JIS G5530 Steel Pipe Sheet Piles

1. Scope

This Japanese Industrial Standard specifies the steel pipe sheet piles used for sheathing, coffering and foundations of structure and the like

2. Classification and symbols

The Steel pipe sheet piles shall be classified into two classes and their symbols shall be as shown in Table 1.

Table 1 Symbol of classes

Class symbols	Reference
	Traditional symbol
SKY 400 SKY 490	SKY 41 SKY 50

World Standard Comparative Table

Standard Basis	KS		JIS	
Standard num.	F 4605		A 5530	
Symbol for Class	Old Symbol	New symbol	Old Symbol	New symbol
	SKY41 SKY 50	SKY400 SKY490	SKY41 SKY50	SKY400 SKY490

3. Constitutions of steel pipe sheet pile and designation of each part

The constitution of steel pipe sheet pile and the designation of each part shall be as follows:

3.1 The steel pipe sheet pile shall be the steel pipe body with the coupling attached and the designation of each individual part shall be as shown in Fig 1, Fig 2 and Fig 3.

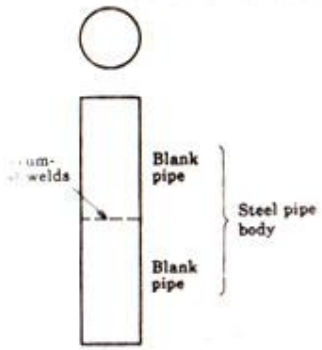


Fig 1. Constitution of steel pipe body and designation of each part

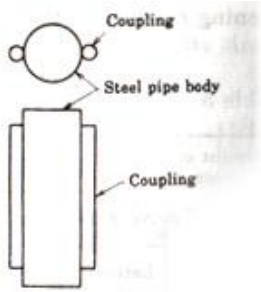


Fig 2. Constitution of steel pipe sheet pile and designation of each part

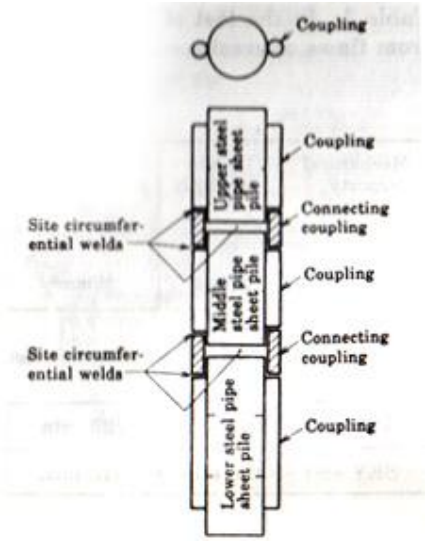


Fig 3. Constitution of steel pipe sheet piles connected on site and designation of each part3.2 The blank pipe is defined as the pipe manufactured by are welding or electric-resistance welding from a steel pipe or a steel plate. The steel pipe body is defined the blank pipe as it is or the pipes jointed by circumferential welding blank pipes at shop.

3.3 The upper side, the middle side and the lower side of the steel pipe sheet pile connected on site shall be designated as the upper steel pipe sheet pile, the middle steel pipe sheet pile, and the lower steel pipe sheet pile, respectively. However, in the case where the middle steel pipe sheet pile consists middle steel pipe and the second middle steel pipe sheet pile and so on going upward from the bottom.

3.4 In connection the steel pipe sheet piles on site, the members used for connecting the couplings of the steel pipe sheet piles with each other shall be designated as the

connection couplings.

4. Chemical composition

The blank pipe shall be tested in accordance with 10.1 and the ladle analysis values ascertained shall be as specified in Table 2.

Table 2. Chemical compositions

Class symbol	Chemical compositions (%)				
	C	Si	Mn	P	S
SKY 400	0.25 max	-	-	0.040 max	0.040 max
SKY 490	0.18 max	0.55 max	1.50 max	0.040 max	0.040 max

Remark

The alloy elements other than those shown above may be added as required.

5. Mechanical properties

The blank pipe shall be tested in accordance with 10.2 and 10.3 and ascertained values of tensile strength, yield point or proof stress, elongation, weld tensile strength and flattening resistance, the walls of the pipe of the pipe shall be free from flaws or cracks

Table 3 Mechanical properties

Mechanical property	Tensile strength N/П	Yield point or proof stress N/П	Elongation %	Weld tensile strength N/П	Flattening resistance
			No. 5 test piece		Distance between flat plates (H) (Dis outside diameter of pipe)
			Lateral direction		
Division of manufacturing method	Arc welding, electric resistance welding			Arc welding	Electric resistance welding
SKY 400	400 min	235 min	18 min	400 min	2/3D
SKY 490	490 min	315 min	18 min	490 min	7/8D

6. Welding materials

The welding materials used for welding the blank pipes, the steel pipe body, couplings and accessories shall have the strength of not less than the tensile strength of materials for the blank pipe, couplings and accessories and comply with the requirements of the following standard

JIS Z 3211

JIS Z 3212

JIS Z 3312

JIS Z 3313

JIS Z 3351

JIS Z 3352

7. Materials of coupling and connecting coupling

The materials of the coupling and the connecting coupling shall be equal or superior in quality to STK 400 of JIS G 3444 and SS 400 of JIS G3101

Further, the materials of accessories shall be in accordance with the above-mentioned coupling and connecting coupling, as appropriate.

