

**ASSESSMENT VMS RP-2000  
OF  
ROTAPANEL INTERNATIONAL B.V.  
according to the standard EN 12966**

Final Report

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## MANAGEMENT SUMMARY

This report describes the assessment of the Prismatic Variable Message Sign (PVMS), type RP-2000 Traffic of RotaPanel International B.V as a “semi-manufactured” product. The assessment covers the major parts of the European standard EN 12966 issues directly related to this semi-manufactured product and can be used by all RotaPanel clients as a firm basis to complete the mandatory EC certificate of conformity for their custom-made end products.

### Commission

RotaPanel commissioned INTRON B.V. and INTRON Certificatie BV to arrange all necessary steps and assessments to grant a partial certificate based on EN 12966 for their product. The work of INTRON covered three main steps:

1. Initial type testing of the test module.
2. Assessment of delivered historical testing data and information by Rotapanel
3. Factory Production control.

In this report the results, findings of this full assessment are described. Additional to that a recommendation is given how the clients of RotaPanel should proceed to complete the requirements of the EN 12966 for granting a CE certificate on their finished products.

### Subject of the assessment

Subject of the assessment was a test module of the VMS, type RP-2000 Traffic, which is, according to RotaPanel, a representative module of the real size VMS produced by their clients. The test module was coded: type nr. V6 / 620 / 1, serial nr. 4452 and production date: 07-06-2007. INTRON tested the model RP-2000 also in 2004 and the former model R2000 in 1999. Relevant clauses from the reports of the tests in 2004 and 1999 are enclosed in this report.



Test module RP-2000 Traffic

Tests were conducted according to the European standard EN 12966-1 and GRL (“Goedkeuringsrichtlijn rotatiewegwijzers”; an approval guideline of the ANWB). The GRL guideline is mainly based on functional requirements. Specific Dutch design issues are therefore not taken into consideration in the assessment.



## Results

Table 1 presents the test results and the findings relevant to the EN 12966-1.

Table 1. Tests/findings of the RP-2000 Traffic in compliance with EN 12966-1 or GRL

Type test	Test+classes	Result <sup>1)</sup>
• Visual assessment	• Visual aspects	+ <sup>3)</sup>
• Functional mechanical tests/assessment	• Vibration resistance	+
	• Impact resistance	+
	• Structural Performance Standard housing (2,0m x 2,0m)	
	○ Wind Load WL7	+ <sup>6)</sup>
	○ Point Load PL4	+ <sup>6)</sup>
	○ Snow Load DSL0	+ <sup>6)</sup>
	○ Bending TDB1	+ <sup>6)</sup>
	○ Torsion TDT0	+ <sup>6)</sup>
	• Lift assessment	+ <sup>5)</sup>
	• Duration test	+ <sup>3)</sup>
• Functional physical tests	• Water penetration test P2 ( IPx5)	+ <sup>2)</sup>
	• Dust penetration P2 ( IP5x)	+
	• Damp Heat	+
	• Change of Temperature	
	○ T1	+
	○ T2	+
	○ T3	+
• Environmental tests	• Corrosion/Salt spray test	+
	• Weatherability test	+ <sup>4)</sup>
	• Sulphur dioxide resistance test	+ <sup>4)</sup>
	• Condensation ability test	+ <sup>4)</sup>
• Material tests	• Adhesion test	+ <sup>4)</sup>
	• Fastening of colour test	+ <sup>4)</sup>
	• Corrosion, staining etc. test	+ <sup>4)</sup>
	• Composition of metal parts analysis	+ <sup>3)</sup>
• Electrical tests	• Electrical tests	+ <sup>6)</sup>
	• Electromagnetic compatibility	+ <sup>6)</sup>
	• Current of wiring test	+ <sup>4)</sup>

1) + = comply with the EN 12966 for this aspect; - = does not comply with the 12966 for this aspect;

2) Water does not access vital parts of the VMS, such as the motor or rotating parts;

3) Tests conducted in 2004 on the model RP-2000.

4) Tests conducted on the former model R2000.

5) RotaPanel VMS is self-bearing up to 2,0m x 2,0m. A separate construction is needed for larger designs.

6) Declared by client Rotapanel with relevant data.

Remarks. *Hollandse Signaalapparaten B.V. tested the RP-2000 module with respect to EMC requirements in 2007 (report 950102551 etr-001, d.d. 22-07-2007). The conclusion is that the control apparatus of the RP2000 series meets the requirements of the standards EN 55082-2 and Generic Emission Standard EN 55081-1, EB 55081-2 and standard EN12966 table 11 and 12.*

The conclusion of the tests conducted by INTRON in 2007 and evaluation of earlier test results is that the PVMS RP-2000 Traffic is in compliance with the mechanical and physical requirements of EN 12966-1 as for the classes given in table 1.

The conclusion of the tests conducted by INTRON in 2004 is that the RotaPanel PVMS, type RP2000, comply with the assessed functional requirements of the GRL. The modified model is improved significantly compared to the model R2000.

INTRON remarks that the tests of the components such as coatings and rubbers were not a part of the research in 2007. The metal parts however are tested in 2004 in order to check for corrosion resistance.

From the factory production control assessment we conclude that the quality system of RotaPanel complies with the standard EN 12966-3 for the semi-manufactured product that RotaPanel delivers to their customers.

