Boilers, etc.

Amended Rules and Guidance

Rules for the Survey and Construction of Steel Ships Part D
Rules for High Speed Craft
Rules for the Survey and Construction of Inland Waterway Ships
Guidance for the Survey and Construction of Steel Ships Part D

Reason for Amendment

The requirements for boilers specified in Chapter 9, Part D of the Rules for the Survey and Construction of Steel Ships were originally adopted in 1984. Although they have been amended as necessary over the years since then, they have never been fundamentally reviewed.

Therefore, as a part of comprehensive review of the Rules for the Survey and Construction of Steel Ships, we conducted a survey on the needs of boiler manufacturers was carried out to ascertain the appropriateness of the existing requirements. The responses received as a result of this survey indicated that some clarification was desired regarding these requirements and their corresponding application.

Accordingly, relevant requirements were amended in consideration of the operational experience and new knowledge gained since 1984 as well as a better understanding of the current needs of relevant industries with respect to boilers.

Outline of Amendment

The main contents of this amendment are as follows:

(1) Amended relevant requirements to clarify their application.
(2) Amended the definition of the term “fittings” to clarify its scope.
(3) Amended relevant requirements to clarify that verification results of structural analysis by FEM were acceptable for approval purposes in cases where it is difficult to calculate structural strength because boilers are of an unusual shape.
(4) Amended the scantling plans used in the formulae for the required diameters of diagonal stays for clarification purposes.

"Rules for the survey and construction of steel ships" has been partly amended as follows:

Part D MACHINERY INSTALLATIONS

Chapter 9 BOILERS, ETC. AND INCINERATORS

9.1 General

Paragraph 9.1.1 has been amended as follows.

9.1.1 Scope

1 The requirements in this chapter apply to ~~boilers excluding those given in the following **(1)** and **(2)**, thermal oil heaters and incinerators:~~ the following.

(1) Boilers (excluding the following **(a)** and **(b)**)

(~~1~~a) Steam boilers with a design pressure not exceeding 0.1 *MPa* and heating surface not exceeding 1 m^2

(~~2~~b) Hot water boilers with a design pressure not exceeding 0.1 *MPa* and heating surface not exceeding 8 m^2

(2) Thermal oil heaters

(3) Incinerators

2 The requirements in **9.11** may be applied to the boilers referred to in the preceding **-1(1)** with a design pressure not exceeding 0.35 *MPa* (hereinafter referred to as "small boilers").

Paragraph 9.1.2 has been amended as follows.

9.1.2 Terminology

Terms used in this Part are defined as follows:

(1) "Boilers" are plants which generate steam or hot water by means of flame, combustion gases or other hot gases and include superheaters, reheaters, economizers and exhaust gas economizers, etc.

(2) "Main boiler" means boilers which supply steam to steam turbines used for the main propulsion of ships.

(~~2~~3) "Essential auxiliary boilers" are boilers which supply steam necessary for the operation of auxiliary machinery essential for main propulsion, auxiliary machinery for manoeuvring and safety as well as for generators.

(~~3~~4) "Exhaust gas boilers" are boilers which generates steam or hot water using only exhaust gases from reciprocating internal combustion engines, have independent steam spaces or hot wells and have outlets for steam or hot water.

(~~4~~5) "Exhaust gas economizers" are those equipment which generates steam or hot water using only exhaust gases from reciprocating internal combustion engines and do not have independent steam spaces or hot wells.

(~~5~~6) "Heating surfaces of boilers" are those areas calculated on combustion gas side surfaces where one side is exposed to combustion gas and the other side to water. Unless specified otherwise, the heating surfaces of superheaters, reheaters, economizers or exhaust gas economizers are excluded.

(~~6~~7) "Approved working pressures of boilers" and "nominal pressure of boilers with built-in superheaters" are as defined in **2.1.21** and **2.1.22, Part A**.

(~~7~~8) "Design pressures" are those pressure used in the calculations made to determine the scantlings of each component and are the maximum permissible working pressure of a component. Design pressures of boiler drums are not to be less than the approved working pressure of their respective boilers.

(9) "Fittings" are items directly attached (i.e. welded) to boilers (e.g. nozzles) as well as items not directly attached but connected to the boilers (e.g. valve boxes (including safety valves) and water level gauges) that receive pressure.

(10) "End plates" means the plates that cover both ends of the shell.

(11) "Tube plates" means end plates to which smoke tubes are attached in the case of smoke tube boilers, or end plates to which water tubes are attached in the case of water tube boilers.

Paragraph 9.1.3 has been amended as follows.

9.1.3 Drawings and Data to be Submitted*

Drawings and data to be submitted are generally as follows:

(1) Drawings (with materials and scantlings)

((a) to (k) are omitted.)

(2) Data

(a) Particulars of the boiler (design pressure, design temperature, maximum evaporation, heating surface, etc.)

((b) to (d) are omitted.)

9.3 Design Requirements

9.3.4 Boilers of Unusual Shape*

Sub-paragraph -1 has been amended as follows.

1 In cases where it is not practicable or reasonable to calculate the strength or to reinforce of the pressure receiving part of the boiler according to the requirements in **9.5** to **9.7** because the part is of an unusual shape, ~~another detailed method of~~ calculation results by another detailed method or analysis results as deemed appropriate by the Society ~~is~~ are to be used after receiving the approval of the Society. Based on the results of such~~this~~ calculation or analysis, the part may be considered to be in compliance with the requirements in **9.5** to **9.7**.

Paragraph 9.3.7 has been amended as follows.

9.3.7 Consideration for Soot Fire*

Consideration is to be given to prevent exhaust gas boilers and exhaust gas economizers, from being damaged by a soot fire.

9.5 Calculations of Required Dimensions of Each Member

Paragraph 9.5.5 has been amended as follows.

