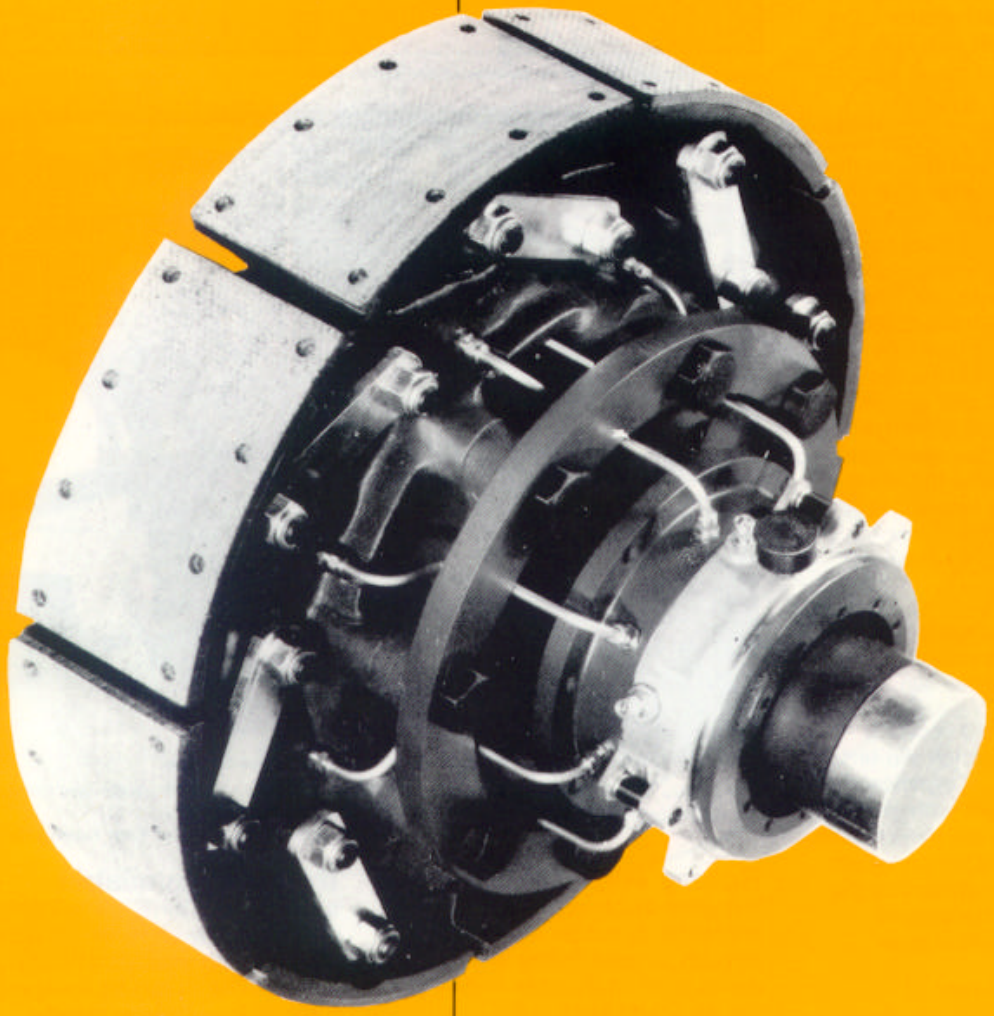
# Twiflex Airstart Centrifugal Clutch Coupling



TWIFLEX

BN111

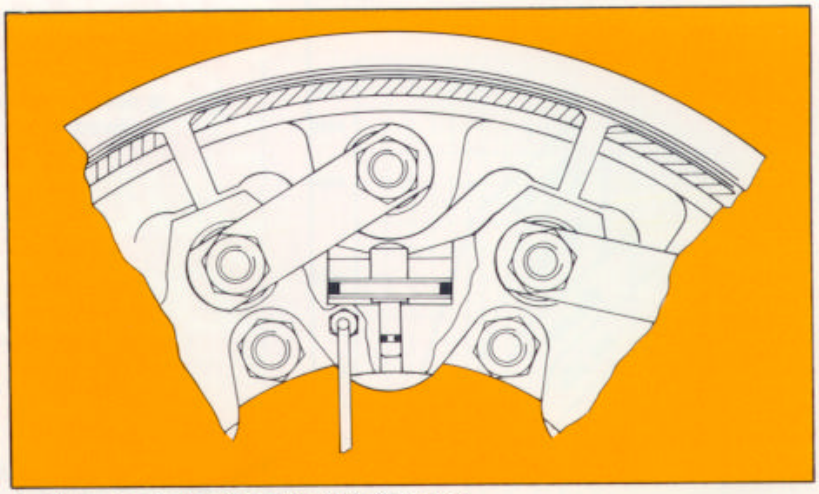
# TWIFLEX AIR START

**The Twiflex Air Start Clutch combines the advantages of the Automatic Centrifugal Clutch Coupling – silky smooth engagement, vibration damping and tolerance of shaft alignment errors – with the following additional features:**

