SAFETY MANUAL

(Rev.0.0 15 05 02)

FOR ROLLER BENDER USE

WARNING!

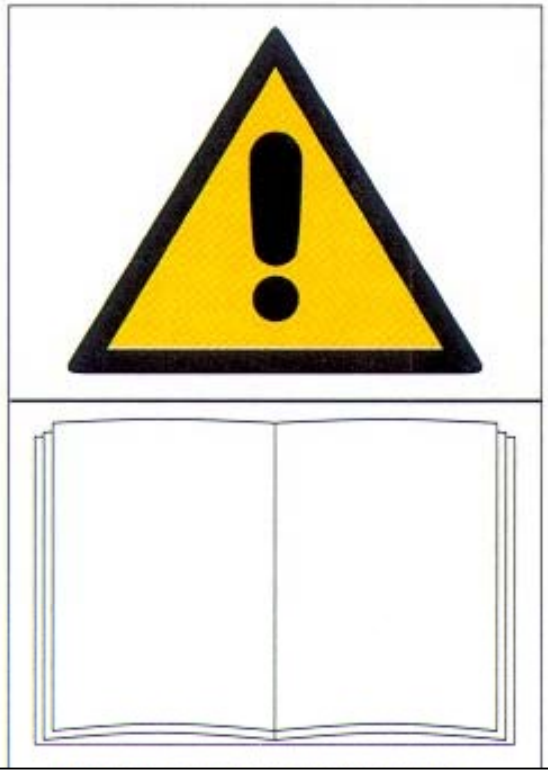
CAREFULLY READ BEFORE USE

NOTE: THE MANUFACTURER IS NOT LIABLE FOR ANY DAMAGES DUE TO THE USE OF NOT ORIGINAL ERCOLINA® TOOLING

INDEX

WARNINGS

Mandatory
Carefully consult documentation supplied with the machine



Leggere attentamente il manuale.
Lire soigneusement le livret d'entretien.
Carefully read the Operator Manual.
Vor inbetriebenahme die Betriebsanleitung lesen

Before performing any operation, assigned personnel must be opportunely trained on both machine function methods and residual risks pertaining to the roller bender.

CML International S.p.A. is not liable for any damages to things or persons caused by a use of the roller bender that varies from the indications given in the Use and Maintenance Manual.

SAFETY NORMS

FORBIDDEN

- **Connect and use the machine without carefully consulting the Use and Maintenance Manual;**
- **Remove protection from gearings and other rotating parts;**
- **Assemble or remove equipment with the general switch on or with the rolls in motion;**
- **Operate on the electrical system without switching off power supply;**
- **Move the machine using inadequate lifting equipment;**
- **Try to manually hold an unsteady load;**
- **Modify the electrical system;**
- **Modify the machine's rolling speed or the work pressure;**
- **Change the rolling speed while processing;**
- **Be distracted when bending or assembling equipment;**
- **Lay hands on material while it moves forward;**
- **Have more than one person working on the same machine;**
- **Have a limited working area compared with the length of the profiles to be worked;**
- **Use the machine beyond the indicated maximum capacity;**
- **Use the machine for other than bending;**
- **Perform maintenance or repairing by unqualified personnel;**
- **Assemble rolls or equipment incompatible with those supplied by CML International S.p.A.;**
- **Clean machine parts without previously switching off power supply;**
- **Use hands to lift the profile when bending more than 360°;**
- **Stand over or under the profile entering or exiting the machine;**
- **Operate rotation with hands laid on the profile entering between the rolls;**
- **Leave the machine unattended with power on.**

MANDATORY

ADEQUATELY TRAIN PERSONNEL ASSIGNED TO MACHINE USE

- **Use protective gloves to manage the material;**
- **Use protective helmet when profiles are suspended or directed upwards;**
- **Use protective shoes, useful in case of heavy loads fall;**
- **Use protective goggles to defend eyes from filings that can be dropped from the profile when bending;**
- **Keep the emergency button installed on the command podium within reach;**
- **Do not change speed when working;**
- **The person who operates machine movements must also introduce and extract the profile to be worked;**
- **Keep adequate space in front of the machine and in the operator's working area;**
- **Pay attention to the part's exiting the roll's grooves;**
- **Carefully read plates and warning signals placed on the machine;**
- **Always stand to the side of the entering and exiting profile at a safety distance from the machine;**
- **Confine the bending operation working area using barriers and/or chains.**

WARNING: further protection devices can be made by the operator or by the person responsible for machine use . Our project department is available to give opportune advice or to satisfy any request.

HANDLING

The machine has several hooking points to perform all the necessary handling operations to move it:

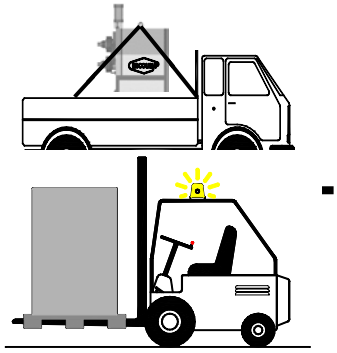
- OVERTURNING/LIFTING from horizontal to vertical axes;
- OVERTURNING/LIFTING from vertical to horizontal axes;
- TRANSPORTATION using forklifts

For this purpose, plates clearly indicating how to use the hooking points have been included.

<u>WARNING:</u> make sure lifting rings are tightly screwed. Any lifting or overturning operation must be performed under maximum safety foreseeing any possible machine's movement or fall.

External transportation

The machine must be loaded with the maximum precautions.
The machine must be loaded with the front part (heavier) towards the back of the transportation mean, to keep stability when breaking.
The machine placed on the transportation mean, must be firmly tied using cables (using also the lifting rings) arranged in triangles to avoid any load movement or fall when departing, curving or breaking roughly.



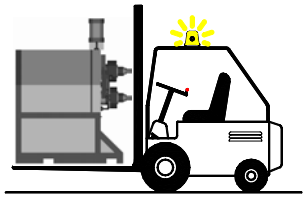
Lifting and transportation

Packed machine

Anchor the machine to the transportation mean, if needed.
Always forklift by the side indicated on pack.

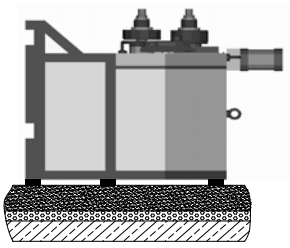
Unpacked machine:

<u>IT'S STRICTLY FORBIDDEN:</u> to try to manually hold the machine in case of suspected instability, keep as far away as possible.

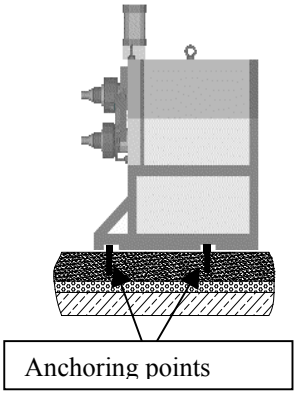


Machine overturning

IMPORTANT: before performing this operations make sure that the mean employed has a lifting capacity that clearly exceeds the one needed to move the machine.



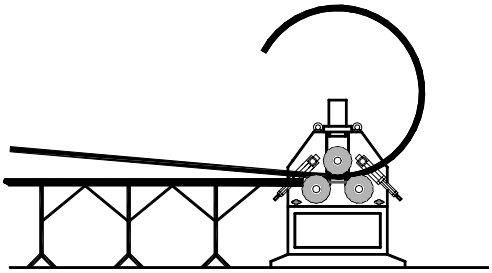
The machine does not require foundations or to be fastened to the floor unless it has to bend extremely heavy and protruding bars; in this case fasten the machine to the floor using the arranged points, indicated in the drawing.



Machine placement

To bend long profiles frontally or horizontally use the adjustable supports to avoid material deformation or inflection.

If a wide radius must be bent, it's better to overturn the machine making it work horizontally.



WARNING: during any machine handling or overturning operation adopt every safety measure and keep the necessary safety distance in case of load instability.

MACHINE PREPARATION

Electrical Connection

<u>WARNING:</u> electrical connections and the other operations must be performed by qualified personnel.

- Before performing electrical connections, check that the power supply conforms to the tension required by the machine.
- Check, that the power supply supports the absorption power of the motors installed on the machine indicated in the TECHNICAL DATA TABLE.

COMMAND DEVICES

All command devices installed on the machine can be comfortably operated standing up, since they are arranged on a PODIUM

Emergency Button
All machines include:

- **"Mushroom head emergency button"** with mechanical block on the operating position.
- **"Pedal"** to activate handling: the pedal includes a safety device to avoid involuntary activations.

After every emergency action:

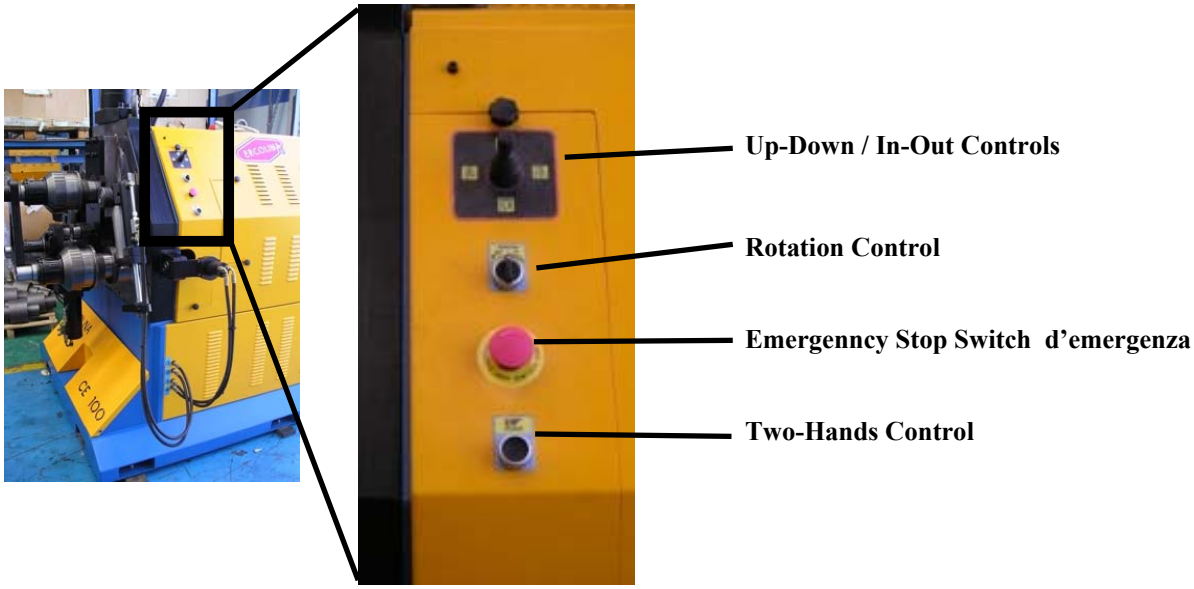
- *Remove the emergency cause;*
- *Release the button rotating it 90°.*

Restart the machine as described in the Use and Maintenance Manual

***MANDATORY:* periodically verify functioning**

SIDE ROLLS ADJUSTMENT

CONTROLS POSITIONS
The controls for the hydraulic lateral rolls adjustment are on the sides of the machine as shown in the picture below.



RESIDUAL RISKS EVALUATION

Overview

The ROLLER BENDER, due to its working and overturning characteristics can not include any shields: since they could collide with the profile during the bending phase and the shield itself could become a limitation while working.

The following is a list of some of the most dangerous and probable potential risks and their relevant suggestions.

WARNING: ***filings projection and/or working material fall danger***

Precautions: respect safety distance

WARNING: ***crushing danger***

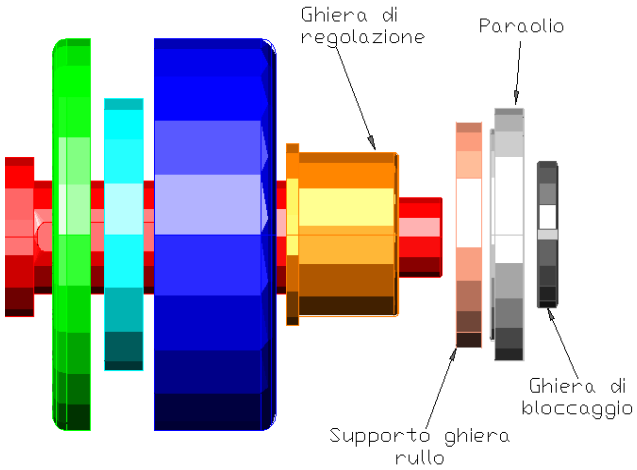
Precautions: keep away from the machine in motion

WARNING: ***catching danger***

Precautions: keep away from the machine when wearing ties or loose clothing.

WARNING: ***slippery floor***

Precautions: keep the working area clean of filings.
Use non slip shoes

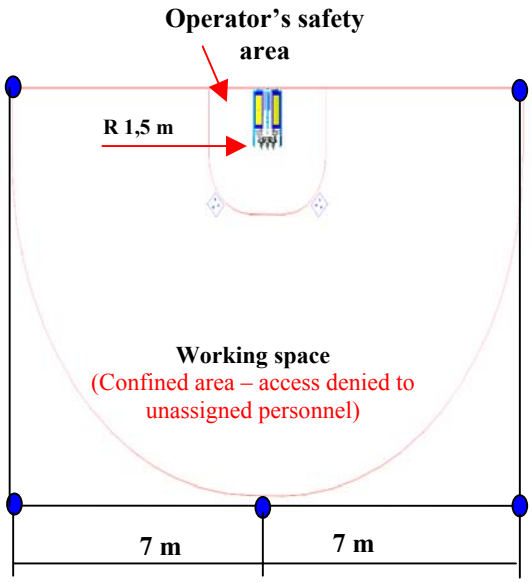


d adjusting rolls

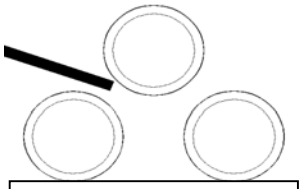
IMPORTANT: ***never assemble or adjust rolls while shafts are rotating***

WARNING: ***machine in motion***

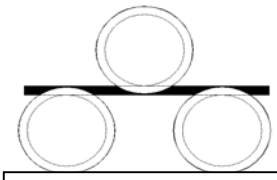
Precautions:
-confine working space;
-indicate danger using necessary signals.



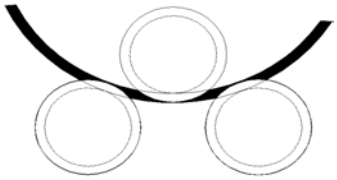
MATERIAL INSERTION BETWEEN ROLLS



Introduce profile with rolls open



Lay upper roll on profile



Activate roll rotation

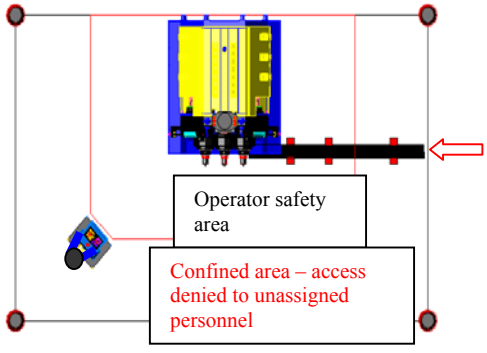
<u>WARNING:</u>
DO NOT INTRODUCE THE PROFILE WHEN ROLLS ARE IN MOTION

OPERATOR'S POSITION

<u>WARNING:</u> ONLY 1 PERSON MUST OPERATE WITHIN THE WORKING AREA

Right to left bending

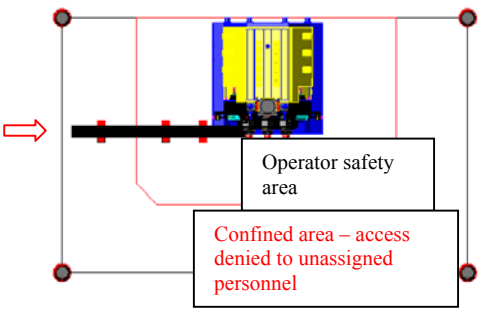
The operator must introduce the bar as previously described.
The command podium must be placed at the profile exit, this means at left as illustrated.
After introducing the part between the rolls, the operator must go to the podium, to start the bending operation.



Left to right bending

Reverse the previously described operations.
The command podium must be placed at the profile exit, this means at right as illustrated.

THE PROFILE MUST BE RECEIVED BY THE OPERATOR WHEN ROLLS ARE NOT IN MOTION



MAINTENANCE

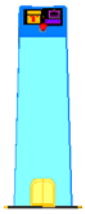
WARNING: ***danger due to maintenance***

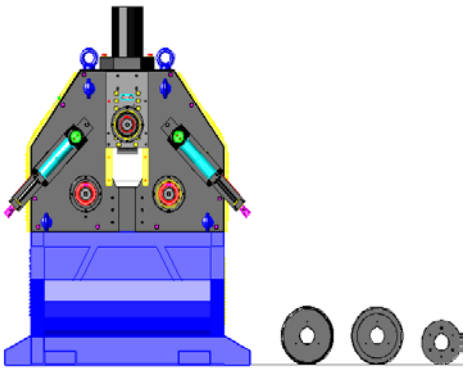
Precautions: when performing maintenance operations remove power supply

WARNING: air development in hydraulic system

WARNING!!

- Before discharging, remove bending rolls to avoid collision between them (operation must be performed with machine turned off);
- Discharge must be made with the machine turned on.





CONCLUSIONS

THIS BRIEF DOCUMENT ABOUT THE MOST **DANGEROUS AND PROBABLE RISKS**, IS NOT INTENDED AS COMPREHENSIVE; BUT AIMS TO MAKE THE OPERATOR REFLECT, SINCE UNPREDICTABLE PROBABLE RISKS COULD BE INFINITE AND IRREVERSIBLE.

REMEMBER

PERSONAL SAFETY COMES BEFORE ANY WORKING NEED .

We would be pleased to receive useful suggestions to improve the next manual to offer a yet safer product for you and all our customers.

Alessandro Caporusso

USE AND MAINTENANCE INSTRUCTION MANUAL

(Rev.0.0 15/05/02)

CE 100H3-RLI

WARNING !!

Any use of the machine that does not conform with what is expressly written in this document immediately frees the MANUFACTURER from any responsibility or warranty obligation.

DIRECTIVE 98/37/EC

"MACHINE DIRECTIVE"

Presidential Decree. 459/96

Directive 98/37/EC – published on the European community Official Journal nr. L 207 of July 23, 1998.

Presidential decree 459/96 – published on the Official Journal nr. 209 of September 06, 1996

NOTES: Carefully read this instruction manual before installing and starting the machine.

The Manufacturer is not liable for any damages due to the use of not original Ercolina® tooling

INDEX

CE 100 ROLLER BENDER DESCRIPTION

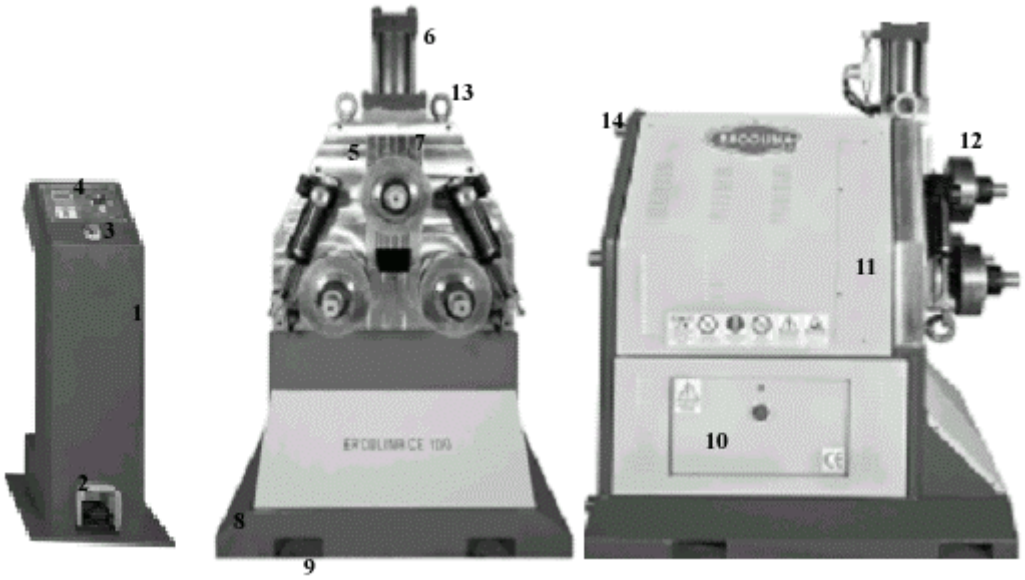
The Ercolina Roller Bender is designed to bend profiles/pipes.
The main machine components are:

- ✓ Stable, resistant and well-finished **base**;
- ✓ **Steel shoulder** of superlative mechanical characteristics;
- ✓ **Reinforced steel shafts** supported by tapered roller bearings of high reliability and endurance;

Main curving devices:

- ➢ **2 fixed lower rolls** with only rotation regulated by relevant gear motor groups;
- ➢ **1 upper roll** besides rotation, has a translatory motion that allows bending, regulated by a hydraulic system;
- ➢ **2 shoulder rolls** that have a double role:
  1. Eliminate distortion phenomena;
  2. Straighten profile.
- ➢ **The podium** where operating and emergency commands are installed.

Main components identification



1	Podium	8	Base
2	Pedal	9	Forklift insertion guides
3	Mushroom head emergency button	10	Electrical panel
4	Control Panel	11	Protection case
5	Shoulder	12	Centre rolls
6	Hydraulic piston	13	Lifting rings
7	Slider	14	Supporting feet for overturning

WARRANTY

Every machine is carefully controlled and tested before shipment. Machine installation is under customer's responsibility, if qualified personnel is required for assistance and training, the cost of the operation will be charged.

