

April 2002

Heavy Duty Steel and Fibreglass Dampers

RUSKIN

Industrial and Tunnel Ventilation Dampers

*action*air

Introduction

For over 40 years, Ruskin has been the leader in designing and manufacturing durable, high performance dampers for industrial and tunnel ventilation applications.

Because Ruskin customers deserve the highest quality products, Ruskin has developed an on-site A.M.C.A (Air Movement Control Association) registered air performance laboratory. Located in Kansas City, Missouri, this test facility has three high capacity wind tunnels, including the largest test tunnel in the industry. These test tunnels help Ruskin simulate demanding wind and air handling situations and are ideal for testing leakage and pressure drop.

Ruskin's goal is to deliver products that meet and exceed industry

standards. Experienced, professional engineers, and development, and the latest in manufacturing technology are the key ingredients that assure superiority of Ruskin products.

With a history of developing original ideas, Ruskin is known for its innovation and use of leading-edge technology. This includes using the latest materials to custom build dampers and louvers to withstand the most stringent environments. Ruskin products are installed in NASA applications, hi-pressure transit tunnels, and highly corrosive environments such as naval ships and waste water treatment facilities.

Ruskin Air Management Limited

In January 2000, Actionair, the leading manufacture of HEVAC dampers in the UK, became part of Ruskin Air Management Limited. This has enabled Actionair and Ruskin to work closely together and now Actionair can offer the complete range of Ruskin Industrial and Tunnel damper products under the banner of Ruskin Air Management Limited.

Ruskin /Actionair association for UK and Europe.

Heavy Duty Control Dampers

Damper Model	Standard Construction Description	Applications	Damper Width (mm) (Single Sections)*	Max. System Pressure (Pa)	Max. System Velocity (m/s)	Leakage With/Without Seals (CFM)	Temperature Range (°C)**
CD80AF4	<ul style="list-style-type: none"> Galvanised construction Welded 2.6mm up to 1219mm wide, 3.25mm 1219mm to 1524mm airfoil blade 19mm axles up 1220mm blade width, 25mm axle 1220mm to 1524mm 203mm x 50mm x 3.25mm channel flange frame Stainless steel sleeve bearing bolted to frame 	Fan discharge	1524	5000	25.4	20 160	121 °C to 204 °C
		Isolation	1219	6500	25.4	20 160	
		Stack Isolation	914	8000	25.4	20 160	
			610	9000	30.4	40 200	
			310	11000	30.4	65 300	
CD80AF3	<ul style="list-style-type: none"> Galvanised construction Welded 1.6mm up to 1220mm wide, 2mm 1220mm to 1524mm airfoil blade 19mm axles Stainless steel sleeve bearing bolted to frame 203mm x 50mm x 2.6mm flange frame 	High Pressure	1524	3500	25.4	20 160	121 °C to 204 °C
		Thermal Oxidzer	1219	4700	25.4	20 160	
		Fans	914	6000	25.4	20 160	
		Fan Intake	610	7200	30.4	40 200	
			305	8500	30.4	65 300	
CD80AF2	<ul style="list-style-type: none"> 203mm x 50mm x 2mm galvanised channel frame 19mm plated axles Stainless steel press fit bearings 3.25mm galvanised steel clevis side linkage Max. single section 1524mm w x 2438mm h 	Paint Ovens	1524	3000	20.3	20 160	121 °C to 204 °C
		Heat Recovery	1219	4200	20.3	20 160	
		Air Handler Intake	914	5500	20.3	20 160	
			610	6700	25.4	40 200	
			305	8000	30.4	65 300	
CD80AF1	<ul style="list-style-type: none"> 203mm x 50mm x 2mm galvanised channel frame 13mm plated axles Stainless steel press fit bearings 3.25mm galvanised steel clevis side linkage Max. single section 1220mm w x 2438mm h 	Face and Bypass	1219	2500	20.3	20 160	121 °C to 204 °C
		Low Pressure	914	3700	20.3	20 160	
		Light Industrial	610	4800	25.4	20 160	
			305	6000	30.4	40 200	
						65 300	
CD80VG2	<ul style="list-style-type: none"> 205mm x 50mm x 2mm galvanised channel frame 19mm plated axles 1.6mm triple vee groove galvanised blades Concealed side linkage Stainless steel press fit bearings 	Air Handler Intake	1219	1700	10.1	40 160	121 °C to 204 °C
		Drying Processes	914	2200	10.1	40 160	
		Balancing	610	3800	10.1	50 200	
			305	5000	10.1	75 300	

Heavy Duty Control Dampers (continued)

