Loma X3 Series X-Ray Inspection Systems

Conveyor and Pipeline Models User Manual
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CAUTIONARY ADVICE

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Safety Warnings

Listed below are all the safety warnings that are used throughout this manual. It is strongly recommended that personnel who are, or will be, responsible for installing, maintaining or operating the equipment described in this manual should read and understand these warnings.

1. **LETHAL HAZARD – ELECTRICAL SUPPLIES.** A current of 100 milli-amps passing through the body for one second can kill. This can occur at voltages as low as 35V ac or 50V dc. The equipment described in this manual uses electrical power which can be lethal. Unless absolutely necessary, cleaning, inspection and maintenance must not be carried out without first isolating the equipment from all electrical supplies.

2. **LETHAL HAZARD – RADIATION.** Whilst every precaution has been taken to make sure that all the necessary guards and safety devices have been fitted to the Loma x-ray unit, it is recommended that all operatives are trained in the use of x-ray food inspection machines. Furthermore, it is the responsibility of the employer to create a set of local rules (see example at the end of this section) regarding the safe use of x-ray food inspection systems. In the U.K., this is in compliance with the Ionising Radiation’s Regulations 1999, users outside of the UK should consult the relevant health and safety executive (see also Radiation Surveys in this manual).

3. **LETHAL HAZARD – COMPRESSED AIR SUPPLIES.** The equipment described in this manual may be supplied with a compressed air supply operating at a pressure, which may be lethal. Unless absolutely necessary, cleaning, inspection and maintenance must not be carried out without first isolating the equipment from all compressed air supplies. In addition, it should be checked that all air pipes are properly connected.

4. **WORKING ON EQUIPMENT.** If it is essential to work on the equipment with electrical and/or compressed air power connected, the work must be undertaken only by suitably qualified and authorised personnel who are fully aware of the danger involved and who have taken adequate safety precautions to avoid contact with dangerous voltages, radiation (see Radiation Surveys) or compressed air supplies.

5. **REJECT DEVICES.** At no time, with compressed air and/or electrical power applied to an automatic reject device, should any part of the body be placed within the operating area of the reject device. In addition, no attempt should be made to operate the X3 x-ray machine without the reject bin or guards in place.

6. **EXCESSIVE NOISE.** When an air blast reject device operates, the noise emitted may constitute a noise hazard. While short exposure to this noise will not normally cause permanent damage to hearing, prolonged exposure may cause some damage. It is recommended that ear defenders are worn by personnel who are regularly exposed to the noise.
7. **HEAVY EQUIPMENT.** The equipment described in this manual is extremely heavy and considerable care must be taken when handling it. Sufficient personnel and a suitable forklift truck or pallet truck must be used to ensure safe handling. In addition attention should be paid to the [X3 Lifting Points](#) drawing in the Installation section of this manual.

8. **LIFTING EQUIPMENT.** Use only the correct slings and lifting tackle to move heavy items of equipment described in this manual. Inspect all slings and lifting tackle prior to lifting the equipment to ensure that:
   a) The safe working load will not be exceeded.
   b) There are no frayed or broken strands.
   c) Hooks, rings, etc. are not damaged.

9. **MOVING THE MACHINE.** The centre-of-gravity of the conveyor is high. Care must be taken when moving such equipment on a slope to ensure that it does not topple over. This could result in death or severe injury to an individual and/or severe damage to the machine (refer to [X3 Lifting Points](#) in the Installation section of this manual).

10. **CONTAMINANTS.** Oils and greases must always be handled with care. Prolonged bare skin exposure to certain oils and greases can cause skin problems. Always handle oils and greases in accordance with the manufacturer's instructions (for types used see section on [routine maintenance](#)).

11. **TRAPPED FINGERS.** Do not place fingers on the underside of the x-ray conveyor belt when the machine is operating. It is possible for fingers to be trapped and subsequently crushed between a moving and fixed component of the machine. Trapped fingers are also to be avoided during pipeline normalisation.

12. **WARNING LABELS.** The Loma X3 x-ray machine has a number of warning labels and engravings throughout the system. Particular attention should be paid to the location of these warnings and their significance in operating the machine safely. If necessary because of local requirements some labelling may also be provided in a second language.

13. **GUARDS.** No machine is to be run without guards fitted unless for maintenance purposes and only if adequate precautions have been taken. Under no circumstances is any interlock to be defeated. This could lead to serious leakage of radiation if operated with x-rays on in such a manner.

14. **PIPELINE NORMALISATION.** Care is to be taken, when moving the cabinet on its frame to carry this out, to ensure correct posture and no over exertion is made.
Local Rules (UK Example)

Ionising Radiations Regulations 1999 Local rules

1. GENERAL

These rules are provided in compliance with the Ionising Radiations Regulations 1999 (IRR99) (Regulation 17) and the Associated Approved Code of Practice - "Work with Ionising Radiation".

The rules are the general principles and description of the means of complying with the Regulations and should be seen as implementing part of the general safety policy required by Section 2 of the Health and Safety at Work etc. Act 1974.

Aims: to ensure that work with ionising radiations is controlled so that:

1) During normal working, radiation doses to all persons are as low as reasonably practicable,

2) Precautions have been taken to minimise the risk of equipment failure or other occurrence which may result in significant radiation doses to any person, and

3) No doses exceed those specified in the Regulations.

2. RADIATION PROTECTION SUPERVISOR (RPS)

[INSERT NAME OF RPS]

The RPS is responsible for ensuring the work is carried out in accordance with requirements of the regulations and for taking all reasonable steps to ensure that these rules are observed. In addition, the RPS should carry out a radiation dose rate survey of the unit at least once a month or after maintenance. Checks should also be made on the operation of any warning lights and door interlocks. A record should be kept of the monitoring results (dose rates should be noted in units of "µSv/h") and safety system checks.

3. AUTHORISED STAFF

Only staff who have been trained in the use of the x-ray unit may operate the equipment. The staff authorised to use the equipment are listed below.

[INSERT NAMES]

4. DESIGNATION OF AREAS

No controlled or supervised areas require to be designated in connection with this unit.
5. **GENERAL PRECAUTIONS**

5.1 Any failure of a warning light or interlocks must be reported to the RPS as soon as possible. In the event of a fault resulting in the failure of the door interlock or shielding, the equipment must not be used until it has been repaired. A notice stating that the unit is out of use must be displayed on the unit.

5.2 Before generating any x-rays, check that the warning lights are functioning.

5.3 Before accessing the interior of the unit, e.g. for cleaning, check that the unit is disconnected from the power supply.

5.4 Do not tamper with or attempt to over-ride the door interlock – this could result in exposure to the primary x-ray beam.

5.5 When the equipment is not in use, remove the key to prevent unauthorised use.

6. **MAINTENANCE**

Maintenance will be carried out by appropriately qualified service engineers when necessary. No attempt should be made to repair the x-ray unit without advice from a qualified service engineer.

After maintenance, the unit should be monitored using a suitably calibrated radiation instrument and a record kept of the monitoring results.

7. **RISK/ HAZARD ASSESSMENT**

Potential hazards are:

7.1 Failure of an interlock resulting in generation of x-rays while the cabinet door is open.

7.2 Radiation leakage from the cabinet as a result of misplaced shielding following repairs to the unit or non-operation of an interlock. Routine monitoring around the unit following repairs or maintenance should minimise this risk.

7.3 Fire or mechanical damage which may effect the integrity of the shielding.

Under normal operating conditions, the equipment is adequately shielded and doses to operators will be low (< 50 µSv per year).

8. **CONTINGENCY PLANS**

IMMEDIATE ACTION is necessary to prevent exposure of persons to radiation.

8.1 In the event of a fault, SWITCH OFF the equipment and remove the key from the switch.

8.2 Do not use the equipment again until the fault has been rectified and the absence of any radiation leakage is verified.

8.3 Notify the RPS of the fault.

8.4 In the event that it is suspected that a person has received an over exposure then the RPS must be contacted immediately.

Under these circumstances, the RPS must ascertain if a person has been exposed and the magnitude of the exposure. If investigations determine that an over-exposure has taken place then the Health and Safety Executive must be notified of this forthwith.
Emergency Shutdown of X-Ray System

Each X3 x-ray system manufactured by Loma Systems is fitted with one or more emergency ‘Stop’ buttons. The main one is mounted on the front of the control panel. The button is red in colour with a yellow background. In the event of an emergency, which requires the conveyor to be immediately stopped, press the stop button and both x-rays and the conveyor will be stopped.

Dealing With Fire

In the unlikely event of fire occurring in an item of equipment manufactured by Loma Systems, it is important that a fire extinguisher containing the correct type of extinguishing material is used. Fire on electrical equipment must be extinguished using either a dry powder or carbon dioxide (CO2) extinguisher.

