

Baosteel UOE Longitudinal
Seam Submerged-Arc Welded Pipe

Product Manual

宝钢UOE直缝埋弧焊管

产品手册



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1 公司简介

Company Profile

UOE LSAW PIPE



宝山钢铁股份有限公司(简称“宝钢股份”)是中国最大、最现代化的钢铁联合企业。宝钢股份以其诚信、人才、创新、管理、技术诸方面综合优势,奠定了在国际钢铁市场上世界级钢铁联合企业的地位。《世界钢铁业指南》评定宝钢股份在世界钢铁行业的综合竞争力为前三名,认为是最具发展潜力的钢铁企业。

宝钢的钢管产业,包括小口径热轧管、特种合金轧管、冷轧和冷拔管、中口径高频电阻焊管、大口径直缝埋弧焊管等产品,集科研、产品开发、加工检验、产品销售于一体,实行从炼铁、炼钢(转炉、电炉)、热轧钢卷、厚板、条钢、到制管的一贯制质量管理,具有特大型钢铁联合企业的综合优势,是目前中国最现代化的钢管生产基地之一。

宝钢UOE大口径直缝埋弧焊管机组投产于2008年,采用世界上先进、成熟的UOE大口径直缝埋弧焊管生产工艺,主体设备由德国SMS-MEER等世界一流设备制造商提供,是目前世界上装备最先进的UOE焊管生产线之一,年产石油天然气输送用管线管、结构用碳钢管和低压流体输送管50万吨。

公司以先进的技术、设备、管理、良好的信誉,保证提供高质量的产品和服务,令客户满意。我公司已贯彻了行之有效的质量控制和质量保证体系,长远规划、保持、控制并改进产品的质量。

全体员工衷心感谢您对本公司产品的关注和使用,竭诚欢迎您对本公司产品和服务提出宝贵意见。如果您所需产品的品种、规格、特殊要求在本公司样本中未覆盖,请告知本公司,本公司将予以及时答复。



Baoshan Iron & Steel Co., Ltd (hereinafter referred as Baosteel Co., Ltd.) is the largest and most modernized integrated steel conglomerate in China. By means of leveraging comprehensive advantages such as good faith, talents, innovation, management and technology, Baosteel is recognized as a world leading steel company by the global steel market. According to World Steel Dynamics, the company ranks No. 3 in the world in terms of comprehensive competency; it is also believed to have the greatest potential of development.

The company's steel pipe industry includes medium & small-diameter hot-rolled tubes, special alloy rolled tubes, cold-rolled and cold-drawn tubes, medium-diameter ERW welded pipes, large-diameter longitudinal submerged-arc welded pipes. Baosteel pipe industry integrates R&D, product development, machining and inspection, distribution. It implements whole process quality control including iron-making, steel-making (BOF, EAF), hot-rolled coils, heavy plates, blooming, pipe rolling and welding. The company's steel pipe industry has comprehensive advantages of super iron and steel complex. It's one of the most modernized steel pipe production bases in China nowadays.

The company's large-diameter LSAW pipe mill was put into production in 2008 with the most advanced UOE technology. The main equipments were imported from the world leading equipment manufactures such as SMS-MEER. It's one of the most advanced UOE welded pipe product lines in the world. The products of the plant are mainly linepipes, structural carbon steel pipes and conveying pipes, with a design capacity of 500,000 t/a.

Relying on competitive advantages such as advanced equipment, technical knowledge, management and high credit, Baosteel can supply quality products and services to satisfy customers' needs. We have been implementing an effective Quality Control and Assurance System. We have a long-run plan to keep, control and improve quality continually.

Our staff sincerely appreciate your use and of concern our products, and welcome you to put forward valuable suggestion on our products and service. If the type, size and special requirements of products are not covered here, please don't hesitate to contact us, and we will reply promptly.

2 质量保证

Quality Assurance

1、管理体系

宝钢以“落实100%措施，确保100%质量”为理念，打造宝钢钢管精品品牌，先后取得了国内外诸多认证公司和权威机构的认证证书。

自1992年起，陆续获得API(美国石油协会)颁发的5CT和5L的会标使用许可证，并顺利通过历次复证。

1998年，获得了国家质量监督检验检疫总局颁发的完善计量检测体系证书。

1994年，获得世界权威认证机构—英国BSI公司颁发的质量、安全、环保的IMS综合管理体系证书。(TS16949、BS EN ISO 9001、BS EN ISO 14001、OHSAS18001)

2006年，通过了GB/T9711.2焊管的生产许可证认证。

1. Management System

Baosteel takes "Fulfilling 100 percent measures, Insuring 100 percent quality" as managing concept, in order to build Baosteel Steel Pipe into a premium brand. Baosteel Branch obtained certificates from authoritative registration companies and organizations.

The pipe has been awarded API 5L and API 5CT Emblem Certificate since 1992.

Baosteel Branch acquired certificate for Perfecting the System of Inspection Measurement and Test from CSBTS in 1998.

Baosteel Branch obtained certificate for its Integrated Management System as per TS 16949, BS EN ISO 9001, BS EN ISO 14001 and OHSAS 18001 from British Standard Institution (BSI) in 1994.

Baosteel Branch won GB/T9711.2 welded pipe manufacture license authentication in 2006.

2、一贯质量管理

钢板的质量是保证焊管质量的先决条件，宝钢实行从钢种设计、钢水冶炼、厚板轧制到焊管生产的全过程质量控制与跟踪管理，使产品质量能够得到稳定的控制，并通过持续改进原料成分设计与轧制工艺等措施，使管体在具备优良的机械性能下同时具有较好的野外焊接性能，可满足各种用户不同用途条件下对各种特性新钢种的要求。

宝钢具有优越的前工序生产条件，从冶炼到轧钢的各个工序都拥有世界先进水平的生产设备和生产技术。

宝钢UOE机组采用的原料钢板全部是由宝钢5m宽厚板轧机提供的，该宽厚板轧机采用了当今世界上宽厚板生产的许多先进技术，生产出来的产品从理化性能、尺寸精度等各项质量指标上均满足UOE机组的生产要求。

2. Coherent Quality Management System

The quality of the plate is the precondition to manufacture high quality welded pipe. Baosteel implements a whole process quality control and track management from the steel designing, steel making, heavy plate rolling to the manufacture of welded pipe to ensure stable quality control. In order to meet customers' different needs, the linepipe has been researched and developed continuously through process improving such as material component design and rolling technique to obtain an excellent mechanical property and a fairly good outside-door weldability at the same time.

Baosteel has a perfect pre-procedure manufacture condition, every process from steel making to plate rolling possesses advanced equipment and technology.

All the material for UOE mill are manufactured by Baosteel 5m rolling mill which applies a lot of world advanced technology. So quality of the material can completely meet the demand of UOE mill, no matter the mechanical property, precision of dimensions, etc.



宝钢焊管产品实行生产全过程一贯制质量管理，完善的四级计算机系统对全过程实行集中统一的管理。

Baosteel uses Coherent Quality Management on the whole manufacture process of welded pipe products. A consummate four-grade computer control system keeps a uniform management throughout the whole manufacture process.

3 产品特点

Product Features

管径和椭圆度等几何尺寸控制精度高，表面光洁，外形美观。

钢质纯净，碳、磷、硫及夹杂物的含量低，管体和焊缝冲击韧性高，焊接性能优良，能保证产品质量及现场对口组装焊接的质量。

可供应钢级达API 5L X100的高强度、高韧性UOE管线管，可用于低温、酸性环境条件下的海底和陆上的石油、天然气输送，稳定性、安全性高。

Highly controlled precision of the dimension such as diameter, ovality; neat and smooth surface, pretty shapes.

Using pure steel material with low percentage of C, P, S and other inclusions. Good toughness for both pipe body and welded seam, good weldability, and so can ensure the quality of pipe proper and batt welded joint.

We can supply high strength and high toughness UOE pipes that reach API 5L X100 grade, which can be widely used in pipelines of petroleum and gas under low temperature and sour environment on land and offshore, with high stability and safety.



4 产品范围

Product Range

1、管线管/Linepipe

材质/Grades: API 5L(A, B, X42-X100)

直径/Outside Diameter: 508mm-1422mm (20"-56")

壁厚/Wall Thickness: 6mm-40mm

长度/Length: 6.0m-18.3m

标准/Standard:

API SPEC 5L

GB/T9711.1、GB/T9711.2、GB/T9711.3

ISO3183-1、ISO3183-2、ISO3183-3

DNV-OS-F101

用途/Uses:

用于海底石油天然气管线，陆上高寒、大落差地段石油天然气管线等各种重要石油天然气输送管线。

Line pipe can meet all requirements of high-pressure transmission pipeline for natural gas and petroleum and can be used in offshore, icy areas and areas with large difference in altitude.



