



AL-1e 4 roller

COMPLETE MACHINE MANUAL



Contents

1. General	4
1.1 Introduction	4
1.2 Manual	4
2. Safety	5
2.1 Definition	5
2.1.1 Icons in the manual	5
2.1.4 Installation and maintenance safety	6
2.1.5 Emergency Shutdown	7
2.1.6 Operating hazards and risks of injury while operating	8
2.1.7 Use of the machine	9
2.1.8 Requirements for the operator	9
2.1.9 Guarantee and Liability	9
3. Technical Data	10
3.1 Installation	10
3.1.1 Description AL-1e	11
3.1.4 Switch-On	12
3.1.5 Start failure	12
4. PPM (<i>Planned Preventative Maintenance</i>)	13
Daily	13
Weekly	13
Quarterly	13
5. Parts Descriptions	15
5.1.1 Illustration AL-1e	15
5.1.2 Measuring devices	16
5.1.3 Inside machine	16
Radius measuring device:	17
Booster	Error! Bookmark not defined.
5.1.5 Equipment installation	18
5.2 Hand controls	19
6. PLC / HMI controls and operation	20
6.1.1 Starting the program	20
6.1.2 Home screen	21
6.1.3 Calibration	22
6.1.4 Machine Settings and Speeds	23

6.1.5 Die / Tool Set up	23
6.1.6 Shaft centres.....	25
6.1.7 Encoder set up	26
6.2 Programming	27
6.2.1 Program Screen	28
6.2.2 Roller Set up.....	29
6.2.3 Shape settings.....	30
6.2.4 Elasticity / Spring back.....	31
6.2.5 Loading the Program	31
6.2.6 Transitions	32
6.2.7 Re-bending.....	33
6.2.8 3D-bending	34
6.2.9 Roll positions during bending	35
6.3 Editing a bend	36
7. Terminology.....	37
8. Risk assessments.....	43

1. General

1.1 Introduction

This instruction manual contains all the necessary information for the installation, commissioning, maintenance, servicing and running of the machine.

Prior to carrying out any work associated with installation and commissioning, this instruction manual must be read by all persons involved in this work or undertake an on-site training course. Supervisors must ensure that all the information contained in the instruction manual has been understood by their immediate staff.

In the event of queries which cannot be answered, or are not fully answered by this instruction manual, please contact us immediately so that the problem can be resolved. Only in this way can potential personal injury or damage to the machine be avoided.

Along with this instruction manual, the usual specific precautions for safe and proper work procedures must be followed in line with your country regulations.

1.2 Manual

The company reserves the right to make technology improvements without notice, if there are changes, refer to the actual product.

Main application and applicable scope:

The CNC Bending machine is used for the forming of ferrous and non-ferrous metals using a rolling system and suitable dies to support the section.

The machine features:

1. The machine adopts imported control unit, servo hydraulic station, AC servo drive system
2. High precision: repeat positioning accuracy ≤ 0.05 mm
3. Standard programs available in CNC controller
4. Other functions of the application software include: auxiliary calculation function, diagnosis function, manual correction function

2. Safety

2.1 Definition

All the safety information is there for your protection. These references will help the operator to identify impending defects on the machine, or on its parts, and provide a fault free and productive operation of the machine.

2.1.1 Icons in the manual

MAINTENANCE

This icon indicates a maintenance comment, suggestion or procedure



SAFETY

This icon indicates a safety tip, suggestion. It may be accompanied by a danger logo.



ELECTRIC RISK / HAZARD

This icon indicates an electrical hazard. It may be accompanied by a danger logo



IMPORTANT

This icon indicates an extremely important statement.



TIPS

This icon indicates a tip based on our experience and knowledge.



2.1.4 Installation and maintenance safety

Please note the following:

1. Each person involved with the aluminium bending machine has the obligation to read this instruction manual, the chapters, 'safety' and 'maintenance'
2. The machine and all its pertaining parts have been produced according to the newest technology. Special attention has been given to the safety and the ergonomic operational control of the machine. Consequently, the machine is safe and relatively simple to operate.

IMPORTANT – Equipment for Safety and protection

Any modifications of the equipment and it's guarding/ cover plates is prohibited.

1. In case of misuse, the manufacturer declines any liability.
2. Only **after** the equipment for safety and protection has been installed can the machine can be operated.



IMPORTANT– Installation and initiation

Before undertaking checks connected with the installation, adjustment and checks inside the machine, ensure it is disconnected from the main power / un-plugged.



1. All working methods which could possibly damage the machine are prohibited.
2. It is the operator's responsibility to notify any malfunctions in the operation of the machine immediately.
3. The operator is obliged to work with the machine only if it is in good working order.
4. The operator must ensure that the machine is always clean and workspace clearly arranged.
5. All risk assessments must be read and understood.
6. While maintenance work or repair work is performed on the machine, the machine must not be used.

2.1.5 Emergency Shutdown

In case of emergency, the machine is stopped using the e-stop located on the panel.



Check your local safety regulations and regulations for prevention of accidents.

2.1.6 Operating hazards and risks of injury while operating

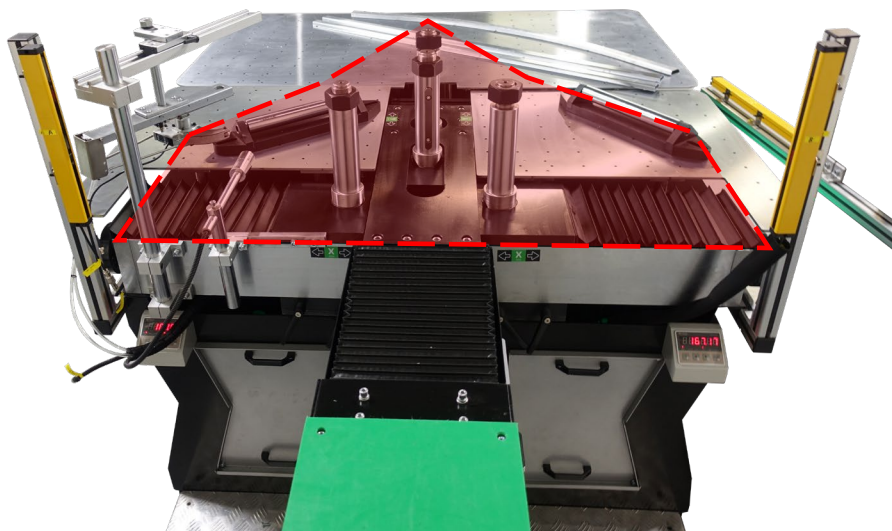
Danger of snagging from rolls

The biggest risk whilst operating the bending machine is trapping hazards when operating. Operators must NOT wear gloves or loose clothing. Warning signs are a reminder of this hazard.



Risk by being trapped by roller and/or profile

When the section is rolling keep your hands clear of the rolls during bending on the side the section is entering.



The yellow light sensors are motion activated and will stop the machine (...)

2.1.7 Use of the machine

The Machine is only to bend ferrous and non-ferrous metals. Other materials are not to be formed on the machine. The manufacturer is not liable for any damages occurring for using any other materials. In this case the risk is to be taken by the operator.

Improper use could result in damage on the machine and danger for the operator.

Using the machine as directed includes observance of conditions of installation and conditions maintenance work.

2.1.8 Requirements for the operator

- a. The machine is only to be handled by an authorised and trained person. The operator should notify the supervisor when changes to machine occur, which could impair the machine or pose a danger to persons.
- b. No unauthorised person is allowed to work on the machine. The operator is in charge of supervision.

2.1.9 Guarantee and Liability

The guarantee is limited to 12 months after delivery except when longer guarantee is agreed. The guarantee is limited to replacement of defect parts. Any other claims or allegations are excluded.

The use of the machine has to conform to all particulars referred to herein. Any other use is not admissible. Alterations or changes are not allowable. Inductaflex Limited or their agents are not liable if the customer or the operator does not adhere to these directions.

