Introduction to API Specification 2C

6th Edition vs. 7th Edition

Goals of API Spec 2C 7th Edition

- Address gross overload/supply boat entanglement issue
- Incorporate all types of offshore cranes, including:
  - Construction
  - Derrick Barges
  - Pipe Lay Vessels
  - Support Vessels
  - Shipboard Cranes
  - Knuckle Boom Cranes
- Provide design requirements for new crane uses without significantly affecting cranes currently covered by previous editions
- Differentiate between crane designs based on intensity or frequency of use

Significant Changes from 6th Edition

- Gross overload / supply boat entanglement
- Duty cycle consideration (frequency / intensity of use)
- Wire rope design factors
- Structural design factors

Background

- API Spec 2C 6th Edition and European standard EN 13852-1 and -2 both published 2004 addressing offshore crane sizing and safety requirements
- API Spec 2C 6th Edition
  - Focused on cranes for oil production and drilling facilities
  - Safety based on structural design and integrity
  - Increased safety factors are emphasized above instrumentation / gadgets as a means of providing safe cranes
- EN 13852
  - Covers cranes for all offshore applications
  - Safety focused on instrumentation / gadgets instead of increased safety factors
  - Main requirement is an Automatic Overload Protection System (AOPS) that takes control away from the operator and releases the brakes while over the supply boat

Background

- API Spec 2C 7th Edition drafted to incorporate additional crane uses, expanding on previous versions and maintaining safe operations as governing theme
  - Designed as a superior international standard for offshore cranes based on more realistic criteria and more definitive guidance

Gross Overload Conditions /
Failure Mode Assessment

API 6th Edition

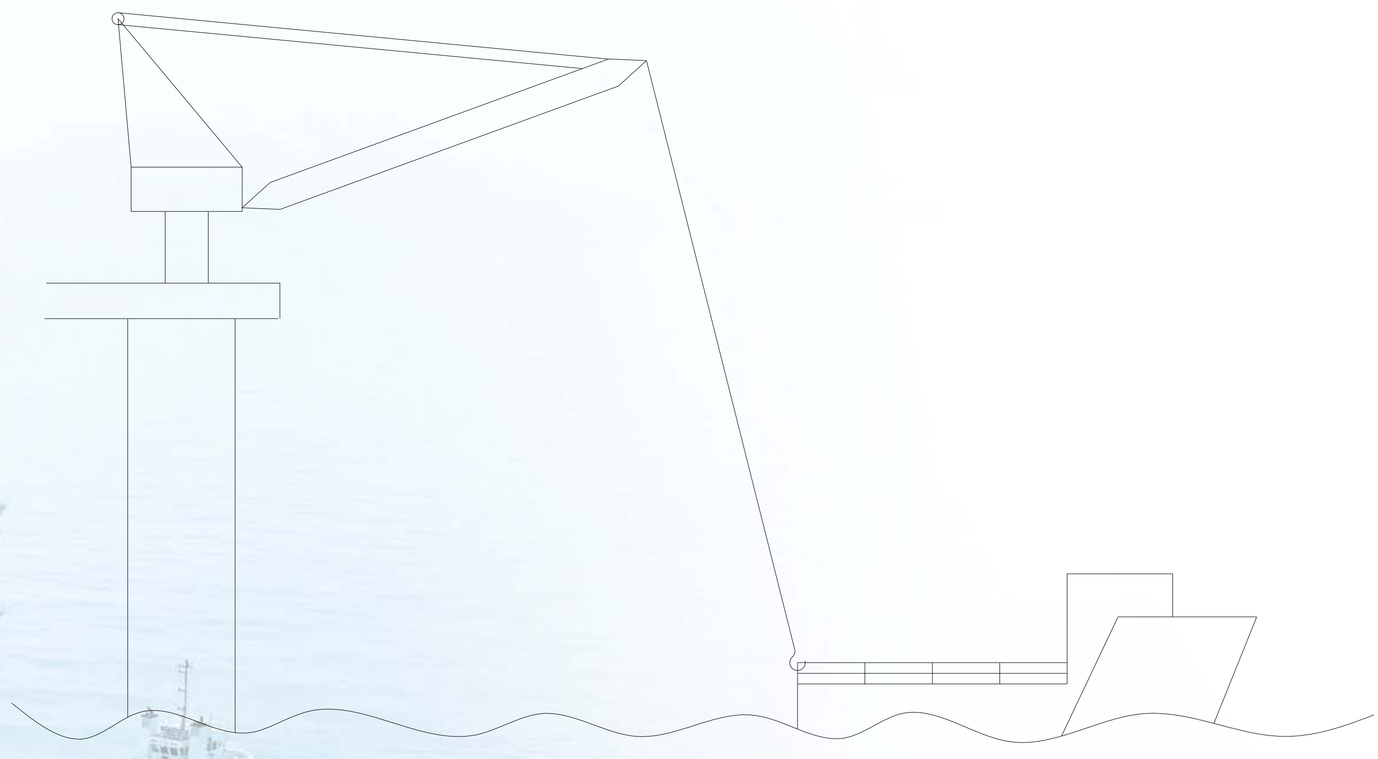
- Did not specifically address Gross overload conditions
- Failure mode calculations only required upon request of purchaser

