

LESSON - 11**INVENTORY MANAGEMENT****11.0 Objective :**

After studying this lesson, you should be able to:

- * understand the nature and objectives of inventory management.
- * know the motives of holding inventory in a manufacturing firm
- * reveal the undesirable consequences of excessive levels of inventory.
- * identify the functions and characteristics of inventory.
- * explain the techniques and strategies of inventory management.
- * suggest the measures for the effective management of inventory

Structure**11.1. Introduction****11.2. Types of Inventories****11.3. Motives for holding inventories****11.4. Need for Inventory****11.5. Characteristics of inventory****11.6. Inventory costs****11.7. Consequences of Excessive Inventory****11.8. Objectives of Inventory Management****11.9. Inventory Control Techniques****11.10. Inventory Control Systems****11.11. Measures to assess the inventory management****11.12. Summary****11.13. Key words****11.14. Self Assessment Questions****11.15. Further Readings****11.1. Introduction**

Inventory management is the most significant part of the working capital management in majority of the business organizations, since inventories constitute on an average about 60 percent of the total current assets. The success of any industry depends upon the effective utilization of its inventory. The inventory manager is expected to ensure right inventory at right time with right quality from a right place at right price in order to minimize the cost of manufacturing of products or services. The most difficult area to the management of a firm is the management of inventory. A firm neglecting the management of inventories will be jeopardizing its long-run profitability and may fail ultimately. For any organization, it is possible to reduce its level of inventories to a considerable extent without any adverse effect on the production and sales, by using the simple inventory management techniques. This reduction of inventory volume carries a positive impact on the profitability of the organization.

11.2 Types of Inventories:

The management of inventory starts from the identification of suppliers passes through various stages and finally reaches the consumer. The various forms of Inventory in which it exists are 3 types. They are:

i) Raw material: these are the basic materials that are converted into finished products ready for consumption, which can be stored for future production.

ii) Work- in- process: this is the stage at which further process is required to reach the final stage of production.

iii) Finished goods: this is the stage of the products which are ready for dispatch for consumption.

iv) Apart from these three levels of inventories, there is one more form of inventory, i.e., **stores and spares**, which is usually a marginal portion of the total inventory.

11.3 Motives for Holding Inventory:

In a country like India inventories (stocks) are necessarily to be held without which production can not be imagined. The motives for holding inventories are 3 types such as transaction precautionary and speculation motive.

i) Transaction motive:

To ensure continuous business transactions raw materials are held. Without adequate inventories it is hardly possible to imagine continuity of production. If enough raw materials are not held, production activities cannot be carried out regularly. If for any reason production is stopped for want of raw materials the salaries to staff, depreciation, rent, etc., will cause severe loss to the firm.

ii) Precautionary motive:

Some times accidents, machine break down, lay off, strike, etc. occur without prior notice under which situation, production should not suffer. Hence, inventories are necessarily to be carried out for smooth going of production and sales even in adverse times.

iii) Speculation motive:

Changes in technology, market conditions, cause sudden rise or fall in prices of supplies. To cope with the changing conditions, businessman carries inventories. Price fluctuations affect demand and supply aspects of goods which will in turn affect production and sales activities. To avoid such odd situations inventory holding is appropriate.

11.4. Need for Inventory

i) Continuous production:

Production without halt will be possible by holding enough inventories. Otherwise, firm has to incur heavy costs for keeping the machine idle.

ii) Continuous supply market:

Proper inventory management will ensure finished goods without interruption and customer satisfaction could be possible.

iii) No stock - out problem:

Shortage of inventories often cause stock - out problem, thereby consumers shift to competitors.

iv) Cost saving:

Enough inventories will ensure continuous production, in the absence of which cost of production will be high.

v) More margin of profit:

Cost saving would enable the problems to enjoy better profit margin and ultimately higher returns to the firm.

vi) Advantage of price gain:

Prices fluctuate due to changes in supply and demand factors when prices rise, the firms holding inventories will enjoy sudden profits.

vii) Scarcity:

At times raw materials may become scarce due to sudden changes in supply or power failures. In these situations inventories holding would enable the firms.

