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Engineering in Electronics

INFORMATION ON SAFE DOORS/GATES EN 12445 EN 12453

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(report by MICROTRONICS engineer, Mr Biason)

CAUTION!!

You are advised to follow the "good use and safety at work" rules, and remember that the illustrations provided, together with the presence of the expert technician, should be considered a helpful, practical example, to assist the installer when using the gauge.

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BRIEF EXPLANATIONS AND APPLICATION OF EUROPEAN STANDARDS EN 12445 and EN 12453

LIABILITY AND LEGAL REQUIREMENTS

- May 2005 marked the end of the transition period for the gradual adaptation to European standards concerning EC marking on doors and gates. As a result, it is now **strictly prohibited** to release industrial, commercial and garage doors and gates onto the market without the CE marking.

- The CE marking requirement renders the manufacturer responsible through the declaration of conformity it supplies with its products, which indicates compliance with EU directives. In the case of industrial, commercial and garage doors and gates, the general reference standard is UNI EN 13241-1, which, if observed as intended, allows the manufacturer to enjoy presumed conformity with the following directives:

- Building Product Directive 89/106/EC (for all types of doors and gates)
- Machine Directive 98/37/EC (for power operated doors and gates)
- Electromagnetic Compatibility Directive 89/336/EC (for power operated doors and gates)

- When the CE mark is affixed to the product, this indicates that all the legal requirements regarding quality and safety have been correctly met and are documented in the Technical File and the Declaration of Conformity.
- Of course, and without wishing to detract in any way from the quality requirements, emphasis must be placed above all on machine safety and therefore on the prevention of risks such as crushing, shearing and trapping.
- Take, for example, a normal automatic gate: obviously, **the installer is directly liable for any damage to people or things caused by the gate** as the installer effectively built the machine, by assembling the electro-mechanical parts from scratch (motor, gate, signalling and protection devices, etc.) in a final set-up which can never be considered a standard product, as each gate assembled is actually a new machine in itself. This means the installer, in its capacity as manufacturer of the "automatic gate machine" , has the following duties:

- 1)**To carry out the work professionally** using appropriate components (which must all be individually marked with the CE standard) in compliance with the requirements of UNI EN 12453:2002.

- 2)**To perform all the tests required, on the end product,** to check operation of the safety and force limiting devices, as laid down by UNI EN 12445:2002.

- 3)**To draft the Technical Folder,** which must include all the technical documentation, an outline of the measures taken to guarantee machine safety and, finally, the test reports (including the force measurement reports).

- 4)**To draw up and sign the EC Declaration of Conformity,** which must be issued to the Customer.

- 5)**To indelibly affix the CE marking** to the product (using a metal plate or other means).

- It must be stressed that the application of the aforesaid standards should not be viewed as a cumbersome bureaucratic burden; instead, it should be considered **an opportunity to valorise and enhance the installer's work** on automatic doors and gates, not only from the point of view of the better quality service provided, but also in preparation **for a potential new, large market**, i.e. all the automatic gates already fitted whose safety will now need to be brought up to standard.

SAFE DOORS/GATES

- Naturally, the main safety issues are connected to the moving parts and the impact and crushing force generated by the electric motor, which is potentially extremely hazardous to people and things.
- Regarding this, EN 12453:2002 lists, in detail, all the possible dangerous situations that should be taken into consideration in order to adopt suitable precautions; these range from the risk of crushing, shearing, trapping, and impact, through to the problems that may arise in the event of a power failure or when power returns unexpectedly.re l'energia elettrica oppure quando quest'ultima dovesse ritornare inaspettatamente.

- Additionally, the standard suggests the most suitable measures to take to make doors and gates safe. Like, for example, the creation of safety distances, the installation of protective barriers, the elimination of dangerous protruding mechanical parts, and the adoption of automatic force limiting systems.
- It is precisely this area, **force limitation**, that plays a fundamental role in safety issues, since it concerns **the harmlessness of automatic doors and gates**, as the majority of risks are posed by the motorised drive.
- Going back to the example of the ordinary automatic gate, let's see what basic measures the installer should take, from the start, to be sure all the impact and crushing risks have been reduced to the minimum:

- **1) Guide the Customer through the gate selection process,** recommending, where possible, lighter models and those with a simple structure and no cutting edges, dangerous jutting parts or slots that could pose a trapping risk.

