DONGBEI SPECIAL STEEL GROUP CO.,LTD.
FUSHUN SPECIAL STEEL CO.,LTD.

Superalloy & Corrosion-resisting Alloy

Advancement in Solution Plan for Metallic Materials

CHINA · FUSHUN

INTRODUCTION

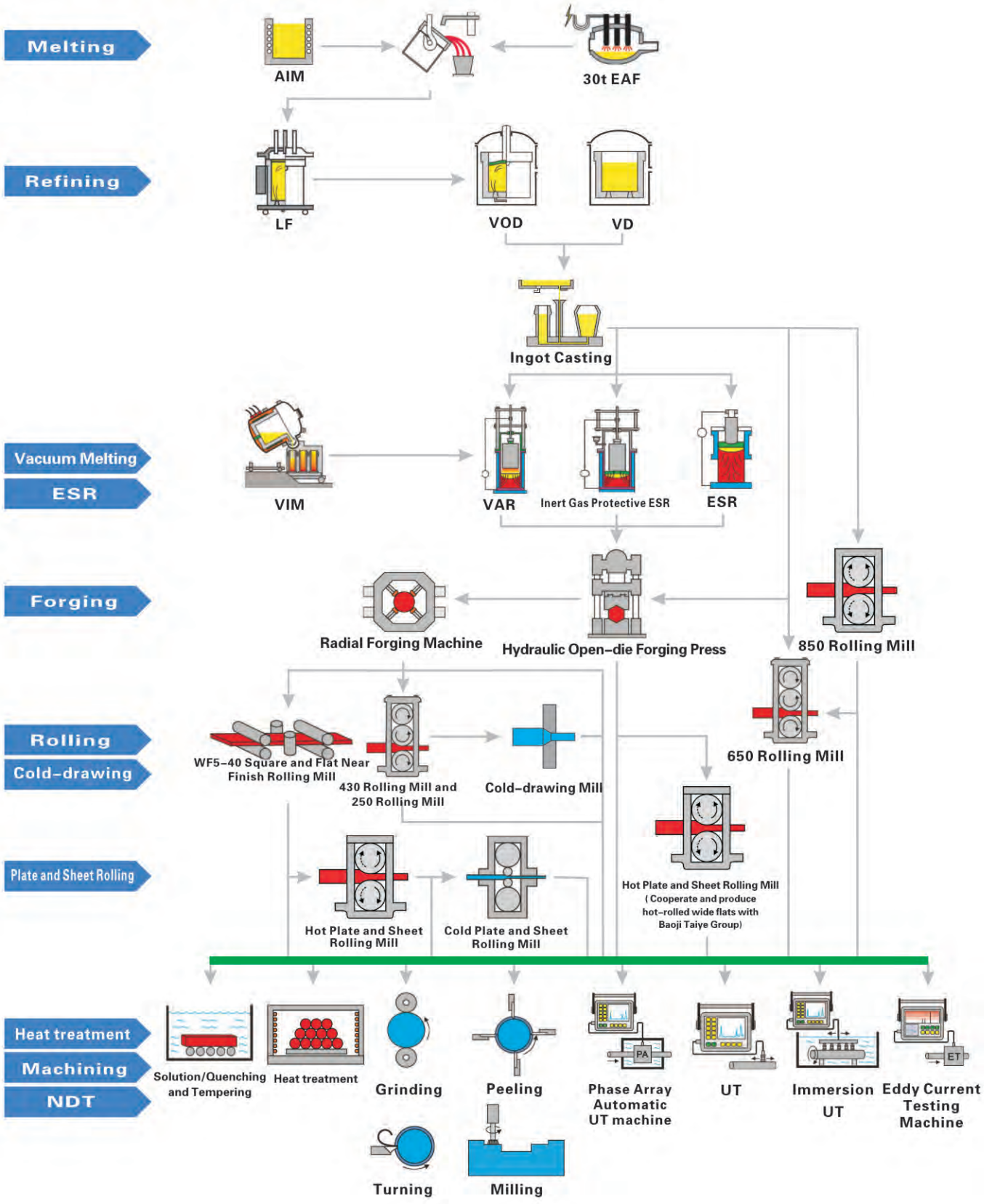
The first heat of superalloy of GH30 was produced in Fushun Special Steel Co.,Ltd. in New China in March 1956.

