

SEVERE DUTY (SD) CONTROL VALVES

OCOPES VULCAN®



The Copes-Vulcan brand from Celeros Flow Technology has been providing control valves and desuperheaters for the power, process and nuclear industries since 1903. Copes-Vulcan provides a wide range of valves for the control of pressure, temperature and flow-induced noise in all types of power plants. Products include severe service and general service control valves, variable orifice desuperheaters, RAVEN™, trim and steam-conditioning valves and nuclear control valves, as well as custom designed specialty valves. Copes-Vulcan is recognized worldwide as a leader in valves for severe and critical service applications. Our strength lies in our ability to provide innovative valve solutions for our customers' application needs.

SD SEVERE DUTY CONTROL VALVES

The Copes-Vulcan SD-Severe Duty valve is Celeros Flow Technology's premium severe duty and critical service control valve design. The SD-Severe Duty range is the next generation of control valves designed specifically for severe duty applications. It is the preferred style of valve for applications such as pump recirculation, feedwater control and feedwater start-up, flashing or cavitating service, critical pressure drop gas and steam service, and any potentially noisy or vibration-prone service. It is also widely used for nuclear "N" stamp and seismic applications.

The SD-Severe Duty range incorporates a number of improvements such as:

- Quick disconnect between valve stem and actuator yoke on most models that greatly simplifies service and inspection.
- An extensive array of standard trims is available including many previously offered only as custom designs.
- Shorter lead times/quicker delivery of both entire valve assemblies and replacement parts.

Improvements such as these, coupled with innovative yet sound engineering practices, and a reputation for building the best control valves

possible, assures that the SD-Severe Duty line is destined to become the new industry standard for severe duty and critical service applications. SD Series valves can be fitted with an extensive array of standard and high performance trims to meet most severe duty/critical service requirements. Copes-Vulcan specialty trims such as RAVENTM, HUSH®, Soft-Seated HUSH®, TANDEM and GADTM trims are readily available to meet the most severe applications. Additionally, custom engineered trims are supplied as required.

All trims are of quick change design to assure ease of maintenance. Most are fully interchangeable between like sizes to ensure maximum flexibility and reduced inventory requirements.

The SD style design is in accordance with ASME B16.1, B16.5, B16.11, B16.25, B16.34 and, when required, will comply with standards including as CAN Z299.2, .3 and .4, ASME SEC.I, ASME SEC.III, B31.1, PED-"CE", 'N' & 'NPT', 97/23/EC-PED-CE and is also ISO-9001 certified.



TYPICAL PRODUCT APPLICATIONS







• Aux. Steam to Deaerator

 Reheater Tank Drain to Condenser

Deaerator Water Level
 Main Control

 Boiler Water Tank to Condensor

Drum Level Control

Sootblower PRV

Continuous Blowdown

Boiler Feedpump

• Min Flow Recirculation

HP Feedwater Start-Up

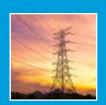
Level Control Valve











RAVEN™ TRIM

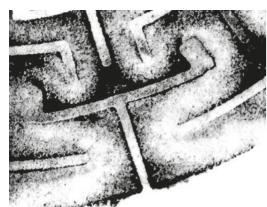
The RAVEN™ trim incorporates a unique advanced design that is superb at limiting flowing velocities to low levels resulting in valves providing service that is quiet, non-cavitating and non-erosive.

The low velocities attained by the RAVEN™ trim are achieved through the use of trim cage made by bonding together a series of individual discs. Each disc has a pattern of carefully controlled orifices and channels with a multitude of sharp turns etched into its surface. As the trim's plug travels within the cage the fluid is throttled and forced to travel an extremely torturous path with each turn effecting a stage of pressure drop.

The combined effect of numerous narrow flow channels, each with many sharp turns and a continually expanding flow path, removes kinetic energy from the fluid while gradually lowering its pressure. In doing so, abrupt velocity increases that are the source of noise are avoided. The additional benefit for liquid flow is the elimination of cavitation and the damage it can do to a valve, its trim and the downstream piping.

