GASCON SYSTEMS AUTO CHANGE-OVER MANIFOLD MAINTENANCE INSTRUCTIONS

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1.0 INTRODUCTION

These maintenance schedules are applicable for the following Gascon Systems auto change-over manifolds: M120, PM120, HM120, MM120, M200TT, M500, MM500, MM500TT, M700, MM700, M1000 & MM1000.

There are two recommended maintenance schedules, one for medical and other critical process applications and another for non-critical process applications. A critical process application is considered to be a process when any interruption to pipeline system in undesirable. A non-critical process application is considered to be a process where a short interruption to the pipeline system is acceptable.

Other documents relating to auto change-over manifolds that designers, installers and users of manifold systems should be familiar with are:

AS2896 – Medical Gas Systems (Installation and testing of non-flammable medical gas pipeline systems),
AS4289 – Oxygen and Acetylene Gas Reticulation Systems
Gascon Systems Manifold Installation Instructions
Gascon Systems Manifold Servicing Instructions (authorized repairs only)

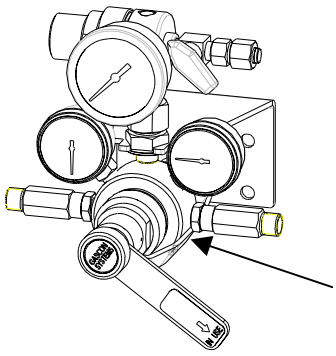
These instructions include descriptions of the recommended maintenance tasks, as well as procedures for carrying out these tasks. The two maintenance schedules at the end of these instructions show the recommended frequency for the maintenance tasks.

It is recommended for organisations that have an auto change-over manifold/pipeline system installations should keep log book records about the system. Information that should be included in these records are; system design information, drawings, commissioning hand-over paperwork, maintenance/servicing schedules and service history.

2.0 IDENTIFYING THE MANIFOLD

Every Gascon Systems manifold has a label affixed to the underside of the first stage regulator body. This label includes a brief part number description and the individual serial number of the manifold, (refer diaphragm).

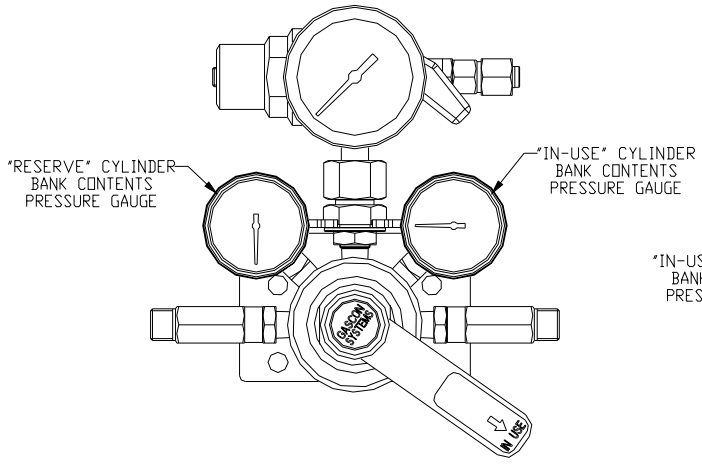
When discussing any issues about a particular manifold, always quote this serial number so Gascon Systems can refer to their internal records on the manifold.



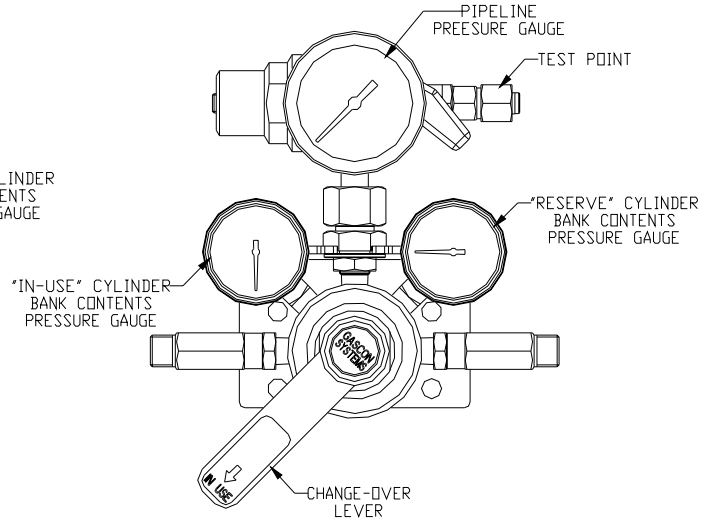
Each manifold comes with an individual specification sheet. The information contained on this sheet is important when undertaking any maintenance of the manifold. The information on the specification sheet includes the following:

- Manifold model,
- Date of manufacture,
- Manifold serial number,
- Maximum working pressure,
- Manifold first stage "*in-use*" and "*reserve*" pressure settings,
- Manifold outlet pressure setting,
- First stage pressure relief valve setting,
- Recommended service kit part number.

The diagram below shows how the "*in-use*" and "*reserve*" cylinder banks alternate according to the lever position. The diagram also points out a few items referred to in this document.



RIGHT HAND SIDE -"IN-USE"
LEFT HAND SIDE "RESERVE"



LEFT HAND SIDE - "IN-USE"
RIGHT HAND SIDE "RESERVE"

3.0 TEST A - TEST GAS FAILURE ALARM SYSTEM

Any alarm systems connected to a manifold should be tested to ensure that they are operating correctly. To check for the correct operation of the alarm system, refer to the alarm system manufacturers instructions.

The signals to alarm systems are usually generated from pressure switches. These pressure switches need to be tested to ensure that their set point has not "*drifted*" from their original settings.

3.1 Change-over Pressure Switches

There are two methods of using pressure switches to indicate the change-over of cylinder banks. Using a two pressure switch system, (one on each cylinder bank inlet to the manifold), or using a one pressure switch system, (a pressure switch located at an intermediate point between the first and second stage manifold regulators). Pressure switches may operate in Normally Open or Normally Closed modes, but Normally Open is more commonly used in medical and critical process applications.

3.1.1 One Switch Systems

The one pressure switch system works on the pressure differential between the first stage regulator "*in-use*" and "*reserve*" pressure settings. This is the more commonly used method for detecting the change-over of cylinder banks. The more commonly used pressure settings are listed below.

"*RESERVE*" PRESSURE SETTING	"*IN-USE*" PRESSURE SETTING	P/SWITCH SET POINT ON FALLING PRESSURE	MAXIMUM P/SWITCH RESET ON INCREASING PRESSURE	MAXIMUM P/SWITCH DEADBAND
750 kPa	1000 kPa	850 kPa	900 kPa	50 kPa
800 kPa	1100 kPa	920 kPa	980 kPa	60 kPa
1000 kPa	1250 kPa	1125 kPa	1175 kPa	50 kPa
2000 kPa	2700 kPa	2300 kPa	2500 kPa	140 kPa

The procedure for testing whether a one change-over pressure switch system is functioning correctly is the same as that detailed in Test B (test function of manifold change-over mechanism). To check at what pressure the switch is activated, a test gauge must be fitted to the manifold test point. On medical and critical process application manifolds this can be done without interrupting the manifold operation by using the isolation valve on the test point. On non-critical applications the flow to the pipeline may require to be interrupted while fitting the test gauge. Monitor pressure on the test gauge as the manifold nears the change-over point. The pressure switch should activate at the specified set point. When re-opening the cylinder valves, very slowly open the first valve and monitor at what pressure the switch is re-activated (reset)

3.1.2 Two Switch Systems

The two pressure switch system uses two pressure switches, or contact gauges, connected directly to the cylinder contents side of each cylinder bank. These directly measure the cylinder pressure and are nominally set to operate at 1.5 times the "*reserve*" pressure setting specification of the manifold. The accuracy of the set point, and the deadband of the pressure switch are less critical on a two switch system than that for a one switch system. The more commonly used pressure settings are listed below

"*RESERVE*" PRESSURE SETTING	CHANGE-OVER P/SWITCH SETTINGS
230 kPa	350 kPa
750 kPa	1130 kPa
1000 kPa	1500 kPa
2000 kPa	3000 kPa

The procedure for checking whether a two change-over pressure switch system is the same as that detailed in Test B (test function of manifold change-over mechanism). To check at what pressure the switches are activated, monitor the pressure shown on the "*in-use*" bank contents pressure gauge as it nears the change-over point. When re-opening the cylinder valves, very slowly open the first valve and monitor at what pressure the pressure is re-activated. This test can be carried out without interrupting the pipeline system on medical manifolds, critical process applications and non-critical process applications.

