WQTB®
万奇太宝

生产基地：

建德市横山钨业有限公司

地址：浙江省建德市寿昌镇

万奇太宝（杭州）钨业有限公司

地址：浙江省建德市城东新区科技园万奇太宝路001号

兆恒威勒（石门）钨业有限公司

地址：湖南省常德市石门县楚江镇电站南路

公司总部：

深圳市威勒达科技开发有限公司

地址：中国深圳市福田区新洲南路金享楼二栋六楼南

400-004-3068 www.wqtb.com

Products catalogue
产品手册

WQTB®

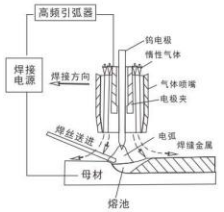
钍钨电极方案 Thoriated tungsten
铈钨电极方案 Ceriated tungsten
镧钨电极方案 Lanthanated tungsten
锆钨电极方案 Zirconiated tungsten
纯钨电极方案 Pure tungsten
钇钨电极方案 Yttrium tungsten
复合电极方案 Compound tungsten

Email:winner@wqtb.com Tel:0755-83456454

钨极惰性气体保护焊 (TIG)

钨极惰性气体保护焊是以钨作为电极材料，在惰性气体的保护下，利用电极与母材金属(工件)之间产生的电弧热熔化母材和填充焊丝的焊接过程，英文称为GTAW-Gas Tungsten Arc Welding 或TIG-Tungsten Inert Gas Welding。由于在焊接时电极不熔化，因此亦称为非熔化极惰性气体保护焊，简称为TIG焊。

Tungsten is used as electrode material in Gas Tungsten Arc Welding , which is the welding process of using the arc heat to melt the base metal and filler under the protection of inert gas,called GTAW-Gas Tungsten Arc Welding or TIG - Tungsten Inert Gas Welding.in that tungsten electrode is non- consumable.so named TIG welding ,short for InertGas Shielded welding.



钨电极非融化极氩弧焊(TIG)

TIG 焊的电流种类和极性

1) 直流正极性 (DCSP—Direct Current Straight Polarity)
2) 直流反极性 (DCRP—Direct Current Reversed Polarity)
3) 交流正弦波TIG焊 (Alternating Current Sine Wave Tig Welding)
4) 交流矩形波TIG焊 (Alternating Current Rectangular Wave Tig Welding)
5) 脉冲TIG焊 (Pulsed Tig Welding)

TIG 焊的工艺特点及应用范围

TIG characteristics and application

1) 惰性气体不与金属发生任何化学反应，在惰性气体保护下焊接，不需使用焊剂就可以焊接几乎所有的金属，焊后不需要去渣，应用面很广。

2) 焊接工艺性能好，明弧，能观察电弧及熔池，即使在小的焊接电流下电弧仍然燃烧稳定。由于填充焊丝是通过电弧间接加热，焊接过程无飞溅，因此焊缝成形美观。

3) 焊接过程中钨极不熔化，电弧比较稳定，容易控制焊接质量。而且焊接薄板时可填丝，亦不可填丝，当然也适用于焊接稍厚的中板。

4) 易于实现机械化和自动化焊接，也适于全位置焊接。

1. Inert gas doesn't have any chemical reaction with the metal,it can weld almost all of the metal without the flux. Without removing slag after welding. Its application is quite wide.

2. Arc welding process performance is good, open arc, and it can observe arc and molten pool. It is Stable arc even in the small welding current.

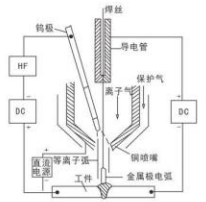
3. Tungsten is non- consumable in the welding process, arc stability . easy to control quality .

4. Easy to realize the mechanization and automation, and also suitable for the all-position welding.

等离子弧焊 (PAW)

等离子体是由大量带电粒子组成的非凝聚系统，等离子体是能够导电的物质，它是由负的电子、正的离子或部分原子和分子构成的混合物，它类似气体，并服从气体的规律。等离子体存在于闪电、极光、电弧、光源、点焊、冶炼等很多场合。等离子弧焊接(PAW)技术，是在钨电极氩弧焊(TIG)的基础上诞生的一种压缩电弧焊接工艺，经过焊炬的机械压缩、电磁压缩以及热压缩效应，等离子射流的速度、温度、能量密度与常规的TIG相比都有了显著的提高。

PAW is Non condensed system which made up of a large number of charged particles. Plasma is the conductive material, It's a mixture which contains negative electron, positive ion or part of a mixture of atoms and molecules, similar to the gas, and obey the regular of gas, plasma exist in lightning, aurora, arc, lighting, spot welding, smelting and so on.Compared with the conventional TIG, welding speed, welding speed and welding thickness have an obvious improvement. The birth of PAW is a compression arc welding technology based on TIG. Through the mechanical compression of the torch , electromagnetic compression and thermal compression effective , compared with the conventional TIG , Plasma jet velocity, temperature, energy density have improved significantly



钨电极非融化极等离子弧焊(PAW)

PAW 焊的电流种类和极性

1) 直流正极性 (DCSP—Direct Current Straight Polarity)
2) 直流反极性 (DCRP—Direct Current Reversed Polarity)
3) 小孔型等离子弧焊 (Keyhole-mode Welding)
4) 脉冲等离子弧焊 (Pulsed Plasma Arc Welding)
5) 变极性等离子弧焊 (Variable Polarity Plasma Arc Welding)

PAW 焊的工艺特点及应用范围

PAW characteristics and application

等离子弧焊是一种可进行单面焊双面形成的焊接，特别适用于背面可达性不好的结构，小电流时电弧稳定，焊缝质量高，对于不同材质，可进行双面焊接的厚度也不同。

等离子弧焊可焊接：碳钢、不锈钢、高强钢、镍基合金、钛合金、铝合金、铜合金、镁合金等。在工业应用中，单道可焊材料厚度范围从0.025mm(微束等离子弧焊)到12.5mm(变极性等离子弧焊)，等离子弧焊接可在平焊、横焊位置下进行，采用脉冲电流时可进行全位置焊接。

PAW can realize the single double-sided welding, especially suitable for the construction with bad accessibility on its back. It is Arc stablity and the welded joint of high quality when it used in low-current . For different material, the thickness which can be used in the double sided welding is also different.

