LT7 Series Bottle Leak Detectors

Technical Manual

PLASTECH
CONTROL SYSTEMS

Quality by Design

Plastech Control Systems Ltd.
17c West Side Industrial Estate, Jackson St,
St Helens, Merseyside, WA9 3AT, UK.
Tel: +44(0) 1744 734 123
Fax: +44(0) 744 734 340
Email sales@plastech-controls.com
Web http://www.plastech-controls.com

US OFFICE
Plastech Control Systems Inc.
8689 North Port Washington Road
PMB 252, Milwaukee, Wisconsin, 53217-2209
Tel: 414-365-2985
Fax: 414-365-2998
Email sales@plastech-controls.com
Web http://www.plastech-controls.com

Contact Details

If you do not see a distributor in your country, please contact the UK head office.

UK Head Office

Plastech Control Systems Ltd

17c West Side Industrial Estate
Jackson St
St Helens
Merseyside
WA9 3AT
Tel +44(0) 1744 734 123
Fax +44(0) 870 0523 168 (main)
Fax +44(0) 1744 734 340 (alternate)

www.plastech-controls.com

Sales:
uk-sales@plastech-controls.com

Technical Support:
support@plastech-controls.com

US OFFICE

Plastech Control Systems Inc.

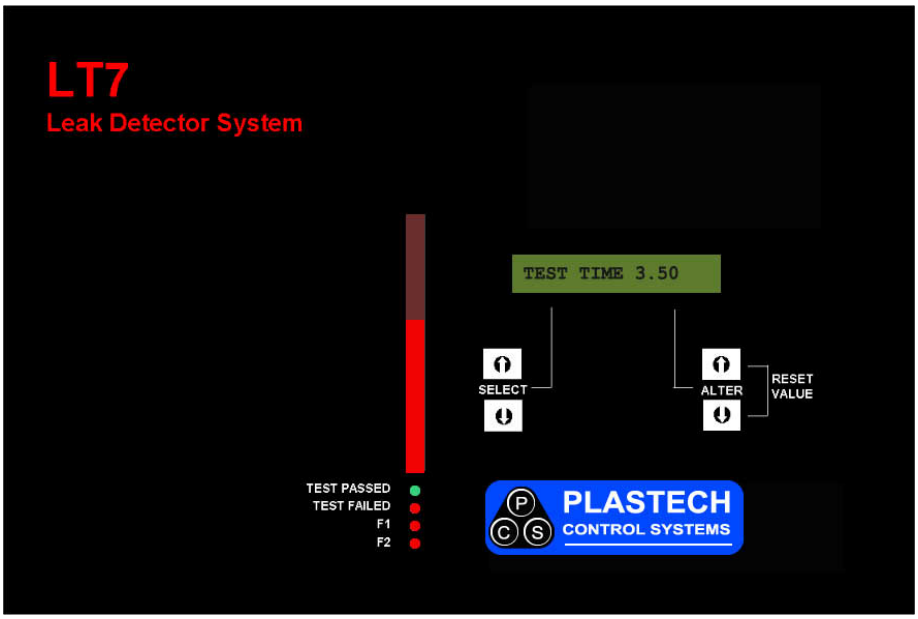
8689 North Port Washington Road
PMB 252, Milwaukee, Wisconsin, 53217-2209
Tel: 414-365-2985
Fax: 414-365-2998
Email sales@plastech-controls.com
Web http://www.plastech-controls.com

Product Areas

- Leak Detection Equipment
- Collating Tables
- Bottle Turners
- Decollating Machines
- Conveyor Systems
- Spin Trimmers
- Control Systems
- Wall Thickness Scanning
- Bottle Handling
- Bottle Quality Control
- Customized OEM Models
- Installation
- Service & Support
- Electronics Design

Contents

1. Leak Tester Features



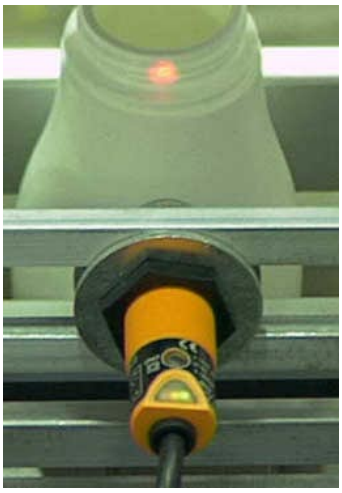
The LT7 series of leak testers have many advanced features:

1.1. High accuracy leakage measurement

The system uses a piezoresistive semiconductor strain gauge pressure transducer with a low noise amplifier and high-speed analog to digital converter. This minimises measurement errors.

1.2. Flexible part transport system

Timings can be easily adjusted to optimise part transport, where required, without sacrificing test time. The latest background suppression photoswitches are used for part detection. This eliminates adjustments used to be required by part colour and finish variations.



