



About HydroComp NavCad™

*National Shipbuilding Research Program
Ship Design & Material Technologies Panel
June 22, 2011 Seattle*



Donald MacPherson
Technical Director
HydroComp, Inc.



HydroComp, Inc.

- ✦ Formed in 1984
- ✦ Mission statement:

To provide naval architects and ship builders with effective resistance and propulsion analysis tools of the highest technical excellence.





Principal activities

Commercial software

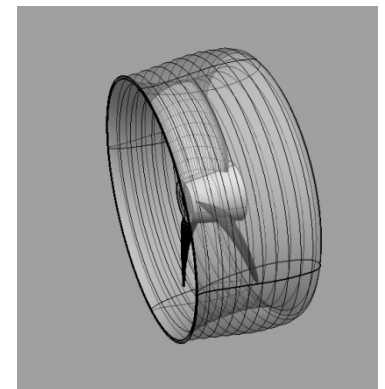
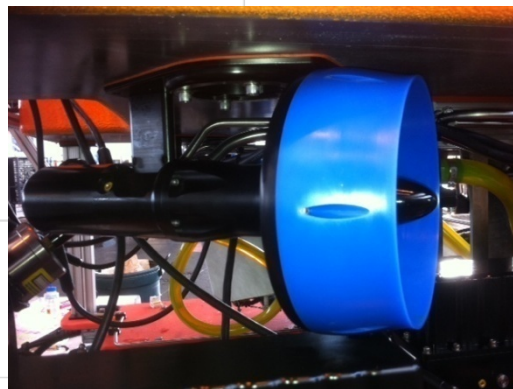
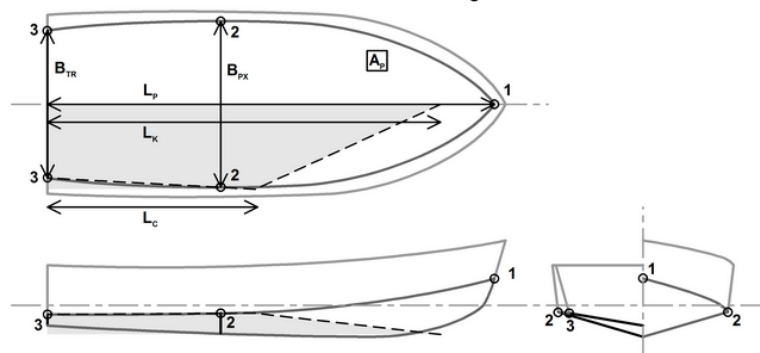
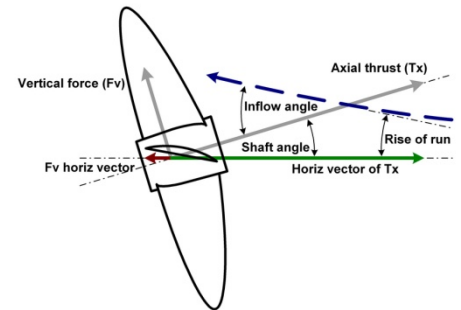
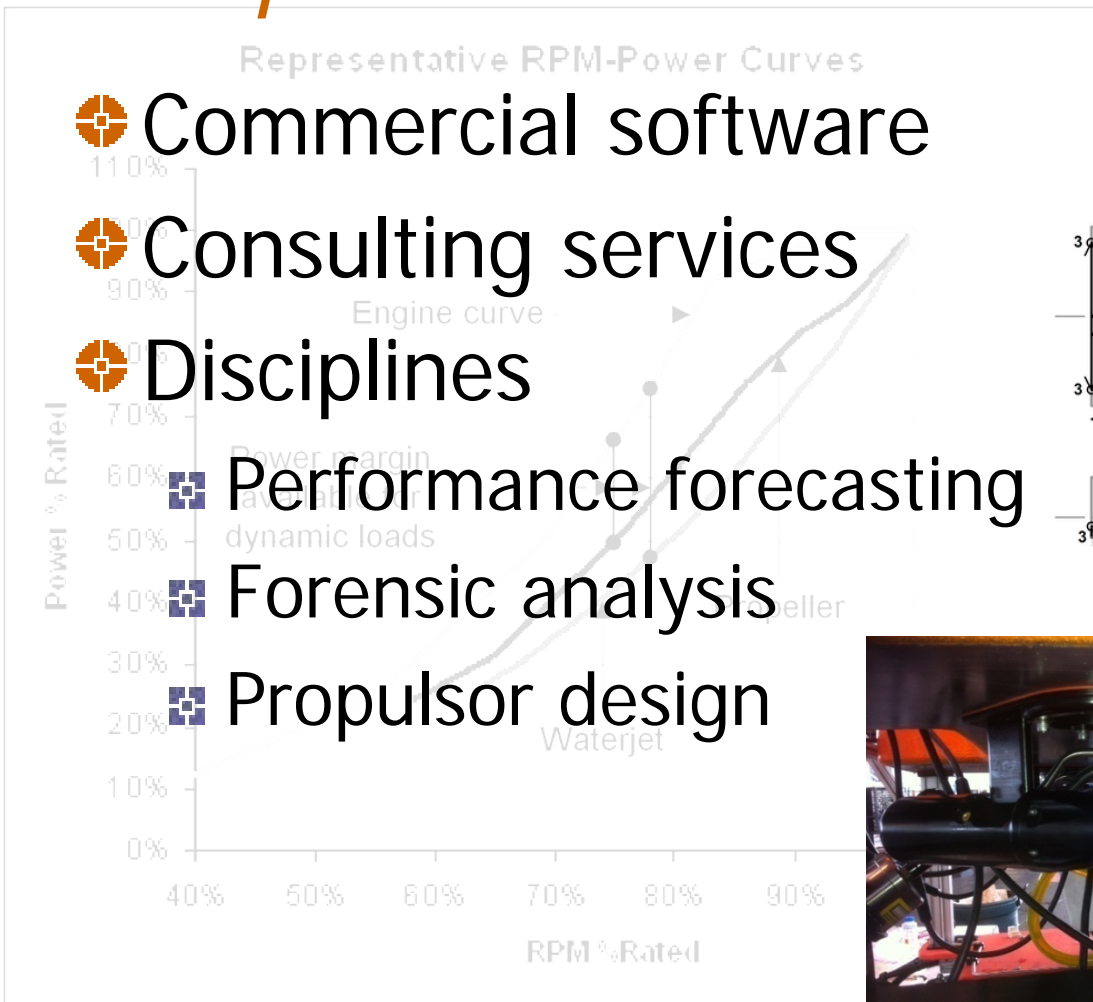
Consulting services

