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L-37 Information Letter 04-1
Sequence Number 30
September 17, 2004

ASTM consensus has not been obtained on this information letter. An appropriate ASTM ballot will be issued in order to achieve such consensus.

TO: L-37 Mailing List

SUBJECT: D 6121 Revision

1. At the June 30, 2004 L-37 Surveillance Panel teleconference meeting, the panel approved a motion to revise Test Method D6121. This revision helps to standardize both the L-37 standard test as well as the L-37 low temperature (Canadian) test. Revised Sections 4.3, 4.5, 6.2.4.3, 10.1.1, 10.1.3, 10.1.7, 10.1.8, 10.2.1, 10.2.3, 10.2.3.1 and New Sections 1.2, 10.2.9, 10.3, 10.3.1, 10.3.1.1, 10.3.1.2, 10.3.1.3, 10.3.1.4, 10.3.1.5, A6.3, A6.3.1, A6.3.1.1, A6.3.2, A6.3.2.1, A6.3.2.2, A6.3.3, A6.3.3.1, A6.3.3.2, A6.3.3.3, and A6.3.3.4 are attached. A new Note 2, Note 3, and Footnote 10 are also attached. These changes are effective June 30, 2004

2. At the August 25, 2004 L-37 Surveillance Panel meeting, the panel approved a motion that requires a correction factor of 0.6065 be added to the pinion and ring transformed ridging distress for lubrited hardware, V1L686/P4L626A gear sets. This correction factor shall only be applied to the L-37 Canadian version, non-reference oil tests. The final merit result shall be ASTM rounded to one decimal place. Revised Section 12.2.3.3 and new Sections A6.3.4 and A6.3.4.1 of Test Method D6121 are attached. This change is effective for any tests completing on or after August 25, 2004.

3. At the request of ASTM Section D02.B0.09, the definitions of Intermediate Precision and Reproducibility have been revised. Revised Sections 14.1.1 and 14.1.2, new Sections 14.1.1.1 and 14.1.2.1, and new Note 6 of Test Method D6121 are attached. Also a new footnote has been added to Table 1. This change is effective the date of this information letter.

Donald T. Bartlett
Chairman
L-37 Surveillance Panel

John L. Zalar
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Attachment

c: ftp://ftp.astmtmc.cmu.edu/docs/gear/l-37/procedure_and_ils/il04-1.pdf

Distribution: Electronic Mail

(Revises Test Method D 6121-04)

1.2 This test method also provides for the running of the low axle temperature (Canadian) L-37 test. The procedure for the low axle temperature (Canadian) L-37 test is identical to the standard L-37 test with the exceptions of the items specifically listed in Annex A6. The procedure modifications listed in Annex A6 refer to the corresponding section of the standard L-37 test method.

Renumber old Section 1.2 to 1.3
Renumber old Section 1.3 to 1.4

4.3 *Gear Conditioning Phase*—Run the charged test unit for 100 min at 440 wheel r/min and 395 lbf-ft (535 Nm) torque per wheel, maintaining an axle sump temperature of 297°F (147°C). (**Warning**—High-speed rotating equipment, electrical shock, high-temperature surfaces.)

4.5 *Gear Test Phase*—Next, run the test unit for 24 h at 80 wheel r/min, 1740 lbf-ft. (2359 Nm) torque per wheel and an axle sump temperature of 275°F (135°C). (**Warning**—See 4.3.)

6.2.4.3 Axle Cooling—Use three spray nozzles to distribute water over the cover plate and axle housing as shown in Fig. A5.1. Actuate the water control valve by the temperature PID control system. See Annex A6.3.2.1 L-37 Canadian Version test.

(1) Spray nozzles[10] shall be any combination of the following part numbers depending on how the system is plumbed: Straight Male NPT (Part No. 3/8GG-SS22), 90° Male NPT (Part No. 3/8GGA-SS22), Straight Female NPT (Part No. 3/8G-SS22), and 90° Female NPT (Part No. 3/8GA-SS22).

(2) Use a single control valve to control the cooling water supply. The control shall be a ½ in. two-way, C linear trim, air to close, Research Control valve. Use a single PID loop to maintain the axle lubricant temperature control for both the Standard and Canadian version test. A separate PID loop control for each version is not permitted. See Annex A6.3.2.2 L-37 Canadian Version test.

(3) Use only 3/8 or ½ in. line material to the spray nozzles.

(4) Use a minimum supply water pressure of 25 psi to the control valve.

(5) Use an axle box cover as shown in Fig. A5.2. The purpose is to contain water and eliminate drafts.

