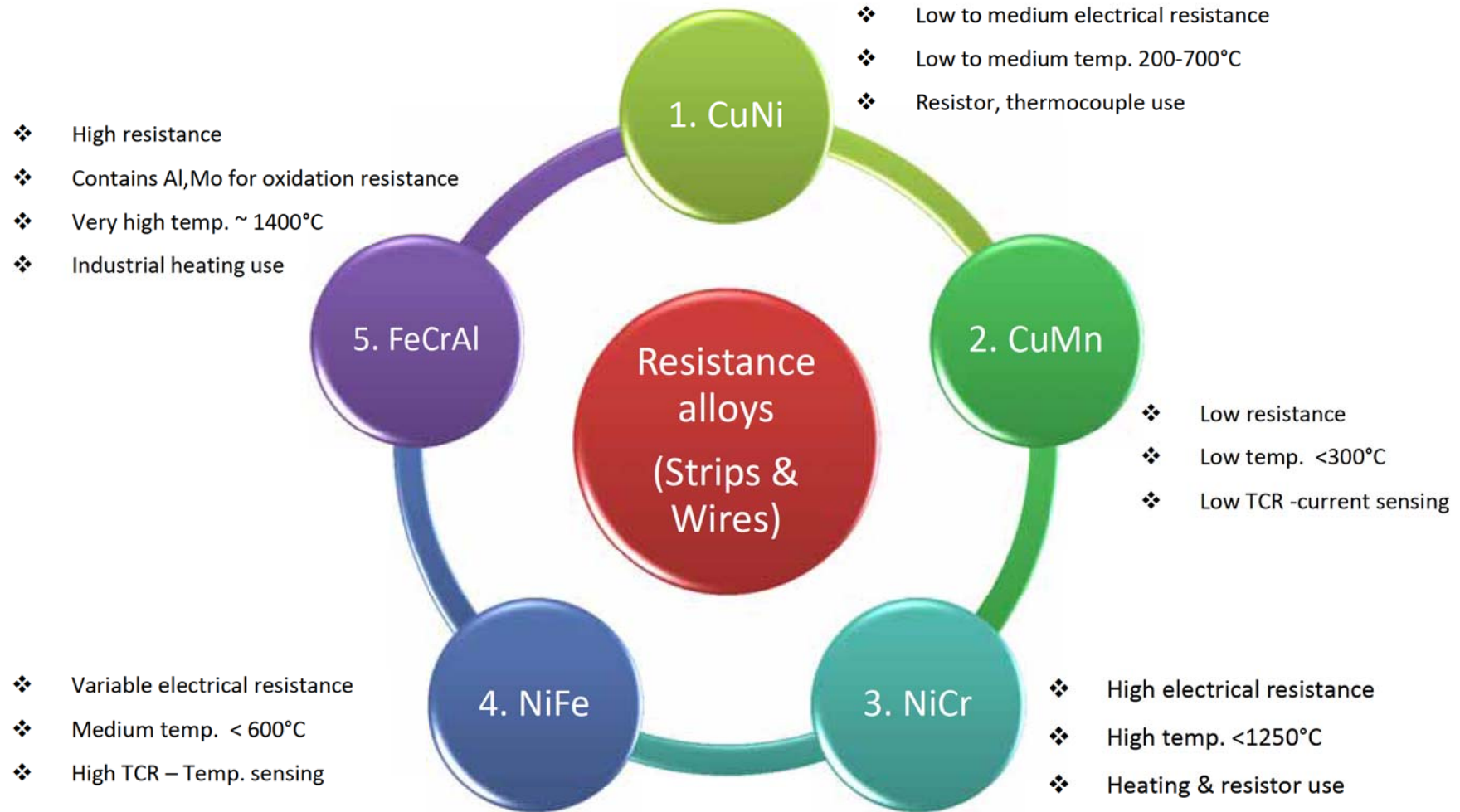




# Resistance alloys

These are typically used for heating, resistance, current measuring & thermocouple applications



# Applications

## **CuNi**

- Low resistance electrical heating
- Wire wound electrical resistors
- Strain-gauge foil
- Thermocouple wire
- Mineral insulated RTD cable

