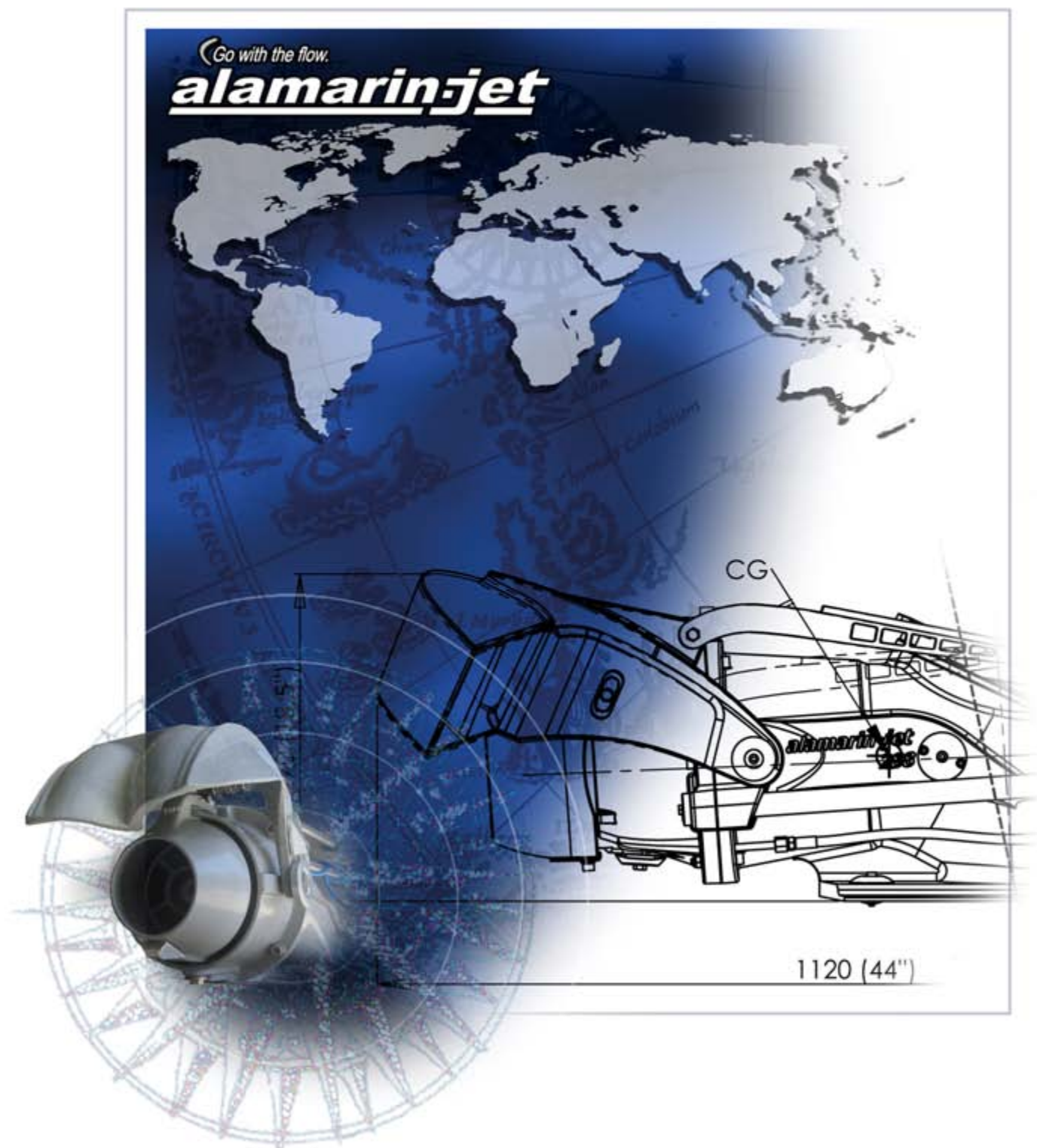


# ***Designer's manual***





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## **1. Introduction**

This is the designer's manual for Alamarin-Jet's water jet propulsion units. This manual is intended for boat designers to help in the design of boats that use Alamarin-Jet water jet propulsion units.

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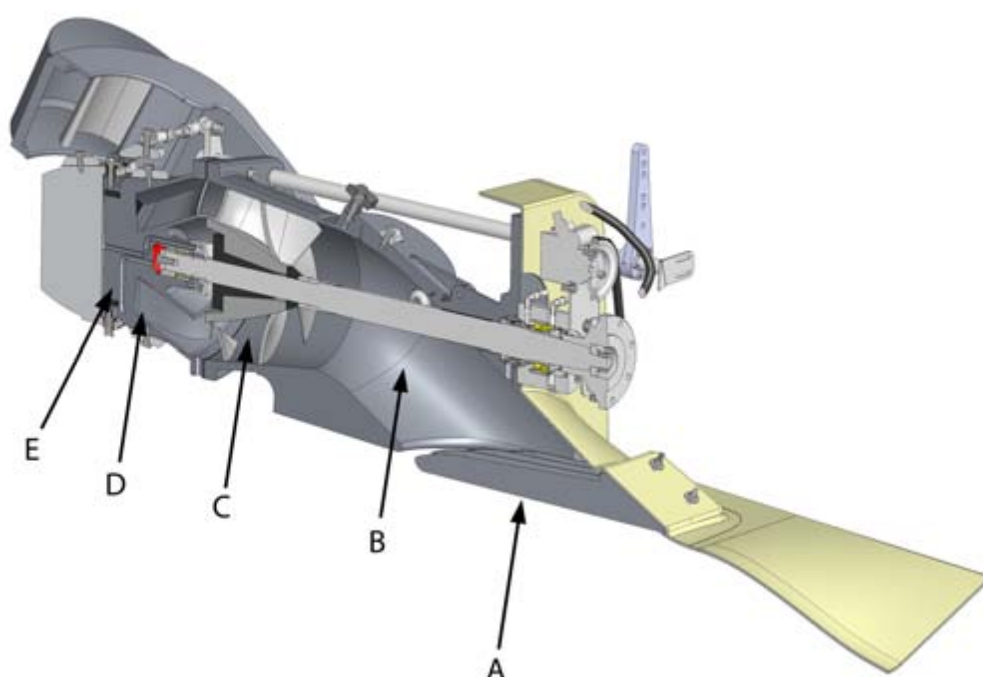
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## 2. General information about water jet propulsion units

The Alamarin-Jet water jet propulsion unit\* is a high-quality propulsion unit for boats. It is a single-stage axial flow pump which produces a high-volume flow rate and thrust with high efficiency. The jet is located at the back of the boat and receives pump water through an intake at the bottom of the boat (figure 1, section A). The intake duct (figure 1, section B) leads the water onto the impeller (figure 1, section C) with minimal loss in efficiency and the impeller raises the pressure of the water. This pressure is transformed into flow rate in the nozzle (figure 1, section E). The stator located before the nozzle (figure 1, section D) straightens the flow.

