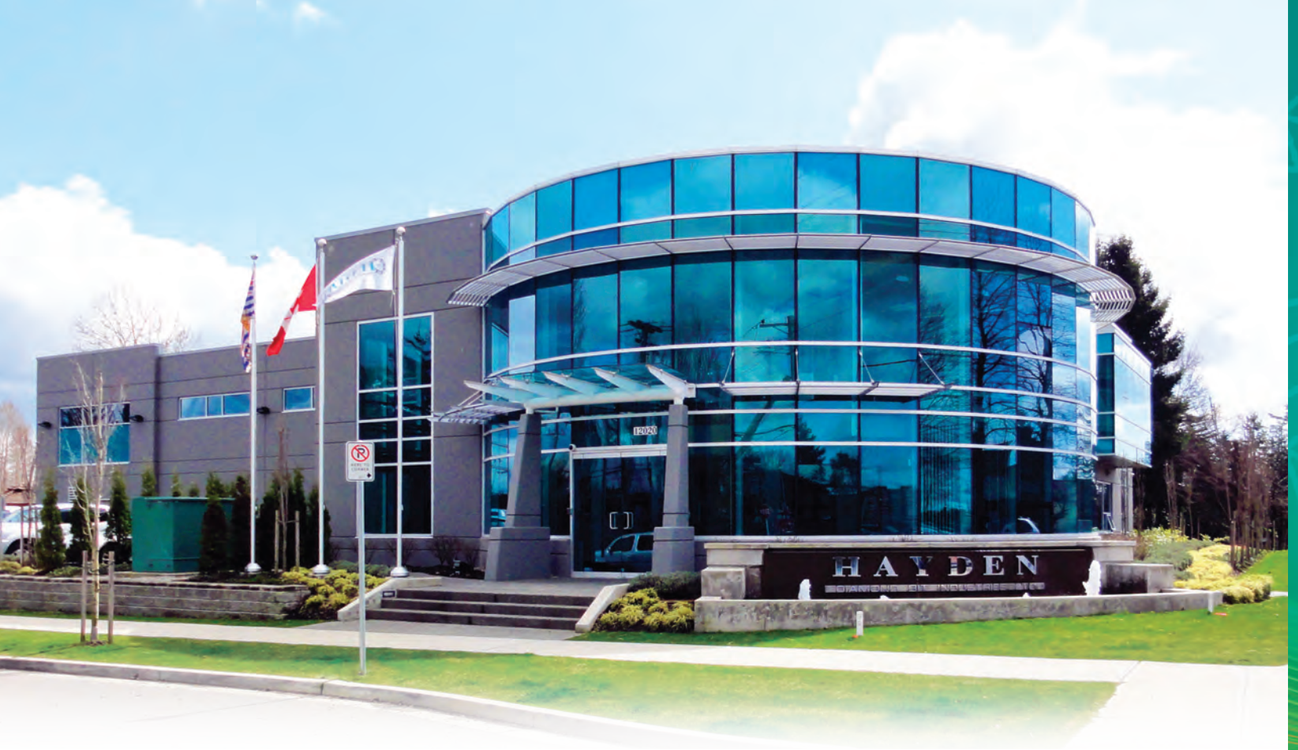


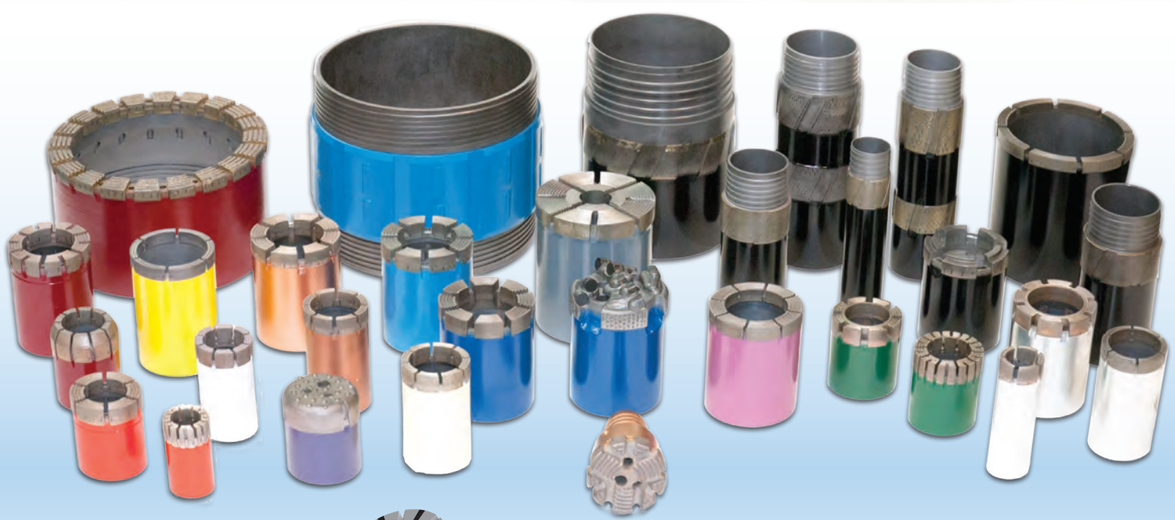

# HAYDEN
DIAMOND BIT INDUSTRIES LTD.

