ISSUE 1
MAR.1992

JetTorque

A Technical and Commercial View of the Waterjet Propulsion Market from HamiltonJet

FROM THE BRIDGE

Maritime history has never seen such rapid growth and emergence of new concepts in the arena of high speed surface craft as has been witnessed over the past decade.

Several new designs have allowed higher speeds and improved ride characteristics; for example the Surface Effect Ship (SES) and wave piercing catamaran. Significant advances have been made in the development of reliable high speed marine diesel engines and gas turbines. Of the propulsion systems better suited to high speeds, the waterjet in particular has gained prominence in the marketplace.

Waterjet propulsion has been a commercial reality since the early 1950's. Sir William Hamilton first navigated a swift flowing New Zealand high country river in a small wooden boat in 1953. Since those days, a continuous research and development programme has lead to Hamilton waterjets being acknowledged as a world leader, with a technically advanced range of 15 separate models for power inputs ranging up to 4800kW.

waterjet propulsion systems to a wide range of work and patrol boats and fast passenger ferries.

It is through the pages of this newsletter that we would like to share some of this practical knowledge with you. This first, and subsequent editions, will feature a series of articles on both technical and commercial aspects of waterjet propulsion which we trust you, our reader, will find both informative and interesting.

Comments and contributions are welcomed and should be addressed to:

The Editor,
HamiltonJet,
P.O.Box 709
Christchurch,
NEW ZEALAND

Phone: + 64 (3) 348 4179
Fax: + 64 (3) 348 6969
Telex: NZ4244

33 METRE PASSENGER FERRY, JAPAN TRIPLE HAMILTON 422 JETS, 35 KNOTS

Many thousands of successful installations all around the world have provided HamiltonJet with an unrivalled level of experience in matching

"As a propulsion unit for all types of high performance vessels, the waterjet is here to stay .... "
Work Boat World magazine Oct.1990

Focus on Quality

With waterjets being the preferred propulsion for new-age high speed passenger ferries and work and patrol boats,commercial influences demand reliability and engineering excellence.

HamiltonJet has built its reputation of providing the best marine jet propulsion system in the world on a philosophy of innovation and excellence.

Each model of jet has been meticuously designed to major international certifying authority standards such as A.B.S; Lloyds etc., using a combination of top people skills and computer aided design techniques.

Our Total Quality Management (TQM) programmes ensure that throughout manufacture, quality assurance procedures are built into every process, not simply left to an inspector at the end of the line.

Comprehensive testing is carried out in both our own static closed circuit water tunnel dedicated to jets and our test boat equipped with state-of-the-art electronic data aquisition systems.

Commitment to providing designers and builders with the optimum propulsion option drives a rigorous and demanding research and development programme closely aligned to trends in high speed craft design and operation, all reinforced by one of the most extensive global logistic support networks in the industry.

FROM THE ENGINE ROOM

What Are You Designing For?

All out top speed....., comfortable cruising with good load carrying capability....., optimum propulsive efficiency.....,or optimum economic life?

In reality, usually a mixture of all the above, as these are all factors that most commercial operators would like to see incorporated into their 'ideal' craft.

But, providing all these features is as practical as the proverbial "illusive dream" so designers should determine early just what the predominant operating parameters are likely to be.

For example, a typical work boat could be designed for a top speed of say 35 knots in a laden condition, when in reality 99% of its operational time may be spent cruising at a more comfortable 27 knots.

One of the major factors influencing the cruising situation is the positioning of the Longitudinal Centre of Gravity (LCG).

For the typical boat above, Figure 1 shows a jet thrust curve superimposed over a typical hull resistance curve with an aft LCG. It can be seen that at the predominant cruising engine RPM, the craft is operating close to the planing threshold ("hump") and would be prone to constantly falling off plane when influenced by external factors such as wind and waves. Because weather conditions have the habit of hardly ever being perfect, the design cruising speed would probably rarely be acheived, much to the operators' concern and dissatisfaction.

