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Aspects regarding some equipment used to research the drawing process

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Abstract. This paper presents some equipment used to measure certain parameters of the embossing process, such as deformations, forces, pressures and others. The studied physical phenomenon is picked up by the transducers, then through the signal conditioning system it is transferred to the data acquisition board, from where it reaches the computer, being processed with the help of the installed software.

Keywords: transducers, electronic tensometer, oscilloscope, data acquisition boards

Introduction

In the optimal development of the drawing process it is important to know some parameters such as: distances, forces, pressures, torsions, deformations and vibrations. Their sizes are determined with the help of the equipment presented below.

1. Used equipment

In the specialized literature were used different equipments for the study of the dependence and the way of variation of the different sizes according to certain parameters, which appeared during the development of the processing process. Some of these are presented below.

Kobayashi [3] proposed and developed a friction simulation device to measure the coefficient of friction at the tip of the hemispherical punch and a die with which the processing was done, determining the critical depth of deformation h_{cr}.

Tulcan [5] compiles a calculation algorithm and a program in QBasic for the calculation of tape accumulators, for the proper operation of automatic cold pressing lines. This program allows you to set the operating time of each machine, minimizing the number of stops. For optimal line operation it is recommended that the control press be slower than the rest of the controlled presses [4].

Han [2] presents the diagrams of two equipment designed to determine the coefficient of friction at drawing, respectively at stretching and bending.

[6] describes the basics of computer data acquisition (DAQ). This way of working is widely used in research, testing and measurement laboratories as well as in industrial automation (Fig. 1 [6]). Many applications use data acquisition boards that transfer data directly to the computer's memory. Other applications use acquisition boards, blocks, separately powered that communicate computer data via the parallel or serial port. Obtaining accurate data from a PC using a data acquisition system depends on each of the following item subsystems: computer; transducers; signal conditioning system; data acquisition board; software.

Transducers are elements that transform a physical phenomenon into an electrical signal; for example: a) thermocouples, thermistors - transforms the temperature variation into an analog signal which the DAQ (Data Acquisition) system can measure it; b) tensometric marks, speed and flow transducers, pressure transducers - transforms voltage, speed, flow, pressure information into electrical signal. In most cases, the electrical signal is proportional to the physical parameter, which is being monitored.

