A Guide to Blasting Nozzle Selection

Choosing the right blast nozzle for each application is simply a matter of understanding the variables that affect cleaning performance and job costs. There are four basic questions to answer for optimum cost/performance.

1. What Blast Pattern Do You Want?

A nozzle's bore shape determines its blast pattern. Nozzles generally have either a straight bore or a restricted venturi bore. **Straight Bore Nozzles** (Figure 1, Number 1) create a tight blast pattern for spot blasting or blast cabinet work. These are best for smaller jobs such as parts cleaning, weld seam shaping, cleaning handrails, steps, grillwork, or carving stone, and other materials. **Venturi Bore Nozzles** (Figure 1, Numbers 2 and 3) create a wide blast pattern and increase abrasive velocity as much as 100% for a given pressure. Venturi nozzles are the best choice for greater productivity when blasting larger surfaces. Long venturi style nozzles like the BRUISER™ blasting nozzles, for example, yield about a 40% increase in productivity compared to straight bore nozzles, while abrasive consumption can be cut approximately 40%.

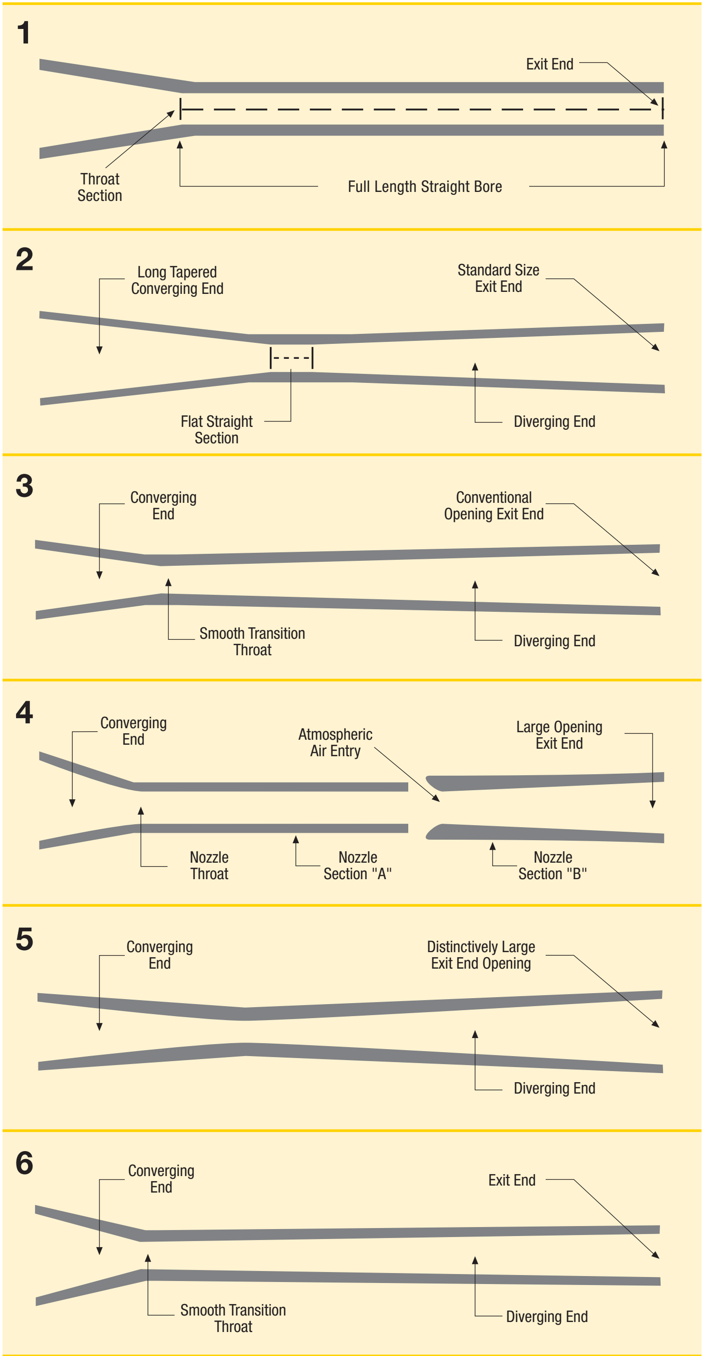
Double venturi and wide throat nozzles are enhanced versions of the long venturi style nozzle.

