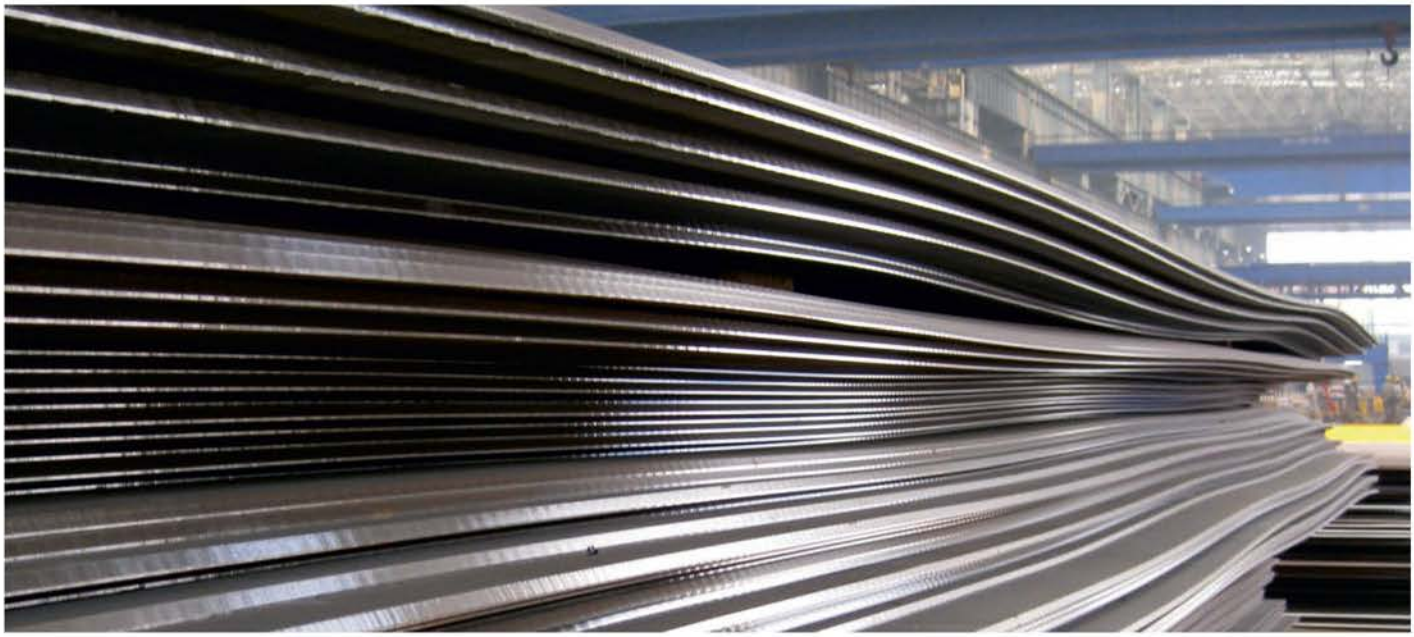


Milling.

Optimized Weld Seam Preparation.

GRAEBENER MASCHINENTECHNIK

Creating Transitions

First and foremost, an optimized weld seam preparation needs one thing: experience.

Graebener Maschinentechnik offers machines and equipment which are based on many kinds of experience:

- on innumerous knowledge profiting from the experience gained during the operation of its own pipe mill (Graebener Großrohr, 1974 to 1997),
- on the ken based on several decades of consistantly developed special machinery as well as
- on the continuous transfer of user know-how considering the state-of-the-art construction principles.

Modern joining techniques set new standards in the field of plate processing and pipe production, for example with the multiple-wire sub arc welding or the laser-/laser-hybrid welding. The vehemently increasing requirements for the quality of the weld seam preparation are decisive, keeping in mind the computer-aided machine controls and various narrow-gap welding processes.

For some years now, the application of laser/laser-hybrid welding has become economically feasible for plate thicknesses of up to 25 mm, not only in plate processing, but also in pipe production. Soon, it will be possible to use laser-hybrid welding even for thicker plates. To ensure a reliable and economical welding process with these highly efficient joining techniques, stringent edge preparation requirements have to be complied with.

