P.T. Outer Shaft

Engine Application(s):		250-C28B, C28C 250-C30, C30G, C30G/2, C30M, C30P, C30S
Subject:		Inspection and Rework Procedures for the E23038136 Power Turbine Outer Shaft.
Compliance:		Any time the PT Outer Shaft is removed for overhaul. Refer to the following Tables and Figures for inspection and Rework Procedures. Table 1: Inspection and Rework Limits Table 2: Additional Inspection Requirements and Re-tempering Procedure Table 3: Turbine Bearing Fit Limits Figure 1: Visual Inspection and FPI Limits and Curvic Couplings Figure 2: PT Outer Shaft Corrosion Pitting Inspection and Repair.
Notes:		Refer to OEM's published data for installation, engine operation and disassembly.
Revisions:	N/C	Dated: 9/22/97 Initial release.
	A	Dated: 1/29/01 Updated format.
	B	Dated: 9/03/09 Updated EXTEX to TIMKEN.
	C	Dated: 2/04/16 Updated Timken to EXTEX Engineered Products.

E23038136
Power Turbine Outer Shaft
Inspection and Rework Limits

Condition	Service Limit	Repair Limit	Corrective Action
Cracks, visual and MPI*	Cracks are not acceptable.	No Repair.	Replace.
Imperfections in the Curvic Coupling (Visual & FPI)	See Figure 1.	No Repair.	Replace.
Bearing Journal Wear	See Table 3.		Restore by re-plating.
Loss of Alseal coating.	See Figure 2.		Apply Alseal coating.
Internal Spline Wear	Max. 0.002 inch. Max over pin diameter (measured in two places): 1.1795 inch over 0.054 inch pins **** See Note Below**		Replace.
Spline Tooth Damage: chips, nicks, grooves, gouges, spalled areas, etc.	Spline tooth damage is not acceptable.	No Repair.	Replace.
Scuffing Wear on the Outside Diameter	Scuffing wear is not acceptable.	Min. wall thickness: 0.070 in.	Blend worn area removing minimum material **OR -** Replace Shaft.
Corrosion Pitting on ID or OD of 1.550/1.530 inch diameter* (Ref Figure 3)**	Corrosion pitting is not acceptable.	Min. wall thickness: 0.070 in.	Blend pitted area removing minimum material **OR -** Replace Shaft.
Corrosion Pitting in the 0.690-0.630 in. area next to Curvic Coupling* (cont.) (Ref Figure 3)**	Max pit depth in spherical dimples: 0.005 inch Max pit depth elsewhere: 0.010 inch.	No repair limit providing material removed is less than: A) 0.005 inch in spherical dimples B) 0.010 inch elsewhere.	Blend pitted area removing minimum material **OR** - Replace Shaft.
Burrs or wear on rotating mating ring seal shoulder	Shoulder FIR to A-A Axis within 0.0002 inch.	No Repair.	Repair or Replace.

NOTES:

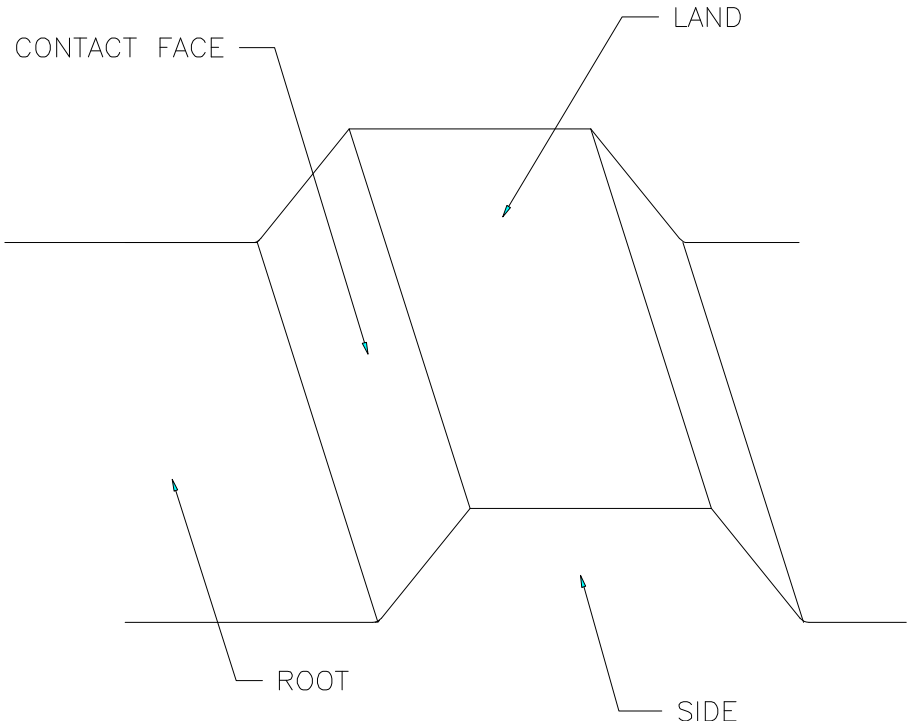
* MPI technique as follows: A) Circular between heads
AND
B) Longitudinal in a coil.

** Check spline wear using both scribe method and over pin method. Use a sharp pointed scribe, 0.020 inch radius, to detect a wear step. If it can be felt with the scribe, it is larger than 0.001 inch, which is over the service limit.

*** Use a sharp scribe, 0.030 inch radius, to detect corrosion pit 0.006 inch or larger.

TABLE 1

E23038136
Power Turbine Outer Shaft
Visual Inspection and FPI
Limits of Curvic Couplings



FPI	MAX SIZE	MIN SEPARATION	LIMITATIONS
INDIVIDUAL INDICATIONS	0.020 INCH	2X	NOT OVER EDGE
CLUSTER INDICATIONS	NONE PERMITTED		

VISUAL (INSPECT WITH 10x MAGNIFICATION OR GREATER.)

POSITIVE IMPERFECTION:

NONE ALLOWED ON CONTACT FACE, ROOT, LAND (SEE ILLUSTRATION). FOLLOW REWORK PROCEDURES FOR HIGH METAL REMOVAL. 0.010 IN. IS ALLOWED ON SIDES IF IMPERFECTION IS SMOOTH AND ADHERENT.

NEGATIVE IMPERFECTION:

CONTACT FACE, SIDES AND LANDS - 0.020 IN. DEEP OR LESS ON NO MORE THAN 25% OF THE SURFACE AREA ON NO MORE THAN SIX TEETH.

