To the casual observer sails when spread and in use appear merely as so many large pieces of cloth; but some of them are of very considerable size: it is not at all un­usual in full square-rigged ships for a main-course or main-sail to contain 1000 yards of canvas (24 inches wide), and a main-top-sail nearly as much,—the single suit for such a vessel comprising upwards of 10,000 yards. Courses and top-sails are made reducible ; in the British navy they are reduced by means of reefs (two in courses, four in top-sails), each fitted with spilling, slab, and reef lines and becket, and toggles on the yard (reef-points throughout being now obsolete). In the merchant service double top-sails—upper and lower—are much in use on account of handiness in reducing sail; there is also “ patent reefing gear,” such as Cunningham’s, which allows reefing to be done as much as possible from deck. The dimensions of masts and yards, quantity of canvas or area of sail, centre of gravity of each sail (from which the moment of sail is obtained and compared with the moment of stability), centre of effort of the sails, and other important calcula­tions necessary in relation to the body of the vessel are made by constructors and naval architects.

*Sailcloth* is obtainable from any description of fibrous material capable of being woven into cloth, having sufficient compactness and closeness of texture, and possessing the requisite strength for sustaining the heavy pressure which sails often have to bear in severe weather. Several de­scriptions of fibre might be enumerated which would to a certain extent serve for sailcloth but for the absence of quality of endurance or resistance; hemp has been and is now occasionally used, as also a mixture of cotton and linen yarn, or cotton only,—especially in America; but in the United Kingdom Flax *(q.v.)* is the usual staple material, since, when well manufactured, it possesses the qualities of flexibility and lightness, and, what is still more important, the element of strength in a very large degree.

The following points may be regarded as of primary importance for securing sailcloth or canvas of a superior quality and durability. Whatever flax is used, it is absolutely necessary that the “warp” and “weft ” of the canvas be spun wholly from the “ longs,” be free from blacks and any mixture of short flax, well dressed or heckled, and that the yarn be well and evenly spun and properly twisted. Both warp and weft yarn should be twice boiled with the best American pot and pearl ashes, and carefully and thoroughly washed and cleansed. No acid chloride of lime or other preparation of chlorine, nor any deleterious substance, should be used in any stage of the process, otherwise the integrity of the fibre will most prob­ably be interfered with ; the only advantage got is that the cloth looks much whiter, which for yachts and pleasure-boats is perhaps desirable, but for naval and mercantile uses is not at all necessary. The yarns are first boiled a sufficient length of time in a solution of the best American potash, in fixed proportions of ashes, green yarn, and water, then mill-washed (beating process), and subse­quently carefully washed in a considerable stream of clear running water, and wrung. They are again boiled for a sufficient length of time in a solution of American pearl ashes, in due proportions of ashes, green yarn, and water, then carefully rinsed, or washed in a clear stream of water, carefully dried, and frequently shaken in the course of drying, so that the fibres of the flax may be equally stretched. These repeated boilings, &c., have the effect of cleansing, bleaching, softening, and removing all vegetable impurities which may be hanging about; no starch, tallow, paste, or weaver’s dressing of any description should be used, otherwise the fabric will tend to mildew if allowed to remain damp for any time. Sail- cloth is made in bolts, mostly 24 inches wide, but also 18 inches wide, and for yachting purposes frequently still less wide, upon the ground that the narrower the cloth the flatter and better will the sail stand to its work. It is generally made of eight different qualities in respect of thickness, numbered 1 to 8 accordingly ; the heavier numbers—Nos. 1, 2, and 3—are used for storm and other sails that have to do heavy work, the remaining numbers for the lighter descriptions of sail. The weight of each bolt of canvas 24 inches wide, from Nos. 1 to 6 inclusive for 39 yards in length and

their top-sails also in two parts, upper and lower or cap-top-sails, an arrangement which makes it easier to reduce or shorten sail; they also have a mizzen course (cross-jack), and carry several light stay-sails so as to catch every breath of wind.

for Nos. 7 and 8 for 40 yards in length, is about as follows, viz., No. 1, 46 lb ; No. 2, 43 ; No. 3, 40 ; No. 4, 36; No. 5, 33 ; No. 6, 30 ; No. 7, 27 ; No. 8, 25 lb. The weight of each bolt of narrower canvas is in proportion. The warp (or lengthwise) should consist of the following proportions of clean unstarched yarn, viz.:—