The following targets can only be achieved if the edge preparation is optimized:

- significant reduction of production/processing time
- considerable reduction of weld deposit being applied
- reduction of energy consumption
- improved working conditions
- optimized weld edge preparation for welding results of the highest quality

GRAEBENER's Modular Programm for Weld Seam Preparation

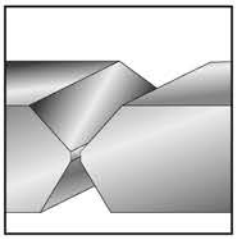
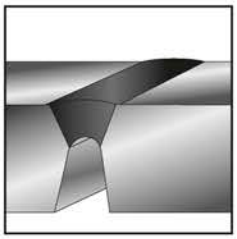
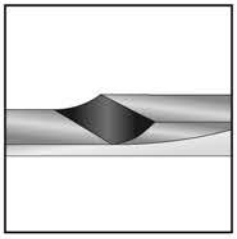
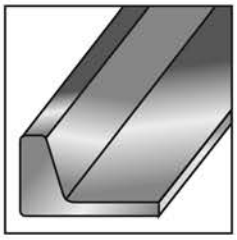
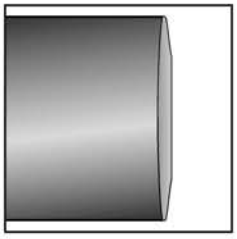
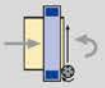
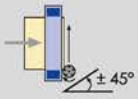
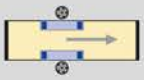
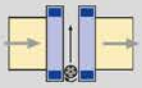
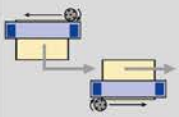
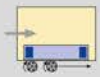
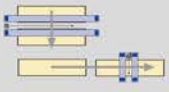
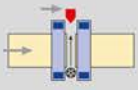
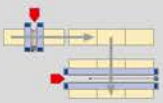
milling of plates		pipe production vessel/apparatus construction shipbuilding tank and silo construction steel service centers plate rolling mills
milling of longitudinal seams		pipe production vessel/apparatus construction offshore industry
milling of circumferential seams		pipe production vessel/apparatus construction offshore industry
milling of plates and subsequent welding		shipbuilding pipe production
milling of sectional steel and slabs		vehicle construction shipbuilding plant engineering section mills
end bevelling		pipe production fitting production dished ends production

Plate Milling Systems

Excerpt of machinery concepts*:

	1-side plate edge milling machine with one milling head or two milling heads, type GPE	small or medium plate lots of various sizes, with usual tolerance requirements on straightness and parallelism, high precision of web height
	1-side plate edge milling machine with pivotable milling head, type GPS	small or medium plate lots of various sizes, milling head pivotable by ± 45°
	Pull-through plate edge milling machine with fixed milling supports without clamping traverses, type GPD-Z (processing of 2 edges) or GPD-V (processing of 4 edges)	medium or large plate lots of various sizes, with low requirements on straightness and parallelism and precision of web height
	2-side plate edge milling machine, type GPZ	medium plate lots of various sizes, high tolerance requirements on straightness and parallelism, high precision of web height
	Tandem plate edge milling machine system, type GPZ-T	medium or large plate lots of various sizes, with high tolerance requirements on straightness and parallelism, high precision of web height
	Two head plate edge milling machine, type GPF-D	medium or large plate lots of various sizes, with high tolerance requirements on straightness, parallelism and web height, parallel pre- and finish-processing of workpiece, clad plates
	Plate edge milling machine for the processing of 4 edges, type GPZ-V	small or medium plate lots of various sizes, with usual tolerance requirements on straightness and parallelism, high precision of web height; also available with vacuum plate clamping system
	4-side plate edge milling machine system, type GPV	medium or large plate lots of various sizes, with high tolerance requirements on straightness and parallelism, high precision of web height of all four plate edges
	2-side plate edge milling machine with movable clamping traverse, type GTWP	same as type GPZ, but integrated use of laser welding or submerged-arc welding possible, welding gap “0”
	Combined 2-side plate edge milling machine system for simultaneous processing of longitudinal and cross edges, with movable clamping traverse and, as an option, with integrated welding unit, type GTWP-V	large plate lots of various sizes, with highest tolerance requirements on straightness, parallelism and web height, for processing of either 1, 2, 3 or 4 plate edges, applicable for integrated operation of laser or UP welding, welding gap “0”

