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Rockwell Automation + Schlumberger

JISKOOT™ MEASUREMENT SYSTEMS

+ InSpec Blender Controller

Installation, Operation & Maintenance Manual

Software Version 5.06 - Volume 2

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1. REVISION HISTORY

REVISION:	DESCRIPTION OF CHANGE:	ISSUER:	APPROVER:	DATE:
1	1st Issue	JMc	SFW	NOV-16-2020

INTELLIGENT ACTION

Important Safety Information

Terms Used in This Manual

	Caution	**Caution, risk of electric shock**
	Attention	**Attention, risque d'électrocution**

	WARNING	**A warning identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.**
	AVERTISSEMENT	**Un avertissement identifie des informations sur des pratiques ou des circonstances pouvant entraîner des blessures corporelles ou la mort, des dommages matériels ou des pertes économiques.**

Caution	Caution statements Indicate actions or procedures which, if not performed correctly, may lead to personal injury or incorrect function of the instrument or connected equipment.
Attention	Indiquez les actions ou les procédures qui, si elles ne sont pas effectuées correctement, peuvent entraîner des blessures ou un mauvais fonctionnement de l'instrument ou de l'équipement connecté.

Note	Indicates additional information about specific conditions or circumstances that may affect instrument operation.
Remarque	Indique des informations supplémentaires sur des conditions ou des circonstances spécifiques pouvant affecter le fonctionnement de l'instrument.

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WARNING!

GENERAL

To avoid the risk of electric shock and fire, the following safety instructions must be observed and the guidelines followed.

The specifications must not be exceeded, and the device must only be applied as described in the following.

Prior to the installation and commissioning of the unit, the installation guide must be examined carefully.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

AVERTISSEMENT!

GENERAL

Pour éviter tout risque de choc électrique et d'incendie, les consignes de sécurité de ce manuel doivent être observées, et les instructions suivies.

Les spécifications ne doivent pas être dépassées, et l'unité ne doit être appliquée que comme décrit dans le texte suivant.

Ce manuel doit être examiné avec soin, avant l'installation et la mise en service de l'unité.

Si l'équipement est utilisé d'une manière non spécifiée par le fabricant, la protection assurée par l'équipement peut être altérée.

WARNING!

INSTALLATION

Installation may only be carried out by electrically skilled and instructed personnel in accordance with national leg-islation, including the relevant standards.

All technical data on the instrument is to be observed.

Changes to the design and modifications to the equipment are not permitted.

The equipment shall only be operated as intended and only in undamaged and perfect condition.

Sufficient segregation must exist between different cables and wires carrying different types of signal or power and all other circuits.

All wires must be terminated, complete with crimping lugs. Unused cores should be terminated to the earth bus bar.

AVERTISSEMENT!

INSTALLATION

L'installation ne peut être effectuée que par un électricien qualifié, conformément à la législation nationale, y compris les normes pertinentes.

Toutes les données techniques sur l'instrument doivent être observées.

Modifications de l'équipement ne sont pas autorisés.

L'équipement ne doit être utilisé comme prévu par le fabriquant et uniquement si il est en parfait état.

Une séparation suffisante doit exister entre les différents câbles et les fils transportant différents types de signaux ou de puissance et tous les autres circuits.

Tous les fils doivent être terminés, avec pattes de sertissage. Les noyaux non-utilisés doivent être terminés au jeu de barres de la terre.

Section 1: **Introduction**

BLENDER

The InSpec blend controller is designed to accurately control the blend ratio of multiple flowing streams to produce a product of closely controlled quality. Also available is a variant blend controller known as a 'Wildstream Blender'. This is sometimes referred to as a "Flow responsive" or "Additive Injection" System. In a Wildstream Blender one of the streams is uncontrolled and its flow rate determines the rate of the other InSpec controlled stream.

The InSpec has both a comprehensive Web browser interface and a front panel menu system with user definable displays. The menus allow frequently accessed blend parameter to be accessed and amended. All interactions from the front panel menu are performed using clear prompting. The operator can monitor the blending process parameters throughout the batch via the Web page or via the front panel menu. The Web interface is the preferred option for configuring the Blender. It also has the additional feature of providing live configurable graph data that automatically updates during a batch. Previous batch data can also be selected and displayed on the graphs. If fully enabled, the InSpec can be networked to other computers via Ethernet LAN or via the Modicon Modbus protocol. The InSpec uses a real-time, multi-tasking operating system and can form part of a distributed control system (DCS).

A single Inspec controller manages 2 streams. When a blender requires more than 2 streams, additional remote IO modules can be connected via Ethernet/ModbusTCP to provide IO for an additional 6 streams. In this expanded scenario, the initial 2 stream Inspec is referred to as the 'master' unit and the additional units as 'remote IO' devices. With remote units connected the Inspec can provide control of up to 8 streams. The remote IO is modularised. The modules available are Analogue Inputs, Analogue Outputs, Pulses and Digital Inputs/Outputs.
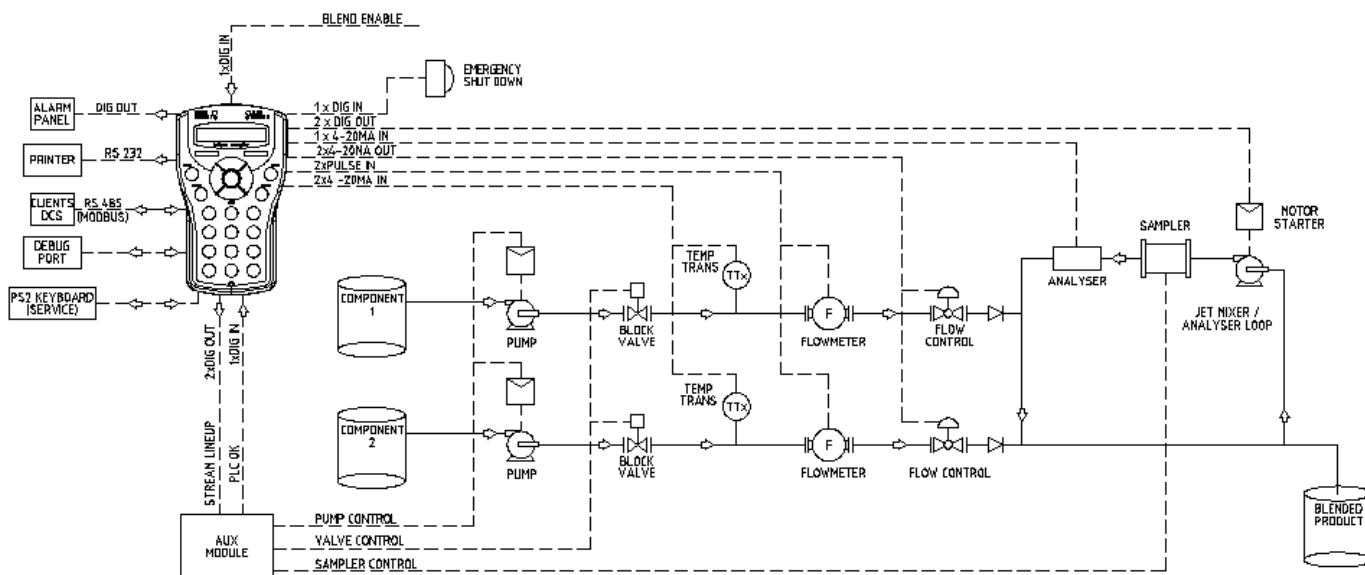
Figure 1 -   An InSpec in a typical 2 stream blending system.

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The InSpec is designed for "controlled rate" or "external flow responsive" blending applications, using its optimising ability for blending at the fastest achievable rate. Simply select "Start" from either the Web or front Panel interfaces upon which the system will automatically prompt for the defined parameters needed. During the blend process, 24 fully configurable parameters can be monitored via either display interface. The InSpec can communicate with other computers using either Ethernet LAN or register data can be read/written via the Modicon Modbus protocol (serial or TCP).

Many configuration and operational features are common across the range of InSpec controller applications (Samplers, Blenders etc). To aid clarity and prevent repetition, this Blender application manual will simply point the reader to the common manual when common controller features occur within the application menu tree.

1.1 MAIN FEATURES

- Operator friendly, simple to use.

- User defined recipes for blends can be prompted at the start of each batch or configured and stored for later use via either interface.

- Emergency stop capability.

- Comprehensive Web based Interface and front panel display for quick access to commonly used parameters.

- Configurable Usernames/Passwords for protected security.

- Configurable graphs for displaying live or historical batch data.

- LED and on-display alarm condition indicators.

- Fast two-step process to view and acknowledge active alarms.

- Alarms highlighted on alarm pages until acknowledged and shown until condition clears.

- Automatic ramp up of flow at start of batch and ramp down of flow at end of batch or on defined alarm conditions.

- Dedicated analogue temperature inputs.

- Supports sulphur, density and viscosity analysers. An 'other' analyser input is also available in the event that another input is required. The other input can be named and scaled according to type.

- The required flow rate can be selected using a combination of the stream flow capabilities and the percentages required, automatically calculating maximum flow-rates or via a fixed flow set point being entered from the touch screen.

- 3 term PID controllers for control valves and trim control.

- 10 Configurable PID Blocks for general purpose use.

- Derived Ratios. Ratios (stream %'s) can be automatically determined by entering a target value for either density, sulphur, viscosity or user var.

- 2 Trims for trimming to user input or calculated Density, Viscosity, Sulphur or other analyser.

- DIN 51757 / IP 200 / API 2540 / ASTM D 1250 temperature compensation.

- Self-tuning for accurate batch sizing.

- Designed for easy control via a DCS using the Modbus communication protocol.

- Dedicated communication registers for flow, temperature and analyser inputs.

- Dedicated spare register types for Modbus communications data.

- Fully configurable pump and block valve control sequence for up to 8 streams.

- Flow can be measured, or a fixed manual flow value can be entered from the front panel.

- Pulse flow meter inputs.

- Provides start and stop control signals suitable for a powered pipeline mixer and fast loop pumps.

- 'Enable' safety feature for dead man's handle, earth link and interlock control.

- Product temperature live, flow-weighted average and min/max levels.

- Automatic blend report and log generation and ability to (re)print previous reports and logs.

- Printer port (RS232/RS22) to print reports, user-definable logs and registers.

- Blender pacing ability under constrained flow conditions.

- Expandable stream architecture with remote IO Inspec controllers, offering up to 8 streams

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Section 2: **SETUP/CALIBRATION CHECKLIST**

These items are described as if they are being configured via the front panel interface. All of the following items need to be considered when first commissioning the InSpec Blender. The Web interface is intuitive and far more user-friendly and if possible, we always recommend setting up the Blender via the web page. Currently, the remote IO modules can only be configured via the web interface.

2.1   SYSTEM SETUP

- IP Settings – If you wish to use the InSpec on the internet then you will need to configure the IP settings beforehand. This will need to be done in conjunction and compliance with the local IT administration team. If you wish to use additional remote IO modules, you will also need to configure these and enter the IP address(es) in the remote IO setup menu option on the master so that it is able to see and communicate with these devices.

- System Time, Date and Date Format.

- GMT Offset. Please enter the offset from GMT (+/-) at your local time zone. This is used for logging purposes. The configurable graphs will not present the correct time data if this is not set.

- NTP Setup. This is only required if the InSpec has an Ethernet connection and only if you wish to use NTP (Network Time Protocol) to check and update the clock with an external reliable time source. If NTP is configured the time will only updated via the Internet during Waiting, unless it is specifically enabled to update during the running phases.

- InSpec ID is purely an identifier string. It is used in the top left panel of the Web Interface screen to identify which particular InSpec unit you are communicating with online. This is very useful when you are configuring/operating several InSpec's from one location. It can also be used in reports, emails or via Modbus to identify an instrument.

- The time out period for the menu security for both Engineers and Operators. Setting Engineers to a short period is advisable for security purposes. This is set from Security menu.

- Serial Ports – Two Serial ports are available for general configuration. Are they to be used? If so, what for? Configure these ports as an additional remote display, a printer or a Modbus connection.

- Display Items – Check and if required, change the 24 display items to meet customer approval/operational needs. The twelve front panel buttons can be configured to display two items, where first press is first item and second press is the second item.

- Set the display decimals for floating point display values.

- Configure Bar Graphs 1 & 2 for displaying the required parameter.

- Email Setup. This is only required if the InSpec is on a Network and only if you wish to use the Emailing facility. If required, batch reports and individual alarms can be configured so that they are automatically emailed to the named email recipient. Note that in order for this facility to work you must also enter an email address for InSpec that sends the email. This can be a fictitious address or a valid address for the company.

2.2   SYSTEM UNITS

- •   Batch Units (Gross Volume, Net Volume or Mass).

- •   Flow Units (Gross Volume Flow, Net Volume Flow or Mass Flow).

- •   Ratio Units (Gross Volume, Net Volume or Mass).

- •   Volume Units (Litres, M3, US GALLONS, BARRELS or other).

- •   Mass Units (KG, Tonnes (Metric), LBS, Tons (Long Tons) or other).

- •   Temp Units (Celsius, Fahrenheit)

- •   Density Units (API / SG (RD) / KG/M3 / KG/L /OTHER – Further Info Below.

- •   Qty To Flow (60/3600/86400/OTHER) – Further Info Below.

2.3   IO CALIBRATION & TESTS

See the IO section in Manual, Volume 1, for further a detailed description of these routines.

