MAGNETEK
ELEVATOR

PM Elevator Drive

Alignment, Optimisation & Faultfinding Supplement.

R1.4

This guide is written to assist with the startup of a PM machine with EnDat encoder fitted to the Magnetek HPV900S2 drive.
Please follow this guide step by step to ensure a smooth and simple installation.

Before powering up the drive

Ensure that the motor connections are phased correctly, that is U,V,W (A,B,C) terminals on the control panel terminal rail are connected to the hoist motor terminals U,V,W.

Step 1 - Encoder Set-Up

Electrical interference and mechanical speed modulations are common problems that can result in improper speed feedback getting to the drive. To help avoid these common problems, the following advice is given:

- Ensure that the motor power cabling is screened and correctly glanded where the braid is clamped within the gland and earthed through it (as is done with armoured cable) – twisting the screen together and terminating it to the motor frame is not recommended procedure.
- Ensure that Encoder cable routing is away from the motor cable, outside of trunking if necessary.
- Ensure the encoder screen is clamped at the drive end in the correct 360 degree 'P' Clamp as shown in **Figure 3** – twisting braid together and connecting it to earth is not recommended.
- After stripping off the encoder cable insulation for terminating in the drive, keep the tails as short as possible - we would recommend no more than 100mm is exposed.
- Please seek advice before extending encoder cables, we recommend one continuous length of Heidenhain branded cable is used to connect the EnDat encoder directly in to the drive where ever possible, if any extension or join is required a 'Heidenhain cable connector' is recommended to connect the existing cable to the Heidenhain extension cable as shown in **Figure 2.** Using unbranded or inferior encoder cable is **not** recommended due to the sensitivity in signalling transmitted from the EnDat encoder, as this may have a detrimental effect to performance/ ride quality
- We would recommend that cables do not exceed 45 meters. If they do, contact Magnetek for further advice

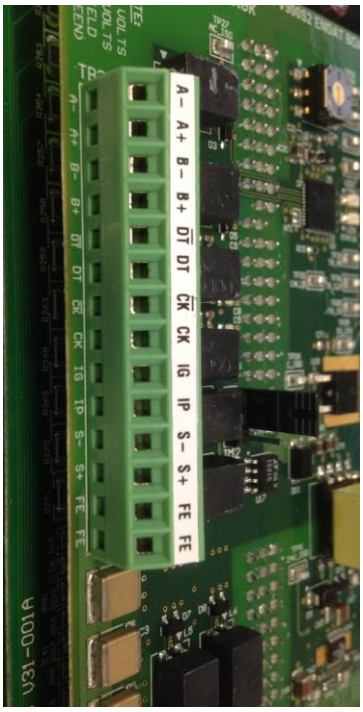


Figure 1: 900 Series 2 Endat encoder connections

Figure 2: Recommended Heidenhain Cable/Connectors

Figure 3: P-Clip connection

The table below shows the correct terminations for the HPV900S2 drive, with several previously encountered cable types. Usually the standard Heidenhain colours will be used, but certain motor manufacturers use different wire colours as detailed in the table.
If you are unsure of the correct wire colours please refer to the encoder/motor supplier's documentation and if required contact them for clarification prior to powering up the equipment – **failure to do this may result in damage to the encoder, the drive or both!** You may wish to note your encoder colours in the 'other' box below for reference.

Encoder Signal	HPV900 S2 Termination	Cable Colour							
		Standard Heidenhain (Xinda, Permagsa, Leroy Somer etc)	Ziehl	CEG	IMEM package extension	Wittur	Wittur 2 (Extension)	Sassi ECN1313	Other
A-	**A-**	Yellow & Black	Red & Blue	Brown	Purple	Yellow	Pink	Purple	
A+	**A+**	Green & Black	Grey & Pink	White	Green	Green	Grey	Red	
B-	**B-**	Red & Black	Red	Yellow	Pink	Pink	Yellow	White	
B+	**B+**	Blue & Black	Blue	Green	Blue	Grey	Green	Brown	
Data -	**/DT**	Pink	Brown	Pink	Brown	White	Brown	Blue	
Data +	**DT**	Grey	White	Grey	Grey	Brown	White	Yellow	
Clock -	**/CK**	Yellow	Black	Red	White	Black	Purple	Pink	
Clock +	**CK**	Purple	Purple	Blue	Black	Purple	Black	Green	
Common	**IG**	Green & White	Pink	Purple	Yellow	Blue	Blue	Red & Blue	
+5VDC	**IP**	Green & Brown	Grey	Black	Red	Red	Red	Grey & Pink	
0V Sense	**S-**	White	Yellow	N/A	N/A	N/A	N/A	Black	
+5V Sense	**S+**	Blue	Green	N/A	N/A	N/A	N/A	Grey	
Shield	**Shield**	Shield	Shield	Shield	Shield	Shield	Shield	Shield	

