UNIT 12 SPARE PARTS MANAGEMENT

Objectives

After reading this unit, you would be able to:

- define the objecties and types of spare parts management in Materials Management;
- describe six stages of life cycle of spare parts management and importance of each stage;
- identify some myths about spare parts management;
- describe the linkage of other systems with spare parts management systems; and
- discuss other aspects like cost control, organization and problems regarding spare parts.

Structure

12.1 INTRODUCTION

Margins are narrowing down, budgets are stretched and operational expenditures are rising. One must find ways to maximize revenues and reduce the operating costs. Knowing what is in your inventory is the first step. Optimal spares conditioning is a necessity for the entire types of maintenance tasks, such as inspections, protective maintenance, and repairs. With the exception of protective activities, spare parts for maintenance tasks are usually required at random intervals. Thus, the rapid and safe coordination of the demand for spare parts with the supply of spare parts at the required time is a vital factor for the prompt execution of the maintenance process. Missing materials are one of the most frequently cited rationales for the interruption in completion of maintenance tasks. As spare parts for equipment are frequently of very high quality, merely increasing warehouse stock cannot solve this problem. A maintenance planner should know about potentially essential parts and their accessibility. Effective maintenance management results in higher productivity, better quality and reduced cost of operations. Spare parts play a vital role in these. You will read about them in more details in the course MS-57: Maintenance Management. Most of the issues discussed in this unit are taken from unit 7 of the Maintenance Management Course.

12.2 SPARE PARTS MANAGEMENT: CONNOTATION

"What you visualize is usually, what you get". You cannot plan and schedule work effectively unless you know about the job at least 24 hours before the job has to be started. Appropriate preparation and management of spare parts inventory is a significant module of an effective spare parts management program. If the accurate parts are available when needed for everyday maintenance or repairs, downtime is prolonged. If moreover many parts are on hand, the organization incurs tremendous costs on carrying the inventory. There exist many approaches to supervise spare parts.

Every business such as mining, chemicals, and service providers such as call centers, banks, and insurance corporations and hospitals use technical equipment to manage their day-to-day work. These tools are not just significant assets in every single company, they also require maintenance and depending on the category and scope of these tools, this can present a real maintenance challenge. In general these tools are denoted as spare parts. Ahead of discussing the impact, lets exemplify the term "Spare parts" and ascertain a widespread perceptive. Spare parts mean a component or a sub-unit or a foremost assembly, which exists in stock for replacement when desirable. "Spare parts" refer to the part requirements for keeping equipments in well operating situation by assembles repair and replacement needs forced by breakdown and preventive and prognostic maintenance etc. The spare part management function is decisive from an operational standpoint especially in asset intensive manufacturing industry such as refineries, chemical plants, paper mills, etc as well as an organization owning and operating costly assets such as airlines, logistics companies, etc.

12.3 TYPES OF SPARE PARTS

Spare parts, maintenance and operating supplies comprises of all variety of parts and materials essential to uphold the production assets in acceptable operating condition so as to accomplish desired production results in terms of quality, quantity and time.

The three basic types of spares parts are:

a) **PM spares:** Those replaced during preventive or opportunity maintenance

b) **Repair Parts (Breakdown spares):** those required to replace parts that fail during service, and

c) **Overhaul (Shutdown) Parts:** Those required during planned overhaul or shut down of the plant.

The quantity and the time of requirement cannot be predicted for the repair parts. Only, the chance of their requirement can sometimes be predicted. Statistical methods are needed for their inventory control.

12.4 LIFE CYCLE OF SPARE PARTS

Spare parts go through the following six stages in their life cycle.

1) Design and specifications (The right spare)
2) Determination of initial requirements (The right quantity)
3) Procurement (The right Price)
4) Storage and preservation (Minimum custodial and inventory carrying cost)
5) Issue and replenishment (Minimum downtime cost through inventory control)
6) Disposal of damaged, surplus and obsolete spares (Minimum damage and maximum disposal value)

The details of each phase will be discussed below.

Stage 1: Design and Specifications

Stringent specifications, high quality of manufacture and careful operation/ maintenance of the machine reduce consumption and cost due to replacement of spares. Ideally, spare parts from the OEM (Original Equipment Manufacturer) should be used. Spares have a huge range - each one having several specifications, which are not available to the user. Without actual fitting, it is not possible to tell whether a part will fit or not. This is clearly is not practicable as spares are stocked in advance of requirement. It will be worth paying for a certificate or warranty for the spare part from its supplier, at least for critical and expensive parts. Only large consumers such as railways, airlines, transport fleets, armed forces etc. can assess the life of parts by destructive or accelerated life-testing or from the quality records of the manufacturer. Warranties cannot compensate for the loss due short life of a part. They only compensate for the cost of the part. Spurious, even reconditioned and defective parts or inferior quality parts are often sold at a lower price than that of the OEM. One should never buy from unauthorized dealers or unproved suppliers.