- **2) Install one of the latest generation motor models available,** equipped with an electronic force-feedback control. Where these motors are concerned, the models most commonly available on the market are DC motors.

- **3) Follow the assembly instructions exactly:** this applies to both the motors and any safety devices recommended by the automation manufacturer

- If all these suggestions are followed, it is reasonable to assume that the end product will be perfectly capable of passing the tests envisaged by UNI EN 12445 in "Industrial, commercial and garage doors and gates; Safety in the use of power operated doors; Test methods"

FORCE TESTS PROVIDED FOR BY EN 12445

- The tests envisaged serve to check the product's conformity with the requirements of EN 12453. Let's have a closer look at the force measurement test methods.
- The forces must be measured using a specific gauge, which is described in detail in the said standard. This gauge must have certain, clearly defined, size, mechanical and accuracy characteristics, as the tests must provide concrete, reliable and repeatable results.
- Microtronics offers an innovative line of EN 12445-compliant force gauges, which starts, at the top end, with the Blue Force, which features the market's most advanced technology, and goes through to the practical and inexpensive Speed Force; both are equipped with fully-developed software which simplifies the testing and final report drafting process remarkably..

- The risk situations linked to closing force are attributable to two fundamental mechanical/physical aspects

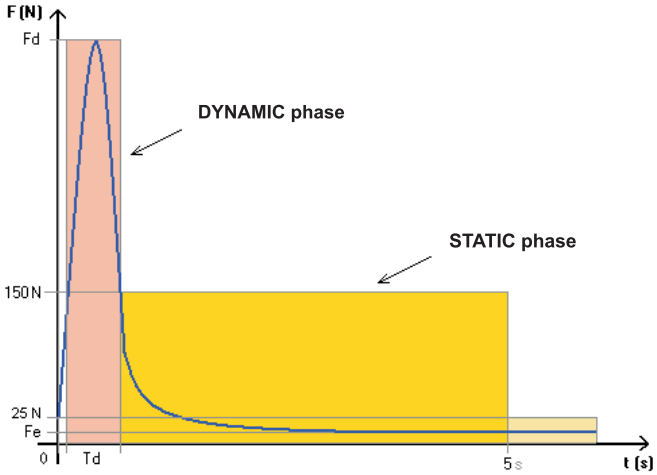
- 1) DYNAMIC PHASE: the kinetic energy released at the time of the actual impact, which is proportional to the gate's weight and, above all, the square of the speed:

$$E_c = \frac{1}{2} m v^2$$

- 2) STATIC ASPECT: any crushing force that may be generated by the motor, in the instants following the impact.

- EN 12445 stipulates that the gauge must be positioned so as to block the gate's trajectory, before the closing point, "registering" the course of the force (measured in Newtons, i.e. 1 kg_weight = 9.8 N) for a period of at least 5 seconds, starting from the initial instant the 25N threshold is crossed. Let's look at the graph below, which shows the simplest situation that could actually arise.

- **Figure 1**
  General Force Time Diagram



- In this particular case, the DYNAMIC phase is easily distinguishable and is marked by the peak in force due to the initial impact. The following parameters and respective limits are characteristic of the dynamic phase:

- **1) Fd:** the maximum force value ("dynamic force") must be below 400 or 1400 N, depending on the location of the measurement point and the type of gate/door.

- **2) Td:** the period during which the force exceeds 150N ("dynamic time") must be below 0.75 seconds.

- From a strictly practical point of view, the Fd (dynamic force) and Td (dynamic time) parameter restrictions (DYNAMIC phase) can only be obtained by slowing down the gate's motion, using the special adjustment control which the motor should feature.
- It is likewise clear that the **application of the so-called "sensing edge" does not exempt the gate from the force tests.** Take, for example, a normal sliding gate: The sensing edge might intervene too late to limit the gate's kinetic energy, because the motor would not be able to invert the motion quickly enough. **So, one possible solution is to fit a motor equipped with a** (closed loop) **electronic speed control**, and calibrate it in situ, using the force gauge to check, on each occasion, the accuracy of each adjustment.
- After the dynamic phase comes the STATIC phase, which begins when the force drops back below the 150N threshold and ends 5 seconds after the initial instant. This phase is essentially characterised by the motor's crushing force:

- **1) Fs:** the (average) force value, calculated from the end of the dynamic period through to 5 seconds from the initial instant. This must not exceed 150N.

