



SURFACE VEHICLE RECOMMENDED PRACTICE

J1204™

DEC2023

Issued 1977-11
Revised 2017-08
Reaffirmed 2023-12

Superseding J1204 AUG2017

(R) Wheels - Recreational and Utility Trailer Fatigue Test Procedure and Performance Requirements

RATIONALE

Definitions were revised to reflect those of SAE J2530.

Wheel markings were added same as in SAE J2530 to reflect marking standard in light truck pass car and aftermarket wheels.

Test termination revisited to be same as in SAE J2530 for consistency.

A method of calculating SLR recommended by JATMA and Tire & Rim Association.

Test sample selection and associated cycles necessary to maintain B90C50 confidence of results see Tables 1 and 2.

A reduced service factor and associated increased cycle requirement are added to Table 2. Reduced service factors allow for better time efficiency of fatigue tests where tire consumption or stud breakage is excessive.

SAE J1204 has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE

This SAE Recommended Practice provides uniform procedures and minimum performance requirements for fatigue testing ferrous and aluminum wheels intended for normal highway service on travel, camping, and boat and light utility trailers drawn by passenger cars, light trucks, and multipurpose vehicles. For procedures and minimum performance requirements for wheels used on trucks, see SAE J267, and for wheels used on passenger cars, see SAE J328. For the application of passenger car and light truck wheels (inset less than 0.10 m) to this trailer service, use this procedure. For the application of heavier truck wheels (inset 0.10 m (or more)) use SAE J267. Mobile home service is outside the scope of this document.

There are two basic test procedures described, a cornering fatigue test and radial fatigue test. The cornering test is directed at the wheel disc, whereas the radial test also examines the rim and attachment portion of the wheel. Both test procedures are required to obtain a thorough examination of the wheel.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2023 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

For more information on this standard, visit

https://www.sae.org/standards/content/J1204_202312/

SAE WEB ADDRESS:

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J175	Wheels - Lateral Impact Test Procedure - Road Vehicles
SAE J267	Wheels/Rims - Truck and Bus - Performance Requirements and Test Procedures for Radial and Cornering Fatigue
SAE J328	Wheels - Passenger Car and Light Truck Performance Requirements and Test Procedures
SAE J393	Nomenclature - Wheels, Hubs, and Rims for Commercial Vehicles
SAE J2530	Aftermarket Wheels - Passenger Cars and Light Truck - Performance Requirements and Test Procedures
SAE J3010	Registration and Conformity Assessment Process for Passenger Cars and Light Trucks Wheels

Kinstler, J., "The Science and Methodology of SAE Wheel Fatigue Test Specifications," SAE Technical Paper 2005-01-1826, 2005, doi:10.4271/2005-01-1826.

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO 3911 Wheels/rims - Nomenclature, designation, marking and units of measurement

2.2.2 Tire and Rim Association Publications

Available from The Tire and Rim Association, Inc., 175 Montrose West Avenue, Suite 150, Copley, OH 44321, Tel: 330-666-8121, www.us-tra.org.

Yearbook, The Tire and Rim Association, Inc.

Engineering Design Information Book, The Tire and Rim Association, Inc.

3. DEFINITIONS

3.1 DESIGN CRITERIA

A performance requirement consisting of a cycle requirement and multiple tests established to provide adequate confidence that a population of wheels meets or exceeds the minimum performance requirements of this recommended practice.

3.2 FUNCTIONAL FASTENER

A connection device such as a bolt, rivet, or wire spoke used to join together the individual components of the wheel assembly.

3.3 LUG NUT/BOLT

Hardware designed for securing the wheel to the vehicle.

3.4 MINIMUM PERFORMANCE REQUIREMENT

A wheel design that meets or exceeds the pairing of test factor and cycle requirements in Tables 1 and 2 should have acceptable field performance in its intended service. The cycle requirements associated with 7 samples in Tables 1 and 2 represent historical, non-statistical, minimum performance requirements. Pairings of test factor and cycle requirements for sample sizes less than 7 represent equivalent confidence and reliability.