Stage 2: Determination of Initial Requirements

The machine supplier usually gives a 'Recommended List of Spares' to the user. This list should be scrutinized for additions that are basically profit-oriented. The supplier should be asked to give consumption rate for various spares. The maintenance engineer can than better assess the spares to be stocked for a chosen initial period – say, for one to two years based on his experience with similar items, number of machines installed, age of machines, operating conditions, engineering factors and the inventory control system in operation. Casual selection of spares at this stage will create a large inventory of nonmoving spares. In initial stages only a few will need replenishment.

Spare parts planning begin with the selection of the machine. At this stage, weight must be given to the following:

- Complete range of parts serviced by the manufacturer including those from his sub-suppliers to be available, along with illustrated catalogues for applicable models
- Assurance of supply for the lifetime of the machine
- Supply of manufacturing drawings as needed
- Availability of observed/estimated consumption rates (not sales data) of spare parts
- Technical data/specifications for assessing failure rate
- Warranty for quality and for life of supplied spares
- Guidance in identification, storage (for sensitive items) and preservation
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Using this information and his own experience, the maintenance engineer assesses the initial requirement for a period that will cover one lead-time or one review period (and safety stocks) for spares for all types of maintenance, insurance items and repair pool. This is a painstaking and time consuming task but it will reduce considerable difficulties later. Prices of spares are usually negotiated at the time of buying the machine but a list of prices for further procurement should be agreed upon at this stage itself.

Stage 3: Procurement

For highly specialized equipment or for that likely go out of production, the user should assess their availability. There is not much room for competitive procurement of spares except at the time of buying the machine. Machines using standard replacement parts (such as ball/roller bearings and hardware) should be preferred. Non-standard parts are always expensive, and often difficult to get. The contract for supply of spare parts should take care of the points made earlier.

Stage 4: Receipt, Storage and Preservation

On receipt, the spare parts are checked for correctness of quantity and quality before storing them. The principles here is 'a place for everything in its place' Spares are stocked machine-wise. Items common to more than one machine are stocked together. The location of each spare is marked on the bin card for the spare. These bin-cards are also the account cards, which indicate the receipt and issue (and stock balance) and particulars (part number etc) of the spare. Mentioning details of interchangeable of substitute spares is a great help in an emergency.

Security of spares in custody is the responsibility of the storekeeper. Small and expensive spares can be easily pilfered. They are kept in a locker. Spares are issued only to authorized maintenance personnel who need them for their work. Physical stock of all items should be checked with ledger balance annually and differences reconciled. Errors are investigated to avoid recurrence.

Different preservatives and methods are needed for different spares. Corrosion is the greatest enemy of all spares. Ball and roller bearings are easily damaged by dust/humidity and should be kept in original packing till needed. Heat sensitive electronic items like transistors should be kept in cool places. Rubber and textile items should not be exposed to direct sunlight or to come in contact with mineral oils. Rubber belts and tubing should not have twists or sharp bends when stored. The condition of all spares including the surplus or obsolete ones should be checked regularly such as at the time of annual stocktaking.

Stage 5: Issue and Replenishment: The Reorder Level System of Inventory Control

The replenishment of parts withdrawn from stock involves two basic questions, namely, 'How much to order?' and 'When to order?' The quantity (and especially) the time of replenishment has to be determined scientifically as they profoundly affect the cost effectiveness of inventory management. Figure 12.1 shows the stock position of a typical item being used up at a steady rate of 30 pieces per week. The value of an initial stock of, say 300 pieces, each costing Rs.10 will be Rs.3000 (point A). It will linearly fall to zero (point B) after 10 weeks. If the item can be ordered and received instantly, we may order it only at this point. Then the stock will rise to the original value of Rs.3000 (Point C), assuming that we ordered 300 pieces. This is called 'Order quantity' or OQ, or just Q. It is expressed either in rupees or in numbers. The average inventory during this repeating cycle of steady consumption is obviously half the OQ i.e. 150 pieces or Rs.1500.

The inventory carrying cost consists of borrowing (or the interest lost) on the capital tied up in inventory and that of handling damage, aging, storage, preservation and obsolescence. These depend upon the nature of the part but can be approximated to an annual 20% of the cost of the spare part i.e., Rs.300 per year. We can reduce this cost by ordering less-say only 150 numbers (Rs.1500) at a time. The stock graph will now be as shown by the lower line in Figure 12.2. The average inventory carrying cost per year will be Rs.750, but we will have to order twice as frequently as before. The ordering cost is for advertisement for supply, contacting and selecting the supplier, paper work and postage involved in correspondence, receiving, inspecting, and putting in bins. Local purchase from dealer's stock may be less expensive.

