



 **BASF**

We create chemistry

Thermocouple cable and assemblies

ENCLAD[®]

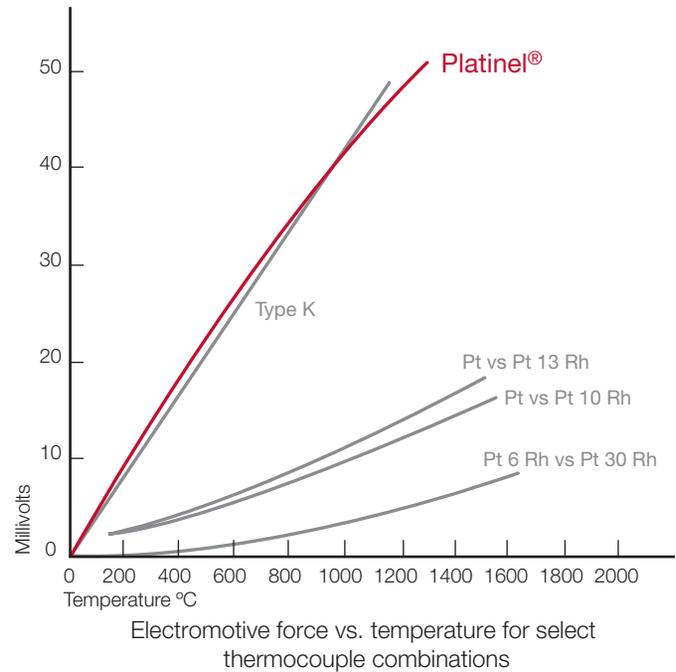
ENCLAD® thermocouples

Introduction

BASF ENCLAD thermocouple products are a precise and rigorously controlled combination of select precious and base metal sheaths, high-purity ceramic insulations and compatible precious metal thermocouple wires consolidated into a rugged assembly.

From molten glass temperatures to rocket exhaust measurements, BASF has supplied ENCLAD thermocouples for a variety of diverse and demanding applications. With our technical capabilities and experience, BASF provides the expertise to meet your application needs.

The following information highlights our most popular combinations and sizes. Many variations and additions are available, and BASF specializes in custom designs.



The BASF advantage

- Quality – ISO 9002
- Precious metals expertise
- Lot calibration at no charge
- Technical expertise
- Advanced manufacturing capabilities
- Calibration services

Applications

BASF ENCLAD thermocouples have been extensively used in the following select applications in which high temperature-resistance or chemical inertness of the sheath material is required.

- Biomedical research
- Ceramic sintering
- Crystal growth
- Energy conversion
- Gas turbine combustor discharge
- Glass melting and working
- Heat-treating furnaces
- Ion implant
- Liquid phase epitaxy
- Nuclear research
- Plasma physics research
- Refractory erosion monitoring
- Soaking pit control

NOTE: Please specify dimensional units (i.e.; inches, millimeter, etc.) required for all length parameters.

Specifications

Dimensions and tolerances

ENCLAD products shall conform to the following tabulated values, except as specifically ordered. (Units: Inches)

Nominal diameter	.032	.040	.0625	.09375	.125	.1875	.25
Actual outer diameter	.032	.040	.0625	.0937	.125	.1875	.250
Tolerance on outer diameter	±.001	±.001	±.002	±.002	±.002	±.002	±.002
Nominal wall (base metal)	.005	.006	.010	.014	.018	.025	.033
(precious metal)	.005	.006	.010	.014	.016	.020	.025
Tolerance on wall	±.001	±.002	±.002	±.002	±.002	±.003	±.004
Nominal wire diameter (precious metal)	.005	.006	.010	.016	.018	.020	.024
Tolerance on wire dia.	±.001	±.001	±.002	±.002	±.003	±.003	±.004

Specifying thermocouple materials

Type S & R thermocouple material are the most popular in the Platinum-Rhodium system. They are noted for excellent stability up to their recommended maximum-use temperature of 1400°C.

Type B thermocouples have proved effective for applications of up to 1750°C, with excellent stability and sensitivity.

BASF Platinel® thermocouples use a precious metal alloy with similar EMF properties to those of the base metal Type K. It may be used to extend the Type K range to 1300°C. As a precious metal alloy, Platinel is free from drift due to preferential oxidation.

