INCH-POUND

MIL-C-10190D
AMENDMENT 4
26 July 2000
SUPERSEDING
AMENDMENT 3
29 August 1997

MILITARY SPECIFICATION

CARTRIDGE, CALIBER .50, BALL, M33

MIL-C-10190D was inactivated on 29 August 1997 for new design.

This amendment forms part of MIL-C-10190D (AR), dated 3 April 1985, and is approved for use by the US Army Armament, Research, Development, and Engineering Center, and is available for use by all Departments and Agencies of the Department of Defense.

PAGE 3

3.3, Delete in its entirety and substitute:

"3.3 Residual stress. The cartridge shall not split when subjected to a 1 percent mercurous nitrate solution for 15 minutes when tested as specified in 4.5.2."

3.5, Delete in its entirety and substitute:

"3.5 Accuracy. The average of the mean radii of all targets of the sample cartridges, fired at 600 yards, shall not exceed 12.0 inches or, when fired at 200 yards, shall not exceed 3.75 inches. The test shall be performed as specified in 4.5.4."

* 3.7, Delete in its entirety and substitute the following:

"3.7 Velocity. The velocity test shall be performed by using either a velocity test barrel, or the Electronic Pressure, Velocity and Action Time (EPVAT) method. The test method employed shall be recorded on the test results.

3.7.1 Velocity measurement by velocity test barrel. The average velocity of the sample cartridges, conditioned at 70°F ± 2°F for a minimum of two hours, shall be 2,910 ft/sec ± 30 ft/sec at 78 feet from the muzzle of the weapon. The standard deviation of the velocities shall not exceed 36 ft/sec. Testing shall be performed in accordance with 4.5.6 & 4.5.10.

3.7.2 Velocity measurement by EPVAT method. The average velocity of the sample cartridges, conditioned at 70°F ± 2°F for a minimum of two hours, shall be 2,905 ft/sec ± 30 ft/sec at 78 feet from the muzzle of the weapon. The standard deviation of the velocities shall not exceed 36 ft/sec. Testing shall be performed in accordance with 4.5.6 & 4.5.10."

* 3.8, Delete in its entirety and substitute the following:

"3.8 Chamber pressure. The chamber pressure test shall be performed by either the copper crush cylinder or EPVAT test method. . The test method employed shall be recorded on the test results.

3.8.1 Chamber pressure by the copper crush-cylinder test method. The average chamber pressure of the sample cartridges, conditioned at 70°F ± 2°F for a minimum of two hours, shall not exceed 55,000 psi. The standard deviation of the velocities shall not exceed 36 ft/sec. The test shall be conducted as specified in 4.5.7 & 4.5.10.

3.8.2. Chamber pressure by EPVAT test method. The average chamber pressure of the sample cartridges, conditioned at 70°F ± 2°F for a minimum of two hours, shall not exceed 65,000 psi when tested as specified in 4.5.7 & 4.5.10."

PAGE 4

3.9, Delete in its entirety and substitute:

"3.9 Function and casualty. The cartridge shall function without casualty. The test shall be performed as specified in 4.5.8."

PAGE 5

4.3.1, Delete "1880" and substitute "1680".

4.3.1, Delete "5/machine or tool" and substitute "5/tool/machine" in four places.

4.3.1, Add: "Filler, Base 7577031 5/tool/machine"

PAGE 6

Table I, Add:

"8. Cyclic rate 0 2/

2/ If any burst fails to meet the cyclic rate requirement specified in 3.9, the first article sample shall be rejected."

PAGE 7

Table II, NO. OF SAMPLE UNITS: Delete "5" and substitute "5/tool/machine" in four places.

Table II, Delete "1800" and substitute "1680".

Table II, NO. OF SAMPLE UNITS: Delete "5/tool/machine" in four places and substitute "5".

