QUALITY ASSURANCE PROVISIONS (QAP)

(PRODUCT ASSURANCE PAM 702-155)

1. COMMAND AGENCY: U. S. ARMY TANK AUTOMOTIVE RESEARCH, DEVELOPMENT & ENGINEERING CENTER, WARREN, MI 48397-5000

2. THESE QAPS FORM PART OF DRAWING / SPECIFICATION **10936276 TAB** AS SPECIFIED IN THE CONTRACT. INSPECTION SHALL BE CONDUCTED AS SPECIFIED HEREIN AND IN ACCORDANCE WITH REFERENCED DOCUMENTS. THIS INCLUDES GENERAL QUALITY ASSURANCE PROVISIONS (STA FORM 458), WHICH FORMS A PART OF THIS QAP.

3.

PART I - LIST OF APPLICABLE DOCUMENTS

DRAWINGS

10925486	FORGING
10880051	INVOLUTE GO COMPOSITE RING GAGE
10880052	INVOLUTE TAPERED TOOTH MASTER PLUG
10880053	NOT GO SOLID TYPE SNAP GAGE
10880097	INVOLUTE GO COMPOSITE RING GAGE
10880098	INVOLUTE TAPERED TOOTH MASTER PLUG
10880099	NOT GO SOLID TYPE SNAP GAGE
10880100	DIAL DEPTH AND SET CHUCK
10880101	FLUSH PIN GAGE
10880110	FIXTURE GAGE
10880111	FIXTURE GAGE
10880112	FIXTURE GAGE
12369003	PAINT SYSTEMS FOR STEELS, EXTERIOR SURFACES, GREEN 383

DISTRIBUTION STATEMENT A. APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.

REVISIONS

4. RELEASE NUMBER	BRI - U4355														
5. DATE	3-20-02														
4. RELEASE NUMBER															
5. DATE															
REVISION STATUS OF SHEETS	6. REVISION	J	J	J	H	H	H	H	H						
	7. SHEET	1	2	3	4	5	6	7	8						
	6.REVISION														
	7. SHEET														

8. QAP FOR: SHAFT, FINAL DRIVE	M992A2/M109/A1/A1B/A2/A3/A3B	9. CODE	19207
10. SUBMITTED BY: BARNES & REINECKE, INC.		11. QAP NO.	10936276
12. DATE 3-25-63	13. APPROVED	14. RELEASE NO. -----	15. PAGE NO. 1 / 16. NO. OF PAGES 8

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PART I - LIST OF APPLICABLE DOCUMENTS (CONTINUED)

STANDARDS

MIL-STD-130	IDENTIFICATION MARKING OF U.S. MILITARY PROPERTY
ASTM E1444	STANDARD PRACTICE FOR MAGNETIC PARTICLE EXAMINATION

SPECIFICATIONS

MIL-S-46172	STEEL FORGINGS

PART II - INSPECTION REQUIREMENTS

TABLE I - CLASSIFICATION OF QUALITY CONFORMANCE CHARACTERISTICS

CLASS	CHARACTERISTIC	INSPECTION METHOD
CRITICAL	NONE	
MAJOR	AQL 1.0% DEFECTIVE	
101	EXTERNAL INVOLUTE SPLINE, FLAT ROOT, 26 TEETH, 30° PRESSURE ANGLE, 8/16 DIAMETRAL PITCH	GAGES 10880051, 10880052, 10880053 AND IMC PAGE 7
102	SPLINE MAJOR DIAMETER 3.3500 - .0035	GO SNAP GAGE NO GO SNAP GAGE
103	EXTERNAL INVOLUTE SPLINE, FLAT ROOT, 26 TEETH, 30° PRESSURE ANGLE, 8/16 DIAMETRAL PITCH	GAGES 10880097, 10880098, 10880099 IMC PAGE 8
104	SPLINE MAJOR DIAMETER 7.6293 - .0050	GO SNAP GAGE NO GO SNAP GAGE
105	3.7413 - .0006 SHAFT DIAMETER	DIAL SNAP GAGE
106	4.499 - .001 SHAFT DIAMETER (-B-)	DIAL SNAP GAGE
107	1.781 + .004 DIMENSION	GAGE 10880100 OR DEPTH GAGE
108	CONCENTRICITY AND PERPENDICULARITY REQUIREMENTS (A) 3.7413 DIAMETER CONCENTRIC TO DATUM -B- WITHIN .002	GAGE 10880111

