



**INSTALLATION, OPERATION
AND
MAINTENANCE INSTRUCTIONS
FOR
VCS Mk3 BRAKE SYSTEM – MINERAL OIL**

MI458

AMENDMENT AND REVISION RECORD – M1458

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1. SPECIFICATION

1.1 General Description

Drawing References:

A13210	G.A. of VCS Mk.3 Long (Text ref. 01)
A13211	Spring Module Assembly Long (Text ref. 02)
A13206	G.A. of VCS Mk.3 Standard (Text ref. 01)
A13207	Spring Module Assembly Standard (Text ref. 02)
A21390	Monitoring Unit - 3 Function

Numbers in the brackets after the text ref. above refer to item numbers on the drawings.

The VCS Mk 3 disc brake caliper is a spring applied, hydraulically retracted unit which may be used on any disc having a diameter of at least 0.5m and a thickness of 20mm or greater. There is no upper limit on diameter or thickness. Braking torque may be controlled at any value up to the maximum by the use of hydraulic back pressure during braking. The caliper consists of two halves which are mounted each side of a vertical mounting plate of a pedestal by means of 2-M24 tie bolts (01/9) and 2-M16 bolts (01/8). For horizontal mounting or other angles, special bleeding arrangements can be incorporated. For horizontal disc see section 2.1, last paragraph.

The braking force is applied by the disc spring packs (02/11) through pistons (02/3) and adjusting screws (02/5) to the pressure plates (02/2) and hence to the friction pads (01/2). The caliper is available with various ratings (see section 1.2.1) which are provided by changes to piston (02/3), spring pack (02/11) and spacers (02/10).

The pads are guided between the sides of a machined recess in the main- mounting casting (02/1), and to which the torque reaction forces are directly applied. Outward radial movement of the pads is prevented by keep plates (02/13). The housing also contains the hydraulic retraction piston (02/3). The spring cover (02/4) is bolted to the housing by means of four M12 bolts (02/29).

WARNING - Care should be exercised with the removal of these bolts, see item 3.8.1.

Two G1/4 tapped ports are provided in each housing for bleed screw and hydraulic feed connections. Two G1/8 tapped ports are provided in each housing and each spring cover as drain ports for piping away any hydraulic leakage away from the braking surfaces. The drain ports are supplied plugged for transit and storage.

In order to provide greater retraction (clearance between disc and pad) for special installations, the VCS-72, -60, -55, -50 AND -40 models are produced in a 'long' version. These have longer spring covers (02/4), spring packs (02/11), M12 bolts for covers, M8 cap screws for pressure plates, piston (02/3) and adjusting screw (02/5).

Brake adjustment is manual and is effected by loosening adjusting nut (02/7) and turning adjusting screw (02/5). The nominal retraction stroke for each model is given on the G.A. drawing. Maintenance of the correct stroke ensures that the braking force is effectively constant and minimises the stress range for the springs, leading to an extended fatigue life. It is therefore recommended to adjust the stroke of the caliper after 1mm of pad wear (per side), as this will keep the reduction in Braking Torque below 10%. Full Performance Curve data is given on graphs G1493 (VCS Long Series) and G1494 (VCS Short Series).

Failure of an individual spring is rare and would result in a proportional loss of braking torque in the affected caliper half only.

See M1589 for marine manual.

Optional monitoring units are available (see section 1.3).

1.2 Detail Specification

1.2.1 *Braking Force & Torque*

The braking force 'F' (kN) acting tangentially on the disc is given by:

$F = 2 \times \mu \times S$ where μ is the pad friction coefficient
 S is the spring pack thrust (kN)

The braking torque 'T' (kNm) is given by:

$T = F (R \cdot 0.054)$ where R is the outside radius of the disc (m).

For standard pad material when used under clean, dynamic conditions with disc of correct material and finish $\mu = 0.4$. Values of F for various spring packs rating are given on the G.A. drawing. For other conditions use service factor. Typically for 'holding only' applications $\mu \geq 0.2$.

Spring Packs

Typically the spring pack for the VCS 72L consists of 10 springs to DIN2093, (100 x 51 x 6) mounted in series (in pairs) as shown on drawing A13211, Sheet. 2. At the nominal 1.9mm stroke the pack produces a thrust of 77kN, see drawing A13210. The corresponding tangential braking force 'F' is 62kN. Minimum fatigue life (for 99% of springs) is 2×10^6 operations.

For other spring pack arrangements see Figures 1 to 8.

1.2.2 **Retraction Cylinders**

Diameter = 110mm
Piston sleeve diameter = 60mm
Effective Area = 6680mm sq.

Hydraulic pressure for brake release = see relevant drawing
Hydraulic pressure for full retraction = see relevant drawing

Hydraulic fluid: Mineral oil such as Shell 'Tellus' 37'

Fluid inlet connections: G 1/4 fittings are supplied to connect the cylinders by means of 8mm old. x 1mm steel tubing.

Bleeding: G1/8 bleed screw (02/15) fitted to each cylinder.

Fluid displacement: Total to give 1mm retraction of each piston = 13.4ml.

1.2.3 **Friction Pads**

Material: Asbestos free with bonded-in steel keep plates.

Initial thickness = 20mm

Fully worn thickness = 11mm minimum

Total pad area (two pads) = 200 cm sq. (31in sq.)

Wear Life: up to 8000MJ (3000hph) depending on duty

Replacement: see section 3.4

1.2.4 **Materials & Quality Assurance**

The housings (02/1), spring covers (02/4) are castings of S.G. iron to BS2789 grade 420-12. Piston (02/3) is in stainless steel grade 303. Calipers may be supplied with non-destructive test (N.D.T.) certificate for all critical components if required. The main hydraulic seals are polyurethane. O-rings are nitrile rubber.

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

1.3 Monitoring Units

A number of monitoring units are optionally available and are supplied factory set and no further adjustment is necessary. The most comprehensive - 3 Function - unit has three micro switches operating on the moving parts and can be used to indicate:

1.3.1 *Full retraction*

This shows that the hydraulic system provides sufficient pressure for full retraction of the brake. The signal can also be used as a 'brake-off' warning.

1.3.2 *Pad Wear Adjustment Required*

This indicates that the forward movement of the piston has increased by more than 1mm. The retraction should now be adjusted to its original setting (see Drawing) in order to avoid undue loss of braking performance.

1.3.3 *Pad fully worn*

This indicates that the pad has worn to its recommended limit and should be replaced at the first opportunity.

NOTE: If the pad is allowed to wear too thin, it may escape from its retention location, with total loss of braking. Damage to the disc may also result.

2. INSTALLATION AND ADJUSTMENT

2.1 Installation

Refer to Drawings A13207, A13206, A13210 and A13211.

Each caliper half is secured by two M24 bolts and two M16 bolts (supplied by Twiflex) which are tightened to a minimum torque 575Nm (426 lbf.ft) and 160Nm (118 lbf.ft) respectively. The brake pedestal should be positioned with respect to the disc as shown on the drawings A13206 and A13210, with the mounting surfaces lined up with the disc rubbing surface by means of a straight edge.

A suitable method for checking the security of the mounting bolts visually is to mark them with white paint.

Calipers are supplied with washers (02/6) fitted under each adjusting nut (02/7), these are used to hold the spring packs in compression to facilitate installation. When the caliper halves have been bolted in position remove the two lower drain plugs from each half; the hydraulic supply should then be connected and all air bled from the system using the bleed screw (02/15).

For calipers on a horizontal disc, first ensure that the piston is at the bottom of the cylinder. This can be done by applying sufficient pressure to retract the brake; then remove brake pad, nut (02/7) and washer (02/6). Now gradually reduce pressure until the piston bottoms.

2.2 Initial Adjustments

- a) With the bleed screws closed the cylinders may be pressurised up to a maximum permissible hydraulic pressure as shown on drawings A13206 and A13210 and the washers (02/6) removed by slackening the nuts (02/7). In the fully pressurised condition the end of the hydraulic piston (02/3) should be level with the outer face of the spring cover (02/4).
- b) The retraction stroke should be set as follows:

Whilst maintaining the retraction pressure, and using a large screwdriver turn one of the adjusting screws (02/5) clockwise until the pad is in firm contact with the disc. Measure the distance from the end of the adjusting screw to the face of the spring cover. Back off (turning anti-clockwise) the adjusting screw until this dimension is increased by the retraction dimension as given for the particular brake model on the G.A. or the performance curve. A simple way to execute this measuring procedure is to use a clock gauge with magnetic base clamped to the spring cover face. With the pad on the disc, zero the gauge on the adjusting screw. Then adjust the screw until the gauge reads the desired retraction. Release hydraulic pressure and tighten lock nuts (02/7), taking care not to disturb the position of the adjusting screw.

Repeat the setting procedure on the other side of the caliper. Operate caliper and check that the retraction strokes are correct. Adjust if required.

Please note that approximate adjustments can be made taking account of the fact that the adjusting screw thread has a pitch of 3.5mm. The amounts of turn to give adjustments required are shown in the following table:-

TURN ANGLE									
1/12	1/8	1/6	1/4	1/3	1/2	2/3	3/4	5/6	1
30 ⁰	45 ⁰	60 ⁰	90 ⁰	120 ⁰	180 ⁰	240 ⁰	270 ⁰	300 ⁰	360 ⁰
ADJUSTMENT IN mm									
0.29	0.44	0.58	0.88	1.16	1.75	2.33	2.63	2.92	3.5

- c) The drain connections (two each side of the caliper) must 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 week of full 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 pipe connections or at the bleed screws, tighten as appropriate, carefully wipe away any spilled fluid and check for further leaks with brakes off.

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 (02/19) and (02/20) 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 of 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.

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
i)	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 is most conveniently done on site by replacing the complete half as in section 3.7. However if servicing on site is essential, proceed as per section 3.8.5.
- (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, when the brake is on, protrusion of adjusting screw from spring cover. A dimension of 11mm indicates that pad needs to be replaced. New thickness is 20mm replacement thickness is 11mm.
- (vi) Retraction stroke (i.e. movement of adjusting screw or hydraulic piston) is as shown on the G.A. Drawing, but is affected by disc axial float and run-out, and will vary by that amount. Apparent stroke measured at the pad will be less, due to deflections of the caliper and clearances in pressure plate retention mechanism. Stroke should therefore be measured relative to the caliper, and movement of the adjusting screw is the most convenient measurement.

When monitoring units on the spring covers are fitted, remove dust cover and measure stroke of adjusting screw (see G.A. drawing). Where no monitoring units are fitted, measure stroke of adjusting screw (see G.A. drawing). When pad wear is very slow (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

- a) Slacken the lock-nut (02/7). This is most easily done with the brake on.
- b) Determine adjustment required to bring piston stroke to value shown on G.A. (see section 3.2 (vi)) or the performance curves.
- c) Set retraction stroke as described under 2.2.b by turning the adjusting screw the required amount, using the table under section 2.2.b as a guide.
- d) Tighten lock nut (02/7).
- e) Repeat for opposite pad; pads should always be adjusted in pairs.

3.4 Friction Pad Replacement

Before removing brake pads, secure the disc against rotation. Remove the monitoring unit. Retract brakes fully hydraulically, and as a **SAFETY** measure, fit washers, as shown in section 3.5.

