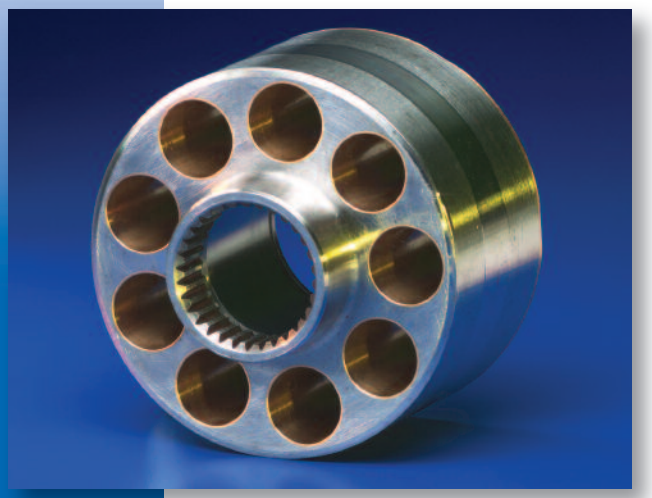
Castle Metals®



Alloy Steel

Quik Guide

Your foremost provider of specialty products, services and solutions

Commercial Quality

GROUP	DESCRIPTION	AISI GRADE	SIZE RANGE	CONDITION OF STEEL	AVERAGE PROPERTIES				TYPICAL HARDNESS		
					TENSILE 1000 PSI	YIELD 1000 PSI	% ELONGATION IN 2″	% REDUCTION OF AREA	BHN	ROCKWELL	RELATIVE MACHINABILITY BASED ON AISI 1212 AS 100%
CASE HARDENING—LOW CARBON	Low Carbon Case Hardening alloys are characterized as steels that produce a hard case with a tough, ductile core. This is achieved primarily through carburizing. The Purecut® series offers our customers the opportunity to improve machinability with the addition of Bismuth. Bismuth steels will machine equal to leaded steels without any of the environmental problems. The Telcut® series of alloys contains a double machining additive, providing a machinability rating of 100% of AISI 1212. Lower cycle times, less tool wear, better surface finish, and improved productivity are achieved with no sacrifice in mechanical properties or heat treat response.	4320 Rounds	3/4″ – 10″	Hot Rolled Cold Finished	110/130	78/110	12/20	40/50	231/269	C21/C27	60%
		4820 Rounds	3/4″ – 10″	Hot Rolled Cold Finished	105/125	70/105	17/25	50/60	200/225	B93/C25	49% 55%
		8620 Rounds	3/16″ – 30″	Hot Rolled Forged Rough Turned Cold Finished	80/105	55/90	15/25	50/65	165/220	B85/97	66%
		Purecut® 20	3/8″ – 4″	Cold Finished	80/105	55/90	15/25	50/65	165/220	B85/97	83%
		8620 Leaded Rounds	1/4″ – 6″	Hot Rolled Cold Finished	80/105	55/90	15/25	50/65	165/220	B85/97	83%
		8620 Mod. Telcut® 20 Rounds	1/4″ – 4″	Cold Finished	80/105	55/90	15/25	50/65	165/220	B85/97	100%
		8822 Rounds	2″ – 10″	Hot Rolled	95/105	65/75	20/27	55/65	200/210	B87/95	64%
DIRECT AND PREHARDENED ALLOYS—MEDIUM—HIGH CARBON	Direct Hardening alloys are characterized as steels that can be quenched and tempered to obtain a wide range of hardness, ductility and strength levels. These results are influenced by both the thermal treatment applied and the alloying elements present. Free machining additives have little effect on mechanical properties. The Purecut® series offers our customers the opportunity to improve machinability with the addition of Bismuth. Bismuth steels will machine equal to leaded steels without any of the environmental problems. The Telcut® series of alloys contains a double machining additive, providing a machinability rating of 100% of AISI 1212. Lower cycle times, less tool wear, better surface finish, and improved productivity are achieved with no sacrifice in mechanical properties or heat treat response.	4140 Rounds	3/4″ – 30″	Hot Rolled As Rolled Hot Rolled Annealed Annealed Forged Rough Turned Cold Finished Annealed	90/125	60/105	15/30	45/60	185/250	B90/C25	66%
		4140 Hexagons	7/16″ – 4″	Cold Finished Annealed	110/125	95/105	15/25	45/55	230/250	C20/25	66%
		4140 Squares	1/4″ – 4″	Cold Finished Annealed	110/125	95/105	15/25	45/55	230/250	C20/25	66%
		4140 Leaded Rounds	3/16″ – 6″	Hot Rolled Annealed Cold Finished Annealed	90/125	60/105	19/30	50/60	185/250	B90/C25	83%
		4140 Leaded Hexagons	1/4″ – 3″	Cold Finished Annealed	95/125	80/105	15/25	50/60	200/220	B93/97	83%
		4140 Mod. Telcut® 40 Rounds	1/4″ – 3″	Cold Finished Annealed	90/125	60/105	19/30	50/60	185/250	B90/C25	100%
		Purecut® 40 Rounds	3/8″ – 4″	Cold Finished Annealed	90/125	60/90	15/30	45/60	185/220	B90/97	83%
		Purecut® 40 Hexes	5/16″ – 1-1/2″	Cold Finished Annealed	90/105	80/90	15/25	50/60	200/220	B93/97	83%

