

CSDA Best Practice

Title: Equipment Maintenance
Management for Contractors
Issue No: CSDA-BP-002
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1. Creating A Preventive Maintenance Program

Why do people start contracting businesses? Probably to perform a trade and hopefully to become successful as a company owner. Most definitely, people don't go into business to perform maintenance on their equipment. Generally, concrete cutters are not a group of equipment maintenance experts, but a group of hard working individuals who enjoy practicing the craft of sawing and drilling.

When a concrete contracting business 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 concrete cutting contractors and most other contractors as well, 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 in the concrete sawing and drilling industry 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.

<u>Equipment Type</u>	<u>Equipment #</u>		<u>Alternate Equipment #</u>
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 individual file folders for every 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.

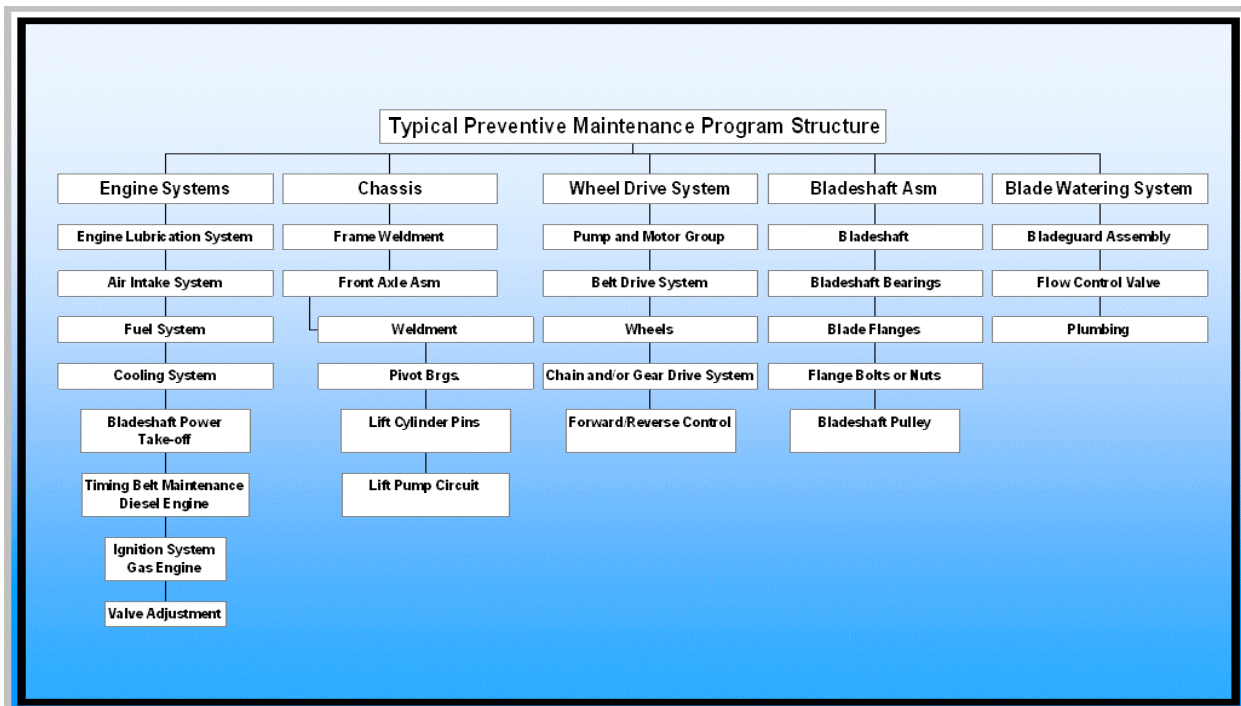
- Manufacturer.
- Model Number.
- Serial Number.
- Date of Purchase.
- Purchase Price.
- Special Configuration Information.
- Local Service Dealer and Contact Info.

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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 has to be set to the component with the lowest service interval requirement, which is generally the engine.

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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.

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**Equipment Maintenance
Work Order**

Equip. Type:	Flatsaw	W.O. TYPE		Page 1 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, PM Inspection	Comments	Condition
ENGINE-		
Inspect for oil leaks		Pass_x_Fail_____
Inspect for coolant leaks		Pass_x_Fail_____
Inspect radiator/cooler for plugging	Partially plugged, service required	Pass___Fail_x____
Inspect turbo condition		Pass_x_Fail_____
Inspect fan belt condition	Worn	Pass___Fail_x____
Inspect air cleaner system for leaks/wear	Hose has spot partially worn through	Pass___Fail_x____
Inspect condition of fuel tank and cap		Pass_x_Fail_____
Inspect condition of fuel lines and valve		Pass_x_Fail_____
POWER TAKE-OFF SYSTEM-		
Inspect condition of pulleys	Note: pulleys should be replaced @ next PM service	Pass_x_Fail_____
Inspect condition of bearings		Pass_x_Fail_____
Inspect condition of drive plate and comp.		Pass_x_Fail_____
Inspect condition of bladeshaft drive belts	Worn	Pass___Fail_x____
BLADESHAFT ASSEMBLY-		
Inspect cond. of Brgs. w/dial indicator	Bearings have .030" radial freeply	Pass___Fail_x____
Inspect cond. of bladeshaft w/dial indicator	Shaft is worn @ location where blade rides	Pass___Fail_x____
Inspect cond. of blade flanges w/dial ind.	Worn undersize	Pass___Fail_x____
Inspect threads @ ea. end of bladeshaft		Pass_x_Fail_____
Inspect threads of flange nuts or bolts		Pass_x_Fail_____
CHASSIS-		
Inspect cond. of front axle assembly		Pass_x_Fail_____
Inspect cond. of front wheels and brgs.	Note: wheels should be replaced @ next PM service	Pass_x_Fail_____
Inspect cond. of axle bearings		Pass_x_Fail_____
Inspect cond. of lift cylinder and pins		Pass_x_Fail_____
Inspect cond. of lift pump-load test	150 amps @ 12.2 VDC	Pass_x_Fail_____
Inspect cond. of depth stop system		Pass_x_Fail_____
Inspect cond. of rear wheels and brgs.	Wheels worn	Pass___Fail_x____
Inspect cond. of rear drive system	Chains loose, adjustment required	Pass___Fail_x____
Inspect cond. of all chassis welments	Small crack LF corner of main platform frame	Pass___Fail_x____
ELECTRICAL AND CONTROLS-		
Inspect general condition of wiring harness		Pass_x_Fail_____
Inspect condition of switches		Pass_x_Fail_____
Inspect condition of instruments		Pass_x_Fail_____
Inspect cond. of Forward/Reverse control	Linkage ends worn	Pass___Fail_x____
Test battery condition-load test		Pass_x_Fail_____
Test starter amp draw		Pass_x_Fail_____
Inspect battery cables/terminals condition		Pass_x_Fail_____
Inspect alternator-load test for max. output	60 amps ourput @ 13.8 VDC	Pass_x_Fail_____
MISC. OTHER-		
		Pass___Fail_____
		Pass___Fail_____
		Pass___Fail_____
		Pass___Fail_____

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**Equipment Maintenance
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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

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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.

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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.

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.

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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 sawing and drilling 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.

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