

A melhor opção em soluções tubulares para exploração, produção e condução de petróleo e gás.

The best option in tubular solutions for the exploration, production and conduction of oil and gas.

Agosto 2018 | August 2018

# TUBING CASING LINE PIPE



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## TECNOLOGIA DE PONTA E SEGURANÇA

### Produtos cada vez melhores para um mercado exigente.

Os investimentos em tecnologia de ponta e infraestrutura fabril, nos permite oferecer ao mercado soluções tubulares de alta qualidade.

Tubos acabados (OCTG) para exploração e produção (E&P) com conexões API 5CT, Premium (JFEBEAR e FOX) e Semipremium (GEOCONN, SUPERMAX e FLUSHMAX). Tubos para aplicações especiais tais como: High Collapse para elevada pressão externa, grau L80 Cr1% ou revestidos interna e externamente para ambientes corrosivos e restrito controle dimensional Special Drift.

Tubos de condução de petróleo e gás, nos níveis de produto API 5L / PSL1 e PSL2, revestidos interna e externamente para ambientes corrosivos.

Tubos para aplicação estrutural, caldeiras, estacas de linha de transmissão e cilindros hidráulicos de alta resistência, além de tubos industriais, perfis quadrados e retangulares que permitem processos subsequentes de corte e dobra, entre outros, garantindo a integridade da solda.

O processo de fabricação é monitorado e certificado por diferentes tipos de controles que conferem aos tubos a garantia da qualidade e a rastreabilidade total do produto, através de inspeções em linha, tais como: ultrassom, eletromagnético e por partícula magnética, dimensional com instrumentos sofisticados, além de teste hidrostático de alta pressão, ensaios mecânicos e químicos, todos interligados em um sistema computadorizado.

As máquinas e equipamentos que compõem o parque fabril possuem sensores e sistemas de proteção que tornam a operação segura e promovem o bem estar dos operadores. Com a visão de que vida é o nosso maior patrimônio, foram implementados programas internos de treinamento e conscientização focados na saúde e segurança, continuamente monitorados através da Política de Qualidade Total.

### TECHNOLOGY, QUALITY AND SAFETY

#### Better products for a demanding market.

Investments in state-of-the-art technology and manufacturing infrastructure allow us to offer the market high quality tubular solutions.

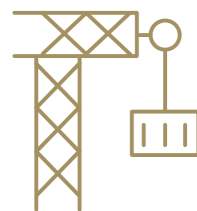
OCTG with API threads, Premium (JFEBEAR and FOX) and Semipremium (GEOCONN, SUPERMAX and FLUSHMAX) connections. Pipes for special applications such as: High Collapse for high external pressures, grade L80 Cr1% or internally and externally coated for corrosive environments and restricted dimensional control (Special Drift).

Oil and gas transportation pipes API 5L / PSL1 and PSL2 product levels, internally and externally coated for corrosive environments.

Pipes for structural application, boilers, transmission line piles and high-strength hydraulic cylinders, as well as industrial pipes, square and rectangular profiles that allow subsequent cutting and bending processes, among others, guaranteeing the integrity of the weld.

The manufacturing process is monitored and certified by different types of controls that ensure product quality and traceability through inline inspections such as: UT, electromagnetic, magnetic particle and dimensional testing with sophisticated instruments, plus high pressure hydrostatic testing, mechanical and chemical tests, all interconnected in a computerized system.

The machines and equipment that make up the factory have sensors and protection systems that make the operation safe and promote the well-being of the operators. With the view that life is our greatest asset, we have implemented internal training and awareness programs focused on health and safety, continuously monitored by the Company's Total Quality Policy.



## CAPACIDADE INSTALADA

### Pronta para o Brasil, pronta para o mundo.

Atualmente, a planta industrial da Apolo Tubulars tem capacidade instalada para produzir 120 mil toneladas de tubos de aço ao ano, voltados à fabricação de tubos para produção e exploração (OCTG) e tubos de condução (LINE PIPE).

Com os novos desenvolvimentos, a Apolo Tubulars está fornecendo OCTG com revestimentos anticorrosivos internos e externos e com conexões premium e semipremium, tanto para poços onshore como offshore.

### INSTALLED CAPACITY

#### Ready for Brazil, ready for the world.

Currently, the Apolo Tubulars plant has installed capacity to produce 120 thousand tons of steel tubes per year, focused on the manufacturing of tubes for production and exploration (OCTG) and pipeline (LINE PIPE).

With new developments underway in the 2016-2017 biennium, ApoloTubulars will now supply OCTG with internal and external anticorrosive coatings and premium and semipremium connections for both onshore and offshore wells.



## EVOLUÇÃO DA EMPRESA

### Pronta para o Brasil, pronta para o mundo.

- 2002: Projeto iniciado com a instalação concluída em 2003. A planta inicialmente atendeu as demandas do mercado industrial (NBR/ASTM) com tubos de 2 1/2" a 8".
- 2003: Visando o mercado de óleo e gás, ampliou o range de fabricação com tubos de 2" a 8".
- 2004: Entrada no mercado de Line Pipe (API 5L), incluindo tubos revestidos externamente com Polietileno e Epóxi. Início das exportações de tubos "plain end" para mercado americano de OCTG (API 5CT).
- 2005: Nova ampliação do range de fabricação de tubos de 2" a 9 5/8".
- 2006/2007: Aporte tecnológico e ampliação fabril com implementação / instalação, entre outros, de: tratamento térmico, rosqueadeiras, forjas de extremidades (upsetter), teste hidrostático e linhas de inspeção, para fabricação dos tubos de revestimento e produção para poços de petróleo e gás.
- 2009: Início de fornecimento para Petrobras através do Contrato Global.
- 2013: Prêmio Petrobras - "Melhores Fornecedores de Bens e Serviços".
- 2016/2017: Com os novos desenvolvimentos neste biênio, ampliamos nosso portfólio para fornecer tubos OCTG com conexões Premium e Semipremium, diâmetro de 7 5/8" e graus de aço com adição de ligas (L80 Cr1%) para poços onshore e offshore.

### EVOLUTION OF THE COMPANY

#### Ready for Brazil, ready for the world.

- 2002: Project initiated with the installations completed in 2003. The plant initially met the demands of the industrial market (NBR / ASTM) with 2 1/2" to 8" pipes.
- 2003: Aiming the oil & gas market, the company expanded its manufacturing range with 2" to 8" pipes.
- 2004: Introduction of Line Pipe (API 5L), including pipes coated externally with Polyethylene and Epoxy. Start of exports of "plain end" pipes to the US OCTG market (API 5CT).
- 2005: Further expansion of the company's manufacturing range with 2" to 9 5/8" pipes.
- 2006/2007: Technological update and plant expansion with the implementation / installation, among others, of: heat treatment, threading machines, upsetter, hydrostatic testing and inspection lines for the production of OCTG.
- 2009: Start of supply to Petrobras through the Global Contract.
- 2013: Petrobras Award - "Best Suppliers of Goods and Services".
- 2016/2017: With new developments during this period, we have expanded our portfolio to provide OCTG pipes with 7 5/8, "Premium and Semipremium connections and steel grades with the addition of alloys (L80 Cr1%) for onshore and offshore wells.

High quality pipe  
for Oil & Gas





# SUSTENTABILIDADE

**Acreditamos que todos podem evoluir juntos.**

A Apolo Tubulars contribui de forma efetiva na busca por um Brasil mais sustentável, desenvolvendo diversos programas ligados ao meio ambiente e responsabilidade social como: remanejamento de áreas verdes, plantio de espécies nativas, ajuda a vítimas de enchentes, saúde da mulher, saúde bucal, Natal das crianças, entre outros.

## SUSTAINABILITY

We believe that all of us can evolve together.

Apolo Tubulars contributes in an effective manner in the search for Brazil more sustainable, developing several programs related to the environment and social responsibility such as: relocation of green areas, planting of native species, aid to flood victims, women's health, Christmas party for children, among others.



# CERTIFICAÇÕES

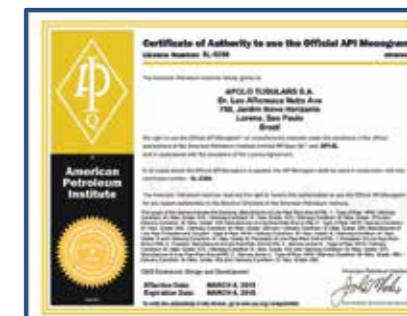
Atendendo a crescente exigência do mercado, a Apolo Tubulars está constantemente focada na busca pela excelência e em agregar valor aos seus produtos através do reconhecimento dos principais institutos e órgãos certificadores internacionais.

## CERTIFICATIONS

In view of the increasing market demands, Apolo Tubulars is constantly focused on the search for excellence and on adding value to its products through the recognition of the main institutes and international certification agencies.



API 5CT



API 5L



# COMPLIANCE

**Acreditamos que a melhor forma de fazer negócios é agindo com clareza, ética e segurança.**

Nosso código de conduta é um conjunto de normas que visam orientar o comportamento da empresa.

A Política Anticorrupção reafirma nosso compromisso de conduzir os negócios com integridade.

## COMPLIANCE

We believe that the best way to do business is to act with clarity, ethics and security.

