CONSIDERATIONS FOR SELECTION OF CHARACTERIZATION METHODS AND PROCEDURES OF LAYER DEPOSITED THROW METAL COATING AND QUALITY CONTROL METHODS

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Abstract. *The paper presents aspects of geometric characterization, micro structural and mechanical physical layer deposited by thermal spraying, control methods and procedures applied in order to achieve coatings with special properties and notable result to the behavior in service.*

Keywords: *characterization procedures, control methods, properties.*

1. GENERAL CONSIDERATIONS

To characterize the deposited layer were considered specific aspects metallic layers applied to both reconditioned and new parts.

Characterization plan includes the following methods and procedures:

a) - geometric characterization (using normal means of measuring and control: calipers, micrometers, parameters, etc.)

b) - micro structural characterization (using optical microscopy and electronic equipment)

c) - The physical-mechanical (toughness, adhesion, porosity)

It is important to note that the layers deposited on the parts can not be characterized only by standard tests, performed with the same parameters and the same material or theoretical support, taking into account the working parameters has been carried out metallization.

Geometric aspects of characterization and micro structural characterization were cleared after trials.

Physic-mechanical characterization, in terms of hardness and porosity, is done electronically.

Material's adhesion deposited by metallization is determined according to standard "Determination of tensile adhesive shear test".

Sample covered with composite material studied, after going through all stages of technological process of metal, after being processed and measured, is subjected to shear test on a 2000 TF press aiming the separation of deposit layer.

Each sample has 3 metallic surfaces. The sample is introduced into the plain, standard, sits on the press table and forces it down with increasingly greater according to the same standard. When the layer is separated, the pressure is record. Loose layer is removed and continue pressing on the second metalized surface of the sample. Repeat the operation and on third metalized surface of the sample. Driving scheme for verifying adherence to the above standard is shown in Figure 1.

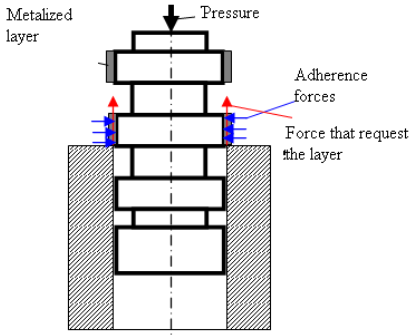

Figure 1. Scheme for determining the shear using adhesion method

After separation of the 3 layers, the sample is removed from the press and the ring widths are measured to lose material deposited on the metallization (rates may differ after mechanical processing of layer, the differences being of tens of microns). Adherence deposited material resulting from the following formula:

$$\sigma = \frac{F}{\pi * D * l} \quad (1)$$

that F is the force that was read from the dial press (kgf)

D - diameter of the sample measured after separation deposited layer (mm)

L - length pressed ring (mm).

Quality control is a management function which checks if the standards of services, materials, processing and manufacturing can ensure prevention of damage.

A company must use all practical means to prevent, detect and correct errors that occur in various stages of operation of the technological process.

To achieve real quality control, must be controlled variables that can affect quality and are the result of human action, natural materials or equipment performance. Quality control is defined as follows: "Techniques and activities used to meet the operational nature of the quality conditions. These operational actions that allow monitoring both a process (running a manufacture, successive phases of a supply of service) and eliminate nonconformities or deviations from what was provided, along the entire process. Inspection is an operation to control the quality at a given stage of the process under consideration, which aims to determine whether the results obtained on this stage are in accordance with specified requirements. Operations to control the quality refer to the order of operations with responsibility for achieving quality throughout this process.

2. CONTROL METHODS. STATISTICAL CONTROL

These depend on the effectiveness of control methods adopted, appropriate processes to be checked and showing compliance with requirements.

Classification presented in Table 6 control methods in relation to various criteria.

