

If weighbridges are installed in designated hazardous areas they must meet ATEX requirements. Refer to section 1.8 on hazardous environment applications.

Construction

Weighbridge decks should be constructed to ensure minimum deflection under all loading conditions. Excessive deflection can affect weighing accuracy and introduce premature fatigue failure.

The foundations of any weighbridge are crucial to their performance. It is of little use having the most accurate load cells and well designed weighbridge structure if the foundations are unlevel or unstable. For pit weighbridges, adequate drainage is also important to prevent flooding. Where applicable, it is possible to install weighbridges on sloping terrain using special steel wedges in the load cell mounting assemblies, or adapted mounting kit assemblies for certain types of load cells.

Significant end to end forces can be generated when vehicles drive on and off the weighbridge, especially if heavy braking occurs. Such forces can damage critical components such as load cells and can also cause serious damage to the surrounding structure. Built-in restraints restricting end-to-end and side-to-side movement are therefore an important part of any weighbridge design.

Instrumentation

In the simplest standalone layout, the weighbridge is typically linked to a basic weight indicator. This will allow rudimentary weighing processes to be carried out and allow operators to initiate zero, tare and print functions (if a suitable ticket or tally roll printer is connected).

For more complex applications the weight indicator may have pre-programmed function keys, memory recall and a key pad for data entry. Interface cards may offer further integration with modern communication protocols including Ethernet. The indicator may provide the capability to operate with more than one weighbridge.

In legal for trade approved installations, regulations relating to the compatibility of modules must be complied with. (See section 3.1)

Modern technology
Traditionally the weighing process in many weighbridge applications has been relatively slow and data collection has been confined to local printouts of tickets and daily tally rolls. Now more emphasis is being placed on developing key peripheral areas. This is aimed at speeding up throughput of vehicles, improving security and extending weighbridge operational periods, together with improving and simplifying data collection and distribution. Technologies employed include Ethernet communication for remote access, automatic vehicle recognition systems, smart card or key readers, wireless interfacing, the world wide web and GSM. Bespoke, yet configurable, software packages can now be tailored for specific applications and are designed for the seamless integration with existing management systems such as ERP.

Driver operated systems
Driver operated systems (often referred to as unmanned weighbridge systems) have been one of the most effective developments for weighbridge operational efficiency. Such systems offer a number of advantages and remove the need to have permanently manned weighbridges. Operation is usually via a designated swipe card or key and the unit provides a complete material handling management system which is easy to use by both vehicle and site operators. Not only does the system speed up weighing operations, but it also extends the available working period for weighbridges. Terminals are located alongside the weighbridge for easy driver access. Operational conditions will dictate if there are terminals at both ends of the weighbridge. Where applicable, the terminal may have two identical displays at different levels to accommodate different vehicles. The terminals must be given suitable (and substantial) mechanical protection to avoid physical damage from the vehicles driving across the weighbridge.

There are essentially two modi operandi, colloquially known as double weighing and single weighing.

Double weighing is carried out on vehicles not registered in the database for a particular site. In this case, the driver stops the vehicle on the weighbridge and either swipes the card or presents the key to the terminal. The terminal then stores the weight and issues a ticket with the inbound weight data. After loading or unloading has taken place, the driver returns to the weighbridge and, having presented the card or key again, receives a ticket automatically calculating the weight of material delivered or collected.

In the single weighing mode, when a card or key for a known vehicle is presented, the terminal retrieves previously stored data relating to that vehicle's registration number and tare weight. Using this information, the terminal then issues a ticket showing the calculated net weight of material being delivered or collected, thereby removing the need for a second weighing.

Data from such systems can be distributed as required within the site or to a central location off site via land line, mobile phone or email to designated recipients. Rapid and effective data collection allows rapid invoicing without the problems associated with manual transcription to spread sheets.

Vehicle recognition
Vehicle recognition systems are effective in increasing vehicle throughput at weighbridges whilst introducing an effective security system. They are particularly effective at remote sites and at those where 'out-of-hours' weighing is required, where they are used in conjunction with driver-operated terminals. Recognition technologies employed include automatic number plate recognition systems using cameras and those which rely on the vehicles being fitted with transponders containing key vehicle details.

For automatic or remote weighing in a typical system, the weighbridges usually have entry and exit barriers. Vehicles approaching the entrance are picked up by the camera and the number plate is checked against the database. If the vehicle is registered it is allowed through the first barrier onto the bridge to be weighed. At this point the driver presents his card or key at the control terminal positioned outside the window and this initiates the weighing.

Simple 'command prompts' guide the driver through the weighing process and as soon as the weighing has been successfully carried out, the vehicle is allowed off the weighbridge. Such systems can also maintain a current and historical record of vehicles on site, allowing a comprehensive vehicle movement log to be maintained at both single and multiple sites.

Service and support

Service and support is a critical issue for weighbridge operators especially for equipment working in harsh environments. New developments are bringing important changes to the way in which servicing can be optimised and this is particularly useful at remote unmanned sites. Any weighbridge breakdowns have a rapid and major impact on daily operations and therefore, effective servicing and trouble shooting is very important. However, traditional methods of servicing do not necessarily cater for the changes in the working pattern of a particular weighbridge. Typically, estimates are made to establish the frequency of servicing, often with the emphasis on minimising costs.

Most of us are familiar with the built-in service monitors on modern cars, which assess servicing requirements based on a combination of factors including time, mileage and how the car is driven. This technology is now available for weighbridges advising, for instance, when the next service is due based on time, number of weighments or a combination of both. The system can also record a history of peak loads, which may be above normal operating capacity and detrimental to the working of the bridge. This information can be useful in determining why, for instance, a particular weighbridge is going out of calibration or suffering from excessive component failure.

Although regular servicing and maintenance can help to minimize problems, predicting what and when things will go wrong is very difficult with traditional analogue weighbridges. Digital load cell technology offers remote maintenance service support capability, which can save considerable time and effort especially for equipment operating in harsh, remote areas.

With such a system installed, any problems with the weighing equipment are automatically flagged up at the supplier's offices. Details are immediately forwarded to the local engineer who can then dial into the weighing system remotely and make a risk assessment of the situation. In many cases, the engineer can carry out a range of checks and, where possible, rectify the problem without having to visit the site. If not, then if appropriate, plans can be made to carry out any remedial work during the next scheduled visit, thereby minimising the disruption to the site operation.

