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Titanium clad steel plate

钛-钢复合板

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Titanium clad steel plate

1 Scope

This Standard specifies technical requirements, test methods, inspection rules, delivery weight, marks, packaging, transport, storage as well as quality certificate and contents of order sheet (or contract) for titanium clad steel plate.

This Standard is applicable to titanium-steel explosive clad plate, explosive-rolled clad plate or rolled clad plate for corrosion resistant pressure vessels, storage tanks and other uses (hereinafter referred to as clad plate).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 223 (all parts), *Methods for chemical analysis of iron, steel and alloy*

GB/T 700, *Carbon structural steels*

GB/T 711, *Hot-rolled quality carbon structural steel plates sheets and wide strips*

GB/T 712, *Hull structural steel*

GB/T 713, *Steel plates for boilers*

GB/T 3274, *Hot-rolled plates and strips of carbon structural steels and high strength low alloy structural steels*

GB/T 3531, *Low Alloy Steel Plate for Low Temperature Pressure Vessels*

GB/T 3620.1, *Designation and Composition of Titanium and Titanium Alloys*

GB/T 3621, *Titanium and titanium alloy sheet and plate*

GB/T 4698 (all parts), *Methods for chemical analysis of titanium sponge, titanium and titanium alloys*

GB/T 6396, *Clad steel plates - Mechanical and technological test*

4.1.2.1 Composite material of clad plate shall be in accordance with GB/T 3621. Substrate shall comply with one of standards listed in Table 2. Composite materials and substrates specified in the table can be freely combined.

Table 2 -- Composite materials and substrates

Composite materials	Substrates
TA1G, TA2G, TA3G, TA9, TA10 in GB/T 3621	GB/T 700, GB/T 711, GB/T 712, GB/T 713, GB/T 3274, GB/T 3531, NB/T 47008, NB/T 47009
NOTE: When composite material is TA1G, TA2G or TA3G, class 2 clad plate allows to use low-strength composite material to replace high-strength composite material, for example, using TA1G to replace TA2G.	

4.1.2.2 Thickness of composite material is usually 0.3mm~15.0mm. When thickness of composite material is greater than 10.0mm, agreed by supplier and purchaser, composite material can be composed of multiple layers.

4.1.2.3 When width of clad plate is greater than 1100mm or length is greater than 3000mm, composite material allows tailored welding and width or length of tailored composite material is not less than 300mm. Tailor-welded welds shall be tested for penetration. Testing results shall comply with provisions of Level II in Table 6 of NB/T 47013.5-2015. When purchaser requires and it is indicated in contract, tailor-welded welds shall be tested for rays. Testing results shall comply with provisions of Level II in Table 22 of NB/T 47013.2-2015.

4.1.3 Delivery state

4.1.3.1 Clad plate can be delivered according to explosion state (B), explosion-rolled state (BR) or rolled state (R).

4.1.3.2 When explosive clad plate is delivered in stress-relief state (m), recommended heat treatment system is: 540°C ~ 650°C, insulation time is not less than 1h, heating and cooling rates are 50°C/h to 200°C/h.

4.1.4 Marking example

Product mark follows a sequence: composite material designation/substrate designation, code, delivery state, specification, standard reference. Marking example is as follow:

Example 1:

Class 1 explosive clad plate of which composite material thickness is 6mm TA2G, substrate thickness is 30mm, width of Q235B steel is 1000mm, length is 3000mm, in stress-relief state, is marked as:

TA2G/Q235B B1 m 6/30×1000×3000 GB/T 8547-2019

4.8.3 It is allowed to clear partial defect on composite material surface along with processing direction. But thickness of composite material after clearance must not be less than minimum allowable thickness.

5 Test methods

5.1 Arbitration analysis for chemical composition of composite material is in accordance with GB/T 4698. Arbitration analysis of chemical composition of substrate is carried out in accordance with GB/T 223.

5.2 Allowable deviation of composite material thickness is in accordance with GB/T 6396. Thickness shall be measured at a distance of not less than 100mm from apex angle and not less than 20mm from edge. Allowable deviation of other sizes is measured by measuring tool of corresponding precision.

5.3 Tensile performance, shear strength and bending performance of clad plate are in accordance with GB/T 6396.

5.4 Bonding area of clad plate is in accordance with Annex A. When it exceeds Annex A, it shall be negotiated by both parties.

