



**LIBERTY**



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# Oil & Gas

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STEEL


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## LIBERTY SPECIALITY STEELS

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Version : 004

Published : Jan 2021

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## Speciality Steels for the Oil & Gas Industry

Liberty Speciality Steels is focused on offering carbon, alloy and stainless steel grades for use in demanding applications such as aerospace, motorsports, the oil & gas sector, bright bar, narrow strip, industrial bearings and niche engineering applications around the world.

We employ over 2,200 people and have major production centres in the Sheffield and West Midlands areas along with dedicated distribution and service centres in Bolton in the UK, Nagpur in India and Suzhou and Xi'an in China.

Within the Oil & Gas sector we produce the widest single range of steel types ranging from basic CrMo products such as AISI 4140, through more capable NiCrMo grades such as AISI 4330V to corrosion resistant stainless steel such as SF 13/2/5.

In addition, at the request of the industry, we have brought to the market a range of bespoke high performance grades including HyPer30, HyPer45 and HyPer30V steel types. Our product range is backed by unparalleled levels of OEM and customer approvals.

### Quality Approvals

To complement our production capabilities; over 100 component and equipment manufacturers, end users, third parties and National bodies have validated our quality management systems.

#### Customer Approvals

Baker Hughes  
Cameron  
Halliburton  
National Oilwell  
Varco (NOV)  
Smith International  
Weatherford

#### Accreditations

BS EN ISO 9001  
BS EN 9100  
BS EN ISO 17025 (Testing)  
Nadcap:  
Heat Treatment  
Testing  
NDT  
Environmental ISO 14001

