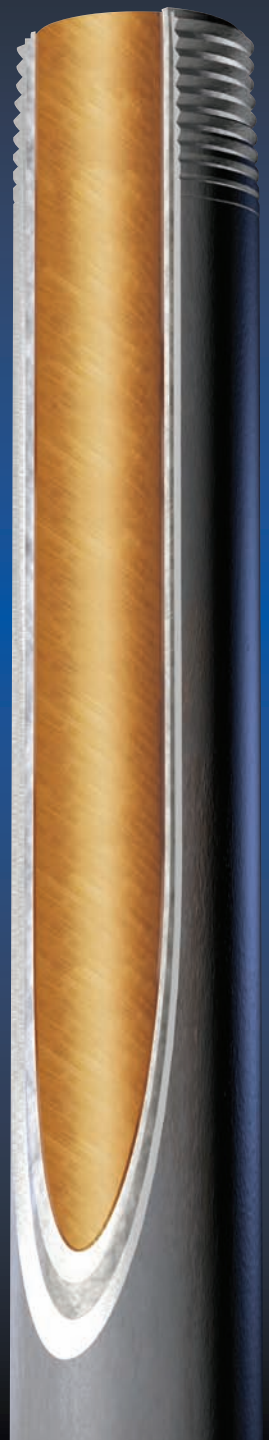
DUOLINE® TECHNOLOGIES

Duoline® lining systems extend the life of your tubulars



The Truth About Why You Need DUOLINE®

DUOLINE® Technologies provides you ***DUOLINE®***: a premium internal corrosion resistant lining system for oilfield steel tubing and line pipe.

This unique insert liner process secures a corrosion resistant material fabricated from filament wound composites or extruded thermoplastics inside the steel pipe. The benefit? Isolation of corrosive oilfield fluids and gases from the steel.

The cost of replacing failed downhole production tubing or subsea flowlines is extremely high. ***DUOLINE®*** products offer an unsurpassed record for prevention of corrosion in very demanding conditions. The proven technology of ***DUOLINE®*** offers cost-effective superior performance compared to the less durable option of spray-on coatings.

High performance ***DUOLINE®*** systems are now used worldwide where previously only high cost corrosion resistant alloys, (CRAs), were used in high temperature or sour downhole applications.

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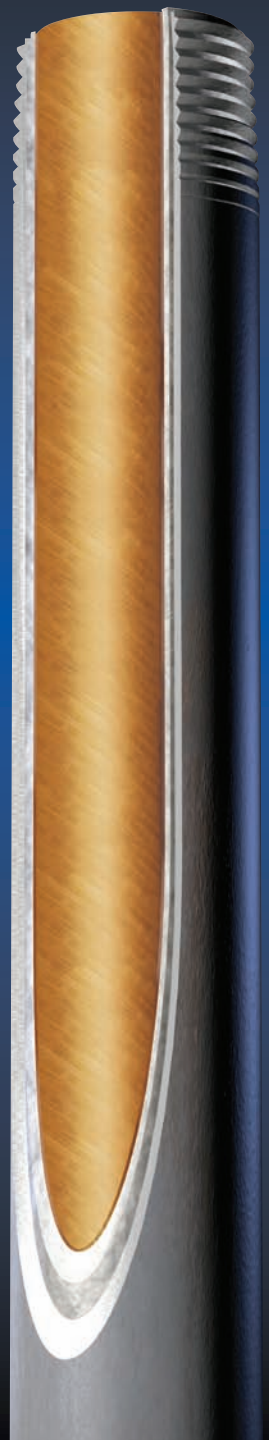

DUOLINE®

vs.

