



JOINT MEDIA RELEASE

Standards Enhance Transparency, Quality and Trust in Singapore's Bunkering Industry

Study shows TR 48 improves productivity and reaps annual savings of at least S\$80m for bunkering industry

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1. *Technical Reference 48 : 2015 (TR 48)*¹ - *Bunker Mass Flow Metering (MFM)*, which is used in the bunkering industry for the delivery of marine fuel oil (MFO) in the Port of Singapore, has the potential to reap annual savings of between S\$80 million and S\$199 million for the industry.
2. Cost savings for bunkering operations account for an estimated 66% to 76% of total savings. Cost savings from the reduction in the number of dispute resolutions as well as the time taken to resolve these resolutions account for the remainder. These are the key findings from a case study initiated by SDO@SCIC, on behalf of Enterprise Singapore and the Singapore Standards Council.
3. The Maritime and Port Authority of Singapore (MPA) has required the adherence to TR 48 since June 2016. Several bunker suppliers surveyed observed enhanced bunker schedule management due to faster and more predictable turnaround in bunkering transactions. A number of shipowners added that inventory management had improved with the increased certainty in the quantity of bunkers received. They highlighted that the transparency arising from MPA's strict

¹ TR 48 was the first standard that covers a set of core requirements for metering system qualification, installation, testing, procedures and documentation of bunker custody transfer using the Coriolis Mass Flow Meter (MFM) system. More details on TR 48 are at https://www.mpa.gov.sg/web/wcm/connect/www/aa312dc3-abcd-45fb-9cee-f3443701480b/FACT_SHEET_TR_on_bunker_mass_flow_metering_15Feb16_final%5B2%5D.pdf?MOD=AJPERES.

implementation of TR 48 has increased their preference to purchase bunkers in Singapore (refer to Annex A for more details of the case study).

4. TR 48 has since been upgraded to a Singapore Standard, SS 648². SS 648 includes new requirements for distillate fuels and bunkers to meet IMO regulations. TR 48 and SS 648 have since formed the basis for the development of two ISO standards on bunkering. Led by Singapore, *ISO 21562: Bunker Fuel Mass Flow Meters on Receiving Vessel – Requirements* was published in July this year. *ISO 22192: Bunkering of Marine Fuel Using the Coriolis Mass Flow Meter System* is expected to be published by end of the year.

Additional Standards to Assure Quality and Confidence in Singapore’s Bunker Supply Chain

5. To enhance quality assurance and confidence in the bunker supply chain, two new standards have been developed:
 - a. Singapore Standard 660 : 2020 (SS 660) covers the upstream process for bunker cargo delivery from the oil terminal to the bunker tanker. Please refer to Annex B for the details.
 - b. Technical Reference 80 : 2020 (TR 80) reflects the criteria and metrological requirements for a master meter as well as the requirements for duty mass flow meters used across the entire bunker supply chain. Please refer to Annex C for the details.

Please refer to Annex D for a diagram showing where each standard is applied in the bunker supply chain.

6. SS 660 includes the quantity measurement requirements during bunker cargo delivery from an oil terminal to a bunker tanker using the Coriolis MFM system. It aims to harmonise the quantity measurement methods at oil terminals and bunker tankers for better accuracy and inventory management. SS 660 also covers quality requirements, which specify taking a representative fuel sample at the custody transfer point³ to determine compliance with the agreed fuel specifications to assure the bunker quality delivered to bunker suppliers.

² Refer to <https://www.enterprisesg.gov.sg/media-centre/media-releases/2019/november/new-standard-to-support-maritime-sectors-shift-to-more-sustainable-fuels> for details on SS 648.

³ The custody transfer point refers to the point where the bunker fuel from the supplier passes the bunker manifold of the receiving bunker tanker and the bunker is considered delivered from the seller to the buyer.

