

当允许兼用于单道焊和多道焊的焊丝/焊剂配合时,应采用单道焊工艺焊制该试件。

702 应如图 12 所示,从试件上截取一个纵向拉力试样,一个横向拉力试样,两个弯曲试样(一个正弯,一个反弯)和六个冲击试样。

703 试件的制备和机械性能要求应符合初次认可试验的要求。

#### D 800 升级

801 一种已认可的焊丝/焊剂配合可被授予比原授等级较高的等级,只要其冲击试验是在对较高级所规定的温度下进行并具有满意的结果即可。但是,当从 I (T/M) 级升到 III (T/M) 级或从任何等级升到 II Y (T/M) 至 V Y (T/M) 以及 II Y40 (T/M) 到 IV Y40 (T/M) 级时,则除符合年度试验的一般规定外,尚应从对接焊缝试件上截取试样进行冲击试验。

### E. 用于金属埋弧焊的焊丝和焊丝/气体配合

#### E 100 一般要求

101 有气体保护和无气体保护的焊丝/气体配合、药芯焊丝或药皮焊丝应分成下列等级:

- 普通强度钢用: I、II 和 III 级;
- 最低屈服强度  $< 355\text{N/mm}^2$  的高强度钢用: I Y、II Y、III Y、IV Y 和 V Y 级;
- 最低屈服强度  $< 390\text{N/mm}^2$  的高强度钢用: II Y40、III Y40 和 IV Y40 级。

经 200 和 300 规定的试验并符合要求,则将予以认可。

102 焊丝分为下列类别:

- 用于半自动多道焊;
- 用于自动多道焊;
- 用于自动双面单道焊。

对拟用于自动焊的焊丝,则应添加后缀字母 T、M 和 TM 以分别表示双道焊、多道焊或兼用于此两种焊接工艺。

对拟用于半自动焊的焊丝,则应在等级符号后添加后缀字母 S。

对兼用于两种焊接工艺的焊丝,应在符号后添加组合后缀字母。

103 试件应采用与申请认可有关的焊接工艺进行制备,但是,如申请认可兼用于半自动和自动焊工艺时,则试件仅需采用半自动焊工艺焊制。如申请认可自动双道焊工艺时,试件也应这样制备。

104 如适用,应提供保护气体的成份。除非本社另行同意,当所用的保护气体与原先认可试验所用的有差异时,可要求进行附加认可试验。

105 制造商可自行决定是否要根据其推荐的焊接条件来对药芯焊丝或药皮焊丝按 A800 的规定进行测氢试验。试验时应将熔敷速度调节到使每个试样上的熔敷金属重量与手工焊焊条焊制时的熔敷金属重量相似。

符合本社 B400 规定要求的焊丝,将在其等级符号后添加后缀 (H15)、(H10) 或 (H5)。

#### E 200 半自动多道焊

201 半自动焊的含义是焊工手持连续进丝的焊枪进行手工焊接的工艺。

对其申请认可,则应按 202 和 203 的规定进行全熔质试验和对接焊试验。

202 全熔质试验应按下述要求进行:

试件的焊制:

应在如图 1 所示的俯焊位焊制两块全熔质试件。

一块试件应使用直径 2.4mm 的或所生产的最大直径的焊丝施焊;而另一块则使用直径 1.2mm 的或所生产的最小直径的焊丝施焊。如仅供有一种直径的焊丝,则焊制一块试件即可。

焊缝金属应按制造厂商推荐的程序熔敷,每层焊缝金属的厚度应在 2mm 至 6mm 范围内。

试件:

应按图 1 所示,从每块试件上截取一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:

试验结果应全部符合表 E1 规定的要求。

**Table E1**

Grade	Tensile test				Impact test	
	$R_m$ , N/mm <sup>2</sup>	$R_{eH}$ , minimum, N/mm <sup>2</sup>	$A_5$ , minimum, %	$Z$ , %	Temperature °C	KV, J, minimum average
I II III	400—560	305	22	1)	20 0 -20	47
I Y II Y III Y IV Y V Y	490—660	375			20 0 -20 -40 -60	
II Y40 III Y40 IV Y40	510—690	400			0 -20 -40	

1) Reduction of area to be reported for information.

#### Chemical analysis:

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.

#### 203 Butt-weld tests are to be performed as follows:

##### Preparation of test assembly:

Butt-weld test assemblies as shown in Fig.2 are to be prepared for each welding position (downhand, horizontal-vertical, vertical and overhead) for which the wire is recommended.

One test assembly is to be prepared in the downhand position, using a 1,2 mm diameter wire for the first run or a wire of the smallest size manufactured and using a 2,4 mm diameter, or of the largest size manufactured for the remaining runs.

In the case where the wire is intended for downhand position only, an additional test assembly is to be prepared by the same welding procedure using wires of different diameter.

The other test assemblies are to be prepared in the vertical, horizontal-vertical and overhead positions using for the first run a wire of 1,2 mm diameter or of the smallest size manufactured and using for the remaining runs the largest size of wire recommended by the manufacturer for the position concerned.

##### Test specimens:

One transverse tensile, two bend (one face and one root 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 test results are all to comply with the requirements given in Table E2. The position of fracture in the transverse tensile test specimen is to be reported. The bend test specimens can be considered as complying with the requirements if, after bending, no crack or defect having any dimensions exceeding 3 mm can be seen on the outer surface of the test specimen.

**Table E2**

Grade	Tensile test	Impact test — KV, J, minimum average		
	$R_m$ , minimum, N/mm <sup>2</sup>	Temperature °C	Downhand, horizontal-vertical and overhead	Vertical (upward and downward)
I II III	400	20 0 -20	47	34
I Y II Y III Y IV Y V Y	490	20 0 -20 -40 -60		
II Y40 III Y40 IV Y40	510	0 -20 -40		41

#### E 300 Automatic multi-run welding

Where approval for use with automatic multi-run welding is requested, all-weld-metal and butt-weld tests are to be carried out as specified in 301 and 302.

#### 301 All-weld-metal tests are to be performed as follows:

##### Preparation of test assembly:

One all-weld-metal test assembly is to be welded in the downhand position as shown in Fig.7.

The preparation of the assembly is to be as described in C201, except that the thickness of each layer is not to be less than 3 mm.

##### Test specimens:

Two longitudinal tensile and three impact test specimens are to be taken from the test assembly as shown in Fig.7.

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 E3.