3.5 OFFSET

The inset, zerset, or outset of the wheel as defined in SAE J1982 Figure 3 (noted in mm).

3.6 WHEEL LOAD

The maximum load rating of the wheel as specified by the wheel manufacturer and shall be no less than one-half of the vehicle static load of the heaviest axle (as specified by the vehicle manufacturer) of any vehicle for which the wheel is intended (as determined by the wheel manufacturer).

4. WHEEL MARKINGS

Wheels that comply with this specification must be permanently marked with the following information. The characters shall be legible and the character size shall not be less than 3.0 mm (0.12 inch).

- 4.1 Wheel manufacturer's name, trademark or symbol.
- 4.2 Date of manufacture of the wheel, indicating the month and year, which may be either coded or specifically indicated.
- 4.3 Manufacturer's part number or code.
- 4.4 Country of manufacture.
- 4.5 Rim Size Designation – Rim diameter, width, and rim profile (e.g., 16x7J for a 16 inch diameter, 7 inches wide and J rim profile).
- 4.6 The manufacturer's wheel load rating as established by design validation testing to this specification expressed in pounds or kg.
- 4.7 The symbol "DOT", constituting a certification by the manufacturer that the rim complies with all applicable motor vehicle safety standards.

Following the symbol, "DOT", a designation which indicates the source of rim's published nominal dimensions as follows:

- "T" indicates The Tire and Rim Association, Inc.
- "E" indicates The European Tyre and Rim Technical Organisation
- "J" indicates Japan Automobile Tire Manufacturers Association, Inc.
- "D" indicates Deutsche Industrie Norm
- "B" indicates British Standards Institution
- "S" indicates Scandinavian Tire and Rim Organization
- "A" indicates Tyre and Rim Association of Australia

- 4.8 "SAE J1204" may be cast in, stamped on, or labeled on wheels that conform to this specification.
- 4.9 If the wheel manufacturer recommends restricting wheel use with certain types of tires then the finished wheel must be permanently marked with the restriction, for example "Not for Use with Radial Tires" (only required if tire restriction).

5. WHEEL QUALIFICATION

When possible, test samples must pass through all of the processes to duplicate the effects and/or characteristics of the final product.

5.1 Test Sample Selection

Test samples shall be representative of wheels produced or to be produced.

5.2 Sample Size for Tests

The sample size for the Dynamic Cornering fatigue test (Section 6) are shown in Table 1 and for the Dynamic Radial fatigue test (Section 7) are shown in Table 2. The sample size shown is between 2 and 7 wheels with the appropriate minimum cycles requirements for that sample size. The cycles are based on the material fatigue curves and use Weibull statistics with a reliability of 90%, a confidence level of 50%, and a beta (slope) of 2. Any combination is acceptable as long as the minimum cycles for all sample wheels are reached. Tests ran to and discontinued at 2X minimum cycle requirement are suspensions in the Weibull analysis.

5.3 Retest and Additional Model Variation Requirements

Changes in either, style, diameter, material, increase in wheel load rating, cross sectional dimensions, maximum tire diameter, offset, functional fasteners, or production processes which could affect wheel's life will require retesting.

For wheels that vary only in finish, it is required to test the wheel with the greatest potential for non-compliance.

For wheels that vary only in width and offset, it is required to test the model variations with the mathematically highest bending moment and include test samples per Section 5 with the largest bolt circle and test samples per Section 5 with the smallest bolt circle and least number of lug holes.

5.4 Inspection of Test Samples

Visual inspection for crack identification shall be executed via corrected 20/20 vision without optical assistance. Dye penetrant inspection for crack verification is recommended, however is not mandatory.

5.5 Acceptance Criteria

Wheels conform to the specification if they meet the acceptance criteria for the testing specified in Sections 4, 6, 7, and 8.