Conclusion

Modern weighbridge systems can offer considerably more than weight information and their integration with other technologies is bringing dramatic changes to a wide range of industries. However, the quality of the data they provide is still totally dependent on sound mechanical design principles and well defined installation procedures.

1.6.2. IN-MOTION VEHICLE WEIGHING

The weighing of vehicles on an axle-by-axle basis is vital to ensure correct weight distribution, as well as compliance with the maximum gross vehicle weight limits permitted in the UK.

Each overloaded axle is considered by the enforcement authorities as a separate offence in law, as is the gross weight and operators, and drivers of commercial vehicles therefore have an obligation to ensure that the maximum allowed axle weights for their vehicle are not exceeded. Operators may be liable for significant fines for overloading, and persistent overloaders may also have their operating licence curtailed or suspended at the discretion of the traffic commissioners. Vehicle prohibition is also being routinely used to prevent overloaded vehicles from moving until the load is redistributed or removed.

This is particularly costly for companies working to 'just in time' delivery schedules, as contracts may be cancelled as a result of this significant delay.

Conventional platform weighbridges, particularly surface mounted systems, are obviously perfect for producing accurate gross weights, but are frequently unsuitable for obtaining axle weight information and so other technologies have to be considered.

Axle weighing systems are available in both static and in-motion versions the latter being particularly suited to weighing long multi-axle combinations where correct positioning of an individual axle for static weighing may be difficult and time-consuming.

With in-motion systems, vehicles can be driven over the weighing platform at speeds normally restricted to 5 kph and a display and print out of each axle weight and the accumulated gross weight is readily available. On the latest systems, the legally permitted weights for each vehicle type are stored in memory and an instant overload warning is produced when appropriate.

These systems were first available in the early 1960's and quickly found a niche as front line law enforcement tools with over 70 systems being installed at strategic locations around the country by the then Department of Transport.

The systems were designed strictly for Law Enforcement and Non-Trade weighing applications and a typical weighing accuracy was ±100 kg per axle.

Developments in loadcell technology and faster processing speeds of modern instrumentation have dramatically improved the accuracy of these systems to the point where a few manufacturers have achieved the 0.5% accuracy needed for O.I.M.L and EC approval Class III for trade use, as an In-Motion Road Vehicle Weighbridge. In-motion weighbridges cannot be Type Approved and Verified for use for trade as there are no regulations covering them as such, they are often however, Type Approved and verified as "static" weighbridges.

These systems are being increasingly used for commercial weighing of low value products such as waste and building materials, whilst also ensuring these vehicles do not contravene the Road Traffic Act in respect of weight distribution.

Many thousands of systems have been installed world-wide as law enforcement agencies and fleet operators alike take advantage of this low cost technology to weigh vehicles of any size and weight in a matter of seconds. Unlike the conventional platform weighbridge, the axle weigher cannot be outgrown and with a capacity of up to 40,000 kg per axle, vehicles of upwards of 240,000 kg can be weighed with ease.

The conventional weighbridge still has its place where high accuracy is demanded but the axle weigher fills an important gap for fleet operators who need to resolve a security or overloading problem quickly and cost effectively.

In recent years, there has also been a substantial growth in the demand for portable weighing systems for fleets of all sizes.

A wide choice of systems is now available and unlike their earlier relations, portability is no longer a problem. New aircraft specification aluminium is now used to great effect to produce systems, which can be easily transported and installed by one man in a matter of minutes. The systems usually consisting of two weighing platforms are placed on a level surface and again, a choice of static or in-motion technology is readily available. The later models may also incorporate cable free RF technology, which allows the user to read the axle weights at a distance of up to 40 metres from the weighing devices. This is particularly important in inclement weather where the weighing console can be located in a vehicle adjacent to the weighing area and the system operated from internal batteries or the vehicle battery system.

Site levels do play a vital role in the performance of both static and in-motion, fixed and portable axle weighing systems. This is largely overcome by careful site construction or the provision of roll out levellers for the portable systems, which remove much of the weight transfer created within mechanical suspension systems as vehicle wheels are driven up on to the weighing platforms.

In the case of permanent axle weighing installations, a distance of 4m before and after the weighing equipment is required to be constructed in concrete to a surface tolerance of +/-3mm. The balance of the approaches for a vehicle's length before and after the weigher needs to be on a consistent gradient, but the surface levels are not as vital, and in most cases do not need any additional reconstruction. (Except in the case of enforcement installations where a strict Code of Practice for the construction of the site applies.)

These systems provide a valuable cost effective alternative to the conventional platform weighbridge and their size and weight dramatically reduces transportation, installation and maintenance costs.

References

OIML Recommendation R134 "Automatic instruments for weighing road vehicles in motion. Total vehicle weighing."

1.7 AUTOMATIC WEIGHING INSTRUMENTS

A full discussion of automatic weighing instruments is outside the scope of this issue of the Technical Articles. However, a brief summary is presented here.

All non-automatic weighing instruments (NAWIs) are governed by the NAWI regulations, whether used for controlled applications or not. In contrast, automatic weighing instruments (AWIs) are only subject to control if they are in use for trade and they are a prescribed type having specific regulations.

Automatic weighing instruments have recently come under new regulations implementing the Measuring Instruments Directive (the MID). The following types of instrument are prescribed for trade use in the UK and an EC type approval will be performed according to the Essential Requirements of the Directive; the instrument will then need to be verified before it can be taken into use:

Continuous totalising automatic weighing instruments (belt weighers)	The Measuring Instrument (Beltweighers) Regulations 2006 – SI 2006 No 1259
Automatic catchweighing instruments	The Measuring Instrument (Catchweighers) Regulations 2006 – SI 2006 No. 1257
Automatic gravimetric filling instruments	The Measuring Instrument (Automatic Gravimetric Filling Instruments) Regulations 2006 – SI 2006 No. 1258
Automatic rail-weighbridges	The Measuring Instrument (Automatic Rail-weighbridge) Regulations 2006 - SI 2006 No. 1256
Discontinuous totalising automatic weighing instruments (totalising hopper weighers)	The Measuring Instrument (Automatic Discontinuous Totalisers) Regulations 2006 – SI 2006 No. 1255

Automatic weighing instruments of these types which were type approved and verified under the previous national regulations can continue in use for trade and can be re-verified to those regulations, although they are now repealed as far as new instruments are concerned.

See also section 1.1 on controlled applications which includes a definition differentiating between non-automatic and automatic instruments and the various sections under 1.4 on type approval and verification.