表 E1

等 级	拉力试验				冲击试验	
	$R_m$ N/mm <sup>2</sup>	$R_{eH}$ 最小值 N/mm <sup>2</sup>	$A_5$ 最小值 %	Z %	温度 ℃	KV, J 最小平均值
I II III	400-560	305	22	1)	20 0 -20	47
I Y <sub>L</sub> II Y III Y IV Y VY	490 - 660	375			20 0 -20 -40 -60	
II Y40 III Y40 IV Y40	510-690	400			0 -20 -40	

1) 断面收缩率应列入报告供备查。

化学分析:

制造厂商应提供每块试件中熔敷的焊缝金属的化学分析报告并包含所有重要的合金元素的含量。

203 对接焊缝试验应按下述要求进行:

试件的制备:

应为每一焊位(俯焊、横向立焊、立焊和仰焊)使用为其推荐的焊丝焊制如图2所示的对接焊缝试件。

应在俯焊位置焊制一块试件,第一道使用直径1.2mm的焊丝或所生产的最小直径的焊丝,其余焊道使用直径2.4mm的焊丝或所生产的最大直径的焊丝。

如焊丝仅拟用于俯焊位置,则应采用相同的焊接程序但使用不同直径的焊丝焊制一块附加试件。其他试件应在立焊、横向立

焊和仰焊位进行焊制,第一道使用直径1.2mm的焊丝或所生产的最小直径的焊丝,其余焊道使用制造厂商对有关的焊位推荐的最大直径的焊丝。

试件:

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(一个正弯、一个反弯)和三个冲击试样。

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E2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,如在其弯曲后,试样凸起的一面未出现有任何尺寸超过3mm的裂纹或缺陷,则视为符合要求。

表 E2

等 级	拉力试验	冲击试验 - KV, J 最小平均值		
	$R_m$ 最小值 N/mm <sup>2</sup>	温 度 ℃	俯 焊 横焊和仰焊	立 焊 (向上和向下)
I II III	400	20 0 -20	47	34
IY II Y III Y IV Y VY	490	20 0 -20 -40 -60		
II Y40 III Y40 IV Y40	510	0 -20 -40		

## E 300 全自动多道焊

如申请认可采用自动多道焊,则应进行按301和302规定的全熔质试验和对接焊缝试验。

301 全熔质试验应按下述要求进行:

试件的制备:

应在如图7所示的俯焊位焊制一块全熔质试件。

试件的制备应按C201的规定,但每层厚不得小于3mm。

试样:

应按图7所示,从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:

试验结果应全部符合表E3规定的要求。

Table E3						
Grade	Tensile test				Impact test	
	$R_m$ , minimum, N/mm <sup>2</sup>	$R_{eH}$ , minimum, N/mm <sup>2</sup>	$A_5$ , minimum, %	Z %	Temperature °C	KV, J, minimum average
I II III	400—560	305	22	1)	20 0 -20	34
I Y II Y III Y IV Y V Y	490—660	375			20 0 -20 -40 -60	
II Y40 III Y40 IV Y40	510—690	400			0 -20 -40	41

1) Reduction of area to be reported for information.

#### Chemical analysis:

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

#### 302 Butt-weld tests are to be performed as follows:

##### Preparation of test assembly:

One butt-weld test assembly is to be welded in the downhand position as shown in Fig.8.

The test assembly is to be prepared in accordance with that prescribed in C202.

##### Test specimens:

Two transverse tensile, four bend (two face and two root bend) and three impact test specimens are to be taken from the test assembly as shown in Fig.8.

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 E4. The position of fracture in the transverse tensile test specimen is to be reported. The bend test specimens can be considered as complying with the requirements if, after bending, no crack or defect having any dimensions exceeding 3 mm can be seen on the outer surface of the test specimen.

Table E4			
Grade	Tensile test	Impact test	
	$R_m$ , minimum, N/mm <sup>2</sup>	Temperature °C	KV, J, minimum average
I II III	400	20 0 -20	34
I Y II Y III Y IV Y V Y	490	20 0 -20 -40 -60	
II Y40 III Y40 IV Y40	510	0 -20 -40	41

#### E 400 Two-run welding

401 When approval for use with two-run technique is requested, two butt-weld test assemblies are to be prepared.

For wires to be approved for use with the two-run technique only, no deposited metal test is required. In this case ap-

proval tests are limited to the butt weld tests described hereafter.

##### Preparation of test assemblies:

Two butt-weld test assemblies are to be prepared as specified in C300, except that one test assembly is to be 12—15 mm thick and the other is to be 20 mm thick.

If approval is required for welding of plates thicker than 20 mm, one assembly is to be prepared using a plate of 20 mm in thickness and the other using a plate of the greatest thickness for which approval is required.

The diameter of wire to be used for the test assemblies is to be in accordance with the manufacturer's recommendation and is to be reported for information.

The edge preparation of the test assemblies is to be as shown in Fig.13. Small deviations in the edge preparation may be allowed, if requested by the manufacturer. For assemblies using plate over 20 mm in thickness, the edge preparation used is to be reported for information.

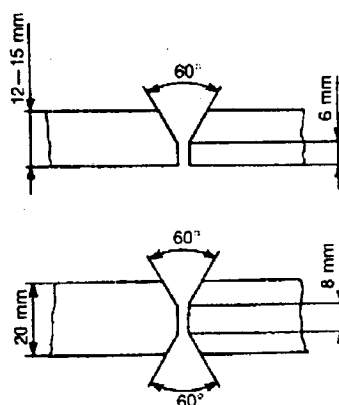


Fig. 13  
Typical edge preparation of two-run technique for wires

##### Test specimens:

Two transverse tensile, two bend (one from each side welded) and three impact test specimens are to be taken from each test assembly as shown in Fig.9.

When approval is required for two-run technique only, one longitudinal tensile test specimen is also to be machined from the thicker plate tested as shown in Fig.9.

This tensile specimen is to be cut with the longitudinal axis coinciding with the centre of the weld about 7 mm below the plate surface on the side from which the second run is made.