Step 2 – Power up & Parameterisation

When all connections and terminations are completed in step 1, and the controller switched to 'Test/Inspection Controls' you can then power up the installation. You will next need to verify the parameters entered in the drive match that of the motor data plate, please do not assume that these are already entered correctly.
You may wish to note your motor data in the adjacent box for reference:

Rated Motor Power (KW)	**KW**
Rated Motor Volts	**Volts**
Rated Motor Current	**Amps**
Motor Poles*	**Poles**
Rated Motor Speed*	**RPM**
Rated Motor Frequency**	**Hz**

Note * Some motors do not quote the number of motor poles however this can be simply calculated using this formula:

$$\frac{120 \times \text{Rated Motor Frequency}}{\text{Rated Motor Speed}}$$

Note ** Motor Frequency is not directly entered in the drive however useful to note to make the above calculation if required. Once Motor poles and speed are set in A5, rated excitation frequency will be displayed in the D2 menu of the drive. This should match the motor dataplate.

Note *** ensure that the motor connections are phased correctly, that is U,V,W (A,B,C) terminals on the control panel terminal rail are connected to the hoist motor terminals U,V,W.

The motor data recorded in the table above should now be entered in the A5 menu of the drive.
When this is complete and the control system is prepared to run with any required wiring/links etc the encoder alignment can take place.
In some instances the data on the motor data plate may not be 100% accurate (if the machine isn't 'made to order' they may quote the motors maximum values as opposed to what is required for your installation) – if this is the case the 'calculated' motor data that matches your installation will have to be obtained from the motor

manufacturer and entered in the drive. This 'Calculated' data may have been used to select the drive and the information on the data plate may be beyond the rating of the drive. It is also important to verify and adjust the CONTRACT MOTOR SPEED parameter in the A1 Menu of the drive at this stage

Step 3 – Encoder Alignment

There are multiple ways to gather the encoder angle alignment, some motor manufacturers 'preset' this to a default value to prevent any need for a motor alignment – if you have this information you can enter it in the drive, if you do not know this skip to option 2.

OPTION 1 – P*redetermined Encoder angle offset*
Some motor manufacturer's factory fit the encoder with a predetermined offset. Provided the encoder hasn't been removed at any stage, that factory value can be entered in the drive:

Motor Manufacturer	Predetermined offset
Ziehl	13
Wittur	0

- Clear any active faults in the drive in the F1 menu (and verify they have cleared)
- Scroll to U10 menu – ROTOR ALIGNMENT and change the parameter ALIGNMENT from DISABLED to ENABLED
- Scroll to the A5 menu and to the parameter ENCODER ANG OFST press enter and manually enter the 'known' offset value – the motor should be then able to run – attempt this on test controls.

If the rotor offset is not known as is the case on the majority of motors/encoders you will have to perform the alignment procedure. The preferred way of doing this is a rotating alignment under no load **(before ropes are fitted or with the ropes lifted and clear of the sheave)** if your ropes are already fitted or it's an existing installation skip to option 3.