7. TR 80 reflects the requirements and procedures for meter verification using a master MFM to verify and check the stability and performance of a duty meter⁴ installed on a bunker tanker or at an oil terminal. The master MFM is qualified for measuring performance that is three times better than a duty meter and the meter verification process is performed by an independent authorised party for integrity purposes.
8. **Ms Choy Sauw Kook, Director-General (Quality & Excellence), Enterprise Singapore**, said, “Standards assure the integrity of value chains by harmonising technical terms, measures and industry benchmarks, and provide transparency and stakeholders’ accountability. They have contributed to the digitisation efforts of the bunkering industry and strengthened Singapore’s position as a trusted bunkering hub. Enterprise Singapore and the Singapore Standards Council will continue to work with industry and the MPA to develop standards to support the transformation efforts of the maritime industry.”
9. **Captain Daknashamoorthy Ganasen, MPA’s Senior Director (Operations and Marine Services)**, said, “The implementation of TR 48 has enhanced trust in Singapore’s bunkering sector. The pioneering method of bunker measurement has increased the transparency and accuracy of bunker custody transfer, as well as improved the operational efficiency of bunkering at the Port of Singapore. We are confident that the new standards, which support the use of mass flow meters, will boost bunker quantity assurance and reinforce Singapore’s position as a leading bunkering hub of the world.”
10. **Mr Seah Khen Hee, Chairman, Technical Committee for Bunkering**, said, “With the completion of SS 660 and TR 80, and the recent launch of SS 648, the Technical Committee for Bunkering completes a trinity of bunkering standards covering the local bunker supply chain. These two new standards are also envisioned to be new additions to ISO MFM bunkering standards that are led by Singapore, contributing to the betterment of the global bunkering environment for international shipping.”
11. **Mr Simon Neo, Executive Director of SDE International**, who is a member of the Advisory Committee for the TR 48 case study in his individual capacity, said,

⁴ Duty meter refers to the mass flow meter in normal operation that is used for custody transfer measurement.

“The potential net annual savings derived from the TR 48 case study for the bunkering industry were based on conservative assumptions so the bunkering industry can be confident of achieving even greater outcomes if their internal practices align even closer to the TR 48.”

12. SS 660, TR 80, TR 48 and its revision, SS 648 can be purchased from the Singapore Standards eShop at www.singaporestandardseshop.sg. A presentation on standards on bunker MFM, including SS 660 and TR 80, as well as a presentation on the economic benefits of TR 48 case study, followed by a panel discussion on **‘Bunkering Standards – Opportunities, Challenges and Prospects’** will be conducted virtually during SIBCON 2020 **‘Powering Fuels of the Future, Driving towards Decarbonisation’** on 7 October 2020. Interested participants can register via www.sibconsingapore.gov.sg.

Annex A: Factsheet on Case Study on TR 48 : 2015 on *Bunker Mass Flow Metering*

Annex B: Factsheet on SS 660 : 2020 on *Code of Practice for Bunker Cargo Delivery from Oil Terminal to Bunker Tanker using Mass Flow Meter*

Annex C: Factsheet on TR 80 : 2020 on *Meter Verification Using Master Mass Flow Meter*

Annex D: Diagram on standards on bunker mass flow metering strengthening the bunker supply chain

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About Enterprise Singapore

Enterprise Singapore is the government agency championing enterprise development. We work with committed companies to build capabilities, innovate and internationalise.

We also support the growth of Singapore as a hub for global trading and startups, and build trust in Singapore's products and services through quality and standards.

Visit www.enterprisesg.gov.sg for more information.

About Singapore Standards Council

The Singapore Standards Council (SSC) facilitates the development, promotion and review of Standards and Technical References in Singapore. This work is done through partnerships with the industry, academia and government organisations, under the national standardisation programme overseen by Enterprise Singapore.

About Standards Development Organisation at Singapore Chemical Industry Council

SCIC is appointed by the national standards body, Enterprise Singapore, as the Standards Development Organisation (SDO) to manage the Chemical Standards Committee (CSC) and Environment & Resources Standards Committee (ERSC). SDO@SCIC administers the development, promotion and implementation of standards in these areas.

