Commissioning & Maintenance Instructions

for

COBRA linear stepping motors

ACP&D Limited.
86 Rose Hill Road,
Ashton-under-Lyne,
Lancashire, OL6 8NS.
Tel : +44 (0)161 343 1884
Fax: +44 (0)161 343 7773
e-mail: sales@acpd.co.uk
Websites: www.acpd.com & www.acpd.co.uk

Edition: 17/12/2008

Index

1.0 Before operating the COBRA for the first time check the following points

- Air filter units with filter cartridges of 5µm (or better) should always be used. Air filters should be checked regularly to ensure that they are in proper working condition and should be changed if necessary.

- If an oil-based air compressor is used an air conditioning filter unit with oil separator and oil absorber should be used in order to remove all the oil from the air supply. Oil in the pneumatics could cause a malfunction of the *COBRA* linear stepping motor over time and will quickly cause air filter to 'clog-up' resulting in a reduction in air flow through the air filter.

- When assembling the load component(s) onto the *COBRA* carriage and fixing the *COBRA* stator in position care must be taken to ensure that the stator surface does not deform. Only components with a polished surface (parallelism < +/-2µm) may be installed onto the carriage. The best way to fix components onto the *COBRA* carriage is to use 3 point fixing. Spacers can be used to help ensure that there are no 'bending forces' exerted onto the carriage or stator.

- Any deformation of the stator must be avoided! If necessary the lower surface of the stator can be checked with a suitable instrument (i.e. a 'hair line' gauge).

- When the *COBRA* is to be used for vertical operation with an 'open-loop' control system, overloading should be avoided (i.e. sudden impacts of high force) since the carriage may lose position. It is advised that if a reference sensor is used on a vertical system that it should be located at the end which is in the bottom position.

- Limit stops with kinetic energy absorbing dampeners can be used if required. This may be especially desirable on vertical axes.

- Heating up of the *COBRA* linear stepping motor system above 50°C should be prevented at all times.

- Before supplying the *COBRA* carriage with electrical power for the first time it is advised that the pneumatics be energized on their own and the carriage moved along the length of the stator by hand. During this procedure the user should be able to 'feel' the exerted force and check that it is uniform across the entire length of stator. If necessary the force can be measured using a 'spring action' meter. Only when the force is deemed to be uniform across the length of the stator should the voltage and current be applied to the carriage.

2.0 General Installation notes

COBRA linear stepping motors are extremely long-lasting due to the pneumatic air bearing incorporated in it's design. Because there is no friction with the *COBRA* system plus the fact that no external transducers are required for the proper functioning of the unit, there is no resulting wear.

For the perfect functioning of the *COBRA* system the user should ensure that the following conditions are adhered to. Failure to meet any of these requirements will invalidate any possible warranty claims in the future:

Frequency of maintenance: The frequency of maintenance of the surface of the stator depends upon the operating conditions in which the unit is working. The higher the degree of pollution or contamination, the more often the unit requires cleaning. Dry dirt particles (e.g. dust, lint, wood or plastic splinters) do not impair the function, since they are blown away by the pneumatics. Air leaking out of the air gap between the carriage and the stator ensures that no particles which are smaller than the gap are allowed between the stator and the carriage. This does not apply to small, sticky' particles which may be liable to stick to surfaces.

Foreign bodies: Materials used in the vicinity of the *COBRA* which may be liable to stick to the stator such as coolants, lubricating oils, sticking dispensation ions, etc. should be allowed to drain, congeal or solidify, and then be removed ***without removing the carriage.*** In principle the surface must be provided with a thin oil film when the *COBRA* unit is not going to be used for a significant length of time however this does not apply when the high grade Stainless Steel Stator is used. Oil film provides corrosion protection for the surface. We recommend using WM 40 oil or another similar preservative agent.

Unnecessary removal of the COBRA carriage: Unnecessary removal of the carriage and it's subsequent placement back onto the stator are to be avoided, since this process can introduce contaminates between the 'air bearing surfaces' or lead to accidental damage to the surfaces.

Prohibited movement of the COBRA carriage: Moving the carriage on the stator without attached compressed air ***is not allowed*** as this can lead to damage to the 'air bearing surfaces'.

