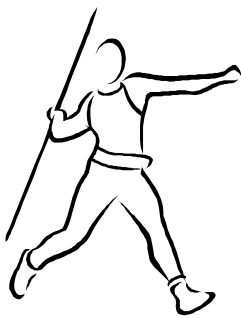


Functional Design Specification for Spin Test Rig



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Prepared for Prospective Client.

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Functional Design Specification Spin Test Rig

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Section 1 F.D.S

1.0 F.D.S Overview & Fundamentals

This F.D.S. is designed to describe the control philosophy of the Spin Test Rig as interpreted by Javelin Controls. The purpose of an F.D.S is to highlight and describe in detail each section of the test rig. Each section should then be debated and edited to the satisfaction of all interested parties. The finished document will describe the function and control philosophy of the test before material purchase and manufacture.

1.1 Test Rig Fundamentals

The test rig described in this document is designed to test seals and print a pass certificate when appropriate and record the test information on a PC for further analysis. The general design will automatically protect against set up or critical seal failures during test.

The test rig is designed to control the environment of the test by controlling motor speed, pneumatic pressures and monitoring temperatures and flows.

Various sensors and transducers monitor temperatures, pressures, speed and flows. All the information that the sensors produce will be saved by the Cimplicity system at a sample rate dictated by the operator/supervisor.

In the case of a seal or set up failure the test rig will automatically remove all forms of power to the rig. (See safety circuit).

1.2 F.D.S. to Manufacture Specification

Once the F.D.S. has been agreed by all parties it can form the specification for manufacture of the test rig.

Section 2 - Cimplicity System

Cimplicity is a PC based SCADA (Supervisory Control and Data Acquisition) system developed by GE Fanuc. It is designed to communicate in both directions, the PLC allowing the operator to view the test status or modify settings to suit individual tests requirements.

2.1 PC Requirements

PC Requirements

For the Cimplicity platform to work reliably we suggest a minimum hardware specification for the PC:-

- 1 Intel 2.0 Ghz processor.
- 2 256Mb fast access RAM.
- 3 40 Gb IDE Hard Disk. & 1 x Removable Caddies.
- 4 48 Speed CD/RW
- 5 1.44 Mb Floppy disk drive.
- 6 10/100 Network Card
- 7 64Mb ATI Radeon 7000 RTL Graphics Card
- 8 PS2 Mouse & Keyboard.

2.2 Communications.

The Alan Bradley PLC communicates to the PC in RS232 using the DF1 Protocol.

2.3 Software

2.3.1 Operating System

The operating system will be Windows XP professional.

2.3.2 Cimplicity HMI Plant Edition

We suggest using the latest revision of this software, namely Cimplicity Plant Edition, Version 6.0 – 75 tag system Runtime / Development with Allen Bradley DF1 communications Protocol. – This is currently being released with Service Pack 2.

The system has the ability to log data in a Microsoft SQL Compatible database format. The system can be scaled as needs arise, and is currently widely used in the manufacturing industry, where reliability is a foremost priority.

2.3.3 Cimplicity Web View

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Cimplicity Webview, is an additional license which can be purchased. It allows all of the Cimplicity Graphics to be served up as web pages and viewed using internet explorer on any networked computer.

The functionality can be restricted which would stop people from actually stopping and starting tests or adjusting set points – however you would get full real time information over the web as if you were sat at the test rig.

Cimplicity Webview can be a nice touch as a sales and marketing technique but has little practical use on day to day running of the rig.

2.4 Cimplicity Application

General

The Cimplicity Application will be developed in such a way that it can always be modified or added to, at a later date, using consistent looking graphics, point naming conventions and Scripting documentation.

Every screen (Graphic / mimic) will have a common title bar and alarm banner at the bottom of the screen.

Colour coding will be used to define certain states – e.g.
Red = alarm state,
Green = healthy.

There will be two access levels:–
OPERATOR and SUPERVISOR

Appropriate access is gained by logging on to the computer as OPERATOR (No Password) or SUPERVISOR (NT Specified Password).

When logged on as SUPERVISOR you will gain full access to all Seal Test Rig variables and be able to modify alarm limits and create new Seal Types.

2.4.1 Seal Type Test Defaults Screen.

The supervisor set up screen is password protected to restrict access to supervisors. The operators will be able to see the settings of test selected but will not be able to alter its values. The supervisor screen is designed to set limits for each type of seal. The supervisor will also be able set-up new seal types in this screen.