11.5 Characteristics of Inventory

- i)** Stock out problem: If adequate stocks are not maintained, the firm faces stock out problem. i.e., risks for not maintaining adequate stocks. If raw materials are not adequate, production schedules suffer and interrupted production will not ensure regular supply of goods whereby firm loses its market. If production activities are stopped due to irregular supply of raw materials and other inputs, cost of production will be high since fixed costs per unit will be more.
- ii)** Lead time: It is the time taken from the initiation of order till the arrival of goods. Lead time may vary from one day to many days. It depends upon the availability

of item, distance, transportation, etc. The time gap can be reduced through proper inventory planning.

- iii) **Quantity discounts:** If goods are produced on large scale producers will enjoy economies of scale. These economies or savings occur where fixed costs are distributed over large production; ultimately cost of production per unit will be lower. Sometimes production will extend to customers by giving quantity discounts. This is a peculiar characteristic associated with inputs mainly raw materials and other consumables.

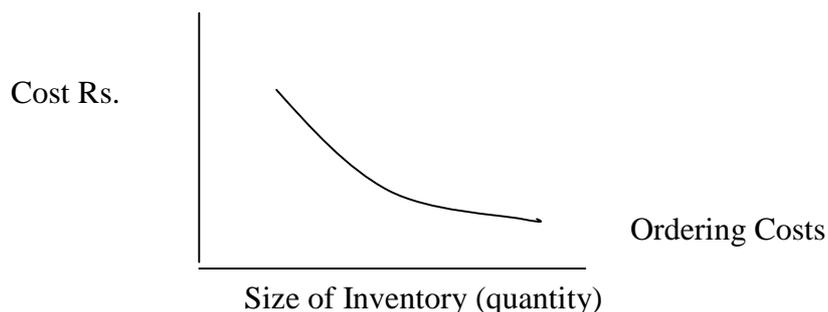
11.6 Costs of Inventory

There are various kinds of costs involved in inventory management policies.

i) **Ordering costs:**

Costs incurred in placing order with suppliers of raw materials, consumables and other inputs are called ordering costs. These costs include stationary, requisitioning, mailing expenses, telephone bills, correspondence charges, typing, salaries, dispatching, inspection, checking, travel, follow up costs, etc. Larger the order size lower the cost per unit. Thus, ordering costs can be minimized by placing order for bigger quantity.

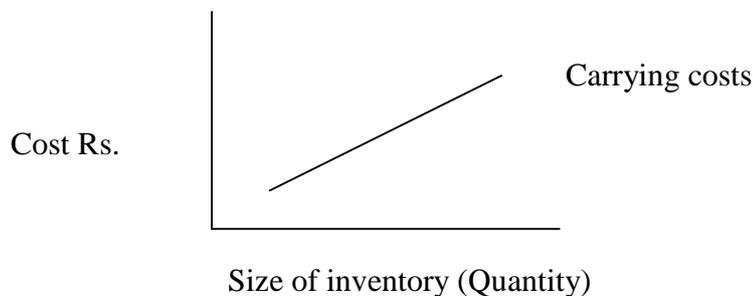
The diagram 11.1 depicts the graphical representation of these costs.



ii) **Carrying costs:**

Warehousing, insurance, wastage, loss due to theft, deterioration, obsolescence etc., are called inventory carrying costs. These costs are more as the level of stock is higher. These costs are also known as holding costs.

The following diagram 11.2 shows the graphic presentation of the carrying costs.



iii) Stock-out costs:

Normally, whenever customers place order, the suppliers should be ready to dispatch the items. At times, the items when not readily available, the suppliers make the customers to wait. But customers (with out waiting) will go to competitors for the supplies immediately. Thus, the regular supplier loses the profit which he would have got. This is known as opportunity cost or lost sales cost

iv) Storage costs:

Costs pertaining to warehousing of goods or inventory are generally called as storage costs. Example: rent, lighting, interest, insurance, checking, etc.

v) Obsolescence cost:

When goods are stored more quantity than demand for it, the quality deteriorates and models will become outdated. At times, they have to be sold at heavy discounts since the quality of goods is poor and design or model is outdated. This loss is called as obsolescence costs.

vi) Set up costs:

Normally production is made regularly an item for few days / weeks. Wherever, order is placed for different items; the producer changes the regular processing and shift to new process to make it suitable to new order placed. Thus, when processing is shifted, the firm incurs costs of design, loss of clerical time consumption of, components and spares, etc. All these constitute set up costs.