The clients of RotaPanel have to complete the Initial Type Testing and the Factory Production Control for their part on the following items:

- ❖ All optical test data (before and after durability testing) regarding the retro reflective materials must be available and evaluated by an independent test institute that fulfils the criteria of the Notified Body (INTRON Certificatie);
- ❖ The quality system must comply with ISO 9001: 2000 and be product specific tot the standard;
- ❖ The testing and evaluation as part of the FPC according to the EN 12966-3 must be fulfilled for "Resistance to horizontal loads", "Impact resistance" and "Water Ingress".



## 1. SCOPE

### Background

RotaPanel produces continuous Prismatic Variable Message Signs (PVMS), type RP-2000 Traffic, according to EN 12966, based on rotating triangular prisms. Without exception all RotaPanel products are supplied to parties who consider this as a semi-manufactured article and produce custom-made end products which are installed above and next to roads.

In a formal sense this means that RotaPanel does not need the mandatory certificate of conformity based on EN 12966. However, all clients of RotaPanel who put these products on the EU market must have such a certificate.

### Goal

The main goal of RotaPanel is grant a partial certificate based on EN 12966 for their products by INTRON Certificatie BV a notified body in this field. This certificate shall cover the major parts of EN 12966 issues directly related to the RotaPanel semi-manufactured product.

This certificate can be used by all RotaPanel clients as a firm basis for granting the mandatory EC certificate of conformity to EN 12966.

### Commission

RotaPanel commissioned INTRON B.V. and INTRON Certificatie B.V. to arrange all necessary steps and assessments to achieve this goal. The work of INTRON covered three main steps:

1. Initial type testing of test module.
2. Assessment of delivered historical testing data and information by RotaPanel
3. Factory Production control.

In this report the results, findings of this full assessment are described. Additional to that a recommendation is given how the clients of RotaPanel should proceed to complete the requirements of the EN 12966 for granting a CE certificate on their end products.

## 2. OBJECTIVE

The objective of the work carried out by INTRON was to assess whether:

- ❖ The Rotapanel initial type is in compliance with all mechanical and physical requirements of annex ZA-1 of EN 12966-1.
- ❖ It can be expected that Rotapanel products will last for a period of minimum 10 years with respect to the non exchangeable parts.
- ❖ The Rotapanel Factory Production Control is in compliance with all technical requirements as given in general in EN 12966-3.



### **3. TEST MODULE**

Tested was a test module of the VMS, type RP-2000 Traffic, which is, according to RotaPanel, a representative module of the real size VMS produced by their clients. The test module was delivered June 2007 and coded:

- type nr.: V6/ 620 / 1
- serie nr: : 4452
- fabrication date: : 07-06-2007
- 230 V, 50 Hz. 25 W

INTRON tested another VMS, type RP-2000 in 2004, INTRON used the former tests results reported in the report R20040182 where relevant. RotaPanel declared not to have changed the choice of materials in between.

With respect to the former model R2000, INTRON used the test results reported in the report R990261 to assess the new model, where relevant.

### **4. ACTIVITIES**

#### **4.1 Initial type testing (ITT) and historical data**

INTRON conducted in 2007 all necessary tests on a test module. The results of this assessment are laid down in the INTRON report: R20070190/MHu, 27 June 2007, "Mechanical and environmental examination of Rotapanel test module, according to EN 12966". INTRON tested the model RP-2000 also in 2004 and the former model R2000 in 1999. Relevant clauses from the reports of the tests in 2004 and 1999 are enclosed in this report.



**The following tests/assessments were conducted in 2007 on the VMS type RP-2000 Traffic.**

1. Overall visual inspection

The VMS RP-2000 Traffic is visually inspected on several quality aspects, according to the ANWB approval guidelines:

- risk for galvanic corrosion (combination of materials)
- performance of fixations / fastenings
- performance of tightness of joints
- performance of ventilation possibilities
- accessibility
- presence of lifting possibilities and fixations with respect to lifting
- assembly of rotating parts (so called prisms)
- presence of codes
- accessibility of the electrical parts; the motor and its wiring
- performance welded parts
- damage of coated parts
- sunk mounting of connector parts
- assembly of rubber parts, and other particulars.

2. Impact test.

The VMS RP-2000 Traffic is tested by an impact test according to EN 12966-1 (EN 60598-1). The test module has been tested for impact resistance on ten different locations (five locations at +20°C and five locations at -5°C) on the housing of the test module by dropping a steel ball  $\varnothing$  50 mm with a mass of 0,51 kg from a height of 1.300 mm. The test has been carried out at two different temperatures (+20°C and -5°C).

After the test the test module front panel or parts of it shall show no damage and the test module shall continue to meet all the requirements of the standard.

3. Vibration test.

The VMS RP-2000 Traffic is tested by a vibration test according to EN 12966-1 (EN 60068-2-64). The test module is tested in three directions for 90 minutes. The frequency range will be 10 Hz to 200Hz. The ASD (Acceleration Spectrum Density) levels will be: 0,02 g<sup>2</sup>/Hz (10 Hz to 50 Hz), 0,02 g<sup>2</sup>/Hz (50Hz to 200 Hz with slope 3dB/octave) and overall RMS acceleration 1,5 g.

After the test a visual inspection and function test is being performed. The requirements that must be fulfilled, are:

- the functionality of the rotating system may not be influenced negatively;
- the fixings may not be loosened;
- no other damage may occur.





4. Corrosion test.

The VMS RP-2000 Traffic is tested by a salt spray test according to EN 12966-1 (prEN ISO 9227). The entire test module is exposed to a neutral salt spray for 240 hours. The operating conditions will be 35°C +/- 2°C.