3. Technical Data

Classification	AL-1e 4 roller
Dimensions L x W x H	1200 x 1100 x 1400 mm
Weight of machine	2200 kg
Capacity	10 tonnes
Maximum workpiece cross section:	See capacity chart
Repeat positioning accuracy	0.05mm
4 rollers	all servo electrically driven
Spindle/tool holder diameter:	60mm
The fixed shaft centre distance:	330 ~ 1000mm
The roller speed	0-15 RPM
X-Axis travel	200 mm

3.1 Installation

Connection power: 50 Hz or 60 Hz
380-415 V
or 480 V

Max. Electrical rating 24A

1. Control system: Schneider
2. AC servo system: Schneider
3. Operation screen: Schneider

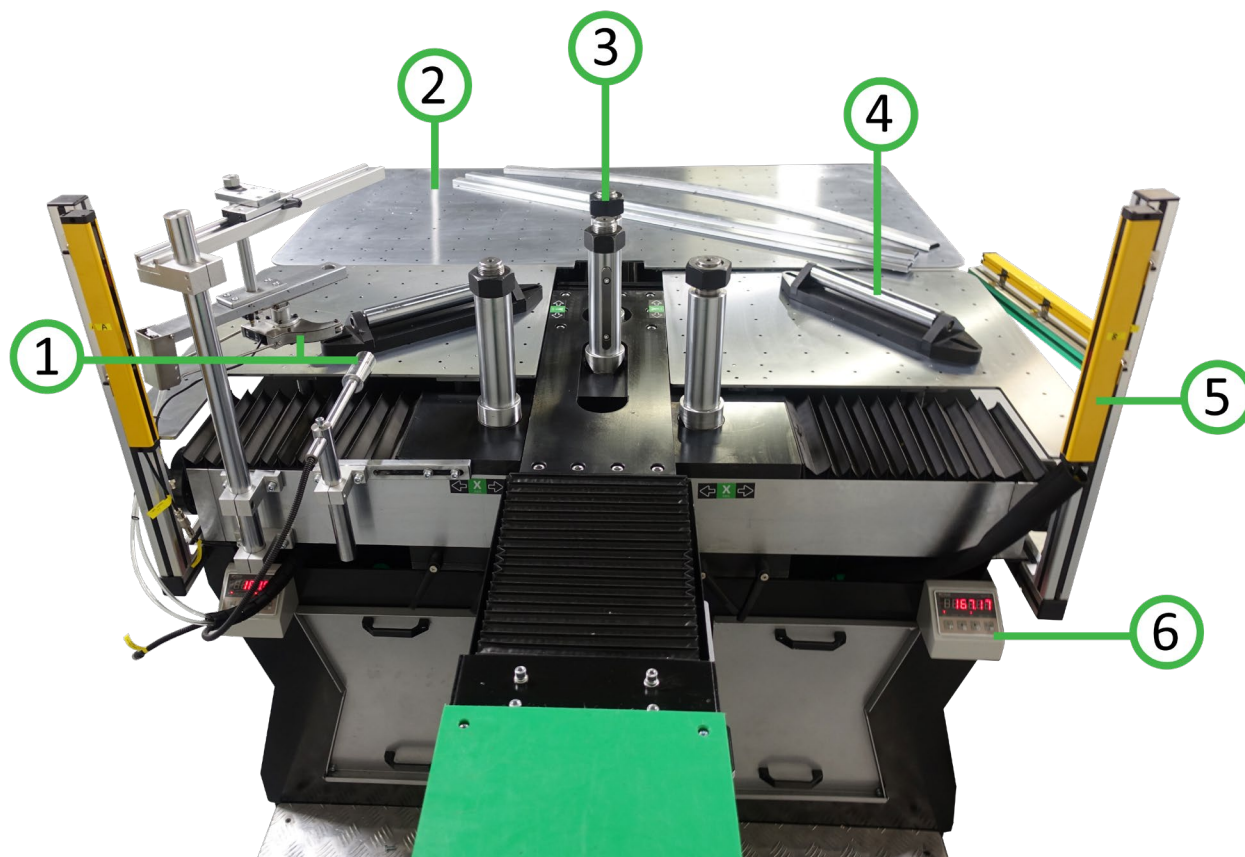
Hazard – Care should be taken when locating the machine.
Ejected or rolled parts need space to bend and be removed.



Tip – place the longest bar you are curving in the rolls each side
to ensure you have enough space to load and unload parts.



3.1.1 Description AL-1e



1. Material sensor
2. Adjustable Support Table
3. Shafts to carry rollers
4. Support Roller
5. Safety Light Curtain
6. Positioning unit

3.1.4 Switch-On



Turn on wall isolator if applicable



Turn on machine lockable switch

3.1.5 Start failure

If machine does not run, items to check are:

1. incoming power on each phase
2. circuit breakers are active / on
3. e-stop is not active
4. connection to the screen and control panel
5. plug connector to the motors
6. servo motor is in 'run – mode'



4. PPM (Planned Preventative Maintenance)

Daily

If the machine is operated in a dusty environment, a cover should be placed over the machine when not in-use.

Take care cleaning the machine with compressed air, this can move the problem elsewhere and may drive the dust into bearings.

Use a powerful vacuum to remove aluminium chippings or nylon scrapings from tool wear. 5 minutes per day gives better longevity of the machine and parts.



Weekly

Lubricate the slides and drives with suitable oil available locally.

(Heavy grease traps chippings – take care with this).

Apply lubricant solution to side support shaft.

Check cables for damage particularly the encoders and section sensor.



Quarterly

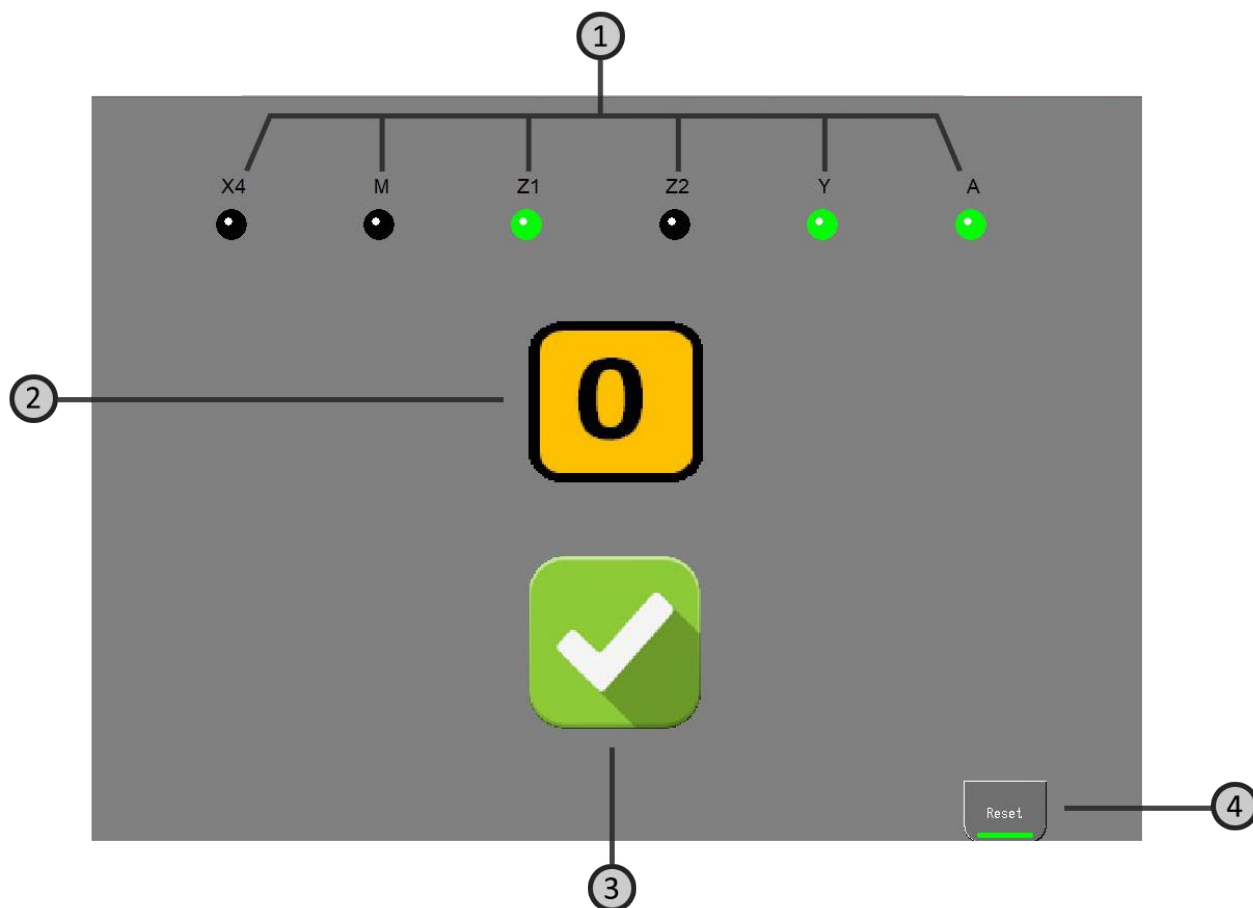
Isolate the machine and clean inside the machine, the slides and screw.

Check internal and external cables for wear.