Warranty conditions and restrictions:

1. Each ERCOLINA roller bender has a 12 month warranty effective from delivery date, against any component's defect. The company reserves the right to request a copy of the sale invoice.
2. Defects must be notified to us within 2 months from the date the defect has been found.
3. Defects are checked on our premises, so every ERCOLINA roller bender must be sent, FREIGHT PREPAID, to our address or to authorized service centres. ANY FREIGHT COLLECT DELIVERY WILL BE REJECTED. If checking at customer's premises is required, a cost for checking on site will be charged.
4. Warranty includes the defective component's substitution or repair excluding labour cost.
5. Electrical parts are not included in the warranty in case of incompatibility with power supply (caused by overvoltage and / or atmospheric events).
6. Operations performed under warranty may not extend warranty terms.
7. Warranty does not respond to damages caused by wear.
8. The warranty does not apply if damages are a result of incorrect handling or of a use that does not conform with specifications described in this manual.
9. The warranty does not apply if the machine has been modified or tampered with.
10. The warranty certificate IS INVALID if dealer stamp with sales date is not included at the bottom of the document and in the attached coupon. Furthermore, the part to be sent to us must be mailed within the 8 days following the invoice date.
11. The whole warranty falls into decline if:
    - The machine has been repaired or maintained by personnel that has not been authorized by CML International S.p.A.
    - Not original parts have been used
    - Damages or errors are due to connections not performed according to the using instructions
    - Errors due to the machine wear
12. In no case the buyer can apply for compensation of damages.
13. The warranty does not include replacement even temporarily of the machine.

MACHINE TRANSPORTATION

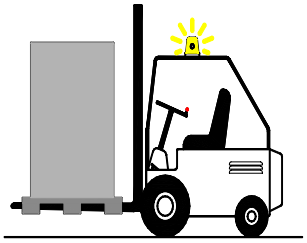
Before proceeding, respect the lifting equipment use norms,
<u>also verify :</u>

- ✓ Machine weight indicated in the Technical Characteristics table;
- ✓ Check if lifting rings are tightly screwed;
- ✓ Make sure cables used are suitable and in excellent conditions.
- ✓ Always check wear conditions of cables and hooks used;
- ✓ Make sure load is securely fastened and balanced;
- ✓ Warn handling start;
- ✓ Make sure machine and installed equipment to be lifted does not exceed the lifting mean's maximum capacity;

Do not abandon control place leaving suspended load unattended..

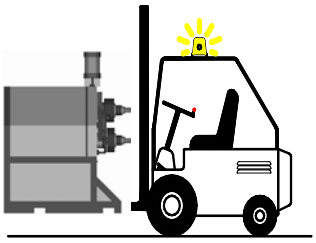
Lifting from bottom with packing
<u>Before proceeding verify:</u>

- ✓ Machine weight indicated in the Technical Characteristics table
- ✓ That the lifting mean used is suitable to lift the weight of machine and installed equipment;
- ✓ Indicated zones of the pallet where grabs should be inserted;



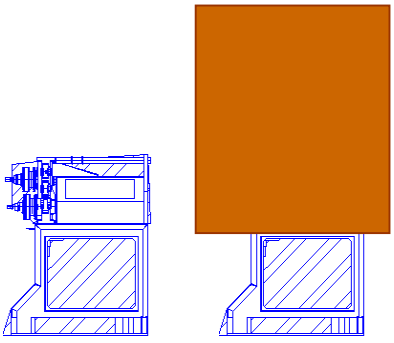
Lifting from bottom without packing
<u>Before proceeding verify</u>:

- ✓ Machine weight indicated in the technical tables section;
- ✓ Make sure the lifting mean used is suitable to lift the weight of machine and installed equipment;
- ✓ Points where grabs should be inserted.



Packing methods
All machines, because of stress caused by transportation and particularly severe climatic conditions (see technical tables section), are carefully packed using appropriate materials to guarantee a total chemical and mechanical protection, in the following sequence:

PHASE 1. Cellophane
PHASE 2. Packed in carton

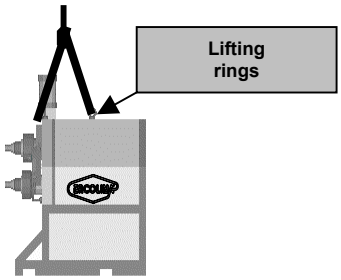


PHASE 1 **PHASE 2**

Lifting from top

Lifting from top is done using arranged lifting rings.
In every handling case, it's necessary to:

- ✓ Respect safety distance from load;
- ✓ Avoid lifting the machine more than the necessary height for handling;
- ✓ Avoid manually holding the machine in case of uncertain stability.

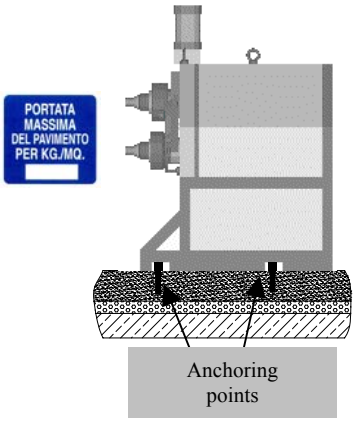


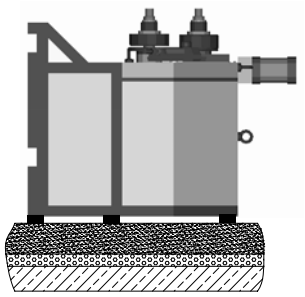
Machine vertical/horizontal positioning

Verify the foundation's allowable load.

The machine is designed to work both vertically and horizontally, as the following illustrates:

- in the frontal/upper zone, lifting rings have been arranged to safely overturn the machine;
- on the rear zone, 6 feet have been arranged to guarantee stability;
- on both working positions the machine's centre of gravity has been placed in a way that guarantees complete stability.





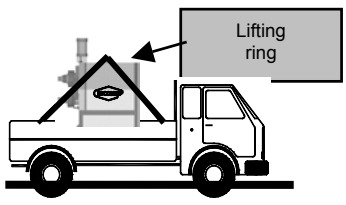
Note: place the machine on a space wide enough to allow working operations. To curve long profiles frontally or horizontally use the adjustable supports to avoid material's inflection deformities.

!WARNING: Anchor machine to the floor on arranged points to avoid overturning! If a wide radius must be bent, it's better to overturn the machine making it work horizontally.

!WARNING: during any machine handling or overturning operation adopt every safety measure and keep the necessary safety distance in case of load fall

Transportation on road using authorized mean

The machine must be loaded with the maximum precautions and in the way illustrated in the figure to guarantee stability.



SAFETY NORMS

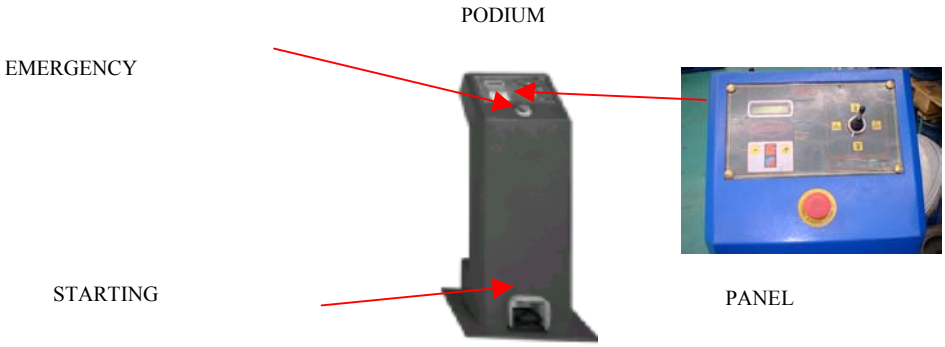
Overview

Active safety

According to the machine technical and operating characteristics and to the variety of products to work, applying fixed or removable protections on bending rolls would obstruct the use of this machine.

Command system

To fully guarantee operator safety, the machine includes a command system installed on a portable podium, that can be placed on a position that allows work and personal safety to be controlled



- *Pedal starting command that blocks roll rotation when released.*
  Two protection devices purposefully designed to obstruct unintentional activation are included: protection on three sides (cover) and internal protection.
  The foot must be deeply introduced in the pedal bay to reach the pedal.
  In addition, the command works at low voltage (24V) coming directly from the transformer in the electrical box.

- *Red mushroom head emergency button with mechanical blocking device.*
  The button remains in emergency position until it is manually released.

- *Panel with ascent and descent commands for pressing roll and rotation command for right/left rotation of all rolls and programming.*
  A transparent film protects each button against dust or other polluting agents penetration that could damage the contact.

Passive safety

Passive safety devices are:

- Sheet metal case fastened to the “base” with Allen screws, that can be removed using the supplied Allen wrench ;
- Fastened cases for all live components;
- General power switch with “electrical panel” door dual lock.

To repair or inspect this zone, make sure the machine is not plugged to the power supply and the general switch is turned off before removing the case.
Repairing operations must be performed by qualified personnel.

!IT IS FORBIDDEN to remove protections and clean, oil, lubricate and repair or regulate devices in motion and with power supply on.

Prescriptions

FORBIDDEN

- **Connect and use the machine without carefully consulting the Use and Maintenance Manual;**
- **Remove motor protections;**
- **Assemble or remove equipment with the general switch on or with the rolls in motion;**
- **Operate on the electrical system without switching off power supply;**
- **Move the machine using inadequate lifting equipment;**
- **Try to manually hold an unsteady load;**
- **Modify the electrical system;**
- **Modify the machine's rolling speed or the work pressure;**
- **Be distracted when bending or assembling equipment;**
- **Lay hands on material while it moves forward;**
- **Have more than one person working on the same machine;**
- **Have a limited working area compared with the length of the profiles to be worked;**
- **Use the machine beyond the indicated maximum capacity;**
- **Use the machine for other than bending;**
- **Perform maintenance or repairing by unqualified personnel;**
- **Assemble rolls or equipment incompatible with those supplied by CML International S.p.A.;**
- **Clean machine parts without previously switching off power supply;**
- **Use hands to lift the profile when bending more than 360°;**
- **Stand over or under the profile entering or exiting the machine;**
- **Operate rotation with hands laid on the profile entering between the rolls;**
- **Leave the machine unattended with power on.**

MANDATORY

ADEQUATELY TRAIN PERSONNEL ASSIGNED TO MACHINE USE

- **Use protective gloves to manage the material;**
- **Use protective helmet when profiles are suspended or directed upwards;**
- **Use protective shoes, useful in case of heavy loads fall;**
- **Use protective lens to defend eyes from filings that can be dropped from the profile when bending;**
- **Keep the emergency button installed on the command podium within reach;**
- **The person who operates machine movements must also introduce and extract the profile to be worked;**
- **Keep adequate space in front of the machine and in the operator's working area;**
- **Pay attention to the part exiting the roll's grooves;**
- **Carefully read plates and warning signals placed on the machine;**
- **Always stand to the side of the entering and exiting profile at a safety distance from the machine;**
- **Confine the bending operation working area using barriers and/or chains.**

!!WARNING: further protection devices can be made by the operator or by the person responsible for machine use. Our project department is available to give opportune advice or to satisfy any request.

Machine equipment

The machine's equipment is able to bend most commercial profiles and special accessories can be assembled to bend profiles of particular geometries and dimensions.

Standard equipment:

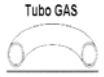
- Standard rolls
- Shoulder rolls with special rectifier to bend leg in/leg out profiles
- Lifting rings for overturning/lifting
- Use and Maintenance manual
- Programming Manual
- Safety Manual
- Service wrenches

Optional accessories

To perform non standard bending, the machine can be equipped with the following accessories:

- Bending rolls for special profiles and tubes;
- Tie bar to increase shaft rigidity
- Arch meter
- Protection barriers
- Service hoist

BENDING CAPACITY

Profile	Dimensions (mm)/(“)	Radius min (mm)/(“)	Rolls (type)
	4“ x 4,50 / 4” x 0,180 4” x 5,4 / 4”x 0,21 5” x Sch40 / 5” x 0,258	600 / 24 800 / 31 1000 / 39	RT RT RT+TI
	30 x 2 / 1,18 x 0,08 150 x 4 / 5,9 x 0,157	250 / 10 1000 / 39	RT RT
	30 x 30 x 2/ 1,18 x 1,18x0,079 120x120x4/4,7 2x4,72x 0,157	250 / 10 1300 / 51	SR SR – TI
	30 x 15 x2/1,18 x 0,59 x 0,079 120 x 60 x 5/4,72x 2,.36x0,197	300 / 12 1500 / 59	SR SR – TI
	30 x 15 x 2 / 1,18x0,59x0,079 140 x 60 x 5/5,51 x2,36x0,197	300 / 12 1500 / 59	SR SR – TI
	30 x 15 x 1,5/1,18x0,59x0,059 100 x 50 x 3/3,94 x1,97x0,118	300 / 12 1000 / 39	SR SR – TI
	30 x 15 x 1,5/1,18x0,59x0,059 120 x 60 x 3 / 4,72x2,36x0,120	300 / 12 1500 / 59	SR SR – TI
	12 / 0,47 70 / 2,75	200 / 8 300 / 12	RT RT
	12/ 0,47 60 / 2,36	300 / 12 300 / 12	RS RS
	12 / 0,47 50 / 1,97	200 / 8 400 / 16	SR SR

Profile	Dimensions (mm)/(“)	Radius min (mm)/(“)	Rolls (type)
	30X5/1,18X0,20 120X20/4,72X0,79	250/10 500/20	RS RS
	50 x 10 / 1,97 x 0,39 200 x 40 / 7,87 x 1,57	250 / 10 500 / 20	RS SR – TI
	30 x 30 x 5 / 1,18 x 1,18 x 0,197 80 x 80 x 12 / 3,15 x 3,15 x 0,472 100 x 100 x12/3,94 x3,94 x 0,472	250 / 10 500 / 20 600 / 24	RS RS RS
	30 x 30 x 5 / 1,18 x 1,18 x 0,197 80 x 80 x 12 / 3,15 x 3,15 x 0.472 100x100x12 / 3,94 x 3,94 x 0,472	250 / 10 500 / 20 800 / 31	RS RS RS
	30 x 30 x 5/1,18 x 1,18 x 0,197 100x100x12 / 3,94 x 3,94 x 0,472	200 / 8 500 / 20	RS RS – TI
	30 x 30 x 5/1,18 x 1,18 x 0,197 100x100x12 / 3,94 x 3,94 x 0,472	250 / 10 500 / 20	RS RS – TI
	U 40 x 35 / 1,57 x 1,38 UPN 180X70 / 7,09X2,75 UPN260X90/10,24X3,54	250 /10 400 /16 600 / 24	SR SR – TI SR – TI
	U 40 x 35 / U 1,57 x 1,38 UPN180X70/7,09”X2,75” UPN260X90/10,24X3,54	250 / 10 400 / 16 600 / 24	SR SR – TI SR – TI
	IPN-IPE 80 (3,15”) IPN-IPE 180 (7,09”) IPN-IPE 240 (9,45”)	500 / 20 500 / 20 600 / 24	SR SR – TI SR – TI
	HE 100 B / 3,94 HE 140 A / 5,51	1000 / 39 1200 / 47	SR - TI SR – TI

We recommend not to use the machine beyond the indicated maximum capacity to prevent permanently deforming some machine devices.

Legend:

RS: Set of three standard rolls
RT: Set of three rolls for solid profiles
SR: Set of three special rolls
TI: tie bar to increase shaft rigidity
RA: Anti-twist device angle leg-in

Note: **The machine was designed to bend the biggest profiles included in the tables, since they offer the highest resistance module.**
Minimal radius refer to material with a resistance of 45 Kg/mm² and obtained with one or more passes.
Note.: for some profiles such as tubes or other pipes, prescribed minimal radius do not depend on the machine’s maximum capacity, but on the plastic deformation limit on which marked ovaling/protrusion is avoided.
If marked ovaling/protrusion conditions are accepted, profiles can be bent with a minimal radius, considerably under values indicated on the table.

We recommend to not exceed the prescribed maximum capacities so as to not cause permanent deformations of some components of the machine.

Bending suggestions

Overview

All materials can be bent with our machines, bending results depend on material's quality.

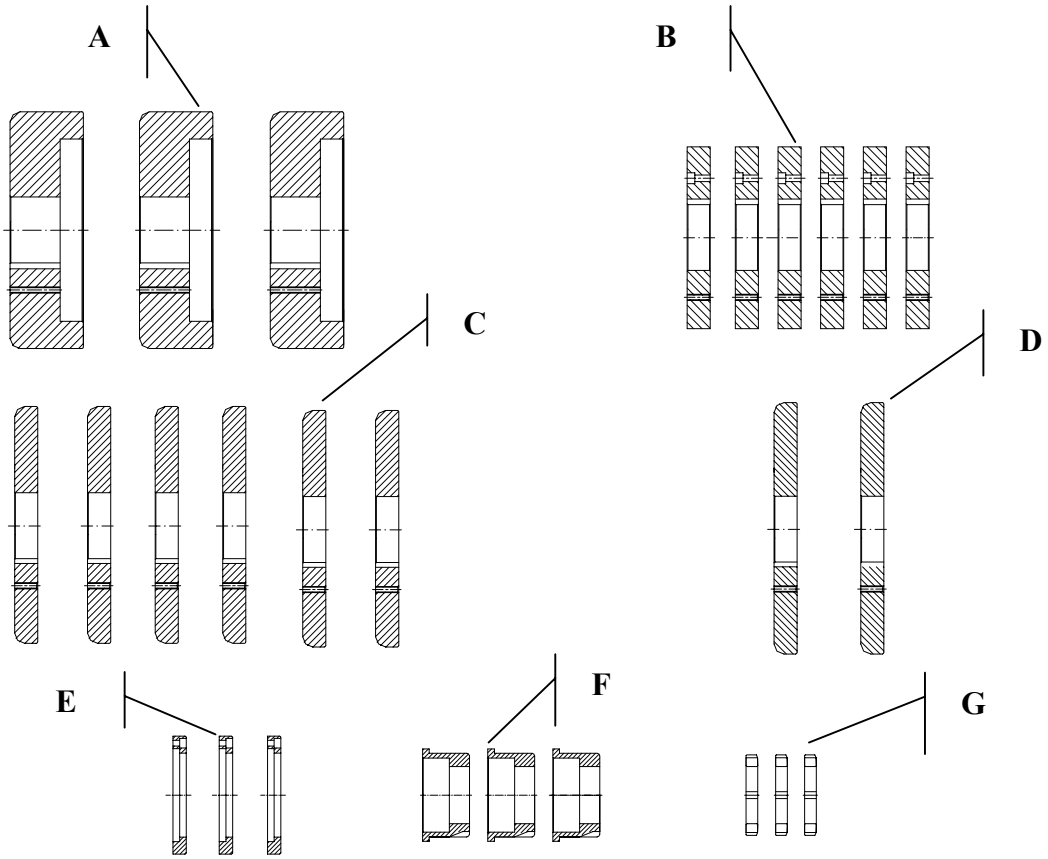
Main parameters that may influence bending:

- Elastic characteristics of material;
- Section's heterogeneity;
- Material temperature;
- Profile distortion;
- Inflection of extremely long bars.

Standard multipurpose rolls

A set of standard rolls is supplied with the machine, it includes:

3 FEMALE ROLLS (**A**),
6 NORMAL FLANGES (**C**),
3 LOCKNUT BLOCKING RINGS (**E**),
3 LOCKNUT FOR ROLLS ADJUSTMENT (**F**),
6 INSERTS (**B**),
2 EXTRA FLANGES (**D**),
3 BLOCKING LOCKNUTS (**G**).



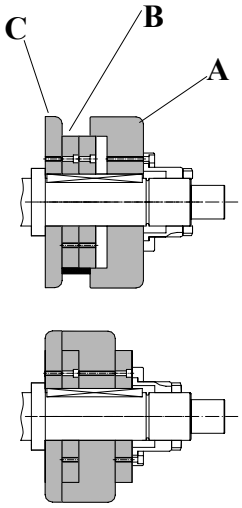
Properly arranged they can bend most commercial profiles.

ROLLS ARRANGEMENT

Rolls must be correctly placed and well aligned according to the profile type to bend. This will avoid excessive machine strain and useless profile distortion.
Rolls opening must be regulated to contain the profile and allow it to slide without excessive friction.
In most profiles, when bending, a remarkable swelling will be noticed in the centre ring, due to natural compression: tightening rolls is advisable to avoid excessive deformation.

For a correct machine use and to avoid excessive strain and useless distortion, in the following pages we include some assembling illustrations for different bending positions.

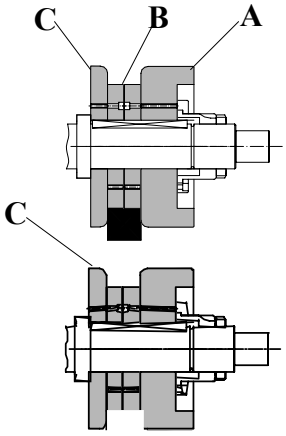
To solve profile bending problems under non standard conditions, please contact our project department.



"**RECTANGULAR SOLID HARD WAY**" **Bending**

Beam dimensions that allow the illustrated assembly are normally worked with rolls included in standard equipment.

Note: if filings are formed during working cycle, we suggest proper adjustment of rolls tightness; furthermore it's preferable to grease profile surfaces to reduce friction.

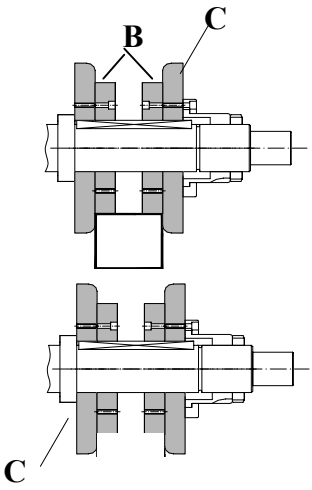


"**SQUARE SOLID**" **Bending**

It's worked with normal rolls included in standard equipment.
If work is continuous , the machine should be equipped with rolls having a groove as wide and deep as the material to bend.
The upper roll housing groove must be regulated **0.5 mm** wider than the material's thickness

Note: if filings are formed during working cycle, we suggest proper adjustment of rolls tightness; furthermore it's preferable to grease profile surfaces to reduce friction.

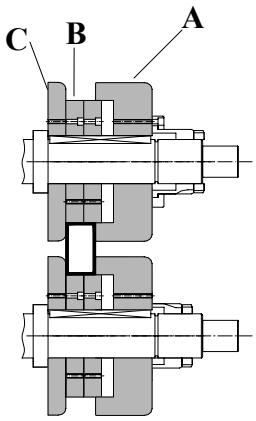
"SQUARE TUBE" Bending



To bend these profiles, particularly those with thin walls, we suggest to equip the roller bender with special rolls supplied upon request.
However, rolls supplied with the machine can be used for thick profiles (see fig.).

