HARRIS
MACHINE TOOLS, INC.
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# Technical Information Package

STEADY-Weld

## Proper Set-up and Alignment of Welding Turning Rolls

Harris Machine Tools, Inc.
3609 Clinton Dr.
Houston, Texas 77020

www.harrismachinetools.com
www.steadyweld.com

Tel: 713.462.5800
Fax: 713.462.7775

# NOTICE

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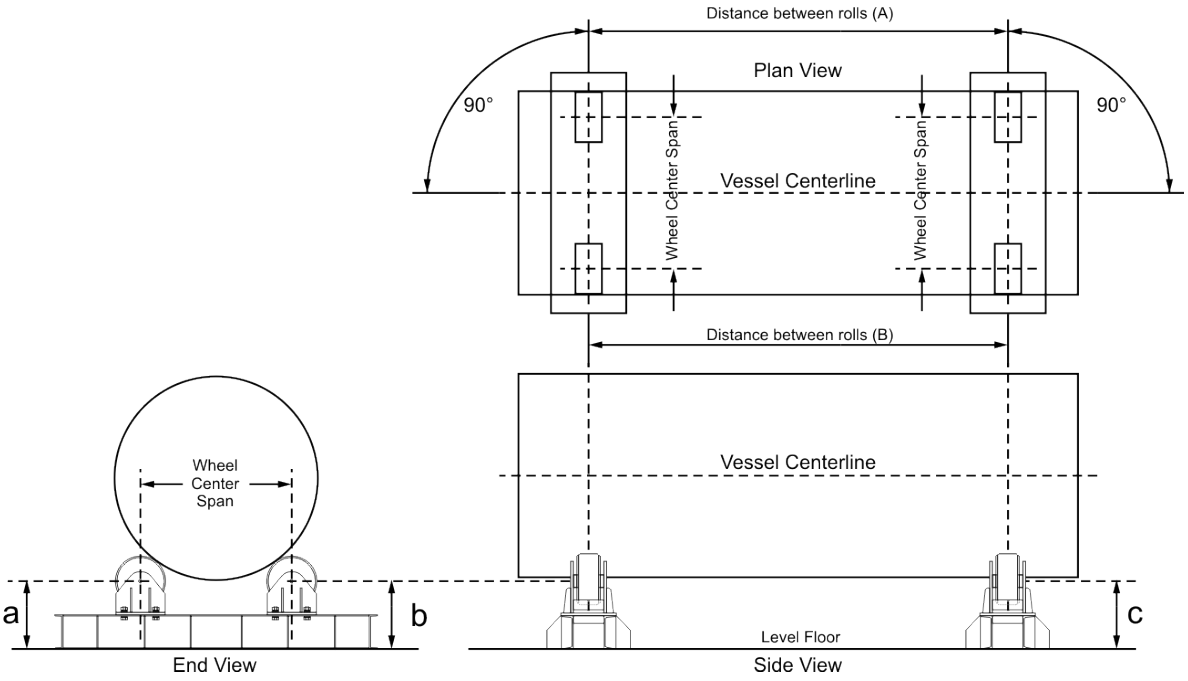
## Introduction

Vessels formed by plate rollers or presses are never true cylinders, perfectly round with no taper, having round ends exactly the same diameter and a true and straight centerline. This is especially true when multiple shorter vessels are welded together to create a longer vessel. There are always imperfections in the roundness of the vessel, whether the ends are truly round and square to the centerline of the vessel, and in the longitudinal and joining weldments. Therefore, alignment problems are always an issue when setting up a turning operation. However, in order to understand the forces that affect the turning of a vessel, we must assume that the vessel we are dealing with is perfectly cylindrical with no taper, otherwise there are too many unknown variables that must be dealt with. In assuming this, we will set the rolls up for a perfect operation, and if endcreep, drift or some other vessel alignment problem arises, it will not be due to faulty setup of the rolls.