表 E3								
等 级	拉 力 试 验				冲击试验			
	$R_m$ 最小值 $N/mm^2$	$R_{eH}$ 最小值 $N/mm^2$	$A_5$ 最小值 %	$Z$ %	温度 ℃	$KV, J$ 最小平均值		
I II III	400-560	305	22	1 )	20 0 -20	34		
IY II Y III Y IV Y VY	490-660	375			20 0 -20 -40 -60			
II Y40 III Y40 IV Y40	510-690	400			0 -20 -40		41	
1) 断面收缩率应列入报告供备查。								

化学分析:  
制造厂商应提供熔敷焊缝金属的化学分析报告并应包含所有重要的合金元素的含量。

302 对接焊缝金属试验应按下述要求进行:

试件的制备:  
应在如图 8 所示的俯焊位焊制一块对接焊缝试件。  
试件应按 C202 所述的要求进行制备。

试样:  
应如图 8 所示, 从试件上截取两个横向拉力试样、四个弯曲试样(两个正弯、两个反弯)和三个冲击试样。  
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 E4 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, 如在其弯曲后, 试样凸起的一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。

表 E4			
等 级	拉 力 试 验	冲击试验	
	$R_m$ , 最小值 $N/mm^2$	温度 $^{\circ}C$	$KV, J$ 最小平均值
I	400	20	34
II		0	
III		-20	
IY	490	20	
II Y		0	
III Y		-20	
IV Y		-40	
VY		-60	
II Y40	510	0	41
III Y40		-20	
IV Y40		-40	

E 400 双道焊

401 当申请认可采用双道焊工艺时, 应制备两块对接焊缝试件。

对仅认可采用双道焊工艺的焊丝, 则不必进行熔敷金属试验。在此情况下, 认可试验仅限于此后所述的对接焊缝试验。

试件的制备:  
应按 C300 的规定焊制两块对接焊缝试件, 但一块试件应为 12 - 15mm 厚而另一块应为 20mm 厚。

如申请认可用于板厚大于 20mm 的焊接, 则一个试件采用 20mm 厚的板, 而另一个则采用申请认可的最厚的板。

试件所用的焊丝直径应按制造厂商推荐的并应列入报告供备查。

试件的坡口型式应如图 13 所示, 如制造厂商提出, 可允许坡口加工有小的差异。对使用板厚 20mm 以上的试件, 应将所采用的坡口型式列入报告以供备查。

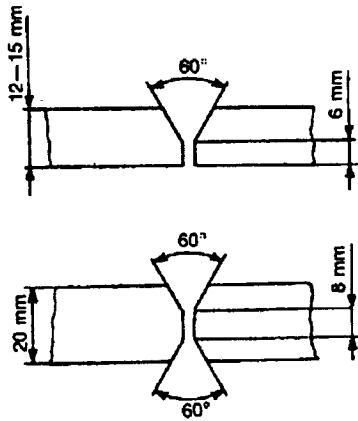


图 13 焊丝试验用双道焊工艺的典型坡口型式

试样:  
应如图 9 所示, 从每块试件上截取两个横向拉力试样、两个弯曲试样(每焊制面各弯一次)和三个冲击试样。

当仅申请认可用于双道焊工艺时, 则尚应如图 9 所示, 从送检的较厚板试件上机加工制备一个纵向拉力试样。

该试样的截取, 应使其纵轴线与焊制第二道那侧板表面下约 7mm 处的焊缝中心线相重合。

The impact test specimens are to be machined from each welded assembly from the positions and with the orientations shown in Fig.11.

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 E3 for the longitudinal tensile test specimens and Table E4 for the transverse tensile and impact test specimens. The bend test specimens can be considered as complying with the requirements if, after bending, no crack or defect having any dimensions exceeding 3 mm can be seen on the outer surface of the test specimen.

## E 500 Annual tests

501 Wires approved are to be subjected to at least the following tests:

Semi-automatic welding only:

One all-weld-metal test — one longitudinal tensile and three impact tests.

Automatic multi-run welding only:

One all-weld-metal test — one longitudinal tensile and three impact tests.

Automatic two-run welding only:

One butt-weld test with 20 mm minimum plate thickness — one transverse tensile, two bend and three impact tests. One longitudinal tensile test is also to be prepared for wire/gas combinations approved solely for the two-run technique.

Wires approved for both semi-automatic and automatic multi-run welding: One all-weld-metal test in semi-automatic technique — one tensile and three impact tests.

502 The test assemblies and specimens are to be prepared and tested in accordance with the same procedures as those for the initial approval tests using wire which is of about the medium size manufactured, except in the case of the two-run technique where the size of wire is to be according to the initial testing procedure.

503 The test results are to comply with the requirements for the initial approval tests.

## E 600 Upgrading

601 An approved wire may be granted a higher grade than that initially granted, provided that impact testing is carried out with satisfactory results at the temperature specified for the higher grade. However, for upgrading from grade I(T/M) to grade III(T/M) or from any grade to grade II Y(T/M) to V Y(T/M) and II Y40(T/M) to IV Y40(T/M), impact tests are to be carried out on specimens taken from butt weld test assemblies in addition to the normal requirements for annual testing.

## F. Combinations for Use in Electro-slag and Electro-gas Welding Processes

### F 100 General

101 Consumables intended for these welding processes will be divided into the following grades:

- for normal strength steels: I and II
- for high strength steels with minimum yield strength up to 355 N/mm<sup>2</sup>: I Y, II Y
- for high strength steels with minimum yield strength up to 390 N/mm<sup>2</sup>: II Y40.

Approval will be considered subject to compliance with the specified tests and requirements in 200.

### F 200 Initial tests

201 The following information is to be reported for the Society's consideration:

- joint designation, wire diameter, type of consumable nozzle, shielding gas if used, welding parameters, weld direction relative to final rolling direction of plates, tensile strength and chemical composition including applied grain refining elements for the base material.

Preparation of test assemblies:

Two test assemblies, one assembly with 20 mm plate thickness and one with 35 mm thickness, are to be made as shown in Fig.14.

Test specimens:

Two longitudinal and two transverse tensile test specimens, two side bend (alternatively one root bend and one face bend) and six impact (three with the notch located in the centre of the weld and three with the notch located at the fusion boundary) test specimens are to be taken from each test assembly as shown in Fig.14.