(1) 1/4″–1″ also carried as Key Stock.
Properties and hardness may vary.
Contact your sales representative for specific on-line heat information.

Calcium Aluminum treated available in all regular quality grades.
Turned and Polished alloy bars, seam and decarb free, are available in all commercial quality grades.

GROUP	DESCRIPTION	AISI GRADE	SIZE RANGE	CONDITION OF STEEL	AVERAGE PROPERTIES				TYPICAL HARDNESS		
					TENSILE 1000 PSI	YIELD 1000 PSI	% ELONGATION IN 2″	% REDUCTION OF AREA	BHN	ROCKWELL	RELATIVE MACHINABILITY BASED ON AISI 1212 AS 100%
DIRECT AND PREHARDENED ALLOYS—MEDIUM—HIGH CARBON	Direct Hardening alloys are characterized as steels that can be quenched and tempered to obtain a wide range of hardness, ductility and strength levels. These results are influenced by both the thermal treatment applied and the alloying elements present. Free machining additives have little effect on mechanical properties. Supercut 150® is an AISI 4140/42 steel with two special machining additives that combines the high strength and hardness levels of a strain tempered product with the excellent impact and toughness properties of a quenched and tempered alloy. e.t.d 150®(3) is elevate temperature drawn steel with various machining additives., which obtains a minimum Rockwell "C" 32 without quenching and tempering.	4140 Rounds ASTM A193 Grade B7	1/2″ – 7″	Hot Rolled M.S. Heat Treated thru 2 1/2″ thru 4″ thru 7″	125 Min. 115 Min. 100 Min.	105 Min. 95 Min. 75 Min.	16 Min. 16 Min. 16 Min.	50 Min. 50 Min. 50 Min.	321 Max.	RC 35 Max.	55%
			1/4″ – 6″	Cold Finished Heat Treated	Same properties as Hot Rolled M.S., Heat Treated						55%
			1/2″ – 6 1/2″	Cold Finished Heat Treated T.G.+P.	Same properties as Hot Rolled M.S., Heat Treated						55%
		4140 Hexagons ASTM A193 Grade B7	1/2″ – 3″	Cold Finished Heat Treated	Same properties as Hot Rolled M.S., Heat Treated						55%
		4140 Squares ASTM A193 Grade B7	1″ – 6″	Hot Rolled M.S. Heat Treated	Same properties as Hot Rolled M.S., Heat Treated						55%
		4140 Heat Treated Rounds	1/2″ – 12″	Hot Rolled M.S. Heat Treated	135/65	115/140	16	45	285/341	C29/36	55%
			10″ – 30″	Forged Rough Turned Heat Treated	135/65	115/140	16	45	285/341	C29/36	55%
		4140 Heat Treated Leaded Rounds	1 1/4″ – 4″	Cold Finished Heat Treated thru 1 1/2″ thru 2 1/2″ thru 4″	130 Min. 125 Min. 115 Min.	110 Min. 105 Min. 95 Min.	16 Min. 16 Min. 16 Min.	50 Min. 50 Min. 45 Min.	269/321	C27/34	70%
		ASTM A193 Heat Treated Grade B16 Rounds	2″ – 8″(2)	Hot Rolled M.S. Heat Treated thru 2 1/2″ thru 4″ over 4″	125 Min. 110 Min. 100 Min.	105 Min. 95 Min. 85 Min.	18 Min. 17 Min. 16 Min.	50 Min. 45 Min. 45 Min.	255/302 293 Max.	C25/30 29 Max.	50% —
			1/2″ – 3 1/2″	Cold Finished Heat Treated	Same properties as Hot Rolled M.S., Heat Treated						55%
		Supercut 150®	3/4″ – 4″	Cold Finished Heat Treated	150 Min.	130 Min.	12	38	—	33 – 37	—
		e.t.d. 150®(3) Rounds	7/16″ – 3 1/2″	Cold Finished	150 Min.	130 Min.	10	34	302 Min.	C32 Min.	75%

