DELIVERABLE D3.12

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ACRONYM	QCITY
TITLE	Quiet City Transport
Subproject 3	Noise from vehicle/infrastructure interfaces
	Prototype solution at STIB for reducing squeal noise: drilled hole application concept for applying lubrication to rail/wheel interfaces in order to reduce squeal noise
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	Amec Spie Rail	AMEC	FR
	Alfa Products & Technologies	APT	BE
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	Voestalpine Schienen	VAS	AU
	Zbloc Norden	ZBN	SE
	Union of European Railway Industries	UNIFE	BE

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This deliverable has been quality checked and approved by QCITY Coordinator
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0 EXECUTIVE SUMMARY

0.1 OBJECTIVE OF THE DELIVERABLE

Make available prototype solution at STIB for reducing squeal noise: drilled hole application concept for applying lubrication to rail/wheel interfaces in order to reduce squeal noise.

0.2 STRATEGY USED AND/OR A DESCRIPTION OF THE METHODS (TECHNIQUES) USED WITH THE JUSTIFICATION THEREOF

Full size prototype has been installed with electric pump and option for manual control of the lubricant volume: four units are installed at entrance of tram depot (curves integrated in turnouts).

0.3 BACKGROUND INFO AVAILABLE AND THE INNOVATIVE ELEMENTS WHICH WERE DEVELOPED

Development is based upon descriptions in D3.6 (mitigation methods), chapter on squeal. Special lubricant (low quantities) has been chosen over friction modifier products for lubrication. Attempt is made to combine TOR lubrication with flange lubrication.

0.4 PROBLEMS ENCOUNTERED

None up to now. Follow-up of the installation is required to avoid problems with grease spillage and obstruction of drilled hole by sand and dust.

0.5 PARTNERS INVOLVED AND THEIR CONTRIBUTION

STIB: concept & installation.
APT: concept.

0.6 CONCLUSIONS

Prototype installation is ready for use. Tests will be carried out to evaluate squeal noise in function of the quantity/type of lubricant used.

0.7 RELATION WITH THE OTHER DELIVERABLES (INPUT/OUTPUT/TIMING)

Input from D3.6.

Input to SP5 (WP5.3).

1 TECHNOLOGY OVERVIEW

A number of TOR lubrication/friction control technologies have been evaluated to address the concern with rail/wheel squeal noise.

Because many issues are site-specific (often identified by complaints by the public), a majority of the transit operators prefer wayside systems as the most practical and cost-effective solution for their situation. Of the wayside TOR systems, many manufacturers offer two basic delivery/transfer design concepts:

- modified wiper bars, and;
- holes drilled in the rail.

The materials differ in their approaches to lubricant dispersion, lubricant application and the lubricant characteristics required for optimum effectiveness.

Since most installed systems are integrated in the road and since in most cases girder rail is used, holes drilled in the rail is the only viable solution, allowing lubricants to be applied directly to the railhead.

Wayside application equipment uses a variety of systems to power and deliver friction control materials to the desired position on the track, including mechanical, hydraulic and electric systems.

Traditionally, pumps and lubricant/friction modifier reservoirs are housed in the same unit to facilitate adjustment and repair and to limit exposure of components between the reservoir and pump. Pumps can be activated mechanically, hydraulically or electrically. Mechanical and hydraulic activation require direct contact between passing wheels and an actuator; therefore, they tent to require more frequent inspection and repair. Mechanical methods also offer less adjustment for output rates and are more susceptible to changes in material viscosity due to temperature variations. For new installations, and for upgrading existing location, electric pumps offer a wider range of output control and are more uniform in output rate. However, they also require a power source (commercial AC power of battery/solar), a separate actuating sensor, and more sophisticated training for component repair.

Because the TOR application requires a very accurate amount of friction control material, the only acceptable method for depositing the material is using electrically operated pumps in place of mechanically operated pumps.

Once the lubricant or friction modifier has been pumped, it must be delivered to the proper location. The reason for recent interest in TOR lubrication is that conventional gage face units do not control TOR migration with sufficient accuracy. If a system deliberately applies materials on top of the rail, the resulting pattern can be optimised to provide the required amount of material at the needed location.

Wayside TOR application devices must be located on track with no cross level (i.e., with zero superelevation) in order to be effective and reduce material waste. As the material is pumped to the TOR area for pickup by passing wheel treads, any superelevation will result in material running off the railhead before being picked up by passing wheels.

Drilled holes can be engineered to apply a material to an exact location on the railhead. For custom applications, the hole can be aligned to different locations. Figure 1.1 shows a typical drilled-hole arrangement on the embedded track of a transit system. The drawback of this option is that the hole cannot be easily relocated if the system needs to be moved, and changing the rail will require a new or replacement hole to be drilled.