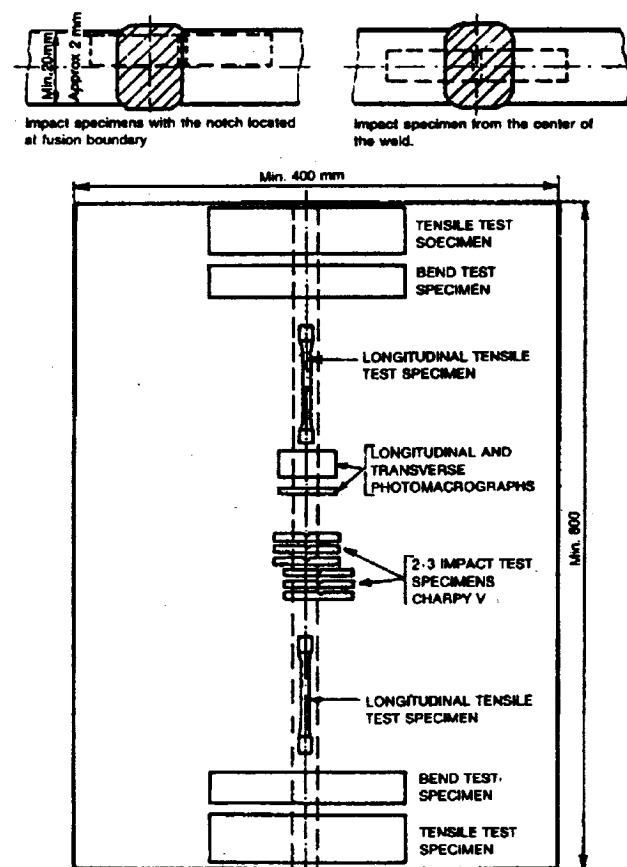


Fig. 14  
Electro-slag and electro-gas welding test assembly and location of specimens

Test requirements:

The test results are all to comply with the requirements given in Table F1.

应从每块焊接试件如图 11 所示的位置和方位上机加工制备冲击试样。

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 E3 (对纵向拉力试样) 和表 E4 (对横向拉力试样和冲击试样) 规定的要求。弯曲试样, 如在其弯曲后, 试样凸起的一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。

## E 500 年度试验

501 已认可的焊丝至少应进行下列试验:

仅用于半自动焊:

一次全熔质试验——一次纵向拉力试验和 3 次冲击试验;

仅用于全自动多道焊:

一次全熔质试验——一次纵向拉力试验和 3 次冲击试验;

仅用于全自动双道焊:

一次用最小板厚为 20mm 的对接焊缝试验——一次横向拉力试验、两次弯曲试验和 3 次冲击试验。

对于仅认可用于双道焊工艺的焊丝/气体配合, 尚应准备作一次纵向拉力试验。

对认可兼用于半自动和全自动多道焊工艺的焊丝: 用半自动焊工艺焊制一次全熔质试件——一次拉力试验和 3 次冲击试验。

502 应按初次认可试验相同的程序使用所生产的中等尺寸的焊丝制备试件、试样和进行试验, 但在采用双道焊工艺时, 焊丝的直径应符合初次试验程序的要求。

503 试验结果应全部符合对初次认可试验的要求。

## E 600 升级

601 一种已认可的焊丝可被授予比原授等级较高的等级, 只要其冲击试验是在对较高级所规定的温度下进行并具有满意的结果即可。但是, 对于从 I (T/M) 级升到 III (T/M) 级, 或从任何等级升到 II Y (T/M) 至 VY (T/M) 以及 II Y40 (T/M) 到 IV Y40 (T/M) 级时, 则除符合年度试验的一般要求外, 尚应对从对接焊缝试件上截取的试样进行冲击试验。

## F. 用于电渣焊和气电焊的配合

### F 100 一般要求

101 拟用于这些焊接工艺的焊接材料将分成下列等级:

- 普通强度钢用: I 和 II 级;
- 最低屈服强度  $< 355\text{N/mm}^2$  的高强度钢用: II Y、II Y 级;
- 最低屈服强度  $< 390\text{N/mm}^2$  的高强度钢用: II Y40 级。

经 200 规定的试验并符合要求, 将予以认可。

### F 200 初次试验

201 下列资料应列入报告供本社参考:

— 接头型式、焊丝直径、熔嘴类型、保护气体 (如采用时)、焊接参数、与板的最终轧制方向相应的焊缝方向, 抗拉强度和化学成份, 包括对母体材料所添加的细化晶粒元素。

试件的制备:

应如图 14 所示, 焊制两块试件, 一块试件用 20mm 厚的板焊制, 而另一块则用 35mm 厚的板焊制。

试样:

应如图 14 所示, 从每块试件上截取 2 个纵向拉力试样和 2 个横向拉力试样, 2 个侧弯曲试样 (亦可用一个反弯和一个正弯试样代替) 和 6 个冲击试样 (3 个缺口位于焊缝中心, 3 个缺口位于熔敷边界)。

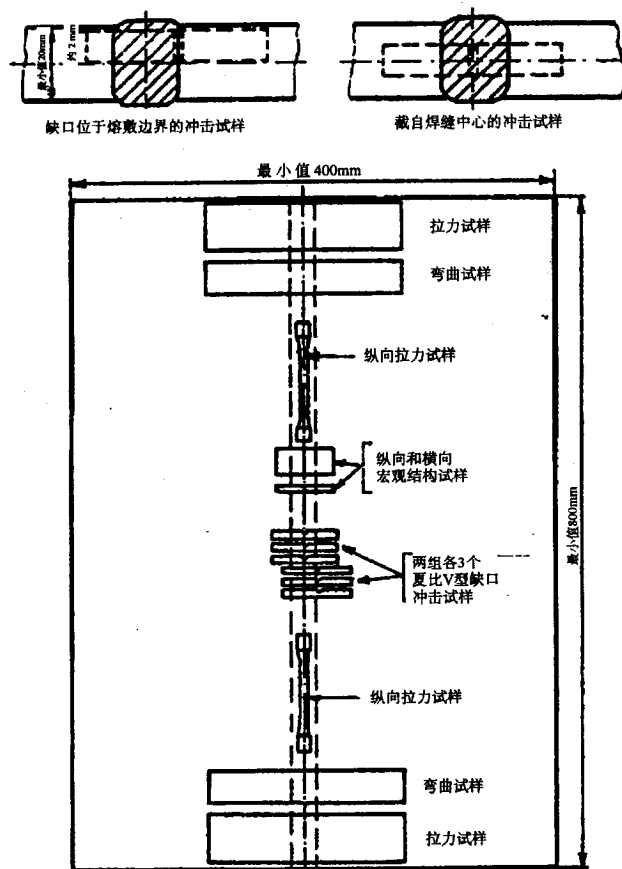


图 14 电渣焊和气电焊试件和试样位置

试验要求:

试验结果应全部符合表 F1 规定的要求。

**Table F1**

Grade	Tensile test			Impact test	
	$R_m$ , N/mm <sup>2</sup>	$R_{mH}$ , minimum, N/mm <sup>2</sup>	A <sub>5</sub> , minimum, %	Temperature °C	KV, J, minimum average
I II	400—560	305	22	20 0	34
I Y II Y	490—660	375		20 0	
II Y40	510—690	400		0	41

**Chemical analysis:**

Chemical analysis of the deposited weld metal is to be supplied by the manufacturer and is to include the content of all significant alloying elements.