## Perfect Set-up – Example of perfectly aligned turning rolls

In this example, the set of turning rolls (drive unit and idler unit), are perfectly aligned, both in relation to each other and in relation to the centerline and diameter of the vessel. In order to achieve this alignment, the floor must be level and flat over the area occupied by the turning rolls. The height of the drive and idler units must be the same, and the wheel diameters and heights must be the same (a=b=c). The drive and idler units must be aligned so that they are square to the centerline of the vessel (90°), and perfectly parallel to each other (A=B). The wheels of the units must also be square to each other and their centerlines must also line up. In this example, the vessel will turn true with no endcreep, drift or other misalignment problems.

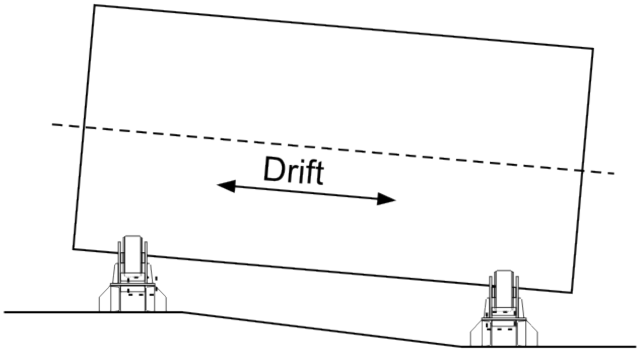


## Drift – Examples of drift and their causes

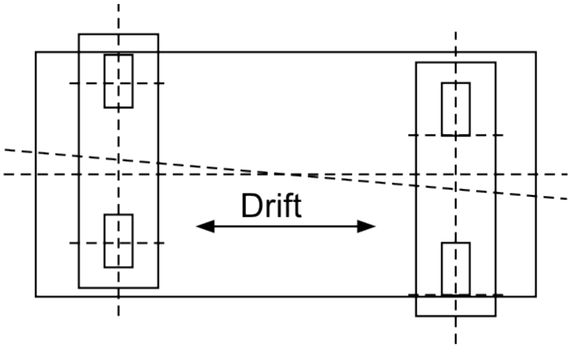
Drift occurs in almost every instance due to a variety of factors, even if the vessel is reasonably cylindrical with a fairly straight centerline and little taper. Some of the factors causing drift that are related to the alignment and setup of the turning rolls are illustrated here. When setting up the turning rolls, it is important to keep these causes in mind to try to eliminate as many setup variables as possible.

In examples A, B, and C, the drift is due to misalignment of the roll units by the operator. In example D, the cause of the drift is due to either faulty manufacturing of the roll units themselves, or excessive wear on the axles and bearings through abuse or age.

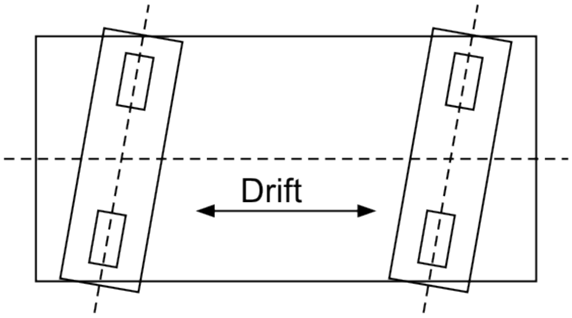
Even if properly aligned, drift can still occur. In those cases it is possible to compensate for drift by tuning the turning rolls. A good quality set of turning rolls, properly aligned and set up, can be tuned to compensate for minimal creep.



