Cables and Controls Rods

AUTOMOTIVE

RAIL

PLANT

CATALOGUE & DESIGN GUIDE
for

Push-pull control cables
Pull-pull control cables
Mechanical control systems

Leaders in Control Cables and Rods

AVIATION

MARINE

The Drallim Group
Leading innovators in technology and quality

INTRODUCTION

Whatever market your product performs in, you need to know your cable assembly is in good hands; Drallim Industries shares with you over 50 years of Engineering and Manufacturing experience. It is our aim to provide you with the perfect control solution to suit your, often unique, requirements.

Our design team are here to work with you through the development of your cable if you require, or we could simply manufacture to your drawing and / or specifications; whether the part is unique or has been discontinued. Kit car building, classic car or aircraft renovators will all benefit from our Copy Cat service.

Our pledge at Drallim Industries Ltd is to provide the ultimate service to our clients, providing high quality cables and rods that conform to the specifications as set out by commercial, military and aerospace regulations, thus completely satisfying the needs and requirements of all our clients.

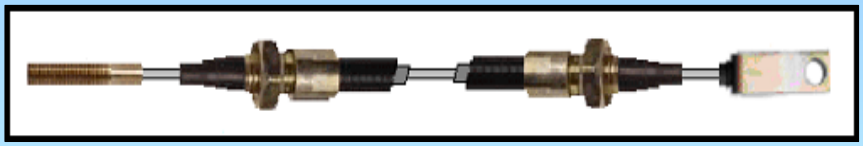
Drallim operates a full Quality Management System across all three divisions of the company and has been registered as an ISO9001 company since 1994. We are approved for Civil Aerospace work, with the European Aviation Safety Agency, enabling us to release both Production of new parts and appliances and Maintenance of our products. In 2010 we achieved the AS9100 approval for our Aerospace division, successfully upgrading to revision C of that standard last year.

Cable range manufactured by Drallim:

Industry	**Application**
Automotive:	Heater & air vent control lever, seat adjustment, bonnet and fuel cap release, choke, gear stick, brake and clutch cables.
Aviation:	Door lanyards, emergency release latch, seat adjuster and release, cargo hook cable release.
Climate control:	Air-conditioner and heater ducting vent control
Construction:	Heavy machinery (backhoe loaders), light machinery (dumpers and concrete mixers), PTO to clutch cables and trailer cables.
Ground support:	Gearbox, clutch, throttle, handbrake and door release cables.
Office & Medical:	Kitchen units, office desks, cupboards, beds and chairs
Robotic:	Push pull operation cables.

CONTENTS

MECHANICAL CONTROL CABLES DESIGN FACTORS



Mechanical control cables provide a simple, lightweight, economical, and reliable way to actuate throttles, latches and a thousand other mechanisms. They're widely used in furniture, vehicles, lawn mowers, and medical devices, as well as seats in cars and planes. They impact our every day life.
The basic design features a moveable core, either a solid-wire or a wire-rope cable that's free to travel axially inside an outer casing or conduit. Actuation of a lever at one end of the cable assembly will produce an output force and motion at the other end. The mechanical cable is designed under two criteria, Push-Pull or Pull-Pull cables.

Push-Pull and Pull-Pull cable are used on a wide variety of applications. The function of the unit being controlled and the routing of the cable need to be analysed before selecting the correct cable. All the external variables need to be addressed, Variables such as load, friction, routing, stretch, length, bends (How many and their radius), temperature, environment and contaminants. Every one of the aforementioned could affect the operation of the cable.

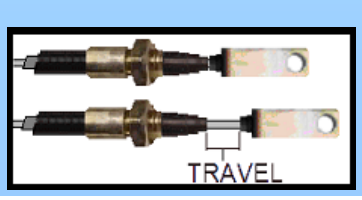
Push-Pull cables are called such because they use the actuation force in both the push and the pull modes. Solid core inners or solid core cables (stiffer cable) would best suit this application however the bend radius would be larger. Push-Pull cables have a greater capacity in the tension (Pull) mode than in the compression (Push) mode. Loads in the compression mode should be around 50% of those in the tension mode. Reducing the push load minimizes a core's tendency to displace the conduit and, reduces the potential for the unsupported core outside the conduit to kink, bend, or distort.

Pull-Pull cables are in most cases more flexible and are used in the tension (Pull) mode. The design has an integral return spring maintaining the load on the cable returning it to the standby position. This spring allows the use of flexible cables allowing tighter radius. Maximum working loads should be minimum breaking load of the core plus a built in safety factor.

