

The background of the entire page is a photograph of an oil well rig at sunset. The sky is a mix of orange, yellow, and blue. In the foreground, a close-up of a pipe joint is shown, with a silver-colored band around the connection point. The rig's structure is visible in the background, with various platforms and ladders.

# **Hardbanding Solutions**

**by**

**Postle Industries**

**Non-Cracking  
NS-1™ Approved**

**Casing Friendly**

**100% Rebuildable**

## Hardbanding Overview

Because tool joints have a larger diameter than the drill pipe, they are susceptible to wear, and therefore must be hardbanded to protect them. Hardbanding is derived from the application of hardfacing on drill pipe tool joints. It generally occurs with a minimum of three (3) “bands” of hardfacing. Tool joints are generally 4137 steel and require care in welding because of the high carbon. Careful attention is required to successfully hardband a tool joint.

When drilling depths are shallow and

bores are straight, tool joints wear very slowly and traditional hardbanding materials such as Tungsten Carbides are used. This offers good protection for the tool joint. But as drilling depths increase and directional bores become more popular, more and more stress or side thrust is placed on the tool joint, and in turn on the casing. Tool joints can be replaced but it is difficult and expensive to replace casing. The burden has been thrust upon the drilling contractor to provide “Casing Friendly Hardbanding”. This rules out Tungsten Carbide.



Hardness is not a good gage for wear resistance. Rockwell and Brinell hardness numbers are derived from an average of all matrix grains, carbides, and other phases. An alloy with no carbides can have the same hardness as an alloy with carbides, yet their wear resistance can be much different.

## Casing Friendly Overview



CASING FRIENDLY products are simply products that do not harm the operators casing. While tungsten carbide in hardbanding deposits goes a long way to preserve the tool joint, it often causes undue damage to the casing. This is particularly true for deep and multidirectional holes. For this reason, Postle continues to develop products that preserve tool joints as well as protect the casing from unwanted wear. And unlike other products that

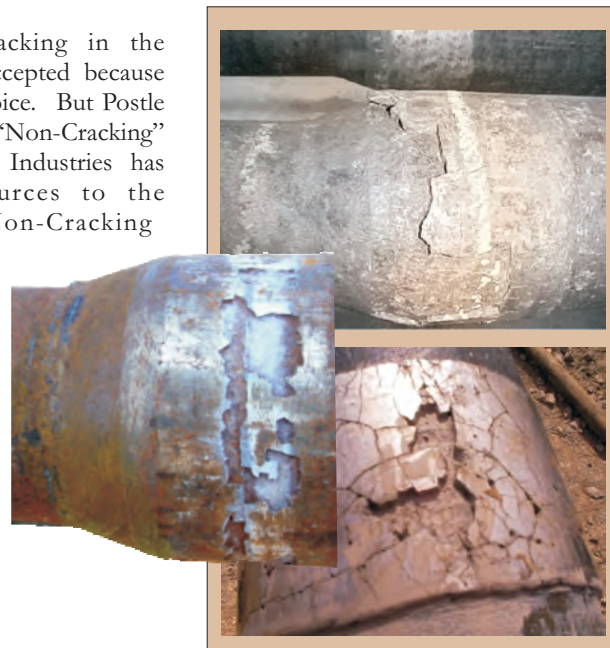
stress crack, Postle’s **Casing Friendly Hardbanding Alloys** are **Non-Cracking**, which satisfies the concerns of those who want crack free deposits in down hole tools. In addition, it allows re-application (rebuilding) without removing previous hardbanding. Those **Casing Friendly** products that are designated with an “NC” at the end of the product name are **Non-Cracking**, while those that do check relief crack do not have the “NC” designation.

## Cracking vs. Non-Cracking

Given enough stress or impact during service, check cracks will generate spalling, which can lead to costly down time and loss of profits. This is becoming a huge concern, especially since drilling depths are increasing and with more use of directional drilling.

Check cracking or check relief cracking is usually associated with hardfacing and hardbanding products. The most popular of these is generally associated with Chromium Carbide alloys. Cracking occurs because of the fine carbides that form on grain boundaries during cooling and the stress generated by the shrinking deposit. All check cracks penetrate into the base material or tool joint, as in the case of hardbanding.

For years, check-cracking in the hardband has been accepted because there was no other choice. But Postle has found another way, “Non-Cracking” hardbanding. Postle Industries has dedicated its resources to the development of Non-Cracking hardbanding alloys, Tuffband® NC and Duraband® NC. When applied with proper welding procedures, both alloys will not generate check cracks or spall, even under the most severe drilling operations.



