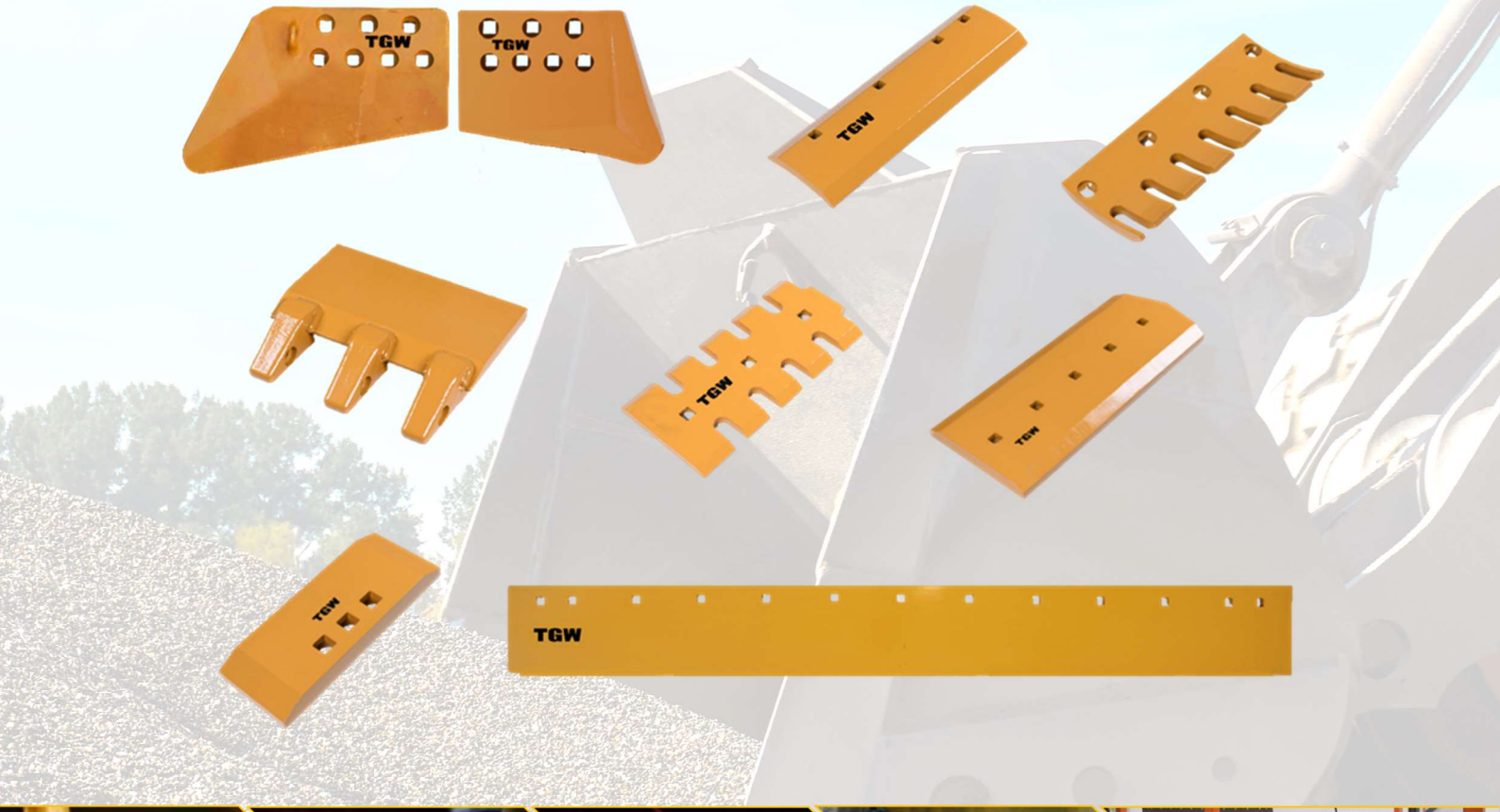
TGW

GROUND ENGAGING TOOLS



Wear Parts Manufacturer since 2006

TRIUMPHAL PRECISION ENGINEERING (ZHEJIANG) LTD.

Triumphal Group incorporated in 1977 and with over 30 years of thriving performance, the Group has grown from a single spare parts retailing business to an importing and wholesaling operation. It has also evolved into a resilient and dynamic group with growing international presence and expanding manufacturing facilities. The Group has now emerged as one of the prominent manufacturers and distributors of heavy machinery spare parts globally.

Triumphal Precision Engineering (Zhejiang) Ltd ("TPE") is a wholly owned subsidiary of Triumphal Associates Sdn Bhd ("Triumphal Group").

