

表 C4 焊接后的机械性能

合金	韧度	填充丝	抗拉强度 R_m 最小值 (N/mm^2)	热影响区处屈服强度 $R_{p0.2}$ 最小值 (N/mm^2)
NV-5052	0,F,H111 H32,H34	5356	170	65
NV-5754	0,F,H111,H24	5356-5183	190	80
NV-5154A	0,H111	5356-5183	215	85
NV-5454	0,F,H111,H34	5356-5183	215	85
NV-5086	0,F,H111, H116,H32,H34	5356-5183	240	100
NV-5083	0,F t < 6mm	5183	270	125
	0,F t > 6mm	5356-5183	270	115
	H116,H321	5356	270	115
	H116,H321	5183	270	125
NV-5383	0,H111,H116 H321	5183	290	140
NV-6060	T5	5356-5183	95	65
NV-6061	T4	5356-5183	165	115
	T5 或 T6		165	115
NV-6063	T5	5356-5183	100	65
	T6		100	65
NV-6005A	T5 或 T6	5356-5183	165	115
NV-6082	T4	5356-5183	170	110
	T5 或 T6		170	115

D. 铁素体-奥氏体 (双联) 不锈钢焊接工艺

D 100 一般要求

101 拟制造用铁素体-奥氏体不锈钢焊制的液货舱柜, 船体结构构件, 加工受压力容器或管系的焊接车间应对建造中各种类型的对接焊缝和重要的填角焊缝进行 WPQT. 见第3章第1节.

102 这类 WPQT 应覆盖各种相关的尺寸、位置和材料的组合. 涉及重要变量、工艺有效性和机械试验的细节应符合 B 的规定和 200 所列的附加要求.

D 200 附加试验

201 对接焊缝和填角焊缝应按 ASTM G48 - 76 方法 A 进行腐蚀试验, 其试样处于焊接后经一般清理的状态, 试样在恒温 20 °C 下在溶液中浸泡 24 小时. 试验要求:

- 在试件的各个表面上无点状腐蚀
- 总的重量损失应不超过 20mg.

指导性意见:

铁素体-奥氏体钢和其他级别不锈钢或 C/Mn 钢之间的焊缝不必进行腐蚀试验.

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202 按 B300 要求进行冲击试验.

冲击试验温度为 -20 °C. 所吸收的冲击功值的平均值应不小于 27J.

203 微观结构检查

试样应由焊缝金属, 热影响区和母体金属组成. 该微观结构经

适当腐蚀处理后, 应清除晶粒边界上的碳化物和沉渣, 放大 400 倍进行检验.

在焊缝金属背部和未经重新加热的焊帽处的铁素体成分应按 ASTM E562 确定, 其范围应在 25-70% 内.

D 300 合格焊接工艺的有效性

301 参见 B900 和下述附加重要变量的任何变化将导致一次新的验证:

- 当输入的热量变化大于 ± 15 % 时.

E. 焊工的认可

E 100 一般要求

101 下述要求适用于本社对从事于对钢和非铁素体金属进行熔焊的焊工的认可. 焊接工艺的资格证书, 要求焊工具有从事手工或部分自动焊接的能力. 焊工应按 200 要求通过认可试验. 船厂和车间应保存焊工资格证书记录, 当需要时, 应提供焊工有效资格证书的副本.

102 使用全部机械化或全自动化焊接的操作工, 一般不必通过认可试验. 但是操作工应接受调整或拟定程序和操作该设备方面的相应训练. 应保存相应的训练记录, 可要求船厂和车间提供有效的认可试验证书.

E 200 认可试验的标准

201 焊工应按本社认可的标准, 例如 EN287, ISO9606, ASME 第 IX 节和 ANSI/AWS D1.1 进行试验.

202 Recognition of other standards is subject to submittal to the Society for evaluation.

E 300 Certification

301 Welding and testing of weld assemblies are to be performed in the presence of the surveyor. Upon successful completion, the Society will certify that the welder has passed the approval testing.

302 Where certification is performed by other IACS members or independent organisations, e.g. accredited or nationally approved certification bodies, recognition of such certification will be evaluated on a case by case basis. The Society reserves the right, however, to require verification of welders' qualifications when deemed necessary. Such verification may include testing prior to production, extra NDT and/or welding production tests.

202 推荐其他标准应经本社评估。

E 300 证书

301 焊缝试件的焊接和试验应在验船师监督下进行。全部通过的，本社将颁发该焊工已通过认可试验的证书。

302 如证书为其他国际船级社成员或独立机构，例如鉴定过的机关或由国家授权发证的机关颁发的，则其证书应每次根据具体情况予以认可。但是如认为必要时，本社保留要求验证焊工的资格的权力。这种验证可包括生产前的试验，附加的无损探伤试验和/或焊接操作试验。

SECTION 3 TYPE APPROVAL OF WELDING CONSUMABLES

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A. General

A 100 Scope

101 This Section specifies the requirements to be complied with for obtaining the Society's type approval of welding consumables for welding of normal, high and extra high strength steels, boiler and pressure vessel steels, steels for low temperature service, austenitic stainless steels, duplex steels and aluminium alloys. This section covers IACS UR W23.