PAW can weld carbon steel, stainless steel, high-strength steel, nickel base alloy, titanium alloy etc., application In the industrial , the thickness of single-channel weldable material varies from 0.025mm (Micro-beam Plasma Arc Welding) to 12.5mm (Variable Polarity Plasma Arc Welding). PAW can operate in the flat welding and horizontal welding, and it can operate all-around welding in the pulsed current.

钨电极
Tungsten electrode

钨电极是TIG焊中常用的易耗材料。钨电极具有电子逸出功能低，再结晶温度高，机械切割性能好，耐高温，强大的电子发射能力等特点。由于钨的熔点高达3410℃、沸点高达5900℃，能耐高温，导电性好，强度高（σ_b可达850-1100MPa），钨的纯度约为99.5%（质量分数），其电子逸出功为4.54eV（1eV=1.602x10^{-19}J，下同），当在钨中加入微量逸出功较小的稀土元素，如钍（Th）、铈（Ce）、锆（Zr）等，或它们的氧化物，如氧化钍（ThO_2）、氧化铈（CeO_2）等，则能显著提高电子发射能力。其应用范围：适用于惰性气体保护电弧焊和等离子焊接、切割、喷涂、熔炼电极。

Tungsten electrode is the consumable material commonly used in TIG. It has the low electron work function, high recrystallization temperature, good mechanical cutting performance, high temperature resistance, strong ability of electron emission ect.,Since the melting point of tungsten up to 3410℃ and boring point up to 5900℃ ,it can high temperature resistance and conduct electricity, and it also has high strength. The purity of tungsten is about 99.5% (mass fraction), and its electron work is 4.54eV. When adding a little of rare earth elements into the tungsten material, such as thorium(Th), cerium(Ce), zirconium(Zr) etc. , or their oxides, such as thorium oxide, cerium oxide, zirconium oxide etc., the ability of electron emission can be improved significantly. It can be applied into inert gas shielded arc welding, plasma arc welding, cutting, painting and melting electrode.

钨电极规格尺寸表
Tungsten electrode specifications

直径 Diameter		直径偏差 Diameter tolerance	长度 Length	长度偏差 Length tolerance
mm	inch	mm	mm	mm
1.0	1/25	(+/-)0.01	50,75,150,175	(+/-)1.0
1.2	6/125	(+/-)0.01	50,75,150,175	(+/-)1.0
1.6	1/16	(+/-)0.01	50,75,150,175	(+/-)1.0
2.0	2/25	(+/-)0.02	50,75,150,175	(+/-)1.0
2.4	3/32	(+/-)0.02	50,75,150,175	(+/-)1.0
3.0	3/25	(+/-)0.02	50,75,150,175	(+/-)1.0
3.2	1/8	(+/-)0.03	50,75,150,175	(+/-)1.0
4.0	5/32	(+/-)0.04	50,75,150,175	(+/-)1.0
4.8	3/16	(+/-)0.04	50,75,150,175	(+/-)1.0
5.0	1/5	(+/-)0.04	50,75,150,175	(+/-)1.0
6.0	15/64	(+/-)0.04	50,75,150,175	(+/-)1.0
6.4	1/4	(+/-)0.04	50,75,150,175	(+/-)1.0
8.0	5/16	(+/-)0.04	50,75,150,175	(+/-)1.0
10.0	2/5	(+/-)0.04	50,75,150,175	(+/-)1.0

根据客户要求可提供特殊规格钨电极 Special length and diameter are also available upon your request.

钍钨电极成分表
Thoriated tungsten electrode composition

牌号 Model	氧化物 Oxide addition		杂质含量% Impurites	钨含量% Tungsten	色标 Color	标准 Standard
	种类 Principal oxide	含量% Contents				
WT10	ThO_2	0.8-1.2	<0.2	余量Balance		AWS A5.12 ISO6848 EN 26 848
WT20	ThO_2	1.8-2.2	<0.2	余量Balance		
WT30	ThO_2	2.8-3.2	<0.2	余量Balance		
WT40	ThO_2	3.8-4.2	<0.2	余量Balance		

我公司是拥有《辐射安全许可证》的钍钨电极合法生产企业。钍钨电极含有0.8%-4.2%的氧化钍，电子逸出功为2.7eV，起弧更容易，电弧更稳定，即使在超负荷电流下也能表现良好，因而广泛应用于各种TIG、PAW焊接领域。氧化钍具有超强的载流能力，再结晶温度高，导电率更好，机械切割性能更强，使用寿命更长。焊接时，钍钨电极尖端保持磨尖，这样在焊接中能更大程度的保证钨电极尖端的球状不易开裂。

Our company is the only legal manufacturer accredited"radiation safety license" to produce thoriated tungsten in China. Thoriated tungsten electrode contains 0.8% - 4.2% thorium oxide, and its electron work function is 2.7eV. arc to be easier,electric arc stable. It performs well with overload current, so it's widely used in various TIG and PAW. Thorium oxide has strong current-carrying capacity, high recrystallization temperature, better conductivity, stronger mechanical cutting performance and longer service life. When welding, the tip of thoriated tungsten electrode keeps sharpening so that the ball on the tip of tungsten electrode can be not easy to crack at a greater degree of assurance.