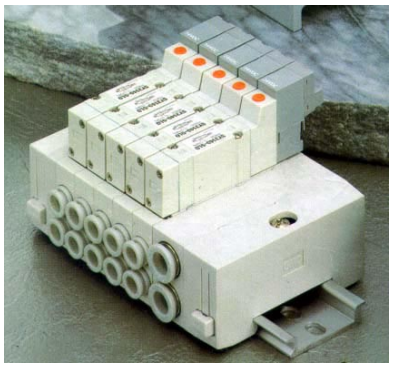
that

1.3. Microprocessor control system

- **Reliable -** Hardened against very high levels of mains spikes and static discharges.
- **Flexible** - can quickly be re-programmed for special needs.
- **Future-proof -** spare inputs and outputs to allow future expansion provided at no extra cost.
- **Easy to Set** - Alphanumeric display allows quick, accurate setting and display of test parameters.
- **International** - Since all information is presented on the front panel display, it is relatively easy to change the program to use another language (where the system is to be used in a non - English speaking country).

1.4. Modular pneumatic system

- Valves rated at over 50 million cycles – An LT7 installation typically has to do 10 million cycles per year!



- High valve flow-rate maximises available test time, hence accuracy
- Low operating power – low load on system supply.
- Modular manifold allows quick customisation for special needs.
- Easy upgrade of system to include extra facilities even after installation.
- Valves can be changed without removing pipes.
- LED state indication on valve.

1.5. Cost Effective

The leak tester electronics has been integrated onto a single PCB. The circuit card has been designed and programmed specifically for this application. Great care has been taken to ensure that the system is easily re-programmable, and reliable. This means that the performance and cost limitations of using a bought-in Programmable Logic Controller are avoided.

1.6. Features Summary

Reliability:

- Interference Immunity
- 50 million cycle rated valves
- Self-Diagnostics, self setting capability

Adjustable Test Pressure

Improved Operator interface:

- Full alphanumeric display Of Settings And Results
- Multinational Language Displays available
- Bargraph display of pressure, led indication of test result
- Push Button, Front Panel Settings

Alarm Output Option

Simple Installation & maintenance procedures:

- Simple machine connection
- Simple Internal Wiring (all electrical functions integrated onto single pcb)
- Low operating power – reduces load on system supply. 115VAC or 230VDC models
- Valves can be changed without removing pipes – all access from front of control enclosure.
- Manual override buttons on all valves
- LED state indication on valves

System Architecture:

- Spare I/O For Extra Functions
- Cost Effective
- Extra Functions
- Backup detection – pauses leak tester when takeout backed up
- Flash detection option
- Uncommitted I/Os

2. Options

The leak tester design is highly flexible with respect to software, electronics, pneumatics and mechanics. This allows a wide range of options to be added at any time, even after installation.

2.1. Choked Bore / Ovality Test

A probe fitted to the test head checks whether the neck is occluded or deformed.

2.2. Height Check

A fibre-optic sensor checks that the part is not too tall. This can detect folded over base flash on some parts, as well as neck flash.

2.3. Automatic self test

This can be used to periodically check the operation of the leak tester. Every 100 cycles (or any other number), a valve is turned on which introduces a known leakage into the system. A leak test is then performed. If the known leak is not detected, then the system will halt with an alarm.

This technique can reduce the use of "test parts" to a minimum.

2.4. Conveyor halt during test

The conveyor motor can be driven directly from the PCB, stopping during the leak test. This is recommended since it improves leak tester accuracy and part stability. However, this is not always practical when the leak tester is attached to an existing conveyor system.

2.5. Auxiliary Sensors

Spare inputs are available which can be used to connect other sensors, which examine the part during the leak test. Examples might be label sensors, flash detection sensors or vision systems. The leak tester would fail the part if any of these inputs were triggered.

2.6. Part transport options

A variety of part transport options can be fitted to replace the standard method. It is recognised that the standard method may not always be suitable, although we have found that is the most flexible as well as the most cost effective. Other methods include side clamps and holding moulds.

2.7. Stabilisation Plate

A pneumatically operated mechanism can be fitted to the infeed of the leak tester. This is only required when the conveyor is to be fed directly from the output of a blow moulding machine with violent take-out movements. The plate supports the queue of parts when push-out occurs. The plate then opens, allowing the parts to travel down the conveyor.

2.8. Vacuum Operation

The system usually pressurises the parts during the leak test. However, it is possible to supply the system for vacuum operation where required.