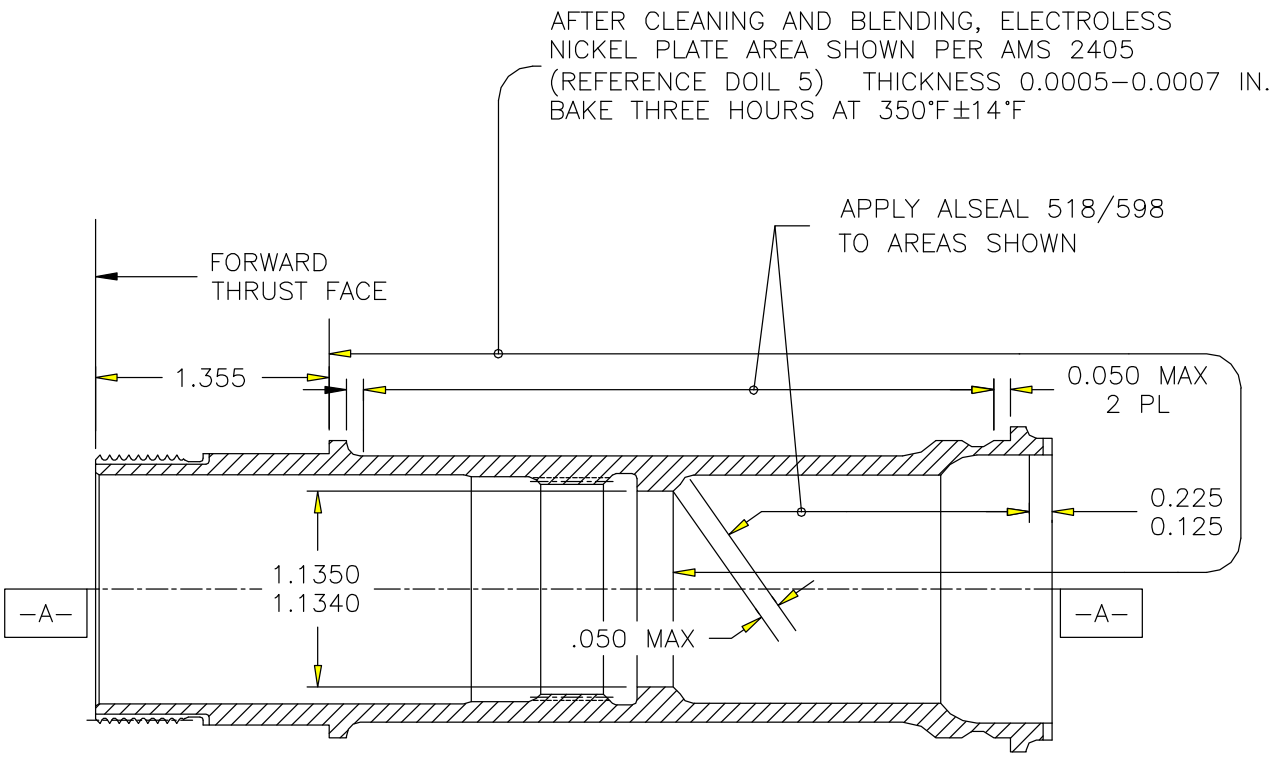
SIDES AND LANDS-0.005 IN. DEEP OR LESS ON MORE THAN 25% OF THE SURFACE AREA ON ANY NUMBER OF TEETH.

ROOT:

NONE ALLOWED.

FIGURE 1

E23038136
Power Turbine Outer Shaft
Inspection & Repair



DIMENSIONS ARE IN INCHES.

FIGURE 2

E23038136
Power Turbine Outer Shaft
Additional Inspection Requirements
and Re-tempering Procedures

1.0 The following procedure is to be used at time of overhaul to inspect the power turbine shaft for re-hardening and/or tempering.

a. Surface Preparation

(1) Remove Alseal coating by soaking the part in a caustic solution of potash.

WARNING

When mixing the caustic solution, wear protective gloves, apron and safety glasses. Add the caustic potash to the water. Never add water to the caustic pot ash or solution. To do so could result in the caustic pot ash or solution boiling over violently.

(a) Add two pounds of potash to one gallon of water. (0.907 kg potash to 3.8 liters of water.)
(b) Stir material well until all is mixed.
(c) Soak the part in the solution for one hour at 125°F (79°C). Rinse with clear water.
(d) After rinsing, remove the residue by glass bead peening at 20 psi (138 kPa).

(2) Remove the nickel coating by immersing the clean dry shaft into concentrated nitric acid. Rinse thoroughly in clear running water for 30 to 60 seconds. Immerse in clean hot water, 160°F (71°C) minimum, for at least 10 seconds, then dry.

b. Etch the Power Turbine Shaft as follows:

Step	Process	Solution	Time	Temp.	Remarks
1	Nitric acid etch	Nitric acid 3-5% (by volume) in alcohol or Nitric acid 3-5% (by volume) in water.	3 min. max.	Ambient	Agitate parts when immersed. Exact time may vary to produce desired black oxide film.
2	Rinse	Circulating water	Rinse only	40°-80°F (4°-26.6°C)	To remove acid, total immersion is required.
3	Hydrochloric acid drip	Hydrochloric acid 4%-6% (by volume in alcohol or water)	30-60 seconds	Ambient	Agitate parts when immersed to remove black oxide film and provide uniform brownish-gray surface.
4	Rinse	Running water	Rinse only	60°-80°F (4°-26.6°C)	Agitate parts when immersed.
5	Neutralize	Any alkali solution, pH of 10 minimum	15 seconds minimum	60°-180°F (15.5°-82.2°C)	Agitate parts when immersed.

