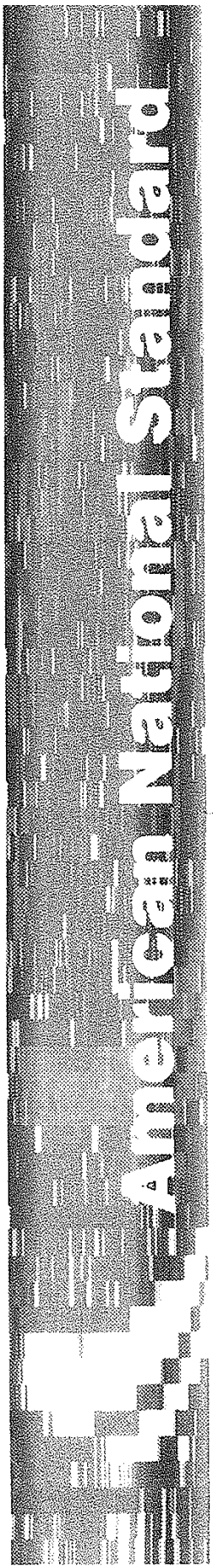
ANSI/SAAMI Z299.1-1992



Voluntary Industry Performance Standards for Pressure and Velocity of Rimfire Sporting Ammunition for the Use of Commercial Manufacturers

ANSI American National Standards Institute
Headquarters
11 West 42nd Street, 13th Floor
New York, NY 10036
Tel: 212 642-4900 Fax: 212 398-0023

American National Standard Voluntary Industry Performance Standards for Pressure and Velocity of Rimfire Sporting Ammunition for the Use of Commercial Manufacturers

Sponsor

Sporting Arms and Ammunition Manufacturers' Institute, Inc.

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Associate Members:

Expro Chemical Products, Inc.
SNC Industrial Technologies

Approved November 24, 1992
American National Standards Institute, Inc.

Abstract In the interests of safety and interchangeability, this Standard provides pressure and velocity performance and dimensional characteristics for rimfire sporting ammunition. Included are procedures and equipment for determining these criteria.

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American National Standard

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Published by

Sporting Arms & Ammunition Manufacturers' Institute, Inc.
11 Mile Hill Road, Newtown, Connecticut 06470

Printed in the United States of America.

(This foreword is not part of American National Standard Z299.1-1992)

Foreword

The development of this voluntary industry performance standard was initiated under the auspices of the Sporting Arms & Ammunition Manufacturers' Institute, Inc. (SAAMI). A Product Standards Task Force was established by the Institute in 1975 and charged with the drafting of standards and their subsequent periodic revisions.

The material presented provides the commercial manufacturer of factory loaded ammunition with pressure and velocity performance and dimensional characteristics. Included are procedures and equipment for determining these criteria. For the purpose of this standard a commercial manufacturer is defined as one who produces ammunition by fabricating component parts from raw materials as opposed to remanufacture with parts originally made by others.

This standard for rimfire sporting ammunition was first published in 1975. Subsequently it was revised in 1977 to keep abreast with the rapid changes taking place in pressure measuring techniques. Since 1977, this standard has been updated every five years in keeping with ANSI policy. The 1988 issue is replaced by this 1992 revision. Changes in the standard with each revision include minor adjustments of velocities, the addition of new load offerings, an updating of recommended equipment sources and the latest procedures for reporting reference ammunition assessments.

Suggestions for improvement of this standard will be welcome. They should be sent to The Sporting Arms and Ammunition Manufacturers' Institute, Inc., 555 Danbury Road, Wilton, Connecticut 06897.

Consensus for this standard was achieved by use of the Canvass Method.

The following individuals and organizations recognized as having an interest in the standardization of safety requirements for factory loaded sporting ammunition were contacted prior to the approval of this standard. Inclusion in this list does not necessarily imply that the individual or organization concurred with the submittal of the standard to ANSI:

A-Square Company, A.B. Alphin
Association of Firearms & Tool Mark Examiners - J. Hamby, M.A.
D.M.W. Laboratory Inc. - P.M. Dougherty
Federal Bureau of Investigation - T. Hollabaugh
Forensic Ammunition Service - G. Kass
J. Gourley Associates, Inc. - G.E. Gourley
Guilford Engineering Associates, Inc. - D. Findlay, P.E.
A. Hill - Independent Expert
R.L. Hillberg - Independent Expert
Hodgdon Powder Company - R. Reiber
National Institute of Standards & Technology - D.E. Frank, PhD.
National Reloading Manufacturers' Association - L.J. Farmer
National Rifle Association - P. Dickey
Nosler Bullets Inc. – G.H. Root
Rock Island Arsenal - L. Miller
Royal Canadian Mounted Police - D. Penk
Tioga Engineering Co., Inc. - W.C. Davis, P.E.
U.S. Customs Service, NFPS - J. Mitchem
J. Warner - Independent Firearms Examiner
H.P. White Laboratory - D. Dunn
Wilson Arms - G. Wilson III

RIMFIRE
SAAMI VOLUNTARY PERFORMANCE STANDARDS

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

SECTION I - CHARACTERISTICS
RIMFIRE
SAAMI VOLUNTARY PERFORMANCE STANDARDS

RIMFIRE CARTRIDGES
FULL & ABBREVIATED NAMES

The following tabulation lists recommended full names and abbreviated names of the rimfire cartridges currently supplied for various types of firearms.

Full Name	Abbreviated Name
22 Short CB	22 SCB
22 Short Standard Velocity	22 SV
22 Short High Velocity	22 SHV
22 Long High Velocity	22 LHV
22 Long Rifle Standard Velocity	22 LRSV
22 Long Rifle High Velocity	22 LRHV
22 Long Rifle Hyper Velocity	22 LRHypV
22 Long Rifle Match	22 LR Match
22 Long Rifle Shot	22 LR Shot
22 Winchester Magnum Rimfire	22 WMRF

RIMFIRE VELOCITY INTERPRETATION

Velocity specification are stated on the basis of a nominal mean velocity ± 90 feet per second, as listed in this section.

In the testing of ammunition, subsequent to its manufacture, allowances must be made for factors which can influence both the average and the variability of velocity observed. Factors such as components, sampling error, and differences in test conditions may influence the observed results.

The specifications include allowances for these sources of variation which are standardized and controlled during the manufacturing cycle, but may vary considerably in subsequent tests.

Manufacturers of ammunition should control velocity during loading at a level which gives reasonable assurance that the product will, in tests subsequent to loading, meet the established specifications.

The following procedures are intended to serve as a guide in establishing loading control limits for velocity which are compatible with the established values. These procedures, based on a modification of the concept of Reject Limits for Averages, permit maximum latitude in loading control while providing adequate assurance that velocity specifications are met.

This procedure requires that a good estimate of σ' (sigma prime) be developed through analysis of the within-sample variation of velocity. Sigma prime is most easily determined by finding the average range (or extreme variation) within samples of size 10 rounds or less and using the factor d_2 to convert the average range to σ'. For sample sizes greater than 10, calculate the standard deviation of each sample, and determine the average standard deviation $\bar{\sigma}$. Divide $\bar{\sigma}$ by the factor c_2 to obtain an estimate of σ'. (Note: Most texts on Quality Control contain tables of c_2, d_2). The test results from at least (50) samples of n rounds each, which include data from the loading of several different lots of powder, should be used in developing the value of sigma prime (σ').

Table A contains the factors (M_1) which are used as multipliers of σ' in determining the Upper and Lower Reject Limits for sample averages. The specific values for M_1 are given for several levels of assurance and a range of sample sizes. The values of t_2 are taken from a table of critical values for the two-sided normal distribution. Values of M_1 are calculated as follows:

$M_1 = t_2 / \sqrt{n}$ where t_2 is as defined above and

n = sample size. For example, the first value

of M_1 in TABLE A is computed as follows:

$$1.65/\sqrt{2} = 1.17.$$

TABLE A
FOR TWO SIDED SPECIFICATIONS FOR AVERAGES
MULTIPLIER (M_1) OF σ' SHOWN
IN THE BODY OF THE TABLE

Selected Level of Assurance %	SAMPLE SIZE								
	t_2	2	3	4	5	10	15	20	25
90	1.65	1.17	.95	.83	.74	.52	.43	.37	.33
95	1.96	1.39	1.13	.98	.88	.62	.51	.44	.39
97.5	2.24	1.65	1.35	1.17	1.04	.74	.60	.52	.47
99	2.58	1.82	1.49	1.29	1.15	.82	.67	.58	.52
99.5	2.81	2.00	1.62	1.41	1.26	.89	.73	.63	.56
99.73	3.00	2.12	1.73	1.50	1.34	.95	.77	.67	.60

EXAMPLE OF THE USE OF TABLE A

Assume that -

1. The product velocity specification is 1235 ± 90 feet per second. Then, the specified limits are 1325-1145 feet per second.

2. The value of σ' has been determined to be 25 ft./s

3. The selected level of assurance = 99%

4. The sample size = 5 rounds

Calculate the sample average Reject Limits -

Upper Reject Limit = 1325-(25 x 1.15) = 1325-28.75 = 1296 ft./s

Lower Reject Limit = 1145+(25 x 1.15) = 1145+28.75 = 1174 ft./s

NOTE: Because of the importance of σ' in this procedure, it is recommended that control charts for the Range (or Extreme Variation) be used to monitor and control the variability of velocity. Procedures for the construction and use of these charts can be found in Quality Control text books.

There are three principal sources of factors affecting pressure measurements. These are instrumentation, ammunition and procedure. The following lists the principal items in each category that may cause difficulties.

INSTRUMENTATION

1. Condition of test barrel (whether minimum or maximum bore and chamber size and headspace, amount of erosion at throating, origin of lands, etc.).
2. Fit of transducer in barrel.
3. Location of transducer.
4. Tightness of barrel mounting.
5. Shape, size, and protrusion of firing pin beyond breech face.
6. Force of firing pin blow.
7. Characteristics of transducer.
8. Quality of transducer.
9. Quality of read-out system.

AMMUNITION

1. Condition of cartridge case.
2. Temperature of ammunition.

PROCEDURE

1. Failure to mount pressure barrel properly in test action to assure minimum headspace.
2. Failure to fire warming shots.
3. Overheating barrel by excessive rate of fire.
4. Failure to clean bore and control metal fouling (leading).
5. Failure to protect gauge against contamination such as oil or water.
6. Transducer calibration.
7. Read-out system calibration.

EXPLANATION OF PRESSURE TERMINOLOGY

SAAMI recognizes ONE pressure measuring system for Rimfire Ammunition. That system is the piezoelectric transducer system with the transducer flush mounted in the chamber of the test barrel. Pressure developed by the burning propellant exerts force on the transducer through the cartridge case wall causing the transducer to deflect, creating a measurable electric charge. Pressures measured with this system are expressed in units of "pounds per square inch" (abbreviated psi).

Maximum Average Pressure - is the recommended maximum pressure level for loading commercial sporting ammunition. This pressure level is positioned two standard errors below the Maximum Probable Lot Mean (MPLM) pressure in order to assure there is a 97.5% probability that the Maximum Probable Lot Mean pressure is not exceeded. See Figure 1.

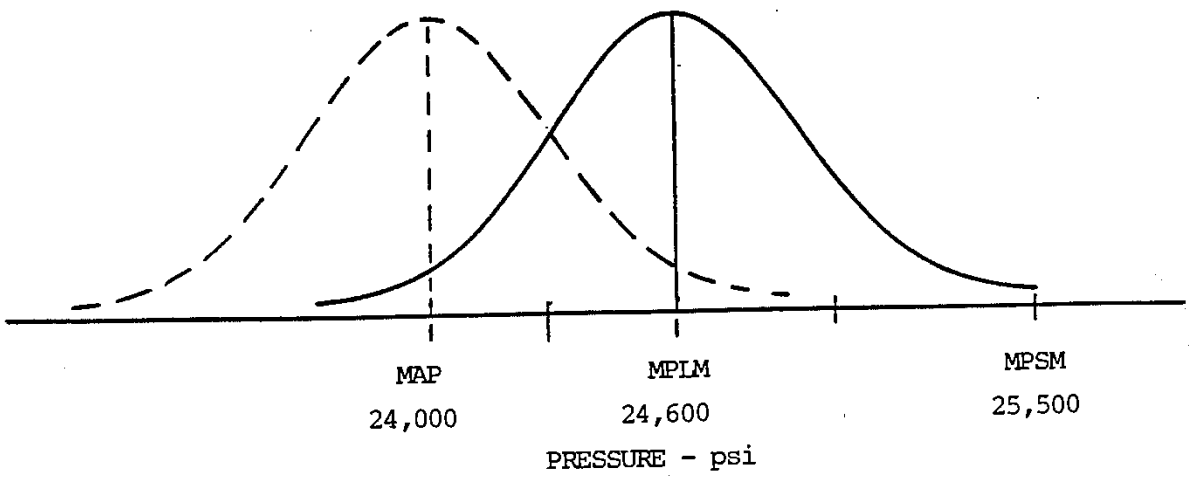


Figure 1

Standard Deviation (S.D.) - The Standard Deviation for each Maximum Average Pressure Level is based on a Coefficient of Variation of 4%. This 4% Coefficient of Variation is maintained throughout the SAAMI pressure spectrum providing a realistic Standard Deviation for each pressure level. To obtain the S. D. for a particular MAP multiply the MAP by 0.04 i.e., 24,000 x 0.04 = 1,000 psi.

Standard Error ($\sigma_{\bar{x}}$) - The standard error is calculated by dividing the Standard Deviation (population S. D. = σ) by the square root of the sample size $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$

Maximum Probable Lot Mean (MPLM) - The MPLM is calculated by adding two standard errors to the Maximum Average Pressure.

The SAAMI pressures are calculated based on a sample size of 10. The Maximum Probable Lot Mean represents the midpoint of the upper service pressure distribution. See figure 1. For example, if the Maximum Average Pressure is 24,000 psi, the Maximum Probable Lot Mean (MPLM) is calculated as follows:

MPLM = Maximum Average Pressure + 2 standard errors
MPLM = 24,000 + (316 x 2) = 24,000 + 632 = 24,632 rounded to 24,600 psi

Maximum Probable Sample Mean (MPSM) - is the maximum expected average pressure that may be observed in the testing of product subsequent to its manufacture and is not intended for use as a loading control point. The Maximum Probable Sample Mean is positioned 3 standard errors above the Maximum Probable Lot Mean i.e., MPLM + $3\sigma_{\bar{x}}$. See Figure 1.

Maximum Extreme Variation - The maximum allowable sample E.V. (Extreme Variation or Range) is a statistic derived from the knowledge of the population Standard Deviation. Applying table figures from the Relative Range Tables (Biometrika Tables for Statisticians) we calculate the Maximum E.V. or Range--- (population S.D.) x 5.16 (table constant for sample of 10 at 99.0% confidence level) i.e., 1,000 x 5.16 = 5,160 psi rounded up to 5,200 psi.

