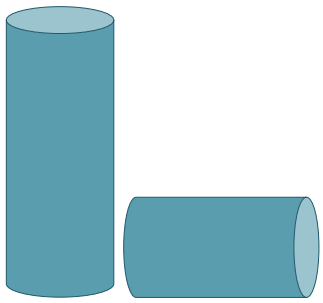
NON-FERROUS REFRACTORY METALS

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Refractory Metals Qualities

Refractory Metals qualities:

- ✧ Very high melting point
- ✧ Very low vapor pressure
- ✧ Low thermal expansion
- ✧ Extremely good corrosion resistance

TYPES OF PRODUCTS

Ingot, Plate, Foil, Bar, Tube, Strip, Powder, Wire, Target, crucible and machined parts on request.





Grade and Chemical Composition

Nb Niobium

Element		Chemical Composition (%)						
		Nb1	Nb2	Nb3	Nb4	FNb1	FNb2	NbHf10-1
Main Element	Zr	0.02	0.02	0.8~1.2	0.8~1.2	0.02	0.02	0.7
	Hf	-	-	-	-	-	-	9.0~11.0
	Ti	-	-	-	-	-	-	0.7~1.3
Impurity Element	Hf	0.02	0.02	0.02	0.02	0.02	0.02	-
	Ti	0.002	0.005	0.02	0.03	0.005	0.01	-
	C	0.01	0.02	0.01	0.01	0.03	0.05	0.015
	N	0.015	0.05	0.01	0.01	0.035	0.05	0.015
	O	0.015	0.025	0.015	0.025	0.03	0.06	0.023
	H	0.001	0.005	0.0015	0.0015	0.002	0.005	0.002
	Ta	0.1	0.25	0.1	0.5	-	0.5	-
	Fe	0.005	0.03	0.005	0.01	0.01	0.04	-
	Si	0.005	0.02	0.005	0.005	0.01	0.03	-
	W	0.03	0.05	0.03	0.05	0.05	0.05	0.5
	Ni	0.005	0.01	0.005	0.005	0.005	0.01	-
	Mo	0.01	0.05	0.01	0.05	0.02	0.05	-
	Cr	0.002	0.01	0.002	-	0.005	0.01	-

Note:

1.Nb1,Nb2,NbZr1 NbZr2,NbHf10-1 for vacuum arc or electron beam melting industrial-grade niobium and niobium alloy material.

2.FNb1 and FNb2 are industrial niobium materials obtained by powder metallurgy method.

3.The total amount (mass fraction) of other impurity elements not required by NbHf10-1 shall not be greater than 0.3%.

4.All of the above grades of zirconium and hafnium, except NbHf10-1, shall be measured at demander's request.

W

Tungsten

Grade	Main Element %				Impurity Element %									
	W	CeO_2 [a)]	ThO_2 [a)]	Re	Al	Ca	Fe	Mg	Mo	Ni	Si	C	N	O
W1	≥99.95 [b)]	-	-	-	0.002	0.003	0.005	0.002	0.01	0.003	0.003	0.005	0.003	0.005
W2	≥99.92 [b)]	-	-	-	0.004	0.003	0.005	0.002	0.01	0.003	0.005	0.008	0.003	0.008
WAl1 WA12	≥99.95 [b)]	-	-	-	-	0.005	0.005	0.005	0.01	0.005	-	0.005	0.003	-
WCe10	Bal	0.8~1.2	-	-	-	0.005	0.005	0.005	0.01	0.003	0.005	0.01	0.003	-
WCe15	Bal	1.3~1.7	-	-	-	0.005	0.005	0.005	0.01	0.003	0.005	0.01	0.003	-
WCe20	Bal	1.8~2.2	-	-	-	0.005	0.005	0.005	0.01	0.003	0.005	0.01	0.003	-
WCe30	Bal	2.8~3.2	-	-	-	0.005	0.00S	0.005	0.01	0.003	0.005	0.01	0.003	-
WCe40	Bal	3.8~4.2	-	-	-	0.005	0.005	0.005	0.01	0.003	0.005	0.01	0.003	-
W-1Re	Bal	-	-	0.90~1.10	-	0.005	0.005	-	0.01	0.003	-	0.01	0.003	-
W-3Re	Bal	-	-	2.85~3.15	-	0.005	0.005	-	0.01	0.003	-	0.01	0.003	-

Note:

1.The content of CeO_2 and ThO_2 is the nominal content and is reported as the amount of CeO_2 and ThO_2 added.

