Special documentation
Proline Prowirl C 200

Procedure for AER Directive 017 Measurement Requirements for Oil and Gas Operations

Endress+Hauser
People for Process Automation

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1 Document information

1.1 Document function

The document is part of the Operating Instructions and serves as a reference for the specific inspection concept, providing a summary of certain sections of the directive, of the approach and the procedure.

1.2 Using this document

1.3 Symbols used

1.3.1 Symbols for certain types of information

Symbol	Meaning
 A0011193	**Tip** Indicates additional information.
 A0011194	**Reference to documentation** Refers to the corresponding device documentation.
 A0011195	**Reference to page** Refers to the corresponding page number.
 A0011196	**Reference to graphic** Refers to the corresponding graphic number and page number.
 A0013140	**Operation via local display** Indicates navigation to the parameter via the local display.
 A0013143	**Operation via operating tool** Indicates navigation to the parameter via the operating tool.
 A0013144	**Write-protected parameter** Indicates a parameter that can be locked against changes by entering a user-specific code.

1.3.2 Symbols in graphics

Symbol	Meaning
1, 2, 3 ...	Item numbers
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections

1.4 Documentation

This manual is Special Documentation and is not a substitute for the Operating Instructions supplied with the device.

For detailed information, refer to the Operating Instructions and other documentation on the CD-ROM provided or visit "www.endress.com/deviceviewer".

The Special Documentation is an integral part of the following Operating Instructions:

Sensor	HART	FOUNDATION Fieldbus	PROFIBUS PA
C	BA01152D	BA01220D	BA01215D

This Special Documentation is available:
- On the CD-ROM supplied with the device (depending on the device version ordered)
- In the Download Area of the Endress+Hauser Internet site: www.endress.com → Download

1.4.1 Content and scope

This Special Documentation contains a description of the inspection concept for Prowirl C 200. According to the requirements of the AER (Alberta, Canada), in certain applications the owner-operator of a plant is required to maintain a servicing interval of 12 months. The condition of the primary measurement element must be checked during these servicing activities. The aim is to be able to ensure a repeatable measurement. Maintenance can be either by way of visual inspection or in line with the recommendations of the equipment manufacturer.

This inspection concept makes it possible to:
- meet these requirements
- perform maintenance on the installed device
- perform a visual inspection
- deliver an opinion about the measurement quality by checking the bluff body dimensions.

2 Introduction

2.1 AER Directive 017

The following sections are taken directly from the relevant Directive 017 sections for information only. Whilst E+H strives to maintain accuracy and up-to-date information it is in no way responsible for this content and it remains the responsibility of the reader to check in Directive 017 for the latest update and content.

2.1.1 Section 12.3.4 "Steam Measurement":

"At a minimum of once per year, steam assisted gravity drainage (SAGD) or other thermal operations must visually inspect the primary element of one wellhead steam injection meter for every five wells on a pad. [...] Should any of the inspected sample set meters be compromised, the operator is required to service (clean or replace) all wellhead injection meters included on the pad within 12 months of discovering the compromised meter. Visual evidence of the primary flow element condition during the meter inspections must be kept on site and made available to the ERCB upon request. [...] All steam measurement devices must be calibrated/proved/verified on an annual basis or as otherwise stated in Section 2.5 or above."

2.1.2 Section 2.5.1 "General Calibration Requirements":

"If devices other than orifice meters are used to measure gas, the associated meter elements and the end devices to which they are connected must be calibrated at the same frequency as orifice meters. The required procedures must be designed to provide consistent and repeatable results and must take into consideration the actual operational conditions the device will encounter. To that end, the procedures must be in accordance with the following, as available and applicable (presented in order of ERCB preference from first to last):

- procedures specified by Measurement Canada,
- procedures described in the API *Manual of Petroleum Measurement Standards (MPMS)*,
- the device manufacturer's recommended procedures, or
- other applicable industry-accepted procedures.

