



Niobium Nb

THE USE OF UP TO 0.1%Nb STEELS FOR API X80 PIPELINE ALLOWS HIGHER CAPACITY GAS TRANSMISSION

INCREASING THE TRANSMISSION CAPACITY OF LONG-DISTANCE GAS PIPELINES IN CHINA

To drive greener economic growth and reduce air pollution in industrial areas, China is replacing coal-fired power generation with renewable energy and natural gas. This strategy has led to a significant demand in natural gas which is forecast to grow from around 320 billion cubic meters in 2020 to 500 billion cubic meters in 2025 (Forbes, 2020). This growth will only be feasible through building additional long-distance gas pipelines and growing LNG imports, including associated investments in storage and transmission infrastructure.

In developing this increased transmission capacity, operators are faced with the challenge of balancing costs and efficiency whilst meeting high safety standards.

The use of API X80 high strength steels, with high resistance and toughness have already increased the annual capacity of long-distance gas transmission pipelines in China, whilst maintaining economic viability.

These pipelines have a high gas transmission capacity, using 1,420 mm diameter pipes. Even with the increased volume, the gas can be transported at the Maximum Allowable Operating Pressure (MOAP), ensuring both efficiency and safety. This has been demonstrated in successive new gas transmission pipelines in China, and detailed in the examples below.

Forbes, A. 2020. China's Challenge: Securing Sufficient Gas. [online] Petroleum-economist.com. Available at: <<https://www.petroleum-economist.com/articles/midstream-downstream/lng/2020/china-s-challenge-securing-sufficient-gas>>[Accessed 9 November 2020].

USING API X80 GRADE STEEL INCREASED THE CAPACITY OF THE 2ND WEST EAST GAS PIPELINE (WEGP)

Figure 1 below presents significant long-distance pipeline projects recently developed in China and Table 1 illustrates the respective specifications and operating parameters.

Figure 1: Gas transmission long-distance pipeline recent projects in China.



Table 1: Specifications and operation parameters of recent gas transmission pipelines in China.

Projects	1st WEGP	2nd WEGP	3rd WEGP	C-REGP
Construction period	2002-2004	2008-2012	2012-2014	2017-2018
Steel grade/API	X70	X80	X80	X80
Diameter/mm	1016	1219	1219	1422
Maximum Working pressure/Pa	10	12	12	12
Wall thickness of spiral pipe/mm	14.7	18.4	18.4	22
Spiral pipe thickness/mm	18.4	22.4	22.4	26
Annual transmission capacity/bm3	15	30	30	38
Investment/billion RMB	140	142	120	-

Shang, C., Guo, F. - The State of the Art of Long Distance Gas Pipeline in China.
https://www.gas-for-energy.com/fileadmin/G4E/pdf_Datein/g4e_1_18/gfe1_18_fb_ShangGuo.pdf

Comparing the 1st West East Gas Pipeline (WEGP), constructed using API X70 grade steel with the 2nd WEGP which used API X80 steel, the annual transmission capacity increased from 15bm³/annum to 30bm³/annum. When the amount of steel used, construction costs and other economic factors are taken into account, the investment required by the 2nd WEGP was almost the same as the first, to transport a much greater volume of natural gas.

The use of API X80 high strength steel not only enables a higher transmission capacity due to a larger pipe diameter, but also decreased the amount of material required and decreased construction costs (less consumables, lower transportation costs).

Table 2 shows the typical compositions of API X80 used for plates and coils for the projects in China, using low carbon content and up to 0.10%Nb.

Table 2: Typical steel chemical composition used on the long distance gas transmission pipelines in China.

Steel	C	Si	Mn	Mo	Nb	Ti	N(ppm)	Cr+Ni+Cu
Strip	0.035	0.23	1.77	0.25	0.11	0.018	≤40	0.73
Plate	0.040	0.22	1.75	-	0.095	0.015	≤40	0.48

Chenjia Shang and Fujian Guo, The State of the Art of Long-Distance Gas Pipeline in China, Issue 1/2018 Gas for Energy)

THE CHINA-RUSSIA PIPELINE (C-REGP) IS ANOTHER SUCCESSFUL PROJECT USING 0.08%Nb FOR HIGH CAPACITY GAS TRANSMISSION PIPELINE IN CHINA

More recently the China to Russia Eastern Gas Pipeline, demonstrated how using API X80 steel with 0.08%Nb increased the capacity potential of the pipeline, using 1,420 mm diameters and 21,4 mm spiral pipes.