8. Shape, dimensions, mass and their tolerances

8.1 Shape of steel pipe sheet pile The shapes of steel pipe sheet pile shall be as follows:

(1) The shapes of the both ends and site circumferential welds of the steel pipe sheet piles shall be as shown in Fig 4.

Where the pipes different in thickness are connected, they shall be worked t shop previously as shown in Fig. 5. as a rule. However, the reinforcement or work, where especially required, may be determined by agreement between the parties concerned.

(1) Head part and tip part (2) Site circumferential welds

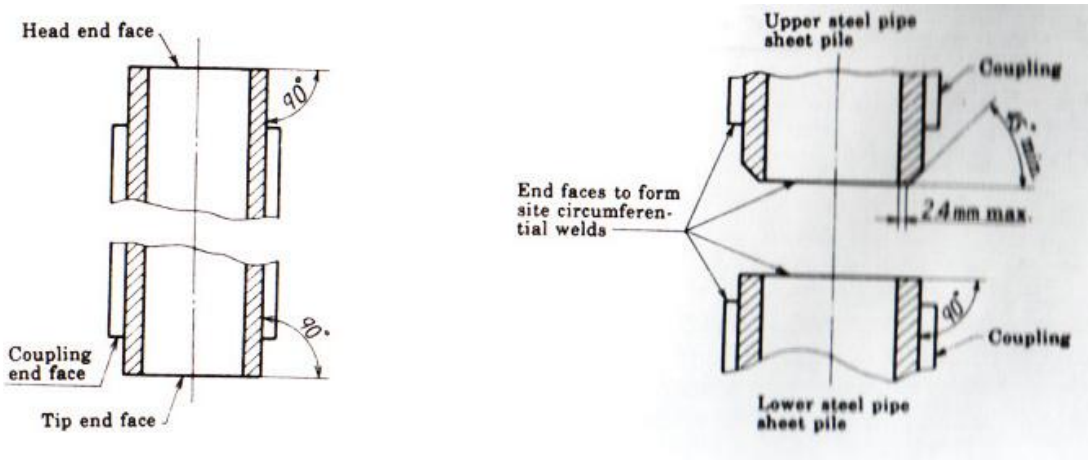


Fig 4. Shapes of both ends and site circumferential welds of steel pipe sheet piles

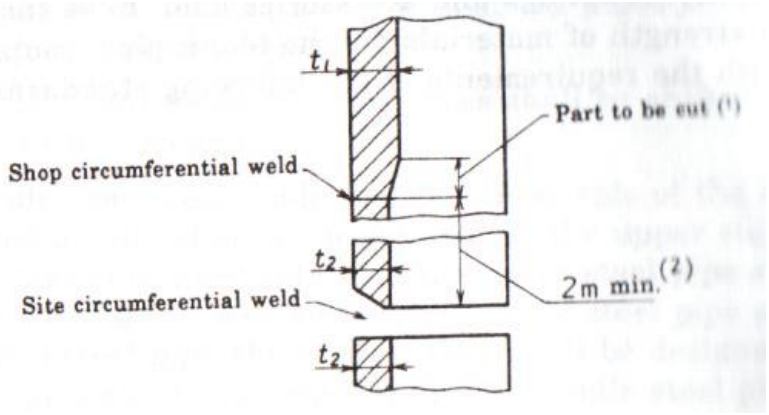


Fig. 5 Shape of circumferential welds of pipes different in thickness

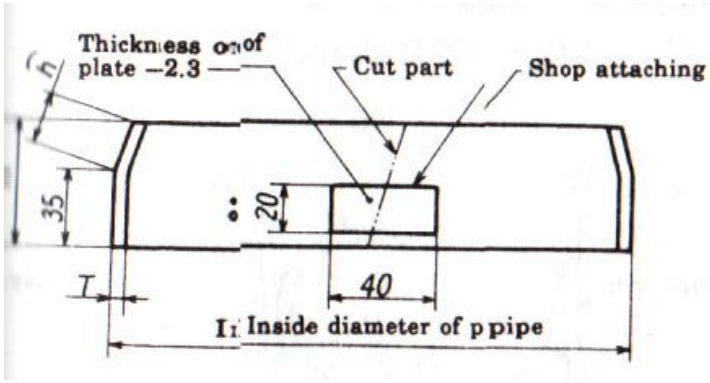
Note

(1) The length of cutting part inside the pipe shall be more than 4 (t1-t2). However, when t1-t2 is not more than 2 mm, or when t1-t2 is not more than 3 mm in the case of both side welding of the shop circumferential welds, the cutting is not required.

