



THE COMPANY

THE PRODUCTS

THE QUALITY



Idromec S.r.l. was set up in Brescia on November 10th, 1979 and it's the youngest among the Italian companies producing water pumps.

Idromec is today composed by a well prepared and motivated managerial team, supported by a qualified staff, in all strategic areas of the company, Idromec is also a company that can be proud of its modern numerical control machines.

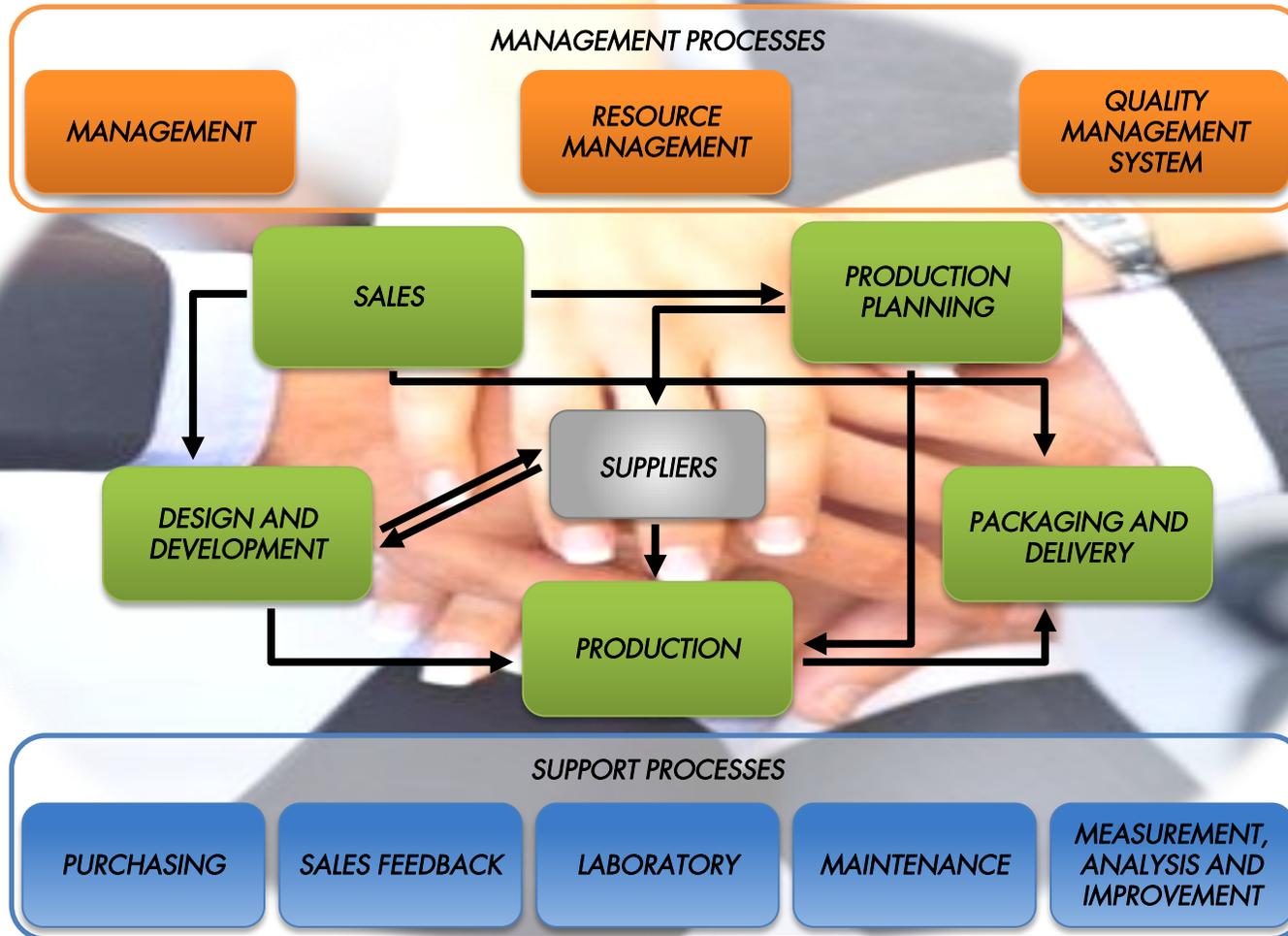
Our footprint goes from creativity and flexibility typically Italian, to the unceasing development of innovative solutions, until the most advanced technological research pursued its total quality in every detail made it possible by our enthusiasm and teamwork.

Idromec certifications are not limited to ISO (after acquiring the 9001-2000 we started TS 16949:2002 certification) but also involve a constant process of self-analysis by testing 100% of our products.

In a specialized laboratory internal to the company measurements and tests are made in every single phase of the process, this method permits us to keep under control all we produce. Our products emblematically represent Idromec's new route as well, they are an essential part of the engine, as well as of its performance and life. Our products play a crucial role in the engine's safety for this reason the process of incessant improvement of quality and safety is for us one of the most important goals.

Reliability, product quality and client service flexibility, in every part of the world, are the cornerstones of our company.

BUSINESS PROCESSES: OUR IDEA OF SYNERGY



QUALITY POLICY

IDROMECA S.r.l. top management establish the following quality policy which is the line of business strategy and is summarized in the following general objectives:

- **full customer satisfaction**
- **continual improvement** of processes and products
- **abidance with statutory and regulatory requirements**
- **consolidation of its image**

Top management identify the following points as the guide lines for achieving such objectives:

- **effectiveness** and **efficiency** of the processes and of the quality management system
- **clear definition of responsibilities and tasks, as a support to a multidisciplinary approach**
- **an effective monitoring and management of possible non conformities**
- **prevention** of potential non conformities through planning activities and FMEA
- **prompt reply to customer requirements regarding new products development**
- **flexibility** of production and adherence to delivery lead time required by customers
- **effective management of purchasing process**
- **motivation and responsabilization** of personnel
- **continuous attention to training** for personnel

CERTIFICATIONS

QUALITY
MANAGEMENT
SYSTEM



ISO/TS 16949:2009

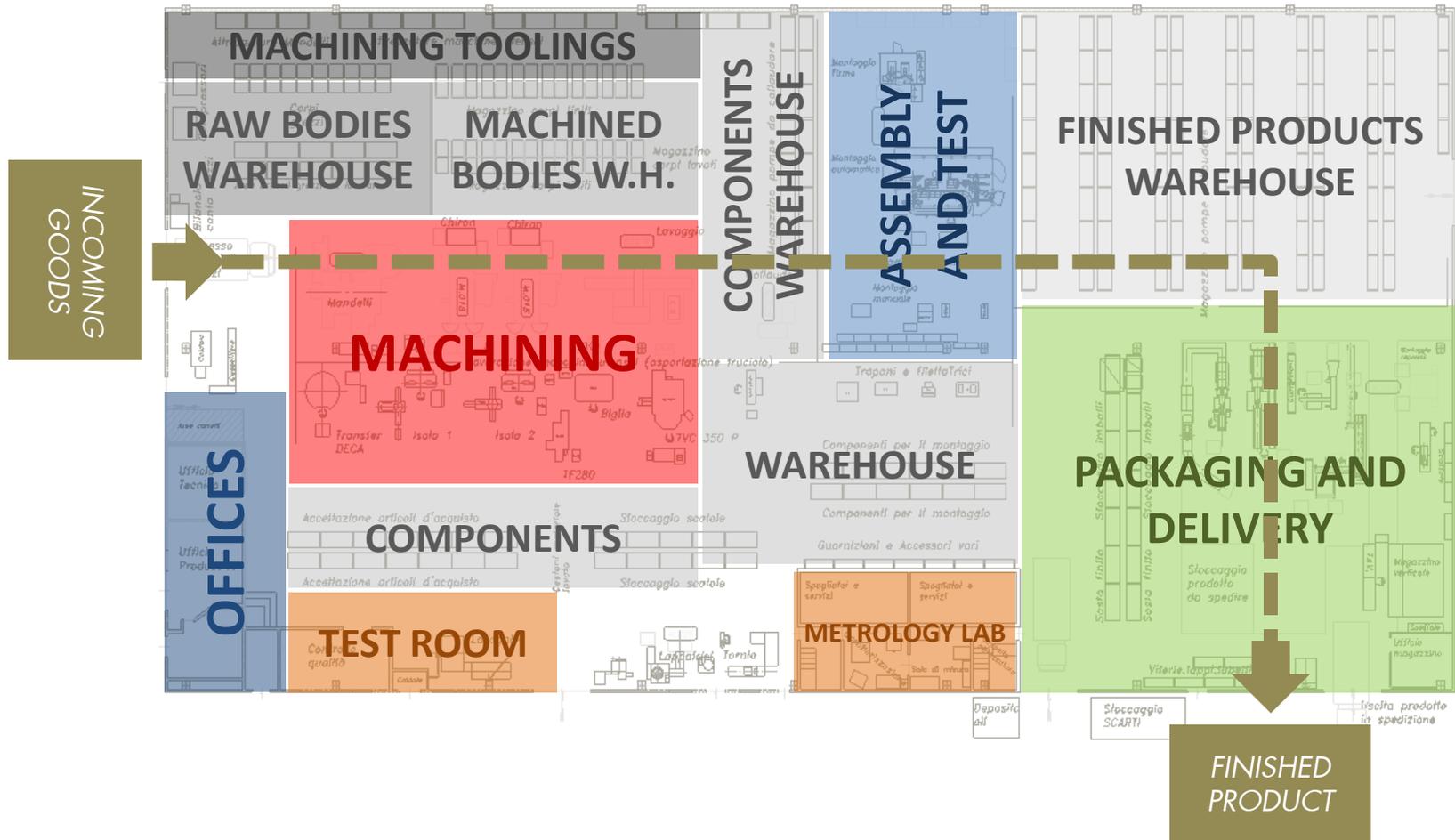
On December 2009, our company passed the periodical quality management system re-assessment and fulfilled the transition to ISO 9001:2008 standard.

Implementation of the ISO/TS 16949:2009 automotive specifications is currently in progress, with the cooperation of the quality assurance managers of various group companies and the assistance by an external consulting office.

PRODUCTION DEPARTMENTS LAYOUT

RESOURCE
MANAGEMENT

Today, with a covered production area of almost 5000 m², our catalogue includes a collection of 720 references.



THE CUSTOMER

SALES

Our sales office is composed of a young and dynamic staff, skilled and motivated.

Customer satisfaction is our first objective and the lifeblood of our work.

Each customer is **unique**, with his requirements and peculiarity, and we aim to establish with each one a relationship where we are judged by what we do and not by what we say.

Efficiency, punctuality and an extreme **flexibility** are the foundation of the service that we offer to our customers, everywhere in the world.



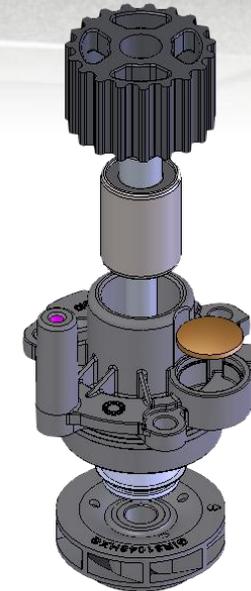
PRODUCT DESIGN

DESIGN AND
DEVELOPMENT

Without the customer drawings, the design of an *aftermarket* product follows the **form, fit & function** principle.

