



Fuelled by the power of human possibility

Bushveld Nitro Vanadium Brochure

Life. Powered.

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THE STRENGTH IN STEEL

Bushveld Nitro Vanadium is the key ingredient to optimising the strengthening mechanisms in high-strength, low-alloy steels, allowing steelmakers to use less vanadium to reach the desired strength or result. Other new innovative uses for vanadium include manufacturing vanadium redox flow batteries for energy storage.

NEW NAME. EVERYTHING ELSE STAYS THE SAME.

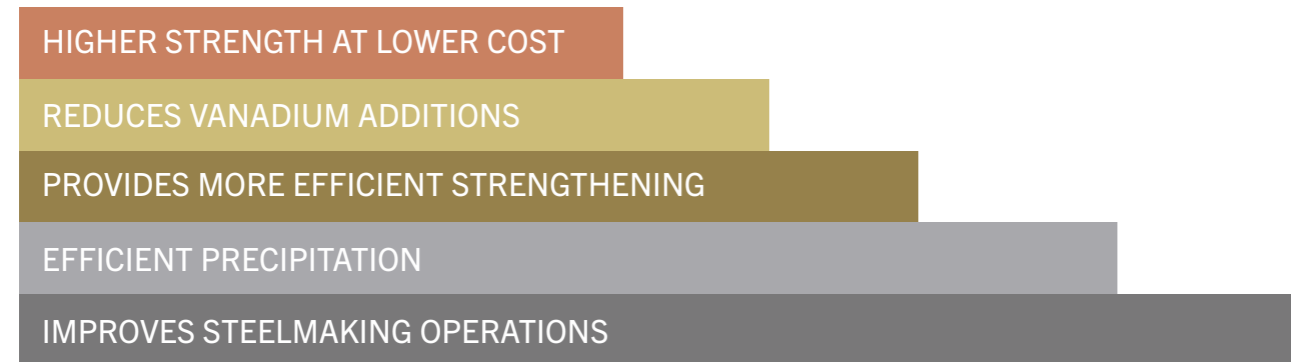
Bushveld Minerals' flagship product Nitrovan is now selling under a new name – Bushveld Nitro Vanadium. It is the same trusted product, made with the same high-grade vanadium you have come to expect from Bushveld Minerals.

The power behind the name

NITROGEN AND VANADIUM ARE STRONGER TOGETHER.

With Bushveld Nitro Vanadium, you can obtain the same equivalent yield strengths with less vanadium. It also equates to substantial cost and resource savings, enhancing both productivity and efficiency.

KEY FEATURES & BENEFITS



NO STRAIN AGEING


For some steelmakers, adding nitrogen would seem to be the fastest way to send carbon steel to the scrapyard. But when we look at the facts, strain ageing is virtually eliminated in vanadium-strengthened steels containing as much as 0,020% nitrogen.

EXAMPLE

To put things in perspective.

Hot-rolled steel containing 100 parts per million of nitrogen requires only 0,04% vanadium to achieve a strength increase of 110 MPa (16 ksi).





A less wasteful,
more resilient tomorrow
requires a shift.
In thinking. In doing.

Harnessing the power of nature

IMPROVED STRENGTHENING

At Bushveld Minerals, we ensure that what we take from the earth goes back into it in the shape of progress. Bushveld Nitro Vanadium enhances precipitation strengthening and grain refinement – two mechanisms that provide up to 70% of the yield strength of a typical high-strength, low-alloy steel.