Our Code of Conduct is a set of standards aimed at guiding the company's behavior.

The Anti-Corruption Policy reaffirms our commitment to conduct business with utmost integrity.



NBR 5590



NBR 5580



BUREAU VERITAS - BURST TEST



ISO 9001



ISO 14001



CRCC PETROBRAS

# FLUXO DE PRODUÇÃO E CONTROLE DE QUALIDADE

MANUFACTURING AND QUALITY  
CONTROL FLOW DIAGRAM



COIL RECEPTION  
AND INSPECTION



SLITTER



FORMING



WELDING



TRIMMING OF  
THE WELD SEAM



ULTRASONIC INSPECTION  
(PROCESS)



ANNEALING



SIZING



CUTTING TO  
INDIVIDUAL LENGTH



FLATTENING TEST



FACING AND BEVELING



VISUAL AND DIMENSIONAL  
INSPECTION OF PIPE



COLD STRAIGHTENER



HYDROSTATIC TEST  
(LINEPIPE)



ULTRASONIC INSPECTION  
(PROVE UP)



UPSET FURNACE  
(TUBING)



UPSETTER  
(TUBING)



INDUCTION FURNACE  
(QUENCHING AND TEMPERING)



HOT STRAIGHTENER



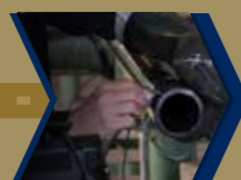
HYDROSTATIC TEST  
(OCTG)



ULTRASONIC INSPECTION (WELD)  
AND ELECTROMAGNETIC (FULL BODY)



MAGNETIC PARTICLE  
INSPECTION (ENDS)



ULTRASONIC  
INSPECTION (ENDS)



LABORATORY TEST



THREADING



VISUAL AND DIMENSIONAL  
INSPECTION OF THREADING



COUPLING AND BUCKING



DRIFT TEST



MARKING AND WEIGHTING



VARNISHING AND PACKING



LOADING AND DELIVERY

# API 5CT

Tubos de revestimento (casing), tubos de produção (tubing) e tubos curtos (pup joint), fornecidos com extremidades forjadas (EU) ou não (NU), roscadas com conexões API, Premium ou Semipremium.

Casing, tubing and pup joint, supplied with EU or NU ends, threaded with API, Premium or Semipremium connections

Premium Connection

Semi Premium Connection

**JFEBEAR**  
Premium Connection



JFEBEAR™ has been designed and tested to meet the needs for critical well loads. The design incorporates metal-to-metal seals with a 15° internal torque shoulder to ensure sealing under extreme loads.

The negative load flank thread form and coupled design provide 100% tensile efficiency for the standard coupling.

## Design Advantage

- |   |   |
|---|---|
| Negative [-5°] load flank angle on threads                      | ➔ Superior bending capability due to hook threads                 |
| 25° angle for thread stabbing flank                             | ➔ Excellent stabbing performance due to high stabbing flank angle |
| 15° torque shoulder   | ➔ Reduced hoop stress   |
| Reduced gap between stabbing flanks on pipe and coupling thread | ➔ High compression rating & galling resistance due to optimum gap |
| Contour metal-to-metal seal between pin and coupling            | ➔ Galling resistance due to point seal type                       |

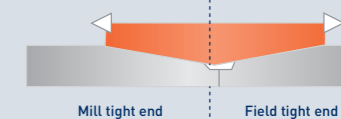
## GEOCONN



**Completely interchangeable with API BTC**  
As GEOCONN is perfectly interchangeable with API Buttress, Casing Accessories with Buttress Thread may be used.

- Internally flush with pin abutment**
- Prevention of turbulence flow;
  - High over torque resistance;
  - Abutment works as metal seal under medium tension loads;
  - High fatigue resistance.

## Manufacturing of GEOCONN



## SUPERMAX

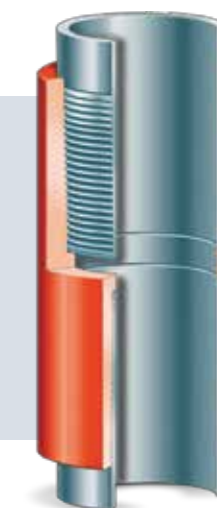
- **Available size:**  
SUPERMAX is tubing connection: 1.900" to 4-1/2"  
SUPERMAX2 is casing connection: 5" to 13-3/8"  
Modified Coupling with Non-metallic seal

- **SUPERMAX-TS:** 2-3/8" to 4-1/2"      • **SUPERMAX-TS2:** 5" to 7"

Coupling with internal shoulder provides: Internally flush to prevent turbulence flow and high torque and compression resistance

Non-upset tubing: Clearance programs where smaller OD than API EUE is desired but joint strength must be higher than API EUE.

- **Application:** Casing or Tubing for deviated hole, low pressure gas well and steam injection. Tubing for high-pressure fracturing jobs and thermal applications.



## FLUSHMAX

- **Available size:** 1.66" - 4"  
Completely flush OD & ID, tension with 38-50% of pipe body yield, compression with more than 60% of pipe body yield, 80% of pipe body internal yield pressure and API Collapse pressure

- **Application:** Liner or slotted liner, wash pipe for gravel packing and casing repair



## MO-EUE-PA

- **Available size:** 2-3/8" - 4-1/2"  
Pin is identical to API EUE, internally flush, coupling is shorter than EUE to have pin to pin abutment.  
Mill end has deeper make up to prevent rotation during field end make up on the rig.  
Pin to pin abutment enhances torque resistance.

- **Application:** High Torque and Progressive cavity pump



**TOLERÂNCIAS DE COMPRIMENTO - CASING / TUBING (JOINT)**

RANGE LENGTHS - TUBING / CASING (JOINT)

	Range 1			
	Min.	Max.	Min.	Max.
	m	m	ft	ft
Tubing	6,10	7,32 <sup>a</sup>	20.0	24,0 <sup>a</sup>
Casing	4,88	7,62	16.0	25,0

	Range 2			
	Min.	Max.	Min.	Max.
	m	m	ft	ft
Tubing	8,53	9,75 <sup>b</sup>	28.0	32,0 <sup>b</sup>
Casing	7,62	10,36	25.0	34,0

	Range 3			
	Min.	Max.	Min.	Max.
	m	m	ft	ft
Tubing	11,58	12,80 <sup>c</sup>	38.0	42,0 <sup>c</sup>
Casing	10,36	13,50	34.0	44.3



<sup>a</sup> By agreement between purchaser and manufacturer, the maximum length may be increased to 8,53 m (28.0 ft).

<sup>b</sup> By agreement between purchaser and manufacturer, the maximum length may be increased to 10,36 m (34.0 ft).

<sup>c</sup> By agreement between purchaser and manufacturer, the maximum length may be increased to 13,50 m (44.3 ft).

**COMPOSIÇÃO QUÍMICA (PORCENTAGEM DE FRAÇÃO EM MASSA)**  
CHEMICAL COMPOSITION (MASS FRACTION)

Group	Grade	Type	%Max.									
			C	Mn	Mo	Cr	Ni	Cu	P	S	Si	
1	H40	-	-	-	-	-	-	-	-	0.030	0.030	-
	J55	-	-	-	-	-	-	-	-	0.030	0.030	-
	K55	-	-	-	-	-	-	-	-	0.030	0.030	-
	N80	Q	-	-	-	-	-	-	-	0.030	0.030	-
2	L80	1	0.43	1.90	-	-	-	0.25	0.35	0.030	0.030	0.45
3	P110	-	-	-	-	-	-	-	-	0.020	0.010	-

**RESUMO DAS INSPEÇÕES APLICÁVEIS**

INSPECTION SUMMARY

Group	Grade	Chemical Properties	Tensile Tests	Impact Tests	Hardness Tests	Dimensional Testing	Flattening Test
1	H40	X	X	-	-	X	X
	J55	X	X	-	-	X	X
	K55	X	X	-	-	X	X
	N80Q	X	X	X	-	X	X
2	L80-1	X	X	X	X	X	X
3	P110	X	X	X	-	X	X

Drift Tests	Hydrostatic Tests	Ultrasonic Inspection (Weld Seam)	Electro-magnetic Inspection (Full Body) <sup>a</sup>	Magnetic Particles Inspection (Pipe Ends) <sup>a</sup>	Ultrasonic Inspection (Pipe Ends) <sup>a</sup>	Visual Inspection (including varnishing)
X	X	X	-	-	-	X
X	X	X	-	-	-	X
X	X	X	-	-	-	X
X	X	X	X	X	X	X
X	X	X	X	X	X	X
X	X	X	X	X	X	X

NOTE: <sup>a</sup>Requirements applicable for pipes full-length heat-treated. NDE Inspection level according to API 5CT