(2) The length of blank pipe at the time of shop circumferential welds shall be not less than 2 m as a rule.

(2) Unless otherwise specified, the shape and dimensions of the backing ring used for the backing strip of the site circumferential weld of the steel pipe bodies and the dimensions of stoppers attached to the lower steel pipe sheet pile shall be as shown in Fig 6.

(1) Backing ring Unit: mm

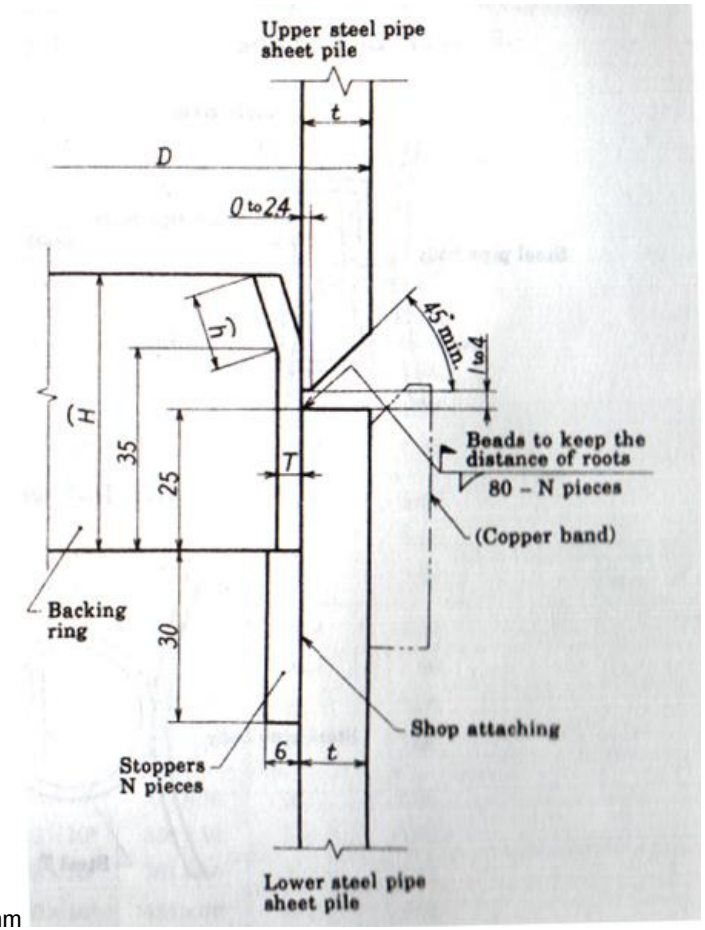


Thickness and height of backing ring

Outer diameter *D*	*T*		

1016 or under	4.5	50	T =50 in the case of 15
Over 1016	6.0	70, 50(3)	T =70 in the case of 35

Note (3) 50 mm shall be applied in the case of pile installation by inner excavation.



(2) Backing ring and stopper Unit: mm

Number of stoppers

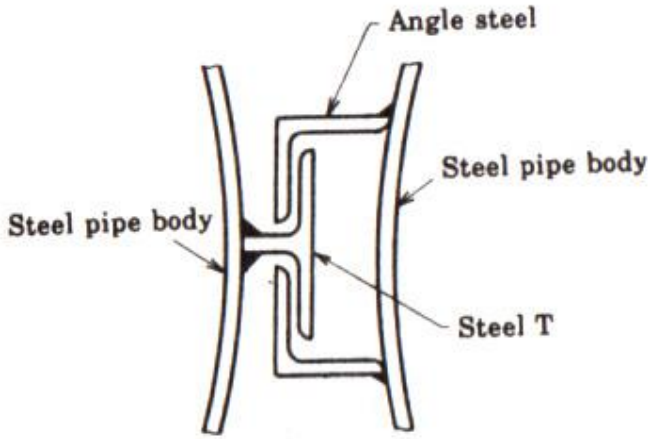
Outside diameter *D mm*	*Number of pieces N*

609.6 or under	4
Over 609.6 up to and incl. 1016	6
Over 1016	8

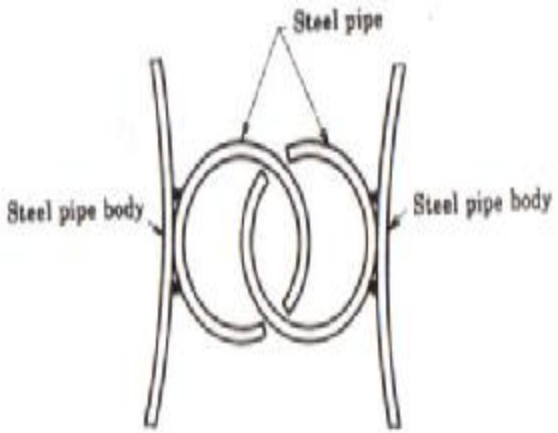
Fig. 6.