**It can be engaged at any speed***

**It can be disengaged at any speed**

**Under heavy overload, it disengages completely and very quickly, protecting the clutch and the rest of the transmission from damage.**



*Detail showing starting air thruster under clutch shoe.*

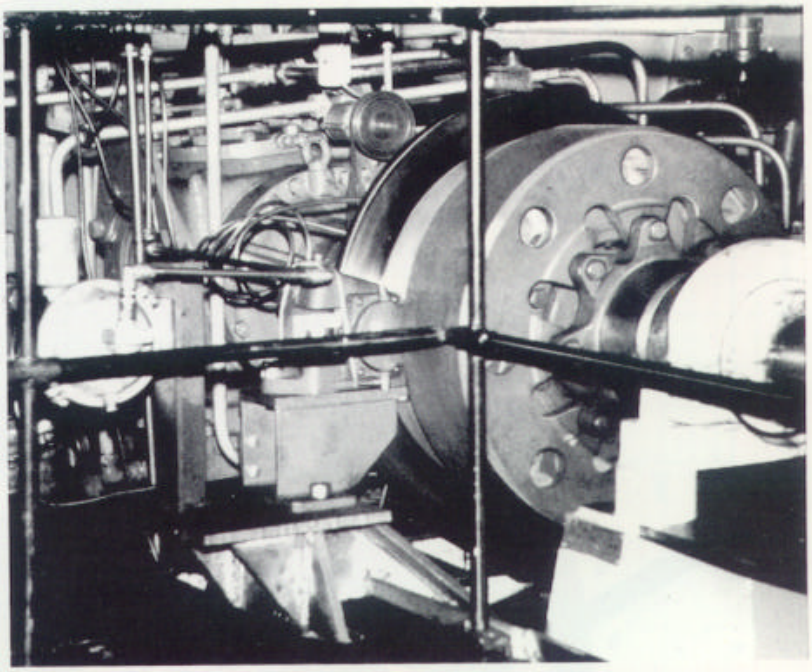
## Construction and operation

The clutch drum is attached to the prime mover, the hub carrying the flexibly mounted friction lined shoes forming the driven half coupling. To initiate engagement, these clutch shoes are moved outwards into pressure contact with the rotating drum by air thrusters built into the driven half hub. This starts the driven half rotating, and as it accelerates the centrifugal effect causes the clutch shoe assemblies to press harder against the drum, giving progressively firmer engagement until after a few seconds the starting air pressure can be removed.

Once run up to operating speed, the clutch transmits normal power demand without further slip.

Should an overload occur sufficient to cause clutch slip or to slow the prime mover significantly, the clutch disengages with great rapidity, protecting the transmission from the high inertia torque which would otherwise be applied by the rotating masses of the engine, electric motor or turbine rotor.

Clutch disengagement (if required) makes use of the above feature. It is effected by a disc brake operating on the driven hub. Thus, when the driven machine is stationary, it is secured against rotation by the brake. (This is an essential requirement in marine propulsion or wherever the load can drive back, as in centrifugal pumps).



*The Twiflex ASC248G Air Start Clutch installation complete with 30 in. brake disc fitted to the rudder propeller transmission of the twin screw MT Skelton Cross.*
*Photograph by courtesy of Tees Towing Co. Ltd.*

## Rotary Air Seal

It is often inconvenient or impossible to supply starting air through an axial drilling in the driven shaft. A valuable feature of the Air Start Clutch is the availability of a patented rotary air seal (see page 5) which makes it possible to inject air directly into the clutch without any modification to the transmission.