Fushun Special Steel Co.,Ltd.(hereinafter referred to as FSSS for short)was set up in 1937, the former Fushun Steel Plant, which is the scientific research and production base of wrought superalloys for aerospace and aviation in China. FSSS, Dalian Iron and Steel Plant and Beiman Special Steel Plant were reorganized to form Dongbei Special Steel Group Co., Ltd . in Sep., 2004. FSSS has the total assets of 10 billion RMB with the manufacturing capacity of 1 million tons of steel and 0.9 million tons of finished products. FSSS has employees of over 8,600, of which special technicians are over 1,100. FSSS has one technical center, which was promoted to one of the first batch of National Enterprises Technical Center in 1993, and became Enterprise Postdoctoral Science and Research base in Liaoning Province in 2007. There are 5 senior engineers at professor level as well as 30 senior engineers in Technical Center, which is the largest in size and the highest in specializing level among Enterprise Technical Centers.

FSSS is the special steel enterprise that produces the largest amount of superalloy and corrosion–resisting alloy in China. FSSS successively supplied batches of key special steel materials for China's First Man–made Earth Satellite, First Missile, First Submarine as well as several items of National Key Projects and Defense Projects, and also supplied critical materials for "Long March" series of Rockets, "Shenzhou" series of Aviation Airship and "No.1 Chang'e" Moon Exploration Project. Many kinds of high–strength superalloy representative of GH202 and GH586 alloys have been successfully developed, which are applied in Aerospace Engineering Projects such as XXX series, liquid oxygen kerosene engine, liquid hydrogen and liquid oxygen engine and XXX engine. In FSSS, A Superalloy turbine disc with the diameter of 1.2 meter was trail–produced and made success for the first time, which initiates the research and development of hard deformable superalloy turbine disc with high property and large size at home, so as to meet the demands of the user. New types of alloy such as GH4049, GH220, GH698 and GH99 have been developed and produced employing the technology and process with Chinese characteristics while improving the chemical composition and heat treatment system on the basis of foreign alloy grades.

Superalloy products have stable quality in actual product and good reputation in the market. They can be produced in accordance with general used standards (GB,GJB,HB,ASME,AMS,ISO) and special demands of users. Superalloys and corrosion resistant alloys include forged bars, forgings, rolled bars, cold–rolled sheets and hot–rolled sheets, cold drawn bars with over 8000 specifications and can be delivered in the specified conditions in accordance with requirements of users.

Manufacturing Process



Nickel–base Superalloy(Corrosion–resisting Alloy)

Alloy Grade	Foreign Alloy Grade	Density g/cm^3	Working Temperature ℃	Material Feature
GH3030	э и435	8.40	700	The alloy has good anti–oxidation,hot fatigue property, cold punching and welding ability; and it has satisfied hot strength and high plasticity up to 800℃.
GH4033	э и437	8.20	700	The alloy has sufficient high–temperature strength at a temperature between 700℃and 750℃,and good anti–oxidation ability up to 900℃, beside is has good cold–working and hot–working ability.
GH4133A		8.14	750	Alloying treatment on the basis of GH33, GH4133A alloy has comprehensive property, uniform and fine grain, high yield strength, and hot formability below 750 ℃.
GH4133B		8.14	750	Adding microelements on the basis of GH4133A, GH4133B alloy has longer endurance life and improved plasticity, and the notch sensitivity has been eliminated.
GH4037	э и617	8.37	800	The alloy has high hot–strength, good comprehensive property and stable structure up to 850℃.
GH3039	э и602	8.30	800	The alloy has intermediate hot–strength and good hot–fatigue property below 800℃ and good oxidation resistance up to 1000℃ ,and it has stable structure while using for a long period, and it also has good cold –formability and weldability.
GH3044	э и868	8.89	900	It is the Solution–strengthening alloy with oxidation resistance and it has high plasticity and medium hot–strength, excellent oxidation resistance, good punching and weldability, and it has stable structure while working for a long period up to 900℃.
GH4049	э и929	8.44	900	It is the hard deformable nickel–base superalloy with high alloying, and it has good oxidation resistance up to 1000℃, better high–temperature strength up to 950℃.
GH4080A	Nimonic80A	8.23	750	The alloy has simple chemical composition, equivalent property as GH33, fine structure, and has good plasticity while hot worked at wide–ranged hot working temperatures.
GH4098	э и99	8.44	900	It is a kind of diffusion strengthening alloy with high alloying and hot–strength, and the working temperature of the alloy can reach as high as 1000℃, It can be used as materials for turbine guide vanes and force enhancing combustion chambers. It has good anti–oxidation, ablity cold–fatigue property, hot–fatigue property and weldability up to 900℃.
GH4099	э и693	8.77	900	It is the nickel–base aging alloy with high alloying. It has higher hot strength, stable structure, satisfied hot–formability and cold–formability and good weldability. The alloy can be using for a long period below 900℃, and the working temperature can reach as high as 1000℃.
GH4105	Nimonic105	8.01	950	It has high resistance to complex stress including vibration, gas abrasion, stress distortion and bend etc, and it can be made into high–temperature turbine vanes of airplane engine.
GH3110		8.21		The alloy has good resistance to high temperature, hydrogen fluoride gas, hydrogen chloride gas and fluorine gas attack; and it is easily weldable; besides, it is mainly applied to atomic energy, chemical industry and melting equipment for nonferrous metals.
GH3111				The alloy is suitable for being used in the cold condensation condition with the medium of F^-, Cl^- and ammonia acid etc., and it also has good corrosion resistance to H_2SO_4, HNO_3 and their mixed solutions.
GH3128		8.81	950	The alloy has high plasticity, higher persistent creep–strength and good anti–oxidation, punching and welding property. It has excellent comprehensive property, and it can be working for a long period below 950℃.

