



## Technical Information: D2 ESR

D2 ESR IS AN AIR HARDENING COLD WORK TOOL STEEL

D2 ESR IS CHARACTERIZED BY GOOD WEAR RESISTANCE COMBINED WITH MODERATE TOUGHNESS

D2 ESR IS USED AS AN UPGRADE TO CONVENTIONAL D2

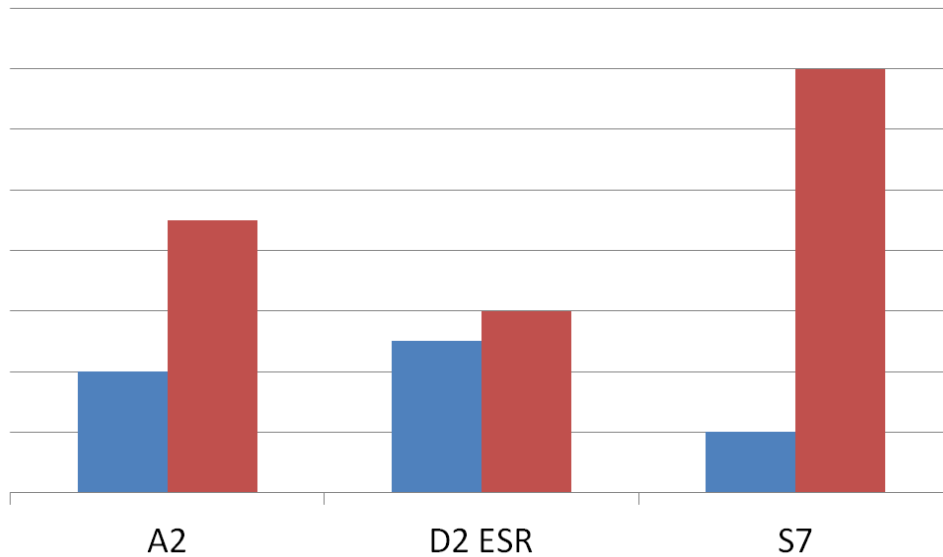
D2 ESR WILL HAVE HIGHER TOUGHNESS AND BETTER CLEANLINESS THAN STANDARD D2

### TYPICAL CHEMICAL COMPOSITION

CARBON	1.55%	CHROMIUM	11.50%
MOLYBDENUM	0.90%	SILICON	0.45%
VANADIUM	0.80%	MANGANESE	0.35%

### SBSM TOOL STEEL PROPERTIES COMPARISON

■ Relative Wear Resistance   ■ Chipping Resistance



### PHYSICAL PROPERTIES

MODULUS OF ELASTICITY.....30 PSI X 10<sup>6</sup> .....(207 GPa)  
 DENSITY..... 0.280 LB/IN<sup>3</sup>  
 ANNEALED HARDNESS.....220-235 BRINELL HARDNESS (BHN)



## Technical Information: D2 ESR

### HEAT TREATMENT

#### ANNEALING

HEAT TO 1600°F, HOLD TWO HOURS  
SLOW COOL 20°F/HOUR TO 900°F  
THEN AIR OR FURNACE COOL TO ROOM TEMPERATURE

#### STRESS RELIEVING

PERFORMED PRIOR OR AFTER MACHINING TO MINIMIZE DISTORTION IN HEAT TREATING  
1100/1200°F, HOLD TWO HOURS  
THEN AIR COOL TO ROOM TEMPERATURE

#### HARDENING

SALT BATH, PROTECTIVE ATMOSPHERE, OR VACUUM FURNACE EQUIPMENT PREFERRED.

#### HIGH HEAT (AUSTENITIZING)

1850°F FOR 30 MINUTES AT HEAT.

#### QUENCH

SALT BATH QUENCH TO 1000-1100°F, EQUALIZE, THEN AIR COOL TO 150°F .  
VACUUM OR ATMOSPHERE QUENCH RATE OF A MINIMUM 50 DEGREES F PER MINUTE DOWN TO 900°F IS  
CRITICAL TO ACHIEVE BEST HEAT TREAT RESPONSE.

TEMPER IMMEDIATELY FOLLOWING QUENCH WHEN MATERIAL REACHES 150°F OR BELOW.

#### TEMPERING

MINIMUM 400°F TEMPERING TEMPERATURE REQUIRED.  
DOUBLE TEMPERING IS REQUIRED, TRIPLE TEMPERING RECOMMENDED.  
AIR COOL TO ROOM TEMPERATURE BETWEEN TEMPERS.

### TYPICAL HEAT TREAT RESPONSE

TEMPERING TEMP		HARDENING	
°F	°C	TEMP	TEMP
		1850°F	010°C
As QUENCHED		62 HRC	
400	205	61 HRC	
500	260	60 HRC	
600	315	59 HRC	
700	371	58 HRC	
800	427	57 HRC	
900	480	56 HRC	
1000	538	55 HRC	
1100	552	50 HRC	