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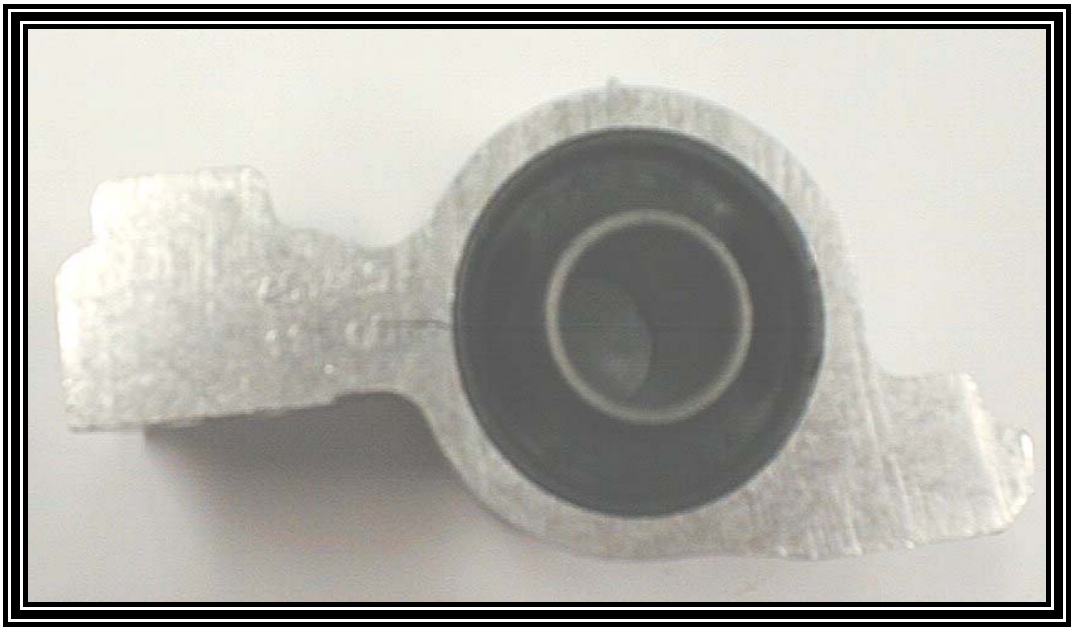
CRACKS DETECTION ON METAL PARTS BY ACOUSTIC EMISSION



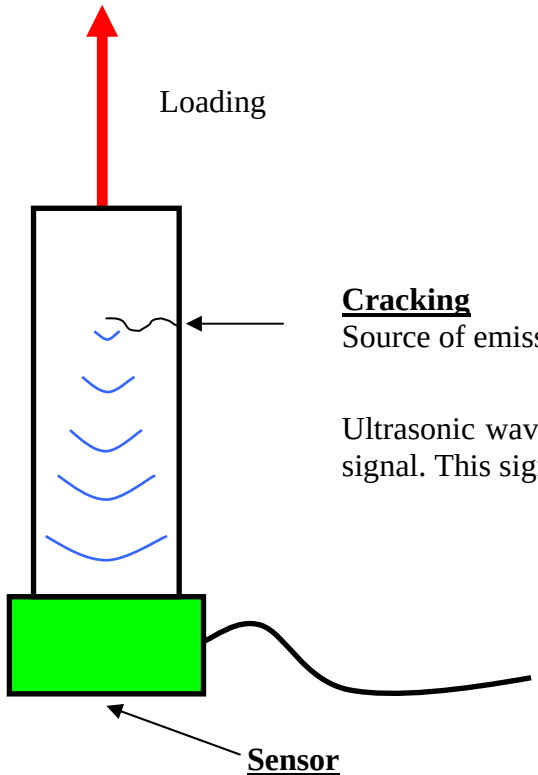
Abstract

Control by acoustic emission during fitting of a bush in a metal part has been selected to detect cracks on the production post. This is the criterion amplitude measured during the growing stage of the fitting's effort which is used. The industrial putting in place of the modulus has showed that this control is efficient to discriminate all wrong parts (containing potentially a defect) with a 0.3 % rate of good parts rejected.

Summary

I- Acoustic emission principle

The acoustic emission is the phenomenon of creation of transitory elastic waves resulting from local internal micro-displacements due to a defect in a material under loading.