## Casing Wear Testing

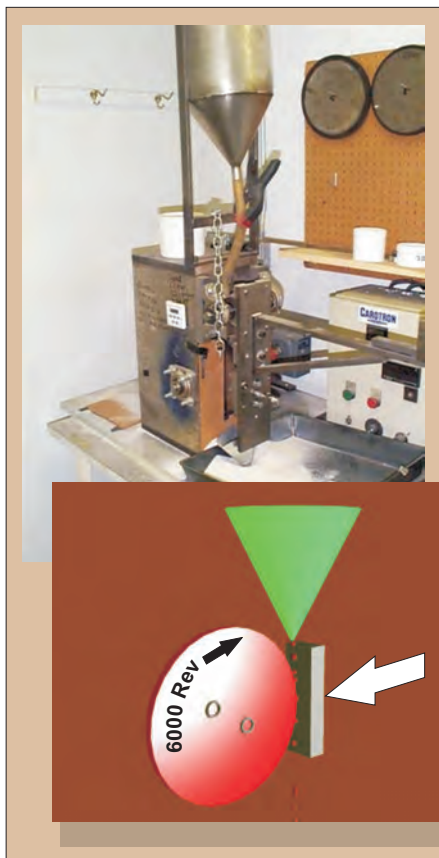
How is a hardbanding rated as being “Casing Friendly”? Typically this is done in a special testing apparatus which utilizes a section of casing and an actual tool joint with hardbanding. There are a number of such devices around the world, but one of the most popular is owned by Mohr Engineering, Houston, TX. This equipment was owned previously by Maurer Engineering.

The test consists of rotating a hardbanded tool joint at 155 RPM in a N80 Casing with a side thrust load of 3000 lbs. for 8 hrs. Periodically, the test is stopped and the wear scar geometry is measured. At the end of the 8 hour test the data is plotted and curve fitted. A number of very valuable parameters are derived that help describe the effects of a certain hardbanding on casing wear. One of these is the “Wear Factor”, in which very low numbers are desirable. Another is the percentage of casing worn in 8 hrs. Again, low numbers are desirable. Another is the number of revolutions required to remove 12.5% of casing. Higher numbers are desirable.

Since Mohr Engineering acquired the equipment, a number of parameters have changed, making comparisons to older data misleading, such as the study (DEA 42) carried out by the Drilling Engineers Assoc. in the year 2000. For example, two very important parameters used as a standard, AISI 4145 Unbanded Tool Joint, have changed dramatically as shown below.

4145 Bare Tool Joint		
Parameter/Year	2005	2007
Wear Factor (E-10/psi)	5.5	7.4
%Casing Wear	17.3	25.6

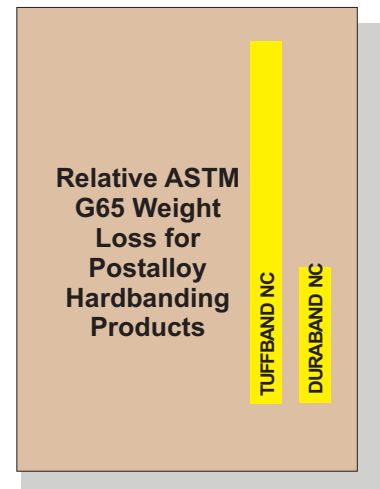
Currently, the API is working to standardize the test, making it much more reliable, repeatable and time worthy. Meanwhile, the industry continues to rely on this data to evaluate hardbanding effects and plan drilling operations. The test data for Postle’s products that have subjected to this test can be made available to interested parties by contacting our office.



## Abrasive Wear Testing

The ASTM G65 Dry Sand Rubber Wheel Abrasion Test is an abrasion test that closely duplicates real world drilling conditions because of the use of sand, which is what most of the earth is made up of.

A (1”x3” x wall thickness) hardbanding is subjected to a rotating steel wheel which is coated with rubber. A constant load of 30 lbs is applied. The test is run for 2000 revolutions, and the original and final sample weights are compared. The specification calls for weight losses to be reported in volume, but if all test samples are steel alloys, the results are reported in weight lost. Low numbers are the most desirable.



**TUFFBAND® NC**  
 A TOUGH NON-CRACKING HARDBANDING  
 FOR HIGH WEAR & IMPACT

NS-1™  
 Approved



Tuffband® NC Alloy Hardbanding (0051/10-2)



Use TUFFBAND® NC  
 by itself for casing  
 friendly applications  
 or  
 with WC for applications  
 outside the casing

**Postalloy® TUFFBAND® NC** is a high hardness hardband that may be used by itself for casing friendly hardband applications or used as a matrix with Tungsten Carbide (WC) when casing protection is not a factor.

**Casing Friendly** When used by itself and without WC, hardbanding deposits are **Non-Cracking**, providing proper preheat, interpass and cooling temperature procedures are followed. The microstructure consists of a hard, but tough tool steel matrix that is casing friendly and can be reapplied over itself. TUFFBAND® NC can be applied over itself without removal, but only if the surface has been properly cleaned and inspected. To apply over other previously

applied hardbanding materials, either remove them, or contact our engineering dept. for recommended procedures.

**With WC (Tungsten Carbide).** When Postalloy® TUFFBAND® NC is used as a “matrix” wire in combination with WC, the weld puddle is fluid and larger than conventional hardfacing wires, thereby allowing the WC bits to be completely consumed. There is no WC residue left on the deposits as is sometimes seen with mild steel and other matrix wires. This means that deposits are filled to the maximum and provide the ultimate in wear resistance. The resulting microstructure is a combination of a hard, wear resistant WC encased in a tough tool steel.

