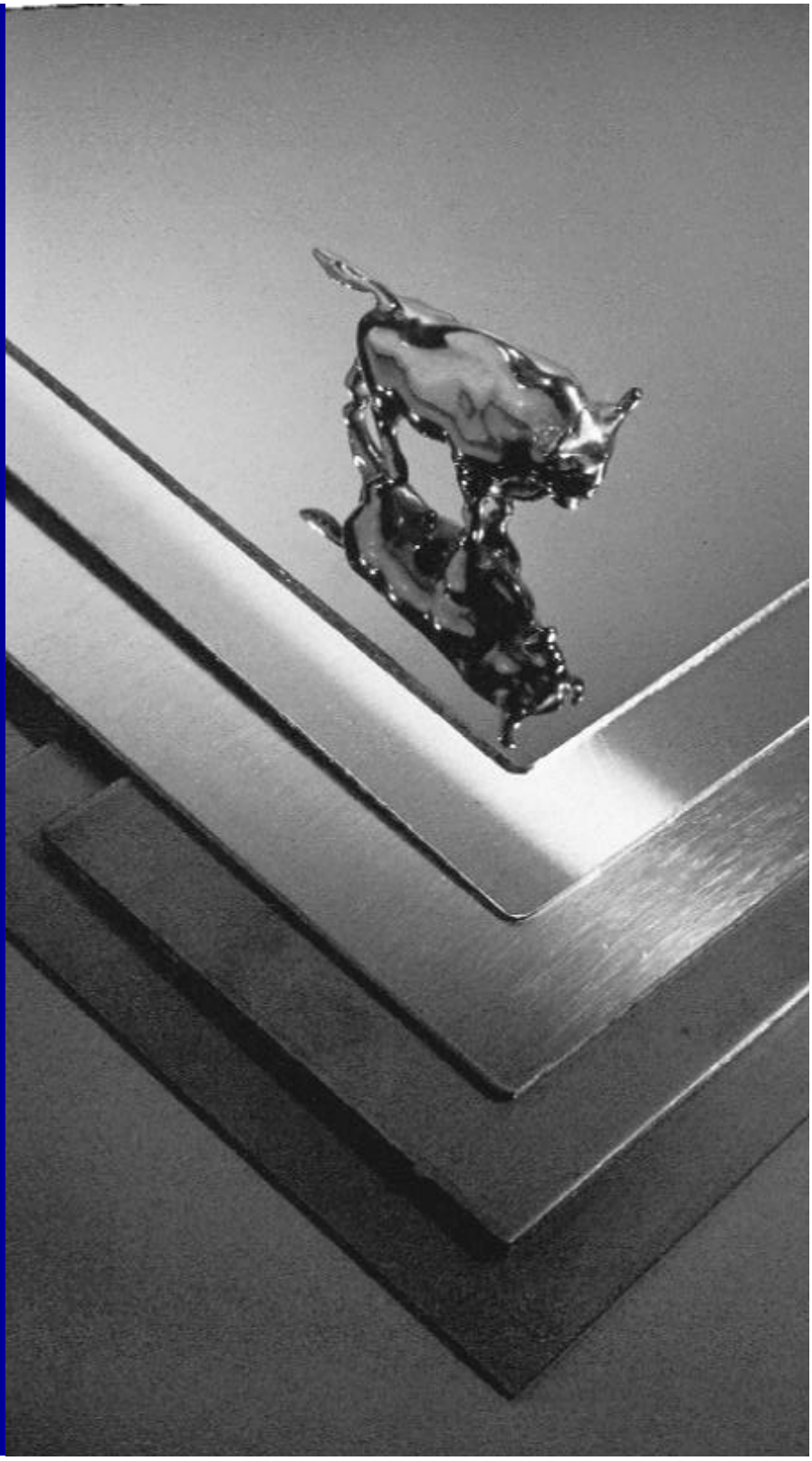
STAINLESS

SOLUTIONS

PRODEC PLATE



PRODEC®--An innovation that is the

Smartest

If you're looking to substantially lower your total cost for machined parts in austenitic stainless steel PRODEC is the answer.

PRODEC is produced exclusively by Avesta Sheffield, to give you PRODuction EConomy.

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THE BEST CHOICE FOR MACHINING APPLICATIONS

PRODEC® is a special quality of austenitic stainless steel plate (and bar), produced for optimal machinability in code-quality plate PRODEC plate is designed to give lower cost machined parts with better final surface and dimensional tolerances. PRODEC plate is a premium quality of stainless steel with consistent properties throughtout each plate - from plate to plate, and from heat to heat.