After the test a visual inspection and function test is being performed. The function test should be positive.

5. Water penetration test/ability against water ingress.

The VMS RP-2000 Traffic is tested by a water penetration test according to EN 12966-1 (EN 60529).

The equipment shall be hosed according to class IPx5 with  $\Phi_v = 12,5$  l/min on all faces and at all angles, from vertically down to horizontal concentrating on points to be "most likely" to result in water ingress. The equipment shall be switched on and function test shall be continuously repeated throughout the test.

The performance of the joints and air inlets (ventilation) must comply with IPx5 for the parts with mechanical and electrical parts (rotating system and motor / wiring). This means no water ingress is allowed over there. Other parts of the housing may contain water, but this must be let out properly (2 litres per minute).

6. Dust penetration test.

The VMS RP-2000 Traffic is tested by a dust penetration test according to EN 12966-1 (EN 60529).

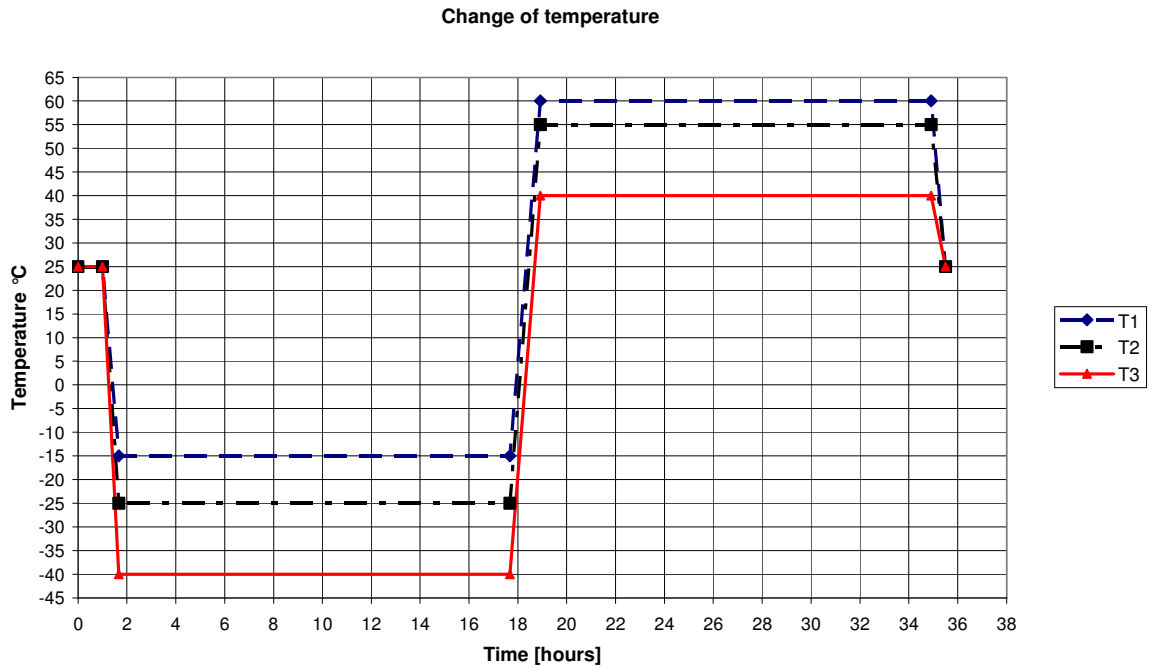
The test module is placed according to class IP5x inside a dust chamber for 8 hours. The equipment shall be switched OFF

After the test a visual inspection and function test is being performed. No dust is allowed to enter the enclosures of the test module. Dust may not lead to malfunction of rotating parts (prisms).



7. Change of temperature.

The VMS RP-2000 Traffic is tested by a change of temperature test according to EN 12966-1 (IEC 60068-2-14, test Nb).



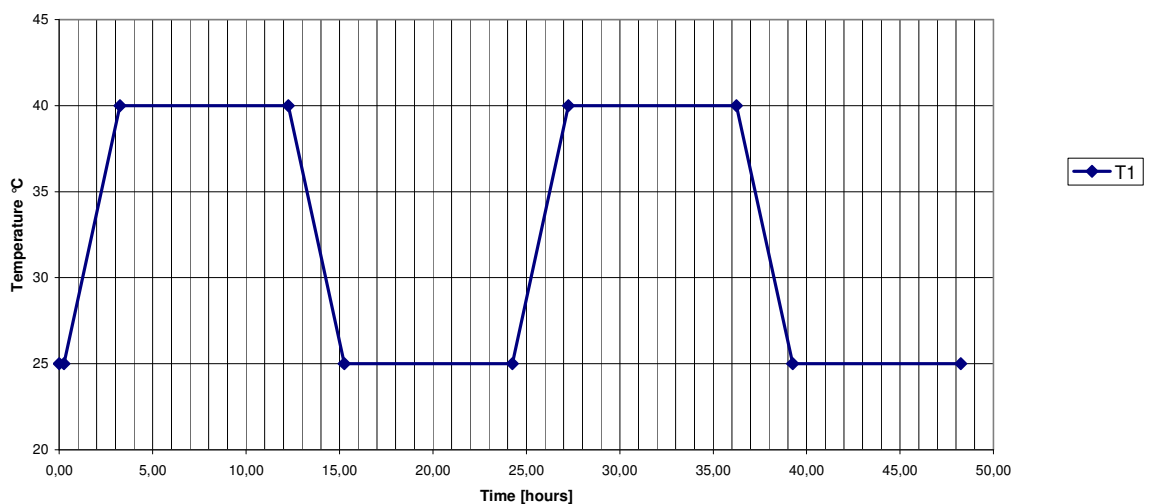
A change of temperature test is intended to determine the effect on the specimen of a change of temperature or a succession of changes of temperature. This test determines the ability of components, equipment or other articles to withstand rapid changes of ambient temperature. The classes to which the test module is being tested are: T1 (-15°C / +60°C), T2 (-25°C / +55°C), T3 (-40°C / +40°C)



8. Damp heat cycling.

The VMS RP-2000 Traffic is tested by a damp heat cycle test according to EN 12966-1 (IEC 60068-2-30, Method Db).