By its very design the RAVEN™ trim allows for many more stages of drop than conventional torturous path trims.

Superior to other velocity control trims, RAVEN™, through the use of a consistent narrow wall design, typically is more efficient at passing flow or allowing more turns or stages of drop in a given valve size.



ACTUAL GASEOUS FLOW THROUGH RAVEN TRIM™.

Most Raven trims contain multiple relief points in the flow path as a standard feature. These relief points allow entrained debris to clear the main fluid flow, or in the case of significant path blockage, they provide an effective bypass route for the fluid. With the benefits of the relief points, the actual fluid flow streams still remain virtually separate or discrete from each other for best velocity control.

By manufacturing the flow channels to extremely close tolerances, the calculated or predicted versus actual pressure drops of the RAVENTM trim are significantly more accurate than other trims. Hence, velocities are more uniform throughout the entire trim, further guarding against noise, erosion and cavitation.

Ultimately, each RAVENTM trim is specifically designed to provide the finest severe duty valve service by reducing and attenuating velocity, erosion and noise.



PROVEN SUPERIOR TECHNOLOGY

Note the highly visible attachment phenomenon wherein the flow stream hugs or clings to each obstruction in its path, effectively taking the path of least resistance. Also, despite multiple relief points in the flow path it can be clearly seen that the fluid does not recombine with the RAVENTM trim, rather the flow streams remain virtually separate or discrete from each other for best velocity control.

HUSH® TRIM

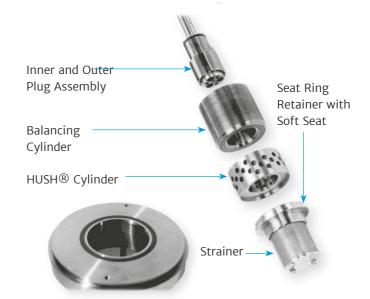
HUSH® Trim is an advanced concept in control valve trim for high pressure-drop liquid, gas and steam applications.

It is a cage guided type trim that provides excellent control for compressible and non-compressible fluid applications by directing the flow through a series of staged pressure drops. This unique trim eliminates cavitation in liquid flow and provides multiple pressure breakdown for noise attenuation in critical pressure drop compressible fluid applications.



EXCLUSIVE SOFT SEATED HUSH® TRIM

Soft Seated HUSH® trim is designed for use in new valves or as a replacement trim in existing Copes-Vulcan valves as well as in valves made by other manufacturers. Any liquid control valve taking a pressure drop up to 5000 psi (34450 kPa) that spends more than 90% of the time in the closed position must use Soft Seated HUSH® maintain zero leakage.



GAD™ TRIM

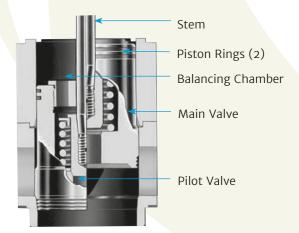
The Port Throttling GAD™ trim was developed to meet the rigorous requirements of feedwater startup control. Designed to give optimum flexibility in power operated control valves, the trim is available in double seat, balanced single seat, and tandem versions.

The GAD™ trim is equally suitable for use with steam and many other fluids. It has been successfully used on high pressure water applications involving pressure of up to 5075 psi (34970 kPa) and pressure differential of up to 3625 psi (24980 kPa).



TANDEM TRIM

The TANDEM trim is designed primarily for high pressure differential applications where tight shutoff is essential. Such applications include steam and water pressure reduction, steam throttling to atmosphere or to a condenser, isolation, super critical boiler startup and a variety of other uses in steam and water control systems.



TRIM TYPES

A wide variety of trims are available for SD-Severe Duty Control Valves. They are designed to match virtually any severe duty/critical service operational requirement. All SD trims feature a quick-change design to reduce downtime for inspection, maintenance or change out, and most are cage guided, further ensuring smooth, accurate operation. The majority of trim options are interchangeable between sizes, and many reduced trims are also available as standard.