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PART II - INSPECTION REQUIREMENTS

TABLE I - CLASSIFICATION OF QUALITY CONFORMANCE CHARACTERISTICS (CONTINUED)

CLASS	CHARACTERISTIC	INSPECTION METHOD
MAJOR		
	(B) SPLINE PITCH DIAMETER (-D-) CONCENTRIC TO DATUM -B- WITHIN .002	
	(C) SPLINE PITCH DIAMETER (-E-) CONCENTRIC TO DATUM -B- WITHIN .002	
	(D) SPLINE PITCH DIAMETER (-E-) PERPENDICULAR TO DATUM -C- WITHIN .002	
	(E) INDICATED SURFACE PERPENDICULAR TO DATUM -B- WITHIN .002	
	(F) -C- SURFACE PERPENDICULAR TO DATUM -B- WITHIN .002	
109	FUNCTIONAL FIT OF 45 TEETH SPLINE AND 4.499 PILOT DIAMETER	GAGE 10880012
110	2.625-12N-2A THREAD SHAFT MAJOR DIA. 2.6250.0012 PITCH DIA. 2.5709-.0083	GO THREAD RING GAGE NO GO THREAD RING GAGE
111	CENTERLINE OF .750-16UNF-2B THREAD HOLE SYMMETRICAL TO INDICATED SPLINE TOOTH DATUM -A- WITHIN .010	GAGE 10880010
112	.005 POSITIONAL TOLERANCE OF (8) THREAD HOLES (PITCH DIAMETER) TO DATUMS -D- AND -E-	DIAL INDICATOR WITH STAND, V-BLOCK SURFACE PLATE, OR CMM
113	.002 PERPENDICULARITY OF (8) THREAD HOLES (PITCH DIAMETER) TO DATUM -C-	DIAL INDICATOR WITH STAND, V-BLOCK SURFACE PLATE, OR CMM
114	.010 POSITIONAL TOLERANCE OF 21/64 DIAMETER (3) HOLES ON A 5.00 DBC	DIAL INDICATOR WITH STAND, V-BLOCK SURFACE PLATE, OR CMM
115	.250 + .003 DIAMETER HOLE	DIAL BORE GAGE

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PART II - INSPECTION REQUIREMENTS (CONTINUED)

TABLE I - CLASSIFICATION OF QUALITY CONFORMANCE CHARACTERISTICS (CONTINUED)

CLASS	CHARACTERISTIC	INSPECTION METHOD
MAJOR		
116	LOCATION OF .250 DIAMETER HOLE	DIAL INDICATOR WITH STAND, V-BLOCK SURFACE PLATE, OR CMM
117	HARDNESS BH 363-415	HARDNESS TESTER
118	HARDNESS HB 261 MIN. (TEETH ONLY)	HARDNESS TESTER
119	PAINT APPLICATION - COVERAGE - COLOR - THICKNESS - WORKMANSHIP (NOTES 3 & 4)	VISUAL AND THICKNESS GAGE
MINOR	**AQL 2.5% DEFECTIVE**	
201	.750-16UNF-2B THREAD (8) HOLES	GO THREAD PLUG GAGE NO GO THREAD PLUG GAGE
202	4.256 - .008 DIAMETER SHAFT	GO SNAP GAGE NO GO SNAP GAGE
203	2.005 - .010 DIMENSION	GAGE 10880110
204	1.750 - .010 DIMENSION	LENGTH GAGE
205	.297 + .010 DIAMETER (2) HOLES - 4 PLACES	GO PIN GAGE NO GO PIN GAGE
206	21/64 + 1/64 DIAMETER (3) HOLES	GO PIN GAGE NO GO PIN GAGE
207	2.157 - .010 DIAMETER SHAFT	GO SNAP GAGE NO GO SNAP GAGE
208	SURFACE TEXTURE "63" - 3 PLACES	COMPARATOR BLOCKS
209	SURFACE TEXTURE "125"	COMPARATOR BLOCKS
210	IDENTIFICATION MARKING (MIL-STD-130)	VISUAL
211	WORKMANSHIP	VISUAL AND TACTILE

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PART II - INSPECTION REQUIREMENTS (CONTINUED)

TABLE II - 100% INSPECTION

1. **MAGNETIC PARTICLE INSPECTION.** AFTER SURFACE HARDENING, EACH FORGING SHALL BE SUBJECTED TO MAGNETIC PARTICLE INSPECTION OVER ITS ENTIRE AREA. FAILURE OF ANY FORGING TO MEET ACCEPTANCE STANDARDS SPECIFIED IN PART IV, PARAGRAPH 1 THROUGH 1.1, TEST METHODS AND PROCEDURES, SHALL BE CAUSE FOR REJECTION.

