Chapter 27. Maintenance Related

Contents:

0) Introduction

There are only 2 applicable clauses in this chapter. The reason why a whole chapter is devoted to this is because the Clauses have new elements that are not commonly misunderstood and/or poorly catered for. Also there are 2 FAQ that are used to clarify some doubts. Many NCs have been written on this clause alone.

1) 8.5.1.5 Total Productive Maintenance (IATF16949)

(Clause Description-Paraphrase)

The organization shall develop, implement, and maintain a documented total productive maintenance system. At a minimum, the system shall include the following:

a) identification of process equipment necessary to produce conforming product at the required volume;
b) availability of replacement parts for the equipment identified in item a);
c) provision of resource for machine, equipment, and facility maintenance;
d) packaging and preservation of equipment, tooling, and gauging;
e) applicable customer-specific requirements;
f) documented maintenance objectives, for example: OEE (Overall Equipment Effectiveness), MTBF (Mean Time Between Failure), and MTTR (Mean Time To Repair), and Preventive Maintenance compliance metrics. Performance to the maintenance objectives shall form an input into management review (see ISO 9001, Section 9.3);
g) regular review of maintenance plan and objectives and a documented action plan to address corrective actions where objectives are not achieved;
h) use of preventive maintenance methods;
i) use of predictive maintenance methods, as applicable;
j) periodic overhaul.

(Highlights of the clause)

- *(Ref to old Standards). There had been a similar clause,* 7.5.1.4. Preventive and Predictive Maintenance, in the previous version of ISO/TS16949.
- Previous requirement was only a)-d). New requirements are from e) to j)
- Therefore the requirements had increase a lot.
- Notable changes are: f) maintenance objectives are needed, g) regular review of maintenance plan and objectives, and take actions when objectives are not met, g) predictive maintenance is no longer mandatory, j periodic overhaul: b) is now on replacement parts for all machines, not only key manufacturing equipment

- There are 2 FAQs. FAQ#26 explains why overhaul is required and available in any situation, FAQ#27 explains the true meaning of TPM.

(Compliance best practice)

8.5.1.5 Total Productive Maintenance

1. *A master list of equipment shall first be compiled. There are many ways to do this.* ***Exhibit 27-1*** *is one specimen.*
2. *Critical spare parts shall also be compiled, stating minimum quantities of the inventory required. See* ***Exhibit 27-2.***
3. *Preventive maintenance schedule shall be planned, with review dates. See* ***Exhibit 27-3.***
4. *Overhaul maintenance shall also be included in the plan. See* ***Exhibit 27-3****. Also see FAQ-26.*
5. *Set objectives that show effectiveness or efficiencies e.g. OEE, MTTR, MTBF etc. The previous common KPI of 100% on-time maintenance is not very acceptable.*
6. *Daily maintenance preferably should be conducted by the user department, not maintenance team (FAQ#27).* ***Exhibit 27-4*** *is a sample of daily maintenance checklist****.***
7. *Review objectives and performance as planned. If results are not satisfactory, take improvement actions.*

2) 8.5.1.6 Management of Production Tooling and Manufacturing, test, inspection tooling and equipment (IATF16949)

(Clause Description-Paraphrase)

The organization shall provide resources for tool and gauge design, fabrication, and verification activities for production and service materials and for bulk materials, as applicable. The organization shall establish and implement a system for production tooling management, whether owned by the organization or the customer, including:

a) maintenance and repair facilities and personnel;
b) storage and recovery;
c) set-up;
d) tool-change programmes for perishable tools;
e) tool design modification documentation, including engineering change level of the product;
f) tool modification and revision to documentation;
g) tool identification, such as serial or asset number; the status, such as production, repair or disposal; ownership; and location.

The organization shall verify that customer-owned tools, manufacturing equipment, and test/inspection equipment are permanently marked in a visible location so that the ownership and application of each item can be determined. The organization shall implement a system to monitor these activities if any work is outsourced

(Highlights of the clause)

- (Ref to old Standards). There had been 2 similar clause, 7.5.1.5 Management of Production Tooling, and 7.5.4.1, customer-owned production tooling, in the previous version of ISO/TS16949. Now they are into a common clause.
- All previous requirements of 7.5.1.5are retained and covered in opening, a)-f) and last paragraph is the former 7.5.1.4.
- The new clause clarified the scope includes manufacturing, test and inspecting tooling and equipment.