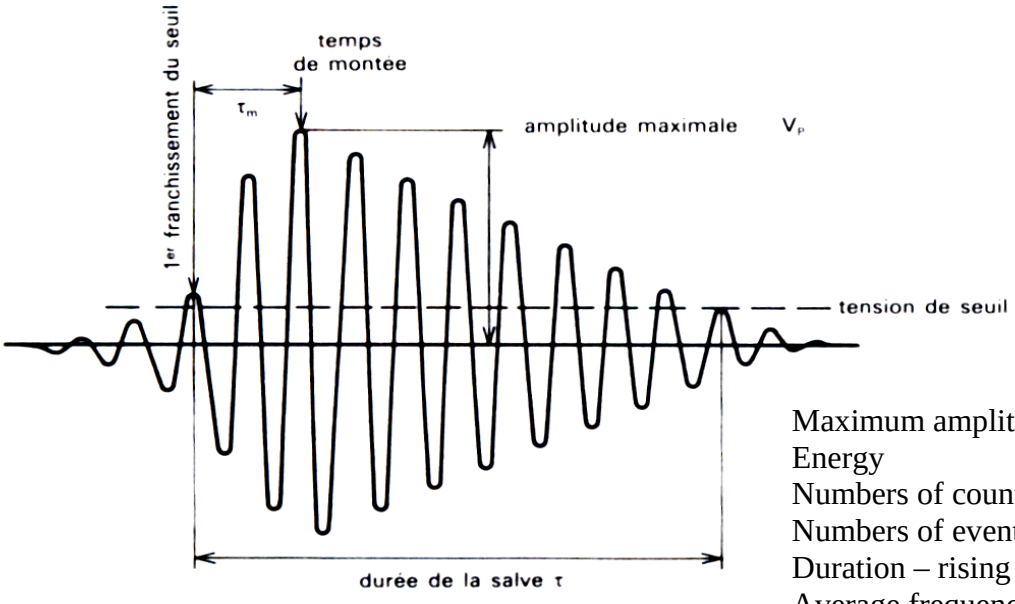


Cracking
Source of emission of ultrasonic waves

Ultrasonic waves are detected, transformed and conditioned in a electric signal. This signal is examined to extract easily different AE parameters.