3.2 Line Failure Pressure Switches

Unless otherwise specified, line failure pressure switches are set to operate when the pipeline pressure drops below 0.8 times the nominal working pressure for medical pipeline system, and 0.7 times the nominal working pressure for other pipeline systems. The more commonly used line pressure settings are listed below

Working Gas	Nominal Pipeline Pressure	Line Failure P/switch Setting
Medical Oxy, N_2O, Air	415 kPa	330 kPa
Turbine Tool Air	1400 kPa	1120 kPa
Laboratory Gases	700 kPa	560 kPa
Incubator Gases	150 kPa	120 kPa

(eg. medical oxygen with a nominal pipeline pressure of 415 kPa are set to operate when the pressure falls below 0.8 x 415 = 330 kPa).

3.3 Emergency Backup Manifolds

If the manifold is being used as an emergency backup for another separate supply system, pressure switches must be fitted to both cylinder banks to monitor cylinder pressures. These pressure switches shall be set to operate when the cylinder pressure drops below 75% of the nominal filling pressure, (eg. if nominal fill pressure is 17,500 kPa, the pressure switch shall operate at 13,000 kPa).

Note:
Pressure switches should always be set to operate on a falling input pressure. After activating, the pressure should be increased to check at what pressure the pressure switch resets, to ensure the deadband of the pressure switch is not excessive.

Only personnel experienced in the testing of gas control equipment should test and adjust pressure switches.

4.0 TEST B - TEST FUNCTION OF MANIFOLD CHANGE-OVER MECHANISM

The manifold auto change-over mechanism should be tested to ensure it is functioning correctly. On systems with an alarm system fitted, ensure that the appropriate personnel are notified prior to undertaking this test, as this test should activate alarm signals.

To start this test, ensure the cylinders on the "*reserve*" cylinder bank are full and their cylinder valves are fully opened. Slowly close all the cylinder valves on the "*in-use*" cylinder bank. The pressure, as indicated on the "*in-use*" bank contents pressure gauge should start to drop, (with some flow through the flow). It should continue to drop until it reaches the "*reserve*" pressure setting of the manifold. At this point any change-over alarm system fitted should have activated. The pressure on the "*reserve*" bank contents pressure should stay constant and there should no change in the pressure indicated on the pipeline pressure gauge. If the "*reserve*" bank contents pressure gauge starts to rapidly drop, then there is a problem with the change-over mechanism. Immediately re-open all the cylinder valves on the "*in-use*" bank and the manifold should return to its previous state. Seek further advice immediately.

If this first cylinder bank change-over test functioned correctly, the change-over mechanism for the other cylinder bank direction must be checked. Move the change-over lever to the opposite position, (thus making the "*reserve*" bank the "*in-use*" bank). Slowly fully open all the cylinder valves on the now "*reserve*" bank of cylinders (ie. the ones which were closed in the first half of this test). Close all the cylinder valves on the

newly selected "*in-use*" bank. As in the previous step, the "*in-use*" contents pressure gauge should drop to the "reserve" setting pressure and any change-over alarms should activate. The "*reserve*" bank contents pressure gauge should remain constant. If not, immediately open all the cylinder valves on the "*in-use*" bank and seek further advice immediately.

After the change-over mechanism has been successfully tested in both directions it is important that all the cylinder valves on both banks are fully opened and the change-over lever moved to a position where the cylinder bank with the lowest pressure is made the "*in-use*" bank.

General plant and equipment maintenance personnel who have received training in the procedure can undertake testing the function of the change-over mechanism

Note:
There must be gas flowing through the manifold for the following tests to be undertaken properly.

5.0 TEST C - TEST MANIFOLD PRESSURE SETTINGS

5.1 Primary or First Stage Pressure Settings

Test and re-adjust, if necessary, the "*in-use*" and "*reserve*" pressure settings of the manifolds first stage regulators. To achieve this a test valve must be fitted to the manifold test point. On medical and critical process applications the test point has an isolation valve so that test valve can be fitted without interrupting the manifold operation. On non–critical process applications the manifold will be required to be isolated from the pipeline system. Each manifolds "*in-use*" and "*reserve*" pressure settings are included on the specification sheet supplied with the manifold.