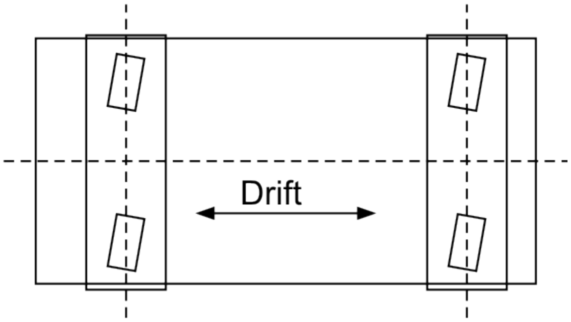
A: Uneven Floor



B: Misaligned Turning Units



C: Cocked Turning Units

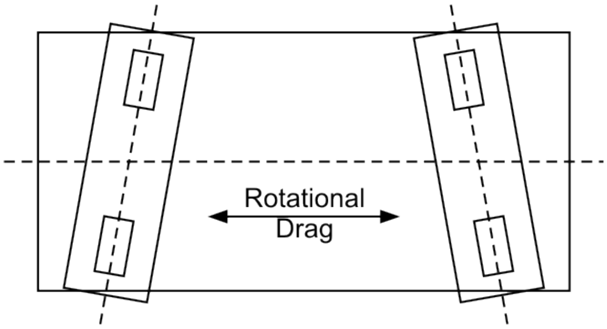


D: Cocked Wheels in Turning Units

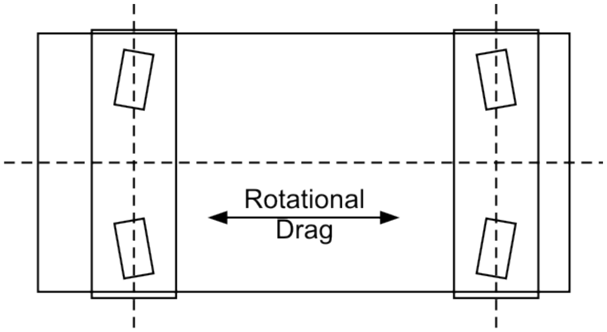
## Rotational Drag – Examples of misalignment of turning rolls causing rotational drag

Rotational drag can be caused by the misalignment of the turning roll units, or by misalignment of the wheels within the units. It adversely affects the tractive power of the drive unit by causing the drive unit to work much harder than necessary to turn the vessel. This can affect not only the effective load rating of the unit, but shorten the working lifespan of the unit through excessive wear and tear.

In example E, the misalignment is a result of the operator not aligning the units properly. This can be easily corrected by paying careful attention to how the units are set up. In example F, the rotational drag is due to misalignment of the wheels within the drive and idler units, and is either the fault of the manufacturer or is caused by abuse or excessive wear on the wheel bearings and axles. This cause of rotational drag should not occur if good quality turning rolls are purchased and maintained properly.



