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Analysis of documental heritage of CETA in standardization of the Spanish manufacturing automotive industry

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Abstract

Standardization has taken an active role in the development of several main industrial sectors and the automotive sector has been one of them. Current work shows the collection, analysis, revision and management process developed on CETA (Center of Automotive Technical Study) standards related to the manufacturing automotive sector, an unknown element of Spanish standardization heritage. Also, a comparative evaluation between CETA standards and current UNE standards has been performed. The results show that CETA standards have had a positive influence in the evolution of the automotive sector as well as an important contribution to the contents of the UNE standards.

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1. Introduction

The Spanish automotive industry started at the beginning of the 20th century. Hispano Suiza and Elizalde were the two main Spanish companies working in this sector. But, they only were assembly plants, there was no manufacturing. Meantime, Ford and General Motors set up in Spain too. In 1930, the manufacturing processes began but they were suspended between 1936 and 1939 because of the Spanish Civil War.

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In 1940, at the end of the Civil War, the Ministry of Industry and Trade established the requirements for the automotive sector development. However, it was not possible to come to an agreement with multinational companies which had allowed it to carry out this sector. Finally, in 1946, the National Autotrucks Enterprise (ENASA) was created.

By mean of ENASA, two main aims were supposed to achieve: to generate own technology and to get the independence of external supplies. The last one was a very critical issue considering that Spain suffered an external isolation because of its political situation. However, it took a very long time to get this purpose because it was necessary to develop others additional industries, like forging or stamp forging. Related to the first objective, in 1946, the Center of Technical Automotive Studies (CETA) was created. Through this center, by means of the experience acquired from the auto-trucks, it was expected to develop the project of a seven or eight tonnes truck, with diesel engine as well others diesel engine for speedboats, fishing boats, railway, etc. It was running by Wifredo P. Ricart Medina as technical manager (Accord of Council of the National Institute of Industry on January the 25th, 1946).

Between 1947 and 1948 completed reports show the different activities carried out by CETA, such as the manufacturing of the engine and transmission of the Pegaso II, the 110 HP Pegaso truck, a special fire truck, a 6 cylinders and 60 HP marine engines or tool-machines Fig. 1.

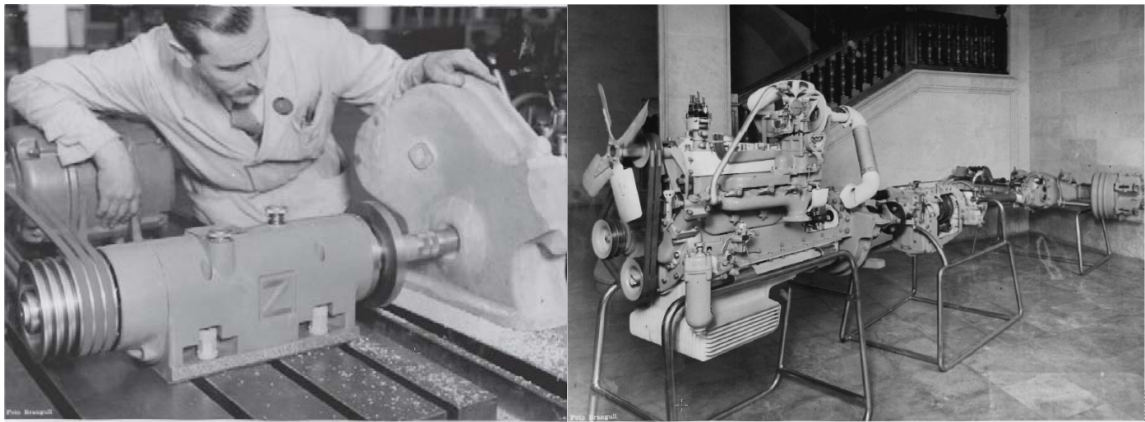


Fig. 1. Precision tool-machine (left). Engine-transmission set Pegaso II (right).

To develop the project adequately, it was necessary to homogenize the working criteria. In this way, mass-produced could be possible as well as the control over raw material and manufactured parts. Therefore, it was considered the establishment of standards for the industrial processes regulation. Thus, CETA standards were born. This situation marks the start of the normalization experience in Spain, within a specific sector.

Present work analyzes this first standardization experience to spread one of the most unknown elements belonging to the Spanish Standardization Heritage.

