



Walson Woodburn™

Crafting Perfection, One Die at a Time.

Technical Handbook

An Indo-American Joint Venture.



*The World's Finest Wires
Start Here.*

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About Walson Woodburn Die

CRAFTING PRECISION, BUILDING TRUST

Located in the Diamond capital of the world, *Walson Woodburn is an Indo-American joint venture between Walson (India) and Woodburn (USA)* - a partnership built on over sixty years of combined expertise in precision engineering.

Since 1970, we've shaped a reputation for uncompromising quality, consistency, and performance - making us a trusted name among leading wire and cable manufacturers worldwide.

Every die we craft begins with a deep understanding of our customer's process and ends with flawless performance - delivering results you can measure, and reliability you can feel.

Introduction

Wire drawing is a metal-working process, where by the cross-section of the wire is reduced by pulling the wire through a single or series of drawing dies. The wire is pulled through the die using tensile force. Since wire's volume remains the same, as the diameter of the wire decreases, its length increases. Normally to get desired size of wire, the wire is successively drawn through more than one die.

Wire Drawing Die is a tool, used for drawing metals of different kinds. It utilizes the ductility properties of the metal that is drawn through it. Its primary function is to

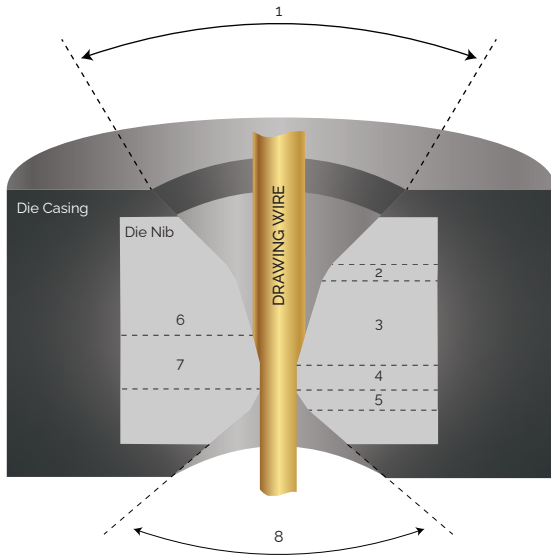
Reduce the diameter (cross-section) of the wire drawn through it.

To improve the surface finish of the wire drawn and

To size (calibrate) accurately the diameter (cross-section) of the wire that is drawn through it.

This book compiles and explains the various technical terminologies commonly used for wire drawing die and in wire drawing process.

Anatomy of Die



1. ENTRANCE ANGLE
2. APPROACH ANGLE
3. REDUCTION ANGLE
4. BEARING LENGTH
5. BACK RELIEF ANGLE
6. CONTACT POINT
7. CONTACT AREA
8. EXIT ANGLE

Inner Profile of Wire Drawing Die

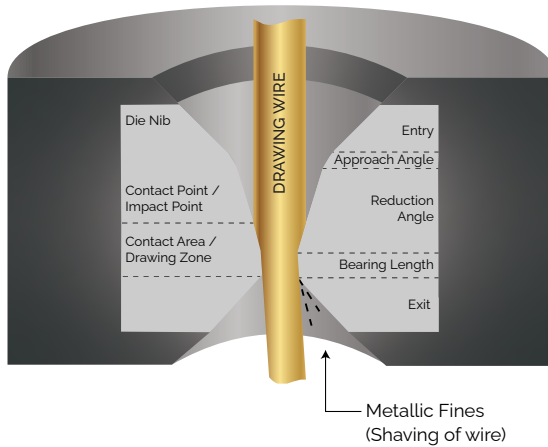
- ENTRANCE ANGLE** As the name suggests, it's the entry point for the wire and lubricant into the die. Its function is to allow easy threading of the wire into the die and to provide access of lubricant into the die. The Entrance Angle should be designed such that the lubricant can easily enter into the drawing area of the die and enables a thin film to form between the die wall and the wire drawn. It should be well blended at the top (with the casing) so that there is no sharp edge at transition.
- APPROACH ANGLE** Its function is to give a smooth transition from the Entrance Angle to the Reduction Angle. This blend also lends itself to keeping the path of the wire and flow of lubrication unrestricted into the heart of the die.
- REDUCTION ANGLE** The actual deformation of wire takes place in this area. The Reduction Angle should be properly designed to allow wire to deform properly especially at higher speeds. It is specified in terms of degrees. Normally, the harder the metal drawn the narrower is the value of the Reduction Angle and just the opposite for softer metals. It is also wider if the reduction percentage of wire is higher. Its design is very critical for proper performance of the die.
- BEARING LENGTH** It is here that the wire is correctly sized (calibrated). It plays a very important role in creating the proper surface finish of the wire drawn. It is specified in terms of percentage (of the die hole size). Its value will depend on the hardness of wire drawn as well as on drawing speeds.

Inner Profile of Wire Drawing Die

- BACK RELIEF ANGLE** It is the highly polished relief area immediately after the Bearing area, for where the wire is exiting. Its primary function is to reduce wire breakage during back-lash when the machine stops, and to avoid formation of metallic-fines during normal drawing process. The drawing below shows the importance of Back Relief Angle.
- CONTACT POINT / IMPACT POINT** It is at this point that the wire first touches the die, and hence the wear is first observed at or slightly below this point of impact.
- CONTACT AREA / DRAWING ZONE** It is this area in the die that the wire actually touches the die, and must be well polished to give longer die life and better surface finish on the wire drawn.
- EXIT ANGLE** As the name suggests, it is the area of the die from where the wire exits the die after it is drawn. It should be designed such, so as to: give enough strength to the die against the mechanical drawing stress of the wire as it passes through the die and to allow easy grabbing of wire while threading into the die.

Importance of Back Relief Angle

Die without Back Relief Angle



Die Profile Tailored For Various Metals

Typical industry accepted standards for Die Profile, for various metals.