Remove the pad keep plate (02/13) and withdraw each pad by sliding through the rear of the caliper. 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. Measure the thickness of the pad at the four corners. If the pad thickness has more than 1.5mm (0.06in) taper, it should be replaced, even if not fully worn. Minimum pad thickness is 11mm. Replacement of the pad is carried out by reversing the removal procedure, but first clean the caliper sliding surfaces and check that the clearance between the pad and these surfaces allows the pad to slide freely. Always replace pads in pairs.

When replacing worn pads by new ones, the pressure plate (02/2) must be retracted by turning the adjusting screw (02/5) fully **anti- clockwise**. After fitting the pads the piston stroke must be reset as in section 2.2 (Initial Adjustment) paragraphs (b) and (d)

3.5 Use of Washers

If it is required to maintain a brake in the 'off' condition for a period of time, without using the hydraulic system, the washers should be used as follows:-

- a) Remove monitoring units, if fitted.
- b) Loosen lock nut (02/7).
- c) Retract brake hydraulically, and slacken off and remove locknut (02/7) so that the washer can be placed under lock nut.
- d) Re-tighten lock nut, finger-tight only.
- e) Release hydraulic pressure.
- f) To remove the washer, the procedure is reversed.
- g) Always check and reset retraction after removing washer or otherwise disturbing the setting.

3.6 Loss of Braking Force

Possible causes are: -

- a) Contaminants on surface of disc or pads, especially lubricant.
- b) Increased 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***

Any significant reduction in the force developed by a spring pack can be detected by the addition of a pressure switch to the hydraulic fluid supply, as shown in data sheet G1354 (see Appendix 2). If the above system is not used, spring force can be checked by the use of a calibrated oil pressure gauge suitable for the maximum back pressure employed. Pressures required for full retraction are given on drawings A13210 and A13206. Consideration should be given to changing the springs (as described in 3.8.5) if there is an appreciable reduction in the retraction pressure.

In this event it may be the easiest procedure to remove the caliper half as in 3.7 below, and return it to Twiflex for service or replacement. The on-site replacement of the springs is however described in section 3.8.

3.7 Removal and Replacement of Caliper Half

- a) Balance load and secure the installation from rotation.
- b) Remove monitoring units.
- c) Retract the brakes hydraulically and remove pads as in (3.4); the hydraulic pressure may then be released.
- d) If the brake pads are re-useable, 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 two M24 (01/9) and two M16 (01/12) mounting bolts.
- h) Carefully remove the caliper half from the brake pedestal.
- i) Replacement of the caliper half is the reverse of removal. It is **essential** to preload the M24 bolts to approximately 120kN (26,980lbf) by torquing to 575Nm (424lbf.ft). The M16 bolts should be preloaded to 50kN (11240 lbf) by torquing to 160Nm (118 lbf.ft).

3.8 Caliper Half Servicing

(see also 3.8.5 for in-situ servicing)

3.8.1 *Dismantling*

- a) Proceed as in 3.7 (a) to (h) and transfer caliper half to workshop.
- b) Remove Lock nut (02/7).
- c) Carefully slacken off bolts (02/29) by a small amount each in turn for the following reason:

The springs inside the spring cover exert considerable force on these bolts, and uneven loosening would tilt the cover and damage the sliding surfaces on piston and cylinder bore, and seals.
- d) Continue unscrewing the bolts until the spring pack has completely expanded. The bolts and cover can now be removed.
- e) The springs may now be removed for inspection - but keep them in their order as assembled if possible.

3.8.2 ***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 NDT method should be adopted which does not give rise to any such danger. Twiflex recommends magnetic particle inspection. Inspect other parts as may be required.

3.8.3 ***Replacement of Seals & Inspection of Working Surfaces***

- a) To enable seals and working surfaces to be inspected, remove the piston after removing cap screw (02/27).
- b) Replace or resurface if there is any significant damage.
- c) Replace seals and 'O'-rings (02/19-23 inclusive).

3.8.4 ***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 springs in the **reverse order**, to that in which they were originally assembled. Always ensure that the springs are arranged so that the spring bearing on the spring spacer does so with its smallest diameter.
- iii) Tighten the M12 bolts in the cover a little at a time in rotation. Finally preload these bolts to 46kN (10340lbf) by torquing to 110Nm (81 lbf.ft) for cap screws and 27kN (6503 lbf) by torquing to 65Nm (48 lbf.ft) for Hex. Hd. Bolts.
- iv) It is essential when re-installing the caliper halves to preload the M24 bolts to approximately 120kN (26980 lbf) by torquing to 575Nm (424 lbf.ft) and the M16 bolts to 50kN (11240 lbf) by torquing to 160Nm (118 lbf.ft).
- v) Refit brake pads and adjust for correct retraction (see 2.2.b).
- vi) Mark position of M16 and M24 bolts or nuts with white paint.
- vii) Cap screw (02/27). Note as 3.8.5.g.

3.8.5 ***'In-Situ' Method of Dismantling Caliper***

This method is only recommended for fault-finding inspection of springs or seals.

- a) Balance load and secure the installation from rotation.
- b) Remove monitoring units.
- c) Release brakes.
- d) Continue with steps as from item b) of section 3.8.1 and section 3.8.3 where required.
- e) Re-assemble following 3.8.4
- f) Adjust for correct retraction (see 2.2.b)
- g) Apply Loctite 270 to cap screw (02/27) and tighten until adjusting screw (02/5) is just free to rotate. Avoid Loctite contaminating the large thread on the adjusting screw.

3.8.6 ***Testing***

Carry out functional testing and operational testing as may be required.

Check settings of monitoring units after refitting to caliper. Adjust if necessary.

3.9 **Releasing Brake after Hydraulic Failure**

3.9.1 ***By Means of Hand Pump***

Provided the failure is in the supply of the hydraulic fluid only, the brakes can be retracted as follows:-

- (a) Connect hand pump direct to the feed port(s) of the caliper.
- (b) Apply pressure, retract brake and remove brake pad as under sections 3.4 and 3.5.

3.9.2 ***By means of large washer (02/6)***

- (a) Remove monitoring units.
- (b) Remove locknut (02/7).

- (c) Place washer (02/6) in position on adjusting screw (02/5) and replace locknut.
- (d) Turn locknut clockwise to release brake.
- (e) Remove brake pad (section 3.4)
- (f) Turn locknut (02/7) **anti-clockwise** to relax disc springs.
- (g) Dismantle and carry out repairs as under section 3.8.

NOTE: On the higher capacity brakes, the torque required to turn the nut (02/7) may be as high as 430Nm (320lbf.ft). Hence if this is found to be too difficult use the method as under 3.9.3.

3.9.3 ***By releasing M12 - Spring Cover Bolts***

- (a) Slacken off the M12 bolts evenly as described in section 3.8.1. b, c and d.
- (b) Remove brake pads.
- (c) Carry out the necessary repairs as under 3.8.

3.10 **RECOMMENDED SPARES FOR VCS-Mk 3 RANGE**

For each brake in use at remote sites or in marine installations, 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 the correct grade of friction material.

Component	Part No.	Quantity	
Pad Assembly	7080105-X - Standard	2	
	or 70A0105-9 - High Friction	2	
<i>One Set of Seals</i>			
2-part rod seal	6000501	2	
2-part piston seal	6000502		2
'O'Ring 40x34x3	6000504	2	
'O'Ring 54x50x2.4	6000275	2	
'O'Ring 65x60x3	6000279	2	