Damper Model	Standard Construction Description	Applications	Damper Width (mm) (Single Sections)*	Max. System Pressure (Pa)	Max. System Velocity (M/S)	Leakage With/Without Seals (CFM)	Temperature Range(°C)
CD80VG1	<ul style="list-style-type: none"> • 205mm x 50mm x 2mm galvanised channel frame • 13mm plated axles • 1.6mm triple vee groove galvanised blades • Concealed side linkage • Stainless steel press fit bearings 	Light Duty Ventilation Fresh Air Intake Damper Louver Combinations	1219	620	10.1	40 160	21 °C to 204 °C
			914	930	10.1	40 160	
			610	1500	10.1	50 200	
			305	2050	10.1	75 300	
TD30AF2	<ul style="list-style-type: none"> • 2.64mm flanged channel frame • Airfoil 2mm galvanised blades • 19mm full length stainless steel axles • Stainless steel blade seals • BS476 Pt.20 approved 	Fire Rated Tunnel Damper Cycle Tested Track Isolation	1524	3000	20.3	20 —	250 °C (2 hour)
			1219	4200	20.3	20 —	Qualified to BS476 Pt. 20 2 Hour
			914	5500	20.3	20 —	
			610	6700	20.3	40 —	
310	8000	20.3	60 —				
CDRI92	<ul style="list-style-type: none"> • Round channel flange frame 3.25mm to 7.9mm • Steel blade with stiffeners (when required) • Adjustable full circumference blade seal • Full length solid steel axle • Shaft seals with outboard mounted ball bearings 	Circular Duct Isolation Gas Vapour Isolation Bio-Labs	1829	3700	35.5	11.5 —	121 °C
			1524	3700	35.5	9.5 —	
			1219	3700	35.5	7.5 —	
			914	3900	35.5	5.5 —	
610	4200	35.5	4.0 —				
305	5000	35.5	2.0 —				
CDR92	<ul style="list-style-type: none"> • Round channel flange frame 3.25mm to 6.3mm • Steel blade with stiffeners (when required) • Grease lubricated bearings mounted to frame • Full length solid steel axle • Full circumference blade stop 	Balancing Fume Extraction Process Piping	1829	3200	30.4	300 1375	121 °C to 204 °C
			1524	3200	30.4	225 1125	
			1219	3200	30.4	175 875	
			914	3500	30.4	140 625	
610	3700	30.4	125 425				
305	4200	30.4	75 250				
CDR82	<ul style="list-style-type: none"> • Round channel flange frame 3.25mm to 4.7mm • Steel blade with stiffeners (when required) • Stainless steel press fit bearings • Full length solid steel axle • Maximum size 1524mm 	Odour Control Face and Bypass Incineration	1524	1500	20.3	225 1125	121 °C to 204 °C
			1219	1500	20.3	175 875	
			914	2000	25.4	140 625	
			610	2000	30.4	125 425	
305	2500	30.4	75 250				
CDRS82	<ul style="list-style-type: none"> • 1.6mm x 203mm galvanised circular channel frame up to 450mm • 2.64mm x 203mm galvanised circular channel frame 450mm and above • 2.64mm flange • Single skin 1.6mm blade • 13mm shaft to 680mm, 19mm shaft to 600mm and above 	Isolation Fume hoods Pharmaceutical Ventilation	1219	1000	12.7	56.5 175	121 °C
			914	1000	12.7	42.5 140	
			610	1000	12.7	28.5 125	
			305	1000	20.3	14.5 75.0	
152	1000	20.3	7.0 37.5				
CDRI95	<ul style="list-style-type: none"> • 4.16mm to 7.93mm thick channel frame • One piece 9.5mm to 19mm thick blades • Minimum 25.4mm stub axles • Adjustable ceramic tadpole seal • 260 C° to 650 C° service 	Thermal Oxidisers High Temperature Circular Ducting Incineration			Consult Ruskin		
IVD	<ul style="list-style-type: none"> • 3.25mm steel circular channel frame • Multiple 1.6mm blades • 13mm Plated axles • Open or bullet nose hub • External linkage with stainless press fit bearings 	Fan Inlet Circular Duct Blancing System Control	1524	1500	11.3	— 450	121 °C to 204 °C
			1219	2000	15.3	— 515	
			914	2000	20.8	— 625	
			610	2000	33.1	— 835	
305	2000	71.6	— 1410				
PDR92	<ul style="list-style-type: none"> • Flanged channel frame • Offset blade • Grease lubricated bearings mounted outboard of frame • External counter weight • Elastomeric seal 	Make Up Air System and Duct Pressure Pressure Relief	1321	Consult Ruskin	30.4	0.225 200	
			1219		30.4	0.25 175	
			914		30.4	0.35 140	
			406		30.4	0.65 125	
			30.4	1.2 100			
CD82HT	<ul style="list-style-type: none"> • Flanged channel frame • Stainless steel axles • Cast iron bearing • Aluminium plant finish 	High Temperature			Consult Ruskin		
TD102	Aluminium				Consult Ruskin		
CBS8BL	Blast Damper				Consult Ruskin		

*Multiple section dampers are available in unlimited sizes.

Leakage information based on pressure differential of 250 Pascals tested per AMCA 500.

**Higher temperature ratings available consult Ruskin.

Note: Alternate materials such as stainless steel construction available as an option.

Nuclear Dampers available, consult Ruskin.

Industrial Rectangular and Circular Dampers

When it comes to industrial ventilation, contractors and engineering firms around the world depend on Ruskin to provide the industry's finest product. From light operations to heavy-duty applications, we build dampers that meet the most demanding situations. Every damper is built with performance in mind and are designed to meet or exceed A.M.C.A (Air Movement Control Association) specifications.

Since most industrial systems cannot be shut down for normal periodic maintenance, our products are designed to support options such as exposed linkages and outboard bearing packages. These facilitate easy maintenance while the system is operational.

Ruskin works with a variety of materials, including galvanised steel, aluminium, stainless steel and fibreglass in order to match our customers exact specifications. By moulding and forming these materials, we can develop dampers to fit almost any application.



CD80

Model CD80 is a versatile product range. Available in different material selections and configurations, this damper range is easily tailored to meet and exceed your system requirements.



CD30

Model CD30 is available in airfoil or 'v' groove blade design and is well suited for induct mounting applications. Factory installed face linkage and stainless steel pivot pins provide smooth operation, whatever the control option.



CDRI92

Model CDRI92 is the lowest leakage rated circular control damper without stepping up to Ruskin's bubble tight damper family. Fitted with a full circumference wiper seal as standard and outboard bearings with shaft seals, this damper can test to 2.5 Pa.

PDR92

Model PDR92 circular purged damper has been specifically designed for both duct protection and additional make-up air applications. It is equipped with a counterbalanced arm and actuation override. This damper can be operated to open upon demand or by system pressure.

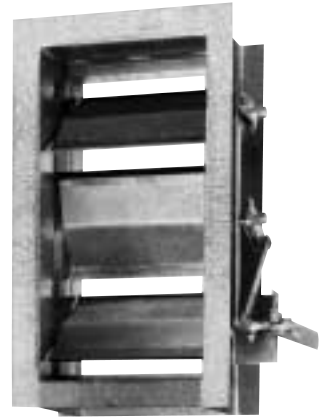
Industrial Steel Products

CD80 Multi-Blade Airfoil

The company has the technology and experience to design and manufacture models like the CD80 multi-blade airfoil damper series. A welded 3mm frame combined with 25mm thick axles and outboard bearings provide the damper with both structural integrity and performance. Perfect for applications requiring low levels of leakage at high static pressures.

