

FM ALLOY

Steels for precision die

DURO-SP

DURO-V5

DURO-V2



Blanking punch

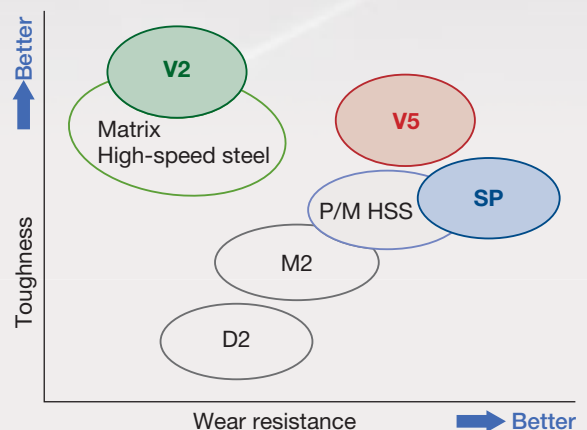
The DURO Series is high performance steel for die that exceeds P/M high-speed steel with a balance of wear resistance and toughness

Features

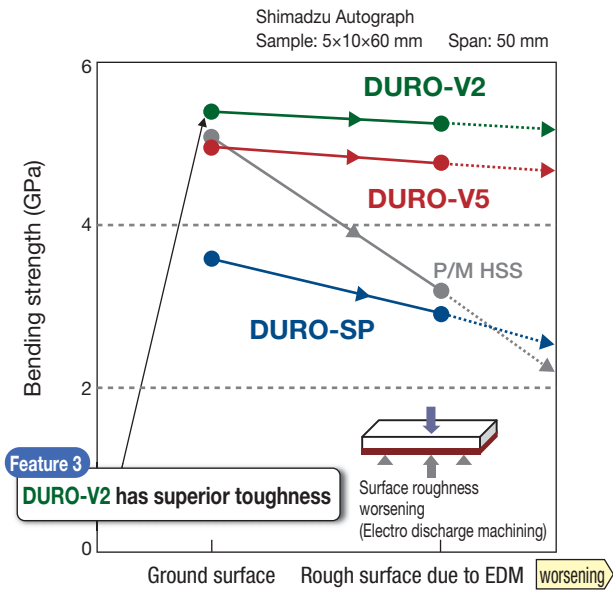
- 1 Toughness decrease is small even if surface roughness worsens
SP, V5, V2

- 2 High wear resistance than P/M high-speed steel in high friction speed range (adhesive wear range)
SP, V5

- 3 Superior toughness than P/M high-speed steel
V2

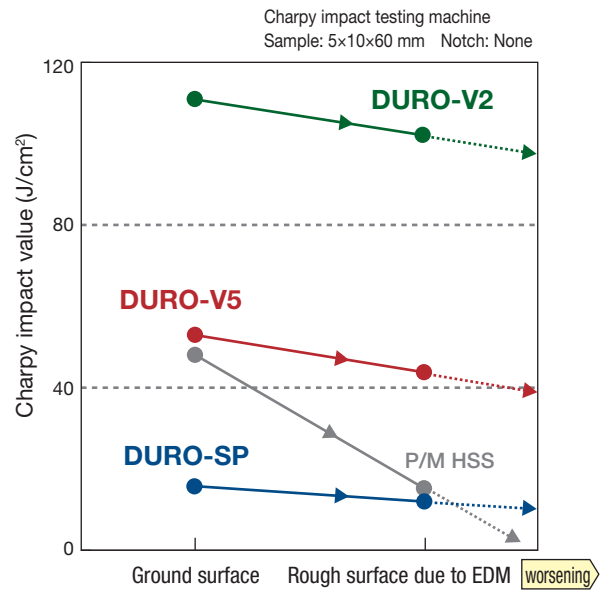


Change in bending strength



Feature 3
DURO-V2 has superior toughness

Change in impact value



Feature 1
With DURO-SP, V5 and V2, toughness decrease is small even if surface roughness worsens

