表 I1

焊接下列钢级的焊接材料	拉力试验				冲击试验	
	全熔质			对接焊缝		
	R_m 最小值 N/mm^2	R_{eH} [1] 最小值 N/mm^2	A_5 最小值 %	R_m 最小值, N/mm^2	温度 ℃	最小平均值 KV,J
NV1.5Ni	420	275	25	420	-95	34
NV3.5Ni	440	345		440	-115	
NV5Ni	570	390		570	-140	
NV9Ni	640	490		660	-196	

1) 在无明显屈服点的情况下，应将 0.2 % 条件屈服强度（$R_{p0.2}$）的值列入报告.

I 300 年度试验

301 根据所用的是焊条、焊丝/焊剂配合或焊丝/气体配合焊接，应分别按 B900、C400 或 E600 的规定进行试验. 但是，试验结果应符合表 I1 规定的要求.

I 400 其他焊接材料

401 屈服应力和/或抗拉强度低于 300 规定的焊接材料可允许用于 NV 9Ni 级钢的焊接，认可试验应按上述规定的方案进行. 这时焊接物的最大许用应力应以认可试验中取得的机械性能数据作为基础确定.

J. 焊接超高强度钢的焊接材料

J 100 一般要求

101 根据冲击试验温度，超高强度钢用焊接材料应分成下列等级:

— 3/Ⅲ级，试验温度为 - 20 ℃

— 4/Ⅳ级，试验温度为 - 40 ℃

— 5/V 级，试验温度为 - 60 ℃

应在等级符号后添加下列符号以表示焊接材料拟适用的母体金属的屈服强度.

在等级符号后添加的符号	母体材料的牌号
Y 42	NV 420
Y 46	NY 460
Y 50	NV 500
Y 55	NV 550
Y 62	NV 620
Y 69	NV 690

每一种较高质量级焊接材料所焊的钢种包括比他低一级（或一些级）焊接材料所焊的钢种. 按第 2 篇第 2 章第 1 节的 A …和 D …级钢应采用质量等级至少为 3/Ⅲ的焊接材料，E …级钢应采用至少为 4/Ⅳ的焊接材料，F …级钢应采用质量等级至少为 5/V 的焊接材料，如下表所示:

焊接材料等级	所包含的钢级
3/Ⅲ Y … 4/Ⅳ Y … 5/VY	D …和 A … E …，D …和 A … F …，E …，D …和 A …

已认可的… Y42、… Y46 和… Y50 级焊接材料也允许用于焊接低于已认可用钢级两个强度等级的钢. 已认可的… Y55、… Y62 和… Y69 级焊接材料也允许用于焊接低于已认可用钢级的强度等级的钢.

本社可以在个别情况下限制应用范围，以使对任一强度级的认可不得随意用于对任何其他强度等级的认可.

102 全熔质试验和对接焊缝试验应全部按 B（药皮焊条）、C（焊丝/焊剂配合）或 E（焊丝/气体配合）以及 200 规定的附加要求进行.

103 屈服强度 Y50 组及其以下各组的药皮焊条均应符合至少对后缀为 H15 级的测氢试验要求. 屈服强度从 Y55 至且包括 Y69 的药皮焊条应符合对后缀为 H5 的测氢试验要求.

制造厂商可自行决定是否将其药芯焊丝或药皮焊丝进行测氢试验，并在其等级符号后添加（H10）或（H5）.

104 对接焊缝试件用的板厚通常应在 11mm 和 20mm 之间. 如所用的板厚小于 11mm，则有关冲击吸收能量的要求应由本社根据每种情况确定.

J 200 附加要求

201 全熔质试验应按下述要求进行:

试样:

应从每一块试件上机加工制备一个纵向拉力试样和至少三个冲击试样.

试验要求:

纵向拉力试验和冲击试验的结果应符合表 J1 规定的要求.

202 对接焊缝试验应按下述要求进行:

试样:

应从每块试件上机加工制备一个横向拉力试样、两个横向弯曲试样（正面和反弯）以及至少三个冲击试样.

如熔敷金属的成份和机械性能明显地不同于母体金属的成份和性能时，则可采用纵向弯曲试样替代两个横向弯曲试样. 如这样做时，则应进行一个正弯和一个反弯试验.

纵向弯曲试样的尺寸如下:

长度: 最小值为 150mm

宽度: 38mm

厚度: 10mm

应清除焊缝加强，反弯和正弯试样应进行机加工，使之达到要

required thickness is obtained. The edges of the specimens may be rounded to a radius not exceeding 2 mm.

203 The following requirements are to be met:

The test results are all to comply with the requirements given in Table J2. The position of fracture in the transverse tensile test specimen is to be reported. The bend test specimens are to be bent through an angle of 120° over a former having a diameter which relates to the thickness of the test specimen as given in Table J2. The bend test specimens can be considered as complying with the requirements if, after bending, no crack or other open defect exceeding 3 mm in dimensions can be seen on the outer surface.

Table J1 All-weld-metal test requirements

Grade	*Tensile test*			*Impact test*	
	R_m, *N/mm²*	R_{eH}, *minimum, N/mm²*	A_5, *minimum, %*	*Temperature °C*	*KV, J, minimum average* [1]
3/III Y42 4/IV Y42 5/V Y42	530—680	420	20	—20 —40 —60	47 47 47
3/III Y46 4/IV Y46 5/V Y46	570—720	460	20	—20 —40 —60	47 47 47
3/III Y50 4/IV Y50 5/V Y50	610—770	500	18	—20 —40 —60	47 47 47
3/III Y55 4/IV Y55 5/V Y55	670—830	550	18	—20 —40 —60	55 55 55
3/III Y62 4/IV Y62 5/V Y62	720—890	620	18	—20 —40 —60	62 62 62
3/III Y69 4/IV Y69 5/V Y69	770—940	690	17	—20 —40 —60	69 69 69

1) For requirements regarding minimum individual values and retests, see A700 and A900, respectively.

Table J2 Butt weld test requirements

Grade	*Tensile test*	*Impact test*		*Bend ratio*
	R_m, *N/mm²*	*Temperature °C.*	*KV, J, minimum average*	*D/t* [1]
3/III Y42 4/IV Y42 5/V Y42	530-680	-20 -40 -60	47 47 47	4
3/III Y46 4/IV Y46 5/V Y46	570-720	-20 -40 -60	47 47 47	4
3/III Y50 4/IV Y50 5/V Y50	610-770	-20 -40 -60	50 50 50	4
3/III Y55 4/IV Y55 5/V Y55	670-830	-20 -40 -60	55 55 55	5
3/III Y62 4/IV Y62 5/V Y62	720-890	-20 -40 -60	62 62 62	5
3III Y69 4/IV Y69 5/V Y69	770-940	-20 -40 -60	69 69 69	5

1) D = mandrel diameter, t = specimen thickness.

The chemical analysis of the deposited weld metal in each test assembly is to be supplied by the manufacturer and is to include the content of all significant alloying elements.