**DIMENSÕES E PROPRIEDADES DE DESEMPENHO (TUBING)**

**DIMENSIONS AND PERFORMANCES PROPERTIES (TUBING)**

Size	Outside Diameter		Inside Diameter		Drift Diameter		Wall Thickness		Label		Grade	Pipe Body Yield Strength <sup>a</sup>	Joint Yield Strength <sup>a</sup>		Collapse Resistance <sup>a</sup>	Internal Yield Pressure <sup>a</sup> (Pipe body)	Type of End-finish
	inch	mm	inch	mm	inch	mm	inch	mm	NU lb/ft	EU lb/ft			NU	EU Regular / Sp.C. <sup>b</sup>			
2 3/8	2.375	60,32	2.041	51,84	1.947	49,46	0.167	4,24	4.00	-	H40	46,300	30,100	-	5,230	4,920	PN
											J55	63,700	41,400	-	7,190	6,770	PN
											K55	-	-	-	-	-	-
											L80	92,600	60,200	-	9,980	9,840	PN
											N80Q	92,600	60,200	-	9,980	9,840	PN
											P110	-	-	-	-	-	-
2 3/8	2.375	60,32	1.995	50,67	1.901	48,28	0.190	4,83	4.60	4.70	H40	52,200	36,000	52,200	5,890	5,600	PNU
											J55	71,700	49,400	71,700	8,100	7,700	PNU
											K55	-	-	-	-	-	-
											L80	104,300	71,900	104,300	11,780	11,200	PNU
											N80Q	104,300	71,900	104,300	11,780	11,200	PNU
											P110	143,400	98,900	143,400	16,130	15,400	PNU
2 7/8	2.875	73,02	2.441	62,00	2.347	59,62	0.217	5,51	6.40	6.50	H40	72,500	52,800	72,500	5,580	5,280	PNU
											J55	99,700	72,600	99,700	7,680	7,260	PNU
											K55	-	-	-	-	-	-
											L80	145,000	105,600	145,000	11,170	10,570	PNU
											N80Q	145,000	105,600	145,000	11,170	10,570	PNU
											P110	199,300	145,200	199,300	14,550	14,530	PNU
2 7/8	2.875	73,02	2.323	59,00	2.229	56,62	0.276	7,01	7.80	7.90	H40	-	-	-	-	-	-
											J55	-	-	-	-	-	-
											K55	-	-	-	-	-	-
											L80	180,300	140,900	180,300	13,890	13,440 <sup>c</sup>	PNU
											N80Q	180,300	140,900	180,300	13,890	13,440 <sup>c</sup>	PNU
											P110	247,900	193,700	247,900	19,090	18,480 <sup>c</sup>	PNU
3 1/2	3.500	88,90	3.068	77,93	2.943	74,74	0.216	5,49	7.70	-	H40	89,100	65,100	-	4,630	4,320	PN
											J55	125,500	89,500	-	5,970	5,940	PN
											K55	-	-	-	-	-	-
											L80	178,200	130,200	-	7,870	8,640	PN
											N80Q	178,200	130,200	-	7,870	8,640	PN
											P110	-	-	-	-	-	-
3 1/2	3.500	88,90	2.992	76,00	2.867	72,82	0.254	6,45	9.20	9.30	H40	103,600	79,600	103,600	5,380	5,080	PNU
											J55	142,500	109,400	142,500	7,400	6,990	PNU
											K55	-	-	-	-	-	-
											L80	207,200	159,100	207,200	10,540	10,160	PNU
											N80Q	207,200	159,100	207,200	10,540	10,160	PNU
											P110	284,900	218,800	284,900	13,530	13,970	PNU
3 1/2	3.500	88,90	2.922	74,22	2.797	71,04	0.289	7,34	10.20	-	H40	116,600	92,600	-	6,060	5,780	PN
											J55	160,300	127,300	-	8,330	7,950	PN
											K55	-	-	-	-	-	-
											L80	233,200	185,100	-	12,120	11,560	PN
											N80Q	233,200	185,100	-	12,120	11,560	PN
											P110	-	-	-	-	-	-
4 1/2	4.500	114,30	3.958	100,54	3.833	97,36	0.271	6,88	12.60	12.75	H40	144,000	104,400	144,000 <sup>d</sup>	4,490	4,220	PNU
											J55	198,000	143,500	198,000 <sup>d</sup>	5,730	5,800	PNU
											K55	-	-	-	-	-	-
											L80	288,000	208,700	288,000 <sup>d</sup>	7,500	8,430	PNU
											N80Q	288,000	208,700	288,000 <sup>d</sup>	7,500	8,430	PNU
											P110	-	-	-	-	-	-
4 1/2	4.500	114,30	3.826	97,18	3.701	94,00	0.337	8,56	15.20	-	H40	-	-	-	-	-	-
											J55	-	-	-	-	-	-
											K55	-	-	-	-	-	-
											L80	352,600	-	-	11,080	10,480	P
											N80Q	-	-	-	-	-	-
											P110	-	-	-	-	-	-



**NOTE**

- <sup>a</sup> According to API TR 5C3.
- <sup>b</sup> Sp.C. = Special Clearance
- <sup>c</sup> Internal Yield Pressure for pipe body and connection are the same, except for these items, verify API TR 5C3.
- <sup>d</sup> These values are applicable for EU Regular only.

**LEGEND**

- NU** = Non-upset tubing connection
- EU** = External upset tubing connection
- P** = Plain End
- N** = Non-upset threaded and coupled
- U** = External upset threaded and coupled.

Size	Outside Diameter		Inside Diameter		Drift Diameter				Wall Thickness		Label	Grade	Pipe Body Yield Strength <sup>a</sup>	Joint Yield Strength <sup>a</sup>			Collapse Resistance <sup>a</sup>	Internal Yield Pressure <sup>a</sup> (Pipe body)	Type of End-finish	
					Regular		Alternative							STC	LTC	BTC				
					inch	mm	inch	mm												inch
4 1/2	4.500	114,30	4.090	103,88	3.965	100,70	-	-	0.205	5,21	9.50	H40	111,000	77,000	-	-	2,760	3,180	PS	
												J55	152,000	101,000	-	-	3,310	4,380	PS	
												K55	152,000	112,000	-	-	3,310	4,380	PS	
												L80	-	-	-	-	-	-	-	
												N80Q	-	-	-	-	-	-	-	
												P110	-	-	-	-	-	-	-	
4 1/2	4.500	114,30	4.052	102,92	3.927	99,74	-	-	0.224	5,69	10.50	H40	-	-	-	-	-	-	-	
												J55	165,000	132,000	-	203,000	4,010	4,790	PSB	
												K55	165,000	146,000	-	249,000	4,010	4,790	PSB	
												L80	-	-	-	-	-	-	-	
												N80Q	-	-	-	-	-	-	-	
												P110	-	-	-	-	-	-	-	
4 1/2	4.500	114,30	4.000	101,60	3.875	98,42	-	-	0.250	6,35	11.60	H40	-	-	-	-	-	-	-	
												J55	184,000	154,000	162,000	225,000	4,960	5,350	PSLB	
												K55	184,000	170,000	180,000	277,000	4,960	5,350	PSLB	
												L80	267,000	-	212,000	291,000	6,350	7,780	PLB	
												N80Q	267,000	-	223,000	304,000	6,350	7,780	PLB	
												P110	367,000	-	279,000	385,000	7,580	10,690	PLB	
4 1/2	4.500	114,30	3.920	99,56	3.795	96,38	-	-	0.290	7,37	13.50	H40	-	-	-	-	-	-	-	
												J55	-	-	-	-	-	-	-	-
												K55	-	-	-	-	-	-	-	-
												L80	307,000	-	257,000	334,000	8,540	9,020 <sup>b</sup>	PLB	
												N80Q	307,000	-	270,000	349,000	8,540	9,020 <sup>b</sup>	PLB	
												P110	422,000	-	338,000	443,000	10,690	12,140 <sup>b</sup>	PLB	
4 1/2	4.500	114,30	3.826	97,18	3.701	94,00	-	-	0.337	8,56	15.10	H40	-	-	-	-	-	-	-	
												J55	-	-	-	-	-	-	-	
												K55	-	-	-	-	-	-	-	
												L80	-	-	-	-	-	-	-	
												N80Q	-	-	-	-	-	-	-	
												P110	485,000	-	406,000	509,000	14,340	14,420 <sup>b</sup>	PLB	
5 1/2	5.500	139,70	5.012	127,30	4.887	124,12	-	-	0.244	6,20	14.00	H40	161,000	130,000	-	-	2,620	3,110	PS	
												J55	222,000	172,000	-	-	3,120	4,270	PS	
												K55	222,000	189,000	-	-	3,120	4,270	PS	
												L80	-	-	-	-	-	-	-	
												N80Q	-	-	-	-	-	-	-	
												P110	-	-	-	-	-	-	-	
5 1/2	5.500	139,70	4.950	125,74	4.825	122,54	-	-	0.275	6,98	15.50	H40	-	-	-	-	-	-	-	
												J55	248,000	202,000	217,000	300,000	4,040	4,810	PSLB	
												K55	248,000	222,000	239,000	366,000	4,040	4,810	PSLB	
												L80	-	-	-	-	-	-	-	
												N80Q	-	-	-	-	-	-	-	
												P110	-	-	-	-	-	-	-	
5 1/2	5.500	139,70	4.892	124,26	4.767	121,08	-	-	0.304	7,72	17.00	H40	-	-	-	-	-	-	-	
												J55	273,000	229,000	247,000	329,000	4,910	5,320	PSLB	
												K55	273,000	252,000	272,000	402,000	4,910	5,320	PSLB	
												L80	397,000	-	338,000	428,000	6,290	7,740 <sup>b</sup>	PLB	
												N80Q	397,000	-	348,000	446,000	6,290	7,740 <sup>b</sup>	PLB	
												P110	546,000	-	445,000	568,000	7,480	10,640 <sup>b</sup>	PLB	
5 1/2	5.500	139,70	4.778	121,36	4.653	118,18	-	-	0.361	9,17	20.00	H40	-	-	-	-	-	-	-	
												J55	-	-	-	-	-	-	-	
												K55	-	-	-	-	-	-	-	
												L80	466,000	-	416,000	503,000	8,830	9,190 <sup>b</sup>	PLB	
												N80Q	466,000	-	428,000	524,000	8,830	9,190 <sup>b</sup>	PLB	
												P110	641,000	-	548,000	667,000	11,100	12,640 <sup>b</sup>	PLB	
7	7.000	177,80	6.538	166,06	6.413	162,88	-	-	0.231	5,87	17.00	H40	196,000	122,000	-	-	1,420	2,310	PS	
												J55	-	-	-	-	-	-	-	
												K55	-	-	-	-	-	-	-	
												L80	-	-	-	-	-	-	-	
												N80Q	-	-	-	-	-	-	-	
												P110	-	-	-	-	-	-	-	



NOTE:

<sup>a</sup> According to API TR 5C3.

