

Proof House Trials 2015

1999 Memorandum

NRA Rule 150

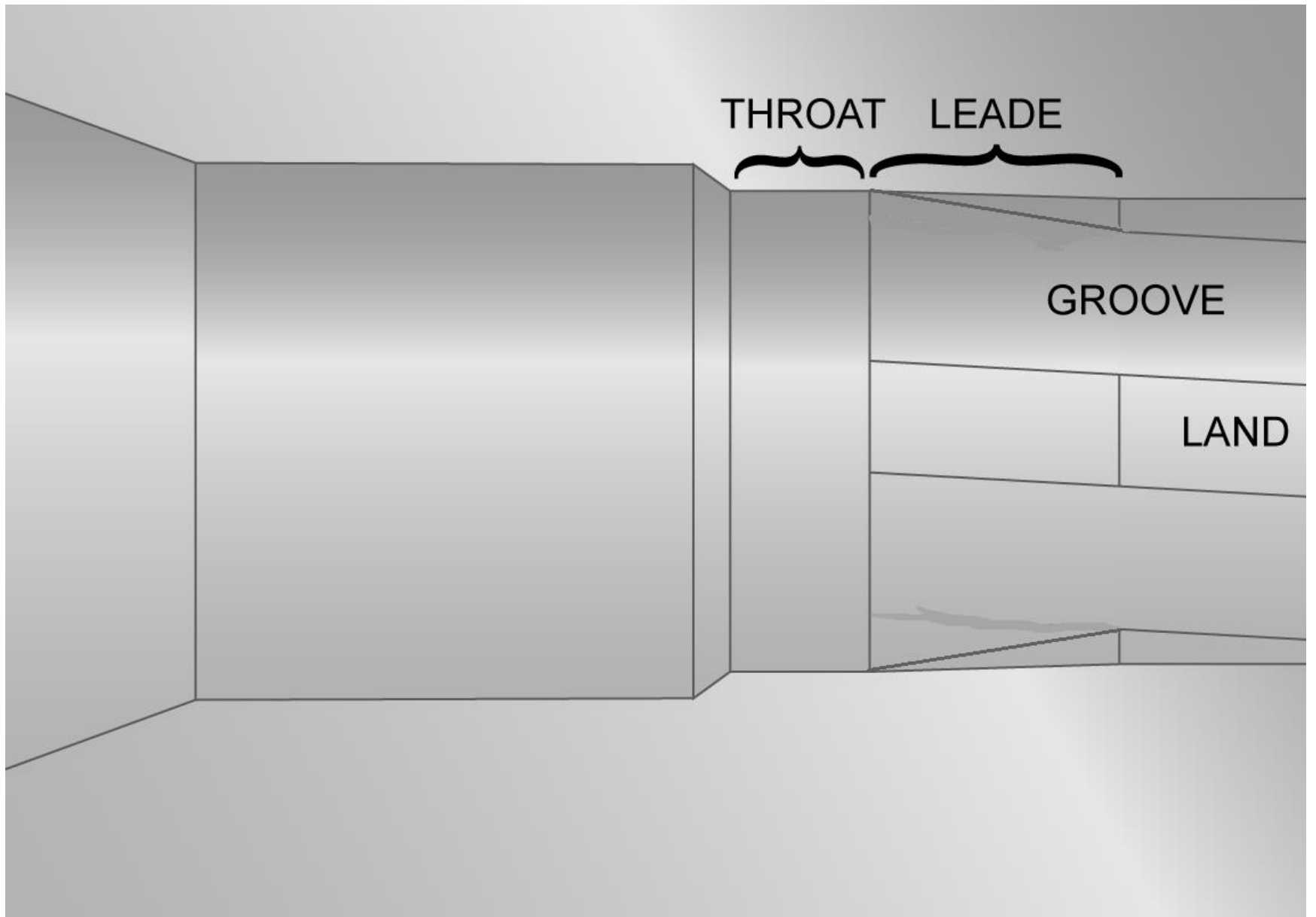
AIM