TABLE 2 (Sheet 1 of 2)

Step	Process	Solution	Time	Temp.	Remarks
6	Rinse	Circulating Water	Rinse only	40°-80°F (4.4°-26.6°C)	To remove caustic.
7	Rinse	Alcohol	Rinse only	Ambient	To remove water.
8	Oil	Rust preventative oil	Dip only	Ambient	To prevent corrosion and aid to color contrast of burns.
9	Inspect and Evaluate				Inspect and evaluate per appropriate criteria within 15 minutes.

TABLE 2 (Sheet 2 of 2)

c. Interpretation of Results
(1) Parts showing no evidence of tempering/re-hardening will be straw to gray color and are acceptable.
(2) Tempered areas will acquire a dark coloration and are acceptable.
(3) If overheating has been extreme, a light colored area surrounded by a dark area will appear. These parts shall either be rejected or tempered and returned to service.

NOTE: The etch inspection cannot be used to inspect shafts that have been tempered because the grain structure of the re-hardened zone will still be evident.

3.0 The following procedure is to be used to temper any shaft that has been rejected because localized circumferential rub has caused re-hardening.
a. The tempering cycle should be 1050° ± 25°F (566°± 14°C) for two hours in an inert atmosphere with a dewpoint of -60°F (-51°C) or below. Cool at a rate equivalent to air cooling. Parts must be properly supported to prevent distortion and permit uniform heating.
b. After each tempering, etch T symbol on the area with the part number and serial number.
c. Tempering will be allowed three times on any shaft.

4.0 Oil which leaks past the seal between the inner and outer power turbine shafts will form an acid which, with time and temperature will corrode the power turbine shaft material. Corrosion pitting is permitted on the surfaces per inspection and repair instructions.
Inspection and Repair:

OD Surfaces: Blend smooth to remove all pits and corrosion. Maximum metal removal limits to 0.010 in. depth.

ID Surfaces: Blend smooth to remove all pits and corrosion. Metal removal limited to
Minimum wall thickness of 0.070 in. except 0.030 in. minimum at scallops.

Curvic Teeth: Clean to remove all oxides, no blending permitted. Pits to 0.010 in. over
not more than 10% of surface area acceptable.

5.0 Apply electroless nickel plating, as shown in Figure 2, to the shafts that have passed the inspection criteria and are considered serviceable.

6.0 Apply Alseal 518/598 coating over the electroless nickel plating in areas shown in Figure 2 except for:
a. Base coat shall be 0.002-0.004 inch thick (two layers 0.001-0.002 inch).

b. Prior to application of top coat, burnish base coat using 00 grade steel wool or lightly aluminum oxide grit blast until a reading of 0.25-3.0 ohms is obtained when the probes of an ohmmeter are lightly held 1.00 in apart.
c. Top coat thickness shall be 0.0001 in. minimum.
d. No requirements are established for coating thickness for deep recesses in which controlled coating thickness cannot be obtained under normal application technique.

NOTES: Scratches on the outer shaft that occur during disassembly and assembly are acceptable if:
(1) Scratched area is less than 5% of the coated area.
(2) Maximum scratch is 0.040 X 0.750 in.
(3) Nickel plating is not damaged under the scratch. The Alseal coating is sacrificial so any uncoated area of a limited size will be protected by the coating on adjacent surfaces.

NOTES: Scratches on the coated safety flange are acceptable if:
(1) Within the optional Alseal coating area. The optional Alseal coating area is defined as between the forward edge and the middle of the locking dimples on the safety flange.
(2) Nickel plating under the scratch is not damaged.

E23038136
Power Turbine Outer Shaft
Bearing Journal Fit Limit

	Serviceable	Nominal	Corrective Action
Shaft OD	1.5748 "	1.5748"-1.5753"	Plate Gearshaft Bearing Journal

TABLE 3