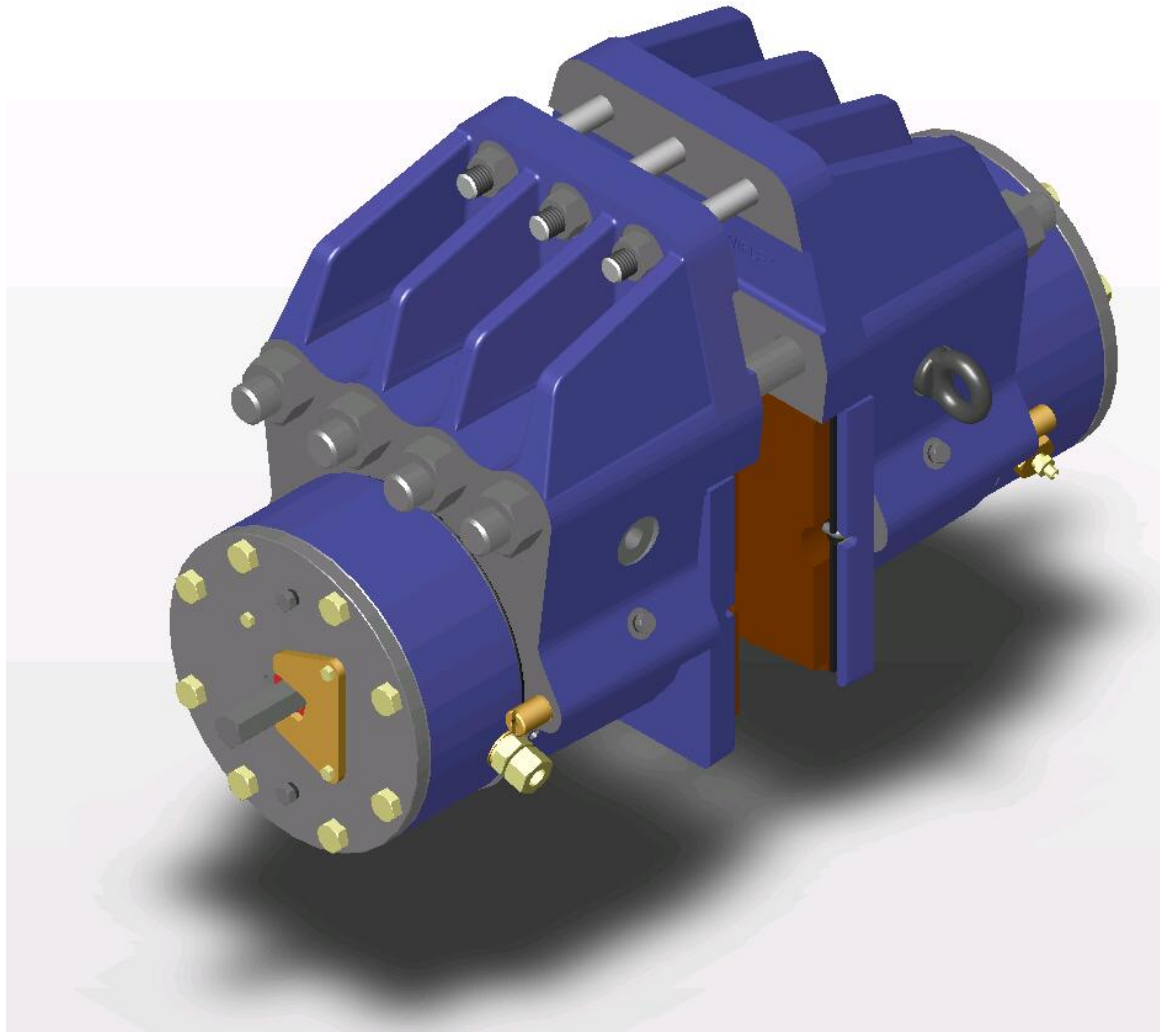




**TWIFLEX
DISC BRAKE CALIPER
TYPE 'VKSD' BASE MODEL
INSTALLATION, OPERATION
AND
MAINTENANCE INSTRUCTIONS
M1438**



AMENDMENT AND REVISION RECORD - M1438

AMENDMENT NUMBER ISSUE AND DATE			SIGNATURE AND DATE WHEN AMENDMENT ISSUED
	01	August 2004	
13325	02	April 2005	

CONTENTS

	Page
1. Specification	
1.1 General description	2
1.2 Detail specification	3
1.3 Monitoring units	5
2. Installation & Adjustment	
2.1 Installation	7
2.2 Initial Adjustment	7
3. Maintenance	
3.1 Running-in period	9
3.2 Maintenance inspection programme	10
3.3 Adjustment for friction pad wear	11
3.4 Friction pad replacement	12
3.5 Hydraulic supply failure	12
3.6 Mechanical retraction	13
3.7 Loss of braking force	13
3.8 Removal and replacement of caliper half	14
3.9 Replacement of seals 'in-situ'	15
3.10 Replacement of springs	16
3.11 Ships shaft brake operation	18
4. Rotabolts	18
5. Conversion of VKSD 119/62 into VKSD 64/28 or vice verse	18
Appendix 1. Spares	20
Appendix 2. Operational sequence (including figs. 1 – 5)	21
G1354 Data Sheet (weak spring detection)	28
G1457 Performance curves of VKSD 119/62	29
G1458 Performance curves of VKSD 64/28	30
G1459 Combined performance curves of VKSD 119/62 and VKSD 64/28	31
List of drawings:	
VKSD 119/62 Caliper General Arrangement and Installation	A01517
VKSD 64/28 Caliper General Arrangement and Installation	A01518
VKSD 119/62 Spring module assembly	A01519
VKSD 64/28 Spring module assembly	A01520
References:	
VKSD Performance Curves – Explanatory Notes.	S1025
V Type Monitor Unit I.O & M Manual.	

1. SPECIFICATION

1.1 GENERAL DESCRIPTION

THE OPERATIONAL SEQUENCE is illustrated in Appendix 2. Numbers in brackets refer to item nos. on Drg. No. A01519 for VKSD 119/62 and A01520 for VKSD 64/28.

The VKSD disc brake caliper is a spring applied, hydraulically retracted unit which may be used on any disc having a diameter of at least 1.0m and a thickness of 20mm or greater. There is no upper limit on diameter or thickness. Braking torque may be controlled by any combination of air gap setting, varying shim thickness, or by the use of hydraulic backpressure during braking. The caliper consists of two halves which are mounted each side of a mounting plate or pedestal by means of 4 M24 tie rods and 3 M16 bolts. No special bleeding arrangements are required for mounting at any angle as the fluid is almost entirely evacuated when the hydraulic pressure is fully released with the pads fully wound back.

The braking force is applied by the disc spring packs (25) through spring guides (4) and thrust screws (3) to the pressure plates (2) and hence to the friction pads. The calliper is available in two models: the VKSD 119/62 with 5 pairs of disc springs per module, and the VKSD 64/28 with 7 single disc springs per module. Conversion of model VKSD 119/62 into VKSD 64/28 is possible and is described in Section 5. The pads are kept in position by pad retraction hooks (13) on to the pressure plates (2), which transmit the braking force to the main housing (1).

The housing contains the spring chamber. The hydraulic retraction cylinder (6) is spigoted to the housing and the bleed screw and inlet port can be positioned by releasing two set screws (55) and rotating the cylinder. The hydraulic retraction piston (5) is held onto the spring-guide by means of a piston collet (8) with its retainer (9).

Brake rating can be varied by removing or adding shims (27,28) between piston (5) and end cover (7). Gap adjustment is manual and is effected by turning the hexagonal adjusting spindle (10). Nominal gaps are as given on the drawing. Maintaining the correct gap ensures that the braking torque is effectively constant and minimises the stress range for the springs, leading to an extended fatigue life. Reduction in torque due to a 1mm stroke increase is about 6% to 8% for the VKSD 119/62 and 4% to 15% for the 64/28. Failure of an individual spring would result in a substantial loss of braking torque in the affected caliper (see 3.7d).

Connections are provided for piping away any oil leakage.

Optional monitoring units are available which indicate:

- a) Full retraction of the brake - i.e. correct functioning of the hydraulic system. In conjunction with a suitable hydraulic pressure switch this facility can be used to give an indication of spring breakage. (see section 3.7 (d))
- b) Need for adjustment for pad wear.
- c) Need for pad replacement.

1.2 **DETAIL SPECIFICATION**

1.2.1 The VKSD series has a special operational feature called 'Parked-Off' position. This is made possible by having a piston stroke long enough to permit the disc springs to fully expand. Hence no internal spring loads exist in this condition. Yet the brake pads can be retracted to be within the mounting face and 11.5mm (0.45") clear of the disc. This brings the following advantages:

- a) The unit can be shipped without a retraction tool and with the cylinder end-cover and monitoring unit in position.
- b) The unit can be installed without the need for hydraulic pressure.
- c) The pads can be safely exchanged without a retraction tool and with the hydraulics at zero pressure.
- d) Hydraulics can be operated and tested, and air gap set without placing unbalanced axial load on the brake disc and shaft.
- e) The module, including spring pack, can be safely assembled and disassembled.
- f) In the case of hydraulic failure, the retraction tool is only required to release the brake. Full retraction is not necessary as upon release the pad can be wound back in the parked-off position, and the retraction tool removed.
- g) For 'ship-shafts' maintenance use, the brake when placed in the 'parked-off' position cannot be applied accidentally or due to inadvertent operation or hydraulic failure (see also 3.11). The 'parked-off' feature combined with a separate cylinder allows:-
- h) Cylinder to be rotated to position the bleed, at any time, even after installation.
- j) Cylinder can be dismantled, permitting replacement of seals and cylinder wearing surface 'in-situ'.

1.2.2. **BRAKING FORCE & TORQUE (SEE DRG. A01517 and A01518 AND CURVES G1457 and G1458)**

The braking force 'F' (kN) acting tangentially on the disc is given by $F = 2 \times \mu \times S$ where μ is the friction coefficient of the brake pad and S is the spring pack thrust (kN) (1bf). Nominal values for braking force are given on the drawings together with the appropriate air gap settings; please note that these values are based on a coefficient of friction $\mu = 0.4$.

This value can only be achieved under ideal conditions. Factors which influence μ are:
- material and surface finish of disc, amount of surface contact (after bedding in), cleanliness of pad and disc, humidity, temperature and grade of pad material, and finally, rubbing speed. In a near static application for example μ can be as low as 0.15.

Braking torque T (kNm) is given by $T = F \times (R - 0.095m)$ where R is the outside radius of the disc in metres.
(T lbf.ft = F lbf x (R - 0.312)ft).

The braking force obtained is also dependent on the gap setting and the amount of shims fitted as is shown on performance curve G1457 and G1458. Please note that these curves are also based on $\mu = 0.4$ and that a service factor has to be applied for a particular application. Also shown on these curves is the fatigue life for (99%) of the springs for a particular gap setting. See Publication S1025 for an explanation of how to read the curves.

1.2.3 **RETRACTION CYLINDERS STANDARD.**

Diameter = 150mm (5.9 ins)
Spring guide diameter = 70mm (2.756 ins)
Effective area = 13823mm² (21.425 in²)

Hydraulic pressures for brake release and full retraction are given on the drawing for the nominal gap setting. For other gap settings or shim settings these pressures can be read from the curves. (See Publication S1025 - Performance Curves - Explanation)

In order to avoid overstressing the 8 M10 set screws on the end cover it is recommended that the maximum hydraulic pressure shall not exceed the retraction pressure by more than 25 bar (363 psi).

Recommended hydraulic fluid is a good quality mineral oil such as Shell 'Tellus 37' or an approved fire resistant type.

Fluid inlet connections are 3/8" BSP (G3/8) and fittings are normally provided to connect the cylinders by means of 12mm o/d. x 1.5mm seamless steel tubing to DIN 2391/C.

1.2.4 **FRICTION PADS**

Friction pads in non-asbestos material are supplied; some types may have a lower coefficient of friction. Initial thickness of the pads (including back plate) = 22mm (0.866in).

Total pad area (two pads) = 694 cm² (107.5 in²)

The permissible wear on these brakes is 10 mm (0.39 ins) with a wear life of 25 000 MJ. For pad replacement see Section 3.4.