Cartridge	Bullet Wt. Grs.	Bullet Type	Velocity in ft/s Mean Instr. @15' (± 90)	Pressure Limits (psi/100)* Maximum Average Pressure (MAP)	Maximum Probable Lot Mean (MPLM)	Maximum Probable Sample Mean (MPSM)
22 Short CB	29	SL	710	210	215	223
22 Short SV	29	SL	1035	210	215	223
22 Short HV	27	HPL	1105	210	215	223
22 Short HV	29	SL	1080	210	215	223
22 Long HV	29	SL	1215	240	246	255
22 LRSV	40	SL	1135	240	246	255
22 LRHypV	33	TCHP	1465	240	246	255
22 LRHypV	36	TCSB	1385	240	246	255
22 LRHV	36	HPL	1260	240	246	255
22 LRHV	37	HPL	1260	240	246	255
22 LRHV	40	SL	1235	240	246	255
22 LRHV	42	TCSB	1200	240	246	255
22 LRHV	25	No.12-Shot	1000	240	246	255
22 WMRF **	40	FMC-HSP	1875	240	255	278

* Based on sample size, n = 10

** Experience has shown that with the 22 WMRF cartridge variations that are higher than normal Rimfire occur. As a result a Standard Deviation of 24 has been established for this cartridge.

FMC: Full Metal Case
HPL: Hollow Point Lead
SL: Solid Lead
HSP: Hollow Soft Point
HV: High Velocity
JHP: Jacketed Hollow Point
SV: Standard Velocity
TCHP: Truncated Cone Hollow Point
TCSB: Truncated Cone Solid Bullet

VELOCITY AND PRESSURE DATA
RIMFIRE MATCH CARTRIDGES

Cartridge	Bullet Wt. Grs.	Bullet Type	Velocity in ft/s Mean Instr. @15' (± 90)	Pressure Limits (psi/100)* Maximum Average Pressure (MAP)	Maximum Probable Lot Mean (MPLM)	Maximum Probable Sample Mean (MPSM)
22 LR (Rifle Match)	40	SL	1100	240	246	255
22 LR (Pistol Match)	40	SL	1135	240	246	255

* Based on sample size, n = 10

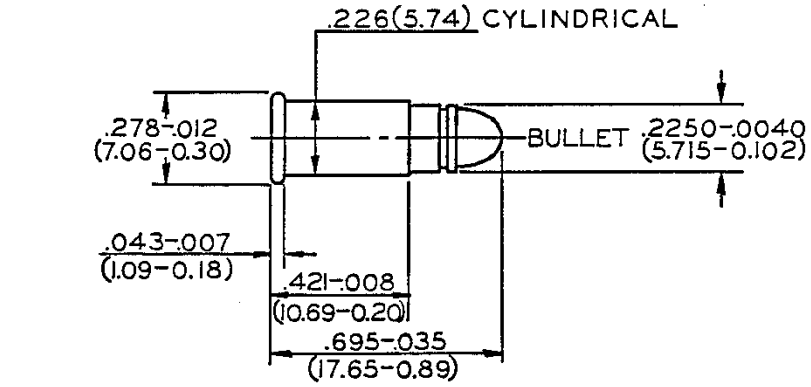
The velocity figures listed above are nominal values; optimum accuracy may require a velocity different from the nominal figure.

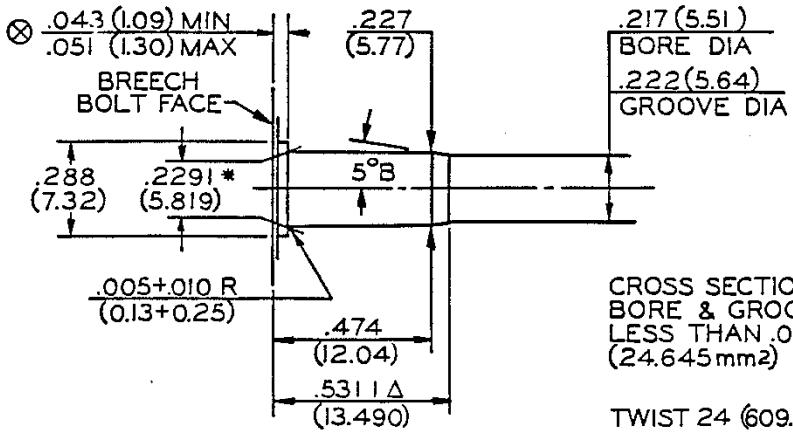
SL: Solid Lead

NOTE: Where manufacturer's practices produce values different in any respect from those tabulated, those practices and the results therefrom shall be considered acceptable when they are statistically equivalent.

CARTRIDGE

UNLESS OTHERWISE NOTED
BODY DIA -.004 (0.10)





CROSS SECTION AREA OF BORE & GROOVES NOT LESS THAN .0382 SQ IN. (24.645 mm2)

TWIST 24 (609.6) RH-OPTIONAL

CHAMBER

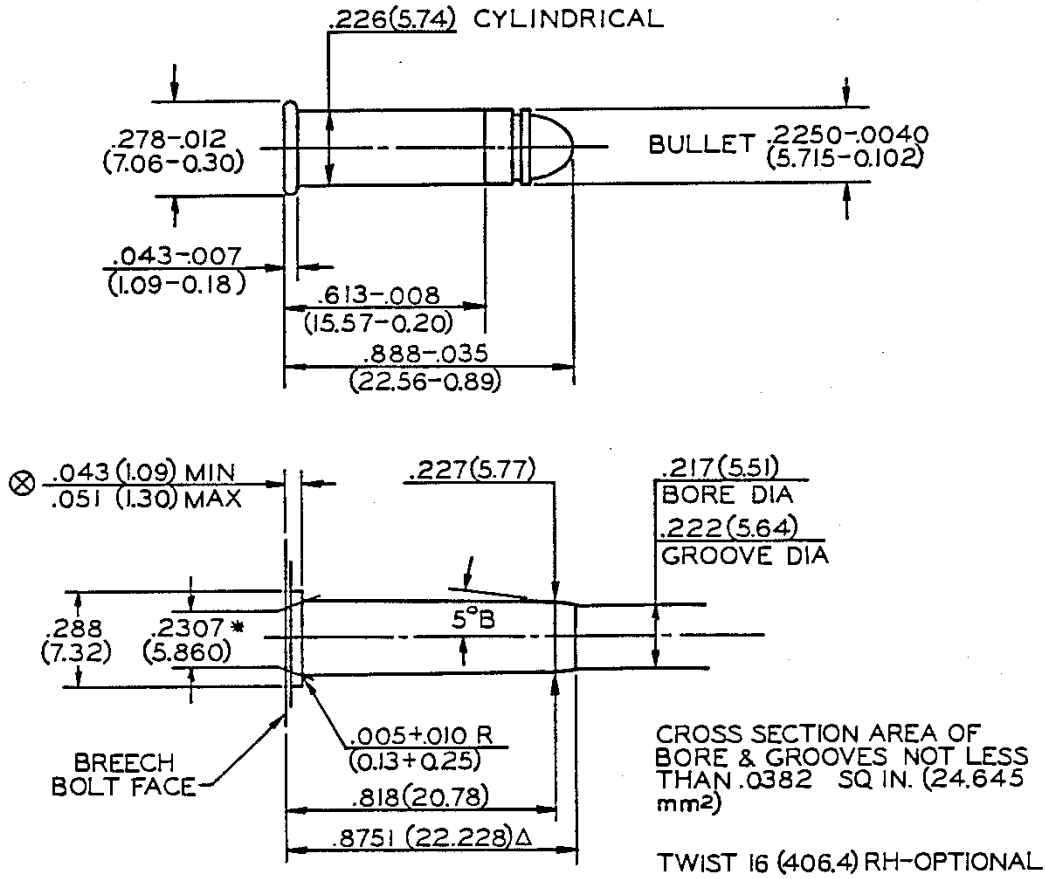
UNLESS OTHERWISE NOTED
ALL DIA +.002 (0.05)
LENGTH TOL +.015 (0.38)

NOTE
B = BASIC
(XX.XX) = MILLIMETERS ⊗ = HEADSPACE DIMENSION
* DIMENSIONS ARE TO INTERSECTION OF LINES Δ = REFERENCE DIMENSION
ALL CALCULATIONS APPLY AT MAXIMUM MATERIAL CONDITION (MMC)

CARTRIDGE & CHAMBER
22 LONG

CARTRIDGE

UNLESS OTHERWISE NOTED
BODY DIA -.004 (0.10)



CROSS SECTION AREA OF BORE & GROOVES NOT LESS THAN .0382 SQ IN. (24.645 mm²)

TWIST 16 (406.4) RH-OPTIONAL

CHAMBER

UNLESS OTHERWISE NOTED
ALL DIA +.002 (0.05)
LENGTH TOL +.015 (0.38)

NOTE
B = BASIC
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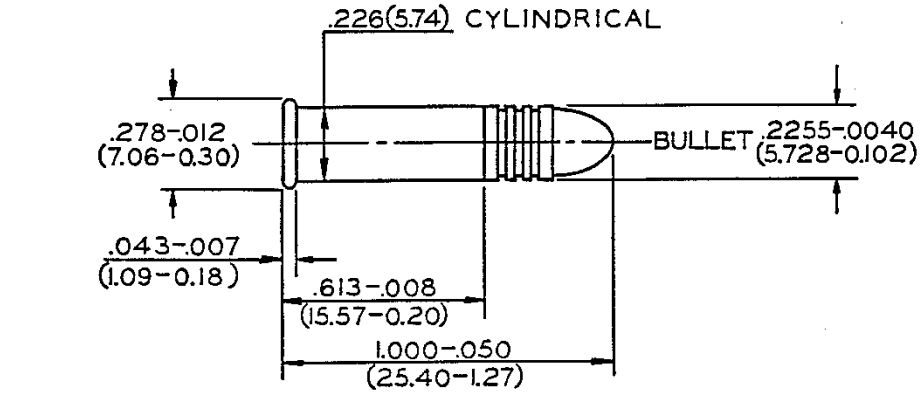
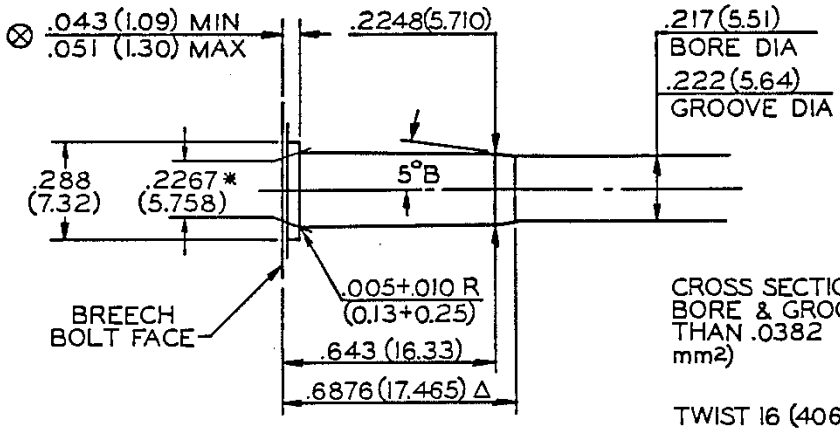
UNLESS OTHERWISE NOTED
BODY DIA -.004 (0.10)





CROSS SECTION AREA OF BORE & GROOVES NOT LESS THAN .0382 SQ IN. (24.645 mm2)

TWIST 16 (406.4) RH-OPTIONAL

CHAMBER

UNLESS OTHERWISE NOTED
ALL DIA +.002 (0.05)
LENGTH TOL +.015 (0.38)

NOTE
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(XX.XX)=MILLIMETERS ⊗=HEADSPACE DIMENSION
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ALL CALCULATIONS APPLY AT MAXIMUM MATERIAL CONDITION (MMC)

CARTRIDGE & CHAMBER
22 LONG RIFLE-SPORTING

CARTRIDGE

UNLESS OTHERWISE NOTED
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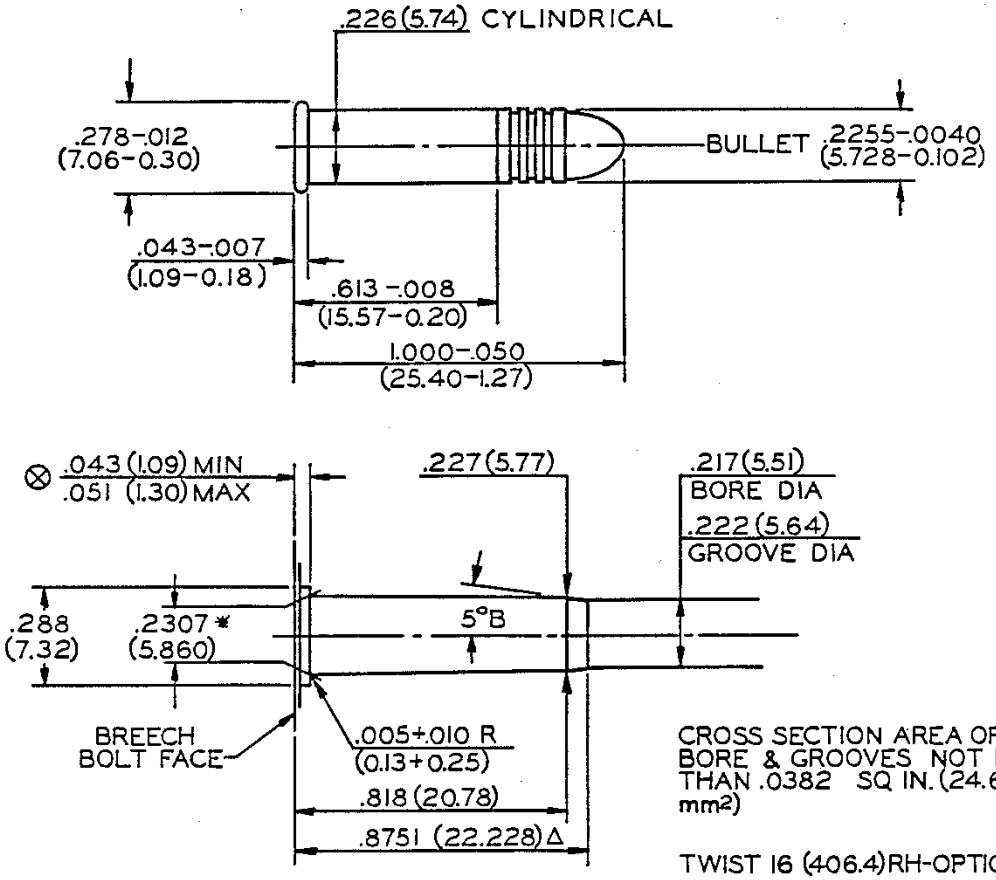

CROSS SECTION AREA OF BORE & GROOVES NOT LESS THAN .0382 SQ IN. (24.645 mm²)

TWIST 16 (406.4)RH-OPTIONAL

CHAMBER

UNLESS OTHERWISE NOTED
ALL DIA +.002 (0.05)
LENGTH TOL +.015 (0.38)