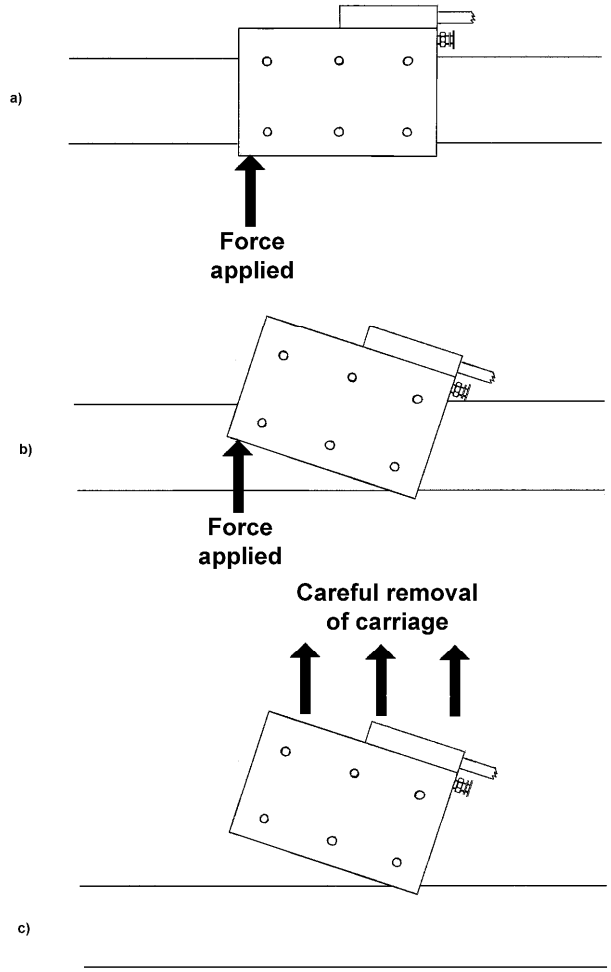
Stator surface: The surface of the stator should be protected against any likelihood of impact. If the stator surface is damaged it should be made smooth again before further usage (see point 2.9).

Determination of COBRA carriage current setting: The *COBRA* stepping motor comprises one or more motor modules mounted inside the carriage. A motor module contains one set of windings. Each motor module is approximately 70mm in length and may be operated up to a maximum current of 3A. If more than one motor module is incorporated into the *COBRA* carriage (i.e. 'n' motor modules) the coils from these motor modules are internally connected in parallel. ***In this case the***

maximum COBRA operating current will be 'n' x 3A. All power must be removed before any cables are connected or disconnected.

Correct pneumatic pressure: For correct functioning of the *COBRA* linear stepping motor systems the compressed air must exhibit a pressure of 3,5 ± 0.3 bar (higher pressures are necessary with certain carriage sizes – see *COBRA* datasheet) and must be free from water, oil and other impurities. The compressed air ***must be filtered*** to 10µm or better (we recommend 3 to 5µm filtering for optimum performance). ***Never operate the system with unfiltered air*** as contaminates can enter the system and cause blockages in the airlines and carriages resulting in the malfunction of the *COBRA* unit. If the *COBRA* is to be operated without compressed air monitoring, care must be taken to ensure that system pressure does not fall below the minimum air pressure stated for each size of unit (see the *COBRA* datasheet). ***Operation below the minimum pressure can lead to damage to the 'air bearing surfaces' and the incorrect functioning of the COBRA unit.***

Correct method of COBRA carriage removal: If the carriage has to be removed from the stator (not recommended if at all possible) it should be pushed away from the side edge of the stator (as indicated in a, b & c below).



Compressed air should be applied during the removal of the carriage and should be as high as possible (up to a maximum of 6 bar). The *COBRA* carriage is 'L' shaped with inner 'air bearing' surfaces facing the grooved top surface and one side surface of the stator. With the pneumatics applied to the carriage (and with electrical power OFF) a force can be applied to one end of the top of the carriage as indicated in a) above. By applying this force the carriage can be 'slid' sideways as indicated in b), thus reducing the magnetic force from the side element of the carriage. With the reduction of the side magnetic field the opposite end of the carriage can be slowly and carefully moved off the stator as indicated in b).

Because of the attractive effect of the permanent magnets in the carriage in the removed condition is should be protected absolutely against Iron filings dust or splinters, since such particles can be removed only with difficulty. Failure to adequately protect the carriage from these particles will cause a malfunction of the *COBRA* unit when the carriage is put back onto the stator.

Due to the high magnetic forces (especially the larger and higher power *COBRA* units) it may be difficult to remove the carriage without scratching the 'air bearing' surfaces. Contact ACP&D Limited for further advice if you are not sure about correctly performing this procedure.