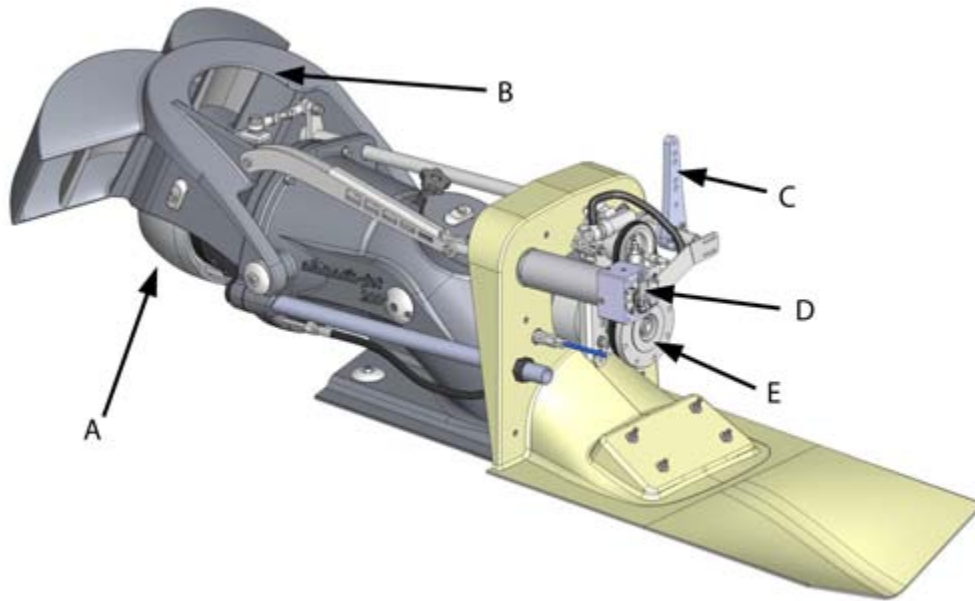
The change in the flow rate creates a reactive force in the direction of the flow, which thrusts the boat forward.



**Figure 1. Cross-section of the jet**

The jet is extremely safe since the impeller rotates while protected inside the jet, and the grill in front of the water intake prevents large objects from entering the intake duct.

\*also referred to as a "jet"



**Figure 2. Steering and control system**

- A Steering device (Steering nozzle)
- B Controlling device (reversing deflector)
- C Steering lever
- D Controlling device for the reversing deflector
- E Coupling flange

By changing the direction of the jet flow, the boat can be steered in the desired direction. This occurs by means of the steering and control system. The jet flow can be directed to the left or right of the centre line with the steering nozzle, while the reversing deflector can be used to direct the jet flow to the bow of the boat, reversing propulsion and causing the boat to move in reverse. The reversing deflector can also be used to keep the boat stationary – even when the jet shaft is rotating and generating thrust (middle position). The various combinations of these settings give the jet a degree of control beyond compare. For example, the boat can be rotated round its vertical axis while stationary. Moreover, a boat equipped with two jets can move sideways without the aid of bow thrusters.

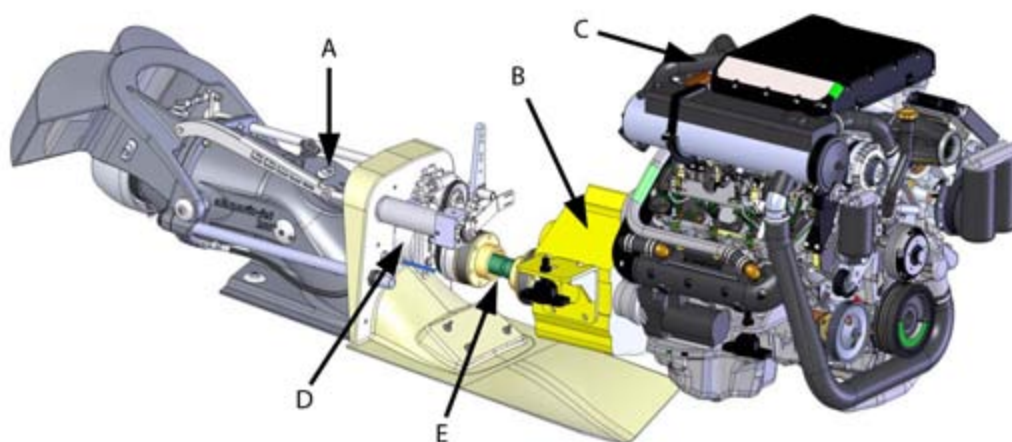
The impeller is usually powered by a high-speed diesel engine. Petrol engine installations are also possible. The engine is connected to the coupling flange with the intermediate shaft. Dedicated pressure bearings are not required, since the front bearing functions as a two-way pressure bearing.

Some engines require the use of a reduction gear that matches the power/RPM coverage areas of the engine with those of the jet. Alamarin-Jet jets feature a conical impeller housing. Thanks to this feature, the power of the jet can be adjusted by changing the diameter of the impeller. This way, the jet can be precisely matched with the type of engine used. A reduction gear can also be used if you want a true neutral gear for the jet – i.e. a setting in which the shaft of the jet stops rotating.

A gearbox can also be used to flush the intake duct in reverse, cleaning the jet of litter and other clogging that reduces water flow (for example chunks



of ice). The intake duct can also be cleaned through the inspection hatch. For installation and safety reasons, the inspection hatch is located outside the boat in all Alamarin-Jet propulsion units.

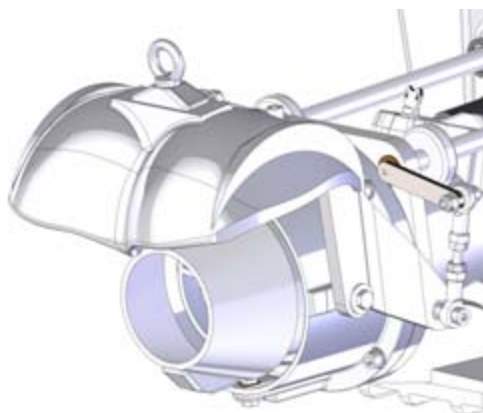


**Figure 3. Power line**

- A Inspection hatch
- B Marine gear
- C Engine
- D Pressure bearing
- E Intermediate shaft

Different reversing deflectors are available for each jet model (see table 3. *Technical specifications of the jet models*, page 7).

The basic difference between round-type and tube-type deflectors is their width. Tube-type deflectors provide better reverse thrust. The Jet-230 model can be equipped with either a round-type or a tube-type deflector, but other models can only be equipped with one or the other. In the reverse position, a round-type deflector might splash water upwards, so it is recommended to use a safety platform (for example, a swimming platform outside the stern) above the jet.



