USERS MANUAL

Vari-speed installation instructions for WARCO WMT300 and WMT500 multipurpose lathes.

!!PLEASE READ THESE INSTRUCTIONS CAREFULLY PRIOR TO USE!!

Installation and Instructions for the WARCO WMT Variable speed control.

Thank you for purchasing the variable speed control system from us, we trust you will find variable speed indispensable once you have started using it.

This system has been primarily designed as a retro-fit system for the WARCO WMT300, but can also be fitted to the WMT500 machines with a small amount of additional wiring .

This system comprises a new replacement 3PH motor, Inverter controller, together with new pushbutton control station to fit in place of the factory fitted NVR switch.

Some basic hand tools will be required to implement the installation of the system. These include; a crimping tool & wire cutters, Soldering Iron, Terminal screw driver, and a set of Metric HEX 'Allen' keys. You will also require the use of a battery drill and selection of metric drills and taps. (M4, M5 etc). The use of bootlace ferrules is also recommended for when you come to terminate some of the smaller cables.

Unpacking and inspection.

Carefully unpack the new three-phase motor, Inverter drive, replacement pushbutton control station. Every care has been taken to make sure it arrives in good condition but you should examine it now to make sure no damage has been caused during transit.
If there has been any damage to the motor or it's controller in transit, you should notify us immediately and not proceed any further with the installation.

Installation - General Notes

⚠ IMPORTANT SAFETY NOTICE ⚠

Whilst the installation of your new motor and its speed controller should be quite straightforward you will need to remove the original motor and its wiring from the lathe first.

⚠ **If you have any doubts about your ability to do this safely then you must stop and consult a qualified electrician to do the work for you!**

If your lathe has additional electrical equipment such as a suds pump or halogen lighting you will need to separate those circuits out from the motor power wiring, if you are unsure how this can be done then you must always consult a qualified electrician.

⚠ **First make sure that your lathe is disconnected from all sources of electrical power, unplug its power cord from the mains and coil it up so that it can not be plugged back in again accidentally.**

⚠ **Note: Whilst removing any wiring or disconnecting any wires on your lathe you should make a note of where they went to, in case you want to remove the speed controller and refit the original equipment later on for any reason.**

The new variable speed control system will still utilise the safety guard switches on the main belt housing, and top mill head belt housing.

The main belt housing switch wiring will be interfaced into the terminal contacts on the rear of our Emergency stop button.

The milling head belt guard switch wiring will be interfaced into the ‘normal’ stop circuit of our drive and its cable should be left in situ for connection into our system later.

If the mill head guard switch is not being used – then leave the small ‘test link’ in place in the control terminal block (see later)

Installation of the Motor

Remove the cover from the main terminal box which is situated on the rear of the belt box above where the motor is situated. Now, carefully proceed to disconnect connections to the terminal block, and remove the terminal strip. Disconnect the existing motor cable from the junction / switch box on the machine, leaving the cable attached at the motor end.

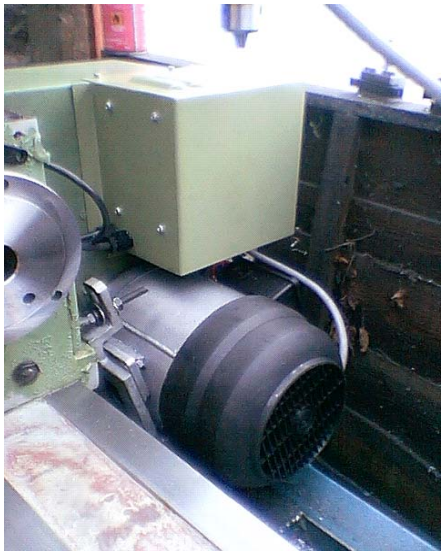
Slacken the motor belt tensioning bolt on your lathe so that the belts are quite slack, and thus can be removed.

Slacken the grub screw holding the motor pulley to the motor shaft and remove the pulley. Set the old motor pulley to one side as this will need to be re-fitted back onto the new motor.