A 200 Approval procedure

201 The surveyor is to be satisfied that the manufacturer's plant, methods of production and quality control of welding consumables are to be such as to ensure a reasonable uniformity in manufacture.

202 All test assemblies are to be prepared under the supervision of the surveyor, and all tests are to be carried out in his presence.

203 When welding consumables are manufactured in several factories of the same company, the complete series of approval tests are to be carried out in one of the works only. In the other factories, a reduced test programme, at least equivalent to annual tests included hydrogen testing for low hydrogen type consumables is permitted if the manufacturer can verify that the materials used and the fabrication process are identical with those used in the main works. This requirement is applicable to all manufacturers of filler products under licence (sister firms). However, should there be any doubt, complete test-series may be required.

204 All welding consumables approved are to be subjected to an annual re-testing. On these occasions, samples of the approved consumables are to be selected by the surveyor

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H. 低合金钢、耐热钢 (NV 0.3Mo、NV 1Cr 0.5Mo和NV 2.25Cr 1Mo)用焊接材料

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- K 300 化学成份
- K 400 可能的附加试验
- K 500 年度试验

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- L 500 腐蚀试验
- L 600 年度试验

M. 焊接常温和低温用铝合金的焊接材料

- M 100 一般要求
- M 200 试件
- M 300 试验
- M 400 年度试验

A. 通 则

A 100 适用范围

101 本节的规定适用于申请本社型式认可的焊接普通强度、高强度和超高强度钢, 锅炉和受压容器用钢、低温用钢、奥氏体不锈钢、双联钢以及铝合金钢的焊接材料。本节包含国际船级社协会的统一要求 W23 (IACS UR W23)。

A 200 认可程序

201 制造厂商的设备、生产方法以及焊接材料的质量控制应确保其产品具有合理的一致性, 并使验船师满意。

202 所有试件均应在本社验船师的监督下进行制备, 和所有的试验均应有验船师在场时进行。

203 当焊接材料在同一公司的几个工厂内制造时, 则整个系列认可试验仅须在其中一个工厂内进行。对其余工厂, 如制造商能证实其采用的材料和制造工艺与主厂采用的是相同的, 则允许采用简化的试验大纲, 但对低氢焊条, 至少应进行相当于包括测氢试验在内的年度试验。此要求适用于持有许可证的所有焊条(丝)制造厂商(姐妹公司), 但是, 如有疑问, 可要求进行完整的系列试验。

204 所有经认可的焊接材料均应进行年度重复试验。在这些情

and subjected to the tests detailed in subsequent sections of these Rules.

Use of a manufacturer's quality assurance system as an alternative to annual testing procedure may be accepted after agreement with the Society.

A 300 Approval testing

301 All weld tests may be performed by the manufacturer or anyone appointed by him.

302 The welding conditions used such as amperage, voltage, travel speed, etc. are to be within the range recommended by the manufacturer for normal good welding practice. When a filler metal is stated to be suitable for both alternating current (A.C.) and direct current (D.C.), A.C. is to be used for the preparation of the test assemblies.

303 The tests prescribed are to be carried out for each type of welding consumable for which approval is required.

304 The Society may request, in a particular case, additional tests or requirements as may be considered necessary.

A 400 Changes

401 Any alteration proposed by the maker to the approved consumable which may result in a change in the chemical composition and the mechanical properties of the deposited

metal, must be immediately notified to the Society. Additional tests may be necessary.

402 Upgrading of welding consumables will be considered only at the manufacturer's request, preferably at the time of annual testing. Generally, for this purpose, tests from butt weld assemblies will be required in addition to the normal annual approval tests.

A 500 Basic groups and grades

501 Welding consumables are divided into groups, depending on the strength of the filler metal and further divided into grades depending on the impact test temperature and the chemical composition of the filler metal.

The grades of welding consumables given in Table A1 are specified in this Section.

502 Welding consumables which have satisfied the requirements for a higher toughness grade, are also considered as complying with the requirements for a lower toughness grade of the same group.

	Normal strength steels	High strength steels	Extra high strength steels	Austenitic stainless steels
Grade of welding consumables	1	2 Y	3/4/5 Y42	308/308Mo/308L
	2	3 Y		309/309L/309Nb/
	3	4 Y	3/4/5 Y46	309Mo/309MoL
	5	5 Y		310/310Nb/310Mo
	I	2/3/4 Y40	3/4/5 Y50	312
	II		3/4/5 Y55	316/316L
	III	I Y		317/317L
	V	II Y	3/4/5 Y62	318
		III Y	3/4/5 Y69	330
		IV Y		347
	V Y		349	
		II/III/IV Y40		

A 600 Testing procedure

601 The test welds are normally to be made on the material for which approval of the welding consumable is desired. Any grade of structural steel may, however, be used for the preparation of the all-weld-metal test assemblies.

602 The test specimens are to be made under controlled conditions, on metal deposited from the filler metal in question.

603 After being welded, the test assemblies are not to be subjected to any heat treatment.

604 It is recommended that the welded assembly is subjected to radiographic examination to ascertain whether there are any defects in the weld prior to testing.