ENHANCED PRECIPITATION

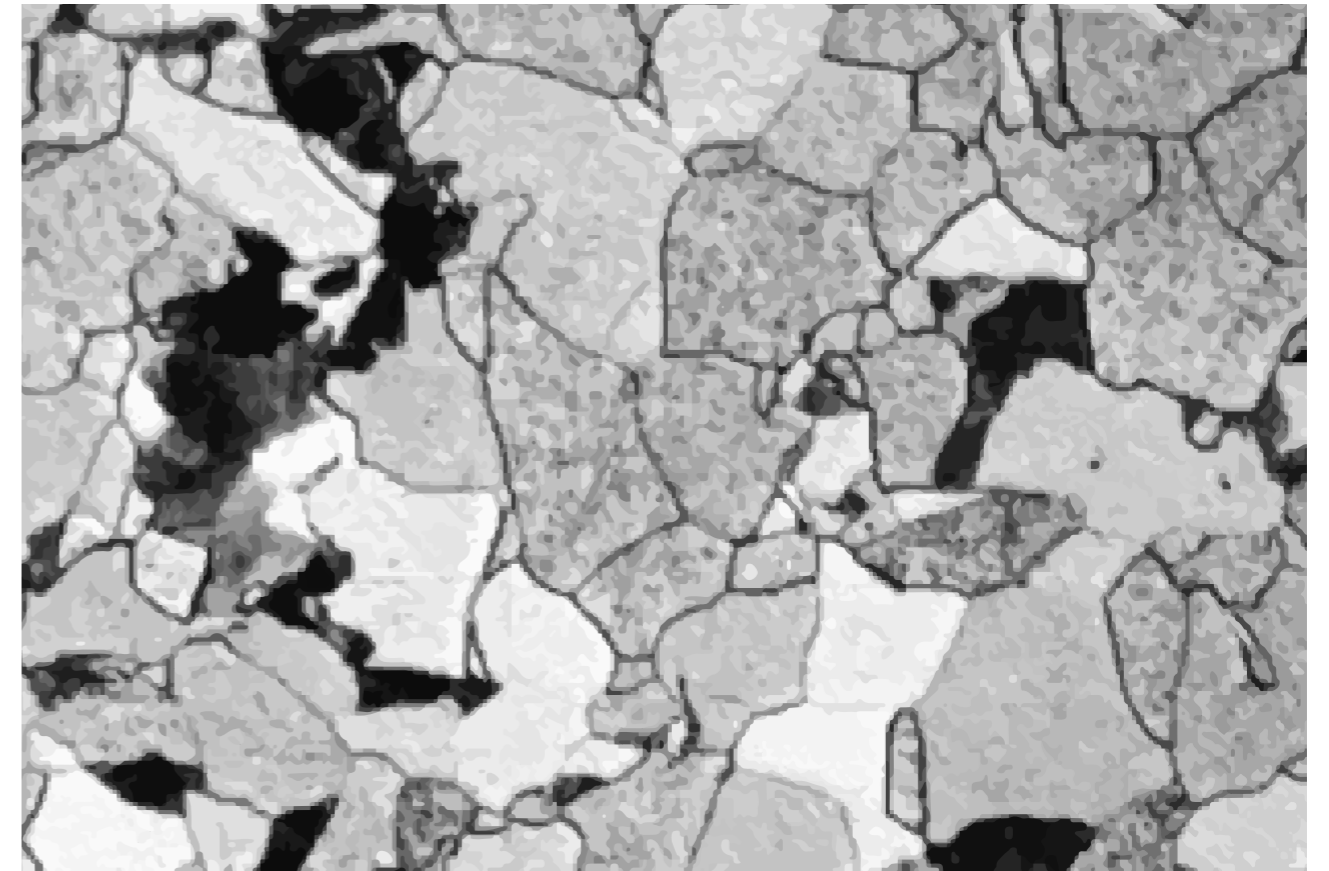
When Bushveld Nitro Vanadium is added to steel, vanadium preferentially combines with nitrogen to form nitrogen-rich vanadium-carbonitride precipitates. The nucleation rate of these precipitates increases at higher nitrogen contents and produces a large number of small particles.