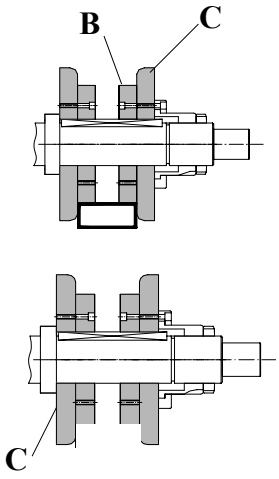
Note: *to correctly bend this type of profile we suggest the use of special sectional rolls (with internal radius).*

"RECTANGULAR TUBE EASY WAY" Bending



Note: *to correctly bend this type of profile we suggest the use of special sectional rolls (with internal radius).*

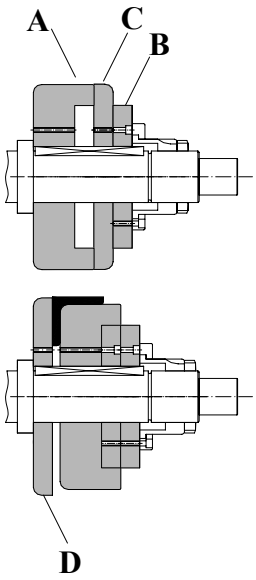
Special rolls are needed to bend thin wall tubes.



"RECTANGULAR TUBE HARD WAY"

Note: *to correctly bend this type of profile we suggest the use of special sectional rolls (with internal radius).*

Special rolls are needed to bend thin wall tubes.



“ANGLE LEG OUT”

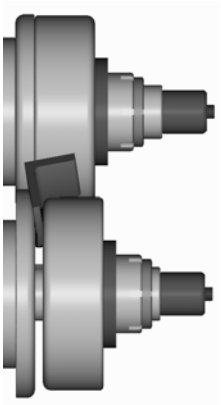
Distortion is a great problem when bending these profiles: caused by unbalanced stresses due to the section’s geometric asymmetry.
Consequently, the machine has been equipped with the necessary tools to eliminate this problem. (SEE FOLLOWING IMAGES)

Solution for distortion problem when bending profiles “ANGLE LEG OUT”:

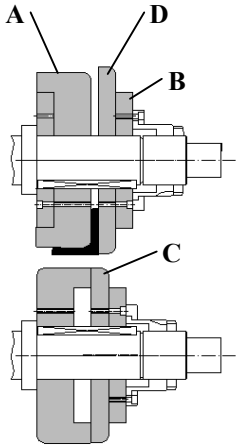
Assemble equipment included in standard supply:

- **Extra flanges** that laterally support profiles;
- **Conical washer** on shoulder roll.

Bending from left to right: Left rectifier must be aligned with material; to avoid distortion right rectifier must be positioned in a way that allows conical washer to work.



"ANGLE LEG IN" Bending

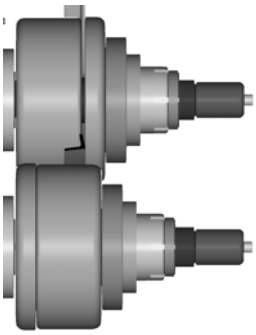


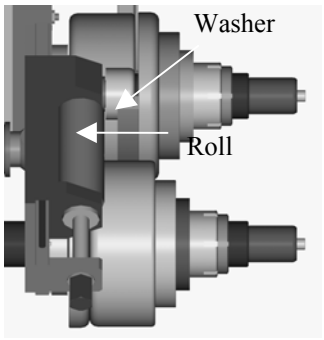
Distortion is a great problem when bending these profiles: caused by unbalanced stresses due to the section's geometric asymmetry. Consequently, the machine has been equipped with the necessary tools to eliminate this problem.

Solution for distortion problem when bending profiles "ANGLE LEG IN".

Assemble equipment included in standard supply:
- **Extra flanges** that laterally support profiles;
- **Cylindrical washer** on shoulder roll.

Bending from left to right: Left rectifier must be aligned with material; to avoid distortion right rectifier must be positioned in a way that allows conical washer to work.



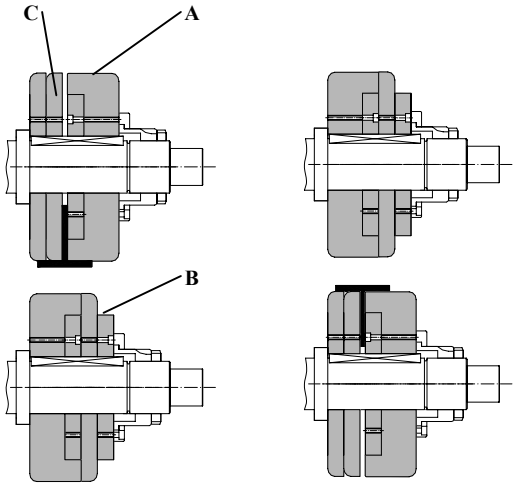


Operations needed to avoid distortion:

1. Move washer touching angle's internal side;
2. Lay roll on angle beam;

"T LEG OUT"/ "T LEG IN"

If a rigorous orthogonality between the leg bended hard way and the bending surface is required, assembling a tie bar at shaft extremities is necessary to increase their rigidity and avoid shaft's flexion as much as possible. These tie bars can be supplied upon request.



INTEGRATIVE NOTE OF CE100 USE AND MAINTENANCE INSTRUCTION MANUAL

" ANGLE LEG IN " RING ROLLING

!!!!WARNING

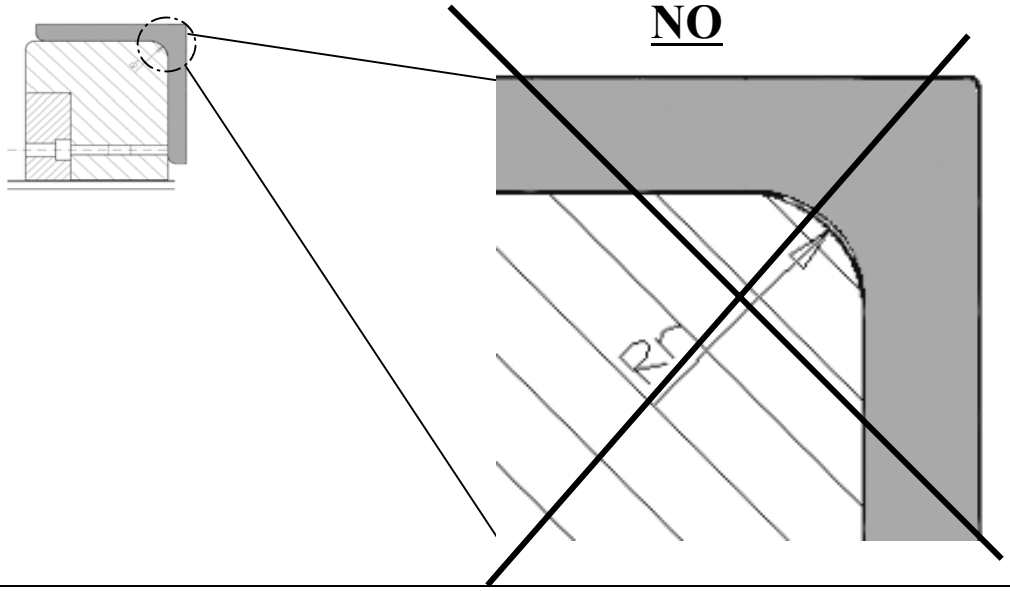
SET CORRECTLY THE RING ROLLS

Before rolling the following represented profile, check that:

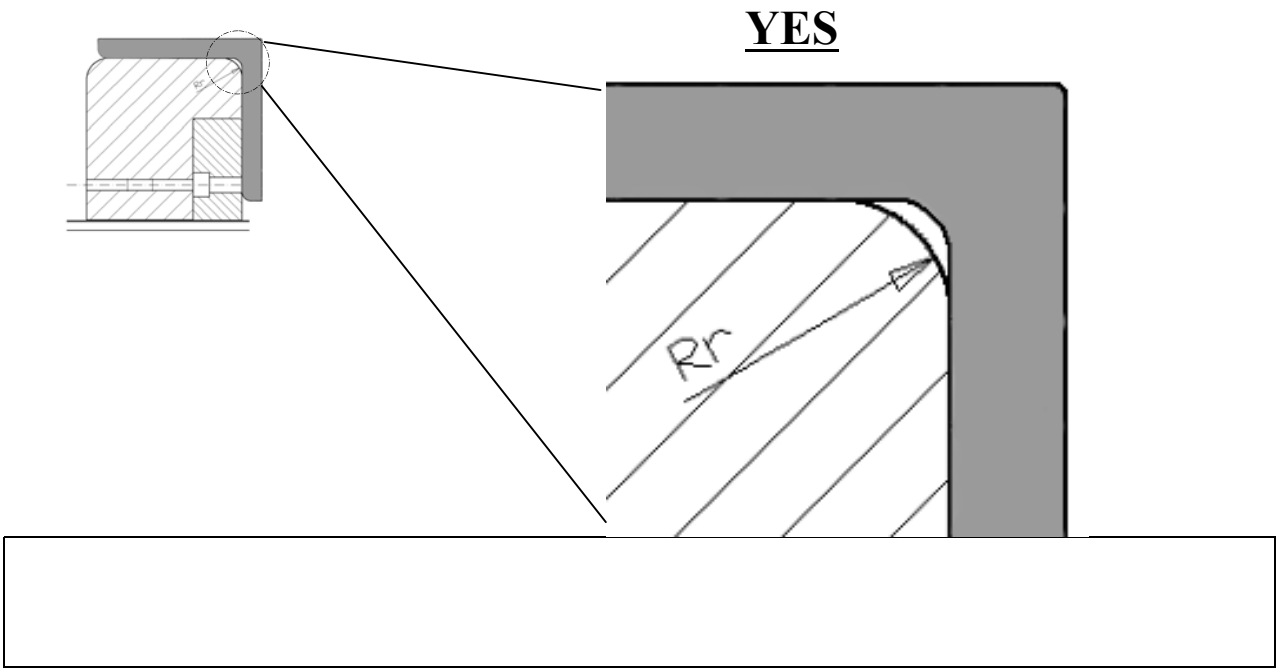
I. CASE: the radius of the roll (Rr) is not bigger than at least 1 ÷ 2 mm the radius of the angle bar (Rr_a). In such case it is not possible to start rolling, since the roll would tend to deform the profile surface.

II. CASE: the radius of the roll (Rr) is shorther than at least 1 ÷ 2 mm the radius of the angle bar (Rr_a), in such case it is possible to start rolling, since the roll will not penetrate the profile surface.

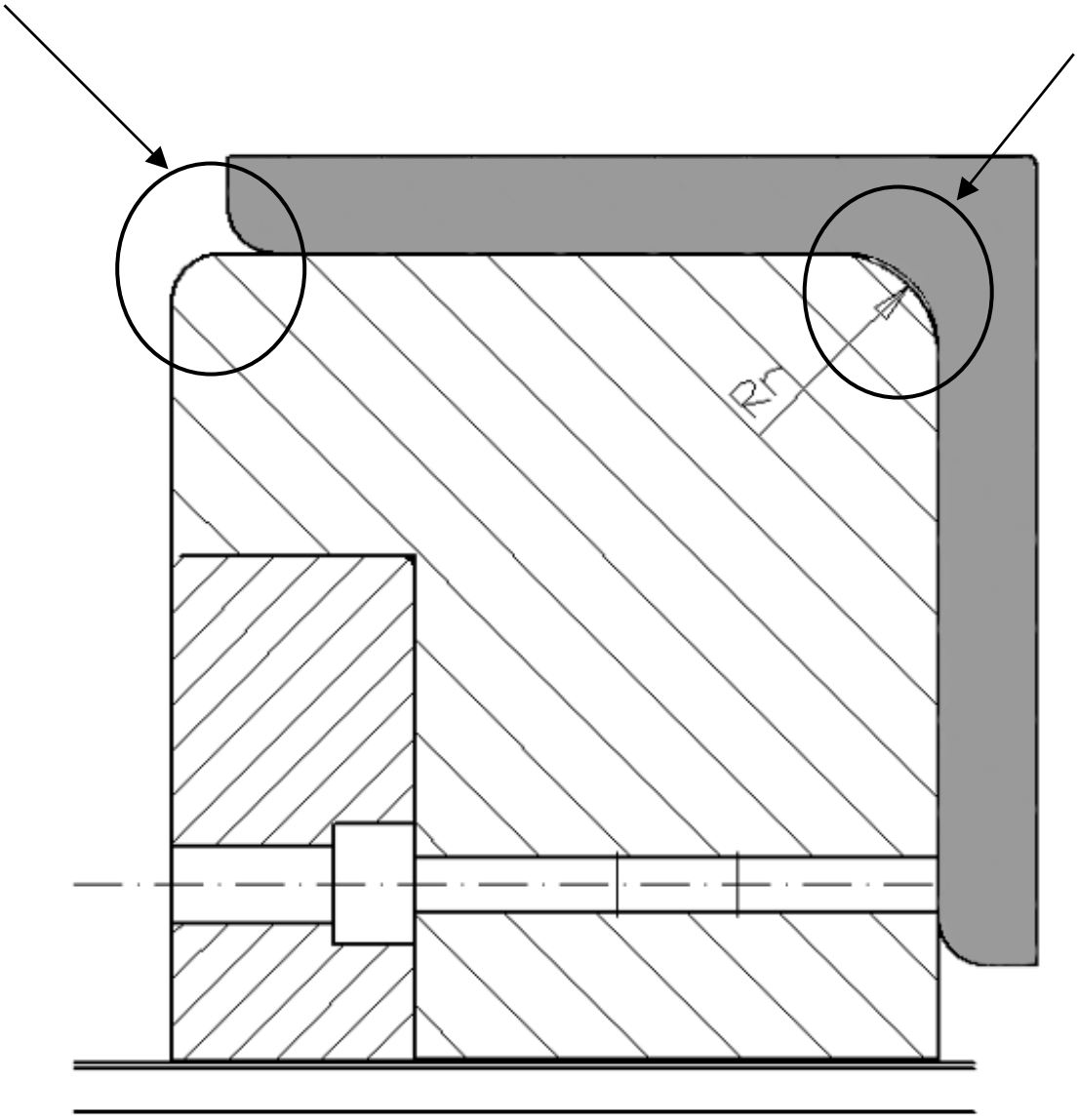
To understand better the above, make reference to the following pictures.



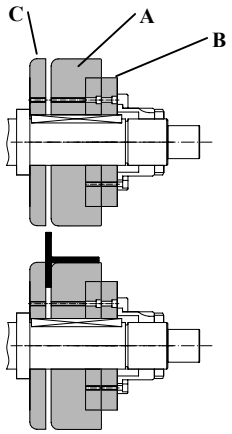
INTERFERENCE Rm > Rr


YES
Rr

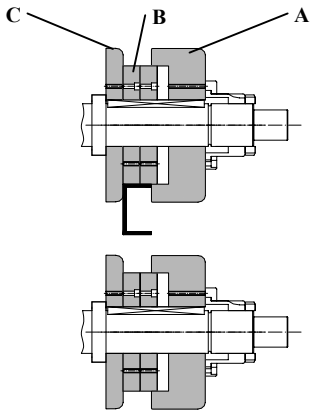
N.B.: THE RADII OF THE ROLL ARE DIFFERENT FOR AN OPTIMUM ADAPTMENT TO THE ANGLE BAR TO BEND



“T LEG UP” Bending

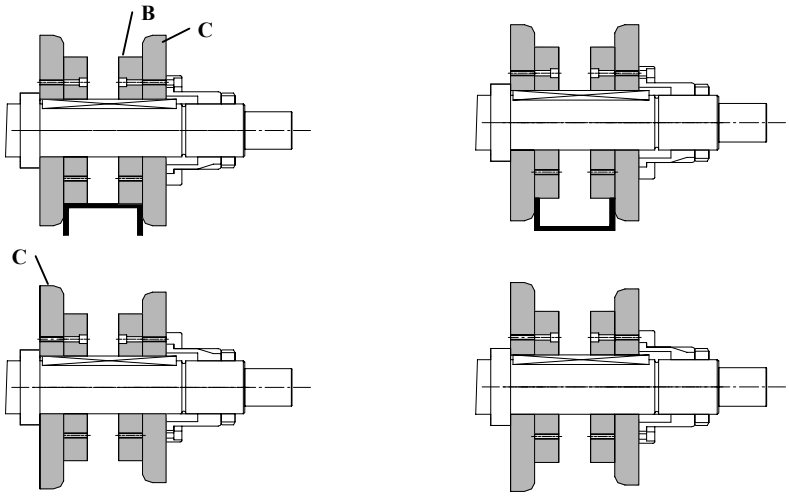


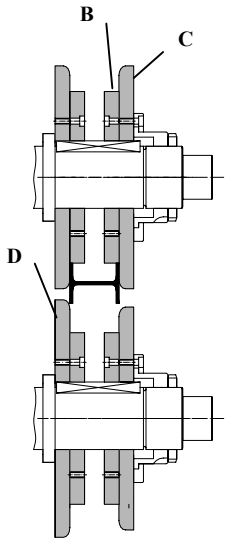
“C LEG OUT” Bending



“C LEG IN” Bending

For profiles of small dimensions rolls supplied with machine can be used.
For biggest profiles we suggest to equip the roller bender with special rolls supplied upon request. Using tie bars is in any case advisable to avoid excessive inflection of shafts.



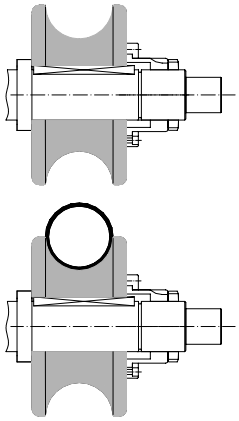


"BEAM HARD WAY" Bending

For profiles of small dimensions rolls supplied with machine can be used.
For biggest profiles we suggest to equip the roller bender with special rolls supplied upon request. Using tie bars is in any case advisable to avoid excessive inflection of shafts.

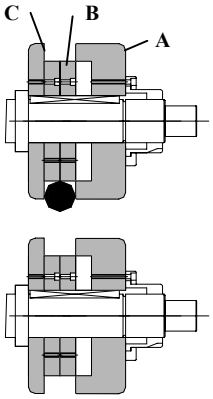
"ROUND TUBES" Bending

There are no particular instructions when bending this type of profiles, the only peculiarity is to equip the machine with rolls that can be supplied upon request, that are not part of the standard equipment.



"ROUND SOLID" Bending

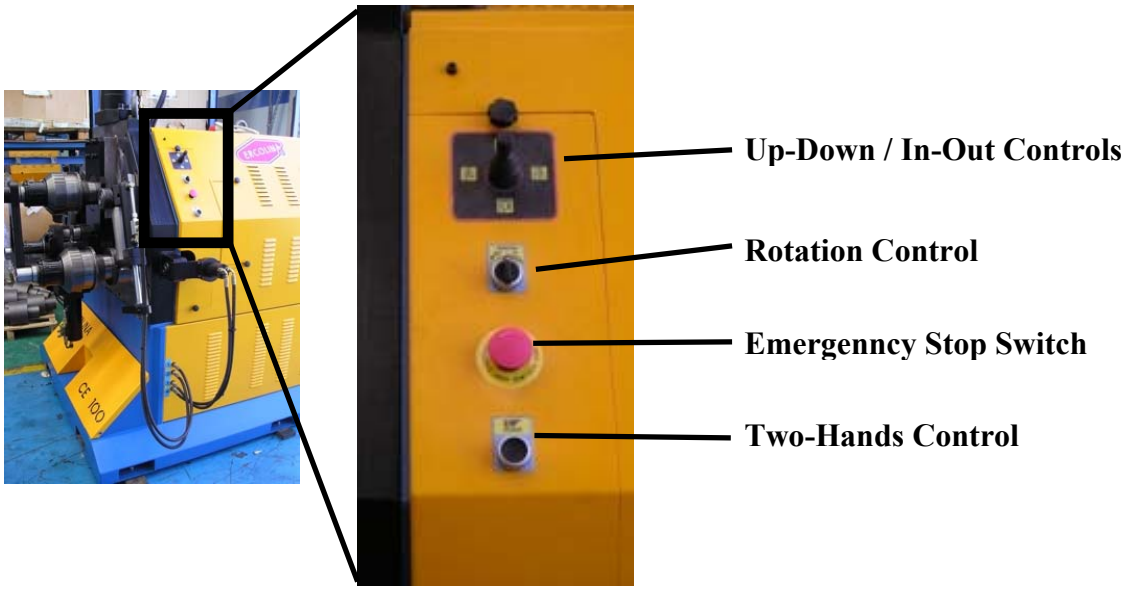
For these profiles, it would be appropriate to equip the machine with rolls having grooves with the same diameter of the beam; but standard rolls can also be used as in the figure.



Note: *for further explanations on other packing configurations not illustrated referring to profiles included in the* ***Capacity*** *table, please contact our project department.*

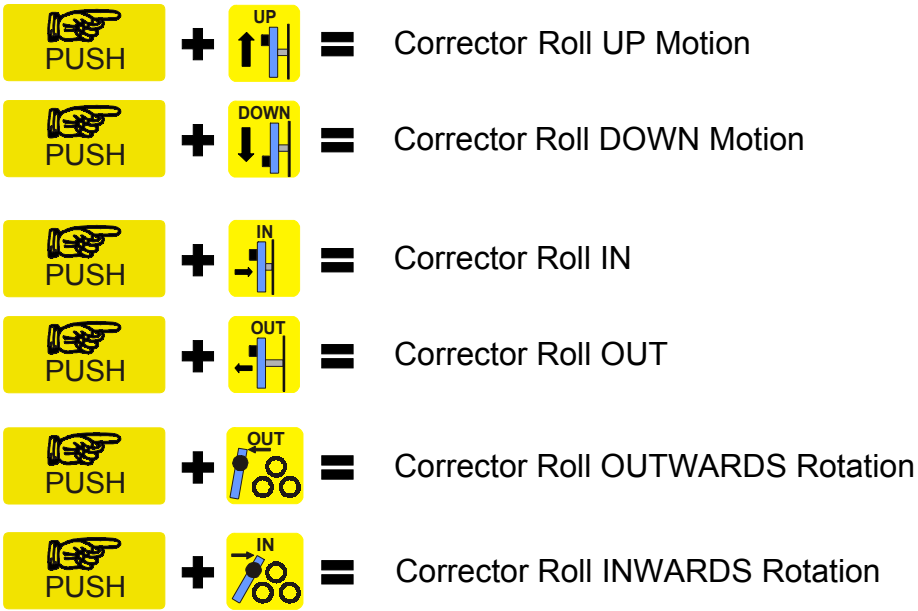
SIDE ROLLS ADJUSTMENT

CONTROLS POSITIONS
The controls for the hydraulic lateral rolls adjustment are on the sides of the machine as shown in the picture below.