OPTION 2 – *Rotating alignment*
FOLLOW THE 'ROPES OFF' INSTRUCTIONS OF THE PM STARTUP FLOWCHART AT THE END OF THIS DOCUMENT. Rotating Alignment is used to confirm motor and encoder phasing is correct, but it is advised that a static alignment (Option 3) is performed afterwards to verify offset the exact offset

- Clear any active faults in the drive in the F1 menu (and verify they have cleared)
- Scroll to U10 menu – ROTOR ALIGNMENT and change the parameter ALIGNMENT from DISABLED to ENABLED
- Also in the U10 alignment menu ensure the parameter ALIGNMENT METHOD is set to OPEN LOOP
- Next change the parameter BEGIN ALIGNMENT to ON RUN
- The drive is now ready for alignment, so simply run up on test control. You should see the brake lift, the motor should rotate for about 4 seconds smoothly then stop on its own accord – it's important that the input to run is maintained for the duration of the tune, if the input to run is released for any reason you will need to restart this procedure. When the motor has stopped and the run LED on the drives operator has extinguished you may release your buttons. If the motor did not rotate smoothly, or oscillated backwards and forwards, try increasing OLA Scale (A5) and aligning again.
- Assuming this went successfully the drive will have established the encoder's position relative to the motor poles. The Encoder Angle Offset value learned from the alignment can be checked in the drives A5 menu, and should be noted down. At this point it is worth performing a "HF Inject alignment" (See static

alignment; Option 3) to confirm the alignment value is correct. Following this, attempt to run on inspection control to verify.

- If this procedure didn't complete successfully and a fault was displayed, please refer to the fault section of this supplement or the drives technical manual for diagnostic information

Option 3 – *Static alignment*

FOLLOW THE 'ROPES ON' INSTRUCTIONS OF THE PM STARTUP FLOWCHART
If it is not possible to perform a rotating alignment the encoder angle offset can be obtained by performing a 'static' alignment where the brake is not lifted.
To perform this:

- Clear any active faults in the drive in the F1 menu (and verify they have cleared)

- Scroll to U10 menu – ROTOR ALIGNMENT and change the parameter ALIGNMENT from DISABLED to ENABLED

- Also in the U10 alignment menu ensure the parameter ALIGNMENT METHOD is set to HF INJECT

Next change the parameter BEGIN ALIGNMENT to ON RUN

- The drive is now ready for alignment, so simply press and hold your RUN UP or RUN DOWN buttons on your test pendant. You should see the run LED on the drive illuminate and the motor will 'buzz', the brake will **not** lift however. It will only take a couple of seconds and when completed the RUN LED on the drives operator will extinguish and you may release your buttons.

- Assuming this went successfully the drive will have established the encoders position relative to the motor poles, this value can be checked in the drives A5 menu (parameter ENCODER ANG OFFST)you are then able the then attempt to run on inspection control to verify.

- If this procedure didn't complete successfully and a fault was displayed, please refer to the fault section of this supplement or the drives technical manual for diagnostic information

Step 4 – Motor Auto Tune

When the encoder angle offset is obtained as a final optimisation procedure, it is possible to gather some further motor characteristics from the motor as part of an 'AutoTune'
In this test the A5 Parameters D AXIS INDUCTANCE, Q AXIS INDUCTANCE & STATOR RESISTANCE are obtained and updated automatically
To perform this:

- Clear any active faults in the drive in the F1 menu (and verify they have cleared)

- Scroll to U12 menu (U11 in the HPV600) – AUTOTUNE SEL and change the parameter AUTOTUNE SELECT to ON RUN

- The drive is now ready for AutoTune, so simply press and hold your RUN UP or RUN DOWN buttons on your test pendant. You should see the run LED on the drive illuminate and the motor will 'buzz', the brake will **not** lift however. It will only take a couple of seconds and when completed the RUN LED on the drives operator will extinguish and you may release your buttons.

