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Example of a 15" touchscreen user interface for checkweighing
Effective quality assurance systems in production are no longer conceivable without modern checkweighing. Pharmaceutical, chemical or cosmetics, food and beverage, metalworking and the automotive supply industry are just a few of many industry segments who rely on dynamic checkweighing systems. This is for a very good reason: checkweighers can do substantially more than just weighing. They can optimise production processes!

Modern weighing systems have proven themselves in operation to be true "jacks of all trades". Oriented toward the particular product and application, they protect against product defects and recalls, ensure compliance with country-specific metrological guidelines and lower operating costs. By virtue of the possibility of linking additional inspection procedures with the checkweigher, its range of application has been greatly expanded to effectively detect such things as defective barcodes or open packages. Moreover, checkweighers are the optimum instrument for generating the necessary statistics and manufacturing documentation. Prescribed responsibilities for due business diligence can be documented in this way – as helpful printouts for audits or as indisputable evidence in legal proceedings. However, for this purpose you need intelligent checkweighing software solutions.

1. Thought through!

"Success is 1% inspiration and 99% perspiration". This motto could also apply to the correct choice of a dynamic checkweigher. Not by chance, the basis for a good decision is also careful preparation. Time and again we hear from companies that the hardware and software used in manufacturing practice does not deliver what has been promised. In retrospect it very often turns out that the basic requirements and company objectives were imprecisely formulated, and quite often the supplier and customer have not been listening to each other. Requirements need to be clear to both sides. This begins with a clearly defined business objective and extends to detailed specifications as the starting point for an efficient solution. Each subsequent change usually means effort, expense and lost trust.

1.1 The solution is good – it just does not match the problem

Intelligent checkweighing systems solutions are dependent on the application software and options. Because each situation is unique, it is critical that the correct software application is used. Two basic requirements are necessary here: the better the customer knows his processes and can describe his requirements, the easier it is to offer a solution. Conversely, it is critical that the supplier is at the cutting edge of software development – which is currently proceeding at a breathtaking pace – in order to have the best solution ready.

A quick "We'll manage that" should not be a criterion for awarding a contract when a specific solution is involved. The devil hides in the details, and more often than not development department queries are necessary before confirmation of a solution can be given. It is a sign of a good supplier if he has recourse to fast processes, with short decision paths, in order to respond to the customer’s wishes regarding software. You should request written confirmation if there is any doubt that the requirements asked for really can be implemented.

"Value selling versus feature selling" – Is the software a feature with a real added value or just a feature? What counts in daily life can also be applied to the company: an electronic device, such as a mobile phone, offers any number of setting options. But if the applications that the user needs are complicated to set up, difficult to understand or are not even available, then all the other features are of little use to him. An application tailored to the customer looks different. The technical data and price of a solution might be very impressive at a first glance if you just look at the numbers – but if it does not fully solve the problem it could turn into a serious business concern.

1.2 Clarify the principles

Remain technically up-to-date, in a way that works for you! Software development is distinguished by its fast pace. What is state of the art today can be out of date tomorrow. It should be a matter of course that suppliers update their software regularly and make these updates available. This can easily occur several times a year.

Note: The latest software version is not always necessary, particularly against the backdrop of a stable running system. In these cases you should discuss the matter with the experts at the manufacturer’s company and clarify the extent to which it pays to install the latest version. (Never change a system that is running well…)
2. Be prepared!
Checkweighing – great in promise and in effect

It is no longer possible to imagine modern industry without checkweighing systems. Mature systems lend strong support to business planning. Any decision-maker who places value on precision, quality and efficiency, should clarify several points for himself in advance. As is often the case, this also no longer involves just a solution-oriented product, but also the service surrounding the product that contributes decisively to success.

2.1 Perspective 1: Quality, security, costs

Thanks to intelligent software, modern checkweighers have expanded their range of tasks enormously. The possibility of weighing 100% of a production run has achieved a great deal especially with the aspect of statutorily-compliant production having long been in the foreground. Modern software enables not only comparative weight calculations, but also the continuous regulation of filling machines based on weight deviations. It can exert a decisive influence on quality, customer satisfaction, production costs and is a key factor in competition. This of course assumes that your requirements are implemented in the software solution.

2.2 Perspective 2: The right supplier

"Jack of all trades" and "yes-men" are just as undesirable in private life as in business life. Modern production systems are high speed production lines that impose enormous demands on each individual component. A solution that is expected to continually function one hundred percent, requires experience, detailed knowledge and creativity. It requires a supplier that takes his time and follows up in a focused manner. A terse "We are sorting it out" does not get it done. It will always be the goal of a good supplier to be a long-term partner in your production.