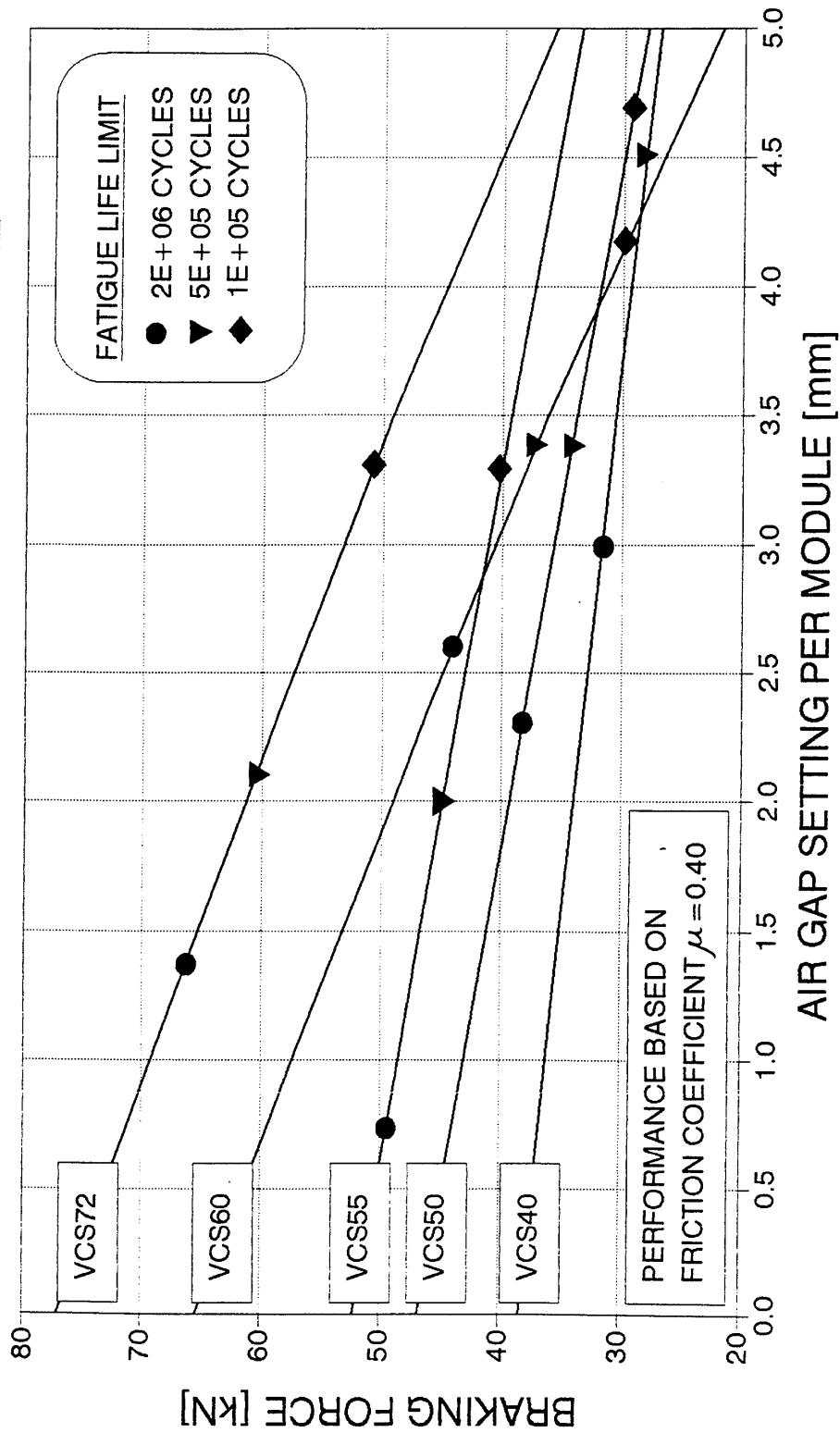
GRAPH
G1493

PERFORMANCE CURVES

VCS-LONG SERIES

MK III

9 NOV 1992



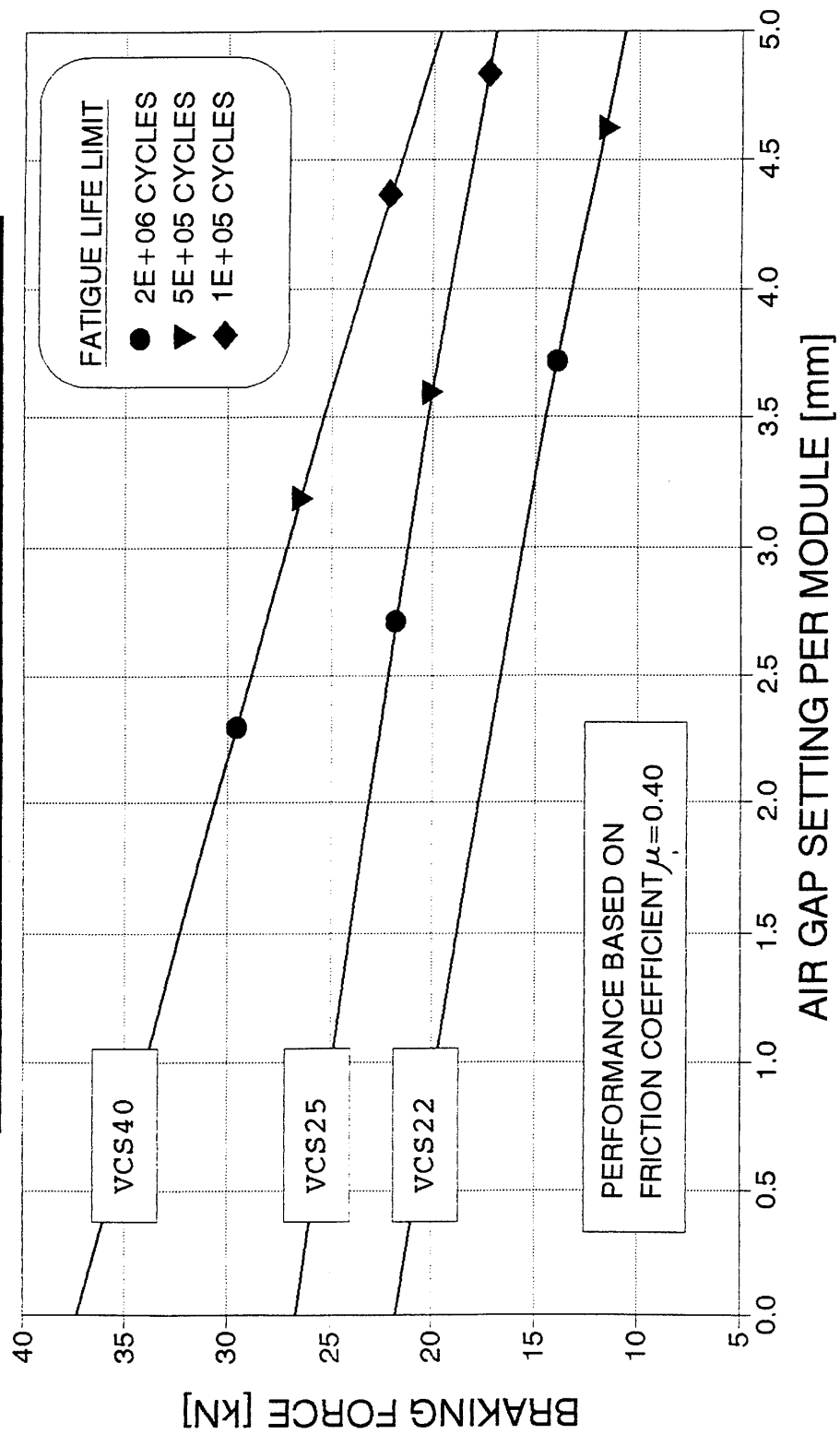
GRAPH
G1494

PERFORMANCE CURVES

VCS-SHORT SERIES

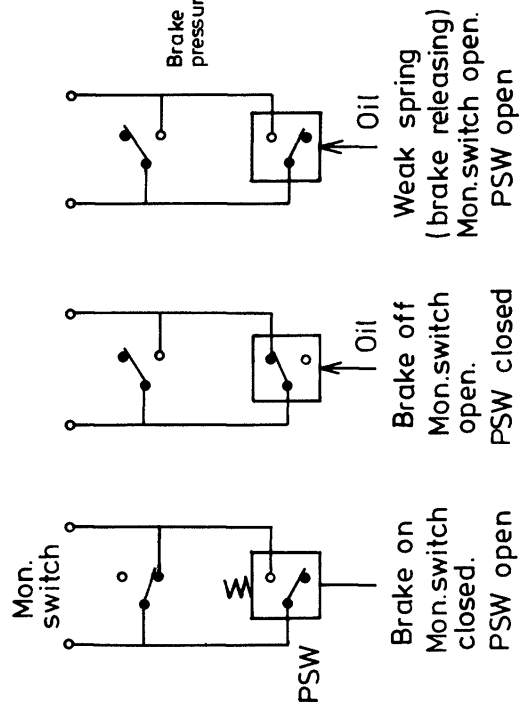
Mk III

9 NOV 1992



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



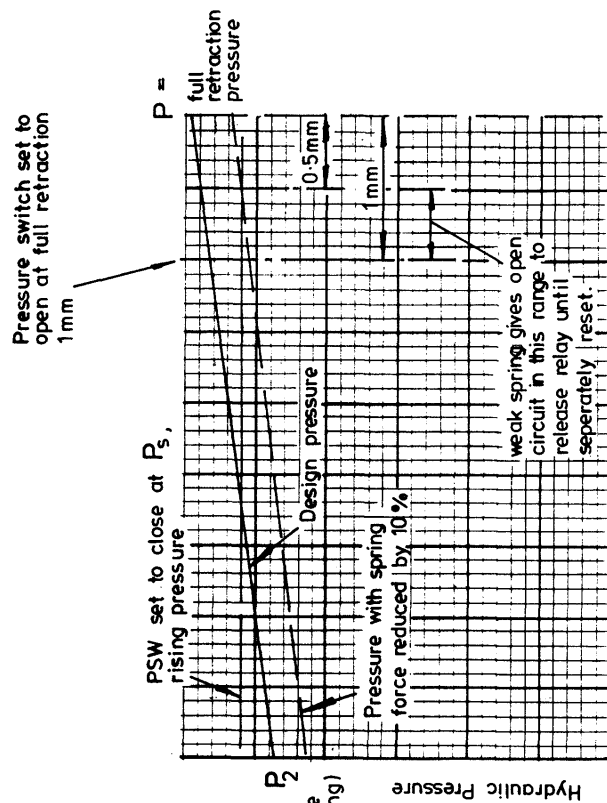
$$\text{PSW setting } P_s = \left[P_2 + \left\{ \frac{R - 0.5}{R} \times (P - P_2) \right\} \right] \times 0.9$$