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- The minimum & maximum motor speed.
- The minimum & maximum permitted dynamic test pressure.
- The minimum & maximum permitted static test pressure.
- The minimum & maximum permitted flow for dynamic test.
- The minimum & maximum permitted flow for static test.
- The minimum & maximum gas consumption % dynamic test.
- The minimum & maximum gas consumption % static test.
- Set the time for dynamic test.
- Set the time static test.
- The maximum seat temperature differential from ambient probe 1 & 2.
- The maximum seat temperature differential air inlet outlet probe 3 & 4.
- The maximum motor current output.
- Operators names and pass words.
- Set the information sample rate. (see note 1)

Note 1:

High sample rates will produce large files that create their own problems in storage and usability. By producing low sample rates the file can lack meaningful data. To help with this quandary we suggest that we have a second file that will continuously monitor the test at high sample rate. This file will only be saved if the seal fails during a test. This high resolution file can then be examined for clues to the seal failure. As the operator changes the standard sample rate the Cimplicity screen will display the estimated file size in k bites.

Seal type Test Defaults will be stored as recipe files; there will be one file per seal type. Typically the parameters of the seal can be altered, and new seal types created using this page. Each Seal Type would contain information about both Static and Dynamic tests as follows:-

Functional Design Specification Spin Test Rig

16th April 2003
 13:02:45

Spin Test Rig - Seal Type Test Data

Seal Type	2" SS316	Info:	Seal Developed in US - Primary use For GB Market	ENTER
------------------	-----------------	--------------	--	--------------

Static Test Data:	Default	Min	Max	
Test Duration	3 Mins <input type="button" value="SET"/>	1 Min <input type="button" value="SET"/>	99 Mins <input type="button" value="SET"/>	
Test Pressure	12 Bar <input type="button" value="SET"/>	7 Bar <input type="button" value="SET"/>	14 Bar <input type="button" value="SET"/>	
Gas Consumption (Supply)		120 ml/min <input type="button" value="SET"/>	150 ml/min <input type="button" value="SET"/>	
Inboard Leakage		110 ml/min <input type="button" value="SET"/>	130 ml/min <input type="button" value="SET"/>	
Outboard Leakage		110 ml/min <input type="button" value="SET"/>	130 ml/min <input type="button" value="SET"/>	
Test Criteria (Gas Leakage)	> 80% <input type="button" value="SET"/>			
Motor Current			4.4 Amps <input type="button" value="SET"/>	

Dynamic Test Data:	Default	Min	Max	
Test Duration	14 Mins <input type="button" value="SET"/>	4 Mins <input type="button" value="SET"/>	99 Mins <input type="button" value="SET"/>	
Test Pressure	12 Bar <input type="button" value="SET"/>	7 Bar <input type="button" value="SET"/>	14 Bar <input type="button" value="SET"/>	
Total Gas Flow		120 ml/min <input type="button" value="SET"/>	150 ml/min <input type="button" value="SET"/>	
Inboard Leakage		110 ml/min <input type="button" value="SET"/>	130 ml/min <input type="button" value="SET"/>	
Outboard Leakage		110 ml/min <input type="button" value="SET"/>	130 ml/min <input type="button" value="SET"/>	
Test Criteria (Gas Leakage)	> 70% <input type="button" value="SET"/>			
Motor Speed	1350 Rpm <input type="button" value="SET"/>	1300 Rpm <input type="button" value="SET"/>	1400 Rpm <input type="button" value="SET"/>	
Temperature Channel 1	50 °C <input type="button" value="SET"/>	45 °C <input type="button" value="SET"/>	55 °C <input type="button" value="SET"/>	
Temperature Channel 2	52 °C <input type="button" value="SET"/>	47 °C <input type="button" value="SET"/>	57 °C <input type="button" value="SET"/>	
Motor Power Consumption	1.2 Kwh <input type="button" value="SET"/>	0 Kwh <input type="button" value="SET"/>	2.1 Kwh <input type="button" value="SET"/>	
Motor Current			4.4 Amps <input type="button" value="SET"/>	

Safety Circuit Tripped
Factory Air Pressure Low

Alarm
Acknowledge

The parameters can be viewed by the OPERATOR, however only SUPERVISOR would be able to change any of the data.

2.4.2 Operators Automatic set up screen

When a seal is to be tested the operator selects the seal type from drop down list. The parameters will be automatically loaded into the screen. The operator will then be required to fill in some details to enable the test to start.