J 300 Annual tests

301 Depending on whether it concerns electrodes, wire/flux combination or wire/gas combinations, the testing is to be carried out according to that prescribed in B900, C400 or E600, respectively. The test results are, however, to comply with the requirements given in Table J1.

K. Welding Consumables for Welding of Austenitic Stainless Steels

K 100 General

101 Approval of welding consumables for austenitic stainless steels will be considered subject to compliance with the specified tests and requirements in 200 to 500.

求的厚度. 试样的边缘应加工成半径不超过 2mm 的圆角.

203 应满足下列要求:

试验结果应全部符合表 J2 规定的要求. 横向拉力试样的断裂位置应列入报告; 弯曲试样应在直径相当于试样厚度倍数如 J2 中规定的心轴上弯曲 120°. 在试样弯曲后, 其凸起的一面上未出现有尺寸超过 3mm 的裂纹或其他开放性缺陷, 则视为符合要求.

表 J1 全熔质试验要求

等级	拉力试验			冲击试验	
	R_m, N/mm^2	R_{eH} 最小值 N/mm^2	A_5 最小值%	温度 ℃	最小平均值 KV,J [1]
3/III Y42 4/IV Y42 5/VY42	530 - 680	420	20	- 20 - 40 - 60	47 47 47
3/III Y46 4/IV Y46 5/VY46	570 - 720	460	20	- 20 - 40 - 60	47 47 47
3/III Y50 4/IV Y50 5/VY50	610 - 770	500	18	- 20 - 40 - 60	47 47 47
3/III Y55 4/IV Y55 5/VY55	670 - 830	550	18	- 20 - 40 - 60	55 55 55
3/III Y62 4/IV Y62 5/VY62	720 - 890	620	18	- 20 - 40 - 60	62 62 62
3/III Y69 4/IV Y69 5/VY69	770 - 940	690	17	- 20 - 40 - 60	69 69 69

1) 对于最小单值和重复试验的要求, 分别见 A 700 和 A900 .

表 J2 对接焊缝属试验要求

等级	拉力试验	冲击试验		弯曲比
	R_m, N/mm^2	温度 ℃	最小平均值 KV,J	D/t [1]
3/III Y42 4/IV Y42 5/V Y42	530 - 680	- 20 - 40 - 60	47 47 47	4
3/III Y46 4/IV Y46 5/VY46	570 - 720	- 20 - 40 - 60	47 47 47	4
3/III Y50 4/IV Y50 5/V Y50	610 - 770	- 20 - 40 - 60	50 50 50	4
3/III Y55 4/IV Y55 5/V Y55	670 - 830	- 20 - 40 - 60	55 55 55	5
3/III Y62 4/IV Y62 5/V Y62	720 - 890	- 20 - 40 - 60	62 62 62	5
3/III Y69 4/IV Y69 5/V Y69	770 - 940	- 20 - 40 - 60	69 69 69	5

1) D = 芯轴直径, t = 试样厚度.

制造厂商应提供每块试件的熔敷金属的化学分析报告, 并应包括所有重要合金元素的含量.

J 300 年度试验

301 根据所用的是焊条、焊丝/焊剂配合或焊丝/气体配合焊接, 应分别按 B900 、 C400 或 E600 的规定进行试验. 但是, 试验结果应符合表 J1 规定的要求.

K. 焊接奥氏体不锈钢的焊接材料

K 100 一般要求

101 奥氏体不锈钢用焊接材料经200至500规定的试验并符合要求, 则予以认可.

102 Parent plate material should preferably have a composition matching that of the electrode to be tested. Mild steel plates may, however, be applied provided that the groove faces are clad with at least two runs by the welding consumable which is to be tested.

K 200 All-weld-metal test

201 Preparation of test assemblies:

Two all-weld-metal test assemblies are to be prepared as shown in Fig.17, one using a 2,4—3,25 mm Ø electrode and the other using the largest size manufactured.

For wire/gas combinations the wire size is to be 1,2 mm Ø and the largest size manufactured.

For flux cored wire combinations the wire size is to be 1,2 or 1,6 mm Ø and the largest size manufactured.

For wire/flux combinations the smallest and largest size manufactured are to be tested.

The weld metal is to be deposited in accordance with normal welding practice. The direction of deposition is to be reversed between subsequent layers, each bead not being wider than 4 times the core wire diameter and not exceeding 4 mm in thickness. Between each run, the assembly is to be left in still air until it has cooled below 100°C, the temperature being checked in the middle of the weld bead surface.

Test specimens:
Depending on the service temperature, the number of test specimens taken according to Fig.17 are as follows:

- service temperature below —103°C; two longitudinal tensile and three impact test specimens are to be taken.
- service temperature above —103°C; two longitudinal tensile test specimens only are to be taken.

The test specimens are to be prepared according to A700.

Test requirements:
The test results are all to comply with the requirements given in Table K1. Welding consumables intended for low temperature service are to be impact tested at —196°C (or other temperatures below —103°C). The average impact value for the three specimens is not to be less than 34J.

K 300 Chemical composition

301 Chemical analysis is to be carried out for all dimensions of welding consumables manufactured. The analysis is to be carried out as stipulated in H300 and is to be reported for approval.

302 The chemical composition of the core wire is also to be reported.

Test requirements:
The chemical composition of the weld metal is to be in the range given in Table K2.

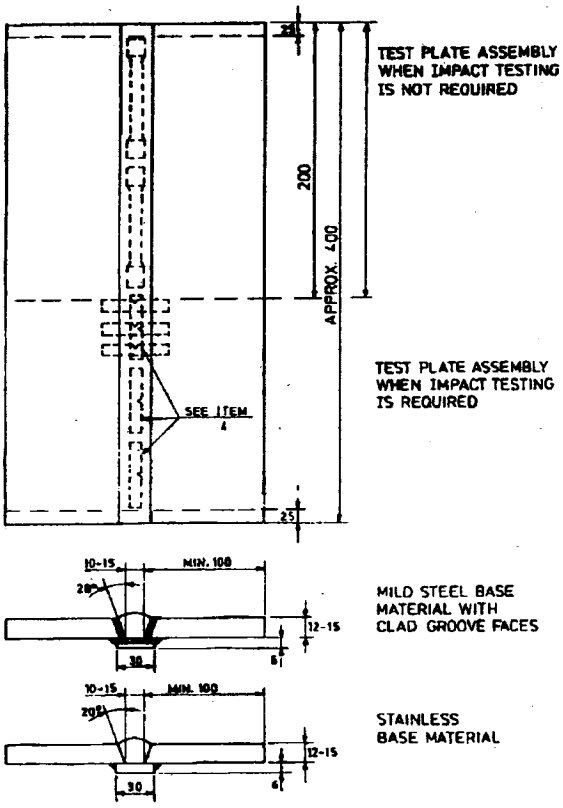


Fig. 17
Test assemblies (all measures in mm)

K 400 Possible additional tests

401 Normally, butt weld tests are not required. Butt weld tests may, however, be required if a welding consumable is to be approved for welding positions or materials for which it is not mainly intended.