Sensor
Mechanical energy transformation into proportional electric signal

Observed parameters

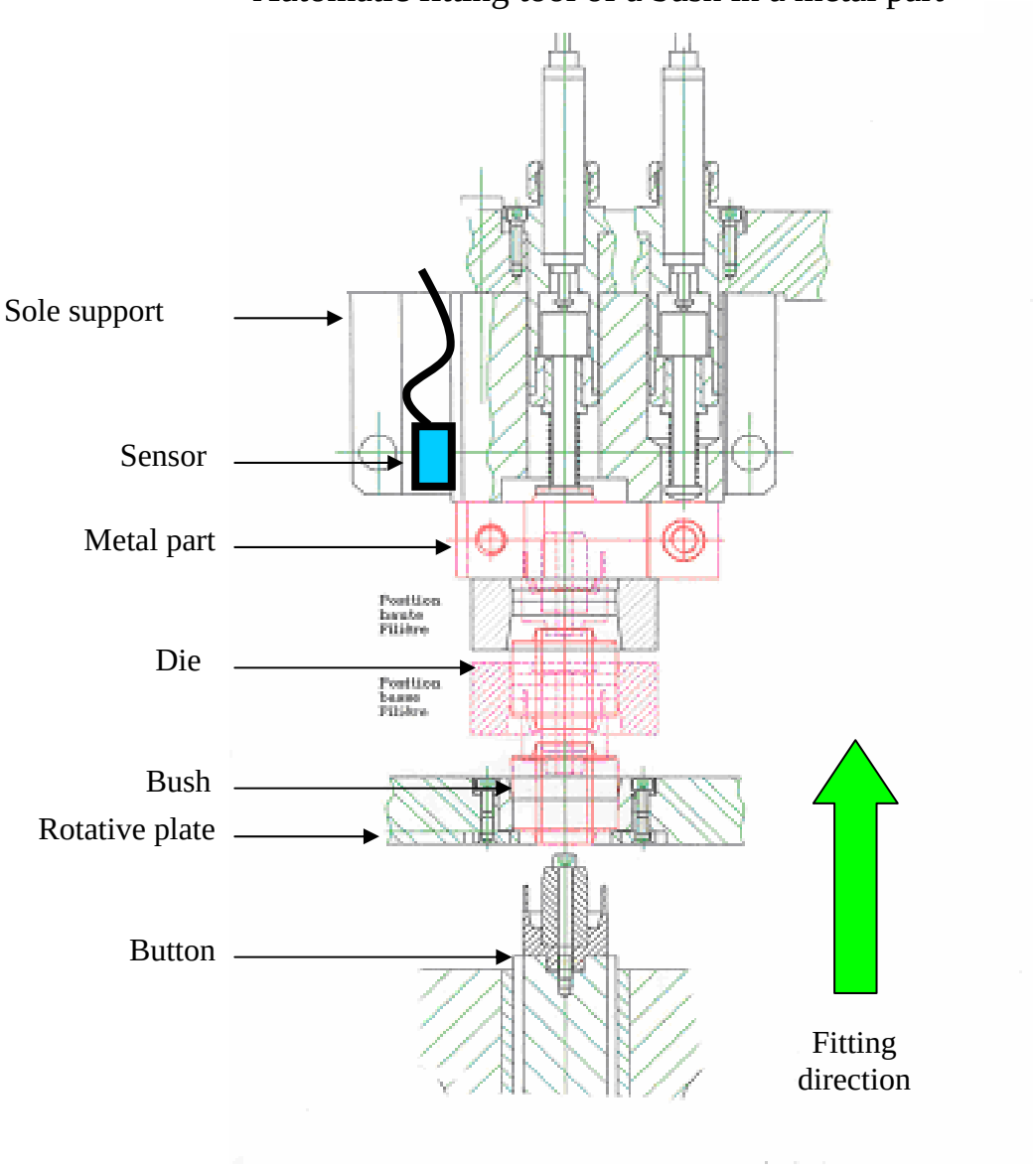


Maximum amplitude
Energy
Numbers of counts
Numbers of events
Duration – rising time
Average frequency

II- Measure principle

The cracking detection system of the part has been installed on the automatic fitting post. In fact, this is during this production stage that the part cracks, at this moment, it's possible de discriminate all wrong parts by this technique.

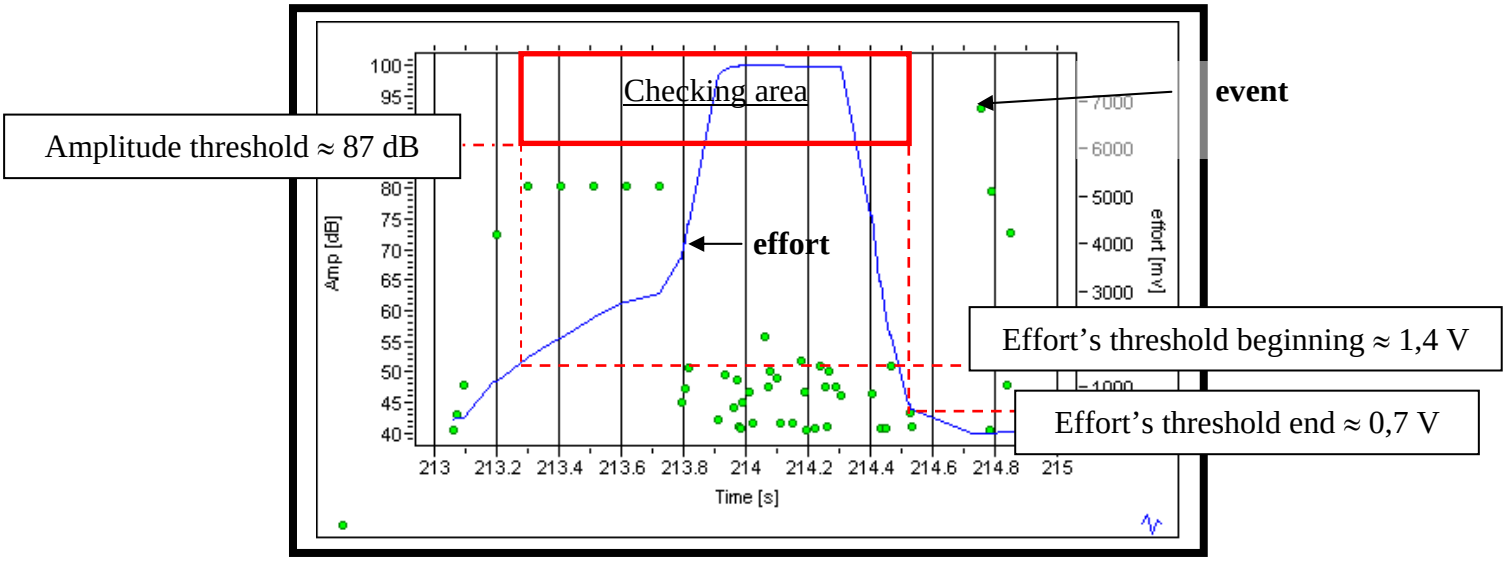
Automatic fitting tool of a bush in a metal part



