isovac®




# isovac 420-65 K HE

## The specialist for shorter final annealing times

Production in modern continuous annealing lines ensures that this semi-processed isovac® grade exhibits homogeneous mechanical and magnetic properties. High dimensional accuracy and defined degrees of roughness guarantee best punchability and further processing. isovac 420-65 K HE (high-efficiency) is highly decarbonized in as-delivered condition, which means that the final annealing time at the customer can be significantly shortened. Subsequent annealing at the customer for the purpose of adjusting optimum magnetic properties completely eliminates any mechanical damage introduced to the material during the punching process.

**Convincing advantages:**

- Shorter final annealing made possible by the low carbon content and thus reduced overall costs resulting from lower energy input
- Best processability through consistent mechanical properties and homogeneous, clean surfaces with defined roughness
- Excellent stackability resulting from high dimensional accuracy (thickness tolerance)

voestalpine supplies isovac 420-65 K HE, an electrical steel of the highest quality. We offer you a customer-focused overall package of products, service and logistics in addition to all the advantages of our integrated metallurgical facility and Steel Service Centers.

## Grade named according to conventional international standards:

| Grade named according to isovac® | DIN EN 10341 | | DIN EN 10126 DIN EN 10165 | IEC/CEI 60404-8-3 | ASTM A 683 M | ASTM A 683 | AISI | IS15391 |
|---|---|---|---|---|---|---|---|---|
| | Material No. | Abbreviation | | | | | | |
| isovac 420-65 K HE | 1.0847 | M 450-65 K | M 450-65 E | 450-65 K5 | 64S573M | 64S260 | - | 65-SP-450 E5 |

## Mechanical properties:

Tensile test according to DIN EN ISO 6892-1 and hardness according to DIN EN ISO 6507-1 (Typical values);
Test direction: Transverse

| Grade named according to isovac® | 0.2 %-Yield strength $R_{p0.2}$ [MPa] | Tensile strength $R_m$ [MPa] | Elongation $A_{80}$ [%] | Hardness HV5 [-] |
|---|---|---|---|---|
| isovac 420-65 K HE | 450 | 490 | 18 | 185 |

## Magnetic properties:

after final annealing according to EN 10341 (Typicyal values);
Test direction: Mean value from longitudinal and transverse measurements at 50 Hz (60 Hz), single-sheet test

| | Specific total loss | | | | Magnetic polarization | | | Relative permeability |
|---|---|---|---|---|---|---|---|---|
| | 1.0 T P10 | | 1.5 T P15 | | 2500 A/m J25 | 5000 A/m J50 | 10000 A/m J100 | 1.5 T $\mu_r$ |
| Grade named according to isovac® | 50 Hz [W/kg] | 60 Hz [W/lb] | 50 Hz [W/kg] | 60 Hz [W/lb] | [T] | [T] | [T] | [-] |
| isovac 420-65 K HE | 1.50 | 0.89 | 3.70 | 2.18 | 1.59 | 1.67 | 1.79 | 1300 |

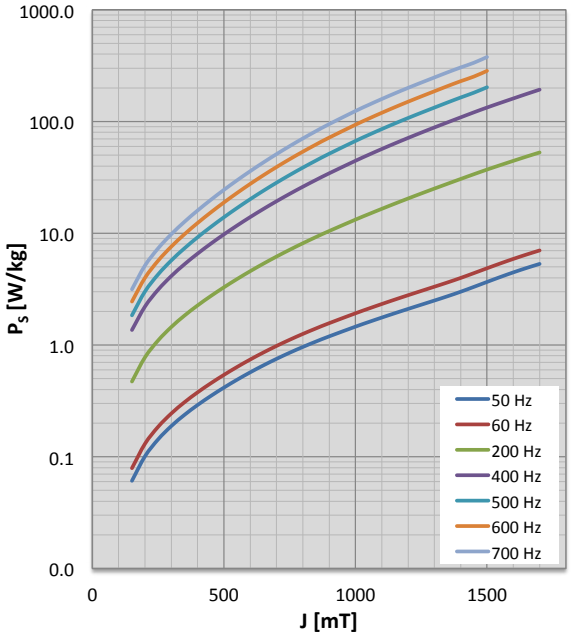
## Physical properties:

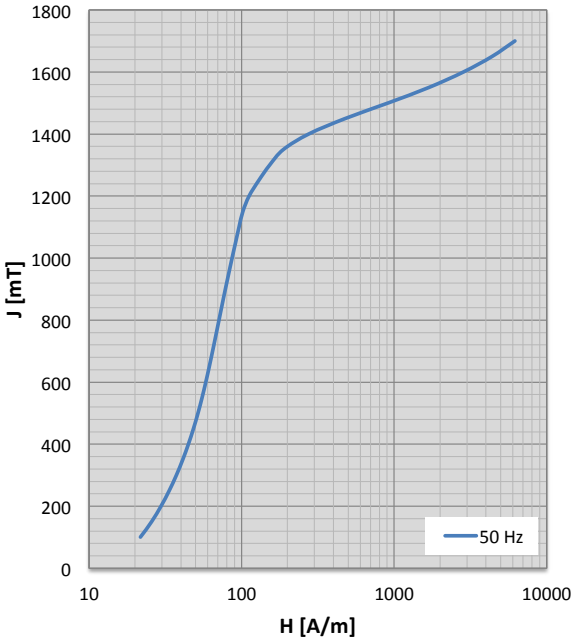
Typical values

| Grade named according to isovac® | Density ρ [g/cm³] | Specific electrical resistance $\rho_s$ [µΩcm] | Thermal conductivity λ [W/mK] |
|---|---|---|---|
| isovac 420-65 K HE | 7.75 | 38.5 | 30 |

### Characteristics $P_s$/J loss curve and characteristics J/H magnetization curve

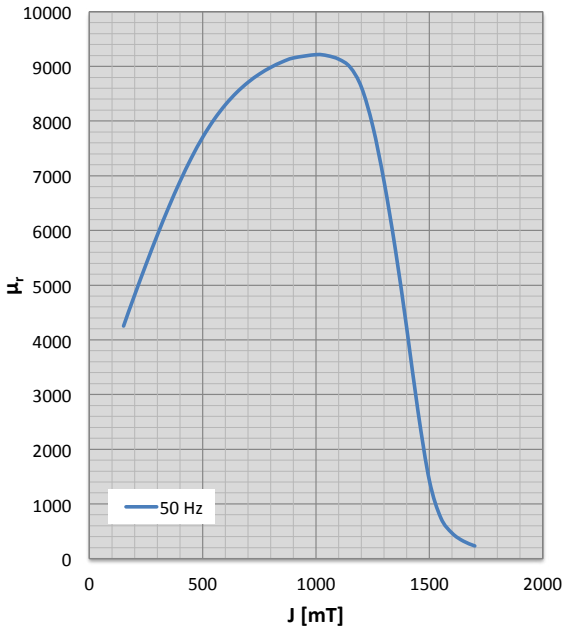
Test direction: Mean value from longitudinal and transverse measurements at indicated frequencies, single-sheet test




### Characteristics $\mu_r$/J permeability curve

Test direction: Mean value from longitudinal and transverse measurements at 50 Hz, single-sheet test



## Frequency dependence of magnetic properties

Test direction: Mean value longitudinal and transverse at indicated frequencies and polarizations, single-sheet test