TPE being the crème and premier company within the Group is located at Zhejiang, China and built on a land area of 52,000 square meters.

To enhance the competitiveness and quality of our products and to also cater for the growing demand, the Group has injected various resources in developing a modern manufacturing plant together with the equipment, on-line quality checking tools, advance and precision production facilities, heat treatment facilities and capability for producing Ground Engaging Tools ("GET").

TGW, which stands for Triumphal Group Worldwide is the brand new identity for TPE GET products. To date, TGW has more than 2,000 types of GET in its production range.

➢ Description

Ground Engaging Tools (GET) is a general term which includes cutting edges, end bits, grader blades, side cutters, bucket teeth, and rippers. These GET accessories are mostly installed on heavy duty construction machineries such as bulldozers, excavators and motor graders. TGW expertizes in design and manufacturing of cutting edges, end bits, overlays, grader blades, bucket teeth and etc. TGW GET are designed and manufactured to meet OEM and industry standard for earthmoving machineries and equipment. The performance of GET is strongly dependable on its mechanical properties such as hardness, tensile strength and impact properties.

Figure 3: Bulldozer End Bits – Hot Cupped

Figure 4: Bulldozer End Bits – Casted

Figure 1: Bulldozer Cutting Edges

Figure 5: Motor Grader - Grader Blades

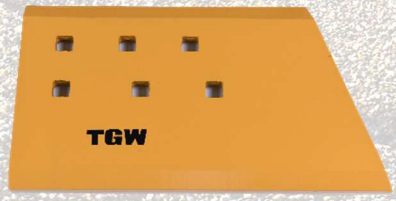


Figure 2: Bulldozer End Bits – Flat

Figure 6: Motor Grader – Serrated Grader Blades

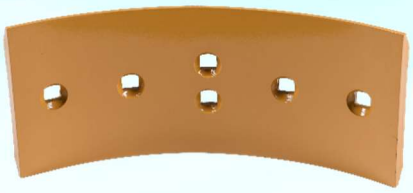


Figure 7: Motor Grader – Overlay

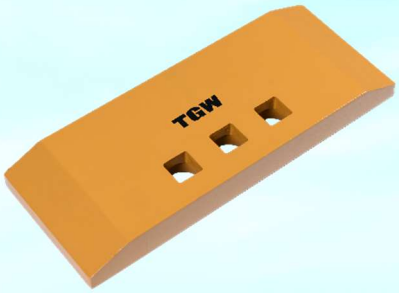


Figure 10: Loader – Corner End Bit

Figure 8: Serrated Cutting Edges

Figure 11: Weld-on Bucket Strip with Adapters

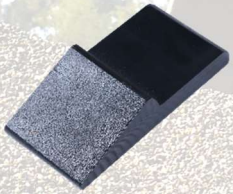


Figure 9: Loader - Half Arrow Blades and Segments (Profile)

Figure 12: Excavator Side Cutters – Hot Cupped

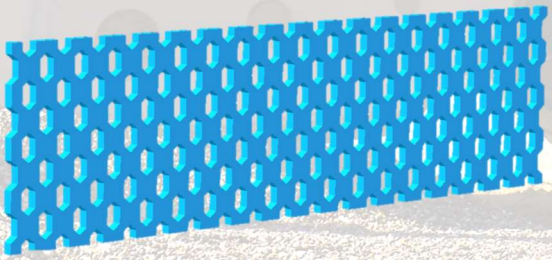


Figure 13: Perforated Blades/Plow Blades

Types of Wear Plates and Dimensions Available

There are various types of cutting edges and

grader blades profiles, with different shapes as indicated below:-

Figure 14: Normal Flat Edge (NFE)

Figure 15: Single Bevel Flat Edge (SBF)

Figure 16: Double Bevel Flat Edge (DBF)

All units are in mm

Shapes	Width	Thickness	Length
NFE	≤ 700	≤ 120	Any
SBF	≤ 700	≤ 120	Any
DBF	≤ 700	≤ 120	Any

Table 1: NFE SBF DBF Dimensions Available

Figure 17: Double Bevel Curve Edge (DBC)

All units are in mm

DBC	Width	Thickness	Length
152-16	152	16	Any
152-19	152	19	Any
203-16	203	16	Any
203-19	203	19	Any
203-25	203	25	Any
254-19	254	19	Any
254-25	254	25	Any

Table 2: DBC Dimensions Available

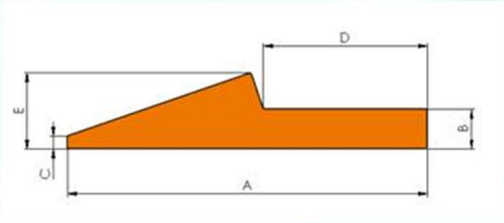


Figure 18: Half Arrow Edge (HAE)