9.5.5 Required Thickness of Flat End Plates and Cover Plates, etc., without Stays or Other Supports

1 In cases where the flat end plates and cover plates without stays or other supports are welded to the shell plates, the required thickness is to be calculated by the following formulae:

(1) Circular plates

$$T_r = C_1 d \sqrt{\frac{P}{f}} + 1$$

(2) Non-circular plates

$$T_r = C_1 C_2 d \sqrt{\frac{P}{f}} + 1$$

where

C_1 : Constant shown in **Fig. D9.~~9~~11**

$C_2 = \sqrt{3.4 - 2.4\frac{d}{D'}}$, but need not be over 1.6.

d : Diameter shown in **Fig. D9.~~9~~11** (for circular plates), or the minimum length (for non-circular plates) (*mm*)

D' : Long span of non-circular end plates or covers measured perpendicular to the short span (*mm*)

2 In cases where the flat cover plates without stays are bolted to the shell plate, the required thickness is to be calculated by the following formulae:

(1) In cases where full face gaskets are used;

For circular plates

$$T_r = d \sqrt{\frac{C_3 P}{f}} + 1$$

For non-circular plates

$$T_r = d \sqrt{\frac{C_3 C_4 P}{f}} + 1$$

(2) In cases where moment due to gasket reaction is to be taken into account;

For circular plates

$$T_r = d \sqrt{\frac{C_3 P}{f} + \frac{1.78 W h_g}{f d^3}} + 1$$

For non-circular plates

$$T_r = d \sqrt{\frac{C_3 C_4 P}{f} + \frac{6 W h_g}{f L d^2}} + 1$$

where

C_3 : Constant determined by bolting methods as shown in **Fig. D9.1~~0~~1**

C_4 : $3.4 - 2.4\frac{d}{D'}$, but need not be over 2.5.

d : Diameter shown in **Fig. D9.1~~0~~2** (for circular plates), or minimum length (for non-circular plates) (*mm*)

D' : Long span of non-circular end plates or covers measured perpendicular to the short span (*mm*)

W : Mean load (*N*) of bolt loads necessary for the watertightness and allowable load of the bolt actually used

L : Total length of the circle passing through bolt centers (*mm*)

h_g : Arm length of moment due to the gasket reaction shown in **Fig. D9.1~~0~~2** (*mm*)

9.5.6 Required Thickness of Flat Plates with Stays or Other Supports*

Sub-paragraph -1 has been amended as follows.

1 The required thickness of flat plates, except tube nests supported by stays or stay tubes, is to be calculated by the following formula. In cases where gusset plates are used as supports instead of stays or stay tubes, they are to comply with standards deemed appropriate by the Society.

$$T_r = C_5 S \sqrt{\frac{P}{f}} + 1$$

where

C_5 : Constant determined by the fixing methods of the stays or stay tubes as given in **Table D9.3**. In cases where various fixing methods are used, the value C_5 is to be the mean of the constants for the respective methods.

S : In cases where the stays or stay tubes are arranged regularly, "*S*" is to be calculated by the following formula:

$$S = \sqrt{a^2 + b^2}(mm)$$

a : Horizontal pitch of stays or stay tubes (*mm*)

b : Vertical pitch of stays or stay tubes (*mm*).

In cases where stays or stay tubes are arranged irregularly, "*S*" is the diameter (*mm*) of the maximum circle drawn to pass through at least three supported points, but not including any supported point in the circle. However, in cases where the maximum circle drawn passes through only two supported points and there are no supported points located within the circle, the diameter (*mm*) of the maximum circle may be used as "*S*".

Paragraph 9.5.11 has been amended as follows.

9.5.11 Required Thickness of Furnace Foundation Ring Plates of Vertical Boilers

The required thickness of a furnace foundation ring plate (refer to **Fig. D9.~~9~~11(d)**(4)E) connecting the furnace bottom of a vertical boiler to the shell is to be calculated by the following formula:

$$T_r = 1.28\sqrt{DP}$$

where

D : Inside diameter of the shell (*mm*)

Paragraph 9.5.12 has been amended as follows.

9.5.12 Required Diameter of Stays*

1 The required diameter of a stay is to be calculated by the following formula:

$$d = C\sqrt{PA} + 3$$

where

d : Required diameter of the stay (*mm*)

A : Net area supported by one stay (mm^2)

C : 0.13

2 In applying the formula in **-1** to diagonal stays, *C* in the formula is to be replaced by C_1 given by the following formula:

$$C_1 = 0.13\sqrt{\frac{L}{H}}$$

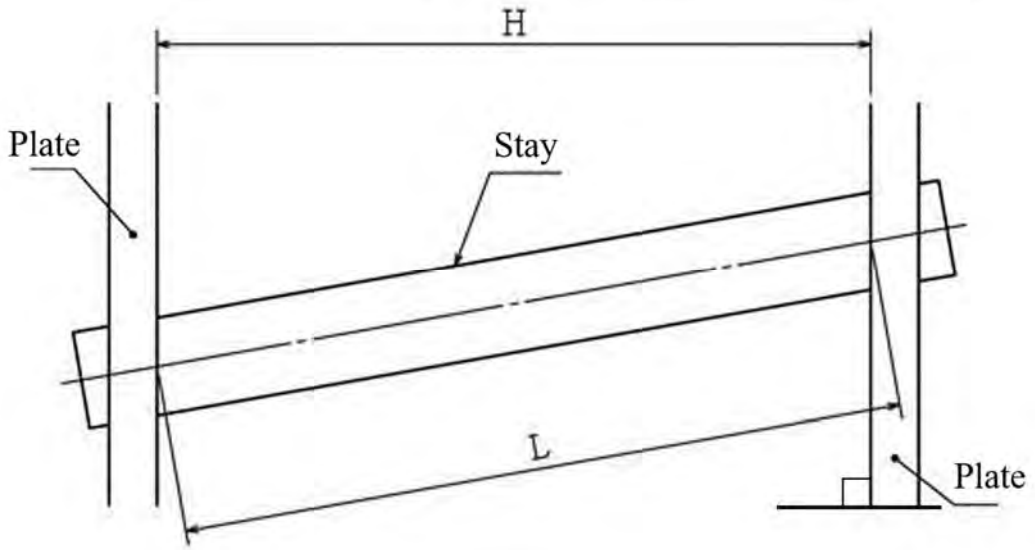
where

L : Length of the diagonal stay (*mm*) (refer to **Fig. D9.7**)

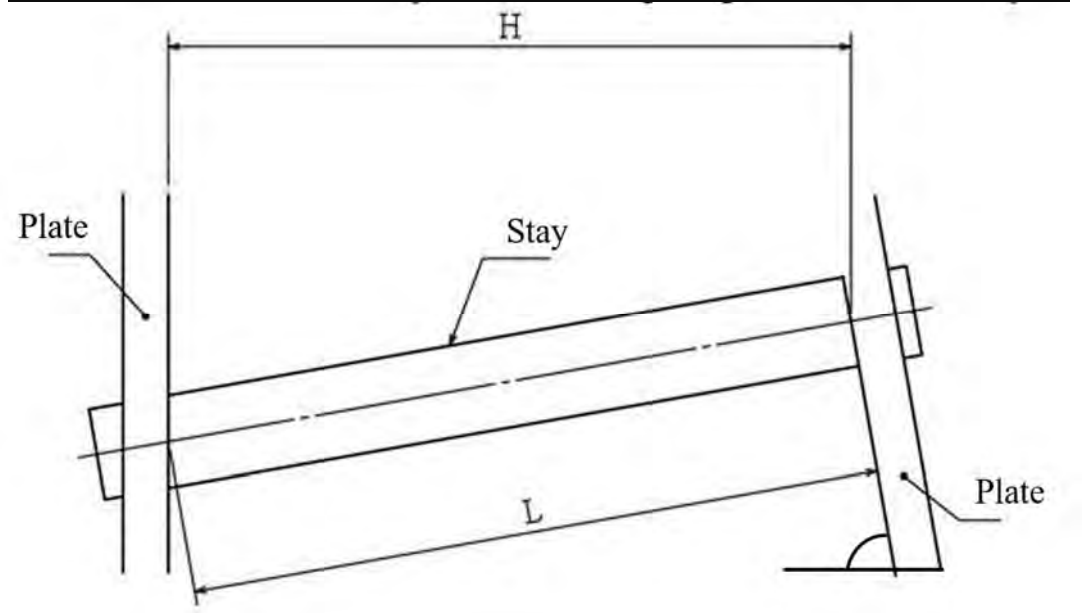
H : Equivalent length of the stays perpendicular to the support surface (*mm*) (refer to **Fig. D9.7**)