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CARTRIDGE

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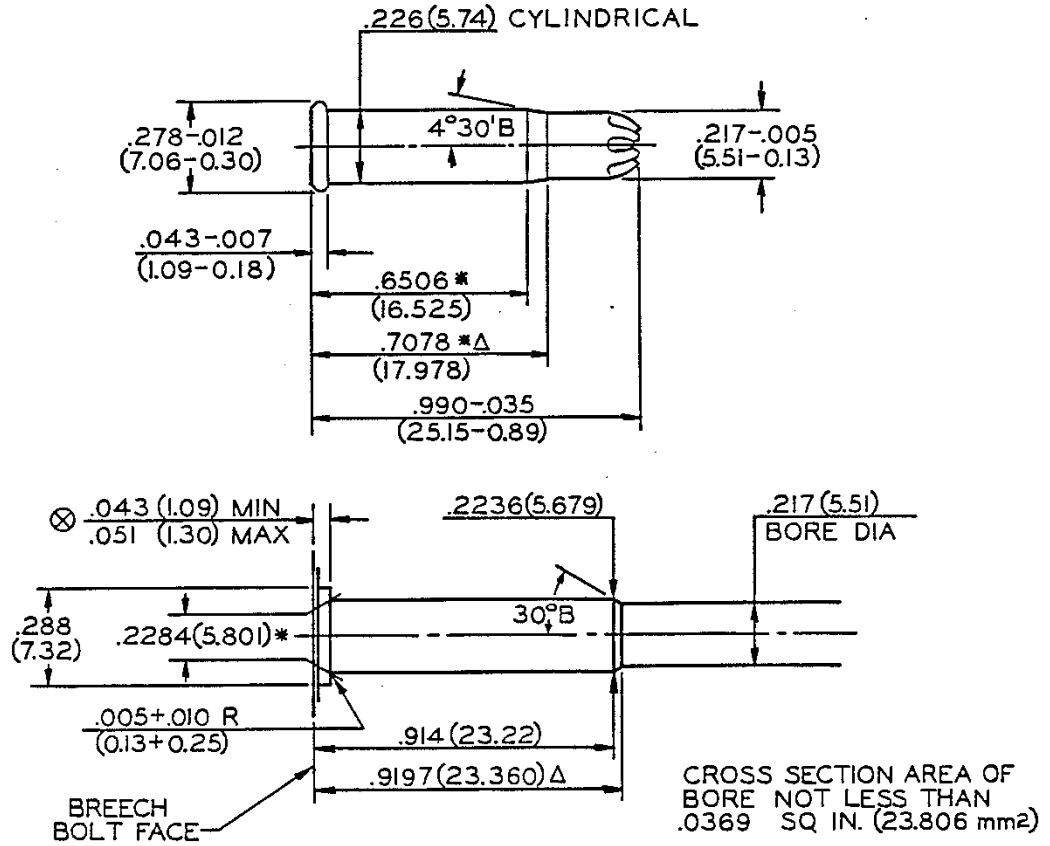

CROSS SECTION AREA OF
BORE NOT LESS THAN
.0369 SQ IN. (23.806 mm2)

CHAMBER

UNLESS OTHERWISE NOTED
ALL DIA +.002 (0.05)
LENGTH TOL +.015 (0.38)

NOTE
B=BASIC
(XX.XX)=MILLIMETERS ⊗=HEADSPACE DIMENSION
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CARTRIDGE

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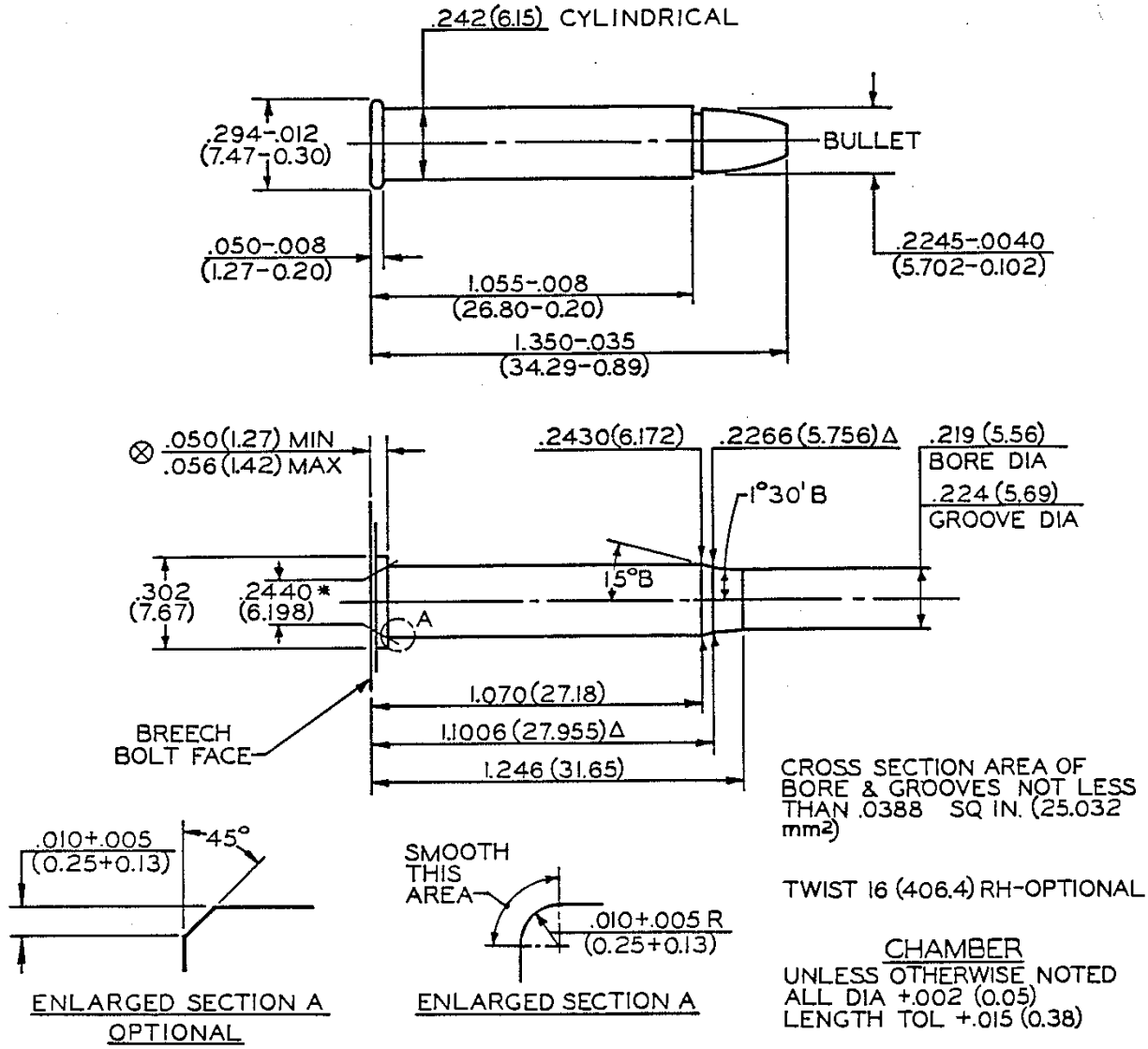
BODY DIA -.004 (0.10)



ENLARGED SECTION A
OPTIONAL

ENLARGED SECTION A

CROSS SECTION AREA OF BORE & GROOVES NOT LESS THAN .0388 SQ IN. (25.032 mm²)

TWIST 16 (406.4) RH-OPTIONAL

CHAMBER

UNLESS OTHERWISE NOTED
ALL DIA +.002 (0.05)
LENGTH TOL +.015 (0.38)

NOTE
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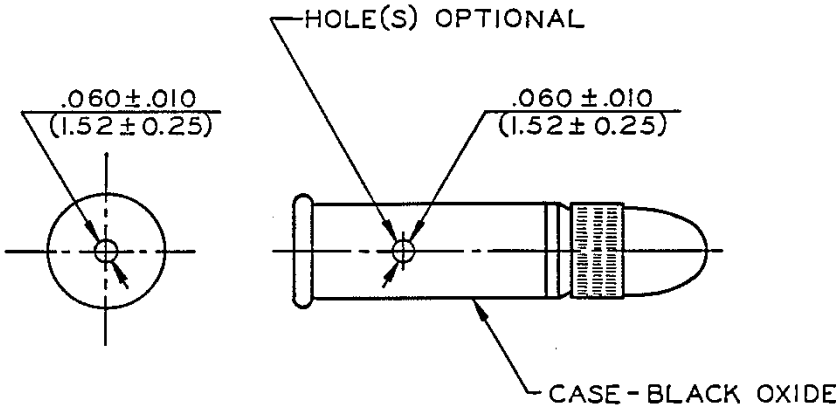
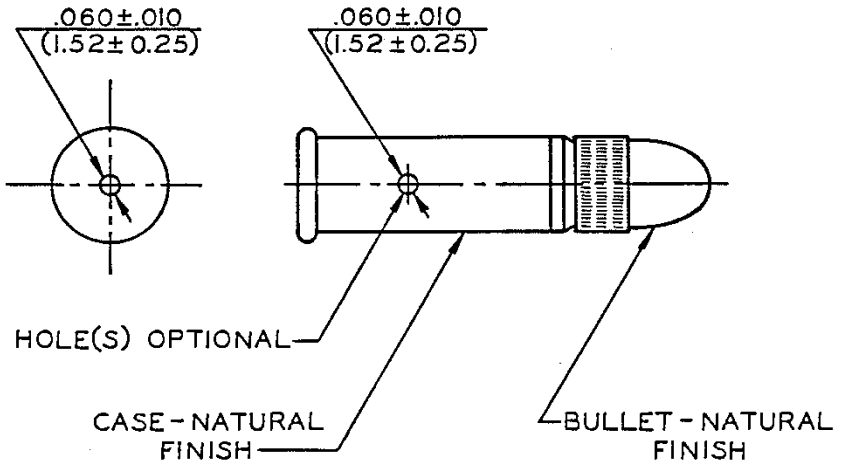


NOTE
ILLUSTRATES FORM ONLY -
PERTINENT DIMENSIONS SHOWN ON
APPROPRIATE CARTRIDGE DRAWING

(XX.XX) = MILLIMETERS



NOTE
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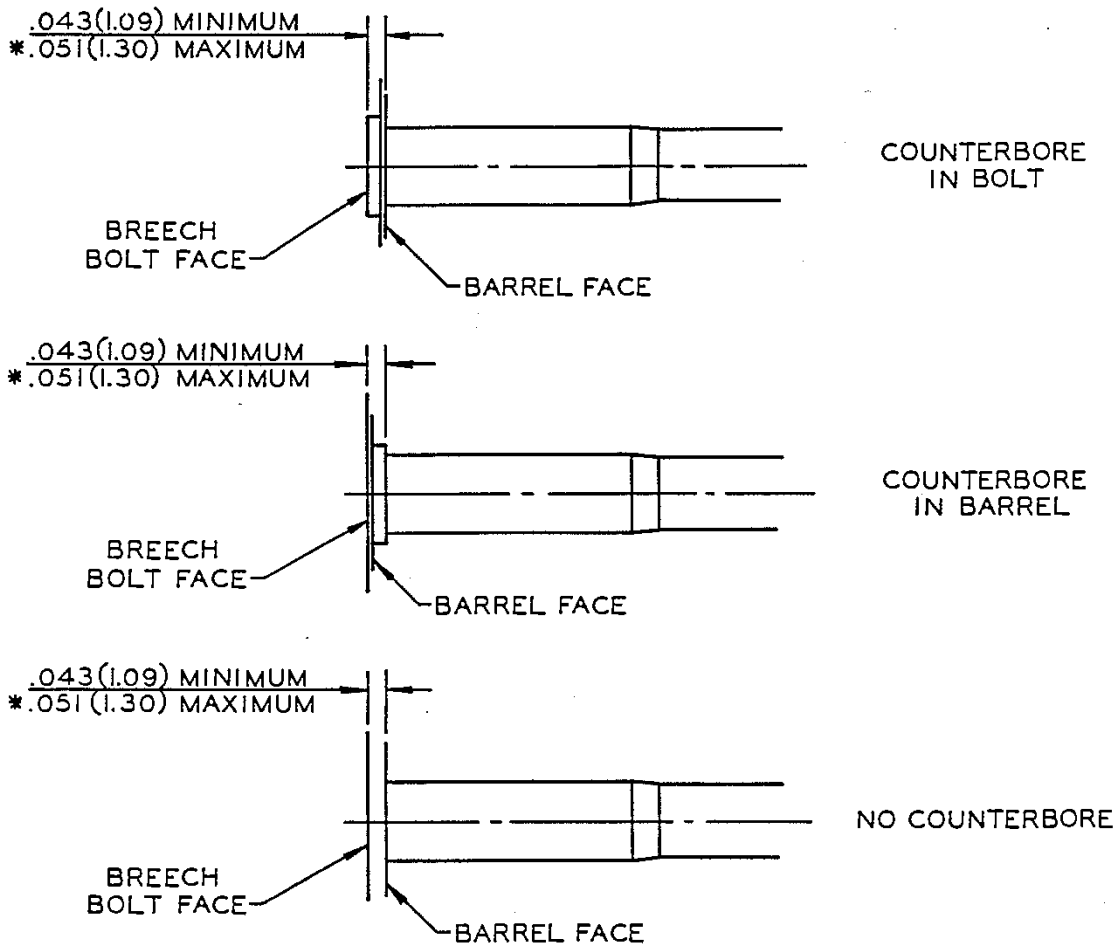
APPROPRIATE CARTRIDGE DRAWING

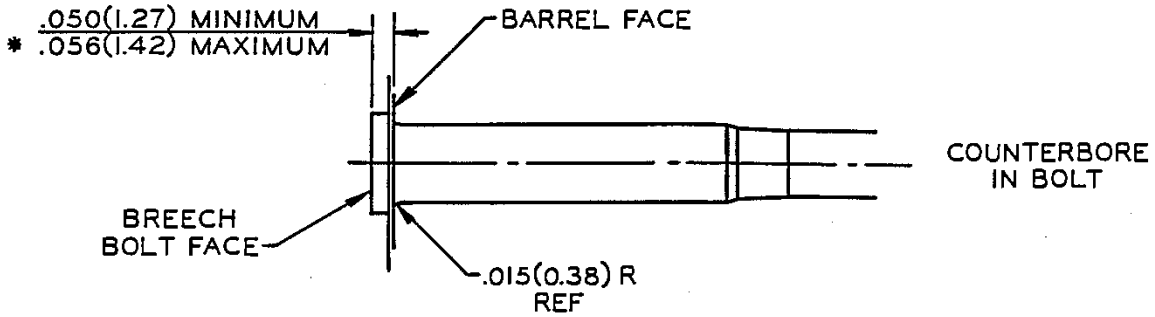
(XX.XX) = MILLIMETERS

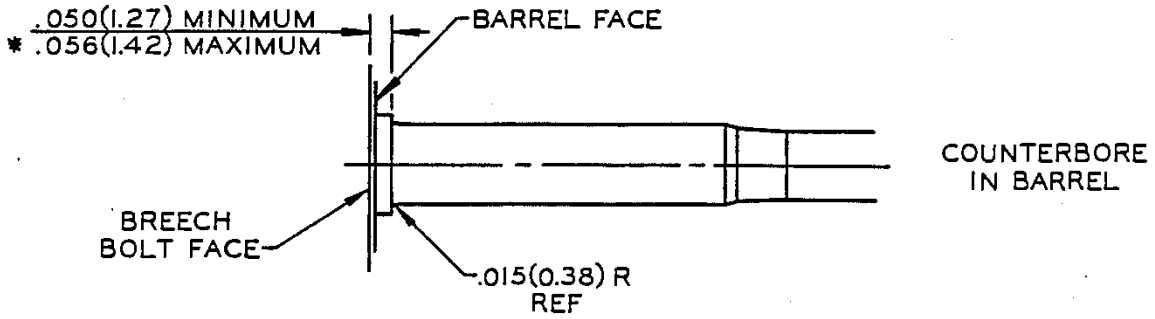
HEADSPACE
22 SHORT, LONG, LONG RIFLE & LONG RIFLE SHOT



NOTE
* REPRESENTS MAXIMUM ADVISABLE CONDITION AFTER USE

(XX.XX) = MILLIMETERS





NOTE
* REPRESENTS MAXIMUM ADVISABLE CONDITION AFTER USE

(XX.XX) = MILLIMETERS

BULLET WEIGHT TOLERANCE

Nominal Weight ± 2%

All barrels are not necessarily suitable for use in determining pressure or velocity levels, even though they may conform to the dimensions given on the appropriate Standard Velocity and Pressure Barrel drawing in this Manual. New barrels may require a number of rounds to be fired to remove sharp corners or burrs resulting from the manufacturing process. Barrels in service do not have an unlimited life and may become unserviceable from wear and erosion. There is no predictable number of rounds to which a barrel should be exposed before use for pressure and velocity determinations, nor is there a predictable round life for such equipment.

