

Castolin Eutectic®
Eutectic Castolin

Hardbanding

For Oil and Gas drilling

**TESTED &
APPROVED**



10SS **16XS** **OTW** **12Ti** **13CF**

Optimized Performance

- Crack Free Design
- Casing Friendly
- Optimized Tool Wear Resistance
- Flexible Rebuild Design

Optimized Solutions Improving Performance & Security



We understand the Industry



We understand the Problem

Today's Drilling Challenges General Performance Requirements

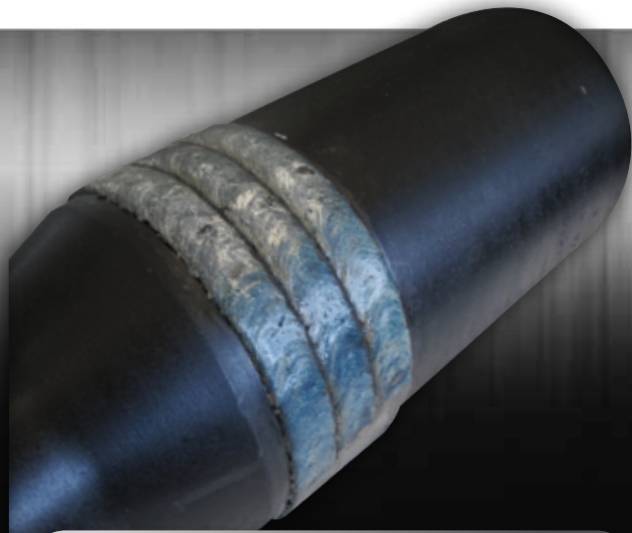
As average well depths have increased over the past decade, directional and extended-reach drilling have become more commonplace. These wellbore trajectories, with their highly deviated paths (ERD) and associated increases in torque and drag, have exerted unprecedented force on the drill pipe, surpassing all previous stress level limits. These trajectories in turn, create severe wear conditions on both the casing and drilling string, which is becoming increasingly detrimental for drilling operations.

Hardbanding has long been acknowledged as an effective means of preventing tool joint wear. During the 1990's, tungsten carbide-based hardbanding was in widespread use and was determined to be the primary cause of casing wear. However the absence of hardbanding, while slowing casing wear to a small degree, allowed the tool joints to wear at an accelerated rate, lessening the torsional capacity of the drill pipe and putting drilling operations at a serious risk. The challenge was to discover a balanced, simultaneously effective solution between both casing wear defense and tool joint protection, which is caused by the worsening conditions associated with highly deviated

ERD wells. Previous casing friendly alloys reduced casing wear, but produced unacceptable tool joint wear as a consequence. Crack-prone design flaws were also present, as widespread cracking of the alloy material often ensued. This caused catastrophic tool joint failure and in some cases, even the failure of the hardbanding itself, due to tool joint spalling.

Industry solutions include:

- Low casing wear determined by Mohr T-95 testing, which is well within industry limits.
- Highly durable and wear-resistant, protecting the tool joint.
- Crack-resistant, preventing cracking in the material and tool joint.
- Spalling-resistant metallurgical compatibility.
- Material is easy to reapply without special prep or pre-conditioning.



We Have the Right Product



We Have Established Experience

Approved & Established Performance Preferred by Majors.

Castolin Eutectic has been performing hardbanding in the Norwegian market for more than 8 years. Due to excellent co-operation between Castolin Eutectic and Statoil, there has been very successful development, use and approval of new, innovative alloys. Today Statoil approves OTW 12Ti, OTW 16XS and the non-welded, patented MX5 coating for drilling.

During development of the OTW range, Castolin Eutectic constructed its very own, unique hardbanding C-Wear testing machine.

The machine tests encompass:

- Casing material combined with full-size, hardbanding alloy-infused wear samples.
- Specific mud parameters, measuring tool-joint, open hole and casing wear rates.
- established hardbanding coating friction dynamics.

In addition to this, we use an automated Micro Hardness Machine, a G65 Abrasion Wear-Test Machine and ICP / XRF Chemical Analysis Units, employing a well trained, customer-oriented technical team. Our global crew of highly qualified engineers tests OTW products on active field components, under the most extreme drilling conditions. These harsh environments provide the necessary criteria for understanding severe wear phenomena and set the standard by which we measure our product integrity.