All units are in mm

HAE	A	B	C	D	E	Length
101-19/11	101	11	3.5	46	19	Any
101-20/11	101	11	3.5	46	20	Any
151-32/16	151	16	5.5	68	32	Any
203-32/19	203	19	6	127	32	Any
254-55/29	254	29	11.2	131.3	55	Any
254-60/29	254	29	11.2	131.3	60	Any
254-65/40	254	40	22.7	131.3	65	Any
254-70/40	254	40	22.7	131.3	70	Any

Table 3: HAE Dimensions Available

Other shapes are available upon request. Please contact TGW via the contacts given in the last page.

Materials and Mechanical Properties

Generally, TGW GET are made from either Carbon or Boron Steel that are heat treated and hardened to improve the lifespan while meeting the demanding requirements of earthmoving and mining applications.

Carbon Steel

Carbon Steel is preferred for lower end of product application due to its more competitive pricing. The Carbon Steel used in TGW GET are Medium Carbon Steel and High Carbon Steel. Medium Carbon Steel would undergo heat treatment hardening process to enhance its performance.

The general material specifications and mechanical properties of Carbon Steel are as follow:

All units are in %

Material Chemical Properties	Medium Carbon Steel TM452	High Carbon Steel TM801
C	0.42-0.50	0.77-0.85
Si	0.17-0.37	0.17-0.37
Mn	0.50-0.80	0.50-0.80
P	≤0.035	≤0.035
S	≤0.035	≤0.035
Cr	≤0.250	≤0.250

Table 4: Carbon Steel Chemical Contents

Mechanical Properties	Medium Carbon Steel TM452	High Carbon Steel TM801
Hardness	≥ HRC 25	HRC 25-32
Tensile Strength	≥ 600MPa	≥ 1,000MPa
Impact @ 20°C Kv	≥ 15 J/cm^2	≥ 10 J/cm^2

Table 5:Carbon Steel Mechanical Properties

Boron Steel

Boron Steel is the recommended material for high end application. They are best used under harsh and highly abrasive working condition. In general, Boron Steel has higher tensile strength with minimum double life span comparing to Carbon Steel. All boron materials would undergo heat treatment hardening process to enhance its mechanical properties such as hardness, tensile strength and impact properties. By achieving the optimum combination between hardness (abrasiveness and wearability), tensile strength and impact properties (toughness and strength), TGW GET provides excellent life span under the harsh and adverse working conditions and environment. TGW offers two types of Boron Steel with the following material specifications and mechanical properties:

All units are in %

Material Chemical Properties	Boron Steel TM301	Boron Steel TM271
C	0.27-0.34	0.24-0.30
Si	0.15-0.35	0.80-1.00
Mn	0.9-1.40	1.70-2.00
P	≤0.025	≤0.025
S	≤0.025	≤0.015
Cr	0.35-0.60	≤0.200
B	0.0005-0.0035	≤0.005

Table 6: Boron Steel Chemical Contents

Mechanical Properties	Boron Steel TM301	Boron Steel TM271
Hardness	HRC 42-50	HRC 46-52
Tensile Strength	≥ 1,300MPa	≥ 1,500MPa
Impact @ 20°C Kv	≥ 30J/cm^2	≥ 35J/cm^2

Table 7: Boron Steel Mechanical Properties

On top of TM301 and TM271 Boron Steel, TGW offers TM221 material which has better weldability characteristic (Please see weldability section to understand more on weldability). Unlike bolt-on cutting edge, TM221 cutting edge is used widely on loader bucket where the cutting edge is welded onto the bucket. TM221 is preferred by loader OEM manufacturers due to its better weldability.

All units are in %

Material Chemical Properties	Boron Steel TM 221
C	0.42-0.50
Si	0.17-0.37
Mn	0.50-0.80
P	≤0.035
S	≤0.035
Cr	≤0.250

Table 8: Boron Steel TM221 Chemical Contents

Mechanical Properties	Boron Steel TM 221
Hardness	≥ HRC 42-48
Tensile Strength	≥ 1,300 MPa
Impact @ 20°C Kv	≥ 35 J/cm^2

Table 9: Boron Steel TM221 Mechanical Properties

Non-Alloy Structural Steel

In certain applications where bucket is used in relatively less harsh and less extreme condition such as agriculture application, non-alloy structural steel weld-on cutting edges is used instead. Non-Alloy Structural Steel is referred to Q355 steel in China, which is equivalent to S355JR in European Standard.