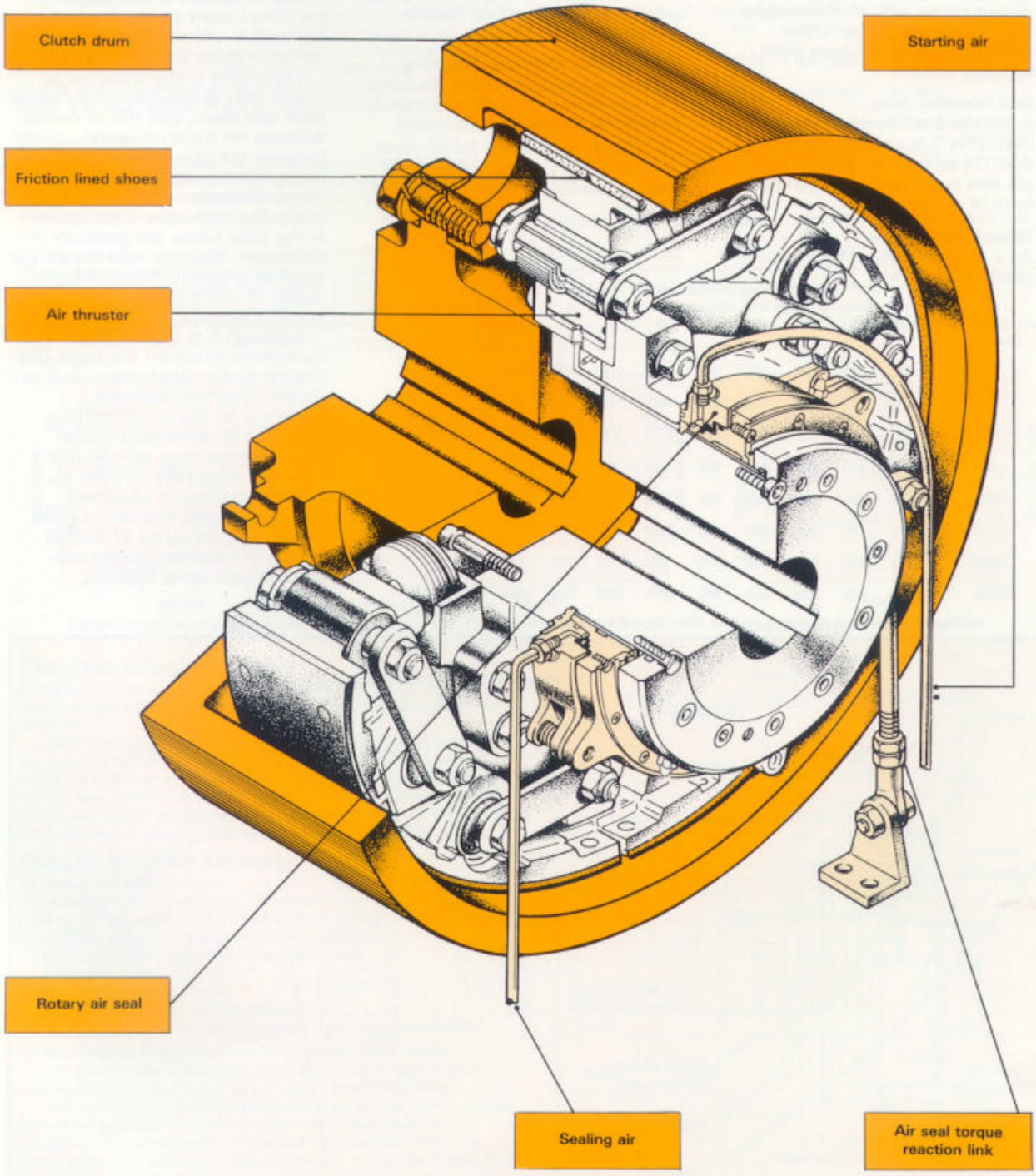
* For common diesel engine and electric motor speeds, but some engaging speed restriction may exist in high inertia drives, depending on frequency of operation.

## If air not available

If compressed air is not available we can supply an Hydraulic Start Clutch giving equivalent performance. It can be operated by a simple lever/master cylinder arrangement or by connection to an existing hydraulic control system, using a rotary hydraulic seal to permit the direct injection of oil to an annular thruster surrounding the shaft which is connected to the clutch shoes through mechanical linkages.

# CENTRIFUGAL CLUTCH COUPLINGS

*Cutaway drawing showing a typical Twiflex air start centrifugal clutch coupling*



# Dimensions

All sizes can be supplied in a variety of mounting arrangements to suit the machinery installation design. A common arrangement in which an electric motor or engine is coupled by the clutch to a layshaft, is shown below with dimensions for each size in the range. Other arrangements which have been supplied include:

**Bell housing type** –
A standard bell housing (to suit SAE 11½") is available for the ASC124 size. Other smaller sizes are also suitable for this compact form of mounting.

**Direct coupling** –
As a direct engine or motor to gearbox coupling.

**Cardan shaft** –
As an in-line floating shaft with a support bearing at the clutch end and a suitable flexible coupling at the driven end. This is useful for accommodating large movements such as that found on flexibly mounted machinery.

**With Low stiffness coupling** –
To give greater torsional flexibility, where necessary with reference to torsional vibration performance.

Clutch dimensions for all these variants will be approximately as shown in the layshaft arrangement below.

| Air Start Clutch | ø W | ø Z | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|
| 124 | 324 | 90 | 102 | 247 | 347 | 440 | 90 | 160 | 550 |
| 156 | 413 | 114 | 145 | 315 | 390 | 490 | 140 | 190 | 450 |
| 185 | 492 | 127 | 160 | 345 | 405 | 520 | 150 | 220 | 500 |
| 216 | 578 | 152 | 160 | 345 | 405 | 530 | 100 | 240 | 780 |
| 248 | 654 | 165 | 160 | 345 | 405 | 550 | 190 | 280 | 870 |
| 308 | 813 | 178 | 210 | 445 | 455 | 600 | 205 | 280 | 1020 |
| 368 | 978 | 235 | 230 | 485 | 475 | 640 | 280 | 320 | 1070 |
| 4510 | 1220 | 250 | 325 | 675 | 665 | 840 | 300 | 330 | 1480 |

