

How Well should a Maintenance Job be Planned?

Abstract

How well should a maintenance job be planned ? All maintenance work needs a plan that lets the maintainer do the work correctly, safely, in the least possible time and for the least cost. Selecting the information and details that go into the maintenance job plan is vital to its success. Leave out necessary specifics and facts and you put the job at increased risk of failure, loss and waste. Exactly what details are necessary to allow maintenance work to flow wonderfully well at minimal cost and time are important for a maintenance planner and their managers to know.

Keywords: maintenance planning, planned maintenance, work process flow, work quality assurance

Do not plan a maintenance job well and watch how quickly it turns into trouble and stress for all concerned. Maintenance work needs fully detailed planning:

1. to ensure the job goes right and is trouble-free from start to finish,
2. to ensure it is done without error,
3. so the equipment is returned to design conditions and operation
4. to minimise the cost of the job,
5. to permit good coordination between parties involved in or affected by the work,
6. to do the job safely, and
7. to do the job in minimal time.

This list gives us a way to measure how well a maintenance job is planned, prepared and performed.

Maintenance planning is not the same as maintenance scheduling; they are totally different. Using an overseas trip analogy: planning is what you put in the suitcase for the trip, scheduling is buying the ticket. You need to be well prepared for the events that will happen at the destination and you also need to get to the destination. Both planning and scheduling need to be done well.

Only planning can make a maintenance job successful, scheduling has no impact on how well the job is eventually done. In fact poor scheduling will ruin a well planned maintenance job and great scheduling cannot save poorly planned work. Scheduling is the timetabling and coordination of resources and can only be done well after there is a plan to be completed. What is not planned cannot be scheduled. If anything is left off the plan the scheduling and coordination cannot correct the error. When the plan is poor or wrong the job result will always be poor and wrong. Hence correct and thorough planning is the foundation of maintenance job success and it is worth spending a great deal of effort in getting the work plan and the preparation right.

All maintenance planners produce a product—the work pack or job pack. The job pack contains every detail and piece of information needed to do the work correctly, effectively and efficiently. Good maintenance planning starts with a list of the things and issues that will be addressed in the job pack. The planner then follows that list of standardised requirements and delivers them fully in the job pack. An example of a list of the minimum requirements for a job pack is shown in Table 1.

A vital part of the job pack is the job plan for doing the work. The job plan is what the scheduler and maintainer follow when they do their work. The job plan is the line-of-sight steps that are followed to complete the work correctly. The job plan is not the job procedure. A job procedure details every task's activities (one task may have several activities to do in order to complete the task), directs all the actions to be done during the work by the maintainers, includes the task

standards that they must be done to produce top quality results, and is a full record of the job showing the condition the equipment was found in and the condition it was left in. The job procedure is written once there is a job plan available. With the job procedure the maintenance planner influences and guides their plant and equipments' reliability and operational performance by the quality and detail of the information and advice they put in the job procedure. You can see a thoroughly detailed job procedure at [ACE 3T Job Procedure Plummer Block Example](#).

MAINTENANCE WORK PACK MINIMUM CONTENT		
ITEM No	DESCRIPTION	COMMENTS
1	Job Plan	The work flow process diagram of job milestones in line-of-sight detail.
2	Skills / Competencies required	The expertise and competencies needed to do the job correctly
3	Job Procedure	Task by task fully detailed description with quality standards and corrective action.
4	All Drawings relevant to the job	Could be mechanical, electrical, civil, structural, process diagrams, etc.
5	Bill of Materials for the job	The parts used in the job including part number, part description and quantity required
6	Tools List for the job	The tools needed to do the job safely and correctly
7	Equipment List for the job	Include the equipment specification e.g. Franna Crane 20T, Mobile Air Compressor 150 CFM, two-man elevated work platform, etc.
8	Settings / Set Points	For calibration and adjustment.
9	Inspection and Test Plan with Quality Standards	Pass/Fail criteria for each task. Includes providing tolerances and condition criteria to confirm a part can remain in-service or is to be replaced.
10	Data Sheets of the equipment	Information on the design and service specifications.
11	Record Sheets	A place to make a record of an observation or measurement as proof. Often satisfied with an Inspection and Test Plan.
12	Calculation Sheets	A place to do the calculation laid-out in the sequence of the calculation with space for the figures and an example of a correct calculation.
13	All Permits and Tags	Safety, environmental, disposal, transport heritage, plant handover, etc approvals
14	Risk Assessment Forms	Site risk assessment and management documents.
15	All Technical Tables	Copies of manufacturer data tables or international engineering tables highlighted to show the information applying to the job.
16	Special Requirements	Instructions and particulars specific to the job that must be observed.
17	Commissioning Plan	Controlled testing to confirm proper operation.
18	Parts and Materials	All parts and materials are identified and gathered together in one location
19	Proof Test Recording Sheet	A check sheet to note the proof test results for each job plan activity that confirms work quality is achieved
20	Failure Mode and Equipment Health Report	A record of the Technicians observations and decisions and photographic evidence of failure modes