1.2.5 MATERIALS AND QUALITY ASSURANCE

The housings, pressure plates and cylinders* on the VKSD are castings of SG iron, to BS 2789, grade 420-12. Other metal components are steel. Calipers can be supplied with non-destructive test (NDT) certificates for all critical components, if required. The main hydraulic seals are PTFE; 'O' rings are nit rile rubber.

* Some cylinders may be steel.

Each caliper is fully tested after assembly and a test certificate issued.

1.3 MONITORING UNITS

Monitoring units are supplied as an option; a typical 3-function model, part number 7700660 (drg. no. A22444) is described below. The unit is fitted to the cylinder end cover. Each unit contains three micro-switches, which may be used to operate warning lamps or other indicating devices. One switch (SWC) is operated by a collar on the adjusting spindle, the other two are operated by a spring loaded actuator which bears directly on the back of the hydraulic piston (SWA, SWB). A 20mm conduit entry is provided. All switches are sealed to IP67 and suitable for temperature down to -50°C. The Box itself is also sealed to be splash proof. The functions and connections of the switches are as follows:

SWA Terminals 2 (NC) 3 (NO)

Switch operates when brake is fully retracted, indicating correct functioning of the hydraulic system, and providing "brake-off" warning.

SWB Terminals 5 (NC) 6 (NO)

Switch closes, with brake on, when stroke has increased due to pad wear sufficiently to required adjustment. Normally set to indicate 1mm wear.

SWC Terminals 8 (NC) 9 (NO)

Switch closes when the pad requires replacement. Normally set to indicate 10mm (3/8 in) pad wear.

The switch settings may be adjusted to some extent to suit particular applications.

These units are supplied loose and correctly set, but should be checked for correct adjustments after re-fitting to the caliper.

The switch ratings, in amperes, are as follows:

VOLTAGE		RESISTIVE LOAD	TUNGSTEN LAMP LOAD		INDUCTIVE LOAD
			N/C	N/O	
AC	125	3	0.5	0.5	3
	250	3	0.5	0.5	3
DC	up to 15	3	3	1.5	3
	30	3	3	1.5	3
	50	1	0.7	0.7	1
	75	0.75	0.5	0.5	0.25
	125	0.5	0.4	0.4	0.05
	250	0.25	0.2	0.2	0.03

For a full description see Publication M1105.

2. INSTALLATIONS AND ADJUSTMENT

2.1 INSTALLATION

Refer to Drawing A01517 for VKSD 119/62 and Drawing A01518 for VKSD 64/28.

Ideally, two calipers should be used on each disc, mounted diametrically opposite each other, in order to neutralise the braking torque reaction forces on the shaft bearings. Any other position can also be catered for, as the bleed screw on the cylinder can be indexed to any position, after releasing the two set screws (55); the set screws should be retightened to 6Nm (4.5 lbf.ft)

Brake mounting plates or pedestals should be of adequate strength and rigidity, and must be flat, and parallel to the disc surface. Each caliper is secured by four M24 tie bolts and three M16 bolts, (can be supplied by Twiflex) which should be tightened to a minimum torque of 775Nm (575 lbf.ft) and 200 Nm (148 lbf.ft) respectively.

NOTE: VKSD 119/62 calipers subject to REVERSING BRAKING LOADS over 70kN must be provided with one M24 'fitted' tie rod at either end of the row of 4 tie rods. One end hole in the mounting plate must also be machined to Ø25(+0.025/+0.000).

The mounting plate should be positioned with respect to the disc as shown on the drawing with the mounting surfaces lined up with, but 6 mm proud of, disc rubbing surface.

Sufficient space should be allowed for access to the calipers for routine inspection and maintenance and for pad renewal as indicated on drawings A01517 and A01518. Calipers are supplied in the "parked off" position in which the springs are fully relaxed and the pad is retracted within the mounting face. When the caliper halves have been bolted into position, the hydraulic supply should be connected and all air bled from the system using the bleed screws (19).

2.2 INITIAL ADJUSTMENT

- a) With the bleed screws closed the cylinders may be pressurised to a maximum of 25 bar (360 psi) above the retraction pressure as given on the drawing. In the fully pressurised condition the back of the spring guide (4) should be 2.0 mm (0.079 in) from the inner face of the cylinder end cover (7) or shims (27,28) where fitted.

- b) The Air Gap should be set as follows:

Remove the M5 screws in the spindle locking plate (12) and disengage its slot from the hexagon spindle (10). Using a 19mm AF spanner turn one of the hexagonal adjusting spindles (10) clockwise until the pad is in firm contact with the disc, then back off by 2/3rds of a turn for 2mm (0.080 in) air gap, 1 turn for 3mm (0.120 in) air gap or 1 1/3 turns for 4mm (0.160 in) air gap. (The pitch of the thrust screw (3) is 3mm (0.12 in)).

The actual retraction dimensions will be slightly greater when the caliper deflects under load. Repeat the setting procedure on the other side of the caliper. Operate the caliper and check that the air gap or stroke is correct; Adjust if required. The minimum adjustment which can be made is 1/6th of a turn = 0.5mm (0.020 in) by leaving the locking plate in the same position or 1/12th of a turn = 0.25mm (0.010 in) by removing the M5 screws and inverting the locking plate (12).

- c) Please note that the correct shim stack height will have been fitted, commensurate with the brake performance required. The braking force can however be reduced by adding shims or increased by removing shims.

Notes i) Maximum shim stack height is 7mm for VKSD 119/62 and 6mm for VKSD 64/28, both with the step on the end cover (7) inwards. Exceeding these amounts will under stress the disc springs and shorten their life.

WARNING The position of the step on the end cover (7) of the VKSD 119/62 MUST ALWAYS BE INWARD - NEVER OUTWARD, as this would severely overstress the disc springs.

- ii) Always remove or add the same amount of shims on each side of the caliper.
iii) Always, after refitting end cover (7), retighten set screws (47) evenly in turn to a torque of 50Nm (36 lbf.ft).

- d) The drain connections (two each side of the caliper) can now be piped away to waste. It may be convenient to use flexible tubing, and if transparent tubing is used any leakage will be immediately apparent.

3. MAINTENANCE

3.1 RUNNING-IN PERIOD

For the first full week of operation make a DAILY CHECK of the following items:

- a) Hydraulic Fluid Leakage. Note and report any evidence of fluid leakage. If the leakage occurs at the pipe connections or at the bleed screws, tighten as appropriate, carefully wipe away spilled fluid and check for further leaks with brakes off.

Note: The air gap is measured between pad and disc at full retraction. The stroke is the air gap plus caliper deflection and is the movement of the adjusting spindle from brake 'on' to full retraction, measured with respect to the end cover (item 7).

If friction pads become fouled with fluid, they must be replaced after curing the leak and the disc(s) wiped clean. A very slight seepage of oil past seals (29) (30) is normal, but should not be such as to cause a flow in the drain pipes.

- b) Observe brake operation including smooth retraction and application of brake pads. Note and report any unusual observations.
- c) Check condition of the brake paths. They should remain smooth and free from contaminants, for example rope lubricant. Remove any deposits.
- d) At the end of the running-in period, check the security of all bolted connections and pipe connections.

The caliper mounting bolts should be paint marked to provide a visual security check.

3.2 MAINTENANCE INSPECTION PROGRAMME

After the running-in period the following schedule should be followed in addition to any statutory requirements.

MAINTENANCE SCHEDULE			
ITEM	WEEKLY	MONTHLY	PERIODIC
a) Check for hydraulic fluid leakage	x (note i)		
b) Observe brake operation	x (note ii)		
c) Clean calipers of accumulated deposits		x	
d) Clean brake paths on disc		x (note iii)	
e) Observe bolt security		x (note iv)	
f) Note and record brake pad thickness		x (note v)	
g) Note and record brake pad movement, (stroke). Adjust if required.		x (note vi)	
h) Check availability and condition of spares and tools			x
j) Remove and inspect brake pads (see 3.4)			x

NOTES

- (i) See note (a) under "Running-in period" (3.1). Any appreciable flow from the drain pipes indicates that one or more of the hydraulic seals needs replacing. This may be conveniently done by replacing the complete half as in Section 3.8. However, if servicing on site is essential, consult Section 3.9.
- (ii) See note (b) under "Running-in period".
- (iii) Under adverse conditions this may be required more frequently.
- (iv) Check that no movement has occurred at paint-marked bolts and test security of other fasteners.
- (v) Note brake pad wear by measuring proximity of pad backing plate edges to disc, with

brakes on. A dimension of 2mm at any position indicates that the pad needs to be replaced. Replacement thickness is 12mm (0.470 in) measured over backing plate. New thickness is 22 mm (0.866in) over backing plate.

- (vi) Air gap is nominally as shown on the drawing or on the curves but is affected by disc axial float and run-out and will vary by that amount. Actual stroke measured at the pad will be greater, due to deflections of the caliper, and movement of the adjusting spindle is the most convenient measurement. - See Publication S1025.

Where no monitoring units are fitted and when pad wear is very low (as is generally the case), comparative checks of pad movement may be made monthly with accurate measurements at less frequent intervals.

3.3 **ADJUSTMENT FOR FRICTION PAD WEAR**

The adjustment is made by turning the adjusting spindle (10) clockwise using a suitable spanner. Adjustment can be made in 0.5mm (0.020 in) increments (1/6th of a turn) by leaving the locking plate in the same position or in 0.25mm (0.010 in) by inverting the locking plate.

- a) Determine adjustment required to bring piston stroke into line with original gap setting (see note (vi), section 3.2 above).
- b) Remove the M5 screws from spindle locking plate (12) and slide it back to disengage spindle.
- c) Turn spindle clockwise by one 'flat' (60°) for 0.5mm (0.020 in) adjustment, two 'flats' (120°) for 1mm (0.040 in) etc. Should adjustment required be 0.25mm (0.002in) then the locking plate must be inverted for 1/12 turn.
- d) Replace locking plate and tighten M5 screws to 6Nm (4.5lbf.ft) so locking the adjusting spindle.
- e) Repeat for opposite pad; pads should always be adjusted in pairs.

3.4 FRICTION PAD REPLACEMENT

Brake pad replacement is indicated when:-

- a) The monitor switch (where fitted) has signalled that pad is fully worn.
- b) Top of the plunger (14) is level with housing face.
- c) The backing plate edges are 2mm or less from disc.
- d) If the pad thickness has more than 2mm (0.08 in) taper, as measured at the four corners, it should be replaced, even if not fully worn.
- e) Minimum pad thickness is 12mm (0.47in).

Before removing brake pads, secure the disc against rotation. Retract brakes fully, hydraulically, and as a SAFETY measure place the brake in the 'parked-off' position by turning the adjusting spindle fully anti-clockwise. The hydraulic pressure may now be released. Unhook the pad retraction hook (13) by inserting a large screwdriver in the pad retraction plunger (14), depressing spring (24) and turning the hook through 180°. The pad can now be removed, first by pushing it away from the pressure plate through the holes provided, then by sliding it along the disc-rubbing surface.

Remove dirt using a clean dry cloth and note condition of pad friction surface, which should be polished, uniformly marked and free of serious pitting. Replacement of the pad is carried out by reversing the removal procedure, but first clean the pressure plate. Ensure that pad is properly seated by turning adjusting spindle such that pad is forced firmly against disc. Refit pad retraction hooks.

After fitting the pads the piston stroke must be reset as in Section 2.2 (Initial Adjustment) paragraph (b).

3.5 HYDRAULIC SUPPLY FAILURE

The brake may be released by means of a hand pump connected direct to the feed port. After the brake has been released the 'parked-off' position can be obtained by turning the adjusting spindle fully anti-clockwise. The hand pump can then be removed.

3.6 MECHANICAL RETRACTION

The retraction tool kit, an optional, can be purchased separately.

The retraction tool should only be required to release the brake when a hand pump is not available or there is a hydraulic failure, such as when the seals leak to such an extent that the brake cannot be released by hand pump. The retraction tool should then be used as follows:

- a) Remove end covers (7) complete with monitoring units, if fitted. Take care not to lose any shims.
- b) With nuts (M12) already threaded onto the retraction screws, attach the retractor flange to the hydraulic piston (5). See scrap view on drawings A01519 and A01520.
- c) Release brake by tightening the nuts evenly in turn.
- d) Turn the adjusting spindle fully anti-clockwise thus placing the brake in the 'Parked-Off' position.
- e) The retractor flange may now be removed, by loosening the nuts evenly in turn.
- f) Always remove retractor flange before resuming normal operation.