The CSC and ERSC are guided by the industry-led Singapore Standards Council, which provides advice on the directions, policies, strategies and priorities for the Singapore Standardisation Programme. The CSC covers key standardisation areas of fuel oil bunkering & LNG bunkering, surface coatings, chemical & processes, nanotechnology as well as petroleum processes and products.

About the Maritime and Port Authority of Singapore (MPA)

The Maritime and Port Authority of Singapore (MPA) was established on 2 February 1996, with the mission to develop Singapore as a premier global hub port and international maritime centre (IMC), and to advance and safeguard Singapore's strategic maritime interests. MPA is the driving force behind Singapore's port and maritime development, taking on the roles of Port Authority, Port Regulator, Port Planner, IMC Champion, and National Maritime Representative. MPA partners the industry and other agencies to enhance safety, security and environmental protection in our port waters, facilitate port operations and growth, expand the cluster of maritime ancillary services, and promote maritime R&D and manpower development.

Visit www.mpa.gov.sg for more information.

Factsheet on Case Study on TR 48 : 2015 on *Bunker Mass Flow Metering*

About TR 48

Launched in 2016, TR 48⁵ was the first standard in the world covering a set of core requirements for metering system qualification, installation, testing, procedures and documentation of bunker custody transfer using the Coriolis MFM system. These requirements aim to provide a fair basis for custody transfer between a bunker supplier and buyer in the Port of Singapore. Users of TR 48 include stakeholders of the bunker supply chain such as shipowners, ship charterers, bunker tanker owners and operators, bunker surveyors, maritime arbitrators and vendors of the Coriolis MFM system.

MPA mandated the implementation of MFM for the delivery of residual fuels and distillates with effect from 1 January 2017 and 1 July 2019 respectively.

Case study on TR 48

The TR 48 case study was initiated by the Singapore Chemical Industry Council, on behalf of Enterprise Singapore, in April 2019 and was successfully completed in February 2020.

The objective of the case study was to determine the quantitative and qualitative benefits of TR 48 to three key groups of stakeholders – bunker suppliers, ship owners/operators and the Implementing Authority (MPA). The study would then assess and evaluate the impact of TR 48 on the Singapore bunkering ecosystem. However, the changes in operations were not uniformly applied by all stakeholders due to differences in internal practices and would account for the ranges in the benefits shown⁶.

The industry boundaries of the TR 48 case study cover the delivery of bunker fuel from the bunker vessel to the receiving vessel during custody transfer of marine fuel oil (MFO).

Financial outcomes

1. The implementation of TR 48 resulted in annual potential net savings of between S\$80.6 million and S\$199.4 million⁷ for the bunkering ecosystem, including:

⁵ Refer to [https://www.nas.gov.sg/archivesonline/data/pdfdoc/20140415004/factsheet_\(bunkering-final\).pdf](https://www.nas.gov.sg/archivesonline/data/pdfdoc/20140415004/factsheet_(bunkering-final).pdf) for a comparison between the old and new bunkering processes.

⁶ Individual stakeholders could realise the full potential of the benefits of TR 48 in deciding to dispense with operational practices e.g. with tank sounding that would no longer be required. The extrapolated financial benefits for the bunkering ecosystem are based on estimates of what the potential benefit could be, if all stakeholders had similar internal practices.

⁷ Converted from USD at an exchange rate of S\$1.36/USD

- a. A 66.3%-76.0% reduction in operation costs for bunker suppliers and shipowners in manpower savings and process efficiency;
- b. 33.9%-25.6% fewer disputes between bunker suppliers and shipowners over the quantity of transferred fuel; and
- c. A 0.6%-2.3% increase in cost for bunker suppliers and MPA to verify the test results for mass flow meters and equipment maintenance respectively. (Note: The focus of the study was on the bunkering process and does not include the mass flow meter installation and commissioning processes.)

Semi-Quantitative outcomes⁸

1. For bunker suppliers surveyed, it was reported that operational turnarounds have increased. A number surveyed also reported that crew could be involved in duties other than directly in the sounding of bunker tanks.
2. For crew management, some ship owner respondents reported that they had reduced their spot checks of their on-board fuel inventory.
3. Data-handling benefits were seen by the MPA which had reported significant time savings of up to 90% in the handling of bunkering data.