Nickel–base Superalloy (Corrosion–resisting Alloy)

Alloy Grade	Foreign Alloy Grade	Density g/cm³	Working Temperature ℃	Material Feature
GH4141	Rene41	8.27	900	The alloy has high tensile strength, durable creep strength, and good anti–oxidation ability at a temperature between 650℃ and 900 ℃.
GH4145	N07750	8.25	800	The alloy has good strength, corrosion resistance and oxidation resistance up to 980℃ and it also has better low–temperature property and good formability. It is mainly made into gas turbine parts in aviation and industry, inner wal l of combustion chamber for rocket engine, high–temperature springs and bolts, washers, and it can also be used in glass manufacturing industry.
GH4163	C263	8.35	800	The alloy has higher yield strength and creep strength, good cold–fatigue property and hot– fatigue property, and low tendency to strain and aging cracks as well as good plasticity, cold–formability and hot– fomability, and weldability up to 800℃, it has excellent strength at a temperature between 540℃ and 870℃ . It is applied to combustion cylinders, installed edges and other force loading components for aviation engine and gas turbine.
GH3182	HastelloyC4	8.77	800	It has good and stable property at high temperature, excellent toughness and corrosion resistance at a temperature between 650℃ and 1040℃, and it has the same corrosion resistance as NS334.
GH4199	э п 199	8.64	950	This alloy has higher high–temperature strength, excellent oxidation resistance, it is weldable to some extent and it can be using for a long period below 950℃.
GH4202	э п 202	8.37	850	This alloy has higher strength and plasticity, satisfied formability and welding property, good corrosion resistance and anti–oxidation ability; and it has stable structure and property at the temperature ranging from –253℃ up to 850℃. It can be used at deep cooling and high temperatures with multiple usages.
GH4220	э п 220	8.36	950	It is the hard deformable nickel–base alloy with high alloying and high property.
NS311	э и 442			The alloy not only has excellent resistance to oxidative mediums such asmixed solutions of nitric acid and hydrofluoric acid at high temperature as well as fluorine gas at relatively lower temperature, but also has high strength and good anti–oxidation ability. It can be made into non–magnetic structural components which are exposed to extremely corrosive environment with high–temperature nitric acid.
NS312	N06600			It is the solution strengthening alloy with heat resistance and corrosion resistance, and it has good resistance at high temperature and good anti– oxidation ability, cold and hot working ability, low temperature mechanical property, and cold and hot fatigue property. It has higher strength and good formability and weldability below 650℃. It is applied to the equipments of heat treatment and chemical processing industry.
NS321	HastelloyB	9.24		It is resistant to reductive mediums, and it is suitable for equipments which are exposed to hot and strong hydrochloric acid and hydrogen chloride gas , and it is also suitable for parts for old type of internal combustion engines and rocket engines. It also has better strength at as high as 1095℃.
NS322	HastelloyB2			It has excellent resistance to strong reductive chemicals such as hydrochloric acid, aluminum chloride catalyzer, and good resistance to intergranular attack. And it is suitable for the equipments which are exposed to the hydrochloric acid and medium sulfuric acid environments (especially at high temperature).
NS333	Hastelloy C			It has basically he same corrosion resistance as NS334 and better radiation resistance.