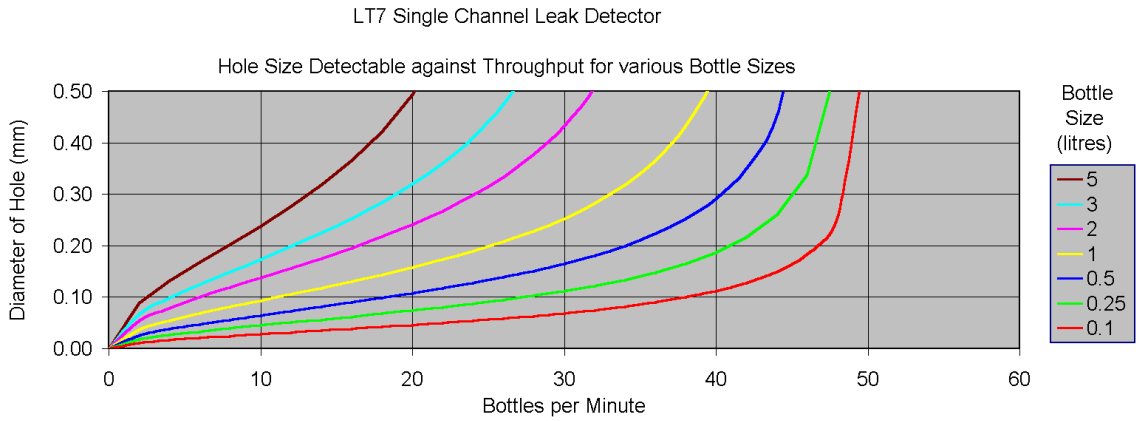
2.9. Special test pressure

The system test pressure is adjustable over a limited range (see specification). If this range is not sufficient, a different transducer can be fitted to allow any test pressure desired.

3. Specification

Item	Specification
Electrical Power Supply	115 or 230 VAC single phase, switchable.
Electrical Power consumption	30 VA (Leak tester) maximum.
Air Supply	4-10 bar
Air Consumption	0.1-1 litre / minute typical
Minimum part volume	No lower limit
Maximum part volume	20 litres (unit will still work with any volume, but cycle time would be improved using another model).
Test Pressure	Adjustable, 5 - 70 mB. This range can be changed on request.
Cycle Time	1.0 - 20.0 seconds, adjustable.
Hole Size Detected	Dependent on cycle time and container size. (See graph). For a 500ml part and at 20 parts per minute, the hole detected would be 0.15mm.
Leak Test Method	Pressure Decay, Auto-zero, Auto-Scale.
Transducer	Piezoresistive semiconductor strain gauge, 0.00 - 80.00 mB, 0.1% resolution, 20 x Overpressure Protection.

3.1. LT7 Performance Graph



To use the graph above, select the size of part from the table on the right. Look along the line of that colour. Select the Parts per minute required from the scale at the bottom and read off the hole size detectable from the scale on the left.

The graph has been calculated assuming particular sensible conveyor speeds, and bottle diameters for the various sizes. The actual performance of the leak tester could therefore vary from that above.

4. Quick Set Guide

For information as to the location of items mentioned below, see System Layout and Control Cabinet Internal Layout sections.

Ensure that the leak tester is mechanically adjusted so that the neck of the part is positioned centrally under the test head during the test.

Adjust the Test Head pressure regulator PR10 so that the test head comes down with enough force to seal on the part.

If the required settings for the job have not yet been established, start as follows (see "Front Panel Controls and Settings" for more information):

Item	Value
Test Time	1 second
Max Decay %	15.0 %
Test Press mB	30 mB
Start Delay	0.3 seconds
Head Delay	0.5 seconds
Gap Set Delay	0.5 seconds

These are the "factory set" values and are intended as a starting point. They can be quickly reached by pressing the "RESET VALUE" buttons together as each setting is displayed.

Send some parts through the leak tester and make any adjustments to the guides that are required.

Adjust the Head Delay so that the part has time to stabilise before the test head descends.

Adjust the Gap Set Delay to achieve a consistent gap between the part just tested, and the next part coming into the test station.

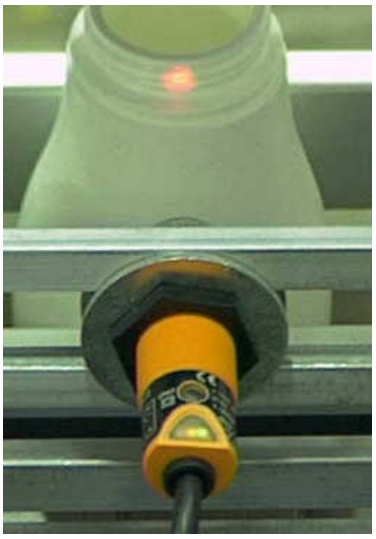
Adjust the Pressurisation restrictor RS9 to achieve approximately the required pressurisation level (about 3/4 of the way up the pressure scale).

Note the Decay % level obtained for good parts (press the SELECT buttons to display this parameter).

Set the Maximum Decay to a level slightly **above** this. About 2% above this is usually correct, but this will depend on the consistency of the results. For example, if good parts are coming through with 8.0 % pressure decay on average, set the Maximum Decay to 10.0 %. If the result is always between 7.5 % and 8.5%, the limit can be reduced to 9.0 % to improve the accuracy.

4.1. Photoswitch Sensitivity Setting

This machine is now fitted with automatically adjusting photoswitches as standard, for part detection. These are advanced background suppression types. They are not confused by container colour, transparency, or objects on the far side of the part under test, such as guide rails, people etc. They also project a visible spot of light so that the exact point of detection can be established.



