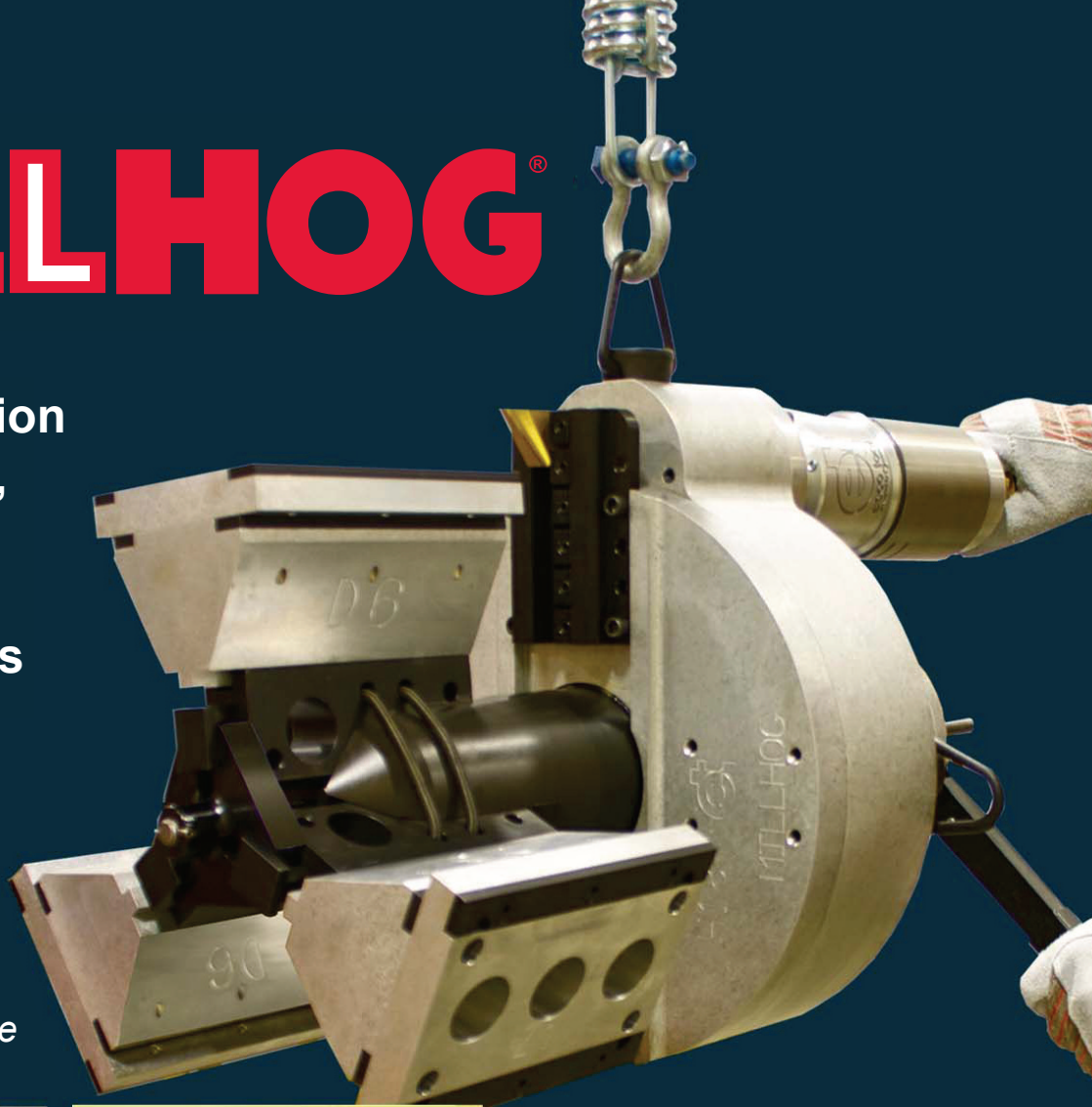


MILLHOG®

**Portable Precision
End Prep Tools,
Abrasive Saws,
Track Systems
and Accessories**

*For Cutting
and Machining
Tube, Pipe,
Pipelines, Boiler
Tube Panels, and more*



*Manufacturer and market leader,
We deliver cutting edge innovation*



et
esco tool®

Manufactured in the U.S.A.

24 Hour Shipment or less, usually available

For over 50 years, Esco Tool has worked closely with end-users on the toughest tube and pipe cutting and end prep applications in the power generation and metalworking industries. Our knowledge and experience has allowed us to invent and manufacture high quality tools that work efficiently and require no special operator training.

This catalog describes our rugged MILLHOG® tools, High-Speed Bevelers and accessories. These tools are built tough and precision machined from the finest materials to make sure that you get your job done properly, on time, and under budget.



The Esco Quality Commitment...

Esco MILLHOG® End Prep Tools are built tough and precision machined from the finest materials.

- **Sturdy Gear Drive**—We select the best components available today. For example, the "Wart" MILLHOG® features dual opposed tapered roller bearings, two ball bearings that support the link between the drive shaft and right angle gear assembly and a bearing supported cutterhead, providing optimum rigidity and stability.
- **Rigid I.D. Clamping**—All MILLHOGS provide torque-free operation and incorporate self-centering draw rod assemblies that rigidly mount to the tube or pipe I.D.
- **EscoLock Blade Lock System**—This wedge lock design creates a superior blade holding force which minimizes vibration, a primary cause of premature blade failure.
- **Superior Bevel Blade Design**—Providing more end preps per bevel blade, Esco's unique chip breaker helps produce a continuous chip which minimizes heat buildup on the blade. All MILLHOG® blades are made of T-15 tool steel which is TiN (titanium nitride) coated. They work on all boiler tube materials, including stainless steel, and are designed to run cooler and produce 2 to 5 times more bevels per blade than competitive blades, without cutting oil.

Esco MILLHOG® Universal Air-Powered Saws provide accurate cuts with no "HAZ" (Heat Affected Zone).

- **Boilermaker Tough and Field Proven**—The PANELHOG® saw glides along the EscoTrack System and produces a straight, clean horizontal cut that requires no further rework for boiler tube panel removal.
- **Pipe Cutting Made Easy**—The EscoWrap Track System is ideal for cutting pipe from 6" to 60" O.D. by 4" wall thickness. This innovative universal pipe trolley and clamp assembly mounts to the pipe and lets the saw glide around the circumference making a perfectly square cut with no heat affected zone.
- **Esco Tool, The World Leader In Boiler Maintenance Tools**—For over 50 years we have worked closely with end-users to solve the toughest maintenance and construction problems in the power generation and metalworking industries.
- **No Special Training Required**—All Esco Tools are rugged, reliable, versatile, and easy to operate so you can get your job done properly, on-time, and under budget.

We pledge to provide you with the finest and most innovative tools and accessories available today and to support them with fair, prompt, and courteous service.

Matthew Brennan

Matthew Brennan, *President*

How to Order



You may contact your local Esco representative
or contact Esco Tool directly by telephone at

508.429.4441 (worldwide)

800.343.6926 (U.S. & Canada)

FAX: 508.429.2811 • e-mail: millhog@escotool.com • www.escotool.com

Typical Applications

- End prepping super duplex pipe
- End prepping high chrome tubes
- Membrane and weld overlay removal from tube O.D.
- Flat facing tube or pipe
- 37 1/2° bevel tube or pipe
- 30° bevel tube or pipe
- Peel back on stainless clad tubes
- Tube sheet seal weld removal
- Tube sheet strength weld removal
- Tube stub removal
- Tube seal weld removal
- Facing fin fan tubes
- Compound bevel for heavy wall pipe step bevel for composite tubes
- Counterboring
- J-preps
- Sawing of waterwall panels
- Notching of membrane
- Slotting of membrane
- Sawing pendant tubes
- Sawing single tubes
- Sawing pipe 6" to 60" dia.
- Sawing concrete lined pipe
- Sawing tanks of any diameter
- Flex Track for custom sawing curved surfaces
- Cut-off of pipe ends
- Flange facing
- Grooving of pipe O.D.
- Hand hole cap removal
- Beveling for window welds
- High speed beveling
- Track mounted beveling

Capabilities Chart

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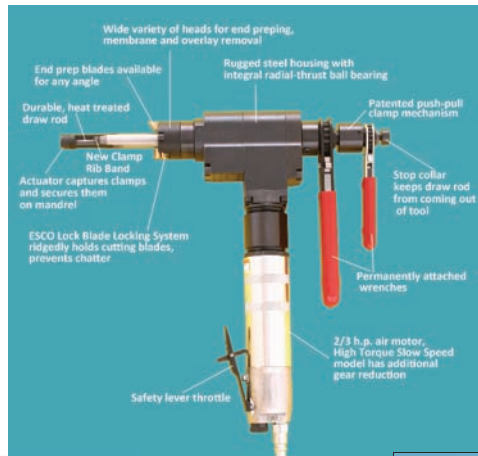
Millhog End Prep Tools	1/2" 12.7mm	1" 25.4mm	2-1/4" 57.15mm	3" 76.2mm	4-1/2" 114.3mm	6-5/8" 168.3mm	8-5/8" 219.1mm	12-3/4" 323.9mm	14" 355.6mm	16-1/4" 412.8mm	18" 460mm	36" 920mm
"Ground" MILLHOG®												
"Mongoose" MILLHOG®												
"Tube Weasel" MILLHOG®												
"Wart" MILLHOG®												
"Fin" MILLHOG®												
"Mini" MILLHOG®												
"C-Hog" MILLHOG®												
"Prepzilla" MILLHOG®												
"Commander" model C-314 MILLHOG®												
"Dictator" model D-418 MILLHOG®												
"Terminator" MILLHOG®												
High Speed End Prep Tools												
HHB-5,000												
HHB-5,000RA												
HHB-10,000												
HHB-10,000RA												
Saws for Boiler Tube Panels/Pipe/Tanks												
APS-438 (Boiler Tube Panel Cutting)												
APS-438LP (Boiler Tube Panel Cutting)												
APS-438 w/Trolley (Pipe Cutting)												and larger
APS-438 (Built in Trolley for Pipe Cutting)												and larger

"Ground" MILLHOG®

Right Angle I.D. Clamping End Prep Tool
0.5" I.D. to 2.25" O.D.
12.7 mm I. D. to 57.15 mm O. D.

Key Features

- Patented push-pull clamping and release system
- Self-centering torque-free operation
- Permanently attached clamps and wrenches
- Rigidly mounts to tube I.D., easy to release
- Sealed construction allows use in any orientation
- Produces a smooth, continuous chip
- Compact, low-maintenance end prep tool
- Performs any angle of bevel
- Steel housing with integral radial-thrust ball bearing
- Chatter-free cutter blade locking design
- Uses TiN coated cutter blades



Available in three styles;
Standard
Air Clamp
High Torque Slow Speed



The new improved G Series Retention Band for G-01A, G-02A & G-03A Clamp Ribs is captured within the Clamp Ribs, is extremely durable, will not slip off and is unaffected by repetitive cycling.



The patented push-pull I.D. clamping system makes disengaging the tool from the tube as easy as clamping it and the blades are securely held in place by the EscoLock blade lock system to provide smooth, chatter-free operation.

Standard



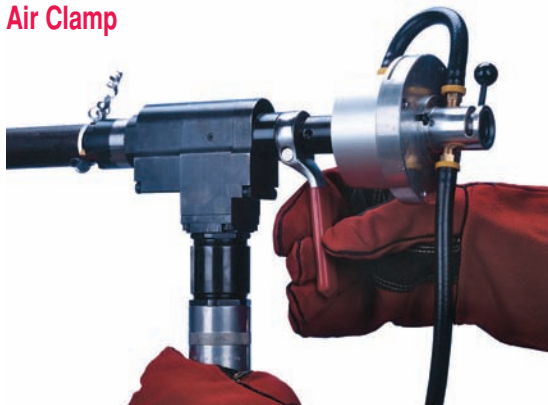
The Standard Ground is only 1.5in wide and is ideal for end prepping all boiler tube materials and accessing single tubes in a boiler tube waterwall. It can also be equipped with a membrane removal head for removing membrane from boiler tubes.



Ground Standard Kit includes:

Gear Head, 2/3 Pneumatic HP Motor, Draw Rod, .625in Mandrel (.500in Mandrel may be substituted; consult factory), Hose with couplings, dirt stopper and oiler, Carrying Case & Foam, and Operating Instructions.

Air Clamp



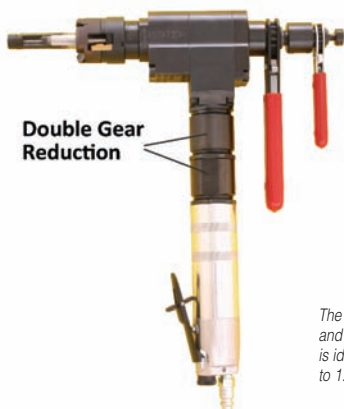
Ground Air Clamp Kit includes:

Gear Head, 2/3 Pneumatic HP Motor, Air Clamp, Draw Rod Assembly, .625in Mandrel (.500in Mandrel may be substituted; consult factory), Hose with couplings, dirt stopper and oiler, and Carrying Case.

The Ground Air Clamp instantly clamps and releases the tool from the tube or pipe i.d. This simple innovation is easy to use, increases production and minimizes operator fatigue by eliminating the tedious and time consuming task of manual clamping.

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High Torque Slow Speed



The Ground High Torque has an additional gear reduction that reduces the rpm and doubles the torque at the cutting edge of the Insert and Blade. This Combination is ideal for removing Membrane as well as Overlay from boiler tubes from .875in o.d. to 1.25in o.d.



MRB-8 inserts do not use screws, are easily removed and rotated to utilize the 360 deg cutting edge.

Ground High Torque Slow Speed Kit Includes:

Gear Head, 2/3 HP High Torque Motor with dual gear reduction, Draw Rod, .625in Mandrel (.500in Mandrel may be substituted; consult factory), Hose with couplings, dirt stopper and oiler, Carrying Case & Foam, and Operating Instructions.

Ground Clamp Rib Selector and corresponding spares

Mandrel, Draw Rod, Actuator, Retention Band and Springs

Clamp Rib Set	I.D. Range				Mandrel		Draw Rod	Actuator	Roll Pin	Retention	
	in	mm	in	mm	Part #	Size				Band	Spring
G-01A	.500	.655	12.7	16.6	G-204	.500"	G-18A	G-17A	G-15A	G-14E	
G-02A	.625	.780	15.9	19.8	G-20	.625"	G-18	G-16	G-15	G-14F	
G-03A	.750	.905	19.1	22.9	G-20	.625"	G-18	G-17	G-15	G-14F	
G-04	.875	1.030	22.3	26.1	G-20	.625"	G-18	G-17	G-15		G-14
G-05	1.00	1.155	25.4	29.3	G-20	.625"	G-18	G-17	G-15		G-14
G-06	1.125	1.280	28.6	32.5	G-20	.625"	G-18	G-17	G-15		G-14
G-07	1.250	1.405	31.8	35.6	G-20	.625"	G-18	G-17	G-15		G-14
G-08	1.375	1.530	35.0	38.8	G-20	.625"	G-18	G-17	G-15		G-14
G-09	1.500	1.655	38.1	42.0	G-20	.625"	G-18	G-17	G-15		G-14
G-10	1.625	1.780	41.3	45.2	G-20	.625"	G-18	G-17	G-15		G-14
G-11	1.750	1.905	44.5	48.3	G-20	.625"	G-18	G-17	G-15		G-14
G-12	1.875	2.030	47.7	51.5	G-20	.625"	G-18	G-17	G-15		G-14
G-13	2.000	2.155	51.0	54.7	G-20	.625"	G-18	G-17	G-15		G-14



MRB-8 tapered inserts are used on the patented ESCO Overlay and Membrane removal heads. They are easily installed and are not held by screws that can break.