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

Example for VKS 137

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

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



G1354

Example for VMS 535

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

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

VCS40 STANDARD

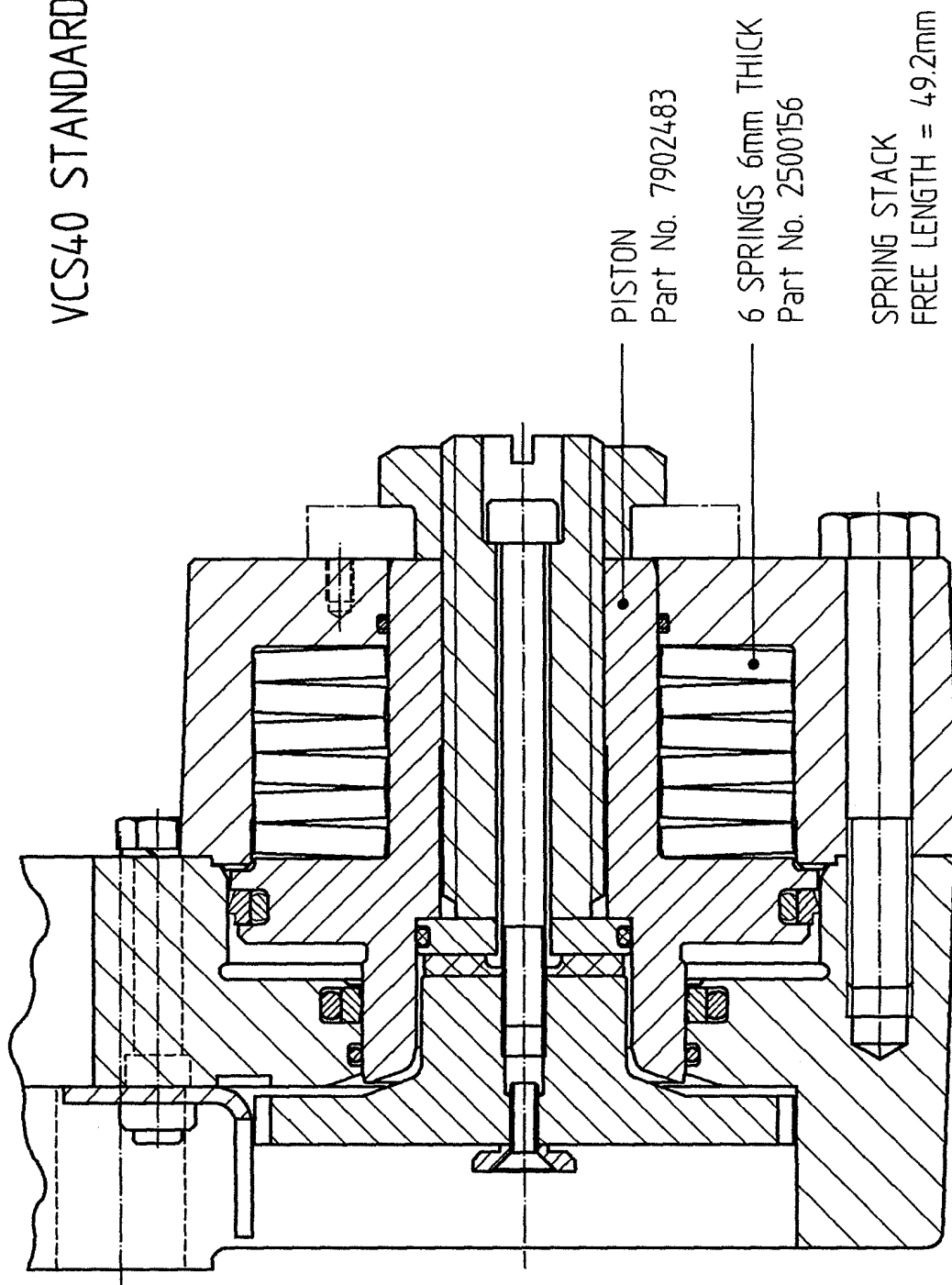


FIGURE 1

VCS25 STANDARD

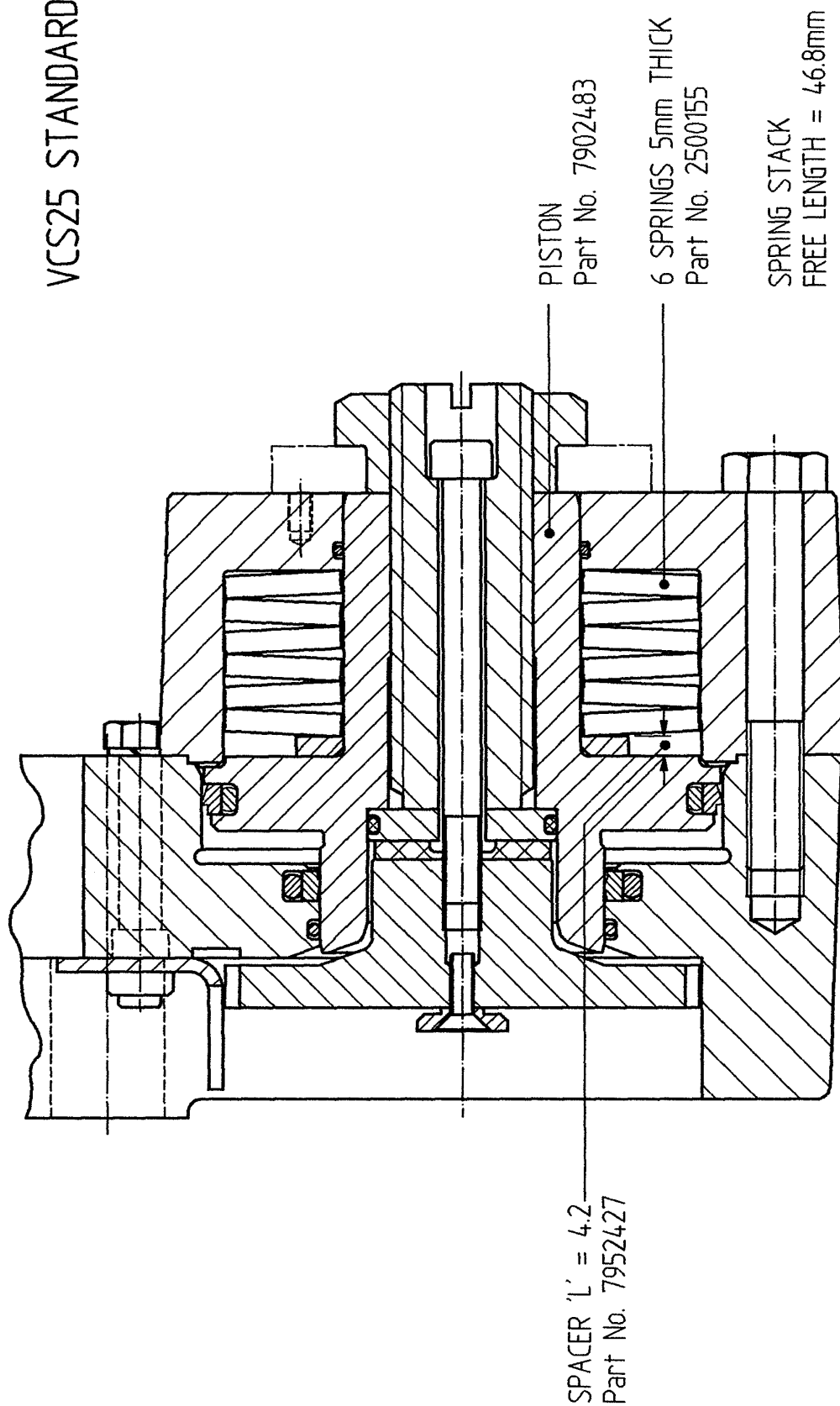


FIGURE 2

VCS22 STANDARD

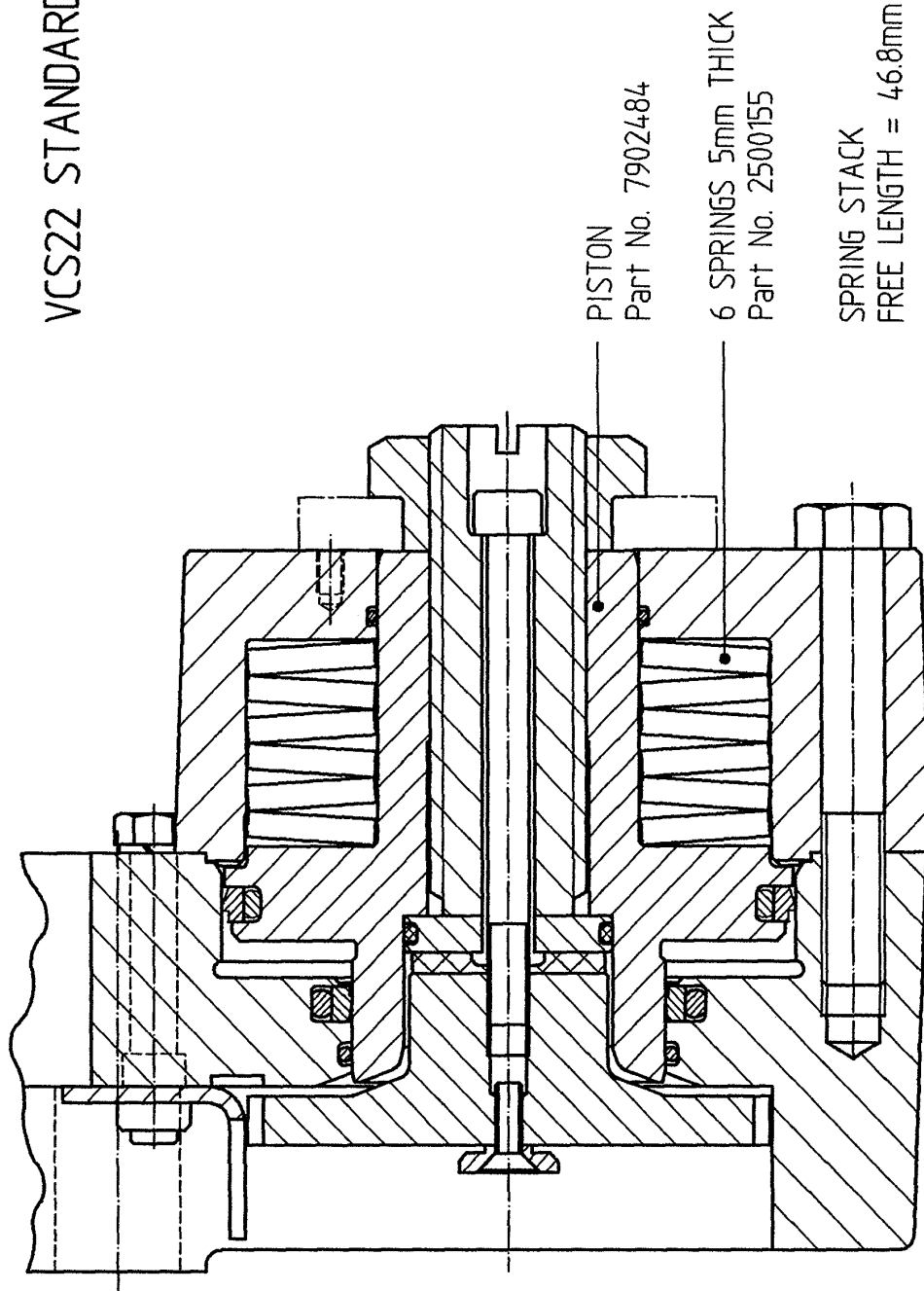


FIGURE 3

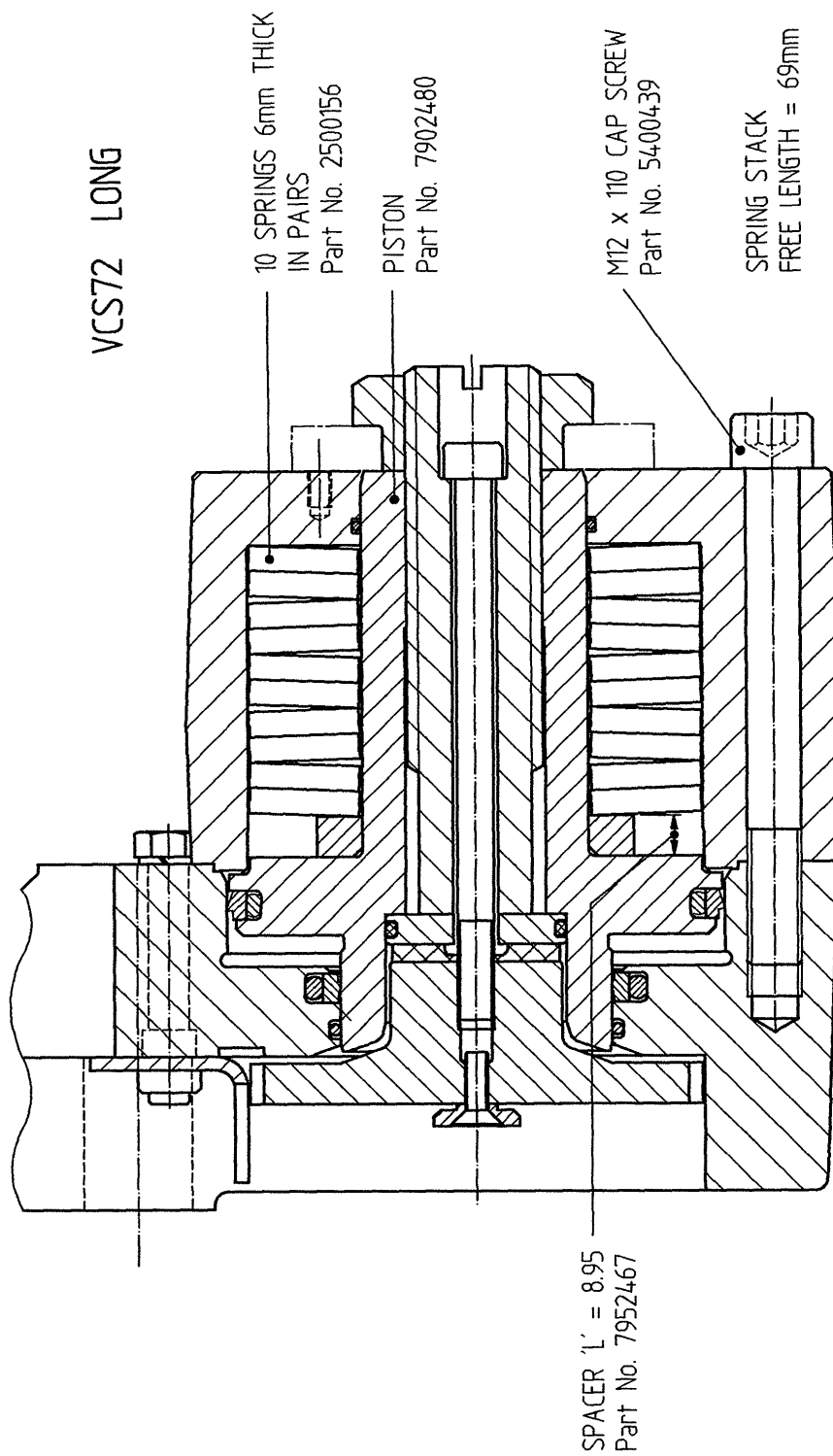


FIGURE 4

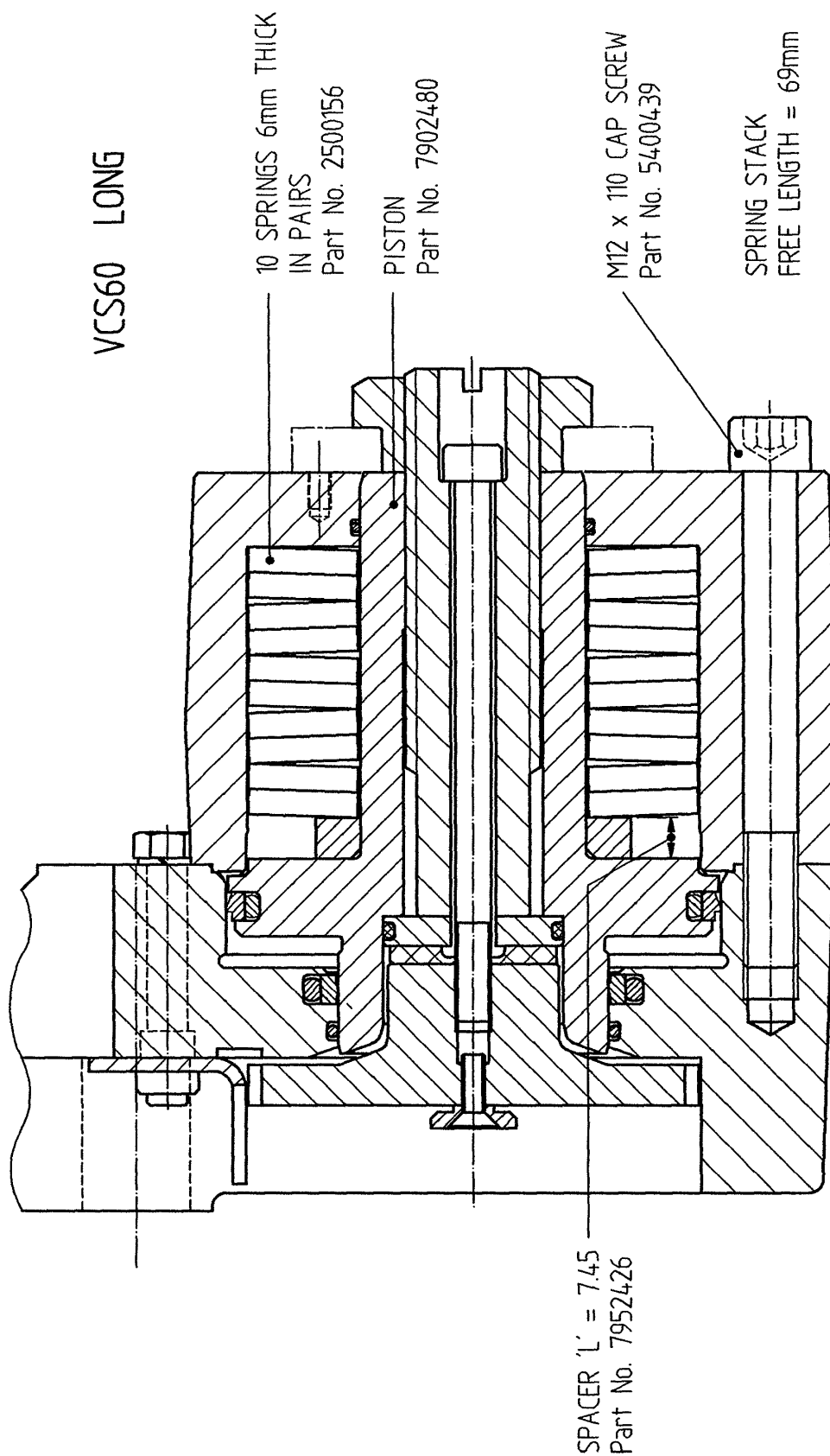


FIGURE 5

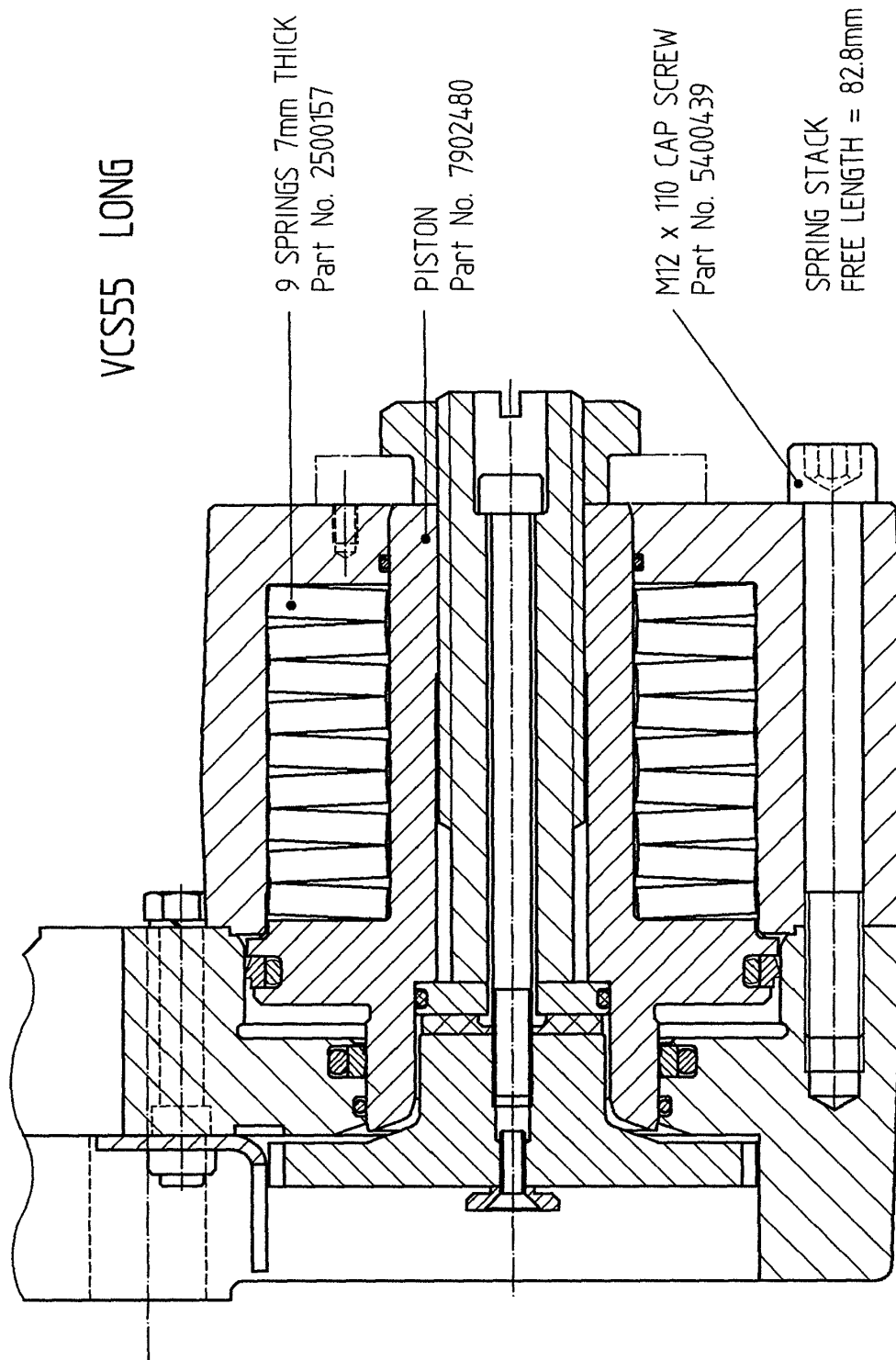


FIGURE 6

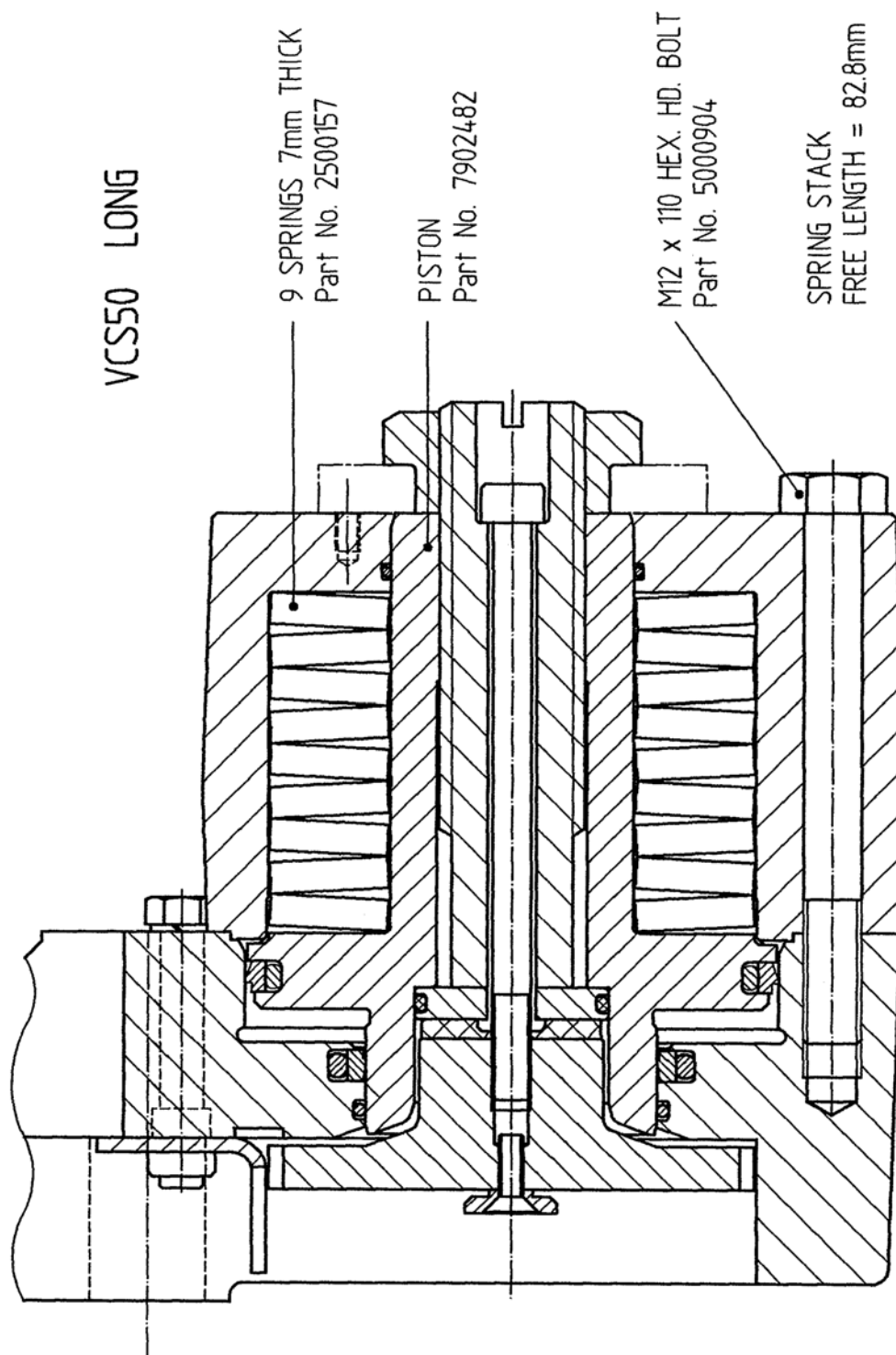


FIGURE 7

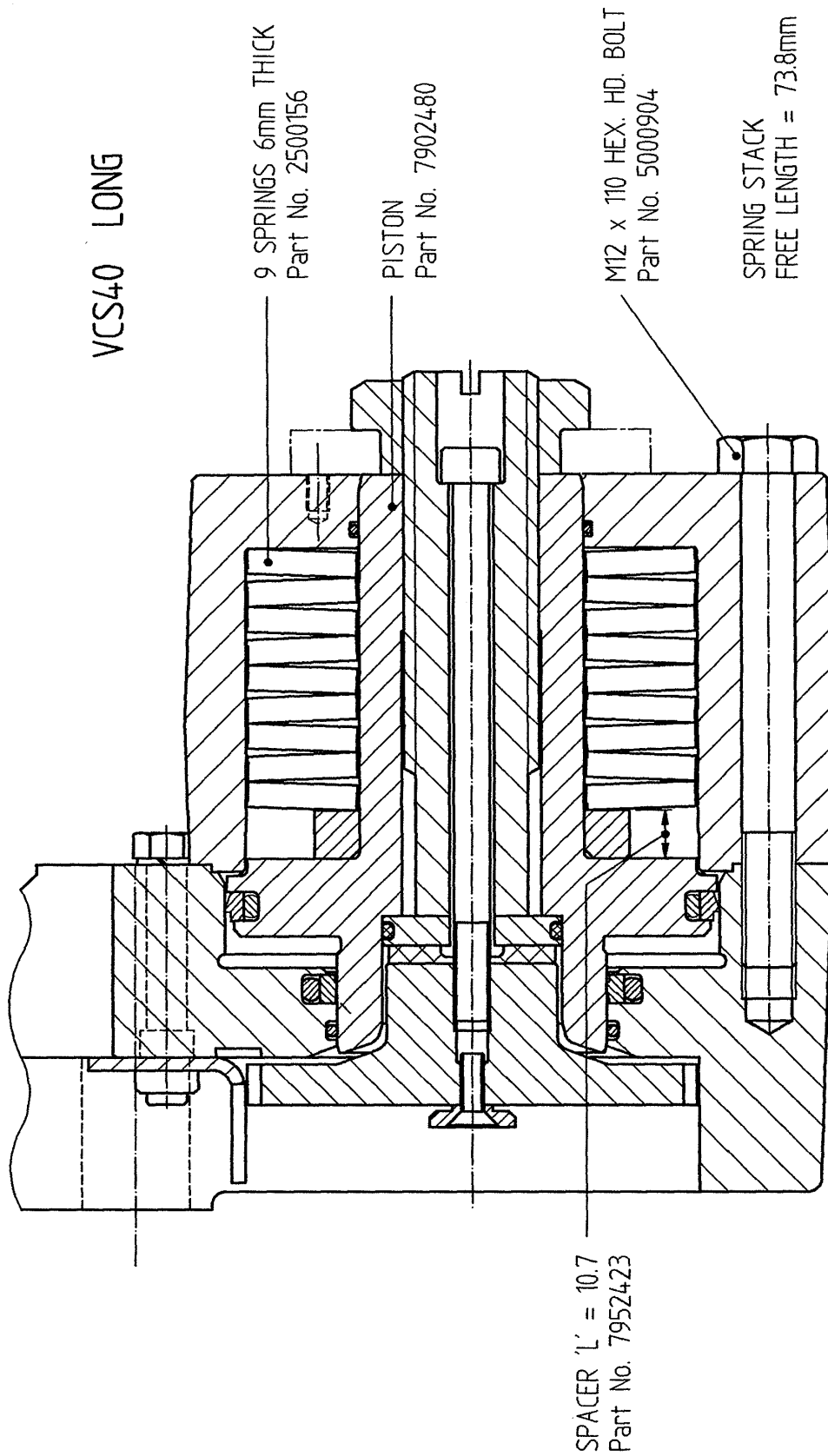








FIGURE 8

Used on	Item Number	Component	Drawing Number	Part Number	Quantity	Remarks	
	1	HOUSING	A13205	7933406	1	MAKE FROM CASTING A121433	
	2	PRESSURE PLATE	A33525	7932419	1	MADE FROM CASTING A335253	
	3	PISTON	A22490	SEE Z145/17	1		
	4	SPRING COVER	A22457	7932421	1	MADE FROM CASTING A224573	