The **Double Venturi** style (Figure 1, Number 4) can be thought of as two nozzles in a series with a gap and holes in between to allow the insertion of atmospheric air into the downstream segment of the nozzle. The exit end is also wider than a conventional nozzle. Both modifications are made to increase the size of the blast pattern and minimize the loss of abrasive velocity.

Wide Throat Nozzles (Figure 1, Number 5) feature a large entry throat and a large, diverging exit bore. When matched with the same sized

Figure 1. Nozzle Types

1. Straight Bore
2. Conventional Design Long Venturi
3. Laminar Flow Design Long Venturi
4. Double Venturi
5. High Pressure
6. High Velocity



hose they can provide a 15% increase in productivity over nozzles with a smaller throat. When wide throat nozzles also feature a larger diverging exit bore (e.g., BAZOOKA™ nozzle), they can be used at higher pressures to yield up to a 60% larger pattern with lower abrasive use.

XL Performance (Figure 1, Number 6) nozzles increase abrasive particle velocity, allowing for increased stand-off distance, resulting in improved production rates and efficiencies.

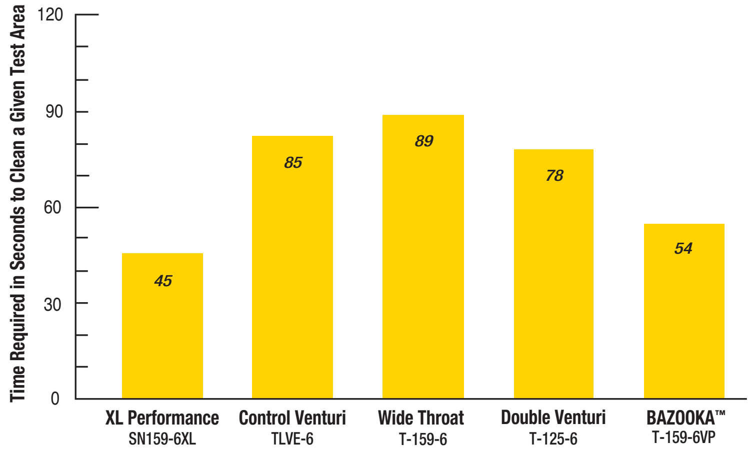
It's also a good idea to have angle nozzles available for tight spots like bridge lattice, behind flanges, or inside pipes. Many operators waste abrasive and time waiting for ricochet to get the job done. The little time it takes to switch to an angle nozzle is always quickly recovered, and total time on the job is reduced.

2. Can Your Compressed Air Supply Support the Nozzle?

As a general rule, the air supply system should be able to provide at least 50% more air volume (cfm) than a new nozzle in order to develop the required working blasting pressure, whether that is 100 psi or 140 psi. This ensures a nozzle can continue to provide good service even after it is slightly worn. Remember, excessive wear should be avoided to prevent a dramatic decrease in productivity.

In addition, the nozzle entry throat must match the inside diameter of your air supply hose. The wrong size combination can lead to wear points, pressure drop, and excessive internal turbulence.

Figure 2. Nozzle Performance Comparison



	XL Performance	Control Venturi	Wide Throat	Double Venturi	BAZOOKA™
Size of Blast Pattern	5"	3"	3"	3"	4"
Nozzle-to-Surface Distance	48"	18"	18"	18"	18"
Av. Back Pressure (lbs.)	13	15	13	14	11

Data compares the time required for different nozzles to clean a given test area based on the nozzle's blast pattern. Also shown is the average back pressure exerted by each nozzle, an indicator of the effect of nozzle selection on operator fatigue.