Fig. D9.7 Corresponding Parts of L and H

(In cases where the ends of the plates are at right angles to the installation part)



(In cases where the ends of the plates are not at right angles to the installation part)



9.6 Manholes, Other Openings for Nozzles, etc. and their Reinforcements

Paragraph 9.6.1 has been amended as follows.

9.6.1 Manholes, Cleaning Holes and Inspection Holes*

1 Boilers are to be provided with manholes or cleaning holes of sufficient size at suitable positions, so that they permit easy access for the inspection and the maintenance. However, in cases where it is impractical to provide manholes or cleaning holes due to construction or dimension concerns, two or more inspection holes provided at positions suitable for internal inspection will be accepted as a substitute for them.

2 The construction of all manholes or cleaning holes is to comply with the following requirements in **(1)** to **(3)**:

(1) The minor axis of any oval manhole provided on the shell plate is to be parallel to the longitudinal direction of the drum.

(2) Internal type manhole covers are to be provided with a spigot which has a clearance of not more than 1.5 *mm* all-round.

(3) Covers are to have sufficient strength and be constructed so that the repetition of covering and uncovering does not to impair safety. In cases where covers are bolted shut, they are to be of such construction so that the breakage of a bolt will not cause any danger.

3 The inspection holes of headers are to be machine-finished so that all inspection hole covers can be effectively fitted.

4 In cases where flange openings on boiler drums are used as inspection holes, the pipes to be connected are to be ones that can be easily removed.

Paragraph 9.6.2 has been amended as follows.

9.6.2 Reinforcement of Openings

In cases where manholes, other openings for nozzles, etc. are provided in the shell, the openings are to be reinforced. However, this reinforcement may be omitted for any of the following single openings:

(1) Openings having a maximum diameter (in threaded openings, the diameter of the root) of not more than 60 *mm* or more than 1/4 of the inside diameter of the shell.

(2) Openings provided on the shell plate having a maximum diameter not exceeding the value given in **Fig. D9.~~7~~8**. In this case, unreinforced openings are not to exceed 200 *mm* in diameter.

(3) Openings provided on the end plate where no reinforcement is required due to the increased thickness of the end plates in compliance with the requirements in **9.5.3-2(3)**.

(4) Openings provided on the end plate or cover plate where the thickness of the end plate or cover plate is increased in accordance with the requirements in **9.6.3-3(2)**.

Fig. D9.~~7~~8 Maximum Diameter of Openings provided on the Shell for which Reinforcement may be Omitted
(Omitted)

Paragraph 9.6.3 has been amended as follows.

9.6.3 Reinforcing Procedures of Openings

1 (Omitted)

2 (Omitted)

3 In cases where flat end plates or cover plates specified in **9.5.5** have openings, they are to comply with the following:

(1) In cases where flat end plates or cover plates have openings with a diameter not exceeding one-

half of the diameter for the circular plates or the minimum length (*d* shown in **Fig. D9.~~9~~11** and **Fig. D9.1~~0~~2**) for non-circular plates, the end plates or cover plates are to have a total cross sectional area of reinforcement not less than that calculated by the following formula:

$A_0 = 0.5 d_0 T_0$

(2) In cases where flat end plates or cover plates have openings with a diameter exceeding one-half of the diameter for the circular plates or the minimum length (*d* shown in **Fig. D9.~~9~~11**and **Fig. D9.1~~0~~2**) for non-circular plates, the thickness of end plates or cover plates is to be 1.5 *times* the required thickness specified in **9.5.5** except for the corrosion allowance.

4 Reinforcement is to be provided within its effective limit. The effective limit of reinforcement is the range on a vertical plane to the wall containing the centre of the opening that is enclosed by two lines along the wall and also by two lines parallel to the axis of the opening. The lengths of the four lines are as follows: (*See* **Fig. D9.~~8~~9**)

(1) (Omitted)

(2) (Omitted)

5 (Omitted)

6 (Omitted)

7 (Omitted)

Fig. D9.~~8~~9 Effective Limit of Reinforcement
(Omitted)

9.7 Tubes

Paragraph 9.7.1 has been amended as follows.

9.7.1 Fitting of Tubes

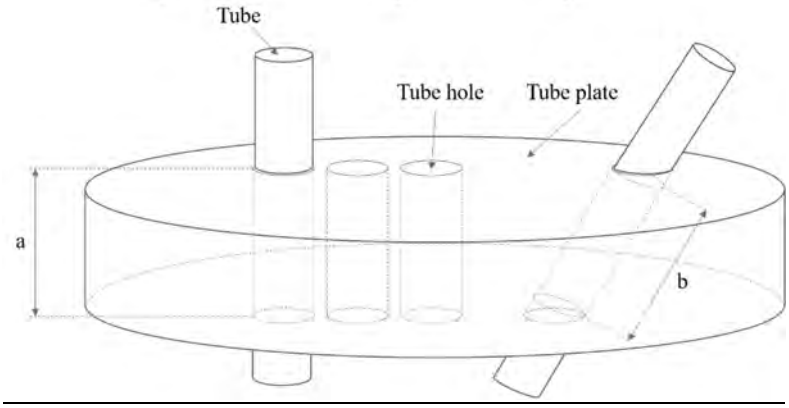
1 Tubes are to be attached to the tube plate by expanding or another suitable method and the tubes are to project through the neck or belt of the parallel seating by not less than 6 *mm*, except for those attached by welding. In cases where the tube end is fitted by welding, consideration is to be given for preventing the deformation (thermal ratchet effect) of tubes due to tube-to-tube differentials in thermal expansion.