## HEAD OFFICE AND MANUFACTURING PLANT

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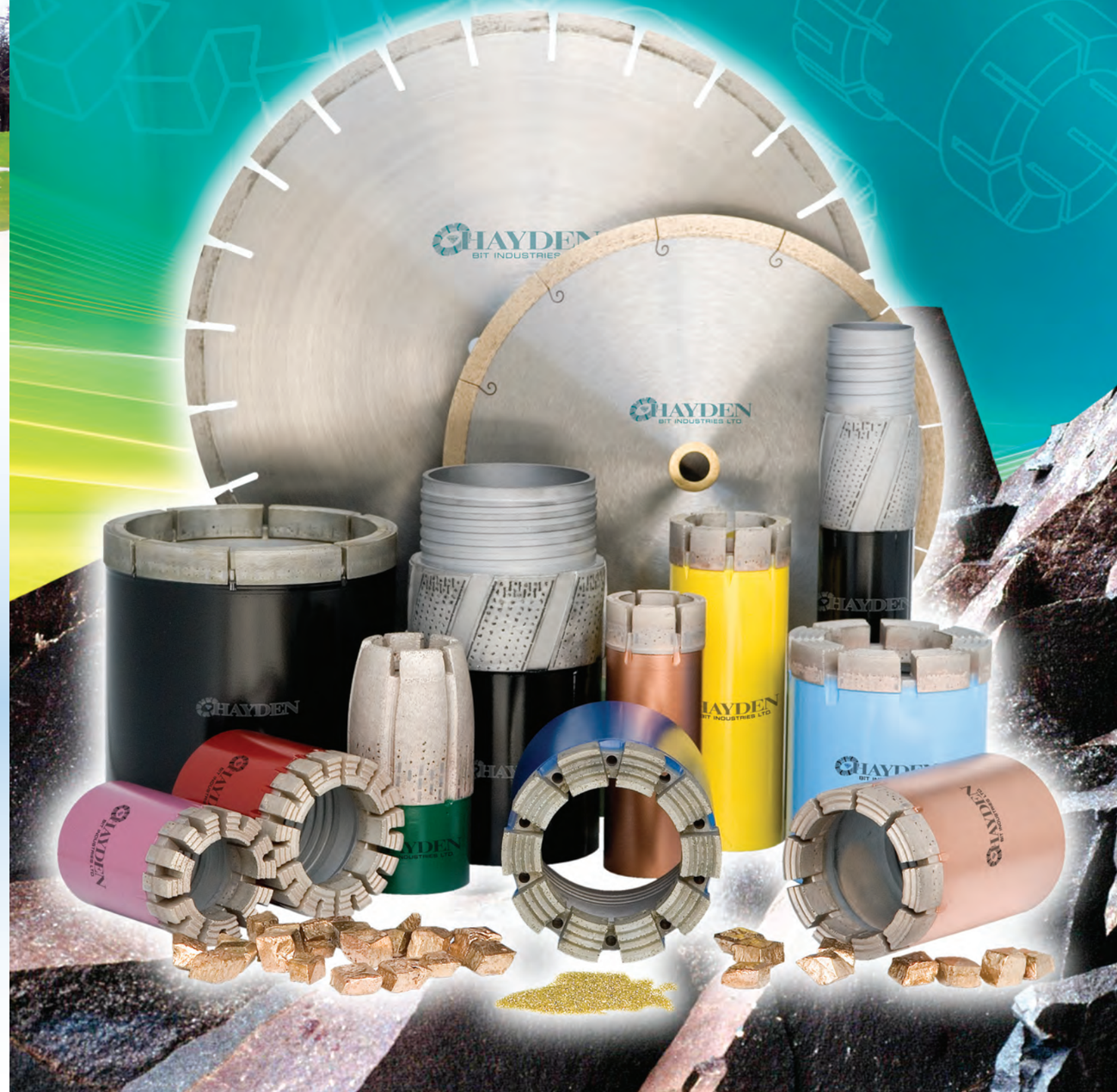