4 产品范围

Product Range

2、结构管及低压流体输送管/Structural Pipes and Low-pressure Liquid Transportation Pipes

材质与标准/Grade and Standard

Grade A – E (ASTM A139)
 Grade 1-3 (ASTM A252)
 STK290 – 540 (JIS G3444)
 Q215 – 345 (GB/T 3091)

直径/Outside Diameter:

508mm – 1422mm (20" – 56")

壁厚/Wall Thickness:

6mm – 40mm

长度/Length:

6m – 12m

用途/Uses:

低压输送流体管道、各种受力及承压结构件以及其他用途。
 Used as low-pressure liquid transportation pipes and different types of load bearing structure units as well as other purposes.



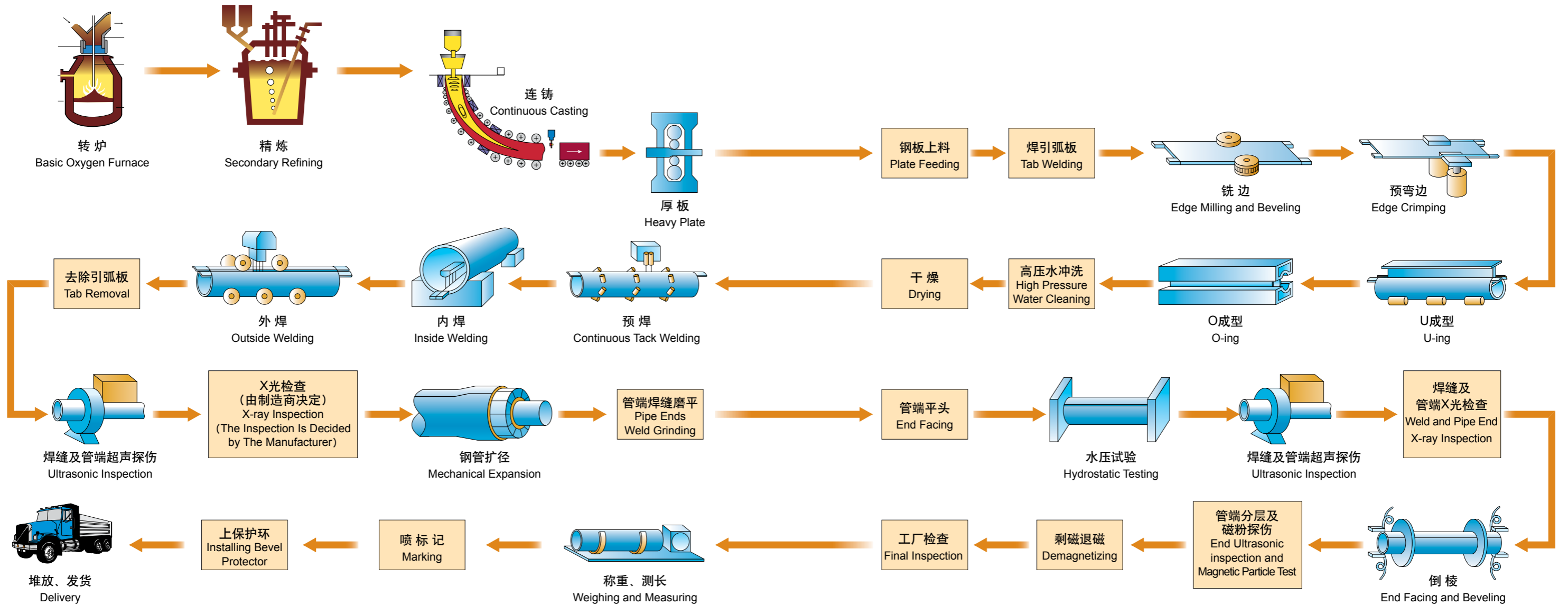
3、典型产品范围/Product Range

管 径 / Pipe O.D.		壁 厚 / W.T.(mm)				
In.	mm	最大屈服强度 / MAX. Yield Strength				
		531 Mpa (X42/X52/结构管)	552Mpa (X60)	621Mpa (X70)	690MPa (X80)	830MPa (X100)
20	508	6.4-28.6	6.4-25.4	6.4-25.4	7.9-22.2	8.7-14.3
22	559	6.4-35.0	6.4-28.6	6.4-28.6	7.9-23.8	8.7-14.3
24	610	6.4-40.0	6.4-31.8	6.4-31.8	7.9-25.4	8.7-15.9
26	660	6.4-40.0	6.4-31.8	6.4-31.8	7.9-27.0	8.7-15.9
28	711	6.4-40.0	6.4-35.0	6.4-31.8	7.9-27.0	8.7-22.2
30	762	6.4-40.0	6.4-35.0	6.4-31.8	7.9-27.0	8.7-22.2
32	813	6.4-40.0	6.4-35.0	6.4-31.8	7.9-27.0	8.7-22.2
34	864	6.4-40.0	6.4-35.0	6.4-31.8	7.9-27.0	8.7-22.2
36	914	6.4-40.0	6.4-35.0	6.4-31.8	7.9-27.0	8.7-22.2
38	955	7.9-40.0	8.7-35.0	8.7-31.8	8.7-27.0	9.5-22.2
40	1016	7.9-40.0	8.7-35.0	8.7-31.8	8.7-27.0	9.5-22.2
42	1067	7.9-40.0	8.7-35.0	8.7-31.8	8.7-27.0	9.5-22.2
44	1118	7.9-40.0	8.7-35.0	8.7-31.8	9.5-27.0	9.5-22.2
46	1168	7.9-40.0	8.7-35.0	8.7-31.8	9.5-27.0	9.5-22.2
48	1219	9.5-40.0	9.5-35.0	9.5-31.8	9.5-27.0	9.5-22.2
50	1270	9.5-40.0	9.5-35.0	9.5-31.8	10.3-27.0	14.3-22.2
52	1320	9.5-40.0	10.3-35.0	10.3-31.8	10.3-27.0	14.3-22.2
54	1371	9.5-40.0	10.3-35.0	10.3-31.8	12.7-27.0	14.3-22.2
56	1422	9.5-40.0	10.3-35.0	10.3-31.8	12.7-27.0	14.3-22.2

经供需双方协商，也可供应中间规格尺寸。
 We also supply pipe with other sizes according to the agreements.

5 生产工艺流程

Diagram of Product Process



6 生产工艺特点

Characteristic of Production Engineering

1、铣边机

通过程序控制进行全自动高速仿形铣边，能够根据板宽超差对铣切速度进行优化，坡口边缘清洁、无毛刺、无冷作变形，具有坡口质量高、铣边效率高的特点。

2、弯边机

弯边机最大压力达到4000t，是目前世界上配置最先进的C成型机之一，为今后生产高钢级管线管预备了条件。

3、U成型机

U成型机垂直方向最大压力达到2350t，两侧还有二个侧向压辊，其压力和中心压模相同，是目前世界上最先进的U成型机之一。

4、O成型机

O成型机采用中心恒定的成型方式，成型压力72000t，为目前世界上能力最大，最先进的O成型机，该成型机的独特之处在于压机梁是浮动的，残余应力小，应力分布均匀。

5、内外埋弧焊机

4套5丝外焊设备，5套4丝内焊设备，焊机配置先进，在整个电流与电压范围内都有很好的焊接特性，在高压和低压时都具有良好的电弧稳定性；并配有高精度焊缝自动跟踪装置；可自动完成焊剂的回收、分离、烘干及输送。

6、机械扩径机

扩径机主拉杆的最大拉力可以达到1500t，是目前世界上能力最大的扩径机之一。椭圆度及管端尺寸形状好，对野外现场环焊极为有利。

7、计算机料流跟踪系统

采用计算机对生产线设备进行控制、进行物料跟踪和生产管理，可对从原料到产品的所有数据进行跟踪及记录，保证出厂的每根钢管都具有准确的详尽记录，具有准确、方便的可追溯性。

Milling Machine

The milling heads with their index able carbide cutters operate fully automatically under program control. This process ensures optimum preparation and a very high quality of the weld seam and clean, burr, free cut-edges without cold forming, and short, easily discharged chips. Furthermore, the cutting speed is optimised in relation to the plate material and the plate width oversize.

Crimping Press

This is one of the most advanced C-ing presses in the world. The maximum press of crimping press is 4000t. It is prepared to produce high strength pipeline in the future.

U-ing Press

The vertical and two side's presses are 2350t presses. It's also one of the most advanced U-ing presses in the world.