**Figure 4. Round-type reversing deflector**



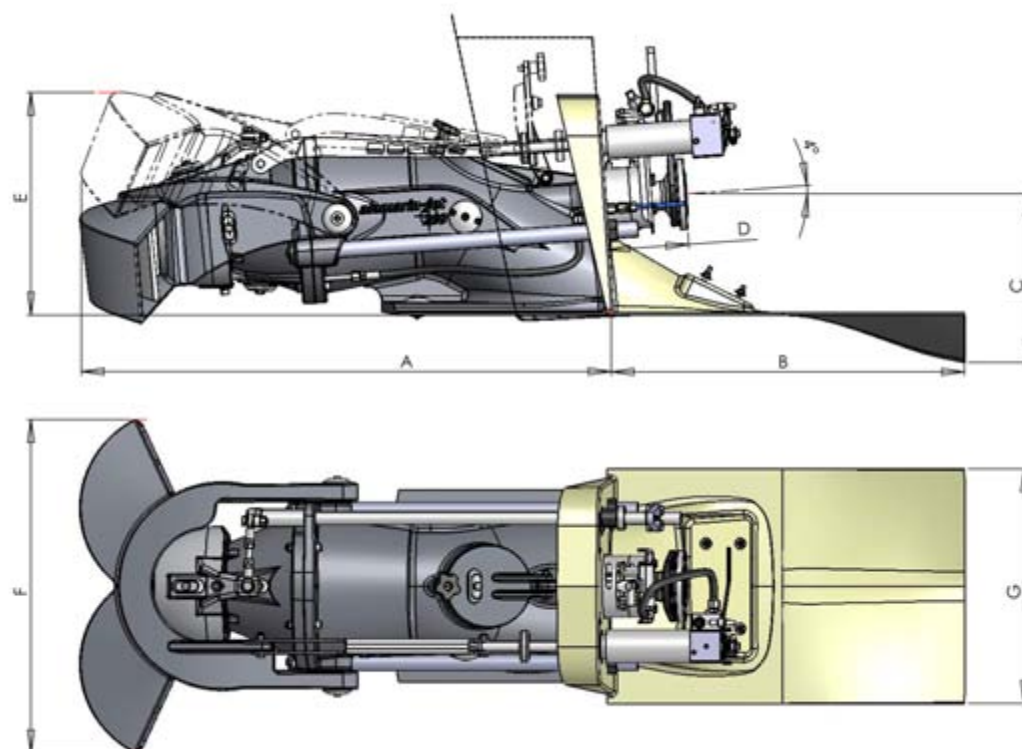
**Figure 5. Tube-type reversing deflector**

## **2.1. Advantages of the jet**

Alamarin-Jets jets provide the following advantages as compared to traditional thrusters:

- no breakable equipment below the bottom of the boat, low draft
- reliable
- no propellers mean people in the water are safe from harm
- superior maneuverability
- good acceleration, high efficiency at fast speeds
- a mechanically simple device; easy to service, low maintenance costs
- low risk of engine overload
- steering movements do not load the gearbox (forward-reverse)
- can often be connected directly to the engine without having to use a reduction gear
- conical impeller duct, easy to adjust impeller gap
- installation requires little space in the engine compartment

### 3. Technical specifications of the jet models



**Figure 6. Dimensions of the jet models**

**Table 1. Dimensions of the jet models**

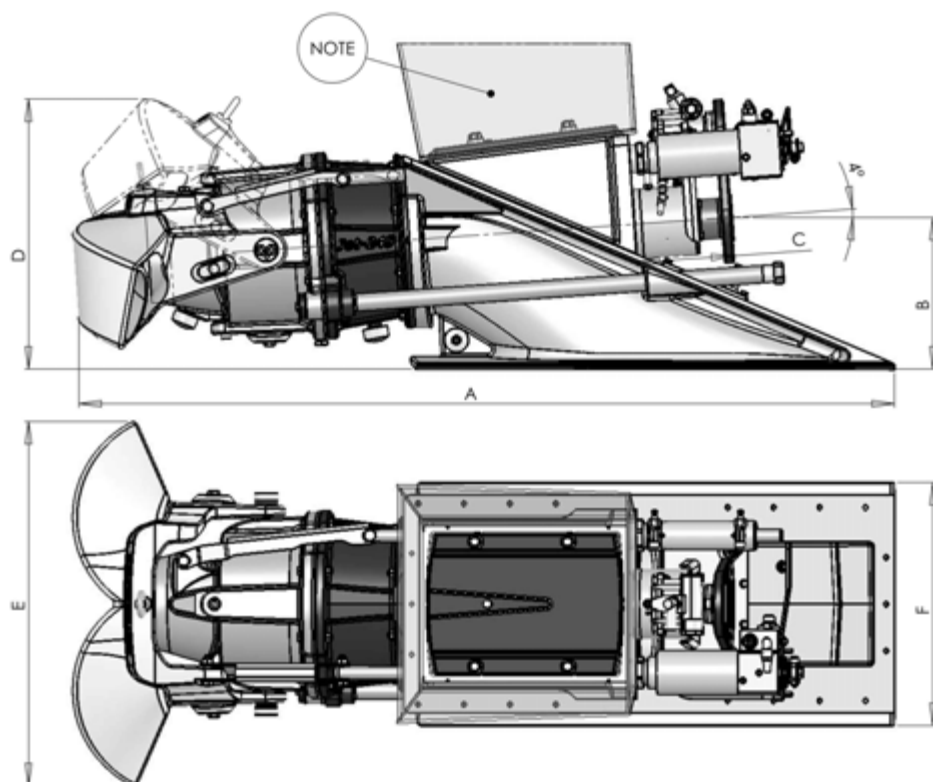
	Jet-160	Jet-180	Jet-185	Jet-230	Jet-288
A [mm/in]	Max. 665/26.2*	max. 755/29.7*	max. 777/30.6*	max. 788/31*	max. 1120/44*
B [mm/in]	560/22	589/23.2	589/23.2	max. 587/23.1*	max. 747/29.4*
C [mm/in]	215/8.5	240/9.4	240/9.4	287/11.3	356/14
D [mm/in]	138/5.4	139/5.5	139/5.5	177/7	173/6.8
E [mm/in]	395/15.6	405/15.9	405/15.9	452/17.8	470/18.5
F [mm/in]	305/12	320/12.6	320/12.6	max. 678/26.7**	704/27.7
G [mm/in]	305/12	306/12	306/12	358/14.1	495/19.5
Dry weight [kg/lb]	38/84	48/105	50/110	79/174**	120/265

\*the positioning of the jet can vary

\*\*depends on the type of reversing deflector used

#### *Dimensions of combi-frame jet models*

Combi-frame refers to a frame solution that allows the jet to be installed in two different depths into the boat's hull. In one option, the inspection hatch is placed inside the boat, while in the other, it is placed outside the boat.

**Figure 7. Dimensions of combi-frame jet models****Table 2. Dimensions of combi-frame jet models**

	Jet-245
A [mm/in]	1307/51.5
B [mm/in]	243/9.6
C [mm/in]	156/6.1
D [mm/in]	433/17
E [mm/in]	584/23
F [mm/in]	390/15.4
Dry weight [kg/lb]	95/209

NOTE: The inspection hatch must be equipped with an elevation collar in short tail installation (see figure 10 in section 6. *Installing the jet*, page 15) if the waterline is above the inspection hatch cover. The final height must be checked during installation.