Brake type and size dependent on operating conditions

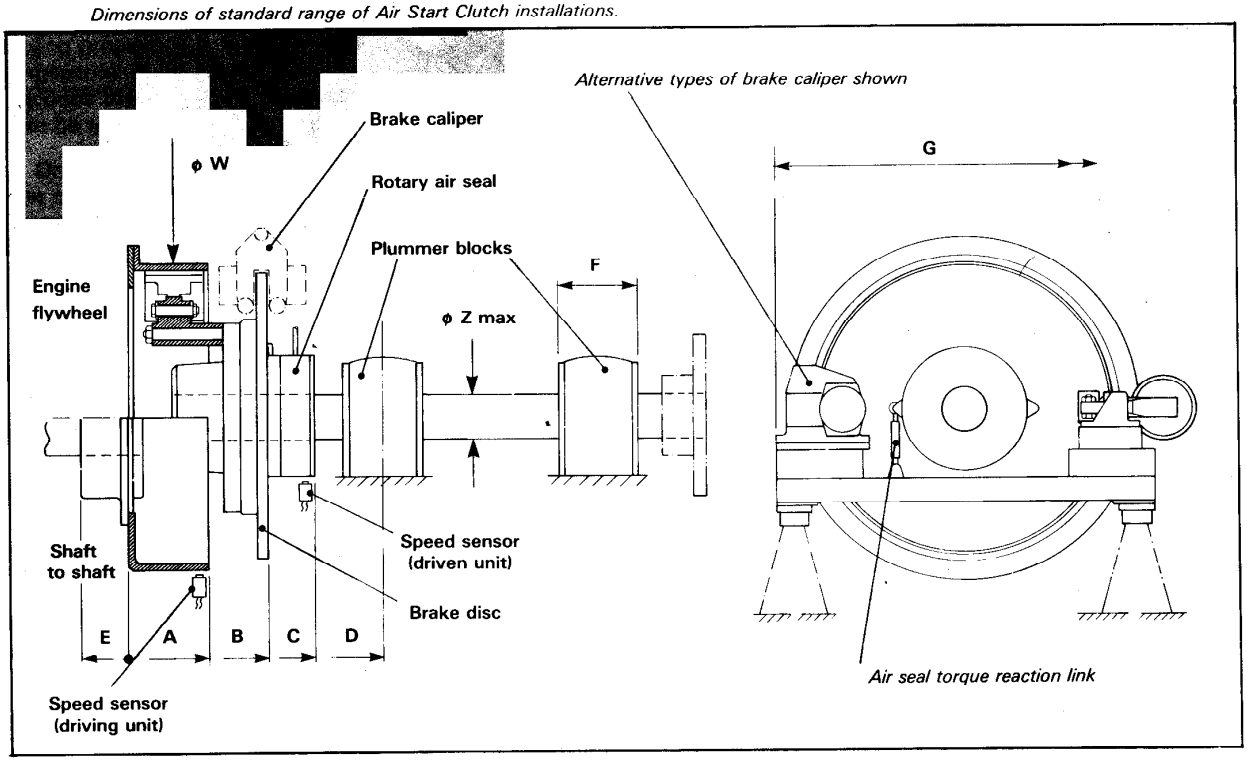
*Dimensions of standard range of Air Start Clutch installations.*

## Disc brake

The disc brake is necessary if the clutch has to be disengaged whilst the machinery is running or if the driven shaft must be held stationary whilst the clutch is disengaged (If the driven shaft can be rotated by the load, it will try to engage the clutch, making a brake essential).

The size of brake is chosen to ensure that clutch disengagement is swift and clean, and this of course depends on the shaft speed because the clutch slip torque is proportional to the square of the speed of rotation of the driven shaft. The brake disc sizes shown in the table below are generally applicable, however, and the torque required is obtained by suitable choice of brake calipers and working pressure.

Although it is most often convenient to mount the brake disc directly to the clutch driven hub as shown, it can be mounted anywhere on the driven shafting. This can be desirable in cardan shaft arrangements with flexibly mounted machinery in order to provide satisfactory alignment between calipers and disc. Details of the standard range of Twiflex discs and mounting bosses are given in data sheet DB5002.



# Power Ratings

It is recommended that final selection of the Air Start Clutch be referred to Twiflex in order to gain the benefit of their experience, which is backed up where necessary by computer simulation of the proposed system to check performance, temperatures, friction liner life and torsional vibration amplitudes. A preliminary selection is easily made, however, using the information in this brochure.

As an indication of the unique engagement/disengagement characteristics of the Air Start Clutch, the three diagrams below have been reproduced to show the speed and torque changes which occur in a typical installation during (a) engagement, (b) sudden overload, (c) gradually applied overload. They relate to a dredge pump drive installed in 1973, which has worked without trouble ever since. Transmitted power is 1110kw (1490hp) at 600 rev/min, using clutch size ASCS368G.

## Selection

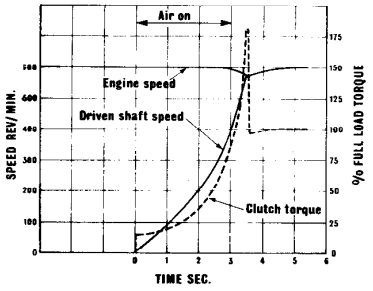
A preliminary selection based on normal running speed and power transmitted may be made from the chart on the back page; starting torques and maximum shaft diameters are given in the table opposite. Starting torque is approximately proportional to air pressure above 4 bar.