3.7 LOSS OF BRAKING FORCE

Possible causes are:-

- a) Contaminants on surface of pads or disc, especially lubricants,
- b) Higher than normal hydraulic back pressure when brakes are applied.
- c) Increased stroke (due to pad wear, necessitating adjustment; or incorrect adjustment).

d) **Damaged or broken disc spring or springs**

Where the monitoring switch assembly is fitted any significant reduction in the force developed by a spring can be detected by the addition of a pressure switch to the hydraulic fluid supply, as shown in data sheet G1354. If the above system is not used, spring force can be checked by use of a calibrated oil pressure gauge suitable for the maximum back pressure employed. Pressures required for full retraction are given on the drawing or can be taken from the curves. Springs should be changed if the reduction in pressure is 12.5% or more. Normally the easiest procedure would be to remove the complete caliper half as in 3.8 below and return it to Twiflex for service or replacement. However, for cases where this is not possible the procedure for seal replacement is described in section 3.9 and replacement springs is described in section 3.10.

3.8 REMOVALS AND REPLACEMENT OF CALIPER HALF

- a) Balance load and secure the installation from rotation.
- b) Remove monitoring units if fitted.
- c) Release the brakes hydraulically or mechanically and place the brake in the 'Parked-Off' position by turning the adjusting spindle fully anti-clockwise; hydraulic pressure may then be released.
- d) If the brake pads are re-usable, remove them and put them in a dry clean place; otherwise ensure that spares are available.
- e) Disconnect the hydraulic unions, controlling the fluid loss.
- f) Support the weight of the caliper half to be removed.
- g) Unscrew and remove the four M24 tie rod nuts and remove the three M16 mounting bolts.
- h) Carefully slide the caliper half from the tie rods.
- j) Replacement of the caliper half is the reverse of removal. It is essential to preload the M24 bolts to 188 kN (42300 lbf) by torquing to 775 (575 lb.ft). The M16 bolts should be torqued to 200Nm (148lb.ft) See Note under 2.1 on calipers subject to reversing loads.

3.9 REPLACEMENT OF SEALS 'IN SITU'

Leakage of large cylinder seal (29) is indicated by oil seeping from the cylinder cover drain. Leakage of rod seal (30) is indicated by oil seeping from the 1/8" BSP holes at the sides of the housing fitted with plugs (58) on delivery. At least one plug, normally the lower one, must be removed.

- a) Follow instructions as under 3.8 a,b,c, and e.
- b) Remove end cover (7) complete with bolts (47) and shims (27-28).
- c) Slacken off set screws (55).
- d) Remove retaining ring (40) from piston.
- e) Retract and remove collet retainer (9) by inserting M4 x 40 screws in the tapped holes in this retainer.
- f) Remove split piston collet (8). It may be necessary to free the segments by tapping them towards the pad end of the caliper. Note that collet segments are marked with a batch number, e.g. B/20.
- g) Remove cylinder (6) and piston (5) together, by means of bar bolted to M12 retraction holes in piston. 'O' ring (36) may be reused unless severely damaged.
- h) Take assembly to work bench and carefully remove piston (5).
- j) Inspect wear surfaces, seals, wear rings and 'O'-rings for damage and refurbish or replace as necessary.
- k) Re-assembly is generally as dismantling procedure but in reverse order; note the following:-
 - i) Exercise great care not to damage seals and wearing surfaces.
 - ii) Clean wearing surfaces on spring guide (4) and cylinder (6).
 - iii) First assemble piston into cylinder.
 - iv) Note that cylinder seal (29) has to be 'sized' by means of the cylinder, and rod seal (30) by means of a tool, with a diameter of 69.970/69.940 (Ø 70f7) with a chamfer of 8mm (0.3 in) long @ 15° blended into this diameter; surface finish to be 0.4 microns (16 micro-ins).
 - v) Slide cylinder-piston assembly onto spring guide, ensuring that cylinder spigot is fully home into housing. Move piston into cylinder so that split collet segments (8) can be entered into groove in spring sleeve. Refit 'O'-ring (35) to hold segments in place. Insert collet retainer (9) and apply some air pressure to the cylinder port to 'blow' piston into place. Collet segments should be

replaced in their original positions, referring to batch number and identifying marks.

- vi) Refit retaining ring (40).
- vii) Turn cylinder so that bleed screw (19) is uppermost. Note that thread at hydraulic feed port and at bleed screw port are the same size; hence adaptor (20) and bonded seal (61) can be removed to port which is nearest top and thus save turning cylinder an unnecessary amount.
- viii) Retighten two set screws (55) to 6 Nm (4.5 lb.ft).
- ix) Refit end cover (7), (note correct position - see note 1), with monitoring unit if fitted, taking care to enter the 3 tension pins (42) into the holes in the spring guide. Tighten set screws (47) evenly in turn to a torque of 50 Nm (36 lbf.ft). Refit external 'O' Ring (36). Finally reconnect hydraulic pipes, bleed and, readjust brakes as under 2.1 and 2.2

Note 1 Note position of end cover (9) and refit as shown on drawing, i.e. flat side is **always** on outside.

Note 2 Tension pins (39) have to be tapped into inside of lid.

3.10 REPLACEMENT OF SPRINGS

3.10.1 DISMANTLING

- a) Proceed as under 3.8 (a) to (h) and transfer caliper half to workshop.
- b) Proceed as under 3.9 steps (b) to (f).
- c) The pressure plate (2), thrust screw (3) and spring guide (4) with springs (25) can now be removed from the housing.
- d) Alternatively the pressure plate (2) and thrust screw (3) can be removed first by rotating the latter clockwise by means of the adjusting spindle (10).

The spring guide (4) with springs (25) can then be removed for inspection.

Note: Take great care not to damage the rubbing surface for the rod seals (29). Keep springs in their order as assembled if possible.

3.10.2 **NON-DESTRUCTIVE TESTING**

If the springs are visually sound an N.D.T. method may be employed. It is essential that the surface finish of the disc springs is not damaged by electrical contacts, sparking or otherwise, so an N.D.T. should be adopted, which does not give rise to any such danger.

Inspect other parts as may be required.

3.10.3 **RE-ASSEMBLY**

Follow generally the reverse of the dismantling procedure, but note:

- i) Exercise great care not to damage seals and bearing surfaces.
- ii) Re-assemble spring in the reverse order to that in which they were originally assembled (to extend their fatigue life).
- iii) Observe assembly notes under 3.9.
- iv) Clean wearing surfaces of cylinder (6), thrust screw (3) and spring guide (4) before re-assembly.

Retighten set screws (55) to 6 Nm (4.5 lbf.ft).
- v) It is essential when reinstalling caliper half to preload M24 tie rods and M16 bolts as under 3.8(j).
- vi) Re-fit brake pads and adjust for correct air gap.

NOTE: The disc spring bearing on the spring guide abutment must do so with its smallest diameter, as shown on the drawing.

3.10.4 TESTING

Carry out functional testing and operational testing as may be required. Check settings of monitoring units (if used) after refitting the caliper. Adjust if necessary.

3.11 OPERATION AS 'SHIP SHAFTS' HOLDING BRAKE

It is assumed that the brakes are in the "Parked Off" Position - 1.2.1g.

3.11.1 HYDRAULIC PRESSURE AVAILABLE

Apply hydraulic pressure and turn adjusting spindle (10) on both sides, until the pads are firmly against the disc. Releasing the hydraulic pressure will apply the brake, and Braking Force will be as for zero gap setting as indicated for the shim height as fitted.

3.11.2 NO HYDRAULIC PRESSURE AVAILABLE

Remove end cover and fit mechanical retraction tools - see section 3.6 a, b, and c.

Continue tightening the nuts until piston is fully retracted, i.e. when spring guide (4) is within 8 mm of retraction tool face. Turn adjusting spindles until the pads are firmly against the disc. Releasing the nuts on retraction bolts will apply the brake. Braking Force will be as for caliper at zero gap setting at no shim height. Braking force will, however, be affected by the factors as under 1.2.2.

4. ROTABOLTS

4.1 Special Tie bolts are available, optionally, with a 'Rotabolt' tell-tale at one end.

This tell-tale can be rotated by hand when the pre-load is below specification and cannot be rotated when the pre-load is correct.

5. CONVERSION OF VKSD 119/62 INTO VKSD 64/28 OR VICE VERSA

5.1 To convert VKSD 119/62 into VKSD 64/28

See Section 3.10.1 and remove the ten disc springs (25). Discard three disc springs and re-assemble springs facing alternate directions, and with the disc spring bearing on the spring guide abutment with its smallest diameter as shown on drawing A01518. Add spacer, part no. 7952008, at the other end of the spring stack.

5.2 Follow further re-assembly instructions as under 3.9 and 3.10.3 and fit shims as required up to a maximum of 4mm with the end cover (7) step outward or 6mm with the cover step inward.

5.3 **To convert VKSD 64/28 into VKSD 119/62**

See section 3.10.1 and remove 7 disc springs and discard spacer. Add 3 disc springs, part no. 2500154, and re-assemble springs into 5 pairs, facing alternate directions, and with the disc spring bearing on the spring guide abutment with its smallest diameter as shown on drawing A01517.

5.4 Follow further re-assembly instructions as under 3.9 and 3.10.3 and add or discard shims as required up to a maximum of 7mm.

NOTE: Position of end cover (7) on VKSD 119/62 the flat side is on outside; on VKSD 64/28 the stepped side is on the outside for the higher capacity settings and to the insider for the lower capacity settings.

5.5 Follow installation and adjustment instructions as under 2.1 and 2.2.

APPENDIX 1 TO PUBLICATION M1438

RECOMMENDED SPARES FOR VKSD SERIES

For each brake in use at remote sites or in marine installation, the following spares should be carried:-

ONE SET OF BRAKE PADS

These are to be stored in a dry place away from contact with oil or grease.

Please order correct grade of friction material.

Component		Part No.	Qty.
Pad – Select from :-	IFI 75103 (non asbestos)	7080153-Z	2
	Ferodo 3904F (non asbestos) STANDARD	70A0153-9	2
	Dynamex/Ferodo D2013 - High Temperature (non-asbestos)	70A0153-AR	2
	Sintered	70M0228-AS	2
One set of seals		6000543	2
2 Part cylinder seal		6000428	2
2 Part rod seal		6000427	2
Bearing ring (piston)	150 I/D	6000402	2
Bearing ring (rod)	70 I/D	6000403	2
Bearing ring	172 I/D	6000404	2
'O' ring 150 x 145 x 3		6000399	2
'O' ring 74 x 70 x 2.4		6000398	2
'O' ring 190 x 185 x 3		6000167	2
'O' ring 65 x 75 x 3		6000445	2
Back-up ring	70 I/D	6000490	2
Quad ring seal	171.05 I/D	6000450	2

APPENDIX 2 TO PUBLICATION M1438

OPERATIONAL SEQUENCE (REF; FIGS 1 TO 5).

Brake 'Parked Off' (Fig.1)

The brake is supplied in the 'Parked-Off' position, so that it can be mounted with disc springs fully relaxed and yet with brake pads 11.5 mm clear of disc.

Brake cannot come on accidentally and can be dismantled safely. Connect hydraulic feed and bleed brake in this position.

To Operate Brake

- Apply hydraulic pressure as for full retraction. This compresses disc springs. Thrust screw and pressure plate will separate at 'A' (Fig. 2).
- Check for oil leaks.
- Turn adjusting spindle clockwise:- up to 5 turns max. On the VKSD 119/62; up to 7½ turns on the VKSD 64/28, thus closing the gap at 'A' (Fig. 3). The number of turns depends on the number of shims fitted.

The brake is now operational with about 11.5 mm retraction.

To Set Correct Air Gap

- Maintaining full retraction pressure, continue turning spindle clockwise until brake pad is firmly up against disc (Fig. 4).
 - Slacken off brake by turning spindle anti-clockwise to obtain required air gap.
 - Thread pitch on thrust screw is 3 mm
- e.g. 1/6 turn for 0.5mm Air Gap
 1/3 turn for 1mm Air Gap
 1/2 turn for 1.5mm Air Gap
 1 turn for 3mm Air Gap etc.
 1/12 turn for 0.25mm Air Gap can be obtained by inverting locking plate.

Releasing hydraulic pressure will now apply the brake.

APPENDIX 2 CONT/D

Replacing Brake Pads

Return brake to 'Parked-Off' position as follows:

- Apply just sufficient hydraulic pressure to release brake
- Turn spindle fully anticlockwise.
- Release hydraulic pressure.