	5	ADJUSTING SCREW	A33527	7952422	1	MADE FROM STUDDING A335275	
	6	WASHER	A31560	4700244	1	ZINC PLATE	
	7	ADJUSTING NUT, M30	A31561	5100259	1	MADE FROM M30 NUT P/N 5100260	
	8	PAD RETAINING DISC	A31026	7950948	1	ZINC PLATE	
	9	'O' RING RETAINER	A33530	7952429	1		
	10	SPRING SPACER	A33566	SEE Z145/17	1		
	11	DISC SPRING	ND	SEE Z145/17			
	12	THRUST WASHER	A33529	4700286	1		
	13	KEEP PLATE ASSY	A31562	7951280	1	COMPRISING : NUT 5100261 & PLATE 7951529/A31562	
	14	KEEP PLATE NUT	A31563	5100261	2	SEE ITEM 13	
	15	BLEED SCREW 1/8" BSP	31033	6700217	1		
	16	ADAPTOR 1/4"BSP(M) x 1/8"BSP(F)	A31599	7300656	1		
	17						
	18						
	19	2 PART ROD STEPSEAL	ND	6000501	1	SHAMBAN S55013-0600-451-K-R	
	20	2 PART PISTON STEPSEAL	ND	6000502	1	SHAMBAN S55014-1100-451-K-R	
	21	'O' RING 40 x 34 x 3	ND	6000504	1	BS4518-0345-30	
	22	'O' RING 54 x 50 x 2.4	ND	6000275	1	BS4518-0496-24	
	23	'O' RING 65 x 60 x 3	ND	6000279	1	BS4518-0595-30	
	24	PLUG, BLANKING, 1/8BSPT, SKT	ND	7301388	4	RS 231-5039	
	25						
	26	SCREW, CSK. M5 x 16	ND	5500070	1		
		Title VCS MK.3 LONG, MINERAL OIL, SPRING MODULE ASSY, BASIC PARTS				Assembly Drawing No.	(A13211)