(3) Unless otherwise specified, the shapes of the coupling and the connection coupling of the steel pipe sheet piles shall be as shown in Fig. 7

(1) L-T Shape



(2) P-P Shape



(3) P-T Shape

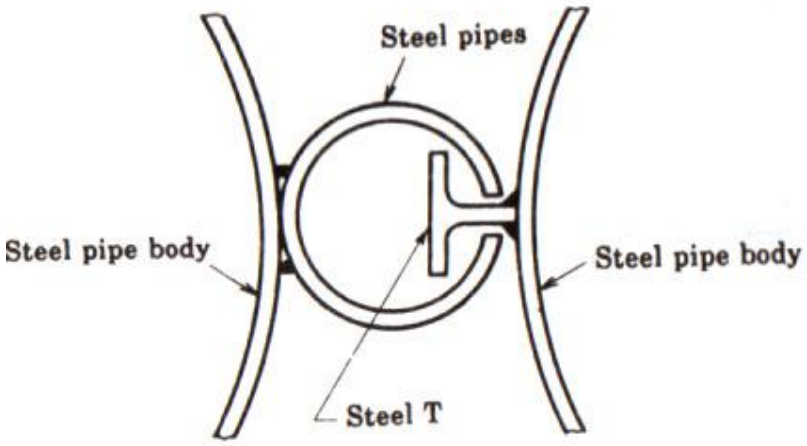


Fig. 7.Shapes of coupling and connecting coupling

8.2 Dimensions and mass of steel pipe body

The dimensions and mass of steel pipe body shall be as follows:

8.2.1 Unless otherwise specified, the outside diameter, thickness, cross-cross-sectional area and mass of the steel pipe body shall be as specified in Table 4.

Table 4 Dimensions and mass

Outside diameterDmm	Thicknesstmm	Cross sectional areaA P	Unit massWkg/m	Reference			
				Geometrical moment of inertial P	Section modulus Z P	Radius of gyration of areai cm	Outside surface aream^2/m
500	91214	138.8184.0213.8	109 144 168	418 】 10^2 548 】 10^2 632 】 10^2	167 】 10 219 】 10 253 】 10	17.4 17.3 17.2	1.57 1.57 1.57
508.0	9 12 147	141.1 187.0 217.3	111 147 171	439 】 10^2 575 】 10^2 663 】 10^2	173 】 10 227 】 10 261 】 10	17.6 17.5 17.5	1.60 1.60 1.60
600	9 12 14 16	167.1 221.7 257.7 293.6	131 174 202 230	730 】 10^2 958 】 10^2 111 】 10^3 125 】 10^3	243 】 10 319 】 10 369 】 10 417 】 10	20.9 20.8 20.7 20.7	1.88 1.88 1.88 1.88

609.6	9	169.8	133	766] 10^3	251] 10	21.2	1.92
	12	225.3	177	101] 10^3	330] 10	21.1	1.92
	14	262.0	206	116] 10^3	381] 10	21.1	1.92
	16	298.4	234	132] 10^3	431] 10	21.0	1.92
700	9	195.4	153	117] 10^3	333] 10	24.4	2.20
	12	259.4	204	154] 10^3	439] 10	24.3	2.20
	14	301.7	237	178] 10^3	507] 10	24.3	2.20
	16	343.8	270	201] 10^3	575] 10	24.2	2.20
711.2	9	198.5	156	122] 10^3	344] 10	24.8	2.23
	12	263.6	207	161] 10^3	453] 10	24.7	2.23
	14	306.6	241	186] 10^3	524] 10	24.7	2.23
	16	349.4	274	211] 10^3	594] 10	24.6	2.23
800	9	223.6	176	175] 10^3	437] 10	28.0	2.51
	12	297.1	233	231] 10^3	577] 10	27.9	2.51
	14	345.7	271	267] 10^3	668] 10	27.8	2.51
	16	394.1	309	303] 10^3	757] 10	27.7	2.51
812.8	9	227.2	178	184] 10^3	452] 10	28.4	2.55
	12	301.9	237	242] 10^3	596] 10	28.3	2.55
	14	351.3	276	280] 10^3	690] 10	28.2	2.55
	16	400.5	314	318] 10^3	782] 10	28.2	2.55
900	12	334.8	263	330] 10^3	733] 10	31.4	2.83
	14	389.7	306	382] 10^3	850] 10	31.3	2.83
	16	444.3	349	434] 10^3	965] 10	31.3	2.83
	19	525.9	413	510] 10^3	133] 10	31.2	2.83
914.4	12	340.2	267	546] 10^3	758] 10	31.9	2.87
	14	396.0	311	401] 10^3	878] 10	31.8	2.87
	16	451.6	354	456] 10^3	997] 10	31.8	2.87
	19	534.5	420	536] 10^3	117] 10	31.7	2.87
1 000	12	372.5	292	455] 10^3	909] 10	34.9	3.14
	14	433.7	340	527] 10^3	105] 10^2	34.9	3.14
	16	494.6	388	599] 10^3	120] 10^2	34.8	3.14