Disciplines

Performance forecasting

Forensic analysis

Propulsor design





Commercial software

✚ Companion software by HydroComp

✚ SwiftCraft™

- Small ship speed and power

✚ PropExpert™

- Propeller sizing for workboats & pleasure craft

✚ PropCad™

- Propeller geometric “design for manufacture”

✚ PropElements™

- Propeller detail “design for performance”



NavCad[™]

- ✦ HydroComp's "flagship" product
- ✦ Principal features
 - ▣ Resistance prediction
 - ▣ Steady-state propulsion analysis
 - ▣ Propulsion sizing
- ✦ Accountability
 - ▣ 20+ years
 - ▣ Over 500 users in 50+ countries

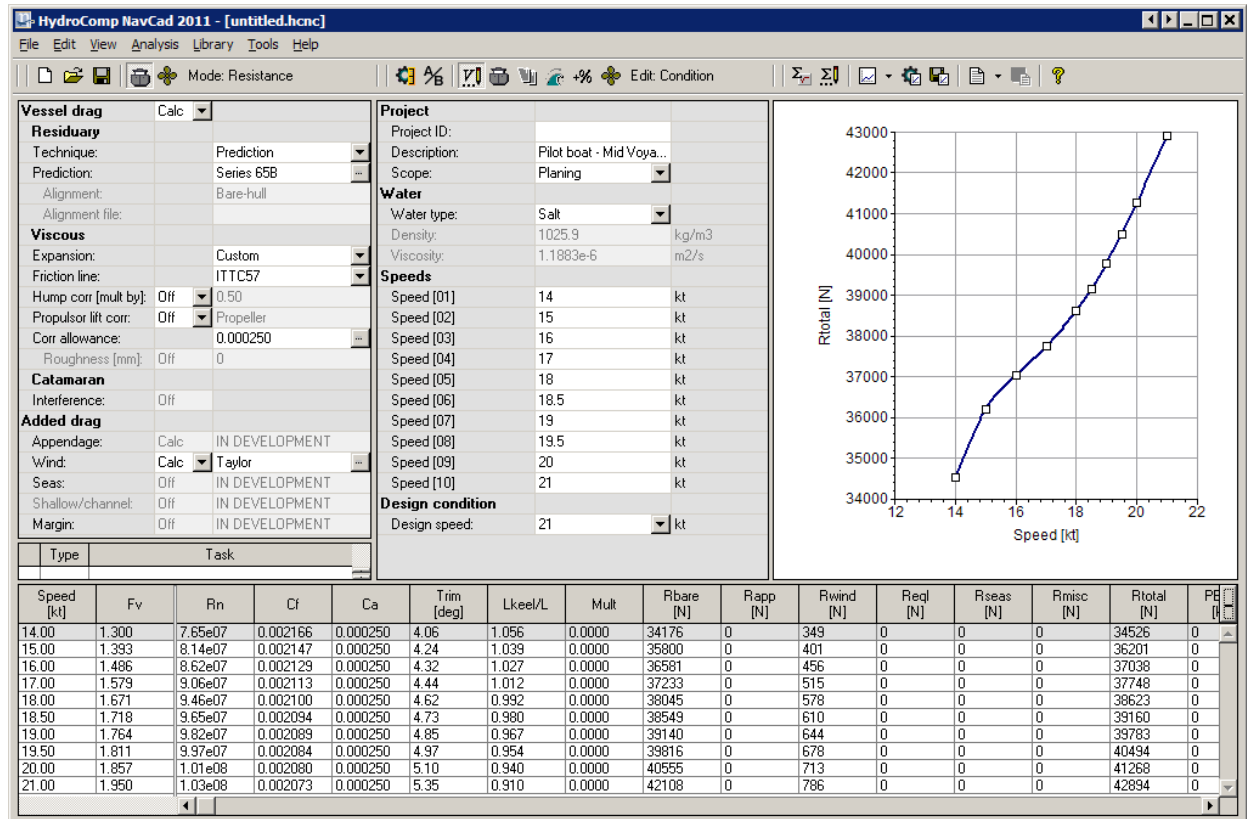
NavCad 



Stand-alone Windows application

32-bit

Fully functional on 64-bit Windows

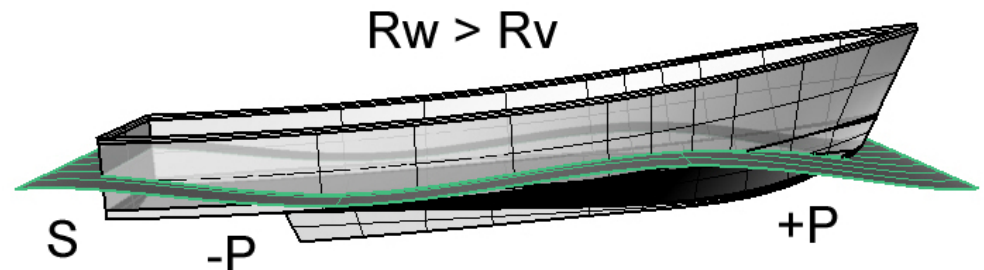
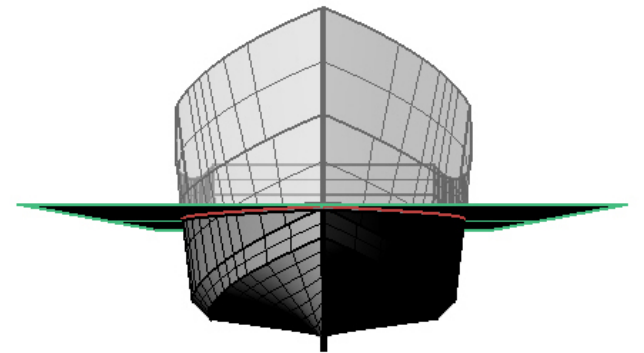




Applications

✦ Vessels

- ✦ Ocean-going merchant and naval vessels
- ✦ Small ships and work boats
- ✦ Motor and sailing yachts
- ✦ High-performance vehicles
- ✦ River barge trains
- ✦ Catamarans