1.8 INDUSTRIAL PROCESS WEIGHING IN HAZARDOUS AREAS

EXPLOSION PROTECTION
In addition to the type approval and certification of industrial weighing systems concerned with accuracy, equipment that is also used in a 'Hazardous Area' must be certified as compliant with the requirements of the Standards for "Explosion Protection". Such requirements provide for its safe use in an area in which a potentially explosive mixture of gas, vapour, mist or dust may be present due to the operation of an industrial process.

European Standards for Explosion Protection are applied to the design, construction, selection, installation, operation, inspection and maintenance of such equipment put into service in the United Kingdom (and indeed throughout Europe).

A common misconception is that any ATEX-approved components can be connected together to form a system. However, it is important to show that the compatibility of the various components have been assessed and that the complete system is compliant.

The plant owner's perspective
It is the industrial plant owner's responsibility (hereafter referred to as the owner) to define the hazards that may be present on their plant by undertaking 'Area Classification'. This process has to be done in accordance with, and by applying, the British Standard, BS EN 60079 Part 10.

Area classification will form part of a risk assessment that is used to determine the likely locations of the hazard(s) and the likely duration. Where there is a higher probability of presence for a longer period of time, the higher the reliability of the type of explosion protection is required. The result is to classify the hazardous areas of the plant into Zones:-

Non-hazardous area: An area in which no explosive gas/air mixture is expected (often referred to as 'Safe Area').

Zone 0, 1, 2 (for Gases, vapours and mists)
and/or
Zone 20, 21, 22 (for dusts).

The definitions of these are provided for reference at the end of the section.

The nature of the hazard(s); the ease of flammability, and other physical properties of the ignitable substances appearing in the zones, will need to be known such that the ignition prevention requirements of suitable apparatus may be specified:-

- the Apparatus Group, i.e. II, IIA, IIB or IIC
  and
- the Temperature Rating, i.e. T1, T2, T3, T4, T5 or T6

These are defined in the Standard BS IEC 60079 Part 0 or EN50014, which cites the general requirements for explosion protection in hazardous areas (other than mines).

Once known, the owner can purchase weighing apparatus that is certified to be adequately safe in the appropriate zones of use.

The manufacturers' approach
The manufacturers offer weighing equipment that is certified to European Standards for Explosion Protection. There are a number of different types of protection that may be used depending on a variety of factors. The type of protection used defines the permitted zones of use; according to the Standard BS EN 60079 Part 14: Installation of explosion protected apparatus in hazardous areas.

One of the most common types of protection used for electronic industrial weighing applications that are made suitable for integration into process control systems is known as "Intrinsic Safety". This is referred to as 'I.S.' or, more correctly now, 'Ex i'. It requires that circuit design is made incapable of causing the ignition of flammable atmospheres. This is achieved by reliably limiting the levels of energy and power, even under specified fault conditions, in apparatus and circuits entering a hazardous area. The construction Standard to which apparatus is certified as compliant is EN50020.

Ex ia circuits are permitted in Zone 0 (the most onerous degree of hazard), or Zone 1 and 2.
Ex ib circuits are only permitted in Zones 1 and 2.

The explosion protection marking seen on apparatus, say, EEx ia IIB T4 (which is also referred to as it's safety code) can be interpreted as meaning:-

EEx: Explosion protected to conform to a European Standard
ia: Permitted to be mounted or connected into a Zone 0
IIB: Permitted to be mounted or connected into hazardous areas requiring IIA or IIB grade of apparatus
T4: Permitted to be mounted or connected into hazardous areas where the hazard's ignition temperatures are not below 135ºC (Maximum ambient temperatures limits must also be observed.)

Often, a weighing application comprises several component hardware modules:-

- the system power supply;
- the operator control;
- local and/or remote ancillary devices such as printers, indicators etc.; and
- the weighing platform, incorporating the loadcell(s).

These component modules, together with any cabling and junction boxes, are interconnected to provide the function that the purchaser needs for the application.

Intrinsically Safe Apparatus
Some or all of these modules may be located in one or more zones of the hazardous area depending on the application. They must be marked with appropriate safety codes indicating how each module is protected. Intrinsically safe apparatus is marked 'Ex i'. Where a module is marked, typically "[EEx ia] IIC", the square brackets indicate that it is 'Associated Apparatus' and MUST be mounted in a safe area, although it is connected to apparatus in the hazardous area according to the manufacturer's instructions.

Some intrinsically safe weighing systems use external mounted 'Shunt Zener Diode Safety Barriers' (Barriers) that are located in between the Hazardous Area mounted modules (usually loadcells) and the Safe Area modules. These are the safety devices that specifically limit the fault energy and power available to the hazardous area circuits to within safe limits. These are normally mounted in enclosures in the safe area and also require connection to a suitable earthing system (known as an Intrinsic Safety Earth) in accordance with the Installation Standard BS EN60079-14:2003.

Weighing systems may be battery-operated and can be self-contained for mounting completely in the Hazardous Area. Where there is a facility for charging the battery whilst in the Hazardous Area, or for bringing out communication signals to external weighing equipment mounted in the Safe Area, barriers will also be required to interface the signals between areas.

In other cases, the energy limiting circuits (the function performed by the Barriers) are built into the electronics of the modules. In these cases, safety earthing may or may not be required, depending on the design and the safety certification, which will state if it is necessary. In all cases, the manufacturer will supply installation information which must be followed.

Other types of protection
In some cases, other types of explosion protection may be used for some modules or parts of the weighing system. These could be as listed below with a brief description of how they prevent ignition of a surrounding flammable atmosphere:

Ex p, Ex o, Ex q and **Ex m** are considered as "separation" techniques; the use of inert gas, liquid, semisolid (particulate) or solid media, respectively, to surround an ignition capable electrical arrangement. Thus, contact with a flammable gas/air mixture is physically prevented. An additional effect is that heat generated by the arrangement may be dispersed through the media. Arcing and sparking may be quenched by the fluid medium in the case of Ex o.

Ex e and **Ex n** avoid being ignition capable by considering the mechanical design and layout of an electrical arrangement. Electrical components are mounted in an enclosure. A flammable gas/air mixture is not specifically prevented from entering and surrounding the internal electrical components. The design prevents the electrical arrangement from causing ignition by the elimination of sparking and control of heating effects. Although it is thought that they use the same basic concepts, the philosophy is very different between the two types and these must not be confused. Ex e apparatus is carefully designed and constructed so as to completely prevent any sparking effect occurring. In addition, the heating effects caused by the conduction of electricity are reduced. It is therefore of much higher integrity than Ex n, which simply relies on normal industrial design to avoid excess heating and sparking with little additional precautions taken and no faults considered.