TRIM TYPES	RAVEN™TRIM	HUSH® TRIM
DESCRIPTION/ APPLICATION	The RAVEN™ trim is Copes- Vulcan's top-of-the-range high performance specialty trim that offers a proven solution for those severe service applications where a true velocity control trim is the best or possibly the only answer. By limiting the fluid velocities inside the valve, the RAVEN™ trim's stacked disc design precludes problems typically associated with high velocity such as erosion, noise, vibration and poor control. Every RAVEN™ trim is custom designed to meet the needs of the toughest liquid, steam and gas services in the power and process industries.	The HUSH® Trim (multiple stage) is a high performance specialty trim that is cage guided and provides excellent control for both compressible and non compressible fluid applications. By directing the flow through a series of staged pressure drops, this unique trim eliminates cavitation in liquid flow and provides multiple pressure breakdown for noise attenuation in critical pressure drop compressible fluid application. It is designed for all valve sizes.
STANDARD FCI 70-2/ANSI RATED SEAT LEAKAGE	Class IV standard Class V optional *Class VI optional	Class IV standard Class V optional *Class VI optional
STANDARD TRIIM CHARACTERISTIC	Linear standard, Specials optional	Linear standard, Specials optional
TYPICAL FLOW DIRECTION	Under the seat Over the seat	Under the seat
MAXIMUM RANGEABILITY	200:1 Or greater as required	35-50:1

^{*} Class VI requires use of soft seat.

The trims shown in this brochure represent the more common selections available. Additional standard, special and custom engineered trims can be supplied as required.

Standard stocked trim materials are 300 series and 400 series stainless steel. Other materials are available on special order.

GAD TRIM	SOFT SEATED HUSH® TRIM	TANDEM TRIM
		A A A A A A A A A A A A A A A A A A A
The GAD™ trim is a high performance specialty trim that is cage guided and engineered to meet the rigorous requirements of feedwater control and feedwater startup control. Designed to give optimum flexibility in automated control valves, this trim is available in double seat, balanced single seat, TANDEM plug and one-stage HUSH™ versions. The GAD™¹rim is equally suitable for use with steam and many other fluids. It has been successfully used on high pressure water applications involving pressure of 5075 psi (34970 kPa) and pressure differential of up to 3625 psi (24980 kPa). It is available for valves 2" (50mm) and larger.	The Soft seated HUSH® Trim (double plug) is a high performance specialty trim that is cage guided and designed to provide and maintain extremely tight shutoff for high pressure differential liquid applications. It is typically applied to operating conditions that exhibit pressure drops in excess of 1800 psig (12400 kPag) that are to remain closed more than 25% of the time. It is typically the ideal trim for applications such as boiler feed pump recirculation, spray block valves and spray control valves.	The TANDEM trim is a high performance specialty trim that is a cage guided, uniquely balanced port throttling trim designed to solve difficult high temperature, high pressure differential applications that would require oversized, expensive actuators if more standard trims were utilized. Due to the relatively small pilot plug designed into the TANDEM trim, tight shutoff of up to Class V can easily be achieved with a moderately sized, economically priced actuator. It is available for valves 4" (100mm) and larger.
Class III-IV Depending upon design selected	Class VI standard	Class IV standard Class V optional
Modified parabolic, linear, equal percentage. All available as standard	Linear standard, Specials optional	Special
Over the seat	Over the seat	Over the seat Under the seat
50:1	10-25:1	25-50:1

^{*} Class VI requires use of soft seat.

TRIM TYPES (CONT.)