2. Revision, classification and management of CETA Standards

The documentary collection process followed for the preparation of this work began with an initial search to the funds of the National Institute of Industry (INI), which, initially, managed the Center of Technical Automotive Studies. The information showed the formalization and creation process of CETA as an organism, as well as the beginning of their activities, but it didn't contain anything about the standards developed by this center (view Activity Report of the CETA 1947 and 1948).

To overcome this limitation, an alternative search relating to CETA Standards was done in several university libraries. It could be confirmed the reduced and dissimilar number of standards. When the documents were

arranged and catalogued the collection of standards (about 1600) came of a set of files which has allowed us to implement a database in order to identify, by means of, different criteria, the material available (Fig. 2.).

The CETA 00002 standard: "Overview of the normalization CETA", defines the development of the normative in five sections, which can be summarized in this way:

- *Definition and objectives.* The objectives are established. The main objective is the unification of criteria related to the industrial activities and the coordination of the works developed.
- *Unification stages.* It is established a classification of the different application scopes within each industry, national and international
- *Development.* It is advised to be considered international standards
- *Advantages.* Two important progresses are intended to:
 - Benefits associated with mass production
 - Benefits associated to technical simplifications
- *Standardization scopes:* It is made reference to subjects to standardization

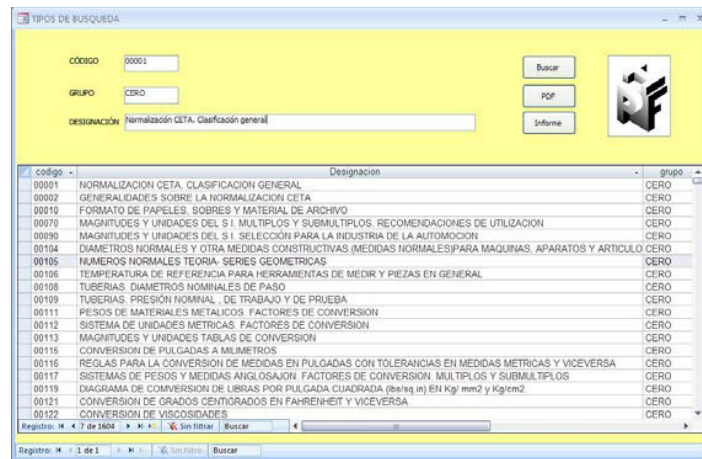


Fig. 2. CETA Data Base.

The CETA 00001 standard: "CETA standardization. General classification", includes the topics normalized by CETA. They are divided into ten groups, numbered from zero to nine and an unnumbered group called *verification group*. Each of them considers the following tasks:

- *Group 0: Fundamental Standards.* This group is divided into two sections. The first one integrates the general standards which include formats, manufacturing tolerances, threads, etc. The second section consists of standards that provide for the calculation, design and parts manufacturing.
- *Group 1: Types of manufacturing.* Parts of the engine an vehicle (fuel filters, flanges, brakes, tires, etc.) are described and designed.
- *Group 2: Materials.* It contains two sections: The first section is referred to assays over materials. The second provides the mechanical properties of the materials used.
- *Group 3: Standardization of common elements.* Basic elements such as screws, bolt, washers and gaskets are normalized.
- *Group 4: Electricity.* This group encompasses different elements which are part of the electrical system of the car and engine, such as dynamos and autovehicle starting, spark plugs, fuses, etc.
- *Group 7: Machine tools and tools.* In this group there are different standards related to machine tools, such as lathes, milling machines, planers, etc. It identifies the basic concepts and terminology, and the different tools used in machines are contemplated. Another important part of this group is dedicated to the sizes used in verification.

- *Group 9: Installation and equipment.* There are no standards in this group.
- *Group Verification of elements:* This group includes the verification of the different parts such as filters, dynamos, storage batteries. Also, the conditions of supply of the different materials (iron and steel products, steel and castings) are contemplated.

Sometimes, related to a specific item, the standard of verification exists but not the general one, and vice versa. Figure 3 shows the consulted CETA standards percentage, differentiated according to the groups defined.

