Quality	**P460NL1**	**Creep-resisting Steel**	*Technical card*
According to standard	**EN 10028-3: 2017**		***Lucefin Group***
Number	**1.8915**		*rev. 2018*

Chemical composition

C% max	**Si%** max	**Mn%**	**P%** max	**S%** max	**Al%** total min	**Cr%** max	**Cu%** max	**Mo** max	
0,20	0,60	1,00-1,70	0,025	0,008	0,020 b) c)	0,30	0,70 a)	0,10	
+0.02	+0.06	±0.10	+0.005	+0.003	-0.005	+0.05	+0.10	+0.03	Product deviations

N% max	**Nb%** max	**Ni%** max	**Ti%** max	**V%** max	**Nb% + Ti% + V%** max
0,025	0,05	0,80	0,03	0,20	0,22
+0.002	+0.01	+0.05	+0.01	+0.01	

CEV *C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15*
max 0,53 for thickness ≤ 60 mm
max 0,54 for thickness ≤ 60 / ≤ 100 mm
max 0,54 for thickness 100 / ≤ 250 mm

a) If the percentage by mass of copper exceeds 0,30 %, the percentage by mass of nickel shall be at least half the percentage by mass of copper.
b) The Al total content may fall short this minimum if niobium, titanium or vanadium are additionally used for nitrogen binding
c) If only aluminium is used for nitrogen binding, a ratio Al / N ≥ 2 shall apply.

Temperature °C

Hot-forming	**Normal supply**	**Soft annealing +A**
1100-850	Normalized +N 920 air	700 air

Temperature values are valid for analysis close to:

C%	*Mn%*	*Si%*
0.18	*1.40*	*0.30*

In some cases, the piece can be normalized and tempered **+NT** or quenched and tempered **+QT**

Normalization Tempering	**Quenching Tempering**	**Stress-relieving +SR**
880-940 air 550-650 air	880-900 water 550-650 air	50° under the t. of tempering

Pre-heating welding: 200

Stress-relieving after welding: slow cooling

Ac_1	**Ac_3**	**M_S**
-	-	**-**

Mechanical properties

P460NL1 1.8915 **Hot-rolled +N** normalized EN 10028-3: 2017

Traction test at room temperature in longitudinal direction

size mm from	to	**R** N/mm^2	**R_{eH}** min N/mm^2	**A%** min	***HB*** *for information*
	16	570-730 a)	460	17	*169-224*
16	40	570-720	445	17	*169-223*
40	60	570-720	430	17	*169-223*
60	100	540-710	400	17	*158-218*
100	150	520-690	380	16	155-210
150	250	510-690	370	16	154-210

a) up to 20 mm product thickness, a minimum R_{eH} of 460 MPa and a R_m range of 630 MPa to 725 MPa may be agreed at the time of enquiry and order.
b) Values may be agreed at the time of enquiry and order

size mm	min. impact **Kv_2** J at **°C** longitudinal c)					min. impact **Kv_2** J at **°C** tangential				
	-50	**-40**	**-20**	**0**	**+20**	**-50**	**-40**	**-20**	**0**	**+20**
≤ 250	30 d)	40	50	70	80	-	27 d)	35 d)	50	60

c) The values apply for product thicknesses up to 40 mm.
d) A minimum impact energy value of 40 J may be agreed at the time of enquiry and order.

P460NL1

Lucefin Group

Thermal expansion	10^{-6}• K	10.5	11.4	11.5	12.1	12.7	13.2	13.6	14.0	14.4
Modulus of elasticity long.	GPa	217	213	212	207	199	192	184	175	164
Modulus of elasticity tang.	GPa	83	82	81	79	76	74	71	67	63
Specific heat	J/(Kg*K)	423	456	461	479	499	517	536	558	587
Thermal conductivity	W/(m•K)	34.7	39.3	39.7	40.9	41.0	39.9	38.2	36.1	33.8
Density	Kg/dm^3			7.84						
Electrical resistivity	Ohm•mm^2/m	0.197	0.250	0.262	0.313	0.385	0.470	0.569	0.685	0.820
Electrical conductivity	Siemens•m/mm^2	5.08	4.00	3.82	3.19	2.60	2.13	1.76	1.46	1.22
°C		**- 100**	**0**	**+20**	**+100**	**+200**	**+300**	**+400**	**+500**	**+600**

Physical properties according to DIN SEW 310 (08/1992)

Esperienza **TRAFILIX**

Cast analysis

C%	Si%	Mn%	P%	S%	Al%	Cr%	Cu%	Mo%	N%	Nb%	Ni%	Ti%	V%
0,18	0,28	1,44	0,009	0,025	0,027	0,09	0,14	0,02	0,009	0,001	0,09	0,002	0,01

Nb% + Ti% + V%	Mo% + Cr%
0,013	0,11

Hot-rolled - mechanical properties of normalized and tempered state. Trafilix Experience

diameter		Traction test at room temperature and Kv in longitudinal					
mm		**R**	**Rp** 0.2	**A**	**Z**	**Kv -20°C**	**HB**
	°C	N/mmq.	N/mmq.	%	%	J	
95	**+20**	611	472	32.0	60.1	161-184-172	183
95	**+100**	541	408	-	-	-	158
95	**+150**	536	385	-	-	-	112

Hot-rolled - mechanical properties of quenched and tempered state**.** Trafilix Experience

diameter		Traction test at room temperature and Kv in longitudinal					
mm		**R**	**Rp** 0.2	**A**	**Z**	**Kv +20°C**	**HB**
	°C	N/mmq.	N/mmq.	%	%	J	
95	**+20**	620	530	18.0	54.0	146-144-162	190
95	**+100**	573	420	-	-	-	172
95	**+150**	531	375	-	-	-	156

EUROPE EN	**ITALY** UNI	**SPAIN** UNE	**GERMANY** DIN	**FRANCE** AFNOR	**UK** B.S.	**SWEDEN** SS	**USA** AISI/SAE
P460NL1	P460NL1	P460NL1	~ TStE 460	A590FP	P460NL1	P460NL1	LF6

Steel grade used for products for pressure containers. The material must be fine-grain > 6, must have undergone the normalization heat treatment or normalization and tempering one and must be suitable for welding.
The processing procedure of the steel is left to the discretion of the supplier.
In the purchase order it is necessary to define the following points
- surface state,
- inner integrity for example trough an ultrasonic method defining the class of acceptance,
- mechanical tests to be performed, direction of the test (longitudinal or tangential) and relative temperatures such as Kv - 20 ° C and so on.

Applications: sheeted and welded plates, nipples, nuts, branch pipes, sutomotive, coupling, pressure pipes, piston rod, distribution valves, waterwork, plants for the petrochemical industry and generic construction.