Example of bad surface roughness

- Advancement of wear
- Remaining tool marks
- Wire cut surface

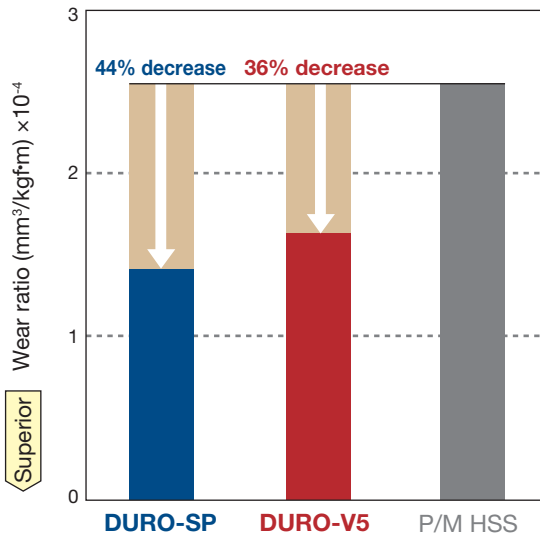
Worsening surface roughness

◆ Toughness decreases due to worsening of surface roughness

Steel grade	Bending strength	Impact value
DURO-SP	Small	Small
DURO-V5	Small	Small
DURO-V2	Small	Small
P/M HSS	Large	Large

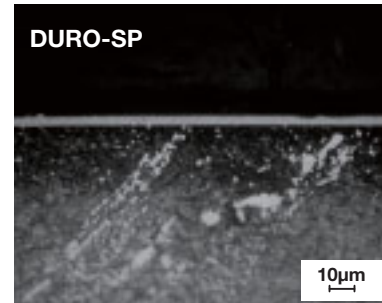
Wear resistance

Test method: Ogoshi type wear testing machine
Friction Length: 200 m Final load: 6.3 kg Lubricant: None
Friction speed: 2.86 m/s Sample: 5×10×60 mm Rotor: SCM435 (102 HRB)

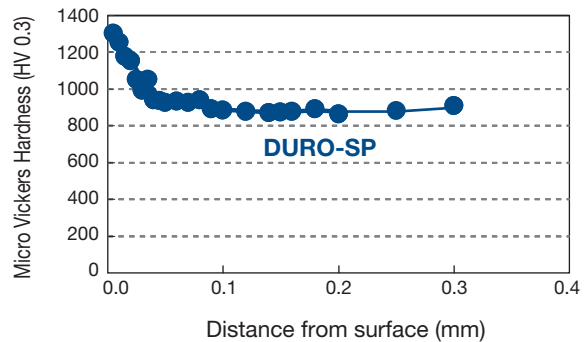


Feature 2
DURO-SP and DURO-V5 have superior wear resistance

Example of surface treatment



Nitriding + coating cross section



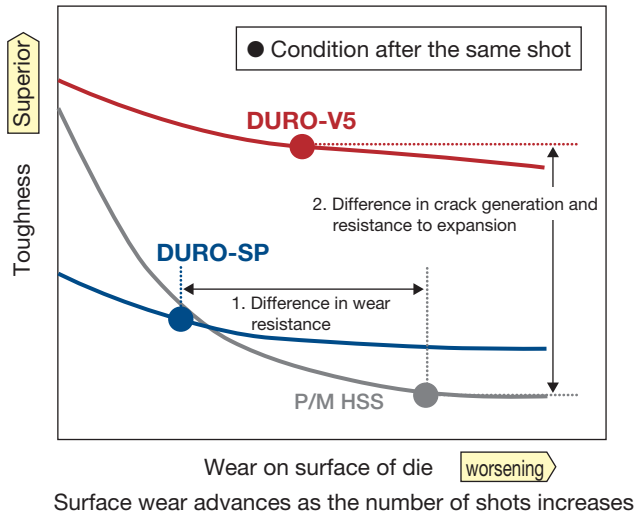
Mechanical properties

Steel grade	Hardness (HRC)	Tensile strength (GPa)	Proof stress (GPa)	Compressive strength (GPa)	Young's modulus (GPa)	Modulus of rigidity (GPa)	Poisson's ratio
DURO-SP	64.0	2.7	2.2	4.2	228	89	0.28
DURO-V5	62.0	2.5	2.0	3.8	215	84	0.28
DURO-V2	62.0	2.6	2.1	3.8	215	84	0.28