A 700 Test specimens

701 The test specimens referred to in this Section is described in Ch.1 Sec.2 and Ch.3 Sec.1.

Tensile tests:

Round tensile test specimens are to be machined to the dimensions shown in Sec.1 B201, type A, care being taken that the longitudinal axis coincides with the intersection between the midplane of the weld, and the midplane of the plates.

Flat specimens of the form given in Sec.1 B201, type C are to be prepared. The upper and lower surfaces of the weld are to be machined flush with the surface of the plate.

Prior to testing, the tensile test specimens may be subjected to a temperature not exceeding 250°C for a period not exceeding 16 hours, for hydrogen removal.

Charpy V-notch impact tests:

Standard Charpy V-notch test specimens are to be prepared as shown in Ch.1 Sec.2

The test temperature for specimens tested at 0, -20, -40 and -60°C are to be controlled and kept within ±2°C of the prescribed temperature.

The test specimens are to be cut with their longitudinal axis transverse to the weld length, with the notch perpendicular to the surface of the plate and positioned as follows:

- for deposited metal and butt weld test assemblies with multi-run technique, the test specimens are to be cut at mid thickness of the weld
- for two-run welded test assemblies the specimens are to be cut on the 2nd run side, 2 mm below the surface
- for electroslag or electrogas welded test assemblies all specimens are to be cut 2 mm below the surface
- for one-side automatic welding processes, the test specimens are to be cut 2 mm below the face side and 2 mm below the root side of the test assembly.

The average absorbed energy value is to comply with the requirements of subsequent sections. One individual value may be less than the required average value provided that it is not less than 70% of this value.

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况下, 经认可材料的样品应由本社验船师进行选择并须进行本规范随后各章节规定的试验。

经本社同意后, 可允许采用制造厂商的质量保证体系来替代年度试验程序。

A 300 认可试验

301 焊缝的全部试验可由制造厂商或其指定的任何部门来进行。

302 所采用的焊接条件, 诸如电流、电压、施焊速度等均应在制造厂商推荐用于常规优良焊接规程的范围内。当说明填充金属适用于交流和直流电时, 则制备试件应采用交流电流。

303 对申请认可的各型焊条均应进行规定的试验。

304 特殊情况下, 本社可要求进行认为必要的附加试验或提出附加规定。

A 400 变更

401 制造厂商对经认可焊接材料提出的可引起熔敷金属化学成份和机械性能变化的任何更改, 应立即通知本社, 同时应进行附加试验。

402 只有在制造厂商的申请下, 最好在年度试验时, 才考虑焊接材料的升级。一般, 为此目的, 除了正常的年度认可试验外, 还应对接焊缝试件进行试验。

A 500 基本组别和等级

501 焊接材料根据其填充金属的强度分成若干组, 和进一步根据填充金属的冲击试验温度和化学成份分成若干等级。

本节规定了表 A1 给出的焊接材料的等级。

502 已符合较高强度等级要求的焊接材料亦视为符合对同组的较低强度级的要求。

表 A1 焊接材料等级

	普通强度钢	高强度钢	超高强度钢	奥氏体不锈钢
焊接材料的等级	1	2Y	3/4/5 Y42	308/308Mo/308L
	2	3Y		309/309L/309Nb
	3	4Y	3/4/5 Y46	309Mo/309MoL
	5	5Y		310/310Nb/310Mo
	I	2/3/4 Y40	3/4/5 Y50	312
	II		3/4/5 Y55	316/316L
	III	I Y		317/317L
	V	II Y	3/4/5 Y62	318
		III Y		330
		IV Y	3/4/5 Y69	347
		V Y		349
		II/III/IV Y40		

A 600 试验程序

601 试验焊缝通常应在所规定的焊接材料认可所用的材料上焊制, 但是, 任何等级的结构钢均可用于制备全熔质试件。

602 试样应限制在熔融了的填充金属上制取。

603 焊接后, 试件不得进行任何热处理。

604 建议将焊接的试件在试验前先经过 X 射线透视检验以发现焊缝中是否存在缺陷。

A 700 试样

701 本节涉及的试样, 其规定见第 1 章第 2 节和第 3 章第 1 节。

拉力试验:

圆型拉力试样应机加工成第 1 节 B201 A 型所示的尺寸, 注意应把试样的纵轴与焊缝的中心面和板材的中层面之间的交线重合。

应制备第 1 节 B201 C 型指定形状的平板试样。应通过加工使焊缝的上下表面与板的表面齐平。试验前, 为除氢计, 拉力试样

可置于不超过 250 °C 的温度下, 放置时间不超过 16h。

夏比 V 型缺口冲击试验:

应制备如第 1 章第 2 节所示的标准夏比 V 型缺口试样。

对在 0 °C、- 20 °C、- 40 °C 和 - 60 °C 温度下试验的试样, 其试验温度应控制并保持在规定的温度 ± 2 °C 内。

试样的截取应使其纵轴横跨焊缝长度方向, 其缺口垂直于板的表面并位于下述位置:

- 对采用多道焊工艺的熔敷金属和对接焊缝试件, 试样应在焊缝的厚度中央截取;
- 对双道焊试件, 试样应在第二次焊道的那一边, 距表面之下 2 mm 处截取;
- 对电渣焊或气电焊试件, 所有试样均应在距表面之下 2 mm 处截取;
- 对单面自动焊, 其试样应在距试件的上表面之下 2 mm 和在距试件的背面之下 2 mm 处截取。

所吸收的平均均值应符合随后各节的要求。一个单值可低于规定的平均值, 但不得低于该规定平均值的 70 %。

Bend test:

Flat bend test specimens, as shown in Sec.1 Fig.2 and 3 are to be used. The upper and lower surfaces of the weld are to be filed, ground or machined flush with the surface of the specimens and the edges of the specimens are to be rounded to a radius not exceeding 2 mm.