Specifications: Ground Millhog

Working Range	1/2" (12.7 mm) I.D. to 2-1/4" (57.15 mm) O.D."
Motor, pneumatic	2/3 h.p. (.497 kw)
Air Pressure	90 psi (6.2 bar)
Air Volume	25 cfm (708 lt/min)
Speed	
Standard & Air Clamp	200 RPM
High Torque Slow Speed	100 RPM
Minimum Clearance	
Standard at cutterhead	1-1/2" (38.1 mm)
Air Clamp at cylinder	3-5/8" (92.1 mm)
High Torque Slow Speed at membrane or overlay head	1-7/8" (47.6 mm)
Head Length	
Standard	14" (355.6 mm)
Air Clamp	16" (406.4 mm)
High Torque Slow Speed	14" (355.6 mm)
Working weight	
Standard	9.0 lbs (4.1 kg)
Air Clamp	11 lbs (5.0 kg)
High Torque Slow Speed	9.5 lbs (4.31 kg)
Shipping Weight	
Standard	40 lbs (18.2 kg)
Air Clamp	55 lbs (25 kg)
High Torque Slow Speed	42 lbs
Shipping Dimensions	
Standard	20" x 18" x 5" (508 mm x 457 mm x 127 mm)
Air Clamp	24" x 20" x 7" (610 mm x 508 mm x 178 mm)
High Torque Slow Speed	20" x 18" x 5" (508 mm x 457 mm x 127 mm)

Manufacturer reserves the right to change specifications without notice.

Cutterhead Blade Lock and Screws

Cutterhead		Mandrel		Blade Lock		Lock Screw	
Part #	Size	Part #	Size	Part #	Per Head	Part #	Per Lock
G-206	1.500	G-204	.500"	G-22	2	G-21	1
G-23	1.500	G-20	.625"	G-22	2	G-21	1
G-24	2.000	G-20	.625"	G-22A	2	G-21	1
G-25	2.250	G-20	.625"	G-22	4	G-21	1

Membrane Removal Heads

Membrane Head		Base Head	Inserts	
Size	Part #	Part#	Part #	Qty
.875	MO-100	GB-100	MRB-8	3
1.000	MO-101	GB-101	MRB-8	4
1.125	MO-102	GB-102	MRB-8	4
1.187	MO-103	GB-103	MRB-8	4
1.250	MO-104	GB-102	MRB-8	4

For the Ground Std and Ground High Torque Slow Speed.

Overlay Removal Heads

Overlay Head		Base Head	Inserts	
Size	Part #	Part#	Part #	Qty
.875	MO-200	GB-100	MRB-8	3
1.000	MO-201	GB-101	MRB-8	4
1.125	MO-202	GB-102	MRB-8	4
1.187	MO-203	GB-103	MRB-8	4
1.250	MO-204	GB-102	MRB-8	4

For Ground High Torque Slow Speed.

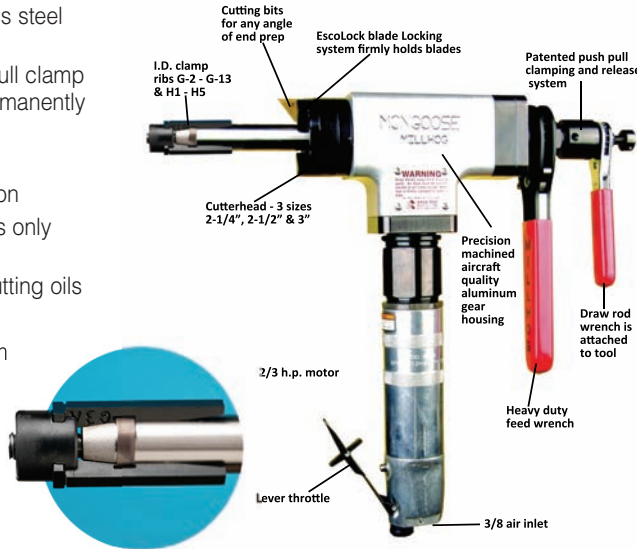
"Mongoose" MILLHOG®

Right Angle I.D. Clamping End Prep Tool
Operating Range
5/8" I.D. to 3" O.D.
15.9mm to 76.2mm

Key Features

- Bevels, faces and bores stainless steel and other highly alloyed tubing
- Patented, self-centering, push-pull clamp and release mechanism has permanently attached wrenches
- Only 2-1/4" wide
- Rugged with torque-free operation
- Powerful pneumatic motor needs only 25 CFM air flow
- Produces a thick chip without cutting oils
- Easy-to-change mandrels
- EscoLock™ blade locking system

Available in three styles;
Standard
Air Clamp
High Torque Slow Speed



The new improved G Series Retention Band for G-01A, G-02A & G-03A Clamp Ribs is captured within the Clamp Ribs is extremely durable, will not slip off and is unaffected by repetitive cycling.

Rugged, fast, and field-proven

The ESCO "Mongoose" MILLHOG®, is a lightweight, small diameter end prep tool for beveling tubes from 5/8" I.D. to 3" O.D. Featuring a patented push-pull clamp and release mechanism, it allows the clamps to release from a tube as easily as they tighten. Ideal for performing bevel facing and boring on a wide range of tube and pipe alloys, the Mongoose has dual opposed tapered roller bearings and employs the rigid EscoLock™ blade locking system to provide chatter-free performance and produce a thick chip without cutting fluids.

Available with 5/8" and 3/4" mandrels and a 1-1/4" wedge, every Mongoose includes attached heavy-duty mandrel wrenches for centering and securing the tool to the I.D. The 1-1/4" wedge attaches to the 3/4" mandrel and uses the H series Wart MILLHOG® clamp ribs with nearly 1/2" expansion, making it easy to clamp-up and release while requiring a minimum of ribs to cover a range of 1.375" i.d. to 3" o.d.

Standard



The Standard Mongoose is ideal for end prepping all boiler tube materials and is only 2.25" wide for accessing single tubes in a boiler tube waterwall. It can also be equipped with a membrane removal head for removing membrane from boiler tubes.



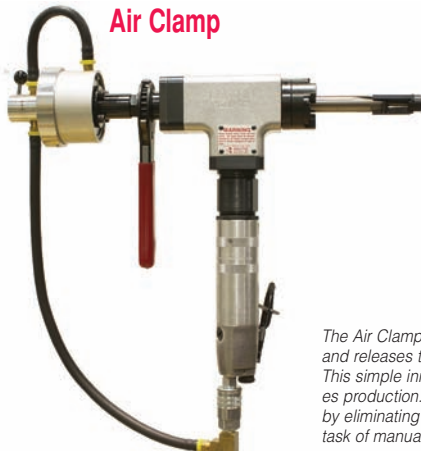
The ESCO patented membrane and overlay removal heads use round, tapered inserts that easily install with a tap of a hammer.



Mongoose Standard Kit includes:

Gear Head, 1-1/14 Pneumatic HP Motor, Draw Rod Assembly, .750in Mandrel (.625in Mandrel may be substituted; consult factory), Hose with couplings, dirt stopper and oiler, and Carrying Case.

Air Clamp



The Air Clamp Mongoose instantly clamps and releases the tool from the tube or pipe i.d. This simple innovation is easy to use, increases production, and minimizes operator fatigue by eliminating the tedious and time consuming task of manual clamping.

Mongoose Air Clamp Kit includes:

Air Clamp Assembly, Gear Head, 2/3 Pneumatic HP Motor, Draw Rod Assembly, .750in Mandrel (.625in Mandrel may be substituted; consult factory), Hose with couplings, dirt stopper and oiler, and Carrying Case.



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"Mongoose" MILLHOG®

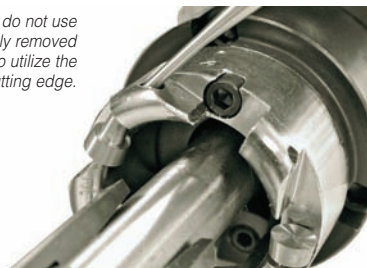
High Torque Slow Speed



The High Torque Mongoose is equipped with a powerful 1.25 hp Slow Speed motor. Its narrow 2.25" wide gear head and wide range of mandrels make it ideal for removing boiler tube Membrane as well as Overlay from 1.187" i.d. to 2.00" i.d.



MRB-8 inserts do not use screws, are easily removed and rotated to utilize the 360 deg. cutting edge.



Mongoose High Torque Slow Speed Kit includes:

Gear Head, 1-1/14 Pneumatic HP Motor, Draw Rod Assembly, .750in Mandrel (.625in Mandrel may be substituted; consult factory), Hose with couplings, dirt stopper and oiler, and Carrying Case.

Mongoose Clamp Rib Selector and corresponding spares

Mandrel, Draw Rod, Actuator, Retention Band and Springs

Clamp Set	I.D. Range		Mandrel		Draw Rod	Actuator	Roll Pin	Retention	
	in	mm	Part #	Size				Band	Spring
G-02A	.625	.780	MG-38A	.625	MG-16	MG-01A	MG-14	G-14F	
G-03A	.750	.905	MG-38	.750	MG-16	MG-01	MG-14	G-14F	
G-04	.875	1.030	MG-38	.750	MG-16	MG-01	MG-14		G-14
G-05	1.000	1.155	MG-38	.750	MG-16	MG-01	MG-14		G-14
G-06	1.125	1.280	MG-38	.750	MG-16	MG-01	MG-14		G-14
G-07	1.250	1.405	MG-38	.750	MG-16	MG-01	MG-14		G-14
G-08	1.375	1.530	MG-38	.750	MG-16	MG-01	MG-14		G-14
G-09	1.500	1.655	MG-38	.750	MG-16	MG-01	MG-14		G-14
G-10	1.625	1.780	MG-38	.750	MG-16	MG-01	MG-14		G-14
G-11	1.750	1.905	MG-38	.750	MG-16	MG-01	MG-14		G-14
G-12	1.875	2.030	MG-38	.750	MG-16	MG-01	MG-14		G-14
G-13	2.000	2.155	MG-38	.750	MG-16	MG-01	MG-14		G-14
H-01	1.375	1.600	MG-38 & MG-59	.750	MG-16	MG-58	MG-57		H-14B
H-02	1.525	1.925	MG-38 & MG-59	.750	MG-16	MG-58	MG-57		H-14B
H-03	1.850	2.250	MG-38 & MG-59	.750	MG-16	MG-58	MG-57		H-14B
H-04	2.175	2.575	MG-38 & MG-59	.750	MG-16	MG-58	MG-57		H-14B
H-05	2.500	2.900	MG-38 & MG-59	.750	MG-16	MG-58	MG-57		H-14B



Mongoose H Series Wedge Clamps

The H Series Wedge Kit maximizes the top end range of the Mongoose with the proven stability of the H Series Clamps that are also used on the Tube Weasel, Wart and Mini. Featuring a wedge that attaches to the .75" Mandrel it attains a range of 1.375in to 2.900in with only (5) sets of Clamps.

Specifications

Working Range:	.625" (15.9 mm) I.D. to 3" (76.2 mm) O.D.
Motor, pneumatic	2/3 h.p. (.497 kw)
Air Pressure	90 psi.(6.2 bar)
Air Volume	25 cfm (708 lt/min.)
Speed	200 RPM
Minimum Clearance	2-1/4" (57.2 mm)
Head Length	15" (381 mm)
Working Weight	13 lbs. (5.9 kg)
Shipping Weight	30 lbs. (14 kg)
Shipping Dimensions	20" x 18" x 5" (508 mm x 457 mm x 127 mm)

Manufacturer reserves the right to change specifications without notice.

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Membrane Removal Heads

For the Mongoose Std and Mongoose High Torque Slow Speed

Membrane Head		Base Head		Inserts	
Size	Part #	Part#	Part #	Qty	
1.187	MO-103	MGB-103	MRB-8	4	
1.250	MO-104	MGB-104	MRB-8	4	
1.375	MO-105	MGB-105	MRB-8	4	
1.500	MO-106	MGB-106	MRB-8	5	
1.625	MO-107	MGB-106	MRB-8	5	
1.750	MO-108	MGB-106	MRB-8	5	
2.000	MO-109	MGB-106	MRB-8	6	

Overlay Removal Heads

For the Mongoose High Torque Slow Speed

Overlay Head		Base Head		Inserts	
Size	Part #	Part#	Part #	Qty	
1.187	MO-203	MGB-103	MRB-8	4	
1.250	MO-204	MGB-104	MRB-8	4	
1.375	MO-205	MGB-105	MRB-8	4	
1.500	MO-206	MGB-106	MRB-8	5	
1.625	MO-207	MGB-106	MRB-8	5	
1.750	MO-208	MGB-106	MRB-8	5	
2.000	MO-209	MGB-106	MRB-8	6	

(also removes membrane)

Mongoose Cutterhead Blade Lock and Screws

Cutterhead		Mandrel		Blade Lock		Lock Screw	
Part #	Size	Part #	Size	Part #	Per Head	Part #	Per Lock
MG-28C	2.250	MG-38A	.625	MG-25	3	MG-24	1
MG-28	2.250	MG-38	.750	MG-25A	3	MG-24	1
MG-28A	2.500	MG-38	.750	MG-25A	6	MG-24	1
MG-28B	3.000	MG-38	.750	MG-25B	6	MG-24	1

"C-HOG" MILLHOG®

O.D. Clamping End Prep Tool
to 3" O.D. 76.2mm O.D.

Built for heavy wall, small bore, hard alloy tubes

Key Features

- Securely grips to the tube O.D.
- Tooling is very easy to change for tubes up to 3" O.D.
- Narrow body fits 1-1/4" membrane boiler tubes
- Ideal for small bore heavy wall stainless steel and chrome tubes
- Ergonomic feed with over 1" of stroke
- Compact, light weight and rugged
- Uses standard MILLHOG® cutting blades and the EscoLock™ wedge-style blade lock system
- Robust ratchet wrenches are securely attached

Secures to tube O.D., comfortable ergonomic operation

The C-HOG is a "C" shaped tool that firmly attaches to the tube outside diameter (O.D.) using a saddle with a massive clamp that minimizes chatter and vibration. This rugged construction allows the tool's cutting blade to prep quickly. Several cutter heads are available for tubes up to 3" O.D. Both the saddle and cutter heads are extremely durable and easy to change.

Designed for maximum comfort, efficiency, safety, and ease of use, the C-HOG's attached ratchet feed wrench lets the operator comfortably feed the tool as it preps the tube end, prep-after-prep all day long with minimal fatigue. The C-HOG is well suited for small bore heavy wall tubes with a high percentage of chrome, stainless steel, and other hard alloys. It accommodates large boring blades and combinations of blades to bevel, face and bore.

Standard and custom blades are offered in a wide variety of angles and sizes and are rigidly secured by the EscoLock™ wedge-style, blade lock system. No cutting lubricants are necessary.

Crafted to deliver reliable performance on the toughest applications, the C-HOG is a rugged tool that is light in weight and compact. Highly engineered, it incorporates state of the art materials and heat treated components.

Rent or buy a C-HOG for your next boiler tube job and see for yourself how it will save you time and money.



The C-HOG is ideally suited for small bore heavy wall tubes with a high percentage of chrome, stainless steel, and other hard alloys.



The optional right angle drive allows the air motor to be mounted in four different positions for use in limited access areas.



This rugged tool has a narrow profile and fits between 1-1/4" O.D. membrane water wall boiler tubes.

Specifications

"C-HOG" Millhog	
Working Range	Up to 3" O.D.
Motor	2/3 h.p. (.497 kw)
Air Pressure	90 psi (6.2 bar)
Air Volume	25 cfm (708 lt/min.)
Speed	200 RPM
Minimum clearance	1-3/4" (44.45 mm)
Head Length	11-5/8" (295.3mm)
Working Weight	19 lbs. (8.62 kg)
Shipping Weight	40 lbs. (18.15 kg)
Shipping Dimensions	22" x 16" x 7" (560 mm x 407 mm x 176 mm)

C-Hog Cutterheads, Blade Locks and Screws

Cutterhead		Blade Lock		Lock Screw	
Part #	Size	Part #	Per Head	Part #	Per Lock
CF-35	1.750	CF-39	3	CF-36	1
CF-35A	2.000	CF-39	3	CF-36	1
CF-35B	2.250	CF-39	6	CF-36	1
CF-35C	2.500	CF-39	6	CF-36	1
CF-35D	2.750	CF-39	6	CF-36	1
CF-35E	3.000	CF-39	6	CF-36	1



C-Hog Kit Includes:

Gear Head, 2/3 HP Motor, Clamp Wrench, Hose with couplings, dirt stopper and oiler, and Carrying Case.

"TUBE WEASEL"

MILLHOG®

Right Angle I.D. Clamping End Prep Tool
3/4" I.D. to 3" O.D.
19.1 mm I.D. to 76.2 mm O.D.

Agile enough to fit between small diameter boiler tubes, this rugged high-tech tool performs end preps on all types of hard alloys quickly and efficiently...