The following procedure is suggested for determining the suitability of any barrel for pressure or velocity test use:

> Fire ten rounds of SAAMI Reference Ammunition following the procedures given in this Manual. The average velocity and pressure results of the test should be within the Inclusion Limits as given on the latest assessment for the lot fired.

In the case of a new barrel, the firing of more breaking-in shots may be indicated after which the Reference Ammunition test should be repeated.

In the case of barrels which have been in service, removal of fouling or other corrective procedures, may be implemented followed by a retest.

VELOCITY AND PRESSURE BARRELS MOUNTING IN RECEIVERS

It is essential that close headspace be maintained in velocity-pressure testing equipment if reliable test results are to be achieved.

In mounting test barrels to Universal Receivers or test actions a headspace not exceeding 0.003" (0.76 mm) over minimum should be maintained. This may be measured by headspace gages, shim stock or feeler gages, or a combination thereof, whichever is most appropriate for the type of equipment being used.

Headspace adjustments with the Universal Receiver may be accomplished by several methods:

1. Formed shim stock behind the Firing Pin Plate.
2. Formed shim stock on the rear bearing shoulder of the Barrel Collar.
3. Adjustment of the Breech Block Locking Screws.

1. Velocities and pressures should be measured simultaneously in horizontally mounted test barrels of the appropriate caliber and length for the cartridges to be tested.

2. Recommended values for velocity and pressure of all rimfire cartridges are tabulated in Section I.

3. Drawings and descriptions of the required equipment are shown in Section III of these standards.

4. Handling of Ammunition (Rotation optional)

   a. Cartridges to be tested should be placed in a vertical position with priming end down in a recessed holding block.

   b. When the appropriate test barrel has been properly serviced and the chronograph reset, a cartridge should be lifted vertically from the block. It should be rotated slowly, end over end, in a vertical plane through 360° pausing momentarily when the powder is at the bullet end and again when the powder is at the priming end.

   c. The cartridge is then rotated slowly, a minimum amount to enter the chamber, keeping priming end in lowest possible position until inserted gently and carefully in the chamber.

   d. The cartridge should be seated in the chamber as far as practicable with the fingers. The bolt or breech mechanism should be closed gently in order not to disturb the position of the powder in the cartridge case. The object of this method of handling cartridges is to position the propellant powder at the priming end of the cartridge case by permitting it to fall gently against the priming end while rotating the case.

   e. The rate of fire should not be rapid enough to cause excessive heating of the barrel. The time between rounds depends on the equipment, as the barrel may be cooled by a constant stream of air on the outside or by directing air through the bore after each ten rounds.

   f. Special conditioning not required.

5. Two warming shots should be fired before firing each series for record. The velocity and/or pressure of these shots may be recorded, but should not be included in the record of the sample.

6. Velocity Determination

Time of flight of the bullet should be measured with a 100 kilohertz (minimum) electronic counter chronograph using photoelectric screens spaced 20 feet (6.10m) apart with the first screen at 5 feet (1.52m) from the muzzle of the test barrel and the second screen at 25 feet (7.62m).

7. Pressure Determination

A. EQUIPMENT PREPARATION

1. All instruments should be operational and calibrated per manufacturer's specification. Establish the transfer function of the charge amplifier (on a selected range) to be used in the transducer calibration.

2. The transducer calibrator and instruments used to calibrate the charge amplifier, peak detector and digital voltmeter should have a certified calibration traceable to the National Institute of Standards and Technology.

3. Transducers should be properly maintained per manufacturer's recommendations and stored in a desiccator when not in use.

4. CAUTION: Cable, transducers and instrument connectors should be covered with plastic caps when not in use to prevent contamination.

5. Measure the internal resistance of the transducer and low noise cable. If the resistance is less than 10^{12} ohms, bake out transducer and low noise cable as described in IIB Transducer Initialization. If the resistance is in the 10^{12} to 10^{14} ohm range, proceed to C, Transducer Calibration.

B. TRANSDUCER INITIALIZATION

1. Clean transducer and low noise cable connectors using Freon TF or equivalent.

B. TRANSDUCER INITIALIZATION (Cont'd)

2. Bake out transducer and low noise cable in a temperature controlled oven for 24 to 48 hours at 250°F (121°C).

3. Allow oven to return to ambient temperature at a slow rate.

4. After removing the transducer and cable from the oven, check the internal resistance of the transducer. The resistance should be in the 10^{12} to 10^{14} ohm range.

5. Place protective caps on transducer and cable connectors to prevent contamination.

C. TRANSDUCER CALIBRATION

1. Initial Set-Up

a. Allow instrumentation to stabilize for at least thirty minutes.

b. Mount transducer with steel spacer rings into a calibrating fixture or test barrel as described in PCB Operating Instruction Manuals.

c. Mount unprimed cartridge case into calibration fixture and complete fixture assembly as per PCB instruction manual.

d. Mount calibration fixture with transducer to transducer calibrator.

e. Connect transducer and instrumentation as indicated in Fig. 1.

f. Set charge amplifier range switch to a suitable range and set time constant switch to LONG.

g. Set DVM to 1-volt or 10-volt range.

h. Adjust Heise readout indicator to 0 psi with no pressure on hydraulic lines.

C. TRANSDUCER CALIBRATION (Cont'd)

i. Reset Charge amplifier and DVM to obtain zero volts output.

j. Apply pressure in 5k psi increments. Calibration pressure range should be from 10K psi to 30K psi. DO NOT exceed recommended manufacturer's maximum pressure limit on fixture or barrel calibrator.

k. Record DVM reading after the Heise readout indicator is exactly at desired pressure level.

l. Release pressure slowly and verify that the instrumentation returns to zero.

m. Replace cartridge case in calibration fixture with new (unused) cartridge case containing a fired primer.

n. Repeat steps h through m a minimum of ten times.

o. CAUTION: Always increase pressure to desired level, never decrease pressure to desired level.

2. Data Reduction

a. Calculate the average value for the output voltages recorded at each pressure increment. Multiply these average values by the charge amplifier range transfer function (pCb/V) to obtain the transducer charge output (Q) at each pressure increment (P).

b. Obtain a least square line equation using the transducer charge output (Q) as the dependent variable and pressure (P) as the independent variable. $Q = mP \pm q$.

C. TRANSDUCER CALIBRATION (Cont'd)

c. A manual method of calculating the least square line equation is given in tabular form in figure 3. It is recommended that when using this technique, all numbers be carried to the third place.

d. Obtain the pressure (P) offset value when Q in the line equation is zero. Refer to figure 4.

3. Transducer Records

a. Date of calibration.

b. History of rounds exposed to test firing.

c. Calibration pressure (P), charge amplifier voltage output (V) and transducer charge output (Q).

d. Charge amplifier range and transfer function.

e. Least square line equation.

f. Pressure offset.

g. Transducer identification.

h. Date of next calibration.

D. FIRING TEST

1. Test Barrel Preparation

a. Refer to the recommended piezoelectric pressure transducer installation in a pressure barrel illustrated in Section III.

2. Initial Set-Up

a. Connect equipment as shown in Figure 2.

b. Allow instrumentation to stabilize for at least thirty minutes.

D. FIRING TEST (Cont'd)

c. Inspect the transducer mounting cavity in the pressure barrel to assure that the seal seat is free of dirt and other foreign matter.

d. It is essential that the sensing surface of the transducer be flush with the chamber inside diameter. Care must be exercised to obtain correct depth as well as exact rotational alignment. Depth adjustment is accomplished by the use of various thickness spacers. With the proper spacer installed in the barrel, install the transducer.

e. Loosen the slotted clamp but do not remove clamp.

f. Thread the transducer into the mounting port. Adjust the slotted clamp to allow guide pin to enter guide hole. Continue to turn transducer nut into the mounting port, but do not tighten when transducer bottoms.

g. Now, tighten the screw closing slotted clamp.

h. Using an open end wrench, tighten the transducer nut. Approximately five to ten ft.-lbs. of torque is sufficient.

i. Inspect chamber to assure that the transducer sensing surface is flush with the surface of the test chamber.

j. Set the charge amplifier controls as follows:

Range switch to a position that will allow for maximum test pressures and direct pressure readout on the digital voltmeter; time constant as required, and sensitivity dial to the value of slope m obtained from the transducer least square line equation.

k. Select peak meter for AC coupling and positive input.

D. FIRING TEST (Cont'd)

1. Take note of the transducer offset (P) value obtained from the least square line equation. This value is to be used later in making final peak pressure determination.

1.a The offset value may also be directly dialed into an instrumentation system capable of providing direct peak pressures without data manipulation.

3. Procedure

a. Reset all pressure instrumentation and assure that the digital voltmeter (DVM) displays all zeros. Test rounds may now be fired.

b. For each round fired, the pressure reading on the DVM should be recorded and pressure instrumentation reset.

4. Peak Pressure Determination

a. To determine peak pressures, add as required, the pressure offset value to the pressure readings obtained in the firing test.

8. Recording of Test Results

The following data should be recorded for each series of shots fired for velocity and pressure.

a. Ammunition data

1. Date of test.
2. Nominal cartridge identification.
3. Cartridge - caliber.
4. Weight of bullet and type.
5. Powder charge and type and lot number.
6. Priming.
7. Type of lubricant.
8. Code or date of loading.

b. Average velocity uncorrected.

c. Average pressure uncorrected.

d. Maximum and minimum individual velocity.

e. Maximum and minimum individual pressure.

f. Extreme variation (range) of velocity.

g. Extreme variation (range) of pressure.

h. Other statistical indication of variation (optional).

i. Correction to results from firing Reference Ammunition (optional).

j. Corrected average velocity (optional).

k. Corrected average pressure (optional).

l. Recommended values.

1. Average velocity.
2. Average pressure.
3. Velocity and pressure variation.

m. Test firearm and range data.

1. Barrel length and serial number
2. Barrel history.
3. Type of chronograph.

n. Test personnel.

9. Use of Reference Ammunition

a. Purpose

Reference ammunition assessed by firings at the ranges of member companies is available for calibrating ranges, firearms and other equipment for velocity and pressure only.

b. Supply

On request, the SAAMI Office, P.O. Box 838, Branford, Connecticut, 06405, will supply information on the manufacturer of specific Reference Ammunition. The method of identifying Reference Ammunition is shown in this section.

Requests for Reference Ammunition should be addressed to the manufacturer of the specific cartridge.

c. Assessment

Details of the assessment tests are shown in this section.

d. Clearing House

Results of assessment tests of Reference Ammunition are tabulated, analyzed, and distributed by the SAAMI Office.

e. Method of applying corrections to tests of service loads in this section.

f. Method of calibrating ranges and equipment see this section.

