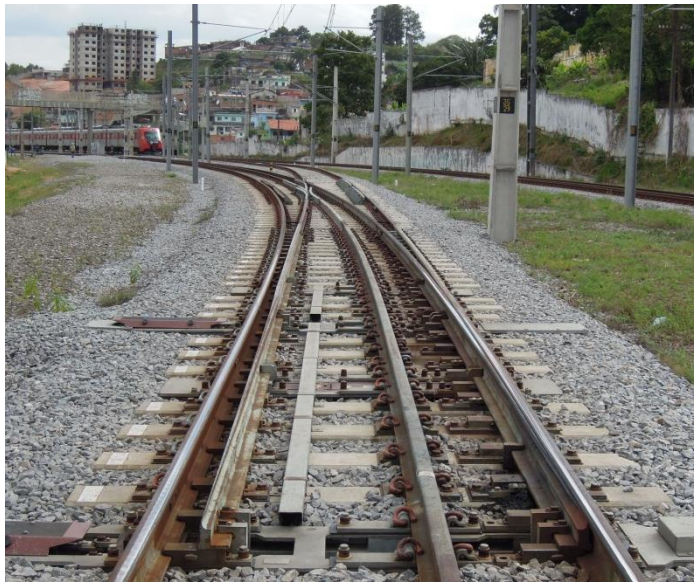
DUAL GAUGE TURNOUTS



Conference on 28th Jan 2016 in Lisbon

Mr. Thomas Klemen

voestalpine VAE GmbH

www.voestalpine.com/vae

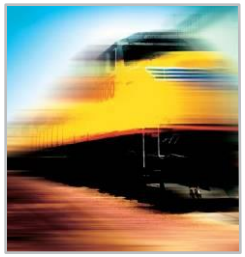
voestalpine
ONE STEP AHEAD.

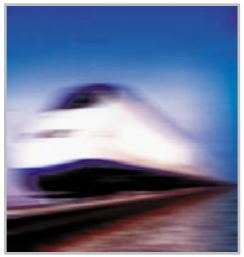
voestalpine VAE GROUP

About Us

voestalpine VAE Group

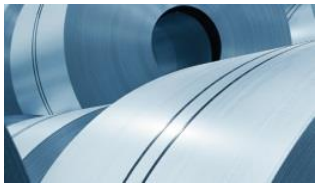
- Has 160 years of know-how
- Is a 100% affiliated company (of the Division Metal Engineering) of voestalpine AG
- Is a world market and technology leader in turnout manufacture
- Runs production and sales centres close to all important rail markets
- Acts as a fully integrated supplier (turnouts, switch machines, locking and monitoring systems as well as services in accordance with all international standards & requirements)
- Endeavours to achieve a durable improvement of the going-concern value, based on
  - Continuous profitability
  - Controlled growth





voestalpine Group

4 Divisions



Steel	Special Steel	Metal Engineering	Metal Forming
Top European player	**Global leadership**	**Global leadership**	**Global leadership**
Top-three European supplier of high quality sheet and global top position in heavy plate for the most demanding applications.	Worldwide leader in tool steel. Leading position in high-speed steel and special forgings.	European market leader for rails and processed wire, world market leader for turnouts and complete railway systems; leading position in welding consumables and seamless tubes.	Leading worldwide provider of high-quality metal processing solutions, in particular special sections and precision steel coil as well as special components for the automobile industry.

