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175-ft WLM Keeper Class Guide for Ice Operations

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INTRODUCTION

The 175-ft WLM Keeper Class cutters are ice-strengthened buoy tenders. On occasion, the 175-ft WLM Keeper Class may be expected to operate in ice-infested waters. Though designed with greater horsepower and more ice-strengthening than their 157-ft predecessors, these cutters still have limitations when operating in ice that must be considered by operators and planners. They were designed primarily as buoy-tenders, capable of retrieving buoys surrounded by light ice, a fundamentally different mission from ice escort operations. In addition, in severe ice years, some cutters from year-round ice-free ports will be deployed to assist in ice-infested waters, and the crews of these cutters will need guidance for icebreaking in order to employ their cutter effectively. The purpose of this report, therefore, is to provide a Guidance Manual for Ice Operations for the 175-ft WLM Keeper Class tenders.

Knowledge of this class's performance capabilities in ice, hull characteristics and systems configuration will facilitate safe and effective ice operations. This guidance manual for ice operations is intended to assist new, inexperienced, and out of practice operators in understanding the performance capabilities of the cutter. Finally, mission planners will be able to match mission requirements due to existing ice conditions to available fleet resources with greater effectiveness.

Data provided in this guide was obtained and validated against the ice trials conducted on the *USCGC Katherine Walker* (WLM-552) on the Hudson River above West Point during January 2011.

TYPICAL ICE CONDITIONS FOR WLM AREAS OF OPERATION

175-ft WLM Keeper Class buoy tenders are stationed along the Atlantic, Gulf, and Pacific coasts. WLM's most likely to encounter significant ice conditions operate on the rivers and bays of the Northeast. Typical ice conditions for these areas are illustrated in Figure 1 and Figure 2.

Rivers with significant flow such as the Hudson River are fresh water. River traffic and the current continually break the ice. Thick brash ice, with the apparent consistency of porridge, can form in the high traffic channels. Rafted broken small floes are typical over wide areas of the river when the solid ice cover is broken and carried down river by current.

Figure 1 - Ice types: old track (brash), fresh track (broken), and level ice

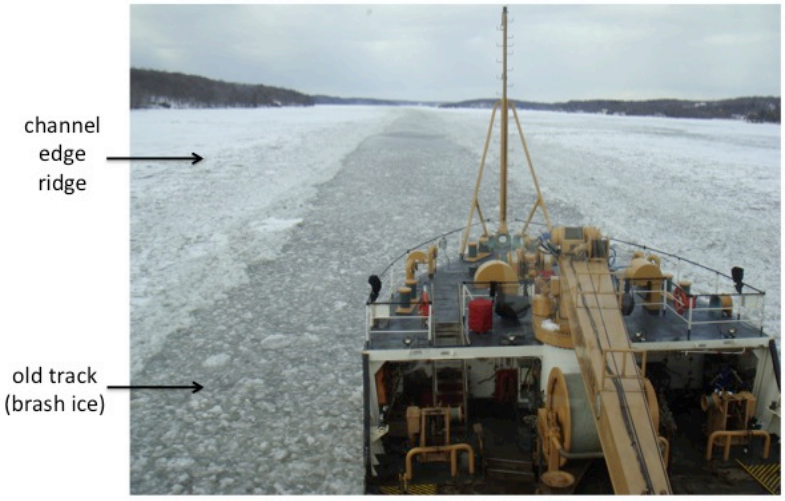


Figure 2 - Old track and channel edge ridge on the Hudson River

HULL FORM AND APPENDAGES

The 175-ft WLM Keeper Class has an icebreaking-type bow (See **Figure 3**) characterized by a low stem angle and parallel buttock lines that generate flair in the forebody. As the ship moves forward in the ice, it rides up slightly on the ice cover and generates a downward bending force on the ice that causes the ice to break. The amount of pitch is almost imperceptible in level ice but increases with ice thickness. If the ship were to ram thicker ice or a ridge, then the pitch becomes more noticeable and, in fact, the ram may not break the obstructing ice feature. The waterline and bow have a pointed wedge shape that provides a balance between maneuverability in level ice and the ability to "grab" into the ice edge when turning out of an existing track in ice. This bow shape also facilitates backing out of a ridge that fails to break.

Figure 3 - Sloped stem and flared bow shape of the 175-ft WLM for icebreaking.

The requirements for higher top end speed in a relatively short ship length and buoyancy required for trim and stability resulted in a wide waterline aft continuing to the transom on the175-ft WLM class. Consequently, backing ability in ice was compromised to meet the primary, Aids to Navigation mission of the ship. The flat vertical transom extends below the waterline (see **Figure 4**) and limits backing ability relative to other ice capable assets. Backing and maneuvering capabilities are addressed later in this Guide.

Figure 4 - 175-ft WLM transom extending below the waterline

The 175-ft WLM Class cutters have fixed-pitch propellers in nozzles and are mounted in azimuthing struts, (**Figure 5**). A direct-linked, mechanical "Z" drive system powers the propellers. These types of propulsors are efficient and responsive for the buoy-tending missions. The nozzles produce high thrust at slow speeds, which is needed for icebreaking and they can direct the thrust or the propeller wash in any direction. On some classes, this feature can be useful in cleaning ice away from a stuck ship or fixed structures such as piers.

Nozzles provide a significant amount of protection for the propeller blades; therefore, protection against high torque excursions on the propulsion drive system due to ice milling. However, nozzles are also prone to clogging in ice which manifests itself as a loss of thrust and occasionally significant vibration. Nozzle clogging is a frequent occurrence on the 175-ft WLM in the heavier ice conditions. On 175-ft WLM's it is not possible to reverse shaft rotation—the typical technique to clear the nozzle of an icebreaker. Instead, working the helm back and forth can sometimes clear nozzles. However, difficult pieces stuck to the inlet of the nozzle will have to be back-flushed by turning the nozzle around while the ship is moving forward. Another technique involves temporarily switching from tiller mode to Z-conn mode. By decoupling the nozzles, one can be rotated to flush out the other with its propeller wash. The ship has to stop to change modes and flush the nozzles. For the majority of operations in ice, there is a strong preference for use of tiller mode.

Figure 5- The 175-ft WLM propulsion units showing the propeller, duct and pod-shaped drive housing.

ICE STRENGTHENING AND THE ICEBELT

The "icebelt" is the portion of the framing and plating around the waterline where the ice loads impact the hull. The coverage of the icebelt for the 175-ft WLM is as shown in **Figure 6**. The 175-ft WLM's hull, nozzles, and machinery are also strengthened specifically to withstand ice loads.

Figure 6 Extent of the icebelt for ice strengthening on the WLM

Ice loads exert a high pressure over a small area when the ship impacts an ice floe. As such, the loads are local but intense, and they can occur anywhere within the icebelt region. To resist these local ice loads, the 175-ft WLM has been designed with a system of closely spaced (20 inch) transverse frames and thicker icebelt shell plating. Mid-span girders (stringers) transfer some of the load from one frame to the adjacent ones and help prevent the frames from tripping (collapsing by lying over) under the high local loads. Such a system gives the ship reserve capacity to take loads well above the design load without rupture or catastrophic failure. Higher grades of steel have been used to prevent brittle fracture (forming of cracks under load) in the cold air temperatures.

A hierarchy of strength has been used in the design. The "weakest link" is designed to be the least critical or most easily replaced element. The best example of this approach might be the propulsion system where the propeller blade fails before the hub and key components like the reduction gear.