These thorough testing procedures provide a simple yet complete understanding of very complex wear phenomena and allow Castolin Eutectic to develop and ensure the best performing range of hardbanding alloys in the industry today. OTW products are guaranteed to ensure to the highest quality through our Production Quality Control Department and Total Quality Management Systems (TQMS). Castolin Eutectic production facilities are also ISO-9000, TUV and Lloyds Certified.

Castolin OTW 13CF

Description

Exclusive, gas shielded, metal cored alloy hardbanding wire specifically. Ideal for repair applications as for batch manufacturing where highest integrity welding, efficiency and productivity are required. The weld deposit is designed to give a crack-free, smooth surface with low friction properties. This gives good resistance to high stress abrasion and erosion at ambient temperatures even when combined with heavy impact or pressure, all of what can be expected in an open hole or cased hole environment.

The slag-free deposit precipitates a dense dispersion of hard, primary niobium and complex CrMo carbide phases finely distributed in a martensitic/residual austenitic matrix. I

This alloy may be cost effectively reapplied over itself to refurbish worn drill pipes after drilling operations. It is only necessary to ensure that the base material and old OTW 13CF coating are free of any physical defects and that safe dimension tolerances are retained.

Technical data

Hardness: 58-64 HRC

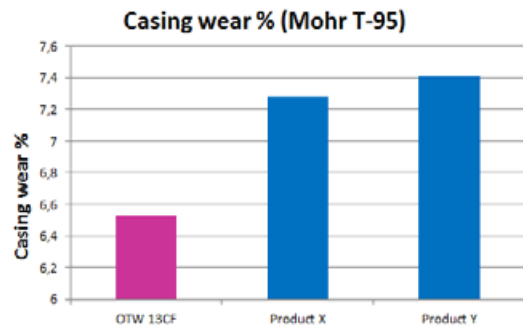
Applications

Specifically developed for new or worn Hardbanding drill pipe tool-joints", this alloy has been tested & approved according to industry standards and customer approvals e.g. Mohr Casing Wear test standard, Stress Engineering, Houston TX. USA. This alloy has been tested & approved according to industry standards and customer approvals e.g. NS1 standard, Fearnley Procter Group

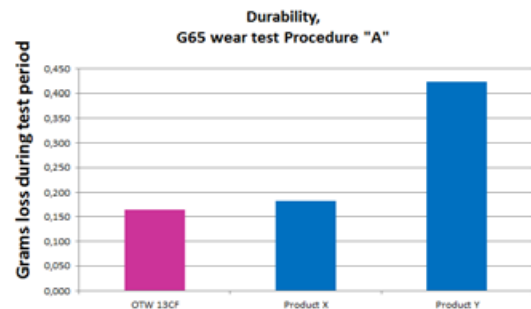
Nb: For extreme open hole performance, this alloy can be injected with carbides to make it more wear resistant



Casing Wear Testing



Tool Joint Wear Testing



Product X* - Replacement to an earlier cracking type alloy
Product Y - designed to be crack free

Performance Data Overview

Hardness HRC 58-64 G65 Test data 1 layer, loss (g) 0,165	Casing Wear Casing Wear %, Mohr 6,53 CW Factor 1,17 Friction factor 0,32 Est. revs. To 87% nom. Wall Infinite
Mohr Wear Tests TJ wear in O/H Mohr (in loss): 0,0470 TJ wear in casing loss 0,0037	



Castolin OTW 12Ti

Description

Proprietary, gas shielded, flux cored alloy wire specifically developed for Hardbanding of drilling pipe tool-joints. The high quality protective alloy weld deposit designed to give a crack-free, smooth surface with low friction properties. Wear resistance performance in open hole situations is amongst the best in the market with lowest casing-wear properties. This alloy may be cost effectively reapplied over itself to refurbish worn drill pipes after drilling operations. It is only necessary to ensure that the base material and old OTW 12Ti coating are free of any physical defects and that safe dimension tolerances are retained.

OTW 12Ti is formulated to produce a unique microstructure with numerous, very fine, ultra-hard Titanium-cermet phases dispersed in a tough, tempered martensitic matrix. This ensures immunity to cracking and excellent all-round resistance to combined wear by gouging abrasion, erosion, heavy impact and pressure in down-hole, drilling service conditions. Relatively thick, wide hardbanding is practical in a single pass. Multi-pass overlays are also possible up to 15 mm thickness. Deposits resist stress relief cracking and spalling. Very low dilution with base metal. Minimal slag residues save weld cleaning time.