**Damp heat cycling**



The damp heat test is used to determine the suitability of components, equipment or other articles for use and storage under conditions of high humidity when combined with cyclic temperature changes and, in general, producing condensation on the surface of the specimen.

This test comprises two temperature cycles in which the relative humidity is maintained at a high level. The test severity is determined by the upper temperature of the cycle (in this case +60°C) and the number of cycles (in this case 2 cycles).

9. Structural performance

A structural calculation has to be made on a so called "standard" housing (2000mm x 2000mm) according to EN 12966-1 and EN12899-1. After evaluation these calculations should demonstrate that a "standard" Rotapanel housing complies with the requirements and classes as given in EN 12899 as follows:

Loads:

Wind load WL 7  
Point Load PL 4  
Snow load DSL 0

Deflection:

Bending TDB 1  
Torsion TDT 0

10. Electrical safety and electromagnetic compatibility

For granting a CE certificate of conformity with EN 12966-1 it is not obliged to assess matters of electrical safety and electromagnetic compatibility. This because these issues are not mentioned in the mandatory part: annex ZA of EN 12966-1. However, INTRON checked the Rotapanel approach towards the requirements for these issues as drawn up in the non mandatory part of EN 12966.

**The following tests were conducted in 2004 on the VMS type RP-2000.**

11. Durability of the rotating apparatus / duration tests

The functionality of the rotating system is tested during 3000 revolutions at a temperature of 20°C.

The requirements that must be fulfilled, according to the ANWB guidelines, are:

- no significant warming up of the rotation motor or related parts
- no changes of the revolution time
- no change of the time needed to start a revolution
- no other particulars

12. Lifting possibilities

The Trivision VMS test module has been assessed with respect to lifting, according to the information given by RotaPanel and the test module. No permanent deformations are allowed.

13. Material tests

Several metal parts are analysed (material composition) using SEM/EDXA (electron microscopy). Materials must comply with stainless steel AISI 304 / 316 and AlMg3. From a functional point of view the materials must consist out of a durable and stainless metal.



**The following tests were performed in 1999 on the former type R2000.**

14. Static wind load test

Basically a static wind load was simulated by loading the front (prisms) of the VMS with sand bags of 150 kg/m<sup>2</sup>. Afterwards, the functionality of the rotating system and the water penetration resistance of the housing were checked.

15. Frost/thaw-temperature/humidity resistance test

This test was conducted to check whether the rotating system of the VMS is able to perform in extreme outdoor conditions. This test is more extreme than the current CIE EIC tests. The VSM was exposed to the following climate cycle for 5 times:

- water spray during 5 minutes;
- check for water penetration and functionality;
- cooling of the wet VMS at an ambient temperature of -12°C during 23 hours; spraying of water during 10 minutes every 6 hours (ice forming on the rotating system);
- check for functionality;
- thawing of the VMS during 55 minutes at a temperature of 23°C;
- water spray during 5 minutes;
- check for water penetration and functionality;
- heating of the VSM at an ambient temperature of 40°C, a relative humidity of 90% and a black-panel surface temperature of 70°C;
- check for functionality.

16. Environmental and material tests

Several accelerated tests were performed on components of the PVSM (such as coatings, rubbers and retroreflecting materials) in order to check for its resistance towards weathering, colouring, staining, corrosion etc. Use is made of international standards such as ASTM B117, SS DIN 50 021, KFW DIN 50 017, DIN 50 014, ISO 1431-1, ISO 4892, EN-ISO 6270 and ISO 3231.

Material tests afterwards checked for adhesion, layer thickness, gloss, tensile strength etc. Use is made of international standards ISO 37, ISO 2813, DIN 67230, ISO 105-A, ASTM D1654, ISO 4628 and the Dutch standard NEN 5335.

17. Electrical tests

The specified current of the wiring was checked at a minimum of 100V.



Table 2. Tests and assessments performed on test module and components as delivered by RotaPanel international (in 1999, 2004 and 2007)