TRIM TYPES	ONE STAGE HUSH® TRIM	CAV B9 [®]
DESCRIPTION/ APPLICATION	One Stage HUSH® trim is a specialty trim designed to reduce noise associated with compressible fluids, as well as to reduce the undesirable effects of flashing and cavitation that would occur with most single pressure drop trims. The HUSH® cage consists of a single cylinder with a large number of radially drilled orifices. The fluid exits the orifices as low energy jets resulting in significant reductions in noise or erosion. Although numerous standard designs are available, One Stage HUSH® is often custom engineered to provide various flow characteristics or optimal performance under specific operating conditions.	The CAV B9® trim can be applied in liquid service where low level cavitation is evident. By utilizing flow over the seat, the radially step-drilled cage design reduces the effects of cavitation along with the associated noise and erosion problems by forcing the cavitation to occur in the center of the cage, away from all metal surfaces. In instances where flashing conditions are experienced, flow under the seat is employed with the multitude of small ports reducing both noise and erosion. Although numerous standard designs are available, the trim can be custom designed to provide various flow characteristics or optimal performance under specific flow conditions. It is available for valves 2" (50mm) and larger.
STANDARD FCI 70-2/ANSI RATED SEAT LEAKAGE	Class IV standard Class V optional *Class VI optional	Class IV standard Class V optional *Class VI optional
STANDARD TRIM CHARACTERISTIC	Linear standard Specials optional	Linear standard Specials optional
TYPICAL FLOW DIRECTION	Under the seat Over the seat	Under the seat (for flashing) Over the seat (for cavitation)
MAXIMUM RANGEABILITY	35-100:1	35-100:1

^{*} Class VI requires use of soft seat.

Actuators

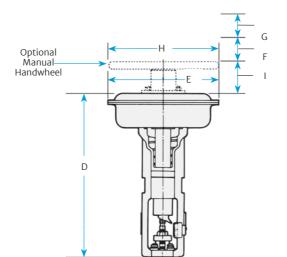
MODEL 1000 ACTUATORS PNEUMATIC DIAPHRAGM — SPRING OPPOSED

Designed specifically for severe duty service, Model 1000 actuators can be used in any application where shock and/or vibration are anticipated, or where seismic analysis is required. They are available with 60, 100, 160, 260 and 400 in² (390, 645, 1030, 1680 and 2580 cm²) of effective diaphragm area in both the direct and reverse acting mode. All models are available with manually operated override wheels.

To illustrate how the actuator transmits force, the shaded areas shown in the diagrams below will move during the direct and reverse acting modes. (Note the position of the diaphragm plate in each case.)

Conversion of the actuator from direct to reverse acting is accomplished simply by unfastening the diaphragm base from the frame and rotating it 90° until it is positioned above the threaded holes in the yoke. The actuator can be returned to the direct acting mode by reversing the procedure. Stem changes may be required.

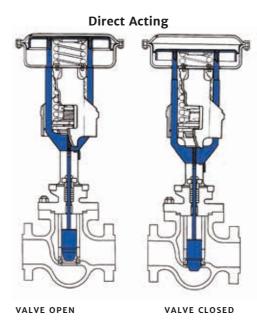


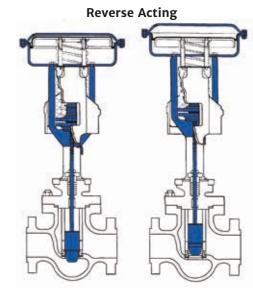


Model 1000 Actuator Dimensions

ACTUATOR MODEL	D in (mm)	E in (mm)	F* in (mm)	G** in (mm)	H in (mm)	l in (mm)
1000-60	17.25	11.50	1.50	8.50	10.00	7.75
	438	292	38	216	254	197
1000-100	25.56	15.12	3.50	11.25	18.00	7.75
	649	383	89	286	457	197
1000-160	30.88	18.00	3.50	11.25	18.00	7.75
	784	457	89	286	457	197
1000-400	47.25 1200	27.50 698	4.50 114	13.00 330	20.00	20.75 527

- * Clearance required for reverse action
- ** Clearance required for actuator removal





VALVE CLOSED

VALVE OPEN

Actuators

THE SD-700 VALVE ASSEMBLY

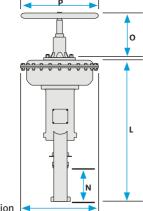
The SD-700 valve assembly is comprised of an SD valve body, bonnet and trim with the 700 series actuator. In those instances where an SD valve (i.e. body, bonnet, trim, etc.) is necessary, but the use of the heavy duty, 1000 style actuator is not needed, the more economical 700 style operator can be utilized.