Nickel–base Superalloy (Corrosion–resisting Alloy)

Alloy Grade	Foreign Alloy Grade	Density g/cm³	Working Temperature ℃	Material Feature
NS334	N10276			It is the corrosion–resisting alloy with multiple excellent properties with good resistant ability to oxidation and intermediate reductive medium, and it has excellent anti–stress corrosion cracking ability and good local corrosion resistance. It has satisfied corrosion resistance to many chemical mediums such as inorganic acid solution with strong attack, chlorine, various mediums containing chloride, dried chlorine, formic acid and acetic acid, acid anhydride, seawater, salt water and the like with strong erode
NS335	Hastelloy C4	8.77		The alloy is resistant to oxidative and reductive compound rich in Chlorine ion and has good hot–stability in structure; it is applied to equipments which are exposed to wet chlorine, hypochlorous acid, sulfuric acid, hydrochloric acid, mixed acids, chloride, and it can be used as soon as it is welded. The alloy has good high–temperature stability, high toughness and corrosion resistance at a temperature between 650℃ and 1040℃, be sides, the alloy has the same basic corrosion resistance as NS334.
M–400	N04400	8.83		It is the corrosion–resisting alloy with high heat resistance and high Ohm resistance, and it has better resistance to kinds of non–oxidation halogens.
GH4500	Udimet500	8.03	870	It is the precipitation–strengthening aging alloy with high aluminum and high titanium, having high yield strength and fracture strength, and it can be applied to the engine turbine discs of helicopters.
GH3520	Udimet520	8.4	980	It is the precipitation–strengthening nickel–base alloy with high alloying, and it can be used for a long period up to 980℃. It has excellent tensile strength, higher hardness and good anti–oxidation ability at elevated temperature.
GH3536	HastelloyX	8.27	900	The alloy has the equivalent property to that of GH3044, and it is applied to the combustion chamber for airplane engine and other high–temperature parts requiring long–period service life up to 900℃.
GH4586		8.47	850	It is the self–developed nickel–base superalloy with hard deforming, and it has higher yield and durable creep strength, and excellent anti–oxidation ability at the temperature ranging from –196℃ up to 800℃. Currently, it is the turbine disc materials with the best comprehensive property at home. However, the alloy has poor resistance to sodium salt attack while working at over 1050℃.
GH3600	N06600	8.42	850	It is the Solution–strengthening alloy with heat resistance and corrosion resistance, having excellent comprehensive properties including good high–temperature resistance and oxidation resistance, good cold–working and hot–working ability, good low–temperature mechanical property, and good fatigue property at both low temperature and heat temperature. It has higher strength, good formability and weldability up to 650℃. As it has high corrosion resistance to various waste gas, alkaline solution, most organic acid and compound, and it is not sensitive to stress corrosion of chlorine ion, it is suitable to be used in petroleum and chemical industry.
GH3625	N06625	8.44	815	The alloy has good corrosion resistance and anti–oxidation ability, and good tensile and fatigue property from low temperature up to 980℃, and stress corrosion resistance in salt mist condition.
GH4648	э п 648	8.31	800	It is the high chromium alloy with good corrosion resistance and comprehensive mechanical property at high temperature.
GH4698	э и 698	8.31	750	It has high durable strength and good comprehensive property at the temperature ranging from 550 up to 800℃, and it has the equivalent property to that of Waspaloy alloy.
GH4708	э и 708	8.55	800	It is the new type of nickel–base aging alloy with good high–temperature strength, excellent oxidation resistance and some weldability, and it can be used for a long period up to 900℃.
GH738 GH864	Waspalloy	8.22	815	The alloy has good resistance to gas attack, higher yield strength and fatigue property, better technological plasticity and stable structure at the temperature from 540℃ up to 815℃.
GH4169	N07718	8.24	700	The alloy has higher yield strength, good plasticity, better weldability and formability as well as higher corrosion resistance, anti–oxidation and irradiation resistance at the temperature up to 650℃, and the alloy has stable structure and property at the temperature ranging from –253℃ up to 700℃.

Cobalt– base Superalloy (Corrosion–resisting Alloy)

Alloy Grade	Foreign Alloy Grade	Density g/cm³	Working Temperature ℃	Material Feature
GH5188	Hastelloy188	9.13	1000	The alloy can be used at high temperature reaching max. 1100℃, having good anti–oxidation and comprehensive mechanical property, stable structure and better plasticity both during cold working and hot working; The alloy has high resistance to sulfide and sodium salt attack.
GH5605	Haynes–25	9.2	1000	The alloy has excellent mechanical property at high temperature, and good anti–oxidation and anti–sulfide ability, better scratch and wear resistance up to 980℃.

