

## Introduction

This document, which I hope will prove useful to WW2 wargamers, gives penetration performance details of WW2 anti-tank weapons.

I have assembled these from over fifty sources, mostly from my own library. All are in the public domain. Those books no longer in print should be easy to buy from a good book search service such as amazon.com, or to borrow from a good library. The documents cited from the Public Records Office, Kew, are available for inspection there to anyone with a Reader's ticket.

Where page numbers are cited, tables usually appear in the original source. In other cases, it has been necessary to extract and tabulate data spread through the body of the text. Sometimes it has been necessary to reduce information presented as graphs or polar diagrams to tabular form, and some loss of accuracy is inevitable in the process. Given the inherent imprecision of all these figures, however, this does not much matter.

Sources referring to the post-war period have been cited where they cover weapons developed during the war. Some entries refer to weapons never introduced into service, such as the British 32-pounder, American experimental 90mm guns, and a variety of German developments; these are included for interest.

To be useful, armour penetration figures should specify not only the gun, range and penetration achieved, but also the ammunition nature and model fired, the angle of impact, and the type of armour attacked. Some few sources provide all this information; most do not. An additional annoyance is that some sources are obviously mistaken or misprinted in places. This has been noted under the heading "Comments and Corrections" where I have been able to spot the error.

The customary angle of impact when quoting penetration performance is 30° from the vertical, but some American weapons are quoted for 20°. German practice was to measure angles from the horizontal, so where 60° is stated, it is usually safe to assume that 30° from the vertical is intended. In action, unless firing from exactly right-angles to the target vehicle, there will be an additional angular component depending on the target tank's facing.

It is also traditional to quote penetration against homogenous armour. Performance against face-hardened plate, especially for smaller weapons firing uncapped rounds, can differ greatly. Armour hardness may vary considerably. For example, according to Kenneth Macksey's "The Guinness Book of Tank Facts and Feats" (Guinness Superlatives, Enfield, 1972), British homogenous armour at the outbreak of WW2 came in "soft" (machineable) and "hard" grades with Brinell hardnesses of 380 and 450 respectively, while Vickers Cemented armour had a Brinell hardness of 600 on the front and 400 on the back.

Where ammunition nature is not specified, it may be possible to make an educated guess based on the muzzle velocity, if the source quotes one, or simply by applying common sense to the magnitude of the penetration figure given — the widely-quoted 140mm penetration at 500m credited to the Soviet 57mm ZIS-2 can hardly apply to a standard AP round, for example. One source shows a significant difference in performance between APHE and APC or APCBC rounds for the same gun, and it can sometimes be difficult to decide which is meant. The nationality of the weapon can serve as a guide; the Germans never used solid steel AP, preferring APHE; the Russians seem to have had a strong preference for APHE; the Americans seem to have been happy with both; and the British never used APHE after the 3-pounder. The question is further complicated by the fact that rounds are sometimes misleadingly designated; for example, some American rounds designated APC are in fact APCBC. In the name of accuracy, some of these, and Panzergranate 39 for guns above 5cm calibre, should probably be designated APCBCHE, but they never are. For complete accuracy, the precise model number needs to be known. Sometimes even this is not enough, as the table from Hunnicutt's "Sherman" shows; there is an appreciable difference between the "early" and "late" 90mm M82 APC, due to "hotter" loading.

Even when all these sources of variation are accounted for, authoritative sources can seem to disagree. Consider the German 75mm PaK40, a common and well-documented weapon, firing PzGr 39 against homogenous armour at 30° at 500 metres (or 600 yards, which is near enough). Even discarding the highest and lowest observations as outliers, we find a variation between 90mm and 106mm, a

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difference of 17% of the lower figure. This highlights the point that armour penetration is far from being a deterministic phenomenon, and giving penetrative performance in millimetres (and even in some cases half-millimetres) suggests a degree of precision that does not really exist. Performance in the field, of course, is subject to very much greater variation. As Shelford Bidwell says in "Gunners at War", "All simplified tables showing the performance of anti-tank guns are misleading". The Bovington booklet "Fire and Movement" says "Chance also causes discrepancies — for instance, a normally certain penetration may be prevented by the deflection away of a projectile on a lifting-lug projecting from a turret; conversely, a normally certain immunity may be removed if that same type of projection deflects a projectile towards the armour at a different angle".

Using penetration tables takes no account either of behind-armour effect following penetration, nor of non-penetrating damage. In principle, penetrating shell with a bursting charge should have better behind-armour effect than solid shot, but whether this matters in calibres above about 50mm seems highly questionable. The most supremely futile attempt to improve behind-armour effectiveness must surely be the German inclusion of a small tear-gas pellet in the AP bullet for the PzB 39 anti-tank rifle. It should still be borne in mind that most of these figures generally indicate the thickness of armour the projectile will just penetrate; the greater the degree to which the armour is overmatched, presumably, the greater will be the damage potential of the penetrating projectile. Hollow-charge weapons are a special case, in that the projectile itself does not penetrate the armour, but rather the jet formed by its charge does. Hollow charge weapons of the WW2 epoch were reputed to have less-than-ideal behind-armour effects. As the Bovington "Fire and Movement" booklet points out, "If the projectile is not an appreciable overmatch for the target, however, the penetration can be small enough to do little damage".

Penetration tables also take no account of non-penetrating damage. The running gear of all vehicles can be vulnerable to AP or HE fire from nearly all calibres. Extremely large calibre rounds can cause catastrophic damage without needing to penetrate the target; a Soviet 122mm shell, for example, might completely remove the turret of its target. Germany and Russia began using welded construction in the 1930s, but Britain and America continued to use rivets until the beginning of WW2. A shot hitting an exposed rivet-head could cause the rivet shank to break off and be projected into the tank, causing damage. The British continued to use rivets in the Cromwell until the end of the war, but these were tapered to prevent this happening.

After the penetrations tables, there is a small section taken from a WW2 Operational Research study on the hit-and-kill probabilities of two British anti-tank guns on some German tank targets. This is principally interesting in that it shows the strong dependence of target facing on weapon effectiveness.

Finally, the last few pages contain a few tables dealing with the still more vexed question of hit probabilities.

Anyone with comments, corrections or additions is invited to e-mail them to [John.Salt@Brunel.ac.uk](mailto:John.Salt@Brunel.ac.uk). Please be sure to include title, author, publisher and year of publication for any source you refer to.

John D Salt 17 December 1998

## WW2 penetration figures

Source: PRO document WO 219/2806, Appendix G to SHAEF/16652/GCT/Arty dated 11 July 1944.

"Perforation of homo at 30° Strike", ranges in yards.

Weapon	Ammo	600	1000	1600	2000
US 57mm	AP M70	78	64	55(a)	50(a)
Br 6-Pr	APCBC	81	74	64	58
	SABOT(b)	130	118	101	90
US & Br 75mm	APCBC M61	100	93	82	77
US 76mm	APC M62A	97	90	80	74
Br 77mm(c)	APCBC	110	100	91	85
	SABOT	178	149	131	120
Ger 75mm PAK 40	APCBC	110	102	92	86
(d) PAK 41	AP	137	100	?	?
(e) KWK 42	APCBC	119	100	95(a)	89
US & Br 3" M-10	APC M62	97	90	80	74
US 90mm	APC M77	111	103	93	86
Br 17-Pr	APCBC	127	120	112	107
	SABOT	183	172	155	145
German 88mm	APCBC	108	102	94(a)	87
KWK 36 (f)					
KWK 43 (f)	APCBC	178	140	131(a)	121
Br 32-Pr (g)	APCBC	138	131	121	115
	SABOT	215	205	189	180

Notes: (a) Approximate figure

(b) Fits US 57mm

(c) In production but NOT in service

(d) Tapered bore

(e) PANTHER gun

(f) TIGER gun

(g) A 1945 project

### Comments and corrections

The original table shows note (b) where note (f) is plainly intended. This has been corrected here.

The high figures for the 75mm gun match those given for APCBC in the Bovington "Fire and Movement" booklet, but are much more generous than other sources. A memo in this document says there seems "little to choose" between the 75mm and 76mm.

The US 90mm round given here seems to be a very weak load — a memo in this document says that 90mm ammunition is being loaded for a higher velocity.

In the memo this table accompanies, it is claimed that "the U.S. 76mm is ineffective against TIGER and only effective against PANTHER flanks", but, by an ordnance officer in the USA that "75mm gun will penetrate Panther tank turret, sides and rear and lower hull to ranges of 2,000 yards. 76mm gun will penetrate Panther tank at all points except chassis front plate to ranges of 5,000 yards and turret front at 2,500 yards, hull front nose plate 1,600 yards".

A very sensible comment by a Colonel Burlton, originator of the memo to which this table forms an appendix, says "Probably, there is a conflict between theory and practice".

Source: PRO document WO171/336, 30 Corps "G" War Diary, quoting 21 A Gp Int Summary No. 131.

Penetration of homogenous armour by 2cm KwK 38, ranges in yards.

Slope	Normal	Normal	30°	30°
Range	100	400	100	400
AP-T	48	38	31	25
AP 40	57	43	49	37

### Comments and corrections

None.

## WW2 penetration figures

Source: "Tank Armament in World War Two", Paul Woodman, in: Airfix Magazine, Vol. 3 No. 5, Alan W. Hall (publications) Ltd, August 1991, page 174.

"All penetration figures come from official archive material and are from tests performed against Homogenous type armour plate". Slope is stated as 30 degrees. Ranges are in metres.

Weapon	Ammo	500	1000	1500	2000
2 Pounder	AP	52	40		
	APCBC	57	45	40	
	APCNR	88	72		
6 Pounder	APCBC	81	74	68	63
	APDS	131	117	103	
17 Pounder	APCBC	140	130	120	111
	APDS	208	192	176	161
77mm	APCBC	120	110	100	90
3.7cm KwK36	APC	29	22	19	
	HVAP	34			
5cm KwK38	APCBC	46	36	28	
	HVAP	58			
7.5cm KwK40	APCBC	96	85	74	64
	HVAP	120	97		
7.5cm KwK42	APCBC	124	111	99	88
	HVAP	174	149	127	
8.8cm KwK36	APCBC	110	100	94	83
	HVAP	156	138	123	
8.8cm KwK43	APCBC	185	165	148	132
	HVAP	217	193	171	
Sov 45mm	AP	51	36		
Sov 76mm	APC	60	53	47	41
	HVAP	80	52		
Sov 85mm	APC	96	88	76	68
	HVAP	121	80		
Sov 100mm	APCBC	170	160	151	139
Sov 122mm	APC	138	132	117	98
Sov 152mm	APC	125	110		
37mm M5/6	APC	46	42	37	
75mm M2	AP	60	53	46	
	APC	65	55	49	
75mm M2	AP	76	63	51	
	APC	66	60	55	
76mm M1	APCBC	94	89	81	76
	HVAP	158	134	116	
90mm M3	APCBC	126	120	114	105
It 47mm	APC	55	43		
Jap 75mm?	AP	59	51	42	

### Comments and corrections

In the original table, the British 77mm is mis-labelled 76mm, and the APCNR ammunition for the 2 pounder is mis-labelled as HVAP. These errors are corrected here.

It is not stated which version of the Soviet 76mm is intended, but the L41 version is assumed. Unless the performance of this gun increases with range, the entries for 500 and 1000 metres have been transposed: The error is corrected here.

The designation of the Japanese weapon is missing in the original. It is noted as being the armament of the Type 97 and Type 1, which is not as helpful as it might be, as there are Type 97 light and medium tanks, and Type 1 medium and gun tanks. It is assumed from the performance figures that the 75mm is intended, as they agree quite closely with those given in the Bovington "Fire and Movement" booklet.