<sup>b</sup> Internal Yield Pressure for pipe body and connection are the same, except for these items, verify API TR 5C3.

LEGEND

STC = Short round-thread casing

LTC = Long round-thread casing

BTC = Buttress round-thread casing

P = Plain End

S = Short round-thread

L = Long round-thread

B = Buttress-thread



Size	Outside Diameter		Inside Diameter		Drift Diameter				Wall Thickness		Label	Grade	Pipe Body Yield Strength <sup>a</sup>	Joint Yield Strength <sup>a</sup>			Collapse Resistance <sup>a</sup>	Internal Yield Pressure <sup>a</sup> (Pipe body)	Type of End-finish
					Regular		Alternative							STC	LTC	BTC			
					inch	mm	inch	mm											
7	7.000	177,80	6.456	163,98	6.331	160,80	-	-	0.272	6,91	20.00	H40	230,000	176,000	-	-	1,970	2,720	PS
												J55	316,000	234,000	-	-	2,270	3,740	PS
												K55	316,000	254,000	-	-	2,270	3,740	PS
												L80	-	-	-	-	-	-	-
												N80Q	-	-	-	-	-	-	-
												P110	-	-	-	-	-	-	-
7	7.000	177,80	6.366	161,70	6.241	158,52	6.250	158,75	0.317	8,05	23.00	H40	-	-	-	-	-	-	
												J55	366,000	284,000	313,000	432,000	3,270	4,360	PSLB
												K55	366,000	309,000	341,000	522,000	3,270	4,360	PSLB
												L80	532,000	-	435,000	565,000	3,830	6,340 <sup>b</sup>	PLB
												N80Q	532,000	-	442,000	588,000	3,830	6,340 <sup>b</sup>	PLB
												P110	-	-	-	-	-	-	-
7	7.000	177,80	6.276	159,42	6.151	156,24	-	-	0.362	9,19	26.00	H40	-	-	-	-	-	-	
												J55	415,000	334,000	367,000	490,000	4,330	4,980 <sup>b</sup>	PSLB
												K55	415,000	364,000	401,000	592,000	4,330	4,980 <sup>b</sup>	PSLB
												L80	604,000	-	511,000	641,000	5,410	7,240 <sup>b</sup>	PLB
												N80Q	604,000	-	519,000	667,000	5,410	7,240 <sup>b</sup>	PLB
												P110	830,000	-	693,000	853,000	6,230	9,960 <sup>b</sup>	PLB
7	7.000	177,80	6.184	157,08	6.059	153,90	-	-	0.408	10,36	29.00	H40	-	-	-	-	-	-	
												J55	-	-	-	-	-	-	-
												K55	-	-	-	-	-	-	-
												L80	676,000	-	587,000	718,000	7,030	8,160 <sup>b</sup>	PLB
												N80Q	676,000	-	597,000	746,000	7,030	8,160 <sup>b</sup>	PLB
												P110	929,000	-	797,000	955,000	8,530	11,220 <sup>b</sup>	PLB
7 5/8	7.625	193,68	7.025	178,44	6.900	175,26	-	-	0.300	7,62	24.00	H40	276,000	212,000	-	-	2,030	2,750	PS
												J55	-	-	-	-	-	-	-
												K55	-	-	-	-	-	-	-
												L80	-	-	-	-	-	-	-
												N80Q	-	-	-	-	-	-	-
												P110	-	-	-	-	-	-	-
7 5/8	7.625	193,68	6.969	177,02	6.844	173,84	-	-	0.328	8,33	26.40	H40	-	-	-	-	-	-	
												J55	414,000	315,000	346,000	483,000	2,900	4,140	PSLB
												K55	414,000	342,000	377,000	581,000	2,900	4,140	PSLB
												L80	602,000	-	482,000	635,000	3,400	6,020	PLB
												N80Q	602,000	-	490,000	659,000	3,400	6,020	PLB
												P110	-	-	-	-	-	-	-
7 5/8	7.625	193,68	6.875	174,64	6.750	171,46	-	-	0.375	9,52	29.70	H40	-	-	-	-	-	-	
												J55	-	-	-	-	-	-	-
												K55	-	-	-	-	-	-	-
												L80	683,000	-	566,000	721,000	4,790	6,890 <sup>b</sup>	PLB
												N80Q	683,000	-	575,000	749,000	4,790	6,890 <sup>b</sup>	PLB
												P110	940,000	-	769,000	960,000	5,350	9,470	PLB
7 5/8	7.625	193,68	6.765	171,84	6.640	168,66	-	-	0.430	10,92	33.70	H40	-	-	-	-	-	-	
												J55	-	-	-	-	-	-	-
												K55	-	-	-	-	-	-	-
												L80	778,000	-	664,000	820,000	6,560	7,900 <sup>b</sup>	PLB
												N80Q	778,000	-	674,000	852,000	6,560	7,900 <sup>b</sup>	PLB
												P110	1.069,000	-	901,000	1.093,000	7,870	10,860 <sup>b</sup>	PLB
7 5/8	7.625	193,68	6.625	168,28	6.500	165,10	-	-	0.500	12,70	39.00	H40	-	-	-	-	-	-	
												J55	-	-	-	-	-	-	-
												K55	-	-	-	-	-	-	-
												L80	895,000	-	786,000	945,000	8,820	9,180 <sup>b</sup>	PLB
												N80Q	895,000	-	798,000	981,000	8,820	9,180 <sup>b</sup>	PLB
												P110	1.231,000	-	1.066,000	1.258,000	11,080	12,620 <sup>b</sup>	PLB
8 5/8	8.625	219,08	8.097	205,66	7.972	202,48	-	-	0.264	6,71	24.00	H40	-	-	-	-	-	-	
												J55	381,000	244,000	-	-	1,370	2,950	PS
												K55	381,000	263,000	-	-	1,370	2,950	PS
												L80	-	-	-	-	-	-	-
												N80Q	-	-	-	-	-	-	-
												P110	-	-	-	-	-	-	-