A significant advantage of the drilled-hole concept is that it can be used in embedded track because it produces little or no spillage or waste. Attachment A includes a full report on a demonstration of the drilled-hole concept in reducing noise and friction/

The application shown in figure 1.1 is limited to the one hole on each rail at the site of application. The application is intended to provide a material to protect one or two curves. Thus, the amount applied and distance covered are limited.

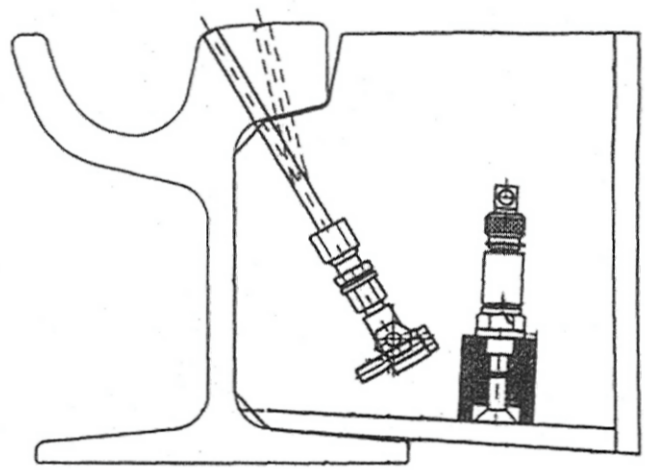

Figure 1.1

2 FRICTION CONTROL MATERIALS

Materials for controlling friction are categorised as either lubricants or friction modifiers.

Lubricants decrease the friction levels, while friction modifiers can increase or decrease friction and will maintain a predetermined friction level based on design characteristics. Figure 2.1 shows the friction control characteristics of lubricants and a generic friction modifier.

A friction modifier is a material designed to change and control the coefficient of friction and behaviour at the wheel/rail interface when applied to the TOR or wheel tread. This material is available in a form that allows it to be delivered to the TOR in much the same way as a TOR lubricant system delivers grease to the TOR. A grease lubricant will usually provide low friction levels, which may have disadvantages in terms of braking and traction. Although some operators have used lubricants in TOR applications, any excessive application can lead to traction control problems.

Friction modifier characteristics can reduce stick-slip and the resulting squeal while maintaining enough positive friction for normal braking and traction operations. Typically, target friction levels of 0.3 to 0.35 µ on top of the rail will provide a reduction in noise yet will not interfere with train handling. Excessive amounts of friction control material, however (as shown on the right side of figure 2.1), can produce less-than-desirable friction levels and may allow wheel slip.

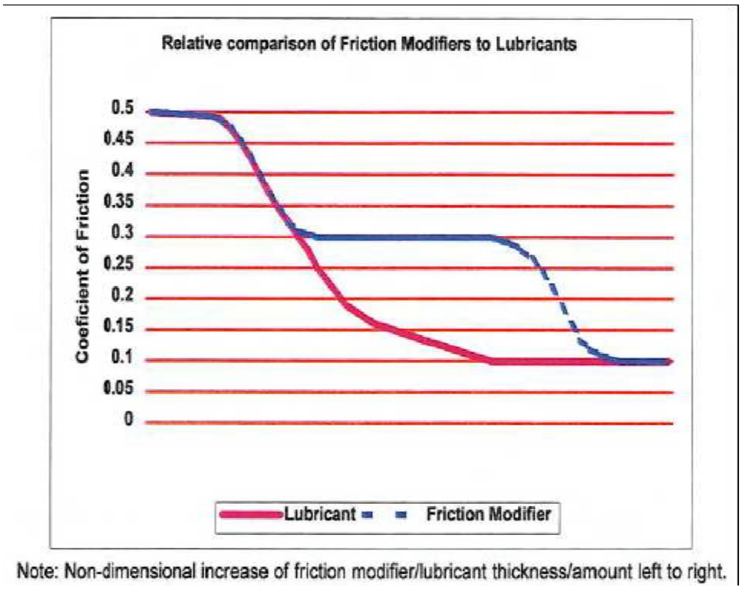

Figure 2.1 Conceptual performance of a lubricant and a friction modifier

3 PROTOTYPE SYSTEMS AT STIB

A full size prototype lubrication system, handling four curves in a turnout complex at the exit/entrance of the STIB tram depot at avenue de l'Hippodrome has been installed: see figures 3.1 to 3.4.

Figure 3.5 to 3.7 show details of the lubrication application system.