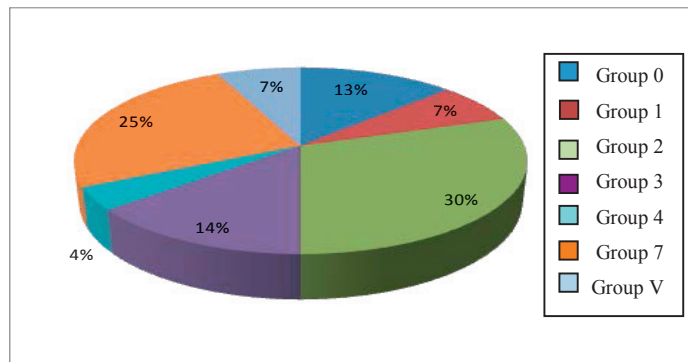


Fig. 3. Standard CETA percentage by groups.

To know as far as the CETA normative process became, at the same time, an analysis about the UNE standards within the automotive sector has been done. This analysis has been carried out by consulting standardization organism, automotive sector manufacturers and different database from the Andalusian Technology Institute (IAT) and the historical archive of the National Industry Institute (INI)

The consulted manufacturers explain that any specific UNE, EN or ISO standard related to car elements are used. Each company develops the process according to their own rules. For example, when an engine block is going to be manufactured, depending on the manufacturer, this element will have different designs.

On the other hand, the RD 2028/1986, June the 6th, pronounce rules to obey CE directives about the homologation of automobile vehicles, trailers and semitrailers and parts of those vehicles.

The number of standards within the automotive sector is vast and a high proportion of them is related to the official approval of the whole engine, not of its components which are usually regulated by suppliers and manufacturers.

The next search field consulted, the Andalusian Institute of Technology (IAT), sent a compendium of UNE standard about automotive sector, where those ones related to engines were included.

The UNE standards search has been finished in the AENOR website (<http://www.aenor.es/>), in its standards management application called SUSCRINORMA. In this service several set of standards has been got.

To present the results obtained in these searches, the standards were classified according to criteria related to the automotive sector, to a greater or lesser extent. This classification contemplated both main elements and those one which are part of the auxiliary systems of internal-combustion engines. Four typologies are considered:

- Type 1. *Standards of combustion engine components.* This group includes the normalization of the main elements.
- Type 2. *Standards of auxiliary circuits elements.* The standards of this type normalize main elements that are part of the auxiliary circuits.
- Type 3. *Standards related to combustion engines.* These standards establish the rules that the engine auxiliary systems have to accomplish (e.g. emissions or engine effective power calculation).
- Type 4. *Standards related to the automotive sector.* The fourth type includes the standards related to the automotive industry in general.

Figure 4 shows the percentage of each type, according to the classification performed.

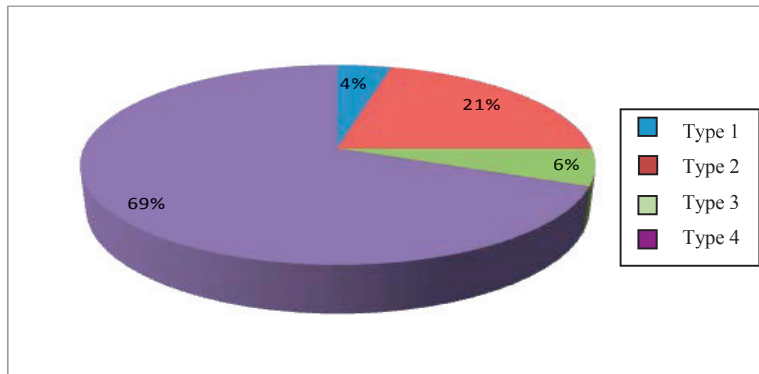


Fig. 4. Standards UNE percentage by types.

3. Analysis of UNE and CETA normative

The results of the analysis completed over the documentary heritage of CETA standards are going to be presented by means of several particular examples, grouped by two main typologies, M. González (2009). The first one is referred to the revision of the CETA standards which are considered especially significant, either for taking into account topical issues such as emissions in vehicles, or for their relevant contents. By the second type, a comparison between CETA and UNE standards with similarity title and content has been done.

3.1 First type of analysis

Case 1.1.

Related to the first type, it has been mentioned before that one of the most important current problem in the automotive sector is the problem of emissions. In Spain, the reduction in polluting emissions began three decades ago. It started with the reduction of the carbon monoxide emission, and continued with the particulate reduction of diesel engines. Nowadays, reductions are focused on carbon dioxide emissions and its impact on the greenhouse effect. The CETA 10946 standard: “Measurement of CO emissions in motor vehicles in idle speed”, establishes a method to determinate the carbon monoxide emissions in vehicles equipped with spark ignition engines, running at idle speed. Although the values are not fitted in with actual values, due to the instruments precision, this standard shows its interest and vision towards the future.