Qualitative outcomes

1. The adoption of TR 48 led to improved scheduling for most bunker suppliers.
2. TR 48 also resulted in enhanced inventory management for some shipowners. Other shipowners continued to rely on remaining on board (ROB) checks for bunker delivery.
3. TR 48 contributed to the digitisation of the bunkering process with the use of modern measuring and data processing equipment.
4. Ship owners and suppliers surveyed reported the increase in transparency of bunkering data as well as improved data integrity with TR 48.

Additional Information

1. The introduction of TR 48 is supported by the International Bunker Industry Association (IBIA) Asia and the Singapore Shipping Association (SSA).
2. Singapore Standard, SS 648 has been mandated since 1 May 2020. TR 48: 2015 will cease to be applied by the Implementing Authority by 30 Nov 2020.
2. TR 48 was upgraded to SS 648 with an expansion of the scope of the standard to include distillate fuels and bunkers that meet IMO regulations. The updated content included the new requirements for multi meter installation, the enhancement of zero verification procedure and better clarity on the role of bunker surveyors in MFM bunkering regime. There were no major changes for SS 648 so the benefits observed with TR 48 are not expected to be impacted when it replaces TR 48.

⁸ Semi-Quantitative outcomes refer to impacts which cannot be converted to financial impacts as they depend on additional measures that companies need to implement.

Quotes on TR 48

1. **Mr Lee Wai Pong, Chairman, Working Committee for TR 48**, said, “The validation of the benefits of the TR 48 which was based on the ISO Methodology for the Economic benefits of standards has further strengthened Singapore’s position as a thought leader in bunkering industry standards. Though TR 48 has been revised to SS 648, there were no major changes for SS 648 so the benefits observed with TR 48 are not expected to be impacted when it replaces TR 48.”
2. **Ms Caroline Yang, President of the Singapore Shipping Association**, said, “The case study has demonstrated the transparency and system integrity that TR 48 has effected for the smooth and efficient running of bunkering operations, as well as bolstering the assurance of quantity ordered and delivered. Savings in time for bunkering processes and dispute resolution have also been experienced by a number of our members.”
3. **Mr Timothy Cosulich, CEO, Fratelli Cosulich Group and Chairman, IBIA Asia**, said, “The benefits of TR 48 validated through this case study would be useful when shared with the bunkering industry stakeholders outside of Singapore as the economic benefits as well as the improved efficiency, productivity and transparency demonstrated, will facilitate the implementation of the MFM system by countries who wish to adopt TR 48. The new TR 80: 2020 will further strengthen the supporting infrastructure for the MFM system while the new SS 660: 2020 will help in obtaining similar MFM system benefits further up the chain with both standards expected to assist the overseas bunkering industry as well.”

Factsheet on SS 660 : 2020 on *Code of practice for bunker cargo delivery from oil terminal to bunker tanker using mass flow meter***What is SS 660 and what does it cover?**

This Singapore Standard covers the quantity measurement and sampling requirements from an oil terminal to a bunker tanker during custody transfer. It is applicable to oil terminals that carry out bunker cargo delivery using the Coriolis mass flow meter⁹ (MFM) to bunker tankers.

Key highlights of SS 660 include:

1. Bunker cargo quality

This section covers bunker cargo specifications, sampling requirements, and related documentation.

2. Traceability and calibration requirements

This section specifies MFM's metrological traceability, calibration and re-calibration requirements for an MFM system applicable to custody transfer of bunker cargo delivery. It also specifies the required maintenance and control of in-service MFM system.

3. System integrity requirements

This section specifies the requirements and procedures to ensure the system integrity of an MFM system at each stage (i.e. pre-installation, installation, commissioning and operation). It includes documentation, equipment checks for mechanical, software, electrical and operational security.