API 7th Edition

- Addresses gross overload using failure mode assessment
- Requires failure mode results to be provided to the customer
- Protects the crane operator in the event of an unbounded gross overload (supply boat entanglement)
- If failure mode cannot be met, gross overload protection system (GOPS) required to assure that structure holding the operator does not fail in the event of a gross overload
- No AOPS required

Supply Boat Entanglement Causing Gross Overload

- Not to be confused with exceeding the SWL of the crane



Gross Overload Conditions
(From Supply Boat Entanglement)

EN 13852

- Seems to consider supply boat entanglement to be a common event
- Damage to equipment unacceptable in catastrophic events
- Accomplished through Automatic Overload Protection System (AOPS) which senses an overload and releases the load
- AOPS creates increased risk of malfunction and dropped loads

API 7th Edition

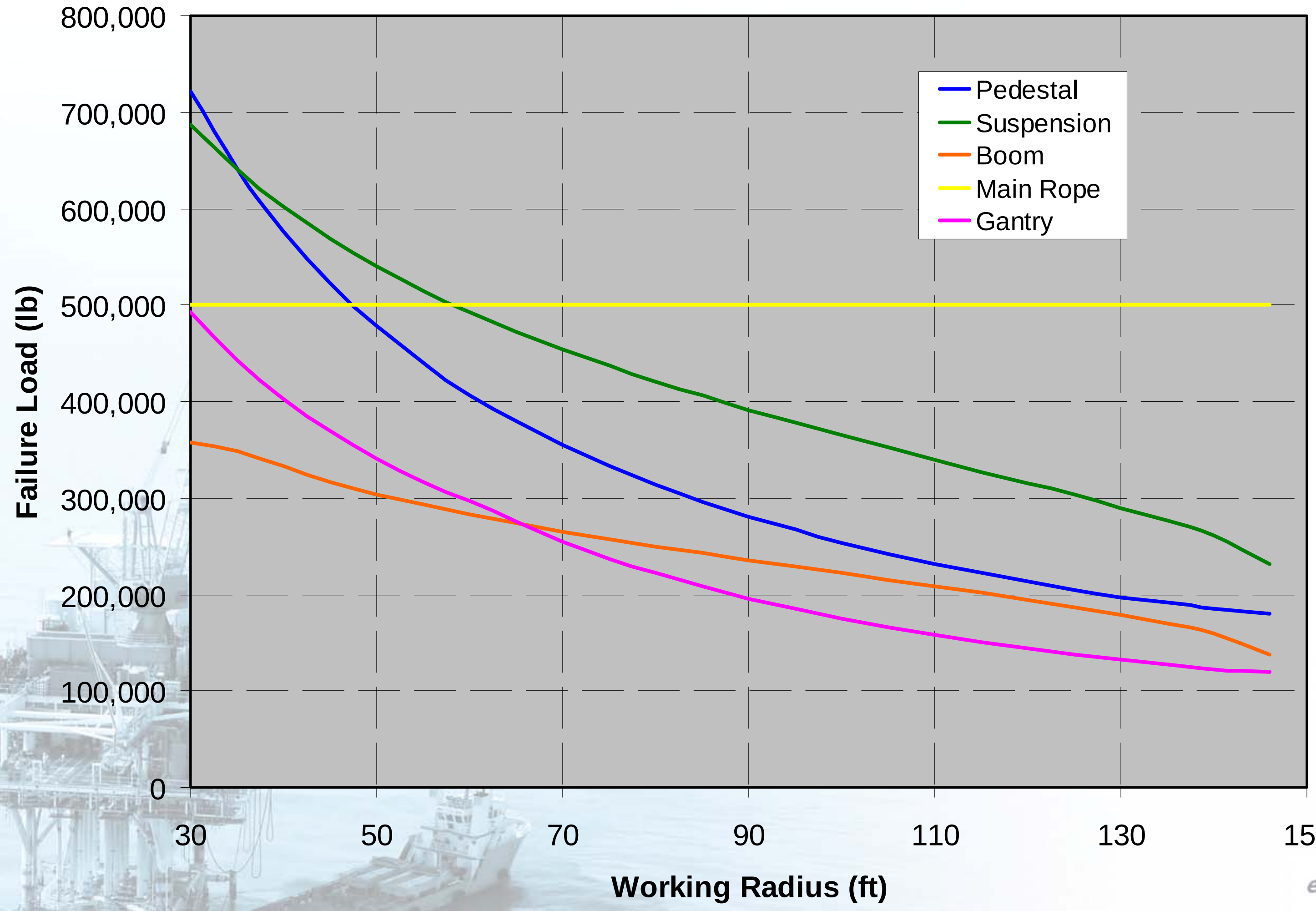
- Considers supply boat entanglement an extremely rare but serious event with special attention required
- Equipment damage considered acceptable in this rare catastrophic event
- Accomplished through failure mode assessment showing structure holding operator's cabin will not be first to fail in any condition
- Considers hazards created by AOPS to be worse than the potential benefits