Ex d permits ignition to occur inside a strong enclosure where a gas/air mixture may enter and be ignited by ignition-capable electrical equipment contained within. The resultant flame must not be transmitted to the outside surrounding atmosphere through any joint. Thus the enclosure is said to be 'flame-proof' and is designed to withstand the force of an internal explosion.

Ex s is applied where none of the above types of protection are actually used but ignition prevention is adequately guaranteed.

The Installation
It is the owner's responsibility to ensure that equipment is installed correctly. This is also in accordance with the Standard, BS EN 60079 Part 14. Thereafter, its safe operation will be determined by the requirements of the apparatus certification depending on the type of explosion protection used. The manufacturer's instructions must also be followed where safety is concerned.

After installation, the equipment must be operated safely and properly maintained to ensure its continued safe operation for the life of the installation, according to existing health and safety Law. The requirements for an initial inspection to verify the correct installation and then subsequent periodic inspections are given, together with some guidance, in another Standard, BS EN 60079 Part 17.

An 'Intrinsically Safe System'
Where pieces of Ex i-certified apparatus are connected together using cables, they form an 'Intrinsically Safe System'. The combination of apparatus must be correctly matched together and shown to meet the Ex i requirements. This is in accordance with Standard, BS EN 60079 Part 25, which is known as the 'Systems Standard'.

Where a manufacturer or weighing equipment supplier provides a standard range of intrinsically safe apparatus-certified devices that are connected together in an application, a Systems Certificate may have been obtained from a testing authority. This is not mandatory for the

manufacturer. If obtained, such a certificate permits the safe interconnection of that apparatus and provides information, such as maximum cable parameters, that the installation in the hazardous area must meet. The systems certificate cannot state the actual installation conditions, as they are unique to each given application.

The Systems Standard requires the production of a 'Descriptive System Document' (DSD). This details the safety considerations of the actual installation. Its purpose is to demonstrate that all aspects of the installation meet the Ex i requirements and are therefore safe. Suggested formats are included in the Standard for guidance.

The DSD must include information from the apparatus certification, provided by the manufacturer or supplier of apparatus. It may cite a system certificate, if there is one, but must show that the apparatus, when connected together, meets the system requirements for Ex i and that the maximum cable parameter values have not been exceeded.

The owner is ultimately responsible for the preparation of the DSD; the manufacturer may provide much of the required initial safety information, such as that stated on the individual apparatus certificates. The installer, who may, of course, be a third party, may be required to complete the DSD as part of their contractual obligations. The document is then passed on to the owner. It is always the owner's responsibility to ensure the safety of the installation. The DSD is effectively the means by which safety is proved.

The DSD is therefore a key document. It is subsequently used for inspection and maintenance because it details all the safety aspects of the given application.

Other types of protection

Other types of protection, for example; Ex d, e, n and/or p, may be used on a weighing arrangements or a part of them depending on the application and suitability. This is much less common than Ex i. The requirements for that type of protection must be followed for installation and maintenance purposes. Whilst no DSD is required, safety must be described as required by the ATEX Directives.

ATEX and DSEAR

In the UK, as from 1st July 2003, all explosion protected apparatus provided by manufactures and suppliers must comply with the ATEX Directives. In addition, any hazardous area installation commenced after this date must comply with the requirements of the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR). As from 1st July 2006, existing installations must be shown to comply with ATEX and DSEAR.

In essence, these Directives and Regulations merely formalise the requirement for users to put into place properly documented safety assessments and solutions such that plant risks are adequately minimised. It requires that personnel are adequately trained and supervised. Management systems must be in place for a safe system of work, such that risks are identified and controlled. A 'responsible person' shall be appointed to oversee these matters.

The DSD's for all Ex i circuits shall be included, together with other safety related documents, in a justification of safety, often referred to as a 'Safety Case', as required by the DSEAR. The Safety Case describes the hazards and the management of all related activities that show how steps are taken to minimise the risks posed.

Conclusion

The Standards and Directives mentioned in this section cover a specific situation where equipment is used in Hazardous Area. This is in addition to Standards for weighing accuracy. Personnel who design, install, operate and maintain a plant in which potentially explosive atmospheres can exist should be familiar at appropriate levels with these Standards. The emphasis is on good management and adequate training to understand the risks and the precautions taken for safety.

Reference section
Relevant Standards are listed in Section 2.3.5 (ATEX documentation)

Definition (and determination) of Zones is to BS EN 60079-10

Zone 0	An area in which an explosive gas/air mixture is continually present or present for long periods
Zone 1	An area in which a gas/air mixture is likely to occur in normal operation
Zone 2	An area in which a gas/air mixture is not likely to occur in normal operation, and if it occurs, it will exist only for a short time
Zone 20	An area in which combustible dust, as a cloud, is present continuously or frequently, during normal operation, in sufficient quantity to be capable of producing an exposable concentration of combustible dust in mixture with air, and / or where layers of dust of uncontrollable and excessive thickness can be formed.
Zone 21	Zone 21 is a Zone not classified as Zone 20 in which combustible dust, as a cloud, is present continuously or frequently, during normal operation, in sufficient quantity to be capable of producing an explosable concentration of combustible dust in mixture with air.
Zone 22	Zone 22 is a Zone not classified as Zone 21 in which combustible dust, as a cloud, is present continuously or frequently, during abnormal operation, in sufficient quantity to be capable of producing an explosable concentration of combustible dust in mixture with air.

Apparatus Grouping

Required Hazardous Area Apparatus Group (determined by ease of ignition of hazardous gas in BSEN60079-20)	Apparatus Group useable I the Hazard
IIC	IIC Only
IIB	IIC and IIB
IIA	IIA, IIB and IIC

'Temperature Rating'

Temperature mark on apparatus	Maximum surface temperature to which gas has access
T1	450°C
T2	300°C
T3	200°C
T4	135°C
T5	100°C
T6	85°C

[If no other mark appears on the apparatus it is assumed ambient temperature range is –20°C to +40°C.]

1.9 SOFTWARE

General
Unless you are using a completely mechanical weighing instrument, it's almost certain that it is controlled by software in one form or another. It would also be fair to say that if your system uses a weight only instrument then there is software within the other areas that will also require consideration.