**Table 3. Technical specifications of the jet models**

	Jet-160	Jet-180/ Jet-185	Jet-230	Jet-245	Jet-288
Impeller max. diameter [mm/inch]	186/7.3	192/7.6 197/7.8	228/9	245/9.6	288/11.3
Max. power [kW/ mhp]	100/136	110/150 120/163	190/260	235/320	330/450
Max. RPM	5000	5000	4500	4600	3700
Max. boat* mass (per jet) [kg/lb]	1000/ 2200	1700/ 3700	3000/ 6600	3500/ 7700	5000/ 11000
Impeller direction of rotation	Counterclockwise (looking towards the bow of the boat)				
Front bearing	Two-way pressure bearing, grease lubrication			Two-way pressure bearing, oil lubrication	
Front bearing seal	Shaft seal			Mechanical seal	
Rear bearing	Slide bearing, grease lubrication			Needle bearing, grease lubrication	Needle bearing, automatic grease lubrication
Rear bearing housing seal	Shaft seal				
Coupling flanges**	CV-10, SAE 1310		CV-15, CV-21, DIN-120, SAE 1410, R&D,	DIN-120, several adapters	DIN-150, several adapters
Inspection hatch	Outside the boat			Chosen freely	Outside the boat
Reversing deflectors	Round-type		Round- type, tube-type 2	Tube-type	
Reversing deflector control	Electronic		Manual hydraulic		
Steering	Manual			Hydraulic	Manual
Electronic steering	-		Intelligent Operation		
Raw water connector	1 pcs ¾” BSP, in the engine room				2 pcs 1” BSP in the engine room
Surface finish	Epoxy-polyester				
Material	AlSi7Mg aluminium casting, stainless steel 1.4404, 1.4460, 1.4462, bronze GTp10				
Corrosion protection	Passive cathodic protection, zinc and aluminium anodes				
Mounting templates	Aluminium, fibreglass				

\*sliding frame \*\*other options available upon request



## **4. Contents of delivery**

### **4.1. Standard delivery**

- An impeller adjusted to the engine and gearbox (bronze for Jet-160-Jet-230 and stainless steel for Jet-288)
- A coupling flange for the most common shaft types
- Raw water intake (2 pcs. for Jet 288, the second one can be used for cleaning the ship's deck, for example)
- Mechanical control for the steering nozzle (all models except Jet-245, which comes equipped with hydraulic control)
- Hydraulic deflector control (Jet-230, Jet-245 and Jet-288), pump, reservoir, cylinder, hoses (excluding the oil return hose, which is part of the extra cooler package)
- Electronic deflector control (Jet-160, Jet 180/185)
- Grease-lubricated rear bearing (enables dry running)
- Automatic lubrication unit for the rear bearing (Jet-288 only)
- Installation screws
- Connection rod for twin installation
- Manuals

### **4.2. Essential accessories**

Available from Alamarin-Jet.

- Cable or hydraulic control kit
- Remote control for the engine, gearbox and reversing deflector
- Separate oil cooler for the hydraulic use of the reversing deflector OR oil hose kit for the engine cooler (in some cases, an unused engine cooler position can be used)
- Intermediate shaft and possible adapter flanges (Jet-288 includes an adapter in the standard delivery)
- Raw water equipment kit (when engine coolant water is taken from the jet)
- Mounting template

### **4.3. Other accessories**

- Intelligent Operation control system
- Mechanical deflector control (Jet-160, Jet 180/185)
- Emergency steering lever
- Emergency control holder for the reversing deflector
- Toolkit
- Automatic lubrication unit (Jet-245)

### **4.4. Booster use**

When a jet is to be used only to increase thrust (the middle jet in a triple installation), you can also order a jet without steering and control systems. Technical details are project-dependent. Please contact Alamarin-Jet for more information.

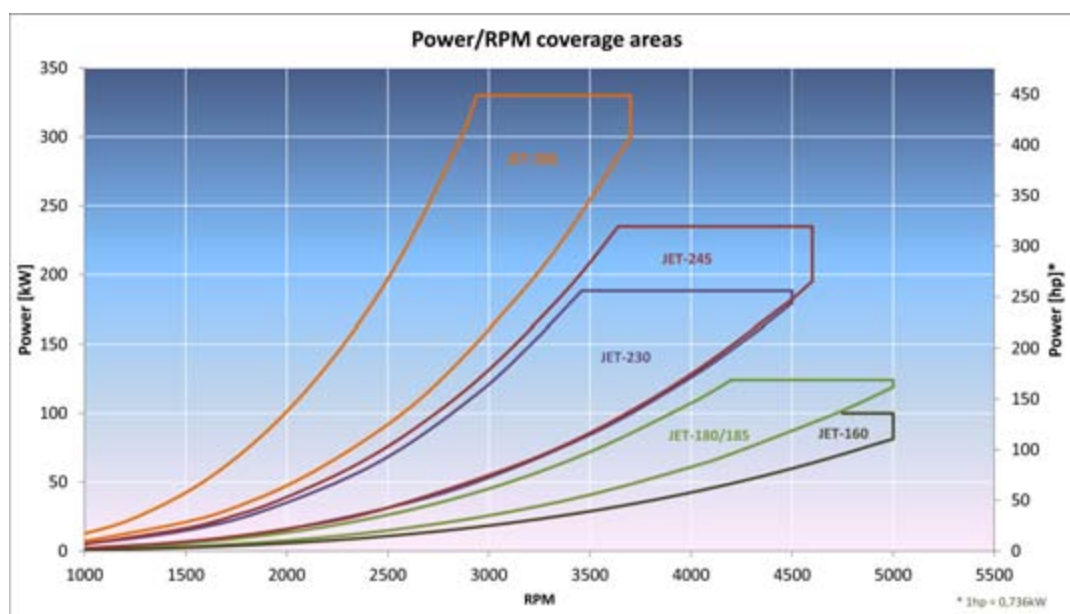


## 5. Operating specifications

### 5.1. Calculating boat speed

Alamarin-Jet estimates a boat's speed based on the information provided. Please fill in the Application Questionnaire (at the end of this manual) and send it to [sales@alamarin-jet.com](mailto:sales@alamarin-jet.com).

### 5.2. Choosing an engine



**Figure 8. Power/RPM coverages of the various jet models**

In most cases, a jet can be used directly without a gearbox or with a 1:1 gearbox. However, if a suitable impeller is not available, a gearbox must be used to adjust the RPM of the engine to correspond with the jet.

For example:

A Mercruiser 8.2 HO engine is used together with a Jet-288

The engine's power/RPM is 317kW/4400-4800.

In this case, a ZF220 1.5:1 reduction gear can be used, which reduces the maximum RPM of the shaft to ~2900rpm. The calculation assumes a power loss of 3% to the gearbox.