	Parameters.	Description
1	Tester Name	Selected from a drop down list box. When selected the operator will be asked for a password.
2	Component No	Unique number used to describe seal.
3	Text Box	Free form text box for operator to describe any special properties of the seal under test. This text box is not a requirement for starting the test.
4	Direction of rotation	This has to be entered and confirmed by the operator.
5	Temperature probe selection.	The operator selects ambient probe differential and/of inlet outlet temperature differential.

Cimplicity checks that the rig is ready to start the test and will instruct the operator of any actions are necessary to facilitate the test i.e.

Functional Design Specification Spin Test Rig

- Is the safety circuit healthy?
- Is the factory air pressure OK?
- Is the set up screen complete and if not what hasn't been filled in?
- Is the motor healthy?

When all conditions have been met the “two hand start buttons” will be made available. Once the operator pressed the start buttons simultaneously the auto test will begin and data will start to be recorded.

Generally the test will start with a static for check “X” minutes. If the static test is successful the seal will automatically go to dynamic test. The dynamic test will check the seal for “X” minutes and providing the seal doesn't hit any critical limits the seal will complete the dynamic test and return to a static test for “X” minutes. With the full test cycle complete the resulting data will dictate a pass or fail. With the test complete all forms of motive force will be removed from test rig.

The criteria for pass/fail can be edited a supervise level to pass a seal that was only a marginal failed.

If any of the alarm points are exceeded the system crash stop and the fault will be described on the alarm banner.

This would typically look as follows:

Spin Test Rig - Test Start

16th April 2003
13:02:45

Seal Type	2" SS316	Test Information		Not sure about factory air quality	ENTER
Product ID	HG6566	SET			
Operator	M Hodge	SET			
Test Type	Auto	SET			

Parameter	Static Default	Static min	Static Max	Dynamic Default	Dynamic Min	Dynamic Max
Test Duration	3 Mins	1 Min	99 Mins	13 Mins	1 Min	99 Mins
Test Pressure	12 Bar	7 Bar	14 Bar	12 Bar	7 Bar	14 Bar
Gas Consumption (Supply)		120 ml/min	150 ml/min		120 ml/min	150 ml/min
Inboard Leakage		110 ml/min	130 ml/min		110 ml/min	130 ml/min
Outboard Leakage		110 ml/min	130 ml/min		110 ml/min	130 ml/min
Test Criteria (Gas Leakage)	> 80%			> 70%		
Motor Current			3.1 Amps			3.1 Amps

Direction	NOT CONFIRMED	SET
Safety Circuit	TRIPPED	Start Test
Factory Air Pressure	LOW	
Motor Healthy	HEALTHY	
Seal Clamp Pressure OK	NO	

Alarm

Safety Circuit Tripped

Factory Air Pressure Low

Alarm Acknowledge

Seal Types

Start Test Screen

Real Time Test Data

Test Trends

Fast Trends

Test Results

Trends Compare

Instrument Calibration

ABORT TEST

2.4.3 Operators manual start screen.

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The operator opens the “manual start up screen” in Cimplicity. The operator will then be required to fill in some details to enable the test to start.

	Parameters.	Description
1	Tester Name	Selected from a drop down list box. When selected the operator will be asked for a password.
2	Component No	Unique number used to describe seal.
3	Text Box	Free form text box for operator to describe any special properties of the seal under test. This text box is not a requirement for starting the test.
4	Direction of rotation	This has to be entered and confirmed by the operator.

Cimplicity checks that the rig is ready to start the test and will instruct the operator of any actions are necessary to facilitate the test i.e.

- Is the safety circuit healthy?
- Is the factory air pressure OK?
- Is the set up screen complete and if not what hasn't been filled in?
- Is the motor healthy?

2.4.3.1 Static test in manual

The static tests pressure will be imported from the last test, but can be adjusted by the operator to any value within the supervisor's set limits.

The static test duration will also be imported from the set up screen, and can be adjusted by the operator from 1 to 99 minutes.

When all required data is complete the two hand buttons will be enabled. When operator presses the start buttons simultaneously the static test will commence at set pressure and for the set duration. The time of the static test can be adjusted on the fly.

Two test stop buttons, one on the screen and one mounted local to the rig can aborted the test any time. If the pneumatic pressure, gas flow, motor current or motor speed alarm points are exceed the system crash stop and the fault will be described on the alarm banner.

2.4.3.2 Dynamic test in manual.

The dynamic tests pressure will be imported from the set up screen, but can be adjusted by the operator to any value within the supervisor's set limits.

The dynamic test duration will also be imported from the set up screen and can be adjusted by the operator from 1 to 999 minutes.

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When an operator presses the two hand start buttons simultaneously the dynamic test will commence at set pressure and for the set duration. The time of the static test can be adjusted on the fly.