- The values obtained from this Auto Tune will be automatically saved and can be viewed in the A5 Menu

Step 5 – Fine Tune

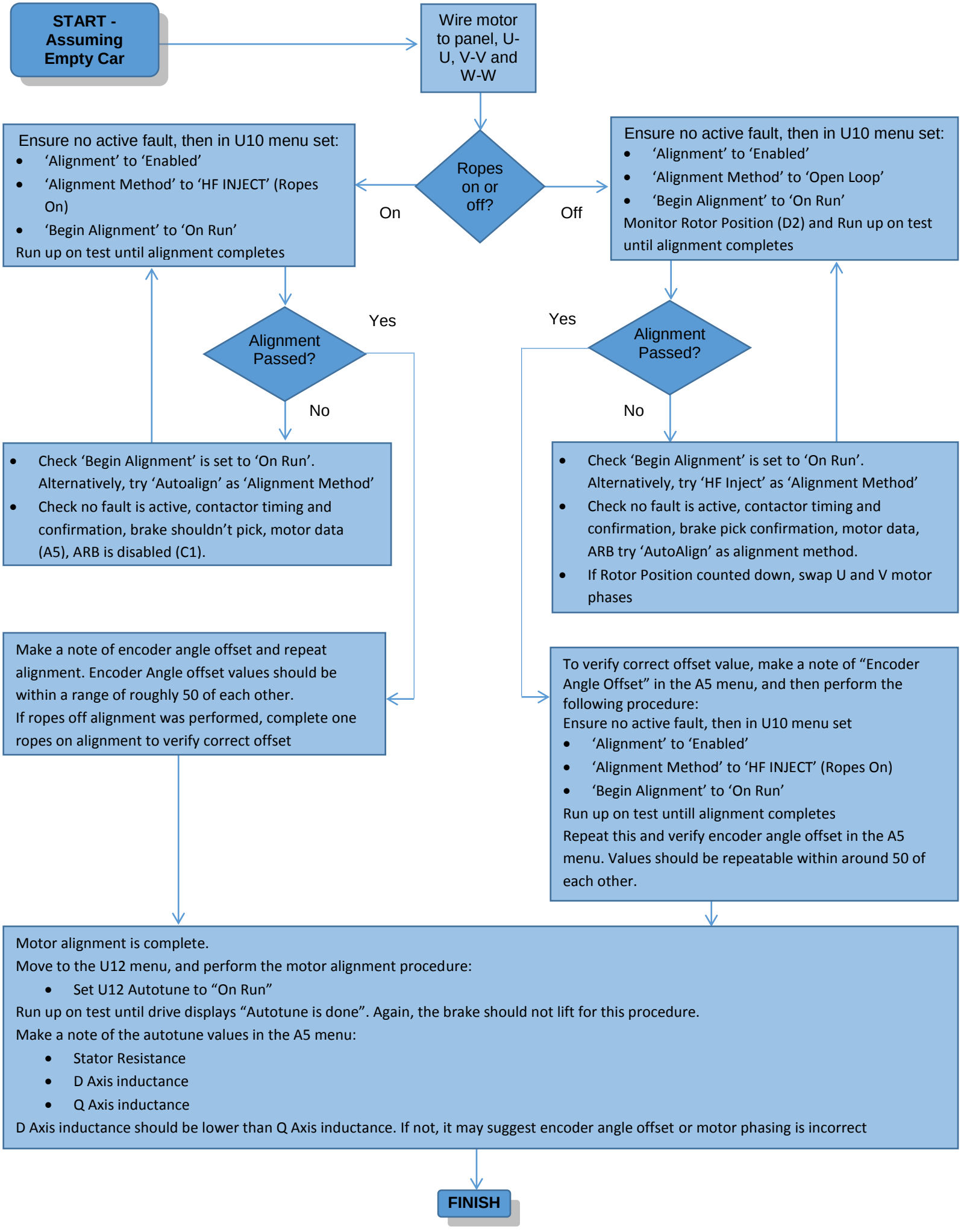
Assuming the above steps have been carried out in full, on most occasions the alignment values obtained will give near perfect alignment results, however if you observe higher than expected motor current, vibrations or encoder related trips we do have a 'fine tune procedure' which can be used to either diagnose if the encoder alignment is correct or assist with correcting it if it is found not to be correct. This procedure is rarely required, however if you do find an application where you would like to perform it, the step by step guide is provided at the end of this guide

