

CRUCIBLE

Crucible 154 CM is a modification of 440C martensitic stainless steel to which molybdenum has been added. 154 CM has better corrosion resistance, better wear resistance and better hot-hardness than 440C. For knifemakers, it offers better edge retention than 440C. It also has higher attainable hardness and better through hardening characteristics than 440C.

Typical Applications

Cutlery
Bearings
Valve Ports
Bushings

Note: These are some typical applications. Your specific application should not be undertaken without independent study and evaluation for suitability.

Machinability

Due to its higher carbide volume, Crucible 154 CM is a little more difficult to machine than 440C. With high speed or carbide tooling, the following machining parameters are suggested:

| Machining Operation | Speed (fpm) | Feed (in/rev) |
|-------------------------|-------------|---------------|
| High Speed Tools | | |
| Turning | 50/60 | 0.003" |
| Forming | 50/60 | 0.001" |
| Drilling | 40 | 0.002" |
| Cutoff | 50/60 | 0.001" |
| Carbide Tools | | |
| Turning | 150 | 0.010" |
| Forming | 100 | 0.0015" |
| Cutoff | 100 | 0.0015" |

Crucible...
The Tool Steel Pros⁷

DATA SHEET

CRUCIBLE 154 CM

Issue #2

| | |
|------------|--------|
| Carbon | 1.05% |
| Chromium | 14.00% |
| Molybdenum | 4.00% |

Physical Properties

| | | |
|-----------------|----------------------------|---------------------------|
| Elastic Modulus | 30 X 10 ⁶ psi | (207 GPa) |
| Density | 0.281 lbs./in ³ | (7.78 g/cm ³) |

Thermal Conductivity

| | | | |
|-----------------|--------------|--------|-------------|
| | BTU/hr-ft-°F | W/m-°K | cal/cm-s-°C |
| at 200°F (95°C) | 14.0 | 24.2 | 0.057 |

Coefficient of Thermal Expansion

| | | |
|----------------------------|-----------------------|------------------------|
| | in/in/°F | mm/mm/°C |
| -100 to 70°F (-74 to 21°C) | 3.90X10 ⁻⁶ | 7.02X10 ⁻⁶ |
| 70-100°F (21-38°C) | 4.07X10 ⁻⁶ | 7.33X10 ⁻⁶ |
| 70-300°F (21-149°C) | 5.75X10 ⁻⁶ | 10.35X10 ⁻⁶ |
| 70-500°F (21-260°C) | 6.06X10 ⁻⁶ | 10.91X10 ⁻⁶ |
| 70-600°F (21-315°C) | 6.15X10 ⁻⁶ | 11.07X10 ⁻⁶ |
| 70-700°F (21-260°C) | 6.33X10 ⁻⁶ | 11.39X10 ⁻⁶ |
| 70-800°F (21-371°C) | 6.45X10 ⁻⁶ | 11.61X10 ⁻⁶ |
| 70-900°F (21-482°C) | 6.59X10 ⁻⁶ | 11.86X10 ⁻⁶ |
| 70-1000°F (21-538°C) | 6.67X10 ⁻⁶ | 12.01X10 ⁻⁶ |

Mechanical Properties

| Grade | Hardness (HRC) | Wear Resistance* | Total Carbide Volume |
|--------|----------------|------------------|----------------------|
| 154 CM | 58.5 | 49 mg | 17.5% |
| 440C | 57.5 | 66 mg, 55 mg | 12% |

* Wear resistance measured by the pin abrasion method. Lower number (mg.) is a lower weight loss (in mg.) and therefore better wear resistance.

Hot Hardness

| Heat Treatment | Initial HRC | HRC tested at | | | Final HRC |
|----------------|-------------|---------------|---------------|---------------|-----------|
| | | 400°F (204°C) | 500°F (260°C) | 600°F (315°C) | |
| A | 62 | 59 | 58 | 55 | 60 |
| B | 62 | - | - | 55 | 62 |
| C | 64 | - | - | 57 | 64 |

(A) Austenitized at 1950°F 1 hr., Oil Quench, cryo treated, tempered 600°F 1hr.
(B) Austenitized at 1950°F 1 hr., Oil Quench, cryo treated, tempered 1000°F 1hr.
(C) Austenitized at 2000°F 20 min., Oil Quench, cryo treated, tempered 1000°F 1hr.

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Thermal Treatments

Annealing: Heat to 1650°F (900°C), hold 2 hrs., slow cool no faster than 25°F (15°C) per hour to 1200°F (650°C), then furnace cool or cool in still air to room temperature. Crucible 154 CM can be cycle annealed by heating to 1600°F (900°C), hold 2 hrs., cool to 1300°F (704°C), hold 4 hrs., then air cool.

Annealed Hardness: About BHN 235

Stress Relieving

Annealed Parts: Heat to 1100-1300°F (595-705°C), hold 2 hours, then furnace cool or cool in still air.

Hardened Parts: Heat to 25-50°F (15-30°C) below the original tempering temperature, hold 2 hours, then furnace cool or cool in still air.

Hardening

Preheat: Heat to 1400°F (760°C) Equalize.

Austenitize: 1900-2000°F (1037-1093°C), hold time at temperature 30-60 minutes.