Through the *reverse engineering* of the original sample we build the tridimensional model of the pump: in this way we guarantee dimensional equivalency and interchangeability. Performance equivalency is verified by comparison of the characteristic curves, detected on the test bench in our laboratory, and by all the tests forecasted by **Fiat Auto specifications** (9.02320/01).

The different phases of the product and process design, from the feasibility analysis up to the final validation, are planned and monitored through the **APQP**, periodically reviewed by the **multidisciplinary team** with respect to the activities proceeding and timing.



PRODUCT VALIDATION

LABORATORY

At the end of the design planning, product validation is carried out according to **Fiat Auto specifications** (9.02320/01).

- *Static leak test at room temperature*
- *Static leak test at -20°C*
- *Dynamic leak test at 90°C*
- *Performance test at room temperature*
- *Performance test at 90°C*



PRODUCT VALIDATION

LABORATORY

- *Life test*
- *Check of impeller-hub adhesion*
- *Thermal cycles*
- *Forced thermal aging*



SUPPLIERS QUALIFICATION

PURCHASING

The "Specifications for the quality of supplies" outlines the general principles designing the relations between Idromec and its suppliers, with the primary objective to maintain and develop a network of suppliers able to guarantee the integrity and reliability of the supplied materials, components and products.

Idromec policy contemplates exclusively contractual relations with qualified suppliers.

Quality Assurance of Idromec is liable for the qualification of potential suppliers, for monitoring and for the audits on the approved suppliers..

Suppliers are qualified by Idromec in keeping with the following principles considered alternatives:

- certification ISO/TS 16949:2009
- certification ISO 9001:2008 + automotive requirements
- audit by Idromec



INSPECTION OF INCOMING GOODS

PRODUCTION

Incoming goods are identified with a tag, waiting for inspection.
The control plan establish the methods and the quantities to be inspected.

Only after QC has signed the tag, goods can be used.

<input type="checkbox"/> Prototype		<input type="checkbox"/> Pre-series		<input checked="" type="checkbox"/> Series		Reference Person /Phone Nr. Q.A.M. - Andrea Vitali +39 030 3581576		Date (Orig) 26/02/2009		Date (Rev.)			
Control plan n°: 877001				Definition group Andrea Vitali Leandro Bachis				Customer Technical Approval (if requested)					
Product Code / Last modification								Customer Quality Approval (if requested)					
Detail description :				Supplier approval data				Other approvals (if requested)					
Supplier's Plant: IDROMECC Srl		Supplier Code		Date of other approval (if requested)									
Phase- Process nr.	Process / Operation description	Machine Installation Tool	Characteristic		Special characteristic	Methods				Reaction plan			
			Nr	Product		Process	Product / process specifications	Measuring system / instrument	Sample Size		Sample Freq.	Check method	Record
AA	CORPO POMPA CFP3004SGR		Stato fusione			Specifica zsm	Visivo	500-9000 10pz 1500-2000 15pz 3000-5000 20 pz 5000-10000 70pz		Attributi	Sistema Informatico	Controllo Qualità	Apertura NC e reso a fornitore
	GIRANTE GR30068		Identificazione prodotto			Disegno	Visivo/calibro	1pz lotto		Attributi	Sistema Informatico	Controllo Qualità	Apertura NC e reso a fornitore
			Diametro piantaggio			Disegno	Alesametro	5 pz lotto		Variabili	Sistema Informatico	Controllo Qualità	Apertura NC e reso a fornitore
	CUSCINETTO CUR227		Identificazione prodotto			Disegno	Visivo/calibro	1pz lotto		Attributi	Sistema Informatico	Controllo Qualità	Apertura NC e reso a fornitore
	PREMISTOPPA PRM30123SR04UN		Identificazione prodotto			Disegno	Visivo/calibro	1pz lotto		Attributi	Sistema Informatico	Controllo Qualità	Apertura NC e reso a fornitore
	TAPPO TPP30090		Identificazione prodotto			Disegno	Visivo/calibro	1pz lotto		Attributi	Sistema Informatico	Controllo Qualità	Apertura NC e reso a fornitore
	PULEGGIA PUL30040		Identificazione prodotto			Disegno	Visivo/calibro	1pz lotto		Attributi	Sistema Informatico	Controllo Qualità	Apertura NC e reso a fornitore
			Diametro piantaggio			Disegno	Alesametro	5 pz lotto		Variabili	Sistema Informatico	Controllo Qualità	Apertura NC e reso a fornitore
	GUARNIZIONE GUA2VAC30021		Identificazione prodotto			Disegno	Visivo	1pz lotto		Attributi	Sistema Informatico	Controllo Qualità	Apertura NC e reso a fornitore
	GUARNIZIONE GUA26AN50021		Identificazione prodotto			Disegno	Visivo	1pz lotto		Attributi	Sistema Informatico	Controllo Qualità	Apertura NC e reso a fornitore



MACHINING

PRODUCTION

n. **2** CNC working centers **CHIRON FZ18W**

- 4 controlled axis (x,y,z + rotating table)
- automatic pallet change
- productivity up to **100 pcs/h**

n. **1** CNC working center **TRAUB TVC350P**

- 3 controlled axis
- automatic pallet change



MACHINING

PRODUCTION

n. 2 CNC vertical turning machines **DOOSAN PUMA V400**

- 2 controlled axis
- auto centering diameter up to 300 mm
- productivity up to 100 pcs/h

NEWS
2010



ASSEMBLY

PRODUCTION

n. 1 semi-automatic assembly machine

- 2 presses with controlled axis for fitting bearing/mechanical seal and flange/impeller
- automatic control of the fitting load of bearing, mechanical seal, flange and impeller
- productivity up to 100 pcs/h



ASSEMBLY

PRODUCTION

n. 1 automatic assembly machine

- 2 presses with controlled axis for fitting bearing/mechanical seal and flange/impeller
- in-line static leak test with automatic scrap of discrepant parts
- automatic control of the fitting load of bearing, mechanical seal, flange and impeller
- productivity up to **200 pcs/h**

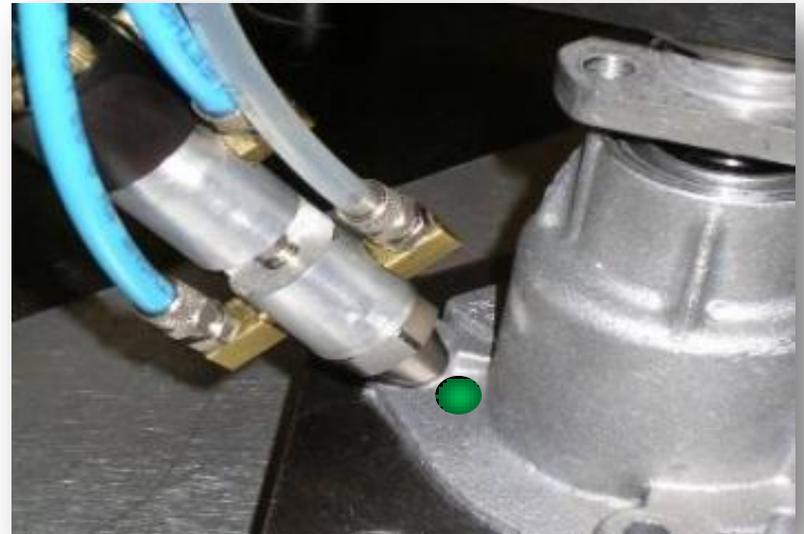
NEWS
2010



LEAK TEST

PRODUCTION

After assembly pumps are 100% leak-tested with a special machine for testing the absence of leaks. An automated control will detect discrepant parts and automatically lock them in station to prevent further processing; test success is shown by a green spot on the body pump.



MARKING, PACKAGING AND DELIVERY

PACKAGING AND
DELIVERY

Marking of water pumps is made with permanent ink-jet markers: it's possible to realize personalized brands with logos and text, according to the customer specifications.

Packaging is agreed with customer as well and the components to be added in box are managed through a computer, allowing the chance to replace the standard components with a personalized warranty or instructions.



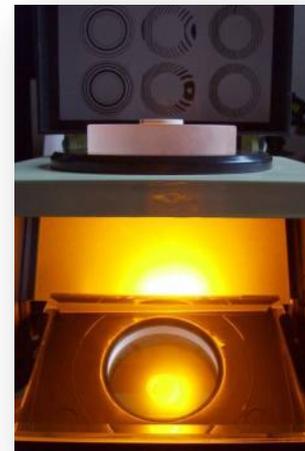
METROLOGY LAB

LABORATORY



MEASUREMENT CAPABILITY OF THE LABORATORY:

- 3D coordinate measuring machine WERTH SCOPE-CHECK
- Roundness, concentricity, radial runout
- Hardness Rockwell A, B, C
- Roughness
- Coating thickness
- Vibrations (integral shaft bearings)
- Flatness of lapped surfaces
- Precision balance

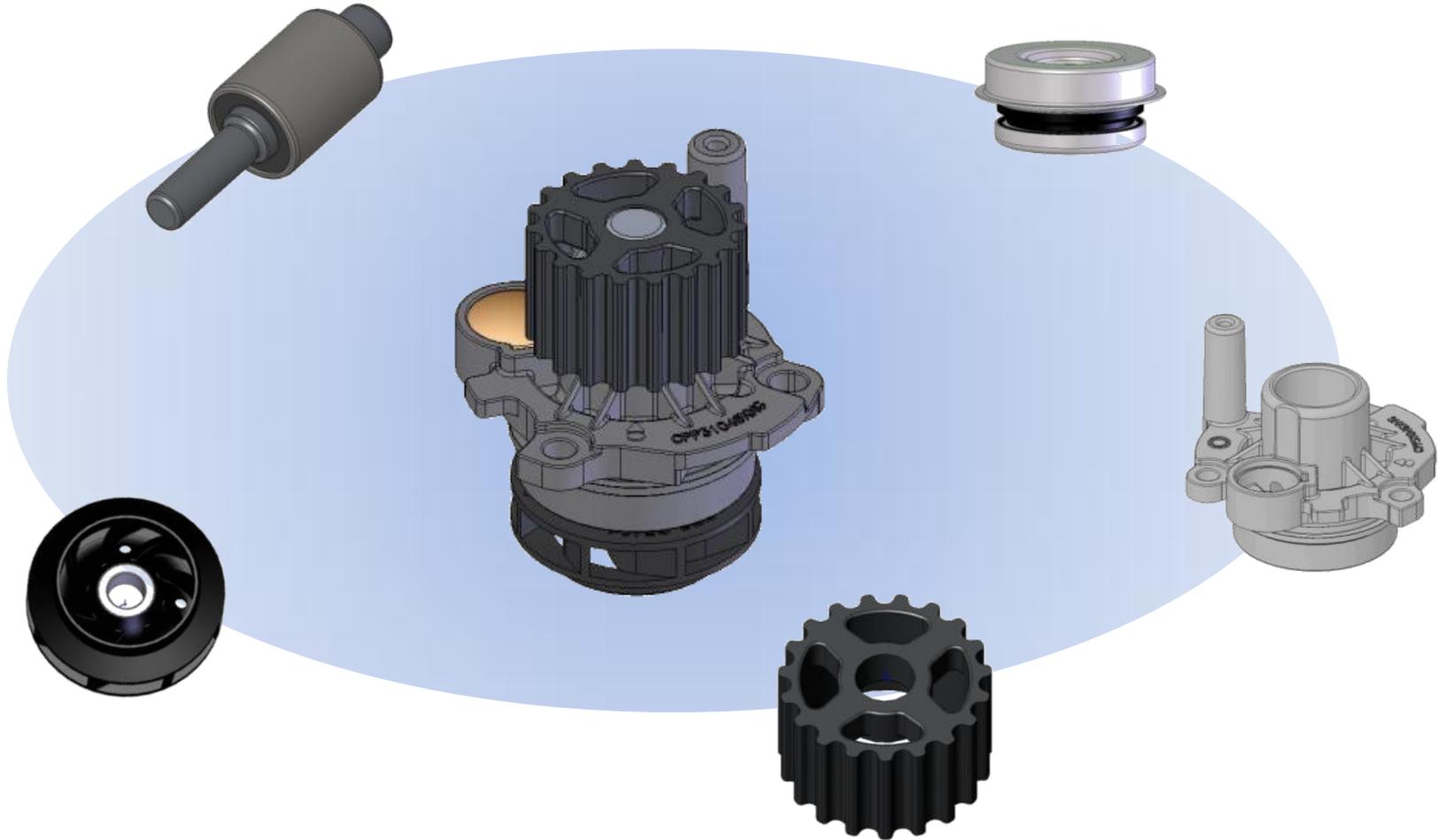


APPENDIXA - MATERIALS



FOREWORD

Idromec has always paid careful attention to the choice of materials to be used, assessing the pros and cons, and has always demanded to ascertain the quality of materials used by its suppliers through analysis at accredited laboratories.



