



Service Manual
for
Advanced Varofoil
Types
40A, 56A, 71A, Mark 3





VAROFOIL MANUAL

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INTRODUCTION

The VAROFOIL fan is a sophisticated energy saving machine. Please follow the instructions given in this manual, they are for your benefit and to omit them may result in unsatisfactory service. A properly installed, commissioned and maintained VAROFOIL fan will normally give many years of trouble-free service.

Additional information or guidance is available from American Fan/Woods or their representatives.



2.1 Site Storage

The fan must be stored in clean, dry conditions in a vibration free area. If storage is for a prolonged period then the impeller should be rotated every month or so in order to keep the lubricant distributed in the bearings. Before installation, the resistance to ground should be measured. If this is less than 100k ohms the motor should be dried out and re-checked before applying power.

2.2 Supply

The details of the site supply must be checked to ensure that the voltage, frequency, power rating and number of phases comply with the details given on the fan nameplate.

2.3 Installation

The majority of Varofoils are suitable for both horizontal and vertical operation.

However the fan should be considered as suitable for horizontal operation only, unless *specifically* supplied for vertical operation.

The Varofoil fan is supplied completely assembled and it is fully tested at the factory. To enable maintenance to be carried out, the duct work connecting to the fan should be removable and doors 24in x 18in (600mm x 450mm) provided to give access to the inlet and outlet of the fan. Some fans are supplied with an access door above the motor. A rail for lifting equipment should be provided above the fan. A typical installation is shown on Drawing 181541 Section 13.

For optimum performance, sharp bends in the duct work in the vicinity of the fan should be avoided. If bends are necessary they should be fitted with air-turning vanes. The connection to the duct work should be by means of a smooth transformation duct with a 60 degree maximum effective included angle when the diameter decreases in the direction of airflow, or a 15 degree maximum effective included angle when it increases in the direction of airflow.

Where anti-vibration mounts are used, flexible connectors and conduit should also be used. The fan should be aligned closely with the inlet and outlet duct work and must be installed in accordance with the airflow direction and rotation arrows shown on the nameplate. The flexible connectors should be fitted so that they are taut and completely overlap the spigot of the matching flange.

When high deflection mounts are used or the fan is suspended on rods, it is essential that the thrust of the fan is not applied to the connector. Horizontal tie-bars, pivoted at each end should be used to constrain the fan which will pull in the opposite direction to the airflow.

To achieve the best performance where no duct work is connected to the fan (i.e. free standing in a chamber), the velocity in the plenum chamber should not exceed 1000ft/min (5m/s), a clearance of at least one fan diameter should be allowed at the inlet and outlet, and a bellmouth or coned inlet and an outlet cone should be fitted.

2.4 Electrical Connection

The wiring must be connected in accordance with the wiring diagram in the terminal box.

The direction of rotation is indicated on the casing nameplate. Rotation should be checked by a trial connection; if incorrect

interchange any 2 phases of the 3 phase supply, or switch leads as indicated for 1 Phase supply.

2.5 Grounding

The fan must be grounded in accordance with the requirements of the local electrical code, or code of practice. A separate ground continuity conductor should be connected to the grounding screw in the terminal box.

2.6 Conduit

Wiring should be in a conduit in accordance with the local regulations, or code of practice. Particular attention should be paid to fans fitted with flameproof or explosion-proof motors. See section 2.10.

2.7 Starting

Run-up time will be reduced by setting the pitch angle to minimum for the start up period. This is recommended particularly when star delta (wye-delta), or other forms of reduced voltage starting are used.

To provide protection against a blown fuse or a bad contact, a starter with single phasing protection must be used.

Starting may be carried out manually or automatically. The number of starts in a given time should be limited as follows:-

- 4 across-the-line starts per hour
- 2 reversals per hour with a run down time of 5 seconds before reversal.
- 2 starts in quick succession followed by 30 minutes cooling, which may be achieved either by running or switching off.

The required current of the motor with the pitch angle set to maximum should be measured immediately after start up to ensure that it does not exceed the nameplate current. It must be rechecked after the control system has been commissioned.

The fan must only be run for short periods until the system has been commissioned, see section 7. During commissioning the volume flow and pressure must be measured to ensure the fan is running on its normal characteristic curve. Failure to do so may result in damage to the duct work system or the fan.

Note: Noise (rattle) due to clearance in blade bearings as the impeller runs down is normal. This clearance is designed to be taken up when the fan is running.

2.8 Protection

Any fuses in the circuit should be regarded as protecting the wiring against the effects of short circuits or ground faults only. They are not suitable for overload protection.

Heater or fuse time ratings must be sufficient to allow the motor to accelerate to full speed. The magnitude and duration of the starting current will vary with the drop in supply voltage, but as a guideline the rating should be sufficient to carry the nameplate starting current for 10 seconds across the line or 30 seconds with reduced voltage starting.

The overload current setting should be 10% to 15% above the nameplate current. The fan will not always absorb the maximum power or nameplate current.



Motors fitted with thermistor or thermostatic overheat protection should be wired in accordance with the instructions given.

2.9 Operating Conditions

Standard fans are suitable for continuous use in an ambient temperature of -20°C to $+40^{\circ}\text{C}$ (-4°F to 104°F). The maximum ambient temperature in which a specific fan may be used is given on the nameplate.

Fans are not suitable for handling air containing free moisture or corrosive fumes, or for use in heavily dirt laden atmospheres unless given special treatment.

2.10 Additional Instructions for Explosion-Proof Fans

2.10.1. Explosion-Proof Certificate

If the motor fitted is explosion-proof it will be signified on the nameplate.

Subject to the recommendations given under "Operating Conditions" in these instructions, the fan is suitable for use in flammable atmospheres such as are associated with petroleum products, cellulose solvents, etc. provided the method of installation complies with the local regulations or code of practice and the Class and Division Rating of the specific motor.

Capacitors, control gear, etc. unless they have been supplied with the explosion-proof enclosures must be installed outside the hazardous area properly wired.

2.10.2. Conduit

Joints should be made through special explosion-proof junction boxes or unions throughout the hazardous area. At a point outside the hazardous area the explosion-proof conduit system must be sealed off by a special junction box having an explosion-proof barrier. Beyond this point any standard method of wiring with non-explosion-proof control gear must be acceptable by local code. Glands and flexible cable should be used to connect to the fan, when it is supported on resilient mountings.

2.10.3. Stopper Boxes

A stopper box, where fitted, must be filled with a barrier compound when the connections have been completed.

2.10.4. Operating Conditions

Provided the motor is not allowed to become coated with dirt, dust or other solid matter which would restrict surface cooling, the carcase temperature will never exceed 80°C when operating in the maximum ambient temperature of 40°C .

It is incumbent on users to satisfy themselves that this carcase temperature is safe under the conditions of use and with respect to the particular flammable media in the vicinity.



3.1 Mechanical Stops

The maximum pitch angle stops are set at the factory to suit the customer's requirement. Should these require adjusting reference should be made to AFC / WOODS USA.

If, however, the customer has adequate facilities then the procedure set out in Section 9 (dismantling impeller) should be implemented to the stage where the reaction plate (Drawing 176426 – item 22) has been removed. It is then possible to loosen the three locknuts (item 8) with a 17mm wrench on sizes 56A or 71A or 13mm wrench on size 40A and adjust the pitch angle adjustment screws (item 7). These three adjustment screws must be adjusted so that they are precisely the same length, in order to avoid jamming the mechanism. Unscrewing (counter-clockwise)

the adjustment screws reduces the maximum pitch angle, screwing them in (clockwise) increases the maximum pitch angle.

In order to check the new maximum pitch angle, the reaction plate will have to be replaced and the actuator (item 16) pulled forward until the pitch angle adjustment screws contact the back of the reaction plate. The pitch angle at the blade tip may then be checked.

It is of the utmost importance that after a change has been made to the maximum pitch angle, a check is carried out on the motor full load current at the new maximum pitch angle to ensure that it does not exceed the full load amperage on the motor nameplate.



4.1 Pilot Positioner

The pilot positioner is a Johnson D9502 which will adjust the pitch angle to a precise position in relation to the control signal.

The positioner is fitted with a spring (or springs) which give the pitch angle variation marked on the nameplate for a control signal range of approximately 3—15 psi (20— 100kPa) i.e. 12 psi operating span.

The pitch angle variation may be altered by changing the spring rate and this can be achieved to some degree by adjusting the position of the spring adjustment clip, thus changing the active length of the spring, see drawing number 184287 Section 4, page 3. Increasing the active length of the spring gives a greater pitch angle variation, reducing the active length of the spring reduces the pitch angle variation.

If the required pitch angle variation is not obtainable from the spring fitted, alternative springs are available.

To alter the control characteristics the pressure at which movement starts may be adjusted by the "starting point adjustment screw" in the pilot positioner.

For details of the above see Section 4.4. In addition to the 3—15 psi (20—100kPa) control signal a mains air supply of 25 psi (170kPa) is required.

4.2 Pneumatic Positioner

D-9502 Positioners are precision pneumatic relay devices used to adjust and maintain actuators in exact positions on those applications requiring precise or otherwise special positioning. The basic positioner provides dynamic stabilization and/or sequential control of actuators.

4.3 Operation

Supply air enters the control output chamber of the positioner relay and is admitted to the actuator when the control signal exceeds the established starting point of the positioner. The starting point is adjustable from 1 to 12 psi; pressure above the starting point causes the actuator shaft to move. Movement of the actuator is fed back to the relay through the positioner spring and lever arm to impose a balancing force against the control signal pressure. When all forces are in balance, the positioner will not allow supply air to pass through to the actuator. The actuator thus establishes a shaft position proportional to the value of the pressure from the controller independently of the sum of spring forces and loads. Any imposed change in actuator shaft position unbalances the relay so that air pressure in the actuator is increased or exhausted to reestablish a balance at the desired shaft position.

The operating range of an actuator with a D-9502 positioner is determined by the span and starting point adjustments of the positioner. The lower value of the range is the control signal pressure at which the actuator begins to stroke. The upper value is the control signal pressure at which the actuator reaches its maximum stroke. The difference between the upper and lower values of control signal pressure is the operating span. The operating span of the D-9502 is adjustable from 3 to 13 psi and is established by the location of the spring in the positioner spring arm. Refer to Section 4.4 for span, operating range and starting point adjustments.

Specifications

Product	D-9502 Pneumatic Positioner
Control Action	Sequential
Starting Point	Approximately 8 psi (55 kPa); adjustable from 1 to 12 psi (7 to 83 kPa)
Operating Span	Adjustable from 3 to 13 psi (20 to 90 kPa)
Supply Pressure	20 to 25 psi (138 to 170 kPa); 30 psi (207 kPa) maximum
Air Connections	Barbed fittings for 5/32 or 1/4 in. O.D. Polyethylene tubing
Ambient Temp. Limits	—20° to 150°F (—29° to 65.6°C)
Mounting	Directly to actuator with bracket furnished

4.4 Adjustments

Operating Range

The operating range is determined by the span and starting point adjustments of the positioner. The lower value of the range is the control signal pressure at which the actuator begins its stroke. The upper value is the pressure at which the actuator reaches its maximum stroke. The difference between the upper value and lower value is the operating span.

Operating Span

The operating span is adjustable from 3 to 13 psi. It is established by placing one end of the positioner spring into the hole in the lever arm which corresponds to the desired span. When attached to the hole closest to the positioner cover, the spring allows a span of 3 psi. At the farther hole on the lever arm the spring allows a span of 13 psi.

Starting Point

The starting point, which is adjustable from 1 to 12 psi, is the point at which the actuator begins its stroke. It is established by adjusting the screw located under the cover. Turning the screw counterclockwise increases the starting point and clockwise decreases the starting point.

Note: The addition of the starting point pressure and the operating span must be equal to or less than the supply air pressure to the positioner. Normal supply pressure is 25 psi; maintain starting point pressures and corresponding operating spans accordingly.

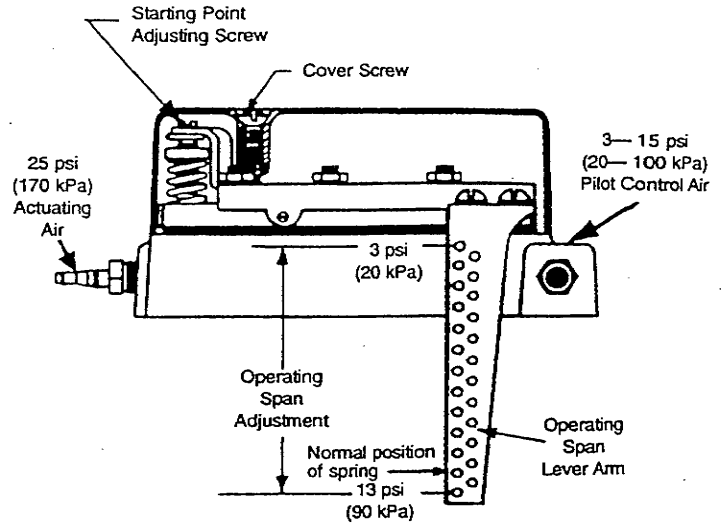
*In this instance the 'actuator' is the pitch angle changing mechanism inside the impeller.

EXAMPLE OF ADJUSTMENT

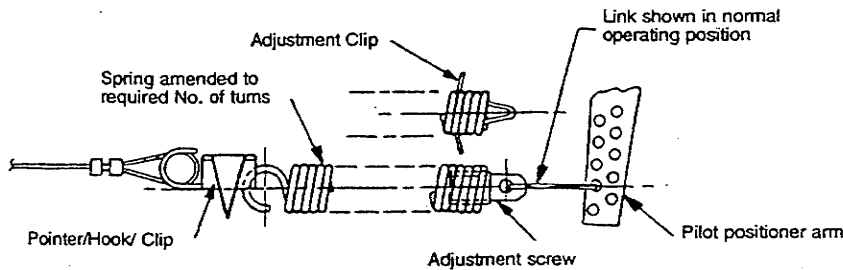
Assume the actuator has a spring range of 8 to 13 psi (5 psi span) and that it is desirable to use the D-9502 positioner to obtain an operating range of 6 to 13 psi (7 psi span). The starting point will be adjusted to 6 psi.

1. Place one end of the positioner spring in the hole of the lever arm which corresponds to a 7 psi span.
2. Apply a controller output pressure of 6 psi to the positioner.
3. Remove the D-9502 cover and turn the adjusting screw clockwise until the pitch angle just begins to change.

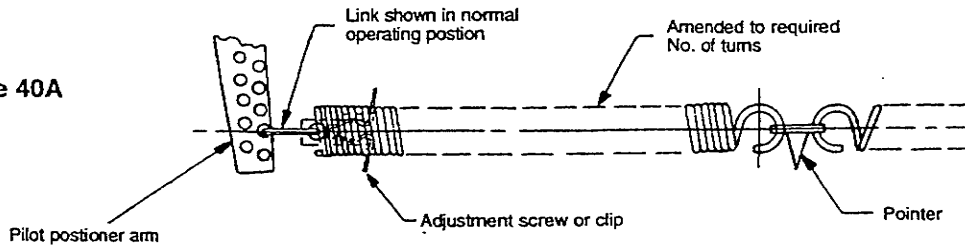
The D-9502 will now position the actuator over a range of 6 to 13 psi.



Types 56A & 71A



Type 40A



ASSEMBLY NOTES

1. CUT SPRING TO THE REQUIRED NUMBER OF TURNS (REFER TO CHART ON RIGHT) AND FIT SCREW INTO END OF SPRING SCREW IN 10 TURNS.
2. FIT SPRING TO POINTER AND LINK TO PILOT POSITIONER ARM. CONNECT LINK TO SCREW IN POSITION SHOWN.
3. BY ADJUSTING SCREW ACTUATOR SHOULD OPERATE OVER FULL 3—15 P.S.I. RANGE (ADJUST POSITIONER ACCORDING TO INSTRUCTION LEAFLET SUPPLIED WITH ACTUATOR.)

GENERAL NOTE

SPRING TURNS IN CHART HAVE BEEN ROUNDED OFF TO NEAREST WHOLE NUMBER.

NUMBER OF TURNS ON PILOT POSITIONER SPRING

TOTAL PA MOVEMENT	TYPE 40A	TYPES 56A & 71A	TOTAL PA MOVEMENT	TYPE 40A	TYPES 56A & 71A
4	16	15	25	47	35
5	17	16	26	48	36
6	19	17	27	50	37
7	20	18	28	51	38
8	22	19	29	53	39
9	23	20	30	54	40
10	25	21	31	55	41
11	26	22	32	57	42
12	28	23	33	58	43
13	29	24	34	60	44
14	31	25	35	61	45
15	32	25	36	63	46
16	33	26	37	64	47
17	35	27	38	66	48
18	36	28	39	67	49
19	38	29	40	69	50
20	39	30	41	70	51
21	41	31	42	72	52
22	42	32	43	73	53
23	44	33	44	74	54
24	45	34	45	76	55



VAROFOIL MANUAL SMOKE SPILL APPLICATION

SECTION
5

5.1 Impellers with Smoke Spill Capabilities

The day to day operation of these impellers will be identical to the standard impeller, any 'normal' failure of air pressure will result in the impeller returning to minimum blade pitch angle.

Under fire conditions where a signal is received from a smoke detection device, an over pressure is applied to the impeller causing it to go into, and lock in maximum blade pitch angle.

For any servicing required on these impellers please contact the American Fan/Woods Service Department or their agents.



VAROFOIL MANUAL COMMISSIONING INSTRUCTIONS

SECTION
6

6.1 Procedure

The following procedure should be followed when commissioning the fan.

If there are other components in the system, such as dampers or variable volume terminal boxes, which are normally under automatic control, the controls must be overridden and the components adjusted so the system will operate at its maximum design volume and pressure.

The fan should be started at minimum pitch angle, i.e. without control air and the pitch angle slowly increased until the maximum is reached or the fan goes into stall. To check for fan stall, monitor the pressure across the fan. If this increases and then suddenly decreases, as the pitch angle is increased, the fan has stalled. This is normally marked by an increase in low frequency noise level. Fans must not be run in stall for more than a short period of time. The current should be measured to ensure it does not exceed the motor nameplate value.

The control system should be adjusted so that the fan automatically gives the minimum pressure required for the system to operate satisfactorily.

If two or more fans are working in conjunction with each other e.g. fans in series, supply and return fans operating from the same controller, the pilot positioners should be adjusted so that the fans start and stop the pitch angle variation is at the same control pressure. See Section 4 Adjustment of Pilot Positioner.



7.1 General

Motors must not be allowed to become coated with dirt, dust or other solid matter that could restrict surface cooling.

Examine the blade tips and the impeller track to remove any build up of dirt or grease initially after 3 months and thereafter as experience dictates.

7.2 Lubrication

The motor bearings and size 40A rotary seal bearings require relubrication. Details of the type and quantity of lubricant and the relubrication periods will be found on the fan nameplate and in the lubrication chart Section 15. On belt driven fans the relubrication details for the impeller shaft bearings will be found on the fan nameplate under the heading 'motor' and the motor relubrication details will be found on the motor nameplate.

The fan is supplied lubricated and does not require further lubricant until after the period stated.

When carrying out relubrication it is essential that every trace of dirt or moisture is removed from the area around the grease nipple and that a clean grease gun is used. Only a low pressure should be required to inject the required charge, if a high pressure is required the cause should be investigated.

7.3 Belt Tension

The belt tension on belt driven fans must be checked after initial running-in and thereafter maintained according to the details given in Section 16.

7.4 Inspection of Operation

After two years, and thereafter yearly, the actuation should be checked for smoothness by applying and removing 15 psi control pressure. If the impeller does not operate over the full pitch angle variation or there is perceptible jerking then the impeller requires servicing.

Jerking may be checked visually or using an ammeter.

7.5 Servicing

Servicing should be carried out by Woods approved personnel or by a maintenance department having good workshop facilities and staff trained to overhaul similar equipment.