Size	Outside Diameter		Inside Diameter		Drift Diameter				Wall Thickness		Label	Grade	Pipe Body Yield Strength <sup>a</sup>	Joint Yield Strength <sup>a</sup>			Collapse Resistance <sup>a</sup>	Internal Yield Pressure <sup>a</sup> (Pipe body)	Type of End-finish	
					Regular		Alternative							STC	LTC	BTC				
					inch	mm	inch	mm												lb
8 5/8	8.625	219,08	8.017	203,64	7.892	200,46	-	-	0.304	7,72	28.00	H40	318,000	233,000	-	-	1,610	2,470	PS	
							J55	-				-	-	-	-	-	-	-		
							K55	-				-	-	-	-	-	-	-		
							L80	-				-	-	-	-	-	-	-		
							N80Q	-				-	-	-	-	-	-	-		
							P110	-				-	-	-	-	-	-	-		
8 5/8	8.625	219,08	7.921	201,20	7.796	198,02	7.875	200,02	0.352	8,94	32.00	H40	366,000	279,000	-	-	2,200	2,860	PS	
												J55	503,000	372,000	417,000	579,000	2,530	3,930	PSLB	
												K55	503,000	402,000	452,000	690,000	2,530	3,930	PSLB	
												L80	-	-	-	-	-	-	-	-
												N80Q	-	-	-	-	-	-	-	-
												P110	-	-	-	-	-	-	-	-
8 5/8	8.625	219,08	7.825	198,76	7.700	195,58	-	-	0.400	10,16	36.00	H40	-	-	-	-	-	-	-	
							J55	568,000				434,000	486,000	654,000	3,450	4,460 <sup>b</sup>	PSLB			
							K55	568,000				468,000	526,000	780,000	3,450	4,460 <sup>b</sup>	PSLB			
							L80	827,000				-	678,000	864,000	4,100	6,490 <sup>b</sup>	PLB			
							N80Q	827,000				-	688,000	895,000	4,100	6,490 <sup>b</sup>	PLB			
							P110	-				-	-	-	-	-	-	-		
8 5/8	8.625	219,08	7.725	196,22	7.600	193,04	7.625	193,68	0.450	11,43	40.00	H40	-	-	-	-	-	-	-	
												J55	-	-	-	-	-	-	-	-
												K55	-	-	-	-	-	-	-	-
												L80	925,000	-	776,000	966,000	5,520	7,300 <sup>b</sup>	PLB	
												N80Q	925,000	-	788,000	1.001,000	5,520	7,300 <sup>b</sup>	PLB	
												P110	1.271,000	-	1.055,000	1.288,000	6,390	10,040 <sup>b</sup>	PLB	
8 5/8	8.625	219,08	7.625	193,68	7.500	190,50	-	-	0.500	12,70	44.00	H40	-	-	-	-	-	-	-	
							J55	-				-	-	-	-	-	-	-		
							K55	-				-	-	-	-	-	-	-		
							L80	1.021,000				-	874,000	1.066,000	6,950	8,120 <sup>b</sup>	PLB			
							N80Q	1.021,000				-	887,000	1.105,000	6,950	8,120 <sup>b</sup>	PLB			
							P110	1.404,000				-	1.186,000	1.423,000	8,420	11,160 <sup>b</sup>	PLB			
9 5/8	9.625	244,48	9.001	228,64	8.845	224,67	-	-	0.312	7,92	32.30	H40	365,000	254,000	-	-	1,370	2,270	PS	
							J55	-				-	-	-	-	-	-	-		
							K55	-				-	-	-	-	-	-	-		
							L80	-				-	-	-	-	-	-	-		
							N80Q	-				-	-	-	-	-	-	-		
							P110	-				-	-	-	-	-	-	-		
9 5/8	9.625	244,48	8.921	226,60	8.765	222,63	-	-	0.352	8,94	36,00	H40	410,000	294,000	-	-	1,720	2,560	PS	
							J55	564,000				394,000	453,000	639,000	2,020	3,520	PSLB			
							K55	564,000				423,000	489,000	755,000	2,020	3,520	PSLB			
							L80	-				-	-	-	-	-	-	-		
							N80Q	-				-	-	-	-	-	-	-		
							P110	-				-	-	-	-	-	-	-		
9 5/8	9.625	244,48	8.835	244,42	8.679	220,45	8.750	222,25	0.395	10,03	40.00	H40	-	-	-	-	-	-	-	
												J55	630,000	452,000	520,000	714,000	2,570	3,950 <sup>b</sup>	PSLB	
												K55	630,000	486,000	561,000	843,000	2,570	3,950 <sup>b</sup>	PSLB	
												L80	916,000	-	727,000	947,000	3,090	5,750 <sup>b</sup>	PLB	
												N80Q	916,000	-	737,000	979,000	3,090	5,750 <sup>b</sup>	PLB	
												P110	-	-	-	-	-	-	-	-
9 5/8	9.625	244,48	8.755	222,38	8.599	218,41	-	-	0.435	11,05	43.50	H40	-	-	-	-	-	-	-	
							J55	-				-	-	-	-	-	-	-		
							K55	-				-	-	-	-	-	-	-		
							L80	1.005,000				-	813,000	1.038,000	3,810	6,330 <sup>b</sup>	PLB			
							N80Q	1.005,000				-	825,000	1.074,000	3,810	6,330 <sup>b</sup>	PLB			
							P110	1.381,000				-	1.105,000	1.388,000	4,420	8,700 <sup>b</sup>	PLB			
9 5/8	9.625	244,48	8.681	220,50	8.525	216,53	-	-	0.472	11,99	47.00	H40	-	-	-	-	-	-	-	
							J55	-				-	-	-	-	-	-	-		
							K55	-				-	-	-	-	-	-	-		
							L80	1.086,000				-	893,000	1.122,000	4,570	6,870 <sup>b</sup>	PLB			
							N80Q	1.086,000				-	905,000	1.161,000	4,570	6,870 <sup>b</sup>	PLB			
							P110	1.493,000				-	1.213,000	1.500,000	5,300	9,440 <sup>b</sup>	PLB			

## TOLERÂNCIAS DE COMPRIMENTO - PUP JOINT

RANGE LENGTHS - PUP JOINTS<sup>d</sup>

Nominal		Min.		Max.	
ft	m	ft	m	ft	m
2.0	0,61	1.7	0,53	2.3	0,69
4.0	1,22	3.7	1,14	4.3	1,30
6.0	1,83	5.7	1,75	6.3	1,91
8.0	2,44	7.7	2,36	8.3	2,52
10.0	3,05	9.7	2,97	10.3	3,13
12.0	3,66	11.7	3,58	12.3	3,74



NOTE:  
Tolerance ±76mm.

## REQUISITOS PARA PROPRIEDADES MECÂNICAS (ENSAIO DE TRAÇÃO E DUREZA)

TENSILE AND HARDNESS REQUIREMENTS

	Grade	Yield Strength				Tensile Strength		Hardness
		Min.		Max.		Min.		Max.
		MPa	psi	MPa	psi	MPa	psi	HRC
API General Service	H40	276	40,000	552	80,000	414	60,000	-
	J55	379	55,000	552	80,000	517	75,000	-
	K55	379	55,000	552	80,000	655	95,000	-
API Sour Service	L80	552	80,000	655	95,000	655	95,000	23
API High-Strength	N80	552	80,000	758	110,000	689	100,000	-
	P110	758	110,000	965	140,000	862	125,000	-



NOTE: Charpy impact test according to API 5CT.

# API 5L

Tubos de condução (Line Pipe) para aplicações em gasodutos e oleodutos, fornecidos nos níveis de especificação PSL1 e PSL2, com ou sem revestimento.

Line Pipe for applications in pipelines, supplied at specification levels PSL1 and PSL2, coated or bare.



## COMPOSIÇÃO QUÍMICA (PORCENTAGEM DE FRAÇÃO EM MASSA)

### CHEMICAL COMPOSITION (MASS FRACTION)

OFFSHORE																				
%Max																				
Grade <sup>c</sup>	C	Mn	P	S	Cu	Ni	Cr	Mo	Si	B	V	Nb	Ti	Al	N	Ca	NV+V+Ti	Nb+V	Ce(Pcm) <sup>f</sup>	Ce(IIW) <sup>g</sup>
L245NO or BNO	0.14 <sup>d</sup>	1.35 <sup>d</sup>	0.020	0.010	0.35	0.30	0.30	0.10	0.40	0.0005	-	-	0.04	0.06 <sup>g</sup>	0.012	-	0.15	0.06	0.19	0.36
L290NO or X42NO	0.14 <sup>d</sup>	1.35 <sup>d</sup>	0.020	0.010	0.35	0.30	0.30	0.10	0.40	0.0005	0.05	0.05	0.04	0.06 <sup>g</sup>	0.012	-	-	-	0.19	0.36
L320NO or X46NO	0.14 <sup>d</sup>	1.40 <sup>d</sup>	0.020	0.010	0.35	0.30	0.30	0.10	0.40	0.0005	0.07	0.05	0.04	0.06 <sup>g</sup>	0.012	-	0.15	-	0.20	0.38
L360NO or X52NO	0.16 <sup>d</sup>	1.65 <sup>d</sup>	0.020	0.010	f	f	f	f	0.45	f	0.10	0.05	0.04	0.06 <sup>g</sup>	0.012	-	0.15	-	0.22	0.43
L2450QO or BQO	0.14 <sup>d</sup>	1.35 <sup>d</sup>	0.020	0.010	0.35	0.30	0.30	0.10	0.40	0.0005	0.04	0.04	0.04	0.06 <sup>g</sup>	0.012	-	-	-	0.19	0.34
L290QO or X42QO	0.14 <sup>d</sup>	1.35 <sup>d</sup>	0.020	0.010	0.35	0.30	0.30	0.10	0.40	0.0005	0.04	0.04	0.04	0.06 <sup>g</sup>	0.012	-	-	-	0.19	0.34
L320QO or X46QO	0.15 <sup>d</sup>	1.40 <sup>d</sup>	0.020	0.010	0.35	0.30	0.30	0.10	0.45	0.0005	0.05	0.05	0.04	0.06 <sup>g</sup>	0.012	-	-	-	0.20	0.36
L360QO or X52QO	0.16 <sup>d</sup>	1.65 <sup>d</sup>	0.020	0.010	0.50	0.50	0.50	0.50	0.45	0.0005	0.07	0.05	0.04	0.06 <sup>g</sup>	0.012	-	0.15	-	0.20	0.39
L390QO or X56QO	0.16 <sup>d</sup>	1.65 <sup>d</sup>	0.020	0.010	0.50	0.50	0.50	0.50	0.45	0.0005	0.07	0.05	0.04	0.06 <sup>g</sup>	0.012	-	0.15	-	0.21	0.40
L415QO or X60QO	0.16 <sup>d</sup>	1.65 <sup>d</sup>	0.020	0.010	0.50	0.50	0.50	0.50	0.45	0.0005	0.08	0.05	0.04	0.06 <sup>g</sup>	0.012	-	0.15	-	0.22	0.41
L450QO or X65QO	0.16 <sup>d</sup>	1.65 <sup>d</sup>	0.020	0.010	0.50	0.50	0.50	0.50	0.45	0.0005	0.09	0.05	0.06	0.06 <sup>g</sup>	0.012	-	0.15	-	0.22	0.42
L485QO or X70QO	0.17 <sup>d</sup>	1.75 <sup>d</sup>	0.020	0.010	0.50	0.50	0.50	0.50	0.45	0.0005	0.10	0.05	0.06	0.06 <sup>g</sup>	0.012	-	0.15	-	0.23	0.42
L555QO or X80QO	0.17 <sup>d</sup>	1.85 <sup>d</sup>	0.020	0.010	0.50	0.50	0.50	0.50	0.45	0.0005	0.10	0.06	0.06	0.06 <sup>g</sup>	0.012	-	0.15	-	e	e
L245MO or BMO	0.12 <sup>d</sup>	1.25 <sup>d</sup>	0.020	0.010	0.35	0.30	0.30	0.10	0.40	0.0005	0.04	0.04	0.04	0.06 <sup>g</sup>	0.012	-	-	-	0.19	-
L290MO or X42MO	0.12 <sup>d</sup>	1.35 <sup>d</sup>	0.020	0.010	0.35	0.30	0.30	0.10	0.40	0.0005	0.04	0.04	0.04	0.06 <sup>g</sup>	0.012	-	-	-	0.19	-
L320MO or X46MO	0.12 <sup>d</sup>	1.35 <sup>d</sup>	0.020	0.010	0.35	0.30	0.30	0.10	0.45	0.0005	0.05	0.05	0.04	0.06 <sup>g</sup>	0.012	-	-	-	0.20	-
L360MO or X52MO	0.12 <sup>d</sup>	1.65 <sup>d</sup>	0.020	0.010	0.50	0.50	0.50	0.50	0.45	0.0005	0.05	0.05	0.04	0.06 <sup>g</sup>	0.012	-	0.15	-	0.20	-
L390MO or X56MO	0.12 <sup>d</sup>	1.65 <sup>d</sup>	0.020	0.010	0.50	0.50	0.50	0.50	0.45	0.0005	0.06	0.08	0.04	0.06 <sup>g</sup>	0.012	-	0.15	-	0.21	-
L415MO or X60MO	0.12 <sup>d</sup>	1.65 <sup>d</sup>	0.020	0.010	0.50	0.50	0.50	0.50	0.45	0.0005	0.08	0.08	0.06	0.06 <sup>g</sup>	0.012	-	0.15	-	0.21	-
L450MO or X65MO	0.12 <sup>d</sup>	1.65 <sup>d</sup>	0.020	0.010	0.50	0.50	0.50	0.50	0.45	0.0005	0.10	0.08	0.06	0.06 <sup>g</sup>	0.012	-	0.15	-	0.22	-
L485MO or X70MO	0.12 <sup>d</sup>	1.75 <sup>d</sup>	0.020	0.010	0.50	0.50	0.50	0.50	0.45	0.0005	0.10	0.08	0.06	0.06 <sup>g</sup>	0.012	-	0.15	-	0.22	-
L555MO or X80MO	0.12 <sup>d</sup>	1.85 <sup>d</sup>	0.020	0.010	0.50	0.50	0.50	0.50	0.45	0.0005	0.10	0.08	0.06	0.06 <sup>g</sup>	0.012	-	0.15	-	0.24	-