Operations for Adjustment

CONTROLS



Machine Preparation

Electrical connection

Electrical panel

The ERCOLINA ROLLER BENDER has been built respecting the CEE, CEN e CENELEC work safety norms in force.

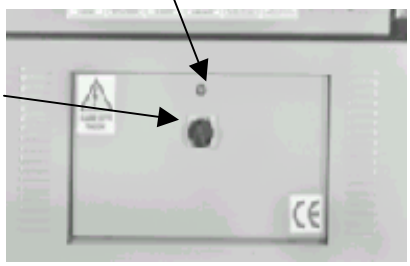
<u>RECOMMENDATION:</u> Electrical connections and other operations should be totally performed by qualified personnel.

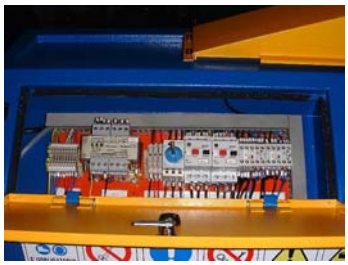
The electrical panel has an hexagonal key lock and a general **"door-lock"** switch**.** It prevents opening the electrical panel door when power is on. The general switch must be set from **1** to **0** before opening the door.

!WARNING: do not remove these protections before unplugging power supply.

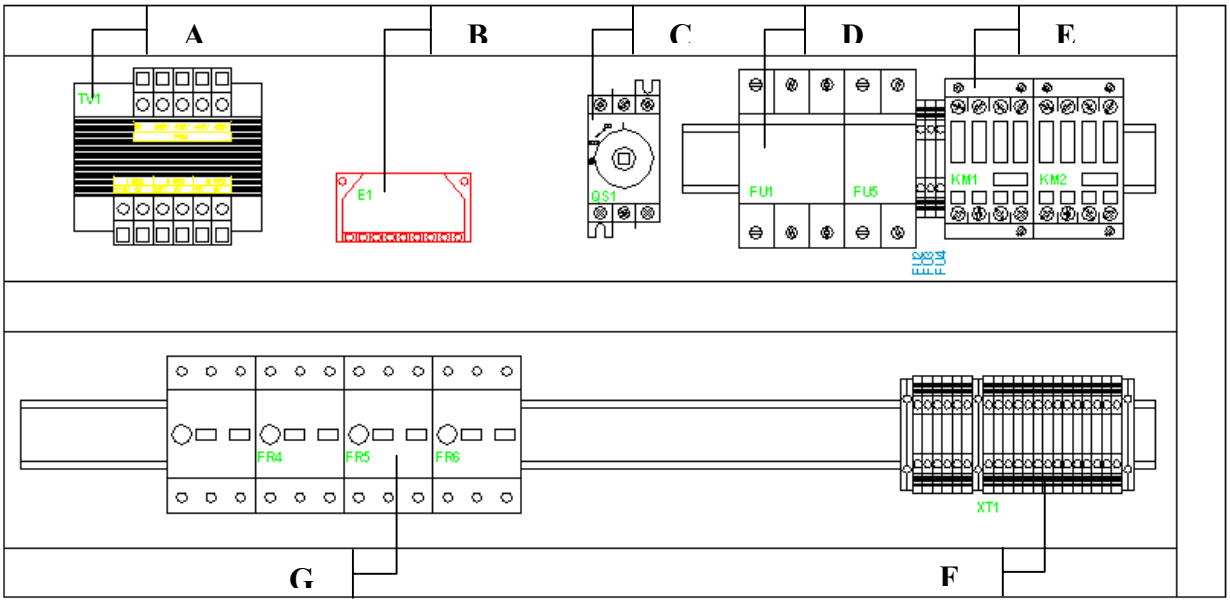
Key lock

Door-lock





Some protections have been installed in the electrical panel, they prevent accessing plain cables arriving to the switch power supply.



Electrical panel topographical diagram

!WARNING: for personal safety, the establishment's ground system must be efficient.

!WARNING: before performing any maintenance or other operation, unplug machine from power supply.

Connection.

Before performing electrical connections check that:

1. the power supply conforms to the tension required by the machine.
2. the power supply supports the absorption power of the motors installed on the machine.

In any case consult chapter :"technical data tables".

Hydraulic power unit

The ERCOLINA Roller Bender is supplied with a full oil tank, therefore, for transportation safety reasons, the breather has been sealed.

!!WARNING

Before using the machine perform the following operations:

1. **Unscrew cap;**
2. **Remove screw and washer;**
3. **Screw cap.**

Troubleshooting

Overview

This paragraph helps determining and possibly resolving, some anomalies that may occur during the life of the ERCOLINA ROLLER BENDER.

The table does not include damages or failures caused by misuse or by a use beyond the machine's capacity, where it's not possible to foresee which components could be exposed to strain or broken. The technical service centre can help you by phone, fax or email to identify the failure if enough information is supplied:

1. Type of anomaly found;
2. Detailed description of operations with anomaly found;
3. Description of movements and diagnostic control lights during anomaly;
4. Anomaly recurrence;
5. Working environment conditions.

In any case, before calling we suggest to check if you can find a reference to the machine failure in the following table.

Anomalies	Diagnosis	Solution
The machine turns on, but the piston doesn't work.	*An input phase of the power unit is inverted.*	*Remove plug and invert phase wires in the plug.*
The control panel display remains off.	*The pedal unit is not connected to the power supply*	*Connect pedal unit to power supply using the plug located in the machine body.*
Rolls don't rotate when pedal is pressed.	*Thermomagnetic protection is disactivated.*	*Check that switches on panel are turned on (I).*
Pressing roll is not kept in position, it jumps when bending.	*Air has been developed on hydraulic system.*	*Discharge system (consult MAINTENANCE section).*
Pressing roll is not kept in position, it looses quota when bending.	*An oil loss on hydraulic system or on lock valve or on piston's gaskets.*	*Substitute the lock valve or remove the piston and substitute gaskets.*
The roll is not kept in position, it slowly looses quota when material passes between rolls.	*An oil loss on hydraulic system or on lock valve by the hydraulic piston or on piston's gaskets.*	*Substitute the lock valve or remove the piston and substitute gaskets.*
The upper roll sometimes doesn't pull the profile enough.	*Friction slides because of friction pads wearing.*	*Friction must be tightened (see friction adjustment).*

Anomaly	Diagnosis	Solution
Bending rolls rotation is too noisy.	*Power supply might not conform to machine needs or the three phases are not present.*	*Check Power supply and machine requirements (see identification plate) and check that the three phases are included in the power supply. Control fuses on each phase.* *Adapt Power supply to fit machine requirements or call the nearest service centre.* *Restore the missing phase or substitute fuse.*
The machine is excessively strained and is too noisy.	*Bushes might be blocked because of lack of oil.*	*Bushes must be substituted by qualified personnel. Check that lubrication oil comes out from nozzles near bushes and from the other parts to be lubricated.*
During centre roll's ascent or descent the panel does not show displaced millimetres.	*Encoder not connected or damaged.*	*Substitute encoder or verify its integrity.*
Machine turns on but the piston doesn't work.	*Emergency button pressed.*	*Remove emergency.*
The piston seems not to have the right driving force.	*Lack of oil on hydraulic circuit.*	*Add hydraulic oil on unit.*

Maintenance

The machine requires very little maintenance because of its solidity and technical design, but in any case it must be performed regularly.

!WARNING: all maintenance activities must be safely performed by qualified personnel.

For a long working life it's advisable to perform some periodical check ups at regular intervals. (Monthly maintenance)

Lubrication
Different machine devices must be lubricated:
- The shoulder correcting rolls, assembled in a particular steel support must be lubricated every 1.000 h.

Bearings
The machine includes bearings on rotating parts.
Motion shafts have **tapered roller bearings**, that perform a double function:

- Axial and radial play holding;
- Possibility to be regulated to eliminate play.

They do not need lubrication since they're sealed and permanently lubricated.
They can be occasionally regulated, if shaft play is excessive.

Bearings regulation:
1. *Remove inspection panel after unplugging power supply (including the one coming directly from electrical panel);*
2. *Locate driving shafts. Shafts are blocked by two locknuts the rear one is self-locking;*
3. *Loosen the clamp screw using the spanner;*
4. *Screw the blocking locknut (front): we suggest screwing the locknut until the shaft can be manually rotated.*
5. *Tighten the self-locking clamp screw;*
6. *Close machine's inspection panel.*

!WARNING
These operations cannot be performed with machine turned off. Remove bending rolls before performing these operations to avoid collision between rolls. Do not lay hands on shafts or devices in motion to avoid crushing.

RECOMMENDATION: qualified personnel should perform these adjustments since this work is important for machine's operation and working life.

Hydraulic power unit

The machine includes a hydraulic power unit that drives the piston.
It is a closed circuit hydraulic system, this means that the same oil used to fill the piston's chamber is automatically re-introduced in the tank when emptying.
During the first working hours it is necessary to check the tank's fluid level to control if there are leakage points.
After the first 100 working hours check filters cleanliness and calibrations.
Every 3000 working hours substitute liquid and filtering elements.

Checking oil level

At regular intervals (every month) it is necessary to check tank's oil level.
To perform this, make sure general switch is off and power supply is unplugged, then loosen fastening screws to remove panel. Unscrew the fill cap and visually check the oil level that must be slightly under the cap level. It's better to perform this operation with the machine in vertical position.

Refilling

The oil level in the power unit must be restored at least every 1000 working hours.
Before refilling make sure general switch is off and power supply unplugged. Unscrew the power unit's tank cap and use a funnel to restore the oil level (see technical tables: suggested lubricants).
Screw cap and restore power supply to the machine.

Discharges

When the power unit is not able to take in oil because of low oil level or for other hydraulic system reasons, air bubbles that cause several machine anomalies are formed; in these cases the roll doesn't keep its position and "*jumps*" when profile is inserted and when bending: the air cushion formed, since it can be compressed, allows piston oscillation. To perform the air discharge, the hydraulic piston has two screws.

Changing oil

Every 10.000 working hours the hydraulic oil in the power unit must be substituted.
The following procedure explains how to perform the operation:

1. *Completely pull down the hydraulic piston;*
2. *Make sure general switch is off;*
3. *Remove the lower-right panel: loosening screws;*
4. *Remove solenoid valve and motor from electrical connections;*
5. *Remove hydraulic tubes connected to the piston;*
6. *Loosen fastening screws on base power unit;*
7. *Extract power unit from base;*
8. *Unscrew drain cap and completely empty the tank;*
9. *Screw drain cap adding teflon on the thread to avoid loss, pay attention not to introduce filings in the power unit. Fill the tank with appropriate hydraulic oil, using adequate filtering means to keep impurities and dirt from getting into the power unit, since they could provoke a machine function failure;*
10. *Re-assemble everything reversing the previously described operations.*

!!WARNING: when performing those operations, be extremely careful not to introduce impurities that could seriously damage the machine's hydraulic components.

For grease and oil type consult technical tables

!!WARNING: depleted oil must not be dispersed in the environment, it should be disposed following the norms in force.

Gear motors

After a 200 hours working period, perform a gear system oil change and wash the inside with liquid detergent.

Oil change operations: verify diagrams and specifications in the attached gear system manual.

The following oil changes must be performed every 2000 working hours.
For the oil type consult the lubricant table.

Cleaning

Overview

When bending ferrous materials, abundant filings dropped from the material's surface cover the machine.
If these filings get into the machine's sliding guides they could block it causing semi-irreparable damage, since the repairing cost is very high.
The machine becomes more vulnerable if it works in a horizontal position (at vertical axes).
For this reason the machine is equipped with a sliding door designed to keep scraps out of the machine avoiding damages to its components.

Precautions: when performing these operations the floor around the machine should also be cleaned to remove oil traces and avoid slippery surfaces.
Use non slip shoes.

Machine cleaning

We suggest you regularly clean the machine from filings, according to the quantity of filings dropped on the machine, particularly if work requires a continuous bending roll adjustment.
To perform this cleaning avoid blowing compressed air, since filings could be blown into the machine causing the difficulties indicated above.

Use a brush to eliminate the bigger filings, trying to throw them away from the machine and away from the mobile mechanic parts.
Once surface filings are completely eliminated, compressed air can be used to eliminate dust traces in the guides.

Note:

- *In the event of a temporary disuse*, (less than two months) it's not necessary to follow particular precautions.
- *In the event of a prolonged disuse*, (more than two months), we suggest turning the machine on for some minutes at regular intervals, approximately every two months, without pressure to guarantee internal lubrication of components.

Risk prevention solutions

Machine stop operations

- *By the operator* (voluntarily and involuntarily): pressing the emergency button at any point and with any angle. It is so sensitive that a minimal impulse is enough to interrupt roll motion;
- *By a third person:* operating directly on the general switch or the emergency button.

If an improbable permanent blocking and /or crushing accident occurs, it's necessary to carefully evaluate the most suitable operation to perform:

1. Invert the advancing direction of the upper roll;
2. Rotate rolls to facilitate extraction;
3. Loosen the tightening locknut

!WARNING: in both conditions the reaction of material inserted between rolls should be evaluated. Before performing the operation, foresee the logical reaction movement of the material and behave consequently.

Risks due to fall or projection of bent part

While the machine works there is no risk of working parts, filings, shavings or fragments projection.

dangerous situations that may arise are:

1. The part, once bending is completed, might fall from the rolls. This situation can be dangerous if the part was bent at a wide radius, since the falling part could harm the operator.

2. The part can remain caught between the rolls in motion, and be dragged in the rotation not held by the three rolls;

3. When bending, the material could remain blocked between the roll grooves and stop their rotation: carefully evaluate the tightening locknut regulation; it's a good rule to leave a small play to admit swelling.

!!MANDATORY: USE PROTECTIVE SHOES (D. p. i.)

RISK TYPE	SAFETY DEVICES
Dangers of mechanical nature	• Driving devices protection; • Pedal controlled working that requiring continuous operator interaction, facilitates machine control and minimises its stopping time ; • Pedal board with protection against involuntary starting; • Mobile metallic protection case that prevents accessing the slider zone.
Dangers of electrical nature due to direct or indirect contact	• Low tension command devices (24V); • Electrical circuit closed on a panel IP 44; • General switch interlocked with the electrical system access door, it prevents door opening while the electrical system is under tension.

Directions for residual risk limitations

To reduce irremovable residual risks, due to the nature of working operations, we have provided:

- *Individual protection systems* and tags posted on the machine indicating the correct operating methods.

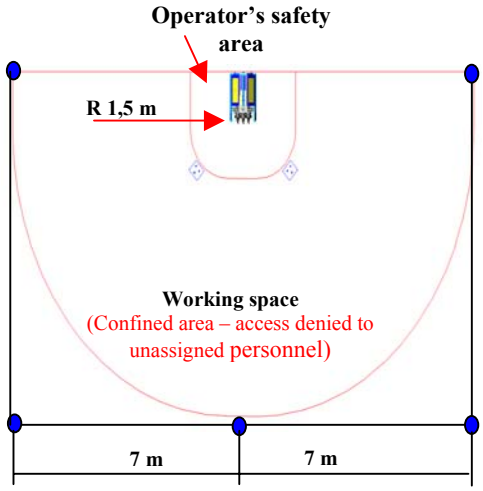
In the following table mandatory individual protection devices are listed associated to the risk they protect from.

RISK TYPE	INDIVIDUAL PROTECTION DEVICES
abrasion, cutting, collision danger	Gloves
Projection of filings, etc.	Goggles
Falling objects danger	Helmet, protective shoes
Catching danger	Protection

- *Confining barriers:* due to the technical and operating characteristics of the machine, installing rigid protection devices like protective shields would impede its use, since the necessary operations would become impossible to perform;

!!MANDATORY: confine the working space using adequate barriers.

Precautions:
- **Confine working space;**
- **indicate danger using necessary signals;**

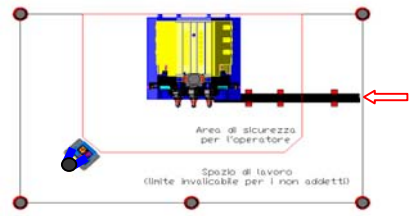


Operator's Position

To guarantee the operator's safety, the machine has been equipped with a remote control unit, installed on a **Podium** to allow the operator to stand on an optimal zone to control the profile bending and at the same time respect the **safety distance of 1.5 m.**

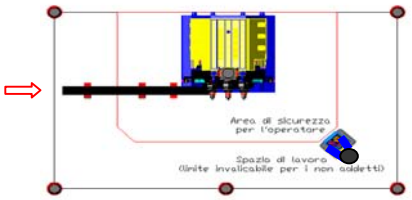
!!WARNING: only 1 person must operate within the working area, and always outside the safety area r 1.5 m (UNI EN 294)

Right to left bending
The operator must introduce the bar as previously described.
The command podium must be placed at the profile exit, this means at left as illustrated.
After introducing the part between the rolls, the operator must go to the podium, to start the bending operation.



Left to right bending
Reverse the previously described operations.

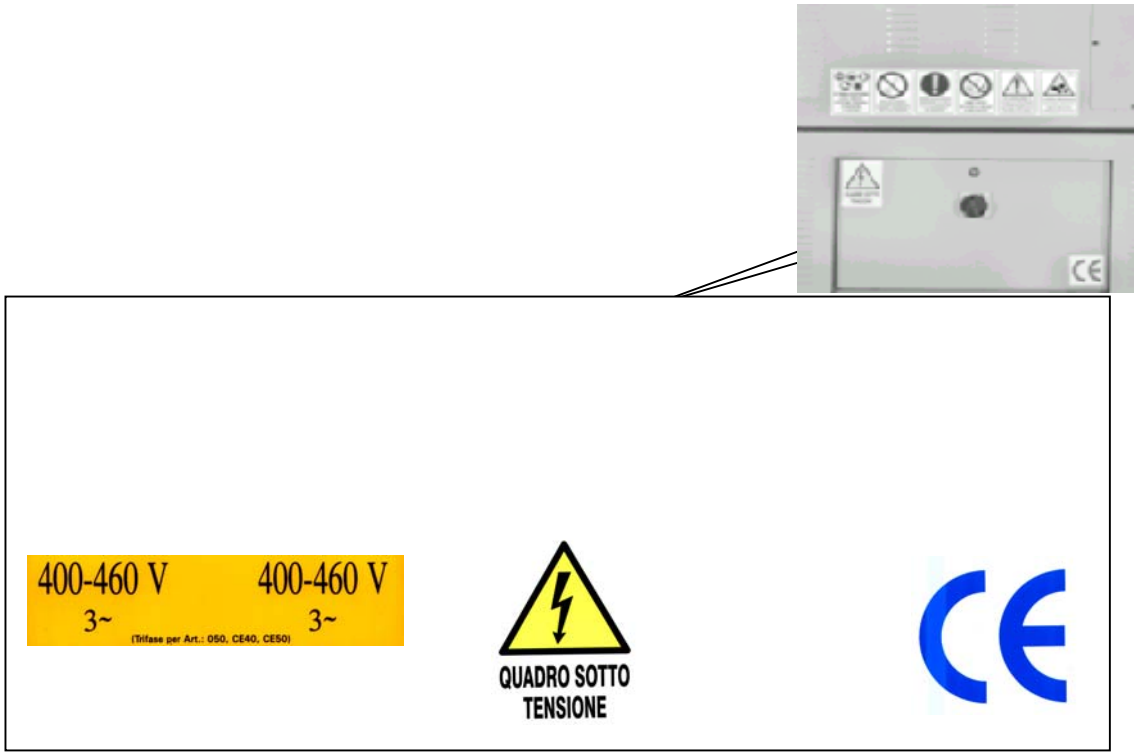
The command podium must be placed at the profile exit, this means at right as illustrated



!!MANDATORY: THE PROFILE MUST BE RECEIVED BY THE OPERATOR WHEN ROLLS ARE NOT IN MOTION

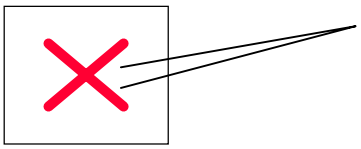
Tags / Plates

Safety signals



Identification Plate CE marking

According to the norms in force (Directive nr. 89/392/EC → 98/37/CEE and Presidential decree nr. 459/1996), the ROLLER BENDER has an identification plate with CE marking, where information on the machine characteristics that may be relevant to safety terms is included. Refer to this information in case of doubt.



The plate is placed on the upper left side of the machine where it can be easily seen and it is not removable. If the identification plate for any reason is damaged, immediately contact the manufacturer for its substitution.

!!WARNING:

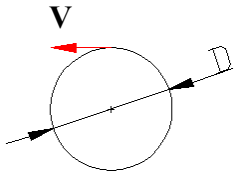
Whoever tampers or removes the plate, can be prosecuted by law and frees the manufacturer from any machine warranty responsibility.

Working speed

The driving system of the ERCOLINA ROLLER BENDER is performed by a gear motor group.

The material's advancing speed depends on the diameter of the rolls where material is laid:

$$V = D \times \pi \times n$$



Where: **V** = material's advancing speed
D = diameter of roll where material is laid
π = 3.14
n = shaft's rotation (RPM)

Nominal speed (with standard rolls set) has been designed considering machine's productivity and danger level.

Scraps disposal

Machine demolition

We recommend deactivating the machine, before proceeding to its demolition:

- Disassembling its components;
- Removing the motor

Before performing these operations completely empty hydraulic system and gear system from oils.

Ecological information

The disposal of the ROLLER BENDER packing materials, substituted parts, lubricants, components or of the machine itself, must be performed respecting the environment, avoiding ground, water and air pollution.
It's the duty of the machine owner to perform this operation conforming to norms in force in the country where the machine is used.