- **2) Fe:** the final force value (measured 5 seconds after the initial instant). This must not exceed 25N.

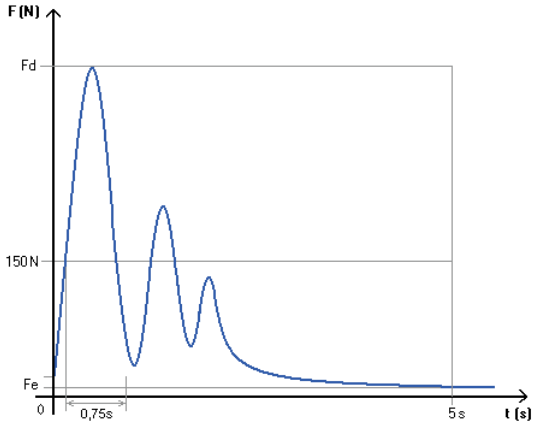
- In other words, the legislation stipulates that, following the impact, the motor's drive must drop and remain, on average, below 150 N, before finally ceasing completely (or at least falling below 25 N) within 5 seconds of the initial instant. Also in this case, **the problem can be easily solved by fitting a motor equipped with a closed loop electronic control.**

Fd (dynamic force) limits	Closing distance: 50, 300, 500 mm	Closing distance: >500 mm
Horizontal sliding gates/doors	400 N	1400 N
Rotating door with axis orthogonal to the ground	400 N	1400 N
Up/down door	400 N	400 N
Rotating door with axis parallel to the ground	400 N	400 N
Barriers	400 N	400 N

EVALUATING THE FORCE TESTS

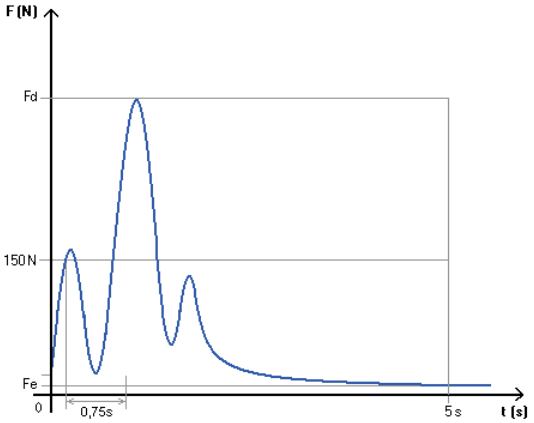
- In the previous paragraph, the graph in Fig.1 was chosen for ease of understanding but in practice it is not representative of all power operated doors. In a real situation, the graph lines encountered are unlikely to be so straightforward, in which case their evaluation should not only take into account the numerical values of the four parameters, but above all should involve an interpretation of the entire course of the force, based on the tester's common sense and experience.
- Let's look at the two examples below (Fig.2 and Fig.3), which represent a situation that occurs often with normal up-and-over garage doors:

- **Fig.2**



- Of course, given the intricacy of the graphs it is impossible to evaluate the tests using just those four standard parameters: how low does the dynamic phase last? Is it right to limit it at the first force peak? And what if (see Fig.3) another peak, with a greater amplitude, should occur?

- **Fig.3**

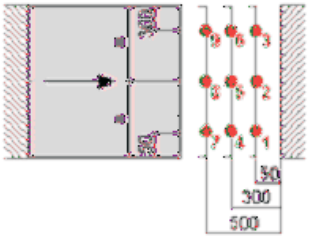


- **EN 12453 expressly states that, in these cases, the graph must be observed**, and the following rule applied: "following the dynamic phase, force peaks with an amplitude of over 150N are admissible as long as they are on a descending course and are no more than 1 second apart". As a result, the test shown in Fig.2 would give a POSITIVE result, while the one in Fig.3 would give a NEGATIVE one**.**

- Microtronics' BlueForce gauge is specially designed to meet all the standard's requirements, as well as to make the installer's job quicker and easier: thanks to the pocket PC's colour touch-screen display, the user can immediately view the graph of the force measured, test by test, accompanied by the four parameters calculated and a positive or negative result symbol, which the software supplies automatically.

- Now let's have a look at an example of how to perform the force tests.
- Let's go back to our power operated sliding gate example.
- EN 12445 expressly stipulates nine measurement points for this type of gate: three points located (horizontally) at the following distances from the stationary edge: 50, 300, 500 mm, with measurements taken at three different heights (50 mm from the bottom, 300 mm from the top, and mid-way between the top and bottom of the gate).