| 50 Hz | | | | 60 Hz | | | | 200 Hz | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| J [mT] | H [A/m] | $P_s$ [W/kg] | $\mu_r$ [-] | J [mT] | H [A/m] | $P_s$ [W/kg] | $\mu_r$ [-] | J [mT] | H [A/m] | $P_s$ [W/kg] | $\mu_r$ [-] |
| 100 | 22 | 0.02 | 3671 | 100 | 22 | 0.03 | 3653 | 100 | 29 | 0.17 | 2718 |
| 150 | 26 | 0.06 | 4251 | 150 | 26 | 0.08 | 4184 | 150 | 37 | 0.47 | 2987 |
| 200 | 30 | 0.10 | 4824 | 200 | 30 | 0.13 | 4708 | 200 | 44 | 0.78 | 3252 |
| 250 | 34 | 0.14 | 5382 | 250 | 35 | 0.19 | 5219 | 250 | 52 | 1.10 | 3505 |
| 300 | 37 | 0.19 | 5919 | 300 | 39 | 0.24 | 5709 | 300 | 59 | 1.45 | 3743 |
| 350 | 41 | 0.24 | 6427 | 350 | 43 | 0.31 | 6173 | 350 | 67 | 1.83 | 3960 |
| 400 | 45 | 0.29 | 6899 | 400 | 47 | 0.38 | 6602 | 400 | 74 | 2.26 | 4150 |
| 450 | 48 | 0.35 | 7328 | 450 | 51 | 0.45 | 6990 | 450 | 82 | 2.74 | 4309 |
| 500 | 52 | 0.42 | 7706 | 500 | 54 | 0.54 | 7331 | 500 | 90 | 3.28 | 4430 |
| 550 | 55 | 0.49 | 8029 | 550 | 58 | 0.64 | 7620 | 550 | 98 | 3.89 | 4511 |
| 600 | 58 | 0.57 | 8300 | 600 | 61 | 0.74 | 7859 | 600 | 106 | 4.58 | 4556 |
| 650 | 61 | 0.66 | 8525 | 650 | 65 | 0.86 | 8054 | 650 | 114 | 5.34 | 4568 |
| 700 | 65 | 0.75 | 8709 | 700 | 68 | 0.98 | 8210 | 700 | 123 | 6.19 | 4555 |
| 750 | 68 | 0.85 | 8860 | 750 | 72 | 1.11 | 8332 | 750 | 133 | 7.12 | 4521 |
| 800 | 71 | 0.96 | 8983 | 800 | 76 | 1.26 | 8426 | 800 | 143 | 8.14 | 4471 |
| 850 | 75 | 1.07 | 9081 | 850 | 80 | 1.41 | 8494 | 850 | 153 | 9.25 | 4410 |
| 900 | 78 | 1.20 | 9155 | 900 | 84 | 1.57 | 8540 | 900 | 165 | 10.47 | 4340 |
| 1000 | 87 | 1.46 | 9215 | 1000 | 93 | 1.92 | 8561 | 1000 | 191 | 13.25 | 4175 |
| 1050 | 91 | 1.61 | 9195 | 1050 | 98 | 2.12 | 8538 | 1050 | 205 | 14.82 | 4082 |
| 1100 | 96 | 1.76 | 9131 | 1100 | 103 | 2.33 | 8497 | 1100 | 219 | 16.54 | 3991 |
| 1150 | 102 | 1.93 | 8986 | 1150 | 108 | 2.55 | 8423 | 1150 | 234 | 18.42 | 3903 |
| 1200 | 112 | 2.10 | 8619 | 1200 | 117 | 2.79 | 8212 | 1200 | 252 | 20.47 | 3787 |
| 1250 | 129 | 2.29 | 7907 | 1250 | 131 | 3.05 | 7743 | 1250 | 276 | 22.69 | 3640 |
| 1300 | 153 | 2.50 | 6891 | 1300 | 152 | 3.32 | 6920 | 1300 | 289 | 25.11 | 3579 |
| 1350 | 188 | 2.73 | 5644 | 1350 | 187 | 3.63 | 5698 | 1350 | 288 | 27.73 | 3635 |
| 1400 | 275 | 3.00 | 4207 | 1400 | 275 | 3.98 | 4211 | 1400 | 330 | 30.61 | 3378 |
| 1450 | 478 | 3.31 | 2678 | 1450 | 474 | 4.40 | 2671 | 1450 | 497 | 33.76 | 2475 |
| 1500 | 912 | 3.67 | 1422 | 1500 | 908 | 4.86 | 1428 | 1500 | 915 | 37.13 | 1422 |
| 1550 | 1687 | 4.06 | 746 | 1550 | 1693 | 5.36 | 752 | 1550 | 1695 | 40.67 | 772 |
| 1600 | 2845 | 4.47 | 465 | 1600 | 2863 | 5.89 | 463 | 1600 | 2871 | 44.46 | 461 |
| 1650 | 4383 | 4.89 | 318 | 1650 | 4409 | 6.45 | 312 | 1650 | 4429 | 48.54 | 299 |
| 1700 | 6190 | 5.32 | 231 | 1700 | 6221 | 7.02 | 226 | 1700 | 6258 | 52.84 | 215 |