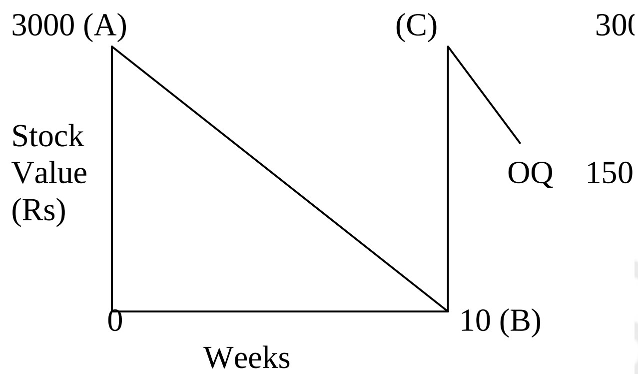

Figure 12.1

Figure 12.2

In the present case, if 'S' is the cost of placing an order, say, Rs,100 per order, then we will spend Rs.100 on ordering 300 pieces once annually, or Rs.200 if we order 150 pieces twice annually. If the annual cost of carrying inventory 'I' is 20%. It will be (Q) (I) /2 for an order size of Q. If the value of annual usage of the item is Rs. N, we will place N/Q order per year, and the annual ordering cost will be (S)(N/Q). The annual total cost is the sum of these two opposite costs will be [(Q)(I)/2+(S)(N/Q)].

It can be shown that this cost will be minimum when Q = $\sqrt{(2A.S/I)}$ $\sqrt{(2A.S/I)}$, this minimum is called Economic Ordering Quantity (EOQ).

In the above case, EOQ= $\sqrt{(2)(10)(300)/0.20}$ = Rs.173/300 = 0.57 piece. Since fractional spares have no existence this will be rounded off to 1. Even with large values of Q, the EOQ is hardly more than 2 or 3, because the high cost items usually have very law consumption (failure) rate and the product (Unit Cost Annual consumption) will be small. That is why EOQ is meaningful only for the high usage (fast moving) spare parts, which are very few in range, and the monetary advantage of EOQ is insignificant. On the other hand, the risk of obsolescence and uncertainly of long-term availability outweighs the EOQ advantage. Finally, OQ powerfully affects safety stock and the risk of stock-out. This consideration is far more important than the above.

Safety stock

The second question in an inventory system is 'When to order?' Spares have to be ordered ahead of the possible need as there is an 'internal' lea-time of several weeks to months to process an indent, obtain quotations, select supplier and place the supply order after arranging for funds (in case of imports). There is also an external lead-time of several weeks to months, for the supplier to organizes dispatches, transportation, customs clearance etc. the total lead-time (abbreviated as LT) must be ... it.

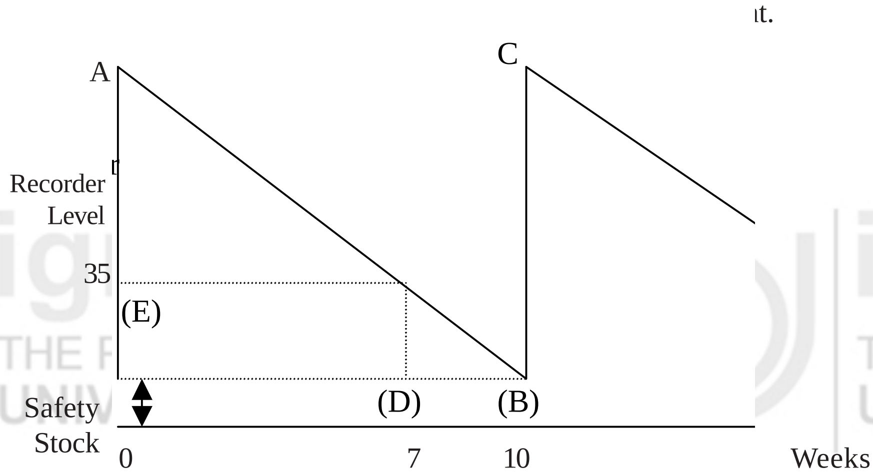

Figure 12.3

In Figures 12.3, a replenishment time of three weeks has been set off (Point D) backwards from the day when stock is expected to fall to Zero. On this day (D) the stock would have fallen to 30 i.e., the expected consumption during LT.A little safety stock, of say 5 pieces, to cater for any unexpected increase in this consumption after the order is placed, is added. The order should be initiated when the stock falls to 30+5=35(point E). This stock level is called the Re Order Level (ROL).

The general inventory expression is, ROL = Average Consumption during LT + Safety stock.

Notice that in a typical operation of this ROL System (Figure12.3) the safety stock remains at full value, whereas the cycle stock i.e. the OQ, gets consumed and replenished resulting in an average inventory of half the OQ. Hence, it can be said that one unit of safety stock is twice as expensive to carry as one unit of cycle stock. Minimizing safety stock, subject to some acceptable risk of stock out during the LT, is much more important than the economic of order quantity.

