

Steel & Special Alloys



São Carlos - São Paulo - Brazil

**STATIC CASTING  
CENTRIFUGAL CASTINGS  
PETROCHEMICAL  
MACHINING  
FORGING**



**ENGEMASA**  
ENGENHARIA E MATERIAIS LTDA

[www.engemasa.com.br](http://www.engemasa.com.br)



## **For more than 40 years keeping values and innovating in technology.**

**ENGEMASA was born from the modernization ideals of the 1970s, when University of São Paulo (USP) and the Federal University of São Carlos (UFSCar) engineers got together in 1976 to found a stainless steel casting and special alloys company with the objective of replacing importations.**

**In the 1990s, through a close relationship with top national universities and research laboratories, ENGEMASA entered the Petrochemical market, supplying static castings in high nickel and chrome alloys for high temperature jobs. In response to the demand of the market it developed its technology for the manufacturing of centricast tubes and the assembly of petrochemical columns according to the most rigorous metallurgical controls of micro alloys additions, guaranteeing their performance at high temperatures.**





## **QUALITY POLICY**

Provide cast, forged and centrifugally-casted products in the rough or machined state of steel or special alloys according to the customer necessities and expectations including, but not limited to:

- Fulfillment of the requirements;
- Continuous improvement of management, process and products;
- Team's motivation and skill enhancement;
- Partnerships with customer and external providers.

## **CERTIFICAÇÕES**

ISO 9001:2015  
AD 2000-Merkblatt W0

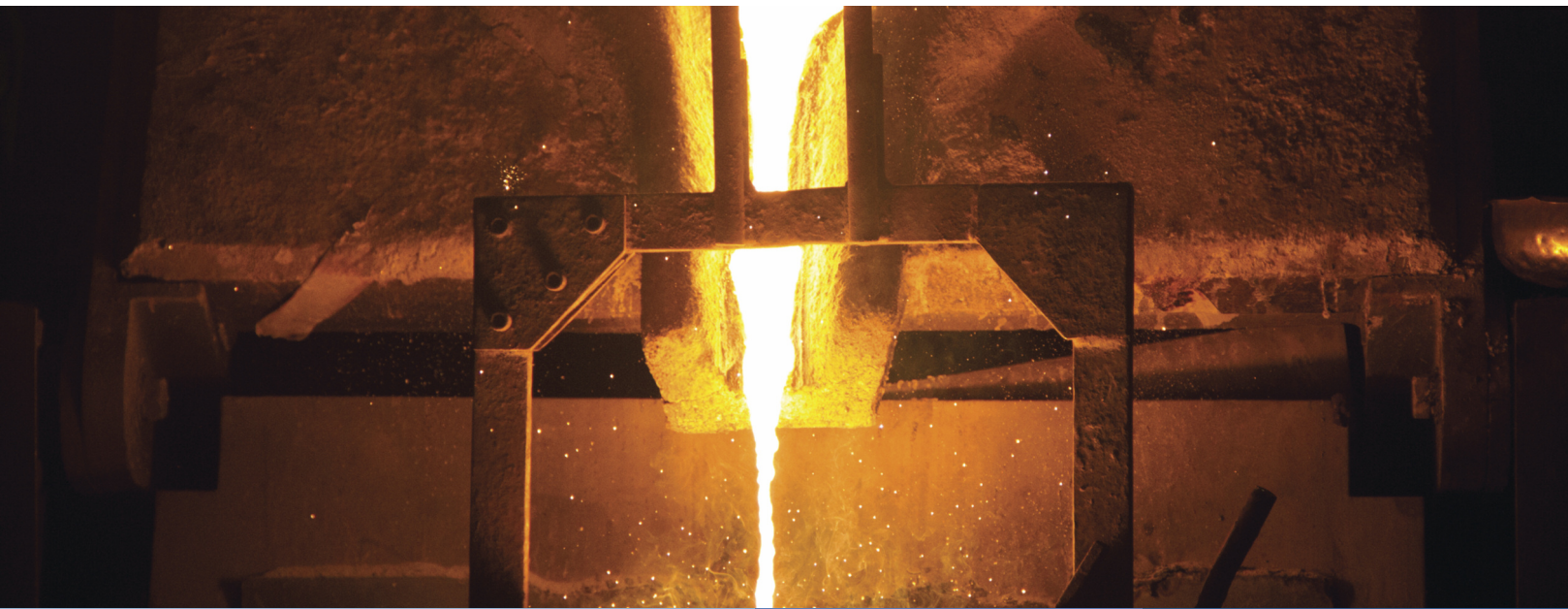
## **QUALITY**

ENGEMASA produces materials to meet the most demanding work conditions in harsh environments, where the materials are subject to corrosion, high temperatures, abrasive work conditions or even a partial or total combination of these.