- •   Analogue input (ADC) calibration via 'System> IO >Calibration' menu.

- •   Digital input (DAC) calibration via 'System>IO >Calibration' menu.

- •   If you wish to test the IO before operation you can also run IO tests (Pulse, Frequency, ADCs, DACs, Digital In, Digital Out) from the 'System>IO>Test' menu.

- •   If you have configured additional remote IO modules, these will also appear as additional IO configuration pages on the web menu of the master unit. They are segregated into IO type, wherein each IO type has a setup page for each module slot and a corresponding test page for each successfully connected module. The test pages are not shown if there is an issue preventing the Master and module to connect over ethernet.

2.4   INPUTS

(On the Web interface, see the pages Application>Blender Setup and Application>Stream Setup)

- •   Set the flow type for each stream (Pulse, Analog or Modbus - Loopback is a Jiskoot test mode). For each, enter the flow cut-off, damping factor and select the flow mode (Gross, Net or Mass). For Pulse, Analog or Modbus you have to enter the 'Flow Source' register. This is the internal data register that the flow is being received and stored in. For pulse flow you also have to enter the 'Volume Source' register. It is the most complicated to set-up. Here is an example of how to set it up. Items in Red can be configured

Value	Pointer Register	Master Inspec
FLOW SOURCE	**P_FLOW_FREQ_STR1-8**	**F_FREQUENCY1-2**
VOLUME SOURCE	**P_QTY_PULSE_STR1-8**	**L_PULSE1-2**

- Set the density type (API, SG/RD, KG/M3 or OTHER). You can also set the density input type for each stream. This can be live, manual or Modbus. Each has a damping factor. The live option asks you to select from which internal register the input is coming into.

- Set the temperature type (Fahrenheit or Celsius). You can also set the temperature input type for each stream. This can be live, manual or Modbus. Each has a damping factor. The live option asks you to select from which internal register the input is coming into.

- Setup the Analogue inputs (ADC's), selecting min and max ADC values as well as minimum and maximum ADC alarm values, scaled values and alarm titles. By default, ADC's 1&2 are setup for temperature inputs 1&2 and ADC3 is setup for the Product quality value (Trim).

- Set the sulphur input type for each stream. This can be live, manual or Modbus. Each has a damping factor. The live option asks you to select from which internal register the input is coming into.

- Set the Viscosity input type for each stream. This can be live, manual or Modbus. Each has a damping factor. The live option asks you to select from which internal register the input is coming into.

- Set the Usrvar input type for each stream. This can be live, manual or Modbus. Each has a damping factor. The live option asks you to select from which internal register the input is coming into.

2.5   QTY TO FLOW

- Set QTY TO FLOW via the menu (time based flow unit). This is the ratio that converts the user flow rate into a quantity\ per unit second and vice versa.

2.6   SETUP VCF

- Setup VCF type (Off, Linear or DIN 51757 / IP 200 / API 2540 / ASTM D 1250).

- If linear, set the linear factor and the reference temperature for each stream.

- If API, set the material table type (Crude oils (A), generalised oils (B), special application (C), lubricating oils (D), Liquid Gases and Bitumen (X) and pure products (Y)) and the reference temperature for each stream.

2.7   BLOCK VALVE AND PUMP CONTROL

- The InSpec Blender has full block valve and pump control for any available streams. Each stream has a configurable pump and valve and there is the additional option of a valve in the product line. There are configurable options for controlling the individual pumps/valves and settings for the inter-pump delay, the post-pump delay, post-valve delay, the start and stop sequence (valves then pumps or pumps then valves) and whether the pumps and valves should be off/closed in stopped. The pumps and valves and their subsequent delays are primed during the LINEUP system phase at the start of a blend and the shutdown sequence occurs during the LINEDOWN_STOP or LINEDOWN_RESET system phase at the end of a blend. There are two linedown phases to account for whether the pumps remain off in stopped, or not.

2.8   ENABLE INPUT

- Is there an external enable signal required before a blend can successfully commence? If so check the field input connection, enable the option via menu and set the required timeout period.

2.9   AUX (AUXILAURY) CONTROL

- Do you wish to control external motors? I.e. to control a mixer, hydraulic power pack or sampler in the flow line etc?
- Select whether you wish to control the auxiliary signals by flow or status.
- Set an auxiliary off delay to prevent fleeting of the motors.
- Set a signal fleet time for the auxiliary control signals.

2.10 SYSTEM TUNING

- The following items available via the 'Operation☐Tune' Menu are used to fine-tune a blending system. Often, no two blenders are alike and as such each bespoke system requires tuning. On the Web interface, you access these settings via the Application☐Tune Blender page or in the specific case of Dual Viscosity: Application☐Viscosity Referral.
- Control Valves – set the total gain, P, I & D terms, Windup cycles,cutback position, valve min, max and start position control of each valve. Some of these items are covered in more detail below.
- Tune Trim PID. Set the gain, P, I and D values for the trim PID controller.
- Tune PID Blocks. Do you have any additional PID blocks to configure? The Blender has 10 bespoke PID blocks. If any of these are in use then configure them as required before use.
- Await For Flow. Configures the blender to wait for flow before being to ramp up.
- Set the Ramp-Up Rate. This is the quantity to increase the flow per second at the start of a batch to achieve the set point flow rate.
- Set the Ramp-Down Rate. This is the quantity to reduce the flow per second at the end of a batch to stop the flow.
- Set the maximum (cutback) valve position before flow in each stream will be restricted.
- Set valve minimum position. Are you using PD pumps? This option is useful in a system where back pressure on the pump is not desirable. It is unlikely to be an issue in systems that use centrifugal pumps. An engineer can configure this option via the 'Tune' menu. See this section for more detail.
- Set the starting position for the valve.
- Set the minimum and maximum flow rates for each stream.
- Dribble Reset. You may wish to reset a dribble value for the blender. These are self-learning variables to provide increasing accuracy at the end of a blend to ensure the required product quantity is met.
- Analyser Damping – The blender trim facility trims product quality according to calculated density, viscosity, sulphur or via any other source value. The live input value may require damping.
- Dual viscosity - This is where you set up field input devices for dual viscosity referral.

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- Set trim modes– on, off or reset? Snap back ratios when off?
- Set trim sources - Make sure Trim is in analogue mode for operational use and not one of the internal simulation modes.
- Set trim refs. Set the reference registers for trim.
- Set the trim limits. The minimum and maximum permitted batch trim values and the required trim max. That is, the maximum adjustment allowable for trim.
- Set trim inhibits. You may wish to inhibit trim calculations when a temperature or analyser alarm (analogue 3) is active. You may also wish to set a quantity of fluid that elapses before the trim is started.

2.11 DELTA VOLS

- Setup delta volumes for ratio calculations/alarms:
- Start Qty – The volume that elapses before ratio calculations begin.
- Delta Small Qty - The small Delta ratio quantity between successive calculations.
- Delta Large Qty - The large Delta ratio quantity between successive calculations.

2.12 AVERAGING

- If required set up flow weighted averaging for the analogue inputs, trim 1, trim 2, user blocks (10 available) or density. The chosen analyser can be weighted by gross volume, net volume, or mass of the product or a single stream.

2.13 AUTO PROMPTS

Decide which prompts you wish enabled at the start of each manual blend. The following are prompts that can be turned on or off.

- Required Quantity.
- Required Percents.
- Required Flow.
- Recipe.
- Batch Title.
- Batch ID.
- Start Prompt?
- Trim 1 Enable.
- Trim 2 Enable.
- Trim 1 Stream
- Trim 2 Stream
- Trim 1 Target.
- Trim 2 Target

- Trim 1 Max.

- Trim 2 Max.

- Measured Density.

- Measured Viscosity.

- Measured Sulphur.

- Measured User Var.

- Custom Prompts

- PID Blocks

- Repeat Batch.

2.14 MANUAL OPTIONS

Here you can set which items are available for manual configuration during a blend, either via the manual menu on the front panel interface or via the web interface. This is more useful for the latter. On the web the options will simply be displayed or not depending on the configuration setting. On the front panel, you can select all options but they will only allow data entry if they have been configured. The options for manual configuration are as follows:

Flow, Quantity, Ratios, Trim Target 1, Trim Enable 1, Trim Target 2, Trim Enable 2, Densities, Viscosities, Sulphurs, Uservars, Density Target, Viscosity Target, Sulphur Target, PID Blocks.

2.15 RECIPES

- Set up a number of standard recipes, ratios, states and product names from the Recipe menu. Here the options are to view current recipe, select which recipe is currently active, view the recipes that are currently defined, add a new recipe (up to 20 recipes can be defined), insert a new recipe at a specific location in the current list of recipes, edit the parameters of an existing recipe or delete an existing recipe.

2.16 ALARMS

- Configure the alarms for the blending system via the 'Alarms☐ Alarm Setup' menu.

- You may wish to turn some alarms off when the associated feature is not enabled. I.e., Trim Limits etc.

- Alarms can also directly affect the behaviour of each trim, e.g., it continues unaltered, freezes or snaps back to the original value.

- All of the Alarm names are in configurable string registers. Do these have to be changed for the specific system?

- Does the alarm require a delay period before it becomes live?

- Does the alarm need to be sent to the general alarm output if it is triggered?

- What operational phases should the alarm be active in?

- Is email notification required when this alarm becomes active?

- Do you wish the general alarm output signal to be held steady or to toggle when there is an active alarm? This is configured via the Alarms☐Alarm Output menu item.

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- What type of alarm is it (Warning, Controlled Stop or Emergency Stop)?

2.17 PRINTER

The following applies for a Serial Printer:

- Set baud rate and page length via menu.
- Make sure that you have the correct hardware configuration for the physical connection (RS232/RS422/RS485). See F3174 Configuration in the Volume 1 manual.

  The following only applies for an Ethernet Network Printer

- If the InSpec in on an Ethernet LAN network and you wish to print to a printer that is on the same network then make sure you have configured the IP settings for the InSpec correctly and configured the Print URL Address via the 'SYSTEM-IP SETTINGS' menu. The URL address can be either a numerical 4 byte address or a string. The URL address for this is something you will have to obtain from the local IT administration team. Note: The Ethernet printer supports the LPR printing protocol.
- Set the page length via menu.

2.18 RECORDS AND LOGS

The Records and logs section of the InSpec menu concerns what data can be printed, logged and emailed. For configuration purposes enter the Print menu of this section and scroll along to the 'Set Page Length' to set the size of your page and then scroll to 'Auto Report Print' to select whether you want reports to be automatically printed at the end of a batch. You can also decide to automatically print sub reports. Sub Reports are ones that are created during starting, controlled stops etc.

If you require historical log data to be gathered during the blending process you will also have to set the period and setup the log format via the 'RECORDS & LOGS-LOG SETUP' menu option. The data you select can be configured to be stored in a text file, a CSV file and you then select the source register for the log item. A name for the log field and, if appropriate, the decimal places required are then prompted for. Note: This data stored in the .CSV file version is what is used to drive the Log Graph screen which is accessible via the web interface. For this reason the first three log items are non-configurable. You can change their name but they will always be present. The Graphs need these to be Data, Time, and GMT offset in order to plot data correctly. Also, if you do not make the other graph items 'CSV FILE ENABLED' then they will not appear for selection on the graphs page of the web interface. There is some additional information on these features in the Common InSpec Manual.

If the required quantity for the blend is set to unlimited (this is configured via the Operation-Source/prompt-'Required Quantity' option from the front panel interface or via the records and logs page of the web based interface) then you can enter an hour here to specify at which hour the batch folder on the SD card will be forcibly reset to a new folder. This is to avoid the continuous batch files from growing too large.

2.19 MODBUS

- Questions to consider for initial configuration. Are you using Modbus?

- Examine and configure if necessary register Modbus addresses.

- Are you using Modbus Serial or Modbus TCP?

  Only for serial Modbus:

- Set Serial Port task via System-Serial Ports. This will step you through the whole setup process Modbus baud rate, parity, node number, mode (ASCII or RTU), and word order (LSW by default).

- Make sure that you have the correct hardware configuration for the physical connection (RS232/RS422/RS485). See F3174 Configuration in the Volume 1 manual.

For Modbus TCP

- If the InSpec is on an Ethernet LAN network and you wish to use Modbus TCP on the same network then make sure you have configured the IP settings for the InSpec correctly and, if you are using Modbus TCP Master, configure the associated Modbus Master Query Block URL Address via the 'SYSTEM-MODBUS TCP MASTER' menu item. The URL address can be either a numerical 4 byte address or a string. You will also then have to enter the required Modbus string size, the byte sequence for strings, the float mode (32 bit or 64 bit), the float word order and the long (INT32) word order.

2.20 SYSTEM SAVE

- After commissioning a new Blending system, it is strongly advisable to save the configuration of the existing system using the system backup method from either the web interface (See advanced settings web page) or the front panel interface. To do this via the front panel interface you have to reboot the InSpec whilst holding down the 'RESET' key. This boots the InSpec into the system menu. Here, after logging in as a user with 'Engineer' level security, scroll through the options until you find the option called 'SYSTEM BACKUP'. After selecting this and confirming the process the backup procedure will begin. This results in all of the configuration and software data being backed up into a time/date stamped folder on the SD card. There is some additional information on this feature in the Common InSpec Manual.