402 The manufacturer is to inform about the welding position and materials for which the welding consumable is to be applied.

K 500 Annual tests

501 Annual testing for welding consumables which are not intended for low temperature service, comprises chemical analysis only. Welding consumables of two different dimensions are to be tested.

502 Annual testing for welding consumables which are intended for low temperature service at —103°C or lower, comprises impact testing at the respective temperature, in addition to chemical analysis. Welding consumables of two different dimensions are to be tested.

102 母体材料的成份应最好与送检焊条的成份相匹配，但只要在开槽面至少堆焊两层，送检焊接材料则用于低碳钢板亦可.

K 200 全熔质试验

201 试件的制备:

应如图 17 所示，制备两块全熔质试件，一块采用直径 2.4 - 3.25mm 的焊条焊接，而另一块则采用所生产的最大直径的焊条焊接.

对于焊丝/气体配合，则采用直径为 1.2mm 和所生产的最大直径的焊丝.

对于药芯/焊丝配合，则采用直径为 1.2mm 或 1.6mm 和所生产的最大直径的焊丝焊接.

对于焊丝/焊剂配合，则应试验所生产的最小和最大直径的焊丝焊接.

焊缝金属应按常规焊接程序熔敷，熔敷方向应在相邻两层之间交替变换. 每层焊道宽不大于 4 倍的芯丝直径，亦不必超过 4mm 厚. 每次焊道焊完后，应将试件置于静止空气中，使焊缝冷却到 100 ℃以下（这一温度是在焊缝表面中心处测定），然后再焊下一焊道.

试样:

根据使用的温度，按图 17 截取的试样数量如下:

- 使用温度低于 - 103 ℃，应截取两个纵向拉力试样和三个冲击试样;
- 使用温度高于 - 103 ℃，仅需截取两个纵向拉力试样.

试样应按 A700 的要求进行制备.

试验要求:

试验结果应全部符合表 K1 规定的要求. 拟用于低温下的焊接材料应在 - 196 ℃（或低于 - 103 ℃的其他温度）进行冲击试验，三个试样的平均冲击值不得低于 34J .

K 300 化学成份

301 所生产的所有尺寸的焊接材料均应进行化学分析，分析应按 H300 的规定进行并应列入报告供认可.

302 药芯焊丝的化学成份亦应列入报告.

试验要求:

焊缝金属的化学成份应在表 K2 规定的范围内.

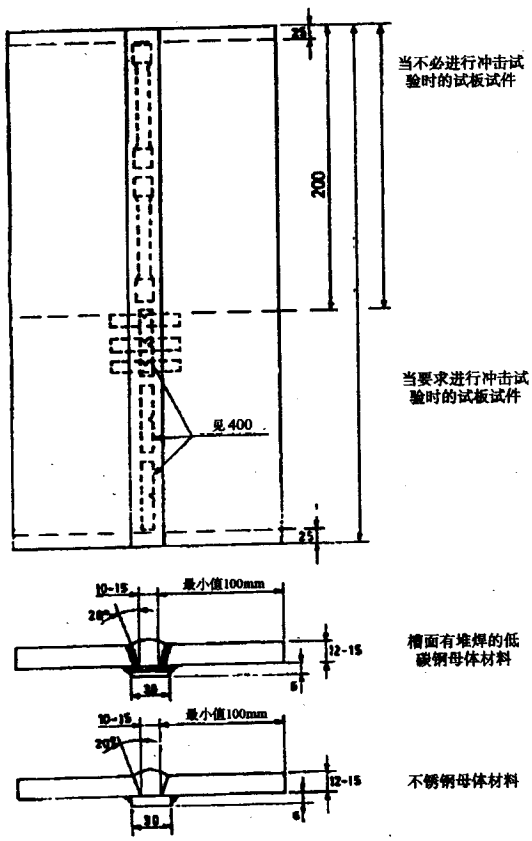


图 17 试件（所有尺寸以 mm 为单位）

K 400 可能的附加试验

401 通常，不必进行对接焊缝试验. 但是，如该焊接材料要认可用于非主要拟用的焊接位置或所用钢材时，则应进行对接焊缝试验.

402 制造厂商应告知焊接材料适用的焊接位置和钢材.

K 500 年度试验

501 对不拟用于低温的焊接材料之年度试验，仅作化学分析即可，应对两种不同直径的焊接材料焊成的试件进行试验.

502 对拟用于低温（ - 103 ℃或以下）的焊接材料之年度试验，除了化学分析外，还应包括在相应温度下进行的冲击试验，应对两种不同直径的焊接材料焊成的试件进行试验.

Table K1 [1]

Electrode grade	*Yield stress*, $R_{p0,2}$ *minimum*, N/mm^2	*Tensile strength*, R_m *minimum*, N/mm^2	*Elongation*, A_5 *minimum*, %
NV 308 Mo	290	550	25
NV 308	290	550	25
NV 308 L	270	520	25
NV 309	290	550	25
NV 309 L	270	520	25
NV 309 Nb	290	550	22
NV 309 Mo	290	550	25
NV 309 MoL	270	520	25
NV 310	290	550	22
NV 310 Nb	290	550	18
NV 310 Mo	290	550	22
NV 312	350	660	16
NV 316	290	550	22
NV 316 L	270	520	22
NV 317	290	550	22
NV 317 L	270	520	22
NV 318	290	550	18
NV 330	270	520	18
NV 347	290	550	22
NV 349	360	690	18

1) The values for reduction of area to be reported for information.

Table K2 [1]