With that in mind, our quality control starts from the receipt of the materials into our facilities, passing through all phases of the manufacturing process until the delivery.

## **RESEARCH E DEVELOPMENT**

Engemasa invests in internal and external research, counting with partnerships with the best Brazilian universities and institutes, developing special alloys, aiming to supply high performance products.



## STATIC CASTING

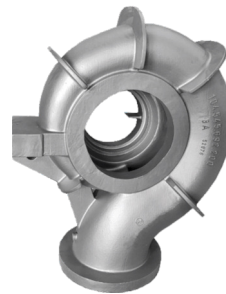
Our castings are made with the most assertive process control to meet the required microstructures and properties. Experienced on various industry segments and casting shapes, Engemasa can cast from 1 up to 6,000 kg net weight parts.

In our facilities, we can perform destructive and non-destructive testings such as hydrostatic, dye penetrant, magnetic particles, ultrasonic and radiographic tests.

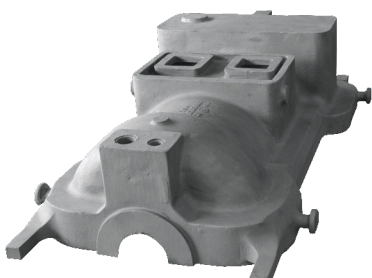
### Valves



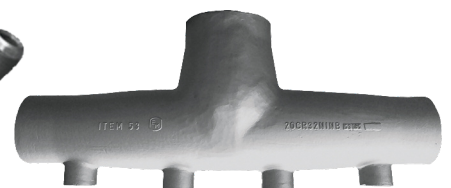
### Pumps

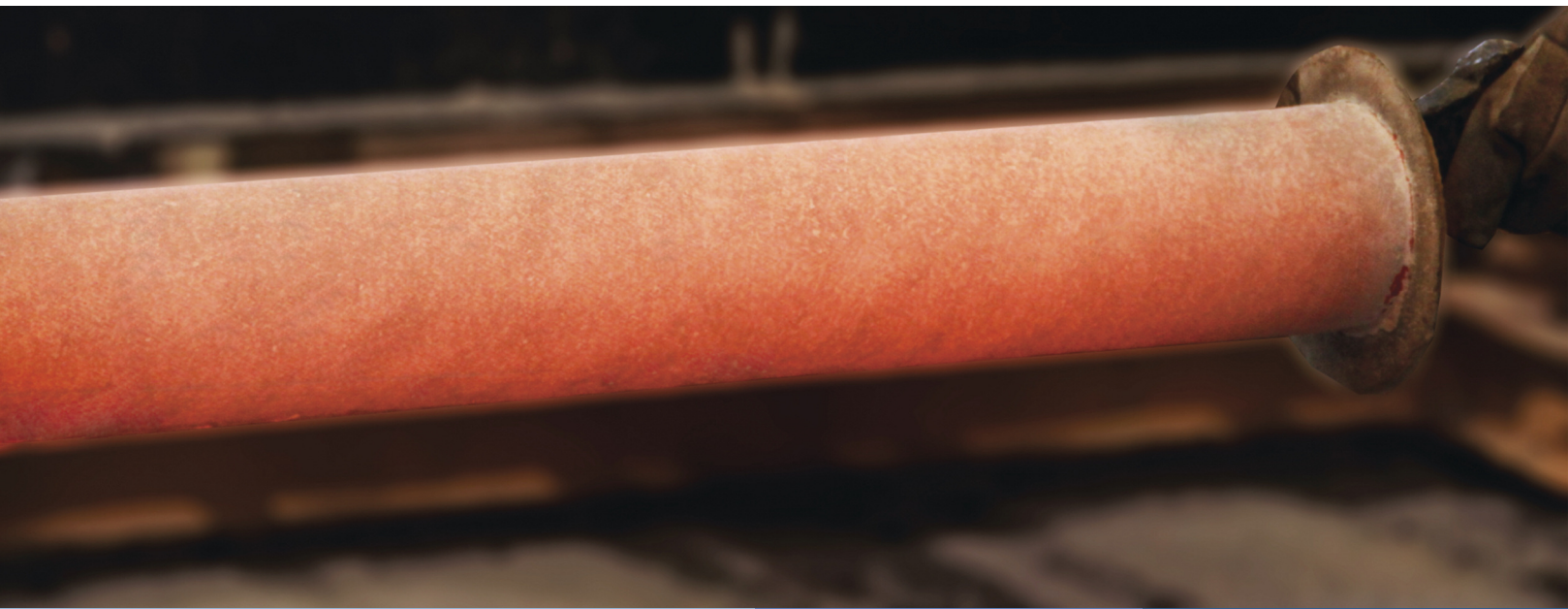


### Turbines



### Chemical and petrochemical





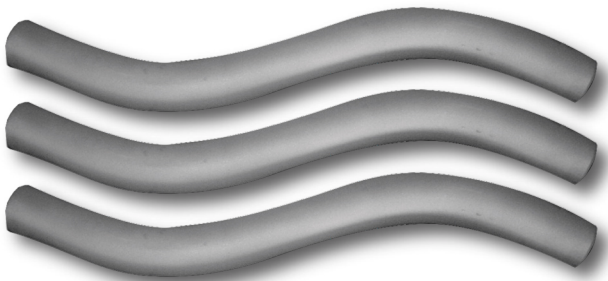
## CENTRIFUGAL CASTING

The centrifugation process counts as one of ENGEMASA's most versatile processes, where it is possible to produce seamless tubes with diameters ranging from 55 to 350 mm and up to 4.500 mm in length.

The tubes are produced under the most rigorous control of chemical composition and centrifugation parameters, in order to provide adequate metallographic structure, dimensional examination and non-destructive tests.