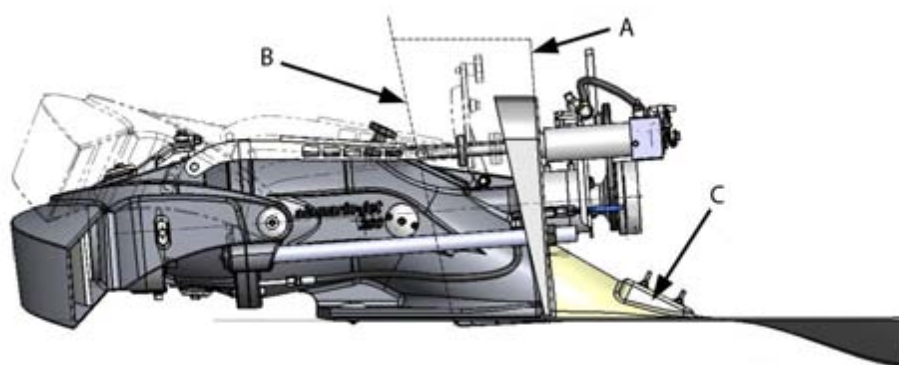
Please contact Alamarin-Jet for more information and to make sure the system is operating optimally.



## 6. Installing the jet

Because of the installation method, Alamarin-Jet jets take very little space inside the boat. This optimises the use of space, since the engine can be placed very close to the stern. However, if you wish to minimise the length of the jet behind the stern, the collar of the mounting template can be used to bring the jet deeper into the hull. With some jet models, it is possible to bring the entire jet inside the hull. This is only possible when a round-type deflector is used. The new combi construction makes it possible to place the inspection hatch either on the inside or the outside of the boat.

### *Jet installation options with the traditional frame*



**Figure 9. Jet installation options with the traditional frame**

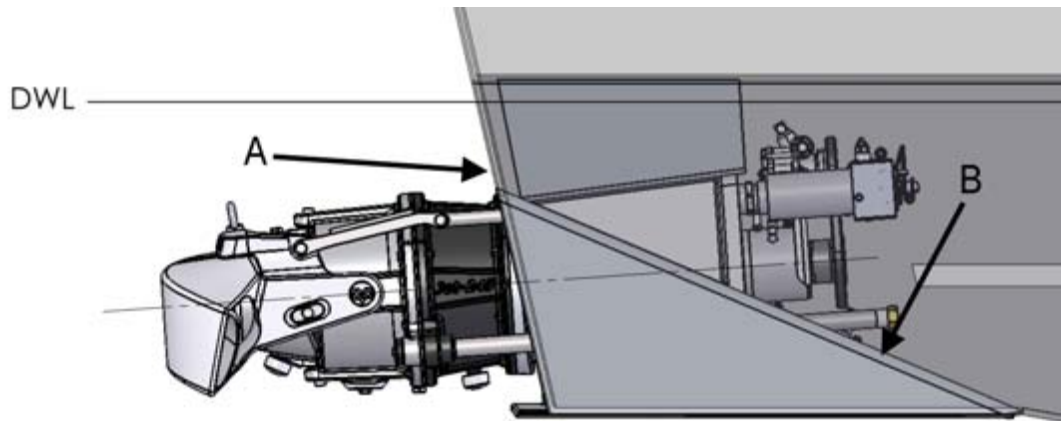
- A Stern, option 1
- B Stern, option 2
- C Mounting template

### *Jet installation options with the combi-frame*

With a combi-frame, there are two primary installation methods available. Both methods have their advantages, and it is up to the boat designer to decide which method is best suited for each boat.

#### *Short tail installation*

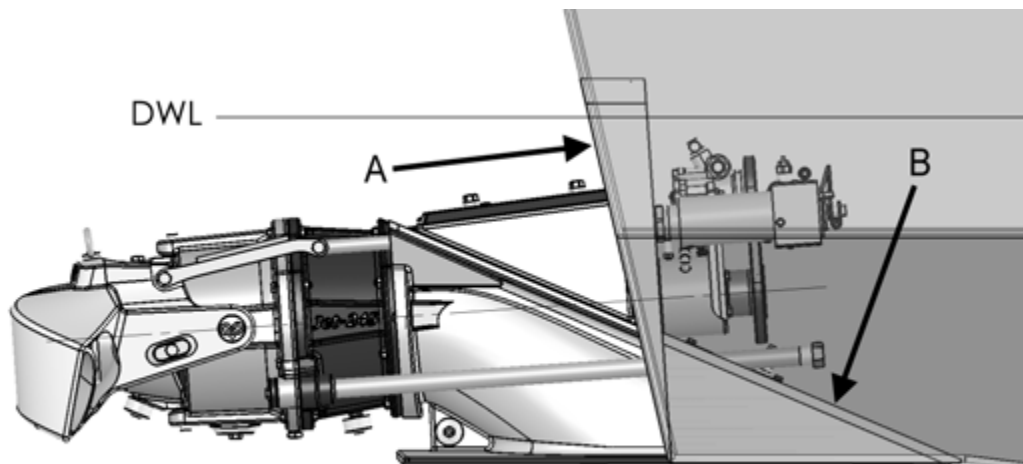
This installation method minimises the installation length of the jet outside the boat. At the same time, the jet's inspection hatch ends up inside the boat, which makes it safer to clean the intake duct on rough seas.

**Figure 10. Short tail installation**

- A Stern
- B Mounting template

#### *Long tail installation*

This installation method minimises the installation length of the jet inside the boat so the engine can be installed closer to the stern of the boat. The jet's inspection hatch ends up outside the boat, which reduces the risk of sinking due to a water leak.

**Figure 11. Long tail installation**

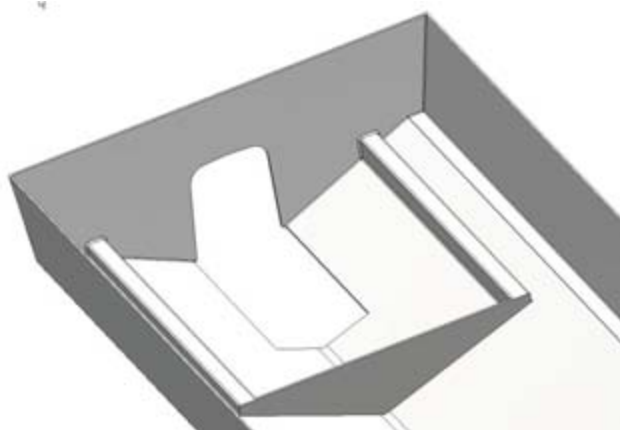
- A Stern
- B Mounting template

Installing an Alamarin-Jet jet is extremely simple. In reinforced plastic boats, the mounting template can be moulded directly to the hull when the boat is manufactured. In this case, installation consists of simply fitting the jet onto the installation surface. For aluminium boats, a mounting template is welded onto the stern and the jet is then attached to the template.

## 6.1. Mounting template

Before installing the jet, a mounting template must be attached to the boat. This can be done in the following ways:

- by cutting a hole on to the hull of the boat (bottom and stern) (see figure 12) and attaching the mounting template to it by either laminating, welding (aluminium) or bolting (steel, polyethylene)
- by adding the mounting template to the hull mould of the boat when it is manufactured, in which case the end-result will be more consistent

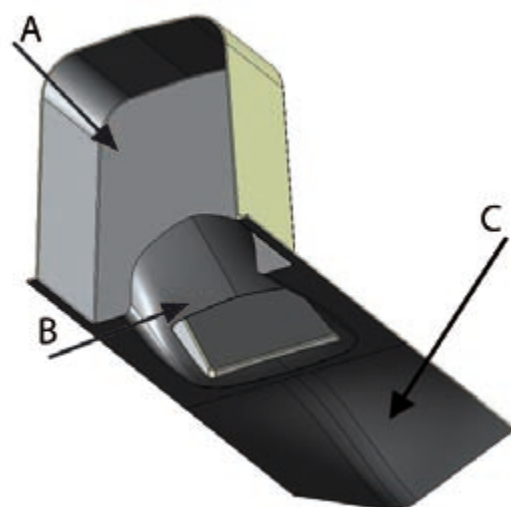


**Figure 12. The hole for the mounting template on a boat's hull**

The mounting template is fitted to the boat with either a v bottom adapter (on the front of the mounting template), or a triangular plate.