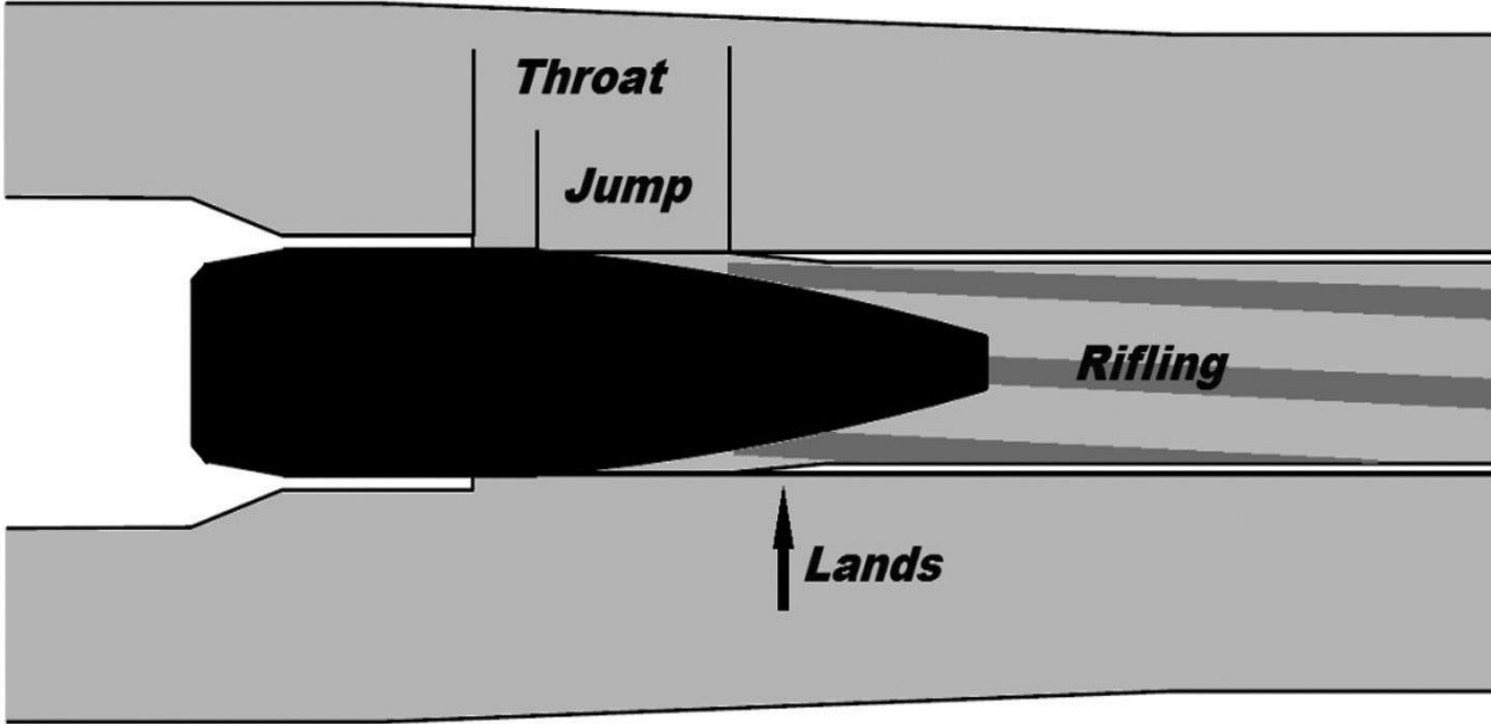
To determine the effect of “freebore” on pressure for the .308W cartridge