Ultrasonic waves which are generated by the aluminium part are detected by the sensor trough the sole support. This part is used as a guide waves. It separates the sensor from the part and simplify the industrial putting in place.

When a part cracks, generated acoustic emission is great, the amplitude measure is superior to 87 dB. Furthermore, to avoid to take into account parasitic acoustic phenomena, only acoustic emission created in versus of fitting's effort is examined.

This graph defines the checking area and different criteria used :



The checking area is define by an amplitude threshold of 87 dB and by 2 effort's thresholds, one for the beginning and the other one for the end.

These two efforts allow to avoid problems due to small signal's oscillations and reduce the impact of an amplitude drift.

Indeed, when one or more events with an amplitude superior to 87 dB are detected in the checking area, the metal part is considered wrong and must be separated.

III- Results

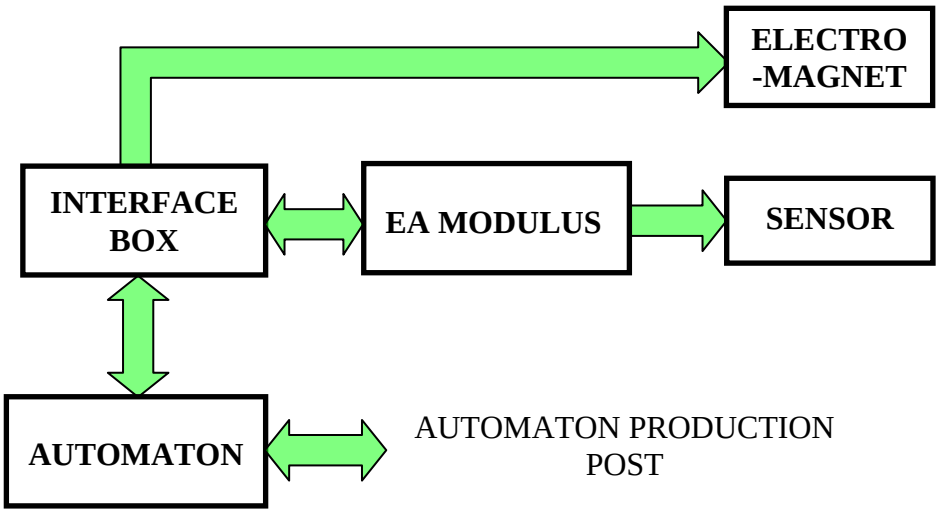
System was validated on one batch of wrong brackets which came from the supplier.

All the brackets with cracking have been detected.

The system is operating since march 2002, it rejects too between 0.3 to 0.8 % of good brackets : these parts are recycled after visual control by operator.

IV- Main functions description

This diagram represents the main functions of the cracking detection system.



ELECTRO-MAGNET : this part is used to check the measure line in good working order. In fact, when you activate it, the moving part touches the sole supports and generates ultrasonic waves. These waves which have an amplitude superior to 90 dB are detected by the sensor and passed on the measure line. So we can keep the system in good working order.

SENSOR : the sensor is the sensitive element to ultrasonic waves. It transforms the mechanical signal in a proportional electric signal and allows to analyse the acoustic emission.

EA MODULUS : this part allows to filter data in versus of an amplitude threshold. This modulus allows to detect signals which have an amplitude superior to a predefine threshold of 87 dB and to transmit this information to the rest of system.

INTERFACE BOX : this box allows to carry out different functions. The adjustment of the detection's threshold around 87 dB, the putting of the maximum amplitude checked during the test, the order of the electro-magnet allowing the control of the measure line, the counting of rejected parts by acoustic emission and the putting of the result of the last control. This box must be accessible to operators to allows to check the system in good working order.