**Photomicrographs:**

Two photomicrographs, approximately 2X magnification, one transverse and one longitudinal with respect to the weld are to be taken. The latter section is to be parallel to the plate surface.

**F 300 Annual tests**

**301** Combinations approved are to be subjected to at least the following tests:

One test assembly, using 20 mm plate thickness is to be prepared.

Two longitudinal, two bend and three impact test specimens are to be taken. The notch of the impact specimens is to be located in the centre of the weld.

One transverse photomicrograph is also to be taken from the test assembly.

**302** The preparation of the test assemblies and the mechanical properties are to be in accordance with the requirements for the initial approval tests.

**G. Welding Consumables for Welding of Steel Grades NV 2-4, NV 2-4L, NV 4-4 and NV 4-4L for Low-Temperature Applications**

**G 100 General**

**101** These welding consumables will be granted the following grades:

- for NV 2-4 and NV 2-4L: 5 (manual welding) and V (semi-automatic and automatic welding)
- for NV 4-4 and NV 4-4L: 5 Y (manual welding) and V Y (semi-automatic and automatic welding)

Approval will be considered subject to compliance with the specified tests and requirements in 200.

**102** Covered electrodes are to satisfy the requirements for low hydrogen electrodes, and will have the suffix H15, H10 or H5 added to the grade mark.

Flux cored or flux coated wires may also, at manufacturer's option, be submitted for hydrogen testing, and will have the suffix (H15), (H10) or (H5) added to the grade mark.

**103** Testing is to be carried out as specified in B (covered electrodes), C (wire/flux combinations) or E (wire/gas combinations) with the additional requirements specified in 200.

**G 200 Additional requirements**

**201** The base metal to be used for the butt weld tests is to be the same as that for which the welding consumable is intended.

**Impact tests:**

The specimens are to be broken at —60°C. Both single values and average values are to be reported.

Welding consumables intended for NV 2-4 and NV 4-4 only, may be impact tested at —55°C.

**Test requirements:**

The butt-weld test results are all to comply with the requirements given in Table G1.

**202** One additional butt-weld test is to be performed as follows:

**Preparation of test assembly:**

One butt-weld test is to be made in the downhand position. This test assembly is to be subjected to stress-relieving at 550 to 600°C prior to mechanical testing.

**Test specimens:**

One transverse tensile and three impact test specimens are to be taken from each test assembly.

**Test requirements:**

The test results are all to comply with the requirements given in Table G1.

**G 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. Impact testing, however, is to be carried out according to 200.

**Table G1**

Grade	Tensile test	Impact test — KV, J		
	$R_m$ , minimum, N/mm <sup>2</sup>	Temperature °C	KV, J, average	KV, J, minimum single value
5/V	400	—55 —60	41 34	27 23
5Y/VY	490	—55 —60	41 34	27 23

表 F1

等 级	拉 力 试 验			冲 击 试 验	
	$R_m$ N/mm <sup>2</sup>	$R_{eH}$ 最小值 N/mm <sup>2</sup>	$A_5$ 最小值 %	温 度 ℃	KV, J 最小平均值
I	400-560	305	22	20	34
II				0	
TY	490-660	375		20	
II Y				0	
II Y40	510-690	400		0	41

## 化学分析:

制造厂商应提供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。

## 宏观试样:

应拍摄两个宏观试样, 放大约 2 倍, 表示有关焊缝的一个横向截面和一个纵向截面, 后一个截面平行于板的表面。

## F 300 年度试验

301 经认可的焊丝/焊剂配合至少应进行下列试验:

应采用 20mm 厚的板制备一块试件。

应截取两个纵向试样, 两个弯曲试样和三个冲击试样, 冲击试样的缺口应位于焊缝中心。

还应从试件上截取一个横向宏观试样。

302 试件的制备及其机械性能应符合对初次认可试验的要求。

## G. 焊接低温用 NV2-4、NV2-4L、NV4-4 和 NV4-4L 级钢的焊接材料

## G 100 一般要求

101 焊接材料将被授予下列等级:

- 对于 NV2-4 和 NV2-4L: 5 (手工焊) 和 V (半自动焊和自动焊)
- 对于 NV4-4 和 NV4-4L: 5Y (手工焊) 和 VY (半自动焊和自动焊)

符合 200 规定的试验和要求, 将予以认可。

102 药皮焊条应符合对低氢焊条的要求, 并在其等级符号后添加后缀 H15、H10 或 H5。

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后缀 (H15)、(H10) 或 (H5)。

103 应按 B (药皮焊条)、C (焊丝/焊剂配合) 或 E (焊丝/气体配合) 的规定和 200 的附加要求进行试验。

## G 200 附加要求

201 对接焊缝试件所用的母体材料应与拟用的焊接材料相同。

## 冲击试验:

试样应在 - 60℃ 下冲断, 其单值和平均值均应列入报告。

拟仅用于 NV2-4 和 NV4-4 级钢的焊接材料, 可在 - 55℃ 下进行冲击试验。

## 试验要求:

对接焊缝试验结果应全部符合 G1 规定的要求。

202 应按下述要求进行一次附加对接焊缝试验:

## 试件的制备:

应在俯焊位置焊制一块对接焊缝试件, 该试件在机械试验前, 应在 550 至 600℃ 下消除内应力。

## 试样:

应从每块试件上截取一个横向拉力试样和三个冲击试样。

## 试验要求:

试验结果应全部符合 G1 规定的要求。

## G 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, 但是冲击试验应按 200 的规定进行。

表 G1

等 级	拉 力 试 验	冲 击 试 验 - KV, J		
	$R_m$ 最小值 N/mm <sup>2</sup>	温 度 ℃	平均值 KV, J	最小单值 KV, J
5/V	400	- 55	41	27
		- 60	34	23
5Y/VY	490	- 55	41	27
		- 60	34	23

## H. Welding Consumables for Low-Alloy, Heat-Resisting Steels (NV 0,3Mo, NV 1Cr 0,5Mo and NV 2,25Cr 1Mo)

### H 100 General

101 The all-weld-metal and butt-weld tests are all to be carried out as specified in B (covered electrodes), C (wire/flux combinations) or E (wire/gas combinations) with the additional requirements specified in 200.

102 Covered electrodes are to satisfy our requirements for low hydrogen electrodes, and will have the suffix H15, H10 or H5 added to the grade mark.

Flux cored or flux coated wires may also, at manufacturer's option, be submitted for hydrogen testing, and will have the suffix (H15), (H10) or (H5) added to the grade mark.

