SAFETY, ESG AND LOW RE

J2 RESOURCES

Distribution Redefined

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SAFETY, ESG AND LOW RE

Simply put carbon steel can be made from scrap or from Iron ore. Iron ore produces very low residual element carbon steel. Scrap on the other hand is typically higher in residual elements.

> ***ASTM A941 (2023) defines residual element in steel as "a specified or unspecified element, not intentionally added, originating in the raw materials, refractories, or surrounding atmospheres used in steel making."***

Given concerns for manmade climate change, many companies are shutting down blast furnaces – Basic Oxygen Furnace combinations (BF - BOF) utilizes iron ore to produce steel, as the BF-BOF steel making process produces approximately 8.5 times as much CO2 per ton of steel when compared to an Electric Arc Furnace (EAF) which relies on scrap as raw material.

American and European steel producers have been trending towards lower emissions and, therefore, Low RE carbon steel is progressively harder to source from traditional refinery-approved manufacturers. Some steel makers can achieve low residual elements with careful selection of scrap. However, multiple heats are usually required to cleanse the refractory bricks. These are typically called wash heats. Consequently, most steel mills choose to focus on throughput rather than the small volume Low RE market.

Historically, the larger the tonnage in a product, the more likely the source material came from traditional iron ore steel making. For instance, line pipe and Oil Country Tubular Goods (OCTG) are relatively large tonnage markets. Buttweld pipe fittings and nipples are made from line pipe, so they fall into the line-pipe classification. Forged products like flanges, forged steel, olets, and forged valves are made from round corner square billet, which is often produced using scrap in the EAF process.

Years ago, the refining industry recognized the difficulty in sourcing Low RE flanges and forged products in general. Going back to 2012, the distribution industry developed several approaches to resolving availability and cost issues associated with Low RE carbon steel for Hydrofluoric Acid Alkylation (HF Alky) applications.

Below we examine market dynamics today by category:

LOW RE SEAMLESS PIPE

Until recently, most pipe from Vallourec Germany, Vallourec Sumitomo Brazil, and United States Steel utilized blast furnaces and BOFs for their raw material.

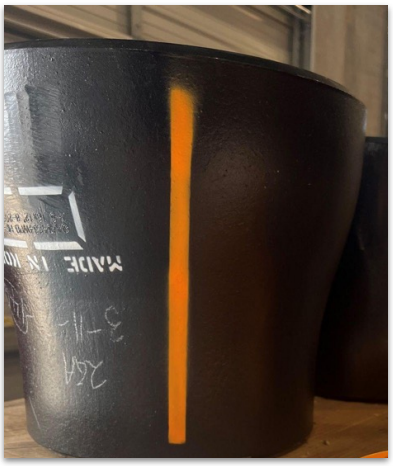
Consequently, much of their production complied with the chemistry requirements of A333 S2 and A106 S9 without being specifically ordered to the supplemental specification. Currently, U.S. Steel has idled their pipe production. Vallourec has stopped producing pipe in Germany. Vallourec and Sumitomo have separated in Brazil, and the new entity idled two blast furnaces and now relies on raw material from an EAF. Therefore, just checking the chemistry on the Material Test Reports (MTRs) and performing a Positive Material Identification (PMI) is no longer a viable supply chain option.

Alternatively, several mills that utilize EAF raw material production offer products with minimum melt quantities. Minimums range from 100 tons to 500 tons. Additionally, each size and wall thickness of pipe has a minimum quantity—usually 10 tons or 20 tons. An example would be to buy 20 feet of 1" sch 160 and the mill minimum would be 7500 feet as part of a $500,000 bill of material; however, as the reader is likely aware, 7500 feet will last a supplier several years. Hence, Low RE pipe sells at a significant premium to normal pipe. As such, if material can be outsourced, many distributors choose to do so.

In terms of PMI and traceability, pipe mills often utilize one billet diameter for a broad size range by modifying the length of the round billet. Accordingly, ½" through 6" diameter pipe can be made from one melt. However, this is the case only if pipe is ordered specifically to the supplemental specifications; it does not apply when searching MTRs and performing a PMI verification.

Pipe is available in both A106 S9 and A333 GR6 S2 from the mills.

