

### 1.0 SCOPE

This specification covers a carburizing operation to be performed prior to a reheat and quench operation for hardening.

### 2.0 APPLICATION

This heat treatment is applicable to parts that require a uniform carburized case and which are subsequently reheated and quenched to obtain required properties of hardness and strength.

### 3.0 QUALIFYING SPECIFICATION

1E2617 General Requirements - Heat Treat

### 4.0 PROCESSING REQUIREMENTS

#### 4.1 Machine Operations

**4.1.1** All machining operations including grinding shall be performed before carburizing and hardening, unless stock removal after hardening is permitted or required on the drawing. The only permissible exception is CBN grinding of gear tooth profiles. CBN grinding of gear profiles is allowed provided that:

**4.1.1.1** The CBN process is controlled to eliminate grinding burns.

**4.1.1.2** The specified surface carbon, surface hardness, hardened depths, and microstructure are attained. To ensure attainment of required hardened depths after grinding, the carburize depth may be increased up to the amount of stock removal permitted. See gear cutter specification.

**4.1.2** CBN grinding is not permitted after heat treatment on gears in which the actual hardened depth is less than 0.7 mm, and cannot be used as a salvage operation without approval from Engineering Design Control P418.

#### 4.2 Heat Treating Operations

**4.2.1** Carburize at a temperature not exceeding grain coarsening temperature of the material. For gears, the maximum carburizing temperature is 1050°C.

**4.2.2** Cool to below the  $A_{r1}$  temperature in a protective atmosphere to prevent decarburization and at a rate that minimizes the formation of a carbide network. A carbide network that is readily soluble when austenitized is acceptable.

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STANDARD CARBURIZE

DATE  
18 FEB 2010


CHG NO  
08

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1E2204

### 5.0 QUALITY REQUIREMENTS

#### 5.1 Control of Heat Treat Special Process Characteristics

**5.1.1** These requirements apply only when tighter control of heat treat process parameters beyond normal heat treat process controls are required by a 1E2966 Special Characteristics

note  on the part drawing.

#### 5.1.2 Special Process Requirements

**5.1.2.1** Temperature control throughout the furnace workspace shall be checked when furnace is placed in service, after major overhauls, or at a frequency specifically requested by the customer. Temperature uniformity throughout the furnace part workspace shall be within  $\pm 5^{\circ}\text{C}$ .

**5.1.2.2** Thermocouples and temperature controllers shall be checked, managed and results recorded in accordance with ME1004 and MQ1010-90.

**5.1.2.3** Furnaces shall be equipped with atmosphere composition- and carbon potential control systems capable of maintaining carbon potentials within  $\pm 0.1$  wt.% C in the furnace atmosphere. For control systems utilizing oxygen probe control only, accuracy should be checked with shim stocks per ME1033 at least once a week at each normal operating temperature/atmosphere setpoint. For control systems utilizing oxygen probe and infrared CO/CO<sub>2</sub> control, it is sufficient to check accuracy with shim stocks monthly. Records for each furnace shall be kept by Heat Treat Manufacturing. Control or supervisory system calculated atmosphere levels shall not be substituted for shim stock checking.

**5.1.2.4** When new equipment is placed in service, after major overhauls, or at a frequency specifically requested by the customer, the atmosphere uniformity shall be determined by 1) running either test pieces or piece parts throughout furnace workspace, and 2) analyzing for proper surface carbon levels and microstructure.

**5.1.2.5** A hardened depth test piece, ME1019 fracture bar or piece part (which can be destructively analyzed) shall be run with each load on batch type furnaces. On continuous furnaces, test pieces shall be run at least daily or any time cycle times are changed. The depth shall be within production process limits established by Heat Treat Engineering. The use of control system 'calculated depth' shall not be a substituted for the actual test pieces, but with customer approval, the frequency of test piece checks may be modified if 'calculated depth' control systems are employed.

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### 6.0 SUBSIDIARY SPECIFICATIONS (FOR CATERPILLAR REFERENCE ONLY)

6.1 At the time of release of 1E2204, Change 08, the following subsidiary versions of 1E2204 were in use by Caterpillar Facilities outside of the United States:

Caterpillar Materiels Routiers S.A. (Rantigny)	"H" Version
Caterpillar Brazil Ltda. (Piracicaba)	"G" Version
Caterpillar France S.A. (Grenoble)	"H" Version
Caterpillar Japan Ltd.(Sagami)	"X" Version
Caterpillar Japan Ltd. (Akashi)	"X" Version

Figure 1

6.2 Subsidiary versions may be changed, released, or canceled without a change to this version of 1E2204. The Engineering Data System (EDS) provides information on the status of subsidiary version specifications and should be referenced for current information.

### 7.0 REFERENCES

Caterpillar Specification	1E2966
Caterpillar Manufacturing Practices	ME1004, ME1019, MG1010-90

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