**Table 4. Fitting the mounting template on various jet models**

	Jet-160	Jet-180	Jet-185	Jet-230	Jet-245	Jet-288
Fibre-glass	v adapter	v adapter	v adapter	v adapter	triangular plate	v adapter
Aluminium	triangular plate	v adapter	v adapter	v adapter	triangular plate	triangular plate

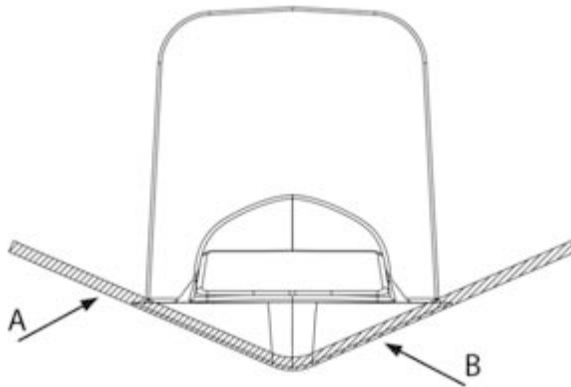


**Figure 13. Mounting template and v adapter/triangular plate**

- A The jet's mounting surface
- B Intake duct
- C V adapter or triangular plate

The mounting template should be set on the same level as the bottom surface of the boat. Excess sills might disrupt the operation of the jet.

The mounting template is made out of reinforced plastic and is approximately 5 mm thick. It must be reinforced to the desired hull thickness during installation.

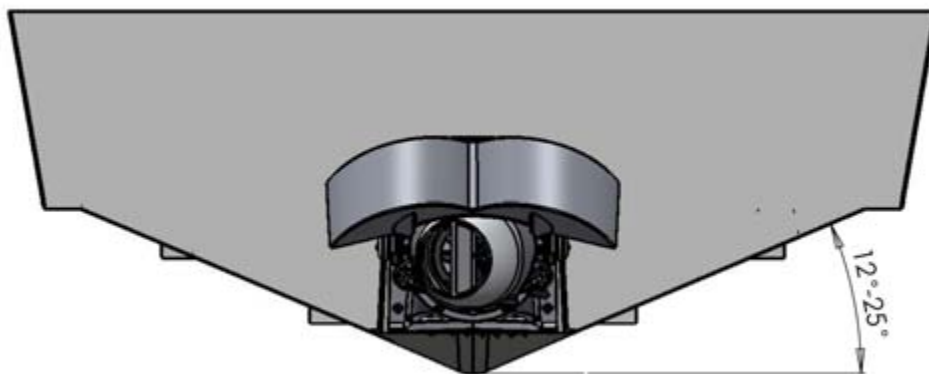


**Figure 14. The welding/lamination seam of the mounting template**

- A Aluminium boat - welding seam
- B GRP - lamination

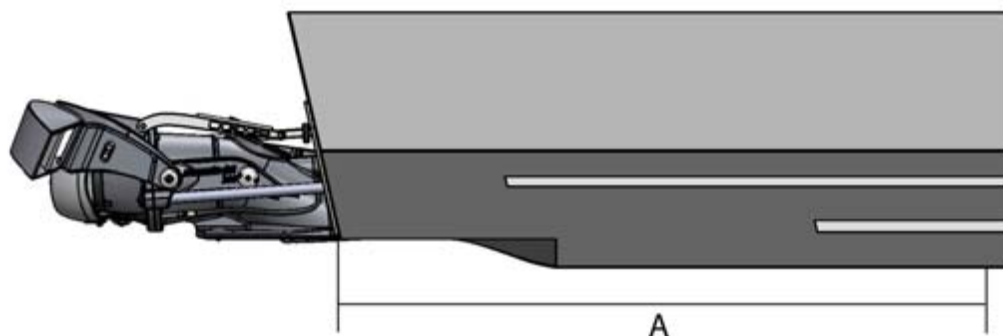
## 6.2. Boat hull

The most suitable hull type for a high-speed jet boat is a v-bottomed "monohedron", which ensures that the v angle of the portion of the hull that touches the water during gliding speed remains constant. Optimal directional stability is achieved with a v angle of 12°...25°. With an angle like this, air flowing under the hull as a result of driving on waves never becomes a problem, since the bottom directs the air to the sides of the boat.



**Figure 15. The v angle of the hull**

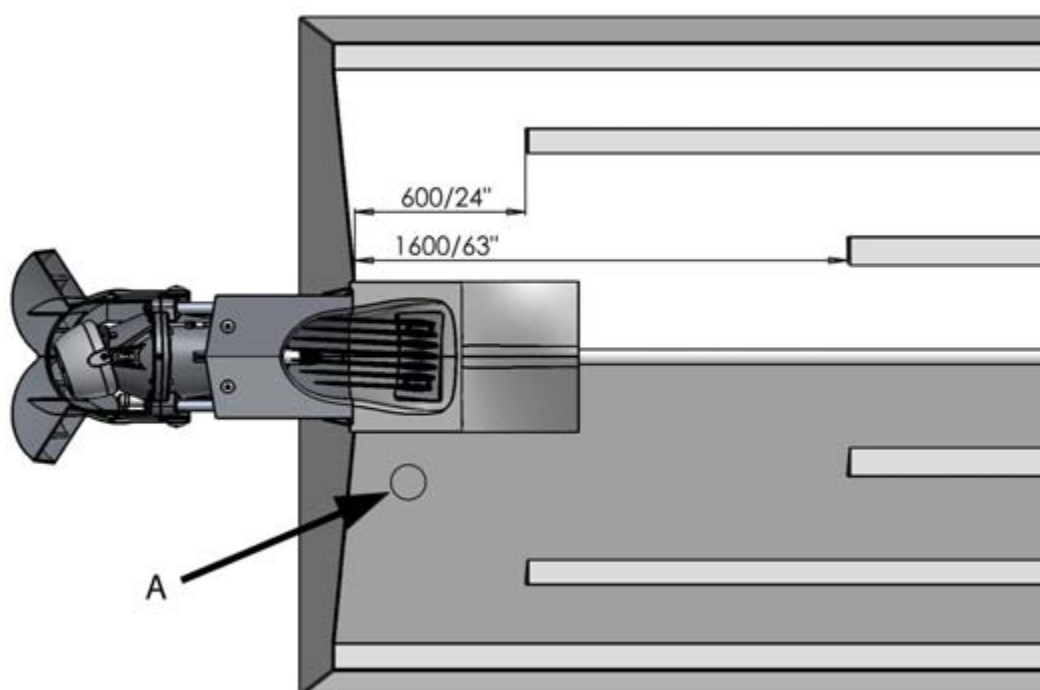
A variable v angle at the rear end of the boat can result in larger resistance at high speeds and problems with directional stability.