Two test stop buttons, one on the screen and one mounted local to the rig can abort the test at any time. If the pneumatic pressure, gas flow, motor current or motor speed alarm points are exceeded the system will crash stop and the fault will be described on the alarm banner. Whenever a manual test is stopped the operator will be asked whether he/she wishes to save the results.

2.4.3.3 Seal Settle Manual Spin

Within the manual program there is provision to settle the seal by spinning it. Cimplicity will check that the seal is correctly set-up to allow the rig to spin i.e.

- Is the safety circuit healthy?
- Is the motor healthy?
- Is the pressure on the seal within set limits.

If all parameters are OK a manual motor two hand start buttons will be enabled. This button is located next to the rig. The motor will only spin while the button is depressed and the required conditions have been met.

2.4.4 Plant Graphic Screen with Alarm Banner

When an auto test has been started the operator has a choice of running screens; the first is an animated graphic of the test rig.

It will display the pneumatic pressures, air flows, probe temperatures, motor current and speed. The information will be displayed in text boxes located in the appropriate position on the graphic. The flow rate will be displayed in ml/min; the pressure will be displayed in bar, motor speed in RPM, motor current in Amps and temperatures °C.

The colour of the text will change to red should the value be out of range. Any alarm will also appear in an alarm banner at the bottom of the screen. This text box will give a fuller description of the alarm, its likely causes and set points.

2.4.5 Sensor & Transducer Screen.

The sensor & transducer screen displays actual values of the sensors and transducers along with alarm and set points. As with the first screen an alarm banner will also be displayed.

This will have an appearance as follows:-

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Spin Test Rig - Real Time Test Data

16th April 2003
13:02:45

Seal Type	2" SS316	
Product ID	HG6566	<input type="button" value="SET"/>
Operator	M Hodge	<input type="button" value="SET"/>
Test Type	Dynamic Auto	<input type="button" value="SET"/>

Test Information
Not sure about factory air quality
ENTER

Dynamic Test Data:	Target	Actual
Test Duration	14 Mins	4 Mins
Test Pressure	12 Bar	12.1 Bar
Total Gas Flow		670 ml
Inboard Leakage		340 ml
Outboard Leakage		330 ml
Test Criteria (Gas Leakage)	> 70%	48 %
Motor Speed	1350 Rpm	1345 Rpm
Temperature Channel 1	50 °C	48 °C
Temperature Channel 2	52 °C	48.5 °C
Motor Power Consumption	1.2 Kwh	1.15 Kwh
Motor Current		3.2 Amps

Alarm

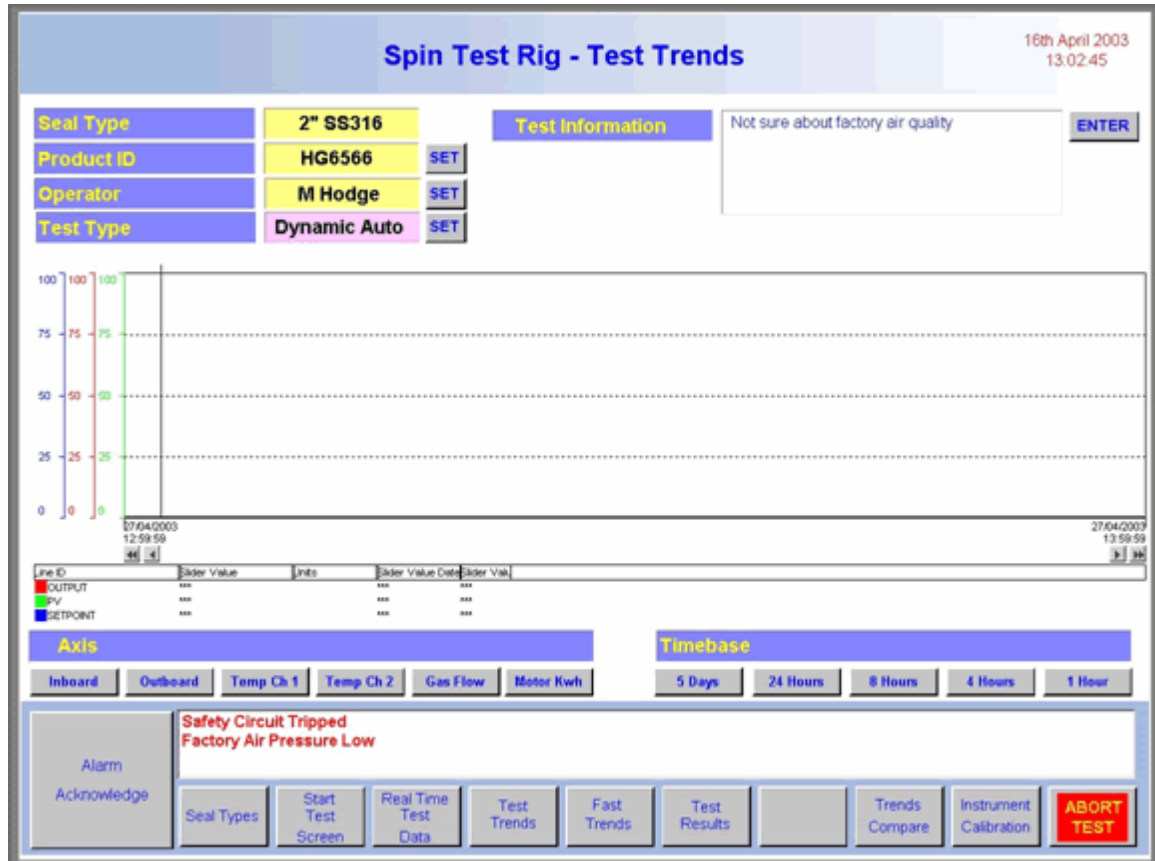
Safety Circuit Tripped
Factory Air Pressure Low

