# AMAG Titanal® for Sports

**With its lead product, AMAG Titanal®, AMAG has retained its market leadership in the field of high and ultra high strength aluminium semis for use in winter sport brand products.**

Photo: Komperdell

### The technology behind the “white experience”

Winter sports mean exciting skiing and snowboarding in powder snow under azure skies, off-piste skiing tours, and the feelings of intoxication or solitude derived from an ermine-covered landscape. Winter sports also mean AMAG Titanal®, which never lets winter sports fans down. In fact, this unique alloy is responsible for an increase in both the fun and safety factors.

First class skis must offer low weight in combination with high torsion resistance, outstanding running characteristics and the greatest possible safety, and it is precisely in these areas that AMAG Titanal® can show its paces.

### The rise of AMAG Titanal® in professional alpine sport and racing skis

The use of aluminium in alpine ski design dates back almost 50 years. On the basis of initial tests carried out in the 1960s, skis utilising an aluminium sandwich construction were the object of ongoing development, the first recognisable successes were achieved at the 1964 Winter Olympics in Innsbruck. From this point onwards, AMAG focused on the creation of a high-strength aluminium alloy for use in the winter sports field. Some 25 years ago, these efforts culminated in the world's strongest aluminium alloy, AMAG Titanal®, on which development work has continued unabated to this day. This special material is used for the shells of the latest sandwich skis, which are designed for racing and the premium segment. AMAG Titanal® forms both the outer layer of the ski, either as its upper surface or just below, as well as the under layer, which is situated above the running surface of the ski and absorbs tension. The shells are found in the zones subject to the highest compression and tension loads and must be capable of bearing these without plastic deformation.

AMAG Titanal® fulfils to perfection the extensive range of demands relating to high-tech ski design. These requirements relate primarily to the need for low weight in combination with high mechanical strength, especially with regard to the highest possible yield strength, outstanding deformation resistance, durability and excellent mechanical processing characteristics. Some customers go even further and use the aluminium with its elegant appearance directly on the upper surface of the ski, which thus transforms AMAG Titanal® into a design element. The use of high-strength fibre prepregs with extremely high E-moduli in combination with AMAG Titanal®, which as compared to the fibres is a quasi isotropic material, provides skiers with a balanced, overall range of features, excellent turning capacity, a solid grip on ice, good track holding and quiet running at high speeds.

Not only the Olympic champions in Vancouver in 2010 will have AMAG Titanal® in their skis. Indeed, virtually anyone who ventures onto the slopes during this winter is more than likely to be either standing or holding an AMAG product.

### Top characteristics for bindings, crampons and sticks

AMAG Titanal® allows the use of extremely stable screw connections in the binding sheets. In addition, it is also used in the bindings themselves, as it considerably enhances the strength of the design.

Moreover, crampons are available for the touring skis of skiing mountaineers, who brave the tough, snow conditions prevailing away from the prepared slopes. These crampons prevent backward slippage of the skis and thus contribute to a safe and rapid ascent, even when skins on the ski undersurface have long ceased to provide any grip.

AMAG Titanal® is also widely used for premium segment walking and ski sticks. This is due primarily to the material's balanced blend of rigidity, minimised weight for a reduction in energy expenditure and in particular, its resilience, especially with regard to impacts, an area in which metallic, ductile characteristics are of advantage compared to fibre compounds.

### Production and technical, material parameters of AMAG Titanal®

AMAG Titanal® belongs to the 7xxx (AlZn) alloy group, and in the appropriate temper, it is the highest strength alloy manufactured in an industrial standard process, from cast ingots in series production. A major prerequisite in this regard is the complete production process, which at the

| Alloy | Cu % | Mg % | Zn % | Zr % |
|---|---|---|---|---|
| **AMAG Titanal®** | ~ 1.7 | ~ 2.5 | ~ 7 | ~0.1 |
| **7075** | ~ 1.2–2.0 | ~ 2.1–2.9 | ~ 5.1–6.1 | - |
| **7050** | ~ 2.2 | ~ 2.2 | ~ 6.2 | - |