O-ing Press

The U-cannings are formed into an open-seam pipe on a 72000t O-ing press. It's the most powerful O-ing press in the world. The special feature of this press is that the press beam is floatable. This helps to minimize and uniform the residual stress.

Inside and Outside Submerged-arc Welding Machine

There are five inside welding stations and four outside welding stations. The welding machines have an excellent welding characteristic, and the arcs have good stability, equipped with high precise weld auto trace device. Flux can be recovered, separated, dried and feeded automatically.

Mechanical Expander

The maximum tension of the main straw-bar is 1500t. It's one of the most powerful expanders in the world. Girth welding will be benefit from the good dimension of pipe end.

Computer Tracking System

All tubes are assigned a tube number, which is registered during the production process at individual machining points. Important production data on the individual pipes can be collected by a data gathering system to which every machine is connected and the data can be compiled and stored on a host computer.

7 在线检测技术

On-line Detecting Technology

为保证产品的质量，尽管国外生产厂家十分强调，UOE 焊管的质量不是检测出来的，是靠先进的设备和操作人员精心操作生产出来的，但在宝钢UOE 焊管生产线上，仍设置了多层次的组合式无损探伤及检查设备，确保不让一根带有缺陷的焊管出厂。

In order to guarantee the quality of the product, although pipe manufactures emphasize that the quality of UOE welded pipe is not gained by testing, which depends on the advanced equipments and the operator's work, the UOE welded pipe product line of baosteel is equipped with the multi-combination nondestructive testing and inspection equipments to insure no pipe with defects is sent to the customer.

内外焊接后：

1#自动超声波焊缝探伤设备

主要用于检查扩径前钢管的焊接质量及生产过程控制。并根据缺陷的不同种类采用不同的标识进行辨别。

1#X射线探伤设备

也是作为扩径前焊缝质量的过程控制,主要采用电子实时成像的方式对超声波发现的缺陷进行射线定位确认,同时也会发现一些超声波不易发现的缺陷如气孔等,也可以用于拍片。

扩径工序后：

大压力水压试验机

最大试验压力达58MPa，为生产高钢级管线管提供了必要的密实性检测手段。

2#超声波探伤设备

扩径后的2#自动超声波探伤设备主要用来检查水压试验后钢管的质量，作为最终成品质量控制。并根据缺陷的种类采用不同的标识进行辨别。

2#、3#射线探伤设备

采用电子实时成像或胶片拍片的方式用作最终成品控制，对修磨补焊后位置的质量进行最终确认，也可对2#自动超声波探伤发现的缺陷进行确认。

1#、2#管端拍片设备

根据标准要求对管端一定范围进行胶片拍片或电子成像。

After Inside and Outside Welding:

1# Automatic Ultrasonic Testing Equipments

The main function of this equipment is inspecting the weld quality before expanding and as manufacture process control. It can spray different colors for different types of defects to identify them easily.

1# X Ray Inspection Equipments

The main function of the equipment is also inspecting the weld quality before expanding and manufacture process control. The homogeneity of weld seams examined by ultrasonic method shall be determined by means of directed through X-ray real time television or image on radiographic film, it can also find some defects such as blow holes which couldn't be easily identified by ultrasonic method.

After Expanding:

Hydraulic Testing Equipment

The maximum test pressure of this equipment is 58MPa, so it can provide necessary hermetic testing method for the manufacture of high-grade line pipe.

2# Automatic Ultrasonic Testing Equipment

The main function is inspecting the weld seam after hydraulic test, it's as the finally product quality control process. It can spray different colors for the different kinds of defects.

2#, 3# X Ray Inspection Equipments

Using the X-ray real time television or radiographic film as the final control method for products, to confirm the quality of repaired area and the defect found by 2#automatic ultrasonic testing system.

1#, 2# X-ray Radiographic Testing System

Radiographic testing of the extreme of weld at each pipe end in accordance with the requirements.

7 在线检测技术

On-line Detecting Technology

管端倒棱后

磁粉探伤装置

在线设置磁粉探伤装置1套，包括两台探伤装置，相对布置在钢管两端，同时对管端坡口进行探伤。

管端超声波探伤装置

设置超声波管端分层探伤装置1套，包括两台探伤装置，相对布置在钢管两端，同时对钢管两端探伤，检测管端母材和焊缝分层缺陷。

After Pipe End Beveled

Magnetic Particle Inspection System

A set of online magnetic particle inspection system, two detectors included, arranged at each end of the pipe, and so can inspect each pipe end bevel at the same time.

Pipe End Lamination Ultrasonic Defect Inspection Equipments

One set of pipe end lamination ultrasonic test system including two platforms of inspection equipments. It can inspect the lamination defect of pipe end and weld area.



宝钢UOE焊管成功应用于西气东输二线工程

8 实验能力

Experimental Ability

配备世界先进的理化检测设备和高素质技术人员，具有测试HIC、SSC等其他标准要求的检测项目。为产品按API和DNV海洋管线管等国内外标准生产奠定基础。

We have world advanced physical and chemical inspection equipment and high educated stuffs, and so have the capacity of test HIC, SSC and test items required by other kinds standard. And so set up a ground for the manufacture according to API and DNV-OS-F101 Offshore Service Standard.

试验设备 / Test Facility	试验项目 / Test Item
万能试验机 / Universal Testing Machine	拉伸试验等 / Tensile Test
冲击试验机 / Impact Tester	冲击试验 / Impact Test
导向弯曲试验机 / Guide Bending Tester	弯曲试验 / Bending Test
硬度试验机 / Hardness Tester	硬度试验 / Hardness Test
落锤试验机 / Drop Weight Tear Testing Machine	DWTT试验 / DWTT Test
插销试验机 / Bolt Testing Machine	冷裂纹敏感性试验 / Cold Crack Susceptibility Test
金相显微镜 / Metallographic Microscope	高倍和低倍分析 / High And Low Times Analyze
腐蚀实验室 / Corrosion Testing Lab	SSC试验 / Sulphide Stress Cracking Test HIC试验 / Hydrogen Pressure Induced Cracking Test
直读光谱仪 / Direct-reading Optical Spectrometer	化学分析 / Chemical Analysis
红外碳硫分析仪 / Infrared C-S Analytic Instrument	化学分析 / Chemical Analysis
氧氮氢联测仪 / O-N-H Analytic Instrument	化学分析 / Chemical Analysis
水压爆破实验室 / Supplementary Hydrostatic Test Lab	爆破试验 / Supplementary Hydrostatic Test
CTOD试验机 / CTOD Tester	CTOD试验 / CTOD Test

9 产品性能与尺寸公差

Product Property and Dimensional Tolerance

1、直径公差、椭圆度、管端尺寸 / Outside Diameter, Ovality, Pipe End Preparation

标准 Standard	外径 / Outside Diameter(mm)				椭圆度 / Out of Roundness(mm)		管端加工 / Pipe End Preparation					
	外径区间 Outside Diameter Range	管体 Pipe Body	管端 Pipe End	两端外径差 Greatest Difference in Pipe Diameter Between Pipe Ends	管体 Pipe Body	管端 Pipe End	坡口 Bevel Angle	钝边 Root Face	切斜 Squareness			
API SPEC 5L	508.0 ≤ D ≤ 914.4	+0.75% / -0.25%	+2.4mm / -0.8mm	≤2.4mm	±1%	±1%	30° (+5°, -0°)	1.6mm ± 0.8mm	Max. 1.6mm			
	914.4 < D ≤ 1422.4	+6.4mm / -3.2mm										
GB/T 9711.1 / ISO3183-1	508.0 ≤ D ≤ 914.4	+0.75% / -0.25%	+2.38mm / -0.79mm	≤2.38mm	±1%	±1%						
	914.4 < D ≤ 1422.4	+6.35mm / -3.2mm										
GB/T 9711.2 / ISO3183-2	508.0 ≤ D ≤ 610.0	±0.5mm或±0.75%D (取较大者/ Take Lager) 但最大为 /max. ±3mm	±0.5mm或±0.5%D (取较大者/ Take Lager) 但最大为 /max. ±1.6mm	-	2%	1.5%	30° (+5°, -0°)	1.6mm ± 0.8mm	0.005D, Max. 1.6mm			
	610.0 < D ≤ 1422.4	±0.5%D, 最大为 /max. ±4mm	±1.6mm							D/T ≤ 75时, 1.5% (但最大为 /max. 15mm); D/T > 75时, 2%D	D/T ≤ 75时, 1%; D/T > 75时, 1.5%D	
GB/T 9711.3 / ISO3183-3	508.0 ≤ D ≤ 610.0	±0.5mm或±0.75%D (取较大者/ Take lager) 但最大为 /max. ±3mm	±0.5mm或±0.5%D (取较大者/ Take lager) 但最大为 /max. ±1.6mm	-	2% (海洋管线1.5% /) (For Offshore Pipeline 1.5%)	0.5% (海洋管线1.0%) (For Offshore Pipeline 1.0%)				30° (+5°, -0°)	1.6mm ± 0.8mm	0.005D, Max. 1.6mm
	610.0 < D ≤ 1422.4	±0.5%D, 最大为 /max. ±4mm	±1.6mm									
DNV-OS-F101	508.0 ≤ D ≤ 610.0	±0.5mm或±0.75%D, 最大为 /max. ±3mm	±0.5mm或±0.5%D, 最大为 /max. ±1.6mm	≤12.5%T	D/T ≤ 75时, 1.5%D, 最大 /max. 15mm; D/T > 75时, 2%D, 最大 /max. 15mm	D/T ≤ 75时, 1.0%D, 最大 /max. 7.5mm; D/T > 75时, 1.5%D, 最大 /max. 7.5mm	-	-	-			
	610.0 < D ≤ 1422.4	±0.5%D, 最大为 /max. ±4mm	±1.6mm									