If none of the foregoing exists, the ERCB will consider applications for and may grant approval of appropriate procedures."

2.1.3 Section 2.5.2 "Gas Meter Internal Inspection":

"A key contributor to meter accuracy is the condition of the internal components of the gas meter. Examples of internal components are orifice plates, vortex shedder bars, and turbine rotors. The internal components must be removed from service, inspected, replaced or repaired if found to be damaged, and then placed back in service, in accordance with the following:

- The required frequency for inspection of the gas meter primary measurement element is semi-annually for gas [facility] accounting meters and sales/delivery point (royalty trigger point) meters and annually for all other gas meters.
- Whenever possible, the inspection should be done at the same time as the calibration of the meter elements and end device, but to accommodate operational constraints the inspection may be conducted at any time, provided that the frequency requirement is met.
- Inspections must be done in accordance with procedures specified by the API, the American Gas Association (AGA), or other relevant standards organizations, other applicable industry-accepted procedures, or the device manufacturer's recommended procedures, whichever are most applicable and appropriate.
- A tag or label must be attached to the meter or end device that identifies the meter serial number, the date of the internal inspection, and any other relevant details (e.g., the size of the orifice plate installed in the meter).
- A detailed record of the inspection documenting the condition of the internal components found and any repairs or changes made to the internal components must be kept for at least one year and provided to the ERCB on request."

3 Approach

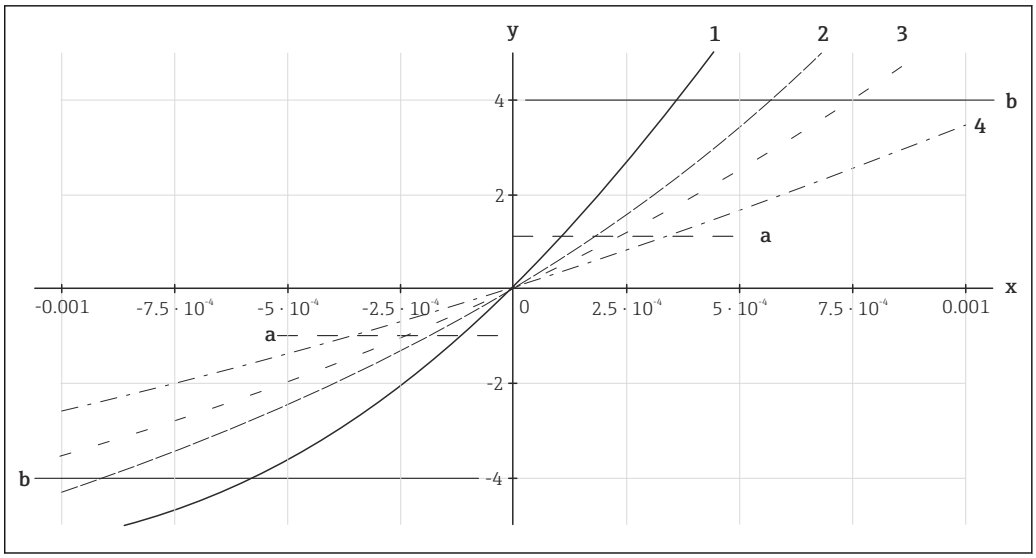
The required measuring uncertainties for steam are shown in table 1 (→ 8). The inspection concept must therefore enable the user to decide whether the meter still meets these uncertainty requirements. The approach that was chosen is as follows:

The approach that was chosen is as follows:

- Only recalibration can guarantee to meet the uncertainty requirements. Especially if the internal dimensions like the vortex shedder bar (bluff-body) width and the wall thickness has changed due to corrosion, abrasion or scale make a recalibration necessary.
- The user decides whether the internal geometry of the meter has changed or not. The discovery of a change leads to recalibration, in case of no changes and no damage the meter can be considered to be in the same condition as when it left the factory.
- To support the user in his decision whether the flowmeter has changed a few simple dimensional checks can be done.
- Assuming uniform corrosion, abrasion or scale (wall and bluff body) the change of the cross section and the resulting additional uncertainty can be calculated ((→ 1, 9)). Knowing this relation an uncertainty budget for the measured dimensions can be calculated, which includes both, manufacturing allowances and the measuring uncertainty for the dimensional check.
- The user therefore can measure the defined dimensions, compare them to the nominal value (taking into account the uncertainty budget) and then decide whether the meter internal geometry has changed. If yes, the meter must be recalibrated. If not, the user can decide not to recalibrate the meter if no damage to the shedder bar is discovered.

Table 1: Summary of single point measurement uncertainty, AER Dir. 017, section 12.4

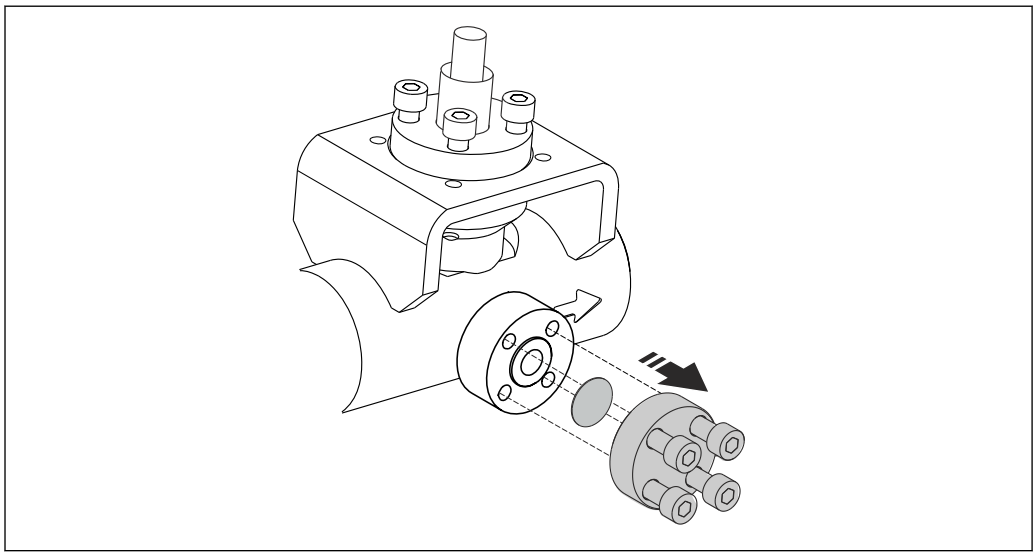
Measurement type	Single point measurement uncertainty
Gas in primary/secondary production or injection	±3 %
Emulsion test using metering	±2 %, excluding the effect of density and S&W determination
Primary/secondary production int treatment facilities (Cold heavy oil/bitumen production only	±1 %, excluding the effect of density and S&W determination
Clean oil/bitumen sales - primary, secondary, and in situ recovery	±0.5 %
Wellhead steam injection (CWE)	±5 %, excluding the effect of steam quality
All other steam measurement, including total steam leaving a steam [facility] separator (CWE)	±2 %
Liquid solvnet injection	±2 %
Fresh, brackish, produced water into injection facilities	±2 %
Boiler feed water, boiler blowdown	±2 %
Water disposal	±2 %



1 *Analytical analysis of the effects of uniform abrasion/corrosion/scale*

x Change of wall thickness due to abrasion/corrosion (negative values) and scale (positive values) [m]
y Deviation of the K-factor [%]
a 1 % additional measuring uncertainty
b 4 % additional measuring uncertainty
1 DN 50 (2")
2 DN 80 (3")
3 DN 100 (4")
4 DN 150 (6")