Type test	Test	Standard	References made to standard
• Visual assessment	• Visual aspects	GRL (5)	
• Functional mechanical tests/assessment	• Vibration resistance	EN 12966-1 (8.3.5)	EN 60068-2-64
	• Impact resistance	EN 12966-1 (8.3.4)	EN 60598-1
	• Structural Performance Standard housing (2,0m x 2,0m):		
	○ Wind Load WL7	EN 12966-1 (8.3.2.1)	EN 12899-1
	○ Point Load PL4	EN 12966-1 (8.3.2.1)	EN 12899-1
	○ Snow Load DSL0	EN 12966-1 (8.3.2.1)	EN 12899-1
	○ Bending TDB1	EN 12966-1 (8.3.2.2)	EN 12899-1
	○ Torsion TDT0	EN 12966-1 (8.3.2.2)	EN 12899-1
	• Lift assessment	GRL (6.1.4)	
	• Duration test	GRL (6.1.1)	
• Functional physical tests	• Water penetration test IPx5	EN 12966-1 (8.2.4)	EN 60529
	• Dust penetration IP5x	EN 12966-1 (8.2.4)	EN 60529
	• Damp Heat	EN 12966-1 (8.2.1)	EN 60068-2-30
	• Change of Temperature		
	○ T1	EN 12966-1 (8.2.1)	IEC 60068-2-14
	○ T2	EN 12966-1 (8.2.1)	IEC 60068-2-14
	○ T3	EN 12966-1 (8.2.1)	IEC 60068-2-14
• Environmental tests	• Corrosion/Salt spray test	EN 12966-1 (8.2.3)	prEN ISO 9227
	• Weatherability test	GRL (6.2.1/2)	
	• Sulphur dioxide resistance test	GRL (6.2.1/2)	
	• Condensation ability test	GRL (6.2.1/2)	
• Material tests	• Adhesion test	GRL (6.2.1/2)	
	• Fastening of colour test	GRL (6.2.1/2)	
	• Corrosion, staining etc. test	GRL (6.2.1/2)	
	• Impact and scratch resistance test	GRL (6.2.2)	
	• Composition of metal parts analysis	GRL (5.3.2)	
• Electrical tests	• Electrical tests	EN 12966-1 (8.4.1)	
	• Electromagnetic compatibility	EN 12966-1 (8.5)	
	• Current of wiring test	GRL (6.1.6)	

## 4.2 Factory Production Control (FPC)

INTRON will assess the Rotapanel Factory Production Control by following the guidelines as presented in:

- EN 12966-3 Vertical Road Signs-Part 3: Factory Production Control.
- Guidance paper B (concerning the Construction Products Directive 89/106/EC, The definition of factory production control in technical specifications for construction products).
- Guidance from the group of Notified bodies for the Construction Products Directive 89/106/EC.
- Checklist for initial inspection of factory and factory production control and continuous surveillance of factory production control, NB-CPD/AG/03/004.

The following stepwise list (paragraph 4.2 of EN 12966-3) is used as a baseline for this assessment:

- a) specification and verification of raw materials and relevant components;
- b) controls and tests to be carried out during manufacture;
- c) verifications and tests carried out on finished products in accordance with the test regime specified in table 1- Minimum frequency of testing for product testing and evaluation as part of FPC;
- d) control of the necessary installations, equipment and trained personnel to execute the tests on the raw materials and components if necessary;
- e) operation maintenance and calibration of appropriate test and manufacturing equipment by qualified personnel;

## 5. RESULTS OF THE ASSESSMENT

The results of the assessment are presented in this chapter. INTRON assessed on functional aspects only. All other aspects (not functional) are mentioned without an assessment. With respect to the model RP-2000 Traffic and the former model R2000, a clear mark is made, where relevant.

### 5.1. Visual assessment

#### 5.1.1. Functional aspects

The following particulars are present with respect to functional aspects:

- It is important that the wiring of the motor is installed properly in order to prevent damage due to the use of the service panel. The model delivered in August 2004 shows the correct installation;
- It is not possible to lock the service panels of the test module temporary.
- Some sharp edges are present in the housing parts that may harm the wiring during service life. *This is further tested performing a vibration test.*
- The bolts are all made out of stainless steel, AISI304/A2 according to the subscript on the bolts. The supporting frame (housing) is made out of aluminium. The rotating system is made out of polymer materials, aluminium, stainless steel parts. *The metal parts are all further analysed.*
- Visually assessed, the construction will not be watertight. *The functionality of the system is further tested performing a water penetration test.*



## 5.1.2. Other particulars

According to the Dutch guidelines, the following aspects need to be considered:

- The test module differs slightly from the construction drawings. The drawings cover RP-2000 signs in general and not a test module specifically.
- The Rotapanel product which is subject of this assessment/certification is fully described and identified in the following Rotapanel document: *“Manual RP-2000 Traffic, version 3.2, Product Rotapanel 2000, 1-6-2006”*.

A full list with component specifications according to the drawings was handed over to INTRON.

- The rotation time, from the switch on the service panel to the moment that the last prism has stopped to rotate, takes app. 10.5s. The time for the prisms itself to rotate, from the point of view of a road user is app. 3.5s.
- The partition between the prisms varies from 4.5 to 5.4mm;
- The flatness of the prisms is 2.6mm;

These aspects are not further being investigated nor assessed.

## 5.2. Functional mechanical tests/assessment

### 5.2.1. Vibration test

Tests performed in 2007 on the model RP-2000 Traffic passed the function test but showed particulars concerning the visual inspection.

Remarks with respect to the visual assessment are disposed due to the result of the function test and the corrective action taken by Rotapanel regarding the fixation of screws.

On these aspects, the results comply with the requirements of the EN 12966 (IEC 60068-2-64).

### 5.2.2. Impact resistance test

Tests performed in 2007 on the model RP-2000 Traffic showed no particulars.

The model passed the visual inspection as well as the function test.

On these aspects, the results comply with the requirements of the EN 12966 (EN 60598-1).

### 5.2.3. Structural performance assessment

From the report on the structural calculations (“\Cristal\DOCUMENTATIE\Werkinstructies\EN-12966\Rapport-Cert\Roos\LoadDeflections1\RP-NEN-NE-12899.doc, Mr. R. de Roos, 29-02-2008) as delivered by Rotapanel, INTRON concludes that a structural calculation has been made on a so called “standard” housing (2000mm x 2000mm) according to EN 12966-1 and EN12899-1.