TABLE III - SPECIAL SAMPLING INSPECTION

1. **PREPRODUCTION INSPECTION.** PRIOR TO INITIAL PRODUCTION APPROVAL, SAMPLE FORGING(S) THAT REPRESENT THE PRODUCTION PROCESSES TO BE USED FOR PRODUCTION FORGINGS SHALL BE SUBJECTED TO EXAMINATION AND TESTS BY THE CONTRACTOR. PREPRODUCTION APPROVAL INSPECTION SHALL INCLUDE VISUAL EXAMINATION, MEASUREMENT FOR DIMENSIONS AND TOLERANCES, CHEMICAL ANALYSIS AND NONDESTRUCTIVE TESTS FOR SOUNDNESS TO DETERMINE CONFORMANCE TO ALL REQUIREMENTS OF DRAWING 10936276 AND MIL-S-46172. NONDESTRUCTIVE TESTS FOR SOUNDNESS SHALL BE BY MAGNETIC PARTICLE INSPECTION AS SPECIFIED IN PART IV, PARA. 1 THROUGH 1.1.

1.1 **MANUFACTURING PROCESS CHANGE.** WHENEVER A CHANGE IS MADE IN THE MANUFACTURING PROCEDURE USED IN PRODUCTION, WHICH MAY AFFECT FIT, FUNCTION, OR SERVICE LIFE OF THE ITEM, THE GOVERNMENT REPRESENTATIVE WILL BE NOTIFIED PRIOR TO THE CHANGE AND ONE OF THE FIRST FIRST ITEMS PRODUCED UNDER THE NEW PROCESS SHALL BE GIVEN A COMPLETE INSPECTION AS SPECIFIED IN PARAGRAPH 1.

1.2 **FAILURE.** FAILURE OF THE PREPRODUCTION SAMPLE TO MEET THE SPECIFIED REQUIREMENTS SHALL BE CAUSE FOR REJECTION. THE CONTRACTOR SHALL PROVIDE OBJECTIVE EVIDENCE TO THE GOVERNMENT WITHIN 20 DAYS AFTER FAILURE, OF EFFECTIVE CORRECTIVE ACTION TAKEN IN PREVENTING RECURRENCE OF FAILURES AND PARAGRAPH 1 SHALL APPLY UNTIL ACCEPTABLE ITEMS ARE PRODUCED.

2. **INITIAL PRODUCTION INSPECTION.** ONE (1) OF THE FIRST ITEMS PRODUCED SHALL BE SELECTED AT RANDOM AND SUBJECTED TO EXAMINATIONS AND TESTS BY THE CONTRACTOR. THE ITEM SHALL BE PRODUCED UNDER MANUFACTURING METHODS TO BE USED IN PRODUCTION. INITIAL PRODUCTION INSPECTION SHALL BE ACCOMPLISHED TO DETERMINE CONFORMANCE TO ALL REQUIREMENTS OF DRAWING 10936276.

2.1 **MANUFACTURING PROCESS CHANGE.** WHENEVER A CHANGE IS MADE IN THE MANUFACTURING PROCEDURE USED IN PRODUCTION, ONE (1) OF THE FIRST ITEMS PRODUCED UNDER THE NEW PROCESS SHALL BE GIVEN A COMPLETE INSPECTION AS SPECIFIED IN PARAGRAPH 2.

2.2 **FAILURE.** FAILURE OF THE ITEM TO MEET INITIAL PRODUCTION APPROVAL REQUIREMENTS SHALL BE CAUSE FOR REJECTION AND PARAGRAPH 2 SHALL APPLY UNTIL ACCEPTABLE ITEMS ARE PRODUCED.