8.1 Fault Diagnosis

Observed Faults	Fault Code No.
All electrical faults	1
Fan will not start	1 2 5
Fan hums but will not start	1 2 3 5
Fan starts but will not run up to full speed	1 2 3 5
Fan runs up to approx. half speed and rapidly overheats	1 2 5
Fan is noisy	4 6 10 11 13
Fan running wrong rotation	1
Fan giving low air performance	1 2 11 12 13
Fan starter tripping	1 2 3 4 5 12
Impeller requires increased actuating pressure	8 9 15
Pitch angle changes in series of jerks	9 15
Impeller will not move through full pitch angle variation	8 9 14 15
Fan vibrates	4 10 11

NOTE; Disconnect and lock out power.

1. Check connections against diagrams.
2. Check voltage across motor terminals with voltmeter. Look for impeller obstruction.
3. Check continuity in all phases of stator winding with either megger or ammeter or test lamps in series with each phase in turn.
4. Lift end of motor shaft if possible to check for bearing wear, shown by excessive lift of shaft. Rotate rotor by hand with ear on carcass or to terminal box, noting any sound of chafing or rubbing.
5. Establish presence of overheating smell inside motor, indicating winding fault has developed.
6. Remove impeller and switch motor on, noting noise level. Apply metal end of screwdriver to endcover adjacent to each bearing in turn and, with ear to end of screwdriver, note sound level of each bearing. If bearings are faulty, it is most unlikely that the sound levels of both bearings will be similar.

A further check to determine if the noise is caused by either or both bearings can be carried out by relubricating each bearing in turn; any obvious reduction in noise resulting from this action will show which bearing is the cause of the noise.



VARFOIL MANUAL

FAULT DIAGNOSIS

SECTION

8
cont'd

7. Check that starter overloads are set at 10% to 15% above current shown on motor nameplates. Check that faulty wiring is not causing a direct short across starter. Insert ammeter in motor line and note recorded amps against nameplate amps. If recorded amps are more than 15% above nameplate amps, motor is overloaded or has developed a fault.
Check supply voltage, low voltage can, under certain circumstances, cause a rise in motor current which is sufficient to cause the starter to trip.
8. Diaphragm failure or leak. Replace Diaphragm.
9. Blade thrust bearing(s) may need replacing.
10. Check fan for build up of dirt on impeller.
11. Check that fan is installed in accordance with installation recommendations (Section 2).

12. Check that pitch angle is set correctly.
13. Measure air performance and ensure that it corresponds to pitch angle setting of fan and that fan is not running in air stall.
(Note — This can result in a lower pressure than that in the catalogue). Alternatively reduce pitch angle using the control signal, if the noise disappears the fan was running stalled.
14. Check for broken Pilot Positioner operating cable.
15. Check for air leaks in the Rotary seal, its associated air lines and the diaphragm (item 26 Drawing 176426 Section 12).



VARFOIL MANUAL

DISMANTLING IMPELLER

SECTION

9

9.1 Dismantling

Disconnect and lock out power supply.

Refer to Drawing number 176426 Section 12.

Disconnect rotary union from impeller ($\frac{7}{8}$ " AF spanner) and remove the impeller duct complete with all the pneumatic controls. (For information on the rotary union the outlet thread is $\frac{5}{8}$ " 18 TPI NF RH and the inlet is $\frac{1}{4}$ ", and $\frac{1}{8}$ " NPT on 40A hubs.)

Mark the position of the end cover, item 33, relative to the hub, item 1.

Remove the screws, item 34 (M6 10mm spanner, on sizes 56A and 71A or M5 8mm spanner on size 40A) then remove end cover. Mark the diaphragm housing, item 29, relative to the actuator item 16.

Remove items 21 and 20 M8 nuts and washers (13mm spanner) or M8 screws (6mm hex wrench), on 40A hubs these are M6 screws (5mm hex wrench). Pull the diaphragm housing forward sliding it along the reaction plate shaft and remove. The diaphragm housing may require a tap with a mallet to release it from the actuator. Remove the M6 screws, item 28, (5mm hex wrench), remove diaphragm item 26, noting that the sealing rib or gasket on the outer periphery faces the diaphragm housing, item 29 and that the sealing rib or gasket on the inner periphery faces the reaction plate item 22.

Mark Reaction Plate item 22 relative to the hub adaptor, item 2. Remove the M8 CSK screws item 23 (5mm hex wrench), *M6 Panhead (slotted) on size 40A hubs, then remove reaction plate, tapping it with a mallet if necessary.

Note 1

At this stage the impeller can be removed from the motor shaft by removing the screw, item 36, (10, 14, 17 or 19mm hexwrench according to motor shaft size) and the clamp washer item 35.

Support the weight of the impeller and remove from shaft. Care must be taken not to damage the blades which must not be allowed to take any significant weight.

Mark actuator, item 16, relative to hub item 1. Remove cam location screw item 19, rotate actuator counterclockwise until the cam followers are clear of the castellated flange of the actuator and draw actuator forward and remove.

9.2 Removal of Blades and Blade Bearings

Mark blade, item 10, and carrier, item 9, relative to the hub port. Hold each blade firmly as near the root as possible external to the hub and undo the blade retaining M20 'Binx' or 24mm 'Binx' nut item 12, M12 'Binx' or M14 'Binx' nut on hub size 40A far enough to protect the end of the thread and tap the head of the nut with a mallet to help separate the blade from the carrier, finally remove the nut and washer, item 37, and separate the blade from the carrier assembly; the blade thrust bearings can now be replaced. Check number of shim washers, items 13, 14 and 15, in each blade port if the blade is to be removed from the hub port.

*See Section 9, Paragraph 9.3.



Note 2

When undoing the blade retaining nut, the blade must be held externally to the hub and as close to the root as possible so that no strain is transferred through the carrier system to the spring tension pins, item 11.

Note 3

The blade bearings are patented and if spares are required they can be ordered from American Fan Co./Woods USA.

Note 4

The impeller may be removed either as described in Note 1 or for hubs having a separate adapter it may be removed leaving the hub adapter on the motor shaft. To do this, first mark the hub, item 1, relative to the hub adapter, item 2, removing the nuts and washers, (M16 24mm spanner), items 5 and 6, and finally remove the hub.

9.3 Reassembly

Reverse the dismantling procedure noting the following:
If the impeller has been removed from the motor shaft, the key-way and shaft should be lightly greased when reassembling.

If the blades have been removed from their respective ports reassemble into the same port with the same number of packing washers.

When fitting blade to carrier fit spring tension pins, item 11, to the blade first.

When tightening the 'Binx' locking nut, item 12, hold blade externally to the hub and as close to the root as possible so that no strain is transferred through the carrier systems to the spring tension pins (item 11).

On 40A hubs only make sure that no burrs are left on the heads of the M6 Panhead screws which secure the reaction plate item 22. Burrs could easily damage the diaphragm.

See Section 11 for tightening torque values.

Notes

Use Loctite Screwlock with screws, items 36, 19, 28, 31 and 38. After assembly check impeller for balance (Section 10).

In order to keep re-balancing to a minimum, it is beneficial to reassemble components in their original positions, thus the reason why components are marked relative to each other before dismantling.



10.1 Balancing

Refer to drawing number 176426 (Section 12).

The impeller should be balanced either statically on or off the fan or dynamically off the fan. It must finally be dynamically balanced assembled into the fan.

10.2 Static Balance of Impeller

The impeller should either be fitted to the motor or to a balancing mandrel supported on rotating knife edges.

Balance weights (items 39, 40 and 41) should be added in equal quantities to the front and back of the impeller, as shown in the illustration, until the impeller remains stationary when rotated to any position.

When fitting weights, the screws should have a thread engagement of at least 1.5 x diameter of the screw.

10.3 Dynamic Balance of Impeller off fan

The procedure is similar to the above except the balance weights should be added in the plane indicated.

10.4 Dynamic Balance with Impeller on fan

To achieve the same standard of balance as achieved prior to shipment from the factory, the fan must be tested on antivibration mounts with an efficiency of over 95%. If the fan is not normally mounted on such mounts then a proportionately lower level of vibration should be set.

Sensors should be placed on the front and back feet of the fan above one of the antivibration mounts to measure the vertical vibration.

The fan should be balanced until the standard of balance over the whole pitch angle range achieved is less than 4.5 mm/s RMS for 50 Hz duties and 3.5 mm/s RMS for 60 Hz duties. The graph (Section 14) shows the relationship between these levels and other common forms of measuring vibration levels.

10.5 Security of Screws

Any screws which have been loosened during balancing should be secured using Loctite "Screwlock".



VARFOIL MANUAL

TIGHTENING TORQUES

SECTION 11

11.1 General

Generally the torque to which the screws are tightened is not critical as long as they are sensibly tight. However the following screws must be tightened to the correct torque.

11.2 Torque Settings

Blade Securing Screw — Drwg. 176426, Item 44		
Hub size	Fan Size	Torque
71A	160 KG-280 JG	19 ft. lbs.

Impeller Securing Screw — Drwg. 176426, Item 36	
Screw Dia.	Torque
12mm	65Nm, 48 ft. lbs.
16mm	135Nm, 100 ft. lbs.
20mm	295Nm, 219 ft. lbs.
24mm	406Nm, 300 ft. lbs.

Blade Securing Nut — Drwg. 176426, Item 12		
Hub Size	Nut size	Torque
40A	M12	unstamped- 45 ft. lbs., blade stamped "H"- 60 ft. lbs.
40A	M14	blade stamped "F"- 70 ft. lbs.
56A-71A	M20	180 ft. lbs.
56A-71A	M24	250 ft. lbs.



VAROFOIL MANUAL

DRAWING NO. 176300 - SHEET 2 OF 2 GENERAL ARRANGEMENT 40A HUB VAROFOIL MK3 IMPELLER

SECTION

12

ITEM	DESCRIPTION	DRG/P.N.	QTY.	REMARKS
22	Clamp ring	403465	1	
23	Screw Skt. Cap M6 x 20LG	71726	4	
24	Housing Diaphragm	403467	1	
26	Screw Skt. Cap M6 x 20LG	71726	8	
27	End Cover	403469	1	
28	Screw Tapille Hex HD M5 x 12LG	401829	9	
29	Rotary Union	404764	1	
30	Balancing kit	AS15854	1	To spec. 93
31	Impeller fixing	—	1	See note 6
32	Plug-Hub Port	406224	3	Fit when reqd. see schedule
33	Washer Hub Port	406225	3	Fit when reqd. see schedule
34	Bolt M10x 45LG	74812	3	Fit when reqd. see schedule
35	Nut M10 Blhx	89095	3	Fit when reqd. see schedule

ITEM	DESCRIPTION	DRG/P.N.	QTY.	REMARKS
1	Hub	403427	1	D132 Motor 9 blades
		403428		D160 Motor 9 blades
		403429		D180 Motor 9 blades
		403430		D200 Motor 9 blades
		403432		D132 Motor 6 Blades
		403433		D160 Motor 6 Blades
		403434		D180 Motor 6 Blades
		403435		D200 Motor 6 Blades
		M14 x 2		
		M12 x 1.75		
2	Blade carrier Assy.	410733	9*	Sub assembly. 0 Deg.
3	Blade	410766	9*	63Kg 2 Pole
		410768	9*	71Kg 2 Pole
		410770	9*	80Kg 2 Pole
		410767	9*	63Kg 4 Pole
		410769	9*	71Kg 4 Pole
		410771	9*	80Kg 4 Pole
		410772	9*	90Jg 4 Pole
		410773	9*	100Jg 4 Pole
4	Pin Tension	403452	18*	spiral ϕ 3 x 12 LG
5	Washer shim	410729	55038	9* 0.635mm (0.025") thick
6	Nut Hex. (metric)	410730	406033	9* Blhx.
7	Washer shim .190 Thk.	88661	9*	Mellinex
8	Washer Shim .508 Thk.	79204	9*	Nylatron G.S.
9	Washer Shim .635 Thk.	79205	9*	Nylatron G.S.
10	Plug Red	404762	1	R Moss Ltd. Type A 1012
11	Actuator	407991	1	with min. stop holes
12	Linear Actuator	403468	1	
13	Pin Spring Tension	403457	1	ϕ 4 x 36 LG
14	Screw Actuator	403475	1	
15	Screw. Hex. HD M8 x 50LG	400495	3	Min stops 404781 Qty:3
16	Nut Full M8	89088	6	
17	Plate reaction	403459	1	
18	Screw pan slot M6 x 20LG	83930	4	
19	Gasket Inner	403460	1	not used with moulded diaph.
20	Diaphragm Flex./Fabricated	403464	1	moulded 409843
21	Gasket outer	403461	1	not used with moulded diaph.

Assembly Notes

- Take hub item 1 & fit blade carrier assemblies item 2 & red plug item 10.
- To Blade item 3 fit pins item 4 & fit into hub, through blade carrier with sufficient shim washers items 7, 8 & 9 so that free end play does not exceed 0.25mm. Retain in position with nut item 6 & washer item 5 after aligning blade carrier & blade. (pitch angle set later.) Ensure nut has correct thread.
- To actuator item 11 fit bearing liner item 12 & pin item 13 in flange hole. Align all cam followers, fit the actuator to hub rotating actuator to retain all cams. Fit screw item 14 into actuator. Fit "stop" screws item 15 into actuator with nuts item 16. Set pitch angle by adjusting "stop" screws & lock in position with nuts.
- Fit reaction plate item 17 hub securing in position with screws item 18.
- (See General Note 4.) Fit gasket inner item 19 on to reaction plate, then position flexible diaphragm item 20, gasket outer item 21 & clamp ring item 22 against reaction plate & retain in position with screws item 23. Take housing diaphragm item 24 fit bearing liner item 25 & then fit housing to actuator, ensuring flexible diaphragm is in position, secure housing to actuator with screws item 26.
- Balance impeller, then fit to motor retaining in position with clamp washer P.N. 403732-35 & screw P.N. 72295 for D132 motor, 71724 for D160/180 motors & 71725 for D200 motors (called for on motor duct assy.) Now see note 10.
- Fit rotary union item 29 to housing diaphragm.
- Use "Loctite" screwlock P.N. 37922 on the following items before assembly.

Item	14	23	26	30	31	34
Part No.	403475	71726	71726	See list.	See Note 6	74812

- Lubricate lightly both sliding bearing surfaces with shell alvania grease R.A. P.N. 35407.
- On final assembly of diaphragm to fan make air-tight seals using 2mm Dia. beading of compound P.N. 88562 around edges of diaphragm and fixing holes before fitting housing. Not required with moulded diaphragms.

General Notes

- Hub ports to be marked in numerical order. All blades & blade carriers to be marked with corresponding numbers to hub port.
- Alignment marks to be stamped on actuator, reaction plate & diaphragm housing.
- Item quantities listed are for full solidity fans, marked thus *
- Inner & outer gaskets are not used with moulded diaphragms (item 20).

Drawn	S.W.	11.9.81	Mod. C	Mod. D	Mod. E	Mod. F	Mod. G	Mod. H
Checked			Redrawn to design mod. alterations	Item 15 was P.N. 404781 M3 x 50 grub screw "W" point	Min. stops added	See sheet 1	See sheet 1	See sheet 1
Traced	MB	13.11.82						
Checked			S.W. 11.9.81	C.R.W. 7.9.82	C.R.W. 14.6.84	C.R.W. 15.10.85	C.R.W. 31.3.87	C.R.W. 10.10.88



VAROFOIL MANUAL

DRG NO. 177724 - SHEET 1 OF 3 IMPELLER DUCT ASSEMBLY W/EXTERNAL PILOT POSITIONER 40A VAROFOIL MK3 12

SECTION

ITEM	DESCRIPTION	DRG/P.N.	QTY.	REMARKS
58	Washer M10 Plain	89080	1	
59	Tube Nylon Flexible 6 Dia.	7086	0.25 M	
60	Elbow Male	89084	1	Johnson F500-21
61	Adaptor Straight	89083	2	Johnson F100-21
62	Plate Pitch Angle Indicator	403567	1	
63	Screw No. 6 x 3/4 PoZI Pan Hd.	655040	2	
64	Guard Pilot Positioner	405039	1	
65	Label Connection Diag.	405055	1	
66	Cable Tie Strap	6899	3	
67	Plug Sight Port	74018	1	
68	Adaptor M5 x 5	405557	1	
69	Tube Nylon Flexible 6" Dia.	7086	0.6 M	Cut to Suit
70	Clip	74046	2	
71	Adaptor M6 x 12	77983	1	
72	Washer Plain M6	82949	1	
73	Connector Nipple M5	77982	1	
74	Lubricator Nipple M6	77982	1	
75	Relay Reversing	408297	1	Satchwell Ref-R418/2
76	Connector T' Pattern	406298	1	Transatlantic products Ltd. Ref-XT1982

ITEM DESCRIPTION	P.N.	QTY.
Blade Thrust Bearing	403448	per blades
Rotary Union (1005-165-064)	404764	1
Pilot Positioner	79984	1
Pilot Positioner Spring	403101	2
Diaphragm (molded)	409843	1
Diaphragm (flexible)	403484	1
Flexible air pipe	405043	1
Flexible tubing (6mm)	74046	per meter
Operating Cable	630	405033
	710	405034
	800	405035
	900	405036
	1000	407456
Reaction Plate Screws (m6x20 pan slot)	83930	4
Blade Securing Nut (M12)	406033	per blades
Blade Securing Nut (M14)	410730	per blades
Set of Balance Weights	AS15854	1
Liner - Actuator (14 3/8")	403468	1
Liner - Diaphragm HSG (2 1/2")	403456	1
Blue Liner Material (bulk)	76097	per foot
Nylon Cam Rollers	401304	per blades
Nylon Cable Trolley	403098	1
Wing Bearing Grease	WC35408	per tube
Loctite Screwlok (#2-2...34oz.)	37922	1

RECOMMENDED SPARE PARTS

ITEM	DESCRIPTION	DRG/P.N.	QTY.	REMARKS
17	Strut Support	405028	1	1000 Duct Dia.
18	Bracket steady air pipe couple	405049	1	800/900/1000 Duct Dia. only
19	Pipe clip	22181	1	800/900/1000 Duct Dia. only
20	Screw M5 x 16 Hex Hd.	89149	3	800/900/1000 Duct Dia. only
21	Washer M5 Plain	89105	3	800/900/1000 Duct Dia. only
22	Nut M5 Full Hex	82501	3	800/900/1000 Duct Dia. only
23	Bracket Rotary Union	405046	1	
24	Bracket Clamp Rotary Union	405047	2	
25	Screw M4 x 16 Hex Hd.	404110	2	
26	Nut M4 Full Hex	54878	4	
27	Grommet	72282	1	
28	Operating Cable	405033	1	630 Duct Dia.
		405034	1	710 Duct Dia.
		405035	1	800 Duct Dia.
		405036	1	900 Duct Dia.
		407456	1	1000 Duct Dia.
29	Cable Restraint	403095	1	
30	Screw M5 x 10 Hex Hd.	89061	2	
31	Washer M5 S/Proof	6024	2	
32	Pulley Mtg. Block	403096	1	
33	Screw M8 x 30 Hex Hd.	76583	1	
34	Washer M6 S/Proof	6025	9	
35	Pin Spring Tension 8 Dia. x 10	403097	1	
36	Screw M6 x 16 Hex Hd.	89075	8	
37	Washer M6 Plain	89078	4	
38	Pulley	403098	1	
39	Pulley Retaining Nut	403099	1	
40	Bracket Pilot Posit. Mtg.	405037	1	
41	Bracket Spring Tension	405038	1	
42	Bracket Operating Cable Adj.	405042	1	
43	Pointer Pitch Angle Indicator	405044	1	
44	Spring tension.	403100	2	
45	Link Operating Cable	405048	1	Johnson V6502
46	Pilot Positioner	79984	1	
47	Arm Pilot Positioner	405045	1	
48	Screw No. 2 x 3/4" S/Tap PoZI Pan Hd.	54088	2	
49	Screw M4x30 PoZI Pan Hd.	83103	1	
50	Screw M4x16 PoZI Pan Hd.	83103	1	
51	Washer M4 Plain	70731	2	
52	Washer M4 S/Proof	6023	2	
53	Spring Pilot Positioner	403101	2	
54	Adj. Clip Spring Pil. Pos.	405678	2	
55	Link Spring Positioner	403102	2	
56	Adaptor Straight	71574	1	
57	Elbow Female 1/8" BSP	22397	1	

ITEM	DESCRIPTION	DRG/P.N.	QTY.	REMARKS
1	Duct Impeller	405012	1	630 Duct Dia.
		405013	1	710 Duct Dia.
		405014	1	800 Duct Dia.
		405015	1	900 Duct Dia.
		405016	1	1000 Duct Dia.
2	Inseal 375 sealant strip	86530	7.0Fl.	630 Duct Dia.
			8.0Fl.	710 Duct Dia.
			9.0Fl.	800 Duct Dia.
			10.5Fl.	900 Duct Dia.
			11.5Fl.	1000 Duct Dia.
3	Screw M10 x 25 Hex Hd.	89121	18	630 Duct Dia. fixing
			24	710/800 Duct Dia. fixing
			24	900/1000 Duct Dia. fixing
4	Washer M10 S/Proof	89384	24	630 Duct Dia. fixing
		89345	18	630 Duct Dia. fixing
			24	710/800 Duct Dia. fixing
5	Washer M12 S/Proof	89346	24	900/1000 Duct Dia. fixing
		89344	18	630 Duct Dia. fixing
			24	710/800 Duct Dia. fixing
6	Nut M12 Full Hex	89072	24	900/1000 Duct Dia. fixing
		402253	2	630 Duct Dia.
		402254	2	710 Duct Dia.
		402255	2	800 Duct Dia.
		404845	2	900-Duct Dia.
		402256	2	1000 Duct Dia.
7	Relay Union	404764	1	Called up on impeller schedule
8	Flexible Air Pipe	405043	1	
9	P.T.E. tape	405038	0.5 Fl.	
10	Pipe Air Couple	405027	1	630 Duct Dia.
		405028	1	710 Duct Dia.
		405029	1	800 Duct Dia.
		405030	1	900 Duct Dia.
		405031	1	1000 Duct Dia.
11	Locknut 1/8" BSP	632369	1	630 Duct Dia.
12	Strap support	405017	1	630 Duct Dia.
		405018	1	710 Duct Dia.
		405019	1	800 Duct Dia.
		405020	1	900 Duct Dia.
		405021	1	1000 Duct Dia.
13	Screw M8 x 30 Hex Hd.	6409	4	
14	Washer M8 Plain	89079	7	
15	Washer M8 S/Proof	5338	4	
16	Nut M8 full Hex	89088	4	
17	Strut Support	405022	1	630 Duct dia.
		405023	1	710 Duct Dia.
		405024	1	800 Duct Dia.
		405025	1	900 Duct Dia.