**DURABAND® NC**  
 A NON-CRACKING HARDBANDING FOR  
 EXTENDED TOOL JOINT LIFE  
 OUTSTANDING CASING PROTECTION

NS-1™  
 Approved



Duraband® NC Alloy Hardbanding  
 (004/08-2 & 0041/109-2)

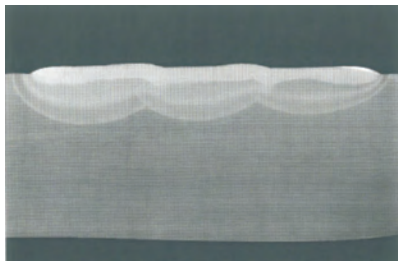
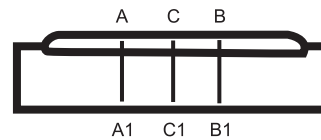
**Postalloy® DURABAND® NC** is a 100% crack-free hardband that provides maximum protection of the tool joint and casing. The DURABAND® NC microstructure consists of a hard, but tough tool steel matrix with a high volume of tightly packed micro-constituents. Their combined attributes ensures excellent wear resistance in **Open Hole Drilling** as well as being **Casing**

**Friendly**, and will not chip or spall off. Deposits are smooth and free of any slag. DURABAND® NC is NS-1 approved for re-application over itself and most competitive products without removal of the worn hardbanding but only if the surface has been properly cleaned and inspected. Contact the Postle Industries Engineering Department for recommended procedures.



Use DURABAND® NC for applications inside and outside the casing.

**10 Kg VICKERS HARDNESS SURVEY**



A photomicrograph showing the overlay. Micon markers at 1mm.

Positon	Spacing	A-A1	C-C1	B-B1
Hardband	Equal	740 (61)	666 (58)	703 (60)
Hardband	Equal	724 (61)	672 (58)	701 (60)
Hardband	Equal	736 (61)	685 (59)	713 (60)
HAZ	0.5mm	348 (35)	364 (37)	375 (38)
HAZ	0.5mm	360 (36)	355 (36)	383 (39)
HAZ	0.5mm	353 (35)	360 (36)	373 (38)
Base	2.0mm	313 (31)	314 (31)	313 (31)
Base	2.0mm	318 (32)	318 (32)	319 (32)
Base	2.0mm	316 (31)	329 (33)	309 (30)

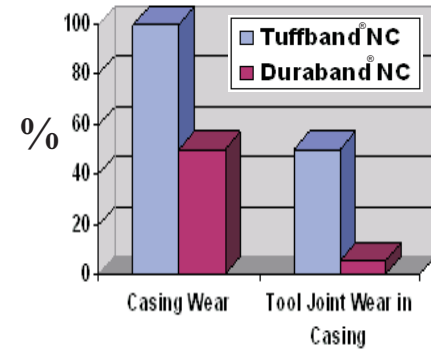
Conversions to Rockwell C Scale (HRC) are provided in parentheses and are approximations only based on ASTM E140

## THE BENEFITS OF NON-CRACKING DURABAND®NC

1. Duraband®NC - applied crack free - provides maximum “casing protection” and “tool joint life”.
2. Duraband®NC - applied crack-free - 100% rebuildable. Duraband®NC can be rebuilt over and over. Re-application costs are lower.
3. Duraband® NC - applied crack free - no spalling. Stress-cracking is not allowed. Even under the most severe drilling conditions spalling will not occur.

## DURABAND®NC AND TUFFBAND®NC OFFER HIGH PERFORMANCE WITHOUT THE NEGATIVE EFFECTS OF STRESS CRACKS.

1. Abrasive materials and drilling fluids cannot get trapped in the cracks.
2. No nucleations for H<sub>2</sub>S gas.
3. No difficult re-applications-No removal of previous hardbands.
4. Stress cracks in competitive hardbands can lead to cracking which can lead to spalling, especially under severe drilling conditions.



### TUFFBAND®NC vs. DURABAND®NC

The above graph shows the wear comparison between Tuffband®NC and Duraband®NC taken from the Mohr Engineering Casing Wear Test. Duraband®NC clearly shows a 50% reduction in casing wear and an 80% reduction in tool joint wear.