Metal Engineering Division

6 Business Units

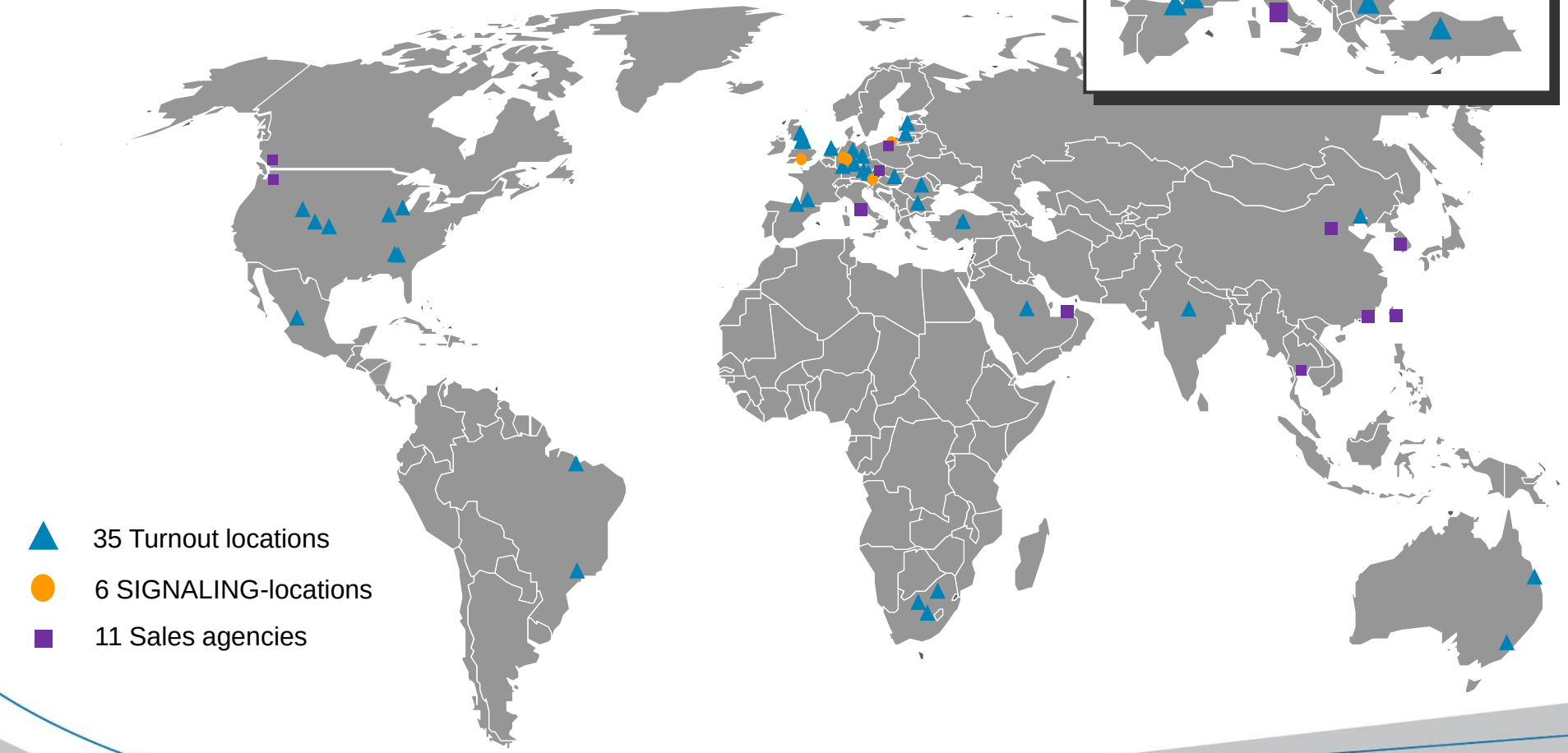





Steel	Rail products	Wire	Seamless tubes	Switch products	Welding
Steel base	**European Top-2 supplier**	**European Top-3 supplier**	**Global Top-3 supplier**	**Global market leader**	**Global Top-3 supplier**
Manufacturer of precursor material and F&E partner for internal and selected external customers.	Rail manufacturer with world-wide acknowledged innovative strength and quality leadership.	Partner of automotive subcontractors, assembly and material handling technology firms as well as of the building industry, for a great number of high-end products.	Manufacturer of high-tech seamless tubes for the oil and gas industry and of special tubes for industrial applications.	Global market and technology leader in turnout systems for standard-gauge railways, metros & trams and heavy-haul railways.	Specialist for medium- and high-alloy metal fillers for high-end industries.