Machine Operation check

Calibration screen



1. Axes to calibrate
Each corresponds to an axis

Light will turn green when calibrated

2. Press '0' to calibrate

Clicking this button will start the calibration process
Ensure the machine is clear

3. Enter the program

Clicking this button will enter the program

4. Reset button
To clear faults

Touch and slide your finger to activate
'Clearable' faults will clear.

5. Parts Overview

Isolate machine before removing covers

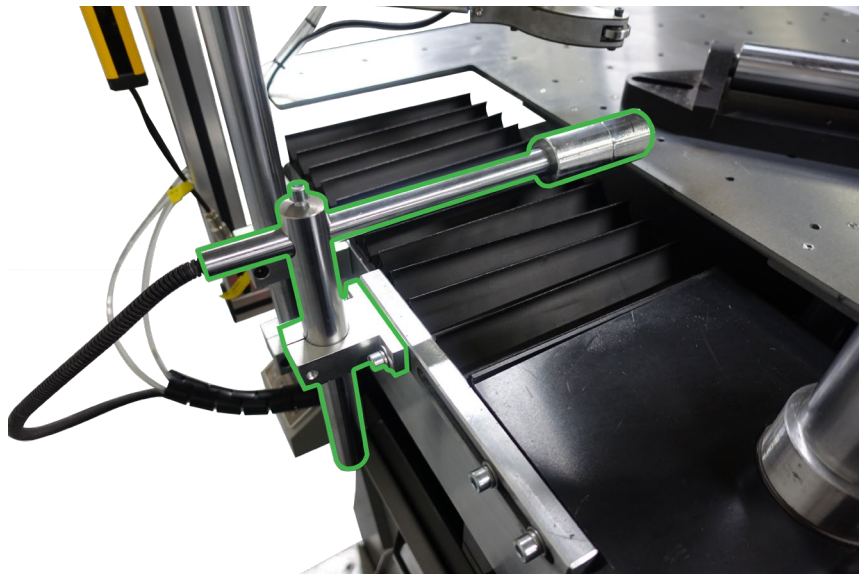
Take care if powering up the machine when unguarded, the screw thread inside is un-guarded underneath and a trapping hazard if accessed during operation.



5.1.1 View AL-1e

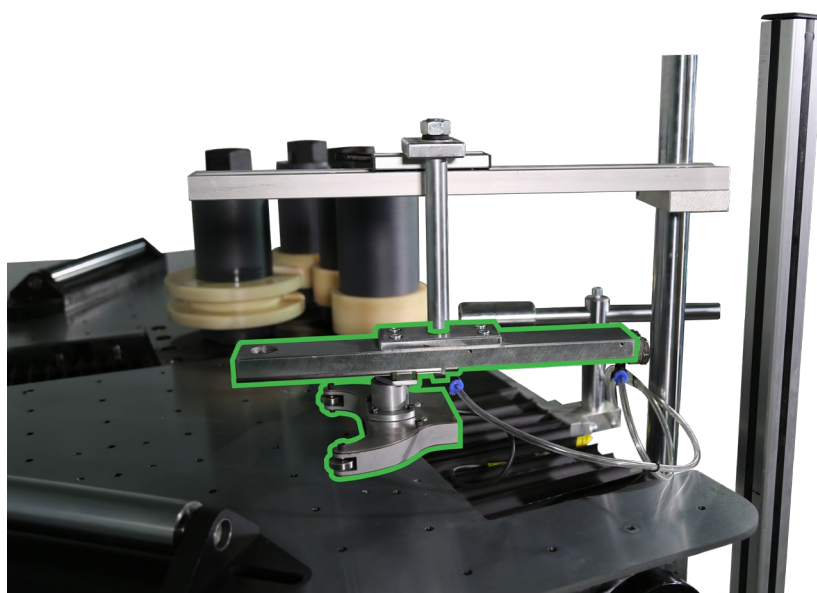


5.1.2 Measuring devices



Measuring unit magic eye material proximity sensor

Material position / length Encoder to control the material location



Radius measuring device

The radius measuring device is an accurate device for measuring the outside surface (extrados)

5.1.3 Optional Extras

Radius measuring device:

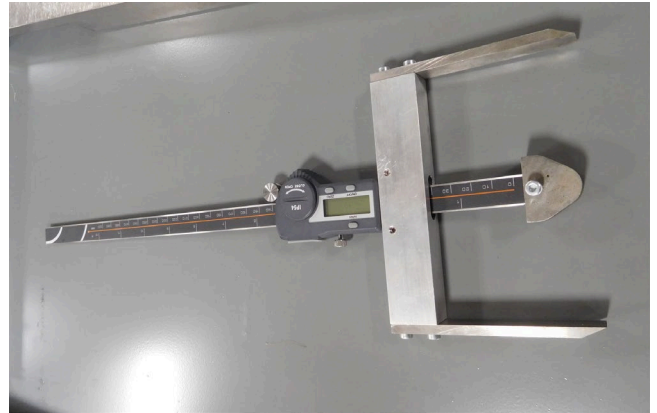
The radius measuring device is an accurate device for measuring the outside surface (extrados)

In principle, you should select the longest 'chord' to give the most accurate measurement.

You should measure the bend area and not the transition.

The area should not be under tension from the rolls.

Use the calculator to find out the radius.



Mandrel with booster

To enable hollow sections to be curved free of distortion it is essential an internal support is used. This internal support (mandrel) stops the walls of the section collapsing.

Normally a booster to drive the section is needed with aluminium as gripping the section to pull it through causes marks on the soft aluminium.



5.1.4 Equipment installation

1. Environmental requirements:

The machine should be installed in a dry clean environment, temperature between 15 ~ 35 degrees Celsius indoor on a hard concrete floor.

2. The machine level adjustment:

Adjust the feet to level the machine in each direction.

3. The machine is connected with the earth:

The machine must be based on the requirements of the electrical wiring diagram and the connecting line is connected to earth; soft copper wire, its cross-sectional area greater than 2.5 square mm, grounding resistance measured is less than 4 ohms.

4. The machine power supply:

The machine input voltage: 480V 60HZ, connecting line for the soft copper wire, it's cross-sectional area greater than 2.5 square mm (three-phase four wire).

5.2 Hand controls

Control Panel



1. **Machine Turning**
Controls the turning of the machine
2. **Z1 Table**
Controls the height of the Z1 table
3. **E-Stop**
Stops the machine in case of an emergency
4. **Z2 Table**
Controls the height of the Z2 table
5. **Rear Table**
Controls the height of the rear table

6. PLC / HMI controls and operation

6.1.1 Starting the program

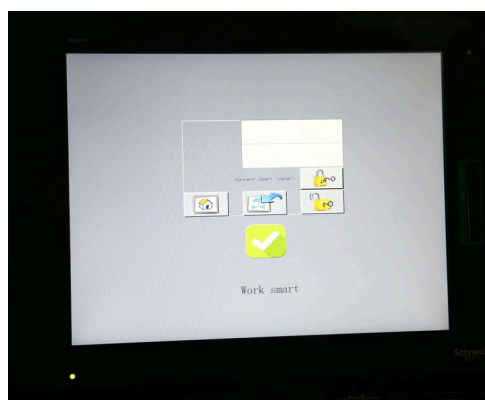
To enter the main interface

Click to accept the health and safety notices **ONLY** if you understand them

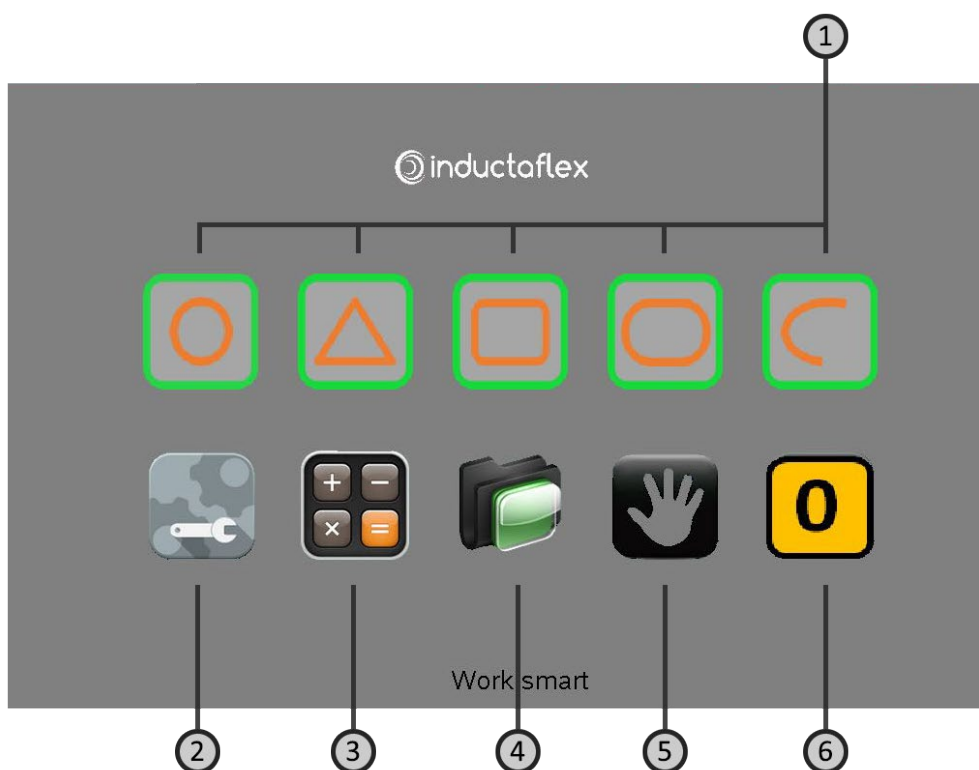
- Entrapment risks – screw threads
- Electricity risks – 410 / 480v machine
- Hair and dangling items risk – neck ties, hanging passes
- Closing die risk – rollers and side supports
- Loose clothing – caught in the rollers.



