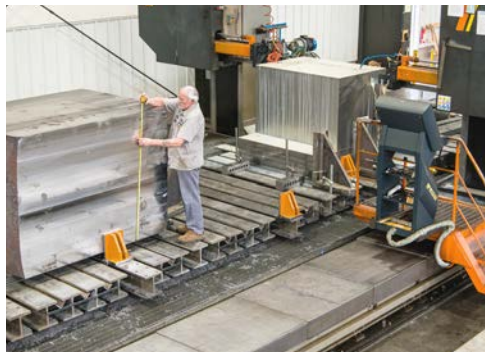




EXELL™ TUF-DIE

Hot Work Tool Steel



ELLWOOD

YOUR METALS PARTNER, FROM MELT TO DISTRIBUTION

ESSsales@elwd.com

800.932.2188

EXELL™ TUF-DIE

ExELL™ TUF-DIE is a premium quality hot work die steel manufactured for highly demanding tooling requirements.

EXELL™ TUF-DIE is a modified version of AISI H-11 to promote both added heat resistance and toughness when compared to H-13. This chromium-molybdenum-vanadium alloyed tool steel is characterized by the following properties:

- High temperature strength
- Very good toughness and ductility
- Resistance to thermal shock and fatigue
- Consistent heat treatment
- Good machinability

MANUFACTURING

ExELL™ TUF-DIE is manufactured to high standards of tooling quality for optimum service performance. Material is produced with excellent cleanliness, structure uniformity and mechanical properties.

Steel manufacture includes:

- Special steel melting and refining
- Precise chemistry control
- Heavy forging reductions
- Special mill thermal treatment
- Complete manufacture, testing and quality assurance within facilities certified to ISO 9002

APPLICATIONS

ExELL™ TUF-DIE is used in die casting applications where a higher level of heat resistance along with good toughness and ductility are required. ExELL™ TUF-DIE is manufactured to meet the demanding criteria of NADCA #207 and automotive OEM specifications for premium material quality.

ExELL™ TUF-DIE is also used in other hot work applications, such as hammer die inserts, press dies and inserts, and extrusion tooling components. It can also be used in plastic molds and as a cold or hot shear knife. ExELL™ TUF-DIE is ideal for punch or holder applications where an optimum combination of strength and toughness is required.



CHARACTERISTICS

PHYSICAL PROPERTIES

Coefficient of Thermal Expansion, in/in/F

- 70-450F - 0.0000070
- 70-1450F - 0.0000077

Density, lbs/cu.in.

- 70F - 0.281
- 750F - 0.277
- 1450F - 0.272

Thermal Conductivity, BTU/ft hr F

- 70F - 15
- 750F - 15.5
- 1450F - 16

Modulus of Elasticity, psi

- 70F - 29,400,000
- 750F - 29,500,000



MECHANICAL PROPERTIES (AT ROOM TEMPERATURE)

	Tensile Strength (psi)	0.2% Yield Strength (psi)	RA Percentage	Elongation Percentage
52 HRC	260,000	220,000	46	10
46 HRC	205,000	185,000	56	12

TYPICAL ANALYSIS

C	0.39
Si	0.25
Mn	0.34
Cr	5.07
Mo	1.80
V	0.65

HEAT TREATMENT (General Recommendations)

STRESS RELIEVING

- After rough machining an annealed component, heat the part to 1200F, equalize and hold 1-2 hours. Furnace cool to 900F and then air cool to room temperature.

ANNEALING

- With a protective atmosphere or vacuum furnace, heat slowly to 1560F. Equalize and hold one hour per inch of thickness.
- Furnace cool 20F/hr to 1100F and equalize. Cool freely in air to room temperature. Hardness will be 229 HB maximum.

HARDENING AND QUENCHING

PREHEATING

Heat to 1200F and equalize. Continue heating to 1550F and equalize. Complete heating to hardening temperature.

HARDENING

Typical austenitizing range is 1850-1900F. Hardening temperature can be adjusted to develop added heat resistance. A hardening temperature of 1885F is normally used for most applications.

QUENCHING

Quenching should be performed as rapidly as possible without promoting excess movement or cracking. Typical quenching media include:

- High speed gas with sufficient positive pressure and circulation in vacuum furnace
- Circulating air/atmosphere for small parts
- Martempering bath or fluidized bed at 575-1020F, then air cool
- Warm oil

QUENCHING		
HARDENING TEMPERATURE	HOLD TIME*	AS-QUENCHED HARDNESS
1885F	30 minutes	53 ± 2 HRC
1900F	15 minutes	54 ± 2 HRC

* Hold Time = time at temperature after tool is fully heated through

TEMPERING

Temper immediately after quenching to 150F. Temper a minimum of two times with intermediate cooling to room temperature.

Choose the tempering temperature to develop required hardness. ExELL™ TUF-DIE should be heated to the desired tempering temperature and held a minimum of two hours. Air cool to room temperature. Check hardness and adjust temperature for additional tempering operation(s). Repeat for added tempers.

Do not retemper in the range of 800-975F to avoid temper embrittlement.

TYPICAL TEMPERING TEMPERATURE RESPONSES		
TEMPERING TEMPERATURE	HARDEN 1885F HRC	HARDEN 1900F HRC
480F	52	53
1000F	53	54
1050F	51	53
1100F	46	49
1150F	42	46
1200F	35	37

SURFACE TREATMENTS

Surfaces of ExELL™ TUF-DIE can readily be chrome plated, nitrocarburized or nitrided by all commercial processes. Care must be taken to avoid hydrogen embrittlement in chrome plating. Temper at 400F for 4 hours after plating. Avoid excessive concentrations of nitrogen during various nitriding processes to minimize white layer and excessive network. Generally, nitride depths greater than 0.010" are not recommended for hot work applications.

TOOLMAKING

For additional information including welding, machining, grinding or EDM processing, please contact ELLWOOD Specialty Steel direct at 800.932.2188.

CAPABILITIES

ELLWOOD Specialty Steel is a fully integrated producer of a wide range of specialty tool steels.

Our ExELL™ grades are made with advanced steel making capabilities. Our steel making expertise and capability is further enhanced from a long forging history with optimum forging and heat treating practices to develop material characteristics of product uniformity, cleanliness, machinability, polishability, strength, toughness, hardenability and other steel properties. All this from production facilities certified to ISO 9002.

QUALITY ASSURANCE

ELLWOOD Specialty Steel is committed to providing products and services which consistently meet or exceed your quality and performance expectations. We will provide customer and technical service that will ensure complete satisfaction.

ELLWOOD Specialty Steel will establish product programs to fully support industry or customer requirements. Our extensive stock programs are supported by short mill lead times of custom forged products.

Customized stock programs can be available for specific customer needs.



This information is intended to provide general data on our products, their uses and is based on our knowledge at the time of publication. No information should be construed as a guarantee of specific properties of the procedures described or suitability for a particular application. ELLWOOD Specialty Steel reserves the right to make changes in practices which may render some information outdated or obsolete. ELLWOOD Specialty Steel should be consulted for current information and/or capabilities.



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ELLWOOD Specialty Steel | 499 Honeybee Lane | New Castle, PA 16105 | 800.932.2188

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