voestalpine VAE

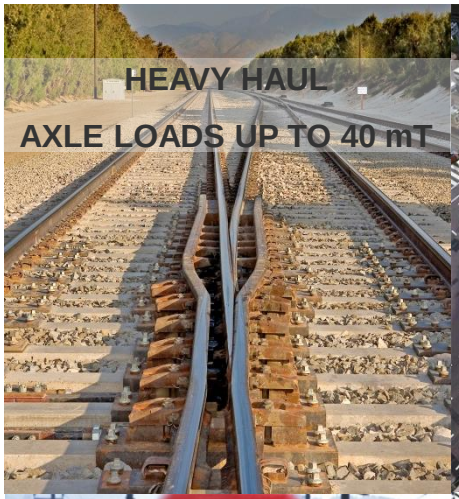
International Locations

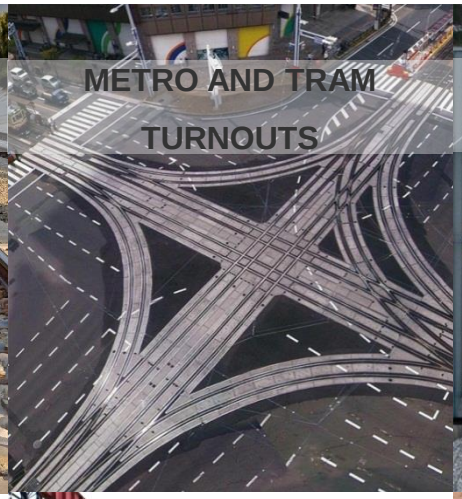


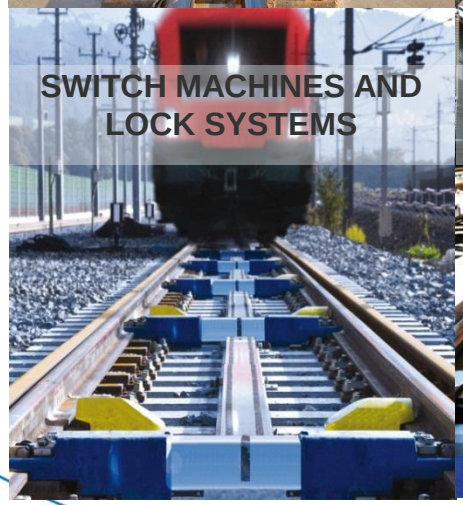
Products & Services

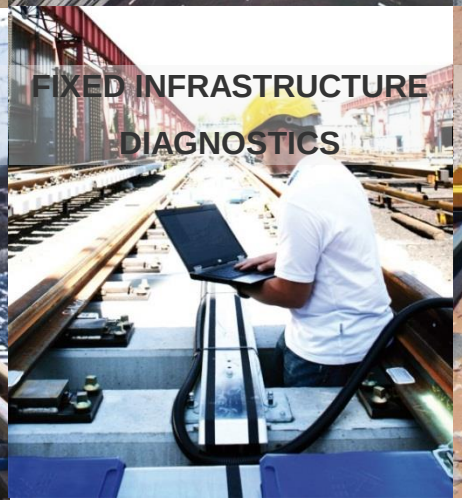
Business Unit Switch Technology

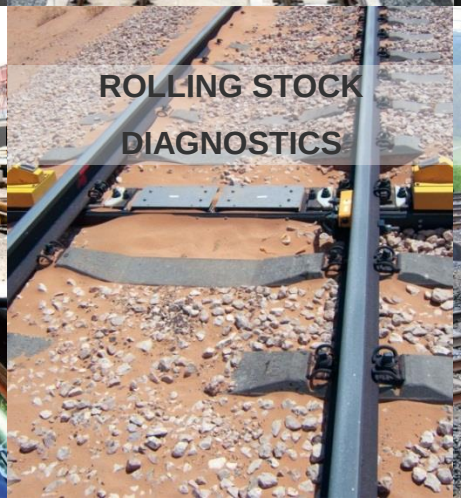
Product Portfolio







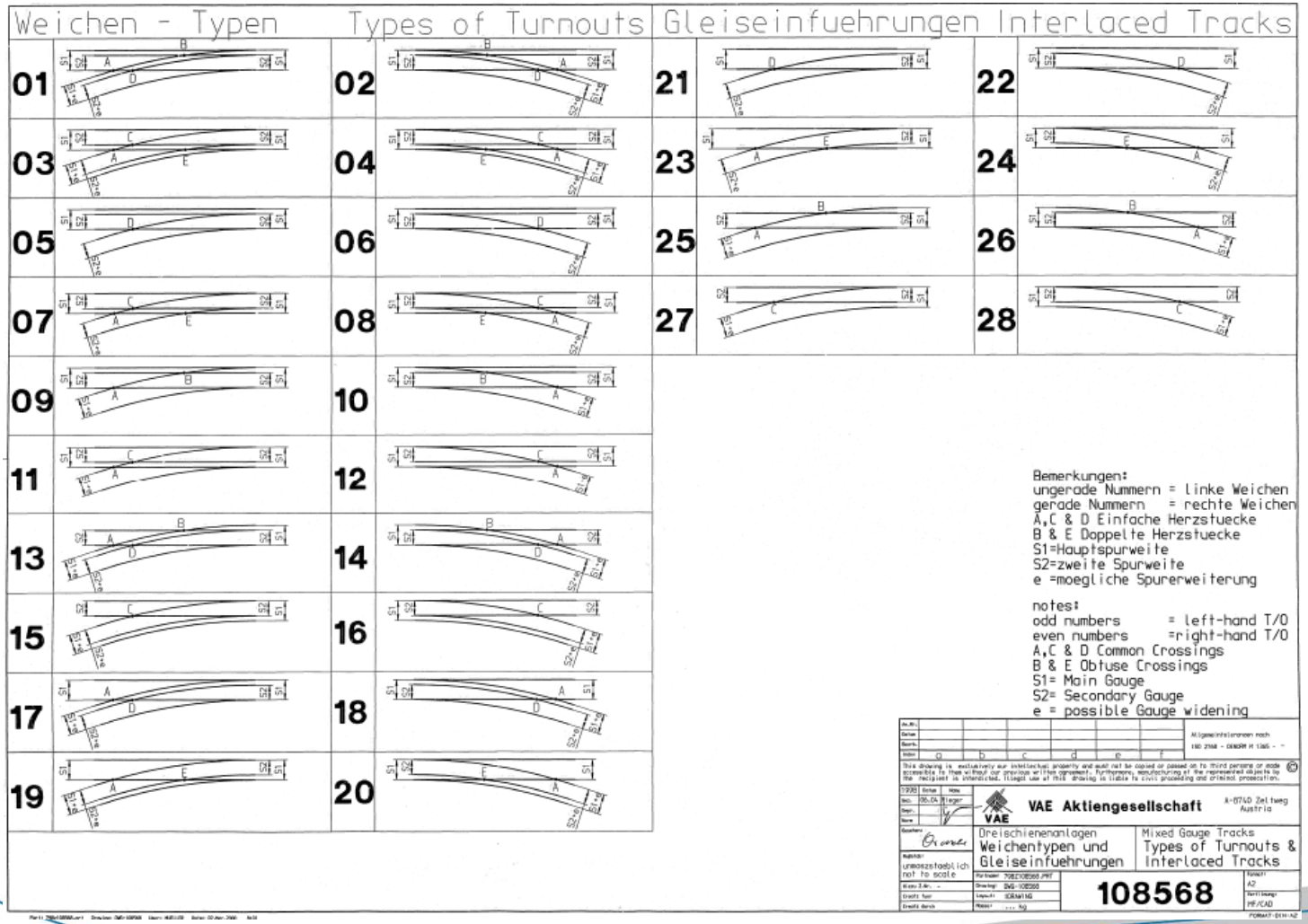




Dual Gauge Turnouts

- What are the differences to standard turnouts ???
  - Additional 3rd rail inside the turnout
  - Depending on the gauge the 3rd could have different positions inside the turnout
  - Depending on the position of the 3rd rail there are several different types of turnouts possible
- What impact has the 3rd rail on the turnout design ???
  - Switch device with 3 moveable components in certain cases
  - Additional interuptions of the running edge (additional crossings required)
  - Complex ALD (Actuation-Locking-Detection) solution