## WW2 penetration figures

Source: Appendix I, "German Tank Armament ", in: "Encyclopedia of German Tanks of World War Two", first edition, Peter Chamberlain, Hilary L. Doyle & Thomas L. Jentz, A&AP 1978, page 245.

"Penetration of Homogenous Armour Plate at 30° from Vertical", ranges in metres.

Weapon	Ammunition	100	500	1000	1500	2000
7.92mm MGs	Patr SmK	8	3			
2cm KwK	PzGr	20	14	9		
or FlaK	PzGr40	49	20			
sPzB41	PzGr41	60	40	19		
3.7cm KwK	PzGr	34	29	22	19	
or Pak35/36	PzGr40	64	34			
3.7cm	PzGr	37	31	26	22	
KwK34(t)						
3.7cm	PzGr	41	35	29	24	
KwK38(t)						
	PzGr40	64	34			
3.7cm FlaK 43	PzGr18	35	28	21	17	
4.7cm PaK(t)	PzGr36(t)	54	48	41	35	
	PzGr40	100	59			
5cm KwK38	PzGr39	54	46	36	28	22
	PzGr40	96	58			
5cm KwK39	PzGr39	67	57	44	34	26
	PzGr40	130	72	38		
5cm PaK38	PzGr39	69	59	48	38	29
	PzGr40	130	72	38		
7.5cm KwK37 or StuK37	K Gr rot Pz	41	39	35	33	30
7.5cm KwK40	PzGr39	98	91	82	72	63
or StuK40 L43	Pzgr40	126	108	87	69	
7.5cm PaK39, KwK40 or	PzGr39	106	96	85	74	64
StuK40 L48 or PaK40	PzGr40	143	120	97	77	
7.5cm KwK	PzGr39/42	138	124	111	99	89
or StuK42	PzGr40/42	194	174	149	127	106
7.62cm	PzGr39	98	90	82	73	65
PaK36(r)	PzGr40	135	116	94	75	58
8.8cm	PzGr	97	93	87	80	72
FlaK18 or 37	PzGr39	127	117	106	97	88
8.8cm	PzGr39	120	110	100	91	84
KwK36	PzGr40	171	156	138	123	110
8.8cm KwK	PzGr39-1	203	185	165	148	132
or PaK43	PzGr40/43	237	217	193	171	153
10cm K18	PzGr rot	164	149	133	119	109
10.5cm leFH18 or StuH42	PzGr	63	59	54	50	46
12.8cm K40	PzGr	201	176	150	132	120
12.8cm	PzGr	189	166	143	127	117
PaK44	PzGr43	187	178	167	157	148

Hollow charge rounds, penetration independent of range:

Calibre	7.5cm	7.5cm	7.5cm	10.5cm	10.5cm	10.5cm	15cm
Ammo	Gr38 H1/A	Gr38 H1/B	Gr38 H1/C	Gr39 H1/A	Gr39 H1/B	Gr39 H1/C	Gr39 H1/A
Penetration	70	75	100	80	90	100	160

### Comments and corrections

These people know exactly what they are talking about.

## WW2 penetration figures

Source: "Fire and Movement", RAC Tank Museum, Bovington, 1975, pages 22–25.

"Penetration v. homogenous armour at 30°, at ranges in yards". The armour is machineable quality.

Weapon	Ammo	100	500	1000	1500	2000	2500
2-pr Mk	AP			40			
IX and X	APCBC		53	49	44	40	
	SV		88	72	60	48	
3-pr Mk II	APHE			25			
6-pr Mk 3 or 5	APCBC		87	80	73	67	
	APDS		131	117	103	90	
75mm Mk V	APC		68	61	54	47	
	APCBC		103	94	86	78	
77mm Mk 2	APCBC		120	110	100	90	
	APDS		182	165	148	130	
17-pr Mk 2	APCBC		125	118	110	98	
	APDS		187	170	153	135	
37mm M6	APC		46	42	40	37	
75mm M2 and M3	APCBC			62	48	40	
	APC		70	59	55	50	
76mm M1A1 or M1A2	APCBC		94	89	81	76	
	HVAP		158	134	117	99	
90mm M3	APCBC		126	120	114	105	
	HVAP		221	200	177	154	
47mm mod 37	APC	55	43	29	23		
20mm L65	AP	31	22				
	APCR	49	35				
37mm L45	APC		30				
	APCR	68	43	22			
50mm L42	APC		56	47	39		
	APCR		66	42	26		
50mm L60	APC		61	50			
	APCR		86	55	32		
75mm L24	APCBC		46	41	35		
75mm L43	APCBC		84	72	62	53	
75mm L48	APCBC		90	79	70	62	
75mm L70	APCBC		141	121	104	89	
88mm L56	APCBC		110	101	93	84	
	APCR		126	103	85	70	
88mm L71	APCBC		182	167	153	139	127
128mm L55	APC		175	150	132	120	
	APCBC		215	202	190	178	
37mm mod 94	APHE		32	25			
47mm Type 1	AP		59	45	34		
75mm 94 or 1	AP		62	53	46		
Sov 76 L41	APCBC	(estimated)	56	50	45	40	
Sov 85 L53	APCBC	(estimated)	103	94	86	77	64
Sov 100 L46	APCBC	(estimated)	130	120	110	100	95
Sov 122 L43	APCBC	(estimated)	140	130	120	110	100

### Comments and corrections

Hollow charge rounds shown are the British 95mm How Mk 1 (110mm), US 105mm how M4 (100mm) and German 75mm L24 (43mm). The last of these seems remarkably ungenerous, but agrees with the figure given in Hogg's "German Artillery of World War 2" for plate at 30°.

Dates for introduction of different kinds of ammunition are given as: 2-pr AP Sep 39; APCBC May 42; SV Jan 43; 6-pr APC, APCBC Oct 42; APDS Jun 44; 17-pr AP, APC, APCBC early 43; HE Jun 44; APDS Summer 44.

## WW2 penetration figures

Source: "Sherman, A History of the American Medium Tank", R. P. Hunnicutt, Presidio Press, 1978, pages 559–570.

Ranges in yards; armour type (FH = Face-hardened, H = Homogenous) as shown at 30°.

Weapon	Ammo	Armour	250	500	750	1000	1500	2000
37mm	APC	H		53		46	40	35
M6	M51	FH		46		40	38	33
2 pdr	APHV/T	H	64	57	51	45		
IX-X	AP/T	H	58	52	46	40		
6 pdr	APCBC-T	H		81		74	63	56
III & V		FH		76		74	68	63
75mm	APC	H		60		55	51	46
M2	M61	FH		69		60	55	48
	APC	H		60		53	46	38
	M72	FH		58		46	33	25
75mm	APC	H		66		60	55	50
M3 or	M61	FH		74		67	60	54
M6	APC	H		76		63	51	43
	M72	FH		66		53	41	33
	HVAP T45	H		117		97	79	64
76mm	APC M62	H		93		88	82	75
M1 and	HVAP M93	H		157		135	116	98
3-in M7	AP M79	H		109		92	76	64
17 pdr	APCBC Mk VIII T	H		140		130	120	111
IV, VII	APSV/DS	H		208		192	176	161
25 pdr II, III	AP-T chg 3	H		63	58	54		
90mm	APC M82 (early)	H		120		112	104	96
M2	APC M82 (late)	H		129		122	114	106
	HVAP M304	H		221		199	176	156
	AP T33	H		119		117	114	109
155mm	AP	H		127		119		
M1918	M112B1	FH		109		102		
155mm	AP	H		160		152		
M1, M2	M112B1	FH		135		130		

### Comments and corrections

The HVAP T45 round for the 75mm was experimental only.

The 105mm howitzer M2A1 and M4 fires HEAT M67, which penetrates 102mm of homogenous armour at 0° at all ranges.

Hunnicutt says "a few" 17 pdr APDS became available in Aug 44, but that the early rounds were "somewhat erratic", and less accurate than APCBC.

## WW2 penetration figures

Source: "British & American Artillery of World War 2", Ian V. Hogg, A&AP, 1978.

Armour type in most cases not stated, but assumed to be homogenous. Ranges in yards.

Weapon	Ammo	Armour	Angle	100	400	500	1000
2pdr	AP Mk 10T		30°				42
6pdr	AP Mk 1-7T		30°				74
	APCBC Mk 9T		30°				88
	APDS Mk 1T						146
6pdr 6cwt AA	APC Mk 3T		30°			75	
17pdr	AP Mk 3T		30°				109
	APC Mk 4T		30°				118
	APDS Mk 1T		30°				231
25pdr	AP Mk 1T-6T, 8T		0°	70			
3in 20cwt AA	AP Mk 2T		30°			84	
3.7in AA	AP Mk 5T		30°			117	
37mm M3	AP M74		0°			36	
	APC M51B1/2		0°			61	
57mm M1	AP M70		20°				73
	APC M86	H	20°				73
		FH	20°				79
75mm M1916	APC M61	H			70		
3in or 76mm	AP M79	H	0°				100
		FH					70
90mm	AP M77	H				142	
	APC M82	H				130	
		FH				140	
105mm T8	APC	H		210			
37mm AA	AP M59A1	H				25	
		FH				48	
40mm AA	AP M18A1	H	0°			52	42

Hollow charge rounds, same at all ranges, armour type and angle unspecified:

Weapon	Ammo	Penetration
105mm howitzer M1	HEAT M67	115
75mm pack howitzer M3A1	HEAT M66	89
3.7in mountain howitzer	HEAT 3.7in Mk 1	63
Smith gun	Bomb, SB, HEAT, Mk 1	63 (approx)

### Comments and corrections

The 105mm T8 was experimental.

The 6pdr 6cwt AA gun, Britain's effort at an "intermediate" AA gun, never entered service.

The 3.7in howitzer HEAT was developed in 1942 for the Indian Army.

The figures claimed for British ATk guns at 1000 yards seem much more believable for 500.

Conversely, the figures stated for the US 90mm are unbelievably poor.

It does not seem likely that the 37mm M59A1 is really almost twice as good against face-hardened as homogenous armour.

In this book, Hogg states that 6pdr APDS was issued in June 1944, although in "The Illustrated Encyclopedia of Ammunition", Apple Press, 1985, he says on p. 58 that it "appeared" in 1944, and on p. 151 that it was "first introduced for the 6-pdr" in 1943. In the same book, he refers to "the grave shortage of tungsten which affected Germany from 1943 onwards".

## WW2 penetration figures

Source: "German Artillery of World War 2", Ian V. Hogg, A&AP, 1975.

Ranges in metres, penetration of homogenous armour.

Weapon	Ammo	Angle	100	250	500	1000	1500	2000	3000
SPzB41	PzGr 41	0°	94		66				
		30°	69		52				
Pak 36	PzGr	0°	65		48				
		30°	50		36				
	PzGr 40	0°	79		50				
		30°	68		40				
PJK 41	PzGr41	0°	120		87	60			
		30°	90		72	53			
Pak 38	PzGr 38	0°		88	78	61			
		30°		67	61	50			
	PzGr 40	0°		141	120	84			
		30°		109	86	55			
Pak 40	PzGr 39	0°	148		132	116	102		
		30°	120		104	89	76		
	PzGr 40	0°	175		154	133	115		
		30°	135		115	96	80		
Pak 41	PzGr 41 HK	0°		226	209	177	149	124	
		30°		185	171	145	122	102	
Pak 36(r)	PzGr 39 rot	0°			120	108	97	87	
		30°			98	88	79	71	
	PzGr 40	0°			158	130	106	84	
		30°			118	92	71	55	
Pak 43	PzGr 39	0°			207	190	174	159	
		30°			182	167	153	139	
	PzGr 40	0°			274	241	211	184	
		30°			226	192	162	136	
Pak 44	PzGr 43	30°			230		200	173	
10.5 cm le FH 18	PzGr rot	0°			67	62	59		
		30°			56	52	49		
Flak 36	PzGr	30°			110	105			
		30°			126	103			
Flak 41	PzGr 39/1	30°				202			
Flak 39	Pz Sprgr	30°				140			

Hollow charge rounds, same at all ranges:

Weapon	Ammo	Angle	Penetration
7.5cm le IG 18 (or LG 40)	7.5cm I Gr 38 Hl	30°	45
10.5cm le FH 18 (or LG40)	10.5cm Gr 39 rot Hl/A	0°	100
		30°	70
Flak 36	8.8cm Hl Gr 39		165
Pak 36	Stielgranate 41		180
Pak 38	Stielgranate 42		180
PAW 600	8cm W Gr Hl		140

### Comments and corrections

The experimental 7.5cm Pak 44 has a claimed performance of 120mm at 2500 metres.