LOW RE BUTTWELD FITTINGS



The simplicity of pipe melts and heats does not exist in buttweld fittings. Quantities are small, tonnage is minimal, and sizes and schedules vary widely. A 4" elbow is not made from the same pipe as a 4" tee or reducer. Fittings are the most difficult in terms traceability and PMI verification. First, fittings manufacturers do not order pipe to meet the A106 S9 or A333 S2, they check MTRs for compliance with S78 chemistry and are not required to report a product analysis unless the supplemental requirement of A960 S50 is a condition of the order.

Hunt and peck with PMI verification is common with buttweld fittings. Before the 2017 edition of Shell's Material and Equipment Standards and Code (MESC) specifications, buttweld fittings commonly had a carbon content of .18 or above. The MESC standard puts a .15 max carbon for low chrome WP11 fittings. As this requirement was mistakenly applied to WPB carbon fittings, availability has been reduced. Domestic manufacturers, that historically utilized Awaji for roughs, no longer meet the chemistry required in S78. In addition, several owners require normalization of fittings so standard production fittings will not qualify. Going forward, scouring MTRs and using PMI to verify chemistry will become more time-consuming and difficult.

There are a couple approved suppliers that can certify to S78 and will normalize WPB fittings. This is not uncommon in STD and XH wall fittings 12" and down. At least two distributors order A960 S78 normalized fittings from Korea. When extending the size range to 24" with wall thicknesses including sch 40, sch 80, sch 120, sch 160, and sch XX certified to A960 S78 and normalized, stock options are extremely limited. If you add in the product analysis, availability may be as few as one supplier.

Why not WPL6?

Manufacturers are unwilling to certify A420 WPL6 S78. Generally, manufacturers prefer lower carbon content in WPL6 fittings, typically in the .12 range. Since brittle fracture issues became a widespread industry concern, fittings manufacturers tend to focus on very high manganese to carbon ratios. As such, there is concern for the higher carbon content S78 requires and the consequences with respect to notch toughness. Residual elements are often low in WPL6 fittings, and the hunt and peck PMI approach will work if carbon below .18% is acceptable. For low temp applications, certain owners reference API 751 and accept carbon below .18% if copper, nickel, and chrome are cumulatively below .15%.

Due to the number of heat numbers present in the buttweld fitting size and wall thickness range, more PMI failures are likely in this category.

LOW RE FLANGES

What used to be the hardest category to find is now easy to locate. Unlike fittings that require many sizes of pipe to complete the range, 24" and down flanges basically require six sizes of round corner square billet for forging the entire range. Therefore, traceability and PMI reliability are easy to maintain. For flanges using billet from iron ore, lower residual elements are easy to achieve. One distributor limits copper, nickel, and chrome to .15%, cumulatively, via purchase product specification. When billet comes from an EAF, the tighter standard for residual elements cannot be maintained. Low RE A105 flanges are commonly normalized and some will pass impact testing at -20F.

A350 LF2/A961 S62 Low RE flanges are available from two manufacturers. Only one can meet LF2 and .15% copper, nickel, and chrome, cumulatively.

When imported A105 flanges not produced specifically to A961 S62 are utilized, it is common to see wide variations between the ladle and product analysis. They are produced to be lowest cost and, therefore, extra caution should be taken for flanges not marked HFN, and for product where MTRS do not include a product and ladle analysis. HFN flanges generally utilize much higher quality billet.

LOW RE FORGED STEEL FITTINGS

Like flanges, a full range of ½" – 2", 3m and 6m, socket weld and threaded forged fittings can be made from six heats out of Korea. This works well for large volume inventory orders and minimizes issues with traceability and PMI.

On the other hand, the majority of forged steel fittings and olets are procured on a job-by-job basis as SKUs (stock keeping units) are plentiful and volume is small. Forging companies, as well as machine shops, fill this niche with lead times from a few days to eight weeks. Due to the spot nature of the business, traceability can be compromised, and PMI can be an issue.

LOW RE VALVES

Many parties are aware of the work Manufacturers Standardization Society (MSS) is doing regarding HF valves. Primary areas being addressed by MSS are inclusions, porosity, and shrinkage in cast valves and Monel plug valves.

With forged carbon valves, the same raw material billet challenges exist as in the world of other A105 products. These include large heat and melt minimums and small volume production. Obviously, optimized supply chain solutions help mitigate the tonnage impact. For instance, the same billet can be used for A105 products in multiple categories.