## **CuMn**

- Pulse proof thick film resistors
- Shunt resistors in Smart meters
- Current measuring resistors for battery management & over-charge protection

## **NiCr**

- As resistors in telecom, automotive, electronics industries
- As heating wire in household devices & industrial furnaces
- Mineral insulated heating cables for freeze protection

## **NiFe**

- For voltage regulators, temperature sensitive resistors, and low temperature heating applications.
- PTC resistor - Positive Thermal Co-efficient
- Resistance Thermometer Devices (RTD)
- Etched foil flexible heaters
- Vape coil in e-cigarettes

## **FeCrAl**

- High-temperature furnaces for heat treatment, ceramics, glass, steel, and metal processing
- Resistor bank for electronic braking in locomotives

These alloys are lighter, cheaper, more oxidation resistant than NiChrome and especially suited to resist sulphur atmosphere.

# 1. Copper Nickel alloys

## 1. Alloys

Alloy	Specific electrical resistivity at 20 °C (μOhm.cm)	Max. operational temp °C	Material   UNS No.	Standard
<b>CuNi2</b>	5 (~35 % ICAS)	200-300	2.0802	DIN 17471
<b>CuNi6</b>	10	300	2.0807	DIN 17471
<b>CuNi10</b>	15	400	2.0811 / C70700	DIN 17471
<b>CuNi15</b>	21	400		
<b>CuNi20</b>	26.5	450	CN104 / C71000	BS 2870
<b>CuNi23</b>	30	500	2.0881	DIN 17471
<b>CuNi25</b>	32	500	2.0830 / C71300	DIN 17664
<b>CuNi44Mn1 Constantan</b>	49 (~3.5% IACS)	600	2.0842 / N04401 / C72150	DIN 17664

## 2. Chemical composition (Reference values in % w/w)

Alloy	Ni (+Co)	Cu	Fe	Mn	C
<b>CuNi2</b>	1.5 - 2.5	balance	≤ 0.2	≤ 1.0	≤ 0.05
<b>CuNi6</b>	5.0 – 7.0	balance	≤ 0.2	≤ 1.0	≤ 0.05
<b>CuNi10</b>	9.0 - 11.0	balance	≤ 0.2	≤ 1.0	≤ 0.05
<b>CuNi15</b>	14.0 - 16.0	balance	≤ 0.2	≤ 1.0	≤ 0.05
<b>CuNi20</b>	19.0 - 21.0	balance	≤ 0.2	≤ 1.0	≤ 0.05
<b>CuNi23</b>	22.0 - 24.0	balance	≤ 0.4	≤ 1.5	≤ 0.05
<b>CuNi25</b>	24.0 - 26.0	balance	≤ 0.2	≤ 0.5	≤ 0.05
<b>CuNi44Mn1 Constantan</b>	43.0 - 45.0	balance	≤ 0.5	0.5 - 2.0	≤ 0.1

## 2. CuMn Current sensing alloys

### 1. Alloys

Alloy	Specific electrical resistivity at 20 °C (μOhm.cm)	Material   UNS No.
CuNi3Mn2	12	Thermocouple wire
CuMn10Ni4	38	
CuMn11Ni4	42	
CuMn12Ni4	43	
CuMn13Ni4	48	
CuMn12Ni2	43	2.1362
CuMn7Sn2.3	29	

These alloys have low thermal co-efficient of resistance (TCR) value between -20°C to 200 °C which is suited for measuring currents accurately.

Alloy	Ni (+Co)	Cu	Sn	Mn
CuMn10Ni4	3.5 - 4.5	balance		9.0 - 11.5
CuMn11Ni4	3.5 - 4.5	balance		9.5 - 12.0
CuMn12Ni4	3.5 - 4.5	balance		10.5 - 13.5
CuMn13Ni4	3.5 - 4.5	balance		11.5 - 14
CuMn12Ni2	1.8 - 2.5	balance		11.5 - 13.2
CuMn7Sn2.3		balance	1.8 - 2.8	5.5 - 8.5