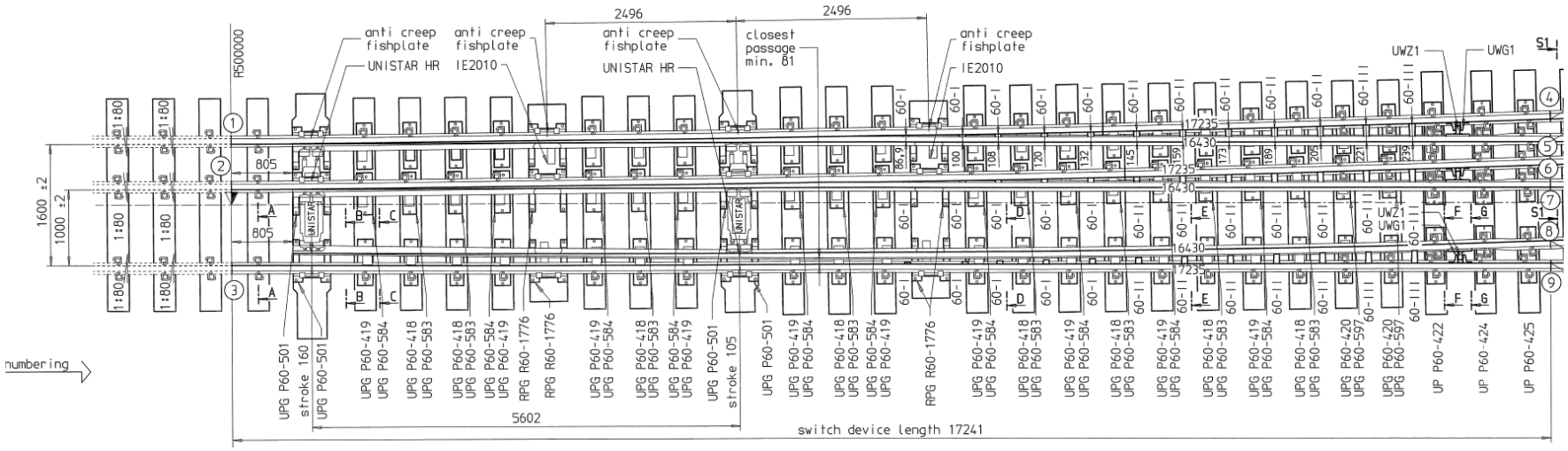
Dual Gauge Turnouts – Type Varieties



Dual Gauge Turnouts – Design aspects for main components

- Switch device:

For gauge combinations 1435/1000mm and 1668/1000mm standard half set of switch devices can be installed beside each other if a deviation for both gauges (type 01,02,03,04) is required. Usually ther in no special switch design necessary. ALD system has to be set for a 3rd switch blade.



Dual Gauge Turnouts – Design aspects for main components

CPTM Sao Paulo T/0 60E1 500-1:14 type 3 1600/1000mm gauge

Dual Gauge Turnouts – Design aspects for main components

Swisserland „Felsberg“ T/0 SBB I 185-1:7 type 4 1435/1003mm gauge

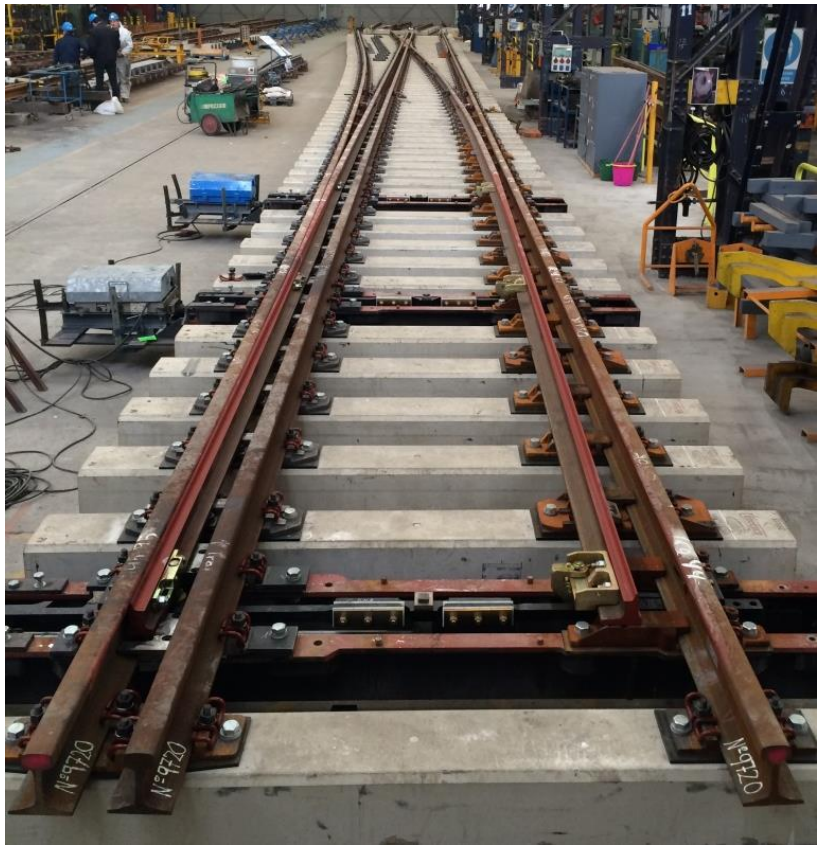
Dual Gauge Turnouts – Design aspects for main components

- Switch device:

For gauge combination 1668/1435mm a special switch design is required.