* further machine concepts available upon request

The plate edge milling machines enhance effectiveness when large-format plates are processed, for example in:

- shipbuilding
- production of large pipes
- bridge construction
- pressure vessel/apparatus construction
- steel service centers
- plate rolling mills
- wind tower production.

Graebener offers machine concepts, especially designed for customers' requirements and the used materials and quality, for various milling and joining tasks.

For the production of "Tailor-Welded"-ship decks the plate edge milling machine can be carried out as TWP®-system with integrated laser-hybrid welding system.

The production data can either be entered in the control system manually or can be retrieved by the automatic control system of the milling machine directly from the production planning software .

In particular since the requirements on quality and the subsequent processing steps – such as welding – are ever increasing, the milling machines offer the following advantages:

- no additional heat input
- clean and metallic bright surface
- high parallelism of the milled edges
- constant web height on the entire length due to plates being clamped over the entire milling length
- reduced wear of milling tips
- recycling of metal chips possible
- low environmental pollution (noise, dust, heat)
- single U-groove seams are possible as well as chamfering
- copying of plate waviness guarantees a constant welding web position.

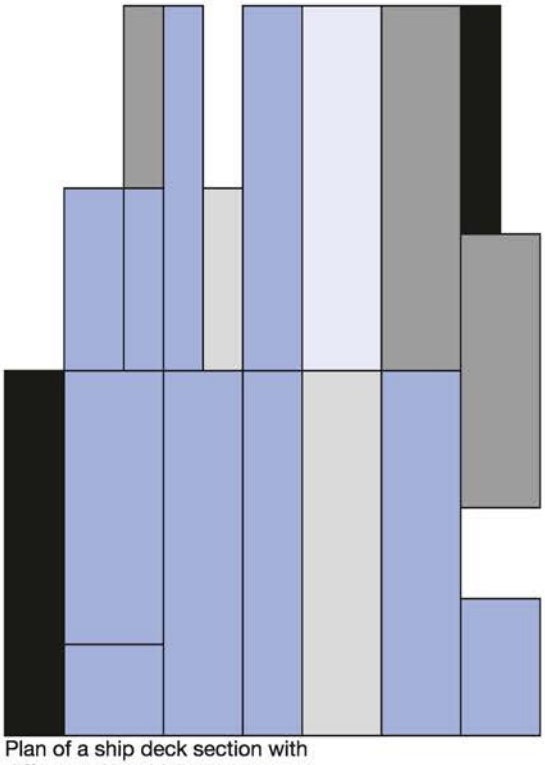
TWP® – "Tailor Welded Plates"-Systems

Important advantages in view of productivity, quality of weld seams and fitting accuracy for subsequent assembly can be achieved by using modern joining techniques such as laser- or laser-hybrid welding. The focus of "Tailor Welded Plates" is, in this case, the plate edge preparation and the joining of the plates.

The milling of the plate edges and also the welding are both carried out in the TWP®-system. The system is used for the simultaneous clamping, processing, and joining together of the plate edges by welding.

Due to the simultaneous processing of two opposite plate edges, the two plates can actually be jointed and welded together with a "zero" gap. Additional tacking and straightening is not necessary.

This "zero" gap is particularly necessary when modern laser welding equipment is used.



Plan of a ship deck section with different plate thicknesses

The TWP®-system allows joining plates of different plate thicknesses in random combinations. Differences in plate thicknesses are compensated by chamfering a transition zone on the thicker plate, so as to achieve a smooth transition. Thus, a pre-determined pitch is applied to the thinner plate.