Case 1.2

The CETA 10947 standard: “Motor vehicles. Device for measuring the opacity of the exhaust gases in diesel engines operating at steady regime”, defines the requirements of the instruments used to measure the opacity of exhaust gases in Compression Ignition Engines and their verifications. The content is more focused on measurement instruments than the measure of gases opacity, which is one of the current problems presented in the MEC.

Case 1.3

A volume of the CETA regulation is focused on elements calculation. For example, the CETA 01140 standard: “Closure by eccentric. Theory and calculation”, defines the conditions that must be taken into account for the calculation of this type of elements. This standard provides a set of technical details, both calculation and graphics, that allows this standard to be understood easier.

3.2 Second type of analysis

Case 2.1

The UNE 10030:1998 standard: “Materials for valves of internal-combustion engines”, contents a set of tables that shows the chemical composition and the mechanical properties of different types of steel used in valves manufacturing. Section 1 describes the purpose of the standard: “This standard specifies the characteristics of the materials in the manufacture of valves for internal-combustion engines, as well as the manufacturing process and supply conditions of them...”. In section 4: *Production and manufacturing process*, it is defined: “Unless noted otherwise, the manufacturer establishes the criteria for manufacturing and testing of the products. He must inform buyer when it is necessary”. This standard propose (section 1) is lost partially because of the specification defined in section 4, according to which, everything only come from manufacturer and purchaser agreements.

The UNE-EN 10090:1998 standard: “Steels and alloys for internal combustion engines valves”, is applicable to materials used in the intake and escape valves of internal combustion engines manufacturing, In section 3.1 is showed the lists of the factors related to the materials used for valves. In section 6: *Manufacturing process*, in the same way as the UNE 10030, it is specified that manufacturing processes, thermal processes, surface finish and manufacturing procedures are under manufacturer decision.

The CETA 21381 standard: “Valve explosion Steels”, is released in January 1964 and the section 1. *Objective*: “This standard is focused on the selective use of stainless steels for standardized internal combustion engines valves”. The standard, which consists of two pages, summarizes the considerations that should be taken into account for choosing a steel to be used in valves manufacturing, describing briefly the characteristics of steels recommended for manufacturing, showing the qualities of each one, depending on the stress conditions and the engine operating regime. Section 6: *Bibliography*, details different books and supplementary material such as tables. Even though it is difficulty the choice of a particular documentary source, this difficulty is made up for the bibliographic guide guaranteed by a Standardization Organism.

Case 2.2

The UNE 18135:1978 standard: “V-belts and pulleys. Transmission for auto-vehicle. Dimensions”, corresponding to the ISO 2790:1974 standard, specifies the dimensional characteristics of the belts and pulleys, specifying the values of these characteristics for two models: AV10 and AV13.

It is usual to think that a standard doesn't give useful contents. However, in the case of the CETA 01315 standard: “V-belts Calculation of Power and Transmission”, the opposite situation is presented. This standard includes the influence of the parameters involved in the calculation of the transmission belt characteristics, showing not just element but also the set of parameters involved. If the educational component reflected in its presentation is added, it is significant the difference showed with the corresponding UNE.

4. Conclusions

It has identified and confirmed the relevance of a specific normative framework in the automotive sector, CETA standard, which aren't currently in force. This normative has been analyzed, showing an important educational component, with a clear development focused to satisfy the needs in vehicle industry manufacturer.

The comparative analysis between UNE and CETA standards shows a number of relevant aspects, such as:

- Although it is not possible to ensure that one of the main objectives of CETA standards was the pedagogical contribution, it is considered an interesting element to be translated to the current normative.
- Calculation examples and recommendations proposed in CETA normative allow both experts and initiated to aim at the objectives. Diagrams and representations presented unequivocally help to give standards more technical aspect, in order to facilitate their understanding.
- Comparative evaluation shows that CETA normative was much more specific than UNE standards, being specifically approached to components manufacturing in the automotive sector.
- The comparative study has revealed the precedence in contents and greater definition over elements to normalize.

To conclude, it has been shown the importance of the standardization process carried out on the industrial sector of vehicles manufacturing. CETA normalization experience takes an important part in the Spanish Industrial Heritage within the manufacturing field.

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