**Figure 16. Monohedron hull**

- A The v bottom angle of the hull is constant for the entire length of the hull when planing.

Lifting strakes or other features that might cause turbulence (such as a coolant water intake) must not be placed directly in front of the jet's intake duct. The lifting strakes near the keel must not extend further than approximately 1600 mm away from the stern. Outer lifting strakes must not extend further than approx. 600 mm from the stern. The ends of the lifting strakes must be smoothened. The same measurement principles are used in twin installation.



**Figure 17. The location of the coolant water intake**

- A Coolant water intake

The coolant water intake or other features that cause unevenness to the hull can be placed near the stern and to the side of the intake duct, approximately 200 mm away from the edge of the duct.

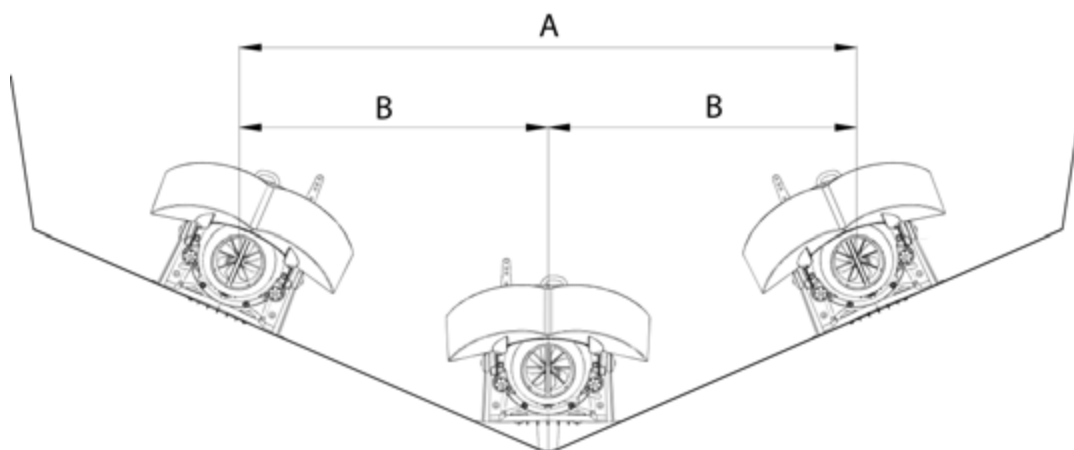
Alamarin-Jet wishes to ensure the optimal installation solution for all projects. Because of this, it is vitally important that you give us all necessary information in the Application Questionnaire form (at the end of this manual).

### 6.3. Multi-installation

In multi-installations, the mounting template is installed the same way as in a single installation. Jets that are installed off the centerline of the hull are installed parallel to the hull and tilted in accordance with the v angle. In this case, a v adapter or triangular plate is not required. The mounting plate must be installed parallel to the keel.

The side jets are installed as close to the centerline as possible so that they are low enough for the static waterline. However, they must be at least as far apart from each other as shown on the figure). In practice, engines always require more width for installation.

The figures do not take into account the space various control systems take up in the engine compartment.



**Figure 18. Jet multi-installation dimensions**

**Table 5. Jet multi-installation measurements for various jet models**

	Jet-160	Jet-180 Jet-185	Jet-230	Jet-230 round	Jet-245	Jet-288
A	520	540	810	650	810	900
B	450	460	770	520	770	820

When the mounting template is attached to the hull, the jet is installed onto the installation surface of the mounting template.

Familiarise yourself with the installation by reading the corresponding installation manual.

### 6.4. Trim tabs

Traditional trim tabs next to the jet can sometimes interfere with the jet's reversing function when a tube-type deflector is used. Jets installed onto the level surface of the hull (in twin or triple installations) in particular should not have any appendages next to them that the reversing stream may hit.

In other words, the size and positioning of trim tabs depends on the shape of the hull and how deep the jet has been set into it.



With a deep v bottom boat, traditional trim tabs can be used, but the dimensioning should make sure that the reverse stream does not hit the trim tabs.



## 7. Intermediate shafts

Intermediate shafts must be chosen according to the engine and gearbox used as well as the power and RPM of the jet. Make sure that you ask about the correct shaft length from the shaft distributor.

The most common shaft types used are constant speed shafts (for example, Aquadrive, Pythondrive), cardan shafts and flexible couplings (for example, Centa, R&D).

### 7.1. Constant velocity shaft



**Figure 19. Constant velocity shaft**

A constant velocity shaft allows different angle deviations between the ends of the shaft (below 5 degrees in practice), which means that the shaft does not need to be aligned as precisely as with other shaft types. The joint must be slightly angled to ensure lubrication. Suitable coupling flanges and adapters are available for various jet models. Ready-made adapters are also available for several gearboxes.

### 7.2. Cardan shaft



**Figure 20. Cardan shaft**

A cardan shaft allows smaller angle deviations in the power/RPM range of the jet than a constant speed shaft, but the joint must still be slightly angled to ensure lubrication. In addition, both ends of the angle must have the same angle deviation (z or w configuration). Incorrect angles lead to vibrations and can even break the system. Regular additional lubrication is required.

### 7.3. Flexible coupling



**Figure 21. Flexible coupling**

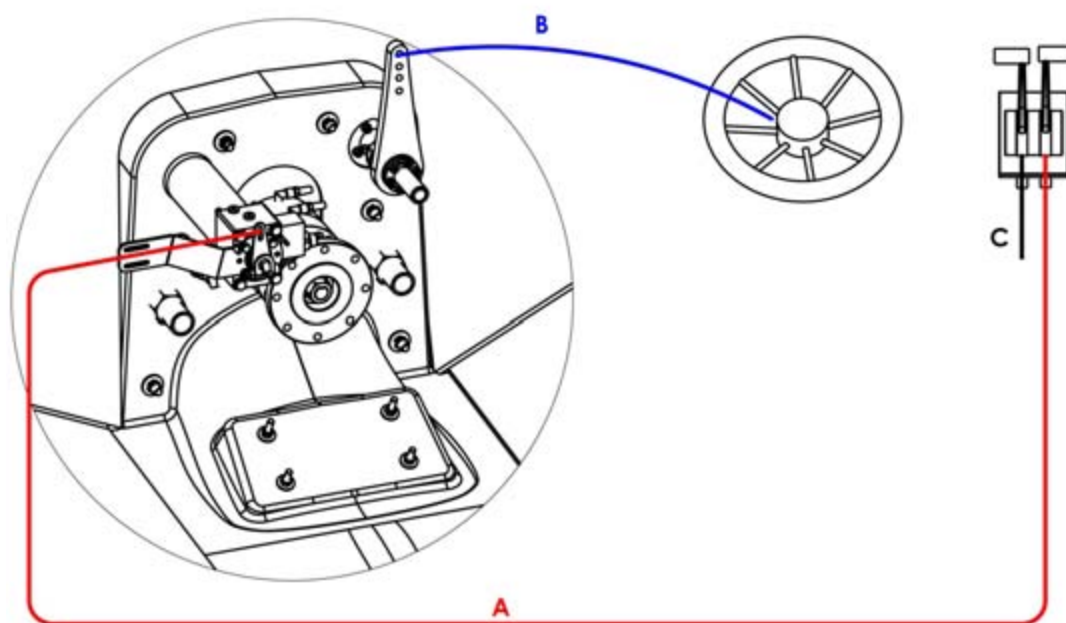
A flexible coupling allows minor angle deviations, depending on the type of coupling. Flexible coupling also effectively reduces rotational vibrations and other vibrations/resonance.