THE WORKING CABLE

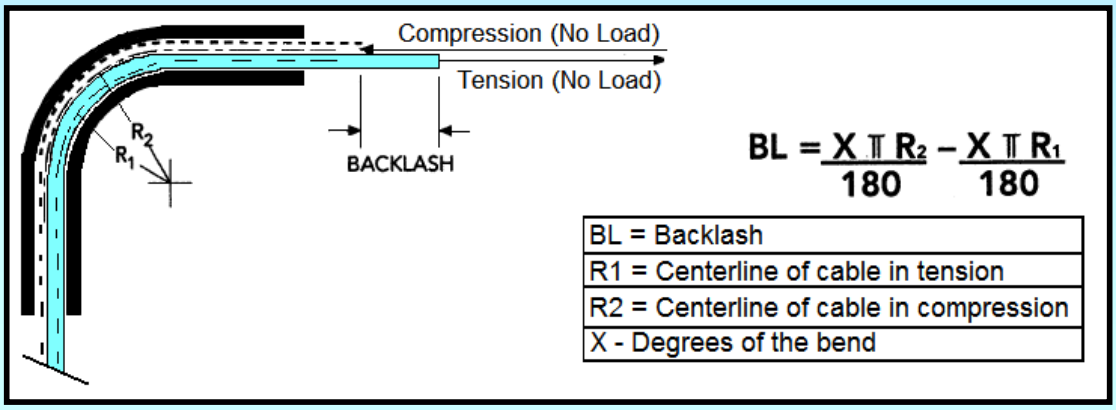
Push-Pull cables would be recommended for light and medium duty applications with a maximum travel (recommended) of 200mm. This will reduce the lost motion % and any bending or damage to the exposed cable.

Pull-Pull cables do not need these restrictions because of the nature of their application.



Push-Pull cables performing a dual function are subject to “lost Motion” between the input and the output ends when operating the cable. This loss is caused from a combination of backlash and deflection.
Backlash is caused from the tolerance (gap) between the inner cable and the inner wall of the outer conduit. This tolerance is evident in every cable made. Backlash is directly proportional to the total degrees of the bends in the installed cable and the clearance between the outer diameter of the core cable and the internal diameter of the conduit or casing.

Backlash Formula



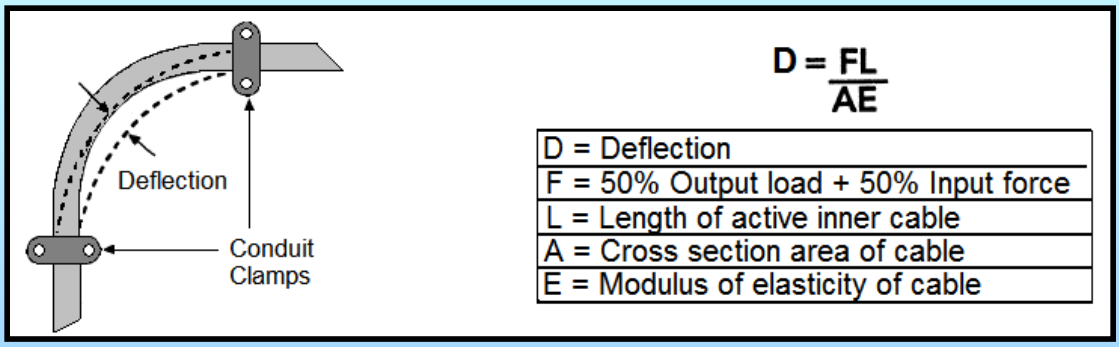
$$BL = \frac{X \pi R_2}{180} - \frac{X \pi R_1}{180}$$

BL = Backlash
R1 = Centerline of cable in tension
R2 = Centerline of cable in compression
X - Degrees of the bend

It must be noted that R1 and R2 will be different under load. This formula will need to be applied for the no load and load applications.

Deflection is caused from the elastic strain caused by the tension (Pull) or compression (Push) loads that are applied to the controller.

Deflection Formula.

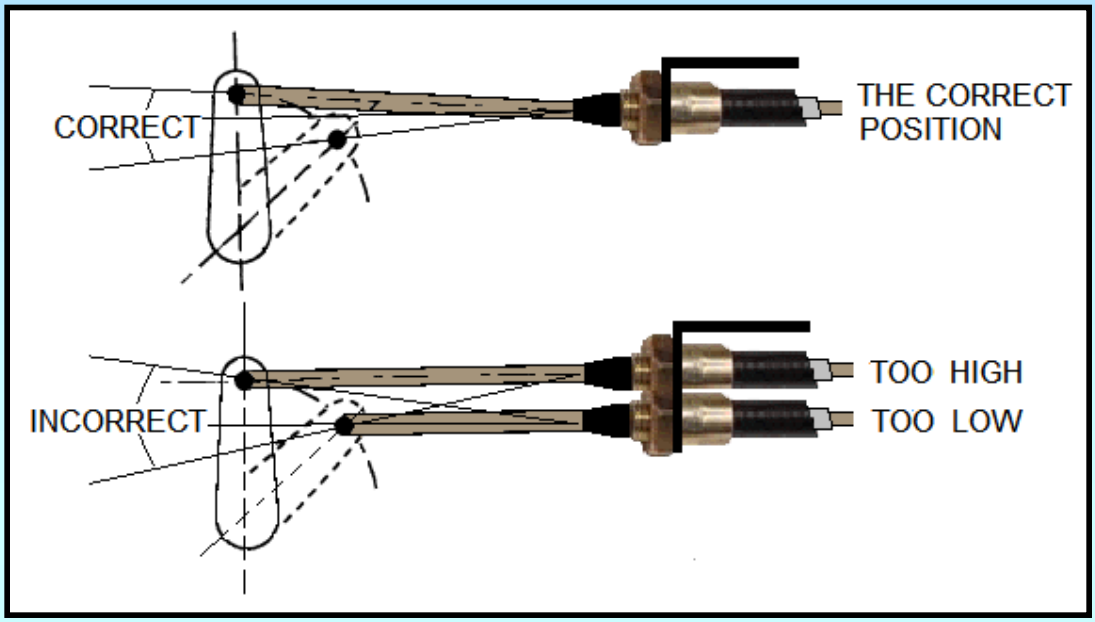


$$D = \frac{FL}{AE}$$

D = Deflection
F = 50% Output load + 50% Input force
L = Length of active inner cable
A = Cross section area of cable
E = Modulus of elasticity of cable