Audible Warnings

The X3 x-ray machine is fitted with a multi-tone alarm, which operates in the event of a fault condition. The maximum volume of the alarm is 116 dB(A) and is adjustable via a potentiometer on the back of the alarm itself. The tone can be changed, by using the 5 switches on the back of the alarm itself.

Visual Indications

The X3 x-ray machine is fitted with indicator lamps, which operate to show a particular status or in the event of a fault condition. The machine must not be operated unless all such indicators are fully operational. There are also more detailed fault listings displayed on the bottom of the operators screen.

Radiation Levels

Each Loma X3 x-ray inspection machine has a critical examination to ensure that the radiation levels emitted from the system are within the specified allowable limits. In fact at Loma we strive to be well inside the allowable limit to maximise confidence in a safe system. The legislative figure in the UK is 1µ Sv / hour but on the X3 machine we generally achieve 0.1µSv / hour on average.

In addition when a system is commissioned on a customers premises another critical examination is carried out and the results stored on record at Loma. A copy of which is also provided to the customer (see Radiation Surveys).
Occupational Safety and Health Administration Warning

“In the United States of America, the Occupational Safety and Health Administration (O.S.H.A.) Acts quite clearly place the burden of compliance on the user of equipment, and the acts are generalised to the extent that determination of adequacy of compliance is a judgement decision on the part of the local inspector. Hence Loma cannot be held responsible for meeting full requirements of O.S.H.A. or O.H.S.A. with regards to any equipment supplied, nor can Loma be held liable for penalty which may be assessed for failure to meet the requirements of the acts as interpreted by an authorised inspector. Loma, however, does act in a responsible manner with regard to safe design of equipment and will always work with customers to assist where possible in the remedy of any violations at a reasonable cost to the buyer.”
Advice On Due Diligence

By your selection of a Loma X3 x-ray system you have demonstrated your intention to assure the quality of your products and thereby protect your customers.

The following six simple actions will help you maintain Due Diligence:

1. Once your Loma x-ray system is installed you should contact your local Loma Service Department to have the system commissioned.

2. Check on a daily basis the radiation levels around the x-ray system (<1µSv/hr) using a suitable radiation meter (Details available from Loma Systems Limited) and record the results (see Radiation Surveys).

3. Regularly check the operation of the x-ray unit (once an hour is recommended). Keep accurate records of those tests and the contaminant samples being used, along with the product details.

4. If the x-ray test fails the test, quarantine the product from the last test and re-introduce through the x-ray unit once the equipment is fit for use.

5. Have the equipment supported by a Planned Preventative Maintenance Contract. Details can be obtained from your local Loma Service Department.

6. If you have or intend to have BS EN ISO 9000 accreditation, write a section into your Operating Procedures Manual covering x-ray test procedures and have each x-ray radiation meter regularly calibrated with a certificate issued.

6. Finally, at least on a yearly basis, have your operators, QA and maintenance personnel trained in the use of the equipment. Details of available training can be obtained from your local Loma Service Department.
RADIATION SURVEYS

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Interlocks and Emergency Stop Switches
Radiation Dose Rates
Routine Operational Testing
External Radiation
Measuring Dose Rate
Frequency of Monitoring
Summary of Test Procedures
Example Survey Report and Form
Introduction

As with all x-ray machines the LOMA X3 produces ionising radiation when x-rays are being generated. However, legislation governs the allowable emission levels and safe working practices when using a x-ray machine. With this in mind the X3 machine has been designed to provide adequate shielding throughout the system, with safety interlocks preventing the guards or access panels from being lifted or removed without x-ray generation being stopped. However, it is recommended, and may be required by your country, state or province, to document a radiation survey of the X3 machine on the following occasions.

1) Daily.
2) After any maintenance has been performed.
3) After the machine has been moved for any reason (new location etc).
4) After any damage has occurred to the system.
4) As per the regulations of your country, state or province.

A documented survey program assures the system is performing correctly, has not been damaged and provides regular data that the system meets all radiation guidelines.

Note: When your X3 system is commissioned your Loma service engineer will carry out an initial survey report and provide you with a copy. The UK regulations also require that radiological information be provided. This information is given in the Cautionary advice section under Local Rules.

Radiation Exam

To ensure that maintenance, modification, damage, or distortion of the cabinet, and cowlings etc. do not result in any deterioration of the safety system it is important that regular checks are carried out.
Interlocks and Emergency Stop Switches

Lids that may need to be opened by operating staff in order to clear obstructions etc. are interlocked to prevent x-rays being generated while the lid is open. Service panels that only need to be opened by trained service personnel are similarly interlocked. The interlocks used are magnetic type safety switches, which via safety relays trip the high voltage power supply and stop x-ray generation. The switch is fixed to the frame of the machine and a protective panel, when properly seated, closes the switch. After the high voltage power supply has been tripped it is necessary to re-start the inspection in order to generate x-rays.

The emergency stop button acts in a similar manner to the interlocks. After actuating an emergency stop it has to be manually reset before the x-ray generator can be restarted.

Radiation Dose Rates

In most if not all countries where ionising radiation is used there will be a maximum allowable emitted dose rate per hour. In addition, the dose measurement must be recorded at a set distance from the machine surface and around the machine at any aperture or discharge conveyor points.

In order to check that the emitted radiation level is within the guidelines a suitable radiation monitor must be used which is regularly calibrated at least once a year.

Please contact your Loma Customer Service office for details on obtaining the correct type of radiation monitor.

Routine Operational Testing

After the x-ray inspection system has been installed the service engineer will carry out a full radiation and safety survey of the x-ray system.

For assurance that the system remains safe both the emergency shut down system and measurement of the surface dose rates need to be included in a regular test schedule.

The emergency stop provides the means for the operational staff to shut down the system rapidly. Although the stop provided is of proven reliability, it is important that it is tested on a frequent basis.

The test consists of actuating the stop while the x-ray generator is operating and noting that the system immediately shuts down. It is also a requirement that when the stop has been manually reset the system does not automatically start up.

The conveyor covers need to be opened to clear blockages, etc. on the conveyor belt and it is important that the safety interlocks immediately shut down the system.

Opening each lid in turn and noting that the system immediately shuts down tests the interlocks. As noted above the system needs to be re-started before x-rays can be generated again.
External Radiation

Changes in radiation dose rate, either at the surface of the machine or at the infeed and outfeed ports, is most likely to be noted following any material alterations to the system such as a change in the arrangement of the conveyor or lids etc. In addition, if the x-ray tubes operating voltage is raised or lowered, this will affect the reading measured. It is therefore important that a full radiation survey should be carried out following servicing or repair work. Otherwise changes in the dose rate at the surface of the machine in general are unlikely to be noticed.

If changes are observed it will be at either the infeed or the outfeed ports because it is here that product enters and leaves the inspection chamber allowing some x-rays to scatter along the conveyor belt. In view of this the ports are the most important places for routine operational monitoring, but all surfaces should be checked as well.

Frequency of Monitoring

As noted above the most sensitive area for changes in the dose rate are the ports and as a consequence these should be monitored most frequently. To measure the dose rate at the two ports will take only a few minutes and should be carried out either once per day or once per shift as appropriate.

It is recommended that the dose rate at the ports be measured at the start of each shift or day so that each operating team can feel confident that all is well when they start work. The results should be noted in some form of record so that any longer term trends can be observed.

Radiation shielding of the main beam and elsewhere in the console is intrinsic to the design and where additional shielding is fitted it is mechanically fixed by welding or bolting. As a consequence of this it is reasonable to assume that there will be no changes in dose rates at the surfaces of the machine etc., and routine monitoring of these may therefore be less frequent. In addition to this a full survey should be made following any maintenance that involves removing or changing any internal parts, or following any damage which results in distorted or split housing or panels.

Where lead curtains are fitted, over time these will wear and potentially tear. Visual inspection of these on a daily basis is recommended so that signs of wear are picked up before the curtains become damaged and so prevent the potential of the external dose rate rising above an acceptable level.
Summary of Test Procedures for Radiation Leakage

Daily or Shift Checks

1) Measure and record the radiation dose rate at the infeed and the outfeed port using the radiation monitor. If it is greater than the maximum allowable shut down the system and report it immediately to the supervisor.

2) Check the condition of the lead curtains ensuring no splits or broken segments.

Weekly Checks

1) Check the emergency stops. If any of them fail report it immediately to the supervisor.

2) Check the conveyor lid(s). If opening the lid does not immediately shut down the system then use the nearest emergency stop and report the failure to the supervisor.

Monthly Checks

1) Carry out a full radiation survey over the accessible surfaces of the machine using the radiation monitor.