						Assembly Part No.	6701596
Drawn	Date	17/12/04				Installation Drawing No.	-
R.E.G.	Alt No.					Schedule No.	
Checked	Issue	01				Z145/63	Sheet 1 of 2
----	Any loose fittings to be placed in a plastic bag and tied to unit						Form No. DO/52-3

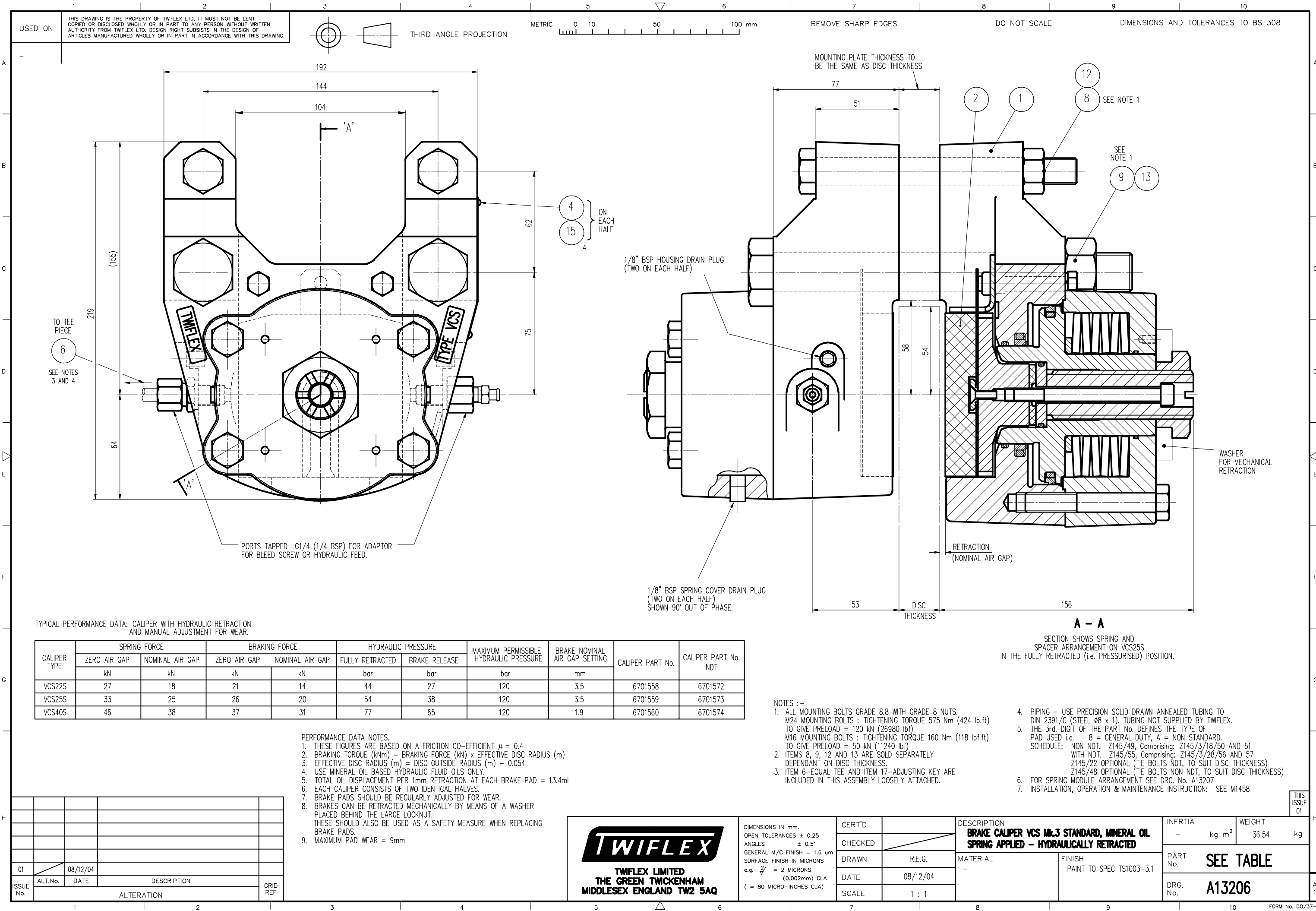
Used on	Item Number	Component	Drawing Number	Part Number	Quantity	Remarks
	27	SCREW, CAP SKT HD, M8 x 120	ND	5400473	1	
	28					
	29	BOLT, HEX HD, M12 x 110	ND	SEE Z145/17	4	
	30	BOLT, HEX HD, M8 x 55	ND	5000818	2	Gr 8.8
	31					
	32	WASHER, SPRING M8	ND	5800005	2	BS4464 TYPE 'A' SINGLE COIL/SQ. SECT.
	33	BONDED SEAL 1/4" BSP	ND	7300142	2	DOWTY No. 400-021-4490-02
	34					
	35	MALE STUD G1/4" - 8	ND	7300665	1	STAUFF S-GEV-8LR
	36	PLUG 1/4" BSP	ND	7300702	1	STEEL LEGRIS 0210 1300
		Title VCS MK.3 LONG, MINERAL OIL, SPRING MODULE ASSY, BASIC PARTS				Assembly Drawing No. (A13211)
						Assembly Part No. 6701596
Drawn R.E.G.	Date Alt No.	17/12/04 				Installation Drawing No. -
Checked -----	Issue	01				Schedule No. Z145/63
Any loose fittings to be placed in a plastic bag and tied to unit						Sheet 2 of 2 Form No. DO/52-3