Table 6. Classification of control methods

No.	Classification criterion	Control Methods
1	The process applied	• Observation • measurement • Test
2	Basic principle for measure	• Mechanic methods • Electric methods • Chemical methods • Thermal methods etc.
3	Control Methodology	• control 100% • control by samples
4	Effect on process control	• active control • passive control
5	Periodicity control	• continuous control • periodic control • inspection specified phase
6	Degree of human participation	• manual control • automatic control • semiautomatic control

Classification as process control applied (first in Table 6) defines three control methods: measuring, testing and observation. These concepts are used with the following meaning:

● Measurement is the use of devices which can achieve a size values for physical, chemical, mechanical, etc.. Examples: mass of a product is measured by weighing, and the diameter or other dimensional parameter can be measured with a pattern, gauge, micrometer, calipers, etc

● Tests are measurements of some characteristics in accordance with a method or procedure. Examples of material tensile strength, hardness materials, engine reliability are determined by testing in certain specified circumstances. All the above examples relate to quantitative characteristics, which can be measured. There are also features assigned by adjectives describing a quality, defect, a functional state. In this case the inspection is done through observation. Examples: the presence of impurities, some stains, a product design and color, etc. Another important classification of control methods is the number of components inspected, two methods are distinguished: control of all parts (control 100%) and statistical control.

● 100% control (or control piecemeal) is the inspection of all products made. Can be applied in modern production conditions for special products (nuclear, for example), complex products, and when manufacturing is unstable and small series. Although it involves checking all products 100% control is not infallible, beyond defective products. In addition, requires a large staff, leading to increased costs of control. Since the early '20 's was founded control, which was widespread in industry in the second half of last century, with increased mass character and large series production.

● Statistical control is done on a smaller number of products, is a partial inspection, random sampling using certain standardized rules for control and decisions on batches of products concerned. Statistical control applies to large mass production and mass, providing significant benefits by playing time and labor consumption associated process control. Statistical control is based on mathematical statistics and science that use sampling to characterize the variation of characteristics of a population statistical. Methods assumes that every feature is a random variable and distribution of its values, when the number is large enough problems, corresponding normal distribution law, called the Gaussian distribution. Using statistical methods is possible to select a sample population of a given community, to infer the distribution characteristic for the whole community under study.

Statistics operates with computer specific relations for determining the parameters characterizing the distribution of values, most important being:

• average value of the variable, n;

• standard deviation, б (which measures the extent of spread of values);

• the probability as variable to enroll in a range of values, P.

It is considered that the process normally takes place if the parameters *n* and *a* falls within a interval limit, called confidence interval or range control. Statistical quality control theory of products takes range limits of the confidence interval 6 б (usually ± 35). These limits of the period were called control limits. Knowing these values can be determined the probability that parameters m and б likely be between the controls limits. It is known from industrial and commercial products that every batch of samples contains a certain proportion of poor quality, which is called the lot fraction defective. Based on the fraction defective p, will be assessed the quality for entire batch. Defective fraction can be expressed as a ratio between the number of irregular pieces (D) and batch size (N): $p = \frac{D}{N}$

Defective fraction takes values between 0 and 1. Its level determines probability of acceptance for the lot of parts, Pa, dependence between two quantities is depicted in Figure 2. On the graphics are marked supplier risk, α, and β, recipient's risk. Supplier risk is that best groups can be rejected and recipient's risk measures the likelihood that poor groups are welcome. Apply them in practice as: α = 5%, β = 10%.

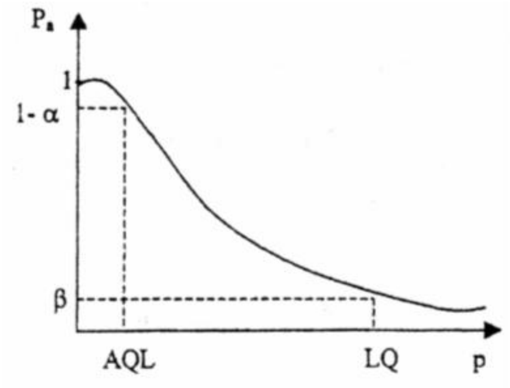

Figure 2. Dependence between p and Pa

Control process is carried out and using the feedback circuit. Its basic elements and interdependencies between them are reproduced in Figure 3.