- Tool identification is a requirement, such as asset no, serial no. Ownership and location shall be indicated on the records
- If customer tooling, it needs ownership permanent marked in visible location.

(Compliance best practice)

8.5.1.6 Management of Production Tooling …

Tooling storage and marking.

1. *This refers to production tolling*
2. *Name of owner shall be clearly marked, and able to be seen from a distance.*

Documentation

3. *If customer owned, master list shall be available showing ID of the tooling, ownership, frequency for maintenance, total tool life. See* ***Exhibit 28-2***
4. *Individual file or card for each tooling with details of service and repairs, should be available*

Method of Preventive Maintenance

5. *Method of service shall be according to customer, example by 'shot count', that is after certain quantity of shots. You need a system to track the operations, and bring the tooling down for maintenance. See* ***Exhibit 27-5****.*
6. *Schedule according to calendar months, if used, need to be justified, or correlated to the method specified by customer*

Total Tool Life

7. *Forward warning to be given to tooling owner to replace tooling when near the total life. In practice do not wait till the total life is exceeded; but inform, say, when it reaches 80% of total life*

Other types of Tools

8. *Other forms of tools e.g. holding jigs and fixture also need maintenance but much less. It may be a thorough checking every 6-12 months. A schedule should also be prepared*
9. *Record shall be updated as maintenance is performed*

Repairs

10. *Repair is a separate item from preventive maintenance. However it should also be recorded and the pattern of breakdowns can provide more clues to the reliability of the machines, and further decisions can be made.*

3) SIs & FAQs

FAQ	IATF Clause	Questions and Answers
26	**8.5.1.5 Total Productive Maintenance**	**QUESTION** **What is the intent of including the term "periodic overhaul" in the requirements for Total Productive Maintenance?** **ANSWER** The intent of all the line items in section 8.5.1.5 is to include the minimum steps to maintain manufacturing equipment over a long period of usage so it can consistently produce product to specification. "Periodic overhaul" is rework of manufacturing tooling and equipment needed when regular maintenance steps are no longer enough to keep the tooling and equipment in a condition where it can continue to make product to specification, as detected using Mean Time Between Repairs or other similar metrics. Periodic overhaul is already defined in section 3 of the standard: "maintenance methodology to prevent a major unplanned breakdown where, based on fault or interruption history, a piece of equipment, or subsystem of the equipment, is proactively taken out of service and disassembled, repaired, parts replaced, reassembled, and then returned to service." Perhaps periodic overhaul is not applicable to some types of tooling and equipment. Perhaps some tooling is simply replaced with a new tool at the end of its useful life. However, all tooling and equipment does have a limited life based on usage, time or other known factors. The tooling and equipment manufacturer would be a good source to determine which factors and to estimate when such major work needs to be completed. Periodic overhaul or its appropriate equivalent (e.g. replacement) would need to be accounted for in the steps of the organization's maintenance plan.
27	**8.5.1.5 Total Productive Maintenance**	**QUESTION** **What is the intent of using the term "Total Productive Maintenance" for this clause, is there a connection to the industry term "Total Productive Maintenance"?** **ANSWER** The term "Total Productive Maintenance" (TPM) used in the IATF 16949 standard refers to various similar approaches that focus on proactive and preventive techniques for improving tooling and equipment reliability through the machines, equipment, processes and employees that add manufacturing value to an organization. For example, the industry approach for TPM places the responsibility for routine maintenance, such as cleaning, lubricating and inspection in the hands of the operators. Clause 8.5.1.5 of IATF 16949 has some requirements which align with some of the pillars of industry TPM. However, the individual requirements of 8.5.1.5 [a) through j)] are as stated in IATF 16949. The use of the term "Total Productive Maintenance" in IATF 16949 gives organizations an opportunity to adopt the underlying principles of industry Total Productive Maintenance while meeting the listed requirements of 8.5.1.5 in IATF 16949.