In relative to Carbon and Boron Steel, non-alloy structural steel has lower abrasive resistance characteristics, and it does not being harden through heat treatment process. Thus, to prolong its wear life, TGW applies high abrasive overlay on the working area of the cutting edge (on the top and the bottom of the bevel). TGW uses robotic welding technology to weld the high abrasive overlay onto the cutting edges. This overlay has a hardness of HRC 45 and above.

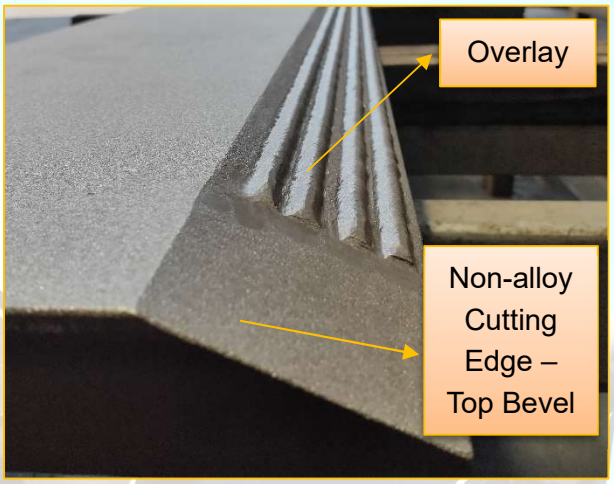


Figure 19: Non-Alloy Cutting Edge with Overlay - Top Bevel

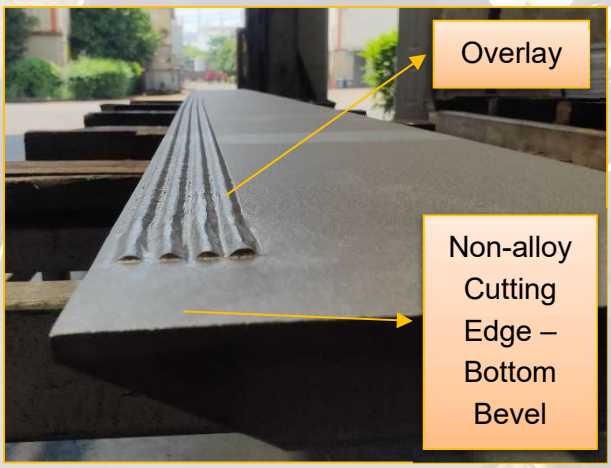


Figure 20: Non-Alloy Cutting Edge with Overlay - Bottom Bevel

Abrasive Resistance Solutions

Abrasive resistance material can be applied on the wear plates to further enhance its wear resistance, increase the lifespan and eventually decrease the cost per operating hour.

TGW offers two types of abrasive resistance solutions:

Tungsten Carbide Overlay

Extreme hard tungsten carbide particle with hardness 80-95 HRA (approx. 70 HRC) is welded together with weld material, with hardness HRC 55-60, and eventually form a composite overlay on top of the surface of wear plates. Practically, this overlay can be applied to any area of the wear parts.

Usually, this overlay is applied to the critical areas of the wear parts as it forms a protective coating on the area. Field results prove that wear area with tungsten carbide overlay can last up to 3-5 times longer compare to those without.

This overlay works best in high abrasion/low-moderate impact application. It is recommended for working environment where sand, gravel and other abrasive material severely diminish wear parts life. However, this method is not recommended for high impact working environment as the tungsten carbide particles may chip off during the heavy impacts.

Figure 21: Tungsten Carbide Overlay

Tungsten Carbide Insert

Unlike Tungsten Carbide Overlay, Tungsten Carbide is inserted into the bottom of the wear plates. A slot at the bottom of the cutting edge is made by milling, and then tungsten carbide is brazed into the slot. With this, the tungsten carbide is “hidden” into the cutting edge and being protected from direct impact during application. This method is used widely on snow removal application.