4 Procedure



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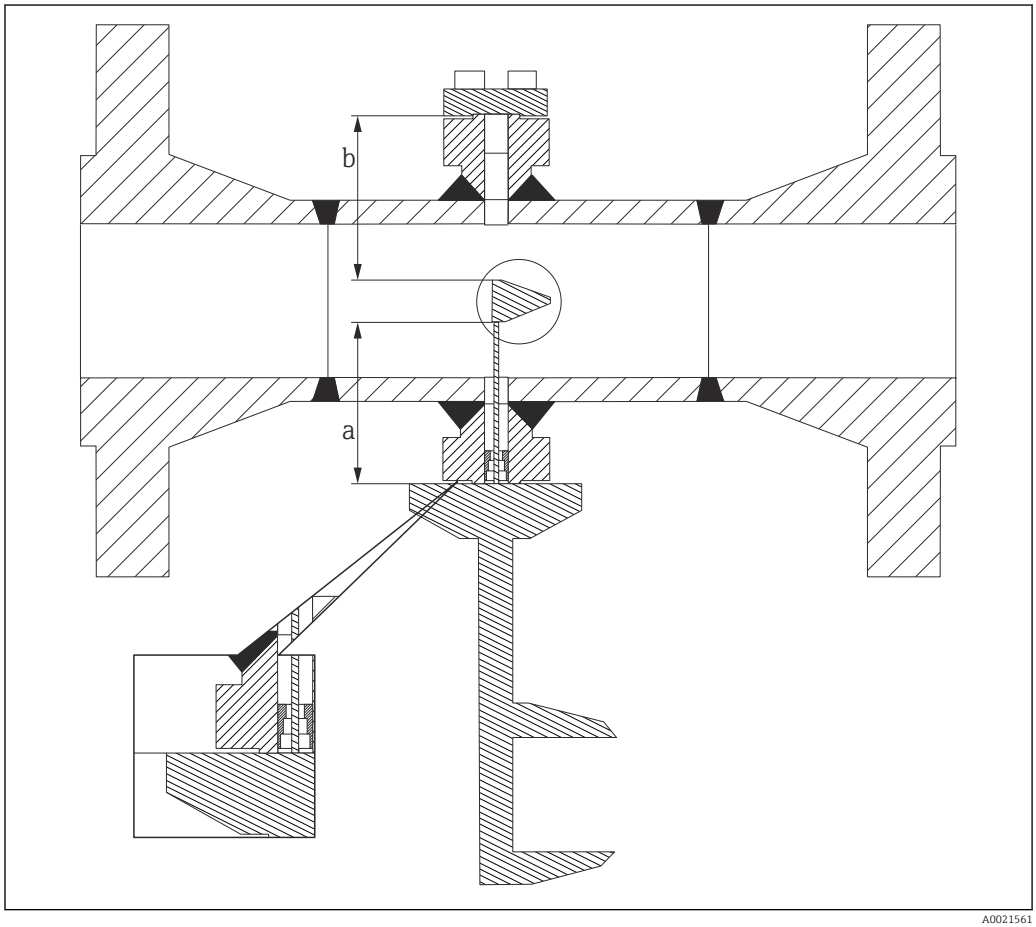
2 Illustration of inspection port components



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3 Illustration of measurement of the primary element (bluff-body)

SI units

Line	Description	DN 50 (2") [mm]	DN 80 (3") [mm]	DN 100 (4") [mm]	DN 150 (6") [mm]
1	Target values of **a**, **b**	58.8	69.5	79.5	101.3
2	Measured value **a**				

Line	Description	DN 50 (2") [mm]	DN 80 (3") [mm]	DN 100 (4") [mm]	DN 150 (6") [mm]
3	Measured value **b**				
4	Target value sum of **a** and **b**	117.60	139.00	159.00	202.60
5	Wellpad: Range of allowed values incl. distance measurement uncertainty	Max. 118.17 Min. 117.24	Max. 139.90 Min. 138.43	Max. 160.18 Min. 158.26	Max. 204.38 Min. 201.47
6	Other installations: Range of allowed values incl. distance measurement uncertainty	Max. 117.70 Min. 117.50	Max. 139.16 Min. 138.84	Max. 159.21 Min. 158.79	Max. 202.91 Min. 202.29
7	Sum of measured values of **a** and **b**				
8	Value in line 4 and value in line 7 agree within the maximum accepted allowance	Yes: ☐ No: ☐			
9	Line 8: If **Yes**: Measurement passed. If **No**: Recalibration at the manufacturer's factory, at another accredited calibration facility or using mobile calibration equipment is required.				