Additional Fault codes for PM Drives Only

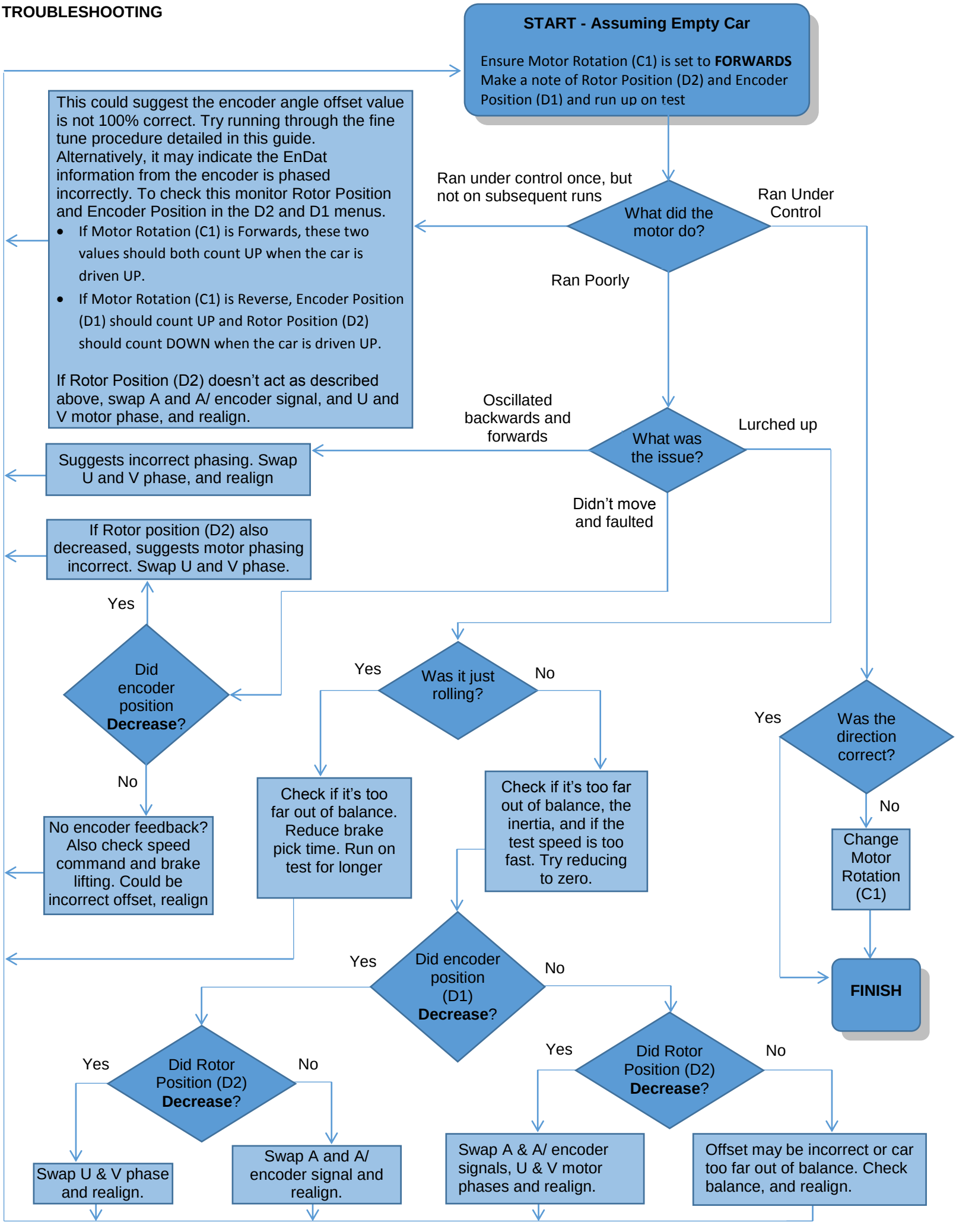
Name	Description	Possible Causes & Corrective Action
Encdr Crc Err	Alarm and Fault: Absolute encoder checksum error is detected. The alarm is posted if the CRC error does not affect drive operation. If the error persists, the alarm is converted into the fault.	**Noise Immunity Issue** ⇩ Make sure that the encoder cable is properly grounded. **Encoder Problem** ⇩ **Encoder wiring problem** (Most likely cause on startup) – check for broken encoder leads. ⇩ Encoder Power Supply folding back, check between pins IP and IG for +5V. If supply is low, verify encoder voltage sense and ground sense wires are not connected together. ⇩ Encoder failure – replace encoder and REALIGN rotor. ⇩ Inadequate encoder type – the absolute encoder option board will only support sin/cos absolute encoders **Option Board Problem** ⇩ Replace the option board
Encoder Flt	The drive is in a run condition and the encoder is giving no incremental feedback, or the feedback is incorrect. Possible causes: • Motor current is too high and no feedback received (Brake not lifting or alignment hasn't been performed) or • Encoder incorrectly wired or • Encoder not functioning or • phasing is not proper with the motor	**Check brake is lifting** ⇩ Verify brake lifts clear Usually drive's "HIT TORQUE LIMIT" alarm message is displayed (depending on setting of TRQ LIM MSG DLY (A1) parameter) **If seen on initial startup, alignment may not have been performed** ⇩ If an alignment hasn't been performed, follow the alignment flowchart at the end of this guide **Encoder Power Supply Loss** ⇩ Check 5 volt supply on terminal strip **Accurate Motor Parameters** ⇩ Verify motor nameplate values are entered correctly ⇩ Decrease D AXIS INDUCT (A5) and Q AXIS INDUCT (A5) **Response of Speed Regulator** ⇩ Enter accurate INERTIA (A1) parameter ⇩ Increase RESPONSE (A1) parameter **Encoder Coupling Sloppy or Broken** ⇩ Check encoder to motor coupling. Rerun the alignment after fixing the encoder coupling. **Excessive Noise on Encoder Lines** ⇩ Check encoder connections. Separate encoder leads from power wiring (cross power lead at 90°) ⇩ Make sure that the encoder cable is properly grounded. **Other Conditions Causing Fault** ⇩ Possible motor phase loss **Hardware Problem** ⇩ Replace Drive Control board or absolute encoder option board.
NoEncoder Card	Main Control Board is not detecting Option Card	**Missing Option Card** ⇩ Verify Option Card is properly seated ⇩ Recycle power **Hardware Problem** ⇩ Replace Main Control Board and Option Card