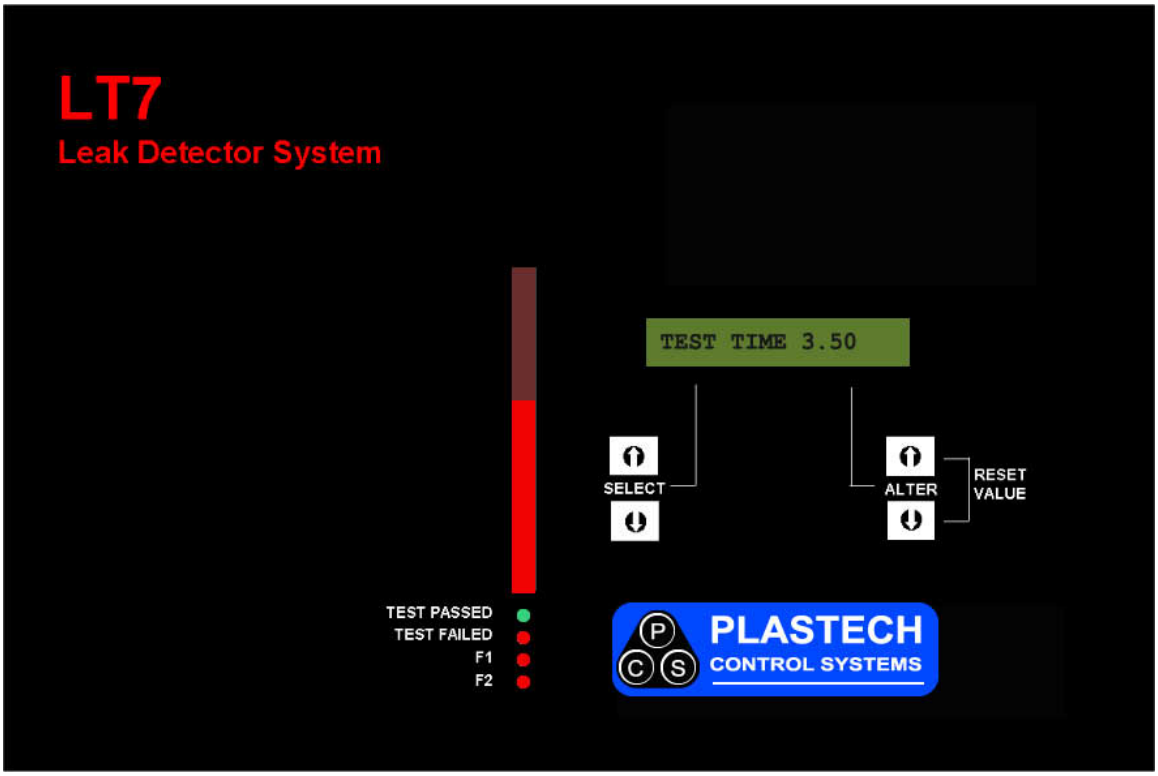
Because the sensors ignore the part colour or material, they should rarely need adjustment. However, for completeness the procedure is detailed below.

The sensors have push button adjustment as follows:

- If possible, ensure nothing else is in view of the photoswitch (guide rail, guards etc). However, if these are going to be present during normal operation, they should be present during this procedure too.
- Press the button on the photoswitch for about 5 seconds until the built in indicator starts flashing.
- Hold a part in front of the photoswitch **at the position required for detection**.
- Press the button again, briefly (sets turn on level).
- Remove the part.
- Press the button again, briefly (sets turn off level).
- Wait until it stops flashing.

This will ensure that the photoswitch only sees objects that are on the conveyor.

5. Front Panel Controls and Settings



The system is provided with a single line alphanumeric display to show all test parameters, diagnostics and results. Push button controls are provided to allow a technician to view items and alter settings where required.

5.1. General Front Panel Operation

To view a particular item, press SELECT UP or SELECT DOWN until the required item is displayed.

To adjust an item, where appropriate, press the ALTER up and down buttons as required.

To reset a setting to a default value or zero a count, press both of the alter buttons together.

5.2. Settings and Displays Available

Item	Description	Min	Max	Default
Passed	This is a count of the number of parts that have passed the test.	0	99999999	0
Failed	This is a count of the number of parts that have failed the test.	0	99999999	0
Test Time	This is used to control the length of the leak test. The higher this setting, the more accurate the leak tests. This should be set to as high a value as possible, consistent with part throughput.	0.5s	20.0s	1.0s
Decay %	This is a number representing the precise result of the leak test. The number displayed is the percentage of the initial pressure, which has been lost during the test. This number is compared against the set limit to determine pass or fail.	N/A	N/A	N/A
Max Decay %	This sets the sensitivity of the test. The percentage of pressure decay measured by the test is compared with this value to determine the test result. If the decay is greater than this value, the part is rejected.	0.0	99.0	15.0
Test Press mB	This is the target pressure used to inflate the part. A value of 30mb is typical. Higher values can give marginally more accurate results but may distort the part during the test. Very low values will reduce test accuracy.	5	70	30
Start Delay	The test cycle is started when a part is detected at the test station. This setting sets the time between the start sensor detecting a part, and the test starting. This delay allows the sensor to be positioned further up the conveyor than would otherwise be possible.	0.0	5.0	0.3
Head Delay	This sets the delay before the test head comes down. This allows the part to stabilise in the test station before being leak tested.	0.0	5.0	0.5
Gap Set Dly	This sets the delay between the part under test being released, and the next part being allowed into the test station. This can be needed to create a gap in the part stream so that the stop cylinder 17 does not crush the next part to be tested.	0.0	5.0	0.5
Pressure mB	This shows the current pressure in the part, in mb.	N/A	N/A	N/A

5.3. Pressure Scale

A pressure scale is displayed, in bar graph form. This gives a quick visual indication of the actual pressure in the part at any instant in time. The display is scaled to the set test pressure, so that full scale always equals the set test pressure.