Matching Nozzle Size and Compressor Size for Required Production Rate

production rate required (sq, ft,/hr)	blast nozzle orifice	production rate at 100 psi nozzle pressure	production rate at 90 psi nozzle pressure	production rate at 80 psi nozzle pressure	compressor size cfm at 100 psi nozzle pressure
Up to 100	1/4"	100	85	70	185 cfm 40 – 50 h,p,
101 – 160	5/16"	160	136	112	250 cfm 60 – 75 h,p,
161 – 230	3/8"	230	195	161	375 cfm 75 – 100 h,p,
231 – 317	7/16"	317	270	222	450 cfm 125 h,p,
318 – 400	1/2"	400	340	280	600 cfm 150 h,p,

This chart is estimated and based upon use of a long venturi nozzle, SSPC-6 commercial blast specification.

Nozzle Pressure, Abrasive Velocity, and Efficiency

blast nozzle pressure	estimated abrasive velocity	estimated efficiency factor
140 psi	588 mph	160%
125 psi	525 mph	138%
110 psi	462 mph	115%
100 psi	420 mph	100%
95 psi	400 mph	93%
90 psi	365 mph	85%
85 psi	330 mph	78%
80 psi	270 mph	70%
75 psi	210 mph	63%
70 psi	190 mph	55%

Nozzle Air and Pressure Requirements Chart

Nozzle Pressure – PSI (Bar)

nozzle orifice mm (in)	air, power, and abrasive requirements	50 psi (3,45 bar)	60 psi (4,14 bar)	70 psi (4,83 bar)	80 psi (5,52 bar)	90 psi (6,21 bar)	100 psi (6,89 bar)	125 psi (8,62 bar)
3,2 (1/8)	air: cu m/min (cu ft/min)	0,34 (12)	0,37 (13)	0,42 (15)	0,51 (18)	0,54 (19)	0,59 (21)	0,74 (26)
	horsepower: kw (hp)	1,30 (1,75)	1,49 (2)	1,86 (2,5)	2,24 (3)	2,61 (3,5)	2,98 (4)	4,47 (6)
	abrasive: kg/hr (lb/hr)	32 (70)	36 (80)	41 (90)	45 (100)	50 (110)	54 (120)	61 (135)
4,8 (3/16)	air: cu m/min (cu ft/min)	0,71 (25)	0,85 (30)	0,99 (35)	1,13 (40)	1,22 (43)	1,27 (45)	1,70 (60)
	horsepower: kw (hp)	3,73 (5)	5,97 (8)	6,71 (9)	7,08 (9,5)	7,46 (10)	7,83 (10,5)	11,93 (16)
	abrasive: kg/hr (lb/hr)	68 (150)	77 (170)	91 (200)	98 (215)	109 (240)	118 (260)	145 (320)
6,35 (1/4)	air: cu m/min (cu ft/min)	1,42 (50)	1,56 (55)	1,70 (60)	1,98 (70)	2,12 (75)	2,27 (80)	2,69 (95)
	horsepower: kw (hp)	7,46 (10)	8,95 (12)	9,69 (13)	11,93 (16)	12,68 (17)	13,42 (18)	18,64 (25)
	abrasive: kg/hr (lb/hr)	122 (270)	136 (300)	159 (350)	181 (400)	204 (450)	227 (500)	306 (675)
8 (5/16)	air: cu m/min (cu ft/min)	2,27 (80)	2,55 (90)	2,83 (100)	3,26 (115)	3,54 (125)	3,96 (140)	5,38 (190)
	horsepower: kw (hp)	12,68 (17)	14,91 (20)	18,64 (25)	20,13 (27)	20,88 (28)	22,37 (30)	26,85 (36)
	abrasive: kg/hr (lb/hr)	213 (470)	240 (530)	272 (600)	306 (675)	340 (750)	374 (825)	454 (1000)
9,5 (3/8)	air: cu m/min (cu ft/min)	3,12 (110)	3,54 (125)	4,11 (145)	4,53 (160)	4,96 (175)	5,66 (200)	7,79 (275)
	horsepower: kw (hp)	18,64 (25)	21,63 (29)	23,86 (32)	26,10 (35)	29,83 (40)	33,56 (45)	42,50 (57)
	abrasive: kg/hr (lb/hr)	306 (675)	352 (775)	397 (875)	442 (975)	481 (1060)	499 (1100)	612 (1350)
11 (7/16)	air: cu m/min (cu ft/min)	4,25 (150)	4,81 (170)	5,66 (200)	6,09 (215)	6,80 (240)	7,22 (255)	8,92 (315)
	horsepower: kw (hp)	26,10 (35)	29,83 (40)	33,56 (45)	37,28 (50)	41,01 (55)	44,74 (60)	52,20 (70)
	abrasive: kg/hr (lb/hr)	408 (900)	454 (1000)	544 (1200)	590 (1300)	635 (1400)	703 (1550)	816 (1800)
12,7 (1/2)	air: cu m/min (cu ft/min)	5,66 (200)	6,37 (225)	7,08 (250)	7,79 (275)	8,50 (300)	9,63 (340)	12,18 (430)
	horsepower: kw (hp)	33,56 (45)	37,28 (50)	41,01 (55)	46,98 (63)	52,20 (70)	55,93 (75)	70,84 (95)
	abrasive: kg/hr (lb/hr)	544 (1200)	612 (1350)	680 (1500)	771 (1700)	839 (1850)	919 (2025)	1145 (2525)
16 (5/8)	air: cu m/min (cu ft/min)	8,50 (300)	9,91 (350)	11,33 (400)	12,74 (450)	14,16 (500)	15,58 (550)	19,82 (700)
	horsepower: kw (hp)	52,20 (70)	59,66 (80)	67,11 (90)	74,57 (100)	82,03 (110)	89,48 (120)	111,85 (150)
	abrasive: kg/hr (lb/hr)	862 (1900)	998 (2200)	1089 (2400)	1225 (2700)	1361 (3000)	1497 (3300)	1814 (4000)
19 (3/4)	air: cu m/min (cu ft/min)	12,18 (430)	14,16 (500)	16,28 (575)	18,41 (650)	19,82 (700)	22,66 (800)	31,15 (1100)
	horsepower: kw (hp)	74,57 (100)	85,76 (115)	96,94 (130)	108,13 (145)	119,31 (160)	130,50 (175)	160,33 (215)
	abrasive: kg/hr (lb/hr)	1225 (2700)	1406 (3100)	1588 (3500)	1769 (3900)	1950 (4300)	2132 (4700)	2586 (5700)