Process comparison between gouging/grinding and seam milling

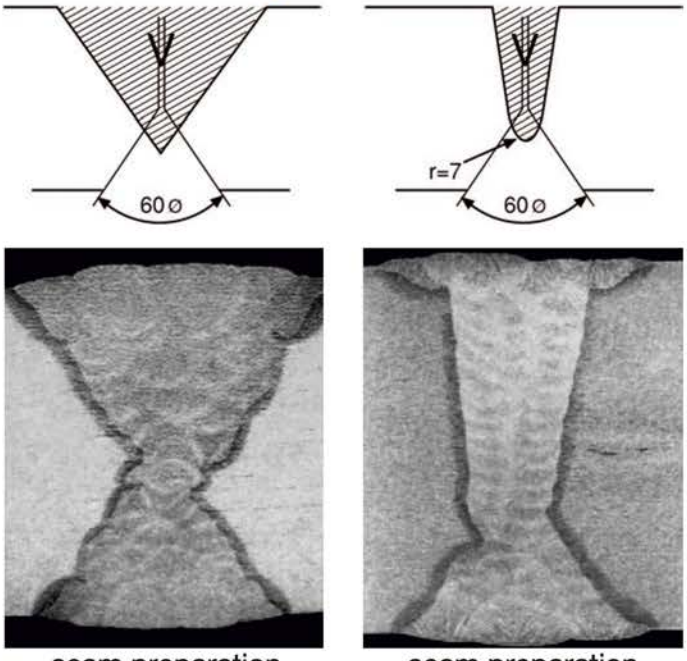
Criteria	Gouging/grinding	GRAEBENER seam milling
Machining time:		
- seam preparation	100 %*	15 %*
- performance of seam preparation per minute	6 cm	55 cm
- seam machining incl. welding	100 %*	58 %*
Material/energy costs:		
- welding consumables (wire and flux) in kg	100 %*	72 %*
- energy consumption (kWh)	100 %*	56 %*
- electrode and abrasive consumption vs. milling tips (€)	100 %*	83 %*
Total costs circ seam preparation	**100 %***	**67 %***

The cost advantage will exceed 50 % with increasing wall thickness.

* practical seam preparation comparison carried out at the company Josef Bertsch Gesellschaft mbH & Co., 6700 Bludenz, Austria

Circ seam milling machine GRF 30, reference dimension: 3,500 mm diameter, 31 mm wall thickness, material grade P355NL1

The micro-section proof



seam preparation outside gouging

V = seam volume 100 %

seam preparation outside milling

V = seam volume 50%

Working conditions	Gouging/grinding	GRAEBENER seam milling
physical strain	manual re-positioning of the grinding unit	controlled working process with ovality and drift compensation
noise	hazardous to health	below 80 dB(A)
heat	high temperatures, with surface contamination	no heat development
grinding dust	grinding dust which is hazardous to health and needs to be extracted mechanically	no emission
waste removal	high development of dust and dirt (harzadous waste removal necessary)	chips can be recycled
Quality		
geometry	varying gap width and depth	machine tool precision of gap width and depth
surface	impure surface (dye penetrant test necessary)	smooth surface, no testing and re-machining required
root pass	risk of included blowholes and existing root defects	no hidden blowholes, constant root removal over the full length
automation	subsequent automatic welding only possible at high effort	subsequent automatic welding possible with low controlling effort

Circ Seam Milling Machines

The longitudinally welded shells are used to produce apparatus, reactors, pipe constructions, dolphins and spud piles. They are internally submerged-arc welded, milled from the outside and then provided with a clean external sub-arc welding preparation.

Circumferential and longitudinal milling machines can partly reduce the costs for one meter weld seam by more than 50 % (see table on page 8).

Circ seam milling machines are available as mobile machines, which can be moved by shop crane or fork-lift truck, and as machines with a railbound carriage.

The machines are equipped with a sensor system which follows the ovality of the pipe automatically, thus guaranteeing a constant seam depth (seam geometry).