THE MACHINERY PLANT OPERATION IN ICE

Machinery Control System

The 175-ft WLM cutters are equipped with two shafts with fixed pitch propellers in steerable nozzles. During normal operation, the nozzles point their wakes outboard at throttle position 0 since the system is direct drive (No clutch). As the throttle is increased, the nozzles rotate toward the stern – aligning with the centerline at throttle position 4. Shaft rotation is increased from throttle position 4 to 10 to provide more thrust.

The 175-ft WLM has two control modes: tiller and Z-conn. In tiller mode, both port and starboard nozzles rotate together. In Z-conn mode, they are decoupled and can be operated independently. Experience has shown that during operations in ice, tiller mode is preferred. However, in the event of significant clogging, temporarily switching to Z-conn mode enables a nozzle to be turned to flush ice from the other with its propeller wash.

Steering Gear

The 175-ft WLM class cutters have no particular operating requirements for the azimuthing nozzles in ice. When going astern in ice, the nozzles will be much closer to the ice being broken. Some care should be taken to not back into heavy ice features. However, the class has limited capability when backing in ice, and nozzle and propulsion are ice-strengthened to ABS Ice Class B0 so the risk of exerting excessive loads on the propeller pod and nozzle is expected to be small. The exception might be when a nozzle does clog with ice. One approach to clear the clogged nozzle is to reverse the direction of the nozzle 180 degrees while still moving ahead so the water force will flush out the ice from the nozzle. Very high loads occur when a piece of ice is caught in the nozzle and the throttle is increased quickly going ahead.

Thrusters

The 175-ft WLB Class is equipped with a bow thruster for improved maneuverability at slow speed and station-keeping intended for use in open water. It is not recommended to use the thruster during operations in ice do to potential damage from ice ingestion.

Guidelines for Seawater System When Working in Ice

The system consists of a port and starboard sea chest supplying a sea bay at the centerline (See **Figure 7**). It is recommended that either the port or the starboard sea chest be on line but not both simultaneously. If the cutter is operated with both sea chests on line, then there is the possibility of both becoming clogged simultaneously. If the cutter is operated with only one sea chest on line and the valves

on the other sea chest shut, then the other sea chest can be in standby with its strainer clean. It is recommended that both sea bay vent valves be kept open to maximize the recirculation of water back to the sea bay and to allow entrained air to escape through sea bay vents. The sea chest recirculation valve serving the stand by sea chest should be cracked open and the sea chest recirculation valve serving the sea chest on line should be fully open. The PMC controller serving the 3-way temperature control valve should be set to automatic mode and the temperature should be set to 60 degrees. The valve should be to recirculate 100% of the water.

The crew of the 175-ft WLM *Katherine Walker* had good success operating the ship in ice using the procedure discussed above, with one sea chest in use and keeping the second on stand by with a clean strainer for a rapid switch to the standby sea chest if the operational strainer is clogged. The procedure they used was to run the Leslie control valve in automatic mode with a target temperature of 60 degrees while keeping the recirculating valve to the operational sea chest fully open and the one to the standby sea chest slightly open. The latter approach keeps a small amount of water going to the standby sea chest to keeping it from freezing up while most of the water is heating the operational one. The supply valves to the sea bay are open from the operational sea chest and the supply valves from the standby sea chest are closed. It should be noted that cleaning an ice-clogged sea strainer on the 175-ft WLM Class can be a difficult operation, and it should not be attempted while underway during icebreaking operations.

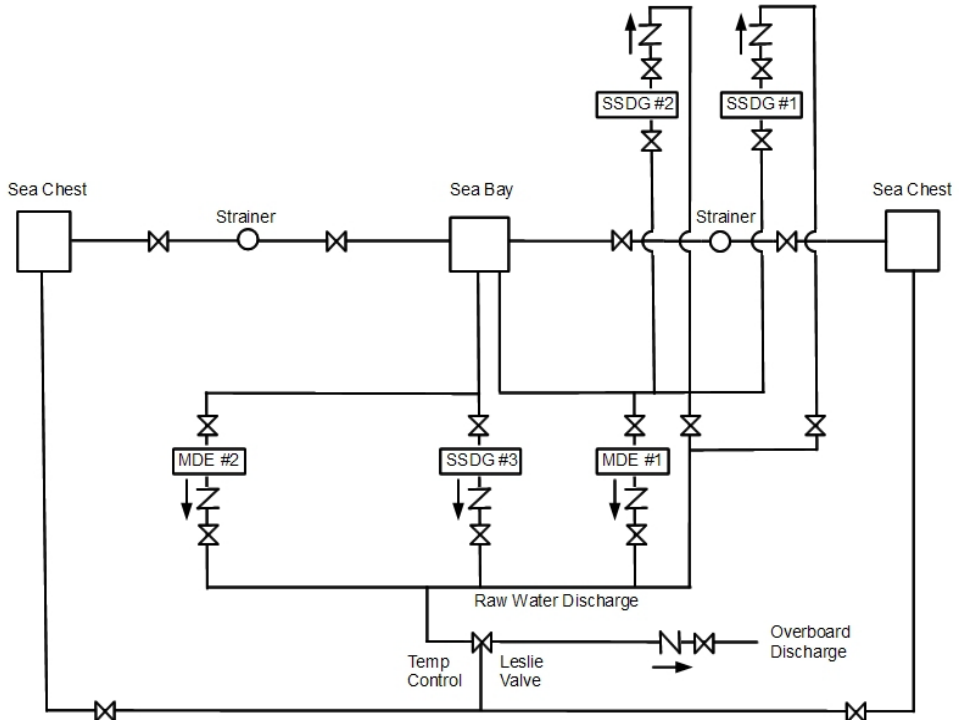


Figure 7 - Schematic of the Sea Water System on the 175-ft WLM Buoy Tenders

PERFORMANCE IN LEVEL ICE

175-ft WLM performance capability in level ice (large patches where ice is unbroken and nearly constant thickness) is estimated based on the analytical models and full-scale trials of *USCGC Katherine Walker* (WLM-552). **Figure 8** presents the performance for the range of throttle positions for effective operation in level ice.