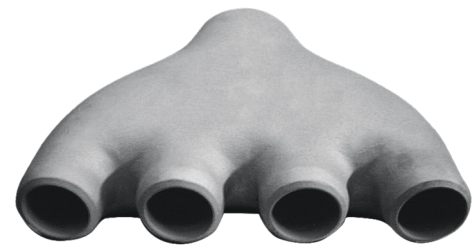
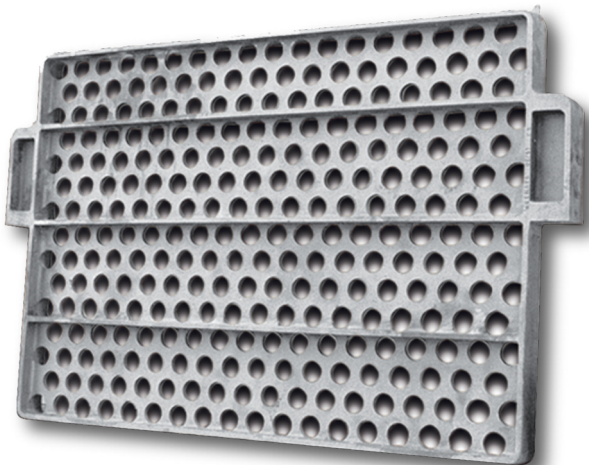
- ✓ ENGEMASA produces seamless pipes centrifuged to meet the most severe conditions of corrosion, high temperatures and abrasion.
- ✓ Technology to bend tubes by thermal induction, which enables conforming tubes of low elongation into various formats.





## **PETROCHEMICAL**

Since 1986 Engemasa has also been gaining worldwide recognition through the manufacture of static castings and centrifuged tubes for application in coils and pyrolysis furnace components for the production of ethylene and reform furnaces for petroleum refineries and ammonia production.



- ✓ Patented technology for measuring and controlling the level of carburizing of the tubes in operation.
- ✓ Material of high performance and chemical composition that decrease coke formation inside the tubes and consequently the carburization, thus increasing the life cycle of the coils.





## **PETROCHEMICAL**

In the aftermarket, Engemasa counts on a specialized team to provide serpentine monitoring services in operation to prevent failures, offering an analysis of metallurgical degradation of the components in relation to the phenomenon of carburization and creep (stretching).

Engemasa seeks to constantly improve its products with its customers, developing new methodologies for the performance and behavior analysis of materials and components in operation, with the main objective of increasing the useful life of the petrochemical furnaces.