Name	Description	Possible Causes & Corrective Action
OLA Endt Flt	Open Loop Alignment EnDat Fault	**Phasing Problem** ⇩ If the motor was running smoothly immediately before the drive declared an **OLA ENDT FLT**, Swap two motor leads (e.g. U and W) to establish proper phasing between absolute position data (EnDat, serial) and motor. ***Note:*** *Swapping encoder leads is* ***NOT*** *the same as swapping motor wiring. Do not swap both motor phase leads and encoder inputs at the same time.* **Torque Constant Scale needs to be adjusted** If the motor was running rough, jerky, or stalled immediately before the drive declared an **OLA ENDT FLT**, increase the value located in TRQ CONST SCALE (A5). **Rotor is Not Moving when Open Loop Alignment Commanded** ⇩ Verify that the brake is picked and that the car is properly balanced. ⇩ Verify that the motor contactor is closed during the alignment. ⇩ Verify motor parameters in A5 menu. ⇩ Increase OLA Vq REF SCALE factor to overcome excessive static friction that may exist in the elevator. **Run command was removed during Open Loop Alignment** ⇩ Verify the run command stayed active while alignment was occurring Note: This is only true when BEGIN ALIGNMENT? = ON RUN **Encoder Problem** ⇩ Encoder failure (replace encoder and REALIGN the rotor).
OLA Inc Flt	Open Loop Alignment Incremental Fault	**Phasing Problem** ⇩ Swap two encoder leads (e.g. A and –A) to establish proper phasing ***Note:*** *Swapping encoder leads is* ***NOT*** *the same as swapping motor wiring. Do not swap both motor phase leads and encoder inputs at the same time.* **Encoder Problem** ⇩ Check encoder coupling: align or replace ⇩ Check encoder wiring ⇩ Encoder failure (replace encoder and REALIGN the rotor) ⇩ Option board failure (replace option board).
RTR NOT ALIGN	Run command given before aligning the rotor, or fault declared if alignment failed	**Initial Setup Not Performed** ⇩ Perform rotor alignment **Alignment Failed** ⇩ Check motor and encoder wiring and motor contactors are pulling in. Repeat the alignment. ⇩ If this is declared after a 'ropes off' rotating alignment (U10 Alignment method = "Open Loop", check brake is lifting. If motor is not rotating smoothly, increase OLA Scale (A5)**.** Otherwise, try HF Inject as alignment Method (U10) ⇩ If this is declared after a ropes on "HF inject" alignment (U10 Alignment method = "HF Inject") try using "Autoalign" as alignment method (U10)
Setup Fault 9	This fault is declared if ENCODER SELECT (C1) = ENDAT ABSOLUTE and the number of pulses entered in ENCODER PULSES (A1) is greater than 3125	**Check Parameters Settings:** ⇩ Verify the setting of ENCODER SELECT (C1) ⇩ If an EnDat Absolute Encoder is used and ENCODER SELECT (C1) is set to ENDAT ABSOLUTE – verify the value placed in ENCODER PULSES (A1) is between 500 – 3125. Should always be 2048 for Heidenhain encoder (Virtually all installations will be like this)