4. Meter selection and installation requirements

This section covers the selection and installation of an MFM system to meet the requirements set out in the standard. It includes pre-selection screening, site survey and highlights the responsibility of the terminal owners/operators and meter vendors in this process.

5. MFM system verification requirements

This section covers the requirement to undergo and pass an onsite verification to ensure that the metrological and system integrity requirements in the standard are met.

6. Metering procedures

This section covers the pre-delivery, delivery and post-delivery documentation and procedures for the delivery of bunker cargo using an MFM system in the terminals in Singapore.

⁹ Coriolis mass flow meters are composed of one or more vibrating tubes that are usually bent. The fluid to be measured passes through the vibrating tube and the fluid accelerates as it moves towards the point where the vibration is at its maximum and decelerates as it leaves this point. This results in a twisting motion in the tubes. The degree of twisting motion is directly proportional to the fluid's mass flow.

How does SS 660 help and benefit the shipping and bunkering industry?

1. Enhances fair trade along bunker supply chain

Bunker tankers receiving their bunker cargo through the MFM at the oil terminal for subsequent supply to vessels will have better assurance on the custody transfer quantity received. In addition, with the same method of measurement and requirements for custody transfer as SS 648 on *Code of practice for bunker mass flow metering*, bunker tanker operators and bunker cargo owners are better able to account for and manage their inventory from the start to the end of the bunker supply chain¹⁰.

The standard also requires the taking of a representative fuel sample at the custody transfer point for analysis to determine compliance with the agreed fuel specifications.

The standard strengthens the application of SS 524 on *Specification for quality management for bunker supply chain*, which is adopted by bunker suppliers.

2. Enhances Singapore's bunkering hub status

This standard catalysed the adoption of digital technology (i.e. use of Coriolis MFM) for terminal operations to improve efficiency, productivity and transparency. Shipowners and operators will have better assurance that not only will their vessels receive bunkers correctly, they will also know that the bunkering service is backed up by the integrity of the entire bunker supply chain.

The implementation of best bunkering practices will encourage more shipowners to have their vessels call at Singapore to take bunkers with greater trust and confidence in Singapore's bunkering industry.

Who would use SS 660?

Users of SS 660 include oil terminals, vendors of Coriolis mass flow meters, bunker suppliers, surveyors, bunker tanker operators and relevant authorities.

Who developed SS 660?

The national Technical Committee (TC) on Bunkering appointed a Working Group (WG) to develop SS 660 under the Singapore Standardisation Programme administered by Enterprise Singapore. The Standards Development Organisation at Singapore Chemical Industry is appointed by Enterprise Singapore to support the Chemical Standards Committee and Environment and Resources Standards Committee and its various committees, including the TC for Bunkering and WGs.

The WG on SS 660 consists of expert members from the oil majors, oil terminals, oil traders, bunker suppliers, bunker tanker operators, testing laboratories, bunker surveying companies, meter vendors and supporting vendors, National Metrology Centre, Enterprise Singapore and Maritime and Port Authority of Singapore.

What is the process of developing SS 660?

From April 2019, the WG on SS 660 prepared the draft SS using TR 48/SS 648 *Code of practice for bunker mass flow metering* as base documents. Upon the TC for

¹⁰ Bunker supply chain refers to the delivery of bunker from oil terminal to bunker tanker and to end user (i.e. receiving vessel).

Bunkering's approval, the draft SS was issued for public comment in mid-2020 to solicit stakeholders' feedback. The refined draft SS with incorporation of feedback was then approved by the Chemical Standards Committee under the Singapore Standards Council.

Purchase of SS 660

SS 660 can be purchased at Toppan Leefung:

Toppan Leefung Pte Ltd

1 Kim Seng Promenade #18-01
Great World City East Tower
Singapore 237994

Tel: (65) 6826 9691

Email: singaporestandardseshop@toppanleefung.com

Website: www.singaporestandardseshop.sg

Price of SS 660 : 2020 is \$42.40 (before GST).

Factsheet on TR 80 : 2020 on *Meter verification using master mass flow meter*

What is TR 80 and what does it cover?