Stielgranate 41 has max range 300m.; Stielgranate 42 has max recommended range 150m.

PAW 600 has max range 750m. PzGr43 for the 128mm PaK44 is a standard APCBC round.

Some penetration figures are quoted as being at 3°, but it seems clear that this is a misprint for 30°.

The text refers to the "the 1942 ban on tungsten" halting production of PzGr 40 for the Pak 40. In the same author's "The guns 1939–1945", Macdonald, 1970, he gives the date of the Führer's order that tungsten was no longer to be used for weapons as June 1942.

## WW2 penetration figures

Source: "The World War II Databook", John Ellis, Aurum, 1993, page 304.  
Ranges in yards, armour type and slope not stated.

Weapon	Ammo	250	500	750	1000	1500	2000
37mm SA18					30		
47mm SA37				80			
37mm L46		32	28				
	PzGr 40	40	28				
50mm L42		56	53	46	40	28	22
	PzGr 40	83	60	42			
50mm L60		67	61	56	50	38	29
	PzGr 40	109	77	46			
75mm L24			46	42	41	33	30
	HI		75	75	75		
75mm L43			92		82	72	63
	PzGr 40		108		87	69	
75mm L48			96		85	74	64
	PzGr 40		120		97	77	
88mm L56			110		100	91	84
	PzGr 40		156		138	123	110
It 20mm		29	24				
It 37mm					32		
It 47mm			48 (400 yds)	38	32		
Jap 20mm ATR		30 (270yds)					
37mm type 94					24		
47mm type 1			51				
Marosczek		20 (300 yds)					
37mm wz 36		40 (100 yds)	33		26		
Boys ATR		21 (300 yds)					
2pdr		58	52	46	40		
	HV shot	64	57	51	45		
37mm		58	53	48	47		
6pdr			79	72	65	52	
17pdr				120	113	96	82
75mm M2	M72		61		53	46	38
	M61		66		61	56	51
75mm M3	M61		66		61	56	51
76mm					98		
25pdr			63	58	54		
Sov 37mm			38 (400 yds)				
Sov 45mm			80		50		
Sov 57mm			140				
76mm F-34	DS AP		92		60		
85mm D-5			138		100		
100mm D-10	HE AP		195		185		
122mm M-30	HE AP		145	145	145		

### Comments and corrections

The figures for the Soviet 45mm and 57mm are obviously with APCR ammunition, although this is not stated in the original. The idea that the French 47mm has better penetration than the 6pdr is extremely hard to believe. It also rather hard to believe that the US 75mm guns M2 and M3 have the same performance with M61. The original shows penetration figures for the German 75mm L24 with a Panzergranate 40 round; presumably the hollow charge round is meant. This has been corrected here, as has the spelling of "Marosczek". Identical figures for the US, UK, USSR, German and Italian weapons listed above appear in Table 62 of the same author's "Brute Force", André Deutsch, 1990.

## WW2 penetration figures

Source: "Soviet Tanks and Combat Vehicles of World War Two", Steven J. Zaloga and James Grandsen, A&AP 1984, page 225.

Ranges in metres, "against vertical steel armour plate".

Weapon	Ammunition	500	1000
20mm TNSh L/107	APHE	22	
45mm mod 32, 34, 38	BR-240 APHE	42	38
L/45	BR-240P APCR	80	50
76.2mm mod 27/32 L/16.5	BR-350 APHE	35	30
76.2mm L-11 L/30.5	BR-350 APHE	62	56
76.2mm F-34 L/42.5	BR-350A APHE	69	61
	BR-350P APCR	92	60
85mm ZiS-S-53, D-5	BR-365 APHE	111	102
L/54.6	BR-365P APCR	138	100
57mm ZiS-2	BP-571P APCR	140	
100mm D-10 L/56	BR-412 APHE	195	185
122mm A-19, D-25 L/46.5	BR-471B APHE	145	145
152mm ML-20 L/28.8	BR-540 APHE	124	124

Hollow charge rounds, same at all ranges:

Weapon	Ammunition	Penetration
76.2mm F-34 L/42.5	BR-353A HEAT	75
122mm M-30 L/22.7, and A-19 or D-25 L/46.5	BR-460A HEAT	200

### Comments and corrections

In the original, APCR rounds are noted as APDS. This has been corrected here.

It seems extremely odd that the 122mm BR-471B and 152mm BR-540 APHE should both have the same penetration at 500 as at 1000 metres; this is probably a typographical error.

The author states that HEAT for the short 122mm in the original SU-122 "never lived up to expectations".

This book seems to be the source for the Soviet figures in the "World War II Databook", although Ellis has arbitrarily changed ranges into yards from the metres specified here.

Source: "The Armies of the Warsaw Pact Nations" (second edition), Friedrich Wiener, Carl Uebereuter, 1978, pages 197–199 and 210.

Armour at 0°, type unspecified, ranges in metres.

Weapon	Ammunition	Range	Penetration
57mm M-43 ZiS-2	HVAP	500	140
85mm M-44 (D-45)	HVAP	500	130
152mm M-3 (ML-20)	AP	1000	124
122mm M-31/37	AP	1000	160

### Comments and corrections

This book is a translation of the German-language original, "Die Armeen der Warschauer-Pakt-Staaten".

## WW2 penetration figures

Source: "Anti-Tank Weapons" Peter Chamberlain and Chris Ellis, MacDonald and Jane's, 1974.

Ranges in units specified, armour type not specified.

Weapon	Ammunition	Range	Angle	Penetration
Skoda 47mm vz 36		700 yds	30°	51
2.8cm sPzB 41		400 yds	30°	56
3.7cm PaK 35/36	AP	400 yds	30°	38
	AP40	400 yds	30°	49
4.2cm lePaK 41	AP	500 yds	30°	72
5cm PaK 38	AP	500 yds	30°	61
	AP40	500 yds	30°	86
7.5cm PaK 40	AP	500 yds	30°	106
	AP40	500 yds	30°	115
7.5cm PaK 41		500 yds	30°	171
7.5cm PaK 97/38		900 yds	30°	60
7.62cm PaK 36(r)	AP	500 yds	30°	98
	AP40	500 yds	30°	118
8.8cm PaK 43		500 yds	30°	226
Panzerfaust klein	HEAT		30°	140
Panzerfaust gross	HEAT		30°	200
R PzB 43	HEAT	150 m		210
R PzB 54 & 54/1	HEAT	200 m		210
7.92mm Pz B 38, 39		100 m	60°	30
Gross Pz Gr 46	HEAT	200 yds		90
It 37/45		400 yds	30°	38
It 47/32 M35		550 yds	0°	43
37mm Type 94		1000 yds	30°	24
37mm Type 97		400 yds		38
47mm Type 1		500 yds	30°	51
20mm ATR Type 97		270 yds		30
wz 35 Marosczek		300 m		20
Solothurn M SS 41		100m	60°	30
Solothurn s18-1100		300 m	30°	15-18
2 pr		500 yds	30°	53
6 pr		1000 yds	20°	69
17 pr		1000 yds	30°	130
Boys ATR		300 m	0°	21
37mm M3A1	AP	1000 yds	20°	25
	APC	1000 yds	20°	53
57mm M1		1000 yds	20°	69
3-in M5		1000 yds	20°	98
2.36 in RL M1, M9	HEAT	700 yds	0°	119
Rifle Gren M9	HEAT			101
37mm M30		400 yds	30°	38
45mm M32		1000 yds	30°	38
45mm M42		300 m		95
57mm M41, 43		500m		140
100mm M1944		450m		192
PTRD, PTRS		500m		25
VPGS 1940		65 yds		30

### Comments and corrections

It should be fairly obvious where performance is given for APCR ammunition, e.g. for the Soviet 45mm M42 and 57mm M41.

I suspect the 60° angle given for two anti-tank rifles means 60° from the horizontal, and so means the same as 30° from the horizontal.

The claimed difference in performance between US 37mm AP and APC is hard to believe.

## WW2 penetration figures

Source: "The Encyclopedia of Infantry Weapons of World War II", Ian V. Hogg, A&AP, 1977, page 190 and from the text in the "Grenades" chapter.

Ranges in units specified, armour type not specified.

Weapon	Ammunition	Range	Angle	Penetration
6 pounder Mk 2		1000 yds	30°	74
37mm M3A1		1000 yds	0°	54
57mm RCL M18	HEAT			75
75mm RCL M20	HEAT			100 (est)
57mm M1		1000 yds	20°	68
45mm M42	AP	500 m	30°	50
	APCR	500 m	30°	54
57mm M43	AP	500 m	30°	86
	APCR	500 m	30°	100
2.8cm s PzB 41	APCNR	500 m	30°	52
3.7cm PaK 36	AP	500 m	30°	36
	APCR	500 m	30°	40
4.2 cm PJK 41	APCNR	500 m	30°	72
5 cm PaK 38	AP	1000 m	30°	50
		500 m	30°	61
		250 m	0°	88
	APCR	1000 m	30°	55
		500 m	30°	86
		250 m	0°	141
7.5 cm PaK 40	AP	1000 m	30°	89
		500 m	30°	104
	APCR	1000 m	30°	96
		500 m	30°	115
7.5 cm PaK 41	APCNR	2000 m	30°	171
		1000m	30°	145
		500m	30°	102
8cm PAW 600	HEAT	850 yds	0°	140
8.8cm PaK 43	AP	2000 m	30°	167
		1000m	30°	139
	APCR	2000 m	30°	192
		1000m	30°	136
37mm Model 94	AP	500m	30°	32
47mm Model 01	AP	700m	30°	70
Boys ATR		500m	0°	20
PTRS, PTRD		500m	0°	25
PzB 38, 39		300m	30°	25
S 18-1000		300m	0°	35
Type 97		200m	0°	12
WZ/35		300m	0°	20
RPG-43	HEAT			76 (homogenous)
Genade, rifle, 68	HEAT	100m	0°	50
ATk grenade M9	HEAT			40
ATk gren M9A1	HEAT			60
PIAT	HEAT	100 yds		75 (approx)
2.36 in RL	HEAT	400 yds		80 (approx)
Haft Hohlladung 3Kg	HEAT			110
Gross Gew PzGr	HEAT	100m		40
Klein Gew PzGr	HEAT	100m		40
Gew PzGr 46mm	HEAT	100m		90
SS Gew PzGr 61mm	HEAT	200m		125
Panzerfaust	HEAT	30, 60, 100, 150m	30°	200
R PzB 54	HEAT	150m	0°	100 (approx)
RW 43 Puppchen	HEAT	750m	0°	100 (approx)

## WW2 penetration figures

### Comments and corrections

Hogg himself points out the difficulty of believing both the Russian and the Japanese figures for their 47mm guns.