With PRODEC plate you're assured of corrosion resistance equal or superior to conventionally produced stainless steel of the same grade. PRODEC plate shows the same yield strength, tensile strength, elongation, hardness, and toughness as conventionally produced plate.

BEST QUALITY PARTS FOR THE LOWEST TOTAL COST

Compared with conventionally produced stainless steel, PRODEC machinable stainless steel offers significant benefits to manufacturers, including:

- faster machining - allowing higher spped and feeds with either carbide or high speed steel tooling
- longer tool life
- better dimensional tolerances in machined parts
- superior machined surface quality and integrity
- reduced scrap losses
- consistent performance, enabling on-schedule production.

PRODEC plate applications range from paper machinery, vacuum processing, and equipment used in food and pharmaceutical production, to end plates in commercial nuclear power plant reactors.

A SPECIAL PROCESS FOR A SPECIAL STEEL QUALITY

Using special ladle injection metallurgy and proprietary production techniques, the unique PRODEC process controls the composition, amount, size, shape, and distribution of the nonmetallic inclusions.

PRODEC meets all ASTM and ASME requirements, as well as international standards and codes. And PRODEC plate requires no special handling with respect to forming, welding, or heat treatment.

Our complete line of PRODEC quality stainless steel is available for delivery from stocking distributors across North America, in a full range of sizes in 304, 304L, 316, and 316L plate.

BENEFIT FROM OUR EXPERIENCE -- THE NEWEST FROM THE OLDEST

Avesta Sheffield has been making stainless steel since it was invented for the production of fine cutlery in Sheffield, England and since it was first mass produced in Avesta, Sweden. Even today, stainless steel is our only product.

For eight decades we've provided innovative solutions to meet the special needs of our customers in industries from pulp and paper and aerospace to breweries and nuclear power plants. And we continue to lead the way in developing new grades, new qualities, and new product forms.

Cutting, Turning, and Milling of PRODEC® Plate

Turning

PLASMA CUTTING

PRODEC plate can be plasma cut, just like conventionally produced stainless steel plate. The exact results obtained in plasma cutting are dependent on the equipment and parameters used in each application. However, experience has demonstrated that the plasma-cut edge of the PRODEC plate is straighter (less "flare") than that for conventional plate. Also, for each plasma cutting setup, the degree of oxidation and roughness of the edge are consistently less for the PRODEC plate. It has been shown that the PRODEC plate plasma-cut edge is readily machined with heavy roughing parameters. Significant savings have been achieved in production of some parts by using the plasma-cut shapes, where previously it was necessary to deal with the "hard edge" in more costly approaches.

BAND SAWING

Band sawing of conventionally produced stainless steel plate is often less than satisfactory because it is difficult to obtain high enough feed rates. So the saw blade steel is always cutting in the stainless steel that has been "smeared" by the prior cutting. The work hardening that is characteristic of all austenitic stainless steels causes this low-feed cutting to be highly abrasive to the saw blade, leading to both significant tooling costs and to "wander" in the cutting. However, PRODEC plate will cut better in band sawing. With a powerful saw that has good steadying of the blade and good coolant flow, the PRODEC stainless steel plate will cut more economically and with a significantly better straightness and final surface quality. Starting

		CUTTING SPEED, sfm			
FEED in/rev (mm/rev)	**CUTTING DEPTH in (mm)**	**CEMENTED CARBIDES GRADE C8(P10)**	**C7(P20)**	**C5-C6(P35)**	**HIGH SPEED STEEL**
≤0.012 (<0.3)	≤0.08 (<2)	750-820 (230-250)	625-660 (190-200)	-	100-130 (30-40)
0.012-0.020 (0.3-0.5)	0.08-0.200 (2-5)	-	560-590 (170-180)	450-490 (140-150)	80-115 (25-35)
0.020-0.040 (0.5-1.0)	0.200-0.400 (5-10)	-	295-330 (90-100)	260-295 (80-90)	50-65 (15-20)

NOTES

1. When turning through a plasma-cut edge use C5 insert with speed of 330-490 sfm (100-150 m/min), 0.015-0.025 in./rev (0.4-0.6 mm/rev), with sufficient depth to remain fully in the piece, and with a rugged but strongly positive chipbreaker.

2. For equal tool life, 316 should favor the lower end of the speed ranges and 304 the higher end.

3. Coolant may be applied in all cases, but is necessary only for finishing operations.

Face Milling with Carbide Tooling

	CUTTING SPEED, sfm (m/min)		FEED	CARBIDE GRADE
	304, 304L	**316, 316L**	in./tooth (mm/tooth)	**(in/rev)**
Roughing	590-820 (130-250)	490-660 (150-200)	0.006-0.012 (0.15-0.30)	C6-C8 P30-P10
Finishing	900-1070 (275-325)	820-1000 (250-305)	0.003-0.006 (0.08-0.15)	C6-C8 P30-P10

NOTES

1. Coolant should be used only for finishing operations (depths <0.020 in. (0.5 mm)).
2. Coated inserts are recommended for roughing. Uncoated inserts may be used for finishing when an exceptionally smooth finish is required.
3. For best cutting, a highly positive axial rake (15°) and a neutral to slightly positive radial rake are recommended.