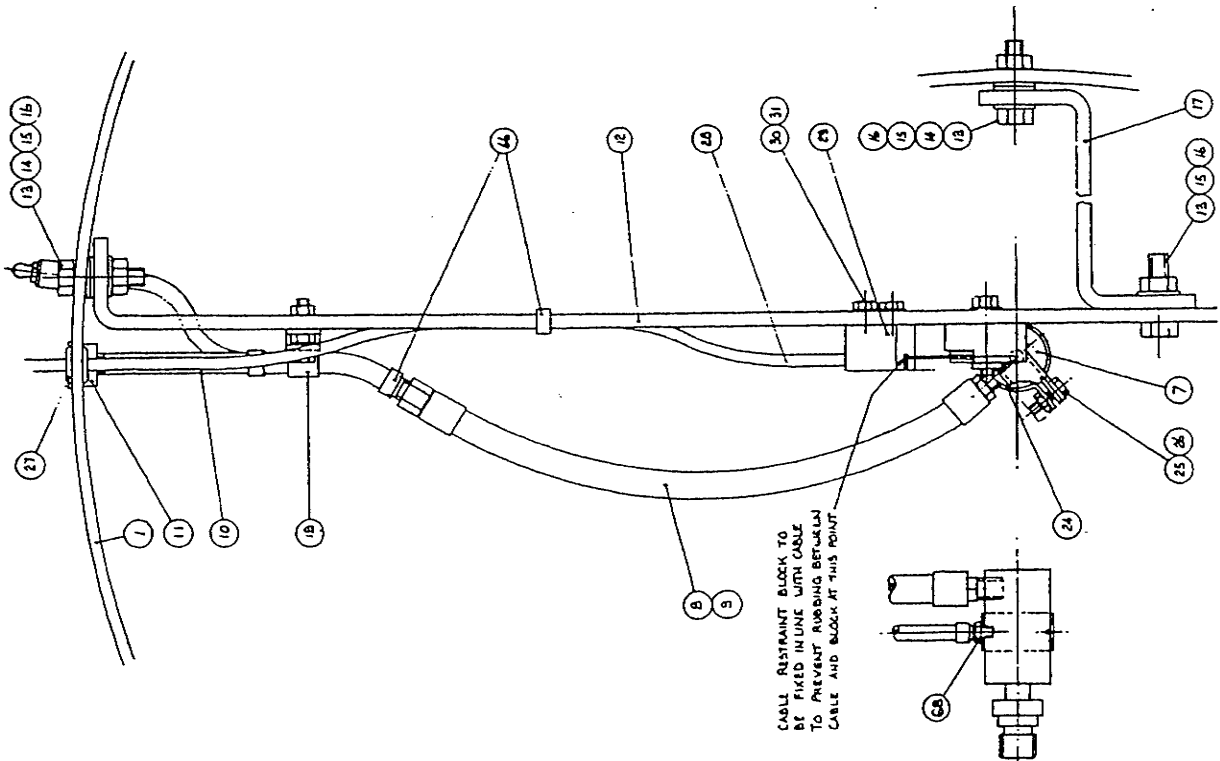
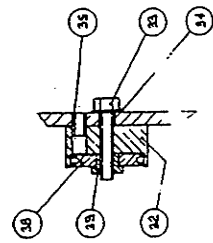
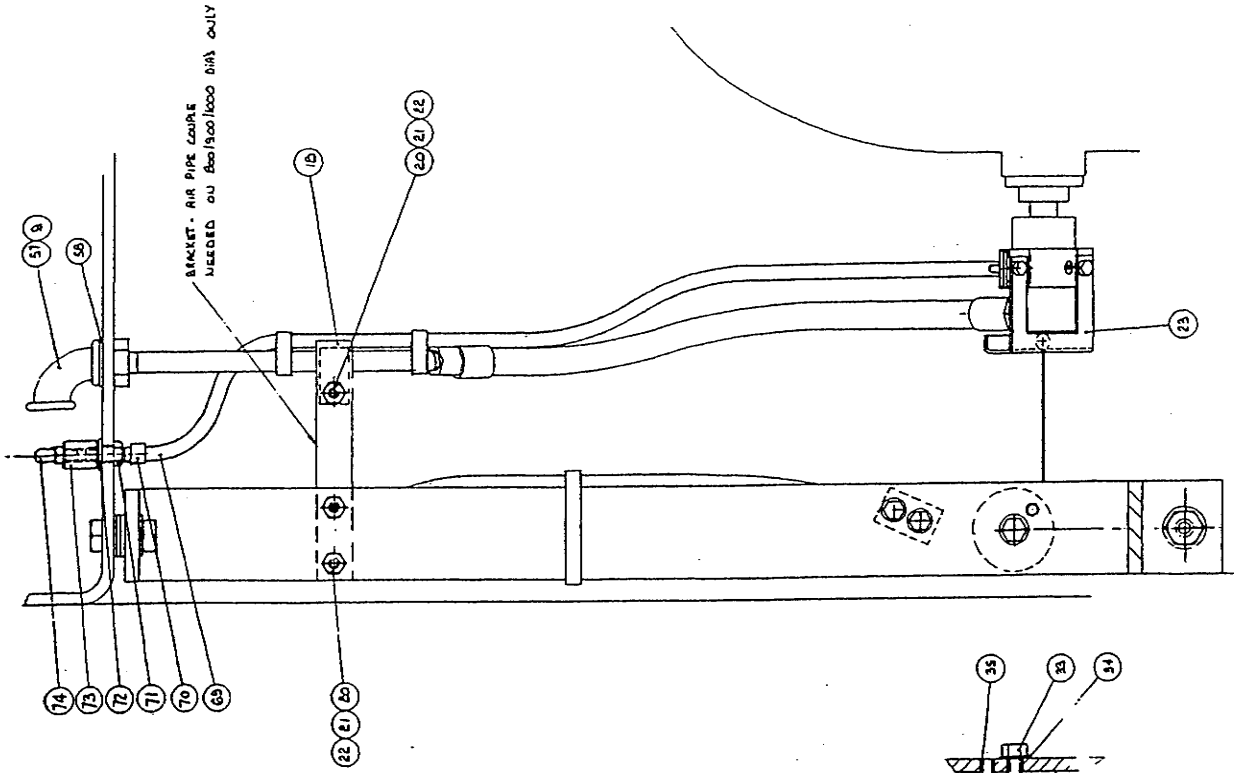
NOTE: For vertical Mtg. stays see Drg. No. 189518

Drawn	Checked	Traced	Checked	Sig.	Date	Mod. A	Mod. B	Mod. C	Mod. D	Mod. E	Mod. F
JHB	28.9.80										
Lubricator pipe Assy. for rotary union added	Items 75 & 76 added. see sheet 3	Items 77 & 78 added. see sheet 3	Item 64 PN 405878 was added. see sheet 3	Item 29 PN's revised	Item 77 1-clip PN 40964 & item 78, 2 screws PN 72560 deleted						
	C.A.W. 5.3.81	GAC 9.12.81	GAC 8.1.82	GPC 1.10.82	C.R.W. 23.12.82	KCD 17.2.84					

Assembly Notes

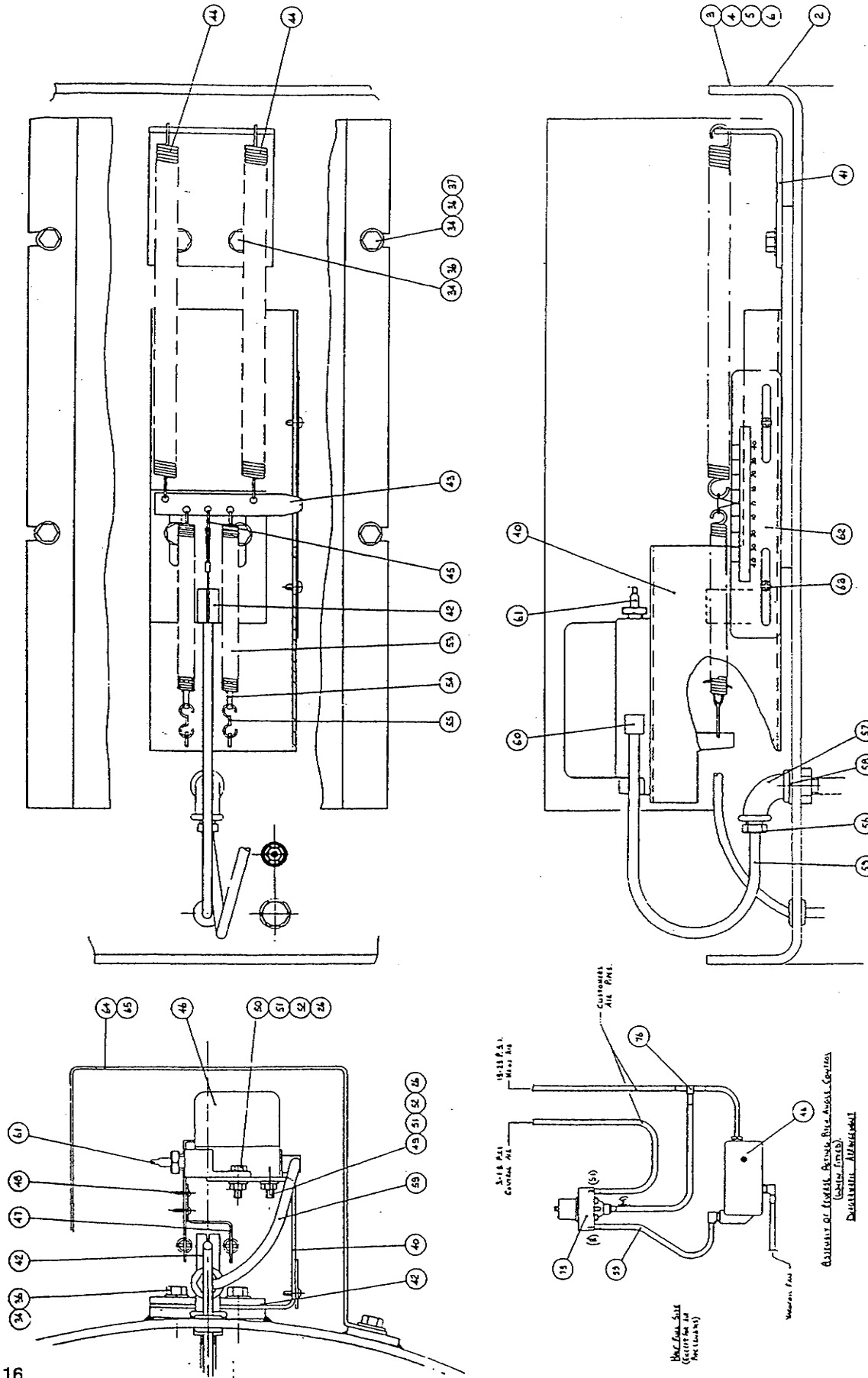
- Take rotary union and fit flexible air pipe sealing thread with PTFE tape then fit rotary union to impeller sealing thread with red hermitite PN 54483.
- Take air couple pipe and fit locknut to straight end. Locate pipe in duct, fit washer and elbow female to pipe on outside of duct. Seal with seamastic sil-ver line sealing compound PN 54376. Tighten locknut on inside of duct ensur-ing that air pipe and elbow are in the correct position. Fit flexible pipe to air couple pipe sealing threads with PTFE tape.
- Adjust operating cable adjustment bracket so as to take up slack in operating cables outer casing and stretch the tension springs to a dimension of 213mm.
- Take pilot positioner and remove cover. Fit positioner to mounting bracket, do not tighten screws at this stage. Take springs and cut to required length. Fit screws and links and connect between positioner and positioner lever arms as shown on Dwg. 177723.
- Supply air at 25 PSI and signal supply at 3 PSI and adjust positioner spring tension to position the positioner on the mounting bracket spring to have 80 initial tension but must not be slack. Tighten fixing screws and roll cover.
- Fit lubricator pipe and fill with grease BR82, SRI-2, Dolum-R, PN 78944.

- Take rotary union and fit flexible air pipe sealing thread with PTFE tape then fit rotary union to impeller sealing thread with red hermitite PN 54483.
- Take air couple pipe and fit locknut to straight end. Locate pipe in duct, fit washer and elbow female to pipe on outside of duct. Seal with seamastic sil-ver line sealing compound PN 54376. Tighten locknut on inside of duct ensur-ing that air pipe and elbow are in the correct position. Fit flexible pipe to air couple pipe sealing threads with PTFE tape.
- Adjust operating cable adjustment bracket so as to take up slack in operating cables outer casing and stretch the tension springs to a dimension of 213mm.

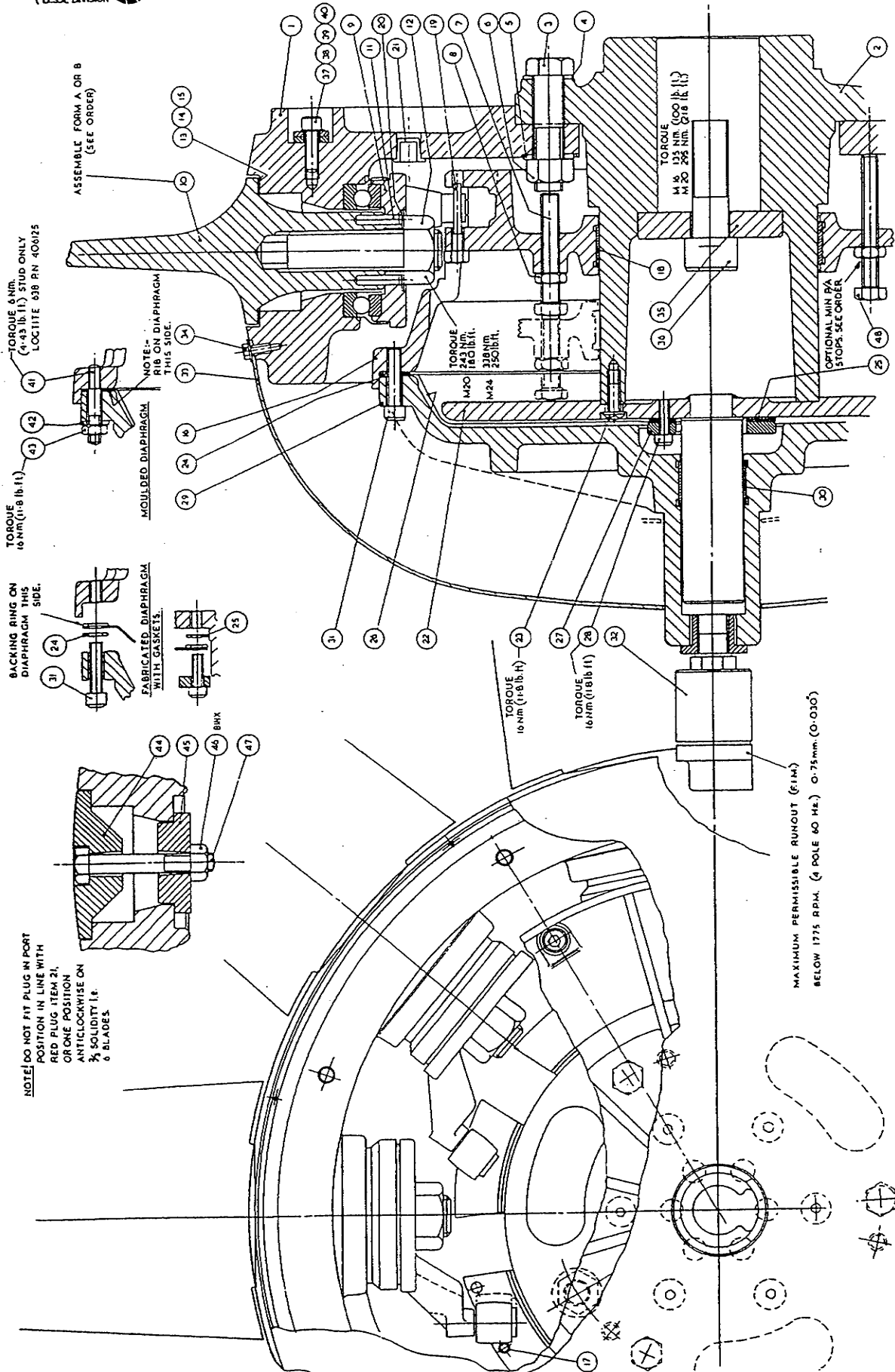


Sig.	Date	Mod. A	Mod. B	Mod. C	Mod. D	Mod. E	Mod. F
JHB	26.9.80	Lubricator pipe assy. for rotary union added	See sheets 1 & 3.	See sheets 1 & 3.	See sheet 1	See sheet 1	See sheet 1
Checked							
Traced							
Checked		C.R.W. 5.3.81	QAC 9.12.81	QAC 8.1.82	GPC 1.10.82	C.R.W. 23.12.82	KCD 17.2.84

DRAWING NO. 177724 - SHEET 3 OF 3
IMPELLER DUCT ASSEMBLY W/EXTERNAL PILOT POSITIONER 40A VAROFOIL MK3



Sig.	Date	Mod. A	Mod. B	Mod. C	Mod. D	Mod. E	Mod. F
Drawn	JHB 126.9.80	Lubricator pipe assy. for rotary union added	Diagram of Filling Reverse Acting P.A. control added. See sheet 1.	Diagram of Filling Reverse Acting P.A. control revised. New type of control	See sheet 1	See sheet 1	See sheet 1
Checked							
Traced							
Checked		C.R.W. 5.3.81	GAC 9.12.81	GAC 9.1.82	GPC 1.10.82	C.R.W. 23.12.82	PCD 17.2.84



Sig.	Date	Mod. A	Mod. B	Mod. C	Mod. D	Mod. E	Mod. F	Mod. G	Mod. H
Drawn	WJR	1.10.75	Corrected pictorially 8 blades from 10. See sheet 2	Revised in line with components.	Revised P/A stops added.	Item 23 was counter-sunk. Screw P.N. 405542	Blade nut torque was 130 lbs. ft. 178 Nm.	M24 Blade fixing added.	Torque figures & Locite added for moulded diaphragm fitting seat compound was P.N. 405714
Checked	MP	23.9.81		DN 19.8.81	EW 14.1.82	EW 14.8.84	CRW 14.2.86	CRW 7.10.88	Item 48 was full cut P.N. 68072
Traced									
Checked									

RECOMMENDED SPARE PARTS

ITEM	DESCRIPTION	P.N.	QTY.
	Blade Thrust Bearing	406138	per blades
	Rotary Union (1115-000-001)	54749	1
	Pilot Positioner	79984	1
	Pilot Positioner Spring	403101	1
	Diaphragm (molded)	406137	1
	Diaphragm (flexible)	403656	1
	Flexible air pipe	403075	1
	Flexible tubing (6mm)	900-1120	per meter
	Operating Cable	1250-1400	1
		1800-1800	1
	Reaction Plate Screws (m8x16 BHc)	407561	6
	Blade Securing Nut (M20)	76599	per blades
	Blade Securing Nut (M24)	408398	per blades
	Set of Balance Weights	AS15558	1
	Liner - Actuator (16 1/8")	403650	1
	Liner - Diaphragm HSG (4 1/2")	403399	1
	Blue Liner Material (bulk)	76097	per foot
	Nylon Cam Rollers	80444	per blades
	Nylon Cable Pulley	403098	1
	Wing Bearing Grease	WC35408	1
	Locitite Screwlok (#242-.34oz.)	37922	1

General Notes

- Hub ports to be marked in numerical order. All blades and blade carrier assemblies to be marked with corresponding numbers to hub ports.
- Alignment marks to be stamped on hub, end cover, reaction plate, actuator and diaphragm housing.
- Add "Locitite" screwlock to the following items before fitting to assembly. P.N. 37922 (Locitite 221).