Where overload protection is a reason for employing the Air Start Clutch, it is important to ensure that the clutch slip torque at the operating speed is appropriate. Each size of clutch can be supplied in several models using different shoe weights and leading or trailing shoe rotation to provide a wide range of slip torque characteristics, meeting most operating conditions. These should be defined as fully as possible in any enquiry.

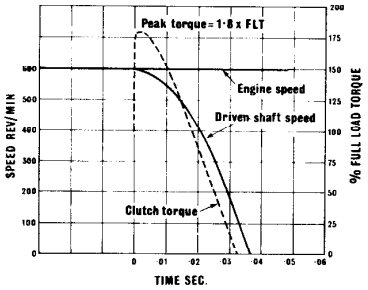
**PERFORMANCE DATA FOR STANDARD RANGE**

| Clutch model | Normal Torque | | Speed range | Power range | Rotary air seal model |
|---|---|---|---|---|---|
| | Starting[1] Nm | Running[2] Nm | rev/min | kw | |
| ASC124 | 660 | 1000 | 600/3500 | 20/340 | RAS120 |
| ASC156 | 940 | 3100 | 550/2900 | 30/1000 | |
| ASC216 | 2700 | 7500 | 450/2000 | 70/1500 | RAS 170 |
| ASC248 | 3700 | 11000 | 400/1850 | 90/2200 | |
| ASC308 | 7200 | 18500 | 350/1500 | 160/2800 | RAS 250 |
| ASC368 | 11200 | 38000 | 300/1200 | 280/4300 | |
| ASC4510 | 22500 | 62000 | 250/1000 | 400/6000 | |

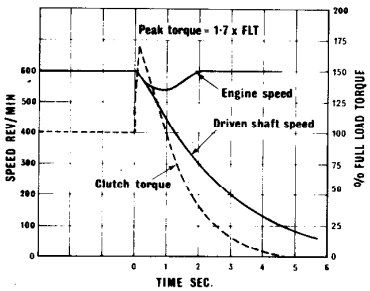
1 Air at 10 bar (leading shoe rotation) (1Nm = 8.851 lbf.in)
2 Without air pressure. The figure is less at low speeds.




*Clutch engagement at full speed*




*Response to massive overload (pump impeller halted in ¼ revolution).*




*Response to progressive overload (reaching 250% full load in 5 seconds with square law torque/speed characteristic).*

## Electric Motor Drives

In induction motor drives, engagement takes place at full speed, providing ideal starting conditions for the motor, and minimising kVA demand.

Direct on line starters can be used for induction motors (subject to any electrical regulations), but if a star-delta starter has to be used, it should be in the delta (fully run up) mode before engaging the clutch. Trailing shoe clutches, which are generally used for electric motor drives, can operate satisfactorily with the relatively high rubbing speeds involved and can deal with substantial driven machine inertia loads.

## Diesel Engine Drives

**A) Constant Speed Drives.**
For centrifugal pumps and other transmissions normally running at a fixed speed, especially auxiliaries driven from a power take off, the Air Start Clutch offers a unique combination of advantages.

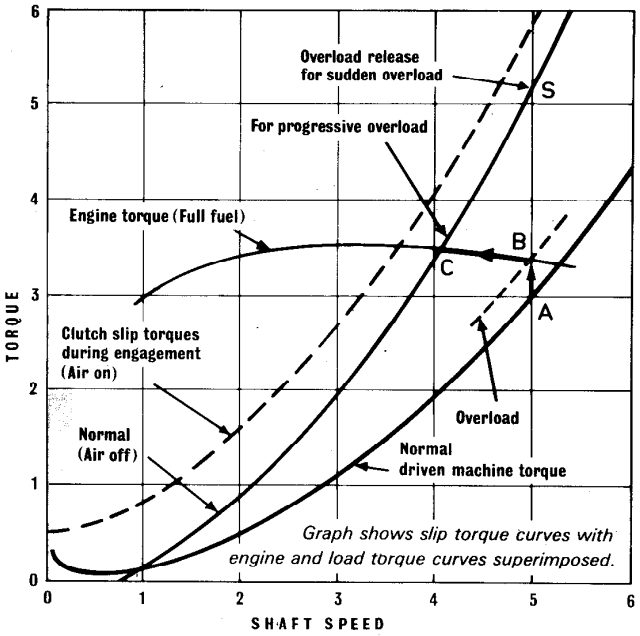
Can be used to engage the drive at any speed
Extremely smooth take-up
No slip at operating speed
Maximum protection against overload

Use the chart on the back cover to select the clutch size required.

**B) Marine Main Propulsion** (and other variable speed drives).
The Air Start Clutch has found a most useful field of application in marine main propulsion, especially in rudder-propeller systems.

The inherent square law torque characteristic of the clutch matches that of the propeller to provide constant ratio overload protection throughout the speed range. In tugs and other vessels working in inland waterways which are frequently subject to propeller fouling, the clutch offers protection of an order unattainable by any other means, without any sacrifice in efficiency and at an economic cost. The necessity to operate at low engine speeds may modify the selection because of the need to ensure an adequate slip torque capacity.