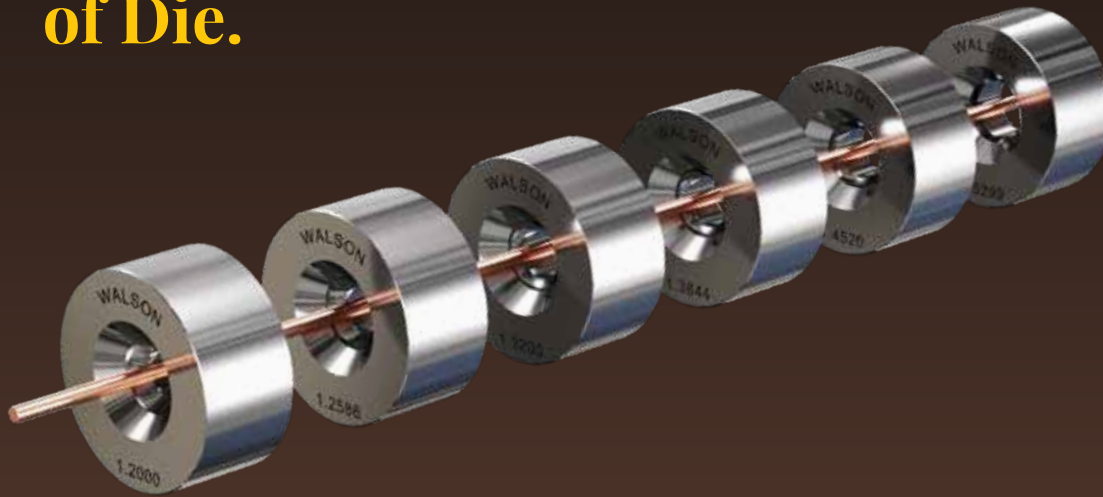
TYPE OF WIRE DRAWN	DEGREE OF BLEND	PCD DIES		NATURAL DIAMOND / SCSD DIES	
		Reduction Angle	Bearing Length	Reduction Angle	Bearing Length
Bare Copper	Well blended	18° ± 2°	30% ± 10%	18° ± 2°	25% ± 10%
Tin or Silver plated Copper	Very Well blended	20° ± 2°	20% ± 10%	20° ± 2°	20% ± 10%
Aluminum EC Grade	Well blended	20° ± 2°	20% ± 10%	18° ± 2°	20% ± 10%
Aluminum Alloy	Slightly blended	16° ± 2°	25% ± 10%	16° ± 2°	25% ± 10%
Stainless Steel	Sharp	14° ± 2°	40% ± 10%	15° ± 2°	35% ± 10%
Tungsten or Molybdenum	Sharp	10° ± 2°	50% ± 10%	10° ± 2°	35% ± 10%

Note: Above values are only indicative and will vary depending on the die draft and machine speeds.

Please contact us for specific die profile.

Blend/Blending (radii of blend) is the transition between the various zones/areas of the die, to allow controlled flow of wire through the die. Typically, for drawing softer metal, the extent of blending is larger and for drawing harder metal, the blending is lesser.

Spectrum of Die.



Natural Diamond Die / SCSD Die

Natural Diamond dies have been a main component of the Walson Woodburn's product line since the company was first incorporated. We continue to refine and improve on the techniques to harness the attributes of this product that nature has blessed us with.

Having one of our primary manufacturing facility located in the heart of the diamond hub of the world Surat (India), we have been very successful in selecting the best quality of diamonds for use in our dies. This close proximity to the diamond market has many benefits and allows us to offer dies in a size range 0.012 mm to 3.000 mm.

Walson Woodburn also offers Single-Crystal Synthetics Diamond dies (SCSD) in a size range of 0.012 - 1.000 mm.



Specification & Tolerances of Natural Diamond Die & SCSD

METRIC TABLE

Size Range (mm)	Total Tolerance (mm)	Ovality Tolerance (mm)	Casing Dimensions (mm)
0.015 - 0.025	0.00025	0.0001	25 or 28 × 6
0.0251 - 0.075	0.0005	0.0002	25 or 28 × 8
0.0751 - 0.300	0.001	0.0005	25 or 28 × 10
0.3001 - 0.750	0.002	0.001	25 or 28 × 10
0.7501 - 2.000	0.003	0.001	25 or 28 × 12
2.0001 - 3.000	0.004	0.002	25 or 28 × 15

Size Range (in)	Total Tolerance (in)	Ovality Tolerance (in)	Casing Dimensions (in)
.0006 - .0010	.00001	.00005	1 or 1.125 × .250
.00101 - .0030	.00002	.00008	1 or 1.125 × .312
.00031 - .0118	.00004	.00002	1 or 1.125 × .375
.01181 - .0291	.00008	.00002	1 or 1.125 × .375
.02911 - .0787	.00012	.00004	1 or 1.125 × .500
.07871 - .1181	.00016	.00008	1 or 1.125 × .625

Note: We also supply dies as per customer's required Tolerance & Casing Size.

Polycrystalline Diamond Die

Polycrystalline Diamond dies have changed the wire industry substantially in the past 30 years when they began to arrive on the market. Walson Woodburn has grown with this product in terms of developing the techniques required to achieve the high surface finish required to meet the demands of today's market.

Walson Woodburn has also established production capabilities to process the "jumbo" nibs available to the market. We have the ability to produce PCD dies in a size range of 0.050mm to over 35.00mm in diameter for potential use in drawing, stranding, bunching, or tube drawing.



Specification & Tolerances of Polycrystalline Diamond Die

METRIC TABLE.

Size Range (mm)	Total Tolerance (mm)	Ovality Tolerance (mm)	Casing Dimensions (mm)
0.025 - 0.075	0.0005	0.0002	25 or 28 × 8
0.0751 - 0.300	0.001	0.0005	25 or 28 × 10
0.3001 - 0.750	0.002	0.001	25 or 28 × 10
0.7501 - 2.000	0.003	0.001	25 or 28 × 12
2.0001 - 3.000	0.004	0.002	25 or 28 × 15
3.001 - 5.000	0.004	0.002	43 × 28 or 53 × 35
5.001 - 7.000	0.006	0.006	43 × 28 or 53 × 35
7mm & Larger	0.010	0.010	43 × 28 or 53 × 35

Size Range (in)	Total Tolerance (in)	Ovality Tolerance (in)	Casing Dimensions (in)
.001 - .003	.00002	.00008	1 or 1.125 × .312
.00031 - .0118	.00004	.00002	1 or 1.125 × .375
.01181 - .0291	.00008	.00002	1 or 1.125 × .375
.02911 - .0787	.00012	.00004	1 or 1.125 × .500
.07871 - .1181	.00016	.00008	1 or 1.125 × .625
.11811 - .1968	.00016	.00008	1.5 × .875 or 2" × 1.378
.19681 - .2756	.00024	.00012	1.5 × .875 or 2" × 1.378
.27561 & Larger	.0004	.0002	1.5 × .875 or 2" × 1.378

Note: We also supply dies as per customer's required Tolerance & Casing Size.

PCD Compacting Die

Walson Woodburn offers large PCD Compacting Dies using Jumbo PCD Nibs from Sumitomo (Japan) and Diamond Innovations (USA). Round PCD Compacting Dies as large as 36 mm in diameter.

Figure shows typical die profile for PCD Compacting dies. The die profile is designed such as to allow easy flow of wires directly from the Lay-Plate of stranding machine into the die. In many cases, Tungsten Carbide cap is also provided on top of the entry of die, to give better entry of wires into the die.



Advantages Of Using Pcd Compacting Dies Over Roller Or Tungsten Carbide Compacting Dies.