Lost Motion will occur in every cable and will increase with higher loads, longer control cables and more frequent and sharper bends. Every control cable needs to have these factors taken into account and the above formulae used to design the correct cable and routing. Depending on the material, bends should be kept to a minimum radius of 50mm to 200mm. Minimum bend radii can be estimated by multiplying the core cable diameter by 100. Clearance between the ID of the outer casing (Conduit) and the OD of the core are essential and for medium to light duty cables a recommended clearance would be an average of 0.5mm.

Alignment and the correct mounting of the cable is critical in that incorrect installation will increase the working load, decrease efficiency and cable life. Every control cable should be securely mounted to ensure the inner cable continues to travel in a straight line to the point of actuation. In the case of the actuated (moved) part being a lever arm, the conduit would be mounted in such a way that the inner cable runs in a straight line to the centre of the two furthest points of the lever arm.



Efficiency. The conduit, core, number of bends, as well as friction between core and conduit, all determine a push-pull cable's efficiency. Estimate the minimum bend radius by multiplying the core diameter by 100. Bends in the system create friction and reduce efficiency. Estimate frictional effects from: I=PF

Where I = Input load, P = output load, F = input load factor. Percent efficiency is then determined from N =(P/I)100.

Solid wire cores generate less friction than Steel Rope Cables. 1 X 19 Cables generate less friction than multi-strand cables. Multi-strand cables may be more flexible however they are more abrasive, stretch more readily and have a lower tensile strength.

Cable Stretch:
All cables will stretch when sufficient load is applied. However if the correct cable is specified at the design stage the cable will cope with its load. There are two types of stretch:

Constructional Stretch: In the cable manufacturing process gaps are left between the strands. With the application of the initial load the cable will stretch out these gaps. To eliminate the possibility of this stretch you will need to proof load the cable up to 60% of the cables minimum breaking strength.

Elastic Stretch: Is the elongation of each of the wire strands as a result of a load being applied that is greater than the yield point of the metal in the cable, If the yield point of the metal is not exceeded the cable will return to it's original length after the load is removed.

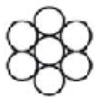
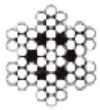
Cable Assembly Breaking Strength.

The minimum breaking strength of a cable and / or a cable assembly is defined as it's minimum tensile strength. The maximum working load and any potential shock load then add a reasonable safety factor and this should be the minimum breaking strength of the cable and / or assembly.

Cable Selection Guide

Cable Selection Pointers				
Charactistics	Greatest – – – – – – – – – – – – – –			Least
Flexibility	7 x 19	7 x 7	1 x 19	1 x 7
Tensile Strength	1 x 19	1 x 7	7 x 19	7 x 7
Stretch Resistance	1 x 7	1 x 19	7 x 7	7 x 19
Efficiency	1 x 19	7 x 19	7 x 7	1 x 7
Relative Cost	7 x 19	7 x 7	1 x 19	1 x 7
Compression Load	1 x 7	1 x 19	7 x 7	7 x 19
Straight Tensile Load	1 x 19			1 x 7
Flexing Tensile Load	7 x 19			7 x 7

Galvanised Wire Rope

Diameter mm	Construction	Description	Uses / Applications	
2.00	1x7	Basic strand, relatively stiff in the larger size. Little stretch	Tension members Pull-Pull Controls	 1 X 7 All Wire Strand
2.50	1x7			
3.00	1x7			
3.50	1x7			
4.00	1x7			
5.00	1x7			
2.00	1x19	Fairly flexible,resists compressive forces. Strongest construction over 2.0mm diameter.	Tension members Guy lines Push-Pull Controls Pull-Pull Controls	 1 X 19 All Wire Strand
2.50	1x19			
3.00	1x19			
3.50	1x19			
4.00	1x19			
5.00	1x19			
2.00	7x7	Durable, High flexibility Good strength Good all rounder	Pull-Pull Controls Use over small diameter pulleys	 7 X 7 Wire Strand Core
2.50	7x7			
3.00	7x7			
3.50	7x7			
4.00	7x7			
5.00	7x7			
2.00	7x19	Strong Very Flexible but has the most stretch	Use over pulleys For Lanyards Reciprocating App.	 7 X 19 Wire Strand Core
2.50	7x19			
3.00	7x19			
3.50	7x19			
4.00	7x19			
5.00	7x19			

Typical Bowden Cables

The typical Bowden control cable is a flexible cable used to actuate movement from a distance, or to transmit a mechanical force over distance by the movement of an inner cable (Steel Wire Rope) within an outer housing or conduit. The outer housing or conduit is generally constructed with an inner plastic lining covered by a helical steel wire, which is covered with a plastic sheath.