GRAIN REFINEMENT

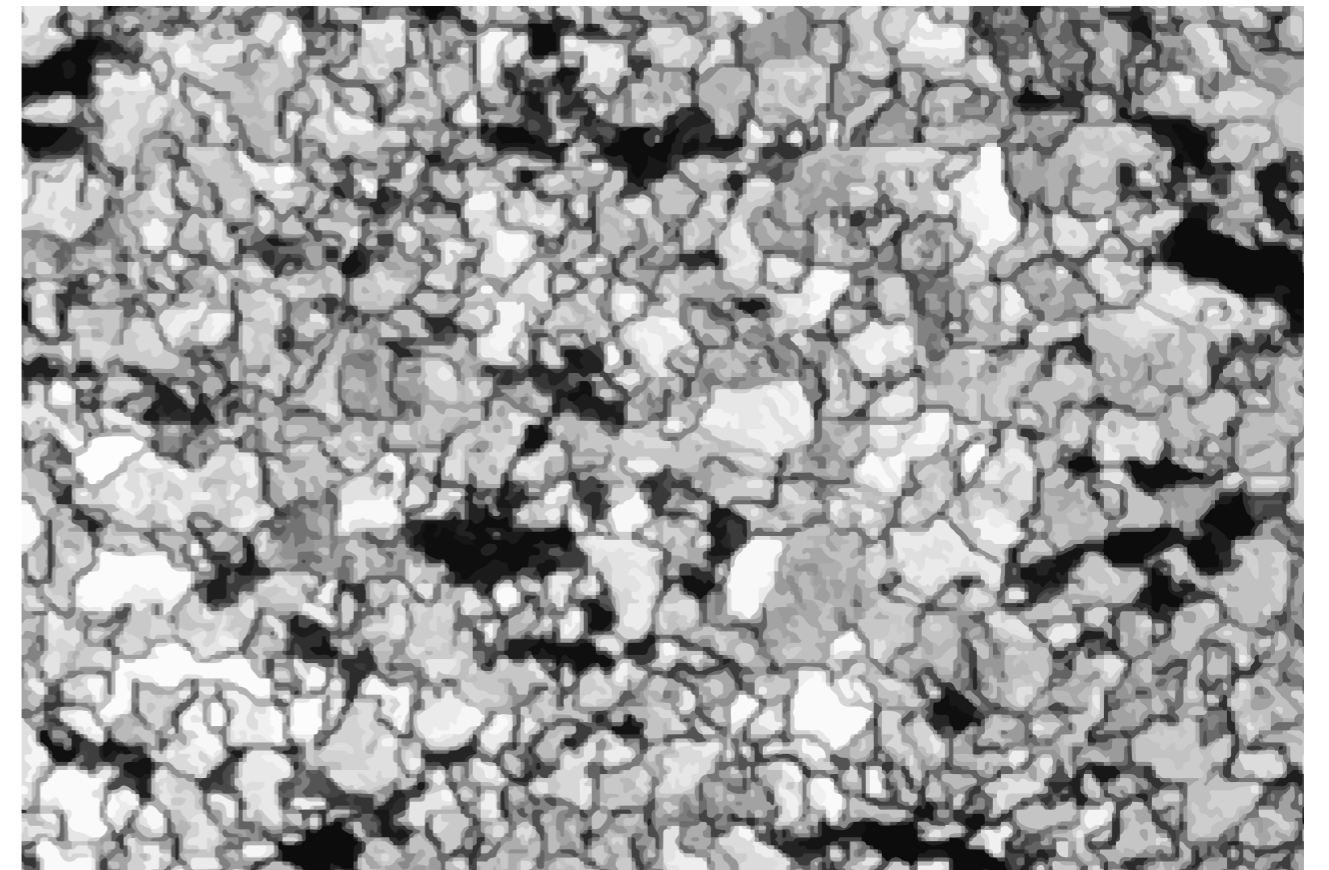
Smaller grains are formed by combining nitrogen and vanadium. Grain refinement is the only mechanism that improves both strength and toughness while reducing the embrittling effects of precipitation. By balancing grain refinement and precipitation hardening, good toughness is obtained in high-strength steels.

EXAMPLE

The smallest grains are found in the vanadium-nitrogen steel at the bottom. Therefore, this steel has the best combination of strength and toughness.