Iron–base Superalloy (Corrosion–resisting Alloy)

Alloy Grade	Foreign Alloy Grade	Density g/cm³	Working Temperature ℃	Material Feature
GH1016		8.31	900	It is the iron–base superalloy with complex solid solution strengthening, and it has good oxidation resistance, high plasticity, higher hot strength, good hot fatigue property; good technological property of punching and welding, and the working temperature is up to 950℃, however, it has poor resistance to sulfuric acid and sodium salt attack.
GH26	R26	8.15	600	It is the Fe–Ni–Co–Cr base alloy with high–temperature and corrosion resistant alloy, having excellent relax and creep resistance, and good plasticity at medium temperature, it can be used in steam at a temperature between 540℃ and 570℃. And it was developed to satisfy the requirement of turbine fasteners with 300,000 to 600,000 kilowatt, and therefore it is suitable for fasteners and seals.
GH1035	э и 703	8.17	700	It is the solution–strengthening austenitic iron–base superalloy, whose main property is equivalent to that of GH3039 alloy, while the fatigue property is similar to that of the nickel–base superalloy of the same usage within intermediate temperature ranges. It has better machining plasticity, cold punching and welding ability, but relatively poor resistance to hydrochloric acid attack.
GH2036	э и 481	7.85	650	It is the precipitation–strengthening iron–base superalloy with VC strengthening, having stable structure and good physical, mechanical property and good machinability within medium temperature range, but poor oxidation resistance at high temperature.
GH2038A	э и 696A	7.98	800	It is the precipitation strengthening iron–base superalloy, having sufficient hot strength, good machinability and weldability below 700℃.
GH1125	FN–2	~8.0		Compared to Incoloy800 with high–temperature and corrosion resistance alloy that is popularly applied to nuclear power pipeline system in international at present, GH1125 alloy has improved property but lower price, and it can meet the service demand for structural materials requiring high temperature resistance and corrosion resistance for nuclear power pipeline system, petroleum and chemical and other industrial industry.
GH1131		8.33	900	It is the complex solution–strengthening iron–base superalloy with high property; the alloy has equivalent hot strength to that of GH3044 alloy, and it has excellent hot–working plasticity, and good technological property of welding and cold formability, while the alloy has poorer oxidation resistance at high temperature and stability in structure compared to the nickel–base superalloy of the same application.

Iron–base Superalloy (Corrosion–resisting Alloy)

Alloy Grade	Foreign Alloy Grade	Density g/cm^3	Working Temperature ℃	Material Feature
GH2132	A–286	7.93	650	The alloy has high yield strength, persistent strength and creep strength below 650℃, and it also has good machining plasticity and satisfied welding property.
GH2132B		7.93	750	The alloy has improved comprehensive property by optimizing and adjusting the control range on the basis of GH132 alloy.
GH2135		7.92	700	The alloy has excellent low–cycle fatigue property and better hot–working plasticity, and its yield strength is increased as the working temperature rises up to 700 ℃; But the alloy has poorer resistance to sodium salt attack at high temperature. It can be used for forging die blocks and filled materials for hammer head.
GH2136	V–57	8.04	700	The alloy has improved stability in structure and property while working for a long period by adjusting the chemical composition and decreasing the precipitation of deleterious phases on the basis of GH132 alloy. It is mainly made into elastic components for turbine.
GH1139	э и 835	7.83	700	The alloy has the equivalent property to that of GH3030 alloy with the characteristics of good hot–working plasticity, stability in structure and good weldability.
GH1140		8.09	800	The alloy has medium hot–strength, high plasticity, good hot –fatigue property, stable structure and welding technological ability. It is suitable for being used below 850℃;And it has some resistance to sulfide attack at high temperature, while poor oxidation resistance in the oxygen–rich condition.
GH2150	э п 718	8.26	800	The alloy has the characteristics of high strength, good plasticity, low expansion coefficient, and it has stable structure while working for a long period up to 750℃; Meanwhile, it has good hot–working plasticity and satisfied welding and machinability. However, the alloy has poor resistance to sea salt attack over 900℃.
NS112	N08810	7.95	750	The alloy has the characteristic of excellent mechanical property, corrosion resistance, machinability and weldability. As it has better resistance to attacks of complex mediums such as steam, soft water, mixtures of steam–air–CO_2, various acid solutions, salts and H_2S, it can be applied in many fields.
GH2302		8.09	800	The alloy has stable structure and property while working for a long period below 700℃, and the working temperature can attain as high as 850℃ for a short period. The alloy has poor resistance to sodium salt attack and oxidation at high temperature, and thus it needs to be protected by coating.
GH2696	э и 696M	7.85	750	The alloy has better cold–working, hot–working and anti–oxidation ability, heat and corrosion resistance, and it has good comprehensive property at around 700℃. It can be made into engine fasteners of gas turbine, bear strengths parts, and high temperature elasticity parts of medical instruments.
GH2706	Inconel706	8.07	650	The alloy has good anti–oxidation ability and corrosion resistance in many mediums at wide–ranged temperatures, and it also has good formability, weldability and machinability.
GH2901	Inconel901	8.21	650	The alloy has higher yield strength and persistent strength below 650℃ and good anti–oxidation ability below 760℃, and it has stable structure while working for a long period. It is mainly made into rotating parts, static parts, fasteners and the like for aviation engine and gas turbine requiring working below 650℃.
GH2907	Inconel907	8.30	450	The alloy has lower hot expansion coefficient and nearly constant elasticity modulus below 450℃.
GH984		8.09	700	It is the corrosion–resisting superalloy with iron, nickel and chromium base. It has higher strength and plasticity as well as good resistance to seawater and high–temperature sodium salt attack. It has good formability at both high and low temperature, and better weldability. It can be made into seamless tubes, welded pipes, plates and strips with various dimensions.