The API X80 grade material used demonstrated excellent properties including the high toughness of the base metal and of the heat affected zone (HAZ), required for this high gas transmission capacity pipeline, as shown in Table 3 and Figure 2.

Table 3: Chemical composition and tensile test results of API X80 pipe used at China-Russia Eastern Pipeline.

Alloy design:

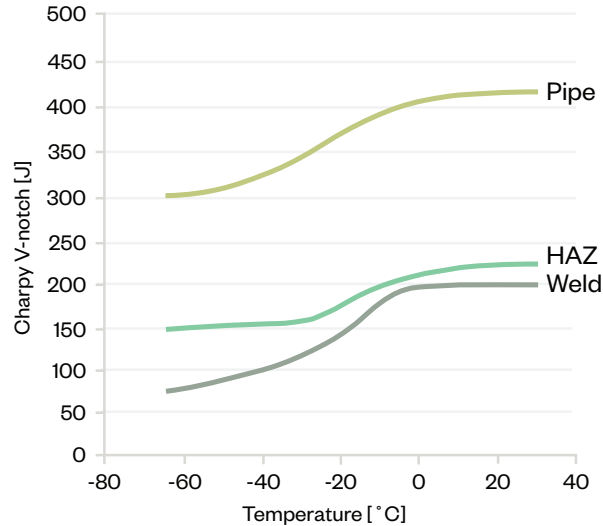
C	Si	Mn	P	S	Nb	Ti	Others
0.044	0.24	1.68	≤0.010	≤0.002	0.08	0.011	Mo Ni Cu Cr

Tensile test:

Position	Rt0.5 (MPa)	Rm (MPa)	A, %	Y/T
Tail	623	697	23	0.89
Middle	574	660	26	0.87
Head	622	695	25	0.89
Spec.	555-690	625-780	min 16	max 0.93

Figure 2: Evaluation of toughness by Charpy V tests of base metal (Pipe), HAZ and Weld of China-Russia Eastern Pipeline.

Charpy impact test of pipe:



Adapted from Huo Chunyong, H. et al. Latest Development and Application of High Strength and Heavy Gauge Pipeline Steel in China, The 26th International Ocean and Polar Engineering Conference Rhodes (Rodos), Greece, 2016.

China has recently initiated a long term plan to be carbon neutral by 2060. Increased investment is required to guarantee that this task will be successful. Natural gas will be the transition energy, playing an important role until China can use renewable and CO₂ free energy alone. LNG will also be important to help fulfill the need for cleaner energy in China. The main new investments will be in pipelines for imports and domestic production of natural gas and for the distribution of LNG from the ports to end users. Again, using API X80 up to 0.10%Nb can provide an opportunity for these major projects to meet economic, capacity and safety demands.

Contact CBMM's technical experts to understand what API X80 up to 0.10%Nb can do for your high capacity gas transmission projects, by increasing the efficiency in gas transportation within safe operational conditions. The use of this concept can help China reach carbon neutrality by 2060, and will be a significant step forward in reducing global emissions. CBMM has a team of specialists in pipe specifications, production and welding who can help you to achieve the benefits of using high-quality API X80 niobium microalloyed steels. The International Welding Technology Center (IWTC) in Xi'an City, Shanxi Province is an initiative from CNPC and its R&D Center TGRI, together with CITIC Metals and CBMM. The role of the center is to support projects in China, providing assurance to operators on welding pipelines and to conduct advanced research on high quality steels using the latest technological equipment and consumables to provide safe and reliable pipeline systems. Contact us via technology@cbmm.com.



World leader in the production and commercialization of Niobium products, CBMM has customers in over 40 countries. With headquarters in Brazil and offices and subsidiaries in China, Netherlands, Singapore, Switzerland and the United States, the company supplies products and cutting-edge technology to the infrastructure, mobility, aerospace and energy sectors. CBMM was founded in 1955 in Araxá, Minas Gerais, and relies on a strong technology program to increase Niobium applications, growing and diversifying this market.



Further information
can be obtained at
www.niobium.tech

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