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ENGINEERING

TEST INSTRUCTIONS

ELECTRO-MOTIVE DIVISION
General Motors Corporation
LaGrange, Illinois

NUMBER
506

FIRST ISSUED
January 17, 1975

SUPERSEDES

SUBJECT	Quality Control Of Critical Fasteners Purchased By The GM Locomotive Group
AFFECTS MODELS	All
PART NOS AFFECTED	See Pages 5, 6, 7 & 8 of this Instruction
REF. DRAWINGS	

I. DEFINITION

A "critical fastener" is a part, the failure of which could affect the performance of vital components and systems and/or could result in major repair expense or safety hazard. This ETI is intended to supplement, not supersede, requirements stipulated by engineering drawings, military/industry specification sheets and purchase orders.

II. GENERAL REQUIREMENTS

- A. This ETI classifies defects for critical fasteners and establishes minimum engineering acceptance standards for qualification of shipments of critical fasteners.
- B. Critical fasteners are identified by reference to ETI 506 on drawings and the attached list of part numbers.
- C. ANSI Standards B1.1, B1.2 and B1.3, as incorporated into Federal Standard Handbook H28/2, shall be used in conjunction with this ETI for fastener specifications, gaging and gaging systems. (Reference GM Standards 11/84, Page X-1.101.)

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ETI 506
Quality Control of Critical Fasteners Purchased by the GM Locomotive Group

- D. Per the above ANSI standards, the gaging system to be employed shall be: "**SYSTEM 22**" (Reference GM Standards 11/84, Page X-1.101). This is the level of inspection deemed necessary to verify that dimension conformance has been achieved.
- E. A **lot** is defined as a quantity of one part number manufactured from a **single heat** number, processed together continuously and consecutively through all operations. Each container must be clearly identified with its respective **lot** number.
- F. A **shipment** may consist of one or more lot numbers, comprised of one or more **heat** numbers. Metallurgical certification (see Section VI.F) is required from the supplier for each heat number associated with each lot.
- G. Grades of classification will be listed on the print. They will be SAE Grade 8 (GM300/GM301) or Grade 5 (GM280/GM286).

III. CRITICAL DEFECTS

Critical Defects shall be defined as follows:

- A. Any deviation from the specified mechanical and chemical composition requirements.
- B. Any deviation from hardness specifications.
- C. Cracks, seams or folds beyond allowable limits. (Reference GM6102 for Bolts/Screws and GM6103 for Nuts.)
- D. Nicks and gouges that cause a fastener to exceed its maximum torque equivalent during the "GO" gauge interference check. Maximum torque equivalent is defined as 13.5 in.lbs. times the nominal diameter (D) of the fastener.
- E. Any deviation from maximum torque equivalent (as defined above) on "torque-type" fasteners. "Torque-type" fasteners are those which make use of non-metallic inserts to increase thread friction.
- F. The normal non-destructive sampling Acceptance Quality Level (AQL) is set by the IQA Department within their Inspection Instruction.

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IV. MAJOR DEFECTS

A. The following shall be considered “major defects” when they do not meet the specified requirements:

<u>Bolts & Studs</u>	<u>Nuts</u>	<u>Washers</u>
Pitch Diameter	Pitch Diameter	Surface parallelism
Major Diameter	Major Diameter	Hole Location
Minor Diameter	Minor Diameter	Surface Finish
2D Thread Lead Error	2D Thread Lead Error	Platings & Coatings
Root Radius	Root Radius	
Thread Concentricity About bolt axis	Bearing Surface Dimensions	
Thread Length	Bearings Surface Angularity	
Radius Under Head	Thread Quality	
Overall Length	Platings & Coatings	
Bearing Surface Dimensions		
Bearing Surface Angularity		
Fasteners Bow		
Thread Quality		
Platings & Coatings		

NOTE: Exceptions to this list may be specified on drawings.

B. The normal non-destructive sampling AQL shall be set by IQA within their Inspection Instruction.

V. MINOR DEFECTS

- A. All other defects not classified as critical or major are to be considered “minor defects.”
- B. The normal non-destructive sampling AQL shall be set by IQA within their Inspection Instruction.

VI. ACCEPTANCE CRITERIA

A. Incoming Quality Assurance will qualify all critical fasteners using the sampling plan “C = 0” or “zero defects” (see the sampling table attached at the end of this ETI). An exception will occur with destructive test items; at this occurrence, a minimum quantity of inspected bolts will required on the Inspection Instruction.