Item	19	28	31	36	37	47	41	23	43
Part No.	403401	71726	72561	77704	71724	See List	89313	405789	407561 89088

- Majority of fans will require shims (Part No. 79212) Item 15 only. However items 13 & 14 may be used as required.
- Lubricate lightly both sliding bearing surfaces with shell alvania grease R.A. P.N. 35407.

Blade Solidity	Carrier Item 9	Blade Item 10	Pin Item 18	Nut Item 9	Shim Item 9	Washers Item 9	Washer Item 9	Items 44-47
9	9	9	18	9	9	9	9	NIL
2/3	6	6	12	6	6	6	6	6
1/3	3	3	6	3	3	3	3	3

ITEM	DESCRIPTION	DRAWN	QTY.	REMARKS
35	Clamp Washer 21 Bore	403660	1	D250-D200 Motor
	Clamp Washer 17 Bore	403861		D180-D160 Motor
38	Screw M20 x 70 Cap Hd.	77704	1	D250-D200 Motor
	Screw M16 x 50 Cap Hd.	71724		D180-D160 Motor
37	Screw M8 cap. Hd.	71724, 71049, 72541, 7048		As Required
38	Balance Weight	401136-41		As Required
39	Washer M8 Plain	89079		As Required
40	Washer Shim	631233		As Required
41	Stud M8 x 48 Lg.	405789	12	Use with molded diaph.
42	Washer M8 Plain	89079	12	
43	Nut M8 Full	89088	12	
44	Plug Hub Port	408226	refer table	Use if on Assy. Schedule
45	Washer Hub Port	408227		
46	Nut M12 Blinx	89068		
47	Ball M12 x 75	89313		
48	Screw M10 x 80	408251	3	Min P/A Stops
49	Screw M10 x 100	409630	3	Alternative if Required

Assembly Notes

- Take hub 1 and fit hub adaptor 2 retaining in position with screws 3 washers 4 & 5 and nuts 6 then fit plug 21.
- Fit blade carrier assembly 9 into hub. Take blade 10 and fit pins 11 then fit blades in hub to blade carrier assemblies retaining in position with washers 20 & nuts 12 after ensuring that free end play does not exceed 0.25 by fitting shim washers 13, 14, & 15 as required.
- Take actuator 16, fit pin 17 and bearing liner 18 align all cam followers, then fit actuator to hub, rotating same to retain all cams. Fit screw 19.
- Fit Screw 7 and nut 8 to actuator and adjust maximum pitch angle.
- Fit reaction plate 22 to hub retaining in position with screws 23.
- Fit studs 41 to actuator.

Flexible diaphragm 26 and clamp ring 27 against reaction plate and retain in position with screws 28. Take housing diaphragm 29, fit bearing liner 30, then fit housing to actuator with washers 42 & nuts 43. Fit rotary union 32 to housing.

- Fit end cover 33 to hub with screws 34, then balance impeller using 37, 38, 39, & 40 spec. 93
- After balancing, fit impeller to motor retaining with clamp washer 35 and screw 36.

On final assembly of diaphragm to fan make air tight seals using 2.0 mm dia. beading of compound P.N. 88562 around edges of diaphragm and fixing holes before fitting housing. Not required with moulded diaphragm.

Drawn	WJF	1.10.79	See Sh.	See Sh.	See Sh.	See Sh.	See Sh.	See Sh.	See Sh.
Checked									
Traced	MP	3.11.81							
Checked									

ITEM	DESCRIPTION	DRAWN	QTY.	REMARKS
1	Hub 9 Blade	403631	1	
	Hub 6 Blade	403632		Not Req'd when plugs used
	Hub 3 Blade	403737		Not Req'd when plugs used
2	Hub Adapter 70 Bore	403635	1	D250 Pad Mid.
	Hub Adapter 60 bore	403636		D225 Pad Mid.
	Hub Adapter 55 Bore	403637		D200 pad Mid.
	Hub Adapter 48 Bore	403638		D180 Pad Mid.
	Hub Adapter 42 Bore	403639		D160 Pad Mid.
3	Bolt M16 x 70 Hex Hd.	89381	6	
4	Washer M16 plain	89098	6	
5	Washer M16 s/proof	55680	6	
6	Nut M16 Full	55917	6	
7	Screw P.A. Adjustment	405792	3	M10 x 65
8	Nut M10 Full	89344	3	Min P/A Stops Qty. 6
9	Blade Carrier Assy.	M20 407557	refer table	M24 408416 5 Deg.
		M20 403642	refer table	M24 408402
		M20 403643	refer table	M24 408403
		M20 403644	refer table	M24 408404
		M20 403645	refer table	M24 408405
		M20 403646	refer table	M24 408406
		M20 403647	refer table	M24 408407
11	Pin Spring Tension 0.6 x 24	404124	refer table	Blade Location
12	Nut Blinx	M20 76589	refer table	M24 408398
13	Shim Washer .190 Thk.	88696	refer table	Mellinex
14	Shim Washer .508 Thk.	79211	refer table	Nyatron G.S.
15	Shim Washer .635 Thk.	79212	refer table	Nyatron G.S.
16	Actuator	403649	1	Min P/A stops 407992
17	Pin Spring Tension 0.6 x 40	78111	1	
18	Liner Actuator	403650	1	
19	Screw Cam Location	403401	1	
20	Washer Shim	M20 531878	refer table	M24 55037
21	Plug Red Polythene	404762	1	
22	Reaction Plate	403653	1	
23	Screw M8 x 16 Button Hd. Skt	407561	6	
24	Gasket Outer	403654	1	Not required with moulded diaphragm.
25	Gasket Inner	403403	1	
26	Flexible Diaph. Fabricated	403656	1	Moulded 406137
27	Clamp Ring	403408	1	
28	Screw M6 x 20 Cap Hd.	71726	6	
29	Housing Diaphragm	407643	1	
30	Liner Housing	403399	1	
31	Screw M8 x 35 Cap. Hd.	76198	12	Used with Fabricated diaph.
32	Rotary Union	54749	1	
33	End Cover	403659	1	
34	Screw M5 x 12 Tapille	401829	9	
35	Clamp Washer 21 Bore	403660	1	D250-D200 Motor
	Clamp Washer 17 Bore	403661	1	D180-D160 Motor
36	Screw M20 x 70 Cap Hd.	77704	1	D250-D200 Motor
	Screw M16 x 50 Cap. Hd.	71724		D180-D160 Motor
		71724, 71049, 72541, 7048		As Required
37	Screw M8 cap. Hd.	401136-41		As Required
38	Balance Weight	89079		As Required
39	Washer M8 Plain	631233		As Required
40	Washer Shim			As Required

Assembly Notes

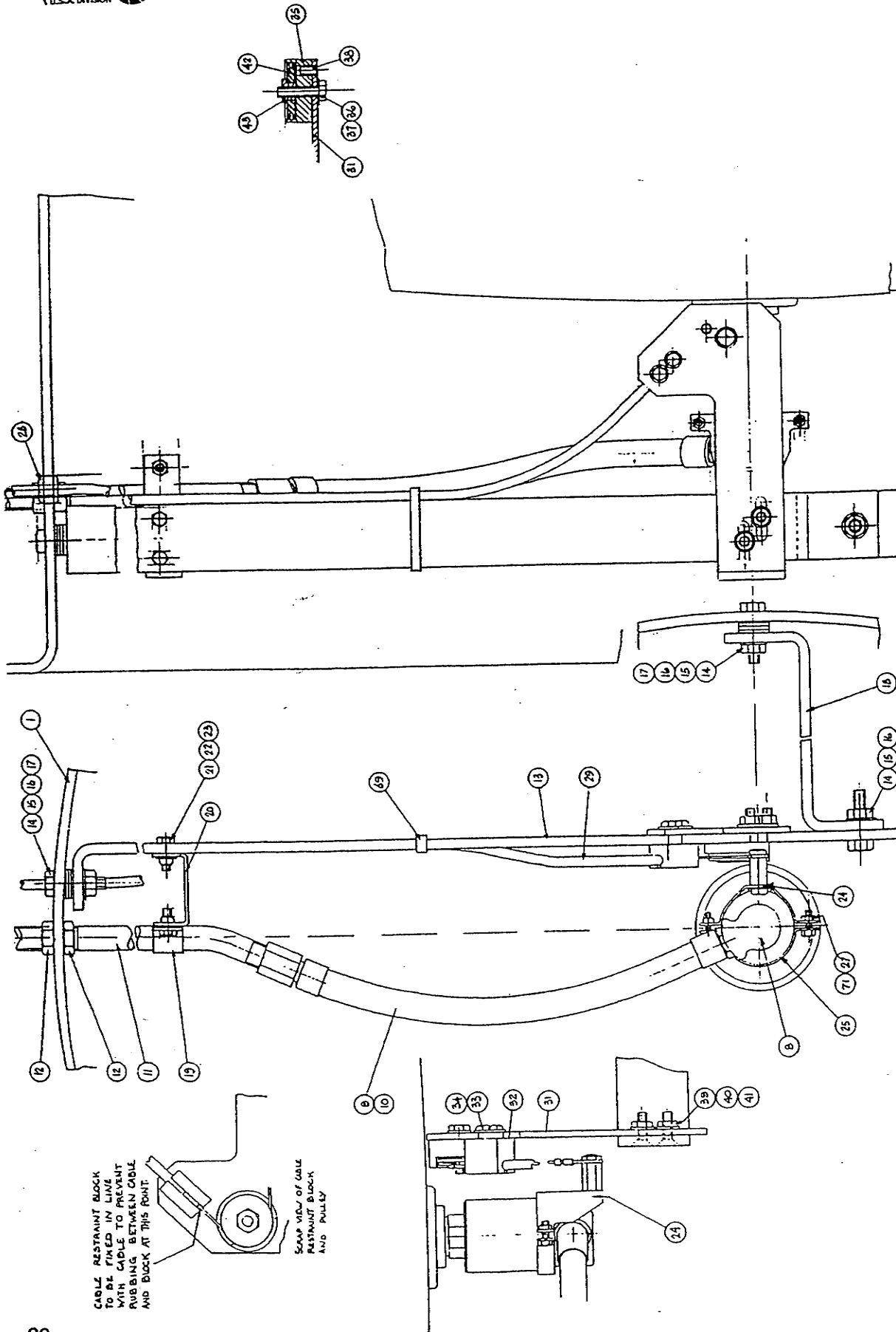
- To duct 1 fit sealant strip 2 to impeller end flange, offer duct to motor duct, centralize about impeller and retain in position with screws 3, washers 4 and nuts 5.
- Fit attachable foot 7 to impeller duct. Secure in position with screws 3, washers 4, and nuts 5.
- Take rotary union 8 and fit flexible air pipe 9, sealing thread with PTFE tape 10. Fit rotary union to impeller, with threads sealed with pure silicon.
- To air pipe couple 11 fit one locknut 12 to straight end and locate pipe in duct - Fit remaining locknut 12 to pipe on outside of duct, seal threads with PTFE tape, and tighten locknut (on outside of duct) after ensuring that the air pipe is in the correct position. Connect flexible air pipe to air pipe couple, sealing threads with PTFE tape.
- Fit strap support 13 to duct with screws 14 washers 15 and nuts 16, centralizing with washers 17. Fit strut support 18 to strap and duct with screws 14 washers 15, and nuts 16, pack gap between strut and duct with washer 17 as required.
- Secure air pipe to strap support with clip 19 and bracket 20 retaining in position with screws 21 washers 22 and nuts 23.
- Fit clamp assembly 24 and clamp 25 to rotary union, securing in position with screws 26 and nuts 27.
- Fit grommet 28 in duct, pass cable operating 29 through grommet, position operating cable 30 loop in groove on cable pillar on clamp assembly.
- To mounting plate pulley 31 fit cable restraint block 32 with screws 33 and washers 34 and pulley mounting block 35 with screw 36 washer 37 and pin 38. Fit plate sub-assembly to strap support with screws 39, washers 40 and nuts 41. Pass inner cable through restraint block and locate outer casing in block. Take pulley 42 locate inner cable in groove and locate to pulley block with pulley retaining nut 43.
- Fit bracket mounting 44 and bracket plate mounting 45 to outside of duct with screws 46 and washers 47. Note position of brackets.
- Take hook cup 47 and fit pointer 48 using rivets 49. Place pin operating clip to retain pin in position. Pass inner cable through hole in boss on mounting bracket and locate outer casing in boss. Fit springs 50 between hook clip and mounting bracket.
- To pilot positioner 51 fit adapter 52 and elbow male 53 as shown in Sht. 3. Remove cover and fit positioner to mounting bracket with screws 54 and 26, washers 55 and 56 and nuts 27 but do not tighten screw at this stage. Take spring 57 and cut to required length, fit clip 58 and link 59 and connect between hook clip and positioner lever arm, as shown on Drg. No. 175719.
- Fit adapter external 60 to air pipe sealing thread with PTFE tape. Take stem elbow connector 61 place nut 62 and cone 63 on stem and connect to adapter. Fit air pipe 64 between stem elbow connector and elbow male on pilot positioner.
- Supply air at 25 PSI and signal supply at 3 PSI and adjust positioner spring tension by positioning the positioner on the mounting bracket. Spring to have no initial tension, but must not be slack. Tighten up fixing screws and retic cover.
- Take pitch angle indicator plate 65 and stamp pitch angles in the panel provided and affix to bracket plate mounting with screws 66. Adjust plate to align with pointer. Check impeller pitch angle range and adjust impeller if necessary.
- Fit guard 67 to duct with washers 39 and nuts 37 and 40. Affix label 68 on top of guard - aligned with pilot positioner.
- Adjust position of operating cable and secure with tyrap 69
- Finally fit plug sight port 70 in duct.

ITEM	DESCRIPTION	DRG/P.N.	QTY.	REMARKS
20	Bracket Air Pipe	403087	1	
21	Screw M5 x 16 Hex Head	89149	4	
22	Washer M5 Plain	89105	4	
23	Nut M5 full Hex	82501	4	
24	Clamp Assembly	403418	1	
25	Clamp	87626	1	
26	Screw M4 x 16 PozDrive Pan Hd.	83103	1	
27	Nut M4 Full Nut	54878	4	
28	Grommet	72282	1	
29	Cable Operating	403088	1	900-120 Duct Dia.
30	Pin Operating Cable	403098	1	1250-1400 Duct Dia.
31	Mounting Plate pulley	403094	1	1600 Duct Dia.
32	Cable Restraint	403095	1	
33	Screw M5 x 10 Hex Head	89061	2	
34	Washer M5 S/Proof	6024	2	
35	Pulley Mounting Block	403096	1	
36	Screw M6 x 25 hex Head	82746	1	
37	Washer M6 S/Proof	6025	11	
38	Pin Spring Tension M6 x 10	403097	1	
39	Screw M8 x 20 CSK Hd.	72077	2	
40	Washer M6 Plain	85078	6	
41	Nut M6 Full Hex	6992	2	
42	Pulley	403098	1	
43	Pulley Retaining Nut	403099	1	
44	Bracket Mounting	406050	1	
45	Bracket Plate Mounting	400485	1	
46	Screw M6 x 16 Hex Hd.	89076	8	
47	Hook Clip	87637	1	
48	Pointer Pitch Angle Indicator	400486	1	
49	Rivet No. 4 x 1/4" Drive Screw	633662	2	
50	Spring Tension	403100	2	
51	Pilot Positioner	79984	1	Johnson Y-9502
52	Adapter Straight	89083	2	Johnson F100-21
53	Elbow Male	89084	1	Johnson F500-21
54	Screw M4 x 30 PozDrive Pan Hd.	71584	1	
55	Washer M4 Plain	70731	2	
56	Washer M4 S/Proof	6023	2	
57	Spring Positioner	403101	1	
58	Adj. Clip. Spring Pil. Pos.	405876	1	
59	Link Spring Positioner	403102	1	
60	Adapter External	400035	1	
61	Stem Elbow Connector	400510	1	Martonall 5/8/1/3
62	Nut 1/4 In. 1/4 BSP	79998	1	
63	Cone 1/4 In.	79987	1	
64	Air Pipe	87639	1	
65	Plate - Pitch Angle Indicator	400408	1	
66	Screw No. 6 x 3/4" S/Tap	655040	2	
67	PozDrive Pan Hd.	400489	1	
68	Guard Pilot Positioner	405055	1	
69	Label Connection Diagram MK3	6899	2	
70	Plug sight Port	74018	1	
71	Screw Hex Hd. M4 x 12	404110	2	

ITEM	DESCRIPTION	DRG/P.N.	QTY.	REMARKS
1	Duct Impeller	404281	1	900 Duct Dia.
		404282		1000 Duct dia.
		404283		1120 Duct Dia.
		404284		1250 Duct Dia.
		404285		1400 Duct Dia.
		404982		1600 Duct Dia.
2	Inseal 375 Strip Sealant	88530	10.5 Ft	900 Duct Dia.
			11.5 Ft	1000 Duct Dia.
			13.0 Ft	1120 Duct Dia.
			14.0 Ft	1250 Duct Dia.
			15.5 Ft	1400 Duct Dia.
			17.5 Ft	1600 Duct Dia.
3	Screw M12 x 30 Hex Head	70855	24	900-1000 Duct Dia. Fixing
			30	1120-1400 Duct Dia. Fixing
			36	1600 Duct Dia. Fixing
4	Washer M12 S/Proof	55834	36	1600 Duct Dia. Fixing
		89346	24	900-1000 Duct Dia. Fixing
			30	1120-1400 Duct Dia. Fixing
			36	1600 Duct Dia. Fixing
5	Washer M16 S/Proof	55880	36	1600 Duct Dia. Fixing
		89072	24	900-1000 Duct Dia. Fixing
			30	1120-1400 Duct Dia. Fixing
			36	1600 Duct Dia. Fixing
6	Nut M16 Full Hex	55917	36	1600 Duct Dia. Fixing
7	Foot Attachable	404845	2	900 Duct Dia.
		402256		1000 Duct Dia.
		402257		1120 Duct Dia.
		402252		1250 Duct Dia.
		402259		1400 Duct Dia.
		402260		1600 Duct Dia.
8	Rotary Union	54749	1	Part of Impeller Assy.
9	Flexible Air Pipe	403075	1	
10	PTFE Thread Sealing Tape	400538	0.5 Ft	
11	Pipe Air Couple	403831	1	900 Duct Dia.
		403076		1000 Duct Dia.
		403077		1120 Duct Dia.
		403078		1250 Duct Dia.
		403079		1400 Duct Dia.
		403080		1600 Duct Dia.
12	Locknut 1/4 BSP.	89055	2	
13	Strap support	403832	1	900 Duct Dia.
		87820		1000 Duct Dia.
		402495		1120 Duct Dia.
		87821		1250 Duct Dia.
		402496		1400 Duct Dia.
		87822		1600 Duct Dia.
14	Screw M8 x 30 Hex Hd.	6409	4	
15	Washer M8 S/Proof	5938	4	
16	Nut M8 Full Hex	89088	4	
17	Washer M8 Plain	89079	9	
18	Strut support	403833	1	900 Duct Dia.
		878107		1000 Duct Dia.
		402497		1120 Duct Dia.
		87811		1250 Duct Dia.
		402498		1400 Duct Dia.
		87812		1600 Duct Dia.
19	Clip Air Pipe	403086	1	