### H 200 Additional requirements

201 The base metal to be used for the butt-weld tests is to be the same as that for which the welding consumable is intended.

Steel grades A, B or D may, however, be used for the all-weld-metal tests when this is found to be convenient.

202 The all-weld-metal test is to be performed as follows:

Two longitudinal tensile test specimens are to be taken from each test assembly as shown in Fig.15.

Pre- and post-heating:

The temperature ranges to be used for pre-heating, inter-pass temperature and annealing is shown in Table H1.

Table H1		
Consumables for welding steel grade	Pre-heat and inter-pass temperature °C	Annealing temperature °C
NV 0,3Mo	100—200	660—700
NV 1Cr 0,5Mo	200—300	680—720
NV 2,25Cr 1Mo	200—300	720—770

The finished test plates are to be uniformly heated to the annealing temperature, kept at this temperature for approximately 30 minutes and cooled in still air.

Tensile tests:

One specimen from each assembly is to be tested at room temperature (approximately 20°C), while the other is to be tested at  $400 \pm 5^\circ\text{C}$ . The elevated test temperature is to be properly controlled (e.g. by thermocouples).

Test requirements:

The test results are all to comply with the requirements given in Table H2.

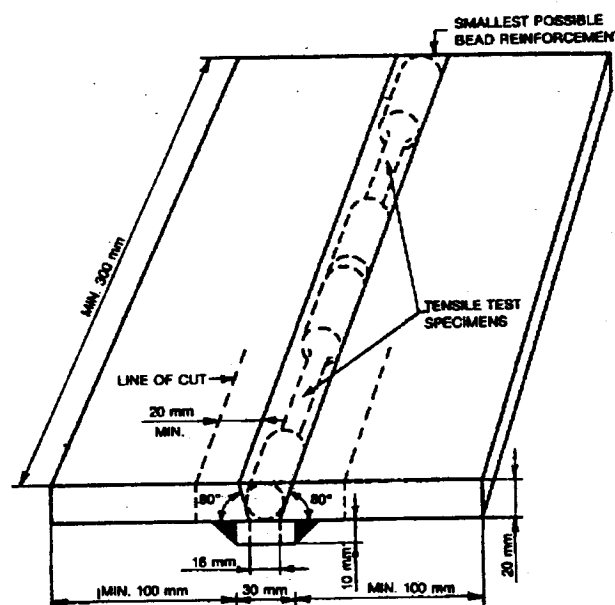


Fig. 15  
All-weld-metal test

Table H2					
Consumables for welding steel grade	Test temperature °C	Tensile test			
		$R_m$ minimum, N/mm <sup>2</sup>	$R_{eH}/R_{p0,2}$ minimum, N/mm <sup>2</sup>	$A_5$ minimum, %	$Z$ %
NV 0,3Mo	20 400	440 1)	305	18	1)
NV 1Cr 0,5Mo	20 400	470 1)			
NV 2,25Cr 1Mo	20 400	480 1)			

1) These values are to be reported for information.

203 Butt-weld tests are to be performed as follows:

The transverse tensile and bend tests are to be tested at room temperature.

Test requirements:

The tensile test results are to comply with the requirements given in Table H3.

Table H3	
Consumables for welding steel grade	$R_m$ minimum, N/mm <sup>2</sup>
NV 0,3Mo	440
NV 1Cr 0,5Mo	470
NV 2,25Cr 1Mo	480

### H 300 Chemical composition

301 The test specimen for chemical analysis of the deposited metal is to be made on a steel plate as shown in Fig.16.

# H. 低合金钢、耐热钢 (NV0.3Mo、NV1Cr 0.5Mo 和 NV2.25Cr 1Mo) 的焊接材料

## H 100 一般要求

101 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) 及 200 的附加要求进行。

102 药皮焊条应符合本社对低氢焊条的要求并将在其等级符号后添加后缀 H15、H10 或 H5。

制造厂商可自行决定是否将其药芯焊丝或药皮焊进行测氢试验,并将在其等级符号后添加后缀 (H15)、(H10)或 (H5)。

## H 200 附加要求

201 用于对接焊缝试件的母体金属应与拟用的焊接材料相同。

但是,如认为方便时,用于全熔质试验的母体材料可采用 A、B 或 D 级钢。

202 全熔质试验应按下述要求进行:

应按图 15 所示,从每块试件上截取两个纵向拉力试样。

预热和焊后加热:

预热温度、层间温度和退火温度所用范围如表 H1 所示。

表 H1		
焊接下列钢用的 焊接材料	预热和层间温度 ℃	退火温度 ℃
NV0.3Mo	100 - 200	660 - 700
NV 1Cr 0.5Mo	200 - 300	680 - 720
NV 2.25Cr 1Mo	200 - 300	720 - 770

焊完的试板应均匀受热至退火温度,保持该温度约 30 分钟并在静止空气中冷却。

拉力试验:

应从每块试件上截取一个试样,一个在常温下 (约 20℃) 而另一个则在  $400 \pm 5^\circ\text{C}$  下进行试验。提高的试验温度应予适当控制 (例如: 采用热电偶)。

试验要求:

试验结果应全部符合表 H2 规定的要求。

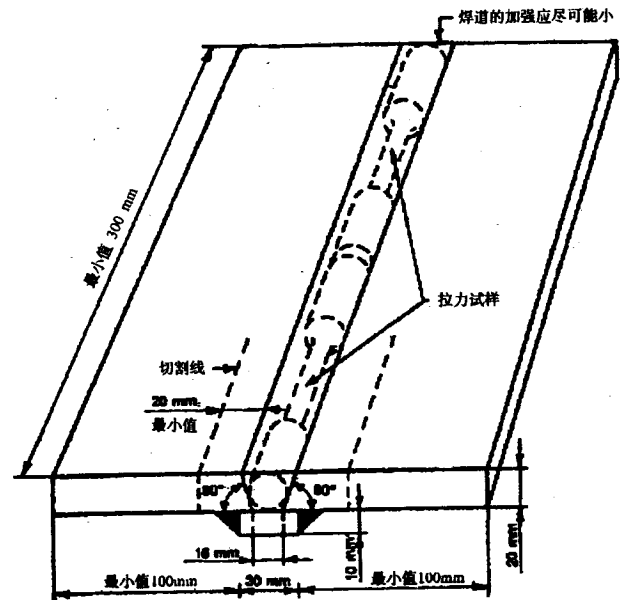


图 15 全熔质试验

表 H2					
焊接下列钢级的 焊接材料	试验温度 ℃	拉力试验			
		$R_m$ 最小值 N/mm <sup>2</sup>	$R_{eH}/R_{p0.2}$ 最小值 N/mm <sup>2</sup>	$A_5$ 最小值 %	$Z$ %
NV0.3Mo	20 400	440 1)	305	18	1)
NV 1Cr 0.5Mo	20 400	470 1)			
NV 2.25Cr 1Mo	20 400	480 1)			