Enter your user and password and click the unlock button

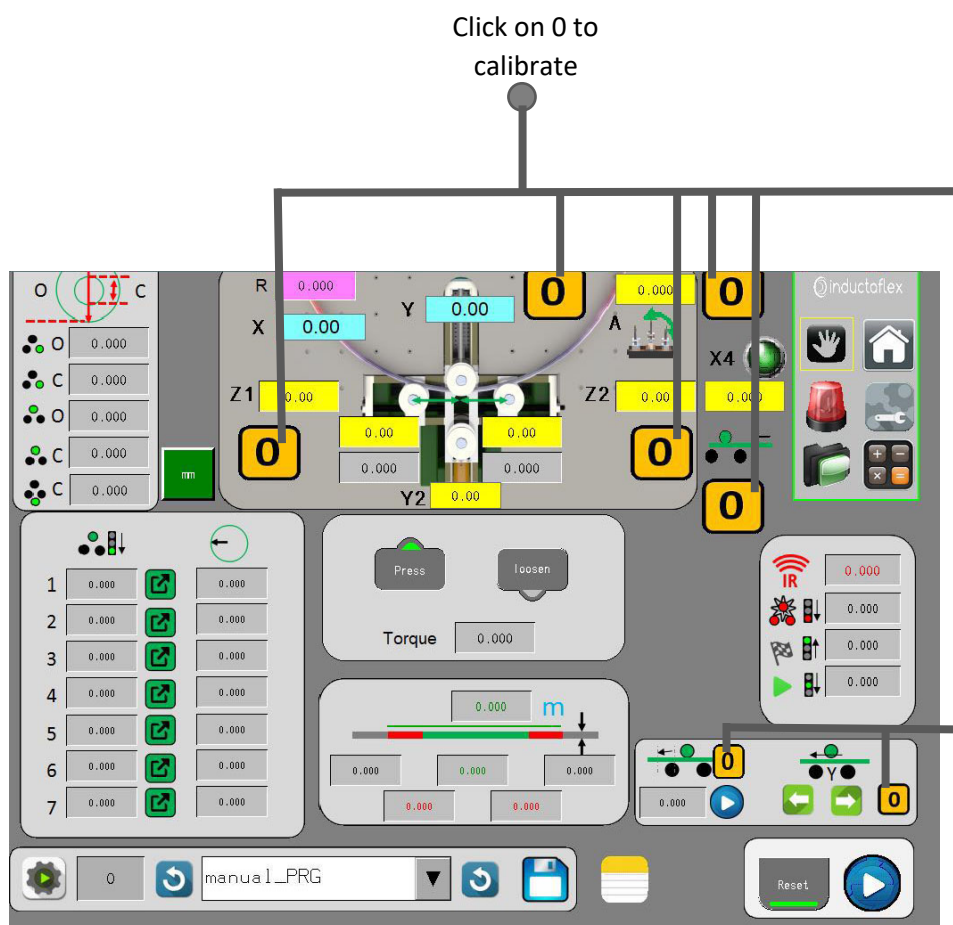
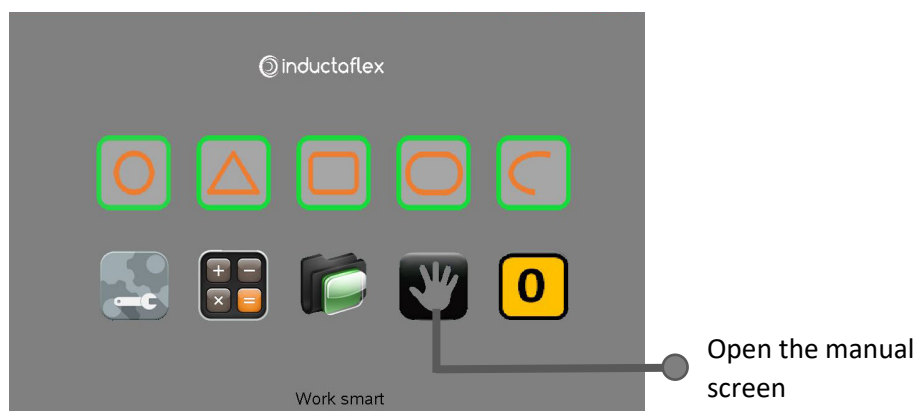


6.1.2 Home screen

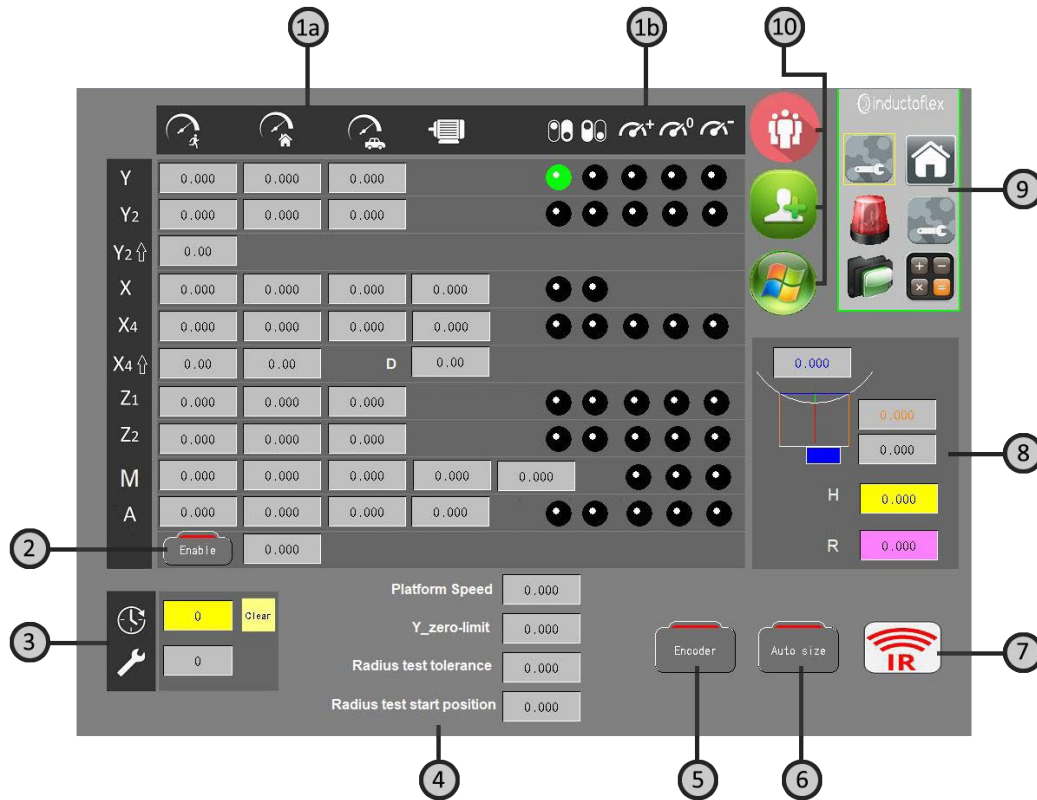


1. **Shape Presets**
Enter one of the preset shape set ups
2. **Settings**
Allows you to modify machine settings and speeds
3. **Calculator**
Calculate various values for the required bends
4. **Files**
Browse through stored files
5. **Manual Input**
Manually input bend values without needing a shape preset
6. **System Test**
Test the machine for faults

6.1.3 Calibration



6.1.4 Machine Settings and Speeds



1. a. Speed settings for Jog, Home and Auto speeds

Jog speed – This is speed using manual controls

Home speed – this is the speed of movement when moving to 'zero' or to the part sensor. This is best set slower for accuracy.