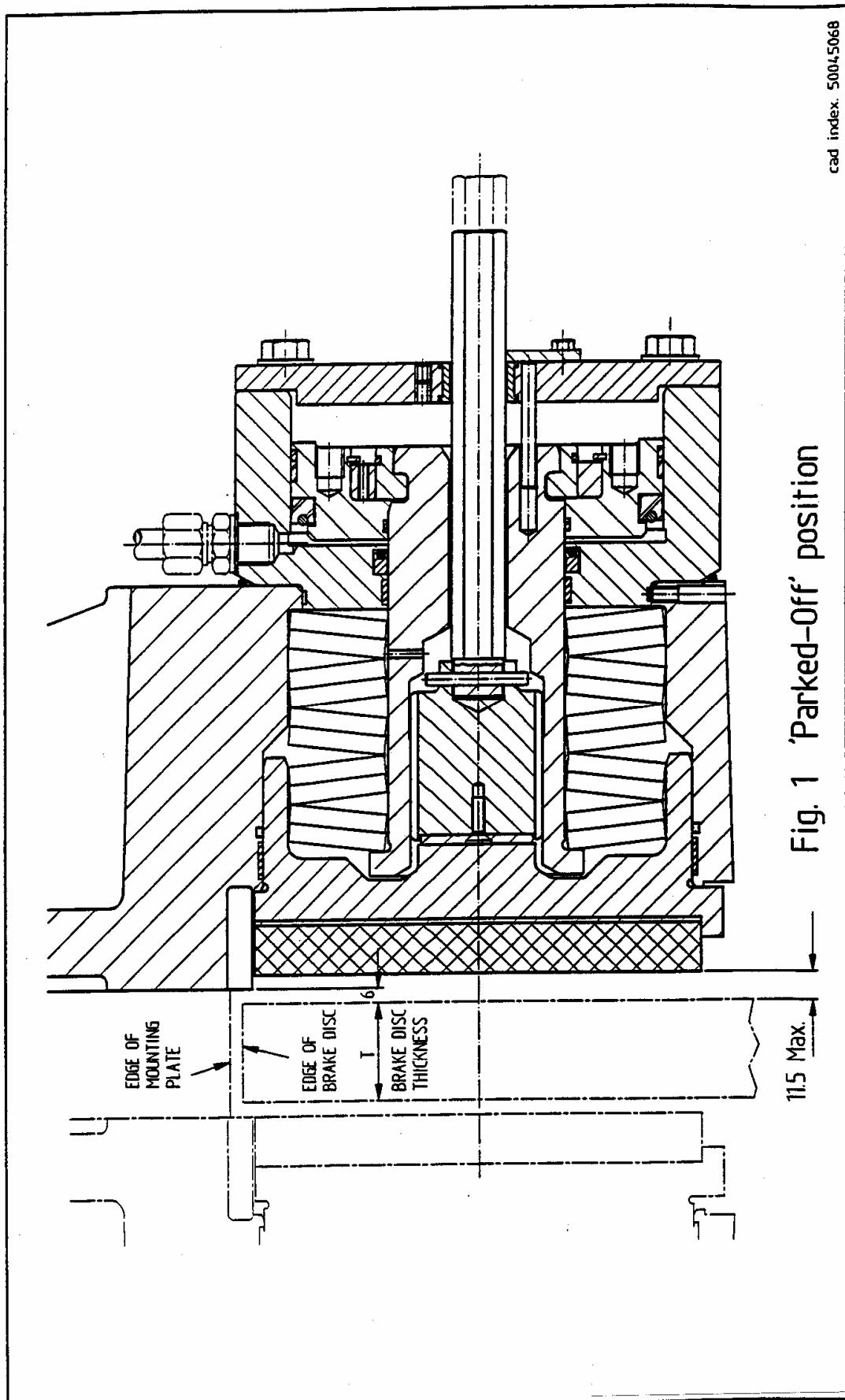
Sufficient space is now available to remove old pad and insert new pad.

Hydraulic Supply Failure

- Release brake by means of hand-pump connected direct to feed port.
- Turn spindle anti-clockwise to obtain 'Parked-Off' position.

Mechanical Retraction

- Fit retraction tool (Fig. 5).
- Release brake by turning nuts the same amount in turn.
- Turn spindle anti-clockwise to obtain 'Parked-off' position.