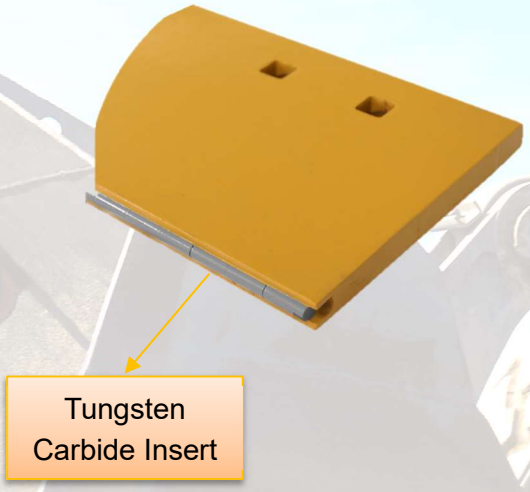


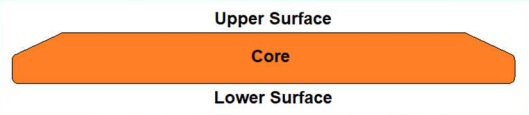
Figure 22: Tungsten Carbide Insert

Production Technology

TGW have the technical capabilities and facilities available to cater for different types of heat treatment requirements. It is also worthwhile to note that all heat-treated products will go through a stress relieving process, i.e. tempering process, to optimize the mechanical properties of each product and provide balance between the mechanical properties which include wear resistance, strength and etc.

Unlike induction hardening which applies the principle of electromagnetic induction to produce heat just on the surface layer of product, TGW applies full furnace heat treatment technology which heats the entire piece of product thoroughly, and subsequently improves the product’s

performance significantly.



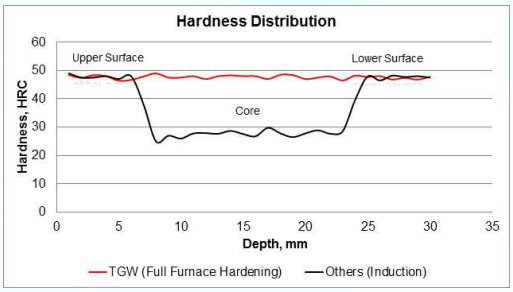


Figure 23: Hardness Distribution

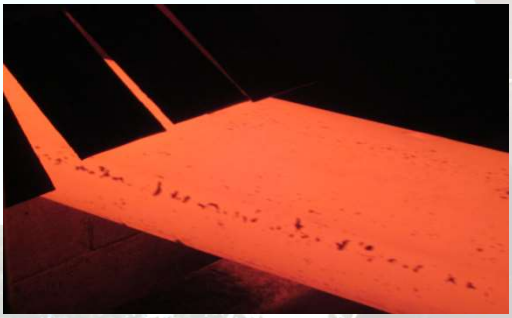


Figure 24: DBC Full Furnace Hardening

Figure 25: End Bit Full Furnace Hardening

➢ Hardness

Hardness is the measurement of the resistance of metal to plastic deformation or the resistance of a substance being scratched by another substance. There are several popular hardness measurement scales used across the industries such as HR (Rockwell), HV (Vickers) and HB (Brinell). In general, the product with higher hardness would have greater wear resistance (longer wear life). TGW uses only Rockwell as a measuring scale and the test is carried out in accordance to ISO6508-1:1999 (GB/T 230.1-2004). As mentioned previously, all TGW Boron Steel GET are hardened via full furnace hardening process, to achieve a hardness of HRC 42-49 and HRC 49-52 for material TM301 and TM271 respectively. This allows the product to have extraordinary wear life, even in highly abrasive working environment which includes mining sector.

➢ Tensile Strength

Tensile Strength is defined as the maximum stress or load that a material can withstand while being stretched or pulled before it fails or breaks. In general, a product with higher tensile strength could sustain a greater load or stress before it breaks. The test is carried out in accordance to ISO6892:1998 (GB/T228-2002). Heat treatment process improves not only the hardness of GET, it improve the strength of the product as well. High tensile strength properties of TGW GET allow it to work perfectly even under extremely high load working conditions.

➢ Impact Energy

Impact is a high force or shock applied over a short period of time during the collision of two bodies. Impact energy is the amount of energy absorbed by the material during fracture. In TGW, impact energy is measured by performing Charpy V-notch Test in accordance to ISO148-1:2006 (GB/T 229-2007). While heat treatment improves the hardness and strength of the products, it reduces the impact properties of the product at the same time. So, the control of impact energy is one of the critical parts in the production line. TGW is able to keep the GET impact properties while improving the hardness and strength of the products.

➢ **Weldability**

Weldability of a material refers to its ability of being welded without having cold cracks (hydrogen-induced cold cracking). At the beginning, researcher discovered that the Carbon content of a steel has a direct relationship with the occurrence of cold cracking during welding. As the study goes deeper, researcher also discovered that the content of other chemical elements of a steel could affect its weldability too. Then, several steel weldability indicators were created to assess and predict a steel weldability, such as Carbon Equivalent (CE). Generally, steel with CE greater than 0.4% would require a preheating before welding. Thus, theoretically pre-heating of TGW GET to 180°C – 240°C is recommended before welding but most of TGW GET users do not do so.

Contact us for further information.

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