Studies have established that the consumption of repair parts during any period (such as LT) varies randomly and asymmetrically, following the Poisson probability distribution. From this, we can calculate Safety Stock (SS) as under:

SS=(k).x ($\sqrt{M}$), where M is the average consumption during lead-time, and K is the safety factor, which takes the following values for different levels of assurance of availability:

Assurance of availability:	=	50%	70%	80%	85%	90%	95%	98%
Safety factor:	=	0.0	0.7	0.8	1.0	1.3	1.7	2.1

Note that the safety factor 'k' increases rapidly with the demand for higher assurance so that for every additional item in SS we get relatively less and less additional assurance. At some point it may not be worth spending so much on SS inventory. This is used in a decision matrix shown later in Figure12.5. This matrix has to be approved by the top management as it reflects their policy of delivering different levels of service for investment in this non-moving inventory (safety stock). Incidentally, an assurance level of 90% does not mean that 90% of the quantity ordered will be delivered ex-stock. It means that 90% of the orders will arrive on time, on time, or that the risk of non-availability ex-stock was 10%.

ABC Analysis – Pareto's Law: In 1948, the Chief Materials Manager of General Electric Co. in USA listed the annual consumption value of each and every material that the company used in decreasing order of magnitude. He noticed that the top 15 to 20 percent of the whole range of items contributed to almost 80% of the total cost contributed by all items. He designated them as A items (Figure 12.4). The next 30 to 35% of the range of items contributed to 15 to 20% of the total cost (B items). Finally, the last 50%of the range of items contributed to barely 5 to 10% of the total cost (C items). ABC analysis suggests that we should control 'A' items tightly, 'B' items carefully and "c" items loosely i.e. concentrate on preventive and corrective action only for a few, worthwhile items. For spare parts we should give generous safely stock for C items (we can afford it), adequate for B items and minimum for A items – in short, allot high, medium and low value of 'k', respectively.

The Italian economist Wilfred Pareto, after whom it is named, first discovered this pattern eighty year ago. He had shown that that every natural phenomenon seems to concentrate in a few points or stages. Typical examples are city traffic on a few roads, failures concentrating in a few components of a machine; most cost of spare parts contributed by only a few spares.

Annual consumption value

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______________________________ **A items** (20% range; 80% value)

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_____ **B items** (30% range; 15% value)

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__ **C items** (50% range; 5% value)

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Figure 12.4: ABC Analysis

Activity 1

List out the spare parts inventory consumption of an organization and carry out ABC analysis.

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Criticality Analysis (V-E-D Analysis): While ABC analysis controls the cost of having the inventory when not immediately required; VED analysis controls the huge cost of not having a part in stock (safety stock) when it is needed. SS reduces the risk of non-availability. For repair parts, the maintenance engineer must define items whose non-availability will cost heavily to the organization (such as due to machine downtime, risk of accidents and loss of opportunity of sale) as very critical or vital (V) items. The moderately critical items are defined as essential (E) items, and the rest are desirable (D) items. Figures 12.5 shows atypical decision matrix for the joint ABC/VED classifications for repair parts along with values of K.

	'A' ITEMS	'B' ITEMS	'C' ITEMS
VITAL 'V'	90% (k=1.30)	95% (k=1.70)	99% (k=2.30)
ESSENTIAL 'E'	80% (k=1.00)	90% (k=1.30)	95% (k=1.70)
DESIRABLE 'D'	75% (k=0.70)	80% (k=1.00)	90% (k=1.30)

Figure 12.5: A typical Decision Matrix for ABS/ VED

Example: A gate value is used at a rate of (m=0.56) per month. The LT is 3 months, so that M, the consumption during LT is (o.56x3) = 1.68. The B/V item for which k= 1.7 (from figure 12.5). Hence, ROL= 168+(1.7) = $\sqrt{1.68}$ 1.68 +2.20=3.88, rounded off to 4. If this were a V item the SS would be 1.68 and the ROL would be 3.36 rounded off to 3.

We can define the service level in terms of 'period to stock out' or ' number of stock outs in a given period, such as one year'. The former is a more meaningful measure to a maintenance engineer. Note that the assurance of availability is for one inventory cycle. If the demand for replenishment is once a year we will be exposed to the risk of stock out only once annually. If order is once in six months the exposure will be doubled. Thus, suppose that the tolerable 'period to stock out'= T years. (i.e., 1 stock out in T years). With an order Quantity Q, and annual consumption rate A, we will have A/Q replenishment orders per year and (A) (T)/(Q) in T years. Of these, (A) (T) (r)/Q will be at risk, where is the risk of stock out per order cycle. Since one stock out in T years is acceptable, we can put (A)(T) (r)/Q=1, from which we get the assurance level of (1-r) i.e. 1- [(Q)/(A) (T)]. This figure is to be used to calculate SS. A decision matrix can now be drawn for various periods to stock out and related levels of assurance (with corresponding values of k. A and Q can be expressed in numbers or in Rupees.