(2) 1/4″–1″ also carried as Key Stock.

(3) Registered Trademarks
e.t.d. 150 LaSalle Steel Company, Subsidiary Quanex Corporation
All others are registered trademarks of A. M. Castle & Co.

(4) Some sizes stocked Resulfurized.

Calcium Aluminum treated available in all regular quality grades. Turned and Polished alloy bars, seam and decarb free, are available in all commercial quality grades.

Quality

GROUP	DESCRIPTION	AISI GRADE	SIZE RANGE	CONDITION OF STEEL	AVERAGE PROPERTIES				TYPICAL HARDNESS		RELATIVE MACHINABILITY BASED ON AISI 1212 AS 100%
					TENSILE 1000 PSI	YIELD 1000 PSI	% ELONGATION IN 2″	% REDUCTION OF AREA	BHN	ROCKWELL	
DIRECT AND PREHARDENED ALLOYS—MEDIUM—HIGH CARBON	Direct Hardening alloys are characterized as steels that can be quenched and tempered to obtain a wide range of hardness, ductility and strength levels. These results are influenced by both the thermal treatment applied and the alloying elements present. Free machining additives have little effect on mechanical properties	4150 Rounds	1″ – 12″	Hot Rolled M.S. Annealed	90/105	65/75	20/30	45/55	185/215	B90/96	60%
			10″ – 20″	Forged & Rough Turned Annealed	90/105	65/75	20/30	45/55	185/215	B90/96	60%
			3/4″ – 5″	Cold Finished Annealed	90/125	65/105	10/30	40/50	185/250	B90/C25	60%
			1″ – 12″	Hot Rolled M.S. Heat Treated	130/55	105/125	15/25	50/60	285/341	C29/36	55%
			10″ – 20″	Forged & Rough Turned Heat Treated	135/165	115/140	15	46	285/341	C29/36	55%
	Pre-hardened alloy bars eliminate the time, expense, and liability of heat treating parts as well as any subsequent machining or grinding operation. Likewise the exact properties of the alloy are known prior to producing parts.	4150 Squares	1″ – 6″	Hot Rolled M.S. Annealed	90/105	65/75	20/30	45/55	185/215	B90/96	60%
		4150 Flats	1/2″ – 1 1/4″ Min. .4″ x 6″ Max.	Hot Rolled Annealed[4]	90/105	65/75	20/30	45/55	185/215	B90/96	60%
		4150 Mod. Telcut® 50 Rounds	3/8″ – 4″	Cold Finished Annealed	90/125	65/105	20/30	40/55	185/250	B90/C25	100%
	The Telcut® series of alloys contains a double machining additive, providing a machinability rating of 100% of AISI 1212. Lower cycle times, less tool wear, better surface finish, and improved productivity are achieved with no sacrifice in mechanical properties or heat treat response.	4340 Rounds	1/2″ – 11″	Hot Rolled M.S. Annealed	100/125	70/85	20/30	45/55	210/250	C16/25	57%
			10″ – 30″	Forged Rough Turned Annealed	70/80	45/65	18/21	35/45	190/227	B92/98	57%
			1/2″ – 3 1/2″	Cold Finished Annealed	90/125	60/85	16/30	42/55	210/250	B96/C24	57%
			1″ – 11″	Hot Rolled M.S. Heat Treated	135/165	115/140	15	43	285/341	C29/36	55%
			10″ – 30″	Forged & Rough Turned Heat Treated	135/165	115/140	15	43	285/341	C29/36	55%
			1″ – 6″	Cold Finished Heat Treated T.G. & P.	135/165	115/140	15	43	285/341	C29/36	55%