In such case the switch opening need to be reduced to approx. 110mm as there is only a gap of 161mm between the two rail heads.

Also a higher number of setting levels might be requiered to ensure the proper opening and min. gap of the switch blade.

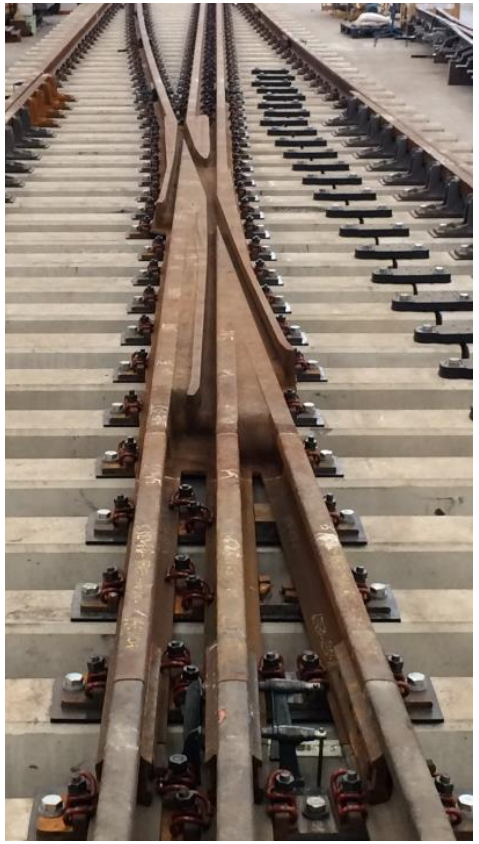


T/0 60E1-500-0,071 type 11 1668/1435mm gauge

Dual Gauge Turnouts – Design aspects for main components

- Crossing design:

As most of the crossings inside dual gauge turnouts are different and of a unique design a build up crossing type COMPACT1400 is suggested, as this type do not require any pattern and it can be designed to the required alignment. For more complex crossing configurations with tight space conditions, cast manganese crossings type CENTRO Mn13 can be used.

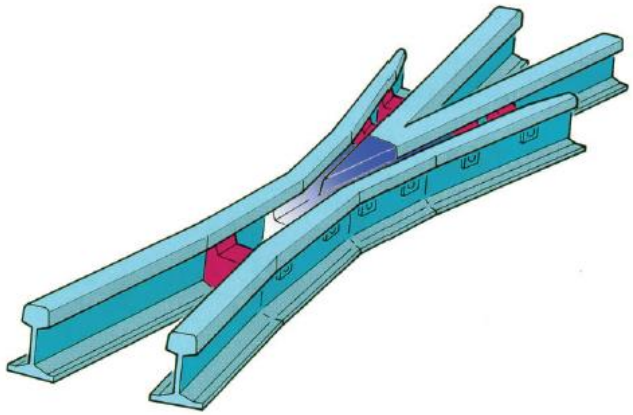


Dual Gauge Turnouts – Design aspects for main components

- Crossing COMPACT 1400:

The crossing vee is machined from a rolled block made of tempered steel. The welding joint between crossing block and closure rails is in any case in the area where the wheel overrun of wing rail/crossing vee is completed.

The closure rails are machined from rolled rail profiles. They are welded together in the area of the head and foot and connected to the crossing vee by means of flash-butt welding. The wing rails are also made from rolled rail profiles, machined and bolted to the welded crossing vee by means of distance blocks.



Dual Gauge Turnouts – Design aspects for main components

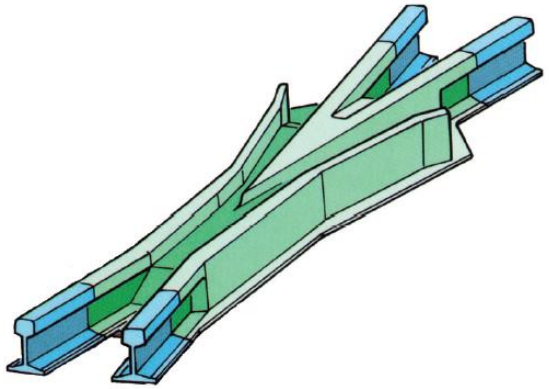
- Crossing CENTRO Mn13:

The complete central part of the crossing is cast in one block from high-manganese steel.

Closure rails are flash-butt welded to the four ends of the central block using a special flash-butt welding technique (intermediate piece welding).

The bearing surfaces (seat of the plates) as well as the complete area of the running and head surfaces are machined. The thus achieved manufacturing accuracy facilitates optimal wheel overrun and interchangeability of crossings on existing sets of plates.

Each different type of cast manganese crossings requires a specific paffern.



