Side-Stream Blending

When using Revision 10.00 firmware or better, the AccuLoad III has the capacity to handle side-stream blending. Side-stream blending is two-product ratio blending where the minor of two products is metered and controlled by a valve, while the main product is free flowing. Another meter and its corresponding control valve are located downstream of where the two products merge.

If side-stream blending is selected on a load arm, Meter 1 is the meter measuring the mingled products, or the batch/recipe. Meter 2 is the meter measuring the minor product. Product 1 is the major, free flowing, stock product, and Product 2 is the minor stock product.

Only one temperature, density, and pressure input is associated with the arm. Meter 1 and Meter 2 share this data for display and volume correction.

Meter 1 may measure a variety of blends containing Product 1 and Product 2; however, only one meter factor curve may be programmed for Meter 1. The AccuLoad does not support a different meter factor curve for each blend.

Blend Delivery

Delivery is similar to that of a normal ratio blender, but certain changes must be made to accommodate side-stream plumbing. For side-stream blending, the batch data (volume representing the blend) is obtained from Meter 1 directly rather than being a sum of Meter 1 and Meter 2.

Recipes allow product percentages ranging from 0 to 100% for Product 1 and 0 to 100% for Product 2; however, the AccuLoad will consider a recipe programmed for 100% of Product 2 to be a special situation (Meter 2 proving).

Product pumps are operated in the same manner as a normal ratio blender. A product pump is not turned on if that product is not to be delivered for a given recipe. (This applies to Meter 2 proving as well.) Injectors are programmed and delivered in the same manner as a normal ratio blender.

Proving

The AccuLoad supports proving Meter 1 of a side-stream blending arm, if the recipe contains 100% of Product 1. The normal proving process is used.

The AccuLoad supports proving Meter 2 of a side-stream blending arm, if the recipe contains 100% of Product 2. This is a special situation. Whenever the AccuLoad is commanded to deliver a recipe of 100% Product 2, it will not open the Meter 1 valve. The AccuLoad assumes that the operator has manually isolated Meter 2 and is delivering Product 2 directly to a prover.

Whenever a recipe of 100% Product 2 is delivered, the clean line feature is ignored and not delivered.

The AccuLoad cannot detect the position of manual valves used for proving purposes. For this reason, the load rack designer and operator are responsible for preventing cross product contamination in the event the AccuLoad is instructed to deliver a recipe of 100% Product 2.

Flow Control

There are two distinct flow control situations to be handled when an arm is configured for side-stream blending.

The first, a special situation, is when a recipe is programmed to deliver only Product 2 (the percentage of Product 1 is zero). In this case, the standard ratio algorithms will be used. This is a special case allowed by the AccuLoad for proving Meter 2. The intent is to manually isolate Product 2 and deliver it to a prover. When the Product 1 blend percentage in the recipe is zero, the Meter 1 valve does not open and the clean line does not apply.

The second situation is when the Product 1 blend percentage in the specified recipe is not zero. This is the "normal" situation for a side-stream blending

arm. In this case, Meter 1 generally uses Meter 1 and Product 1 flow control parameters, and Meter 2 generally uses Meter 2 and Product 2 flow control parameters. All of the following apply in this situation:

- Product 2 is completely delivered at or before the time Product 1 completes; it is not possible to deliver Product 2 only
- It is possible to correct under-delivery of Product 1, but not possible to correct under-delivery of Product 2
- There are two methods of preventing under-delivery of Product 2. They are as follows:
    - The AccuLoad III calculates the product flow rates such that Product 2's final trip coincides with Product 1's first trip
    - The AccuLoad III restricts the valve control flow tolerance to err on the positive side for Product 2's valve. Assume, for example, that Product 2's actual valve tolerance normally calculates to ±8%; for side-stream blending, only +8% tolerance is used.

Clean line is delivered as it normally is for ratio blending. Only Product 1 may be designated as the clean line product.

As product flow rates are calculated for various phases of delivery, the Product 1 (unmetered stream) flow rate may not drop below the Product 1 minimum flow rate. This prevents the condition where Product 2 cannot flow because the combined product's valve is closed.