**Table 1 - Test factors and minimum cycle requirements for wheels
in normal highway service - dynamic cornering fatigue**

Wheel Type (Material)	S	Minimum Cycles					
Sample Size =		2	3	4	5	6	7
Ferrous	1.45	35000	30000	25000	22000	20000	18000
Aluminum Cast and Forged, Aluminum/Steel Two-Piece, and Aluminum Modular	1.75	95000	75000	65000	60000	55000	50000
	1.4	150000	120000	105000	95000	85000	80000
	1.2	475000	375000	325000	300000	275000	250000

**Table 2 - Test factors and minimum cycle requirements for wheels
in normal highway service - dynamic radial fatigue**

Wheel Type (Material)	K	Minimum Cycles					
Sample Size =		2	3	4	5	6	7
Ferrous	2.0	750000	600000	525000	475000	425000	400000
	1.6	1500000	1200000	1050000	950000	850000	800000
Aluminum Cast and Forged, Aluminum/Steel Two-Piece, and Aluminum Modular	2.25	1100000	900000	775000	700000	650000	600000
	1.8	1850000	1500000	1300000	1200000	1100000	1000000

6. DYNAMIC CORNERING FATIGUE

6.1 Equipment

Use a test machine that: (see Figures 1, 2, and 3)

- Imparts a constant rotating bending moment to the wheel
- Maintains the test load within $\pm 3.0\%$
- Monitors and measures the deflection of the system at the point of load application during the test.

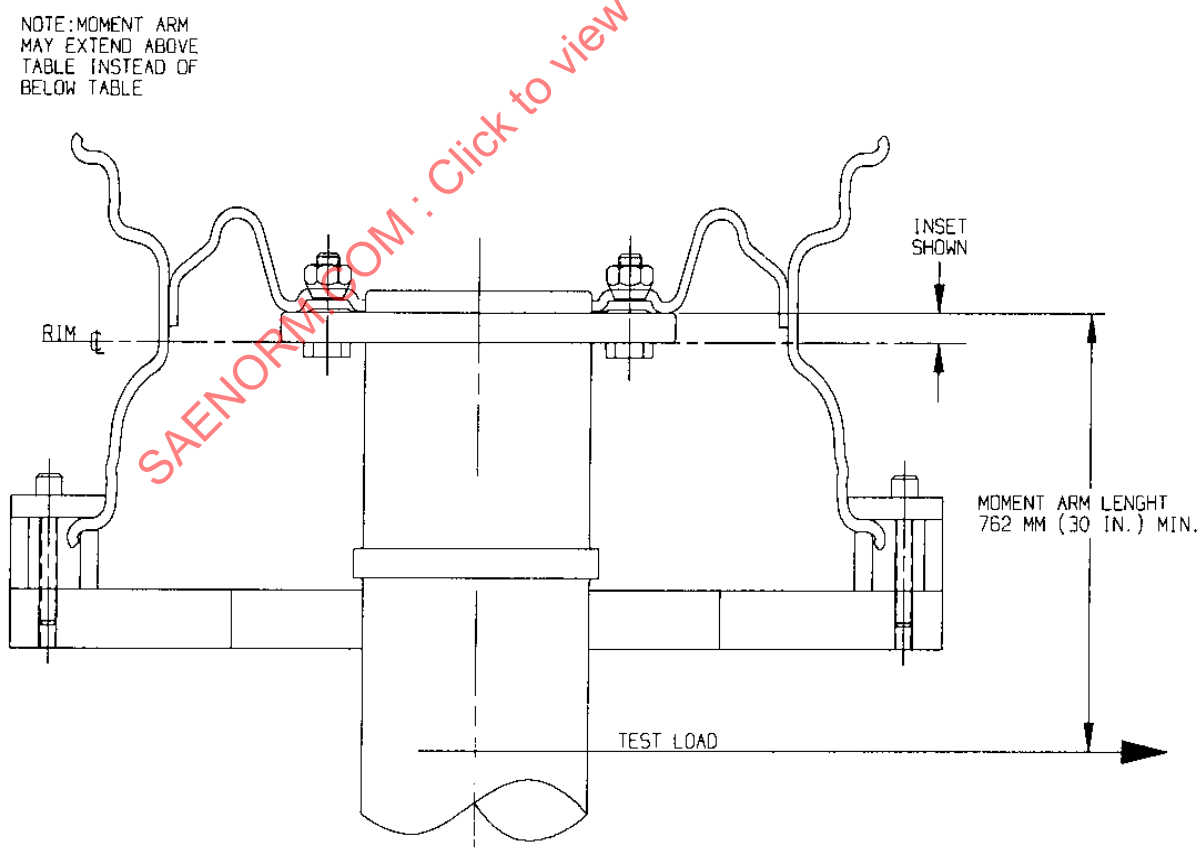


Figure 1 - Dynamic cornering fatigue (typical set-up)