Used on	Item Number	Component	Drawing Number	Part Number	Quantity	Remarks		
-	1	SPRING MODULE ASSEMBLY	SELECT FROM Z145/62		2			
	2	BRAKE PAD ASSEMBLY	A31552	SEE Z145/3	2			
	3							
	4	LABEL	A31872	7901483	2	SECURED USING ITEM 15		
	5							
	6	EQUAL TEE		7300649	1			
	7							
	8	M16 HEX. HEAD BOLT		SEE Z145/48		SOLD SEPARATELY, NOT PART OF B.O.M.		
	9	M24 HEX. HEAD BOLT		SEE Z145/48				
	10							
	11							
	12	M16 NUT		SEE Z145/48				
	13	M24 NUT		SEE Z145/48				
	14							
	15	HAMMER DRIVE SCREW No.2 x 1/4"		5600019	8			
	16							
	17	ADJUSTING KEY	A31632	7951349	1			
		Title				Assembly Drawing No.		A13210
		VCS MK.3 LONG, MINERAL OIL, CALIPER ASSEMBLY				Assembly Part No.		SEE DRAWING
Drawn	Date	15/12/04					Installation Drawing No.	-
R.E.G.	Alt No.						Schedule No.	
Checked	Issue	01					Z145/61	Sheet 1 of 1
-----	Any loose fittings to be placed in a plastic bag and tied to unit							Form No. DO/52-3


Used on	Item Number	Component	Drawing Number	Part Number	Quantity	Remarks		
-	1	SPRING MODULE ASSEMBLY	SELECT FROM Z145/68		2			
	2	BRAKE PAD ASSEMBLY	A31552	SEE Z145/3	2			
	3							
	4	LABEL	A31872	7901483	2	SECURED USING ITEM 15		
	5							
	6	EQUAL TEE		7300649	1			
	7							
	8	M16 HEX. HEAD BOLT		SEE Z145/22		SOLD SEPARATELY, NOT PART OF B.O.M.		
	9	M24 HEX. HEAD BOLT		SEE Z145/22				
	10							
	11							
	12	M16 NUT		SEE Z145/22				
	13	M24 NUT		SEE Z145/22				
	14							
	15	HAMMER DRIVE SCREW No.2 x 1/4"		5600019	8			
	16							
	17	ADJUSTING KEY	A31632	7951349	1			
		Title				Assembly Drawing No.		A13210
		VCS MK.3 LONG, MINERAL OIL, CALIPER ASSEMBLY, NDT				Assembly Part No.		SEE DRAWING
Drawn	Date	17/12/04					Installation Drawing No.	-
R.E.G.	Alt No.						Schedule No.	
Checked	Issue	01					Z145/67	Sheet 1 of 1
-----	Any loose fittings to be placed in a plastic bag and tied to unit							Form No. DO/52-3


Used on	Item Number	Component	Drawing Number	Part Number	Quantity	Remarks		
	1	HOUSING	A13205	7933406/T	1	MAKE FROM CASTING A121433		
	2	PRESSURE PLATE	A33525	7932419/T	1	MADE FROM CASTING A335253		
	3	PISTON	A22490	SEE Z145/26	1			
	4	SPRING COVER	A22457	7932421/T	1	MADE FROM CASTING A224573		
	5	ADJUSTING SCREW	A33527	7952422/T	1	MADE FROM STUDDING A335275		
	6	WASHER	A31560	4700244	1	ZINC PLATE		
	7	ADJUSTING NUT, M30	A31561	5100259	1	MADE FROM M30 NUT P/N 5100260		
	8	PAD RETAINING DISC	A31026	7950948	1	ZINC PLATE		
	9	'O' RING RETAINER	A33530	7952429	1			
	10	SPRING SPACER	A33566	SEE Z145/26	1			
	11	DISC SPRING	ND	SEE Z145/26				
	12	THRUST WASHER	A33529	4700286	1			
	13	KEEP PLATE ASSY	A31562	7951280	1	COMPRISING : NUT 5100261 & PLATE 7951529/A31562		
	14	KEEP PLATE NUT	A31563	5100261	2	SEE ITEM 13		
	15	BLEED SCREW 1/8" BSP	31033	6700217	1			
	16	ADAPTOR 1/4"BSP(M) x 1/8"BSP(F)	A31599	7300656	1			
	17							
	18							
	19	2 PART ROD STEPSEAL	ND	6000501	1	SHAMBAN S55013-0600-451-K-R		
	20	2 PART PISTON STEPSEAL	ND	6000502	1	SHAMBAN S55014-1100-451-K-R		
	21	'O' RING 40 x 34 x 3	ND	6000504	1	BS4518-0345-30		
	22	'O' RING 54 x 50 x 2.4	ND	6000275	1	BS4518-0496-24		
	23	'O' RING 65 x 60 x 3	ND	6000279	1	BS4518-0595-30		
	24	PLUG, BLANKING, 1/8BSPT, SKT	ND	7301388	4	RS 231-5039		
	25							
	26	SCREW, CSK. M5 x 16	ND	5500070	1			
		Title VCS MK.3 LONG, MINERAL OIL, SPRING MODULE ASSY, BASIC PARTS, NDT				Assembly Drawing No.	(A13211)	
						Assembly Part No.	6701618	
Drawn	Date	17/12/04					Installation Drawing No.	-
R.E.G.	Alt No.						Schedule No.	
Checked	Issue	01					Z145/69	Sheet 1 of 2
----	Any loose fittings to be placed in a plastic bag and tied to unit							Form No. DO/52-3


Used on	Item Number	Component	Drawing Number	Part Number	Quantity	Remarks
	27	SCREW, CAP SKT HD, M8 x 120	ND	5400473	1	
	28					
	29	BOLT, HEX HD, M12 x 110	ND	SEE Z145/26	4	
	30	BOLT, HEX HD, M8 x 55	ND	5000818	2	Gr 8.8
	31					
	32	WASHER, SPRING M8	ND	5800005	2	BS4464 TYPE 'A' SINGLE COIL/SQ. SECT.
	33	BONDED SEAL 1/4" BSP	ND	7300142	2	DOWTY No. 400-021-4490-02
	34					
	35	MALE STUD G1/4" - 8	ND	7300665	1	STAUFF S-GEV-8LR
	36	PLUG 1/4" BSP	ND	7300702	1	STEEL LEGRIS 0210 1300





Used on	Item Number	Component	Drawing Number	Part Number	Quantity	Remarks		
-	1	SPRING MODULE ASSEMBLY	SELECT FROM Z145/56		2			
	2	BRAKE PAD ASSEMBLY	A31552	SEE Z145/3	2			
	3							
	4	LABEL	A31872	7901483	2	SECURED USING ITEM 15		
	5							
	6	EQUAL TEE		7300649	1			
	7							
	8	M16 HEX. HEAD BOLT		SEE Z145/22		SOLD SEPARATELY, NOT PART OF B.O.M.		
	9	M24 HEX. HEAD BOLT		SEE Z145/22				
	10							
	11							
	12	M16 NUT		SEE Z145/22				
	13	M24 NUT		SEE Z145/22				
	14							
	15	HAMMER DRIVE SCREW No.2 x 1/4"		5600019	8			
	16							
	17	ADJUSTING KEY	A31632	7951349	1			
		Title				Assembly Drawing No.		A13206
		VCS MK.3 STANDARD, MINERAL OIL, CALIPER ASSEMBLY, NDT				Assembly Part No.		SEE DRAWING
Drawn	Date	08/12/04					Installation Drawing No.	-
R.E.G.	Alt No.						Schedule No.	
Checked	Issue	01					Z145/55	Sheet 1 of 1
-----	Any loose fittings to be placed in a plastic bag and tied to unit							Form No. DO/52-3

Used on	Item Number	Component	Drawing Number	Part Number	Quantity	Remarks
-	1	SPRING MODULE ASSEMBLY	SELECT FROM Z145/50		2	
	2	BRAKE PAD ASSEMBLY	A31552	SEE Z145/3	2	
	3					
	4	LABEL	A31872	7901483	2	SECURED USING ITEM 15
	5					
	6	EQUAL TEE		7300649	1	
	7					
	8	M16 HEX. HEAD BOLT		SEE Z145/48		SOLD SEPARATELY, NOT PART OF B.O.M.
	9	M24 HEX. HEAD BOLT		SEE Z145/48		
	10					
	11					
	12	M16 NUT		SEE Z145/48		
	13	M24 NUT		SEE Z145/48		
	14					
	15	HAMMER DRIVE SCREW No.2 x 1/4"		5600019	8	
	16					
	17	ADJUSTING KEY	A31632	7951349	1	
		Title VCS MK.3 STANDARD, MINERAL OIL, CALIPER ASSEMBLY				Assembly Drawing No. A13206
						Assembly Part No. SEE DRAWING
Drawn R.E.G.	Date 08/12/04					Installation Drawing No. -
	Alt No.					Schedule No.
Checked -----	Issue 01					Z145/49
Any loose fittings to be placed in a plastic bag and tied to unit						
						Sheet 1 of 1 Form No. DO/52-3

