by repair to bring the machine up to the standard, but rather to see that the machine is constantly operating up to standard and to remedy any conditions which may result in a lowering of the standard in the future.

If a system of preventive maintenance through inspection is to be practicable a few fundamental requirements must be met.

1. Standards must be established for every piece of machinery and equipment, and every machine should be placed in this standard condition. In order to maintain a standard, a standard must be first established. In bringing existing machinery and equipment up to a standard, complete overhauling is sometimes necessary; sometimes mere adjustment suffices. Some companies in which maintenance of plant and equipment has been well developed, in taking over other factories where no systematic maintenance was practiced, make it a rule to overhaul completely all machinery and equipment to be certain that it is placed in standard condition.

2. A careful study should be made of the machinery and equipment in order to develop a schedule which will indicate the frequency of necessary inspections of the various parts to be inspected. Obviously the possibility of failure of all parts is not equal. Some parts may require daily inspection, whereas for others monthly inspections may be adequate.

3. After the schedule of inspection has been developed, a tickler file should be established which will automatically bring forth those items which are to be inspected on a particular day. This is a device which has been used with great effectiveness from the earliest days. Individuals may forget, but a properly operated tickler never forgets.

4. The method of inspection should be carefully defined. The inspector should be told definitely the items to be inspected and instructed in the method to be followed and a written report covering every item should be obtained from him. If an inspector without detailed instructions is told to inspect a given machine it is very likely that he will overlook some important part. If he is told what to inspect and how to inspect, and asked to report the condition of every item he checks, thorough inspection is assured. As a result of this inspection report repair orders may be issued, or the date of the next inspection determined if that date is to be sooner than the next regular inspection.

5. Best results from inspection have been obtained when the responsibility for inspection has been placed upon full-time inspectors in plants with sufficient work for such inspectors. Inspectors should be carefully chosen for their honesty and knowledge of the equipment involved, and instructed in inspection methods. The attitude that anyone will make a good inspector will lead quickly to the failure of the entire plan of preventive maintenance. The inspector should make no repairs although he may make minor adjustments in the course of his inspection. When inspection is added to the regular duties of other maintenance men, such as millwrights and electricians, it is very likely that it will be neglected. Routine duties will then be performed before inspection, and inspection will be looked upon as a means of filling in time.

6. Should a failure of a machine or a piece of equipment occur in spite of regular inspections a careful investigation of the cause should be made to determine why the failure was not anticipated by the inspection, and thus prevented. It may be that as a result of this investigation a revision of the inspection schedule will be necessary.

TABLE 1 INSPECTION TIME-TABLE FOR MAINTENANCE EQUIPMENT[a]

Item	Period of Inspection
Belting, leather—new belt	End of 24 hr.
	End of 48 hr.
	End of 1st week
	End of 1st month
	Thereafter every 2 months
Downspouts and flushing	During every storm
Drinking water system	Every day
Electric lamps	Every 6 months
Electric lamps (industry location)	Every 3 months
Fire escapes	Paint every 2 years
Fire pails	Every week
Hose	Test under pressure every year
Hose	Dry immediately after using
Insulation (steam or hot water pipes)	Every month for damages
Putty in sash	Every fall
Racks, storesroom	Every 6 months
Roofs	After every storm
Sash steel	Paint every 3 years
Sash wood	Paint every 3 years
Shafting	Every 6 months
Sprinkler equipment	Every week
Steel tanks	Paint every 3 years
Structural steel	Paint every 2 years
Tin roofs	Paint every 3 years
Toilets	Every day
Turbine, steam	Every year
Valves (heating system)	Every fall
Washbowls (office)	Twice every day
Washbowls (shop)	Every day

Figure 1

[a]Alford, L.P., editor, *Management's Handbook*, New York, The Ronald Press Company, 1924, p. 1043.

It is well to bear in mind that regular inspection of machinery and equipment has a very favorable psychological effect upon the worker. If he knows that his machine is going to be inspected at regular intervals and that a report as to its conditions, use, abuse and cleanliness will be made, he ordinarily will take greater care of it. This result has been noticed by a number of companies.

Regular inspections of the buildings proper, floors, lighting, piping, painting, roofs, etc., should be scheduled exactly as inspections of machines and equipment are scheduled. This portion of plant maintenance is just as important as mechanical maintenance, especially from the standpoint of safety, the provision of proper working conditions and the prevention of undue waste of the assets of the company.

Lubrication

Since the keynote of modern maintenance is prevention, any discussion of this subject without at least a brief description of the importance of proper lubrication and its contribution to preventive maintenance would be inadequate. It is in the field of lubrication that real progress has been made in recent years.

A study of the causes of mechanical breakdowns will show that a very large number can be directly attributed to the failure to supply adequate and proper lubrication. This does not mean necessarily that sufficient oil has not been used, but it does mean that there was not sufficient oil at the points which required lubrication. The losses due to the failure properly to lubricate all the points requiring lubrication and the wastes resulting from the use of the wrong lubricant and careless performance are enormous. In order to overcome these losses a number of things are being done:

1. There is a distinct tendency in the direction of making lubrication as automatic as possible, thus eliminating the human element. By these improved methods of lubrication sufficient lubricant is forced under pressure to every point requiring it. There is no need for the worker to avoid oiling certain parts of the machine because they are difficult to reach. Machine manufacturers, recognizing the importance of adequate lubrication, are equipping their machines with these devices and many manufacturers are installing such systems upon the machines which they already have in their shops.

2. The responsibility for properly lubricating machines is rapidly being taken from the machine operator, who frequently has proven unsatisfactory as an oiler, and is being centralized in the hands of a single individual, sometimes called a lubrication engineer, who is responsible for the adequate lubrication of all machinery and equipment. Along with this centralization, careful cost records, which prove valuable in the study of lubrication problems, are kept.

3. A more careful study is being made of the lubricant to use in order to ascertain whether or not it will meet the purpose for which it is to be used.

4. Lubrication surveys are being made in plants, as a result of which both the cost of oil and the cost of labor are being reduced.

5. Lubrication is being scheduled and the oiler routed, time studied, and placed on incentive systems of wage payment with considerable success.

Without doubt one of the most efficient means of preventing mechanical failures of machines is supplying adequate lubrication.

Standing Order for Maintenance Department

After standards have been established for the maintenance of plant and equipment, as indeed for any phase of the business, the development of a standing order is an invaluable aid in maintaining that standard. The standing order for the maintenance department explains in detail the purpose of the maintenance department, its functions and its method of operation. It serves as a means of placing before the members of the maintenance department the basic ideas behind maintenance work and of instructing them in the standard method of carrying out these ideas. As a device to aid in maintaining standards the standing order has been of no small importance.

It is not the purpose here to outline in detail the methods of operating a maintenance department charged with the maintenance of standards of plant and equipment. However, it is well to note that all of the principles of good management which apply to the various production units apply equally well in the maintenance department. In the past many maintenance engineers were wont to plead that their departments were different; that no two jobs were ever exactly alike and therefore that those principles of good management which were applicable in shops manufacturing a stand-