Comparison of the properties of ZERON 100HS and 6% Mo Slicklines.

There are a number of proprietary 6%Mo Super Austenitic alloys that have been used for wireline operations by the Oil & Gas industry that comply with UNS S31254 or UNS N08926. Over the last few years a number of companies have changed from the 6% Mo grades to ZERON 100HS, a Super Duplex wireline, for a number of different reasons. This report compares the properties of the two grades of stainless steel to highlight the advantages of the super duplex wire and so explain the reasons why some companies have changed to the ZERON 100HS wireline. The nominal composition of the alloys is shown below.

ALLOY	Nominal Composition (wt%)							PRENW*
	Fe	Cr	Ni	Mo	N	Cu	W	
UNS S31254	**Bal**	**20**	**18**	**6**	**0.2**	**0.7**	**-**	**43**
UNS N08926	**Bal**	**20**	**25**	**6**	**0.2**	**0.8**	**-**	**44**
ZERON 100HS	**Bal**	**25**	**7**	**3.5**	**0.25**	**0.7**	**0.7**	**42**

Bal = balance *PRENW = %Cr + 3.3 (%Mo + 0.5 x %W) + 16 x %N*

The Pitting Resistance Equivalent Number or PRENW is an empirical relationship that has been shown to be related to the resistance to localised corrosion in chloride containing solutions. The higher the PRENW the greater is the resistance to localised corrosion attack. The 6% Mo alloys have a typical PRENW of 43 whilst that of ZERON is typically 42. This does not mean that the 6% Mo alloys are more resistant to corrosion as it has also been demonstrated by a number of workers that the resistance also depends on microstructure as well as the composition. It has been shown that a higher PRENW is required in an austenitic alloy to get the same corrosion resistance as a duplex alloy, for instance in seawater you need a minimum PRENW of 40 for a duplex alloy whereas a PRENW of 43 minimum is required for an austenitic alloy.

The main advantages of a Super Duplex wire over a Super Austenitic wire are:

COST

Because the 6% Mo alloys contain 18% or 25% Nickel compared to the 7% in ZERON, and 6% Molybdenum compared to 3.5% and as Nickel and Molybdenum are expensive alloying elements, ZERON100HS is commercially very attractive in capital cost of the wire, especially in times of alloy surcharges.

BREAKING LOADs

The duplex wires have a higher inherent strength as the structure is 50/50 austenite/ferrite, and therefore higher breaking loads for a given ductility can be achieved. ZERON 100HS has the highest breaking loads for a corrosion resistant wireline and this again makes it more attractive. See the table below of breaking load for common 6Mo alloys compared to ZERON 100HS.

Alloy	Breaking Load lbf				
	0.092”	0.108”	0.125”	0.140”	0.160”
ZERON 100HS	1920	2500	3300	4050	5150
Supa 75	1550	2170	2900	3400	4230
GD31 Mo	1550	2170	2900	3400	4400
25-6 Mo	1500	2050	2650	3250	4250

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Sanicro 26	1530	2105	2820	3541	4620

The table below shows that the ZERON 100HS wire with its significantly higher payload for a given diameter allows additional capacity and extended use of a wire, reducing the high cost in service of equipment changes and the consequent downtime.

	0.140" 6Mo	0.125" Z100HS
Breaking Load lbf	3550	3300
Weight lbs	1312	1046
Payload max lbf	2239	2255
Additional capacity %	-1	
Extra Weight %	25	

CORROSION

In sour service downhole with HTHP, when chlorides are present, the corrosion performance of ZERON 100HS and 6% Mo alloys can be similar. The 6% Mo alloys are generally better at temperatures below 120°C whilst ZERON 100HS is better at temperatures above 120°C.
NACE MR0175/ISO 15156 is the accepted guideline for the use of Alloys downhole in sour conditions and both UNS S32154 and UNS N08926 are listed in the standard. Both of these alloys comply with material type 3b which is listed to 15psi (1 Bar) H2S at a maximum 171°C and 5000 chlorides, but at a hardness limit of 35HRC. Most conditions in sour applications are beyond these limits and the hardness of the wire is in excess of 35HRC. However 6Mo has extensive service experience as a slickline in sour applications.

ZERON 100HS has been tested to 12 psi (0.8 bar) H2S at low chloride levels, (1,000ppm) and 7 psi (0.5 bar) H2S at high chloride levels (150,000ppm) on actual slickline so at representative hardness levels. ZERON 100HS has also been tested at high CO2 levels to 280°C.

SERVICE PERFORMANCE

One operator in the Far East who has been using ZERON 100HS for two years advises that he gets a much longer life from a ZERON 100HS wire as compared to the 6% Mo grade by a factor of 3. It is thought that this is because the wire is not cold worked to such a high level that there is still some inherent ductility and so can stand a certain amount of abuse in the field.

SUMMARY

Overall the advantages of ZERON 100HS when compared to the 6% Mo Grades are:

- ✓ Lower Capital Cost
- ✓ Higher breaking loads leading to improved working envelope and reduced cost of downtime.
- ✓ Better service life, up to 3 times the life.
- ✓ The overall cost of using ZERON 100HS is therefore very attractive.

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