Key Features

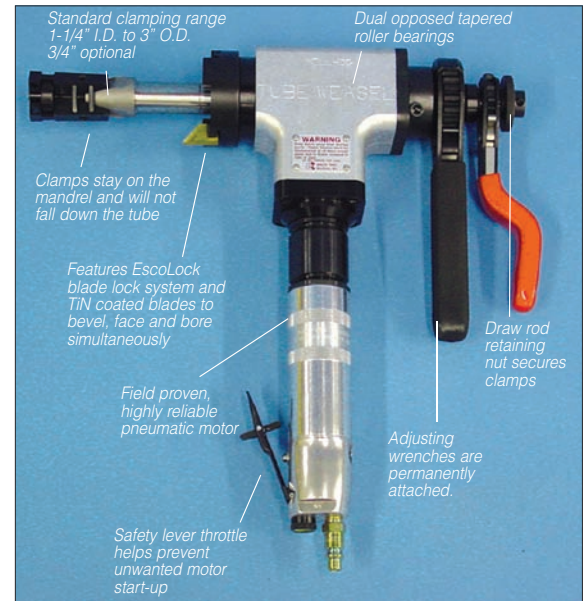
- Right angle tool rigidly mounts to tube I.D.
- Sealed construction allow use in any orientation
- Fits a "Dutchman" and handles hard alloys
- Clamping system is self-centering and easy to use
- EscoLock blade lock system securely holds cutting blades
- Chatter-free end preps produce thick continuous chip
- Torque-free operation with TiN coated cutting bits
- Requires only (25 cfm), 708 lt./min air flow
- Gear head design has performed millions of end preps
- Field proven and simple to operate and maintain

Provides Superior Value and Performance

The ESCO "Tube Weasel" MILLHOG® is a lean, extremely durable tool that performs end preps on all boiler tube alloys quickly and efficiently. Featuring a right angle gear head drive system which incorporates dual opposed tapered roller bearings, this compact tool provides a big bite with a small appetite because it requires only (25 cfm), 708 lt./min of air to pull a heavy continuous chip.



"Tube Weasel" features the rigid EscoLock blade lock system and titanium nitride coated cutter blades which combine to pull a thick continuous chip on all types of tube and pipe without cutting oils.



The "Tube Weasel" fits a Dutchman window for single tube end prep work and totally sealed construction allows it to be used in any orientation. Most importantly, the holding clamps are designed to stay on the mandrel and not fall down the tubes.



The "Air Clamp" Tube Weasel MILLHOG® is ideal for production applications and takes only minutes to convert from a manual clamping end prep tool to one of the fastest clamping tools on the market.



Tube Weasel Kit includes:

Gear Head, 2/3 Pneumatic HP Motor, Draw Rod Assembly, Hose with couplings, dirt stopper and oiler, and Carrying Case.

Air Clamp Tube Weasel Kit includes:

Air Clamp Assembly, Gear Head, 2/3 Pneumatic HP Motor, Draw Rod Assembly, 1.250in Mandrel, Hose with couplings, dirt stopper and oiler, and Carrying Case.

Tube Weasel Clamp Rib Selector and corresponding spares

Mandrel, Draw Rod, Actuator, Retention Band and Springs

Clamp Set	I.D. Range				Mandrel Part #	Size	Draw Rod	Actuator	Roll Pin	Retention	
	in		mm							Band	Spring
G-03A	.750	.905	19.1	22.9	H-241	.750	H-247	G-17	G-15	G-14F	
G-04	.875	1.030	22.3	26.1	H-241	.750	H-247	G-17	G-15		G-14
G-05	1.000	1.155	25.4	29.3	H-241	.750	H-247	G-17	G-15		G-14
G-06	1.125	1.280	28.6	32.5	H-241	.750	H-247	G-17	G-15		G-14
G-07	1.250	1.405	31.8	35.6	H-241	.750	H-247	G-17	G-15		G-14
G-08	1.375	1.530	35.0	38.8	H-241	.750	H-247	G-17	G-15		G-14
G-09	1.500	1.655	38.1	42.0	H-241	.750	H-247	G-17	G-15		G-14
G-10	1.625	1.780	41.3	45.2	H-241	.750	H-247	G-17	G-15		G-14
G-11	1.750	1.905	44.5	48.3	H-241	.750	H-247	G-17	G-15		G-14
G-12	1.875	2.030	47.7	51.5	H-241	.750	H-247	G-17	G-15		G-14
G-13	2.000	2.155	51.0	54.7	H-241	.750	H-247	G-17	G-15		G-14
H-00	1.000	1.300	25.4	33.0	H220	1.00	H-51	H-12A	H-11		H-14A
H-01	1.375	1.600	34.9	40.6	H-21	1.25	H-51	H-12	H-11		H-14B
H-02	1.525	1.925	28.8	48.9	H-21	1.25	H-51	H-12	H-11		H-14B
H-03	1.850	2.250	47.0	57.2	H-21	1.25	H-51	H-12	H-11		H-14B
H-04	2.175	2.575	55.3	65.4	H-21	1.25	H-51	H-12	H-11		H-14B
H-05	2.500	2.900	63.5	73.7	Attaches to H-02						

Specifications

"Tube Weasel" MILLHOG®	
Working Range:	3/4" (19.1 mm) I.D. to 3" (76.2 mm) O.D.
Motor, pneumatic	2/3 h.p. (.497 kw)
Air Pressure	90 psi. (6.2 bar)
Air Volume	25 cfm (708 lt./min.)
Speed	200 RPM
Minimum Clearance	3" (76.2 mm)
Head Length	14-1/2" (368.3 mm)
Working Weight	18 lbs. (8.2 kg)
Shipping Weight	40 lbs. (19 kg)
Shipping Dimensions	20" x 18" x 5" (508 mm x 457 mm x 127 mm)
Manufacturer reserves the right to change specifications without notice.	

"Wart" MILLHOG®

Right Angle I.D. Clamping End Prep Tool
.75" I.D. to 4.5" O.D.
19.1 mm I.D. to 114.3 mm O.D.

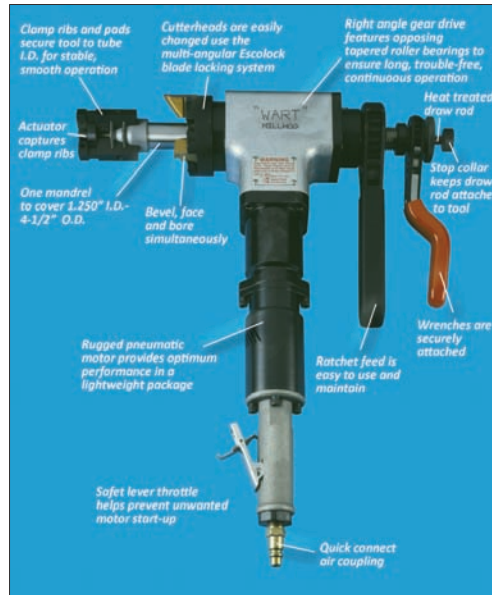
Built for boilermakers, handles hard alloys, and fits between tubes for single tube removal

Key Features

- A heavy duty ratchet wrench and knurled knob allows easy clamping and is perfect for limited access areas
- Mounts rigidly to produce a clean, continuous chip
- Requires no cutting lubricant
- Simultaneously bevels, faces, and bores
- Lightweight and requires no special training
- Efficient chatter-free cutter blade locking design
- Torque-free operation prevents operator fatigue
- Low maintenance, compact, air-powered tool

Engineered for High Volume Use

The Esco "Wart" MILLHOG® is a right angle, I.D. clamping end prep tool that features an efficient, low-maintenance design incorporating dual opposed tapered roller bearings. This makes the "Wart" rigid, stable and extremely durable. Built for boilermakers, there are no bushings to wear out and the sealed mandrel prevents debris from getting inside the tool, allowing it to be used in any orientation. What's more, the compact design requires a minimum of 2-5/8" to fit between tubes.

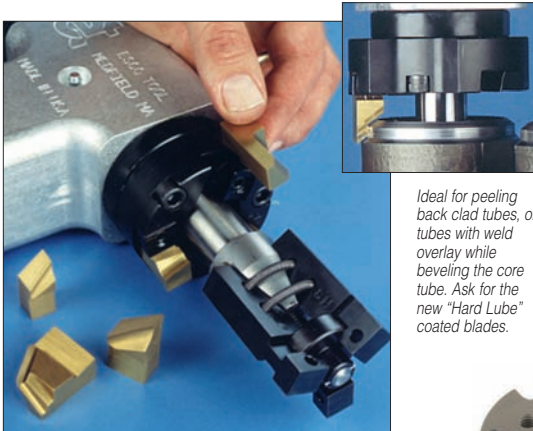


The "Wart" MILLHOG® is also available with a number of accessories to accommodate more specific end prep application needs.

Interchangeable Clamp and Rib Pads

Simple to operate, the "Wart" MILLHOG® uses one mandrel for the vast majority of jobs (see clamp rib and clamp pad selector chart). All you have to do is measure the tube I.D., select the correct ribs and/or pads and install them on the mandrel. Because they self-align, that's all there is to it.

Now insert the mandrel into the tube I.D., expand the clamp ribs and/or pads and perform your end preps in seconds.



Ideal for peeling back clad tubes, or tubes with weld overlay while beveling the core tube. Ask for the new "Hard Lube" coated blades.

One mandrel covers 1.250" I.D. to 4.500" O.D. and titanium nitride coated cutter blades fit securely into the multi-angular Escalock blade locking system.



Ideal for limited access areas, the "Wart" MILLHOG® requires a minimum width of 2-5/8" clearance to fit between tubes, and easily clamps into place with the Knurled Knob and Heavy Duty Ratchet.



Membrane removal heads and Overlay removal heads efficiently remove material from between boiler tubes.



Base Heads attach to the tools drive shaft.



Membrane and Overlay Heads attach to the Base Head.



Membrane and Overlay Heads look very similar. Overlay heads have a slightly smaller circumference. Base Heads can be fitted with a Bevel Blade.



Bevel, face and bore simultaneously up to 4.5" (114.3mm) o.d.

"Wart" MILLHOG®

Specialty End Prep Tools



Like the Air Powered "Wart", the "Electric Wart" is ideal for close quarters.



Already own a "Wart", no problem, the electric motor is interchangeable, takes only minutes to switch, and requires no special tools.

"Electric Wart" MILLHOG®

Interchangeable with the pneumatic motor, the "Wart" gear head can easily convert from Air Driven to Electrically Powered in a matter of minutes, and requires no special tools or training. Easily turned "on" and "off", the powerful variable speed, 1400 watt double insulated motor and the ESCO proprietary speed reduction spider combine to develop maximum cutting force at the blade, that produces a thick chip, and prevents work hardening without using a cutting lubricant.

Wart Electric Kit includes:

Gear Head, Electric Motor - .932kw, Draw Rod Assembly, 1.250in Mandrel, Hose with couplings, dirt stopper and oiler, and Carrying Case.



"Z Wart" MILLHOG® End Prep Tool

The "Z Wart" MILLHOG® is a powerful narrow body specialty end prep tool for applications when tool width is critical and torque needs to be maximized. A slender 2-5/8" wide, the "Z Wart" MILLHOG® adds an additional right angle drive into the conventional "Wart" MILLHOG® drive train that reduces the RPM by half, and doubles the torque at the cutting blade.

The low RPM and high torque of the "Z Wart" MILLHOG® make it well suited for end prep applications that include tube stub removal and weld overlay. Please consult factory for application specifications, and ordering information.



The "Z Wart's" low RPM and high torque make it well suited for applications that include tube stub removal.

The "Z Wart" features a cutter-head that holds the cutting blades 180 degrees apart, and distributes the cutting force evenly on the cutting surface. This significantly reduces chatter, which helps to prolong blade life.

"Contour Wart" MILLHOG®

The "Contour Wart" MILLHOG®, or "fish-mouth", is a specialty end prep tool for profiling tube ends so they sit evenly on the radius of a header and allows for full penetration welds. The profile shape of the end prep is specific to the application, and is ideal when a large number of end preps, of consistent size need to be profiled. For ordering information, and application specifications, please consult the factory.



Fast, perfectly contoured end preps are easily accomplished and requires no further rework prior to end prepping... every time.



The Contour "Wart" MILLHOG® produces flawless end preps on tube ends when accurate fit-up is needed to weld tubes to a header.



Wart Clamp Rib Selector and corresponding spares Mandrel, Draw Rod, Actuator, Retention Band and Springs

Clamp Set	I.D. Range				Mandrel		Draw Rod		Actuator		Retention	
	in	mm	Part #	Size	Part #	Size	Part #	Roll Pin	Part #	Roll Pin	Band	Spring
G-03A	.750	.905	19.1	22.9	H-241	.750	H-247	G-17	G-15		G-14F	
G-04	.875	1.030	22.3	26.1	H-241	.750	H-247	G-17	G-15		G-14	
G-05	1.000	1.155	25.4	29.3	H-241	.750	H-247	G-17	G-15		G-14	
G-06	1.125	1.280	28.6	32.5	H-241	.750	H-247	G-17	G-15		G-14	
G-07	1.250	1.405	31.8	35.6	H-241	.750	H-247	G-17	G-15		G-14	
G-08	1.375	1.530	35.0	38.8	H-241	.750	H-247	G-17	G-15		G-14	
G-09	1.500	1.655	38.1	42.0	H-241	.750	H-247	G-17	G-15		G-14	
G-10	1.625	1.780	41.3	45.2	H-241	.750	H-247	G-17	G-15		G-14	
G-11	1.750	1.905	44.5	48.3	H-241	.750	H-247	G-17	G-15		G-14	
G-12	1.875	2.030	47.7	51.5	H-241	.750	H-247	G-17	G-15		G-14	
G-13	2.000	2.155	51.0	54.7	H-241	.750	H-247	G-17	G-15		G-14	
H-00	1.000	1.300	25.4	33.00	H-220	1.00	H-51	H-12A	H-11		H-14A	
H-01	1.375	1.600	34.9	40.6	H-21	1.25	H-51	H-12	H-11		H-14B	
H-02	1.525	1.925	28.8	48.9	H-21	1.25	H-51	H-12	H-11		H-14B	
H-03	1.850	2.250	47.0	57.2	H-21	1.25	H-51	H-12	H-11		H-14B	
H-04	2.175	2.575	55.3	65.4	H-21	1.25	H-51	H-12	H-11		H-14B	
H-02 & H-05	2.500	2.900	63.5	73.7	H-21	1.25	H-51	H-12	H-11		H-14B	
H-03 & H-05	2.825	3.225	71.8	81.9	H-21	1.25	H-51	H-12	H-11		H-14B	
H-04 & H-05	3.150	3.550	80.0	90.2	H-21	1.25	H-51	H-12	H-11		H-14B	
H-02 & H-08	3.475	3.875	88.3	98.4	H-21	1.25	H-51	H-12	H-11		H-14B	
H-03 & H-08	3.800	4.200	96.6	106.6	H-21	1.25	H-51	H-12	H-11		H-14B	
H-04 & H-08	4.125	4.525	104.8	114.9	H-21	1.25	H-51	H-12	H-11		H-14B	

Membrane Removal Heads

Membrane Head Size	Part #	Base Head Part#	Inserts Part #	Qty
2	MO-110	HB-110	MRB-8	6
2.125	MO-111	HB-110	MRB-8	6
2.25	MO-112	HB-110	MRB-8	6
2.5	MO-113	HB-110 or HB-114	MRB-8	7
2.75	MO-114	HB-114	MRB-8	7
3	MO-115	HB-114	MRB-8	8

Overlay & Membrane Removal Heads

Overlay Head Size	Part #	Base Head Part#	Inserts Part #	Qty
2	MO-210	HB-110	MRB-8	6
2.125	MO-211	HB-110	MRB-8	6
2.25	MO-212	HB-110	MRB-8	6
2.5	MO-213	HB-110 or HB-114	MRB-8	7
2.75	MO-214	HB-114	MRB-8	7
3	MO-215	HB-114	MRB-8	8

Wart Cutterheads

Cutterhead		Mandrel		Blade Lock		Blade Screw	
Part #	Size	Part #	Size	Part #	Per Head	Part #	Per Lock
H-242	2.625	H-241	.750	H-22	3	H-23	1
CH-20	2.625	H-220 or H-21	1.00 or 1.250	H-22B	3	H-23	1
CH-21	3.00	H-21	1.250	H-22C	3	H-23	1
CH-22	3.50	H-21	1.250	H-22A	6	H-23	1
CH-23	4.00	H-21	1.250	H-22A	3	H-23	1
				H-22C	3	H-23	1
CH-24	4.50	H-21	1.250	H-22C	6	H-23	1

Specifications

"Wart" and "Electric Wart" MILLHOG®
 Working Range: 3/4" (19.1 mm) I.D. to 4-1/2" (114.3 mm) O.D.
 Motor, pneumatic/electric 1-1/4 h.p. (.932 kw)
 Power Requirements 120 volt 12.2 amp 50/60 hz 1400 watt
 230 volt 6.9 amp 50/60hz 1450 watt
 Air Pressure 90 psi (6.2 bar)
 Air Volume 40 cfm (1133 l/min.)
 Speed 180 RPM (electric speed variable up to 180 RPM)
 Minimum Clearance 2-5/8" (66.68 mm)
 Head Length 14-1/2" (368.3 mm)
 Working Weight 19 lbs. (8.7 kg)
 Shipping Weight 55 lbs. (25 kg)
 63 lbs (28.6kg) pneumatic - approx.
 55 lbs (25kg) electric - approx.
 Shipping Dimensions 24" x 20" x 7" (610 mm x 508 mm x 178 mm)
 Manufacturer reserves the right to change specifications without notice

"Mini" MILLHOG®

I.D. Clamping End Prep Tool
1.25" I.D. to 6.625" O.D.
31.8 mm I.D. to 168.3 mm O.D.