*"Hayden is capable of designing and manufacturing diamond coring bits to the customer specifications and world's exploration industry."*

## HAYDEN

A young and dynamic company founded in 2001.

The personnel at **HAYDEN** have experience in the mining industry going back to the early 1960's. Their expertise in designing, engineering and manufacturing has placed **HAYDEN** in the forefront of drill bit technology.

Using sophisticated, state of the art furnacing techniques and experts in powder metallurgy, has enabled **HAYDEN** to manufacture a broad range of matrices to achieve the best possible bonds for every day drilling demands.

**HAYDEN** has a continuing commitment to Research and Development. We are constantly striving to improve our products and test new matrices and innovative designs. Quality control is our assurance of consistent products, and is of paramount importance to our manufacturing facility.

**HAYDEN** ensures the product arrives when and where it is needed. The **HAYDEN** team is dedicated to provide outstanding service and meaningful relationship with customers.

**HAYDEN'S** manufacturing plant and Head Office is in Vancouver, British Columbia. Sales Offices in Eastern Canada, the United States and Mexico with services to North and South America and overseas markets.

## IMPREGNATED DIAMOND DRILL BITS

**HAYDEN** impregnated diamond bits are manufactured using high quality raw materials for optimum drilling performance. As a result of more than 40 years of experience in the drilling industry, HAYDEN can recommend the optimum design for optimum performance in a variety of applications and conditions. Various face profiles, bonds and diamond qualities are available for superior coring performance and longer bit life resulting in fewer trips in and out of the hole, reducing costs and improving production.

## CASING AND ROD SHOES

**HAYDEN'S** range of shoes is the cost efficient solution for drilling the insertion of casing. The tough design and re-enforced ID and OD gauge makes sure the gauge size is maintained in all the abrasive conditions. The impregnated shoes are available in either the VV profile or flat face. The casing and rod shoes are manufactured with quality raw materials to suit the customer's requirements. These are also available in Heavy Duty and Super Duty.

## HAYDEN REAMING SHELLS

Ensure a 360-degree hole wall contact, which maximizes shell stability. Longer life is therefore achieved due to the smoothness of the drilling, and the hole gauge maintained.

The diamond pads are reinforced with tungsten carbide inserts on the leading edge, which reduces the erosion of matrix around the diamonds by forcing the abrasive cuttings up the waterways and not allowing it to travel across the face of the diamond pad.

## FLUID VELOCITY

Fluid flow is another critical variable in optimizing drilling efficiency. The fluid must effectively cool the bit and remove the cuttings from the bit face and then transport these cuttings up the annulus of the hole to the surface as efficiently as possible. Fluid volume should be increased as penetration rates increase. The velocity of the fluid and its carrying ability of the cuttings depend on the fluid viscosity. Generally, cuttings should always have an upward velocity of 4 in/sec. (10 cm/sec).

## MATRIX RANGE-EASE OF SELECTION

**HAYDEN** uses a number reference guide (Hayden 1–15), corresponding to the matrix hardness for ease of selection. (HAYDEN 1 being the hardest matrix and **HAYDEN** 15 being the softest.) The higher the number, the harder, finer grained, more competent and non-abrasive the rock type the bit is capable of drilling. Conversely, the lower the number selected the more broken, fractured coarser grained and abrasive a formation the bit is capable of drilling.

