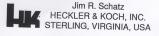
THE DEVELOPMENT STATUS OF THE HECKLER & KOCH G11 RIFLE WITH CASELESS AMMUNITION

PRESENTED AT THE
1990 ANNUAL MEETING
SMALL ARMS SYSTEM DIVISION
AMERICAN DEFENSE PREPAREDNESS
ASSOCIATION

30 OCTOBER - 1 NOVEMBER 1990 ABERDEEN PROVING GROUND, MD



G 11

Weapon / Ammunition System
G 11 rifle



with caseless ammunition



INTRODUCTION

G11

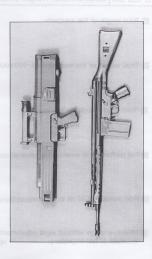
Heckler & Koch CmbH has been designing and producing highly innovative military small arms since the adoption of the G3 rifle by the West German Bundeswehr in 1957. Numerous other very successful weapons, such as the MP5 submachine gun, were designed and manufactured around the unique roller-locked bolt system employed in the G3 rifle. Even today, the G3 is considered one of the most robust, accurate and reliable combat rifles ever devised. However, even the pronounced superior qualities inherent in the roller-locked HK rifles of today provide the user only a marginal increase in combat capability over other more conventional rifles available worldwide.

In the early 1960's, this concern was already being addressed by the West German military. A list of design criteria, to include both technical and troop specifications, was completed in 1970 by the West German Department of Defense for a new and revolutionary combat rifle that would multiply the individual combat capability of the West German infantryman.

The search for the G11 rifle had thus begun.

G11 TOP: G11 RIFLE (K2 CONFIGURATION), #253, 4.73X33MM CASELESS, 1990 BOTTOM: G3 RIFLE, #2261, 7.62X51MM NATO, 1959

GRUPPE



Military - Technical



Military - Technical Economical Requirement

G 11 12/89 E-25

100	Total	length	of	the	weapon:

< 750 MM

Total weight of the weapon incl. 100 rounds:<4,5 kg

Number of rounds on the weapon:

min. 50

Full performance even under adverse conditions

High probability of hit in the 3-round burst

Effective range without sight adjustment because of flat trajectory: up to 300 m

Entwicklung Wehrtechnik



Functional Features

G 11

12/89 E-16



- high hit probability even unde combat conditions
- quick readiness to fire
- maximum reliability under all environmental conditions
- no impeding recoil effect on the shooter
- low system weight
- compact form
- no ejected cases
- simple care and maintenance
- short training times for users
- small cartridge dimensions
- low cartridge weight
- large number of rounds can be carried

The major area of concern for the designers was centered around the need to increase the soldiers ability to hit targets under realistic battlefield stress. It is well known how combat-induced stress degrades the marksmanship ability of a rifleman. Poor trigger control, sight alignment, sight picture and unstable firing positions materialize, even in a proficient marksman, when facing incoming enemy fire. In addition, targets on the field of battle seldom resemble those on a training range. They are most often only partially exposed, moving at various speeds and angles, and partially protected or obscured by cover, concealment or smoke.

All of these conditions severely decrease the probability of the rifleman hitting his target, especially while firing in a semi-automatic mode. Conventional fully-automatic fire, even when limited to a burst of a predetermined number of rounds, seldom results in more targets hit. It is generally agreed that if the first round of a burst fired from a conventional assault rifle does not strike the target, the natural rotation of the human torso when subjected to the recoil impulse of weapon will direct the latter rounds of that burst high and to the right (or left) over the target.



INTRODUCTION-Cont.

G11

A study conducted by the Battelle Institute in Frankfurt in the early 1960's gave birth to two possible methods to dramatically increase the firer's probability of hitting a target with a single trigger-pull.

1. THE "SHOTGUN" APPROACH -

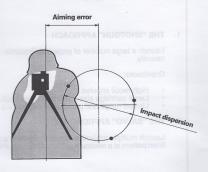
Launch a large number of projectiles instantaneously.