(6) Use a locating pin or stop block as an indexing device to ensure that all subsequent axle installations are consistently installed perpendicular with the axle housing cover to engine and transmission driveshaft centerline.

[10] The sole source supply of the apparatus known to the committee at this time is Spray Systems Company, and can be purchased through E.I. Pfaff Company, 3443 Edwards Road, Suite D, Cincinnati, Ohio 45208. Tel: 513-871-9900.

Renumber old footnotes 10 thru 15 to 11 thru 16 respectively

10.1.1 Set the temperature control to maintain a lubricant temperature of 297 ± 3°F (147.2 ± 1.7°C). See Annex A6.3.3.2 for L-37 Canadian Version test.

10.1.3 After reaching the appropriate gear, accelerate smoothly to 440 ± 5 wheel r/min and apply dynamometer load to achieve a torque load of 395 ± 15 lbf-ft (535 ± 20 Nm) on each wheel (see Note 2).

10.1.7 At the end of the 100 min and as the load and linear speed ramp down is started, set the axle lubricant temperature controller to a set point of 275 ± 3°F (135.0 ± 1.7°C). Shift transmission to neutral and ensure that the axles stop turning. Record ending time and temperature of the lubricant. See Annex A6.3.3.3 for L-37 Canadian Version test.

The new note below follows Section 10.1.7

NEW NOTE 2—The intent is to allow water to be added to the axle unit while it is still turning to cool the axle lubricant temperature and ensure that the water is shut off when the axle lubricant temperature drops below the set point.

Renumber Old Note 2 to New Note 4

10.1.8 Restart the test, as detailed in Section 10.3.1, if the test is stopped for any reason (power outage, maintenance, and so forth.). This stoppage shall count as one of the allowed shutdowns during the test. Do not calculate deviation percent values or report out of limit operational values until test conditions are again achieved. If the test is stopped at the start of the conditioning phase, before speed and torque conditions are reached, the stoppage will not count as one of the allowed shutdowns.

10.2.1 Ensure that the temperature control is still set to maintain a lubricant temperature of 275 ± 3°F (135.0 ± 1.7°C). See Annex A6.3.3.4 for L-37 Canadian Version test.

The new note below follows Section 10.2.2

NEW NOTE 3—The transition from the end of the conditioning phase (Section 10.1.7) to the appropriate test gear of the gear test phase is approximately 5 min.

Renumber Old Note 3 to New Note 5

10.2.3 After reaching the appropriate gear, accelerate smoothly to 80 ± 1 wheel r/min and apply dynamometer load to achieve a torque load of 1044 ± 35 lbf-ft (1415 ± 47 Nm) on each wheel. Hold at this condition until the axle lubricant temperature reaches 175 ± 3°F (1.0 ± 1.7°C).

10.2.3.1 Once the axle lubricant temperature reaches 175 ± 3°F (1.0 ± 1.7°C), immediately apply dynamometer load to achieve a torque load of 1740 ± 35 lbf-ft (2359 ± 47 Nm) on each wheel.

10.2.9 Restart the test, as detailed in Section 10.3.1, if the test is stopped for any reason (power outage, maintenance, and so forth.). This stoppage shall count as one of the allowed shutdowns during the test. Do not calculate deviation percent values or report out of limit operational values until test conditions are again achieved. If the test is stopped at the start of the test phase, before test conditions are reached (speed, load, and axle temperature), the stoppage will not count as one of the allowed shutdowns.

10.3 *Unscheduled Downtime*—An unscheduled downtime event is defined as anytime the engine and/or the gears stop turning during the steady state gear conditioning or steady state gear test phases after test conditions are achieved.

10.3.1 *Restart After Unscheduled Downtime*-- Restart the test as outlined in Sections 10.3.1.1 thru 10.3.1.5 any time there is an unscheduled downtime event.

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10.3.1.1 Set the temperature control to maintain the lubricant temperature at the set point condition when the shutdown occurred.

10.3.1.2 With the engine warmed up and with no load on the dynamometers, shift smoothly to a gear appropriate for the test condition.

10.3.1.3 After reaching the appropriate gear, accelerate smoothly to the wheel r/min set point condition at the time of the shutdown.

10.3.1.4 Apply a dynamometer load on each wheel to achieve a torque value that is 60% of the set point value when the shutdown occurred. Hold at this condition until the lubricant temperature reaches 175 ± 3°F (1.0 ± 1.7°C).