- **Fig. 4**
  Sliding gate measurements



- What is more, according to the standard, three measurements must be taken for each test position, the arithmetical average of which should be used for the testing purposes.

- Also in this case, the software contained in the BlueForce pocket PC can be of help to the tester as it includes all the legislation and the instructions on the force measurement points and methods, for all types of gates and doors.

- Having a handheld PC at the user's disposal clearly simplifies the test cataloguing work considerably, as the software automatically allocates each measurement point a progressive number, and adds the date and time of the test, and even more helpful it allows a short descriptive text to be entered, or a mnemonic code.

- Finally, the test session ends with the printout of a report summarising all the measurements taken, which represents an essential part of the technical file. According to legislation, the report must contain all the test results, along with all the data required to identify the door or gate, the installer and the tester, as well as the gauge serial number and calibration date.

- The following pictures show various stages of measurement at different positions on a sliding gate:
- **1** ideal gauge positioning, **2** measurement at a distance of 5 cm at mid-height, **3** measurement at a distance of 50 cm at mid-height, **4** assembling the accessories, **5** detail of the "sensing edge", **6** checking the data using the pocket PC.

- The following pictures show various measurement stages, at different positions on a sectional garage door:
- **7** measurement at opening distance of 5 cm in mid position, **8** measurement at a distance of 30 cm in mid position, **9** measurement at a distance of 1.3 m in mid position **10** reading the data on the gauge display, **11** transferring the data to the handheld computer, **12** detail of the angular accessory.

KEEPING AFLOAT IN THE SEA OF LEGISLATION

- Let's draw this brief overview of standards EN 12453 and EN 12445 to an end by summing up the essential points covered:

- At present, installers of industrial, commercial and garage doors and gates are required by law to:

- *Affix the CE marking to the door/gate*

- *Issue a Declaration of Conformity*

- *Draw up a Technical File (accompanied by force tests, since the door/gate in question is power operated).*

- To make it easier to meet the requirements of EN12453, it is advisable to install one of the latest generation motors, equipped with an electronic closed-loop force control.
- To perform the force test as provided for by EN 12445, the use of a specific gauge is compulsory.
- To obtain the results, the tests must be evaluated using the force/time graph, not by simply considering whether or not the limits of the numerical parameters have been met.

SPECIMEN CE MARKING

- The CE marking on the automatic/automated doors/gates must state, indelibly and in a clearly legible from, the following information:

Commissioning technician: .....

Address: .....

Model: .....

Serial n.: .....

Installation year: .....

Dimensions: (LxH): .....

Weight (moving parts): .....

CE

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EC DECLARATION OF CONFORMITY

CE

■ The undersigned:

Name .....
Address .....

■ in my capacity as commissioning technician, declare that the following product:

Door/Gate Model .....
Type .....
Serial n. .....
Location .....

■ complies with the provisions of the following EU Directives:

Machine Directive 98/37/CE
Low Voltage Directive 73/23/EEC and subsequent modifications thereto
Low Voltage Directive 73/23/EEC and subsequent modifications thereto

■ Furthermore, I declare that the following harmonised standards and relative technical specifications have also been applied:

☐ EN 12604: Industrial, commercial and garage doors and gates Mechanical aspects - Requirements and classification
☐ EN 12605: Industrial, commercial and garage doors and gates Mechanical aspects Test methods
☐ EN 12453: Industrial, commercial and garage doors and gates Safety in the use of power-operated doors - Requirements
☐ EN 12445: Industrial, commercial and garage doors and gates Safety in the use of power-operated doors Test methods
☐ .....
☐ .....

■ Enclosures: Technical File

Place ..... Date .....

Purchaser ..... Declarant .....