After evaluation we conclude that this calculations do demonstrate that a “standard” Rotapanel housing complies with the requirements and classes chosen by the client as given in EN 12899.





#### **5.2.4. Lift assessment**

No specific lifting device is present at the test module. RotaPanel explains the mounting of the RP-2000 Traffic to a steel structure by construction drawings (in the manual). The test module itself is self-supporting and it is possible to lift the module without deformations using lift belts.

On this aspect, according to INTRON, the test module complies with the requirements of the GRL.

#### **5.2.5. Functional duration test**

Before and after the duration test, no particulars were found. No difference with respect to the wave-effect occurred. The revolution time was the same during all the tests. After 3000 revolutions, no damage occurred whatsoever. During the test, the motor temperature was about 32°C at an ambient temperature of 26°C which is significantly lower than during former tests.

On these aspects, the results comply with the requirements of the GRL.

### **5.3. Functional physical tests**

#### **5.3.1. Water penetration test**

Several joints and fixings of the construction let in a minimum amount of water in the construction. Water flows into the housing parts with mechanical and electrical components. Therefore, the motor is sealed watertight and the wiring is protected additionally. Besides, several holes in the construction let out the water. These holes make ventilation throughout the construction possible.

The functionality of the electrical and mechanical parts of the VMS was not influenced negatively during the tests. The water outlets of the construction do function.

According to INTRON the test module does comply with the requirements of the EN 12966 (EN 60529) class IPx5.

#### **5.3.2. Dust penetration test**

In a visual assessment a minimum amount of dust was located that has penetrated into the bottom of the test module through the dewatering holes.

The functionality of the electrical and mechanical parts of the VMS was not influenced negatively during the test.

According to INTRON the test module does comply with the requirements of the EN 12966 (EN 60529) class IP5x.



### **5.3.3. Damp heat test**

In visual assessments during and after the damp heat test no particulars were found.

The function test was continuously repeated during first 3 h of each cycle; during last hour of each cycle at 40 °C; and during the final cool down period of the last cycle. The functionality of the electrical and mechanical parts of the VMS was not influenced negatively during the test.

According to INTRON the test module does comply with the requirements of the EN 12966 (EN 60068-2-30, Method Db).

### **5.3.4. Change of temperature tests**

In visual assessments during and after the temperature tests no particulars were found.

The switch on and the function test was continuously repeated during the warm up from ambient temperature; during the last hour at the upper temperature; during the cool down period; and minimum one hour after reaching laboratory ambient temperature. The functionality of the electrical and mechanical parts of the VMS was not influenced negatively during the tests.

According to INTRON the test module does comply with the requirements of the EN 12966 (EN 60068-2-14, Test Nb) classes T1, T2 and T3.



## **5.4. Environmental tests / chemical resistance**

These tests give insight in the resistance of the components of the VMS RP-2000 Traffic to several chemical loads, such as salt spray, sulphur dioxide and water condensation. After performing the tests several properties are determined such as the coating adhesion, the impact and scratch resistance of the coatings. Tests were performed in 2007 on the model RP-2000 Traffic and in 1999 on parts of the former model R2000.

Besides the composition of the metal parts was analysed in order to check for corrosion resistant materials. The analysis was performed on the model RP-2000.

### **5.4.1. Corrosion/Salt spray test**

In a visual assessment several screw rings on the inside of the test module showed signs of corrosion, therefore in the future all metal fastening parts inclusive rings shall be checked on A2 quality.

The functionality of the electrical and mechanical parts of the VMS was not influenced negatively by the test.

According to INTRON the test module does comply with the requirements of the EN 12966 (prEN ISO 9227).

### **5.4.2. Resistance of components**

The components delivered and tested comply with the requirements of the GRL with respect to chemical resistance. Additional information can be found in INTRON report R990261.



### 5.4.3. Material assessment

The metal parts of the test module were taken from the test module and analysed. The results are given below.

Table 3. Metal parts analysis

specimen		percentage (%(m/m))						
Nr.	Mo	Cr	Ni	Al	Mn	Fe	Cu	Comply with
1	0,4	19	9					AISI304/A2
2	0,9	16	8					AISI304/A2
3	0,2	17	9					AISI304/A2
4	0,2	18	9					AISI304/A2
5	0,7	18	10					AISI304/A2
6	0,7	18	9					AISI304/A2
7	0,9	18	9					AISI304/A2
8	0,5	17	9					AISI304/A2
9	0,9	18	9					AISI304/A2
10	2,2	17	9					AISI316/A4
11	0,8	18	9					AISI304/A2
12	0,8	17	10					AISI304/A2
13	0,6	18	9					AISI304/A2
14	0,4	17	9					AISI304/A2
15	0,6	18	9					AISI304/A2
16	0,8	19	8					AISI304/A2
17	1,8 *	0,4	0,4	82	0,4	1,7	1	AI
18								Identified but not disclosed by Client

17 = part of the housing (filing samples)

18 = part of the rotating system (filing samples)