Drawbacks:

- High recoil impulse.
- Large cartridge size. Limited combat load.
 - Limited range and penetration capabilities.

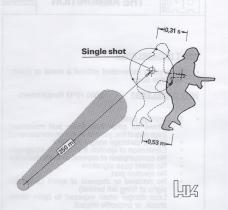
2. THE "SALVO" APPROACH -

Launch multiple projectiles simultaneously in a defined pattern at a minimum of 2000 RPM rate of fire.





8



Target speed: 1.7 m/s (

≤ 5.6 ft/s)
Aiming and lead error: approx. 2 mils



THE AMMUNITION

AMMC

WHAT IS CASELESS?

A cartridge assembled without a metal or plastic cartridge case.

WHY CASELESS? - 2000 RPM Requirement

No cartridge case:

 Allows for other than linear bolt movement (high rate of fire, yet less stress on components)

Lighter cartridge weight (@50%)

Elimination of ejection & extraction stoppages
 No consumption of expensive case materials

No spent case signature

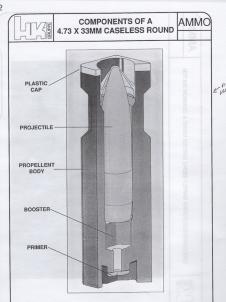
No ejection port

- No retrieval or disposal of spent cases (no signs of firing left behind)
 - Less danger when exposed to open flame, shock, or projectile impact.
 - Less toxic ingredients than NC.

· No CARBON RESIGNE

- Diminutive cartridge weight & dimensions
 - · More stowed rounds in weapon
 - More ammunition portability by the operator
 - Simplified supply and logistics
 - Smaller/lighter system components and weapon.





AMMO

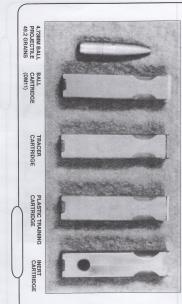
7,35 kg

7,35 kg



VARIOUS 4.73X33MM CASELESS ROUNDS PRODUCED BY DYNAMIT NOBEL

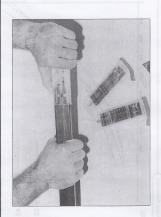
AMMO

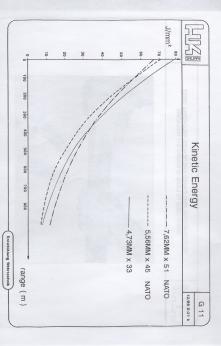


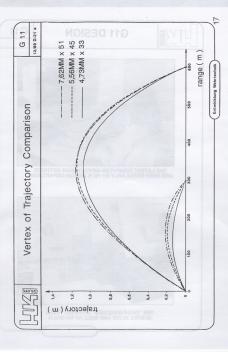


FIFTEEN-ROUND, PRELOADED AND SEALED RELOADING UNITS BEING USED TO LOAD 45 ROUND G11 MAGAZINE

AMMO







G11 DESIGN

G11



THE LATEST COMPUTER-AIDED DESIGN METHODS ARE USED REGULARLY BY HK'S DESIGN DEPARTMENT



THE "OLD-FASHIONED" DRAWING TABLE IS STILL ALIVE AND WELL AT HK-GmbH

G11





G11 TECHNICIAN ASSEMBLING PROTOTYP



CNC MACHINERY USED TO MANUFACTURE G11 PARTS

ALL G11 PROTOPYPES:

- ARE GAS-OPERATED
- HAVE SEMI-AUTOMATIC, FULLY-AUTOMATIC AND THREE-ROUND BURST (2000-2200 RPM) MODES OF FIRE
- HOUND BURST (2000-2200 HPM) MODES OF FIRE.

