



Flash butt welded anchor chain cables

1. **Scope** This Japanese Industrial Standard specifies flash butt welded anchor chain cables (hereinafter referred to as "chain") and their accessories for ship and harbour use.

Remark: This standard makes reference to the following standards:

- JIS G 3101 – Rolled steel for general structure
 JIS G 3105 – Steel bar for chains
 JIS G 4051 – Carbon steel for machine structural use
 JIS G 5101 – Carbon steel casting
 JIS Z 2201 – Test pieces for tensile test for metallic materials
 JIS Z 2202 – Test pieces for metallic materials

2. **Classification** The chains shall be classified by their construction and quality as given in the Table 1.

Table 1 Class

Type of chain	Type symbol
Stud link chain	Class 1 ST 1
	Class 2 ST 2
	Class 3 ST 3
Studless link chain	SH

3. **Construction, shape and dimensions** The construction, shape and dimensions of the chain shall be as shown in Attached Figs. 1 and 2, and the following requirements:

- (1) The nominal diameter of the chain is derived from the diameter d of the common link, and the corresponding dimensions shall be as given in Attached Table 1.
- (2) The length of chain is represented by the length from the inside extreme point of the end link at one end to the same at the other end, which shall be 25 m or 27.5 m. The length may include a joining or Kenter shackle.
- (3) The total number of links in each length of chain shall be odd, except where a swivel is used.
- (4) The shapes of all kinds of links, shackles and swivel shall be determined in accordance with the proportions shown in Attached Figs. 1 and 2. Their shapes shall be uniform and their curved parts shall be such that joining links fit properly and work freely.

4. **Tolerances on dimensions** The tolerances on the dimensions of the chains and accessories shall conform respectively to the following (1) and (2) by measuring a length of the chains after proof inspection.

(1) Chains

- (a) The minus tolerances on the necessary diameters of all kinds of links shall be as given in Table 2, and the plus tolerances shall be 5 percent of the necessary diameters or 1.5mm whichever is greater. However, the minus tolerances at the sectional area of bending part shall not be allowed.

Table 2 Tolerances on the dimensions

Unit: mm					
Necessary dia.	Exceeding	40	84	122	
	or less	40	84	122	
Tolerances		1	2	3	4

- (b) The tolerance on the length of joined five common links shall be +2.5% and -0%.
 - (c) Other tolerances except (a) and (b) shall be $\pm 2.5\%$.
- (2) **Accessories for the chains**
- (a) The tolerances on the diameters at bending parts shall be +5% and -0%.
 - (b) The tolerances except (a) shall be $\pm 2.5\%$.

5. **Mass** The mass of the chains in accordance with the specification as given in **Attached Table 1**, shall be measured after proof inspection
6. **Materials** The materials for the chains shall be as given in **Table 3**.

Table 3 Materials

Parts of chain	Material			
	Stud link chain (ST)			Studless link chain (SH)
	Class 1	Class 2	Class 3	
All kinds of links	JIS G 3105-SBC 300, JIS G 3101-SS400 or JIS G 4051-S20C	JIS G 3105-SBC 490	JIS G 3105-SBC 690	JIS G 3105-SBC 300, JIS G 3101-SS400 or JIS G 4051-S20C
Shackle and Swivel	The same material as link or JIS G 4051-S25C ~ S35C	The same material as link, JIS G 4051-S38C ~ S50C or steel casting for Class 2 chain specified in Table 4	The same material as link or steel casting for Class 3 chain specified in Table 4	The same material as link or JIS G 4051-S25C ~ S35C
Stud	The same material as link, carbon steel for machine structure, carbon steel casting or malleable iron casting	The same material as chain, rolled steel, steel castings or steel forgings. Malleable iron castings or gray iron castings shall not be used.		

- Remarks:**
1. It is recommended that the links making a length of chain are made of the same material.
 2. Where end links and enlarged links are made of cast steel, their material shall be SC 410 or SC 450 in JIS G 5101 for Class 1 chain, and steel casting for Class 2 or Class 3 chains specified in **Table 4** for Classes 2 and 3 chains respectively.
 3. The materials used for all kinds of links, shackles, swivel and studs may be those of Class 2 chain for Class 1 chain and those of Class 3 for Class 2.
 4. Where carbon steel for machine structure is used for all kinds of links, shackles and swivel, it shall be tested for mechanical properties and shall satisfy those in JIS G 3105 as applicable.