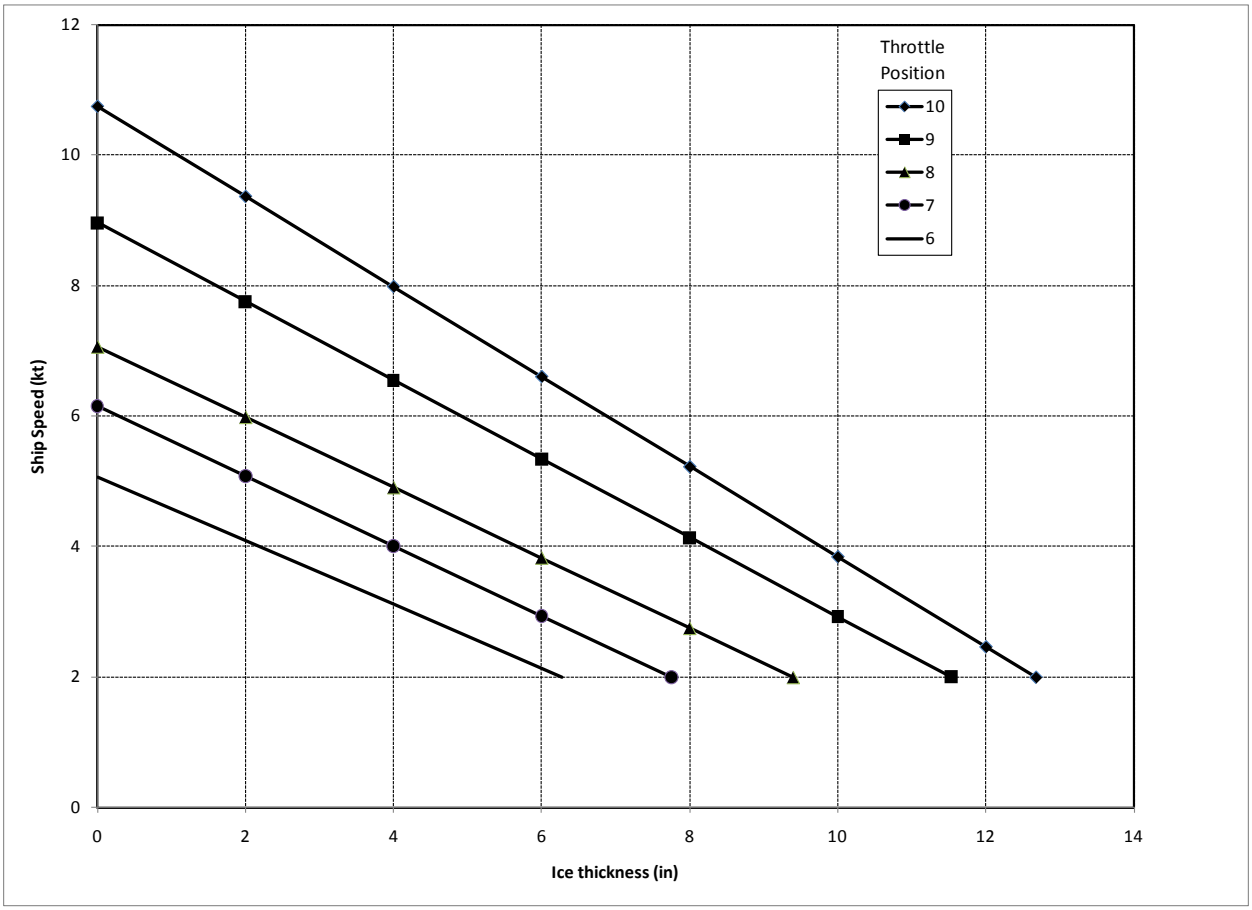


Figure 8 - 175-ft WLM performance in level fast ice as a function of throttle position

As seen in the figure, a 175-ft WLM operating in level fast ice 4 inches thick could travel at 4 knots at throttle position 7. If the throttle is increased to position 9, the attainable speed will be closer to 6.7 knots. Considered another way, if the 175-ft WLM travels at 4 knots, it can break almost 6 inches of level fast ice at throttle position 8. To maintain a speed of 4 knots in 8 inches of level fast ice, the throttle will have to be increased to position 9. Although the 175-ft WLM may be capable of going at almost 4 knots in 10 inches of ice (at throttle position 10), to do so would leave no margin of power in case more difficult level ice conditions are encountered. Note that 2 knots is generally the lowest speed considered

for continuous level icebreaking. Caution should be taken when operating in level ice greater than 8 inches thick to avoid getting stuck because the 175-ft WLM is limited in backing ability (see section below on backing).

Various factors can affect level ice performance. Hull-ice friction is a significant one. The 175-ft WLM Class has a low-friction hull coating, but surface conditions on the ice such as snow can affect performance. Depending on the zone of operations, there can be areas of high snowfall and also areas where high winds sweep the ice clean. For a reasonable approximation of the effect of snow cover, treat the ice as being bare and thicker by the addition of one-third of the snow depth. In cases when the snow is very sticky, the effect can be greater

Trim is important for good ice performance and safe operation. Trim by the stern reduces the bow's effectiveness in breaking ice, but the influence is small. Operation at even keel is recommended.

PERFORMANCE IN A TRACK (BROKEN ICE AND BRASH ICE PERFORMANCE)

In addition to level ice, a 175-ft WLM will likely encounter broken ice and brash ice. Broken ice is composed of flat pieces approximately three feet across that completely fill a fresh track. In contrast, brash ice is an accumulation of floating ice made up of fragments generally not more than a few inches across. Typical places where a 175-ft WLM will operate in brash occur where passing vessels have repeatedly broken a channel through level ice. In these old channels, thick brash ice resembles the consistency of porridge. (See again **Figure 1**)

Figure 9 shows 175-ft WLM performance in a freshly broken channel for different throttle positions. A ship transiting a freshly broken track is not subject to the same resistance as would be the case breaking level ice. Contrasting the performance capabilities in level ice with those in a freshly broken track, for a constant speed of 2 knots the range of throttle positions 6 through 10 allow maximum ice thicknesses of roughly 7 to 15 inches in the fresh broken track, but only 6 to 13 inches in level ice.

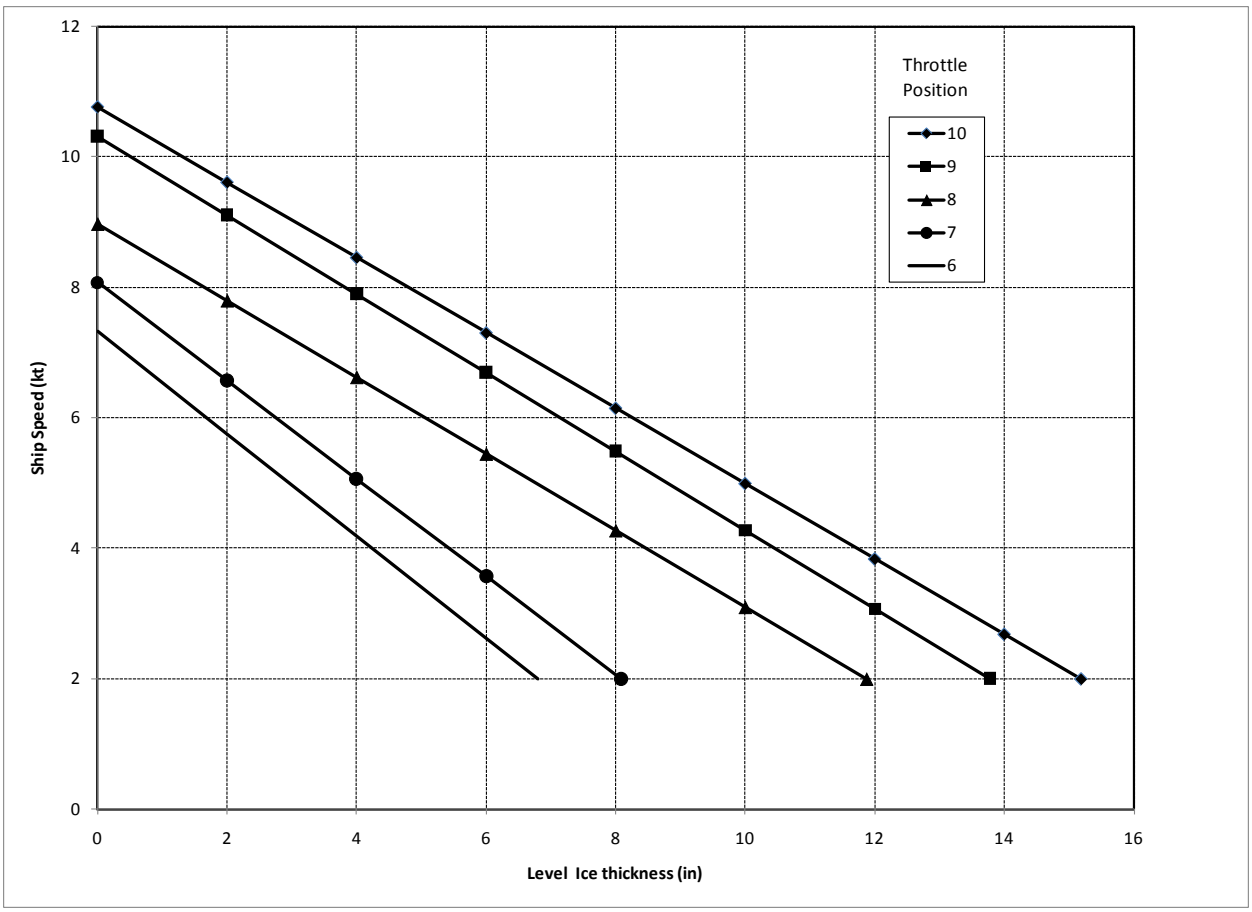


Figure 9 - 175-ft WLM performances in a freshly broken track as a function of throttle position

Figure 10 shows the performance in an old channel (after many transits through the channel) for different throttle positions. The brash ice thicknesses in **Figure 10** are large relative to those for level and broken ice. They can be expected in older channels formed where there is high ship traffic such as the entrances to ports and in rivers.