2.21 SYSTEM RESTORE

- Alternatively, you may wish to restore a previous system or create a duplicate on another machine. This can be done using the SYSTEM RESTORE procedure which is also accessed via the system menu. On selecting this you will be able to browse the backup folder on the SD card and select which date/time stamped image you wish to restore. This method also restores the software so it is possible to revert to a previous configuration that was saved on a different version of software. There is some additional information on this feature in the Common InSpec Manual.

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Section 3: **Installation**

3.1   MENU SECURITY LEVEL – NO LOGIN (LOCKED)

--> SECURITY
----> LOGIN USER

3.2   MENU SECURITY LEVEL OPERATOR

--> CONTROL
----> START
----> STOP
----> RESET
----> EM.STOP
--> MANUAL
----> FLOW
----> PERCENTS
----> QUANTITY
----> TRIM
------> TRIM 1 TARGET
------> TRIM 1 ENABLED
------> TRIM 2 TARGET
------> TRIM 2 ENABLED
----> DENSITY
----> VISCOSITY
----> SULPHUR
----> PIDBLOCK SP
--> ALARMS
---->DISPLAY ALARMS
--> RECORDS AND LOGS
---->PRINT
------> BATCH REPORT
------> BATCH LOG
------> ALARM PHASE LOG
---->EMAIL
------> BATCH REPORT
------> BATCH LOG
------> ALARM PHASE LOG
---->UNLIM BATCH HOUR
-->SECURITY
---->LOGIN USER
---->LOGOUT
---->WHO AM I?
---->EDIT USER

3.3   MENU SECURITY LEVEL ENGINEER

--> CONTROL
----> START
----> STOP
----> RESET
----> EM.STOP
--> MANUAL
----> FLOW
----> PERCENTS
----> QUANTITY
----> TRIM
------> TRIM 1 TARGET
------> TRIM 1 ENABLED
------> TRIM 2 TARGET
------> TRIM 2 ENABLED
----> DENSITY
----> VISCOSITY
----> SULPHUR
----> DERIVED DENSITY
----> DERIVED VISCOSITY
----> DERIVED SULPHUR
----> PIDBLOCK SP
--> ALARMS
---->DISPLAY ALARMS
---->CONFIG ALARMS
---->DELETE CONFIG ALARM
---->SCROLL SETUP
---->ALARM OUTPUT
--> REGISTER ACCESS
---->DISPLAY
------> TIME
--------> CURRENT
--------> STARTING
--------> ELAPSED
--------> DATE
--------> FINISH
------> FLOWS
--------> PROD FLOW
------------> REQUIRED
------------> GROSS
------------> NET
------------> MASS
--------> STREAM FLOW
------------> GROSS
------------> NET
------------> MASS
------> QUANTITIES
--------> RQD PROD
--------> NET PROD
--------> GROSS PROD
--------> MASS PROD
--------> NET STREAM
--------> GROSS STREAM
--------> MASS STREAM
------> PERCENT
--------> RQD STR

--------> CALC GROSS STR
--------> CALC NET STR
--------> CALC MASS STR
------> TEMP
--------> TEMP PROD
--------> TEMP STREAM
-------------> TEMP (KELVIN)
-----------------> TEMP PROD
-----------------> TEMP STREAM
------> USER FWA BLOCK
------> TRIM 1
--------> LIVE TRIM
--------> TRIM TARGET
--------> FWA TRIM
------> TRIM 2
--------> LIVE TRIM
--------> TRIM TARGET
--------> FWA TRIM
------> DENSITY
--------> DENSITY PROD
--------> DENSITY STREAM
--------> FWA DENSITY PROD
--------> FWA DENSITY STREAM
------> SULPHUR
--------> SULPHUR PROD
--------> SULPHUR STREAM
------> VISCOSITY
--------> VISCOSITY PROD
--------> VISCOSITY STREAM
------> USER VAR
--------> USER VAR PROD
--------> USER VAR STREAM
------> FREQUENCY
------> ADC
--------> INPUT
-------------> SCALED
-------------> 0-1
-------------> RAW
-------------> FWA
--------> OUTPUT
-------------> 0-1
-------------> RAW
------> DISPLAY SETUP
--------> SCROLL SETUP
--------> DISPLAY ITEMS
--------> DISPLAY DEC
--------> ENGINEER DISPLAY
--------> BAR GRAPH 1
--------> BAR GRAPH 2
--> RECORDS AND LOGS
---->PRINT
------> BATCH REPORT
------> BATCH LOG
------> ALARM PHASE LOG
------> UCL PROGRAM FILE
------> REPORT TEMPLATE
------> REGISTERS
------> RECIPES
------> SET PAGE LENGTH
------> AUTO REPORT PRNT
---->DELETE BATCHES
---->EMAIL
------> BATCH REPORT

------> BATCH LOG
------> ALARM PHASE LOG
------> REGISTER LOG
------> MODBUS LOG
------> REBOOT LOG
------> REPORT_TEMPLATE
------> ALL SYSTEM FILES
------> UCL PROGRAM FILE
------> CONFIG.TXT
------> CONFIG.MODBUS.CSV
------> CONFIG.ALARM.CSV
------> CONFIG.CAL
------> CONFIG.BIN
------> AUTO REPORT MAIL
------> AUTO LOG MAIL
------> AUTO ALARM MAIL
------> BACKUP IMAGE
---->LOG SETUP
------> PERIOD
------> FORMAT
---->UNLIM BATCH HOUR
--> RECIPES
------> VIEW CURRENT
------> VIEW RECIPES
------> ADD RECIPE
------> INSERT RECIPE
------> EDIT RECIPE
------> DELETE RECIPE
--> OPERATION
---->STREAMS
---->WILDSTREAM
---->UNITS
---------->BATCH UNITS
----------> FLOW UNITS
----------> RATIO UNITS
----------> VOLUME UNITS
----------> MASS UNITS
----------> TEMP UNITS
----------> DENSITY UNITS
----------> QTY TO FLOW
---->VCF SETUP
---->PUMPS AND VALVES
----------> ENABLE PUMPS
----------> SETUP PUMPS
----------> P&V OFF IN STOP
----------> ENABLE B.VALVES
----------> SETUP B.VALVES
----------> START SEQUENCE
----------> STOP SEQUENCE
---> TRIM 1
----------> TRIM SOURCE
----------> TRIM STREAM
----------> TRIM MODE
----------> TRIM DIRECTION
----------> TRIM LIMITS
----------> TRIM REFS
----------> TRIM INHIB QTY
---> TRIM 2
----------> TRIM SOURCE
----------> TRIM STREAM
----------> TRIM MODE
----------> TRIM DIRECTION
----------> TRIM LIMITS

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----------> **TRIM REFS**
----------> **TRIM INHIB QTY**
---->**DELTA VOLS**
----------> **START QTY**
----------> **D.SMALL QTY**
----------> **D. LARGE QTY**
----------> **DQS PERC LIMIT**
----------> **DQL PERC LIMIT**
---->**AUX CONTROL**
---->**ENABLE INPUT**
---->**DISCARD VOLUMES**
---->**AVERAGING**
----------> **ANALOGUE INPUTS**
----------> **DENSITY**
----------------> **FWA MODE**
----------------> **RESET**
----------> **TRIM 1**
----------> **TRIM 2**
----------> **USER BLOCKS**
---->**TUNE**
----------> **TUNE C.VALVES**
----------> **TUNE TRIM PID**
----------> **TUNE PID BLOCKS**
----------> **AWAIT FOR FLOW**
----------> **RAMP UP**
----------> **RAMP DOWN**
----------> **STREAM MIN/MAX**
----------> **DRIBBLE RESET**
---->**FIELD SETUP**
----------> **ADC SETUP**
----------> **DAC SETUP**
----------> **FLOW METERS**
----------> **TEMPERATURE STR**
----------> **DENSITY STREAM**
----------> **VISCOSITY STREAM**
----------> **SULPHUR STREAM**
----------> **USRVAR STREAM**
----------> **DUAL VISCOSITY**
---->**SOURCE/PROMPT**
----------> **RQD QUANTITY**
----------> **RQD PERCENTS**
----------> **RQD FLOW**
----------> **RECIPE**
----------> **BATCH TITLE**
----------> **BATCH ID**
----------> **START PROMPT**
----------> **TRIM 1 ENABLE**
----------> **TRIM 2 ENABLE**
----------> **TRIM 1 STREAM**
----------> **TRIM 2 STREAM**
----------> **TRIM 1 TARGET**
----------> **TRIM 1 MAX**
----------> **TRIM 2 TARGET**
----------> **TRIM 2 MAX**
----------> **MSD DENSITY**
----------> **MSD VISCOSITY**
----------> **MSD SULPHUR**
----------> **MSD USER VAR**
----------> **CUSTOM PROMPTS**
----------> **PID BLOCKS**
----------> **REPEAT BATCH**
---->**MANUAL OPTIONS**
-->**SECURITY**

```
----------> LOGIN USER
----------> LOGOUT
----------> WHO AM I?
----------> SECURITY TIMEOUT
----------> ADD USER
----------> EDIT USER
-->SYSTEM
----------> INSPEC ID
----------> SET DATE/TIME
----------> GMT OFFSET
----------> DATE FORMAT
----------> NTP SETUP
-------------> ENABLE NTP
-------------> NTP URL
-------------> NTP IP ADD
-------------> NTP POLL TIME
----------> EMAIL SETUP
-------------> SET SMTP URL
-------------> SMTP IP ADD
-------------> EMAIL FROM NAME
-------------> EMAIL FROM DOMAIN
-------------> EMAIL TO NAME
-------------> EMAIL TO DOMAIN
----------> SERIAL PORTS
-------------> PORT 2
-------------> PORT 3
----------> MODBUS TCP SLAVE
----------> MODBUS TCP MASTER
----------> IP SETTINGS
-------------> CONFIGURE DHCP
-------------> INSPEC IP ADDR
------------------> VIEW CURRENT
------------------> SET STATIC
-------------> SUBNET MASK
------------------> VIEW CURRENT
------------------> SET STATIC
-------------> DEFAULT GATEWAY
------------------> VIEW CURRENT
------------------> SET STATIC
-------------> PRIMARY DNS
------------------> VIEW CURRENT
------------------> SET STATIC
-------------> SECONDARY DNS
------------------> VIEW CURRENT
------------------> SET STATIC
-------------> SMTP URL ADDR
------------------> SMTP URL
------------------> VIEW IP ADD
-------------> PRINT URL ADDR
------------------> PRINT URL
------------------> VIEW IP ADD
-------------> NTP URL ADDR
------------------> NTP URL
------------------> VIEW IP ADD
-------------> VIEW MAC ADDR
----------> USER COMMANDS
----------> I/O
-------------> CONFIGURE
------------------> DIGITAL TYPES
------------------> CONTROL DIGITALS
------------------> REMOTE IP ADD
-------------> TESTS
------------------> PULSE/FREQ
```

INTELLIGENT ACTION

```
-----------------> ADCS
-----------------> DACS
-----------------> DIGITAL IN
-----------------> DIGITIAL OUT
--------------> CALIBRATION
-----------------> ADCS
-----------------> DACS
```

A description of each menu item will now be given. In order to cover all topics, the options available under the 'Engineer' menu will now be explained.

3.4   CONTROL

Both the Operator and the Engineer access levels provide the same available functions under the InSpec Blender's control menu. The Control menu contains the primary controls for initiating the blender the parameters of the blend. These functions will be accessed frequently by the operator of the InSpec and have therefore been placed at the start of the menu.

3.4.1   START

Note, when you are not in the menu the button labelled 'Start' on the front panel has the same functionality as this item in the control menu. For day-to-day use an operator is far more likely to stick to the three front panel control buttons (Start, Stop and Reset) rather than enter the menu tree to initiate a batch.

3.4.2   STOP

The stop command is used to stop and initiate a blend. On selecting this option a confirmation prompt will appear before the stop command is executed or cancelled. Again, the front panel 'Stop' button also performs this operation.

3.4.3   RESET

The Reset command is used to reset the blend and return the InSpec to the waiting phase. A blend will normally be stopped and then reset, although it is possible to select reset whilst the blender is running. In either case a prompt will appear asking you to confirm your decision to reset the blender. The front panel 'reset' button also performs this operation.

3.4.4   EM.STOP

The Emergency Stop command is a quick method of immediately terminating a blend from the front panel. When you use the Stop command to halt a blend it can take some time for the stream flow to ramp down. With Emergency stop the blend is forced into immediate shutdown. In reality the emergency stop conditions for a Blender should be configured to take place automatically under configured alarm conditions and there should never be a need to simply rely on the front panel menu option to do so. This option is also very useful to speed up testing and commissioning of the initial system.

3.5 MANUAL

The Manual sub-menu of the control menu contains items which the operator or engineer can change during an active batch.

3.5.1 FLOW

This allows the current flow value to be manually altered.

3.5.2 PERCENTS

This allows an operator to change the stream percentages manually during a blend. If trim is enabled then changing the percentages will affect the trim target. If it is enabled you will also be asked to check / reset the trim targets.

3.5.3 QUANTITY

This allows the current blend quantity to be amended during a blend.

3.5.4 TRIM 1 TARGET

This allows the trim 1 quality value to be amended during a blend.

3.5.4.1 TRIM 1 ENABLED

This allows trim 1 to be enabled/disabled during a blend.

3.5.5 TRIM 2 TARGET

This allows the trim 2 quality value to be amended during a blend.

3.5.5.1 TRIM 2 ENABLED

This allows trim 2 to be enabled/disabled during a blend.