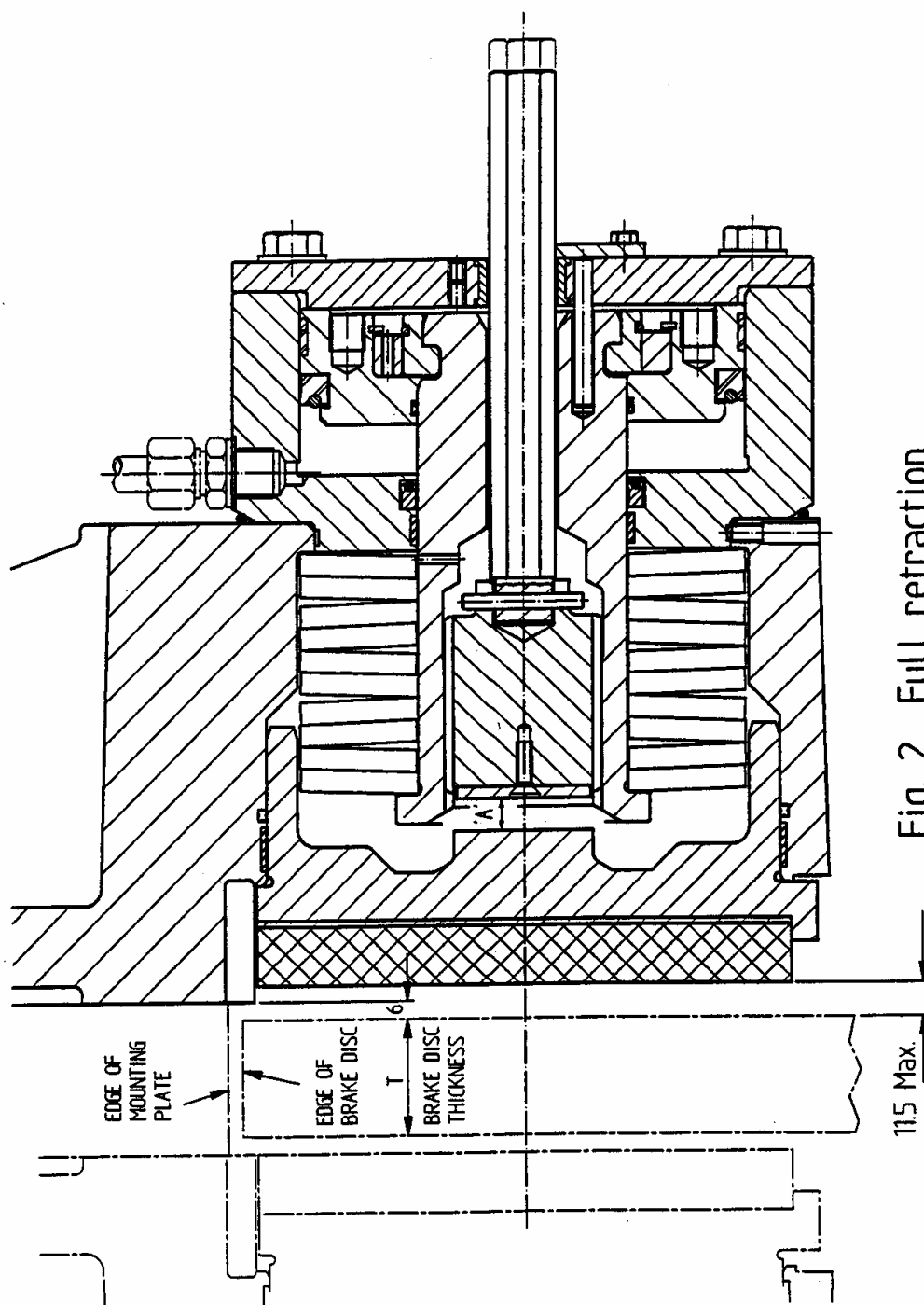


Fig. 2 Full retraction

cad index. 50045072

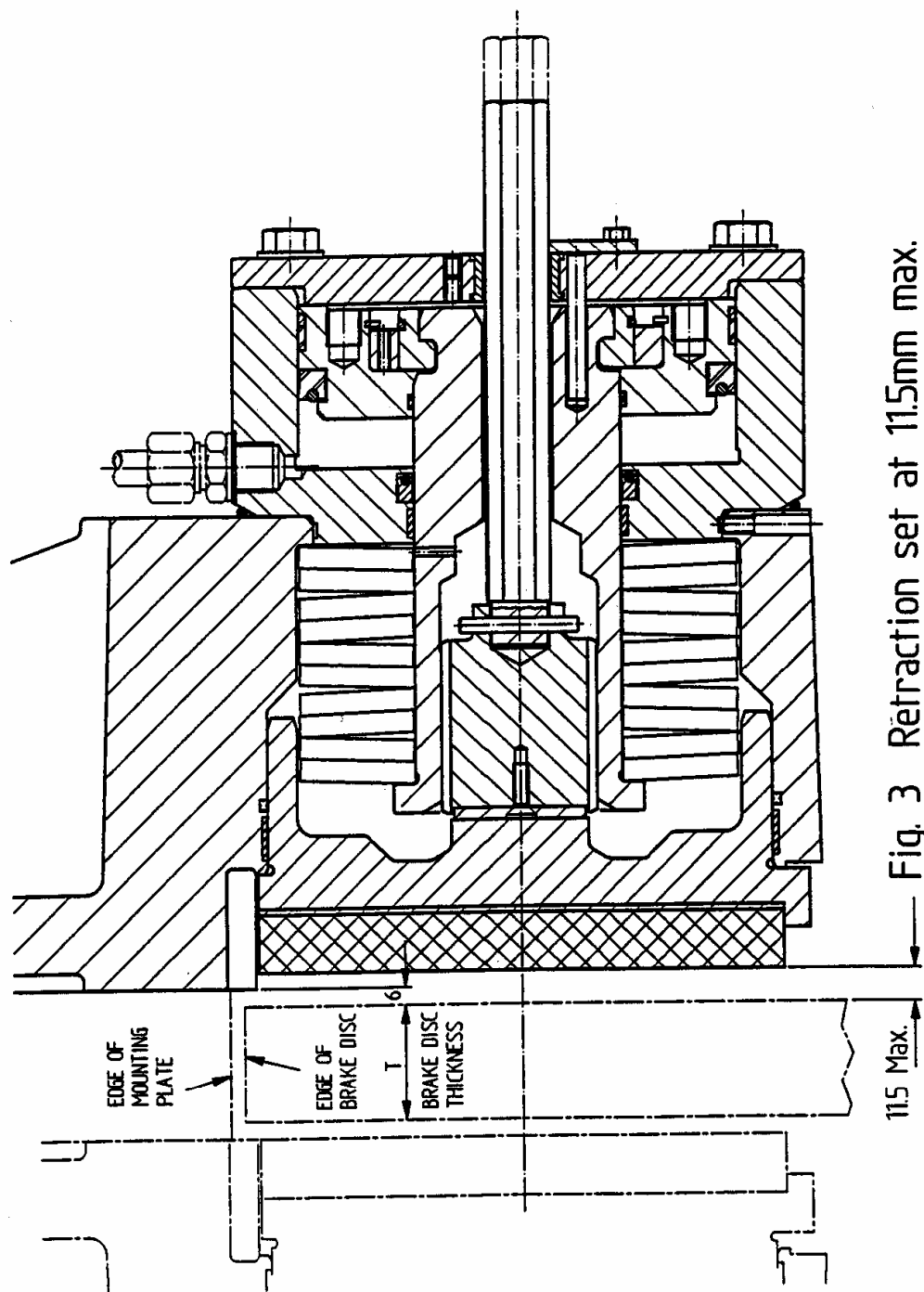
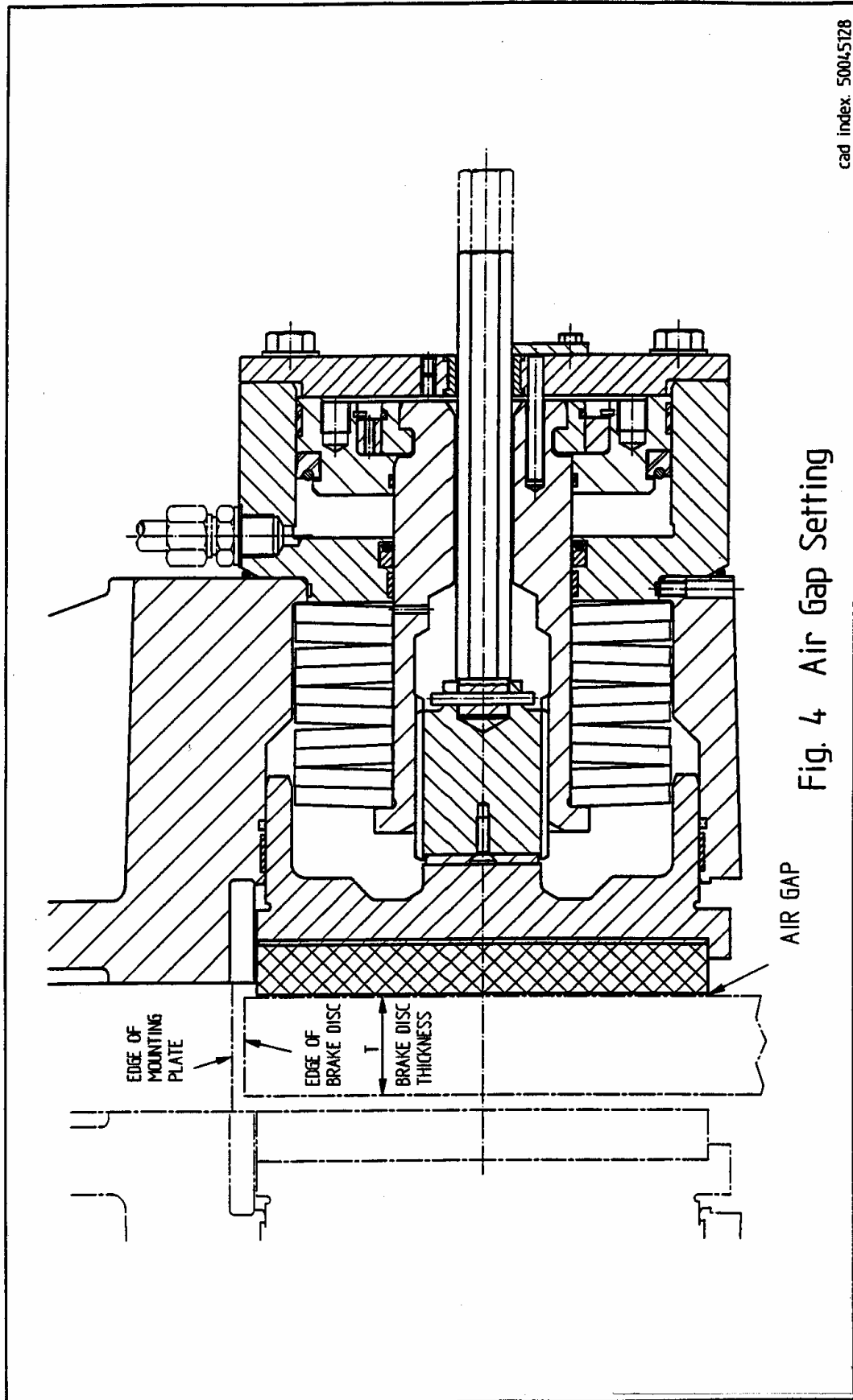
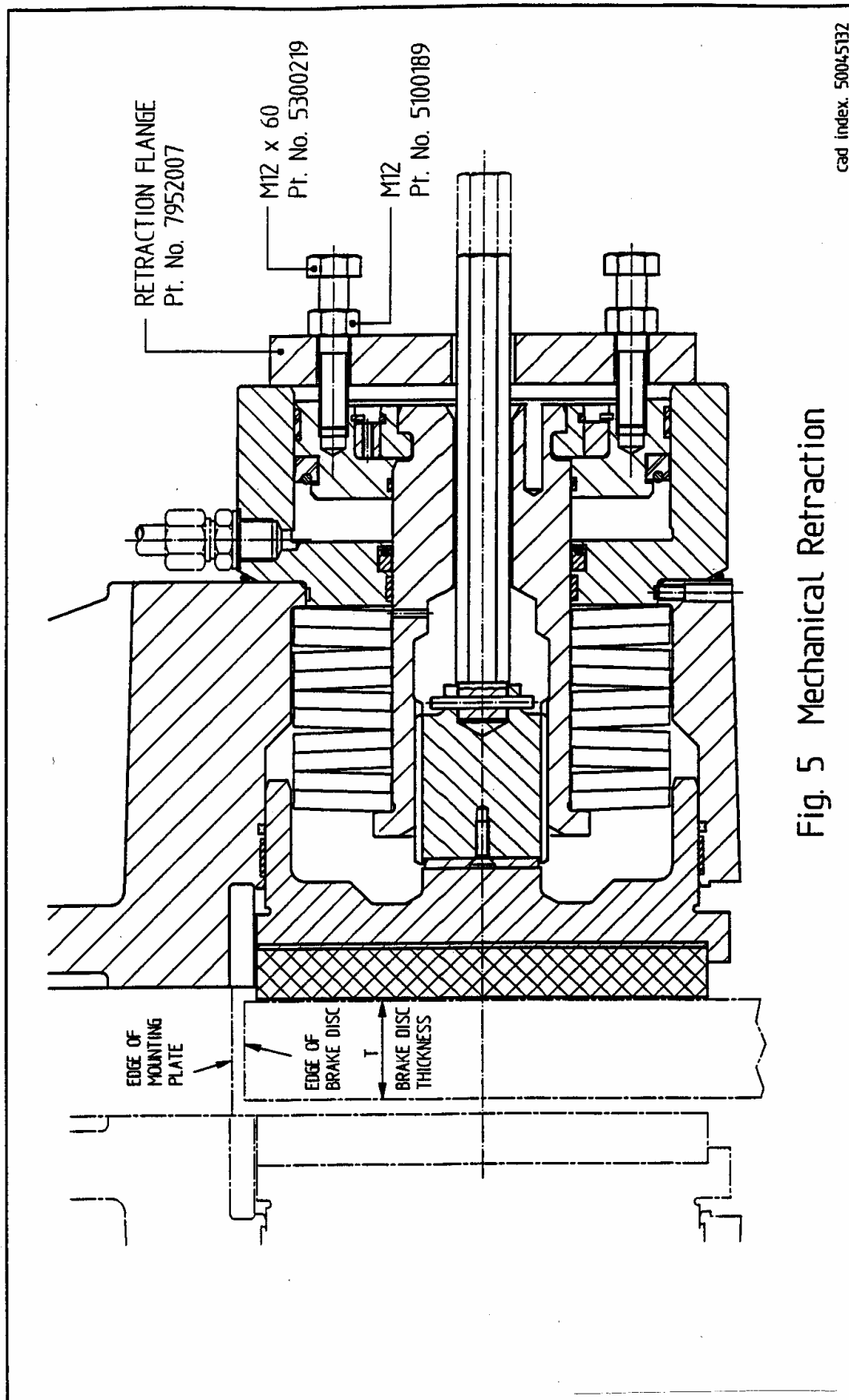


Fig. 3 Retraction set at 11.5mm max.

cad index. 50045076



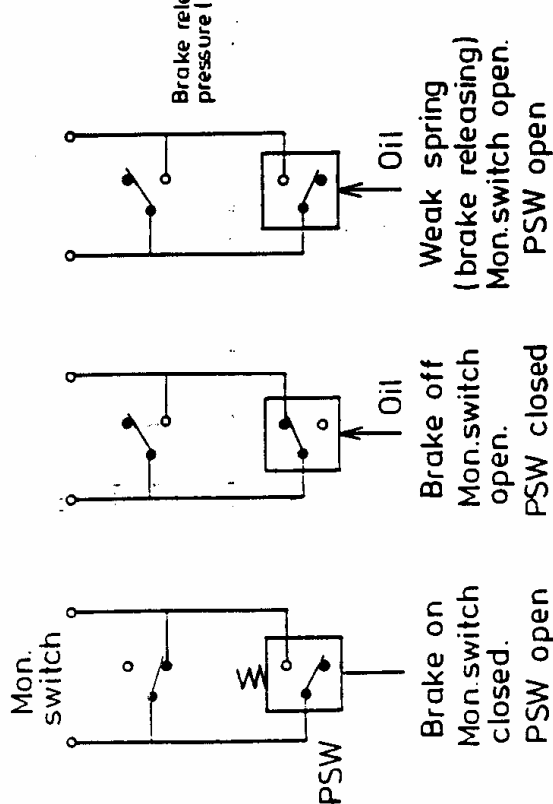


Cad Index: 50045132

Fig. 5 Mechanical Retraction

Suggested circuit for weakened spring detection using retraction monitoring switch in conjunction with a fluid pressure switch PSW

Circuit feeding N.O. relay.
Performing warning or interlock function



$$\text{PSW setting } P_s = \left[P_2 + \left\{ \frac{R - 0.5}{R} \times (P - P_2) \right\} \right] \times 0.9$$

where P_2 = Brake release pressure (rising) } from test
 P = Full retraction pressure } certificate
 R = Retraction setting

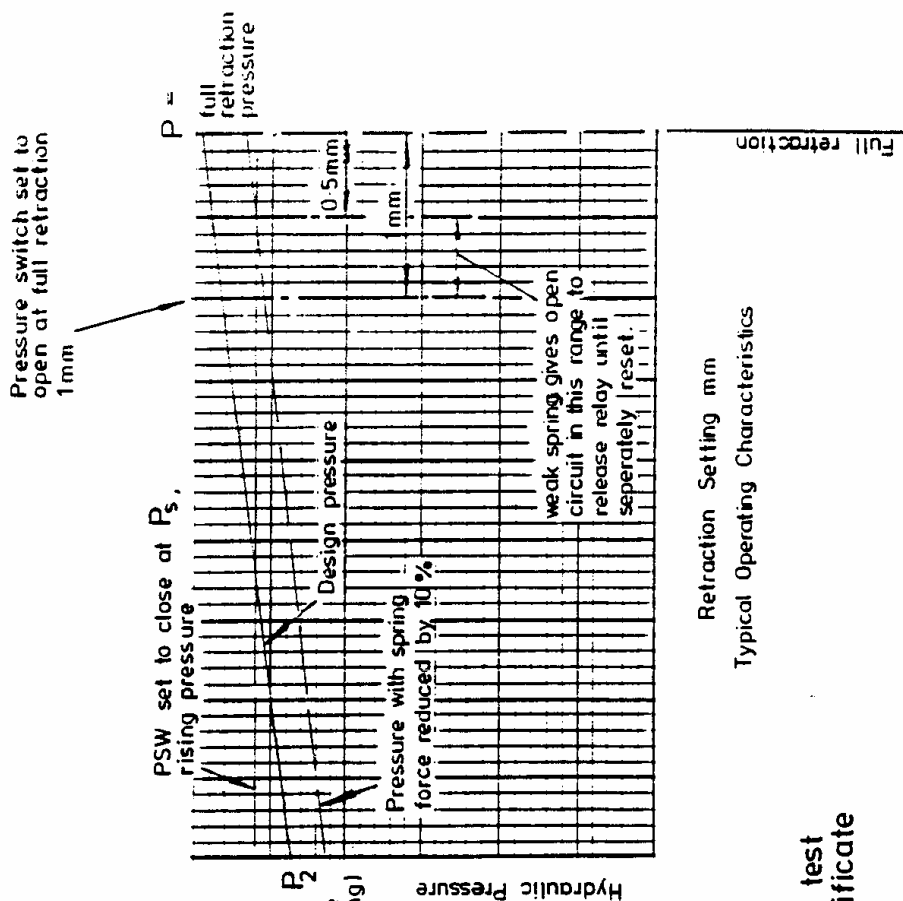
Example for VKS 137

$$P_2 = 92 \text{ bar, } P = 123 \text{ bar, } R = 4.5 \text{ (from test certificate)}$$

$$P_s = \left[92 + \left\{ \frac{4.5 - 0.5}{4.5} \times (123 - 92) \right\} \right] \times 0.9 = 107.6 \text{ bar}$$