1) 这些值应列入报告供备查。

203 对接焊缝试验应按下述要求进行:

应在常温下进行横向拉力试验和弯曲试验。

试验要求:

拉力试验结果应符合表 H3 规定的要求。

表 H3

焊接下列钢级的焊接材料	$R_m$ , 最小值, N/mm <sup>2</sup>
NV 0.3Mo	440
NV 1Cr 0.5Mo	470
NV 2.25Cr 1Mo	480

## H 300 化学成份

301 应如图 16 所示,在钢板上截取对熔敷金属进行化学分析的试样。

#### Preparation of test assembly:

One such test specimen is to be made for each dimension of welding consumable to be approved. Chips for chemical analysis are to be machined, so that the distance between the final cut and the plate corresponds to at least 4 layers of weld.

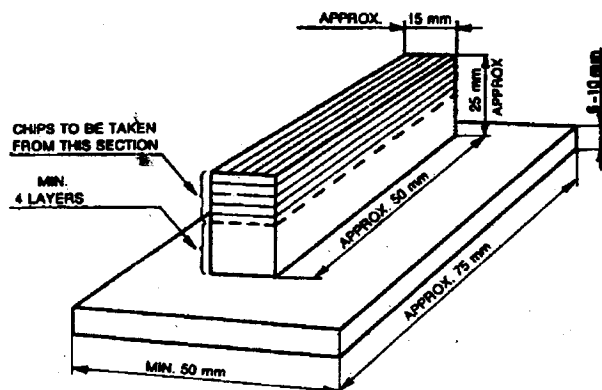


Fig. 16  
Test specimen for chemical analysis

Table H4

Consumables for welding steel grade	C maximum %	Si maximum %	Mn %	Cr %	Mo %	P maximum %	S maximum %
NV 0,3Mo	0,12	0,8	0,6—1,6	—	0,3—0,7	0,04	0,03
NV 1Cr 0,5Mo			0,4—1,0	0,7—1,4	0,4—0,7		
NV 2,25Cr 1Mo			0,4—1,0	2,0—2,6	0,9—1,2		

### I. Welding Consumables for Welding of Steel Grades NV 1,5Ni, NV 3,5Ni, NV 5Ni and NV 9Ni

#### I 100 General

101 The all-weld-metal and butt-weld tests are all to be carried out as specified in B (covered electrodes), C (wire/flux combinations) or E (wire/gas combinations) with the additional requirements specified in 200.

102 Covered electrodes are to satisfy the requirements for low hydrogen electrodes, and will have the suffix H15, H10 or H5 added to the grade mark.

Flux cored or flux coated wires may also, at manufacturer's option, be hydrogen tested, and have the suffix (H15), (H10) or (H5) added to the grade mark.

103 The plate thickness for the butt-weld tests is normally to be between 11 mm and 20 mm. If plates with thickness less than 11 mm are used, the requirement regarding absorbed energy is to be agreed upon with the Society in each case.

104 Welding consumables approved for welding of a higher grade within this group may also be used for the lower grades.

#### I 200 Additional requirements

201 The all-weld-metal tests are to be performed as follows:

##### Test specimens:

One longitudinal tensile and at least three impact test specimens are to be machined from each test assembly.

##### Test requirements:

302 Each test specimen is to be analysed separately.

##### Test requirements:

The test results are to comply with the requirements given in Table H4.

#### H 400 Annual tests

401 Consumables approved are to be subjected to at least the following tests:

Chemical analysis of the deposited metal of two different dimensions of the approved combinations are to be carried out.

402 The preparation of the test assemblies and the test requirements are to be in accordance with the requirements for the initial approval tests specified in 300.

The longitudinal tensile and impact test results are to satisfy the requirements given in Table I1.

202 The butt-weld tests are to be performed as follows:

##### Bend tests:

If the composition and mechanical properties of the deposited metal differ markedly from the composition and properties of the base metal, the two transverse bend tests may be replaced by longitudinal bend tests. If this is done, one face bend and one root bend test are to be carried out.

The dimensions of the longitudinal bend specimens are to be as follows:

Length, minimum 150 mm

Width 38 mm

Thickness 10 mm

The weld reinforcements are to be removed, and the root/face side of the specimens is to be machined so that the required thickness is obtained. The edges of the specimens may be rounded to a radius not exceeding 2 mm.

##### Charpy V-notch impact tests:

At least three impact test specimens are to be machined from each test assembly.

##### Test requirements:

The test results are all to comply with the requirements given in Table I1. The position of fracture in the transverse tensile test specimen is to be reported. The bend test specimens can be considered as complying with the requirements if, after bending through an angle of 180° over a former with a diameter of 40 mm, no cracks or defects can be seen on the outer surface of the test specimen. The reduction of area is to be reported for information.

#### 试件的制备:

对申请认可的每种尺寸的焊接材料均应制备一块这样的试样。  
化学分析用切片应采用机加工方法截取,使其最终切口和板面间的距离至少为4层焊道的厚度。

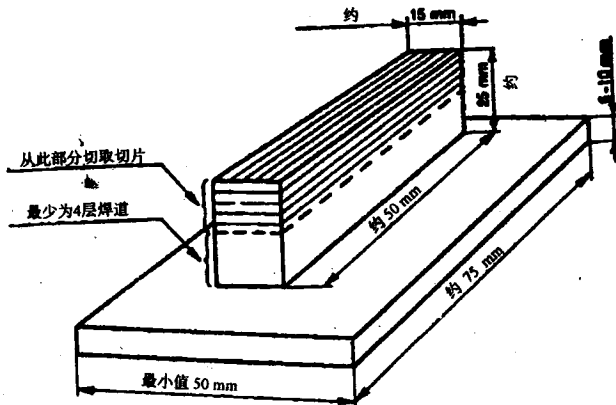


图 16 化学分析用试样

表 H4							
焊接下列钢级的 焊接材料	C 最大值 %	Si 最大值 %	Mn %	Cr %	Mo %	P 最大值 %	S 最大值 %
NV 0.3Mo	0.12	0.8	0.6 - 1.6	-	0.3 - 0.7	0.04	0.03
NV 1Cr 0.5Mo			0.4 - 1.0	0.7 - 1.4	0.4 - 0.7		
NV 2.25Cr 1Mo			0.4 - 1.0	2.0 - 2.6	0.9 - 1.2		