We manufacture slight variances of the standard matrices to fine-tune the bits' performance considering the drill rig capabilities and formations being encountered.

## ENGINEERING

**HAYDEN** engineers have expertise, experience and designed specialized bits for:

- Deep hole mineral exploration
- Scientific drilling programs
- Offs-shore projects
- Quality control and technology

Using precise techniques to ensure the product is designed to the customers specifications. **HAYDEN** engineers establish the objectives and criteria of the application and through synthesis, analysis, construction, testing and evaluation begin to design the bit. With the addition of computer aided design (or CAD) and high speed CNC machining **HAYDEN** is able to design and manufacture bits with the upmost of precision and efficiency.

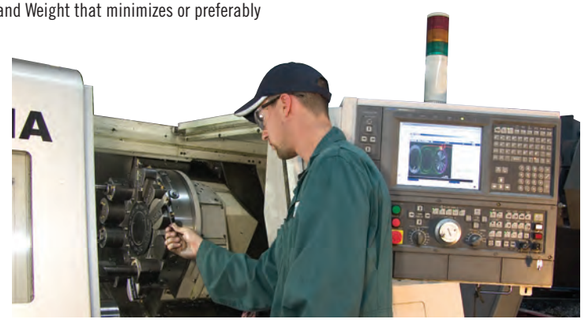
**HAYDEN** engineers continue to explore areas and methods of identifying new product opportunities and manufacturing processes to rapidly bring new products to the ever growing market.

| | HIGH (SOFTER ROCK) | | | | | MEDIUM ROCK | | | | | LOW (HARD ROCK) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MATRIX** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12–14** | **15** | **16** |
| OVERBURDEN | GREY | | | | | | | | | | | | | |
| HOLE OBSTRUCTIONS | | | | | | | | | | | | | | |
| ABRASIVE SANDSTONE | | BLACK | | | | | | | | | | | | |
| BROKEN ABRASIVE ROCK TYPE | | | LIGHT BLUE | | | | | | | | | | | |
| SANDY SHALES | | | | BLUE | | | | | | | | | | |
| PYROXENITE | | | | | YELLOW | | | | | | | | | |
| NORITE | | | | | | GREEN | | | | | | | | |
| GABBRO | | | | | | | RED | | | | | | | |
| DIABASE | | | | | | | | ORANGE | | | | | | |
| DOLERITE | | | | | | | | | | | | | | |
| MICA SCHIST | | | | | | | | | | | | | | |
| SISTSTONE | | | | | | | | | | | | | | |
| GRANITE | | | | | | | | | | | | | | |
| HEMATITE | | | | | | | | | COPPER | | | | | |
| BASALT | | | | | | | | | | | | | | |
| HARD QUARTZITE | | | | | | | | | | SILVER | | | | |
| QUARTZ CONGLOMERITE | | | | | | | | | | | VIOLET | | | |
| BANDED IRONSTONE | | | | | | | | | | | | GOLD | | |
| TACONITE | | | | | | | | | | | | | WHITE | CREAM |
| GLASSY QUARTZ | | | | | | | | | | | | | | |
| CHERT | | | | | | | | | | | | | | |

## STRING STABILITY

In all recommended operating parameters it is important to select a combination of RPM and Weight that minimizes or preferably eliminates drill string vibration. Factors contributing to drill string vibration are:

- Misalignment of the drill string with the hole
- Excessive bit weight or rotation speed
- Operating within critical ranges of the drill string
- Oversize annulus
- Bent core barrel or rods



## ROTATIONAL SPEED RELATIVE TO PENETRATION (RPI)

Optimum rotational speeds depend on the formation types being drilled and inter-relationship between the rig capabilities, peripheral equipment being used, and the individual drilling styles.

RPI (revolutions per inch) is singularly the most important factor to consider when trying optimizing bit life and productivity. It is a ratio of the rotational speed (rpm) to the penetration rate. (If the RPI is too low, premature diamond loss from the matrix is very likely. Conversely, if the RPI is too high, it is very likely that the diamonds will become polished and penetration rates will fall off.)