4) Supplementary Notes

Legend: HOC= Highlights of Clause, CBP= Compliance Best Practice, S&Q= SIs & FAQ, EXH= Exhibits

Clause	Section	Clarification Subjects
8.5.1.5	CBP	**SN27.1. Is a machinery & equipment master list required? What is the purpose?**
8.5.1.5	CBP	**SN27.2. Why are we still taking about critical spare parts, when the clause now asks for replacement parts for all machines on the master list?**
8.5.1.5	CBP	**SN27.3. Can I set maintenance objectives such as a) 100% ontime maintenance as an objective? Or b) below certain amount of expenditure per year?**
8.5.1.5	CBP	**SN27.4. Are we allowed to outsource maintenance?**
8.5.1.5	CBP	**SN27.5. If we are practicing preventive maintenance but still having frequent breakdowns, is it a finding?**
8.5.1.5	CBP	**SN27.6. If I can't stop machine for preventive maintenance, due to heavy demand by production, how should I do it?**
8.5.1.5	CBP	**SN27.7. If we don't need to do overhaul, so how do we comply?**
8.5.1.5	CBP	**SN27.8 What does preservation means in this maintenance context?**
8.5.1.5	CBP	**SN27.9. How do we plan the review for objectives? What do we review?**
8.5.1.5	CBP	**SN27.10. Do we need a report as the records?**
8.5.1.6	CBP	**SN27.11. How to I schedule tooling maintenance, by calendar month?**
8.5.1.6	CBP	**SN27.12. Can I use external for maintenance?**
8.5.1.6	CBP	**SN27.13. How is permanent marking done on tooling. What if the customers do not allow engraving on their tooling?**.
8.5.1.6	CBP	**SN27.14. For other types of tools e.g. holding jigs and inspection jig, what is the method to show regular maintain?**
8.5.1.5	CBP	**SN27.15. Some spares are critical but too costly to keep, such as, PLC, air compressors, what can we do?**

SN27.1. Is a machinery & equipment master list required? What is the purpose?

That is a requirement. It is to show total and types of machines and equipment are available. It is part of infrastructure planning. Also you need this to plan Master Preventive Maintenance Schedule, to guide on maintenance.

SN27.2. Why are we still taking about critical spare parts, when the clause now asks for replacement parts for all machines on the master list?

It will be perfect if the new requirements can be provided. However it may be too much to change over within a short period. Providing spare parts for critical equipment will largely meet the needs, if criticality is defined as time taken for procurement. In this case, you will not run of stock resulting in unplanned outage.

SN27.3. Can I set maintenance objectives such as a) 100% on-time maintenance? Or b) below certain amount of expenditure per year?

No. They can be maintained as additional objectives. What IATF wants to see is something that indicate effectiveness or efficiency such as OEE, MTBF, MTTR, MTTF etc

SN27.4. Are we allowed to outsource maintenance?

Yes. Most organizations do that for specialized equipment e.g. air compressors. You can delegate the work, not the whole responsibility. You must still be tracking the timing and operational reliability.

SN27.5. If we are practicing preventive maintenance but still having frequent breakdowns, is it a finding?

It should be. Preventive maintenance is supposed to prevent breakdowns. If breakdowns are frequent, it means your preventive program is not effective; and something should have been done, instead of allowing the breakdowns to go on.

SN27.6. If I can't stop machine for preventive maintenance, due to heavy demand by production, how should I do it?

You need to step up your in-process inspection, for the extended period, to make sure quality is OK. Stop at the first opportunity for maintenance. Better still, if you know of the heavy use upfront, service the machine ahead of the schedule, so the machine operations would not be interrupted.

SN27.7. If we don't need to do overhaul, so how do we comply?

See FAQ-26 for the answer. Unless we are referring to consumable type of tools e.g. drilling and cutting bits, which are simply replaced when they are no longer functional. All other equipment should require overhaul to extend total life, or to overcome frequent, nagging problems.

SN27.8 What does preservation mean in this maintenance context?