E: Pigeon-Toed Turning Units

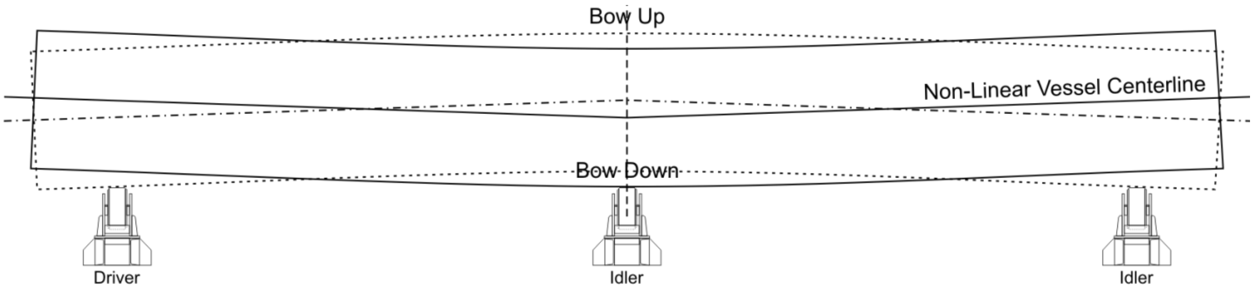


F: Non-parallel Wheel Drag

## Overload – Example of overload caused by a bent (non-linear) vessel centerline

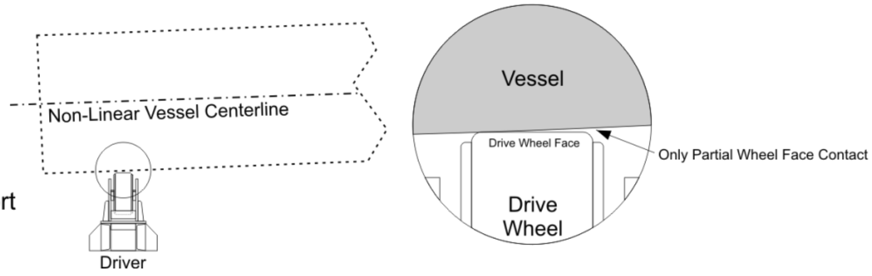
Example G is an exaggeration of a long vessel with a bent centerline cradled on three turning rolls, a driver and two idlers. If the vessel weighs 60,000 lbs., the rated loadings of the single driver and two idler units should be 20,000 lbs. each. In this situation, when the bow is up, the driver on one end and the idler on the other end are carrying the entire weight of the vessel, or 30,000 lbs. each. This is a 50% overload on each of the turning units. When the bow is down, the entire weight of the vessel is carried by the middle idler unit, a 200% overload over rated capacity. In reality, this situation would not occur because when the bow is down, the drive unit would not be engaged and the vessel would cease turning. The drive unit cannot be put in the middle position, because when the bow is up, the unit would not be in contact with the vessel and rotation would cease. For this situation to work at all, the middle idler unit must be offset further from the drive unit a distance at which the drive unit is always in contact, providing tractive pull on the vessel. Even in this case, the overload situation would still occur for the same reasons as outlined below.

In example G we show three turning roll units to turn the vessel.  In ideal situations, you would want the vessel to be supported by only four wheels from two units, the driver and one idler.  This is a much more stable configuration.  In this case the units would need to be rated for 30,000 lbs. each to accommodate the 60,000 lb. vessel. Even if that were the case in this example, the overload situation would still exist because of the bent centerline of the vessel (see example H).  As the vessel rotates, the face of the roller wheels would be in only partial contact with the vessel, so only a portion of each wheel is carrying the load of the vessel.  To overcome the overload problem in these situations, it is advisable to always use turning rolls, both drive and idler units, with rated capacities greater than needed for a given vessel weight.



G: Overload Situation: Non-linear vessel centerline, three roll support

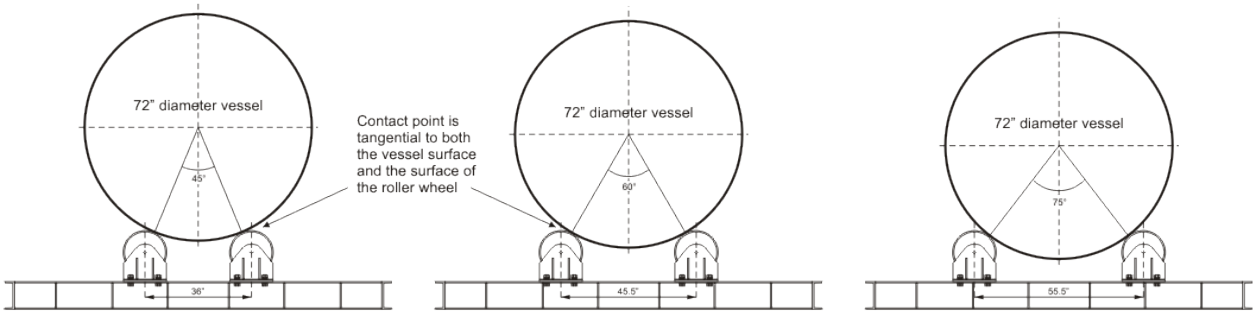
H: Overload Situation:
Partial wheel face support



