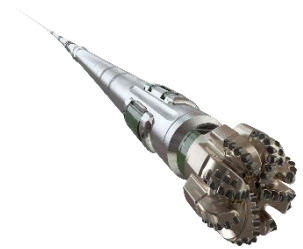


# Extreme Equipment Sales & Rentals

## PowerDrive – Recommended Practice for Azimuthal Control

Revision 1.0



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Applicability: PowerDrive Orbit

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### BACKGROUND INFORMATION

Hold Inclusion and Azimuth (HIA) is a key feature of PowerDrive Orbit. Azimuthal control is a significant advantage of the PowerDrive over competitor RSS tools on the market. This enables Extreme to deliver a high-quality wellbore with low tortuosity to our clients, while simultaneously minimizing downlink commands to the tool.

The below guidance will help get the best performance from the HIA algorithm as improvements are continually made to the algorithm. High risk scenarios include: low angle HIA, high dip angle, drilling close to zone of exclusion and near magnetic north or south.

### SOLUTION – BEST PRACTICES FOR UTILIZING HIA

Utilize the following to troubleshoot HIA performance, whether you have a real-time link with the PowerDrive or are relying only on MWD surveys. If operating without RT data, refer to section 2.

#### 1. IF CONFIGURED TO RECEIVE REAL-TIME DATA FROM THE POWERDRIVE (RT)

##### Pre-run

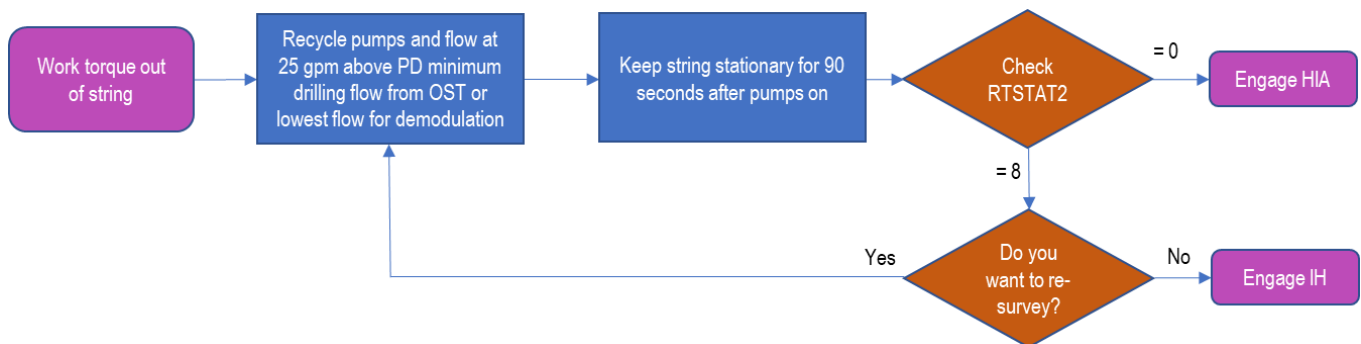
- Ensure the RTSTAT2 dpoint is included in the MWD frames (Extended or Flex dpoints required). It is preferred to include this in the utility frame so that PowerDrive survey quality can be confirmed before engaging HIA. RTSTAT2 = 8 means bad survey based on GTOT, i.e. the tool was moving around too much during the survey and affecting the survey quality.

##### Planning Steering Decisions

- The tool requires a good static survey during the run (RTSTAT2 = 0) before HIA can be engaged. **Don't engage HIA if there was never a good static survey, which was free from casing interference on the run.** As long as there has been one good static survey with a valid G total, the tool will refer to that. It must be free from magnetic interference.
- Make sure the inclination at the PowerDrive is more than 10°. **HIA will not engage at less than 10° inclination.**
- If significant turn correction (more than 6°) is required and azimuth is within 25° of magnetic north or south, then consider using IH or an absolute toolface instead of HIA for turn.
- Before engaging HIA, compare PD continuous azimuth to what's expected. If there is a significant discrepancy (>10°), be wary of potential azimuth issues.