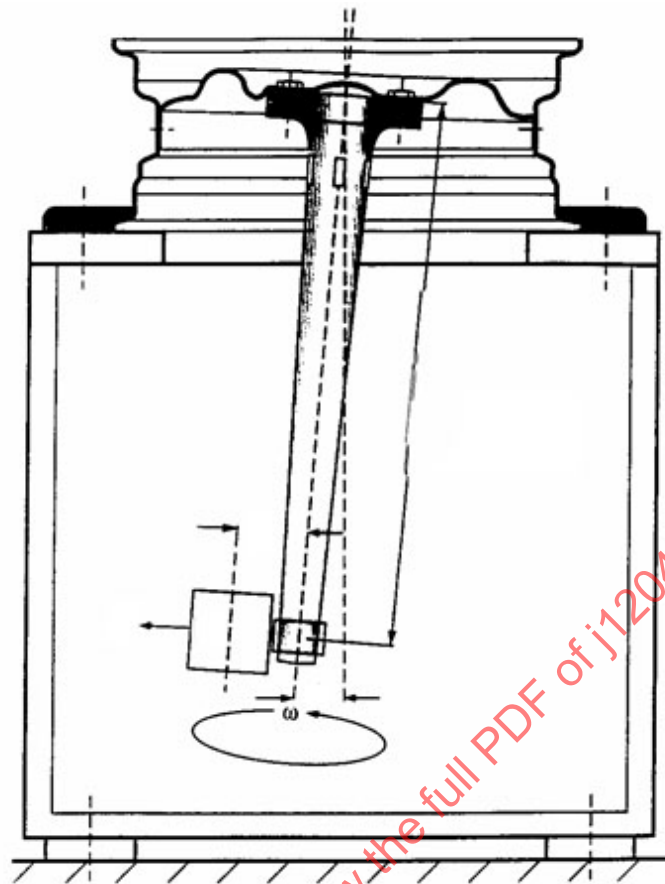


Figure 2 - Eccentric mass construction

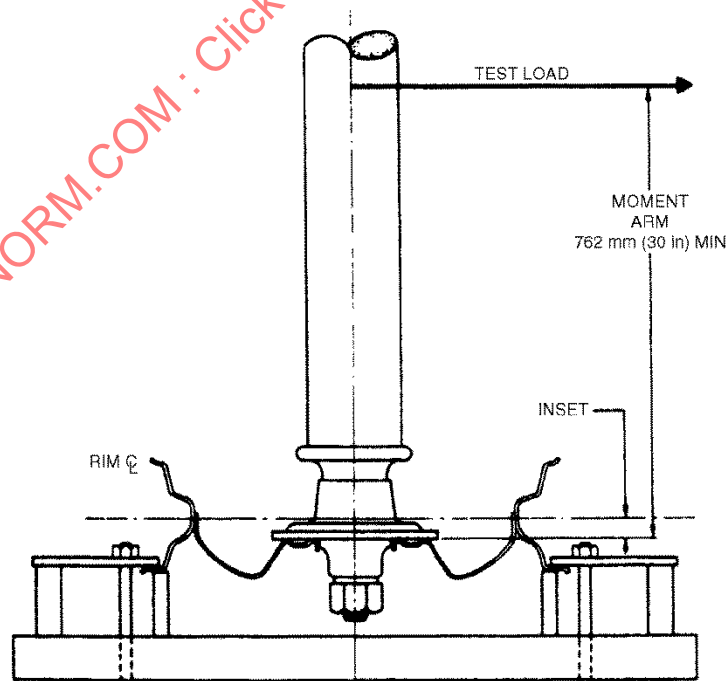


Figure 3 - Rotary test

6.2 Procedure

- a. Use only fully processed new wheels, which are representative of wheels intended for the vehicle and ready for road use. Separate wheels are to be used for each test.
- b. Use a test adapter, studs, and nuts representative of those specified for the wheel.
- c. Verify the mating surfaces of the wheel and adapter are free of foreign material or excessive wear (wear plate optional).
- d. Attach a rigid load arm shaft and test adapter to the wheel mounting surface.
- e. Tighten the nuts (dry) as specified or as follows:

M12x1.25, M12x1.5, M12x1.75, and 1/2-20; 115 Nm $\pm$ 7 Nm

M14x1.5, M14x2, and 9/16-18; 158 Nm $\pm$ 7 Nm

M16x1.5 and 5/8-18; 178 Nm $\pm$ 7 Nm
- f. Clamp the rim securely to the test device.
- g. Adjust the system to be within 0.25 mm (0.010 inch) total indicator reading normal to the load arm shaft at the point of load application.
- h. Apply the test load parallel to the plane of the rim.
- i. Nut torque values may be checked at 5000 cycles.
- j. Broken studs or other parts of the test fixture do not require test termination but may result in damage to the wheel and test invalidation. Optionally, all studs may be replaced once and the test continued.
- k. Report data with the minimum amount of fields noted in Appendix A.

6.3 Bending Moment Test Load Calculation

Calculate the bending moment (Force x Load Arm Length) to be applied to the test wheel as follows in Equation 1:

$$M = W(R_{\mu} + d)S \quad (\text{Eq. 1})$$

where:

W = 1/2 the maximum vertical static load on the axle as specified in newtons by the trailer manufacturer or the load rating of the wheel as specified by the wheel manufacturer:

R = Static loaded radius (SLR) of the largest tire specified by the trailer and/or wheel manufacturer. If the SLR is not specified use the formula listed below:

$$SLR = 0.50 \times Dr + 0.85 \times H$$

SLR = Tire Static Loaded Radius

Dr = Nominal Rim Diameter in inches, needs to be converted to m for use in formula

H = TRA Design Tire Section Height

M = Bending moment

$N\mu$ = Coefficient of friction developed between the tire and the road; use $\mu = 0.7$

d = The inset or outset of the wheel mm: Use positive sign for inset and negative sign for outset

S = Load Factor (see Table 1)

6.4 Test Termination/Suspension

6.4.1 Test Termination

Test Suspension - Test can be suspended at twice the minimum cycle requirement (see Table 1). At twice the minimum cycle requirement, one can use the data in Weibull analysis as a suspended test.

Terminate the test when any of the following conditions occur.

- a. Wheel exceeds the initial deflection at point of load application by 20%.
- b. A visually detected crack penetrating through a section of the wheel in the base metal or propagation of any existing fracture/crack resulting in a fatigue crack penetrating through any section of the wheel at the minimum cycles for the sample size used specified as in Table 1. Inspection should be done at the minimum cycles for the sample size used in Table 1. Cracking in the wheel finish alone shall not be the basis for finding a test termination.
- c. One or more lug nuts loosening to less than 60% of the initial torque at the minimum cycles for the sample size used as specified in Table 1. If loosening is due to broken wheel bolts, studs, or nuts (see 6.4.1e). Inspection should be done at the minimum cycles for the sample size used as specified in Table 1.
- d. Break or crack of a functional fastener.
- e. Broken lug bolts or other parts of the test fixture do not require test termination but may result in damage to the wheel and test invalidation. Broken lug bolts shall not be replaced more than once per test. All bolts should be replaced if lug bolts are replaced. If necessary the test shall be terminated and the wheel retested or replaced and retested.