TR 80 covers:

1. Terms and definitions used in the standard
2. The criteria and metrological requirements for qualifying a master meter and the maintenance of its master meter status
3. The requirements and procedures for meter verification using master mass flow meter to verify and check the stability and performance of a duty meter installed on a bunker tanker or at an oil terminal
4. The output of the meter verification which is a meter verification report
5. The meter verification process that is undertaken by an authorised party as defined in the standard

How does TR 80 help and benefit the shipping and bunkering industry?

1. When undertaken by an authorised party, meter verification using master mass flow meter is a more efficient and less costly process that independently monitors and checks if a duty meter performance meets the requirements of SS 648 or SS 660 (as the case may be) during its commercial lifespan.

This standard supports the application of the new SS 660 *Code of practice for bunker cargo delivery from oil terminal to bunker tanker using mass flow meter* and SS 648 *Code of practice for bunker mass flow metering*, which respectively apply at the start of the bunker supply chain (i.e. bunker loading at terminals) to final delivery of bunker to ships. Singapore delivers some 50 million tonnes of bunkers worth about USD 20 billion (or S\$27.2 billion¹¹) to international shipping every year¹².

2. Enhances Singapore's bunkering hub status

This TR is a world first standard for the bunkering industry. The development of this standard relied on the collective expertise of the working group members to establish and lay down bunkering specific requirements and procedures that also drew upon international guidelines, OIML R117 and API MPMS 4.8 as well as meter verification results obtained from local trials using a master MFM.

This TR also supports the global bunkering industry and will be useful in helping ports all over the world to transition to MFM bunkering. This standard will be an important reference for the potential development of a new ISO standard that can be used with ISO 22192 *Bunkering of marine fuel using the Coriolis mass flow meter (MFM) system* and ISO 21562 *Bunker fuel mass flow meters on receiving vessel — Requirements for verification of mass flow meter (duty meter) installed on bunker tanker or receiving vessel*.

¹¹ Converted from USD at an exchange rate of S\$1.36/USD

¹² Source: <https://shipandbunker.com/prices>

This standard aims to build trust and confidence under fair trade principles, promote growth, and improve industry and business sustainability for the benefit of all stakeholders in the Singapore bunkering industry.

Who would use TR 80?

Users of this standard include oil terminals, vendors of Coriolis mass flow meters, bunker suppliers, surveyors, meter verification service providers, bunker tanker owners and operators, shipowners/buyers and relevant authorities.

Who developed TR 80?

Under CSC, the Technical Committee (TC) on Bunkering appointed a Working Group (WG) to develop and draft a new code of practice for meter verification using master mass flow meter (MFM) under the Singapore standardisation programme, which is administered by Enterprise Singapore. Since April 2011, Enterprise Singapore has appointed the Singapore Chemical Industry Council Limited to manage the Chemical Standards Committee and its committees, including the TC for Bunkering.

The WG consists of expert members from oil terminals, oil traders, bunker suppliers, bunker tanker operators, testing laboratories, bunker surveying companies, measuring instruments calibration/verification companies, meter vendors, National Metrology Centre, Enterprise Singapore and Maritime and Port Authority of Singapore.

What is the process of developing TR 80?

From August 2019, the WG prepared the framework of the draft TR with reference to international guidelines. The requirements and meter verification procedures in the draft TR were validated with results obtained from local trials using a master MFM. The draft TR was approved by the multi-stakeholder TC for Bunkering with incorporation of feedback from members. The final draft TR was then approved by the Chemical Standards Committee under the Singapore Standards Council.

Purchase of TR 80

TR 80 can be purchased at Toppan Leefung:

Toppan Leefung Pte Ltd

1 Kim Seng Promenade #18-01
Great World City East Tower
Singapore 237994

Tel: (65) 6826 9691

Email: singaporestandardseshop@toppanleefung.com

Website: www.singaporestandardseshop.sg

Price of TR 80 : 2020 is \$ 25.90 (before GST).

Diagram on standards on bunker mass flow metering strengthening the bunker supply chain