Now proceed to remove the existing motor. You will need to remove the motor complete with the motor mounting bracket so that you can get to all four securing bolts. The motor mounting bracket is removed by withdrawing the kingpin. Unbolt the existing single-phase motor and carefully remove it from the bracket.

⚠ **The motor is heavy and you may require an assistant to help you.**

Remove the tape holding the key in the key way of the new motor. Carefully clean the motor shaft with a soft cloth moistened with white spirit to remove any adhesive or anti rust treatment. Refit the key into its key-way; do not shorten the key as the motor has been balanced with a full key.



Proceed to bolt the new motor onto the motor mounting bracket. Do not tighten fully until the motor belt has been checked for alignment with the lathe counter shaft pulley. Offer the motor and bracket assembly up to do a dry fit first etc.

The motor pulley should now be re-fitted, the belt re-fitted, and correctly tensioned.

The new motor will have been supplied with a 3PH motor cable. This should be carefully shortened to the desired length, and fed through one of the compression glands in the side of the inverter housing. The individual cores of this cable are marked 1, 2, 3 and green/yellow (EARTH).

These should be connected into the terminal strip and corresponding to the following colours;

Core 1 to **RED** (u phase)
Core 2 to **YELLOW** (v phase)
Core 3 to **BLUE** (w phase)
Yellow/Green core to the Earthing point.

Installation of the new Pushbutton controls

The new pushbutton control station will fit in place of the original factory fitted NVR (no volt release) switch which will first need to be removed.

The existing NVR switch is removed by removing the screw fixings either side of its bezel, and then carefully proceed to withdraw the unit away from the belt housing.

The are a number of spade crimp connections on the rear of the NVR switch .These can be removed from the back as we will not be using this wiring.

Most of this wiring, except the 2-core + EARTH cable, can then be pulled through the flexible conduit which passes through the belt housing.
The 2-core + EARTH cable will be used later on in the installation as a means of interfacing the belt guard switch to our system

⚠ **Note: Whilst removing any wiring or disconnecting any wires on your lathe you should make a note of where they went to, in case you want to remove the speed controller and refit the original equipment later on for any reason.**

Before proceeding any further with the wiring, offer up the new pushbutton control station to its intended position (see picture) and mark out the holes for drilling. These should be drilled M3.5, then tapped for M4 machine screws.

Main Belt guard switch wiring:
The **EARTH** core of the existing cable that has been retained should be reinstated to the earth point on the front of the belt box housing.

The **BROWN** core should be connected to one of the 'blade type' connections on the belt guard switch. You will need to make a small linking wire up from some of the cables you have removed, and this will need to be connected from blade connection on the other side of the guard switch – and then connected to one side of the contact block on the rear of the Emergency Stop button on our new front panel.

The **BLUE** core should be connected to the other side of the Emergency stop button contact block.

At the **new inverter drive** housing – the free end of the existing 2-core & earth cable should be fed through one of the compression glands in the side of the new inverter housing, and connected into the terminal rail where indicated by a label which reads "Belt Switch"

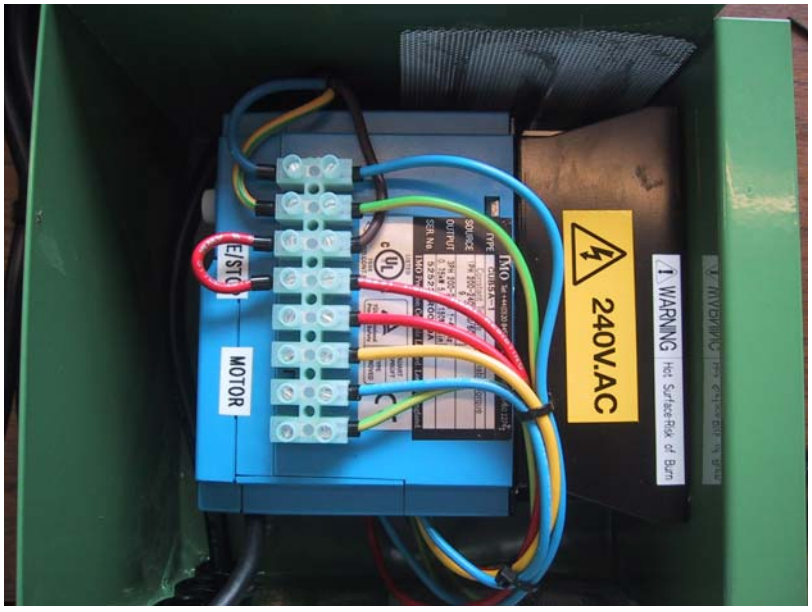
You will now need to carefully feed the NEW cable attached to our pushbutton station down the flexible conduit, through the belt housing, to the area above the motor where the inverter housing will be installed. The cores of this cable are colour coded, and will have to be stripped & prepared, and should be fitted with bootlace ferrules to ensure good connections are made. You may also want to reduce the length of this cable which has been intentionally left longer than required.