Features include:

- Ability to withstand 11.5 kpa static pressure with blades closed at fan shut-off.
- Operate in temperatures up to 205 °C.
- Double-skin airfoil type blades from 146mm to 196mm wide.
- Optional blade seals in EPDM, Silicone or stainless steel and jamb seals in stainless steel.
- Fan discharge and fan isolation.
- Electric or pneumatic actuation.
- Position sensors.
- Elevated temperature construction.



Steel Inlet Vane Dampers for Class 1 and 2 Fans

Steel, heavy duty inlet vane dampers are designed for fan shut off and volume control applications in medium pressure and variable air volume systems.

Features include:

- Sizes available in excess of 1650mm in diameter.
- Flange mount frame to allow bolting to fan.
- Open, capped or bullet nose hub to increase performance.
- Standard 3mm steel channel frame (heavier construction options available).
- Standard design operation to 93 °C (higher temperatures attainable through variations in design).

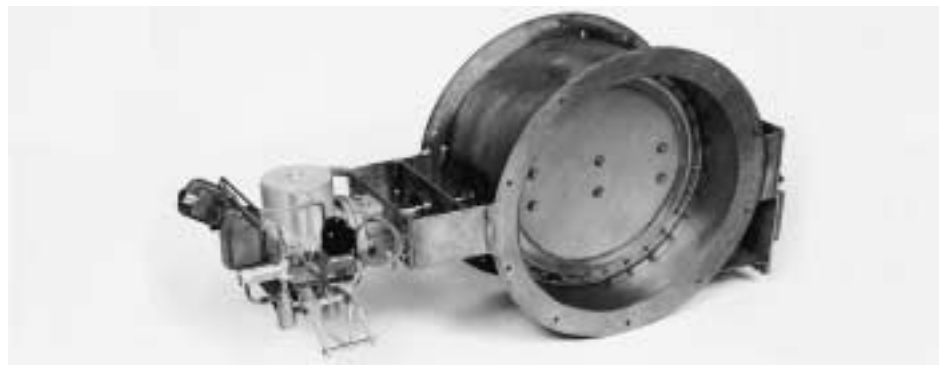


CDRI 95 High Temperature, Low Leakage Damper

High temperature applications are no problem for Ruskin. Where heat is a concern, dampers have been designed that offer bearings and linkages that extend from the frame to allow for both insulation and heat dissipation. Actuation may also be installed outboard by using Ruskin's exclusive high temperature couplers.

Through constant testing and damper development, Ruskin has the information needed to calculate blade lengths and cross sections for practically any application. Although a particular blade may be designed for high temperature, it may not withstand extreme system pressures, that's why Ruskin performs actual in-house testing. This allows us to select the right blade design to meet customer needs.

With continual product development for the pollution control industry, Ruskin continues to surpass the competition.



The CDRI95 damper is designed to operate efficiently in environments where low leakage is critical and where airflow temperatures are extreme. Functioning as a Diverter Valve that constantly redirects process exhaust gases from one chamber to another, the CDRI95 will enhance system efficiency through precise airflow control.

Product features include:

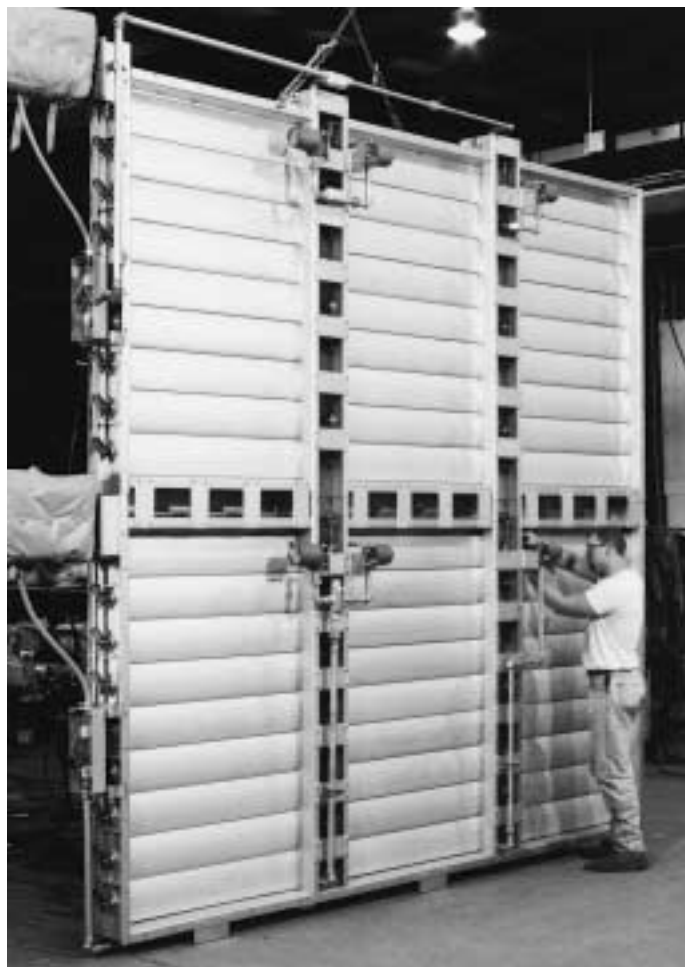
- Removable ceramic tadpole seal design, allows for ease of maintenance and minimises leakage at high temperatures.
- Designed for continuous operation up to 260 °C and intermittent excursions to 650 °C.
- Available in standard carbon steel or various grades of stainless steel.
- Centre pivoting blade design to enable 'positive' seating.
- Engineered coupler for direct mounting of actuator in high temperature applications.

Tunnel Ventilation Products

Ruskin tunnel ventilation dampers are relied upon worldwide. From London to Hong Kong to Los Angeles, Ruskin ventilation products are supplying commuters a breathe of fresh air even when they are underground.

These specialised dampers provide fire protection as well as purge and smoke control during emergency conditions. With an option of galvanised steel, aluminium and stainless steel, tunnel dampers can withstand the harshest conditions, including the constantly changing environments found in most tunnels.

Engineers designing tunnel ventilation safety systems, which include smoke and fire dampers, have relied on our expertise for over 40 years. They know that each damper is thoroughly checked, tested and cycled before it is delivered to site. In addition to this and to make certain each damper performs to specifications, leakage and performance requirements are verified through Ruskin's Research and Development department.