	19	585.6	460	705] 10^3	141] 10^2	34.7	3.14
1 016.0	12	378.5	297	477] 10^3	939] 10^2	35.5	3.19
	14	440.7	346	553] 10^3	109] 10^2	35.4	3.19
	16	502.7	395	628] 10^3	124] 10^2	35.4	3.19
	19	595.1	467	740] 10^3	146] 10^2	35.3	3.19
1 100	14	477.9	375	704] 10^3	128] 10^2	38.4	3.46
	16	544.9	428	800] 10^3	146] 10^2	38.3	3.46
	19	645.3	506	943] 10^3	171] 10^2	38.2	3.46
1 117.6	14	485.4	381	739] 10^3	132] 10^2	39.0	3.51
	16	553.7	435	840] 10^3	150] 10^2	39.0	3.51
	19	665.8	515	990] 10^3	177] 10^2	38.8	3.51
1 200	14	521.6	409	917] 10^3	153] 10^2	41.9	3.77
	16	595.1	467	104] 10^4	174] 10^2	41.9	3.77
	19	704.9	553	123] 10^4	205] 10^2	41.8	3.77
	22	814.2	639	141] 10^4	235] 10^2	41.7	3.77
1 219.2	14	530.1	416	963] 10^4	158] 10^2	42.6	3.83
	16	604.8	475	109] 10^4	180] 10^2	42.5	3.83
	19	716.4	562	129] 10^4	212] 10^2	42.4	3.83
	22	827.4	650	148] 10^4	243] 10^2	42.3	3.83
1 300	16	645.4	507	133] 10^4	205] 10^2	45.4	4.08
	19	764.6	600	157] 10^4	241] 10^2	45.3	4.08
	22	883.3	693	180] 10^4	278] 10^2	45.2	4.08
1 320.8	16	655.9	515	140] 10^4	211] 10^2	46.1	4.15
	19	777.0	610	165] 10^4	249] 10^2	46.0	4.15
	22	897.7	705	189] 10^4	287] 10^2	45.9	4.15
1 400	16	695.7	546	167] 10^4	238] 10^2	48.9	4.40
	19	824.3	647	197] 10^4	281] 10^2	48.8	4.40
	22	952.4	748	226] 10^4	323] 10^2	48.7	4.40
1 422.4	16	706.9	555	175] 10^4	246] 10^2	49.7	4.47
	19	837.7	658	206] 10^4	290] 10^2	49.6	4.47
	22	967.9	760	237] 10^4	334] 10^2	49.5	4.47

1 500	19	884.0	694	242] 10^4	323] 10^2	52.4	4.71
	22	1 021.5	602	279] 10^4	372] 10^2	52.3	4.71
	25	1 158.5	909	315] 10^4	420] 10^2	52.2	4.71
1 524.0	19	898.3	705	254] 10^4	334] 10^2	53.2	4.79
	22	1 038.1	815	293] 10^4	384] 10^2	53.1	4.79
	25	1 177.3	924	331] 10^4	434] 10^2	53.0	4.79
1 600	19	943.7	741	295] 10^4	369] 10^2	55.9	5.03
	22	1 090.6	856	340] 10^4	424] 10^2	55.8	5.03
	25	1 237.0	971	384] 10^4	480] 10^2	55.7	5.03
1 625.6	19	959.0	753	309] 10^4	381] 10^2	56.8	5.11
	22	1 108.3	870	356] 10^4	438] 10^2	56.7	5.11
	25	1 257.1	987	403] 10^4	495] 10^2	56.6	5.11
1 800	22	1 228.9	965	486] 10^4	540] 10^2	62.9	5.65
	25	1 394.1	1 094	549] 10^4	610] 10^2	62.8	5.65
2 000	22	1 367.1	1 073	669] 10^4	669] 10^2	69.9	6.28
	25	1 551.2	1 218	756] 10^4	756] 10^2	69.8	6.28

Remark

1. The numerical value of mass is calculated from the following formula taking steel as 7.85 g per cm^3 and rounding off to three significant figures (four significant figures for 1000kg/m or over) in accordance with JIS Z 8401.

$$W = 0.02466t(D - t)$$

Where W : unit mass of pipe Ц/m

t : thickness of pipe mm

D : outside diameter of pipe mm

2. This dimensions and mass other than the relevant column in Table 4 shall be in parties concerned, in advance.

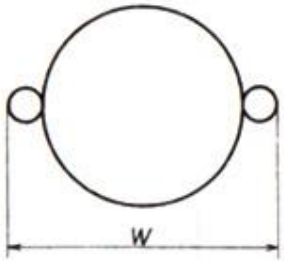
8.2.2 The length of the steel pipe body shall be not less than 6m as a rule and be graduated in 0.5m.