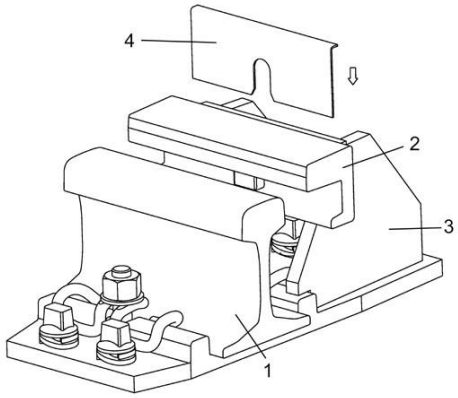
Dual Gauge Turnouts – Design aspects for main components

Swisserland „Felsberg“ T/0 SBB I 185-1:7 type 4 1435/1003mm gauge

Dual Gauge Turnouts – Design aspects for main components

- Check rails 33C1 as a basic design:

The check rail is made from the rolled profile 33C1 (UIC33), which is machined in the area of the entry and the check end flare. The check-rail chair plate is made as a stable welded construction (web-type construction). The check rail rests on the check-rail chair and is fastened with bolts. For a correct adjustment of the check-rail flangeway and the check gauge, shims can be positioned between check-rail chair and check rail. Maximum possible compensation of wear is around 10 mm.

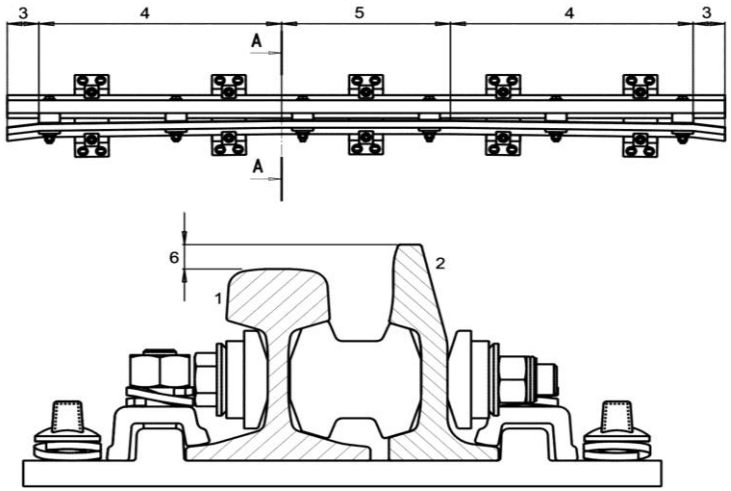


1) Running rail
2) Check Rail
3) Check-rail chair
4) Shim

Dual Gauge Turnouts – Design aspects for main components

- Check rails 48C1 for use in space restriced areas:

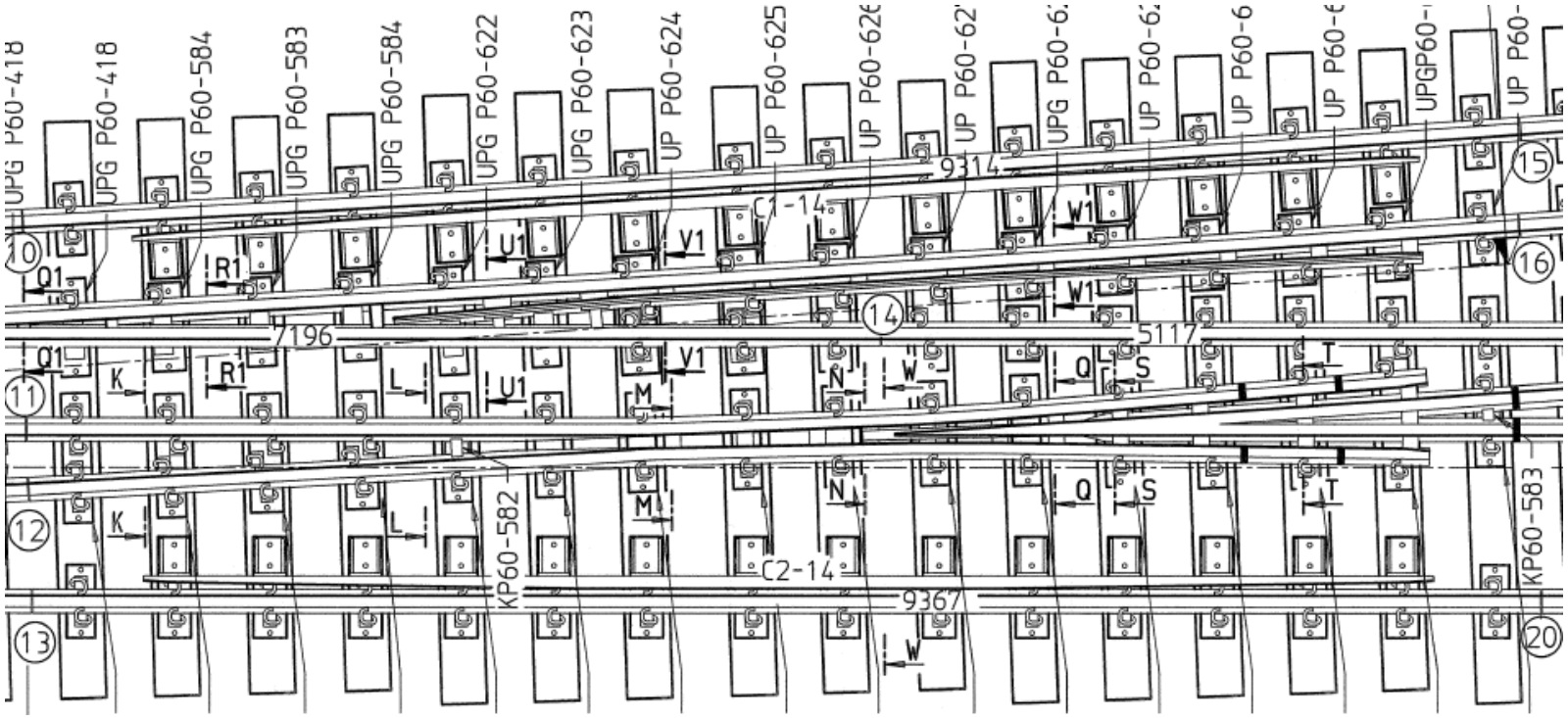
The check rail is made from a rolled profile, e.g. 48C1 (RL 1-54), which is bent according to the requirements in the area of the entry and the check end flare. The check rail is bolted via distance blocks to the running rail and forms a stable unit.