BODY - ALUMINIUM

REFERENCE STANDARDS

Aluminium alloy EN AB-46000	EN 1676
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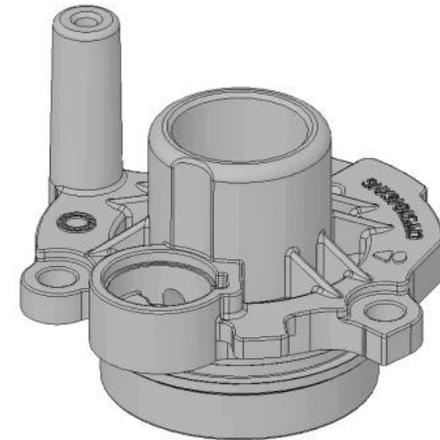
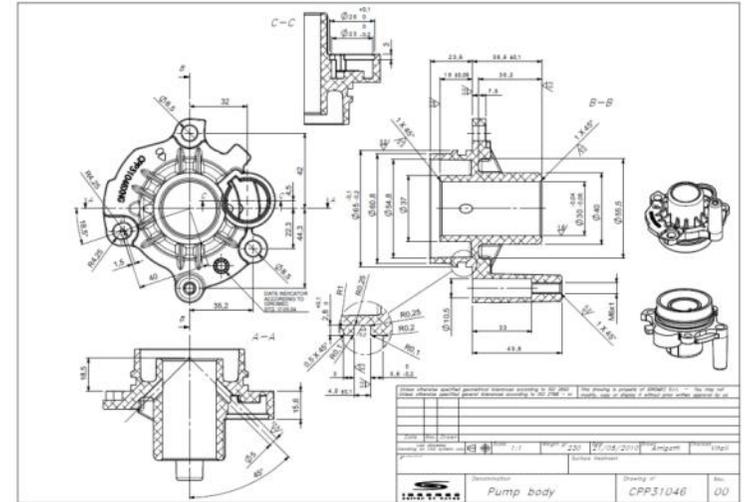
MECHANICAL PROPERTIES

Tensile strength [MPa]	240
Yield point [MPa]	140
Elongation [%]	1
Hardness [HB]	80

CHEMICAL PROPERTIES

Si	Fe	Cu	Mn	Mg	Cr	Ni
8.00 11.0 0	0.60 1.10	2.00 4.00	- 0.55	0.15 0.55	- 0.15	- 0.55

Zn	Pb	Sn	Ti	Others		Al
				Each	Total	
- 1.20	- 0.35	- 0.25	- 0.20	- 0.05	- 0.15	balance



PULLEY

REFERENCE STANDARDS

Sintered steel S-102-E	Fiat Auto 9.53141/03
Sintered steel C11	DIN 30910

MECHANICAL PROPERTIES

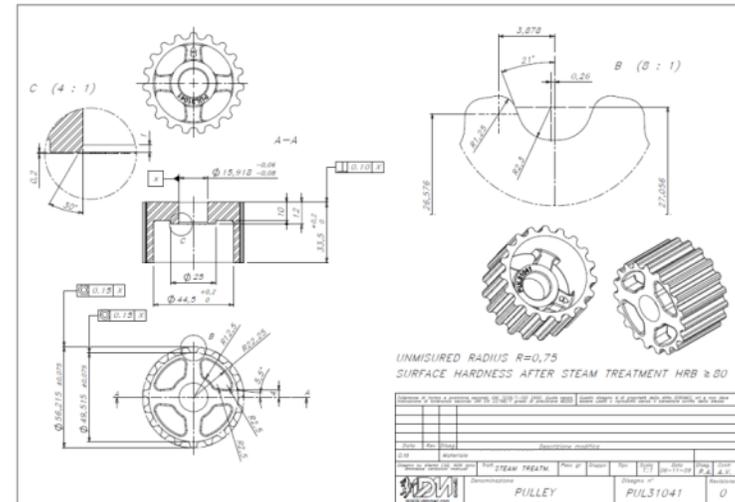
Tensile strength [MPa]	400
Yield point [MPa]	280
Density [g/cm ³]	6.4 ÷ 6.8
Hardness [HB]	100

CHEMICAL PROPERTIES

C _T *	C _C **	Cu	Fe
0.40 1.50	0.40 1.00	1.00 5.00	balance

* total Carbon

** combined Carbon



FLANGE

REFERENCE STANDARDS

Steel 11SMnPb37

EN 10277-3

MECHANICAL PROPERTIES

Tensile strength [MPa]

400 ÷ 650

Yield point [MPa]

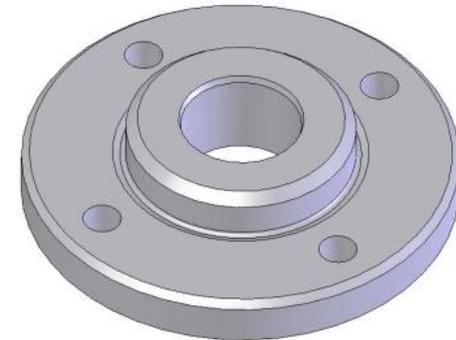
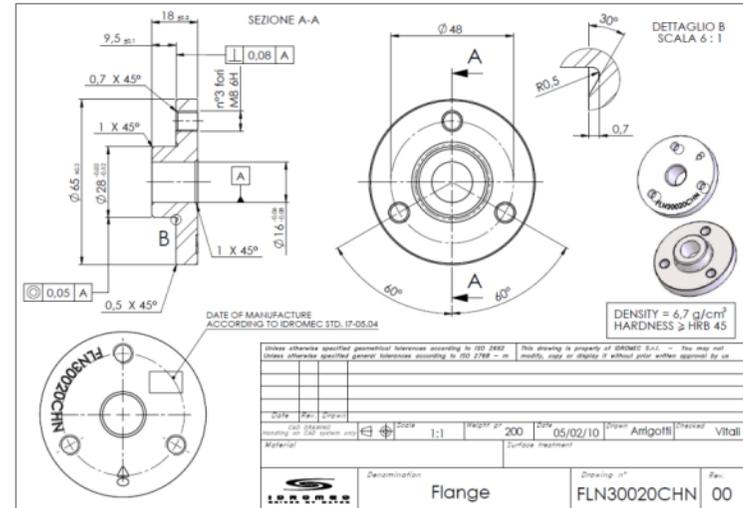
305

Elongation [%]

9

CHEMICAL PROPERTIES

C	Mn	Si	P	S	Pb	Fe
- 0.14	1.00 1.50	- 0.05	- 0.11	0.34 0.40	0.20 0.35	balance



IMPELLER

REFERENCE STANDARDS

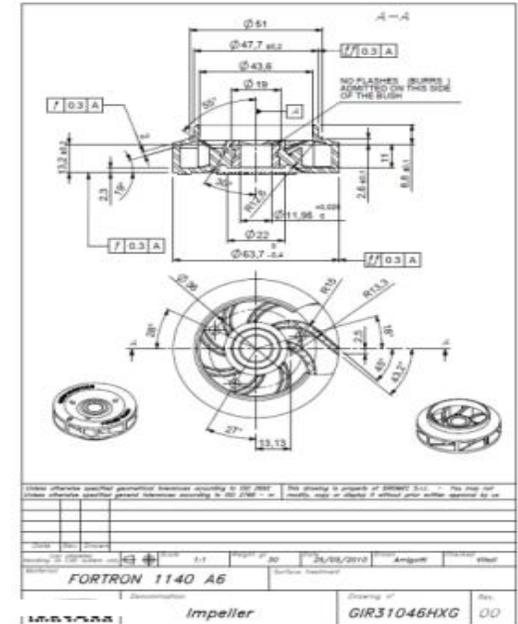
Nylon 6,6 >PA66-GF30< *	EN ISO 11469
Polyphenylsulfide >PPS-GF40< **	EN ISO 11469

MECHANICAL PROPERTIES

	PA66-GF30	PPS-GF40
T of deflection under load [C]	250	270
Density [g/cm ³]	1.36	1.66
Tensile stress @ break [MPa]	175	210
Flexural strength [MPa]	280	290

- * nylon 6,6 reinforced with 30% fiber glass
- ** polyphenylsulfide reinforced with 40% fiber glass

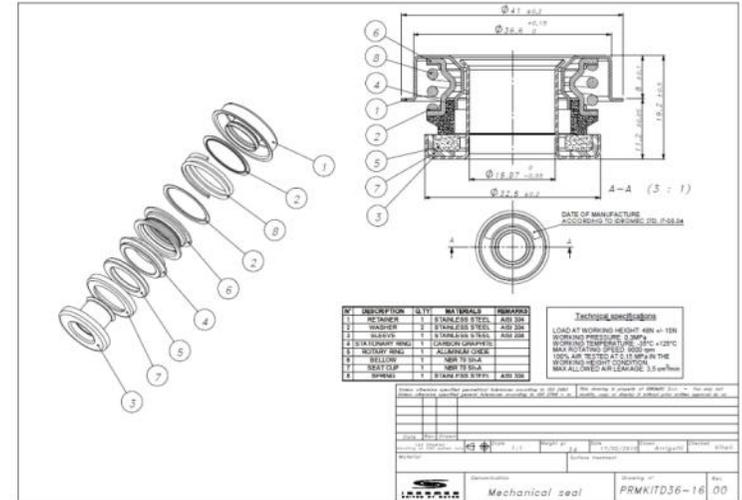
BOTH THESE MATERIALS ARE USED BY MAJOR CAR MANUFACTURERS, SO IT GOES WITHOUT SAYING THAT THEY ARE APPROPRIATE FOR ITS INTENDED USE IN NORMAL OPERATING CONDITIONS. THE SAME MATERIALS ARE USED FOR THEIR CHEMICAL AND HEAT RESISTANCE, AS WELL AS EXCELLENT DIMENSIONAL STABILITY, FOR THE CONSTRUCTION OF FUEL SUPPLY SYSTEMS.