Name	Description	Possible Causes & Corrective Action
SpdDev Flt *&* **Spd Dev Alm**	The speed feedback is failing to properly track the speed reference.	**Encoder Cable not properly grounded** ⇩ Verify Encoder Cable is properly grounded using the shield clamp provided on the drive **Motor Runaway Condition – Rotor Alignment Issues:** ⇩ Encoder is slipping on the shaft – fix the encoder coupling and repeat the alignment ⇩ Wrong SETUP OFFSET (A5) value is uploaded or entered – enter correct value or repeat the alignment ⇩ If this occurs after a HF inject alignment, and the motor has yet to run successfully, it suggests the motor is incorrectly phased. Swap two motor leads and run alignment procedure again. ⇩ If the motor ran on one or two occasions, but then lurched away giving speed dev and/or encoder faults, it may indicate the absolute position encoder is not in sync with motor phasing (would be detected during the open loop alignment, but NOT if manual or quick alignment methods were used). Swap two motor leads and A and A/ encoder wires. **Drive and/or Motor is Undersized** ⇩ Usually drive's "HIT TORQUE LIMIT" alarm message is displayed (depending on setting of TRQ LIM MSG DLY (A1) parameter) ⇩ Verify drive and/or motor sizing. May need a larger capacity drive or motor. **Check Parameter Settings** ⇩ Usually drive's "HIT TORQUE LIMIT" alarm message is displayed (depending on setting of TRQ LIM MSG DLY (A1) parameter) ⇩ Check speed regulator parameters RESPONSE and INERTIA (A1) ⇩ Fault/Alarm sensitivity – SPD DEV FLT LVL or SPD DEV ALM LVL (A1) parameter is set too low for required acceleration/deceleration rate. **NOTE:** Setting SPD DEV FLT LVL too high will reduce drive's sensitivity to dangerous runaway conditions!


START - Assuming Empty Car
Wire motor to panel, U-U, V-V and W-W
Ropes on or off?
On
Off
Ensure no active fault, then in U10 menu set:
• 'Alignment' to 'Enabled'
• 'Alignment Method' to 'HF INJECT' (Ropes On)
• 'Begin Alignment' to 'On Run'
Run up on test until alignment completes
Alignment Passed?
Yes
No
• Check 'Begin Alignment' is set to 'On Run'. Alternatively, try 'Autoalign' as 'Alignment Method'
• Check no fault is active, contactor timing and confirmation, brake shouldn't pick, motor data (A5), ARB is disabled (C1).
Make a note of encoder angle offset and repeat alignment. Encoder Angle offset values should be within a range of roughly 50 of each other.
If ropes off alignment was performed, complete one ropes on alignment to verify correct offset
Ensure no active fault, then in U10 menu set:
• 'Alignment' to 'Enabled'
• 'Alignment Method' to 'Open Loop'
• 'Begin Alignment' to 'On Run'
Monitor Rotor Position (D2) and Run up on test until alignment completes
Alignment Passed?
Yes
No
• Check 'Begin Alignment' is set to 'On Run'. Alternatively, try 'HF Inject' as 'Alignment Method'
• Check no fault is active, contactor timing and confirmation, brake pick confirmation, motor data, ARB try 'AutoAlign' as alignment method.
• If Rotor Position counted down, swap U and V motor phases
To verify correct offset value, make a note of "Encoder Angle Offset" in the A5 menu, and then perform the following procedure:
Ensure no active fault, then in U10 menu set
• 'Alignment' to 'Enabled'
• 'Alignment Method' to 'HF INJECT' (Ropes On)
• 'Begin Alignment' to 'On Run'
Run up on test untill alignment completes
Repeat this and verify encoder angle offset in the A5 menu. Values should be repeatable within around 50 of each other.
Motor alignment is complete.
Move to the U12 menu, and perform the motor alignment procedure:
• Set U12 Autotune to "On Run"
Run up on test until drive displays "Autotune is done". Again, the brake should not lift for this procedure.
Make a note of the autotune values in the A5 menu:
• Stator Resistance
• D Axis inductance
• Q Axis inductance
D Axis inductance should be lower than Q Axis inductance. If not, it may suggest encoder angle offset or motor phasing is incorrect
FINISH