Table 4 Materials

Name of materials	Tensile test			Impact test ⁽¹⁾		
	Yield point or yield strength (N/mm ²)	Tensile strength (N/mm ²)	Elongation (L=5d) (%)	Reduction of area (%)	Test temperature (°C)	Minimum mean value of absorbed energy (J)
Cast steel for Class 2 chain	295 or more	490~690	22 or more	—	—	—
Cast steel for Class 3 chain	410 or more	690 or more	17 or more	40 or more	0	60

Note ⁽¹⁾: Absorbed energy value of 2 or more test pieces out of 1 lot test sample may be minimum mean value or more of absorbed energy specified, or any one piece of test sample may be 70% or more of specified value.

7. **Method of manufacture** The chain shall be manufactured by flash butt welding and in accordance with the following.
- (1) Where the stud is put in, it shall be perfectly squeezed in the middle of the link.
 - (2) Shackles and swivels shall be manufactured by forging or casting.
8. **Heat treatment** The chain shall be heat-treated as follows:
- (1) Class 1 or Class 2 chains which have been flash butt welded with sufficient preheating may be exempted from heat treatment.
 - (2) Class 3 chains shall be heat-treated by quenching and tempering or a suitable method. Where a Class 2 chain has been made of the material for Class 3 chain, it shall be heat-treated adequately.

9. **Test and inspection** The chain shall be inspected for the following (1) to (6):

(1) **Material inspection** The material inspection shall be carried out in accordance with the reference standard in **Table 3** as applicable. However, the method for taking the test pieces in **JIS G 3105** and their types and the retests shall comply with the following, and mechanical test may be omitted for material of stud.

- (1.1) Define 50 t or its fraction of steel bars for chains from the same melt as one lot, select a bar with the maximum diameter out of it and take this as the test sample. Cut one tensile test piece and a set (three pieces) of impact test pieces from this sample.
- (1.2) The notch of impact test piece shall be parallel nearly to the radius direction. The test piece cutting at longitudinal direction shall be parallel to the rolling direction. The test pieces shall be cut a position of 1/6 radius distant or near from peripheral surface of test sample as shown in **Fig. 1**.

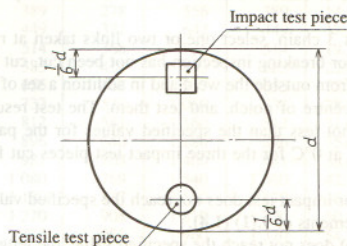


Fig. 1

(1.3) Tensile test pieces and impact test pieces shall comply with **Table 5**.

Table 5

Material symbol	SBC 300	SBC 490	SBC 690
Tensile test	No. 14A in JIS Z 2201		
Impact test	—	No. 4 in JIS Z 2202	

(1.4) **Retest**

(1.4.1) When the results of tensile test do not conform to the requirements specified, retests may be made on additional 2 test pieces cut from the same sample.

In this case, the results of retests shall be subjected to satisfy all of the requirements specified.

(1.4.2) When the results of impact test do not conform to the requirements specified, excepting following cases (a) or (b), retests may be carried out on additional 1 test piece cut from same sample.

In this case, the average value of absorbed energies in total 6 test pieces including unsatisfied test data shall be more than that specified, and also number of test pieces with lower than that specified and lower than 70% of that specified, respectively, shall be less than 2 test pieces and 1 test piece.

- (a) When all of the test pieces do not conform to the minimum mean value of absorbed energy specified.
- (b) When either of the 2 test pieces of the sample do not conform to 70% of that specified.
- (c) When the test results of sample heat-treated do not conform to the requirements specified, retest may be carried out on same sample after reheat treatment. In this case, all of mechanical test shall be done over again.

(2) **Breaking inspection** The breaking inspection shall be carried out as follows:

- (a) The breaking test of chain shall be carried out on a test chain consisting of three or more links taken at random from the chain.
- (b) One test chain shall be taken from every four lengths of the chain. If the length is as short as the sum of two lengths does not reach 25 m or 27.5 m, the two lengths are taken as one.
- (c) The test chain shall be subjected to the breaking test load as appropriate to its class as given in **Attached Table 1**, and shall withstand the load.
- (d) When the test chain has failed inspection of (c), additional two test chains shall be taken from the same length and re-tested and shall conform to the requirements specified. Remaining length (a) to (c) for acceptance.