Note: For vertical mtg. stays see Drwg. No. 189518

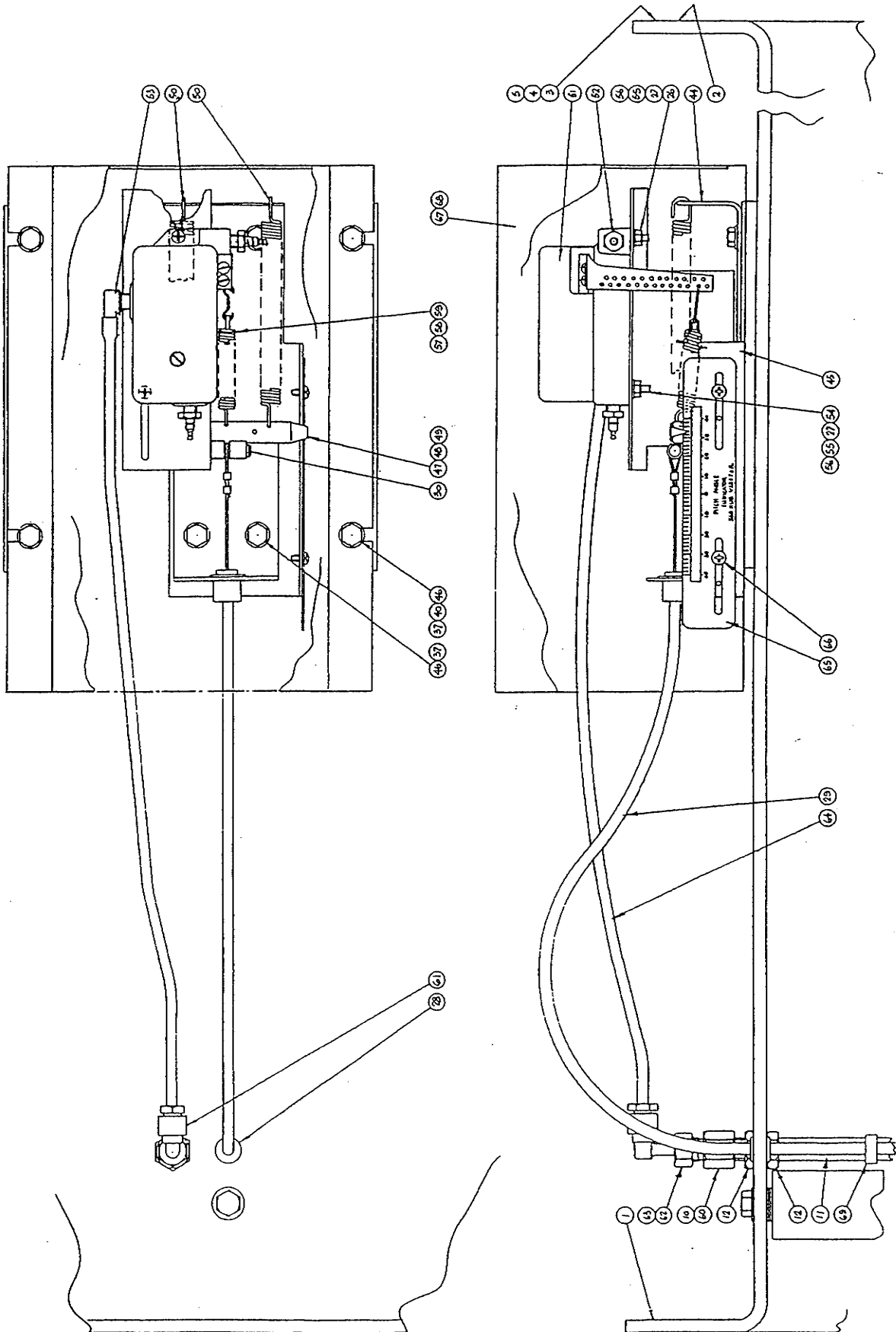
Sig.	Date	Mod. A	Mod. B
Drawn	DN	8.5	Item 44 PN 405055 was 400507
Checked			Item 68 PN 406050 was 878
Traced			
Checked			CRW 24.2.82 QAC 9.12.81



CABLE RESTRAINT BLOCK
TO BE FIXED IN LINE
WITH CABLE TO PREVENT
RUBBING BETWEEN CABLE
AND BLOCK AT THIS POINT.

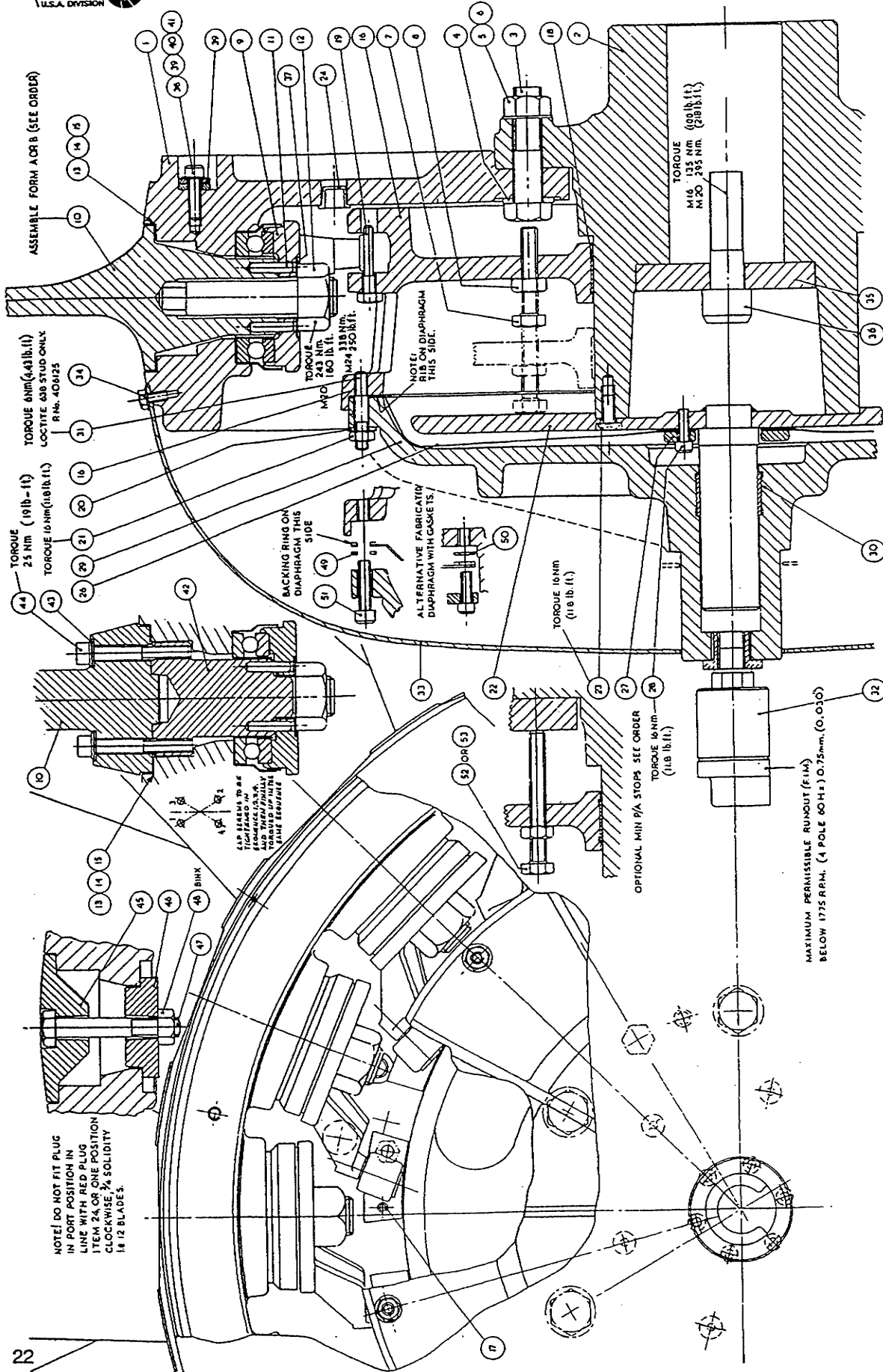
SCAP VIEW OF CABLE
RESTRAINT BLOCK
AND PULLEY

Sig.	Date	Mod. A	Mod. B
DN	8.5	See Sh. 1	See Sh. 1
Checked			
Traced			
Checked		CRW 24.2.82	GAC 9.12.81



Sig.		Date	Mod. A	Mod. B
Drawn	DN	8.5	See Sht. 1	See Sht. 1
Checked				
Traced				
Checked			CRW 24.2.82	GAC 9.12.81

VAROFOIL MANUAL
DRAWING NO. 176426 - SHEET 1 OF 2
GENERAL ARRANGEMENT 71A VAROFOIL MK3 IMPELLER



Sig.	Date	Mod. A	Mod. B	Mod. C	Mod. D	Mod. E	Mod. F	Mod. G	Mod. H	Mod. J	Mod. K	Mod. L	Mod. M
WJF	23.8.79	Items 22, 25, 26, 27, 29, 30 corrected	Items 37, 38, 39, 40, 41 added. Item 20 (89080) removed. Item 34 was M5 x 16 Torque Screw. 75553 General note added. (3) Ret. Locktite & (4) Blade shims added	Revised in line with components	Revised diaphragm, stops & blade fixings added	Item 23 was counterbore screw PN 405542	Blade nut torque was 176 Nm, 150 Lb Ft	Blade nut torque was 203 Nm, 150 Lb Ft	M24 Blade fixing added	Torque figures & Locktite advice for diaphragm fixings. Seal compound was 408714	Position of nut, detail 8, moved	Washer PN 78717 (Item 43) changed to PN 411102. Torque changed from 35 Nm (26 Lbf) to 25 Nm (19 Lbf). Note on torque sequence added	Item 48 was full out PN 89072
MP	19.2.81	ed. Pictorially				CRW 14.1.83	EDN 8.7.83	EDN 22.7.83	CRW 14.6.84	CRW 13.2.85	PJ 19.2.88	PY 27.6.88	
WJF	24.9.79		PJ 7.2.80										CRW 10.10.88

RECOMMENDED SPARE PARTS		P.N.	QTY.
Blade Thrust Bearing		400138	per blades
Rotary Union (1115-000-001)		54748	1
Pilot Positioner		79984	1
Pilot Positioner Spring		403101	1
Diaphragm (molded)		405061	1
Diaphragm (flexible)		403407	1
Flexible air pipe		403075	1
Flexible tubing (6mm)		87639	per meter
Operating Cable	1000-1120	403088	1
	1250-1400	403089	1
	1600-1800	403090	1
	2000-2240	403091	1
	2500-2800	403092	1
Reaction Plate Screws (m8x16 BHC)		407561	6
Blade Securing Nut (M20)		76589	per blades
Blade Securing Nut (M24)		408398	per blades
Set of Balance Weights		AS15558	1
Liner - Actuator (19 15/16")		403400	1
Liner - Diaphragm HSG (4 1/2")		403389	1
Blue Liner Material (bulk)		76097	per foot
Nylon Cam Rollers		80444	per blades
Nylon Cable Pulley		403038	1
Wing Bearing Grease		WC35408	per luba
Loctite Screwlok (#242- 34oz.)		37922	1

General Notes

- Hub ports to be marked in numerical order. All blades and blade carrier assemblies to be marked with corresponding numbers to hub ports.
- Alignment marks to be stamped on hub, end cover, reaction plate, actuator and diaphragm housing. Lubricate lightly both sliding bearing surfaces with shell alvania grease R.A. PN 35407.
- Add Loctite screwlock to the following items before assembly. PN 37922. (Loctite 221)

Item	19	28	31	36	38	44	47	21	23
Part No.	403401	71726	405789	77704	See list 78132	89313	89088	407561	

- Majority of fans will require shims. (Part No. 79212) Item 16 only. However items 13 & 14 may be used as required.

*alternatively - take blade 10 & fit into blade adaptor 42 using washers 43 & screws 44. Fit pins 11 and fit blade adaptor to blade carrier assemblies.

ITEM	DESCRIPTION	DRG/P.N.	QTY.	REMARKS
37	Washer Shim	M20 631878	refer table	M24 55037
38	Screw M8 Cap Hd.	71725,7408 72561,74088	-	As Required
39	Balance Weight	40136-41	-	As Required
40	Washer M8 Plain	89079	-	As Required
41	Washer Shim	631233	-	As Required
42	Adaptor Blade	M20 405638	refer table	M24 408448
43	Washer M8 special	411102	refer table	160 Kg-280Jg Blade Fixing
44	Screw M8 x 60 Socket Cap Hd.	78132	refer table	160 Kg-280Jg Blade Fixing
45	Plug Hub port	408226	refer table	Use II on assy. schedule
46	Washer Hub Port	408227	refer table	
47	Bolt M12 x 75 Lg	89313	refer table	
48	Nut M12 Blinx	89068	refer table	
49	Gasket Outer	403402	1	Use with fabricated diaphragm.
50	Gasket Inner	403403	1	
51	Screw M8 x 35 Lp.	76198	12	
52	Screw M10 x 80 Lg.	408251	3	Min. P/A stops
53	Screw M10 x 100 Lg.	408630	3	Alternative II required

Assembly Notes

- Take hub 1 and fit plug 24 then fit hub adaptor 2 retaining in position with screws 3 washers 4 & 6 and nuts 6.
- Fit blade carrier assembly 9 into hub. Take blade 10 and fit pins 11 then fit blade in hub to blade carrier assemblies retaining in position with washers 37 and nut 12 ensuring that free end play does not exceed 0.25 by fitting shim washers 13, 14, & 15 as required.
- Take actuator 16 fit pin 17 and bearing liner 18. Align all cam followers, then fit actuator, rotating at the same time to retain all cam followers. Check alignment with drawing then fit screw 19.
- Fit screws 7 and nuts 8 to actuator and adjust for maximum pitch angle.
- Fit reaction plate 22 to hub, retaining in position with screws 23.
- Fit studs 31 to actuator, fit flexible diaphragm 26 and clamp ring 27 against reaction plate and retain in position with screws 28. Take housing diaphragm 29. Fit liner 30 then fit housing to actuator with washers 20 and nuts 21. Fit rotary union 32 to housing.
- Fit end cover 33 to hub with screws 34, then balance impeller using 38, 39, 40, 41. Max. 4 weights per screw. Balance spec. 93.
- After balancing fit impeller to motor, retaining with clamp washer 35 and screw 36.
- On final assembly of diaphragm to fan make air tight seals using 2.0mm Dia. bearing of compound PN 88582 around edges of diaphragm and fixing notes before fitting housing. Not required with molded diaphragm.

Blade Solidity	Carrier Item 9	Blade Item 10	Pin Item 11	Nut Item 12	Shim Washers		Washer Items 37, 45-48
					Item 13	Item 14	
Full	16	18	32	16	As Req'd.	16	16
3/4	12	12	24	12	*	12	12
1/2	8	8	16	8	*	8	8

ITEM	DESCRIPTION	DRG/P.N.	QTY.	REMARKS
1	Hub 16 blade	403370	1	
	12 blade	403371		Not Req'd. when plugs used
	8 blade	403372		Not Req'd. when plugs used
2	Hub Adaptor: 85 bore	403380	1	D 315D Fig. Mid.
	80 bore	403381		D 280D Fig. Mid.
	70 bore	403382		D 250D Fig. Mid.
	60 bore	403383		D 225D Fig. Mid.
	55 bore	403384		D 200D Fig. Mid.
	48 bore	405791		D 180D Fig. Mid.
3	Bolt M16 x 70 Hex Hd.	89361	6	
4	Washer M16 Plain	89098	6	
5	Washer M16 S/P	55880	6	
6	Nut M16 Full	55917	6	
7	Screw P.A. Adjustment	405792	3	M10 x 65 Hex Hd.
8	Nut M10 Full	89344	3	Min. P/A Stops Qty. 6
9	Blade Carrier Assy.	M20 407557	refer table	M24 408416 5 Deg.
10	Blade 100 Hg	M20 403395	refer table	M24 408408
	112 Hg	M20 403396	refer table	M24 408409
	125Kg	M20 403397	refer table	M24 408410
	140 Kg	M20 403398	refer table	M24 408411
	160 Kg	87290	refer table	
	180 Jg	87289	refer table	
	200 Jg	87288	refer table	
	224 Jg	87287	refer table	
	250 Jg	87286	refer table	
	280 Jg	87285	refer table	
11	Pin spring tension ø 6 x 24	404124	refer table	Blade location
12	Nut Blinx	M20 76589	refer table	M24 408398
13	Shim Washer .190 Thk.	88686	refer table	Mellinex
14	Shim Washer .508 Thk.	79211	refer table	Nyatron G.S.
15	Shim Washer .635 Thk.	79212	refer table	Nyatron G.S.
16	Actuator	403374	1	Min P/A stops 407993
17	Pin Spring Tension ø 6 x 40	78111	1	
18	Liner Actuator	403400	1	
19	Screw Cam location	403401	1	
20	Washer Normal Heavy	89078	12	M8
21	Nut M8 Full	89088	12	
22	Reaction Plate	403386	1	
23	Screw M8 x 16 Button Sk. Hd.	407561	6	
24	Plug Red Polythene	404762	1	
26	Flexible Diaphragm	405061	1	403407 Fabricated
27	Clamp Ring	403408	1	
28	Screw M6 x 20 Cap Hd.	71726	6	
29	Housing Diaphragm	403376	1	
30	Liner Housing	403399	1	
31	Slud M8 X 46	405769	12	
32	Rotary Union	54749	1	
33	End Cover	403409	1	
34	Screw M6 x 16 Tapille	401928	6	Washer Integral w/head
35	Clamp Washer	403470	1	55mm bore to 85mm bore
	Clamp Washer	405973	1	48mm bore
36	Screw M20 x 70 Cap Hd.	77704	1	55mm bore to 85mm bore
	Screw M16 x 50 Cap.Hd.	71724	1	48mm bore

Sig.	Date	Mod. A	Mod. B	Mod. C	Mod. D	Mod. E	Mod. F	Mod. G	Mod. H	Mod. J	Mod. K	Mod. L	Mod. M
Drawn	DN	10.6.81											
Checked													
Traced	MP	7.9.81											
Checked													