Electrode grade	*C maximum* %	*Cr* %	*Ni* %	*Mo* %	*Nb-Ta* %	*Mn maximum* %	*Si maximum* %	*P maximum* %	*S maximum* %	*W* %
NV 308 Mo	0,08	18,0—21,0	9,0—11,0	2,0—3,0	—	2,5	0,90	0,04	0,03	—
NV 308	0,08	18,0—21,0	9,0—11,0	—	—	2,5	0,90	0,04	0,03	—
NV 308 L	0,03	18,0—21,0	9,0—11,0	—	—	2,5	0,90	0,04	0,03	—
NV 309	0,15	22,0—25,0	12,0—14,0	—	—	2,5	0,90	0,04	0,03	—
NV 309 L	0,03	22,0—25,0	12,0—14,0	—	—	2,5	0,90	0,04	0,03	—
NV 309 Nb	0,12	22,0—25,0	12,0—14,0	—	0,7—1,0	2,5	0,90	0,04	0,03	—
NV 309 Mo	0,12	22,0—25,0	12,0—14,0	2,0—3,0	—	2,5	0,90	0,04	0,03	—
NV 309 MoL	0,03	22,0—25,0	12,0—14,0	2,0—3,0	—	2,5	0,90	0,04	0,03	—
NV 310	0,20	25,0—28,0	20,0—22,5	—	—	2,5	0,75	0,04	0,03	—
NV 310 Nb	0,12	25,0—28,0	20,0—22,0	—	0,7—1,0	2,5	0,75	0,04	0,03	—
NV 310 Mo	0,12	25,0—28,0	20,0—22,0	2,0—3,0	—	2,5	0,75	0,04	0,03	—
NV 312	0,15	28,0—32,0	8,0—10,5	—	—	2,5	0,90	0,04	0,03	—
NV 316	0,08	17,0—20,0	11,0—14,0	2,0—3,0	—	2,5	0,90	0,04	0,03	—
NV 316 L	0,03	17,0—20,0	11,0—14,0	2,0—3,0	—	2,5	0,90	0,04	0,03	—
NV 317	0,08	18,0—21,0	12,0—14,0	3,0—4,0	—	2,5	0,90	0,04	0,03	—
NV 317 L	0,03	18,0—21,0	12,0—14,0	3,0—4,0	—	2,5	0,90	0,04	0,03	—
NV 318	0,08	17,0—20,0	11,0—14,0	2,0—3,0	6xC—1,0	2,5	0,90	0,04	0,03	—
NV 330	0,25	14,0—17,0	33,0—37,0	—	—	2,5	0,90	0,04	0,03	—
NV 347	0,08	18,0—21,0	9,0—11,0		8xC—1,0	2,5	0,90	0,04	0,03	—
NV 349	0,13	18,0—21,0	8,0—10,5	0,35—0,65	0,75—1,2	2,5	0,90	0,04	0,03	1,25—1,75

1) Chromium % minimum 1,9 x % Ni. Tantalum % maximum 0,10%. Titanium % maximum 0,15%.

表 K1 [1)]

焊条等级	屈服应力 $R_{P0.2}$ 最小值 N/mm^2	抗拉强度 Rm 最小值 N/mm^2	伸长率 A_5 最小值 %
NV 308 Mo	290	550	25
Nv 308	290	550	25
Nv 308 L	270	520	25
NV 309	290	550	25
NV 309 L	270	520	25
NV 309 Nb	290	550	22
NV 309 Mo	290	550	25
NV 309 MoL	270	520	25
NV 310	290	550	22
NV 310 Nb	290	550	18
NV 310 Mo	290	550	22
NV 312	350	660	16
NV 316	290	550	22
NV 316 L	270	520	22
NV 317	290	550	22
NV 317 L	270	520	22
NV 318	290	550	18
NV 330	270	520	18
NV 347	290	550	22
NV 349	360	690	18

1) 断面收缩率值应列入报告供备查.

表 K2 [1)]

焊条等级	C 最大值 %	Cr %	Ni %	M0 %	Nb-Ta %	Mn 最大值 %	Si 最大值 %	P 最大值 %	S 最大值 %	W %
NV 308 Mo	0.08	18.0-21.0	9.0-11.0	2.0-3.0	-	2.5	0.90	0.04	0.03	-
Nv 308	0.08	18.0-21.0	9.0-11.0	-	-	2.5	0.90	0.04	0.03	-
Nv 308 L	0.03	18.0-21.0	9.0-11.0	-	-	2.5	0.90	0.04	0.03	-
NV 309	0.15	22.0-25.0	12.0-14.0	-	-	2.5	0.90	0.04	0.03	-
NV 309 L	0.03	22.0-25.0	12.0-14.0	-	-	2.5	0.90	0.04	0.03	-
NV 309 Nb	0.12	22.0-25.0	12.0-14.0	-	0.7-1.0	2.5	0.90	0.04	0.03	-
NV 309 Mo	0.12	22.0-25.0	12.0-14.0	2.0-3.0	-	2.5	0.90	0.04	0.03	-
NV 309 MoL	0.03	22.0-25.0	12.0-14.0	2.0-3.0	-	2.5	0.90	0.04	0.03	-
NV 310	0.20	25.0-28.0	20.0-22.5	-	-	2.5	0.75	0.04	0.03	-
NV 310 Nb	0.12	25.0-28.0	20.0-22.0	-	0.7-1.0	2.5	0.75	0.04	0.03	-
NV 310 Mo	0.12	25.0-28.0	20.0-22.0	2.0-3.0	-	2.5	0.75	0.04	0.03	-
NV 312	0.15	28.0-32.0	8.0-10.5	-	-	2.5	0.90	0.04	0.03	-
NV 316	0.08	17.0-20.0	11.0-14.0	2.0-3.0	-	2.5	0.90	0.04	0.03	-
NV 316 L	0.03	17.0-20.0	11.0-14.0	2.0-3.0	-	2.5	0.90	0.04	0.03	-
NV 317	0.08	18.0-21.0	12.0-14.0	3.0-4.0	-	2.5	0.90	0.04	0.03	-
NV 317 L	0.03	18.0-21.0	12.0-14.0	3.0-4.0	-	2.5	0.90	0.04	0.03	-
NV 318	0.08	17.0-20.0	11.0-14.0	2.0-3.0	6xC-1.0	2.5	0.90	0.04	0.03	-
NV 330	0.25	14.0-17.0	33.0-37.0	-	-	2.5	0.90	0.04	0.03	-
NV 347	0.08	18.0-21.0	9.0-11.0		8xC-1.0	2.5	0.90	0.04	0.03	-
NV 349	0.13	18.0-21.0	8.0-10.5	0.35-0.65	0.75-1.2	2.5	0.90	0.04	0.03	1.25-1.75

1) 铬%最小值为 1.9 x % Ni. 钼% 最大值为 0.10 %. 钛%最大值为 0.15 %.

L. Welding Consumables for Welding of Ferritic-Austenitic Stainless Steels (Duplex Steels)

L 100 General

101 Approval of welding consumables for ferritic austenitic stainless steels (duplex steels) will be considered subject to compliance with the specified tests and requirements below.

102 Parent plate material should preferably have a composition matching that of the electrode to be tested.

L 200 Test assemblies

201 All-weld-metal tests
Two all-weld-metal test assemblies are to be prepared as shown in Fig.17, one using a 2,4—3,5 mm Ø electrode and the other using the largest size manufactured.

For wire/gas combinations the wire size is to be 1,2mm and the largest size manufactured.

For flux cored wire/gas combination the wire size is to be 1,2 or 1,6 mm and the largest size manufactured.

For wire/flux combinations the smallest and largest size manufactured are to be tested.

The weld metal is to be deposited in accordance with normal welding practice. The direction of deposition is to be reversed between subsequent layers, each bead being not wider than 4 times the core wire diameter and not exceeding 4 mm in thickness. Between each run, the assembly is to be left in still air until it has cooled below 150°C, the temperature being checked in the middle of the weld bead surface.

Test specimens:
Two longitudinal tensile and three impact test specimens are to be taken from each test assembly as shown in Fig.17.

The test specimens are to be prepared according to A700.

Test requirements:
The tensile strength, yield point and elongation are to be reported. For information, the value for reduction of area is also to be reported. The results of the tensile tests are not to be less than that specified for the base material, for which the consumable is intended.