Super alloy for Aviation and Aerospace Industry

Superalloy products are widely applied to aviation and aerospace industry in China, and they are mainly made into key components including vanes, turbine discs, casings, fasteners, combustion chambers, plates, and shafts etc. for multiple types of aviation engine, dynamic mechanism for multiple types of rockets and missiles as well as hot end parts for engines. Besides, FSSS has also provided superalloy materials that are made into critical components and parts for the key components and parts for "Shenzhou" series of manned spacecrafts and "Chang'e" moon satellite carrier rocket.

★ Main Grade of Super alloy for Aviation and Aerospace	
GH4169	Mainly for airplane engine vanes, turbine discs and fasteners
GH2907	Mainly for structural components and parts such as aviation engine casing and sealed rings
GH4141	Mainly for aviation engine turbine discs and fasteners
GH4099	Mainly for high-temperature components for combustion chamber of airplane engine and household firebox
GH4133B	Mainly for vanes, turbine discs and fasteners of aviation engine and high-pressure gas compressor
GH3536	Mainly for high-temperature components for combustion chamber of airplane engine and household firebox
GH3128	Mainly for high-temperature components for combustion chamber of airplane engine and household firebox
GH3230	Mainly for high-temperature components for combustion chamber of airplane engine and household firebox

★The Example of Product and its Application			
Grade	GH4169		
Similar Grade	Inconel718		N07718
Main Feature	The alloy has high yield strength, good plasticity below 650℃ ,and it has good weldability and formability, higher corrosion resistance, oxidation and radiation resistance; it has stable structure and property at the temperaturefrom -253℃ up to 650℃.	Mainpplication	Mainly for vanes, turbine discs and fasteners of airplane engine and high-pressure compressor

Chemical Analysis wt%											
C	Cr	Ni	Mo	Nb	Al	Ti	Fe	Mn	Si	S	P
0.04	19.00	53.00	3.10	5.20	0.20	0.90	Bal	0.20	0.10	0.002	0.005

Melting Method
VIM+VAR

Mechanical Property				
Test Temperature	R_m MPa	$R_{p0.2}$ MPa	A5 %	Z %
at room temperature	≥1350	≥1150	≥17	≥34
at 650℃	≥1150	≥1020	≥22	≥38

Superalloy (Corrosion–resisting Alloy) for Nuclear Energy

Superalloy (corrosion–resisting alloy) was developed for nuclear energy by FSSS in 2000, and it is mainly applied to the nuclear dynamic mechanism for nuclear submarine. The quality system for nuclear power product has been established based on the technical advantages of military products with high quality, and then superalloy(corrosion–resisting alloy) has successively been produced for controlling bar drive mechanism and steam generators for nuclear islands and reactor components and parts.

Main Grade, Application and Product of Superalloy (Corrosion–resisting Alloy) for Nuclear Energy

Grade	Application	Main Product	Technical Standard
Incoloy800	Tube billets for steam generator	Forged bars	ASME SB443 ASME SB446 ASME SB166 ASME SB168
N06690	Pipe billets, controlling bar drive organization of steam generator	Forged bars	
Inconel X750	Controlling bar drive mechanism, reactor internals	Rolled round bars, cold-drawn wires	
Inconel 600	Reactor internals	Rolled round bars	
GH4169	Controlling bar drive mechanism, reactor internals	Rolled round bars	
GH2132	Reactor internals	Rolled round bars	
N06625	Controlling bar drive mechanism	Cold–rolled sheets	

★The Example of Product and its Application

Grade	Incoloy800		
Main Feature	High purity, excellent mechanical property, and good corrosion resistance	Main Application	Nuclear power valve

Chemical Analysis wt%

C	Si	Mn	P	S	Cr	Ni	Al	Ti	Fe
0.02	0.20	0.50	0.005	0.002	20.50	31.50	0.18	0.55	Bal

Melting Method

VIM+ESR

Ti/C:20~30 Ti/(C+N) :18~25

Non–metallic Inclusion:
Type A, B,C,D each≤class 0.5 for thin series and class 0 for thick series

Superalloy (Corrosion–resisting alloy) for Turbine

Fushun Special Steel is the special steel enterprise that manufactured superalloy for turbine from the earliest time after the foundation of PRC. Superalloy which is melted with the process of VIM+ESR has high purity, good uniformity in structure and excellent stability in mechanical property for high–temperature components of turbine. The actual product has leading quality level in China.