Barry Gregory and John Batchelor's "Airborne Warfare 1941–1945", Phoebus, 1979, also gives "approximately 75mm" as the penetration of the PIAT, with no further qualification.

The 50mm penetration figure for the British No. 68 rifle grenade is repeated in Hogg's "Illustrated Encyclopedia of Ammunition", The Apple Press, 1985, although again without specifying armour type or slope.

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Source: "British and American Tanks of World War II", Peter Chamberlain and Chris Ellis, A&AP, 1969, pages 202–207.

Ranges in yards, armour type not specified, at 30°.

Weapon	Ammo	Range	Penetration
2pdr Mk IX, X & XA	AP	500	57
	APCBC	500	57.5
6 pdr Mk 3		500	81
6 pdr Mk 5		500	83
75mm Mk V, VA		500	68
17pdr Mk II, IV, VI, VII		500	120
	APDS	500	186
77mm Mk II		500	109
95mm How Mk 1	HEAT	500	110
37mm M6		500	48
75mm M2		500	60
75mm M3		500	70
76mm M1, M1A1,	APC	1000	88
M1A1C, M1A2	HVAP	1000	133
90mm M3	APC	1000	120
	HVAP	1000	195

### Comments and corrections

This seems to be the source for the gun performance table on page 55 of Malcolm Bellis' splendid privately-published "Datafile" booklet, "British Tanks and Formations 1939–45". Other books that use these figures, in whole or in part, are Donald Featherstone's "Tank Battles in Miniature" and Terry Gander and Peter Chamberlain's Airfix Magazine guide no. 17, "British Tanks of World War 2", Patrick Stevens Ltd, 1976.

This source states that APCBC for the 2pdr was introduced in September 1942, APDS for the 6pdr in early 1944, and for the 17pdr in 1944.

The authors state that the American 90mm was inferior in penetrative power and accuracy the 17pdr and similarly inferior to the 88mm.

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## WW2 penetration figures

Source: Airfix Magazine guide 26, "American Tanks of World War 2", Terry Gander and Peter Chamberlain, Patrick Stevens Ltd, 1977.

Ranges in yards, ammunition type and armour type and slope unspecified.

Weapon	Range	Penetration
37mm gun M6	500	61
75mm gun M2	500	60
75mm gun M3	500	70
3-inch gun M7	1000	80
76mm gun M1	1000	88
90mm gun M3	1000	120

### Comments and corrections

It is not clear why Chamberlain did not use the figures from "British and American Tanks of World War II", which he co-authored with Chris Ellis.

These figures seem to show that the 37mm is as good as the 75mm M2 at 500 yards, and that there is a noticeable performance difference between the 76mm and 3-inch guns.

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## WW2 penetration figures

Source: " Tank versus Tank", Kenneth Macksey, Guild Publishing, 1988.

Ranges in metres at which "high-velocity projectiles fail to penetrate" the specified target at 30°.

Weapon	Ammo	Target	Armour	Range
40mm (2-pdr)	AP	Pz Kw III	30	1200
47mm (Somua)		"	30	1000
37mm (Pz Kw III)	APC	Matilda II	70	0
		Somua	60	200
88mm L/56 FlaK	AP	Matilda II	70	2000
		Somua	60	2000
50mm L60	APC	T34/76B	60	500
		KV1	90	0
		Sherman M4A1	85	350
75mm L48	APCBC	T34/76B	60	2000
		KV1	90	500
		Sherman M4A1	85	800
Sov 76mm	APCBC	Pz Kw IIIJ	57+20	200
		Pz Kw IVF	50	1000
75mm L/40	APC	Pz Kw IIIJ	57+20	0
		Pz Kw IVF	50	2000
		Tiger I	110	0
		Panther D	120	0
57mm L50 (6-pdr)	APCBC	Tiger I	110	200
		Panther D	120	0
85mm L/53	APCBC	Tiger I	110	500
		Panther D	120	100
88mm L/56	APCBC	Sherman M4A1	84	1500
		Churchill IV	88	1400
		T34/85	75	1400
75mm L/70	APCBC	Sherman M4A1	84	2000+
		Churchill IV	88	2000+
		T34/85	75	2000+
		Sherman (76)	105	1600
		Comet	101	1500
		Pershing	145	600
		JS2	160	400
88mm L/71	APCBC	Sherman (76)	105	2500+
		Comet	101	2500+
		Pershing	145	1800+
		JS2	160	1200
76mm L/55	HVAP	Panther D	120	1500
		Tiger II	185	0
76mm L/50 (77mm)	APDS	Panther D	120	1500
		Tiger II	185	500
90mm L/53	HVAP	Panther D	120	2000+
		Tiger II	185	1300
122mm L/43	APCBC	Panther D	120	1500
		Tiger II	185	1200

### Comments and corrections

Each table bears the weird legend "Range which high-velocity projectiles fail to penetrate vary according to range and angle of impact".

On p. 129, the 17pdr is cited as penetrating 118mm with APCBC, 170mm with APDS; and the 88mm, 101mm with APCBC, 103mm with APCR, against homogenous armour at 1000m and 30°. The British introduction of APC is dated to May 1942.

## WW2 penetration figures

Source: "Tank Battles in Miniature: A wargamer's guide to the Western Desert Campaign 1940–1942", Donald Featherstone, Patrick Stevens Ltd, 1973, pages 141–143.

"At 50°–90° angle-of-impact gun can penetrate maximum armour thickness of: (in millimetres)", ranges in yards, armour and ammunition types unspecified.

Weapon	Angle	200	400	600	1000	1600	2000	2600	3000
37mm	50°	56	50	42	26				
	90°	65	58	51	29				
75mm M2	50°	66	61	55	45	28	19		
	90°	76	70	64	53	33	23		
75mm M3	50°	77	69	62	50	33	22		
	90°	87	80	73	59	39	25		
2 pdr	50°	56	50	42	26				
	90°	66	58	51	29				
6 pdr	50°	93	85	79	60	36	20		
	90°	108	99	92	70	43	24		
25 pdr	50°	80	71	66	52	31	19	10	5
	90°	89	73	68	58	38	26	19	15
20/55	50°	32	24	16					
KwK	90°	35	28	19					
sPzB 41	50°	54	50	38	12				
	90°	63	57	45	15				
37/45	50°	49	40	32	16				
KwK	90°	61	52	43	26				
37/45	50°	55	47	39	22				
PaK	90°	64	55	46	29				
47mm	50°	55	57	53	46	35	27	12	
	90°	69	66	62	54	41	30	14	
50/60	50°	120	98	80	55	33	18	0	
PaK	90°	142	129	112	84	54	35	5	
50/60	50°	67	63	59	50	34	23	10	
KwK	90°	89	82	75	61	40	28	12	
75/24	50°	50	45	38	27	12			
KwK	90°	60	53	45	30	14			
75/43-48	50°	100	93	87	80	63	52	35	24
	90°	115	107	102	93	74	63	50	39
75/46	50°	115	109	104	94	79	72	53	40
PaK	90°	144	138	132	121	103	91	70	59
88/56	50°	118	112	108	101	90	82	71	63
KwK	90°	130	134	122	107	94	86	76	68

On p. 95, the following figures for the 88mm FlaK are given, against homogenous armour at 30°:

Ammunition	500	1000	1500	2000
PzGr 39	111	102	93	86
PzGr 40	157	141	126	114

It is also stated that the hollow-charge Gr 39 Hl penetrates 90mm at all ranges.

### Comments and corrections

These figures were calculated by R. D. Miles, and include many more range bands than there is space to show here. Some figures matching those from Chamberlain & Ellis are also given on pp 96-97. In the main table, angles seem to be given in German style, from the horizontal. The figures are given in pairs; it is not wholly clear that the lower is at 50° and the higher at 90°, but that is how they have been interpreted here. The strange behaviour of the lower figure for the 47mm is not accounted for. From their higher penetration, it seems that PaKs have been credited with APCR ammunition,

## **WW2 penetration figures**

although their performance does not seem to fall off as rapidly as one might expect with increasing range.

## WW2 penetration figures

Source: "Artillery of the World" (first edition), Christopher Foss, Ian Allan, 1974.

Ranges in metres, armour type and slope not specified.

Weapon	Calibre	Ammunition	Range	Penetration
6 Pounder	57mm		475	118
17 Pounder	76mm		1000	222
M-1943 D-1	152mm	Semi-AP	1000	82
M-1938 M-10	152mm	Semi-AP	1000	82
M-1937 ML-20	152mm	APHE	1000	124
M-1931/37 A-19	122mm	APHE	1000	190
M-1938 M-30	122mm	HEAT		200
M-1944 D-10	100mm	APHE	1000	185
M-1945 D-44	85mm	APHE	1000	102
		HVAP	1000	130
M-1942 ZIS-3	76mm	APHE	500	69
		HVAP	500	92
		HEAT		120
M-1943 ZIS-2	57mm	APHE	500	106
		HVAP	500	140
M-1942	45mm	HVAP	500	66
M-1939 (LAA)	37mm	AP	500	46
ZPU-1	14.5mm	API	500	32
M-101A1 How	105mm	HEAT	1500	102
M-1 LAA	40mm		900	50 @ 30°

### Comments and corrections

D-1, M-10 and M-30 are howitzers; A-19, D-10 and all smaller calibre pieces are guns; ML-20 is a gun-howitzer. The 45mm M-1942 is the long-barrelled (L/66) version of the weapon.

The M-1939 KS-12 and M-1944 KS-18 85mm AA guns are credited with the same penetration performance as the M-1945 D-44.

Foss quotes 380mm penetration for the 100mm D-10 HEAT round, but this sounds like post-war ammunition. The 120mm quoted for the ZIS-3 76mm ammunition is more believable for WW2 ammunition, but still more generous than the figure stated by Zaloga.

Although the ZPU-1 is a post-war weapon, it is mentioned here because the KPV 14.5mm HMG fire the same cartridge as the wartime PTRS and PTRD anti-tank rifles.

It is not clear what the significance of the range figure is for the US 105mm howitzer HEAT round, but perhaps this represents the maximum effective engagement range.

The performance given for the U.S. M-1 LAA gun – the familiar 40mm Bofors – seems quite optimistic.

The 1976 second edition of the book amends none of the figures cited here.

Source: "Modern Soviet Armour", Steven J. Zaloga, A&AP, 1979, page 57.

Penetration at 1000 metres and 0°, armour type not stated.

Weapon	with APHE	with APCR
57mm Ch-51M	85	100
85mm D-5S85	102	130

### Comments and corrections

Both weapons are developments of WW2 weapons, so performance is assumed to be similar. Still, it seems strange that the figure for the 57mm should be so far inferior to the 140mm normally quoted.

## WW2 penetration figures

Source: "Artillery Tactics 1939–1945", Shelford Bidwell, Almark, 1976, page 72.

Armour at 30° slope, type unspecified. Ranges in yards.

Weapon	Ammunition	250	500	540	1000	2000
US or Ger	37mm		36		27	
2 pdr		58	53		40	
Russian			60		38	
45mm						
Russian				140		
57mm						
25 pdr			62		54	
German			65		53	
50mm						
88mm FLAK			112		103	
6 pdr			75		63	
	APDS		146			
German			171		130	
75mm						
Russian			90		83	
76mm						
17 pdr			123		113	86
	APDS				231	

### Comments and corrections

This book is one of Almark's "Mechanics of War" series. The original table has the last four rows misaligned; the error is corrected here. Many of these figures are also given on page 234 of Bidwell's "Gunners at War", A& AP, 1970, which states the slope as 30° and gives the 2 000 yard figure for the 17-pounder.

The figures for APDS are included as notes, with no range given, but the main text attributes 231mm penetration to the 17-pdr with APDS at 1000 yards, which seems a lot, but agrees with Hogg's "The Guns of World War II".