## Frequency dependence of magnetic properties

Test direction: Mean value longitudinal and transverse at indicated frequencies and polarizations, single-sheet test

| 400 Hz | | | | 500 Hz | | | | 600 Hz | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| J [mT] | H [A/m] | $P_s$ [W/kg] | $\mu_r$ [-] | J [mT] | H [A/m] | $P_s$ [W/kg] | $\mu_r$ [-] | J [mT] | H [A/m] | $P_s$ [W/kg] | $\mu_r$ [-] |
| 100 | 40 | 0.54 | 2003 | 100 | 43 | 0.72 | 1870 | 100 | 47 | 0.97 | 1689 |
| 150 | 50 | 1.36 | 2183 | 150 | 54 | 1.84 | 2015 | 150 | 60 | 2.45 | 1812 |
| 200 | 61 | 2.21 | 2357 | 200 | 66 | 3.02 | 2156 | 200 | 74 | 4.00 | 1930 |
| 250 | 71 | 3.13 | 2523 | 250 | 78 | 4.29 | 2289 | 250 | 88 | 5.69 | 2040 |
| 300 | 82 | 4.14 | 2673 | 300 | 91 | 5.71 | 2407 | 300 | 102 | 7.60 | 2139 |
| 350 | 94 | 5.28 | 2805 | 350 | 104 | 7.34 | 2508 | 350 | 118 | 9.80 | 2221 |
| 400 | 106 | 6.58 | 2913 | 400 | 118 | 9.21 | 2586 | 400 | 134 | 12.36 | 2282 |
| 450 | 118 | 8.06 | 2992 | 450 | 134 | 11.38 | 2637 | 450 | 152 | 15.36 | 2320 |
| 500 | 131 | 9.77 | 3037 | 500 | 150 | 13.91 | 2657 | 500 | 171 | 18.87 | 2330 |
| 550 | 145 | 11.73 | 3046 | 550 | 167 | 16.83 | 2643 | 550 | 192 | 22.95 | 2309 |
| 600 | 160 | 13.96 | 3023 | 600 | 186 | 20.19 | 2600 | 600 | 215 | 27.66 | 2263 |
| 650 | 176 | 16.49 | 2976 | 650 | 207 | 24.01 | 2536 | 650 | 239 | 33.04 | 2198 |
| 700 | 193 | 19.34 | 2910 | 700 | 229 | 28.35 | 2457 | 700 | 266 | 39.15 | 2121 |
| 750 | 211 | 22.53 | 2834 | 750 | 253 | 33.23 | 2372 | 750 | 294 | 46.02 | 2039 |
| 800 | 231 | 26.09 | 2754 | 800 | 279 | 38.68 | 2286 | 800 | 325 | 53.72 | 1959 |
| 850 | 253 | 30.03 | 2675 | 850 | 306 | 44.75 | 2206 | 850 | 358 | 62.28 | 1886 |
| 900 | 276 | 34.39 | 2597 | 900 | 335 | 51.47 | 2132 | 900 | 393 | 71.76 | 1820 |
| 1000 | 326 | 44.52 | 2443 | 1000 | 399 | 66.99 | 1996 | 1000 | 468 | 93.60 | 1701 |
| 1050 | 353 | 50.37 | 2365 | 1050 | 433 | 75.87 | 1932 | 1050 | 508 | 106.06 | 1645 |
| 1100 | 383 | 56.76 | 2289 | 1100 | 468 | 85.56 | 1870 | 1100 | 550 | 119.63 | 1593 |
| 1150 | 414 | 63.71 | 2216 | 1150 | 505 | 96.09 | 1811 | 1150 | 593 | 134.40 | 1543 |
| 1200 | 446 | 71.28 | 2143 | 1200 | 544 | 107.50 | 1755 | 1200 | 639 | 150.38 | 1496 |
| 1250 | 478 | 79.52 | 2069 | 1250 | 585 | 119.81 | 1701 | 1250 | 686 | 167.66 | 1450 |
| 1300 | 516 | 88.48 | 2005 | 1300 | 627 | 133.21 | 1649 | 1300 | 735 | 186.44 | 1407 |
| 1350 | 562 | 98.24 | 1954 | 1350 | 678 | 148.07 | 1600 | 1350 | 792 | 207.39 | 1364 |
| 1400 | 595 | 108.96 | 1873 | 1400 | 721 | 164.06 | 1545 | 1400 | 843 | 229.60 | 1321 |
| 1450 | 640 | 120.77 | 1705 | 1450 | 759 | 181.05 | 1455 | 1450 | 890 | 252.43 | 1268 |
| 1500 | 933 | 133.38 | 1387 | 1500 | 1009 | 202.52 | 1227 | 1500 | 1085 | 283.86 | 1114 |
| 1550 | 1695 | 146.60 | 905 | | | | | | | | |
| 1600 | 2904 | 160.79 | 452 | | | | | | | | |
| 1650 | 4471 | 176.31 | 211 | | | | | | | | |
| 1700 | 6281 | 192.81 | 148 | | | | | | | | |