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PART III - CERTIFICATION REQUIREMENTS

NUMBER	CHARACTERISTIC	CERTIFICATION METHOD
401	MATERIAL (MIL-S-46172 OR P/N 10925486) - CHEMICAL ANALYSIS - SOUNDNESS REQUIREMENTS	CERTIFIED MATERIAL REPORT
402	HEAT TREATMENT	CERTIFIED PROCESS REPORT
403	CLEANING AND PRETREATMENT (DWG. 12369003)	CERTIFIED PROCESS REPORT
404	PRIMER AND PAINT (DWG. 12369003)	CERTIFIED MATERIAL REPORT FROM APPROVED SUPPLIER
405	PRIMING AND PAINTING (DWG. 12369003)	CERTIFIED PROCESS REPORT

PART IV - TEST METHODS AND PROCEDURES

1. **MAGNETIC PARTICLE INSPECTION PROCEDURE**. THE CONTRACTOR SHALL PROVIDE A WRITTEN PROCEDURE FOR MAGNETIC PARTICLE INSPECTION OF PRODUCTION LOT. THE PROCEDURE SHALL BE SUBJECT TO GOVERNMENT APPROVAL PRIOR TO PRODUCTION LOT. THE PROCEDURE SHALL INCLUDE ESTABLISHMENT OF ACCEPTANCE STANDARDS THAT DETERMINE THE NATURE AND MAXIMUM SEVERITY OF DEFECTS THAT WILL BE ACCEPTED IN PRODUCTION PARTS.

1.1 **MAGNETIC PARTICLE INSPECTION**. AFTER FINAL HEAT TREATMENT IS COMPLETED, MAGNETIC PARTICLE INSPECTION SHALL BE CONDUCTED IN ACCORDANCE WITH ASTM E1444, UTILIZING A GOVERNMENT APPROVED PROCEDURE (METHOD TO BE USED IS OPTIONAL). SURFACE CRACKS, LAPS, OR SEAMS ARE UNACCEPTABLE. SURFACE DEFECTS MAY BE REMOVED WITHIN DIMENSIONAL LIMITS OF THE DRAWING.

QUALITY ASSURANCE PROVISIONS (QAP) -- INSPECTION METHOD CONTROL

(PRODUCT ASSURANCE PAM 702-165)

INSTRUCTIONS: USE SYMBOLS IN ACCORDANCE WITH ANSI Y14.5 — USE EXPANDING
LEGEND: MANDATORY REQUIREMENT — = LOCATI — = MEASURING POINT — = DEVICES

3

SPLINE INSPECTION METHODS

TOOTH FORM:	(X) INVOLUTE	(-) STRAIGHT	(-) PARALLEL
TYPE OF FIT:	(X) SIDE	(-) MAJOR DIA	(-) MINOR DIA
ROOT TYPE:	(X) FLAT ROOT	(-) FULL FILLET ROOT	

INSPECTION WITH GAGES

(X) CIRCULAR TOOTH THICKNESS (EXTERNAL):
- (X) MAXIMUM EFFECTIVE .1965
- (X) MINIMUM EFFECTIVE (-) REF .1959
- (X) MAXIMUM ACTUAL (-) REF .1943
- (X) MINIMUM ACTUAL .1937

(-) CIRCULAR SPACE WIDTH (INTERNAL):
- (-) MINIMUM EFFECTIVE
- (-) MAXIMUM EFFECTIVE (-) REF
- (-) MINIMUM ACTUAL (-) REF
- (-) MAXIMUM ACTUAL

(-) MAJOR DIAMETER FIT:
- (-) THE MAJOR DIAMETER AND EFFECTIVE SPLINE MUST BE CONCENTRIC AT MAXIMUM MATERIAL CONDITIONS

(-) MINOR DIAMETER FIT:
- (-) THE MINOR DIAMETER AND EFFECTIVE SPLINE MUST BE CONCENTRIC AT MAXIMUM MATERIAL CONDITIONS

ANALYTICAL INSPECTION NOTES

1. THE MAJOR AND MINOR DIAMETER INSPECTION METHODS ARE SPECIFIED ON PAGE/S 2 CHARACTERISTIC NUMBERS 101-102
2. FOR ROUTINE INSPECTION WITH GAGES, THE FOLLOWING SPLINE DATA MARKED (*) SHALL SERVE AS REFERENCE. THIS DATA HOWEVER MAY BE USED TO EVALUATE PARTS REJECTED BY GAGES OR MAY BE USED AS ACCEPTANCE CRITERIA FOR PROTOTYPE PARTS OR FOR SHORT RUNS WHERE SPLINE GAGES ARE NOT USED.
3. WHEN MARKED (X), ANALYTICAL INSPECTION IS REQUIRED AS A SUPPLEMENT TO INSPECTION WITH GAGES WHERE EACH INDIVIDUAL VARIATION MUST BE CONTROLLED.
   - (*) PROFILE TOLERANCE
     - (X) ZERO AT 3.2500 PITCH DIAMETER + .0005/- .0007
     - (X) FORM DIAMETER (X) MAX (-) MIN (-) 3.144
   - (*) TOTAL INDEX TOLERANCE .0019
   - (*) LEAD TOLERANCE ACROSS 4 1/8 LENGTH OF ENGAGEMENT .0007
   - (X) MEASUREMENT (X) OVER (-) BETWEEN TWO .2400 DIAMETER PINS 3.6183/3.6192