These cores can now be connected into the terminal strip inside the inverter housing colour by colour. i.e. **Red-to-red**, **Blue-to-blue**, **Yellow-to-yellow**, **Green-to-green**, **Purple-to-purple**, **Brown-to-brown**, **Black-to-black.**
All except for the WHITE – which is to be connected on the other side of the terminal block, opposite side from where an 'orange' test link is fitted.

Notes for WMT300 users:
Identify the cable coming down from the milling head guard switch, and feed the free end of this cable through one of the vacant compression glands in the side of the inverter box.

The two cores of this cable should then be connected into the two terminals where there will be a 'test link' fitted across them. Remove the test link, and connect the mill head guard switch wiring in here. The polarity in which you connect these two cables in does not matter.

For users of the WMT300 lathe not equipped with milling head – then leave the factory fitted test link in place.



Notes for WMT500 users:
For users of the WMT500 machine with the 'powered' head – the above wiring has to be implemented slightly differently. (See simplified power wiring diagram)

Identify the cable coming down from the milling head guard switch, and feed the free end of this cable through one of the vacant compression glands in the side of the inverter box.

The **BLUE** core of this cable should be connected into the incoming 'NEUTRAL' terminal.
The **BROWN** core of this cable should be connected into the incoming 'LIVE' terminal.

The pushbutton control station can now be secured to the front of the main belt housing using the flange fixings at the top and bottom of the pushbutton controls housing. Take care when finally offering the unit up to the belt housing, ensuring that none of the wires or cables are pulled or strained etc.

You can now proceed to mount the main inverter controller housing onto the rear of the belt housing. The inverter housing has been designed to fit above the motor, and 'flush' with the top of the belt housing.
Offer the unit up to its intended position (see picture) and mark out the holes for drilling. These should be centre punched, drilled M3.5, then tapped for M4 machine screws.

Take care when offering the inverter drive housing up to the belt housing, ensuring that none of the wires or cables are pulled or strained as you move the housing into its position.
This can now be secured in place using the M4 machine screws.

Instructions for use.
Please now completely familiarise your self with the controls to avoid any problems later on.

Description of the controls.
Emergency Stop.
Pushing this will cut off all power to the inverter and the machine will coast to a standstill.
To release the stop button, the head is turned anti-clockwise allowing it to return to its' normal position. The machine can then be restarted with the green start button.

⚠ ***Important note:***
The emergency stop push button should only be used for emergencies, or for example to provide safe power disconnection when setting change wheels for screw cutting or changing the lathe chuck etc For all other situations use the "normal Stop" push button. Repeated use of the emergency stop button (several times over a few minutes) may cause damage to the inverter power circuits and should be avoided.

When you have finished working with your lathe, push in the emergency stop button and switch off at the mains socket.

RED Stop button.
The red "normal" stop push button is to be used for all non-emergency stops. For example to measure a diameter on the work piece, to remove a work piece from the lathe chuck or to change a cutting tool. There is no limit to the number of times you can start and stop the motor using the normal stop push button; no damage will result to the inverter or motor.

GREEN Start button.
The green start push button will cause the motor to run FORWARD at the selected speed, and when the green button is released the motor will continue to run until stop is pushed. The start button is also used in conjunction with the "Jog" function.