2 In cases where water tubes are secured against being pulled out by means of bellmouthing only, the included angle of belling is to be not less than 30 *degrees*.

3 Tube holes are to be formed so that the tubes can be effectively tightened inside them. Where the tubes are practically normal to the tube plates, the parallel seating of the holes is not to be less than 10 *mm* in depth(a). Where the tubes are not normal to the tube plate, the depth of the holes perpendicular(b) to the tube plate is not to be less than 10 *mm* for tubes not exceeding 60 *mm* in outside diameter, and not to be less than 13 *mm* for tubes exceeding 60 *mm* in outside diameter. (refer to **Fig. D9.10**)

4 In horizontal smoke tube type vertical boilers, each alternate smoke tube in the outer vertical rows of tubes is to be a stay tube.

Fig. D9.10 Depth of Seating Tubes



9.8 Joints and Connection of Each Member

Paragraph 9.8.2 has been amended as follows.

9.8.2 Shapes of Joints and Connections

The shapes of welded joints and connections are to be as shown in **Fig. D9.~~9~~11**, or be of an equivalent shape that has been approved by the Society.

Paragraph 9.8.3 has been amended as follows.

9.8.3 Construction of Bolted Cover Plates

The construction of unstayed flat cover plates bolted to shells is to be as shown in **Fig. D9.1~~0~~2** or be of an equivalent construction that has been approved by the Society.

Fig. D9.9 has been amended as follows.

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case

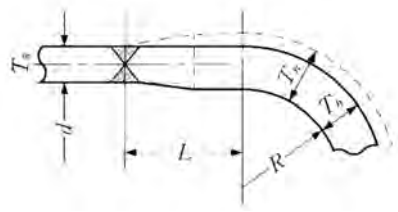
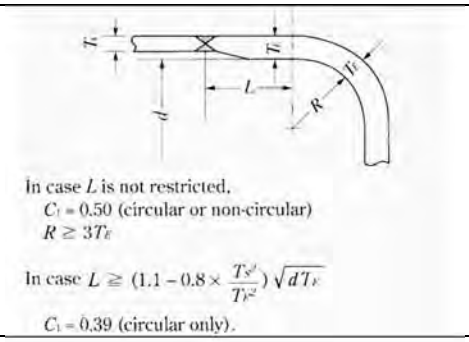
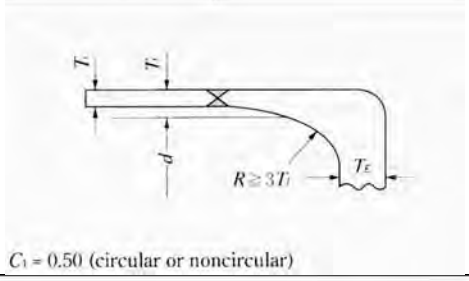
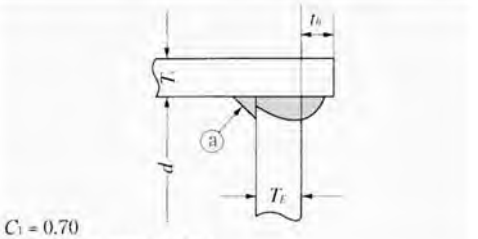
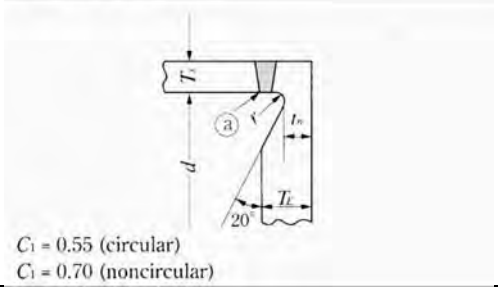
Welding part	Symbol	Welding mode and value of constant C_1	Remarks
(1) Welding joint between formed end plate and shell	*A*		L $\geq 3T_h$, but need not be more than 38 *mm* Where $T_h \leq 1.25T_s$, the above-mentioned value may be reduced.
(2) Welding joint between flat end plate or cover plate and shell	*A*	 In case L is not restricted, $C_1 = 0.50$ (circular or non-circular) $R \geq 3T_E$ In case $L \geq (1.1 - 0.8 \times \frac{T_s'}{T_s}) \sqrt{dT_E}$ $C_1 = 0.39$ (circular only).	
	B	 $C_1 = 0.50$ (circular or noncircular)	$T_f \geq 2T_s$
	C	 $C_1 = 0.70$ (circular or noncircular)	(1) $T_s \geq 1.25T_{ro}$ (2) $t_h \geq T_s$ (3) Where the welding of part ⓐ, is considered difficult, the backing strip is to be used or the welding process, which ensures a good penetration to the root, is to be employed.
	D	 $C_1 = 0.55$ (circular) $C_1 = 0.70$ (noncircular)	(1) $r \geq 0.2T_E$, but not less than 5 *mm* (2) $t_n \geq 1.25T_{ro}$ (3) In welding the part ⓐ, such a welding process as to have a good penetration to the root, is to be employed. (4) End plates or cover plates are to be made of forged steel

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case (continued)