Face Milling with High Speed Steel Tooling

	CUTTING SPEED, sfm (m/min)		FEED
	304, 304L	316, 316L	in./tooth (mm/tooth)
Roughing	80-100 (25-30)	65-80 (20-25)	0.005-0.008 (0.12-0.20)
Finishing	100-130 (30-40)	80-100 (25-30)	0.002-0.004 (0.085-0.10)

NOTES

1. With TiN coated tools, the speed can be increased by up to 50%.
2. Generous flow of coolant, e.g., a 5-10% synthetic coolant/lubricant.
3. Attention should be given to chip removal to prevent chips from re-entering cutter.

blanks may be band sawed more quickly and with better economy, and in some cases, band sawing has been sufficient to make an acceptable finished part size tolerance.

Side and End Milling with Cemented Carbides

	CUTTING SPEED, sfm (m/min)		FEED	CARBIDE GRADE
	304, 304l	316, 316l	in./tooth (mm/tooth)	
Side	660-820 (200-250)	590-720 (180-220)	0.004-0.012 (0.10-0.30)	C5-C7 (P40-P20)
End	660-720 (200-220)	590-660 (180-200	0.004-0.006 ((0.10-0.15)	C5-C7 (P40-P20)
End*	295-330 (90-100)	260-330 (80-90)	0.002-0.006 (0.05-0.15)	C8 (P10)

* Solid cemented carbide.

NOTES

1. Exposed length of tool should be no greater than necessary for machining with good access to part.
2. Use coolant for finishing operations only.
3. Use coated inserts for roughing, uncoated inserts for finishing with fine surface.

Side and End Milling with High Speed Tools

	CUTTING SPEED, sfm (m/min)		FEED
	304, 304L	316, 316L	(in./tooth (mm/tooth)
Side	115-130 (35-40)	100-115 (30-35)	0.006-0.012 (0.15-0.30)
End	80-100 (25-30)	65-80 (20-25)	0.001-0.004 (0.02-0.10)

NOTES

1. Use coolant/lubricant in all cases.
2. Exposed length of tooling should be no greater than necessary.
3. For end milling, maximum depth should be no greater than 0.5 times tool diameter.
4. With TiN-coated tools, speed can be increased by up to 50%.

CARBIDE SAWING

Precision sawing of conventionally produced stainless steel plate, especially for larger pieces with long lengths of cut, has always been difficfult because of the high work hardening response of stainless steel. However, with PRODEC plate and a powerful saw that has good rigidity in the presentation of the plate and cut part, it is possible to produce long cuts of exfellent straightness and part width tolerance, such as ±0.030 for standard cutting and ±0.010 inch for specified precision cut parts. Such saws must be of rugged design to maintain saw presentation and must be capable of rigid clamping of both the plate3 and the off-cut piece to prevent vibration and tool wear. Particular success has been found for the MET*L® ferrous metals saw that is designed with a good clamping system and a rugged saw drive for an aggressive "climb" cutting of stainless steel. The edge quality produced and shape tolerance of parts that are precision sawed are excellent. Sawing has been accepted as an economical approach both to blanking and to producing the final part outer dimension.

Drilling, Reaming, and Tapping of PRODEC® Plate

Drilling with High Speed Steel Twist Drills

DRILL DIAMETER IN. (MM)	SPEED rpm	SPEED sfm (m/min)	FEED in./rev (mm/rev)
0.040 (1)	3200-3800	33-40 (10-12)	0.0015 (0.04)
0.12 (3)	1260-1270	33-40 (10-12)	0.004 (0.10)
0.20 (5)	760-890	40-46 (12-14)	0.008 (0.20)
0.40 (10)	380-480	40-50 (12-15)	0.012 (0.30)
0.60 (15)	250-320	40-50 (12-15)	0.016 (0.40)
0.80 (20)	190-240	40-50 (12-15)	0.018 (0.45)
1.20 (30)	130-160	40-50 (12-15)	0.022 (0.55)
1.60 (40)	95-120	40-50 (12-15)	0.024 (0.60)
2.00 (50)	80-100	40-50 (12-15)	0.024 (0.60)
2.40 (60)	60-80	40-50 (12-15)	0.026 (0.65)