## Global Support and Distribution

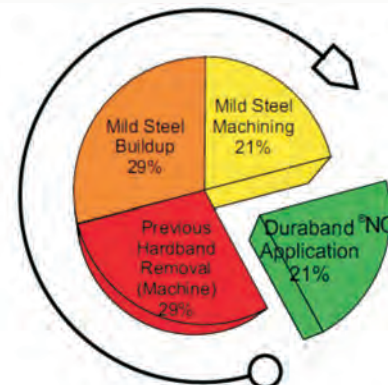
**Postle Industries Global Support Team consists of strategically placed Technical Centers throughout the world. Our Technical Centers offer technical assistance to Operators, Drilling Contractors, Pipe Suppliers, Pipe Manufacturers, Hardbanding Applicators and third party inspectors for any questions relating to hardbanding. In addition, they qualify Applicators for the proper application of Duraband® NC and Tuffband® NC. See back cover for Technical Center locations.**

## Hardbanding Re-Application Costs are Dramatically Reduced with Tuffband® NC and Duraband® NC

The cost of hardband re-application can be very expensive if the previous hardband must be removed before re-application can precede. As the chart below shows - close to 80% of the total cost of the re-application is dominated by previous hardbanding removal, the application of mild steel as a buildup, and subsequent machining of the mild steel to prepare the tool joint for the application of the hardband.

Duraband®NC or Tuffband®NC can substantially reduce the cost of re-application since they can be applied over some previous hardbandings, without the need for removal, providing that proper inspection procedures have been carried out. However, there are certain ones that they cannot go over. If this is the case, then a complete re-application is required, which includes previous hardband removal, mild steel build up and machining. It should be noted that once this procedure has been completed, any subsequent re-application of Duraband®NC or Tuffband®NC should not include removal of the hardbanding and any associated procedures.

### The Relative Cost of Worn Hardbanding Removal and Application of Duraband® NC or Tuffband® NC



## Tungsten Carbide Hardbanding

Traditional Hardbanding calls for spherical tungsten carbide that is dropped into a molten mild steel weld. The mild steel becomes the matrix that holds the tungsten carbide. For these applications, the use of Tuffband<sup>®</sup>NC or Duraband<sup>®</sup>NC as the matrix weld, instead of mild steel wire, will improve wear resistance.

Mild steel wires have been used for many years for two reasons. They are readily available and the tungsten carbide drops easily into the weld. The drawback though, is that the mild steel weld matrix is soft, and as it wears away, the tungsten carbide fractures and falls away. By improving the abrasion resistance of the matrix weld, the tungsten carbide stays in place longer. The result - the hardbanding will last longer. Tuffband<sup>®</sup>NC is 2.5 times more abrasion resistant than mild steel. Duraband<sup>®</sup>NC is 5 times more abrasion resistant than mild steel. To get the most out of hardbanding

with tungsten carbide, specify:

Tuffband<sup>®</sup>NC - our most popular wire. A tough, non-cracking tool steel weld with a hardness of 55 Rc.

Duraband<sup>®</sup>NC - a tool steel like Tuffband<sup>®</sup>NC, but with metal carbides already in the matrix for additional abrasion resistance



### Characteristics of Tuffband<sup>®</sup>NC and Duraband<sup>®</sup>NC:

- A molten puddle surface free of slag and scum.
- Maximum molten puddle surface to accept the Tungsten Carbide.
- High deoxidization to ensure high integrity bonds between carbide and matrix.
- Good wetting properties to ensure maximum carbide encapsulation.

**The Ultimate  
in Wear  
Resistance**

## WIRE USAGE CHART (Lbs of Hardbanding to Order)

Tool Joint Dia	Hardband Dia	Hardband Lbs/Inch	Hardband Width in Inches							
			0.75	1	1.5	2	2.5	3	3.5	4
4.5	4.6875	0.42	0.31	0.42	0.63	0.83	1.04	1.25	1.46	1.67
4.75	4.9375	0.44	0.33	0.44	0.66	0.88	1.10	1.32	1.54	1.76
5	5.1875	0.46	0.35	0.46	0.69	0.92	1.16	1.39	1.62	1.85
5.25	5.4375	0.48	0.36	0.48	0.73	0.97	1.21	1.45	1.70	1.94
5.5	5.6875	0.51	0.38	0.51	0.76	1.02	1.27	1.52	1.78	2.03
5.75	5.9375	0.53	0.40	0.53	0.80	1.06	1.33	1.59	1.86	2.12
6	6.1875	0.55	0.41	0.55	0.83	1.11	1.38	1.66	1.94	2.21
6.125	6.3125	0.56	0.42	0.56	0.85	1.13	1.41	1.69	1.98	2.26
6.25	6.4375	0.58	0.43	0.58	0.86	1.15	1.44	1.73	2.01	2.30
6.5	6.6875	0.60	0.45	0.60	0.90	1.20	1.50	1.80	2.09	2.39
6.625	6.8125	0.61	0.46	0.61	0.91	1.22	1.52	1.83	2.13	2.44
6.75	6.9375	0.62	0.47	0.62	0.93	1.24	1.55	1.86	2.17	2.48
7	7.1875	0.64	0.48	0.64	0.97	1.29	1.61	1.93	2.25	2.57
7.25	7.4375	0.67	0.50	0.67	1.00	1.33	1.67	2.00	2.33	2.67
8	8.1875	0.73	0.55	0.73	1.10	1.47	1.84	2.20	2.57	2.94
8.25	8.4375	0.76	0.57	0.76	1.14	1.51	1.89	2.27	2.65	3.03
8.5	8.6875	0.78	0.58	0.78	1.17	1.56	1.95	2.34	2.73	3.12

# Duraband® NC Certified for Re-Applications

by Bob Miller, Materials Manager, Postle Industries, Inc.