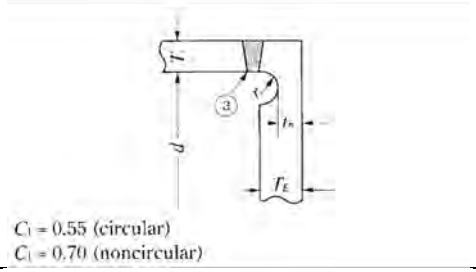
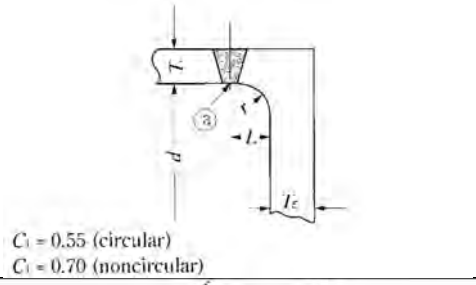
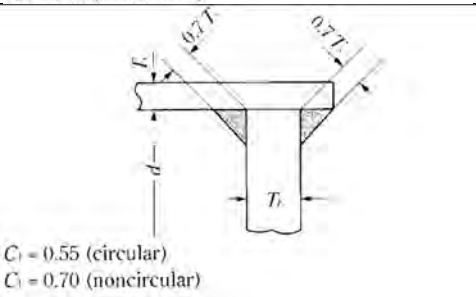
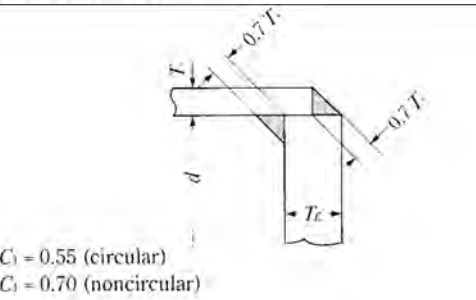
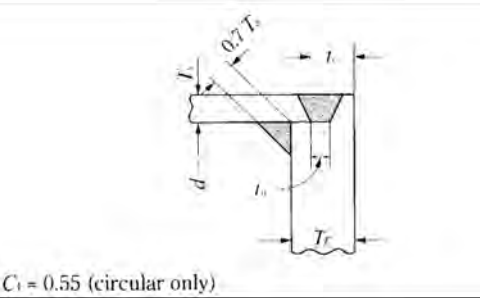
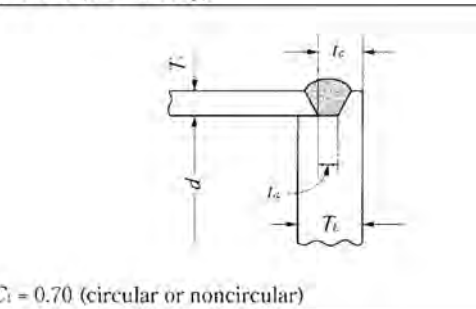
Welding part	Symbol	Welding mode and value of constant C_1	Remarks
(2) Welding joint between flat end plate or cover plate and shell	*E*	 $C_1 = 0.55$ (circular) $C_1 = 0.70$ (noncircular)	(1) $r \geq 0.2T_E$, but not less than 5 *mm* (2) $t_n \geq 1.25T_{ro}$ (3) In welding the part ⓐ, such a welding process as to have a good penetration to the root, is to be employed. (4) End plates or cover plates are to be made of forged steel.
	F	 $C_1 = 0.55$ (circular) $C_1 = 0.70$ (noncircular)	(1) $r \geq 0.3T_E$ (2) $L \geq T_E$ (3) For the part ⓐ, the same is required as above. (4) End plates or cover plates are to be made of forged steel.
	G	 $C_1 = 0.55$ (circular) $C_1 = 0.70$ (noncircular)	$T_s \geq 1.25T_{ro}$
	H	 $C_1 = 0.55$ (circular) $C_1 = 0.70$ (noncircular)	$T_s \geq 1.25T_{ro}$
	I	 $C_1 = 0.55$ (circular only)	(1) $T_s \geq 1.25T_{ro}$ (2) $t_a \geq T_s$, but need not be over 6.5 *mm*. (3) t_e is not be less than $2T_{ro}$ or $1.25T_s$, whichever is the greater.
	J	 $C_1 = 0.70$ (circular or noncircular)	(1) Tube headers only. (2) $T_s \geq 1.25T_{ro}$ (circular only) (3) $t_a \geq T_s$, but need not be over 6.5 *mm* (4) t_e is not be less than $2T_{ro}$ or $1.25T_s$, whichever is the greater.

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case (continued)

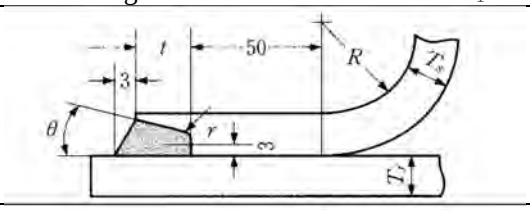
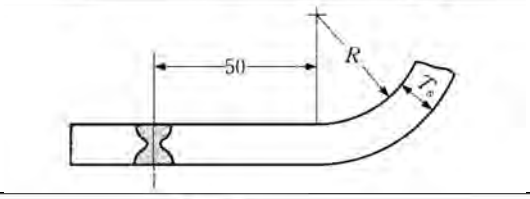
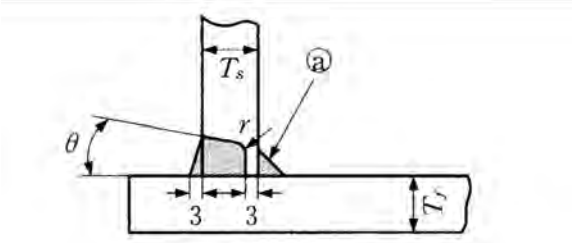
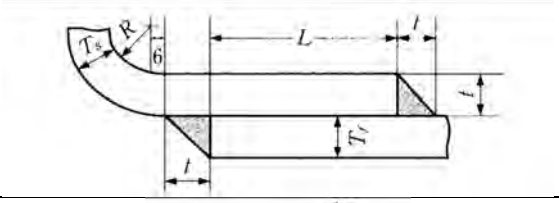
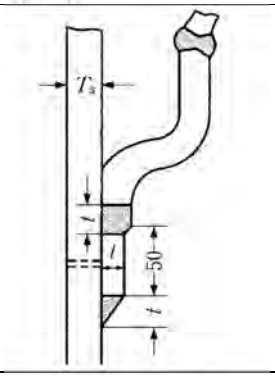
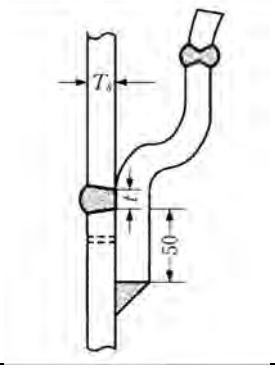
Welding part	Symbol	Welding mode and value of constant C_1	Remarks
(3) Welding joint between furnace and shell plate or end plate	*A*		(1) To be applied to welding joint on the front side of boiler. (2) $t \geq T_s - 3$ (3) θ ranges between 10°and 20° inclusive. (4) $10 \geq r \geq 5$
	B		
	C		(1) To be applied to welding joint on the front side of boiler. (2) The part ⓐ is to be of light fillet weld（throat thickness 4～6 *mm*）。 (3) θ ranges between 10°and 20° inclusive. (4) $10 \geq r \geq 5$
	D		(1) To be applied to welding joint on the front side of boiler. (2) $t \geq T_f$ (3) $L \geq 2T_s$
(4) Welding joint between ogee ring and shell plate	*A*		$t \geq T_s$
	B		$t \geq T_s$

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case (continued)