Pitfalls of AOPS

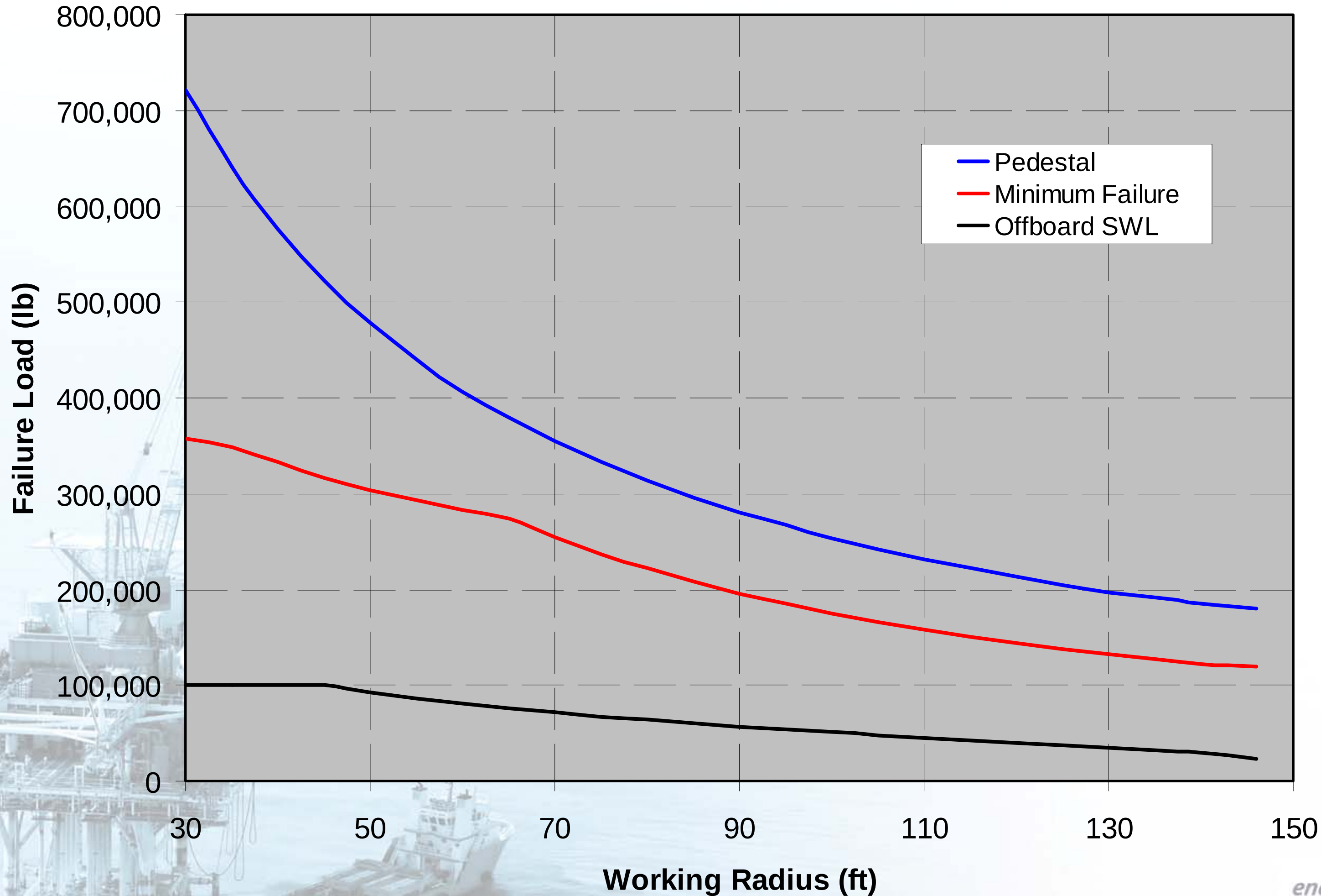
- AOPS requirements over emphasize protection of replaceable components/machinery to the extent of creating additional hazards to personnel.