G 1354

M1438



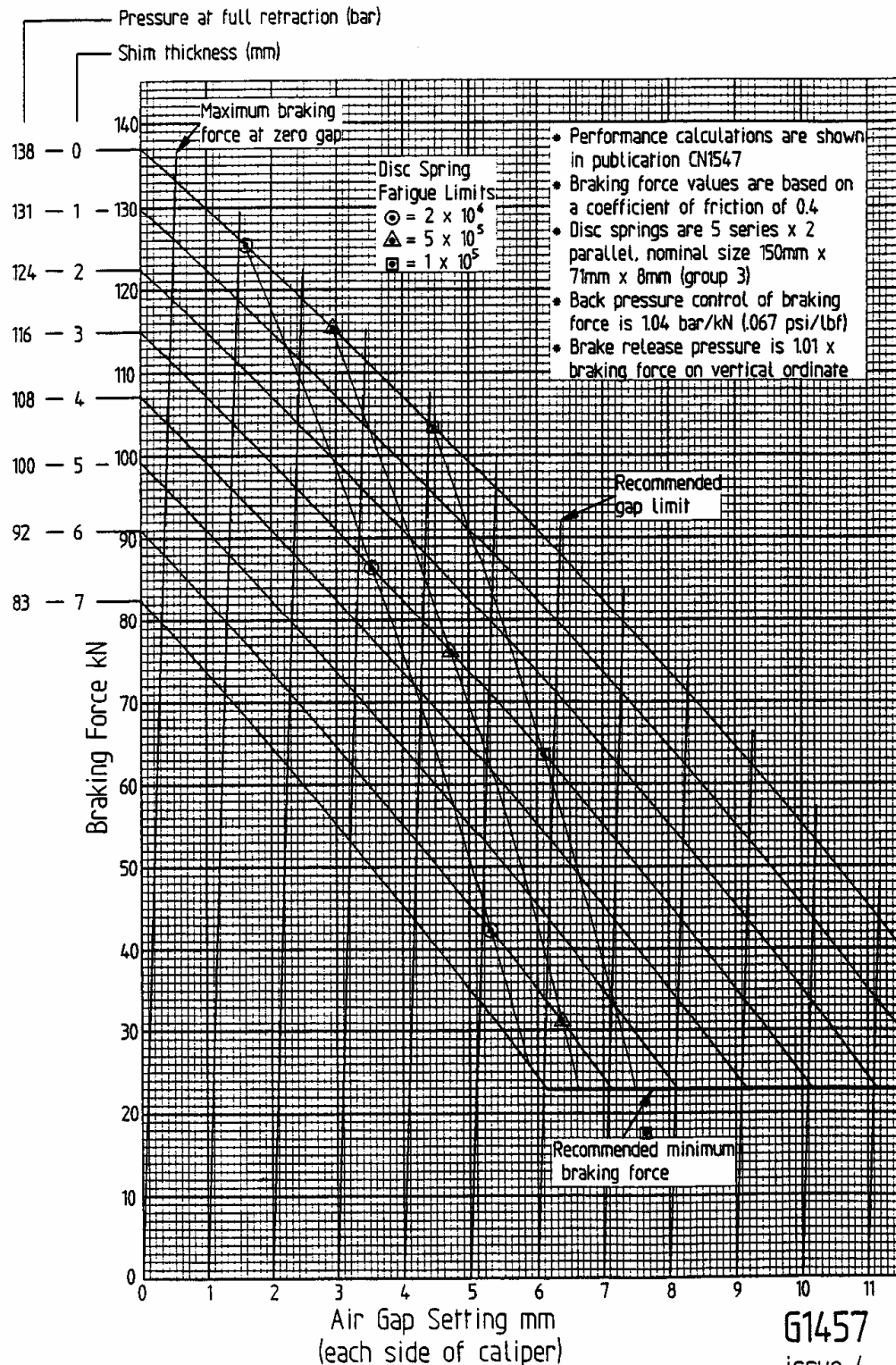
Example for VMS 535

$$P_2 = 149 \text{ bar, } P = 184 \text{ bar, } R = 3 \text{ (from test certificate)}$$

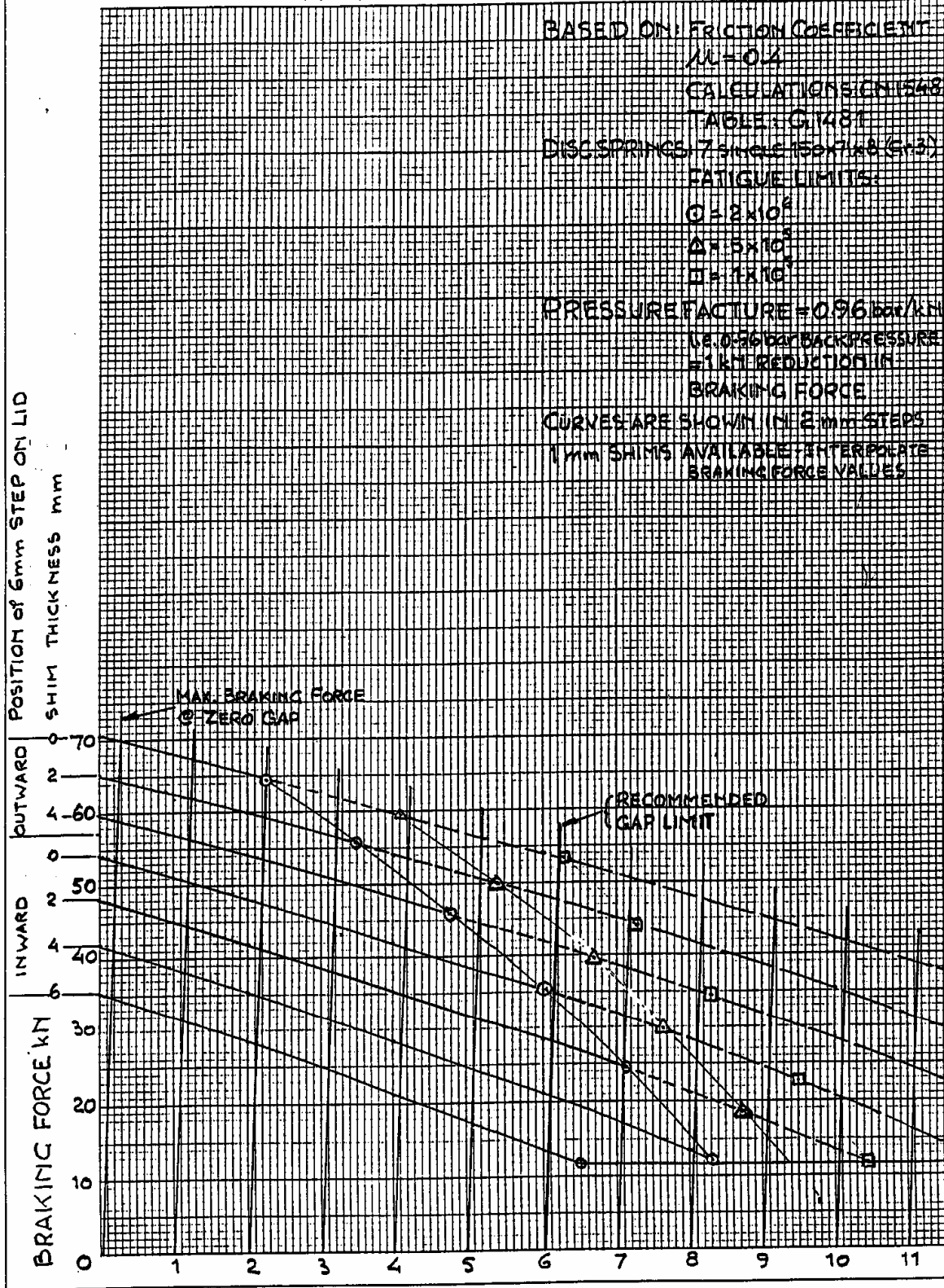
$$P_s = \left[149 + \left\{ \frac{3 - 0.5}{3} \times (184 - 149) \right\} \right] \times 0.9 = 160.4 \text{ bar}$$

G1354

Performance curves for VKSD 119/62



PERFORMANCE CURVES VKSD 64/28



AIRGAP SETTING mm (Per Side)