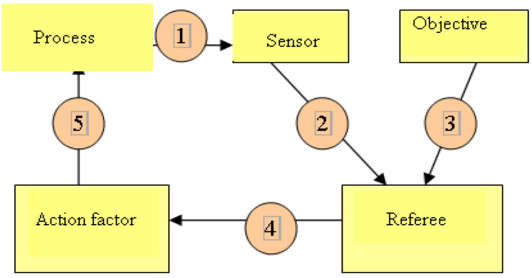

Figure 3.Feedback circuit

The course of events is as follows:

1. Sensor (which is "connected to the process) evaluate actual performance.
2. The sensor reports the performance of an arbitrator.
3. Referee receives also sought information on the scope or standard;
4. Compare actual performance with the objective. If the difference justifies the action, referee activated factor action;
5. Action factor make necessary changes to bring the result aims pursued.

All employees of a company are active in terms of quality control and all use the feedback loop. There are still differences. One of them is linked to control. At employment level, objectives consist mainly of various characteristics of products and processes contained in the technical and procedural manuals. At management level, objectives are wider. They tend to be commercial and that emphasis is often placed on the market to be competitive. Differences regarding the subject leads to other differences.

Sensors. The workers tend to be "technology" - which means they are tied of the process itself. Sensor technology can be instruments which measure physical, chemical or electrical properties. May be the information generated during the provision of services, such as numbers of units or time periods. At managerial levels, sensors tend to take the form of data systems. Technology and market conditions vary by area of activity, trade and market, but related concepts of quality assurance systems and financial implications of these systems are generally valid. The objective must be producing products and services at affordable prices that meet consumer needs.To achieve this, we have adopted a systematic method of design, production / operations, quality assurance, supply, sales and other departments - from which nobody should be exempt. A systematic approach to total quality is not a separate branch of science or a theory of independent quality control. It is a valuable set of tools and systems as part of the approach to quality "total", throw a real commitment and teamwork. The term intelligent control is becoming more common in the literature, while highlighting issues characteristic which distinguishes it from what could be defined as "conventional control" in the sense of the word already established control. In Romanian the word "control" has been avoided long time, being replaced, where appropriate, with terms "leadership" and "adjustment."

That same duality semantics suggest that the technical term "control" is something more complex and might attempt to use it as such, with a convincing explanation of all attributes. Therefore, the term "control" attribute is associated with "intelligent", the term "intelligent control" already having an established meaning and is becoming more appropriate for advanced process control techniques. Also, current practice use the terms "leadership" and "control" when in context appear to be the appropriate. Next is presented a more rigorous definition of the concept of intelligent control and the principal means of implementing intelligent control procedures.

Defining intelligent control

Precise definition of intelligent control problem is still a topical issue. In May 1993, the Technical Committee of Intelligent Control IEEE Control Systems Society formed a working group aimed to determine which attributes can be embedded in intelligent control area, the characteristics and the role of the intelligent control systems, can be recognized as such systems and how they differ from conventional control systems and also to identify those problems and solving them only intelligent control techniques work.

That time, it was estimate that a single definition will not be possible, given the many facets of intelligent control, so that several points raised by specialists were analyzed and discussed in order to extract the essential features.

Intelligent control and conventional control.

