LucasMilhaupt®
A Handy & Harman Company
Global Brazing Solutions®

Technical Data Sheet

LUCANEX®

GENERAL DESCRIPTION

This proprietary product eliminates the need for molybdenum/manganese metallizing or other pre-metallizing treatments typically required in the joining of technical ceramics.

TYPICAL BRAZE FILLER METALS USED WITH LUCANEX

	Silvaloy 616[(1), (2)]	Silvaloy 716[(1),(2)]	Silvaloy 721[(1),(2)]
Silver	61.5% ± 1.0%	71.5% ± 1.0%	72.0% ± 1.0%
Copper	Remainder	Remainder	Remainder
Nickel	--	0.5% ± 0.2%	--
Indium	14.5% ± 0.5%	--	--

(1) The basic alloy compositions shown are for the filler metal powder in Lucanex paste.
(2) The titanium content in Lucanex paste will vary, dependent on the application, from 2.00% - 10.0%.

BINDER: Inert, proprietary binder systems. Binder leaves no residue after heating in proper furnace conditions.
FLUX: None required for use in proper atmosphere or vacuum furnaces.

PHYSICAL PROPERTIES OF BRAZE FILLER METALS

	Silvaloy 616[(1), (2)]	Silvaloy 716[(1),(2)]	Silvaloy 721[(1),(2)]
Melting Point (Solidus) (3)	1155°F (620°C)	1435ºF (780ºC)	1435ºF (780ºC)
Flow Point (Liquidus) (3)	1305°F (710°C)	1465ºF (795ºC)	1435ºF (780ºC)
Brazing Temperature Range	1520°F - 1650°F	1650º F - 1750ºF	1550ºF - 1750°F
	(827°C - 898°C)	(899ºC - 954ºC)	(843°C - 954°C)

(3) Solidus and liquidus temperatures shown are for the standard filler metal component of the product. Brazing ranges shown are for use with Lucanex.

Color	Light Brown
Filler Metal Powder (%)	79.0 - 81.0 by weight
Powder Mesh Size	-325 Mesh (44 Microns, 0.0017 in) unless otherwise specified
Paste Viscosity (Cps) [(4)]	300,000 - 400,000

(4) Cps = Centipoise

PRODUCT USES

Lucanex brazing products are used for bonding or hermetically sealing a broad range of ceramic and non-metal components to themselves and to other ceramics or metals without the need for molybdenum/manganese metallizing or other pre-metallizing treatments. Lucanex paste may also be used for selectively coating the surfaces of these same materials through the use of silk-screening, brushing, or syringe type applicators.

Heating to bonding temperatures in vacuum or under argon or helium atmospheres is required. During heating, the filler metal will melt and subsequently flow in relation to the furnace temperatures employed. Bonding to ceramics results from a reaction with the ceramic surface to form a fully bonded transition zone between the ceramic and the ductile filler metal.

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PRODUCT USES (CONT.)

The compositions of the possible transition zones vary with the composition of the ceramic base and heating conditions. Joining to metal surfaces is accomplished through the metallic bonding expected in standard braze joints.

Lucanex has been shown to produce successful bonds in components manufactured from alumina, silicon nitride, zirconia, diamond, titanium carbide, sapphire, and graphite when these materials are bonded to themselves or appropriately selected metals and non-metals. Successful bonds would be expected in many higher strength "technical" ceramics and other strong non-metallic materials capable of withstanding the temperatures and vacuum conditions typically employed in joining.

Weaker, more friable or brittle materials such as as-cast ceramics, cements, glasses, or loosely bonded graphites would be expected to produce weaker bonds in most cases. Materials which outgas or decompose during heating while in vacuum or under high purity protective atmosphere would not be appropriate for bonding with Lucanex.

When joining metals to non-metals, consideration must be given to the often higher thermal expansion of the metal component, which may crack the non-metal upon cooling from bonding temperature or under service conditions. Generally, mismatch from expansion differences are reduced by decreasing the dimensions of the bonding area, by selecting metals and non-metals with relatively small differences in thermal expansion and by designing joints to produce compressive stresses or symmetrical distribution of stresses. For example, thin walled stainless steel caps can be bonded to the ends of large alumina cylinders using a knife-edge joints design. Small steel tabs can be bonded to larger silicon nitride bars. The low thermal expansion of molybdenum or the higher thermal expansion of zirconia can be used advantageously to reduce mismatch. When bonded surface areas are large compared to the thicknesses of the dissimilar materials, increasing thickness of one or both components can reduce bending stresses resulting from thermal distortion. As each application will introduce its own design consideration, evaluation of base material and joint design on trial parts is recommended.