PVC sheath with a spring wire inner dressed with the desired ends.

Wire ends could be soldered or have pigtails, they may be bespoke.

The most common cable in use is 1 x 7 to 7 x 7 in sizes ranging From 0.5mm to 5.0mm in both galvanised and Stainless Steel.

The liner fits between the Conduit and the inner cable allowing a smoother flow and will help in reducing Backlash.

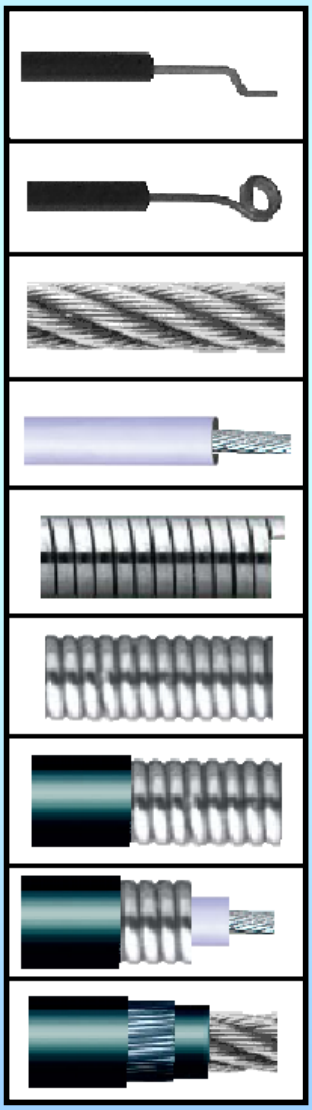
Bowden flat wire, Crush resistant, Flexible, and highly efficient.

Bowden round wire, Crush resistant, Flexible, and highly efficient.

Bowden Conduit used in most typical Bowden cables.

Bowden Conduit with a liner used in most typical Bowden cables.

Long Lay is a conduit used in heavy-duty cable applications.



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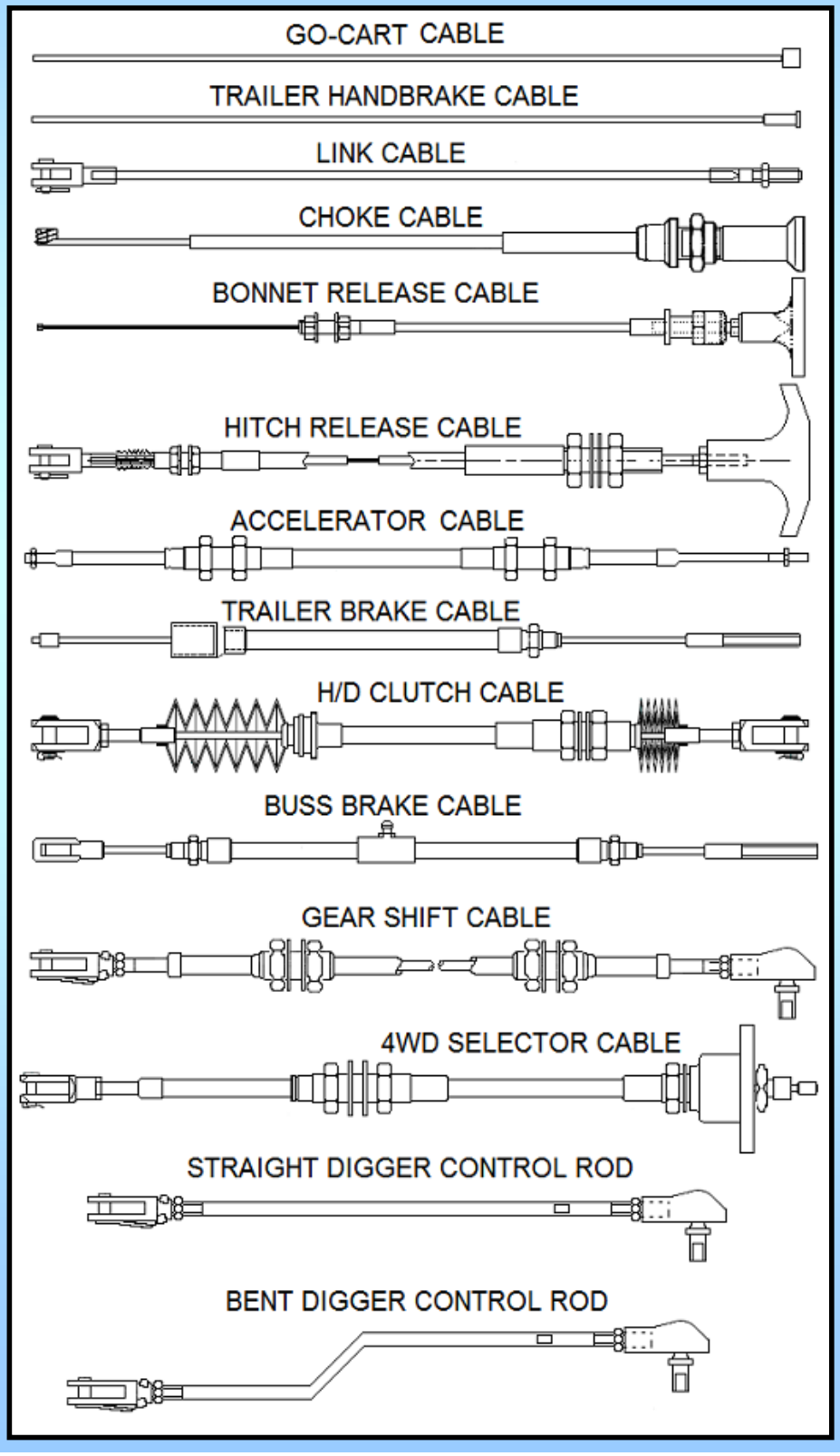
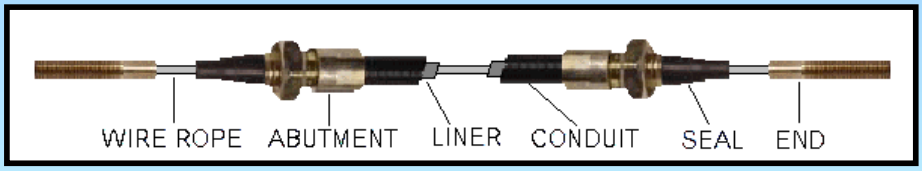
TYPICAL CONTROL CABLE DESIGNS