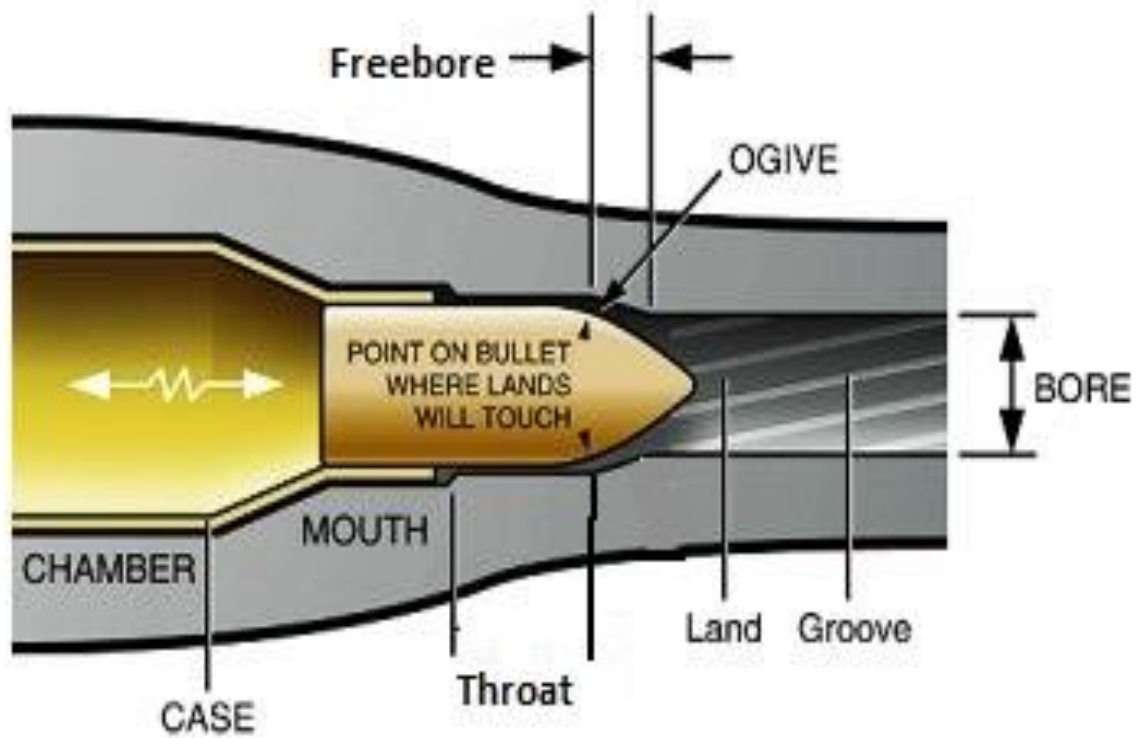
What is Freebore?

Freebore is the distance moved by a bullet from a chambered cartridge before it contacts the lead of the rifling

Also known as “jump” or throat length







Three types of Freebore

- **Zero Freebore** : where the bullet is in contact with the rifling lead – the unfired cartridge is the **same length** as the chamber
- **Negative Freebore** : where the bullet engages the rifling lead before firing – the unfired **cartridge is longer** than the chamber
- **Freebore** : where the bullet has to move before it engages with the rifling lead – the unfired **cartridge is shorter** than the chamber

.308W Bore & Chamber Dimensions

	CIP	1999 Memorandum	Rule 150
Min Bore Diameter	0.300"	0.298"	0.298"
Min Groove Diameter	0.3080"	0.3065"	0.3065"
Min Throat Diameter	0.3098"	0.3085"	0.3085"
Freebore for Sierra 2155	0.105"	Not Specified	~0.015"

Ammunition

- CIP Max Average Pressure : 4150 Bar
- Max Pressure Single Cartridge : 4772 Bar
- NRA Specification Ammunition
Maximum Ave Pressure : 3650 Bar
(Specified in 1999 Memorandum)

The “System”

CIP MAXIMUM average working pressure for
.308W calibre Firearm and Ammunition “system”

4150 Bar

That is to say : whatever the bore dimensions
and ammunition used, the maximum permitted
pressure for **that combination** is **4150Bar**

Achieving the AIM

Fire a series of trials using typical TR specification
Ammunition in typical TR specification barrels

1st Trial @ zero freebore

Increase freebore

2nd Trial.....

Final Trial @ full CIP spec freebore (0.105" with
Sierra 155 bullet)

The Trials

- 4 Lots of Ammunition – all Sierra 155gn bullets
 1. 120-GGG-14
 2. RUAG Lot 60 PG
 3. RUAG Lot 60 PG – Reworked
 4. Handloads
- 2 Barrels used
Proof House given 4 barrels, they selected 2 for the trials

The Birmingham Proof House Laboratory Pressure Gun



Trials Ammunition

Overall Cartridge Length (OCL) measured for a sample of 20 cartridges taken from each Lot

Cartridge Lot	Mean OCL, (inches)	Range of OCL's (inches)
120-GGG-14	2.789	2.785 - 2.790
RWS/RUAG 60PG	2.782	2.778 - 2.785
Rework RWS/RUAG	2.778	2.774 - 2.782
Hand loads	2.788	2.785 - 2.795