- Standard lengths are 10 feet. Longer lengths are available.
- Materials for popular sizes of .062" diameter and .125" diameter are generally in stock for rapid turnaround.
- Other materials can be made to special order requirements. Please consult with the factory.
- BASF Fibro® Platinum thermocouples are available for substitution in ANSI Type S & R.

Specifying sheath material

The choice of the outer sheath material must be made after considering its compatibility with the environment, its operating temperature and its structural loading. No hard and fast rules exist to aid the evaluation. Time-dependency factors often determine material selection as do shock, vibration and duty-cycle.

Platinum-Platinum/Rhodium alloy sheath materials are noted for their freedom from oxidation attack. They are also highly resistant to chemical attack. The alloys with a higher Rhodium content provide increased strength at high temperatures as does the oxide dispersion strengthened, grain stabilized, platinum (GS Pt). Platinum and its alloys are the only materials usable to 1600°C (2900°F) and higher, in air or other strongly oxidizing environments.

In general, the following temperatures have been found suitable for ENCLAD sheath materials.

- | | | | |
|------------|--------|----------------|--------|
| ■ Pt | ~1200° | ■ Pt 20 Rh | ~1650° |
| ■ GS Pt | ~1600° | ■ Inconel® 600 | ~800° |
| ■ Pt 10 Rh | ~1500° | | |

Insulation compaction density

Compaction density is governed by the method of consolidation; swaging or drawing.

The following values generally apply:

- > 90% theoretical for swaged cable
- > 82% theoretical for drawn cable

Insulation shall be self-supporting and not fall away when sheath is cut or when the cut end is rapped sharply on a hard surface.

Thermocouple conductors

Thermocouple conductors are selected pairs, fully annealed or stabilized to comply with the following tolerances to the latest version of internationally recognized standards.

Pt vs Pt 10 Rh – Meets or exceeds ±.25% from 600°C to 1400°C

Pt 13 Rh – Meets or exceeds ±.25% from 600°C to 1400°C

Pt 6 Rh vs Pt 30 Rh – Meets or exceeds 0.5% from 800°C to 1700°C

Platinel EMF – Meets or exceeds 0.75% from 600°C to 1200°C

All thermocouple conductors shall be continuous and of one piece from one end of the cable to another. No joints or splices are allowed.

Insulation

Standard ceramic insulation is MgO. Pre-fired and partially sintered preforms are exclusively used to avoid loss in cable integrity due to porosity, density and dimension variations. Loose powder fill or wet extrusion of ceramic is not used. Basic purity of ceramic preforms is 99.4% minimum.

Junction

For all assembly products, the thermocouple junctions are un-grounded for maximum protection from contamination and superior isolation between wires and sheath. Exposed and grounded junctions are available on special request.

Bendability

All ENCLAD products can be bent 180 degrees around a mandrel whose diameter is twice the assembly diameter. For composite-sheath ENCLAD's, bending within 1 inch on either side of the transition is not recommended.

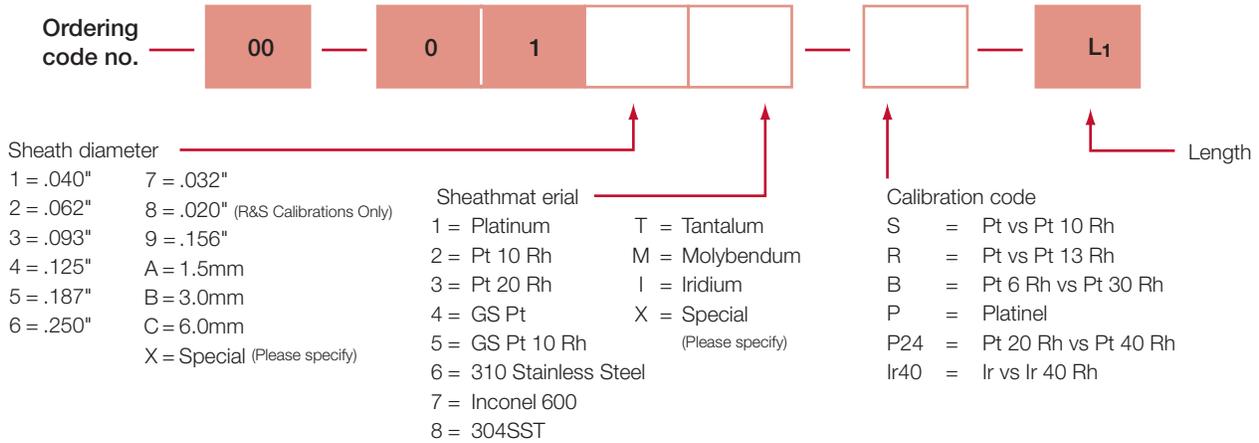
Insulation resistance

Minimum insulation resistance at 25°C and 50 VDC shall be no less than 1000 megohms for cables up to 30' in length.