It should be noted that snow and dense brash in the channel might create conditions for ice "sticking" to the hull. This condition, sometimes called an ice "moustache", will significantly increase ice resistance, slow progress, and make maneuvering more difficult. This phenomenon is known to occur more frequently at very low speed and cold temperatures and is also affected by the hull conditions (friction). The best way to minimize the probability of this phenomenon is to sustain reasonably high speed when possible. It is important to maintain the hull surface in good condition painted with an ice-resistant coating. Sallying the ship by rotating the thrust of the Z-drives helps loosen ice build-up and can be used to help improve speed while operating in ice.

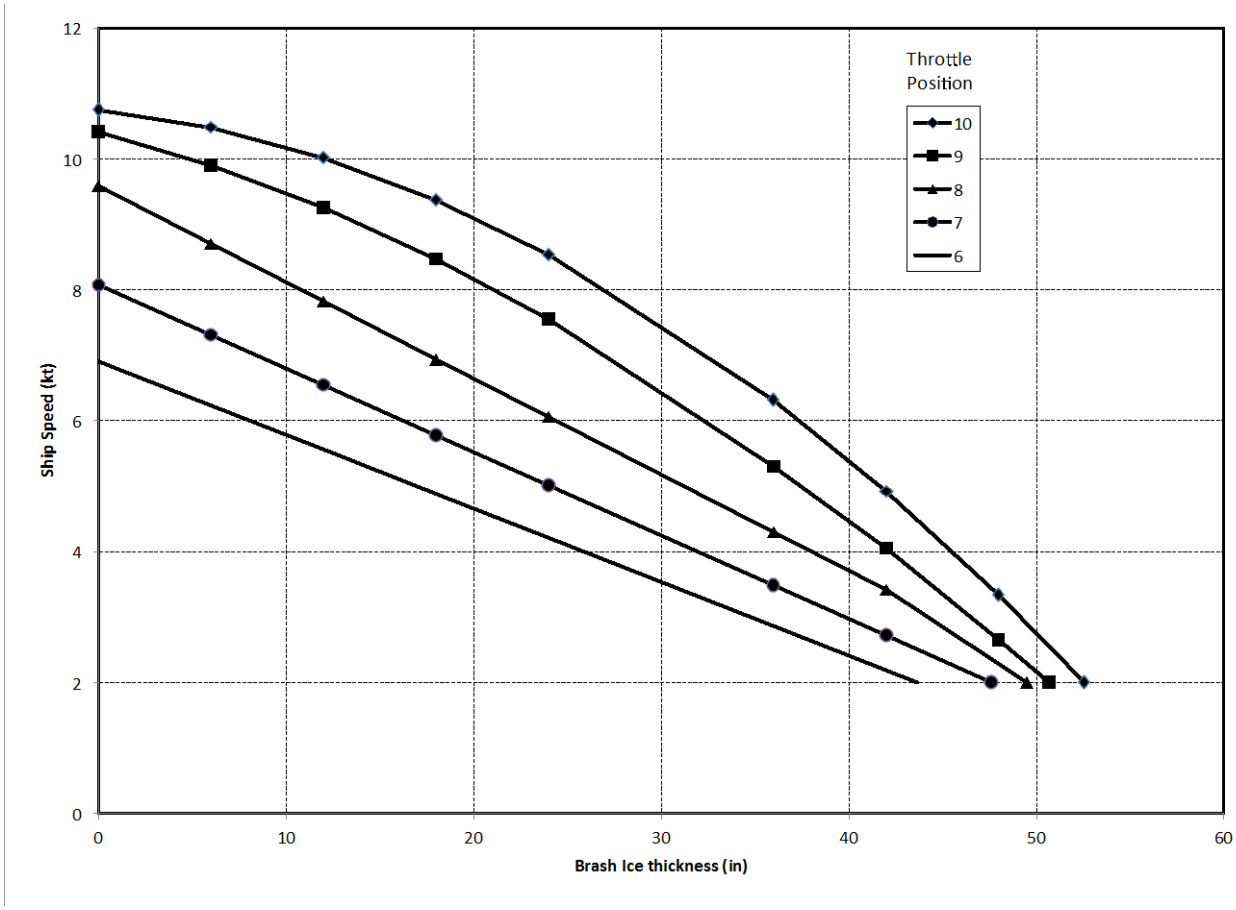


Figure 10 - 175-ft WLM performance in an old channel (brash ice) as a function of throttle position

PERFORMANCE IN RIDGES

Ridges can form along the edges of a track (as shown in **Figure 2**) when broken pieces of ice accumulate. Though the freeboard of the ridge may appear small from the surface, its depth is considerably greater, leading to deceptively difficult obstacles. In general it is recommended that the 175-ft WLM avoid areas of ridges when possible. The chance of getting stuck in ridges is high and the 175-ft WLM were not designed for this duty.

PERFORMANCE IN OTHER TYPES OF ICE CONDITIONS

This section discusses general performance in some typical ice conditions that are not covered above. They include the effects of currents and wind, ice jams, and backing in high ice concentrations.

Open and Close Pack Ice

The 175-ft WLM performance in Open Pack Ice (ice concentration from 4/10 to 6/10) and especially Very Open Pack Ice (ice concentration from 1/10 to 3/10) is not significantly affected by the presence of the ice. The ship speed in this case is limited more by the water resistance than ice resistance because typically there is a lot of room to transit through the leads and navigate around the big ice floes. However, it is not always possible to avoid collisions with heavy ice formations that may generate some dangerous ice loads on the hull structure and/or the propeller and rudder. As a precaution, it is recommended that speed be reduced to 8 knots when entering Open Pack Ice that exceeds 1 ft. If ice is less than 1 ft, operate normally in open pack ice.

The 175-ft WLM performance in Close Pack Ice (ice concentration from 7/10 to 8/10) will vary between Open Pack Ice performance and Level Ice performance depending on ice thickness. Open Pack Ice precautions are applicable for Close Pack Ice. Performance in Very Close Pack Ice (ice concentration from 9/10 to 10/10) is usually equal to or slightly better than performance in level continuous ice.

Wind and Current

Wind and currents can affect capability when operating in ice by acting on the ship directly or via ice moving downstream. These can alter vessel performance and must be considered when determining the operational limits. For example, while trying to transit a section of heavy ice or a track edge ridge, there is a difference between doing so moving downstream or upstream. In addition, wind and current can cause lateral pressure in the ice field and rafting or ridging, both of which will degrade icebreaking performance.