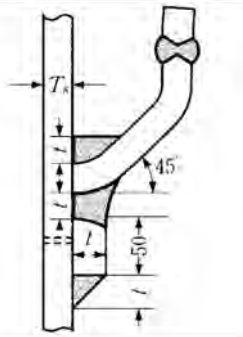
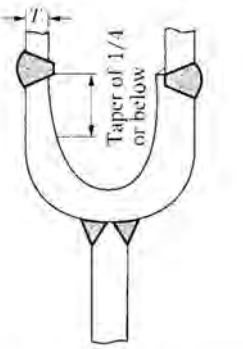
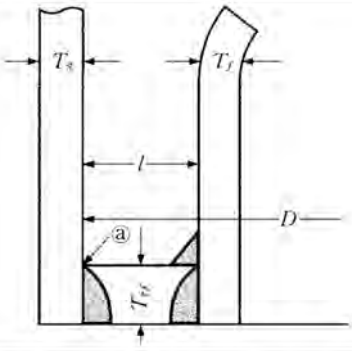
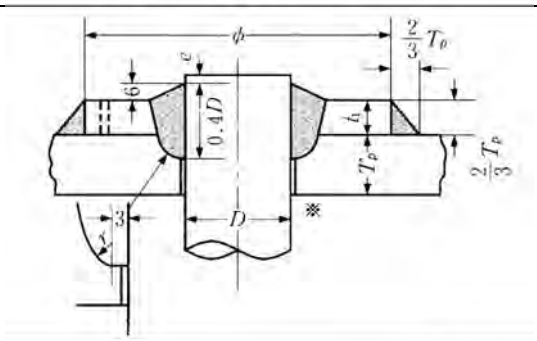
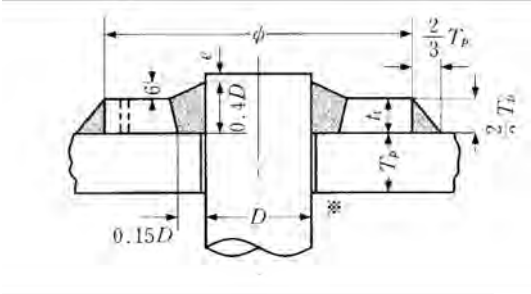
Welding part	Symbol	Welding mode and value of constant C_1	Remarks
(4) Welding joint between ogee ring and shell plate	*C*		$t \geq T_s$
	D		$t \geq T_s$
	E		(1) If $D \leq 750$, $l \geq 50$. If $D > 750$, $l \geq 60$. (2) In welding the part ⓐ, such a welding process as to have a good penetration to the root, is to be employed.
(5) Welding joint between stay and tube plate or end plate	*A*		(1) $\phi \geq \frac{2}{3}P$(P means the pitch of stays, hereinafter the same being referred) (2) $t_1 \geq \frac{2}{3}T_p$ (3) The part marked by ※ is to be applied with light fillet welding (root thickness, 4～6 *mm*) or caulking from the side of plate for filling the gap. (4) On the fire side, to be $e \leq 1.5$
	B		(1) $\frac{2}{3}P > \phi \geq 3.5D$ (2) $t_1 \geq \frac{2}{3}T_p$ (3) The part marked by ※ is to be same as above. (4) On the fire side, to be $e \leq 1.5$

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case (continued)

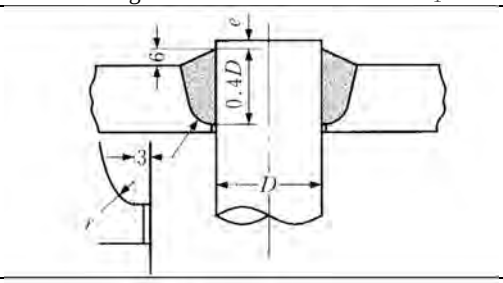
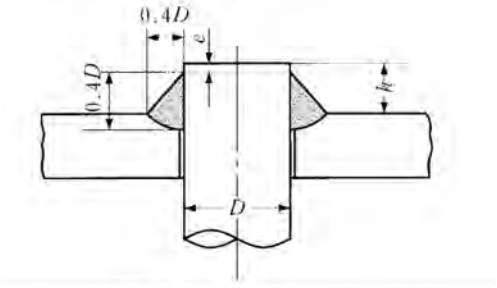
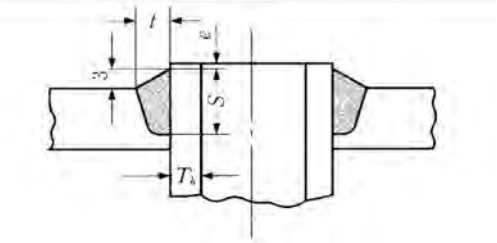
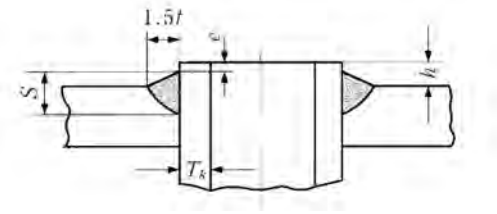
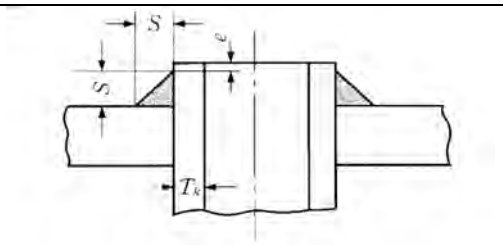
Welding part	Symbol	Welding mode and value of constant C_1	Remarks
(5) Welding joint between stay and tube plate or end plate	*C*		On the side exposed to flame, $e \leq 1.5$
	D		On the side exposed to flame, $h \leq 10$ and $e \leq 1.5$
(6) Welding joint between stay tube or tube and tube plate or end plate	*A*		(1) $t \geq T_k$ (2) $S \geq 2t$ (3) On the side exposed to flame, $e \leq 1.5$
	B		(1) $t \geq T_k$ (2) $S \geq 1.5t$ or $t + 3$ On the side exposed to flame, $h \leq 10$ and $e \leq 1.5$
	C		(1) $S \geq T_k + 3$ (2) ~~(To be welded after having tube expansion.~~ To conduct tube expansion either before or after welding. (3) On the side exposed to flame, $e \leq 1.5$

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case (continued)