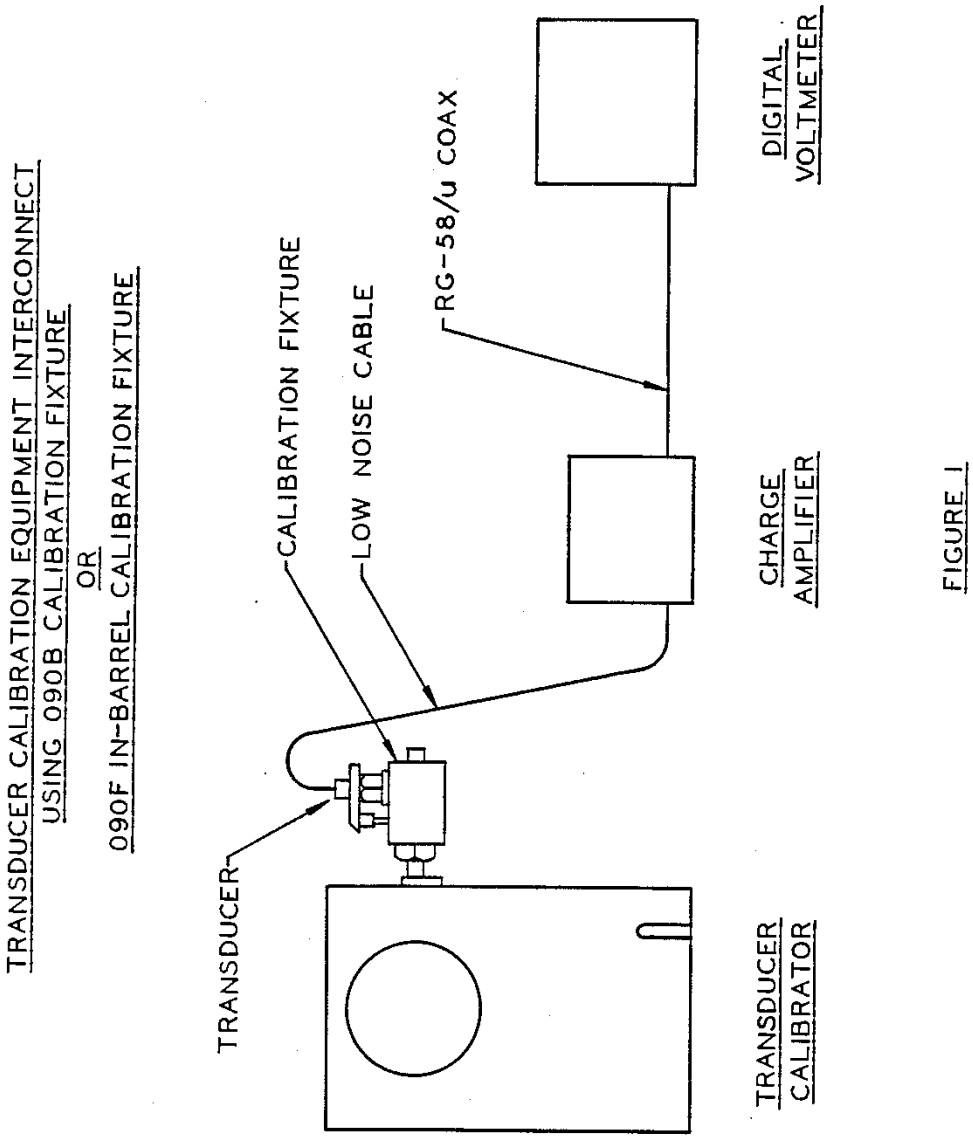


FIGURE 1

PROCEDURE FOR USING CONFORMAL TYPE PIEZO ELECTRIC TRANSDUCERS IN THE MEASUREMENT OF RIMFIRE PEAK PRESSURES

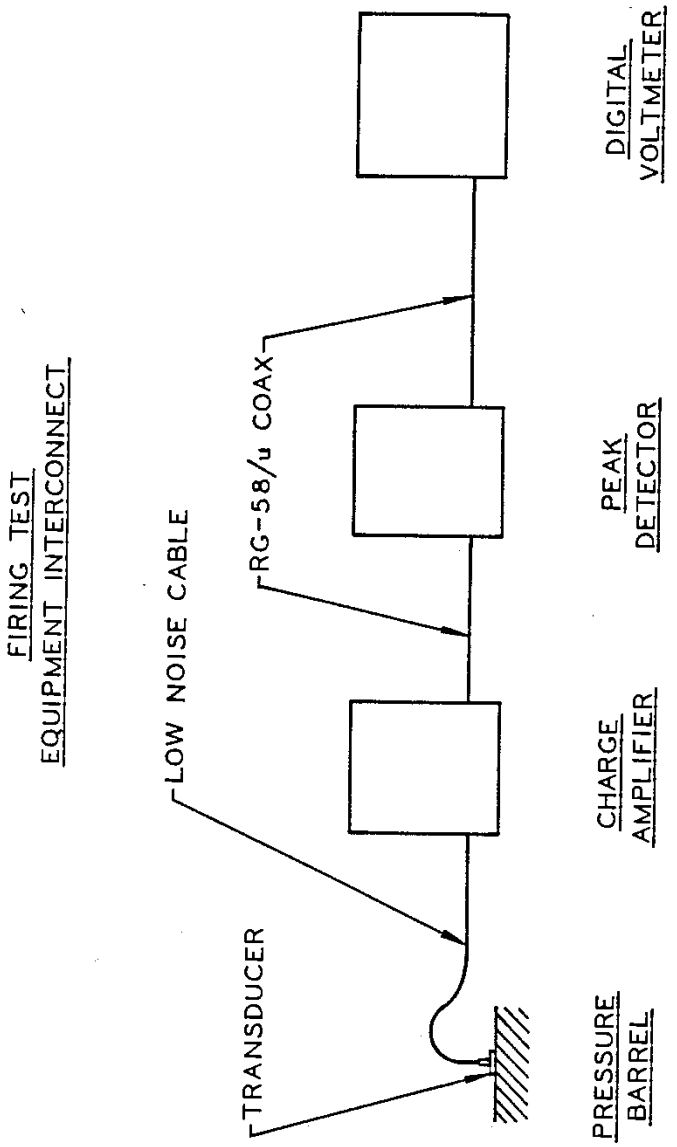


FIGURE 2

LEAST SQUARE LINE COMPUTATION

$Q = mP \pm q$

where:

Q - Charge in picocoulombs

m - Slope $\Delta Q/\Delta P$

P - Pressure in pounds per square inch

q - Charge intercept in picocoulombs

$$m = \frac{\Sigma PQ - \frac{\Sigma P \Sigma Q}{n}}{\Sigma P^2 - \frac{[\Sigma P]^2}{n}}$$

$$q = \frac{\Sigma P \Sigma PQ - \Sigma P^2 \Sigma Q}{[\Sigma P]^2 - n \Sigma P^2}$$

	P	Q	PQ	P^2
TOTAL				

FIGURE 3

PROCEDURE FOR USING CONFORMAL TYPE PIEZO ELECTRIC TRANSDUCERS IN THE MEASUREMENT OF RIMFIRE PEAK PRESSURES

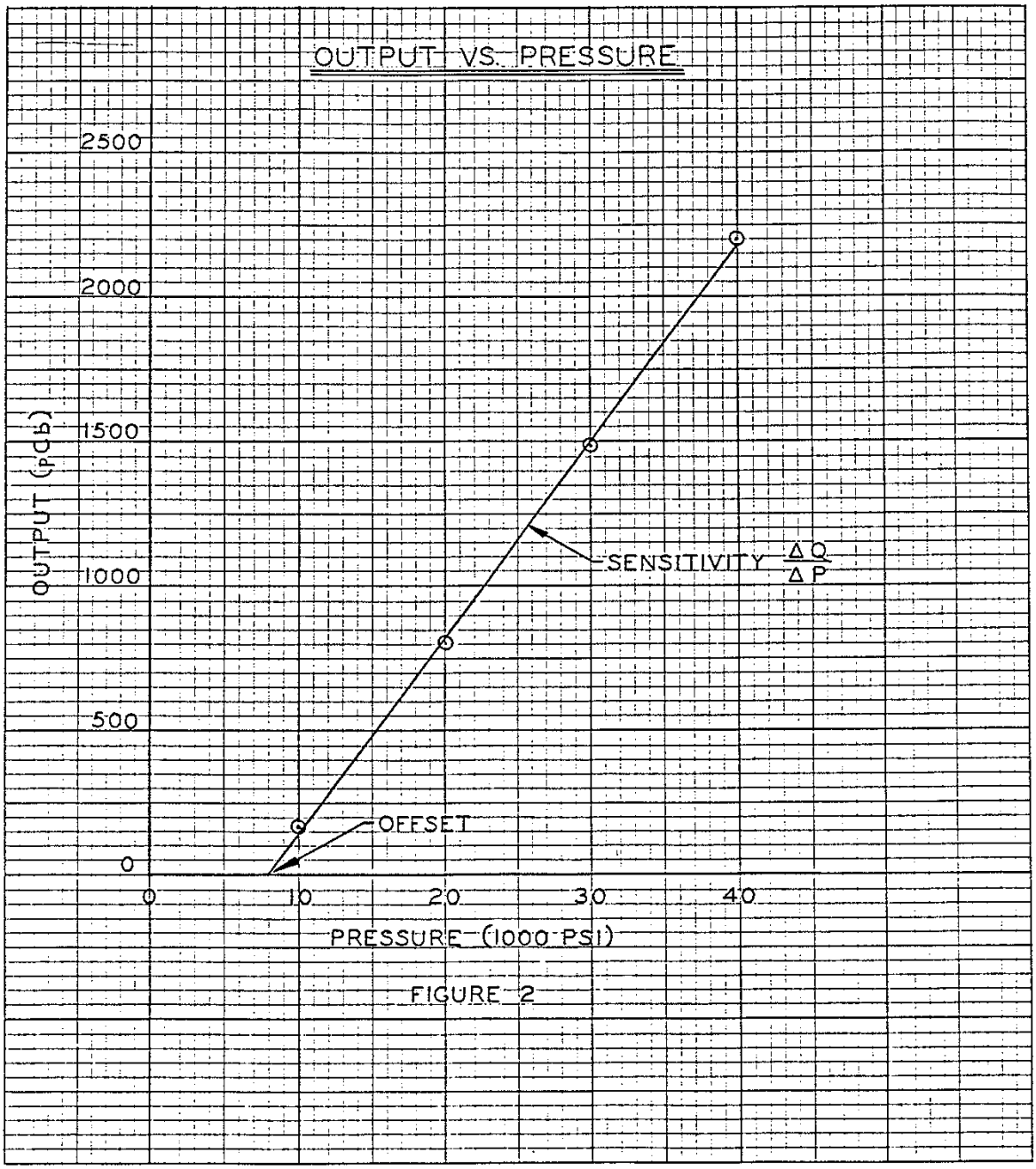


FIGURE 2

NEW REFERENCE LOTS

I. GENERAL

Reference Ammunition Lots have been established for those lots or loads designated by the Technical Committee. Responsibility for production of each of the selected lots is assigned to a member company which is responsible for maintaining a supply. A five-year supply is recommended. It is desirable that Reference Ammunition be consistent with Standards values for that particular round.

When a new lot has been prepared by a producer, it shall be the producer's responsibility to announce the lot to the SAAMI Office, giving a tentative assessment and other data.

The SAAMI Office will announce the availability of the new lot to the participating ranges, giving the tentative assessment and other pertinent data.

II. METHOD OF ASSESSMENT - NEW LOTS

A. Before announcing a new lot of Reference Ammunition to the SAAMI Office, the manufacturer should make sufficient tests to determine Tentative Values of pressure and velocity for the lot.

1. The test barrels shall conform to SAAMI specification for internal dimensions, length and piston location.

2. Counter-chronographs and photoelectric screens shall be used in velocity measurements.

3. Ammunition shall be conditioned for 24 hours at 70° ± 2°F (21.1° ± 1.1°C) with relative humidity of 60% ± 5% before firing.

4. Only a transducer shall be used in pressure measurements.

NEW REFERENCE LOT REPORTING FORM AND INSTRUCTIONS

These instructions pertain to the form which is used for a Reference Ammunition producer to announce new lots to the SAAMI Office, as well as for the SAAMI Office to announce the new lot to participating ranges.

SUBJECT: Reference Ammunition, Rimfire T-4020
New Reference Lot

TO: (When used by a producer):

SAAMI OFFICE

(When used by SAAMI Office to notify test stations):

Current address of all stations and personnel.

(1) Name and address of source for procurement.

SIGNED: Authorized Person
Producer Company
Name, Address
(Include Zip Code).

DATE:

ANNOUNCEMENT OF NEW REFERENCE AMMUNITION LOT

SUBJECT: Reference Ammunition - Rimfire T-4020
New Reference Lot

TO:

CARTRIDGE_____ LOT NO._____

ORDER SYMBOL_____

TENTATIVE ASSESSMENT:

VELOCITY (ft/s)		PRESSURE (psi) (in Units of 100)	
Average	S.D.	Average	S.D.

Lot Number This Replaces_____

Please order the ammunition, test and report results to the SAAMI Office on Range Comparison Report as soon as possible. Address your orders to the address given in the left bottom corner of this letter.

SIGNED:

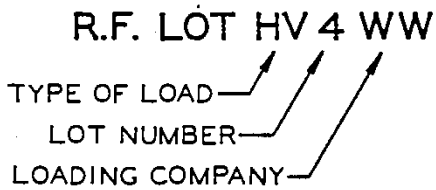
(1)

DATE:

SAAMI REFERENCE AMMUNITION

THIS AMMUNITION IS TO BE USED ONLY FOR CALIBRATION
OF TEST GAGES FOR VELOCITY AND PRESSURE

LOT NUMBERING SYSTEM
(TYPICAL NUMBERS)



LOT SYMBOLS-MANUFACTURER

WW = OLIN
F = FEDERAL
R = REMINGTON

TYPE OF LOAD

HV = HIGH VELOCITY - 22 LONG RIFLE
SV = STANDARD VELOCITY - 22 LONG RIFLE
HVS = HIGH VELOCITY - 22 SHORT

NOTE
BLACK LETTERING

ASSESSMENT - PERIODIC

I. PERIODIC TESTS

A Stations

1. All test conditions should conform as closely as possible to those prescribed in this Standard, and the following conditions should be met:

   (a) Tests should consist of ten (10) rounds for velocity and pressure fired during a single day.

   (b) Test barrels shall conform to SAAMI specifications for internal dimensions, length and piston location.

   (c) Counter chronographs and photoelectric screens shall be used in velocity measurements.

   (d) Ammunition shall be conditioned for 24 hours at 70° ± 2°F (21.1 ± 1.1°C) with relative humidity of 60% ± 5% before firing.

   (e) Only a transducer shall be used in pressure measurements.

2. Each station should report results of its firing in the test on approved forms to the SAAMI Office.

I. PERIODIC TESTS (continued)

B. Clearing House

1. The SAAMI Office serves as a clearing house for all Reference Ammunition ballistics and related information. It shall be the responsibility of the SAAMI Office to schedule testing and to assemble and distribute results of periodic tests. This should be done on the proper Reference Ammunition report form.

2. The Reference Ammunition Report shall contain the average pressure, velocity and related standard deviations as reported by each station for that lot. From this data, the SAAMI Office will calculate and report the Raw Average, Corrected Average, Standard Deviation Averages and Inclusion Limits.

3. To obtain the Raw Averages, the SAAMI Office shall include the 10 round averages for both mean and sigma (S.D.) of pressure and velocity of all reporting stations and the first and second previous assessment values. If the 10 round average from any station varies from the Raw Average by more than plus or minus 25 FPS in velocity OR plus or minus 1700 psi in pressure, the pressure or velocity data from that station(s) should be discarded. The mean pressure and velocity should be recalculated, omitting the discarded data. The new mean is the "Corrected Average". If the mean pressure value of a station is outside of the limits as defined above, but the velocity is in, the pressure data should be dropped and the velocity data retained. The converse is true as well. Using the Corrected Averages, the Inclusion Limits are determined as follows:

VELOCITY	MEAN = Same as Corrected Average HIGH = MEAN + 25 FPS LOW = MEAN - 25 FPS
PRESSURE	MEAN = Same as Corrected Average HIGH = MEAN + 1700 psi. LOW = MEAN - 1700 psi.

T-4020 STATION REPORT
REFERENCE AMMUNITION - PERIODIC ASSESSMENT
RIMFIRE

STATION _____ SAAMI REFERENCE LOT _____

DATE _____ PREVIOUS ASSESSMENT:
Velocity _____
Pressure _____

Barrel No. _____ Type of Gage _____
Barrel History _____ No. _____

	VELOCITY	PRESSURE
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
AVG.		
OFFSET		
CORR. AVG.		
S.D.		

TECHNICAL SERVICES REPORT - REFERENCE AMMUNITION

PERIODIC ASSESSMENT - RIMFIRE

MARCH - 1992

LOT NO: 22SV-40-12R GAGE: PIEZO

	VELOCITY	S.D.	PRESSURE	S.D.
BLOUNT	1167	9.0	228	7.7
FEDERAL	1170	17.0	213	16.0
HERCULES	-	-	-	-
HORNADY	-	-	-	-
OLIN - MFG.	1133	19.0	233	9.0
OLIN - ST.M.	1173	17.0	223	8.7
REM - ILION	-	-	-	-
REM - LONOKE	1133	19.4	209	13.1

1ST PREV. AVG.	1157		218	
2ND PREV. AVG.	1154		222	
	VELOCITY	S.D.	PRESSURE	S.D.
RAW AVG.	1155		221	
CORRECTED AVG	1155		221	

INCLUSION LIMITS @ 99.95%

UPPER LIMIT	1180	238
LOWER LIMIT	1130	204

ASSESSMENT:..... 1155 221

The use and usefulness of Reference Ammunition in connection with the testing of ammunition for velocity and pressure is predicated upon two basic assumptions as follows:

1. Associated with a given batch of Reference Ammunition at a given time is an assessed average velocity, an assessed average pressure, as well as Upper and Lower limits for each, which the averages of any ten round test may be expected to fall within when:

   a) The user has blended the Reference Lot before use.

   b) The ammunition is tested only after being conditioned under controlled temperature and humidity.

   c) The ammunition is tested in standard test equipment.

   d) The ammunition is handled strictly in accordance with the specific method.

   e) All auxiliary measuring equipment is in proper working condition.