Technical data

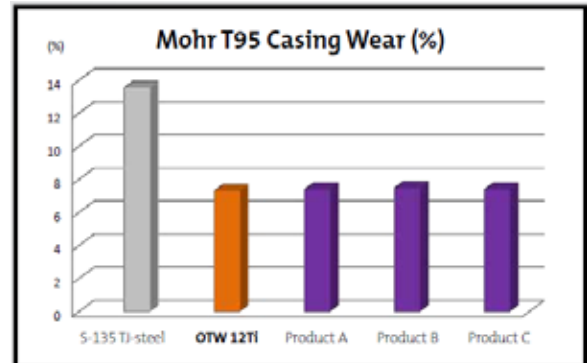
Hardness: 55-58 HRC

Applications

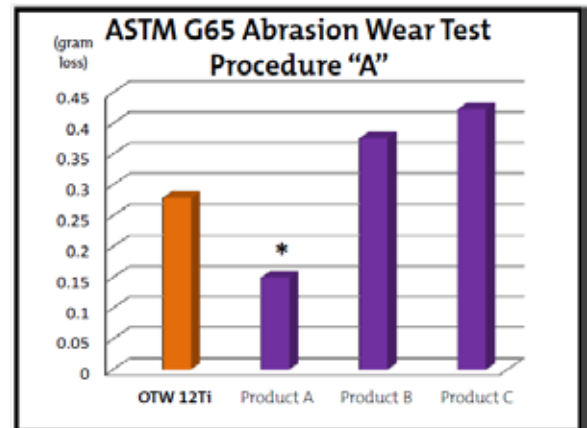
Specifically developed for new or worn Hardbanding drill pipe tool-joints", this alloy has been tested & approved according to industry standards and customer approvals e.g. NS1 standard, Fearnley Procter Group etc. The additional self-shielding capabilities of OTW-12Ti make it an ideal choice for field work or on-site applications.



Casing Wear Testing



Tool Joint Wear Testing



Product A* - Cracking type
Product B & C - designed to be crack

Performance Data Overview

Hardness HRC 59-64	Casing Wear
G65 Test data	Casing Wear %, Mohr 14,42
1 layer, loss (g) 0,279	CW Factor 2,89
Mohr Wear Tests	Friction factor 0,39
TJ wear in O/H	Est. revs. To 87% nom. Wall
Mohr (in loss): 0,0497	Infinite



Castolin OTW 10SS

Description

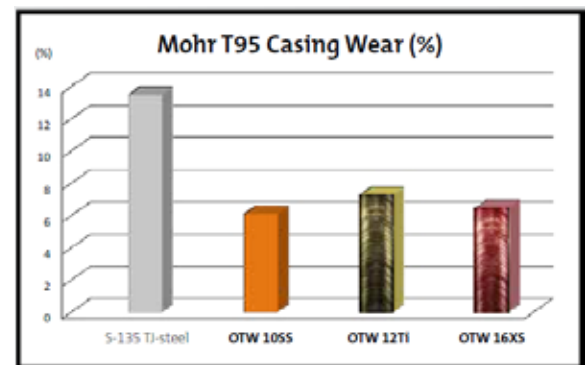
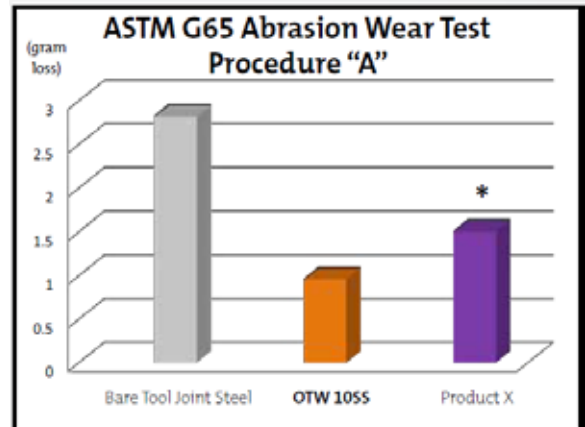
Exclusive, gas shielded, metal cored alloy Hardbanding wire designed specifically for Sour Service Drill Pipe tool joints.

- Crack-free, smooth surface with low friction properties.
- Ideal for multipurpose hardbanding applications, including heavy weight drill pipe tool joints and drill collars.

OTW 10SS is formulated to produce a unique hard tool steel microstructure with numerous, very fine, ultra-hard hard phases dispersed in a tough, tempered martensitic matrix. This ensures immunity to cracking and excellent all-round resistance to combined wear by gouging abrasion, erosion, heavy impact and pressure in down-hole, drilling service conditions..