- Examples of additional personnel hazards
  - Holds loads over supply boat personnel with brakes intentionally disabled
  - Loads supported only by retention or containment of hydraulic oil pressure
  - Can and have inadvertently dropped loads on supply boat
  - Complexity of components adds to number of parts that must be maintained, inspected, and tested
  - Numerous components increase likelihood of failure
  - Creates a false sense of security

Example of Failure Assessment
(From Supply Boat Entanglement)



Example of Failure Assessment
(From Supply Boat Entanglement)



Example of Supply Boat Entanglement

- Crane on semi-submersible subjected to event while handling anchors
- Instantaneous overload in excess of 200% SWL
- Wire rope pulled off the hoist drum, hydraulic motor destroyed due to overspeed
- ***No personnel injuries***
- Crane returned to service following replacement of wire rope and hydraulic motor
- Outcome acceptable under API 7th Edition but not EN 13852

Structural Fatigue

API 6th Edition

- Structural fatigue requirement is 25,000 cycles at 133% of max SWL
- Crane structures expected to last 30-40 years

* ***EN 13852 and ISO assume machinery and structures have same useful life***

API 7th Edition

- Structural fatigue requirement is 1,000,000 cycles at 50% onboard SWL
- Equivalent fatigue damage of 6th Edition
- Differentiates between structures and machinery*
- Crane structures expected to last at least 30-40 years

Machinery and Wire Rope Duty Cycle

API 6th Edition

- Did not address duty cycle, only structural fatigue

* ***EN 13852 and ISO assume machinery and structures have same useful life***

API 7th Edition

- Differentiates between structures and machinery*
- Machinery expected to last 5 years before major overhaul / replacement
- API machinery is replaced or overhauled multiple times before crane structure is retired
- Duty classifications based on actual historical crane usage data

Duty Classifications Examples

Production Duty

Construction Duty

Intermediate Duty

Drilling Duty

Crane Duty Classifications

Crane Duty Cycle Classification	Typical Annual Operating Hours	Typical Applications
Production Duty	200	Offshore cranes on fixed production platforms
Construction Duty	1000	Offshore cranes on barges or vessels, heavy lift cranes
Intermediate Duty	2,000	Offshore cranes on fixed or floating platforms with temporary rigs or intermittent periods of intensive use
Drilling Duty	5,000	Offshore cranes on MODUs or floating production facilities with full-time, heavy-use drilling operations