Maintaining a good RPI ensures that the diamonds stay exposed and that the bit wears at an even and controlled rate. Ideally, the RPI should be between 200-250 for impregnated drill bits. Factors such as drill string vibration or rig constraints might prevent operating within an optimum RPI range, in which case a lower ratio should be used to optimize the bits performance under adverse drilling conditions.

## BIT WEIGHT

The weight applied to the drill bit is the other important variable in optimizing bit life and achieving a desired RPI. The weight has to be sufficient to maintain a rate of advance relative to the rotational speed (to keep the bit penetrating), as indicated by the RPI factor. However, a weight that is too high can cause diamond re-impregnation or rapid wear due to stripping or even a mechanical failure of the matrix. Too low of a weight often leads to the diamonds becoming polished, requiring the matrix to be stripped to expose a new layer of diamonds.

Ideally, the matrix being used performs best when it wears at the same rate as the diamonds. If the matrix requires continuous stripping to achieve an acceptable penetration rate, then a softer matrix (higher HAYDEN number) should be used.

As a guideline, the weight on an impregnated bit should never exceed 2000-2500 psi or (1378 N/cm$^2$-1723 N/cm$^2$).

### OPERATING RECOMMENDATIONS TABLE

| BIT SIZE | ROTATION | RPI RANGE | KERF AREA | | BIT WEIGHT RANGE | | FLUID VOLUME RANGE / min. | |
|---|---|---|---|---|---|---|---|---|
| | | | INCHES | CM | LBS | KN | US Gal. | Liters |
| LTK (46 mm) | 1500-2500 | 200-250 | 1.099 | 7.09 | 1000-3000 | 4.5-13.25 | 2.5-3.5 | 9.5-13.5 |
| JTK (48 mm) | 1500-2500 | 200-250 | 1.289 | 8.32 | 1000-3000 | 4.5-13.25 | 2.5-3.5 | 9.5-13.5 |
| AW34 | 1500-2500 | 200-250 | 1.438 | 9.28 | 1000-3000 | 4.5-13.25 | 2.5-3.5 | 9.5-13.5 |
| AWL | 1000-2000 | 200-250 | 1.920 | 12.39 | 2000-5000 | 8.9-22.25 | 4-5 | 15-16 |
| BW44 | 1000-2000 | 200-250 | 1.955 | 12.62 | 2000-4000 | 8.9-17.75 | 3-4 | 13-17 |
| BWL | 800-1600 | 200-250 | 2.763 | 17.86 | 2000-5000 | 9.0-22.25 | 6-8 | 23-30 |
| NWL | 600-1400 | 200-250 | 4.214 | 27.19 | 3000-6000 | 13.25-26 | 8-10 | 30-38 |
| CHD76 | 600-1400 | 200-250 | 4.670 | 30.13 | 3000-6000 | 13.25-26 | 8-10 | 30-38 |
| HWL | 400-1200 | 200-250 | 6.325 | 40.81 | 4000-8000 | 17.75-35 | 10-12 | 38-46 |
| CHD101 | 400-1200 | 200-250 | 7.532 | 48.60 | 4000-8000 | 17.75-35 | 10-14 | 38-46 |
| PWL | 300-800 | 200-250 | 9.512 | 61.37 | 5000-10,000 | 22.45-44 | 18-23 | 68-87 |
| CHD134 | 300-800 | 200-250 | 13.074 | 84.35 | 5000-10,000 | 22.45-44 | 18-23 | 68-87 |