YELLOW The yellow start push button will cause the motor to run REVERSE at the selected speed, and when the yellow button is released the motor will continue to run until stop is pushed. The yellow start button is also used in conjunction with the "Jog" function.

Congratulations! Your WARCO lathe now has a high torque industrial grade three phase induction motor that along with its speed controller (Variable frequency drive) will make your lathe much more pleasurable to use.

When you use your machine you will be amazed at how smooth it has become, gone are the vibrations, humming and rattles that your old single-phase motor created.
Each time you start the lathe it now starts progressively and smoothly without any jolting, jarring and snatching of the drive train.

The speed controller smoothly accelerates the motor to the desired speed and there are no large currents whenever the motor starts unlike the old motor that could easily peak at 40 amps during start up, that's why single phase induction motors can be notoriously short lived!

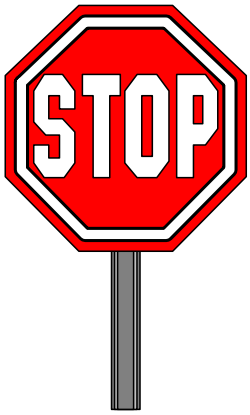
Now please read the remainder of the manual carefully, the new drive system will easily deliver full motor torque at 10^{th} motor speed so you need to exercise as much caution when the motor is turning slowly as at full speed. Learn firstly how to start and stop the motor normally or in an emergency, this is essential for your own safety.

Lathe belt changing and back gear setting.
Depending on the job to be done, you should select the most appropriate belt speed.
Far less belt changing needs to be done with speed control and many jobs can be turned at slow speed without even using the back gears but you should always strive to have the lathe in a belt position which allows the motor to run quickly enough for its' cooling to be effective, this is more important when carrying out lengthy machining operations at low speed.

Over a short period of time you will quickly become familiar with what can be achieved and probably find that a middle range belt speed in conjunction with speed variation suits 80% of your machining needs.

Protection.
Your speed controller has been pre-programmed with all the motor parameters and will protect the motor against overloading. It is also protected against under or over voltage, over current, over temperature and short circuits on the motor output side.

!!! SAFETY FIRST!!!



1. **Always use eye protection when using your lathe.**

2. **Never allow the speed controller or it's controls to become wet.**

3. **Keep swarf and cutting oils out of the motor ventilation slots and end shields.**

4. **Switch off the main power when not in use.**

5. **Do not allow the motor cable or power lead to become damaged or frayed.**

6. **Do not try to dislodge any swarf or material from inside the motor body at any time unless the power is completely switched off. High voltages exist within the motor even when the motor is at standstill!**

Trouble shooting:

The unit will not run?
Is the power plug pushed into a good working socket?
Is the motor plug inserted into its socket at the base of the speed controller?
Is the emergency stop button released? It has a stay put action when pushed in, turn the head counter clockwise to release it.
Check that both the belt housing guard switches are closing correctly.
Check the fuse in the moulded 13-amp plug supplied with the speed controller, it may have blown if the emergency stop button has been used frequently to power down the system. If so fit another fuse of the same type and try again. If the fuse blows repeatedly there may be a problem with the inverter requiring attention at our workshop. Please phone for advice.

The motor appears noisy or a regular knocking noise is heard from the drive train, which gets worse as the machine speeds up.
Check that the drive pulley is a good fit on the motor shaft, any looseness of the pulley or grub screw holding the key in position will cause a knocking noise.
Check that the belts and pulleys are lined up properly and that the motor and headstock drive belts are in good condition with no tears or splits.
Make sure that the motor shaft and motor pulley are not fouling the belt guards and covers.
Make sure the motor and headstock belts are not over tightened.

If none of the above faults are found, remove the motor drive belt and run the motor in “Jog” mode, hold down the green start button and observe the motor pulley, it should rotate smoothly without any tendency to jerk or pulsate, if any pulsation’s are visible or if the motor vibrates then there may be a problem with the motor or it’s speed controller.
If you have tried the above procedures then please contact our Technical Support department.

The motor does not continue to run when the green start button is released.
The Jog / Run selector switch is in “Jog” position, move it to the “Run” position!