LEGEND: (X) APPLICABLE (-) NOT APPLICABLE (*) SEE NOTES 2 AND 3

17 QAP REVISION SYMBOL & DATE					18 CHARACTERISTICS	11 QAP NUMBER
	H 10-14-99				101	10936276
						15 PAGE NUMBER
					102	7

QUALITY ASSURANCE PROVISIONS (QAP) -- INSPECTION METHOD CONTROL

(PRODUCT ASSURANCE PAM 702-165)

INSTRUCTIONS: USE SYMBOLS IN ACCORDANCE WITH ANSI Y14.5 — USE EXPANDING
LEGEND: MANDATORY REQUIREMENT — = LOCAT — = MEASURING POINT — = DEVICES

3

SPLINE INSPECTION METHODS

TOOTH FORM:	(X) INVOLUTE	(-) STRAIGHT	(-) PARALLEL
TYPE OF FIT:	(X) SIDE	(-) MAJOR DIA	(-) MINOR DIA
ROOT TYPE:	(X) FLAT ROOT	(-) FULL FILLET ROOT	

INSPECTION WITH GAGES

(X) CIRCULAR TOOTH THICKNESS (EXTERNAL):
- (X) MAXIMUM EFFECTIVE _____ .0982
- (X) MINIMUM EFFECTIVE (X) REF _____ .0982
- (X) MAXIMUM ACTUAL (X) REF _____ .0982
- (X) MINIMUM ACTUAL _____ .0982

(-) CIRCULAR SPACE WIDTH (INTERNAL):
- (-) MINIMUM EFFECTIVE _____
- (-) MAXIMUM EFFECTIVE (-) REF _____
- (X) MINIMUM ACTUAL (-) REF _____
- (-) MAXIMUM ACTUAL _____

(-) MAJOR DIAMETER FIT:
- (-) THE MAJOR DIAMETER AND EFFECTIVE SPLINE MUST BE CONCENTRIC AT MAXIMUM MATERIAL CONDITIONS

(-) MINOR DIAMETER FIT:
- (-) THE MINOR DIAMETER AND EFFECTIVE SPLINE MUST BE CONCENTRIC AT MAXIMUM MATERIAL CONDITIONS

ANALYTICAL INSPECTION NOTES

1. THE MAJOR AND MINOR DIAMETER INSPECTION METHODS ARE SPECIFIED ON PAGE/S 2 CHARACTERISTIC NUMBERS 103 - 104
2. FOR ROUTINE INSPECTION WITH GAGES, THE FOLLOWING SPLINE DATA MARKED (*) SHALL SERVE AS REFERENCE. THIS DATA HOWEVER MAY BE USED TO EVALUATE PARTS REJECTED BY GAGES OR MAY BE USED AS ACCEPTANCE CRITERIA FOR PROTOTYPE PARTS OR FOR SHORT RUNS WHERE SPLINE GAGES ARE NOT USED.
3. WHEN MARKED (X), ANALYTICAL INSPECTION IS REQUIRED AS A SUPPLEMENT TO INSPECTION WITH GAGES WHERE EACH INDIVIDUAL VARIATION MUST BE CONTROLLED.
   - (*) PROFILE TOLERANCE
     - (X) ZERO AT 7.500 PITCH DIAMETER + .0005/- .0007
     - (X) FORM DIAMETER (X) MAX (-) MIN (-) 7.3183
   - (*) TOTAL INDEX TOLERANCE .0023
   - (*) LEAD TOLERANCE ACROSS 1 3/8 LENGTH OF ENGAGEMENT .0005
   - (X) MEASUREMENT (-) OVER (X) BETWEEN TWO .3200 DIAMETER PINS 7.9918/7.9889

LEGEND: (X) APPLICABLE (-) NOT APPLICABLE (*) SEE NOTES 2 AND 3

17 QAP REVISION SYMBOL & DATE					18 CHARACTERISTICS	11 QAP NUMBER
	H 10-14-99				103	10936276
					104	15 PAGE NUMBER
						8