当静水压试验压力高于标准压力时, 可协议采用其他公差
 备注: 表中D表示名义外径, L表示钢管长度, T表示钢管名义壁厚。
 If the hydraulic pressure is higher than the standard pressure, other tolerance can be adopted by agreement.
 Note: D-Nominal outside diameter, L—Pipe length, T—Nominal wall thickness

9 产品性能与尺寸公差

Product Property and Dimensional Tolerance

2、壁厚公差、重量公差、直度公差 / Wall Thickness, Weight, Straightness

标准 Standard	壁厚公差 / Wall Thickness Tolerance			单根重量公差 Single Pipe Weight Tolerance	直度(mm) Straightness
	钢级 Grade	壁厚区间 (mm) Wall Thickness Range	公差 Tolerance		
API SPEC 5L	不高于B级 ≤B	6≤T≤40	+17.5%/-12.5%	+10%/-3.5%	≤0.2%L
	不低于X42 >X42	6≤T≤40	+19.5%/-8.0%		
GB/T 9711.1 / ISO3183-1	不高于L245 ≤L245	6≤T≤40	+17.5%/-10.0%	+10%/-3.5%	≤0.2%L
	L290~L555	6≤T≤40	+19.5%/-8.0%		
GB/T 9711.2 / ISO3183-2	全部 All	6≤T≤10	+1.0mm/-0.5mm	+10%/-3.5%	≤0.2%L, 局部<4mm/m Some Part<4mm/m
		10<T<20	+10%/-5%		
		T≥20	+2mm/-1mm		
GB/T 9711.3 / ISO3183-3	全部 All	T≤6	±0.5mm	+10%/-3.5%	≤0.15%L, 局部<3mm/m Some Part<3mm/m
		6<T≤15	±0.75mm		
		15<T≤20	±1.0mm		
		T>20	+1.50mm/-1.00mm		
DNV-OS-F101	全部 All	T≤15	±0.75mm	+10%/-3.5%	≤0.15%L
		15<T≤20	±1.0mm		
		T>20	+1.50mm/-1.00mm		

3、产品力学性能 / Product Mechanical Properties

标准 Standard	钢级 Grade	屈服强度 Yield Strength (MPa)		抗拉强度 Tensile Strength (MPa)		延伸率 Elongation (%) ①min	夏比冲击试验0°C / Charpy Impact Test 0°C			落锤撕裂试验 DWTT②						
							最小冲击功 / Minimum Impact Energy (J)				平均最小 剪切面积③ Min. Shear Area③					
			管体纵向 Pipe Body Longitudinal	管体横向 Pipe Body Transverse	焊缝 Welded Seam											
API SPEC 5L	PSL1					公式见④ Formula Note④	-	-	-	-	-					
	B	≥241	≥414													
	X42	≥290	≥414													
	X46	≥317	≥434													
	X52	≥359	≥455													
	X56	≥386	≥490													
	X60	≥414	≥517													
	X65	≥448	≥531													
	X70	≥483	≥565													
	PSL2															
		Min.	Max.	Min.	Max.							Avg⑤				
	B	241	448	414	758							41(31)	27(21)			
	X42	290	496	414	758							41(31)	27(21)			
	X46	317	524	434	758							41(31)	27(21)			
X52	359	531	455	758	41(31)	27(21)										
X56	386	544	490	758	41(31)	27(21)										
X60	414	565	517	758	41(31)	27(21)										
X65	448	600	531	758	41(31)	27(21)										
X70	483	621	565	758	41(31)	27(21)										
X80	552	690	621	827	101(76)	68(51)		70%	60%(40%)							
GB/T 9711.1 / ISO3183-1	L245	≥245	≥415	21	-	-	-	-	-							
	L290	≥290	≥415	21												
	L320	≥320	≥435	20												
	L360	≥360	≥460	19												
	L390	≥390	≥490	18												
	L415	≥415	≥520	17												
	L450	≥450	≥535	17												
	L485	≥485	≥570	16												
L555	≥555	625	825	15	68(27)⑥		70%(40%)	60%(40%)								

9 产品性能与尺寸公差

Product Property and Dimensional Tolerance

3、产品力学性能 / Product Mechanical Properties

标准 Standard	钢级 Grade	屈服强度 Yield Strength (MPa)		抗拉强度 Tensile Strength (MPa)		延伸率 Elongation (%) ①min	夏比冲击试验0°C / Charpy Impact Test 0°C				落锤撕裂试验 DWTT②		
		最小冲击功 / Minimum Impact Energy (J)						平均最小 剪切面积③ Min. Shear Area③					
		R _{10.5} Min.	R _{10.5} Max.	R _m Min.	R _{10.5} /R _m Max.	管体纵向 Pipe Body Longitudinal	管体横向 Pipe Body Transverse		焊缝 Welded Seam	管体纵向 Pipe Body Longitudinal		管体横向 Pipe Body Transverse	焊缝 Welded Seam
							<610 ≤720	<720 ≤1220	<1220 ≤1422	所有④			
GB/T 9711.2 / ISO3183-2	L245NB	245	440	415	0.80	22	60(45)	40(30)	42(32)	40(30)	-		
	L245MB				0.85								
	L290NB	290	440	415	0.80	21							
	L290MB				0.85								
	L360NB	360	510	460	0.85	20							
	L360MB				0.85								
	L415NB	415	565	520	0.85	18							
	L415MB				0.85								
	L450MB	450	570	535	0.87	18						43(32)	47(35)
	L485MB	485	605	570	0.90	18						68(51)	58(44)
L555MB	555	675	625	0.90	18	92(69)	87(65)	96(72)					
Avg: 85%													

①注：括号内为冲击功单值最小值，括号外为冲击功平均值。
 ②注：括号内为每炉批的最低平均值要求，括号外为所有炉批的最低平均值要求。
 ③延伸率标距：API SPEC 5L为50.8mm，公式 $e=1944A^{0.2}/U^{0.9}$ (A:拉伸试样横截面积，U:规定抗拉强度最小值),GB/T9711.1,GB/T9711.2为 $5.65 \times$ 试样截面面积^{1/2};
 ④若考虑API 5L标准中的补充断裂韧性，则要求PSL2产品规范钢级X80的0°C的全尺寸横向冲击功≥80J；X80钢级以下的要求≥40J。
 ① Note: The value inside bracket is the minimum single value, outside bracket is the average value.
 ② Note: The value inside bracket is the minimum average requirement for each heat, outside bracket is the minimum average requirement for all heat.
 ③ Elongation gauge length: API SPEC 5L(50.8mm),equation $e=1944A^{0.2}/U^{0.9}$ (A: cross sectional area of the tensile test specimen(in.²)(mm²), U: specified tensile strength(ksi)(MPa)), $5.65 \times S_0^{1/2}$ (S₀: cross sectional area of the tensile test specimen)for GB/T9711.1,GB/T9711.2.
 ④ If supplementary fracture toughness tests is required according to API 5L, the full size transverse impact energy for grade X80 should not lower than 80J; the others should not lower than 40J.