The test specimens are to be capable of withstanding bending through an angle of 120° over a former having a diameter three times the thickness of the specimen.

A 800 Hydrogen test

801 Low hydrogen consumables are to be subjected to a hydrogen test. The test is to be carried out in accordance with the mercury method specified in ISO 3690-1977, or any method such as the gas chromatographic which correlates with that method. The glycerine method may be admitted at the discretion of the Society. This method is described below.

Prior to welding, the consumables may undergo a normal drying process recommended by the manufacturer.

802 Four test specimens are to be prepared measuring 12 x 25 mm in cross-section by about 125 mm in length. The parent metal may be any grade of structural steel. Before welding, the specimens are to be weighed to the nearest 0,1 gram. On the 25 mm surface of each test specimen, a single weld bead about 100 mm in length is to be deposited by a 4 mm diameter electrode, using about 150 mm of the electrode. The welding is to be carried out with an arc as short as possible and with a current of approximately 150 A. All four test specimens are to be welded within a period of 30 minutes. For iron powder electrodes, an electrode with a dimension giving approximately the same quantity of deposited metal as an ordinary 4 mm diameter electrode is to be used. For each test specimen, a new electrode is to be used.

Within 30 seconds of the completion of the welding of each specimen, the slag is to be removed and the specimen quenched in water at approximately 20°C.

After 30 seconds in the water, the specimen is to be cleaned and dried and then placed in an apparatus suitable for the collection of hydrogen by displacement of glycerine. The last step is to be completed within 2 minutes after breaking the arc. The glycerine is to be kept at a temperature of 45°C during the test. All specimens are to be welded and treated identically.

The specimens are to be kept immersed in the glycerine for a period of 48 hours and, after removal, are to be cleaned in water and alcohol, dried and weighed to the nearest 0,1 gram to determine the amount of weld deposit.

803 The amount of gas given off is to be measured to the nearest 0,05 cm³ and corrected for temperature and pressure to 20°C and 760 mm Hg.

A 900 Re-testing

901 Tensile and bend tests:

Where the result of a tensile or bend test does not comply with the requirements, duplicate test specimens of the same type are to be prepared and satisfactorily tested. Where insufficient original welded assembly is available, a new assembly is to be prepared using welding consumables from the same batch. If the new assembly is made with the same procedure as the original assembly, only the duplicate re-test specimens needs to be prepared and tested. Otherwise, all test specimens should be prepared as for re-testing.

902 Charpy V-notch impact tests:

When the average value of a set of three impact test specimens fails to meet the stated requirements, or the value of

more than one specimen is below the required average value, or when the value of only one specimen is below 70% of the specified average value, three additional specimens from the same piece may be tested and the results added to those previously obtained to form a new average. If this new average complies with the requirements and if no more than two individual results are lower than the required average and no more than one result is below 70% of the specified average value, the tests may be accepted.

B. Covered Electrodes for Shielded Metal Arc Welding of Normal and High Strength Steels

B 100 General

101 Electrodes will be divided into the following grades:

- for normal strength steels: 1, 2 and 3
- for high strength steels with minimum yield strength up to 355 N/mm²: 2 Y, 3 Y, 4 Y and 5 Y
- for high strength steels with minimum yield strength up to 390 N/mm²: 2 Y40, 3 Y40 and 4 Y40

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

102 Electrodes complying with the requirements stipulated in 400 will be given the suffix H15, H10 or H5 added to the grade mark. Electrodes for high strength steels are to be hydrogen tested and are to satisfy the requirements for at least the suffix H15.

B 200 All-weld-metal test

201 Preparation of test assemblies:

Two all-weld-metal test assemblies are to be welded in the downhand position as shown in Fig.1, one using 4 mm diameter electrodes and the other using the largest size manufactured. If an electrode is available in one diameter only, one test assembly is sufficient.

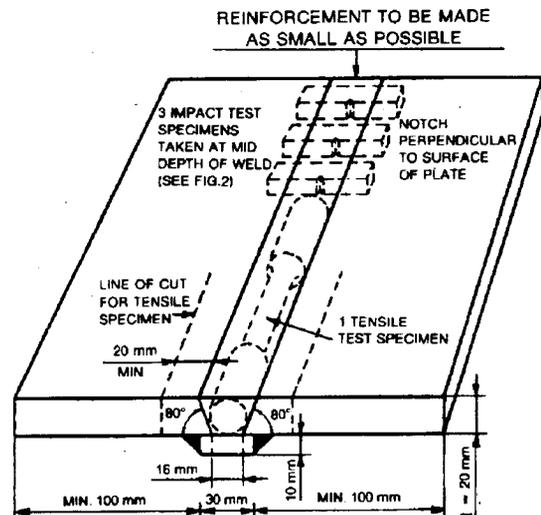


Fig. 1
All-weld-metal test

The weld metal is to be deposited in single or multi-run layers according to normal practice, the direction of deposition being reversed between subsequent layers, each bead being no less than 2 mm and not more than 4 mm thick. Between each run, the assembly is to be left in still air until it has cooled below 250°C, the temperature being checked in the middle of the weld bead.