WQTB®

铈钨电极成分表
Ceriated tungsten electrode composition

牌号 Model	氧化物 Oxide addition		杂质含量% Impurites	钨含量% Tungsten	色标 Color	标准 Standard
	种类 Principal oxide	含量% Contents				
WC20	CeO_2	1.8–2.2	< 0.20	余量Balance		AWS A5.12 ISO6848 EN 26 848

我公司是国内最早生产铈钨电极的生产厂家，产品曾获省级科技进步奖，铈钨电极含有1. 8– 2. 2%的氧化铈，电子逸出功为2. 4 eV，在低电流条件下有优良的起弧和稳弧性能，维弧电流较小。因此，铈钨电极经常用于管道、不锈钢制品和细小精密部件的焊接，在低电流直流条件下或钨电极直径要求2. 0以下的焊接一般首选铈钨电极。

氧化铈具有很高的迁移率，因此铈钨并不适合高电流条件下的应用，因为在高电流下，氧化物会快速的移动到高热区，即钨电极焊接处的顶端，这样对氧化物的均匀度造成破坏，因而因为氧化钨均匀所带来的好处将不复存在。

Our company is the earliest manufacturer of cerium tungsten electrodes, and our products have obtained the provincial science and technology progress prize. contains 1.8%-2.2% ceria. electron work is 2.4eV. This electrode plays a good performance on starting arc and stabilizing arc with low current. Therefore, Ceriated tungsten electrode are commonly using in pipeline, stainless steel and Small precision parts welding. And it's the first choice when the condition is in the low and direct current or the diameter demands below 2.0mm.

The mobility of cerium oxide is quite high, so ceriated tungsten is not suitable for the application in the high current. If it's used in the high current, the oxide may accelerate to the high hot area, which is the top of the tungsten electrode, and the uniformity of oxide may suffer damage. the benefit brought by cerium oxide will disappear.

WQTB®

镧钨电极成分表
Lanthanated tungsten electrode composition

牌号 Model	氧化物 Oxide addition		杂质含量% Impurites	钨含量% Tungsten	色标 Color	标准 Standard
	种类 Principal oxide	含量% Contents				
WL10	La_2O_3	0.9–1.2	< 0.20	余量Balance		AWS A5.12M ISO6848 EN 26 848
WL15	La_2O_3	1.4–1.6	< 0.20	余量Balance		
WL20	La_2O_3	1.9–2.1	< 0.20	余量Balance		

镧钨电极含有0.8%-2.2%的三氧化二镧，电子逸出功为2.8eV-3.0eV。镧钨电极低电流下容易起弧，并且能稳定低电流下的电弧。主要用于直流焊接，用于交流焊接时也表现良好。三氧化二镧抗蠕变性能更好，延展性强，搅拌率小，因而镧钨电极的尖端温度更低，这样有助于阻止晶粒长大，提升电极使用寿命。如果无过载电流，镧钨电极寿命比钍钨长，尤其擅长防止热冲击，短周期焊接中重复点火的情况下，焊接良好，避免污染。在焊接管道时，焊工对这种镧钨电极尤其满意，因为使用寿命长而减少停机时间。

Lanthanated tungsten electrode contains 0.8%-2.2% lantanna ,the electron work is 2.8eV-3.0eV. It is easy to arc and arc stability with low current ,it is mainly used in DC, performance well in AC welding .Lanthana has better of Creep Resistance,strong ductility ,smaller stirring rate,therefore the tip temperature of lanthanated lower ,which helps to precent grain growth , the service life of electrode can be increased substantially, without overload current ,the life of lanthanated tungsten electrode longer than thoriated tungsten electrode , particularly good at preventing thermal shock,In the welding of short cycle,under the condition of repeated ignition, it can be welded well and prevents from pollution. When welding the pipeline, welders are quite satisfied with this lanthanated tungsten, because the service time is long to reduce the downtime.

WQTB®

锆钨电极成分表
Zirconiated tungsten electrode composition

牌号 Model	氧化物 Oxide addition		杂质含量% Impurites	钨含量% Tungsten	色标 Color	标准 Standard
	种类 Principal oxide	含量% Contents				
Wzr3	ZrO_2	0.15–0.5	< 0.20	余量Balance		AWS A5.12 ISO6848 EN 26 848
WZr8	ZrO_2	0.7–0.9	< 0.20	余量Balance		

在交流焊接中，锆钨电极是最常用的，锆钨电极含少量的氧化锆。电子逸出功为2.5eV-3.0eV。锆钨电极焊接性能良好，在焊接时比纯钨容易起弧，而且弧束稳定，也能很好的防治污染，载流能力也不错。该电极最大的特点是在高负载电流的情况下，其端部能保持成圆球状而减少渗钨现象，并具有良好的抗腐蚀性。锆钨电极表现出来的优越性能，是其他电极不可替代的。

Zirconiated tungsten electron is the most commonly used in alternating current welding, which contains a small amount of zirconium oxide. Its electron work is 2.5eV - 3.0eV. Zirconiated tungsten electron performs well, and it is easier to start arc than pure tungsten. Arc stability. It can also prevent and control pollution well. Current-carrying capacity is quite good as well. The biggest characteristic of this electron is that its top can keep globular to reduce the seepage of tungsten in the high load current and it also has good corrosion resistance. The superior performance of zirconiated tungsten electron cannot be replaced by other electron.

WQTB®

纯钨电极成分表
Pure Tungsten products composition

牌号 Model	氧化物 Oxide addition		杂质含量% Impurites	钨含量% Tungsten	色标 Color	标准 Standard
	种类 Principal oxide	含量% Contents				
WP	—	—	< 0.20	余量Balance		AWS A5.12 ISO6848 EN 26 848

纯钨电极是氩弧焊接最早使用的电极，也被广泛使用在各个特定的焊接行业。纯钨电极含钨量最低99.5%，没有合金元素。纯钨电极仅作为交流条件下的焊接电极或作为电阻焊电极，它能提供清洁母材表面，加热时焊球变尖，这种形状提供一个平衡的波形交流焊接电弧稳定，是特别良好的。纯钨具有非常高的电子逸出功能，蒸汽压力低，电阻小，导电性好，热膨胀小，弹性模亮高。所以在低电流时电弧稳定，低于5A时能够很好地焊接铝、镁及其合金，但发射电子要求电压较高，要求焊机空载电压高，长时间大电流工作时钨极烧损较明显，端部熔化后落入熔池会使焊缝夹钨，因此只作为某些黑色金属焊接用，或焊接不重要部位。

Pure tungsten electrode is the earliest use of electrodes in tig welding. it contains tungsten content minimum 99.5%, without other impurities. Pure tungsten electrode is only as welding electrode under the condition of AC or resistance welding electrode, It can clean surface of base matel .welded ball became tapering when heating. This shape provides a good and balanced waveform for AC welding. pure tungsten electrode has a very high electron output, low vapor pressure, low resistance. good conductivity, thermal expansion, high elastic modulus bright. Therefore, stable arc at low currents, even as low below the 5A it also do the welding aluminum, magnesium and other. But the emission of electron demands high voltage and high no-load voltage of welding machine.The tungsten electrode is burned apparently if it works in the high current for a long time. The end may drop into molten pool after melting, which will bring the tungsten into the welding gap.So, it's just used for welding some black metal or welding the unimportant parts.