The figures for the Russian 57mm at 540 yards and the 2-pdr at 250 yards are added from the main text.

Bidwell lists the 37mm as "British", as well as US and German.

The "Russian" 76mm shown here is better known as the PaK 36(r) in German service.

The German 75mm entry carries the comment "A very good gun, but short lived." and the footnote "supplies of tungsten carbide for its special shot ran out", from which it seems safe to conclude that the weapon referred to is the PaK 41 Gerlich gun, rather than the PaK40.

## WW2 penetration figures

Source: "Men against Tanks, A History of Anti-Tank Warfare" (Book Club edition), John Weeks, Purnell, undated, but after 1973.

Ammunition type and armour type not specified, ranges in units stated.

Weapon	Range	Slope	Penetration (ins)	Penetration (mm)
Various 20mm	400 yds		0.6–1	15–25
Various 37mm	1000 yds		just over 1	26
Armstrong 37mm	300 yds		just over 1	26
Maroszek ATR	300 yds		$\frac{3}{4}$	19
Boys ATR	300 yds		just over $\frac{1}{2}$	14
No. 74 "Sticky bomb"	0		1	25
PAK 36 stick bomb	200 yds		5	127
20mm PzB41	250 yds		1 $\frac{1}{4}$	30
PAK 40	1000 metres	30°	3.7	94
Panzerfaust			7–8	178–203

### Comments and corrections

Penetration figures in the original are given in inches.

PAK 41 performance quoted as being "about 50 percent better than the PAK 40".

The Japanese 75mm anti-tank gun M90 is quoted as being able to knock out a Sherman at 1000 yards.

## WW2 penetration figures

Source: Pages 186-187 of an unknown small-format (8 × 5½ inches) hardback, possibly about anti-tank artillery, as no tank-only guns are listed.

Ranges in metres, armour type and slope not specified.

Weapon	Ammunition	Range	Penetration
2 pounder	AP	1000	42 @ 30°
	APCNR	1000	57
6 pounder	AP	1000	74
	APCBC	1000	88
	APDS	1000	136
17 pounder	AP	1000	109
	APCBC	1000	119
	APDS	1000	200
37mm M3	APHE	500	30
	APC	500	50
57mm M1	AP	1000	70
	APCHE	1000	70
3 inch M5	APHE	1000	85
90mm M1	APHE	1000	110
It 47/32 Model 37	AP	1000	26
It 90/53 AA gun	AP	1000	101
Jap 37mm Type 97	APHE	500	35
Jap 47mm Type 1	AP	1000	40
45mm M1937	AP	1000	38
45mm M1942	APHE	500	50
	APCR	500	54
	APHE	500	86
57mm M1943	APHE	500	86
	APCR	500	100
100mm M1944	AP	500	186
	APHE	500	153
	APCR	500	181
2.8 cm SPzB41 (Taper)	APCNR	500	52
3.7 cm PAK 36	APHE	500	36
	APCR	500	40
4.2 cm PJK41 (Taper)	APCNR	1000	53
5 cm PAK 38	APHE	1000	50
	APCR	1000	55
	APHE	1000	89
7.5 cm PAK 40	APHE	1000	89
	APCR	1000	96
7.5 cm PAK 41 (Taper)	APCNR	1000	145
	APHE	1000	88
7.62 cm PAK 36(r)	APCR	1000	92
	APHE	1000	167
8.8 cm PAK 43, 43/1	APCR	1000	192
	APHE	1000	230
12.8cm PAK 44	APHE	1000	230

### Comments and corrections

Note the significantly inferior penetrative performance of APHE to AP for the US 37mm, and of APHE to AP for the Soviet 100mm. Unfortunately, Hogg's "British & American Artillery of World War 2" considers the M74 AP round inferior to the M51B1 APC (APHE). Failure to specify the ammunition nature being used may be one of the main reasons for disagreement between sources.

## WW2 penetration figures

Source: "Panzerfaust and other German Infantry Anti-Tank Weapons", Wolfgang Fleischer, Schiffer, 1994, page 47.

Ranges in metres, armour type and slope not specified.

Weapon	Range	Penetration
AP rifle bullet	100	8
ATk rifle gren 30	40	50
Large ATk rifle gren	80	80
ATk Rifle Gren 46	60-80	90
ATk rifle gren 61	60-80	125
ATk rifle gren GGP		45
Wurfkörper 326 HL/LP		50
Panzerwurfkörper 42 LP	75	80
Panzerbüsche 38 or 39	300	25
Granatbüsche 39	80	80
Panzerbüsche 35(P)	100	30
Panzerbüsche 783(r) or 784(r)	100	30
ATk hand gren 41	10-15	30
ATk throwing mine (short)	25	150
ATk hand mine 3	0	130
ATk hand mine 4	0	150
Hollow charge 3	0	140
Hollow charge 3.5	0	180
T-mine 35	0	80-100
Clustered charge 3Kg	0	60
Faustpatrone	70 (max)	140
Panzerfaust klein	30	140
Panzerfaust gross (30m)	30	200
Panzerfaust 60 m	60-75	200
Panzerfaust 100 m	100	200
Panzerfaust 150 m	150	220
Panzerfaust 250 m	250-300	220
Raketenpanzerbüsche 54 or 54/1	150-180	160
Raketenpanzerbüsche 10.5 cm		220

### Comments and corrections

The ranges are maximum effective ranges, so kinetic-energy weapons (ATRs here) may not have the performance indicated at exactly the range indicated.

Panzerfaust 150 was undergoing troop trials at the end of the war. Neither Panzerfaust 250 nor 10.5cm Raketenpanzerbüsche were ever issued.

Source: "T-34, Russian Armour", Douglas Orgill, Macdonald, 1971.

Armour type unstated, ammunition type unstated, ranges in yards.

Weapon	500	1000	"about a mile"
76mm L/41	69		54
100mm		160	
88mm L/71	182		

### Comments and corrections

I assume "about a mile" means 1500 yards.

## WW2 penetration figures

Source: TM-E 30-451, "Handbook on German Military Forces", 1945, section VII, pages 22–100.

Armour type unspecified except where indicated, ranges in yards.

Weapon	Ammunition	Range	Angle	Penetration
7.5cm LG40	Hollow-charge		30°	50
2.8cm sPzB41	AP	400	30°	53
3.7cm Pak	AP40	400	30°	49
	Stick bomb	150 (mvng target)		152 (approx)
4.2cm le Pak 41	AP	700	30°	68
5cm Pak 38	AP	1000	30°	56
7.5cm Pak 40	APCBC	1000	30°	102
7.5cm Pak 41	AP	1000	30°	130
7.62cm Pak 36(r)	APCBC	1000	30°	83
8.8cm Pak 43, 43/41	APCBC	500	30°	184
	APCBC	1000	30°	169
	APCBC or AP40	1500	30°	130
12.8cm PaK 44	APC	500	30°	172
	APCBC	500	30°	212
	APC	1000	30°	148
	APCBC	1000	30°	200
SS Gew PzGr 46	Hollow charge	"long"		90
		"short" (18 ft)		70
SS Gew PzGr 61	Hollow charge	220		126
		"short" (18 ft)		100

### Comments and corrections

This source is a facsimile edition of the original.

Obviously, the AP rounds listed for the sPzB41, le Pak 41 and PaK 41 Gerlich guns are APCNR. The figures for the Pak 36, PaK 36(r), Pak 41, Pak 43 and Pak 44 specify homogenous armour.

Source: "Handbook on the Italian Army", Athena Books, 1983, pages 106 and 156.

Ranges in yards, armour type and ammunition unspecified.

Weapon	Range	Angle	Penetration
20mm Breda	500	0°	25
		30°	15
Solothurn ATk rifle	550	15°	25
25mm L/72	100		40
37mm L/35	400	30°	38

### Comments and corrections

This source is a facsimile edition of a 1943 original.

## WW2 penetration figures

Source: "Aggressors Volume 1: Tank Buster vs. Combat Vehicle", Alex Vanags-Baginskis and Rikyu Watanabe, Airline, 1993.

Armour type not specified, ranges in metres.

Weapon	Ammo type	Range	Angle	Penetration
3-inch rocket	solid AP rocket	460		100
45mm M-1932 L/45		500	0°	50
57mm L/73		500	0°	140
BK 3.7	AP	100	60°	58
	APCR	100	60°	120
30mm MK 101	APCR	100		103
		300		75
BK 7.5 (Pak 40L)		1000		130
Panzerfaust	Hollow charge			200
Panzerschreck II	Hollow charge	100-120		120
Panzerblitz II (Pb II)	Hollow charge	500		110
PbIII R4/HL	Hollow charge		0°	160
PTAB 2.5-1.5	1.5Kg ATk bomb		0°	60
Förstersonde	45mm SG113A			48

### Comments and corrections

It is assumed that the 60° slope specified is in the German style, from the horizontal.

The Panzerblitz II only just made it into service before the end of the war, serving for five or six weeks with I(Pz)/SG9.

The Förstersonde, an unusual weapon fired by an electro-magnetic probe, did not quite make it. The penetration figure for the Förstersonde is based on the observation, on page 40, that trials at Rechlin showed it could just penetrate the 48mm roof armour of the M4A3 Sherman.

The AP warhead of the 3-inch rocket, developed for attacking tanks, was stable under water, and so an excellent anti-submarine weapon; it was however inferior as a tank-killer to the 60lb HE warhead, originally developed for use against submarines.

The German SD4/HL anti-tank bomb is credited with being able to penetrate the roof armour of "any Soviet tank", but no penetration figure is given. There was also an SD9/HL, the designations indicating hollow-charge bombs of 4 and 9Kg respectively.

Two other snippets from the variety of fascinating information to be found in this book: PTAB attacks (a Shturmovik carried 220) against "small groups of tanks" showed a hit probability of 15%; US P-47 pilots found they could destroy German AFV with 0.5" API fire from the rear.

Source: "The Pusan Perimeter", Maj. F.A. Godfrey, in: "The Korean War: History and Tactics", Ed. David Rees, Orbis, 1984, page 24.

Penetration at 500 metres, ammunition type and armour type and slope not specified.

Weapon	Penetration
85mm in T-34	114
76mm in M4A3 Sherman	110

### Comments and corrections

The accompanying graphic suggests that these figures are for an impact angle of 30°. These look like APCR performance figures in both cases.

## WW2 penetration figures

Source: "U.S. Army Handbook" (first edition), George Forty, Ian Allan, 1979, pages 99 and 107.

Ammunition and armour type unspecified, ranges in yards

Weapon	Range	Angle	Penetration (inches)	Penetration (mm)
37mm M3A1	1000	20°	2.1	53
57mm M1	1000	20°	2.7	69
3in M5	1000	20°	3.85	98
M1 or M9 Bazooka		90°	4.7	119

### Comments and corrections

The conversion from inches in the original has been done into centimetres, using assuming 2.5cm to the inch, giving figures of 5.25cm, 6.75cm and 9.63cm respectively for the guns, and 11.75cm for the Bazooka. The figures given here use the correct conversion factor of 25.4mm to one inch.

Evidently the 90° is from the horizontal; the 20°, however, must be from the vertical.

"The Imperial War Museum Book of the Desert War 1940–1942", Adrian Gilbert, BCA 1992, page 134, gives a figure of 2.7in penetration at 1000 yards for the 6-pounder.

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Source: "Japanese Army Handbook 1939–1945", A. J. Barker, Ian Allan, 1979, page 95.

Armour at normal, armour type not specified, range not specified.

Weapon	Penetration
37mm ATk gun	25
47mm ATk gun	51

### Comments and corrections

The original gives penetration in inches.

