REFERENCE ENGINEERING / TECHNICAL NOTE

Why UTC Is Insufficient for Rotating Equipment

PHASE-AUTHORITATIVE TIMING FOR REPEATING MECHANICAL STATES

Core Vega Systems / Industrial Reference Group

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Applies to: HRO-12 / firmware 4.8 or later

A timestamp is not a position.

UTC can identify the second.

It cannot identify which way the shaft was facing.

TIME AND PHASE

The Same Time Is Not the Same State

Rotating equipment revisits mechanically similar positions while time advances monotonically. A UTC timestamp identifies when a sample was taken, but it does not establish rotational phase, cycle identity, direction or load state.

SIGNAL	ESTABLISHES	ANSWERS	LIMITATION
UTC	Absolute time	When	No mechanical state
Encoder	Local angle	Where	No shared authority
Cycle count	Accumulated turns	Which repetition	Reset dependent
Phase authority	Time + angle + direction	Which state	Reference required

> UTC knows when the event occurred. It does not know what the machine meant by returning.
>
> REFERENCE ENGINEERING

FAILURE MODES

What Timestamps Permit Machines to Dispute

CONDITION	OBSERVED STATE	RISK	REQUIRED CONTROL
Encoder rollover	Same angle / later cycle	False duplicate	Track cycle identity
Clock correction	Time moves / shaft does not	Phase discontinuity	Hold authority
Network reorder	Later sample arrives first	Causal jitter	Neutral arbitration
Reverse rotation	Angle repeats backward	Direction loss	Signed phase
Sensor replacement	Zero moves	New local truth	External reference

When equipment and control software disagree, selecting the most recent timestamp merely awards authority to the fastest reporter. Recency is a transport property, not a metrological one.

IMPLEMENTATION

A Reference the Machine Cannot Renegotiate

The HRO-12 combines a stable timebase with an externally governed phase reference. Each observation is bound to UTC, angular phase, direction, cycle identity and reference confidence before distribution to the control network.

FIELD	MEANING	FUNCTION
T	UTC epoch	Traceable time
PHI	Angular phase	Mechanical position
D	Direction	Signed movement
N	Cycle identity	Repeated-state separation
R	Reference confidence	Authority quality

> A clock should not negotiate with the equipment it times.
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> HRO-12 OPERATING PRINCIPLE

Where local phase and the authoritative reference disagree, preserve both. Operate from the reference. Open a maintenance action against the machine.