Circ Seam Milling Machine Types

	GRF 30	GRF 45	GRF 55	GRF 45-V	GRF 55-H
Capacity	30 kW	45 kW	55 kW	45 kW	55 kW
Milling depth up to	60 mm	100 mm	120 mm	100 mm	120 mm
Transport	shop crane, fork-lift truck	shop crane, fork-lift truck	shop crane, fork-lift truck	with carriage, on rails	with carriage, on rails

Long Seam Milling Machines

In accordance to the circumferential milling machines, a clean and fast external longitudinal seam preparation on pipes, vessels and apparatus is most important.

The external longitudinal seam preparation on internally submerged-arc welded (SAW) pipes, shells, etc. is carried out by a longitudinal milling machine. Graebener long seam milling machines are available as underfloor or floor-mounted design. The under floor machine is installed in the foundation and mills under ground level in 6-o'clock position.

The long seam milling machine as flour-mounted construction does not need a foundation and thus can be used as an on-site machine for seam milling of large and heavy-walled pipes, shells, vessels, apparatus etc. The workpiece is being milled in a 45 degree angle.

In order to compensate probable surface roughness, ovality and deviations in straightness, the longitudinal milling machines are likewise equipped with a copying system. This guarantees a constant milling depth (seam geometry) during the milling process.

End Bevelling Machines

The Graebener end bevelling machines prepare weld seams on pipes, shells, fittings, reducers, tees, etc.

In order to facilitate universal end bevelling on these components, Graebener has developed a system which

- reduces set-up times;
- duplicates the ovality mechanically or by using non-contact laser tracking, depending on the requirement;
- refers the ovality of a work piece as nominal value for the component to be joined.

The design of the production process is simple. The work piece is positioned in front of the machine. Due to the fact that a calculation of the work piece center is done automatically by the control system, an aligning is not necessary.

The ovality of the work piece is evaluated during a measuring run of max. 24 measuring values.

The measuring profile thus created determines the nominal value for the machining. The ovality is duplicated without contact.

The measuring profile of, for example, a dished end can be memorized and used at a later stage as nominal value.

The end bevelling machines for large pipe mills can either be supplied as 1-side or 2-side version. The complete transport of the pipes can be done fully automatically.

Profile Milling Machines

In the shipbuilding industry, namely for the production of large deck sections, welding units for stiffening profiles to be welded onto the shipbuilding sections are required. It is necessary to remove the rolling edges first, so that these shipbuilding sections can be welded on, utilizing modern joining techniques such as laser or laser-hybrid welding. For this purpose, Graebener has developed special profile milling machines.

Profile milling machines can also be used for the profiling of sections, slabs, etc.

Service

All Graebener machines are equipped with a remote maintenance system. And this already since the beginning of the 90s. Thus, our customers can rely on a fast and competent assistance; a “just-in-time”-service – worldwide!

A competent all-in service, which includes after sales service, high availability of spare parts as well as optimum customer support, is part of the high technological level Graebener is renowned for.

By the way: Graebener Maschinentechnik is, of course, certified according to DIN EN ISO 9001:2008 quality system.


Certificate

Standard: ISO 9001:2006

Certificate Register No.: 01 100 061227

TÜV Rheinland Cert GmbH certifies:

Certificate Holder: GRAEBENER Maschinentechnik GmbH & Co. KG
& Hydroline Schrupp GmbH & Co. KG
Am Heller 3
D - 57250 Netphen-Werthenbach

Scope: Development, manufacture, sale, trading, assembly, service and maintenance of products in machine and hydraulic plant construction, as well as contract production and prototyping

An audit was performed, Report No. 061227. Proof has been furnished that the requirements according to ISO 9001:2008 are fulfilled.
The due date for all future audits is 11-03 (dd.mm).

Validity: The certificate is valid from 2011-03-15 until 2014-03-11.
First certification 2006

2011-03-15

TÜV Rheinland Cert GmbH
Am Grauen Stein · 51105 Köln

IAF

DQS-ZM-58 99-00

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