AUTOMATON : the automaton treats the information from the modulus via the interface box. In comparing acoustic emission and the effort's signal, it interprets data and returns to concerned components (automaton production post and interface box) information about the state of the checked part.

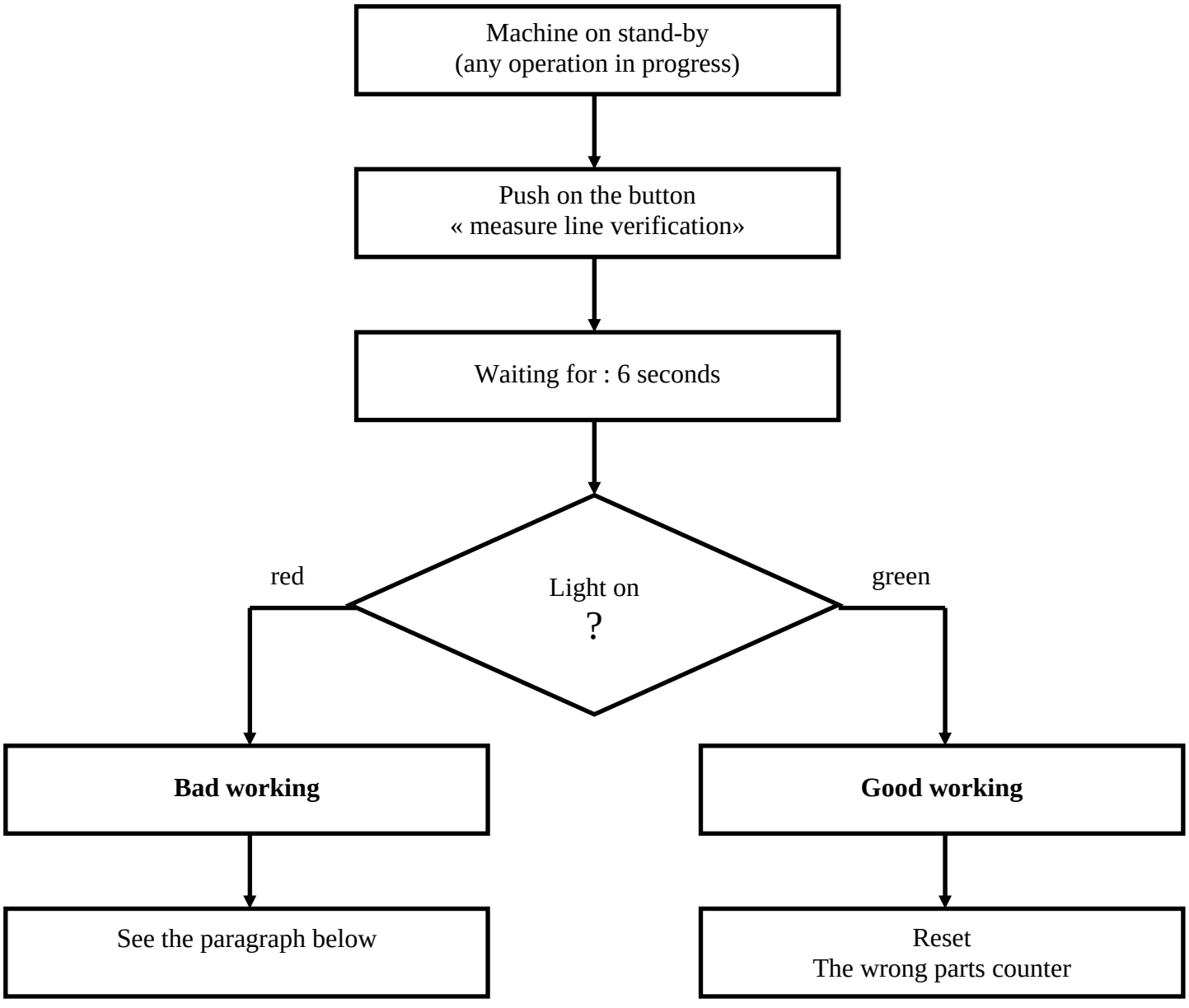
V- Procedures

The following procedures allows to check the system in good working order and assure the maintenance of tool and repairing if it becomes necessary.

At the beginning of production time.

The operator must verify if the system is in good working order. For that, the procedure “measure line verification” must be applied.

This verification is described below :



When a bad operation is detected (red light on during “measure line verification”), the following instructions can allow to find the good working order for the system.