11.7 Consequences of Excessive Inventory

- * Unnecessary tie up of funds,
- * Interest burden,
- * Low profitability,
- * Deterioration in quality of goods,
- * Theft and obsolescence,
- * Excessive carrying costs,

11.8 Objectives of Inventory Management

The objectives of the inventory management are to ensure maximum and uninterrupted production with minimum investment in inventory. Thus, the efficient inventory management results the following advantages:

- i) ensure continuous production;
- ii) anticipate price changes and take advantage of it
- iii) control investment and keep inventory at optimum level;

- iv) maintain sales operations and delivery commitments.
- v) increase operational efficiency and production levels
- vi) economy in purchasing

11.9 Inventory Control Techniques:

The essence of inventory management is to maximize profits with minimum investment on inventory. To achieve this objective the firm should determine the optimum level of inventory by answering the following two questions. They are:

- * How much should be ordered?
- * When should it be ordered?

The first question, how much to order, relates to the problem of determining the economic order quantity and the second one is identification of reorder point.

11.9.1 Economic order quantity (EOQ) : For efficiency, in inventory management the often encountered question, is for how much quantity one has to 'order for'. But it varies from item to item. The optimum quantity which is economically viable is called "economic order quantity" or "economic lot size". An order size should neither be high nor low. Higher the order size, an enterprise practice, more the carrying costs the firm incurs. Smaller the order size more the ordering costs the company incurs, since the firm places order many times a year. Here, management has to trade off between big and small size and reaches optimum size, where the total cost per unit is minimum. This is clearly shown in diagram. 11.3.

Illustration- 11.1

From the following information, find out the economic order quantity

- a) Annual consumption = 1000 units
- b) Carrying cost = Rs.2/-
- c) Ordering cost = Rs.50/-

Solution :

Order size (in units)	1000	500	250	100	50
Average inventory (Q/2)	500	250	125	50	25
Number of orders (A/Q)	1	2	4	10	20
Carrying cost $C \times (Q/2)$	1000	500	250	100	50
Ordering costs $O \times (A/Q)$	1050	100	200	500	1000
Total costs (Rs)	2050	600	450	600	1050

From this we can conclude that 250 units is the ideal order size. Hence, at this economic order quantity the firm is able to maintain the inventory with minimum cost.

11.9.2 Formula approach:

The trial and error approach is somewhat tedious to calculate the economic order quantity. Therefore, an easy approach to determine the EOQ is to use the order-formula approach.

Using the following formula, one can determine the EOQ:

$$Q^* = \frac{2AO_c}{C_s}$$

Where, Q^* - economic order quantity

A - Annual consumption

O_c - Ordering cost per order

C_s - Carrying cost per unit per year
 $2 \times 1000 \times 50$

$$EOQ = \frac{2 \times 1000 \times 50}{2} = 250 \text{ units.}$$

If we solve the above illustration-11.1 by using the above said equation we will get 250 units, which is the economical quantity.

Illustration- 11.2

.A company uses a particular material in a factory is 20,000 units per year. The cost per unit of material is Rs. 10. The cost of placing one order is Rs. 100 and the inventory carrying cost 20% on average inventory. From the above information calculate economic order quantity.

Solution:

Determination of economic order quantity:

$$EOQ = \frac{2AO_c}{C_s}$$

Where,

A = Annual consumption, i.e., 20,000 units

O_c = cot per order, i.e., Rs. 100

P_c = price of the material, i.e., Rs. 10

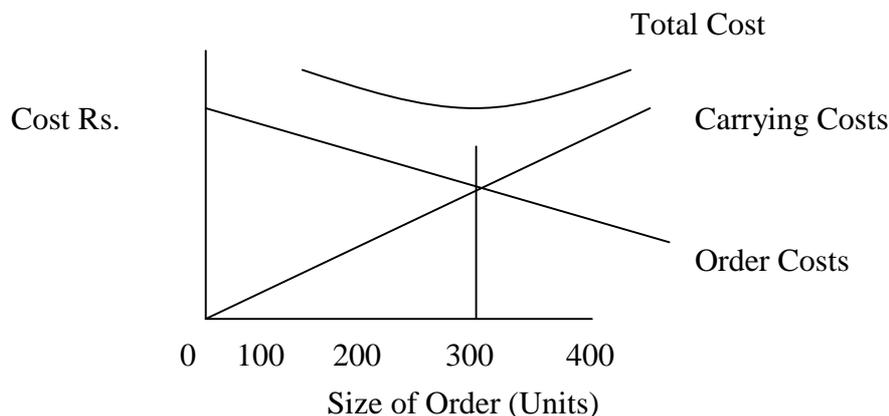
C_s = storage cost, 20 per cent of the material cost, i.e., Rs. 2.