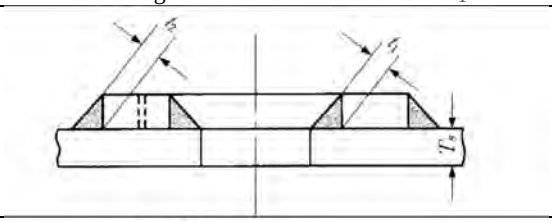
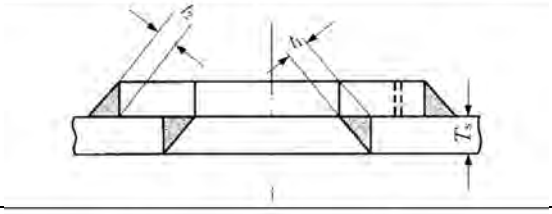
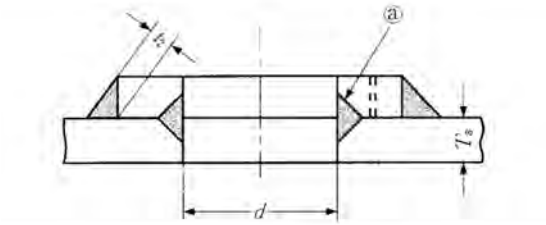
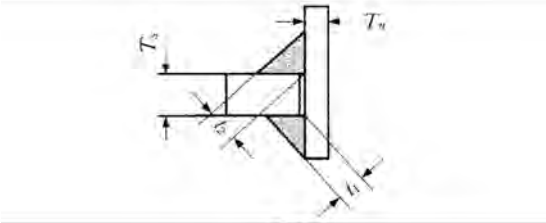
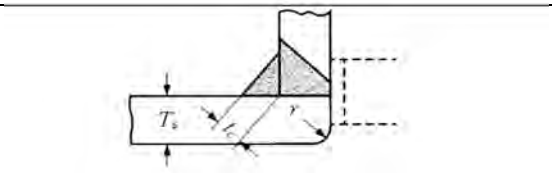
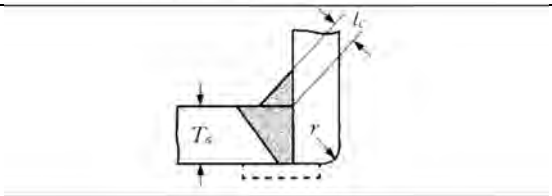
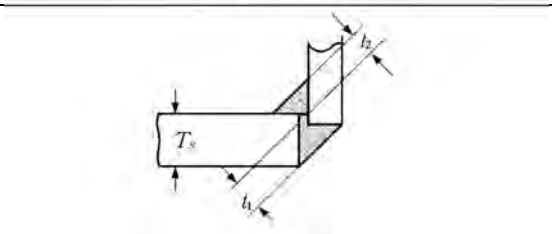
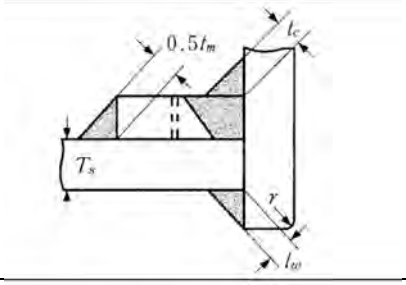
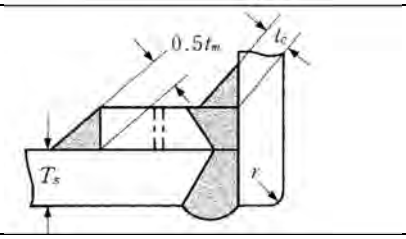
Welding part	Symbol	Welding mode and value of constant C_1	Remarks
(7) Welding joint between seat or reinforcement ring and shell plate or end plate	*A*		(1) $t_1 + t_2 \geq 1.25t_m$ (2) $t_1,\ t_2 \geq \frac{1}{3}t_m$ but the minimum is 6.5 *mm*
	B		
	C		(1) To be applicable only for the case of $d < 60$. (2) $t_2 \geq 0.7t_m$ (3) The part ⓐ is to be welded for stopping leakage.
(8) Welding joint between nozzle and shell plate or end plate	*A*		(1) $t_c \geq 6.5$ or $0.7t_m$, whichever is the smaller (2) $t_1 + t_2 \geq 1.25t_m$ (3) $t_1,\ t_2 \geq \frac{1}{3}t_m$, ~~but the minimum is 6.5 *mm*~~: 6.5 *mm* or $0.7t_m$ whichever is the smaller.
	B		
	C		(1) $t_c \geq 6.5$ or $0.7t_m$, whichever is the smaller (2) $t_1 + t_2 \geq 1.25t_m$ (3) $t_1,\ t_2 \geq \frac{1}{3}t_m$, ~~but the minimum is 6.5 *mm*~~: 6.5 *mm* or $0.7t_m$ whichever is the smaller.
	D		

Fig. D9.~~9~~11 Examples of Welded Joints Approved for Each Case (continued)

Welding port	Symbol	Welding mode and value of constant C_1	Remarks
(8) Welding joint between nozzle and shell plate or end plate	*E*		(1) $t_c \geq 6.5$ or $0.7t_m$, whichever is the smaller (2) $t_1 + t_2 \geq 1.25t_m$ (3) t_1, $t_2 \geq$ ~~$\frac{1}{2} t_m$, but the minimum is 6.5 *mm*~~: 6.5 *mm* or $0.7t_m$ whichever is the smaller. (4) $t_w \geq 0.7t_m$
	F		

Notes:

1. Constant C_1 is the value used for the formula in **9.5.5**.
2. The dimensions of welded parts are their minimum values.
3. The unit of all values in the figures is in *mm*.
4. The definitions of the symbols used in the figures are as Follows (units: *mm*):

T_s : Actual thickness of the shell plate
T_h : Actual thickness of the formed end plate
T_E : Actual thickness of the flat end plate or cover plate
T_{ro} : Required thickness of the seamless shell
T_p : Actual thickness of the tube plate or flat end plate (formed end plate)
T_{rf} : Required thickness of the furnace foundation ring plate
T_k : Actual thickness of the stay tube or tube
T_n : Actual thickness of the nozzle
t_m : Smaller value of the thickness of plates to be welded, but the maximum value is 20 *mm*.

Fig. D9.10 has been renumbered to Fig. D9.12.

Fig. D9.1~~0~~2 Examples of Bolting Covers and End Plates
(Omitted)

9.10 Tests

9.10.1 Shop Tests*

Sub-paragraph -2 has been amended as follows.

2 Boilers are to be subjected to hydrostatic tests at a pressure of 1.5 *times* the design pressure for boilers and at a pressure of 2 *times* the design pressure for boiler fittings that are not directly welded to boilers.

9.11 Construction etc. of Small Size Boilers

Paragraph 9.11.1 has been amended as follows.

9.11.1 General

Notwithstanding the requirements in **9.2** to **9.10**, the requirements in **9.11** may be applied to boilers with a design pressure that does not exceed 0.35 *MPa* ~~(hereinafter referred to as the "small boilers")~~.

Chapter 10 PRESSURE VESSELS

10.9 Tests

10.9.1 Shop Tests*

Sub-paragraph -2 has been amended as follows.

2 Pressure vessels and their fittings are to be subjected to hydrostatic tests according to the following requirements after being manufactured:

(1) (Omitted)

(2) Fittings of pressure vessels

The fittings ~~of~~ <u>that are not directly welded to</u> pressure vessels of Group I and Group II are to be subjected to hydrostatic tests at a pressure equal to 2 *times* their design pressure.