3.5.6 DENSITY

Selecting this option during a blend will result in you being asked if you wish to modify the blend. If you select yes then you will be asked for which stream density you wish to amend. You then enter your chosen density value.

3.5.7 VISCOSITY

Selecting this option during a blend will result in you being asked if you wish to modify the blend. If you select yes then you will be asked for which stream viscosity you wish to amend. You then enter your chosen viscosity value.

3.5.8 SULPHUR

Selecting this option during a blend will result in you being asked if you wish to modify the blend. If you select yes then you will be asked for which stream sulphur value you wish to amend. You then enter your chosen sulphur value.

3.5.9 DERIVED DENSITY

Selecting this option during a blend will result in you being asked if you wish to modify the derived density target. However, this will only be possible if the required percents have been set to 'Density Derived'.

INTELLIGENT ACTION

3.5.10 DERIVED VISCOSITY

Selecting this option during a blend will result in you being asked if you wish to modify the derived viscosity target. However, this will only be possible if the required percents have been set to 'Viscosity Derived'.

3.5.11 DERIVED SULPHUR

Selecting this option during a blend will result in you being asked if you wish to modify the derived sulphur target. However, this will only be possible if the required percents have been set to 'Sulphur Derived'.

3.5.12 PIDBLOCK SP

If you select this during a blend and any of the ten PID blocks are enabled then you will be prompted to select the PID block by number and then enter a new set point for the PID block.

3.6 ALARMS

As a master unit, the InSpec Blender contains the facility for 70 standard alarms. When the Blender is defaulted the first 36 configurable alarm slots are set-up with default alarms. Of course if any of these alarms are undesirable or need adjusting then simply step through the setup for each alarm and change as required. You may also wish to turn some of the alarms off. This way they still exist but will never become active and impinge upon the Blending process. The default alarms and a brief description of each one now follows. When the master unit is extended via the remote IO Inspec controllers, the number of available configurable alarms expands with 5 additional alarms available per added stream. So in an 8 stream blender, the number of alarms would be 70 as per a standard two stream blender, plus an additional 30 (6 extra streams * 5 = 30) alarms for the next 6 streams, equalling 100 alarms in total.

3.6.1 DISPLAY ALARMS

Use this item to display a list of the currently active/unacknowledged alarms.

3.6.2 CONFIG ALARMS

The following alarms are predefined specific to the blender controller.

3.6.2.1 Temp Alarm 1

This alarm is used to indicate when the current temperature in stream 1 is above or below the configured minimum and maximum values. By default the temperature input for this alarm is held in register F_ADC_SCALED1.

3.6.2.2 Temp Alarm 2

This alarm is used to indicate when current temperature in stream 2 is above or below the configured minimum and maximum values. By default the temperature input for this alarm is held in register F_ADC_SCALED2.

3.6.2.3 Trim PV 1

This alarm is used to indicate when the current trim 1 input is above or below the configured minimum and maximum values. By default the temperature input for this alarm is held in register F_ADC_SCALED3.

3.6.2.4 CV Wide Open 1

This alarm indicates when the control valve in stream 1 rises above the configured maximum value (scaled between 0 and 1). By default the value that drives this input for this alarm is held in register F_CV_POS1.

3.6.2.5 CV Wide Open 2

This alarm indicates when the control valve in stream 1 rises above the configured maximum value (scaled between 0 and 1). By default the value that drives this input for this alarm is held in register F_CV_POS1.

3.6.2.6 Blend Unob

t the start of each blend the required blend parameters are checked to see if the requested blend is viable. If it is not a flag is set and the Blend Unobtainable alarm will be raised. This value, set in register C_BLEND_UNOB, is what drives this alarm.

3.6.2.7 Trim 1 Limit

When trim 1 is enabled during blending the internal mathematics of the blending operation continually calculates what adjustment is required to the Trim PID control to obtain/maintain the required trim target. If this adjustment exceeds the configured maximum (+/-) then the C_TRIM_LIMIT flag that drives the alarm is set.

3.6.2.8 Low Flow 1

During blending, if the current stream 1 flow is less than the configured minimum flow F_MIN_FLOW1 and there is a percentage required from stream 1 then the C_LOW_FLOW1 flag that drives this alarm will be set.

3.6.2.9 Low Flow 2

During blending, if the current stream 2 flow is less than the configured minimum flow F_MIN_FLOW2 and there is a percentage required from stream 2 then the C_LOW_FLOW2 flag that drives this alarm will be set.

3.6.2.10 High Flow 1

During blending, if the current stream 1 flow is higher than the configured maximum flow F_MAX_FLOW1 and there is a percentage required from stream 1 then the C_HIGH_FLOW1 flag that drives this alarm will be set.

3.6.2.11 High Flow 2

During blending, if the current stream 1 flow is higher than the configured maximum flow F_MAX_FLOW1 and there is a percentage required from stream 1 then the C_HIGH_FLOW1 flag that drives this alarm will be set.

3.6.2.12 Autoflowing

Under certain flow conditions (flow too high, flow restricted etc) the InSpec Blender will switch into an autoflow mode in order to preserve the blend. The flag that drives this alarm is set in C_AUTOFLOW.

3.6.2.13 Rqd Flow Low 1

For the given stream percentages, a calculated minimum flow is derived. If this minimum value is greater than the currently requested flow in stream 1 then the associated required flow low alarm flag, C_RQD_FLOW_LOW1,that drives this alarm is set.

3.6.2.14 Rqd Flow Low 2

For the given stream percentages, a calculated minimum flow is derived. If this minimum value is greater than the currently requested flow in stream 2 then the associated required flow low alarm flag, C_RQD_FLOW_LOW2,that drives this alarm is set.

3.6.2.15 Rqd Flow High 1

For the given stream percentages, a calculated maximum flow is derived. If this maximum value is less than the currently requested flow in stream 1 then the associated required flow high alarm flag, C_RQD_FLOW_HI1,that drives this alarm is set.

3.6.2.16 Rqd Flow High 2

For the given stream percentages, a calculated maximum flow is derived. If this maximum value is less than the currently requested flow in stream 2 then the associated required flow high alarm flag, C_RQD_FLOW_HI2,that drives this alarm is set.

3.6.2.17 Leak Flow 1

If the required percent for stream 1 is zero but flow is seen in the stream then the C_LEAK_FLOW1 flag that drives this alarm is set.

3.6.2.18 Leak Flow 2

If the required percent for stream 2 is zero but flow is seen in the stream then the C_LEAK_FLOW2 flag that drives this alarm is set.

3.6.2.19 Ratio S DQTY1

This short term delta quantity alarm is used to indicate if the short term delta quantity over the previous period for stream 1 has exceeded the configured percentage change as configured in F_DQS_ALARM_PERC1. The flag register for this alarm is C_DQS_RATIO1.

3.6.2.20 Ratio S DQTY2

This sort term delta quantity alarm is used to indicate if the short term delta quantity over the previous period for stream 2 has exceeded the configured percentage change as configured in F_DQS_ALARM_PERC2. The flag register for this alarm is C_DQS_RATIO2.

3.6.2.21 Ratio L DQTY1

This long term delta quantity alarm is used to indicate if the long term delta quantity over the previous period for stream 1 has exceeded the configured percentage change as configured in F_DQL_ALARM_PERC1. The flag register for this alarm is C_DQL_RATIO1. By default this alarm is set to induce a controlled stop if triggered during a blend.

3.6.2.22 Ratio L DQTY2

This long term delta quantity alarm is used to indicate if the long term delta quantity over the previous period for stream 2 has exceeded the configured percentage change as configured in F_DQL_ALARM_PERC2. The flag register for this alarm is C_DQL_RATIO2. By default this alarm is set to induce a controlled stop if triggered during a blend.

3.6.2.23 Power Failure

When the InSpec powers up, if the system is not in the WAITING phase then a power failure has occurred during an operational phase. This sets the C_POWER_FAILURE flag register that drives this alarm.

3.6.2.24 Enable Failure

If required via the C_ENABLE_ENABLED register (0=OFF, 1=ON) register, the enable sequence occurs at the beginning of a batch in order to line up the field equipment (block valves) prior to blending. If the enable sequence times out/fails during this process the C_ENABLE_FAILURE flag register that drives this alarm will be set.

3.6.2.25 Zero Flow

The blender software repeatedly calculates the achievable flow. The Zero Flow alarm has a minimum and a maximum value. If the calculated flow, recorded in F_ACHIEVABLE_FLOW is outside of these minimum/maximum values then the alarm will be triggered.

3.6.2.26 Trim 1 Inhibited

If any alarm is inhibiting trim then the C_TRIM_INHIBITED alarm flag that drives this register will be set.

3.6.2.27 Trim 1 Unob

The Trim PID control repeatedly checks what trim target is realistically achievable. If this goes beyond what is achievable then the C_TRIM_UNOB flag register that drives this alarm is set.

3.6.2.28 VCF Range Out1

If the VCF stream 1 calculations are out of range the C_VCF_RANGE_OUT1 flag register that drives this register is set.

3.6.2.29 VCF Range Out2

If the VCF stream 2 calculations are out of range the C_VCF_RANGE_OUT2 flag register that drives this register is set.

3.6.2.30 SD Card Memory Min

This alarm is to flag when the memory available on the SD card has become critical. The minimum value for this is L_SD_MEMORY_MIN. When this alarm is triggered the batch data on the SD card is being automatically deleted in order to make space for new data.

3.6.2.31 SD Card Memory Low

This alarm is to flag when the memory available on the SD card is becoming low but is not yet critical. The minimum value for this is L_SD_MEMORY_LOW.

3.6.2.32 REPORT NUM. MAX

This alarm warns you when the current batch folder has produced the maximum amount of allowable report files (per folder). This is 30 and as each report is created, the I_REPORT_NUMBER counter register increments.

3.6.2.33 IO COMMS FAILURE

This alarm indicates if a remote Inspec connection has failed. The following register is set when this a comms failure occurs, C_IO_FAILURE. By default this is an emergency stop alarm.

3.6.2.34 IO SOFTWARE IS INCOMPATIBLE

The blender software and the remote Inspec IO software are released as a pair. If the versions or expected application software is incorrect, the following register is set which triggers this alarm - C_COMPAT_FAILURE. By default this is a warning alarm.

3.6.2.35 TRIM 1 OFF

This alarm is set when trim 1 has been on but is then turned off. It is driven when C_TRIM1_ON goes to zero after being on.

3.6.2.36 TRIM 2 OFF

This alarm is set when trim 2 has been on but is then turned off. It is driven when C_TRIM2_ON goes to zero after being on.

3.6.3 DELETE CONFIG ALARM

This option allows you to delete any of the configured alarms from the available slots. If you confirm the wish to delete an alarm the slot will become empty. E.g., if you scroll to alarm 5/60 and delete the alarm and then go back into the CONFIG ALARMS page you will see that position 5 now simply contains the text EMPTY SLOT.

3.6.4 SCROLL SETUP

This item allows you to configure whether or not you want the auto scroll feature on in the alarms menu and what the time out period is between each displayed item.

3.6.5 ALARM OUTPUT

The register 'C_ACTIVE_ALARM' is used to send a general output signal to indicate when there is an active alarm. The Alarm Setup menu (see above) allows for individual alarms to be masked

or included. The output signal itself can be held steady or it can toggle between being on/off. This menu allows you to choose whether you want the output signal to be steady or toggling. The behaviour of the output state is controlled in the 'C_ALARM_OUT_STEADY' register, where 1 = Steady Output and 0 = Toggle Output.

3.7   LEDS

Figure 2 -   Blender LEDs

There now follows a short description of the LEDs as shown in the above diagram.

- RESETTING: ALL OFF
- WAITING: ALL OFF
- ENABLE: BLUE STEADY
- CHECKING: BLUE STEADY
- LINEUP   BLUE STEADY
- STARTING: BLUE STEADY
- BLEND_ENABLE   GREEN STEADY
- AWAITFLOW   GREEN STEADY
- RAMPUP: GREEN STEADY
- RAMPDOWN: GREEN STEADY
- BLENDING: GREEN STEADY
- LOADING: GREEN STEADY
- WILDSTREAM: GREEN STEADY
- LINEDOWN_STOP   RED STEADY
- LINEDOWN_RESET   RED STEADY
- STOPPING: RED STEADY
- STOPPED: RED STEADY
- EM_STOPPING: RED FLASHING
- EM_STOPPED: RED FLASHING

3.7.2 ALARM LED

The Alarm LED shows the current highest level of alarm ranging from no alarms to controlled stop or emergency stop alarms (acknowledged or unacknowledged). If the LED is off it indicates no alarms, blue indicates a warning alarm and red indicates a controlled stop or emergency stop alarm. Blue (warning alarms) and red (controlled stop/emergency stop alarms) flash if the given alarm is unacknowledged. The following indicates the alarm led condition in accordance with what alarm types are currently active and whether they are acknowledged or unacknowledged.

ALARM TYPE	STATE	LED
NO ALARMS	N/A	OFF
WARNING ALARM	UNACKNOWLEDGED	BLUE FLASHING
WARNING ALARM	ACKNOWLEDGED	BLUE STEADY
CONTROLLED STOP ALARM	UNACKNOWLEDGED	RED FLASHING
CONTROLLED STOP ALARM	ACKNOWLEDGED	RED STEADY
EMERGENCY STOP ALARM	UNACKNOWLEDGED	RED FLASHING
EMERGENCY STOP ALARM	ACKNOWLEDGED	RED STEADY

Alarms can be acknowledged in a two-step process using the front panel down key (labelled 'ACK' beneath the key). Pressing this down key once when you are not in the menu takes you straight into the alarm page. All alarms will be listed, and you can step through them in a list to see which alarms are currently active (acknowledged or unacknowledged). Pressing this key again will acknowledge all the alarms.