钇钨电极成分表

Yttrium tungsten electrode composition

牌号 Model	氧化物 Oxide addition		杂质含量% Impurites	钨含量% Tungsten	色标 Color	标准 Standard
	种类 Principal oxide	含量% Contents				
WY	YO_2	1.8–2.2	< 0.20	余量Balance		AWS A5.12 ISO6848 EN 26 848

钇钨电极含有1.8%-2.2%的氧化钇，电子逸出功为2.8eV-3.2eV。钇钨电极在焊接时，弧束细长，压缩程度大，在中、大电流时其熔深最大。在焊接高强度钛合金承力构件，以及喷气发动机高温部件采用的单晶或粗晶材料，金属间化合物，陶瓷或金属基复合材料等新型材料时，性能优越。所以，主要应用于军事工业和航空、航天工业。

Yttrium tungsten electrode contains 1.8% -2.2% yttria which its electron function of 2.8eV-3.2eV. when used in welding , Yttriated Tungsten is primarily used in military and aviation industry with narrow arc beam, high compressing strength, highest welding penetration at medium and high current. Its superior performance also recommends use in the welding of high strength titanium bearing components, as well as high-temperature jet engine components using a single crystal or coarse-grained materials, intermetallic compounds, ceramic or metal matrix composites and other new materials. Therefore they are mainly used in military industry and the aerospace industry.

复合钨电极成分表

Compound tungsten electrode composition

牌号 Model	氧化物 Oxide addition		杂质含量% Impurites	钨含量% Tungsten	色标 Color	标准 Standard
	种类 Principal oxide	含量% Contents				
WS2	La_2O_3 YO_2 ZrO_2	1.8–2.2	< 0.20	余量Balance		AWS A5.12 ISO6848 EN 26 848

复合钨电极又称三元复合稀土钨电极,含有1.5%的氧化镧，0.8%的氧化锆，0.8%的氧化钇三种元素，其本身不具有放射性，复合目的就是为了平衡内部电子的迁移率和蒸发率，使得钨电极性能发挥到极致，而且降低电子的电子逸出功。复合钨电极起弧和重复起弧很容易。如果焊接周期在大于15分钟的情况下，它的使用寿命会更长。复合钨电极尖端烧损明显优于其它钨电极。由于三种氧化物在电极中掺杂混合，对生产工艺有极为严格的要求，因此生产成本较高。

Compound tungsten electrode also known as three elements of rare earth containing 1.5% lanthana , zirconia0.8%, and 0.8% yttria.. It is a non-radiation material . it is good to balance the electron mobility and evaporation rates, making tungsten electrodes to maximize their performances. For compound tungsten electrode, it's easy to start and restart arc. If the welding cycle more than 15 minutes, its life will be last longer. WS tungsten electrode tip burning significantly better than other tungsten electrodes. As three kinds of doping the oxide mixture in the electrode. It's strict with the production process and the cost of production is more expensive.

钨电极焊接电流

不同的电极材料的参考准则略有差别，其他气体的使用也会导致电流的变化。可使用以下图表作为参考，对于定量的电流，大直径的电极持续时间会更长，但是引弧较难。过高的电流会导致电极的熔化以及烧损，过低的电流会导致电弧的不稳定。

如需更多相关钨电极资料，请通过邮箱winner@wqtb.com或者拨打0086-0755-83456454联系万奇太宝相关技术人员。

Tungsten electrodes rating for welding currents

Different electrode materials will vary slightly from these guidelines.Use of other gases will aslo change the recommended currents.Use this chart as a general guide.Aslo keep in mind that for a given amount of amperage,larger diameter electrodes will last longer but will be harder to start.Excessive current will cause the electrode to melt and drop off.Insufficient current will lead to an unstable arc.

For further assistance in selecting the correct tungsten electrode for your welding application,please contact an WQTB® technician via email at winner@wqtb.com, phone 0086-0755-83456454.

电极直径 Electrode Diameter	直流电 Direct Current(A)		交流电 Alternating Current(A)	
	正接 Straight Polarity	反接 Reverse Polarity	非对称波形 Unbalanced Wave	对称波形 Balanced Wave
	DCEN	DCEP		
.020”(0.50mm)	5–2	n/a	5–15	10–20
.040”(1.0mm)	15–80	n/a	10–60	20–30
1/16”(1.6mm)	70–150	10–20	50–100	30–80
3/32”(2.4mm)	150–250	15–30	100–160	60–130
1/8”(3.2mm)	250–400	25–40	150–210	100–180
5/32”(4.0mm)	400–500	40–55	200–275	160–240
3/16”(4.8mm)	500–750	55–80	250–350	190–300
1/4”(6.4mm)	750–1100	80–125	325–450	325–450

1.电流类型的影响

1. 1一般情况

电弧由直流电以及交流电提供，以下图表显示了哪种类型的电流更适合哪种金属类型或合金的焊接。

1. 2直流电

电弧行为取决于电极是否与电源的正极或负极连接。与正极连接时，相比于与负极连接，有更大的电极热量输出和较少的渗透，电极的电流承载能力也将因此降低。

1. 3交流电

交流电的应用中，电流经常改变方向。电极的正极和负极的电流交替，电极的电流承载能力要比负极连接时要弱，但是比正极连接时要强。

1.Influence of the type of current

1.1 General

The electric arc may be supplied with either direct current or alternating current. Table below indicates which type of current is generally more suitable to the type of metal or alloy to be welded.