Auto speed – this is the speed in automatic operation.

b. Control input testing

When a switch is toggled one way or another, the light will activate to register the movement. While adjusting the control it will display whether the axis is positive, on or negative to the zero location of that axis.

3. Time to Maintenance

This will alert the operator when the input time has past and any maintenance must be performed

4. Settings pre-set by Inductaflex

These will almost never need to be changed by the operator

5. Toggle Encoder

Press to toggle between encoder and servo

6. Toggle Auto size

Press to toggle the auto size on or off

7. IR toggle

Press to toggle the IR sensor on or off

8. Radius Test

Allows you to set the size of the Radius Sensor and test its functionality

9. Navigation panel

Navigate to other screens

10. Login and New User

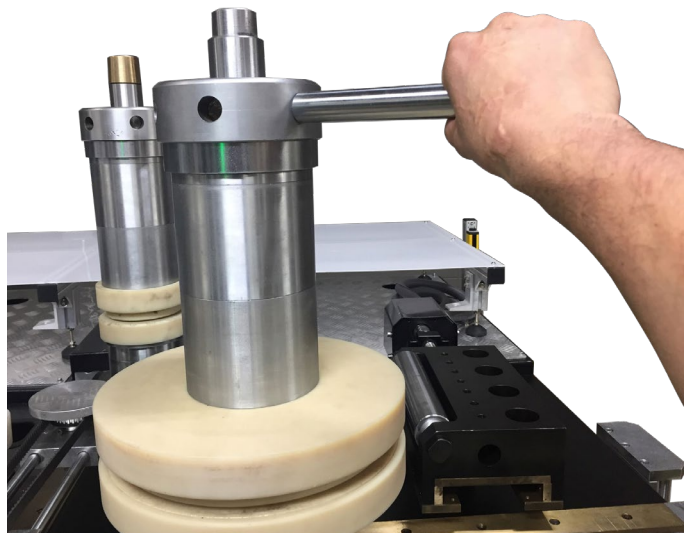
In order to change machine setting the user will need to login

After opening this page and changing any figures, click - re-set on the program page.



6.1.5 Die / Tool Set up

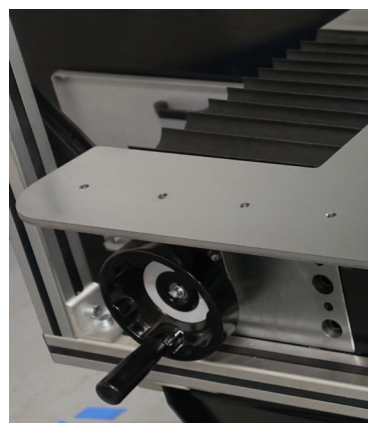
From bare shafts, set up the tools based upon the shaft drawings / screen notes / pictures



Hand tighten unless specified otherwise. The pinch bar only is needed when noted

6.1.6 Shaft centres

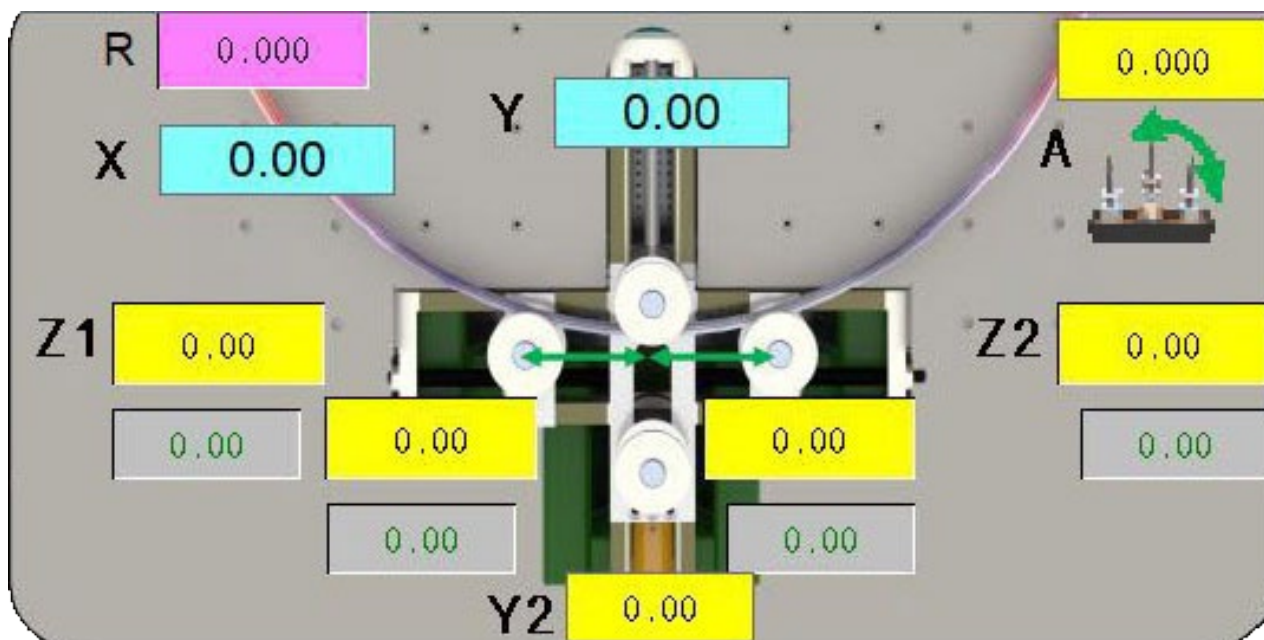
The shaft centres are variable based upon the section size and tool size. The side handle moves these.



Positioning

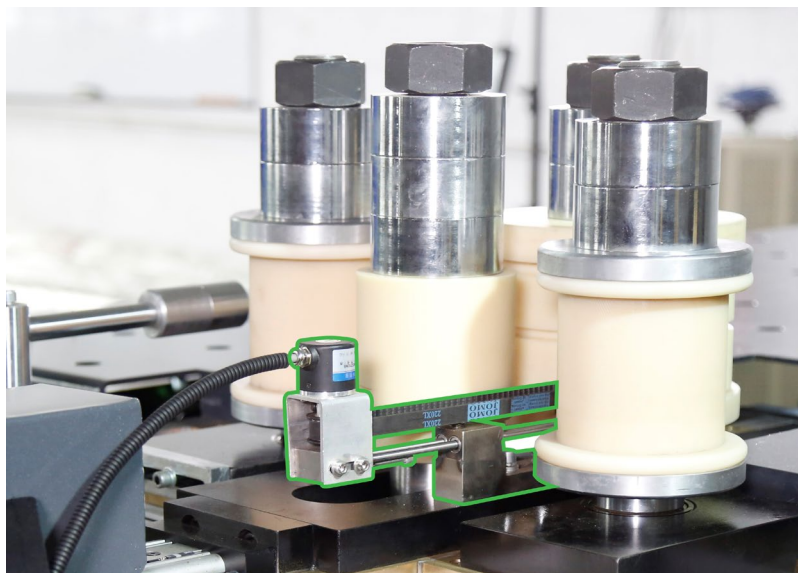
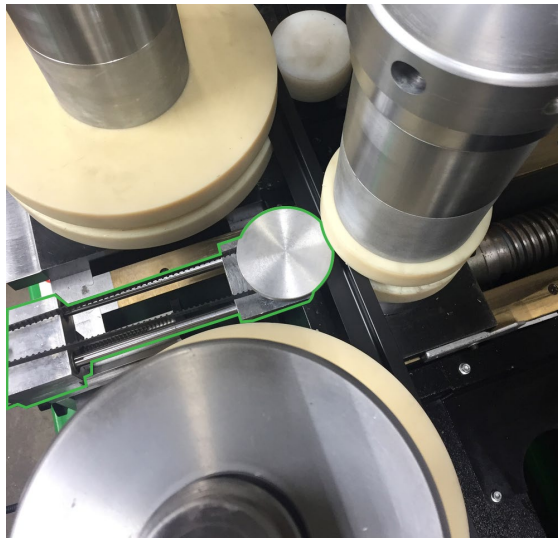
Side Handle

Each side is set to the details on the screen.