The failure to specify range makes these figures less than informative, but we might assume 500 yards.

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Source: "Tank Warfare", Bryan Perrett, A&AP, 1990, page 59

Armour type and slope not specified, at 1000 yards.

Weapon	Penetration
122mm L/43 in IS-II	185

### Comments and corrections

The author also states that the German 75mm L/43 "could penetrate 89mm armour set back at 30 degrees", but this time without specifying the range.

Elsewhere he makes the rather dubious statement that "The IS-II was regarded as more than a match for the up-gunned Pz Kpfw IV and the Panther, but could be penetrated by the Tiger E at 1,900 yards". Given that he credits the IS-II with 160mm of armour, I assume that Tiger B was intended.

On page 62, Perrett states that the Germans began using APCR in 1941, the Russians in 1942 and the Americans in 1944; that the British introduced APDS in 1944; and that HEAT began reaching the battlefield in 1942.

## WW2 penetration figures

Source: "Panzer Bait: With the 3rd Royal Tank Regiment 1940–1944", William Moore, Leo Cooper, 1991.

Armour type and slope not specified, range in yards.

Weapon	Ammunition	Range	Penetration
50mm	PzGr40	440	78
It 47mm in M13, M14		400	48
88mm		2000	83
75mm in Mk IV special		1000	70
Improved 75mm		1000	84
Panther 75mm		2000	100

### Comments and corrections

It is fairly obvious which weapons are referred to here; the 50mm is the PaK 38, and the 88mm is the FlaK 36. Of the 75mm guns, the Mk IV special gun is the L/43, the improved version is the L/48, and the Panther's gun the L/70.

This source says that in Spring 1941, British technical intelligence estimated the penetrative performance of the 88mm as being in the same class as the 50mm, 80–90mm at 400 yards; equally oddly, they overestimated the performance of the "short" 75mm (L/24) as being 100mm at 600 yards. Moore also states that it was only by early summer 1942 that face-hardened plate was identified on German tanks, and that time "Only the Honey had capped rounds and these were not entirely satisfactory".

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Source: "Infantry Tactics 1939-1945", Anthony Farrar-Hockley, Almark, 1976, page 41.

Ammunition and armour type not specified, range in yards.

Weapon	Range	Slope	Penetration
2 Pounder	1000	30°	40

### Comments and corrections

This is another title from Almark's "Mechanics of War" series.

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Source: "Sherman Medium Tank 1942-1945", Steve Zaloga and Peter Sarson, Osprey 1993, pages 10 and 14.

Armour type and slope unspecified, ranges in yards.

Weapon	Ammunition	500	1000
75mm M3	M61 APC	68	60
76mm M1A1C	M-62 APC-T	98	90
	T-4 HVAP-T	150 (approx)	132

### Comments and corrections

The authors say that, before 1945, seldom were more than 2 or 3 HVAP rounds available per tank, and maybe 5 thereafter, as preference was given to tank destroyer units.

## WW2 penetration figures

Source: "Patrol! Modern Infantry Tactics, 1914–74", David C. Isby, in: Strategy & Tactics No. 46, Simulations Publications, Inc., Sept/Oct 1974, page 35.

Armour type and slope not specified, ranges in metres.

Weapon	Range	Penetration
M9 2.36" Bazooka	100	100
Panzerfaust 60	80	203
Panzerfaust 44-1	200	320

### Comments and corrections

The original notes the PF-44 as "In svce., 1944 to date", but the penetration figure looks as if it applies to a post-WW2 warhead.

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Source: "Highway to the Reich: Operation Market-Garden 17–26 September 1944", Phil Kosnett, in: Strategy & Tactics No. 61, Simulations Publications, Inc., March/April 1977, page 32.

Ammunition type and armour type and slope not specified, ranges in metres.

Weapon	Range	Penetration
Panzerfaust	30	175
Panzerschreck	400	100
PIAT	50	100
Bazooka	400	150
PAK 40	500	154
PAK 43	500	274
6pdr	500	80
M-1 57mm	500	80

### Comments and corrections

No other source is so generous as to give Panzerschreck a range of 400m.  
The 6pdr is mis-designated as "6-lb" in the original.

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Source: "Panzer Battles: The Evolution of Mechanized Warfare, 1939–1979", David C. Isby, in: Strategy & Tactics No. 73, Simulations Publications, Inc., March/April 1979, page 9.

Armour type and slope not specified, ranges in metres.

Vehicle	Ammo	500	1000	1500	2000
Grant	APC	66	61	56	51
Pz IIIj	AP	61	48	38	

### Comments and corrections

It is assumed that the weapons intended are the 75mm M2 for the Grant and the 50mm L/60 KwK 39 for the Pz III J.

## WW2 penetration figures

Source: "Small Arms, Artillery and Special Weapons of the Third Reich", Terry Gander and Peter Chamberlain, Macdonald and Jane's, 1978.

Armour type unstated, ranges in metres.

Weapon	Ammunition	Range	Penetration @ 0°	Penetration @ 30°
7.92 mm PzB 38, 39		300		25
7.92mm M SS 41		300	20	
13mm EW 141		300		25
2.8 cm sPzB41	PzGr 42	100	94	69
		200	86	65
		300	79	60
		400	72	56
		500	66	52
		600	60	48
		700	54	44
		800	49	41
3.7 cm Pak 35/36	PzGr	200	56	42
		400	51	38
		500	48	36
		600	46	34
	PzGr 40	100	79	68
		200	72	61
		300	65	55
		400	58	49
4.2 cm Pak 41	StielGr 41	200	180	
	PzGr 41	0	124	95
		250	105	83
		500	87	72
		750	70	62
5 cm Pak 38	PzGr	1000	60	53
		0	99	73
		250	88	67
		500	78	61
		750	69	56
		1000	61	50
		1200	53	45
		1500	47	40
	PzGr 40	0	165	143
		250	141	109
		500	120	86
		750	101	69
		1000	84	55
7.5 cm Pak 40	PzGr 39	1250	70	44
		0	149	121
		500	135	106
		1000	121	94
		1500	109	83
		2000	98	73
	PzGr 40	0	176	137
		500	154	115
		1000	133	96
		1500	115	80
		2000	98	66
		2500	83	53

/continued...

## WW2 penetration figures

Weapon	Ammunition	Range	Penetration @ 0°	Penetration @ 30°	
7.5 cm Pak 41	PzGr 41	0	245	200	
		250	226	185	
		500	209	171	
		750	192	157	
		1000	177	145	
		1250	162	133	
		1500	149	122	
		1750	136	111	
		2000	124	102	
		7.62 cm Pak 36(r)	PzGr 39	0	133
500	120			98	
1000	108			88	
1500	97			79	
2000	87			71	
2500	78			64	
8.8 cm Pak43, 43/1	PzGr 39	0	225	198	
		500	207	182	
		1000	190	167	
		1500	174	153	
		2000	159	139	
		2500	145	127	
		PzGr 40/43	0	311	265
	500		274	226	
	1000		241	192	
	1500		211	162	
	2000		184	136	
	2500		159	114	
	12.8 cm Pak 44			500	219
		1000		202	
1500		187			
8 cm PAW 600	Hollow charge	750	140		
7.5/5.5 cm Pak 44		2500		120	
10 cm PAW 600	Hollow charge			200	
Hammer		500		100	
3.7 cm Pak 36(p)		400		37	
		600	40		
4.5 cm Pak 184(r)		900		38	
7.92mm PzB 35(p)		300	25–33		
13.9mm PzB 782(e)		300	21		
14.5mm PzB		100	30		
		783 or 784(r)	300	27.5	
2cm PzB 785(s)		500	25		
		100		20–22	
		300		15–18	
Panzerfaust klein		30		140	
Panzerfaust 30		30		200	
Panzerfaust 60		80		200	
Panzerfaust 100		100		200	
Panzerfaust 150		150		200	
Panzerfaust 250		200		200	
RPzB 54, 54/1				160	

/continued...

## WW2 penetration figures

Weapon	Range	Penetration
2.5cm Pak 112(f) (L/72)	600	50
2.5cm Pak 113(f) (L/77)	600	50 (not confirmed)
4.7 cm Pak 36(t)	1200	60 (homogenous)
4.7cm Pak 181 or 183(f)	200	80
4 cm Pak 192(e)	183	60
	365	55
	548	51
5.7 cm Pak 208(r)	500	140

### Comments and corrections

This wonderful book, in achieving compendious coverage of weapons of the Third Reich, includes a large number of non-German weapons. Those given here include:

Country of origin	German designation	Original designation
Poland	7.92mm PzB 35(p)	wz 35 Maroszek
	3.7 cm Pak 36(p)	wz 36
Russia	14.5mm PzB 783(r)	PTRD-41
	14.5mm PzB 784(r)	PTRS-41
	4.5 cm Pak 184(r)	45mm PTP M-1930
	4.5 cm Pak 184/1(r)	45mm PTP M-1932
	5.7 cm Pak 208(r)	57mm PTP M-1941 ZiS-2
England	7.62 cm Pak 36(r)	76mm M-1936
	13.9mm PzB 782(e)	0.55" Boys Mk I
	4 cm Pak 192(e)	OQF 2 pr
Switzerland	2cm PzB 785(s)	Solothurn s18-1100
France	2.5cm Pak 112(f) (L/72)	SA-L mle 1934
	2.5cm Pak 113(f) (L/77)	SA-L mle 1937
	4.7cm Pak 181 or 183(f)	SA mle 1937 or 1939
Czechoslovakia	4.7 cm Pak 36(t)	Skoda PUV vz 36

The Czech 47mm was mounted in the Panzerjäger 1.

The Polish 37mm is the Bofors model, widely used by other nations, including Britain.

The Maroszek ATR was also in Italian service.

The penetration quoted for the Soviet 57mm is presumably with APCR.

Of the German weapons listed, the following were experimental, and did not see service during the war:

13mm EW 141, Gerät 318	1938: Intended for RK 9 and VK 601 recce cars
7.5/5.5 cm Pak 44	Under development 1942-45
10 cm PAW 600, PWK 10H64	Work started 1944
Hammer, Panzertod, Panzerschreck	Work started Oct 1943, suspended most of 1944.
Panzerfaust 150 and 250	At trials stage by end of war

The authors state that APC was introduced with the 5cm Pak 38, and APCBC with the 7.5cm Pak 40. Mention is made of PzGr 40 being used in "the early days" of the invasion of Russia.

These authors give the date of the decision to give priority for tungsten supplies to the machine-tool industry as 1941.

## WW2 penetration figures

Source: "The Guns of World War II", Ian V. Hogg, Macdonald and Jane's, 1976.

Ammunition type and armour type unstated, ranges in yards.

Weapon	Ammunition	Range	Angle	Penetration
2-pounder		1000		50
Ger 75mm		1000		94
88mm		1000	30°	105
	PzGr 40	500		126
	Hollow charge			165
Pak 36(r)		1000		108
	PzGr 40	1000		130
US 90mm M1-3		1000		109
	HVAP	1000		173
US 90mm T54	HVAP	1000		300
US 90mm T8	HVAP	1000		250
17-pounder		1000		110
	APDS	1000		231
Ger 105 FH 18/40		1000		62
	PzGr 39TS	1000		80

### Comments and corrections

The 90mm T54 and T8 were experimental only.

In this book, Hogg says tungsten supplies for ammunition dried up "after 1943".

Source: "World War II Tanks", Eric Grove, Orbis, 1976.

Armour type unstated, conventional armour-piercing ammunition unless otherwise stated, ranges in yards.