2.3 Perspective 3: The model documents

After personal discussion, understandable and comprehensive documents are the most important resource in the search for solutions. Active support in this area is critical whether this is for the preparation of a purchasing decision or later as accompanying documentation or service information. Exemplary documents are a must for every supplier. A good partner makes complete documentation available promptly. And what is more, faultless documents should be available not only in German or English, but also in the languages that your employees speak.

3. Promised!
Does the checkweighing software solution deliver what the supplier promises?

The difference between theory and practice is the end result. Often, much is promised but little is delivered. Someone who installs and operates numerous practical solutions inevitably gains practical experience and solution expertise. Simple installation procedures, reliability, services and sophisticated applications in weighing technology are based on proven expert knowledge. In order to get a comparison with the company’s own operating targets and requirements, it is necessary to provide an overview of the software facilities available in standard commercial weighing technology. The aspects presented below are not supposed to be just an initial overview, but should also help you to check your own requirements.

3.1 Aspect: Handling and user friendliness

Simple, understandable and reliable – that is the requirement nowadays for basic checkweigher operation. In this context, the control console becomes the central reference point. A user-friendly operating interface must satisfy the requirements of the modern working world: fewer specialised employees and more multilingual machine operators mean that simple, multilingual solutions that are reliable to operate are required.
• Pay attention to the display and input functions!
Clearly visible, easily understandable and simple illustrations on the user interface are crucial. An intuitive menu-driven system should be standard, as should the largest possible selection of languages. Thanks to configurable “user profiles”, product changeovers and modifications to other system settings can be carried out quickly and with the minimum of downtime. Depending on the requirement, it must also be possible to use operator terminals while wearing protective gloves or under poor lighting conditions in an operationally safe manner. Some global trade relationships require that Chinese characters be used in the system. The internationally recognised standard “Pinyin” input option is only offered in very infrequent cases.

• Make sure that there is quick access to important information!
Only easily accessible and generally comprehensible user documentation ensures quick and harmonious familiarisation with machine operation and pro-actively prevents production errors and accidents. Standard operations, characteristics, functions and options of the checkweigher should be clearly documented and explained.

3.2 Aspect: Connectivity problems
It must be possible to seamlessly integrate a checkweigher into a production line – it should not require modifying the existing infrastructure! Modern checkweighers are designed in such a way that they can be adapted to the existing networks, data protocols or production management systems and not vice-versa. Only in this way can downtime and integration costs be avoided. This requirement is very important, particularly against the backdrop of the extremely large variety and complexity in today’s manufacturing companies.

• Pay attention to the requirements of the Fieldbus networks!
In the packaging industry, Fieldbus networks, such as DeviceNet, ControlNet, Ethernet TCP/IP or Profibus DP, have established themselves as the standards. A number of checkweigher manufacturers have developed interfaces for the standard commercially available programmable logic controller (PLC) formats in order to ensure flawless integration into the production line. The extent to which these manufacturers support PLCs must be investigated in each individual case. Serious suppliers describe the networking options and the degree of integration for each interface in an interface manual. Only in this way can a high level of automation technology be attained.

If a checkweigher is integrated in a Fieldbus network, then direct control via a PLC or a controller over a Distributed Control System (DCS) or Supervisory Control And Data Acquisition (SCADA) system is possible. The latter has proven very advantageous in practice, because only one control module is needed for all the machines that can be operated via the Fieldbus network.

• Look at the OPC requirements!
OLE for Process Control (OPC), as an open connectivity standard interface, is increasing in significance by virtue of the fact that it is independent of specific applications. It represents a bridge between many Windows®-based applications and the hardware of the process controller. Because the type of access remains independent of the type and source of the data, companies can freely choose software and hardware without having to worry about the availability of proprietary drivers. Practice has shown that OPC-compatible checkweighers offer the possibility of faster interface connection to SCADA systems – a clear time and cost advantage. Here again it is true that serious suppliers make an interface document for OPC servers available.

