CSDA Best Practice

Title: Equipment Maintenance Management for Contractors
Issue No: CSDA-BP-002
Effective Date: Jun 21, 2006
Revised Date: May 6, 2020

1. Creating A Preventive Maintenance Program

When a CSDA contracting business (Cutting, Coring, GPR, Polishing, Robotic Demolition) is started, the focus is on the short-term direct costs of contracting, mostly tools, trucks and labor. The long-term costs of maintenance are probably, at least initially, not a top priority. However, over time, maintenance costs continue to increase to a point where they are cutting into profits at a rate that was probably never anticipated. This is the point where controlling maintenance costs is unavoidable and it must become an integral part of the operation of a business.

For today's contractors, the challenges are the same. Equipment must be well maintained for the business to succeed. In addition, for employees to succeed in the field, they must be issued reliable, properly performing equipment. This is the only way an owner can successfully control maintenance costs.

In an industry that relies so heavily on the performance of the equipment that it uses, it becomes apparent how the performance of an equipment fleet is directly related to the overall performance of a company. There are many issues to consider relative to the performance of a fleet. Some, but certainly not all, of the issues included are:

- The company's reputation for on-time, reliable service.
- Morale of the personnel who work with the equipment on a daily basis.
- Safety/Liability concerns related to improperly functioning equipment.
- Financial performance of the company.

However, since the cost of maintaining a fleet plays an integral part in the success of an operation, controlling these costs is paramount to success. To control these costs, a comprehensive preventive maintenance program must be initiated and sustained.

Unfortunately, many operators don't fully understand the negative impact poor maintenance practices can have on operations. In addition, many operators simply don't know how to implement a properly managed maintenance program. However, to succeed in any equipment intensive business, operators and owners must become maintenance managers.

2. Setting up a Preventive Maintenance Program

The process of setting up a preventive maintenance program will require multiple steps. In actuality, the steps are quite easy to implement. First, start with a simple base. Then, as the program gains momentum levels of sophistication can be added to improve the capabilities of the PM (preventive maintenance) program.

2.1. Step 1 – Identify and Issue Equipment Numbers

Issue equipment numbers for all pieces of equipment. This step is very important, as it will become the means of tracking all information related to a specific piece of equipment, including cost of operation. Even hand-operated power tools should be given an equipment number. Following are two examples of how the equipment numbers can be established.

Equipment Type	Equipment #		Alternate Equipment #
Flat Saws	FS-01 and up	or	101 and up
Wall Saws	WS-01 and up	or	201 and up
Core Drills	CD-01 and up	or	301 and up
Hyd. Power Units	HPU-01 and up	or	401 and up
Hand Saws	HS-01 and up	or	501 and up
Chain Saws	CS-01 and up	or	601 and up
Trucks	TR –01 and up	or	701 and up
Trailers	TRL-01 and up	or	801 and up
Backhoes	BH-01 and up	or	901 and up
Skid Steers	SS-01 and up	or	1011 and up
Generators	GEN-01 and up	or	1101 and up