TD102

Aluminium airfoil blade control dampers are well suited for tunnel ventilation projects. Damper blades are extruded from 6063T5 aluminium and finished with a 215RI anodised treatment.

Axles are mechanically fixed in full length extruded blade tubes and supported on each end by externally mounted flanged bearings. A 3.5mm minimum hot dipped galvanised frame is provided with offset flanges for ease of installation. Tested and approved to 250 °C for one hour.

TD30AF2 (Fire Rated)

Galvanised airfoil blades and stainless steel axles, provide the TD30AF with optimum performance for fire rated tunnel ventilation dampers. It's construction meets requirements of BS476 Pt.20, UL555S and NFPA 130 and has been tested in accordance to AMCA 500.

Equipped with either pneumatic or electric spring return actuators, this damper provides excellent fail safe protection. Press fit stainless steel bearings and stainless steel blade and jamb seals, provide the corrosion protection needs of tunnel environments.



Accessories and Options

Ruskin has designed dampers to fit practically every industrial application. Guesswork is eliminated when ordering and selecting dampers, by offering many standard features, including bolt-on bearings and shaft seals. To make certain dampers meet specifications, Ruskin's in-house testing facility verifies damper leakage and performance.

From manual to pneumatic type actuation, Ruskin can engineer and install the right actuation for any application. Auxiliary positioners, limit switches and other communication output signal devices are considered part of the complete package. All actuation packages are cycled and tested for accuracy and performance prior to shipment.

Standard catalogue construction is called out on all Ruskin specification sheets. Pressure rating and leakage rates are based on standard construction. Industrial grade dampers are capable of being tailored to meet certain demands, such as larger flanges or non-standard bolt patterns. These options can be used on both rectangular and circular dampers. Elevated temperatures may require axle bolting or tolerance increase, which may change standard catalogue performance ratings.

Axles

It has been proven that the electro-zinc plating that we use on our standard axles begins to flake off at approximately 230 °C. When this occurs, the plating material can collect between the bearing and axle, causing increased friction and torque, with the possibility of the damper seizing up. To prevent this, 304 stainless steel axles are used when temperature exceeds 204 °C.

- All full length axles above 260 °C to be bolted to the blade.
- Rectangular dampers – Stub axles can be welded to the blade up to 450 °C. Above this bolt blade to axle.
- Circular dampers – As a rule, Ruskin recommends bolting the blade to the axle for all temperatures above 260 °C continuous operation.

Heatshields

Heatshields are used to deflect the radiant heat coming off the damper frame, away from the actuator. However, this does not stop the heat from conducting through the axle and coupling from entering the actuator. Therefore the actuator is offset from the power axle to eliminate this problem. Excessive heat present in the actuator can damage internal seals and liquefy the necessary lubricants in the actuator, thus causing failure in actuator operation. Ruskin make every effort to eliminate the damaging effects that heat can have on actuators by supplying heat dissipating couplers.

- Use heatshields at temperatures between 204 °C – 260 °C.
- Above 260 °C mount actuator offset of power axle. No heatshield is required if actuator is offset and temperature is below 426 °C, unless specified.
- Use high temperature seals in pneumatic actuators if offered by actuator manufacturer. Check with manufacturer on seals and temperature ratings.

Bearings

Maximum recommended temperature sintered stainless steel bearings is 815 °C. For temperatures above this, use cast iron bearings.

Graphite bearings are not recommended unless specified. Graphite bearings have a tendency to absorb moisture and crack. If graphite bearings are to be used, then stainless steel axles are required. Carbon steel axles may rust inside of the bearing causing axles to bind.

Relube ball bearings packed with Dupont Krytox 240 AC grease can be bolted to frame up to 149 °C. If mounted outboard of frame, the bearing could be used in applications up to 260 °C.

Consult Ruskin to discuss your particular needs and system requirements as industrial grade dampers are easily modified.

Temperatures above the standard construction can be met by using many different methods.



Electric spring return actuator.



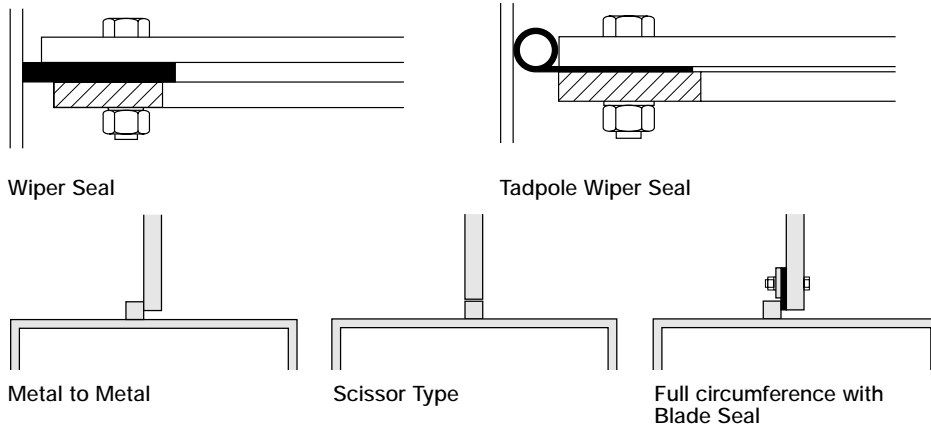
Double clevis crank arms and bolt on bearings are standard on CD80 series dampers.



Certain elevated temperature applications may require the use of Ruskin's high temperature couplers reduced heat transfer into the actuator.