Conventional or traditional term control is used below to define the theories and procedures developed in recent decades, management of dynamic systems whose behavior is described by differential or difference equations. But note that this mathematical framework is not always covering and is enough to recall discrete manufacturing processes or communication systems, which can not be avoided in finite automatics theory, theory of queues, etc. Many experts outside the computer science and systems deemed "intelligent control" as a particular form of artificial intelligence based on fuzzy sets or neural networks. It is true that these methods are part of the arsenal of intelligent control that the perception mentioned is reinforced by numerous articles published recently on these two lines, but control is not just smart at all. Moreover, according to the characteristics of intelligent control, not any fuzzy or neural controller is necessarily intelligent, and on the other hand some problems that cannot be formulated and studied in differential equations and mathematical differences requires a number of methodologies resolution unanimously accepted as intelligent control. Also is appropriate to note that in many cases an intelligent control system uses the "lower level" conventional control techniques and so it is included so intelligent control area, subject to improvements that lead to solving complex problems. It is therefore understandable that the term "control" in the phrase "intelligent control" has a broader meaning then the phrase "conventional control. First, processes can be described not only driven by models with differential equations or difference but through discrete event system models or hybrid models that include both types of representation. This has led to theories of dynamic management processes continue studying hybrid technique of finite automatic and sequential state machines. And intelligent control objectives are appropriately wider. Thus, an intelligent vehicle piloting system includes a conventional steering control system and can also be decomposed into a series of conventional control tasks (referral distance instituting speed, acceleration / deceleration, etc.) which together lead to intelligent control of travel on a certain path. To achieve such performance intelligent controller must deal with a number of situations with uncertainty (incomplete set) that a classic controller, even adaptive, it would not cope. Objectives even in conditions of partial uncertainty leads to the need to associate the intelligent control procedures for diagnosis, dynamic reconfiguration, readjust, training. We can therefore safely say that the area is interdisciplinary intelligent control combining methods and procedures of systems theory, computer science, artificial intelligence, and communications to meet objectives. However, methods borrowed from the fields mentioned above can be used only rarely as such, in most cases they must be adjusted, associated with improved or new methods developed specifically. Particularly in developing research in intelligent control some important theoretical concepts such as stability, accessibility and controllability gets new values, in connection with calculation problems predicative or Markov chains.

Another difference between conventional and intelligent control is the separation between the automation device (we'll call most frequently controller to suggest specificity compared with other established names such as regulatory or compensatory) and system or process control. In conventional control system was conducted so called "technological facility" or "fixed part" because its parameters were considered known and no possibility of change, or changes in time perfectly defined. The intelligent control, separation between the driving and driven not so obvious, often control laws are the result of which involves the auto training led system.

Smart and intelligent.

The concept of "intelligent control" can not be discussed outside the "intelligent", which actually means a nuance of the term "intelligent" use the two phrases. Moreover this term is found in literature about artificial intelligence. It is generally accepted that artificial intelligence is defined by all methods involvement providing a similar mind using computers but do not believe that there is a consensus in defining the technical terms "intelligence". But it is obvious that controllers are designed to emulate the behavior of mental faculties such as adaptation and training (learning), planning under imprecision (uncertainty), and the combination of miscellaneous information. Perhaps an alternative definition to that of "intelligent control" could be the "self control" to emphasize the pronounced degree of autonomy which must provide an intelligent control system. Furthermore, intelligent control concept might not be final. Let us not forget that what the '60s were called "modern management techniques" are now incorporated in "conventional control" or "traditional", so maybe a few years now trying to define what the intelligent control will be called pure and simple control. The most important thing remains the adequacy of concepts and methods to control what the definition suggests, not the terminology itself. In this respect, you have to accept that an intelligent control system is a special case of "intelligent", which applies the following definition:

An intelligent system is able to act adequately defined incomplete, understanding an action by appropriate action to maximize probability of success, success is partial fulfillment of the objectives of one whose whole is the ultimate goal. An intelligent system can be characterized by a series of attributes or dimensions merged. These are degrees or levels of intelligence. A minimum level of capacity would be to hold environmental recognition, decision making and action in order to execute them. A minimum level of capacity that would be the recognized to environmental decision, making and action in order to execute them. A higher level of intelligence may involve recognition of events or objects, their representation in a model (eg knowledge base), the composition of a long-term plan. Highest levels require the ability to perceive and understand, to choose wisely and act appropriately in all circumstances, including in conditions of hostile environment. Above characterization of intelligent systems is very general. Reported to it, a large number of systems can be considered intelligent; even if it operates at a very low level (an iron thermostat could satisfy the requirements of the minimum of intelligence). Therefore, the following definitions are presenting some aspects of intelligence shades designed to "technical" and insist on those artificial intelligent systems, so "artificial" or in other words "intelligent machines". "Technical intelligence" is a process of analyzing, organizing and converting data into knowledge through understanding knowledge of structured information acquired and used to remove a degree of uncertainty related to achieving a specific goal of "smart machine". This definition states the principle of using the more accurate the decision as less intelligent, meaning that a "smart car" is able to leave a clean database and develop analytical techniques, assembly and training. So, a further objective of an "intelligent machines" is to organize dynamic knowledge base to synchronize it with its own dynamic behavior to achieve the final goal. Organization so that knowledge is one of the essential attributes of intelligence, intelligent machine that gives autonomy, because they no longer depends on the design, but the self-organization capability of the machine. We say that a system controller with self-organization in relation to internal rules and principles is an intelligent control system.

We now make a procedural characterization of intelligent systems, meaning that intelligence is a property of the system resulting from a combination of methods, combinatorial search and widespread information input which applied producing the desired output. In this regard, once the basic procedures defined, structured intelligence can develop mechanisms that allow the definition of recurrence several hierarchical levels of intelligence. It was concluded that an intelligent system must define its objectives. So, an intelligent system should be a management system to achieve those objectives.

Conversely, intelligence is needed to ensure desired operation of the system constantly changing conditions and to ensure a high degree of autonomy.

So, management (control) is essential to any intelligent and this notion of "intelligent control system is identical to that of" intelligent control system and more complete and nuanced than that defined "smart car" as conclusive results from the following wording: An intelligent control system should be designed independently to achieve high goals, even if the plant model or process driven and even the structure and objectives of the system are not fully defined, either because of partial knowledge or due to changes unanticipated.

***Attributes of intelligent systems*.**

These are:

Adaptation and training. Adaptability to varying conditions is imperative. It does not imply the ability to learn (training), but the degree of variability of conditions is higher education becomes a prerequisite. It should be noted that training is not a stage or level of intelligence, but as a way to increase intelligence as a result of experience. The instruction memory is implemented in the short term and long-term memory to change the system behavior based on what was saved. Training is therefore a mechanism for storing knowledge about the outside world and learning a way to behave. Also, training is associated with the adjustment process of generalization, because the training process underlying any decision processing system that builds knowledge from abstract models, general.Generalization is an attribute of adaptation that achieves essential desideratum of intelligent control namely increased functionality without increasing complexity of computing functions.

Autonomy and intelligence. A system is considered independent when it has the capacity to act properly defined incomplete without external intervention over a period of time. There are several degrees of autonomy, which we may associate with control functions included in intelligent control: a control system with fixed parameters is the minimum degree of autonomy, adaptive control systems have a higher degree of autonomy. To the extent that a system has a greater degree of autonomy, it is acceptable that has a higher level of intelligence. To distinguish degrees of intelligence can adopt other criteria such as computing power system, the level of complexity of algorithms used for acquisition, processing and evaluating data from the environment for ambient storage capacity of data memory. In most artificial systems, reflected by increased intelligence and computing power storage capacity is on account of increasing complexity of hardware and thus can become an obstacle to implementation is a cost too high or impossible for real-time processing stored information. For more specific, try a definition of "intelligence vector" like IQ tests used in human capacity. Parameters intelligence components of the vector could be: power calculation, the number of processors, communication inter processor, memory size, speed addressing, type of knowledge representation maps, symbols, pairs of attributes values, state variables, knowledge of operating procedures such as question-answering, searching lists, queues organization, functional capacity evaluation and decision, dynamic range and resolution of related sensors, data processing module of sensors - signal processing in symbols, recovery drowned by the noise signal, recursive estimation, prediction ability of the development parameters, the ability to evaluate the costs and risk, given the possibility of learning ability to recognize objects and symbols of assimilation of experimental results provided by an instructor.