The procedure for testing/setting manifold first stage pressures are included in the Gascon systems Auto Change-over Manifold Service Instructions, available to approved service personnel.

Only personnel experienced in the testing of gas control equipment, and who are familiar with Gascon Systems recommended procedures should adjust the pressure settings of a manifold.

5.2 Pipeline or Second Stage Pressure Setting

Measure and re-adjust the manifold outlet pressure. This is pressure is shown on the 2-1/2" pipeline pressure gauge. If this pressure needs to be reduced, ensure that there is a bleed flow downstream from the manifold so that outlet pressure can be set correctly.

Note:
For medical manifolds, the maximum static (no flow) pipeline pressure is 1.1 times the nominal working pressure (AS2896 Clause 3.7), eg. medical oxygen with nominal pipeline pressure of 415kPa, maximum static pressure can be 1.1 x 415 = 460kPa

It is normal, good practices to set the static outlet pressure close to this maximum 460kPa in order to maximize the flow performance of the manifold.
Flow performance is measured at 375kPa, 416kPa is the average pressure under flowing condition, 460kPa includes seat closure, (approximately 20kPa at no flow conditions).

6.0 TEST D - TEST PRESSURE RELIEF VALVES

Remove the pressure relief valves from the pipeline and check to ensure they "*crack*" and re-seat at the required pressures. For medical manifolds with a G1135 three way service facilities the two pressure relief valves fitted can be individually isolated and removed from the pipeline system without interrupting the system operation.

Unless the pipeline has a pressure relief valve isolation system, this check cannot be done while the pressure relief valves are fitted to the pipeline system. This applies to both critical and non-critical process applications.

Useless otherwise specified the pressure relief valves are set to crack between 1.3 and 1.4 times the nominal pipeline pressure and reseat at a minimum of 1.2 times the nominal pipeline pressure. Commonly used pressure relief valve settings are listed below.

Working Gas	Nominal Pipeline Pressure	Minimum PRV cracking pressure	Maximum PRV cracking pressure	Minimum PRV re-seating pressure
Medical Oxy, N_2O, Air	415 kPa	540 kPa	580 kPa	500 kPa
Turbine Tool Air	1400 kPa	1820 kPa	1960 kPa	1680 kPa
Acetylene	150 kPa	195 kPa	210kPa	180 kPa
Laboratory Gases	700 kPa	910 kPa	980kPa	840 kPa

Only personnel experienced in the testing of gas control equipment should test pressure relief valves.

7.0 TEST E – PRESSURE CONTROL ASSEMBLY SERVICE

The internal components of the pressure control assembly, (including seat capsules, diaphragms, non-return valve seats, inlet filters), should be replaced. This servicing requires the manifold to be removed from the pipeline system. The pipeline system must either be shutdown, or an auxiliary gas supply source be connected to the pipeline system, (eg. through the G1135 three way service facility for medical manifolds).

This servicing requires that the manifold is dis-assembled, the recommended internal components be replaced, re-assembled, tested and the pressure settings re-set prior to being put back into operation.

This procedure must only be undertaken by Gascon Systems approved service personnel using approved spare parts and in accordance with factory approved procedures.

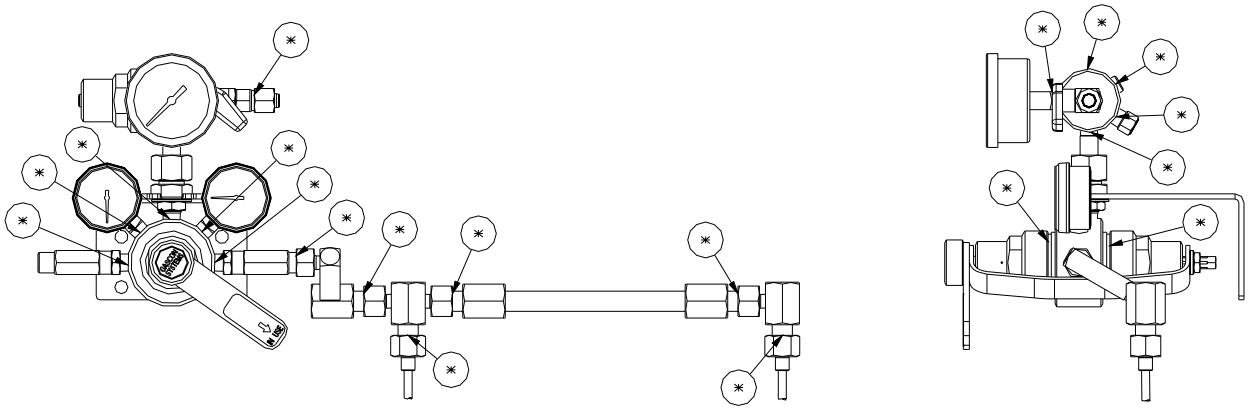
Note:
To reduce the amount of downtime required for this servicing, service exchange pressure control assemblies are available on request. Service exchange pressure controls assemblies are manifolds that have been previously returned, and been factory rebuilt to an "as new" operating condition.