Accessories and Options

Typical Blade Seal Arrangements (Round Dampers)



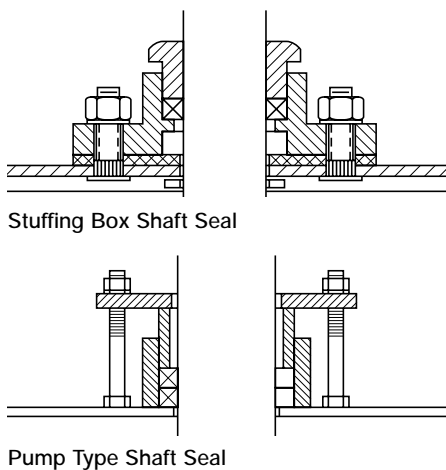
Typical Blade Seal Arrangements (Rectangular Dampers)



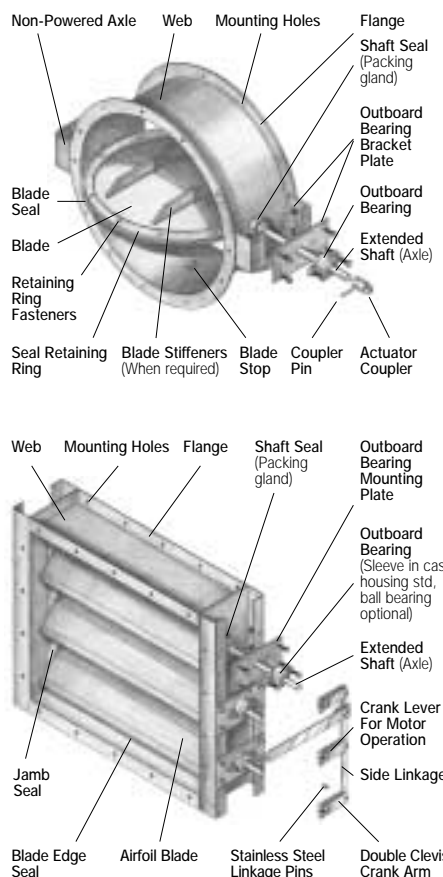
Type	Temperature
Silicone	204 °C Maximum
Neoprene	121 °C Maximum
EPDM (Nordell)	121 °C Maximum
Tetraglass	537 °C Maximum
Ceramic	1204 °C Maximum
Viton (Fluorocarbon)	204 °C Maximum
Stainless Steel	537 °C Maximum

The illustrations below depict typical damper construction. Ruskin dampers may or may not use all the options shown. Depending on your application or system requirements you may require additional variations than those shown. Use these drawings as reference when selecting your next Ruskin Industrial dampers.

Typical Shaft Seal Arrangements



Packing Types	Temperature
Non-Asbestos and Silicone free Fibre Infused TFE	232 °C
Chrysotile Asbestos Graphite and Asbestos Core with Inconel Wire	537 °C
100% Graphite	1371 °C



Swartwout Fibreglass Composite Products

To compliment the range of Ruskin Industrial dampers, our sister company Swartwout has for over 30 years been supplying the air control industry with the most efficient and versatile range of fibreglass composite dampers. Our goal is to provide you with the finest and most cost effective solutions to your corrosive needs experienced engineering, drafting and manufacturing teams continue to satisfy the changing demands within the industry through on going research and development and the application of new technologies.

Corrosion Resistant Products Designed for Extended Service Life

In harshly corrosive environments, engineering, material selection and manufacturing of appropriate ventilation system products are critical. Fibreglass composite dampers are respected industry-wide for workmanship, performance and long service life, fulfilling your ventilation product requirements for corrosive applications. So why choose fibreglass composite products?

Composites are strong, durable and lightweight

- Dent, crack and break resistant.
- Resistant to harsh climates, salt spray and corrosive chemicals.
- Corrosion liners standard on all products.
- Constructed from fibreglass-reinforced plastic (FRP) made with exceptionally strong vinyl ester resin.

Composites offer "built-in" safety

- Fire retardant.
- Electrically non-conductive.

Composites provide low operating costs

- Last many years longer than the best stainless steel units, yet cost less.
- Thermally non-conductive to reduce energy costs.

Fibreglass Composite Products

912 and 914 Fibre-Aire Circular Control Dampers

Fibre-Aire circular control dampers are designed specifically for use in corrosive environments such as:

- Wastewater Treatment Plants
- Pharmaceutical Facilities
- Pulp and Paper Mills

Features include:

- Accurate control of airflow through round ductwork.

- Flange mount channel frame.
- Single piece blade with 3 frame style options to meet your specific requirements.
- Sizes from 100mm to 1800mm in diameter.
- Type 912 designed to withstand pressures up to 2500 pa.
- Type 914 designed to withstand pressures up to 7500 pa.



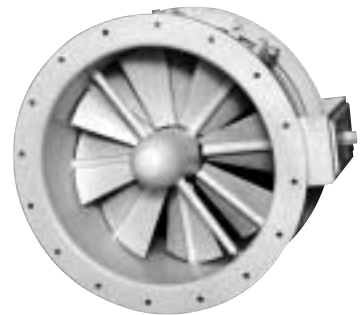
851FG Fibre-Aire Inlet Vane Damper

Fibre-Aire inlet vane dampers are designed for use with fibreglass fans in variable air volume systems. Units can be manually set, electrically or pneumatically actuated to achieve required performance.

Features include:

- Flange mount frame to allow bolting to fan.

- Capped or bullet nose hub to increase performance.
- Sizes from 300mm to 1800mm in diameter.
- Blades coated using a resin transfer moulding technique (RTM) to ensure optimised corrosion resistance in the airstream.



SPVC12 PVC Circular Damper

Circular polyvinyl chloride control damper offers an effective and economical material resistant to most corrosive gases. Able to withstand temperatures to 82 °C, the SPVC 12 is ideal for a wide range of industrial applications:

Features include:

- Material conforms to ANSI/ASTM specification D-1784-81PVC, Type 1.
- Self-lubricating, ultra high molecular-

weight polyethylene bearings.

- Stainless steel set collar.
- Sizes from 150mm to 400mm in diameter.
- Ideally suited for Fume Hood systems.

Options include:

- Electric or pneumatic operates.
- Flange mounted design.
- Extended frame lengths for a variety of applications.



1108AF Multi-Blade Control Damper

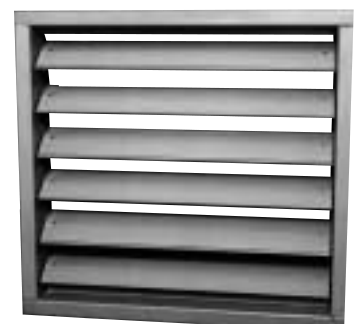
Model 1108AF multi-blade control damper offers low leakage and non corrosive components to provide the best fibreglass damper on the market.