Table 1 The Contents of a Maintenance Job Pack



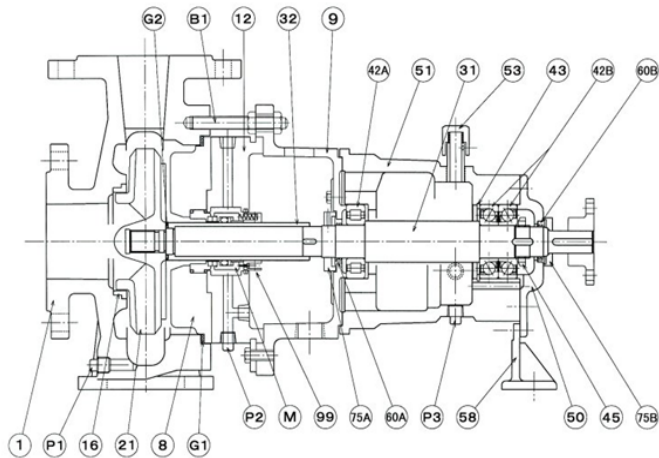
Developing the Line-of-Sight Job Plan

The second duty for a maintenance work planner is to develop the work plan in a tabular format showing the line-of-sight tasks (the first duty is to go to the job site and scope the work). Line-of-sight means that as each task is done the next task to be undertaken is clearly obvious and requires no need to imagine what it will be. Line-of-sight is an ideal way to show what needs to be done to do a job well, while making it clear exactly how the job will run to reach its successful conclusion.

Figure 1 shows a centrifugal pump set and the assembly drawing of a pump. We will use it in an example of how to develop a job plan to replace the bearings in the housing because a condition monitoring inspection found them running noisily and rapidly approaching failure.



NOTE: Needs jacking devices installed for shaft aligning



51	BEARING CASE	M	MECHANICAL SEAL
50	BEARING COVER	P3	PLUG
45	BEARING NUT	P2	PLUG
43	STOP RING	P1	PLUG
42B	OIL BEARING	G2	O-RING
42A	ROLER BEARING	G1	CASE GASKET
32	SHAFT SLEEVE	B1	ADJUSTING BOLT & NUT
31	SHAFT	99	BACKUP RING
21	IMPELLER	75B	SLINGER
16	CASEWARE RING	75A	SLINGER
12	MECHA COVER	60B	LABYRINTH
9	ADAPTER	60A	LABYRINTH
8	CASING COVER	58	SUPPORT
1	CASING	53	OIL COVER

Figure 1 Centrifugal Pump Set and Pump Cross Section

In a well organised and managed maintenance planning system there will be a standardised template covering the work plan for this job. When a centrifugal pump needs maintenance the template is accessed, adjusted for the specifics of the job and completed. For this example we will develop the job plan and you can use it as a template in your operation if you wish.