NOTE: Applicable to PSL1 and PSL2

<sup>a</sup> For pipe with a product analysis carbon mass fraction equal to or less than 0.12 %, the carbon equivalent, CE(IIW), shall be determined using the following equation:

$$CE(Pcm) = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Cu}{20} + \frac{Ni}{60} + \frac{Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B$$

<sup>b</sup> For pipe with a product analysis carbon mass fraction greater than 0.12 %, the carbon equivalent, CE(IIW), shall be determined using the following equation:

$$CE(IIW) = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Ni+Cu}{15}$$

<sup>c</sup> S = Sour Service; O = Offshore

<sup>d</sup> For each reduction of 0.01% below the specified maximum concentration for carbon, an increase of 0.05% above the specified maximum concentration for manganese is permissible, up to a maximum increase of 0.20%.

<sup>e</sup> As agreed between the purchaser and the manufacturer.

<sup>f</sup> Not specified.

<sup>g</sup> The concentration of Al must be higher than or equal to twice the N concentration, except for steels that are titanium-killed or titanium-treated.

## REQUISITOS PARA PROPRIEDADES MECÂNICAS (ENSAIO DE TRAÇÃO)

### TENSILE REQUIREMENTS

Grade	PSL1 and PSL2							
	Yield Strength <sup>a</sup>				Tensile Strength			
	Min.		Max. <sup>b</sup>		Min.		Max. <sup>b</sup>	
	MPa	psi	MPa	psi	MPa	psi	MPa	psi
L245 ou B	245	35,500	450 <sup>c</sup>	65,300 <sup>c</sup>	415	60,200	655	95,000
L290 ou X42	290	42,100	495	71,800	415	60,200	655	95,000
L320 ou X46	320	46,400	525	76,100	435	63,100	655	95,000
L360 ou X52	360	52,200	530	76,900	460	66,700	760	110,200
L390 ou X56	390	56,600	545	79,000	490	71,100	760	110,200
L415 ou X60	415	60,200	565	81,900	520	75,400	760	110,200
L450 ou X65	450	65,300	600	87,000	535	77,600	760	110,200
L485 ou X70	485	70,300	635	92,100	570	82,700	760	110,200
L555 ou X80 <sup>b</sup>	555	80,500	705	102,300	625	90,600	825	119,700

Grade	Offshore							
	Yield Strength <sup>a</sup>				Tensile Strength			
	Min.		Max. <sup>b</sup>		Min.		Max. <sup>b</sup>	
	MPa	psi	MPa	psi	MPa	psi	MPa	psi
L245 ou B	245	35,500	450	65,300	415	60,200	655	95,000
L290 ou X42	290	42,100	495	71,800	415	60,200	655	95,000
L320 ou X46	320	46,400	520	75,000	435	63,100	655	95,000
L360 ou X52	360	52,200	525	76,000	460	66,700	760	110,200
L390 ou X56	390	56,600	540	78,300	490	71,100	760	110,200
L415 ou X60	415	60,200	565	81,900	520	75,400	760	110,200
L450 ou X65	450	65,300	570	82,700	535	77,600	760	110,200
L485 ou X70	485	70,300	605	87,700	570	82,700	760	110,200
L555 ou X80 <sup>b</sup>	555	80,500	675	97,900	625	90,600	825	119,700



NOTE:

<sup>a</sup> Applicable for pipe body only.

<sup>b</sup> Applicable for PSL2 only.

<sup>c</sup> For pipe with D < 219,1 mm (8.625 in), the maximum yield strength shall be equal or smaller than 495 MPa (71,800 psi).

## REQUISITOS PARA ENSAIO CHARPY - PSL2

### CHARPY TEST REQUIREMENTS - PSL2

Grade	Minimum CVN Absorbed Energy Requirements <sup>a, b</sup>	
	J	ft.lbf
≤ L415/X60	27	20
> L415/X60 ≤ L450/X65	27	20
> L450/X65 ≤ L485/X70	27	20
> L485/X70 ≤ L555/X80	40	30



NOTE:

<sup>a</sup> Individual test values for any test piece shall be equal or greater than 75% of the required minimum average (of a set of three test pieces) absorbed energy values.

<sup>b</sup> Full size specimen, at 0°C





**COMPOSIÇÃO QUÍMICA (PORCENTAGEM DE FRAÇÃO EM MASSA)**  
CHEMICAL COMPOSITION (MASS FRACTION)

Specification	Grade	%Max.									
		C	Mn	P	S	Cu	Ni	Cr	Mo	V	Si
ASTM A53	A	0.25	0.95	0.050	0.045	<sup>a</sup>	0.40 <sup>b</sup>	0.40 <sup>b</sup>	0.15 <sup>b</sup>	0.08 <sup>b</sup>	-
NBR 5590	B	0.30	1.20	0.050	0.045	<sup>a</sup>	0.40 <sup>b</sup>	0.40 <sup>b</sup>	0.15 <sup>b</sup>	0.08 <sup>b</sup>	-
DIN EN 10255	-	0.20	1.40	0.035	0.030	-	-	-	-	-	-
NBR 6591	1006	0.08	0.25 - 0.45	0.040	0.050	-	-	-	-	-	-
	1008	0.10	0.25 - 0.50	0.040	0.050	-	-	-	-	-	-
	1010	0.08 - 0.13	0.30 - 0.60	0.040	0.050	-	-	-	-	-	-
	1015	0.13 - 0.18	0.30 - 0.60	0.040	0.050	-	-	-	-	-	-
	1016	0.13 - 0.18	0.60 - 0.90	0.040	0.050	-	-	-	-	-	-
	1020	0.18 - 0.23	0.30 - 0.60	0.040	0.050	-	-	-	-	-	-
	1021	0.18 - 0.23	0.60 - 0.90	0.040	0.050	-	-	-	-	-	-
	1025	0.22 - 0.28	0.30 - 0.60	0.040	0.050	-	-	-	-	-	-
ASTM A178	A	0.06 - 0.18	0.27 - 0.63	0.035	0.035	-	-	-	-	-	-
	C	0.35	0.80	0.035	0.035	-	-	-	-	-	-
	D	0.27	1.00 - 1.50	0.030	0.015	-	-	-	-	-	0.10 <sup>c</sup>



NOTE

<sup>a</sup> Maximum value Cu: for ASTM A53 Grade A and B = 0.50 / for NBR 5590 Grade A and B = 0.40

<sup>b</sup> The sum of these elements shall be smaller than 1.00%.

