

Instrumentation Inspection Checklist **(Part 5 of 7 – FLOW Instruments & Transmitters)**

NOTE – THIS CHECKLIST APPLIES ONLY TO FLOW INSTRUMENT SPECIFICS.

THIS CHECKLIST SHOULD BE USED IN CONJUNCTION WITH THE GENERAL CHECKLIST (Part 1) THAT APPLIES TO GENERIC CHECKS FOR ALL INSTRUMENTS.

DP BASED FLOW MEASUREMENT

- ENSURE SQRT FUNCTION IS ONLY OCCURRING IN ONE LOCATION (TYPICALLY AT CONTROLLER). SOMETIMES DP FLOWS ARE INADVERTENTLY SQUARE ROOTED AT TRANSMITTER AND AT CONTROLLER. WHEN THIS OCCURS, THEY LOOK RIGHT AT 0 AND 100%, BUT ARE WAY OFF THROUGH MID-RANGES.

- ENSURE THE TRANSMITTER CONFIGURATION PROPERLY ALIGNS WITH SPEC SHEET OF PRIMARY ELEMENT (ORIFICE, ETC.).
 - OFTEN TIMES, ENGINEERS MISTAKENLY DO A LINEAR “PRORATED” CHANGE TO DP FLOW SYSTEMS (BECAUSE THEY FORGET HOW THEY WORK). IF THE CONFIG DOESN’T MATCH THE SPEC SHEET OR IF THE SPEC SHEET HASN’T COME FROM FACTOR OR SOURCE OF THE ACTUAL PRIMARY ELEMENT, RESOLVE IT.

- ENSURE PROPER TUBING LINEUPS (NO DENTS, KINKS, POCKETS, TRAPS, OR SLUDGE BUILDUP SPOTS).

- LOOK AT HISTORICAL TRENDS
 - NOTE DP VARIABILITY OVER TIME TO CHECK FOR SIGNS OF SENSOR TUBE CLOGGING, OR BUILDUP / EROSION OF PRIMARY ELEMENT.
 - (IF POSSIBLE) COMPARE DP VALUE VS PUMP SPEED OR OTHER VARIABLES OR DOWNSTREAM FLOW MEASUREMENTS THAT DIRECTLY RELATE TO FLOW RATE.

- PERIODICALLY, YOU SHOULD INSPECT AND GAUGE OUT THE PRIMARY ELEMENT (EVEN TINY AMOUNTS OF WEAR ON ORIFICE HOLE EDGES WILL CAUSE SURPRISINGLY LARGE ERRORS OR NOISE).
 - THIS STEP WOULD BE A FAIRLY INVASIVE PROCEDURE IN MOST CASES DUE TO REQUIREMENT TO PULL THE ELEMENT – BUT IS OFTEN NEGLECTED FOR EXTREMELY LONG PERIODS OF TIME AND IS THE REAL CAUSE OF MANY/MOST DP FLOW MEASUREMENT PROBLEMS.

- ENSURE THAT GAS FLOWS ARE PROPERLY DENSITY COMPENSATED – THIS MEANS THEY NEED TO BE BASED ON ABSOLUTE PRESSURE (I.E. PSIA SCALE) AND ABSOLUTE TEMPERATURE (I.E. KELVIN OR RANKINE SCALES).
 - I OFTEN SEE SITUATIONS WHERE GAS FLOW DENSITY CORRECTIONS UTILIZE PSIG CONFIGURED TRANSMITTERS AND SCALING – THIS COULD LEAD TO A SIGNIFICANT ERROR IN LOWER PRESSURE SYSTEMS, SINCE THE AMBIENT PRESSURE CAN VARY CONSIDERABLY (0.5 PSIA CONCEIVABLY), WHICH WOULD RESULT IN INCORRECT DENSITY FACTORS.

TIME BASED FLOW MEASUREMENTS (VORTEX, CORIOLIS, ULTRASONIC, ETC.)