When some machines are not used for a long time, it will deteriorate e.g. gathering of dust, rusting, moving parts getting jammed etc. Preservation means step taken to protect the equipment while not in use e.g. apply antirust, plastic wrap the equipment to keep out the dust, use desiccants to prevent moisture etc.

SN27.9. How do we plan the review for objectives? What do we review?

You can base your priority on problematic equipment or critical equipment. For review, you should look into the achievement of objectives, breakdown frequencies and impact on production, for the preceding period/year. You can then decide if the maintenance frequencies, checking items, and methods are adequate or suitable.

SN27.10. Do we need a report as the records?

Records are definitely needed. The format is not prescribed by ISO or IATF. You can use one that suits your circumstances.

SN27.11. How to I schedule tooling maintenance, by calendar month?

Most customer would want the preventive maintenance to be based on actual usage. For production tooling, for example, maintenance by shot-count is usual. Once decided, say 50000 shots for service, you track the shot-count to bring down the tooling for maintenance. You also need to follow a checklist to conduct the preventive maintenance. There is also a common practice to have minor and major

maintenance, using different checklists. Calendar month-based is acceptable, so long calendar months can correlate to the specified shot-count. This is tedious, and you have a lot to prove during audit.

SN27.12. Can I use external for maintenance?

Yes, it is practiced, although in rare cases. But most organizations would manage the whole process with their own employee, for better flexibilities. If you have to use outsourced contractors, you must still be responsible to track the work timing and ensure work quality.

SN27.13. How is permanent marking done on tooling. What if the customer does not allow us to engrave on their tooling?

Engraving is one way. If you are not allowed to do that, you can consider having dedicated areas for each customer's tooling. Color-coding for different customers' tooling is another method. Customer names can be placed on the dedicated racks, if cannot be engraved. A matrix can also be used to show tooling serial number against owners, and prominent displayed. On top of that, the tooling itself must have some identification e.g. serial no etc.

SN27.14. For other types of tools e.g. holding jigs and inspection jig, what is the method to show regular maintenance?

You need to check on damage and deformation on the tools regularly. Common frequencies seen are once a year, but it depends on usage rates.

SN27.15. Some spares are critical but too costly to keep, such as, PLC, air compressors, what can we do?

You may work out some arrangement with your local supplier to keep the spare part on your behalf. Anyway they have other customers who are also in the same situation, and could already be providing this service. If you can produce some evidence that such an agreement is on, it would be acceptable. Better still you can visit them once a year to see if they keep their promises. If there is no local supplier, then you would have to keep the spare part, or take the risks. You can reduce the risk by keeping tight surveillance on the machines for signs of malfunctioning, and order the part at the earliest possible time.

Exhibit 27-1. Equipment Master List

Equipment Master List

Key: H=High, M= Medium, L= Low

No.	Description	Model/Serial No.	Location	Usage (H.M.L)	Maintenance every			
					30 days	3 Months	6-monthS	12 months

Remarks given in this section explain on the Exhibit. Do not include them as part of the document

- This is an example of an equipment master list. The majority of the organization I have seen, had skipped this and prepare a master schedule instead. (Exhibit 27-3)
- It is also acceptable to proceed direct to the schedule (Exhibit 27-3), except the basis of preventive maintenance should be seen

Exhibit 27-2. Spare Part List

Critical Spare Parts Control

No.	Spare Part	Machine	Reasons for keeping Stock	Min quantity	Remarks
1	V-belt 200X	TRE 200	Consumable and common for many machines	5 pc	
2	Syntex H XED	OYR optical machine	Consumable, 2 machines, part is from Germany. Lead time 2 months	5pc	
3	Reducing valve. BN-3R01 15°	TRE 300	Have life span. Common for 4 machines	3	
4	PLC xxx	Press	Can break down without warning. Common for 5 machines. Lead time 2 weeks air freight	0	Too expensive. Will monitor carefully for signals of problems
5	Air compressor	Whole plant	Only 1 unit working. The smaller ones are all spoilt	0	Agreement with rental company to loan if spoilt. 2 days to install.