3.3 Aspect: Fill quantity checking
In filling processes, every gram counts, and in some cases even every milligram! With an optimised fill quantity control, the exact quantity prescribed is added, thereby reducing costs resulting from overfilling. Increasing raw material prices demand options and control possibilities that contribute to guaranteeing consistent products and maximum quality. These ensure not only enormous savings, but also brand protection and customer satisfaction.
• **Watch out for negative trends!**
The best way to prevent errors is to anticipate them and take the proper actions to prevent them. This ensures not only better and consistent product quality and easily achieved adherence to calibration specifications, but also a clear reduction of underfilling and overfilling – and therefore waste. With the so-called "Extended feedback control", this proactive approach is becoming reality. The statistical interpretation of the weight distributions in the filling of the products enables the automatic regulation of the filler so quickly that product weight errors and material waste are reduced to a minimum. (See chapter 4.1)

• **Watch out for weight fluctuations due to environmental conditions!**
Occasionally it happens that characteristics change very slowly in the course of production. For example, with paper products, the outside temperature and humidity can result in changes in weight occurring as a result of moisture absorption. If such environmental influences change product characteristics, it is advisable to have a checkweigher which is able to automatically detect and correct this situation. This requires special software, such as so-called "Gliding Limits", which can avoid unwarranted rejections caused in this way. (See chapter 4.3)

3.4 Aspect: Sophisticated product handling

The variety of the different product characteristics and influences that may have an effect during the manufacture of products leads to any number of danger points for seamless production. Solutions are required that keep the manufacturing process flowing stably. It is often avoidable little things that trigger complaints and returns from the customer: open flaps on a single package or a smeared barcode print have already compelled some customers to return complete batches resulting in costly reworking and scrap.

• **Watch for solutions that support a seamless manufacturing process!**
It is often trivial little things that interrupt a manufacturing process and cause additional costs. Solutions are therefore required that help to suppress this and thereby ensure safety and quality. If it is good if a checkweighing system is capable of promptly detecting products that are incorrectly positioned on the conveyor and rejecting them. It is likewise important if those packages for which the flaps are not correctly positioned are identified and removed from the manufacturing process. Today’s manufacturing processes, which operate at high speeds, also need systems that monitor the operations at all times, if necessary ensuring that the action has actually occurred. In this way intelligent countercheck software also ensures, for example, that products which are supposed to be rejected are actually removed from the process.

• **Watch for additional weight zones!**
A large number of applications and manufacturing processes require more than the three standard weight zones and their product counters. For these cases, an extension with up to four additional zones is useful. It is ideal if each zone can be assigned its own action.

3.5 Aspect: Data security

Statutory regulations and country-specific legislation, such as the Code of Federal Regulations: 21 CFR Part 11, require that data in production lines is protected, access to all equipment is monitored and records are generated. The security of manufacturing processes must therefore be ensured at all times. Modern checkweighing systems should provide solutions that ensure that only authorised operating personnel have access to sensitive areas and that corresponding verification records can be generated.

• **Pay attention to safety and traceability!**
In many sensitive manufacturing sectors it must be possible to trace every step in the production. Such solutions should be not only safe, but also easy to manage. Thus, it is useful, for example, if users can log into all systems using only one password. Documentation systems running in the background can facilitate the traceability. For centralised data analysis, it may be of great use here if all data from production is stored immediately on a central PC for further processing.
Pay attention to flexibility in data handling!
There are always situations in which data from ongoing production must be available elsewhere for further processing, for example, for printing or for generating statistics. If this data can be transported in encrypted form via a secure USB stick, this makes the entire production process easier. In addition, should the entire manufacturing system fail, a backup program on a USB stick would prove to be exceptionally valuable!

3.6 Aspect: Additional functions

Practice has shown that each checkweighing application is unique. The requirements stemming from the production situation, product characteristics, statutory requirements, company goals and quality demands constitute an individual mix for each. In order to attain an efficient and effective process, a broad range of functions and options is needed in the checkweighers. Whether as an individual measure or bundle of measures, their coordination must be precisely adapted and implemented for the individual situation. This demand requires a high degree of competence and experience on the part of the supplier.

Pay attention to statistics functions that help you!
Statistical analyses can be displayed, temporarily stored or printed out by various checkweighers. The printed output is certainly the simplest version of storage. However, anyone who wants to make use of data processing has to temporarily store and process the data. A modern checkweighing controller makes it possible to produce data records or printouts regularly. This can occur at certain times of the day, after a specific number of weighed products, when there is a change in the item parameter settings or by individual request. Serious checkweigher manufacturers offer their customers the latest statistical software for the specific country and for the respective set of requirements and body of regulations.