Weapon	Slope	Range	Penetration
20mm KWK 30	0°	500	24
75mm L/43 KWK 40	30°	500	89
PaK 36(r)	30°	500	83
...with PzGr 40	30°	500	118
88mm KWK 36	30°	500	112
75mm KWK 42	30°	1000	120
88mm PaK 43	30°	500	226
88mm KWK 43	30°	500	182
2-pounder	30°		57
3-pounder	30°		27
77mm	30°	500	109
17-pounder	30°	500	120
M-40 76mm L/41	30°	500	about 65
D-5T85 (M-44) 85mm	30°	1000	95
D-10S 100mm	0°	1000	160
75mm M2	30°	500	60
75mm M3	30°	500	70
76mm M1A1C or M2	30°	500	94
3-in M7	30°	500	over 100

### Comments and corrections

The difference between the performance stated for the two "long" 88s is presumably due to the figure for the PaK43 applying to APCR. The muzzle velocities quoted tend to support this view.

## WW2 penetration figures

Source: "German Tanks of World War II Tanks", Dr F. M. von Senger und Etterlin, A&AP, 1971, pp 209–210.

Armour type unstated, ranges in metres.

Weapon	Ammo	Slope	0	457	915	1372	1829	2286
sPzB 41	AP 41	90°		66				
		60°		52				
KwK 35		90°		48				
		60°		36				
PaK 36	AP40	90°		51				
		60°		43				
PaK 4.7t		60°		55	47			
KwK 42		60°		56				
KwK 39	AP39	90°	99	78	61	47		
		60°	73	61	50	40		
PaK 38	AP40	90°	165	120	84			
		60°	143	86	55			
KwK 37		60°		41				
7.5 L43		60°		89				
7.5 L46 (PaK 40)	AP39	90°	149	135	121	109	98	
		60°	121	106	94	83	73	
	AP40	90°	176	154	133	115	98	83
		60°	137	115	96	80	66	53
7.5 L48		60°		90	80			
7.5 L70		60°		141	121			
PaK 36(r)	AP39	90°	133	120	108	97	87	78
		60°	108	98	88	79	71	64
	AP40	90°	190	158	130	106	84	65
		60°	152	118	92	71	55	43
KwK 36		60°		110				
KwK 43	AP 39/43	90°	225	207	190	174	159	145
		60°	198	182	167	153	139	127
PaK 43	AP 40/43	90°	311	274	241	211	184	159
		60°	265	226	192	162	136	114
PaK 44	AP 43		215	202				
			(500m)	(1000m)				

### Comments and corrections

It is unlikely that the 7.5 cm L46 is really superior to the L48 by the amount indicated.

The author indicates that hollow-charge rounds were available for most 7.5 and 8.8cm guns.

## WW2 penetration figures

Source: "The Unknown Alamein", Charles Messenger, Ian Allan, 1982, pp 29–31.

Armour type and impact angle unstated, ranges in yards.

Weapon	Range	Penetration
2pdr	1000	40
6pdr	1500	52
25pdr	1000	54
US 37mm	1000	46
US 75mm	2000	38
Ger 20mm	500	25
Ger 37mm	500	28
50mm (short)	750	46
50mm (long)	1000	50
75mm (short)	1000	41
75mm (long)	2000	62
76.2mm	2000	53
88mm	2000	83
It 20mm Breda	500	24
It 47/32	1000	32

Accompanying the above figures is a graph showing penetration of 30° armour against range in yards. The curves shown are almost exclusively linear; the following approximate figures can be read off:

Weapon	250	500	1000	1500	2000
Short 50mm	59	53			
2pdr		54	42		
US 37mm	59	55	46		
Long 50mm		62	50		
US 75mm		63	55	47	
25pdr		64	56		
6pdr		79	66	54	40
75mm L43		89	79	69	59
88mm		111	103	93	84

### Comments and corrections

Note that the figures given on the graph do not always exactly match those given in the text. The author indicates that a hollow-charge round was available for the long 75mm gun, with a penetration of approx. 75mm.

Source: "Handbook on USSR Military Forces", HERO, 1978?, pages IX 120 and XI 91–100.

Angle unspecified, ranges in metres.

Weapon	Ammunition	Armour type	Range	Penetration (mm)
ShKAS 7.62mm	B-32 API	cement	200	7–8
	BV-46 AP-T		200	6
12.7mm MG	B-22 API	cement	200	20
	BSF-46 AP-phos	"strong"	200	20
	BST AP-T		200	15
20mm ShVAK	BS API		1000	25
LMG rocket mine	Hollow charge		any	102

### Comments and corrections

This source is a facsimile edition of a 1945 original, TM 30-430. Probably "cement" means cemented, that is, face-hardened armour.

## WW2 penetration figures

Source: "Arms and Uniforms: The Second World War, Vol. 4", Liliane and Fred Funcken, Ward Lock, 1976.

Ammunition type and armour type and slope not stated, ranges in yards.

Weapon	Range	Penetration
US 37mm	1000	38
PTRD	333	38
sPzB41	440	51
German ATk grenades	100–200	63–127
PIAT	100	102
Jap hollow charge grenade	0	76
Lunge mine	0/90°	152
	0/60°	102
Stielgranate	200	152

### Comments and corrections

Penetration figures in the original are given in inches.

Source: "The Germans come to the Help of their Ally (1941)", Volume II of the Official History "The Mediterranean and Middle East, Maj-Gen I. S. O. Playfair, HMSO, 1956.

Penetration of homogenous plate at 30°, ranges in yards.

Weapon	Ammo	200	250	400	500	750	1000	2000
Pak 35/36	PzGr	42		38				
	PzGr 40	61		49				
Pak 38	PzGr		67		61	56	50	
	PzGr 40		109		86	69	55	
50mm L42	PzGr		54		49	44	39	
	PzGr 40		83		66	53	42	
Flak 36 2-pdr	AP		58		52	46	40	83

### Comments and corrections

The accompanying text reminds the reader that "in battle the conditions are so variable that, except in extreme cases, only broad forecasts can be made".

The author cites DAK ammunition returns as showing that 13% of ammunition for ATk guns was at first PzGr40. "They asked for a great deal more, but their demands were not met in full".

Source: "Storming Eagles", James Lucas, Grafton Books, 1988.

Armour type unstated, range in yards.

Weapon	Range	Slope	Penetration
Panzerfaust			200
sPzB 41	400	30°	53
7.5cm LG40		30°	50

### Comments and corrections

None.

## WW2 penetration figures

Source: "Encyclopaedia of the German Army in the 20th Century", Bruce Quarrie, Patrick Stephens Ltd, 1989.

Armour type unspecified, angle of impact 30°, ranges in metres.

Weapon	Ammo	500	1000	2000	3000
sPzB41	APCNR	50			
PaK 35/36	PzGr 39	36			
	PzGr 40	55			
le PaK 41	APCNR	70	50		
4.7 PaK 36(t)		55			
PaK 38	PzGr 39	61	50		
	PzGr 40	86	55		
PaK 40	PzGr 39	104	89		
	PzGr 40	115	96		
PaK 41	APCNR	171	145		
PaK 97/38		100			
PaK 36(r)	PzGr 39	98	88	71	
	PzGr 40	118	92	55	
PaK 43	PzGr 39/43	182	167	139	
	PzGr 40/43	226	192	136	
PaK 44			230	202	173
2cm 30		20			
3.7cm L45		30			
5cm L42		56			
5cm L60		61			
7.5cm L24		41			
7.5cm L43		89			
7.5cm L48		104			
7.5cm L70		141			
8.8cm L56		110			
8.8cm L71		182			

Weapon	Range	Angle	Penetration
Stielgranate 41	300	30°	180
PzB 38/39	100	90°	30
	300	90°	25
RPzB 54	120	30°	100
Panzerfaust	30, 60, 100, 150	30°	140
Haft-Hohlladung	0		110
Panzerwurfmine	18		64
Gew PzGr	45		20
Gross Gew PzGr	90		33
Gross PzGr 46	200		90
Gross PzGr 61	200		126
SchussGranate P-40	90		37
Pappmine	0		22
Panzer Schnell	0		26
Holzmine 42	0		23
Sprengriegel 43	0		35
Tellermine 29-43	0		24
Topfmine	0		25
R-mine 43	0		17
LPZ	0		10
Eismine 42	0		8

### Comments and corrections

Mine figures are from US TM-9-1900, German Explosive Ordnance, 1953.

## WW2 penetration figures

Source: "Tank Killers", Ian Hogg, Pan, 1997.

Ranges in yards.

Weapon	Ammo	Range	Angle	Armour	Penetration
sPzB41		545			66
		600		Homogenous	60
6-pdr	APDS	1000			146
Boys ATR		330			21
Marocszek		330			20
PzB 39		110			33
s18-1100		330			27
PTRS, PTRD		545			25
		545	30°		20
Panzerfaust			30°		140
37mm Bofors		1000			20
PaK 36		545			48
25mm SA-L 34		545			40
47mm SA-37		875			70
2-pounder		1000	30°		42
					51
PaK 38		1000			60
	PzGr 40	1095			84
PaK 40		110			116
	PzGr 40	1095			133
lePaK 41		545			87
PaK 41		2185			124
25-pounder		440			70
17-pounder	AP	1000			109
	APC	1000			118
	APDS	1000	30°	Face-hardened	231
	APDS	1000			230
PaK 43		2185	30°		159
	PzGr 40/43	2185	30°		184
PaK 44		1000			200
		3280			173
Sov 57mm		545			140
76mm M-42		545			69
85mm D-44		545			100
	APCR	545			113 or 130
Bazooka		109			178
100mm DS-3	APCR	1095			185
	APCR	1095			180
37mm M3A1		545			64
3-in M5		1000			100
US 105mm		1000			210
57mm RCL					76
75mm RCL					92
US 90mm		1000			122
	HVAP	1000	0°		230
Sov 122mm		1095			160
Rotkäppchen		1095	30°		200
30mm MK101	APCR	330			75

### Comments and corrections

Hogg gives the introduction dates for APDS as June 1944 for the 6-pdr and August 1944 for the 17-pdr, and dates the German tungsten decision to "early 1942". The ambiguity about the Soviet 85mm D-44 occurs in the original. The Rotkäppchen ATGW and the US 105mm never saw service.

## WW2 penetration figures

Source: PRO document WO291/741, Comparison of the performance of 75mm and 76mm tank gun ammunition.

"Thickness of homogenous armour plate penetrated at 30° angle of attack by APCBC/HE shell."  
Ranges in yards.

Range	75mm	76mm
Point blank	79.5	108.2
200	75.3	104.2
400	72	100.2
600	68.5	96.7
800	65.5	93
1000	63	89.7
1200	60.3	86.3
1400	57.8	83.1
1600	55	80
1800	52.6	77
2000	50	74

### Comments and corrections

Precision in fractional millimetres seems excessive, and suggests results by interpolation rather than measurement. This document also compares the HE performance of the two guns, concluding that in this respect the 75mm is noticeably superior.

## WW2 hit probability figures

Source: PRO document WO291/171, OR report on effectiveness of British anti-tank guns, 1943.

Ranges in yards, armour as detailed in notes.