The impact test specimens are to be tested at —20°C and minimum average impact energy is to be 27 J for full size test specimens.

202 Butt weld tests
Butt-weld test assemblies as shown in Fig.2 are to be prepared for each welding position for which the wire is recommended.

The test assemblies are to be prepared using wire or electrode of one of the smaller sizes manufactured and for the remaining runs wires or electrodes of the largest size for the position concerned.

Test specimens:
One transverse tensile, two bend and three impact test specimens are to be taken from each test assembly as shown in Fig.2

The test specimens are to be prepared according to A700.

Test requirements:
The result of the transverse tensile test is not to be less than that specified for the base metal, for which the consumable is intended.

The impact test specimens are to be tested at -20°C and minimum average impact energy is to be 27 J for full size test specimens.

The bend test specimens can be considered as complying with the requirements if, after bending, no crack or defect having any dimension exceeding 3 mm can be seen on the outer surface of the test specimen.

L 300 Chemical composition

301 Chemical analysis is to be carried out for all dimensions of welding consumables manufactured. The analysis is to be carried out as stipulated in H300 and is to be reported for approval.

302 The chemical composition of the core wire is also to be reported.

L 400 Microstructural examination

401 The ferrite/austenite-ratio of the weld is to be determined. The ferrite content in average is to be in the range of 25 to 70%.

L 500 Corrosion test

501 For the determination of pitting and crevice corrosion resistance, one test according to ASTM G48, Method A is required. The test specimen is to be exposed to the solution at a temperature of 20°C for 24 hours. No pitting attack shall be visible on the test faces, and the general weight loss is to be less than 20 mg.

L 600 Annual tests

601 Annual test for welding consumables comprises chemical analysis only. Welding consumables of two different dimensions are to be tested.

M. Welding Consumables for Welding of Aluminium Alloys for General and Low-Temperature Service

M 100 General

101 Approval of welding consumables for aluminium alloys will be considered subject to compliance with the specified tests and requirements in 200 to 400.

M 200 Test assemblies

201 The welding consumables are to have a suitable hardness and smooth surface free from slivers, depressions, scratches or foreign matters that would adversely affect the welding properties when operating the welding equipment.

202 Tolerances for dimensions are to be kept within the limits guaranteed in the manufacturers specifications.

203 The recommended and used composition for the shielding gases is to be reported.

Preparation of test assemblies:
Two test assemblies with dimensions as shown in Fig.18 are to be welded in the flat position, one using the smallest wire size manufactured and the other using the largest size manufactured.

Application of backing strips is optional, i.e. the joint may be welded without backing strip with the root of weld chipped out to sound metal and re-welded from the second side. The metal for the backing strip is to be the same as that for the test plates. The test assemblies are neither to be preheated nor postheat treated. The welding is to be carried out at ambient temperature.

M 300 Testing

301 Non-destructive examination:
Prior to testing the backing strip is to be chipped off. The radiographic test will be considered as passed, provided the

L. 焊接铁素体－奥氏体不锈钢（双联钢）的焊接材料

L 100 一般要求

101 铁素体－奥氏体不锈钢（双联钢）用焊接材料，经下列规定的试验并符合要求，将予以认可.

102 母体材料的成份最好应与送检焊条的成份相匹配.

L 200 试件

201 全熔质试件

应如图 17 所示，制备两块全熔质试件，一块采用直径 2.4 － 3.5mm 的焊条焊接，而另一块则采用所生产的最大直径的焊条焊接.

对焊丝/气体配合，焊丝直径应为 1.2mm 和所生产的最大直径.

对于药芯焊丝/气体配合，焊丝直径应为 1.2 或 1.6mm，以及所生产的最大直径. 对于焊丝/焊剂配合，则应用所生产的最小和最大直径的焊丝来焊接试件.

焊丝金属应按常规焊接程序熔敷，熔敷方向应在相继两层之间交替变换，每一焊层焊道宽应不大于 4 倍的丝芯直径，厚度应不大于 4mm . 每次焊道焊完后，应将试件置于静止空气中，使焊缝冷却至 150 ℃以下（这一温度应在焊缝表面的中心处测定），然后再焊下一焊道.

试样:

应如图 17 所示，从每块试件上截取两个纵向拉力试样和三个冲击试样.

试样应按 A700 的要求进行制备.

试验要求:

应将抗拉强度、屈服点和伸长率列入报告，断面收缩率也应列入报告供备查. 拉力试验值应不小于对焊接材料拟用的母体材料所规定的值.

冲击试样应在 － 20 ℃下进行试验，并且对于全尺寸试样，其最低平均冲击功值应为 27J .

202 对接焊缝试验

如图 2 所示的对接焊缝试件应在每一个焊接位置用所推荐的焊丝进行焊制.

试件应使用所生产的较小直径焊丝或焊条中的一种焊第一道，其余焊道使用适用于该焊位的最大直径的焊丝或焊条来焊制.

试样:

应按图 2 所示，从每块试件上截取一个横向拉力试样，两个弯曲试样和三个冲击试样.

试样应按 A700 的要求进行制备.

试验要求:

横向拉力试验结果应不小于对焊接材料拟用的母体材料所规定的值.

冲击试样应在 － 20 ℃下进行试验，且其最小平均冲击能量，对于全尺寸试样应为 27J . 弯曲试样，如在其弯曲后，试样的凸表面上未出现有任何尺寸超过 3mm 的裂纹或缺陷，则视为符合要求.

L 300 化学成份

301 对所生产的所有直径的焊接材料应进行化学分析，分析应按 H300 的规定进行并应列入报告，以供认可.

302 药芯焊丝的化学成份也应列入报告.

L 400 微观结构检验

401 应确定焊缝的铁素体/奥氏体比率，平均铁素体含量应在 25 % 至 70 % 范围内.

L 500 腐蚀试验

501 为确定腐蚀凹坑和裂缝，应按 ASTM G48 方法 A 进行一次试验. 试样应在温度为 20 ℃的溶液内浸泡 24 小时，试样表面应无凹坑侵蚀，且其总失重应小于 20mg .

L 600 年度试验

601 焊接材料的年度试验仅包括化学分析. 应对两种不同直径的焊接材料进行试验.

M. 焊接常温和低温用铝合金的焊接材料

M 100 一般要求

101 铝合金焊接材料经 200 至 400 规定的试验并符合要求，将予以认可.

M 200 试件

201 焊接材料应具有合适的硬度和平滑的表面，无裂片、凹穴、划痕或当操作焊接设备时会严重影响焊接性能的杂质.

202 直径的容差应保持在制造厂商技术说明书中所确保的限值内.

203 对保护气体的推荐成分和实际使用成份均应列入报告.

试件的制备:

应在平焊位焊制两块如图 18 所示尺寸的试件. 一块试件采用所生产的最小直径的焊丝焊接，而另一块则采用所生产的最大直径的焊丝焊接.