5.4. Test Result Indicators

Immediately below the bargraph are indicator lights, which show the results of the test.

5.4.1. Passed

The part has passed all tests.

5.4.2. Failed

The part has failed a test.

5.4.3. F1 / Blocked Bore

A sensor can be fitted in the test head, which detects blocked or partially blocked neck bores in the part. This light will come on when this is detected. Occasionally other fault sensors may be indicated by this light, e.g. handle flash detection.

5.4.4. F2 / Other Fault

This indicates detection of some other fault, which is not a simple leakage. These possibilities are as follows

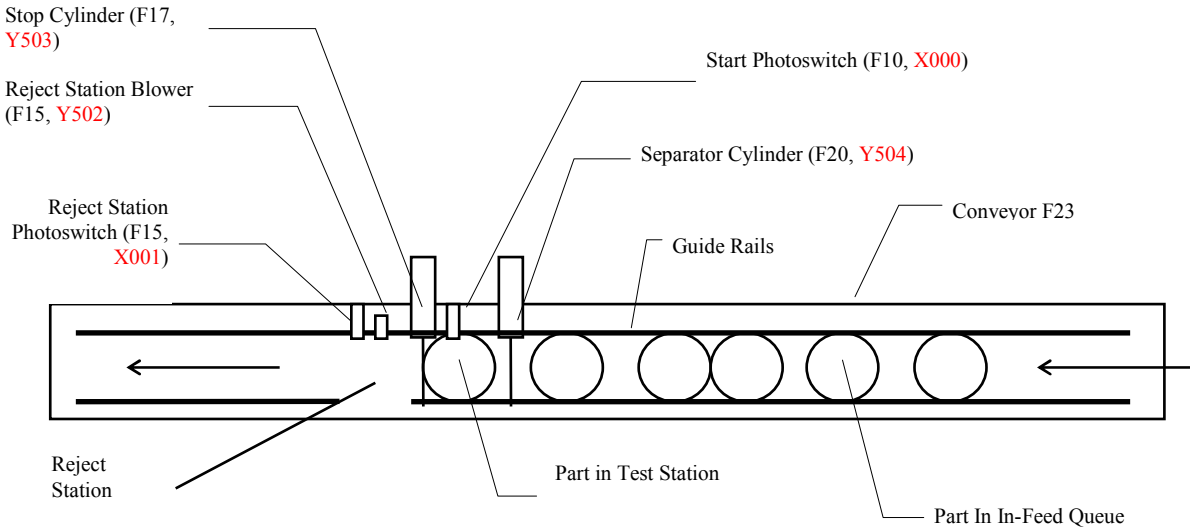
5.4.4.1.Over Pressurisation

If the part becomes over pressurised during the test, the pressure may go outside the range of the transducer resulting in an invalid test. This is detected automatically and the part rejected as a precaution. If this occurs, reduce the flow during pressurisation by turning RS9 clockwise.