G1458

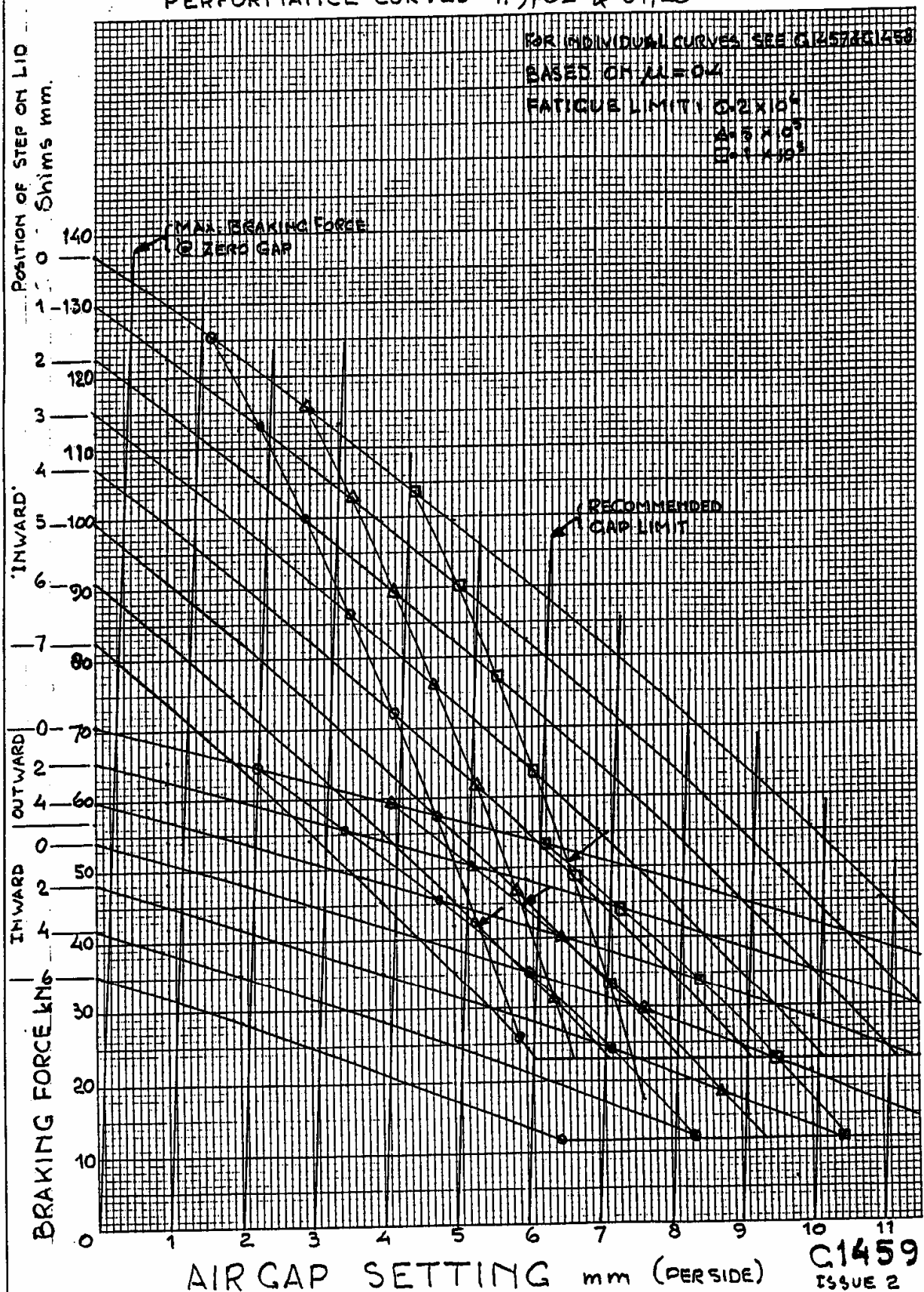
Issue 3

M1438

Page 30 of 31, Issue 02

April 2005

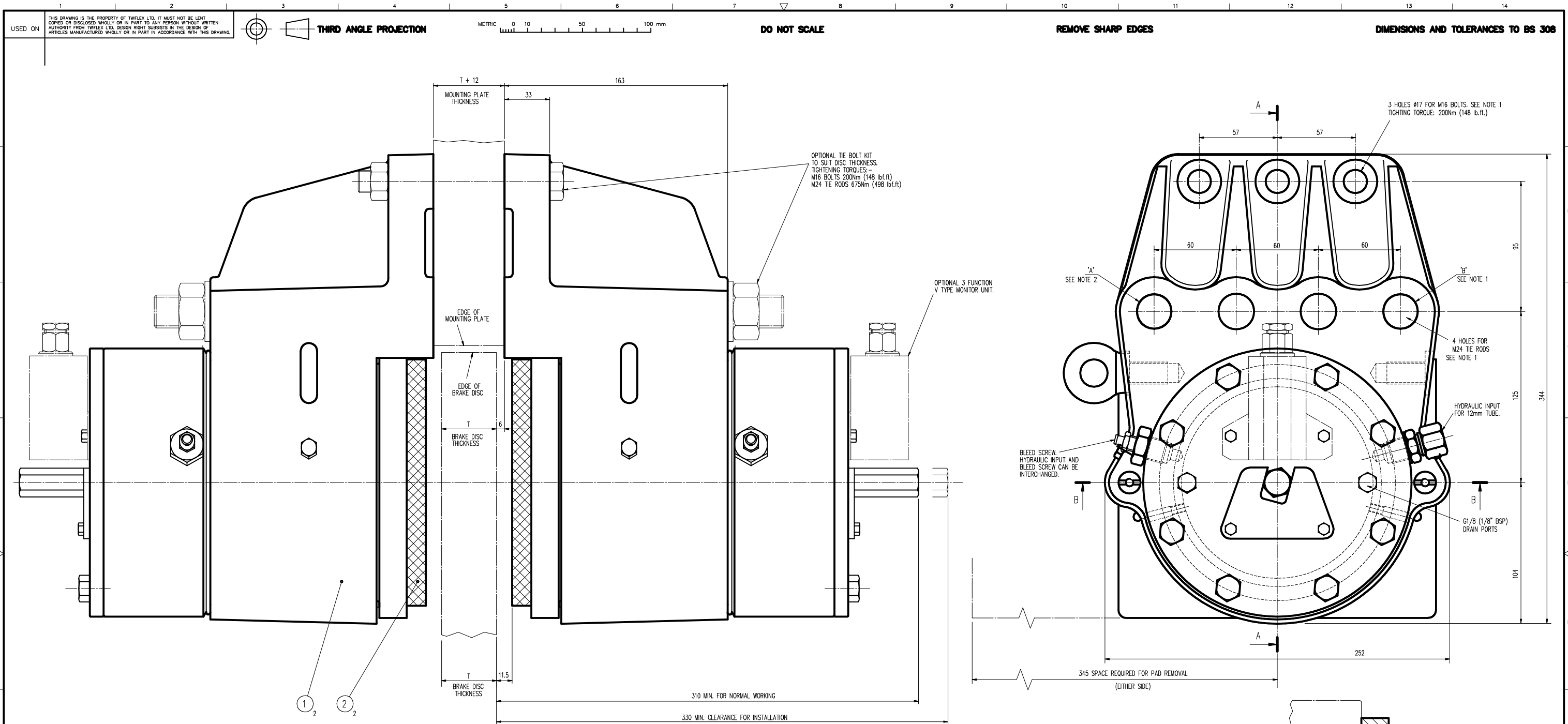
PERFORMANCE CURVES 119/62 & 64/28 COMBINED



C1459
ISSUE 2

HHR 20/11/89

M1438

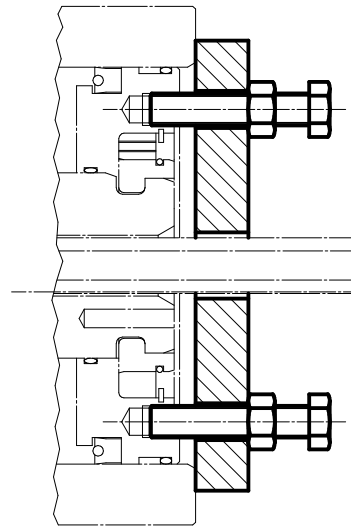


TOTAL OIL DISPLACEMENT = 28ml for 1mm RETRACTION (FOR BOTH PADS)

PERFORMANCE DATA													
TYPICAL VALUES OF BRAKING FORCES ARE GIVEN FOR 2mm AND 4mm GAP SETTINGS. THESE CAN ONLY BE ACHIEVED WITH FULLY BEDDED AND CONDITIONED BRAKE PADS OPERATING ON BRAKE DISCS OF CORRECT MATERIAL HARDNESS AND FINISH. FOR OTHER CONDITIONS APPLY SERVICE FACTORS. FOR BRAKING FORCE AT OTHER GAP SETTINGS SEE CURVE GRAPH. G1457													
END COVER POSITION	SHIMS	AIR GAP SETTING EACH SIDE		BRAKING FORCE		BRAKE RELEASE		FULL RETRACTION		MAX. PERMISSIBLE		FATIGUE LIFE OPERATING AT STATED GAP CYS.	
		mm	inch	kN	lbf	bar	p.s.i.	bar	p.s.i.	bar	p.s.i.		
AS SHOWN	0	2	0.079	119	26775	124	1798	138	2001	163	2364	> 5 x 10 ⁵	> 1 x 10 ⁵
	4	0.157	104	23383	108	1566	131	1900	156	2262	< 2 x 10 ⁶	> 5 x 10 ⁵	> 1 x 10 ⁵
AS SHOWN	1	2	0.079	112	25115	116	1682	131	1900	156	2262	< 2 x 10 ⁶	> 5 x 10 ⁵
	4	0.157	96.3	21652	100	1450	124	1798	149	2160	< 2 x 10 ⁶	> 5 x 10 ⁵	> 1 x 10 ⁵
AS SHOWN	2	2	0.079	104	23383	108	1566	124	1798	149	2160	< 2 x 10 ⁶	> 5 x 10 ⁵
	4	0.157	88.2	19831	92	1334	116	1682	141	2045	< 2 x 10 ⁶	> 5 x 10 ⁵	> 1 x 10 ⁵
AS SHOWN	3	2	0.079	96.3	21652	100	1450	108	1566	133	1928	< 2 x 10 ⁶	> 5 x 10 ⁵
	4	0.157	80	17987	83	1204	92	1334	108	1566	133	< 2 x 10 ⁶	> 5 x 10 ⁵
AS SHOWN	4	2	0.079	88.2	19831	92	1334	100	1450	125	1812	< 2 x 10 ⁶	> 5 x 10 ⁵
	4	0.157	71.2	16009	75	1088	83	1204	109	1566	133	< 2 x 10 ⁶	> 5 x 10 ⁵
AS SHOWN	5	2	0.079	80	17987	83	1204	100	1450	125	1812	< 2 x 10 ⁶	> 5 x 10 ⁵
	4	0.157	62.4	14030	65	947	75	1088	117	1696	133	< 2 x 10 ⁶	> 5 x 10 ⁵
AS SHOWN	6	2	0.079	71.2	16009	75	1088	92	1334	117	1696	< 2 x 10 ⁶	> 5 x 10 ⁵
	4	0.157	53.7	11961	56	817	65	947	109	1566	133	< 2 x 10 ⁶	> 5 x 10 ⁵
AS SHOWN	7	2	0.079	62.4	14030	65	947	83	1204	109	1566	< 2 x 10 ⁶	> 5 x 10 ⁵
	4	0.157	43.7	9826	46	667	56	817	109	1566	133	< 2 x 10 ⁶	> 5 x 10 ⁵

NOTES

- HOLES IN MOUNTING PLATE ARE Ø26 FOR M24 TIE RODS AND Ø17 FOR M16 BOLTS. CALIPERS SUBJECT TO REVERSING BRAKING LOADS OVER 70kN MUST BE PROVIDED WITH ONE M24 'FITTED' TIE ROD AT EITHER 'A' OR 'B' OF THE ROW OF FOUR TIE RODS. REQUIRING HOLE 'A' OR 'B' TO BE MACHINED TO Ø25.025/25.000
- MINIMUM BRAKE DISC DIAMETER - 1000mm
- FOR PART IDENTIFICATION SEE SCHEDULE Z157/16
- BLEED SCREW AND INPUT PORTS ARE PLUGGED FOR TRANSPORT PURPOSES. THESE ARE TO BE REMOVED AND BLEED SCREW AND COUPLING FITTED ON INSTALLATION.
- FOR INSTALLATION, OPERATION AND MAINTENANCE SEE MANUAL: M1438



MECHANICAL RETRACTION DETAIL
TOOL KIT PART No. 7903437
TO BE PURCHASED SEPARATELY
SCHEDULE: Z157/22

ISSUE No.	ALT. No.	DATE	DESCRIPTION	GRID REF.
02	13325	13/04/05	MECHANICAL RETRACTION TOOL KIT PART No. 7903437 & SCHEDULE: Z157/22 ADDED	
01		28/06/04		

TWIFLEX
THE GREEN TWICKENHAM
MIDDLESEX ENGLAND TW2 5AQ

DIMENSIONS IN mm.
OPEN TOLERANCES ± 0.25
ANGLES ± 0.5°
W/C AT ✓
SURFACE FINISH IN MICRONS
e.g. ✓ = 2 MICRONS
(0.002mm) CLA
(= 80 MICRO-INCHES CLA)

CERT'D
CHECKED
DRAWN
DATE
SCALE

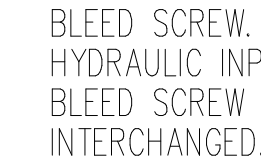
RE.G.
28/06/04
1 : 1


DESCRIPTION
**BRAKE CALPER ASSEMBLY
WSD119/62, BASE MODEL**

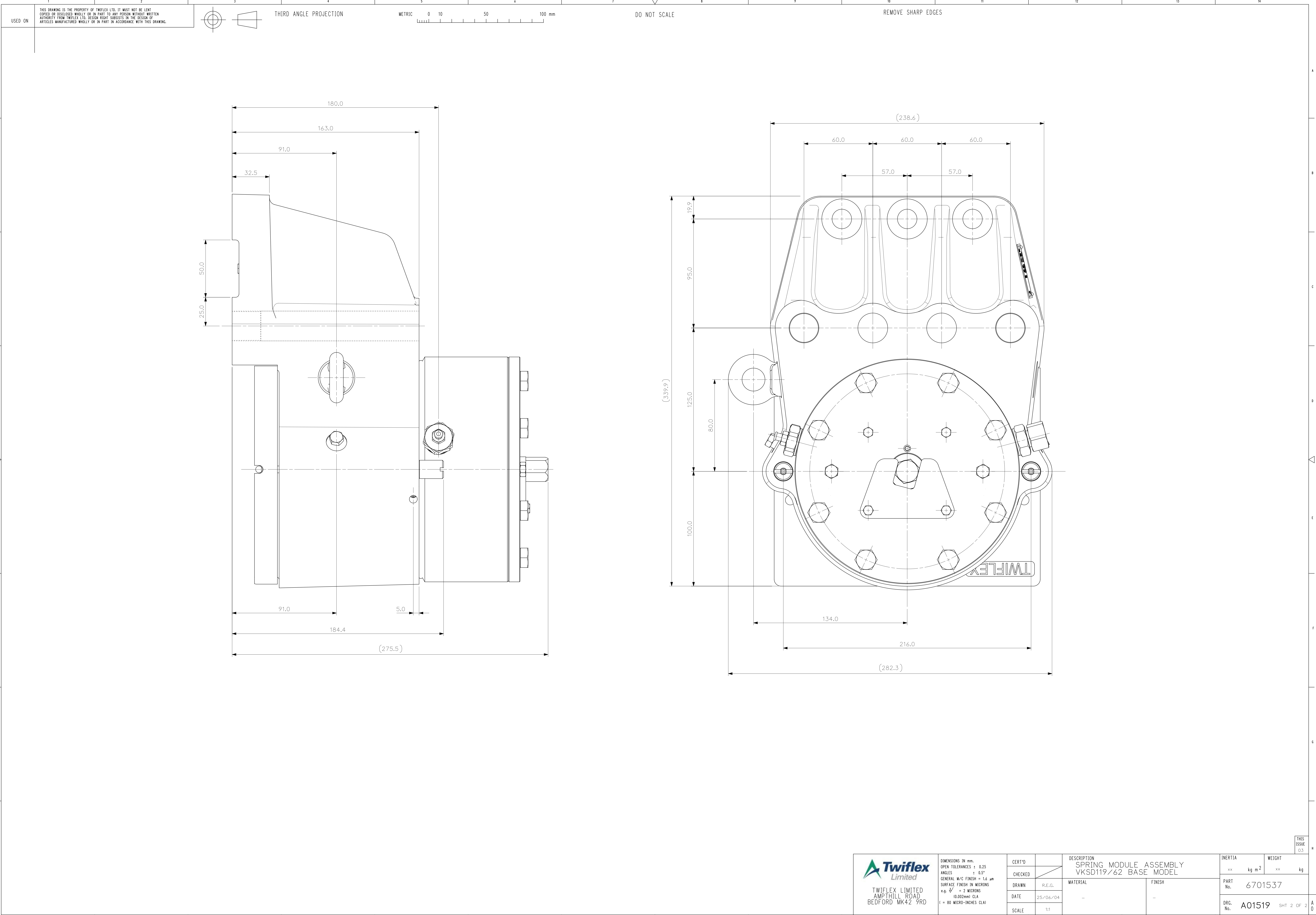
INERTIA
- kg m² [2 MODULES] 146 kg
PART No.
67A1541
DRG. No.
A01517

