

INCH-POUND

MIL-HDBK-62624(AT)

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**DEPARTMENT OF DEFENSE  
HANDBOOK**

**COBALT BASE ALLOY INVESTMENT CASTINGS**



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### FOREWORD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense.
2. This handbook is for guidance only. This handbook cannot be cited as a requirement. If it is, the contractor does not have to comply.
3. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

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## MIL-HDBK-62624(AT)

### 1. SCOPE

1.1 Scope. This handbook gives guidelines for chemical, mechanical and physical properties for investment castings of the cobalt alloy commercially known as L-605, Haynes 25, or Unitemp L605. This handbook is for guidance only. This handbook can not be cited as a requirement. If it is, the contractor does not have to comply.

1.2 Purpose. The material covered by this handbook is primarily for parts requiring strength at high temperatures up to 1500 degrees Fahrenheit (°F) (816 degrees Celsius (°C)) and oxidation resistance up to 2000°F (1093°C).

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### 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirement documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in latest issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplements thereto.

#### SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

- |         |   |
|---------|---|
| AMS2269 | - Chemical Check Analysis Limits - Wrought Nickel Alloys and Cobalt Alloys (DoD Adopted). |
| AS478   | - Identification Marking Methods (DoD Adopted).   |

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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### 3. DEFINITIONS

3.1 Grain size. The measurements made to determine grain size are made on the surface of the casting. The dimensional limitations specified herein are defining grain structure as a surface phenomena. Internal grain size is excluded from the physical properties described in 4.3.1.

3.2 Master heat. A master heat is previously refined metal of a single furnace charge. Gates, sprues, risers, and rejected castings shall only be used in preparation of a master heat. They shall not be remelted directly, without refining for pouring of castings. Metal in the form of shot from more than one master heat may be uniformly blended to form a master heat lot.

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## 4. CASTING PROPERTIES AND PROCEDURES

4.1 Chemical properties. The chemical composition of heat treated cast and machined test specimens should conform to the percentages by weight of each element as specified in table I.

TABLE I. Chemical composition.

Element	Percentage by weight	
	minimum	maximum
Carbon	--	0.15
Manganese	1.00	2.00
Silicon	--	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	19.00	21.00
Tungsten	14.00	16.00
Nickel	9.00	11.00
Iron	--	3.00
Cobalt	Remainder	

4.1.1 Composition variations. Composition variation should meet the requirements of SAE AMS2269 except the check analysis limits should be 0.10 percent (%) under minimum and over maximum for tungsten and 0.10% over maximum for iron.

4.2 Mechanical properties.

4.2.1 Tensile properties. The tensile properties of the casting should be as follows:

- Ultimate tensile strength - Not less than 80 000 pounds per square inch (psi) (552 megapascals (MPa)).
- Yield strength at 0.2% offset - Not less than 52 000 psi (359 MPa).
- Elongation in 4 diameters (D) - Not less than 10%.
- Reduction of area - Not less than 10%.

4.2.2 Stress rupture. Stress rupture properties should be as follows:

- Specimens should not rupture in less than 24 hours when maintained at  $1500 \pm 3^{\circ}\text{F}$  ( $816 \pm 2^{\circ}\text{C}$ ) while an axial load of 24 000 psi (165.5 MPa) is continuously applied.
- After 48 hours, the load should be increased by 5000 psi (34.5 MPa) every 24 hours until failure occurs in the specimen.
- The elongation after rupture, measured at room temperature, should not be less than 10% (in 3 to 4D). If the time to rupture exceeds 48 hours, the elongation should be not less than 6%.



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4.3 Physical properties.

4.3.1 Grain size. Unless otherwise specified on the engineering drawing, the grain size should conform to the requirements specified herein. The casting should be 100% macroetched by methods and procedures mutually agreed upon between the procuring activity and supplier. The grain size should be generally equiaxed and uniform throughout the entire part and should not exceed 0.187 inches (in.) (4.75 millimeters (mm)) in any direction.

4.3.2 Surface oxides. Surface oxides should be permitted provided the depth of penetration does not exceed 0.0010 in. (0.025 mm). Isolated areas of this condition are permitted to a depth of 0.0020 in. (0.050 mm). Castings with excessive penetration may be chemically or mechanically cleaned and provided engineering drawing tolerances can be maintained.

4.4 Character or quality.

4.4.1 Condition. Unless otherwise specified, castings should be delivered in the solution heat treated condition, clean and free of investment and core materials. Cleaning should be performed by sandblasting or other methods approved by the procuring activity.

4.4.2 Quality. Castings should meet all the requirements of the specification and be uniform in quality and condition, sound and free from foreign materials, internal and external imperfections in excess of those permitted by this specification or detrimental to the fabrication or performance of parts.

4.5 Casting.

4.5.1 Master heat. Castings should be produced from remelted master heat metal or directly from a master heat.

4.5.2 Casting control. The establishment of the refining, pouring, and mold temperature should be accomplished after determining what is necessary for satisfactory mold filling, soundness, grain size control and mechanical properties.

4.5.3 Heat treatment. The casting should be solution heat treated as follows:

- a. Heat parts to 2100  $\pm$ 25°F (1149  $\pm$ 14°C).
- b. Hold at heat for 30 to 60 minutes.
- c. Water quench or rapid air cool.

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4.6 Identification and marking. Unless otherwise specified on the drawing, each casting should be marked in accordance with SAE AS478, method 6A or 30, as follows:

- a. Each casting should contain the drawing number and revision letter, casting lot number and the casting supplier's identification (trademark, symbol, etc.). The symbols should be marked in the location specified on the drawing number using marking method 6A.
- b. Castings acceptable by fluorescent penetrant, radiographic, and grain size inspection should be identified using an approved symbol and marking method 30.

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### 5. NOTES

5.1 Intended use. This material is primarily for parts requiring strength at high temperature up to 1500°F (816°C) and oxidation resistance up to 2000°F (1093°C).

5.2 Historical data. MIL-C-62624(AT), superseding AVCO Lycoming specification M3504C, is hereby cancelled; however, the technical information from this specification has been preserved in MIL-HDBK-62624. This handbook is for guidance only and should not be cited as a requirement, but information in the handbook may be useful in determining or evaluating requirements.

#### 5.3 Subject term (key word) listing.

Chemical composition

Grain size

Heat treatment

Oxides

Stress

Tensile

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CONCLUDING MATERIAL

Custodian:  
Army - AT

Preparing Activity:  
Army - AT  
  
(Project MECA-0582)

## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

### INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

<b>I RECOMMEND A CHANGE:</b>	1. DOCUMENT NUMBER <b>MIL-HDBK-62624(AT)</b>	2. DOCUMENT DATE (YYMMDD) <b>980127</b>
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### 3. DOCUMENT TITLE

**COBALT BASE ALLOY INVESTMENT CASTINGS**

### 4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

### 5. REASON FOR RECOMMENDATION

### 6. SUBMITTER

a. NAME <i>(Last, First, Middle Initial)</i>	b. ORGANIZATION	
c. ADDRESS <i>(Include Zip Code)</i>	d. TELEPHONE <i>(Include Area Code)</i> (1) Commercial (2) AUTOVON <i>(If applicable)</i>	7. DATE SUBMITTED (YYMMDD)

### 8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE <i>(Include Area Code)</i> (1) Commercial (810) 574-8745 (2) AUTOVON 786-8745	
c. ADDRESS <i>(Include Zip Code)</i> Commander U.S. Army Tank-automotive and Armaments Command ATTN: AMSTA-TR-E/BLUE Warren, MI 48397-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403 Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	