是否采用背衬条是任选的. 即焊接接头也可在无背衬条时施焊，然后在焊根处铲至完好金属，并从反面再焊的方式施焊. 背衬条的金属应与试板金属相同，试件既不作预热处理，也不必进行焊后处理. 焊接应在常温下进行.

M 300 试验

301 无损探伤检验

试验前，背衬条应予铲除，只要 X 射线透视试验符合 ASME《锅炉和受压容器规则》第Ⅷ节第 2 条 A1 － 511 的要求，则视为

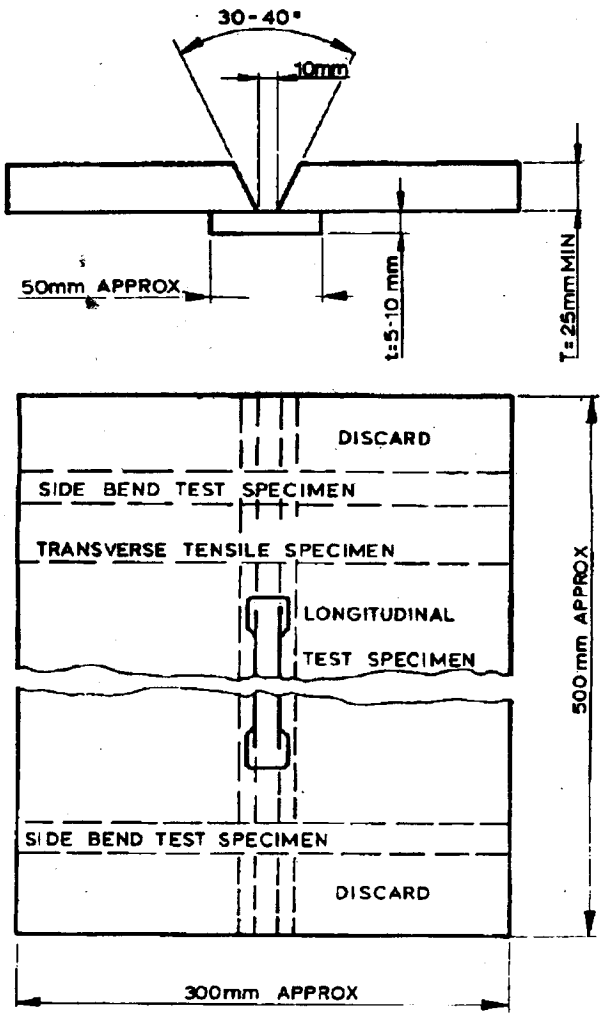


Fig. 18
Test assembly and location of specimens

requirements in ASME Boiler and Pressure Vessel Code. Sec. VIII, Div. 2, A1-511 are satisfied.

Mechanical testing:
One longitudinal and one transverse tensile test specimen and two side bend test specimen («wrap around» bending) are to be taken as shown in Fig.18.

The test specimens are to be prepared according to A700.

Mechanical test requirements:
The tensile strength, yield point and elongation are to be reported for the Society's consideration. The tensile- and yield strength for both weld metal and welded joint are not to be less than that specified for the parent material (in soft condition), for which the consumable is intended. For materials in deformation hardened or aged condition, the choice of consumable and requirements to mechanical properties are to be evaluated in each particular case.

The bend test specimens can be considered as complying with the requirements if, after bending through an angle of 180° over a former with diameter four times the thickness of the specimen, no crack or defect having any dimensions exceeding 3 mm can be seen on the outer surface of the test specimen.

M 400 Annual tests

401 One test assembly is to be welded in the flat position. Testing of this assembly is to be carried out as prescribed above for the initial testing.

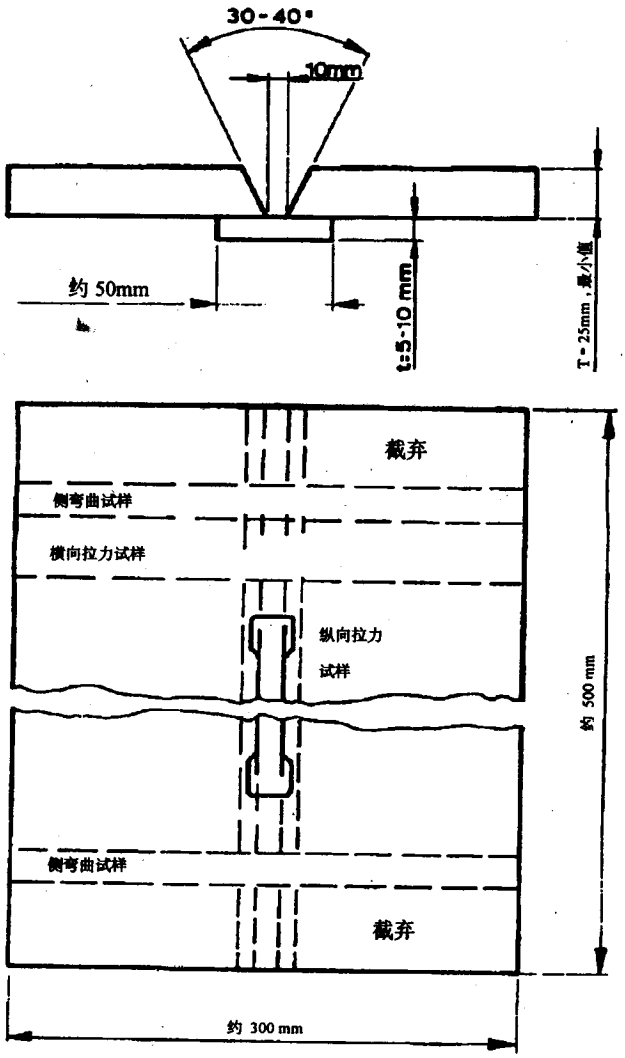


图 18 试件和试样位置

通过了该项试验.

机械试验:

如图所示，应截取一个纵向拉力试样和一个横向拉力试样以及两个侧弯曲试样（《缠绕》弯曲）.

试样应按 A700 的要求进行制备.

机械试验要求:

抗拉强度、屈服点和伸长率均应列入报告供本社考虑. 焊缝金属和所焊的接头之抗拉强度和屈服强度不得小于对焊接材料所拟用的母材（在软状态下）所规定的抗拉强度和屈服强度. 对处于变形硬化或时效硬化中的材料，则应根据具体情况选择焊接材料，及其机械性能要求.

弯曲试样，如在其绕一直径 4 倍于试样厚度的芯棒上弯曲角度为 180° 时，试样的外表面上未出现有任何尺寸超过 3mm 的裂纹或缺陷，则视为符合要求.

M 400 年度试验

401 应在平焊位焊制一块试件，该试件的试验应按上述初次试验所规定的要求进行.