Table II, Delete:

"Filler, Base (Dwg. 7577031)				
Examination for defects	5/tool /machine	ACC-0 Rej-1	3.1 3.11"	Gage 1/

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* Table II - First Article Inspection, Delete:

"Action time	80	Acc-1 Rej-2	3.6	4.5.5
Velocity	50	1/	3.7	4.5.6 and 4.5.10
Chamber pressure	50	1/	3.8	4.5.7 and 4.5.10"

Substitute:

"Copper crush cylinder test method

Action time	80	Acc-0 Rej-1	3.6	4.5.5
Velocity	50	1/	3.7.1	4.5.6 and 4.5.10
Chamber pressure	50	1/	3.8.1	4.5.7 and 4.5.10
EPVAT test method 3/				
Action time	50	Acc-0 Rej-1	3.6	4.5.5
Velocity	-	1/	3.7.2	4.5.6 and 4.5.10
Chamber pressure	-	1/	3.8.2	4.5.7 and 4.5.10"

Add:

"3/ The EPVAT test method for measuring chamber pressure, velocity and action time shall be performed simultaneously."

4.4.1.2 a thru d, Delete and substitute:

"a. Cartridge cases from one unchanged process and from one manufacturer.
b. Bullets from one unchanged process and from one manufacturer.
c. Primers from one lot interfix number and from one manufacturer/
d. Propellant from no more than two lot numbers and from one manufacturer.

* 4.4.3.1, Quality Conformance Inspection, Delete:

"Action time	50	1/	3.6	4.5.5
Velocity	20	3/	3.7	4.5.6 & 4.5.10
Chamber pressure	20	3/	3.8	4.5.7 & 4.5.10"

Substitute:

"Copper crush cylinder test method

Action Time	50	1/	3.6	4.5.5
Velocity	20	3/	3.7.1	4.5.6 & 4.5.10
Chamber Pressure	20	3/	3.8.1	4.5.7 & 4.5.10

EPVAT test method 5/

Action Time	30	1/	3.6	4.5.5
Velocity	-	3/	3.7.2	4.5.6 & 4.5.10
Chamber Pressure	-	3/	3.8.2	4.5.7 & 4.5.10"

Table III, Add:

"8. Cyclic rate	0	5/	Major"

Table III, Delete:

"8. Cyclic rate	0	5/	Major"

* 4.4.3.1, Quality Conformance Inspection,

Add:

"5/ The EPVAT test method for measuring chamber pressure, velocity and action time shall be performed simultaneously."

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Table III, NOTES, Add:

"5/ Failure of any burst to comply with the applicable requirement shall be cause for rejection of the lot subject to the testing of a second sample consisting of double the number of cartridges in the first sample. Failure of any burst in the second sample to comply with the applicable requirement shall be cause for rejection of the lot. The second sample, if required, shall only be fired in the weapon type in which the failure occurred."

Table III, NOTES, Delete Note 5 in its entirety.

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4.5.4, Add: "The size of the target shall be adjusted to suit the target range (200 or 600 yards)."

4.5.6 and 4.5.7, Add: "Prior to this test the cartridge shall be temperature conditioned in accordance with 4.5.10."

4.5.8, Delete: "Observation for compliance with Table I and Table III, as applicable and the cyclic rate of each test weapon shall be made. Cyclic rate of each weapon shall be recorded." and substitute: "Observation for compliance with Table I and Table III, as applicable, shall be made. Cyclic rate of each weapon shall be recorded."

* 4.5.5, Delete in its entirety and substitute the following:

"4.5.5 Action time. The test shall be conducted either in accordance with SCATP - 7.62 when using the action time test method or in accordance with Appendix A when using the EPVAT test method."

* 4.5.6, Delete in its entirety and substitute the following:

"4.5.6 Velocity. The test shall be conducted in accordance with TECP 700-700, Vol. III when using the velocity test barrel method, or in accordance with SCATP - 7.62mm when using the EPVAT test method."

* 4.5.7, Delete in its entirety and substitute the following:

"4.5.7 Chamber pressure. The test shall be conducted in accordance with TECP 700-700, Vol. III when using the copper crush cylinder method, or in accordance with Appendix A when using the EPVAT test method."

PAGE 20

5.2, Delete the following drawing numbers: "D7553544, D7553346", and substitute the following drawing numbers: "D12576456, D12576567".

5.3, Delete the following drawing numbers: "D7553544, D7553346", and substitute the following drawing numbers: "D12576456, D12576567".

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* Add new Appendix A as included page 27.