Indications for correct waste disposal

- Ferrous materials, aluminium, copper: are recyclable materials that must be taken to the proper authorized collecting centre;
- Plastic and rubber materials: must be taken to a refuse disposal site or to the proper recycling centre;
- Depleted oils: deliver to the proper authorized collecting centre (in Italy: Consorzio Obbligatorio Olii Esausti).

Technical tables

Technical data tables

Technical characteristics	Measure unit	Mod. CE 100
SHAFT DIAMETERS (On Rolls and Bearings)	mm	100
Standard Rolls Diameter	mm	310
Shafts speed	RPM	6
Standard Shafts working length	Mm	200
Upper Roll motor(230 V,Y 400 V)	KW	1,8
Lower Roll Motor(230 V,Y 400 V)	KW	2 x 1,5
Hydraulic Power Unit Motor(.Δ..230 V,Y 400 V)	KW	2.2
Piston thrust	Ton	36
Thrust Roll Max. Stroke	Mm	200
Nr. Of Driving Rolls		3/smooth
Machine's Working Surface		horiz.-vert.
Centre Roll Regulation		Hyd
Centre Roll Reading		Digital progr.
Base		YES
Tridimentional Contrasting Side Rolls		YES
Bt Electrical Foot Pedal		YES
Steel Machine Body		C 40
Noise Rating	dB	<70

Dimensions Table

Description	Measure Unit	Mod. CE 100
Overall Dimensions (base x length x height)	Cm	145 x 190 x 150
Packed dimensions	cm.	150 x 200 x 160

Weights Table

Description	Measure Unit	Mod.CE 100
Net machine weight	Kg	2100
Machine weight with standard equipment	Kg	2200
Packing weight	Kg	15

Environmental Table

Description	Measure Unit	Mod. CE 100
Working Temperature	°C	0-40
Relative humidity		90%max
Environment		Non explosive

List of lifting equipment

Description	Measure Unit	Capacity
TRANSPORT PALLET (with EC certification)	Kg	3000

Suggested greases

Description	Brand	Equivalent
Lubricant grease	AGIP GR MU EP/0	SHELL ALVANIA
Sliding Grease	AMECO, OPTIMOL VISCOGEN 4 TYPE	
Bearings Grease	AGIP GRMUEP 2	

Suggested Lubricants

Brand	DIN 51524 Specifications	DIN 51524 Specifications
	HLP 32	HLP 46
AGIP	OSO 32	OSO 46
BP	ENERGOL HLP 32	ENERGOL HLP 46
CASTROL	HYSPIN AWS 32	HYSPIN AWS 46
ELF	ELFOLNA 32	ELFOLNA 46
ESSO	NUTO H 32	NUTO H 32
FINA	HYDRAN 32	HYDRAN 46
IP	HYDRUS 32	HYDRUS 46
MOBIL	DTE 24	DTE 25
Q8	HAYDIN 32	HAYDIN 46
SHELL	TELLUS 32	TELLUS 46
TEXANO	RANDO HD 32	RANDO HD 46
TOTAL	AZOLLA ZS 32	AZOLLA ZS 46

Command devices functions and colours association table

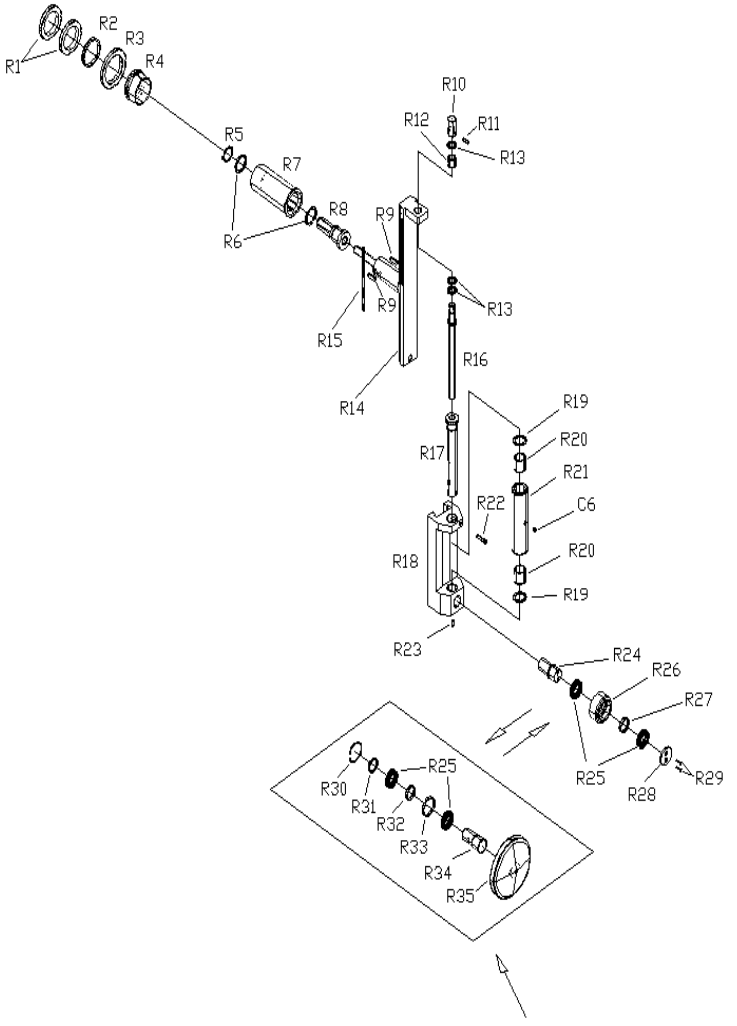
Colour	Meaning	Explanation	Application examples
Red	Emergency	Activate in case of dangerous conditions or emergency.	Emergency stop. Emergency function start.
Yellow	Abnormal	Activate in case of abnormal conditions.	Abnormal condition elimination. Interrupted automatic cycle re-starting operation.
Green	Normal	Activate to start a normal condition.	Confirming a command .
Blue	Mandatory	Activate if a condition requires a mandatory action.	Reset function.
White Grey Blue	No specific meaning	For general functions starting, excepting emergency stop.	Start/Stop.

Millimetres to inches conversion table

Inches	0"	1"	2"	3"	4"	5"
	mm	Mm	mm	mm	mm	mm
0"	—	25,400.	50,8	76.200	101,8	127.000
1/64"	0,397	25,797	51,197	76.597	101.997	127.397
1/32"	0,794	26,194	51,594	76,994	102.394	127,794
3/64"	1,191	26,591	51,991	77.391	102,791	128.191
1/16"	1,588	26,988	52.388	77,788	103,188	128,588
5/64"	1.984	27,384	52,784	78,184	103584	128,984
3/32"	2,381	27,781	53,181	78.581	103,981	129,381
7/64"	2.778	28,178	53,578	78.978	104,378	129,778
1/8"	3,175	28,575	53,975	79,375	104,775	130.175
9/64"	3.572	28.972	54.372	79.772	105.172	130.572
5/32"	3.969	29.369	54,769	80,169	105,569	130.969
11/64"	4,366	29,766	55,166	80,566	105,966	131,366
3/16"	4,762	30,162	55,562	80,962	106,362	131,762
13/64"	5,159	30,559	55,959	81.359	106.759	132.159
7/32"	5.556	30,956	56,356	81,756	107,156	132,556
15/64"	5,953	31,353	56,753	82.153	107.553	132,953
1/4"	6.350	31 .750	57,15	82.550	107.950	133.350
17/64"	6,747	32,147	57,547	82,947	108,347	133,747
9/32"	7,144	32544	57,944	83,344	108,744	134,144
19/64"	7,541	32,941	58,341	83,741	109.141	134,541
5/16"	7,938	33,338	58,738	84,138	109,538	134,938
21/64"	8.334	33,734	59,134	84,534	109.934	135,334
11/32"	8,731	34.131	59,531	84,931	110,331	135,731
23/64"	9,129	34.528	59,928	85.328	110,728	136,128
3/8"	9,525	34,925	60,325	85.725	111,125	136,525
25/64"	9,922	35,322	60.722	86,122	111,522	136,922
13/32"	10,319	35,719	61,119	86,519	111,919	137,319
27/64"	10,716	36,116	61,516	86,916	112,316	137,716
7/16"	11,112	36,512	61.912	87.312	112,712	138,112
29/64"	11,509	36,909	62,309	87,709	113,109	138,509
15/32"	11,906	37,306	62,706	88.106	113.506	138,906
31/64"	12,303	37.703	63.103	38,503	113.903.	139.303
1/2"	12,7	38,1	63,5	88.900	114,3	139,7
33/64"	13,097	38,497	63,897	89.297	114,697	140,097
17/32"	13,494	38,894	64,294	89.694	115,094	140,494
35/64"	13,891	39,291	64,691	90,091	115,491	140,891
9/16"	14.288	39,688	65,088	90,488	115,888	141,288
37/64"	14.684	40,084	65,484	90,884	116.284	141,684
19/32"	15,081	40,481	65,881	91,281	116,681	142,081
39/64"	15.478	40,878	66,278	91.678	117,078	142,478
5/8"	15,875	41,275	66,675	92,075	117,475	142,875
41/64"	16,272	41,672	67,072	92,472	117,872	143,272
21/32"	16,669	42.069	67,469	92.869	118,269	143,669
43/64"	17,066	42.466	67,866	93.266	118,666	144,066
11/16"	17.462	42,862	68,262	93,662	119,062	144,462
45/64"	17,859	43,259	68,659	94,059	119,459	144,859
23/32"	18,256	43,656	69,056	94,456	119,856	145,256
47/64"	18,653	44,053	69,453	94,853	120,253	145,653
3/4"	19,05	44,45	69,85	95.250	120,65	146,05
49/64"	19,447	44,847	70,247	95,647	121,047	146,447
25/32"	19,844	45,244	70,644	96,044	121,444	146,844
51/64"	20,241	45,641	71,041	96,441	121,841	147,241
13/16"	20,638	46,038	71,438	96,838	122,238	147,638
53/64"	21,034	46,434	71,834	97,234	122,634	148,034
27/32"	21,431	46,831	72,231	97,631	123,031	148,431
55/64"	21,828	47,228	72.628	98,028	123,428	148,828
7/8"	22,225	47,625	73.025	98.425	123,825	149,225
57/64"	22,622	48,022	73,422	98,822	124,222	149,622
29/32"	23,019	48,419	73,819	99.219	124,619	150,019
59/64"	23,416	48,816	74,216	99,616	125,016	150,416
15/16"	23,812	49,212	74,612	100,012	125,412	150,812
61/64"	24,209	49,609	75.009	100,409	125,809	151,209
31/32"	24.606	50,006	75,406	100.806	126,206	151,606
63/64"	25,003	50,403	75,803	101,203	126,603	152,003

CORRECTING ROLL GROUP

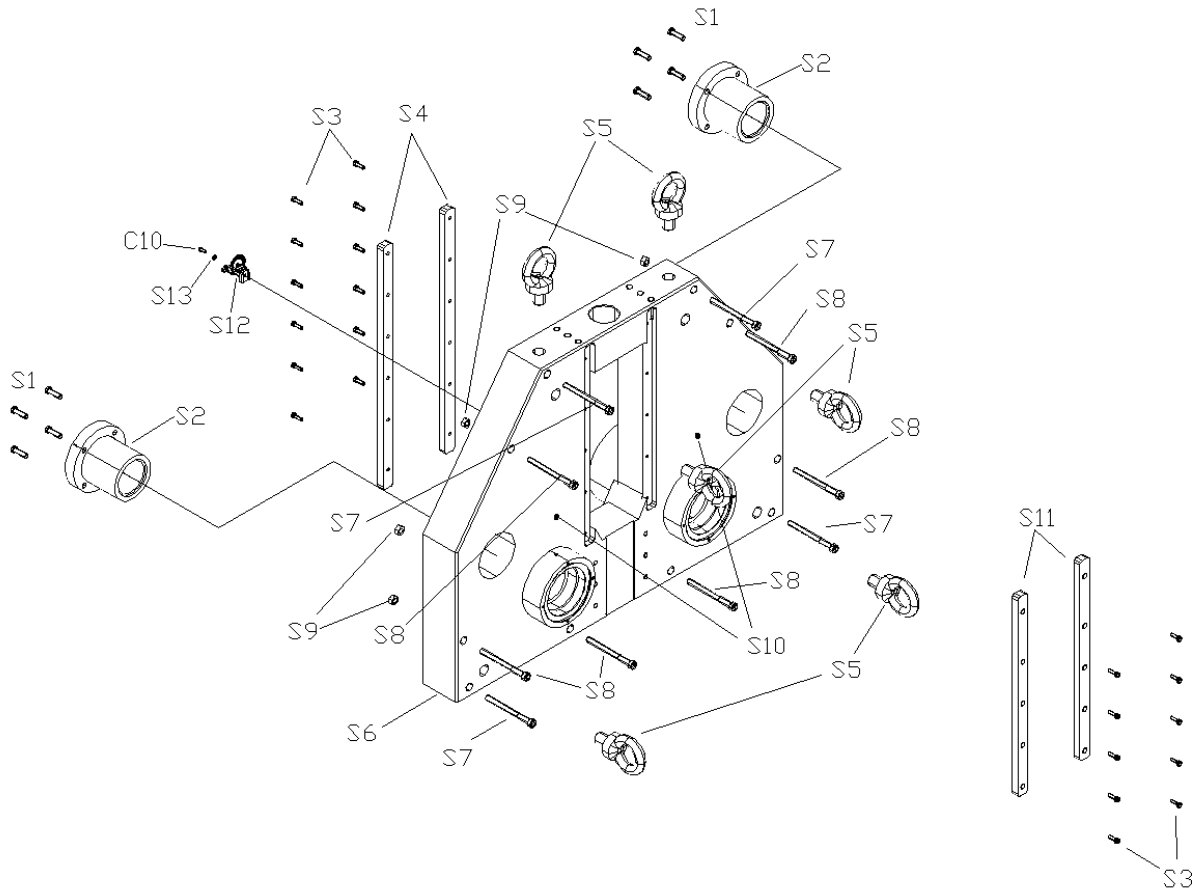
R1	Locknut type KM18 SKF
R2	Spacer
R3	Locknut type KM21 SKF
R4	Pressure bushing type AHX 319 SKF
R5	Seeger Ring UNI 7435 - 50
R6	Shim ring
R7	Quill
R8	Nut Driver
R9	Tang A 10x8x40 UNI 6604-69
R10	Sleeve for wrench
R11	Snap ring 8x32 UNI 6873-71
R12	Bushing
R13	Shim washer
R14	Slip-joint hinge
R15	Millimetric ruler 250 mm length
R16	Slider screw
R17	Roll axis
R18	Slider
R19	Shim washer
R20	Bushing
R21	Roll
R22	Roll blocking pivot
R23	Screw UNI 5923 M10x20
R24	Washer pivot
R25	Bearing type 61909 SKF
R26	Washer
R27	Spacer
R28	Washer
R29	Screw UNI 5933 M6x20 8.8
R30	Seeger Ring UNI 7437 - 68
R31	Conical washer pivot spacer
R32	Tapered roller bearings internal spacer
R33	Tapered roller bearings external spacer
R34	Conical washer pivot
R35	Conical washer



GRUPPO RONDELLONE CONICO
PER ANGOLARE ALA ESTERNA

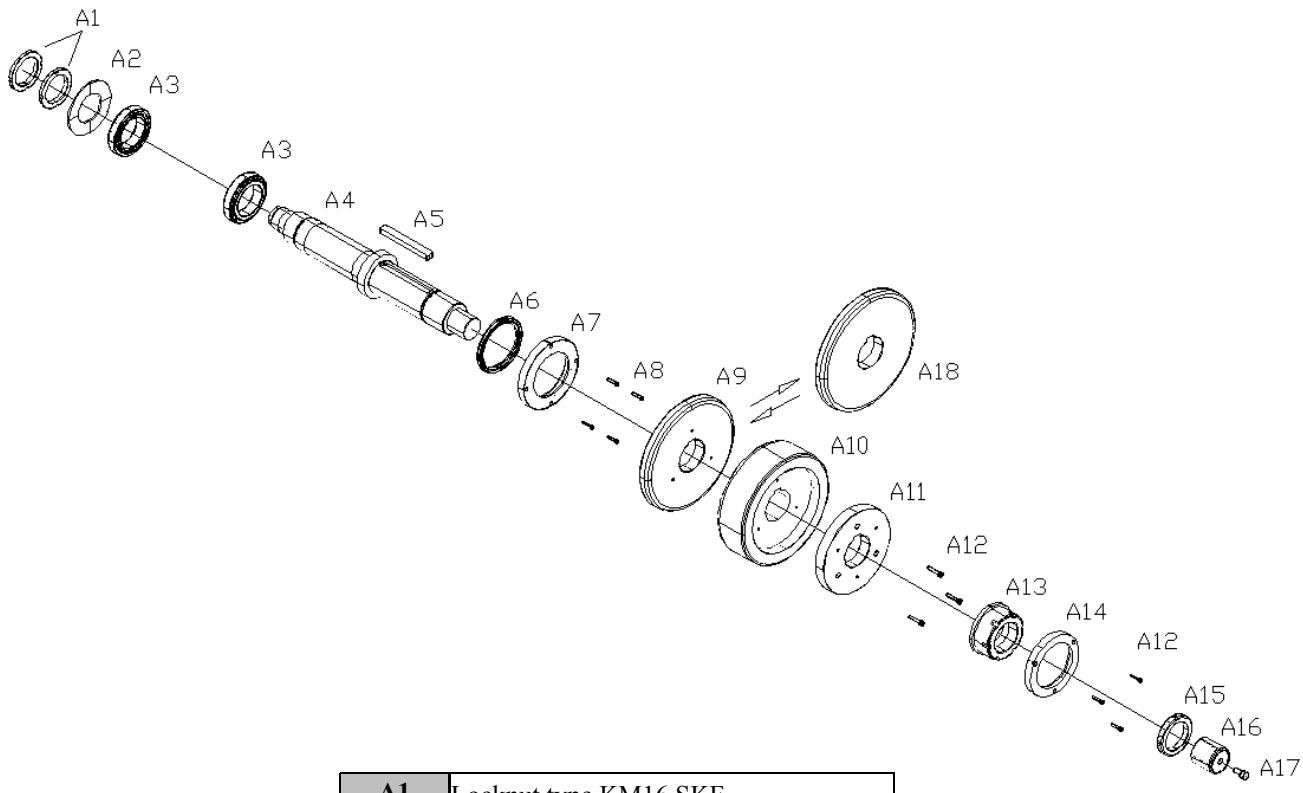
Sostituisce il rondellone normale per poter centinare l'angolare in posizione di ala esterna. In dotazione di serie.

SHOULDER GROUP



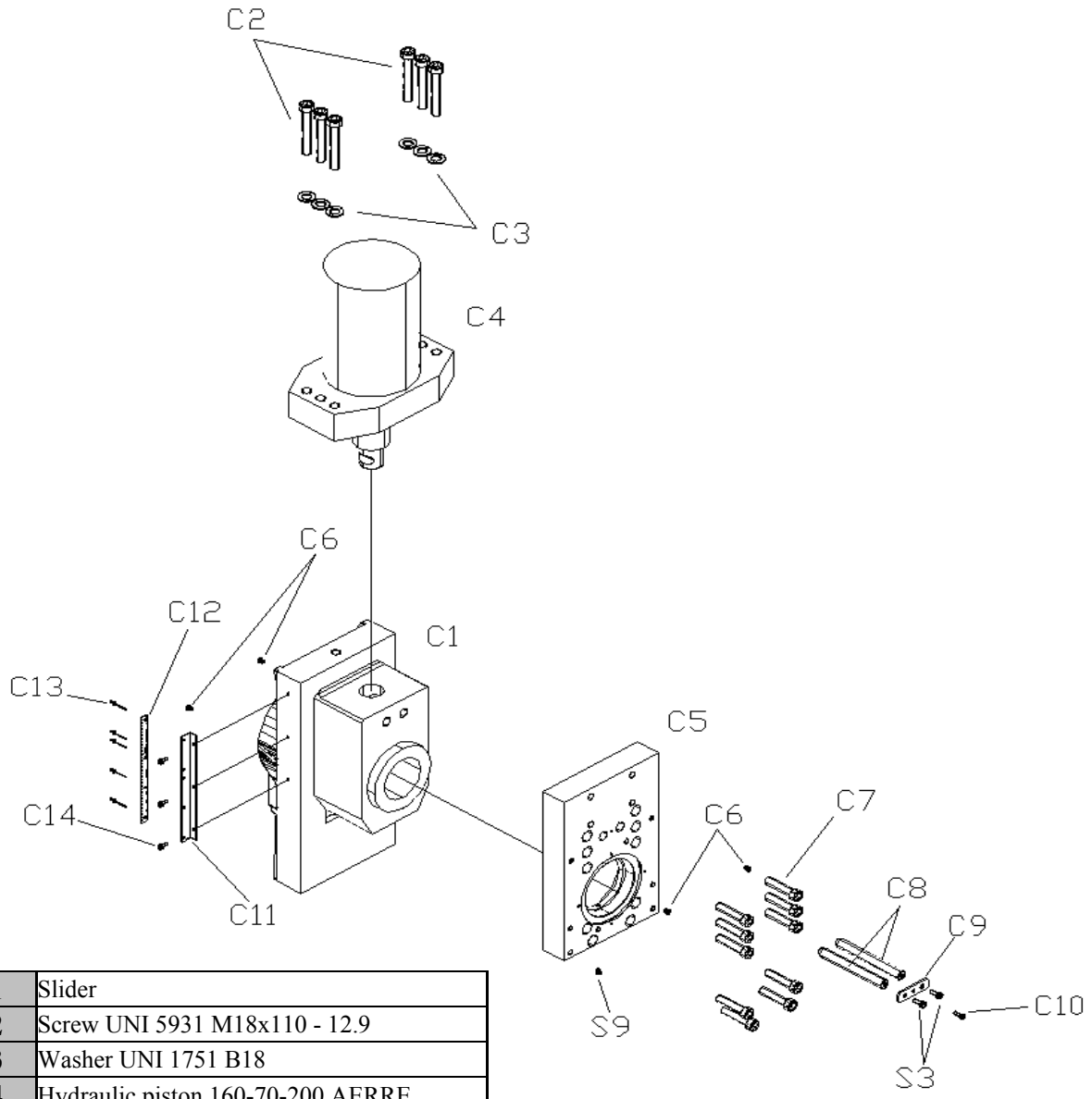
S1	Screw UNI 5931 M12x40 - 8.8
S2	Shoulder roll hub
S3	Screw UNI 5931 M8x25 - 8.8
S4	Rear tracks
S5	Lifting rings M30 UNI 2947
S6	Shoulder
S7	Screw UNI 5931 M14x130 - 8.8
S8	Screw UNI 5931 M14x150 - 8.8
S9	Nut UNI 5588 M14 4D
S10	Nipple A6 M8x1,25 - 5.8
S11	Front tracks
S12	Optical encoder
S13	Washer UNI 1751 B6