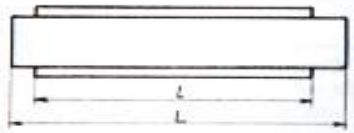
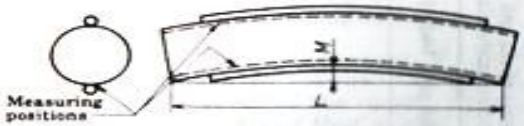
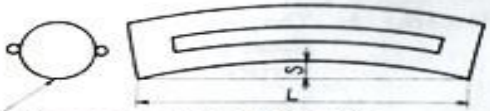
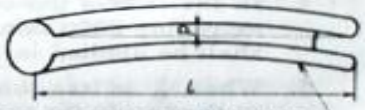
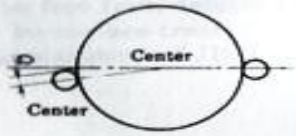
8.3 Shapes and dimensional tolerances of steel pipe sheet piles

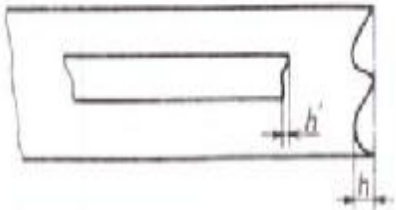
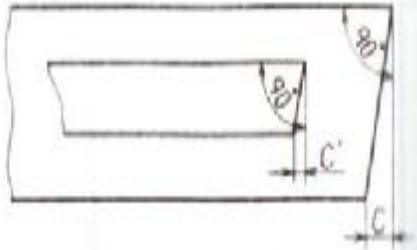
The shapes and dimensional tolerances of steel pipe sheet piles sheet piles shall be as follows:

8.3.1 The shapes and dimensional tolerances of the steel pipe sheet piles shall be as specified in Table 5.

Table 5. Shapes and dimensional tolerances

Division			Tolerance	Remarks
Outside diameter (D)	End part of pipe		± 0.5 %	Outside diameter (D) = length of outside circumference ÷ π
Width (W)	$\frac{t}{D}$ 1.1 % to and excluding 1.5 %		± 2.0 %	
	$\frac{t}{D}$ 1.5 % or over		± 1.5 %	
Thickness (t)	Thickness under 16 mm	Outside diameter 500 mm or over	+ Not specified	—
		Outside diameter under 800 mm	− 0.7 mm	
		Outside diameter 800 mm or over	+ Not specified	
		Outside diameter 2000 mm or under	− 0.8 mm	
	Thickness 16 mm or over	Outside diameter 500 mm or over	+ Not specified	
		Outside diameter under 800 mm	− 0.8 mm	
		Outside diameter 800 mm or over	+ Not specified	
		Outside diameter 2000 mm or under	− 1.0 mm	

Division		Tolerance	Remarks
Length	Steel pipe body (L)	+ Not specified 0	
	Coupling (l)		
Flexure (M)	—	Within 0.1 % of length of steel pipe body (L)	 The measuring position shall be either on the concave or the convex side near the coupling.
Camber (S)	—	Within 0.1 % of length of steel pipe body (L)	 The measuring position shall be either on the concave or the convex side.
Straightness (P) of the opening of coupling	Length of coupling (l) 15 m or under	10 mm max.	 The measuring position shall be either on the concave or the convex side. Coupling
	Length of coupling (l) over 15 m	Within $\frac{1}{1500}$ of length of coupling (l)	
Attaching position of coupling (Q)	Pipe end part	5 mm max.	

Division				Tolerance	Remarks
Flatness of the end face to form the shop circumferential weld	Steel pipe body (h)			2 mm max.	
	Coupling (h')				
Perpendicularity of the end face to form the site circumferential weld	Steel pipe body (C)	Outside diameter 1000 mm or under	Length of steel pipe body 18 m or under	Within 0.5 % of outside diameter, but maximum 3 mm	
			Over 18 m	Within 0.5 % of outside diameter, but maximum 4 mm	
		Outside diameter over 1000 mm			
	Coupling (C')			2 mm max.	

Remark

1. The flexure shall be taken in the direction parallel to the steel pipe sheet pile wall and the camber shall be taken in the direction vertical to the steel pipe sheet pile wall.
2. The outside diameter and the thickness shall be measured of the steel pipe body

3. Although Fig. 2, 3, 4 and figures in Remarks of Table 5 are illustrated by the P-P type, the same principle likewise applies to the other shapes of couplings, as appropriate.

4. In the case of the outside diameter less than 500 mm and that exceeding 2000 mm, the agreement between the parties concerned shall be applied in advance.

5. When t/D is less than 1.1%, the reinforcing band shall be +-2.0%. The dimension of reinforcing band shall be given on the basis of Fig. 8.