标准 Standard	钢级 Grade	管体①/Pipe Body				焊缝②/Weld Seam		夏比冲击功 / Charpy V-Notch Impact Energy				
		屈服强度 Yield Strength (MPa)	抗拉强度 Tensile Strength (MPa)	屈强比③ Ration Max	延伸率④ Elongation (%)	抗拉强度 Tensile Strength	弯轴直径D Diameter of Mandrel for Bend Test	试验温度与壁厚(T) mm			平均值 Average	单个最小值 Min. Individual Value
								T≤20	20<T≤30	T>30		
		R _{10.5}	R _m Min.	R _{10.5} /R _m	A%Min.						J	J
GB/T 9711.3 / ISO3183-3 (非酸性环境) (Non-Sour Service)	L245NC	245-440	415	0.90	22	415	3T	TD-10°C	TD-20°C	TD-30°C	27	22
	L290NC	290-440	415	0.90	21	415	3T	TD-10°C	TD-20°C	TD-30°C	30	24
	L360NC	360-510	460	0.90	20	460	4T	TD-10°C	TD-20°C	TD-30°C	36	30
	L290MC	290-440	415	0.90	21	415	3T	TD-10°C	TD-20°C	TD-30°C	30	24
	L360MC	360-510	460	0.90	20	460	4T	TD-10°C	TD-20°C	TD-30°C	36	30
	L415MC	415-565	520	0.92	18	520	5T	TD-10°C	TD-20°C	TD-30°C	42	35
	L450MC	450-570	535	0.92	18	535	6T	TD-10°C	TD-20°C	TD-30°C	45	38
	L485MC	485-605	570	0.92	18	570	6T	TD-10°C	TD-20°C	TD-30°C	50	40
	L555MC	555-675	625	0.92	18	625	6T	TD-10°C	TD-20°C	TD-30°C	56	45

① 壁厚超过25mm的机械性能协议确定。
 ② 屈强比适用于钢管，对原料不做要求，对L415MCS、L450MCS和L485MCS钢级，屈强比经协议可增加到0.93。
 ③ 对M级别的钢管屈强比只适用于纵向试样。
 ④ 这些值适用于从管体上截取的横向试样，采用纵向试样时，延伸率应增加2%。
 ① Mechanical properties that the wall thickness is up to 25mm shall be adopted according to agreement.
 ② The value for the yield strength ratio apply to the product "pipe". They cannot be required for the starting material. For grades L415MCS, L450MCS和L485MCS, the ratio may be increased by agreement to 0.93.
 ③ The R_{10.5}/R_m ratio for M grades applies to transverse test only.
 ④ These values apply to transverse test pieces taken from the pipe body. If longitudinal test pieces are tested. The values of elongation shall be 2 units higher.

9 产品性能与尺寸公差

Product Property and Dimensional Tolerance

3、产品力学性能 / Product Mechanical Properties

GB/T 9711.3 / ISO3183 (酸性环境) (Sour Service)	钢级 Grade	管体 ^① /Pipe Body				焊缝 ^② /Weld Seam		夏比V型缺口冲击功/Charpy V-Notch Impact Energy				
		屈服强度 Yield Strength (MPa)	抗拉强度 Tensile Strength (MPa)	屈强比 ^③ Ration Max	延伸率 ^④ Elongation (%)	抗拉强度 Tensile Strength	弯轴直径D Diameter of Mandrel for Bend Test	试验温度与壁厚(T)mm Test Temperature Thickness			平均值 Average	单个最小值 Min. Individual Value
		R _{10.5}	R _m Min.	R _{10.5} /R _m	A%Min.			T≤20	20<T≤30	T>30	J	J
	L245NCS	245-440	415	0.90	22	415	3T	TD-10°C	TD-20°C	TD-30°C	27	22
	L290NCS	290-440	415	0.90	21	415	3T	TD-10°C	TD-20°C	TD-30°C	30	24
	L360NCS	360-510	460	0.90	20	460	4T	TD-10°C	TD-20°C	TD-30°C	36	30
	L290MCS	290-440	415	0.90	21	415	3T	TD-10°C	TD-20°C	TD-30°C	30	24
	L360MCS	360-510	460	0.90	20	460	4T	TD-10°C	TD-20°C	TD-30°C	36	30
	L415MCS	415-565	520	0.92	18	520	5T	TD-10°C	TD-20°C	TD-30°C	42	35
	L450MCS	450-570	535	0.92	18	535	6T	TD-10°C	TD-20°C	TD-30°C	45	38
	L485MCS	485-605	570	0.92	18	570	6T	TD-10°C	TD-20°C	TD-30°C	50	40

- ① 壁厚超过25mm的机械性能协议确定。
- ② 强比适用于钢管，对原料不做要求，对L415MCS、L450MCS和L485MCS钢级，屈强比经协议可增加到0.93。
- ③ 对M级别的钢管屈强比只适用于横向试样。
- ④ 这些值适用于从管体上截取的横向试样，采用纵向试样时，延伸率应增加2%。
- ① Mechanical properties that the wall thickness up to 25mm and shall be adopted according to agreement.
- ② The value for the yield strength ratio apply to the product "pipe". They cannot be required for the starting material. For grades L415MCS、L450MCS和L485MCS, the ratio may be increased by agreement to 0.93.
- ③ The R_{10.5}/R_m ratio for M grades applies to transverse test only.
- ④ These values apply to transverse test pieces taken from the pipe body. If longitudinal test pieces are tested. The values of elongation shall be 2 units higher.

DNV-OS - F101	钢级 Grade SMYS	屈服强度 ^① Yield Strength	抗拉强度 ^② Tensile Strength	屈强比 ^③ Ration	延伸率 Elongation (%)	最高硬度 Max. Hardness (HV10) BM, WM, HAZ	夏比V型缺口冲击功/Charpy V-Notch Impact Energy							
		MPa (T+L)	MPa (T)	R _{10.5} /R _m	A%Min.		气体/Gas			液体/Liquid			吸收功 ^④ (KVT)	
							试验温度与壁厚(T)mm Test Temperature Thickness			试验温度与壁厚(T)mm Test Temperature Thickness			Impact Energy Min. Jc	
							T≤20	20<T≤40	T>40	T≤20	20<T≤40	T>40	平均 Average	单值最小 Min. Individual Value
	245	245	370	0.90	22	270	T0=Tmin-10	T0=Tmin-20	协议	T0=Tmin	T0=Tmin-10	协议	27	22
	290	290	415	0.90	21	270	T0=Tmin-10	T0=Tmin-20	协议	T0=Tmin	T0=Tmin-10	协议	30	24
	360	360	460	0.90	20	270	T0=Tmin-10	T0=Tmin-20	协议	T0=Tmin	T0=Tmin-10	协议	36	30
	415	415	520	0.92	18	270	T0=Tmin-10	T0=Tmin-20	协议	T0=Tmin	T0=Tmin-10	协议	42	35
	450	450	535	0.92	18	270	T0=Tmin-10	T0=Tmin-20	协议	T0=Tmin	T0=Tmin-10	协议	45	38
	485	485	570	0.92	18	270	T0=Tmin-10	T0=Tmin-20	协议	T0=Tmin	T0=Tmin-10	协议	50	40
	555	555	625	0.92	18	300	T0=Tmin-10	T0=Tmin-20	协议	T0=Tmin	T0=Tmin-10	协议	56	45

- ① 实际纵向屈服强度高于SMYS的量不应大于120MPa。
- ② 纵向SMYS值可比横向所要求的值低5%。
- ③ 测试时KVL值应比所需的KVT值应高50%。
- ④ 对标准材料，纵向屈强比不应大于横向规定最大值0.020，对酸性环境材料不应超过0.030。
- ① The actual yield strength in the longitudinal direction shall not exceed SMYS by more than 120MPa.
- ② SMYS in the longitudinal direction, can be 5% less than the required value in transverse direction.
- ③ The KVL value (when tested) shall be 50% higher than the required KVT value.
- ④ The R_{10.5}/R_m ratio in the longitudinal direction shall not exceed the maximum specified value in the transverse direction, by more than 0.020 for standard material, and more than 0.030 for sour service material.