PRODUCT APPLICATION

Lucanex paste formulations can be modified to facilitate special aspects of manufacturing operations. They may be modified to alter the reaction and bonding effects for optimum performance on specific applications.

Lucanex paste is of a consistency suitable for application by syringe, automatic paste dispenser, brush or silk-screening. Lucanex will easily coat ceramic and metal surfaces and, after drying, will hold well to vertical or inverted surfaces. This cling and hold characteristic permits a degree of self-fixturing between components and allows for reasonable handling after assembly and paste application. Lucanex was designed to dry in air to prevent unnecessary flow due to binders liquefying during heating.

The standard mesh size of Lucanex paste ingredients makes Lucanex suitable for most application methods and joint designs. Silk-screening will typically produce a 0.003 in. (0.076 mm) thick layer of brazing alloy after heating when screened through a 110 mesh screen onto a ceramic substrate. Thicker alloy layers may be applied by use of templates, syringe applicators, or brushing. Lucanex will cover 20.0 - 75.0 square inches (12,903-48,387 square millimeters) per avoirdupois ounce depending on thickness of metal layer required.

Lucanex pastes may be applied directly between joint surfaces or to the exterior of joints where part design will direct alloy flow towards the joints. Success of the latter method will be dependent on base materials, joint gap, joint length and heating conditions. Reasonable flow and joint penetration are possible with gaps of 0.005 in. (0.12 mm) per side at temperatures of 1700°F (927°C).

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PRODUCT APPLICATION (CONT.)

There are two types of Lucanex products. One type dries quickly and can be used to self-fixture parts. The other will permit more open time (for silk-screening applications). To take advantage of self-fixturing characteristics of Lucanex pastes, components should be assembled before the paste has dried. After drying, either type of Lucanex will permit reasonable handling of parts prior to heating for bonding.

Lucanex brazing products have been used to produce bonds between a variety of dissimilar materials. The following list describes a number of applications of Lucanex and provides an indication of the creative manufacturing alternatives available.

- One inch diameter, ¼" thick Zirconia discs joined to stainless steel support bars.
- Silicon nitride wear pads (1" x 1" x 3/8") bonded to cast iron stems.
- Silicon nitride bars butt joined end to end.
- Stainless steel end caps hermetically sealed to alumina cylinders.
- Polycrystalline diamond discs joined to carbide discs.
- Diamond grits bonded to low carbon steel tool surfaces that had been coated with Lucanex paste in selected tool areas.
- Graphite to graphite joints to produce configurations not readily available.
- Molybdenum and stainless steel tabs to alumina bases.
- Conductive silver-copper paths silk-screened to alumina and silicon nitride substrates.

HEATING METHODS & FURNACE CONDITIONS

Vacuum furnaces capable of maintaining 10^{-4} Torr minimum vacuum or atmosphere furnaces maintaining a high purity argon or helium atmosphere are required. A partial pressure backfill of argon entered into a vacuum furnace after initial heating will prevent evaporation of filler metal alloy when high brazing temperatures are employed. Successful bonds are possible using alternate heating methods such as resistance, induction, electron beam, and laser. Though rapid heating has been used successfully, a ten minute minimum hold time at brazing temperature is recommended for most applications. The fluidity of Lucanex during bonding will vary with temperatures ranging from sluggish to highly fluid as temperature is increased. Accordingly, temperature may be used to regulate the flow as appropriate for the application.

BASE MATERIAL PREPARTION

Standard cleaning methods to remove grease, scale, etc., from the base metals in preparation for brazing are sufficient. Lucanex will braze to metals normally considered difficult to wet in furnace atmospheres. Ceramics in the as-fired condition will generally result in joints of maximum strength. However, cutting and grinding may produce surface micro cracks in ceramics resulting in weak joints even though bonding was successful. Careful lapping to remove damaged surface layers or re-sintering prior to joining may be necessary.

SPECIFICATIONS

Lucanex conforms to the following specifications: N/A

APPLICABLE PRODUCT CODE(S)

The applicable Lucas-Milhaupt product code(s) for this technical data sheet: *Please contact Technical Service Department to attain product code(s).*

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SAFETY INFORMATION

The operation and maintenance of brazing equipment or facility should conform to the provisions of American National Standard (ANSI) Z49.1, "Safety in Welding and Cutting". For more complete information refer to the Material Safety Data Sheet for Lucanex.

WARRANTY CLAUSE

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