WHAT IS CLAIMED IS:

1. A cartridge assembly, comprising:

a housing including a flow cell chamber to receive a flow cell;

a well plate having liquid wells to receive desired amounts of liquids, the well plate including a valve station, a pump station and a fluidics analysis station, the well plate including channels associated with the wells, the valve station, pump station and fluidics analysis station;

a pump assembly provided on the well plate at the pump station, the pump assembly to manage fluid flow through the channels between the pump station and the fluidics analysis station; and

a rotary valve assembly positioned on the well plate at the valve station, the rotary valve assembly including a rotor shaft and rotor valve positioned to rotate about a rotational axis and to selectively couple the wells to the pump station,

the rotor shaft having a distal end exposed through the housing,

the rotor shaft including a dual spline configuration at the distal end thereof, the dual spline configuration having first and second sets of splines, the first set of splines forming a drive interface, the second set of splines forming a position encoding interface.

2. The cartridge assembly of claim 1, wherein the distal end of the rotor shaft extends into a shaft well provided in the housing, thereby exposing the dual spline configuration to a valve drive assembly of a fluidics analysis instrument.

3. The cartridge assembly of claim 1, wherein the first set of splines represent exterior splines extending about an exterior of the distal end, wherein lateral sides of adjacent splines are separated by a first predetermined spline to spline spacing, the spline to spline spacing corresponds to a spline pattern on a drive shaft of a valve drive assembly.

4. The cartridge assembly of claim 1, wherein the second set of splines represent interior splines formed about an interior of a cavity provided at the distal

end of the rotor shaft, the interior splines having lateral sides that are angled such that adjacent lateral sides form a predetermined non-parallel angle with respect to one another, wherein the adjacent lateral sides merge at a bottom to form pockets to receive mating splines on a drive shaft of the valve drive assembly, the position encoding interface utilized by the valve drive assembly to track a position of the rotor shaft.

5. The cartridge assembly of claim 1, wherein the rotor valve is mounted to a proximal end of the rotor shaft through a coupling flange, the coupling flange to allow a predetermined amount of tilting movement between the rotor valve and rotor shaft.

6. The cartridge assembly of claim 4, wherein the rotor valve including a rotor base having one or more ribs positioned about a proximal end of the rotor shaft, the coupling flange held between the ribs and the proximal end of the rotor shaft.

7. The cartridge assembly of claim 1, wherein rotor valve includes well plate engaging face having a central port and a radial port, the rotor valve including a channel oriented to extend in a radial direction outward from the central port to the radial port.

8. The cartridge assembly of claim 7, wherein the central port is aligned to correspond with a rotational axis of the rotor shaft and to align with a central feed port in the well plate, the rotor valve to rotate about the rotational axis to align the radial port with a corresponding well port.

9. The cartridge assembly of claim 1, wherein the rotary valve includes a well plate engaging face formed with an interface ring thereon, the interface ring extending about a perimeter of the well plate engaging face.

10. The cartridge assembly of claim 1, further comprising:

a valve cap including an interior cavity to rotatably receive the rotary valve, the valve cap including one or more latch arms to secure the valve cap to the wells and downward against the well plate; and

a biasing element provided within the interior cavity and to apply a biasing

force against the rotary valve to maintain a sealed interface between ports in the rotary valve and ports in the well plate.

11. The cartridge assembly of claim 1, wherein the pump assembly includes a plunger having a drive end and a biasing surface located at opposite ends of the plunger, the drive end and biasing surface exposed at upper and lower surfaces of the housing such that corresponding unidirectional drive and biasing forces are applied thereto in connection with moving the plunger in a reciprocating motion.

12. The cartridge assembly of claim 11, wherein the plunger has a drive arm and a plunger arm joined with one another through a bridge segment in a U-shape and are formed together in a monolithic structure, the drive and plunger arms to be received within support posts located on the well plate.

13. The cartridge assembly of claim 11, wherein the plunger comprises a plunger arm and plunger element that are molded together from different materials.

14. The cartridge assembly of claim 13, wherein the plunger element is formed on a leading end of the plunger arm, the plunger element to move within the corresponding support post to form high and low pressure states at the pumping station.

15. The cartridge assembly of claim 1, wherein the pump station includes a channel segment functionally divided into a preparation segment, a discharge segment and a pump work segment, all of which are formed continuous with one another to support fluid flow in either direction.

16. The cartridge assembly of claim 1, wherein the pump station includes an work area sandwiched between a pair of pinch valves located upstream and downstream of the work area, the pump assembly comprising a plunger aligned with the work area, the plunger to reciprocally move toward and away from the work area to introduce high and low pressure states, the pump assembly further comprising push pins aligned with the pinch valves, the push pins to be alternately moved to open and close the pinch valves.

17. The cartridge assembly of claim 1, further comprising a piercer unit

provided in the housing and positioned proximate to the wells, the piercer unit including a piercer element, the piercer unit to be moved to a piercing position where the piercer element pierces a cover for the corresponding well.

18. The cartridge assembly of claim 17, wherein the housing includes a cover having a piercer access opening that provides an instrument access to an upper end of the piercer unit.

19. The cartridge assembly of claim 17, wherein the piercer unit includes a body that is shaped in a conical tubular manner with a lower platform, an intermediate segment and an upper flange, at least one of the lower platform or upper flange including piercing elements distributed in a predetermined manner, the piercing elements arranged to align with the wells on the well plate.

20. The cartridge assembly of claim 1, further comprising a piercer unit having a platform that fits over the rotor shaft, the platform including indexing features that engage mating features on the rotary valve assembly to locate the piercer unit in a predetermined rotational orientation with respect to the rotor shaft in order to align piercer elements with corresponding wells.

21. The cartridge assembly of claim 1, wherein the well plate includes well transition ports arranged in a predetermined pattern corresponding to the rotary valve assembly, the well plate including well discharge ports aligned with corresponding wells, the well plate including well discharge channels extending between corresponding well discharge ports and well transition ports.

22. The cartridge assembly of claim 1, wherein the well plate includes a base having top and bottom surfaces, at least one of which includes the channels, the channels including open sided channels, the base joined to a backing layer to close the open sided channels.

23. The cartridge assembly of claim 1, wherein the well plate includes an optical interface window, provided within the optical analysis station, a top side of the well plate including an insertion limit element to engage an illumination element on an instrument.

24. The cartridge assembly of claim 23, wherein the insertion limit element

represents one or more ribs that are provided about the optical interface window, the ribs defining a Z-tolerance between an illumination element and the optical interface window.