Used on	Item Number	Component	Drawing Number	Part Number	Quantity	Remarks	
	1	HOUSING	A13205	7933406	1	MAKE FROM CASTING A121433	
	2	PRESSURE PLATE	A33525	7932419	1	MADE FROM CASTING A335253	
	3	PISTON	A22490	SEE Z145/18	1		
	4	SPRING COVER	A22491	7932487	1	MADE FROM CASTING A224913	
	5	ADJUSTING SCREW	A31551	7951278	1	MADE FROM STUDDING A315515	
	6	WASHER	A31560	4700244	1	ZINC PLATE	
	7	ADJUSTING NUT, M30	A31561	5100259	1	MADE FROM M30 NUT P/N 5100260	
	8	PAD RETAINING DISC	A31026	7950948	1	ZINC PLATE	
	9	'O' RING RETAINER	A33530	7952429	1		
	10	SPRING SPACER	A33566	SEE Z145/18	1		
	11	DISC SPRING	ND	SEE Z145/18			
	12	THRUST WASHER	A33529	4700286	1		
	13	KEEP PLATE ASSY	A31562	7951280	1	COMPRISING : NUT 5100261 & PLATE 7951529/A31562	
	14	KEEP PLATE NUT	A31563	5100261	2	SEE ITEM 13	
	15	BLEED SCREW 1/8" BSP	31033	6700217	1		
	16	ADAPTOR 1/4"BSP(M) x 1/8"BSP(F)	A31599	7300656	1		
	17						
	18						
	19	2 PART ROD STEPSEAL	ND	6000501	1	SHAMBAN S55013-0600-451-K-R	
	20	2 PART PISTON STEPSEAL	ND	6000502	1	SHAMBAN S55014-1100-451-K-R	
	21	'O' RING 40 x 34 x 3	ND	6000504	1	BS4518-0345-30	
	22	'O' RING 54 x 50 x 2.4	ND	6000275	1	BS4518-0496-24	
	23	'O' RING 65 x 60 x 3	ND	6000279	1	BS4518-0595-30	
	24	PLUG, BLANKING, 1/8BSPT, SKT	ND	7301388	4	RS 231-5039	
	25						
	26	SCREW, CSK. M5 x 16	ND	5500070	1		
		Title VCS MK.3 STANDARD, MINERAL OIL, SPRING MODULE ASSEMBLY, BASIC PARTS				Assembly Drawing No.	(A13207)
						Assembly Part No.	6701564
Drawn	Date	08/12/04				Installation Drawing No.	-
R.E.G.	Alt No.					Schedule No.	
Checked	Issue	01				Z145/51	Sheet 1 of 2
----	Any loose fittings to be placed in a plastic bag and tied to unit						Form No. DO/52-3

Used on	Item Number	Component	Drawing Number	Part Number	Quantity	Remarks		
	27	SCREW, CAP SKT HD, M8 x 90	ND	5400437	1			
	28							
	29	BOLT, HEX HD, M12 x 80	ND	5000903	4	Gr 8.8		
	30	BOLT, HEX HD, M8 x 55	ND	5000818	2	Gr 8.8		
	31							
	32	WASHER, SPRING M8	ND	5800005	2	BS4464 TYPE 'A' SINGLE COIL/SQ. SECT.		
	33	BONDED SEAL 1/4" BSP	ND	7300142	2	DOWTY No. 400-021-4490-02		
	34							
	35	MALE STUD G1/4" - 8	ND	7300665	1	STAUFF S-GEV-8LR		
	36	PLUG 1/4" BSP	ND	7300702	1	STEEL LEGRIS 0210 1300		
		Title VCS MK.3 STANDARD, MINERAL OIL, SPRING MODULE ASSEMBLY, BASIC PARTS				Assembly Drawing No.	(A13207)	
						Assembly Part No.	6701564	
Drawn	Date	08/12/04					Installation Drawing No.	-
R.E.G.	Alt No.						Schedule No.	
Checked	Issue	01					Z145/51	Sheet 2 of 2
----	Any loose fittings to be placed in a plastic bag and tied to unit							Form No. DO/52-3

Used on	Item Number	Component	Drawing Number	Part Number	Quantity	Remarks			
	1	HOUSING	A13205	7933406/T	1	MAKE FROM CASTING A121433			
	2	PRESSURE PLATE	A33525	7932419/T	1	MADE FROM CASTING A335253			
	3	PISTON	A22490	SEE Z145/28	1				
	4	SPRING COVER	A22491	7932487/T	1	MADE FROM CASTING A224913			
	5	ADJUSTING SCREW	A31551	7951278/T	1	MADE FROM STUDDING A315515			
	6	WASHER	A31560	4700244	1	ZINC PLATE			
	7	ADJUSTING NUT, M30	A31561	5100259	1	MADE FROM M30 NUT P/N 5100260			
	8	PAD RETAINING DISC	A31026	7950948	1	ZINC PLATE			
	9	'O' RING RETAINER	A33530	7952429	1				
	10	SPRING SPACER	A33566	SEE Z145/28	1				
	11	DISC SPRING	ND	SEE Z145/28					
	12	THRUST WASHER	A33529	4700286	1				
	13	KEEP PLATE ASSY	A31562	7951280	1	COMPRISING : NUT 5100261 & PLATE 7951529/A31562			
	14	KEEP PLATE NUT	A31563	5100261	2	SEE ITEM 13			
	15	BLEED SCREW 1/8" BSP	31033	6700217	1				
	16	ADAPTOR 1/4"BSP(M) x 1/8"BSP(F)	A31599	7300656	1				
	17								
	18								
	19	2 PART ROD STEPSEAL	ND	6000501	1	SHAMBAN S55013-0600-451-K-R			
	20	2 PART PISTON STEPSEAL	ND	6000502	1	SHAMBAN S55014-1100-451-K-R			
	21	'O' RING 40 x 34 x 3	ND	6000504	1	BS4518-0345-30			
	22	'O' RING 54 x 50 x 2.4	ND	6000275	1	BS4518-0496-24			
	23	'O' RING 65 x 60 x 3	ND	6000279	1	BS4518-0595-30			
	24	PLUG, BLANKING, 1/8BSPT, SKT	ND	7301388	4	RS 231-5039			
	25								
	26	SCREW, CSK. M5 x 16	ND	5500070	1				
		Title VCS MK.3 STANDARD, MINERAL OIL, SPRING MODULE ASSEMBLY, BASIC PARTS, NDT				Assembly Drawing No.		(A13207)	
						Assembly Part No.		6701578	
Drawn	Date	08/12/04						Installation Drawing No.	-
R.E.G.	Alt No.							Schedule No.	
Checked	Issue	01						Z145/57	Sheet 1 of 2
----	Any loose fittings to be placed in a plastic bag and tied to unit								Form No. DO/52-3

Used on	Item Number	Component	Drawing Number	Part Number	Quantity	Remarks	
	27	SCREW, CAP SKT HD, M8 x 90	ND	5400437	1		
	28						
	29	BOLT, HEX HD, M12 x 80	ND	5000903/T	4	Gr 8.8	
	30	BOLT, HEX HD, M8 x 55	ND	5000818	2	Gr 8.8	
	31						
	32	WASHER, SPRING M8	ND	5800005	2	BS4464 TYPE 'A' SINGLE COIL/SQ. SECT.	
	33	BONDED SEAL 1/4" BSP	ND	7300142	2	DOWTY No. 400-021-4490-02	
	34						
	35	MALE STUD G1/4" - 8	ND	7300665	1	STAUFF S-GEV-8LR	
	36	PLUG 1/4" BSP	ND	7300702	1	STEEL LEGRIS 0210 1300	
		Title VCS MK.3 STANDARD, MINERAL OIL, SPRING MODULE ASSEMBLY, BASIC PARTS, NDT				Assembly Drawing No.	(A13207)
						Assembly Part No.	6701578
Drawn	Date	08/12/04				Installation Drawing No.	-
R.E.G.	Alt No.					Schedule No.	
Checked	Issue	01				Z145/57	Sheet 2 of 2
-----	Any loose fittings to be placed in a plastic bag and tied to unit						Form No. DO/52-3

USED ON

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DO NOT SCALE

THIRD ANGLE PROJECTION

DIMENSIONS AND TOLERANCES
TO BS308

A11264

APPLY LOCTITE 270 TO THREAD OF BOLT ITEM ⑦ ONLY AND TIGHTEN SO THAT WASHER ITEM ③ IS JUST FREE TO ROTATE

② LEVER TO PIVOT FREELY

NOTE POSITION OF SCREW HEADS

FIT TEMPORARY M5 NUTS TO KEEP COVER ON

RED PLUNGER ON SWITCH MUST BE POSITIONED AT PIVOT END OF ACTUATOR
FIT INSULATING SHEET BETWEEN SWITCH-ACTUATOR ASSY AND MOUNTING FACE AS SHOWN

HEX. HD. BOLT, WASHER, SPACER & ADJUSTING NUT NOT SUPPLIED WITH MONITOR UNIT. REFER TO FLIMSY & SCH.'S Z.45/12

OPERATING POSITION SWITCH 'C' AT 34mm ±0.5

SET OPERATING POSITION OF SWITCH 'A' AT 20.5 mm ± 0.5

SET OPERATING POSITION OF SWITCH 'B' AT 20 mm MINUS RETRACTION ± 0.5

PLUS 1mm WEAR ALLOWANCE

ISSUE No.	No.	DATE	DESCRIPTION	GRID REF
06	12052	9-8-97	WEAR ALLOWANCE ADDED	
05	11570	31-8-95	SEE ALT NOTE	
4	10994	7-10-93	TABLE CHANGED	C5
3	10004	17-5-90	REF. SCH. Z145/12 WAS Z145/122	
2	9891	20-10-89	ITEMS 3,4 & 17 DELETED. NOTE ADDED. PT. NO. TABLE ADDED. OR NOTES ALTERED.	
1				

TWIFLEX

TWIFLEX COUPLINGS LTD.,
THE GREEN, TWICKENHAM, MIDDLESEX.

A MEMBER OF THE  GROUP OF COMPANIES

PRODUCT DESIGNATION
VCS

SCH. No Z274/ FL.

ALWAYS QUOTE THIS
REFERENCE IN FULL.

DESCRIPTION -

MONITOR UNIT (3-FUNCTION)

MATERIAL:

FINISHED WEIGHT

WR²

REMOVE SHARP EDGES

OPEN TOLS $\pm 25 (\pm .010")$

FINISH

SURFACE FINISH IN MICRONS E.G.
= 2 MICRONS (002mm) CLA = 80 MICRO INCHES

M/C AT \checkmark GRIND AT 'G'

UNSPECIFIED UNITS ARE mm

DRAWN

CHECKED

DATE

SCALE

PART

No. SEE TABLE

DRG.

No. A21390

CALIPER TYPE	PAD RETRACTION mm	MONITOR UNIT PART No	MONITOR UNIT IP65 SWITCH PTN ^o
VCS 40 VCS 60L MK3 VCS 72L	1.9	7700279/AK61	7700723/AP78
VCS 50L VCS 55L	2.4	7700279/AK62	7700723/AP79
VCS 22 VCS 25 VCS 40L	3.5	7700279/AK63	7700723/AP80

FOR MARINE UNIT SEE SCHEDULE Z274/9
FOR STD UNIT SEE SCHEDULE Z274/3
INSTALLATION & OPERATION MANUAL: SEE M1178

ELECTRICAL RATING OF MICRO SWITCHES

VOLTAGE	24V D.C	48V DC	110VAC
RESTIVE LOAD	2 amp	0.7 amp	5 amp
TUNGSTEN LAMP LOAD	1.5 amp	0.7 amp	0.5 amp
INDUCTIVE LOAD	1 amp	0.5 amp	5 amp

SWITCH CONNECTIONS	FUNCTION	TERMINAL CONNECTIONS
1 Common		1
SW 'A' 2 N.C.	Opens at full retraction - brake off	2
3 N.O.	Closes " " " "	3
1 Common		4
SW 'B' 2 N.C.	Closes when Pad adjustment required - brake on	5
3 N.O.	Opens " " " "	6
1 Common		7
SW 'C' 2 N.C.	Opens when Pad replacement required	8
3 N.O.	Closes	9

WIRING LAYOUT SCHEMATIC