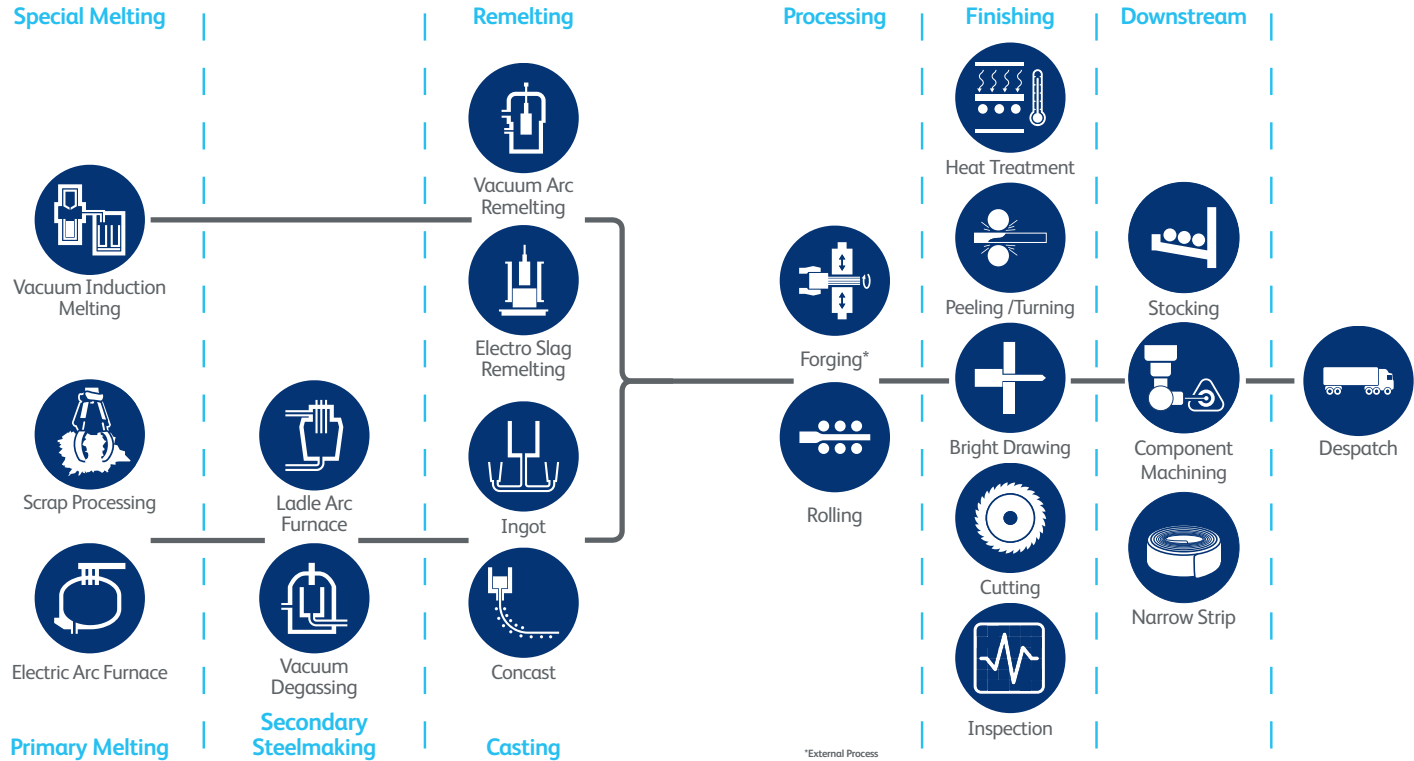
#### Third Party Approvals

Germanischer Lloyd  
Lloyds Register  
PED  
ABS  
DNV



## Process flow

Our modern integrated production facilities with in-house finishing and testing capability help us to meet the specific requirement of our customer's supply chain.



## HyPer grades

At the request of the Oil & Gas industry we have developed and brought to the market bespoke high performance steel grades. These HyPer grades have unique combinations of mechanical properties that outperform the industry standard offerings.

This is coupled with a service package specific to your requirements from a fully integrated supply chain. Utilising our integrated supply chain enables us to react quickly to our customers with precision products, short lead times, small quantities and just-in-time deliveries.

### HyPer30

Low alloy steel grade with improved corrosion resistance.

HyPer30 is a high performance low alloy steel grade with improved corrosion resistance. The chemistry and heat treatment schedules have been specifically designed to give improved strength and toughness characteristics.

The chemistry of HyPer30 has been optimised so that it meets or exceeds the requirements of National Association of Corrosion Engineers (NACE) in relation to its resistance to sulphide stress corrosion cracking (SCC).

### HyPer45

High strength alloy with impact properties @ -20°C

HyPer45 is a high performance alloy steel grade with enhanced mechanical properties compared to the standard grades. The chemical analysis and heat treatment schedules of HyPer45 have been specifically designed to give enhanced strength whilst maintaining toughness at low temperatures.

### HyPer30V

165ki yield strength with impact properties at room temperature (23°C)

HyPer30V is a high performance alloy steel grade with enhanced mechanical properties compared to the standard grades. The chemical analysis and heat treatment schedules of HyPer30V have been specifically designed to give enhanced strength whilst maintaining market leading toughness.

## Nominal chemical analysis %

Grade	C	Mn	Cr	Mo	Ni	V	Nb	Cu	Ni
HyPer30	0.29	0.85	1.30	0.70	-	-	-	-	-
HyPer45	0.47	1.10	1.15	0.30	-	-	-	-	-
HyPer30V	0.32	0.90	0.95	0.47	1.95	0.08	-	-	-

## Mechanical properties

Grade	0.2% PS	UTS	EI	R of A	HBW	CVN
	ksi min	ksi min	% min	% min	min/max	mean
HyPer30	95	105	18	40	19/25 HRC	42ft.lbs@-40°F
HyPer30	125	135	14	40	29/34 HRC	42ft.lbs@-40°F
HyPer45	130	145	13	35	302/352	42J@-20°C
HyPer30V	165	175	14	45	255/392	47J@23°C

## Diameter

Grade	1"Ø	2"Ø	3"Ø	4"Ø	5"Ø	6"Ø	7"Ø	8"Ø	9"Ø	10"Ø	11"Ø	12"Ø
HyPer30			Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Please enquire	Please enquire					
HyPer30			Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Please enquire	Please enquire					
HyPer45	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius
HyPer30V			Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Capable at mid-radius	Please enquire	Please enquire	

■ Capable at mid-radius   
 ■ Capable at 1" below   
 ■ Please enquire   
  No current capability

