CASE STUDY

MANITOU B.F., S.A.
R&D, Production and EU Noise Directive Testing

France

Automotive

PULSE™, Transducers, Calibrators

Back in 1957, Marcel Braud, the founder of MANITOU, had a brilliant idea – to reverse the layout of a conventional farm tractor, and add a lifting mast and hydraulic steering. The result was the world's first rough-terrain fork-lift truck. The concept was an immediate success with users and MANITOU has become a household name. Today, MANITOU is a major international group with its headquarters at Ancenis in the west of France. With fifteen subsidiaries throughout the world, the group globally employs some 2000 people.

A Brüel & Kjær PULSE™ data acquisition system is extensively used in both R&D, and for sound power measurements to ensure that MANITOU products comply with the EU Directive 2000/14/EC, and other relevant noise legislation throughout the world.

Photo by kind permission of MANITOU B.F., S.A.

History of a Unique Concept

Behind any great success story you can find one strong, simple idea. In 1957, Marcel Braud, the founder of the company, thought up the unique MANITOU principle – to turn round the shape of a conventional farm tractor, and add to it a lifting mast and hydraulic steering. The result was the world's first rough-terrain fork-lift truck.

Fig. 1
MANITOU's headquarters is at Ancenis in the west of France. The facility occupies some 30 hectares with 8 hectares of covered area
Photo by kind permission of MANITOU

The concept was an immediate success and the company has grown steadily to become a household name and the world leader in rough-terrain fork-lift trucks. MANITOU products are manufactured at the group's headquarters at Ancenis, at three other factories in France, and at facilities in the USA and Italy. Since 1998 the family-owned group has been managed by Marcel Claude Braud, son of the founder. With over 500 sales outlets throughout the world, in 2003 the MANITOU group had a consolidated turnover of over 680 million Euros.

The prime reason for this success is the groups ability to offer every type of user the most relevant and reliable solution.

MANITOU focuses on three major market sectors:

- Building
- Agriculture
- Industry

Product Range

MANITOU offers its customers a very wide range product range:

- MANITOU – rough-terrain masted forklift trucks, semi-industrial masted forklift trucks
- Maniscopic – trucks with telescopic arms
- MRT – telescoping rotating trucks
- Maniaccess – self-propelled aerial work platforms
- Manitransit – truck-mounted forklifts with masts and slew capacity
- Maniloader – articulated loaders and swing shovel loaders
- Manilec – a range of warehouse equipment

Fig. 2
It was in the building market that the MANITOU group first won acclaim. MANITOU offers effective solutions to meet the industry's need needs.
Photo by kind permission of MANITOU

MANITOU manufactures up to 12 000 machines each year. The company has a dedicated department that designs, modifies and manufactures machines for specific uses, for example, machines used in military applications. The group is globally accredited to ISO 9001.

Always striving for innovative solutions, insistence on product quality, and an enterprising spirit that runs throughout the company, MANITOU products will continue to globally dominate its core markets.

The name MANITOU means 'handles everything'. In the North American Indian language, it is a word for 'God'. This unique range of products is aptly named.

The Environment

Waste Handling

MANITOU has, since its formation nearly 50 years ago, been strongly associated with environmental matters. Nowadays, the environment has a constantly increasing focus, and many companies take environmental dimensions into consideration in their strategic planning. Moreover, the legal obligations that cover the recycling of industrial and domestic waste, and the proposed laws on recycling the ultimate waste from public buildings and works mean that local authorities, businesses and the individual are all faced with new obligations.

MANITOU products are widely used in the environmental sector where users demand rough-terrain machines that can clean, gather, sort, extract, compact and store waste. MANITOU is a member of the Fédération Nationale des Activités du Déchet et de l'Environnement (FNADE), a French organisation for the waste-disposal and environmental industries.

All MANITOU products fully conform to the relevant exhaust emission regulations.

Environmental Noise

MANITOU products are amongst the quietest on the market and throughout its history, the company has focused on constantly reducing noise levels. Within the European Union, the noise generated by equipment and machinery used outdoors is now controlled by legislation.

Noise legislation is also implemented by many other countries throughout the world, for example, Japan and Australia.

Fig. 3
The agricultural industry is one of MANITOU's core markets. Today, the noise generated by machinery used outdoors is controlled by legislation
Photo by kind permission of MANITOU

EU Directive

The EU Directive on Noise Emission by Outdoor Equipment, 2000/14/EC came into effect on January 3rd, 2002. It applies to 57 types of equipment for use outdoors, ranging from construction machinery to lawn mowers. The directive requires declarations from manufacturers on the 'guaranteed' sound-power levels of their products before they can be marketed in the EU. In addition, the directive demands that quality-control procedures be established, to ensure continued compliance with the new legislation.