* Sample taken from φ50 mm rolled material

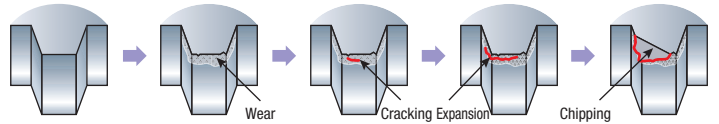
Failure process

◆ Toughness with condition of surface wear



DURO-SP and DURO-V5 are better against wear on die

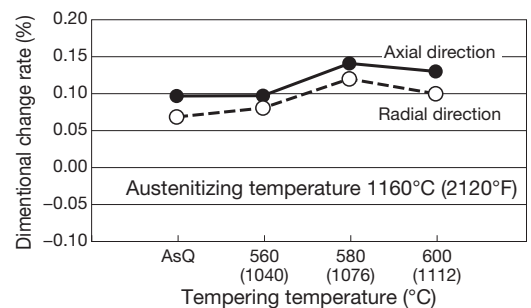
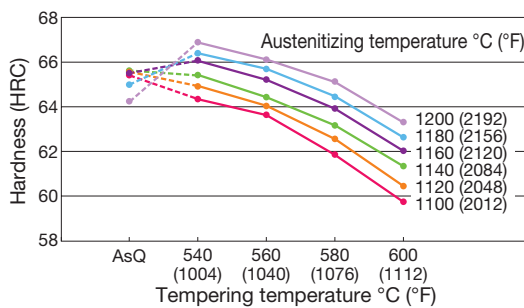
1. DURO-SP has superior wear resistance so development of unevenness due to wear is slow
2. DURO-V5 has great resistance to generation and expansion of cracks



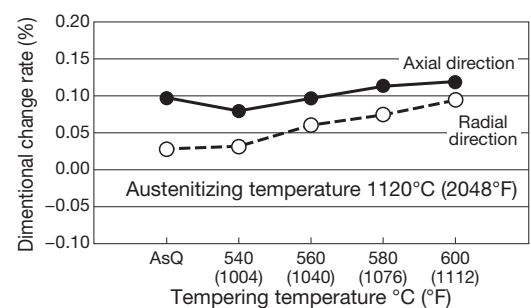
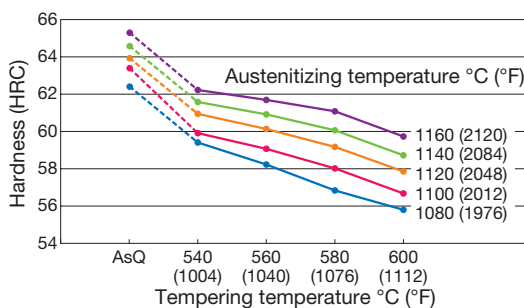
Based on the conditions after the same shot usage (see ●), the DURO-SP has better wear resistance than P/M HSS so the wear is not as advanced (see 1 in diagram). Comparing toughness shown on the vertical axis, the toughness of the DURO-SP is better than P/M HSS. In addition, the DURO-V5 has both better wear resistance and toughness than P/M HSS, as shown by the large difference in the toughness after wear has advanced (see 2 in diagram). This shows that the DURO-SP and V5 are tougher than P/M HSS for die. The life of a die increases by as much as its toughness increases.

Heat treatment conditions

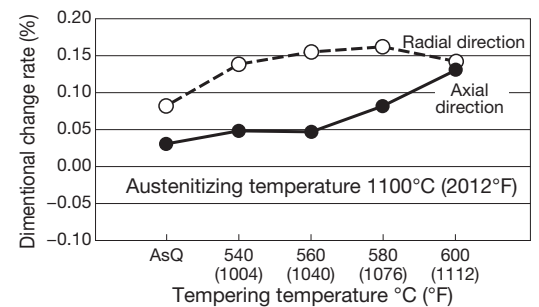
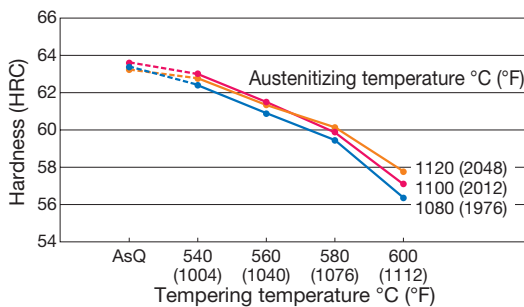
DURO-SP



DURO-V5



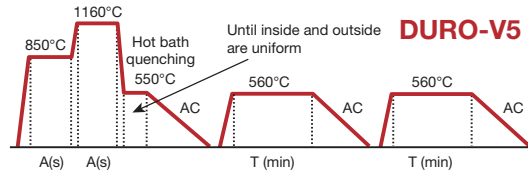
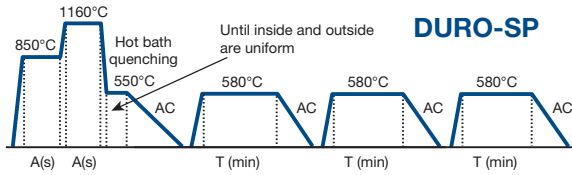
DURO-V2