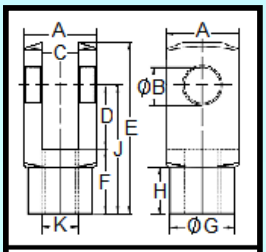


Typical Control Cable Assembly

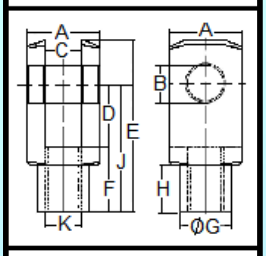


The typical control cable is made up with too many different types of ends and abutments to mention. Every application known to man may have it's own bespoke configuration and thus it's own bespoke abutments or ends. Below are some of the most popular components used in control cable assembly.

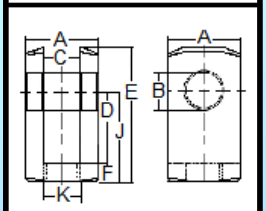
Typical Control Cable Components



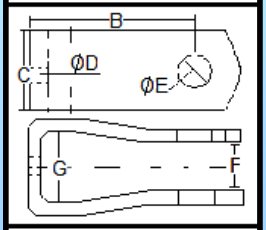
Clevis Threaded Stem



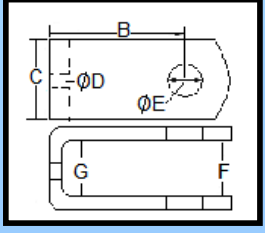
Clevis Swage Stem



Clevis Threaded



Strap Shackle Stepped



Strap Shackle Straight

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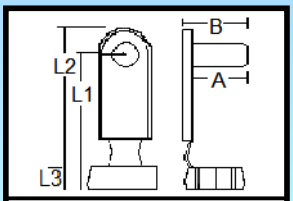
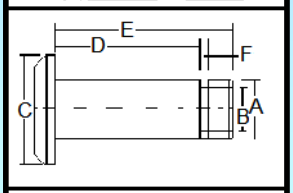
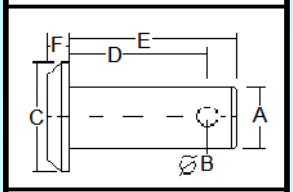


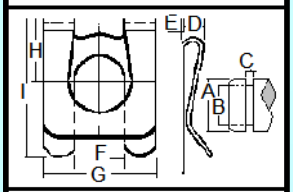
Spring Pin



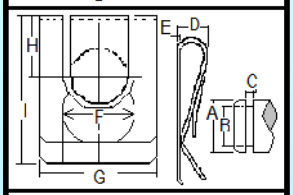
Clevis Pin Grooved



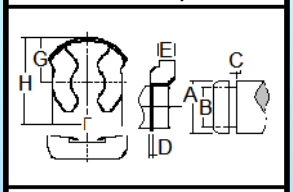
Clevis Pin with Hole



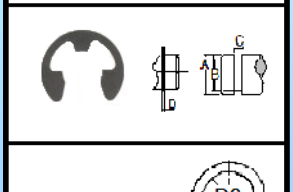
SL Retainer



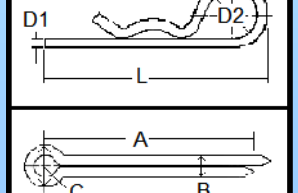
Bayonet Clip



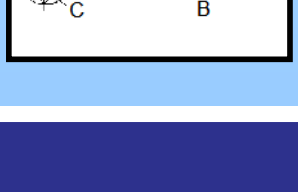
KL Retainer



E Clip



R Clip



Split Pin

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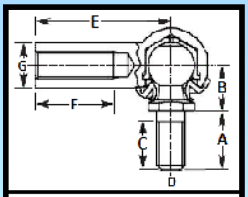
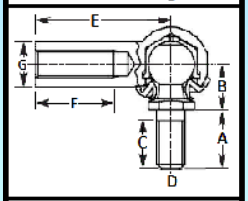
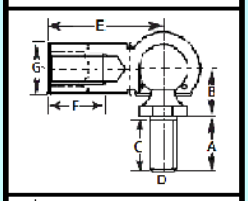