2.4.6 Current Trends

The current trends screen will show trends of all sensors and transducers. This screen will be generated in real time. The operator will be able to view the trends at different time intervals from 10 seconds to 20 minutes.

This will have the following appearance:-

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2.4.7 Test Result Screen

Once the test is completed, the test results page will display the following data:-

- Seal Type & Product ID
- Operator Name
- Test type
- Table of Test Result Data
- Gas Consumption each side / vs Total Gas Consumption
- Overall PASS / FAIL Decision.

Note: You will still have access to the trended data logged during the test.

Note also, that if the test finished prematurely, the last portion of the test will be captured in the high speed trends for further examination.

This screen will have the following appearance:-

Functional Design Specification Spin Test Rig

Spin Test Rig - Test Results 16th April 2003
13:02:45

Seal Type	2" SS316
Product ID	HG6566
Operator	M Hodge
Test Type	Static & Dynamic Auto

Static Auto Test Result Data:	
Test Duration	14 Mins
Total Gas Consumed Through Test	1202 ml
Inboard Gas Leakage as % of Total Gas Consumed	61 %
Outboard Gas Leakage as % of Total Gas Consumed	29 %

Dynamic Auto Test Result Data:	
Test Duration	14 Mins
Total Gas Consumed Through Test	1202 ml
Inboard Gas Leakage as % of Total Gas Consumed	62 %
Outboard Gas Leakage as % of Total Gas Consumed	28 %

Test Comments	<input type="button" value="ENTER"/>
Test ran ok - Extremely warm day so Ambient Air temp may have been high	

Test Verdict	Log Data
PASS	<input type="button" value="Save Test Data & Print Certificate"/>