Apart from the obvious requirement that the software controls correctly, it is imperative that the software is secure. Security is required to ensure that changes to that software can either not be carried out, or, if changes are made then there is an indication. This security can also encompass both stored and transmitted data to provide confidence in its validity.

Once a weighing instrument or, say an EPOS device, has been type approved, certain aspects of the operating software is classified as legal metrology relevant and the approval restrictions will be applied to it. Changes to these areas are not permitted without authority and possible changes in the type approval certificate (weighing instruments) or the EC test certificate (EPOS software).

The software used in weighing instruments and other systems, for example an EPOS system, is often divided into two categories, legal metrology relevant and non-relevant to facilitate practical future development.

Legal metrology relevant software
The legal metrology relevant areas of the software will include those processes or routines that deal with the metrology data or the control of data to and from this area. For example, procedures that calculate weight data from raw A/D data, procedures that process and store calibration, and even the procedures that ensure that valid data comes from the A/D and valid weight data is passed on for processing. This classification would include procedures in an EPOS system, as well as a weighing instrument, which takes weight information and calculates prices.

It is important that these procedures are not accidentally altered. Equally as important is the need to prevent malicious alterations, but today's use of normal computers and high technology tools make this almost impossible, so it has become necessary to provide a means of tamper indication.

The most secure form of software is that which is contained in ROM or some other form of one-shot memory and is recognised as "embedded". Although secure, it is necessary that these components are either sealed in position or that some form of tamper indication is available.

Those instruments that use a PC for processing also use freely programmable software. This form of software is perceived as the most vulnerable to both accidental and malicious attack. A common security measure is to provide an indicator in the form of a checksum or CRC. This information is published in the certificate and the system provides a means of comparison.

Software submitted for approval must be produced in a controlled fashion, usually demonstrated by a form of issue version identification. Any alteration to the status of a software package should be reflected in a change to its version identification and submitted for any relevant changes to the certificate.

Non-relevant software

It would be unreasonable to require changes to a certificate if a software modification did not affect its legal metrology relevant area. For example, changes to move the position of an item on the screen or to alter a colour feature. This type of software is not relevant to the legal metrology; therefore, it need not be included within the security measures. It is still necessary to maintain some form of modification control and in these cases it might prove useful to use an issue identification system that clearly indicates the use of separated software. For example, the first issue of the software could be identified as **Issue 01.01** where the number to left of the point would relate to the legally relevant part of the software and the number to the right to the non legally relevant part; the Type Approval Certificate would then say that any software with an issue number 01.xx. is acceptable. Thus when the non-legally relevant part of the software was updated, e.g. to alter the position of some information on the screen, the software issue identification would be updated to **Issue 01.02** but it would still be acceptable under the Type Approval Certificate.

Controlled updating

With today's technology, it is possible to carry out remote updates to software in the field. If this is to be carried out, updates either direct or remote must be authorised and controlled. Remote updating poses a number of questions, the most important of which are, has the update been completed successfully and does the instrument or system still operate correctly?

References

WELMEC 2.3 Guide for Examining Software
WELMEC 7 Guidelines for Examining and Testing Interfaces and Peripheral Equipment
WELMEC 7.2 Software Guide (Measuring Instrument Directive 2004/22/EC)
BS EN 45501

1.10 METRICATION

When the UK joined the EEC, one of the obligations it took on was to implement the EC Directives relating to units of measurement. The EC produced a number of Directives on this subject, culminating in Council Directive of 20 December 1979 on the approximation of the laws of the Member States relating to units of measurement (No 80/181/EEC).

This Directive made it compulsory for EC Member States to use only metric units of measurement "for economic, public health, public safety or administrative purposes".

A number of derogations were negotiated by various UK Governments, but finally, on 1st January 2000, it became mandatory to only use metric units for trade purposes. At first, enforcement of this compulsory metrication was patchy to say the least, and a number of high profile Court cases challenging the legality of compulsory metrication clouded the issue. Finally, however, on 3rd February 2004, the European Court of Human Rights issued a judgment that made it clear that compulsory metrication was lawful and that no individual had suffered a violation of the rights and freedoms set out in the European Convention on Human Rights. This ended any opposition and since then enforcement of metrication has gone ahead quietly and generally quite efficiently.

There is a little confusion still existing, due to one final concession negotiated in 1999. Under the concession, prepackaged goods marked with the quantity in metric units can also carry a "supplementary indication" of quantity in other units, such as the "lb" or the ounce. This was agreed basically to allow packers to dual mark products for sale in both Europe and USA, as the USA still requires pre-packs to be marked with quantity in imperial units. The concession for supplementary indications also means that it is possible for weighing instruments that indicate quantity in both metric units and imperial units **at the same time** to be Type Approved and then verified. What is clear is that weighing instruments that primarily indicate in Metric units, but can, by means of a push button or other command, indicate in Imperial units as an alternative, do not fulfill the supplementary indication criteria, and as such cannot be Type Approved or verified. The European Commission has now indicated that the concession to allow the use of supplementary units, which was due to end in 2010, will be made permanent.

As most beer drinkers will know, there is a notable exception to the compulsory use of metric units for trade purposes; the pint is still a legal unit for dispensing draught beer and cider, and strangely, it can still be used for selling pre-packed milk in returnable containers (bottles to you and me).

1.11 CE MARKING

Ironically, the main objectives of CE marking are to remove barriers to free trade within the EU, though the process is seen by many manufacturers as a burden. The underlying intention is that products bearing the CE mark may be traded freely within the EU. The guide to the New Approach Directives (introduction) states:

> *"Member States must presume that products bearing the CE marking comply with all the provisions of the applicable directives providing for its affixing. Accordingly, Member States may not prohibit, restrict or impede the placing on the market and putting into service in their territory of products bearing the CE marking, unless the provisions relating to CE marking are incorrectly applied.!*

Manufacturers of any products to be placed on the market must ensure that those products comply with all relevant directives and the CE marking indicates compliance with those directives. The definition of CE mark in the Decision 768/2008/EC reads:

> *"a mark by which a manufacturer indicates that the product is in conformity with the applicable; requirements set out in the Community harmonisation legislation provided for its affixing:"*

The source legislation requiring CE marking is rather fragmented with; Council Decision 768/2008/EC providing overall requirements for conformity assessment and affixing the mark, Directive 93/68/EEC amending the relevant sections of the specific technical directives, and the individual technical directives themselves. The specific technical directives that typically would have to be considered for weighing equipment include:

2004/108/EC	Electromagnetic compatibility (EMC) directive	General electrical equipment
2006/95/EC	Low voltage directive	Equipment designed for use with a voltage rating between 50 and 1000V a.c. and/or 75 and 1500V d.c.
2009/23/EC	Non-automatic weighing instruments directive	Weighing instruments used for controlled applications
2006/42/EC	Machinery directive	Equipment with powered moving parts and machinery accessories
93/42/EC	Medical Devices	Instruments used for the purposes outlined in the Directive

It is the responsibility of the manufacturer to determine which directives are applicable. The guide to the New Approach directives gives a full list of directives that require CE marking. In addition to the CE marking, a declaration or certificate of conformity must be produced, identifying the directive(s) concerned and any technical standards used.