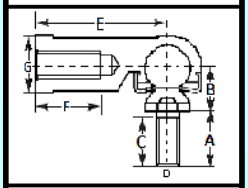
CM Series Ball Joint



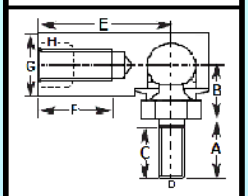
AM Series Ball Joint



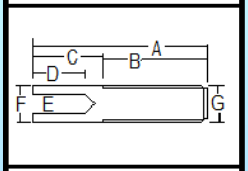
CMG Series Ball Joint



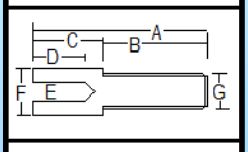
BL Series Ball Joint



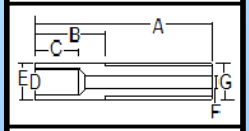
F Series Ball Joint



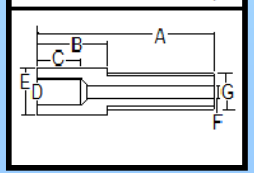
Straight Screwed End



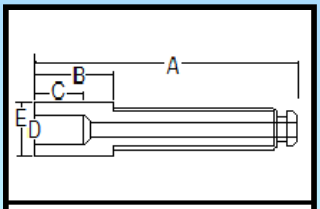
Shouldered Screwed End



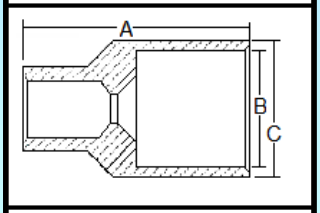
Straight Screwed Abutment



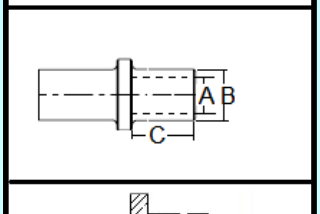
Shouldered Screwed Abutment



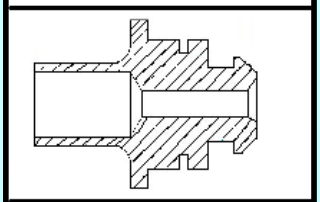
Shouldered Adjuster with seal



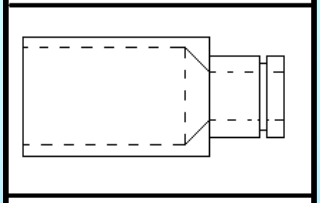
Bell Abutment



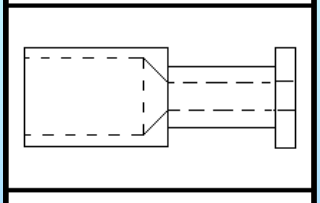
Plain Abutment



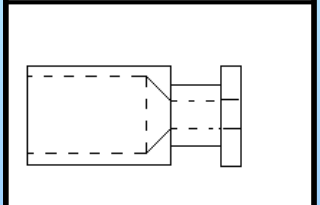
Grooved Abutment with Seal



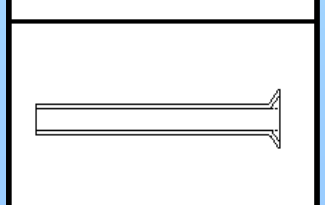
Grooved Abutment



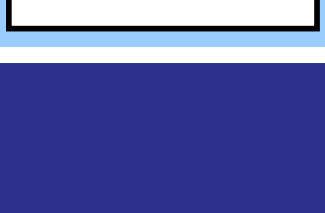
Bespoke Abutment



Bespoke Abutment



Bent and Flared Tube



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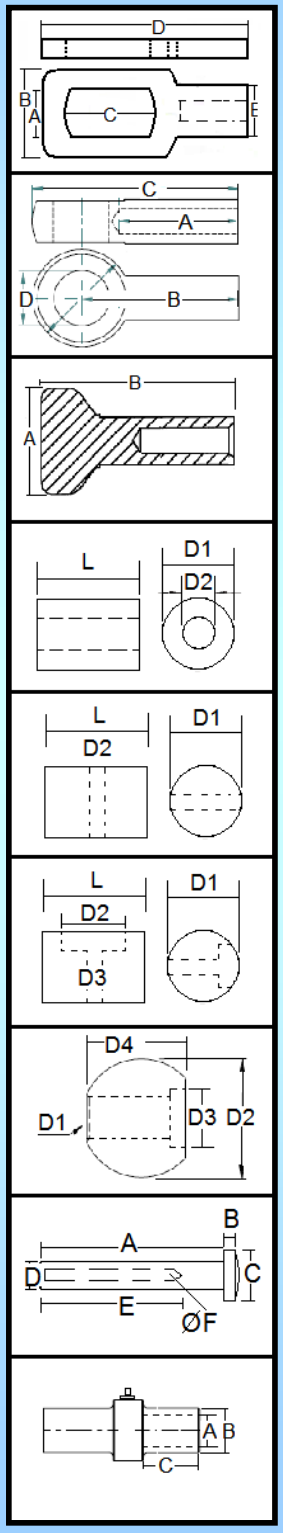