Bearing Quality

GROUP	DESCRIPTION	AISI GRADE	SIZE RANGE	CONDITION OF STEEL	SPECIFI-CATIONS	MILITARY SPECIFICATIONS[5]	TYPICAL HARDNESS		RELATIVE MACHINABILITY BASED ON AISI 1212 AS 100%
							BHN MAX	ROCK-WELL	
TUBING	Bearing Quality Steels have superior surface quality for severe anti-friction bearing application. All of Castle's bearing quality steels are ordered to stringent ASTM and AMS designations to assure the highest in quality.	E4118 Tubing	1.391″ OD 4.014″ OD	Hot Rolled Cold Finished	ASTM ASTM A534	—	—	—	60%
		E8620 Tubing	1.875″ OD – 11″ OD	Hot Rolled Seamless	ASTM A534	—	220 Max	—	66%
		E5160 Tubing	1.889″ OD – 16.403″ OD	Hot Rolled Cold Finished	ASTM A534	—	220 Max	—	66%
		E52100 Tubing	1″ OD – 11.250″ OD	Spheroidize Annealed	295 AMS 6440	—	207	B95 Max.	45%
ROUNDS	E52100 bearing quality steel is a moderately deep hardening alloy having high resistance to wear, medium toughness, and low resistance to softening at high temperatures. E52100 is used for such critical applications as anti-friction bearings; mill rolls and journals;and taps, punches, and other tools.	E8620 Rounds	3 1/2″ – 10″ 1/2″ – 3 1/2″	Hot Rolled M.S. Cold Finished	ASTM A534	—	165/200 200/220	B85/93 B93/97	66%
		E52100 Rounds	.130″ – 3″	Cold Finished Spheroidize Annealed	ASTM A295 AMS 6440 ASTM A892	MIL-S-7420 Refer to AMS–S–7420	248	C24 Max.	50%
			2″ – 10″	Hot Rolled M.S. Spheroidize Annealed			207	B95 Max.	45%
		E3310 Rounds	2″ – 11″	Hot Rolled M.S. Annealed	ASTM A322 A534	—	207	B95 Max.	51%
		E4118 Rounds	1/2″ – 3″	Hot Rolled M.S. Cold Finished	ASTM A322 A534 A304	—	—	—	60%

(5) MIL-S specs, discontinued on 1/1/97 by the Department of Defense, are provided for your convenience and information. (THE SPECIFICATION MAY BE OUTDATED AND NO LONGER VALID.)

Castle Metals® is one of the largest distributors of alloy bar in the world and is a major source for unusual alloys and unique incremental sizes.

Aircraft Quality

GROUP	DESCRIPTION	AISI GRADE	AMS	MILITARY[5] SPECIFICATION	SIZE RANGE	CONDITION OF STEEL	TYPICAL HARDNESS			RELATIVE MACHINABILITY BASED ON AISI 1212 AS 100%
							BHN MAX	JOMINY		
								MAX.	MIN.	
DIRECT AND PREHARDENED ALLOYS—MEDIUM—HIGH CARBON	E4130 is a chrome-moly alloy. It is very popular for welding applications. It is often used in the normalized condition without further heat treatment. It can be nitrided to enhance its wear quality.	E4130 Rounds	6370 2301	MIL-S-6758 Refer to AMS-S-6758	3/16″ – 4″	Cold Finished Normalized	241	6370 Rc34 @ J5 Rc27 @ J8		75%
					3/4″ – 10	Hot Rolled M.S. Normalized	229			
					1/4″ – 1 1/2″	Cold Finished Heat Treated	321			45%
		E4130 Hexagons			5/16″ – 2″	Cold Finished Annealed	241			72%
					3/8″ – 1 1/2″	Cold Finished Heat Treated	269/321			45%
		E4130 Squares			1/2″ – 1 1/2″	Cold Finished Normalized	241			75%
					1/4″ – 1 1/2″	Cold Finished Heat Treated	269/321			45%
		E4130 Flats			3/16″x1 1/2″ Min 1 1/2″x6″ Max	Cold Finished Normalized	241	Mil-S-6758 Rc35 @ J5 Rc28 @ J8		75%
					1 1/2″x5″ Min 4″x6″ Max	Hot Rolled Normalized	229			
					3/4″x1″ Min. 1 1/2″x3″ Max.	Cold Finished Heat Treated	321			45%
	E4140 is a chrome-moly alloy produced in Electric Furnaces. When quenched and tempered, it is a relatively deep hardening steel.	E4140 Rounds	6382 2301	MIL-S-5626 Refer to AMS-S-5626	1/4″ – 4″	Cold Finished Annealed	241	Rc50 @ J6 Rc44 @ J9		66%
					3/4″ – 10″	Hot Rolled M.S. Annealed	229			
		E4140 Hexagons			1 5/8″ – 7 1/4″	Hot Rolled M.S. Heat Treated	269/321			55%
		E4140 Squares			1/2″ – 2″	Cold Finished Annealed	241			66%
		E4140 Flats			1/2″ – 1 1/2″	Cold Finished Annealed	241			
					1/4″x1″ Min. 1 1/2″x6″ Max.	Cold Finished Annealed	229			
					1″x2″ Min. 4″x6″ Max.	Hot Rolled Annealed	229			