After a Major Service

1) Carry out a radiation survey over all accessible surfaces and at the openings of the infeed and outfeed ports. Check the emergency stops and the interlocks are operational.

After a machine has been moved

1) Carry out a radiation survey over all accessible surfaces and at the openings of the infeed and outfeed ports. Check the emergency stops and the interlocks are operational.

Note: When using the radiation monitor it must be moved slowly over the surface that you are measuring. The suggested rate is less than 6 inches per second, however users should refer to the monitor instruction manual and specification.

It is strongly recommended that persons appointed to carry out radiation surveys have received the necessary radiation awareness training qualification. In some countries this may be mandatory and it is recommended that the user seeks advice from the local health and safety executive.
LOMA X3

RADIATION SURVEY REPORT
X-RAY FOOD INSPECTION UNITS

LOMA AXIS X-RAY INSPECTION UNITS
CRITICAL EXAMINATION / RADIATION SURVEY REPORT*
(Regulation 31(2) of IRR99)  * Delete as appropriate

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<th>1. Unit Details</th>
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<td>Adequate guarding fitted:</td>
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<td>Power On warning lights labelled, visible from both sides and operate correctly:</td>
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<td>X-Ray On warning lights labelled, visible from both sides and operate correctly:</td>
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<tr>
<td>Fault warning lights labelled, visible from both sides and operate correctly:</td>
</tr>
<tr>
<td>Emergency stops fitted, labeled and operate correctly:</td>
</tr>
<tr>
<td>Conveyor interlocks fitted and operate correctly:</td>
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<td>X-ray warning labels fitted to infeed and outfeed:</td>
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<th>4. Dose Rate Results (refer to relevant drawing)</th>
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<td>For measurement point dose rates see attached drawing:</td>
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<td>External dose rate less than 1 µSv/h:</td>
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<th>5. Radiation Monitor Used</th>
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<td>Calibration date:</td>
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Comments

Test conducted by approved Engineer
Name: ___________________ Signature: ___________________ Date: ___________________
PRINCIPLES OF INSPECTION

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X-Ray Generation
Detection of X-Rays
Product Absorption
Imaging Software
Contaminant Detection
X-Ray Generation

X-rays are one of many types of electromagnetic radiation that are produced for a particular use. At some time or other most people will have received medical treatment or diagnosis, which will have involved the use of x-rays. Indeed used in the correct manner x-rays can be safely produced and have a number of uses, one of which is for the inspection of food products.

Note: X-rays cannot make food products radioactive, as soon as the power source ceases x-ray generation stops and no residual radiation is present.

The principle of x-ray generation is one that is simple to understand and is shown in the diagram below. An evacuated glass tube is used to house a cathode (-ve terminal) and an anode (+ve terminal) which is itself then housed inside a led lined oil filled tank which electrically insulates the tube from the case. In addition the oil is circulated and cooled to dissipate the unwanted heat that is generated when x-rays are produced.

A filament emits electrons inside the tube and a high voltage is then applied which accelerates the electrons towards the target on the anode. When the electrons hit the target x-rays are given off in the form of a conical shaped beam. In effect the voltage controls the brightness and the current the contrast.

Detection of X-Rays

Once x-ray generation has taken place and we have the aforementioned conical shaped beam, the next step in the process used on the X3 machine is to include a device which will receive the x-ray energy and process its signal values.

To do this we first position an assembly directly under the x-ray tank known as the collimator. The collimator in effect allows only the small centre section of the x-ray beam to be emitted approximately one millimeter in thickness. This section of the beam can be considered to be fan shaped and positioned at ninety degrees to the product flow direction as shown in the diagram below.
Located on the under side of the centre section of the X3 machine is a device known as the detector array which is positioned directly in line with the x-ray beam. A line of photosensitive diodes receive the x-ray energy of which the values are then processed in the form of grayscales - 0 (black) to 255 (white). These scan lines take place at hundreds of scans per second which means a direct relationship between scan rate and belt speed/flow rate exists.

When product is not passing through the x-ray beam the detector array receives 100% of the x-ray energy over the entire length of the array.

When product is introduced through the beam less than 100% of x-ray energy is received of which the signal values will be processed and shown as a grayscale image.

**Product Absorption**

When we refer to the product absorption level we mean the amount of x-ray energy that the product will consume (absorb) when x-rays are passed through it. The higher the density of the product passing through the beam, the greater the product absorption factor.

At this stage it is worth noting that just because a product may measure to be higher than another product it does not follow that the greater size is necessarily of a greater overall density. A good example of this is to compare a quantity of water to a quantity of ice cream that measures the same in size. This is shown in the diagram below.
It can therefore be seen that the 100mm of water will absorb a much higher level of x-ray energy than an equivalent quantity of ice cream. In turn the detector array mentioned earlier would receive a lower quantity of x-ray energy through the water compared to the ice cream. The consequence of this is one that generates a lighter grayscale image on the screen in the case of the ice cream.

Further to our examination into product absorption it is important to remember that not all products will have an even absorption factor across its entire area. The ‘water’ ‘ice cream’ example shows the density differences assuming both products are homogeneous.

In the case of a particulate product it must be understood that density values will vary across the entire area of the product. Therefore it follows that the level of x-rays reaching the array (detector) will also vary. This will result in an image being shown on the screen of varying grayscale levels. An example is shown below of the effect a particulate product will have in terms of absorption factor.

<table>
<thead>
<tr>
<th>A = 2 x Absorption</th>
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<tbody>
<tr>
<td>B = 5 x Absorption</td>
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<td>C = 3 x Absorption</td>
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Module 4000
When we talk about the absorption factor it is useful to know that the density value is dependant on the specific gravity of the product and that by multiplying the specific gravity value of the product by the height, we can calculate the absorption factor.

**Equating Absorption**

Water has a SG (specific gravity) of 1. The relative absorption can be derived from multiplying the product height by the SG.

In the example above the absorption factor is $75 \times 1 = 75$

By introducing a 1mm steel contaminate of SG = 8, the absorption of the water has been reduced to $74 \times 1$ (1mm displacement) but the overall absorption factor has increased.

$$(74 \times 1) + (1 \times 8) = 82$$, a 9% increase

The system detects the density change. If the above example is changed to 5mm high an even larger increase is observed.

$$5 \times 1 = 5$$ now becomes $$(4 \times 1) + (1 \times 8) = 12$$, a 140% increase

From the following diagram it can be seen that contaminate A is easier to detect than B. With B the x-ray beam passes through more of the product and therefore has a higher absorbency factor.
Imaging Software

On the PC mounted in each x-ray machine is loaded software dedicated to the image acquisition, analysis and viewing on the monitor. The version being run on a particular machine is shown in the blue start screen.

Parameter values are then setup to optimize the system performance and requirements suitable for each application.

Contaminate Detection

The analysis is carried out by comparing each image pixel to a threshold value and rejecting anything below this value i.e. it is denser and hence darker than the product itself. This relationship to density means that if a contaminate is close to water (it floats) then it cannot be detected e.g. insects, wood, hair or paper.
INSTALLATION

CONTENTS

Installation - Mechanical
Installation - Electrical
Installation - Pneumatics
Checking and Powering Up

Module 5000
When moving the X3 conveyor machine place the forks in the indicated position. Care must be exercised when lifting and moving the X3 making sure that the control unit is not too close to the fork lift face. In addition care must be taken to make sure that the X3 cannot slip when the forklift is in motion.

**LIFTING AND MOVING AN X3 MACHINE**

When moving the X3 pipeline machine place the forks in the indicated position. Care must be exercised when lifting and moving the X3 making sure that the control unit is not too close to the fork lift face. Be aware that the centre section must be locked in place before attempting to move the machine. In addition care must be taken to make sure that the X3 pipeline machine cannot slip when the forklift is in motion.

**X3 CONVEYOR INCLUDING RAPID**

**X3 PIPELINE**

PLACE FORKS HERE

PLACE FORKS HERE
Installation - Mechanical

Pre-Installation Note For Pipeline Machines

Please note that the infeed and outfeed product pipes need to be fixed to ensure they remain stationary when machine is normalised. These fixings are the responsibility of the user unless supplied with the machine under the agreed machine specification.

Preparing to Install the Machine

The system is dispatched from Loma Systems in the following state:

1) Feet are screwed fully in.
2) The X-Ray tank breather screw is in and locked.
3) Delicate items are covered in protective wrapping material and attached or boxed (i.e. lamp stack)

Space Required for Installation and Maintenance

It is important that sufficient free space is left at the front and back of an X3 x-ray machine to enable commissioning and maintenance personnel to easily gain access to components. It is recommended that a minimum of 1 metre free space is available at the front and rear of the machine.