Testing Expertise

Fig. 4
Mr. Pierre Hersant is MANITOU's noise and vibration expert and has worked for the company for 22 years
Photo by kind permission of MANITOU

Mr. Pierre Hersant is MANITOU's Advanced Project Manager. He has worked for the company for 22 years and is a specialist in noise and vibration measurement and analysis for Manitou's testing service department.

Mr. Hersant says, "I have always worked in engineering since I stated working for the company. Initially, I worked on product design, up to the pre-study phase. I became involved with sound and vibration in 1987. Of course, I have seen very big changes over the years, especially in the area of noise and vibration, and these days there is a huge focus on these parameters with our products, not only regarding the effects of noise on the environment, but also the noise and vibration for the machine operator".

He continues, "My main responsibility is pre-project development. I find new solutions for new ideas, and help transfer the concepts from our marketing department into manufactured products".

"Noise and vibration is just a part of this. There is a special department within R&D that works with noise and vibration and they ensure that all MANITOU products conform to the relevant legislation. I sometimes assist R&D in solving noise and vibration related problems."

Noise and Vibration Testing

Fig. 5
A Maniscopic machine hard at work making silage – winter feed for cattle
Photo by kind permission of MANITOU

Mr. Hersant explains, "We made the decision to buy a PULSE system in 2000. Although the EU Directive did not come into effect until 2002, this gave us time to prepare and get everything in place before the implementation date. In fact, the EU Directive was a good reason to buy PULSE because we wanted to further our investigations into noise and vibration. We find that there is ever increasing focus on noise and vibration parameters. Although MANITOU is the leader in our industry, we now have many competitors in different markets, and the quietness of our machines is a key selling point and product differentiator".

The relationship between MANITOU and Brüel & Kjær goes back over 15 years. Before acquiring PULSE, Mr. Hersant and his colleagues used Type 2260 and 2230 Sound Level Analyzers for 1/3-octave measurements.

Sound Power Testing

Mr. Hersant continues, "We carry out testing to verify that the sound power of our products complies with EU Directive 2000/14/EC. In the beginning, we defined the necessary procedures and setups. We defined the frequency of testing each model with

the agreement of the appointed directive auditor. To ensure full compliance, we chose to 100% test every machine. These days, the measurements for the directive are made by our quality department and generally testing is carried out twice per month. The models tested depend on their production volumes".

"However, when modifications are made to existing products, the prototype test department has to consider the effects on the noise and vibration parameters."

Fig. 6
There is very quiet area, far away from any other activities, which is used for noise testing
Photo by kind permission of MANITOU

Owing to their size, the machines have to be tested outside and, subject to acceptable weather conditions (maximum wind speed is 5 metres per second), testing takes place throughout the year.

There is very quiet area, far away from any other activities, which is used for this work. For the EU Directive test, there must be no reflecting material within 50 metres of the test object.

Brüel & Kjær Microphones Type 4190 can be placed 10 or 16 metres from the mid-point of the machine. The test specifies six measurement points and therefore the three microphones only have to be repositioned once. The microphones are calibrated before each test using a Brüel & Kjær Sound Level Calibrator Type 4231.

The first test is made with the machine lifting 70% of its lifting capacity and at maximum speed. The second test involves driving from point to point, from one microphone to the next. The machine is initially stationary and then accelerates for a specified distance until it reaches the second microphone point. Machines intended for building applications and for general industrial use are limited to a top speed of about 25 km/h, while those used in agriculture reach speeds of some 40 km/h.

Mr. Hersant continues, "Phase II of the EU legislation will come into force in 2006. This will specify a reduction in sound power levels of 3 dB(A) less than the directive currently in force. This is a tough requirement and we are already working on measures to reduce the sound power of our products to ensure future compliance".

Sound Pressure Testing

MANITOU also makes sound pressure level measurements inside the cabin of its machines. In accordance with the standard EN 12053, two microphones are placed near the operators ears. Measurements are made at three modes of operation. The first two are in accordance with the requirements of EU Directive 2000/14/EC. The third set of measurements are made when the machine is stationary and the engine running at idle speed.

Mr. Hersant adds, "In fact, to reduce testing time, we are currently considering making the external sound power and in-cabin sound pressure level measurements at the same time. This will require an additional PULSE front-end with a sufficient number of channels with a wireless connection between the two PULSE systems".

Vibration Testing

Legislation concerning the vibration levels to which operators of machinery are exposed, is at an earlier stage. For end users, EU Directive 2002/44/EC has been published and applies to whole body exposure levels of 1.15 m/s^2 over 8 hours. This directive is expected to come into force on July 6^{th}, 2005.

Mr. Hersant says, “For whole body measurements in accordance with the recent standard EN 13059 for fork-lift trucks, we are using an ISOTRON® Accelerometer Type 65 – 10 and a Triaxial Seat-Accelerometer Type 4322”.