9 产品性能与尺寸公差

Product Property and Dimensional Tolerance

4、产品化学成分(%) / Chemical Composition (%)

标准 / Standard	等级	钢级 / Grade	C	Si	Mn	P	S	V	Nb	Ti	Ceq	备注
			Max.									
API SPEC 5L	PSL1	B	0.26		1.20	0.030	0.030			0.04		①, ②
		X42	0.26		1.30	0.030	0.030			0.04		②
		X46, X52, X56, X60	0.26		1.40	0.030	0.030	-	-	0.04	-	②
		X65	0.26		1.45	0.030	0.030			0.06		
		X70	0.26		1.65	0.030	0.030			0.06		
	PSL2	B	0.22		1.20	0.025	0.015			0.04		②, ③, ④
		X42	0.22		1.30	0.025	0.015			0.04		②, ④
		X46, X52, X56, X60	0.22		1.40	0.025	0.015			0.04	0.43	
		X65	0.22		1.45	0.025	0.015			0.06		
		X70	0.22		1.65	0.025	0.015			0.06		
GB/T 9711.1 / ISO3183-1	L245	0.26		1.15	0.030	0.030						
	L290	0.28		1.25	0.030	0.030						
	L320, L360	0.30		1.25	0.030	0.030						
	L390, L415	0.26		1.35	0.030	0.030						
	L450	0.26		1.40	0.030	0.030	-	-	-	-		
	L485	0.23		1.60	0.030	0.030						
GB/T 9711.2 / ISO3183-2	L555	0.18		1.80	0.030	0.030						
	L245MB	0.16	0.45	1.50	0.025	0.020	0.04	0.04	-	0.40		
	L290MB	0.16	0.45	1.50	0.025	0.020	0.04	0.04	-	0.40	⑤	
	L360MB	0.16	0.45	1.60	0.025	0.020	0.05	0.05	0.04	0.41		
	L415MB	0.16	0.45	1.60	0.025	0.020	0.08	0.05	0.06	0.42		
	L450MB	0.16	0.45	1.60	0.025	0.020	0.10	0.05	0.06	0.42	②, ⑤	
L485MB	0.16	0.45	1.70	0.025	0.020	0.10	0.06	0.06	0.43			
L555MB	0.16	0.45	1.80	0.025	0.020	0.10	0.06	0.06	协议			

碳含量每降低0.01%，锰允许提高0.05%。但对X42~X52钢级，锰含量最高不允许超过1.50%，对高于X52但低于X70钢级，最高锰含量不允许超过1.65%，对X70及以上钢级，最高锰含量不超过2.00%。
 $C_{eq} = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$
 $P_{cm} = C + Si/30 + (Mn + Cu + Cr)/20 + Ni/60 + Mo/15 + V/10 + 5B$
 ① V+Nb≤0.03% ② V+Nb+Ti≤0.15% ③ V+Nb≤0.06% ④ Pcm≤0.25%
 ⑤ Cu≤0.25%, Cr≤0.30%, N≤0.30%, Mo≤0.10%, TAI: 0.015~0.060%, N≤0.012%, TAI/N≥2

For each reduction of 0.01% below the maximum carbon content, an increase of 0.05% manganese above the specified maximum value is permitted. For grade X42~X52, the maximum manganese content should not exceed 1.50%, for grade higher than X52 but lower X70 the maximum manganese content should not exceed 1.65%, for grade X70 and higher grade, the maximum manganese content should not exceed 2.00%.
 $C_{eq} = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$
 $P_{cm} = C + Si/30 + (Mn + Cu + Cr)/20 + Ni/60 + Mo/15 + V/10 + 5B$
 ① V+Nb≤0.03% ② V+Nb+Ti≤0.15% ③ V+Nb≤0.06% ④ Pcm≤0.25%
 ⑤ Cu≤0.25%, Cr≤0.30%, N≤0.30%, Mo≤0.10%, TAI: 0.015~0.060%, N≤0.012%, TAI/N≥2

	钢级 / Grade	C	Si	Mn ^①	P	S	V	Nb	Ti	其他 ^②	Ceq ^③	Pcm ^④
GB/T 9711.3 / ISO3183-3 (非酸性环境) (Non-Sour Service)	L245NC	0.14	0.40	1.35	0.020	0.010				⑤	0.36	0.19
	L290NC	0.14	0.40	1.35	0.020	0.010	0.05	0.05	0.04	⑤	0.36	0.19
	L360NC	0.16	0.45	1.65	0.020	0.010	0.10	0.05	0.04	⑥, ⑦	0.43	0.22
	L290MC	0.12	0.40	1.35	0.020	0.010	0.04	0.04	0.04	⑤	0.34	0.19
	L360MC	0.12	0.45	1.65	0.020	0.010	0.05	0.05	0.04	⑦	0.37	0.20
	L415MC	0.12	0.45	1.65	0.020	0.010	0.08	0.06	0.06	⑥, ⑦	0.38	0.21
	L450MC	0.12	0.45	1.65	0.020	0.010	0.10	0.06	0.06	⑥, ⑦	0.39	0.22
	L485MC	0.12	0.45	1.75	0.020	0.010	0.10	0.06	0.06	⑥, ⑦	0.41	0.23
L555MC	0.14	0.45	1.85	0.020	0.010	0.10	0.06	0.06		协议		
GB/T 9711.3 / ISO3183-3 (酸性环境) (Sour Service)	L245NCS	0.14	0.40	1.35	0.020	0.003					0.36	0.19
	L290NCS	0.14	0.40	1.35	0.020	0.003	0.05	0.05	0.04		0.36	0.19
	L360NCS	0.16	0.45	1.65	0.020	0.003	0.10	0.05	0.04	⑤	0.43	0.22
	L290MCS	0.10	0.40	1.25	0.020	0.002	0.04	0.04	0.04		0.34	0.19
	L360MCS	0.10	0.45	1.45	0.020	0.002	0.05	0.05	0.04		0.37	0.20
	L415MCS	0.10	0.45	1.45	0.020	0.002	0.08	0.06	0.06	⑥	0.38	0.21
	L450MCS	0.10	0.45	1.55	0.020	0.002	0.10	0.06	0.06	⑥, ⑩	0.39	0.22
	L485MCS	0.10	0.45	1.55	0.020	0.002	0.10	0.06	0.06	⑥, ⑩	0.41	0.23

① 碳含量每降低0.01%，锰允许提高0.05%，锰含量最多可超过上表最大值0.20%；
 ② TAI<0.006； N≤0.012%，TAI/N≥2（不适用于Ti镇静钢）；
 ③ $C_{eq} = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$ ；
 ④ $P_{cm} = C + Si/30 + (Mn + Cu + Cr)/20 + Ni/60 + Mo/15 + V/10 + 5B$ ；
 ⑤ Cu≤0.35%， Ni≤0.30%， Mo≤0.10%， B≤0.0005；
 ⑥ V+Nb+Ti≤0.15%；
 ⑦ Cu≤0.50%， Ni≤0.50%， Cr≤0.50， Mo≤0.50%， B≤0.0005；
 ⑧ TAI<0.006； N≤0.012%， TAI/N≥2（不适用于Ti镇静钢），Cu≤0.35%（协议≤0.10）， Ni≤0.30%， Cr≤0.30， Mo≤0.10%， B≤0.0005；
 ⑨ 若有意加入Ca，则当S≥0.0015%时，Ca/s≥1.5，但Ca含量应限制在0.006%以内；
 ⑩ Mo含量如果超过0.35%应协商确定。

① For each reduction of 0.01% below the maximum carbon content, an increase of 0.05% manganese above the specified maximum value is permitted, the maximum manganese content should not exceed 2.00%.
 ② Al total<0.006； N<0.012%， TAI/N>2 (not available to titanium-killed steels)；
 ③ $C_{eq} = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$ ；
 ④ $P_{cm} = C + Si/30 + (Mn + Cu + Cr)/20 + Ni/60 + Mo/15 + V/10 + 5B$ ；
 ⑤ Cu≤0.35%， Ni≤0.30%， Mo≤0.10%， B≤0.0005；
 ⑥ V+Nb+Ti≤0.15%；
 ⑦ Cu≤0.50%， Ni≤0.50%， Cr≤0.50， Mo≤0.50%， B≤0.0005；
 ⑧ TAI<0.006； N≤0.012%， TAI/N>2 (not available to titanium-killed steels)，Cu≤0.35%（协议≤0.10）， Ni≤0.30%， Cr≤0.30， Mo≤0.10%， B≤0.0005；
 ⑨ If calcium is intentionally added, Ca/s shall be ≥1.5 when S≥0.0015%， but Ca shall be restrict to 0.006%；
 ⑩ Molybdenum content up to 0.35% may be agreed.