Conformity assessment

Council Decision 2008/768 EC describes 8 different methods (modules) of conformity assessment, which may be combined, resulting in quite a complex scheme. However, it is the individual specific technical directives that determine the method(s) of conformity assessment(s) to be used for each. To identify these methods, the original directives must be combined with the amendments listed in Directive 93/68/EEC.

In practice, there are two different general principles: either the manufacturer makes a declaration of conformity based on the equipment design, examination and testing (where testing may be carried out by a third party and a test report produced), or in addition to the manufacturer's declaration, a notified body issues a type-approval certificate for the product and each unit is then tested, affixed with the identification number of the notified body performing the tests, and issued with a certificate of conformity (unit verification).

References

Guide to the implementation of directives based on the New Approach and the Global Approach.
Council decision 2008/768
Directives 93/68/EEC, 90/384/EEC, 98/37/EC, 2004/108/EC, 2006/42/EC, 2006/95/EC

1.12 ROHS AND WEEE DIRECTIVES – APPLICATION TO WEIGHING INSTRUMENTS

WEEE Directive

The WEEE Directive 2002/96/EC as amended by Directive 2003/108/EC has been implemented in UK regulations Waste Electronic and Electrical Equipment Regulations 2006.

The intention of the Directive is to promote the re-use and/or, recycling of electrical and electronic equipment at the end of its normal life, or where this is not possible reduce pollution by requiring the environmentally sound disposal of such equipment. Targets are set for the amount of re-use and recycling that should be achieved.

The Directive imposes the responsibility for financing the treatment of waste electrical and electronic equipment (WEEE) on Producers. A Producer is a person or organisation that:

- manufactures and sells electrical and electronic equipment under his own brand or,
- resells under his own brand equipment produced by others or,
- imports or exports electrical or electronic equipment on a professional basis into a Member State.

A number of approved Schemes have been set up under which the Scheme Operator arrange for the collection, transport and treatment of WEEE on behalf of Producers. These Schemes are responsible for ensuring that WEEE is collected and dealt with correctly and that the mandatory recycling and re-use targets imposed by the Directive are achieved. All Producers were required to initially register with one of the Approved Schemes by the 15th March 2007 and thereafter annually. At the time of initial registration, the Producer must supply the Scheme with accurate data concerning the total weight of electrical and electronic equipment that he has placed on the UK market in the calendar year 2006. The Producer must also state the split between equipment intended for use by consumers and that intended for professional use. Producers may change Schemes if they wish but must do so by the 30th October in any year and they will then remain in the new Scheme. Failure to register with a Scheme will be an offence.

Retailers, i.e. those who sell equipment direct to consumers, will be required either to offer a take-back service, whereby a consumer buying a new piece of equipment can give an old item of equipment performing the same function to the retailer to dispose of safely, or to join a retailer Scheme whereby facilities are provided where consumers can safely dispose of electrical and electronic equipment without charge. There is no direct equivalent for Producers selling equipment for professional use, but they will be required to fund the safe disposal. (Producers may reach a contractual agreement with their professional customers under which, the user will assume the responsibility for the cost of safe disposal, but how this will be monitored and controlled is not yet known.)

The UKWF has reached an arrangement with WEEE Link, one of the Approved Schemes to provide WEEE registration and systems for the weighing industry. UKWF Members are of course free to register with any of the Schemes. Not all members, however, will need to register and those who do register should be aware that not all of their products come under the scope of the WEEE Directive. The following extract from the notes of a meeting between the UKWF and WEEE Link explain the position:

> *"Agreed that the following items are outside the scope of the regulations as they are not supplied directly to end user (except possibly as spare parts in which case they are still outside the scope of the regulations)*
>
> - *Indicators*
> - *Load Cells*
> - *Other peripheral equipment (e.g. remote display units)*

Agreed that weighbridges that are intended to be connected to, or form part of control systems (e.g. incoming and outgoing weighbridges incorporated into a waste treatment plant control system), are at the moment classified as being part of a fixed installation and, as such, are outside the scope of the regulations.

It is likely that this exemption will be removed during future amendment of the EC Directive; however weighbridges also fall under the heading of large scale stationary industrial tools and thus, will remain exempt. However, such equipment will fall under Category 6 of Schedule 1 to the regulations and as such, will be subject to the RoHS Directive; this is not considered to be a major problem as the vast majority of electrical / electronic components used in weighing instruments are only available in RoHS compliant form.

(NOTE: These exemptions do not apply to portable weighbridges)

Similarly, large capacity dormant platform machines are also regarded as exempt."

RoHS Directive

The RoHS Directive has recently been recast as Directive 2011/65**.** The new directive defines the same ten groups of instrument as the previous directive and the WEEE directive. The important change is that, although previously exempted, all types of non-automatic and automatic weighing instruments will fall within either category 8 or 9 of annex 1 of the Directive (Category 8. Medical Equipment; Category 9. Monitoring and control instruments, including industrial monitoring and control instruments.)

At present, the implementing regulations are still "The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2005". It is likely that the regulations implementing the new directive will be introduced in 2013 and will implement the effect of the changes by 22nd July 2014.