2. Although there may be changes with time in the velocity and pressure assessments, the changes occur sufficiently slowly to be detected by periodic reassessments before they have achieved a magnitude sufficient to impair the usefulness of the reference rounds. In other words, the velocity and pressure assessments are reasonably stable with time.

The average velocity and average pressure that may be developed by a sample of Reference Ammunition in any test barrel under given conditions may be different from the results obtained under the test conditions referred to above in assumption 1. Such values may be perfectly real, providing no errors are introduced by the auxiliary equipment. However, the average of any ten round test with a lot of Reference Ammunition, fired under the conditions listed above should fall within the limits given with the assessment of that lot under the heading, "Inclusion Limits".

In order to realize the benefits of Reference Ammunition, some rules must be adhered to. Nevertheless, the final judgments concerning how often it is used and the use of the data must be made by each individual user. It is important, therefore, that there be a clear realization of what it can and what it cannot tell the ammunition tester.

Reference Ammunition cannot guarantee the absolute accuracy of any test system. It does, however, provide simple and direct data from any given ammunition test equipment to determine how closely it duplicates the acceptable, average system as used by other SAAMI members.

In line with the preceding discussion, the following recommendations are made for the use of Reference Ammunition:

A. Each Reference Lot should be blended at each station or range and conditioned before use.

B. How often Reference Ammunition is used shall be determined by the accuracy required.

C. The minimum sample size shall be ten rounds.

D. The Upper and Lower "Inclusion Limits" for both velocity and pressure are the limits within which the averages of a ten round test may be expected to fall.

E. A correction need not be applied to the test equipment as long as the velocity and pressure averages are within the Inclusion Limits.

F. If one average is outside of the Inclusion Limits and the other within, the average that exceeds the limits shall be corrected according to the procedure given in Step H.

G. If both averages are outside of the Inclusion Limits, a second ten round test should be fired to verify the data.

H. If the correction is to be applied, the correction shall be the difference between the assessed value and the observed average of the twenty round test.

SECONDARY REFERENCE AMMUNITION

Occasionally, a test station will have need for an inordinately large supply of Reference Ammunition in considerable excess of the usual volume. In order to minimize the premature exhaustion of any particular lot, it is suggested that the station create its own secondary reference lot to fill the special need.

A secondary reference lot should consist of a supply of off-the-shelf ammunition, each box bearing the same manufacturer's code number. The secondary reference lot should be approximately equivalent to the Reference Ammunition which it replaces.

List of Equipment

1. Electronic Counter Chronograph - 100 Kilohertz (minimum)

   Oehler Research or equivalent

2. Lumiline photoelectric screens

   Oehler Research or equivalent

3. Machine rest - Frankford Arsenal type

   Cannatech, Inc. or equivalent

4. Receiver

   a. Universal Receiver

      Cannatech, Inc.

   b. Equivalent

5. Barrels

   a. Remington Arms Co., Inc.

   b. Wilson Arms Co.

   c. H-S Precision Inc.

   d. Equivalent

6. Digital Voltmeter

   a. Fluke Model 8110A

   b. Equivalent

List of Equipment (continued)

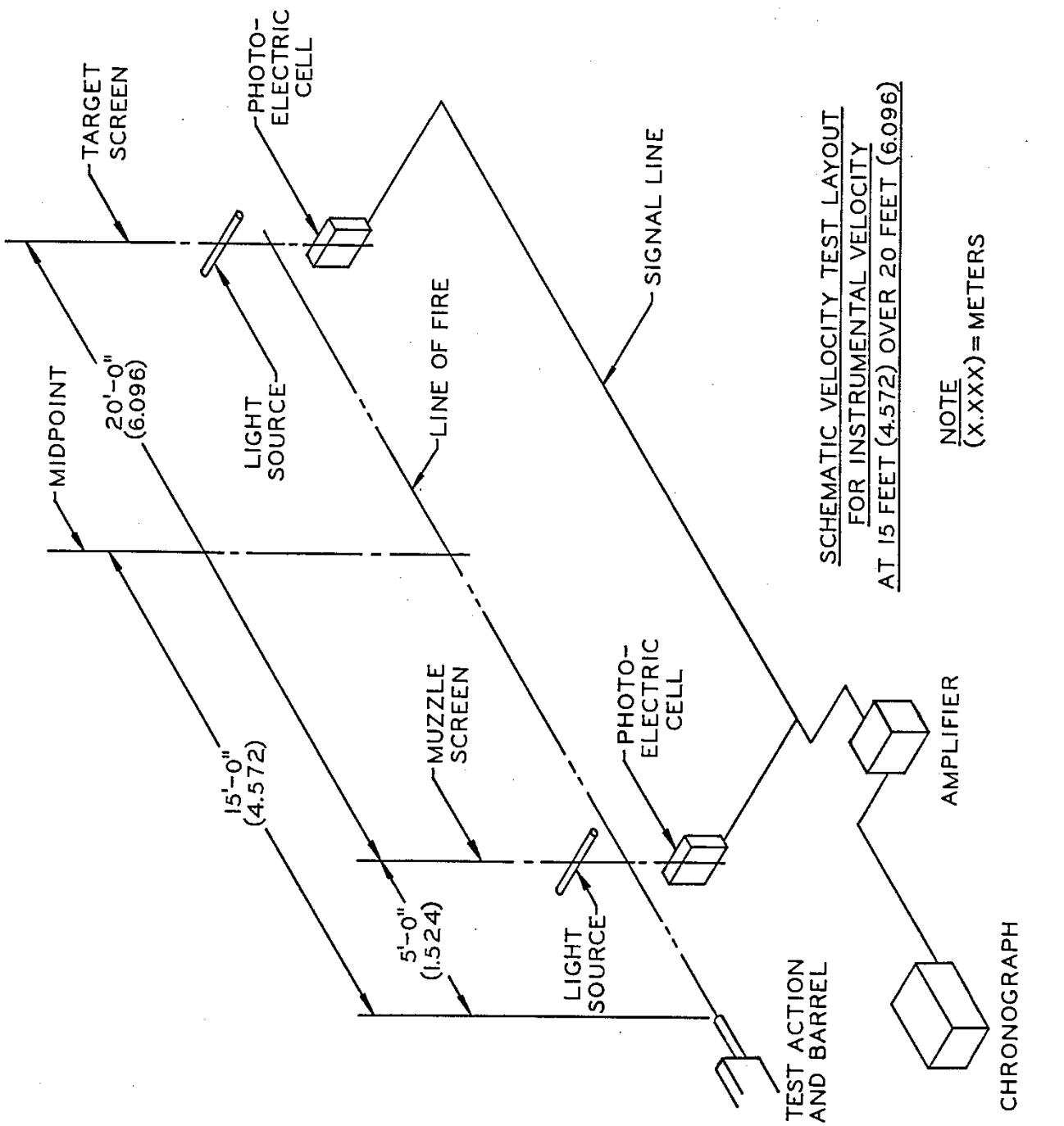
7. Ballistic Peak Pressure Meter (combines 8 & 9 below)
   a. PCB Model 400A20
   b. Equivalent
8. Charge Amplifier
   a. PCB Model 462B52
   b. Equivalent
9. Peak Meter
   a. PCB Model 451A07
   b. Equivalent
10. Transducer
   a. PCB Model 117B
   b. Equivalent
11. Low Noise Cable
   a. PCB Model 003A05
   b. Equivalent
12. High Pressure Calibrator
   a. PCB Model 090B Series
   b. Equivalent
13. Calibration Fixture
   a. PCB 090H Series
   b. Equivalent

SECTION III - EQUIPMENT
RIMFIRE
SAAMI VOLUNTARY PERFORMANCE STANDARDS

		RECOMMENDED EQUIPMENT SOURCES
1.	Electronic Counter Chronograph	Oehler Research P.O. Box 9135 Austin, Texas 78766
2.	Photoelectric Screens	Oehler Research P.O. Box 9135 Austin, Texas 78766
3.	Gun Rest	Cannatech, Inc. 15 Spring Hollow Drive Erial, New Jersey 08081
4.	Receivers	Cannatech, Inc. 15 Spring Hollow Drive Erial, New Jersey 08081
5.	Barrels	Remington Arms Co. Attn: Custom Shop 14 Hoefler Ave. Ilion, New York 13357 Wilson Arms Co. 63 Leetes Island Rd. Branford, Connecticut 06405 H-S Precision, Inc. 1301 Turbine Drive Rapid City, S.D. 57701
6.	Digital Voltmeter	John Fluke Mfg. Co., Inc. P.O. Box 9090 Everet, WA 98206
7.	Charge Amplifier	PCB Piezotronics, Inc. 3425 Walden Ave. Depew, New York 14043-2495
8.	Peak Detector	PCB Piezotronics, Inc. 3425 Walden Ave. Depew, New York 14043-2495
9.	Transducer	PCB Piezotronics, Inc. 3425 Walden Ave. Depew, New York 14043-2495

	RECOMMENDED EQUIPMENT SOURCE
10. Low Noise Cable	PCB Piezotronics, Inc. 3425 Walden Ave. Depew, New York 14043-2495
11. Transducer Calibrator	PCB Piezotronics, Inc. 3425 Walden Ave. Depew, New York 14043-2495
12. Calibration Fixture	PCB Piezotronics, Inc. 3425 Walden Ave. Depew, New York 14043-2495

SCHEMATIC VELOCITY LAYOUT-
SCREENS



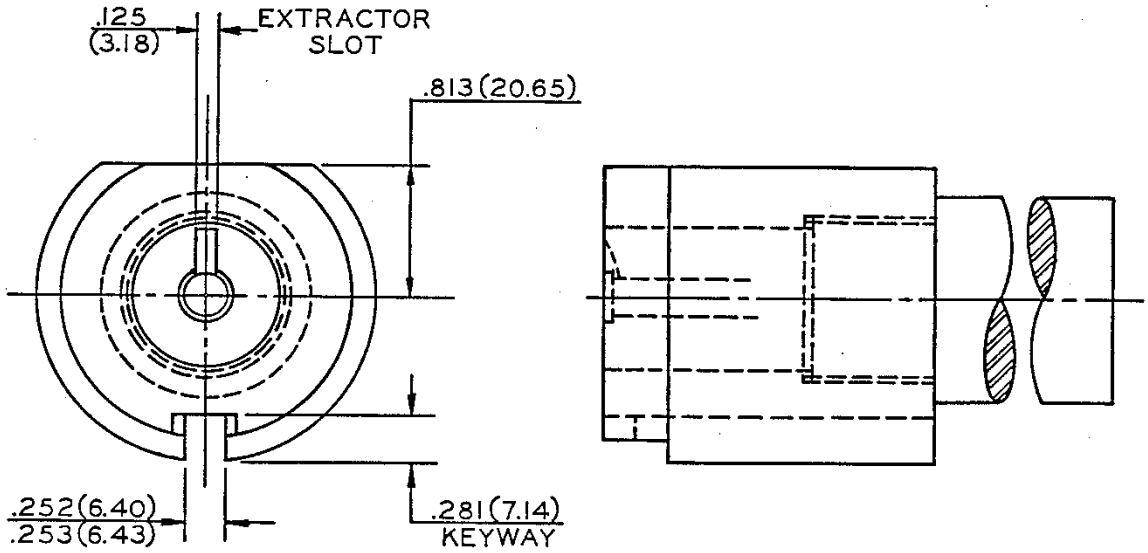
The following calibers of Rimfire Reference Ammunition for the verification of ranges, barrels and other equipment are available.

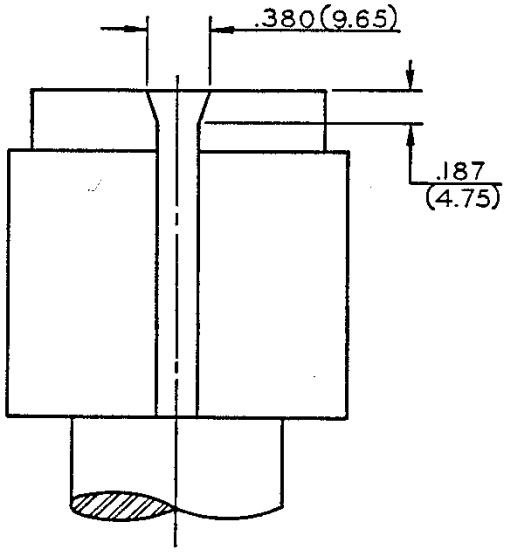
Information on procurement and assessment data may be obtained from the SAAMI Office.

Current Assessment Data are maintained by the SAAMI Office, P.O. Box 838, Branford, CT. 06405.