NOTES

1. Cutting fluid should provide both cooloing and lubrication, e.g., an ample flow of 10% emulsion coolant
2. When drilling with short NT drills, the feed may be increased by about 25%.
3. When drilling to depth greater than 2 to 4 times the drill diameter, peck with hole clearance to clear chips and provide for coolant access to depth of hole.
4. When using TiN-coated HSS drills, the speed may be increased by about 10%.
5. For oil hole drills, the speed may be increased by up to 25%.
6. Cobalt alloyed high speed steel drills are harder, but lower in toughness. For best tool life without drill breakage, cobalt should be 2 to 3% for drills with diameter less than 1 inch (25 mm), and greater than 3% for drills with diameter greater than 1 inch (25 mm).
7. Point angle should increase with increasing drill diameter.
8. When drilling vertically, care should be taken to avoid short chips falling back into the hole during a peck cycle. For smaller diameters, where there is limited shipbreaking, the drilled length between pecks may be increased. For larger diameters with good chipbreaking, a slightly lower point angle may be used to increase the chip length.
9. For best tool life and tolerances, a self-centering drill geometry should be used.
10. It is not normally necessary to "point" the hole prior to drilling.

Drilling with Indexable Carbide Insert Drills

DRILL DIAMETER in. (mm)	SPEED sfm (m/min)	FEED in./rev (mm/rev)
O.8 (20)	590-820 (180-250)	0.004 (0,10)
1.2 (30)	590-820 (180-250)	0.005 (0.12)
1.6 (40)	590-820 (180-250)	0.006 (0.15)
2.0 (50)	590-820 (180-250)	0.008 (0.20)

NOTES

1. The center insert is typically a tougher grade of cemented carbide and the periphery insert is a harder grade, each suitable for the range of speeds at those positions.
2. Cutting data for indexable insert drills are hightly dependent on the make of the drill; the manufacturer's recommendations should be considered.
3. Stability of chip fow from the hole is essential. Lower speeds and feeds may promote unstable chip flow, resulting in tool breakdown.

Reaming

REAMER DIAMETER	CUTTING SPEED, sfm (m/min)		FEED
in. (mm)	CEMENTED CARBIDE	HIGH SPEED STEEL	in./rev (mm/rev)
<0.4 (<10)	165 (50)	33-50 (10-15)	0.00400.008 (0.10-0.20)
0.4-0.8 (10-20)	165 (50)	33-50 (10-15)	0.008-0.020 (0.20-0.50)
>0.8 (>20)	165 (50)	33-50 (10-15)	0.020-0.028 (0.50-0.70)

NOTES

For best results, the coolant/lubricant should emphasize enhanced lubricating properties.

Tapping

TOOL	CUTTING SPEED sfm (m/min)
High Speed Steel	33-40 (10-12)

NOTES

1. Results may be substantially influenced by a particular tool design.
2. It is important to select a lubricant that will remain with the tool as it progresses, ideally one with high-pressure lubricating additives.
3. The superior roundness and reduced work hardening of the drilled hole in PRODEC plate provides significant improvement in this operation, which is sometimes difficult or inconsistent in conventionally produced plate.

Thread Milling With Cemented Carbides

	WITH COOLAND		WITHOUT COOLANT	
	CUTTING SPEED, sfm (m/min)	FEED, in./tooth (mm/tooth)	CUTTING SPEED, sfm (m/min)	FEED, in./tooth (mm/tooth)
Internal	195-260 (60-80)	0.004-0.008 (0.10-0.20)	590-920 (180-280)	0.003-0.008 (0.08-0.20)
External	260-395 (80-120)	0.008-0.016 (0.20-0.40)	655-1150 (200-350)	0.006-0.012 (0.15-0.30)

PRODEC technology is supported by our experienced metallurgy specialists in North America and backed by the Avesta Sheffield machining laboratory in Sweden.

The Avesta Sheffield team will be pleased to review individual applications, provide machining data, and assist in machining program development with on-site demonstrations.

PRODEC® technology is supported by metallurgists based at the Avesta Sheffield Inc. headquarters in Schaumburg, Illinois and at regional locations around the United States and Canada. With direct experience in the machining of PRODEC plate and bar, and with access to the Avesta Sheffield machining laboratory in Sweden, these specialists are dedicated to assisting users of PRODEC stainless steel plate and bar.

Avesta Sheffield is prepared to review individual applications with fabricators and end users and to provide machining data and on-site demonstration and assistance in machining program development.

Avesta Sheffield PRODEC stainless steel plate and bar are available in a full range of sizes from stocking distributors all over the United States and Canada. Special sizes are available upon inquiry from production at Avesta Sheffield facilities in the United States.

Stainless Solutions. From the Start, for the Future

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