Series 700 actuators are pneumatic diaphragm operators that have spring return in both direct and reverse acting styles, offering fail-open and fail-closed modes respectively. The pressed steel diaphragm case construction along with the nylon reinforced Buna N rubber diaphragm permits a maximum allowable air supply pressure of 80 psig (550 kPag). This pre-formed diaphragm provides a constant effective area throughout the full extent of travel. With effective diaphragm areas ranging from 60–160 in² (385–1030 cm²), Series 700 actuators can provide the necessary stem force to meet many operating requirements.

SERIES 700 ACTUATOR (SHOWN WITH OPTIONAL TOP-MOUNTED HANDWHEEL)

Reverse Acting (Sp	pring-to-Close)
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	0 (1 0										
ACTUATOR SIZE	60 in (mm)	160 in (mm)	160L in (mm)								
L	21.09	28.06	32.38	40.81							
	536	713	822	1037							
Μ	11.50	15.12	18.00	18.00							
	292	384	457	457							
N*	6.50	6.50	6.25	6.38							
	165	165	159	162							
0	6.72	11.38	11.56	17.19							
	171	289	294	437							
Р	10.00	18.00	18.00	18.00							
	254	457	457	457							



Direct Acting (Spring-to-Open)														
ACTUATOR SIZE	60 in (mm)	100 in (mm)	160 in (mm)	160L in (mm)										
L	20.50 521	28.12 714	32.31 821	39.75 1010										
M	11.50 292	15.12 384	18.00 457	18.00 457										
N*	7.56 192	9.38 238	9.31 236	11.81 300										
0	5.81 148	9.44 240	9.50 241	15.19 386										
P	10.00 254	18.00 457	18.00 457	18.00 457										

*Distance to actuator stem connection



MODEL 1000-260 ACTUATOR

This actuator provides 260 in² (1680cm²) of effective diaphragm area and is offered with either direct or reverse action. As a variation of the 1000 style, the 1000–260 actuator has a number of features.

- Heavy duty, one-piece frame
- Large assortment of springs to cover a wide range of applications
- High thrust and long travel capability
- · Optional handwheel activated hydraulic override units

MODEL 200 PISTON ACTUATORS

When necessitated by travel or thrust requirements, model 200 pneumatic actuators are supplied.

SERIES 300 MOTOR OPERATED

Motor operated actuators are available to meet specified operations.

SIDE MOUNTED HANDWHEEL

Side mounted handwheels are available for the Series 700 actuator.

SERIES 800 MANUAL OPERATED ACTUATORS



Handwheel operated actuators are offered for applications where an automated valve is not required or where compressed air service is unavailable. Series 800 actuators are suitable for both on/off and modulating service.

ACCESSORIES

Typical valve-mounted accessories such as positioners, air filter regulators, solenoids, and limit switches are available as standard offerings.