Main Grade and Application of Superalloy (Corrosion–resisting Alloy) for Turbine	
Grade	Application
GH1016	For turbine impellers and vanes
R26	For turbine vanes
GH2136	For spring pieces of turbine
GH4145	For turbine impellers and connecting bolts
GH4783，GH864	For turbine connecting bolts
N08120	For protecting rings of turbine

★The Example of Product and its Application			
Grade	GH4145		
Similar Grades	Inconel X750	N07750	
Main Feature	The alloy has good strength, good corrosion and oxidation resistance, better property at low temperature and good formability. It is mainly made into turbine parts for aviation gas turbine and for industrial gas turbine, inner wall of combustion chamber for rocket engines, high – temperature springs, bolts and washers; it can also be used in glass manufacturing industry.	Main Application	Turbine and connecting bolts

Chemical Analysis wt%										
C	Si	Mn	S	P	Fe	Ni	Cr	Al	Ti	Nb
0.04	0.20	0.40	0.003	0.005	7.00	Bal	15.50	0.70	2.50	1.00

Melting Method
VIM+ESR

Mechanical Property				
Test temperature	Rm MPa	Rp0.2 MPa	A5 %	Z %
at room temperature	1000	550	12	18

Corrosion-resisting alloy for Petroleum and Petrochemical Industry

High purity and high corrosion resistant alloy has been produced and applied to many domestic chemical equipments based on the long-term production experiences and state-of-the-art special melting facilities of FSSS, meanwhile, tube billets with high corrosion resistance to H_2S/CO_2 have been trail-produced for petroleum well pipelines by FSSS from the earliest time, which has made success with the quality reaching advanced level of abroad products of the same class.

★Main Grade, Application and Product of Corrosion-resisting Alloy for Petroleum and Petrochemical Industry

Grade	Application	Main Product
N08825	Tube billets for petroleum well pipeline	Forged bars
N08028	Tube billets for petroleum well pipeline	Forged bars
TDJ-G3	Tube billets for petroleum well pipeline	Forged bars
N06625	Tube billets for chemical industry	Forged bars
N10276	tube billets for petroleum and petrochemical industry	Forged bars
N08367	tube billets for petroleum and petrochemical industry	Forged bars
N08810	tube billets for petroleum and petrochemical industry	Forged bars

★The Example of Product and its Application

Grade	N08028		
Main Feature	Resistance to H_2S, CO_2 in the condition of high temperature and high humidity, pitting resistance, strong toughness, good working ability and weldability	Main Application	Petroleum well pipeline

Chemical Analysis wt%

C	Si	Mn	P	S	Cr	Ni	Mo	Fe
0.02	0.30	0.80	0.020	0.003	26.75	31.50	3.40	Bal

PREN=Cr%+3.3Mo%+16N%≥36

Melting Method

EAF+LF+VOD+ESR

Non-metallic Inclusion

Non-metallic Inclusion: Type A, B,C,D each≤class 0.5 for thin series and class 0 for thick series

Product Category	Forging	Product Dimension	∮90~380X>9500

Metallurgical Equipments

Special Melting Production Line

VIM

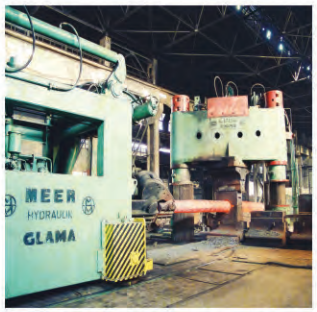
VAR

Inert Gas Protective ESR

Forging Line

3150t Hydraulic Open–die Forging Press(SIEMPELKAUP)

3500t Hydraulic Open–die Forging Press(MEER)



2000t Hydraulic Open–die Forging Press(MEER)

1800t Radial Forging Machine(GFM)

D53K–5000 Type Ring Rolling Machine

Rolling Line

24–stand Continuous Rolling Mill(POMINI)

WF5–40 Square and Flat near finish Rolling Mill

Central Laboratory

Central Lab of FSSS takes on the tasks of testing and determining of purchased raw materials as well as inspecting the quality of steel products, and has passed the attestations of CNAS and Nadcap respectively in 2006 and 2007.