## Wheel Span – Example of tractive power and torque as a function of wheel spacing

The examples shown below illustrate the relationship between wheel spacing, traction and torque requirements for a given vessel size.  For some styles of turning rolls, the wheel spacing adjustment is infinitely variable between the minimum and maximum settings (e.g. Vanguard’s leadscrew adjustable turning rolls).  This makes it easier to adjust the wheel spacing to obtain the best relationship between the vessel size, the wheel spacing and the torque required to turn the vessel.  For other styles (bolt adjustable turning rolls), the spacing is set by the distance between bolt holes.  In any case, the wheels should be spaced properly to provide the most tractive power using the minimum amount of torque.  This will allow for safe and efficient turning operations without undue wear and tear on the drive unit motor or gears.

The wider the wheel spacing, the more tractive power is available, but it requires more torque from the drive unit. A narrow spacing provides less tractive power, but also requires less torque to rotate the vessel. Always try to use the minimum wheel spacing possible for a well balanced, symmetrical vessel. This will generally fall between the contact angles of 45° and 75°. The contact of the vessel with the wheel should be as close to the tangential contact point between the two as possible and should not exceed 110°, as any angle greater than this will put excessive stress on the motor and gears.



I: Narrow spacing: normal traction, min. torque req.

J: Medium spacing: more traction, more torque req.

K: Wide spacing: max. traction, max. torque req.

## Vessel loading – Considerations for loading a vessel onto the turning rolls

Loading the vessel onto the turning rolls is probably the most damaging moment to the turning roll. At that moment, the entire weight of the vessel, plus the dynamic force of it being lowered, generally impacts a single wheel, exerting all of that force onto the gears of that one wheel (or in the case of a non-powered wheel, the axle and bearings of that wheel). It is almost impossible for a crane or lift operator to lower the vessel so that it contacts all four (or more) wheels equally and simultaneously.

When lowering the vessel onto the drive rolls, the movement (and force) of the vessel is straight down. Unless the wheels are spaced such, or the diameter of the vessel is so large, that the vessel sets straight down on the top of the wheel, the vessel will exert tremendous tangential force on the first wheel it contacts. If it is a drive wheel, and has a self-locking feature, the force of the impact from the vessel will try to rotate the wheel. This force is transferred to the gears, and may cause damage to, or excessive wear on the gears.

There is no surefire remedy to this situation, except to purchase good quality, well built turning rolls, and practice safe and cautionary measures when loading the rolls.

## Rotating the Vessel – Considerations for rotating a vessel

When rotating the vessel, ideally the drive wheels are sharing the rotational load, but in reality, generally only one of the drive wheels is providing the rotational power. This is due to the fact that when the vessel was loaded onto the rolls, it struck one drive wheel first, causing a backlash in the gears. As the vessel is settled onto the other drive wheel, that wheel will experience backlash, but in the opposite direction. As rotation starts, the vessel is rotated by the effort of the one final drive wheel whose backlash has been loaded against the direction of rotation. This means that only one of the drive wheels is providing the driving force. Only if one of the wheels slips, will the driving force be shared by both of the wheels. The driving force is not increased with both wheels sharing the load, but the life of the drive wheels and gears is increased.

After loading of the vessel, the next most damaging moment for the turning rolls is when an uneven lap joint is encountered during the rotation. If the difference between the two joined surfaces is great enough, when the uneven lap joint hits the first drive wheel, that wheel must shoulder all of the rotation force. Because of the difference in vessel diameter, it must also lift the vessel, causing strain on the drive gears. The opposite drive wheel does not help with this, but will experience the same strain when the uneven lap joint reaches it.

This second rotational situation can be alleviated by making sure that the weld joints that will encounter the wheels of the turning rolls are even, smooth and follow the curve of the vessel diameter.