Square Eye Piece

Round Eye Piece

Mushroom Nipple

Horizontal Nipple

Vertical Nipple

Barrel Nipple

Ball Nipple

Headed Nipple

Grease Nipple

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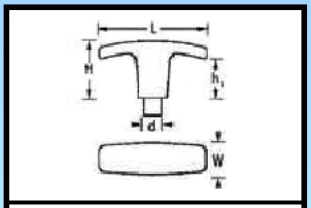
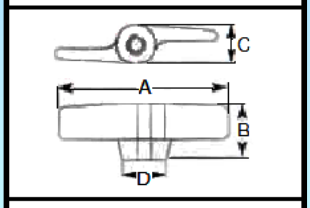
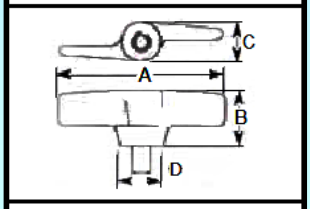
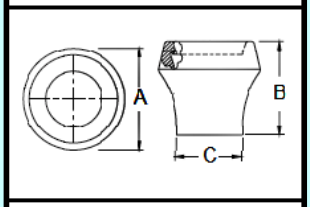
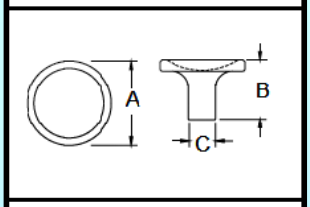
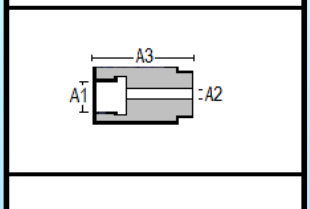
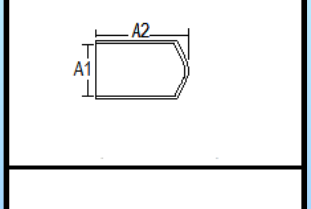
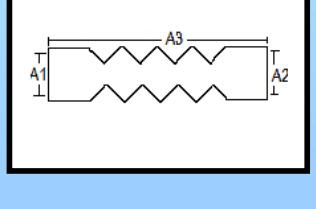
	T Handle Male/Female	
	Offset T Handle Female	
	Offset T Handle Male	
	Vernier Control	
	Red Pull to Operate Knob	
	Seal for Abutment’s	
	End Cap	
	Rubber Bellows	

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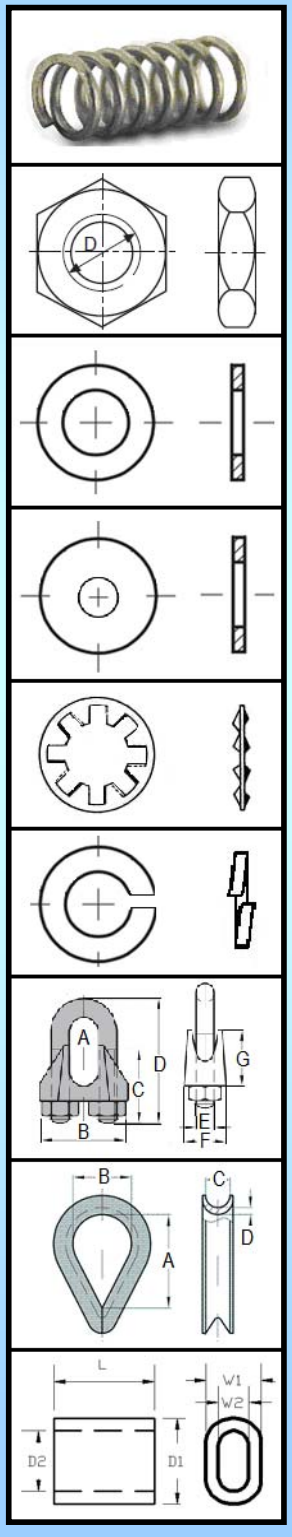
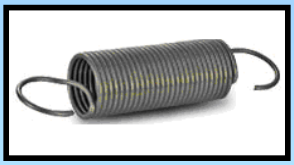