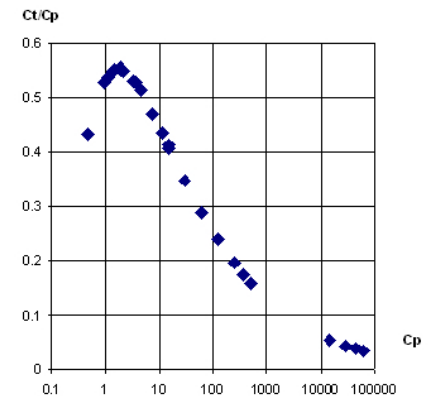
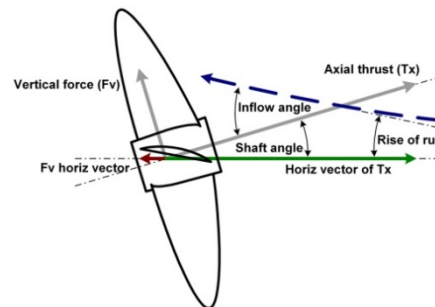
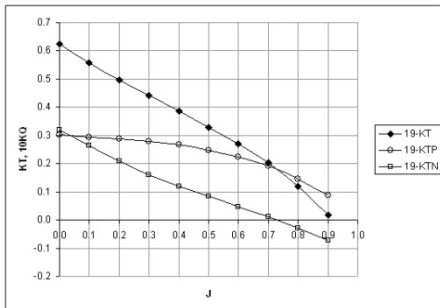
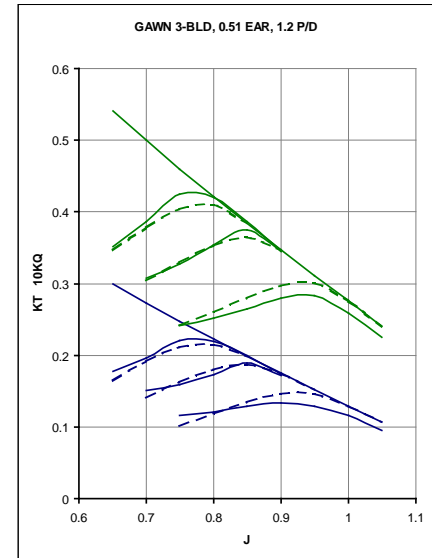




Applications

Propulsors

- Conventional propellers (open, ducted, cavitating)
- Waterjets
- Special propulsors
- User-specified performance





Resistance prediction

- ☛ User-controlled prediction methodologies
 - ☒ Published methods (extensive library)
 - ☒ Expansion of model-tests or sea-trials
 - ☒ Hybrid “aligned prediction”
(A favorite feature of dozens of international towing tanks.)
- ☛ Complete analysis
 - ☒ Bare-hull (CT-based & planing)
 - ☒ Added drags (wind, seas, etc.)

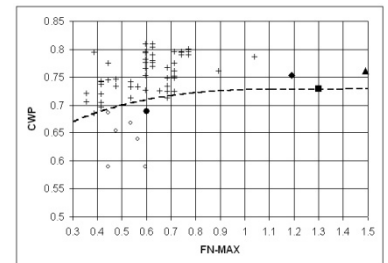
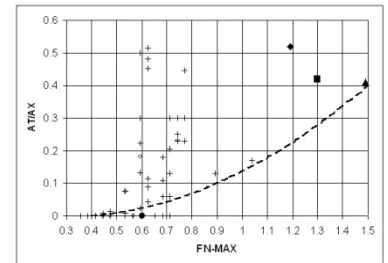
Vessel drag		Calc
Wave-making		
Technique:		Prediction
Prediction:		Holtrop 1984
Align by:		Rbare/W
Align to:		
Viscous		
Expansion:		Standard
Friction line:		ITTC-57
3D form factor:	On	1.1551
Speed corr:	On	
Corr allowance:		0.00067
Rough [mm]:	Off	0
Catamaran		
Interference:		Off
Added drag		
Appendages:	Calc	Holtrop 1988
Wind:	Off	Taylor head wind
Seas:	Off	NavSea small naval
Shallow water:	Off	Landweber channel
Misc [margin]:	Off	Hull drag only

Type	Task
<input type="checkbox"/>	Data 09. Set Resistance parameters
<input type="checkbox"/>	Calc 10. Run Resistance prediction
<input type="checkbox"/>	Report 11. Create Resistance reports
<input type="checkbox"/>	Report 12. Create Resistance graphs