AXIS GROUP



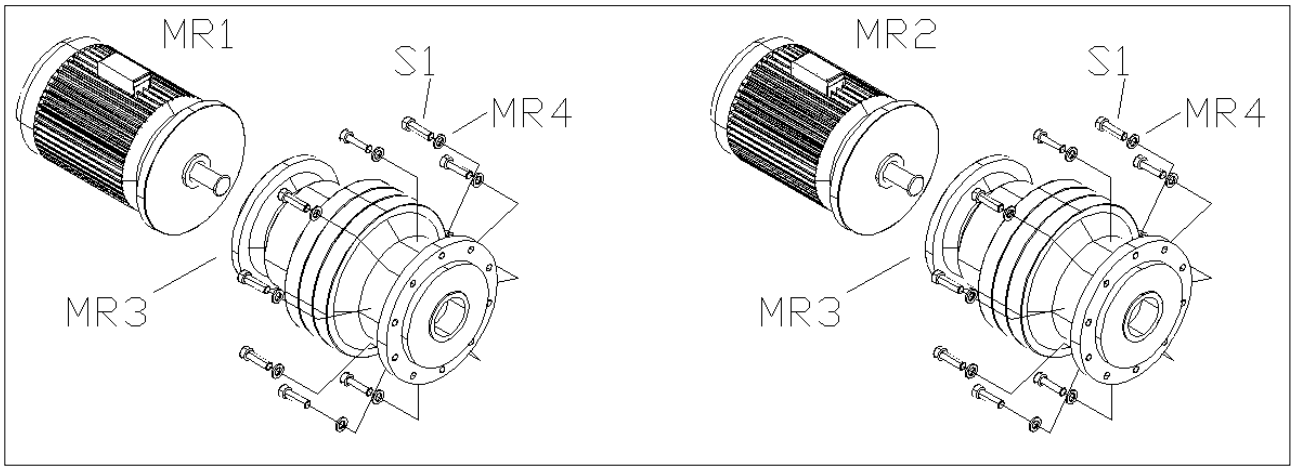
A1	Locknut type KM16 SKF
A2	Washer
A3	Bearing type 32017x SKF
A4	Shaft
A5	Tang A 22x14x160 UNI 6604-69
A6	Oil seal type A DIN 3760 CORCOS
A7	Oil seal holding cap
A8	Screw UNI 5931 M6x30 - 8.8
A9	Normal flange 305 mm diameter
A10	Bending roll 305 mm diameter
A11	Insert
A12	Screw UNI 5931 M8x40 - 8.8
A13	Rolls regulation locknut
A14	Rolls regulation locknut support
A15	Locking clamp screw
A16	Shaft's extremity protection hood
A17	Screw UNI 5931 M14x30 - 8.8
A18	Larger flange 325 mm diameter

SLIDER GROUP



C1	Slider
C2	Screw UNI 5931 M18x110 - 12.9
C3	Washer UNI 1751 B18
C4	Hydraulic piston 160-70-200 AERRE
C5	Slider front plate
C6	Nipple for under pressure greasing 10 mm diameter
C7	Screw UNI 5931 M16x70 - 12.9
C8	Cylinder fastening pin
C9	Cylinder fastening pin holding plate
C10	Screw UNI 5931 M6x20 - 8.8
C11	Bracket for encoder rack
C12	Encoder rack
C13	Rivets UNI 9200 A 4x8 Al/Fe
C14	Screw UNI 5931 M6x10 - 8.8

MOTOR-GEAR SYSTEM GROUP

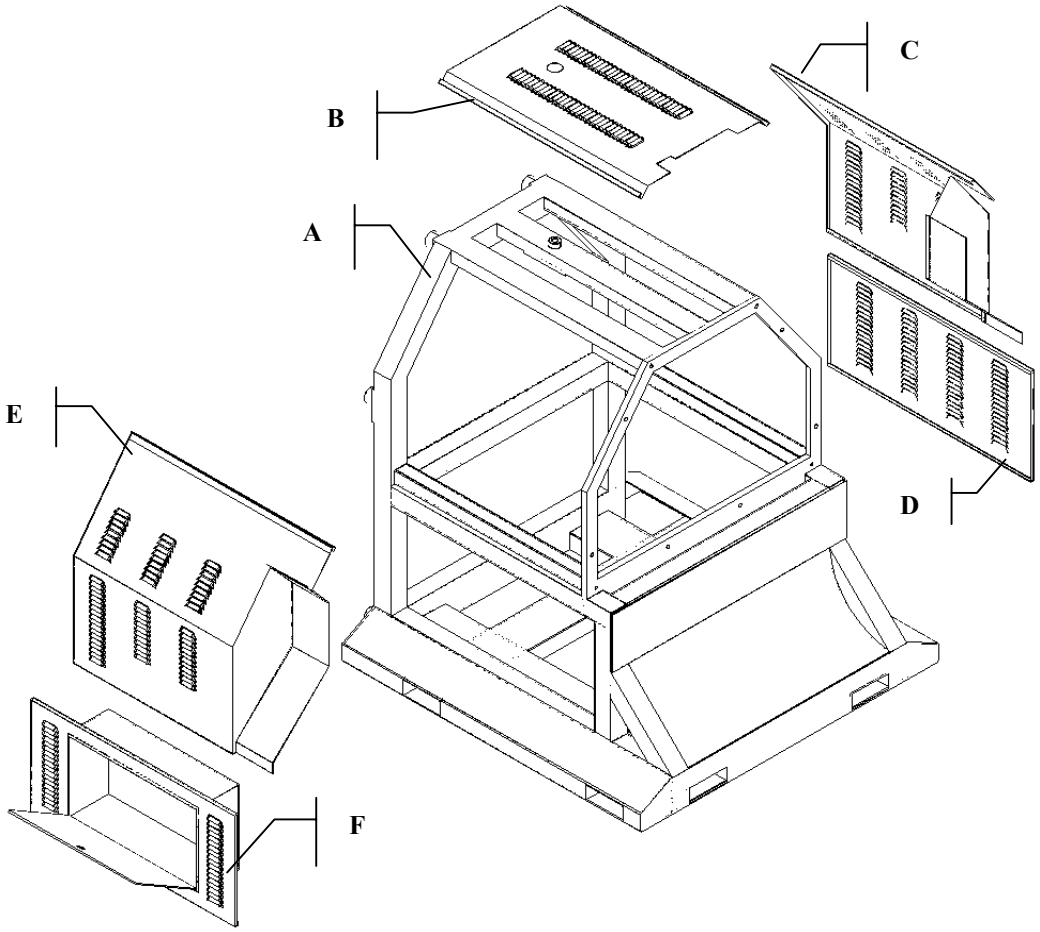


LOWER axis configuration UPPER axis configuration

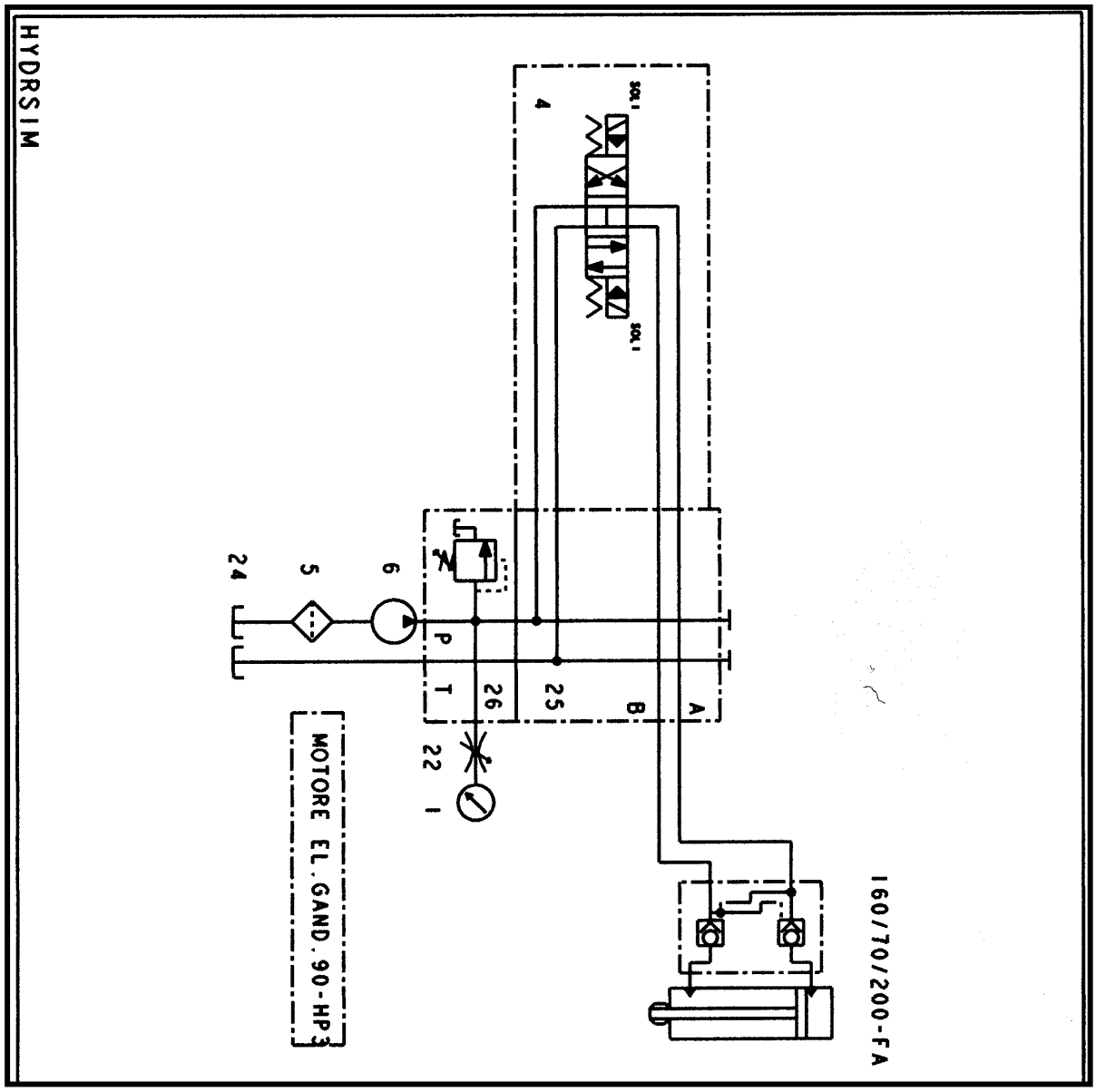
MR1	Electrical motor 1,5 Kw 4 pole GAMAR
MR2	Electrical motor 2 Kw 4 pole GAMAR
MR3	Epicyclic gear system ET3020/FET/00 BREVINI
MR4	Washer UNI 1751 B12

SUPPORTING FRAME

A	Supporting structure
B	Upper casing
C	Upper right casing
D	Lower right casing
E	Upper left casing
F	Lower left casing