This is a quick method of quickly accessing the alarms. Alternatively, you can of course browse the menu structure 'Control → Alarms→ Display Alarms'. Again, pressing the down ack cursor button in this display will acknowledge all alarms.

3.7.3 STREAM 1

By default, the stream LEDs indicate the current condition of the Blender's first two streams:

• All OK and NOT FLOWING: OFF

• FLOWING and OKAY: GREEN

• STREAM PROBLEM = RED

• LEAK FLOW / NO FLOW = RED FLASH (Leak flow occurs when a stream that should contain no flow appears to have flow)

3.7.4 STREAM 2

As for stream 1 but for stream 2.

Note: By default the Stream 1 and 2 LEDs look at C_STREAM_CONDITION1/2. These are configured in the registers P_LED_REF1/2. They can be setup to look at other streams beyond 1 and 2 if required.

3.8   REGISTER ACCESS

See common manual

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3.9   DISPLAY (FRONT PANEL)

The InSpec display consists of a 20x2 LCD display. The display operates within several modes. A full description of the controller interface is covered in the InSpec common manual. The most common screen that an operator will see during day-to-day use is the front display screen. This is a typical default screen shown during operation.

Note that the three-letter status indicator display is application specific. The following three letter abbreviations are used to denote the following Blender status conditions:

- RST = RESETTING
- WGT = WAITING
- STA = STARTING
- BLD = BLENDING
- STG= STOPPING
- STD = STOPPED
- ESG = EM STOPPING
- ESD = EM_STOPPED
- WLD = WILDSTREAM
- RMU = RAMPUP
- RMD = RAMPDOWN
- LNU = LINEUP
- LDS = LINEDOWN STOP
- LDR = LINEDOWN RESET
- LDG = LOADING
- ENA = ENABLE
- AFL = AWAITFLOW
- PSG = PAUSING
- PSD = PAUSED

The display menu item allows specific commonly required values to be selected for display. There is a detailed section in the common manual about the display options. Selecting any of the given display items will result in a prompt appearing to ask you which one of the twelve display slots you wish to assign the item to. Most of these items are self-explanatory by their title alone. Many items have sub options under each item.

3.10 DISPLAY ITEMS

3.10.1 DISPLAY TIME

3.10.1.1   CURRENT

Select this item to display the current time.

3.10.1.2   STARTING

Select this item to display the time at which the current or the last batch was started.

3.10.1.3   ELAPSED

Select this item to display the time that has elapsed since a batch was started. The elapsed time is calculated on a per batch basis.

3.10.2 DATE

Selecting this item will display the current date. The current format is used for display purposes. The date format is configurable via the system menu.

3.10.3 FINISH

Selecting this item will display the finish time for the last finished blend.

3.10.4 DISPLAY FLOWS

3.10.4.1 PROD FLOW,

3.10.4.1.1 REQUIRED,

This will display the required product flow.

3.10.4.1.2 GROSS

This displays the gross product flow.

3.10.4.1.3 NET

This will display the net product flow, compensated for VCF temperature corrections, etc.

3.10.4.1.4 MASS

This will display the mass product flow

3.10.4.2 STREAM FLOW

3.10.4.2.1 GROSS

This will display the gross flow. You are prompted to say which stream flow you wish to display.

3.10.4.2.2 NET

This will display the net flow. You are prompted to say which stream flow you wish to display.

3.10.4.2.3 MASS

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This will display the mass flow. You are prompted to say which stream flow you wish to display.

3.10.5 DISPLAY QUANTITIES

3.10.5.1 RQD PROD

This will display the required product quantity.

3.10.5.2 NET PROD

This will display the net product quantity.

3.10.5.3 GROSS PROD

This will display the gross product quantity.

3.10.5.4 MASS PROD

This will display the mass product quantity.

3.10.5.5 NET STREAM

This will display the net quantity for the prompted stream.

3.10.5.6 GROSS STREAM

This will display the gross quantity for the prompted stream.

3.10.5.7 MASS STREAM

This will display the mass quantity for the prompted stream.

3.10.6 DISPLAY PERCENT

3.10.6.1 RQD STR

This displays the required percent for the prompted stream.

3.10.6.2 CALC GROSS STR

This displays the calculated gross percent for the prompted stream.

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3.10.6.3 CALC NET STR

This displays the calculated net percent for the prompted stream.

3.10.6.4 CALC MASS STR

This displays the calculated mass percent for the prompted stream.

3.10.7 DISPLAY TEMP

3.10.7.1 TEMP PROD

This displays the current temperature for the product.

3.10.7.2 TEMP STR

This displays the current temperature for the prompted stream.

3.10.7.3 TEMP (KELVIN)

3.10.7.4 TEMP (KELVIN) PROD

This displays the temperature in Kelvin for the product.

3.10.7.5 TEMP (KELVIN) STREAM

This displays the temperature in Kelvin for the prompted stream.

3.10.8 USER FWA BLOCK

3.10.9 TRIM 1

3.10.9.1 LIVE TRIM

This displays the live input value for Trim 1.

3.10.9.2 TRIM TARGET

This displays the target value that Trim 1 is attempting to achieve.

3.10.9.3 FWA TRIM

Displays the flow weighted average value for Trim 1 input.

3.10.10 TRIM 2

3.10.10.1 LIVE TRIM

This displays the live input value for Trim 2.

3.10.10.2 TRIM TARGET

This displays the target value that Trim 2 is attempting to achieve.

3.10.10.3 FWA TRIM

Displays the flow weighted average value for Trim 2 input.

3.10.11 DISPLAY DENSITY

3.10.11.1 DENSITY PROD

Display the density value of the product stream (%).

3.10.11.2 DENSITY STR

Display the density content for the prompted stream.

3.10.11.3 FWA DENSITY PROD

Display the flow weighted average density value for the product.

3.10.11.4 FWA DENSITY STREAM

Display the flow weighted average density value for the prompted stream.

3.10.12 DISPLAY SULPHUR

3.10.12.1 SULPHUR PROD

Display the sulphur content of the product stream (%)

3.10.12.2 SULPHUR STREAM

Display the sulphur content for the prompted stream (%)

INTELLIGENT ACTION

3.10.13 DISPLAY VISCOSITY

3.10.13.1 VISCOSITY PROD

Display the viscosity of the product stream

3.10.13.2 VISCOSITY STR1

Display the viscosity of stream 1

3.10.13.3 VISCOSITY STR2

Display the viscosity of stream 2

3.10.14 USER VAR

The 'USER VAR' option refers to the possible existence of another analyser. By default the InSpec Blender accommodates viscosity, sulphur and density analysers. The 'USER VAR' option covers any other analyser input.

3.10.14.1 USER VAR PROD,

Display the USER VAR of the product stream

3.10.14.2 USER VAR STREAM,

Display the USER VAR for the prompted stream.

3.10.15 DISPLAY FREQUENCY

This item allows the frequency to be displayed. You will be prompted and asked for which frequency you wish to display and from which device, the master unit or (if configured) a remote IO Inspec. In both instances, you will be prompted for which channel, 1 or 2. The front panel menu does not currently allow the automatic display of frequencies derived from a remote IO module. To enable this, please use the display set up page on the web interface.

3.10.16 ADC

In all instances, here you will be prompted and asked for which value you wish to display and from which device, the master unit or (if configured) a remote IO Inspec. In both instances, you will be prompted for which channel. The front panel menu does not currently allow the automatic display of ADCs derived from a remote IO module. To enable this, please use the display set up page on the web interface.

3.10.16.1 INPUT

The ADC Input value is further broken down into the following display options

3.10.16.1.1 SCALED

Analogue input scaled to the user units.

3.10.16.1.2 0-1

Analogue input scaled 0 to 1.

3.10.16.1.3 RAW

Analogue input as an integer bit value direct from the hardware.

3.10.16.1.4 FWA

Flow weighted averaged analogue value in user scaled units.

3.10.16.2 OUTPUT

The ADC output value is further broken down into the following display options

3.10.16.2.1 0-1

Analogue output scaled 0 to 1.

3.10.16.2.2 RAW

Analogue output scaled as an integer bit value directly sent to the hardware.

3.10.17 DISPLAY SETUP

3.10.17.1 SCROLL SETUP
See common manual

3.10.17.2 DISPLAY ITEMS
See common manual

3.10.17.3 DISPLAY DEC
See common manual

3.10.17.4 ENGINEER DISPLAY
See common manual

3.10.17.5 BAR GRAPH 1
See common manual

3.10.17.6 BAR GRAPH 2
See common manual

3.11 RECORDS AND LOGS

3.11.1 GENERATE REPORT

This allows for a report to be produced instantaneously on the fly during a running batch. When the inspec is in Waiting, no reports can be produced.

3.11.2 PRINT

3.11.2.1 BATCH REPORT
See common manual

3.11.2.2 BATCH LOG
See common manual

3.11.2.3 ALARM PHASE LOG
See common manual

3.11.2.4 UCL PROGRAM FILE
See common manual

3.11.2.5 REPORT TEMPLATE
See common manual

3.11.2.6 REGISTERS
See common manual

INTELLIGENT ACTION

3.11.2.7 RECIPES

This prints outs the batch recipes configured within the instrument

3.11.2.8 SET PAGE LENGTH

See common manual

3.11.2.9 AUTO REPORT PRNT

See common manual

3.11.2.10 NUM. OF REPORTS

See common manual

3.11.3 DELETE BATCHES

See common manual

3.11.4 EMAIL

3.11.4.1 BATCH REPORT

See common manual

3.11.4.2 BATCH LOG

See common manual

3.11.4.3 ALARM PHASE LOG

See common manual

3.11.4.4 REGISTER LOG

See common manual

3.11.4.5 MODBUS LOG

See common manual

3.11.4.6 REBOOT LOG

See common manual

3.11.4.7 REPORT TEMPLATE

See common manual

3.11.4.8 ALL SYSTEM FILES

See common manual

3.11.4.9 UCL PROGRAM FILE

See common manual

3.11.4.10 CONFIG.TXT

See common manual

3.11.4.11 CONFIG.MODBUS.CSV

See common manual

3.11.4.12 CONFIG.ALARM.CSV

See common manual

3.11.4.13 CONFIG.CAL

See common manual

3.11.4.14 CONFIG.BIN

See common manual

3.11.4.15 AUTO REPORT MAIL

See common manual

3.11.4.16 AUTO LOG MAIL

See common manual

3.11.4.17 AUTO ALARM MAIL

See common manual

3.11.4.18 BACKUP IMAGE

See common manual

3.11.5 LOG SETUP

3.11.5.1 PERIOD

See common manual

3.11.5.2 FORMAT

See common manual

3.11.5.3 UNLIM BATCH HOUR

Sets the hour when a new batch directory is created when the system in running in unlimited size / continuous batch mode.

3.12 RECIPES

3.12.1 VIEW CURRENT

Selecting this option will display the current recipe that is selected.

3.12.2 VIEW RECIPES

This option allows you to scroll through and view the currently defined recipes.

3.12.3 ADD RECIPE

This option steps you through the prompted stages required to define a new recipe. The maximum number of recipes for the blender is 20. If this maximum number of recipes has already been reached, you will be informed that you are unable to add any more recipes.

The items which you are prompted for will only appear if they are configured in your system to be recipe entered. For example, the batch title prompt (see register C_BATCH_TITLE_PROMPT) can be either off, user entered or recipe stored. You will only be prompted if the associated prompt is recipe entered.

INTELLIGENT ACTION

3.12.4 INSERT RECIPE

This option behaves the same as add recipe, except you are prompted for where you would like to add the recipe, from 1 to C_NUM_RECIPES. If added before the last recipe, the subsequent recipes are all moved up one location and the number of recipes increases by one.

3.12.5 EDIT RECIPES

Any defined recipe can be edited from this menu option

3.12.6 DELETE RECIPE

Any defined recipe can be deleted from this menu option

3.13 OPERATION

3.13.1 STREAMS

Here you enter the number of streams in the Blender system.

3.13.2 WILDSTREAM

This item asks you to say whether or not the Blend Controller will contain a Wildstream. A Wildstream Blender is sometimes referred to as a "Flow responsive" or "Additive Injection" System. In a Wildstream Blender one of the streams is uncontrolled and its flow rate determines the rate of the Inspec controlled stream. In the Inspec the Wildstream is always stream 1.

3.13.3 UNITS

3.13.3.1 BATCH UNITS

These are the units that the blender uses to control the overall batch size, these can be either gross volume, net volume or mass

3.13.3.1.1 FLOW UNITS

These are the units that the blender uses to control the flow rates, these can be either gross volume flow, net volume flow or mass flow.

3.13.3.1.2 RATIO UNITS

These are the units that the blender controls stream ratios these can be either gross volume, net volume or mass.

3.13.3.1.3 VOLUME UNITS

Here the user sets up the volume units from the choice of "LITRES", "M3", "US GALLONS", "BARRELS", "OTHER". If they select 'other' they then have to enter in their own "LTR TO USER VOL" conversion factor for internal calculation purposes.

3.13.3.1.4 MASS UNITS

Here the user sets up the mass units from the choice of "KG", "TONNES (METRIC)", "LBS", "TONS (LONG TONS)", "OTHER". If they select 'other' they then have to enter in their own "KG TO USER MASS" conversion factor for internal calculation purposes.