Choke Points and Ice Jams

River currents move ice downstream and can cause small floes to raft (one floe on top of another doubling the thickness). **Figure 11** shows a region of ice rafting on the Hudson River. This condition would make transiting more difficult for the 175-ft WLM. If the process continues, ice jams can form at chokepoints where accumulated rafted ice may refreeze. It is not advised for the 175-ft WLM to try to break up or break through an ice jam. Suddenly freed pieces and current could sweep the ship downstream and could cause loss of vessel control. If heading downstream to ram an ice jam, currents also increase the likelihood of getting stuck.

Figure 11 - Small floes rafting due to current

Backing in Level Ice and Broken Channel.

With the wide submerged transom arrangement, the transom impacts the ice cover first when backing. A theoretical calculation shows that the 175-ft WLM is not able to back in unbroken level ice when the thickness is much greater than 1 to 2 inches thick because the level ice must break by buckling instead of by bending and its thrust is insufficient to overcome this large load. The limitation in backing in ice also limits the 175-ft WLM's ability to back and ram if beset in ice. The 175-ft WLM performs better when backing in a pre-existing track, either fresh or old (i.e. broken or brash ice) than in level unbroken ice. **Table 1** shows data demonstrating its capability in backing in pre-existing tracks during 175 ft WLM ice trials. The 175-ft WLM is able to back 1.4 ship lengths on average in a fresh track measuring 7 to 8.5 inches thick brash before being stopped. When backing in a fresh broken track, broken ice piles up on the transom, filling the broken channel causing a significant increase in ice resistance. With greater thicknesses, the resistance of the ice on the wall-sided stern also increases. Eventually, the force required to break ice will overcome ship thrust to arrest its progress. The 175-ft WLM performs better in an old track of mostly loose brash and rubble ice. It backs an average of 1.6 ship lengths through brash ice 57 to 69 inches thick loose brash and rubble ice before movement ended.

Table 1 - Demonstrated Capability of the 175-ft WLM to Back in Pre-existing Tracks

Backing Performance						
	measured thickness (in)			# of ship lengths		
ice type	minimum	maximum	average	minimum	maximum	average
Fresh broken track	7	8	7.6	0.8	2	1.4
Old track of loose brash and rubble	57	69	63	1.0	2.3	1.6

MANEUVERING IN ICE

STEADY TURNS IN UNBROKEN LEVEL ICE AND IN AN OLD TRACK (BRASH ICE)

Turning circles in both level ice and in an old track were attempted during the Ice Trials of the 175 ft WLM. During the trials, turning circles were limited due to geographical constraints making complete circles impossible. Partial turns were extrapolated to obtain the values presented in **Table** 2 and **Table 3** for different speeds and rudder (thrust) angles. Note that the rudder (thruster) angles are referenced with zero ahead. There is variability in duration and diameter due to the applied nozzle angles, the initial ship speed, and the ice conditions. Comparing the tables indicates that turning in an old track is easier than turning in unbroken level ice. Additionally, the square stern quarters present largely wall-sided boundaries to surrounding ice, making turning difficult due to ice being pushed aside by the hull.

Avoid using the bow thruster in ice due to damage from ice ingestion. In light ice conditions, it may be possible to maintain directional control while backing by using the azimuthing nozzles.

Table 2 - Turning Circles in Unbroken Level Ice

Ice Thickness (in)	Port Rudder Angle (deg)	STBD Rudder Angle (deg)	Ship Speed (kt)	Duration (min)	Diameter (ft)	Diameter (Ship Lengths)
7 to 8.5	18	16	4.4	14.8	2,114	12.1
7 to 8.5	267	289	3.4	12.5	1360	7.8

Table 3 - Turning Circles in an Old Track (Loose Brash and Rubble Ice)

Ice Thickness (in)	Port Rudder Angle (deg)	STBD Rudder Angle (deg)	Ship Speed (kt)	Duration (min)	Diameter (ft)	Diameter (Ship Lengths)
4 to 8	323	347	6.8	6.3	1360	7.8
57 to 69	163	273	7.7	2.8	680	3.9
60	296	327	4.7	9.6	1460	8.3

BREAK-OUT OF AN EXISTING LEVEL ICE TRACK

The break-out maneuver starts in a broken track and is a method to leave the track in level ice without frozen brash ridges on the sides of the broken track. The maneuver is useful for turning around in a track in limited space. **Figure 12** shows the 175-ft WLM trackline during one 180-degree turn using break-outs. Segments 1, 2, and 3 in the figure together make one complete break-out maneuver. Note that this is a multi-point turn during which the ship is backing at segments 2 and 4.

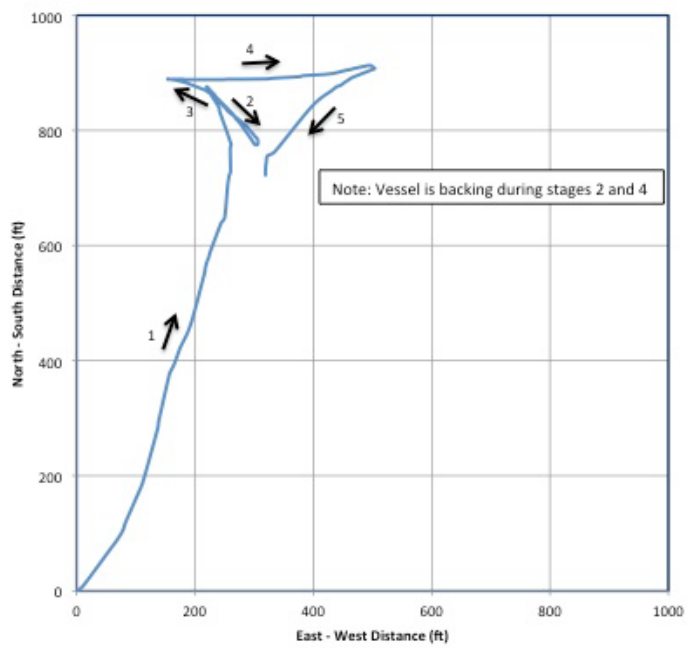


Figure 12 - Example trackline of maneuver to break out of track and turn around

The times and distances for the break-out turn in **Figure 12** are shown in **Table 4**. During the backing stages, the 175-ft WLM backed as far as it could until the ice resistance stopped its movement.

Table 4 - Breaking Out of a Fresh Level Ice Track

Breaking Out of a Fresh Level Ice Track 7"-8.5" thick				
segment #	direction	duration (min:sec)	distance (ft)	# ship lengths
1	ahead	0:37	174	1.0
2	backing	0:36	132	0.8
3	ahead	0:44	185	1.1
4	backing	1:11	351	2.0
5	ahead	0:29	261	1.5
	total time:	3:37		