Remarks given in this section explain on the Exhibit. Do not include them as part of your working document

- The list is fictitious and the purpose is to show how to fill the form
- There is another stock card normally to be used in tandem, see below
- Item 4 and item 5 are interesting. They are not technically correct but frequently practiced. The organizations would not keep spares but adopt alternative measures with good reasons.
- Item 4, PLC is not advisable to keep as it can get spoilt on long-holding; and when discovered, the warranty is over. Again there may be excess machines so the situation is not so critical
- For air compressor's case, it is not a big issue as rental units are available at very short notice.

Stock Card

Spare Parts	Std Packing	Shell Life	Min Stock	Max Stock	Lead Time
V-belt 200X	10 pc/ box	3 years	5 pc	15 pc	1 month

Date	Description/Document	Qty In	Qty Out	Balance	Remarks
1/3	Carried down	15			
5/4	GRN-0118/19		2	13	
7/5	GRN-0320/10		5	8	Order for 10
9/5	GRN- 350/19		3	5	
15/5	GRN- 358/19		1	4	
1/6	Receive	10		14	

Remarks given in this section explain on the Exhibit. Do not include them as part of the document

- Stock control is by each type of spare part.
- There are many ways to keep track of stock movement: Stock card as above, bin card at the storage area, or an excel page in the computer etc.
- Good stock control takes into consideration of lead time, historical consumption, and trends

Exhibit 27-3. Preventive Maintenance

Machine Maintenance Schedule (2019)

No.	Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	M/C to Review	Status	Report Ref
1	NC Turning 1	x			x			x			x					
		12/1			14/4											
2	NC Turning 2		x			x			x			⊗				
			1/2													
3	NC Turning 3			x			x			x			x	x		
				1/4												
4	CNC Milling 1	x			x			x			x					
		2/2			4/4											
5	CNC Milling 2		x			x			x			x				
			15/2													
6	Press 1			x			x			x			x	x		
				13/3												
7	Press 2	x			x			x			x					
		8/1			18/4											

⊗ = Overhaul

Remarks given in this section explain on the exhibit. Do not include them as part of your document

- Crosses at the yellow zone, are planning for performance review. This is done besides KPI such as MTBF, MTTR, downtime etc.
- Review should include: comparison on breakdowns, frequencies of maintenance, maintenance costs, production hour losses etc. Appropriate recommendations should be made to management if current method is OK, or machine should be replaced etc.
- Reviews are usually done at year end after completing 12 months, and records of review available

Exhibit 27-4. Daily Maintenance Checklist

Daily Maintenance Check List

Equipment	No/Identification	Person Responsible	Months-Year

Place "√" for good situations and "X" for bad situations on each column respectively. Inform supervisor immediately on problems or symptoms. Denote 'S' for Sundays under relevant dates.

No.	Service/Task/Checking	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
	Checker's Initials																
	Superior's random checks																

No.	Service/Task/Checking	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	Checker's Initials																
	Superior's random checks																

ecord actions taken for 'X':

Remarks given in this section explain on the Exhibit. Do not include them as part of your working document

- This is an example of daily maintenance checklist. It should be pinned up near the machine, and it is OK for it to get soiled
- The recording is in 2 layers in the above example. However if there are many checking items, you might have to use 2 sheets for 1 month
- The job of daily checking is best done by the operators, and not technicians, for creating sense of ownership. See FAQ 27.

Exhibit 27-5. Tooling Shot Count Tracking

Tooling Shot Count

CUSTOMER	:		MOULD MAKER	:	
PART NAME	:		NUMBER OF CAVITY	:	
PART NUMBER	:		Shots for PM	:	Say 50000

PRODUCTION RECORDER :

PRODUCTION DATE	QUANTITY (SHOT)	ACCUMULATIVE SHOT	REMARK

Remarks given here explain on the Exhibit. Do not include them as part of your working document

- This is an example of production tooling shot-count control. The shot-count for maintenance is fixed at certain shots, at the start of maintenance program
- The quantity data is taken from production or planner and tracked daily
- When the shot count reaches the shot-limit or thereof, preventive maintenance is to take place

>> End of Chapter 27 <<