### I. 焊接NV 1.5Ni、NV 3.5Ni、NV 5Ni和NV 9Ni级钢的焊接材料

#### I 100 一般要求

101 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。

102 药皮焊条应符合对低氢焊条的要求,并将在其等级符号后添加后缀 H15、H10、或 H5。

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后缀 (H15)、(H10)、或 (H5)。

103 对接焊缝试验用的钢板厚度通常应在 11mm 到 20mm 之间。如使用厚度小于 11mm 的钢板,有关冲击功值的要求则应根据每种情况取得本社的同意。

104 允许用于本组内较高等级钢材的焊接材料也可用于较低等级钢材的焊接。

#### I 200 附加要求

201 全熔质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纵向拉力试样和至少三个冲击试验试样。

试验要求:

302 每块试样应分别进行分析。

试验要求:

试验结果应符合表 H4 规定的要求。

#### H 400 年度试验

401 已认可的焊接材料至少应进行下列试验:

应对已认可的配合中的两种不同直径的焊接材料的熔敷金属进行化学分析。

402 试件的制备和试验要求均应符合 300 对初次认可试验的要求。

纵向拉力试验和冲击试验的结果应符合表 I1 规定的要求。

202 对接焊缝试验应按下述规定进行:

弯曲试验:

如熔敷金属的化学成份和机械性能明显不同于母体材料的成份和机械性能,则两个横向弯曲试验可由纵向弯曲试验替代,如这样做,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 150mm

宽度: 38mm

厚度: 10mm

应去除焊缝加强,试样的反面和正面应进行机加工以获得规定的厚度,试样的边缘应加工成半径不超过 2mm 的圆角。

夏比 V 型缺口冲击试验:

应从每块试件上机加工制备至少三个冲击试样。

试验要求:

试验结果应全部符合表 I1 规定的要求,横向拉力试样的断裂位置应列入报告。如弯曲试样绕直径为 40mm 的芯轴弯曲 180° 角时,试样凸起的一面未出现有任何裂纹或缺陷,则该试验视为符合要求。断面收缩率应列入报告供备查。

Table II						
Consumables for welding steel grade	Tensile test				Impact test	
	All-weld-metal			Butt weld	Temperature °C	KV, J, minimum average
	R <sub>m</sub> , minimum, N/mm <sup>2</sup>	R <sub>eH</sub> , <sup>1)</sup> minimum, N/mm <sup>2</sup>	A <sub>5</sub> , minimum, %	R <sub>m</sub> , minimum, N/mm <sup>2</sup>		
NV 1,5 Ni	420	275	25	420	-95	34
NV 3,5 Ni	440	345		440	-115	
NV 5 Ni	570	390		570	-140	
NV 9 Ni	640	490		660	-196	

1) In case of no marked yield point, the proof stress at 0,2% elongation (R<sub>p0,2</sub>) is to be reported.

### I 300 Annual test

301 Depending on whether it concerns electrodes, wire/flux combination of 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 II.

### I 400 Other welding consumables

401 Welding consumables with yield stress and/or tensile strength less than that specified under 300, may be approved for welding of steel grade NV 9 Ni. Approval testing is to be carried out according to the programme specified above.

The maximum permissible stress in welded vessels is, however, in such cases to be based on the mechanical properties obtained from the approval tests.

## J. Welding Consumables for Welding of Extra High Strength Steels

### J 100 General

101 Depending on the impact test temperature, welding consumables for extra high strength steels are divided into the following grades:

- Grade 3/III, test temperature - 20°C
- Grade 4/IV, test temperature - 40°C
- Grade 5/V, test temperature - 60°C.

The following symbols are added to the grade mark to indicate yield strength of the base metal for which the welding consumable is intended:

Symbols added to grade mark	Base material designation
Y42	NV 420
Y46	NV 460
Y50	NV 500
Y55	NV 550
Y62	NV 620
Y69	NV 690

Each higher quality grade includes the one (or those) below. Grade A.. and D.. steels according to Pt.2 Ch.2 Sec.1 are to be welded using welding consumables of at least quality grade 3/III, grade E.. steels using at least quality grade 4/IV and grade F.. steels using at least quality grade 5/V as shown in the following table :

Consumable grade	Steel grades covered
3/IIIIY.. 4/IVY.. 5/VY..	D.. and A.. E.., D.. and A.. F.., E.., D.. and A..

Welding consumables approved with grades ..Y42, ..Y46 and ..Y50 are also considered suitable for welding steels in the two strength levels below that for which they have been approved. Welding consumables approved with grades

..Y55, ..Y62 and ..Y69 are also considered suitable for welding steels in the strength level below that for which they have been approved.

The Society may, in individual cases, restrict the range of application in (up to) such a way, that approval for any one strength level does not justify approval for any other strength level.

102 The all-weld-metal and butt-weld tests are all to be carried out as specified in B (covered electrodes), C (wire/flux combinations) or E (wire/gas combination) with the additional requirements specified in 200.

103 Covered electrodes in yield strength group Y50 and below are to satisfy the hydrogen test requirements for at least the suffix H10. Electrodes in yield strength group ranging from Y55 up to and including Y69 are to satisfy the hydrogen test requirements for the suffix H5.

Flux cored or flux coated wires may also, at manufacturer's option, be hydrogen tested, and have the suffix (H10) or (H5) added to the grade mark.

104 The plate thickness for the butt-weld tests is normally to be between 11 mm and 20 mm. If plates with thickness less than 11 mm are used, the requirement regarding absorbed energy is to be agreed upon with the Society in each case.

### J 200 Additional requirements

201 The all-weld-metal tests are to be performed as follows:

Test specimens:

One longitudinal and at least three impact test specimens are to be machined from each test assembly.

Test requirements:

The longitudinal tensile and impact test results are to satisfy the requirements given in Table J1.

202 The butt-weld tests are to be performed as follows:

Test specimens :

One transverse tensile, two transverse bend tests (face and root bend) and at least three impact test specimens are to be machined from each assembly.

If the composition and mechanical properties of the deposited metal differ markedly from the composition and properties of the base metal, the two transverse bend tests may be replaced by longitudinal bend tests. If this is done, one face bend and one root bend test are to be carried out.

The dimensions of the longitudinal bend specimens are to be as follows:

Length, minimum 150 mm

Width 38 mm

Thickness 10 mm

The weld reinforcements are to be removed, and the root/face side of the specimens is to be machined so that the