Alarm
Acknowledge

Safety Circuit Tripped
Factory Air Pressure Low

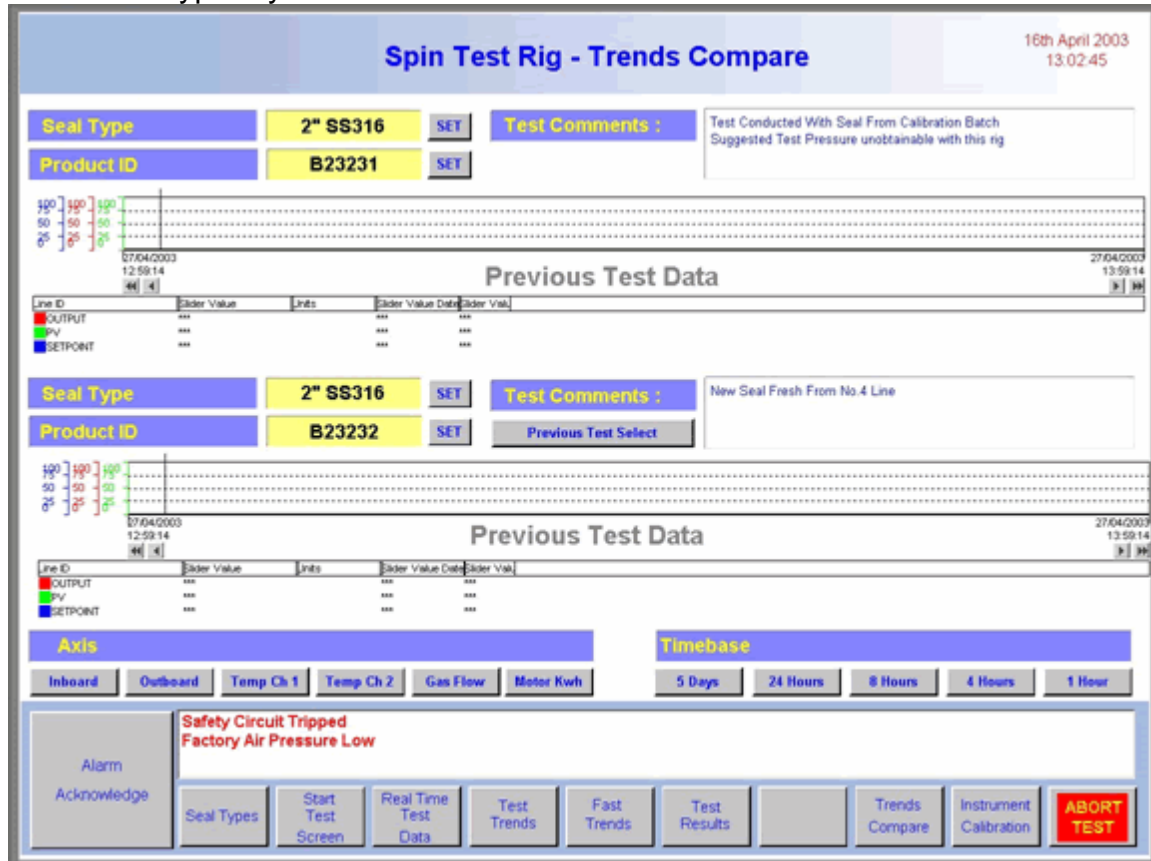
Seal TypesStart Test ScreenReal Time Test DataTest TrendsFast TrendsTest ResultsTrends CompareInstrument Calibration**ABORT TEST**

2.4.8 Historic Data Compare.

This will allow two previously logged tests to be compared one against the other. The screen displays two sets of trends and for each you would need to select a seal type and product ID.

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This would typically look as follows:



2.5 Database Convention.

When a test is brought to a conclusion the data is saved into the database. The fields of each record will contain specific information relating to the Seal type, Product Id, Test type, Test Pass/Fail, Reason for fail and logged data.

The test types can be Static Manual, Static Auto, Dynamic Manual and Dynamic Auto.

Reason for failure will include a fault code which would be a 0 when the test is passed and a number greater than 0, relating to failure reasons stored in another table.

As with all tests there is a fast trend that will capture data at a higher rate than the normal trends. If a test fails, then this data will also be archived into the main table, which can be viewed later.

2.6 Test Certificate

This will automatically be printed when a test is brought to a successful conclusion. It is assumed that a networked printer will be made available for this purpose, and that the appropriate printer drivers are obtainable.

The test certificate will take the following form:

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Seal Type : 2" SS316

Product ID : HG6566

TEST : PASSED

Operator : M Hodge

Test Type : Static & Dynamic Auto

Test Date : 20/04/03 10:00:02

Seal Information : Seal Developed in US - Primary use For GB Market

Test Comments : Test ran ok - Extremely warm day so
Ambient Air temp may have been high

Static Auto Test Results

Test Duration : 3 Mins

Total Gas Consumed Through Test : 1100 m/l

Inboard Gas Leakage as % of Total Gas Consumed : 62 %

Outboard Gas Leakage as % of Total Gas Consumed : 28 %

Dynamic Auto Test Results

Test Duration : 14 Mins

Total Gas Consumed Through Test : 1202 m/l

Inboard Gas Leakage as % of Total Gas Consumed : 62 %

Outboard Gas Leakage as % of Total Gas Consumed : 28 %

2.7 Network Connection

2.7.1 Network PC.

It will be necessary to connect the PC to your factory network; we have assumed that your IT department will carry out this phase of the test rig installation. However we can prepare the PC for networking if we are given addresses and protocol information.

Section 3 Loading & Clamping Component

3.1 Mounting Seal & Clamping

The seal is mounted into the rig with the dowel located into the base. The swing arm is pulled over to the locking position and clamped. The seal is secured by screwing down the clamp. As the clamp is tightened the tension bar is lifted into retaining slots that prevent the tension from swinging open. Safety switch monitor the tension bar position and when made the tension bar is safely retained. The test rig will be at a zero emergency state before the tension bar can be opened.