## Nominal chemical analysis %

Grade	C	Mn	Cr	Mo	Ni	V	Nb	Cu	Ni
<b>Alloy - Heat treated</b>									
4130	0.30	0.55	1.00	0.24					
4140	0.40	0.80	1.00	0.20					
4140 Mod	0.40	1.00	1.00	0.30					
4145H Mod	0.47	1.10	1.10	0.30					
F22	0.12	0.50	2.25	1.00					
8630 Mod	0.30	0.85	0.95	0.40	0.85				
4330V	0.32	0.85	0.90	0.45	1.95	0.08			
EN30B	0.30	0.55	1.25	0.30	4.10				
4340	0.40	0.70	0.80	0.25	1.80				
9CrMo1	0.12	0.45	9.00	0.95					
<b>HyPer Grades</b>									
HyPer30	0.29	0.85	1.30	0.70					
HyPer45	0.47	1.10	1.15	0.30					
HyPer 30V	0.32	0.90	0.95	0.47	1.95	0.08			

## Alloy steels

Grade	Related standards & specifications	Summary of properties
<b>Alloy - Heat treated</b>		
4130	NACE MR0175/ISO15156, API 6A	Standard 0.3%C CrMo steel with good combination of strength and toughness
4140	NACE MR0175/ISO15156, API 6A	Standard 0.4%C CrMo steel for use at higher strength levels
4140 Mod	NACE MR0175/ISO15156, API 6A	Enhanced hardenability version of 4140 for larger section sizes
4145H Mod	API 7-1	Enhanced hardenability version of 4145 for larger section sizes, suitable for drill collars
F22	ASTM A182, UNSK21590, NACE MR0175, ISO 15156	Weldable steel with good low temperature toughness
8630 Mod	NACE MR0175, ISO 15156	High strength alloy steel with good low temperature toughness
4330V	AMS 6427, ASTM A646, AMS 4330M, UNS K23080	High strength, high toughness, low alloy steel for oil tool applications
EN30B	BS970 - 1955 835, M30 - BS970 Pt11983	High strength alloy, combined with good impact properties
4340	ASTM A434	High strength alloy steel
9CrMo1	ASTM A199, ASTM A213, NACE MR0175, ISO 15156	High strength alloy steel with corrosion resistance superior to the 41xx series
<b>HyPer Grades</b>		
HyPer30	TM0177 - Method A	A high performance low alloy steel grade with improved corrosion resistance
HyPer45		High strength alloy with impact properties @-20°C
HyPer 30V		165ki yield strength with impact properties at room temperature (23°C)



## Mechanical properties

Grade	0.2% PS ksi min	UTS ksi min	EI % min	R of A % min	HBW min/max	CVN mean
<b>Alloy - Heat treated</b>						
4130	75	95	18	35	217/235	27J@-60°C
4140 L80	80	100	20	45	217/235	42J@-32°C
4140 P110	110	125	13	35	286/341	27J@-32°C
4140 Mod L80	80	100	20	45	217/235	42J@-32°C
4140 Mod P110	110	125	13	35	286/341	27J@-32°C
4145H Mod	110	140	14	40	286/341	30J@-32°C
4145H Mod	120	140	14	45	286/341	42J@-32°C
4145H Mod	125	140	14	45	286/341	42J@-32°C
F22'	75	95	18	35	197/235	30J@-32°C
8630 Mod	85	100	17	35	/235	42J@-60°C
8630 Mod	100	130	13	35	/241	27J@-30°C
4330V	135	145	14	50	286/341	50J@-40°C
4330V	150	160	14	45	321/375	32J@-20°C
4330V	155	165	14	45	341/388	32J@-20°C
EN30B	135	160	13	50	/388	30J@-46°C
4340	105	120	14	35	/321	40J@-20°C
4340	135	150	13	40	/375	27J@-20°C
9CrMo1	80	95	20	40	217/237	47J@-10°C