Cuts heavy wall pipe or tube!
Fast, chatter-free and easy to use...

Key Features

- Tool rigidly mounts to pipe or tube I. D.
- Self-centering draw rod assembly
- Single gear drive system for optimum performance
- One mandrel covers majority of the cutting range
- Cutter blade locking design eliminates chatter
- Cutter blades index easily for proper set up
- Pneumatically powered with torque-free operation
- Removes tube stub welds and prepares the header
- Automatically squares off the end of pipe or tube
- Produces clean, continuous chip without cutting oils
- Lightweight and simple to operate without special training

Rugged, Fast and Reliable

Esco MILLHOG® "Mini" Series end prep tools are the most ruggedly built and efficiently designed tools available today for milling heavy wall pipe and tube from 1.25" I.D. to 6.625" O.D. Rigidly mounting to the I.D. by a draw rod clamping assembly which centers the tool automatically, they utilize a ratchet mechanism for feeding the cutter head. Featuring titanium nitride coated cutter blades for smooth milling, without requiring cutting oils, they produce a clean, continuous chip and square off the end of the pipe or tube.



Esco MILLHOG® "Mini" Series end prep tools rigidly mount to the pipe or tube I.D. by a draw rod clamping assembly which centers the tool automatically to produce a clean bevel with a square end.

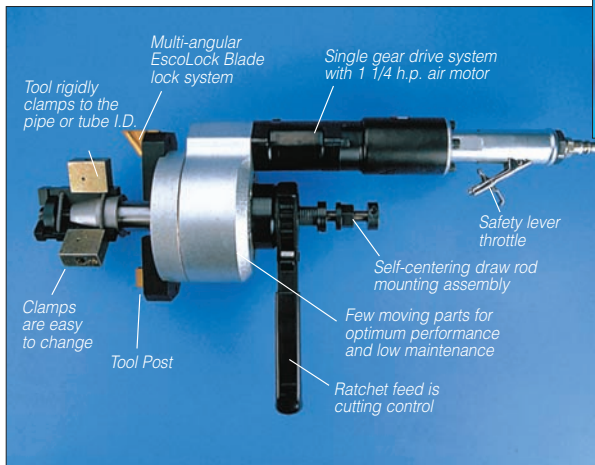


Mini Standard Kit Includes:

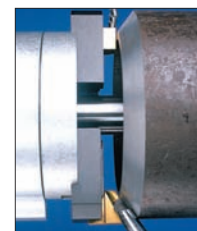
Gear Head, Tool Post, 1-1/4 HP Pneumatic Motor, Draw Rod Assembly, 1.800in Mandrel (1.250in Mandrel may be substituted; consult factory), Hose with couplings, dirt stopper and oiler, and Carrying Case.

Mini Clamp Rib Selector and corresponding spares

Clamp Set	I.D. Range				Mandrel		Draw Rod	Actuator	Roll Pin	Retention Spring
	in		mm		Part #	Size				
H-01	1.250	1.600	31.8	40.6	M-361	1.250	M-65	H-12	H-11	H-14B
H-02	1.525	1.925	38.8	48.9	M-361	1.250	M-65	H-12	H-11	H-14B
M-01	1.800	2.270	45.8	57.6	M-36	1.800	M-53	M-46	M-47	M-52
M-02	2.240	2.695	56.9	68.4	M-36	1.800	M-53	M-46	M-47	M-52
M-03	2.665	3.120	67.7	79.2	M-36	1.800	M-53	M-46	M-47	M-52
M-04	3.050	3.500	77.4	88.9	M-36	1.800	M-53	M-46	M-47	M-52
M-02 & M-05	3.415	3.865	86.7	98.1	M-36	1.800	M-53	M-46	M-47	M-52
M-03 & M-05	3.780	4.230	96.0	107.4	M-36	1.800	M-53	M-46	M-47	M-52
M-04 & M-05	4.145	4.595	105.3	116.7	M-36	1.800	M-53	M-46	M-47	M-52
M-02 & M-08	4.510	4.960	114.5	126.0	M-36	1.800	M-53	M-46	M-47	M-52
M-03 & M-08	4.875	5.325	123.8	135.2	M-36	1.800	M-53	M-46	M-47	M-52
M-04 & M-08	5.240	5.690	133.1	144.5	M-36	1.800	M-53	M-46	M-47	M-52
M-02 & M-11	5.605	6.055	142.3	153.8	M-36	1.800	M-53	M-46	M-47	M-52
M-03 & M-11	5.970	6.420	151.6	163.0	M-36	1.800	M-53	M-46	M-47	M-52



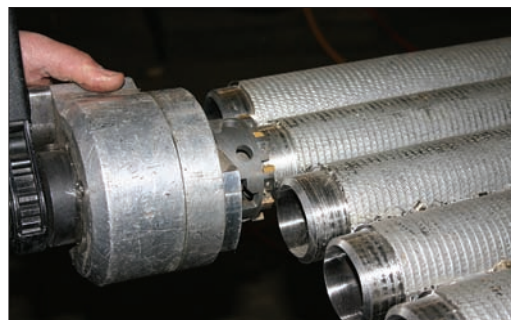
Titanium nitride coated cutter blades provide smooth milling, without cutting oils, and produce a clean continuous chip.



Because of our unique EscoLock blade locking system, it is easy to pull a heavy chip on the toughest alloys.



Low RPM and extraordinary torque at the cutting bit make the Mini Millhog a great choice for many tube stub and overlay removal applications.



Mini Membrane Removal Heads

Membrane Head		Base Head	Inserts	
Size	Part #	Part#	Part #	Qty
2.5	MO-113	MMB-113	MRB-8	7
2.75	MO-114	MMB-113	MRB-8	7
3	MO-115	MMB-113	MRB-8	8

Mini Overlay Removal Heads

Membrane Head		Base Head	Inserts	
Size	Part #	Part#	Part #	Qty
2.5	MO-213	MMB-113	MRB-8	7
2.75	MO-214	MMB-113	MRB-8	7
3	MO-215	MMB-113	MRB-8	8

Tool Post (Holds Cutting Blades(s))

Tool Post	Blade Lock		Blade Lock Screw	
Part #	Part #	Qty	Part #	Per Lock
M-68	M-48A	8	M-51	1



Membrane/Overlay heads look similar.



Base Heads mount to the tools drive shaft.

Specifications

"Mini" MILLHOG®
Working Range: 1-1/4" (31.8 mm) I.D. to 6-5/8" (168.3 mm) O.D.
Motor, pneumatic: 1-1/4 h.p. (.9325 kw)
Air Pressure: 90 psi. (6.2 bar)
Air Volume: 40 cfm (1133 lt/min.)
Speed: 34 RPM
Minimum Clearance: 5-1/4" (133.3 mm)
Head Length: 13" (330.2 mm)
Working Weight: 25 lbs. (11.33 kg)
Shipping Weight: 65 lbs. (29.5 kg)
Shipping Dimensions: 21" x 18" x 7" (533 mm x 457 mm x 178 mm)
Manufacturer reserves the right to change specifications without notice.



Overlay heads have a smaller circumference than Membrane heads. Both mount to a base head that can be fitted with a bevel blade.

U.S. Patent 7,938,047

"Prepzilla" MILLHOG®

I.D. Clamping End Prep Tool
1.575 I.D. to 8.625 O.D.
40 mm I.D. to 219.1 mm O.D.

The world standard for all other tools of its type on the market, this tool is powerful, smooth and quiet running.

Key Features

- Only (8) sets of clamps to cover entire range
- One mandrel covers entire range
- Single point attachment allows preps on all wall thicknesses at any angle
- Optional cross feed for flange facing, pipe grooving and severing
- EscoLock blade locking system for maximum blade life
- Dual opposed tapered roller bearings deliver rock solid performance
- Heavy duty clamping system does not break
- Directional exhaust
- Low R.P.M. with tremendous torque
- Produces thick chips on all highly alloyed tube and pipe, without cutting fluids

Typical applications include;

End prepping stainless steel, super duplex, P-91 and other hard to machine alloys.

Cross Feed Attachment

This optional attachment easily bolts to the Prepzilla and is easy to use. It permits flange facing, grooving for couplings, and torched end severing.

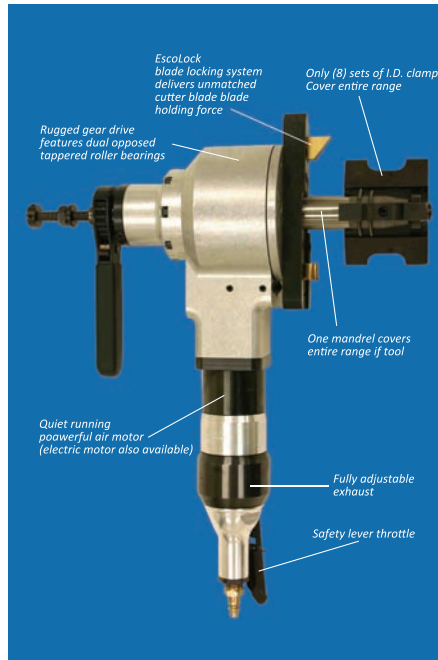
High Performance, Low Maintenance

Like all other MILLHOGS, high performance and low maintenance were important design criteria for the Prepzilla MILLHOG®. This tool is suitable for prepping any type of tube material including super duplex and uses one mandrel to cover the full operating range of the tool.

Prepzilla Clamp Rib Selector and corresponding spares

Mandrel, Draw Rod, Actuator, Retention Spring

Clamp Set	I.D. Range				Mandrel	Draw Rod	Actuator		Retention Spring
	in		mm		Part #	Size	Part #	Roll Pin	
P-01	1.575	2.050	40.0	52.1	P-30	1.575	P-11	P-14	P-10A
P-02	2.025	2.505	51.4	63.6	P-30	1.575	P-11	P-14	P-10A
P-03	2.475	2.955	62.9	75.1	P-30	1.575	P-11	P-14	P-10A
P-04	2.925	3.405	74.3	86.5	P-30	1.575	P-11	P-14	P-10A
P-02 & P-05	3.375	3.855	85.7	97.9	P-30	1.575	P-11	P-14	P-10A
P-03 & P-05	3.825	4.305	97.2	109.3	P-30	1.575	P-11	P-14	P-10A
P-04 & P-05	4.275	4.755	108.6	120.8	P-30	1.575	P-11	P-14	P-10A
P-02 & P-06	4.725	5.205	120.0	132.2	P-30	1.575	P-11	P-14	P-10A
P-03 & P-06	5.175	5.655	131.4	143.6	P-30	1.575	P-11	P-14	P-10A
P-04 & P-06	5.625	6.105	142.9	155.1	P-30	1.575	P-11	P-14	P-10A
P-02 & P-07	6.075	6.555	154.3	166.5	P-30	1.575	P-11	P-14	P-10A
P-03 & P-07	6.525	6.980	165.7	177.3	P-30	1.575	P-11	P-14	P-10A
P-04 & P-07	6.950	7.430	176.5	188.7	P-30	1.575	P-11	P-14	P-10A
P-02 & P-08	7.400	7.880	188.0	200.2	P-30	1.575	P-11	P-14	P-10A
P-03 & P-08	7.850	8.330	199.4	211.6	P-30	1.575	P-11	P-14	P-10A
P-04 & P-08	8.300	8.780	210.8	223.0	P-30	1.575	P-11	P-14	P-10A



The Prepzilla MILLHOG® cuts heavy wall pipe and tube, producing a heavy chip with no cutting oils; resulting in perfect end preps.



Prepzilla Standard Kit Includes:

Gear Head, Feed Mechanism, 2 HP Pneumatic Motor (electric may be substituted), 8.625in Tool Post, Draw Rod Assembly, 1.575in Mandrel, Hose with couplings, dirt stopper and oiler, & Carrying Case. (deluxe kit shown that includes all clamp ribs and pads for entire range).

Only (8) sets of clamps and one mandrel cover the entire range.



The available electric motor is easily swapped with the pneumatic motor when air is not available. It produces awesome power and the variable speed motor is ideal for all types of tube and pipe alloy. Like the pneumatic drive, cutting oil is not required.

Specifications

"Prepzilla" MILLHOG®	
Working Range:	1.575" (40 mm) I.D. to 8-5/8" (219.1 mm) O.D.
Motor, pneumatic	2 h.p. (1.492 kw)
Air Pressure	90 psi. (6.2 bar)
Air Volume	80 cfm (2690 lt/min.)
Speed	30 RPM
Motor, electric	110 volt 1800 watt 40/60 hz, 230 volt (consult factory)
Minimum Clearance	8-3/4" (222.3 mm)
Head Length	19-3/4" (501.7 mm)
Working Weight	40 lbs. (18.2 kg)
Shipping Weight	110 lbs. (50 kg)
Shipping Dimensions	27" x 21" x 7" (686 mm x 534 mm x 178 mm)
Manufacturer reserves the right to change specifications without notice.	

"COMMANDER" MILLHOG®

Model C-314
I.D. Clamping End Prep Tool
3.75" I.D. to 14" O.D.
88.9 mm I.D. to 355.6 mm O.D.

Bevels heavy wall tube, pulls a thick chip without cutting oils...

Key Features

- One mandrel and 7 sets of clamps cover entire range.
- Wide clamp ribs spread the contact force for superior clamping.
- Three powerful drive choices:
 - 3 hp pneumatic straight drive motor
 - 1800 watt electric motor
 - Hydraulic motor drive with speed control.
- Available off-set gear box reduces the rpm and multiplies the torque
- Motor drive options are easily changed and are interchangeable with the "Dictator"
- Ultra rugged gears and dual opposed tapered bearing set-up deliver produces a low maintenance tool designed for years of trouble free service
- Fully portable for on-site use
- Available for sale or rent

Applications

- Pipeline construction
- Off-shore super duplex
- Petrochemical
- Power generation
- Systems fabrication

Built for Performance

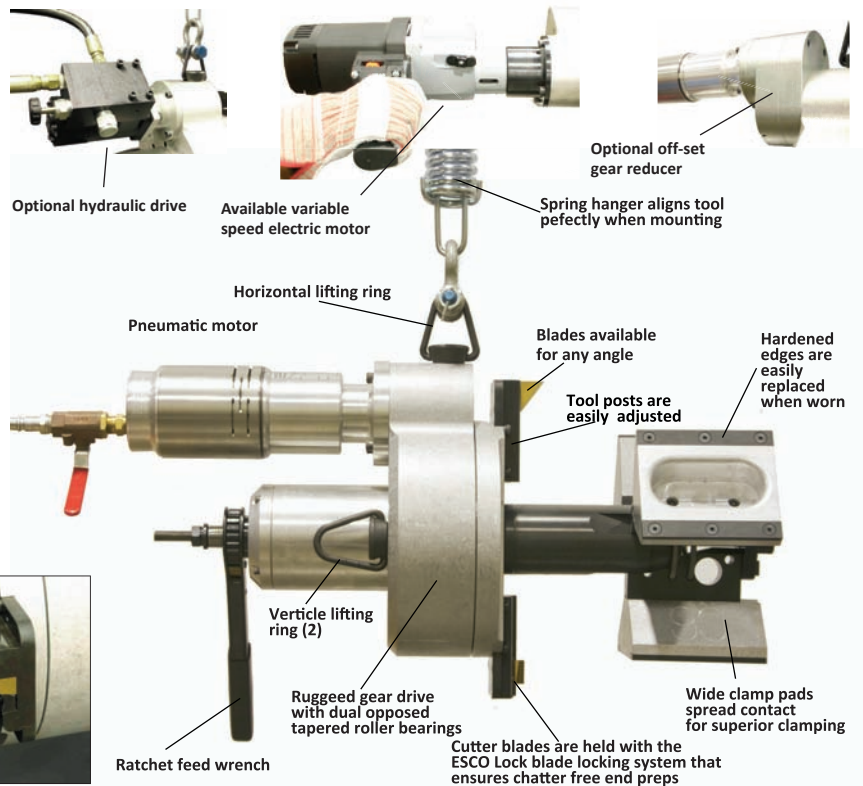
Designed to prep all schedules of pipe from 3.75" I.D. to 14" O.D., the "Commander" MILLHOG® Model C-314 features a state of the art I.D. clamping system that spreads the contact points of the clamps radially inside the pipe. This minimizes vibration for chatter-free end preps on both thin and heavy wall pipe. To assure stable, smooth rotation of the cutterhead, this rugged tool employs opposed tapered roller bearings that are easy to adjust and never wear out.

