CLAIMS

WHAT IS CLAIMED:

1. A fluid sealing and transfer element, comprising:

a flow body comprising a first end and a second end;

a first flow groove proximate said first end and a second flow groove proximate said second end;

first and second flow passages passing through said flow body, wherein said first flow passage intersects said first flow groove and said second flow passage intersects said second flow groove; and

a third flow passage passing through said flow body, wherein said third flow passage intersects said first and second flow passages and facilitates fluid communication between said first and second flow grooves.

2. The fluid sealing and transfer element of claim 1, wherein each of said first and second flow grooves are disposed around a perimeter of said flow body.

3. The fluid sealing and transfer element of claim 1, wherein said flow body comprises a cylindrical shape, wherein said perimeter is a circumference of said cylindrical shape, and wherein at least one of said first and second flow grooves is substantially continuously disposed around said circumference.

4. The fluid sealing and transfer element of claim 3, further comprising a plurality of seals, wherein each of said plurality of seals is substantially continuously disposed around said circumference.

5. The fluid sealing and transfer element of claim 1, wherein at least one of said first and second flow passages comprises a pair of intersecting flow passages.

6. The fluid sealing and transfer element of claim 1, wherein said fluid sealing and transfer element is adapted to be positioned at a flow position in a first coupling so as to establish a continuous flow path between a first flow channel of said first coupling and a second flow channel of a second coupling positioned proximate said first coupling.

7. The fluid sealing and transfer element of claim 6, wherein said fluid sealing and transfer element is adapted to establish said continuous flow path when said first flow groove is positioned in fluid communication with said first flow channel of said first coupling and when said second flow groove is positioned in fluid communication with said second flow channel of said second coupling.

8. The fluid sealing and transfer element of claim 1, wherein said fluid sealing and transfer element is adapted to be positioned at a sealing position in a first coupling so as to block flow between a first flow channel of said first coupling and a second flow channel of a second coupling positioned proximate said first coupling.

9. The fluid sealing and transfer element of claim 8, wherein said flow body further comprises a flow blocking portion between said first and second flow grooves, and wherein said fluid sealing and transfer element is further adapted to block said flow when said flow blocking portion of said flow body is positioned so as to block flow from said first flow channel of said first coupling.

10. A flow control system that is adapted to establish fluid communication between an interface tool and an equipment item, the flow control system comprising:

a movable transfer tube sealing cartridge comprising a first end, a second end, and a plurality of flow passages that are adapted to facilitate fluid flow between said first end and said second end; and

a movement apparatus that is adapted to move said movable transfer tube sealing cartridge to a flow position so as to facilitate fluid flow between a first flow channel of said equipment item and a second flow channel of said interface tool.

11. The flow control system of claim 10, wherein said movable transfer tube sealing cartridge is adapted to at least partially displace a replaceable transfer tube sealing cartridge from a sealing position in said equipment item when said movement apparatus moves said movable transfer tube sealing cartridge to said flow position.

12. The flow control system of claim 10, wherein said plurality of flow passages comprises a first flow groove that is positioned proximate said first end of said movable transfer tube sealing cartridge and a second flow groove that is positioned proximate said second end of said movable transfer tube sealing cartridge, and wherein said movement apparatus is adapted to position said movable transfer tube sealing cartridge so that said first flow groove is in fluid communication with said first flow channel of said equipment item and said second flow groove is in fluid communication with said second flow channel of said interface tool.

13. The flow control system of claim 10, wherein said movement apparatus is further adapted to move said movable transfer tube sealing cartridge to a sealing position so as to block fluid flow between said first and second flow channels.

14. The flow control system of claim 13, wherein said movable transfer tube sealing cartridge is adapted to replace a replaceable transfer tube sealing cartridge positioned in said

equipment item when said movement apparatus moves said movable transfer tube sealing cartridge to said sealing position.

15. The flow control system of claim 10, wherein said movable transfer tube sealing cartridge further comprises a flow blocking portion positioned between said first end and said second end, and wherein said movement apparatus is adapted to position said movable transfer tube sealing cartridge so that said flow blocking portion substantially blocks flow to or from said first flow channel of said equipment item.

16. The flow control system of claim 10, wherein said movement apparatus comprises one of a pneumatic and a hydraulic control system that is adapted to control movement of said movable transfer tube sealing cartridge.

17. An interface tool that is adapted to interface with an equipment coupling on subsea equipment, the interface tool comprising:

an interface coupling that is adapted to be removably coupled to said equipment coupling on said subsea equipment during a coupling operation; and

a flow control system that is adapted to establish fluid communication between said interface tool and said subsea equipment after said coupling operation, said flow control system comprising a fluid sealing and transfer element, said fluid sealing and transfer element being adapted to replace a replaceable fluid sealing and transfer element that, prior to said coupling operation, is positioned in said equipment coupling.

18. The interface tool of claim 17, wherein said interface tool is adapted to perform at least one interfacing operation with said subsea equipment after said fluid communication has been established.

19. The interface tool of claim 18, wherein said at least one interfacing operation comprises at least one of a purging operation, a fluid sampling operation, a clean-out operation, and a chemical injection operation.