As the drilling industry evolves to accommodate the challenges of deep well and horizontal techniques, more demand is being placed on the maintenance of drill strings, and in particular the tool joints. Perhaps as little

as 15 years ago, tool joints were protected quite adequately by tungsten carbide hardbanding. These hardbandings provided maximum wear resistance for the tool joints, and because of the limited use of casing while drilling, casing wear was not an issue. As well bores became deeper and deviated, more casing was used and thus became a serious target for wear by the tungsten carbide hardbanding. For the most part tungsten hardbanding has been banned from drill string hardbanding except on drill collars and heavyweight. This resulted in relying upon more traditional type hardfacing alloys, but at the sacrifice of tool joint wear. Many of these alloys were considered “casing friendly” and did not wear out the casing prematurely. Many of the more effective alloys produced cracks due to the metallurgical structure of the hardbanding. These cracks often lead to premature failures, spalling and numerous re-application problems.

For over 40 years, Postle Industries, Inc. has been designing alloys and procedures for many industries including mining, farming, agriculture, recycling, to name a few. With a successful history in hardfacing, it was only natural for Postle Industries to become involved in the complex wear of drill pipe, heavyweight, drill collars and casing/risers.

Four years ago, Duraband® NC (referred to as simply Duraband® in this article), hardbanding wire was introduced to the drilling industry and carried Fearnley Procter’s NS-1™ “New Application” Certification. Duraband® in uniquely qualified to deposit a high quality hardbanding to minimize tool joint and casing wear. While this certification covers the “New Applications”, it does not cover the “Re-applications” of Duraband® over itself, or Duraband® over other worn competitive hardbanding products.

*Fearnley Procter Group, headquartered in Aberdeen, Scotland, with offices in Houston, TX is a third party inspection and specification group dedicated to oilfield products and issues. Their NS-1™ New Application Certification involves the application of a hardbanding product onto three tool joints, which are then sectioned and examined extensively via a crush test, micro hardness studies, etc. In addition to the physical welding and examinations, the product’s procedure manual is scrutinized by an expert committee and a casing wear test conducted. Only after all the criteria have been met is the Certification awarded.*

Critical to the longevity and overall maintenance costs of drill strings is the choice of hardbanding products used and their ability to be re-applied easily and cost-effectively. Therefore, re-application procedures and specifications are critically important, and perhaps even more so than new applications. Postle Industries immediately recognized the need for pursuing Fearnley Procter’s new NS-1™ Re-application Certification for Duraband® over previously worn Duraband®. In addition, in-depth conversations with applicators, drilling contractors and operators quickly revealed the need for procedures to also re-apply Duraband® over popular competitive products. Postle Industries, therefore, added those products to the list for Fearnley Procter’s NS-1™ Re-application Certification. In January of 2010, Fearnley Procter awarded the NS-1™ Re-application Certification for Duraband® over Duraband® and over three other popular competitive hardbanding products. This product certification places Duraband® in a very unique pioneering position. At last the industry has a highly credible third party approval and procedures for the re-application of hardbanding.

As with many pioneering efforts, questions abound. The foregoing are the most frequently asked questions regarding Duraband® applications and re-application hardbanding.

## What is Duraband®?

Duraband® is a premium, NS-1 Certified, metal cored, gas shielded welding wire that is capable of depositing a casing friendly, non-cracking, 100% rebuildable hardbanding in the shop or field. It is designed to maximize the wear resistance of tool joints while at the same time minimize the casing wear. Duraband® does not require removal prior to re-application and is compatible for re-application over previous select competitive hardbandings.

Duraband® can also be used with tungsten carbide additions to enhance the wear resistance of heavyweight and drill collars. The addition of tungsten carbide however, renders this deposit non-casing friendly.

## What are Casing Friendly Hardbandings?

During a period of time when wells were shallow and straight, it was common practice to drop tungsten carbides chips into mild steel weld puddles. This combination resulted in excellent tool joint protection. However, as wells became deeper and multidirectional, casings became the target for catastrophic wear by the tungsten carbide hardbanding. Tungsten carbide chips are recycled and crushed machine tools and therefore act as cutting agents when coming into contact with metal. The industry quickly realized that these tungsten carbide chips wore through the casing in relatively short time. These failures were costly and time consuming to repair. Alternative alloys were considered for hardbanding that came into contact with the casing. In the early 1990’s, the DEA3 (Drilling Engineer Association) conducted a study (No.42) with the intent to categorize competitive hardbandings and their relationship to casing wear. Tests were conducted on the Maurer Engineering test apparatus. The results the DEA 42 study were published and a 2.0 casing wear number was established as a benchmark. Anything below 2.0 was considered “casing friendly” and anything above 2.0 was considered not casing friendly.