2.Content (mass fraction) of W =100%- The sum of the contents (mass fraction) of the elements listed in the table.



Ta

Tantalum

Grade		Ta1	Ta2	FTa1	FTa2	TaNb3	TaNb20	TaNb40	TaW2.5	TaW10
Main Element	Ta	Bal	Bal	Bal	Bal	Bal	Bal	Bal	Bal	Bal
	Nb	-	-	-	-	-1.5~3.5	17~23	35.0~42.0	-	-
	W	-	-	-	-	-	-		2.0~3.5	9.0~11.0
Impurity Element	C	0.010	0.020	0.010	0.050	0.020	0.020	0.010	0.010	0.010
	N	0.005	0.025	0.010	0.030	0.025	0.025	0.010	0.010	0.010
	H	0.0015	0.0050	0.0020	0.0050	0.0050	0.0050	0.0015	0.0015	0.0015
	O	0.015	0.030	0.030	0.035	0.030	0.030	0.020	0.015	0.015
	Nb	0.050	0.100	0.050	0.100	-	-	-	0.500	0.100
	Fe	0.005	0.030	0.010	0.030	0.030	0.030	0.010	0.010	0.010
	Ti	0.002	0.005	0.005	0.010	0.005	0.005	0.010	0.010	0.010
	W	0.010	0.040	0.010	0.040	0.040	0.040	0.050	-	-
	Mo	0.010	0.030	0.010	0.020	0.030	0.020	0.020	0.020	0.020
	Si	0.005	0.020	0.005	0.030	0.030	0.030	0.005	0.005	0.005
	Ni	0.002	0.005	0.010	0.010	0.005	0.005	0.010	0.010	0.010

Note:

1. Ta1,Ta2, TaNb3, TaNb20,TaNb40, TaW2.5, TaW10 are industrial grade tantalum and tantalum alloy for vacuum electron beam melting or arc melting.

2. FTa1 and FTa2 are industrial grade tantalum material obtained by powder metallurgy method

Mo

Molybdenum

Grade	Main Element %					Impurity Element %								
	Mo	W	Ti	Zr	C	Al	Ca	Fe	Mg	Ni	Si	C	N	O
Mo1	⩾99.95	-	-		-	0.002	0.002	0.010	0.002	0.005	0.010	0.010	0.003	0.008
RMo1 [a]	⩾99.95	-	-		-	0.002	0.002	0.010	0.002	0.005	0.010	0.020	0.002	0.005
Mo2	⩾99.90	-	-		-	0.005	0.004	0.015	0.005	0.005	0.010	0.020	0.003	0.010
MoW_{20}	Bal	20±1	-		-	0.002	0.002	0.010	0.002	0.005	0.010	0.010	0.003	0.008
MoW_{30}	Bal	30±1	-		-	0.002	0.002	0.010	0.002	0.005	0.010	0.010	0.003	0.008
MoW_{50}	Bal	50±1	-		-	0.002	0.002	0.010	0.002	0.005	0.010	0.010	0.003	0.008
MoTi0.5	Bal		0.40~0.55		0.01~0.04	0.002	-	0.00S	0.002	0.005	0.010	-	0.001	0.003
TZM [b]	Bal		0.40~0.55	0.06~0.12	0.01~0.04	-	-	0.010	-	0.005	0.010	-	0.003	0.003
TZM [c]	Bal	-	0.40~0.55	0.06~0.12	0.01~0.04	-	-	0.010	-	0.005	0.010	-	0.003	0.030
TZC	Bal	-	1.0~3.5	0.10~0.50	0.10~0.50	-	-	0.025	-	0.02	0.02	-	-	0.30
MoLa	Bal	-	Nominal addition of La2O3 (molybdenum based) : 0.1~1.8			0.005	0.004	0.015	0.005	0.005	0.010	0.010	0.003	0.010

Note:

1. RMo1 is fused molybdenum.

2. For TZM molybdenum alloy, the oxygen content should be no more than 0.003%, and 0.02% boron (B) is allowed.



Ti

Titanium

Grade			TA1	TA2	TA3	TA4	TA5	TA6	TA8	TA9	TA10	TC1	TC4	TC11
			GR1	GR2	GR3	GR4				GR7	GR12		GR5	
Chemical Composition						Ti-3Al	Ti-4Al-0.05B	Ti-5Al	Ti-0.05Pd	Ti-0.2Pd	Ti-0.3Mo-0.8Ni	Ti-2Al-1.5Mn	Ti-6Al-4V	Ti-6.5Al-3.5Mo-1.5Zr-0.3Si
Main Element	Ti		Bal	Bal	Bal	Bal	Bal	Bal	Bal	Bal	Bal	Bal	Bal	Bal
	Al					2.0~3.3	3.3~4.7	4.0~5.5				1.0~2.5	5.5~6.8	5.8~7.0
	Mo										0.2~0.4			2.8~3.8
	Mn											0.7~2.0		
	Ni										0.6~0.9			
	Zr													0.8~2.0
	Si													0.20~0.35
	B						0.005							
	Pd								0.04~0.08	0.12~0.25				
Impurity Element (≤)	Fe		0.20	0.30	0.30	0.30	0.30	0.30	0.30	0.25	0.30	0.30	0.30	0.25
	C		0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.10	0.08	0.08	0.08	0.08
	N		0.03	0.03	0.05	0.05	0.04	0.05	0.03	0.03	0.03	0.05	0.05	0.05
	H		0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.012	0.015	0.012
	O		0.18	0.25	0.30	0.15	0.15	0.15	0.25	0.25	0.25	0.15	0.02	0.15
	Other	Unit	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
		Total	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40

Zr

Zirconium

Type		General Industry			Nuke Industry		
Grade		R60700	R60702	R60705	R60001	R60802	R60804
Main Element	Zr	-	-	-	Bal	Bal	Bal
	Zr+Hf	⩾99.2	⩾99.2	⩾99.5	-	-	-
	Hf	⩽4.5	⩽4.5	⩽4.5	-	-	-
	Sn	-	-	-	-	1.20~1.70	1.20~1.70
	Fe	-	-	-	-	0.07~0.20	0.18~0.24
	Ni	-	-	-	-	0.03~0.08	-
	Nb	-	-	2.0~3.0	-	-	-
	Cr	-	-	-	-	0.05~0.15	0.07~0.13
	Fe+Ni+Cr	-	-	-	-	0.18~0.38	-
	Fe+Cr	⩽0.2	⩽0.2	⩽0.2	-	-	0.28~0.37
Impurity Element (⩽)	Al	-	-	-	0.0075	0.0075	0.0075
	B	-	-	-	0.00005	0.00005	0.00005
	Cd	-	-	-	0.00005	0.00005	0.00005
	Co	-	-	-	0.002	0.002	0.002
	Cu	-	-	-	0.005	0.005	0.005
	Cr	-	-	-	0.020	-	-
	Fe	-	-	-	0.15	-	-
	Hf	-	-	-	0.010	0.010	0.010
	Mg	-	-	-	0.002	0.002	0.002
	Mn	-	-	-	0.005	0.005	0.005
	Mo	-	-	-	0.005	0.005	0.005
	Ni	-	-	-	0.007	-	0.007
	Pb	-	-	-	0.013	0.013	0.013
	Si	-	-	-	0.012	0.012	0.012
	Sn	-	-	-	0.005	-	-
	Ti	-	-	-	0.005	0.005	0.005
	U	-	-	-	0.00035	0.00035	0.00035
	V	-	-	-	0.005	0.005	0.005
	W	-	-	-	0.010	0.010	0.010
	Cl	-	-	-	0.010	0.010	0.010
	C	0.050	0.050	0.05	0.027	0.027	0.027
	N	0.025	0.025	0.025	0.008	0.008	0.008
	H	0.005	0.005	0.005	0.0025	0.0025	0.0025
	O	0.10	0.16	0.18	0.16	0.16	0.16

*The content of Zr+Hf is 100% minus the analytical values of other elements except Hf

Allowable deviation in chemical composition retest analysis of zirconium and zirconium alloys

Element	Allowable deviation for retest according to the range specified in the table above	
	Nuke Industry	General Industry
Sn	0.050	-
Fe	0.020	-
Ni	0.010	-
Cr	0.010	-
Fe+Ni+Cr	0.020	-
Fe+Cr	0.020	0.025
O	0.020	0.02
Hf	0.002 or 20% of the prescribed limit, the smaller one	0.10
Nb		0.05
H		0.002
C		0.01
N		0.01
Other impurities		-