### 2. Chemical composition (Reference values in % w/w)

# 3. Nickel Chromium alloys

## 1. Alloys

Alloy	Specific electrical resistivity at 20 °C (μOhm.cm)	Max. operational temp °C	Material   UNS No.
<b>NiCr20-25</b>	95	1050	1.4843 / UNS S31400
<b>NiCr30-20</b>	104	1100	1.4860
<b>NiCr40-20</b>	104	1100	
<b>NiCr60-15</b>	111	1150	2.4867 / UNS N06004
<b>NiCr70-30</b>	119	1250	2.4658 / UNS N06008
<b>NiCr80-20</b>	112	1230	2.4869 / UNS N06003
<b>NiCr20Al</b>	132		2.4872

## 2. Chemical composition (Reference values in % w/w)

Alloy	Ni (+Co)	Cr	Fe	Mn	Si	Al
<b>NiCr20-25</b>	19.0 – 21.0	23.0 – 25.0	Bal.	1.50 max	1.50 – 2.50	
<b>NiCr30-20</b>	30.0 – 31.0	19.50 - 21.50	Bal	1.0 max	1.80 – 3.00	
<b>NiCr40-20</b>	34.0 – 37.0	18.0 – 21.0	Bal.	1.0 max	1.60 – 2.50	
<b>NiCr60-15</b>	Min. 59	14.0 – 17.0	Bal.	1.0 max	1.0 – 1.75	
<b>NiCr70-30</b>	Bal.	29.0 – 31.0	1.0 max.	1.0 max	1.0 – 1.50	
<b>NiCr80-20</b>	Bal.	19.0 – 21.0	1.0 max.	1.0 max	1.0 – 1.50	
<b>NiCr20Al</b>	Bal.	18.0 – 20.0	0.50 max	0.50 max	1.0 max	3.50 Max

# 4. Nickel Iron alloys

## 1. Alloys

Alloy	Specific electrical resistivity ( $\mu\text{Ohm.cm}$ )		Max. operational temp °C	Material   UNS No.
	at 20 °C	at 500°C		
<b>NiFe42</b>	61	116	600	1.3917 / UNS K94100
<b>NiFe48</b>	47	116	600	1.3922 / UNS K94800
<b>NiFe52</b>	43		600	2.4478 / UNS N14052
<b>NiFe70</b>	33	89	600	
<b>NiFe28</b>	21		600	

## 2. Chemical composition (Nominal values in % w/w)

Alloy	Ni (+Co)	Fe
<b>NiFe42</b>	42	Bal.
<b>NiFe48</b>	48	Bal.
<b>NiFe52</b>	52	Bal.
<b>NiFe70</b>	Bal.	30
<b>NiFe28</b>	Bal.	28

# 5. Iron Chromium Aluminium alloys

## 1. Alloys

Alloy	Specific electrical resistivity at 20 °C (μOhm.cm)	Max. operational temp °C	Material   UNS No.
FeCrAl13-4	116	1000	UNS K91470
FeCrAl14-4	125	1050	1.4725 / UNS K91670 / K91870
FeCrAl20-5	135	1250	1.4767 / UNS K92400
FeCrAl21-5	140	1250	1.4765 / UNS K92500
FeCrAl23-5	145	1300	1.4765 / UNS K92500
FeCrAl25-5	145	1350	1.4765 / UNS K92500
FeCrAl27-7	153	1400	

## 2. Chemical composition (Reference values in % w/w)

Alloy	Fe	Cr	Al	Ni	Mn	Si	Mo
FeCrAl13-4	Bal.	12.0 – 15.0	3.0 – 5.0	0.40	0.35	0.30	
FeCrAl14-4	Bal.	14.0 – 16.0	3.50 – 5.0	0.40	0.50	0.70	
FeCrAl20-5	Bal.	19.0 – 21.0	4.0 – 5.0	-	0.50	0.60	
FeCrAl21-5	Bal.	20.0 – 21.0	5.0 – 6.0	0.40	0.50	0.60	
FeCrAl23-5	Bal.	21.0 – 24.0	5.0 – 6.0	0.40	0.50	0.60	
FeCrAl25-5	Bal.	23.0 – 26.0	4.50 – 6.0	0.40	0.50	0.60	
FeCrAl27-7	Bal.	26.50 – 27.80	6.0 – 7.0	0.50 max	0.30 max	0.60 max	