The Maurer test apparatus changed hands a couple of times and it is now performing tests in the Mohr Engineering laboratories, Houston, TX. The test and the standards have deviated greatly from the DEA 42 study, and the resulting data differ greatly from the DEA 42 results. No longer is the casing number of 2.0 considered the benchmark for casing friendly hardbanding. The casing wear test, standards, and procedures are being reviewed by API<sup>6</sup> with the intent to ultimately publish a standard. The unfortunate result of the changes in the test has caused confusion and apprehension about what is considered to be a casing friendly hardbanding. And until the API concludes their review and publishes a specification, the industry is confined to their own interpretations of the Mohr Engineering Test data.

#### **What makes Duraband<sup>®</sup> NC Different?**

Duraband<sup>®</sup> is unique in that deposits are crack free, highly wear resistant, and 100% rebuildable. It is what is commonly known as “casing friendly”, meaning that it will not wear out the casing as does tungsten carbide. The casing friendly attribute of Duraband<sup>®</sup> comes from a detailed casing wear test conducted at Mohr Engineering, Houston, TX. During this test the Duraband<sup>®</sup> deposit is rotated against a standard casing material while at the same time sand bearing mud is trickled down between the deposit and casing. The tool joint rotates at 155 rpm and is also oscillated back-and-forth. A 3000 pound per foot load is applied during the test. The test runs for eight hours. At the end of this test, a final wear scar depth measurement is made and determined how much metal has been removed. From this value, and other parameters, a casing wear number is calculated. Low value wear factors are considered desirable. In the past, N80 casing was used for the test. The new standard is T95 casing.

#### **Duraband<sup>®</sup> NC is NS-1<sup>™</sup> is certified for Initial Application and Re-Application. What are these certifications?**

In 2000, Fearnley Procter Group<sup>7</sup> purchased Shell SQAIR rights from Shell UK<sup>8</sup> and published certifications under the NS-1<sup>™</sup> designation. To be qualified for NS-1<sup>™</sup> Certification, Initial Application, the Duraband<sup>®</sup> procedure had to be approved by a committee of experts. A number of tool joints were welded using this manual, and exhaustive testing was conducted on them to ensure integrity, bonding and consistent hardness. In addition to this testing, Duraband<sup>®</sup> is required to be casing wear tested, in this case by Mohr Engineering, Houston, TX.

NS-1<sup>™</sup> Re-Application Certification is handled a little differently. The Duraband<sup>®</sup> Re-Application procedures are examined. Tool joints with worn hardbanding products on them are then welded according to the re-application procedures and appropriate sections are taken from the tool joint and tested for bonding, hardbanding integrity, hardness consistency and heat affected zone integrity.

#### **Why is NS-1<sup>™</sup> important?**

For the most part, hardbanding is a self regulated procedure, unless third party inspectors are employed during the process. In that respect, it is extremely important to have an outside party examine, evaluate, and regulate hardbanding products

qualifies each and every Applicator. Applicators are visited on a frequent basis for compliance to Postle Industries’ manual and procedures. Non-compliant applicators are reviewed and handled accordingly.

#### **How many times can Duraband<sup>®</sup> NC be re-applied?**

Duraband<sup>®</sup> can be applied over itself any number of times. The Duraband<sup>®</sup> procedural manual calls out exactly how worn hardbanding should be inspected and demonstrates the acceptable criteria. Serious defects such as large porosity, numerous porosity, cracking and spalling are addressed in the manual. The re-application of Duraband<sup>®</sup> over itself is similar to the initial application of Duraband<sup>®</sup> on the tool joint. Because the tool joint has experienced previous welding temperatures, it is very critical for exact re-application procedures to be followed to avoid any unnecessary heat affected zone issues.

#### **Does Duraband<sup>®</sup> NC need to be removed before re-application?**

Duraband<sup>®</sup> does not require removal before re-application over itself, providing that the worn hardbanding is free from gross defects incurred during drilling. Re-applications of Duraband<sup>®</sup> over competitive brand previous worn hardbanding should be scrutinized carefully for excessive cracking and gross porosity. Duraband<sup>®</sup> re-applications are only as good as the previously worn hardbanding’s condition. If for any reason the previously worn hardbanding requires removal and build-up, Postle Industries suggests using Tuffband<sup>®</sup>, another premier Postle hardbanding product. Tuffband<sup>®</sup> is much more forgiving as a build-up for Duraband<sup>®</sup>. Since Tuffband<sup>®</sup> is similar in chemistry to Duraband<sup>®</sup>, it combines well with re-applications and contributes to increasing tool joint life.

#### **Some worn hardbandings are cracked. How does this affect Duraband<sup>®</sup> NC re-applications?**

Typically worn hardbanding products are returned for re-application displaying cracks, which may be due to the natural characteristics of some competitive hardbandings. Careful examination should reveal any wide or deep cracking, which should be rejected. Cracks, unfortunately, harbor a great deal of debris which can effect the re-application of Duraband<sup>®</sup>. Practically all cracks in the worn deposit will also be reproduced in the Duraband<sup>®</sup> re-application. Depending on the amount of debris within the worn deposit crack, gas and porosity may also be noted in the final deposit of Duraband<sup>®</sup>. These may or may not be acceptable in accordance with the Duraband<sup>®</sup> Procedure Manual.