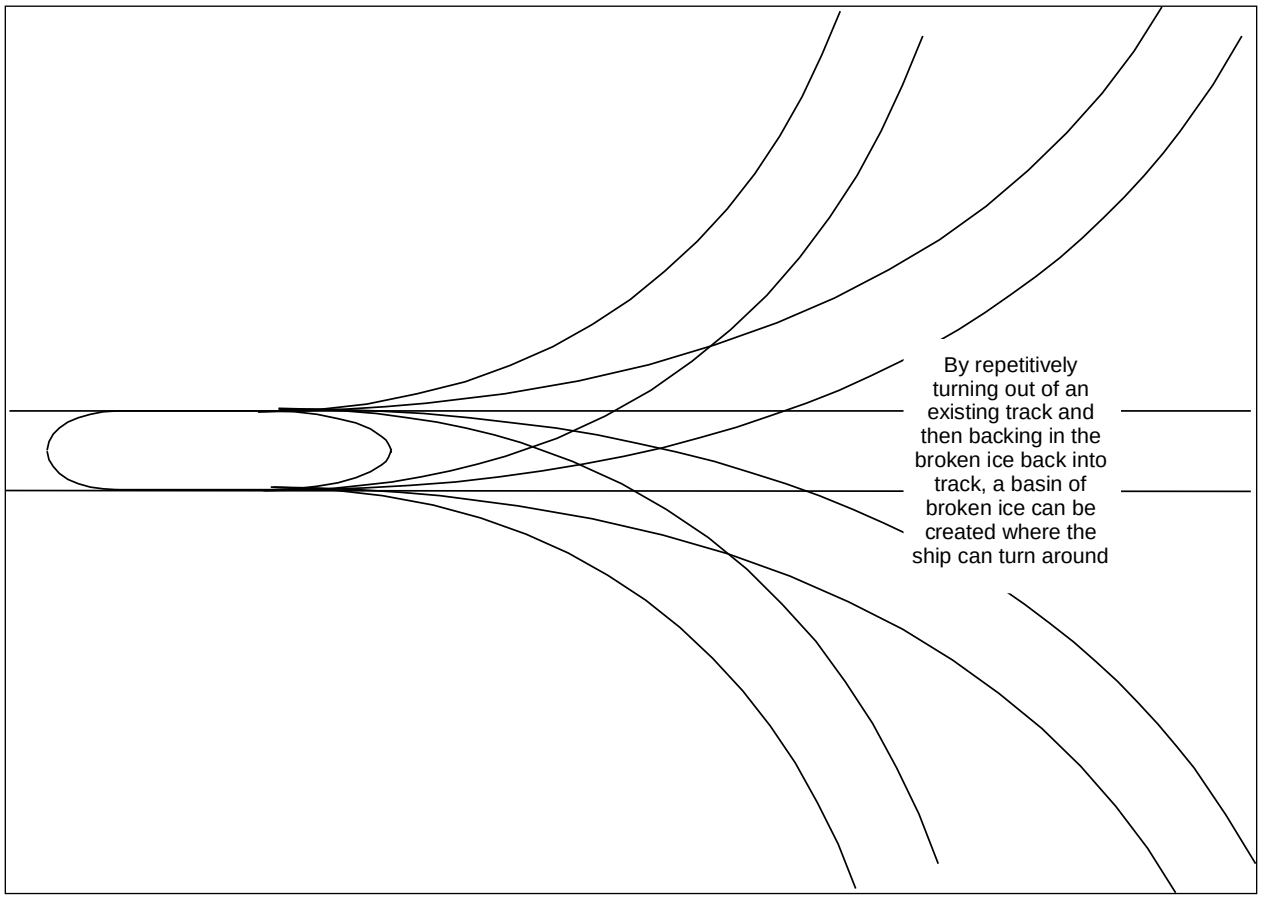


Figure 13 - Maneuver developed on the Hudson River by WLB for creating a turning basin in the ice from an existing track

TURNING AROUND IN AN EXISTING TRACK

A method for turning around in an existing track has been developed during 225-ft WLB operations on the Hudson River. A pictorial view of this maneuver is shown in **Figure 13**. The cutter repetitively turns out of the track to the left and to the right, each time backing down its track into the original one. Eventually, all the ice is broken in a large area forward of the cutter forming a turning basin that is big enough to maneuver the ship around. When possible it is also prudent to use the turning basin created by other ships operating in the area. This maneuver may be limited by the ability of the 175-ft WLB to turn into and break through a frozen brash ice ridge commonly present in the sides of a frequently used channel. The ability to break out of an existing track critically important if there is commercial traffic using the track.

STAR MANEUVERS IN LEVEL ICE

The star maneuver is an effective means for turning around in ice for many ships. The star maneuver is a commonly used piloting technique to turn the ship around in the ice when use of a turning circle is not possible or not feasible. This type of maneuver is usually performed when the ice thickness exceeds the capability of the ship to move continuously while turning or when sufficient space for such a turning circle maneuver is not available. The maneuver typically starts from the vessel breaking out of the channel and turning until the ice, fairway limit, or other limitations stop the ship. After that backing into unbroken ice is conducted as far as possible or desirable. It takes several “backing and ramming” cycles, each of which provides a relatively small angle turn. The maneuver is complete when the vessel has changed heading 180 degrees and entered its own track. The imprint of such a maneuver very often looks like a star. However, there are a number of different terms applied to the same or very similar technique. Some of the most common terms include cast about, modified captain’s maneuver, herringbone, and Christmas tree.

A sample trackline from a 175-ft WLM star maneuver is shown in **Figure 14** and shows that the ship backed approximately 1.0 to 2.3 ship lengths during each step. Details of the maneuver are given in **Table 5**. As with the break-out maneuver of **Figure 12**, the 175-ft WLM backed as far as possible until ice resistance stopped its movement. Note the number of small turn advances results from limited backing and turning ability caused by the wide flat stern and transom. The time required to complete these maneuvers is critically important if there is commercial traffic using the broken track.

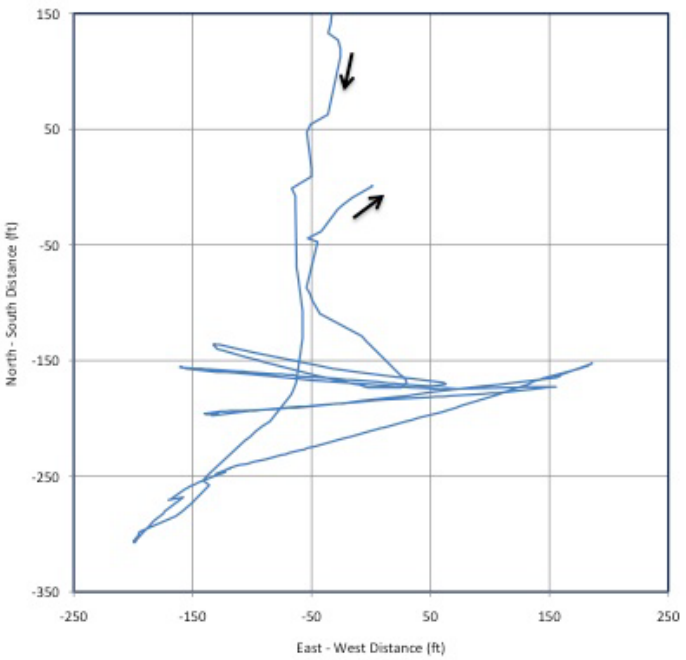


Figure 14 - Trackline of star maneuver in an old track

Table 5 - Star maneuver in an old track

57"-69" thick brash and rubble ice				
segment #	direction	duration (min:sec)	distance (ft)	# ship lengths
1	ahead	0:29	149	0.9
2	backing	0:50	166	1.0
3	ahead	0:37	198	1.1
4	backing	1:09	223	1.3
5	ahead	0:47	314	1.8
6	backing	1:19	297	1.7
7	ahead	1:01	328	1.9
8	backing	2:34	411	2.3
9	ahead	0:56	273	1.6
	total time:	9:42		

OPERATIONAL ISSUES IN ICE

OPERATIONS TO APPROACH WITH CAUTION OR AVOID

Avoid using too much power while icebreaking ahead as the possibility exists of getting stopped ahead such that astern thrust is insufficient to get unstuck. Do not get "beached" on a ridge when ramming ridges. Astern thrust is equal to ahead thrust for the 175-ft WLM but resistance of the hull in ice is much greater moving astern due to the wide flat vertical transom.

Note that operations in ice occur in slow motion relative to operations in open water. The uninitiated operator must resist the temptation to apply too much power to make events happen faster than is prudent. A certain amount of reserve power should be saved in case the ship becomes stuck, and it is needed to break free.