PULSE

Fig. 7
MANITOU purchased its 4-channel PULSE data acquisition system in 2000
Photo by kind permission of MANITOU

Mr. Hersant says, “We have used our PULSE analyzer for about four years. It is a 4-channel system and we also have a Sound Intensity Probe Kit Type 3599. In addition to PULSE FFT & CPB Analysis Type 7700 software, we also have Data Recorder Type 7701, Order Analysis Type 7702, Acoustic Test Consultant Type 7761 and Noise Source Identification Type 7752”.

MANITOU’s PULSE system runs under Windows® 2000.

“We wanted a test and measurement system that was portable, so it could, if needed, be installed in a machine to make noise and vibration measurements. We chose PULSE because it is a fine product and is the best solution for our wide range of measurement tasks. Also, we have been very satisfied with other Brüel & Kjær products over the years, so this was another major factor we took into consideration”, says Mr. Hersant.

“Because it is intuitive and Windows®–based, we found it very easy to learn to use PULSE. In the early days, we had a lot of help and support from the local Brüel & Kjær sales engineer. I was the first to be trained, and during the first measurement phase, I trained other users. They now do not have to configure the system, just how to calibrate, start, stop and save the data. It is very user-friendly”.

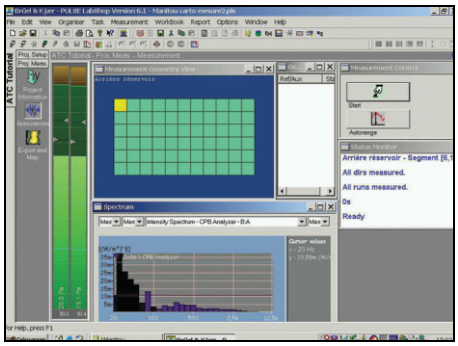
Research and Development

Fig. 8
Sound intensity measurements are made using Sound Intensity Probe Type 3599, PULSE and Noise Source Identification Type 7752. Measurements are made on up to 60 points
Photo by kind permission of MANITOU

“We only make sound power tests on complete machines, according to the EU Directive. However, we also use our PULSE system and transducers extensively for R & D investigations, and the data acquisition must be fast and totally accurate. For example, we don’t only test the complete machine but many of its components. These include hydraulic motors, pumps, diesel engines, etc.”

Mr. Hersant adds, “We use the Sound Intensity Probe and Acoustic Test Consultant software extensively for external measurements on machines, searching for noise sources and to investigate the effectiveness of acoustic insulation by looking at areas of sound leakage.

Fig. 9
Typical display from Acoustic Test Consultant Type 7761 used with Noise Source Identification Type 7752
By kind permission of MANITOU

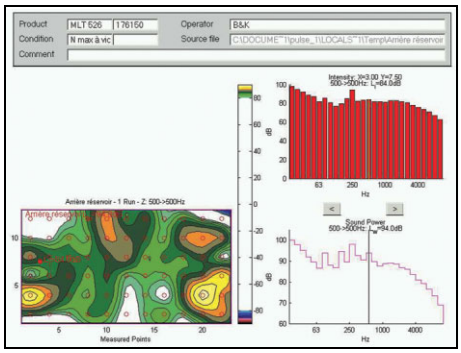


"We generally make a test using 60 measurement points".

"Setting up a test and making the measurements only takes about one hour. The post-processing is done back in the office. It is a very flexible and efficient system", says Mr. Hersant

Data Handling and Reporting

Fig. 10
Sound intensity map generated by PULSE at 500 kHz. If required, a photo of the test object can be superimposed on the contour plot
By kind permission of MANITOU



"To generate reports in accordance with the EU Directive we use the facility in PULSE to export the test data to Microsoft® Excel. It was quite simple to make our own Excel programme in VBA. It is similar to PULSE Value Pack but it is not automatic and uses 'copy and paste' techniques, and is somewhat simpler. The printed reports are submitted to our external 'auditor' and he verifies that the sound power levels of our machines conform to the legislation."

"The reports are also sent to our management, to R&D and the production department. It's a close circle and speed is essential. In addition to the official directive report, we also make graphs and print out the basic test data."

The data is initially saved on the PC's hard disk and then transferred to MANITOU's network together with the report documents. Complete PULSE projects are saved on CD-ROM.

Mr. Hersant concludes, "With PULSE version 8.0 we will have PULSE Data Manager Type 7767. This is very interesting because we often need to compare data and in general data management is a major issue within MANITOU. Data Manager will help us to efficiently manage our noise and vibration data, especially the measurements that we make concerning the EU Directive, and other present and future legislation".

Key Facts

- In 1957, Marcel Braud, the founder of MANITOU, thought up the unique principle
- MANITOU focuses on three major market sectors – building, agriculture, industry
- The relationship between MANITOU and Brüel & Kjær goes back over 15 years
- "We made the decision to buy a PULSE system in 2000"
- "We find that there is ever increasing focus on noise and vibration parameters"
- "We carry out testing to verify that the sound power of our products complies with EU Directive 2000/14/EC"
- "We chose PULSE because it is a fine product and is the best solution for our wide range of measurement tasks"

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