

On the other remaining section, the weld on the second side is to be gouged or machined and the section fractured using the same procedure. The fractured surfaces are to be examined and there is to be no evidence of incomplete penetration or internal cracking and they are to be reasonably free from porosity.

#### B 600 Covered electrodes for gravity or contact welding

**601** Where an electrode is submitted solely for approval for use in contact welding using automatic gravity or similar welding devices, deposited metal tests, fillet weld tests (see 500) and, where appropriate, butt weld tests similar to those for normal manual electrodes are to be carried out using the process for which the electrode is recommended by the manufacturer.

Where an electrode is submitted for approval for use in contact welding using automatic gravity or similar welding devices in addition to normal manual welding, fillet weld and, where appropriate, butt weld tests, using the gravity or other contact device as recommended by the manufacturer, are to be carried out in addition to the normal approval tests.

##### Preparation of test assembly:

The fillet welding is to be carried out using the welding process recommended by the manufacturer, with the longest size of the electrode manufactured. The manufacturer's recommended current range is to be reported for each electrode size.

#### B 700 Deep penetration electrodes

**701** Deep penetration electrodes will be approved as grade 1 electrode only. The suffix DP will be added.

**702** If an electrode approved as a normal penetration electrode is also desired approved as a deep penetration electrode for downhand butt welding and horizontal-vertical fillet welding, the additional tests given below are to be carried out.

**703** When a manufacturer states that an electrode having deep penetrating properties, also can be used for downhand butt welding of thicker plates with bevelled edges, the electrode will be tested as a normal penetration electrode and the full series of tests in the downhand position are to be carried out, together with the deep penetration tests given below.

**704** When an electrode is recommended for deep penetration welding of butt joint and horizontal-vertical fillets only, the tests given below are required.

##### Preparation of butt weld test assemblies:

Two plates of thickness equal to twice the diameter of the core of the electrode plus 2 mm are to be butt welded, with one downhand run of welding from each side, see Fig.5.

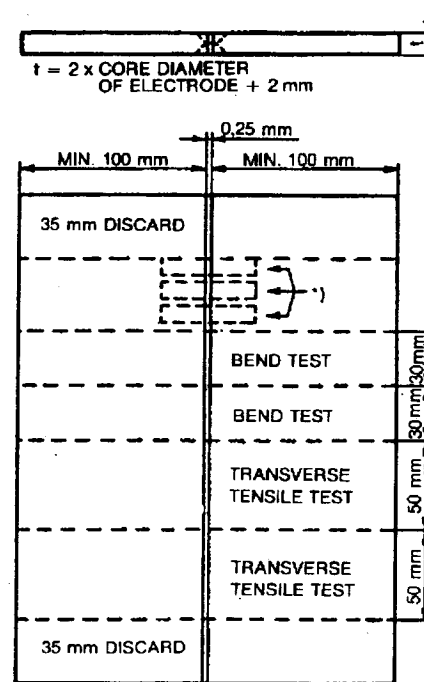
The joint edges are to be prepared square and smooth. The gap is not to exceed 0,25 mm after the tack welding.

The test assembly is to be welded with and 8 mm diameter electrode or the largest size manufactured if this is less than 8 mm.

##### Butt weld test specimens:

Two 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.5.

The test specimens are to be prepared according to A700.



CHARPY V-NOTCH TEST SPECIMENS FROM DOWNHAND AND VERTICAL TEST ASSEMBLIES. THE TEST SPECIMENS ARE TO BE CUT AS SHOWN IN FIG. 2.

Fig. 5  
Deep penetration butt weld tests

##### Butt weld test requirements:

The transverse tensile strength is not to be less than 400 N/mm<sup>2</sup>.

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.

The average impact value for the three specimens taken from the centre of the weld is not to be less than 47 J at +20°C.

##### Preparation of fillet weld test assemblies:

A fillet weld test assembly is to be prepared as shown in Fig.6. The welding is to be carried out in one run for each fillet weld, with plate A in the horizontal plane during welding. The length of the fillet weld is to be 160 mm and the gap between the plates is not to exceed 0,25mm.

One side is to be welded with 4 mm diameter electrode and the second side is to be welded with the maximum size of electrode manufactured. The welding current used is to be within the range recommended by the manufacturer and the welding is to be carried out using normal welding practice.

The welded assembly is to be cut by sawing or machining about 35 mm from the ends of the fillet welds and the joints are to be ground, polished and etched.

##### Fillet weld test requirements:

The welding of the fillet made with a 4 mm diameter electrode is to show a penetration of 4 mm, see Fig.6, and the corresponding penetration of the fillet made with the maximum size electrode is to be reported.

而折断, 对第三个截面应把第二侧的焊缝刨去或机加工去除, 并以同样的方法将截面折断。检查断面表面应无未焊透区、内部开裂, 和完全没有气孔。

### B 600 重力焊或接触焊用药皮焊条

601 如送检焊条仅允许用于采用自动重力焊或类似焊接方法的接触焊, 则应使用由制造厂商推荐焊条的焊接规程进行熔敷金属试验, 填角焊缝试验 (见 500), 并且, 如适用, 还应进行类似对普通手工焊条的对接焊缝试验。

如送检焊条除允许用于普通手工焊外, 还可用于采用自动重力焊和类似焊接方法的接触焊, 则除一般认可试验外, 还应采用由制造厂所推荐的重力焊或其他方法的接触焊进行填角焊缝和对接焊缝 (适用时) 的试验。

试件的焊制:

应采用制造厂推荐的焊接规程及其制造的最粗的焊条进行填角焊试件的焊制。制造厂商应提供每种尺寸的焊条推荐的焊接电流范围。

### B 700 深熔焊条

701 仅有深熔焊条才能被认可为 1 级焊条, 后缀加 DP。

702 如已认可作为普通熔深的焊条也申请认可作为用于对接俯焊和横向填角立焊的深熔焊条时, 则应进行下列规定的附加试验。

703 当制造厂说明具有深熔特性的焊条也能用于已开坡口厚板的对接俯焊时, 则该焊条将作为普通熔深的焊条进行试验, 且应在进行下列规定的深熔试验的时候还要进行俯焊位置下的全套试验。