APPENDIX A

ELECTRONIC PRESSURE, VELOCITY AND ACTION TIME (EPVAT) TEST PROCEDURES

A.1 SCOPE

A.1.1 Scope. This appendix details the procedures to conduct the chamber pressure, velocity and action time tests. These tests are performed simultaneously. This appendix and supporting annexes are a mandatory part of the specification.

a. The chamber pressure test determines the pressure exerted in the chamber (cartridge case mouth location) of a weapon. The test is performed as a safety measure to insure that the pressure developed by the ammunition is safe for firing in the weapons for which it is intended.
b. The velocity test determines the velocity level and uniformity of the ammunition.
c. The action time test determines the overall primer ignition, propellant burning time, and barrel time (to antenna bar).

A.2 APPLICABLE DOCUMENTS (This section is not applicable)

A.3 EQUIPMENT

A.3.1 Equipment listed in the application Inspection Equipment List shall be used. Alternate designs may be submitted to TACOM-ARDEC for approval prior to use.

A.3.2 The pier or mount, on which the test fixture assembly is mounted, shall be of rigid construction.

A.4 USE OF REFERENCE CARTRIDGES

A.4.1 Reference cartridges shall be used to qualify test setups and establish range and equipment connections prior to firing an ammunition lot for acceptance.

A.4.2 One reference cartridge shall be fired for each cartridge of the test sample to be fired, up to 20 cartridges. When the test consists of more than 20, but not more than 40 cartridges, then 20 reference cartridges shall be fired. When the test consists of more than 40 cartridges, then one reference cartridge shall be fired for every two test cartridges.

A.4.3 After the required number of reference cartridges has been fired, the actual mean chamber pressure and velocity of the reference cartridge shall be compared with their respective assessed values as follows:

a. If the assessed value is greater than the actual mean value, the difference shall be added to the respective mean values obtained for the test cartridges.
b. If the assessed value is less than the actual mean value, the difference shall be subtracted from respective mean values obtained for the test cartridges.

APPENDIX A

c. If the Assessed Values equals Actual Mean Value, no correction is applied to test cartridge data.

A.4.4 The transducer Pressure Test barrel will be acceptable provided the mean velocity and chamber pressure results obtained with the referenced cartridges are within 35 ft/sec., and ± 3,500 psi, respectively, of the assessed values.

A.4.5 It is required that informational charts be maintained, for record purposes, of results from each test barrel in which reference cartridges are fired.

A.5 OPERATING PROCEDURE FOR THE BALLISTIC PRESSURE TRANSDUCER

A.5.1 The chamber pressure shall be determined by using acceptable ballistic pressure transducers of the type specified in the appropriate Inspection Equipment List. Alternate designs may be submitted to TACOM-ARDEC for approval prior to use.

A.5.1.1 One transducer shall be used at the chamber location (case mouth) of the test barrel.

A.5.2 The transducer shall have its sensitivity determined prior to the test and after successive 120 $\pm$ 20 cartridges are fired, at the pressure level of 50,000 psi. The transducer sensitivity shall be expressed in units of picocoulomb per psi and shall be identified as being determined at 50,000 psi. The method for determining the transducer sensitivity is detailed in Annex 1.

A.5.3 After having determined the sensitivity for the transducer, the value shall be compared to the value of the sensitivity obtained at the very last sensitivity determination. If the sensitivity change since the last determination at the pressure level of 50,000 psi (if the transducer will be used for measuring chamber pressure) is greater then $\pm$ 2 percent or more than $\pm$ 10 percent from the original calibration, the transducer shall be disqualified and shall be unacceptable for further testing at that pressure level.

A.5.4 The sensitivity value to be used for testing shall be the most recent value obtained for the pressure level that the transducer will be exposed to during the test.

A.5.5 A record shall be maintained of the sensitivity obtained for the transducer at the 50,000 psi pressure level as a function of the number of cartridges fired on each transducer. A suggested format is shown at the end of Annex 1.

A.5.6 New transducers shall be completely tested for acceptability according to the methods detailed in Annex 1.

A.5.7 The linearity determination for the transducers shall be performed as stated in Annex 1 after each time an accumulation of 500 cartridges has been fired on the transducer.