Note : OCL measured for all cartridges in trial

Trial Barrels

- **ALL** Chamber dimensions first checked by Proof House & initial freebore (jump) measured using Sierra 2155 bullet for all 4 barrels
- Proof House then selected 2 barrels used for the trials from the 4 supplied by NRA

Trial Barrels Dimensions

- Bore and Chamber dimensions comply with Rule 150 / 1999 Memorandum
- Bore dia : 0.298"
- Groove dia : 0.3065"
- Throat dia : 0.3085"

Except for Initial Maximum Chamber Length

- Barrel DB47276 : 2.783"
- Barrel DB47277 : 2.783"

Preliminary Test

- 20 rounds from each of the four lots of ammunition plus proof ammunition fired in **Standard CIP Pressure Gun**

Ammunition	Mean Pressure, (bar)	Mean Velocity (ft/sec)	Standard Deviation		Correlation Coefficient
			Pressure (bar)	Velocity (ft/sec)	
GGG	3569	2805	94.7	15.5	0.95
RUAG	3501	2765	70.9	11.9	0.90
Reworked RUAG	3555	2782	84.6	10.5	0.98
Handloads	3864	2814	69.8	11.9	0.96
Proof Loads	5161	-	-	-	-

The Trials

- 20 rounds of each lot of ammunition fired in each barrel at 5 different freebore lengths (jump)

Test Number	Nominal Freebore, Inches (mm)	
	Barrel Number DB47276	Barrel Number DB47277
1	Nominally 0	Nominally 0
2	0.0125"	0.0115"
3	0.0260"	0.0260"
4	0.0695"	0.0680"
5	0.105"	0.105"