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- B. Any defects found are cause for rejection for part or all of shipment. The final disposition will be made by Quality Assurance and Product Engineering. The decision to accept a discrepant lot will be documented in the lot record with the name of the engineer authorizing acceptance *and* with a Materials Engineering Lab report or with a Discrepancy Approval form (reference EMD standard procedure manual, procedure No. 305)
- C. Hardness checks are performed using one of four methods:
1. Threaded end of bolt.
 2. Unthreaded shank of bolt.
 3. On the side of the hex flats.
 4. Transverse cross-section of the bolt.
- NOTE: Method #4 shall be used as a reference for resolving any questionable differences in hardness readings.
- D. All requirement of GM's Targets for Excellence (TFE) (General Procedure No. 5, GM1738) must be met.
- E. All rejections will be processed using TFE's "GP5" Problem Reporting/Resolution procedures using form No. GM1376.
- F. Test reports are required for all shipments of fasteners supplied completely finished to Engineering drawing requirements. The reports shall contain the following information: Heat number, Chemical composition, Hardness and Tensile strength. Also desirable are the Proof-load and/or yield strength. In cases where more than one heat is contained in a shipment, the required information must be provided for *each* heat number.

VII. REJECTED HEAT NUMBERS

- A. Heat numbers previously rejected to a supplier and reworked must be certified by the supplier as being satisfactorily reprocessed and reinspected to conform to requirements, before resubmitting any lots of the rejected heat number.
- B. Each returned shipping carton must be identified as part of a reprocessed/resubmitted material with its respective lot and heat numbers.
- C. Material from rejected heat numbers (resubmitted/reprocessed) must also be identified with dates of the previous rejections attached to the sampling documentation.
- D. The TFE "PR/R" procedure is to be followed. This requires the supplier to provide analysis of the nonconformance (root cause analysis) with corrective action measures to prevent recurrence.

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CRITICAL FASTENERS PURCHASED BY EMD

<u>Location</u>	<u>Fastener</u>	<u>P/N</u>	
Head-to Liner	Stud	8411641	
		8411642	
		8411643	
		8413916	
		8413917	
	Stud-Pilot	8413918	
		8411644	
		8411645	
		8411646	
		8413919	
		8413920	
		8413921	
		8411776	
	Stud	8411780	
		8411781	
		8411782	
		8411783	
		8411784	
	Stud-Pilot	8411777	
		8411785	
		8411786	
		8411787	
		8411788	
		8411789	
	Stud-Pilot	9547846	
		9547847	
		9547848	
		9547849	
		9547850	
Piston Pin to Rod	Stud	9547851	
	Stud-Pilot	8172730	
	Nut	8173814	
	Washer	8060089	
		8140912	
	Piston Pin to Rod	Bolt/Spacer Asm	8159340
	Rod to Basket	Bolt/Washer Asm	8127868
Basket Splitline	Bolt	8259128	
	Nut	8487883	
	Washer-Hardened	8260114	

CRITICAL FASTENERS PURCHASED BY EMD

ETI 506
Quality Control of Critical Fasteners Purchased by the GM Locomotive Group

<u>Location</u>	<u>Fastener</u>	<u>P/N</u>	
Main Bearing Cap to Crankcase	D Nut	8213064	
	Washer-Hardened	8412532	
	Nut	8408684	
	Stud	8271449	
	Stud	8473541	
	Stud	9541582	
	Stud	9541583	
	Bolt	40056030	
	Bolt	40085897	(K)
Handhole Cover	Bolt	8481901	
Exhaust Manifold	Bolt/Washer Asm	9318052	
	Bolt/Washer Asm	8460207	
Spring Drive Gear	Bolt	8419063	
	Bolt	8314057	
	Bolt	8358566	
	Bolt	9513657	
Idler Stubshaft	Bolt	8358580	
	Bolt	8358567	
Carrier Bearing Support	Bolt	8358581	
Oil Jumper	Bolt	8358572	
Camshaft Stubshaft	Bolt	8266361	
Bearing Bracket-8 cyl	Bolt	8499216	
	Bolt	8266424	
	Bolt	8499156	
Engine Lifting Shackles	Bolt	40019577	(272580)
	Bolt		9096320
	Bolt		9096428
Crab System	Washer		9319172
	Nut		9571494
	Nut		8155104
	Bolt		9085894
	Bolt		40028826
Turbo External Clutch	Bolt		9584413

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ETI 506
Quality Control of Critical Fasteners Purchased by the GM Locomotive Group