2.2. Step 2 – Create a Maintenance History System

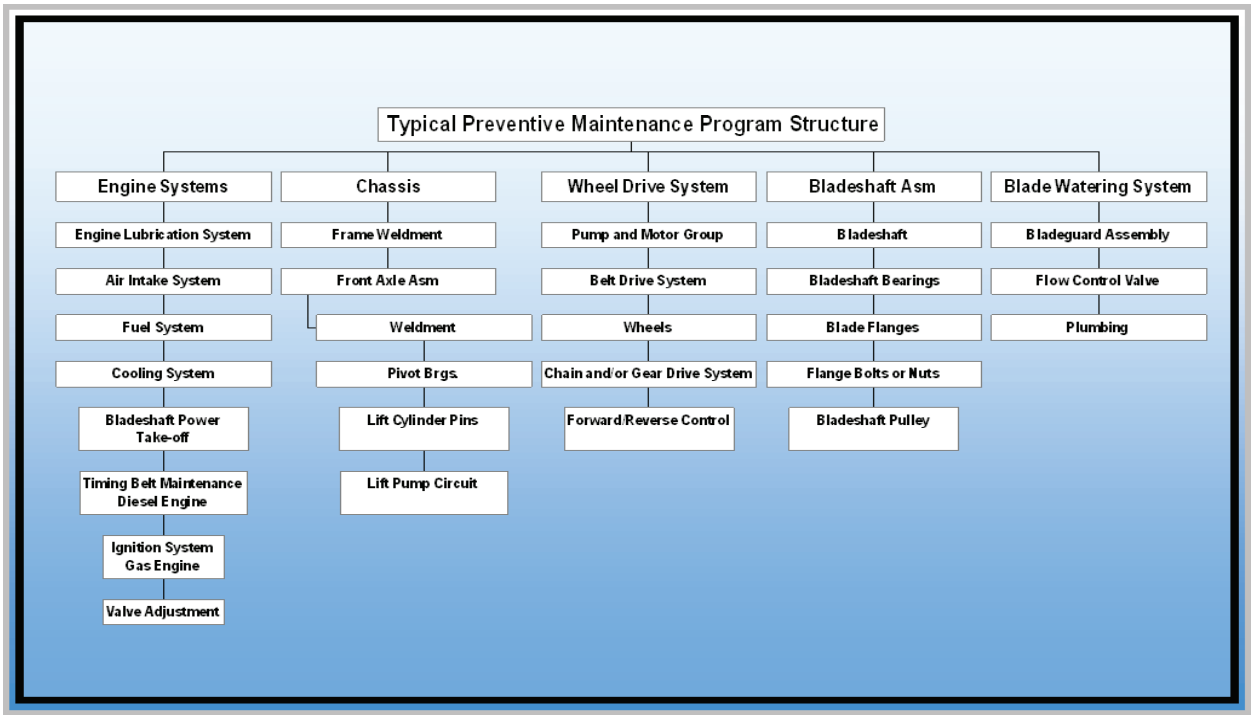
Gather all information for each piece of equipment in a central location. Create system to track individual piece of equipment in the fleet. The information should be updated regularly and maintained in a manner that is easily accessible. Following are examples of the type of information that should be maintained in individual equipment files.

- Manufacturer.
- Model Number.
- Serial Number.
- Date of Purchase.
- Purchase Price.
- Special Configuration Information.
- Local Service Dealer and Contact Info.

2.3. Step 3 – Create Preventative Maintenance (PM) Inspection Reports

It is important to create forms tailored to each line of equipment, as each type of equipment will have maintenance requirements specific to it. For example, a pavement saw would require a different inspection report than a core drill. If your fleet includes different models of a particular type of equipment, you may require different PM inspection forms for each model. A common practice is to include all possible configurations for a particular type of equipment on the inspection report. During regularly scheduled preventative maintenance, the technician performing the inspection will simply mark the line items that do not apply as "not applicable."

The chart below represents systems and components of a typical pavement saw that requires inspection or service during regularly scheduled preventative maintenance.



2.4. Step 4 – Create Multiple Levels of Service

One of the keys to minimizing maintenance costs is to structure PM service intervals that match the maintenance requirements of each individual component or system as closely as possible. Since service interval requirements for different components vary, it would not make sense to service every component or system at every service interval so you need to establish multiple levels of service. First, identify the proper service intervals for each component or system. Then make sure that the interval for the upper level of service is divisible by the lowest level of service. For example, if an adequate service level for a diesel saw is 125 hours and the interval for its wheel drive system is 500 hours, then the levels of maintenance would be 125 hours, 250 hours, 375 hours, 500 hours and so on. Most equipment will require 4 levels of PM service or less, although some equipment might require more. It is important to understand that the Level 1 service interval must be set to the component with the lowest service interval requirement, which is generally the engine.

2.5. Step 5 – Creating Work Orders

This operation ties back into steps three and four, which are creating PM inspection reports. When creating a work order it will be necessary to know which level of service is due. This will be determined by the odometer, hour-meter reading or time intervals. Once the level of service is determined, the work order should start with the appropriate PM inspection tasks. As each item is inspected, it should be indicated as pass or fail. If an inspected item fails inspection, the deficiency needs to be indicated on the report. At this point, a decision will be made by the maintenance manager whether to repair the deficiency at the time of inspection or schedule the repair for a later date. The next step in creating the work order is to apply the labor functions required for the level of service being performed. Finally, material requirements need to be added to the work order.

The following illustration is an example of a level-4 work order for a pavement saw with 600+ hours of use. In this example, the saw was scheduled for a level-4 service. First, the PM inspection tasks for a pavement saw level-4 service were added to the work order. After the PM inspection was performed, the additional labor and material requirements were added. In this example, all items that failed inspection were repaired during the PM service. Note the comments and technician signature columns. These items are a very important part of the work order, since all information feedback is generated from these fields.