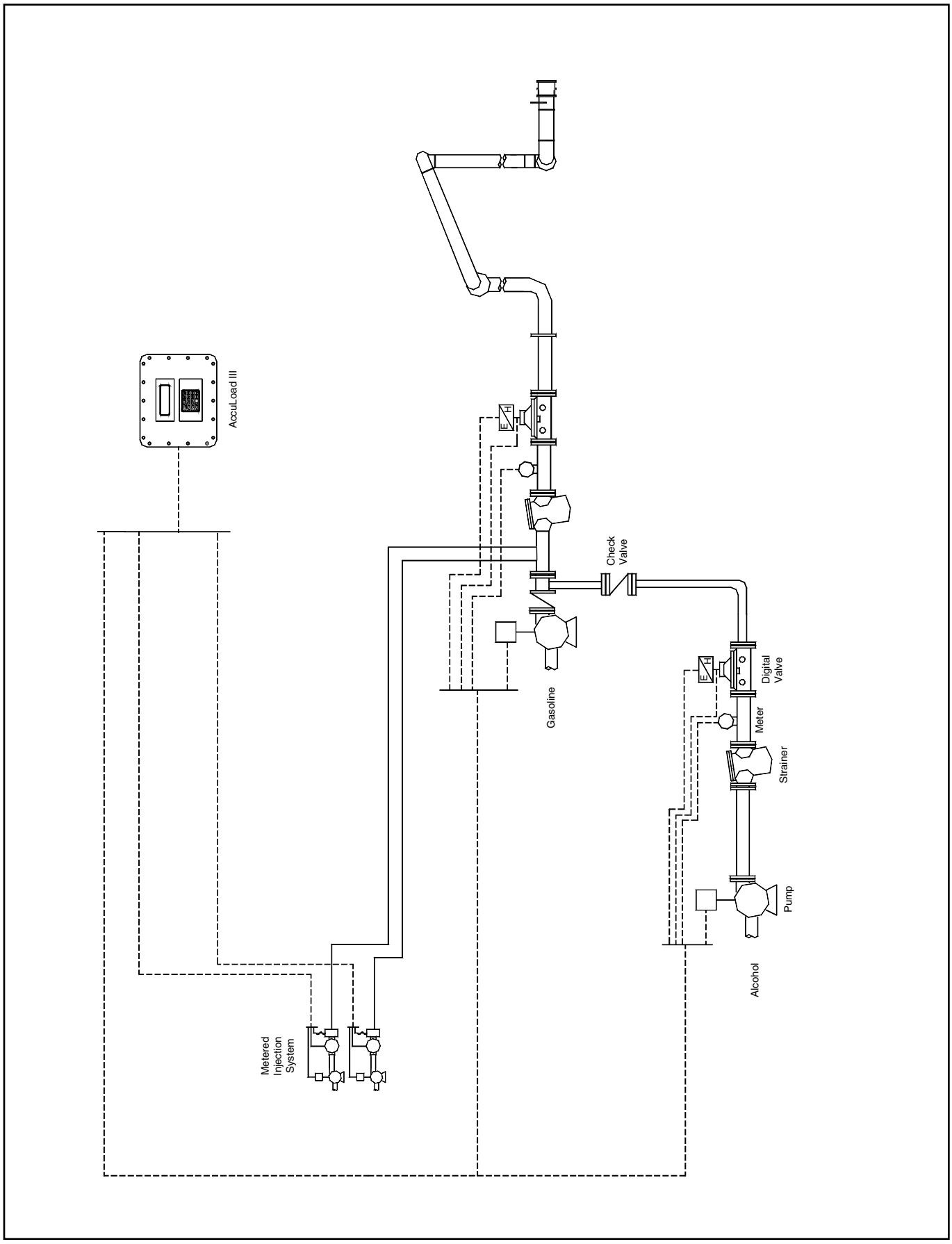
The flow rate assigned to Meter 1 is the sum of the calculated flow rates for Products 1 and 2. This keeps the flow rates balanced for each flow recalculation during a delivery cycle and minimizes the effects of the valves interacting with each other. If for any reason the actual flow rate for Product 1 is calculated to be negative, the AccuLoad clamps it to zero (not allowing negative flow). This may happen in unusual circumstances, such as pulses being received from Meter 2 but not from Meter 1.

Volume Accumulation

Two distinct volume accumulation situations must be handled when an arm is configured for side-stream blending. The first, a special situation, is when a recipe is programmed to deliver only Product 2 (the Product 1 blend percentage is zero). In this case, the AccuLoad uses standard ratio volume accumulation algorithms in all respects. This is a special case allowed by the AccuLoad to prove Meter 2. The intention is to manually isolate Product 2 and deliver it to a prover. When the Product 1 blend percentage in the recipe is zero, the Meter 1 valve does not open and clean line does not apply.

A second case applies when the Product 1 blend percentage in the specified recipe is not zero. This is the "normal" situation for a side-stream blending arm. In this situation, the AccuLoad takes what is measured with Meter 1 and applies it to the batch, then uses what is known from Meter 1 and Meter 2 to calculate, or infer, volumes for Product 1. Indicated Volume and Gross Volume are determined from the difference between Meter 1 and Meter 2. Volume temperature correction for Product 1 is based on Product 1's inferred Gross Volume. Product 2's volumes shall be calculated normally from Meter 2's data. This general concept of calculating values for Product 1 allows the AccuLoad to appear as a normal ratio blender to a supervisory control system; thus, no special programming of that system is needed to accommodate side-stream blending.

The AccuLoad infers Product 1's volumes and mass. The AccuLoad assumes there is no inherent volumetric change due to the blending of the two products (such as exothermic or endothermic reactions). The operator is responsible for error analysis of Product 1's inferred volumes, if required by the customer for legal or reconciliation purposes.


AccuLoad III
Check Valve
Digital Valve
Meter
Strainer
Pump
Gasoline
Alcohol
Metered Injection System

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