ENCLAD® cable



Product code for 00-01XX series
ENCLAD cable



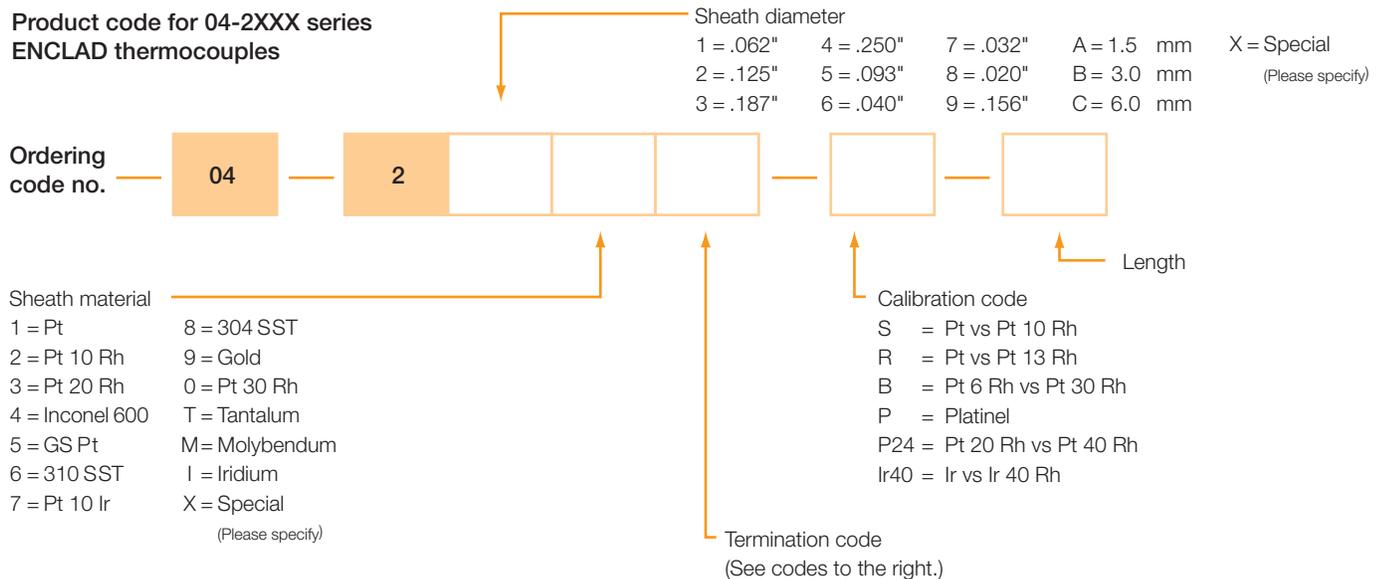
Example

Part number 00-0142-R-120" represents a type R ENCLAD cable, Pt 10 Rh sheath, .125 inch diameter with a length of 120 inches.

Standard ENCLAD® thermocouples



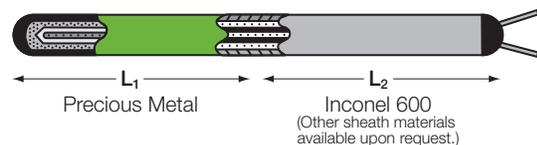
Product code for 04-2XXX series
ENCLAD thermocouples



Example

Part number 04-2223-S-18" represents a .125" diameter Pt 10 Rh sheath ENCLAD thermocouple with a standard size plug. The calibration is Type S and the length is 18 inches.

Composite-sheath ENCLAD® thermocouples



Product code for 04-3XXX series
Composite-sheath ENCLAD
thermocouples

Ordering
code no.



Sheath material
1 = GS Pt
2 = Pt 10 Rh
3 = Pt 20 Rh
4 = Pt
5 = Pt 30 Rh

Termination code
(See codes below.)