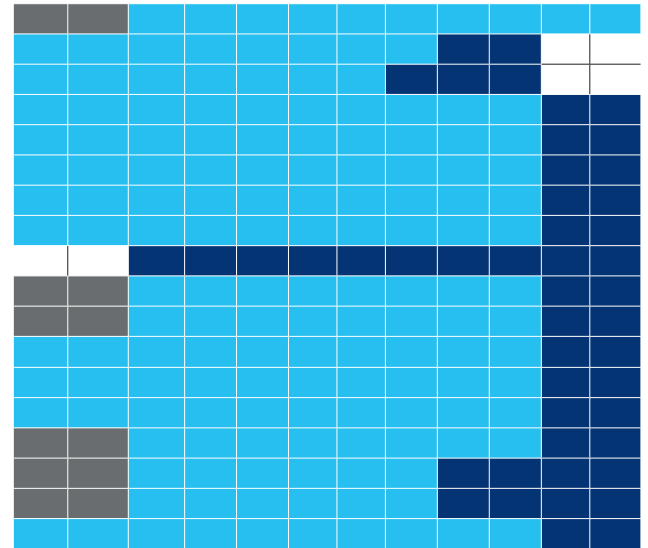
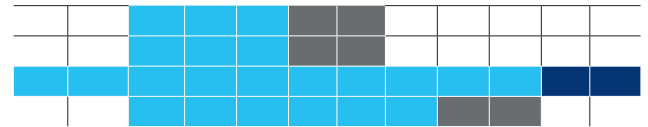
**HyPer Grades**

HyPer30	95	105	18	40	19/25 HRC	42FT.lbs@-40°F
HyPer30	125	135	14	40	29/34 HRC	42ft.lbs@-40°F
HyPer45	130	145	13	35	302/352	42J@-20°C
HyPer30V	165	175	14	45	255/392	42J@-23°C

Note (1) - Property data may be sourced from a providing test.

## Diameter

1"Ø	2"Ø	3"Ø	4"Ø	5"Ø	6"Ø	7"Ø	8"Ø	9"Ø	10"Ø	11"Ø	12"Ø
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**Alloy - Heat treated****HyPer Grades**

Capable at mid-radius

Capable at 1" below

Please enquire

No current capability

## Stainless steels

Grade	Related standards & specifications	Summary of properties
<b>Martensitic</b>		
410	UNS S41000, ASTM A276, ASTM A479, NACE MR0175, ISO 15156	13% Cr steel with high strength and better corrosion resistance than alloy steels
420 mod	UNS S42000, NACE MR0175/ISO15156	Lower ferrite 13%Cr steel for improved corrosion resistance and enhanced workability
SF13/2/5	UNS S41427, NACE MR0175/ ISO15156, X2CrNiMoV13-5-2, X2CrNiMoV13-5-2, NORSOK M650 (110KSI)	Enhanced 13%Cr steel with superior corrosion resistance, strength and toughness
<b>PPT Hardening</b>		
FV520B	B55S100, 1.4594, X5CrNiMoCuNb14	Machinable corrosion resistant steel with freedom from distortion on heat treatment to high strengths
17/4PHH1150D	UNS S17400, NACE MR0175/ISO15156, ASTM A564, ISO 15156, W 1.4548	Improved corrosion resistant age hardening stainless steel with minimal distortion and scaling on heat treating after machining

## Mechanical properties

Grade	0.2% PS ksi min	UTS ksi min	EI % min	R of A % min	HBW min/max	CVN mean
<b>Martensitic</b>						
410	80	95	20	40	217/235	20J@-10oC
420	80	100	20	45	217/235	20J@-10oC
SF13/2/5	95	105	20	45	/29HRC	81J @ -10°C (L)
SF13/2/5	110	125	13	45	/32HRC	81J @ -10°C (L)
<b>PPT Hardening</b>						
FV520B	115	135	15	45	/311	54J @ 23°C (IZOD)
17/4PH H1150D	105	135	18	50	/311	27J @ -60°C

## Nominal chemical analysis %

C	Mn	Cr	Mo	Ni	V	Nb	Cu	Ni
<b>Martensitic</b>								
0.10	0.50	13.00						
0..20	0.70	13.00						
0.02	0.40	12.20	2.00	5.50	0.16			
<b>PPT Hardening</b>								
0.05	0.80	13.50	1.50	5.50		0.30	1.70	
0.05	0.80	16.00		4.00		0.30	3.50	