VAROFOIL MANUAL

SECTION

DRAWING NO. 175729 - SHEET 1 OF 3

12

IMPELLER DUCT ASSEMBLY W/EXTERNAL PILOT POSITIONER 71A VAROFOIL MK3

Assembly Notes

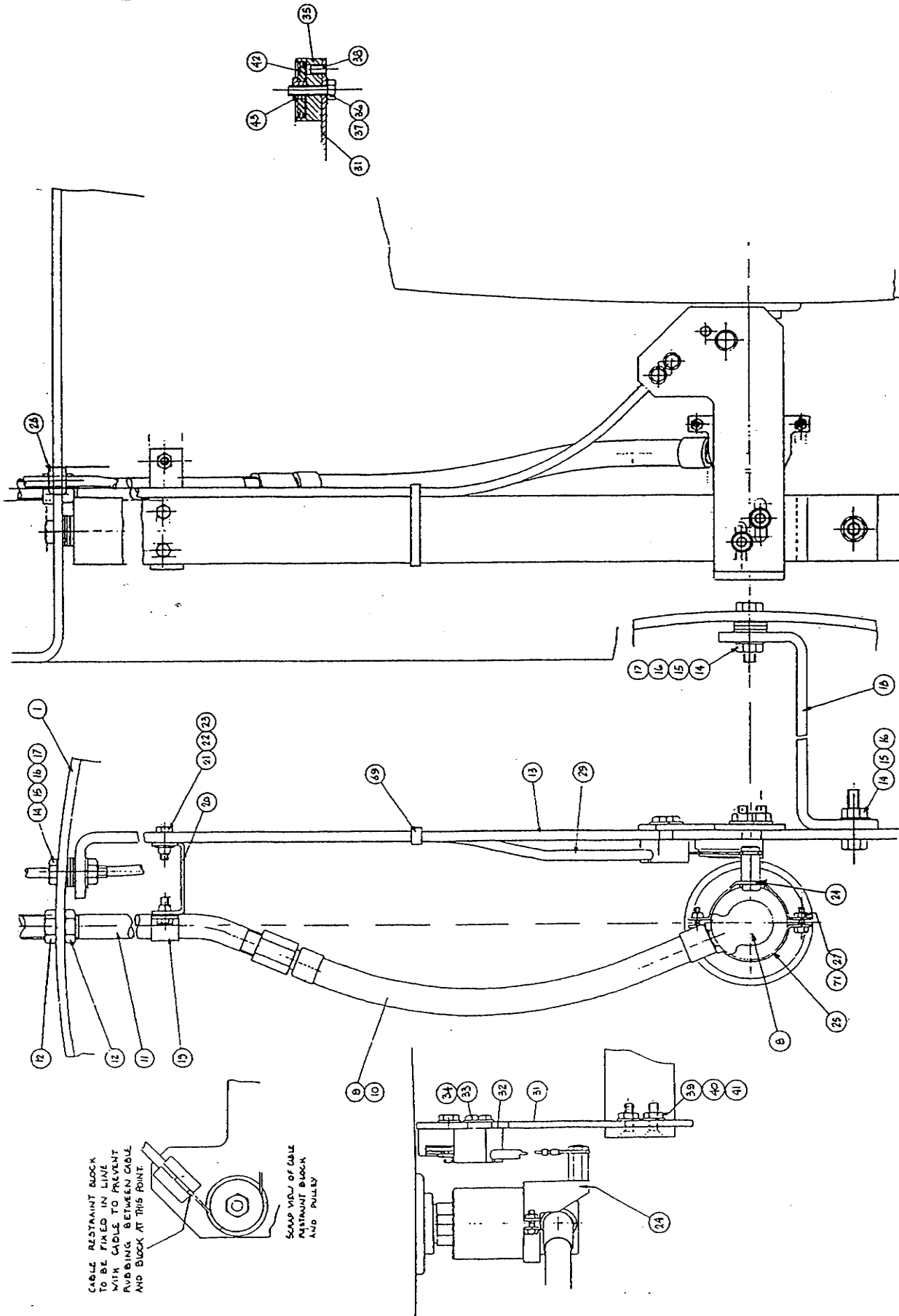
- To duct 1 fit sealant strip 2 to impeller end flange, offer duct to motor duct, centralize about impeller and retain in position with screws 3 washers 4 and nuts 5.
- Fit attachable foot 7 to impeller duct secure in position with screw 3 washers 4 and nuts 5.
- Take rotary union 8 and fit flexible air pipe 9, sealing thread with PTFE tape 10. Fit rotary union to impeller, with threads sealed with red hermatite PN 54463.
- To air pipe couple 11 fit one locknut 12 to straight end and locate pipe in duct - fit remaining locknut 12 to pipe on outside of duct, seat threads with secomatic silver tint sealing compound PN 54376, and tighten locknut (on outside of duct) after ensuring that the air pipe is in the correct position, connect flexible air pipe to air pipe couple, sealing threads with PTFE tape.
- Fit strap support 13 to duct with screws 14 washers 15 and nuts 16, centralizing with washers 17 fit strut support 18 to strap and duct with screws 14 washers 16, and nuts 16, pack gap between strut and duct with washer 17 as required.
- Secure air pipe to strap support with clip 19 and bracket 20 retaining in position with screws 21 washers 22 and nuts 23.
- Fit clamp assembly 24 and clamp 25 to rotary union, securing in position with screw 28 and nuts 27.
- Fit grommet 26 in duct, pass cable operating 29 through grommet, position operating cable 30 loop in groove on cable pillar on clamp assembly.
- To mounting plate pulley 31 fit cable restraint block 32 with screws 33 and washers 34 and pulley mounting block 35 with screw 36 washer 37 and pin 38. Fit plate sub-assembly to strap support with screws 39, washers 40 and nuts 41. Pass inner cable through restraint block and locate outer casing in block. Take pulley 42 locate inner cable in groove and locate to pulley block with pulley retaining nut 43.
- Fit bracket mounting 44 and bracket plate mounting 45 to outside of duct with screws 46 and washers 37. Note position of brackets.
- Take hook cup 47 and fit pointer 48 using rivets 49. Place pin operating cable 30 in cable loop, then locate in hook clip. Pinch over ends of hook clip to retain pin in position. Pass inner cable through hole in boss on mounting bracket and locate outer casing in boss. Fit springs 60 between hook clip and mounting bracket.
- To pilot positioner 51 fit adapter 52 and elbow male 53 as shown in Sht. 3. Remove cover and fit positioner to mounting bracket with screws 54 and 26, washers 55 and 56 and nuts 27 but do not tighten screws at this stage. Take spring 57 and cut to required length, fit adj. clip 58 and link 59 and connect between hook clip and positioner lever arm, as shown on Drp. No. 175719.
- Fit adapter external 60 to air pipe sealing thread with PTFE tape. Take stem elbow connector 61 place nut 62 and cone 63 on stem and connect to adapter. Fit air pipe 64 between stem elbow connector and elbow male on pilot positioner.
- Supply air at 25 PSI and signal supply at 3 PSI and adjust positioner spring tension by positioning the positioner on the mounting bracket. Spring to have no initial tension, but must not be slack. Tighten up fixing screws and retit cover.
- Take pitch angle indicator plate 65 and stamp pitch angles in the panel provided and affix to bracket plate mounting with screws 66 adjust plate to align with pointer. Check impeller pitch angle range and adjust impeller if necessary.
- Fit guard 67 to duct with screws 39 and washers 37 and 40 affix label 68 on top of guard - aligned with pilot positioner.
- Adjust position of operating cable and secure with tyrops 69
- Finally fit plug sight port 70 in duct.

ITEM	DESCRIPTION	DRG./P.N.	QTY.	REMARKS
20	Bracket Air Pipe	403087	1	
21	Screw M5 x 16 Hex Head	89149	4	
22	Washer M5 Plain	89106	4	
23	Nut M5 full Hex	82501	4	
24	Clamp Assembly	403418	1	
25	Clamp	87626	1	
26	Screw M4 x 16 PozDrive Pan Hd.	83103	1	
27	Nut M4 Full Nut	54878	4	
28	Grommet	72662	1	
29	Cable Operating	403088	1	1000-1200 Duct Dia.
		403089		1250-1400 Duct Dia.
		403090		1600-1800 Duct Dia.
30	Pin Operating Cable	403093	1	
31	Mounting Plate pulley	403094	1	
32	Cable Restraint	403095	1	
33	Screw M5 x 10 Hex Head	89061	2	
34	Washer M5 S/Proof	24	2	
35	Pulley Mounting Block	403096	1	
36	Screw M6 x 25 Hex Head	82746	1	
37	Washer M6 S/Proof	6025	11	
38	Pin Spring Tension M6 x 10	403097	1	
39	Screw M6 x 20 CSK Hd.	72077	2	
40	Washer M6 Plain	89078	6	
41	Nut M6 Full Hex	6992	2	
42	Pulley	403098	1	
43	Pulley Retaining Nut	403099	1	
44	Bracket Mounting	406050	1	
45	Bracket Plate Mounting	400485	1	
46	Screw M6 x 16 Hex Hd.	89075	8	
47	Hook Clip	87637	1	
48	Pointer Pitch Angle Indicator	400488	1	
49	Rivet No. 4 x 1/4" Drive Screw	633662	2	
50	Spring Tension	403100	2	
51	Pilot Positioner	79984	1	Johnson Y-9502
52	Adapter Straight	89083	2	Johnson F100-21
53	Elbow Male	88084	1	Johnson F500-21
54	Screw M4 x 30 PozDrive Pan Hd.	71684	1	
55	Washer M4 Plain	70731	2	
56	Washer M4 S/Proof	6023	2	
57	Spring Positioner	403101	1	
58	Adj. Clip. Spring Pli. Pos.	405876	1	
59	Link Spring Positioner	403102	1	
60	Adapter External	400035	1	
61	Stem Elbow Connector	400510	1	Martomar 5/61/3
62	Nut 1/4 In. 1/4 BSP	79988	1	
63	Cone 1/4 In.	79987	1	
64	Air Pipe	87639	1	
65	Plate - Pitch Angle Indicator	400488	1	
66	Screw No. 6 x 3/4" S/Tap	655040	2	
67	PozDrive Pan Hd.	400469	1	
68	Label Connection Diagram MK3	405085	1	
69	Cable Tie, Tyrap	8899	1	
70	Plug sight Port	74018	1	
71	Screw Hex Hd. M4 x 12	404110	2	

ITEM	DESCRIPTION	DRG./P.N.	QTY.	REMARKS
1	Duct Impeller	403577	1	1000 Duct Dia.
		403578		1120 Duct Dia.
		403110		1250 Duct Dia.
		403111		1400 Duct Dia.
		403112		1600 Duct Dia.
		403113		1800 Duct Dia.
2	Inseal 375 Strip Sealant	77257		11.5 Fl 1000 Duct Dia.
				13.0 Fl 1200 Duct Dia.
				14.0 Fl 1250 Duct Dia.
				15.5 Fl 1400 Duct Dia.
				17.5 Fl 1600 Duct Dia.
				19.5 Fl 1800 Duct Dia.
3	Screw M12 x 35 Hex Head	89309	20	1000 Duct Dia. Fixing
			25	1120-1400 Duct Dia. Fixing
			30	1600-1800 Duct Dia. Fixing
4	Screw M16 x 40 Hex Head	6884	30	1000 Duct Dia. Fixing
	Washer M12 S/Proof	89346	20	1000 Duct Dia. Fixing
	Washer M16 S/Proof	56680	30	1600-1800 Duct Dia. Fixing
5	Nut M12 Full Hex	89072	20	1000 Duct Dia. Fixing
	Nut M16 Full Hex	55917	30	1120-1400 Duct Dia. Fixing
			30	1600-1800 Duct Dia. Fixing
6	Foot Attachable	402256	1	1000 Duct Dia.
		402257		1120 Duct Dia.
		402258		1250 Duct Dia.
		402259		1400 Duct Dia.
		402260		1600 Duct Dia.
		402261		1800 Duct Dia.
8	Rotary Union	54749	1	Part of Impeller Assy.
9	Flexible Air Pipe	403075	1	
10	PTFE Thread Sealing Tape	400538	0.5 Fl	
11	Pipe Air Couple	403076	1	1000 Duct Dia.
		403077		1120 Duct Dia.
		403078		1250 Duct Dia.
		403079		1400 Duct Dia.
		403080		1600 Duct Dia.
		403081		1800 Duct Dia.
12	Locknut 1/4 BSP.	89055	2	
13	Strap support	87620	1	1000 Duct Dia.
		402495		1120 Duct Dia.
		87621		1250 Duct Dia.
		402498		1400 Duct Dia.
		87622		1600 Duct Dia.
		402642		1800 Duct Dia.
14	Screw M8 x 30 Hex Hd.	6409	4	
15	Washer M8 S/Proof	5993	4	
16	Nut M8 Full Hex	89088	4	
17	Washer M8 Plain	89079	7	
18	Strut support	878107		1000 Duct Dia.
		402497		1120 Duct Dia.
		87811		1250 Duct Dia.
		402498		1400 Duct Dia.
		87812		1600 Duct Dia.
		402643		1800 Duct Dia.
19	Clip Air Pipe	403086	1	

Note: For vertical mtg. stays see Drwg. No. 189518

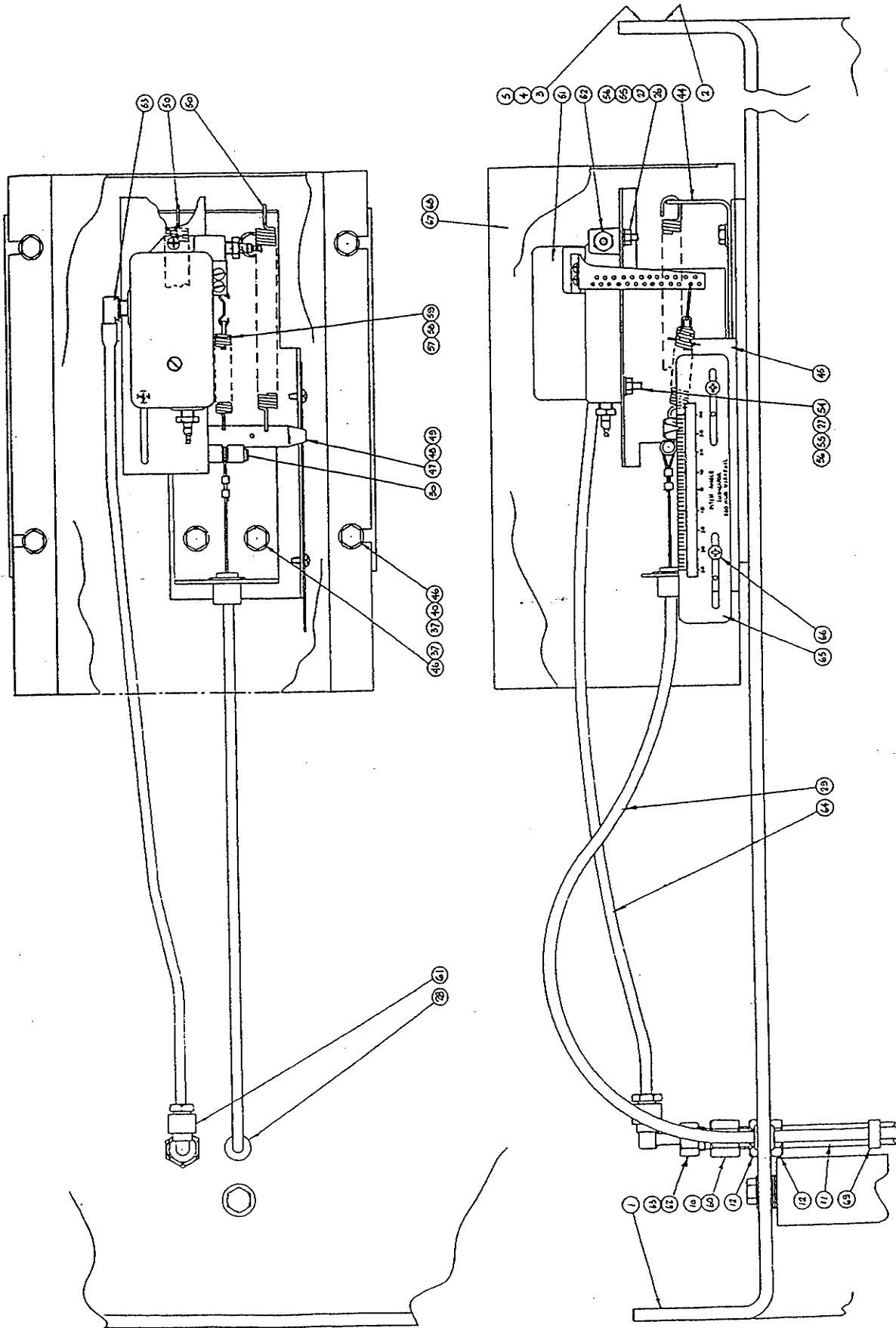
Sig.	Date	Mod. A	Mod. B	Mod. C	Mod. D	Mod. E
Drawn	DN	8.5	Item 24 P400418 was PH added; (2 off) Item 71 was 8, 1000 added; (2 off) Item 26 (f off) was (3 off)	Item 6 deleted	Item 6, PH 405055 was deleted	Item 6, PH 405055 was 47632
Checked						
Traced						
Checked						



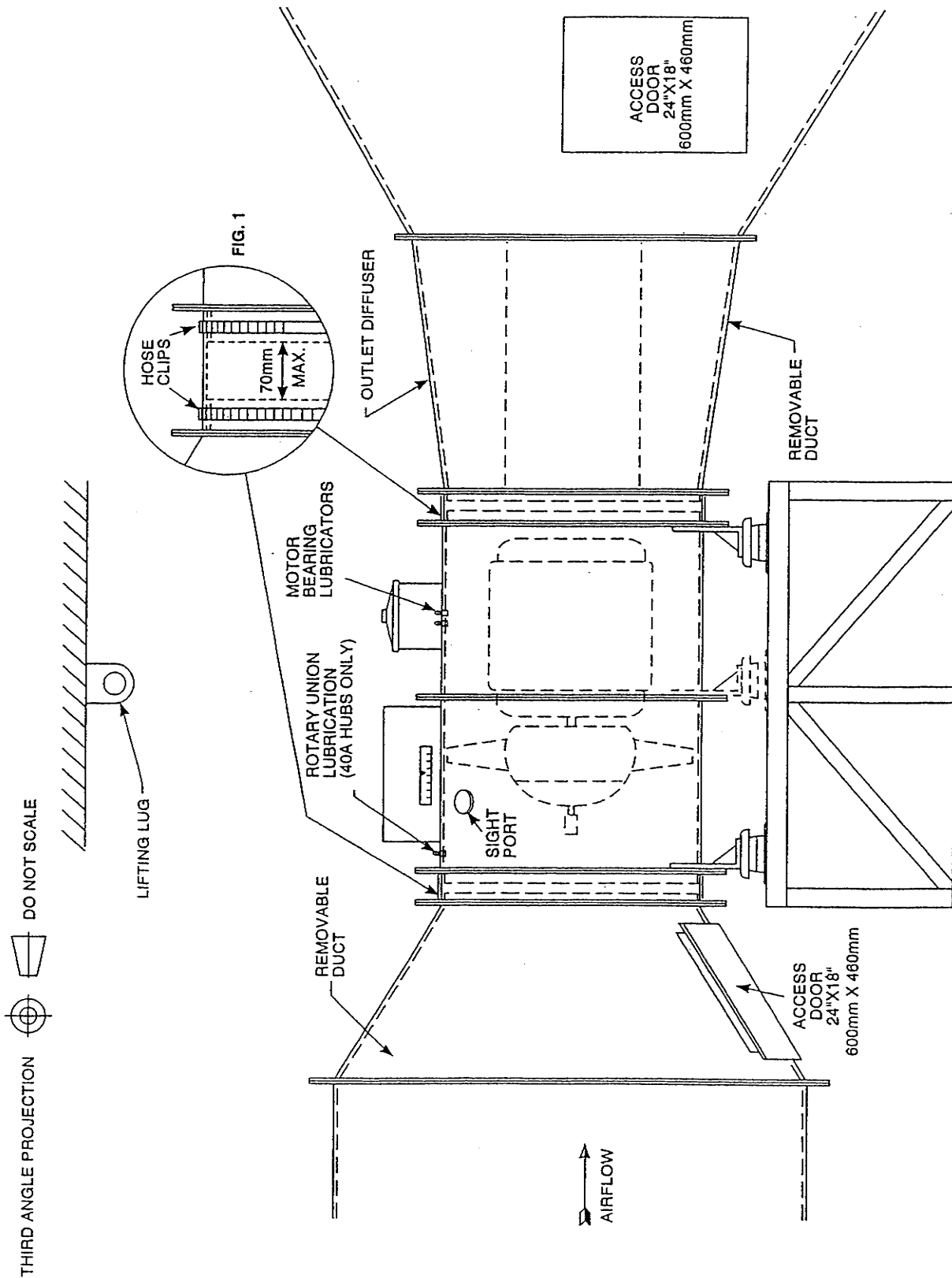
CABLE RESTRAINT BLOCK TO BE FIRED IN LINE WITH CABLE TO PREVENT RUBBING BETWEEN CABLE AND BLOCK AT THIS POINT.