MECHANICAL SEAL

BILL OF MATERIALS

RETAINER		Stainless steel AISI 304
WASHER		Stainless steel AISI 304
SLEEVE		Stainless steel AISI 304
STATIONARY RING		Carbon graphite
ROTARY RING		Aluminum oxide
BELLOW		Rubber NBR 70 SH A
SEAT CUP		Rubber NBR 70 SH A
SPRING		Stainless steel AISI 304



TECHNICAL SPECIFICATIONS OF MECHANICAL SEALS

Load @ working height [N]	38 ÷ 58
Max working pressure [MPa]	0.3
Working T [C]	-35 ÷ 125
Max rotating speed [rpm]	9000

SEALS ARE **100% AIR TESTED** AT A PRESSURE OF 0.15 MPA AND THE MAX ALLOWED AIR LEAKAGE IS 3.5 CM³/MIN.
 AFTER ASSEMBLY PUMPS ARE **100% LEAK-TESTED**; TEST SUCCESS IS SHOWN BY A GREEN SPOT ON THE BODY PUMP.



BEARING

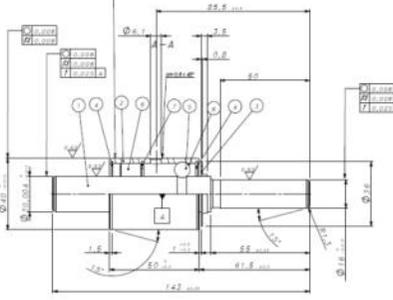
BILL OF MATERIALS

SHAFT		Steel 100Cr6
OUTER RING		Steel 100Cr6
SEAL		Rubber NBR 70 SH A
BALLS		Steel 100Cr6
ROLLERS		Steel 100Cr6
CAGES		Nylon 6,6 >PA66-GF25<

Radial play [mm]	0.020 ÷ 0.035
Axial play [mm]	0.020 ÷ 0.035
Grease working T [°C]	-40 ÷ 180
Load capacity [N]	according to drawing

*DURING ASSEMBLY BEARINGS ARE **100% CHECKED** WITH AN AUTOMATED CONTROL OF THE FITTING LOAD IN ORDER TO AVOID FAILURE OF THE BEARING BECAUSE OF TOO TIGHT OR TOO LOOSE FIT.*

DATE OF MANUFACTURE
ACCORDING TO DRAWING: 17.01.2014



Radial play (under 50N load) - Balls: 0,020 - 0,035mm
 Radial play (under 50N load) - Rollers: 0,020 - 0,035mm
 Axial play (under 50N load): 0,05 - 0,20mm
 Grease: SHELL ALVANIA R3
 Load capacity:

CURB001		
	Q	C
Flow of Balls	10000	180000
Flow of Rollers	25000	275000

Bill of materials:

Q	DESCRIPTION	QTY	MATERIALS	MATERIAL TREATMENT
1	SHAFT	1	STEEL 100CR6	NO HARDENING -IRC 58-63 (DEPTH 0,3-3mm)
2	COVER RING	1	BRONZ 70/30	HARDENING -IRC 60-64
3	SHIELD	1	BRASS 70/30	
4	SEAL	1	NBR 70 SH A	
5	BALL W/SH	4	STEEL 100CR6	HARDENING -IRC 60-64
6	ROLLER W/SH	4	STEEL 100CR6	HARDENING -IRC 60-64
7	ROLLERS GUIDE	1	PA66-GF25	
8	BALLS GUIDE	1	PA66-GF25	

Other relevant technical specifications (reference drawing: 17.01.2014) - This bearing is provided in different sizes - for the full list, please refer to the general catalogue, starting from 01.00001 to 01.00000.

Reference:	17.01.2014	QTY:	10000	DATE:	17.01.2014
Author:		Service:		Drawing of:	Bearing
Check:		Service:		Drawing of:	CURB0001
Rev:		Service:		Rev:	00



APPENDIX B - WAYS OF FAILURE



FOREWORD

1. LIMITING POTENTIAL FAILURE MODES

Potential failure modes are limited through very strict controls during all production process. Quality of supplies is constantly monitored according to our specifications, which ensure compliance with the highest standards; we cooperate with our main suppliers in setting quality goals, with a view to a continuous improvement, according to our quality policy.

The most severe potential failure modes which affects water pumps are:

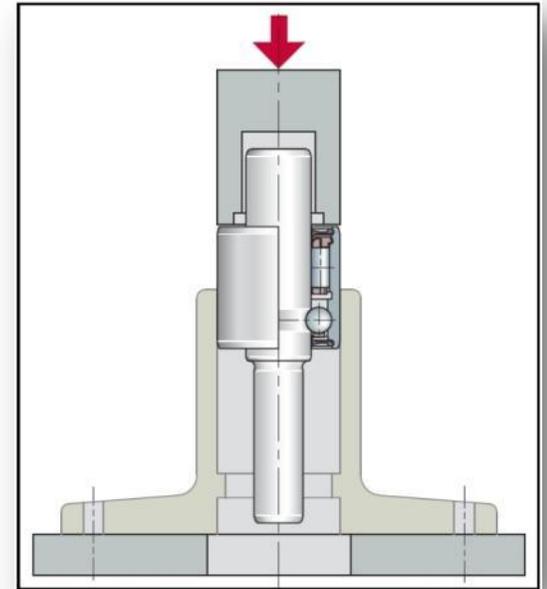
➤ **failure of the bearing because of too tight or too loose fit:** to avoid this, when we machine the body we strictly abide with the tolerances prescribed by bearings manufacturers and when we assembly the pump, an automated control of the fitting load will detect discrepant parts and automatically lock them

in station to prevent further processing.

According to the last 3 years quality records, occurrence of this failure mode is around 250 ppm and detection is 100%.

➤ **leakage because of defective mechanical seal:** to avoid this, after assembly pumps are 100% leak-tested; an automated control will detect discrepant parts and automatically lock them in station to prevent further processing; test success is shown by a green spot on the body pump.

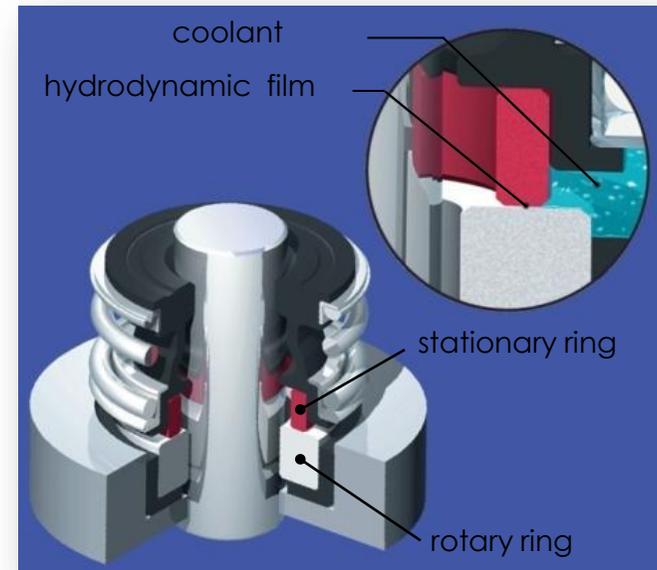
According to the last 3 years quality records, occurrence of this failure mode is around 3000 ppm and detection is around 97%.



2. MECHANICAL FACE SEALS

In a mechanical face seal, sealing is assured by the faces of two rings sliding on each other under the pressure of a spring. The stationary ring, usually made by graphite, is integral with the pump body, whereas the rotary ring, usually made by ceramic, is integral with the bearing shaft. The faces are lapped to obtain a flatness within $2 \mu\text{m}$ and high-density pressed to avoid early wear. A thin film of coolant always need to be present between the two faces: it takes away heat generated by friction and, at the same time, it acts as a lubricant, reducing the friction between the two faces. The most common phenomena which may menace the correct work of a mechanical seal are:

- **adhesion**, that is the transfer of material from one face to the other - it takes place in the absence of coolant film - or from particles circulating through the cooling system such as sealant or dirt
- **abrasion**, that is the scraping of the sliding faces by hard particles circulating through the cooling system such as oxides, dirt or limestone
- **thermal fatigue**, that is the cyclic elastic deformation of the sliding faces due to thermal stress: it takes place in the absence of coolant film

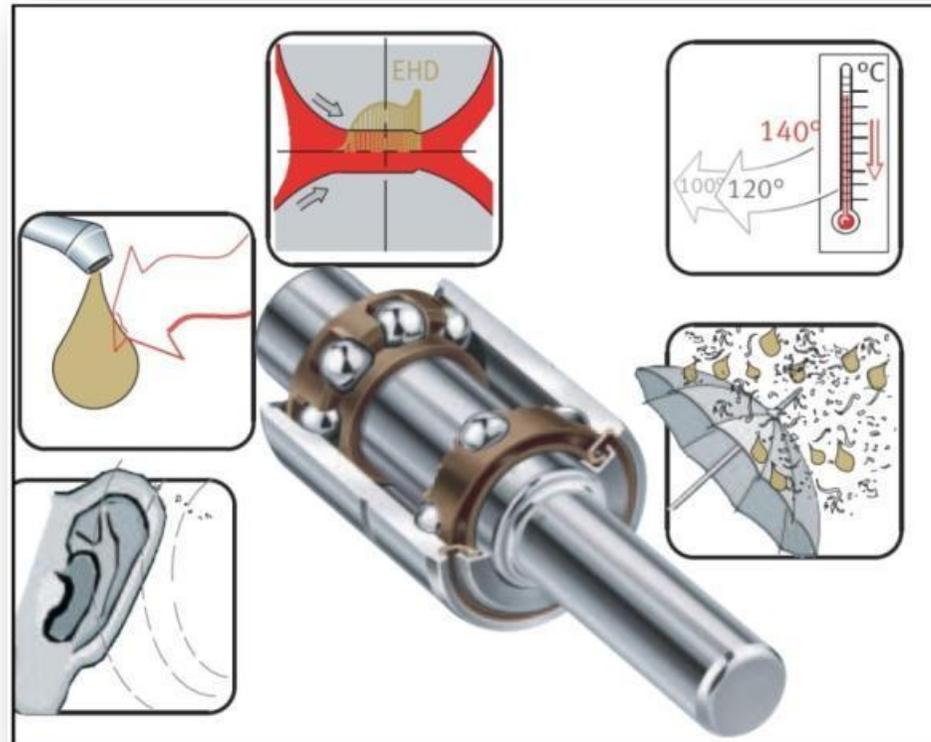


3. INTEGRAL SHAFT BEARING

Water pump bearings are double row bearings whose raceways are machined directly into the shaft. They are ready-to-fit bearing units and they are lubricated for life. The function of the lubricant is to carry away heat, to protect bearing surfaces from corrosion, to reduce friction and to dampen running noise.

The most common phenomena which may menace the correct work of a bearing are:

- **lubricant contamination:** if the mechanical seal is leaking, coolant may seep into the bearing, causing the rolling elements to rust with pitting and corrosion, reducing bearing life.
- **overload:** over-tension or misalignment of the belt produce an overload condition on the rolling elements, causing overheating and reducing bearing life



4. GUARANTEE

The 24-month guarantee is limited to the replacement of defective products, returned ex our premises, for reasons assessed by the manufacturer.

Idromec is responsible only in case of intrinsic defects affecting its products and **not in case of wrong use**.

The guarantee is not extended if the fitting instructions, supplied together with the product, are not followed.