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A.6 PREPARATION

A.6.1 The required number of test and reference cartridges shall be placed in a vertical position, primer end down, in recessed holding blocks. The recessed holding blocks containing the cartridges shall be placed in a temperature-controlled container or room in such a manner that all cartridges are subjected to a uniform temperature for a minimum of two hours prior to firing. The container or room shall be maintained at a temperature of 70^0F $\pm$ 2^0F, with a relative humidity of 60 percent $\pm$ 5 percent, and be of sufficient capacity to allow free circulation of air.

A.6.2 The test barrel is assembled in the test fixture on the mount. The chamber and bore of the barrel are wiped dry. The barrel is then bore sighted into position.

A.6.3 The test fixture assembly shall be in conformance with the latest IEL.

A.6.4 The transducer mounting hole shall contain NO particles of foreign material.

A.6.5 The transducer shall be installed within the test barrel as per the instructions detailed in Annex 2. The firing mechanism shall be fitted with a device that reliably transmits an electrical signal to initiate timing on a chronograph at the instant of contact between firing pin and primer. The chronograph stop pulse shall be provided by antenna bar and channeled to a signal conditioning unit through the filtered amplifier. The signal conditioning unit shall not "load down" nor adversely affect the characteristics. A suitable chronograph shall be used such that the action time measurement error shall not exceed $\pm$ 2 microseconds.

A.6.6 The velocity screens are checked for position. It is of the utmost importance that the screens be placed in their proper positions; measurements must be within 1/8 inch. Velocity screens shall be checked for position. The instrumental point (mid-point between screens) shall be 78 feet from the muzzle of the barrel. The baseline is 100 feet between screens.

A.7 CONDUCTING THE TEST

A.7.1 Five warning (fouling) shots shall be fired. Velocity, pressure and action time readings shall be recorded to assure that the measuring equipment is functioning properly. After the last warming shot, the chamber pressure transducer shall be re-tightened to the appropriate torque level specified in Annex 2.

A.7.2 When firing EPVAT at 70^0F, the recessed holding blocks containing the reference and test cartridges shall be removed from the controlled temperature room or box and placed at a point convenient to the technician, provided the temperature of the firing room is approximately 70^0F $\pm$ 2^0F. If the firing room is not at approximately 70^0F $\pm$ 2^0F, the cartridges shall be placed in an insulated box (five cartridges at a time) which has been conditioned at the required temperature and the box placed at a point convenient to the technician. The cartridges shall then be removed singly from the insulated box immediately before firing. If an insulated box is not available, the cartridges shall be removed singly from the temperature controlled room or box immediately before firing.

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A.7.3 In order that the propellant shall be uniformly positioned from cartridge-to-cartridge, attention to detail is necessary in handling and chambering the cartridges. The cartridge shall first be held vertically, bullet upward. It shall then be rotated slowly in a vertical plane, stopping the rotation momentarily after 180^0 of rotation when the bullet is downward and then continuing throughout the remainder of the 360^0, stopping when the cartridge is again bullet end upward. The bullet end of the cartridge should now be lowered slowly to a position slightly above horizontal and chambered very carefully, taking care that the primer end of the case is not elevated above the bullet end of the case. (The object is to have the cartridge seated in the chamber ready to fire, with the propellant in a loose condition at the primer end of the case, and with such airspace as is present at the bullet end of the case.)

A.7.4 The breechblock is closed gently. If the technician encounters any difficulty closing the breech block or engaging the trip lever, the test shall be discontinued until such difficulty is corrected. If any delay should occur after the cartridge is placed in the chamber and the duration of the delay is approximately 30 seconds or longer, the cartridge shall be extracted and another cartridge inserted in its place.

A.7.5 The trip lever to which the lanyard is attached shall be engaged with the hammer. The technician shall retire to a safe position and pull the lanyard with a smooth, firm motion. The action time, velocity, peak chamber pressure of the shot shall be recorded. The breech block shall be opened, the fired case extracted and visually inspected by the technician to possible casualties.

A.7.6 The procedure prescribed in 7.3 through 7.5 shall be repeated until the required number of reference cartridges has been fired.

A.7.7 Continuous air cooling should be used on the barrel. If air cooling is not available, the barrel shall be allowed to cool to ambient temperature between each series of tests, or after a maximum of 20 cartridges has been fired. At no time shall the exposed metal surface of the test barrel become too hot to grasp with the bare hands (approximately 140^0F).