#### **Does worn deposit thickness effect Duraband<sup>®</sup> NC re-applications?**

Duraband<sup>®</sup> does not require previously worn Duraband<sup>®</sup> hardbanding to be flush with the tool joint for re-application. However, this is not always the case with competitive worn hardbandings. Often grinding is necessary to prepare the tool joint for re-application, or the drill string may be returned to service and hardbanded in the next inspection cycle.

**How does Duraband®NC compare to other, competitive, hardbanding?**

Duraband® is a premium hardbanding and is very competitive with other premium hardbanding products. Duraband®'s unique attributes, such as trouble free re-application, field application and the ability to accept WC products for use on heavyweight, are by far more cost-saving than the cost of the hardbanding wire. Keep in mind that Duraband® hardbanding does not require the drill string to be sent to the applicator's shop for hardbanding. Hardbanding can be done in the field given proper equipment and procedures. This can relate to a vast savings in shipping costs and downtime.

**How can Duraband®NC save me money?**

Whether you are a drilling contractor or energy producer/operator, the use of Duraband® on drill strings and heavyweights can save you a great deal of money in terms of maintenance and downtime. Since Duraband® is crack free, re-applications are very easy. If you are currently employing a hardbanding product that requires removal before re-application, the use of Duraband® bypasses the removal process because Duraband® can be applied over itself for any number of applications. Employing a hardbanding that requires removal

before re-application costs 4-5 times as much as the original application. All of the costs associated with removal, build-up, and machining are eliminated when Duraband® is chosen as the hardbanding of choice. As for heavyweight, WC chips or pellets can be dropped into the Duraband® puddle to create a highly abrasive resistance matrix with WC embedded. This is probably the pinnacle of abrasion resistance for drilling tools. Using Duraband® by itself on drill strings and Duraband® with WC embedded requires the applicator to stock only one wire, Duraband®. These features in themselves have a far-reaching impact on the cost of hardbanding. They will benefit both the operator and drilling contractor.

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<sup>6</sup>American Petroleum Institute (API)  
1220 L Street, NW  
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<sup>2</sup>Fearnley Procter Inc.  
1001 South Dairy Ashford, Suite 120  
Houston, TX 77077

<sup>7</sup>Fearnley Procter Group  
Aberdeen, Scotland

<sup>3</sup>DEA  
Drilling Engineers Association  
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Houston, TX 77042

<sup>8</sup>Shell U.K. Limited  
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13135 Dairy Ashford Rd  
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NS-1™ is a trademark. Fearnley Procter Group

Duraband®NC is a trademark, Postle Industries, Inc

<sup>5</sup>Mohr Engineering Division  
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Houston, TX 77041-1205

Tuffband®NC is a trademark, Postle Industries, Inc.

TEMPERATURE CONVERSION CHART												
	°C	°F		°C	°F		°C	°F		°C	°F	
	0	-18	32	260	127	500	520	271	968	780	416	1436
	10	-12	50	270	132	518	530	277	986	790	421	1454
	20	-7	68	280	138	536	540	282	1004	800	427	1472
	30	-1	86	290	143	554	550	288	1022	810	432	1490
	40	4	104	300	149	572	560	293	1040	820	438	1508
	50	10	122	310	154	590	570	299	1058	830	443	1526
	60	16	140	320	160	608	580	304	1076	840	449	1544
	70	21	158	330	166	626	590	310	1094	850	454	1562
	80	27	176	340	171	644	600	316	1112	860	460	1580
	90	32	194	350	177	662	610	321	1130	870	466	1598
Example:	100	38	212	360	182	680	620	327	1148	880	471	1616
Your Temperature = 100°F >>	110	43	230	370	188	698	630	332	1166	890	477	1634
Your Conversion = 38°C	120	49	248	380	193	716	640	338	1184	900	482	1652
or	130	54	266	390	199	734	650	343	1202	910	488	1670
Your Temperature = 100°C	140	60	284	400	204	752	660	349	1220	920	493	1688
Your Conversion = 212°F	150	66	302	410	210	770	670	354	1238	930	499	1706
	160	71	320	420	216	788	680	360	1256	940	504	1724
	170	77	338	430	221	806	690	366	1274	950	510	1742
	180	82	356	440	227	824	700	371	1292	960	516	1760
	190	88	374	450	232	842	710	377	1310	970	521	1778
	200	93	392	460	238	860	720	382	1328	980	527	1796
	210	99	410	470	243	878	730	388	1346	990	532	1814
	220	104	428	480	249	896	740	393	1364	1000	538	1832
	230	110	446	490	254	914	750	399	1382	1010	543	1850
	240	116	464	500	260	932	760	404	1400	1020	549	1868
	250	121	482	510	266	950	770	410	1418	1030	554	1886

