Cables and Controls Rods

CATALOGUE & DESIGN GUIDE for

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

Leaders in Control Cables and Rods

AUTOMOTIVE

RAIL

PLANT

AVIATION

MARINE
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:

<table>
<thead>
<tr>
<th>Industry</th>
<th>Application</th>
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</thead>
<tbody>
<tr>
<td>Automotive:</td>
<td>Heater &amp; air vent control lever, seat adjustment, bonnet and fuel cap release, choke, gear stick, brake and clutch cables.</td>
</tr>
<tr>
<td>Aviation:</td>
<td>Door lanyards, emergency release latch, seat adjuster and release, cargo hook cable release.</td>
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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**

\[
BL = \frac{X \times R_2 - X \times R_1}{180}
\]

**Deflection Formula.**

\[
D = \frac{FL}{AE}
\]

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:

**Construcational 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 its 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 its 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

<table>
<thead>
<tr>
<th>Cable Selection Pointers</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>Flexibility</td>
<td>7 x 19</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>1 x 19</td>
</tr>
<tr>
<td>Stretch Resistance</td>
<td>1 x 7</td>
</tr>
<tr>
<td>Efficiency</td>
<td>1 x 19</td>
</tr>
<tr>
<td>Relative Cost</td>
<td>7 x 19</td>
</tr>
<tr>
<td>Compression Load</td>
<td>1 x 7</td>
</tr>
<tr>
<td>Straight Tensile Load</td>
<td>1 x 19</td>
</tr>
<tr>
<td>Flexing Tensile Load</td>
<td>7 x 19</td>
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</table>

Galvanised Wire Rope

<table>
<thead>
<tr>
<th>Diameter mm</th>
<th>Construction</th>
<th>Description</th>
<th>Uses / Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.00</td>
<td>1x7</td>
<td>Basic strand, relatively stiff in the larger size. Little stretch</td>
<td>Tension members Pull-Pull Controls</td>
</tr>
<tr>
<td>2.50</td>
<td>1x7</td>
<td>Fairly flexible, resists compressive forces. Strongest construction over 2.00mm diameter.</td>
<td>Tension members Guy lines Push-Pull Controls Pull-Pull Controls</td>
</tr>
<tr>
<td>3.00</td>
<td>1x19</td>
<td>Durable, High flexibility Good strength Good all rounder</td>
<td>Pull-Pull Controls Use over small diameter pulleys</td>
</tr>
<tr>
<td>3.50</td>
<td>7x7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.00</td>
<td>1x19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.00</td>
<td>1x19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td>7x7</td>
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<td>2.50</td>
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<td>4.00</td>
<td>7x7</td>
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</tr>
<tr>
<td>5.00</td>
<td>7x7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td>7x19</td>
<td>Strong Very flexible but has the most stretch</td>
<td>Use over pulleys For Lanyards Reciprocating App.</td>
</tr>
<tr>
<td>2.50</td>
<td>7x19</td>
<td></td>
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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.
TYPICAL CONTROL CABLE DESIGNS

- GO-CART CABLE
- TRAILER HANDBRAKE CABLE
- LINK CABLE
- CHOKE CABLE
- BONNET RELEASE CABLE
- HITCH RELEASE CABLE
- ACCELERATOR CABLE
- TRAILER BRAKE CABLE
- H/D CLUTCH CABLE
- BUSS BRAKE CABLE
- GEAR SHIFT CABLE
- 4WD SELECTOR CABLE
- STRAIGHT DIGGER CONTROL ROD
- BENT DIGGER CONTROL ROD
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 its own bespoke configuration and thus its 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**
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
Square Eye Piece
Round Eye Piece
Mushroom Nipple
Horizontal Nipple
Vertical Nipple
Barrel Nipple
Ball Nipple
Headed Nipple
Grease Nipple
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
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 its own accreditations.

**Drallim Industrial**

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

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

**Drallim Utilities**

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


**Drallim Aerospace**

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

“COPY-CAT”
PUSH-PULL CONTROL CABLES

REPLACEMENT CABLES MANUFACTURED 
FROM YOUR ORIGINALS

Manufactured in Great Britain 
on our premises

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