CRA (Corrosion-Resistant Alloy) material

Duoline® Features	Duoline® Benefits	Disadvantages of CRA
- Inherently holiday-free (steel surfaces isolated)	- No steel surfaces exposed	- CRA based material is fully and constantly exposed to the well-bore fluids and gasses at all times
- ***DUOLINE®*** has a higher C-Factor (the higher the C-Factor the smoother)	- Improves down-hole drift-ability - Improves through-flow - Reduces turbulence	- Higher turbulence is typically associated with non-Duoline pipe - C-Factor of steel pipe 120-80
- ***DUOLINE®*** interfaces well with CRA accessories - Incorporates connection designs specifically for this purpose	- Enhances smooth flow while reducing turbulence due to lining systems being centralized to connections	- Non-Duolined CRA tubulars are typically manufactured with a toleranced eccentricity which can create turbulence
- ***DUOLINE®*** is composed of a non-corrosive material - ***DUOLINE®*** prevents the re-charge of trapped corrosive molecules due to the "dead cell effect"	- Unaffected by constantly replenished sources of Hydrogen Sulphide, Carbon Dioxide and Oxygen - Minimizes the affects of standard corrosive environments	- Corrosive fluids and these gasses at elevated temperatures make alloy materials very susceptible to corrosive attack
- ***DUOLINE®*** will increase lifetime of carbon steel pipe	- Carbon steel with ***DUOLINE®*** installed has a much lower propensity for galling during running operations - There are much less onerous handling issues and requirements associated with the carbon steel host pipe	- Chrome and CRA have high inherent handling costs - Chrome and CRA have higher inherent risk of handling and galling damage
- ***DUOLINE®*** protects base tubulars from corrosive attack in High O_2, H_2S and CO_2 environments	-***DUOLINE®*** product can tolerate high concentrations of H_2S	- Depending on alloy contents, CRA materials have limited ability to tolerate high corrosive gasses, especially high levels of H_2S or CO_2

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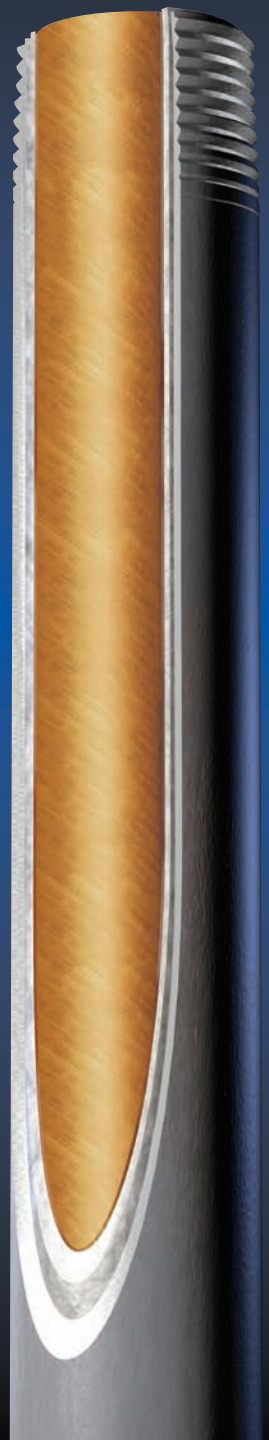

DUOLINE® vs. Internal Plastic Coating (IPC)

Duoline® Features	Duoline® Benefits	Disadvantages of IPC
- Inherently holiday-free (steel surfaces isolated)	- No steel surfaces exposed	- IPC coatings offer inadequate coating of bare carbon steel ID due to roughness of the surface - IPC chips off exposing surface, a target for corrosive energy in well bore fluid
- Durable 50-95mil thickness	- Highly resistant to wireline damage and coiled tubing intervention [1]	- IPC is highly susceptible to damage from wireline tools and coil tubing operations
- Flexible-bending modulus exceeds that of steel host pipe	- Capabilities to withstand pressure bending and handling are limited only by steel tubing [2]	- IPC has tendency to flake off in areas of high stress resulting in a holiday surface
- High hoop strength modulus	- Liner not susceptible to collapse upon depressurization of tubing string in gas service	- IPC will flake off upon penetration by and subsequent expansion of trapped gas molecules. Similar effect is observed in less rigid plastic liners.
- Bonded by a mechanical cohesion to internal surface of steel tubular.	- Steel is the only load-bearing member of lined tubular assembly	- IPC has tendency to flake off in areas of high stress and forms holiday surface
- Resistant to erosion in fluid production or injection	- High-velocity fluid will not degrade liner's capabilities to contain fluid/gas [3]	- IPC products typically crack and disbond in identical high-velocity environment
- Long product life due to durability of GRE products	- High Net Present Value of asset over extended period vs. short-lived coated products. Documented installations in service for 25+ years.	- Advertised product life of IPC products less than ten years
- GRE tubulars exhibit consistent concentric make up	- Concentric make up in the connection provides fewer drift issues	- Eccentric make up in the connection provides exposed coating edges which can be easily damaged by tool passage
- Resistant to damage from gas penetration (H_2S & CO_2, e.g.)	- Gas molecules trapped between liner and steel surfaces have no corrosive effect - Reaction not subject to O_2 recharge due to dead cell effect	- IPC easily penetrated by gas - Susceptible to recharge of oxygen in acid-forming reaction - Corrosive reaction repeats with recharge of O_2 as fluids circulate
- Highly resistant to low-pH environments	- Multiple applications in Acid-Gas disposal facilities - Stimulation by injection of 15% and 28% Hydrochloric Acid not unusual	- IPC products extremely unstable in low pH environments