Uses include:

- Wastewater Treatment Facilities
- High Purity Electronic Chip Production
- Fertiliser/Compost Production Facilities

Features include:

- Tooled in blade seal pockets for a variety of blade seal materials.
- Flange mount or in-duct frame styles.
- All vinyl ester construction.
- High strength airfoil blade design.
- Teflon bearings.



Custom Products Developments

Developing products which meet the ever changing demands of the air control industry while providing the highest level of customer service.

We recognise the uniqueness of each customers requirements. This is what drives us to continually research product improvements and to incorporate new technologies. We rely on versatile manufacturing capabilities to develop and manufacture customer specific products.

Development of products utilising Fibreglass Reinforced Plastic is an example of our commitment to our customers. Incorporating this technology has led to the development of the FRP2000 Slide Gate and to the 426AF Backdraft damper. Both these dampers are manufactured to withstand the severely corrosive gases present in electronic chip production.

FRP 2000 Slide Gate

Model FRP 2000 Slide Gate Positive Shut Off Damper. This damper is laminated entirely of fire retardant, vinyl ester resin and is suited for corrosive environments. Available in manual or automatic operation and can be serviced without removal from the system. Seal package can be replaced from one of three sides.

Options available:

- Rectangular or circular mounting flanges.
- Various types of seal materials.
- Manual or motorised operation.



426AF Backdraft Damper

Utilising a hollow airfoil design, the model 426AF provides high strength and low pressures drop advantages. It incorporates a tooled-in blade edge seal pocket for various types of elasto-meric materials when in conjunction with either 316 stainless steel or polycarbonate side seals.

Features include:

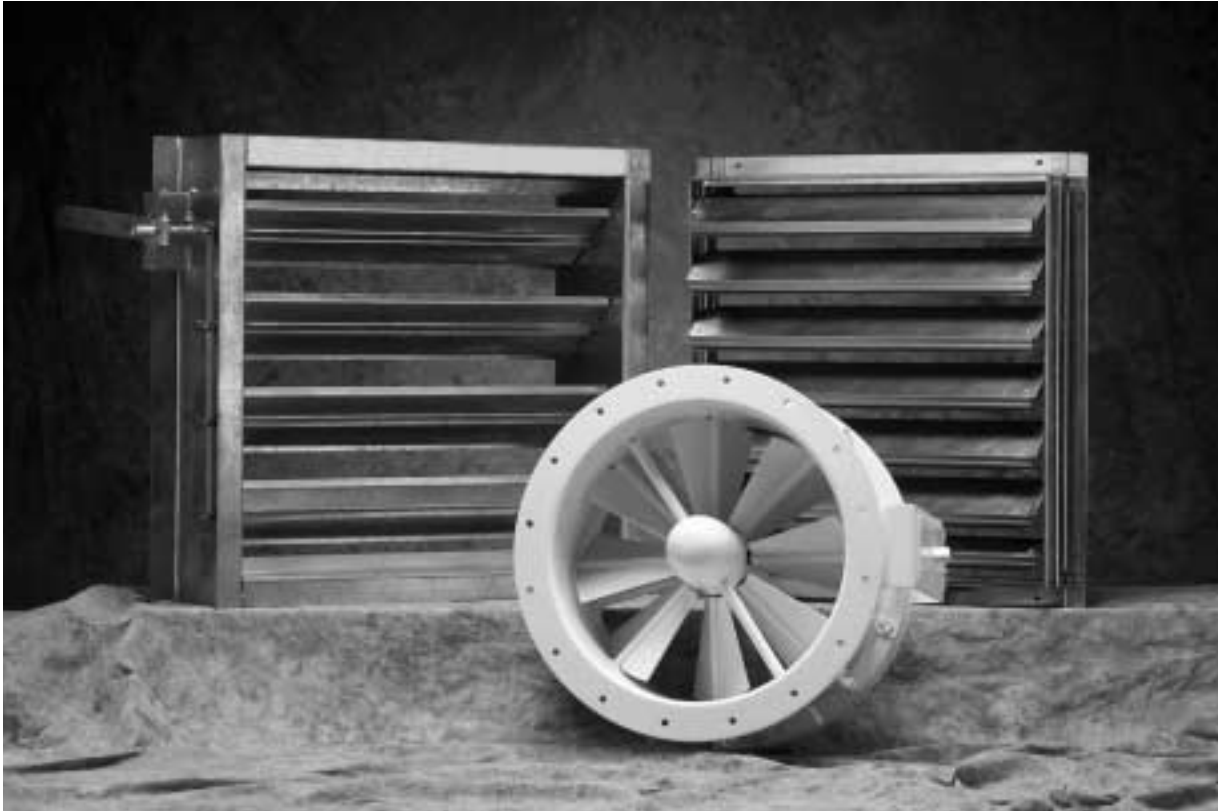
- Fully engineered backdraft damper.
- Low leak minimal pressure drop airfoil blade design.
- Static pressure up to 3500 pa.
- Standard stainless steel counter balance side linkage.
- Silicone, viton and EPDM blade seal material availability.