Better Compaction Ratio

Higher compaction can be achieved with PCD Compacting Die in comparison to Rollers or TC Compacting Dies. As much as 3% to 5% improvement in compaction ratio has been achieved. This helps in reducing the diameter of final conductor without compromising on CR Value of conductor. Thus saving money on insulation cost.

Dimensional Control Of Finished Conductor

Superior control of Conductor's diameter is achieved with PCD Compacting Die. Also the Ovality observed is very less with PCD Compacting Dies as compacted with Rollers.

Surface Finish Of Conductor

Excellent surface finish is achieved with PCD Compacting Dies, without formation of any metallic fines, which reduces failure of final cable. With Rollers or TC Dies, the surface finish deteriorates quicker and leads to formation of metallic fines.

Tool's Life And Its Effect Of Process Stability

The die-life of PCD Compacting Die is more than 500 times in comparison to TC Compacting Die. Hence the diameter of final conductor remains stable for much longer period, which improves process stability and helps in reduction of operation cost as well.

METRIC TABLE.

CONDUCTOR SIZE

300 MM sq (ROUND)

Material	Aluminum, Ec Grade	
	Old Values achieved	New Values achieved
Tool used for compaction	Rollers	PCD Compacting Die
Number of passes	3	3
Final diameter of compacted conductor	20.600 mm	19.800 mm
CR of final compacted conductor	0.100 Ohm/km @ 20°C	0.100 Ohm/km @ 20°C
Ovality	Approximately 0.050 mm	Less than 0.010 mm
Surface condition of compacted conductor	Matt surface finish, with roller's marks. Metallic fines formation	Very smooth and shiny finish. No metallic fines found.
Improvement in process speed	Nil, as any increase in process speed lead to increase in wire breakage.	Almost 30% increase in speed, without increase in wire breakage frequency.
Maintenance of tool used for compaction	Frequent change in rollers and bearings.	Die-life over 5000 km.

Note: *Walson Woodburn offers PCD Compacting Die sets upto 1000 mm sq.*

PCD Compacting Dies have helped our customers get higher compaction, better surface finish and process stability. Contact us to know how we can help you with your compacting process.

Types of Wire Drawing Dies

Listed below are different types of commonly used wire drawing dies, their pros & cons.

TYPES OF DIES	PROS	CONS	TYPICAL APPLICATION
Natural Diamond Dies	<p>Best surface finish of the wire drawn, amongst all kind of Dies.</p> <p>Higher drawing speeds can be achieved.</p> <p>Very small hole sizes can be produced.</p>	<p>Lower die-life in comparison to PCD dies</p> <p>Very expensive for larger die sizes</p> <p>Requires frequent polishing and resizing.</p>	<p>Natural diamond dies (as small as 0.015mm) are ideal for fine sizes wire, high-speed drawing application as well as application requiring good surface finish of wire drawn.</p> <p>For example: For multi-wire drawing machines For drawing superior surface finish magnet wires & SS wires</p>
PCD Dies	<p>Longer die-life.</p> <p>Very good dimensional control of drawn wires.</p> <p>Available in larger size where natural diamond dies are prohibitively expensive.</p>	<p>Surface finish of wire drawn is inferior to that of wire drawn through natural diamond die.</p> <p>Lower wire drawing speeds</p>	<p>Where a balance is required between die-life and surface finish.</p> <p>Where better size control of drawn wire is needed.</p> <p>For example: Copper RBD and Aluminum RBD process Drawing very hard wires like SS Used for large size compacted conductors</p>
Tungsten Carbide (TC) Dies	<p>Low cost dies.</p> <p>Easy to recondition and maintain.</p> <p>Available in very large sizes, where PCD blanks are not available.</p>	<p>Lower die life is very less.</p> <p>Poor dimensional control of drawn wire</p>	<p>Typically used for application where cost of Natural Diamond die & PCD die is very high.</p> <p>For example Drawing high carbon steel wire. Drawing large size bars & tubes.</p>

Pressure Die System

FEATURES

- Each Draw Nib is marked with Unique ID for excellent traceability.
- Inspection Report and Quality Certificate with each die.
- Pressure Pod's dimensions can be customised to fit your existing die box.
- Superior raw material from Sandvik, ensures superior performance.
- Substantially reduces freight cost of the dies.
- Reduces overall cost of dies and improves drawing efficiencies.

BENEFITS

- Improves lubrication on surface of wire.
- Increase drawing speeds.
- Better die life and surface finish of drawn wire.
- Sales support in over 25 countries for ease of doing business.
- Available in many casing sizes and compatible with most of the pressure die systems.



Pressure Pods with Fins for Water Cooling Systems

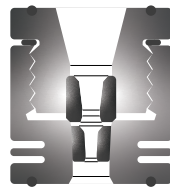
TYPE: PRESSURE POD WITH STRAIGHT OD

Item Code	Outside Diameter	Assembled Length	Matching Press. Insert	Matching Taper Insert
PP-ST-43X44UU	43 mm	44 mm	PI-U	TI-U
PP-ST-43X28UB	43 mm	28 mm	PI-B	TI-U
PP-ST-53X57UU	53 mm	57 mm	PI-U	TI-U

TYPE: PRESSURE POD WITH TAPER OD

PP-TT-43X44UU	43 mm, 6°	44 mm	PI-U	TI-U
PP-TT-43X28UB	43 mm, 6°	28 mm	PI-B	TI-U
PP-TT-53X57UU	53 mm, 6°	57 mm	PI-U	TI-U

Note: Other OD and Length can be made available as per customer's need.



Enameling Die

Enameling Dies are used in manufacturing of magnet wires (enameled wires) and these dies helps in getting consistent, accurate and concentric enamel coating thickness on the wire. This helps in improving wire quality as well as reduce enamel expenditure.

Walson Woodburn offers various types of solid enameling dies with TC, PCD and Natural Diamond inserts. Enameling dies, suitable for both, horizontal and vertical applications are available, made from corrosion-resistant stainless steel or aluminum body. Enameling dies with PCD insert have helped customer get better tolerance on coating thickness as well as the life time is 8 to 10 time more in comparison to enameling dies with TC inserts.

Various body types of enameling dies are available with us, so as to suit customer's machine. The drawing of most commonly used enameling dies is given here. Enameling dies can be made as per customer's drawing. In case the drawing is not available then please send us your worn-out/used die and we can make drawing of it.



