AL-6XN® Alloy for Air Pollution Control Systems

Specifications

UNS: N08367 **ASTM:** B 688, A 240, B 675, A 312, B 676, A 249, B 804, B 691, A 479, B 462, A 182, B 564, B 366, B 472
ASME: SB-688, SA-240, SB-6 75, SA-312, SB-276, SA-249, SB-691, SA-479, SB-462, SA-182, SB-564, SB-366 Case N-438-3, B-31.1 Case 155-1

Chemical Composition, %

	Ni	Cr	Mo	Mn	Cu	Si	C	N	S	P	Fe
MIN	23.5	20.0	6.0	–	–	–	–	0.18	–	–	–
MAX	25.5	22.0	7.0	2.0	0.75	1.0	0.03	0.25	0.03	0.04	balance

Industry News

Fossil fuel plants are now faced with stricter air quality control laws and EPA regulations. New multi-pollutant legislation will control more emissions at more plants. How do you best achieve compliance with these regulations economically with available materials of construction for flue gas desulfurization (FGD) systems and wet electrostatic precipitators (WESP)?

A variety of austenitic alloys are available for use in FGD and WESP systems. Alloys with a molybdenum content varying from 2 to 16 percent have been used. The 6% Mo AL-6XN (N08367) alloy has performed better in laboratory testing and actual service conditions than the 3-5% Mo stainless steels 317L, 317LMN, and 904L, and approaches the performance of nickel based 625 and C-276 alloys in some environments. Lack of availability of 3-5% Mo stainless steels and the economic benefit over nickel based alloys have made AL-6XN alloy a fitting candidate for pollution control systems. In fact, AL-6XN alloy has been in service for over 20 years at several power plants with no reported problems.

Past corrosion test studies completed by the Nickel Institute further support the use of 6% Mo alloys, like AL-6XN for FGD systems. Testing of a 6% Mo alloy at Orlando Utilities Stanton Energy FGD system for 270 days of continuous exposure with conditions averaging 70,000 ppm Cl, a pH of 5.6, and temperatures of 130°F indicated excellent resistance. Only the 6% Mo alloy and C-276 showed zero corrosion. Alloys 316L, 317LMN, and 2205 each suffered crevice attack.

Overall, AL-6XN Alloy has proven to be a cost-effective material of construction to fill the gap between the 4% Mo austenitic stainless steels and higher-Mo nickel based alloys. As AL-6XN is an established material of construction, it is readily available in all product forms necessary to complete an FGD or WESP system, including plate, sheet, round bar, pipe, fittings, flanges, and suggested welding consumables.

Louisville Gas & Electric Cane Run #6

AL-6XN replaced a 317LMN liner in two FGD downcomer ducts. This plant burns 3.5% sulfur coal. 317LMN failed in less than 3 years. 14ga & 16ga sheet was used to wallpaper the duct. The last update showed that AL-6XN was still in operation after 10 years. AL-6XN subsequently replaced a 16-in. diameter pipe section used in the pump suction system for recirculating scrubber liquor.

Korean Electric Power (KEPCO) Taean #1-4 and Hadong #1-6

AL-6XN was utilized as the material of construction for 10 wet limestone FGD absorber towers with forced oxidation. Units rated at 500MW each. AL-6XN used for the main absorber body, internal structural components, and piping systems. Units constructed in late 1990s. Inlet SO_2 concentration reported as 645 ppm. Chloride concentrations restricted to a maximum of 20,000 ppm.

WESTAR Energy Jeffrey Energy Center

Westar Energy used over 500 ton of AL-6XN plate to upgrade their FGD units in 2008. AL-6XN was chosen due to its track record in similar FGD environments. The AL-6XN was mainly used for ductwork to connect the three existing FGD units as well as for modifications to the FGD units in order to increase the SO_2 removal rate to 95%. C-276 was also used in these modifications and new installations where environments were more severe and required a higher corrosion resistant alloy.

Central Illinois Public Service Company Newton Power Station

AL-6XN was used for turning vanes installed in the flue stack. Unit is 34.5-ft. tall, V-shaped and is approximately 15-ft. across at the widest point. The plant burns high sulfur coal hence condensation of a combination of acids and chlorides on the turning vane was of concern. AL-6XN was selected after coupon testing.

San Miguel Electric Cooperative

San Miguel has used the AL-6XN alloy in few areas within their FGD System. Over 5 years ago, they tested both 2205 and AL-6XN for turning vanes in their ductwork. After inspection, they noticed that both the 2205 and AL-6XN looked brand new after several months in service. AL-6XN was also selected for the walls and ceiling of the outlet ducting downstream of the reheater where acid concentrations are higher. AL-6XN was also used in some areas on the floor of the ducting along with C-276. It was noticed that where the acids pool on the floor, the AL-6XN did not hold up as well as the C-276, but on the walls and ceiling where the acids could run down the walls, AL-6XN has held up great for nearly 5 years now.