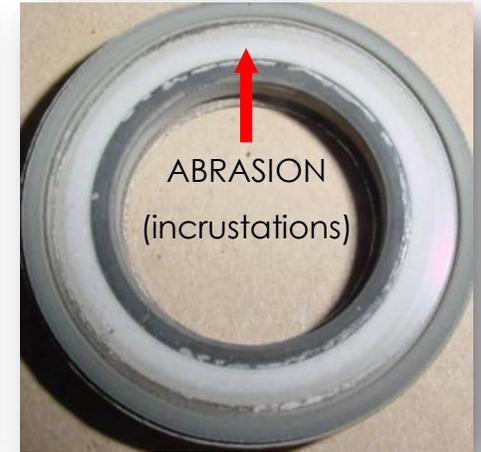
5. FITTING INTRUCTIONS

1. When the engine is cold, empty the cooling circuit completely
2. Remove the drive device (belt) and remove the old pump
3. Clean carefully the coupling surface of the engine block
4. **Wash the cooling circuit carefully**, eliminating any traces of dirt or incrustations
5. Only if the pump is not supplier with a gasket seal or an O-ring, spread an appropriate layer of sealant between the pump and the engine block
6. Place the pump and tighten the fixing screws to the torque specified by the car manufacturer
7. If sealant is used, wait for it to set and then fill the circuit **using only quality coolants**. Bleed the circuit according to the instruction of the car manufacturer.
8. Reassemble the drive device. We strongly suggest to replace the belt and the whole drive kit, if the pump is part of it. Check the condition of the joints connecting the pump to the fan. The vibrations generated by devices in bad working order produce noise and reduce the life of the pump.
9. **Tense the belt according to the instruction of the car manufacturer**. An excessive tension reduces the life of the water pump bearing
10. Start the engine and check the correct working. In this phase it's possible that a small leak occur from the drawing hole; it is due to the seal setting and it will stop in a short time.

DIRT OR INCRUSTATIONS

Before installing any new pump it is necessary to thoroughly flush the cooling system to remove any contaminants. These contaminants could also be the reason for the failure of the original pump.

The particles in solution or suspension may damage the sealing surfaces of the mechanical seal which will start to leak. This is why mechanics are advised to wash the cooling system carefully, changing the old fluid and replacing any other rusty or damaged system components.



In old engines the contamination of coolant may be due also to lack of tightness in the cylinder head gasket with leakage of combustion gases into the cooling system: this modifies both the chemical state and the pressure of the coolant.

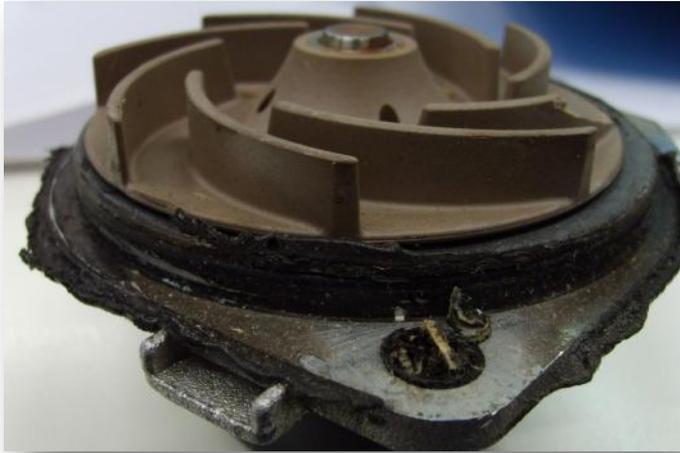
If the chemical properties of the coolant are modified, it might no longer be compatible with the various materials which make up the cooling system, which will fail after a short time.



EXCESSIVE USE OF GASKET SEALANT

Excessive use of gasket sealant during installation of pumps leads to strands of sealant detaching from the joint and circulating throughout the cooling system. When sealant particles are present in the coolant they become deposited on the seal faces leading to leakage and, ultimately, pump failure.

When the pump already has a gasket or an O-ring seal instant sealant must not be used. Many mechanics still like to use it because "they feel safer" when actually they're only menacing the good working of the gasket or O-ring.



CORROSION

The cooling system should be filled with a coolant solution using a quality antifreeze containing a corrosion inhibitor at the strength determined by the vehicle manufacturer. A corrosive attack results in rust particles circulating throughout the cooling system: these particles become deposited on the seal faces leading to leakage and, ultimately, pump failure.

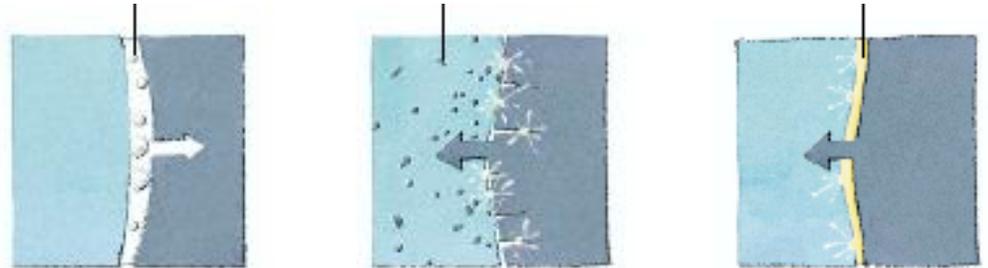
The coolants recommended by automotive manufacturers are not only antifreeze. They vary due to the different requirements in terms of chemical and physical compatibility with the various materials which make up the cooling system, which include a very wide range of metals, polymers, rubbers and ceramic materials. Nowadays engines work at very high temperatures and that's why coolants are also required to raise the boiling point up to 110°C. Not all coolants on the market are suitable for this, especially those who are not "brand name". No need to say that the use of plain water may cause the complete corrosion of some metals parts of the pump and cooling system.



CAVITATION AND EROSION

Air cavities may develop in the cooling system during refilling and they can be trapped if the system is not carefully bled allowing the air to be expelled. The air cavities driven by the flow in a region of high pressure (e.g. round about the impeller) will implode and generate high-pressure pulses leading eventually to erosion.

Air cavities may also develop when the temperature goes over the boiling point of the coolant. This is another reason why the use of a branded coolant is highly recommended.



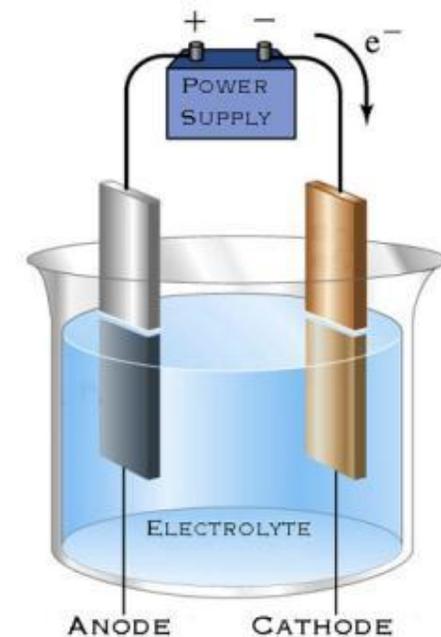
ELECTROLYSIS

Electrolysis is erosion caused by an electrical current generated by dissimilar metals bathed in acidic fluid (pH below 7.0). When this phenomenon takes place the aluminium parts of the cooling system (engine block, water pump) work as the anode: the aluminium undergoes oxidation and it is transferred to the iron parts of the cooling system.

In the case of the engine block the erosion will likely cause the new head gasket to fail prematurely because there is not enough contact surface left to carry heat away from the head gasket.

In the case of the water pump the erosion will likely cause the clearance between the housing and the impeller to increase, reducing the flow of coolant and leading to overheating.

Once again the use of a branded coolant is highly recommended!

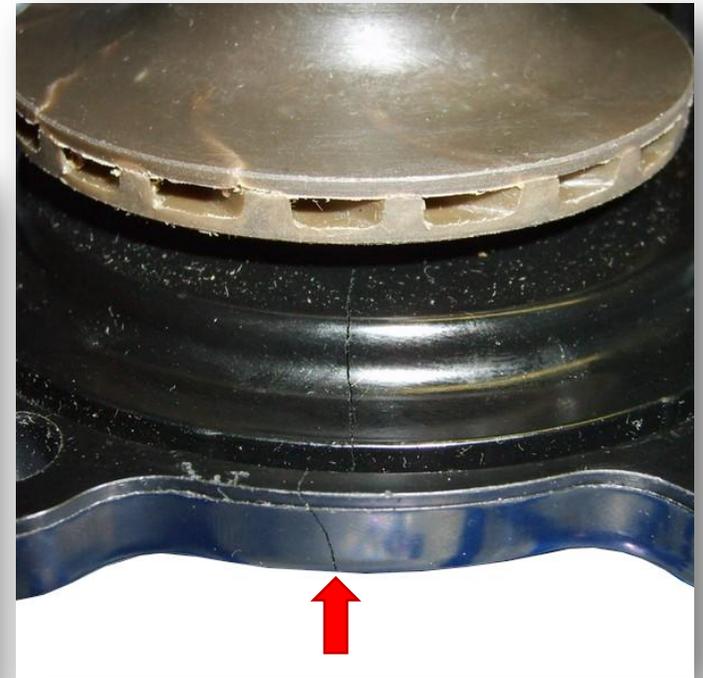
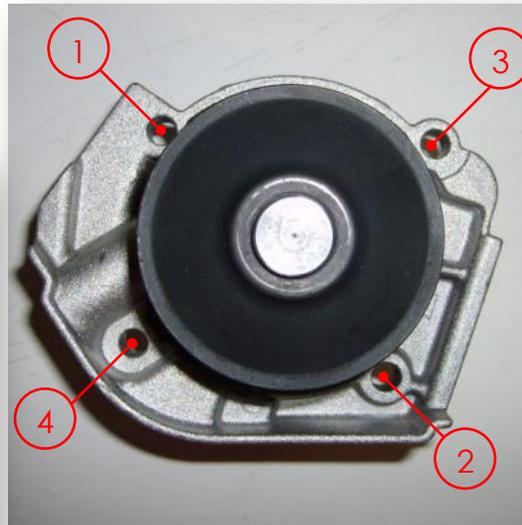
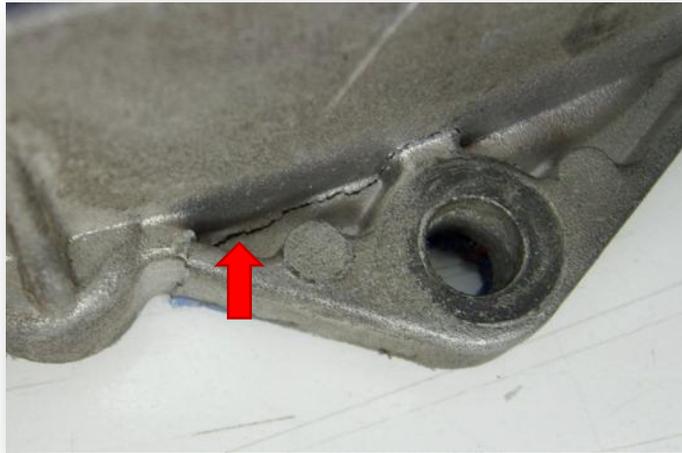


CRACKING OF THE BODY

It is quite unlikely that cracking of the body is due to the presence of a blow-hole in the cast; anyway, if so, it is clearly visible on the crack surface.

Body crackings are mostly due to overtightening of screws. It is very important that screwing torque complies with the manufacturer manual. It's also important to tighten the screws following an alternate order, to avoid tension to be generated in the body.