<sup>c</sup> Minimum value.

# NBR | DIN | ASTM

## Tubos Estruturais e Industriais

Tubos com requisitos químicos e mecânicos específicos, para atender segmentos específicos, tais como: Geotecnia (estacas para torres de transmissão), Energia Solar (perfis quadrado e retangular), Máquinas e Implementos Agrícolas e Rodoviários (cilindros hidráulicos), Construção Civil, Sucreenergético, Automotivo, Naval e Telecomunicações.

## Structural and Industrial Pipes

Pipes with specific chemical and mechanical requirements, for special segments such as: Geotechnics, Solar Energy (square and rectangular profiles), Machinery, Agricultural and Road Implements (hydraulic cylinders), Civil Construction, Sugar Cane Plants, Automotive, Naval and Telecommunications.

## REQUISITOS PARA PROPRIEDADES MECÂNICAS (ENSAIO DE TRAÇÃO)

TENSILE AND HARDNESS REQUIREMENTS

Specification	Grade	Yield strength		Tensile strength			
		min.		min.		max.	
		MPa	psi	MPa	psi	MPa	psi
ASTM A53	A	205	30,000	330	48,000	-	-
NBR 5590	B	240	35,000	415	60,000	-	-
DIN EN 10255	-	195	28,282	320	46,412	520	75,420
ASTM A178	A	180	26,000	325	47,000	-	-
	C	255	37,000	415	60,000	-	-
	D	275	40,000	485	70,000	-	-



## DIMENSÕES DIN EN 10255


DIMENSIONS DIN EN 10255

Nominal Diameter	Outside Diameter		Wall Thickness		Class	Nominal Masses	
	inch	mm	inch	mm		lb/ft	kg/m
2	2 3/8	60,30	0.177	4,50	H	4.16	6,19
			0.142	3,60	M	3.38	5,03
2 1/2	3	76,10	0.177	4,50	H	5.34	7,95
			0.142	3,60	M	4.32	6,44
3	3 1/2	88,90	0.197	5,00	H	6.95	10,34
			0.157	4,00	M	5.63	8,37
4	4 1/2	114,30	0.213	5,40	H	9.74	14,50
			0.177	4,50	M	8.19	12,18
5	5 1/2	139,70	0.213	5,40	H	12.02	17,88
			0.197	5,00	M	11.16	16,61
6	6 1/2	165,10	0.213	5,40	H	14.29	21,27
			0.197	5,00	M	13.26	19,74

## DIMENSÕES DIN EN 10305-3<sup>a</sup>

DIMENSIONS DIN EN 10355-3


Diameter mm (inch)	Nominal	60,3 (2 3/8")	73,0 (2 7/8")	88,9 (3 1/2")	101,6 (4")	114,3 (4 1/2")	139,7 (5 1/2")	141,3 (5 9/16")	165,1 (6 1/2")	168,3 (6 5/8")	177,8 (7")	193,7 (7 5/8")	219,1 (8 5/8")
		Tolerance	± 0,30	± 0,35	± 0,40	± 0,50	± 0,60	± 0,80	± 0,80	± 1,00	± 1,00	± 1,00	± 1,00
Length (mm)	L	Standard		Special									
		6.000	6.400	5.000 < L ≤ 8.000	L > 8.000								
Tolerance	-0 +100	-0 +100	-0 +10	.									
Straightness max <sup>b</sup>	≤ 0,002 L												


**SUBTITLE**  
 +CR1/ + CR2= Welded and cold sized  
 + A= Annealed  
 + N= Normalized

## COMPOSIÇÃO QUÍMICA (PORCENTAGEM DE FRAÇÃO EM MASSA)

CHEMICAL COMPOSITION (MASS FRACTION)

Grade	Chemical composition (mass fraction) - % max					Tensile requirements (min.)										
						+ CR1		+ A		+ N				+ CR2		
	C	Mn	Si	P	S	Tensile strength	Elongation %	Yield strength	Elongation %	Tensile strength min.	Tensile strength max.	Yield strength	Elongation %	Tensile strength	Yield strength	Elongation %
E155	0.11	0.70	0.35	0.025	0.025	290	15	260	28	270	410	155	28	-	-	-
E190	0.10	0.70	0.35	0.025	0.025	-	-	-	-	-	-	-	-	270	190	26
E195	0.15	0.70	0.35	0.025	0.025	330	8	290	28	300	440	195	28	-	-	-
E220	0.14	0.70	0.35	0.025	0.025	-	-	-	-	-	-	-	-	310	220	23
E235	0.17	1.20	0.35	0.025	0.025	390	7	315	25	340	480	235	25	-	-	-
E260	0.16	1.20	0.35	0.025	0.025	-	-	-	-	-	-	-	-	340	260	21
E275	0.21	1.40	0.35	0.025	0.025	440	6	390	21	410	550	275	21	-	-	-
E320	0.20	1.40	0.35	0.025	0.025	-	-	-	-	-	-	-	-	410	320	19
E355	0.22	1.60	0.55	0.025	0.025	540	5	450	22	490	630	355	22	-	-	-
E370	0.21	1.60	0.55	0.025	0.025	-	-	-	-	-	-	-	-	450	370	15
E420	0.16	1.70	0.50	0.025	0.025	-	-	-	-	-	-	-	-	490	420	12


**NOTE**  
 As agreed between the purchaser and the manufacturer, is possible to supplied welded annealed pipes on the bond line, this is a special condition that eliminate the heat treatment full body before the cold-draw.

## DIMENSÕES ASTM A53 e NBR 5590

DIMENSIONS ASTM A53 and NBR 5590

Nominal Diameter	Outside Diameter		Wall Thickness		SCH	Nominal Masses	
	inch	mm	inch	mm		lb/ft	kg/m
2	2 3/8	60,30	0.154	3,91	40	3.65	5,44
			0.218	5,54	80	5.03	7,48
2 1/2	2 7/8	73,00	0.203	5,16	40	5.80	8,63
			0.276	7,01	80	7.66	11,41
3	3 1/2	88,90	0.125	3,18	-	4.52	6,72
			0.156	3,96	-	5.57	8,29
			0.188	4,78	-	6.66	9,92
			0.216	5,49	40	7.59	11,29
			0.250	6,35	-	8.69	12,93
			0.281	7,14	-	9.67	14,40
			0.300	7,62	80	10.26	15,27
3 1/2	4	101,60	0.125	3,18	-	5.19	7,72
			0.156	3,96	-	6.41	9,53
			0.188	4,78	-	7.67	11,41
			0.226	5,74	40	9.12	13,57
			0.250	6,35	-	10.02	14,92
			0.281	7,14	-	11.18	16,63
			0.318	8,08	80	12.52	18,63
			0.125	3,18	-	5.86	8,71
			0.156	3,96	-	7.24	10,78
			0.188	4,78	-	8.67	12,91
			4	4 1/2	114,30	0.219	5,56
0.237	6,02	40				10.80	16,07
0.250	6,35	-				11.36	16,90
0.281	7,14	-				12.68	18,87
0.312	7,92	-				13.96	20,78
0.337	8,56	80				15.00	22,32
0.156	3,96	-				9.01	13,41
0.188	4,78	-				10.81	16,09
0.219	5,56	-				12.51	18,61
0.258	6,55	40				14.62	21,77
5	5 9/16	141,30	0.281	7,14	-	15.87	23,62
			0.312	7,92	-	17.50	26,05
			0.344	8,74	-	19.20	28,57
			0.375	9,52	80	20.79	30,94
			0.188	4,78	-	12.95	19,27
			0.219	5,56	-	14.99	22,31
			0.250	6,35	-	17.04	25,36
6	6 5/8	168,30	0.280	7,11	40	18.99	28,26
			0.312	7,92	-	21.05	31,32
			0.344	8,74	-	23.11	34,39
			0.375	9,52	-	25.05	37,28
			0.432	10,97	80	28.60	42,56
			0.188	4,78	-	16.97	25,26
			0.203	5,16	-	18.29	27,22
			0.219	5,56	-	19.67	29,28
8	8 5/8	219,10	0.250	6,35	20	22.38	33,31
			0.277	7,04	30	24.74	36,81
			0.289	7,34	-	25.75	38,33
			0.312	7,92	-	27.71	41,24
			0.322	8,18	40	28.59	42,55
			0.344	8,74	-	30.46	45,34
			0.375	9,52	-	33.06	49,20
			0.406	10,31	60	35.67	53,08
			0.438	11,13	-	38.35	57,08
			0.500	12,70	80	43.43	64,64