Provide following information at the time of placing order

HORIZONTAL ENAMELING DIE

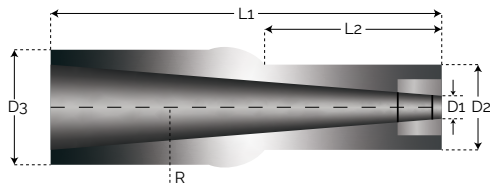
Dimensions are in **mm** or **inches**

Die size / Hole size **D1**

Measured value of **D2** and **D3**

Measured value of **R**

Measured value of **L1** and **L2**



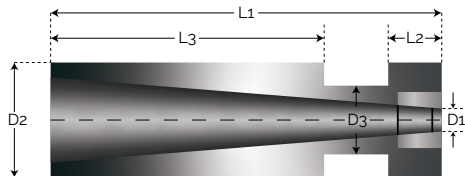
VERTICAL ENAMELING DIE

Dimensions are in **mm** or **inches**

Die size / Hole size **D1**

Measured value of **D2** and **D3**

Measured value of **L1**, **L2** and **L3**

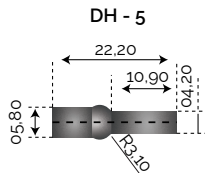
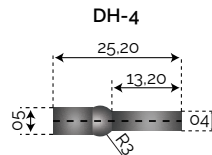
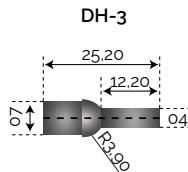
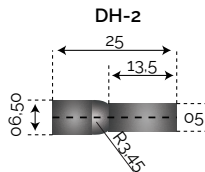
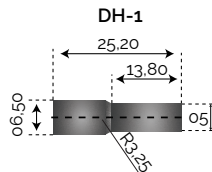


Note: Please see the drawings for reference and fill in the dimensions and email to us.

Provide following information at the time of placing order

HORIZONTAL ENAMELING DIE

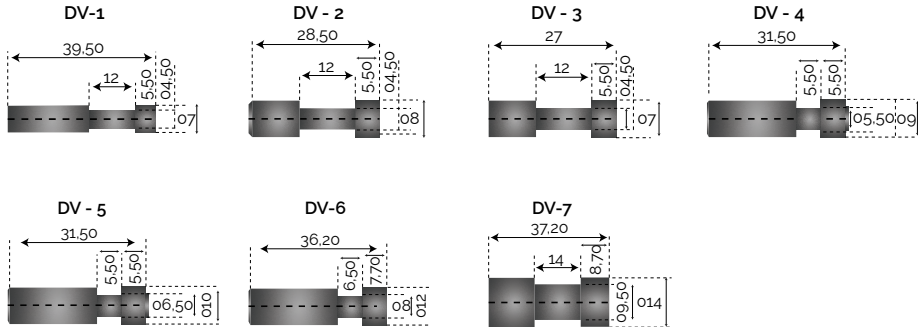
Size Range	0.100 mm to 2.000 mm
Type of inserts	TC, PCD and Natural Diamond
Body material	Stainless Steel and Brass
Marking	Solvent proof pin marking for easy readability.



Provide following information at the time of placing order

VERTICAL ENAMELING DIE

Size Range	0.300 mm to 6.000 mm
Type of inserts	TC, PCD and Natural Diamond
Body material	Stainless Steel and Aluminum
Marking	Solvent proof pin marking for easy readability.



Extrusion Tooling

We have been supplying extrusion tools with high precision and accuracy for the wire and cable industry.

Our tools have excellent surface characteristics and concentricity within 5 microns, So as to help our customer get highest performance and quality

Tools made with specialty grade steel, with Natural Diamond / SCSD / PCD / TC inserts are available with us to supply our customers as per their needs. However, we recommend them to use Natural Diamond / SCSD inserted Tips / Guides over TC inserted Tips / Guides, as the life time of former is at least 3-5 times more in comparison TC inserted Tips / Guides. Similarly, we recommend solid TC (full TC) Die in comparison to TC inserted or solid steel Die, as the surface finish and life time of full TC Die is much superior to the later.



Various Types of Extrusion Die

They are available in following three materials

Full TC (Tungsten Carbide) body,

Full steel (special grade) hardened body and

Steel body with TC insert

Provide following information at the time of ordering

Dimensions are in **mm** or **inches**

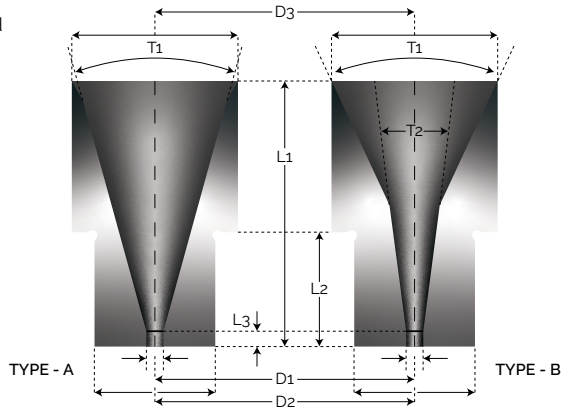
Die size / hole size **D1**

Measured Value of **D2 & D3**

Measured Value of **L1, L2 & L3**

For Die Type A **T1**

For Die Type B **T1 & T2**



Extrusion die can be made as per customer's drawing. In case the drawing is not available then please send us your worn-out/un-used die and we can make drawing of it

Various Types of Extrusion Tip / Guide

They are available in following three materials

Steel body with Natural Diamond/SCSD insert

Steel body with PCD insert

Steel body with TC (Tungsten Carbide) insert

Full steel body (special grade) hardened body

Provide following information at the time of ordering

Dimensions are in **mm** or **inches**

Tips size / hole size **D1**

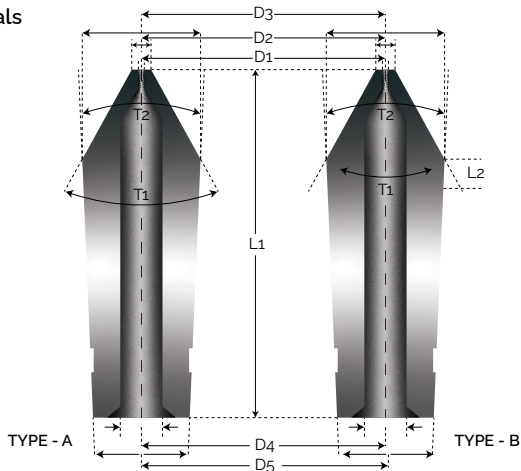
Measured Value of **D2 (D1+X)**

Measured Value of **D3, D4 & D5**

Measured Value of **T1 & T2**

For Die Type A **L1**

For Die Type B **L1 & L2**



Extrusion Tip / Guide can be made as per customer's drawing. In case the drawing is not available then please send us your worn-out/un-used die and we can make drawing of it

How to Order Extrusion Tooling

EXTRUSION DIE

Specify extrusion die's material type: Full TC/TC inserted/Solid Steel

Specify extrusion die's bore size and tolerance (mm or inches)

Attach drawing or send sample die for making drawing

Specify quantity required per size and type

EXTRUSION TIP / GUIDE

Specify extrusion tip / guide's material type: Solid steel / TC inserted / PCD inserted / ND inserted / SCSD inserted

Specify extrusion die's bore size and tolerance (mm or inches)

Attach drawing or send sample die for making drawing

Selection of PCD Die Blank

PCD die blanks are available in various grain sizes and should be selected properly, depending upon application and wire surface finish requirement. The table below lists a few types of grain size option along with their pros and cons.