CARTRIDGE	BULLET GRAINS WEIGHT	BULLET TYPE
22 Short HV	29	Solid Lead
22 Long Rifle SV	40	Solid Lead
22 Long Rifle HV	40	Solid Lead
22 Winchester Mag RF	40	Hollow Soft Point

UNIVERSAL RECEIVER
COLLAR & TEST BARREL

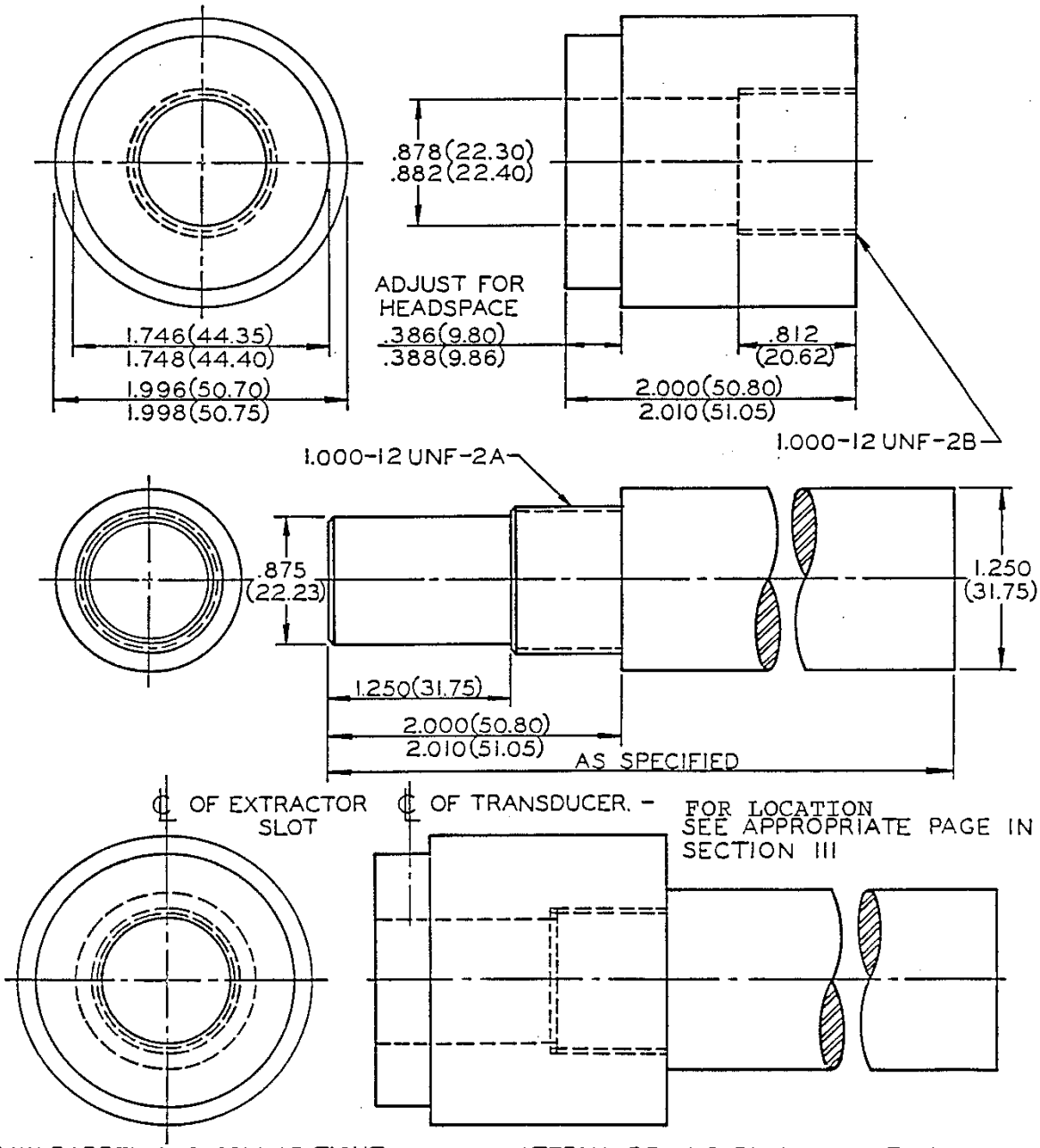




FOR DETAIL
INFORMATION
SEE PAGE
55

NOTE
(XX.XX)=MILLIMETERS

UNIVERSAL RECEIVER
COLLAR & TEST BARREL



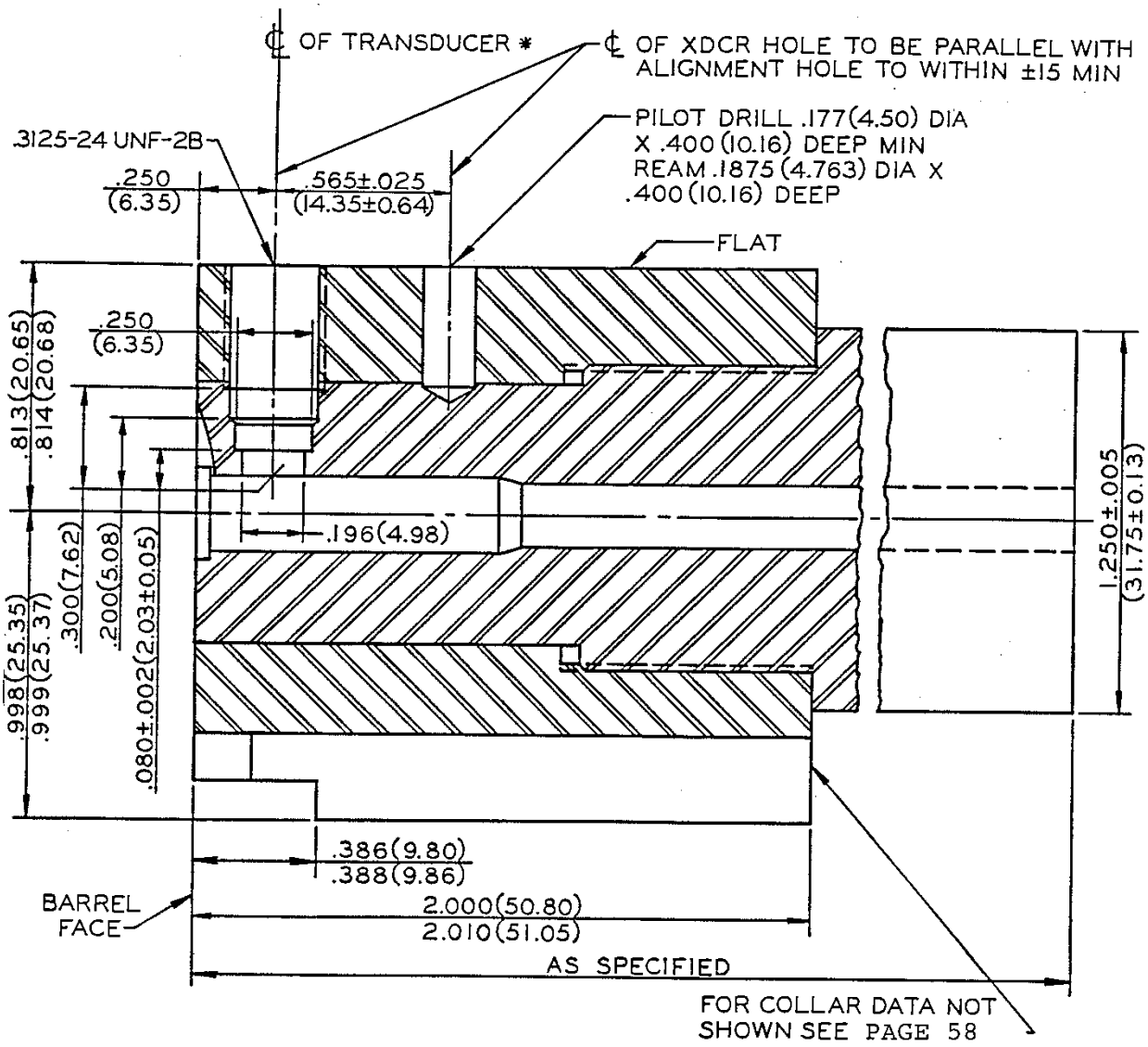
DRAW BARREL AND COLLAR TIGHT.
TRANSDUCER HOLE AND HEAD CUTS
MADE AFTER ASSEMBLY-SEE PG 3075
ONE PIECE BARRELS ARE ACCEPTABLE
NOTE (XX.XX)=MILLIMETERS

MATERIAL: RESULFURIZED 4140 STEEL
HEAT TREAT PRIOR TO MACHINING TO
BRINELL HARDNESS 277 TO 321(R_c 29 TO 35)

Cartridge	CENTERLINE OF TRANSDUCER FROM BOLT FACE* Inches	mm
22 Short	0.250	6.3
22 Long	0.250	6.3
22 Long Rifle	0.250	6.3
22 Win Mag Rimfire	0.750	19.0

*Tolerance: Minus 0.010" (2.25mm)

UNIVERSAL RECEIVER
TEST BARREL
INSTALLATION OF
PRESSURE TRANSDUCERS



NOTE

* TRANSDUCER LOCATION FOR CALIBER 22 WMR IS .750(19.05) FROM BARREL FACE

(XX.XX) = MILLIMETERS

PROCEDURES FOR DIMENSIONING CHAMBERS OF VELOCITY AND PRESSURE TEST BARRELS

Chamber and bore dimensions of velocity and pressure test barrels shall conform to the dimensions of the chamber and bore at Maximum Material Condition (MMC) for each cartridge as originally introduced. Fabrication tolerances, however, are much reduced.

It is recognized that changes may be made to cartridge or chamber dimensions in order to improve the velocity-pressure relationship, accuracy or functioning in rifles, pistols or revolvers as production experience indicates. However, none of these changes should be of such nature that they would cause a significant increase in pressure level of a given lot of ammunition.

No changes will be made to velocity and pressure barrel dimensions which would result in a reduction of the recorded pressure level of any given lot of ammunition, because this would result in the possibility of future lots of ammunition being loaded with increased powder charges, which would cause increased pressure in existing rifles, pistols and revolvers.

Production barrels may be adapted for velocity and pressure testing provided that they conform to all dimensions shown on the appropriate test barrel drawing.

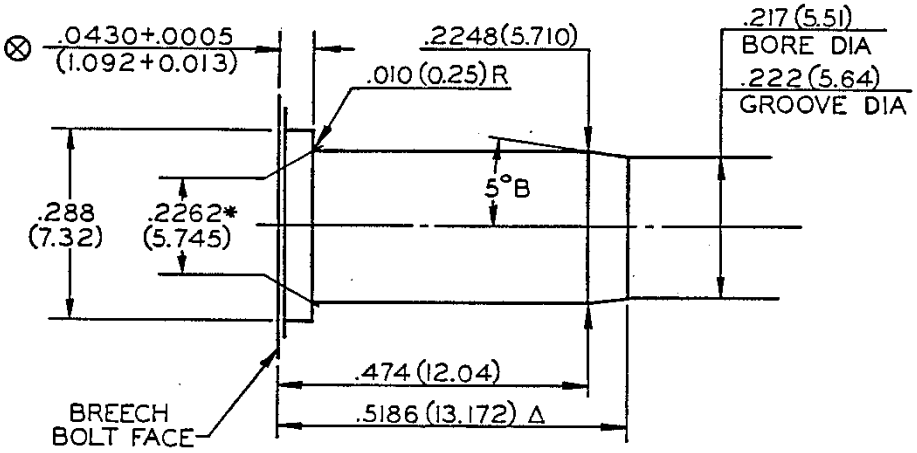
All standard rimfire rifle test barrels shall be 24 inches long; exterior ballistic data for all rimfire rifle cartridges shall be based on this length.

PROCEDURE FOR MEASURING BARREL LENGTH

Rimfire test barrels for rifles, pistols or revolvers are measured by inserting a rod down the bore from the muzzle until it touches the breech face with the action closed and the firing-pin retracted.

A stop collar or other marking means is utilized to mark the point on the rod adjacent to the most forward part of the barrel or the bottom of the counterbore in barrels having a counterbore recess at the muzzle.

The rod is then removed and the distance from the mark to the end of the rod is measured. This measurement is recorded as the barrel length.



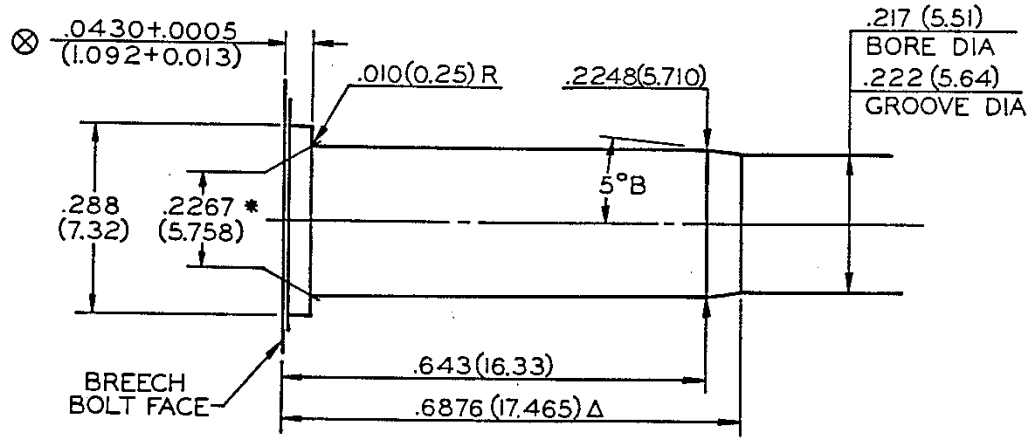
NO. OF GROOVES	6
WIDTH OF GROOVES	.085+.002 (2.16+0.05)
TWIST	16 (406.4) RH
LENGTH OF BARREL	24.000±.010(609.60±0.25)

LAND & GROOVE DIMENSIONS TO BE WITHIN TOLERANCES THROUGHOUT LENGTH OF BARREL

UNLESS OTHERWISE NOTED
ALL DIA +.0005(0.013)
LENGTH TOL +.005(0.13)

NOTE
B = BASIC
(XX.XX) = MILLIMETERS
* DIMENSIONS ARE TO INTERSECTION OF LINES
⊗ = HEADSPACE DIMENSION
Δ = REFERENCE DIMENSION
ALL CALCULATIONS APPLY AT MAXIMUM MATERIAL CONDITION (MMC)

STANDARD VELOCITY &
PRESSURE BARREL
22 LONG
22 LONG RIFLE

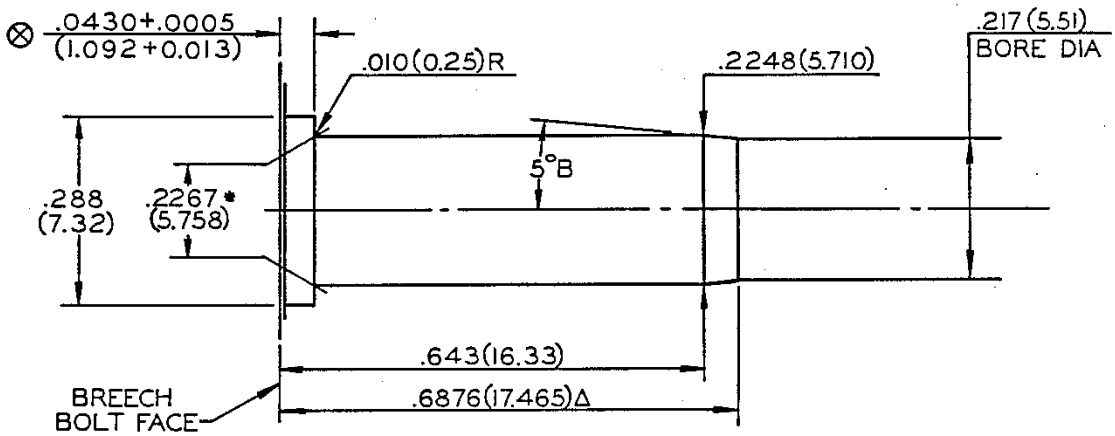


NO. OF GROOVES	6
WIDTH OF GROOVES	.085+.002 (2.16+0.05)
TWIST	16 (406.4) RH
LENGTH OF BARREL	24.000±.010(609.60±0.25)

LAND & GROOVE DIMENSIONS TO BE WITHIN
TOLERANCES THROUGHOUT LENGTH OF BARREL

UNLESS OTHERWISE NOTED
ALL DIA +.0005(0.013)
LENGTH TOL +.005(0.13)

NOTE
B = BASIC
(XX.XX) = MILLIMETERS
* DIMENSIONS ARE TO INTERSECTION OF LINES
⊗ = HEADSPACE DIMENSION
Δ = REFERENCE DIMENSION
ALL CALCULATIONS APPLY AT MAXIMUM MATERIAL CONDITION (MMC)