Powerful and versatile, torque at the cutting blade for the Model C-314 is achieved with the choice of three motor options suited to fit your application(s). All drives are easily changed and are also interchangeable with the "Dictator."

Like all MILLHOGS, the "Commander" MILLHOG® Model C-314 is simple to operate and designed for years of trouble free service.

Specifications

"Commander" MILLHOG® model C-314	
Working Range:	3.750" (95.25 mm) I.D. to 14" (355.6 mm) O.D.
Motor, pneumatic	3 h.p. (2.237 kw)
Air Pressure	90 psi. (6.2 bar)
Air Volume	95 cfm (2690 lt/min.)
Speed	16 RPM
Motor, electric	110 volt 1800 watt 40/60 hz, 230 volt (consult factory)
Hydraulic pump requirements	(8-12) gallons per minute, 5 h.p., 200 volt (3) phase 20 gallon reservoir @ 1,500 psi
Minimum Clearance	12.750" (323.9 mm)
Head Length	19.750" (501.7 mm) 12" (305 mm) with right angle drive
Working Weight	85 lbs. (38.5 kg)
Shipping Weight	200 lbs. (91 kg)
Shipping Dimensions	32" x 15" x 17" (813 mm x 381 mm x 432 mm)
Manufacturer reserves the right to change specifications without notice.	



Wide clamp ribs spread the contact force for superior clamping and the EscoLock blade locking system minimizes vibration, producing a heavy chip and superior end prep.



Electric or pneumatic both drive motors deliver plenty of power for the toughest pipe alloys.

Commander Clamp Rib Selector and corresponding spares

Mandrel, Draw Rod, Actuator, Retention Spring

Clamp Set	I.D. Range				Mandrel		Draw Rod	Actuator		Retention Spring
	in		mm		Part #	Size		Part #	Roll Pin	
C-01	3.750	4.500	95.250	114.300	C-37	3	C-14	C-11	C-12	C-13
C-02	4.375	5.250	111.130	133.350	C-37	3	C-14	C-11	C-12	C-13
C-03	5.125	6.000	130.180	152.400	C-37	3	C-14	C-11	C-12	C-13
C-04	5.875	6.800	149.230	172.720	C-37	3	C-14	C-11	C-12	C-13
C-01 & C-05	6.750	7.562	171.450	192.080	C-37	3	C-14	C-11	C-12	C-13
C-02 & C-05	7.437	8.250	188.900	209.550	C-37	3	C-14	C-11	C-12	C-13
C-03 & C-05	8.125	8.938	206.380	227.030	C-37	3	C-14	C-11	C-12	C-13
C-04 & C-05	8.875	9.700	225.430	246.380	C-37	3	C-14	C-11	C-12	C-13
C-01 & C-06	9.687	10.500	246.050	266.700	C-37	3	C-14	C-11	C-12	C-13
C-02 & C-06	10.375	11.125	263.530	282.580	C-37	3	C-14	C-11	C-12	C-13
C-03 & C-06	11.000	11.812	279.400	300.030	C-37	3	C-14	C-11	C-12	C-13
C-04 & C-06	11.750	12.500	298.450	317.500	C-37	3	C-14	C-11	C-12	C-13
C-03 & C-07	12.400	13.250	314.960	336.550	C-37	3	C-14	C-11	C-12	C-13
C-04 & C-07	13.125	14.000	333.380	355.600	C-37	3	C-14	C-11	C-12	C-13

"Dictator" MILLHOG®

Model D-418
I.D. Clamping End Prep Tool
4.5" I.D. to 18" O.D.
114.3 mm I.D. to 457.2 mm O.D.

Preps heavy wall pipe including Super Duplex and is as easy to use as our smaller models offering an affordable alternative to specialized machine service companies.

Key Features

- One mandrel and 8 sets of clamps needed to cover entire range.
- Three powerful drive choices:
 - 3 hp pneumatic straight drive motor
 - 1800 watt electric motor
 - Hydraulic motor drive with speed control.
- Available off-set gear box reduces the rpm and multiplies the torque.
- Motor drive options are easily changed and are interchangeable with the "Commander"
- Self-centering draw rod actuated clamping system.
- Wide Clamps produce superior clamping force for chatter free end preps
- Uses standard MILLHOG® cutter blades
- All gear drives are interchangeable with the "Commander"
- Fully portable for on-site and shop work
- Available for sale or rent

Applications

- Pipeline construction
- Off-shore super duplex
- Petrochemical
- Power generation
- Systems fabrication

Built for Performance

The ESCO "Dictator" MILLHOG® model D-418 features three drive choices that are capable of performing any degree of end prep on pipe up to 18" schedule 160 without cutting fluids. This portable tool has many advances including a self-centering draw rod actuated clamping system and wide clamps that produce a superior clamping force for chatter free end preps while assuring maximum blade life.

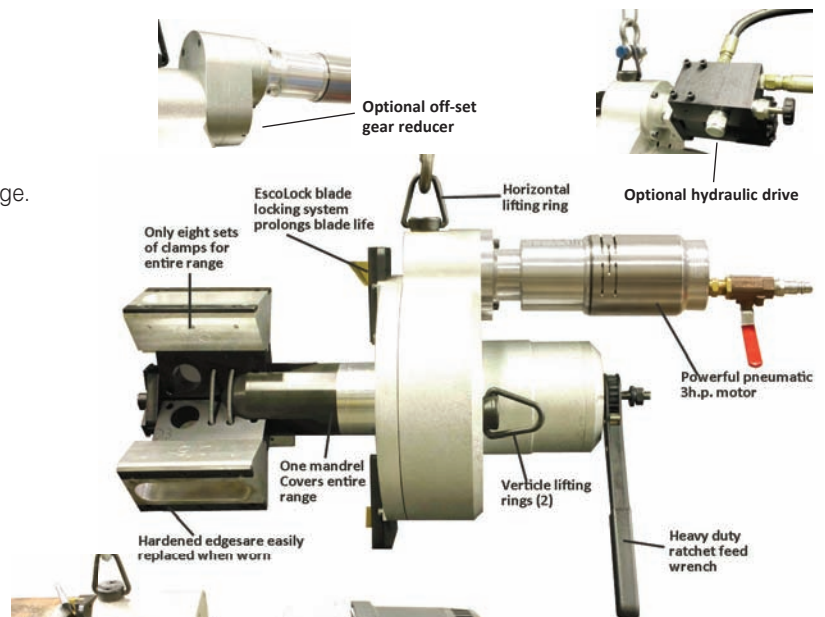
Designed for years of trouble free service the D-418 proprietary gear and bearing system delivers the stability and performance that all MILLHOG® tools have become known for.

Eliminate the need for specialized machine service companies and call today to arrange a no obligation demonstration and see for yourself the difference a MILLHOG® makes.

Dictator Clamp Rib Selector and corresponding spares

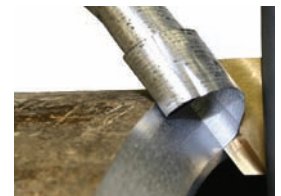
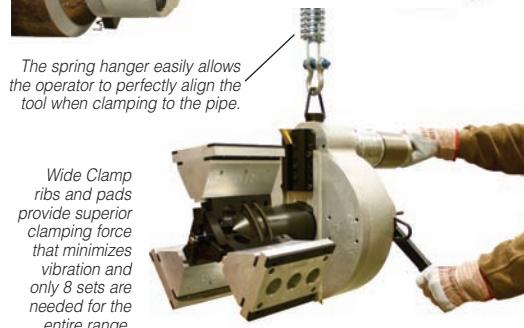
Mandrel, Draw Rod, Actuator, Retention Spring

Clamp Set	I.D. Range				Mandrel		Draw Rod		Actuator		Retention Spring
	in	mm			Part #	Size	Part #	Size	Part #	Roll Pin	
D-01	4.5	5.625	114.3	142.9	D-37	4	D-15	D-12	D-13	D-14	
D-02	5.5	6.625	139.7	168.3	D-37	4	D-15	D-12	D-13	D-14	
D-03	6.5	7.625	165.1	193.7	D-37	4	D-15	D-12	D-13	D-14	
D-02 & D-04	7.5	8.625	190.5	219.1	D-37	4	D-15	D-12	D-13	D-14	
D-03 & D-04	8.5	9.625	215.9	244.5	D-37	4	D-15	D-12	D-13	D-14	
D-02 & D-05	9.5	10.625	241.3	269.9	D-37	4	D-15	D-12	D-13	D-14	
D-03 & D-05	10.5	11.625	266.7	295.3	D-37	4	D-15	D-12	D-13	D-14	
D-02 & D-06	11.5	12.625	292.1	320.7	D-37	4	D-15	D-12	D-13	D-14	
D-03 & D-06	12.5	13.625	317.5	346.1	D-37	4	D-15	D-12	D-13	D-14	
D-02 & D-06 & D-07	13.5	14.625	342.9	371.5	D-37	4	D-15	D-12	D-13	D-14	
D-03 & D-06 & D-07	14.5	15.625	368.3	369.9	D-37	4	D-15	D-12	D-13	D-14	
D-02 & D-08	15.5	16.625	393.7	422.3	D-37	4	D-15	D-12	D-13	D-14	
D-03 & D-08	16.5	17.625	419.1	447.7	D-37	4	D-15	D-12	D-13	D-14	



The hydraulic motor with speed control motor offers consistent power at various RPMs for the most difficult materials and produces 6,000 ft. lbs. at the cutting bit.

The variable speed electric motor combined with the gear box reducer delivers plenty of power for heavy wall pipe.



Dictator Standard Kit Includes:

Gear Head, Feed Mechanism, 3 HP Pneumatic Motor (Electric or Hydraulic Motor may be substituted; consult factory), 2 Blade Blocks, Draw Rod Assembly, Mandrel, Hose with couplings, dirt stopper and oiler, & Carrying Case.

Specifications

"Dictator" MILLHOG® model D-418	
Working Range:	4.5" (114.3 mm) I.D. to 18.00" (457.2 mm) O.D.
Motor, pneumatic	3 h.p. (2.244 kw)
Air Pressure	90 psi. (6.2 bar)
Air Volume	95 cfm (2690 lt/min.)
Speed	8 RPM
Motor, electric	110 volt 1800 watt 40/60 hz, 230 volt (consult factory)
Hydraulic pump requirements	(8-12) gallons per minute, 5 h.p., 200 volt (3) phase 20 gallon reservoir @ 1,500 psi
Minimum Clearance	19" (482.6 mm)
Head Length	19-3/4" (501.7 mm) 12" (305 mm) w/ R. A. drive
Working Weight	145 lbs. (66 kg)
Shipping Weight	290 lbs. (132 kg)
Shipping Dimensions	38" x 20" x 20" (965 mm x 508 mm x 508 mm)
Manufacturer reserves the right to change specifications without notice.	

U.S. Patent 6,994,002

Key Features

- Rigidly clamps to pipe ID up to 36"
- All angles of end prep attainable
- Formed tool bits for m.w.t. in excess of 2.5"
- Pneumatic or Hydraulic Driven
- ID tracker produces symmetrical end preps
- Performs any angle of prep
- Only eight sets of clamps and two wedges required to cover entire range
- Simple to operate, quick set-up
- Preps all pipe alloys
- Patent pending safety chain lanyard and dual spring hangers makes tool alignment easy and safe

The ESCO Terminator Millhog is a powerful, easy to use id clamping end prep machine capable of delivering precision end preps on pipe of all alloys including Super Duplex and has a working range of 8-5/8" id to 36" od. A powerful 5 hp pneumatic motor or available hydraulic motor provide smooth quiet operation and are easily interchanged.

The Terminator rigidly mounts to the pipe id and uses formed tool bits for wall thicknesses in excess of 2.5". The available id tracker creates precision symmetrical end preps on out of round pipe at any angle, including J. ESCO Millhog end prep tools have been around for over 50 years and have a reputation for being rugged, reliable and easy to use. Our experienced personnel are committed to help you get the tool you need to get the job done efficiently. Please contact us for more information.

Specifications

Working range	8.625" id to 36" od
Motor pneumatic	5 hp (3.73kw)
Air pressure	90 psi (6.2 bar)
Air volume	95 cfm (2690 lt/min)
Speed	2-4 rpm

Terminator MILLHOG® Clamp Selector

I.D. Range (in)	I.D. Range (mm)	Wedge Part No.	Clamp Combination
8.625	10.75	219 Wedge	T1
10.50	12.75	219 Wedge	T1 & T2
12.50	14.75	219 Wedge	T1 & T3
14.50	16.75	219 Wedge	T1 & T4
16.50	18.75	219 Wedge	T1 & T5
18.50	20.75	219 Wedge	T1 & T-219 Extension & T2
20.50	22.75	219 Wedge	T1 & T-219 Extension & T3
22.50	24.75	219 Wedge	T1 & T-219 Extension & T4
24.50	26.75	219 Wedge	T1 & T-219 Extension & T5
14.75	16.25	374 Wedge	T1
16.00	18.50	374 Wedge	T1 & T2
18.00	20.50	374 Wedge	T1 & T3
20.00	22.50	374 Wedge	T1 & T4
22.00	24.50	374 Wedge	T1 & T5
24.00	26.50	374 Wedge	T1 & T6
26.00	28.50	374 Wedge	T1 & T-374 Extension & T2
28.00	30.50	374 Wedge	T1 & T-374 Extension & T3
30.00	32.50	374 Wedge	T1 & T-374 Extension & T4
32.00	34.50	374 Wedge	T1 & T-374 Extension & T5
34.00	36.50	374 Wedge	T1 & T-374 Extension & T6
34.00	36.50	374 Wedge	T1 & T-374 Extension & T6



36" pipe has never been easier to end prep. Quick set-up, precise alignment and patent pending safety lanyard.

The Terminator is shown with a 5 h.p. pneumatic motor and off-set gear drive that can also be used with the available hydraulic drive.



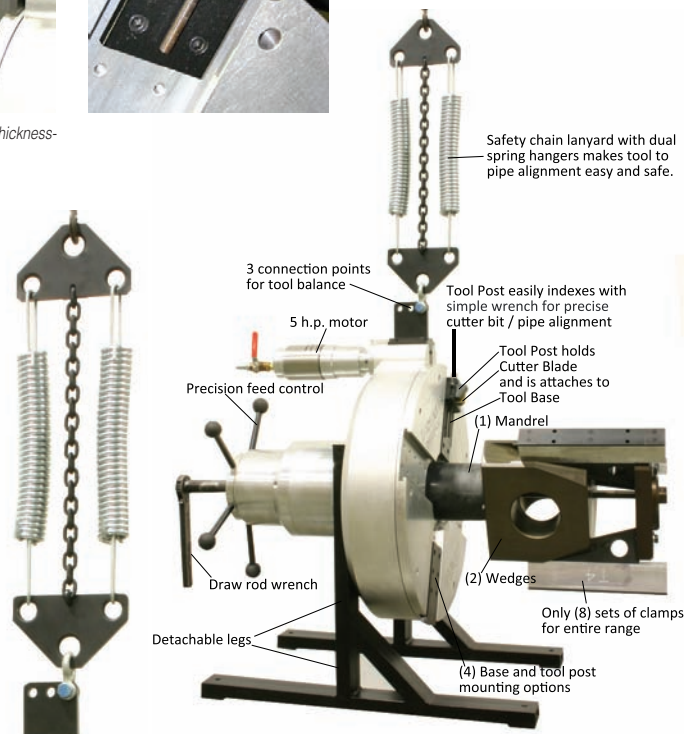
Only eight sets of clamps and two wedges required to cover entire range. Simple to operate, quick to set up.



