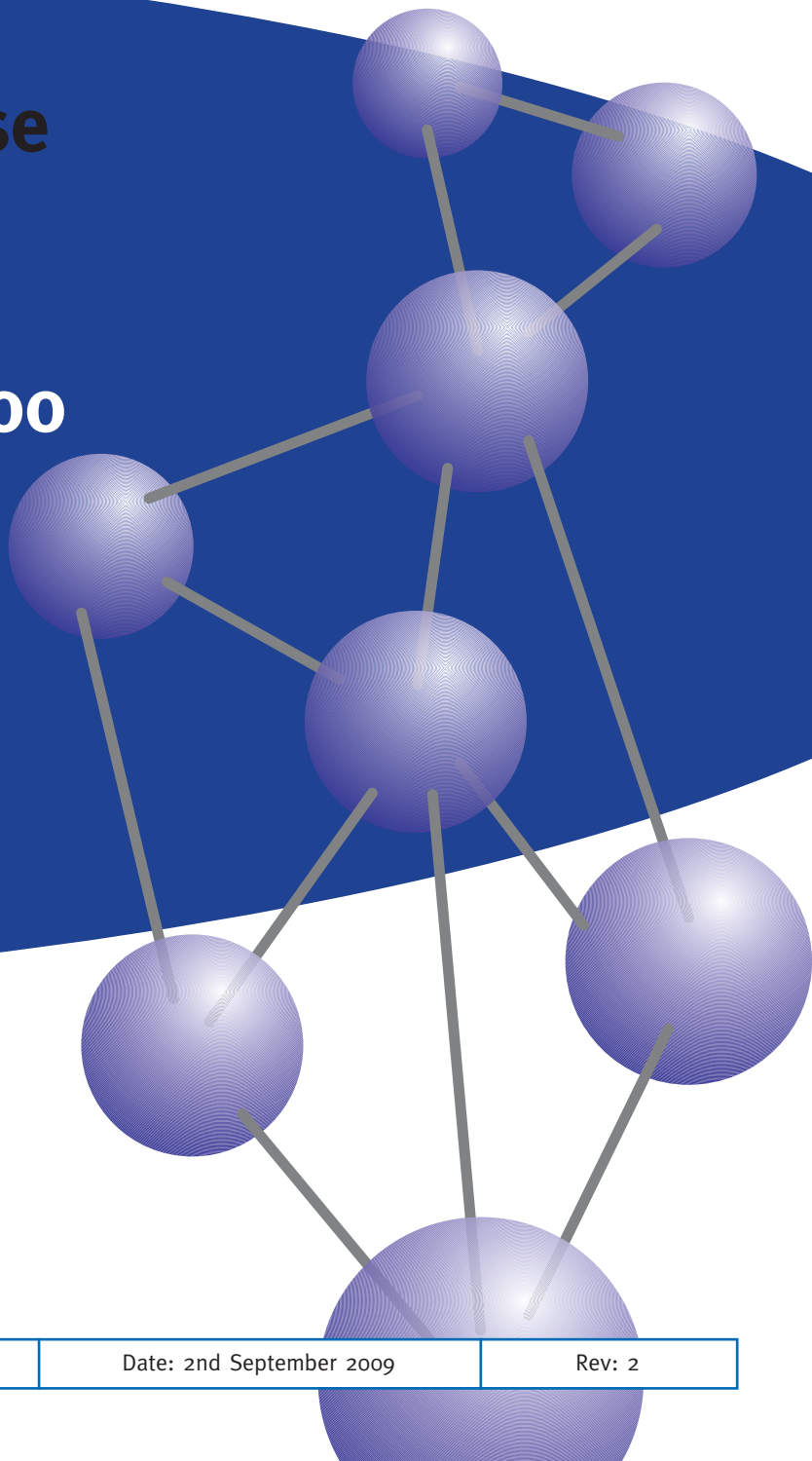
Langley Alloys

Material Purchase Specification for

LANGALLOY K-500 Bar and Forgings



DOCUMENT No. MLA-MPS-K500-BAR/FORGINGS	Date: 2nd September 2009	Rev: 2

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1.0 Scope

This specification is for the purchase of bar and forgings in LANGALLOY K-500 high strength nickel-copper-aluminium-titanium alloy. The material is to be manufactured in accordance with BS 3076:1989 NA18 and ASTM B865 No5500 supplemented by the requirements below.

2.0 Related Documents

Specifications BS 3076:1989 NA18, ASTM B865 No5500, AMS 4676 and QQ-N-286, DIN 2.4375

3.0 Production Processes

Production process shall be in accordance with internal written Langley Alloys Procedures. Melting is by electric induction and further refining may be applied. At each stage of production melt and batch traceability shall be maintained.