Indianapolis Power & Light

AL-6XN was used for the wallpapering of a carbon steel duct connecting the electrostatic precipitator to the flue stack. Lower than expected temperatures led to condensation in the bottom of the 12-ft. wide duct. Duct was approximately 150-ft. long. 35,000 pounds of 14ga AL-6XN sheet was supplied to wallpaper the bottom of the duct with AL-6XN to help protect against corrosion by the condensate which would include sulfurous acid and chlorides. Gas estimates through the duct were 33 lbs/hour of Cl- and 29 lbs/hr of SO_2.

After 5 years in service the duct was removed from service with no reported problems. Reason for removal was the installation of a wet FGD scrubber system. Due to the success of AL-6XN in this application, it was selected for portions of the absorber tower contacted after the quench section.

Hoosier Energy Merom Station

Hoosier Energy has relined all six of their FGD absorbers with AL-6XN. The original FGD's were constructed from a lower corrosion resistant alloy and after detecting some corrosion, it was determined to reline all of the absorbers using AL-6XN.

Northern Indiana Public Services Co. Bailly Generating Station Units #7 & 8

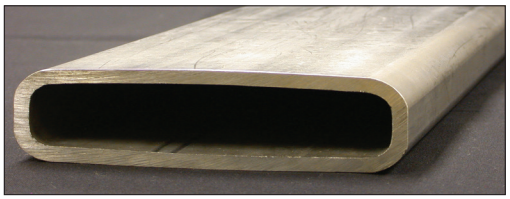
AL-6XN piping was used for the construction of slurry recirculation piping and a rotary sparger unit submerged in the limestone scrubber tank. This power plant uses 2 to 4.5% sulfur bituminous coal. AL-6XN piping has been in service for over 10 years. Lining material of AL-6XN sheet in the wet dry zone has been in service for 6 years. Estimates of conditions in the absorber are a pH of 6, 11,000 ppm Cl, and 130°F

Northern Indiana Public Services Co. Bailly Generating Station Units #7 & 8

Successful performance of AL-6XN in earlier applications led to its utilization in areas such as top hat inserts to protect flanged connections in rubber lined steel used for slurry recirculation. AL-6XN has also been used for internal box beam supports in the absorber tower.

New Brunswick Power Coleson Cove Power Plant

AL-6XN box beams were supplied for a Wet Electrostatic Precipitator (WESP). Nearly 14,000 feet of AL-6XN beams were drawn to an overall size of 1.0-in. x 6.0-in. x 0.120-in. average wall for the application. AL-6XN sheet was used for collector plates, which were hung from the box beams.



Inventory Availability

Other fittings and sizes available upon request with mill lead time.

Plate B 688/SB-688	Sheet B 688/SB-688	Bar B 691/SB-691	Welded Pipe - B 675/SB-675 Schedule 10	Schedule 40	Fittings
3/16" - 3"	10-22 GA	3/8" - 8"	1" - 8"	1/2" - 8"	Conc. Red, Tees, Elbows, Flanges, Stub Ends, Couplings, Fasteners

Relative Pricing

Based on 3/8" PMP plate pricing in the 1st quarter of 2011 relative to 316L as 1.00.

Alloy	316L	317L	2205	ZERON® 100	AL-6XN	625	C-276
Price Ratio	1.00	1.20	0.90	1.30	2.50	5.50	5.60

Crevice Corrosion

Temperature for Initiation of Crevice Corrosion in 10% Ferric Chloride ($FeCl_3 \bullet 6H_2O$) Solution

Alloy	UNS	% MO	°F	PRE_N
316L	S31603	2.1	27	24
317L	S31703	3.2	35	29
317LMN	S31726	4.4	68	33
2205	S32205	3.1	68	35
ZERON® 100	S32760	3.6	104	41
AL-6XN	N08367	6.2	110	45
625	N06625	9.0	113	51
C-276	N10276	15.4	130	66

10%$FeCl_3 \bullet 6H_2O$, per ASTM G 48 Practice B, $PRE_N = Cr + 3.3Mo + 16N$

Crevice Corrosion Testing in Simulated Scrubber Environment (Green Death)

Alloy	Weight Loss, g/cm²		
	75°F	122°F	158°F
316L	0.0006	0.0343	0.0390
317L	0.0007	0.0377	0.0500
317LMN	0.0000	0.0129	0.0462
AL-6XN	0.0000	0.0000	0.0266
625	0.0000	0.0000	0.0149
C-276	0.0000	0.0000	0.0004

7% H_2SO_4, 3%HCl, 1%$CuCl_2$, 1%$FeCl_3$ - ASTM G 48 Practice B, 72 Hours

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