



# 11 Metal Sourcing Tips for LNG Tanks

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## Metal Sourcing Tips for LNG Tanks

The United States is currently the world's top producer of natural gas. One of the fastest growing areas of this energy source is liquefied natural gas (LNG). Legislation is currently being examined that will expedite the approval of LNG exports from the US, which have long been banned by legislation written when gas was a scarce commodity. New LNG plants are being built in a number of different locations in America and beyond. As the market for this product continues to grow, so does the need to produce safe, reliable tanks to contain it. To remain a liquid, LNG needs to remain at extremely cold temperatures, requiring the construction of high quality, well-insulated tanks.

These tanks have been traditionally made from nickel steel alloys with percentages of nickel averaging around 9%. Using nickel at this level is a time-honored method that ensures maximum safety. However, the use of large amounts of nickel in these alloys can be very expensive. Is there a more economical method? Recent research has indicated that lower levels of nickel can be used in the construction of these tanks. We will examine the use of both low-nickel and high-nickel steel alloys in the construction of LNG storage tanks. At either level, this material is essential for creating safe, high-quality storage vessels.

## Nickel Alloys: an Effective Solution

In liquid form, natural gas is odorless, colorless, non-corrosive, and non-toxic. The important factor for it to maintain these benign qualities is that it stays in liquid form. LNG cannot burn, but if it becomes vaporized, it poses fire, explosion, and thermal radiation hazards. To keep this from happening, storage tanks are designed with low aspect ratios, highly efficient insulation, and nickel steel alloy inner tanks.

Nickel steel alloys meet all the necessary requirements for keeping natural gas at liquefaction temperatures (-163°C). Steel with nickel levels from 6 to 9% is able to remain ductile and crack resistant when containing materials of extremely low temperatures, including LNG. This temperature resistance is the result of the fine-grained structure of nickel-ferrite. Heat treatment makes this temperature resistance even more effective. These alloys are also very strong. Steel nickel alloys can be created with reduced wall thickness, creating cost-efficient solutions for constructing LNG storage and transportation tanks.

## Superior Weldability

It is also essential for LNG tanks to be constructed from materials that have excellent weldability. Nickel alloy levels from 6 to 9% are well known for their weldable traits. Welding techniques for these alloys typically include shielded metal arc welding (SMAW), submerged arc welding (SAW), and occasionally gas metal arc welding (GMAW). Using nickel based consumables guarantee metal ductility for welding while reducing the possibilities for hydrogen-induced cracking.

Another important issue related to welding is temperature resistance. Welded joints need to maintain the highest levels of toughness and resilience. Otherwise, brittle fracture could result, allowing for the possible vaporization of the LNG. Fortunately, a great deal of research has been done to establish the safest materials for welding LNG tanks. Nickel alloys have withstood temperatures of  $-196^{\circ}\text{C}$  without losing toughness. This has been confirmed in studies covering tanks in locations worldwide for a period spanning over a decade.



## Low Nickel vs. High Nickel Steel

The overwhelming concern in the amount of nickel used in creating tanks is safety. Nickel levels in the alloys must be high enough to ensure that the metal remains rupture-proof. Fortunately, in addition to the research done on welding, a broad range of testing and experimentation has been done on using lower nickel alloys. Keeping nickel levels at 6 to 7.5% has been found to be a viable alternative for more commonly-used 9% steel-nickel alloys. Companies in the LNG industry can take advantage of these findings to create more cost- and resource-efficient tanks.

The 9% levels of nickel that have become ubiquitous in LNG tanks were originally developed in 1946. This level of nickel steel alloy was determined to have an adequate arresting property at the  $-163^{\circ}\text{C}$  service temperature, making it the standard for nearly all tanks for the next 50 years, and many still today. However, research in recent years has determined that 6-7.5% nickel steel also will successfully accommodate LNG. In order to ensure that the lower level nickel alloys would effectively perform their task, researchers employed a thermomechanical controlled processing (TMCP) technique. By employing the advanced TMCP, 6-7.5% nickel steel exhibited superior fracture resistance properties. Lower level nickel alloys are now often employed for this purpose, creating considerable cost savings and resource conservation.

## Stainless Steel

Of course, the other critical element in a nickel steel alloy is the stainless steel itself. High quality stainless steel holds a number of advantages in creating LNG tanks. The material is highly weldable, generally exhibiting no problems or weaknesses during any welding process. In addition, low carbon steels are highly resistant to corrosion and do not undergo phase transformations while welding occurs.

However, for stainless steel to have the best resistance to cracking, there are certain elements that need to be present. A minimum level of delta ferrite is one. Stainless steel with higher levels of ferrite reduces the impact of low temperatures. When applied with sub-arc flux and covered electrode coatings, the stainless steel maintains a lower amount of micro-slag and higher ductility as a result. Stainless steel with these qualities makes an ideal partner for nickel in the construction of LNG tanks and containers.

## Sourcing the Best Metals

As the LNG industry continues to grow, companies that build tanks for storage and transportation will need to source large quantities of nickel stainless steel alloys. It is vital to partner with a company that is well known for supplying the best quality alloy metals. In the case of LNG, it is truly essential, as only the best nickel alloys should be employed to house natural gas in its liquefied form.

At Continental Steel, we are well known throughout the industry as a supplier of the finest nickel alloys available on the market. We currently distribute over 20 different nickel and high temperature alloys for all different industries, including those who need to contain LNG. Our stainless steel is also available in a wide variety of grades and forms. When constructing tanks for highly volatile substances, using quality materials is of paramount importance. If you are a customer who needs materials to house LNG, please contact us.

We are known as one of the world's leading suppliers of the highest quality metals, and we remain committed to providing our exhaustive inventory with fast lead times and highly competitive prices.



## Standards Compliance

In the current market, where competition is fierce and resources are scarce, complying with standards can improve the quality and consistency of the product. The ability to purchase materials with defined properties and a recognized level of quality reduces the risk of incompatibility or failure, and ensures that products perform as intended. Businesses can be assured that metals and components supplied by different companies will be mutually compatible. Using standards also helps businesses demonstrate to regulators and customers that their products and services meet defined safety, quality, and environmental standards. Improved ability to meet legislative and regulatory requirements enables companies to develop competitive manufacturing capabilities and expand their market reach by ensuring conformity with various industry, military, aerospace, and automotive standards.