1) Running rail
2) Check Rail
3) Emergency entry
4) Flange way
5) Parallel Groove
6) Superrelevation check rail

Dual Gauge Turnouts – Design aspects for main components

- Use of Check rails 48C1 in space restriced areas:



CPTM Sao Paulo T/0 60E1 500-1:14 type 3 1600/1000mm gauge

Dual Gauge Turnouts – Design aspects for main components

- Use of Check rails 48C1 in space restriced areas:

CPTM Sao Paulo T/0 60E1 500-1:14 type 3 1600/1000mm gauge

Dual Gauge Turnouts – Design aspects for main components

- Consideration of different wheel sets for crossing and check rail flangeway design (FSD – Functional and safety dimensions):

For defining the FSD all possible wheel set variations need to be considered for the flangeway design for crossing and check rails.

In the worst case, if the wheels sets are completely different, and no common solution for the check rail flangeway can be found, moveable point crossings have to be used instead of the fixed crossings.

A proper FSD study is one of the most important points to be set up at the beginning of design to ensure a safe design.

Dual Gauge Turnouts – Design aspects for main components

- Design of obtuse crossings

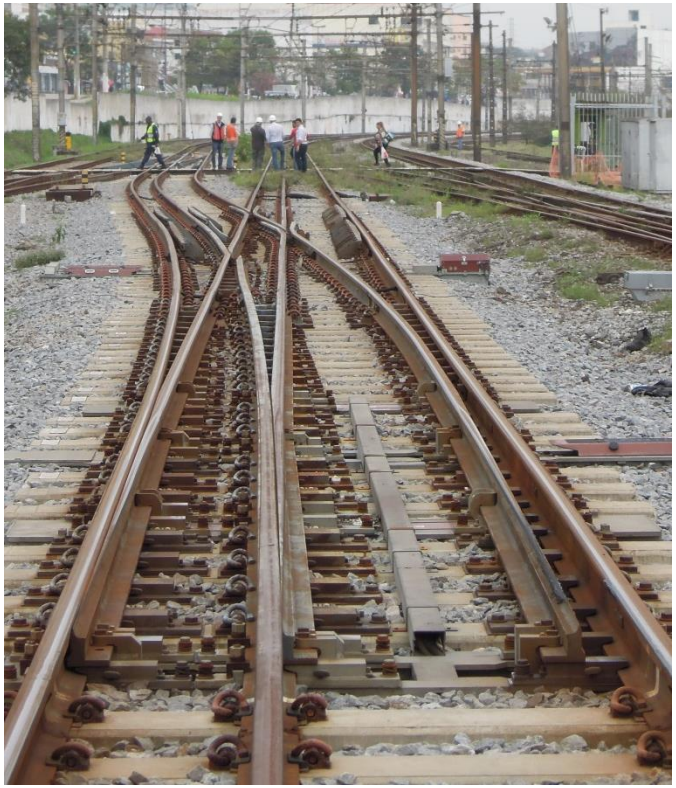
Several turnout configurations like type 01,02,03,04,07,08,09,10,13,14,19 and 20 requires obtuse crossings as a result of 3rd rail position.

On the above mentioned turnout types the rails of the smaller gauge intersects the switch rail of the wider gauge which results in an obtuse crossing configuration. As there is no opposite crossing existing for ensurance of safe guidance (same as in diamond crossings), special designs like moveable obtuse crossings are necessary, to ensure a safe passage of the wheels.

For moveable obtuse crossings full set of ALD equibment (Actuation-Locking-Detection) need to be considered, thus there is also an impact on the interlocking station.

Dual Gauge Turnouts – Design aspects for main components

- Design of moveable obtuse crossings



CPTM Sao Paulo T/0 60E1 500-1:14 type 3 1600/1000mm gauge with moveable obtuse crossing

Dual Gauge Turnouts – Design aspects for main components

- Special switch device to change side of broad or narrow gauge

This type of switch device can be used in front of complex turnout configuration to achieve a simpler design of turnout, just by shifting the 3rd rail to an other position.

E.g. a turnout type 10 (with 1 obtuse crossing & 1 single) can be converted to a turnout type 12 (With 2 single crossings).