- ✓ Coil lifting device allows observation and control of the arrangement and accommodation of the coils in an upright position prior to field installation.

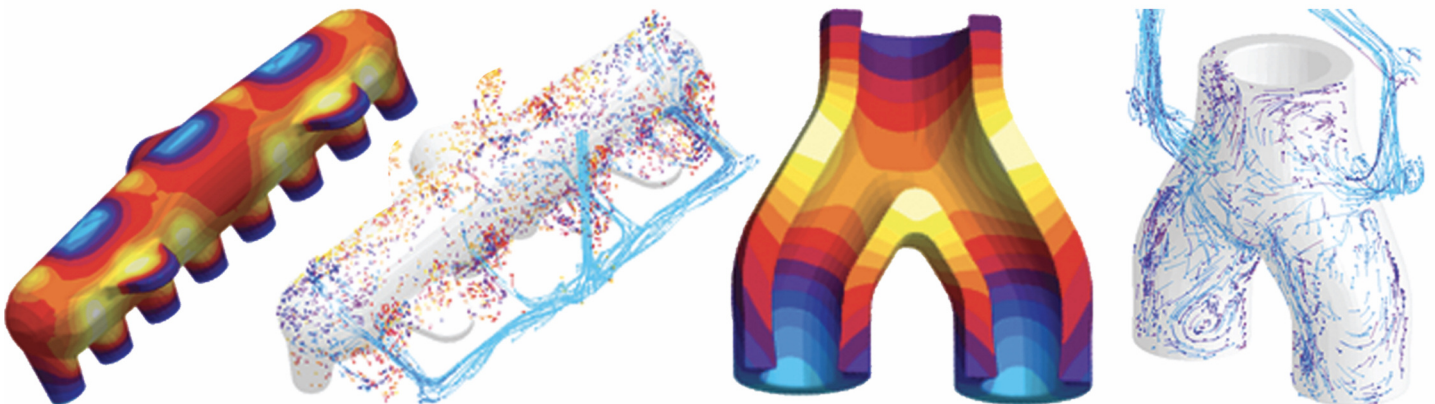




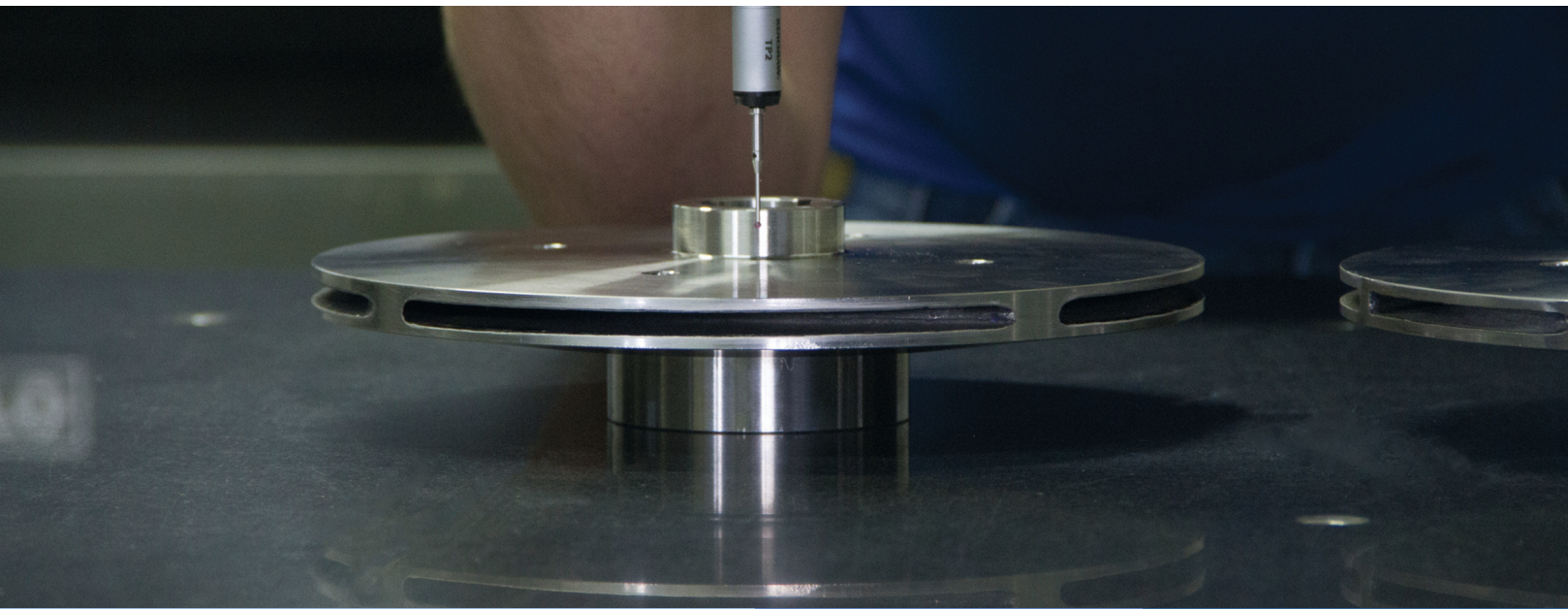
## **PROCESS ENGINEERING AND CASTING SIMULATION SOFTWARE**