The manufacturer's instructions should be followed in all issues related to intermediate shafts. Alamarin-Jet is happy to help with any questions you may have regarding intermediate shafts.

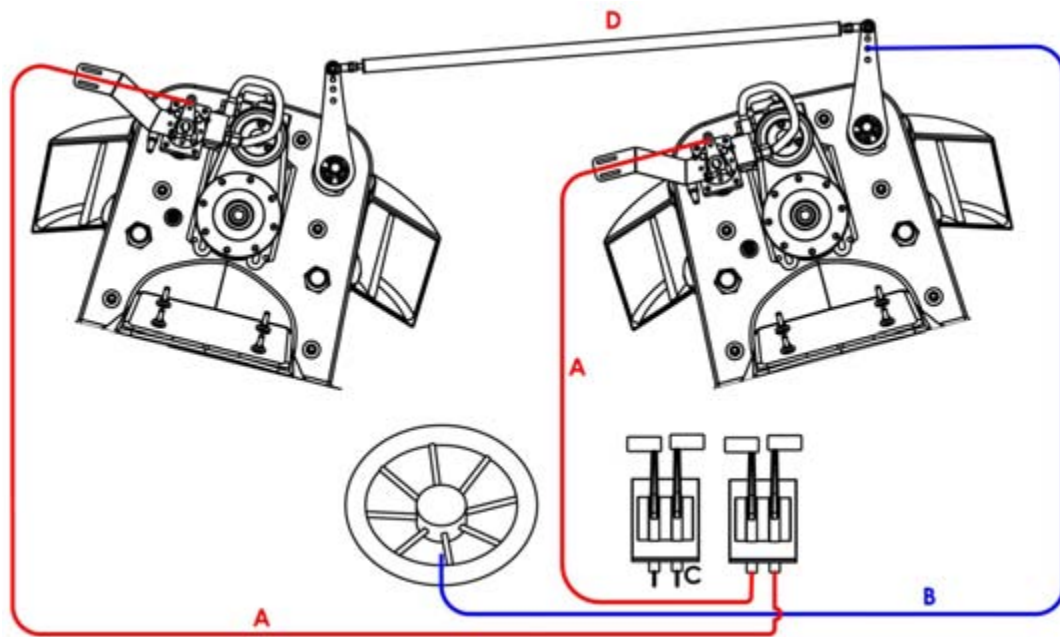
## 8. Control systems

It is important that the correct remote control systems are used with each jet model. This will ensure that you can fully utilise the jet's superior manoeuvrability. The following figures illustrate the basics of the system when using manual remote control. This is the most common control solution.

- A Jet reversing deflector remote control, cable (for example, a Teleflex 33C cable). An optional electronic system is available for Jet-160/180 models.
- B Jet steering nozzle control, cable or hydraulic (number of steering wheel revolutions from lock to lock 1.5 to 2.5). Jet-245 includes an integrated hydraulic cylinder, which is compatible with common steering pumps (such as Seastar).
- C Engine and gearbox remote control, 1 or 2 acting.
- D Connecting rod between steering levers in twin installation.



**Figure 22. Control system in a single jet installation**



**Figure 23. Control system in a twin jet installation**

Alamarin-Jet delivers complete solutions and provides recommendations on accessories. For example, in the Jet-230 and Jet-288 hydraulic control kit, the cylinder stroke has been adjusted to the range of the steering level and the kit also includes a cylinder installation plate, which makes installation quick and simple.

## 8.1. Alamarin-Jet IO

The Alamarin-Jet IO (Intelligent Operation) system is a comprehensive control system solution. The system makes handling the boat considerably easier. For example, steering sideways can be performed with a simple joystick movement instead of using four levers and a steering wheel.



**Figure 24. The Alamarin-Jet IO system control panel**

The system is available for models Jet-230 and Jet-288. It is meant for twin installations that use one to three control stations.



**Figure 25. The Alamarin-Jet IO system components**





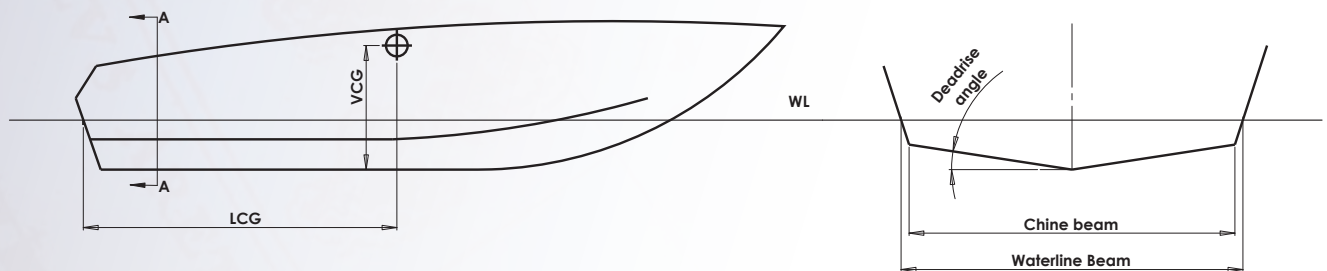
# Application Questionnaire

## General information

Name			
Company			
Address			
Postal number and city			
E-mail address		Telephone	
Project name			

## Hull details

Laden displacement		tonne/kg/lb.	Deadrise at transom		degrees
Lightship displacement		tonne/kg/lb.	Deadrise at mid-waterline		degrees
Waterline length		metres/feet	LCG (from transom at waterline)		metres/feet laden
Waterline beam		metres/feet			metres/feet lightship
Chine beam at transom		metres/feet	VCG (from keel)		metres/feet laden
Required boat speeds		knots laden			metres/feet lightship
		knots lightship	Draft at transom		metres/feet
Cross-sectional area above waterline		square metres/feet	Hull type	<input type="radio"/> Mono hull <input type="radio"/> Catamaran <input type="radio"/> Trimaran <input type="radio"/> Displacement <input type="radio"/> Planing <input type="radio"/> Other	



Please attach a lines drawing and hull resistance data, if available.

Installation: ☐ Single ☐ Twin ☐ Triple    Hull construction: ☐ Wood ☐ GRP ☐ Aluminium ☐ Steel ☐ Other

## Engine details

Make		Model	
Max. power		hp/Kw/RPM	Gearbox: <input type="radio"/> Yes <input type="radio"/> No