Technical data

Hardness: 53-59 HRC



Castolin OTW 16XS

Description

Proprietary, gas shielded, flux cored alloy hardbanding wire. The high quality protective alloy weld deposit designed to give a crack-free, smooth surface with very low friction properties.

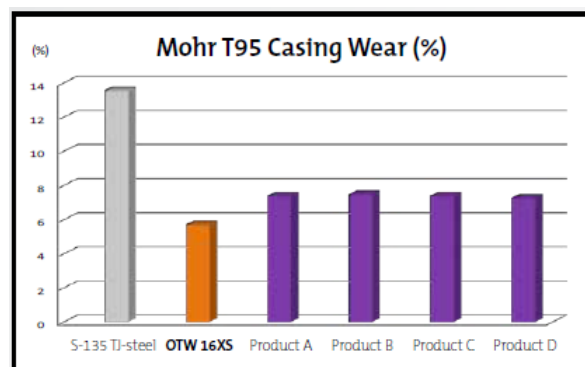
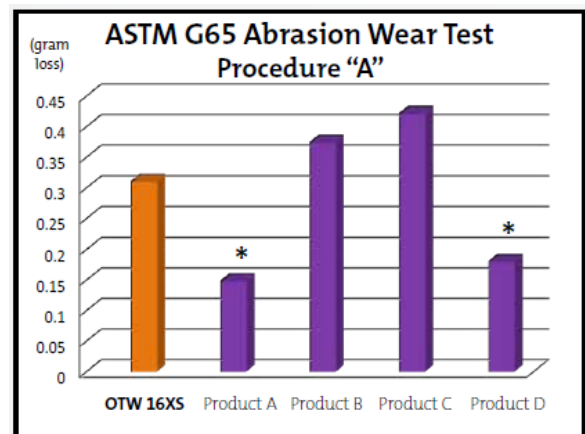
The alloy demonstrates excellent low casing wear properties and also one of the best wear resistant materials

in an open hole and cased hole environment. This alloy will be cost effectively reapplied over itself to refurbish worn drill pipes after drilling operations.

OTW 16XS has weighted mix of multi-carbides (Cr, Ti, Mo, and W) imparts both a uniform & tempered martensitic micro-structure with optimized deposit through-thickness properties for maximum wear resistance.

Technical data

Hardness: 56-60 HRC



Castolin OTW 24NM

Description

Castolin OTW 24NM is a, hard, stainless steel alloy, specially designed to protect non-mag drill collars, drill pipes and related components on the bottom hole assembly in drilling industry.

The wear life as welded will show about 3,5-5 times longer than the non-mag base material alloy, and for increased wear life in open hole environments may be dramatically increased by injection of tungsten carbide pellets into the alloy.

The alloy is formulated to be tough, corrosion resistant with low magnetic permeability, less than 1.01. This alloy has been tested & approved according to industry standards.

In field gradient measurements the results is lower than 0.03Ut as welded.

Applications

Specifically developed for new or worn non-magnetic hardbanding of wear bands applied on Non-magnetic drill collars and related drilling components. Designed to be applied on chromium-manganese, austenitic stainless steels and nitrogen bearing austenitic stainless steels. Commonly known base materials such as; P530, AG17, 1515LC NMS-100 and others.

Technical data

Hardness, as welded: 40-44 HRC

Work hardened: 46-48 HRC



Castolin OTW 43ST / 43ST-0A

Description

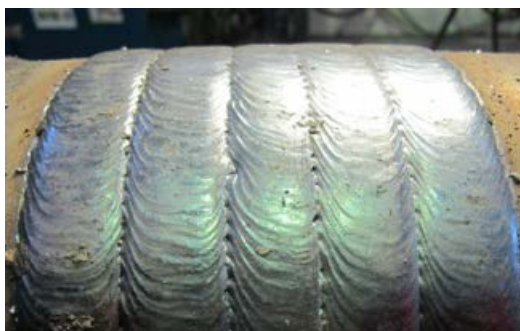
Proprietary alloy wire specifically developed for rebuilding of drilling pipe tool-joints. The alloy has been designed to completely replace the any missing materials on a tool joint surface, especially when the properties must be maintained equal to tool joint material, AISI 4137, heated and quenched to a hardness of about 30 – 36 HRC

Technical data

Hardness: 30-36 HRC

Applications

The OTW 43St is specifically developed for rebuilding worn Hardbanding drill pipe tool-joints". Where the target is replacing the missing surface with the same mechanical properties of new tool-joint materials.



Stronger, with Castolin Eutectic



Your resource for protection, repair and joining solutions

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