Task No	Task Name	Detailed Task Description	Done By	Additional Comments
1	Scope job	Fully understand the complexity of the job and its knock-on consequences to the business and personnel safety	Planner	
2	Plan job tasks and risk assess each one	Develop line-of-sight task list to complete the job correctly	Planner	
3	Write job procedure	Develop details of all activities in each task and the required standards to be met for each	Planner	Apply Creative Disassembly steps



Task No	Task Name	Detailed Task Description	Done By	Additional Comments
4	Secure parts and materials	Purchase all needed parts and materials	Planner	
5	Secure external resources	Purchase the use of all sub-contracted labour, equipment and services	Planner	
6	Schedule job	Timetable the job for the approved date and time	Scheduler	
7	Coordinate resources	Ensure all parts, materials, services, equipment and people are available at the necessary time	Scheduler	
8	Allocate job to maintainer	Select competent persons to do the work	Supervisor	Competence is proven by education, training, skills and experience
9	Creative disassembly first step	Review equipment history, observe equipment in operation, check for distortion	Maintainer	Use creative disassembly checklist
10	Help Operator make equipment safe	Make all necessary preparations for safe plant access and handover to do the whole job	Maintainer	
11	Provide safe plant and safe access	Provide plant and equipment safe to access and available to work on safely	Operator	
12	Equipment handover	Confirm the equipment is safe and accept the equipment handover from Operator	Maintainer	
13	Creative disassembly second step	Observe equipment condition, location, local environment and distortion changes	Maintainer	Use creative disassembly checklist
14	Disconnect drive coupling	<i>You will need to describe this in clear detail</i>	Maintainer	
15	Unbolt adaptor from volute	<i>You will need to describe this in clear detail</i>	Maintainer	
16	Unfasten pump from base	<i>You will need to describe this in clear detail</i>	Maintainer	
17	Separate pump from pump set	<i>You will need to describe this in clear detail</i>	Maintainer	
18	Take pump to workshop	<i>You will need to describe this in clear detail</i>	Maintainer	
19	Separate wet end and bearing casing	<i>You will need to describe this in clear detail</i>	Maintainer	
20	Remove mechanical seal	<i>You will need to describe this in clear detail</i>	Maintainer	Keep seal safe from damage and dirt
21	Remove bearing cover	<i>You will need to describe this in clear detail</i>	Maintainer	
22	Extract drive end bearings	<i>You will need to describe this in clear detail</i>	Maintainer	
23	Remove shaft from bearing housing	<i>You will need to describe this in clear detail</i>	Maintainer	
24	Remove wet end bearing	<i>You will need to describe this in clear detail</i>	Maintainer	
25	Micrometer both bearing journals	Rebuild pump to precision standards including Creative Disassembly third step requirements	Maintainer	Tolerance and form to be within OEM specs
26	Micrometer both bearing housings	<i>You will need to describe this in clear detail</i>	Maintainer	Tolerance and form to be within OEM specs
27	Check shaft straightness	<i>You will need to describe this in clear detail</i>	Maintainer	Tolerance and form to be within OEM specs
28	Mount wet end bearing	<i>You will need to describe this in clear detail</i>	Maintainer	
29	Position shaft in bearing housing	<i>You will need to describe this in clear detail</i>	Maintainer	
30	Mount drive end bearings	<i>You will need to describe this in clear detail</i>	Maintainer	
31	Mount adapter to	<i>You will need to describe this in clear detail</i>	Maintainer	



Task No	Task Name	Detailed Task Description	Done By	Additional Comments
	housing			
32	Place mechanical seal on shaft	<i>You will need to describe this in clear detail</i>	Maintainer	
33	Take pump back to pump set location	<i>You will need to describe this in clear detail</i>	Maintainer	
34	Position pump into pump set	<i>You will need to describe this in clear detail</i>	Maintainer	
35	Assemble bearing housing/adaptor to volute	<i>You will need to describe this in clear detail</i>	Maintainer	
36	Connect drive coupling	<i>You will need to describe this in clear detail</i>	Maintainer	
37	Align pump and drive motor shafts	<i>You will need to describe this in clear detail</i>	Maintainer	
38	Locate mechanical seal in final position	<i>You will need to describe this in clear detail</i>	Maintainer	
39	Put oil onto bearing housing	<i>You will need to describe this in clear detail</i>	Maintainer	Use correct oil grade
40	Make pump set safe	<i>You will need to describe this in clear detail</i>	Maintainer	
41	Clean and tidy work face	<i>You will need to describe this in clear detail</i>	Maintainer	
42	Hand back to Operator	<i>You will need to describe this in clear detail</i>	Maintainer	
43	Commission pump set	<i>You will need to describe this in clear detail</i>	Operator	
44	Complete work order report	<i>You will need to describe this in clear detail</i>	Maintainer	
45	Return tools, equipment and materials to Store	<i>You will need to describe this in clear detail</i>	Maintainer	
46	Update databases	Put necessary information into the planning and engineering databases for future use	Planner	