8.0 TEST F – INSPECT FOR EXTERNAL LEAKS

The manifold assembly and inlet header system should be inspected for any leaks at all threaded connection points. Connection points that should be tested are indicated in the diagram below and include:

- Connections between cylinder lead and header extensions,
- Connections between header extensions,
- Connections between header extensions and inlet arms,
- Connections into the first and second stage manifold bodies (such as gauges, relief valves, outlet fitting, test point fittings, inlet non-return valves, pressure switches, …etc.).

The recommended method of testing for leaks is to apply a suitable leak detection solution, (eg Snoopy™, Bubbles™), to all the indicated connections (*) while the system is pressurised, wait for five minutes and then inspect for any bubbling of the solution.



General plant and equipment maintenance personnel can undertake the inspection for external leaks.

9.0 TEST G – INSPECTION OF CYLINDER LEADS

The flexible cylinder leads, or copper pigtails, should be inspected for any signs of metal fatigue, work hardening or damage to threaded cylinder connection. The condition of any sealing washers or o-rings should be inspected and replaced if necessary

General plant and equipment maintenance personnel can undertake the inspection of cylinder leads.

10.0 TEST H - CHECK THAT CYLINDERS HAVE BEEN CHANGED

The cylinders on each manifold bank should be checked to ensure that there are securely connected to the manifold and that their cylinder valves are fully opened. The "*reserve*" bank pressure contents pressure gauge should indicate full cylinders, (unless the manifold has recently changed over). If the "*reserve*" bank pressure contents pressure gauge does not indicate full cylinders there could be a system leak, the cylinder valves might not have been opened, an empty cylinder may have been connected accidentally, or there could be a fault with the manifold.

At an appropriate time after a change-over has occurred it should be checked that the recently emptied cylinders have been replaced with full cylinders.

General plant and equipment maintenance personnel can undertake the check that cylinders have been changed.

11.0 TEST I - CHECK FOR EXCESSIVE FROSTING OR CONDENSATION

The manifold system should be visually checked for signs of excessive frosting or condensation build up on the first stage manifold regulators. Excessive frosting may indicate a sign of system problems such as:

- leaks in the downstream pipeline system
- an under sizing of the manifold flow capacity for the system application
- extreme local environmental conditions around the manifold and cylinder supply systems.

General plant and equipment maintenance personnel can undertake the check for excessive frosting/condensation

Note:
Some condensation on the manifold is normal, but continued excessive frosting may be solved by the addition of gas heaters upstream of the manifold, or the addition of another stage of pressure reduction upstream of the manifold. Frosting is most common of the liquifiable gases such as carbon dioxide, nitrous oxide, LPG, …etc.

12.0 TEST J – TEST HEADER NON-RETURN VALVE FUNCTION

The non-return valves in the headers, (between the inlet extensions and the flexible leads/pigtails), function should be checked. These valves are not designed to provide a 100% seal against reverse flow. They are designed to stop rapid decanting in case an empty cylinder is accidentally connected to the manifold. A reverse flow of several litres per minute is acceptable. If any cylinders are to be removed from the manifold for extended periods of time, the inlet connections should be fitted with blanking plugs.

13.0 TEST K – TESTING OF FLASHBACK ARRESTORS

Any flashback arrestors fitted to pipeline system should be removed and tested for the following:

- flow performance
- leak tightness
- correct function of non-return valves
- visible signs of flashbacks

Refer to the flashback arrestor manufacturers' recommendations for testing.