$$Q^* = \frac{2 \times 16,000 \times 18}{1 \times 20\%} = 1414 \text{ units.}$$

11.9.3 Graphical Approach:

The economic order quantity can also be found out graphically in Figure 11.4 which illustrates the economic order quantity function. The ordering, carrying and total costs curves are plotted in the graph on vertical axis and the horizontal axis is used to present the order size. It can be noticed in the figure that the total carrying costs increase as the order size increases, because on an average, a larger inventory level will be maintained, and ordering costs decline with increase in order size because larger order size leads less number of orders. The behavior of total cost line is noticeable since it is a sum of two types of costs which behave differently with the order size. Thus, the economic order quantity occurs at the point Q^* , where the total cost is the minimum and with it the firm is able to maximize its operating profit.

Figure 11.3 Economic order quantity



11.9.4 Quantity Discount:

In practice, many suppliers encourage their customers to place large orders by offering them quantity discounts. With this quantity discounts, the firm will save on the per unit purchase price, however, the firm will have to increase its order size more than the EOQ level to avail the quantity discount. This will reduce the number of orders and increase the average inventory holding. Thus, in addition to discount savings, the firm will save on ordering costs, but will incur additional carrying costs, if the net return is positive, the firm's order size should equal the quantity necessary to avail the discount, otherwise it should be equal to EOQ level.

11.9.5 Reorder point

The reorder point is that level of inventory at which or when a firm has to place order for an inventory items. To determine the reorder point under certainty, one should know the lead time, average usage and economic order quantity. The lead time is the duration of time taken in

replenishing inventory after the order has been placed. In the normal circumstances, the lead time and consumption level do not fluctuate. Under such a situation, the reorder point is simply that inventory level which will be maintained for consumption during the lead time, that is lead time multiplied with average usage of the inventory. If the lead time is nil the reorder point will be the zero level of inventory.

11.9.6 Safety Stock:

In practice, the usage of inventory is generally not known with certainty and it fluctuates during the given period of time. In addition to the usage, the lead time is also subject to some variations. Therefore, when we allow for uncertainty in usage as well as in lead time, a safety stock is advisable. The required amount of safety stock to be maintained depends on several factors, viz., usage of inventory, lead time period, stock-out costs, costs of carrying the inventory, etc. Normally manager of inventory do add safety stock while calculating the average inventory.

Safety stock = lead time x number of units consumed per day

11.9.7 Ageing schedule:

The inventory items are grouped-into basing on the number of days / months they have been lying in warehouse. More the no. of days / months an item is held in warehouse, it is said to old. The economic value of an item depends upon its quality, usage and relevance. Utility value of old items i.e., lying in go downs for a long time will be low.

The ageing schedule helps in assessing liquidity value of inventory. More the age of the inventory, less is the liquidity of the firm. If many items are lying in go downs for a long time, it can be said that the liquidity of the firm is poor. A firm having more items of recent purchases will have more and more i.e., liquidity since their utility (in terms of quality) is high. The liquidity position of the firm can be gauged from the following Illustration - 11.3.

Illustration: 11.3

Age of Items	Firm A	% in total value	Firm B	% in total value
1 month old	15.00	35%	35.00	65%
above 1 month and less than 3 months	20.00		30.00	
Above 3 months and Below 6 months	30.00	30%	20.00	20%
Above 6 months and Below 1 year	35.00	35%	15.00	15%
Total	100.00	100%	100.00	100%

Now, firm B is stronger, in liquidity point of view as it has 65% (out of total value) of its inventory is 3 month old. Firm A is relatively poor state since of inventory position 65% of its

inventory is purchased beyond 3 months. From this illustration it is evident that firm with latest purchases will be strong in business. Here both firms are holding inventories worth Rs. 100 lakhs each. But, Firm B is found to relatively be strong after analysis.

