

THE FACTS AND MYTHS OF HARDBANDING

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Author's Key Points:

- Clarifying the industry's misconception of hardbanding and its' impact on drill pipe tool joint life and casing wear.
- Offering an alternative hardbanding that will actually extend tool joint life and reduce casing, marine riser and B.O.P. wear at the same time.

Hardbanding of drill pipe tool joints and other drilling equipment has been around since the late 1930's. Originally, hardbanding was applied to primarily protect the drill pipe and other tools from rapid abrasive wear. In today's drilling of high angle, horizontal, high pressure and high temperature wells, the emphasis has shifted to protecting the casing from wear caused by drill string rotation and tripping. The need to protect the drill string is still important, but it has become much less important than the other items of concern. Given the increased cost and delivery time of new drill pipe and drilling tools, this sets new challenges to drilling contractors and rental tool companies.

Hardbanding, though a simple process, is widely misunderstood as to what role it plays in the protection of drill pipe tool joints. Laboratory tests and casing wear studies in recent years has proven new causes for casing, marine riser and B.O.P. wear, as well as casing and riser failures. The primary culprit is the drill pipe tool joint, either not hardbanded or hardbanded with tungsten carbide. The tungsten carbide wears the opposing surface by an abrasive action while the non-hardbanded tool joint wears the opposing surface by a galling action; both being equally destructive.

In the last eight years, new wear resistant alloy "casing friendly" hardbandings have been developed to protect the casing, riser, B.O.P. and drill string at the same time. Even with these developments there is a general lack of understanding and widespread confusion about hardbanding. The following points should help in clearing up some of these misconceptions.

Myth #1 **Tungsten Carbide hardbanding is the best hardbanding to use to protect the drill pipe.**

Fact: **Tungsten Carbide hardbanding, when used in a raised (proud) condition**, would be an effective material for tool joint protection. However, because of the relatively soft matrix of this type of hardbanding, the embedded tungsten carbide particles are quickly exposed during use. This causes severe abrasive wear to the casing, marine riser and B.O.P. walls. Operators began experiencing casing and riser failures on a regular basis as a result of this. They immediately called on the drill pipe manufacturers to come up with a solution. Their first solution was to use an improved shape of tungsten carbide particle. This slightly improved the situation, but was not the answer to their problems. The manufacturers then suggested lowering of the hardbanding to flush with the O.D. of the tool joint surface.

Myth #2: Applying Tungsten Carbide hardbanding in a flush application will prevent or reduce casing wear and still protect the tool joint.

Fact: FALSE! As determined in casing wear tests performed by Maurer Engineering in September, 1993, for Arnco Technology, AISI 4137 tool joint material produced almost as much casing wear as did Tungsten Carbide hardbanding. If you have a flush tungsten carbide application, the entire length of the tool joint, as well as the Tungsten Carbide hardbanding, will contact the casing wall, causing increased friction, which results in higher drag and torque, when then results in increased tool joint, casing, riser and B.O.P. wear simultaneously.

Myth #3: Burying the Tungsten Carbide particles under a layer of mild steel will prevent or reduce casing wear.

Fact: FALSE! Again, as in Myth #2, mild steel causes increased casing wear due to high friction between the two metals. Also, because of the high friction, the drill pipe tool joint experiences rapid wear, thereby quickly exposing the buried tungsten carbide particles. Once this occurs, two negative results come into being; One, the tool joint will have worn at least 3/16" off the O.D. and, Two, the tungsten carbide particles will begin wearing the casing at a rapid pace.

Myth #4: All casing friendly, wear resistant alloy hardbandings are the same.

Fact: FALSE! Even though they are all known as "casing friendly" or "wear resistant alloy" hardbandings, they are far from being the same. There are primarily two different types, sometimes described as "crystalline" and "amorphous". The "crystalline" type hardbanding such as the **Arnco 100XT** and **Arnco 200XT** has a consistent thru-wall hardness of 45 – 60 HRc and has a high tolerance for the high stress abrasion encountered in open hole. It also has an extremely low coefficient of friction. This allows it to be applied in a raised (proud) condition as it will not rapidly wear the casing in contrast to Tungsten Carbide hardbanding, tool joint steel, or other flush-applied wear resistant hardbandings. The "amorphous" type hardbanding has only a thin, work-hardened layer of a few microns in thickness and a low tolerance for high stress abrasion. For this reason it is recommended that it be applied flush. This, in turn, allows the tool joint to contact the casing, thereby resulting in more rapid tool joint, casing, marine riser and B.O.P. wear.

Conclusions:

Arnco Technology Trust Ltd. manufactures two hardbanding wires, **Arnco 100XT** and **Arnco 200XT**, that have an extremely low coefficient of friction and, when in contact with the casing, riser, B.O.P. walls will produce only minimal wear. For this reason, both wires are recommended to be applied in a **3/32" Raised** condition. When applied as recommended, the raised hardband prevents the tool joint from contacting the casing wall or open hole wall and thereby significantly extends the life of the drill pipe tool joint, the casing and marine riser, and the B.O.P. Actual case histories show the following results:

- **Arco Alaska** – Lowered casing wear from 60% to negligible, began using a lower grade and weight casing and totally eliminated casing failures in our drilling program. Applied in a 3/32" raised condition, the **Arnco 200XT** wear life as 29% better than Tungsten Carbide hardbanding.
- **Deutag Drilling** – "For maximum casing and optimum tool joint protection as well as friction reduction of interacting tubulars, we recommend the application of **Arnco 200XT** hardbanding on tool joint box and pin in the "raised/proud" shape." *Deutag/BP Wytch Farm ERD Equipment Information No. 1/96 – January, 1996, John Gammage*
- **Unocal Thailand** – Drilled 110,000' of directional hole with the new **Arnco 100XT** and it outperformed the tungsten carbide in open hole by 20% and gave us little or no casing wear. *Unocal Thailand, July, 2000*
- **Amoco Canada Ltd.** - Switched from a competitive casing friendly hardbanding to the new **Arnco 100XT** due to the fact that it is crack free, much easier and cheaper to re-apply and creates less casing wear than anything we have used to date. *Amoco Canada Ltd. – August, 2000*
- **Weatherford UK** – Specified **Arnco 100XT** on all new tubulars ordered from August, 2000 due to crack free status, ease of re-application and less downtime for refurbishment. *Weatherford UK – August, 2000*

The utilization of drill pipe and drilling equipment with **Arnco 100XT** and **Arnco 200XT** hardbanding applied in the recommended "raised" condition allows the drilling contractors to simultaneously protect their drill pipe, marine riser and B.O.P., as well as the operator's casing.

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