The Development and Application of Standards to Production Management[1]

A Case from the Iron Industry

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Introduction

THIS PAPER is not intended as a presentation of the arguments for, or the advantages of, standards as an aid to production, but is presented with the assumption that they are accepted in principle by a majority of this audience. Neither is it an attempt to present a new method or an ideal procedure for attacking the problem of the development and application of standards.

It is intended simply to show the line of approach being used by one company in the manufacture of puddled wrought iron products.

This paper is not even a presentation of a finished case, as the task has really only been started.

It represents, then, the application of an accepted principle to an old but complicated industry in which little has been done on standardization other than on the finished product. Tradition and opinion have each played a part, resulting in undirected growth or drift rather than organized effort.

The work is only in process of formation and the author is glad to present this paper as a possible check on his own thinking. He also hopes it may arouse discussions and bring out some thoughts that will be helpful to others as well as himself.

Webster defines a standard as that which is established by authority, custom or general consent as a model or example. Modern industrial management employs the word in a more strictly limited sense: That which is established by custom or general consent does not become a standard until it has been subjected to investigation and experiment, reduced to writing and definitely and formally approved by proper authority. It is this latter sort of standard with which we are dealing.

In the development and application of standards, we have found it advisable to sell our program to the supervisory force, and also to employes to some extent. To do this, we emphasize that standardization is not new and even cite certain historical facts.

While standardization in the more limited sense is comparatively recent, in the more general sense it is as old as the human race. Primitive man had his stone axe which closely resembled those carried by other members of his tribe. The individual variations were due rather to inability to produce exact duplicates than to direct intent. Standards such as these were based only on custom and general consent, or were perhaps due merely to lack of initiative.

The Egyptians carried them one step farther in that the artist or physician whose method departed from standard was subject to heavy penalties. Here we have standards established by authority in addition to custom and general consent, but not based on careful experiment.

The Chinese had standards which became "frozen" centuries ago. Like the Egyptians they suffered, not because they adopted standards in the first place, but because they did not improve their standards to meet changed conditions. The rest of the world outstripped them.

In our work we endeavor to profit from the lessons of history and to keep before us the fact that standards are not, and cannot be, permanent. They represent a progressive state of improvement rather than an ultimate end or ideal. Standards naturally lead to better standards.

In developing standards, as far as possible, we are building from the bottom, step by step, rather than accepting past or present practice, and then trying to cut out unnecessary steps.

We believe that at the start too much emphasis should not be put on accuracy, as the standard will probably not be perfect anyway. Imperfect as it may be, however, it will be better than no standard at all.

Since the object of business is net profit, we started on a study of costs. We found wide fluctuations due

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to many causes, some of them not definitely known. In order to control costs it was first necessary to control our materials and methods. A brief study of the situation indicated that there was a definite need for the development of standards and their strict application. Instructions, practice, specifications, etc., had not been reduced to writing. In other words, while the quality of the product had been carefully safeguarded, little had been done to standardize methods or rates of production in order to control the cost of the product.

The Process

For the benefit of those who may not be familiar with the process it may be well to state now that the manufacture of puddled wrought iron is quite different from the manufacture of steel.

Pig iron is produced from ore in blast furnaces in the usual manner, according to specifications to suit our particular requirements. Pig iron, however, is a brittle, non-malleable material running about 93 per cent metallic iron.

Puddled wrought iron is produced from pig iron by a method called puddling which removes impurities such as silicon, phosphorus, sulphur, carbon and manganese, and results in a tough, fibrous material very different in its characteristics from the brittle, non-malleable pig iron.

An essential feature of the process is the relatively low temperature at which the oxidation is carried out. At no time does it exceed 2400° F. or about four to six hundred degrees less than the steel processes. Because of this low temperature the iron is in a pasty condition during most of the process and physical agitation is necessary in order to secure a uniform degree of refinement throughout the batch. As the pasty mass of iron is immersed in a bath of liquid slag a certain amount of the slag is incorporated with the iron and remains through the subsequent rolling and heating operations.

The iron is drawn from the puddling furnace in the form of a ball, and after a preliminary "squeezing" is passed through a train of rolls reducing it to a "muck bar" about five-eighths of an inch thick by three to six inches wide.

The muck bars are later cut up into suitable lengths, piled (in order to get elongation of fibers and reduction in cross section), reheated and, by a second rolling, converted into skelp, plate or bars. Skelp is the plate from which pipe is made by bending and welding. During the rolling operation, the incorporated slag layers are extended, imparting to the resulting product the fibrous structure and the desirable characteristics of puddled wrought iron.

Among these characteristics are resistance to shock, fatigue, corrosion (particularly atmospheric corrosion), ability to hold protective coatings and the quality of acting under rupturing strain much as a rope does, giving way, fibre by fibre, gradually and with warning.

Problems in the Manufacture of Puddled Wrought Iron

As already mentioned, this industry is very old, and its practices, based on custom or tradition, go back for many years. From its beginning, the manufacture of puddled wrought iron, in many of its phases at least, has been a craft rather than a science. To a large extent, responsibility for quality was left to the skill of the workman, and the personal equation was prominent in many of the processes. Until recently, management had rarely attempted to standardize conditions or reduce them to writing. There is a belief in many quarters today that conditions cannot be standardized. However, this belief seems to have been the common experience of all industries wherever the development and application of standards have been attempted.

Puddled wrought iron is on the market today because of its inherent characteristics resulting in unusual resistance to corrosion, fatigue, shock, etc. Therefore, quality control is of first importance.

The quality of wrought iron is dependent principally on the degree of refinement, slag content and distribution. The mechanical working put upon it and the temperatures to which it has been subjected during process (400° to 600° below the steel process) have as much to do with the quality as its chemical composition.

For these reasons, failure to control some detail almost anywhere in the process may result in difficulties which may not show up until several more operations have been performed and, when detected, may be difficult to trace back to the original cause.

Some of the factors requiring close control are: (1) raw materials; (2) process at blast furnace; (3) processes at puddle mills; (4) processes at heating furnaces and rolling mills (skelp mill); (5) processes at pipe furnaces; (6) finishing processes.

1. *Raw materials.* Raw materials are controlled by standard specifications in the usual manner and offer no special problem.

2. *Process at the blast furnace.* The proportions