Table 2 Example of Line-of-Sight High-Detail Job Plan

Many people would question the high level of detail in this job plan. The reason so many steps are listed is to create a clear task-to-task line-of-sight workflow process. You need this level of job flow detail to fully plan and accurately track the job progress from its request to its completion.

Another question often asked is why Tasks 1 to 8 are noted in the job plan when they are not done by the Maintainer. Because it is a job plan you need to show Tasks 1 to 8 and Task 46 so that the Planner, Scheduler and Supervisor are given clear authority and responsibility to make sure the job is planned, controlled and done correctly the first time. Showing these tasks also makes clear how important they are for the successful performance of the maintenance work itself. If the planning, scheduling and supervision for the job is poorly done it reduces the chance of the job going right.

A high-detail Job Plan makes clear to everyone throughout the company what is necessary to do a job and the resources and effort that will be required to complete it properly and safely. Imagine how much more unlikely it would be that this job will be done efficiently, effectively and right-first-time if there were no specifics of exactly how the job can be done correctly, right-first-time.

Remember that this job plan is not the job procedure for the maintenance work being undertaken. It is quite likely the job procedure to be followed by the maintainer is 200 or more activities long and will include dozens of tests and spot inspections to prove the pump was assembled and installed precisely. If the aim of the repair was to have a pump with bearings that would last failure free for a



decade or more, then that longevity is only certain with a job procedure that specifies the necessary reliability-creating quality, backed up with proof tests and inspections to ensure the necessary task precision was achieved. To give a work order to the maintainer with only a job plan and without a complete, thorough job procedure means you have no way to control the work quality. It makes hope and luck that the maintainer knows exactly what to do, and cares enough to do it well, as your only way of getting quality work done—that is an impossible way to reliability success.

Draw the Job Plan Flow Chart

To further improve the chance of doing the job right-first-time and delivering a long-lived, highly reliable machine you then develop the workflow process diagram and include the milestone work quality inspection points. Figure 2 shows the work process flow diagram for the pump roller bearing replacement. On the flow diagram for the job are each of the Job Plan steps listed in the tabulated Job Plan.

For this example the Maintenance Job Plan and the Job Flowchart took me two hours to develop. In doing that I have created a template for all other back-pullout centrifugal pumps in the operation. For the rest of my career I will never again need to invest another two hours in creating a centrifugal pump bearing replacement Job Plan.

Making a work process flowchart of the Job Plan gives us several great advantages, such as:

- It is a 'picture' of the job that can be discussed with all people.
- It shows that the job tasks obviously form a series arrangement. Series arrangements are high risk because any vital task done wrong makes the whole job go wrong. (In fact if the critical tasks that create reliability are poorly done you can be sure that the bearings will fail too soon and the pump will again be out of service for repair.)
- It makes the job into a process with measurable inputs and a measurable outputs.
- You can now build performance KPIs into the process and measure workflow effectiveness.
- You can set clear quality test points into the work process to prove reliability was built into the machine.
- It allows you to do Lean value stream mapping for workflow efficiency improvements.
- Each task can be risk analysed to identify how it can go wrong and what to do to prevent its failure.

What seems at first glance to be a lot of unnecessary work for a maintenance planner to do when planning a job, is in fact of great importance, value and lasting worth to the organisation. If you want to build a great business that does great things then you need to make sure that world class quality work done right-first-time is everyday standard practice in your company.

If you have any questions about this approach to maintenance job planning please ask me. We also provide distance education in Maintenance Planning and Scheduling via Internet downloads, see the [Online Maintenance Planning and Scheduling training course.html](#).

My best regards to you,

Mike Sondalini

www.lifetime-reliability.com