1.2 Direct current supply

The arc behaviour is different depending on whether the electrode is connected to the positive or negative terminal of the power source. With electrode positive (d.c.+)polarity, there is greater output heat at the electrode and less penetration of the work than with electrode negative (d.c.-)polarity. The current-carrying capacity of an electrode of a given size will therefore be lower with positive polarity than with negative polarity.

1.3 Alternating current supply

With alternating current (a.c.)supply,the current changes direction each half-cycle.The arc alternates between electrode positive polarity and electrode negative polarity. The current-carrying capacity of an electrode is then less than when it is used with electrode negative polarity,but greater than when it is used with electrode positive polarity.

供电类型的匹配

Suitability of current supply type

焊接金属及合金的类型 Type of metal or alloy to be welded	电极 Electrode type	直流电 Direct current		交流电 Alternating current
		负极 Electrode negative(–)	正极 Electrode positive(+)	
铝及其合金（厚度小于2.5毫米） Aluminium and its alloys(thickness ≤2.5mm)	WL15,WP,WZr8	Acceptable	Acceptable	Best
铝及其合金（厚度大2.5毫米） Aluminium and its alloys(thickness >2.5mm)	WL15,WP,WZr8	Acceptable	N.R. a	Best
镁及其合金 Magnesium and its alloys	WP	N.R.	Acceptable	Best
非合金钢以及低合金钢 Non–alloy steel and low alloy steels	WL15,WC20,WT20	Best	N.R.	N.R.
不锈钢 Stainless steels	WL15,WC20,WT20	Best	N.R.	N.R.
铜 Copper	WL15,WC20,WT20	Best	N.R.	N.R.
青铜 Bronze	WL15,WC20,WT20	Best	N.R.	Acceptable
铝青铜 Aluminium bronze	WP	Acceptable	N.R.	Best
硅青铜 Silicon bronze	WL15,WC20,WT20	Best	N.R.	N.R.
镍及其合金 Nickel and its alloys	WP	Best	N.R.	Acceptable
钛及其合金 Titanium and its alloys	WL15,WC20,WT20	Best	N.R.	Acceptable

a N.R.=Not recommended a N.R.=不推荐 Best=最佳 Acceptable=可用

WQTB®

常见母材的TIG 焊参数

手工钨极氩气保护焊(GTAW)参照表

Manual GTAW welding references

焊接材料与电极接法 Material & Methods	板厚 Thickness /mm	焊丝直径 Welding wire d /mm	焊接电流 Welding current/A	喷嘴口径 φ Nozzle /mm	氩气流量 Ar/dm³ · min⁻¹	钨极直径 φ Electrode d/mm	焊接速度 Welding speed /cm · min⁻¹	焊枪电流 Torch current
不锈钢直流正极性 Stainless steel (DCSP)	0.6~1	0~1.6	30~70	6.8	4~5.7	1~1.6	200~400	<75A
	2.0	1.6~2.0	60~120	6.8	4.8~6	1.6~2.5	150~300	<150A
	3.0	2~3	110~150	8.9	5~6	2~3	~300	<150A
	4.0	2.5~4	130~180	9、10	6~8.4	3~4	≈280	<200A
	5.0	3~5	150~220	9、12	8~10.5	3~5	≈260	<200A
	6.0	3~5	180~250	12、16	10.5~12	3~4	≈250	<200A
	8.0	4~6	220~300	12、16	11~12.7	3~5	≈170	<500A
	12.0	5~6	300~400	16、18	11.5~14.5	4~6	≈80	<500A
铝或铝合金交流加高频（脉冲） Al/ Aluminum Alloy. (ACHF)	0.6~1	0~0.6	50~70	6.8	4~5.7	1~1.6	200~400	<75A
	2.0	1.6~2.0	60~110	6.8	4.8~6	1.6~2.5	150~300	<150A
	3.0	2~3	100~140	8.9	5~6	2~3	~300	<150A
	4.0	3~4.5	140~180	9、10	6~8.4	3~4	≈280	<200A
	5.0	4~5.5	170~220	9、12	8~10.5	3~5	≈260	<200A
	6.0	4~5.5	200~270	12、16	10.5~12	3~4	≈250	<200A
	8.0	4~5.5	240~320	12、16	11~12.7	3~5	≈170	<500A
	12.0	>6	250~400	16、18	11.5~14.5	4~6	≈80	<500A

1Cr18Ni9Ti不锈钢TIG点焊工艺参数

Stainless steel TIG welding parameter

母材厚度 Thickness/mm	焊接电流 Welding current/A	焊接时间 Weld period/s	二次脉冲电流 Twice pulse current/A	二次脉冲时间 Twice pulse current/S	氩气流量 Ar /L · min-1	焊点直径 Spot size /mm
0.5+0.5	80	1.03	80	0.57	7.5	4.5
0.5+0.5	100	1.03	100	0.57		5.5
2+2	160	9	300	0.47		8
2+2	190	7.5	180	0.57		9
3+3	180	18	280	0.69		10
3+3	200	18	280	0.69		11

直流脉冲TIG焊不锈钢薄钢板工艺参数

DC Pulse TIG welding stainless steel sheet parameter

板厚 Thickness/mm	电流 Current /A		时间 Time/s		焊接速度 Welding speed /cm · min-1	氩气流量 Ar/L · min⁻¹
	I_p	I_b	t_p	t_b		
0.3	20~22	5~8	0.06~0.08	8	50~60	0.6~0.8
0.5	55~60	10	0.08	7	50~60	0.8~1.0
0.8	85	10	0.12	5	80~100	0.8~1.0

WQTB®

直流脉冲TIG焊薄钢板工艺参数

DC pulsesTIG welding of thin steel plate parameter

板厚 Thickness /mm	电流 Current /A		时间 Time/s		焊接速度 Welding speed /cm · min-1	氩气流量 Ar /L · min-1
	I_p	I_b	t_p	t_b		
0.2	8~12	0.8~1.5	0.15~0.20	0.2	26~30	4~5
0.3	10~15	0.8~1.5	0.15~0.20	0.2	30~36	4~5
0.4	10~25	0.8~1.5	0.18~0.22	0.2	30~36	4~5
0.5	10~25	0.8~1.5	0.18~0.24	0.2	36~42	4~5