GRAIN SIZE OF PCD	PROS	CONS	TYPICAL APPLICATION
50 Micron	Longer die-life Better dimensional control for larger size wires.	Poor surface finish of wire drawn. Lower drawing speed	Where lubrication is inadequate or where surface finish of wire drawn is not critical. For example: Tube Drawing, Compacted Conductors.
25 Micron	Longer die-life	Average surface finish of wire	Where a balance is required between die-life and surface finish. For example: Copper RBD and Aluminum RDB process.
5 Micron	Higher drawing speeds can be achieved. Excellent surface finish of wire drawn.	Lower die-life Frequent polishing of dies is required.	It is most commonly used PCD type. Best suited for high speed drawing application as well as application requiring good surface finish of wire drawn. For Example: For Multi-wire drawing machines; For drawing superior surface finish SS wires.

Suggested Die Size Range of PCD Blanks

NIB SIZE (ADDMA #)	NOMINAL HOLE SIZE RANGE	MAXIMUM HOLE SIZE FOR HARD WIRE	MAXIMUM HOLE SIZE FOR SOFT WIRE
D6	mm 0.050 – 0.500 Inch .002* – .020*	0.400 mm .016*	0.600 mm .024*
D12	mm 0.200 – 0.750 Inch .008* – .030*	0.650 mm .026*	1.000 mm .040*
D15	mm 0.500 – 1.400 Inch .020* – .056*	1.200 mm .048*	1.600 mm .064*
D18	mm 0.950 – 2.100 Inch .038* – .084*	1.800 mm .072*	2.500 mm .100*
D21	mm 1.750 – 3.200 Inch .070* – .128*	2.750 mm .110*	3.500 mm .140*
D24	mm 2.500 – 4.200 Inch .100* – .168*	3.250 mm .130*	4.750 mm .190*
D27	mm 3.750 – 6.200 Inch .150* – .248*	5.000 mm .200*	6.750 mm .270*
D30	mm 5.000 – 8.500 Inch .200* – .340*	7.000 mm .280*	9.000 mm .360*

Maximum Hole Size of Hard Wire: Is calculated considering Reduction Angle of 12° and Bearing Length of 40%.

Maximum Hole Size of Soft Wire: Is calculated considering Reduction Angle of 22° and Bearing Length of 15%.

ADDMA: Stands for "American Diamond Die Manufacturers Association"

Note: Above figures are indicative only. Depending on material drawn and die-draft, blank selection may vary.

Contact us for exact calculations.

*Innovations that Wire
the future.*

Formulas Used in Wire Production.

The table below shows the commonly used formulas for calculating production rate during wire drawing.

ABBREVIATIONS

Wire Diameter (d) : in mm or inches	Weight of wire produced (Wp) : in Kg/Hr or Lb/Hr
Weight per length (W) : in g/m or Lb/ft	Velocity of drawn wire (Vd) : in mtrs/sec or ft/min
Density (Dn) : g/mm ³ or Lb/in ³	Constant (K) : As listed below

ILLUSTRATION	FORMULA	EXAMPLE
Co-relating weight & length	$W = K \times d^2 \times Dn$ Note: • K for g/m is 785.4 • K for w/ft is 9.425	The weight per meter of 0.330 mm bare copper wire is: $W = 785.4 \times 0.330^2 \times 0.00889$
How to calculate amount of wire drawn in an hour	$WP = Vd \times d^2 \times Dn \times K$ Note: • K for kg/h is 2827 • K for Lb/h is 565.5	The amount of 0.330 mm bare copper wire drawn at the speed of 50 m/s is: $WP = 50 \times 0.330^2 \times 0.00889 \times 2827$ $WP = 136.9 \text{ kg/h}$

Note: Density for electrolytic copper is 0.00889 g/mm³ or .321 lb/in³

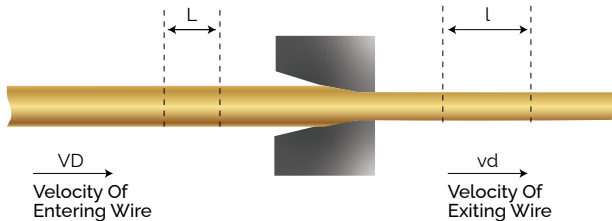
Frequently Used Formulas

During wire drawing process, the volume of the material remains constant, hence when the cross-section (diameter) is reduced, the length of the wire increases.

The reduction of diameter is called Area Reduction.

Lengthening of the wire is called Elongation.

The speed of wire exiting the die is more than the speed of wire entering into the die.



CO-RELATING ABOVE TERMINOLOGIES THROUGH AN EXAMPLE

Diameter of entering wire (D) : 0.330 mm

Diameter of exiting wire (d) : 0.300 mm

Velocity of entering wire (VD) : 826 m/min

Velocity of exiting wire (Vd) : 1000 m/min

Elongation % (E) : 21 %

Area Reduction % (Ar) : 17.36 %

Frequently Used Formulas

ILLUSTRATION	FORMULA	EXAMPLE
Elongation % (E)	$E = 100 \left\{ \left(\frac{D}{d} \right)^2 - 1 \right\}$	$E = 100 \left\{ \left(\frac{0.330}{0.300} \right)^2 - 1 \right\} \quad E = 21\%$
Area Reduction % (Ar)	$Ar = 100 \left\{ 1 - \left(\frac{d}{D} \right)^2 \right\}$	$Ar = 100 \left\{ 1 - \left(\frac{0.300}{0.330} \right)^2 \right\} \quad Ar = 17.36\%$
Diameter of entering wire (D)	$D = \frac{d}{\{1 - (Ar/100)\}^{1/2}}$	$D = \frac{0.300}{\{1 - (17.36/100)\}^{1/2}} \quad D = 0.330\text{mm}$
Diameter of exiting wire (d)	$d = D \{ \sqrt{1 - (Ar/100)} \}$	$d = 0.330 \{ \sqrt{1 - (17.36/100)} \} \quad d = 0.300\text{mm}$
Velocity of entering wire (VD)	$VD = vd \left\{ \left(\frac{d}{D} \right)^2 \right\}$	$VD = 1000 \left(\frac{0.300}{0.330} \right)^2 \quad VD = 826 \text{ m/min}$
Velocity of exiting wire (vd)	$vd = \frac{VD}{1 - (Ar/100)}$	$vd = \frac{826}{1 - 17.36/100} \quad vd = 1000 \text{ m/min}$
Correlation between Elongation (E) & Area Reduction (Ar)	$E = \frac{100 Ar}{100 - Ar} \quad Ar = \frac{100 E}{100 + E}$	$E = \frac{100 \times 17.36}{100 - 17.36} = 21\% \quad Ar = \frac{100 \times 21}{100 + 21} = 17.36\%$