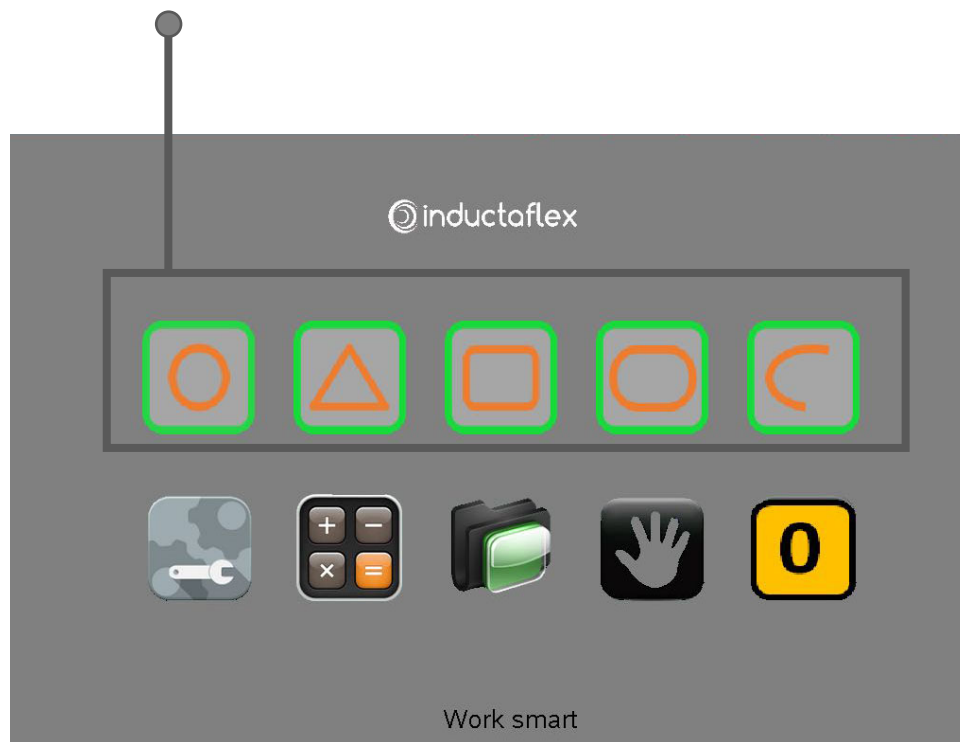
6.1.7 Encoder set up

If using the external encoder, touch the section and clamp by 10 mm / 3/8. This ensures the wheel will grip on the section will not slip.

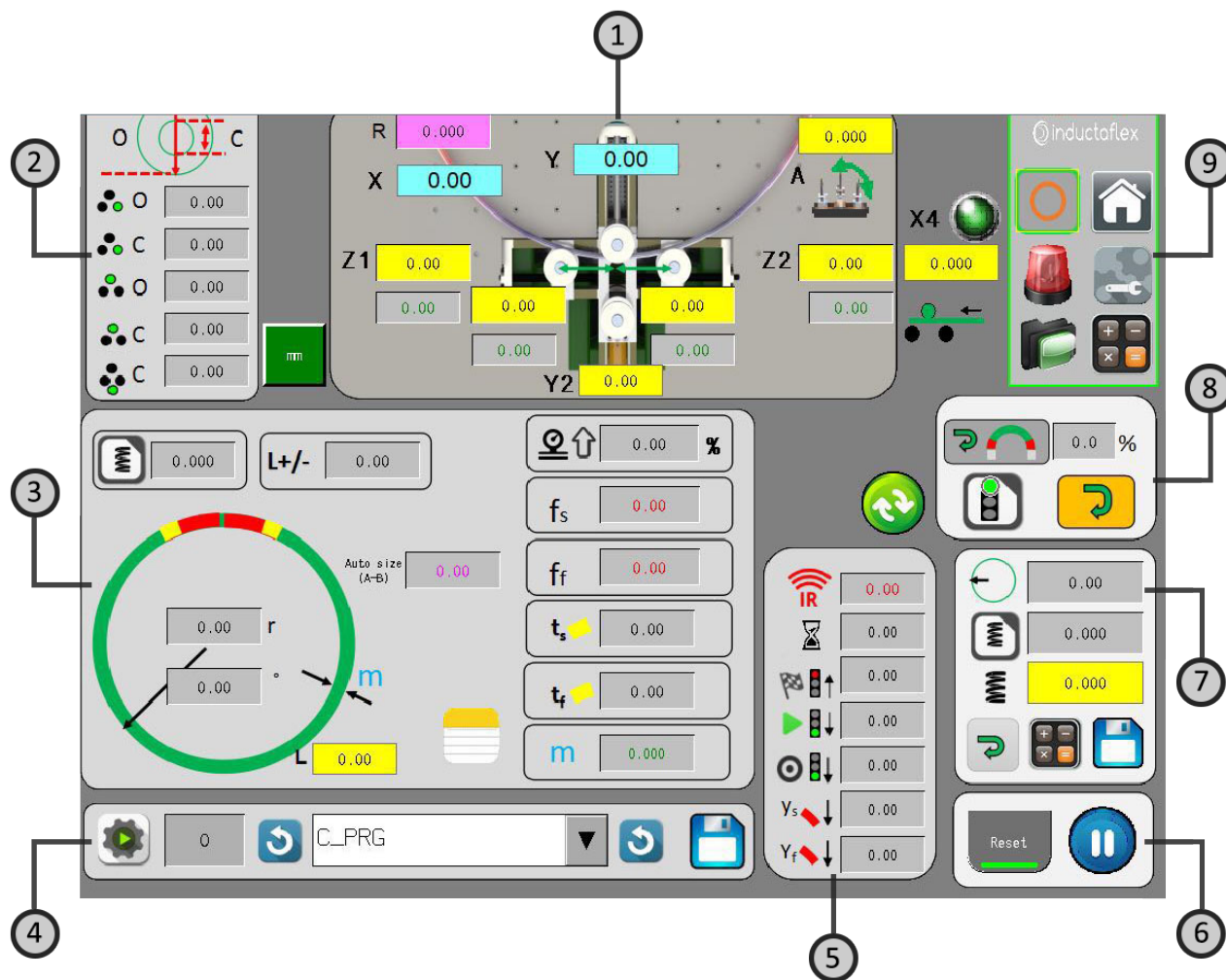


6.2 Programming

Select the program by clicking the desired shape

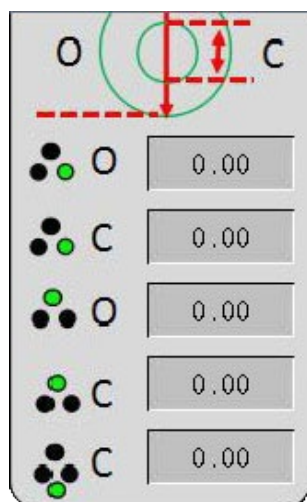


6.2.1 Program Screen



1. **Table overview**
A display of all the current locations of the moveable axis.
2. **Roller Set Up**
Enter the size of each roll here
3. **Shape Settings**
Measurements that will define the shape that you will need to bend
4. **Program Loader**
Browse for and load saved programs
5. **Roll positions during bending**
6. **Machine Reset/Pause**
'Reset' this screen to its default options or 'Pause' any action the machine is currently doing
7. **Elasticity Compensator**
Enter the diameter of the bend and the elasticity of the material to calculate how much elasticity to compensate for.
8. **Re-Bending**
Allows you to make minor corrections when a bend hasn't come out just right.
9. **Navigator**
Navigate to other screens

6.2.2 Roller Set up



Enter the sizes of each roll as per the diagram

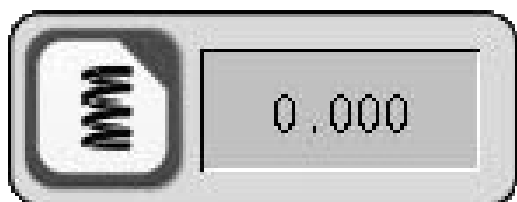
'O' = outside diameter of roll

'C' = the diameter of the roll which is in contact with the section

- R = RADIUS

- Enter the details as per the drawing
- ALWAYS use the radius
- 'L' = **outside** arc length

6.2.4 Elasticity / Spring back



Check the guide for setting initially until you become familiar with your section for both the transition and the spring back figure.

Single pass bending forming (reference only)

Bending radius	250	300	350	400	450	500	600
Rebound	0.76	0.78	0.79	0.80	0.81	0.82	0.83
Transition	130	130	130	130	130	100	100

Softer material springs back less so depending upon the hardness these figures will vary. Once you have a base to work from you will then have a good idea of the starting figures.

6.2.5 Loading the Program



Find your program with the arrow.