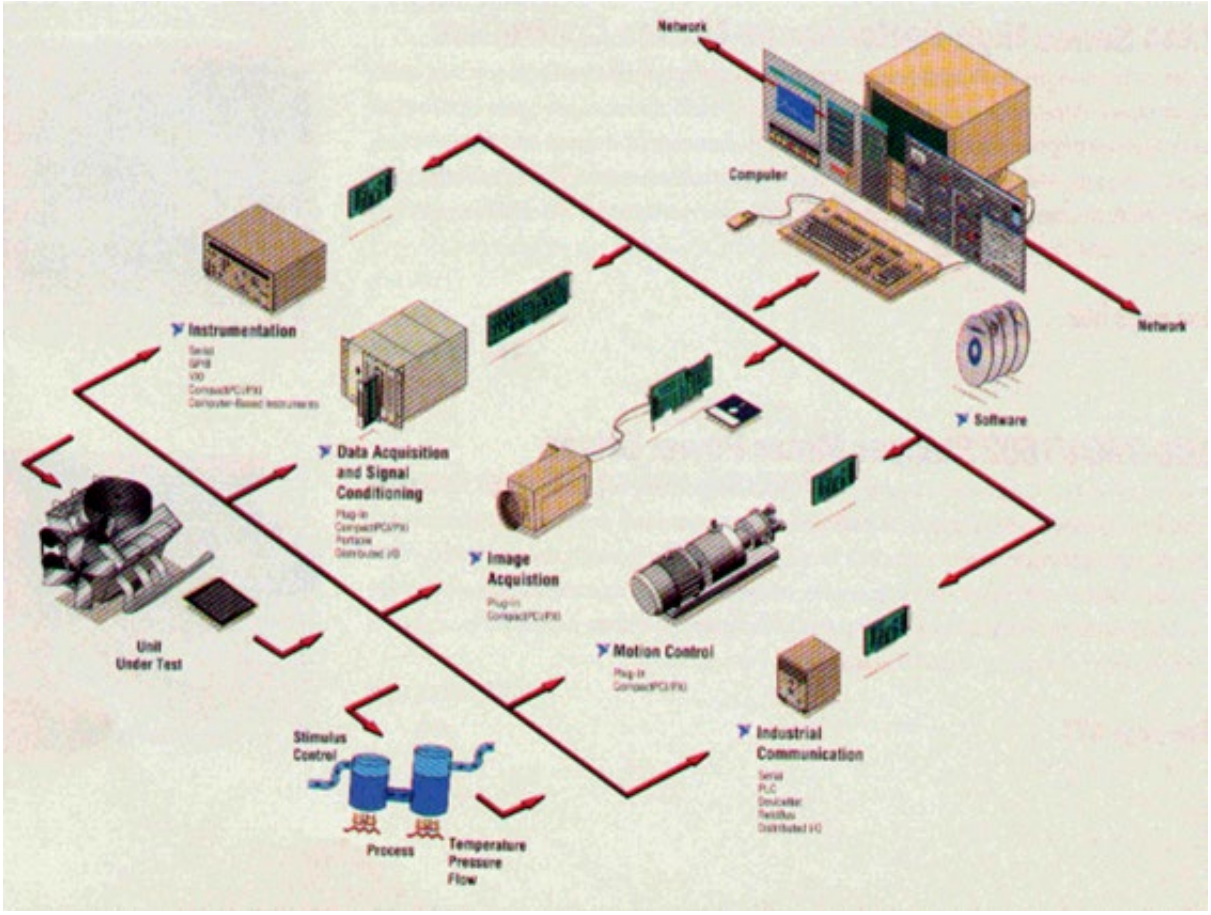
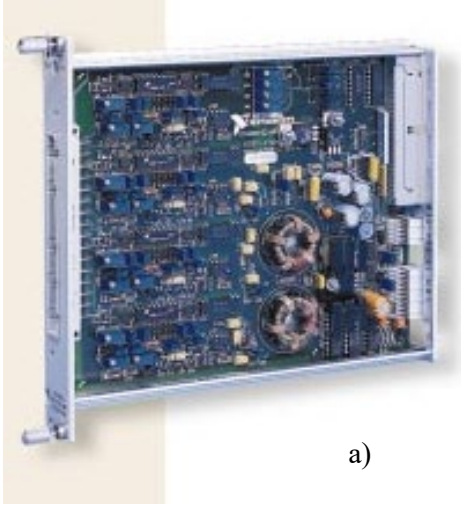


Fig. 1 Data acquisition system



a)

The electrical signal generated by the transducer must be optimized according to the input range in the acquisition board. The conditioning system (fig. 2) can amplify very small signals, isolate and filter them to increase the accuracy (precision) of the measurement

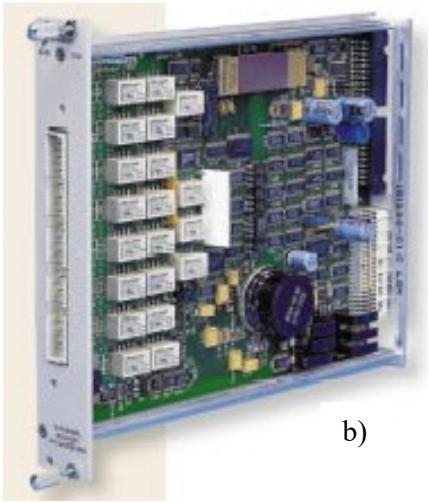
SCXI 1121 (fig. 2a)

Technical specifications:

- 4 isolated channels;
- 4V excitation voltage;
- input signal range ± 5 mV… ± 250V;

- input current 0… 20 mA or 4… 20 mA;
- configurable low pass filter in the range 4Hz…10kHz;

- output signal ± 5V;
- output impedance 100Ω.



b)

SCXI 1122 (fig. 2b)