Various compromises could be applied to effect a remedy - trim tabs will assist the craft onto the plane but as these add to the hull resistance it is necessary to trade-off the improved performance against the increased drag. Ballast could be added forward to improve the pre-planing attitude but only adds weight to the craft, again affecting the sought-after economy and handling characteristics.

By far the best approach however is to design the craft from the outset with an LCG position that will meet the operators' requirements under conditions of normal use. Generally, it is found that locating the LCG to give the lowest hull drag in the "hump" or cruise region may have very little effect on the top speed.

Again, by looking at the example of the craft given above, by locating the LCG slightly further forward, the resistance curve is much flatter in the critical region. This results in a much higher cruising speed for the same engine RPM with only a minimal drop-off in top speed.

This speed would probably have still satisfied the operators' repressed racing-driver aspirations while providing him with a craft that performs to expectations in regards to his day-to-day activities.

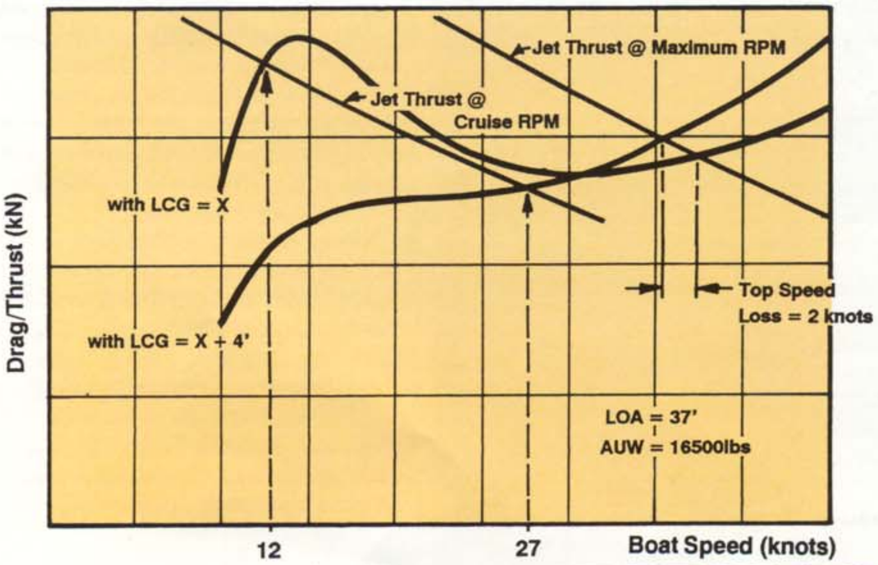


FIG.1-TYPICAL JET THRUST/HULL RESISTANCE CURVES SHOWING LCG EFFECT

At HamiltonJet we are not in the hull design business but are always happy to share our many years of experience with waterjet propulsion by advising on the suitability of a hull design for a particular jet application. Where the designer or naval architect is unable to provide hull resistance values, we have a computor program that will estimate these values for planing hulls and calculate factors such as optimum LCG from just a few known inputs. Using a combination of computer modelling and practical experience, similar data can also be provided for some other hull forms.

When to use Waterjets

The modern waterjet unit is an extremely versatile propulsion system capable of being applied successfully to most modern mono and multi-hull forms.

The correlation between a conventional propeller and a waterjet is that the waterjet nozzle diameter is equivalent to the propeller diameter. So, just as a small diameter high speed propeller is required for a fast planing craft, then similarly a waterjet with a small nozzle diameter and being driven directly from the engine flywheel be necessary.

If this relationship is translated to heavier displacement speed craft, then just as with propellers, a waterjet with a large nozzle and being driven through a reduction gearbox would need to be applied.