A summary of the operations that should be approached with caution or avoided, if possible, by the 175-ft WLM Class are listed below:

- While the 175-ft WLM has the capability to break nine inches level ice at three knots ahead, operating in level fast ice and heavy refrozen brash ice should be attempted with caution and due consideration of the documented backing and turning capabilities.
- Hitting thick ice too fast. More rams at slower speed are better.
- When operating in areas of unknown ice thickness, transiting an established track for the first time, or where ridging is known to exist, keep speed less than five knots to maintain reserve power in case the 175-ft WLM becomes beset.

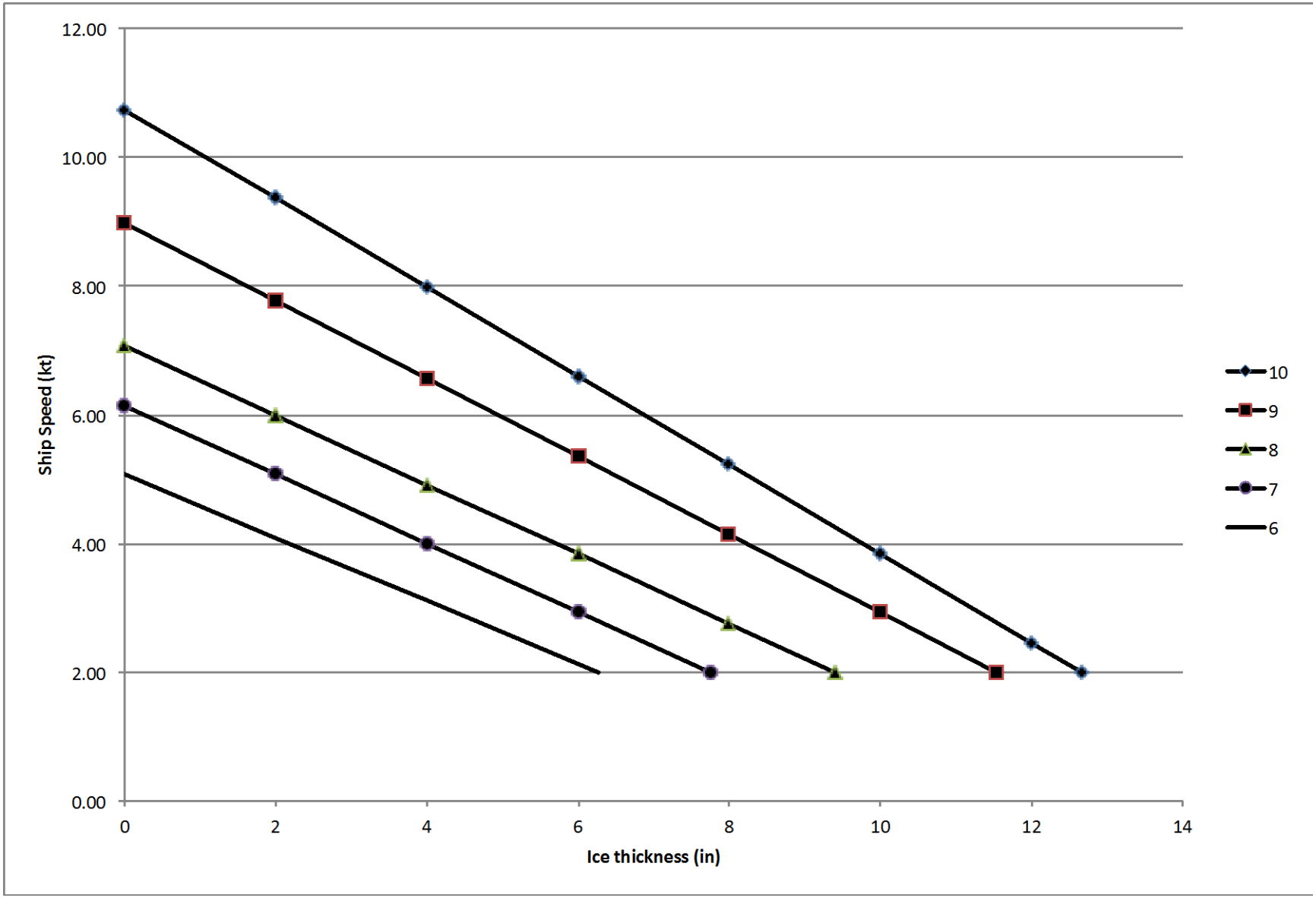
ICE CONDITIONS TO AVOID

A summary of the ice conditions that have been discussed and should be avoided, if possible, by the 175-ft WLM Class are listed below:

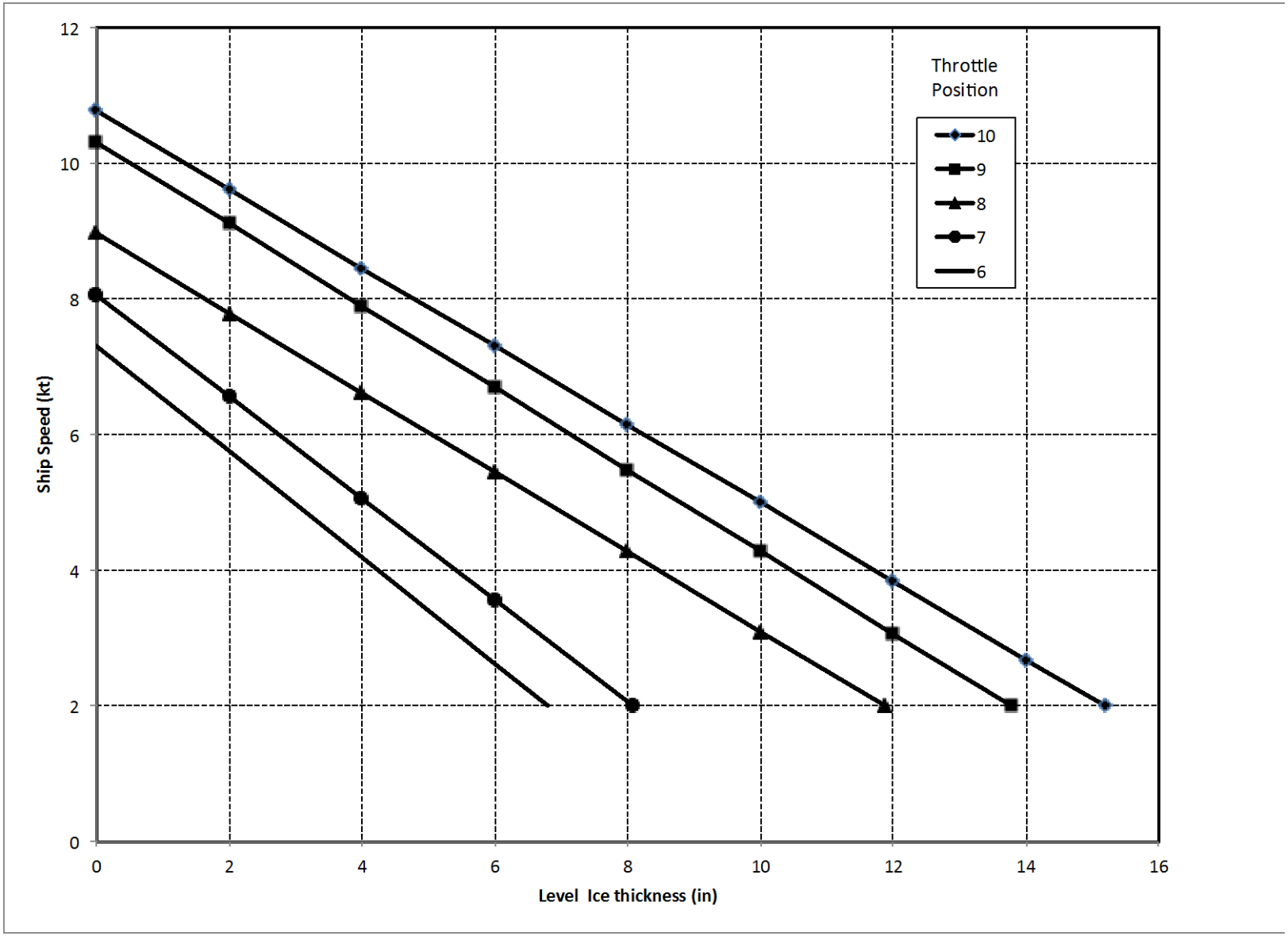
- Ice floes in rapidly moving currents.
- Ice jams (e.g. choke points in river bends).
- Breaking into frozen brash ridges formed on the sides of frequently used brash tracks as shown in **Figure 2**.
- Brash and broken ice conditions producing high vibration when ice milling occurs.