Technical specifications:
- 16 isolated channels;
- 2V excitation voltage;
- input signal range ± 5 mV… ± 250V;
- input current 0… 20 mA or 4… 20 mA;
- low pass filter configurable in the 4Hz… 4kHz range;
- output signal ± 10V;
- output impedance 75Ω.

c)

SC-2043 (fig. 2c)

Technical specifications:
- ± 2,5 mV excitation voltage.

d)

SCC-SG (fig. 2d)

SCC-SG01 - 120Ω quarter of tensometric bridge;
SCC-SG02 - 350Ω quarter of tensometric bridge;
SCC-SG01 - half bridge tensometric;
SCC-SG01 - full tensometric bridge.
For these, the excitation voltage is 2.5 V.

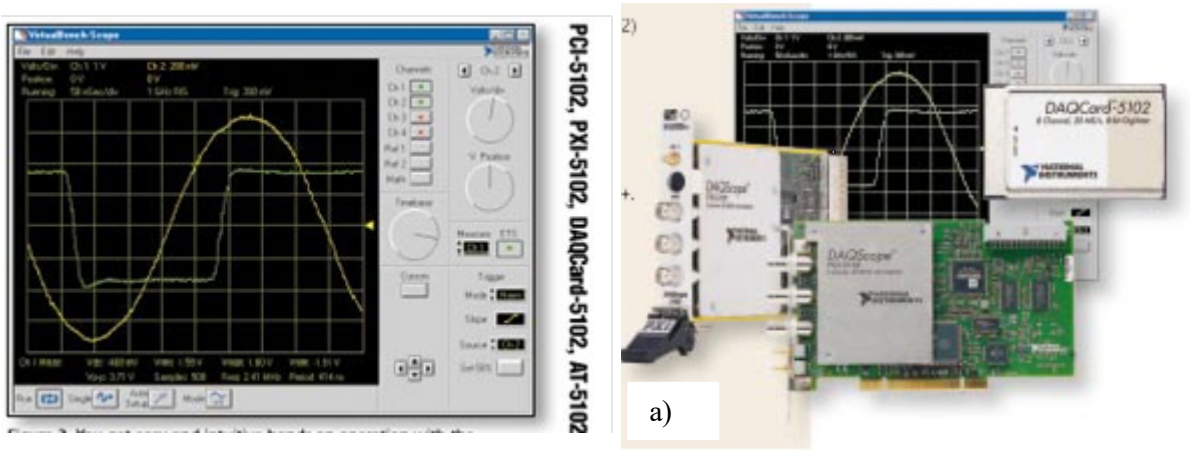
Fig. 2 Conditioning systems

The following types of two-channel modules are recommended for compatible operation (Fig. 3).

PCI 5102 Module (fig. 3a)

Technical specifications:
- frequency 15 MHz;
- 2 channels;
- 8-bit vertical resolution;
- input signal range ± 50 mV… ± 500V;

– memory 4… 16 MB.
– LabView software, LabWindowa / CVI, VirtualBench-scope, IVI-compliant instrument driver



NI 5112 Module (fig. 3b)
Technical specifications:
– 2 channels;
– 2 triggers (pretrigger, posttrigger);
– frequency 100 MHz;
– 8-bit vertical resolution;
– input signal range ± 25 mV… ± 25V;
– 16 MB RAM memory;
– LabView software, LabWindowa / CVI, VirtualBench-scope, IVI-compliant instrument driver