**TYPICAL OPERATING CONDITIONS**




*Graph shows slip torque curves with engine and load torque curves superimposed.*

# Rotary Air Seal

To supply air to the clutch, three sizes of rotary air seal are available:
RAS 120 for shaft sizes up to ø 118
RAS 170 for shaft sizes up to ø 168
RAS 260 for shaft sizes up to ø 260
The air seal is mounted to the driven hub and is provided with two ¼" BSP (R¼) ports for flexible air line connections. One of these is used to feed starting air to the clutch, and the other uses reduced pressure to load the sealing faces during the starting period. Because the seal operates only for the brief starting period, wear is minimal and seal life can be expected at least to match major plant overhaul periods. A torque reaction link holds the outer member of the seal stationary, and an anchorage for this has to be provided.

The seals can handle air pressures up to 10 bar, which provides sufficient starting torque for most installations.

## Construction

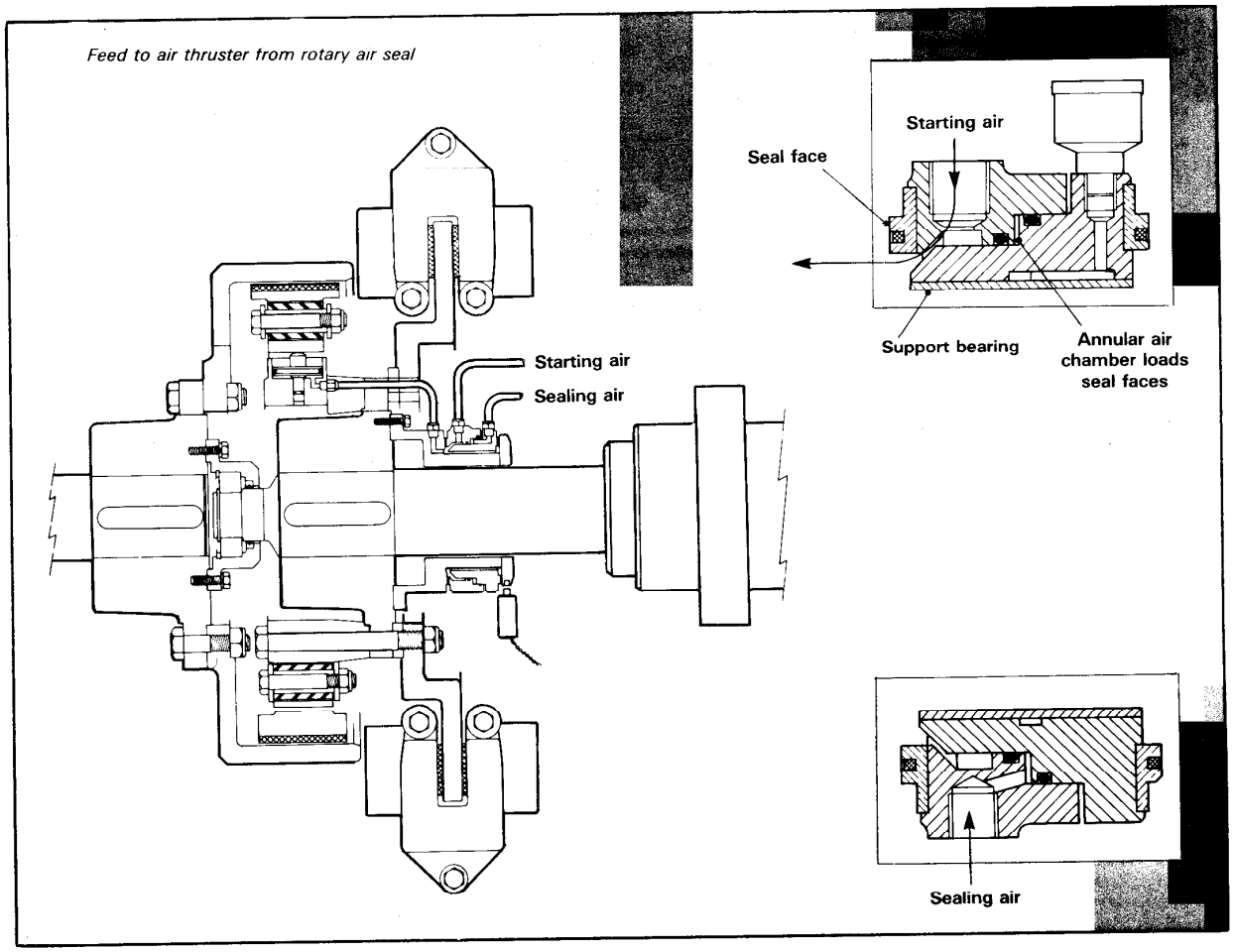
The non-rotating half of the seal consists of two aluminium alloy rings which slide axially, one within the other, to enclose a sealed annular air space. When the clutch is to be engaged, air pressure is introduced to force the two halves apart, loading the bronze sealing rings against the cast iron counterfaces of the rotating part of the seal. The air supply to the clutch at the required pressure is then introduced through a separate port as shown in the drawings. A thin wall journal bearing supports the non-rotating assembly, and a screw-down lubricator is provided. To reduce the reaction force on the journal bearing to a minimum, the torque reaction link is positioned according to the direction of rotation. Alternative mountings for the links and alternative air ports are provided.