7. DYNAMIC RADIAL FATIGUE

7.1 Equipment

Use a test machine that (see Figure 4):

- a. Has a suggested drum diameter of 1707 mm – 187 revolutions per km (67.23 inches – 300 revolutions per mile)
- b. Has a driven rotatable drum which presents a smooth surface wider than the loaded test tire section width
- c. Imparts a constant load to the test wheel and tire normal to the surface of the drum and in line radially with the center of the test wheel and drum
- d. Can maintain the test load within $\pm 3.0\%$
- e. The rotational axis of the test wheel and drum are parallel.

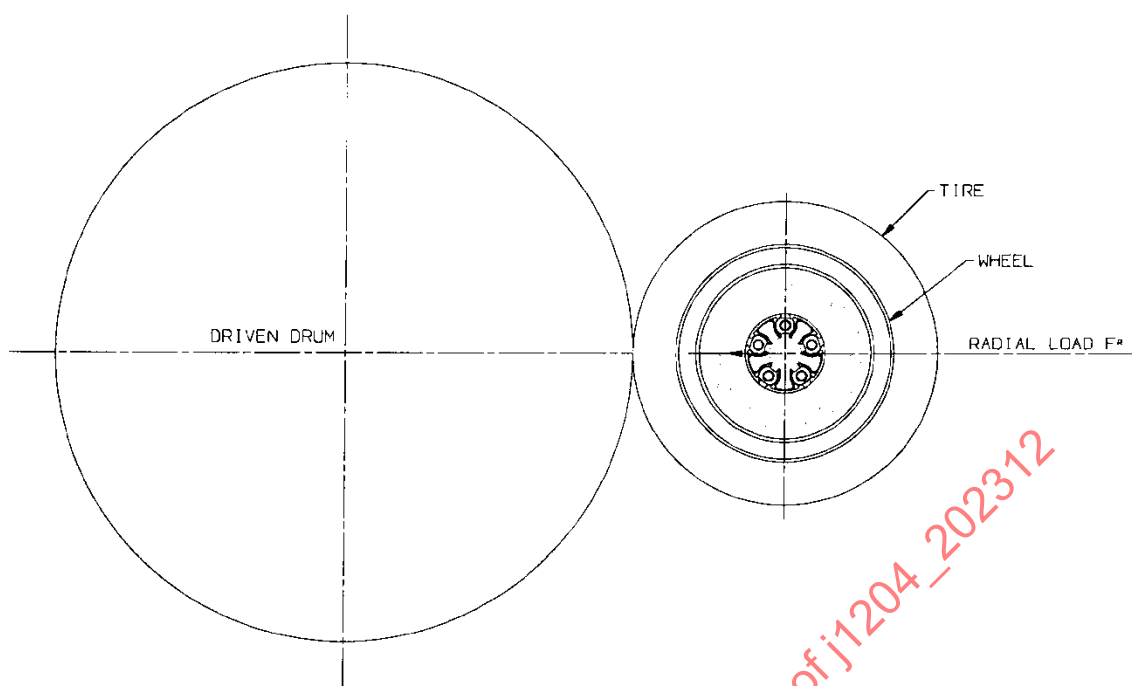


Figure 4 - Radial fatigue (typical set-up)

7.2 Procedure

- Use only fully processed new wheels, which are representative of wheels intended for the vehicle and ready for road use.
- Select test tires that are representative of the maximum size and type approved by the vehicle or wheel manufacturer for the wheel under test.
- Use a test adapter, studs, and nuts that are representative of those specified for the wheel.

Table 6 - Test inflation pressures

Usage Tire Pressure kPa	Usage Tire Pressure psi	Test Pressure ± 20 kPa kPa	Test Pressure ± 3 psi psi
Up to 280	Up to 40	450	65
280-410	41- 60	550	80
420-550	61- 80	690	100
560-690	81-100	900	130

- Inflate tires per Table 6. There may be an increase in inflation pressure during the test. This is normal, but it is permissible to adjust back to the test pressure.
- Use caution as the test tires are severely overloaded and may fail.
- Failure of the test tire or other parts of the test fixture does not require test termination, but may result in damage to the wheel and test invalidation. Optionally, the tire may be replaced and the test continued.
- Report data with the minimum amount of fields noted in Appendix B.