This table is to be used as reference only. Actual results may vary depending on specific abrasive medium used. This table is based on abrasive with a bulk density of 100 pounds per cubic foot.

3.) What bore size do you need?

For maximum productivity, select the nozzle bore size based on the desired blast pressure and the available air pressure and flow. For example, assume you are running a 375 cfm compressor at 80% capacity. In addition to the blast cleaning nozzle, the compressor is supplying air to an air helmet and other components such as air motors and pneumatic controls, leaving 250 cfm available for the nozzle. Referring to the chart on the previous page, you can see that 250 cfm is sufficient for a 7/16" nozzle operating at 100 psi. A larger nozzle, or a worn 7/16" nozzle, will require more air flow to maintain 100 psi. This extra flow requirement will either overwork your compressor or decrease productivity. On the other hand, choosing a nozzle with a bore smaller than your compressor can supply will result in less than maximum productivity from the system.

4.) What are the Various Nozzle Material Choices?

Nozzle material selection depends on the abrasive you choose, how often you blast, the size of the job, and the rigors of the job site. Here are general application guidelines for various materials.

Aluminum Oxide "Alumina" (Ceramic) Nozzles offer good service life at a lower price than other materials. They are a good choice for low usage applications where unit price is a primary factor and nozzle life is less important.

Tungsten Carbide Nozzles offer long life and economy when rough handling can not be avoided and mineral or coal slag abrasives are used. All tungsten carbide nozzles are not equal — Kennametal nozzles feature top wear grade material and durable construction.