The following example will show the calculations using different value of A and T:

A	A=Rs.2,000			Rs.20,000			Rs.50,000		
Q	Rs 4000, common for all cases for illustrative purposes								
T	1yr	5 yr	10 yr	1yr	5 yr	10 yr	1yr	5 yr	10 yr
1-{(Q)/(A)(T)	0.00*	0.60	0.80	0.80	0.96	0.98	0.92	0.98	0.99

* In this case, the assurance level becomes negative. Negative or Zero assurance means that no safety stock is needed (k = 0). The high OQ itself gives the protection against stock out.

The appropriate values of k, the safety factor to be used to calculate safety stock can now be read off from a table of Poisson probabilities. Typically, if A=Rs.20,000 and Q = Rs.4,000 then for T=1 year, the assurance level works out to 80% for which the value of k (from Poisson tables) is 0.80. For T = 10 years, k will be 2.1. As will be seen, the value of k (and the safety stock associated with it) rises as the 'stock out-free' period increases from1 year to 10 years.

In the Reorder Level (ROL) system, the ROL and Q are fixed but the time for replenishment varies inversely with consumption. The ROL is like the 'reserve' in the fuel tank of a motorcycle. Replenishment quantity is always the same i.e. full tank, but the time for replenishment will very.

Periodic Review System: In the periodic review system, replenishment is at fixed intervals but the OQ changes. Figures 12.6 shows an ordering cycle with a Review Period (RP) of six month i.e., interval between points A, B, and C. On the day of review (Point A) the physical stock in hand plus 'dues in' i.e. order placed earlier but not received yet, are noted as 'Assets'. Forecast consumption during (LT+RP) plus (SS) is calculated as 'Liability'. Excess of Liability over Assets is the order quantity.

Order is placed at A, B, C etc; stock is received at D, E, F, etc after Lead Time (LT), and Quantity on order = Liability – Assets

= [Consumption during (AB+BE)+SS}]-[Stock on hand & on order]

= [Consumption during AE] + [AH+0], (assuming that no order was pending)

= HG

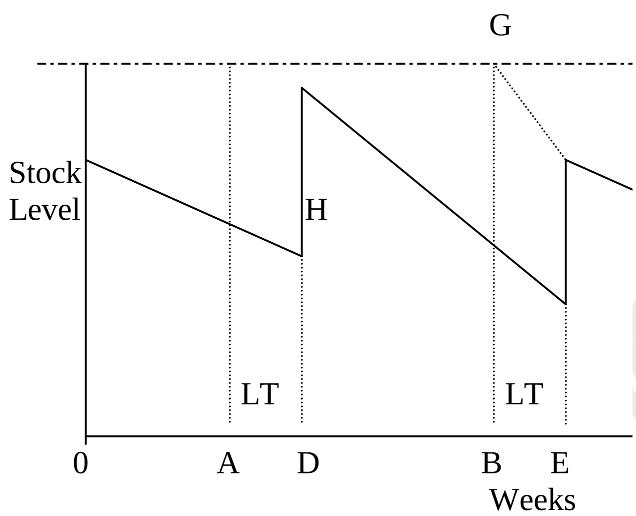

Figure 12.6: An ordering cycle with a review period of six months

In the above example, stock On Order = 0 because the LT is small compared to the Review Period. If the LT exceeds the Review Period, some earlier orders would still be pending and will have to be included in the 'assets'. In this system, the forecast has to cover both the LT and the Review Period. Safety stock caters for both LT and review period. Typically, if the consumption rate (M) of an item is 5 per month, the LT is 4 months, and the review period is 6 months, then, Liability= (5)(4+6) +SS for (4+6) months.

SS is calculated as for the ROL system using the appropriate safety factor, k. Thus, if the consumption during Review Period Plus LT was 50, the SS was 10, the stock in hand was 20 and the stock on order (also called 'dues in') was 12, the OQ can be calculated as under:

OQ = Liability – Assets = (50+10) – (20 +12) = 60 – 32 = 28

Theoretically, this system requires higher safety stock than the ROL system but in both systems, for most spare parts the error caused by rounding off fractional order quantity overshadows the precision of other calculations and this disadvantage can be ignored. The review cycle can be matched to the supplier's production cycle so as to get stable, predictable lead times for supply- especially for the parts that are not normally sold off the shelf through a dealer network. All spares from the same suppliers can be packed and transported together cheaply, unlike the piecemeal – and hence expensive- deliveries for the ROL system. Therefore, large transport companies who deal directly with their suppliers prefer this system. Those having distributed stocks of spares (users or dealers), obviously have to use this system. It does not need the excessive amount of documentation of the ROL system. An 'Economic Review Period' can also be calculated for this system. However, for the same reasons mentioned earlier for the ROL system, other factors (such as matching with supplier's production cycle etc) neutralize the economic advantage.

Slow Moving Items: The consumption rates for fact moving items can be assessed fairly accurately even without any consumption data. Later, data accumulates quickly and the rates can be updated fast. The relative period-to-period variation in consumption increases as the mean value of a Poisson distribution goes down. For items having low consumption rates, consumption data over moderate period does not give a reliable average; an average based on short periods is extremely unreliable. Most spares fall into this category.