Removal of Packing Materials

1. Remove and discard all packing and protective materials.
2. All X3 machines are delivered secured to a pallet by 12mm bolts, which are screwed through the feet of the machine. Remove these bolts where fitted.

Removing the X3 off the Pallet

Note: Refer to LIFTING AND MOVING AN X3 MACHINE in this section.

Using a Fork Lift Truck

1. Position the forks beneath the machine at the lifting points indicated so that it does not tilt (Refer to LIFTING AND MOVING AN X3 MACHINE). Raise the lift sufficiently to lift the machine clear of the pallet and any obstacles.
2. Carefully move the machine to the required location following the advice stated in LIFTING AND MOVING AN X3 MACHINE.
3. Lower the forks and withdraw them from the machine.
Adjusting/Levelling the Machine

1. Level the machine by adjusting the foot studs. The stud flats are 17mm A/F. Make sure that all feet are firmly on the ground, and are evenly supporting the machine so that it does not rock. If necessary, anchor the machine to the ground using bolts screwed through the feet.

2. Due to the fact that each X3 machine has an oil filled tank (in which the x-ray tube is immersed) it is necessary to level the machine to ensure that 100% of the x-ray tube is immersed. To this end use a spirit level across the top of the cabinet, in the direction of flow, adjusting the feet until a level condition is achieved.

3. When the height and level is correct, lock the foot stud half-nuts. The lock nut hexagon is 30mm A/F. Failure to do so can have an adverse effect on the components of the X3 x-ray system.

4. You are recommended to apply silicone sealant around the feet and floor.

Unlocking the X-Ray Tank Breather

Each X3 machine is delivered with the x-ray tank breather screw locked. Therefore it follows that this screw needs to be unlocked before powering up the machine.

To do this, open the cabinet lid by removing & retaining the fastenings. The breather screw is easily located on the top of the x-ray tank filler plug. Loosen the screw by two or three turns anti-clockwise and refasten the lid.

Where an air conditioner or heat exchanger cooling is specified, the breather should be unlocked before fitting the cooler/lid assembly.

Fitting the Air Conditioner or Heat Exchanger Option

It should be noted that in most cases conveyors fitted with air conditioner or heat exchanger cooling will have the lid/cooler assembly supplied loose. The electrical connector must be made to the underside of the cooler. It will require 2 persons to fit the lid/cooler assembly due to the weight. The necessary fastenings are supplied.

The cooler parameters will have been factory preset.
Installation - Electrical

Connecting Electrical Supplies

The supply voltage for the system is indicated on the identification/rating plate that is mounted on the frame. The maximum line current is also shown.

1. Open the door on the rear of centre section cabinet to access the electrical services area.

2. The isolator switch is located at the bottom right hand of the cabinet when viewed from the rear. Beneath it on the bottom of the cabinet is the cable gland access for the power cable.

3. The system-input power will depend on the country and system type that has been delivered. For details refer to the rating plate mounted on the frame of the X3 machine in conjunction with the wiring diagrams delivered with the user manual.

4. Split the cable inside the box and cut the wires to suitable lengths. An armoured/braided cable is recommended when cable conduit is not used. A suitable earth conductor is also to be fitted.

5. Refer to Figure below for isolator switch wiring details. Make the connections to the isolator switch as specified in Table 1.

Isolator Switch Terminals

Module 5000
## Table 1 Electrical Supply Connections

<table>
<thead>
<tr>
<th>European</th>
<th>Colour</th>
<th>North America</th>
<th>Colour</th>
<th>Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIVE</td>
<td>Brown or black</td>
<td>HOT</td>
<td>Black</td>
<td>1/3/5</td>
</tr>
<tr>
<td>NEUTRAL</td>
<td>Blue</td>
<td>NEUTRAL</td>
<td>White</td>
<td>N</td>
</tr>
<tr>
<td>EARTH</td>
<td>Green/Yellow</td>
<td>GROUND</td>
<td>Green</td>
<td>E</td>
</tr>
<tr>
<td>SCREEN</td>
<td>-</td>
<td>SCREEN</td>
<td>-</td>
<td>E</td>
</tr>
</tbody>
</table>

6. Check that all connections are secure then close and lock the door.
Installation - Pneumatics

Connecting the Air Supply

All X3 x-ray systems require a compressed air supply, primarily to operate the automatic reject system. In addition the standard X3 conveyor model requires a further air supply to feed the vortex cabinet cooler situated on the top of the central cabinet. In this situation when a reject occurs operation of the vortex is inhibited to allow maximum air to the reject mechanism. It is therefore essential that the air supply is robust enough for correct operation of the X3 machine when either the reject or vortex operate.

The X3 pipeline machine also requires an additional air supply for the operation of the shutter piston located by the side of the collimator. The minimum air pressure must not fall below 65psi (4.5 bar) when the reject operates on all models.

In the case of a pusher reject, a dump valve is also fitted in order to protect an operator in case of an emergency. As soon as an emergency stop is activated the mains air supply is shut off and all air is exhausted from the system.

In addition for failsafe reasons an air pressure switch is fitted in order to alert the operator that the air supply is low and shut down the system generating a fault condition.

The mains air supply is to be connected as shown below to the input side of the air regulator and should be set to 5.5 bar (80 psi).

![Pneumatic diagram]

**Pneumatic assembly** (pipeline shutter valve not shown)
Installing Module 5000

Checking Guards

1. Check that all guards and interlocks are securely fastened in place.
2. Check that the infeed and outfeed of the system are clear of obstructions.

Powering Up the System

WARNINGS

1. **LETHAL HAZARD – ELECTRICAL AND COMPRESSED AIR SUPPLIES.** This equipment uses electrical and compressed air supplies that can be lethal. Unless absolutely necessary, work must not be carried out without first isolating the equipment from all electrical and compressed air supplies.

2. **LETHAL HAZARD – RADIATION.** Whilst every precaution has been taken to make sure that all the necessary guards and safety devices have been fitted to the Loma x-ray unit, it is recommended that all operatives are trained in the use of x-ray food inspection machines. In addition users must adhere to the necessary requirements required by their country, state or province. Furthermore it is the responsibility of the employer to create a set of local rules (see example in Cautionary Advice) regarding the safe use of x-ray food inspection systems. In the U.K. this is in compliance with the Ionising Radiation’s Regulations 1999, users outside of the U.K. should consult the relevant health and safety executive (see also Radiation Surveys).

3. **WORKING ON EQUIPMENT.** If it is essential to work on the equipment with electrical and/or compressed air power connected, the work must be undertaken only by qualified and authorised personnel who are fully aware of the danger involved and who have taken adequate safety precautions to avoid contact with dangerous voltages, compressed air supplies or radiation.

4. Each x-ray system manufactured by Loma Systems is fitted with emergency ‘Stop’ buttons. This is mounted on the front of the control panel. The button is red in colour with a yellow background. In the event of an emergency, which requires the machine to be immediately stopped, press the stop button and both x-rays and the conveyor will be stopped. In addition an alarm will sound and an amber lamp will be illuminated.

5. Before powering up any X3 machine for the first time, a suitably qualified person should be present to carry out a critical examination (see Radiation Surveys). For advice please contact your local Loma Service office.

6. Switch on the compressed air supply to the system and open air isolator switch.

7. At the bottom left hand side of the central electrical services cabinet switch on the mains isolator. The system automatically boots up in a failsafe fault condition with the alarm sounding and the amber fault lamp on.
8. Press the amber fault reset button, the alarm should stop and then again to clear the amber fault lamp.

9. On fixed speed conveyor models only operate the green ‘Start’ switch located on the system control panel. Check that the Conveyor belt runs in the correct direction. If incorrect swap two of the phase cables over in the incoming supply. Variable speed conveyors will be correct and not need adjustment.

10. At this stage contact an authorised key holder to insert the key into the x-ray key switch and switch to the on position. Refer to operators guide and setup section for further details.

**Checking Belt Tracking**

The belt must be checked for correct tracking before running the conveyors for any length of time. The tracking adjusters are found adjacent to the end rollers of the X3 conveyor machine.

If belt tracking needs to be reset, carry out the belt tracking procedure described in the section titled Routine Maintenance (Weekly/Monthly) in the Maintenance section of this manual.

**Setting Up Reject**

**WARNING**

REJECT DEVICES. At no time, with air and/or electrical power applied to an automatic reject device, should any part of the body be placed within the operating area of the reject device.

**General**

The system is normally supplied with the reject mechanism correctly set up for at least one product. If the Reject Delay and Dwell times need to be adjusted for further products, these are set up via the user interface. Refer to the sections titled Reject Setup in the operators guide.