TROUBLESHOOTING



Fine Tune Alignment Procedure

This procedure is usually not needed. Generally, running the 'HF Inject' alignment detailed in this guide (Option 3, static alignment, or the 'Ropes On' section of the flowchart) will result in the optimal value for Encoder Angle Offset. If the 'HF Inject' alignment is not possible, the following fine tune procedure can be used to verify the correct value for Encoder Angle Offset

Procedure:

1. Set FINE TUNE OFST (A4) to 0.

2. With an empty car, start at the top of the shaft and run down on test for a few seconds and note the steady running current displayed in MOTOR CURR (D2) in table below

3. Reduce FINE TUNE OFST (A4) to a negative value in decrements of 10.00 until steady running current is noticeably higher than recorded in Step 2.

4. Set FINE TUNE OFST (A4) back to 0.00, and then increase FINE TUNE OFST (A4) to a positive value in increments of 10.00 until steady running current is the same as recorded in Step 3.

FINE TUNE OFST (A4) Value	MOTOR CURRENT (D2)	FINE TUNE OFST (A4) Value	MOTOR CURRENT (D2)
-100		+10	
-90		+20	
-80		+30	
-70		+40	
-60		+50	
-50		+60	
-40		+70	
-30		+80	
-20		+90	
-10		+100	
0			

Calculate new ENCODER ANG OFFSET

5. Use the values acquired in from steps 3 and 4 in the following formula to determine the value in ENCODER ANG OFSET (A5)

$$\begin{pmatrix}\text{ENCODER ANG OFSET (A5)}\\ \textbf{new}\end{pmatrix} = \begin{pmatrix}\text{ENCODER ANG OFSET (A5)}\\ \textbf{old}\end{pmatrix} - \left(\frac{\begin{pmatrix}\text{FINE TUNE OFST (A4) positive value}\end{pmatrix} + \begin{pmatrix}\text{FINE TUNE OFST (A4) negative value}\end{pmatrix}}{360 \times \text{number of poles}} \times 8192 \right)$$

Enter new ENCODER ANGLE OFFSET

6. Enable Alignment by setting ALIGNMENT (U10) to ENABLE, then change the value in ENCODER ANG OFSET (A5) to the value calculated in the formula above

7. Set FINE TUNE OFST (A4) to 0.0

This completes the fine-tuning procedure for the EnDat Alignment. With a balanced car, running current and voltage should be the same in both directions. Running current and voltage should now also be the same if Fine Tune Offset is set to +30 and -30

EXAMPLE:

Fine Tune Offset (A4)	*Motor Current (D2)*
-30	15A
0	12A
+20	11A
+40	12A
+70	15A

ENCODER ANG OFSET (A5) old value = 185
FINE TUNE OFST negative value (A4) = (-30)
FINE TUNE OFST positive value (A4) = 70
Number of poles = 16

$$(128) = (185) - \left(\frac{(70) + (-30)}{360 \times 16} \right) \times 8192$$ New Offset = 128