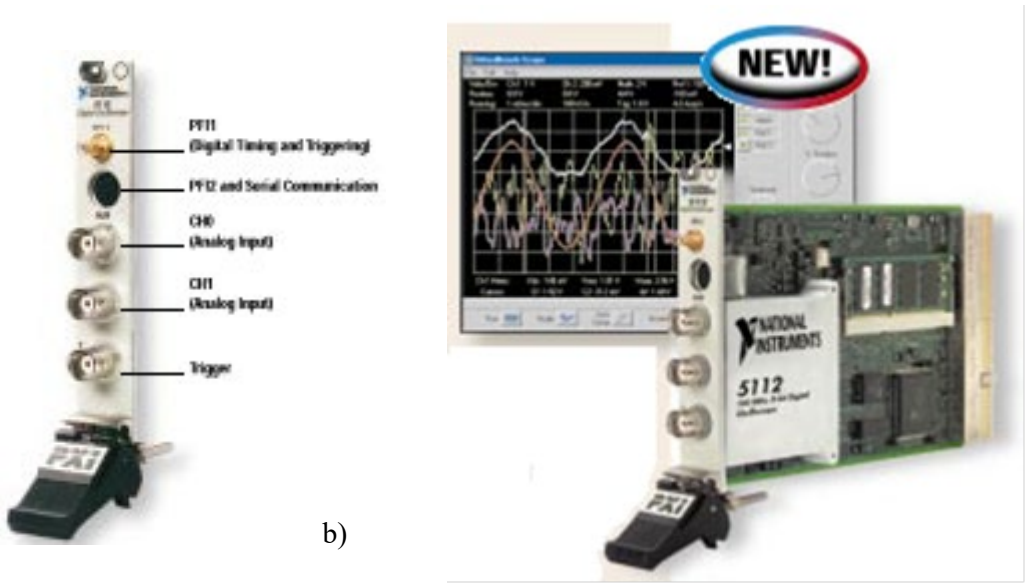


Fig. 3 Types of two-channel modules

The conditioning system provides the voltage and current needed to excite the transducers.

The system allows signals to be multiplexed, so that several signals can be input and processed successively on a single channel. The transfer rate on each channel is inversely proportional to the number of signals. For example, the AMUX-64T analog multiplexer can measure up to 256 signals per channel. Most SCXI modules have filtering thresholds between 4Hz and 10kHz to eliminate noise, after which the signal is digitized (numerically encoded).

For transducers that have a nonlinear response (thermocouples) there are linearization routines including in the programs LabWiew, LabWindows / CVI and VirtualBench.

Some of the conditioning systems used are shown in fig. 2.

The basic characteristics of an acquisition board are: a) the number of channels; b) the sample rate; c) the resolution; d) the field of entry.

Oscilloscopes modules interconnected to the computer can be used for viewing, storing graphics and acquiring data. These modules can be included in external blocks (PXI, MXI-3 Multisystem Extension Interfaces) connected through parallel interfaces to the computer or they can be connected directly to the PC motherboard to one of the parallel ports. The parameters of the oscilloscopes are adjusted through of the software specific to each module. Fig. 3 shows the different types of two-channel modules.

2. Scheme of the inductive displacement transducer

In the case of successive deep-drawing in the strip of small parts [1], inductive displacement transducers were used, which generally allow the transformation of the above mentioned parameters (distances, forces, pressures, torsions, deformations, vibrations) into displacements.

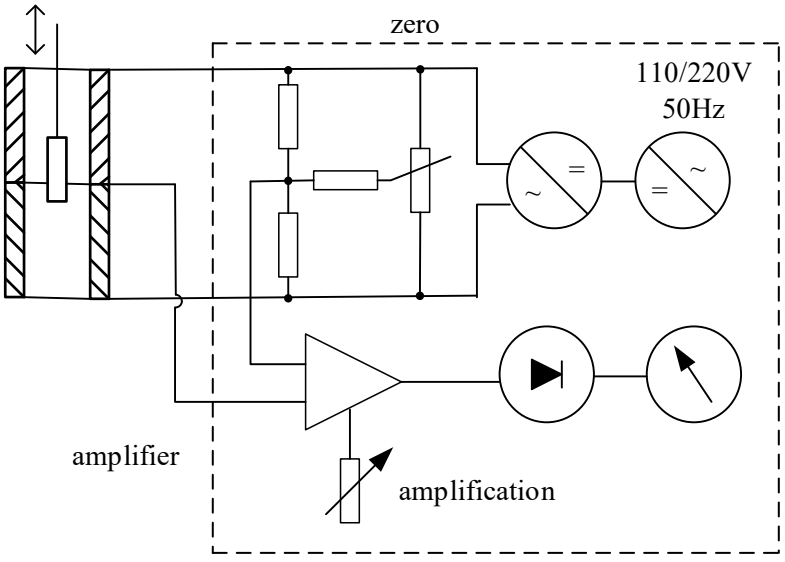


Fig.4 Scheme of the inductive displacement transducer [7]