US units

Line	Description	(2") [in]	(3") [in]	(4") [in]	(6") [in]
1	Target values of **a**, **b**	2.315	2.735	3.13	3.99
2	Measured value **a**				
3	Measured value **b**				
4	Target value sum of **a** and **b**	4.63	5.47	6.26	7.98
5	Wellpad: Range of allowed values incl. distance measurement uncertainty	Max. 4.65 Min. 4.62	Max. 5.51 Min. 5.45	Max. 6.31 Min. 6.23	Max. 8.05 Min. 7.93
6	Other installations: Range of allowed values incl. distance measurement uncertainty	Max. 4.63 Min. 4.63	Max. 5.48 Min. 5.47	Max. 6.27 Min. 6.25	Max. 7.99 Min. 7.96
7	Sum of measured values of **a** and **b**				
8	Value in line 4 and value in line 7 agree within the maximum accepted allowance	Yes: ☐ No: ☐			
9	Line 8: If **Yes**: Measurement passed. If **No**: Recalibration at the manufacturer's factory, at another accredited calibration facility or using mobile calibration equipment is required.				

1. Note the **Device serial number** and **Tag number**:
2. Ensure that the meter is depressurized and at ambient temperature.
3. Loosen the bolts (→ 2, 10). Remove the bolts, the inspection port cover and the gasket. Make sure that the sealing surfaces are not damaged and are free of residues. For detailed information on the installation of the inspection ports: see Installation Instructions "Inspection Ports" EA01058D.
4. Check the shedder bar by inserting an endoscope with recording capabilities into the inspection openings. Keep visual evidence of the condition of the shedder bar.
5. Check if the shedder bar shows signs of wear, scale, corrosion or other types of damage. Meter shows signs of damage.
   ↳ No: proceed with step no. 6.

   Yes, damage found: go directly to step no. 10.
6. Measure the distance **a** from the sealing surface to the side wall of the shedder bar as shown (→ 3, 10) (e.g. using a caliper and the E+H supplied inspection centering sleeves, preferably with depth base attachment). Note the measured value in the table above in line 2 (→ 10). Repeat the measurement for the other side of the meter (distance **b**).

7. Calculate the sum of **a** and **b** and note the result in the table above (→ 10) in lines 1, 2 and 7.
8. Evaluate the measurement according to line 8 and proceed according to line 9 in the table above (→ 10).
   ↳ Summary:
9. The meter has passed the inspection measurement according to the table above (→ 10):
   ↳ Yes: ☐

   No: ☐

   The meter shows no signs of damage according to step no. 5.

   Yes: ☐

   No: ☐

   If both answers are **Yes** the inspection is passed. Continue with re-assembly.
10. The meter has either not passed the inspection measurement accuracy or shows damages to the shedder bar. Therefore, the flow meter must be recalibrated at the manufacturer's factory, at another accredited calibration facility, or using mobile calibration equipment.
11. Continue with re-assembly.

Date, Print Name, Signature

Keep this document as inspection proof. Note that only recalibration can guarantee the specified measurement uncertainty.

NOTICE

The sensor voltages indicate whether the DSC sensor is fully functioning.
They are continuously monitored and an error message is displayed if the sensor voltages are out of the allowed range. No additional inspection is required for the DSC sensor.

- ► It is recommended to document the device status by saving the current device parameters using FieldCare.

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