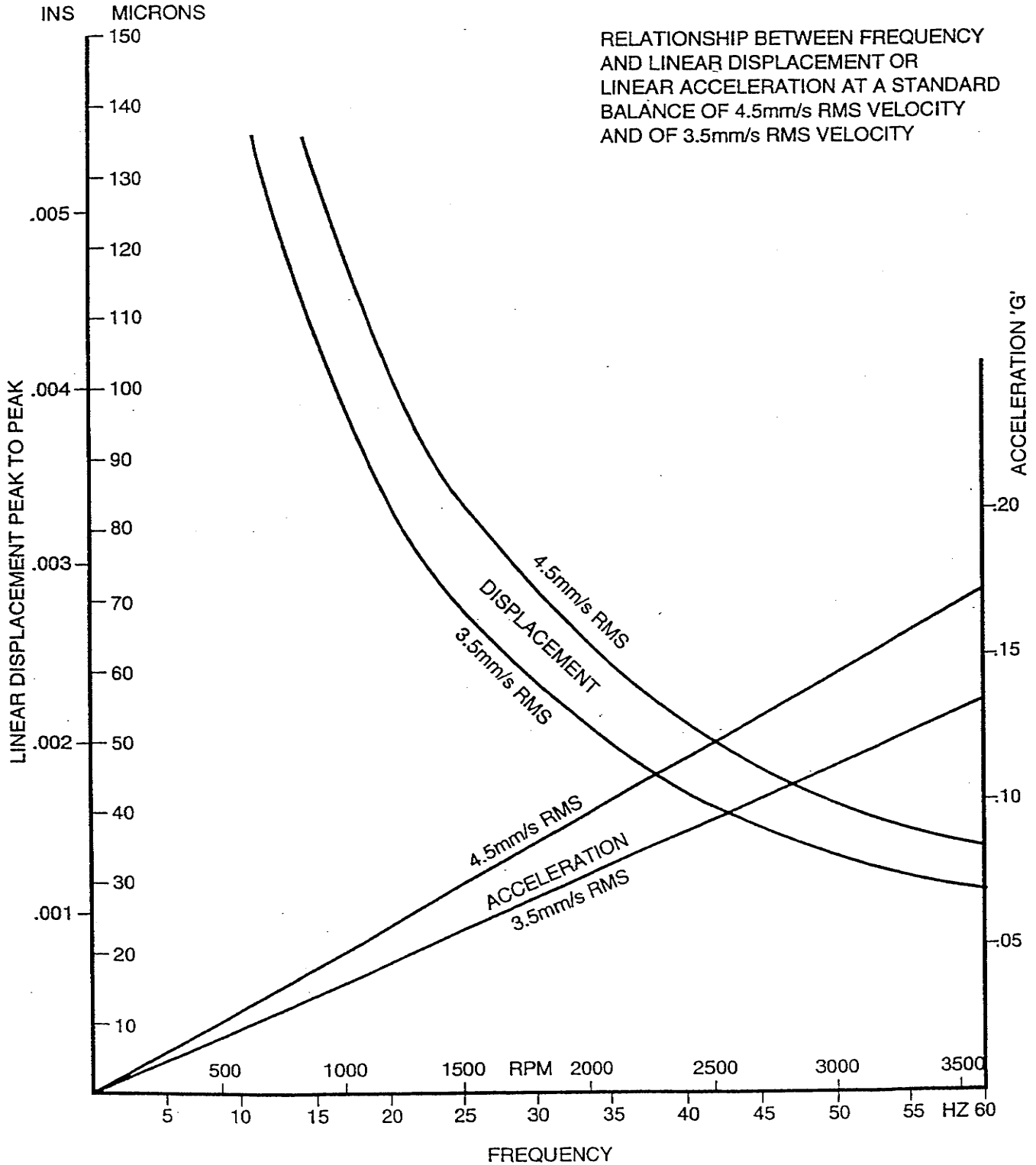
SCAMP VIEW OF CABLE RESTRAINT BLOCK AND PULLEY

Drawn	DN	8.5	Item 24 corrected plotability See Sins. 165	Item 71 added (2 o/f) Item 25 (1 o/f) was (3 o/f)	Item 6 deleted	See Sht. 1	See Sht. 1
Checked							
Traced							
Checked			WJF 30.8.78	PGJ 12.2.80	DN 6.5.81	CW 24.2.82	GFC 1.10.82



Sig.	Date	Mod. A	Mod. B	Mod. C	Mod. D	Mod. E
Drawn	DN	8.5	Item 24 corrected pictorially See Sht. 1 & 3	Item 71 added, (2 off) Item 28 (1 off), was (3 off)	Item 6 deleted	See Sht. 1
Checked			WJF 30.8.79	PCJ 12.2.80	DN 8.5.81	CW 24.2.82
Traced						GPC 1.10.82
Checked						







VAROFOIL MANUAL

RELUBRICATION CHART

SECTION 15

Motor Frame Size	Relubrication Period 1000 hrs. Running				Quantity of Lubricant				Bearing Type		Lubricant
	3600 to 3001 rev/min	3000 to 1801 rev/min	1800 to 1501 rev/min	1500 rev/min and below	Drive End		Non Drive End		Drive End	Non Drive End	
					ml	cu ins	ml	cu ins			
Motor codes having an oblique stroke (/) followed by two numerals indicate pad mounting EG. D160/27											
D132	4	4	8	16	8	0.5	7	0.45	6209Z	6208Z	Chevron or Caltex SR1-2 or Shell Dolium R
D160	4	4	8	16	12.5	0.75	8	0.5	6309Z	6209Z	
D160S	4	4	8	16	15	0.9	8	0.5	6310 C3	6209Z	
D180	4	4	8	16	15	0.9	9	0.55	6310 C3	6210 C3	
D180S	4	4	8	16	17.5	1.1	9	0.55	6311 C3	6210 C3	
D200	2	4	8	8	20	1.2	12	0.75	6312 C3	6212 C3	
D200A	2	4	8	8	23	1.4	23	1.4	6313 C3	6213 C3	
D200S	2	4	8	8	23	1.4	12	0.75	6313 C3	6212 C3	
D225	-	-	8	8	23	1.4	17.5	1.1	6313 C3	6211 C3	
D225A	-	-	8	8	23	1.4	17.5	1.1	6313 C3	6211 C3	
Motor codes having an oblique stroke (/) followed by two or three letters indicate pad mounting EG. D225/MP											
D132	4	4	8	16	7	0.45	7	0.45	6208 C3	6208 C3	Shell Alvania RA
D160	4	4	8	16	12.5	0.75	8	0.5	6309 C3	6209 C3	
D180	4	4	8	16	15	0.9	9	0.55	6310 C3	6210 C3	
D200	2	4	8	8	20	1.2	12	0.75	6312 C3	6212 C3	
D225	-	-	8	8	16	1.0	16	1.0	6215 C3	6215 C3	
D250	-	-	4	4	21	1.3	21	1.3	6217 C3	6217 C3	
D250M	-	-	8	8	-	-	-	-	-	-	
Motor codes followed by one or two letters indicate foot or flange mounting EG. D250M (foot) D250MD (flange).											
D180	-	-	8	16	See Nameplate or Enquire				See Nameplate or Enquire		Shell Alvania RA
D200	-	-	8	8							
D225	-	-	8	8							
D250	-	-	4	4							
D280	-	-	4	4							
D315	-	-	4	4							
D355	-	-	4	4							
D450	-	-	4	4							
Motor codes prefixed AFP indicate pad mounting with flameproof enclosures EG. AFP5044											
AFP 40	4	4	8	8	12.5	0.75	5.5	0.3	6309	NU 305	Shell Alvania RA
AFP 50	4	4	8	8	17.5	1.1	8.5	0.5	6311	NU 307	
If motor cannot be identified from the above descriptions please enquire giving serial number from nameplate.											
Rotary Union (40A Hub only) Referred to as Actuator Bearing on fan name plate.	2	2	8	8	2	0.13	2	0.13	Note: The quantity of lubricant must not be exceeded		Chevron or Caltex SR1-2 or Shell Dolium R

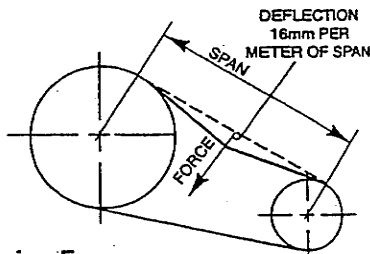
16.1 Installation

- Always use a matched set of belts.
- Clean any oil and grease from pulleys: remove any rust or burrs from the grooves.
- Reduce the center distance until the belts can be put into the pulley grooves without forcing.
- Make sure the pulleys are correctly aligned and that the shafts are parallel.
- Place the belts into the pulley grooves and tension the drive.

16.2 Tensioning

The high performance of modern belts, particularly Wedge, cannot be achieved without correct tensioning. To check for correct tension proceed as follows:

- 1 Measure the span.
- 2 At the center of the span apply a force at right angles to the belt to deflect one belt 16mm per meter of span.
- 3 Compare this force with value in table below.



16.3 Tensioning Forces

Belt Section	Force required to deflect belt 16mm per meter of span		
	Small Pulley Diameter (mm)	Pa	Kilogramforce (Kgf)
SPZ	67 to 95	10 to 15	1.0 to 1.5
	100 to 140	15 to 20	1.5 to 2.0
SPA	100 to 132	20 to 27	2.0 to 2.7
	140 to 200	28 to 35	2.8 to 3.5
SPB	160 to 224	35 to 50	1.0 to 1.5
	236 to 315	50 to 65	5.1 to 6.6
SPC	224 to 355	60 to 90	6.1 to 9.2
	140 to 200	28 to 35	2.8 to 3.5
Z	56 to 100	5 to 7.5	0.5 to 0.58
A	80 to 140	10 to 15	1.0 to 1.5
B	125 to 200	20 to 30	2.0 to 3.1
C	200 to 400	40 to 50	4.1 to 6.1

Installation and Operation of Belt Drives

If the measured force falls within the values given the drive tension should be satisfactory. A measured force below the lower value indicates undertensioning. A new drive should be tensioned to the higher value to allow for the normal drop in tension during the running period. After the drive has been running for a few hours the tension should be checked and re-adjusted to the higher value. The drive should be subsequently tensioned at regular maintenance intervals.

16.4 Belt Matching

A code number 50 indicates that the actual belt pitch length coincides with the nominal length. Each 2mm variation from the nominal length is represented by one unit. SPB 3550 V-belts, for example, measure 3550mm pitch length and could be coded:

- 50 indicating an actual length of 3550mm
- 51 indicating an actual length of 3552mm
- 49 indicating an actual length of 3548mm

The code number is shown on a cellulose tape attached to each V-Belt and care should be taken to ensure that a matched set of belts falls within the following limits:

- 1900 to 3190mm inclusive; do not exceed two consecutive code numbers;
- 3200 to 4890mm inclusive; do not exceed four consecutive code numbers;

Over 7000mm, do not exceed five consecutive code numbers; For example, a suitably matched set of, say SPB 4560 V-Belts could be made from codes 48, 49, 50 or 50, 51, 52 and so on. For SPB 3170, however, only codes 49, 50 or 50, 51 and similar combinations should be selected.

16.5 Storage

V-Belts should be stored in a dry location, and contact with hot pipes and direct sunlight should be avoided.

Where possible, hang the belts loosely in single (or triple) coils. Always avoid tying them tightly with thin string.

16.6 Trouble Shooting

Small cracks on V-Belt side and base

Generally caused by excessive heat and chemical fumes. The heat may be generated by a lack of belt tension.

V-Belt swelling or softening

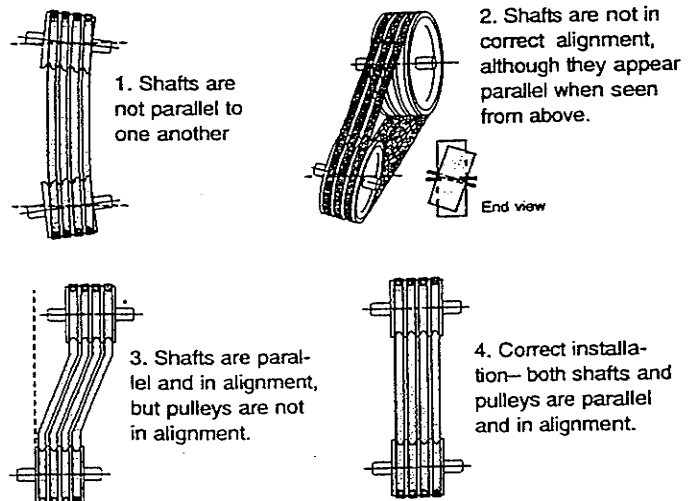
Caused by excessive contamination by oil, certain cutting fluids or rubber solvent.

Whipping during running

Usually caused by incorrect tensioning, principally on long center drives. If a slightly higher (or lower) tension does not solve the problem there may be a critical vibration frequency in the system which requires re-design or a Concord Belt. Consult American Fan/Woods.

16.7 Alignment

Good alignment of Pulleys is important otherwise the belt flanks will wear quickly.



Dotted lines emphasize the faults by indicating the correct position.



VARIABLE MANUA TOSHIBA MOTOR INSTALLATION & MAINTENANCE

SECTION 17

INSTRUCTIONS: Installation and Maintenance

Toshiba World Energy Motors Polyphase Motors

- Frames 143T through 507UZ Dripproof
- Frames 143T through N587UZ Totally Enclosed Fan Cooled
- Frames 143T through 447TZ DripProof

STORAGE

- 1 Store motor in a clean, dry location and cover completely with plastic. (Leave opening for ventilation)
- 2 Motor must be thoroughly dry before applying power.
- 3 Every six months, give winding a megger test. A minimum of 10 megohms are recommended.
- 4 Also, every six months, rotate shaft and add grease as needed.

READ CAREFULLY BEFORE INSTALLING AND STARTING MOTOR RECEIVING

- 1 Check nameplate data.
- 2 Check whether any damage has occurred during transportation. (Motors are normally shipped F.O.B. factory. Freight claims must be submitted by the consignee to the carrier.)
- 3 When supplied, be sure to remove bearing lock plate before start-up.
- 4 Turn shaft by hand to check that it turns freely.

LOCATION

- 1 All motors should be located in an area where ventilation is not restricted and affects the operation of the motor.
- 2 Dripproof Motors are designed for installation in a well ventilated place where the atmosphere is reasonably free of dirt and moisture.
- 3 Totally enclosed motors may be installed where dirt, moisture (not running water) and corrosion are present, or in outdoor locations.
- 4 Explosion Proof motors are designed and built for hazardous duty. Listed by UL for Class I, Group D, and Class II, Groups E and G. Also listed by CSA.

MOUNTING

- 1 Mount Motor securely on a firm, flat base. All ball and roller bearing normal thrust motors may be mounted in any position.
- 2 Align motor accurately, using a flexible coupling if possible. For drive recommendations consult with drive or equipment manufacturer, or Toshiba. See additional information on page 3 and 4.
- 3 V belt Sheave Pitch Diameters should not be less than the following Table 1, values (NEMA recommended values).
- 4 Tighten belts only enough to prevent slippage. belt speed should not exceed 5000 ft. per min.
- 5 Motors must not be subjected to vibration exceeding 0.5 G force. (Motors should not be mounted to shaker screens.

POWER SUPPLY AND CONNECTIONS

- 1 Nameplate voltage and frequency should agree with power supply. Motor will operated satisfactorily on line voltage within 10% of nameplate value; or frequency within 5%; combined variation not to exceed 10%. 230 Volt motors can be used on 208 Volt network systems, but with slightly modified performance characteristics.
- 2 Dual voltage and single voltage motors can be connected for the desired voltage by following connection diagrams on pages 5 and 6.
- 3 Explosion Proof motors have Temperature Limiting Devices in the motor enclosure to prevent external surface temperature of the motor in accordance with UL standards. Terminals of thermal protectors (P1, P2) should

GREASING PERIOD TO PREVENT OVER GREASING
Greasing amount and interval 30 Grams = 1 Ounce

Radial bearing (same for angular bearing)

BEARING NO.	1ST GREASING AMOUNT (g)	GREASING AMOUNT FROM 2ND GREASING (g)	GREASING INTERVAL FOR 24 HOURS OPERATION (DAYS)					
			NUMBER OF POLES					
			2	4	6	8	10	12
6310	50	30	70	130	130	130	130	30
6311	100	30	70	130	130	130	130	30
6312	100	30	50	130	130	130	130	30
6313	50	30	50	130	130	130	130	30
6314	200	50	-	130	130	130	130	30
6315	200	50	-	90	130	130	130	30
6316	200	50	-	90	130	130	130	30
6317	200	50	-	90	130	130	130	30
6318	300	50	-	90	130	130	130	30
6319	300	50	-	70	130	130	130	30
6320	400	80	-	70	130	130	130	30
6321	400	80	-	70	130	130	130	30
6322	400	80	-	70	130	130	130	30
6324	400	80	-	50	90	130	130	30
6326	400	100	-	-	90	130	130	30
6328	400	100	-	-	90	130	130	30

Cylindrical Roller Bearings

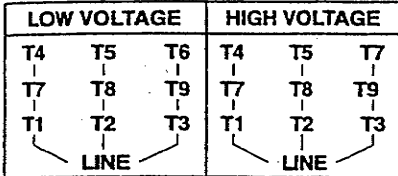
BEARING NO.	1 ST GREASING AMOUNT (g)	GREASING AMOUNT FROM 2ND GREASING (g)	GREASING INTERVAL FOR 24 HOURS OPERATION (DAYS)					
			NUMBER OF POLES					
			4	6	8	10	12	
NU314	100	50	-	70	90	130	130	30
NU315	100	50	-	50	90	130	130	30
NU316	100	50	-	50	90	130	130	30
NU317	200	50	-	50	90	130	130	30
NU318	200	50	-	50	90	130	130	30
NU319	200	50	-	40	70	130	130	30
NU320	300	80	-	40	70	90	130	30
NU322	300	80	-	40	70	90	130	30
NU324	400	80	-	-	50	90	130	30
NU326	600	100	-	-	50	90	130	30
NU328	600	100	-	-	50	90	90	30

Connection Diagrams

A. Wye-connected Dual Voltage (230/460 V) 9 Leads

Pole	ODP	TEFC & EXP
2P	1½HP-7½HP	1½HP-5HP
4P	1HP-5HP	1HP-5HP
6P	¾HP-5HP	¾HP-5HP
8P	¾HP-5HP	¾HP-5HP

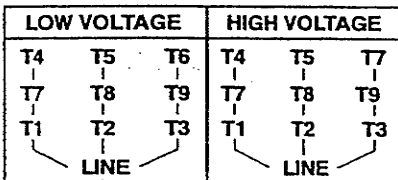
A.1 Across the Line Starting



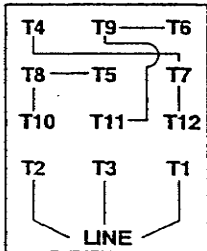
B. Delta-connected Dual Voltage (230/460 V) (12 Leads)

Pole	ODP	TEFC & EXP
2P	10HP-500HP	7½HP-300HP
4P	7½HP-400HP	7½HP-400HP
6P	7½HP-300HP	7½HP-300HP
8P	7½HP-250HP	7½HP-250HP

B.1 Across the Line Starting

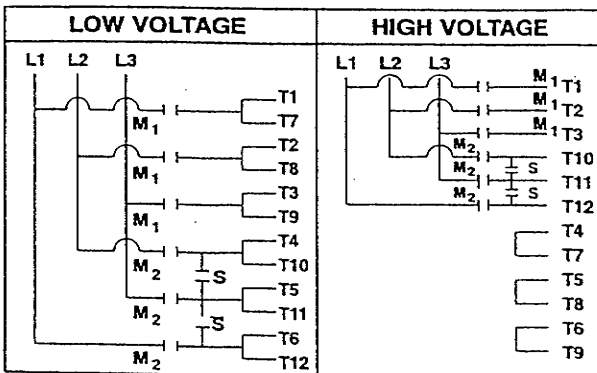


B-2 575 Volt Connection (see Note 1)

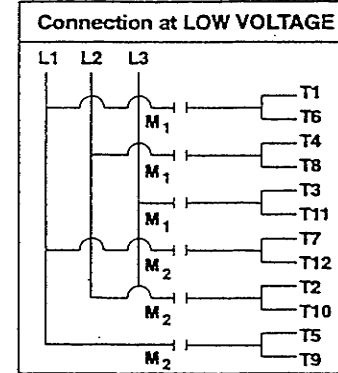


	Start	Run
M ₁	Close	Close
M ₂	Open	Close
S	Close	Open

B-3 Wye Start Delta Run



D-3 Part Winding Starting (4 pole & 6 pole motors)



	Start	Run
M ₁	Close	Close
M ₂	Open	Close

M₂ should be energized within 2 seconds after M₁ is energized.