How To Calculate Die Series

The table below shows the relationship between elongation and area reduction used in calculating a die series

Wire Elongation. %	Area Reduction. %	Die Diameter Factor	Wire Elongation. %	Area Reduction. %	Die Diameter Factor	Wire Elongation. %	Area Reduction. %	Die Diameter Factor
5.0	4.76	1.02470	19.5	16.32	1.09316	34.0	25.37	1.15758
5.5	5.21	1.02713	20.0	16.67	1.09545	34.5	25.65	1.15974
6.0	5.66	1.02956	20.5	17.01	1.09772	35.0	25.93	1.16191
6.5	6.10	1.03199	21.0	17.36	1.10000	35.5	26.20	1.16404
7.0	6.54	1.03441	21.5	17.70	1.10227	36.0	26.47	1.16619
7.5	6.98	1.03682	22.0	18.03	1.10454	36.5	26.74	1.16833
8.0	7.41	1.03923	22.5	18.37	1.10680	37.0	27.01	1.17047
8.5	7.83	1.04163	23.0	18.70	1.10905	37.5	27.27	1.17260
9.0	8.26	1.04403	23.5	19.03	1.11131	38.0	27.54	1.17473
9.5	8.68	1.04642	24.0	19.35	1.11315	38.5	27.80	1.17686
10.0	9.09	1.04881	24.5	19.68	1.11580	39.0	28.06	1.17898
10.5	9.50	1.05119	25.0	20.00	1.11803	39.5	28.32	1.18110
11.0	9.91	1.05357	25.5	20.32	1.12027	40.0	28.57	1.18322
11.5	10.31	1.05594	26.0	20.63	1.12250	40.5	28.83	1.18533
12.0	10.71	1.05830	26.5	20.95	1.12472	41.0	29.08	1.18743
12.5	11.11	1.06066	27.0	21.26	1.12694	41.5	29.33	1.18954
13.0	11.50	1.06301	27.5	21.57	1.12916	42.0	29.58	1.19164
13.5	11.89	1.06536	28.0	21.88	1.13137	42.5	29.82	1.19373
14.0	12.28	1.06771	28.5	22.18	1.13358	43.0	30.07	1.19583
14.5	12.66	1.07005	29.0	22.48	1.13578	43.5	30.31	1.19791
15.0	13.04	1.07238	29.5	22.78	1.13798	44.0	30.56	1.20000
15.5	13.42	1.07471	30.0	23.08	1.14018	44.5	30.80	1.20208
16.0	13.79	1.07703	30.5	23.37	1.14237	45.0	31.03	1.20416
16.5	14.16	1.07935	31.0	23.66	1.14455	45.5	31.27	1.20623
17.0	14.63	1.08167	31.5	23.95	1.14673	46.0	31.51	1.20830
17.5	14.89	1.08397	32.0	24.24	1.14891	46.5	31.74	1.21037
18.0	15.25	1.08628	32.5	24.53	1.15190	47.0	31.97	1.21244
18.5	15.61	1.08858	33.0	24.81	1.15326	47.5	32.20	1.21450
19.0	15.97	1.09087	33.5	25.09	1.15542			

How to use

To calculate a die series, multiply the die diameter ratio applicable, to the finish die hole size, to find the next larger die size in the die series & so forth.

EXAMPLE

Elongation %: 21% (Area reduction %: 17.36%)

If the finish die size is 0.300 mm, then to calculate the die series multiply 0.300 mm with the die diameter factor (which for 21% Elongation is 1.10000, see table of formulas)

THE DIE SERIES WILL BE

Formula = 0.3000 mm × Die Diameter Factor

(2nd Die)

$$\begin{aligned} &0.3000 \text{ mm} \times 1.10000 \\ &= 0.3300 \text{ mm} \end{aligned}$$

(3rd Die)

$$\begin{aligned} &0.3300 \text{ mm} \times 1.10000 \\ &= 0.3630 \text{ mm} \end{aligned}$$

(4th Die)

$$\begin{aligned} &0.3630 \text{ mm} \times 1.10000 \\ &= 0.3993 \text{ mm} \end{aligned}$$

(5th Die)

$$\begin{aligned} &0.3993 \text{ mm} \times 1.10000 \\ &= 0.4392 \text{ mm} \end{aligned}$$

(6th Die)

$$\begin{aligned} &0.4392 \text{ mm} \times 1.10000 \\ &= 0.4831 \text{ mm} \end{aligned}$$

(7th Die)

$$\begin{aligned} &0.4831 \text{ mm} \times 1.10000 \\ &= 0.5314 \text{ mm} \end{aligned}$$

(8th Die)

$$\begin{aligned} &0.5314 \text{ mm} \times 1.10000 \\ &= 0.5845 \text{ mm} \end{aligned}$$

(9th Die)

$$\begin{aligned} &0.5845 \text{ mm} \times 1.10000 \\ &= 0.6430 \text{ mm} \end{aligned}$$

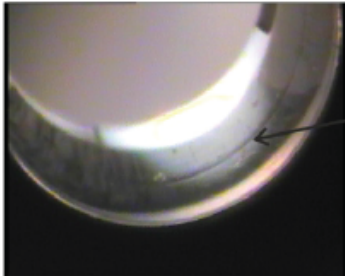
(10th Die)

$$\begin{aligned} &0.6430 \text{ mm} \times 1.10000 \\ &= 0.7073 \text{ mm} \end{aligned}$$

Preserve Your Precision

Die being a tool, undergoes wear and tear upon usage. Hence it becomes necessary to have periodic checks and maintenance.

As discussed in earlier topic, the wire first comes in contact with the die at the Impact Point in the die. It is here that the first wear appears (in form of wear-ring). The picture below shows the wear ring in a Natural Diamond Die. This die, with the wear ring, if not polished, will lead to deep wear ring formation which then leads to lines formation in Reduction Angle and Bearing Area. This can ultimately lead to crack in the die.



This is the wear ring, occurring at the point where the wire touched the die

Above picture shown start of wear ring at the Contact Point in a Natural Diamond die

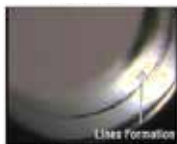
Stages of Die Wear Displayed



MINOR WEAR



DEEP WEAR RING



FORMATION OF LINES



CRACK MARK

Above pictures show gradual increase in wear in the dies. Last picture shows occurrence of crack.

Hence it is important to have an effective die maintenance program, so that the dies are inspected periodically and are then polished or re-sizes when required, so as to avoid pre-mature breakage of the die.