Actual Freebores – Trial #1

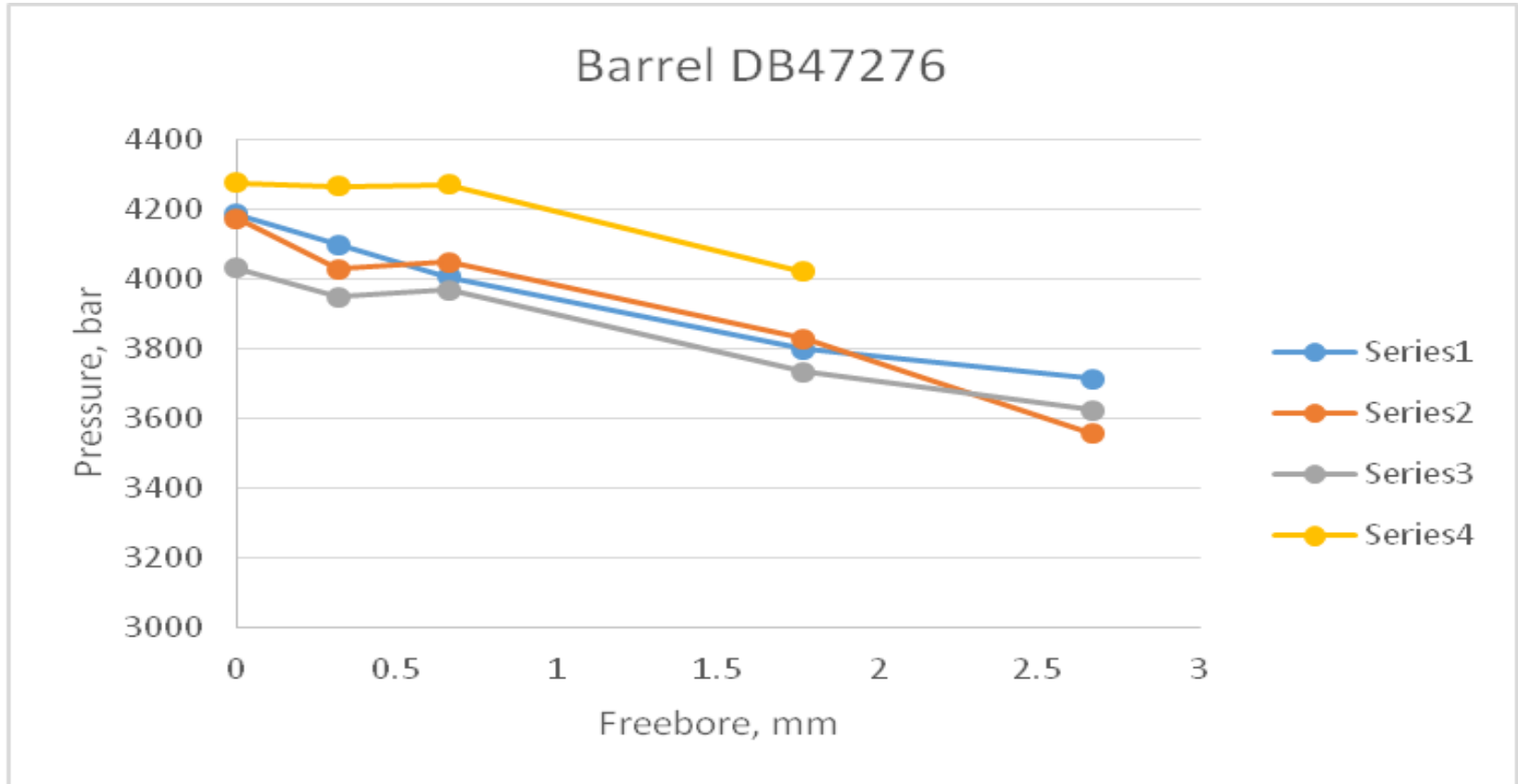
GGG Ammunition

- Mean freebore = $2.783'' - 2.789'' = -0.006''$
- Freebore varies from $-0.002''$ to $-0.007''$

RUAG Lot 60PG

- Mean freebore = $2.783'' - 2.782'' = +0.001''$
- Freebore varies from $+0.005''$ to $-0.002''$

The Results (1)