**Pusher and Plough Rejects**

The system is supplied with the reject cylinders already set, and normally no further adjustment should be necessary.

In certain instances Loma may supply a Reject Device only, and the end user supplies the Reject Catchment Device, Bin / Table, etc. The safety of the Reject Device is therefore a
function of the design of the User’s Reject Catchment Device. It becomes the User’s responsibility to ensure the safety of the complete Reject System.

In most instances the product is delivered onto the system by conveyors. The System has to have entry and exit points. There is a possible hazardous area at the transfer between the conveyors. Loma rely on the total line being made safe by the End User.

**WARNING**

The internal cabinet areas of the machine contain electrical devices that may be at 400V 3Ph, or 230V 1Ph or 110V 1Ph potential depending on the supply voltage. These voltages may cause injury or death on contact. Work in this area should only be carried out by a qualified Technician with the Isolator switched off. (The Isolator is located at the bottom left-hand side of the Electrical Services Box).

Diagnostic work should not be undertaken unless the Technician has been Loma trained.

**WARNING**

For fixed speed conveyors and pipelines located in a wet environment a Ground Fault Interrupter or RCCB must be used. This is not recommended for variable speed conveyors as the inverter may cause the device to trip.
Installation, PC & Communications Options

The PC has a read/write CD module installed as standard. This enables multiple product images and operating data to be stored to disc. Writing is only possible when the machine is out of run. The disc can be removed for reviewing the stored images off line.

Remote support/communications option.

The 2 appropriate communication ports on the rear of the computer are shown on drawing 8900/C3/43562-Man_F.

1. Modem connection.
   The commissioning engineer will have to set up the modem to operate locally if the machine is outside the UK.
   The modem must be connected for Remote Support to function.
   Remote Support is available, for an authenticated Loma representative only, to dial into the machine externally. This allows remote diagnosis and/or intervention where possible.
   The user must manually switch on Remote Support. For security reasons, this will default to off when the system is restarted. For the communications software to properly start up a mouse must be connected.
   The procedure for this is as follows:
   
   - Turn power off at isolator (to prevent internal PC fuse blowing).
   - Connect the mouse to the mouse socket.
   - Turn the power back on to restart system.
   - Go to System Setup and navigate to the Power Check screen.
   - Activate Remote Diagnostics.
   - Acknowledge the message that reports that this will affect system performance.

   Running Remote Support is detrimental to the processing speed of the system, and could impact on system operation.
   Once the Remote Diagnostics is finished return to the Power Check screen to deactivate it. The mouse should be disconnected otherwise system performance may be affected. When disconnecting the mouse, the machine must again have the power turned off first.

2. Network connection.
   Networking operates by making a shared directory, available on the network to an authenticated user, over NT networking on TCP/IP. This is only possible when the machine is out of run.

3. RS232 connection
   This port is available for use with optional Lomanet or internal printer if specified.

Module 5000
Please note that the customer must drill the cabinet for communication cable entries. This must be done with care regarding the existing wiring and components, and relevant glands fitted to meet the required environmental protection.

Ensure that any swarf is removed by vacuuming. It must not be blown out using a compressed air line, as this will cause contamination within the delicate electronic components.

All functions described here should be discussed with a Loma representative, to assess suitability in particular applications, and to aid machine set-up prior to shipping.

**UPS (uninterruptable power supply)**

If the machine has been switched off for a period greater than one week or if the unit has been switched on and off a few times in quick succession, it is advisable to leave the machine switched on for at least one hour to charge the UPS batteries.
ATTENTION

IT IS IMPERATIVE THAT THIS MACHINE IS CORRECTLY EARTHED.

PLEASE CHECK SUPPLY VOLTAGE BEFORE SWITCHING ON.

Errors will affect Loma warranty

For X3 fixed speed conveyor machine
ATTENTION

IT IS IMPERATIVE THAT THIS MACHINE IS CORRECTLY EARTHED.

THIS MACHINE SHOULD NOT BE SUPPLIED VIA AN EARTH LEAKAGE CIRCUIT BREAKER (RCD)

PLEASE CHECK SUPPLY VOLTAGE BEFORE SWITCHING ON.

Errors will affect Loma warranty

For X3 variable speed conveyor machine
ATTENTION

IT IS IMPERATIVE THAT THIS MACHINE IS CORRECTLY EARTHED.

PLEASE CHECK SUPPLY VOLTAGE BEFORE SWITCHING ON.

Errors will affect Loma warranty

THIS MACHINE WILL EMIT X-RAYS IF NOT CONNECTED USING OFFSET FEED PIPES OR IN A PIPELINE & SHOULD NOT BE ENERGISED UNTIL CORRECTLY INSTALLED.

For X3 pipeline machine
MAINTENANCE

CONTENTS

Inspection and Cleaning
Routine Maintenance (Daily/Weekly)
Routine Maintenance (Weekly/Monthly)
Inspection and Cleaning

Loma x-ray inspection systems should provide trouble-free operation, particularly if a sensible routine maintenance procedure is carried out, as described in this section. The following topics are covered:

- Inspection and Cleaning
- Routine maintenance.

If you have any queries relating to the maintenance of your x-ray system your Loma Service Centre will be pleased to advise you.

WARNINGS

1. LETHAL HAZARD – ELECTRICAL AND COMPRESSED AIR SUPPLIES. This equipment uses electrical and compressed air supplies that can be lethal. Unless absolutely necessary, inspection and cleaning must not be carried out without first isolating the machine from all electrical and compressed air supplies.

2. WORKING ON EQUIPMENT. If it is essential to work on the equipment with electrical and/or compressed air power connected, the work must be undertaken only by qualified and authorised personnel who are fully aware of the danger involved and who have taken adequate safety precautions to avoid contact with dangerous voltages or compressed air supplies.

3. REJECT DEVICES. At no time, with air and/or electrical power applied to an automatic reject device, should any part of the body be placed within the operating area of the reject device. Under no circumstances must the system be operated with any reject valve removed. When working on pipelines the additional precaution of isolating the pump must also be taken before any work is carried out.

Cleaning Materials Required

The following materials are required to clean the machine:

- Mild detergent.
- Clean water
Daily

1. Isolate the electrical and compressed air power supplies to the system.

2. Check that there is no build up of debris on the conveyor and in the case of a pipeline clear any remaining product left inside the product pipe.

3. Check that the belt and belt rollers are clean and are free from a build up of either product or foreign material, e.g. wrapping film. Material on the rollers may cause incorrect tracking of the belt and also transfer dirt to the conveyor belt.

4. Check that the reject container is not full. This is particularly important if a ‘Bin Full’ detection device is not fitted. If necessary, empty the container in accordance with company practice on removal of rejected product.

5. Either wipe or wash the system using a mild detergent solution. Pay particular attention to the centre section of the main cabinet behind the curtains, as this area is not seen when in production.

6. Clean / wipe the photoelectric cell (PEC) and the reflector. These are located behind the inside curtains in the centre main cabinet and are mounted either side of the conveyor. Should the machine be fitted with an overhead PEC wipe clean the face only as this is distance setting where no reflector is necessary.

7. Clean / wipe the curtains on the infeed, inner left, inner right and outfeed.

8. If a hose wash is to be used the following information may be of use:

   If necessary the Loma X3 conveyor model has the facility to override the interlock switches for the purpose of running the conveyor to wash down. To do this the power must be switched on and the key switch must be in the cleandown position (refer to operators section).

   **Note:** When the keyswitch is in the cleandown position x-rays cannot be generated therefore the user must insure that the X3 is not in RUN in order that a fault condition is not generated.

   - Water jet nozzle is <12.5mm (1/2") diameter, rounded.
   - Water delivery rate is <105 litres/minute (23.1 gallons/minute) rounded.
   - Distance of nozzle from equipment 2.5 - 3 metres (8.2-9.8 ft) rounded.

   **Note:** Do not inject water directly into bearings.

9. If not already actioned in the previous step switch on the electrical and compressed air power supplies to the system.

10. Switch the keyswitch to the x-ray on position, enter RUN mode and check that the reject mechanism successfully rejects a contaminated product into the reject bin.
Weekly Inspection

1. Isolate the electrical and compressed air power supplies to the system.

2. Check the security of fixtures and fittings and that all guards are securely fastened in place.

3. Check that all interlocks and emergency stops function correctly.

4. Check that the system and associated equipment has been cleaned correctly and there is no build-up of product or debris, particularly in the centre section of the conveyor model.

5. Check that all of the curtains (conveyor model) are in good condition and that there are no splits in the material.

6. Inspect the conveyor belt for damage and contamination.

7. Check that the conveyor belt is correctly tensioned and is neither too tight nor too slack. If a belt is too loose, adjust it as described in the section titled Routine Maintenance Daily / weekly.