 UTILIZETHEFLOATING INTERIOR SYSTEM WHEREIN THE BARREL, MAGAZINE AND BREECH MECHANISM RECIPROCATE AS ONE UNIT WITHIN THE SYNTHETIC HOUSING.
- UTILIZE FIFTY (50) ROUND MAGAZINES ("TECHNICAL TEST" PROTOTYPE, ACR AND G11K2 UTILIZE 45 ROUND MAGAZINES.)
- ALL OPTICAL SIGHTS MANUFACTURED BY HENSOLDT AND ARE 1:1X, EXCEPT ACR SIGHT WHICH IS MANUFACTURED BY SWARDVSKI AND ALSO EMPLOYS 3.5X MAGNIFICATION.
- ALL OPTICS UP TO PROTOTYPE 14 (AND G11K2) COULD BE REMOVED.
- ALL OPTICS UNTIL PROTOTYPE 12 HAD OPEN, SINGLE POST RETICLE, PROTOTYPE 13 AND ACR AND HAD CROSSHAIR. ALL OTHERS HAVE RING RETICLE.



PROTOTYPE 5

- · NC AMMUNITION
- TWO-PART CHAMBER
- 90∘ ROTATING CHAMBER
 FIRED IN 1977 NATO TESTS
- FIRED IN 1977 NATO TESTS
 ROUND EJECTED FROM TOP
- OF BUTTSTOCK AT 45°

- METAL HOUSING IN WHICH NON-DETACHABLE MAGAZINE
 - RECIPROCATED. RELOADED
 - WITH 15 ROUND CLIPS.



G11 LINEAGE- Cont.

G11



PROTOTYPE 6

- · NC AMMUNITION · METAL HOUSING
- TWO-PART CHAMBER

- 90∘ ROTATING CHAMBER · ROUND EJECTED FROM TOP
 - OF BUTTSTOCK AT 45°



PROTOTYPE 12

- · NC AMMUNITION · METAL HOUSING
- TWO-PART CHAMBER
- · 360° ROTATING CHAMBER
- · FIRST ROTATING COCKING HANDLE ON LEFT SIDE
- VISIBLE SYSTEM LOCKING LEVER



PROTOTYPE 13

- · STARTED WITH NEW NC AMMO. SWITCHED TO H.I.T.P. (HIGH INCENDI-ARY TEMPERATURE PROPELLANT) AMMUNI-TION WITH "SHOULDER."
- · METAL HOUSING WITH PLASTIC HANDGUARD

- · THREE-PIECE CHAMBER
- WITH TWO CAPS 360∘ ROTATING CHAMBER
- ROUND EJECTED FROM BOTTOM OF BUTTSTOCK



PROTOTYPE 14

- TELESCOPIC H.I.T.P. AMMO
 ALL PLASTIC HOUSING
- TWO-PART CHAMBER (ONE CAP)







G11 LINEAGE- Cont.

G11



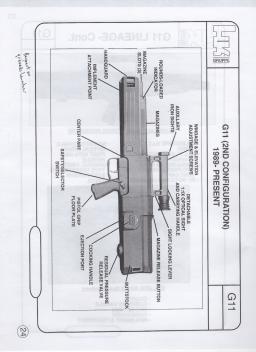
TECHNICAL/TROOP TESTING PROTOTYPE

- · TELESCOPIC H.I.T.P.
- AMMO · ALL PLASTIC HOUSING. CHANGEDTO PLASTIC
- MAGAZINE (45 RDS.) · TWO-PART CHAMBER (ONE CAP)
 - 90° ROTATING CHAMBER
- · NON-DETACHABLE OPTICAL SIGHT. FIRST WITH RING RETICLE · ORIGINAL PROTO-
- TYPE ENTERED INTO BUNDESWEHR TESTS.