A.7.8 The velocity and pressure corrections shall then be obtained as prescribed in 4.3.

A.7.9 If the mean velocity, chamber pressure or port pressure obtained for the reference cartridges is not within the limits permitted, the test barrel shall be removed from the test, another barrel substituted and another series of reference cartridges fired. If this firing fails to produce satisfactory mean velocity, chamber pressure or port pressure values, the cause thereof shall be identified and eliminated before resuming the test.

A.7.10 After the test barrel has cooled to ambient temperature, warming (fouling) shots shall be fired in accordance with 7.1.

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A.7.11 The test cartridges shall then be fired following the procedure prescribed in 7.2 through 7.7. After the number of required test rounds have been fired on the transducers, the following steps shall be taken:

a. Remove the signal lines from the transducers. The signal connector on the transducer and interconnecting line shall be wiped clean with lint-free industrial wipes.

b. Remove the transducers and inspect all components for excessive combustion particle residue; be careful to distinguish between normal combustion residue and metallic particles removed from the bullet jacket. Also inspect the transducer threads for combustion residue.

c. Clean the transducers and the cavities thoroughly using paper wipes and degreaser spray. Once cleaned, inspect the sealing surfaces of both the transducer and the chamber cavity for signs of gas flow past the annular vee ring.

Upon completion of the above steps, the following procedures shall be followed:

1) If the transducers and cavities appear normal, the test results are considered valid. Transducers may be reinstalled and another cartridge lot fired using the same reference values.

2) If the transducers threads show signs of combustion residue, both the barrel and transducer with sealing components shall be removed from the test. The sealing surface of the barrel shall be machine refinished with a flat-end chucking reamer to a surface finish of 32 microinch or better before attempting to reuse the barrel, or a new barrel may be substituted. A replacement transducer shall be assembled into the test barrel and the test restart shall begin. The last test lot(s) fired back to the last transducer inspection with acceptable results or the last reference lot shall be retested to assure that the condition did not influence the test lot(s).

3) If the cavity seat in the test barrel shows signs of gas-flow through the sealing surfaces, the barrel shall be removed for refinishing of the cavity seat. Similar signs of gas-flow through the sealing surface of a transducer and/or component shall cause that unit to be removed from testing. The test restart shall begin with the replacement of the defective unit(s), and the procedure for refinishing the barrel sealing surface prescribed in paragraph (2) above.

A.8 RECORDING OF RESULTS

A.8.1 The test data shall be reported to the following precisions:

Chamber Pressure	-	nearest 10 psi
Velocity	-	nearest 1 fps
Action Time	-	nearest 0.1 millisecond

A.8.2 Reference cartridges – the following data shall be recorded:

CHAMBER PRESSURE, VELOCITY & ACTION TIME:

a. Individual values
b. Mean values

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c. Extreme variation of individual values
d. Standard deviation

A.8.3 Test cartridges – the following data shall be recorded:

CHAMBER PRESSURE, VELOCITY:

a. Individual values
b. Mean values
c. Correction factors
d. Mean values (corrected)
e. Extreme variation of individual values
f. Standard deviation

ACTION TIME:

a. Individual values
b. Extreme variations of individual values
c. Mean values
d. Standard deviation

A.8.4 In addition, the following information shall be recorded:

a. Barrel number
b. Receiver number
c. Number of rounds fired in barrel prior to test
d. Headspace measurement, firing pin protrusion measurement and number of rounds fired on transducer prior to test.
e. Transducer serial number
f. Case defects

APPENDIX A
ANNEX 1

BALLISTIC PRESSURE TRANSDUCERSENSITIVITY DETERMINATION AND LINEARITY CHECK

A.1 SCOPE

A.1.1 Scope. This procedure is for determining transducer sensitivity and linearity. The determination of a transducer's sensitivity is required to establish the ratio of pressure input to electrical output. Once determined, the sensitivity value is used to translate the electrical output of the transducer into a measurement of pressure. The linearity check is required to ensure that the transducer's sensitivity value is maintained throughout the full range of pressures to be measured.