Section 4 Pneumatic Control

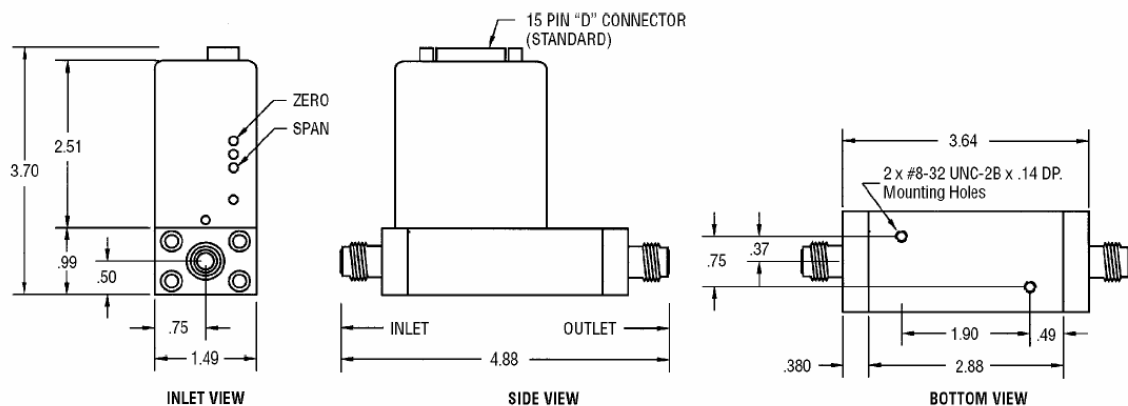
4.1 Pneumatic Overview

The seals are tested statically and dynamically. On the static test the seal is tested with high pressure at relatively high volume i.e. (12 bar at approximately 6,000ml/min) on the dynamic test both the pressure and flow is lower i.e. (3 bar at 500ml/min).

4.2 Transducer Overview

At your suggestion I have investigated Hastings flow meters. The 200 series that you currently use takes 7 seconds to read through full scale. This is too slow for our application. Hastings does however manufacture a 300 series that suits our purpose well. Having read the specification I believe we can monitor both high and low flow through the same transducer.

Model HFM-300



4.3 Pneumatic Control Overview

Manual control limits the operator/supervisor to two pre-set values i.e. 3 bar and 10 bar. Both set points are manually adjustable by pressing the appropriate set pressure push button within the pneumatic cabinet the pressure will be displayed on the regulator and on the SCADA screen. The output stability of a manual pressure regulator is approximately 1% of full scale. We intend to use 0 to 16 bar

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regulator for the 12 bar test, and 0 to 4 bar regulator on the 3 bar test. We should achieve a pressure accuracy of 0.16 bar on the high flow test and 0.04 bar on the low flow test.

4.4 Pneumatic Components.

No	Description	Purpose
1	Manual isolation valve lockable in the off position	Used to isolate pneumatic supply at times of maintenance.
2	Pneumatically driven dump valve.	This valve is used to dump high pressure air during an emergency stop or when the system is isolated.
3	Pressure switch factory air.	Used to check factory air pressure is above operational minimum.
4	Control air pressure switch.	This analogue pressure switch monitors the control pressure after the pressure regulators. The PLC monitors the pressure.
5	Filter regulator 0 to 8 bar.	Used to dry factory air and to set pressure for intensifier. The intensifier will be set to approximately 14 bar @ 4:1 = 3.5 bar. This will also be the source pressure for the dynamic test.
6	High pressure regulator 0 to 16 bar.	Used to manually set pressure for the high pressure test i.e. 12 bar.
7	Low pressure regulator 0 to 4 bar.	Used to manually set pressure for the low pressure test i.e. 3 bar.
8	High pressure reservoir	This reservoir is sized to hold enough high pressure air (at 14 bar approximately) to maintain the static test for 4 min at 12 bar.
9	One way valves.	These valves are designed to isolate the high pressure from the low pressure circuits.
10	Manual flow restrictors	These flow restrictors are designed to restrict the maximum flow attainable to protect the gas flow transducers.
11	3/2 electrically operated solenoid valve	Used to turn on and off high pressure static test air. In the absence of power to the solenoid the valve will close removing high pressure air from the seal.
12	3/2 electrically operated solenoid valve	Used to dump accumulated pressure at test rig & for pressure setup.