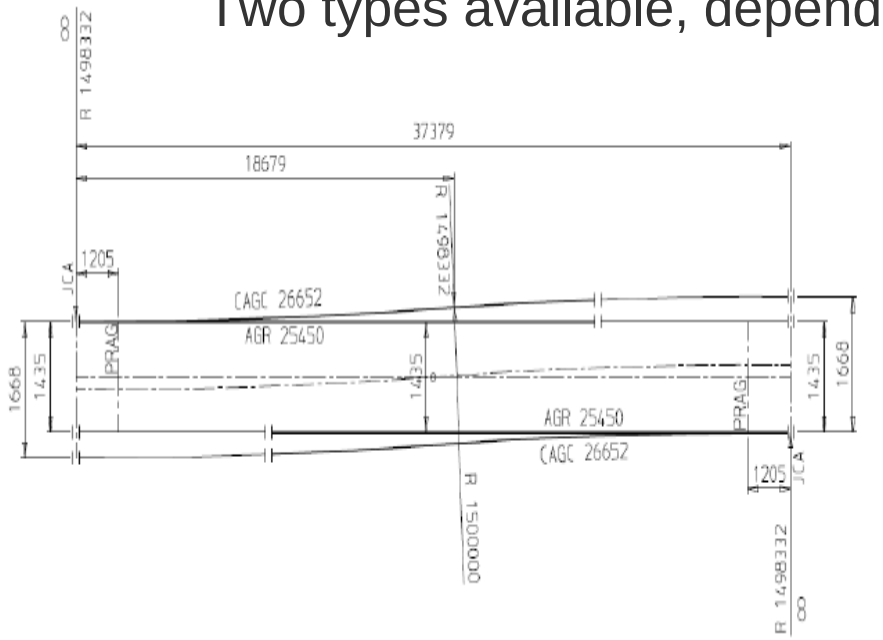
This special type switch device consists of two half sets of switches which are placed in two„S“ shape curves.

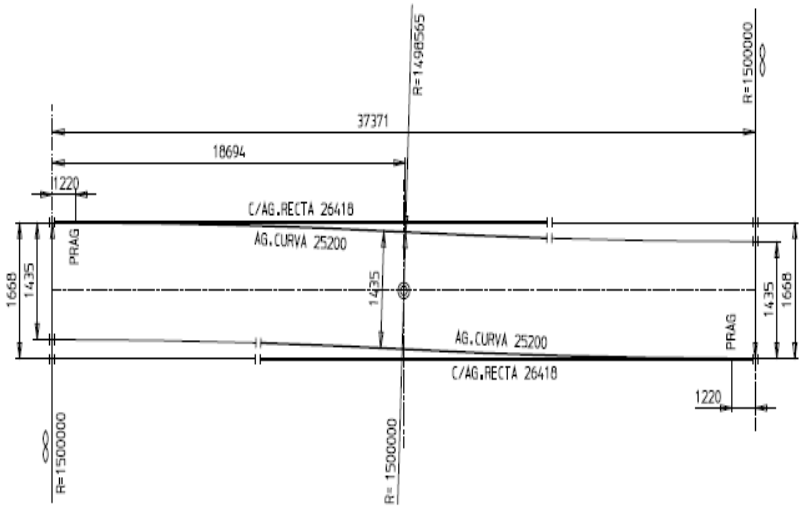
The use of such type of special switch device, requires more space, which need to be considered espacially in station areas.

Dual Gauge Turnouts – Design aspects for main components

- Special switch device to change side of broad or narrow gauge.

Two types available, depending on the track to be shifted.





Geometrical sketch

Dual Gauge Turnouts – Design aspects for main components

- Special switch device to change side of broad or narrow gauge

- Tangential design with deviation radius of 1500m
- With 4 setting levels

Dual Gauge Turnouts – Maintenance issues

- Due to special design and possible design compromises higher maintenance might be necessary on main components due to:
  - Shortend wingrail flares in space restricted areas thus higher impact forces and wear.
  - Reduced parallel flangeways in guiding area thus shorter overrunning areas in crossings, higher impact forces on the crossing point will occur.
  - Use of check rail 48C1 in space restriced areas which cannot be readjusted when worn.
  - Use of moveable point crossings, additional maintenace of moveable parts like greasing necessary. Also additional ALD equipment need to be maintained.

Dual Gauge Turnouts – Conclusion

Basically all types of dual gauge turnouts could be designed and manufactured.

All critical issues as mentioned in the introduction could be solved and handeld in the design by means of the proposed design solutions.

Dual Gauge Turnouts – Conclusion

BUT, for an economic final solution of the track work, it should be taken care **already at stage of alignment planning** to avoid the most complicated types of dual gauge turnouts, and to avoid types with obtuse crossings (which can be handeld by use of the special type of switch device to change the broad or narrow gauge to the other side).

By having less complex types of dual gauge turnouts in the network,

- **turnout investment costs**
- **costs for additional ALD equipment**
- **costs for additional set up in the interlocking station**
- **installation costs**
- **maintenance costs**

can be reduced or even avoided.

Dual Gauge Turnouts – Conclusion

Such projects need to be viewed from system perspective,

Planning – track – signalling – maintenance,

to achieve an optimum economic solution for all parties.

Thank you for your attention!

Thomas Klemen

voestalpine VAE GmbH

Design & Engineering

Alpinestrasse 1

8740 Zeltweg, Austria

T. +43/(0)50304/28-563

F. +43/(0)50304/68-563

Thomas.klemen@voestalpine.com

www.voestalpine.com/vae