A.2 APPLICABLE DOCUMENTS (This section is not applicable)

A.3 EQUIPMENT

A.3.1 Equipment listed in the BALLISTIC TRANSDUCER SENSITIVITY section of the appropriate Inspection Equipment List shall be used.

A.4 PROCEDURE FOR DETERMINING TRANSDUCER SENSITIVITY AND LINEARITY

A.4.1 The hydraulic pressure source and electronic instrumentation shall be calibrated with standards traceable to the National Bureau of Standards or equivalent.

A.4.2 The transducer shall be installed into a hydraulic pressure manifold according to the installation procedure specified in Annex 2. Adjust the electronic instrumentation such that when the system is in the "ground state", zero volts (± 0.001 volts) is indicated by the electronic recording device. Similarity properly adjust the electronic instrumentation for direct reading; when a full scale voltage (i.e. 5±0.001 volts) is applied to the input, in place of the transducer, the electronic recording device shall indicate the same full scale voltage. Connect the signal cable from the transducer to the electronic instrumentation.

A.4.3 Apply 0 psi (atmospheric pressure) of hydraulic pressure to the transducer, the indicated reading from the electronic recorder shall be 0.000 ± 0.001 volts and shall remain such for at least 15 seconds.

A.4.4 Apply the following hydraulic pressure levels to the transducer:

a. 40,000 psi
b. 50,000 psi
c. 60,000 psi

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Each pressure level shall be applied three times, either by applying increasing pressure levels in step a through step c, or by applying one pressure level at a time and returning to zero pressure before repeating. Electronic system drift and stability shall dictate which method should be used. If drifting is noticed, the pressure source shall be checked for fluid leaks. Drifting caused by fluid leakage is too severe for either method to yield acceptable measures. Record the voltage readings at each pressure level and calculate the average voltage for each pressure level.

A.4.5 Determine the transducer sensitivity (T.S.) for each pressure level by the following calculations:

a. For picocoulomb per psi, use:

$$\frac{\text{Average Transducer Output (volts)}}{\text{Pressure Input Level (K psi)}} = \text{T.S.}$$

b. For psi per volt, use:

$$\frac{\text{Pressure Input Level (K psi)}}{\text{Average Transducer Output (volts)}} = \text{T.S.}$$

d. Record the resulting sensitivity in units of either picocolomb/psi or psi/volt. For the transducer to be acceptable for use, the sensitivity value obtained at each pressure level shall not be more than 2 percent different from the previously obtained sensitivity at that pressure level nor more than 10 percent different from the original sensitivity determination for that transducer. A transducer calibration record must be kept for each transducer. An example is at figure 1.

A.4.6 The transducer linearity shall be determined by the full-scale (F.S.) error band method used in conjunction with the zero-based best straight line. The following is a description of this method:

a. Determine the average transducer output voltage for each of these pressure levels: 40,000, 50,000 and 60,000 psi.

b. Determine the straight line, intercepting the origin (0,0), to the data points by equalizing the error between the points below the line and the points above the line.

c. The $\pm$ 1 percent Full Scale Error Bands shall be determined for the data group. The transducer shall be determined to have full range acceptable linearity if all data points fall within the appropriate error bands. If one or more data points fall outside the error band(s), the transducer shall be considered to have unacceptable linearity.

A.4.7 An example for determining transducer linearity is at figure 2.

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ANNEX 1

EXAMPLE

Ser. No.	PRESSURE TRANSDUCER CALIBRATION RECORD CAL 50
Calib. Interval 120±20	

DATE	LOCATION	REMARKS	DATE OF CALIB	ROUNDS FIRED	TOTAL ROUNDS			50K	CERT. BY
6/15/99	CHAMBER	NEW IN SERVICE	5/24/99	50	50			9782	XXX
			6/15/99	50	100			9782	XXX

MAKE & MODEL: KISTLER Mod. 6215

Figure 1 - Annex 1 to Appendix A

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ANNEX 1

EXAMPLE

TRANSDUCER LINEARITY RECORD - CAL 50

Transducer Mfg: KISTLER Pressure Stand:
Transducer Mod: 6215 Amplifier:
Transducer SN: Digital Voltmeter:
No. of Rounds:
Cert by: Date:

Pressure Levels	Transducer output (volts) First	Second	Third	Mean	Linear	T.S.	F.S.
40K =	4.075	4.077	4.073	4.075	-0.3	9816	IN
50K =	5.109	5.112	5.113			5.111	0.0
9782 IN							
60K =	6.139	6.141	6.139			6.140	0.1
9773 IN							

ERROR BAND LINEARITY VALUES

40K	LOW	4.027	50K	LOW	5.049	60K	LOW	6.071
40K	MEAN	4.088	50K	MEAN	5.110	60K	MEAN	6.132
40K	HIGH	4.149	50K	HIGH	5.171	60K	HIGH	6.193

TRANSDUCER LINEARITY DETERMINATION
(METHOD OF LEAST SQUARES)

Least squares line that passes through the origin to
Obtain a straight line fit in which y = Bx where

$$B = \frac{x1y1 + x2y2 + x3y3}{x1^2 + x2^2 + x3^2} = \text{Slope}$$

$$= \frac{40*4\ .075 + 50*5\ .111 + 60*6\ .140}{40^2 + 50^2 + 60^2} = .1022$$

Bx1 = .1022*40 = 4.088
Bx2 = .1022*50 = 5.110
Bx3 = .1022*60 = 6.132

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ANNEX 1

Error band width = ± .01*6 .132 = ± .06132

Pressure input level (kpsi)	Transducer output reading (volts)
x1 = 40	y1 = 4.075
x2 = 50	y2 = 5.111
x3 = 60	y3 = 6.140

NOTE: The mean voltage output value obtained at each pressure level must fall within the error band linearity values for the corresponding pressure levels.

Figure 2 - Annex 1 to Appendix A

APPENDIX A
ANNEX 2

BALLISTIC TRANSDUCERINSTALLATION AND OPERATING PROCEDURE

A.1 SCOPE

A.1.1 Scope. This procedure is for the installation of a transducer. The ballistic pressure transducer must be seated properly in the test barrel or sensitivity block with sufficient and proper torque to ensure accuracy and reliable operation.

A.2 APPLICABLE DOCUMENTS (this section is not applicable)

A.3 EQUIPMENT

A.3.1 Equipment listed in the appropriate Inspection Equipment List shall be used in addition to the following:

a. Lint-free industrial paper wipes.
b. Degreaser spray
c. High vacuum grease: Heat Stable Silicone type

A.4 SEALING SURFACE PREPARATION

A.4.1 The following procedure shall be followed for all transducer installations, i.e. sensitivity block, chamber and port positions of the test barrel.

a. Shallow annular grooves (0.001 or 0.002 inches in depth) in sealing surface are normal; any burning, combustion particle residue or corrosion shall be removed by touching up the surface with a flat-end reamer.
b. Clean cavity and transducer thoroughly: use clean, lint-free industrial paper wipes and degreaser spray.
c. Transducer threads shall be coated with a thin film of high vacuum grease prior to installation.
d. The signal connector on the transducer and interconnecting line shall be wiped clean with lint-free industrial wipes.

A.5 TRANSDUCER INSTALLATION

a. The sealing ring Type 1100 shall be placed on the face of the DIAG 6215 transducer and a very small amount of silicon grease shall be placed in the vee impression of the transducer to make the ring adhere. The diaphragm protection Type 6567 shall then be placed over the face of the transducer and snapped evenly over this face. A second Type 110 sealing ring shall then be placed in the vee impression on the face of the Type 6567 diaphragm protection with a very small amount of silicon grease to make the ring adhere. The assembly shall then be placed into the mounting cavity.

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b. In all installations, the transducer shall be tightened with a torque wrench to 180 in-lbs.

c. The signal line shall be reconnected to the transducer and securely tightened, finger tight.

d. For calibration of the Kistler 6215 transducer, the diaphragm protection Type 6567 and second sealing ring Type 1100 shall not be used.

e. Transducer storage – Transducers should be stored in a clean, moisture-free environment. Transducers, diaphragm protections and cables shall be kept free from contamination and possible damage when not in use.

The margins of this amendment are marked with asterisks to indicate where changes (additions, modifications, corrections, deletions) from the previous amendment were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous amendment.

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(Project 1305-0230)