

# SUPRA 36

## Fe-Ni SOFT MAGNETIC ALLOY

### I. INTRODUCTION

The distinctive feature of the 36% nickel alloy is the fact that it has the highest electrical resistivity in the Fe-Ni system (twice that of Fe-Si alloys), giving it good magnetic properties in the medium frequency range from 1 to 50 kHz.

The table below gives the nominal chemical composition of Supra 36 in weight % :

Ni	Si	Mn	C	Fe
36	0.40	0.35	0.01	Balance

### II. PRINCIPAL APPLICATIONS

- Telephony : profiles for translators and transformers
- Magnetic protection : drawn shields for automotive instrumentation, shields for audio tape cassettes, shielding for TV tubes, etc.
- Electronics : cores for pulse transformers, for special passive components and for oscillating circuit inductances, circuits and transformers (perfectly adapted for 400 Hz)
- Electrical engineering : massive relay parts and pole-pieces for electro-magnets.

### III. PHYSICAL PROPERTIES

	Typical values	Unites
Density <sup>(1)</sup>	8.1	g.cm <sup>-3</sup>
Specific heat <sup>(1)</sup>	500	J.kg <sup>-1</sup> . °C <sup>-1</sup>
Thermal conductivity <sup>(1)</sup>	10.5	W.m <sup>-1</sup> . °C <sup>-1</sup>
Mean CTE between 0 °C and + 100 °C	1.1	10 <sup>-6</sup> .°C <sup>-1</sup>
Electrical resistivity <sup>(1)</sup>	75	μΩ.cm
Curie point	230	°C
Magnetostriction <sup>(1)</sup>	20 × 10 <sup>-6</sup>	-
Melting temperature	1450	°C

<sup>(1)</sup> measured at ambient temperature

#### IV. MAGNETIC PROPERTIES

The tables below give typical values of the magnetic properties determined after heat treatment in compliance with the standards :

- ASTM A 596
- DIN 50560
- IEC 60404

##### IV.1 Typical DC magnetic properties

The measurements are performed on 0.34 mm ring specimens with 36 mm outside diameter and 25 mm inside diameter. The rings are heat treated for 2h at 1050°C in pure dry hydrogen.

Coercive field H <sub>c</sub> (A/m)	Maximum permeability μ <sub>maxcc</sub>	Remanent induction B <sub>R</sub> (Tesla)	Saturation induction B <sub>s</sub> (Tesla)
6	30 000	0.4	1.3

##### IV.2 Typical AC magnetic properties

The measurements are performed on 0.34 mm ring specimens with 36 mm outside diameter and 25 mm inside diameter. The rings are heat treated for 2h at 1050°C in pure dry hydrogen.

Permeability at 0.4A/m and 60Hz	Maximum permeability at 60 Hz
7 000	30 000

#### V. HEAT TREATMENT OF FINISHED PARTS

The optimum magnetic properties of SUPRA 36 are obtained after heat treatment for 3 to 5 hours at a temperature of around 1 050°C in pure dry hydrogen.

However, treatment at a lower temperature (1 000°C) is possible for certain applications.

## VI. MECHANICAL PROPERTIES

The figures given below are typical values measured at 20°C

Property	Cold worked condition	Annealed condition
Hardness (HV)	230	130
UTS (MPa)	700	480
0.2% PS (MPa)	680	300
Elongation (%)	3	30
Grain size	-	9

On request, Imphy Alloys can supply non standard conditions that may be required by the user.

## VII. IMPLEMENTATION

### ***VII.1 Cut-out and strip shearing***

Cold worked metal is used for these applications.

### ***VII.2 Bending, deep drawing, stretching and lathe spinning***

For these forming processes, the metal is used in the annealed condition.

When the annealed metal is subjected to large plastic strains, significant hardening occurs and an intermediate softening treatment is sometimes necessary during component forming sequences.

Imphy Alloys recommends holding for a minimum of 1 hour at 800°C–850°C. It is essential to take all necessary precautions to avoid contamination of the metal, including a clean furnace and clean parts, and a protective atmosphere, which may even be reducing, with a dew point less than –40°C.

### VII.3 Machining

SUPRA 36 is a « sticky » alloy with chips that tend to adhere to the tool. Relatively low cutting speeds are therefore required. Cold worked metal is better suited to machining than annealed material. The typical machining conditions are given in the table below :

	Turning		Milling	Drilling
	Peeling	Cutting		
<b>Tool</b>	S3 or S4 carbide	High speed steel	Improved high speed steel	High speed steel
<b>Lubricant</b>	Soluble oil	Soluble oil	Soluble oil	Soluble oil
<b>Cutting angle (°)</b>	12-17	7-10	15	-
<b>Rake angle (°)</b>	5-8	6-10	3-7	9-13
<b>Cutting speed (m/minute)</b>	50-75	15-20	10-15	10
<b>Advance rate</b>	0.2 to 0.5 mm/rev	0.03 to 0.07 mm/rev	0.05 to 0.10 mm/tooth	0.10 mm/rev

The parts must be carefully cleaned after machining to reduce the risk of contamination, particularly by the lubricant.

### VIII. AVAILABLE FORMATS

Treated cores (1)	Treated parts (1)	Cold rolled strip
■	■	■

(1) : cores, profiles, stacked laminations, rotor and stator sheets, shielding, plates for chemical machining sold by MECAGIS, a subsidiary of Imphy Ugine Précision, like Imphy Alloys

Format	Typical thickness (mm)	Maximum width (mm)	Condition
Cold rolled strip delivered in coils or straight lengths	0.1 to 1.5	640	Cold worked or annealed
Cold rolled strip delivered in cut-to-length sheets (maximum length 3500 mm)	0.1 to 1.5	640	Cold worked or annealed