CLAIMS

1. An intrusive probe system for flush insertion into a metal asset comprising:

a probe body having a solid first end portion defined by an exposed surface configured to be exposed to a corrodent located within the metal asset, the probe body having an internal opening that terminates at a location spaced from the exposed surface;

an insert disposed within the internal opening of the probe so as to define a collection cavity defined between the insert and an inner wall of the probe body;

a diffusion barrier disposed along the inner wall of the probe body and formed of a material that is impermeable to a gas generated in the collection cavity by the corrodent so as to prevent passage of the gas from the collection cavity to the surrounding inner wall of the probe body;

a conduit in fluid communication with the collection cavity for receiving the gas generated by the corrodent; and

a pressure measuring device coupled to the conduit for measuring a pressure of the gas generated by the corrodent.

2. A probe system according to Claim 1, in which a first end of the insert is in a flush abutting relationship to the solid end portion of the probe body, whereby the collection cavity is formed surrounding a side wall of the insert and spaced from an interface between the first end of the insert and the solid end portion.

3. A probe system according to Claim 1, in which the insert comprises a cylindrical shaped filler rod and the collection cavity has an annular shape.

4. A probe system according to Claim 1, in which the collection cavity extends longitudinally within the probe body to a distance from the exposed surface.

5. A probe system according to Claim 1, in which the solid first end portion is formed of a material that permits diffusion of atomic hydrogen therethrough.

6. A probe system according to Claim 1, in which the solid first end portion, including the exposed surface, is formed of a metal.

7. A probe system according to Claim 1, in which the diffusion barrier is an oxide layer.

8. A probe system according to Claim 1, in which the diffusion barrier is an austenitic stainless steel sleeve.

9. A probe system according to Claim 1, in which the internal opening comprises a blind hole and a closed end of the internal opening is defined by the solid first end portion of the probe body.

10. A probe system according to Claim 1, in which the insert is formed of a material that has no hydrogen diffusivity properties.

11. A probe system according to Claim 1, in which the insert is formed of an austenitic stainless steel material.

12. A probe system according to Claim 1, further including a probe cap which is coupled to an end of the probe body opposite the solid first end portion; an access fitting to which the probe body is coupled; and a coupling mount that is configured to be sealingly inserted into an access hole formed in the metal asset and to which the access fitting is coupled, in which the access fitting includes first threads and the coupling mount includes second threads, the first and second threads being oriented such that the end of the exposed surface can be placed in a flush relationship with an inner surface of the metal asset when the access fitting and coupling mount mate together.

13. A probe system according to Claim 12, in which the probe cap includes outer threads that mate with inner threads formed in the access fitting.

14. A probe system according to Claim 1, in which the pressure measuring device is configured to send an alert once the hydrogen build-up rate reaches a threshold value that is indicative of an increased chance of HIC or step-wise cracking (SWC) in the metal asset.

15. A probe system according to Claim 1, in which the diffusion barrier has a HIC-resistant microstructure.

16. A probe system according to Claim 1, in which an interface between one end of the insert and the solid end portion is resistant to atomic hydrogen passage, thereby causing the corrodent to pass into the collection cavity that surrounds a side wall of the insert.

17. A probe system according to Claim 1, in which the probe body is configured such that the exposed surface placed flush relative to an inner wall of the metal asset.

18. An intrusive probe system for flush insertion into a metal asset comprising:

a probe body having an access end portion with an exposed surface configured to be exposed to a corrodent located within the metal asset, the access end portion having a recessed portion formed opposite the exposed surface;

a seal member coupled to and surrounding an outer surface of the access end portion proximate the exposed surface;

an insert having an access end and a base end, the access end being disposed adjacent recessed portion of the probe body so as to define a collection cavity that is fluid-tight and configured to collect the atomic hydrogen that permeates through the exposed surface of the probe body, whereby a gas is generated in the collection cavity by the atomic hydrogen , in which the insert includes a through hole that passes therethrough and is open at both the access end and the base end such that the through hole is in fluid communication with the collection cavity; and

a pressure measuring device in fluid communication with the through hole of the probe body for measuring a pressure of the gas generated by the diffused atomic hydrogen within the collection cavity.

19. A probe system according to Claim 18, in which the gas generated by the diffused atomic hydrogen in the collection cavity is molecular hydrogen gas.

20. A probe system according to Claim 18, in which the recessed portion is formed along a face of the access end portion opposite the exposed surface.

21. A probe system according to Claim 18, in which the recessed portion has a stepped construction including a landing portion against which the access end of the insert sealingly seats.

22. A probe system according to Claim 18, in which the through hole is centrally located within the insert.

23. A probe system according to Claim 18, in which the access end portion has a cylindrical shape.

24. A probe system according to Claim 18, further including a probe cap that is coupled to the base end of the insert, the probe cap having a through hole that axially aligns with the through hole formed in the insert to define a conduit to the pressure measuring device.

25. A probe system according to Claim 18, in which the insert comprises a cylindrical shaped filler rod.

26. A probe system according to Claim 18, further including an O-ring coupled to the access end portion adjacent to the exposed surface.

27. A probe system according to Claim 18, in which the access end portion is formed of a material that permits diffusion of atomic hydrogen therethrough but has an HIC resistant microstructure.

28. A probe system according to Claim 18, in which the access end portion, including the exposed surface, is formed of a same metal grade as the metal asset.

29. A probe system according to Claim 18, in which the insert is formed of an austenitic stainless steel material.

30. A probe system according to Claim 18, further including a probe cap that is coupled to the base end of the insert; an access fitting to which the probe body is coupled; and a coupling mount that is sealingly inserted into an access hole formed in the metal asset and to which the access fitting is coupled.

31. A probe system according to Claim 18, in which the corrodent comprises atomic hydrogen and the collection cavity comprises a HIC-simulation cavity in which the diffused atomic hydrogen permeates to and recombines to form hydrogen gas and as hydrogen gas content in the collection cavity increases, the pressure in the collection cavity increases correspondingly, mimicking a HIC process, the pressure measuring device monitoring the pressure within the collection cavity with a hydrogen sensor and determines corresponding hydrogen build-up rates.

32. A probe system according to Claim 31, in which the pressure measuring device is configured to send an alert once the hydrogen build-up rate reaches a threshold value that is indicative of an increased chance of HIC or step-wise cracking (SWC) in the metal asset.

33. An in-line-inspection system for monitoring an inner surface of a metal asset comprising:

an intrusive probe system according to Claim 1;

a first communication module that is associated with the intrusive probe device;

an inspection device that is configured to travel along the inner surface of the metal asset, the inspection device including a second communication module that is configured to communicate with the first communication module to allow for data transfer between the intrusive probe device and the inspection device.