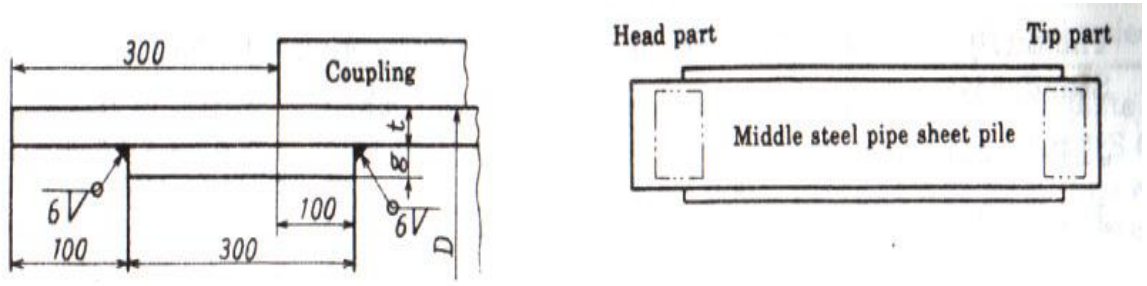


Fig.8 Reinforcing band to prevent deformation

8.3.2 The allowable value of the dislocation to appear on the exterior of the steel pipe bodies of the steel pipe sheet piles connected on site (hereafter referred to as "dislocation of the site circumferential welds") shall be as specified in Table 6.

Table 6. Allowable values of dislocation of site circumferential welds

Outside diameter	Alloyable	Remarks
500mm or over to and excl. 700mm	2mm max	Indicate the difference between the outside circumference of the upper steel pipe sheet pile and that of the lower steel pipe sheet pile, with the upper limit of 2 mm 】
700mm or over up to and incl. 1016mm	3mmmax	Indicate the difference between the outside circumference of the upper steel pipe sheet pile and that of the lower steel pipe sheet pile, with the upper limit of 3mm 】
Over 1016mm up to and incl. 2000mm	4mm max	Indicate the difference between the outside circumference of the upper steel pipe sheet pile and that of the lower steel pipe sheet pile, with the upper limit of 4mm 】

Remarks

1.The steel pipe sheet pile less than 500 mm, exceeding 2000 mm in outside diameter and t/D being less than 1.1% shall be agreed upon previously between the parties concerned.

2. Where it is necessary to preliminarily decide the combinations of part or all of steel pipe sheet piles to conform to the allowable values, the steel pipe sheet piles to combined shall be individually marked with numbers or symbols ro ward off errors during site works.

9. Appearance

The steel pipe sheet pile shall be free from defects harmful to use. However, external defects harmful to use may be surface-treated in accordance with 9. (Appearance) of JIS G 3192 and (Appearance) of JIS G 3193.

10. Test

10.1 Analysis test The analysis test shall be as follows:

(1) General items and sampling method for the analysis test shall be as specified in 3.(Chemical composition) of JIS G 0303

(2) The analysis method shall e in accordance with one of the following Standards:

JIS G 1211

JIS G 1212

JIS G 1213

JIS G 1214

JIS G 1215

JIS G 1253

JIS G 1256

JIS G 1257

10.2 Tensile test

10.2.1 Test piece The test piece shall be as follows:

(1) The test piece for the tensile test shall be No.5 test piece specified in JIS Z 2201 and the sampling method shall be in accordance with either of the following:

(a) Cut off the test piece from the pipe or he steel strip or steel plate to be used for the pipe in the case of the pipes formed other than by expanding.

(b) Cut off the test piece from the pipe which is to be formed by expanding

(2) The weld tensile test piece of arc welded steel pipe shall be No. 1 test piece specified in JIS Z 3121 which is cut off from the specimen of the end of the pipe welded under the same condition as the pipe or the pipe body.

10.2.2 Test method The test method shall be as specified in JIS Z 2241

10.2.3 Number of test pieces The method of sampling specimens and the number of test pieces shall be as specified in Table 7.

Table 7. Sampling of specimens and number of test pieces

Division	Method of sampling specimens and the number of test pieces
In the case of taking specimens from steel pipe	Take on specimen from each length of 1250 m or its fraction of the same dimensions ([4]) and take one tensile test piece and one weld tensile test piece or one flattening test piece from this specimen.
In the case of taking specimens for tensile test from steel plate or steel strip	Sampling the specimens for tensile test for the steel plate of the steel strip shall be in accordance with Class A in JIS G 0303. In the case of steel plate, take one test piece from each lot of the same heat and the maximum thickness not more than twice the minimum thickness. However, from each lot exceeding 50t, take two test pieces. In the case of steel strip, take one test piece from each lot of the same heat and thickness. However, from each lot exceeding 0 t, take two test pieces.
In the case of taking weld tensile test pieces from specimen welded under the	Take on specimen from each quantity equivalent to 1250m or its fraction of pipe of the same dimensions ([4]) and take one weld tensile test piece from this specimen

specimen welded under the same conditions as steel pipe body	

Note ([4]) "The same dimensions" means the same outside diameter combined with the same thickness

10.3 Flattening test

10.3.1 Test piece

Cut off a length of not less than 50mm from the end of the electric-resistance welded steel pipe to serve as flattening test piece.