弯曲试验

应采用如第1节图2和图3所示的平板弯曲试样。焊缝的上下表面应铲平、磨光或加工至与试样的表面齐平，试样的边缘应加工成半径不超过2 mm的圆角。

试样应能承受得住绕直径3倍于试样厚度的心轴上作120°角的弯曲。

A 800 测氢试验

801 低氢焊条应进行测氢试验。该试验应按ISO 3690 - 1977中规定的水银测定法进行，或按其他与水银测定法相关联的方法如气体扩散法测定。经本社同意，可采用甘油测氢法，该方法规定如下：

焊前，焊条可进行制造厂商推荐的常规的干燥处理。

802 应制备四块横截面为12 × 25 mm，长约125 mm的试样，母材可为任何等级的结构钢。焊接前，试样应称重，精确到0.1g，在每块试样的25 mm的表面上，应采用直径4 mm的焊条，耗用约150 mm的焊条长度，堆焊一条约100 mm长度的单焊道。应采用尽可能短的电弧和约150 A的电流进行施焊，全部四个试样应在30分钟内焊制。对于铁粉焊条，应采用其熔敷金属量与普通直径4 mm的焊条的熔敷金属量几乎相同的焊条。对每一块试样，均应使用新的焊条。

在每块试样焊后的30秒钟内，即行脱渣然后将试样置于约20℃的水中冷却。

在水中30秒后，试样应予清洗和干燥，然后放在适合收集用甘油置换出的氢气的容器中，最后的步骤应在断弧后2分钟内完成。试验期间，甘油应保持45℃的温度，所有试样的焊制和处理方法均应完全相同。

试样应浸没于甘油中保持48小时，取出后，应在水和酒精中清洗，待干燥后称重(精确到0.1g)以确定焊缝的熔敷量。

803 应测量排出气体量，精确到0.05 cm³。排出气体量应换算为温度20℃和压力760 mm Hg时的数值。

A 900 重复试验

901 拉力试验和弯曲试验

如拉力试验或弯曲试验结果不符合要求，则应制备双份同类型重复试验试样并进行满意的试验。如原焊制的试件不足以制备重复试验试样，则应使用同一批焊条焊制一块新试件。如新试件的焊制程序与原试件相同，则只需制备和试验双份的复试试样，否则，应为重复试验制备所有试样。

902 夏比V型缺口冲击试验

当一组三个冲击试样的平均值不符合规定要求或一个以上试样的试验结果低于规定的平均值时，或有一个试样的试验值低于规定平均值的70%时，则允许对取自同一试件的三个附加试样进行试验并将结果与原先获得的结果相加形成一个新的平均

值。如该新的平均值符合要求，且低于规定的平均值的试样不超过两个，其中低于规定平均值的70%的试样不超过一个，则复试可予接受。

**B. 普通强度和高强度钢气体保护金属
电弧焊用皮焊条**

B 100 一般要求

101 焊条划分成下列等级：

- 对普通强度钢：1级、2级和3级
- 对最低屈服强度 < 355 N/mm² 的高强度钢：2Y、3Y、4Y和5Y级
- 对最低屈服强度 < 390 N/mm² 的高强度钢：2Y40、3Y40和4Y40级

符合200和300规定的试验和要求的电焊条将予以认可。

102 符合400规定要求的电焊条，将在其等级标记后增加后缀H15、H10或H5；高强度钢用电焊条应进行测氢试验，并应至少满足对后缀为H15电焊条所规定的要求。

B 200 全熔质试验

201 试件的焊制

应在俯焊位置焊制两块如图1所示的全熔质试件，一块试件采用直径4 mm的焊条而另一块试件则采用所制造的最大直径的焊条，如仅供有一种直径的焊条，则仅需焊制一块试件即可。

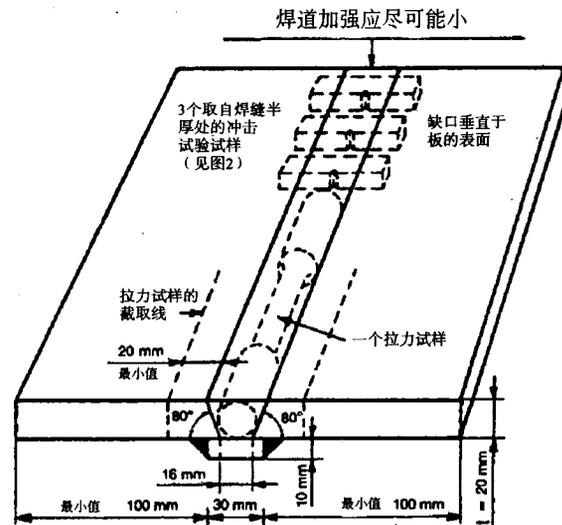


图1 全熔质试验

焊缝金属试件按常规应采用单道或多道焊焊制，接连的两道焊制方向应在试件的两端交替变换，每一焊道厚度应为2mm至4mm。每焊完一道后，试件应置于静止空气中冷却到250℃以下，温度应在焊道的中段测得，然后再焊下一道。

202 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 A 700.