普通钢对接接头手工TIG焊参数

Ordinary steel butt joint TIG manual welding parameter

板厚 Thickness /mm	焊接电流 Welding current/A	焊丝直径 Welding wire d /mm	焊接速度 Welding speed /cm · min-1	气体流量 Gas/L · min-1
0.9	100	1.6	300~370	4~5
1.2	100~125	1.6	300~450	
1.5	100~140	1.6	300~450	
2.3	140~170	2.4	300~450	
3.2	150~200	3.2	250~300	

铜及铜合金TIG手工焊参数

Copper and copper alloy TIG manual welding parameter

焊接材质 Welding material	板厚 Thickness /mm	电源种类及极性 Current type and polarity	焊接电流 Welding current/A	氩气流量 Ar /L · min-1	备注 Remark
紫铜 Red copper	1.5	直流正接 DCSP	110~140	6~8	
	3		175~225	6~10	
	4.0~5.0		190~260	8~12	60° V形坡口，1.5mm钝边，预热100° C~250°C 60° single V groove, Root face 1.5mm, Preheat:100° C~250°C
	6.0~10.0		200~320	10~14	
磷青铜 Phosphor bronze	1.5	直流正接 DCSP	90~150	6~15	
	3		100~220	6~15	
铝青铜 Aluminium bronze	1.5	交流 AC	25~80	8~15	
	3		60~175	8~15	
	10		210~330	15	70° V形坡口 70° single V groove
硅青铜 Silicon bronze	1.5	直流正接 DCSP	100~120	6	
	3		130~150	6	
	4~6		150~200	10	60° V形坡口 60° single V groove
	10		230~280	10	
	12		250~300	10	

钛合金自动TIG焊参数
Titanium alloyTIG Auto-welding parameter

对接板厚 Thickness /mm	填丝直径 Filler d/mm	焊接电流 Welding current/A	焊接速度 Welding speed /cm·min⁻¹	氩气流量 Ar /L·min⁻¹		
				焊枪 Torch	后拖 Hinder	背面 Back
0.8	—	40~80	20~40	6~8	3~5	2~3
1.0	—	65~100	25~40	6~8	3~5	2~3
1.2	—	70~120	25~40	6~8	3~5	2~3
1.5	—	70~140	25~40	6~8	3~5	2~3
1.8	—	80~140	25~40	6~9	3~5	2~3
2.0	—	100~150	25~40	6~9	5~7	2~3
2.5	—	140~200	25~30	7~10	5~7	3~4
3.0	—	180~200	25~30	7~10	5~7	3~4
1.0	1.5	80~120	25~40	6~8	3~5	2~3
1.2	1.5	100~140	25~40	6~8	3~5	2~3
1.5	1.5	140~180	25~40	6~8	3~5	2~3
2.0	1.5	180~200	25~28	6~8	5~7	2~3
3.0	1.5~2.0	200~260	22~25	7~10	5~7	2~3

一些钛及其合金的自动等离子弧焊接工艺参数
Titanium and titanium alloy PAW auto-welding paramater

材料种类 Material	厚度 Thickness /mm	焊接电流/A Welding current /A	焊接速度 Welding speed /mm·min⁻¹	气体流量 Gas /L·h⁻¹				焊透方式 Penetration mode	喷嘴孔径 Nozzle d/mm
				离子气 Ion gas	保护气 Protective gas	拖罩气 Cover Gas	背面气 Backing gas		
钛合金 Titanium Alloy[1]	0.1	7	225	9	240	—	18	熔透 Penetration welding	0.75
	0.2	14	225	13.2	300	—	18	熔透 Penetration welding	0.90
	0.3	18	225	16.8	420	—	18	熔透 Penetration welding	1.1
	0.4	24	225	24	510	—	18	熔透 Penetration welding	1.5
钛合金 Titanium alloy[1]	3.2	185	508	224	1680	—	y exist	穿透 Penetrate	—
	4.7	175	330	504	1680	—	y exist	穿透 Penetrate	—
	9.9	225	254	816	1680	—	y exist	穿透 Penetrate	—
	12.7	270	254	He75% 756	1680	—	y exist	穿透 Penetrate	—
钛合金 Titanium alloy[2]	4	145~150	240	He50% 120	2000	3300	400		3~3.5
纯钛 Titanium [3]	5	200	333	300	1200	1500	1500		2.8
纯钛 Titanium	10	200	150	350	1200	1500	1500		3.2

钛合金手工TIG焊参数
Titanium alloy TIG manual welding parameter

对接板厚 Thickness /mm	填丝直径 Filler d/mm	焊接电流 Current /A	氩气流量Ar /L·min⁻¹	
			焊枪 Torch	背面 Back
1.2	—	65	5	1~2
1.5~2.0	—	90	7	3
0.5~0.8	1.5	15~50	6~8	2~3
1.0~1.2	1.5~2.0	40~60	6~8	2~3
1.5~1.8	1.5~2.0	60~80	8~10	2~3
2.0	2.0~2.5	70~100	8~10	2~4
2.5	2.0~2.5	100~130	10~12	2~4
3.0	2.5~3.0	120~160	10~12	2~4

