

# Welding Consumables in Industry

## Offshore



# **TIENTAI**

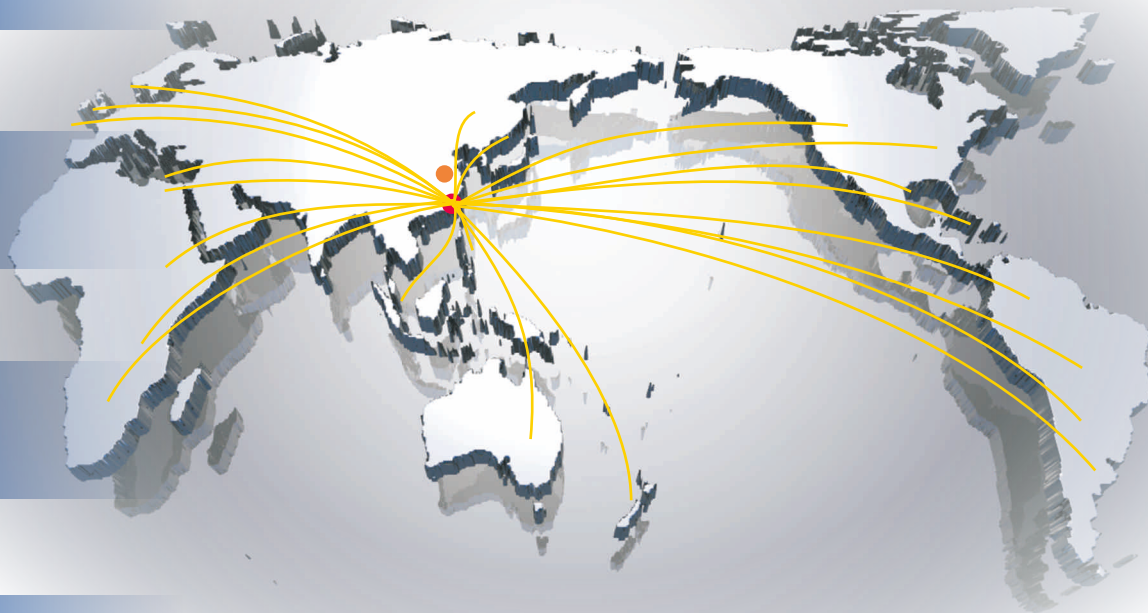
AN ILLINOIS TOOL WORKS COMPANY

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TIENTAI ELECTRODE CO., LTD.

# ITW- Tradition of Excellence



Illinois Tool Works Inc. (NYSE:ITW) designs and produces an array of highly engineered fasteners and components, equipment and consumable systems, and specialty products and equipment for customers around the world. A Fortune 200 diversified manufacturing company with more than 100 years of history. ITW's 650 decentralized business units in 45 countries employ nearly 49,000 men and women who are focused on creating value-added products and innovative customer solutions.

"During its more than 100 years of existence, ITW's recipe for success has been focused on creating "value-added products for key customers around the world. We do this by growing our business and making acquisitions which provide additional product solutions to our customers.

Many of our best product innovations come from simple observation coupled with a keen understanding of our customers' needs. Most companies design products specifically to increase sales volume. ITW's main goal is not to create a best seller, but to enhance customers. To attain that goal, our product design engineers develop value-added, proprietary products. Our unique approach begins at our customers' plants or worksites. By working closely with our customers. We determine how an ITW product or process could provide a better solution. Proof of our highly innovative culture is seen in our patent activities. In 2004, we had more than 16,000 unexpired patents and pending patent applications worldwide, including 2,900 U.S. Patents and 1,116 pending U.S. Applications. We typically rank in the top 100 of patent issuers in the U.S.

# Offshore



For global offshore equipments and construction, TienTai provide consumables with top quality and specialized welding services.



Welding is the key component of offshore construct procedure. The Welding process must obey related international regulations, engineering specification, and proprietor's requirements. The jacket welding, the main works of offshore welding, shall not only obey the related regulations but also involve in the factors as follows:

1. Fracture toughness: to assure the fracture toughness, the tests are included in not only BS7448-1997(2mmV test) but also CTOD. The CTOD value of offshore usually regards as 0.25mm under  $-10^{\circ}\text{C}$
2. Fatigue strength jacket is diagonal tubular structure contains complex welding connection.
3. The season cracking, hydrogen resistance induced: hydrogen sulfide contained in the seawater triggers SSCC of welding bead. To prevent SSCC, Weld bead shall be limited by Vickers hardness index (max. 290)
4. Cold cracking resistance: It is because the jacket mainly produced from high tensile steels thick section, the prevention for cold cracking is crucial. The Cep, Pcm, diffusible hydrogen of welding bead metal, and the binding strength of welding connection impact the cold cracking resistance of welding bead. The materials of offshore are usually constructed from low hydrogen welding consumables to prevent cracking.

## Your Perfect Welding Solutions

The limited page cannot afford whole specific contents of products and techniques. Please contact us if further information required.