Note: Where possible, purchaser specified data used in place of duty classifications

Historical Crane Usage Data

Usage (Hours)	Year		
	2006	2007	2008
Drilling Contractor Data: (based on logs & engine hours)			
Average of Jackups-Primary Crane	2340	2656	2550
Max of Jackups-Primary Crane	6552	6300	6009
No. of Primary Cranes	19	24	24
Average of Semi/DrillShips-Primary Crane	1746	2208	2325
Max of Semi/DrillShips-Primary Crane	3120	4868	4416
No. of Primary Cranes	10	10	11
Production Platform Data #1: (based on Engine Hours)			
Average of Platform Cranes w/o Drilling			46
Max of Platform Cranes w/o Drilling			312
No. of Cranes			33
Production Platform Data #2: (based on Hoist Hour Meters)			
Average of Platform Cranes w/o Drilling			46
Max of Platform Cranes w/o Drilling			408
No. of Cranes			164

Floating Production / Drilling Systems:	
Spars/TLP with Drilling Rig (4)	Ave / Max 2315 / 5000 engine hr/yr
Spars/TLP w/o Rig (1)	650 engine hr/yr

energy API

Wire Rope Design Factors

API 6th Edition

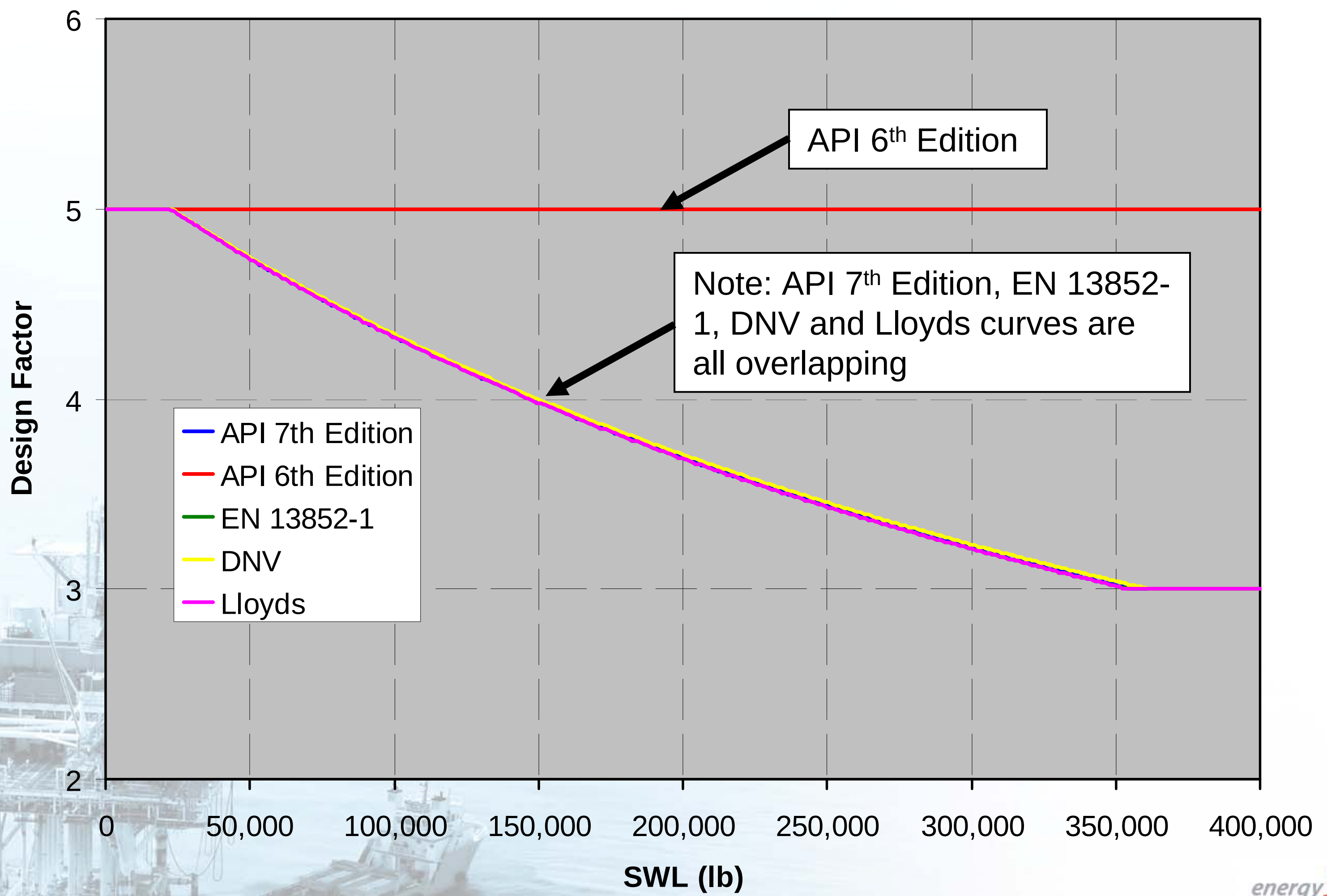
- Fixed design factor of 5 for running rigging without reeving efficiency
- Fixed design factor of 4 for standing rigging
- Impractical for larger cranes, such as construction cranes and derrick barges