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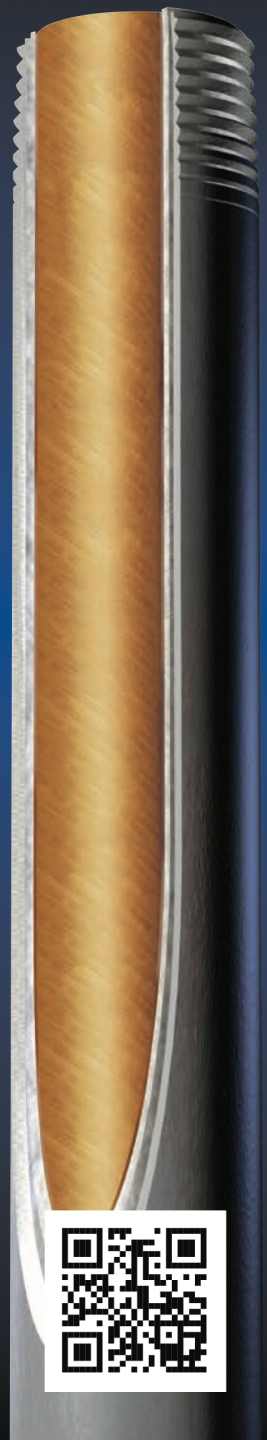

DUOLINE®
vs. Other Liners

Duoline® Features	Duoline® Benefits	Disadvantages of Other Liners
- ***DUOLINE®*** liners have a high hoop strength	- ***DUOLINE®*** is not susceptible to decompression controlled rates in gas (or partial gas) installations	- Some liners are susceptible to collapse in gas service
- ***DUOLINE®*** used in installations for "standard" API or higher service "Premium Gas-Tight" connections	- ***DUOLINE®*** provides user flexibility in selecting both the correct liner and connections	- Poly (PVC, HDPE) linings only used in low end service conditions - There are currently limited opportunities to modify "Premium Connections" which can be used in high end applications with these types of liners.
- ***DUOLINE®*** can be installed into "Non-Modified" Premium Gas-Tight connections utilizing the new DL-Ring system	- Un-modified connections are able to utilize the full design attributes of the Premium Gas-Tight Connection - ***DUOLINE®*** provides user the flexibility of using existing pipe stock for internal lining	- No other liner system, in severe loading conditions, can outperform ***DUOLINE®***
- ***DUOLINE®*** represents a less intrusive installation into welded flow-lines and pipe-lines	- Enhanced through flow capacity	- Less fluid/gas will pass through those reducing efficiency and increasing cost - These linings also have their inherent application issues, as noted above
Field Service Friendly	Easily reusable	Can require factory rework
Requires only standard couplings	Save time and money not having a special high grade steel	Other liners require coupling protection
Diversity of connections - API, VAM®, BTS, BTC, NSTC, NSCC, Hydrill, Hunting,VAGT	Whatever the application, good chance we can make the connection.	Lack of experience in premium connections.

Documentation References:

[1] Major North Sea operator has qualified ***DUOLINE®*** over various coatings by running wireline tools through lined & coated tubing strings in a deviated test well

[2] Stress Engineering Services, Houston Texas, Combined Loading test on ***DUOLINE®*** joint, 1995

[3] LaQue Corrosion Services, High Velocity Seawater Testing, performed for StatOil, 1995

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