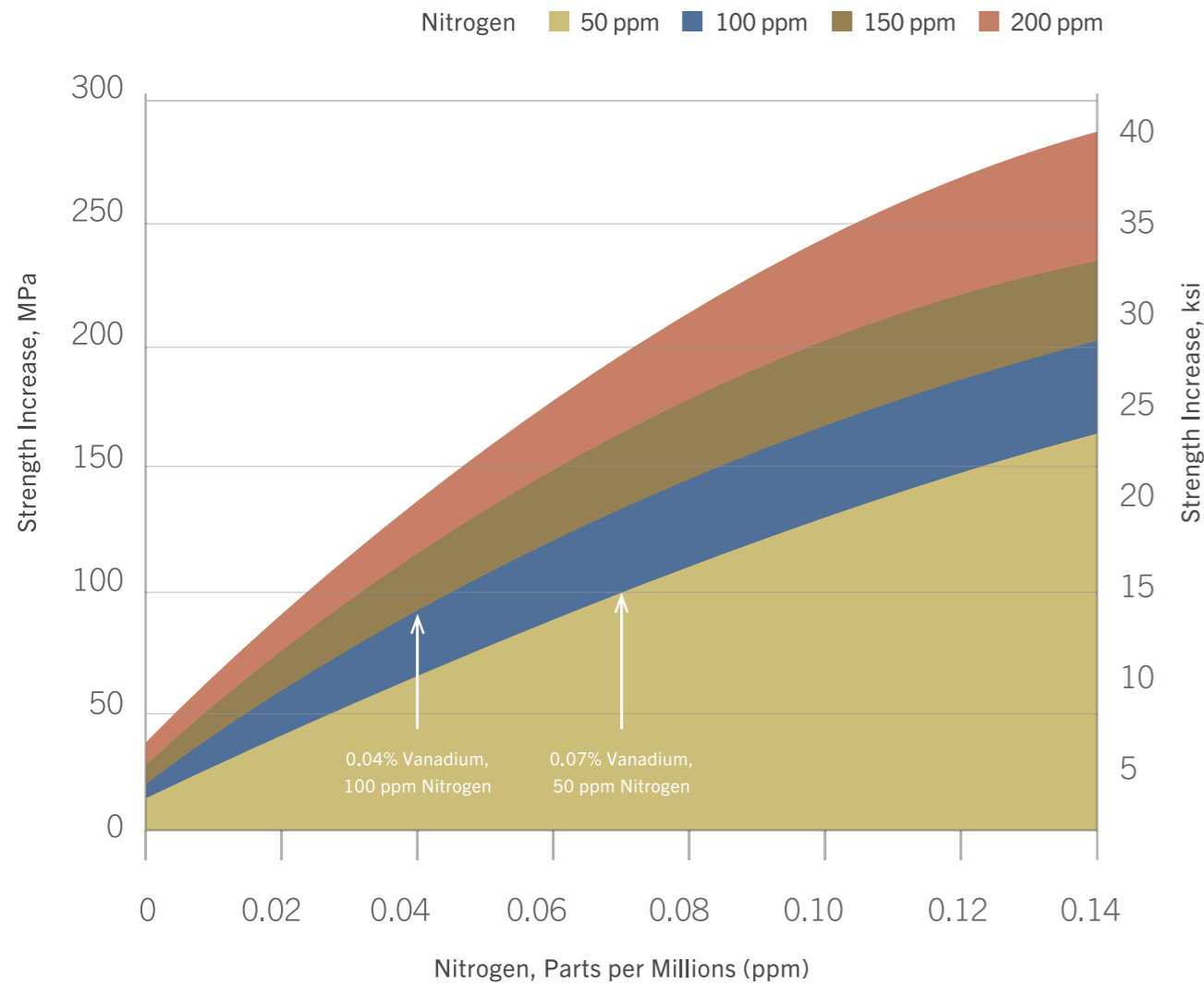
No Vanadium, 44 parts per million of nitrogen



0.48% Vanadium, 212 parts per million of nitrogen

Reduce Vanadium additions by using Bushveld Nitro Vanadium

NITROGEN: INCREASES EFFECTIVENESS OF VANADIUM



Hot-rolled steel containing 100 parts per million of nitrogen needs only 0.04% vanadium to obtain a strength increase of 110 MPa (16 ksi). In contrast, a steel containing about 50 parts per million of nitrogen requires 0.07% vanadium to obtain a similar increase in strength.

NITROGEN: AN EFFICIENT STRENGTHENER

In the presence of vanadium, nitrogen is converted from an impurity into a cost-effective alloying element. The vanadium nitrides formed by vanadium and nitrogen are more stable and more finely dispersed than vanadium carbides. For that reason, vanadium strengthening is more efficient in the presence of nitrogen.

SAME STRENGTH WITH LESS VANADIUM

By increasing strength, nitrogen allows steelmakers to use less vanadium, as shown in the graph above. Here, a 0.07% vanadium addition is needed to obtain a 110 MPa (16 ksi) increase in yield strength in a steel containing only 50 parts per million of nitrogen. If the nitrogen content is increased to 100 parts per million, only 0.04% vanadium is needed to obtain the same yield strength.

SUBSTANTIAL SAVINGS

Reducing vanadium additions yields major cost savings. In the example below, equivalent yield strengths are obtained when either 0.10% vanadium is added as ferrovanadium or 0.06% vanadium is added as Bushveld Nitro Vanadium. Using Bushveld Nitro Vanadium reduces vanadium additions by 0.40 kg (0.90 lbs.) per metric ton of steel.