20. The interface tool of claim 17, wherein said interface tool is adapted to be releasably supported by a manipulator arm, and wherein said interface tool is further adapted to be removably coupled to said equipment coupling by said manipulator arm.

21. The interface tool of claim 17, wherein an axis of said interface coupling is adapted to be substantially aligned with an axis of said equipment coupling during said coupling operation.

22. The interface tool of claim 21, wherein said interface tool is adapted to be oriented at a non-zero angle relative to a substantially horizontal reference plane after said coupling operation.

23. The interface tool of claim 17, wherein said flow control system comprises a movement apparatus that is adapted to move said fluid sealing and transfer element from said interface coupling to said equipment coupling.

24. The interface tool of claim 17, wherein said fluid sealing and transfer element is adapted to be positioned in a first position so as to facilitate said fluid communication.

25. The interface tool of claim 24, wherein said fluid sealing and transfer element is further adapted to be positioned in a second position so as to prevent said fluid communication.

26. The interface tool of claim 17, further comprising at least one sample bottle proximate said interface coupling, wherein said at least one sample bottle comprises a sample-

receiving volume that is adapted to receive a flow of a fluid sample from said subsea equipment during a sampling operation.

27. The interface tool of claim 26, wherein said sample bottle is adapted so that, after said sampling operation, said fluid sample fills at least approximately 98% of said sample-receiving volume.

28. The interface tool of claim 26, wherein a fluid flow distance between said interface coupling and said sample bottle is approximately 3 feet or less.

29. The interface tool of claim 28, wherein said fluid flow distance is approximately 1 foot or less.

30. The interface tool of claim 26, further comprising a fluid communication system that is adapted control said flow of said fluid sample into said at least one sample bottle.

31. The interface tool of claim 30, wherein said fluid communication system comprises a plurality of valves, wherein each of said plurality of valves is adapted to control fluid communication between at least three fluid sources.

32. The interface tool of claim 31, wherein at least one of said plurality of valves comprises a 2-position/3-way valve.

33. The interface tool of claim 31, wherein at least one of said plurality valves is adapted to facilitate fluid communication between said interface tool and a fluid flushing and purging system that is adapted to perform a purging operation so as to purge a residual fluid from a sampling/purging system circuit prior to said sampling operation, said sampling/purging system circuit comprising said

fluid communication system, said flow control system, and an equipment fluid communication system on said subsea equipment.

34. The interface tool of claim 33, wherein said fluid communication system is further adapted to control a flow of a purging fluid from said flushing and purging system to said subsea equipment during said purging operation.

35. The interface tool of claim 34, wherein said fluid communication system is further adapted to control said purging operation so that less than approximately 30% of a pre-purged volume of said residual fluid remains in said sampling/purging system circuit after said purging operation.

36. A system that is adapted to interface with subsea equipment, the system comprising:

an interface tool comprising an interface coupling, said interface coupling being adapted to be removably coupled to an equipment coupling on said subsea equipment during a coupling operation, said interface tool further comprising a fluid transfer element that is adapted to facilitate fluid communication between said interface tool and said subsea equipment after said coupling operation, said fluid transfer element being further adapted to replace a replaceable fluid transfer element that, prior to said coupling operation, is positioned in said equipment coupling; and

a manipulator arm that is adapted to support and position said interface tool during said coupling operation.

37. The system of claim 36, wherein said manipulator arm is further adapted to align an axis of said interface coupling with an axis of said equipment coupling during said coupling operation.

38. The system of claim 36, wherein said manipulator arm is adapted to release said interface tool after said coupling operation.

39. The system of claim 36, wherein said interface tool is adapted to be oriented at a non-zero angle relative to a substantially horizontal reference plane after said coupling operation.

40. The system of claim 36, wherein said system is adapted to perform at least one interfacing operation on said subsea equipment.

41. The system of claim 40, wherein said at least one interfacing operation comprises at least one of a fluid sampling operation, a clean-out operation, and a chemical injection operation.

42. The system of claim 36, further comprising an ROV that is adapted to position said system adjacent to said subsea equipment, wherein said manipulator arm is mounted on said ROV.

43. The system of claim 42, wherein said ROV comprises an axis that is substantially aligned with a direction of forward travel of said ROV, and wherein said ROV is adapted to be positioned adjacent to said subsea equipment during said coupling operation so that said axis of said ROV is oriented along a plane that intersects an axis of said equipment coupling at a non-zero angle.

44. The system of claim 43, wherein said non-zero angle is approximately 90° or less.

45. The system of claim 42, further comprising an equipment skid supported by said ROV, said equipment skid comprising interfacing equipment that is adapted to facilitate said at least one interfacing operation.

46. The system of claim 45, wherein said interface tool is operatively coupled to said interfacing equipment.

47. The system of claim 45, wherein said interfacing equipment comprises at least one of a methanol supply, a methanol pump, a purge fluid reservoir, a glycol supply, a valve control unit, and a heating control unit.

48. The system of claim 36, wherein said subsea equipment comprises one of a wellhead, a flow module, a pipeline end termination and a separator vessel.

49. The system of claim 36, wherein a configuration of said fluid transfer element is substantially the same as a configuration of said replaceable fluid transfer element.

Claims

1. An invention not claimed in any divisional application.