6 pdr AP on Tiger I						
Exposure	Success %	0°	45°	90°	135°	180°
Full view	90 %	-	-	-	-	-
	50 %	-	-	1200	-	1000
	30 %	650	650	1350	500	(missing)
Hull down	90 %	-	-	-	-	-
	50 %	300	-	500	-	-
	30 %	650	200	850	550	650
6 pdr APCBC on Tiger I						
Exposure	Success %	0°	45°	90°	135°	180°
Full view	90 %	-	-	700	-	-
	50 %	500	-	1650	500	1650
	30 %	750	650	2100	350	1350
Hull down	90 %	-	-	-	-	-
	50 %	300	-	500	-	-
	30 %	650	200	900	550	650
17 pdr AP on Tiger I						
Exposure	Success %	0°	45°	90°	135°	180°
Full view	90 %	-	-	700	-	500
	50 %	1750	700	2050	600	1950
	30 %	1850	1450	2600	1600	2500
Hull down	90 %	-	-	-	-	-
	50 %	750	-	800	600	-
	30 %	1300	550	1200	1000	800
17 pdr APCBC on Tiger I						
Exposure	Success %	0°	45°	90°	135°	180°
Full view	90 %	-	-	900	-	550
	50 %	2000	600	2300	650	2050
	30 %	2700	1300	2850	1750	2850
Hull down	90 %	-	-	-	-	-
	50 %	700	50	750	650	-
	30 %	1300	450	1250	1050	850
6 pdr AP on Panther						
Exposure	Success %	0°	45°	90°	135°	180°
Full view	90 %	-	-	750	-	900
	50 %	50	800	1350	800	1200
	30 %	100	1200	1800	1200	1800
Hull down	90 %	-	100	100	50	50
	50 %	-	300	850	300	800
	30 %	50	700	1150	800	850
6 pdr APCBC on Panther						
Exposure	Success %	0°	45°	90°	135°	180°
Full view	90 %	-	-	850	-	1150
	50 %	50	750	1650	1000	1450
	30 %	100	1500	2200	1400	1950
Hull down	90 %	-	50	50	50	50
	50 %	-	250	850	250	850
	30 %	50	800	1150	850	1150
17 pdr AP on Panther						
Exposure	Success %	0°	45°	90°	135°	180°
Full view	90 %	-	-	1250	1200	1100
	50 %	50	1800	2350	2000	2100
	30 %	100	2150	2850	2550	2750
Hull down	90 %	-	-	300	400	350
	50 %	450	550	1000	1150	1100
	30 %	650	1150	1750	1750	1800
17 pdr APCBC on Panther						
Exposure	Success %	0°	45°	90°	135°	180°
Full view	90 %	-	-	1200	1250	1200
	50 %	50	1750	2350	2350	2250
	30 %	100	2550	2900	2850	2850
Hull down	90 %	-	-	400	500	450
	50 %	300	550	1100	1200	1100

## WW2 hit probability figures

		30 %	700	1150	1850	1850	1850
<b>6 pdr AP on Panzer IVG</b>							
Exposure	Success %	0°	45°	90°	135°	180°	
Full view	90 %	-	-	650	650	-	
	50 %	800	1000	1450	1450	1250	
	30 %	1250	1550	1900	1500	1700	
Hull down	90 %	50	50	100	100	50	
	50 %	450	300	600	500	450	
	30 %	800	500	950	900	800	
<b>6 pdr APCBC on Panzer IVG</b>							
Exposure	Success %	0°	45°	90°	135°	180°	
Full view	90 %	50	50	700	750	150	
	50 %	450	1100	1450	1500	1300	
	30 %	1400	1750	2100	2100	1850	
Hull down	90 %	-	-	100	150	50	
	50 %	300	200	550	500	350	
	30 %	800	850	1000	1000	800	
<b>17 pdr AP on Panzer IVG</b>							
Exposure	Success %	0°	45°	90°	135°	180°	
Full view	90 %	50	550	800	750	650	
	50 %	1350	1700	2050	2100	1700	
	30 %	1900	2250	2600	2600	2250	
Hull down	90 %	-	200	250	300	300	
	50 %	600	650	800	800	850	
	30 %	1050	1150	1250	1250	1050	
<b>17 pdr APCBC on Panzer IVG</b>							
Exposure	Success %	0°	45°	90°	135°	180°	
Full view	90 %	250	500	800	800	700	
	50 %	1350	1850	2100	2250	1700	
	30 %	2200	3000+	3000+	3000+	2550	
Hull down	90 %	-	100	250	250	300	
	50 %	550	700	850	850	850	
	30 %	1050	1150	1250	1250	1050	
<b>6 pdr AP on Panzer IIIIL</b>							
Exposure	Success %	0°	45°	90°	135°	180°	
Full view	90 %	-	-	600	200	100	
	50 %	800	950	1450	1200	1100	
	30 %	1000	1550	1900	1550	1250	
Hull down	90 %	-	-	100	100	100	
	50 %	300	250	550	550	550	
	30 %	800	400	850	900	950	
<b>6 pdr APCBC on Panzer IIIIL</b>							
Exposure	Success %	0°	45°	90°	135°	180°	
Full view	90 %	-	-	700	450	50	
	50 %	1050	1000	1500	1200	1050	
	30 %	1500	1600	2150	1900	1600	
Hull down	90 %	-	50	100	150	50	
	50 %	450	250	550	550	500	
	30 %	900	450	950	1000	900	
<b>17 pdr AP on Panzer IIIIL</b>							
Exposure	Success %	0°	45°	90°	135°	180°	
Full view	90 %	250	300	750	700	150	
	50 %	1300	1450	2000	1650	1500	
	30 %	2000	2150	2600	2400	2150	
Hull down	90 %	50	200	250	350	350	
	50 %	650	700	800	900	750	
	30 %	1050	1000	1200	1250	1150	
<b>17 pdr APCBC on Panzer IIIIL</b>							
Exposure	Success %	0°	45°	90°	135°	180°	
Full view	90 %	50	700	800	750	200	
	50 %	700	1850	2050	2000	1500	
	30 %	2500	3000	3000+	3000+	2300	
Hull down	90 %	50	150	50	250	300	
	50 %	650	700	650	750	750	
	30 %	1050	1150	1200	1200	1150	

## WW2 hit probability figures

### Comments and corrections

The tables above are extracted from a set of polar diagrams plotted to show the 30%, 50% and 90% contours for the chance of success from all angles around the target vehicle. The tables therefore omit much of the information in the original diagrams, which was calculated using 15° intervals from head-on (0°) to rear-on (180°). There is a noticeable tendency for many of the polar plots to form "clover-leaves", and these are especially clear on the Panther and Tiger.

The original document emphatically stresses the approximate nature of these results, and cautions that they should be treated as comparative rather than absolute figures. It details the definitions used, simplifying assumptions made, and in some cases assesses the distortion these may cause.

"Chance of success", as used here, means the probability of hitting and killing with a single shot. There is assumed to be a systematic error of 35 yards in range and zero in line. The gun layer is assumed to lay with the same accuracy as the 90% zone of the gun. This will tend to overestimate effectiveness at long range. All targets are assumed to be static.

The damage criterion for a kill is taken to be complete perforation of the armoured box, through which the whole length of the projectile passes. All tank components outside the armoured box, such as running gear, are ignored. Behind-armour effects are ignored, although it is noted that tanks are very unlikely to survive penetrations by projectiles of 6-pdr size and greater.

Shots that strike the target are assumed to be uniformly, not normally, distributed over the target areas presented. This may tend to overestimate the amount of "invulnerable" side-armour presented in fine front quarter shots, and neglects the possibility of the gunner choosing to aim at a specific vulnerable point on the target tank. Hull-down targets have been treated as being bounded below by the turret ring.

Armour quality has been treated as falling into three categories. German machineable-quality (MQ) armour on the Panther and Tiger has been treated as equivalent to British MQ. The MQ armour on the Panzer III and Panzer IV has been treated as equivalent to a 10% greater thickness of British MQ. The face-hardened (FH) plate has been taken as having a critical impact velocity for penetration 500 feet per second greater than British MQ with respect to AP projectiles, 200 feet per second greater with respect to APCBC. The first assumption is regarded as reasonable; the second as rough, possibly tending to overestimate the German armour; and the final assumption is thought to be very doubtful. The original document does not state whether the Panzer III and IV targets were considered to be using Schürzen.

It is hard to see how some diagrams, for example that for the 17 pounder vs Panther, can show a better performance from some aspects against a hull-down target than a fully exposed one.

## WW2 hit probability figures

Source: PRO document WO291/180, OR report on accuracy of anti-tank gunnery.

Ranges in yards, target assumed to be Pz VI size.

Probability (%) of hitting static hull-up target with first round:

Gun	OK for...	500	1000	1500	2000	2500
6 pdr	line	100	100	96	87	
	range	87	33	13	3	
	both (hit)	87	33	12	3	
17 pdr	line	100	100	100	98	93
	range	98	46	20	10	5
	both (hit)	98	46	20	10	5

Probability (%) of hitting static hull-up target after first round:

Gun	500	1000	1500	2000	2500
6 pdr	100	86	59	41	
17 pdr	100	94	71	50	36

Probability (%) of hitting moving target (direct-crossing at 15 mph) after first round:

Gun	500	1000	1500	2000	2500
17 pdr	86	48	26(e)	16	

Probability (%) of hitting hull-down target with first round:

Gun	500	1000
17 pdr	59	18

Probability (%) of hitting static hull-down target after first round:

Gun	500	1000	1500	2000	2500
6 pdr	85	43	22	14	
17 pdr	88	51	29	18	12

### Comments and corrections

These values are those plotted on the graphs in the report; the value marked (e) is interpolated from other data points. The overall shape of the fitted curves in each case is sinusoidal.

This report recommends that the maximum range of engagement for 6-pdr and 17-pdr ATk guns be considered 800 and 1000 yards respectively. The criteria stated for maximum range of engagement for a statically-sited ATk gun are:

- 50% chance of first-round hit on a static hull-up target;
- 90% chance of subsequent rounds hitting a static hull-up target;
- 50% hits on a hull-up direct-crossing target moving at 15 mph after MPI roughly corrected;
- 50% hits on a static hull-down target after MPI roughly corrected.

The first table clearly shows that errors in range have a much more important effect on accuracy than errors in line.

Penetration ranges against Pz VI for each gun (ammunition not specified) are stated as being 800 yards for 6-pdr on the front, 1600 yards on the side, and 2000–2500 yards for 17-pdr. Hit probability is therefore regarded as a more important limitation on maximum engagement range than penetration.

## WW2 hit probability figures

Source: "Tank Battles in Miniature: A wargamer's guide to the Western Desert Campaign 1940–1942", Donald Featherstone, Patrick Stevens Ltd, 1973, page 105.

"Hit probabilities for Second World War tank guns", ranges in yards.

	500	1000	1500	2000	2500
9-ft high target	78%	37%	10%	2%	1%
3-ft high target	45%	21%	6%	1%	
2nd shot on target	95%	90%	80%	20%	15%

### Comments and corrections

No indication is given as to the kind of gun, ammunition or fire control system used. I assume the targets are static, though this is not stated.

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Source: "Panzer Battles: The Evolution of Mechanized Warfare, 1939–1979", David C. Isby, in: Strategy & Tactics No. 73, Simulations Publications, Inc., March/April 1979, page 10.

"Probability of a first round hit (not kill) of a tank gun firing at a tank-sized, standing target. Ammunition is assumed to be APDS — any other type would have somewhat less accuracy due to its lower velocity." Ranges in metres.

	500	1000	1500	2000	2500	3000
76mm	87%	21%	5%	3%	2%	2%
90mm	90%	65%	31%	14%	6%	5%

### Comments and corrections

The original shows the 76mm gun as representative of the WW2 era, the 90mm as representative of Korea. It is claimed that "These figures show not only the calibre increase in the tank guns, but the increased effectiveness of their range-finders and fire-control systems as well". Tanks carrying the 90mm gun in Korea were the M-26 Pershing and M-46 Patton, neither of which has an advanced range-finder, so presumably the difference is to be attributed to improved quality of optics and linkages; nonetheless, a three-fold improvement at 1000 yards seems distinctly excessive. Why APDS is assumed is unclear, as no such round existed for the 76mm, nor, I believe, for the 90mm in Korea.