3.13.3.1.5 TEMP UNITS

Here the user sets up the temperature units to either "CELSIUS" or "FAHRENHEIT".

3.13.3.1.6 DENSITY UNITS

Select either API, SG(RD) or KG/M3, enter the KGL TO USER DENS value and set density minimum and density maximum.

3.13.3.1.7 QTY TO FLOW

This is used to convert flow rates in 1 time base to flow per second or visa versa. Three options are given (60 (minute), 3600 (hour) and 86400 (day)). If these are not acceptable any other value may be input using the "Other" option.

3.13.4 VCF SETUP

The user is presented with a choice of whether there is to be no correction applied, linear correction or correction to the DIN 51757 / IP 200 / API 2540 / ASTM D 1250 standards.

If linear correction is selected the user then has to enter a linear factor and a reference temperature for each stream. This value is the increase per degree centigrade, for instance 0.01, which is 1% per DegC.

If the API2540/IP200 standard is selected the user will then have to enter the material type for the stream, selecting from "A CRUDE OIL", "B GENERALISED OILS", "C SPECIAL", "D LUBRICATING OILS"), "X GASES AND BITUMEN" and "Y PURE PRODUCTS", and then also enter a reference temperature for each stream. For some tables (SPECIAL and PURE PRODUCTS) a density at reference temperature will also be required.

3.13.5 PUMPS AND VALVES

3.13.5.1 ENABLE PUMPS

Here we are prompted to turn on global pump control.

3.13.5.2 SETUP PUMPS

Here we are prompted to decide which streams have pump control. Note that even if we select yes for all or any stream pump, it will not be actioned during a blend unless global pump control (see above) is also turned on.

3.13.5.3 P&V OFF IN STOPPED

A simple yes/no question asking if we want the pumps and valves to stop/close when the blender is stopped. If we say no then they will stop and close in the resetting phase before the Blender goes back into the waiting phase.

3.13.5.4 ENABLE B.VALVES

Here we are prompted to turn on global block valve control.

3.13.5.5 SETUP B.VALVES

Here we are prompted to decide which streams have valve control. We are also asked if there is a block valve in the product line.Note that even if we select yes for all or any stream or product valve, it will not be actioned during a blend unless global valve control (see above) is also turned on.

3.13.5.6 START SEQUENCE

Here we chose the order of the start sequence, do the valves open before the pumps start or, alternatively, do the pumps start before the valves open.

3.13.5.7 STOP SEQUENCE

As above, but in reverse during the stopping phase of the blend.

3.13.6 TRIM 1

Trim is used in blending operation where the streams have different properties, e.g. density, viscosity, etc, and it is important that the final product is of the correct quality. Trim is used to alter one stream's ratio to obtain the correct final product quality. One trim stream has its percentage changed to obtain the desired quality and the other stream reacts in sympathy to the trimming stream. The following configuration options are available for each trim.

3.13.6.1 TRIM SOURCE

Here we set the live source input for trim and are able to point the input to the live analyser value. As well as a live input (the operational mode), we can select simulated inputs for testing from simulated density, viscosity, sulphur or user var.

3.13.6.2 TRIM STREAM

Which stream is the trim stream? This is the stream that the remaining streams will react in sympathy with.

3.13.6.3 TRIM MODE

This trim feature presents three options:

On - This item turns the trim feature on. If the trim was not reset it starts off from where trim was last at. Note: Trim is automatically reset between blends.

Off - This item turns the trim mode off.

Reset - This item resets the current trim value/associated trim error. This is done automatically between blends.

3.13.6.4 TRIM DIRECTION

Here we select whether trim operates in normal or reverse mode.

3.13.6.5 TRIM LIMITS

Set the limits for trim by entering the following values.

RQD TRIM MIN

RQD TRIM MAX

TRIM MAX

3.13.6.6 TRIM REFS.

Set trim reference points, these are the registers that give the reference values for the trim direction detection.

3.13.6.7 TRIM INHIBITS

Set the start quantity that needs to accumulate before trim calculations become active.

3.13.6.8 TRIM INHIBIT QTY

The volume that needs to pass before trim becomes active.

3.13.7 TRIM 2

All of the same configuration options as above for Trim 1

3.13.8 DELTA VOLS

3.13.8.1 START QTY

This is the total batch quantity that must elapse before the percentage registers are calculated. This is used to help prevent early calculation errors due to uneven flows at the start and restart of batches.

3.13.8.2 D.SMALL QTY

This is the delta batch quantity used to calculate quantity over a small range of the batch.

3.13.8.3 D.LARGE QTY

This is the delta batch quantity used to calculate quantity over a large range of the batch.

3.13.8.4 DQS PERC LIMIT

Here you set the % limits that are to be applied to the short delta quantity alarms for each stream. When the short delta quantity exceeds this tolerance (+/-) the alarm is triggered.

3.13.8.5 DQL PERC LIMIT

Here you set the % limits that are to be applied to the short delta quantity alarms for each stream. When the short delta quantity exceeds this tolerance (+/-) the alarm is triggered.

3.13.9 AUX CONTROL

Auxiliary Control is primarily used in the blender to control motors for fast loop/mixing in the flow. Under European legislation motors must be controlled by a fleeting contact, with start being held low and pulsed high to start the motor, and stop being held high and pulsed low to stop the motor. Thus in the event of controller failure, the stop input would not be energised, therefore held low and therefore stopping and preventing the motor from starting.

On selecting this item you will be prompted for which auxiliary control you wish to configure, 1 to 5. On entering further, you will select whether the auxiliary control is initiated by status or flow and enter the auxiliary off delay, the signal fleet time, the start quantity that will elapse before the auxiliary control is activated, whether the auxiliary signal is deactived in the stopped phase and whether to reset the run time counter for the auxillary input. This value in seconds is held in registers L_AUX_RUNTIME1-5.

3.13.10 ENABLE INPUT

The enable input is a line up signal used to indicate that the entire system is ready for blending. This fail-safe feature can be configured to be on or off. If on a timeout period is entered. This is the period that the system waits for the enable signal to be received. This timeout period may vary from system to system.

3.13.11 DISCARD VOLUMES

A simple yes/no option to determine if volume should be discarded in non-operational system phases – waiting, enable, stopped and emergency stopped.

3.13.12 AVERAGING

3.13.12.1 ANALOGUE INPUTS

Averaged against gross, net or mass in either the product, stream 1 or stream 2. There is also an option to reset the current accumulated average.

INTELLIGENT ACTION

3.13.12.2 DENSITY

Setup averaging for density and select whether it is averaged against gross, net or mass product. There is also an option to reset the current accumulated average.

3.13.12.3 TRIM 1

Setup averaging for trim 2. Here you select if it is averaged against gross, net or mass product.

3.13.12.4 TRIM 2

Setup averaging for trim 2. Here you select if it is averaged against gross, net or mass product.

3.13.12.5 USER BLOCKS

Setup the result for one of the 10 generic FWA blocks. Here you select the source register for the block, the block title, the units required and whether it is averaged against the gross, net or mass of a specific stream or the product line. There is also an option to reset the current accumulated average.

3.13.13 TUNE

3.13.13.1 TUNE C.VALVES

This feature sets up the control valves for each stream. First you are asked to select which stream valve you wish to tune. You will then be asked to enter the gain value for the valve and the proportional, integral and derivative values for the PID tuning algorithm.

Select valve, gain, P term, I term D term, Valve cutback pos, valve min run pos, valve start pos.

3.13.13.2 TUNE TRIM PID

Gain, p term, I term, d term.

3.13.13.3 TUNE PID BLOCKS

Here you can configure the ten PID blocks, specifying whether they are on, their title, their units, total gain, P, I, D terms, their windup cycle, setpoint, source register and which phases the block is active in. Select each phase that the control is required to operate in. You can also enter the on value, whether it jumps when off to a user entered off value and finally what the minimum and maximum values for this control can be.

3.13.13.4 AWAIT FOR FLOW

You will be prompted for whether you wish to wait for flow or not? This is a useful feature if PD pumps are in use and flow has to be waited for.

3.13.13.5 RAMP UP

You will be prompted to set the ramp up rate in QTY/S?

3.13.13.6 RAMP DOWN

You will be prompted to set the ramp down rate in QTY/S?

3.13.13.7 STREAM MIN/MAX

You will be prompted to set the minimum and maximum flow rates for each stream.

3.13.13.8 DRIBBLE RESET

Confirm with yes if you wish to reset the self-learned dribble value for the current recipe? NOTE: There is a dedicated dribble value for each recipe. If there are no recipes currently defined then it will default to and reset the value associated with register F_DRIBBLE_QTY1.

3.13.14 FIELD S ETUP

3.13.14.1 ADC SETUP

You will be prompted and asked if the ADC channel you wish to configure is on the master unit or (if configured) a remote IO Inspec. You will then be prompted for which ADC channel (1-3)

This menu item allows the ADC inputs to be scaled. You will be prompted for the min and a max scaling value and the min and max alarm threshold values for the selected ADC, 1 to 3.

3.13.14.2 DAC SETUP

You will be prompted and asked if the DAC channel you wish to configure is on the master unit or (if configured) a remote IO Inspec. You will then be prompted for which DAC channel (1-2). You will then enter the source register for the DAC and the minimum and maximum value that is permitted.

3.13.14.3 FLOW METERS

Here you setup and choose the flow input type for each meter. Select from either loopback, Pulse or Modbus. You then select whether the meter flow is in gross, net or mass. If the input type is loopback you will be asked for a slope value, if you choose pulse then you will now have to enter the meter factor and the cut-off and damping values.

3.13.14.4 TEMPERATURE STREAM

First you will be prompted for which stream temperature you wish to configure. Select the temperature source register and then enter the damping factor for the temperature input.

3.13.14.5 DENSITY STREAM

First you will be prompted for which stream density you wish to configure. Select the density source register and then enter the damping factor for the density input.

3.13.14.6 VISCOSITY STREAM

First you will be prompted for which stream viscosity you wish to configure. Select the viscosity source register and then enter the damping factor for the viscosity input.

3.13.14.7 SULPHUR STREAM

First you will be prompted for which stream sulphur you wish to configure. Select the sulphur source register and then enter the damping factor for the sulphur input.

3.13.14.8 USRVAR STREAM

First you will be prompted for which stream usrvar you wish to configure. Select the usrvar source register and then enter the damping factor for the usrvar input.

3.13.14.9 DUAL VISCOSITY

This is where you set up field input devices for dual viscosity referral. You are prompted to enter whether you wish to use kinematic or dynamic calculations before selecting the source inputs for the viscometers, the densitometers and temperature inputs You then enter the 3 reference temperatures. In addition to this you are also asked to enter the time (in seconds) to collect data for viscosity referral and the minimum temperature delta that must be present for valid referral calculations to take place.

Note: Dynamic viscosity measures the force needed to overcome internal friction in a fluid. kinematic viscosity is the measure of a fluid's inherent resistance to flow when no external force, except gravity, is acting on it.

3.13.15 SOURCE/PROMPT

3.13.15.1 Rqd Quantity,

Select whether you want the batch quantity to be off or prompted as user entered, recipe stored or unlimited (continuous blend).

3.13.15.2 Rqd Percents,

Select whether you want the batch percents to be off or prompted as user entered, recipe stored, density derived, sulphur derived, viscosity derived or other derived. In the case of the density, sulphur or viscosity options you will be asked to enter a target value for the chosen option. This will adjust the percents accordingly to try and meet the requested target.

3.13.15.3 Rqd Flow,

Select whether you want the batch percents to be off or prompted as user entered, recipe stored or to maximise the flow rate with auto flow.

3.13.15.4 Recipe,

Select whether you want the recipe prompt to be on or off. If it is on you will be taken through the prompts that have been selected as 'recipe stored'.

3.13.15.5 Batch Title,

Select whether you want the batch title prompt to be off, user entered at the start of a batch or recipe stored.

3.13.15.6 Batch ID

Select whether you want the batch ID prompt to be fixed or user entered. If fixed, the same ID is used for each batch and an incremental suffix is added to each batch directory name.

3.13.15.7 Start Prompt,

Select whether you want the batch prompt off or to be prompted at the start of a batch.

3.13.15.8 TRIM 1 ENABLE

Select whether you want the trim enable prompt to be recipe stored, fixed on or user Entered.

3.13.15.9 TRIM 2 ENABLE

Select whether you want the trim enable prompt to be recipe stored, fixed on or user entered.

3.13.15.10 TRIM 1 STREAM

Select whether you want the trim enable prompt to be recipe stored, fixed on or user entered.

3.13.15.11 TRIM 2 STREAM

Select whether you want the trim enable prompt to be recipe stored, fixed on or user entered.

3.13.15.12 TRIM 1 TARGET

Select whether you want the trim enable prompt to be recipe stored, fixed on or user entered.

3.13.15.13 TRIM 1 MAX

Select whether you want the trim enable prompt to be recipe stored, fixed on or user entered.

3.13.15.14 TRIM 2 TARGET

Select whether you want the trim enable prompt to be recipe stored, fixed on or user entered.

3.13.15.15 TRIM 2 MAX

Select whether you want the trim enable prompt to be recipe stored, fixed on or user entered.

3.13.15.16 MSD DENSITY

Select whether you want the batch density prompt off, user entered or recipe stored.