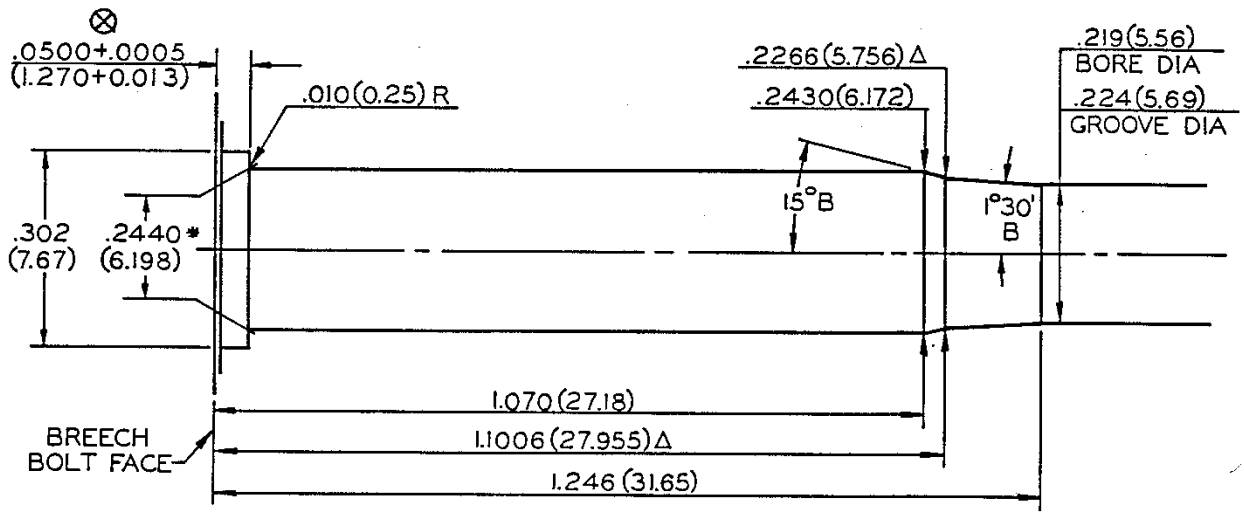


BARREL	SMOOTH BORE
LENGTH OF BARREL	24.000±.010(609.60±0.25)

UNLESS OTHERWISE NOTED
ALL DIA +.0005(0.013)
LENGTH TOL +.005(0.13)

NOTE
B = BASIC
(XX.XX) = MILLIMETERS
⊗ = HEADSPACE DIMENSION
* DIMENSIONS ARE TO INTERSECTION OF LINES
Δ = REFERENCE DIMENSION
ALL CALCULATIONS APPLY AT MAXIMUM MATERIAL CONDITION (MMC)

STANDARD VELOCITY &
PRESSURE BARREL
22 WINCHESTER MAGNUM
RIMFIRE



NO. OF GROOVES	6
WIDTH OF GROOVES	.074+.002 (1.88+0.05)
TWIST	16 (406.4) RH
LENGTH OF BARREL	24.000±.010(609.60±0.25)

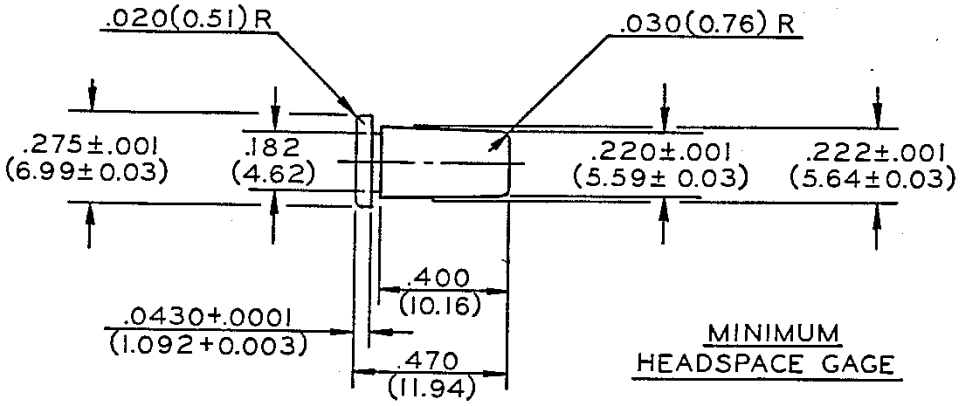
LAND & GROOVE DIMENSIONS TO BE WITHIN
TOLERANCES THROUGHOUT LENGTH OF BARREL

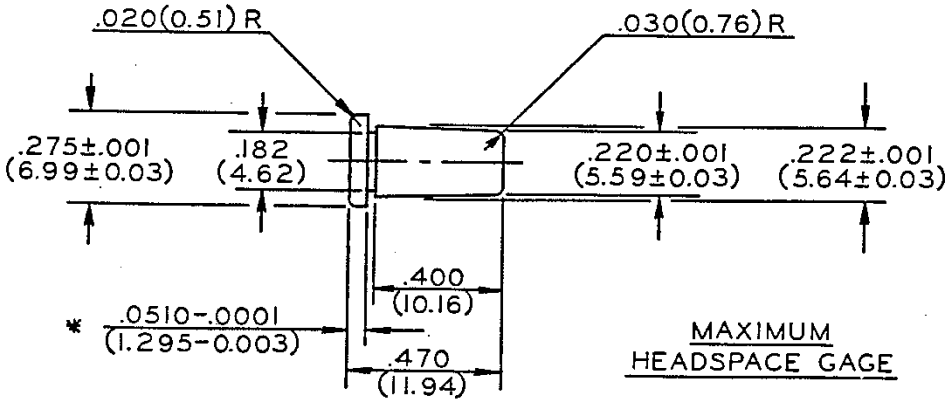
UNLESS OTHERWISE NOTED
ALL DIA +.0005(0.013)
LENGTH TOL +.005(0.13)

NOTE
B = BASIC
(XX.XX) = MILLIMETERS
* DIMENSIONS ARE TO INTERSECTION OF LINES
ALL CALCULATIONS APPLY AT MAXIMUM MATERIAL CONDITION (MMC)

⊗ = HEADSPACE DIMENSION
Δ = REFERENCE DIMENSION

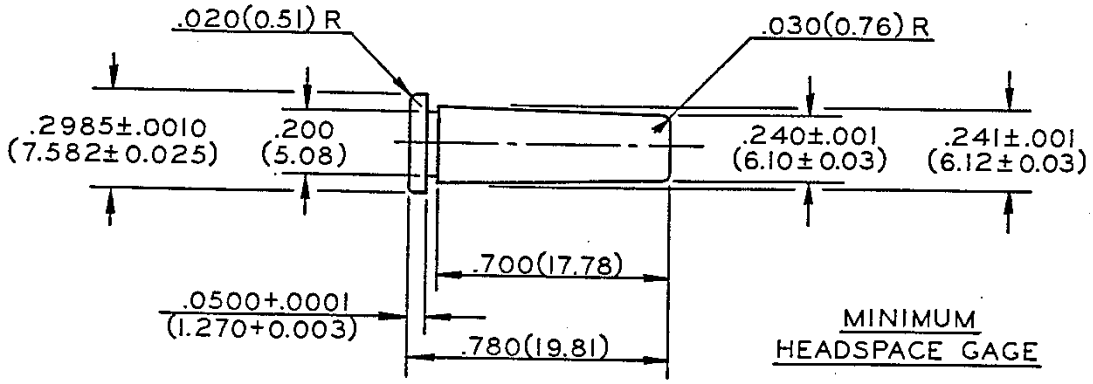
HEADSPACE GAUGES
22 CAL SHORT, LONG, LONG RIFLE, AND LONG RIFLE SHOT



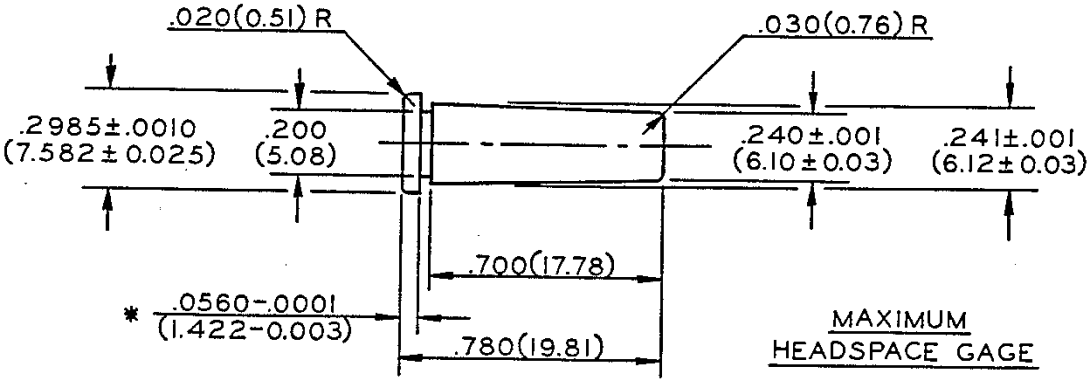


NOTE
(XX.XX) = MILLIMETERS
HARDEN AND GRIND
* REPRESENTS MAXIMUM ADVISABLE CONDITION AFTER USE
UNLESS OTHERWISE NOTED ALL TOLERANCES ±.005(0.13)

HEADSPACE GAUGES
CAL 22 W.R.F. AND
22 W.M.R.F.



MINIMUM
HEADSPACE GAGE



MAXIMUM
HEADSPACE GAGE

NOTE
(XX.XX) = MILLIMETERS
HARDEN AND GRIND
* REPRESENTS MAXIMUM ADVISABLE CONDITION AFTER USE
UNLESS OTHERWISE NOTED ALL TOLERANCES ±.005(0.13)

DEFINITION AND PURPOSE

SAAMI Definitive Proof cartridges are cartridges commercially loaded by SAAMI member companies to develop pressures substantially exceeding those developed by normal service loads. The pressure levels are designed to assure firearms safety when using ammunition loaded to service pressures in accordance with accepted American practices.

Proof cartridges are designed to stress firearms components which contain the cartridge in order to assure safety in the recommended use of firearm during its service life.

It is important from the safety standpoint that Definitive Proof cartridges be used only for the proof of firearms. Adequate precaution must be taken to protect personnel performing firearms proof testing.

Definitive Proof cartridges are loaded with the heaviest bullet for the particular cartridge. The slowest powder which will meet the pressure values is used in order to maintain effective pressure-distance relationships.

The following specifications define the proof loads based on tests fired in standard test barrels with the ammunition at a temperature of 60°-80°F (15.6°-26.7°C). Tests shall be in accordance with the procedures and equipment shown in Sections II and III of this standard.

Pressure values are given on the following pages in terms of minimum and maximum averages and extreme variations for 10-round tests in standard test barrels.

For Rimfire, the standard deviation is the same for service loads and proof loads.

The minimum and maximum average Definitive Proof pressures for Rimfire are 25% and 40% greater than the MPLM service pressure and are computed as follows:

The Minimum Average Definitive Proof pressure is calculated by multiplying the Maximum Probable Lot Mean (MPLM) service pressure by a factor of 1.25 (i.e., 125%) and rounding up to the nearest multiple of 500 lbs.

The Maximum Average Definitive Proof Pressure is calculated by multiplying the Maximum Probable Lot Mean (MPLM) service pressure by a factor of 1.40 (i.e., 140%) and rounding downward to the nearest multiple of 500 lbs.

Example:

22 Long Rifle MPLM Pressure = 24,600 psi S.D. = 1,000 psi

1. Minimum Average Definitive Proof pressure = Max Probable Lot Mean Pressure x 1.25 i.e. 24,600 psi x 1.25 = 30,750 rounded up to 31,000 psi.

2. Maximum Average Definitive Proof pressure = Max Probable Lot Mean Pressure x 1.40 i.e. 24,600 psi x 1.40 = 34,440 rounded down to 34,000 psi.

The Maximum Proof Pressure E.V. is a statistic derived from knowledge of the population Standard Deviation. Applying table figures from Relative Range Tables (Biometrika Tables for Statisticians), we calculate the maximum E.V. or Range equal to the population S.D. times the table constant 5.16 (for sample of 10 at 99.0% confidence level). For example, 22 Rimfire Proof S.D. = 1,000 psi, 1,000 psi x 5.16 = 5,200 psi which is the maximum allowable E.V. for the 22 Long Rifle Rimfire proof loads.

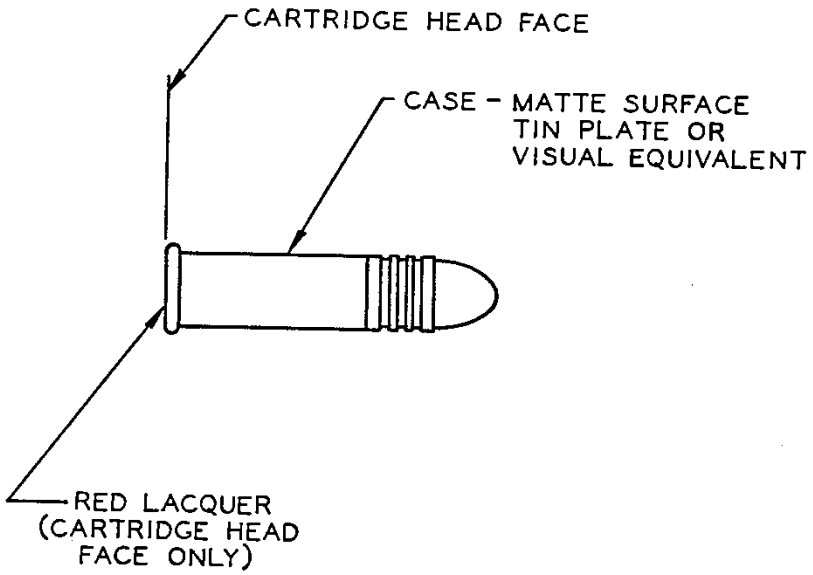
PRESSURE DATA

Cartridge	Bullet Wt. (grs.)	Service Maximum Average Pressure	Minimum & Maximum Pressure Values of Proof Cartridges (psi/100) Minimum Average	Maximum Average	Max. E.V.
22 LR	40	240 *	310	340	52
22 WMRF	40	240 *	320	355	124

NOTE: All pressures are in units of 100 pounds per square inch.

* No specific recommendation is made as to proof testing of Rimfire firearms designed for average service pressures below 25,000 psi.

PROOF CARTRIDGE IDENTIFICATION



NOTE
(XX.XX) = MILLIMETERS

SOURCE

Rimfire Definitive Proof Loads should be used for one purpose only: The proof testing of rifles, pistols and revolvers.

A list of suppliers of Rimfire Definitive Proof Loads may be obtained from the SAAMI Office.

RIMFIRE DEFINITIVE PROOF PACKAGE IDENTIFICATION

DANGER - HIGH PRESSURE

Definitive Proof Cartridges for use only in Proof Range.

These cartridges are loaded to SAAMI recommendations.

Firearm to be fired only from a fixed rest with operator properly protected.

(Red lettering on white background)