General selection of diamond powder for reconditioning of PCD dies is listed below

POWDER SIZE	APPLICATION	POWDER SIZE	APPLICATION
8 – 16 micron powder	Re-cutting: Used for removing severe die wear or when reshaping the die.	1 – 2 micron powder	For removal of slight surface roughness
4 – 8 micron powder	Re-cutting: When nominal size is to be increased, due to normal wear.	0 – 1 micron powder	Polishing: For final polish
2 – 4 micron powder	Minor removal of wear rings.	0 – 0.25 micron powder	Polishing: For getting mirror polish

Stereo Zoom Die Inspection Microscope

The Stereo Zoom Microscope has side mount zoom control system. It provides excellent 3D images with high resolution. Once brought in focus, images remain clear throughout whole zoom range, it has large field of view, long working distance, and big depth of field.

SPECIFICATION

Suitable for die size range from 0.100mm to 8mm.

Zoom Range: 0.7x-4.5x

Total Magnification: 7x-90x standard

Comes with one pair of WF10x High Point Eye-Pieces and one pair of 20x eye-pieces with eye cup.

Working Distance: 108mm at 45x magnification

Inter-papillary Distance: Adjustable 55-57mm

Pole Stand with die table, for easy rotation and tilting of dies, which makes it possible to have complete view of the die.

Microscope comes with bottom light, best suited for clear view of die's surface finish.



Image taken from the Microscope.

Ultrasonic Die Cleaner

Ultrasonic cleaner helps to clean dies quickly

SR. NO. CAPACITY IN LITER

1 0.5

2 1.0

3 1.8

4 2.25

5 3.5

6 6.0



Note: All available with built-in heater.

Measuring Pin set for size checking

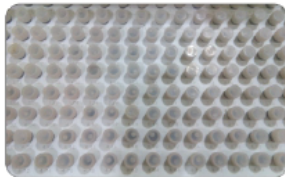
SPECIFICATION

Size Range Available 0.500 to 25.00 mm.

Available in Steps of 0.010, 0.020 and 0.050mm.

Length 60.00mm








Material Hardened











Craft your perfect Die

How to Order?

NATURAL DIAMOND DIE (SCSD)

-  Casing Dimensions
-  Hole Size (mm or inches)
-  Hole Size Tolerance
-  Wire Material Drawn
-  Reduction Angle
-  Bearing Length
-  Input Wire

POLYCRYSTALLINE DIAMOND DIE

-  Casing Dimensions
-  Hole Size (mm or inches)
-  Hole Size Tolerance
-  Wire Material Drawn
-  Blank Number / Nib Size
-  Reduction Angle
-  Bearing Length
-  Input Wire

To assure prompt service please provide following information at the time of placing order

Products & Services Available

Multi-Wire Die Sets (Elongation Sets)

Natural Diamond Die (0.015mm to 3mm)

Monocrystalline (SCSD) Diamond Die (0.015mm to 1mm)

Polycrystalline Diamond Die (0.025mm to 35mm)

Tungsten Carbide Die (Up to 100mm)

Enameling Dies (Horizontal and Vertical type) with PCD & TC inserts

Shaving Dies

Bunching Dies & Compacting Dies

Diamond Powder

Die Cutting & Reconditioning

Die Shop Equipment

Conversion Table

A.W.G	INCHES	MM	A.W.G	INCHES	MM	A.W.G	INCHES	MM	A.W.G	INCHES	MM
6/0	14.733	0.580049	13.5	1.724	0.067909	29	0.011258	0.285	44.5	0.001866	0.047402
5/0	13.120	0.519549	14	1.627	0.064084	29.5	0.010624	0.269	45	0.001761	0.044732
4/0	11.684	0.460000	14.5	1.536	0.060474	30	0.010025	0.254	45.5	0.001662	0.042213
3/0	10.404	0.409642	15	1.449	0.057068	30.5	0.009461	0.240297	46	0.001568	0.039835
2/0	9.265	0.364797	15.5	1.367	0.053854	31	0.008928	0.226	46.5	0.001480	0.037592
1/0	8.251	0.324861	16	1.290	0.050821	31.5	0.008425	0.213991	47	0.001397	0.035474
1	7.348	0.289297	16.5	1.218	0.047958	32	0.007950	0.201	47.5	0.001318	0.033476
1.5	6.934	0.273003	17	1.149	0.045257	32.5	0.007503	0.190564	48	0.001244	0.031591
2	6.543	0.257626	17.5	1.084	0.042708	33	0.007080	0.179	48.5	0.001174	0.029812
2.5	6.175	0.243116	18	1.023	0.040303	33.5	0.006681	0.169702	49	0.001108	0.028131
3	5.827	0.229423	18.5	0.966	0.038033	34	0.006305	0.160	49.5	0.001045	0.026548
3.5	5.499	0.216501	19	0.911	0.035891	34.5	0.005950	0.151124	50	0.000986	0.025053
4	5.189	0.204307	19.5	0.860	0.033869	35	0.005615	0.142	50.5	0.000931	0.023642
4.5	4.897	0.192800	20	0.811	0.031961	35.5	0.005298	0.134580	51	0.000878	0.022310
5	4.621	0.181941	20.5	0.766	0.030161	36	0.005000	0.127	51.5	0.000829	0.021053
5.5	4.361	0.171693	21	0.722	0.028462	36.5	0.004718	0.119847	52	0.000782	0.019868
6	4.115	0.162023	21.5	0.682	0.026859	37	0.004453	0.113097	52.5	0.000738	0.018749
6.5	3.883	0.152897	22	0.643	0.025347	37.5	0.004204	0.106727	53	0.000697	0.017693
7	3.664	0.144285	22.5	0.607	0.023919	38	0.003965	0.100716	53.5	0.000657	0.016696
7.5	3.548	0.136159	23	0.573	0.022572	38.5	0.003735	0.095065	54	0.000620	0.015756
8	3.263	0.128490	23.5	0.541	0.021300	39	0.003513	0.089690	54.5	0.000585	0.014868
8.5	3.079	0.121253	24	0.510	0.020101	39.5	0.003332	0.084638	55	0.000552	0.014031
9	2.906	0.114424	24.5	0.484	0.018969	40	0.003145	0.079871	55.5	0.000521	0.013241
9.5	2.742	0.107979	25	0.457	0.017900	40.5	0.002967	0.075372	56	0.000492	0.012495
10	2.588	0.101897	25.5	0.429	0.016892	41	0.002800	0.071127	56.5	0.000465	0.011791
10.5	2.442	0.096158	26	0.403	0.015941	41.5	0.002643	0.067121	57	0.000438	0.011127
11	2.304	0.090742	26.5	0.382	0.015043	42	0.002494	0.063341	57.5	0.000413	0.010500
11.5	2.175	0.085631	27	0.360	0.014196	42.5	0.002353	0.059773	58	0.000390	0.009909
12	2.052	0.080808	27.5	0.340	0.013396	43	0.002221	0.056406	58.5	0.000368	0.009351
12.5	1.936	0.076257	28	0.321	0.012641	43.5	0.002096	0.053229	59	0.000347	0.008824
13	1.827	0.071962	28.5	0.303	0.011929	44	0.001978	0.050231	59.5	0.000328	0.008327
									60	0.000309	0.007858