SECTION 4
WELDING OF CLAD STEEL PLATES

Contents

A. General

A 100 Scope

101 The requirements in this Section specify welding of steel plates with austenitic stainless steel cladding.

B. Welding

B 100 Welding methods — deposited metal

101 For welding of steel plates with austenitic stainless steel cladding, only electrodes approved by the Society are to be used, and welding is to be carried out only by certified welders.

102 The welding may be carried out by means of shielded metal-arc welding, automatic or semi-automatic arc welding under inert gas and/or flux or a combination of these methods.

103 The weld joint is to have the same resistance to corrosion as the cladding metal, and the corrosion-resistant deposited metal is to have at least the same thickness as the cladding metal.

104 The chemical composition of the weld metal in the top layer on the clad side is to correspond to the composition of the cladding metal. The cladding deposited by welding is to have at least the same thickness as the cladding on the original plate.

B 200 Groove preparation

201 Proper groove shape in connection with correct welding sequence is to be employed. The edges are to be prepared with a cutting tool or by grinding.

202 Clad steel may be flame-cut provided this is done from the base plated side. It is recommended that the cutting face is removed in a depth of about 2 mm. When shearing is used, the cladding side must face upwards.

203 If there are alignment difficulties or if the welded connection is highly stressed, an edge preparation involving the removal of the cladding, adjacent to the weld is recommended.

B 300 Welding procedure

301 When welding clad materials, mixing of base metal and weld deposit, as well as mixing of the two types of high alloyed weld deposit is to be held at a minimum. Low welding current and small welding consumable dimensions are to be used. The degree of dilution is preferably to be kept below 30%. The degree of dilution is defined as the amount of base metal in the weld metal.

302 The use of low-alloyed or non-alloyed consumables on the cladding is not allowed.

303 At least two layers of the alloyed weld metal are to be deposited when welding the backing from the clad steel side, even if it is necessary to chip or grind off part of the first stainless bead to make room for the second pass. At least, the first bead is to be made with an over-alloyed consumable (e.g. NV 309).

304 The mild steel backing is as far as possible to be welded before the stainless cladding and is to be welded with suitable mild steel consumable. Care must be taken to prevent the root bead from penetrating into the cladding. Tack welds are to be of sufficient size, have full penetration and an even surface, so that they may be covered by the first weld bead without removal.

Guidance note:

For the top layer on the backing only extensively dried, extra-low hydrogen type of electrodes with grade-suffix HH are to be used.

---e-n-d---o-f---G-u-i-d-a-n-c-e---n-o-t-e---

305 When welding pipes where there is access only from the outside, the entire cross-section is to be built up by alloyed weld metal corresponding to the cladding. The sides of the groove are preferably to be covered with an over-alloyed consumable (buttering) before joining.

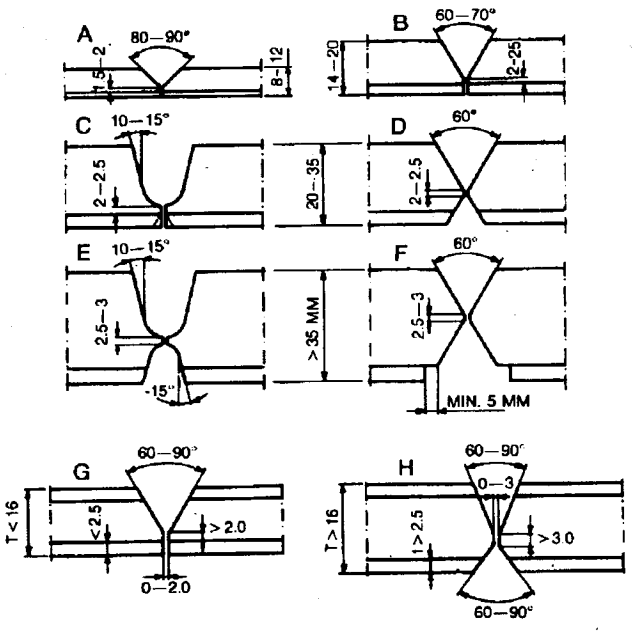


Fig. 1
Examples on most commonly used grooves

第4节 复合钢板的焊接

目 录

A. 通 则

A 100 适用范围

101 本节的规定适用于奥氏体复合不锈钢板的焊接.

B. 焊 接

B 100 焊接方法 —— 熔敷金属

101 奥氏体不锈钢复合钢板的焊接，只能采用本社认可的电焊条和由持证的焊工进行焊接.

102 焊接可采用气体保护金属－电弧焊，惰性气体和/或焊剂保护的自动或半自动电弧焊或这些方法的组合来进行.

103 焊接接头应具有与复合金属相同的耐腐蚀性，并且耐腐蚀熔敷金属至少具有与原复合板中的复合层相同的厚度.

104 焊接金属复合面一方的顶层的化学成分应与复合金属的成分一致. 焊接熔敷金属的复合层至少应具有原钢板上复合层相同的厚度.

B 200 坡口制备

201 应采用与正确的焊接顺序相适应的专门的坡口形状，坡口应采用切割工具或磨削方法制备.

202 复合钢板可用火焰切割，但切割应从基板一侧进行，建议去除切割面上深度约为 2mm 的一层. 当采用剪切法时，复合面应朝上.

203 如对线有困难或焊接接头要承受高应力，则建议在坡口制备时应将坡口边缘连同焊缝附近的复合层也一起去掉.

B 300 焊接工艺

301 在焊接复合材料时，母体金属和焊缝熔敷金属的混合以及两种高合金焊缝熔敷金属的混合要控制到最小，应采用低的焊接电流和小尺寸的焊接材料. 其稀释度最好保持低于30%. 稀释度即焊缝金属中母体金属的数量.

302 对复合层不允许采用低合金或非合金焊接材料.

303 当从复合金属一侧背焊复合钢板时，至少应熔敷两层合金焊缝金属，即使为此而铲去或磨去第一条不锈钢焊道，才能为第二条焊道留出空间也在所不惜，至少第一条焊道应采用超合金焊接材料(例 NV309)进行焊接.

304 低碳钢背焊应尽可能在焊不锈钢复合层之前焊接，并应采用合适的低碳钢焊接材料. 必须注意防止根部焊缝穿出复合层，定位焊点应有恰当尺寸，并完全焊透且应有平坦的表面，以便不必铲除定位焊点就可直接复盖上第一条焊道.

指导性意见:

对于背焊金属顶层，仅能采用非常干燥的超低氢型的 HH 级焊条.

－指－导－性－意－见－结－束－

305 当只能从外面焊接管子时，应采用和复合钢相当的合金焊接整个横截面. 在连接前，坡口两边最好用超合金焊接材料(予堆边焊)加以复盖.