APPENDIX A

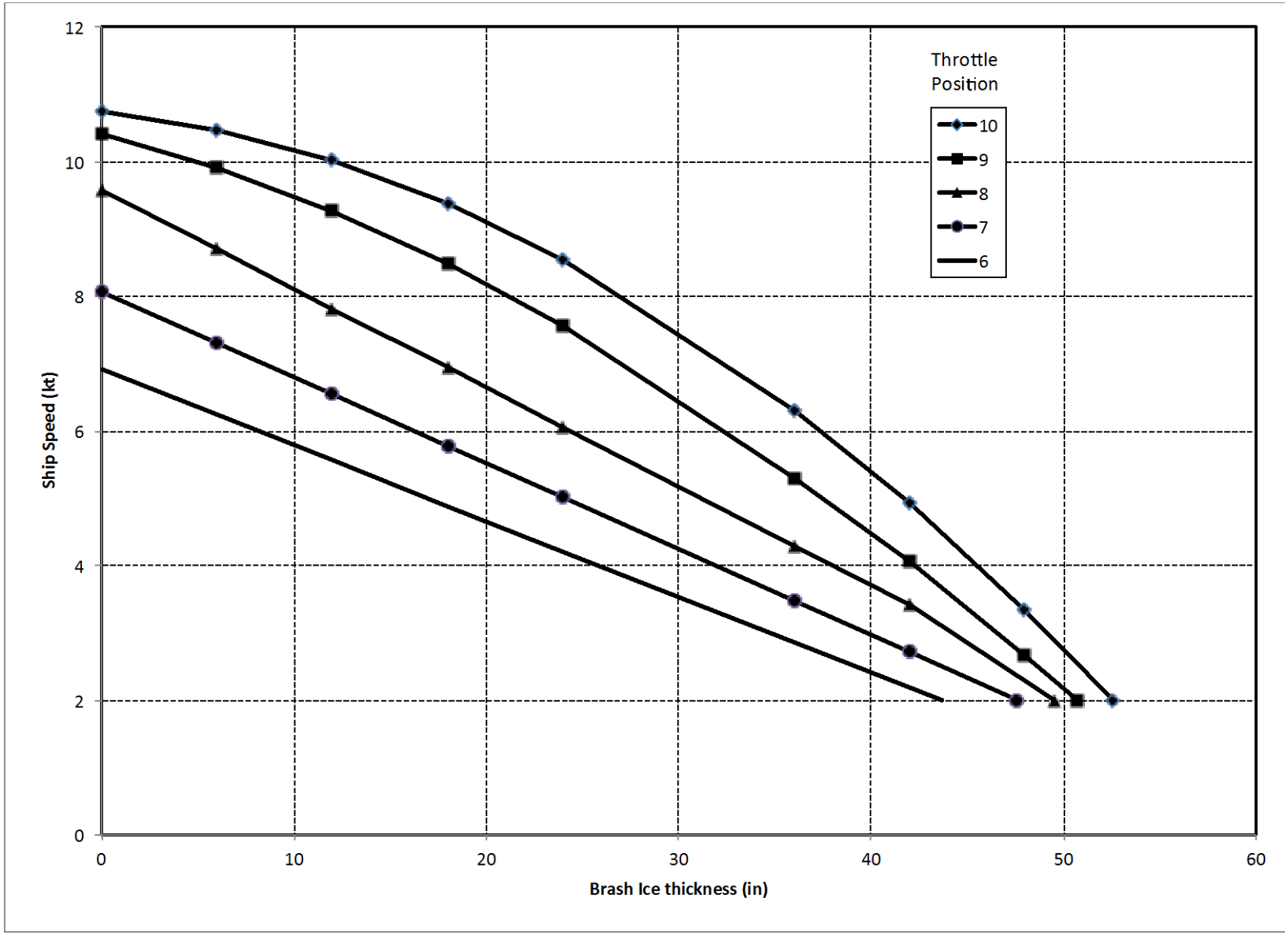
PERFORMANCE PLOTS FOR 175-FT WLM



175-ft WLM icebreaking performance in fresh water level ice as a function of throttle position



175-ft WLM performance in a freshly broken track as a function of throttle position



175-ft WLM performance in an old channel (brash ice) as a function of throttle position

APPENDIX B

ICE OPERATIONS BILL AND ICE ANALYSIS CHECKLISTS

ICE OPERATIONS BILL CHECKLIST

_____ OOD/CONN verifies ice environment: takes the following actions.

_____ Notifies CO of ice type and range

_____ Pipe and log. **"NOW SET THE ICE OPERATIONS BILL!"**

_____ Slow to a safe speed

_____ Conduct risk assessment and log. **Score:** _____ **G A R**
Remarks:_____

_____

_____ Pipe and log. **"SET STRUCTURAL ZEBRA MAIN DECK AND BELOW!"**

_____ Ensure operating in **TILLER MODE**.

_____ Limit Bow Thruster use to **ONLY** with CO's consent.

_____ Verify with ECC plant status:
_____Sea strainer suction
_____Restricted Maneuvering
_____1.2.3 Generators paralleled

_____ Ensure all bridge equipment is energized and configured IAW navigation Standards.

_____ When clear of ice environment pipe. **"SECURE FROM ICE OPERATIONS BILL!"**

Ice Analysis Checklists:

_____ Conduct Pre-Brief of Ice Operations (Crew & Naval Engineers)

_____ Conduct Risk Assessment _____G. _____A. _____R
Remarks:_____
_____
_____
_____

_____ Security Call Via VHF 13/16 executed prior to evolution and every 15 minutes until all personnel recovered and accounted for.

_____ Ice Info Entered in Ship's Log
Air Temp: _____ Water Temp: _____ ICE Type: _____

_____ Time Commenced _____ Time Secured

_____ Authorized Foul WX Gear: Ice Walkers: _____
Rescue swimmer:_____

_____ Members conducting Ice Walk: 1)_____
2)_____
3)_____

_____ Communications Brief Conducted: hand signals for distress identified

_____ Triage location identified in case of emergency

_____ Nearest Destination for Emergency Evac Identified: _____

_____ EMT Briefed prior to commencement of Evolution

_____ Standby Rescue Swimmer Identified; _____

_____ Line Tenders Identified: 1)_____
2)_____
3)_____

_____ Engineer plant status: _____
_____

_____ Non-Essential Machinery Secured: _____ Bow Thruster _____ Z-drives

_____ Access to ice identified: _____Port Buoy Deck / _____Stbd Buoy deck