If the shaft of the pump also drives the cooling fan, it is very important to check that it is fitted correctly, in order to prevent dysfunctional vibrations.



CRACKING OF THE IMPELLER

The boxes in which the pumps are packaged and the dimensions of the pallets leaving our warehouse, are designed to adequately protect the pump during transport. In case the pallets are opened and re-packaged in the warehouses of our customers, the same standards adopted by Idromec, or similar within the limits of common sense, must be respected; when handling the boxes careful attention must be paid to avoid accidental falls.

While a pump with a broken impeller is easily identifiable and unlikely to be assembled even by an inexperienced as careless mechanic, a pump whose impeller has only cracked (see photo below) could be fitted even by a very experienced mechanic. Since the speed of rotation of the impeller is proportional to the speed of rotation of the engine, it is not difficult to imagine how the forces acting on the impeller during its operation will lead in a short time to a failure with detachment of the plastic part from the bush.

We recommend to always check that the impellers are free from defects before installing the pump.



PLASTIC IMPELLERS

REFERENCE STANDARDS

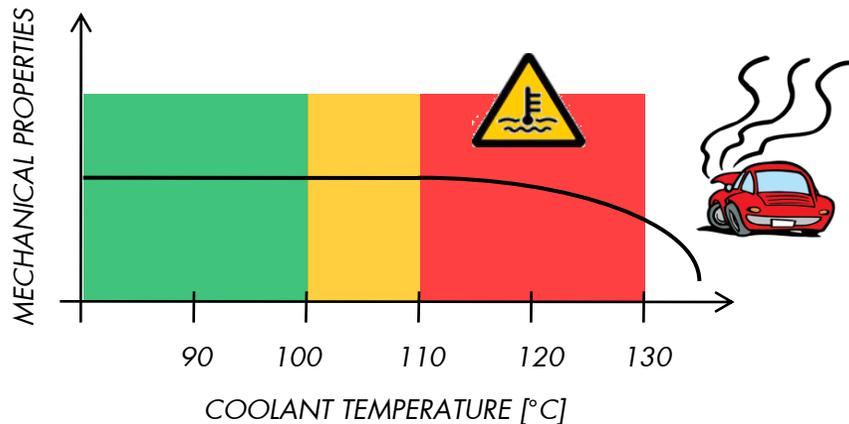
Nylon 6,6 >PA66-GF30< *	EN ISO 11469
Polyphenylsulfide >PPS-GF40< **	EN ISO 11469

MECHANICAL PROPERTIES

	PA66-GF30	PPS-GF40
T of deflection under load [°C]	250	270
Density [g/cm ³]	1.36	1.66
Tensile stress @ break [MPa]	175	210
Flexural strength [MPa]	280	290

* nylon 6,6 reinforced with 30% fiber glass

** polyphenylsulfide reinforced with 40% fiber glass



The data in the technical sheets refer to air as a working environment; talking about water pumps the plastic impeller working in a coolant (mixture of ethylene glycol and water in a ratio of 1:1).

PA66-GF30 is resistant to coolant at 108°C (in normal operating conditions the engine temperature is ~ 95°C), which means that no modification at all will take place until this working temperature. This requirement coming from the main car manufacturers specifications: in fact this material has been successfully used in vehicle cooling circuits for many decades, so it goes without saying that it is appropriate for its intended use in normal operating conditions.

Over this temperature its mechanical characteristics will start to lower: the higher the temperature, the less time you need to reach the condition when the impeller fails.

Obviously a sufficient level of mechanical properties following storage in coolant at 120 or 130°C is desired. As a reference, the material has been tested following immersion in coolant at 130°C. The table shows the properties after 10/21/42 days of forced aging.

PROPERTIES AFTER "FORCED AGING"

PA66-GF30	10 d	21 d	42 d
Weight increase [%]	10	11	11
Tensile stress @ break [MPa]	75	66	32
Flexural strength [MPa]	107	84	36

If the operating conditions are not the expected ones, other external factors, which are out of any possible control, will affect the impeller life.

In particular, coolant pollution (by rust, dirt, incrustations, etc.) will affect the chemical properties of the coolant.

The coolants recommended by automotive manufacturers are **not only antifreeze**. They vary due to the different requirements in terms of chemical and physical compatibility with the various materials which make up the cooling system, which include a very wide range of metals, polymers, rubbers and ceramic materials.

If the chemical properties of the coolant are modified by an external factor, it might no longer be compatible with the impeller material, which will fail after a short time.

In any case, never forget that all the vehicles produce warning signals (leaks, noise, over-heating of coolant) that should alert the driver to the malfunction; that enables to repair the fault before it produce more serious damages.

We can conclude that when the impeller breaks because of lowered mechanical properties, it can only be due to:

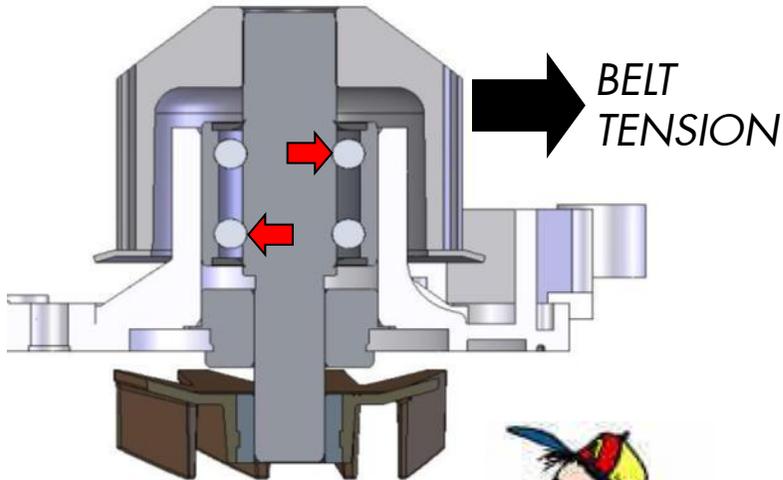
- 1) coolant temperature $> 130^{\circ}\text{C}$
- 2) coolant temperature within 110°C and 130°C for a long time
- 3) coolant temperature $< 110^{\circ}\text{C}$ with inadequate coolant

In any of these cases we consider ourselves not responsible.

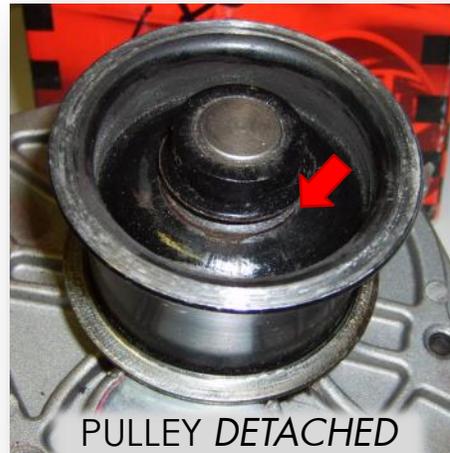


OVERLOAD

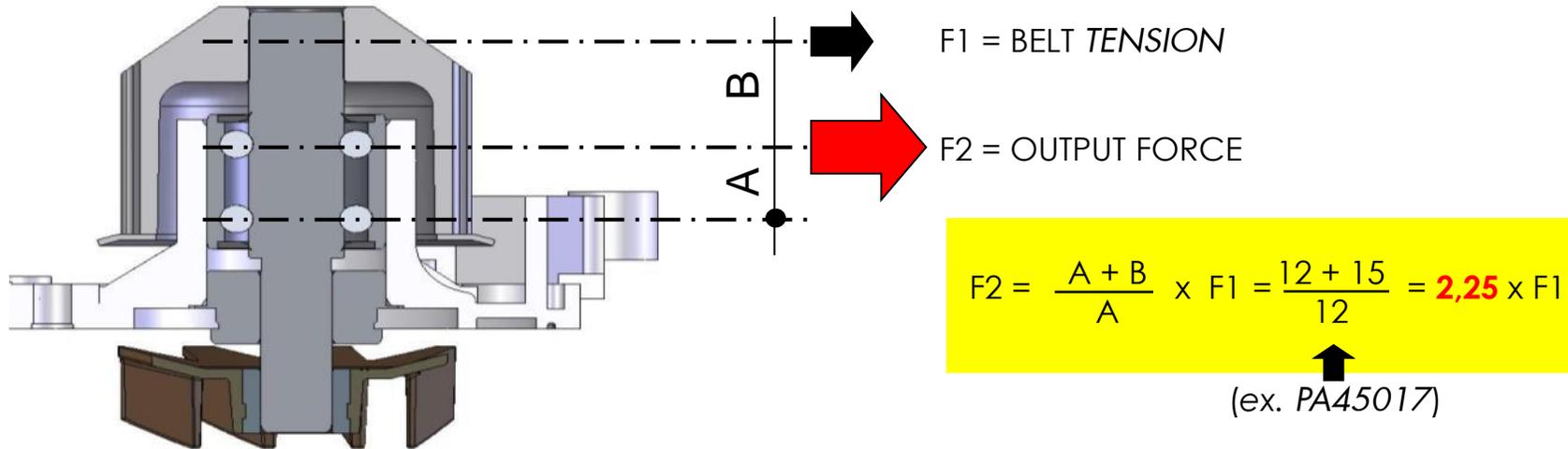
A wrong tension of the belt is still a quite common reason for failure, even if the widespread use of automatic tensioners *might* lead to believe that it is impossible to set up the belt tension wrongly. Failure of the timing belt often involves huge repair costs and that's why mechanics don't like to take their responsibility about this.



CASES OF FAILURE DUE TO OVERLOAD



When one of these situations happen, the bearing analysis can tell us if a condition of overload actually existed: in fact the bearing works as a second-class lever (nutcracker) where the row of balls on impeller side is the "fulcrum", the belt tension is the "input effort" and the row of balls on pulley side generates the "output load".



When a condition of overload exists, the rolling elements of the bearing will show signs of overheating. If the bad working condition is protracted and/or combined with other bad working conditions (for example a leaking mechanical seal, with coolant seeping into the bearing), the rolling elements will start to degrade, showing signs of rust, pitting and corrosion.



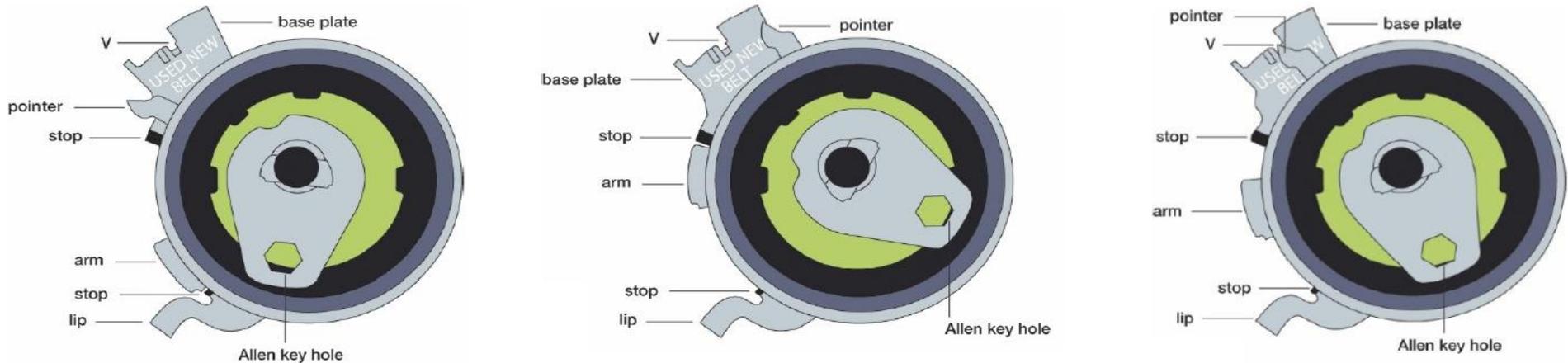
AUTOMATIC TENSIONERS

Belt drive systems for both timing and accessory drive can have different tensioning systems. In the past, engines used a manual tensioner (or eccentric pulley) which had to be installed and then locked in place. Over time the belt tension would change as there is no adjustment of the tensioner after the initial installation. Nowadays, automatic tensioners are being used to maintain an almost constant belt tension.

