Metal Seal Material Temper

We provide clear recommendations on the best choice of material condition for the type of seal selected and material type. For high performance resilient metal seals manufactured from nickel alloys such as X-750, 718 and Waspaloy, we recommend a solution annealed and age hardened heat treatment to our standard (-6) condition after forming. This increases springback and load by increasing yield strength, as well as improving fatigue resistance and creep resistance. Metal O-Rings and Spring Energized C-Rings are frequently manufactured from austenitic stainless steels which are not precipitation hardenable. These seals are supplied in the work hardened condition.

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Temper Code

Temper Code	Temper Description
1	Work Hardened
2	Age Hardened
4	Annealed
6	Solution Heat Treat, (Stabilization Heat Treat if applicable), and Precipitation Heat Treat
8	Temper For Service Per NACE MR0175 Specification

Temper Codes for Non-Spring Energized Seals

Material Code	Material (Common Designation)	C-Ring (Face Seal)	Axial C-Ring	E-Ring	O-Ring	U-Ring	Wire Ring
01	304 Stainless Steel				1		4
02	316 Stainless Steel				1		4
03	321 Stainless Steel				1		4
04	347 Stainless Steel				1		4
05	Monel 400				1		4
06	Alloy 600				1		
07	Alloy X-750	6	1		1†		
08	Aluminum Alloy 1100						4
09	Haynes 25				1		
10	Gold						4
11	Silver						4
12	Copper						4
13	Nickel						4
14	Alloy 718	6*	1 or 6*	6*	1†	6*	
15	Stainless Steel Alloy A-286	6	1				
16	17-4 PH Stainless Steel	6	1				
20	Hastelloy C-276	1	1				
23	Waspaloy	6	6	6		6	
25	Alloy 625	6	1				
29	Rene 41	6	6	6		6	
39	Haynes 188	1	1			1	

*NACE APPROVAL – For approval in corrosive service per NACE MR-01-075 Specification, specify temper code 8.
†Alloy X-750 and 718 O-Rings are available in -6 and -2 tempers for increased fatigue and stress relaxation resistance and seating load.

Temper Codes for Spring Energized Seals

The -1 Work Hardened temper code is standard for all Spring Energized Seals. All springs are supplied in an appropriate spring temper prior to installation in the seal jacket. The -6 Solution Annealed and Age Hardened temper code is available for increased fatigue resistance of the jacket/spring combinations (at right) in cyclic operating conditions such as piston engines.

Material Code	Jacket/Spring Materials
06	Alloy X-750/Alloy X-750
11	Alloy 718/Alloy 718

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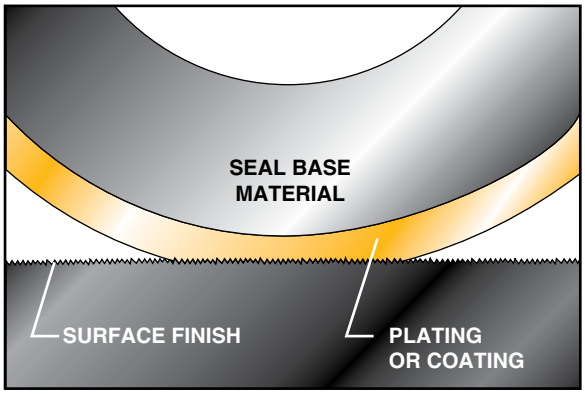

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Finish Code

Finish Thickness

Specialized platings and coatings allow us to modify the surface properties of a metal seal to create a ductile, low hardness outer surface layer. This acts as an integral "gasket" and ensures optimum sealing despite mating surface imperfections. However, unlike a large surface area traditional flat gasket, the narrow footprint of a metal seal produces a high localized contact stress without excessive bolt-up loads.

Platings and coatings can also improve seal performance by reducing the coefficient of friction of the seal and preventing galling. This assists the seal to slide and "seat down" properly during initial compression or permit, for example, limited dynamic use as a valve stem seal.

In addition to the primary physical properties of ductility and softness, seal coatings are also chosen to withstand high temperatures and often corrosive or oxidizing environments. With a wide choice of surface coatings available, we recommend the selection be made by the following process of elimination.

1. Eliminate all platings and coatings with inadequate high temperature capability (see table below).
2. Eliminate all coatings chemically incompatible with the fluid medium.
3. Choose the softest remaining coating able to withstand the seating stresses. (Ultra soft materials such as Indium and Lead are very easily damaged and subject to creep if overstressed. They should only be selected for specially critical applications with well controlled handling and installation instructions.)
4. NOTE: Silver remains, for many applications, the preferred choice.

Finish Code	Finish Material	Properties, Uses And Limitations	Maximum Temp °F	Maximum Seal Load Lb/In
	Unplated	Typically air applications where total leak tightness is not required. Lowest cost. Contact your local representative for anti-gall coating options.	depends on base	not limited
SFX (unplated) SSX (Silver) SGX (Gold) etc.	Super-Finishing	Spin-polished substrate sealing surfaces with a circular lay. Improves leakage control on unplated or low load seals, or for high vacuum.	depends on base & plating	depends on plating
IP	Indium (In)	Extremely soft metal, excellent for cryogenics, low strength flanges, optical components and vacuum. Not for use with high load seals or at high pressures, due to creep and extrusion.	150	350
LP	Lead (Pb)	Similar properties to Indium, although slightly harder and higher temperature capability. Not for use with high load seals.	400	400
PC	Tin (Sn)	Very soft metal, excellent for cryogenics, low strength flanges, optical components and vacuum. Not for use with high load seals or at high pressures, due to creep and extrusion.	400	400
TC	Teflon (PTFE)	Chemically inert soft polymer. Not for use with high load seals. Permits some permeation of gases.	450	450
SP	Silver (Ag)	Closest to an ideal plating material and therefore most frequently selected for a wide variety of applications. Soft in its pure and annealed form. Good corrosion and temperature resistance. Used in nuclear seals/borated water. Excellent anti-galling properties. Inexpensive.	500 (oxidizing) 1200 (non-oxidizing)	not limited
AP	Gold under Silver	Oxidizing environments above 500°F. As high temperature oxygen permeates the outer silver layer the thin gold layer ensures proper adhesion of the silver.	1200	not limited
GP	Gold (Au)	Soft metal with excellent chemical and oxidation resistance and very high temperature capability. Expensive for larger sizes.	1700	not limited
CP	Copper (Cu)	Relatively soft and inexpensive plating. Good high temperature resistance. Not for use with Waspaloy.	1700	not limited
NP	Nickel (Ni)	Very high temperature capability, but harder than either Silver or Copper even when annealed. Used instead of silver in hot, oxidizing environments.	2200	not limited