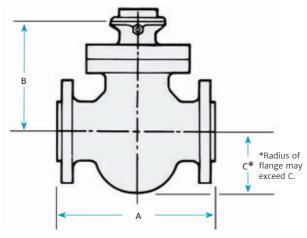
Dimensions

SD Valve Body/Bonnet Assembly

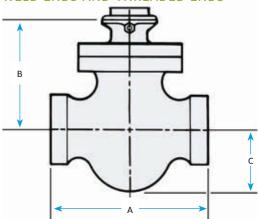
FLANGED ENDS

VALVE	CLASS 150			CLASS 300			CLASS 400			CLASS 600			CLASS 900			CI	LASS 150	00	CLASS 2500		
SIZE in (mm)			С			С		В	С			С	А		С	A	В	С		В	С
.75	7.25	7.00	2.56	7.62	7.00	2.56	8.12	7.00	2.56	8.12	7.00	2.56	11.12	10.00	2.50	11.12	10.00	2.50	12.12	10.00	2.50
20	184	178	65	194	178	65	206	178	65	206	178	65	282	254	64	282	254	64	308	254	64
1	7.25	7.00	2.56	7.75	7.00	2.56	8.25	7.00	2.56	8.25	7.00	2.56	11.50	10.00	2.75	11.50	10.00	2.75	12.50	10.00	2.75
25	184	182	65	197	178	65	210	178	65	210	178	65	292	254	70	292	254	70	318	254	70
1.5	8.75	7.55	2.88	9.25	7.25	2.88	9.88	7.25	2.88	9.88	7.15	2.88	13.12	10.15	3.00	13.12	10.15	3.00	14.12	10.15	3.25
40	222	184	73	235	184	73	251	184	73	251	182	73	333	258	76	333	258	76	359	258	83
<u>2</u>	10.00	7.34	3.50	10.50	7.34	3.50	11.25	7.34	3.50	11.25	7.34	3.50	14.75	10.15	3.75	14.75	10.15	3.75	15.75	10.15	3.88
50	254	186	89	267	186	89	286	186	89	286	186	89	375	258	95	375	258	95	400	258	99
<u>2.5</u>	10.88	9.31	4.06	11.50	9.31	4.06	12.25	9.31	4.19	12.25	9.31	4.19	16.12	12.15	4.44	16.12	12.15	4.44	17.38	12.15	4.62
60	276	236	103	292	236	103	311	236	106	311	236	106	409	309	113	409	309	113	441	309	117
3	11.75	9.72	4.44	12.50	9.72	4.44	13.25	9.72	4.50	13.25	9.72	4.50	17.38	12.47	4.56	18.12	12.47	4.81	19.62	12.47	5.56
75	298	247	113	318	247	113	337	247	114	337	247	114	441	317	116	460	317	122	498	317	141
<u>4</u>	13.88	9.91	5.38	14.50	9.91	5.38	15.25	9.91	5.56	15.50	9.91	5.56	20.62	13.56	6.12	21.38	13.56	6.12	23.12	13.56	6.50
100	353	252	137	368	252	137	387	252	141	394	252	141	524	344	155	543	344	155	587	344	165
<u>6</u>	17.75	12.16	7.69	18.62	12.16	7.69	19.50	12.16	7.88	20.00	12.16	7.88	23.62	14.81	8.12	27.25	14.81	8.94	32.25	14.81	9.44
150	451	309	195	473	309	195	495	309	200	508	309	200	600	376	206	692	376	227	819	376	240
<u>8</u>	21.38	13.31	10.25	22.38	13.31	10.25	23.38	13.31	10.56	24.00	13.31	10.56	30.75	16.06	10.82	33.00	16.06	11.25	40.50	16.06	11.94
200	543	338	260	568	338	260	594	338	268	610	338	268	781	408	275	838	408	286	1029	408	303
<u>10</u>	29.38	19.00	13.00	30.75	19.00	13.00	31.75	19.00	13.00	32.50	19.00	13.00	34.00	22.06	13.00	42.00	22.06	14.00	54.00	22.06	14.88
250	746	482	330	781	482	330	806	482	330	826	482	330	864	560	342	1067	560	356	1372	560	378
<u>12</u> 300	35.25 895	23.06 586	15.00 381	36.75 933	23.06 586	15.00 381	37.75 959	23.06 586	15.19 386	38.50 978	23.06 586	15.10 386	40.00 1016				26.06 662	15.31 389	62.00 1575	26.06 662	16.38 416

FLANGED ENDS







Note: The SD-style bonnet is easily adaptable to all sizes and types of pneumatic, electric and hydraulic actuators.