Resistance prediction

- ✚ Prediction method assessment & validation
 - ✚ Not every method makes it into NavCad
 - ✚ Must pass very critical in-house review
- ✚ *Method Expert* ranking
- ✚ Method constraints and revision
 - ✚ Examples
 - Holtrop: bulbs, hull loading
 - HSDH: transom immersion, WPA
 - Savitsky: effective deadrise





Propulsion analysis

Physics-based prediction methodologies

- Hull-Propulsor-Engine model
- Extensive library of methods and series
- Corrections: scale, duct, tunnel
- Effect of engine specification

System analysis

- Free-run; Towing; Bollard
- Vessel acceleration

Propulsive coeffs		
Wake fraction:	Calc	Holtrop 1984
Thrust deduction:	Calc	Holtrop 1984
Rel-rotative effy:	Calc	Holtrop 1984
Corrections		
Viscous scale corr:	Off	Custom
Rudder location:		Free stream
Friction line:		ITTC-57
3D form factor:		1.1551
Corr allowance:		0.00067
Rough [mm]:	Off	0
Ducted prop corr:	Off	
Tunnel stern corr:	Off	
Effective diam [ft]:		0
Recess depth [ft]:		0
System analysis		
Cavitation criteria:		Keller eqn
Analysis type:		Free run
CPP method:		Fixed RPM
Engine RPM:		0
Acceleration		
Added mass mult:		0
RPM constraint:		None
Limit to [RPM/s]:		0
Type	Task	
<input type="checkbox"/> Data	13. Enter Propulsor data	

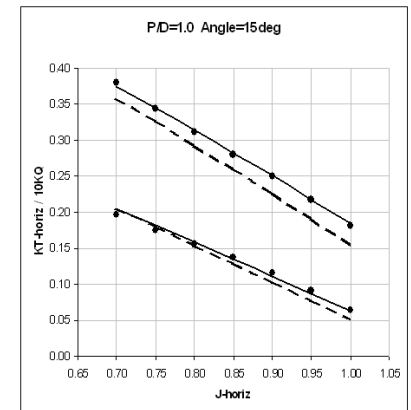
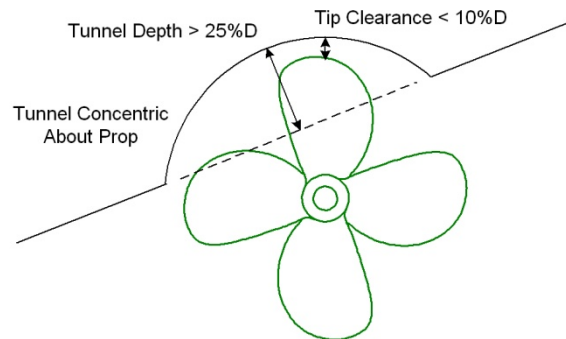
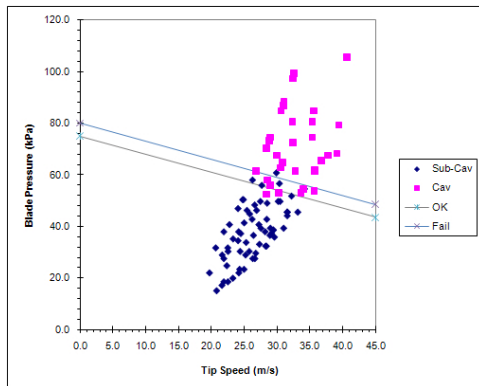


Propulsion analysis

Real propeller performance

- Effects of cavitation, oblique flow
- "Aligned series" allows use of model tests
- Studies of roughness, waviness