Calibration code

S = Pt vs Pt10Rh
R = Pt vs Pt13Rh
B = Pt 6 Rh vs Pt 30 Rh
P = Platinel
P 24 = Pt 20 Rh vs Pt 40 Rh
Ir 40 = Ir vs Ir 40 Rh

Length of sheath
(hot & cold portions)

Sheath diameter
1 = .125" 4 = .062" 7 = .032" A = 1.5 mm X = Special
2 = .187" 5 = .040" 8 = .020" B = 3.0 mm (Please specify)
3 = .250" 6 = .093" 9 = .156" C = 6.0 mm

Example

Part number 04-3222-R-10"-30" represents a Composite-sheath ENCLAD thermocouple that is .187 inch in diameter with a Pt 10 Rh hot portion sheath with standard size plug.

Standard ENCLAD Thermocouple Termination codes



Termination code 1

Bare wire 3/4" stripped leads. Sealed with epoxy to preserve insulation resistance.



Termination code 2

Miniature plug (used on .062" diameter and below).



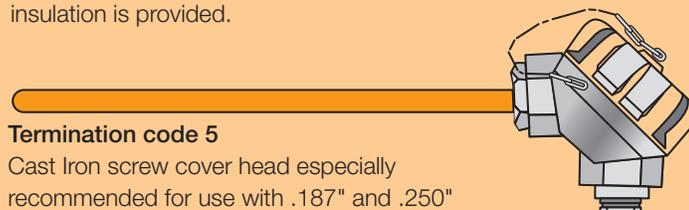
Termination code 3

Standard size compensating plug for all sheath sizes. Compensating cable is available order part no. 00-6200-calibration code-length.



Termination code 4

Transition splice of thermocouple wire to extension lead wire provided in a water resistant epoxy potting compound. Unless otherwise requested, 36" of 24 ga., solid lead wire with Teflon® thermocouples insulation is provided.



Termination code 5

Cast Iron screw cover head especially recommended for use with .187" and .250" sheath diameter assemblies.

Termination code 6

Injection molded

Composite-sheath ENCLAD Thermocouple Termination codes



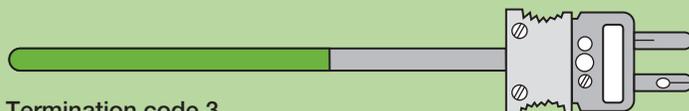
Termination code 1

Bare wire 3/4" stripped leads. Sealed with epoxy to preserve insulation resistance.



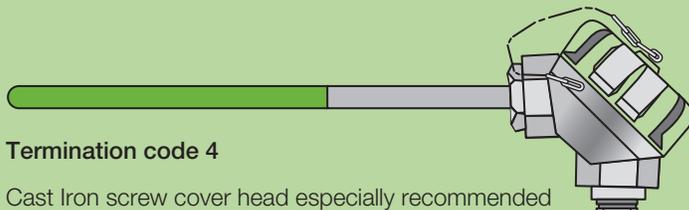
Termination code 2

Transition splice of thermocouple wire to extension lead wire provided in a water resistant epoxy potting compound. Unless otherwise requested, 36" of 24 ga., solid lead wire with Teflon insulation is provided.



Termination code 3

Standard size compensating plug for all sheath sizes. Compensating cable is available order part no. 00-6200-calibration code-length.



Termination code 4

Cast Iron screw cover head especially recommended for use with .187" and .250" sheath diameter assemblies.

Precious metals expertise

Metals – particularly those in the platinum group – are critical components of many products made by BASF such as contact thermocouples. Ensuring that those raw materials are where they need to be, when they need to be there, in the form they need to be and at the lowest possible cost is what BASF's Materials Services group is all about. Given our unique understanding of market fundamentals, such as current and future supply, technology changes and market risks, we help ensure that BASF and our customers have a cost-effective, reliable supply of the raw materials they need.

A fundamental understanding of precious metal and precious metal technologies is also critical. The experience of our research and development group in precious metal and precious metal technologies is unmatched. From Fibro® platinum to Platinel® thermocouple wire we have led the industry with breakthrough innovations. No one knows more about precious metals. We are the precious metal experts.

About us

BASF's Catalysts division is the world's leading supplier of environmental and process catalysts. The group offers exceptional expertise in the development of technologies that protect the air we breathe, produce the fuels that power our world and ensure efficient production of a wide variety of chemicals, plastics and other products, including advanced battery materials. By leveraging our industry-leading R&D platforms, passion for innovation and deep knowledge of precious and base metals, BASF's Catalysts division develops unique, proprietary solutions that drive customer success.

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