As the clutch is engaged and the driven half (with the rotating part of the seal) accelerates, it soon reaches a speed at which the starting air pressure can be removed. As soon as this occurs, return springs withdraw the sealing rings from the counterfaces by a small but constant distance to prevent wear during subsequent motion. The small radial air flow passing the sealing rings as the seal is pressurised, provides a self-cleaning action. Oiled felt rings fitted in the sealing rings give the required amount of lubrication at the sliding faces.

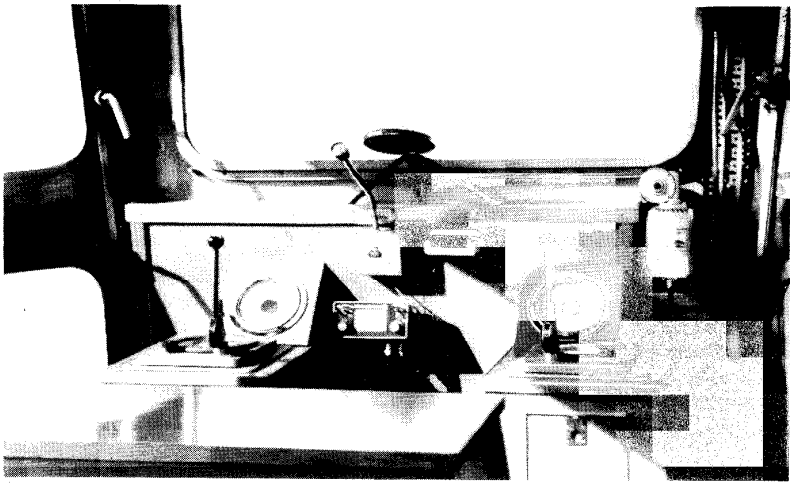
## Testing

Every seal assembly is works tested to ensure satisfactory operation. Our excellent service record provides an assurance of trouble free working for many years of normal operation.

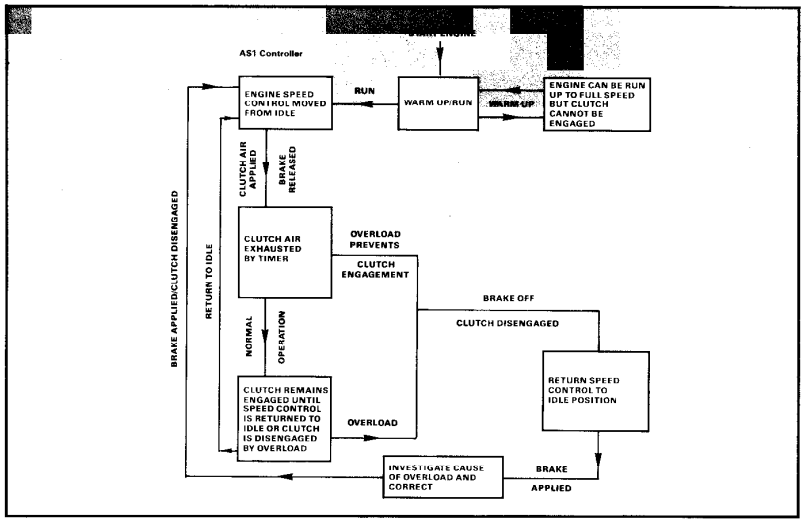
The Twiflex Rotary Air Seal is protected by British Patent 1535318 and corresponding foreign patents.



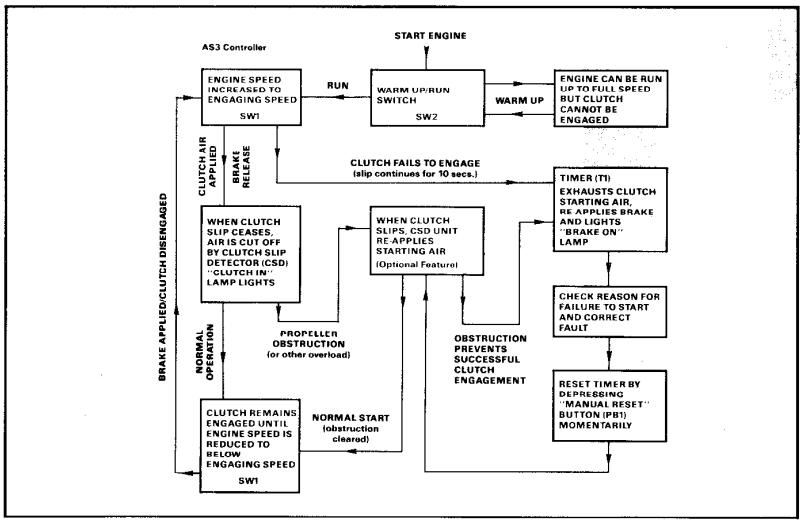
# Controllers



*Bridge of MT Skelton Cross showing single lever controls for each rudder propeller system. Photograph by courtesy of Tees Towing Co. Ltd.*