The variation of consumption from period to period is so great that any moving average that we may use will have large error. Basing the SS on the 'higher-thantrue average will further inflate safety stock. Hence, we have to apply the statistical approach of 'Prediction Intervals' in which the ROL is calculated from the following formula:

$$ROL = C\,(T2/T1) + z\sqrt{C(T2/T1)(T1+T2)}$$

Here, T1 is the base period during which the consumption was C. The lead-time is T2, and Z (Similar to the safety factor 'k') takes the value of 0.65 and 1.65 for 75% and 90% levels of assurance respectively, fractions are to be rounded off as in case of the fast moving spare parts. For the periodic Review System, T2 includes Review Period, besides Lead Time.

Example: C=3; T1 = 2 years. For an assurance level of 90% (z=1.65), and forecast base of T2 = 0.5yr, ROL =3(0.50) / 2+1.65 $\sqrt{3(0.50/2)(2+0.5)}$ = 3.12, i.e. 3 numbers of spares. Ordinarily, we would have calculated the ROL as 3(0.50/2)+1.3 $\sqrt{3(0.50/2)}$ = 1.87,i.e. 2. It is conceivable that in the particular two years of our observation, the consumption happened to be on the low side and our estimate of the average was understated. It could also have been over stated, as the variation from period to period is quite high in the Poisson distribution. The method of prediction intervals is a via media. It gives safety against underestimates but without increasing safety stock too much.

Activity 2

In a University library, randomly select 1000 books. Verify the frequency of issue of these books to readers. Categorize the books as fast, slow and non-moving types (a typical FSN analysis). What management decisions you are taking for slow and non-moving items?

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Insurance Spares

When M, the consumption during LT is only a small fraction, the rounding off error is large, as can be seen from the following examples. (k is kept at 2.1 for all values of M, for easy comparison).

M	1	0.5	0.1	0.01
SS	2.1	1.47	0.7	0.21
ROL=M+SS	3.1	1.97	0.8	0.22
Rounded off to	3	1 or 2	0 or 1	0 or 1

The rounding off error in the last two cases is (-100% to + 40%) and (-100% to + 350). This will increase further for still lower consumption rates (i.e. for very long life items). The safety stock given is already large, since k=2.1 (98% assurance). Rounding off adds still more to safety stock. If these spares are extremely critical (and expensive) both the options i.e., of stocking zero or 1 are wrong, have a large margin of error, and extremely expensive. Such spares are called 'insurance spares'. They are indeed in the nature of insurance as both the options have a large order of error.

The maintenance engineer naturally prefers to stock these items (which eventually become the non-moving items) whereas the high cost of stocking makes the management question the wisdom of stocking them. This decision has to be made on the basis of risk/cost relationship. Thus, if C1 = Cost of the spare (as quoted by the supplier at the time of buying the machine), say Rs.1 lakh, C2 is the expected loss due to non-functioning of the machine during later period of its life, say Rs.20 lakh, then the ratio (C1/C2) = 1/20=5% can be used as a 'break even point' for making this decision. The maintenance engineer makes his best judgment as to whether the probability of requiring the spare part during the lifetime of the machine would exceed this figure, if it is likely to, then the spare is to be stocked; otherwise the decision is postponed till more experience on the machine is available. At that point the same question is again asked.

Rotable/Floats/Repair Pool

A repairable item or assembly is called a Rotable, float, or repair pool. It goes through a repair cycle. That can be treated as the LT, the other calculations being the same as for other repair parts. They, amongst the installed costly electric motors ('A' item) of a particular model which is also very critical to production ('V' item) there are on an average 3 failures per year. The Repair cycle time (treated as LT) is two months. A-V items are given 85% assurance in this organization (k=1.0).

Hence, ROL =(3) (2)/12+1.0 $\sqrt{(3920/12]}$ = 1.2, rounded off to 1.0. This is held in stock as a rotable, float or a repair pool. In a large airline or transport fleet, several engines may be kept in the repair pool on this basis. A very critical, expensive and long life repairable them can also become an insurance item for which the decision will be to stock 1or none.

Stage 6: Disposal of Damaged, Surplus and Obsolete Spare Parts

An organization expecting good resale value for its surplus spare parts should ask itself whether it would buy 'second hand' spares from another unit as any price other than scrap value. One can never be sure as to how long the parts had been in stock and what deterioration had set in during storage. Such spares get some value only when they are sold along with the used machine itself. Further, it is not wise to dispose off spare parts applicable to existing machines simply because they had not been used. Only stock of insurance spares exceeding 1 could be sold off-but not at scrap value. It is safer to carry the inventory. Possibilities should be explored for alternative uses or as substitutes (Even with modifications) for the surplus/obsolete spare parts.