10.3.1.5 Once lubricant temperature reaches 175 ± 3°F (1.0 ± 1.7°C), immediately apply dynamometer load on each wheel to achieve the torque load set point condition at the time of the shutdown.

12.2.3.3 When using the lubrited hardware, gear set V1L686/P4L626A, for non-reference oil tests, add a correction factor of 0.5186 to the pinion transformed ridging test result and add a correction factor of 0.9922 to the ring transformed ridging test result. Record these results on Form 1 of the test report (Figure A7.2). See Section A6.3.4.1 for L-37 Canadian Version test.

14.1.1 *Intermediate Precision Conditions* — Conditions where test results are obtained with the same test method by the same laboratory, with the same gear batch using the same test oil, with changing conditions such as operators, measuring equipment, test stands, test engines, and time.

Note 6—Intermediate precision is the appropriate term for this test method rather than repeatability which defines more rigorous within-laboratory conditions.

14.1.1.1 *Intermediate Precision Limit (i.p.)*—The difference between two results obtained under intermediate precision conditions that would, in the long run, in the normal and correct conduct of the test method, exceed the values shown in Table 1 in only one case in twenty. When only a single test result is available, the Intermediate Precision Limit can be used to calculate a range (test result ± Intermediate Precision Limit) outside of which a second test result would be expected to fall about one time in twenty.

14.1.2 *Reproducibility Conditions* — Conditions where test results are obtained with the same test method using the same gear batch on the same test oil in different laboratories with different operators using different equipment.

14.1.2.1 *Reproducibility Limit (R)*—The difference between two results obtained under reproducibility conditions that would, in the long run, in the normal and correct conduct of the test method, exceed the values shown in Table 1 in only one case in twenty. When only a single test result is available, the Reproducibility Limit can be used to calculate a range (test result ± Reproducibility Limit) outside of which a second test result would be expected to fall about one time in twenty.

(Revises Test Method D 6121-04)

TABLE 1 Reference Oil Test Precision Data—Transformed Units

NOTE—These statistics are based on the L-37 Standard version test results obtained on Test Monitoring Center Reference Oils 127, 128, 128-1, and 129. There are no statistics for the Canadian version test at this time.

where:

$S_{i.p.}$	=	intermediate precision standard deviation,
i.p.	=	intermediate precision,
S_R	=	reproducibility standard deviation, and
R	=	reproducibility.

Hardware Type	Variable	$S_{i.p.}$	i.p.	S_R	R
Lubrited	Pinion ridging [A], -ln(10.5 – merit)	0.3836	1.0741	0.3859	1.0805
	Pinion rippling [A], -ln(10.5 – merit)	0.5645	1.5806	0.6412	1.7954
	Pinion wear, merit	1.0181	2.8507	1.0648	2.9814
	Pinion pitting/spalling [A], -ln(10.5 – merit)	0.7124	1.9947	0.7124	1.9947
Non-lubrited	Pinion ridging [A], -ln(10.5 – merit)	0.4847	1.3572	0.5209	1.4585
	Pinion rippling [A], -ln(10.5 – merit)	0.5303	1.4848	0.5993	1.6780
	Pinion wear, merit	1.0352	2.8986	1.0728	3.0038
	Pinion pitting/spalling [A], -ln(10.5 – merit)	0.4298	1.2034	0.4414	1.2359

[A]This parameter is transformed using a natural log. When comparing two test results on this parameter, first apply this transformation to each test result. Compare the absolute difference between the transformed results with the appropriate (intermediate precision or reproducibility) precision limit.

A6.3 L-37 *Canadian Version Test Requirements*

A6.3.1 Calibration Test Acceptance (see Section 9.0).

A6.3.1.1 Calibration status of the L-37 Canadian Version test is determined by successfully calibrating a test stand according to the L-37 Standard Version test requirements detailed in Section 9.0. In other words, a stand that is calibrated for the L-37 Standard Version test is automatically calibrated for the L-37 Canadian Version test.

A6.3.2 Apparatus

A6.3.2.1 Use five spray nozzles to distribute water over the cover late and axle housing as shown in Fig. A5.1. Actuate the water control valves by the temperature PID control system (see Section 6.2.4.3).

A6.3.2.2 Use two control valves to control the cooling water supply. The control valves shall be a ½ in. two-way, C linear trim, air to close, Research Control valve. Use only one PID loop to maintain axle lubricant temperature control (see Section 6.2.4.3.2).

A6.3.3 Test Procedure

A6.3.3.1 Operate the test as outlined in Sections 10.1 thru 10.3 of the L-37 Standard Version test with the exceptions of the following sections. The procedure modifications listed in this Annex refer to the corresponding section of the L-37 Standard Version test.