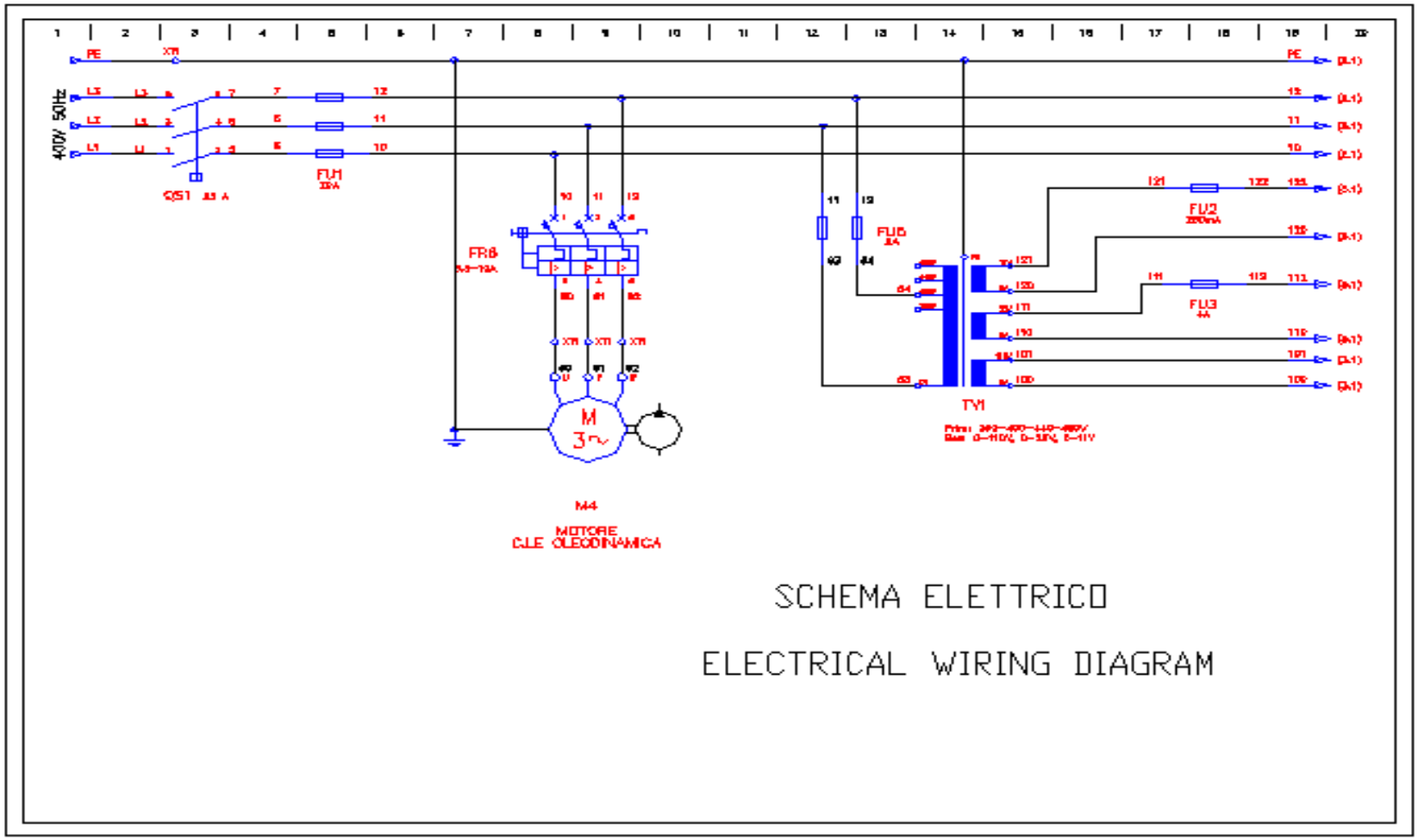


Hydraulic system scheme

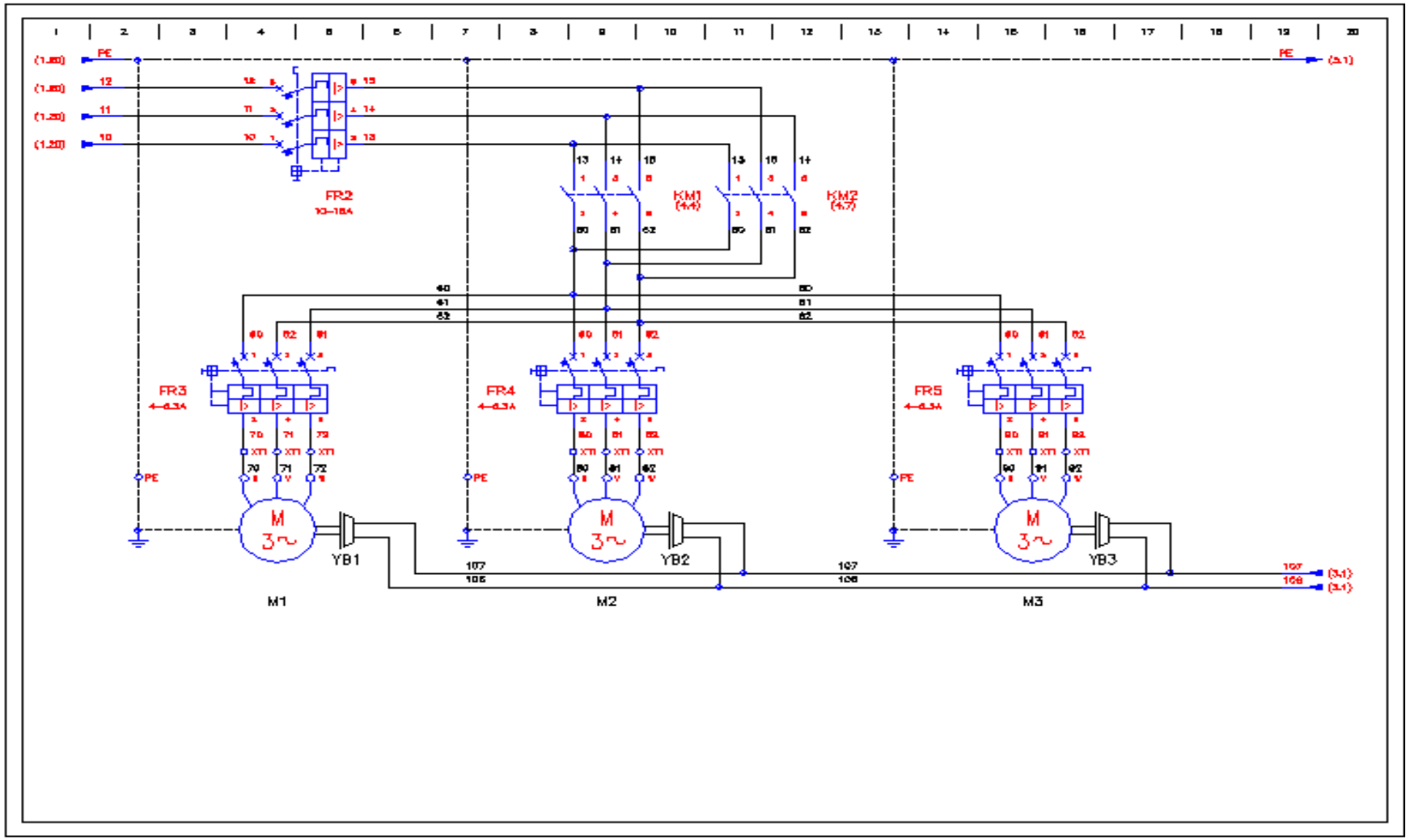


Electrical wiring diagrams

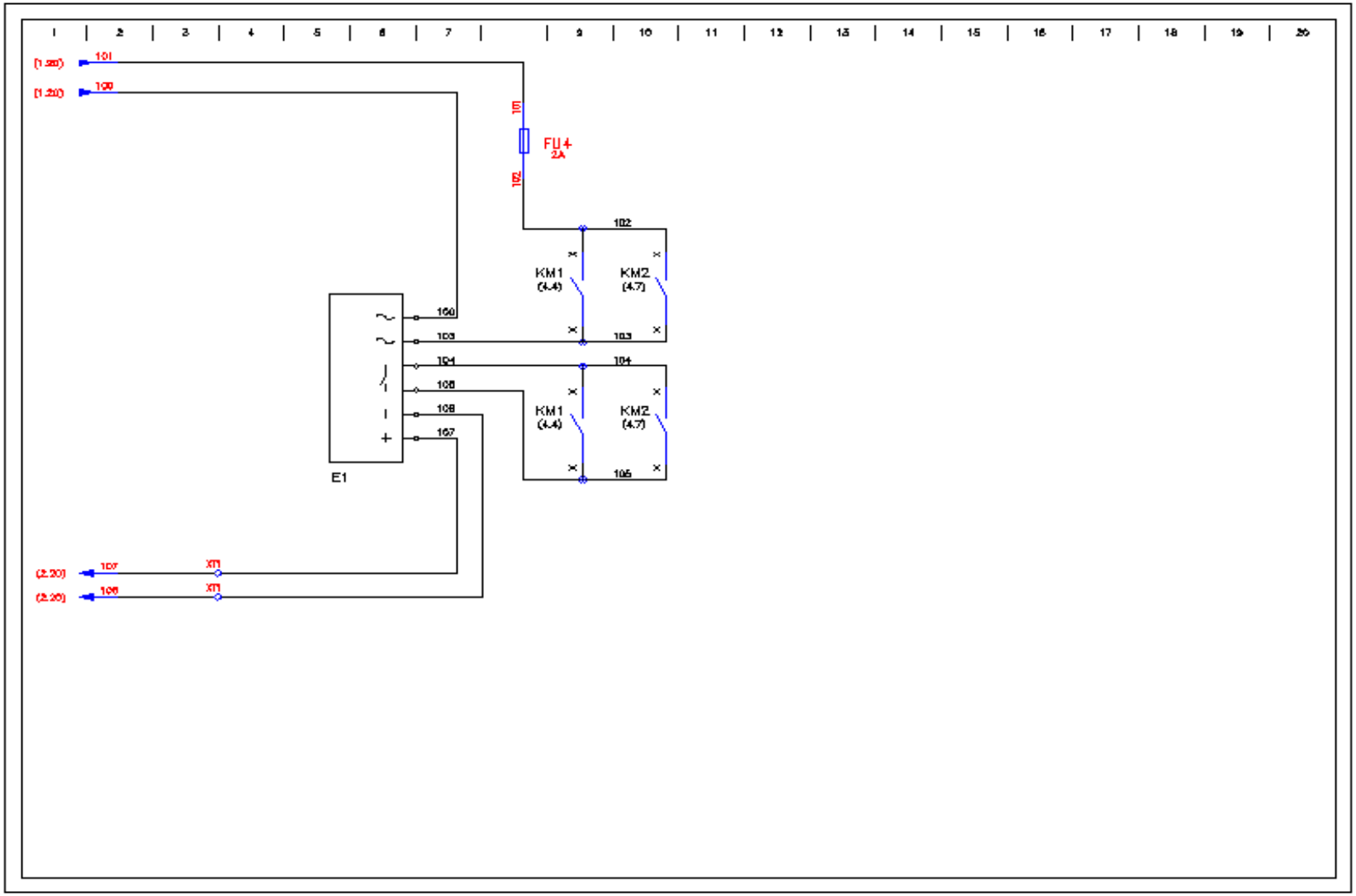
DRAWING Nr.1



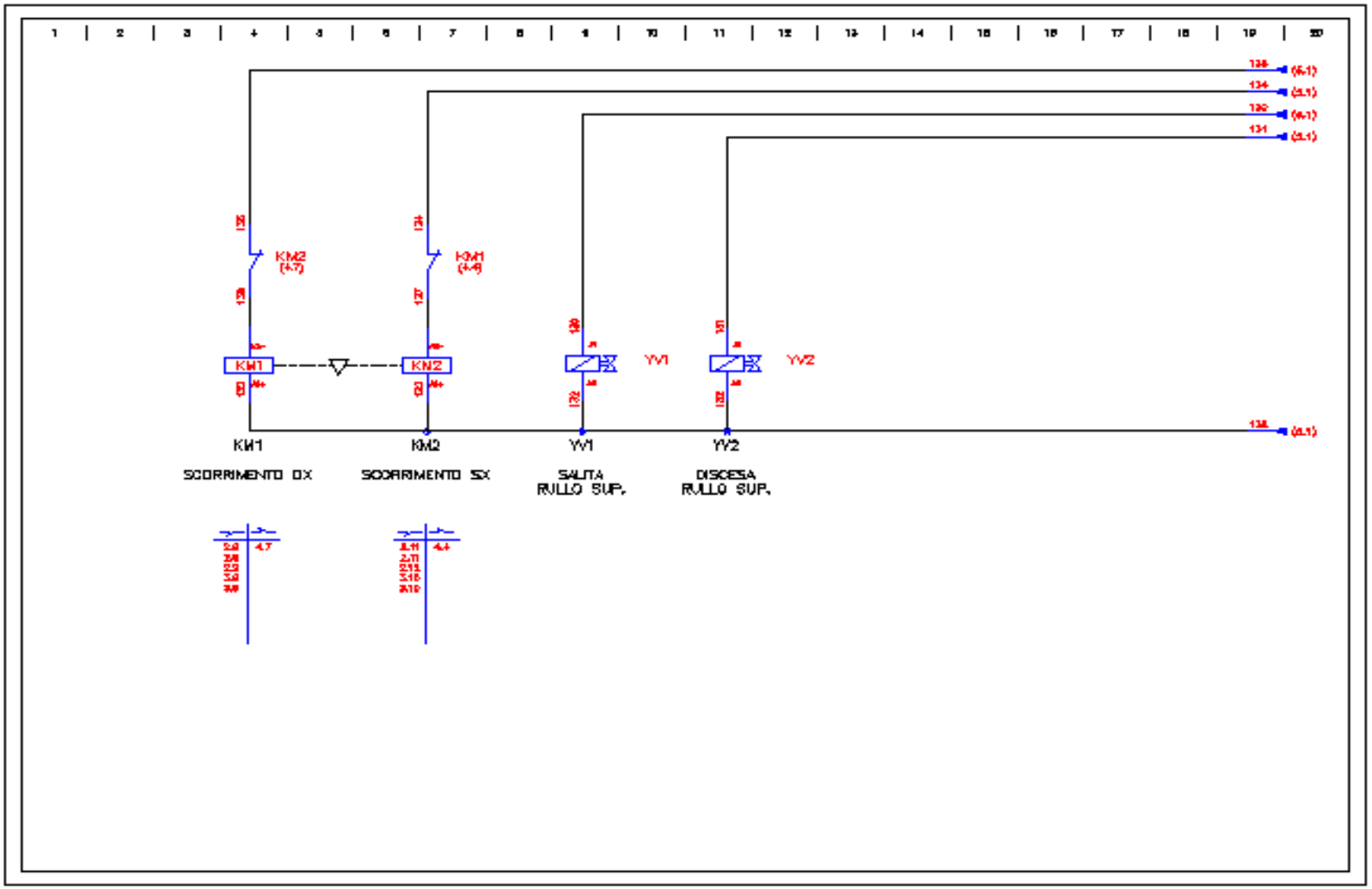
DRAWING Nr.2



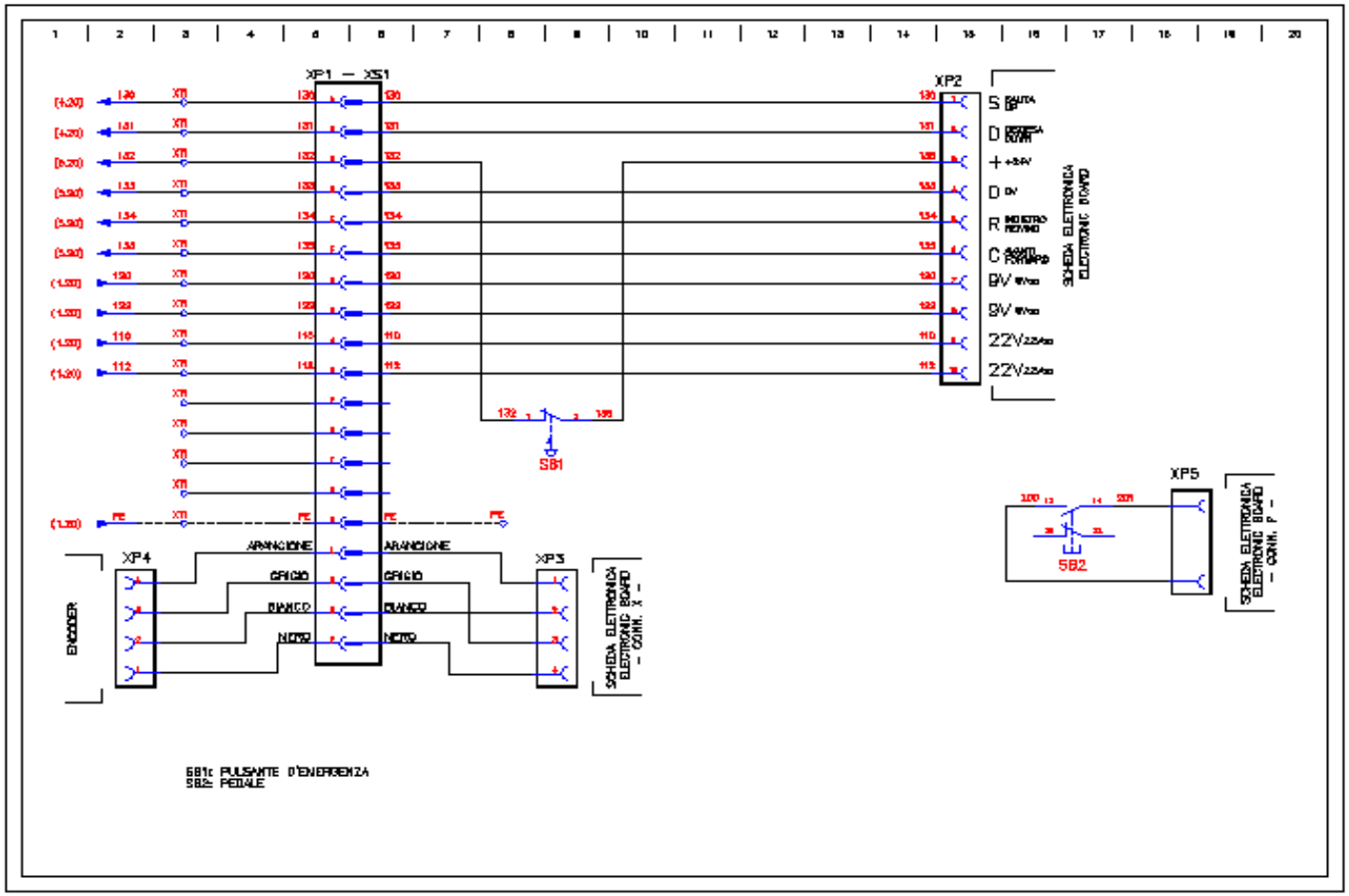
DRAWING Nr. 3


1 2 3 4 5 6 7 9 10 11 12 13 14 15 16 17 18 19 20
(1.20) 101
(1.20) 100
101
FU.4
2A
102
KM1
(4.4)
KM2
(4.7)
100
103
104
106
108
107
E1
105
(2.20) 107
(2.20) 108
XT1
XT1

DRAWING Nr. 4


KM1
KM2
YV1
YV2
SCORRIMENTO DX
SCORRIMENTO SX
SALITA
RULLO SUP.
DISCESA
RULLO SUP.

DRAWING Nr. 5


XP1 – XS1
XP2
XP3
XP4
XP5
ENCODER
ARANCIONE
GRIGIO
BIANCO
NERO
SB1
SB2
SCHEDA ELETTRONICA
ELECTRONIC BOARD
SB1: PULSANTE D'EMERGENZA
SB2: PEDALE

PROGRAMMING THE CARD

Overview

The ***"RC100"*** *control card* can save 8 unrelated programmes and constantly controls working tolerances (+/- 0.2 mm).

Each programme requires the setting of the "reference point" on the material and of the "working area" that allows the part's insertion and extraction.

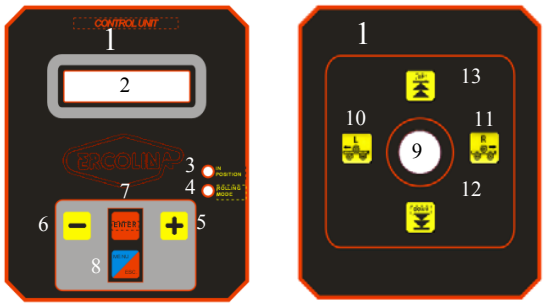
Programmes are identified on the display as: "R0 , R1 , …….R7".

Each one of these can be kept in memory until it's modified for further processing.

R0 programme provides a single pass rolling.

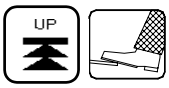
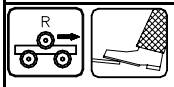
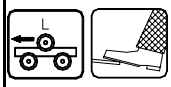
The other programmes manage multiple pass rolling, to obtain final quota.

. "CONTROL PANEL" DESCRIPTION



1	Electronic Card
2	LCD Display
3	Machine ready for rolling indication
4	rolling command Awaited
5	0.1 mm. Increase
6	0.1 mm. Decrease
7	Entered data saving. Programmed sequence enabling.
8	Parameter setting on display. Parameter display.
9	Joystick
10	Counter anticlockwise rolling. 1 mm increase
11	Clockwise rolling. 10 mm. Increase
12	Centre roll descent
13	Centre roll ascent

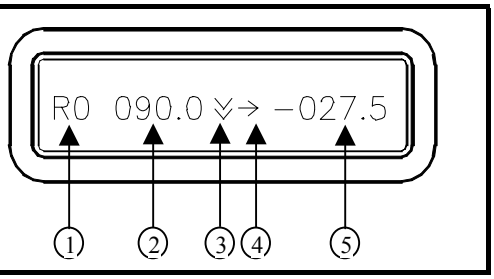
Machine movements/command devices association table

	Centre roll ascent	**Comb.1**
	Centre roll descent	**Comb.2**
	Saving working area (first press - and then Enter)	**Comb.3**
	Saving reference point (first press + and then Enter)	**Comb.4**
	Clockwise material movement	
	Counter anticlockwise material movement	
	Parameter settings in programming mode (to move the cursor through the displayed items, press the 'MENU' key several times until the desired item is reached)	
	0.1mm penetration quota increase on programming mode. Working programme setting.	

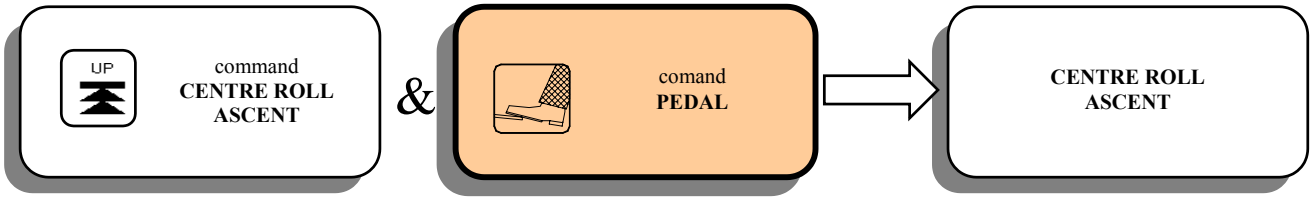
	0.1mm penetration quota decrease on programming mode. Working programme setting.
	1mm penetration quota increase on programming mode. Counter anticlockwise slide setting of the material during rolling.
	10mm penetration quota increase on programming mode. Clockwise slide setting of the material during rolling.
	Saving values set during programming phase. Enabling sequence programmed during working phase.

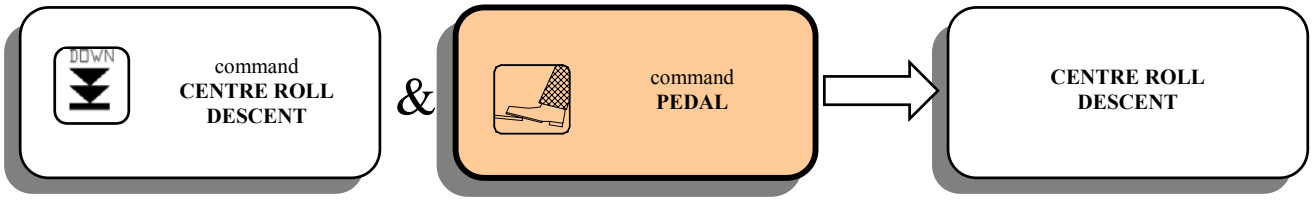
USER INTEFACE DISPLAY OF THE SOFTWARE PROGRAMMING SYSTEM

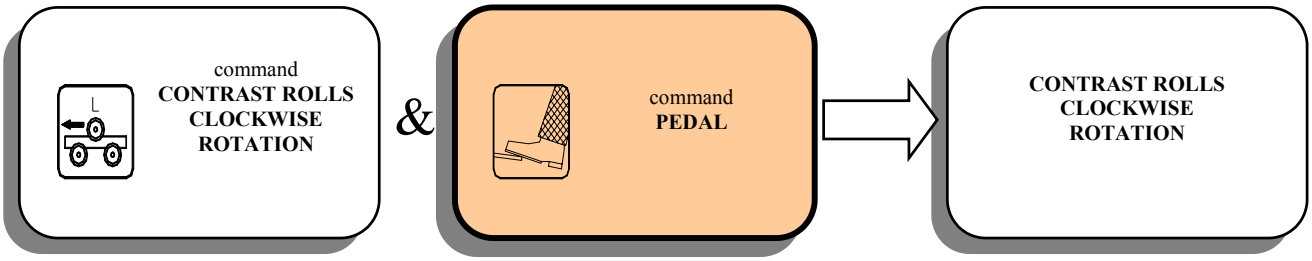
1	Programme set (R0…R7)
2	Maximum increase quota (compared to reference point)
3	Centre roll sliding direction
4	Material movement direction
5	Programmed increase per pass (not valid for R0 programme)

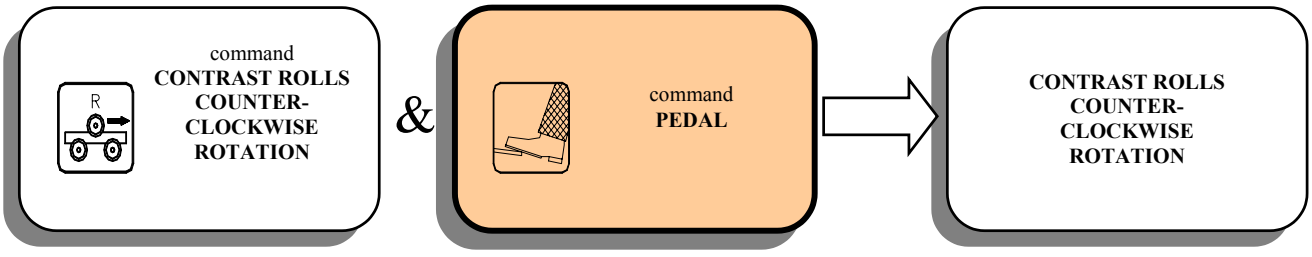


FUNCTIONAL MANAGEMENT OF STOPPING COMMANDS









MACHINE SETTING

Programme choice

Press:

menu once, the cursor will blink and use keys;

+ and - to select the chosen programme (R0… R7);

press the **enter** key to save the programme.

Reference settings

The following procedure must be repeated for each programme (RO……..R7)

"reference point" (fig. 2):

a) **Comb. 1**: the centre roll *raises* and the part can be inserted,(FIG.1);

b) **Comb. 2:** the centre roll *lowers* until it touches the material;

c) **Comb. 4:** the ***"reference point"*** is *saved*. (first press + and then ENTER)

"working area":

a) **Comb.1:** the centre roll raises until the desired working area is reached (fig.1).

b) **Comb.3:** saves the defined "working area". (press first - and then ENTER)

The following procedures must be repeated for each programme (R0…R7).

PROGRAMMING IN R0

This programme is chosen for a ***single pass rolling***.

Generally, this programme is used, according to material resistance and machine capacity, to produce springs or wide range rolling.

Programming procedure:

a)The display indicates the **R0** programme already selected during the previous phase.

b) Press the **menu** key (twice) the blinking cursor moves to the value to be modified "MAXIMUM INCREASE QUOTA" enabling programming.
With the blinking cursor on the selected field, values can be modified as follows:

KEYS:

+ or - : for decimal increase : (0.1 - 0.9);

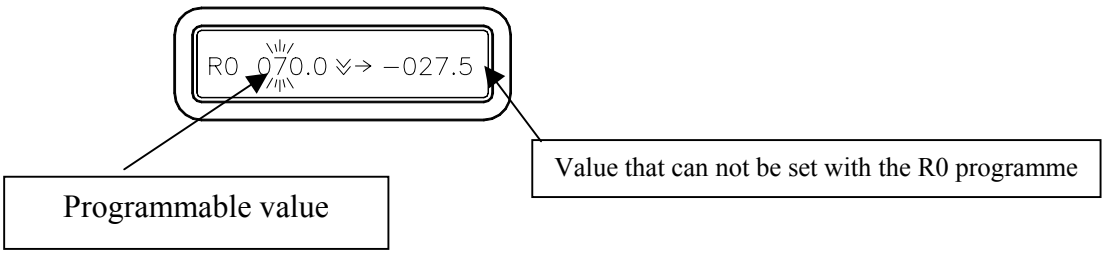
JOYSTICK:

L: for unit increase :(1, 2, 3,..);

Or

R: to increase by 10 units;

Note:



c) press the **enter** button to confirm entered data.

Rolling command sequence using R0 programme:

a) move centre roll to the working area using **Comb. 1** (green light indicator on: in position);

b) Insert material between rolls;

c) Select the material's sliding direction using the **R and L** buttons**;**

d) Using **Comb.2**: the centre roll descent is enabled (the display will show the " ⩔ " indication) and it moves on the material at a "zero quota";

e) Use the **enter** key : to confirm the increase value previously programmed;

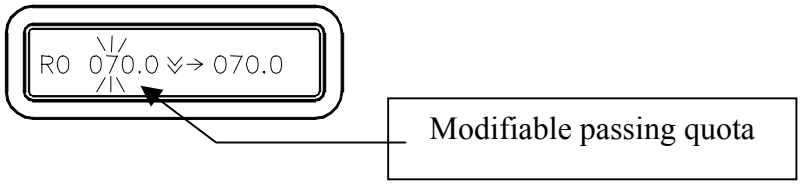
f) Press the **pedal** the centre roll penetrates the material according to the value set, (without rolling);

g) Remove foot from pedal: orange light indicator on **(rolling mode)**;

a) Press the **pedal** for the necessary time to perform rolling: when operation is completed release pedal..

Note: use the **menu** key**:** to further modify the achieved passing quota without removing the centre roll for a new machine setting.

Ex.:



Part extraction:

a) Use the **Comb.1** button: to enable the centre roll ascent (the display will show the indication:**"⩓ ")** it will reach the maximum working area quota programmed during the relevant phase (fig. 2);

b) The part can be removed and the machine is ready for the next rolling operation.

!!WARNING: IN THIS PHASE THE PART IS NOT HELD BY THE ROLLS AND IT CAN FALL. TAKE ALL NECESSARY PRECAUTIONS TO AVOID ANY DANGER.

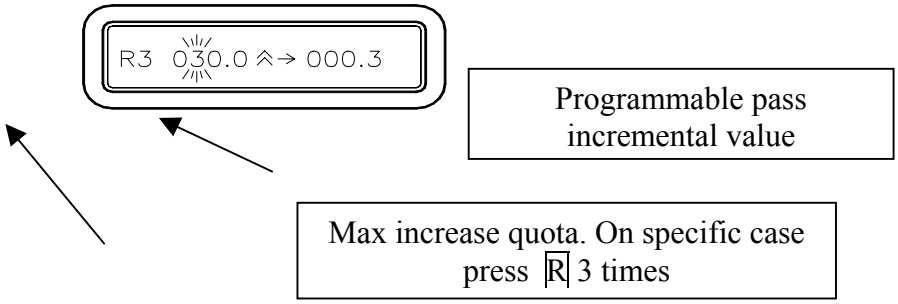
R1……..R7 PROGRAMMES

These programmes are normally used for rolling requiring high precision and repetition; for this reason they can bend with programmed increases at multiple passes.
To activate these programmes, repeat the previous "**machine setting**" procedures

Programming procedure:

a) Press the **menu** key (twice) the blinking cursor moves to the "MAXIMUM INCREASE QUOTA" value, enabling programming (·)

Ex.:



b) Press the **enter** button to confirm the entered value variation;

c) Press the **menu** button (**3 times**) the blinking cursor moves to the *"programmable pass increase"*. (·)

d) c) press the **enter** button to confirm.