Such a transducer has a cylindrical body made of stainless steel and inside it contains a piston that moves longitudinally and a solenoid (Fig. 4). The solenoid is connected to an amplifier through of a bridge for measuring the resistances. The displacement of the piston changes the solenoid impedance and unbalances the bridge [7]. Inductive transducers most often operate at mains frequency (50 Hz). For high-precision measurements, the assemblies are supplied with high frequency signals (1 kHz … 50 kHz) and a voltage of (1V ... 6 V).

3. Scheme of the stand used in the process of processing by cold plastic deformation of thin sheets

The realized stand (fig. 5 [1]) had the purpose of collecting the values of the drawing force in correlation with the displacement of the punch. The signals collected from the dynamometer sensing device of the die 1 and from the inductive transducer 2 are transmitted to an electronic tensometer 3, which amplifies them. These are to be transmitted to an oscilloscope 4 for viewing.

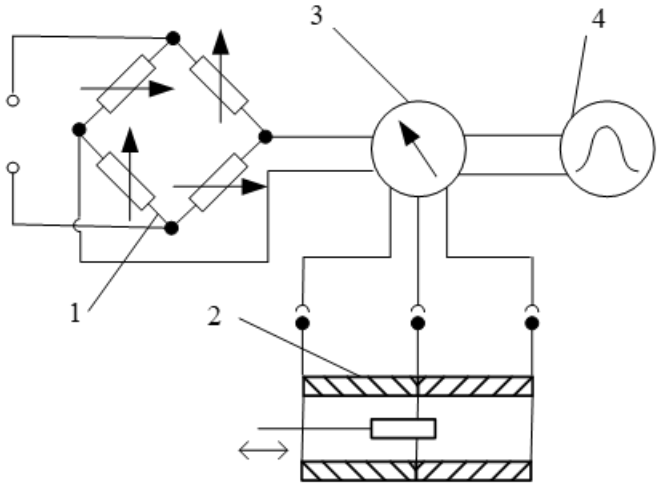


Fig. 5 Block diagram of the stand for measuring and visualizing the force variation along the stroke of the punch [1]

The force signal from the electronic tensometer transducers is applied to the "YA" input of the oscillograph. The displacements signal is applied to the "X" input of the same oscilloscope.

The calibration of the tensometer is done by establishing a correlation between the displacement of the punch and the horizontal deviation of the light spot.

The variation curve of the drawing force depending on the stroke of the punch, observable on the oscilloscope, is the result of the composition of the deviation of the spot horizontally (due to the stroke) with that on the vertical (due to the force).

Parameters such as displacements, pressures, forces, torques, etc. they are transformed into electrical signals by means of resistive or inductive tensometric sensitive elements. The tensometric marks (resistive transducer and resistive compensation transducer) are connected to the tensometer on one channel, and the inductive displacement transducer is connected on the second channel.

The tensometer allows the processing of the characteristics of the input signals, such as: voltage phase, capacitive load, amplification size, measuring scale, resistive and capacitive balancing fine, average and gross.

The oscilloscope that is part of the stand has the following characteristics:

- a two-channel amplifier in the 0.50 MHz band;
- sensitivity of 20 mV / division;
- three working modes: automatic, triggered and single triggered;
- two 1 kHz rectangular calibration signals;
- two filters, one low-pass (10 kHz-2MHz) and one high-pass (2MHz-50MHz).

Conclusions

To obtain pieces characterized by a dimensional and surface quality after the drawing processing, it is necessary that different parameters, such as drawing force, flange retaining pressure, friction forces and others be correlated and have optimal values. These values are measured with different equipment that uses a data acquisition system consisting of the following element subsystems: computer, transducers, signal conditioning system, data acquisition board, software.

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