Figure 3.8 shows the external lubricant housing and the pump unit, integrated in the pavement.

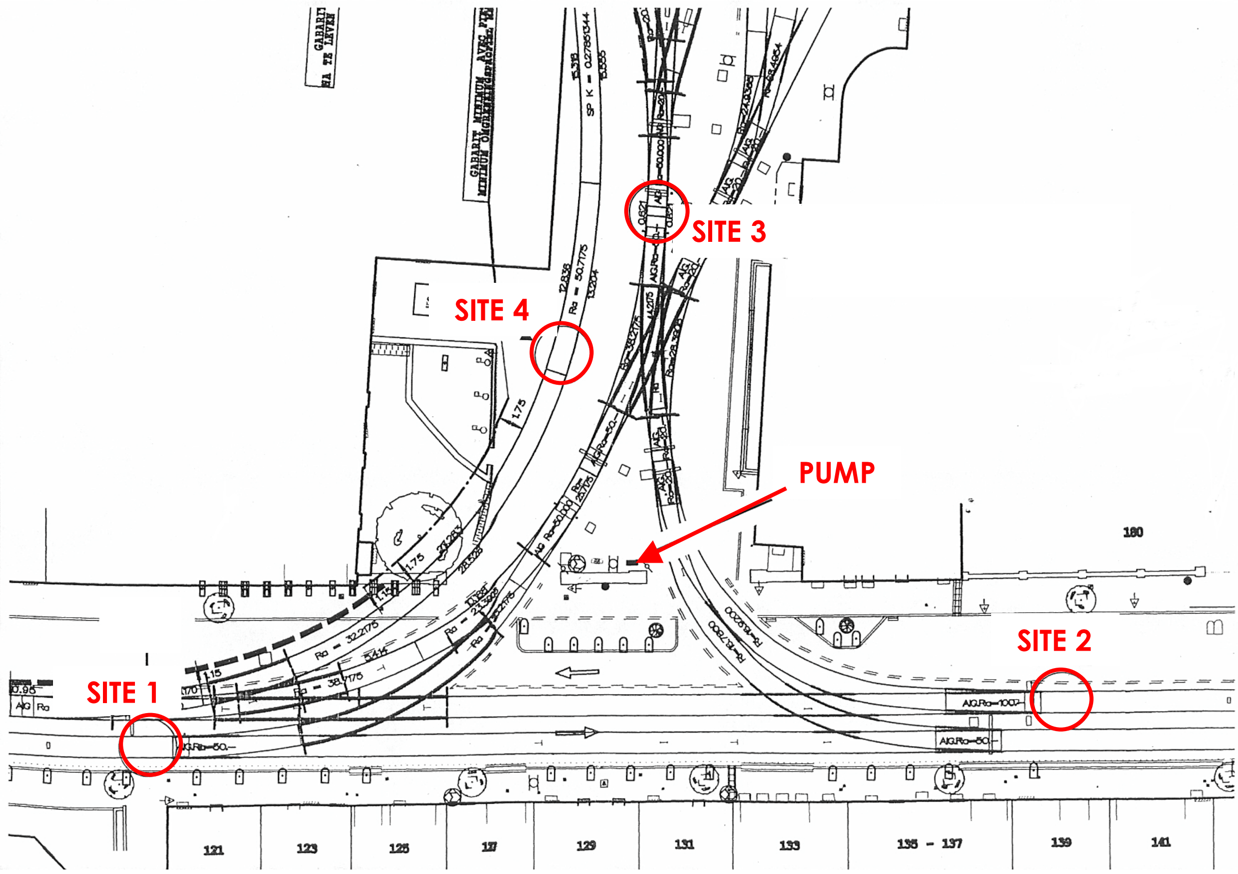

Figure 3.1

Figure 3.2 General view

Figure 3.3 Site 1

Figure 3.4 Site 2

Figure 3.5

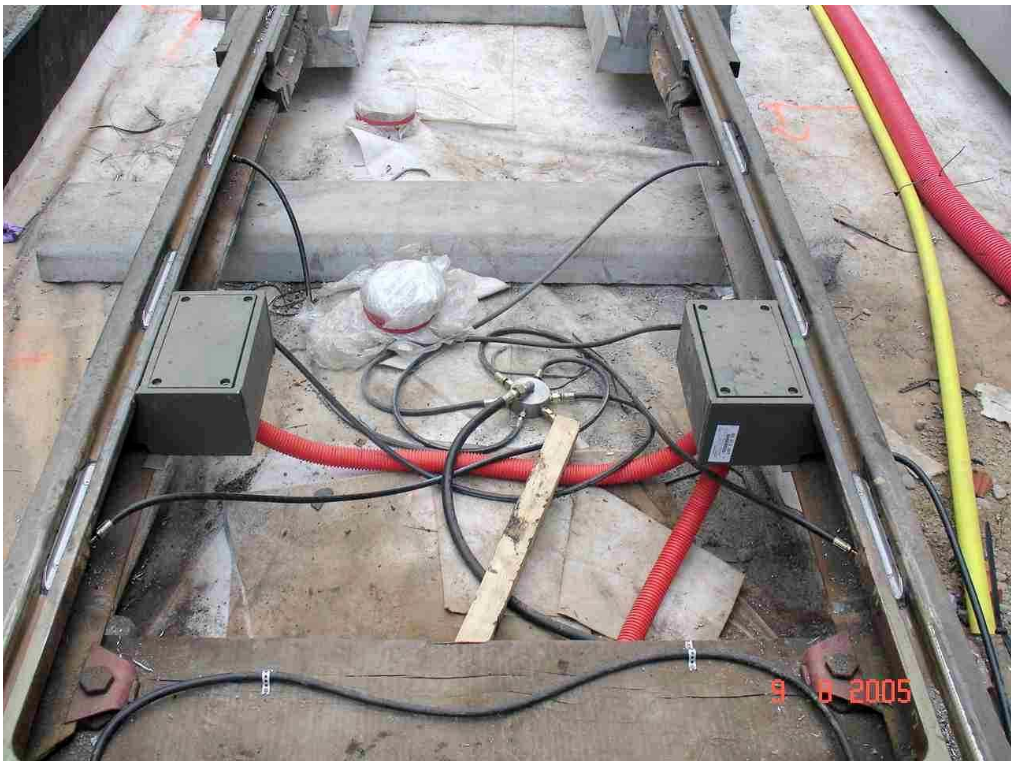

Figure 3.6

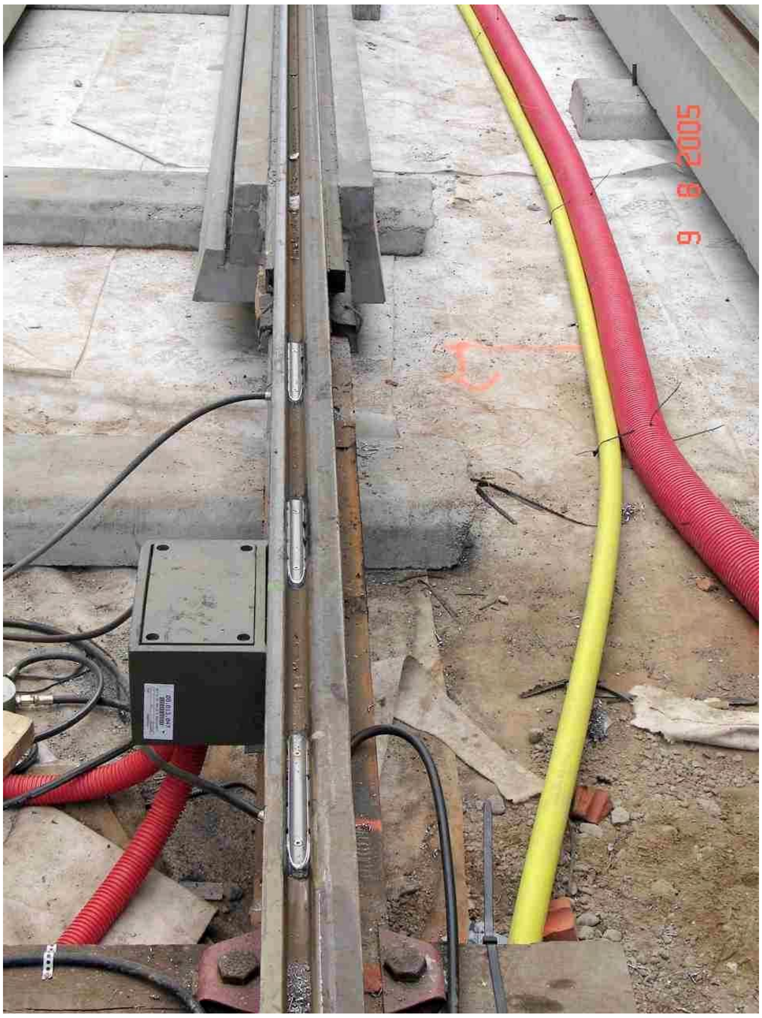

Figure 3.7

Figure 3.8

Main features of the system are:

1. use of electric application pump – 200 bar;
2. possibility of manual control of applied lubrication volume;
3. pump unit is separated from lubricant reservoir, which is installed in a separated unit on the sidewalk for easy access;
4. lubricants have been chosen instead of friction modifiers. The experience with friction modifiers in other networks (e.g. Madrid) was not successful up to now. The principle is to use lubricants of special types whereby only a very limited amount of lubricant is required (in order not to contaminate the road and the environment).
5. the lubricant is applied through a hole in the groove of the rail. The idea is to try to combine top of rail friction control with gage face lubrication: see figure 3.9.