VERIFY THE CONFIGURATION MATCHES THE OFFICIAL SPECIFICATION SHEET. IT IS WISE TO PERIODICALLY DO A LOGIC CHECK OF THE CONFIG SPECS AS WELL, SINCE THE PROBLEM IS SOMETIMES IN THE ORIGINAL CONFIGURATION.

FOR CORIOLIS FLOW METERS, ENSURE OPERATING DENSITY RANGE IS CORRECT PER SPECS.

FOR ULTRASONIC FLOW METERS, ENSURE THE INTERFACE IS IN GOOD SHAPE (YOU MAY NEED TO RESEAL THE TRANSDUCER TO PIPE IN SOME CASES).

NOTE - TIME-BASED MEASUREMENTS THEMSELVES HAVE EXTREMELY LOW DRIFT RATES SINCE THEY ARE TYPICALLY BASED ON THE TIMING OF THE ONBOARD CRYSTAL TIME REFERENCES WHICH ARE INSANELY ACCURATE AND CONSISTENT DUE TO MODERN CHIP MANUFACTURING. MOST PROBLEMS WITH THESE TYPES OF INSTRUMENTS WILL BE IN THE INSTALLATION, NEGLECTED SPECS, IMPROPER CONFIGURATIONS, OR PROCESS MATERIAL PARAMETERS BEING OUTSIDE THE SPECIFIED/CONFIGURED RANGES.

MAGNETIC FLOW MEASUREMENTS (MAG-METERS)

ENSURE THERE IS NO GAS/AIR BUILDUP IN THE MEASUREMENT PART OF THE MAG-METER. THERE IS OFTEN A VENT/BURP VALVE THAT WILL ALLOW ONE TO 'BURP' ANY GAS BUILDUP SINCE THIS WOULD RESULT IN A DIRECT MEASUREMENT ERROR.

OCCASIONALLY, THE ELECTRODES OF THE MAG-METER SHOULD BE CHECKS. SOME NEWER MAG-METERS HAVE GREAT ONBOARD DIAGNOSTICS AND ANALYTICS AND THE NEW ELECTRODES TEND TO LAST MUCH LONGER THAN EARLIER MAG-METERS.

ENSURE THE GROUNDING IS CORRECT. THERE ARE MANY WAYS TO GROUND A MAG-METER DEPENDING ON PIPING MATERIAL, FLUID, ETC. AND IT MUST BE DONE CORRECTLY PER VENDOR REFERENCES OR PROBLEMS AND ERRORS WILL OCCUR. TAKE THE TIME TO STUDY THE VENDOR REFERENCES (OR TALK TO THEM) AND BE SURE THAT ANY GROUNDING WIRES, BONDING BARS/STRAPS, ETC. ARE INSTALLED PROPERLY.

ROTARY / PULSE BASED FLOW METERS (TURBINE, PADDLEWHEEL, AND POSITIVE DISPLACEMENT FLOW METERS)

ENSURE THE CONNECTION IS TIGHT AND SENSOR IS SECURE AND SENSOR CABLE IS IN GOOD SHAPE.

ENSURE SENSOR SPACING AND MOUNTING IS CORRECT.

ENSURE NO MAGNETIC FIELDS OR PARASITIC/RELIC MAGNETISM EXISTS NEAR SENSORS.

VERIFY THE PICKUP AMPLIFIER IS OPERATING PROPERLY (AS APPLICABLE).

ALSO REFER TO VENDOR SPECIFIC INSPECTION AND INSTALLATION RECOMMENDATIONS AS THEY VARY.

OCCASIONALLY IT IS GOOD TO LOOK AT THE WAVEFORM ON O-SCOPE AND COMPARE TO A BASE REFERENCE OF THE INSTRUMENT WHEN WORKING WELL/NEW. YOU SHOULD KEEP A RECORD OF THE WAVEFORMS IN MATERIAL HISTORY FILES OR EQUIVALENT. (IT IS ALSO WISE TO LIST THE O-SCOPE TYPE AND SETTINGS FOR THE WAVEFORM RECORD).