Formed tool bits for wall thicknesses in excess of 2.5in.



Using the escolock blade locking system the cutter blade is held by the tool post that is attached to the tool base allowing easy, precise alignment to the pipe.



The Safety Chain Lanyard with Dual Spring Hangers off-set the weight of the Terminator and allows the operator to easily maneuver the tool while tightening it to the i.d. This simple action gives the operator a perceivable feel of the tool squaring itself to the i.d. as the clamps move up the tapered mandrel. (patent pending)

High Speed Hand Held Bevelers

Model HHB-5000
Model HHB-10000
Model HHB-5000 RA
Model HHB-10000 RA

*Straight-Thru, Track-Mountable, and
Right Angle Models available*

Key Features

- Capable of prepping tubes in seconds
- Air-powered beveling with no torque reaction
- Pilot automatically locates on tube or pipe I.D.
- No clamping or loose parts that can fall down tubes
- Handles variety of tubes, materials and applications
- Field changeable pilot and cutterhead saves time
- Carbide blade inserts have multiple cutting edges
- High speed cutterhead spins faster than 5,000 RPM
- Precise end preps without cutting oils
- Field proven tools require very little maintenance



High Speed Hand Held Bevelers prep tubes in seconds, set up is quick and no clamping is necessary.



These high speed straight-thru hand held bevelers provide torque-free operation and feature quick-change tooling. Right angle models are available for getting into tight spaces.



Both the HHB-5,000 and HHB-10,000 Straight Drive models can be hand held or track mounted.

High Speed Kits include the following:

High Speed Air Motor w/ Oiler, Right Angle Gear Drive, Chip Shield, Chip Guard Bracket, Hose, .500in w/ Filter, Oiler & .375in Coupler, Wrench Set (17mm x 17mm), Carrying Case, Allen Wrench Set, & Operating and Maintenance Instructions. (HHB-10,000RA Right Angle shown)



Straight-Thru and Right Angle Models

The straight-thru models can machine any degree of bevel on heavy and thin wall tubes, as well as tangent tubes. The most powerful pneumatic high speed end prep tools available anywhere, they can be used by hand or with the EscoTrack mount panel replacement system by using the optional Track Chassis and Post Assembly. With this option, these tools make fast work out of repetitive end preps and cut hours and even days off of boiler tube panel replacement outages.

When you need to get into a "Dutchman" of less than six inches, our right angle models do the job better than ever. The HHB-5000 RA or HHB-10000 RA end prep tools are every bit as rugged as our straight-thru models, and are ideal for single boiler tube repairs. All of these hand held bevelers feature quick-change tooling and the automatic pilot system that locates itself on the tube I.D.

Fast, Accurate and Easy to Use

These high speed bevelers feature the EscoPilot locating system which eliminates the need for clamping and special operator training. Unlike conventional end prep tools that require clamping to the tube or pipe I.D., these tools locate themselves automatically and there are no loose parts that can fall down the tube and waste your time. Simple to operate, just insert the pilot into the tube I.D., squeeze the throttle and finish your end prep completely in as fast as 3 seconds!

Specifications

	HHB-5000	HHB-5000 RA	HHB-10000	HHB-10000 RA
Working range to	.450" (11.43 mm) 2.250" (57.15 mm)	.450" (11.43 mm) 2.250" (57.16 mm)	.450" (11.43 mm) 4.00" (101.6 mm)	.450" (11.43 mm) 4.00" (101.6 mm)
Motor, pneumatic	1.5 h.p. (1.122 kw)	1.5 h.p. (1.122 kw)	3 h.p. (2.244 kw)	3 h.p. (2.244 kw)
Air pressure	90 psi (6.2 bar)	90 psi (6.2 bar)	90 psi (6.2 bar)	90 psi (6.2 bar)
Air Volume	50 cfm (1416 lt/min.)	50 cfm (1416 lt/min.)	80 cfm (2265 lt/min.)	80 cfm (2265 lt/min.)
Speed	5000	5000	10000	10000
Radial	1.5" (38.1 mm)	1.9" (48.3 mm)	2.125" (54 mm)	2.5" (63.5 mm)
Working weight	9 lbs.(4.1 kg)	8 lbs.(3.7 kg)	14 lbs.(6.4 kg)	13 lbs.(5.9 kg)
Shipping weight	40 lbs.(18.2 kg)	40 lbs.(18.2 kg)	45 lbs.(20.4 kg)	45 lbs.(20.4 kg)
Track mountable	yes	no	yes	no
Shipping dimensions	27"x18"x7" (686 mm x 457 mm x 177 mm)			
Manufacturer reserves the right to change specifications without notice.				

Part #	Size	O.D. Dimension	Max. Tube O.D.	Min Tube I.D	Insert Size
1050-01	1-1/4" (31.76 mm)	1.600" (40.64 mm)	1.250" (31.76 mm)	.450" (11.44 mm)	1/2" inserts
1050-02	1-1/2" (38.11 mm)	1.850" (46.99 mm)	1.500" (38.11 mm)	.700" (17.79 mm)	1/2" inserts
1050-03	1-3/4" (44.47 mm)	2.100" (53.4 mm)	1.750" (44.47 mm)	.700" (17.79 mm)	5/8" inserts
1050-04	2" (50.81 mm)	2.350" (59.7 mm)	2.000" (50.81 mm)	.950" (24.15 mm)	5/8" inserts
1050-05	2-1/4" (57.16 mm)	2.600" (66 mm)	2.250" (57.16 mm)	1.200" (30.5 mm)	5/8" inserts
1050-06	2-1/4" (63.51 mm)	2.850" (72.4 mm)	2.500" (63.51 mm)	1.450" (36.85 mm)	5/8" inserts
1050-07	2-3/4" (69.87 mm)	3.100" (78.8 mm)	2.750" (69.87 mm)	1.700" (43.2 mm)	5/8" inserts
1050-08	3" (76.21 mm)	3.350" (85.1 mm)	3.000" (76.21 mm)	1.950" (49.55 mm)	5/8" inserts
1050-09	3-1/4" (82.57 mm)	3.600" (91.5 mm)	3.250" (82.57 mm)	2.200" (55.9 mm)	5/8" inserts
1050-10	3-1/2" (88.91 mm)	3.850" (97.8 mm)	3.500" (88.91 mm)	2.450" (62.25 mm)	5/8" inserts
1050-11	3-3/4" (95.27 mm)	4.100" (104.2 mm)	3.750" (95.27 mm)	2.700" (68.59 mm)	5/8" inserts
1050-12	4" (101.61 mm)	4.350" (110.5 mm)	4.000" (101.6 mm)	2.950" (74.95 mm)	5/8" inserts



37-1/2deg cutterheads are standard other angles are available.



Inserts are available with two or four cutting edges and in two sizes, .5in and .625in. Double edge Inserts disperse heat quickly, last longer and perform well on a wide range of boiler tube alloys. Four edge inserts have two extra cutting edges that provide extra economy for beveling Carbon Steel and similar materials.



Pilots

Blank Pilots can be turned on the job-site to the perfect size. Accurate Pilot size ensures maximum cutting insert life and fast, chatter free bevels.

1050-140 Pilot blank (.400-1.500) available in 1/4" (6.35mm) increments
1050-141 Pilot blank (1.501-2.500) available in 1/4" (6.35mm) increments
1050-142 Pilot blank (2.501-3.500) available in 1/4" (6.35mm) increments
1050-143 Pilot blank (3.501-3.900) available in 1/4" (6.35mm) increments

Factory sized Locating Pilots are precision machined and marked with their exact size.

1050-40 I.D. pilot (range .400-1.500) O.D. & m.w.t., or pipe size & sch. needed
1050-41 I.D. pilot (range 1.501-2.500) O.D. & m.w.t., or pipe size & sch. needed
1050-42 I.D. pilot (range 2.501-3.500) O.D. & m.w.t., or pipe size & sch. needed
1050-43 I.D. pilot (range 3.501-3.900) O.D. & m.w.t., or pipe size & sch. needed



A properly sized Pilot is .015in - .030in under the i.d which is necessary for smooth operation, long blade life and chatter free bevels.

The broadest selection of saws and accessories for cutting boiler tube panel and removing membrane, cutting pendant tube, working around clusters of large pipe, and cutting big tanks.

Key Features

- Provides accurate cuts with no "HAZ" heat affected zone
- Eliminates rework and grinding before end prepping
- Standard model APS-438 accepts 10" and 12", or optional 14" blades
- Safety relief valve prevents running at excessive speeds
- Cuts tough materials with a high percentage of chrome
- Ergonomic design has optimum balance of speed and torque
- Glides effortlessly on easy to install EscoTrack
- Works with EscoWrap track for cutting pipe up to 60" O.D.
- Powerful 3 HP pneumatic motor operates on 90 psi shop air and uses only 80 CFM

Boilermaker Tough and Field Proven

The MILLHOG® Universal Air Powered Saw APS-438 is the complete, all around maintenance tool. Effortlessly gliding along the 5 ft. steel EscoTrack System, this powerful saw makes both horizontal and vertical cuts. After completing a horizontal cut, all you have to do for membrane removal is either remove the saw, rotate it 90° and reinstall it on the track, or for even faster membrane notching use the membrane removal bracket. This system is faster and safer than torch cutting and there is no heat affected zone or further rework needed before end prepping.



Standard APS-438 and Low Profile APS-438LP

Specifications

Standard APS-438–Low Profile APS-438LP–Low Radial Clearance APS-438LRC	
Motor, pneumatic	3 h.p. (2.244 kw)
Air Pressure	90 psi.(6.2 bar)
Air Volume	80 cfm (2265 lt/min.)
Speed	5050 RPM
Radial Clearance	
Standard APS-438	13.5" (343 mm)
Low Profile APS-438LP	7.5" (191 mm)
w/ 10" blade fully plunged into tube	
Low Radial Clearance APS-438LRC	6.0" (153 mm)
w/ 8" blade fully plunged into tube	
Working Weight	
Standard APS-438	28 lbs. (12.7 kg)
Low Profile APS-438LP	28.5 lbs. (13 kg)
Low Radial Clearance APS-438LRC	30 lbs. (13.6 kg)
Shipping Weight	
Standard APS-438	65 lbs. (29.5 kg)
Track	19 lbs. (9 kg)
Low Profile APS-438LP	65 lbs. (29.5 kg)
Low Radial Clearance APS-438LRC	68 lbs. (30.85 kg)
Shipping Dimensions	
Tool kit	26" x 15" x 11"
	(660 mm x 382 mm x 280 mm)
Track	66" x 3" (1676 mm x 77 mm)
Manufacturer reserves the right to change specifications without notice.	

Standard APS-438



The PANELHOG® APS-438 Air Powered Saw glides along the EscoTrack System for boiler tube panel removal, producing a straight, clean horizontal cut that requires no further rework.



APS-438 w/5' track kit

Kit includes:

Air motor assembly
Saw chassis w/brake
Hose, 3/4" w/filter, oiler & 1/2" coupler
Track, 5' w/3 weld tabs
Operating & maintenance instructions
Wrench set (17 x 22 x 9/16)
Carrying Case

Low Profile APS-438LP



Designed especially for cutting pendant tube panels in tight spaces using the EscoTrack System, this model only requires a 7-1/2" clearance. The APS-438LP is equipped with a 10" blade, uses the same powerful motor as our standard model, and, like all our tools, requires no special operator training.



APS-438LP Low Profile w/5' track

Kit includes:

Air motor assembly
Saw chassis w/brake
Hose, 3/4" w/filter, oiler & 1/2" coupler
Track, 5' w/3 weld tabs
Operating & maintenance instructions
Wrench set (17 x 22 x 9/16)
Carrying Case

Accessories

Field Proven Innovations

Quick Clamp



The Esco Quick Clamp is especially useful for:

- Boiler tube panel manufacturers
- Cutting pendant tubes



The Quick Clamp features jaws which securely grip a boiler tube panel or steel plate section for making perfectly straight cuts.



Ordering Information

Part No.	Description
Quick Clamp Parts	
TR-QC	Quick Clamp
For tracks 8' or longer the following is required	
QC-17	Track support
QC-18	Track leveler (length of track needed)
QC-19	Track joiner
QC-20	Quick clamp cut-line indicator gauge
Membrane bracket	
APS-215	Membrane removal blade, 3/8"
APS-215A	Membrane removal blade, 1/4"
APS-218	Membrane bracket
Single tube cut-off bracket	
APS-220	Single tube cut-off bracket

Membrane Removal Bracket



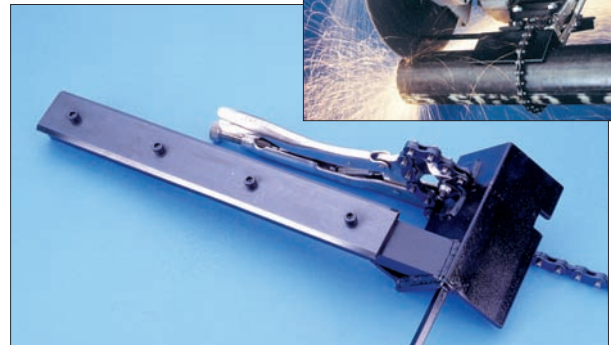
This bracket mounts right onto the EscoTrack to let you easily remove membrane from between boiler tubes.



Single Cut Bracket



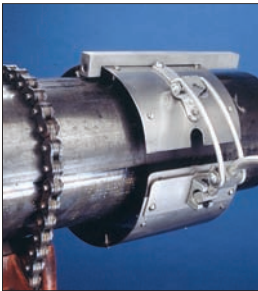
This bracket turns the APS-438 into a Portable Chop Saw. It is ideal for cutting tube, pipe, or solid stock up to 4" O.D.



These innovative kits were developed
 for cutting pipe from 6" to 60" O.D.

Standard APS-438 Trolley

Standard APS-438 Trolley fits the EscoWrap Track.



Mount band to pipe



Clamp into position



Mount trolley



Adjust and secure



Trolley is adjustable for a
 variety of EscoWrap
 Tracks



Mount saw to trolley



Wrap Tracks are made
 of stainless steel and designed
 to fit standard pipe sizes.
 Special sizes can be made to
 customer specification. Please
 don't hesitate to contact us.

U.S. Patent 5,081,768

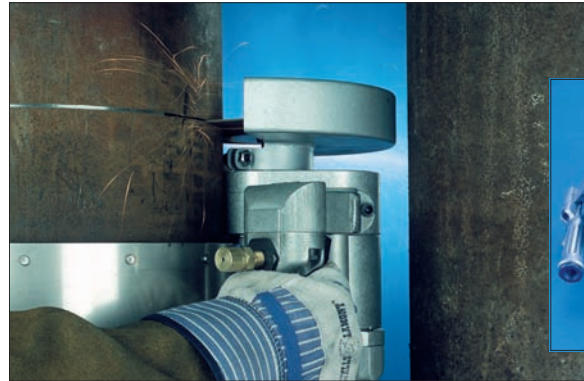


Wrap Tracks and the APS-438 with Trolley or
 the APS-438 LRC set up easily to cleanly cut
 concrete lined pipe.



Set up and cut a 10" Sch. 160 pipe in under
 10 minutes, producing a perfectly square cut.

Dedicated Wrap Track Saw



Requires less than
 6-1/4" radial clearance.



APS-200LRC is designed exclusively for use on the EscoWrap Track.