Programming is completed.

(·) **Note:** With the blinking cursor on the selected field, values can be modified as follows:

KEYS:

+ or – for decimal increase (0.1- 0.9) :

JOYSTICK:

L : for unit increase:(1, 2, 3,..):

R : to increase by 10 units:

"ROLLING" PHASE

a) Move centre roll to the working area;

b) Insert material between rolls: (fig.1);

c) Select the rolls' sliding direction using the **R** and **L** buttons**;**

d) Use **Comb. 2**, to enable the centre roll descent (⩛); press the **"pedal"** until the centre roll reaches the material at a "zero" quota;

e) Remove foot from **pedal** ;

f) Use the **enter** key, to confirm the programmed increase value per pass;

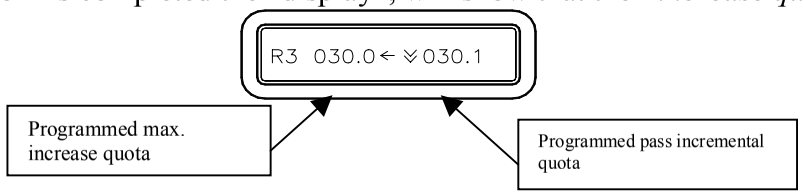
g) Press the **pedal** : material's rolling on the set direction starts simultaneously to the centre roll descent (press the pedal for the necessary time to perform rolling). when operation is completed release pedal;

h) Invert the material's sliding direction using the **R** or **L** buttons;

i) Repeat the **"f, g, h"** operations sequence until the maximum bow established during programming phase is reached to obtain the desired bending radius;

Note: when work is completed the "display", will show that the *"increase quota of programmed passes*" equals the "maximum increase" quota.

Ex.:

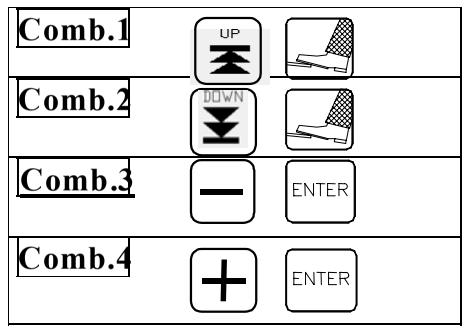


Note: the *"maximum increase quota"* value can be corrected or raised without changing the *"incremental quota per pass"*. To obtain this variation, repeat the "programming procedure".

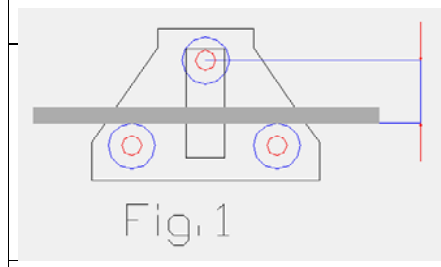
Part extraction:

a) Use the **Comb.** button.**1** : to enable the centre roll ascent (the display will show the " ⩚ " indication) it will reach the maximum working area quota programmed during the relevant phase (fig. 2);
b) The part can be removed and the machine is ready for the next rolling operation.

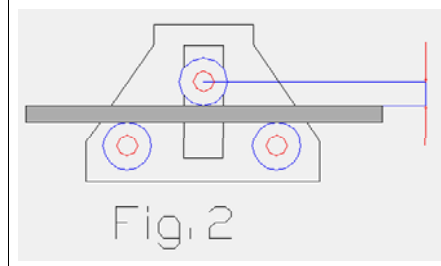
!!WARNING: IN THIS PHASE THE PART IS NOT HELD BY THE ROLLS AND IT CAN FALL. TAKE ALL NECESSARY PRECAUTIONS TO AVOID ANY DANGER.



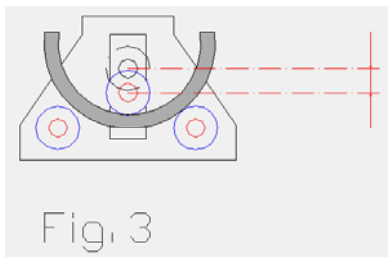
WORKING AREA



REFERENCE POINT



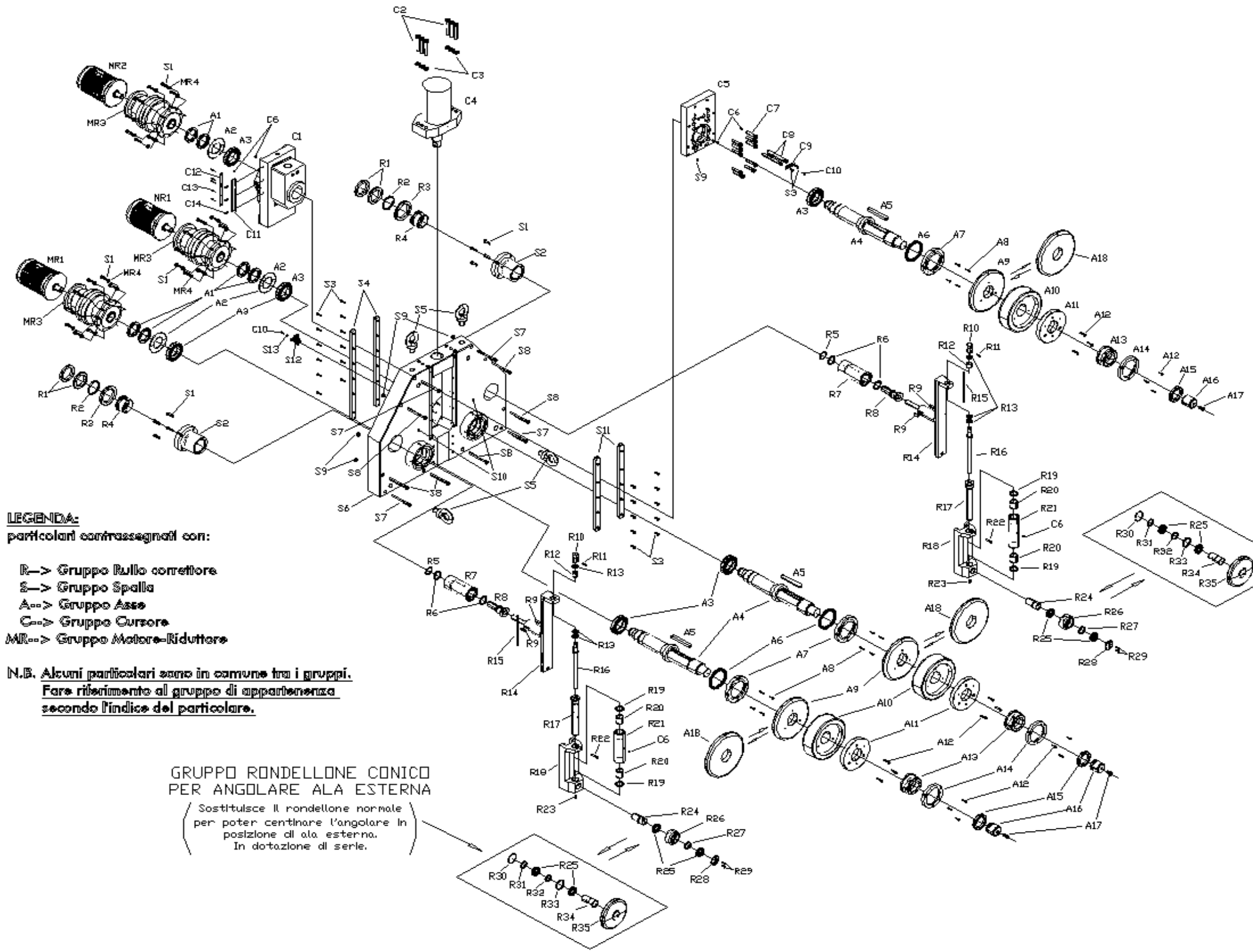
PART DEFORMATION



Bending Radius

T: distance between lower rolls/material contact points;
F: penetration depth

$$R = \frac{F}{2} + \frac{T^2}{8xF}$$



LEGENDA:
particolari contrassegnati con:

R--> Gruppo Rullo correttore
S--> Gruppo Spalla
A--> Gruppo Asse
C--> Gruppo Cursore
MR--> Gruppo Motore-Riduttore

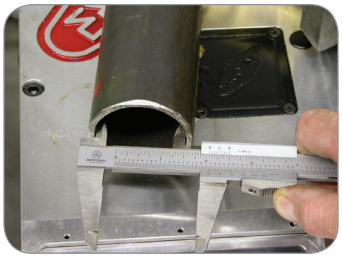
N.B. Alcuni particolari sono in comune tra i gruppi. Fare riferimento al gruppo di appartenenza secondo l'indice del particolare.

GRUPPO RONDELLONE CONICO
PER ANGOLARE ALA ESTERNA

Sostituisce il rondellone normale per poter centinare l'angolare in posizione di ala esterna. In dotazione di serie.

PIPE INFORMATION

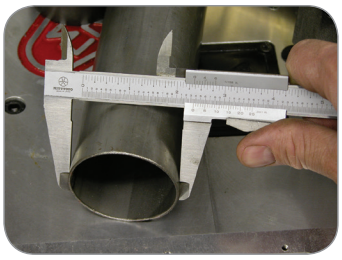
Pipe dimensions are based on I.D. of material (2″ sch. 40 pipe measures 2.375″ O.D.)



Commercial Pipe and Wall Thickness							
Nominal Size	O.D.	← Schedule → 5	10	40	80	160	XX Strong
1/4″	.540		.065	.088	.119		
3/8″	.675		.065	.091	.126		
1/2″	.840	.065	.083	.109	.147	.188	.294
3/4″	1.050	.065	.083	.113	.154	.219	.308
1″	1.315	.065	.109	.133	.179	.250	.358
1-1/4″	1.660	.065	.109	.140	.191	.250	.382
1-1/2″	1.900	.065	.109	.145	.200	.281	.400
2″	2.375	.065	.109	.154	.218	.343	.436
2-1/2″	2.875	.083	.120	.203	.276	.375	.552
3″	3.500	.083	.120	.216	.300	.438	.600
3-1/2″	4.000	.083	.120	.226	.318		.636
4″	4.500	.083	.120	.237	.337	.531	.674

ROUND TUBE INFORMATION

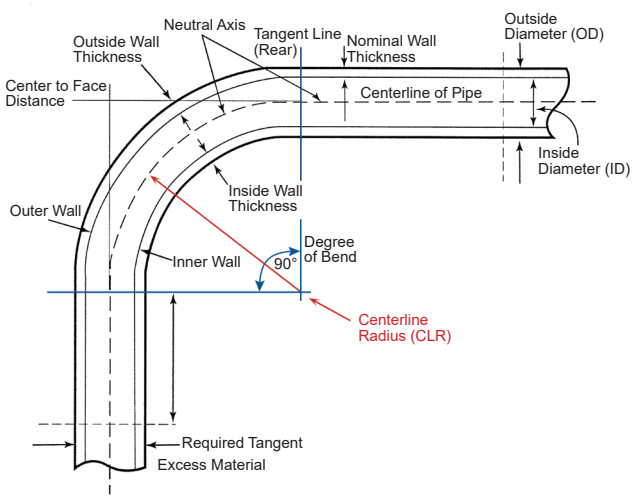
Tube dimensions are based on O.D. of material (2″ tube measures 2.00″ O.D.)



Minimum Achievable "Centerline Radius" with Standard Tooling

Tube Size	Wall Thickness							
	.035 20 Ga.	.049 18 Ga.	.065 16 Ga.	.083 14 Ga.	.095 13 Ga.	.109 12 Ga.	.120 11 Ga.	.134 10 Ga.
1/4″	1.4	1.4	1.4	1.4	1.4	1.4	.78	.78
3/8″	1.4	1.4	.78	.78	.78	.78	.78	.78
1/2″	1.4	1.4	1	1	1	1	1	1
5/8″	1.8	1.8	1.8	1.4	1.4	1.4	1.4	1.4
3/4″	2.6	2.6	2.6	1.8	1.8	1.8	1.8	1.8
7/8″	2.6	2.6	2.2	1.8	1.8	1.8	1.8	1.8
1″	3.2	3.2	2.6	2.2	2.2	2.2	2.2	2.2
1-1/8″	3.2	3.2	3.2	2.6	2.2	2.2	2.2	2.2
1-1/4″	4.4	4.4	4.4	3.2	2.6	2.6	2.6	2.6
1-3/8″	4.4	4.4	4.4	3.2	3.2	3.2	3.2	3.2
1-1/2″	7.5	5.9	5.1	3.9	3.9	3.5	3.5	3.5
1-5/8″	7.5	5.9	5.1	3.9	3.9	3.5	3.5	3.5
1-3/4″			6.7	6.7	5.1	3.9	3.9	3.9
1-7/8″			7.5	5.9	5.1	3.9	3.9	3.9
2″			7.5	7.5	5.9	4.7	4.7	4.7
2-1/8″			7.5	7.5	5.9	5.1	5.1	4.7
2-1/4″				7.5	5.9	5.1	5.1	5.1
2-3/8″				7.5	5.9	5.1	5.1	5.1
2-1/2″					11.8	10.2	9.8	
3″					11.8	10.2	9.8	

BEND FORMULA



Material Consumption for Bend Angle

Radius x Degree of Bend x .0175 = Length

To calculate total pipe length, add distance from end of pipe to the first bend, plus first bend arc length, plus distance to second bend.

Decimals

1/64	.0156	23/64	.3593	45/64	.7031
1/32	.0312	3/8	.3750	23/32	.7187
3/64	.0468	25/64	.3906	47/64	.7343
1/16	.0625	13/32	.4062	3/4	.7500
5/64	.0781	27/64	.4218	49/64	.7656
3/32	.0937	7/16	.4375	25/32	.7812
7/64	.1093	29/64	.4531	51/64	.7968
1/8	.1250	15/32	.4687	13/16	.8125
9/64	.1406	31/64	.4843	53/64	.8281
5/32	.1562	1/2	.5000	27/32	.8437
11/64	.1718	33/64	.5156	55/64	.8593
3/16	.1875	17/32	.5312	7/8	.8750
13/64	.2031	35/64	.5468	57/64	.8906
7/32	.2187	9/16	.5625	29/32	.9062
15/64	.2343	37/64	.5781	59/64	.9218
1/4	.2500	19/32	.5937	15/16	.9375
17/64	.2656	39/64	.6093	61/64	.9531
9/32	.2812	5/8	.6250	31/32	.9687
19/64	.2968	41/64	.6406	63/64	.9843
5/16	.3125	21/32	.6562	1	1.000
21/64	.3281	43/64	.6718		
11/32	.3437	11/16	.6875		

Millimeters

1 - .0393	26 - 1.023	51 - 2.007	76 - 2.992
2 - .0787	27 - 1.062	52 - 2.047	77 - 3.031
3 - .1181	28 - 1.102	53 - 2.086	78 - 3.070
4 - .1574	29 - 1.141	54 - 2.125	79 - 3.110
5 - .1968	30 - 1.181	55 - 2.165	80 - 3.149
6 - .2362	31 - 1.220	56 - 2.204	81 - 3.188
7 - .2755	32 - 1.259	57 - 2.244	82 - 3.228
8 - .3149	33 - 1.299	58 - 2.283	83 - 3.267
9 - .3543	34 - 1.338	59 - 2.322	84 - 3.307
10 - .3937	35 - 1.377	60 - 2.362	85 - 3.346
11 - .4330	36 - 1.417	61 - 2.401	86 - 3.385
12 - .4724	37 - 1.456	62 - 2.440	87 - 3.425
13 - .5118	38 - 1.496	63 - 2.480	88 - 3.464
14 - .5511	39 - 1.535	64 - 2.519	89 - 3.503
15 - .5905	40 - 1.574	65 - 2.559	90 - 3.543
16 - .6299	41 - 1.614	66 - 2.598	91 - 3.582
17 - .6692	42 - 1.653	67 - 2.637	92 - 3.622
18 - .7086	43 - 1.692	68 - 2.677	93 - 3.661
19 - .7480	44 - 1.732	69 - 2.716	94 - 3.700
20 - .7874	45 - 1.771	70 - 2.755	95 - 3.740
21 - .8267	46 - 1.811	71 - 2.795	96 - 3.779
22 - .8661	47 - 1.850	72 - 2.834	97 - 3.818
23 - .9055	48 - 1.889	73 - 2.874	98 - 3.858
24 - .9448	49 - 1.929	74 - 2.913	99 - 3.897
25 - .9842	50 - 1.968	75 - 2.952	100 - 3.937

TERMS AND CONDITIONS OF WARRANTY

1. Definitions. CML USA, Inc. ("CML") hereunder; the term "End-User" means the ultimate user of the Goods; the term "Dealer" means an independent contractor of CML whom purchased the Goods from CML to sell to the End-User; and the term "Goods" means the goods, equipment, products, parts, services, labor, or other items or work provided.

2. Warranty. CML hereby disclaims any warranty regarding speed of production or output or economics of operation with respect to the Goods. If such matters are set forth or described in the specifications applicable to the Goods such statement or description shall be deemed to be an estimate only. Any warranties of CML with respect to the Goods shall be null, void and without effect if such Goods have been altered or repaired by persons or entities other than CML, unless otherwise agreed to (in writing) by CML. Notwithstanding any contrary provision contained herein, the warranties of CML hereunder shall become effective and valid only for one year from the date of the bill of lading issued by the carrier at the designated FOB point. **THE WARRANTIES ATTACHED TO THIS ARE CML'S CURRENT EXCLUSIVE WARRANTIES AND CML EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES (WHETHER WRITTEN, ORAL, IMPLIED OR STATUTORY), INCLUDING (BUT NOT LIMITED TO) ANY WARRANTIES OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.** Any claim for breach of CML's warranties must be demonstrated to CML's satisfaction to have existed at the time of delivery of the Goods and shall be deemed waived by the End-User unless written notice of such claim is actually received by CML within twelve (12) months after CML has shipped the Goods (FOB, CML's Factory) to which such claim relates. CML's liability shall be expressly limited (at CML's option) to the replacement or repair of non-conforming or defective Goods or to the credit for the purchase price of non-conforming Goods. Prior to said repair, replacement, or credit, CML has the right to inspect the Goods claimed to be defective or non-conforming, and, if requested by CML, End-User shall return such Goods to CML at CML's direction and expense. No Goods are to be returned to CML without CML's prior written authorization. THE REMEDIES SET FORTH HEREUNDER SHALL CONSTITUTE THE EXCLUSIVE REMEDIES AVAILABLE TO THE END-USER AND ARE IN LIEU OF ALL OTHER REMEDIES.

3. End-User's Materials. All materials required by CML to test the operation of the Goods shall be furnished by the End-User (at its sole cost and expense). All materials and equipment furnished by the End-User for the construction, remodeling, or testing of Goods (or for any other purpose) shall be delivered to CML at no cost to CML, FOB CML's warehouse floor. The End-User shall bear the risk and cost of returning all such materials and equipment to the End-User. The End-User shall pay all applicable crating and delivery costs and expenses for samples and parts delivered to the End-User and, except as may be required for testing purposes, the End-User shall pay all costs and expenses pertaining to producing parts or samples requested by the End-User.

4. Tolerance and Variations. Except as specified by the End-User and expressly agreed to by CML (in writing), the Goods shall be produced in accordance with CML's standard business practices. All Goods (including, but not limited to, Goods produced to meet an exact specification) shall be subject to tolerances and variations consistent with good manufacturing practice in respect to dimensions, weight, section, chemistry and mechanical properties, the normal variations in surface and internal conditions and in quality, and to deviations from tolerances and variations consistent with practical testing and inspection methods.

5. Limitation of Liability. IN NO EVENT SHALL CML BE LIABLE FOR INCIDENTAL, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES RESULTING FROM THE FURNISHING, PERFORMANCE, OR USE OF THE GOODS SOLD HEREUNDER (IF AT ALL), WHETHER AS A RESULT OF BREACH OF CONTRACT, BREACH OF WARRANTY, THE NEGLIGENCE OF CML OR OTHERWISE. CML's liability under no circumstances will exceed the purchase price for the Goods for which liability is claimed.

6. Indemnification; Assumption of Risk. To the extent permitted by law, the End-User agrees to indemnify and hold CML (and its respective agents and employees) harmless from and against any and all liabilities, damages, losses, actions, causes of action, claims (including, but not limited to, claims of patent infringements), expenses, costs (including, but not limited to, attorney's fees), fines, penalties and any other expenses directly or indirectly arising from End-User's actual use or intended use of the Goods. The End-User agrees to assume all risk of loss or damage to person or property while on the premises of CML or of CML's related corporations. To the extent permitted by law, the End-User (on behalf of itself and all of its agents and employees) hereby releases and forever discharges CML (and its respective employees and agents) from any and all claims, demands, causes of action, liabilities, losses or damages resulting or arising from the End-User's presence (or the presence of the End-User's employees and agents) on the premises of CML. The End-User warrants to CML that the End-User has the authority to grant this release on behalf of the End-User's agents and employees.

7. Non-Waiver. No waiver, alteration or modification of any of the provisions hereof shall be binding on CML unless such waiver is expressed in writing by CML. Waiver by CML of any breach or default by End-User hereunder shall not be deemed a waiver by CML of any default or breach by End-User which may thereafter occur.

8. Assignment. CML reserves the right to subcontract all or any part of the work to be performed hereunder, without obtaining the consent of the End-User. No notice to the End-User of any subcontracting by CML is required. The rights and obligations of the End-User hereunder may not be assigned without the prior written consent of CML.

9. Governing Law; Jurisdiction; Venue. The laws of the State of Iowa shall govern all disputes, controversies, interpretive matters and litigation arising under this warranty. PROPER AND EXCLUSIVE JURISDICTION AND VENUE for all disputes, controversies, interpretive matters and litigation arising hereunder (or otherwise between the parties) lies with the Iowa District Court located in Scott County, Iowa or the United States District Court for the Southern District of Iowa, Davenport Division. The End- User hereby submits to the personal jurisdiction of such courts.

10. Limitations for Suits. Any cause of action or claim arising out of or relating to CML's performance or failure to perform hereunder or the furnishing, performance, or use of the Goods hereunder must be commenced within one (1) year after the claim or cause of action has accrued.

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