



Anaco Stainless

Experts in stainless steel for engineering and construction

Lean Duplex Stainless Steels

The price of stainless steel, like all steel, is driven by commodity prices for scrap and new metal supply. Sadly, because most corrosion resistant alloys of stainless steel contain significant quantities of base metals which are expensive to extract and fluctuate in price in the world markets (driven as much by speculation as demand), it is very much more expensive than simpler carbon steels. A 30% increase in carbon steel may be an inconvenience but a 30% increase in the price of stainless can seem terrifying - particularly if it is looked at in isolation and not as part of a whole project cost.

The cost of stainless, its volatility and, thus, inability to fix for long periods of time, has been a significant inhibitor to its wholesale adoption in the very price sensitive world of civil engineering. It is therefore exciting to learn of a new generation of stainless steel alloys which help to address these concerns.

This is very good news for a price sensitive industry like civil engineering where lead times from project inception and to final completion tend to be long.

We have already discussed the superior characteristics of the Duplex alloys in previous articles. They are the most corrosion resistant of the common stainless alloys and have excellent mechanical strength. They tend to be more commonly viewed as material used for high precision engineered aeronautical applications rather than concrete. However, their qualities allow for good and affordable durability.

Now a new generation of duplex alloys has been introduced which is referred to by the industry as the 'Lean Duplexes'. This sub-group of the the duplex family has much less Nickel and Molybdenum. These elements, in particular, have the greatest influence over the price of these robustly corrosion resistant stainless steels.

Outokumpu Stainless, in particular, has now introduced the first which has been incorporated into the revised British Standard BS6744. Its trade registered name is LDX2101[®] and it is a patented product.

The following table illustrates how it compares in terms of chemistry with the common austenitics and duplex steel discussed above taking only the principal key elements into consideration:

Steel Designation No.	Cr Approx. %	Ni Approx. %	Mo Approx. %	Alloy Type
EN1.4301	18	8	0	Austenitic -304
EN1.4436	17	11	2.5	Austenitic -316
EN1.4462	22	5	3	Duplex
LDX2101 [®]	21.5	1.5	0.3	New Lean Duplex

Publications to date are only prepared to state that its corrosion resistance is equivalent to or better than Grade 304 stainless steel. However, given that it has a theoretical PREN of over 27, it is highly likely that, eventually, it will be accepted as being much closer to if not on a par with the 316 austenitics when considered for application as a reinforcement in concrete. Mechanically, it is not as good as its more robust full Duplex but still is comparable to or better than the common austenitics.

LDX2101[®] will be much less price sensitive than the existing robust stainless steels because of its low Ni and Mo content. In practice, this will mean that prices will be fixable at the outset of the tender period for a project in parallel with what is common practice when using high tensile carbon steel. Clearly, if there is a significant supply crisis, as has been experienced in the steel reinforcement business as a whole in the over the last year or so, the rules change for all supply. But the price predictability for the new alloy will be comparable to carbon steel and a substantial improvement over the existing alloys. We ignore here the ferritic stainless steels which do not have the same level of corrosion resistance.

Like any new product, it will take time for this new sub-group of alloys to gain universal acceptance.

Currently, Grade 304 (ENi.4301), an austenitic, is most frequently specified. But as the advantages in terms of comparable corrosion resistance; superior mechanical

properties and greater price stability become more widely understood, we are sure that 304 will gradually disappear from regular usage.

There are other mills which are creating similar alloys to Outokumpu's alloy and will carry the Lean Duplex generic all label.

In addition, a further Lean Duplex with a higher Nickel content EN1.4362 has been introduced into the British Standard BS6744. This alloy is being promoted as the replacement for the white elephant of the stainless alloys in the British Standard BS6744, namely, BS EN1.4436 - an alloy specified by committee for committable reasons.

It is our view that this alloy has rather limited application. The lower Nickel alloys like Outokumpu's EN1.4162 will be best complimented by the full duplex EN1.4462.

Again, we believe that the two alloys and their close variants meet nearly all applications other than extremes of temperature and where magnetic permeability is a serious consideration.

Indeed, we would hope that any sane engineer will begin to accept that the only specification issue worth real consideration are (aside from the two exceptions to the rule: temperature extremes and magnetic sensitivity) to what extent the reinforcement is surrounded by concrete (the cover) and the relative aggression of the environment within which the reinforced concrete structure sits.

So long as concrete cover exists, the Lean Duplex alloys will be specified in temperate environments. Where there is little or no cover and the environment is aggressive the full duplex will be specified.

As we mention in Designing with Stainless Steel, greater confusion is likely to arise as and when the European Standard is ushered by too many self-interested mills into existence. The rambling mess currently under discussion can be best likened to the workings of the European Community.

At the time of writing, there are a plethora of alloys being insisted upon by various interested European mills with no interest in how an engineer will cope with making a choice of which alloy to use - aside of course from insisting that such and such mill's stainless is the best for the job. Alas for responsible reason. Due to the relative inadequacies of some of the mills production routes, the vast choice of alloys will be accompanied by a happy medley of different tensile strengths. A predictable assorted nightmare of choice will follow - alloys specified by committee for committable reasons.

As currently proposed, the European Standard will serve to confuse and slow down the implementation and development of stainless steel as the still only real proven reinforcement capable of providing long-term support to concrete in aggressive environments.

We conclude by encouraging engineers, specifiers and clients to cut through the confusion and come to appreciate the simplicity offered by adopting a two alloy solution for all applications other than the occasional specialised exceptions mentioned above where the ferrite -austenite structure of the duplex alloys reduces their effectiveness.

We are confident that the low Nickel Lean Duplex alloys offered currently by Outokumpu and under licence by Valbruna and the shortly to be available close variants and the full duplex alloy (EN1.4462) are the only one necessary to make long-term reinforced concrete structures.