Personnel experienced in testing flashback arrestors, using flashback arrestors' manufacturer recommended test equipment and test procedures, should undertake the testing of flashback arrestors.

14.0 TEST J - INSPECT FOR UNAUTHORIZED MODIFICATIONS

The manifold system should be visually inspected for any signs of authorized modifications since the last inspection. Such modification may include:

- removal or addition of valves
- removal, dis-connection or addition of pressure switches
- removal or replacement of system components
- addition of new piping
- bending or replacement of cylinder leads or pigtails
- removal of system operating instructions

General plant and equipment maintenance personnel can undertake the inspection for authorized modification to a manifold.

15.0 PRESSURISING AND RE-PRESSURING PIPELINE SYSTEM

When initially pressuring, or re-pressuring the manifold/pipeline system after maintenance/servicing it in important that it is done in a controlled manner. Allowing the manifold rapidly pressurise an empty pipeline system can damage the regulator seats. The recommended procedure for pressurizing the system is to:

- Close the isolation valve immediately downstream of the manifold,
- Partially open the first cylinder **very slowly**, allow the pressure (as shown on the inlet content gauges to increase **slowly**,
- After the inlet pressures have stablised, open the remaining cylinder valves,
- Partially open the system isolation valve **slowly**, and let the pipeline slowly pressurise, (**do not** fully open the valve at this stage),
- After the pipeline pressure has stabilsed, fully open the isolation valve.

16.0 GASCON SYSTEMS AUTO CHANGE-OVER MANIFOLD MAINTENANCE SCHEDULE

for medical and critical process applications

MAINTENANCE TEST	RECOMMENDED FREQUENCY OF TESTING							
	ON SYSTEM COMMISSIONING	EVERY WEEK	EVERY MONTH	EVERY THREE MONTHS	EVERY SIX MONTHS	EVERY YEAR	EVERY THREE YEARS	WHENEVER CHANGING CYLINDERS
A – Test gas failure alarm system	YES	-	-	-	YES	-	-	-
B – Test function of change-over system	YES	-	-	YES	-	-	-	-
C – Check manifold pressure settings	YES	-	-	-	-	YES	-	-
D - Test pressure relief valves	-	-	-	-	-	YES	-	-
E – Service pressure control assembly	-	-	-	-	-	-	YES	-
F – Inspection for external leaks	YES	-	-	-	YES	-	-	YES
G – Inspection of cylinder leads	YES	-	-	-	YES	-	-	YES
H - Check that cylinder have been changed	YES	YES	-	-	-	-	-	YES
I – Check for excessive frosting/condensation	YES	-	-	YES	-	-	-	YES
J – Test header non-return valves	-	-	-	-	-	-	YES	-
K – Testing of flashback arrestors	-	-	-	-	-	YES	-	-
L – Inspect for unauthorized modifications	YES	-	-	-	-	YES	-	-

17.0 GASCON SYSTEMS AUTO CHANGE-OVER MANIFOLD MAINTENANCE SCHEDULE

for non critical process applications

MAINTENANCE TEST	RECOMMENDED FREQUNCY OF TESTING							
	ON SYSTEM COMMISSIONING	EVERY WEEK	EVERY MONTH	EVERY THREE MONTHS	EVERY SIX MONTHS	EVERY YEAR	EVERY FIVE YEARS	WHENEVER CHANGING CYLINDERS
A – Test gas failure alarm system	YES	-	-	-		YES	-	-
B – Test function of change-over system	YES	-	-		YES	-	-	-
C – Check manifold pressure settings	YES	-	-	-	-	YES	-	-
D - Test pressure relief valves	-	-	-	-	-	-	YES-	-
E – Service pressure control assembly	-	-	-	-	-	-	YES	-
F – Inspection for external leaks	YES	-	-	-	YES	-	-	YES
G – Inspection of cylinder leads	YES	-	-	-	YES	-	-	YES
H - Check that cylinder have been changed	YES	YES	-	-	-	-	-	YES
I – Check for excessive frosting/condensation	YES	-	-	-	YES	-	-	YES
J – Test header non-return valves	-	-	-	-	-	-	YES	-
K – Testing of flashback arrestors	-	-	-	-	-	YES	-	-
L – Inspect for unauthorized modifications	YES	-	-	-	-	YES	-	-