Click to load

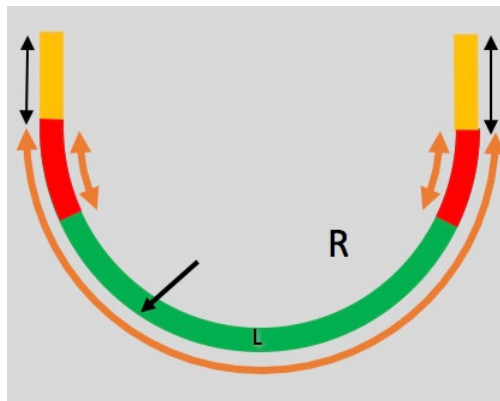


6.2.6 Transitions

Also called 'interpolation'

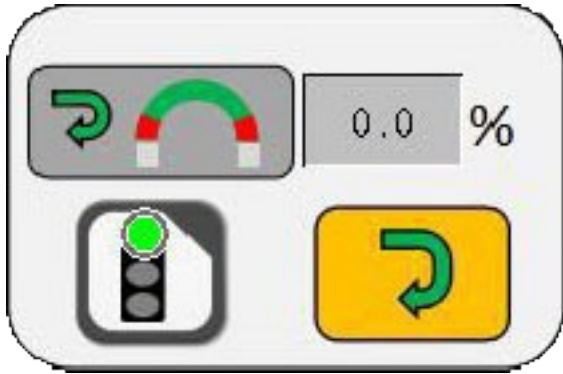
This is the part of the bend that covers the change from bent to un-bent material

- Blending of the curve to straight or bend to bend
- Smaller radii will have a longer transition
- Bend to bend is approximately half the normal transition



6.2.7 Re-bending

The process of re-bending a bar that was not bent correctly on the first run.

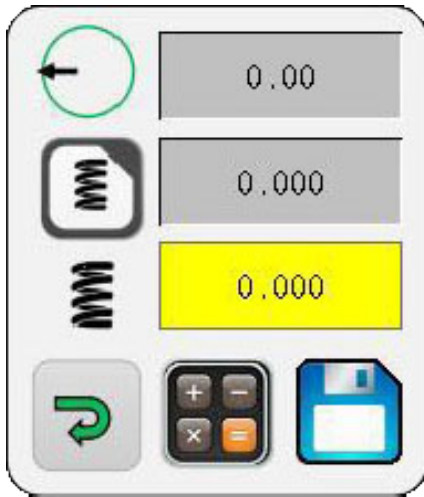


- Click the 'traffic light' to red before starting
- If under bent, you can add a % of bend.
- Based upon % of start and finish

This is purely to save a bar for the 1st bend when trialling single pass bending and only works on under bent material.

6.2.8 3D-bending

(Brief description)



Similar to excel format

The operation is in bend order from left to right.

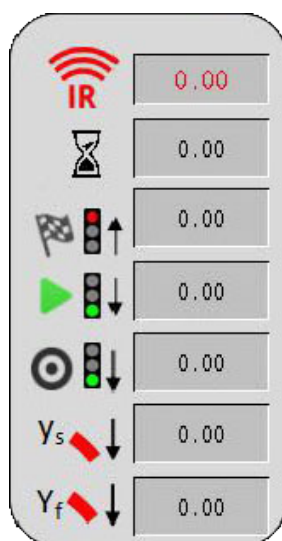
P1 – set up rolls screen

P2 – bending positions

P3 – further steps

	Radius – enter the outside radius you need
	Enter the outside arc length
	Transition – based upon the chart
	Z-axis is trial and error
	Position of the clamping roller is manual decided
	Twisting of the roller
	Spring back of this part
	Roll position for the bend
	Bend speed per segment

6.2.9 Roll positions during bending



IR sensor location

Distance from the centre of the sensor to centre of side roller

Waiting time

Time that the machine will wait after the movement is complete

Retreat position

The position the centre roll moves to after bending

Start position

The position the centre roll is at when the section is touching all rollers

Target position

The position the centre roll reaches when it is in the correct position to make the bend

Pre ending Start

Pre ending Finish

6.3 Editing a bend

Radius

under bent template has **gaps** at the end



Over bent template has a **gap** in the middle



Increasing arc length

If the radius is correct to the template but at the wrong angle, increase the arc length.

This can be calculated using π easily...angle needed then calculate the extra length.

Whole bend is under bent

Try to edit the start position by 0.1 mm or 0.2mm increments, this will edit all the bends slightly and often a nice quick solution.

7. Terminology

A

Air Bending

Is where the material is bent but the material does not 'bottom out' or touch the bottom of the tool. It is most commonly used in press braking material into a vee block.

Arc

The curved portion of a bend.

Arc Length

The length of the curved portion of a bend. This can be measured around the outside of the bend, along the centerline (C/L) or the inside.

B

Backwall

The outside of a pipe or section, during or after bending.

Bending Moment

The amount of force required to bend a straight length of material.

Bending Procedure

A written procedure detailing the steps an operator takes to produce a bend.

Buckling

Definite folds, creases or wrinkles formed on the surface of the pipe or the tube during the bending operation. (Solution, use a heavier gauge or smaller section)

C

Camber

A slight bend in a bar designed to compensate for deflection when load is applied.

Centre to Centre distance

The distance between the calculated centres. Usually used to describe the centreline distance between the two legs of a 'U' bend.

Centre-line radius (CLR)

The distance from the centre of curvature to the centre-line (axis) of the pipe.

Chord

The straight distance measured between any two points of a bend / arc.

Coining

A process where a force is applied to material to force it into a die.

Cold Bending

The bending of sections pipes at ambient temperature.

Compression force

The force on the inside of the neutral axis during bending. This also causes the thickening of material on the inside face.

Compound Bend

A curved bar with more than one radius in the same plane.

D**“D” of Bend**

Centreline Radius (CLR) divided by tube diameter or nominal pipe size. (I.e. 3d, 5d etc.) 8” pipe to 3d = 24” (610mm) radius.

Degree of Bend (DOB)

The angle to which the bend is formed.

Diameter (Dia)

A straight line passing through the centre of and touching both sides of a circle.

Distance Between Bends

The actual length of the straight section between the tangent points of two adjoining bends (see Tangent).

Distortion

A change from original shape and dimension. Note: Occurs in every rolled part to some degree.

Ductility

The ability of the material to deform without fracture. This is measured by elongation of the area in a tensile test.

E**Elastic Modulus**

The mathematical description of an object or substance's tendency to be deformed elastically (i.e., non-permanently) when a force is applied to it.

Elongation

The increase in length of material fibres during bending, expressed as a percentage of the original length.

Extrados

The outside arc of the bend (see Backwall).

F**Flat Plane**

The deviation of the horizontal plane of a single bend between its tangent points, based on the theoretical centre-line of the bend.

Flattening

The distortion of the cross section of pipe or tube from its normal (round) shape.

H**Hot Bending**

The bending of pipe or shapes through hot methods.

Hard Way

The most difficult axis to bend a section. Often referred as the X-X in beams / channels / Rectangular Sections.

Hump

A rounded protrusion or bulge on the intrados / extrados. Often found at transitions or bend starts.

I**I.D. / I.R.**

Inside Diameter / Radius of the material.

Intrados

The inside arc of the bend.



J**Joggle**

A profile with 2 or more bends in a row in which each bend is in the opposite direction as the previous.

M**Minimum Wall Thickness**

The wall thickness specified on the fabrication drawing or computed in accordance with the applicable specification as the minimum acceptable for temperature and pressure application.

Machining Allowance

An amount of material added to the section to be curved to allow the section to be machined back to an exact size. Careful note of the tolerances will help select the correct amount needed. Generally, the larger the section the greater the allowance needed.

N**Neutral Axis**

The area where there is neither compression nor tension during bending.

Nominal

Usually refers to pipe sizes up to and including 12 inch. Also used in reference to wall thickness, generally as a "mean" or average measurement.

Nominal O.D.

Usually refers to referenced pipe sizes, not actual O.D.

O**O.D.**

Outside Diameter of the material.

Ovality

The distortion of the cross section of pipe or tube from its normal (round) shape usually expressed as a percentage of the difference between major and minor axis (Pipe Fabrication Institute (PFI) Standard is 8%).

P**Plane of Bend (POB)**

Is referred as the rotation from a neutral axis. It is specifically used for changes of plane in successive bends.

R

Radius

A line segment that joins the centre of a circle with any point on the materials circumference (see Centre-Line Radius).

Roller Bender

The standard machine for the large radius bending of sections and pipe. The definition of large radius would be over five times the diameter of the pipe.

Rise

The distance between the midpoint of the chord and the midpoint of the arc.

S**Section Modulus**

The ratio of a cross section's second moment of area to the distance of the extreme compressive fibre from the neutral axis.

Slope

Is calculated as the rise/run of a segment.

Spring back

Memory of the material to return to its original condition.