BP200 SiAlON Nozzles offer service life and durability similar to tungsten carbide, but are only about half the weight. BP200 SiAlON nozzles are an excellent choice when operators are on the job for long periods and prefer a lightweight nozzle.

Boron Carbide Nozzles provide long life with optimum air and abrasive use. Boron carbide is ideal for aggressive abrasives such as aluminum oxide and selected mineral aggregates when rough handling can be avoided. Boron carbide will typically outwear tungsten carbide by five to ten times.

ROCTEC® Composite Carbide Nozzles provide even longer life than that of boron carbide nozzles. We currently offer two grades of this popular "binderless" tungsten carbide hard material: ROCTEC® 100 and ROCTEC® 500. This nozzle material is ideal for applications using aggressive abrasives like aluminum oxide and silicon carbide. Special angle nozzles, industrial gun inserts for the popular styles, etching nozzles, and pencil blast nozzles are a few special types of nozzles currently available. Contact us when you have precision requirements in blasting, drilling, or cutting to see if your current nozzle styles are available in ROCTEC®.

Service Life Comparisons

Approximate Service Life in Hours

nozzle material	steel shot/grit	slag	aluminum oxide
Aluminum Oxide	20 – 40	10 – 30	1 – 4
Tungsten Carbide	500 – 800	300 – 400	20 – 40
BP200 SiAlON	500 – 800*	300 – 400	50 – 100
Boron Carbide	1500 – 2500	750 – 1500	200 – 1000
ROCTEC®	2500 – 5000+	1500 – 3000+	1000 – 2000+

Estimated values for comparison. Actual service life will vary depending on blast pressure, media size, and particle shape.
* Not recommended for 'H' hardness steel shot/grit.

Reduce Nozzle Replacement Costs

Kennametal's nozzle replacements may cost more initially, but provide much longer service life. The per-hour cost with Kennametal nozzles can be a fraction of the cost of cheaper nozzles.

Proven Methods to Increase Nozzle Service Life

1. Avoid dropping or banging nozzles against anything — materials can break.
2. Be sure to use a nozzle designed for your application and the abrasive you wish to use.
3. Always use the new gasket or washer supplied with your nozzle or nozzle insert. It can help prevent the nozzle's entry throat from being blasted away. Inspect and replace, if necessary, the gasket, or washer after every 10 to 20 hours of use.
4. If you are using a Kennametal nozzle in a flanged holder, rotate the nozzle a quarter turn each week. This will help to ensure more uniform wear and prolong nozzle life.

Inspect and Replace Nozzles

How much wear is too much?

Here are three simple tests:

1. Insert a drill bit of a size that matches the original bore of the nozzle. If there's any slop, it's time to replace it. Nozzle wear means pressure loss. Pressure loss means lost productivity, there is a 1-1/2% loss of productivity for every pound of air pressure lost.
2. Hold an open nozzle up to the light and look down the bore. Any ripple or orange peel effect inside the carbide liner will create internal turbulence that reduces abrasive velocity. If you notice any uneven wear or pressure drop, it's time to replace.
3. Check the nozzle's exterior, too. The materials used to build nozzles are tough, but can be brittle. Nozzle jacketing materials are designed to help protect breakable liners from impact damage. If the jacket is cracked or dented, chances are the liner is also cracked. If the liner is fractured, even with hairline cracks, the nozzle should be replaced immediately. It is not safe to use a cracked nozzle.

   Remember that all nozzles will eventually wear out. Keep a supply of back-up nozzles on hand to minimize down time.

Comparing Nozzle Costs

Based on approximate nozzle service life using aluminum oxide abrasive. (Amounts in US$)

	Boron Carbide	Tungsten Carbide
approximate nozzle cost	$80	$35
nozzle life in hours*	200	28
cost per hour*	$0.40	$1.20

*Performance may vary based upon pressure, abrasive grit size, quality, and other variables. These data are based on comparative testing under controlled conditions.