# HARDNESS CONVERSION CHART

Brinell Hardness	Rockwell Hardness			Tensile Strength	Brinell Hardness	Rockwell Hardness			Tensile Strength
	Tungsten Carbide Ball 3000 Kg	A Scale 60 Kg	B Scale 100 Kg			C Scale 150 Kg	(Approx psi)	Tungsten Carbide Ball 3000 Kg	
-	85.6	-	68	-	331	68.1	-	35.5	166,000
-	85.3	-	67.5	-	321	67.5	-	34.3	160,000
-	85	-	67	-	311	66.9	-	33.1	155,000
767	84.7	-	66.4	-	302	66.3	-	32.1	150,000
757	84.4	-	65.9	-	293	65.7	-	30.9	145,000
745	84.1	-	65.3	-	285	65.3	-	29.9	141,000
733	83.8	-	64.7	-	277	64.5	-	28.8	137,000
722	83.4	-	64	-	269	64.1	-	27.6	133,000
712	-	-	-	-	262	63.6	-	26.6	129,000
710	83	-	63.3	-	255	63	-	25.4	126,000
698	82.6	-	62.5	-	248	62.5	-	24.2	122,000
684	82.2	-	61.8	-	241	61.8	100	22.8	118,000
682	82.2	-	61.7	-	235	61.4	99	21.7	115,000
670	81.8	-	61	-	229	60.8	98.2	20.5	111,000
656	81.3	-	60.1	-	223	-	97.3	20	-
653	81.2	-	60	-	217	-	96.4	18	105,000
647	81.1	-	59.7	-	212	-	95.5	17	102,000
638	80.8	-	59.2	329,000	207	-	94.6	16	100,000
630	80.6	-	58.8	324,000	201	-	93.8	15	98,000
627	80.5	-	58.7	323,000	197	-	92.8	-	95,000
601	79.8	-	57.3	309,000	192	-	91.9	-	93,000
578	79.1	79.1	56	297,000	187	-	90.7	-	90,000
555	78.4	-	54.7	285,000	183	-	90	-	89,000
534	77.8	-	53.5	274,000	179	-	89	-	87,000
514	76.9	-	52.1	263,000	174	-	87.8	-	85,000
495	76.3	-	51	253,000	170	-	86.8	-	83,000
477	75.6	-	49.6	243,000	167	-	86	-	81,000
461	74.9	-	48.5	235,000	163	-	85	-	79,000
444	74.2	-	47.1	225,000	156	-	82.9	-	76,000
429	73.4	-	45.7	217,000	149	-	80.8	-	73,000
415	72.8	-	44.5	210,000	143	-	78.7	-	71,000
401	72	-	43.1	202,000	137	-	76.4	-	67,000
388	71.4	-	41.8	195,000	131	-	74	-	65,000
375	70.6	-	40.4	188,000	126	-	72	-	63,000
363	70	-	39.1	182,000	121	-	69.8	-	60,000
352	69.3	-	37.9	176,000	116	-	67.6	-	58,000
341	68.7	-	36.6	170,000	111	-	65.7	-	56,000

**“... Maximizing Drill Pipe Performance  
and Minimizing Casing Wear Through  
Superior Hardbanding Technology...”**

**Research and Development**



All customers and applicators are entitled to and have access to Postle Industries' extensive knowledge bank, lab facilities and metallurgical analysis as it pertains to all aspects of hardbanding and related procedures. Hardbanding is the oil industry's terminology for the hardfacing of tool joints for drill pipe, HWDP and collars. Postle Industries has been in the hardfacing and wear business for over 40 years.

market the drilling industry's next generation of hardbanding products.

Postle Industries is committed to developing crack-free, casing friendly alloys and welding techniques to meet the industry's needs. Our laboratories are well staffed with personnel and equipment to formulate, test and evaluate new products. From chemical analysis to microhardness testing to wear testing, Postle Industries enjoys a wealth of state-of-the-art resources.

Our focus isn't just on laboratory, marketing, production and delivery skills. It is also focused on keeping a pulse on the oil/gas and drilling industries through active participation in such organizations as the API Casing Wear Group, IADC and DEA, as well as the American Welding Society. Only through this close and dedicated effort are we able to address the pressing issues and trends of the day and the future. It is our aim not only react to the markets but to be an influential leader as well.



The key to Postle Industries' success as a hardbanding and hardfacing supplier is the ability to quickly analyze and address welding issues in a timely manner. The world's demand for successful and economical exploration and extraction of hydrocarbons will continue to place pressures on R & D efforts in all related industries. Postle Industries has met that challenge by producing two crack-free, casing friendly hardbanding products, Tuffband® NC and Duraband® NC. But the work doesn't cease there. It takes a continual and aggressive R & D program to innovate and bring to



**Postle Industries furnishes hardbanding products for non-magnetic applications. Contact our main office for help. [sparky@postle.com](mailto:sparky@postle.com)**



# **HARDBANDING SOLUTIONS**

by

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