Activity 3

Carry out a detail study of spare parts management in an organization. Examine each one of the six stages of spare parts life cycle and give suggestion for improvement.

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12.5 MYTHS ABOUT SPARE PARTS MANAGEMENT PROGRAM

There are certain misconceptions which could deviate the reader from understanding the concepts with respect to spare parts management, the below mentioned myth can facilitate in getting rid of it:

Table 12.1: Myths about Spares Parts Management Program

S.No.	Myth	Fact
1	*Spare parts management is a blockage*	Spare parts management process facilitates and supports real-time part selections, providing cost-effective design decisions.
2	*Spare Parts management is difficult task*	Usage of computerized systems allows real-time analysis and makes available decision-support tools for recognizing the right spare parts.
3	*Spare Parts management is a cost driver*	Spare Parts management gets hold of money and reduces logistics support and parts redundancy costs.
4	*Service provider logistics support nullifies the importance of spare parts management*	Service provider should administer parts to stay competitive and develop logistics readiness.
5	*It restricts design flexibility and restrains the introduction of new parts*	An efficient program integrates system design, and parts management personnel. Spare Parts management facilitates with reviewing new parts procedure.

One should clearly understand the truths about spare parts so that the real benefits of spare parts management can be visualized.

12.6 SPARE PARTS MANAGEMENT AND OTHER SYSTEMS

Spare parts management involves numerous business processes that require application support and data from diverse classes of applications. A spare parts management system needs to interact with the following systems:

- **ERP Systems (Enterprise Resource Planning):** systems is a broad set of activities supported by multi-module application software that facilitate the organization in product planning, parts purchasing, maintaining inventory, interacting with supplier & customer, tracking order etc. The core task of this category of system is to manage transactions such as procurement, inventory transactions, returns, etc.
- **MES Systems (Manufacturing Execution Systems):** Systems that accommodates maintenance planning and implementation, capture of service history, etc. moreover time attendant systems, quality control systems, production scheduling systems, etc.),
- **SCM Systems (Supply Chain Management):** Systems for advanced planning and scheduling capabilities, the elements that affect your supply chain efficiency, including inventory reduction, supplier relationships and IT strategy. Supply Chain Management systems are an overturn of prior practices where manufacturers supplied spare parts to customers they required them. Now customers tell

suppliers how and when they want their spare parts delivered. The driver behind Supply Chain Management is to eradicate inefficiencies, excess costs and excess inventories from the supply pipeline, which extends from the customer back all the way through his suppliers and his suppliers' suppliers and so on. By having the program driven by the customer, it is anticipated that inventories, caused by uncertainties and sluggish response, will be appreciably eliminated.

- **MIS Systems (Management Information Systems):** The MIS for spare parts is similar to that for other materials and has the same aims. Typical reports generated by the MIS are:
  - Stock and consumption status report
  - Pending indents report
  - Pending purchase orders report
  - Stock-out report (also dangerously low stock position report)
  - Over-stock/ Under-stock report
  - ABC analysis- separately for repair items and overhaul items

In addition, the computer should automatically adjust the inventory parameters, such as ROL, SS, LT for routine indenting. Special' 'alerts' may be build into the system to identify deviations from expectations e.g. sudden rise/fall of consumption rates of spares. Typically, a sudden increase in the usage rate of a component may be due to related increase in failure rate, which in turn could be due to poor quality for latest supplier. If the drop in consumption of a part is accompanied by sudden rise in the consumption of the assembly into which is goes, evidently for some reason maintenance had started replacing assemblies instead of parts.

The range of spare parts is so vast that computers have to be sued for getting replies to the numerous queries that will arise in managing spare parts.

12.7 BENEFITS OF SPARE PARTS MANAGEMENT

Merger of economic, technological & market forces have made it critical for companies to promote it sales service and particular service parts supply. Spare Parts Management is a constructive way for implementing a robust in-house parts management. The supply of spare parts have turn out to be increasingly fundamental for companies wishing to stay ahead of competition This section defines the essential elements of a spare parts management process, including establishing an in-house parts management board, developing a preferred parts list or corporate parts baseline, establishing a process for selecting and authorizing parts and establishing a process for qualifying parts etc.:

- **Condensed Acquisition Lead-Time:** When preferred spare parts are used, the government and industry keep away from the expenses and delays of designing and developing parts and the issue of acquiring a new item with no obtainable history or documentation. Using preferred spare parts diminishes the time between the purchase request and the receipt of the part.
- **Cost Savings:** Spare Parts management facilitates save design and life-cycle costs of equipment by encouraging the application of frequently used or preferred parts. Standardization of parts, replacing numerous similar parts with one universal part, results in larger part-type buys because the general parts are used in multiple applications. Larger part-type buys permit both the contractor and the customer to promote from the economies of scale. Part standardization also diminishes the contractor's cost of maintaining technical data and storing, tracking, and distributing multiple parts.