TECHNICAL FILE list of documents

- The Technical File must be drawn up by the installer and must be looked after, and kept available to the competent authorities for at least 10 years from the power-operated door or gate's manufacturing date.
- N.B. (the Technical File normally contains a large number of pages, nevertheless, many documents may also be stored in an electronic format)

CONTENTS:

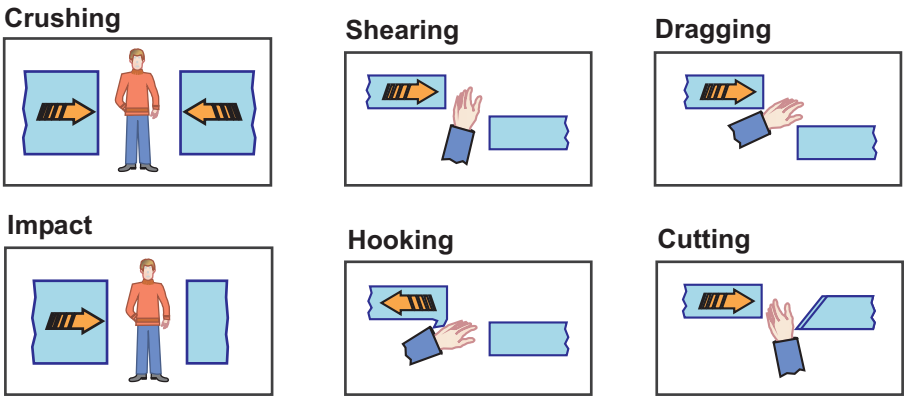
- General arrangement drawing of the power operated door or gate
- Wiring and control circuit diagrams
- Risk analysis, including: The list of requirements (as provided for by the Machine Directive) and the list of risks with the relative solutions adopted
- Force test report (tests must be carried out using the specific gauge)
- Installation and Maintenance Manual
- Instructions for use (with one copy for the purchaser)
- Maintenance Register (with one copy for the purchaser)
- EC Declaration of Conformity (with one copy for the purchaser)
- Label or plate (to affix to the door or gate)

RISK ANALYSIS:

- This document must contain a detailed list of the possible risks that an automatic door or gate may pose and the solutions adopted to eliminate or reduce the danger.

- The Machine Directive envisages the following definitions:
- **Hazardous areas**: any area inside and/or in the vicinity of a machine within which the presence of an exposed person constitutes a risk for the health and safety thereof.
- **Exposed person**: any persons found fully or partially inside a hazardous areas

TYPES OF RISK LINKED TO THE MOVEMENT OF THE DOOR/GATE

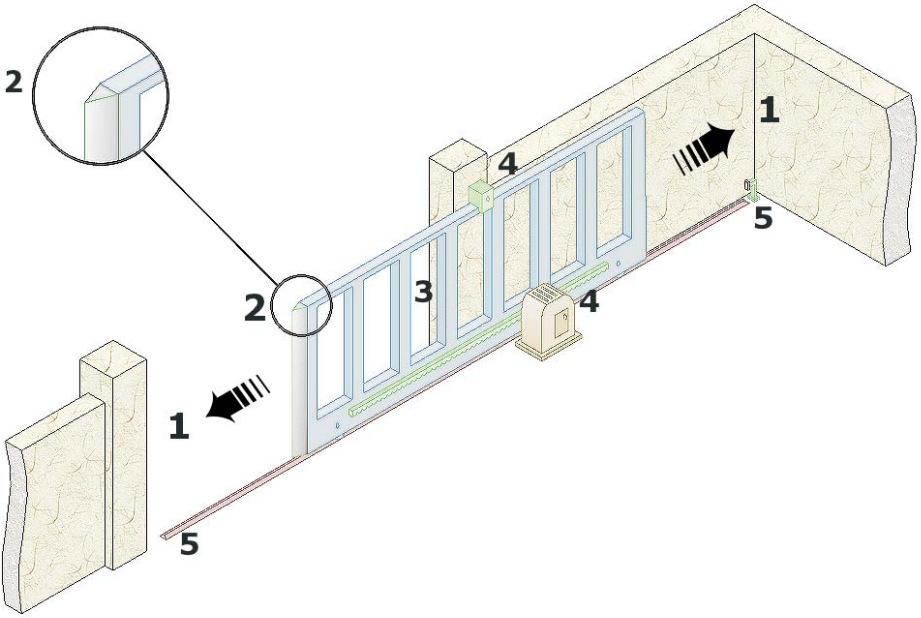


RISK ANALYSIS (AREAS TYPICALLY AT RISK)

■ Parts / Installation Inspection Overview

■ Legend:

1) Risk of Impact/ Crushing
2) Sensing Edge (Active /Passive Safety Device)
3) Risk of Shearing/Dragging
4) Risk of Snagging/Dragging
5) Risk of Tripping



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