2.9 **Replacement of the COBRA carriage:** Putting the carriage onto the stator may take place ***only after*** the 'air bearing' surfaces of both the carriage and the stator have been adequately cleaned and no damage is visibly noticeable. Damage caused by scratches, splinters and the like are to be treated and smoothed with an even and fine grained abrasive material such as a Lap Stone. If damage is caused to either the carriage under side or stator top and side bearing surface and correction is not possible you should contact ACP&D Limited for further advice.

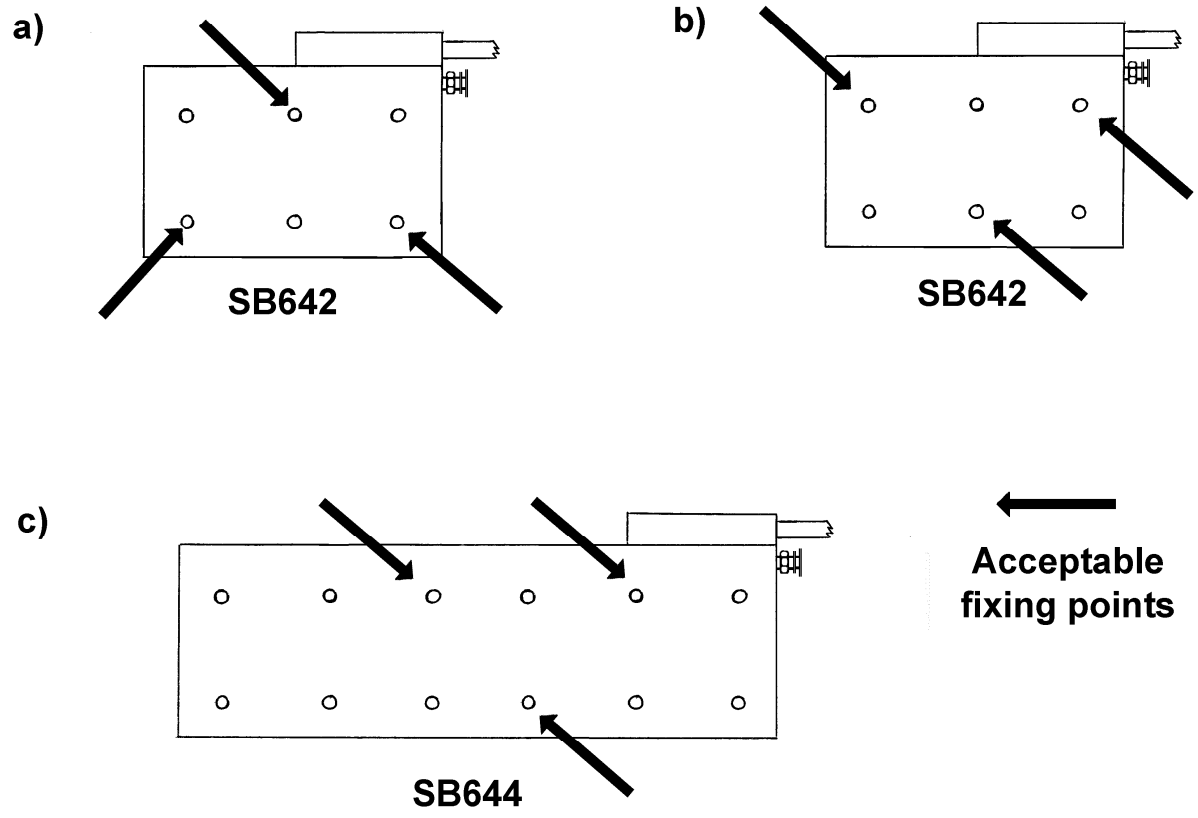
Replacing the carriage back onto the stator should take place with a higher pressure than the normal operating pressure. We suggest using a pressure of 6 bar. The side face on which the carriage travels is identified by a mark (indentation) at each end of the stator. ***Only the designated side should be used. The fitting of the carriage to the wrong side of the stator can cause damage to both carriage and stator, cause malfunctioning of the COBRA unit and will invalidate any subsequent warranty claim.***

It must be noted that the carriage is pulled toward the stator by the magnetic field strength of the permanent magnets within the carriage and the magnetic field generated by the motor coils. Before attempting to remove or replace the carriage you must remove the electrical power to the *COBRA* unit. The magnetic force increases exponentially as the carriage gets closer to the stator. ***Care must be taken when holding the carriage such that fingers cannot be trapped between carriage and stator. Care must also be taken such that scratches to surfaces are avoided during this process.***