- **Enlarged Supportability and Safety of Systems and Equipment:** Preferred parts diminish risk and enhance the chances that equipment will accomplish reliably. Preferred parts have a history of established reliability; enduring rigorous testing and performing at stated levels. Their use decreases the number of part failures, reducing the number of maintenance actions and potentially precluding failures that could cause mission breakdown or loss of life.
- **Improved Logistics Readiness and Interoperability:** When items or systems allocate general components, repair time is shorter because parts are more possible to be on hand and technicians use up less time solving individual problems. Moreover, using regular components simplifies logistics support and augments substitutability because fewer parts are stocked. This translates to savings in procuring, testing, warehousing, and transporting parts.

12.8 COST CONTROL FOR SPARE PARTS: ROLE OF MAINTENANCE

Cost due to end of spare parts occurs as:

a) Cost due to non-availability when required for the machine,

b) Consumption value,

c) Inventory carrying cost, and

d) Capital cost of non-moving items.

To minimize the need for troublesome repair parts, operations must prevent failures, and maintenance must ensure that maintenance is done on time and is of high quality. Maintenance must give top priority to eliminate failures requiring the high cost items that are also critical. Worn parts can often be rebuilt at a fraction of the price of new parts. Standard parts, low LT, purchase from OEM/reliable suppliers will reduce cost. Simple procedures, using computer for scientific analysis and updating of inventory parameters will reduce the operating cost of the spare parts system. Maintenance must assist in identification, preservation, and inspection of spare parts.

12.9 ORGANISING FOR EFFECTIVE SPARE PARTS MANAGEMENT

In large organizations there should be a ‘spare parts cell’ consisting of a representative each of maintenance, purchasing, and stores. Apart from initiating the indents, this cell should operate the MIS and continuously look for improvement in inventory control and cost control, introduce computers for MIS, carry out various analyses, and in general, act as ‘internal consultants’ in the complex area of spare parts management. They should report to a senior level in the Technical Services Department. The members of the cell should develop expertise in this area. In a medium size organization the spare parts cell may have part-time members. They should report to the Chief of materials. This places the responsibility of planning and providing spare parts squarely where it belongs. In small organizations, only those maintenance engineers who are trained in scientific inventory control of spare parts should be allow ed to indent spares parts. Their services should be utilized during a period (say, every two or three years) updating of the system as a whole.

12.10 UNIQUE PROBLEMS OF SPARE PARTS MANAGEMENT

Raw materials and consumables are primary materials, which are related to continuous functioning of the machines. Spare parts are ‘secondary’ items and are related non-functioning of the machines. These characteristics create most of the problems of managing spare parts inventory. These are summarized below:

1) Requirements are unpredictable in time and quantity.

2) In relation to consumption rate the safety stock is very high, resulting in idle inventory.

3) Separate inventory control system needed for different types of spare parts

4) Detailed inspection of purchased parts is not possible. This gives rise to spurious spares market.

5) Data is not available for estimating consumption rates for most spares. Engineering assessment can go wrong for new type of machines.

6) Prices of spare parts are not related to cost of this production, but to other commercial interests.

7) Changes in models, modifications create difficulties in procurement of older parts.

8) The range of spare parts that needed is too large for effective control by manual methods.

9) The large variety makes identification and preservation difficult and error prone.

10) Obsolescence is common. Even serviceable parts have practically no resale value

12.11 SUMMARY

Spare parts refer to the part requirements for keeping equipment in good operating situations and are decisive from an operational standpoint. Managing spare parts is the biggest challenge in materials and maintenance management. With the scientific tools available now, much improvement can be achieved, provided those tools are used. The spare parts go through six stages in their life cycle: Design and specifications; Determination of initial requirements; Procurement; Storage and preservation; Issue and replenishment; Disposal and damaged, surplus and obsolete spares. Like inventory management, ABC and VED analysis play important role in spare parts management. For low consumption and slow moving spares, the re-order level has been computed. MIS of spare parts management can be effectively used for preparation of reports for stock and consumption, pending indents, purchase orders, stock-out etc. There are certain misconceptions, which interpret spare parts management as blockage, cost driver and restricts the introduction of new parts. However effective design decisions and reviewing new parts procedure can change these myths. Comparison of spare parts management with numerous business processes such as ERP systems, MES systems, SCM systems and MIS systems can give a clear picture of diverse classes of applications. At last spare parts management is a constructive way for implementing a robust in-house parts management, which is increasingly giving an edge to the organisations.

12.12 SELF ASSESSMENT QUESTIONS

1) What is the aim of spare parts inventory management? In what way does it influence the different stages of the life cycle of spare parts?

2) What are the different types of spare parts, and when are they used?

3) What is EOQ? Why is the EOQ formula not useful for spare parts?

4) What is Pareto’s Law? In what ways is it used for spare parts?

5) What is VED analysis and how is it used?

6) Which problems are unique to spare parts that other materials do not exhibit? Why do these problems occur?

12.13 REFERENCES AND SUGGESTED FURTHER READINGS

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