## Frequency dependence of magnetic properties

Test direction: Mean value longitudinal and transverse at indicated frequencies and polarizations, single-sheet test

| 700 Hz | | | |
|---|---|---|---|
| J [mT] | H [A/m] | $P_s$ [W/kg] | $\mu_r$ [-] |
| 150 | 66 | 3.15 | 1662 |
| 200 | 81 | 5.15 | 1762 |
| 250 | 97 | 7.34 | 1855 |
| 300 | 113 | 9.81 | 1938 |
| 350 | 130 | 12.67 | 2006 |
| 400 | 149 | 16.00 | 2056 |
| 450 | 169 | 19.90 | 2085 |
| 500 | 191 | 24.46 | 2089 |
| 550 | 214 | 29.79 | 2066 |
| 600 | 240 | 35.95 | 2020 |
| 650 | 268 | 43.03 | 1958 |
| 700 | 299 | 51.10 | 1885 |
| 750 | 332 | 60.24 | 1808 |
| 800 | 368 | 70.52 | 1732 |
| 850 | 406 | 82.03 | 1662 |
| 900 | 447 | 94.78 | 1598 |
| 1000 | 535 | 124.16 | 1488 |
| 1050 | 581 | 140.85 | 1438 |
| 1100 | 629 | 159.00 | 1392 |
| 1150 | 679 | 178.72 | 1349 |
| 1200 | 730 | 199.99 | 1307 |
| 1250 | 785 | 222.87 | 1268 |
| 1300 | 840 | 247.81 | 1232 |
| 1350 | 911 | 275.47 | 1186 |
| 1400 | 970 | 304.69 | 1149 |
| 1450 | 988 | 335.44 | 1143 |
| 1500 | 1162 | 377.65 | 1029 |

## Available Dimensions

| Grade named according to isovac® | Delivery form | Width [mm] | Length [mm] |
|---|---|---|---|
| isovac 420-65 K HE | Wide strip / Slit strip | 19 – 1600 | - |
| | Cut-to-length sheets | 300 – 1600 | 300 – 5000 |



Please find further information and downloadable files at
www.voestalpine.com/isovac

**voestalpine Stahl GmbH**
voestalpine-Straße 3
4020 Linz, Austria
T. +43/50304/15-8018
produktmanagement@voestalpine.com
www.voestalpine.com/isovac

voestalpine
ONE STEP AHEAD.