APS-438 w/trolley

Kit Includes
 Operating & maintenance instructions
 Pipe trolley w/cut-line indicator gauge
 Air motor assembly
 Wrench set (17 x 22 x 9/16)
 Saw chassis w/brake
 Carrying Case
 Hose, 3/4" w/filter, oiler & 1/2" coupler



APS-438 Low Radial Clearance

Kit Includes
 Low clearance air motor assembly
 Saw chassis w/trolley
 Hose, 3/4" w/filter, oiler & 1/2" coupler
 Carrying Case
 Wrench set (17 x 22 x 9/16)
 Operating & maintenance instructions

Wrap Track Selections

Part No.	EscoWrap Tracks
EW-06	EscoWrap Track, 6"
EW-08	EscoWrap Track, 8"
EW-10	EscoWrap Track, 10"
EW-12	EscoWrap Track, 12"
EW-14	EscoWrap Track, 14"
EW-16	EscoWrap Track, 16"
EW-18	EscoWrap Track, 18"
EW-20	EscoWrap Track, 20"
EW-22	EscoWrap Track, 22"
EW-24	EscoWrap Track, 24"
EW-26	EscoWrap Track, 26"
EW-28	EscoWrap Track, 28"
EW-30	EscoWrap Track, 30"
EW-32	EscoWrap Track, 32"
EW-34	EscoWrap Track, 34"
EW-36	EscoWrap Track, 36"
EW-38	EscoWrap Track, 38"
EW-40	EscoWrap Track, 40"
EW-42	EscoWrap Track, 42"
EW-44	EscoWrap Track, 44"
EW-46	EscoWrap Track, 46"
EW-48	EscoWrap Track, 48"
EW-50	EscoWrap Track, 50"
EW-52	EscoWrap Track, 52"
EW-54	EscoWrap Track, 54"
EW-56	EscoWrap Track, 56"
EW-58	EscoWrap Track, 58"
EW-60	EscoWrap Track, 60"

Accessories

FlexTRACK®

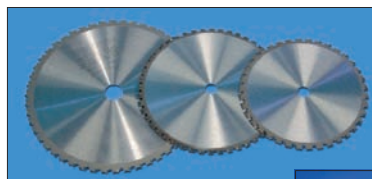
This flexible mounting track permits perfectly square cuts on big tanks. It is a 2" wide steel track that attaches by tack welds to the side of any straight, contoured or cylindrical structure with a radius of 2-1/2 ft. or larger.



There is no limit to the size of the tank because the FlexTRACK® comes in standard 6 ft. sections which can be joined together.



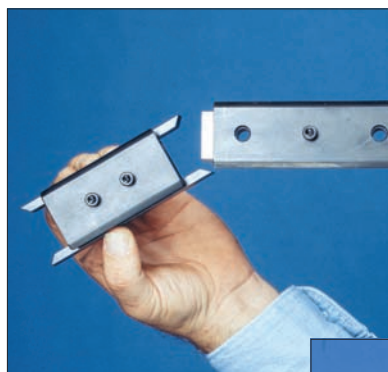
Saw blades, tracks and accessories are always available.



Carbide blades are available for various applications and work with our standard APS-438 Air Powered Saw. Please consult factory for details.

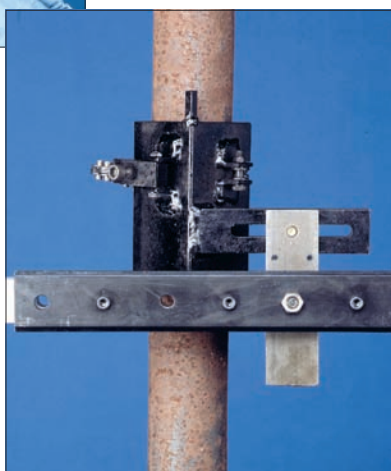


Challenge us with your toughest application requirements.



Track Connector

The track connector is used for extended runs and easily clips on.



Chain Mount Tab

Instead of welding bracket to tube, this bracket incorporates a chain that tightens on the tube. Any diameter up to 4-1/8" can be cut.



APS-438FL w/5' Flex Track

Kit includes:

Air motor assembly
Saw chassis w/brake
Flex Track, 5'
Hose, 3/4" w/filter, oiler & 1/2" coupler
Wrench set (17 x 22 x 9/16)
Carrying Case
Operating & maintenance instructions

Tooling Selections

Part No.	Flex Track
TR-FL	Flex track
TR-FLCL	Flex track cut-line indicator
QC-16	Clamp stop support
QC-17	Track support
QC-18	Track leveler
QC-19	Track joiner
APS-211	Cut-off Blades
APS-212	Cut-off blades, 8"
APS-213	Cut-off blades, 10"
APS-214	Cut-off blades, 12"
APS-214A	Cut-off blades, 14" concrete
	Accessories
TR-05	Track, 5'
TR-CL	Track, custom length (price per foot)
TR-FL	Flex Track (price per foot)
TR-CM	Chain mount tab (min. 2 required)
TR-QC	Quick clamp
TR-TC	Track connectors
TR-WT	Weld tabs
TR-205	Pipe trolley w/cut-line indicator gauge

“Fin” MILLHOG®

*Tube Fin Removal Tool
Removes fin from tube O.D. and bevels
tube end in one-step*

*This innovative, time-saving tool eliminates the need for
chipping hammers and grinders*

Key Features

- Removes 4" (101mm) of fin from the tube O.D. in under two minutes
- Bevels the tube end after removing the fin, all in one-step
- Pneumatically powered with no reaction torque to the operator
- High grade tool steel cutter blade can be resharpened
- Heavy-duty rack and pinion feed mechanism assures smooth operation for greater fin removal control
- Rigidly clamps to the tube I.D.
- Works in any position to separate the fin from tube
- Easy to operate and no cutting lubricants are necessary
- Saves a lot of time by eliminating chipping and grinding

Proprietary Blade Produces Exceptional Results

The Fin MILLHOG® tube fin removal tool is air-powered, clamps to the tube I.D., and features a patented fin removal head that peels the fin from a tube I.D. Forget about chipping hammers and grinders. A true time saver, this tool can remove a 4" (101mm) fin from a tube O.D. in under two minutes!

Easy to operate, the Fin MILLHOG® does it all. Once it is clamped into the tube I.D. and you engage the throttle, the fin removal head rotates, is fed into the fin, and efficiently cuts the bond between the fin and tube O.D. Built tough, the cutter blade is made from a high grade tool steel that can be resharpened, while a heavy-duty rack and pinion feed mechanism assures smooth operation, without requiring any cutting fluids.



This hand-held fin removal tool features a cutter head that efficiently cuts the bond between the fin and the tube O.D.



Left hand wound fin.



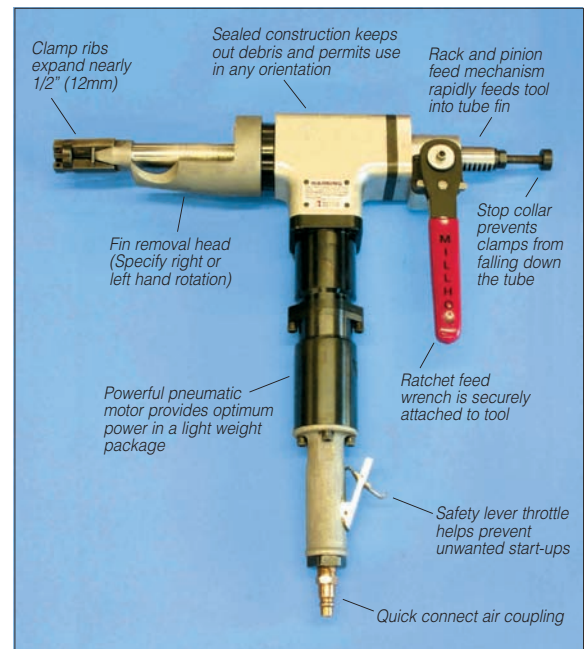
The tube is ready for end prepping after the fin is removed.



Right hand wound fin.



The Fin MILLHOG can remove a 4" fin from a tube O.D. in under two minutes and can be used in any orientation.



© U.S. Patent 7,305,746 & 7,774,909

Specifications

"Fin" MILLHOG®	
Working Range	1-1/4" (31.8 mm) I.D. to 3" (76.2 mm) O.D.
Motor, pneumatic	1-1/4" h.p. (.932 kW)
Air Pressure	90 psi (6.2 bar)
Air Volume	40 cfm (1133 lpm)
Speed	180 rpm
Minimum Clearance	2-5/8" (66.68 mm)
Head Length	19" (483 mm)
Working Weight	24 lbs (10.9 kg)
Shipping Weight	63 lbs (28.6 kg)
Shipping Dimensions	24" x 20" x 7" (610 mm x 508 mm x 178 mm)
Manufacturer reserves the right to change specifications without notice.	

Ordering Information

Kit No.	Description
FH-200	"Fin" Millhog for 1-1/4" I.D. to 3" O.D.
<i>Kit Includes:</i>	
Pneumatic motor and gear drive	
Fin Hog mandrel	
(1) Fin removal head, specify size and fin direction of tube	
Draw rod wrench assembly	
(1) Clamp rib set (choose from H-1-H-4)	
Hose with filter, oiler and 3/8" couplers	
Allen wrench set	
Carrying case	
Operating instructions	

MILLHOG® Rolling Motors and Tube Expanders, for fabricating and maintaining boilers, heat exchangers and condensers...

MILLHOG® Rolling Motor Features

- Quickly, automatically, and accurately control tube expansion
- Precise, consistent tube wall reduction
- Tight tube joints
- Torque Control helps prevent over / under expansion
- Pneumatically powered
- Right angle models available for tight, restricted areas
- Many models available for rent

MILLHOG® Tube Expander Features

- 3/8" to 4-1/2" O.D.
- Tube sheets to 5-3/8"
- Flare and straight rolls
- Kits available for sale or rent

Precisely Bonds Tube to Tube Sheet

Equipped with the proper MILLHOG® Tube Expander and MILLHOG® Rolling Motor, premature tube failure and damage to the tube sheet, due to over/under expansion is prevented, assuring a tight, uniform bond between the tube O.D. and the tube sheet.



Available for sale or rental, tube expanding kits are custom fitted to meet your needs.



MILLHOG® torque controlled, pneumatically powered rolling motors are available in a variety of configurations that include; lever, and roll throttle models.



Tube expanders for Heat Exchangers, Condensers and Boilers are available from stock in a choice of configurations including; Straight, Flare, and Long Reach.

MILLHOG® Rolling Motor Selection Chart

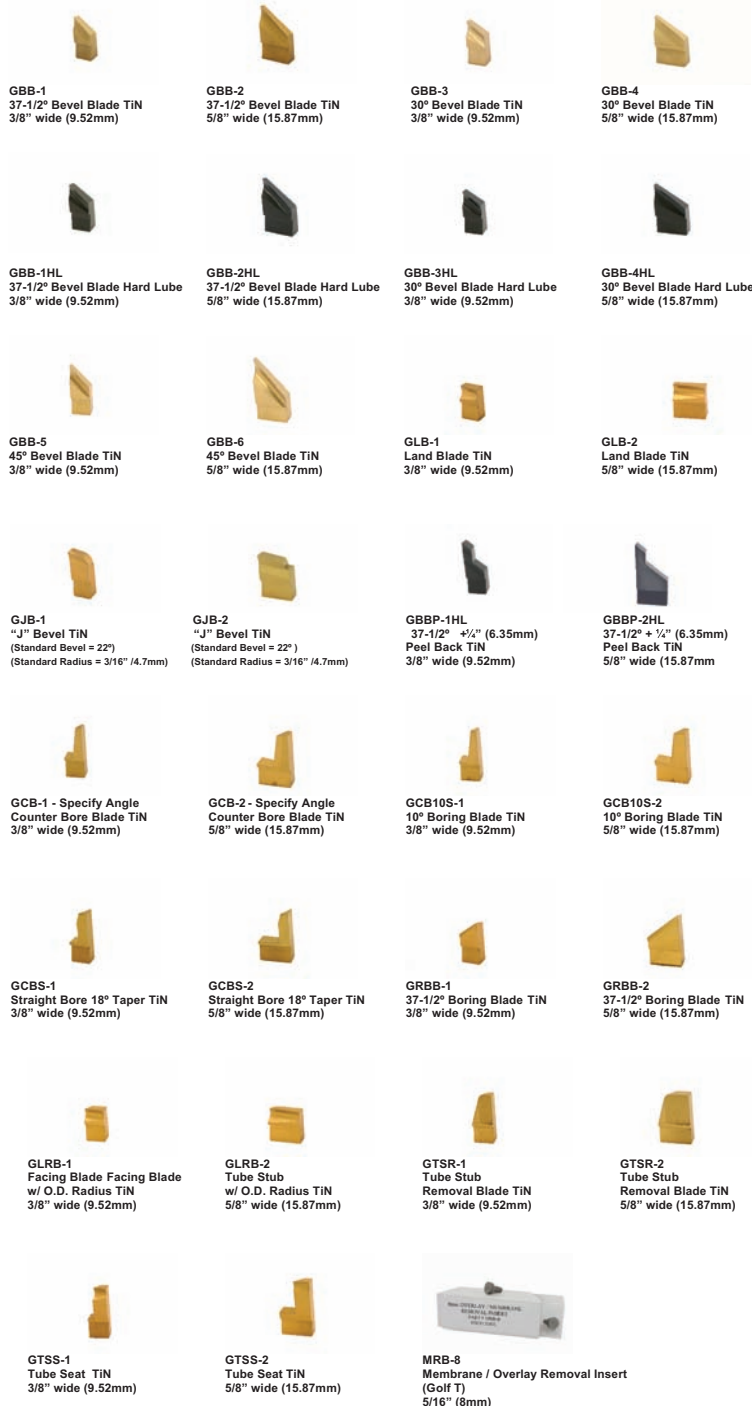
Models	Free Speed	Maximum Torque		Minimum Torque		Overall Length		Weight		Side To Center		Operating Hose		CFM	DR SQ	Tube Capacities		Chucks	
		IN. LBS.	Nm	IN. LBS.	Nm	IN.	mm	LBS.	KG.	IN	mm	IN	mm			IN	mm	included	optional
*710-3000	3000	9	0.68	2	0.23	7-9/16	192	1.9	0.86	13/16	20.6	1/4	7	8	-	3/16	4.8	1/4 QC	-
*710-2000	2000	9	1.02	2	0.23	7-13/16	198	1.9	0.86	13/16	20.6	1/4	7	8	-	1/4	6.3	1/4 QC	-
*720-1800B	1000	27	3.05	2	0.226	7-7/8	200	24	1.09	13/16	20.6	1/4	7	17	1/4	3/8	9.5	1/4 QC	3/8 QC
*720-550B	550	75	8.47	2	0.226	8-5/8	219	2.7	1.23	13/16	20.6	1/4	7	17	3/8	1/2	12.7	1/4 QC	3/8 QC
*850-1250A	1066	126	14.2	9.6	1.08	12-1/4	311	10.5	4.76	1-7/16	36.5	3/8	10	48	3-8	3/4	19	3/8 QC	1/2 QC
850-600A	486	230	26	4.4	1.63	12-1/4	311	10.5	4.76	1-7/16	36.5	3/8	10	48	3/8	1	25.4	3/8 QC	1/2-3/4 QC
	FT. LBS.	Nm	FT. LBS.	Nm															
1050-400	388	26.4	35.8	3.3	4.5	13-5/8	346	14	6.35	1-15/16	50	1/2	13	68	1/2	1-1/4	1.7	3/8 QC	1/2-3/4 QC
*1550-900	756	30.7	41.6	4.7	6.4	18	457	27	2.25	1-15/16	50	1/2	13	70	1/2	1-1/2	38.1	3/8 QC	1/2-3/4 QC
1550-250	220	109.9	149	14.3	9.4	18	457	27	12.25	1-15/16	50	1/2	13	56	1/2	2-1/2	63.5	3/4-1 QC	3/8-1/2 QC

Models	SPEED & TORQUE 90 psig AIR PRESSURE					Overall Length				HEAD DIMENSIONS		Square Drive Size	Tube Capacities	Chuck Size
	Free Speed	Maximum Torque	Minimum Torque							Side To Center	STD Less Square Drive			
	(RPM)	FT. LBS.	Nm	FT. LBS.	Nm	IN.	mm	LBS.	KG.	IN./mm	IN./mm	IN.	IN./mm	
*2055-R-370	370	48	65	24	32	19.75"	489	7/3/04	3.5	7/8 23	3.0/76.1	1/2"	1.5/38	1/2
2055-R-190	190	95	129	43	58	19.75"	48 9	7/3/04	3.5	7/8 23	3.0/76.1	1/2"	2/50.8	1/2
Reversible Lever Throttle														
*1573-L-190	190	140	190	70	95	20.1	550	13	5.8	1.1/28	2.6/65	5/8	2.5/63.5	3/4
*1573-L- 90	90	305	410	150	200	21.7	550	14.75	6.7	1.5/37	2.6/65	5/8	4/101.5	1
Reversible Roll Throttle														
1753-R-190	190	140	190	70	95	20.1	550	13	5.8	1.1/28	2.6/65	5/8	2.5/63.5	3/4
1752-R- 90	90	305	410	150	200	21.7	550	14.75	6.7	1.5/37	2.75/70	5/8	4/101.5	1
Reversible Roll Throttle Stall Type														
1753-RS-190	190	155	210	-	-	18.5	465	18.5	8.4	1.1/28	2.6/65	5/8	2.5/63.5	3/4
*1753-RS-90	90	325	440	-	-	19	485	18.5	8.4	1.5/37	2.75/70	3/4	4/101.5	1

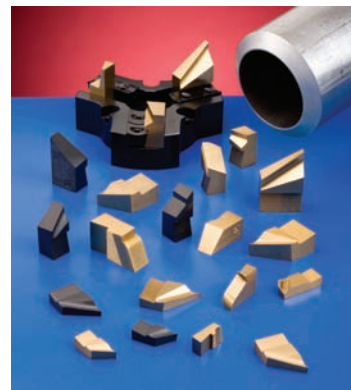
* Rental Item, check availability

These two pages show our most popular MILLHOG® cutter blades and are available with TiN coating for extended blade life or Hard Lube for superior heat resistance and more end preps per blade.