   **Note:** Over tensioning the belt may cause damage to bearings and motors.

8. Check the internal radiator fins are clear of dust and debris.
Routine Maintenance (Daily/Weekly)

1. The X3 system is fitted with an air regulator and an integrated automatic water trap. Check that the bottle/filter is clean and the outlet not blocked.

2. Switch on the electrical and compressed air supplies to the system.

3. Switch the keyswitch to the x-ray on position, enter RUN mode and check that the reject mechanism successfully rejects a contaminated product into the reject bin.

4. Check that the conveyor belt is tracking correctly. If tracking is not correct, adjust it as described in the section titled Routine Maintenance (Weekly/Monthly).

The ‘Daily/Weekly’ routine must be carried out on a daily basis when the system is in constant use, but can be stretched to a week when the demands on it are low. If you have any queries relating to the maintenance of your system, your Loma Service Centre will be pleased to advise you.

WARNINGS

1. LETHAL HAZARD – ELECTRICAL AND COMPRESSED AIR SUPPLIES. This equipment uses electrical and compressed air supplies that can be lethal. Unless absolutely necessary, maintenance must not be carried out without first isolating the system from all electrical and compressed air supplies.

2. WORKING ON EQUIPMENT. If it is essential to work on the equipment with electrical and/or compressed air power connected, the work must be undertaken only by qualified and authorised personnel who are fully aware of the danger involved and who have taken adequate safety precautions to avoid contact with dangerous voltages or compressed air supplies.

3. REJECT DEVICES. At no time, with air and/or electrical power applied to an automatic reject device, should any part of the body be placed within the operating area of the reject device. Under no circumstances must the system be operated with any reject valve removed. When working on pipelines the additional precaution of isolating the pump must also be taken before any work is carried out.
Routine Maintenance (Weekly/Monthly)

Recommended Greases and Oils

CONTAMINANTS. Oils and greases must always be handled with care. Prolonged bare skin exposure to certain oils and greases can cause skin problems. Always handle oils and greases in accordance with the manufacturer’s instructions.

**Oil**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Oil Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHELL</td>
<td>Transformer 148 (x-ray tank)</td>
</tr>
</tbody>
</table>

**Grease**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.P.</td>
<td>Energrease LS2</td>
</tr>
<tr>
<td>Mobil</td>
<td>Mobilux EP2</td>
</tr>
<tr>
<td>Texaco</td>
<td>Multifak All Purpose EP2</td>
</tr>
</tbody>
</table>

**Greasing**

All X3 conveyor units fitted with outboard bearings require greasing at regular intervals.

Bearings should be greased four (4) times per year, unless the environment or cleaning regime dictates that they are greased more frequently.

1. Isolate the electrical and compressed air power supplies to the machine.

2. Remove the covers from the motor drive housing to gain access to the grease nipples on the drive unit bearings.

3. Using a grease gun, apply grease to each nipple in turn. Take care not to apply too much grease. Grease should not issue from the bearing. Refit the covers to the motor drive housing.

4. Using a grease gun, apply grease to each nipple on the remaining roller bearings throughout the system. Take care not to apply too much grease. Grease should not issue from the bearing.

5. Switch on the electrical and compressed air power supplies to the X3 machine.

Module 6000
**Air Regulator/Water Trap Maintenance**

All X3 Systems are fitted with an air regulator/filter unit. Adjust the pressure setting as described below:

1. Check that the regulator pressure setting is correct. This should be between 60psi (4.2 bar) and 80psi (5.5 bar). To adjust the regulator pressure, pull up the cap and turn it either clockwise to increase the pressure or counter-clockwise to decrease the pressure. Push down the cap to lock it when finished.

2. Check that the water trap is empty. Empty it by pressing the drain pin.

The ‘Weekly / Monthly’ routine must be carried out on a weekly basis when the system is in constant use, but can be stretched to a month when the demands on it are low. If in doubt, your Loma Service Centre will be pleased to advise you.
**Electrical Services/ X-Ray Cabinet**

1. Check that the internal cabinet fan is working, this is located in the upper section of the cabinet. This should be running all the time that mains power is on. **Note: Do not attempt to check this with x-rays on and interlocks overridden.**

   Check that the fan is working on the x-ray tank cooling system located at the lower left rear of the cabinet when viewed from the rear. In addition the PC fan also needs be checked that it is operational. **Note: Do not attempt to check this with x-rays on and interlocks overridden.**

   **Caution:** DO NOT operate the system if either of these two fans is not running. In this unlikely event, check the fuses or contact your local Loma Service Department.

2. Check the oil level in the x-ray tank is approximately 15 mm below the filler plug. The filler plug is located on the top of the x-ray tank situated in the upper area of the cabinet on both the conveyor and pipeline models. If the level is lower than stated telephone your local Loma service office for advice. **Note: This oil level should not change unless a leak in the system is present. In addition it should be noted that the oil is of a special insulating type and should not contain any moisture or air bubbles (Refer to RECOMMENDED OIL AND GREASE).**

3. On pipeline models check that the shutter mechanism inside the collimator assembly is operating correctly and that the DELAY BEFORE ON timer setting is correct. This timer is located at the front of the cabinet behind the access panel.

**Setting & Adjusting the Conveyor Belt Tension & Tracking**

**NOTE:** Do not over-tension the belt, as this will cause premature wear of the bearings and damage the belt.

If the belt slips or moves during normal operation, check the condition of the rollers and make sure that debris has not built up between the rollers and the conveyor belt. This alone can cause tracking problems.

Follow the steps described below:

**Note:** If any difficulty is found with tensioning or tracking, consult your local Loma Customer Service Department.
**Adjusting the Belt Tension (conveyor model only).**

The belt tensioning screws are located adjacent to the second roller in from the end of the X3 conveyor.

1. Check that the belt and all rollers are clean and free from debris and greasy elements.
2. Check that all rollers are square across the conveyor and are free to rotate.
3. With the belt in a slack condition, i.e. belt slipping when the motor is running, and centralised along the length of the conveyor, adjust the tensioning screws evenly until belt drive is achieved.
4. Increase the tension until there is no slip condition with the belt under load (full product load).

**Setting the Belt Tracking**

The belt tracking screws are located adjacent to the rollers at the end of the X3 machine.

With the belt tension set, the belt should now be running down the centre of the conveyor. If the belt moves to one side, this indicates that the tracking needs to be adjusted.

1. Turn the tracking screw on the same side of the conveyor to which the belt is moving by a quarter turn clockwise.
2. If the belt still moves in the same direction, repeat Step 1 until the belt moves back to the centre of the roller.

**NOTE:** Do not over-tension the belt whilst adjusting the tracking.

3. If necessary, slacken the opposite tracking screw by turning a quarter turn counter-clockwise.

**NOTE:** When making adjustments to the tracking each adjustment should be in small increments at a time. In addition time should be allowed for the belt to move before further adjustments are made.
Adjusting the Drive Chain Tension (conveyor model only)

WARNING

When the cover is removed from the drive module the sprockets and chain are exposed. Care must be taken when making adjustments.

1. The drive chain has an automatic tensioner, which will take up any stretch of the chain. If the chain requires checking or lubricating, follow the procedure below.

2. Remove the drive cover from the drive unit. (In some cases it may be necessary to remove the reject bin).

3. Check the tension of the drive chain and free movement available of the spring loaded tensioner. The chain should not be so tight that there is no movement whatsoever, inversely it should not be so loose that the chain tensioner is at the end of its movement.

4. If the chain needs replacement, retract the tensioner and hold in place with a suitable tool, remove the chain split link & remove the chain. Replace with a new chain with the same number of links. Release the tensioner and re-check the tension.

5. Check to ensure the sprocket alignment is correct and the grubscrews that lock the sprockets to the shafts are tight.

6. If necessary lubricate the drive chain with a suitable lubricant.

7. Replace the drive cover and any other covers removed.
Adjusting the Reject Mechanisms

WARNING

REJECT DEVICES. At no time, with air and/or electrical power applied to an automatic reject device, should any part of the body be placed within the operating area of the reject device.

If the reject Delay and reject On times need to be adjusted, these are set up via the user interface from the control panel. Refer to the menu titled setup reject.

Pusher and Plough Rejects

At the solenoid valve, adjust the two throttle screws, in conjunction with the reject delay and dwell times, until the required reject timing and speed of operation are obtained. The air pressure supplied to the conveyor affects both the reject timing and the speed of operation.

Air Blast Reject

Since this type of reject has no throttles, the only variables that can be adjusted are the reject delay and reject on times.