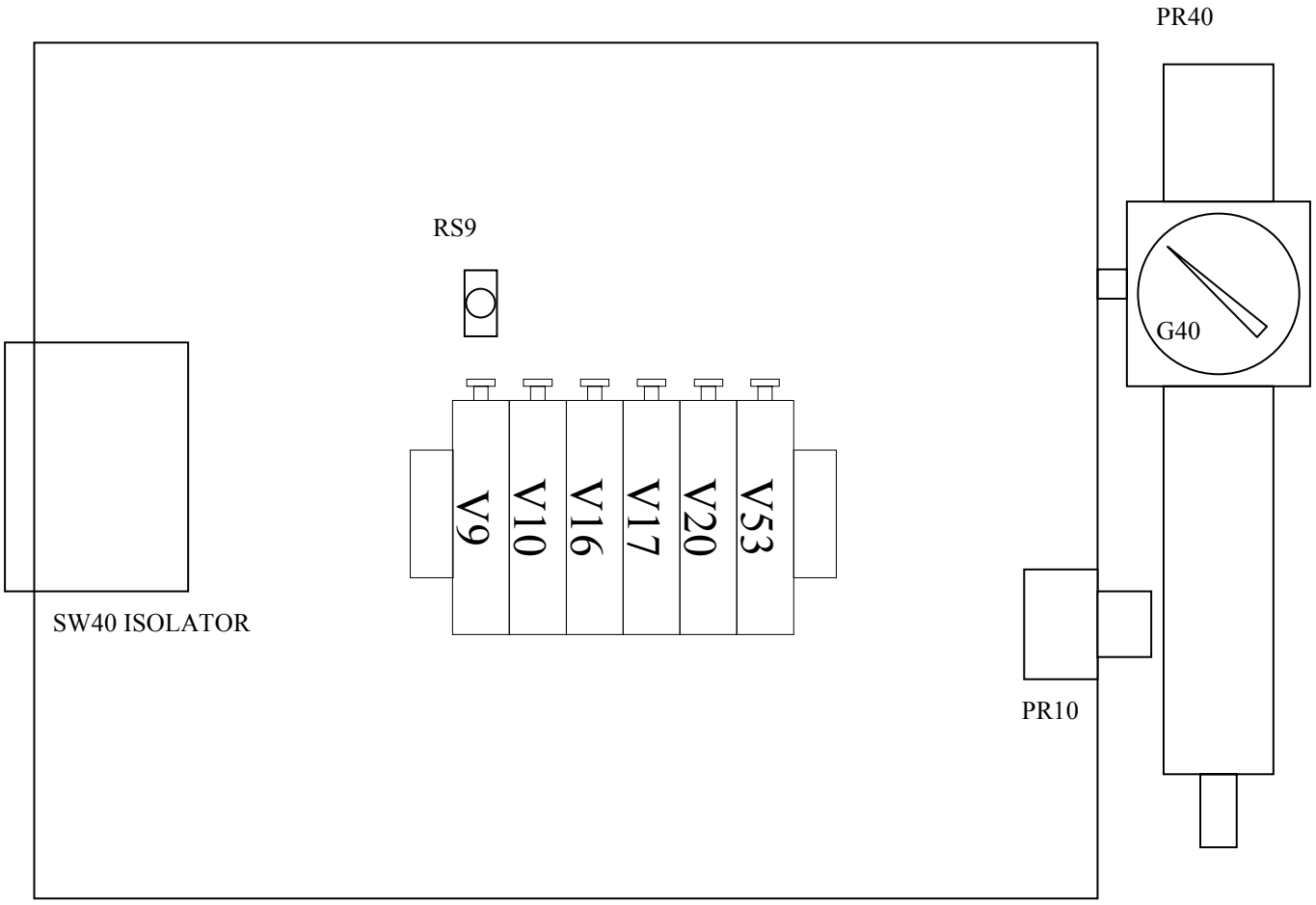
5.4.4.2.Special Tests

Special test functions or alarm conditions requested by the customer may be indicated using this light also.