704 当焊条被推荐为深熔焊条并仅用于对接焊和横向填角立焊时, 则仅要求进行下列规定的试验。

对接焊试件的焊制:

将厚度等于焊芯直径的两倍加 2mm 的两块板, 采用每侧单道俯焊进行对接焊, 见图 5。

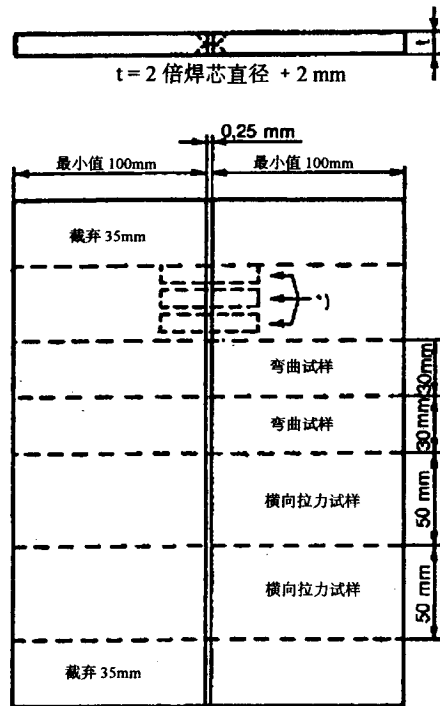
接头的边缘应加工得正直而光滑, 点固焊后的间隙不得超过 0.25mm。

试件应采用直径 8mm 的焊条施焊, 如所生产的焊条最大直径小于 8mm, 可采用所生产的最大直径的焊条施焊。

对接焊缝试样:

应从每块试件上截取两个横向拉力试样、两个弯曲试样 (一个正弯试样和一个反弯试样) 和 3 个冲击试样, 如图 5 所示。

试样应按 A700 的要求制备。



从俯焊和立焊试件上截取夏比V型缺口试样, 试样应如图2所示截取

图 5 深熔对接焊缝试件

对接焊缝试验的要求:

横向抗拉强度不得小于  $400\text{N/mm}^2$ 。

弯曲试样弯曲后, 如在试样的凸出边表面上未出现任何超过 3mm 的裂纹或缺陷, 则视为符合要求。取自焊缝中心的三个冲击试样在  $+20^\circ\text{C}$  下的平均冲击值不得小于 47J。

角焊缝试件的焊制:

应焊制一块如图 6 所示的角焊缝试件。对每个角焊缝采用单道焊施焊, 焊接时 A 板应为水平, 角焊缝的焊缝长度应为 160mm, 且板的间隙不得超过 0.25mm。

一侧角焊应使用直径 4mm 的焊条施焊, 另一侧角焊应采用所生产的最大直径的焊条施焊, 所用的焊接电流应在制造厂商推荐的范围内。并且应采用常规焊接规程施焊。

应用锯或机械从角焊缝的两端各切去约 35mm 长的一段, 接头处应进行研磨、抛光和腐蚀。

角焊缝试验要求:

采用直径 4mm 的焊条焊接的角焊缝应能显示 4mm 的熔深, 见图 6, 采用最大直径的焊条焊接的角焊缝的相应熔深应列入报告。

而折断, 对第三个截面应把第二侧的焊缝刨去或机加工去除, 并以同样的方法将截面折断。检查断口表面应无未焊透区、内部开裂, 和完全没有气孔。

### B 600 重力焊或接触焊用药皮焊条

601 如送检焊条仅允许用于采用自动重力焊或类似焊接方法的接触焊, 则应使用由制造厂商推荐焊条的焊接规程进行熔敷金属试验, 填角焊缝试验 (见 500), 并且, 如适用, 还应进行类似对普通手工焊条的对接焊缝试验。

如送检焊条除允许用于普通手工焊外, 还可用于采用自动重力焊和类似焊接方法的接触焊, 则除一般认可试验外, 还应采用由制造厂所推荐的重力焊或其他方法的接触焊进行填角焊缝和对接焊缝 (适用时) 的试验。

试件的焊制:

应采用制造厂推荐的焊接规程及其制造的最粗的焊条进行填角焊试件的焊制。制造厂商应提供每种尺寸的焊条推荐的焊接电流范围。

### B 700 深熔焊条

701 仅有深熔焊条才能被认可为 1 级焊条, 后缀加 DP。

702 如已认可作为普通熔深的焊条也申请认可作为用于对接俯焊和横向填角立焊的深熔焊条时, 则应进行下列规定的附加试验。

703 当制造厂说明具有深熔特性的焊条也能用于已开坡口厚板的对接俯焊时, 则该焊条将作为普通熔深的焊条进行试验, 且应在进行下列规定的深熔试验的时候还要进行俯焊位置下的全套试验。

704 当焊条被推荐为深熔焊条并仅用于对接焊和横向填角立焊时, 则仅要求进行下列规定的试验。

对接焊试件的焊制:

将厚度等于焊芯直径的两倍加 2mm 的两块板, 采用每侧单道俯焊进行对接焊, 见图 5。

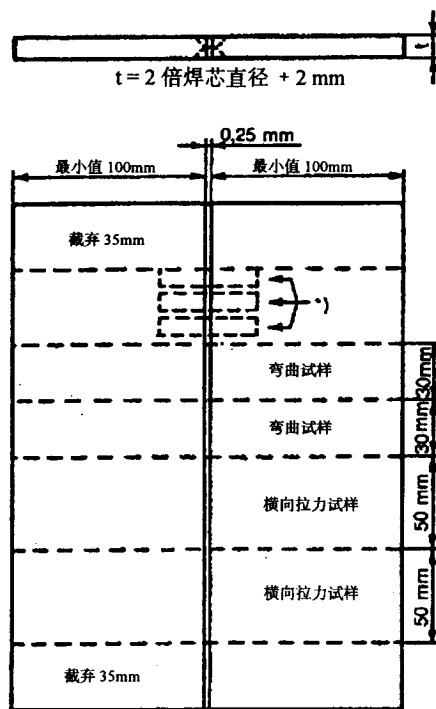
接头的边缘应加工得正直而光滑, 点固焊后的间隙不得超过 0.25mm。

试件应采用直径 8mm 的焊条施焊, 如所生产的焊条最大直径小于 8mm, 可采用所生产的最大直径的焊条施焊。

对接焊缝试样:

应从每块试件上截取两个横向拉力试样、两个弯曲试样 (一个正弯试样和一个反弯试样) 和 3 个冲击试样, 如图 5 所示。

试样应按 A700 的要求制备。



从俯焊和立焊试件上截取夏比V型缺口试样, 试样应如图2所示截取

图 5 深熔对接焊缝试件

对接焊缝试验的要求:

横向抗拉强度不得小于  $400\text{N/mm}^2$ 。

弯曲试样弯曲后, 如在试样的凸出边表面上未出现任何超过 3mm 的裂纹或缺陷, 则视为符合要求。取自焊缝中心的三个冲击试样在  $+20^\circ\text{C}$  下的平均冲击值不得小于 47J。

角焊缝试件的焊制:

应焊制一块如图 6 所示的角焊缝试件。对每个角焊缝采用单道焊施焊, 焊接时 A 板应为水平, 角焊缝的焊缝长度应为 160mm, 且板的间隙不得超过 0.25mm。

一侧角焊应使用直径 4mm 的焊条施焊, 另一侧角焊应采用所生产的最大直径的焊条施焊, 所用的焊接电流应在制造厂商推荐的范围内。并且应采用常规焊接规程施焊。

应用锯或机械从角焊缝的两端各切去约 35mm 长的一段, 接头处应进行研磨、抛光和腐蚀。

角焊缝试验要求:

采用直径 4mm 的焊条焊接的角焊缝应能显示 4mm 的熔深, 见图 6, 采用最大直径的焊条焊接的角焊缝的相应熔深应列入报告。

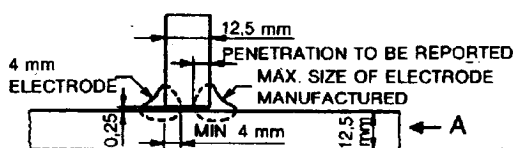


Fig. 6  
Deep penetration fillet weld test

## B 800 Annual tests

**801** Covered electrodes for normal and fillet welding are to be tested as follows:

Two all-weld metal test assemblies are to be prepared in accordance with 200. The extent of testing and mechanical requirements are to be as given in 200.

These requirements also applies to electrodes which are approved for fillet welding only.

**802** Covered electrodes for gravity or contact welding are to be tested as follows:

One deposited metal test assembly using the gravity or other contact device as recommended by the manufacturer is to be prepared. If this electrode is approved also for normal manual arc welding, the annual test is to be performed according to 801.

**803** Covered electrodes for deep penetration are to be tested as follows:

Two plates are to be prepared as given in 700. One transverse tensile test specimen, two bend (one face and one root) test and three impact test specimens are to be prepared. At each cut in the test assembly, the joints are to be examined to ensure that complete fusion has taken place.

**804** For those electrodes which are approved for both normal penetration welding and for deep penetration welding in the downhand position, deep penetration weld tests are to be carried out in addition to the deposited metal tests for normal penetration.

Annual test requirements:

The tensile strength, yield stress, elongation and impact test results are all to comply with the requirements for initial approval tests.

Additional tests:

If any of the above tests fails, re-testing is to be carried out in accordance with A900.

## B 900 Upgrading

**901** An approved electrode 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 1 to grade 3, or from any grade to grade 2, 3, 4, 5 Y H15/Y H10/Y H5 and 2, 3, 4 Y40 H15/Y H10/Y H5, impact tests are to be carried out on specimens taken from butt weld test assemblies (downhand, horizontal-vertical, vertical or overhead as applicable), in addition to the normal requirements for annual testing. Upgrading of electrodes from grade H15 to grade H10 or H5 may also be consid-

ered, provided that hydrogen tests are carried out in accordance with 400. Welding consumables which have not previously been subjected to a hydrogen test, are to be tested according to 400 when upgrading to the grades 2, 3, 4, 5 Y H15/Y H10/Y H5 and 2, 3, 4 Y40 H15/H10/H5 is applied for.

## C. Wire/Flux Combinations for Submerged Arc Welding

### C 100 General

**101** Wire/flux combinations will be divided into the following grades:

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

Approval will be considered subject to compliance with the specified tests and requirements in 200 and 300.

**102** The tests are intended for automatic single or multiple electrode submerged arc welding and the combinations are divided into the following categories:

- for use with the multi-run technique
- for use with the two-run technique.

The suffixes T, M or TM will be added to the grade mark to indicate two-run technique, multi-run technique or both techniques, respectively.

When a manufacturer states that a particular wire/flux combination is suitable for welding with both techniques, both series of tests are to be carried out.

### C 200 Multi-run technique

**201** Where approval for use with multi-run technique is requested, all-weld-metal and butt-weld tests are to be carried out as specified in 202 and 203.

**202** 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 direction of deposition of each run is to alternate from each end of the plate. After completion of each run, the flux and welding slag is to be removed. Between each run, the assembly is to be left in still air until it has cooled to 250°C, the temperature taken in the centre of the weld on the surface of the seam. The thickness of each layer is not to be less than the diameter of the wire, nor less than 4 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 to comply with the requirements given in Table C1.