After the carriage has been replaced back onto the stator the pneumatic pressure should be adjusted back to the 'normal' operating pressure and the carriage should be moved by hand in order to check for smoothness of movement. This must be

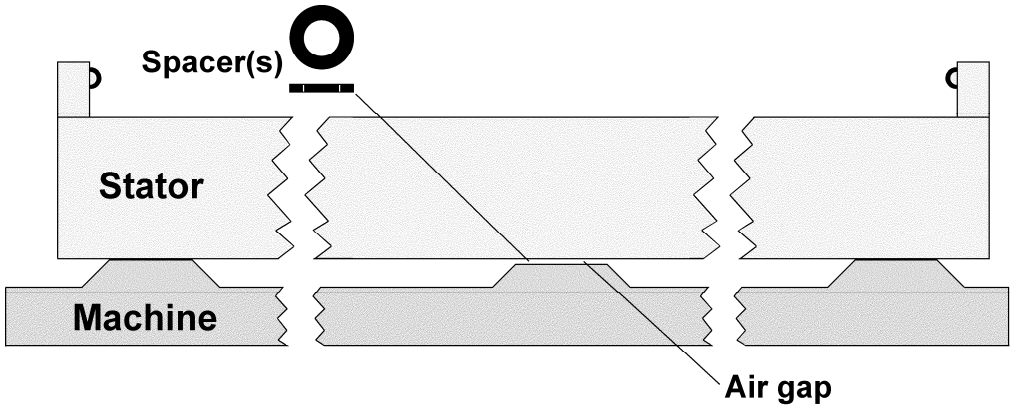
done with the electrical power off. If the movement is not smooth and friction can be felt particles may be trapped between the carriage and the stator. If this is the case then the carriage must be carefully removed again. Both the carriage and stator should be cleaned and checked for damage. If necessary the carriage and stator 'air bearing' surfaces should be carefully smoothed with a fine grade abrasive material such as a Lap Stone.

2.10 **Correct attachment of load:** The attachment of objects onto the carriage should only be undertaken directly onto the top surface of the carriage. ***The carriage must not be tensioned or bent in any way as this will cause the COBRA to malfunction.*** The best way to attach an object to the carriage is to bolt it on using three points of fixing (see diagram below).



Before tightening the fixing bolts the user must check that there are no air gaps between the carriage and object. If any air gaps are found suitable 'spacers' should be used to remove the gap. Only then can the object be bolted onto the carriage. If there is any tension in the carriage or worse, bending of the carriage the *COBRA* unit will malfunction causing possible damage to the unit. ***Damage to the COBRA unit due to incorrectly fitted objects to the carriage will invalidate any warranty claim.*** If you are in doubt about the fixing of any objects to the COBRA please contact ACP&D Limited for further advice.

2.11 **Correct fitting of the COBRA stator:** Care must be taken when attaching the stator to any machinery. The fixing should be free of any tension as this may cause the stator to flex resulting in failure of the air bearing. The fixing of the stator can be attained most accurately by the use of three point fixing. Should the stator be required to be fixed in more than three points then care must be taken to ensure that the fixing points are parallel and that there are no air gaps between the point of fixture and the stator. Should there be an air gap a suitable spacer should be used to remove the gap as indicated in the drawing below.



The linearity tolerance of the stator's top (grooved) surface on which the carriage 'floats' on it's air bearing is <5µm per 300mm of stator length. ***It is imperative that the stator be fixed in such a way that there is no tension in it which could lead to a bending of the stator in any way***. Spacers should have been supplied with your *COBRA* unit to help in the correct mounting of the stator and also objects onto the carriage however should you require more please contact ACP&D Limited.

2.12 **Maximum stator temperature:** As a function of the stepping motor driver an increased heating up of the carriage can occur due to it's 'chopping frequency'. The temperature at the carriage ***must not exceed 50°C***.