The following table outlines whether the RoHS Directive (2011/65/EC) will have effect on different types of weighing equipment:

Weighing Machine Type / Description	**WEEE Category**	**RoHS Applies?**
Non-automatic Weighing Instruments		
Stand alone retail weighing instruments	9	Yes
Stand alone industrial weighing instruments	9	Yes
Stand alone retail weighing instruments with in-built printer	9	Yes
Stand alone industrial weighing instruments with in-built printer	9	Yes
Retail weighing instruments with networking capability	9	Yes
Industrial weighing instruments with networking capability	9	Yes
Retail weighing instruments incorporated in EPOS Systems	3	Yes
Retail weighing instruments connected to computers for data management purposes	9	Yes
Industrial weighing instruments connected to computers for data management purposes	9	Yes
Retail Weighing Instruments connected to cash registers for cash handling purposes	3 or 9	See Note 1 below
Domestic weighing instruments (Kitchen / bathroom)	2 & 9	Yes
Medical weighing instruments	8	Yes
Automatic weighing instruments		
Gravimetric Filling Machines	9	Yes
In-motion Rail Weighbridges	9	Yes
Discontinuous Totalisers	9	Yes
Continuous Totalisers	9	Yes
Checkweighers	9	Yes
Weigh/Price Labellers	9	Yes

It is impossible to provide a detailed list of weighing instrument types because there are now so many variants and options possible, however, the descriptions listed above should encompass the vast majority of equipment. In the event that a particular instrument does not fall precisely within one of the descriptions listed above or has additional features / facilities to those listed, then the following test should be applied:

- Is the primary function of the instrument weighing for use for trade (as defined in Section 7 of the Weights and Measures Act 1985) or weighing for one of the controlled applications set out in Article 1.2.a of the NAWI Directive 2009/23/EC in a professional environment? If so, the instrument will be considered as falling within category 9 and will therefore be exempted from the RoHS Directive.

(Note: This is one of those awkward cases where there is no clear answer and the situation would need to be judged on a case by case basis. If, for example, the weighing instrument and cash register were sold together and the cash register was capable of working even if the weighing instrument were switched off, then it would be difficult to distinguish this case from a typical POS system. If, however, the weighing instrument was the primary unit and had the ability to produce a

totalised receipt but the use of a simple cash drawer was optional, then it may well be that the weighing instrument is still exempt from the RoHS Directive.)

The Federation is grateful to the NMO for their guidance in this matter. The Federation accepts and understands that the interpretation of legislation is, in the final instance, a matter for the Courts and that the guidance from the NMO is given on that understanding. Members are advised to seek their own legal advice should they have any serious doubts or questions on aspects of the legislation.

1.13 THE WASTE BATTERIES AND ACCUMULATORS REGULATIONS 2009

The regulations apply to Producers of all types of batteries and accumulators, regardless of shape, volume, weight, composition or use. Both disposable batteries and rechargeable batteries (accumulators) are covered.

"Producers" are defined as "any person in the UK that, irrespective of the selling technique used (distance sellers included) places batteries **including those incorporated into appliances or vehicles** on the market for the first time in the UK on a professional basis." So if you manufacture batteries in the UK or import equipment into the UK for sale in the UK, and that equipment contains a battery, no matter how large or small that battery may be, you are regarded as a battery producer. The obligations you have depend upon whether you are dealing with "portable batteries" or "industrial batteries".

Portable battery means any battery or battery pack which is:

- Sealed
- Can be hand-carried by an individual person without difficulty and
- Is neither an automotive battery nor an industrial battery.

(Remember it is irrelevant whether the battery is an individual item or incorporated into the product (such as a button type battery on a printed circuit board in a computer or weighing machine) the person placing that product on the market in the UK for the first time is regarded as the battery producer.)

Producers who place more than one tonne of portable batteries on the market in a year **must** join a Battery Compliance Scheme (similar to the WEEE schemes that already exist). The scheme will then deal with your registration with the Environment Agency, collect and collate data from members, pay the fees and then recharge their members accordingly. Details of approved schemes can be found on the Environment Agency website (www.environment-agency.gov.uk).

Small producers, i.e. those placing less than a tonne of portable batteries on the market in a year need to register with the relevant environment agency (if you have not yet registered you should do so immediately), and report their sales data to the agency by the 31st January each year. Small Producers have no collection, treatment or recycling obligations.

There is one other aspect to consider. If you are a **Distributor** of portable batteries, you will have an obligation to take back portable batteries. You are regarded as a Distributor of Portable Batteries if you sell portable batteries to end users professionally. So, for example, if you sell portable batteries as spares for your products you are a Distributor and if you sell more than 32kg of batteries per year then you have an obligation to accept back waste batteries without charge.

Industrial Battery means any battery or battery pack of any size or weight which is:

- designed exclusively for industrial or professional use, or
- unsealed but is not an automotive battery, or
- sealed but is not classified as a portable battery

The obligations on Producers of Industrial Batteries are a little more onerous. They are:

- The producer must register with BERR
- Take Back of waste batteries from January 2010. Take Back must be
    - free from an end user if you supply new industrial batteries to that end user during the calendar year, or
    - free from an end user on request when that end user is unable to return waste industrial batteries to his supplier – the battery must be of the same chemistry as those that the producer places on the market, or
    - free from any end user that is unable to dispose of waste industrial batteries by either of the two methods above.
- Publish on or before 1st December each year how an end user of industrial batteries may request take back of waste industrial batteries
- Ensure that waste industrial batteries for which they have taken responsibility are delivered to and accepted by an approved battery treatment operator or exporter.
- Report annually to BERR the total tonnage, and the chemistry, of industrial batteries placed on the UK market
- Report the tonnage and chemistry information on batteries collected and delivered to an approved treatment operators.
- Keep records for 4 years and make them available to BERR on demand.

A producer's obligation to take back batteries does not end once he has taken back the amount of batteries he has placed on the market.

Disclaimer

The above notes are NOT an authoritative Guide to the Regulations; they are intended for brief reference only on the principles. For detailed Guidance you are strongly recommended to obtain the Government Guidance Notes referred to above.

References

More detailed guidance on these Regulations can be found in Government Guidance Notes which can be downloaded from the web-sites of BERR (www.berr.gov.uk) DEFRA (www.defra.gov.uk) or the Environment Agency (www.environment-agency.gov.uk).

1.14 MEDICAL WEIGHING

Introduction
The Non-automatic Weighing Instruments (NAWI) Directive was made part of UK law on 1 January 1993. The Directive not only controls the technical and performance characteristics of NAWI, but also specifies which tasks require the use of "controlled" NAWI. One of those specified tasks is:

> *"Weighing patients for the purposes of monitoring, diagnosis and medical treatment"*

This means that from 1 January 2003, when the full effects of the Directive come into force, all new weighing instruments used for medical weighing will have to comply with the requirements of the Directive. These notes are intended to make users and purchasers of medical weighing instruments aware of the requirements.