	钢级 / Grade SMYS	C ^①	Si	Mn ^②	P	S	Cu	Ni	Mo	Cr ^③	TAL ^④	Nb ^{⑤⑥}	V ^⑦	Ti ^⑧	N ^⑨	B ^⑩	CE ^⑪	Pcm ^⑫
DNV-OS-F101	L245	0.14	0.40	1.35	0.020	0.010	0.35	0.30	0.10	0.30	0.06	—	—	—	0.010	0.0005	0.36	0.19
	L290	0.12	0.40	1.65	0.020	0.010	0.35	0.30	0.10	0.30	0.06	0.04	0.04	0.04	0.010	0.0005	0.34	0.19
	L360	0.12	0.45	1.65	0.020	0.010	0.50	0.50	0.50	0.50	0.06	0.05	0.05	0.04	0.010	0.0005	0.37	0.20
	L415	0.12	0.45	1.65	0.020	0.010	0.50	0.50	0.50	0.50	0.06	0.06	0.08	0.06	0.010	0.0005	0.38	0.21
	L450	0.12	0.45	1.65	0.020	0.010	0.50	0.50	0.50	0.50	0.06	0.06	0.10	0.06	0.010	0.0005	0.39	0.22
	L485	0.12	0.45	1.75	0.020	0.010	0.50	0.50	0.50	0.50	0.06	0.06	0.10	0.06	0.010	0.0005	0.41	0.23
	L555	0.14	0.45	1.85	0.020	0.010	0.50	0.50	0.50	0.50	0.06	0.06	0.10	0.06	0.010	0.0005	0.44	0.25

本化学成分适用于壁厚35mm以下，超过35mm应协议确定；
 炼钢过程中若加入废钢，则下列元素的含量不应超过以下数值，0.03%As，0.01%Sb，0.02%Sn，0.01%Pb，0.01%Bi，0.006%Ca；
 如有意加钙，则当 S≥0.0015%时，Ca/s≥1.5；
 未经特别同意，除了脱氧元素外，其它任何本表未及元素不应有意加入；
 ① 碳含量每降低0.01%，锰允许提高0.05%，锰含量最多可超过上表要求0.10%；
 ② 经协议，Cr含量可以为0.5~1.0%；
 ③ Al/N≥2(不适用于Ti镇静钢)；
 ④ V+Nb+Ti≤0.12%，经协议该值可增加至0.15%；
 ⑤ 对SMYS≥485Mpa的钢种，经协议Ni含量可增加至0.10%；
 ⑥ 经协议，可增加B的含量，但最大不超过30ppm；
 ⑦ $CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$ ；
 ⑧ $P_{cm} = C + Si/30 + (Mn + Cu + Cr)/20 + Ni/60 + Mo/15 + V/10 + 5B$

Chemical composition applies for wall thickness up to 35mm and shall be subject to agreement for larger wall thickness;
 When scrap material is being used in steel production, the amount of the following residual shall be determined and reported and the value shall not exceed: 0.03%As, 0.01%Sb, 0.02%Sn, 0.01%Pb, 0.01%Bi, 0.006%Ca;
 Except for deoxidation elements, other elements than those mentioned in this table shall not be intentionally added if not specifically agreed;
 ① For each reduction of 0.01% below the maximum carbon content, an increase of 0.05% manganese above the specified maximum value is permitted with a maximum increase of 0.1%;
 ② 0.5~1.0%Cr may be used subject to agreement;
 ③ Al/N≥2(not applicable for titanium killed steel);
 ④ V+Nb+Ti≤0.12%, this value may be increased to maximum 0.15% subject to agreement;
 ⑤ For SMYS≥485Mpa, the Nb content may be increased to 0.10% subject to agreement;
 ⑥ Boron(max. 30ppm) may be added subject to agreement;
 ⑦ $CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$;
 ⑧ $P_{cm} = C + Si/30 + (Mn + Cu + Cr)/20 + Ni/60 + Mo/15 + V/10 + 5B$

10 宝钢UOE直缝埋弧焊管线管业绩

Baosteel SAWL Linepipe (UOE) Reference

用户 Customer	项目名 Project	生产 日期 Year	钢级 Grade	规格 Dimensions (diam., WT, length)	数量(吨) Amount supplied (MT)	涂层/交货状态 Coating type /applicator	服役类型 Service type (oil, gas, sour, non-sour)
中石油 CNPC	西气东输一线 The First West-East Natural gas pipeline Project	2008- 2011	X70	1016*21/26.2/30.4 (MM) 12.2 (M)	53,704	3PE	天然气 Gas non-sour service
中石油 CNPC	西气东输二线 The Second West-East Natural gas pipeline Project	2008- 2011	X80	1219*18.4/22/26.4/27.5/33 (MM) 12.2 (M)	321,673	3PE	天然气 Gas non-sour service
中石油 CNPC	西气东输二线 The Second West-East Natural gas pipeline Project	2008- 2010	X70	1016*17.5/21/26.2/30.4 (MM) 12.2 (M)	231,994	3PE	天然气 Gas non-sour service
中石化 Sinopec Group	日照-仪征管线 Rizhao-Yizheng Oil Pipeline,China	2009	X65	914*17.5 (MM) 12.2 (M)	4,847	光管 bare pipe	原油 Oil non-sour service
中海油广东 天然气公司 CNOOC Guangdong Natural Gas Co.,Ltd.	广东管网 Guangdong Local Natural Gas Pipeline,china	2009	X70	914*17.5/22.2/25.0 (MM) 1219*18.4 (MM) 12.2 (M)	5,287	3PE	天然气 Gas non-sour service
中石油 CNPC	泰青威管线 Tai-Qing-Wei Natural Gas Pipe Line	2009	X70	1016*26.2 (MM) 12.2 (M)	34,600	3PE	天然气 Gas non-sour service
深圳管网 Shenzhen Gas Group Co.,Ltd.	深圳天然气管线 Shenzhen Natural Gas Pipeline,china	2009	X65	813*19.1/22.2 (MM) 12.2 (M)	44,429	3PE	天然气 Gas non-sour service
中石油 CNPC	秦沈线 Qinghuangdao- Shenyang natural gas pipeline project	2009	X70	1016*21/26.2 (MM) 12.2 (M)	23,000	3PE	天然气 Gas non-sour service
中石油 CNPC	陕京三线 The third Shanxi-Beijing natural gas pipeline project	2009	X70	1016*17.5/21/26.2 (MM) 12.2 (M)	32,995	3PE	天然气 Gas non-sour service
中石油 CNPC	山东管网 Shandong Natural Gas Pipe Line	2010	X70	1016*17.5 (MM) 12.2 (M)	4,986	3PE	天然气 Gas non-sour service
中石油 CNPC	江苏LNG项目 Jiangsu Lng Pipeline,china	2010	X70	1016*26.2 (MM) 12.2 (M)	12,400	Zinc-rich primer	天然气 Gas non-sour service

用户 Customer	项目名 Project	生产 日期 Year	钢级 Grade	规格 Dimensions (diam., WT, length)	数量(吨) Amount supplied (MT)	涂层/交货状态 Coating type /applicator	服役类型 Service type (oil, gas, sour, non-sour)
武汉天然气 集团 Wuhan Gas Group Co.	武汉天然气管网 Wuhan Natural Gas Pipeline,china	2010	X65	813*11.9/15.9 (MM) 12.2 (M)	6,100	3PE	天然气 Gas non-sour service
澳大利亚 QCLNG公司 QCLNG Pipe Line Pty Ltd.	澳大利亚QGC观想 QGC LNG gas pipeline project	2010- 2011	X70	1067*14.1/18/23.5 (MM) 12.2 (M)	210,489 MT	2FBE	天然气 Gas non-sour service
中石油 CNPC	塔中-轮南管线 Tazhong-lunnan Natural Gas Pipeline,china	2010	X70	813*11.9/12.5/14.2/17.5 (MM) 12.2 (M)	2,500	光管 bare pipe	天然气 Gas non-sour service
中石油 CNPC	川渝天然气管线 Chuanyu Natural Gas Pipeline,china	2010	X70	914*16.0/19.1 (MM) 12.2 (M)	11,400	光管 bare pipe	原油 Oil non-sour service
Transcanada	加拿大 Transcanada 管线项目 Transcanada gas pipeline project	2011	483	1219*17.8 (MM) 18.3 (M)	417	光管 bare pipe	天然气 Gas non-sour service
中海油 CNOOC	南海深水管线项目海管 South China Sea Deep Water Gas Development Project (offshore pipeline)	2011	X65 X70	X65-762*28.6/30.2 (MM) X70-762*/31.8 (MM) 12.2 (M)	42,628	光管 bare pipe	天然气 海底管线 Gas Offshore, non-sour service
中石油东南 亚管道公司 South-East Asia Gas Pipeline Company Limited	缅甸-中国海底管线 Offshore Pipeline Section of Myanmar-China Gas Pipeline Project (Myanmar Section)	2011	X70	1016*25.4 (MM) 12.2 (M)	3,630	光管 bare pipe	天然气 海底管线 Gas Offshore, non-sour service
中海油广东 天然气公司 CNOOC Guangdong Natural Gas Co.,Ltd.	广东管网项目 Guangdong Local Natural Gas Pipeline (The Second Phase)	2011	X70	1016*25 (MM) 12.2 (M)	34,000	3PE	天然气 Gas non-sour service
中石油 CNPC	伊宁-霍尔果斯项目 Yining-Huoguoosi Gas Pipe Line	2011	X80	1219*26.4/33 (MM) 12.2 (M)	14,772	3PE	天然气 Gas non-sour service
中石油 CNPC	新疆呼图壁 储气库项目 Xinjiang Hutubi Gas Pipe Line	2011	X80	1219*26.4 (MM) 12.2 (M)	11,501	3PE	天然气 Gas non-sour service