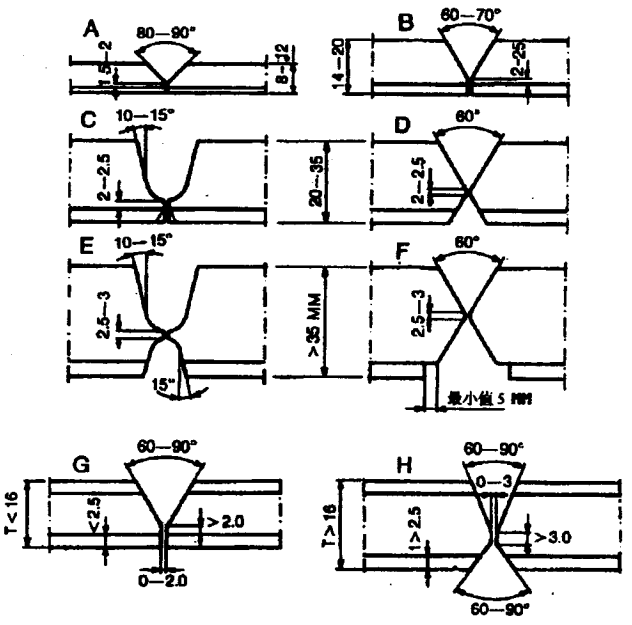
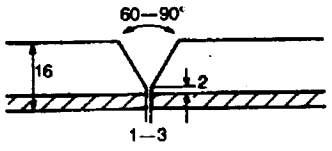
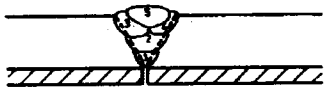


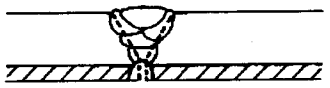
图 1 最常用的坡口型式图例



Weld grove face to be ground smooth.



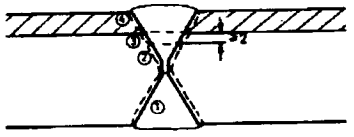
Root bead (1) of mild steel is not to penetrate the cladding.



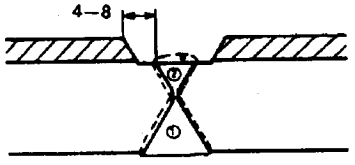
The root bead is back-gauged or ground.

First bead on the clad side to be welded with an over-alloyed consumable (309-type), top layer to match the composition of the cladding (308-type).

RECOMMENDED TYPES OF JOINTS

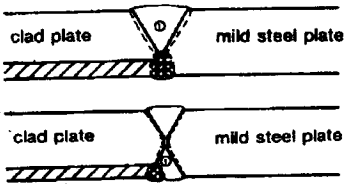


③ to be welded with an over-alloyed consumable.
④ to be welded with a consumable matching the composition of the cladding.

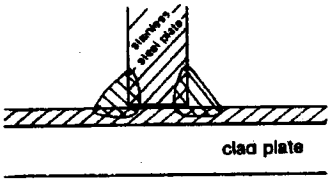


Backing to be ground back enough to give room for at least two high-alloyed layers.

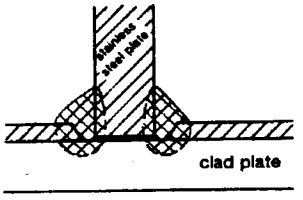
Butt weld between clad plate and stainless steel plate:
The groove edge on the clad plate is buttered with an over-alloyed consumable, the joint may then be welded with a consumable matching the stainless steel.



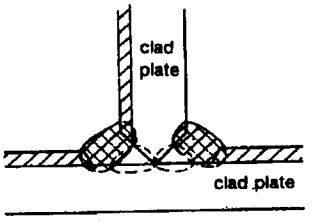
Butt weld between clad plate and mild steel plate; the cladding is welded with an over-alloyed type of consumable.



Only to be used in assemblies subjected to low stresses; consumable to match the cladding.

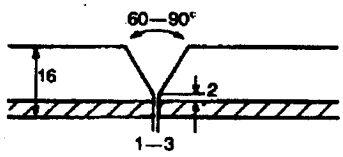


To be used in assemblies subject to high stresses: consumable to be of over-alloyed type to compensate for the mixing with mild steel backing.

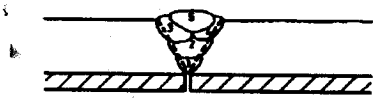


Assembly subjected to high stresses; root beads can be welded with over-alloyed consumables and the top layer with ordinary stainless steel consumable, or root bead is welded with a mild steel consumable and the top layer with over-alloyed consumable.

Fig. 2
Examples on welding sequence



焊接坡口表面应磨平

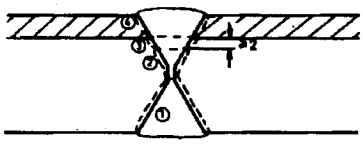


低碳钢根部焊道(1) 不得侵入钢板的复合层

根部焊道应从反面刨或打磨

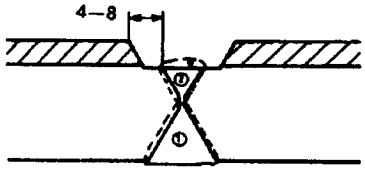
应在复合面的一侧采用超合金焊接材料(309 型)焊接第一焊缝，其顶层的化学成份应与钢板复合层(308 型)相当.

推荐的接头型式



③应采用超合金化的焊接材料施焊.

④应采用与钢板复合层成分相当的焊接材料施焊.

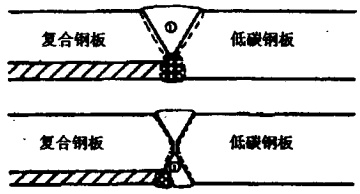


应在反面磨削足够的尺寸，以便至少为两层高合金焊层提供所需要的空间.

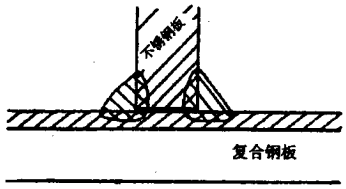
图 2 焊接顺序图例

复合钢板和不锈钢板之间的对接焊:

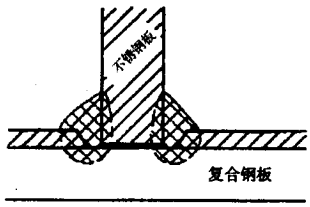
复合钢板一侧的坡口应采用超合金焊接材料先进行予堆边焊，然后接头再用与不锈钢相当的焊接材料施焊.



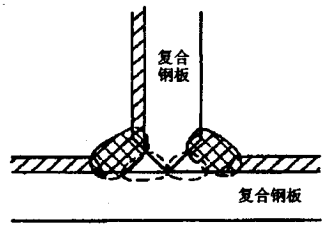
复合钢板和低碳钢之间的对接焊: 板的复合层应采用超合金焊接材料施焊.



只能用于承受低应力的组装件; 焊接材料与复合钢板相当.



用于承受高应力的组装件: 应采用超合金焊接材料，以补偿和低碳钢母板的混合



复合钢板用于承受高应力的组装件; 根部焊道采用超合金焊接材料施焊，顶层用普通不锈钢焊接材料施焊或根部焊道采用低碳钢焊接材料而顶层用超合金焊接材料施焊.