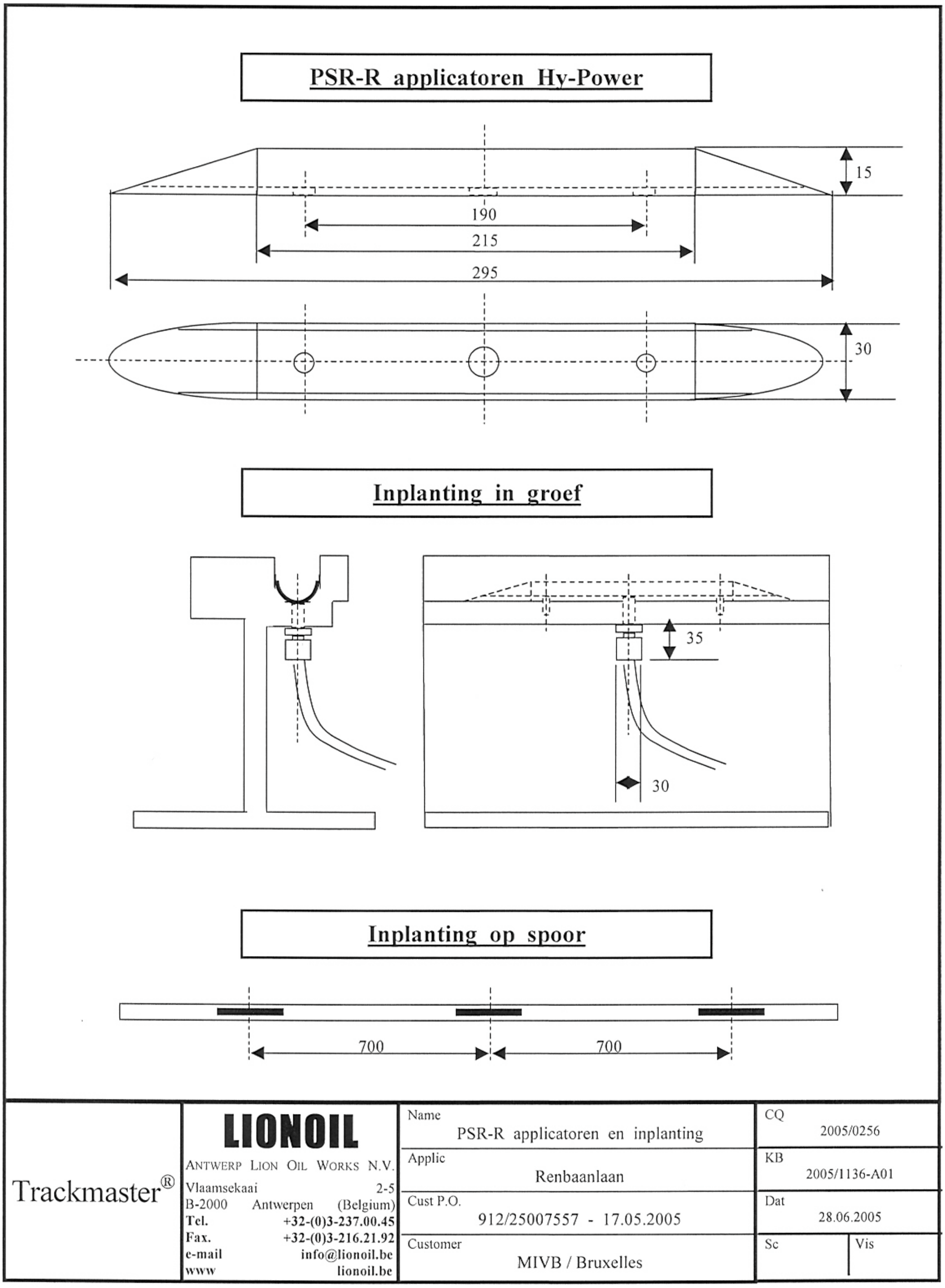
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Figure 3.9

4 FOLLOW-UP

The performance of the system and follow-up including tests with amounts and types of lubricants will be part of SP5 (WP5.3). Squeal noise will be evaluated.