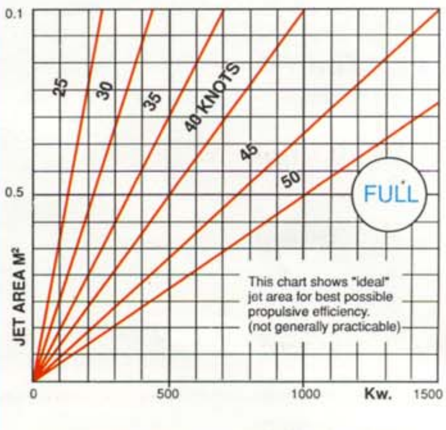


FIG.2 OPTIMUM NOZZLE SELECTION

For displacement speed vessels, the large slow waterjet selected purely in terms of optimum propulsive efficiency may offer no significant advantages over a propeller unless there are overriding factors such as shallow draught capability or manoeuvring characteristics that only a waterjet can deliver.

In some applications however,it is possible to apply a waterjet of smaller than optimum size with a resultant loss in efficiency that is in fact quite small.

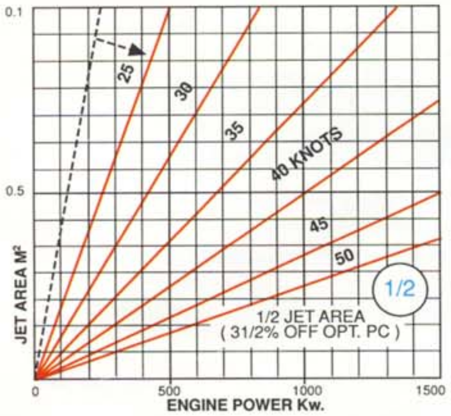


FIG.3 1/2 OPTIMUM NOZZLE SELECTION

As boat speeds increase and the optimum nozzle diameter reduces, it is generally accepted that at between 25-30 knots the waterjet becomes small enough to be acceptable in weight, size and cost and begins to overtake the conventional propeller in overall propulsive efficiency. Up to boat weights of approximately 15 tons per jet unit, and in this speed range, the waterjet can almost always be direct driven and the cost and weight of a gearbox eliminated.

The direct driven Hamilton waterjet offers designers -

- **simplicity**
- **reliability**
- **low weight**
- **low installed cost**
- **no gearbox power losses**
- **unrivalled manoeuvrability**

A full chapter on the correct selection of waterjets including speed predictions, hull and engine matching will be included in future editions of JetTorque.

FROM THE LOG BOOK

Several hundred printed JetBrief study sheets have been produced showing diverse and interesting applications of HamiltonJet propulsion systems all around the world.

This data base of information covers all types of craft including fast passenger ferries, rescue boats, work and patrol boats, landing craft etc. and JetBriefs are available to any designers contemplating waterjet propulsion in similar craft. JetBriefs contain interesting comment on each crafts construction and operation together with a schedule of vital statistics.

Availability of new productions will be advised in this publication from time-to-time and they will be readily available to readers on request.

Some recent JetBrief publications include:

U.S. FIREBOAT USES HAMILTON MODEL 211 WATERJET (No.211)

Features a *Response FR7.4* fire/rescue boat recently delivered to the Verplank (NY) Fire Department.Propulsion is a single model 211 waterjet and an interesting aspect of this craft is that both the propulsion system and the fire pump are powered simultaneously by the same diesel engine.

HIGH SPEED HELSINKI POLICE PATROL CRAFT (No.213)

The Helsinki (Finland) Boat Police have a new high speed patrol craft. Being required to operate all year round, often in waters littered with ice pieces, is no problem for this craft with its Hamilton model 271 waterjet propulsion system.

SPAIN CHOOSES NEW JET RESCUE CRAFT FROM NORWAY (No.215)

Three 34 knot rescue craft, designed and built in Norway with waterjets from New Zealand and destined for operations in Spain - thats the story behind the new high-tech *Alusafe MOB1400* craft, each with twin Hamilton 362 waterjets.

JAPANESE FAST FERRY 'EMERALD'-JEWEL OF THE SOUTH PACIFIC (No.216)

'Emerald' is a 19 tonne fast monohull passenger ferry powered by twin model 362 waterjets.
Designed for fast, comfortable passage in choppy coral infested waters around the Japanese resort of Amimi Island.