OBTAINING EQUIVALENT YIELD STRENGTHS WITH LESS VANADIUM

ALLOY USED	VANADIUM USED		VANADIUM SAVINGS PER METRIC TON OF STEEL USING BUSHVELD NITRO VANADIUM
	VANADIUM ADDITION PER METRIC TON	VANADIUM CONTENT IN STEEL	
BUSHVELD NITRO VANADIUM	0.60 kg (1.35 lbs.)	0.06%	0.40 kg (0.90 lbs.)
80% FERROVANADIUM	1.0 kg (2.25 lbs.)	0.10%	

How Bushveld Nitro Vanadium provides more efficient strengthening through grain refinement

SMALLER GRAINS FORMED BY VANADIUM AND NITROGEN

Austenitic grain refinement in high-strength steels is achieved by hot rolling in the recrystallization-temperature region. The coarse austenitic grains found at the beginning of the rolling process are refined by repeated deformation and recrystallization during hot rolling. Although grain growth between these rolling passes would normally be expected, grain growth is retarded by the presence of the vanadium and nitrogen in the steel.

The accelerated cooling that takes place after the final rolling pass helps produce a very-fine ferritic structure after the austenitic grains transform to ferrite. This rapid cooling enhances ferrite nucleation and slows grain growth, providing the desirable balance of strength and toughness that is characteristic of high-strength, vanadium-nitrogen steels.

INTERGRANULAR FERRITE NUCLEATION IN HEAVY SECTIONS

In heavy sections where accelerated cooling cannot be achieved, the vanadium-nitride precipitates produced during deformation promote the nucleation of ferrite grains within the grain boundaries. The combined nucleating effect within the grains and the grain boundaries produces a fine ferritic structure in the finished steel.

The smallest grains are found in the vanadium-nitrogen steel at the bottom. Therefore, this steel has the best combination of strength and toughness.



Powering a better tomorrow

PACKAGED FOR PROGRESS

Bushveld Nitro Vanadium is a high-purity product with low levels of residual elements. Its aluminium content is particularly low compared to ferrovanadium. Briquets of Bushveld Nitro Vanadium are packed in strong, moisture-resistant bags that can be added directly to steel. The use of bags eliminates handling losses and simplifies weighing and inventory control.

MAXIMISED RECOVERIES

Bushveld Nitro Vanadium should be added to molten steel in the same manner as ferrovanadium. Maximum vanadium recoveries are obtained by adding Bushveld Nitro Vanadium after adding deoxidants such as aluminium and ferro-silicon. Aggressive agitation of the steel prevents localised super-saturation of nitrogen and leads to high-nitrogen recoveries.

LOW RESIDUAL PICKUP

Bushveld Nitro Vanadium is a high-purity product with low levels of residual elements. Its aluminium content is particularly low compared to ferrovanadium.

EXCELLENT WELDABILITY

Extensive research and technological studies have shown that the toughness of the heat-affected zone (HAZ) in vanadium-nitrogen steels depends on the transformation products and not on the nitrogen content. Excellent toughness can be obtained in these steels at heat inputs up to 4 kJ per mm (100kJ per in.) used in a majority of welding processes.

CUSTOMISABLE BASED ON YOUR PRACTICE

Steelmakers using Bushveld Nitro Vanadium have a choice of two vanadium-to-nitrogen ratios. Bushveld Nitro Vanadium 16 introduces 30% more nitrogen than Bushveld Nitro Vanadium 12. The low-carbon content of Bushveld Nitro Vanadium 16 is also an advantage in low-carbon steels.

SPECIFICATIONS: NITROGEN STRENGTHENING PLUS LOW ALUMINIUM				
ALLOY USED	VANADIUM	NITROGEN	CARBON	ALUMINIUM
BUSHVELD NITRO VANADIUM 12	77-81%	10-14%	10% max.0	.15% typical
BUSHVELD NITRO VANADIUM 16	76-81%	14-18%	6% max.0	.15% typical
80% FERRO VANADIUM	78-82%	ALLOY0	.25% max.1	.5% max.

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more resilient tomorrow
requires a shift.
In thinking. In doing.

At Bushveld Minerals we're committed to pulling
this kind of future forward. To bringing manufacturing,
development, energy, and growth not just to life,
but to lives.



Contact Details

Make the shift

The road to a more advanced future
starts with a single step –
contact us today:

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