T**Tangent**

An accurately formed transition from curve to straight. This is different to the rolling allowance on a bar which is NOT a smooth transition from bend to straight. These can be any length and are usually to reduce the number of welded joints.

Tangent Point

The point at which the bend is started or ended.

Tensile Strength

The strength of material stretched to the point at which it will rupture.

Throat

The inner half of the pipe or the half undergoing compression during bending (see Intrados).

Transition area

The area at the tangent points of the bend that covers the change (transition) from bent to un-bent material or between differing radii. The radii changes exponentially here.

W

Wall

The thickness of tubular material, usually expressed as "nominal" or "minimum".

Wall Factor

The ratio of the pipe outside diameter (O.D.) to its wall thickness (t). i.e. OD/ t.

Wall Thickness

The thickness of the material usually stated in "schedule" for pipe or "gauge" for tube.

Wall Thinning

The amount of reduction from original wall thickness of pipe or tube to the amount of wall thickness remaining in the extrados of a bend after forming (see Extrados).

Wrinkles

Definite folds, creases or ripples formed on the surface of the pipe during bending operation. (see also buckling)

X**X-X Axis**

Generally, the hardest way to bend a section. It is the stiffest axis. Y-Y axis (easy way) is actually harder with RHS due to increased height and susceptibility to ripple.

Y**Y-Y Axis**

Generally, the easiest way to bend a section. Channels toe in / toe out, beams bent on weak axis.

Yield Point

The point at which material will deform permanently during bending.

Yield Strength

It is the stress at which a material exhibits a specified permanent deformation and is a practical approximation of elastic limit.

8. Risk assessments

The risk assessments are provided and developed following many years of operation.

Assessment was made by experienced operators and qualified health and safety auditors.

The following assumption is made

- The manual is read and understood
- The risk assessments are read and understood
- The warnings are observed.

It is recommended that these are reviewed in line with your own policy.

Instructions are in English. It may be necessary for these to be translated for an operator to understand if English is not their first language.

Customer Job Risk Assessment

Risk assessed in line with UL / CSAZ432-04 (2014) / HSE 2014 Guide

Assessed By Craig Barnshaw NEBOSH Cert / Rospa Assessor	Date of Assessment 26/04/2017		Review Date 27/04/2017		C.R.A. No. 1		Risk Assessed	AL-2e Super duty - overview
Hazard / Issue	People affected	Existing Controls			Likelihood	Severity	Score	Further action required
Noise – Hearing loss, other physiological disorders (e.g. loss of balance, loss of awareness)	Customer	Maximum reading when moving bend roll 70db average. 65db when rolling. Below thresholds for PPE. PPE is mandatory on site.			1	1	1	
Vibration – Use of hand-held machine, resulting in a variety of neurological and vascular disorders.	Customer	No vibration of the hand-held machine parts.			1	1	1	
Radiation – Low frequency, radio frequency radiation, infrared and ultraviolet light, lasers.	Customer	Low range light detector is used.			1	1	1	
Materials and substances processed or used by the machine e.g. from contact with or inhalation of harmful fluids, gases, mists, fumes and dust. Fire or explosions.	Customer	No gasses ejected. Lubricants used subject to standard company procedures.			1	4	4	Ensure any lubricants used are entered into the register. Beware of slip hazards relating to spilled lubricants. Possibly during PPM.
Neglect of ergonomic principles in machine design e.g. Unhealthy posture, inadequate lighting, mental overload, and stress, inadequate design of manual controls, VDU's.	Customer	Good working height, clear PLC coupled with manual controls. Lighting in the area is at least 500 lumens which is an ideal operating environment. Up-right operation at all times including for measurement.			1	1	1	
Unexpected start-up, unexpected overrun/overspeed or any similar malfunction from failure/disorder of the control system.	Customer	There is no automatic start procedure.			1	1	1	
Impossibility of stopping the machine in the best possible conditions	Customer	Machine continuing to run will not cause safety problems to the machine. E-stop is conveniently located for the operator. Light curtains will protect the area.			1	1	1	
Variations in rotational speed tools	Customer	All speeds are incredibly slow, and variations will make no noticeable difference. There are no reasons for the speed to vary from the programmed speed			1	1	1	
Failure of the energy source	Customer	Hazards will not be created by a failure of the energy source.			1	1	1	

Delay	Very unlikely 1	Un-likely 2	Possible 3	Likely 4	Very Likely 5	
Minor injury / no lost time 1	1	2	3	4	5	Stop immediately and add additional
Injury recordable 2	2	4	6	8	10	Review controls within 7 days
Injury / time lost and reportable 3	3	6	9	12	15	Max acceptable risk, review periodically to improve
Major injury / considerable lost time 4	4	8	12	16	20	
Life changing injury / death 5	5	10	15	20	25	

Customer Job Risk Assessment

Risk assessed in line with UL / CSAZ432-04 (2014) / HSE 2014 Guide

Assessed By Craig Barnshaw NEBOSH Cert / Rospa Assessor		Date of Assessment 26/04/2017	Review Date 27/04/2017	C.R.A. No. 1		Risk Assessed AL-2e Super duty - overview	
Hazard / Issue	People affected	Existing Controls	Likelihood	Severity	Score	Further action required	
Failure of the control circuit	Customer	No hazards will be created from a control circuit failure.	1	1	1		
Errors of fitting	Customer	Installation check procedure in place and regular maintenance reviews.	1	1	1		
Break-up during operation	Customer	Slow operation, all mechanicals over specified using FE analysis. No cast parts are used so failure is likely to be contained within the yield of the material.	1	1	1		
Falling or ejected objects or fluids	Customer	Training to show the careful removal of the parts after bending.	1	4	4	Further training needed when larger parts are manufactured. 2 further days planned for booster.	
Loss of stability / overturning of the machine	Customer	Well balanced machine.	1	1	1		
Slip, trip and fall of persons (related to the machine)	Customer	Beware of control cable duct trip hazard and placing rolls around the machine.	1	3	3		
Pace of work	Customer	Good, steady, controlled pace.	1	1	1		
Excessive overtime and fatigue	Customer	N/A for installer.	-	-			
Operator trapping hazard	Customer	Trapping hazards are identified and hazard labels are present to remind the operator. Guarding present reduces risk. The control is at a distance so the operator has reduced access to the trapping zones.	1	5	5	Decide upon the permanent guarding. Existing controls reduce this to good for current section but not other parts.	

		Very unlikely	Un-likely	Possible	Likely	Very Likely		
		1	2	3	4	5		
Delay	1	1	2	3	4	5		
Minor injury / no lost time	1	1	2	3	4	5		
Injury recordable	2	2	4	6	8	10		
Injury / time lost and reportable	3	3	6	9	12	15		
Major injury / considerable lost time	4	4	8	12	16	20		
Life changing injury / death	5	5	10	15	20	25		

Stop immediately and add additional
 Review controls within 7 days
 Max acceptable risk, review periodically to improve

Customer Job Risk Assessment

Risk assessed in line with UL / CSAZ432-04 (2014) / HSE 2014 Guide

Assessed By Craig Barnshaw NEBOSH Cert / Rospa Assessor	Date of Assessment 26/04/2017		Review Date 27/04/2017		C.R.A. No. 1		Risk Assessed AL-2e Super duty - overview	
	Hazard / Issue	People affected	Existing Controls		Likelihood	Severity	Score	Further action required
Tool / die loading	Operator, pedestrians	Limited leaning over with heavy tools. Training on tool loading.		1	2	2	Step would possibly assist the loading of the tools. Ensure rolls are not over the company / lifting limit when designing tools.	
Moving the rolls	Operator, pedestrians	Twin step CNC start for safety. 1 to load 1 to run. Training on operation. Safety curtain restricts access to the machine.		1	1	1		
Incorrect die set up	Operator, pedestrians	Set up dies to a plan. Generally, the part will fail or the tool will be damaged. Operator injury not likely.		1	1	1	Mark the dies. Place the dies in marked containers. Set up a checklist.	
Electric shock from power unit	Operator, pedestrians	Lockable unit, clear warning signs. Entire machine is grounded including the hex panel bolts. This has been checked back to new supply.		1	5	5		

		Very unlikely	Un-likely	Possible	Likely	Very Likely		
		1	2	3	4	5		
Delay	Minor injury / no lost time	1	2	3	4	5		
	Injury recordable	2	4	6	8	10		
	Injury / time lost and reportable	3	6	9	12	15		
	Major injury / considerable lost time	4	8	12	16	20		
	Life changing injury / death	5	10	15	20	25		

Stop immediately and add additional
 Review controls within 7 days
 Max acceptable risk, review periodically to improve