Pay attention to helpful detail functions!
Very often there are small programs that ensure an efficient and problem-free manufacturing sequence. For example, it is often necessary for quality reasons to take measurements after a certain number of products, or for samples to be drawn without the production and weighing processes being interrupted. This requires solutions to be implemented in software that cannot be mastered by every manufacturer. Options that appear trivial at first glance, such as automatic display of the measured weight as fill quantity (volume) or as the piece count contained in a product package, simplify the process monitoring to a very high degree – for operators as well as for production line managers. Sophisticated software solutions can provide these capabilities. Whether the product length is to be detected, an activity must stop after a certain number of errors, or a defined routine process stops at the end of a production cycle, a software program that can achieve this ensures the necessary safety and quality... ultimately for an optimised production process!

4. Exemplary!
The application determines the control method – and imposes high demands on software solutions. A key way to optimise filling processes is to conform to tighter tolerance limits. They represent reduced product waste and less follow-up work, because the filled products are within the prescribed weight range. This gives the accurately working checkweigher and its control possibility an important task. Control systems that enable quick and reliable fine-tuning of the filling heads make this process possible.

4.1 Feedback control in combination with statistics
In feedback control, the filling heads of the filling system are automatically adjusted as needed. The checkweigher thus directly controls the filling system to which it is connected. A mean weight is regularly calculated in a continuous process. As soon as this deviates from the target weight, a correction signal is sent to the filling system, which adjusts the filling quantity. An intelligent software enhancement then combines the feedback control with the statistical function of the checkweigher. In this context, the statistical mean values are taken into account in the control calculation. The combination of control and statistics ensures that at the end of the production...
cycle there is never a “statistical mean value” that is too low and that could entail official sanctions. This is how it works: as soon as the "statistical mean value" begins to deviate from the target weight, the feedback control is automatically activated. This is true even with weights that are correct for the currently weighed products.

The main advantage of this combination is that the target weight comes considerably closer to the weight marked on the pack. The fill levels are actively changed so that at the completion of the production cycle the mean value – it is normally slightly above the value on the label – corresponds to the target value. Moreover, continuous checking of the mean value obviates manual fill level settings for maintaining net weight requirements at the end of a production run.

4.2 Optimum overfilling

Such a function continually calculates the optimum values for mean value and nominal weight. The calculation is not only based on the standard deviation determined by the checkweigher and the normal weight distribution pattern. Beyond that, it takes into account that, depending on the applicable specifications, a certain percentage of the production (typically 2%) may be below the T1 limit value (see illustration further below).

At the beginning of production, the nominal value is automatically set in order to utilise the permissible leeway (e.g. max. 2% of the products with a weight of less than T1). An automatic start signal instructs the filling machine to be oriented to the new nominal weight during filling. The following illustration shows the settings at the beginning and their change in the course of production. The goals are a reduction of overfilling, closer approximation of the nominal weight to the labelled weight, and optimum utilisation of the legally permissible percentage of products having a weight less than the T1-limit value.
The expanded feedback control – Advantages at a glance:
- It permits perfect adaptation of the filling process. The consequence: minimisation of product waste.
- It is in direct communication with the statistics program and ensures an ongoing mean value check.
- It leads to the actual weight (product weight) automatically converging toward the published weight.
- It ensures even easier compliance with legal provisions and rules for net package contents.
- It does not require any manual resetting of the fill level at the end of the production run.
- It contributes to an extremely high and consistent product quality.

4.3 What can be done in the case of gradual weight change due to environmental influences?

There are solutions for this too. “Gliding Limits”, also referred to as “Mean Value Tracking”, provides protection from the incorrect rejection of packages that contain the correct piece count but have a deviating weight. When there are long-term changes of the mean value, the limit values of the individual weight zones are tracked to the mean value (mean package weight). This software, based on measured trends of long-term and short-term mean values, detects how they must shift the preset nominal value and the limit values (tolerance limits) of the weight zone in order to compensate for this change. The “Gliding Limits” software automatically increases or reduces the preset internal tolerance limits within the predefined limits at article setup. As a consequence, fewer rejects provide a stable manufacturing process and financial savings.

5. Informed!
Software decisions require information

Making the basic decision for a checkweighing system – and with it a supplier – requires a fundamental analysis of production requirements. This is not always easy, because many things are assumed, on the basis of practical experience, to be obvious and known – they are discussed rarely, if at all. It becomes clear again here that the serious supplier actively looks after the customer’s interests: from the culture of open dialogue that develops knowledge, to the information database with download facilities on the Internet. But only someone who actively engages his supplier in discussion and makes himself available for questions and answers will be able to fully exploit the possibilities for optimisation.
A serious producer keeps informative documents available for every phase of decision-making:

- Leaflets and brochures
- Production database with search function
- Data sheets with technical information
- Case studies from various branches of industry
- White papers with general solutions
- Webinars for interactive dialogue
- Software tools (such as Total Cost of Ownership (TCO) calculator)
- Expert discussion

**Tips from practice** – Run the acid test and identify your high-performing and competent suppliers:

- Does the supplier activate his software options for a test period of e.g. 30 days to enable a thorough test?
- Does the supplier present the advantages of his user interface on a laptop (e.g. using demo software) and so give a realistic impression?
- Does the supplier offer to adapt his software options or write new software for a special solution, and in that way prove his competence and experience?