Section 5 Motor & Drive

5.1 Motor Details

Manufacturer: Brook Crompton.
Size : 7.5 kW
Volts : 380 - 415
F.L.C.(Amps): 14.0 – 13.3
Hz : 50
R.P.M. : 3480 @ 50Hz
Type : AC
Serial No : IEC 60034 DA132SJ G259938

5.2 Drive Details

Manufacturer: Mitsubishi.
Model : Freqrol –A100 FR-A140E – 7.5K-EC
Volts : 380 - 460
Power : 7.5kW 16 Amp
Hz : 50/60
Serial No : IEC C69973009 TC100A312G52 BC1 32U894A

5.2 Drive Controls Current

The drive has only 1 configurable analogue output, and your specification requests information on both motor speed and current. I have chosen to configure the drive analogue output to transmit motor current to the PLC via a 0-10v.

5.3 Drive Controls Speed Loop

As I don't have an analogue output to check the speed I have made allowance to install a proximity sensor. As I have changed the PLC to The Micrologix 1500 the scan times are faster than SLC 500 I had previously chosen, typically 1ms. This PLC Also contains 2 high speed counters that can accept pulses up to 20kHz. By changing the PLC we have removed the need for a pulse divider.

5.4 Drive Controls EMC

The drive doesn't conform to current electrical noise regulations and we suggest that we fit a mains infeed line filter. This will reduce the emitted EMC but is still unlikely conform to current regulations.

We will also change the current wiring method and add ferrite rings on the drive if practical.

Section 6 Program Logical Controller (PLC)

6.1 PLC Overview

The PLC will be used to monitor digital and analogue inputs from the test rig and output analogue and digital information in response. It will be used to control the various PID loops, and calculate values used or set by the Cimplicity system. The test rig is in essence controlled by the PLC and monitored by Cimplicity.

We have selected Allen Bradley Micrologix 1500 range PLC for speed and flexibility. It is modular in design and can be easily expanded if required. The Allen Bradley Micrologix 1500 range has an extensive existing range cards to suit most test rig and industrial applications.

6.3 PLC I/O Description.

Base Unit (16 way digital input).

Address	Description
I:0/0	Motor speed Input Pulse
I:0/1	Emergency Stop Button 1 & 2
I:0/2	Spare
I:0/3	Safety Relay Healthy
I:0/4	Factory Air Pressure OK
I:0/5	Drive Healthy
I:0/6	Start Test Button
I:0/7	Stop Test Button
I:0/8	Tension beam in position switch 1
I:0/9	Spare
I:0/10	Drive running / at zero speed
I:0/11	Drive overload
I:0/12	Two hand safety relay status
I:0/13	Reset Button
I:0/14	Low pressure set push-button
I:0/15	High pressure set push-button

Functional Design Specification Spin Test Rig

Base Unit (12 way digital output).

Address	Description
O:0/0	Motor drive contator
O:0/1	Drive Forward Rotation
O:0/2	Drive Reverse Rotation
O:0/3	High pressure solenoid
O:0/4	Spare (Isolated with emergency stop).
O:0/5	Spare (Isolated with emergency stop).
O:0/6	Pressure release & pressure setup solenoid.
O:0/7	Spare (Isolated with emergency stop).
O:0/8	Alarm Beacon (Maintained)
O:0/9	Reset Lamp
O:0/10	Start push-buttons
O:0/11	Stop Button

Card 1 (4 Way Analogue Input Module).

Address	Description
I:1/0	"High Flow" Out Put Flow Transducer
I:1/1	"High Flow" In Put Flow Transducer
I:1/2	Air pressure Transducer.
I:1/3	Motor current

Card 2 (4 Way Analogue Input Module).

Address	Description
I:2/0	Temperature probe 1 (ambient)
I:2/1	Temperature probe 2 (seat probe)
I:2/2	Temperature probe 3 (inlet air temperature)
I:2/3	Temperature probe 4 (outlet air temperature)

Card 3 (2 Way Analogue Output Module).

Address	Description
I:3/0	Motor Speed Output. (Used for speed Loop).
I:3/1	Spare

Section 7 Safety Circuit

7.1 Safety Circuit

An emergency stop button and a safety position switches will be monitored by a Pilz relay. When the Pilz relay is operated it immediately remove the enable signal from the drive. The drive contactor will be released after a short delay allowing the motor to be driven to a stop rather than allowing it to coast to a stop. After a short delay the air pressure will be dumped and the motor isolated from its supply.

Section 8 Electrical drawings

8.1 Electrical Drawings

The electrical drawings have made assumptions on completed design. The templates will remain largely untouched but the contents will change to mirror completed design.