Nominal Diameter	Outside Diameter		Wall Thickness		Class	Nominal Masses	
	inch	mm	inch	mm		lb/ft	kg/m
2	2 3/8	60,30	0.118	3,00	L	2.85	4,24
2 1/2	3	76,10	0.132	3,35		4.04	6,01
3	3 1/2	88,90	0.132	3,35		4.75	7,07
3 1/2	4	101,60	0.148	3,75		6.08	9,05
4	4 1/2	114,30	0.148	3,75		6.87	10,22
2	2 3/8	60,30	0.118	3,00	L	2.85	4,24
2 1/2	3	76,10	0.132	3,35		4.04	6,01
3	3 1/2	88,90	0.132	3,35		4.75	7,07
3 1/2	4	101,60	0.148	3,75		6.08	9,05
4	4 1/2	114,30	0.148	3,75		6.87	10,22
2	2 3/8	60,30	0.148	3,75	M	3.51	5,23
2 1/2	3	76,10	0.148	3,75		4.50	6,69
3	3 1/2	88,90	0.157	4,00		5.63	8,37
3 1/2	4	101,60	0.167	4,25		6.86	10,20
4	4 1/2	114,30	0.177	4,50		8.19	12,18
5	5 1/2	139,70	0.187	4,75		10.62	15,81
6	6 1/2	165,10	0.197	5,00	13.26	19,74	
2	2 3/8	60,30	0.148	3,75	M	3.51	5,23
2 1/2	3	76,10	0.148	3,75		4.50	6,69
3	3 1/2	88,90	0.157	4,00		5.63	8,37
3 1/2	4	101,60	0.167	4,25		6.86	10,20
4	4 1/2	114,30	0.177	4,50		8.19	12,18
5	5 1/2	139,70	0.187	4,75		10.62	15,81
6	6 1/2	165,10	0.197	5,00	13.26	19,74	
2	2 3/8	60,30	0.177	4,50	P	4.16	6,19
2 1/2	3	76,10	0.177	4,50		5.34	7,95
3	3 1/2	88,90	0.177	4,50		6.29	9,37
3 1/2	4	101,60	0.197	5,00		8.00	11,91
4	4 1/2	114,30	0.220	5,60		10.09	15,01
5	5 1/2	139,70	0.220	5,60		12.44	18,52
6	6 1/2	165,10	0.220	5,60	14.80	22,03	
2	2 3/8	60,30	0.177	4,50	P	4.16	6,19
2 1/2	3	76,10	0.177	4,50		5.34	7,95
3	3 1/2	88,90	0.177	4,50		6.29	9,37
3 1/2	4	101,60	0.197	5,00		8.00	11,91
4	4 1/2	114,30	0.220	5,60		10.09	15,01
5	5 1/2	139,70	0.220	5,60		12.44	18,52
6	6 1/2	165,10	0.220	5,60	14.80	22,03	

Nominal Diameter	Outside Diameter		Wall Thickness		Nominal Masses	
	inch	mm	inch	mm	lb/ft	Kg/m
2	2 3/8	60,30	0.148	3,75	3.51	5,23
			0.167	4,25	3.95	5,87
			0.177	4,50	4.16	6,19
			0.187	4,75	4.37	6,51
			0.197	5,00	4.58	6,82
2 1/2	2 7/8	73,00	0.220	5,60	5.08	7,55
			0.148	3,75	4.30	6,40
			0.167	4,25	4.84	7,21
			0.177	4,50	5.11	7,60
			0.187	4,75	5.37	7,99
2 1/2	2 7/8	73,00	0.197	5,00	5.63	8,38
			0.220	5,60	6.25	9,31
			0.248	6,30	6.96	10,36
			0.280	7,11	7.76	11,55
			0.148	3,75	5.29	7,87
3	3 1/2	88,90	0.167	4,25	5.96	8,87
			0.187	4,75	6.62	9,86
			0.197	5,00	6.95	10,34
			0.220	5,60	7.73	11,50
			0.248	6,30	8.62	12,83
3	3 1/2	88,90	0.280	7,11	9.64	14,34
			0.315	8,00	10.72	15,96
			0.148	3,75	6.87	10,22
			0.167	4,25	7.75	11,53
			0.177	4,50	8.19	12,18
4	4 1/2	114,30	0.187	4,75	8.62	12,83
			0.197	5,00	9.06	13,48
			0.220	5,60	10.09	15,01
			0.248	6,30	11.27	16,78
			0.280	7,11	12.63	18,79
4	4 1/2	114,30	0.315	8,00	14.09	20,97
			0.148	3,75	8.55	12,72
			0.167	4,25	9.65	14,36
			0.177	4,50	10.20	15,18
			0.187	4,75	10.75	15,99
5	5 9/16	141,30	0.197	5,00	11.29	16,81
			0.220	5,60	12.59	18,74
			0.248	6,30	14.09	20,97
			0.280	7,11	15.81	23,53
			0.315	8,00	17.67	26,30
5	5 9/16	141,30	0.148	3,75*	10.22	15,22
			0.167	4,25	11.55	17,19
			0.177	4,50	12.21	18,18
			0.187	4,75	12.87	19,16
			0.197	5,00	13.53	20,13
6	6 5/8	168,30	0.220	5,60	15.10	22,47
			0.248	6,30	16.91	25,17
			0.280	7,11	18.99	28,26
			0.315	8,00	21.25	31,62

NOTE:  
\*Under consult

## DIMENSÕES NBR 6591

DIMENSIONS NBR 6591

NBR  
DIN  
ASTM

Nominal Diameter	Outside Diameter		Wall Thickness		Nominal Masses	
	inch	mm	inch	mm	lb/ft	Kg/m
7	7	177,80	0.148	3,75 <sup>a</sup>	10.81	16,10
			0.167	4,25 <sup>a</sup>	12.22	18,19
			0.187	4,75	13.62	20,27
			0.197	5,00	14,32	21,31
			0.220	5,60	15.98	23,78
			0.248	6,30	17.90	26,64
			0.280	7,11	20.11	29,93
			0.315	8,00	22.51	33,50
8	8 5/8	219,10	0.148	3,75 <sup>a</sup>	13.38	19,91
			0.167	4,25 <sup>a</sup>	15.13	22,52
			0.177	4,50 <sup>a</sup>	16.00	23,81
			0.187	4,75	16.87	25,11
			0.197	5,00	17.74	26,40
			0.220	5,60	19.81	29,48
			0.248	6,30	22.21	33,06
			0.280	7,11	24.97	37,17
9	9 5/8	244,48	0.148	3,75 <sup>a</sup>	14.96	22,26
			0.167	4,25 <sup>a</sup>	16.92	25,18
			0.177	4,50 <sup>a</sup>	17.89	26,63
			0.187	4,75 <sup>a</sup>	18.87	28,08
			0.197	5,00 <sup>a</sup>	19.84	29,53
			0.220	5,60	22.17	32,99
			0.248	6,30	24.86	37,00
			0.280	7,11	27.96	41,62
0.315	8,00	31.35	46,65			

## PERFIL RETÂNGULAR E QUADRADO

RECTANGULAR AND SQUARE PROFILE

PROFILE	DIAMETER For Reference		mm	WALL THICKNESS								
	mm	inch		mm	inch	3,00	3,75	4,75	5,60	6,40	7,60	8,20
150 x 150	7 5/8	193,68	kg/m	14,11	17,56	22,13	25,97	29,56	34,87	37,51	43,15	
			lb/ft	9.48	11,80	14.87	17.45	19.86	23.43	25.20	28.99	



NOTE:  
For reference only NBR 8261 / NBR 6591.  
The profile can be manufactured under  
consult in according to drawing and if  
necessary including other wall thickness  
and dimensions such as:  
100 x 80; 100 x 60; 90 x 90; 70 x 70.

## DIMENSÕES ASTM A178

DIMENSIONS ASTM A178

Nominal Diameter		mm	Wall Thickness						
inch	mm		inch	2,40	2,65	2,75	3,05	3,40	3,75
2	50,80	kg/m	2,86	3,15	3,26	3,59	3,97	4,35	4,88
		lb/ft	1.92	2.11	2.19	2.41	2.67	2.92	3.28
2 3/8	60,30	kg/m	3,43	3,77	3,90	4,31	4,77	5,23	5,87
		lb/ft	2.30	2.53	2.62	2.89	3.21	3.51	3.95
2 1/2	63,50	kg/m	3,62	3,98	4,12	4,55	5,04	5,53	6,21
		lb/ft	2.43	2.67	2.77	3.06	3.39	3.71	4.17
2 7/8	73,00	kg/m	4,18	4,60	4,76	5,26	5,84	6,40	7,21
		lb/ft	2.81	3.09	3.20	3.54	3.92	4.30	4.84
3	76,20	kg/m	4,37	4,81	4,98	5,50	6,10	6,70	7,54
		lb/ft	2.94	3.23	3.35	3.70	4.10	4.50	5.07
3 1/2	88,90	kg/m	5,12	5,64	5,84	6,46	7,17	7,87	8,87
		lb/ft	3.57	3.79	3.93	4.34	4.82	5.29	5.96
4	101,60	kg/m	5,87	6,47	6,70	7,41	8,23	9,05	10,20
		lb/ft	3.95	4.35	4.50	4.98	5.53	6.08	6.86
4 1/2	114,30	kg/m	6,62	7,30	7,56	8,37	9,30	10,22	11,53
		lb/ft	4.45	4.90	5.08	5.62	6.25	6.87	7.75