Corrosion-Resistant Materials of Construction

KEY: R – RECOMMENDED NR – NOT RECOMMENDED CS – CONSULT RUSKIN

CHEMICAL FUMES (200° MAX)			CHEMICAL FUMES (200° MAX)			CHEMICAL FUMES (200° MAX)			CHEMICAL FUMES (200° MAX)			CHEMICAL FUMES (200° MAX)			
FIBREGLASS REINFORCED PLASTIC	STAINLESS STEEL 304	STAINLESS STEEL 316	FIBREGLASS REINFORCED PLASTIC	STAINLESS STEEL 304	STAINLESS STEEL 316	FIBREGLASS REINFORCED PLASTIC	STAINLESS STEEL 304	STAINLESS STEEL 316	FIBREGLASS REINFORCED PLASTIC	STAINLESS STEEL 304	STAINLESS STEEL 316	FIBREGLASS REINFORCED PLASTIC	STAINLESS STEEL 304	STAINLESS STEEL 316	
Acetaldehyde	NR	R	R	Chlorine Dry Gas	R	NR	R	Glycerine	R	R	R	Nickel Sulfate	R	R	R
Acetic Acid 0-25%	R	R	R	Chlorine, Wet Gas	R	NR	NR	Glycol, Ethylene	R	R	R	Nitric Acid 0-5%	R	R	R
Acetic Acid 25-50%	R	R	R	Chlorine, Liquid	NR	R ₍₁₀₀₇₎	R ₍₁₀₁₇₎	Glycol, Propylene	R	R	R	Nitric Acid 20%	R	R	R
Acetic Anhydride	NR	R	R	Chlorine, Water	R	NR	NR	Chloroacetic Acid	R	R	R	Nitric Acid Fumes	R	R	R
Acetone	NR	R	R	Chloroacetic Acid 0-50%	R	NR	NR	Gold Plating Solution: (63% Potassium Ferrocyanide 2% Potassium Gold Cyanide 8% Sodium Cyanide)	R	NR	R	Nitrobenzene	NR	R	R
Acrylonitrile	NR	R	R	Chlorobenzene	NR	R	R	Octanoic Acid	R	CS	CS	Oil, Sour Crude	R	NR	NR
Alcohol, Butyl	R	R	R	Chloroform	NR	R	R	Oil, Sweet Crude	R	R	R	Oleic Acid	R	R	R
Alcohol, Ethyl 10%	R	R	R	Chlorosulfonic Acid	NR	NR	NR	Oleum (Fuming Sulfuric)	NR	R	R	Olive Oil	R	NR	NR
Alcohol, Ethyl 100%	R	R	R	Chromic Acid 20%	NR	R	R	Oxalic Acid	R	NR	R	Peroxide Bleach	R	CS	CS
Alcohol, Isopropyl 10%	R	R	R	Chromic Acid 30%	NR	R	R	Hydrobromic Acid 0-25%	R	NR	NR	Hydrochloric Acid 0-37%	R	NR	NR
Alcohol, Isopropyl 100%	R	R	R	Citric Acid	R	CS	CS	Hydrocyanic Acid	R	R	R	Hydrofluoric Acid 10%	R	NR	NR
Alcohol, Methyl 10%	R	R	R	Coconut Oil	R	R	R	Hydrofluosilicic Acid	R	NR	R	Hydrogen Bromide, Wet Gas	R	CS	CS
Alcohol, Methyl 100%	NR	R	R	Hydraulic Fluid	R	CS	CS	Hydrogen Chloride, Dry Gas	R	R	R	Hydrogen Chloride, Wet Gas	R	R	R
Alcohol, Methyl Isobutyl	R	R	R	Copper Chloride	R	NR	NR	Hydrogen Peroxide	R	R	R	Hydrogen Sulfide Dry	R	R	R
Alcohol, Secondary Butyl	R	R	R	Copper Cyanide	R	R	R	Hydrogen Sulfide, Aqueous	R	NR	R	Hydrogen Fluoride, Vapour	R	R	R
Aluminium	R	NR	R	Copper Fluoride	R	NR	NR	Hydrochloric Acid 0-10%	R	CS	CS	Hydrochloric Acid 10-20%	R	CS	CS
Aluminium Chloride	R	NR	NR	Copper Nitrate	R	R	R	Iron & Steel Cleaning Bath: (9% Hydrochloric 23% Sulfuric)	R	CS	CS	Isopropyl Amine	R	CS	CS
Aluminium Hydroxide 5%	R	R	R	Copper Plating Solution: (Copper Cyanide 10.5% Copper, 14% Copper Cyanide 6% Rochelle Salts)	R	NR	NR	Isopropyl Palmitate	R	CS	CS	Isopropyl Palmitate	R	CS	CS
Aluminium Nitrate	R	R	R	Copper Plating Solution: (Copper Cyanide 10.5% Copper, 14% Copper Cyanide 6% Rochelle Salts)	R	NR	NR	Jet Fuel	R	R	R	Jet Fuel	R	R	R
Aluminium Potassium Sulfate	R	NR	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Kerosene	R	R	R	Kerosene	R	R	R
Ammonia, Aqueous 0-10%	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Lactic Acid	R	R	R	Lactic Acid	R	R	R
Ammonia, Gas	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Lauryl Chloride	R	NR	NR	Lauryl Chloride	R	NR	NR
Ammonium Bicarbonate	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Lauric Acid	R	R	R	Lauric Acid	R	R	R
Ammonium Bisculfite	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Lead Acetate	R	R	R	Lead Acetate	R	R	R
Ammonium Carbonate	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Lead Nitrate	R	R	R	Lead Nitrate	R	R	R
Ammonium Citrate	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Lead Plating Solution: (8% Fluoroboric Acid 4% Boric Acid)	R	R	R	Lead Plating Solution: (8% Fluoroboric Acid 4% Boric Acid)	R	R	R
Ammonium Fluoride	R	NR	NR	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Levellinic Acid	R	CS	CS	Levellinic Acid	R	CS	CS
Ammonium Hydroxide 5%	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Linseed Oil	R	R	R	Linseed Oil	R	R	R
Ammonium Hydroxide 10%	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Lithium Bromide	R	NR	R	Lithium Bromide	R	NR	R
Ammonium Hydroxide 20%	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Lithium Sulfate	R	CS	CS	Lithium Sulfate	R	CS	CS
Ammonium Nitrate	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Magnesium Bisulfite	R	CS	CS	Magnesium Bisulfite	R	CS	CS
Ammonium Persulfate	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Magnesium Carbonate	R	NR	NR	Magnesium Carbonate	R	NR	NR
Ammonium Phosphate	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Magnesium Chloride	R	R	R	Magnesium Chloride	R	R	R
Ammonium Sulfate	NR	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Magnesium Hydroxide	R	R	R	Magnesium Hydroxide	R	R	R
Arsenious Acid	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Magnesium Sulfate	R	R	R	Magnesium Sulfate	R	R	R
O-Benzoyl Benzoic Acid	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Meleic Acid	R	NR	NR	Meleic Acid	R	NR	NR
Barium Acetate	R	CS	CS	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Mercuric Chloride	R	NR	NR	Mercuric Chloride	R	NR	NR
Barium Carbonate	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Mercurous Chloride	R	NR	NR	Mercurous Chloride	R	NR	NR
Barium Chloride	R	NR	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Methylene Chloride	NR	R	R	Methylene Chloride	NR	R	R
Barium Hydroxide	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Methyl Ethyl Ketone	NR	NR	NR	Methyl Ethyl Ketone	NR	NR	NR
Barium Sulfate	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Methyl Isobutyl Carbitol	NR	R	NR	Methyl Isobutyl Carbitol	NR	R	NR