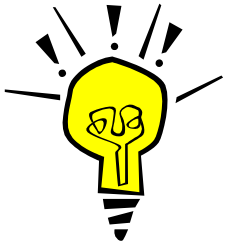
Maintenance
Your speed controller should need no maintenance apart from keeping the outer box and controls clean.

The motor has ‘lubricated for life’ bearings, thus all that is required is to keep the motor clean and free from swarf.

If swarf enters the motor or controller, unplug the controller from the mains power before attempting to remove it.

In normal operation the controller should produce very little heat due to its high efficiency.

Frequently asked questions and answers, (FAQ)



What is the difference between a single phase and three phase motor?
The single-phase induction motor.

Your lathe would have been fitted originally with a single-phase motor for use with the normal 240VAC domestic supply, but a single-phase motor has several disadvantages, which make it far from suitable for lathe work.
Firstly in the single phase induction motor a true rotating magnetic field is not produced in the stator windings, to be precise the field "pulsates" back and forth over 90 electrical degrees, these pulsation's are induced in the rotor and can be felt as a vibration, it is for this reason that many single phase motors are "resiliently mounted" in a cradle which dampens out most but not all of the vibration.
The vibrations can be transmitted through the lathe drive train and give rise to a poor surface finish when using the auto traverse. A three phase motor by comparison, has a true rotating field where each stator winding is displaced by 120 electrical degrees causing the field to rotate at the applied frequency, the rotor is influenced by the stator field and rotates smoothly with no vibration. The best analogy I can give you is that the difference in smoothness is best compared to a two cylinder locomotive and one having three cylinders, on the two cylinder locomotive the cranks are at 90 degrees to each other causing uneven running and vibration whereas the three cylinder locomotive has cranks at 120 degrees resulting in smooth slow speed running and no vibration.

Secondly, the single phase motor is not inherently self starting, most will have a centrifugal switch which connects in a "starting winding" when the motor is at rest, as the motor accelerates up to speed the switch is thrown out by centrifugal force and the motor continues to rotate by the "run winding" alone. Since the "start winding" is only short term rated if for any reason the switch fails to open the winding will burn out in a matter of a few seconds in a cloud of smoke, if the switch fails to close at standstill then the motor fails to rotate at all and the "run winding" burns out (the run winding is of a much higher resistance and takes longer to burn out than the start winding.) Other single-phase motors may have start and run capacitors with or with out a built in switch but once again repeated starting and stopping will eventually cause the starting mechanism to fail.

Thirdly, you will probably have noticed that when you started your lathe the current drawn would make the workshop lights dim momentarily, this is due to the action of the "start winding" which has a very low resistance, the starting current on even a ½ HP single phase motor can peak at 30 – 40 amps!

So if you ever tried repeatedly “inching” your lathe, for example when setting a four jaw chuck you will have found that your old motor protested loudly accompanied by noticeable disturbance on your domestic supply. For this reason your lathe might have been fitted with a clutch or you might be in the habit of slipping the drive belt when trying to “inch” your lathe.

The three phase induction motor.

In industry, the three phase induction motor reigns supreme, often described as the “work horse of industry” it is available in power range from a few Watts to several tens of megawatts. It has the following advantages;

1. High efficiency
2. Runs in the most hostile environments.
3. Is inherently self-starting.
4. Has an excellent short term overload rating and good starting torque.
5. It has only one major moving part namely the rotor.
6, It requires virtually no maintenance.
7. Can be had in range of voltages from 110V to 33,000 Volts!
8. It is very easy to reverse.

What is the efficiency of the inverter?

About 97% efficient!

What is the overall efficiency of the inverter and it’s three-phase motor?

About 85% depending on the load, the greater the load the more efficient the system becomes.

If you experience any problems with your speed controller, need advice or have any comments or suggestions on how we can improve our products, then please do not hesitate to contact us. We will always be pleased to hear from you.

Designed and manufactured in the UK, exclusively for Warren Machine Tools by

Newton Tesla (Electric Drives) Limited
Units G14 & G18, Warrington Business Park, Off Long Lane.
Warrington, Cheshire. WA2 8TX

www.newton-tesla.com
info@Newton-tesla.com