手工钨极氩气保护焊(GTAW)参照表
Manual GTAW welding references

焊接材料与电极接法 Material & Methods	板厚 Thickness /mm	焊丝直径 Welding wire d /mm	焊接电流 Welding current/A	喷嘴口径 φ Nozzle d/mm	氩气流量 Ar/L·min⁻¹	钨极直径 φ Electrode d/mm	焊接速度 Welding speed /cm min⁻¹	焊枪电流 Torch current
铝或铝合金交流加高频（脉冲） Al/ Aluminum Alloy. (ACHF)	0.6~1	0~0.6	50~70	6.8	4~5.7	1~1.6	200~400	<75A
	2.0	1.6~2.0	60~110	6.8	4.8~6	1.6~2.5	150~300	<150A
	3.0	2~3	100~140	8.9	5~6	2~3	~300	<150A
	4.0	3~4.5	140~180	9 10	6~8.4	3~4	280	<200A
	5.0	4~5.5	170~220	9 12	8~10.5	3~5	260	<200A
	6.0	4~5.5	200~270	12 16	10.5~12	3~4	250	<200A
	8.0	4~5.5	240~320	12 16	11~12.7	3~5	170	<500A
	12.0	6	250~400	16 18	11.5~14.5	4~6	80	<500A

交流TIG焊铝合金工艺参数
AC TIG Aluminum alloys parameter

母材牌号 Material	厚度/mm Thickness	焊丝直径 Diameter /mm	电流Current/A		频率 Frequency /Hz	脉宽比 Pulse width ratio /%	电弧电压 Arc voltage /V	氩气流量 Argon flow /L·min⁻¹
			I_p	I_b				
LF3Y2	2.5	2.5	95	50	2	33	15	5
LF2Y2	1.5	2.5	80	45	1.7	33	14	5
LF6Y2	2.0	2.0	83	44	2.5	33	10	5
LY12CZ	2.5	2.0	140	52	2.6	36	13	8

钨极氩弧焊焊接特性
Tungsten electrode welding speciality

母材 Material	电源 Power	焊接特性 Speciality
铝（任何厚度） Aluminum （In any thickness）	交流（高周波）ACHF (high frequency)	引弧性佳，焊道清洁，耗气量小 Good Arc cleaning low gas consumption
铝铜合金 Aluminum copper	交流或直流正接 AC/ DCSP(straight polarity)	最宜于母材表面补焊 Repair weld on surface properly
镁（1.5mm以上） Megnesium (Blow 1.5mm)	交流（高周波）ACHF(high frequency)	焊道清洁，耗气量小 Cleaning low gas consumption
低碳钢（3mm以下） Low-carbon steel blow 3mm	直流正接 DCSP	焊道清洁，平焊时熔池易控制 Cleaning, molten pool easily control
低合金钢 Low alloy steel	直流正接 DCSP	同低碳钢 Low-carbon steel
不锈钢 Stainless steel	直流正接 DCSP	较薄母材焊接熔透易控制 Think material easily control
钛（薄壁管）Ti (thin tube)	直流正接或交流 DCSP/AC	焊道清洁，熔化率适宜 Cleaning, good melting rate
镍铜合金 Ni-Cu alloy	直流正接或交流 DCSP/AC	施焊易控制 Welding easily contro;
硅铜合金 silicon copper	直流正接 DCSP	电弧长度适宜，易控制 Suitable arc length, easily control

压力传感器焊接工艺参数
Pressure transducer welding parameters

焊接部位 Welding Part	焊接电流 Welding current/ A	焊接转速 Revolving speed	等离子气流量 Ion /L h^{-1}	保护气流量 Protective gas/L · h^{-1}	孔外弧长 Arc legth /mm	喷孔直径 Nozzle d/mm	钨电极直径 Electrode d/mm
芯管+体 Core tube	22	3	180	200	2	1.6	1.6
膜片+体 Mebrane	18	6	180	200	2	1.6	1.6

焊接时效对照
Weld aging chart

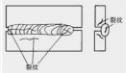
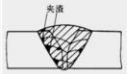
	1小时 (H)	2小时 (H)	3小时 (H)	4小时 (H)	5小时 (H)
高品质产品 High-quality products					
传统产品 Traditional products					

焊缝形成及影响因素
Weld joint forming & influence factors

影响因素 Influence factors	描述 Description
钨电极直径 Tungsten electrode diameter	按选定的焊接电流类型与大小选定钨电极的种类和直径大小，并参照钨电极末端的形状与使用的电流范围确定钨电极末端的形状。 According to the type and size of the welding current chose the different tungsten electrode in different diameter, and select the shape of the terminal refer to current.
焊接电流 Welding current	是决定焊缝熔深的主要参数，一般按焊件材料、厚度、接头形式、焊接位置等因素来选定，先确定电流类型和极性，然后确定电流大小。 It is main parameter for depth of fusion.Generally ,select type and size of the welding current as per welding materials 、thickness and position of welding ect.
喷嘴直径与保护气体流量 Nozzle diameter and gas flow	在一定条件下气体流量和喷嘴直径有一个最佳配合范围，此时的保护效果最好，有效保护区大，一般手工TIG焊的喷嘴内径范围为520mm，流量范围为525L/min，以排走焊接部位的空气为准，若气体流量过低，则气体流挺度不足，排除空气能力弱，影响保护效果，若流量太大，则形成紊流，使空气卷入，也降低保护效果，当气体流量一定时，喷嘴过大，气流速度过低，挺度小，保护不好，而且影响焊工视野。 It will be a best preventive effect when nozzle diameter and gas flow are in a good condition. generic handmade TIG diameter 520mm, gas flow 525L/min, removing the air in the welding position as a standard. If gas flow is too low, air removing ability is weak, impact protection. if the flow is too large, forming the turbulent flow, it also will reduce the protective effect. when the gas flow was confirmed. and the nozzle is too big, air flow rate is too low. It also bad for welder's field of vision.
电弧电压 Arc voltage	电弧电压主要影响缝宽，它由电弧长度决定，增加弧长会降低气体保护效果，一般弧长在15mm为宜，应视钨电极的直径与末端形状以及填充焊丝粗细灵活掌握。 Arc voltage mainly affects slit width, which determined by arc length, and adding arc length will reduce effect of gas shielded. The arc length should between 1mm and 5mm.
焊接速度 Welding speed	当焊接电流确定后，焊接速度决定着单位长度焊缝所输入的能量，提高焊接速度则熔深和熔宽均减小，反之则增大，因此，若要保持一定的焊缝形状系数，焊接电流和焊接速度应同时提高或减少。 After knowing welding current, welding speed decide to input energy of weld. improve welding speed.
钨电极伸出长度 Extension length	钨电极伸出喷嘴孔的距离，通常钨电极伸出长度主要取决于焊接接头的外形，内角焊接要求钨电极伸出的长度最长，这样电弧才能达到接头的根部，并能看到较多焊接熔池，卷边焊缝只需要很短的电极伸出长度，甚至可以不伸出，常规的伸出长度一般在12倍钨电极直径，要求弧短时，伸出的长度宜比常规的大一些，给焊工提供更好的视野，并有助于控制弧长。但是，外伸过长，势必加大气体保护流量，才能维持良好的保护状态。 Tungsten electrodes extend out nozzle with a distance, usually it was determined on the shape of the soldered joint. inside corner weld Require the tungsten electrode stretched out the longest length, So Arc can touch the end of joint.and see the more weld molten pool. But flanged edge weld need a short tungsten electrode extended length even without. The extended length normally need 1-2times of the diameter. when we require the short Arc, the extended length should longer than the general. it can provide a better field of vision for welder. and it also help with us to control arc length. However, if the extended length is to long, enlarge gas flow rate and maintain a good state of protection.