Conversion Table

S.W.G	MM	INCHES	S.W.G	MM	INCHES	S.W.G	MM	INCHES	S.W.G	MM	INCHES
1.00	7.620	.3000	7.25	4.369	.1720	13.50	2.185	.0860	19.75	0.939	.0370
1.25	7.468	.2940	7.50	4.267	.1680	13.75	2.108	.0830	20.00	0.914	.0360
1.50	7.315	.2880	7.75	4.166	.1640	14.00	2.032	.0800	20.25	0.889	.0350
1.75	7.163	.2820	8.00	4.064	.1600	14.25	1.982	.0780	20.50	0.864	.0340
2.00	7.010	.2760	8.25	3.962	.1560	14.50	1.932	.0760	20.75	0.838	.0330
2.25	6.859	.2700	8.50	3.861	.1520	14.75	1.879	.0740	21.00	0.813	.0320
2.50	6.705	.2640	8.75	3.760	.1480	15.00	1.829	.0720	21.25	0.788	.0310
2.75	6.553	.2580	9.00	3.658	.1440	15.25	1.778	.0700	21.50	0.762	.0300
3.00	6.401	.2520	9.25	3.556	.1400	15.50	1.727	.0680	21.75	0.737	.0290
3.25	6.274	.2470	9.50	3.454	.1360	15.75	1.676	.0660	22.00	0.711	.0280
3.50	6.147	.2420	9.75	3.353	.1320	16.00	1.626	.0640	22.25	0.686	.0270
3.75	6.020	.2370	10.00	3.251	.1280	16.25	1.575	.0620	22.50	0.660	.0260
4.00	5.893	.2320	10.25	3.175	.1250	16.50	1.524	.0600	22.75	0.635	.0250
4.25	5.766	.2270	10.50	3.094	.1220	16.75	1.473	.0580	23.00	0.610	.0240
4.50	5.639	.2220	10.75	3.023	.1190	17.00	1.422	.0560	23.25	0.597	.0235
4.75	5.512	.2170	11.00	2.946	.1160	17.25	1.371	.0540	23.50	0.584	.0230
5.00	5.385	.2120	11.25	2.871	.1130	17.50	1.320	.0520	23.75	0.571	.0225
5.25	5.258	.2070	11.50	2.794	.1100	17.75	1.269	.0500	24.00	0.559	.0220
5.50	5.131	.2020	11.75	2.718	.1070	18.00	1.219	.0480	24.25	0.546	.0215
5.75	5.004	.1970	12.00	2.642	.1040	18.25	1.167	.0460	24.50	0.533	.0210
6.00	4.877	.1920	12.25	2.566	.1010	18.50	1.117	.0440	24.75	0.520	.0205
6.25	4.775	.1880	12.50	2.490	.0980	18.75	1.066	.0420	25.00	0.508	.0200
6.50	4.674	.1840	12.75	2.413	.0950	19.00	1.016	.0400	25.25	0.493	.0195
6.75	4.572	.1800	13.00	2.337	.0920	19.25	0.991	.0390	25.50	0.482	.0190
7.00	4.470	.1760	13.25	2.261	.0890	19.50	0.965	.0380	25.75	0.469	.0185

Conversion Table

S.W.G	MM	INCHES	S.W.G	MM	INCHES	S.W.G	MM	INCHES	S.W.G	MM	INCHES
26.00	0.457	.0180	32.25	0.269	.0106	38.50	0.142	.005590	44.75	0.074	.002913
26.25	0.447	.0176	32.50	0.264	.0104	38.75	0.137	.005393	45.00	0.071	.002795
26.50	0.437	.0172	32.75	0.259	.0102	39.00	0.132	.005196	45.25	0.069	.002716
26.75	0.427	.0168	33.00	0.254	.0100	39.25	0.129	.005078	45.50	0.065	.002559
27.00	0.417	.0164	33.25	0.249	.0098	39.50	0.126	.004960	45.75	0.063	.002480
27.25	0.407	.0160	33.50	0.244	.0096	39.75	0.124	.004881	46.00	0.061	.002401
27.50	0.397	.0156	33.75	0.239	.0094	40.00	0.122	.004803	46.25	0.059	.002322
27.75	0.386	.0152	34.00	0.234	.0092	40.25	0.119	.004685	46.50	0.056	.002204
28.00	0.376	.0148	34.25	0.229	.0090	40.50	0.117	.004606	46.75	0.054	.002125
28.25	0.368	.0145	34.50	0.224	.0088	40.75	0.114	.004488	47.00	0.051	.002007
28.50	0.360	.0142	34.75	0.218	.0086	41.00	0.112	.004409	47.25	0.049	.001929
28.75	0.352	.0139	35.00	0.213	.0084	41.25	0.109	.004291	47.50	0.046	.001811
29.00	0.345	.0136	35.25	0.208	.0082	41.50	0.107	.004212	47.75	0.044	.001732
29.25	0.337	.0133	35.50	0.203	.0080	41.75	0.104	.004094	48.00	0.041	.001614
29.50	0.329	.0130	35.75	0.198	.0078	42.00	0.102	.004015	48.25	0.038	.001496
29.75	0.322	.0127	36.00	0.193	.0076	42.25	0.099	.003897	48.50	0.035	.001377
30.00	0.315	.0124	36.25	0.188	.0074	42.50	0.097	.003818	48.75	0.032	.001259
30.25	0.310	.0122	36.50	0.183	.0072	42.75	0.094	.003700	49.00	0.030	.001181
30.50	0.305	.0120	36.75	0.178	.0070	43.00	0.091	.003582	49.25	0.028	.001102
30.75	0.300	.0118	37.00	0.173	.0068	43.25	0.089	.003503	49.50	0.027	.001062
31.00	0.295	.0116	37.25	0.168	.0066	43.50	0.086	.003385	49.75	0.026	.001023
31.25	0.290	.0114	37.50	0.163	.0064	43.75	0.084	.003307	50.00	0.025	.000984
31.50	0.285	.0112	37.75	0.157	.0062	44.00	0.081	.003188			
31.75	0.279	.0110	38.00	0.152	.0060	44.25	0.079	.003110			
32.00	0.274	.0108	38.25	0.147	.0058	44.50	0.076	.002992			



Walson Woodburn™

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