* ***Certifying authorities for larger cranes use design factor of 3 for lifts over 160 tons and account for reeving efficiency***

API 7th Edition

- Little to no effect on cranes covered by API 6th Edition
- Sliding factor based on SWL that allows larger cranes lower factors in line with industry practice*
- Reeving efficiency now considered due to high number of parts of line required for larger construction cranes
- Higher capacity cranes, such as derrick barges, have similar factors to current certifying authorities

Wire Rope Design Factors



Structural Design Factors

EN 13852

- Uses same factor of safety for pedestal / slew bearing as the rest of the crane structure
- No additional factor on the pedestal / slew bearing

API 7th Edition

- Uses higher factor of safety for pedestal / slew bearing compared to the rest of the crane structure
- Significant additional factor of safety applied to the pedestal / slew bearing to help ensure that the main crane structure and operator remain attached to the platform in a catastrophic event

Structural Design Factors

API 6th Edition

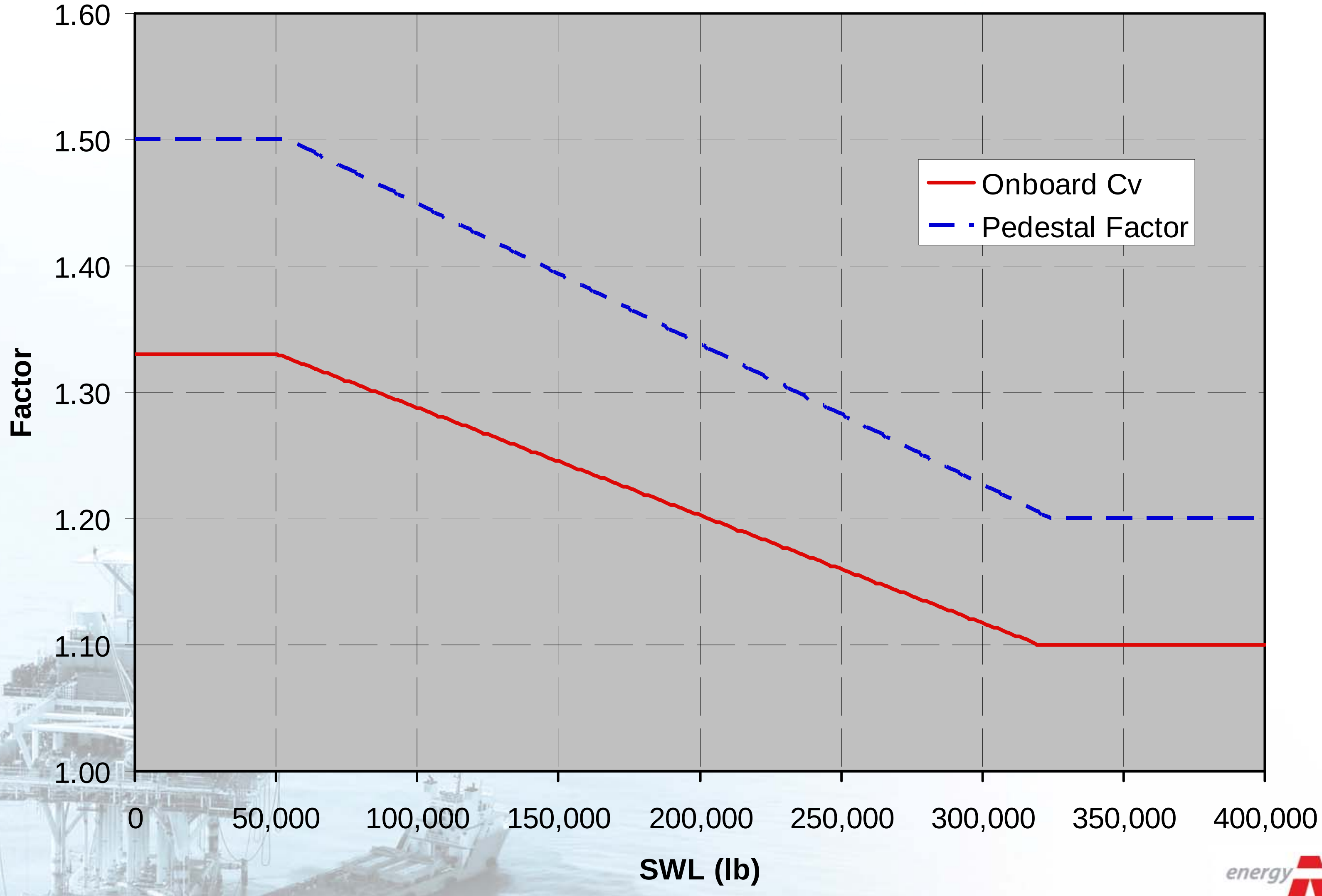
- Minimum onboard dynamic coefficient (Cv) of 1.33
- Additional Pedestal factor of 1.5
- Impractical for large construction cranes, derrick barges or shipboard cranes in calm waters