## List of welding consumables for offshore construction

1. This list helps readers select the welding consumables for offshore construction. The consumers, however, must confirm if the product meet all their working requirements, which include related regulations and others, before using. The impact value is mean index form three test pieces, and yielding strength contains yielding point and 0.2% ranges.
2. The selection of DC polarity should obey the instruction.

| Base Metal - Filler Metal Combinations<br>(Special primary structure, primary structure)               |                 |  |  |
|--|-----------------|--|--|
| Base Metal   | Welding process | TienTai Brand                                      | AWS spec.                                |
| AH32, DH32, EH32<br>AH36, DH36, EH36<br>API 2H Gr.50<br>API 5LX52<br>ASTM A572 Gr.50<br>ASTM A537 Cl 1 | SMAW            | TL-508<br>TL-581                                   | E7018<br>E7018-1                         |
|  | FCAW            | TWE-711<br>TWE-711Ni                               | E71T-1C<br>E71T-1CJ/9CJ                  |
|  | GTAW            | TGA-50   | ER70S-G                                  |
|  | SAW             | TF-210/TSW-12KH<br>TF-565/TSW-12KM                 | F7A8/P8-EH12K<br>F7A4-EM12K              |
| ASTM A537 C12<br>WEL-TEN60<br>NVE 40S<br>HT-60   | SMAW            | TL-60  | E8016-G                                  |
|  | FCAW            | TWE-81K2<br>TWE-811Ni2                             | E81T1-K2<br>E81T1-Ni2                    |
|  | GTAW            | TGA-80   | ER80S-G                                  |
|  | SAW             | TF-210/TSW-E12<br>TF-210/TSW-E40<br>TF-585/TSW-60G | F8A6-EA2-A2<br>F8A8/P8-EG-G<br>F8A4-EG-G |

1.  $40 < t \leq 63.5$ mm AW,  $-10^{\circ}\text{C}$   $\delta \geq 0.35$ mm;  $t > 63.5$ mm, PWHT,  $-10^{\circ}\text{C}$   $\delta \geq 0.25$ mm (  $\delta$  c indicate CTODvalue ) .
2. Primary structure  $t \geq 40$ mm, Secondary structure  $t \geq 50$ mm PWHT required, and Hardness at HAZ should be less Hv280.
3. Diffusion hydrogen less 10ml/100g.
4. We got CTOD approvals for these two grades.
5. 48/34 indicates average value minimum 48J, each can less 48J, but not less 34J.
6. This product we can get average value minimum 34J, each can less 34J, but not less 27J at  $-40^{\circ}\text{C}$ .
7. The leg of jack-up rig has heavy section, for racks uses HT-80 steels.

| Base Metal - Filler Metal Combinations for Offshore Process Piping                                     |                 |                      |                    |
|--|-----------------|----------------------|--------------------|
| Base metal   | Welding Process | TienTai Brand        | AWS Spec.          |
| AH32, DH32, EH32<br>AH36, DH36, EH36<br>API 2H Gr.50<br>API 5LX52<br>ASTM A572 Gr.50<br>ASTM A537 Cl 1 | SMAW            | TL-508<br>TL-581     | E7018<br>E7018-1   |
|  | FCAW            | TWE-711<br>TWE-711Ni | E71T-1<br>E71T-1MJ |
| A106Gr. B  | GTAW            | TGA-52               | ER70S-2            |
|  | SMAW            | TL-501<br>TL-581     | E7016-1<br>E7018-1 |
| A333 Gr. 6   | GTAW            | TGA-56               | ER70S-6            |
|  | SMAW            | TL-60                | E8016-G            |
| Duplex<br>stainless steel  | 22%Cr           | GTAW                 | TGA-2209           |
|  |                 | SMAW                 | TS-2209            |
| Inconel 625<br>Incoloy 825<br>254 SMO  | GTAW            | TGS-61               | ERNiCrMo-3         |
|  | SMAW            | TNM-10               | ENiCrMo-3          |