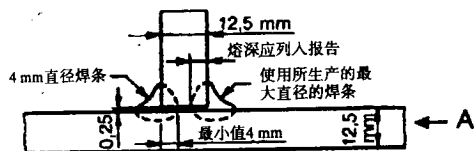


图6 深熔角焊缝试验

**B 800 年度试验**

**801 普通焊接和角焊用药皮焊条应按下述要求进行试验:**

应按 200 要求制备两块全熔质试件。试验范围和机械性能要求应符合 200 规定的要求。

这些规定同样也适用于仅认可用于角焊的焊条。

**802 重力焊或接触焊用的药皮焊条应按下述要求进行试验:**

应采用制造厂商推荐的重力焊或其他接触焊装置焊接一块熔敷金属试件。如该焊条也允许用于普通手工电弧焊, 则应按 801 的要求进行年度试验。

**803 深熔药皮焊条应按下述要求进行试验:**

应按 700 规定制备两块试板, 应制备一个横向拉力试样、两个弯曲试样(一个正弯、一个反弯)和三个冲击试样。每次在试件中截取试样时, 应检查其接头以确保已完全熔合。

**804 对允许用于俯焊位置下普通熔深焊和深熔焊的焊条, 除应进行对普通熔深焊的熔敷金属试验外, 尚应进行深熔焊焊缝的试验。**

年度试验要求:

年度试验时的抗拉强度值、屈服应力值、伸长率和冲击试验值应全部符合对初次认可试验的要求。

附加试验:

如上述试验的任何一项不符合要求, 应按 A 900 的要求进行重复试验。

**B 900 升级**

**901 经认可的某种焊条可被授予比原授受等级较高的等级, 只要在对较高等级焊条所规定的温度下进行的冲击试验具有满意的结果即可。但是, 对于从 1 级升到 3 级, 或从任何等级升到 2、3、4、5 Y H15/Y H10/Y H5 以及 2、3、4 Y40 H15/Y H10/Y H5 级, 除符合年度试验的一般要求外, 尚应对对接焊缝试件(俯焊、横向立焊、视情况立焊或仰焊位)上截取试样进行冲击试验。如已按 400 要求进行测氢试验, 也可考虑将 H15 级焊条升到 H10 或 H5 级。原先未进行测氢试验的焊接材料, 当申请升级到 2、3、4、5 Y H15/Y H10/Y**

H5 和 2、3、4 Y40 H15/H10/H5 等级时, 应按 400 的要求进行试验。

**C. 埋弧焊用焊丝/焊剂配合****C 100 一般要求**

**101 埋弧焊用焊丝/焊剂配合将分为下列等级:**

- 用于普通强度钢: I、II 和 III 级
- 用于最低屈服强度  $< 355\text{N/mm}^2$  的高强度钢: IY、II Y、III Y、IV Y 和 VY 级
- 用于最低屈服强度  $< 390\text{N/mm}^2$  的高强度钢: II Y40、III Y40 和 IV Y40 级

经过 200 和 300 规定的试验且符合要求的焊丝/焊剂配合将予以认可。

**102 拟进行单丝或多丝自动埋弧焊试验, 焊丝/焊剂配合分成下列类别:**

- 用于多道焊工艺的;
- 用于双面单道焊工艺的。

等级符号后面加上后缀 T、M 或 TM 字母, 分别表示应用于双面单道焊工艺、多道焊工艺或双面单道焊和多道焊兼用的工艺。当制造厂商说明一种具体的焊丝/焊剂配合适用于两种工艺的施焊时, 则应进行两套系列试验。

**C 200 多道焊工艺**

**201 当申请对多道焊工艺的认同时, 应按 202 和 203 规定进行全熔质试验和对接焊缝试验。**

**202 应按下列要求进行全熔质试验:**

试件的焊制:

应按图 7 所示的俯焊位置制备一块全熔质试件。

每一焊道的熔敷方向应从板的两端交替变换, 每道焊完后均应清除焊剂和焊渣。每焊完一道, 试件应放在静止空气中, 至使焊道中段的焊缝表面温度冷却到  $250^\circ\text{C}$  以下, 然后再焊下一道。每一焊层的厚度既不得小于焊丝直径, 也不小于 4mm。

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:

试验结果应符合表 C1 规定的要求:

Grade	Tensile test				Impact test	
	$R_m$ , $N/mm^2$	$R_{eH}$ , minimum, $N/mm^2$	$A_5$ 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 <sup>1</sup> 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.

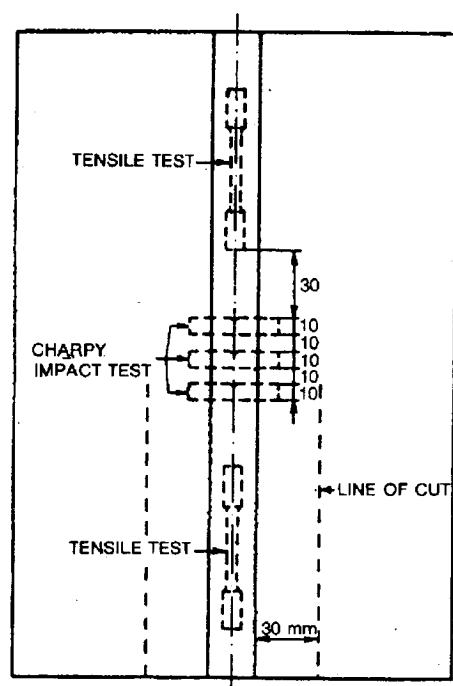
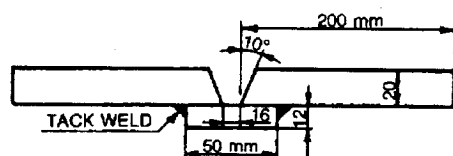


Fig. 7  
Multi-run weld. All-weld-metal test

#### Chemical analysis:

The 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.

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

##### Preparation of test assemblies:

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

The welding is to be carried out by the multi-run technique and the welding conditions are to be the same as those adopted for the deposited metal test assembly.

The back sealing run is to be applied in the downhand position after cutting out the root run to clean metal.