G11, ACR, G11K2 (top to bottom)

- SIGHTS
- · CARRYING HANDLE
- MAGAZINE(S)
 HANDGUARD
- · IMPLEMENT ATTACHMENT





Technical Data

12/89 E-17 G 11



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A



Calibre Type of ammunition Length of weapon Width of weapon Height of weapon

Modes of fire:

Single fire

3-round burst

Sustained fire



> 2000 rounds/min approx, 450 rounds/min

Theoretical rates of fire:

• 3-round burst

• Sustained fire

approx. 160 N approx. 110 N

Max. shoulder pressure:

• 3-round burst

• Single and sustained fire

15 rounds

3.8 kg (8.38 lb) 4.3 kg (9.48 lb)	
Weight of weapon with 2 magazines loaded with 90 rounds	

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0.11 kg (3.89 oz)

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g	ndt
le	2 2
9	fling
Ban	Εĕ

Combat range Steel helmet penetration	Operating principle	Breech principle
(3.89 oz)	nm (21.26 in)	(0.1011)

ng principle Magazine capacity

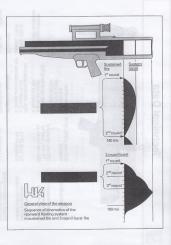
Gas-operated, cartridge in chambe Cylindrical drum principle



>300m (328 yd) up to 600m (656 yd)

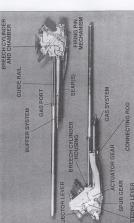
G11 INTERIOR FLOATING SYSTEM

G11



911

G11 BREECH AND BARREL ASSEMBLY (B&BA) (INTERIOR FLOATING SYSTEM)

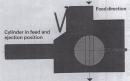


RIGHT SIDE VIEW

LEFT SIDE VIEW

G11 FEEDING AND FIRING G11

Operating principle



Ejection direction



LIK

G11

G11 CHAMBER



G11 FIRING PIN G11



2. buttstock 1. magazine

5. receiver complete with

- guide compl.

trigger mechanism compl.

4. cylinder 3. control disc

- safety

- grip complete with scope - base

- handguard

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Assembly Groups - Overall View

12/89 E-8 G 11

⑤ handguard complete grip complete with scope buttstock complete

(6) magazine complete

(1) receiver complete

2 breech cylinder housing with barrel, complete

Entwicklung Wehrtechnik

WEST GERMAN BUNDESWEHR TESTING

G11







G11 FIELDING STATUS IN GERMANY

G11

1989 Completion of technical testing at Meppen
1/1990 Completion of troop testing at Infantry
Schools
3/1990 Issuance of "Statement of Troop Useability"
4/1990 Issuance of "Statement of Technical Maturity for Fielding"

1/1991 Issuance of "Permit for Fielding" expected.
-alsoAward of production contracts for weapons

and ammunition.

- G11 will replace G3 rifles and MP2 SMG's
- Immediate requirement for 58,050 G11's for German/French Brigade.
- Option quantity for 121,000 for Ranger Units.
- Requirements of Air Force and Marine units still undisclosed.
- G11 has passed all required troop and technical tests. Only political obstacles still remain.



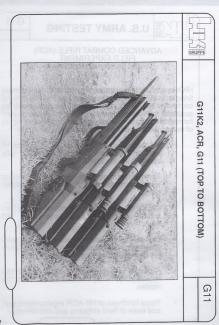
U.S. ARMY TESTING

G11

ADVANCED COMBAT RIFLE (ACR) FIELD EXPERIMENT FORT BENNING, GEORGIA 1990

HK has successfully completed nine months of intensive firing tests at Fort Benning and Aberdeen Proving Ground on twenty HK-ACR's. While no official results will be available until after November 1990, our systems performance during this period was outstanding. Highlights of our experience at Fort Benning are listed below:

- No major mechanical failures on any of the 15 weapons. All weapons finished test in fully operational condition.
- Excellent semi-automatic accuracy in hands of test personnel, both during zeroing and down range.
- 60,000 rounds fired. Estimated ammunition failure rate was approximately one in 485 rounds.
- Implemented various modifications and reinforcements to weapons during test to enhance performance, durability and handling.
- Achieved safe minimum cook-off rate of 150 rounds (at 60 RPM) in sustained and burst fire modes.
- Troop fondness of HK-ACR ergonomic design and ease of field stripping and maintenance.



