Anvil Steel © P. M. Main MSEE 11/12/07	Preface

This is purely and individual work by the author. I have tried to be as accurate and dispassionate as possible. The people & companies that make anvils seem to fall into three general groups: 1) Those like, Tom Clark, Uri Hofi, and Nimba, who are rightfully very proud of their product and are willing to tell you anything you want to know about it. 2) Those like Refflinghaus, Angele, and Kohlswa that consider the composition of their steel and heat treatment methods trade secrets that give them a competitive advantage. As an engineer who has had many of his ideas “borrowed”, I can respect that. 3) This group (no names) either doesn't know (more common than you may suspect) or doesn't want you to know as their quality and materials may not be the best. Again, I would say that I have tried my best to be accurate. If anyone has new information to share or corrections to inaccuracies that they would like me to make, feel free to email me at: pmmain@dishmail.net

Sincerely,
P. Michael Main, MSEE
Electrical and Computer Engineering Consultant
(And amateur Blacksmith and Bladesmith)

Anvil Steel © P. M. Main MSEE 11/12/07	Hardness vs. Toughness									
	S7 Tool Steel		H13 Tool Steel		6150		1045/C45		4140	
Temper (°f)	HRC	CVN (ft-lbs)	HRC	CVN (ft-lbs)	HRC	CVN (ft-lbs)	HRC	CVN (ft-lbs)	HRC	CVN (ft-lbs)
As Quenched	60		53		59					
300	59	85								
350										
400	57	125			58		52		52	
450										
500	55	125			56	1				
550										
600	54	115			54	4	47		47	
650										
700	53	105			52	7				
750										
800	53	105			50	10	39		40	
850										
900	52	120			45	12				
950										
1000	51	150	52	12	41	15	29		30	
1050			49	19						
1100	47	190	46	21	38	21				
1150			44	22						
1200							20	20	20	
1250										
1300										
1350										
1400										
	Ozark Anvil – Tom Clark		Rat Hole Forge		Angele - Hofi		Peddinghaus		Emerson	

Anvil Steel © P. M. Main MSEE 11/12/07	Hardness vs. Toughness									
	80-55-06 Ductile Iron		8640		1030 (similar to 1536) (Less Mn)		SAE 1536 / DIN 1.1166 Czech 34Mn5 Japan SMn433		1330 (similar to 1536) (More Mn)	
Temper (°f)	HRC	CVN (ft-lbs)	HRC	CVN (ft-lbs)	HRC	CVN (ft-lbs)	HRC	CVN (ft-lbs)	HRC	CVN (ft-lbs)
As Quenched	56						54			
300									50	
350										
400			55	8.5	52				48	
450										
500	54	2								
550							46			
600	52	2.57	48	11.5	43				43	
650										
700	48	3.14								
750										
800	43	3.72	44	20	32				36	
850										
900	38	4.29	42	30						
950										
1000	32	4.86	36	40	25				27	
1050										
1100	25	5.43	32	54					23	68
1150										
1200	13	6	28	71.5	15				18	
1250										
1300										
1350										
1400										
	TFS & JHM & Cliff Carrol		Nimba		For comparison.		Czech import by BRANCO		For comparison.	

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Despite what anyone will tell you to the contrary, a number of the “Good Anvils” sold today are in fact CAST IRON. Ductile Iron is one of the four grades of cast iron: White (massive carbide), Gray (flake graphite), Malleable (clump-like graphite), and Ductile (spheroidal graphite). Anyone trying to convince you otherwise either: A) DOSENT KNOW WHAT THEY ARE TALKING ABOUT. B) IS TRYING TO HIDE THE TRUTH. I have a small Cliff Carrol anvil that Cliff claims is Ductile Iron. It is certainly hard enough (low to mid 50s Rockwell C on my tester) for an adequate anvil. Ductile Iron may be more flexible and chip resistant than White or Gray cast iron, but if you look carefully at the column containing Charpy and Izod values (a measure of toughness), you will note that it is less tough than most of the better steels. Just keep this in mind when you are selecting an anvil. If you are an amateur like me, you probably spend as much time beating on the anvil as the hot iron. This is probably not so much a problem for the pros. You will note that some of the steels, notably S7 is tougher at Rockwell 58C than many of the other steels and all cast irons are in an annealed condition. For this reason, I switched to one of the Czech anvils which is not nearly the quality of, or as well finished as the Carrol anvil, but is made out of tough manganese steel. This way when I inevitably miss there are dents but no chips. This is just another thing for the amateur black or blade smith to consider when you select an anvil.
(See the references 1 & 2 below for more information on cast iron. It will clear up any misunderstandings as to just what “Ductile Iron” really is.)

		C	Mn	Cr	Ni	Mo	V	Si	Mg
Cast Iron									
Ductile Iron									
	80-55-06	3.50						2.00	0.05
Steel									
Plain Carbon									
	1030	0.28-0.34	0.60-0.90						
	1045	0.43-0.50	0.60-0.90						
(From here down are “Alloy” steels)									
Manganese									
	1330	0.28-0.33	1.60-1.80						
Carbon-Manganese									
	1536	0.30-0.37	1.20-1.50						
Chromium-Molybdenum									
	4140	0.38-0.43	0.75-1.00	0.80-1.10		0.15-0.25			
Chromium-Vanadium									
	6150	0.48-0.53	0.70-0.90	0.80-1.10			0.15 (min)		
Nickel-Chromium-Molybdenum									
	8640	0.38-0.43	0.75-1.00	0.40-0.60	0.40-0.70	0.15-0.25			
Tool Steel									
(Hot-Work class)	H13	0.40	0.35	5.20		1.30	0.95	1.00	
(Shock-Resisting class)	S7	0.50	0.70	3.25		1.40	0.25	0.30	

1. “Engineering Materials and Their Applications”, Second Edition, by Flin and Trojan. Houghton and Mifflian. 1981. ISBN: 0-395-29645-5 pp254-263.
2. ”Machinery's Handbook”, Twenty Seventh Edition. Industrial Press. 2004. ISBN: 0-8311-2711-2 pp1360-1362
3. Phosphorus (P) usually considered an impurity and kept as low as possible. Usually 0.04maximum.
4. Sulfur (S) usually considered an impurity and kept as low as possible. Usually 0.05 maximum.
5. Metallurgy of Steel for Bladesmiths & Others who Heat Treat and Forge Steel, by John D. Verhoeven, ebook www.feine-klingen.de/PDFs/verhoeven.pdf