Central Lab possesses 300 sets of the inspecting equipments and instruments of the state of art which can satisfy the inspecting requirements of users on chemical composition analysis, microstructure and mechanical property as follows: Photoelectric Direct-reading Spectrometer, Infrared Carbon and Sulphur analyzer, Joint Measurement of Oxygen and Nitrogen analyzer, X-ray fluorescence Spectrometer, Hydrogen analyzer, Analytic Balance, Spectrophotometer, Mass Spectrometer, ICP Spectrum Analyzer, Precision Microscope, Scanning Electron Microscope(SEM), Electro-hydraulic Servo Universal Testing Machine, Electronic Tensile Testing Machine, High-temperature Tensile Testing Machine, Endurance Testing Machine, Impact Tester for Metallic Materials, Various Hardness Tester, Computer group Controlled Heating treatment Furnace.


中国合格评定国家认可委员会
实验室认可证书
（注册号：CNAS L2589）

CNAS Attestation(in 2006)


Nadcap

In accordance with SAE Aerospace Standard AS7003, to the revision in effect at the time of the audit, this certificate is granted and awarded by the authority of the Nadcap Management Council to:

Fushun Special Steel Co Ltd

No.8 East of Anshan Road
Fushun, 113001
China

This certificate demonstrates conformance and recognition of accreditation for specific services, as listed in www.eAuditNet.com on the Qualified Manufacturers List (QML), to the revision in effect at the time of the audit for:

Materials Testing

Joseph G. Pinto
Vice President and Chief Operating Officer

Nadcap Attestation(in 2007)

Quality Testing Equipments

Equipment Items	Type No.	Main Purpose	Photographs
Electro-hydraulic Servo Universal Testing Machine	DDL series	Suitable for testing the mechanical properties of metallic materials	
High-frequency Fatigue Tester	GPS100	Suitable for testing the fatigue property and mechanical property after fracture at the condition of tension, shrinkage, preset crack as well as tension and pressure alternating loads at high frequency for metallic materials, components and parts.	
Electronic Creep and Endurance Testing Machine	PDW30050 Mode involving two types of RD50 and RD50A	Suitable for testing the properties of endurance, creep and strain slack for metallic materials	

Quality Testing Equipments

Equipment Items	Type No.	Main Purpose	Photographs
Infrared Carbon and Sulphur analyzer	CS–600 Type (LECO)	Suitable for determination of the contents of carbon and sulphur using infrared method for iron and steel, and superalloys	
ICP Spectrum Analyzer	Axios Pw4400 Type (PANalytical B.V.); S8TIGER Type (Bruck)	Suitable for determination of the contents of elements such as Mn, Si, P, Ni, Cr, W, V, Mo, Al, Ti, Cu, Co, Nb and Fe in Fe–base alloy, Ni–base alloy and Co–Base alloy and high–alloy steel	
Atomic Absorption Analyzer	Z–2000 Type (HITACHI)	Suitable for analysis of trace elements such as Cu, Co, Ni, Mg, Pb, Ca in superalloys and raw materials; suitable for analysis of five deleterious elements, Ag, Se and Te.	
Oxygen and Nitrogen Analyzer	TC–600 Type (LECO)	Suitable for determination of the nitrogen content in various types of high–alloy steels and low–alloy steels, superalloys and ferroalloys using the testing method of pulse heating the inert gas fusion thermal conductivity. Suitable for analysis of oxygen content ranging from 0.05ppm to 5.0 percent, and analysis of nitrogen content ranging from 0.05ppm to 3.0 percent	
Inverted Microscope	GX51 (OLYMPUS)	Equipped with PE and CIR analysis software from Clemex Compay of Canada, of which PE software is for analyzing various kinds of metallurgical structures such as grain size, decarburization layer, the content of the second phase area, spheroidizing rate, granule size, dimension and surface roughness,and CIR is mainly for testing the non–metallic inclusions	
SEM (Scanning Electron Microscope)	EVO18 (ZEISS)	Equipped with INCA Energy 450 spectrum as well as X–MAX20 Premuem Probe, the first domestic company to customize INCA MICS F with high solution of 124eV, the third generation of image selection and analysis processor, and the second generation of wave selection and processing analyzer of INCA X–Stream 2; Employing the spectrum analyzer with the highest solution capacity and analyzing function using the latest and the most advanced Navigator and various kinds of Intelligent software	

Environment-friendly Steel
Low Carbon Living

Fushun Special Steel Co.,Ltd.

Add. : No.8 Anshan East Road, Wanghua District, Fushun City, Liaoning Province
P.C. : 113001