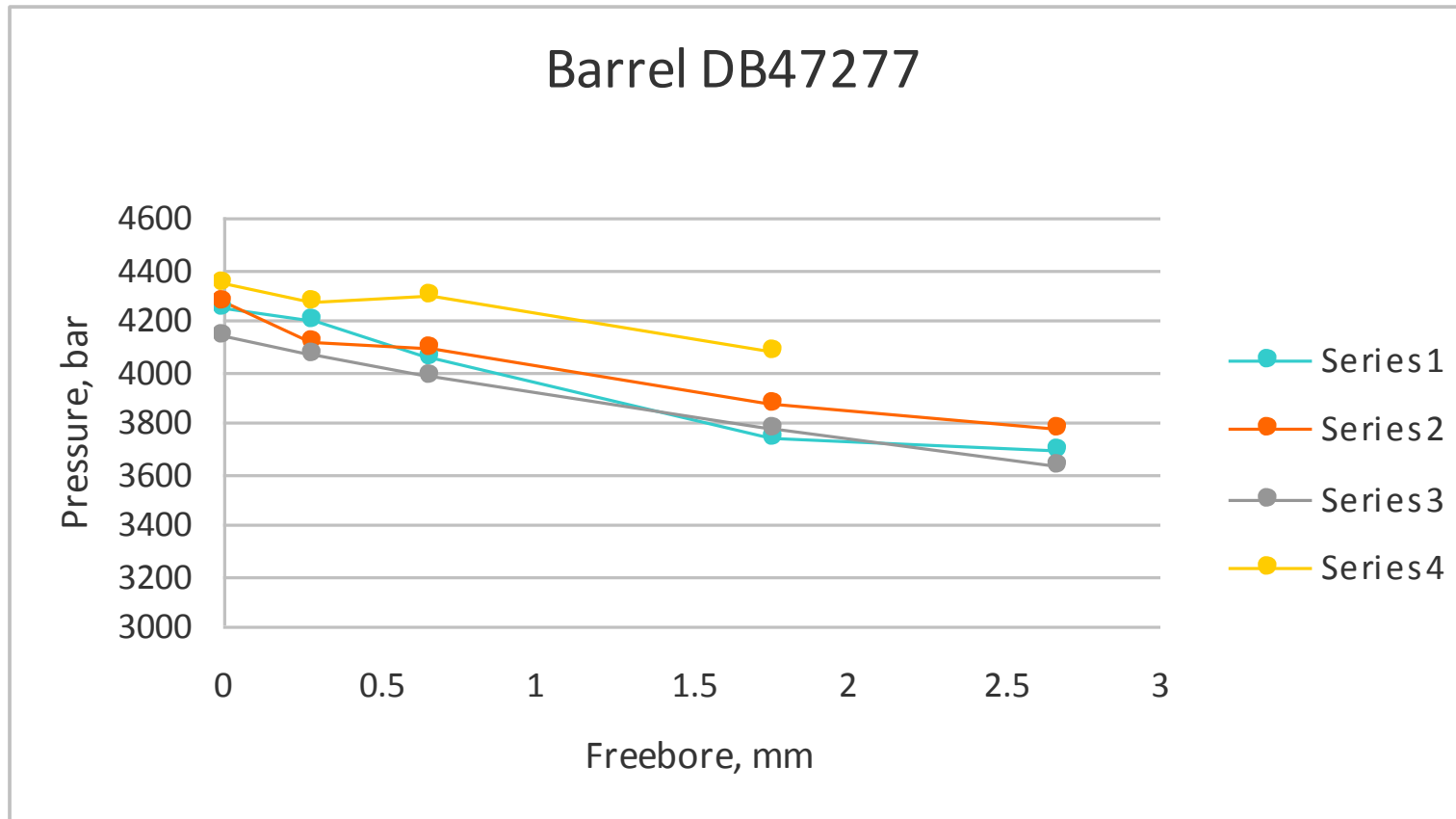
Series 1 : GGG

Series 3 : RUAG Reworked

Series 2 : RUAG 60PG

Series 4 : Handloads

The Results (2)



Series 1 : GGG

Series 3 : RUAG Reworked

Series 2 : RUAG 60PG

Series 4 : Handloads

Rule 150 Freebore

- Chamber length measured using Sierra 155 bullet must not be less than 2.800”
- Average OCL of RUAG 60PG : 2.782”
- Rule 150 gives freebore (jump) for RUAG of $2.800 - 2.782 = \mathbf{0.018}$ ”
- Average OCL of 120-GGG-14 : 2.789”
- Rule 150 gives freebore (jump) for GGG of $2.800 - 2.789 = \mathbf{0.011}$ ”

The Results in Numbers

Average Pressures for both barrels

Freebore (jump)	Mean Pressure P_{\max} (Bar)			
	GGG	RUAG	Reworked RUAG	Handloads
0	4214	4219	4083	4305
0.012" (0.3175 mm)	4147	4072	4009	4265
0.026" (0.6604 mm)	4028	4066	3977	4288
0.069" (1.7653 mm)	3768	3847	3753	4048
0.105" (2.667 mm)	3702	3668	3630	

Single Cartridge Pressures

Max single cartridge pressures recorded during the trials were :

- GGG : 4355 Bar (+4.9%)
- RUAG 60 PG : 4335 Bar (+4.5%)
- RUAG 60 PG r/worked : 4367 Bar (+5.2%)
- Handloads : 4514 Bar (+8.8%)
- Max Permitted by CIP : 4772 Bar (+15%)

Conclusion #1

The average working pressure in a rifle

Which complies with Rule 150

does not exceed

4150 Bar, the maximum allowed by CIP,

when used with NRA Specification issued

ammunition

Conclusion #2

No factory cartridge fired during the trials exceeded the maximum average pressure by more than 217 Bar (5.2%), far less than the 622 Bar (15%) variance permitted by CIP for any single cartridge.

Also the case for every lot of NRA ammunition tested at BPH over the past 15 years

Conclusion #3

There is **NO** “**spike**” (sudden increase) in pressure when freebore becomes negative as has been claimed.

Effect on Velocity

Ammo	Freebore				Change	
	Nominal ZERO		CIP (0.105")			
	Pressure Bar	Velocity ft/sec	Pressure Bar	Velocity ft/sec	Pressure Bar	Velocity ft/sec
GGG	4214	2983	3655	2926	559	57
RUAG	4083	2933	3630	2887	453	46

Effect on Wind Allowance

Ammo	Freebore		Change		Change in Wind Allowance
	Nominal ZERO	CIP (0.105")			
	Velocity ft/sec	Velocity ft/sec	Pressure Bar	Velocity ft/sec	10 min wind @1000x
GGG	2983	2926	559	57	
RUAG	2933	2887	453	46	
					50 ft/sec = 0.25 MoA