Although the drive is equipped with an automatic tensioner, this still has to be set up correctly. If the tension is not set up correctly, the tensioner will maintain the wrong tension over time. When the vehicle is released with a wrong positioned tensioner, severe engine damage will happen sooner or later.

As many branded belt manufacturers keep saying:

just because there's an automatic tensioner doesn't mean it's working right!



WHOSE RESPONSIBILITY?

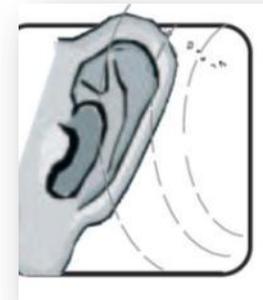
When we dismantled a pump because its bearing had failed we almost always stated that the fault was not due to a sudden break but to a protracted bad working condition.

All the vehicles produce warning signals (leaks, noise, over-heating of coolant) that should alert the driver to the malfunction; that enables to repair the fault before it produce more serious damages.

This is why, anyhow, we consider us not liable for damages that could have been avoided simply by paying attention to warning signals.



NO LEAK OR NOISE
DETECTED BEFORE
THE ENGINE CRASH?



IDROMEC COOLANTS

Given the importance of the coolant in the operation of the water pump, Idromec decided to insert among its own products a range of quality coolants free from substances toxic for health such as Nitrites, Phosphates and Borates and completely biodegradable.

Our coolants, diluted 1:1, lower the freezing point to -40°C and at the same time raise the boiling point to $+110^{\circ}\text{C}$, protecting from limestone, rust and erosion.

Our coolants contain proper corrosion inhibitors in the percentages indicated by car producers; however, the inhibitors guarantee the proper protection if the dilution percentages are greater than 30% and lower than 50%.

DILUTION	FREEZING POINT	BOILING POINT
10% vol.	-4°C	102°C
20% vol.	-9°C	104°C
30% vol.	-17°C	106°C
40% vol.	-26°C	108°C
50% vol.	-38°C	110°C

SPECIFICATION	COMPLYING
Renault 41-01-001/q	✓
VW TL 774 D (G 12)	✓
Mercedes MB 325.3	✓
GM US 6277 M	✓
Ford ESE M97B49-A	✓
SEAT	✓
SKODA	✓

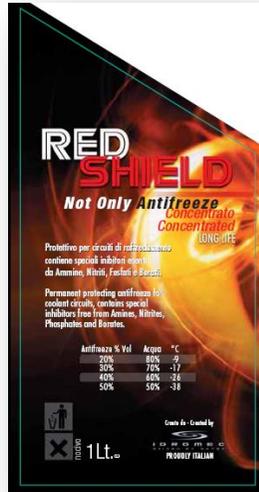
Our coolants, thanks to the fact that they are based on pure monoethylene glycol and thanks to the advanced formulation of the inhibitors, are highly reliable products towards metallic and non-metallic materials forming the cooling circuit: they are in compliance with the ASTM D3306 specification that establishes the requirements according to which antifreezes based on monoethylene glycol protect from corrosion and they are in compliance with the specifications of the main car producers.

IDROMECC COOLANTS



PA31001
mileage: 10.000 km

INADEQUATE COOLANT



PA30090
mileage: 100.000 km

QUALITY COOLANT

APPENDIX C - COMPARISON WITH COMPETITORS



FOREWORD

Our laboratory carried out a full comparison (Idromec vs. COMPETITORS A and B) of the dimensional and performances. The analysis has been carried out following Idromec Specifications for the parts approval I7-12.02, which complies with Fiat Auto Specifications 9.02320/01. Purpose of this Specifications is to outline the characteristics the water pumps have to meet for the validation of a new part approval and to identify the tools to be used for the tests and the methods to be applied for measuring these characteristics.

IDROMECC - PA37034

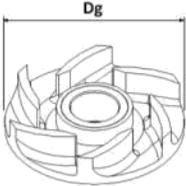
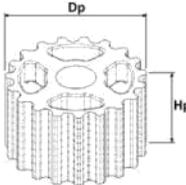


COMPETITOR A



COMPETITOR B



	IDROMECC - PA37034	COMPETITOR A	COMPETITOR B
	Pulley side diam. = 15.008 mm Impeller side diam. = 15.008 mm Outer ring diameter = 30 mm Outer ring height = 38.9 mm INNER STRUCTURE: roller-ball	Pulley side diam. = 15.008 mm Impeller side diam. = 15.008 mm Outer ring diameter = 30 mm Outer ring height = 36 mm INNER STRUCTURE: roller-ball	Pulley side diam. = 15.918 mm Impeller side diam. = 15.918 mm Outer ring diameter = 30 mm Outer ring height = 36,5 mm INNER STRUCTURE: roller-ball
	Outer diameter = 36.6 mm Inner diameter = 14.9 mm COUNTERFACE: Al ₂ O ₃ - C	Outer diameter = 36.6 mm Inner diameter = 14.9 mm COUNTERFACE: Al ₂ O ₃ - C	Outer diameter = 36.6 mm Inner diameter = 15.9 mm COUNTERFACE: Al ₂ O ₃ - C
	Outer diameter = 62 mm Number of vanes = 9 MATERIAL: PA66-GF30 Weight: 27 g	Outer diameter = 62 mm Number of vanes = 8 MATERIAL: <i>steel plate</i> Weight: <i>52 g</i>	Outer diameter = 62 mm Number of vanes = 8 MATERIAL: <i>steel plate</i> Weight: 49 g
	Centering diameter = 50 mm Threaded holes = 3 x M8 Interaxis = 68 mm MATERIAL: sintered steel	Centering diameter = 50 mm Threaded holes = 3 x M8 Interaxis = 68 mm MATERIAL: sintered steel	Centering diameter = 50 mm Threaded holes = 3 x M8 Interaxis = 68 mm MATERIAL: sintered steel

The main differences, highlighted in red, are:

the impeller material and weight (COMPETITOR A is 92% heavier)

the number of vanes of the impeller (IDROMECC is bigger)

VISUAL ANALYSIS

Specifications requirements: the pumps must be free from dents, burrs and any other defects which might jeopardize fitting and correct working.

	RESULT	NOTES
IDROMECC	OK	No defects/anomalies
COMPETITOR A	OK	No defects/anomalies
COMPETITOR B	OK	No defects/anomalies

STATIC LEAK TEST AT ROOM TEMPERATURE

Specifications requirements: fit the pump on the test bench for leak test; close all the holes (beside the drain hole) and process the pump for 30 s with an internal pressure of 1.5 bar *. No leaking (no drops) is admitted at the drain hole.

[* working pressure on a car is ~ 0.7 bar]

	RESULT	NOTES
IDROMECC	OK	No leak detected
COMPETITOR A	OK	No leak detected
COMPETITOR B	OK	No leak detected



STATIC LEAK TEST AT -20°C

Specifications requirements: fit the pump on the test equipment filled with cooling liquid; put the pump inside the freeze room and set the temperature to -20 °C; process the system for **30 minutes** with an internal pressure of **1.5 bar**. No leaking (no drops) is admitted at the drain-hole.

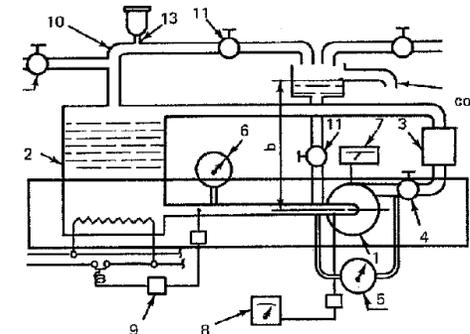
	RESULT	NOTES
IDROMECC	OK	No leak detected
COMPETITOR A	OK	No leak detected
COMPETITOR B	OK	No leak detected



DYNAMIC LEAK TEST

Specifications requirements: fit the pump on the test bench and set the temperature to +90 °C; when the room temperature is stable close the outlet valve and process the pump for **5 minutes** with an outlet pressure of **1.5 bar**. No leaking (no drops) is admitted at the drain-hole.

	RESULT	NOTES
IDROMECC	OK	No leak detected
COMPETITOR A	OK	No leak detected
COMPETITOR B	OK	No leak detected



PERFORMANCE TEST

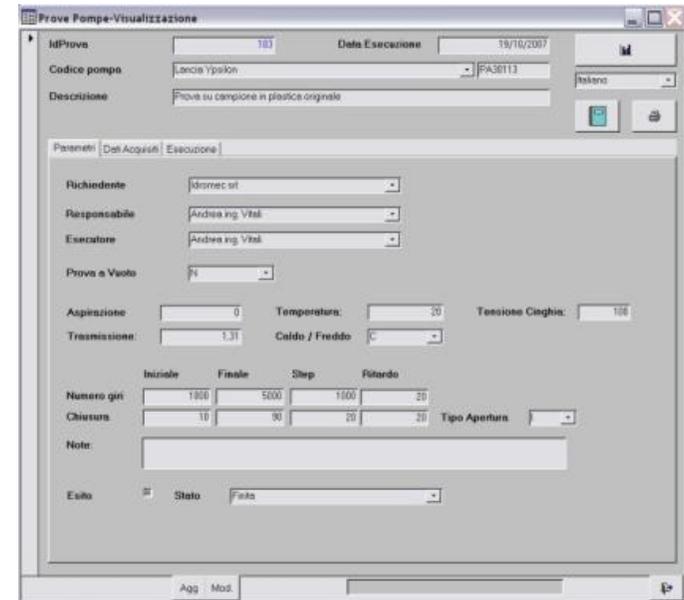
Specifications requirements: fit the pump on the test bench and, with the inlet valve fully open, set the temperature to **+25 °C**; at various values n_i of the speed of rotation*, detect the curve head H / flow rate Q .

Carry out the same test in the same conditions on the OE sample and compare the curves: the values detected on the sample under test must be within **± 7%** of the ones detected on the OE sample.