Springs



Thin Nut

Flat Washer

Penny Washer

Shake-proof Washer

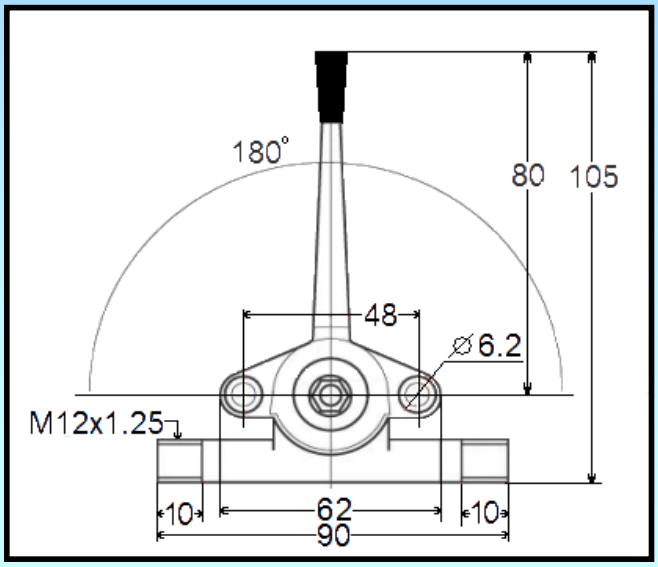
Split Washer

Bulldog Grip

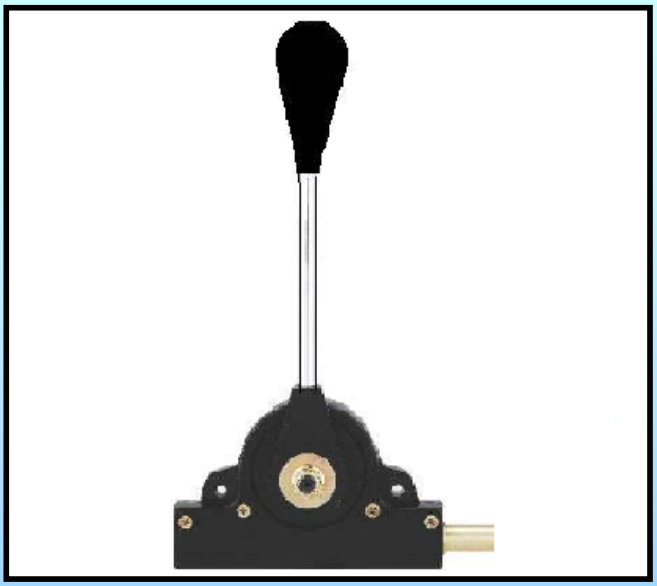
Thimble

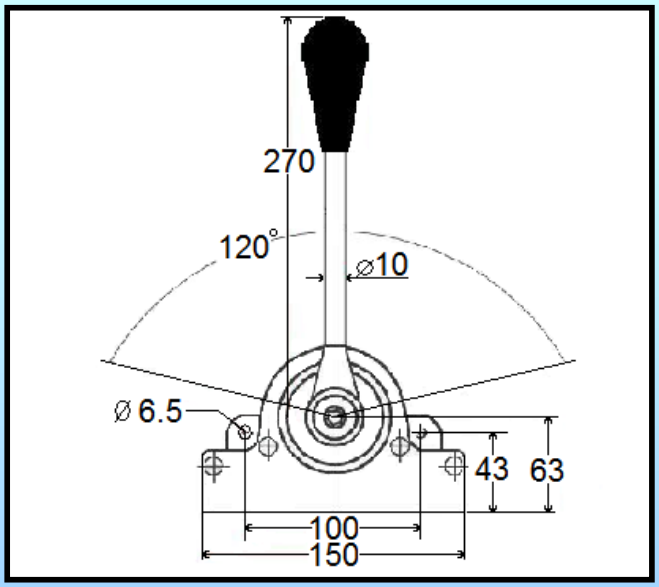
Ferrule

Mechanical Control Levers



YK1D Universal Control Lever.
Maximum stroke: 48mm





YK1A Universal Control Lever.
Maximum stroke: 80mm

Accreditations

Drallim Industries Ltd is a multi faceted company with a large range of products and capabilities.
We have grouped these into three main sectors, with each sector carrying it's own accreditations.

Drallim Industrial

Automation and Controls
Valves and Fittings
Mechanical Cables
Lighting and Accessories
Process
Oil and Gas
All Industries
Commercial and Industrial

BS EN ISO9001:2008 and BS8555: Environmental management system.

Drallim Utilities

Condition monitoring
Test equipment
Cable pressurisation
High voltage testing
Gas
Water
Telecommunication
Power

BS EN ISO9001:2008, UVDB – Achilles verify B2, BS8555: Environmental management system.

Drallim Aerospace

Component and tooling
Wheel management
Hooks and slings
Lashings and restraints
Mechanical cables
Maintenance
Ground support
Military
Cargo handling

AS9100: The quality standard for the aerospace sector. EASA Part 21 subpart G (Production Organisation). EASA Part 145 (Maintenance Organisation)

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ISOQAR REGISTERED UKAS MANAGEMENT SYSTEMS 0026
Certificate No. 8223
ISO9001
EASA
ISOQAR REGISTERED UKAS MANAGEMENT SYSTEMS 0026
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AS9100
RoHS COMPLIANT
Asia Pacific Utilities Group
UVDB UTILITIES PREQUALIFICATION SCHEME
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