ALLOY STEELS HAVE THESE BENEFITS:

- Tensile Strength
- Yield Strength
- Fatigue Resistance
- Toughness
- Wear Resistance

Aircraft Quality

GROUP	DESCRIPTION	AISI GRADE	AMS	MILITARY[5] SPECIFICATION	SIZE RANGE	CONDITION OF STEEL	TYPICAL HARDNESS: BHN MAX	TYPICAL HARDNESS: JOMINY MAX.	TYPICAL HARDNESS: JOMINY MIN.	RELATIVE MACHINABILITY BASED ON AISI 1212 AS 100%
CASE HARDENING—LOW CARBON AND DIRECT HARDENING—MEDIUM CARBON	E-4340 is a triple alloy (Ni-Cr-Mo). When quenched and tempered, it results in a deep hardening, tough, shock and impact resistant steel with excellent torque strength. This steel is used where heavy duty, high strength requirements are to be met.	E4340 Rounds	6415 2301	MIL-S-5000 Refer to AMS-6415	1/4″ – 1 1/2″	Cold Finished Annealed Normalized & Tempered	255	6415 Rc53 @ J6 Min. Rc50 @ J20 Min. MILS-S-5000 Rc50 @ J20 Min. Rc45 @ J32 Min.		57%
					1″ – 10 1/2″	Hot Rolled M.S. Annealed Normalized & Tempered	235			
		E4340 Hexagons			5/8″ – 2″	Cold Finished Annealed	255			57%
		E4340 Squares			1/2″ – 2″	Cold Finished Annealed				
		E4340 Flats			1/4″x1″ Min. 1 1/2″x6″ Max.	Cold Finished Annealed Normalized & Tempered				57%
					1 3/4″x2″ Min. 4″x6″ Max.	Hot Rolled M.S. Annealed	235			
		E6150 Rounds	6448 2301	MIL-S-8503 Refer to AMS-S-8503	1″ – 10″	Hot Rolled Annealed	235	Rc52 @ J6 Min. Rc45 @ J8 Min.		50%
					1/4″ – 3 1/2″	Cold Finished Annealed	248			
	Aircraft Quality 8620 is intended for the purpose of case hardening. This popular steel is widely used throughout the industry, because of its relative low cost and high quality, developing a uniform hard case, a tough ductile core, and minimum distortion during heat treating. E8740 is a triple alloy (Ni-Cr-Mo) produced in Electric Furnaces. When quenched and tempered, it provides good hardenability, and resistance to shock.	E8620 Rounds	6274 2301	MIL-S-8690 Refer to AMS-S-8690	1/4″ – 3 1/2″	Cold Finished	248	Rc48@J1	Rc32@J3	66%
					2 3/4″ – 10″	Hot Rolled M.S.	229			
		E8740 Rounds	6322 2301	MIL-S-8690 Refer to AMS-S-8690	1/4″ – 3 1/2″	Cold Finished Annealed	241	6322 Rc50 @ J5 Min. Rc40 @ J8 Min. MIL-S-6049 Rc49 @ J5 Min. Rc35 @ J10 Min.		66%
					3 3/4″ – 7″	Hot Rolled Annealed	229			
		E8740 Hexagons			3/8″ – 1 1/2″	Cold Finished Annealed	241			
	E9310 Aircraft Quality is a triple alloy (Ni-Cr-Mo) produced for the purpose of case hardening. It is a deep hardening steel. It is used for applications where strength, toughness, and high wear resistance are required.	E9310 Rounds	6260 2301	MIL-S[5] 7393 Comp III	3/8″ – 3 3/4″	Cold Finished Annealed	248	Rc41@J1	Rc32@J6	51%
					1″ – 10 1/2″	Hot Rolled M.S. Annealed	229			
					3/4″ – 10 1/2″	H R Normalized M.S. & Tempered	—			
		E9315 Rounds	6263 2301	—	3/8″ – 3 3/4″	Cold Finished Annealed	248	Rc44@J1	Rc35@J8	49%
					1″ – 10 1/2″	Hot Rolled M.S. Annealed	229			
	This Chrome-moly alloy with aluminum when nitrided exhibits an extremely hard case with a strong ductile core.	Nitriding 135 Mod Rounds	6472 2301	MIL-S-6709 Refer to AMS-S-6709	1/2″ – 1 3/4″	Cold Finished Heat Treated	241/285	Rc50 @ J8 Min. Rc45 @ J12 Min.		50%
					7/8″ – 10″	Hot Rolled M.S. Heat Treated	—			