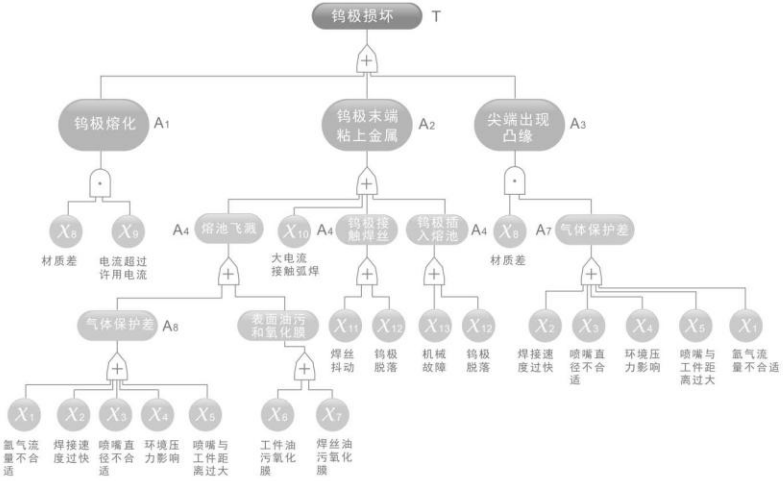
氩弧焊缺陷产生原因及预防

TIG Common Problems and Troubleshooting

缺陷种类 Problems (Symptoms)	图例 Description	产生原因 Possible Cause	预防措施 Recommended Action
未焊透 Welded Area Non-Penetrate (Poor Weld)		焊接电流太小；焊接速度太快；坡口角度太小，钝边太大或间隙太小；钨极烧损，电弧不集中；送丝太快。 Welding amperage set low; Welding speed too fast;Incorrect angle,wrong tilting or ever gap; Burning tip,welding arc not focus.	增加焊接电流；降低焊接速度；坡口角度不小于30度，钝边不大于2mm；间隙不小于2mm；修磨钨极尖端；减低送丝速度。 Check and set to proper current input;Reduce and control welding motion;Adjust tilting angle near 30 degree;Gap spacing not over 2mm; Grind and sharpen electrode tip.
咬边 Electrode Stuck in the Weld Puddle		焊接电流太大；电弧电压太高；焊炬摆幅不均匀；送丝太少，焊接速度太快。 Current was set too high;TIG machine incorrect voltage;Welding erratic in the work piece.	降低焊接电流；降低弧长；保持摆幅均匀；适当增加送丝速度或降低焊接速度。 Reduce current control setting; Readjust to correct voltage;Control and welding position properly.
气孔 Bubbled Building up and unclean surface of work piece		有风；氩气流量太小或太大；焊丝或工件太脏；氩气管内有水气；焊炬漏水；进水管道或接头有漏气处；送丝手法不好，破坏了氩气保护区；钨极伸出太长，或喷嘴高度太大。 Windy area;Excessive argon gas flow;Electrode or work piece contaminated;Gas pipe may contain water;Water leakage or moisture working area;Nozzle distances over high;Electrode stretched too much from nozzle; Gas or regulator leakage.	设法挡风；调整氩气流量；清除焊丝及工件待焊区的污物；用干燥无油的热空气吹干氩气管；消除漏水处；检查气路；调整送丝手法；减少钨极伸出长度及喷嘴高度。 Workshop need to be wind shelter; Control Argon gas flows;Cleaning or polish work piece;Dry it with hot air;Work in dry area;Reduce the distance within work piece;Minimise the stretched electrode;Check the gas hoses and regulator.
裂纹 Crater Cracks		焊丝与母材不配，或有害杂质硫、磷含量太高；焊件拘束应力太大；收弧太快，弧坑太深；焊丝、工件不干净。 Incorrect metal;High sulfur or phosphorus;Work piece temperature changes rapidly;High speed filling or Concave deepen;Contaminated instruments or parts.	选用硫、磷含量低的焊丝；设法减少拘束，或采用预热缓冷措施；调整收弧衰减参数，或多次收弧，填满弧坑；加强清理。 Select low sulfuric electrode; Preheating or preventing sudden cool;Reduce the speed and fillings; Cleaning or polish instruments.
夹钨 Welding Drops		无高频或脉冲引弧装置失效；钨极伸出太长；加丝技术不好；焊接电流太大，钨极熔化。 Value controller failure;Electrodes over stretched from nozzle;Inproper welding skill;Excessive current, overmelted electrodes.	修理或增添引弧装置；适当减少钨极伸出长度；改善填丝手法；适当降低焊接电流，或加大钨极直径。 Replace or repair;Check the correct measurement;Improve the welding skills;Check proper current and size of rods.

钨电极抗烧损分析图

Tungsten electrode resistance to burning diagram



应用领域

Application area

航空 Aerospace

高铁 High-speed rail

建筑 Construction

制造 Manufacture

军工 War Industry

桥梁 Bridge