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# Offshore



## Typical chemical composition of weld metal (wt%)

| Product Name |                  | C     | Si   | Mn   | Ni   | Mo   | P     | S     | Other |
|--------------|------------------|-------|------|------|------|------|-------|-------|-------|
| TWE-711      |                  | 0.05  | 0.55 | 1.45 | -    | -    | 0.015 | 0.008 | -     |
| ArcStar T9   |                  | 0.05  | 0.51 | 1.35 | -    | -    | 0.015 | 0.005 | -     |
| TWE-711Ni    |                  | 0.05  | 0.43 | 1.35 | 0.45 | -    | 0.018 | 0.009 | -     |
| TWE-811Ni1   |                  | 0.05  | 0.55 | 1.25 | 1.00 | 0.18 | 0.018 | 0.006 | -     |
| TWE-811Ni2   |                  | 0.05  | 0.40 | 1.10 | 2.55 | -    | 0.016 | 0.008 | -     |
| TWE-81K2     |                  | 0.04  | 0.45 | 1.35 | 1.60 | -    | 0.016 | 0.008 | -     |
| TLH-581      |                  | 0.06  | 0.50 | 1.40 | -    | -    | 0.02  | 0.004 | -     |
| TLH-581R     |                  | 0.06  | 0.45 | 1.20 | -    | -    | 0.02  | 0.005 | -     |
| Product Name | Wire             | C     | Si   | Mn   | Ni   | Mo   | P     | S     | Other |
| TF-210       | TSW-12KH         | 0.08  | 0.39 | 1.50 | -    | -    | 0.011 | 0.003 | -     |
|              | TSW-12KM         | 0.06  | 0.23 | 1.16 | -    | -    | -     | -     | -     |
|              | TSW-E12          | 0.06  | 0.19 | 0.99 | -    | 0.47 | 0.013 | 0.004 | -     |
|              | TSW-E13          | 0.057 | 0.41 | 1.26 | -    | 0.42 | -     | -     | -     |
|              | TSW-E32          | 0.06  | 0.24 | 0.98 | 2.23 | -    | 0.007 | 0.002 | -     |
|              | TSW-E40          | 0.07  | 0.39 | 1.35 | 0.93 | 0.23 | 0.012 | 0.003 | -     |
|              | TSW-E41          | 0.07  | 0.22 | 1.55 | 0.98 | 0.48 | -     | -     | -     |
|              | SubCor M13K mod. | 0.075 | 0.33 | 0.98 | -    | -    | 0.011 | 0.003 | -     |
| TF-565       | TSW-12KM         | 0.06  | 0.4  | 1.7  | -    | -    | 0.03  | <0.02 | -     |
|              | TSW-12KH         | 0.05  | 0.4  | 2.0  | -    | -    | <0.03 | <0.02 | -     |
|              | TSW-E12          | 0.06  | 0.29 | 1.6  | -    | 0.45 | <0.03 | <0.02 | -     |

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## Typical mechanical properties of weld metal:

| Product Name     |          | Yield Stress (N/mm <sup>2</sup> ) | Tensile Strength (N/mm <sup>2</sup> ) | Elongation (%) | Charpy V-Notch (J) | Temperature (°C) | PWHT        |
|------------------|----------|-----------------------------------|---------------------------------------|----------------|--------------------|------------------|-------------|
| TWE-711          |          | 530                               | 580                                   | 29             | 100                | -20              | –           |
| ArcStar T9       |          | 565                               | 615                                   | 28             | 70                 | -40              | –           |
| TWE-711Ni        |          | 515                               | 575                                   | 29             | 80                 | -40              | –           |
| TWE-811Ni1       |          | 540                               | 620                                   | 26             | 50                 | -30              | –           |
| TWE-811Ni2       |          | 540                               | 630                                   | 26             | 50                 | -40              | –           |
| TWE-81K2         |          | 580                               | 640                                   | 27             | 50                 | -60              | –           |
| TLH-581          |          | 500                               | 580                                   | 30             | 98                 | -45              | –           |
| TLH-581R         |          | 470                               | 580                                   | 29             | 90                 | -45              | –           |
| Product Name     | Wire     | Yield Stress (N/mm <sup>2</sup> ) | Tensile Strength (N/mm <sup>2</sup> ) | Elongation (%) | Charpy V-Notch (J) | Temperature (°C) | PWHT        |
| TF-210           | TSW-12KH | 463                               | 557                                   | 34             | 181                | -50              | –           |
|                  |          |                                   |                                       |                | 115                | -60              | –           |
|                  |          | 407                               | 517                                   | 34             | 158                | -50              | 620°C * 8hr |
|                  |          |                                   |                                       |                | 148                | -60              |             |
|                  | TSW-12KM | 414                               | 493                                   | 38             | 190                | -50              | –           |
|                  | TSW-E12  | 498                               | 573                                   | 28             | 167                | -40              | –           |
|                  |          |                                   |                                       |                | 130                | -50              |             |
|                  | TSW-E13  | 656                               | 670                                   | 25             | 90                 | -40              | –           |
|                  | TSW-E40  | 549                               | 628                                   | 26             | 90                 | -60              | –           |
|                  | TSW-E32  | 484                               | 563                                   | 32             | 63                 | -70              | –           |
|                  | TSW-E41  | 655                               | 716                                   | 26             | 59                 | -50              | AW          |
|                  |          |                                   |                                       |                | 571                | 644              | 29          |
| SubCor M13K mod. | 476      | 556                               | 28                                    | 126            | -60                | AW               |             |
| TF-565           | TSW-12KM | 460                               | 530                                   | 33             | 40                 | -40              | –           |
|                  |          |                                   |                                       |                | 65                 | -30              | –           |
|                  | TSW-12KH | 508                               | 600                                   | 31             | 32                 | -50              | AW          |
|                  | TSW-E12  | 546                               | 614                                   | 26             | 60                 | -30              | AW          |

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The Portfolio of Brands





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