Steel grade	Requirement	Austenizing temperature °C (°F)	Tempering temperature °C (°F) × Cycles	Hardness (HRC)
DURO-SP	For hardness and wear resistance	1200 (2192)	600 (1112) × 3	66
	Standard	1160 (2120)	580 (1076) × 3	64
	For toughness	1120 (2048)	560 (1040) × 3	61
DURO-V5	Standard	1160 (2120)	560 (1040) × 2	62
	For toughness	1140 (2084)	580 (1076) × 2	60
DURO-V2	Standard	1100 (2012)	550 (1022) × 2	62

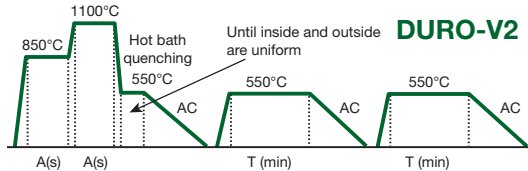
Heat treatment conditions

◆ Salt bath heat treatment (example of standard conditions)



DURO-SP and DURO-V5

Diameter or Thickness	up to 10 mm up to 2/5 inch	10 to 25 2/5 to 1	25 to 50 1 to 2	50 to 75 2 to 3	75 to 100 3 to 4	over 100 over 4
Heating time A(s)	80 to 190	190 to 310	310 to 520	520 to 720	660 to 720	over 720
Tempering time T (min)	60	90	120	150	180	210



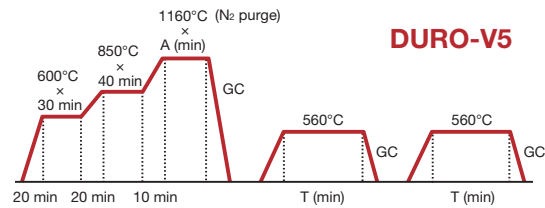
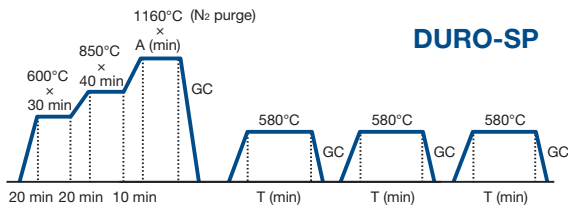
DURO-V2

Diameter or Thickness	up to 10 mm up to 2/5 inch	10 to 25 2/5 to 1	25 to 50 1 to 2	50 to 75 2 to 3	75 to 100 3 to 4	over 100 over 4
Heating time A(s)	12×D*	10×D	8×D	7×D	6×D	5×D
Tempering time T (min)	90	90	120	120	120	120

* D: Workpiece diameter or thickness [mm]

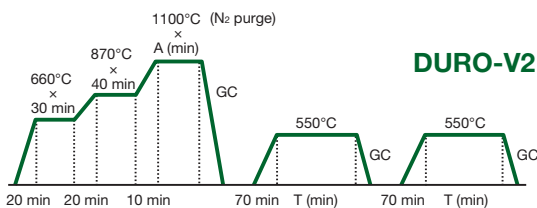
Point • Immersion time shall be extended if salt bath temperature falls

◆ Vacuum furnace heat treatment (example of standard conditions)



DURO-SP and DURO-V5

Diameter or Thickness	up to 10 mm up to 2/5 inch	10 to 25 2/5 to 1	25 to 50 1 to 2	50 to 75 2 to 3	75 to 100 3 to 4	over 100 over 4
Heating time A (min)	up to 15	15 to 20	20 to 25	25 to 30	30 to 35	over 35
Tempering time T (min)	90	120	150	150	180	180



DURO-V2

Example of workpiece dimensions (mm)	5×10×50 mm 0.2×0.4×2 inch	φ50×60 φ2×2.36	55×65×200 2.2×2.6×8
Heating time A (min)	5	15	20
Tempering time T (min)	120	180	180

Point • Cooling at quenching shall be done as quickly as possible
• Heating time shall not be excessively long

* Temperature increase and heating times are reference values only due to variations in heat processing furnace.

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