Quench: Oil or positive pressure (4 bar minimum) to below 125°F (50°C), or salt quench to about 1000°F (540°C), then air cool to below 125°F (50°C). Salt bath treatment, if practical, will ensure the maximum attainable toughness for a given hardening treatment.

Temper: Twice at 400-1200°F (204-650°C), 2 hours minimum each time.

Note: As with all martensitic stainless steels, tempering at 800-1100°F (425-600°C) will result in sensitization which causes a minor reduction in both corrosion resistance and toughness. We recommend that this tempering range be avoided.

Aim hardness: HRC 55-62

Note: Properties shown throughout this data sheet are typical values. Normal variations in chemistry, size and heat treat conditions may cause deviations from these values. For additional data or metallurgical engineering assistance, consult your local Crucible Service Center.

Service Center Locations

| Location | Phone | Toll Free | FAX |
|------------------|--------------|--------------|--------------|
| Auburn, MA | 508-832-5353 | 800-365-1101 | 508-832-2217 |
| Charlotte, NC | 704-372-3073 | 800-365-1160 | 704-342-0985 |
| Chicago, IL | 630-378-0093 | 800-365-1151 | 630-378-1965 |
| Cincinnati, OH | 513-771-1310 | 800-365-1163 | 513-771-0119 |
| Cleveland, OH | 330-562-3131 | 800-365-1132 | 330-562-7818 |
| Columbus, OH | 614-2624959 | 800-365-1131 | 614262-7850 |
| Dallas, TX | 817-6492800 | 800-365-1168 | 817-633-8142 |
| Detroit, MI | 248-528-0332 | 800-365-1133 | 248-528-1977 |
| Grand Rapids, MI | 616-554-9699 | 800-365-1137 | 616-554-9328 |
| Huntsville, AL | 256-772-0201 | 800-365-1161 | 256-772-3361 |
| Indianapolis, IN | 317-638-4501 | 800-365-1146 | 317-634-7375 |
| Los Angeles, CA | 323-775-7344 | 800-365-1179 | 310-830-9784 |



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Heat Treat Response

| Hardness HRC | | | | | | |
|---------------------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|
| Austenitizing Temperature | | | | | | |
| Tempering Temperature | 1900°F (1038°C) | | 1950°F (1065°C) | | 2000°F (1093°C) | |
| Time at Temp. | 1 hr. | | 1 hr. | | 30 min. | |
| Quench (*Optional Freeze) | Oil & Freeze | Oil & Freeze | Oil & Freeze | Oil & Freeze | Oil & Freeze | Oil & Freeze |
| As Quenched | 62 | 63 | 61 | 63 | 54 | 63 |
| 400°F (204°C) | 59 | 60 | 59 | 62 | 52 | 62 |
| 600°F (315°C) | 56 | 59 | 56 | 60 | 50 | 60 |
| 800°F (427°C) | 56 | 56 | 57 | 60 | 50 | 61 |
| 900°F (482°C) | 56 | 57 | 58 | 61 | 52 | 61 |
| 1000°F (540°C) | 54 | 58 | 60 | 61 | 54 | 63 |
| 1050°F (565°C) | 51 | 52 | 55 | 56 | 52 | 58 |
| 1100°F (593°C) | 47 | 48 | 47 | 48 | 49 | 51 |
| 1200°F (649°C) | 43 | 44 | 45 | 46 | 45 | 47 |
| Time at Temp. | 2 hrs. | | 2 hrs. | | 2 hrs. | |
| No. of Tempers | 2 | | 2 | | 2 | |

Results may vary with hardening method and section size. Salt or oil quenching will give maximum response. Vacuum or atmosphere cooling may result in up to 1-2 HRC points lower.

Recommended Heat Treat Practice

To completely transform any retained austenite, a freezing treatment with dry ice at -100°F (-74°C) is recommended either after the quench or in between the two tempers. The freezing treatment is most effective right out of the quench, however complex parts with sharp corners are more safely frozen between the two tempers. Thin sections can be successfully quenched in forced air and will obtain results to those in the table above.

Surface Treatments

If surface treatments such as CVD, PVD, or nitriding are used, ensure that the coating process temperature is below the tempering temperature.

Note: Nitriding will reduce the corrosion resistance of Crucible 154 CM or any other stainless steel.

| Location | Phone | Toll Free | FAX |
|----------------------|-----------------|--------------|-----------------|
| Meadville, PA | 814-337-8804 | 800-365-0530 | 814-337-8808 |
| Milwaukee, WI | 262-781-6710 | 800-242-0948 | 262-781-6743 |
| Minneapolis, MN | 612-331-6320 | 800-365-1153 | 612-331-4137 |
| St. Louis, MO | 636-272-7220 | 877-201-4049 | 636-978-9559 |
| Canada | | | |
| Wallaceburg, ONT | 519-627-2245 | 800-265-5293 | 519-627-2247 |
| Mexico (SISA) | | | |
| Monterrey, N.L. | 52-818-351-7220 | | 52-818-351-2981 |
| Naucalpan, E de M | 52-555-576-4011 | | 52-555-360-1865 |

CRUCIBLE SERVICE CENTERS DIVISIONAL HEADQUARTERS:

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