3.0 Trouble shooting guide

Symptom	Possible Cause	Action to be taken
Carriage fails to move when driven by the drive.	No electrical connection	Check all electronics i.e. drives, cables, etc. for correct functioning.
	No pneumatics	Check pneumatic pipes are correctly connected and that the pressure and flow conforms to the COBRA requirements (see COBRA datasheet).
	Not enough pneumatics	Check the pneumatic pressure and increase it above 3.0 bar if it is below this pressure. Check that the air ducts and nozzles on the under side of the carriage are not blocked, clearing any blockage as necessary. Check air filters and change if necessary. If air cleaner unit is used to remove oil from the air supply check it and replace if necessary.
	'Bowing' of the stator or carriage due to incorrect fixing.	Refer to Commissioning and Maintenance instructions for correct fixing procedure. Is there any air gaps between the stator and the apparatus to which it is connected? If so use thin spacers to remove the air gap. Refer to Commissioning and Maintenance instructions for correct fixing procedure. If there are any air gaps between the load and the carriage before bolting to the carriage use the supplied spacers to remove the air gaps. Carefully remove the carriage from the stator (please refer to the Commissioning and Maintenance Instructions for the correct procedure) and visually inspect for damage. An even and fine grained Lap Stone can be used to repair any damage. If deep scores are found refer to ACP&D Limited for advice. Check that the side element of the carriage is located on the correct side (see mark on the end of the stator) of the stator. If not carefully remove the carriage and check for damage before fitting it back onto the top and correct side surface. Refer to the Commissioning and Maintenance instructions for the correct procedure. Check cooling arrangements of the COBRA stator and improve them if necessary .
Carriage 'stalls' over part of it's movement.	Particle contamination located between the COBRA carriage and the stator.	Carefully remove the carriage from the stator (please refer to the Commissioning and Maintenance Instructions for the correct procedure) and visually inspect for damage. An even and fine grained Lap Stone can be used to repair any damage. If deep scores are found refer to ACP&D Limited for advice. Check that the air ducts and nozzles on the under side of the carriage are not blocked, clearing any blockage as necessary.

Symptom	Possible Cause	Action to be taken
Carriage 'stalls' over part of it's movement. (Continued)	Particle contamination located between the COBRA carriage and the stator. (Continued)	Check air filters and change if necessary. If air cleaner unit is used to remove oil from the air supply check it and replace if necessary. Check flatness of the stator and carriage using a suitable instrument (i.e. hair line gauge)
	Non-parallel forces applied to the carriage	Check the attachment of the load to the carriage. Ensure that exerted forces on the carriage are running parallel with the stator and make adjustments as necessary. There must be no twisting motion on the carriage as this could affect the air gap between the carriage and the stator.
	The driver controlling the COBRA unit has not been optimally set-up.	Check that the current setting of the driver is correct. Check that the voltage settings of the driver are correct. Examine the movement profile and introduce longer dwell times if possible. Reduce drive current whilst the drive is in a dwell time.
Static maximum force is not achieved	The air flow is too low	Check the pneumatic pressure and increase it above 3.0 bar if it is below this pressure. Check that the air ducts and nozzles on the under side of the carriage are not blocked, clearing any blockage as necessary. Check air filters and change if necessary. If air cleaner unit is used to remove oil from the air supply check it and replace if necessary. Check that the current setting of the driver is correct. Check that the voltage settings of the driver are correct.
Score marks appear on the stator.	Particle contamination located between the COBRA carriage and the stator.	Carefully remove the carriage from the stator (please refer to the Commissioning and Maintenance Instructions for the correct procedure) and visually inspect for damage. An even and fine grained Lap Stone can be used to repair any damage. If deep scores are found refer to ACP&D Limited for advice. Check that the air ducts and nozzles on the under side of the carriage are not blocked, clearing any blockage as necessary.
	'Bowing' of the stator or carriage due to incorrect fixing.	Refer to Commissioning and Maintenance instructions for correct fixing procedure. Is there any air gaps between the stator and the apparatus to which it is connected? If so use thin spacers to remove the air gap.

Symptom	Possible Cause	Action to be taken
Score marks appear on the stator. (Continued)	'Bowing' of the stator or carriage due to incorrect fixing. (Continued)	Refer to Commissioning and Maintenance instructions for correct fixing procedure. If there are any air gaps between the load and the carriage before bolting to the carriage use the supplied spacers to remove the air gaps. Carefully remove the carriage from the stator (please refer to the Commissioning and Maintenance Instructions for the correct procedure) and visually inspect for damage. An even and fine grained Lap Stone can be used to repair any damage. If deep scores are found refer to ACP&D Limited for advice. Check that the side element of the carriage is located on the correct side (see mark on the end of the stator) of the stator. If not carefully remove the carriage and check for damage before fitting it back onto the top and correct side surface. Refer to the Commissioning and Maintenance instructions for the correct procedure. Check cooling arrangements of the COBRA stator and improve them if necessary .
	Non-parallel forces applied to the carriage.	Check the attachment of the load to the carriage. Ensure that exerted forces on the carriage are running parallel with the stator and make adjustments as necessary. There must be no twisting motion on the carriage as this could affect the air gap between the carriage and the stator.