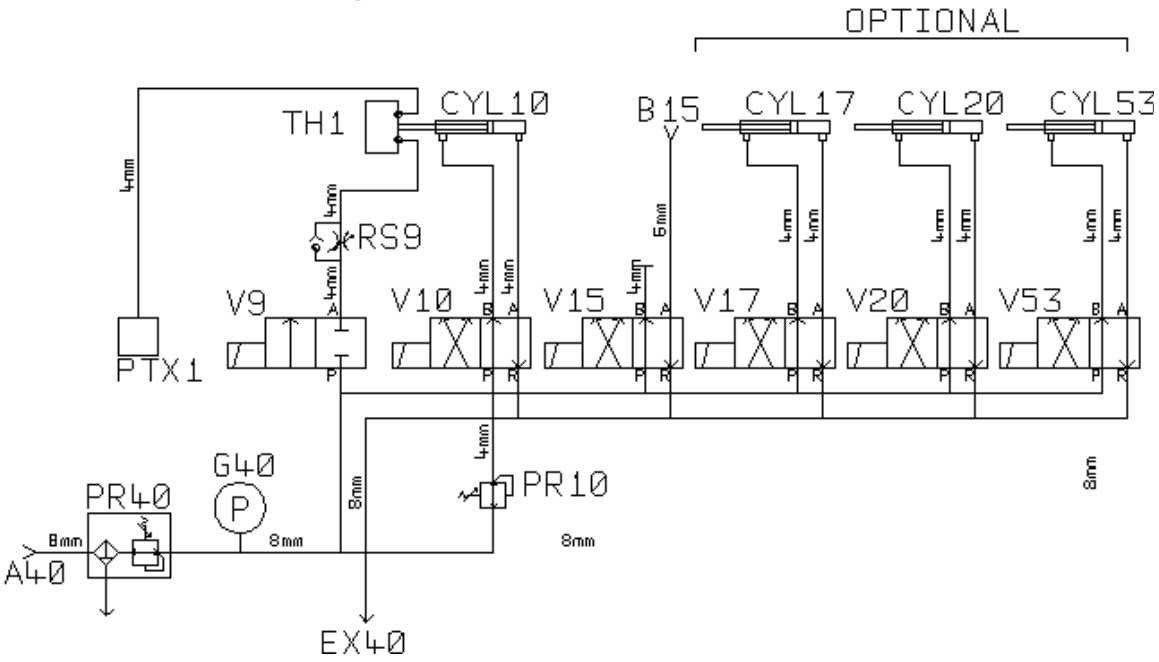
6. System Layout



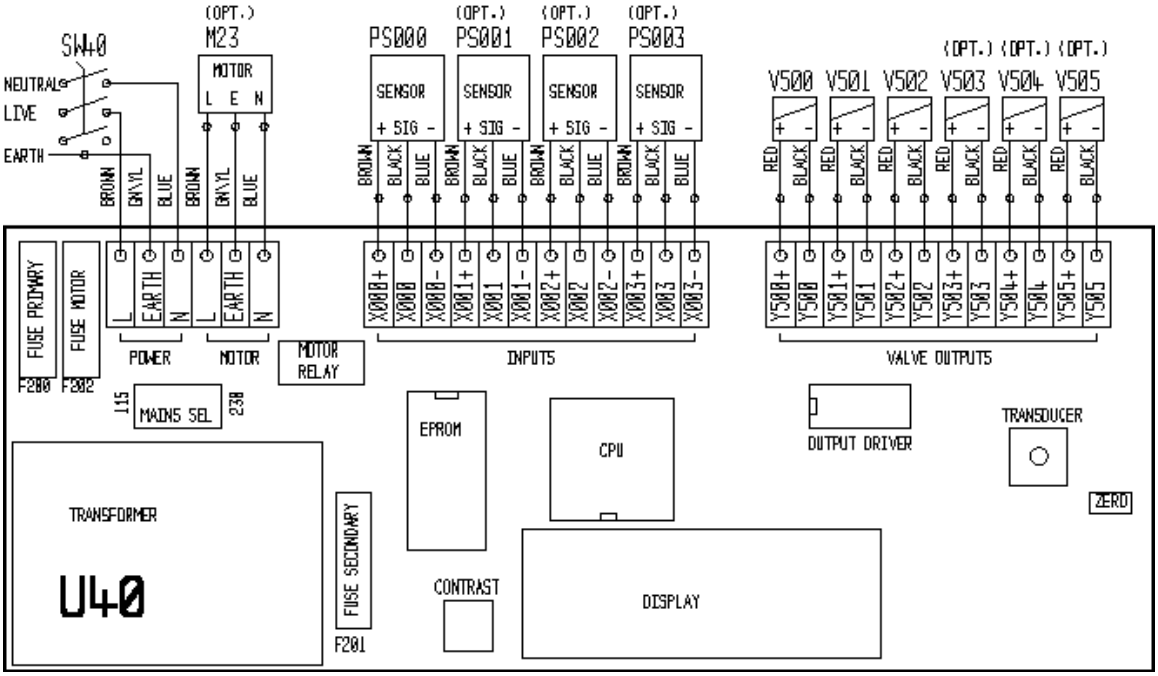
7. Control Cabinet Internal Layout



8. Pneumatics Diagram



9. Electrical Diagram & PCB Layout



This is a generic wiring diagram that applies to all LT7 installations.

10. Component Numbering Scheme - Explanation

The drawings following show the layout and interconnections of the various components, electrically, pneumatically and mechanically. The component numbering system is not obvious and requires explanation.

The heart of the machine is an electronic control system with various inputs and outputs (I/O's). There are a fixed number of these for any given installation (although extra I/O's can be added). These I/O's are connected to various devices (photoswitches, valves, cylinders motors etc), which make the machine work. A controller program reads the inputs and controls the outputs according to its program.

The controller card I/Os have a fixed numbering system, with inputs starting at 0000, 0001, 0002 etc and outputs starting at 0500,0501,0502 etc. The I/O's are labeled in this way on the circuit card LED's, also on the I/O page of the machine display.

The function of a particular I/O number may be different depending on the configuration of machine supplied. There are so many options and configurations that it would be very wasteful to dedicate an I/O for the same function on all machines. Instead, the controller program for a particular machine configuration allocates I/O's, more or less sequentially.

To avoid having to make individual electrical, pneumatic and layout drawings for each machine combination, Universal Function Numbers have been defined. I/O numbers are related to Function Numbers by a single table in the product manual. Function specific parts (e.g. the Test Head Cylinder) are given a number according to that function (in this case, Cylinder 10). This will be the same in any PCS product that has a Test Head Cylinder; it will always be Cylinder 10, CYL10 etc. The photoswitch that actuates the test head could also be called Photoswitch 10, PS10, etc. The actual I/O number can vary between machine types (although will be the same for two machines of the same model)

11. Universal Function Number List (All Products)

ID	Description
1	Pressurization Leak Test Channel 1
2	Pressurization Leak Test Channel 2
3	Pressurization Leak Test Channel 3
4	Pressurization Leak Test Channel 4
5	Pressurization Leak Test Channel 5
6	Pressurization Leak Test Channel 6
7	Pressurization Leak Test Channel 7
8	Pressurization Leak Test Channel 8
9	Pressurization
10	Test Heads Down
11	Test Head Down Channel 1
12	Test Head Down Channel 2
13	Test Head Down Channel 3
14	Test Head Down Channel 4
15	Reject
16	Leak Test Reject
17	Leak Test Bottle Stop
18	Leak Test Bottle Stop 1
19	Leak Test Bottle Stop 2
20	Leak Test Bottle Separator
21	Conveyor Merge Gate
22	Brush
23	Infeed Conveyor
24	Indexing Conveyor
25	Turner
26	Turner Queue Brake
27	Collating table Infeed Stop