FROM THE MESS DECK

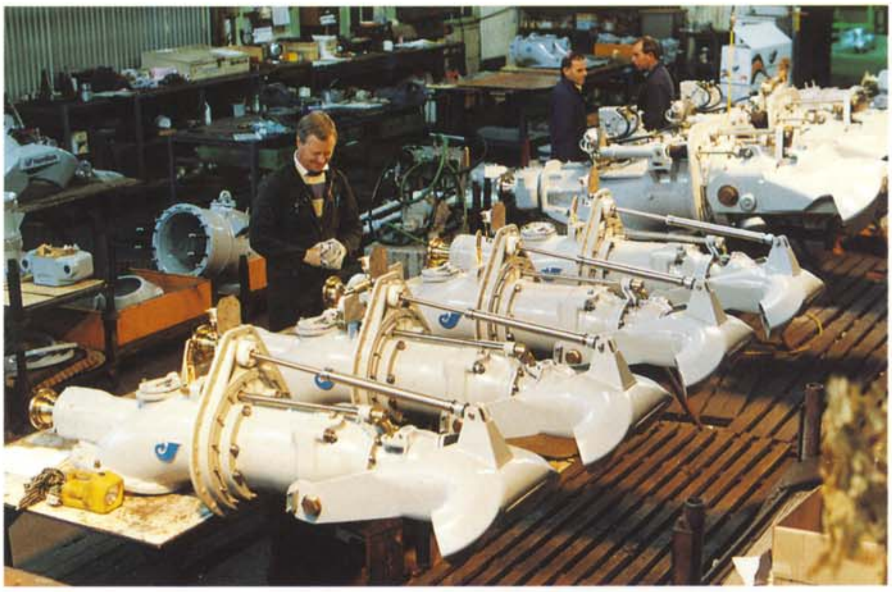
IMAS 91 Conference

Organised by the Institute of Marine Engineers, the IMAS 91 High Speed Marine Transportation Conference was held in November 1991 in Sydney, Australia.

HamiltonJets' Technical Manager, Dr. Keith Alexander BSc, BE(Hons), PhD, MIPENZ presented a paper entitled "Two Stage Waterjets for High Speed Commercial Craft" as an opportunity to introduce the new Hamilton HS Series of two-stage units to the 300 delegates who attended from all around the world.

Dr. Alexander says, *"that with the recent trend for commercial craft to travel at higher speeds have come changes in hull forms and propulsion methods."*
The waterjet has become increasingly popular as the prefered propulsion unit for these craft and his paper outlined the reasons for this. He goes on to say *"that for speeds above 40 knots, there are some advantages in using two stage axial flow waterjet designs."*
His paper explored the attractions of this configuration, covering the suitability of the pump characteristics for these high speeds, their resistance to cavitation and tolerance to aerated water. With over 30 years experience in New Zealand with multi-stage waterjets in small fast craft, some at speeds up to 90 knots, the paper notes how this technology has been transferred to the larger two-stage HS Series of commercial waterjets recently developed.

Dr. Alexander concludes *"it is predicted that, as speeds rise toward the 50 knot mark, the two stage waterjet may well become the preferred propulsion unit for commercial craft."*
It is intended to reproduce this paper in full in an upcoming issue of Jet-Torque..



QUADRUPLE SHIPSET OF TWO-STAGE JETS UNDERGOING FINAL ASSEMBLY

New Zealand Innovators Recognised.

The developers of ten landmark "Kiwi" innovations were recognised in their home country with the launch of the Rutherford Awards (after New Zealander Lord Rutherford, the first man to split the atom).

One of these recipients was the late Sir William Hamilton for his pioneering work with the development of the commercial waterjet unit.

Representing Sir William at the awards was his son, Jon Hamilton, Chairman of the Board and Technical Director of C.W.F.Hamilton & Co.Ltd. While there was considerable honour attached to the award, a touch of humour was injected into the ceremony when Jon was presented with a "prototype" of the HamiltonJet propulsion unit - a giant squid !!