Equipment Maintenance Work Order					
Equip. Type:	Flatsaw	**W.O. TYPE**		**Page 2 OF 2**	
Equip. #:	FS-100	**Preventive Maintenance:**	x	**W.O. #:**	EXAMPLE
Model#:	FS-60HP Diesel	**PM Service Level:**	4	**Start Date:**	6/20/2005
Mfr. Serial #:	FS-010105	**On-Demand (Emergency):**	N/A	**Due Date:**	6/22/2005
Mfr. Name:	Generic	**Hr. Meter:**	620	**Odometer:**	N/A

Operation, Labor Functions	Comments	Work performed by
Change engine oil		**Tech Initials here**
Take engine oil sample		**Tech Initials here**
Replace engine oil, air, and fuel filters		**Tech Initials here**
Lube all grease points		**Tech Initials here**
Replace lift pump fluid		**Tech Initials here**
Replace wheel drive fluid and filter		**Tech Initials here**
Pressure wash entire unit		**Tech Initials here**
Operation, Additional Labor Functions from Inspection		
Replace engine fan belt		**Tech Initials here**
Clean radiator/cooler		**Tech Initials here**
Replace worn air intake hose		**Tech Initials here**
Replace bladeshaft drive belts		**Tech Initials here**
Replace entire bladeshaft assembly		**Tech Initials here**
Replace rear wheels		**Tech Initials here**
Adjust wheel drive chains		**Tech Initials here**
Weld crack @ LF corner of platform		**Tech Initials here**
Replace worn forward/reverse control linkage ends and adjust		**Tech Initials here**
Material Requirements		**Materials Installed**
15W-40 Motor Oil, 16 Qts.		**Tech Initials here**
Oil sample kit, PN 12345, Qty. 1		**Tech Initials here**
Air filter, PN 23456, Qty. 1		**Tech Initials here**
Oil filter, PN 34567, Qty. 1		**Tech Initials here**
Fuel filter, PN 45678, Qty. 1		**Tech Initials here**
4 oz. HP waterproof grease		**Tech Initials here**
5-30W motor oil, 1 Qt.		**Tech Initials here**
Hydraulic filter, wheel drive, PN 56789, Qty. 1		**Tech Initials here**
Fan belt, PN 67890, Qty. 1		**Tech Initials here**
Hose, air intake, PN 78901, Qty. 1		**Tech Initials here**
Belt, 5G3VX530, Qty. 2		**Tech Initials here**
Bearings, Bladeshaft, PN 89012, Qty. 2		**Tech Initials here**
Bladeshaft, PN 90123, Qty. 1		**Tech Initials here**
Inner flanges, blade, PN 01234, Qty. 2		**Tech Initials here**
Outer flanges, blade, PN 98765, Qty. 2		**Tech Initials here**
Bolts, bladeshaft, PN 87654, Qty. 2		**Tech Initials here**
Wheels, rear, PN 76543, Qty. 2		**Tech Initials here**
Linkage ends, PN 65432, Qty. 2		**Tech Initials here**

3. Preventive Maintenance Scheduling Techniques

Due to time constraints or other considerations, it is not always possible to repair all failed inspection items during the scheduled PM service. It is at this point that scheduled maintenance practices come into play. If it is determined the item that failed inspection is still serviceable for a reasonable period then the repair can be re-scheduled for an interim repair or at the next PM service. Notice that two items (pulleys and front wheels) were given a pass rating, but in the comments column it was noted that they should be replaced at the next scheduled PM. This approach will allow the maintenance department to procure the needed materials at the best pricing, minimal freight cost and without spending extra labor for emergency purchases.

A very important activity that is often overlooked and under-utilized in the scheduling of equipment maintenance is the constant gathering of information regarding the condition of the equipment between regularly scheduled preventive maintenance intervals. Through constant gathering of information and updating of maintenance files, the effectiveness of preventive maintenance scheduling can be greatly enhanced. This process informs the maintenance department beforehand of the service requirements of a given piece of equipment, allowing all materials and labor resources to be available for the next scheduled PM service. Again, by preparing before the maintenance is due, equipment downtime and expense is minimized.