10.3.2 Test method

The flattening test shall be carried out as follows. Place the test piece between two flattening plates at ordinary temperature, compress it until the distance of the flattening plates becomes the specified value and examine for the existence or nonexistence of flaws or cracks on the pile walls. Put the seam weld at right angles to the pressing direction as shown in Fig 9.

10.3.3 Number of test pieces The method of sampling specimens and the number of test pieces shall be as specified in Table 7..

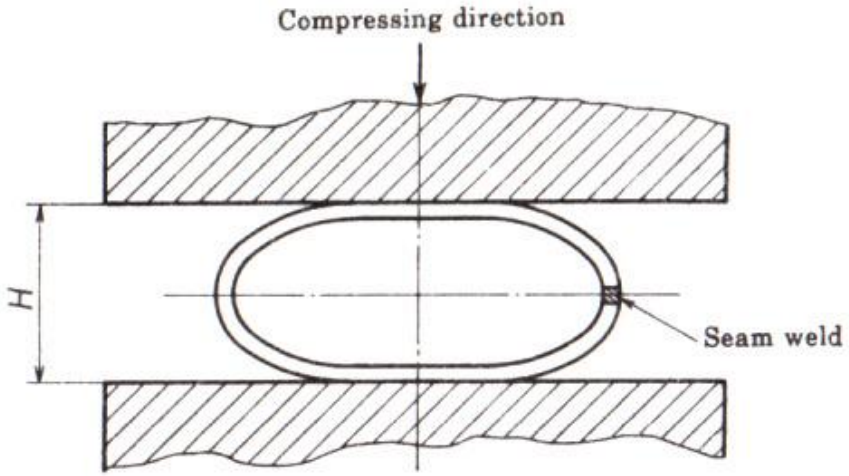


Fig. 9

11. Inspection

11.1 Inspection The inspection shall be as follows:

(1) General matters of inspection shall be as specified in JIS G 0303

(2) The inspection of shape, dimensions and appearance of the steel pipe sheet pile shall be carried out for each pile as a rule and the results shall comply with the requirements of 3. (2), 8 and 9.

(3) The chemical composition and mechanical properties of the blank pipe shall comply with the requirements of 4. and 5.

(4) The purchaser may specify a nondestructive examination of the shop circumferential welds

The criteria of acceptance for the examination shall be preliminarily agreed upon by the parties concerned with acceptance.

11.2 Reinspection

A retest specified in 4.4(Retest) of JIS G 0303 may be conduced for final acceptance.

12. Marking

The steel pipe sheet pile having passed the inspection shall be indelibly marked with the following items. However, the order of arranging the items is not specified

(1) Symbol for class

(2) Manufacturer's mane or identifying brand

(3) Manufacture number

(4) Dimensions (outside diameter, thickness and length)

13. Report

The manufacturer shall submit the inspection certificate and the table of dimension inspection result (one for every ten or its fraction) to the purchaser.

Further, where the specifications in Remarks of Table 2 is invoked, the content of added elements shall elements shall be noted in the inspection certificate.

Attached Table 1. Applicable standards

JIS G 0303	General rules for inspection of steel
JIS G 1211	Methods for determination of carbon in iron and steel
JIS G 1212	Methods for determination of silicon in iron and steel
JIS G 1213	Methods for determination of manganese in iron and steel
JIS G 1214	Methods for determination of phosphorus in iron and steel
JIS G 1215	Methods for determination of sulfur in iron and steel
JIS G 1253	Method for photoelectric emission spectrochemical analysis of iron and steel
JIS G 1256	Method for X-ray fluorescence spectrometric analysis of iron and steel
JIS G 1257	Iron and steel - Methods for atomic absorption spectrometric analysis
JIS G 3101	Rolled steel for general structure
JIS G 3192	Dimensions, mass and permissible variations of hot rolled steel sections
JIS G 3193	Dimensions, mass and permissible variations of hot rolled steel plates, sheets and strip

JIS G 3444	Carbon steel tubes for general structural purposes
JIS G 2201	Test pieces for tensile test for metallic materials
JIS Z 2241	Method of tensile test for metallic materials
JIS Z 3121	Methods of tensile test for butt welded joints
JIS Z 3211	Covered electrodes for mild steel
JIS Z 3212	Covered electrodes for high tensile strength steel
JIS Z 3312	MAG welding solid wires for mild steel and high steel
JIS Z 3313	Flux cored wires for gas shielded and self- shielded metal arc welding of mild steel, high strength steel and low temperature service steel
JIS Z 3351	Flux cored wires for gas shielded and self-shielded metal arc welding of mild steel, high strength steel and low temperature service steel