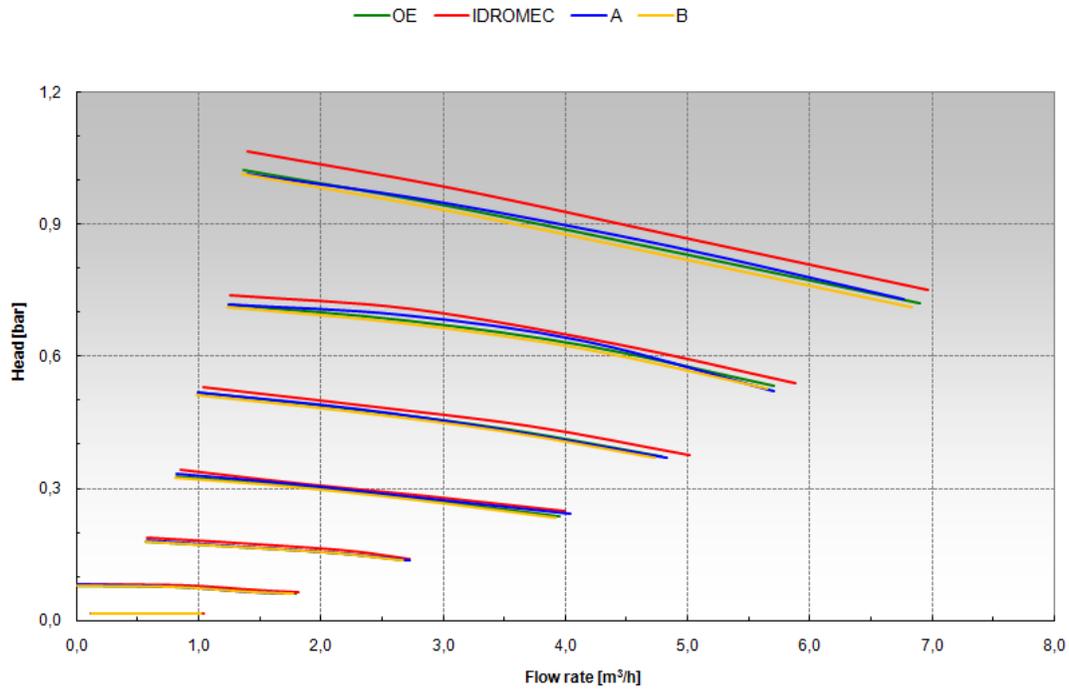
[* here: from 1000 rpm to 7000 rpm]



Picture of the test bench for performance test



Control panel of the test bench for performance test



	RESULT	NOTES
IDROMECC	OK	+3 % compared to OE
COMPETITOR A	OK	+0 % compared to OE
COMPETITOR B	OK	-1 % compared to OE

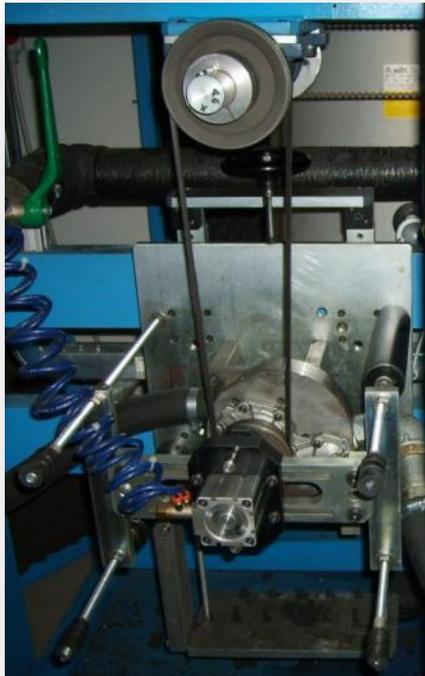
IDROMECC, COMPETITOR A and COMPETITOR B pumps are within the acceptance limit.

LIFE TEST

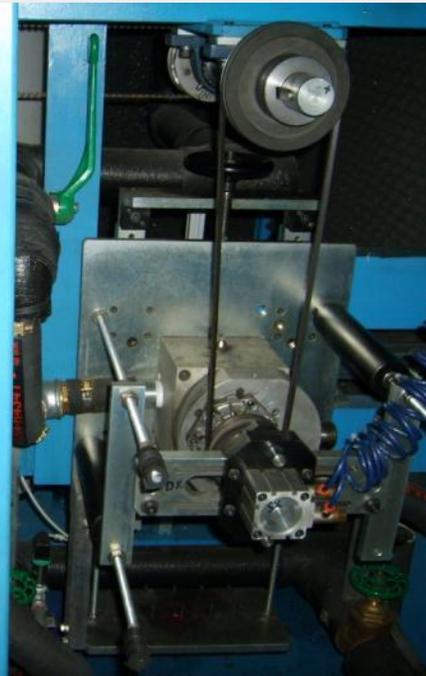
Specifications requirements: fit the pump on the test bench and set the temperature to $+90\text{ }^{\circ}\text{C}$. Process the pump at 6000 rpm for 500 h under a load of 50 daN .

During the test the pump should not give rise to any incidents.

IDROMECC - PA37034



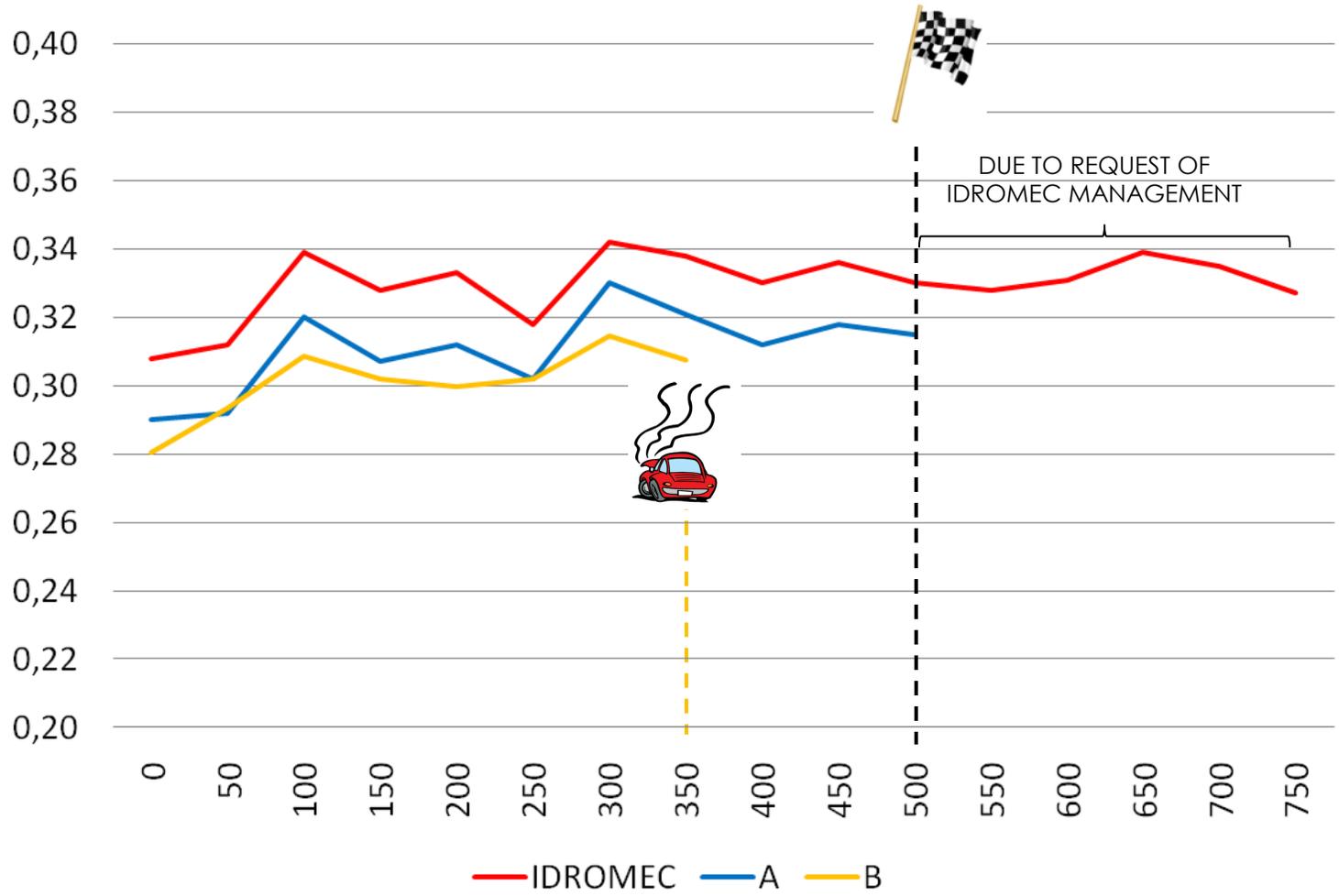
COMPETITOR A



COMPETITOR B



$6000 \text{ rpm} \times 500 \text{ h} = 240 \text{ km/h} \times 500 \text{ h} = \mathbf{120.000 \text{ km}}$
 $6000 \text{ rpm} \times 750 \text{ h} = 240 \text{ km/h} \times 500 \text{ h} = \mathbf{180.000 \text{ km}}$



IDROMECC - PA37034



IDROMECC	RESULT	NOTES
PA37034	OK	No leak detected

COMPETITOR A



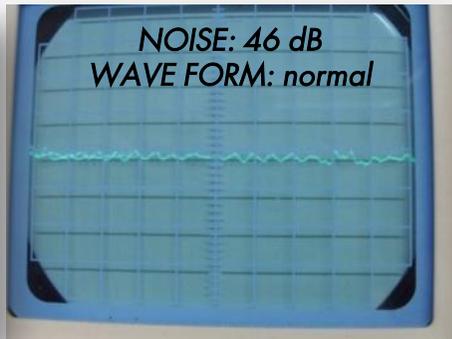
COMPETITOR A	RESULT	NOTES
PA37034	OK	No leak detected

COMPETITOR B



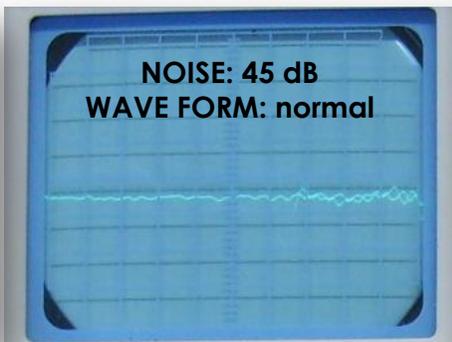
COMPETITOR B	RESULT	NOTES
PA37034	NO	Leaking after 374 h

IDROMECC - PA37034



INNER STRUCTURE:
6 balls $\varnothing 6.345$
9 rollers $\varnothing 4.80 \times 11.8$
HARDNESS:
shaft - 61.0 HRC
raceway - 62.5 HRC
balls - 61.0 HRC
rollers - 61.5 HRC

COMPETITOR A



INNER STRUCTURE:
6 balls $\varnothing 6.345$
9 rollers $\varnothing 5.00 \times 8.0$
HARDNESS:
shaft - 61.5 HRC
raceway - 63.0 HRC
balls - 61.0 HRC
rollers - 61.0 HRC

COMPETITOR B



INNER STRUCTURE:
6 balls $\varnothing 6.345$
10 rollers $\varnothing 4.50 \times 8.0$

GENERAL CONCLUSIONS

The **dimensional results** brought to light no differences about dimensions that we regard as critic.

The **material results** brought to light no differences at all in the body, bearing, mechanical seal and flange materials.

For the impeller IDROMECC uses PPS-GF40, while COMPETITORS A and B uses steel plate.

BRASS AND STEEL PLATE IMPELLERS ARE THE PAST, PA66-GF30 AND PPS-GF40 ARE THE FUTURE

In fact almost all the car manufactures require PA66-GF30 and PPS-GF40 impellers for the OES water pumps.

The **functional tests results** brought to light

- no differences between IDROMECC and COMPETITOR A
- **important differences** between IDROMECC and COMPETITOR B, in fact:

COMPETITOR B's pump began to leak after 374 h , the bearing was noisy and showed signs of overheating which means that it was going to fail

IDROMECC pump began to leak after 780 h , the bearing was still working correctly.