ID	Description
28	Carriage Up
29	Carriage Down
30	Carriage Forward
31	Carriage Back
32	Carriage Up-Down
33	Carriage Forward-Back
35	Flash Detection
36	Blocked Bore Sense Channel 1
37	Blocked Bore Sense Channel 2
38	Bottle Support
40	System
41	Emergency Stop
42	Safety OK
43	Power On
44	Machine Run
45	Machine Stop
46	Alarm
47	Motor Tacho
48	Test A
49	Turner Downstream Stop
50	Turner Upstream Stop
51	Test B
52	Update Data
53	Unused I/O
54	Reject Channel 1
55	Reject Channel 2
56	Reject Channel 3
57	Reject Channel 4
58	Collating Table Short Row Stop
59	Leak Test Downstream Backup
60	Diverter Mechanism

ID	Description
61	Leak Test Infeed Brake
62	Diverter Gate Infeed Brake
63	Diverter Gate 1
64	Diverter Gate 2
65	Diverter Gate 3
66	Main Drive
67	Blower
68	Fan
69	Busy
70	Cycle Start
71	Ready
72	Start 1
73	Start 2
74	Index Position
75	Lock Settings
76	FallenSenseTop
77	FallenSenseBottom
78	FallenSenseEject
79	SupportPlate
80	Alignment Plate
81	Holding Moulds
82	Box Inverter
83	Machine Reset
84	Test Pass
85	Test Fail
86	Vent
87	Seal Neck
88	Seal Aux
89	Leak Tester Self Test

11.1. I/O Allocation (By I/O Number)

IO #	Func	Description	Comment
0000	70	Cycle Start	Input
0001	15	Reject	Input, PNP, 24VDC
0002	36	Blocked Bore Sense Channel 1	Input, PNP, 24VDC
0003	59	Leak Test Downstream Backup	Input, PNP, 24VDC

0500	9	Pressurisation	Output, NPN, 24VDC
0501	10	Test Heads Down	Output, NPN, 24VDC
0502	15	Reject	Output, NPN, 24VDC
0503	17	Leak Test Bottle Stop	Output, NPN, 24VDC
0504	20	Leak Test Bottle Separator	Output, NPN, 24VDC
0505	53	Unused I/O	Output, NPN, 24VDC

12. Control Cabinet Spare Parts List

Ref	PartID	Description
U40	580	PCB-ID4
SW40	294	Isolator, mains
PR10	305	Pressure regulator, M5 ported, low pressure (0.2-2 bar)
G40	304	Pressure Gauge, screw-in, 1/8 ported, 0-4 Bar
RS9	293	Restrictor, in-line, with check valve, 4mm
FR40	281	Filter Regulator, auto drain, 1/4 ported
	1103	LT7 Membrane Front Panel, Generic

12.1. Valve Manifold Spare Parts List

Ref	PartID	Description
V9, 10	835	SY3000 Series Valve, SY3140R (external pilot supply)
V15-	834	SY3000 Series Valve, SY3140
	760	SY VA Series Plug and Lead 600mm

13. Special Option: LT7-C-S1 (Higher Part Volume & Pressure Range)

This variant is designed for handling larger containers. The main differences from the standard model are:

- 6mm valve ports instead of 4mm.
- Extended setting ranges for long test times.
- Higher test pressure range (up to 7 PSI). The transducer is changed to a 15-PSI type and the PCB is a special version calibrated for the new test pressure range.
- Option for venting of part before test head released.
- External test head valve. The usual internal valve is used to pilot a very high flow external valve. The internal valve must run at system pressure so regulator PR10 is omitted.
- RS9 is omitted since maximum pressurisation flow is desired.
- Switched 110V output for external conveyor stop/start. This is used to drive an external 3-phase contactor, which switches the conveyor motor.
- Reject is by cylinder instead of air jet.
- Special program type LT7-C-S1 required.

13.1. Special Settings available in LT7-C-S1 software

Because this model of leak tester is expected to be used with unusual parts for test, extra settings have been introduced to allow precise adjustment of every aspect of the test cycle.

Item	Value
Test Time	Length of time for leak test. Set to highest value possible consistent with maintaining the required throughput.
Stop Delay	Delay between the start photoswitch seeing the part, and conveyor stop.
Head Delay	Delay between conveyor stop and test head down.
Fill Time	Time allowed for pressurisation. The leak tester will inject air into the part until the test pressure is reached, or until this time elapses.
Start Delay	Time between test head up and conveyor start.
Reject Delay	Time between reject photoswitch blocked and reject cylinder on.
Reject Time	Time for which reject cylinder is on.

13.2. Special Parts for LT7-C-S1

Ref	PartID	Description
U40	1234	PCB-ID4-5PSI main circuit board
V10-A	1389	VFA5120-03 (Test head fixture valve)