### 6. Comments/sources

Expand your knowledge about checkweighing

METTLER TOLEDO has wholeheartedly dedicated itself to the development of highly qualified and reliable weighing and measuring solutions in the areas of industrial manufacture and logistics. For additional information, please consult our latest product and solution overviews, which you can download or order at no cost.

Find the right solution for your specific requirements – from food processing to the production of drug ingredients, pharmaceutical formulation, petrochemical plants as well as polymer plants, shipping, receiving and storage, through to the heavy machinery – regardless of whether you are seeking a laboratory application or a solution suitable for industry: we make our experience and our knowledge available to you.

Industrial equipment and software from METTLER TOLEDO make it possible to optimise your processes, from goods receiving to delivery with solutions for the many areas of production, final inspection, and logistics. The advantages include improved product quality, accelerated and automated processes, increased efficiency and conformity with legal requirements. Many of our solutions can be directly integrated into ERP systems.
New!
Checkweigher software compendium
The checkweigher software compendium describes software functions and options for achieving easy navigation as well as optimisation of the checkweigher system. It supplies a comprehensive overview of the equipment features of the checkweigher models in the X series. The compendium can help producers, for example, shorten the retooling times when changing the production line. Furthermore, there are solutions for improved fill quantity checkweighing, perfect product transport and maximum data security.

www.mt.com/garvens-software

Guidelines for weighing technology
Creating an effective checkweighing program
The Garvens manual "Principles of checkweighing" is recommended as a reference document. It offers insights into all aspects of checkweighing, starting with the basic principles up to the implementation of a comprehensive checking program.

This 70-page FREE manual helps producers as a companion document for setting up such a weighing program and is required reading for everyone who has anything to do with checkweighing systems.

www.mt.com/cwguide

Calculators
ROI calculation for in-line checkweighers
This calculator helps you to calculate the amount of savings you can achieve by minimising overfilling and waste. It includes a sample calculation.

www.mt.com/garvens-roi

Manual or "in-line" weighing?
With a comparison of manual and dynamic weighing, this calculator helps you to decide whether replacing a static scale with a dynamic scale is more profitable for you.

www.mt.com/garvens-dynamic

Whitepapers
Overall Equipment Effectiveness OEE
This white paper provides a detailed description of the overall equipment effectiveness and demonstrates using a simple calculation how you can increase productivity at a low expense.

www.mt.com/garvens-oee

Principles of hygienic design
This white paper covers all aspects of hygienic design of checkweighers. The last chapter describes a tool that assists you in the assessment of hygiene requirements.

www.mt.com/garvens-hygiene

Optimising filling systems
This white paper relates to usual problems with filling, and offers tips and solutions for optimising the fill quantities. This has a direct effect on quality and cost-effectiveness.

www.mt.com/garvens-filler

Calculating the Total Cost of Ownership
This white paper explains in detail the factors which must be taken into consideration when calculating the TCO for production line equipment. It lists and explains in detail the critical costs, the savings which can be accrued and the support you should expect from your supplier.

www.mt.com/garvens-tco

On-demand webinars
Those who are interested can access on-demand webinars, around the clock. You can obtain specific information about types of use and products, learn about everything related to branch trends and standards, and find useful and informative illustrations.

www.mt.com/pi-ondemand

Available webinars on checkweighing are listed below:

- Maximise your profits through intelligent weighing technology
- High performance checkweighing for optimum overall equipment effectiveness
- Pharmaceutical serialisation – selection of the right equipment supplier
- Weight measuring for the improvement of your products and processes
Contact:
If you are seeking additional information about dynamic checkweighing solutions, please contact METTLER TOLEDO:

Australia – Mettler-Toledo Ltd., Victoria 3207
Austria – Mettler-Toledo GmbH, 1230 Vienna
Belgium – N.V. Mettler-Toledo S.A., 1932 Zaventem
Brazil – Fabbrima Máquinas Automaticas Ltda., Guarulhos, SP
Bulgaria – Romy Tech, B, Prolom St., 1113 Sofia
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