## Diameter

1"Ø	2"Ø	3"Ø	4"Ø	5"Ø	6"Ø	7"Ø	8"Ø	9"Ø	10"Ø	11"Ø	12"Ø
<b>Martensitic</b>											
<b>PPT Hardening</b>											

■ Capable at mid-radius   
■ Capable at 1" below   
■ Capable at 1/2" below   
■ Please enquire   
 No current capability



## Chain, Carbon and Carburising Steels

Grade	Related standards & specifications	Summary of properties
<b>Chain</b>		
R3		
ORQ		
ORQ + 20%		
R3S		
R4		
R4S		
R5		
<b>Carbon</b>		
LF2	ASTM A350	Standard carbon flange steel with good notch toughness
X65	API 5LX	Higher strength, tough weldable, carbon steel with good resistance to Hydrogen Induced Cracking
<b>Carburising</b>		
8620		Carburising steel
4715		Carburising steel
4815		Carburising steel
9310		Carburising steel

## Mechanical properties

Grade	0.2% PS ksi min	UTS ksi min	El % min	R of A % min	HBW min/max	CVN mean
<b>Chain</b>						
R3	410	690	17	50		40@-20°C
ORQ	410	690	17	40		58@0°C
ORQ + 20%	540	750	15	40		58@0°C
R3S	490	770	15	50		45@-20°C
R4	580	860	12	50		50@-20°C
R4S	700	900	12	50		56@-20°C
R5	760	1000	12	50		58@-20°C
<b>Carbon</b>						
LF2	36	70	22	30		20@-46°C
X65	65	77				50@-46°C

## Nominal chemical analysis %

C	Mn	Cr	Mo	Ni	V	Nb	Cu	Ni
<b>Chain</b>								
0.30								
0.30								
0.23								
0.23								
0.23								
0.19								
0.19								
<b>Carbon</b>								
0.15	1.20							Optional V/Nb to customer requirements
0.08	1.30							
<b>Carburising</b>								
0.20	0.80	0.50	0.20	0.50				
0.15	0.80	0.45	0.35	1.00				
0.15	0.50		0.25	3.50				
0.10	0.50	1.20	0.12	3.25				

## Diameter

1"Ø	2"Ø	3"Ø	4"Ø	5"Ø	6"Ø	7"Ø	8"Ø	9"Ø	10"Ø	11"Ø	12"Ø

Mechanical properties dependent on bar size

## Sizes, Tolerances and Rolling Reduction

### Rolled Rounds

Liberty Steel is able to offer both metric and imperial sizes in the as-rolled or peeled/turned condition.

Min (mm)	Max (mm)	Min (in)	Max (in)
25	381	1	15

### Machining Tolerances

For 'Machining Quality Bar' to ASTM A29 tolerances the minimum machining allowance should be as follows.

Ordered Surface Condition	Minimum Stock Removal
Peeled/Smooth Turned	1% per side
Black	1.6% per side

### Minimum Rolling Reduction Ratios for Black bars

	3"Ø	4"Ø	6"Ø	10"Ø	12"Ø
5.4t	52.6:1	29.6:1	13.1:1	4.7:1	3.2:1
6.6t	66.3:1	37.3:1	15.5:1	5.9:1	4:1

### Other Forms

	Top (mm)	Bottom (mm)	Length (mm)	Weight (mm)
Large Bloom Cast	560	400	6500-13000	n/a
Square ingot	653	490	2310	5.4
Square ingot	721	550	2285	6.6
Rolled slabs, width	100	500		
Rolled slabs, Thickness	50	330		

	Top (in)	Bottom (in)	Length (in)	Weight (short tonne)
Large Bloom Cast	22	15 <sup>3/4</sup>	256-512	n/a
Square ingot	25 <sup>3/4</sup>	19 <sup>1/4</sup>	91	5.9
Square ingot	28 <sup>3/8</sup>	21 <sup>11/64</sup>	90	7.3
Rolled slabs, width	3 <sup>7/8</sup>	19 <sup>5/8</sup>		
Rolled slabs, Thickness	2	12 <sup>7/8</sup>		