Signal Only

Where signal only is required adjustment to the dwell and delay reject times is all that is necessary unless an auxiliary reject is fitted outside of the X3 machine.
PRODUCT DESCRIPTIONS

CONTENTS

Technical Specification
X-Ray Subsystem
Conveyors
Safety Guards/Devices
Reject types
Electrical services
Other standard equipment
Optional equipment
Technical Specification

X-ray unit.............................................................................................................Loma X3
Case Material..........................................................Stainless steel 304L, fabricated
Case Finish..........................................................Bead blasted
Environmental Protection........................................Dust and waterproof to IP66 level (Nema 4x)
.......................................................................................................................... Rapid & SnaX3 to IP55 only
Control Unit.............................................................................................................Loma X3
Computer .................................................................................................. 933 MHz (minimum)
LCD Screen ..................................12.1” TFT (Rapid) & 15.1” TFT (Std.Conveyor & SnaX3)
Mounting ............................................................On adjustable feet

Power Requirements

Supply voltages..............................230v/1ph/ 50Hz, 400v / 3ph / 50Hz
.......................................................................................................................... 220v / 3ph / 60Hz, 110V /1ph / 60Hz
Load Current (typical) ................................Conveyor - 110V / 11A, 230V / 6A
.......................................................................................................................... Pipeline - 110V / 5A, 230V / 2A
.......................................................................................................................... Rapid - 110V / 5A, 230V / 2A

Environment

Operating Temperature .................................................................+2º to +30ºC
.................................................................................................................. With air conditioning unit fitted maximum temperature is +40ºC
Relative Humidity.............................................90% non-condensing (maximum)
Nominal line height .................................................................900mm ± 100mm
Air supply ..............................................................5 to 8 bar / 80 to 100 psi at a volume of 25 cfm
Weight .................................................................Conveyor - approximately 550 kilograms
.......................................................................................................................... Pipeline - approximately 350 kilograms
.......................................................................................................................... Rapid - approximately 250 kilograms
X-Ray Subsystem

The x-ray components and control system are fitted inside the central stainless steel cabinet.

X-Ray Tank

A x-ray generating tube is mounted inside the oil-cooled tank. A mains driven pump circulates the oil around, through a fan cooled radiator to stop the x-ray tube from overheating. The oil used is a mineral based transformer oil. If required a copy of the UK health and safety COSHH data sheet can be provided upon request.

High voltage PSU

The x-ray power is supplied by a high voltage power supply, which controls the power level (kV) ranging from 20 to 80 kV depending on the model.

Filament PCB

The current (mA) supplied to the tube filament is regulated by a separate filament drive PCB.

Detector Array

The detector array comprises of a line of photosensitive diodes (the number varies depending on the width used) - 256 diodes for 200mm wide, 384 diodes for 300mm wide, 640 diodes for 500mm wide and 768 diodes for 600mm wide - which receive the x-ray energy emitted from the x-ray tube. The diodes used are 0.8mm across. The SnaX3 machine uses 640 1.6mm diodes in a L shaped configuration. The detector scans at a rate of hundreds per second (typically 620) depending on the belt/product speed. Both serial and parallel connections go directly to the PC, the parallel connections providing the image data and the serial connection allowing full control of the sensor by the PC. The PLC provides timing signals in the form of the 'scan' and 'acquire' signals.

Warning – The system should not be left generating x-rays for extended periods of time with no product passing through, as this is likely to reduce the life of the detector.

PLC

The PLC has a number of functions. To control and monitor the power level and the current supply to the x-ray tube. It also monitors and controls various systems. This includes the reject signal and serial communication to the PC.

PC (Computer)

The PC is located in the centre section of the X3 machine and is where the control software, image processing software and hardware are located. Data is received from the detector, analysed and then displayed on the monitor. The PC also communicates with the PLC. When power is removed from the system e.g. due to a power failure the PC operating system will still shut down in an orderly manner due to a small internal uninterruptable power supply (UPS) which maintains power for at least the duration of this process.
User Interface

A display monitor is fitted behind a clear polycarbonate panel. On the right hand side and below are membrane switches used in conjunction with the screen information. Down the left hand side are the control switches. Details of these are shown at the end of the Section.

X3 X-Ray PC Software

This software is used to provide for the operator interface to the system, gather and display image information of product passing through the machine and communicate with the PLC.

CONFIGURATION

One of two standard power levels is provided on each unit as follows:

a) 100 Watt System, Tube voltage (max) = 50 kV Tube current = 1.0 to 2.0mA
b) 400 Watt System, Tube voltage (max) = 75 kV Tube current = 1.0 to 5.0mA

The 100watt version is used on pipelines. For special applications e.g. SnaX3 the maximum tube voltage is 80kV.

In addition to the power levels available, the detector array selected is dependent on the width of the conveyor as follows:

a) 205mm (for a 200mm wide Rapid conveyor or pipeline)
b) 307mm (for a 300mm wide conveyor)
c) 512mm (for a 500mm wide conveyor)
d) 614mm (for a 600mm wide conveyor)
e) 800mm high x 1225mm wide (L shaped for SnaX3)

Conveyors

A 250 watt 0.3hp (187W for the Rapid) motor drives the conveyor. The speed can be supplied as fixed or variable speed via an inverter. In addition the conveyor is fitted with a suitable reject system that will best ensure that contaminated product is successfully placed in a suitable container e.g. reject bin.

The non-crack surface makes it easier to clean and in addition is non-absorbent. The standard belt supplied is PU but Intralox belt is supplied if required. The conveyors are supplied in the following standard sizes:

Nominal line height: 900mm ± 100mm
Belt widths: 200mm (Rapid), 300mm, 500mm, 600mm.
Typical Lengths: 1900mm (Rapid), 2100mm (Standard) and 2800mm (Bulk Flow)
### Safety Guards / Devices

#### Guarding

For x-ray machines the use of guarding is extremely important in order to shield operators from the ionising radiation present when x-rays are on. Legislation specifies the radiation limits surrounding a x-ray machine. Radiation levels must not be greater than $1.0 \mu \text{Sv per hour}$. The level emitted from the Loma X3 machine is much less, on average not greater than $0.1 \mu \text{Sv per hour}$. This is achieved by engineering and design. The stainless steel construction creates most of the shielding required with the addition of internal lead protection and four lead loaded curtains. These curtains are fitted at each side of the internal x-ray cabinet and at the infeed and outfeed ends of the conveyor. For high power units two curtains are fitted at each of the four locations; the two curtains are staggered to ensure that the fingers of each curtain overlap. For these applications it is important that if for any reason the curtains are replaced that this overlap is maintained. In certain bulkflow applications the curtains may not be fitted and protection is provided by the fact that access cannot be obtained via the infeed and outfeed apertures.

#### Interlock switches

Each cover and panel providing shielding protection and access to the radiation areas is fitted with an interlock switch. When opened x-rays will switch off and a fault condition is generated. There is no residual radiation present when x-rays are off.

#### Safety Relay and Circuits

As safety is paramount, two (one on a pipeline) failsafe relays are fitted to ensure that if a contact of the interlocks were to fail the safety relay will automatically detect the fault and therefore shut down x-rays and activate a fault condition.

The conveyor safety relays work as follows. The infeed cover, outfeed cover and the front panel interlocks are connected in series and monitored by the safety relay ES1. A contact of ES1 and the remaining emergency stop, back door, and lid interlocks are in series and monitored by safety relay ES2. The 'Tank Over temperature' switch, ES1 and ES2 then control the 'Mains Voltage' relay RL1. Both this circuit and safety relays status is monitored by the PLC. The PLC programme utilizes these signals to generate the 'X-Ray Enable' output which tells the PC to generate x-rays or not. A contact from ES2 also switches the main contactor, which controls the inverter and the motor circuit.
Reject Types

X3 machines are supplied with the following reject types:

- Air Blast reject;
- Pusher reject;
- Ball valve (pipeline only)

Alternatively, a conveyor or pipeline can be supplied without a reject device with a ‘Signal Only’ output. On detection of a contaminant in the product, the control unit provides an output signal only. This can be used for wiring into other equipment such as a PLC.

Air Blast Reject

An air blast reject is pneumatically operated. On detection of a contaminant a high-pressure blast of compressed air is directed from the air blast reject device to the product, causing the contaminated product to be blown off the belt into the reject bin.

Pusher Reject

A pusher reject is pneumatically operated. On detection of a contaminant the compressed air supply activates the pusher, causing it to push the contaminated product off the belt into the reject bin.