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. 1 not less than 26 lb... | | ...161/2  ...161/2 | score reed.. | ... 660 double threads. ...660 |
| 2 » | 24 „... |
| 3 „ | 22 „... | ...164 |  | ...660 ,, |
| 4 ,, | 21 „..· | ...17 |  | ...680 „ |
| 5 ,, | 19 „... | ...17 |  | ...680 ,, |
| 6 ,, | 18 „... | . ..17 |  |  |
|  | 1.5 „... | ... 20 |  |  |
| 8 „ | 14„... | ...20 | ,, | ...800 „ |

As a rule about 40 yards in length may be considered as the average content of each bolt. Particular attention should be paid to the weaving, that the texture be struck sufficiently close, and the selvages be evenly and well manufactured; what is termed a slack selvage (that is, one selvage longer than the other) is not only awkward for the sailmaker but unsatisfactory both in wear and appearance, the slack side showing itself puckered. Sailcloth made upon these conditions is very likely to be a good article ; tests, however, can be applied, generally to strips 1 inch wide from Nos. 1 to 6 inclusive, and 11/2 inch wide from Nos. 7 and 8. Weft and warp (24 inches in length) in each case are placed in a small testing machine, which has a dial plate with a spring under­neath ; vices are attached to grip the strips, one vice to the spring, the other in connexion with a long screw’ with a handle ; by turning this handle the vices are drawn asunder until the strip breaks, and the hands on the dial-plate indicate the strain in pounds. The following is a fair test of strength for the various numbers of good sailcloth :—

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. 1.... | *Weft.*  ...,480 lb.... | *Warp.* ....340 lb | No. 5.... | ....370 lb.... | *Warp.*  ....260 lb |
| 2... | ....460 .... | .. ..320 | 6.... | ....350 .... | ....250 |
| 3... | ....440 .... | ....300 | 7.... | .... 390 .... | ....330 |
| 4.. .. | ....400 .... | ....280 | 8.... | ....380 .... | ....310 |

It is not at all unusual, however, to find some sailcloth stand a strain considerably in excess of this. Freedom from blacks, twist and spun of the yarn, stiffening, calendering, &c., can be discovered by observation and a magnifying glass, excessive dressing by a little tincture of iodine.

*Sailmaking* is a very old branch of industry in connexion with the navy and commerce, and it still continues to be important notwithstanding the enormous extent to which steam is now employed in navigation.

The operations of the sailmaker may be stated as follows. The dimensions of mast and yards and sail plan being supplied, the master sailmaker is enabled to determine the dimensions of each sail—after due allowance for stretching—in terms of cloths and depth in yards—if a square sail, the number of cloths in the head, number in the foot, and the depth in yards ; if a fore-and-aft sail (triangular), the number of cloths in the foot, and the depth in yards of the luff or stay and of leech or after-leech ; if a fore-and- aft sail (trapezium form), the number of cloths in the head, number in foot, and the depth of mast or luff and of after-leech. These particulars obtained, there is got out what is technically termed a “casting,” which simply means the shape, length, &c., of each in­dividual cloth in the sail. These figures are given to the cutter, who proceeds to cut out the sail cloth by cloth in consecutive order, numbering them 1, 2, 3, 4, &c. ; the series of cloths thus cut out are handed over to the workman, who joins them together by care­fully made double flat seams, sewn with twine specially prepared for the purpose, with about 120 stitches in a yard. In the heavy sails the seam is about an inch and a half in width and in the British navy stuck or stitched in the middle of the seam to give additional strength ; the seams in the lighter sails are about an inch wide. The whole of the cloths are then brought together, and spread out, and the tabling (or hemming, so to speak) is turned in and finished off with about 72 stitches to a yard. Strengthen­ing pieces or “linings” are affixed where considered necessary, in courses and top-sails such pieces as reef-bands, middle-bands, foot- bands, leech-linings, bunt-line cloths ; in top-sails (only) a top- lining or brim ; in other and lighter sails such pieces as mast-lining clew and head, tack, and corner pieces ; holes, such as head, reef, stay (luff), mast, cringle, bunt-line, &c., are also made where re- quired, a grommet of line of suitable size being worked in them to prevent their being cut through. The next thing to be done is to secure the edges of the sail,—an important operation, as much depends upon this whether the sail will stand well and do its work efficiently. Bolt-rope, a comparatively soft laid rope made from the finer hemp yarn (Italian) is used for this purpose ; in the British navy it ranges from 1 inch (increasing in size by quarter inches) up to 8 inches inclusive, the size selected for each part of a sail being determined by the amount of strain it will have to bear; it is then neatly sewn on with roping twine specially pre­pared, the needle and twine passing between and clear of every two strands of the rope in roping. Where slack sail has to be taken in, it is the practice to leave it to the judgment of the sail­