203 Test requirements:

The test results are all to comply with the requirements given in Table B1.

204 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.

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
1 2 3	400—560	305	22	1)	20	47
					0	
	-20					
2 Y 3 Y 4 Y 5 Y	490—660	375			0	
					-20	
					-40	
			-60			
2 Y40 3 Y40 4 Y40	510—690	400	0			
			-20			
			-40			

1) Reduction of area to be reported for information.

B 300 Butt-weld test

301 Preparation of test assemblies:

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 electrode is recommended, except that electrodes satisfying the requirements for downhand and vertical position will be considered as also complying with the requirements for the horizontal-vertical position.

When an electrode is intended for downhand position only, one additional test assembly is to be prepared in this position.

302 Welding procedure for test assemblies:

The following welding procedure is to be applied when making the test assemblies:

Downhand welding:

First run with 4 mm diameter electrode. Remaining runs (except last two layers) with 5 mm diameter electrode or greater according to the normal welding practice with the electrode. The runs with the last two layers with the largest diameter of electrode manufactured.

Where a second downhand test is required, the following procedure is to be adapted:

First run with 4 mm diameter electrode. Next run with an electrode of intermediate diameter of 5 mm or 6 mm, and the remaining runs with the largest diameter of electrode manufactured.

Horizontal-vertical welding:

First run with 4 mm or 5 mm diameter electrode. Subsequent runs with 5 mm diameter electrodes.

Vertical and overhead welding:

First run with 3 mm diameter electrode. Remaining runs with 4 mm diameter electrodes, alternatively 5 mm diameter electrodes, if recommended by the manufacturer for the positions concerned.

Vertical downwards welding:

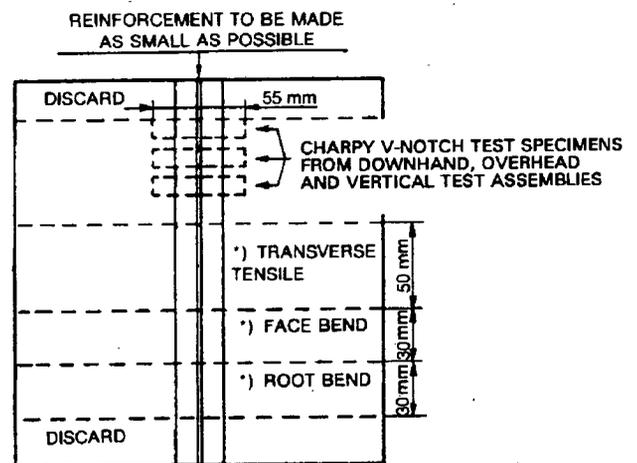
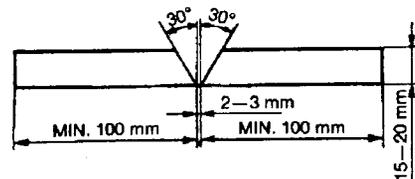
Vertical downwards technique should be adopted for the preparation of the test assembly, using electrode diameters as recommended by the manufacturer.

For all assemblies the back sealing runs are to be made with 4 mm diameter electrodes in the welding position appropriate to each test sample, after back chipping. For electrodes suitable for downhand welding only, the test assemblies may be turned over to carry out the back sealing run.

Test specimens:

One transverse tensile, two bend tests (face and 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.



THESE TESTS ARE ONLY REQUIRED FOR GRADES 2 Y, 3 Y, 4 Y, 2 Y40, 3 Y40 AND 4 Y40 ELECTRODES AND FOR ELECTRODES FOR WELDING OF SPECIAL QUALITIES WHEN REQUIRED BY THE INSTITUTION

Fig. 2
Butt weld test assembly

Test requirements:

202 试样

应从每块试件上取出一个纵向拉力试样和三个冲击试样, 如图 1 所示。

试样应按 A 700 的要求进行制备。

203 试验要求

试验结果应全部符合表 B1 规定的要求。

204 化学分析

制造厂商应提供每块试件中熔敷金属的化学分析报告并应包括所有重要的合金元素的含量。

焊条等级	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 %	Z %	温度 ℃	KV, J 最小平均吸收功值
1 2 3	400-560	305	22	1)	20	47
2Y 3Y 4Y 5Y					0	
2Y40 3Y40 4Y40	510-690	400			-20	
					0	
					-20	
					-40	
					-60	

1) 断面收缩率应列入报告供备查。

B 300 对接焊试验

301 试件的焊制:

应为每种焊接位置(俯焊、横向立焊、立焊和仰焊)制备如图 2 所示的对接焊缝试件, 并使用对各焊位推荐的焊条, 但符合俯焊和立焊位要求的焊条可视为也符合横向立焊位的要求。当焊条仅拟用于俯焊位时, 则应对该焊位制备一块附加试件。

302 试件的焊接程序:

当焊制试件时, 应采用下列焊接程序:

俯焊:

第一道用直径 4 mm 的焊条, 其余焊道(除最后两层外)用直径 5 mm 的焊条或根据常规的焊接规程所用焊条采用稍大直径的焊条, 最后两层焊道应采用所制造的最大直径的焊条。

如要求第二次俯焊试验时, 则应采用下列程序:

第一道用直径 4 mm 的焊条, 下一道用中等直径 5 mm 或 6 mm 的焊条, 其余焊道则用所制造的最大直径的焊条。

横向立焊:

第一道用直径 4 mm 或 5 mm 的焊条, 随后几道用直径 5 mm 的焊条。

立焊和仰焊:

第一道用直径 3 mm 的焊条, 其余各道用直径 4 mm 的焊条, 或者按制造商对这些焊位的推荐, 也可用直径 5 mm 的焊条。

向下立焊:

应采用向下立焊工艺来制备试件, 使用的焊条直径由制造厂商推荐。

对于所有试件, 底部铲平后均应用直径 4 mm 的焊条在适于每块试件的焊接位置进行封底焊。对仅适于俯焊的焊条, 试件可

以翻转进行封底焊。

试样:

应从每块试件上截取一个横向拉力试样、两个弯曲试样(正弯和反弯)和三个冲击试验用试样, 如图 2 所示。

试样应按 A 700 的要求制备。

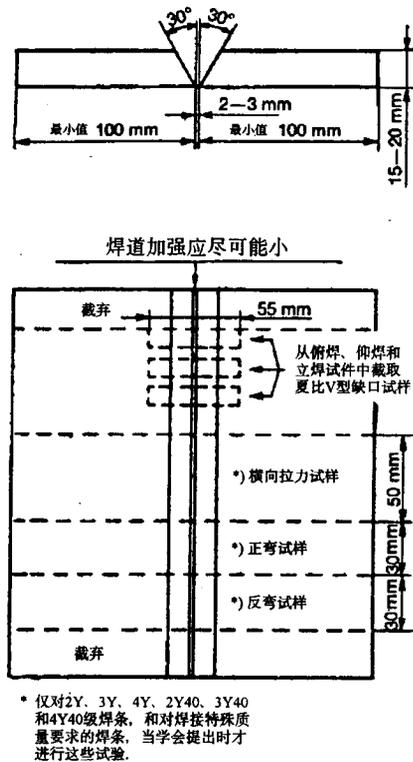


图 2 对接焊缝试件试验要求:

The test results are all to comply with the requirements given in Table B2. 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.

Grade	Tensile test	Impact test — KV, J, minimum average			
	R _m , minimum, N/mm ²	Temperature °C	Downhand, horizontal- vertical and overhead	Vertical (upward and downward)	
1 2 3	400	20 0 -20	47	34	
2 Y 3 Y 4 Y 5 Y	490	0 -20 -40 -60			
2 Y40 3 Y40 4 Y40	510	0 -20 -40			41

B 400 Hydrogen test

401 Hydrogen test requirements

Electrodes passing the hydrogen test as stipulated in A 800 are to satisfy the requirements given in Table B3. Both the individual and the average diffusible hydrogen contents of the specimens are to be reported and the average value in cm³ per 100 grams is not to exceed the following:

Mark	Mercury method (ISO 3690-1977)
H15	15 ¹⁾
H10	10 ²⁾
H5	5 ³⁾

1) 10 when Glycerine method is used.
2) 5 when Glycerine method is used.
3) Glycerine method is not allowed.

B 500 Covered electrodes for fillet welding

501 Where an electrode is submitted for approval for fillet welding only, and to which the butt-weld test required in 300 is not considered applicable, the initial approval tests are to consist of the fillet weld tests given below and all-weld-metal tests similar to those indicated in 200. Where an electrode is submitted for approval for both butt and fillet welding, the initial approval tests may, at the discretion of the Society, include one fillet weld test as detailed below and welded in the horizontal-vertical position.

Preparation of fillet weld test assemblies:

Test assemblies as shown in Fig.3 are to be prepared for each welding position (horizontal-vertical, vertical upwards, vertical downwards or overhead) for which the electrode is recommended by the manufacturer.

The first side is to be welded using the maximum size of electrode manufactured and the second side is to be welded using the minimum size of electrode manufactured and recommended for fillet welding. The length of the test assemblies L is to be sufficient to allow at least the deposition of the entire length of the electrode being tested.

The fillet size will in general be determined by the electrode size and the welding current employed during testing.

Hardness testing/requirements:

Each test assembly is to be sectioned to form three macro-sections, each about 25 mm thick, as shown in Fig.3.

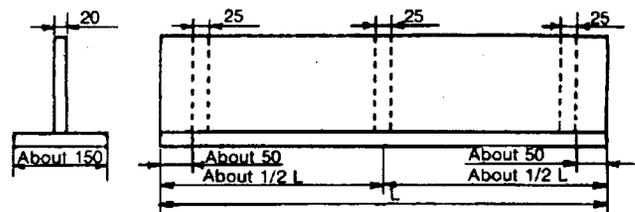


Fig. 3
Fillet weld test assembly

Hardness readings are to be made in each section as indicated in Fig.4. The hardness of the weld is to be determined and is to meet the requirements in Table B4.

