1.8 Stowage Factor and Broken Stowage

KEY POINTS

- **Stowage factor is the ratio of weight to stowage space required under normal conditions**
- **broken stowage is the space lost due to the uneven shape of the cargo or unavoidable gaps in cargo stowage, expressed as a percentage of the total volume of the cargo.**

Stowage Factor

This is the space occupied by a unit weight of cargo under normal conditions. A ship has a limited amount of space in which to load the cargo. The stowage factor of the cargo will allow calculation of the space it will occupy in the hold, given its weight. The lower the stowage factor, the denser the cargo. For example, iron ore has a stowage factor of 0.28 m^3/t, while cotton waste has a stowage factor of 2.78 m^3/t. The stowage factor of the same type of cargo may vary depending on the nature of cargo and the region from where it is sourced. Where bale goods are concerned, an important point is whether the bales are carried compressed or uncompressed. For example, hemp in bales uncompressed has a stowage factor of 7.3 m^3/t, while the same cargo compressed has a stowage factor of 2.55 – 3.4 m^3/t.

Relationship between Weight, Volume and Stowage Factor

Stowage factor is the volume occupied by a unit weight of cargo. Therefore, to convert a given weight to the corresponding volume, the following formula is used:

Volume (m^3) = Weight (tons) × Stowage Factor (SF) (m^3/t)

Broken Stowage

This is the space lost through either the uneven nature of the cargo or the packaging or dunnage between cargoes.

It is often expressed as a percentage of the volume of the cargo and will vary with the nature of the cargo carried.

Calculation Examples

1. A 250 tonnes parcel of palletised cargo has an SF of 1.8 m^3/t. Allowing for 5% broken stowage, calculate the space this parcel of cargo will occupy in a hold.

   $V = Wt \times SF$; $Wt = V/SF$; $SF = V/Wt$

   Volume Occupied $250 \times 1.8 = 450\ m^3$

   5% Broken Stowage $= 5\% \times 450 = 22.5\ m^3$

   Space occupied $= 450 + 22.5 =$ **$472.5\ m^3$**

   (Alternatively, $105\% \times 450 =$ **$472.5\ m^3$**)

2. If the parcel is placed in a hold of 1200 m^3 bale capacity, calculate the space remaining for other cargo.

   Space available $= 1200.0\ m^3$

   Space remaining $= 1200 - 472.5 =$ **$727.5\ m^3$**

3. Calculate the weight of cargo, SF 1.3 m^3/t BS 5%, that may be loaded in the remaining space.

The space remaining = 105% of the volume of cargo to load

$727.5\ m^3 = 105\% \times$ Volume of cargo

$$\frac{727.5}{1.05} = \text{Volume of cargo to load}$$

Volume of cargo to load
$= 692.86\ m^3$

$$\text{Wt of cargo to load} = \frac{692.86\ m^3}{1.3\ m^3/t}$$

$= \mathbf{532.97\ t}$

1.9 Cargo Gear: Derricks

KEY POINTS

- **General cargo vessels tend to have their own gear to load and discharge cargoes**
- **cargo derricks come in a variety of designs and safe working loads.**

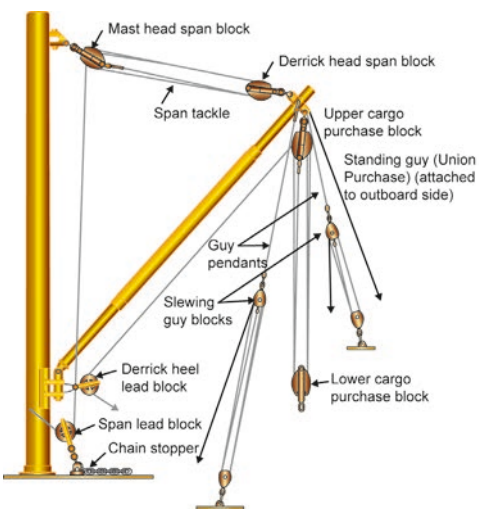
General Cargo Vessel

Many general cargo vessels have their own gear that helps them to load and discharge in ports lacking infrastructure. This is usually in the form of a derrick or crane serving each hold and it is often a distinguishing feature of general cargo ships.

Single Swinging Derrick

The most basic form of cargo gear is the single derrick. This can be equipped with span tackles and cargo purchases.

The span blocks are secured to the mast of the derrick head and the 'topping wire' is permanently fitted on to a winch. The operation of this winch raises or lowers the derrick boom. The 'runner wire' runs through the



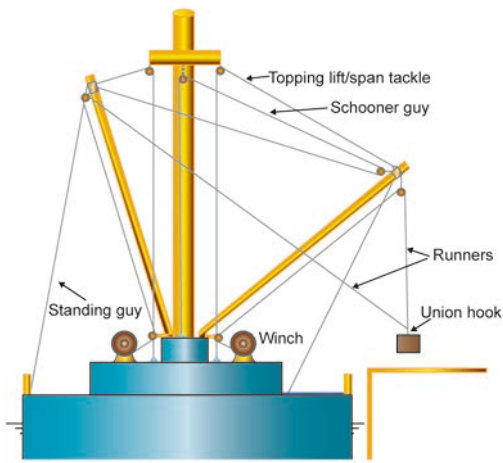
Single Swinging Derrick

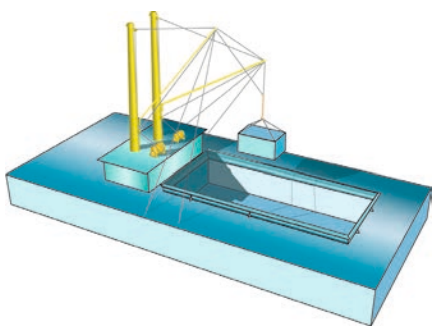
upper and lower cargo blocks and the 'slewing wire' runs through slewing guy blocks on either side of the derrick. In its most basic form, the derrick is plumbed over the hatch square and secured. The cargo is then lifted with the runner blocks and the slewing guys are operated to swing the derrick and discharge the cargo over the side.