Our engineers are focused on prevention and resolution of casting problems and are directly working on our products. To assess our analysis, we work with MAGMASOFT®, a robust metal filling and solidification simulation software. Amongst the advantages of casting simulation and analysis are:

- Improved assertiveness on casting project;
- Improved predictability of defects during conception of casting projects;
- Reduced incidence of repairs and scrapped parts.





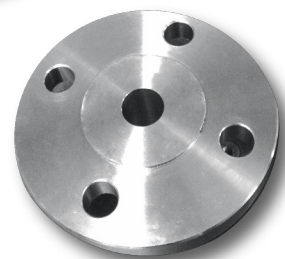


## MACHINING

ENGEMASA has in its facilities a Machining Division, which is equipped with Conventional and Vertical Lathes, Boring Machines and CNC Machining Centers. All equipment with availability of tool preparation devices and dimensional controls of the highest standard, among other machines.



- ✓ The Metrology Laboratory is highly equipped for dimensional inspections, geometric and position measurement.



## CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES OF CASTING ALLOYS

Use	Casting alloy		Chemical Compositions (wt. %) (A)									Mechanical Properties (B)				Similar Rolled (C)	Commercial Name (D)
	Designation	ASTM	C	Mn	Si	P	S	Cr	Ni	Mo	Other Elements	TS (MPa)	YS (MPa)	E (%)	RA (%)	Designation	Designation
Corrosion and Abrasion	CA6N	A743	0.06	0.50	1.00	0.02	0.02	10.5 12.5	6.0 8.0	-	-	965	930	15	50	-	-
	CA6NM	A743	0.06	1.00	1.00	0.04	0.03	11.5 14.0	3.5 4.5	0.40 1.00	-	755	550	15	35	-	-
	CA15	A217 A743	0.15	1.00	1.50	0.04	0.04	11.5 14.0	1.00	0.50	-	620	450	18	30	AISI 410	-
	CA40	A743	0.20 0.40	1.00	1.50	0.04	0.04	11.5 14.0	1.00	0.50	-	690	485	15	25	AISI 420	-
	CB30	A743	0.30	1.00	1.50	0.04	0.04	18.0 21.0	2.00	-	Cu: 0.90-1.20 Optional	450	205	-	-	AISI 431 AISI 442	-
	CB7Cu-1	A747	0.07	0.70	1.00	0.035	0.03	15.5 17.7	3.60 4.60	-	Cu: 2.50-3.20 Nb: 0.15-0.35 N: 0.05	860 1170	670 1000	10 5	-	17-4 PH	17-4 PH
	CB7Cu-2	A747	0.07	0.70	1.00	0.035	0.03	14.0 15.5	4.50 5.50	-	Cu: 2.50-3.20 Nb: 0.15-0.35 N: 0.05	860 1170	670 1000	10 5	-	15-5 PH	15-5 PH
	CC50	A743	0.50	1.00	1.50	0.04	0.04	26.0 30.0	4.00	-	-	380	-	-	-	AISI 446	-
Corrosion	1B (CD4MCuN)	A890 A995	0.040	1.00	1.00	0.040	0.040	24.5 26.5	4.7 6.0	1.70 2.30	Cu: 2.7-3.3 N: 0.10-0.25	690	485	16	-	-	-
	3A (CD6MN)	A890 A995	0.060	1.00	1.00	0.040	0.040	24.0 27.0	4.0 6.0	1.75 2.50	N: 0.15-0.25	655	450	25	-	-	-
	4A (CD3MN)	A890 A995	0.030	1.50	1.00	0.040	0.020	21.0 23.5	4.5 6.5	2.5 3.5	Cu: 1.00 N: 0.10-0.30	620	415	25	-	-	-
	5A (CE3MN)	A890 A995	0.030	1.00	1.00	0.030	0.025	24.0 26.0	6.0 8.0	4.0 5.0	N: 0.10-0.30	690	515	18	-	-	-
	6A (CD3MWN)	A890 A995	0.030	1.00	1.00	0.030	0.025	24.0 26.0	6.5 8.5	3.0 4.0	Cu: 0.50-1.00 W: 0.50-1.00 N: 0.20-0.30	690	450	25	-	-	-