(3) (Omitted)

“Rules for high speed craft” has been partly amended as follows:

Part 9 MACHINERY INSTALLATIONS

Chapter 6 BOILERS, THERMAL OIL HEATERS, INCINERATORS AND PRESSURE VESSELS

6.1 Boilers

Paragraph 6.1.1 has been amended as follows.

6.1.1 Drawings and Data

Drawings and data to be submitted are generally as follows:

(1) Drawings (with materials and scantlings)

((a) to (k) are omitted.)

(2) Data

(a) Particulars of the boiler (design pressure, design temperature, maximum evaporation, heating surface, etc.)

((b) and (c) are omitted.)

"Rules for the survey and construction of inland waterway ships" has been partly amended as follows:

Part 7 MACHINERY INSTALLATIONS

Chapter 7 BOILERS, ETC. AND INCINERATORS

7.1 General

Paragraph 7.1.1 has been amended as follows.

7.1.1 Scope

1 The requirements in this chapter apply to ~~boilers excluding those given in the following **(1)** and **(2)**, thermal oil heaters and incinerators:~~ the following.

(1) Boilers (excluding the following **(a)** and **(b)**)

(~~1~~a) Steam boilers with a design pressure not exceeding 0.1 *MPa* and heating surface not exceeding 1 m^2

(~~2~~b) Hot water boilers with a design pressure not exceeding 0.1 *MPa* and heating surface not exceeding 8 m^2

(2) Thermal oil heaters

(3) Incinerators

2 The requirements in **7.2** may be applied to the boilers referred to in the preceding **-1(1)** with a design pressure not exceeding 0.35 *MPa* (hereinafter referred to as "small boilers").

Paragraph 7.1.2 has been amended as follows.

7.1.2 Terminology

Terms used in this Part are defined as follows:

(1) "Boilers" are plants which generate steam or hot water by means of flame, combustion gases or other hot gases and include superheaters, reheaters, economizers and exhaust gas economizers, etc.

(2) "Main boiler" means boilers which supply steam to steam turbines used for the main propulsion of ships.

(~~2~~3) "Essential auxiliary boilers" are boilers which supply steam necessary for the operation of auxiliary machinery essential for main propulsion, auxiliary machinery for manoeuvring and safety as well as for generators.

(~~3~~4) "Exhaust gas boilers" are boilers which generates steam or hot water using only exhaust gases from reciprocating internal combustion engines, have independent steam spaces or hot wells and have outlets for steam or hot water.

(~~4~~5) "Exhaust gas economizers" are those equipment which generates steam or hot water using only exhaust gases from reciprocating internal combustion engines and do not have independent steam spaces or hot wells.

(~~5~~6) "Heating surfaces of boilers" are those areas calculated on combustion gas side surfaces where one side is exposed to combustion gas and the other side to water. Unless specified otherwise, the heating surfaces of superheaters, reheaters, economizers or exhaust gas economizers are excluded.

(~~6~~7) "Approved working pressures of boilers" and "nominal pressure of boilers with built-in superheaters" are as defined in **2.1.21** and **2.1.22, Part A**.

(~~7~~8) "Design pressures" are those pressure used in the calculations made to determine the scantlings of each component and are the maximum permissible working pressure of a component. Design pressures of boiler drums are not to be less than the approved working pressure of their respective boilers.

(9) "Fittings" are items directly attached (i.e. welded) to boilers (e.g. nozzles) as well as items not directly attached but connected to boilers (e.g. valve boxes (including safety valves) and water level gauges) that receive pressure.

(10) "End plates" means the plates that cover both ends of the shells.

(11) "Tube plates" means end plates to which the smoke tubes are attached in the case of smoke tube boilers, or end plates to which the water tubes are attached in the case of water tube boilers.

Paragraph 7.1.3 has been amended as follows.

7.1.3 Drawings and Data to be Submitted*

Drawings and data to be submitted are generally as follows:

(1) Drawings (with materials and scantlings)

((a) to (k) are omitted.)

(2) Data

(a) Particulars of the boiler (design pressure, design temperature, maximum steam evaporation, heating surface, etc.)

((b) to (d) are omitted.)

7.2 Construction etc. of Boilers

7.2.1 General

Sub-paragraph -1 has been amended as follows.

1 Boilers with design pressures that do not exceed 0.35 *MPa* ~~(hereinafter referred to as the "small boilers") are to~~may be compl~~y~~ied with the requirements specified in **7.2.2** and **7.2.3**.

"Guidance for the survey and construction of steel ships" has been partly amended as follows:

Part D MACHINERY INSTALLATIONS

D9 BOILERS, ETC. AND INCINERATORS

D9.2 Materials and Welding

Paragraph D9.2.1 has been amended as follows.

D9.2.1 Materials

1 The pressure parts of boilers in **9.2.1-1, Part D of the Rules** which are required to use materials complying with the requirements given in **Part K of the Rules**, include all those shown in **Fig. D9.2.1-1** such as: nozzles welded to the boiler drum, manhole rings, stiffeners (except for those used for screwing fittings), flanges attached to nozzles (except for those used for connecting piping), manhole covers, cleaning hole covers, inspection hole covers, etc.

2 The boiler fittings "whose dimensions and conditions of service have been approved by the Society" referred to in **9.2.1-2, Part D of the Rules** means the fittings specified in **D1.1.4.** In addition, the wording "standards recognized by the Society" referred to in **9.2.1-2, Part D of the Rules** means national or international standards such as *JIS*.

Section D9.3 has been added as follows.

D9.3 Design Requirements

D9.3.4 Boilers of Unusual Shape

The "analysis results as deemed appropriate by the Society" specified in **9.3.4, Part D of the Rules** means structural strength analysis by a strength assessment such as FEM.

D9.3.7 Consideration for Soot Fire

The "consideration" specified in **9.3.4, Part D of the Rules** means (but is not limited to) arrangements for soot cleaning such as the soot blowers with cleaning holes.

D9.5 Calculations of Required Dimensions of Each Member

Paragraph D9.5.6 has been amended as follows.

D9.5.6 Required Thickness of Flat Plates with Stays or Other Supports

1 (Omitted)

2 The standards "deemed appropriate the Society" specified in **9.5.6-1, Part D of the Rules** means national or international standards such as *JIS*.

~~**2**~~**3** (Omitted)

Section D9.11 has been added as follows.

D9.11 Construction etc. of Small Size Boilers

D9.11.2 Materials, Construction, Strength and Accessories of Small Boilers

The wording “recognized standard” referred to in **9.11.2-1, Part D of the Rules** means the requirements of national or international standards such as *JIS*.