(6) Except etch test
Continuous Line Marking Waived.
All properties shown in this guide are typical properties only, and are not to be used for specifications. All sizes shown as rounds unless otherwise noted.
NOTE: ALL CASTLE METALS® aircraft quality bars are produced to cleanliness require AMS 2301 except VAR which is AMS 2300.
Certifications can be furnished to show conformity to applicable specifications.

Premium Quality

GROUP	DESCRIPTION	AISI GRADE	AMS	MILITARY SPECIFICATION[5]	SIZE RANGE	CONDITION OF STEEL	TYPICAL HARDNESS			RELATIVE MACHINABILITY BASED ON AISI 1212 AS 100%
							BHN MAX	JOMINY		
								MAX.	MIN.	
CASE HARDENING—LOW CARBON AND DIRECT HARDENING—MEDIUM—HIGH CARBON	4330 MOD VAR has greater usable strength, superior transverse properties, higher fatigue strength, improved notch toughness & improved resistance to crack propagation.	E4330 Mod VAR Rounds	6411 2300	MIL-S-8699 Refer to AMS 6427	1 3/8″ – 7 1/2″	Hot Rolled M.S. Annealed	241	Rc49 @ J14 Min.		57%
					1″ – 8 1/2″	Normalized & Tempered		Rc45 @ J24 Min.		
	Ultra high strength aircraft structural parts. Aircraft landing gear parts.	E4340 VAR Rounds	6414	MIL-S-8844 CLASS I Refer to AMS 6414	1 1/4″ – 8 1/2″	Hot Rolled Annealed	235	Rc53@J6 Min.	Rc50@J20 Min.	57%
					1″ – 8 1/2″	Normalized & Tempered				
	A triple alloy (Ni-Cr-Mo) VAR material for applications requiring high transverse ductility, fatigue strength, fracture toughness, impact strength. Used in aircraft missile parts.	E4340 "300 M" VAR Rounds	6417 2300	MIL-S-8844 Refer to AMS 6257	1″ – 7″	Hot Rolled M.S. Normalized & Tempered	235	Rc55@J8	Rc53@J20	57%
	AMS 6265 Material is vacuum arc Remelted, resulting in the highest quality, cleanliness and reliability.	E9310 VAR Rounds	6265 2300	—	1″ – 9″	Hot Rolled Annealed M.S.	229	Rc41@J1	Rc32@J6	49%
					1/2″ – 2 3/4″	Cold Finished Annealed Normalized & Tempered				
					1″ – 9″	HR M.S. Normalized & Tempered				
	E52100 VAR is an oil hardening, high carbon, chrome steel used in various bearing applications for aircraft or other critical parts. It has excellent wear and abrasion resistant qualities and can also be used in place of tool steels.	E52100 VAR Rounds	6444 2300	—	3/8″ – 2 3/8″	Cold Finished Spheroidize Annealed	248	—		50%

NOTE: Additional specifications are available on most Premium Aircraft Quality, VAR steels. Please inquire for specific heat certification.

Continuous Line Marking Waived.

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