ACR FIELD EXPERIMENT



CLASSROOM TRAINING



RANGE FIRING





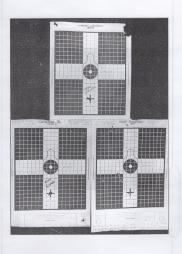
RANGE FIRING



WEAPONS CLEANING



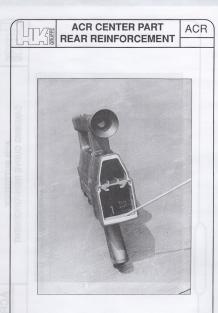
25M ZERO TARGETS ACR FIELD TEST



25M ZERO TARGETS
ACR FIELD TEST

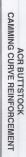
GRUPPE

ACR CENTER PART FRONT REINFORCEMENT



ACR CENTER PART REAR REINFORCEMENT

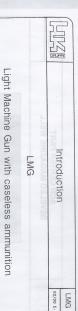




ACR CENTER PART BEVELED MAGAZINE WELL



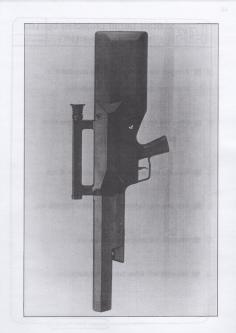




LMG

44

Military Technology R&D





Staff target projected by LMG IEPG on a new LMG

- Firing of the weapon must be possible in all static and dynamics firing conditions
- Effective fire by the weapon at ranges from 0 - 600 m
- Overall LMG weight without ammo < 5 kgs</p>
- Throw-away type magazine, capacity 200 rds
- Weapon for long suppressive fire
- No cook-off after firing a full magazine



German army requirements on a new LMG

LMG

1	ופוערע	on a new LMG	06-90 E-
	Operable by mor	unted and dismount	ed infantry
		rapid to engage in a	all kinds of terrain
		ble, compact maga	
		for firing on the mo	
	Sufficient fire po	wer for suppression	i fire W
	High ammunition	capacity, no need t	for reloading
(during longer con	mbat sequences	
	Light weight, con	npact system > n	o fatigue to the
	shooter		
	Same ammunition	n calibre 4.73MMx33	as G11 rifle

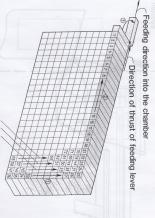
	System chara	notorietics	LMG
	System Char	acteristics	06/90 E-
☐ Total w	veight, including 300) rounds: < 7 kg	
	ine capacity:	300 rounds	
☐ Disposa	able, compact mag	azine, water	
	reloadable, no maga		
☐ Weapo	n length: Wa Tol 184	≤ 900 mm	
☐ Revolve	er breech drum with	n 3 chambers	
(no cod	ok-off after 300 rou	unds sustained f	ire)
☐ Recoil	operated breech sy	rstem Inglew Ing	
☐ Rearwa	ard floating system		
☐ Rate o	f fire:	< 600 rds/min	
☐ 4.73MM	1x33 G11 ammunitio	n	

Defence Technology R&D



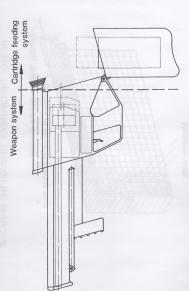
LMG - FOR CASELESS AMMUNITION

PATH OF THE CARTRIDGE THROUGH THE MAGAZINE





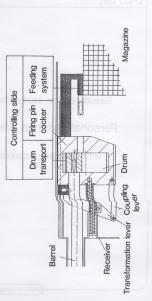
LMG - FOR CASELESS AMMUNITION





LMG ~ FOR CASELESS AMMUNITION

OPERATIONAL PRINCIPLE OF THE WEAPON - NORMAL POSITION



NBW

06/90 E-

Results of the study about a

Personal Defence Weapon

with caseless ammunition



NATO - Requirements

NBW 06/90 E-



In the NATO Document AC 225 of April 16th, 1989 there is a requirement for a

"Personal Defence Weapon" for the post 2000 period.

....

The weapon should be....