	CF3	A351 A743	0.03	1.50	2.00	0.040	0.040	17.0 21.0	8.0 12.0	0.50	-	485	205	35	-	AISI 304L	18/8 Baixo C
	CF8	A351 A743	0.08	1.50	2.00	0.040	0.040	18.0 21.0	8.0 11.0	0.50	-	485	205	35	-	AISI 304L	18/8
	CF20	A351 A743	0.20	1.50	2.00	0.04	0.04	18.0 21.0	8.0 11.0	-	-	485	205	30	-	AISI 302	-
	CF3M	A351 A743	0.03	1.50	1.50	0.040	0.040	17.0 21.0	9.0 13.0	2.0 3.0	-	485	205	30	-	AISI 316L	18/8/2 Baixo C
	CF3MN	A351 A743	0.03	1.50	1.50	0.040	0.040	17.0 21.0	9.0 13.0	2.0 3.0	N: 0.10-0.20	515	255	35	-	-	-
	CF8M	A351 A743	0.08	1.50	1.50	0.040	0.040	18.0 21.0	9.0 12.0	2.0 3.0	-	485	205	30	-	AISI 316	18/8/2
	CF8C	A351 A743	0.08	1.50	2.00	0.040	0.040	18.0 21.0	9.0 12.0	0.50	Nb: 8 x %C-1.00	485	205	30	-	AISI 347	18/8 Estabilizado
	CF10SMnN	A351 A743	0.10	7.00 9.00	3.50 4.50	0.060	0.030	16.0 18.0	8.0 9.0	-	N: 0.08-0.18	585	295	30	-	-	-
	CG3M	A351 A743	0.030	1.50	1.50	0.04	0.04	18.0 21.0	9.0 13.0	3.0 4.0	-	515	240	25	-	-	-
	CG8M	A351 A743	0.08	1.50	1.50	0.04	0.04	18.0 21.0	9.0 13.0	3.0 4.0	-	515	240	25	-	AISI 317	-
	CH20	A351 A743	0.04	1.50	2.00	0.040	0.040	22.0 26.0	12.0 15.0	0.50	-	485	205	30	-	AISI 309	-
	CK3MCuN	A743	0.025	1.20	1.00	0.045	0.010	19.5 20.5	17.5 19.5	6.0 7.0	N: 0.18-0.24 Cu: 0.50-1.00	550	260	35	-	-	-
	CK20	A351 A743	0.04	1.50	1.75	0.040	0.040	23.0 27.0	19.0 22.0	0.50	-	450	195	30	-	AISI 310	-
	CN7M	A351 A743	0.07	1.50	1.50	0.040	0.040	19.0 22.0	27.5 30.5	2.0 3.0	Cu: 3.0-4.0	425	170	35	-	-	Alloy 20
	CW2M	A494	0.02	1.00	0.80	0.03	0.02	15.0 17.5	Bal.	15.0 17.5	Fe: 2.00 W: 1.0	495	275	20	-	-	-
	CW6M	A494	0.07	1.00	1.00	0.03	0.02	17.0 20.0	Bal.	17.0 20.0	Fe: 3.00	495	275	25	-	-	-
	CW6MC	A494	0.06	1.00	1.00	0.015	0.015	20.0 23.0	Bal.	8.0 10.0	Nb: 3.15-4.50 Fe: 5.00	485	275	25	-	-	Inconel 625
	CW12MW	A494	0.12	1.00	1.00	0.030	0.020	15.5 17.5	Bal.	16.0 18.0	W: 3.75-5.25 V: 0.20-0.40 Fe: 4.5-7.5	495	275	4	-	-	-
	CX2M	A494	0.02	1.00	0.50	0.020	0.020	22.0 24.0	Bal.	15.0 16.5	Fe: 2.0-6.0	495	270	40	-	-	-
	CY40	A494	0.40	1.50	3.00	0.03	0.02	14.0 17.0	Bal.	-	Fe: 11.0	485	195	30	-	-	Inconel
	CZ100	A494	1.00	1.50	2.00	0.03	0.02	-	95.00 Min.	-	Cu: 1.25 Fe: 3.00	345	125	10	-	-	Níquel fundido
	CU5MCuC	A494	0.050	1.00	1.0	0.030	0.020	19.5 23.5	38.0 44.0	2.5 3.5	Nb: 0.60-1.20	520	240	20	-	-	-
	N7M	A494	0.07	1.00	1.00	0.030	0.020	1.0	Bal.	30.0 33.0	Fe: 3.00	525	275	20	-	-	-
	M35-1	A494	0.35	1.50	1.25	0.03	0.02	-	Bal.	-	Cu: 26.0-33.0 Nb: 0.50 Fe: 3.50	450	170	25	-	-	Monel
	M35-2	A494	0.35	1.50	2.00	0.03	0.02	-	Bal.	-	Cu: 26.0-33.0 Nb: 0.50 Fe: 3.50	450	205	25	-	-	Monel
M25S	A494	0.25	1.50	3.5 4.0	0.03	0.02	-	Bal.	-	Cu: 27.0-33.0 Fe: 3.50	-	-	-	-	-	Monel	
M30C	A494	0.30	1.50	1.0 2.0	0.03	0.02	-	Bal.	-	Cu: 26.0-33.0 Fe: 3.50	450	225	25	-	-	Monel	

## CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES OF CASTING ALLOYS

Use	Casting alloy		Chemical Compositions (wt. %) (A)									Mechanical Properties (B)				Similar Rolled (C)	Commercial Name (D)
	Designation	ASTM	C	Mn	Si	P	S	Cr	Ni	Mo	Other Elements	TS (MPa)	YS (MPa)	E (%)	RA (%)	Designation	Designation
High Temperature	CT15C	A351	0.05 0.15	0.15 1.50	0.50 150	0.03	0.03	19.0 21.0	31.0 34.0	-	Nb: 0.50-1.50 N: 0.10 Cu: 0.10 / Al: 0.06	435	170	20	-	-	Manaurite 900
	HC	A297	0.50	1.00	2.00	0.04	0.04	26.0 30.0	4.00	0.50	-	380	-	-	-	-	-
	HD	A297	0.50	1.50	2.00	0.04	0.04	26.0 30.0	4.0 7.0	0.50	-	515	240	8	-	-	-
	HE	A297	0.20 0.50	2.00	2.00	0.04	0.04	26.0 30.0	8.0 11.0	0.50	-	585	275	9	-	-	-
	HF	A297	0.20 0.40	2.00	2.00	0.04	0.04	18.0 23.0	8.0 12.0	0.50	-	485	240	25	-	AISI 302 B	-
	HH	A297	0.20 0.50	2.00	2.00	0.04	0.04	24.0 28.0	11.0 14.0	0.50	-	515	240	10	-	AISI 309	-
	HI	A297	0.20 0.50	2.00	2.00	0.04	0.04	26.0 30.0	14.0 18.0	0.50	-	485	240	10	-	-	-
	HK	A297	0.20 0.60	2.00	2.00	0.04	0.04	24.0 28.0	18.0 22.0	0.50	-	450	240	10	-	AISI 310	-
	HK40	A351	0.35 0.45	1.50	1.75	0.040	0.040	23.0 27.0	19.0 22.0	0.50	-	425	240	10	-	-	-
	HL	A297	0.20 0.60	2.00	2.00	0.04	0.04	28.0 32.0	18.0 22.0	0.50	-	450	240	10	-	-	-
	HN	A297	0.20 0.50	2.00	2.00	0.04	0.04	19.0 23.0	23.0 27.0	0.50	-	435	-	8	-	-	-
	HP	A297	0.35 0.75	2.00	2.50	0.04	0.04	24 28	33 37	0.50	-	430	235	4.5	-	-	-
	HP-40	-	0.30 0.40	1.50	1.50	0.03	0.03	23.0 27.0	33.0 35.0	-	Nb: 1.50	430	235	4.5	-	-	-
	HT	A297	0.35 0.75	2.00	2.50	0.04	0.04	15.0 19.0	33.0 37.0	0.50	-	450	-	4	-	-	-
	HU	A297	0.35 0.75	2.00	2.50	0.04	0.04	17.0 21.0	37.0 41.0	0.50	-	450	-	4	-	-	-
	HW	A297	0.35 0.75	2.00	2.50	0.04	0.04	10.0 14.0	58.0 62.0	0.50	-	415	-	-	-	-	-
	E2032Nb	-	0.08 0.15	0.15 1.25	0.50 150	0.030	0.030	19.0 21.0	31.0 34.0	-	Nb: 0.80-1.50 Cu: 0.25 / Al: 0.05 Pb, Sn, Zn, As: 0.010 (each)	450	186	30	-	-	-