**Table 1:** Chemical composition of AMAG Titanal® in comparison with other high-strength alloys

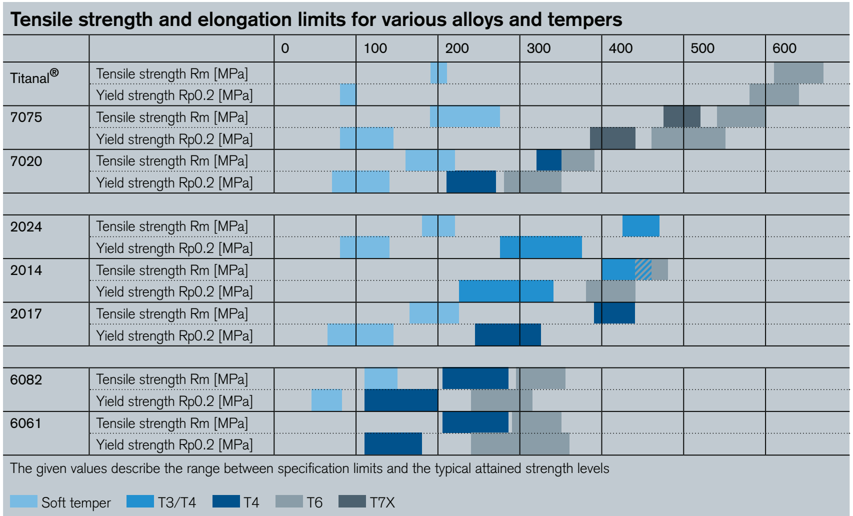


**Table 2:** Maximum AMAG Titanal® strengths

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AMAG Titanal® requires a special, restricted chemical composition and as Table 1 shows, the material has higher alloying levels than the 7050 and 7075 alloys well known from the aerospace sector. As a consequence, the alloy is extremely difficult to cast, a fact that necessitates the use of highly developed melt treatment, grain refinement and extremely precisely tuned casting parameters, in combination with a metallurgically ideal EMC (Electro Magnetic Casting) process. During this type of casting, the liquid metal is held in "shape" by a magnetic field and does not touch the wall of the mould. As compared to standard processes (conventional direct chill casting - DC or low head composite casting - LHC), this special casting procedure facilitates the production of ingots with extremely low levels of macro-segregation, which among results, leads to reduced edge cracking during rolling and thus guarantees process efficiency.

The cast ingots are then subjected to several thermo-mechanical treatments with a large number of hot and cold rolling phases that lead up to the final heat treatment, which provides the desired microstructure. The solution annealing of the strips is carried out in a continuous heat treatment line, which allows specially adjusted temperature management and ensures a highly efficient and controlled quenching to room temperature, in order to achieve an optimised combination of maximum cooling rate and controllable distortion. This is a major prerequisite for the attainment of a lower thickness level for AMAG Titanal® sheets of only 0.3 mm, which are scratch-free and can be produced with excellent flatness levels.

## Highest Strength

In combination, the details contained in the production sequence result in strength values, which are approximately 20 per cent higher than those of standard 7075 alloy in a T6 temper. For ski industry shells, the material is only produced in an ultra high-strength T6 temper and in thicknesses of 0.3 – 1.2 mm. Furthermore, for other applications, overaged heat treatment tempers (T7x) are available, which as opposed to T6, offer slightly less strength in combination with balanced corrosion resistance. For decorative purposes, the material can be supplied with anodised and appropriately coloured surfaces. Table 2 shows a comparison between the strengths attainable with AMAG Titanal®, as opposed to those of other types of heat treatable alloys, which among other areas of application, are used in the aerospace and automotive industries.

## Future potential applications for AMAG Titanal®

On the basis of its comprehensive know-how in the fields of metallurgy, production processes and in particular, the heat treatment of aluminium alloys, AMAG rolling has attained a special place in the sports and leisure industry with AMAG Titanal®. Moreover, 25 years of experience with this ultra high-strength alloy furnishes the company with an excellent platform for the further development of other high-strength alloys. AMAG's rapid qualification as a supplier of 7050, 7475, etc. alloys to the aerospace sector underlines this expertise. The parameters shown in Table 2 for 7xxx alloys clearly indicate that high-strength aluminium alloys can be employed in a diversity of areas, as a very large strength range can be covered.
However, to date high and ultra high strengths were generally linked to limitations with regard to cold forming capacity. Happily, the latest developments in the semi-hot forming of 7xxx sheet alloys facilitate component geometries and degrees of complexity, which until now were never attainable in a T6 temper. This opens up possibilities for new sports equipment advances, as well as products for automotive design and other branches for which the manufacture of ultra high-strength aluminium alloys in highly complex components was previously impossible. In ski racing, ultra high-strength AMAG Titanal® sheet is used with a maximum thickness of 1.2 mm, but the know-how regarding this alloy with its high Zn content can also be transferred to the plates segment. Indeed, at present AMAG offers AMAG Titanal® plates with a thickness of 40 mm, whereby nearly the same characteristics can be attained as in sheet. ■