Barium Sulfide	R	CS	CS	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Methanol (see Alcohol)	R	R	R	Methanol (see Alcohol)	R	R	R
Beer	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Methyl Isobutyl Ketone	NR	R	R	Methyl Isobutyl Ketone	NR	R	R
Benzene	NR	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Methyl Styrene	NR	CS	CS	Methyl Styrene	NR	CS	CS
5% Benzen in Kerosene	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Mineral Oils	R	R	R	Mineral Oils	R	R	R
Benzen Sulfonic Acid	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Molybdenum Disulfide	R	CS	CS	Molybdenum Disulfide	R	CS	CS
Benzoic Acid	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Monochloro Acetic Acid	NR	CS	CS	Monochloro Acetic Acid	NR	CS	CS
Benzyl Alcohol	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Monoethanolamine	NR	R	R	Monoethanolamine	NR	R	R
Benzyl Chloride	NR	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Motor Oil	R	R	R	Motor Oil	R	R	R
Brass Plating Solution: (3% Copper Cyanide 6% Sodium Cyanide 1% Zinc Cyanide 3% Sodium Carbonate)	R	NR	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Myristic Acid	R	NR	NR	Myristic Acid	R	NR	NR
Butyl Acetate	NR	NR	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Naptha	R	R	R	Naptha	R	R	R
Butyric Acid 0-150%	R	R ₍₁₀₀₇₎	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Naphthalene	R	R	R	Naphthalene	R	R	R
Butylene Glycol	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Nickel Chloride	R	R	R	Nickel Chloride	R	R	R
Cadmium Chloride	R	CS	CS	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Nickel Nitrate	R	R	R	Nickel Nitrate	R	R	R
Cadmium Cyanide Plating Solution: (3% Cadmium Oxide 10% Sodium Cyanide 1% Caustic Soda)	R	NR	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Nickel Plating: (8% Lead 8% Fluoroboric Acid 4% Boric Acid (11% Nickel Sulfate 2% Ammonium Chloride 1% Boric Acid) (44% Nickel Sulfate 4% Ammonium Chloride 4% Boric Acid)	R	R	R	Nickel Plating: (8% Lead 8% Fluoroboric Acid 4% Boric Acid (11% Nickel Sulfate 2% Ammonium Chloride 1% Boric Acid) (44% Nickel Sulfate 4% Ammonium Chloride 4% Boric Acid)	R	R	R
Cadmium Bisulfite	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Formaldehyde	R	R	R	Formaldehyde	R	R	R
Calcium Carbonate	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Formic Acid	R	NR	NR	Formic Acid	R	NR	NR
Calcium Chlorate	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Fuel Oil	R	R	R	Fuel Oil	R	R	R
Calcium Chloride	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Gas, Natural	R	R	R	Gas, Natural	R	R	R
Calcium Hydroxide	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Gasoline, Auto	R	R	R	Gasoline, Auto	R	R	R
Calcium Hypochlorite	R	NR	NR	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Gasoline, Aviation	R	R	R	Gasoline, Aviation	R	R	R
Calcium Nitrate	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Gasoline, Ethyl	R	CS	CS	Gasoline, Ethyl	R	CS	CS
Calcium Sulfate	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Gasoline, Sour	R	R	R	Gasoline, Sour	R	R	R
Calcium Sulfite	R	CS	CS	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Gluconic Acid	R	CS	CS	Gluconic Acid	R	CS	CS
Caprylic Acid	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Glucose	R	R	R	Glucose	R	R	R
Carbon Dioxide	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	8-8-8 Fertiliser	R	CS	CS	8-8-8 Fertiliser	R	CS	CS
Carbon Disulfide	NR	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Fertiliser (Urea Ammonium Nitrate)	R	NR	NR	Fertiliser (Urea Ammonium Nitrate)	R	NR	NR
Carbon Monoxide	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Flue Gas	R	R	R	Flue Gas	R	R	R
Carbon Tetrachloride	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Fluoboric Acid	R	R	R	Fluoboric Acid	R	R	R
Carbonic Acid	R	R	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Fluosilicic Acid 0-20%	R	CS	CS	Fluosilicic Acid 0-20%	R	CS	CS
Castor oil	R	R ₍₁₀₀₇₎	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Formaldehyde	R	R	R	Formaldehyde	R	R	R
Carbon Methyl Cellulose	R	CS	CS	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Formic Acid	R	NR	NR	Formic Acid	R	NR	NR
Chlorinated Wax	R	CS	CS	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Fuel Oil	R	R	R	Fuel Oil	R	R	R
Chlorine Dioxide Air	R	NR	R	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Gas, Natural	R	R	R	Gas, Natural	R	R	R
Chlorine Dioxide, Wet Gas	R	NR	N	Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Gasoline, Auto	R	R	R	Gasoline, Auto	R	R	R
				Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Gasoline, Aviation	R	R	R	Gasoline, Aviation	R	R	R
				Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Gasoline, Ethyl	R	CS	CS	Gasoline, Ethyl	R	CS	CS
				Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Gasoline, Sour	R	R	R	Gasoline, Sour	R	R	R
				Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Gluconic Acid	R	CS	CS	Gluconic Acid	R	CS	CS
				Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Glucose	R	R	R	Glucose	R	R	R
				Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	8-8-8 Fertiliser	R	CS	CS	8-8-8 Fertiliser	R	CS	CS
				Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Fertiliser (Urea Ammonium Nitrate)	R	NR	NR	Fertiliser (Urea Ammonium Nitrate)	R	NR	NR
				Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Flue Gas	R	R	R	Flue Gas	R	R	R
				Copper Plating Solution: (45% Copper Fluoroborate 19% Copper Sulfate 8% Sulfuric Acid)	R	CS	CS	Fluoboric Acid	R	R	R	Fluoboric Acid	R	R	R



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