The challenge for forged valves is mainly in the larger size, flanged (1-1/2 and above), where the billet size is specific for each forging die. When it comes to billet sizes above 200 mm, the available supply base is limited to a few steel mills. Tonnage requirements to get the right size is a major factor. In our case, we had to buy 5 ton to make less than 20 valves with a total weight of 500 kg...

- Vogt Testimonial

Other initiatives include welded bonnets for forged A105N valves, expansion of the forged size range up to 4", and a forged Monel deux valve up to 4" diameter. All these new options will soon be available from distributor inventory.

LOOKING AHEAD

Direct Reduction of Iron (DRI) uses hydrogen to remove oxygen from iron ore. As such, CO2 emissions are eliminated. This is nicknamed “green steel.” As it uses iron ore as raw material, it will be low in residual elements. You can learn more about this on the Arcelor Mittal website.

As API 751 requires PMI testing, the issue going forward is to ensure that material that makes it to the installation site passes PMI. This priority is facilitated through a small number of distributor procedures:

1. Develop detailed Purchase Product Specifications based on available raw material.
2. Develop detailed First Article Qualification Protocols to qualify consistent and reliable manufacturers.
3. Require product and ladle analysis on MTR.
4. Align supply chain with distributors that stock large volumes of HFN certified material and have reliable supply chains.
5. Do not buy material that meets the chemistry on the surface but is not certified HFN.
6. Avoid buyouts of non-HF certified products.

Low RE material is widely available at reasonable price premiums in most product categories. In the near-term, pipe in the 8” – 16” size range could be difficult to replenish. New steel making technologies may alleviate this issue over time.

The mill price for Monel is slightly more than ten times the price of Low RE carbon pipe. Monel is available from multiple master distributors, which source from two primary mills--Special Metals and Salzgitter Mannesmann. Mill minimums are as little as one ton per size. Wall thickness of 1” sch 160 alloy 400 may range in price between $150-$200 whereas 1” sch 160 Low RE carbon pipe will range from $60-$140, depending on delivery requirements. Similarly, 3” alloy 400 will range from $275-$350, while 3” std A106 S9 will range from $55-$ 120.

In the above examples, the mill minimum impact on carbon pricing is evident. Generally, Low RE pipe will be 40% or less of the cost of alloy 400 pipe. However, in short lead time situations, Low RE pipe and other products demand a significant price premium as scarcity can be an issue. This issue becomes significant in larger diameter heavier wall pipe and associated products where alloy 400 is not available. Many distributors are forced to rely on machine shops at very high prices for these ultra niche items.

SUMMARY

Given the dangers associated with hydrofluoric acid, safety is a driving concern of API 751. Many myths exist surrounding products suitable and available for HF Alky applications. Low RE carbon steel products are available at significant cost savings to alloy 400 materials. Alloy 400 is historically serviced by master distributors and is more available as an outsourced item. Low RE material is not a focus in traditional master distribution of carbon and stainless material. As such, outsourcing Low RE products occurs between competitors and pricing is very opportunistic.

This adversarial supply chain lends itself toward old habits of searching through MTRs (hunting and pecking) and hoping PMI verifies compliance with chemical requirements. This tolerance for products not manufactured in full compliance with supplemental requirements unnecessarily introduces operational risk. As the National Association of Corrosion Engineers (NACE) may require normalization again, in the near future unplanned needs will become more expensive and difficult to fill according to supplemental specifications.

J2 has a rigorous purchase product specification, which exceeds ASTM requirements in most product categories, and is coupled with an efficient supply chain for material manufactured to all the supplemental specifications applicable to Low RE products. J2's diversity of sizes and wall thicknesses is unrivaled on a global basis. J2's inventory is further enhanced by incoming valve solutions, including welded bonnet forged valves, Monel forged deux valves, and 3" and 4" forged carbon valves manufactured to HF specifications.

Given this scale of commitment to a niche market, no other supplier can provide better value to the operator. Material that is competitively priced, readily available, and fully meets specifications without fail saves your company unnecessary labor costs waiting for the right material to arrive. Lower costs and less down time in turnarounds yield greater utilization while simultaneously mitigating risk.

In addition to (i) unique purchase product specifications, (ii) first article qualification testing on a repetitive basis, and (iii) independent third-party testing utilizing Leco analyzers for carbon content, J2 receives color coded flanges and fittings to eliminate mistakes during fabrication. Without a doubt, working with J2 is your safest option for Low RE products.

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