The hardness of both heat affected zone (HAZ) and base metal is also to be determined and is to be reported for information.

Method	Grades 1, 2, 3	Grades 2 Y, 3 Y, 4 Y, 5 Y 2 Y40, 3 Y40, 4 Y40
Vickers (50 or 100 N load)	To be reported for information	150 minimum
Rockwell B (1000 N load)		80 minimum

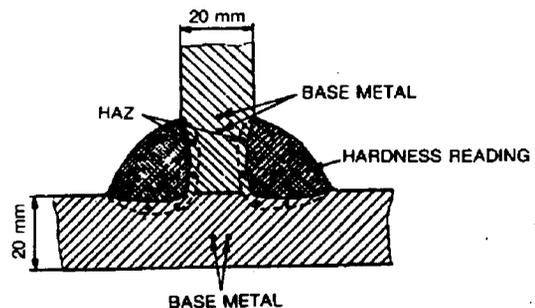


Fig. 4
Hardness readings

Breaking test/requirements:

One of the remaining sections of the fillet weld is to have the weld on the first side gouged or machined to facilitate breaking the fillet weld on the second side by closing the two plates together, subjecting the root of the weld to tension.

试验结果应全部符合表 B2 规定的要求。应将横向拉力试样的断裂位置列入报告。如弯曲试样弯曲后，在试样的外表面上未

发现任何尺寸超过 3 mm 的裂纹或缺陷，则视为符合要求。

等级	拉力试验 R_m 最小值 N/mm^2	冲击试验—KV, J, 最小平均值		
		温度 $^{\circ}C$	俯焊, 水平立焊和仰焊	向上或向下立焊
1	400	20	47	34
2		0		
3		-20		
2Y	490	0		
3Y		-20		
4Y		-40		
5Y		-60		
2Y40	510	0	41	
3Y40		-20		
4Y40		-40		

B 400 测氢试验

401 测氢试验的要求

通过 A 800 规定的测氢试验的焊条应符合表 B3 规定的要求。应报告试样扩散氢含量的单值和平均值，其每 100 g 扩散氢含量的平均值 (cm^3) 不得超过下列值:

后缀标记	水银测氢法 (ISO 3690 - 1977)
H15	15 ¹⁾
H10	10 ²⁾
H5	5 ³⁾

1) 当使用甘油测氢法时为 10。
2) 当使用甘油测氢法时为 5。
3) 不允许使用甘油测氢法。

B 500 填角焊用药皮焊条

501 如送检焊条仅允许用于填角焊，且 300 中规定的对接焊试验认为不适用时，则初次认可试验应包括下列规定的填角焊试验和与 200 指定的相似的全熔质试验。如送检焊条允许兼用于对接焊和填角焊时，则经本社同意，初次认可试验可包含一个如下规定的填角焊试验，且在横向立焊位进行施焊。

填角焊试件的焊制:

应在每一种焊位（横向立焊、垂直向上、垂直向下或仰焊）采用制造厂商对该焊位所推荐的焊条焊制如图 3 所示的试件。

第一侧应使用所制造的最大直径的焊条焊制；第二侧应使用所制造的对角焊所推荐的最小直径的焊条焊制。试件的长度 L 应至少足以允许熔敷整根送检焊条。填角尺寸通常将根据焊条直径和试验期间所用的焊接电流来决定。

硬度试验要求:

每一试件应截取三个宏观分段截面，每个截面厚度约 25mm，如图 3 所示。

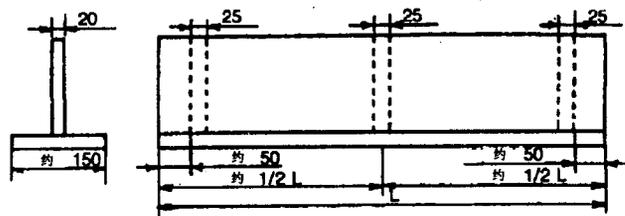


图 3 填角焊缝试件

每一截面应作出如图 4 所示的硬度测量点，以确定焊缝的硬度并应满足表 B4 的要求。

还应确定热影响区 (HAZ) 和母体金属两者的硬度并列入报告以备查。

测量方法	1、2、3 级焊条	2Y、3Y、4Y、5Y、2Y40、3Y40、4Y40 级焊条
维氏硬度 (载荷 50 或 100N)	应列入报告	最小值 150
洛氏硬度 B (载荷 1000N)	供备查	最小值 80

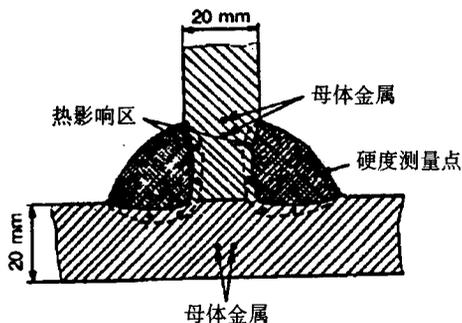


图 4 硬度测量点

折断试验/要求:

填角焊缝其余两个截面之一的第一侧的焊接物应予刨去或机加工去除，以便在将两块板材合拢时使第二侧的角焊缝根部受拉