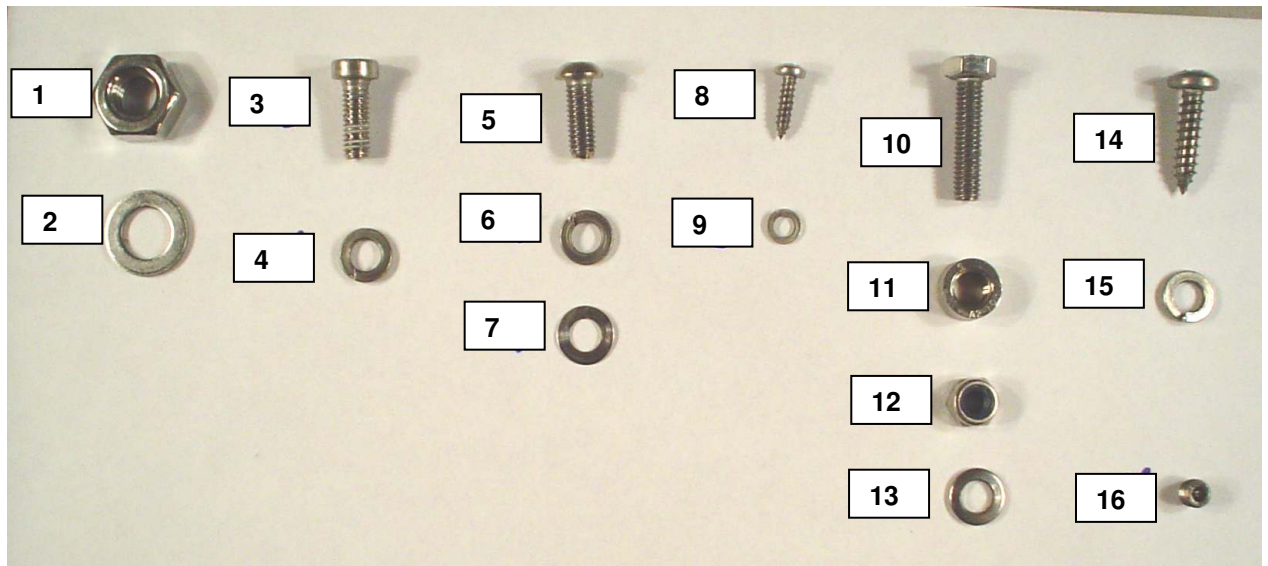


Figure 1. Tested metal parts

Table 4. Table tested components (see picture)

Specimen nr.	Tested part
1	Bolt M10, fixed upper housing frame
2	Nut, belongs to specimen 1
3	M6 bolt, fixed lower housing frame
4	Spring-ring M6, belongs to specimen 3
5	M6 bolt, fixed to prism lower housing frame
6	Spring-ring, belongs to specimen 5
7	nut, fixed to prism lower housing frame
8	bolt service panel
9	nut, belongs to specimen 8
10	M6 bolt, fixed lower housing frame
11	Belongs to specimen 10
12	Belongs to specimen 10
13	Belongs to specimen 10
14	Screw Ø5 mm, fixed to housing
15	Nut, belongs to specimen 15
16	Security lock bolt
17	Housing
18	Inner bearing component of the rotating system

With respect to the materials used, all fixings of the VMS, model RP-2000, fulfil the requirements with respect to stainless steel. The housing is made of corrosion resistant aluminium. The inner bearing component of the rotating system contains metals of construction steel with a high content of chrome, but no water penetration is expected in this area. Remarks with respect to the visual assessment are disposed due to this test result.



## 5.5. Electrical test/assessment

### 5.5.1. Electrical tests and Electromagnetic Compatibility assessment

Hollandse Signaalapparaten B.V. tested the RP-2000 and RP-2000 Profibus module with respect to EMC requirements in 2007 (report 9501025551 XX-EQR-001 REVISION 2.2, d.d. 22-07-2007). The conclusion is that the control apparatus of the RP2000 series meets the requirements of the Generic Immunity Standard EN 55082-2 and Generic Emission Standard EN 55081-1 and EN 55081-2 And also according to standards EN 12966 table 11 and 12.

After evaluation INTRON concluded that the ROTAPANEL declarations as presented in a report from Hollandse Signaal Apparaten B.V., report no. *950102551 etr-001, d.d. 12-07-2007* are based on sound and reliable data.

### 5.5.2. Current of wiring test

Tests were performed in 1999. The wiring complies with the requirements of the GRL.

## 5.6. Factory production Control

According to EN 12966-3: “a manufacturer who is having a FPC system which complies with EN ISO 9001:2000 and which is product specific to this standard” are deemed to satisfy the requirements of this standard (EN 12966-3 Vertical road signs—Part 3: Factory production control)”.  
Therefore the status of the FPC system is reviewed by INTRON. The results of this review are summarised in table 3.

Table 3. Results Factory Production Control

Assessed issue	Remarks	Result
ISO 9001 system as a basis for EN 12966-3	There is no valid ISO 9001 certificate but there is a Quality System which complies with ISO 9001 and is product specific to the standard EN 12966-3.	+
Conformity Initial types versus production types	INTRON observed that the production type does not differ from the approved initial types on the most essential parts	+
FPC requirements for product testing and evaluation: Table 1 EN 12966-3: minimum frequency of testing	Random check by INTRON during production, INTRON verified that: 1. electrical function/safety are conducted on all relevant product parts.	+
	2. resistance to horizontal loads is not determined on samples bigger than the standard housing 3. impact tests are not conducted 4. retroreflective/optical measurements are not conducted on products and initial on test modules. 5. water ingress is not conducted.	+*

\*) These tests/calculations must be done by clients of Rotapanel who make end products; guidelines are given by Rotapanel but should be completed for all EN 12966 issues as mentioned in this table.