Pneumatic Specification for reject type

**Pusher**

Optimum supply pressure..........................5.5 Bar (80 psi)
Minimum supply pressure..........................4.5 Bar (65 psi)
Maximum supply pressure......................... 6.0 Bar (90 psi)
Capacity (Litres/second at 100 psi)..................10

**Air Blast**

Optimum supply pressure..........................6.8 Bar (100 psi)
Minimum supply pressure..........................5.5 Bar (80 psi)
Maximum supply pressure......................... 8.0 Bar (120 psi)
Capacity (Litres/second at 100 psi)..................20
Lee Ball Valve

Optimum supply pressure…………………………………6.9 Bar (102 psi)

Minimum supply pressure…………………………………5.5 Bar (80 psi)

Maximum supply pressure………………………………..8.0 Bar (120 psi)

Capacity (Litres/second at 100 psi).………………………………………20

Electrical Services

Electrical services for the x-ray machine are inside the main x-ray cabinet with mains cable entry points in the bottom. Access is from the rear of the machine except for Pipeline machines where it is at the front.

The conveyor contactor and overload are also located here. For conveyor motors controlled by an inverter no overload is fitted.

The isolator for isolating the electrical power to the machine is located at the lower right-hand side of the x-ray cabinet, when viewed from the rear. On the Pipeline machine it is fitted at the front.

Safety Devices

Emergency ‘Stop’ buttons and cover/panel interlocks are fitted. When operated these switch x-rays off and exhausts the air out of the reject device (where applicable).

Other Standard Equipment

Air Pressure Switch

An air pressure failure switch is fitted to both the conveyor (excluding the Rapid) and pipeline models. The switch is factory set to operate if the compressed air supply pressure to the machine falls below approximately 3 bar (42 psi). The conveyor then stops, x-rays switch off and the fault alarm and lamp are activated. In the case of the pipeline all the above will take place and the reject will stay open for failsafe operation.

Product Registration Photo-Electric Cell

The Loma X3 conveyor model is supplied fitted with a photoelectric Cell (PEC) as standard. The PEC is mounted on the side of the conveyor just prior to the x-ray beam. It is used to register the position of the products on the conveyor. As an option, the PEC may be mounted directly above the belt. This is particularly suitable for the registration of products that have very little depth (flat).

Bulkflow machines are not fitted with a PEC.
Internal cabinet thermostat / cooler

A thermostat is fitted to guard against system overheat. Pipelines and some low power conveyors may not require cooling. If the internal temperature of the cabinet rises above the set limit the thermostat switches a solenoid valve which in turn activates the cooler (type will vary depending on application) to cool the internal temperature. This is factory set and should not be changed.

Vortex Cooler

To keep the internal temperature of the x-ray cabinet at an acceptable level, a method of cooling is installed. It should be noted that in some applications no cooling is fitted. For those with cooling a vortex cooling unit is the standard method used (see optional equipment for other methods). Air flows through the vortex cooler and is discharged into the main x-ray cabinet at a much-reduced temperature. The vortex does not operate all the time but only if necessary and operators should be made aware that it may operate at anytime when the machine is running. It should be noted that the operation of the vortex is inhibited when a reject occurs. This is to ensure that there is a full supply of air available to the reject mechanism.

Indicator lamp Stack

In addition to the indication on the control panel a lamp stack is fitted on the top of the x-ray cabinet to indicate power on (white), x-rays on (red) and fault (amber). In some cases an additional lamp stack is fitted at the front of the cabinet. This is done to ensure all round visibility of the indicators e.g. when an air conditioning unit is fitted.

Audible Alarm

An audible alarm is fitted to the x-ray cabinet to alert the operator that the fault condition is active and the conveyor has stopped.

X-Ray tank sensors

In addition to the cabinet cooling thermostat, two others are fitted to the x-ray tank itself. The first level gives a warning indication via the front user interface. The second level is failsafe and will automatically via the safety circuit stop generation of x-rays.
Optional Equipment

Reject confirmation PEC

This device is fitted across the aperture of a reject bin directly in the path of the rejected product. If the rejected product does not break the photocell beam in a given time a fault condition is activated. The conveyor will then stop and the operator will be alerted by means of an audible alarm and lamp. The fault will be displayed on the front screen.

Bin full PEC

This device is fitted near to the top of the reject bin. If the bin should fill up with rejected product there is a danger that further rejected product could be deflected back on to the conveyor and into the good product path. If a bin full photocell is fitted, the rising product will break the photocell beam and will activate a fault condition. The conveyor will then stop and the operator will be alerted by means of an audible alarm and lamp. The fault will be displayed on the front screen.

Overhead PEC

If the product to be inspected is extremely flat there is a possibility that the side mounted product registration photocell (PEC) fitted to the side of the conveyor might not register positively. In this case an overhead photocell would be required.

Communications Package

There are a number of communication options that are detailed in section 5 of the manual.

Remote support can be provided via an external modem.
Network connection can be provided over NT networking on TCP/IP
RS232 connection provides the facility to send reports back to a dedicated PC via Lomanet. This allows collating and achieving to be done.

Another option that can be supplied is a connection to a printer (remote hand held or desktop). This is via a serial link port at the rear of the machine. The printer needs to be set at rate 9600 Baud. A printer can also be fitted directly to the X3 machine.

Reject

The system operates a timed reject, which does not compensate for any changes in the conveyor belt speed. Any change in speed requires resetting the parameters and re-normalising the system.
Cooling Methods

For environments where high ambient temperatures are expected a roof mounted air conditioning unit may be fitted instead of the vortex.

A roof mounted heat exchanger can also be selected to replace the vortex. The unit is an air to air heat exchanger that uses ambient air to cool the cabinet air via two isolated cooling circuits.
Multilane Reject

For some conveyor applications a multilane reject is fitted for bulkflow systems. Multilane reject systems consist of up to 5 reject flaps across the width of the belt; so that in bulkflow mode only the minimum product is rejected when necessary.

Mass Measurement / Missing Product

These are two special functions incorporated into the software if requested. Also separate rejects in addition to the contaminate can also be incorporated if required.

Variable Speed

Due to production constraints a variable speed conveyor may be necessary. This is done by controlling the motor via an inverter, instead of a direct on line contactor.

Roller Track Reject

This is fitted instead of the reject bin. Reject conformation and bin full PECs are still available if required.
USER INTERFACE (Conveyor & Pipeline)

The user controls the system from an on-screen menu system via a monitor screen and membrane switches. To navigate the menu system and enter values the user is presented with on-screen text boxes that correspond to the selection keys on the right hand side of the screen. These are used to choose the action to be taken.

FRONT PANEL LAYOUT
MEMBRANE KEYPAD

Refer to Front Panel Layout Diagram shown on previous page.

Password Key (key graphic)

The password system is active at all times. If the user presses the password button, a password entry dialogue will be shown on the screen. Normal passwords are entered as four digit numbers.

Enter Key (‘CR’ graphic)

The enter button is used to confirm data entry whenever the user needs to make a choice. It does not exit from the screen in use.

Cancel Key (‘C’ graphic)

The cancel button is used to discard all data entry from the screen in use.

Help Key

The help button activates a simple help file which can be navigated using the up/down keys, and provides information about the current screen that the user is in.

Menu Key

The Menu button returns the user to parent menu / screen.

Zoom In / Zoom Out Keys

The Zoom feature is used to highlight and Zoom in on Contaminated Pixels on existing images. It will be initiated by pressing the “Zoom In” button. This will select the First Contaminant pixel which will then be highlighted. Pressing the button again will select the Next Contaminant pixel, and so on and so forth until all Contaminated Pixels have been seen. Once all contaminated pixels have been seen the image will return to the first one again.

Coming out of zoom will be initiated by pressing the “Zoom Out” button.
CONVEYOR OPERATOR CONTROL PANEL

- KEYSWITCH
  - XRAY ON/OFF AND CLEANDOWN
- CONVEYOR START/STOP SELECTOR SWITCH
- EMERGENCY STOP BUTTON
- XRAY ON
- FAULT / RESET BUTTON

**Module 7002**
PIPELINE OPERATOR CONTROL PANEL

- **KEYSWITCH**
  - XRAY ON/OFF AND CLEANDOWN

- **XRAY ON**

- **PUMP RUNNING LAMP**

- **FAULT / RESET BUTTON**

- **EMERGENCY STOP BUTTON**
KEYSWITCH POSITIONS

XRAY ON
OFF
CLEANDOWN

X-ray on / off
/ cleandown

Caution:
Xrays produced
when energized
OPERATORS GUIDE AND SETUP

Note
Guidance on the terminology, parameters and set-up of the X3 machine is provided by the ‘Help Files’ accessed on each machine through the front panel interface.

Supplements
If your machine is fitted with non-standard software which has enhancements or added functions supplements are provided with this manual in this section for reference.
WIRING SCHEMATICS
CERTIFICATE of CONFORMITY
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29/08/02