10 宝钢UOE直缝埋弧焊管线管业绩

Baosteel SAWL Linepipe (UOE) Reference

用户 Customer	项目名 Project	生产 日期 Year	钢级 Grade	规格 Dimensions (diam., WT, length)	数量(吨) Amount supplied (MT)	涂层/交货状态 Coating type /applicator	服役类型 Service type (oil, gas, sour, non-sour)
陕西天然气公司 Shanxi Province Natural Gas Co.	靖边-西安 管线项目 Jingbian-Xian Natural Gas Pipe Line Project	2011	X70	914*16/19.1 (MM) 12.2 (M)	10,351	3PE	天然气 Gas non-sour service
中石油 CNPC	中卫-贵阳 管线项目 Zhongwei-Guiyang Natural Gas Pipe Line	2011	X80 X70	X80-1016*15.3/18.4/22.9 (MM) X70-813*17.5/21 (MM) 12.2 (M)	34,186	3PE	天然气 Gas non-sour service
Petrogas	stainalloy	2011	X80	914*19 (MM) 12.2 (M)	1,668	Zinc-rich primer (inorganic ethyl zinc silicate)	天然气 Gas non-sour service
中石油 CNPC	辽河油田项目 Liaohe Oil Field Pipe Line Project	2011	X70	1016*17.5/26.2 (MM) 660*20/22.2 (MM) 12.2 (M)	7,978	光管 bare pipe	天然气 Gas non-sour service
中石油 CNPC	中缅管线项目 国内段 Myanmar-China Gas Pipeline Project (China Section)	2011	X80	1016*18.4 (MM) 12.2 (M)	12,446	3PE	天然气 Gas non-sour service
中石油 CNPC	西二线轮南-吐鲁番 支线项目 Lunnan-Tulufan Branch Pipe Line of the second West-East natural gas pipeline project	2011	X70	1016*21 (MM) 12.2 (M)	9,125	3PE	天然气 Gas non-sour service
中石油 CNPC	中缅中国段 抗大应变钢管 Strain-based design Pipeline Section of China-Myanmar Gas Pipeline Project (China Section)	2012	X70	1016*17.5 (MM) 12.2 (M)	10,245	3PE	天然气 抗大应变设计 Gas Strain-based design, non-sour service
中石油 CNPC	哈萨克斯坦北特鲁瓦外输管线项目 Kazakstan Beitelu field output Pipeline Project	2012	L360MS	559*12.5/16 (MM) HIC &SSC Test 12.2 (M)	7,500	光管 bare pipe	天然气 抗硫服役 Gas Sour service

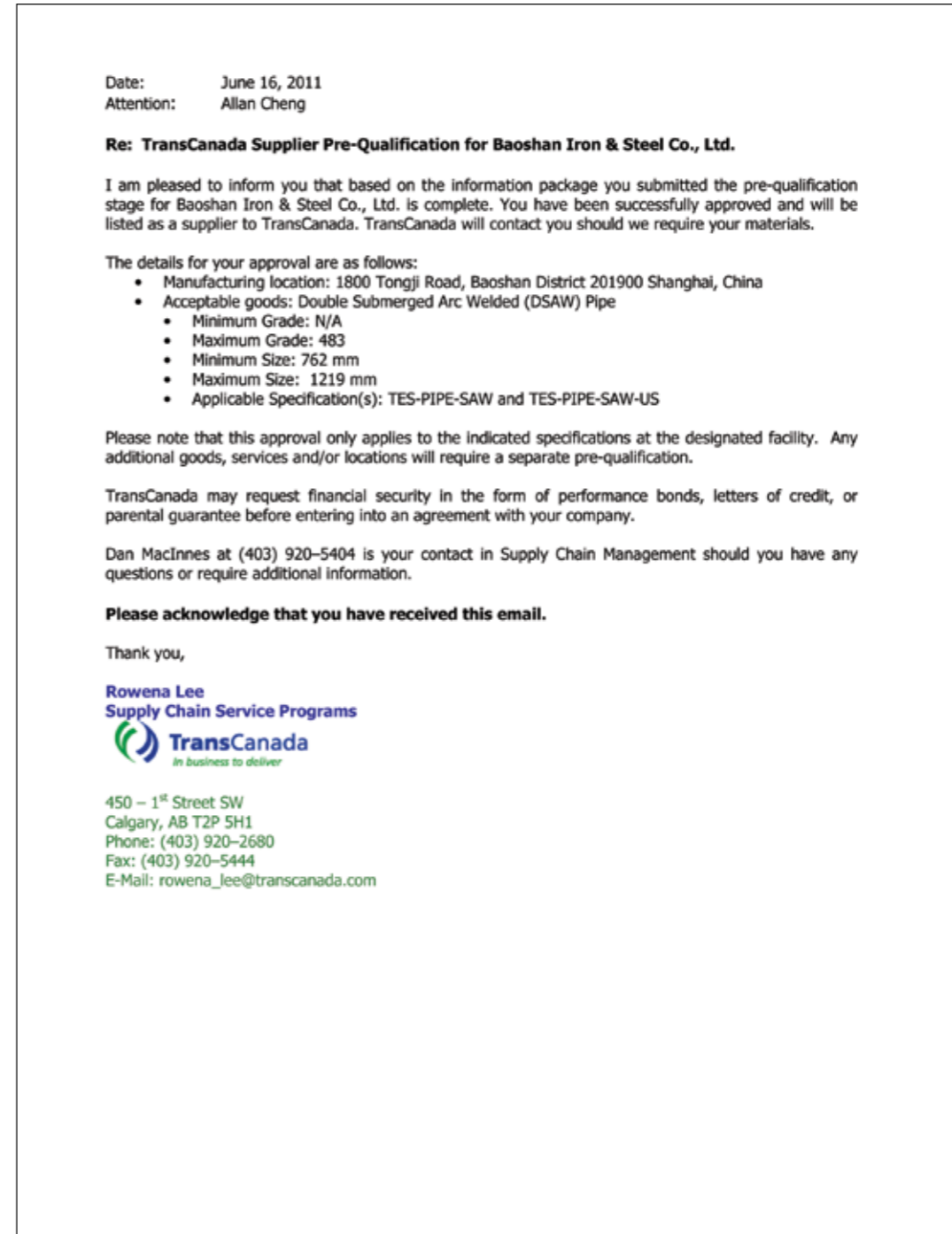
用户 Customer	项目名 Project	生产 日期 Year	钢级 Grade	规格 Dimensions (diam., WT, length)	数量(吨) Amount supplied (MT)	涂层/交货状态 Coating type /applicator	服役类型 Service type (oil, gas, sour, non-sour)
中石油 CNPC	土库曼斯坦南约落坦天然气管线 Turkmenistan South Yolotan gas pipeline project	2012	L360MS	711*25/28/32 (MM) HIC &SSC Test 12.2 (M)	15,603	3PE	天然气 抗硫服役 Gas Sour service
中海油 CNOOC	珠海高栏项目 Zhuhai gas pipeline project	2012	X65	1422*28.6 (MM) 12.2 (M)	4,900	Zinc-rich primer	天然气 Gas non-sour service
中石油 CNPC	西气东输三线项目 The Third West-East Natural gas pipeline Project	2012	X80	1219*19.1/22 (MM) 12.2 (M)	8,700	3PE Bare pipe	原油 Oil non-sour service
中石油 CNPC	西气东输三线项目站场用管 The Third West-East Natural gas pipeline Project Station Pipe	2012	X80 X70 X60	1219*27.5(MM) 1016*26.2(MM) 914*30(MM) 711*22.2(MM) 610*22.2(MM) 12.2 (M)	7,500	3PE Bare pipe	天然气 -45℃冲击要求 Gas non-sour service CVN-45℃
TOTAL					1,199,782MT		

11 证书

Certificates

宝钢UOE直缝埋弧焊钢管通过壳牌石油认证、加拿大TransCanada公司认证、中亚Gost认证、Ausenco PSI公司认证。

The Baosteel UOE Longitudinal Seam Submerged-Arc Welded Pipe was approved by Shell Company, TransCanada Company, Ausenco PSI Company and Gost.



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欧非中东大区 Europe, Africa & Middle East Region

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