##### Troubleshooting Static Survey Issues (RTSTAT2 = 8)

- If having difficulties obtaining a good static survey and you have had no good static surveys from PowerDrive while clear of casing during the run, attempt the following workflow:



## Engaging HIA

- Be aware that the PowerDrive Azimuth Target will show 0° at the start of the run until HIA is initially engaged.
- After engaging HIA, confirm that the downlink was accepted and take note of the PowerDrive Azimuth Target, PowerDrive Continuous Azimuth and MWD Continuous Azimuth.
  - o If PD continuous azimuth differs significantly (more than 2°) from the azimuth target, and that difference is not expected, then consider obtaining a new static survey
  - o If after re-engaging HIA the PD continuous azimuth still differs significantly from the azimuth target, utilize IH for steering.
  - o If PD continuous azimuth differs significantly (more than 15°) from the MWD continuous azimuth, then proceed with caution as the tool may have accepted a 'bad' reference value.
- DO NOT nudge PD based on an offset between PD continuous azimuth and expected azimuth or MWD continuous azimuth. There is typically an "offset" in the PD continuous azimuth reading caused by drillstring magnetic interference. The magnitude of this "offset" should be noted and accounted for when making steering decisions.

## Monitoring HIA Performance

- After initially engaging HIA, observe steering performance (toolface and steer ratio). If the tool is steering 100% left or right, or MWD surveys indicate turning, but significant turn correction is not required, then downlink to IH instead.
- Monitor trend in PD continuous azimuth (if RT equipped) and MWD continuous azimuth. If the RT data trend doesn't match or the PowerDrive steers opposite the desired direction, then downlink to IH and utilize that for steering.
- If PD azimuth is trending to one constant direction and MWD azimuth confirms the same (also PD would alternate between high and low steer ratio every drill cycle) then correct with a nudge.
- Watch out for significant "jumps" in the PD continuous azimuth. If this is seen, then stop and downlink to IH and utilize that for steering.
- If excessive oscillation in inclination or azimuth measurement around the target is observed and the tool is constantly steering in 100% and oversteering past the inclination and azimuth targets, consider downlinking to ROP Range 2 (low gain setting). Discuss with your Extreme coordinator when utilizing ROP range 2.
- If you have downlinked to IH due to suspected azimuthal control issues, HIA can be attempted again later in the run if real-time data indicates that the continuous azimuth measurement is performing as expected. Look for a significant "jump" in the PD continuous azimuth as it returns to the correct value. You can also look for RTSTAT2=0 as an indication that the tool is getting good surveys.

## 2. IF CONFIGURED WITHOUT REAL-TIME DATA FROM POWERDRIVE

- If near external magnetic interference (e.g. casing), it is best to downlink to IH or an absolute toolface setting and drill ahead for at least 500 ft prior to engaging HIA. This will help ensure getting a good survey prior to engagement and avoid chasing a bad azimuth.
- If HIA issues are suspected based on erratic performance or undesired turn, especially when drilling near north or south, initiate the reset workflow. (See section "Monitoring HIA Performance" for description of erratic performance.)
  - o Downlink to IH (or absolute toolface if significant correction is required).
  - o Correct the wellbore trajectory and drill ahead for at least 500 ft to increase the probability a useable static survey was recorded by the tool.
  - o While drilling ahead for 500 ft, perform the pump up procedure in the "**Troubleshooting Static Survey Issues (RTSTAT2 = 8)**" section at each survey point to further increase the probability of recording a passing static survey. Avoid taking surveys on the fly during the 500 ft period to increase the chance of better HIA performance once re-engaged.
  - o Re-engage HIA and monitor steering performance.

Implementing these recommendations should give directional drillers the best opportunity to address poor azimuthal control. If issues are encountered on a job, please input an SQI with details of symptoms observed and steps implemented when attempting to resolve the issue. Follow up with the Extreme Command Center to see if they require any additional details to ensure the issues are effectively captured and investigated.