4.0 Chemical Composition

K-500 ingots are produced to a specified melting procedure using high purity virgin materials and fully cleaned self-generated remelt. Chemical analysis is carried out during analysis and on the final poured metal. The final composition is according to the following:

Ni+Co$_{min}$	Cu	Al	Ti	C	Fe$_{max}$	Co$_{max}$	Mn$_{max}$	Si$_{max}$	S$_{max}$
63.0	27.5-32.0	2.60-3.15	0.40-0.80	0.09-0.18	1.6	0.3	1.0	0.4	0.01

5.0 Heat Treatment

Bar shall be delivered in a hot worked and precipitation hardened condition

Precipitation shall be carried out by one of the following cycles:

(a) 580°C- 610°C, 4-16 hours followed by furnace cooling at approximately 12°C/hr to 480°C then air cool

(b) 640°C, 2 hours followed by furnace cooling at approximately 16°C/hr to 480°C then air cool

Exact time and temperatures are to be reported

6.0 Mechanical Properties

6.1 Frequency of Testing

Mechanical testing shall be performed on each melt of material per heat treatment batch.

6.2 Tensile Testing

Tensile testing shall be carried out in accordance with ASTM A370 or EN10002-1 at room temperature in a longitudinal direction for bar.

Properties are to be as follows:

0.2% Proof Stress	690 N/mm² [100ksi] minimum
Tensile strength	970 N/mm² [140ksi] minimum
Elongation, 4D and 5.65 $\sqrt{S_0}$	20.0% minimum
Reduction of Area	25% minimum
Hardness (Rockwell C)	27-35
Hardness (Brinell)	Information supplied
Magnetic Permeability (Room Temperature at 200 Oersted)	1.01 maximum (1.002 typical)
Magnetic Permeability (-25°C)	Information supplied
Charpy V-notch (25°C or colder) (Temperature to be stated)	Average 42J minimum (Single minimum 33J)

7.0 Non Destructive Testing

Each complete batch of material is ultrasonically tested in accordance with ASTM A388, BS EN 10228, BS EN 12223 and BS EN 12668. Inspection will be to Langley Alloys procedure PS:NDT2:01 Rev 3. All NDT personnel qualified to at least Level 2 of SNT-TC-lA.

Reference Blocks used for the ultrasonic examination are as follows:

Section Thickness	**Diameter of Flat Bottomed Vertical Holes and Central Horizontal Hole**
Up to and including 25mm	1.5 mm.
Over 25mm. to 60mm. (inclusive)	2.5 mm.
Over 60mm. to 100mm. (inclusive)	3.5 mm
Over 100mm. to 150mm. (inclusive)	4.5 mm
Over 150mm	6.0 mm

Any defect which causes a signal either equal to or greater than the signal produced by the calibration standard (having made allowance for any differences of attenuation between test block and material under test) is deemed to be unacceptable. In such cases, the material under test is rejected and scrapped.

For LANGALLOY K-500 forgings, which are supplied in a proof machined condition, it is mandatory to carry out dye penetrant testing. If required by the customer, dye penetrant testing is also employed out on bar products. Dye penetrant testing is carried out in accordance with ASME Section VIII App VIII. Inspection will be to Langley Alloys procedure PS:NDT1:01 Rev 3. No defects are permitted.

8.0 Inspection

8.1 Bars

All bars are inspected by the manufacturer before despatch with the following requirements for dimensional tolerances and identification.

All bars shall be straight to within 2 parts in 1000

All bars shall be free of surface defects such as laps, cracks and shall undergo 100% ultrasonic inspection as given in section 8.

All bars shall be in the proof machined condition of surface finish of 125µ inches CLA or better, with the following tolerances on diameter:

Bars up to 80mm diameter:	*+0.8mm/-0.0mm*
Bars 81mm to 200mm diameter:	*+1.00mm/-0.0mm*
Bars above 200mm diameter:	*+1.50mm/-0.0mm*

Bars are supplied in random lengths of typically 2.5-5.0m, unless cut pieces are to be supplied. Bar of lengths up to 6m would be acceptable.

Supply of full bars of shorter lengths than 2.5m would be subject to agreement on a case by case basis.

For the supply of cut pieces, tolerance on the cut lengths would be -0, +6mm

Bars of diameter up to and including 25mm are bundled together in single batches only and securely labelled.

Bars of diameter above 25mm are hard stamped on the bar ends.

8.2 Forgings

All forgings shall be inspected by Langley Alloys before despatch with the following requirements for dimensional tolerances and identification.

All forgings shall be free of surface defects such as laps, cracks, etc

All forgings shall be supplied in the proof machined condition of surface finish of 125µin CLA or better

Tolerances on machined dimensions shall generally be within the range +1.5mm to +2mm, -0

9.0 Identification

Articles shall be suitably identified with the manufacturer's stamp, the batch number and the alloy code (K500). The batch number uniquely defines both the melt and heat treatment batch from which the bars are taken.

For forgings, the method of identification, whether by labelling or stamping, will depend on the size and shape of the forgings and shall be agreed between the customer and material's supplier.

10.0 Certification

Test Certification is supplied to BS EN 50049.3.1. with each batch of bar and/or forgings. Details on the certificate shall include as a minimum:

a) Product description and specification

b) Heat Treatment Condition

c) Langley Alloys and customer's order numbers

d Results of chemical analysis and room temperature tensile tests in accordance with this specification

e) Certificates relating to NDT testing

f) Signature of an authorised signatory of Langley Alloys

Additional documentation can be supplied by agreement between the materials supplier and customer at the enquiry and order stage.

Langley Alloys

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