As the cargo purchase, the topping lift and the two guys must operate independently; four independent winches are needed to operate this type of derrick.

Union Purchase Derrick

One of the most efficient rigs is the Union Purchase Derrick, which is a rig





Union Purchase Derrick

where a pair of derricks are used in combination, the derricks being fixed and the cargo runners coupled.

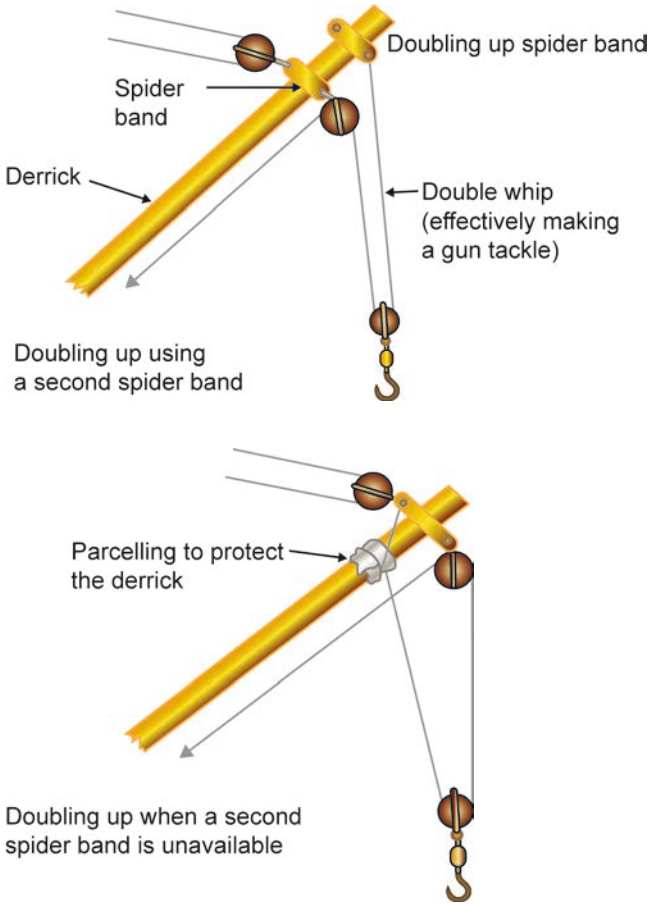
One derrick plumbs the hatch and the other plumbs overside. The falls of the two derricks are fastened together at the cargo hook. One derrick boom is arranged over the hold and the other is overside. The booms are then fixed in position. When the vessel is discharging cargo, the derrick that is plumbing the hold lifts the load. After the load has been lifted over the hatch coamings, it is gradually transferred to the fall from the other derrick, which is plumbing overside. This is done by heaving on one fall and slacking on the other. Due to the coordination required in slacking one fall and heaving the other, only experienced operators must be employed. Union Purchase can become an extremely fast method of loading/discharging cargo in units of up to about 1½ tonnes each, but it has the disadvantage of placing heavy stresses on the outboard guys of both derricks, so additional static *preventer (standing) guy*s are used. There is not a great deal of stress on the inboard guys, but these must be set taut to prevent the derrick jerking. As an alternative to inboard guys, a *schooner guy* may be rigged between the derrick boom heads, reducing deck clutter.

Precautions:
When using the derricks in the Union Purchase mode, the maximum load must not exceed either 1/3 the SWL of the lowest rated derrick in the pair or an absolute maximum of 2.5 tonnes.

Narrow angles between the outboard guys and the vertical should be avoided as this increases the load on them. However, the angle should not be too large as this increases the chance of the derrick jack-knifing. To avoid undue stresses on the rig, the angle between the falls should not exceed 90° and should never exceed 120°.

Doubling Gear
When using derricks in a Union Purchase Rig, the maximum load must not exceed 1/3 the SWL of the lowest rated derrick. Therefore, if there is a requirement to lift a load heavier than the SWL of the union rig, but less than that of the SWL of an individual derrick, the rig can be unhitched and the single derrick can be used as a swinging derrick. If the item's weight is close to or in excess of the SWL of the cargo runner, it may be lifted by *doubling up* the cargo runner so that the stress limit is not exceeded.

Doubling up the runner in this way will allow the lifting of a weight in excess of the SWL of the runner if rigged as a *single whip*. It does NOT, however, permit the lifting of a weight in excess of the SWL of the lifting appliance as a whole.



Seamanship Techniques by David House, published by *'Elsevier'*.

Velle Derrick

The Velle derrick is a patented derrick that was popular on general cargo vessels built in the 1970s. This is a single swinging derrick, the distinguishing feature of which is 'T' bar or 'floating bridle bar' at the derrick head to which the cargo hoist head blocks and topping spans blocks are secured. The advantage of this arrangement is that it allows a greater slewing radius and the 'T' bar provides stability when discharging or loading containers or heavy lifts.