##### 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.

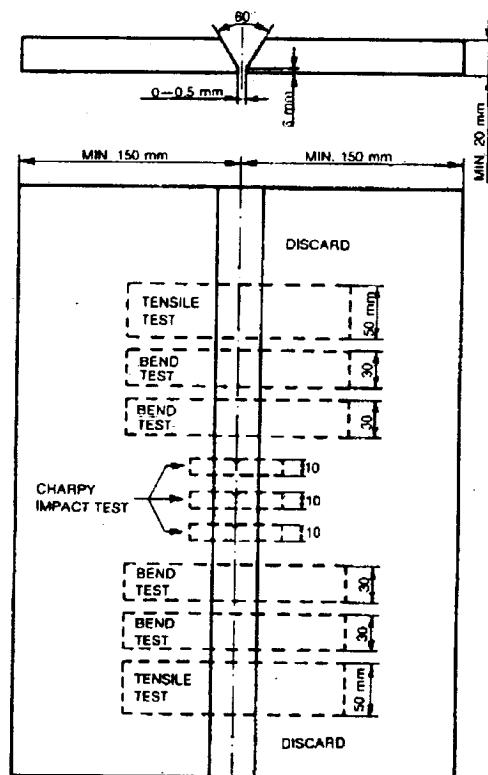


Fig. 8  
Multi-run weld. Butt weld test

##### Test requirements:

The test results are all to comply with the requirements given in Table C2. The position of fracture in the transverse tensile test 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 C2			
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	

### C 300 Two-run technique

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

When a wire/flux combination is submitted for approval for use with the two-run technique only, no deposited metal test is required. In this case approval tests are limited to the butt weld tests described hereafter.

Preparation of test assemblies:

Two butt-weld test assemblies are to be prepared, using the following thicknesses:

- for grades I and IY 12—15 mm and 20—25 mm
- for grades II to VY 20—25 mm and 30—35 mm
- for grades II Y40 to IV Y40 20—25 mm and 30—35 mm

The maximum diameter of wire, grades of steel plate and edge preparation to be used are to be in accordance with that shown in Fig.10. Minor deviations from the stipulated edge preparation may be accepted, if requested by the manufacturer. The root gap is not to exceed 1 mm. Each butt weld is to be welded in two runs, one from each side, using amperage, voltage and travel speed in accordance with the recommendations of the manufacturer and normal good welding practice. After completion of the first run, the flux and welding slag are to be removed and the assembly is to be left in still air until it has cooled to 100°C, the temperature taken in the centre of the weld, on the surface of the seam.

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 test 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.

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.

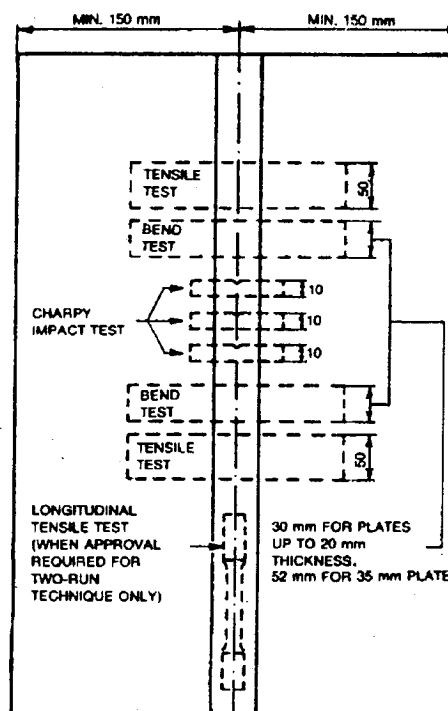


Fig. 9  
Two-run weld. Butt weld test

Test requirements:

The test results are all to comply with the requirements given in Table C1 for the longitudinal tensile test specimens and Table C2 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.

### C 400 Annual tests

401 Wire/flux combinations approved are to be subjected to at least the following tests:

Multi-run technique:

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

Two-run technique:

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

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

### C 500 Upgrading

501 An approved wire/flux combination 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.



表 C2			
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	
IV	490	20	
II Y		0	
III Y		-20	
IV Y		-40	
VY	510	-60	41
II Y40		0	
III Y40		-20	
IV Y40		-40	

### C 300 双道焊工艺

301 当申请对双面单道焊工艺认可时, 应制备两块对接焊缝试件。

当一种焊丝/焊剂配合仅允许用于双面单道焊工艺时, 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规定的对接焊缝试验。

试件的制备:

应使用下列厚度的板材焊制两块对接焊缝试件:

- 对 I 级和 IV 级焊丝/焊剂: 12 - 15mm 和 20 - 25mm;
- 对 II 级至 VY 级焊丝/焊剂: 20 - 25mm 和 30 - 35mm;
- 对 II Y40 级至 IV Y40 级焊丝/焊剂: 20 - 25mm 和 30 - 35mm。

采用的最大直径的焊丝、钢板等级和坡口加工均应符合图 10 所示的规定。如制造厂商提出要求, 可允许规定的坡口加工有微小的差异。焊根间隙不得超过 1mm, 每条对接焊缝应焊两道, 每侧一道, 采用的焊接电流、电压和施焊速度应符合制造厂商所推荐的范围, 并采用常规优良的焊接规程。第一道焊完后, 应清除焊剂和焊渣, 试件应置于静止空气中, 使焊缝中段的表面温度冷却到 100  $^{\circ}C$  以下。

试样:

应按图 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 (从所焊的试件每侧各取一个) 和三个冲击试样。

当仅申请对双面单道焊工艺进行认可时, 还应按图 9 所示, 从较厚的试板上机加工制备一个纵向拉力试样。

这种拉力试样的切割应使其纵轴与焊缝中心线重合, 并位于第二道焊缝一侧的表面下方约 7mm 之处。

应从每块试件如图 11 所示的位置和方位上机加工制备冲击试样, 试样应按 A700 的要求制备。

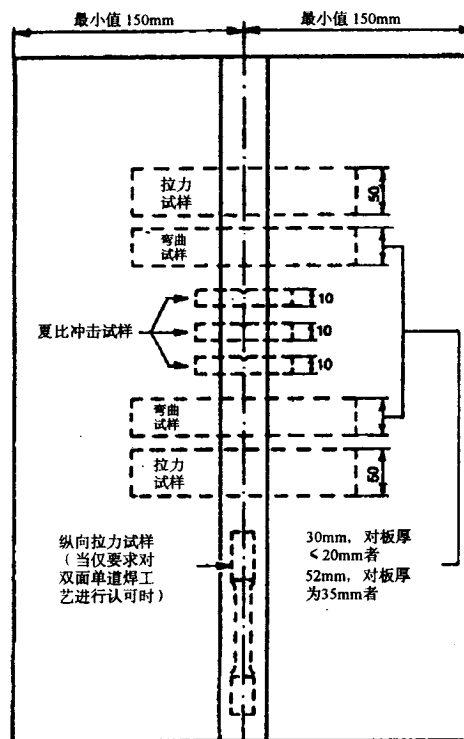


图 9 双面单道焊对接焊缝试件

试验要求:

试验结果均应符合表 C1 (对纵向拉力试样) 和表 C2 (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, 试样凸起的一面未出现任何尺寸大于 3mm 的裂纹或缺陷, 则视为符合要求。

### C 400 年度试验

401 已认可的焊丝/焊剂配合至少应经过下列试验:

多道焊工艺:

一个全熔质试件 —— 一个拉力试验和 3 个冲击试验。

双面单道焊工艺:

一个对接焊缝试件, 板厚至少为 20mm —— 一个横向拉力试样, 两个弯曲试样和 3 个冲击试样。对仅认可用于双面单道焊工艺的焊丝/焊剂配合, 还应制备一个纵向拉力试样。

402 试件的焊制及其机械性能要求均应符合对初次认可试验的要求。

### C 500 升级

501 经认可的某种焊丝/焊剂配合可被授予比原授等级更高的等级, 只要在对较高等级所规定的温度下进行冲击试验并且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) 级、到 VY (T/M) 级以及 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, 尚应从对接焊缝试件上截取试样进行冲击试验。

Plate thickness (mm)	Typical edge preparation	Maximum diameter of wire (mm)	Grade of wire/flux combination	Grade of steel
12-15		5	I IY	A A-32, A-36 <sup>1)</sup>
20-25		6	I II III IY IIY IIIIY IVY	A A B, D or E A-32, A-36, A-40 <sup>1)</sup> A-32, A-36, A-40 <sup>1)</sup> D-32, D-36, D-40 <sup>1)</sup> Any grade of HT steel <sup>1)</sup>
30-35		7	II III IIY IIIIY IVY	B, D or E B, D or E A-32, A-36, A-40 <sup>1)</sup> D-32, D-36, D-40 <sup>1)</sup> Any grade of HT steel <sup>1)</sup>

1) For testing of grade IY, IIY, IIIY and IVY combinations, the tensile strength of parent plate material is not to be less than 490 N/mm<sup>2</sup>, and the chemical composition, including the refining element, should be reported for information.

Fig. 10  
Two-run weld, butt weld test, root gap 0 — 0,7 mm

## D. Combinations for Use in One-side Automatic Welding Processes

### D 100 General

101 This welding process will be divided into the following grades:

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

Approval will be considered subject to compliance with the specified tests and requirements in 200 and 300.

102 Separate tests are specified for:

- one-run welding
- multi-run welding (including two-run welding).

Information regarding joint design, wire diameter, number of runs, tandem or multi-arc welding etc. is to be reported.

103 The welding conditions are to be the same as those indicated for wire/flux combinations in C, with the amendments and additions made in 200 to 800.

### D 200 One-run welding

201 Preparation of test assemblies:

Two test assemblies with 12—15 mm plate thickness are to be made. If a shipyard intends to apply the tested combina-

tion for one-side, one-run welding on thicker plates, special procedure tests are to be carried out on the thickest plate intended welded with this technique.

Test specimens:

The number of test specimens are to be as stipulated in 500 and as shown in Fig.12.

Test requirements:

The test results are all to comply with the requirements given in Table D1.

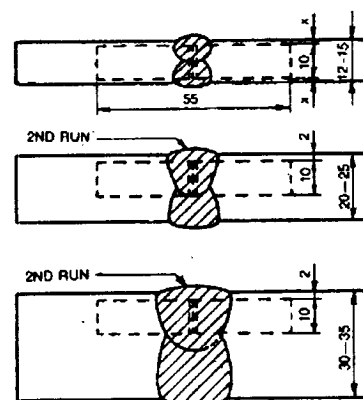


Fig. 11  
Two-run weld. Impact tests

板厚 (mm)	典型的坡口型式	最大的焊丝 直径 (mm)	焊丝/焊剂 配合等级	钢材等级
12-15		5	I IY	A A-32, A-36 <sup>1)</sup>
20-25		6	I II III IY IIY IIY IVY	A A B, D 或 E A-32, A-36, A-40 <sup>1)</sup> A-32, A-36, A-40 <sup>1)</sup> D-32, D-36, D-40 <sup>1)</sup> 任何等级的高强度钢 <sup>1)</sup>
30-35		7	II III IIY IIY IIIY IVY	B, D 或 E B, D 或 E A-32, A-36, A-40 <sup>1)</sup> D-32, D-36, D-40 <sup>1)</sup> 任何等级的高强度钢 <sup>1)</sup>

1) 对于 IY、IIY、IIIY 和 IVY 级配合的试验, 母体板材的抗拉强度不得小于 490N/mm<sup>2</sup>, 化学成份包括晶粒细化元素在内应列入报告, 供备查。

图 10 双面单道焊试件的对接焊缝试件 焊根间隙 0 ~ 0.7mm

## D. 用于单面自动焊过程的配合

### D 100 一般要求

101 本焊接工艺用配合将分成下列等级:

- 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: IY、IIY、IIIY、IVY 和 VY 级;
- 最低屈服强度  $< 390\text{N/mm}^2$  的高强度钢用: IIY40、IIIY40 和 IVY40 级。

经过 200 和 300 规定的试验合格, 将予以认可。

102 对下列焊接规定了各自的试验:

- 单道焊
- 多道焊 (包括双面单道焊)