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A6.3.3.2 Set the temperature control to maintain a lubricant temperature of 220 ± 3°F (104.4 ± 1.7°C) (See 10.1.1).

A6.3.3.3 At the end of the 100 min, set the temperature control to maintain a lubricant temperature of 200 ± 3°F (93.3 ± 1.7°C), close the throttle smoothly, shift transmission to neutral, and record ending time and temperature of the lubricant (see Section 10.1.7).

A6.3.3.4 Ensure that the axle temperature control is still set to maintain a lubricant temperature of 200 ± 3°F (93.3 ± 1.7°C) (see Section 10.2.1).

A6.3.4 Determination of Test Results

A6.3.4.1 When using the lubrited hardware, gear set V1L686/P4L626A, for non-reference oil tests, add a correction factor of 0.6065 to the pinion and ring transformed ridging test result (See Section 12.2.3.3). Record these results on Form 1 of the test report (Annex A7).

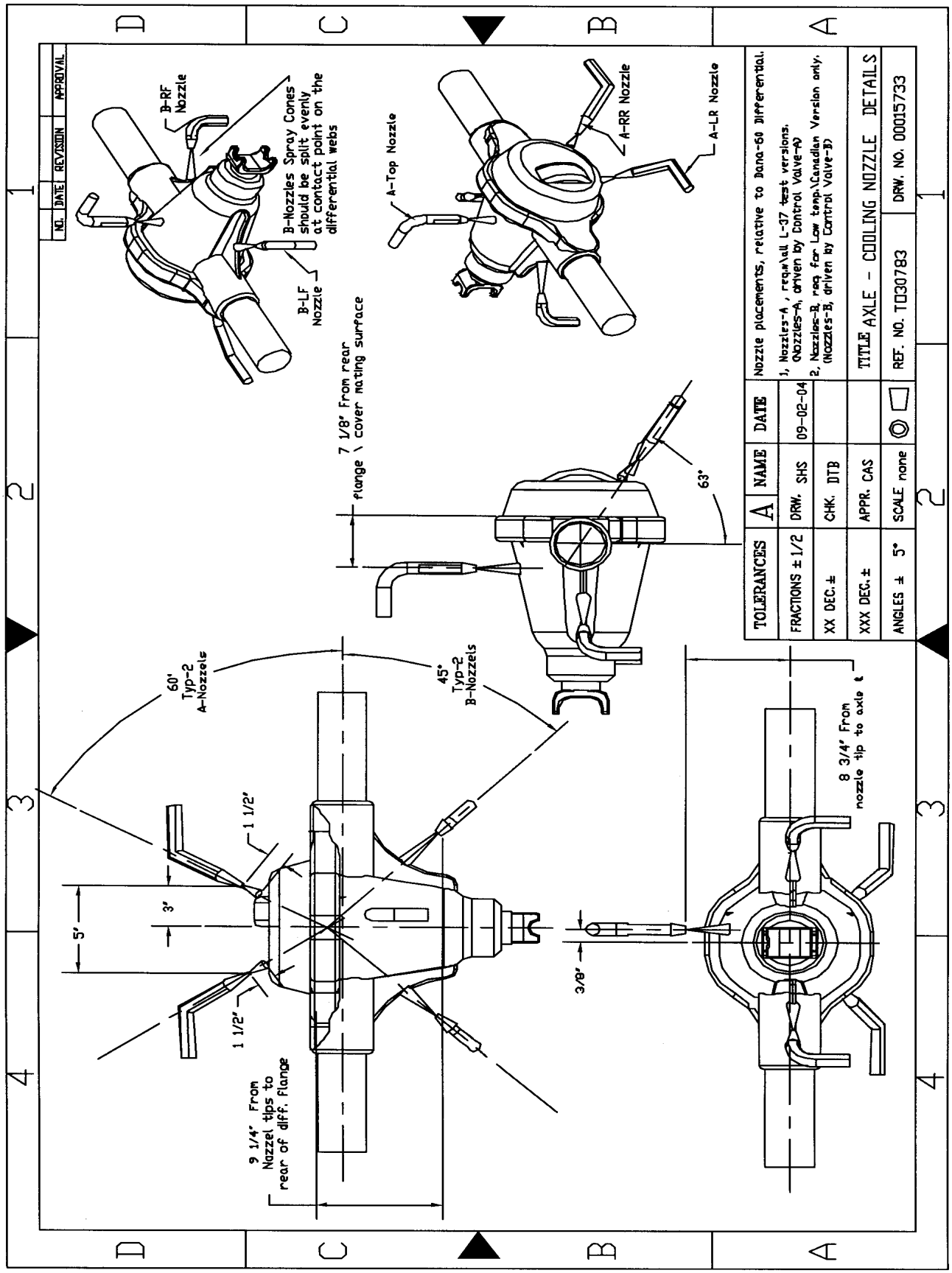

FIG. A5.1 Location of Spray Nozzles on Axle

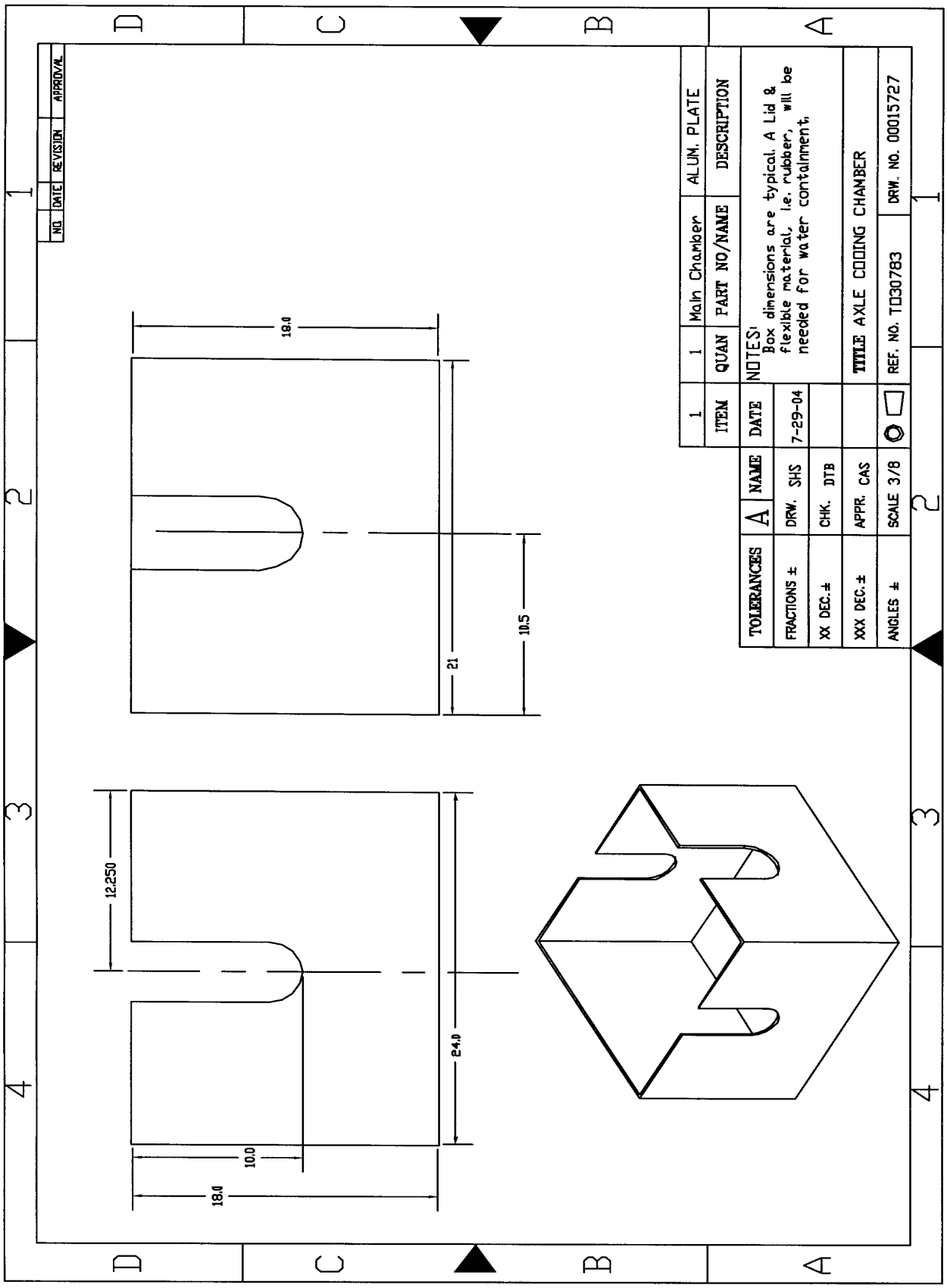

FIG. A5.2 Axle Box Cover