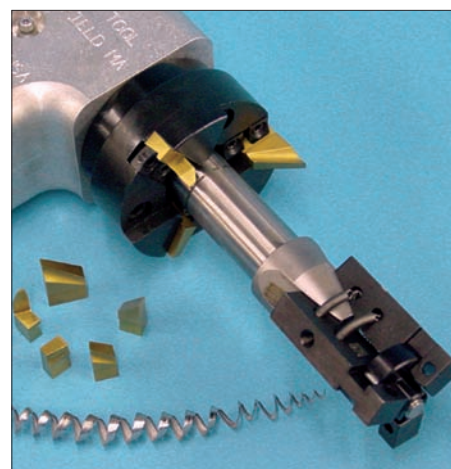
Cutter Blades for the Ground, C-Hog, Mongoose and Tube Weasel MILLHOGS



Millhog cutter blades have a sharp edge that gets under the material and radical chip breaker that curls a thick chip and transfers heat away from the surface.

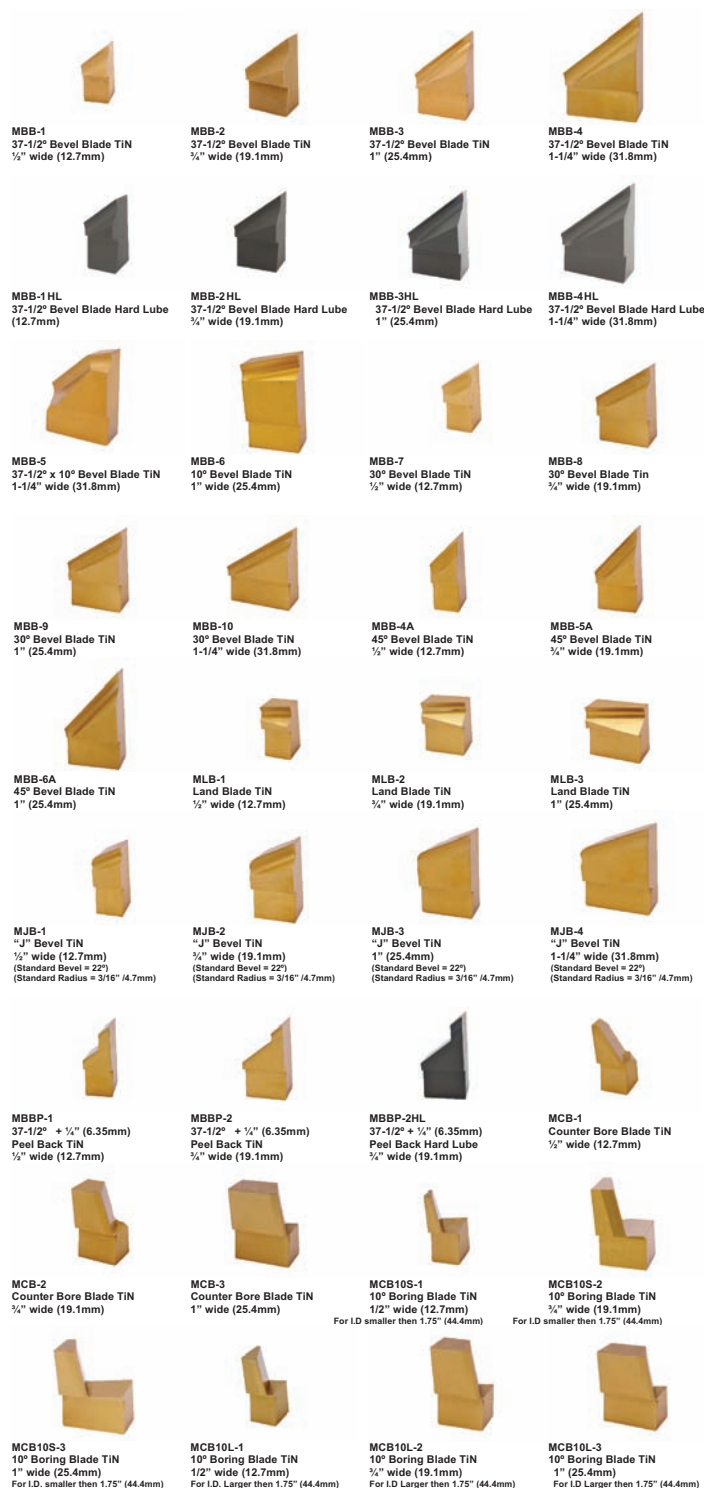


An endless range of standard and custom cutter blades are offered with Titanium Nitride (TiN) coating. For extended blade life, try our new "Hard Lube" coated cutter blades which provide superior heat resistance and more end preps per blade.



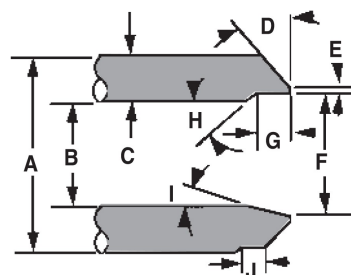
Titanium Nitride Coated (TiN) Cutter Blades for the entire MILLHOG® family of End Prep Tools produce a Thick Chip without cutting oils.

Cutter Blades for the Wart, Mini, PrepZilla, Commander, Dictator and Terminator MILLHOGS



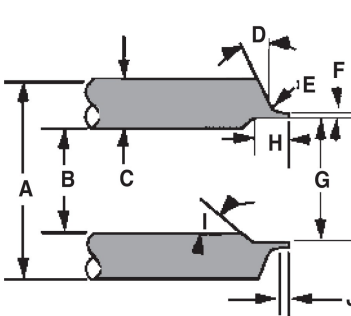
For a custom blade request please fill in the appropriate information in the Your Spec. column.

Specifications for "V" Prep Custom Blades



		Standard	Your Spec.
A	Tube O.D.	—	
B	Tube I. D.	—	
C	Wall thickness	—	
D	Bevel Angle	37-1/2°	
E	Land or Face	—	
F	Bore Dia.	—	
G	Depth of Bore	3/8	
H	Taper Angle	18°	
I	Bore Angle	10°	
J	Peel Back	1/4"	

Specifications for "J" Prep Custom Blades



		Standard	Your Spec.
A	Tube O.D.	—	
B	Tube I. D.	—	
C	Wall thickness	—	
D	Bevel Angle	22°	
E	Radius	3/16	
F	Land or Face	—	
G	Bore Dia.	—	
H	Bore Depth	3/8	
I	Bore Taper	18°	
J	Nose (Straight)	—	
K	Tapered bore angle instead of straight bore	10°	





*Photocopy
and mail or fax*

Pipe Size Tube O.D.	Pipe Sch M.W.T.	Quantity	End Prep Angle	Counterbore	Pipe/Tube Material	Location	Mechanical Restrictions

We accept

[illegible]

Pipe Chart

Nominal Pipe Size (Inches)	Schedule Number	Wall Thickness (Inches)	Inside Diameter (Inches)	Nominal Pipe Size (Inches)	Schedule Number	Wall Thickness (Inches)	Inside Diameter (Inches)	Nominal Pipe Size (Inches)	Schedule Number	Wall Thickness (Inches)	Inside Diameter (Inches)
1/8 (0.405)	10S 40ST, 40S 80XS, 80S	0.049 0.068 0.095	0.307 0.269 0.215	8 (8.625)	5S 10S 20 30 40ST, 40S 60 80XS, 80S 100 120 140 XX 160	0.109 0.148 0.250 0.277 0.322 0.406 0.500 0.594 0.719 0.812 0.875 0.906	8.407 8.329 8.125 8.071 7.981 7.813 7.625 7.437 7.187 7.001 6.875 6.813	20 (20)	5S 10S 10 20, ST 30, XS 40 60 80 100 120 140 160	0.188 0.218 0.250 0.375 0.500 0.594 0.812 1.031 1.281 1.500 1.750 1.969	19.624 19.564 19.500 19.250 19.000 18.812 18.376 17.938 17.438 17.000 16.500 16.062
1/4 (0.540)	10S 40ST, 40S 80XS, 80S	0.065 0.088 0.119	0.410 0.364 0.302	10 (10.75)	5S 10S 20 30 40ST, 40S 60XS, 80S 80 100 120 140, XX 160	0.134 0.165 0.250 0.307 0.365 0.500 0.594 0.719 0.844 1.000 1.125	10.482 10.420 10.250 10.136 10.020 9.750 9.562 9.312 9.062 8.750 8.500	24 (24)	5S 10, 10S 20ST XS 30 40 60 80 100 120 140 160	0.218 0.250 0.375 0.500 0.562 0.688 0.969 1.219 1.531 1.812 2.062 2.344	23.564 23.500 23.250 23.000 22.876 22.324 22.062 21.562 20.938 20.376 19.876 19.312
3/8 (0.675)	10S 40ST, 40S 80XS, 80S	0.065 0.091 0.126	0.545 0.493 0.423	12 (12.75)	5S 10S 20 30 ST, 40S 40 XS, 80S 60 80 100 120, XX 140 160	0.156 0.180 0.250 0.330 0.375 0.406 0.500 0.562 0.688 0.844 1.000 1.125 1.312	12.438 12.390 12.250 12.090 12.000 11.938 11.750 11.626 11.374 11.062 10.750 10.500 10.126	30 (30)	5S 10, 10S ST 20, XS 30	0.250 0.312 0.375 0.500 0.625	29.500 29.376 29.250 29.000 28.750
1 (1.315)	5S 10S 40ST, 40S 80XS, 80S 160 XX	0.065 0.109 0.133 0.179 0.250 0.358	1.185 1.097 1.049 0.957 0.815 0.599	14 (14)	5S 10S 10 20 30, ST 40 XS, 80S 60 80 100 120, XX 140 160	0.156 0.188 0.250 0.312 0.375 0.438 0.500 0.594 0.750 0.938 1.094 1.250 1.406	13.688 13.624 13.500 13.376 13.250 13.124 13.000 12.812 12.500 12.124 11.812 11.500 11.188	32	10 STD XS, 20 30 40	0.312 0.375 0.500 0.625 0.688	31.376 31.250 31.000 30.750 30.624
1-1/4 (1.660)	5S 10S 40ST, 40S 80XS, 80S 160 XX	0.065 0.109 0.140 0.191 0.250 0.382	1.530 1.442 1.380 1.278 1.160 0.896	16 (16)	5S 10S 10 20 30, ST 40 XS, 80S 60 80 100 120 140 160	0.169 0.188 0.250 0.312 0.375 0.438 0.500 0.594 0.750 0.938 1.094 1.250 1.406	15.670 16.624 15.500 15.376 15.250 15.000 14.688 14.312 13.938 13.562 13.124 12.812	34	10 STD XS, 20 30 40	0.312 0.375 0.500 0.625 0.688	33.376 33.250 33.000 32.750 32.624
1-1/2 (1.900)	5S 10S 40ST, 40S 80XS, 80S 160 XX	0.065 0.109 0.145 0.200 0.281 0.400	1.770 1.682 1.610 1.500 1.338 1.100	18 (18)	5S 10S 10 20 30, ST 40, XS 60 80 100 120 140 160	0.165 0.188 0.250 0.312 0.375 0.500 0.562 0.750 1.031 1.219 1.438 1.594	17.670 17.624 17.500 17.376 17.250 17.124 17.000 16.876 16.500 16.124 15.688 15.250 14.876 14.438	36	10 STD, 40S XS, 80S	0.312 0.375 0.500	35.376 35.250 35.000
2 (2.375)	5S 10S 40ST, 40S 80XS, 80S 160 XX	0.065 0.109 0.154 0.218 0.344 0.436	2.245 2.157 2.067 1.939 1.687 1.503	20 (20)	5S 10S 10 20 30, ST 40, XS 60 80 100 120 140 160	0.169 0.188 0.250 0.312 0.375 0.500 0.562 0.750 1.031 1.219 1.438 1.594	15.670 16.624 15.500 15.376 15.250 15.000 14.688 14.312 13.938 13.562 13.124 12.812	  A Unit of ESCO TECHNOLOGIES, INC. 75 October Hill Road Holliston, MA 01746			
2-1/2 (2.875)	5S 10S 40ST, 40S 80XS, 80S 160 XX	0.083 0.120 0.203 0.276 0.375 0.552	2.709 2.635 2.469 2.323 2.125 1.771	22 (22)	5S 10S 10 20 30, ST 40, XS 60 80 100 120 140 160	0.169 0.188 0.250 0.312 0.375 0.500 0.562 0.750 1.031 1.219 1.438 1.594	15.670 16.624 15.500 15.376 15.250 15.000 14.688 14.312 13.938 13.562 13.124 12.812				
3 (3.5)	5S 10S 40ST, 40S 80XS, 80S 160 XX	0.083 0.120 0.216 0.300 0.438 0.600	3.334 3.260 3.068 2.900 2.624 2.300	24 (24)	5S 10S 10 20 30, ST 40, XS 60 80 100 120 140 160	0.165 0.188 0.250 0.312 0.375 0.500 0.562 0.750 1.031 1.219 1.438 1.594	17.670 17.624 17.500 17.376 17.250 17.124 17.000 16.876 16.500 16.124 15.688 15.250 14.876 14.438				
3-1/2 (4)	5S 10S 40ST, 40S 80XS, 80S	0.083 0.120 0.226 0.318	3.834 3.760 3.548 3.364	26 (26)	5S 10S 10 20 30, ST 40, XS 60 80 100 120 140 160	0.165 0.188 0.250 0.312 0.375 0.500 0.562 0.750 1.031 1.219 1.438 1.594	17.670 17.624 17.500 17.376 17.250 17.124 17.000 16.876 16.500 16.124 15.688 15.250 14.876 14.438				
4 (4.5)	5S 10S 40ST, 40S 80XS, 80S 120 160 XX	0.083 0.120 0.237 0.337 0.438 0.531 0.674	4.334 4.260 4.026 3.826 3.624 3.438 3.152	28 (28)	5S 10S 10 20 30 ST XS 40 60 80 100 120 140 160	0.165 0.188 0.250 0.312 0.375 0.500 0.562 0.750 0.938 1.156 1.375 1.562 1.781	17.670 17.624 17.500 17.376 17.250 17.124 17.000 16.876 16.500 16.124 15.688 15.250 14.876 14.438	800.343.6926 • 508.429-4441 • Fax 508.429-2811 e-mail: millhog@escotool.com • www.escotool.com Available for Sale or Rent			
5 (5.563)	5S 10S 40ST, 40S 80XS, 80S 120 160 XX	0.109 0.134 0.258 0.375 0.500 0.625 0.750	5.345 5.295 5.047 4.813 4.563 4.313 4.063	30 (30)	5S 10S 10 20 30 ST XS 40 60 80 100 120 140 160	0.165 0.188 0.250 0.312 0.375 0.500 0.562 0.750 0.938 1.156 1.375 1.562 1.781	17.670 17.624 17.500 17.376 17.250 17.124 17.000 16.876 16.500 16.124 15.688 15.250 14.876 14.438				
6 (6.625)	5S 10S 40ST, 40S 80XS, 80S 120 160 XX	0.109 0.134 0.280 0.432 0.562 0.719 0.864	6.407 6.357 6.065 5.761 5.501 5.187 4.897	32 (32)	5S 10S 10 20 30 ST XS 40 60 80 100 120 140 160	0.165 0.188 0.250 0.312 0.375 0.500 0.562 0.750 0.938 1.156 1.375 1.562 1.781	17.670 17.624 17.500 17.376 17.250 17.124 17.000 16.876 16.500 16.124 15.688 15.250 14.876 14.438				

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