

N426 - N475 - N485

Fe Ni Cr SEALING ALLOYS

1 – INTRODUCTION

Iron-nickel-chromium alloys for seals complete the range of iron-nickel and iron-nickel-cobalt alloys for bonding to glass and ceramics.

These alloys are suited to the characteristics of soft leaded and lead-free glasses to which they are attached by means of either a matched seal or a compression seal.

The addition of chromium to the iron-nickel alloys imparts all of the following:

- higher expansion
- a lower Curie temperature
- a lower oxidation rate
- a more adherent, more impermeable, less brittle, but more soluble oxide.

2 – INDICATIVE ANALYSIS

Grade	Ni	Cr	C	Si	Mn	Fe
N426	42	6	0.015	0.20	0.20	remainder
N475	47	5	0.010	0.15	0.20	remainder
N485	48	6	0.010	0.20	0.25	remainder

3 – PHYSICAL PROPERTIES

3.1 – Thermal expansion

Grade	Mean expansion coefficient in 10^{-7} between 0°C and:						
	- 100°C	+ 100°C	+ 200°C	+ 300°C	+ 400°C	+ 500°C	+ 600°C
N426	- 66	68	72	81	97	114	126
N475	- 86	87	87	88	96	110	126
N485	- 88	91	92	92	99	113	125

3.2 – Stability

Between the melting point and the lowest temperatures, the arrangement of the crystal structure remains the same for all grades, the alloy remains stable.

3.3 – Magnetic properties

The magnetic properties of FeNiCr alloys are essentially dependent upon preceding operations, in particular the final anneal and the maximum temperature attained during the glass-metal sealing process.

Under these circumstances, the magnetic properties of these alloys following bonding to the glass can vary according to the techniques employed.

3.4 – Other physical properties

Grade	Density at 20°C g/cm ³	Curie point °C	Melting point °C	Resistivity at 20°C μΩ cm	Thermal conductivity at 20°C cal.s ⁻¹ cm ⁻¹ °C ⁻¹	Specific heat cal.g ⁻¹ °C ⁻¹
N426	8,10	270	1 450	93	0,033	0,120
N475	8,15	340	1 450	87	0,022	0,120
N485	8,20	350	1 450	85	0,034	0,120

4 – MECHANICAL PROPERTIES

Materials tested in accordance with standards NF EN 10002, NF EN ISO 6507, NFA 04102

Grades	Metallurgical condition	Hv	Rp0.2 (MPa)	Rm (MPa)	A %	IG
N485 – N475	Annealed	140	250	540	35	9
N485 – N475	Work-hardened	230	700	730	4	
N426	Work-hardened	200/300		720	> 1%	

- Annealed condition recommended for bending, pressing and flow turning.
Work-hardened condition recommended for stamping and shearing.

5 – EXECUTION OF GLASS-METAL SEAL

5.1. – Examples of glass employed

0120 – CORNING GLASS	(U.S.A.)
8095 – SCHOTT	(Germany)
8510 – SCHOTT	(Germany)
8422 – SCHOTT	(Germany)
8196 – SCHOTT	(Germany)

5.2. – Procedure

In order to obtain a satisfactory seal, the parts must be carefully degreased (in particular, removal of any impurities containing carbon, as carbon causes the formation of bubbles in the glass at the glass-metal interface).

Decarburisation treatment is recommended: this consists of annealing in wet hydrogen at 1100°C (2012°F) for 5 to 30 minutes, followed by cooling in the furnace.

No chemical or mechanical cleaning can substitute for this treatment.

Matched seals must be cooled slowly in an oven.

Given the application, it is necessary to remove the oxides coating the metal in the areas outside the seal; this may be performed by electrolytic pickling in an alkaline bath (e.g. 10% sodium hydroxide).

6 – APPLICATIONS

These alloys are generally employed for watertight glands in soft glass.
Applications include:

- cathode ray tube anode buttons (N475 / N485)
- automotive lighting

7 –PRODUCT FORMS

- Cold-rolled strip
- Drawn bar
- Hot-rolled bar