The Non-automatic Weighing Instruments Regulations 2000
The Directive is implemented in the UK by the Non-automatic Weighing Instruments Regulations 2000. Under these Regulations, the design of medical weighing instruments must be approved by a Notified Body (in the UK this is the National Measurement Office) and all product from the production line must be individually verified for conformity and accuracy by a Trading Standards Officer or other approved verifier. Each instrument must be covered by a Declaration of Conformity and bear the 'Green M' label indicating conformity with the Directive and the Regulations.

Medical weighing instruments purchased and in use before 1 January 2003 can continue in use indefinitely, even though they may not meet the requirements of the NAWI Regulations.

Medical weighing instruments not used for medical practice, for example in health clubs, fitness centres and slimming clubs, do not have to conform to the NAWI Regulations.

From 1 January 2000, only metric units have been legal for controlled purposes. Weighing instruments that have both metric and imperial (lb. & oz.) indications can continue in use, but the Notified Bodies have told us that they will not be granting Type Approval for new models unless they have both indications available at the same time.

Accuracy Classes
The Regulations define 4 accuracy classes. Classes I and II are for very high accuracy instruments, Class III for weighing scales in general use for trade and Class IIII where a lower level of accuracy is acceptable, such as weighing waste or ballast. The maximum permissible error (mpe) on the weighing instrument is related to its accuracy Class and its resolution (division size).

Selection of Accuracy Class for Required Applications
The UKWF believe that Class IIII scales only have sufficient accuracy for the checking of a patient's weight for record purposes, as typically carried out in the GP's consulting room. Where a weighing result is required for diagnostic purposes or treatment, we recommend that a Class III instrument should be used.

In hospitals, there is a multiplicity of weighing scales used for both critical and non-critical weighing and for weighing babies through to obese adults. We recommend that whatever the intended application of the scales, only Class III instruments are used in hospitals. Scales are often moved from department to department, and that could result in inappropriate Class IIII instruments being used for more critical applications.

Recommended Minimum Classes for specific applications

Purpose:	Hospitals	Hospital associated medical centres	Ante / Post Natal Clinics	Medical Practice Treatment Rooms	GP Consulting Rooms	Mobile / Visiting Health care	Nursing Homes
Monitoring	III	III	III	III	IIII	IIII	IIII
Diagnosis	III	III	III	III	III	III	III
Treatment	III	III	III	III	III	III	III

Selection of Class III Weighing Scales for a required application

Within the Class III accuracy specifications, there is a range of accuracies that may be chosen. In some instances, even a Class III specification may not be accurate enough for a particular medical requirement. Accuracy is generally proportional to the size of weighing interval and purchasers should take this into account when making their choice.

Recommended maximum scale interval for specific applications

	Adults	Young Children	Babies
Checking weight for records	500g	200g	50g
Regular monitoring to assess weight change	200g	100g	10/20g
Measuring weight to assist medical diagnosis	200g	50/100g	10/20g
Measuring weight for critical treatment eg dialysis	50/100g	20/50g	5g
Recording birth weight			20g
Measuring weight before and after breast feeding			10g
The above figures were taken from a limited survey of medical practitioners and specialist scales distributors			

CE Marking

All instruments conforming to the Directive must carry the 'Green M' label as well as the CE mark. (They will also have a 4 digit number indicating the organisation responsible for the verification of the instrument.) Weighing instruments that do not conform to the NAWI requirements may bear the CE mark to demonstrate conformity to other EC Directives such as the EMC, Low Voltage and Medical Devices Directives, but such instruments cannot legally be used for medical purposes.

Enforcement

Enforcing the regulations will be the responsibility of Trading Standards Officers (TSOs) from the local Council. They will have the power to enter premises and inspect and test weighing instruments. If the instruments are outside the permitted error allowance, the TSO may have them put out of use straight away. We recommend that medical establishments ensure that their weighing instruments are calibrated at yearly intervals to ensure they hold their accuracy to the required standards.

1.15 CRANE SCALES

Crane scales are to be regarded as lifting equipment and legislation treats them as such. The Lifting Equipment Regulations 1998 (LOLER) came into force on 5th December 1998 and cover all crane scales and Loadlinks. They implement the Lifting provisions of the Amending Directive to the Use of Work Equipment Directive (AUWED, 95/63/EC). The Regulations apply in all premises and work situations subject to the HSW Act and build on the requirements of the Provisions and Use of Work Equipment Regulations.

LOLER requires that all crane scales are:

Strong and stable enough for the particular use and marked to indicate safe working load
The regulation requires that (a) machinery and (b) accessories are clearly marked to **indicate** their safe working loads (SWL). Most 'traditional' lifting equipment, i.e. machinery and 'conventional' accessories, should be marked *with* the SWL, as should other equipment which presents similar risks.

Positioned and installed to minimise any risks
The crane scale should sufficiently strong, stable and suitable for the proposed use. Similarly, the load and anything attached (e.g. timber pallets, lifting points) must be suitable and positioned or installed to prevent the risk of injury, e.g. from the equipment or the load falling or striking people.

Used safely i.e. the work is planned and organised by competent people
The person appointed to plan the lift (referred to as the 'competent person') will normally be an in-house employee. They should have adequate practical and theoretical knowledge and experience to plan the lifting operation properly. The plan should address issues such as "the lift" remaining safe for the whole of the operation, i.e. from where the load starts to where it finishes.

Subject to ongoing thorough examination and, where appropriate, inspection by competent people
The crane scale should be checked:

1) When lifting equipment is first 'supplied', (i.e. used for the first time by that employer);
2) Periodically during the lifetime of equipment
3) Following exceptional circumstances

It is usual practice for the competent person carrying out a thorough examination to be employed by a separate company, e.g. a third party examining company. However, the regulation does not prohibit an employer from selecting a member of its own staff to carry out thorough examinations provided that he/she is competent.

In capacities of up to 50T, crane scales must have an ultimate strength of 5:1 and when first supplied, must be proof tested before calibration. Generally, proof testing involves loading the crane scale three times with a load of 2 x SWL.

Once the crane scale is proof tested, calibration is performed in the usual way, tested at equal points through the range and adjusted, as required.

References

The Lifting Operations and Lifting Equipment Regulations 1998, SI 1998 No. 2307.
Simple Guide to LOLER – download from the HSE website.
Safe use of lifting equipment. Lifting Operations and Lifting Equipment Regulations.
1998. Approved Code of Practice and guidance L113.
HSE Books 1998 ISBN 0 7176 1628 2.