Waterjets and other propulsors





Supplemental calculations

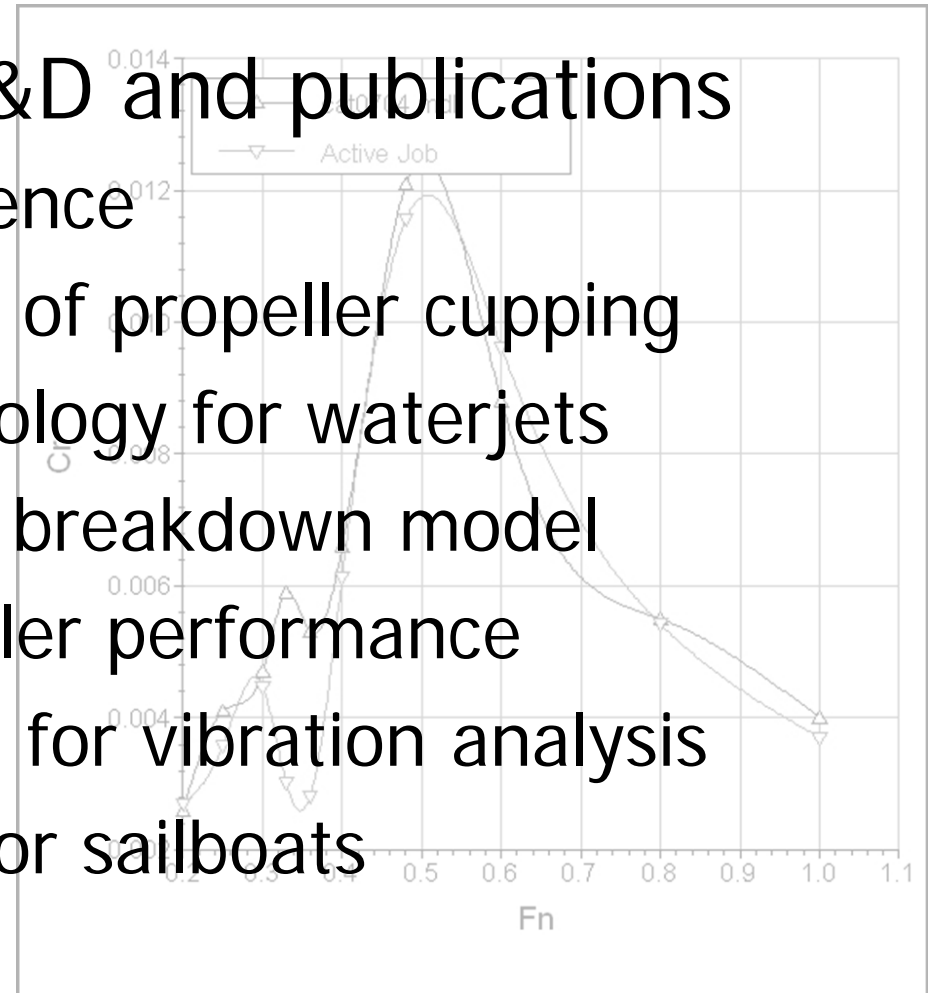
- ✦ Hydroacoustics & noise
- ✦ Sinkage & trim
 - ▣ Under-keel clearance
- ✦ River barge train resistance
- ✦ Synchronous pitching



Proprietary development

❁ In-house funded R&D and publications

- ❁ Catamaran interference
- ❁ Performance model of propeller cupping
- ❁ Calculation methodology for waterjets
- ❁ Propeller cavitation breakdown model
- ❁ Oblique flow propeller performance
- ❁ Propeller properties for vibration analysis
- ❁ Folding propellers for sailboats





Pertinent NavCad user community

- ✦ Naval architects and designers
 - ✦ AMSEC, BMT D&P, Gibbs & Cox, Alion, CSC
- ✦ Ship and boat builders
 - ✦ BIW, NASSCO, NNSB
- ✦ Propulsion equipment manufacturers
 - ✦ Rolls-Royce, Kamewa
- ✦ Navies, coast guards & schools
 - ✦ ONI, CDNSWC, NSWWDG



Proposed improvements

- ✦ Naval ship specific considerations
- ✦ New vehicle design
 - ✦ Landing craft hull form resistance prediction
 - ✦ Barge hull form resistance prediction
 - ✦ Multi-hull & SWATH speed & power
 - ✦ Wave-making code for early-stage prediction



Proposed improvements

✚ Propulsor analysis

- ✚ Counter-rotating propellers
- ✚ Wake-adapted propeller analysis engine
(potentially merging with PropElements)

✚ Production

- ✚ Weight & center sensitivity on speed/power
- ✚ USN-specific sea trial planning & documentation



NavCad[®] 2011

Coming This Summer...



HYDROCOMP_{INC.}

Forecasting Hydrodynamic Performance
From Design to Manufacture. Since 1984.



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