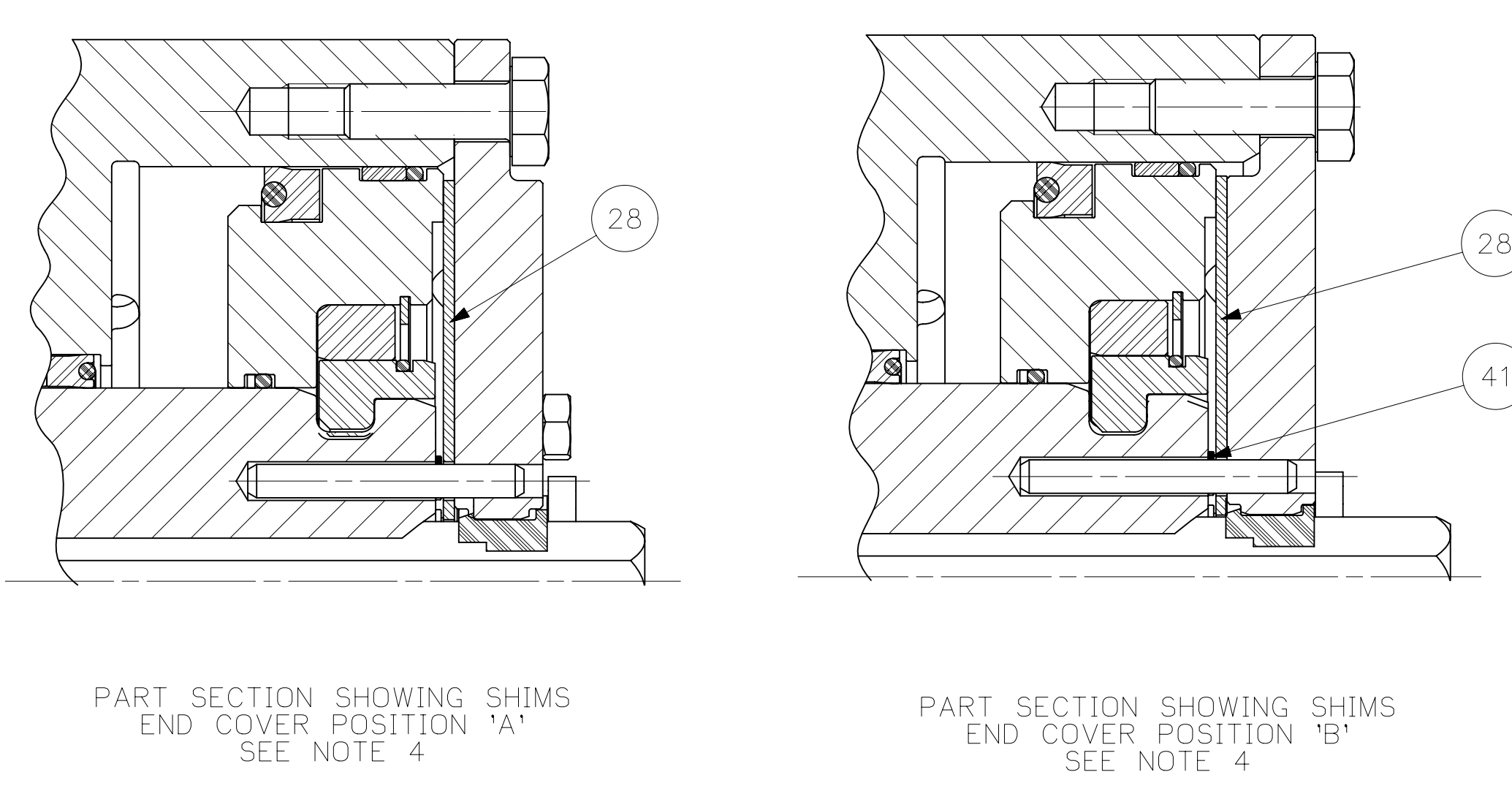
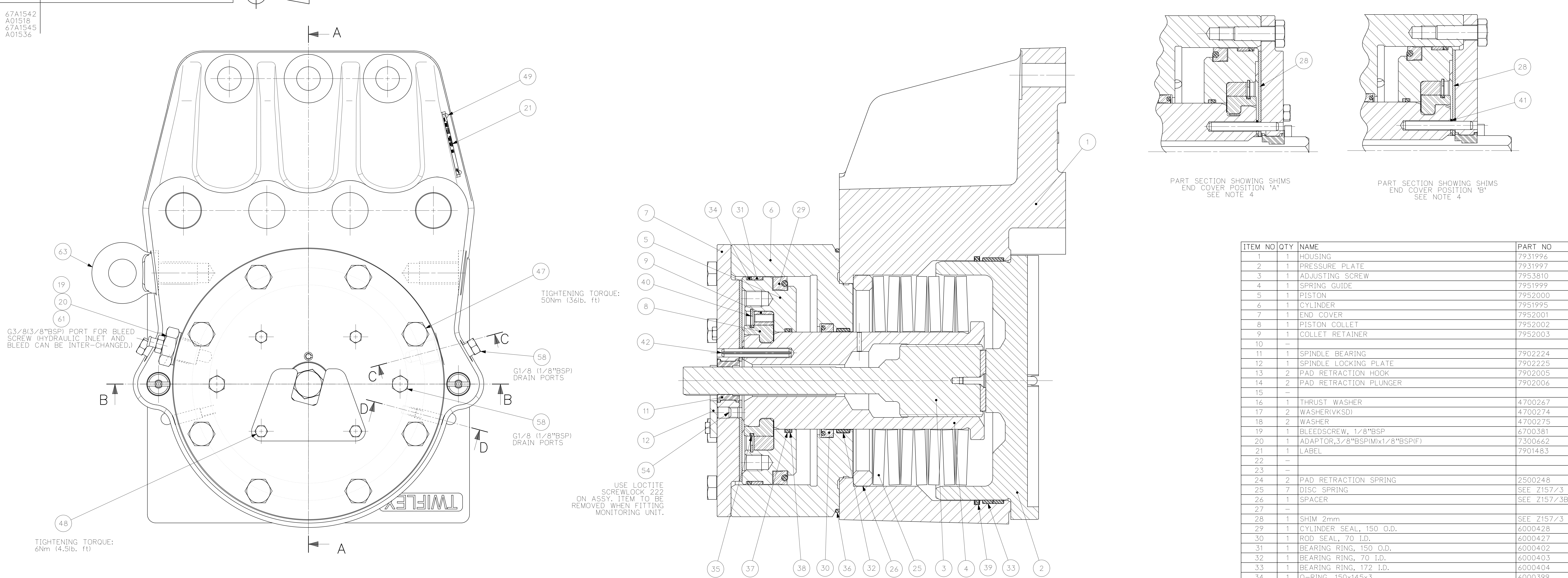
THIS
ISSUE
02

A
0

FORM No DO/36-3

Used on	Item Number	Component	Drawing Number	Part Number	Quantity	Remarks		
A01519 A01520	1	RETRACTOR FLANGE	A32661	7952007	1	STEEL PLATE BS4360 GRADE 43A		
	2	SCREW, HEX. HEAD, M12 x 60		5300219	6	GRADE 8.8, ZINC & YELLOW PASSIVATE		
	3	NUT, M12		5100189	6			
			Title				VKSD MECHANICAL RETRACTION TOOL KIT	
							Assembly Drawing No.	A35035
						Assembly Part No.	7903437	
Drawn	Date	12-4-05					Installation Drawing No.	
AD	Alt No.						Schedule No.	
Checked	Issue	01					Z157/22	
Any loose fittings to be placed in a plastic bag and tied to unit								
							Sheet 1 of 1	
							Form No. DO/52-3	





ITEM NO	QTY	NAME	PART NO
1	1	HOUSING	7931996
2	1	PRESSURE PLATE	7931997
3	1	ADJUSTING SCREW	7953810
4	1	SPRING GUIDE	7951999
5	1	PISTON	7952000
6	1	CYLINDER	7951995
7	1	END COVER	7952001
8	1	PISTON COLLET	7952002
9	1	COLLET RETAINER	7952003
10	-		
11	1	SPINDLE BEARING	7902224
12	1	SPINDLE LOCKING PLATE	7902225
13	2	PAD RETRACTION HOOK	7902005
14	2	PAD RETRACTION PLUNGER	7902006
15	-		
16	1	THRUST WASHER	4700267
17	2	WASHER(VKSD)	4700274
18	2	WASHER	4700275
19	1	BLEEDSCREW, 1/8"BSP	6700381
20	1	ADAPTOR,3/8"BSP(M)x1/8"BSP(F)	7300662
21	1	LABEL	7901483
22	-		
23	-		
24	2	PAD RETRACTION SPRING	2500248
25	7	DISC SPRING	SEE 2157/3
26	1	SPACER	SEE 2157/3B
27	-		
28	1	SHIM 2mm	SEE 2157/3
29	1	CYLINDER SEAL, 150 O.D.	6000428
30	1	ROD SEAL, 70 I.D.	6000427
31	1	BEARING RING, 150 O.D.	6000402
32	1	BEARING RING, 70 I.D.	6000403
33	1	BEARING RING, 172 I.D.	6000404
34	1	O-RING, 150x145x3	6000399
35	1	O-RING, 74x70x2.4	6000398
36	1	O-RING, 190x185x3	6000167
37	1	O-RING, 67x75x3	6000445
38	1	BACK UP RING, 75 I.D.	6000490
39	1	QUAD RING SEAL, 171.05 I.D.x3.53 SECTI	6000450
40	1	RETAINING RING, 100 I.D.	4300195
41	3	GRIP RING,6 DIA	4300193
42	3	PIN, TENSION, 6DIAx50	3800183
43	-		
44	-		
45	1	SCREW, SOCKET CSK, M5x16	5500070
46	-		
47	8	SCREW,HEX,HEAD,M10x30	5300192
48	4	SCREW, HEX. HEAD, M5x12	5300286
49	4	SCREW, HAMMER DRIVE No. 2	5600019
50	-		
51	-		
52	-		
53	2	SETSCREW, HEX. SOCKET, M6x8	5400469
54	1	SETSCREW, HEX. SOCKET, M8x10	5400472
55	2	SETSCREW, HEX. SOCKET, M6x12	5400470
56	-		
57	2	PLUG,3/8"BSP (TRANSPORT PURPOSES ONLY)	7300663
58	4	PLUG, 1/8" BSP	7300657
59	1	COUPLING, MALE STUD,3/8" BSPx12TUBE	7300664
60	-		
61	1	SEAL, BONDED, 3/8" BSP	7301025
62	2	SEAL BONDED, 3/8" BSP (TRANSPORT PURPOSES ONLY)	7300148
63	1	COLLAR EYEBOLT, M16	1402353

NOTES.

1. FOR PART IDENTIFICATION SEE SCHEDULE Z157/15 (SPRING MODULE BASIC PARTS, PART No.6701539)

2. (a) USE LITHIUM COMPLEX GREASE HTEP (INDUSTRIAL PRODUCTS LTD)

(b) GREASE INNER AND OUTER ABUTMENT FACES OF ALL DISC SPRINGS.

3. ITEM 47 AND 62 FITTED FOR TRANSPORT PURPOSES. THESE ARE TO BE REMOVED AND ITEMS 19, 20, 59 AND 61 FITTED ON INSTALLATION

4. SEE THE PERFORMANCE DATA CHART ON DRAWING No. A01518 SHOWING END COVER POSITIONS 'A' AN 'B' REQUIREMENTS.