* ***Certifying authorities use approximately 1.1 for Cv for lifts over 160 tons and many do not use a pedestal factor***

API 7th Edition

- Little to no effect on cranes currently covered by API 6th Edition
- Sliding minimum onboard dynamic coefficient from 1.33 to 1.1 based on SWL
- Additional sliding pedestal factor from 1.5 to 1.2 based on SWL
- Offboard dynamic coefficients for typical oil production cranes have not changed
- Higher capacity cranes, such as derrick barges, have similar factors to current certifying authorities

API 7th Edition Structural Design Factors



Minimum Hook Velocity

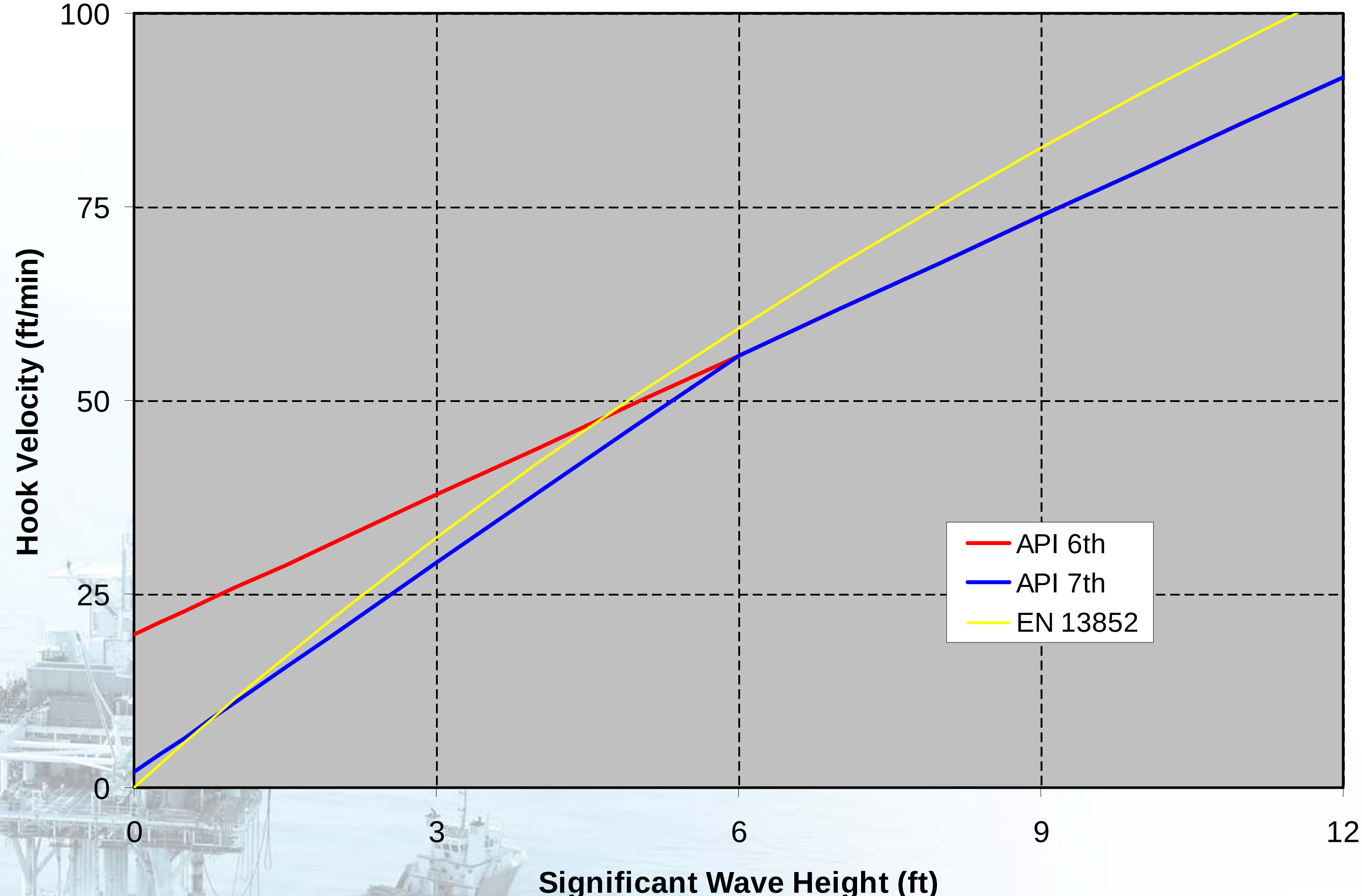
API 6th Edition

- Calculations given but was not mandatory
- Minimum hook velocity of 20 ft/min at 0 ft significant wave height

API 7th Edition

- Mandatory for all offboard ratings
- If not met, load chart cannot be provided for the specific conditions
- Minimum hook velocity of 2 ft/min at 0 ft significant wave height
- Above 6 ft significant wave height minimum hook velocity is the same as the 6th Edition

Minimum Hook Velocity



Other Changes

- Cylinder design factors updated to include dynamic load factor Cv
- Hoist section updated to require separate dynamic and static brakes
- Load/moment indicators required on intermediate, drilling, and construction duty cranes
- Personnel capacity increased to 50% of SWL as opposed to 33% of SWL to more adequately align with OSHA and other standards and simplify ratings
- Align noise requirements with OSHA

Other Changes

- Material requirements clarified and aligned throughout the standard
- Minimum toughness (Charpy) requirements provided instead of relying on crane manufacturer to determine ductility requirements
- Example calculations updated to reflect changes
- Default Dynamic Method (fixed Cv of 2.0) renamed Legacy Dynamic Method to discourage use
- Drastically reduced number of references to external standards for ease of use internationally

energy API

Summary

- API 7th Edition is a viable international standard incorporating all offshore crane applications
- Failure mode calculations/GOPS ensure operator safety without increasing the risk of dropping the load
- In the rare event of supply boat entanglement, injury to personnel is prevented
- Cranes covered by the 6th Edition essentially unchanged while higher capacity cranes use similar to factors used by certifying authorities
- Entire standard reviewed and updated to match current technology and practice

Summary

- API 7th Edition provides definitive technical guidance and unambiguous design rules to ensure cranes are designed to safely operate in the challenging offshore environment

- Cranes designed to API 2C 7th Edition provide a superior balance of safety and simplicity