11.10 Inventory Control Systems:

In a large organization, where more number of inventories are maintaining, it is not desirable to keep the same degree of control on all the items. In order to effectively manage these inventories, every firm needs an inventory control system. In an organization, the size of the inventory, nature of the materials, type of inventory and size of the firm dictate the selection of an inventory control system. In practice, there is several inventory control systems are in vogue. The following are some of the systems which are following by the firms for controlling the inventory.

(i) ABC Analysis:

Large number of firms has to maintain several types of inventories. Therefore, the firm should pay maximum attention to those items whose value is the highest. Hence, the firm should be selective in it's approach to control investment in various types of inventories. This approach for maintaining the inventory in the organization is called the ABC analysis which measures each item of inventory in terms of its value. The highest valued items are categorized as 'A' items the lowest valued items are grouped a 'C' category and the moderate items are branded as 'B' items. More over, all these items may not be consumed everyday. Since A items are very costly, tight control is used, B items are under reasonable control and C items are under simple no control, since they are of low value. A tight control may be applied for high-value items and relatively loose control for low-value items. Thus, the control by importance and exception by the firm attains the maximization of profitability on its investment.

. The graphical representation shows that items A, which is only 16 per cent in the total units of all the items, represents 60 per cent in terms of value. Whereas, 'C' items though represent 50 per cent in the total number are of only 20 per cent in terms of value and 'B' items occupied middle place. Thus, 'A' items are under tight control while planning, ordering, checking storing, dispatching, etc. and if any negligence on the part of management would cause heavy loss because items are of high values.

Table 11.1 ABC Analysis

Item	Units	% of Total quantity	Number Cumulative Percentage	Unit Price	Total value	% of total value	Cumulative percentage of value
1	1000	10	15	10	10000	19.15	
2	500	5		50	25000	47.89	67.06

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3	1600	16	35	3	4800	9.19	
4	1900	19		4	7600	14.55	23.76
5	3000	30		1.20	3600	6.89	
6	1000	10	50	0.50	500	0.95	9.18
7	1000	10		0.70	700	1.34	
Total	10000	100	100	--	52200	100.00	100.00

Stocks are also divided into 3 categories such as Vital, Essential and Desirable, which helps for planning, controlling and other inventory decisions are taken more carefully and seriously for items of vital category next comes essential and followed by desirable items. The division of materials based on consumption pattern also helps the management to control the inventory rightly. According to this approach, the inventory items are categorized into fast moving, slow moving and non moving. Inventory decisions are very carefully taken in the case of 'not moving category'. In the case of item of fast moving items, the manager can take decisions quite easily because any error happened will not trouble the firm so seriously. Since risk is less in fast moving items, because they can be consumed quickly unlike the non - moving category which are carried in the go downs for more time period. As risk is high in case of slow - moving and non-moving - items, the inventory decisions have to be taken carefully without affecting the objectives of profitability and liquidity of the organization.

(ii) Just-in-Time System:

As a matter of fact, inventory costs are high and controlling inventory is complex because of uncertainties in supply, dispatching, transportation, etc. Lack of coordination between suppliers and ordering firms is causing severe irregularities, ultimately the firm ends-up in inventory problems. Toyota Motors in Japan has first time suggested just - in - time approach in 1950s to minimize the investment on inventory. According to this system material or any component for manufacturing of goods/services arrive to the site just few hours before they are put to use. Thus, the supply of material is synchronized with the production cycle, eliminates the necessity of carrying large inventories and saves lot of carrying and other costs of storages. Since, it requires close coordination between suppliers and the ordering firms, and therefore, only units with systems approach will be able to implement it.

(iii) Out-Sourcing System:

A few years ago there was a tendency on the parts of many companies to manufacture all components in-house. Now, more and more companies are adopting the practice of out-sourcing. It is a way of getting the work from outside the organization, which is not possible or economical to get it within the organization. More specifically, it results reduction in the cost of production, shortening of the purchasing cycle and saving of administration and supervisory expenditure. It is a more popular concept in Information Technology field and now it is a step

beyond IT area and becoming a strategic choice of companies looking to achieve cost reduction while improving their service quality, increasing shareholder value and focusing on their core business capabilities.