Establishing a degree of intelligence is reflected in other attributes of intelligent system, in particular the resilience and autonomy. Since intelligence is an internal property system and way of behavior, intelligence level cannot always be appreciated by system behavior, but by active testing scientifically selected conditions. One way to show this degree is to examine the behavior of the system when there are changes in the symbolic representation of information, which may reveal the extent to which the system "understands" the meaning of the symbols they use and determine the difference of autonomy and an ad hoc, a priori, the latter being the only specific situations where the system can operate with any semantic grouping symbols.

Structure and hierarchy. As a complex, intelligent system must have a corresponding functional architecture, usually divided into modules and organized by different levels of abstraction (resolution, granularity) or at least have some form of partial ordering to ensure the hierarchy. Prioritizing the functions and objectives relate to either the degree of resolution and lead, but not mandatory, the hierarchy and hardware architecture. We stated that the resolution of a mean size of the control system of non- distinctly to represent an object model, plan, or bill adjustment. Resolution determines the size of computing power. The control system resolution is higher, the sophistication of its increase. Total Area of interest must be considered, at least in the initial phase, the low resolution, and then this space must be selected subsets of interest for a higher resolution. By this approach avoids an excessive Perla is also a way of operating structures based multi-task decomposition. A system with multiple levels of resolution (also called many resolution representation systems) will call the generalization procedure which several subsets of interest groups and replace with entities with greater abstraction. Therefore, several times the levels of resolution are also called in literature and levels of abstraction or generalization levels. Existence of several levels of abstraction and suggests a hierarchical structure and this could even use an entropy measure based on the complexity of each level. Such an approach may reveal at least three hierarchical levels structured to turn on more appropriate functional sublevels. First hierarchical level (below) is the level of organization, modeled as a Boltzmann machine used to abstract reasoning, planning and decision-making tasks'. The second level is the level of coordination compound rule of Petri nets that allow the exchange of commands and interface with the organization. The upper level is the implementation, containing specialized hardware blocks in data acquisition, processing it and providing appropriate commands to process.

Definition of intelligent system. Given all these considerations, we will make further define "work" for a system (control) intelligent. An intelligent control system is highly adaptable to unanticipated changes, so that training is essential during the operation. The system must have a high degree of autonomy in relation to the need for operation in conditions of weak structured and pronounced degree of uncertainty. To solve these complex problems the system should have a complex, multifunctional and hierarchical architectures encompassing. Mentioned that the complex structure of the system involves complex intelligent computing, which cause serious problems adapting to real-time management processes. Reduce computer while maintaining overall performance is an important requirement for high performance systems. In this respect the use of highly abstract models, which need only minimal information is essential, equally important is the ability to accelerate calculations using dedicated processors, parallel processing and data structures with multiple processors.

3. CONCLUSIONS

Of the submitted plan shows that the metallization process control consists of: Interoperable control phase, after each individual operation; A final check on whether the piece meets the technical and can be mounted in service.

Interoperable control every operation / phase of the technological process of metal in seeking how was executed operation / phase that the results obtained, it appears if you switch to the operation / next phase or if repeat operation / phase for that operation parameters necessary to achieve the transition to the next. Ultimate control in determining whether to play through all operations / stages of technological process can be brought into service. The operation follows:

- Verification of geometric dimensions of the piece restored
- Verification of metallic adhesion

Checking geometric dimensions of the piece is restored by means of measuring and controlling classics like: calipers, micrometers, rulers, guidelines, etc.. Checking adhesion material is basically made by striking metallic layer with a light hammer (250 g) and comparing noise: if noise is full means that the adhesion is good, and if noise is broken adhesion is weak (in which case remove the deposited layer and resume the process of reconditioning technology for blasting operation). Apart from checking the grip shown above practice, you can check adhesion on metallic test pieces with the same material and in the same piece considered to be subjected to adhesion test standard. This method of verifying the destruction layer is deposited on the sample, according to the test piece to be attached to the bearing layer deposited by metallization.

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