## 6. CONCLUSIONS

### Mechanical and physical test

Form the results of the test as carried out by INTRON on a Rotapanel test module it can be concluded that Rotapanel continuous signs, based on rotating triangular prisms is in compliance with the mechanical and physical requirements of EN 12966-1 as for the classes given in table 4.

Table 4. Approved tests

Subject	Class
Impact resistance [EN 60598-1]	
Vibration resistance	
Resistance to corrosion [ISO 9227]	
IP-protection [EN 60529]: - Water Penetration - Dust Penetration	Class P2, IPx5, IP5x
Temperature Tests: - Damp Heat [IEC 60068-2-30] - Change of Temperature [IEC 60068-2-14]	T1 = [-15°C..+60°C]
	T2 = [-25°C..+55°C]
	T3 = [-40°C..+40°C]

### Structural calculations

For the structural performance we conclude that these do demonstrate that a “standard” Rotapanel housing (2mx2m) complies with the requirements and classes chosen by RotaPanel (Table 1 and 2) as given in EN 12899.

### Durability

Provided, Rotapanel does not change the design or choice of materials in between, all historical data on durability tests stay valid. This means that we conclude that we expect that Rotapanel products will last for a period of minimum 10 years with respect to the non exchangeable parts above and next to European roads in general.

### Electrical performance

We conclude that Rotapanel demonstrated that their prism signs comply with the non mandatory electrical safety and electromagnetic compatibility requirements of EN 12966-1



## **Factory Production control**

From the factory production control assessment we conclude that the quality system of RotaPanel complies with the standard EN 12966-3 for the semi-manufactured product that RotaPanel delivers to their customers.

The clients of RotaPanel have to complete the Initial Type Testing and the Factory Production Control for their part on the following items:

- ❖ All optical test data (before and after durability testing) regarding the retro reflective materials must be available and evaluated by an independent test institute that fulfils the criteria of the Notified Body (INTRON Certificatie);
- ❖ The quality system must comply with ISO 9001: 2000 and be product specific tot the standard;
- ❖ The testing and evaluation as part of the FPC according to the EN 12966-3 must be fulfilled for “Resistance to horizontal loads”, “Impact resistance” and “Water Ingress”.





## APPENDIX A CURRICULUM VITAE OF INTRON B.V.

### Section

Dynamic traffic management

### History

Already in the late eighties INTRON was asked by the Dutch Ministry of Transport, Public Works and Water Management to consult in the development of test programs for traffic signalizers. The result of this project is part of the general development of traffic signalizers for the Dutch highways. The development resulted in the first generation of Dutch traffic signalizers.



From that time INTRON tested, independently, over 800 single traffic signalizers on several mechanical and physical aspects, such as dust and water penetration, vibration resistance, wind resistance, thermal resistance, frost resistance, salt fog resistance, UV-resistance and others. Both initial test type tests and regular production control tests were performed.

Besides INTRON developed, in commission of several companies, new test protocols, advised with respect to production efficiency, material and product selection of coatings and metals. This resulted in modified products such as highway current cabinets, vertical traffic signs, traffic messengers, dynamic route information panels, tunnel signalizers and others. Not only for the Netherlands, but companies all over Europe have been consulted by INTRON already (Schott Benelux, Vialis, Brimos, Swarco Futurit, Stork, GTI, Peek Traffic, Fabricom, Zelisco, Dambach, Odeco, Ortana).



## References

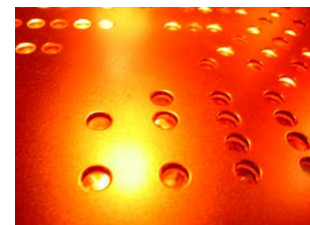
- Prototype tests on over 30 different signalizers from different companies, from 1989-2008
- Serial product tests on over 800 different signalizers from different companies, from 1990-2008
- “Functional Requirements for Traffic Signalizers”, by order of the Dutch Ministry of Transport, Public Works and Water Management, in 2002 / 2003 / 2005
- “Functional Requirements for dynamic traffic signs”, by order of Stork Industrial Modules, in 1998
- Technical requirements on highway control equipment, by order of the Dutch Ministry of Transport, Public Works and Water Management, in 1996
- Development and performing of a technical test program to select suitable high performance coating systems for:
  - All projects by order of the Dutch Ministry of Transport, Public Works and Water Management;
  - Zeelandbrug (2 km concrete bridge), HSL-bridge (2 km steel bridge), Al-Shindagha Tunnel (Dubai), etc..



## Tests facilities

The INTRON laboratory is equipped with a highly qualified personnel and testing facilities, such as:

- Optical test equipment
- Salt fog apparatus tests, Frost/de-icing cabinet tests
- 2x Weather-o-meter (Atlas) tests
- Kesternich cabinet tests for acid fog tests, condensation tests, etc.
- Climate rooms for building components / elements (2x3x2 m<sup>3</sup>) tests
- Vibration tests
- Thermal resistance tests
- Wind resistance tests
- Determination of chemical and physical material properties (XRF, XRD, SEM, EDXA, IR, AAS, GC-MS, etc.)



## Qualifications

INTRON has got all the important qualifications required by European regulation and the Dutch Ministry of Transport, Public Works and Water Management, in order to test traffic components and high performance coating systems independently according to the EN 12966, such as:

- NEN-EN-ISO/IEC 17025:2000 (Sterlab)
- ISO 9001-2000 (DNV)