*Operational Flow Diagram for Type AS1 Controller*




*Operational Flow Diagram for Type AS3 Controller*

A controller is required to feed air to the clutch for the starting sequence and also to operate the brake in order to disengage the clutch. It does this in response to an electrical signal, normally held on when the clutch is engaged. In engine driven systems, the signal is commonly supplied from a switch operated by the speed control lever as it is removed from the idling speed position. This switch can be inhibited to permit the engine to run up to speed without clutch engagement for warming up or test purposes.

Two standard controllers are available, the type AS1 for straightforward applications where the operator is present and remote monitoring of clutch status is not required, and the type AS3, which provides such monitoring and also has an automatic variable closed loop starting sequence making it more suitable for frequent starting or for starting under varying load conditions and in remote situations.

Both controllers incorporate separate pressure regulating valves for each air pressure, starting air pressure and brake pressure, which can be adjusted to suit operating requirements.

A smoothed 24VDC electrical supply rated at not less than 20W is required for operation of the solenoid valves and electronic circuits. A battery supply is ideal and recommended where maximum security in operation is important. In the event of electrical supply failure, the valves can be operated manually.

## Type AS1 Controller

The commending features of this unit are simplicity, compactness and low cost. An adjustable timer for the duration of starting air application is used, and this is quite satisfactory where the frequency of starts is not such as to place severe demands on the seal or where wide variations in starting load demand the variable timing incorporated in the AS3 controller. The flow diagram below will clarify the operational sequence.

## Type AS3 Controller

In this unit an electronic slip detector (ESD) senses when the clutch is fully engaged and removes the starting and seal air pressures at the optimum moment to minimise seal wear whilst at the same time ensuring that the starting air is not removed prematurely when adverse starting conditions occur.

The additional feature of automatic re-start is also included for use in situations where immediate re-engagement is needed after a momentary overload has started to disengage the clutch (such as in marine-propulsion). The flow diagram shows how this operates.

## Control Cabinet Dimensions

Type AS1 230 high × 270 wide × 150 deep
Type AS3 230 high × 270 wide × 150 deep

# Why an Air Start Clutch?

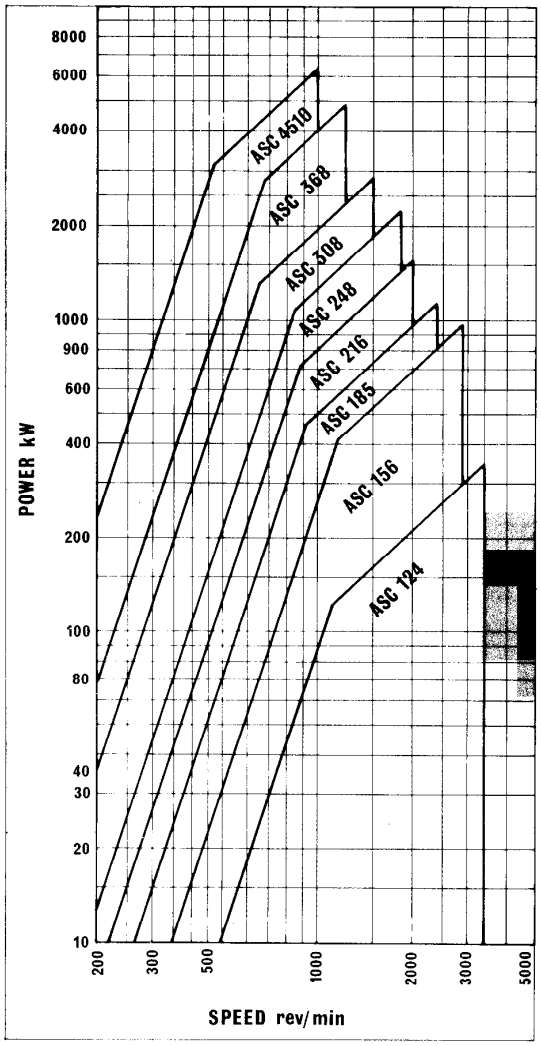
## Overload Protection
No other transmission element currently available (even a fluid coupling) provides comparable protection against overload.

## Efficiency
With no slip in the operating speed range and minimal power loss during engagement, it can save its own cost in fuel within a year compared to fluid couplings.

## Cost
Far cheaper in first cost than a fluid coupling or an oil immersed clutch, the Air Start Clutch also fulfils the function of an engine coupling to offer unrivalled value as a transmission element.

## Maintenance
Easily replaceable clutch friction linings and disc brake pads can be inspected visually without dismantling. Only one lubrication point (for Rotary Air Seal).

## Service
We provide a total service from the design stage through manufacture, installation, after sales and for as long as is required. We have a good reputation for customer support, and intend to keep it.



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