<u>Location</u>	<u>Fastener</u>	<u>P/N</u>
High Temperature Turbo Applications	Bolt	8358566
	Bolt	8366279
	Bolt	9535701
	Bolt	40019578 (186609)
	Bolt	40020156 (186725)
	Bolt	40019579 (442734)
	Bolt	40019580 (9430216)
	Bolt	40019581 (186622)
	Bolt	40019582 (186628)
	Bolt	40019583 (427572)
Fuel Tank Mounting	Bolt	40019584 (9431632)
	Bolt	40019585 (9424184)
	Bolt	40019586 (9433372)
	Bolt	40019587 (9427520)
Cooling Fan	Bolt	40019588 (223516)
	Bolt	40019589 (223517)
	Bolt	40019590 (223518)
Commutator	Bolt	8136504
	Bolt	8173528
	Bolt	8300056
Gen./Alt. Rotor Pole	Bolt	8266137
	Bolt	8266138
	Bolt	8350867
	Bolt	8364479
	Bolt	9320400
	Bolt	40053930
	Bolt	40053884
Traction Motor Axle Cap	Bolt	9095753
	Bolt	9572880
Exhaust Silencer	Bolt	9531636
Roller Support Brg Hsg	Bolt	40037899
	Bolt	40053300

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H ENGINE CRITICAL FASTENERS

<u>Location</u>	<u>Fastener</u>	<u>P/N</u>
Main Bearing	Stud-Main Bearing	40065918
Bearing Cap	BoltM30x3.5 Hex Hd	40072070
Bearing Cap	BoltM30x3.5 Hex Hd	40072071
C/Shaft Damp-Gear-Asm	Bolt-M42-4.5-6g 12Pt	40064566
C/Shaft Damp-Gear-Asm	Bolt-M20-2.5 12Pt	40062216
Cyl Head	Stud-Cyl Head	40076429
Head Liner	Bolt-M20x1.5 Hex	40060892
Head Liner	Washer-M20	11511519
Piston Crown	Stud M12-Piston Crown	40061335
Con Rod	Nut M22 Hex	40061095
Con Rod	Washer-M22 Flat	40063166
Power Pack	Bolt-M20x2.5x300 Hex	40061694
Lube Oil Sys	Bolt M10 12Pt Spcl	40071148
Main Bearing Cap		
Cross Bolt	Washer-Special	40066671

H-TURBO CRITICAL FASTENERS

<u>Location</u>	<u>Fastener</u>	<u>P/N</u>
Turbo Asm	Bolt M10 12Pt Spcl	40070088
Turbo Asm	Bolt M6 12Pt Spcl	40070089
Turbo Whl/Imp Bal Asm	Screw M6x1x40 HS Cap	40077201
Turbo Whl/Imp Bal Asm	Bolt M16x2.00 Hex	40086826
Turbo Whl/Imp Bal Asm	Nut M20x1.5 Spcl	40062473
Turbo Whl/Imp Bal Asm	Washer Spcl	40062472

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C=0 SAMPLING PLANS
INDEX VALUES
(ASSOCIATED AQLS)

LOT SIZE	.010	.015	.025	.040	.065	.10	.15	.25	.40	.65	1.0	1.5	2.5	4.0	6.5	10.0
	SAMPLE SIZE															
2 to 8	*	*	*	*	*	*	*	*	*	*	*	*	5	3	2	2
9 to 15	*	*	*	*	*	*	*	*	*	*	13	8	5	3	2	2
16 to 25	*	*	*	*	*	*	*	*	*	20	13	8	5	3	3	2
26 to 50	*	*	*	*	*	*	*	*	32	20	13	8	5	5	5	3
51 to 90	*	*	*	*	*	*	80	50	32	20	13	8	7	6	5	4
91 to 150	*	*	*	*	*	125	80	50	32	20	13	12	11	7	6	5
151 to 280	*	*	*	*	200	125	80	50	32	20	20	19	13	10	7	6
281 to 500	*	*	*	315	200	125	80	50	48	47	29	21	16	11	9	7
501 to 1,200	*	800	500	315	200	125	80	75	73	47	34	27	19	15	11	8
1,201 to 3,200	1250	80	500	315	200	125	120	116	73	53	42	35	23	18	13	9
3,201 to 10,000	1250	800	500	315	200	192	189	116	86	68	50	38	29	22	15	9
10,001 to 35,000	1250	800	500	315	300	294	189	135	108	77	60	46	35	29	15	9
35,001 to 150,000	1250	800	500	490	476	294	218	170	123	96	74	56	40	29	15	9
150,001 to 500,000	1250	800	750	715	476	345	270	200	156	119	90	64	40	29	15	9
500,001 and over	1250	1200	1112	715	556	435	303	244	189	143	102	64	40	29	15	9

*Indicates entire lot must be Inspected!
NOTE: The Acceptance Number in all cases is ZERO

TABLE NO. 1.

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