### STANDARD DIAMOND SET DIMENSIONS

| BIT DESCRIPTION | SET BIT DIMENSIONS (+/-.005) | | | | REAMING SHELL DIMENSIONS (+/-.005) | |
|---|---|---|---|---|---|---|
| | OUTSIDE DIAMETER | | INSIDE DIAMETER | | OUTSIDE DIAMETER | |
| | INCHES | MM | INCHES | MM | INCHES | MM |
| RTW, RWG | 1.175 | 29.8 | 0.735 | 18.7 | 11.172 | 29.800 |
| EWD3 | 1.485 | 37.7 | 0.835 | 21.2 | 1.485 | 37.700 |
| EWG, EW, EWL | 1.485 | 37.7 | 0.845 | 21.5 | 1.485 | 37.700 |
| EWT, EWK, EXT, EXK | 1.485 | 37.7 | 0.905 | 23.0 | 1.485 | 37.700 |
| EIW, EIWS, EIX, EIXS | 1.485 | 37.7 | 0.995 | 25.3 | 1.485 | 37.700 |
| TT46MM / LTK46MM | 1.811 | 46.0 | 1.389 | 35.3 | 1.823 | 46.300 |
| AWC / S | 2.345 | 59.6 | 1.900 | 48.3 | | |
| ADBGM, ATW | 1.875 | 47.6 | 1.193 | 30.3 | 1.890 | 48.000 |
| ATK | 1.875 | 47.6 | 1.201 | 30.5 | 1.890 | 48.000 |
| AWT, AXT | 1.875 | 47.6 | 1.281 | 32.5 | 1.890 | 48.000 |
| AW34 | 1.875 | 47.6 | 1.320 | 33.5 | 1.890 | 48.000 |
| LTK / JTK (48MM) | 1.875 | 47.6 | 1.389 | 35.3 | 1.890 | 48.000 |
| TT56MM / LTK56MM | 2.205 | 56.0 | 1.783 | 45.3 | 2.217 | 56.300 |
| LTK60 | 2.345 | 59.6 | 1.735 | 44.1 | 2.360 | 59.900 |
| BWL | 2.345 | 59.6 | 1.433 | 36.4 | 2.360 | 59.900 |
| BTK | 2.345 | 59.6 | 1.601 | 40.7 | 2.360 | 59.900 |
| BWD4, BWD3 | 2.360 | 59.9 | 1.615 | 41.0 | 2.360 | 59.900 |
| BX, BDBGM, BTW | 2.345 | 59.6 | 1.654 | 42.0 | 2.360 | 59.900 |
| BWT, BXT | 2.360 | 59.9 | 1.750 | 44.5 | 2.360 | 59.900 |
| BW44 | 2.360 | 59.9 | 1.755 | 44.6 | 2.360 | 59.900 |
| CHD76 | 2.980 | 75.7 | 1.713 | 43.5 | 2.980 | 75.700 |
| NWL3, NWLTT | 2.965 | 75.3 | 1.775 | 45.1 | 2.980 | 75.700 |
| NWL | 2.965 | 75.3 | 1.875 | 47.6 | 2.980 | 75.700 |
| NW2 | 2.965 | 75.3 | 1.995 | 50.7 | 2.980 | 75.700 |
| NWD4, NWC3 | 2.980 | 75.7 | 2.060 | 52.3 | 2.980 | 75.700 |
| NWG, NWM, NWL | 2.965 | 75.3 | 2.155 | 54.7 | 2.980 | 75.700 |
| NDBGM, NTW | 2.965 | 75.3 | 2.209 | 56.1 | 2.980 | 75.700 |
| NX | 2.965 | 75.3 | 2.155 | 54.7 | 2.980 | 75.700 |
| HWD4, HWD3, HXBWL | 3.650 | 92.7 | 2.400 | 61.1 | 3.650 | 92.700 |
| HWL3, HWLTT | 3.762 | 95.6 | 2.406 | 61.2 | 3.783 | 96.100 |
| HWL | 3.762 | 95.6 | 2.500 | 63.5 | 3.783 | 96.100 |
| CHG101 | 3.980 | 101.3 | 2.500 | 36.5 | 3.980 | 101.300 |
| PWL3, PWLTT | 4.805 | 122.1 | 3.270 | 83.1 | 4.828 | 122.600 |
| PW3 | 4.827 | 122.6 | 3.270 | 83.1 | 4.827 | 122.600 |
| PWL | 4.865 | 122.1 | 3.345 | 85.0 | 4.825 | 122.600 |
| CHD134 | 5.276 | 134.0 | 3.345 | 85.0 | 5.276 | 134.000 |

NOTE: O/D bit sizes for CDDA specifications are 0.015 less except HWL & PWL sizes which are 0.020 less