- (1) Lighter, more durable, should make use of the latest state-of the art materials
- (2) Easy to handle, require minimum of maintenance
- (3) Feature reduced audible and visible signature
- A multi-purpose weapon with modular design Objective: Reduction of the variety of different weapons and fire control systems in a unit

Defence Technology R&I



Requirements on the PDW

NBW

06/90 E-



- Simple, compact, robust
- ☐ Firing comfort
 - low recoil impulse
- ☐ High hit probability
- Perforation capacity
- steel helmet 100 m
 - 45 layers of Kevlar shelem the ent
 - Effect after perforation of body armor
- □ No impediment of main task, objective: Self defence
 - consequence: permanently carried on the soldier



Fields of application

NBW

Military utilization

□ Signal troops, medical staff, military police,
supply units, drivers and service personnel
□ For use in close quarters e.g. by tank crews,
helicopter crews, radar operators and command

Police, law enforcement utilization

- Surveillance, personal controls, traffic controls,
 - house searches
- Searches and scours



Personal Defence Weapon

NBW

07/90 E-

Defence Technology R&D



NBW

H	PDW o	characterist	ics	06/90 E-
	Caseless ammunition	n		Cartrido
	Cartridge 4.73MMx2	5		
	Method of operation	: Gas operated		
	Weights:	Weapon incl. r	nagazine	1.2 kg
		Cartridge 4 g		
	Weapon dimensions:	Length:	300 mm	
		Width:	35 mm	1
		Height:	160 mm	1
	Modes of fire:	Single fire, sus	stained fi	re
		or limited sust	ained fire	9
	Magazine capacity:	20 rounds		
		(optional 40 ro	unds)	

Defence Technology R&D



Comparison of caseless cartridges

NBW

04/90 D.



Cartridge mass:
Bullet mass:
Muzzle velocity:

4,0 g 2,75 g 7: 585 m/s

Max. pressure:

2750 bar

Cartridge mass: 5,2 g
Bullet mass: 3,33 g
Muzzle velocity: 925 m/s
Max. pressure: 3850 bar

Cartridge 4,73MMx33 G11

Wehrtechnik Entwicklung



Question

NBW 06/90 E-



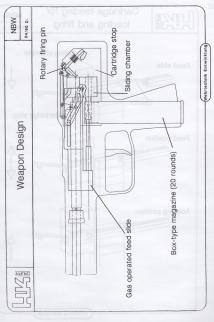
Why not Personal Defence Weapons in cal. 9mm, 5.56mmx45 or other?

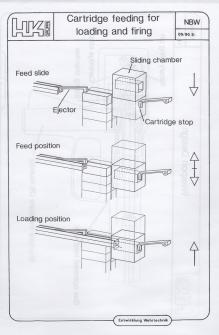
- ☐ Body armor (e.G. Kevlar)
 - makes 9 mmx 19 inefficient
- Cal. 5.56 mmx 45
 - + Good perforation performances
 - unfortunately the weapons are too heavy,
 - or too cumbersome for this purpose
 - and have high recoil with lots of signature

get ballistics

NBW 06/90 E-

	Persona am, 5.56	4,73MMx25 PDW	9MMx19 MP 2	
Weapon		HK - PDW	MP 2	
Range (m)		100		
Block of gelatine (cm)		15 x 15 x 15		
V _o	(m/s)	585	400	
V _{Target}	(m/s)	480	315	
E _o	(Joule)	471	640	
E _{Target}	(Joule)	317	395	
E	(Joule)	97	314	
E _{ab}	(Joule)	220	161	
Bullets inspected after firing		ngid No deformation		
Steel helmet per	etration	Yes	No	
Kevlar, 45 layers		Yes	No	



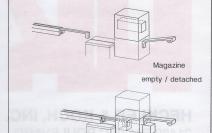




[LIZE

Unloading

NBW 09/90 E -



Positively controlled unloading operation

Entwicklung Wehrtechnik



HECKLER & KOCH, INC. 21480 PACIFIC BOULEVARD STERLING, VIRGINIA 22170-8903 USA TELEPHONE (703) 450-1900 TELEFAX (703) 450-8160 TELEX 7109550846