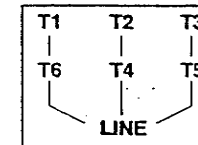
NOTES:

1. Motors can be used on 575 - Volt network in accordance with B - 2 connection.
2. 4 pole and 6 pole motors are satisfactory for Part Winding starting at low voltage (230 V).

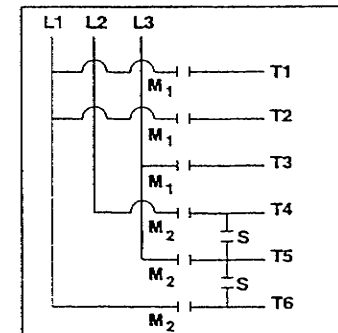
C. Delta-connected Single Voltage (460 V) (12 Leads)

Pole	ODP	TEFC & EXP
2P	300HP-350HP	200HP-300HP
8P	125HP-250HP	125HP-250HP

C.1 Across the Line Starting



C-2 Wye Start Delta Run



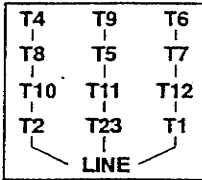
	Start	Run
M ₁	Close	Close
M ₂	Open	Close
S	Close	Open

Connection Diagrams Continued

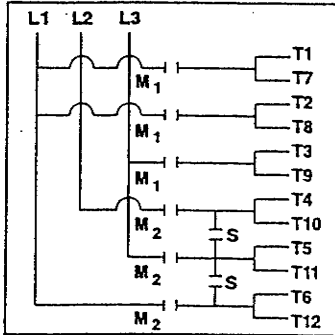
D. Delta-connected Single Voltage (460 V)

Pole	ODP	TEFC & EXP
2P	400HP-600HP	_____
4P	250HP-400HP	200P-400HP
6P	150HP-300HP	150HP-300HP

D.1 Across the Line Starting

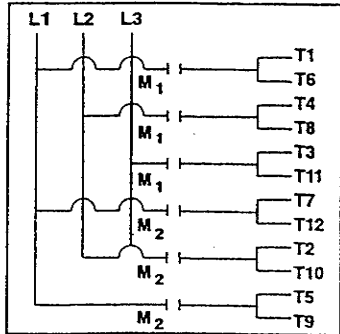


D-2 Wye Start Delta Run



	Start	Run
M ₁	Close	Close
M ₂	Open	Close
S	Close	Open

D-3 Part Winding Starting (4 pole & 6 pole motors)



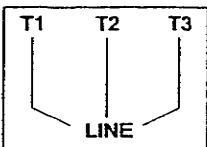
	Start	Run
M ₁	Close	Close
M ₂	Open	Close

M₂ should be energized within 2 seconds after M₁ is energized.

E. Wye-connected 575 Volt Motors (3 Leads)

Pole	ODP	TEFC & EXP
2P	1½HP-7½HP	1½HP-5HP
4P	1HP-5HP	1HP-5HP
6P	¼HP-5HP	¼HP-5HP
8P	¾HP-5HP	¾HP-5HP

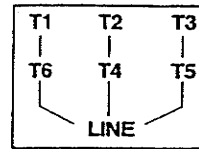
E.1 Across the Line Starting



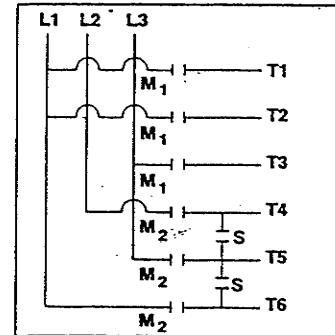
F. Delta-connected 575 Volt Motors (6 Leads)

Pole	ODP	TEFC & EXP
2P	10HP-500HP	7½HP-300HP
4P	7½HP-400HP	7½HP-400HP
6P	7½HP-300HP	7½HP-300HP
8P	7½HP-250HP	7½HP-250HP

F.1 Across the Line Starting



F-2 Wye Start Delta Run

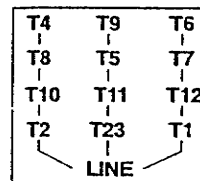


	Start	Run
M ₁	Close	Close
M ₂	Open	Close
S	Close	Open

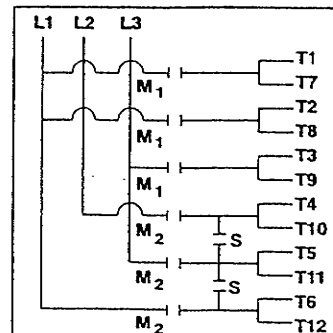
G. Delta-connected 575 Volt Motors (12 Leads)

Pole	ODP
2P	600HP

G.1 Across the Line Starting



G-2 Wye Start Delta Run



	Start	Run
M ₁	Close	Close
M ₂	Open	Close
S	Close	Open

WARNINGS

Motors built F-1 Assembly will be standard counter clock wise rotation facing non drive end of motor. Motors built F-2 Assembly will have a clock wise rotation facing non drive end of motor. With the exception of low voltage TEFC 400T through N587UZ Frame motors, whose rotation will remain counter clock wise.

WARNING

BEFORE STARTING MOTOR, REMOVE ALL UNUSED SHAFT KEYS AND LOOSE ROTATING PARTS TO PREVENT THEM FROM FLYING OFF.

CAUTION

Check direction of motor rotation before coupling motor to load.

WARNING

ROTATING PARTS, SUCH AS COUPLINGS, PULLEYS, EXTERNAL FANS, AND UNUSED SHAFT EXTENSIONS, SHOULD BE PERMANENTLY GUARDED AGAINST ACCIDENTAL CONTACT WITH HANDS OR CLOTHING. THIS IS PARTICULARLY IMPORTANT WHERE THE PARTS HAVE SURFACE IRREGULARITIES SUCH AS KEYS, KEYWAYS OR SET SCREWS.

WARNING

WHEN A LIFTING MEANS IS PROVIDED FOR HANDLING THE MOTOR OR GENERATOR, IT SHOULD NOT BE USED TO LIFT THE MOTOR OR GENERATOR PLUS ADDITIONAL EQUIPMENT SUCH AS GEARS, PUMPS, COMPRESSORS, OR OTHER DRIVEN EQUIPMENT.

WARNING

THE FRAMES AND OTHER METAL EXTERIORS OF MOTORS AND GENERATORS (EXCEPT FOR INSULATED PEDESTAL BEARINGS) USUALLY SHOULD BE GROUNDED TO LIMIT THEIR POTENTIAL TO GROUND IN THE EVENT OF ACCIDENTAL CONNECTION OR CONTACT BETWEEN LIVE ELECTRICAL PARTS AND THE METAL EXTERIORS.

WARNING

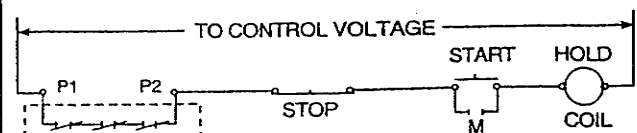
WHEN CAREFUL CONSIDERATION OF THE HAZARDS INVOLVED IN A PARTICULAR APPLICATION INDICATE THE MACHINE FRAMES SHOULD NOT BE GROUNDED OR WHEN UNUSUAL OPERATING CONDITIONS DICTATE THAT A GROUNDED FRAME CANNOT BE USED, THE INSTALLER SHOULD MAKE SURE THE MACHINE IS PERMANENTLY AND EFFECTIVELY INSULATED FROM GROUND. IN THOSE INSTALLATIONS WHERE THE MACHINE FRAME IS INSULATED FROM GROUND, IT IS RECOMMENDED THAT APPROPRIATE WARNING LABELS OR SIGNS BE PLACED ON OR IN THE AREA OF THE EQUIPMENT BY THE INSTALLER.

WARNING

FOR EXPLOSION-PROOF MOTOR

Disconnect power before working on motor driven equipment. This motor is equipped with an automatic temperature-limiting device. The National Electrical Code and Underwriter's Laboratories require connection of leads P1 and P2 into the control circuit of a manual reset starter per following diagram.

KLIXON TYPE	AC VOLT	VOLT AMP RATING
9700L	120 600V	125 VA
9700K	120 600V	720 VA



(NC) MOTOR THERMOSTATS

NOTE:

Frame 256T and smaller has two Thermostats.

MAINTENANCE

1. INSPECTION

Inspect motor at regular intervals. Keep motor clean and vent openings clear.

2. LUBRICATION

- a. Frames 143T thru 256T are furnished with double sealed or shielded bearings, prelubricated prior to installation. Grease fittings are not supplied and bearings are designed for average 100,000 hours operation under standard conditions. (See table 2 below.)
- b. Frames 284T thru N587UZ are furnished with double shielded or open ball or roller bearings. (Depending on HP size and/or speed.) It is necessary to relubricate anti-friction bearing motors periodically. (See table 2 below.)
These motors are supplied with provision for greasing and have been lubricated prior to test, however before start-up it is recommended to apply approximately 30 grams (1 oz.) of grease because of possible settling of grease during storage and handling. However, oil leakage around bearing caps indicate overpacking and excess grease should be purged out by operating motor temporarily with relief open.

Table 2. Frequency of Relubrication

SYNC. RPM RANGE	FRAME RANGE	TYPE OF SERVICE	
		STANDARD DUTY	SEVERE DUTY
3600	143T - 256T	*5 Years	*3 Years
	284TS - 286TS	12 Mos.	4 Mos.
	324TS - N587USS	9 Mos.	3 Mos.
1800	143T - 256T	*7 Years	*3 Years
	284T - 326T	4 Years	1.5 Years
	364T - 365T	2.5 Years	10 Mos.
	404T - 447TZ	2 Years	8 Mos.
	505US - N587UZ	1.5 Years	6 Mos.
1200 AND SLOWER	143T - 256T	*7 Years	*3 Years
	284T - 326T	4 Years	1.5 Years
	364T - 447TZ	3 Years	1 Year
	505US - N587UZ	1.5 Years	6 Mos.

The above table shows typical regreasing schedules to be used unless otherwise specified by the motors grease nameplate.

*It is recommended to change bearings after the time shown in Table 2.

SERVICE CONDITIONS	
STANDARD DUTY	Eight hours per day, light to normal loading, clean condition free from dust.
SEVERE DUTY	Twenty-four hours per day, or light to normal shock loading vibration, exposure to dirt or dusty conditions. For very severe conditions where the motor is subject to high vibration or heavy shock loading & vibration use 1/3 of the value shown in the severe duty table.

3. INSTRUCTIONS FOR LUBRICATING

Toshiba motors (284T - N587UZ) are furnished with grease fittings. Before greasing, be sure grease fittings are clean and free from dirt. Remove grease relief plug or plate and using a low pressure grease gun, pump in the required grease. Do not overgrease. Relubrication intervals are specified in Table 2 above. After relubricating, allow motor to run for 10 minutes before replacing relief hardware

4. RECOMMENDED GREASES FOR STANDARD APPLICATIONS

Use the following greases listed for the given temperature range, unless otherwise shown by the motors grease nameplate.

OPERATING AMBIENT TEMP. - 30°C to 50°	
CHEVRON SRI	CHEVRON
EXXON UNIREX #2	EXXON CORP.
EXXON POLYREX	EXXON CORP.
SHELL DOLIUM R	SHELL OIL CO.

5. RECOMMENDED GREASES FOR SPECIAL APPLICATIONS

The following greases are recommended for special applications only and should be used for motors specifically built for such conditions.

MINIMUM AMBIENT TEMP. - 60°C	
BEACON 325	EXXON CORP.
MAXIMUM AMBIENT TEMP. - 90°C	
DOW CORNING 44	DOW CORNING CORP
EXXON UNIREX S2	EXXON CORP.

Warning: In general it is not recommended to mix greases of different brands. The mixing of different types of thickeners may destroy the composition and physical properties of the grease. In the event that a different grease is required by the end user, the following steps can be taken. Using the instructions for the lubrication, open the grease outlet and purge the system as much as possible of the old or unwanted grease. Repeat this same operation after 1 week of service. Consult Toshiba/Houston Engineering for further recommendations on grease compatibility.

Warranty

Generally, TOSHIBA will correct at it's option, by repair or replacement (f.o.b. a TOSHIBA-AUTHORIZED SERVICE SHOP), any defect in material and workmanship when properly used for a period of one year after installation or 18 months after shipment, whichever comes first. TOSHIBA is not responsible for apparatus returned without proper authorization and identification, improper handling or storage, misapplication of the motor or the driven equipment, defects in the driven equipment or device, or improper circuit protection. The amount of liability shall not exceed the purchase price of the product. In no event shall TOSHIBA have a liability for commercial loss, claims for labor, removal and installation charges or consequential damages of any type. It is expressly agreed that Buyer's remedies expressed in this paragraph are Buyer's exclusive remedies.

Renewal Parts

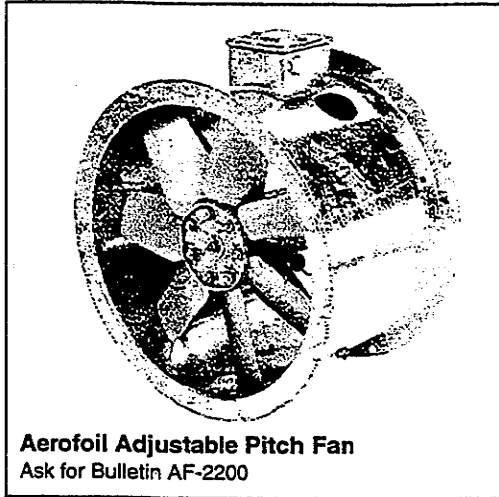
1. Use only genuine TOSHIBA renewal parts.
2. When ordering, specify complete information (at least Model Number and Serial Number) of the motor. Specify quantity and describe part.

WARNING

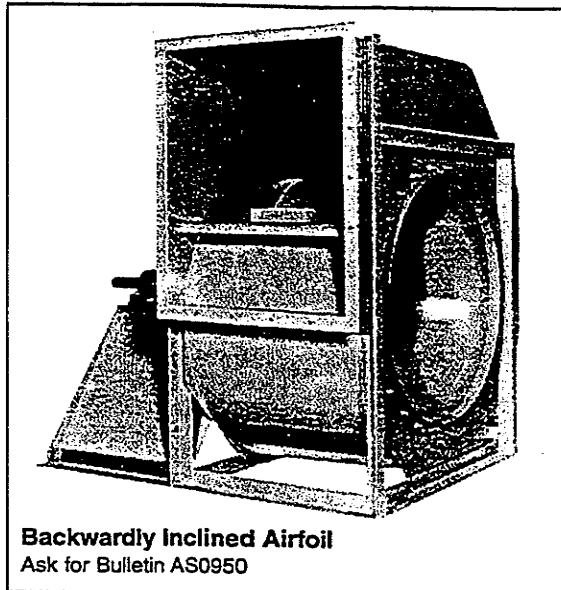
EXPLOSION-PROOF MOTORS are constructed to comply with the UL Label Service Procedure Manual. Repairs of EXPLOSION-PROOF MOTORS must be made by the manufacturer or UL listed service center to maintain the UL Listing.

SPECIAL NOTICE:

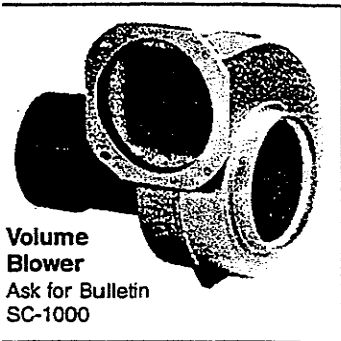
As of June 1991, Toshiba changed their grease type to a Polyurea base. Please consult with factory for more specific information.



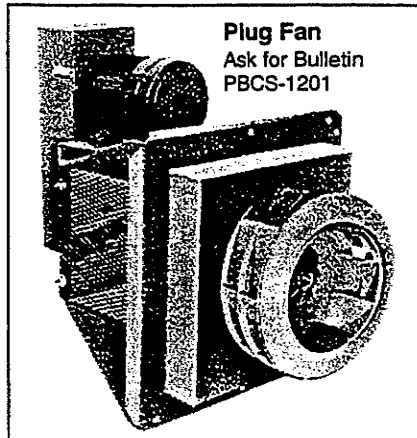
Aerofoil Adjustable Pitch Fan
Ask for Bulletin AF-2200



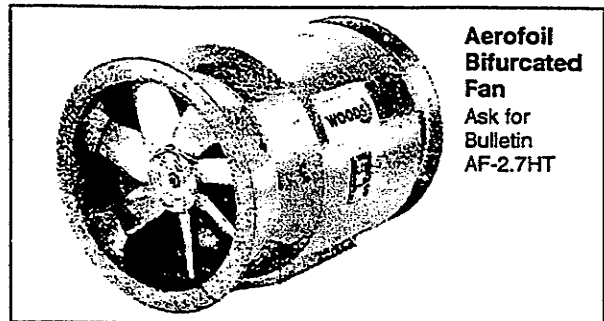
Backwardly Inclined Airfoil
Ask for Bulletin AS0950



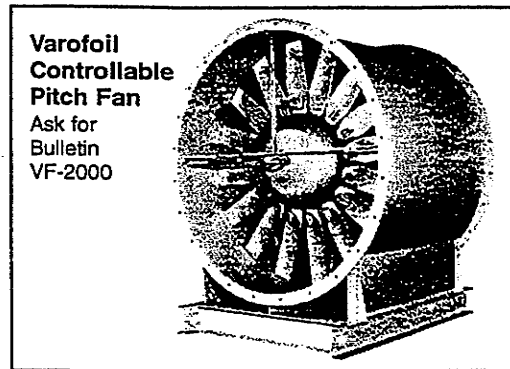
Volume Blower
Ask for Bulletin SC-1000



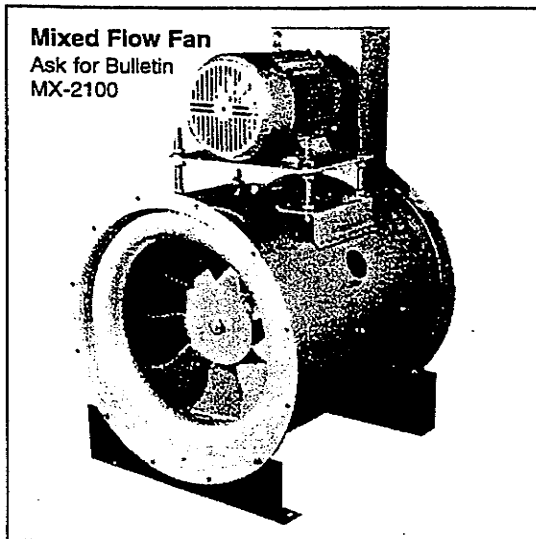
Plug Fan
Ask for Bulletin PBCS-1201



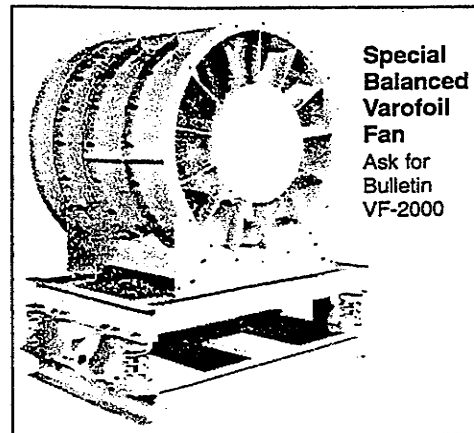
Aerofoil Bifurcated Fan
Ask for Bulletin AF-2.7HT



Varofoil Controllable Pitch Fan
Ask for Bulletin VF-2000



Mixed Flow Fan
Ask for Bulletin MX-2100



Special Balanced Varofoil Fan
Ask for Bulletin VF-2000



2933 Symmes Road, Fairfield, Ohio 45014