关于接头设计型式、焊丝直径、道数、串联焊或多弧焊等资料均应列入报告。

103 焊接条件应与 C 中对焊丝/焊剂配合所规定的相同, 并包括 200 至 800 中所作的修改和补充。

### D 200 单道焊

#### 201 试件的制备

应焊制两块板厚为 12-15mm 的试件。如船厂拟将送检的焊丝/

焊剂配合用于更厚板材的单面单道焊, 则应对拟用此工艺焊接的最厚板材按专用程序进行试验。

试样:

试样的数量应符合 500 的规定并如图 12 所示。

试验要求:

试验结果应全部符合表 D1 规定的要求

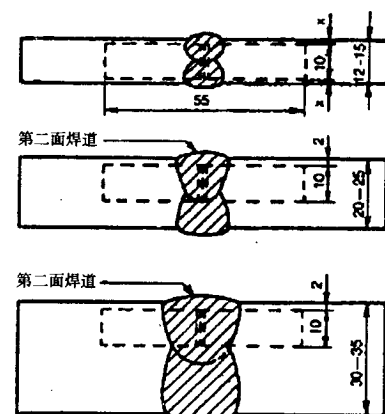


图 11 双面单道焊的冲击试样

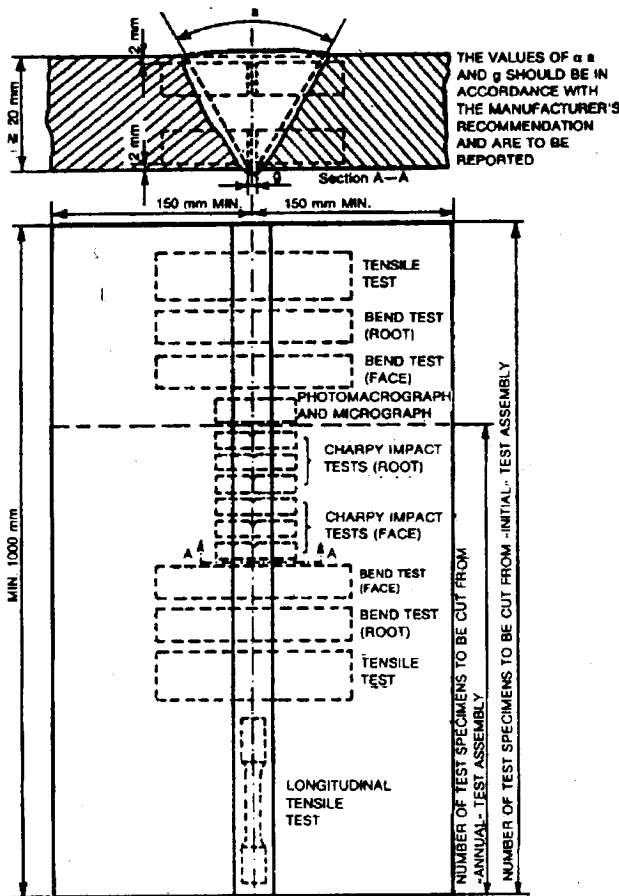


Fig. 12  
One-side automatic welding, test assembly and location of specimens

### D 300 Multi-run welding

#### 301

Preparation of test assemblies:

Two test assemblies, one assembly with 15–25 mm plate thickness and one with 35 mm thickness, are to be made as shown in Fig.12.

Test specimens:

The number of test specimens are to be as stipulated in 500 and as shown in Fig.12.

Test requirements:

The test results are all to comply with the requirements given in Table D1.

### D 400 One-and multi-run welding

#### 401 Preparation of test assemblies:

One test assembly with 15 to 25 mm plate thickness is to be welded by one-run welding technique and one is to be welded with 35 mm thickness by multi-run technique.

Test specimens:

The number of test specimens are to be as stipulated in 500 and as shown in Fig.12.

Test requirements:

The test results are all to comply with the requirements given in Table D1.

### D 500 Testing

#### 501 Mechanical test specimens:

One longitudinal tensile, two transverse tensile, four transverse bend test (two face and two root bend) and six impact (three from the face side and three from the root side) test specimens are to be taken from each welded test assembly as shown in Fig.12.

The test specimens are to be prepared according to A700.

Macro- and microstructure:

One photomicrograph from the fusion zone of the thickest test assembly (one- or multi-run) is also to be forwarded for consideration.

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.

### D 600 Requirements

601 The test results are all to comply with the requirements given in Table D1. The position of fracture in the transverse tensile test specimens 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 D1						
Grade	Tensile test				Impact test	
	Transverse	Longitudinal			Temperature °C	KV, J, minimum average
		$R_m$ , minimum, N/mm <sup>2</sup>	$R_{eH}$ , minimum, N/mm <sup>2</sup>	$A_5$ , minimum, %		
I II III	400	400–560	305	22	20 0 –20	34
I Y II Y III Y IV Y V Y	490	490–660	375		20 0 –20 –40 –60	
II Y40 III Y40 IV Y40	510	510–690	400		0 –20 –40	
						41

### D 700 Annual tests

701 Combinations approved for one- or multi-run welding are to be tested as follows:

One test assembly with 12–25 mm plate thickness as shown in Fig.12 is to be welded.