5.5 Visually inspect surface quality of clad plate.

5.6 Penetration testing is in accordance with NB/T 47013.5-2015.

5.7 Radiation testing is in accordance with NB/T 47013.2-2015.

6 Inspection rules

6.1 Check and acceptance

6.1.1 Products shall be inspected by supplier to ensure product quality meets requirements of this Standard.

6.1.2 Purchaser shall re-inspect received products according to provisions of this Standard. When re-inspection results do not conform to provisions of this Standard and order sheet (or contract), it shall be proposed to supplier in a written form and shall be solved by both parties via negotiation. Objections to dimensions and surface quality shall be proposed within one month since date of receipt of product. Objections to other performances shall be proposed within three months since date of receipt of product. If arbitration is required, it shall be determined by supplier and purchaser via negotiation.

6.2 Batching

- c) product lot number;
- d) detonation point of clad plate (when it is required by purchaser and indicated in contract).

8.2 Packaging, transport and storage

8.2.1 Clad plate uses unpacked packaging. When two faces of composite material face each other, use moisture-proof paper to line the middle; use metal wire to tie external part. Special requirements for packaging shall be negotiated by supplier and purchaser.

8.2.2 Prevent collision, moisture and active chemical corrosion during transportation and storage of product.

8.3 Quality certificate

Each batch of products shall be attached with quality certificate that conforms to this batch of products, indicating:

- a) supplier name or code;
- b) product name or code;
- c) product designation (composite material and substrate), specification and state;
- d) product batch number and substrate batch number, composite material furnace number;
- e) batch weight and number of pieces;
- f) analysis inspection results of each item and seal of inspection department;
- g) reference to this Standard;
- h) date of packaging.

9 Contents of order sheet (or contract)

Order sheet (or contract) for materials listed in this Standard shall contain the following information:

- a) product name;
- b) designation;
- c) state;

Annex A

(Normative)

Ultrasonic testing method for titanium-steel clad plate

A.1 Scope

This method takes steel as substrate, titanium as composite material. Total thickness is greater than 4mm. It is an ultrasonic testing method of multi-layer composite explosion, explosion-rolled and rolled clad plates.

A.2 General requirements

A.2.1 Purpose

It is mainly used to detect degree of application between composite material and substrate of clad plate.

A.2.2 Method category

This Standard specifies to use P-wave pulse reflection method (or multiple pulse reflection method) for ultrasonic testing. Both contact method and water immersion method can be used.

A.2.3 Requirements for flow detection personnel

Flaw detection operators shall reach ministerial level or equivalent level that has learn Level I and above non-destructive testing personnel level. Inspection report signing and explanation personnel shall reach ministerial level or equivalent level that has learn Level II and above non-destructive testing personnel level.

A.2.4 Flaw detection surface

A.2.4.1 Clad plate surface must be free from dirt such as scale, oil and rust that affect flaw detection.

A.2.4.2 Surface roughness of flaw detection R_a shall not exceed 5 μm .

A.2.4.3 Under specified flaw detection sensitivity, noise level of material shall not exceed 5%.

A.3 Flaw detection equipment

A.3.1 Flaw detection device

Use pulse reflection ultrasonic flaw detector. Flaw detector shall comply with technical performance indicators specified in JB/T 10061.

A.3.2 Probe

A.3.2.1 Use straight probe of which wafer is cylindrical or rectangular. It can also use double-crystal probe.

A.3.2.2 Cylindrical wafer size is generally $\Phi 10\text{mm} \sim \Phi 30\text{mm}$. Rectangular wafer size can be length(15mm~30mm) $\times$ width(10mm~20mm). Frequency is 2MHz~5MHz.

A.3.3 Coupling agent

When using contact method to detect flaw, it may use clean tap water as coupling agent or other substances such as motor oil, soluble oil.

A.3.4 Contrast test block

A.3.4.1 Contrast test block shall be made of composite plate material that has same or similar material thickness, acoustic performance and surface state with clad plate to be detected.

A.3.4.2 See Figure A.1 for patterns and sizes of contrast test block A and test block B.

A.4 Flaw detection

A.4.1 Selection of detecting surface

According to surface state of plate to be detected, composite material thickness, acoustic impedance and appearance, decide to perform detection from composite material surface or substrate surface.

A.4.2 Flaw detection sensitivity

A.4.2.1 Flaw detection sensitivity can be adjusted according to multilayer thickness of plate to be tested.

A.4.2.2 When multilayer thickness is large, according to the following requirements, use contrast block to adjust flaw detection sensitivity:

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