

ardized, or nearly standardized, article could not be applied by them. We are rapidly learning that good management is not limited in its application to any one department or series of departments; that it is just as applicable to the maintenance department with all its variety as it is to an actual producing department. For example, carefully developed organization with definite lines of authority and fixed responsibility is as necessary in a maintenance department as in any activity. Records carefully developed to suit the needs of the maintenance department supply information which can be used in a most effective manner. Such records, for example, would be records of individual machines, giving their cost, facts about their capacity and use, location, etc., as well as a list of repairs made on each machine and the dates and cost of these repairs. These records give very valuable information with reference to the performance of every machine. They often result in information leading to the redesign of parts and are valuable in the purchase of new machines. Job study and the application of various types of incentive wage payment are being used in some maintenance departments and give evidence of good possibilities. Accurate information with reference to maintenance costs is being kept and maintenance budgets are being used in many companies. Maintenance work can be as successfully planned as the work of the average manufacturing department. While one still occasionally hears the old objections, setting forth the difficulties of maintenance management, there can be no doubt whatever that maintenance management has improved remarkably within recent years.

#### Maintenance of Tool Standards

In any discussion of the maintenance of plant and equipment it is desirable to emphasize particularly the importance of tool maintenance. This problem, after proper tool standards have once been established, involves a discussion of: (1) tool inspection, (2) tool repair and (3) proper storage and control of tools.

1. *Tool Inspection.* In order that the established standards of tools may be maintained it is necessary that no tool be returned to its storage place in the tool room unless it has been first inspected. It is also necessary that all new tools which have been purchased be carefully inspected in order to determine whether or not they meet the established standards. This inspection of tools is an essential portion of tool-room operation and cannot be omitted if standards are to be maintained. A definite inspection code should be

TABLE 3 INSPECTION CODE\*

TYPE OF TOOL	INSPECT FOR	INSPECTION TOOLS
Arbors, Mandrels, etc.	Freedom from scratches or flats, wear, condition of centers	Snaplimit gage, or micrometer
Clamping Bolts	Condition of thread, condition of nut	
Gages	Size	Master gages
Hammers	Condition of head, condition of handle	
Lathe	Sharpness, soundness (Freedom from cracks, chips, etc.), correctness of cutting angles, height of nose	Height gage, angle gage
Milling Cutters	Sharpness, soundness	
Planer	Sharpness, soundness (Freedom from cracks, chips, etc.), correctness of cutting angles, height of nose	Height gage, angle gage
Reamers	Sharpness, soundness, size, condition of wrench shank	Micrometer or limit gage
Taps	Sharpness, wear, condition of shank	Screw gages
Twist Drills	Sharpness, condition of point, condition of shank	
Wrenches	Size of opening	Standard nuts

Figure 2

developed indicating what each type of tool is to be inspected for, and what inspection tools are to be used in making the inspection. Such an inspection code is shown in Figure 2.

2. *Tool Repair.* Tools which cannot pass inspection should be repaired so that they will meet definitely established standards before they are returned to their place of storage in the tool room. The tool-repair department is usually operated in connection with the tool room. Tool repair should not be left to the workers in the shop.

3. *Proper Storage and Control of Tools.* One of the functions of the tool room is to supply the proper standard tools to the shop when required. In order to do this it is necessary that the tools be properly

\*Management's Handbook, op. cit., p. 585.

classified and stored in the tool room and that they be properly charged to the persons using them.

If tools are not maintained in standard condition, neither quantity nor quality work can be turned out by the producing departments.

#### Maintenance of Quality of Standards

Present-day competition is forcing the production of a product whose quality is constantly being improved. Present-day production methods, involving the large use of interchangeable parts which must be assembled rapidly and without fitting along a moving assembly line is forcing the adoption of close manufacturing standards. Present-day management methods involving careful production planning control of work and the utilization of incentive systems of wage payment demand that quality standards be closely maintained.

In discussing the maintenance of quality standards, it is well to divide the discussion into a consideration of: (1) maintenance of raw material standards, (2) maintenance of standards of material in process and (3) maintenance of standards of finished product.

1. *Maintenance of Raw Material Standards.* Increased numbers of manufacturers are using specifications for the purchase of materials and are carefully maintaining the standards set forth in the specifications by inspection upon the arrival of the material at the factory. In the case of materials, as with any other standards, the standard is valuable only when it is properly maintained through careful inspection. In the report on "Recent Economic Changes in the United States," the following statement is made with reference to this subject:

Buying upon specification and checking by testing laboratories has become the going practice. Most of the larger companies, and many of the smaller ones, have their own laboratories; and commercial laboratories are freely used by them as well as by those which cannot afford their own. Practically all managers report that they are increasing the precision of their specifications, which in the larger companies comprise several printed volumes. Some work out their own specifications, as must be done in special cases; but, for the more staple items, the large majority are using the published standards which leading trade associations have been active for several years in developing. The American Society for Testing Materials and the American Engineering Standards Committee have had large shares in this development, and a considerable number of companies are using to an increasing extent the specifications of the United States Bureau of Standards.

\*Dennison, H. S., on "Management" in *Recent Economic Changes in the United States*, McGraw-Hill Book Company, Inc., New York, 1929, p. 510.

As an example of the care being exercised in a number of plants to be certain that materials supplied are in accordance with established standards the following example is given. In a full-fashioned hosiery mill manufacturing a high-grade product the greatest care is taken to see that all materials are standard. In addition to the usual tests to which shipments of silk are subject, it is examined upon a scriplane, a machine having a black board upon which the silk is carefully wound one thread at a time, and no two threads upon each other. The black background upon which this silk is wound makes the evenness of the silk clearly visible. The appearance of the silk while wound on this board is compared with a standard card and the silk rated in a percentage figure. Unless the silk comes up to the established standard for evenness it is rejected. In the same mill, before silk is used in the plant, a sample is run through a series of machines and a careful record of the number of times the thread breaks with the reasons for the breakage is made. These figures are tabulated for every lot of silk and unless the established standard is met the lot is rejected. The advantages of making these tests are evident from the standpoint of turning out a high-quality product, free from the imperfections caused by the use of poor material. Standard material also results in better labor relations, inasmuch as the rates of pay are uniform and the wages are not dependent upon whether or not a good lot of silk is being worked upon.

2. *Maintenance of Standards of Material in Process.* Maintenance of proper quality standards of materials in process may be said to depend at least in part upon the following conditions: (1) definite and reasonable quality standards; (2) supplying the worker with the proper materials, machines, tools and equipment to perform the job, as well as the use of properly maintained measuring devices both by worker and inspector; (3) the position of the inspection department in the organization and a proper consideration of where the ultimate responsibility for quality in an organization rests; (4) the development of the idea of preventive inspection and the development of co-operation between workers and the inspection department.

In setting up quality standards for manufacturers, these standards should be definite and fixed, and there should be no doubt in the minds of either the worker or the inspector as to what the standard is. The standard should also be reasonable and consistent with the conditions under which the work is to be done and