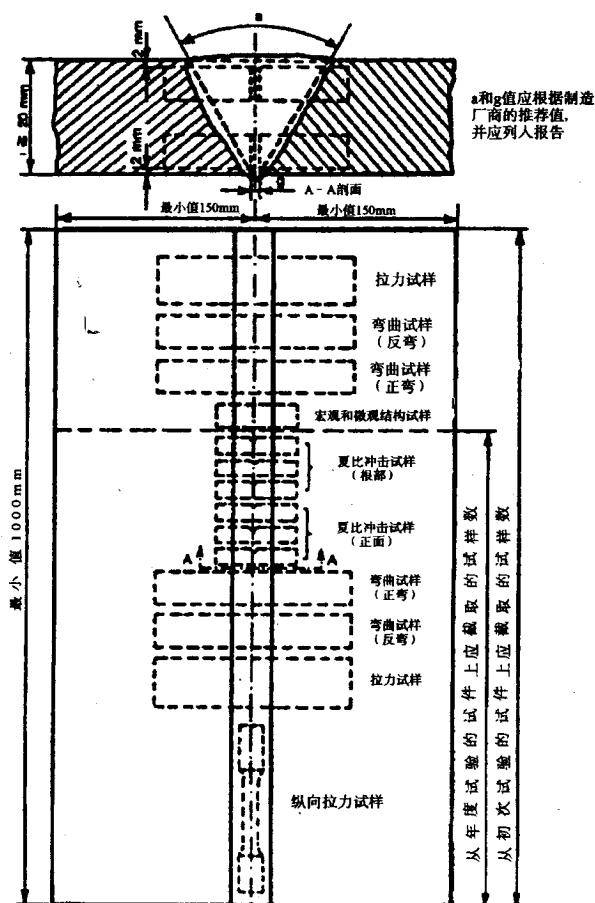


图12 单面自动焊试件和试样位置

**D 300 多道焊****301 试件的制备:**

应按图12所示焊制两块试件, 一块用15~25mm厚的板, 另一块用35mm厚的板。

试样:

试样的数量应按500规定并如图12所示。

试验要求:

试验结果应全部符合表D1规定的要求。

**D 400 单道和多道焊****401 试件的制备**

应采用单道焊工艺焊制一块板厚为15至25mm的试件和采用多道焊工艺焊制的一块板厚为35mm的试件。

试样:

试样的数量应符合500的规定并如图12所示。

试验要求:

试验结果应全部符合表D1规定的要求。

**D 500 试验****501 机械试验试样:**

应按图12所示, 从每块焊制的试件上截取一个纵向拉力试样, 两个横向拉力试样, 四个横向弯曲试样 (两个正弯, 两个反弯) 以及六个冲击试样 (三个取自正面, 三个取自根部)。

试样应按A700的要求进行制备。

宏观和微观结构试样:

还应从最厚单道焊或多道焊试件的熔融区截取一个微观结构试样供检验。

化学分析:

制造厂商应提供熔敷焊缝金属的化学分析报告以及所有重要的合金元素的含量。

**D 600 要求**

**601** 试验结果应全部符合表D1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, 如其弯曲后, 在试样凸起的一面未出现有任何尺寸大于3mm的裂纹或缺陷, 则视为符合要求。

表D1

等级	拉力试验				冲击试验		
	横向	纵向			温度	最小平均值	
		R <sub>m</sub> 最小值 N/mm <sup>2</sup>	R <sub>eH</sub> 最小值 N/mm <sup>2</sup>	A <sub>5</sub> 最小值 %	℃	KV , J	
I II III	400	400-560	305	22	20 0 - 20	34	
I Y II Y III Y IV Y V Y	490	490-660	375		20 0 - 20 - 40 - 60		
II Y40 III Y40 IV Y40	510	510-690	400		0 - 20 - 40		41

**D 700 年度试验**

验:

**701** 允许用于单道焊的焊丝/焊剂配合应按下列要求进行试

应按图12所示焊制一块12~25mm板厚的试件。

When a combination is approved for both one- and multi-run welding, the test assembly is to be welded with the one-run technique.

**702** One longitudinal and one transverse tensile test specimen, to bend (one face and one root bend) and six impact test specimens (three root and three face) are to be taken from the test assembly as shown in Fig.12.

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

#### **D 800 Upgrading**

**801** An approved combination 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.

### **E. Wires and Wire/Gas Combinations for Metal Arc Welding**

#### **E 100 General**

**101** Wire/gas combinations, flux cored or flux coated wires with or without shielding gas will be divided into the following grades:

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

Approval will be considered subject to compliance with the specified tests and requirements in 200 and 300.

**102** The wires are divided into the following categories:

- for use in semi-automatic multi-run welding
- for use in automatic multi-run welding
- for use in automatic two-run welding.

For wires intended for automatic welding, the suffixes T, M and TM will be added to indicate two-run, multi-run or both welding techniques, respectively.

For wires intended for semi-automatic welding, the suffix S will be added to the grade mark.

For wires intended for both welding processes, the suffixes will be added in combination.

**103** The test assemblies are to be prepared by the relevant welding technique for which approval is requested, however, where approval is requested for both semi-automatic and automatic techniques, test assemblies need only be prepared by the semi-automatic technique. If approval of automatic two-run welding technique is requested, test assemblies are also to be prepared by this technique.

**104** Where applicable, the composition of the shielding gas is to be reported. Unless otherwise agreed by the Society, additional approval tests are required when the shielding gas used is different from that used for the original approval tests.

**105** Flux cored or flux coated wires may, at manufacturer's option, be submitted to a hydrogen test as detailed in A800, using the manufacturer's recommended welding conditions and adjusting the deposition rate to give a weight of weld deposit per sample similar to that deposited when using manual electrodes.

Wires complying with our requirements stipulated in B400 will have the suffix (H15), (H10) or (H5) added to the grade mark.

#### **E 200 Semi-automatic multi-run welding**

**201** The term semi-automatic is used to describe processes in which the weld is made manually by a welder holding a gun through which the wire is continuously fed.

Where approval for use with semi-automatic welding is requested, all-weld-metal and butt-weld tests are to be carried out as specified in 202 and 203.

**202** All-weld-metal tests are to be performed as follows:

Preparation of test assembly:

Two all-weld-metal test assemblies are to be welded in the downhand position as shown in Fig.1.

One test assembly is to be welded using a wire of 2,4 mm diameter or of the largest size manufactured and the other using a wire of 1,2 mm diameter of of the smallest size manufactured. Where wires are available in one diameter only, one test assembly is sufficient.

The weld metal is to be deposited according to the practice recommended by the manufacturer and the thickness of each layer of weld metal is to be in the range of 2 mm to 6 mm.

Test specimens:

One longitudinal tensile and three impact test specimens are to be taken from each test assembly as shown in Fig.1.

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 E1.