WELD ENDS AND THREADED ENDS (FOR 2" (50MM) AND SMALLER)

VALVE	c	CLASS 150		CLASS 300		CLASS 400			CLASS 600			CLASS 900			CLASS 1500			CLASS 2500			
SIZE in (mm)	A	В	С	А	В	С	А	В	С	A	В	С	А	В	С	А	В	С	A	В	С
.75	7.75	7.00	2.56	7.75	7.00	2.56	7.75	7.00	2.56	7.75	7.00	2.56	7.75	10.00	2.50	7.75	10.00	2.50	8.50	10.00	2.50
20	197	178	65	197	178	65	197	178	65	197	178	65	197	254	64	197	254	64	216	254	64
1	7.75	7.00	2.56	7.75	7.00	2.56	7.75	7.00	2.56	7.75	7.00	2.56	7.75	10.00	2.75	7.75	10.00	2.75	8.50	10.00	2.75
25	197	178	65	197	178	65	197	178	65	197	178	65	197	254	70	197	254	70	216	254	70
1.5	9.25	7.25	2.88	9.25	7.25	2.88	9.25	7.25	2.88	9.25	7.25	2.88	9.25	10.15	3.00	9.25	10.15	3.00	10.25	10.15	3.25
40	235	184	73	235	184	73	235	184	73	235	184	73	235	258	76	235	258	76	260	258	83
2	10.50	7.34	3.50	10.50	7.34	3.50	10.50	7.34	3.56	10.50	7.34	3.56	11.50	10.15	3.75	11.50	10.15	3.75	12.50	10.15	3.88
50	267	186	89	267	186	89	267	186	90	267	186	89	292	258	95	292	258	95	318	258	99
2.5	11.50	9.31	4.06	11.50	9.31	4.06	11.50	9.31	4.19	11.50	9.31	4.19	11.50	12.15	4.44	11.50	12.15	4.44	12.50	12.15	4.62
60	292	236	103	292	236	103	292	236	106	292	236	103	292	309	113	292	309	113	318	309	117
3	12.50	9.72	4.44	12.50	9.72	4.44	12.50	9.72	4.50	12.50	9.72	4.50	12.50	12.47	4.56	12.50	12.47	4.81	15.00	12.47	5.56
75	318	247	113	318	247	113	318	247	114	318	247	113	318	317	116	318	317	122	381	317	141
4	14.50	9.91	5.38	14.50	9.91	5.38	14.50	9.91	5.56	14.50	9.91	5.56	14.50	13.56	6.12	14.50	13.56	6.12	16.00	13.56	6.50
100	368	252	137	368	252	137	368	252	141	368	252	137	368	344	155	368	344	155	406	344	165
6	20.00	12.16	7.69	20.00	12.16	7.69	20.00	12.16	7.88	20.00	12.16	7.88	20.00	14.81	8.12	22.00	14.81	8.94	24.00	14.81	9.44
150	508	309	195	508	309	195	508	309		508	309	195	508	376	206	559	376	227	610	376	240
8	24.00	13.31	10.25	24.00	13.31	10.25	24.00	13.31	10.56	24.00	13.31	10.56	24.00	16.06	10.82	27.00	16.06	11.25	30.00	16.06	11.94
200	610	338	260	610	338	260	610	338	260	610	338	260	610	408	275	686	408	286	762	408	303
10 250	30.00 762	19.00 482	13.00 330	30.00 762	19.00 482	13.00 330	30.00 762	19.00 482	_	30.00 762	-	13.00 335	-		13.00 342	34.00 864		14.00 356	40.00 1016	22.06 560	14.88 378
12"	36.00	23.06	15.00	36.00	23.06	15.00	36.00	23.06	15.19	36.00	23.06	15.19	36.00	26.06	15.56	38.00	26.06	15.31	44.00	26.06	16.38



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