3.13.15.17 MSD VISCOSITY

Select whether you want the batch viscosity prompt off, user entered or recipe stored.

3.13.15.18 MSD SULPHUR

Select whether you want the batch sulphur prompt off, user entered or recipe stored.

3.13.15.19 MSD USRVAR

Select whether you want the batch other prompt off, user entered or recipe stored.

3.13.15.20 CUSTOM PROMPTS

Configure one of 12 custom prompts.

3.13.15.21 PID BLOCKS

Enable and configure one of the ten PID block prompts.

3.13.15.22 REPEAT BATCH

Select whether you want the batch repeat prompt on or off.

3.13.16 MANUAL OPTIONS

In this menu, you select which items you want to be able to modify via the 'Manual' menu during a blend. A similar menu exists in the web interface to direct the available options on the web page's manual interface.

Flow, Quantity, Ratios, Trim 1 Target, Trim 1 Enable, Trim 2 Target, Trim 2 Enable, Densities, Viscosities, Sulphurs, Uservars, Density Target, Viscosity Target, Sulphur Target and Pidblocks.

3.14 SECURITY

3.14.1 LOGIN USER

3.14.2 LOGOUT

3.14.3 WHO AM I?

3.14.4 SECURITY TIMEOUT

3.14.5 ADD USER

3.14.6 EDIT USER

See common manual

3.15 SYSTEM

The system menu is covered in the common manual.

3.15.1 INSPEC ID

See common manual

3.15.2 SET DATE / TIME

See common manual

INTELLIGENT ACTION

3.15.3 GMT OFFSET

See common manual

3.15.4 DATE FORMAT

See common manual

3.15.5 NTP SETUP

See common manual

3.15.6 EMAIL SETUP

See common manual

3.15.6.1 SERIAL PORTS

See common manual

3.15.6.2 MODBUS TCP SLAVE

See common manual

3.15.6.3 MODBUS TCP MASTER

See common manual

3.15.6.4 IP SETTINGS

See common manual

3.15.6.5 USER COMMANDS

See common manual

3.15.6.6 I/O

See common manual

Section 4: **BLENDER IO**

This table shows the InSpec Blender's relay connections:

	Terminal	I/O Description	Default Duty
Plug 1 (Relay)	1	Common	
	2	Normally Open	
Plug 2 (Relay)	1	Common	
	2	Normally Open	
Plug 3 (Relay)	1	Common	Auxiliary Start/On Signal
	2	Normally Open	
Plug 4 (Relay)	1	Common	Auxiliary Stop/Off Signal
	2	Normally Open	

Plugs 1 to 4 - Relay Connections

	Terminal	I/O Description		Default Duty
	1	0V (+24V DC GND)		
	2	+24V DC Supply		
	3	Digital I/O Point No.8		General Alarm Output
	4	Digital I/O Point No.7		
	5	Digital I/O Point No.6		Enable/Interlock
	6	Digital I/O Point No.5		Emergency Stop
	7	-	Pulse Input No.2	Flow Meter Stream 2
	8	+		
	9	-	Pulse Input No.1	Flow Meter Stream 1
	10	+		
	11	-	Analogue Output No.2	Control Valve 2
	12	+		
	13	-	Analogue Output No.1	Control Valve 1
	14	+		
	15	-	Analogue Input No.3	Analyser
	16	+		
	17	-	Analogue Input No.2	Temperature Stream 2
	18	+		
	19	-	Analogue Input No.1	Temperature Stream 1
	20	+		

This table shows the terminal 3 block connections for the InSpec Blender Plug No.6

Plug 6 Connections – Power, Digital, Pulse, Analogue

The InSpec blender IO is defaulted as follows.

4.1 ANALOGUES

4.1.1 ANALOGUE INPUTS

Analogue Input 1 = Temperature Stream 1

Analogue Input 2 = Temperature Stream 2

INTELLIGENT ACTION

Analogue Input 3 = Analyser

4.2 ANALOGUE OUTPUTS

Analogue Output 1 = Control Valve 1

Analogue Output 2 = Control Valve 2

4.3 PULSE INPUTS

Pulse input 1   = Flow Meter Stream 1

Pulse input 2   = Flow Meter Stream 2

4.4 DIGITALS

4.4.1 DIGITAL OUTPUTS

(Note: the last 4 digitals (5,6,7 and 8) can act as either inputs or outputs. Hence digital 8 is assigned as a general alarm in the output listing below).

1 =

2 =

3 = Auxiliary Start/On Signal

4 = Auxiliary Stop/Off Signal

8 = General Alarm

4.4.2 DIGITAL INPUTS

5 = Emergency Stop

6 = Enable/Interlock

Section 5: **BLENDER OPERATION**

5.1 A TYPICAL BATCH

Below is a typical batch profile, it does not include displacement, flushing or any manual adjustments to the batch.
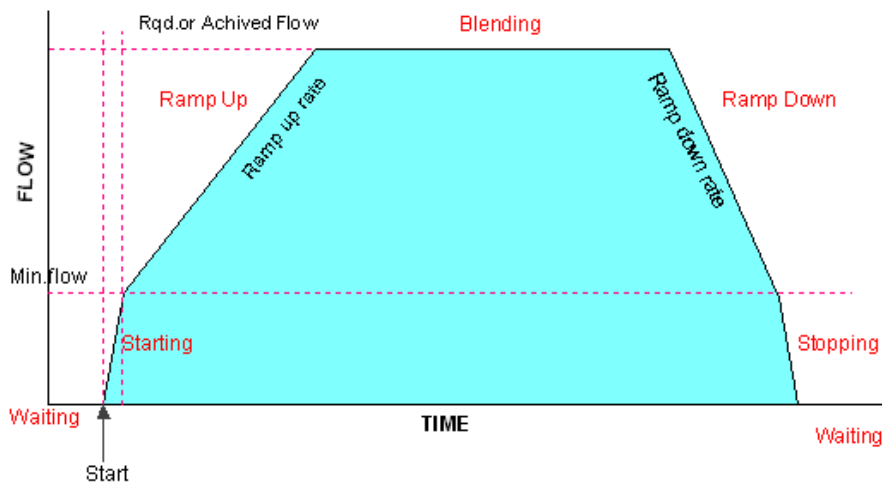

Figure 1 - A typical Batch profile

5.1.1 WAITING PHASE

This is initial phase before a batch starts. The system is prevented from starting a new batch when not in this phase. Once a batch has been completed the blender will automatically return to this phase.

5.1.2 STARTING PHASE

When the blender starts, the control valves will jump to their starting positions, then they will rapidly open until the flow rate has increased above the flow cut-off level. This happens until the flow minimum, (called flow cut-off) is reached. When flow is below the flow cut-off the blender assumes that there is no flow.

5.1.3 RAMP UP PHASE

After achieving the flow cut-off level, the blender will slowly "Ramp Up" at a predetermined rate until it reaches or approaches the desired or maximum achievable flow rate. This is done so that the blender is best able to maintain the required stream ratios while the flow rate is increasing.

5.1.4 BLENDING PHASE

Once the flow rate has reached its target upper limit, the blender will control the flow at this level until it approaches the end of the batch, assuming there are no process problems.

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5.1.5 RAMP DOWN PHASE

Once approaching the end of the batch the system will attempt to ramp down at a predetermined rate so that the desired batch quantity is achieved.

5.1.6 STOPPING PHASE

Once the flow drops below the flow cut-off the system will rapidly stop the flow, and then turn off all the field equipment. It is the transitional phase before the stopped phase.

5.1.7 STOPPED PHASE

The Stopped phase indicates that the system has come to a controlled pause during a batch. The batch may be continued by again starting the batch, or can be terminated by resetting the batch.

5.1.8 EM. STOPPED PHASE

The Em.Stopped phase indicates that the system has emergency stopped during a batch due to some serious or dangerous condition. Once the problem has been cleared the batch may be continued by again starting the batch, or can be terminated by resetting the batch.

5.1.9 LOADING PHASE

Loading phase indicates that the batch is not a blend but a controlled load of a single stream.

5.1.10 RESETTING

The resetting phase occurs automatically once a blend finishes. It can also be selected manually from the menu to stop an existing blend. It is the transitional phase before the waiting phase.

5.1.11 EM. STOPPING PHASE

This phase initialises an emergency stop. It is a transitional phase before Emergency stopped.

5.1.12 WILDSTREAM PHASE

The Wildstream phase will only ever occur within a "Wildstream Blender". This is a specific variant of the InSpec Blender. The flag register C_WILDSTREAM determines the blender type. If set to 1 the InSpec is a Wildstream Blender, else it is a normal Blender.

A Wildstream is a stream that is not controlled by the InSpec and as such a Wildstream blender can never enter the phases of BLENDING or LOADING. Instead the Blender enters the Wildstream phase. In Wildstream, the stream that is not controlled by the InSpec regulates the total flow of the blender, the InSpec uses the Wildstream flow rate to calculate the other stream flow rate using the required ratios.

5.1.13 ENABLE PHASE

The enable phase waits for a fail-safe signal before proceeding to the Lineup phase. The waiting period is determined by an enable timeout value (in register C_ENABLE_TIMEOUT_VAL). If the timeout period is exceeded and enable is activated the enable failure alarm will come on. By default this alarm is configured to cause an emergency stop. This enable safety feature can be activated or deactivated. If the feature is off the C_ENABLE_FLAG register is automatically set to 1 and the phase transition from enable to Lineup occurs immediately.

5.1.14 LINEUP PHASE

This is a transitory phase, unless pumps and valves are configured. If they are, the pump and valve priming sequence, with any configured delays, occurs during this phase.

5.1.15 LINEDOWN PHASE

This is a transitory phase, unless pumps and valves are configured. If they are, one of the following phases is used. pump and valve sequence closes, with any configured delays. during this phase.

5.1.16 LINEDOWN STOP

This is a transitory phase, for when pumps and valves are configured. In this phase the Inspec is stopping and awaiting the pumps and valves to be closed. It remains in this phase during the transition.

5.1.17 LINEDOWN RESETTING

This is a phase prior to reset. The full reset command is issued once the pumps and valves have closed.

5.1.18 AWAITFLOW PHASE

The Awaitflow phase waits for flow before the blender begins ramping up at the start of a batch. This feature is configurable via the tune menu. If set to 0 (off), the blender will ramp immediately, otherwise if the feature is set to 1 (on), the blender will wait for flow before ramping up begins. This phase is useful in a system where pumps are being started after the blender has been started, for instance when backpressure on PD pumps is undesirable.

5.2 CONTROLLING A BATCH

5.2.1 STARTING A BATCH

A new batch may be started whenever the unit's phase currently is "Waiting" at the bottom left of the display. To start blending select the START button, or select start from the Menu system. As an alternative you could use an external a SCADA system to start the blender.

If you use the front panel, you will then be asked various questions before starting the batch depending upon the configuration of the batch prompts and recipes.

5.2.2 STOPPING A BATCH

The batch will automatically stop once the required batch quantity has been delivered. To stop the blend manually use the control panel brought up by touching the bottom left screen area and touch STOP.

To stop the blender manually select the START button, or select start from the Menu system, you can also stop the blender from a SCADA system. The blender then attempts to perform a stop in a controlled manner in order to maintain the required stream ratios until all flow is stopped.

If an emergency stop is performed the blender will shut down as quickly as possible. This can happen due to conditions raised in the blender, manually via the menu or via an external input from a SCADA system.

While the unit is in either the Stopped or Emergency Stopped states the user may reset the batch by using the Reset option from the control menu or continue until the batch completes by restarting with the control menu Start. If the batch is reset it means the batch is terminated early.

When the batch completes, a compensation factor based on the difference between the delivered and required volume is calculated for the recipe or flush and is stored in the associated register. This figure is then used to determine the end of the next batch. This facility may be turned off and fixed at the present values by setting register c_lock_dribble to one.

5.2.3 RESETTING A BATCH

After a batch has been either stopped or emergency stopped, the batch can be terminated before completion by issuing a reset command.

5.3 THE EMERGENCY STOP CONDITION

In certain situations, the blender will shutdown as quickly as possible, this is termed an "Emergency Stop". The system switches off the pumps, closes the control and block valves, disables any other devices and sets the phase to Emergency Stop.

Several conditions can cause an emergency stop these are as follows,

- The emergency stop button is activated (if fitted).

- A control valve is wide open but no flow has been detected (an alarm, if configured).

- Another fatal alarm exists (see alarms later, if configured).

- Release of the safety interlock (if fitted).

- SCADA command.

5.4 MID-BLEND ADJUSTMENTS

During the blending operation, the operator may make some minor adjustments to the batch parameters via the menu. These include stream ratios, product flow rate, batch volume and trim target. If any parameter is manually altered, a warning will be printed on the batch report indicating a mid-blend adjustment has taken place.

5.5 AUTOFLOW

Autoflow attempts to achieve either the users requested flow rate or the maximum achievable flow rate for a specific blend recipe ratio.

Due to the stream interaction on the total flow setpoint, Autoflow is a combination of the two parts a and b below.

5.5.1 AUTOFLOW PART A)

If the user enters a requested flow rate then:

1. The minimum achievable flow rate is calculated from recipe ratios and the stream minimum flow rates. If the users requested flow rate is below the minimum achievable flow rate, then this minimum is used as the target setpoint.

2. The maximum achievable flow rate is calculated from recipe ratios and the stream maximum flow rates. If the users requested flow rate is above the maximum achievable flow rate then this maximum is used as the target setpoint.