	E2535Nb-MA (Pyrolysis)	-	0.35 0.55	1.50	2.00	0.030	0.030	24.0 27.0	34.0 37.0	0.50	Nb: 0.50-1.50 Cu: 0.25 / Al: 0.05 Ti microadded Pb, Sn, Zn, As: 0.010 (each)	448	242	8 (centricast) 6 (Static)	-	-	-
	E2535Nb-MA (Reforming)	-	0.35 0.55	1.50	1.00	0.030	0.030	24.0 27.0	34.0 37.0	0.50	Nb: 0.50-1.50 Cu: 0.25 / Al: 0.05 Ti microadded Pb, Sn, Zn, As: 0.010 (each)	448	242	8 (centricast) 6 (Static)	-	-	-
	E2535Nb-LC	-	0.10 0.15	1.50	2.00	0.030	0.030	24.0 27.0	34.0 38.0	0.50	Nb: 0.50-1.50 Cu: 0.25 / Al: 0.05 Pb, Sn, Zn, As: 0.010 (each)	440	186	25	-	-	-
E2848W	-	0.35 0.60	1.50	1.00 2.00	0.030	0.030	27.0 30.0	47.0 50.0	0.50	Nb: 0.60 / Co: 1.0 W: 4.0-6.0 / V: 0.12 Cu: 0.25 / Al: 0.05 Pb, Sn, Zn, As: 0.010 (each)	448	242	4	-	-	-	
E2535CoW	-	0.40 0.60	2.0	1.0 2.0	0.030	0.030	24.0 29.0	33.0 37.0	0.50	Co: 14.0-16.0 W: 4.0-6.0 Nb: 0.60 / Cu: 0.25 Al: 0.05 Pb, Sn, Zn, As: 0.010 (each)	480	270	5	-	-	-	
E3545Nb-MA	-	0.40 0.50	1.50	1.20 1.80	0.030	0.030	33.0 37.0	43.0 47.0	0.50	Nb: 0.50-1.50 Cu: 0.25 / Al: 0.05 Ti microadded Pb, Sn, Zn, As: 0.010 (each)	440	235	5 (centricast) 3 (Static)	-	-	-	
E3045AlNb-MA	-	0.40 0.50	1.50	1.50	0.030	0.030	28.0 32.0	43.0 47.0	0.25	Nb: 0.50-1.00 Al: 3.0-5.0 Ti microadded Pb, Sn, Zn, As: 0.005 (each)	560	415	4	-	-	-	
ENiCrAl-MA	-	0.30 0.40	1.50	2.00	0.030	0.030	23.0 27.0	Bal.	0.50	Fe: 7.5-11.5 Cu: 0.25 Nb, Al, Ti microadded Pb, Sn, Zn, As: 0.010 (each)	450	250	5	-	-	-	
Non Ferrous	Designation	ASTM	Cu	Al	Fe	Mn	Ni	Si	-	-	-	TS (MPa)	YS (MPa)	E (%)	RA (%)	Commercial Name	
	C95500	B148	81.0	11.0	4.0	-	4.0	-	-	-	-	620	275	6	-	Nickel Aluminum Bronze	
	C95800	B148	81.3	9.0	4.0	1.2	4.5	-	-	-	-	585	240	15	-	Nickel Aluminum Bronze	
	C95820	B148	79.0	9.5	4.5	1.0	5.2	-	-	-	-	650	270	13	-	Nickel Aluminum Bronze	



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