4. Communicating Maintenance Needs

Without a doubt, the most effective way to gather information regarding the condition of the equipment is from the employees using the equipment. How do we open the lines of communication between the operators in the field and the maintenance department? First, it is necessary to develop a work environment where the importance of equipment maintenance is appreciated by the field personnel. It is also important that everyone understands that the success of each employee and the success of the company as a whole are dependent on the performance of the equipment that is used in daily operations activities. Ways in which to improve communication between the field and maintenance departments include:

4.1. Maintenance Department

- Make it easy for the operators to report equipment deficiencies.
- Create equipment deficiency forms/reports for operators to use to communicate with the maintenance department.
- Create OUT OF SERVICE tags.
- Create READY FOR SERVICE tags.
- Create a system where operators can report problems with their equipment even if maintenance personnel are not present.

4.2. Field Operators

- Take responsibility for communicating equipment deficiencies.
- Perform daily routine inspections of assigned equipment.
- Turn in equipment deficiency reports to maintenance department.
- Whenever possible, give the maintenance department as much advance warning as possible.

5. Improving Communication Systems

Most operators are not as likely to report problems with the equipment if there is not a procedure in place to do so. There are only two basic kinds of reports. The first is non-emergency information that allows the maintenance department to prepare in advance for the needed maintenance. The second is on-demand or emergency maintenance requirements. A very simple, yet effective system to use for reporting on-demand deficiencies are heavy manila tags with wire ties built onto the tag. These inexpensive tags can be printed with whatever information is needed. These kinds of tags can also be pre-formatted. All an operator has to do is complete the tag and tie the tag to the piece of equipment that requires service. This information will assist the maintenance personnel in determining what repairs are required for that particular piece of equipment. This is especially helpful if the equipment was brought back to the shop while maintenance personnel were absent. Tags can fall into two categories, out of service and ready for service. The out-of-service tag will also prevent another operator from attempting to use the equipment before it has been serviced. A yellow tag can be added to this system to communicate a machine that is functionally operational but needs minor future repairs (not a red tag and not fully green).

RED TAG

OUT OF SERVICE
Employee:
Date:
Equipment Number/Description:
Hour-meter Reading:
Description of Deficiency:

GREEN TAG

READY FOR SERVICE
Technician:
Date:
Equipment Number/Description:
Hour-meter Reading:
Description of Service/Repair:

6. Visual Aids for Identifying In-Service and Out-of-Service Equipment

An effective method for identifying out-of-service and ready-for-service equipment is to have an area of the shop that is dedicated for incoming equipment (out of service). This equipment should be red tagged. After the equipment has been repaired it should be green tagged and taken back to the ready for service area. If the layout of your facility allows, these areas should be as far apart as possible to reduce any confusion about status of the equipment. This system will minimize the risk of operators taking an unserviced piece of equipment to the field. It will also help alert maintenance personnel to current service requirements.

7. Measuring Performance

Availability is the unit of measurement for rating how well a maintenance program is performing. The term “equipment availability” refers to what percentage of time a piece of equipment is available when there is scheduled demand for it. This is not to be confused with total downtime of a piece of equipment but only unscheduled downtime that occurs when the equipment is needed in the field. It is acceptable for a piece of equipment to be out of service, but only if it is not needed in the field. Equipment availability ratings of less than 95 percent will have devastating effects on the profitability of any sawing and drilling operation.

There is a domino effect in terms of the costs associated with unscheduled downtime. Some of the costs are intangible, like customer dissatisfaction due to non-performance. Other costs are more readily identified such as re-scheduling labor and equipment resources back to a project that wasn’t completed on time. This is a double hit, since the equipment and personnel that would be generating revenue today are consumed completing yesterday’s work. In addition to inefficiencies related to production, the costs of emergency maintenance are estimated to be 3-5 times that of regularly scheduled maintenance.

Properly maintained equipment rarely fails unexpectedly. By performing preventive maintenance, unscheduled downtime can be reduced to almost zero percent. Bear in mind that preventive maintenance involves a bit of a different mindset than dealing with mechanical problems after the failure. Remember too that all equipment will eventually require maintenance. A PM program allows the maintenance to be performed under specific, planned and controlled conditions. In addition, it is important to have periodic meetings with employees to discuss what is working well with the PM program and what needs to be improved. For the program to work well, everyone has to participate.

8. Making the Move from Reactive to Proactive Maintenance

Most contractor maintenance departments consist of a single person. The benefits for a small contractor are the same as a large one. A contractor does not require a large maintenance department to take advantage of PM practices. Preventive maintenance has to become part of the culture of your company and this culture has to be created and cultivated by management. Without the support of management, the program will break down and reactive emergency maintenance practices will prevail. By utilizing preventive maintenance practices in your business, you will ultimately have the ability to reduce and control maintenance cost as a predictable ratio of revenue.