3. If the maximum achievable flow rate is less than the minimum achievable flow rate the blend is flagged as impossible and will not be allowed to start.

If the user selects AUTOFLOW rather than enters a requested flow rate then the maximum flow from 2 above is used, unless 3 above is true where the blend cannot be started.

5.5.2 AUTOFLOW PART B)

This second part becomes active if the valve position of any one of the streams valves opens to a user defined maximum limit, say 90%, (only one stream is ever in this condition at a time). In this condition the stream that reached the 90% limit is considered to have some form of restriction (this could be either up or down stream of the valve). The flow rate of this restricted stream is then used to

calculate a dynamic maximum flow rate for the product based on the ratios. This dynamic maximum flow rate is then used as a the target setpoint.

Typically when the user selects AUTOFLOW rather than enters a flow rate the system eventually uses part b as the maximum flowrate, as the maximum flowrate in part a 2 is not often attainable unless the system has been commissioned carefully with realistic stream limits.

5.6   TRIM

Trim is used in blending operation where the streams have different properties, e.g. density, viscosity, etc, and it is important that the final product is of the correct quality. Trim is used to alter one stream's ratio to obtain the correct product quality of one property. One stream has its percentage increased while the other has its percentage decreased to obtain the desired quality.

The most commonly properties used are density and viscosity, but depending on the meter used, trim can be pointed at any input reading, so RVP, colour or any other accurately measurable data can be used. There is a maximum adjustment for each stream, which will generate an alarm if it is reached.

Trim can be entered into a recipe or can be entered at the start of a batch. This is configurable from the trim configuration menu option.

5.6.1   CONTROL VALVE PID

The flow control valves use a PID algorithm to achieve the desired flow rate. They do this by measuring difference between the desired flow rate and the actual flow rate, and the greater the difference the faster the valve is opened or closed. As the difference decreases, the valve movement rate slows, to minimise overshoot and oscillation around the desired flow rate. The PID calculates the adjustment according to the normal PID three-term control algorithm, then multiplies this by an overall gain and finally adds this to the output variable to control the valve.

5.6.2   PID CONTROL (USED IN TRIM AND CONTROL VALVE FEEDBACK)

A PID (proportional-integral-derivative) controller is a 3-term control loop feedback mechanism used in industrial control systems. In an industrial process a PID controller attempts to correct the error between a measured process variable and a desired set point by calculating and then outputting a corrective action that can adjust the process accordingly.

The PID controller calculation (algorithm) involves three separate modes, the Proportional mode, the Integral mode and the Derivative mode. The proportional mode determines the reaction to the current error, the integral mode determines the reaction based on recent errors and the derivative mode determines the reaction based on the rate by which the error has been changing. The weighted sum of the three modes is outputted as a corrective action to the control valve/trim set point.

5.7   TEMPERATURE VOLUME CORRECTION

Volume correction can be either linear correction or by the API2540 / IP200 tables.

5.7.1   LINEAR CORRECTION

This requires a calculated or known Alpha value to be entered for each stream. A reference temperature and a density will also be required for correct mass and water calculations. The system then uses this Alpha to calculate out the Volume Correction Factor (VCF) to apply to the streams uncorrected volume giving the corrected volume.

5.7.2 API2540/IP200 CORRECTION

The API254, IP200-1, IP200-2 and DIN 51757 uses special formulas for converting densities to reference temperature densities and for converting observed volumes to reference temperature volumes.

The categories are as follows:

Table A General Crude Oils.

Table B General Products: Heating, Fuel oil, Kerosene, Diesel, Jet Fuels, Petrol's, Naphthalene's, etc.

Table C Special APPS

Table D Lubricating Oils.

Table X   LGA and Bitumen

Table Y   Pure Substances

Using the Tables A B D and X the system can convert an observed density to a reference density and then be able to automatically calculate out the Alpha variable used for volume correction.

Table Y is for handling various pure substances which well defined characteristics, These characteristics are predefined within the table, so it is just a matter of selecting the pure product.

There is also a special category (Table C) that requires you to enter a calculated or known Alpha value and a reference temperature and density, used in the mass calculations.

For information regarding the formulas and calculation involved please refer to the following documents, (ASTM D 1250-80 Petroleum Measurement Tables - Volume correction factors, Volume X Background, Development and Program documentation) and (Institute of Petroleum - Petroleum Measurement Paper Number 3), DIN 51757.

5.8   BATCH QUANTITY TYPE

The blender allows the selection of the units that the batch quantity will be measured and controlled to. The batch quantity can be measured in raw volume (GROSS), corrected volume (NET) or mass.

5.9   FLOW TYPE

The blender allows the selection of the units that the flow will be measured and controlled to. The flow-rate can be measured in raw (GROSS), corrected (NET) or mass.

5.10 RATIO TYPE

The blender allows the selection of the units that the streams will be proportioned to. The ratio units can be measured in raw volume (GROSS), corrected volume (NET) or mass.

5.11 METER CONFIGURATION

The system allows for any combination of "NET volume", "GROSS volume" and "Mass" meters, though for this to work correctly you must have temperature correction enabled. It is also vital for the system to be provided with the current densities to perform the required conversions. This can be done by either providing a live density input or by manually entering the density.

5.12 RATIO ALARMING

5.12.1 PERCENTAGE CALCULATIONS

The system calculates the actual ratios for each stream over a small delta quantity (F_DQS_QTY), a large delta quantity (F_DQL_QTY) and over the entire batch, this excludes any manual ratio changes. The system then calculates the small percentages over these quantities in NET & GROSS volumes and MASS units.

From these values a deviation from the required (after being adjusted for trim) is calculated for each stream over small delta quantities, large delta quantities and the entire batch, giving a small delta quantity difference.

The delta quantity calculations do not start until the quantity f_ratio_inhibit_qty has passed, for accuracy purposes. A quantity of zero in f_ratio_inhibit_qty will disable this function.

5.12.2 RATIO ALARMS

The system triggers alarm flags on the stream percentage deviations once the alarm inhibit delay. It does this by comparing the differences with associated tolerance's, which are, small delta quantity difference tolerance's (f_dqS_alarm_perc, f_dqL_alarm_perc).

5.13 BATCH RECIPES

Batch recipes are a convenient method of quickly choosing and running a batch with pre-defined percentages, a particular recipe state pattern and trim values. You can define up to 50 recipes, but when first installed there are no default recipes. Only recipes with a name are recognised by the system. A recipe can be given a name up to 14 characters long to make identification easier. The blend constituents can be given grade names of up to 14 characters, these names are applicable to all recipes.

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Section 6: **Remote Control of the Blender**

The InSpec can be controlled remotely from an external computer by reading from and writing to registers via either the Allen-Bradley or the Modicon Modbus protocol links. For an explanation on what a register is, see the related sections in the InSight Manual, full details on each of the registers are provided later in this manual. The Modbus address of each register is given in the register list section of this manual. You can use these addresses in your Modbus driver to access the following registers. But it is now preferable to create your own table of Modbus addresses for both speed and future compatibility.

6.1   BATCH DETAILS

To provide minimum system control the following registers need to be accessed:

Set the batch details in the following registers.

- **f_rqd_qty** (Total required quantity in Batch units).
- **f_rqd_flow** (Requested flow-rate in Flow units).
- **f_rqd_percent**{1,2…etc} (Percentages per stream).

Other registers which might be required depending on the system configuration are as follows.

- **f_msd_density**{1,2…etc} (density per stream).
- **f_trim_max_perc** (Maximum amount of trim as a percentage).
- **f_rqd_trim_target** (Value to which you are trying to trim to).

6.2   BATCH CONTROL

To start, stop and reset batches, write to the register, **i_command** it can have any of the following values written to it. It is a WRITE only register.

- 1 = Start
- 2 = Stop
- 3 = Reset
- 5 = Emergency stop
- 6 = Stop & Reset
- 7 = Go (does not load data from a recipe when initiating the start of the batch)
- 9 = Generate Report

6.3   SYSTEM STATUS OR PHASE

To see the current system phase, read the register, **i_phase**, it can contain any of the follow values. This is a READ only register.

- 0 = Waiting
- 1 = Starting
- 6 = Stopping
- 7 = Stopped
- 8 = Emergency Stopping
- 9 = Emergency Stopped
- 10 = Resetting

- 13 = Blending
- 14 = Loading
- 15 = Wildstream
- 16 = Rampup
- 17 = Rampdown
- 18 = Lineup
- 19 = Linedown Stop
- 20 = Linedown Reset
- 21 = Blend Enable
- 22 = Awaiting flow
- 23 = Checking blend

6.4 BLENDER DETAILS

To give a more detailed picture of what the system is doing you can read a number of system parameters these may include:

• **f_flow_gross_p**	Product flow (GROSS).
• **f_flow_gross**_{1,2,..etc}	Flow (GROSS) per stream.
• **f_flow_net_p**	Temperature corrected (NET) product flow.
• **f_flow_net** {1,2,..etc}	Temperature corrected (NET) flow per stream.
• **f_flow_mass_p**	Product mass flow.
• **f_flow_mass** {1,2,..etc}	Mass flow per stream.
• **f_qty_gross_p**	Measured batch volume (GROSS).
• **f_qty_gross** {1,2,..etc}	Measured stream volumes (GROSS).
• **f_qty_net_p**	Temperature corrected (NET) batch volume.
• **f_qty_net** {1,2,..etc}	Temperature corrected (NET) stream volumes.
• **f_qty_mass_p**	Measured batch mass.
• **f_qty_mass**{1,2,..etc}	Measured stream masses.
• **f_tempc**{1,2,..etc}	Product and stream temperature readings in Celsius
• **f_tempf**{1,2,..etc}	Product & stream temperature readings in Fahrenheit
• **f_perc_gross**{1,2,..etc}	Calculated gross volume percentages per stream.
• **f_perc_net**{1,2,..etc}	Calculated net volume percentages per stream.
• **f_perc_mass**{1,2,..etc}	Calculated mass percentages per stream.
• **f_density**{1,2,..etc}	Density per stream and product.
• **f_viscosity**{1,2,..etc}	Viscosity per stream and product.
• **f_adj_percent**{1,2,..etc}	Percentages adjusted for trim per stream.

Exactly which registers to read and write will depend on the complexity and requirements of the control system.

Section 7: **REMOTE IO MODULE**

7.1   INTRODUCTION

The Master InSpec Controller can expand the capabilities of its core process application via expansion of the available Field IO. There is an additional InSpec application called the Remote IO (RIO) There are four Remote IO variants with a maximum slot expandability of up to 14 RIO Modules.

Using the web interface connected to the Master InSpec Controller access to the RIO is made via the IP address of the RIO unit. The RIO device can literally be remote in the field and connected to via the Master InSpec controller's web interface.

7.2   TYPE OF RIOS

There are 4 types of RIO available. The IO points and maximum number of RIO combinations are:

Type	Number of points	Max Modules	Static IP Default
DIO	8 input/outputs	6	192.168.92.100
Pulse	8 inputs	2	192.168.92.110
ADC	8 inputs	4	192.168.92.120
DAC	8 outputs	2	192.168.92.130

The remote capability of this IO can be used by the Master unit to enhance control or provide control for existing features. I.E., The Grab Output signal can reside on a remote digital.

7.3   INITIAL CONFIGURATION

Unlike the InSpec master base units (InSpec Sampler or InSpec Blender), there is very little to configure on the RIO device. The configuration and calibration of the actual RIO is done via the master unit's web interface. It is very helpful to conceptualise the InSpec RIO device as an add-on to the base unit.

7.4   ETHERNET

This is the most important configuration option for the InSpec RIO device. All the RIO field inputs coming into the device are communicated back to the Master unit. This is only possible if the Ethernet is configured on the same immediate network or another accessible network. The IO data is then communicated across the network link between the remote device and the base unit using Modbus Master TCP/IP. The parameters for this internal Modbus Master connection cannot be reconfigured by the user.

Once determined, the IP address of the RIO device needs to be entered into the master unit in one of the designated remote URL registers. When any of these registers contain data, it forces the master unit to attempt a connection. If successful, the IO data from the remote unit is then continually communicated to the base unit.

Section 8: **Maintenance and Troubleshooting**

8.1 DEVICE MAINTENANCE

8.1.1 DEVICE CLEANING

Use only a damp cloth to clean the instrument to avoid static electricity.

8.1.2 DEVICE REPAIR

CAUTION!	There are no user-serviceable parts within this product. Any attempt to repair the device may invalidate the warranty.
ATTENTION!	*Il n'y a à l'intérieur aucun élément susceptible d'être changé ou modifié par l'utilisateur. Toute tentative de réparation de l'appareil peut invalider la garantie.*

8.2 DEVICE TROUBLESHOOTING

Please observe all safety warnings and precautions at the front of this handbook.

8.3 SERVICE

8.3.1 RECOMMENDED SPARES

When requesting assistance or spare parts, please provide the instrument model and serial numbers to ensure that the correct options are supplied.

8.3.2 REPACKING FOR SHIPMENT

When shipping the device to Sensia for service or repair, we recommend the box-in-box technique. Place the instrument in all its original packaging, and then place this box inside a strong outer box, with about 60 to 100 mm internal cushioning material, closed and sealed by H-taping with pressure sensitive tape.

If the original packaging is not available, pack the module in electrostatic discharge (ESD) shielding packaging, and then place into static-free (low charging) packaging materials to avoid additional damage to your device.

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Appendix A: **Publisher Notes**

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