(iv) Computerized Inventory Control System:

It is an automatic system of counting inventories, recording withdrawals and revising the balance. In this method, there is an in-built system of placing order as the computer notices that the reorder point has been reached. In the present business world, majority companies are adopting the computerized inventory control system, which enables a firm to easily track large items of inventories. Today, it is inevitable for large business firms which carry thousands of inventory items. The success of this system is more depended on the development of the communication new work.

11.11 Measures to assess the inventory management

Following are the ratios in use to measure the effectiveness of the inventory management.

- i) Inventory turnover ratio : $\text{Cost of goods sold} / \text{average total inventories}$.

The higher the ratio, more the efficiency of the firm

- ii) Work in process turnover ratio

Here, in this ratio also higher the ratio, more the efficiency of the firm.

- iii) Weeks inventory finished goods on hand

This ratio reveals that the lower the ratio, the higher the efficiency of the firm

- iv) Weeks raw material on order

This ratio indicates that the lower the ratio, the higher the efficiency of the firm.

- v) Average age of raw material inventory

This ratio says that the lower the ratio the higher the efficiency of the firm.

- vi) Average age of finished goods inventory

This ratio comes that the lower the ratio the higher the efficiency of the firm.

- vii) Out of stock index

This ratio indicates the lower the ratio higher the efficiency of the firm.

- viii) Spare parts index

This ratio reveals that the higher the ratio the more the efficiency of the firm.

11.12 Summary:

Inventory constitutes about 60 per cent of the total current assets of any manufacturing organization in India. There are several forms of this inventory, i.e., raw material, work-in-process; semi-finished, finished and spare materials. There are three motives for holding inventory. The objective of inventory management is maximization of the value of the firm. The inventory costs are broadly grouped them as carrying costs and ordering costs. In order to attain the objective of inventory management the firm should minimize these costs. There are mainly two issues involved in the management of inventory, viz., how much to order and when to order. The first one relates to calculation of economic order quantity and the second one is with respect to re-order point. In practice the determination of the reorder level is depends on the lead time and usage of inventory in the firm. Apart from these issues, there are other areas of inventory management to make use for effective management of inventory.

11.13 Key Words

1. A B C Inventory Control System: it is a method that controls expensive inventory items more closely than less expensive items.

2. Economic Order Quantity: it is the order quantity at which the total inventory costs are minimized over the firm's planning period.

3. Safety Stock: Inventory stock held in reserve as a cushion against uncertain demand and replenishment lead time.

4. Stock-out-Cost: It is the stock level at which not having sufficient stock to issue for production.

11.14 Self Assessment Questions

1. What is inventory and why should it be held?
2. Explain the costs associated with inventory management
3. What is economic order quantity? How do you calculate it?
4. Explain the various inventory control systems and its relevance in Indian Industries.
5. What is the risk return trade-off? How it is associated with inventory management?
6. From the following details what should be the ideal level of inventory

Annual consumption = 1,00,000

Cost of the material = Rs. 5/- per unit

Ordering cost = Rs.20/- per order

Inventory carrying cost = 36% of the inventory cost

Lead time = 30 days

Safety stock = 20 days consumption.

7. A firm uses 1000 units of a product per year, its carrying cost per unit is Rs.5/- and ordering cost is Rs. 50/-. It takes 15 days to receive a shipment after an order is initiated and the firm intends to hold inventories for 30 day's usage as safety stock. Calculate the EOQ and reorder point.
8. XYZ Co. Ltd., uses 20,000 units every year. Inventory carrying cost is Rs.50/-. Cost per order is Rs.500/-. Decide the annual order costs and total inventory costs, if the firm orders in quantities of 5,000, 10,000 respectively.
9. From the following data, suggest whether the firm can avail of the quantity discount.
- Annual usage - 10,000 units. Cost per order - Rs. 600/-
- Price Per unit Rs. 100/- Carrying cost 10% of inventory value
- 10.. From the following information
- i) Rank the items on the basis of usage value.
 - ii) Record the percentage of usage items
 - iii) Classify the items into 3 categories i.e., A, B and C

Item	Annual usage (number of items)	Price Per Unit (Rs.)
A	1400	200
B	6000	400
C	1200	500
D	300	600
E	1500	700
F	1300	800
G	8400	900
H	90600	100
I	4000	200

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J	100	1000
K	50	1100
L	400	1200

11.14 Further Readings

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