

TL 9000 Measurement Outputs and Calculations – Release 4.5

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All measurement calculations are to be performed using the formulas in the TL 9000 Measurements Handbook, Release 4.5. This document provides supplemental information about how the Performance Data Reports (PDRs) are calculated – including [smoothing](#) and data [eligibility](#) rules.

The TL 9000 PDRs use only the data from [certified registrations](#). Data from registrations that are not certified are not used. In addition, the PDRs must meet the requirements of Section 3.5.1.e) 2) of the Measurements Handbook, which states the data for any output data point must be derived from data submitted by three or more companies.

All calculated outputs are reported by the month. When data are combined from multiple submissions they are converted, if necessary, to monthly data. For example, if data are submitted for a 4-week fiscal month they are converted to a calendar month before being used in the output formulas.

Certified Registration

A certified registration is a TL 9000 registration that has been certified compliant to TL 9000 by an accredited certification body.

Outputs

There are four TL 9000 PDR outputs derived from the submitted TL 9000 data per product category and per measurement

- [Best in Class](#)
- [Worst in Class](#)
- [Industry Average](#)
- [Monthly Average](#)

[Best in Class](#), [Worst in Class](#), and [Industry Average](#) calculations for a particular month are based on data submitted from several previous consecutive months, which is called a time window. The time window is either 6 or 12 months depending on the measurement as defined in [Table 5](#).

[Best in Class](#) is the best performance from a single registration for a product category for a particular measurement. For some measurements, the optimum performance is zero while for others it is 100%, as shown in [Table 5](#). [Worst in Class](#) is the worst performance from a single certified registration. [Industry Average](#) is the composite average of data from all [eligible](#) submissions over a defined time window.

Smoothed Outputs

[Best in Class](#), [Worst in Class](#), and [Industry Average](#) performance data calculations are derived from data over a period of multiple consecutive months, which is referred to as 'smoothing'. For some measurements, a 6-month time window is used and in other cases a 12-month time window is used, as shown in [Table 5](#). In all cases, reporting of smoothed data starts after 6 months of data becomes available. For those measurements with a 12-month time window, the benchmarking expands to include additional data (up to 12 months) as the data becomes available. After obtaining 12 months of information, then the most immediate 12 months are used for further calculations. See [Example A](#) for more detail.

Best In Class

The Best-in-Class data point, in a particular month, is the best performance for a single certified registration for that measurement over the appropriate time window shown in [Table 5](#), from all [eligible](#) data submitted.

Worst In Class

The Worst-in-Class data point, in a particular month, is the worst performance for a single certified registration for that measurement over the appropriate time window shown in [Table 5](#), from all [eligible](#) data submitted.

Industry Average

For most measurements, the Industry Average data point, in a particular month, is the [composite average](#) data for that measurement over the time window, shown in [Table 5](#), from all [eligible](#) data submitted. For FRT and OFR, the Industry Average is based on the average value calculation.

Monthly Average

The Monthly Average data point, in a particular month, is the [composite average](#) data for that measurement for that month only. The only eligibility rule that applies to the monthly average is that the data comes from certified registrations from three or more companies.

Composite Average

The composite average applies only to data from multiple submissions. Each output measurement is defined in the TL 9000 Measurements Handbook as a formula applied to one or more input data points. The composite average is derived by applying the formula to the summed values of the individual inputs of the data submissions. That is, all the values for the same measurement are summed from the data submissions and then the summed values are used in the formula. Scaling factors such as annualization or percentage are not summed.

Composite Average Example for a Single Month

The TL 9000 outputs, such as NPR1, are derived from [certified registration](#) data submitted to the Measurements Repository System. These data are combined to produce the average by adding the individual numerators and denominators, and then applying the appropriate formula from the Measurements Handbook to the summed inputs. For example, the formula for NPR1 is

$$\text{NPR1} = \text{Afactor} * \text{Np1} / \text{NPRs}$$

Assume there are 5 data submissions from certified registrations during a single month for NPR as follows:

Submission	1	2	3	4	5
Np1	2	5	4	2	3
NPRs	15	30	20	16	30
Afactor	12	12	12	12	12

The calculated output, NPR1, for each submission is

Submission	1	2	3	4	5
NPR1	1.6	2.0	2.4	1.5	1.2

The total of numerators, Np1, is $2+5+4+2+3 = 16$ and the total of denominators, NPRs, is $15+30+20+16+30 = 111$. The annualization factor, 12, is a scaling factor and thus is not summed. The Monthly Average is therefore $12*16/111 = 1.73$.

The Industry Average is calculated in a similar way. It simply includes all eligible data submitted over the defined time window. Note that [eligibility](#) rules are applied to all smoothed calculations.

Average Value

By rule, the value of FRT or OFR for any month with no data is set to 100%. To accurately reflect this in the industry data, the Industry Average, Best In Class, and Worst in Class values for FRT and OFR are calculated based on the average of the monthly values.

Average Value Example

Month	1	2	3	4	5	6	6 Mo. Rolling
Fr2c	1	0	2	0	1	0	
Fr2d	1	0	2	1	1	0	
FRT2	100	100	100	0	100	100	83.3

Eligibility Rules

Only data from [certified registrations](#) are eligible for inclusion in these calculations.

Data from a certified registration are eligible for the [Best in Class](#) designation in a particular month when the data from the registration meet either of the following two conditions:

- 1) The data represent 2% or more of the sum of the denominators for that measurement over the time window.
- 2) For certain measurements and product categories, the data are greater than a non-zero threshold as shown in [Table 6](#).

Data from a [certified registration](#) are eligible for the [Worst in Class](#) designation in a particular month when the data from the registration meet one or more of the following three conditions:

- 1) The data represent 2% or more of the sum of the denominators for that measurement over the time window.
- 2) For certain measurements and product categories, the data are greater than a non-zero threshold as shown in [Table 6](#).
- 3) The data from the registration represent 5% or more of the sum of the numerators for that measurement over the time window.

Data from a [certified registration](#) are eligible for the [Industry Average](#) calculation in a particular month when the data are eligible for the [Best-in-Class](#) designation. If data are excluded from the [Best-in-Class](#) calculation or [Worst-in-Class](#) calculation, they are also excluded from the [Industry Average](#) calculation.

The NPRs denominator is used to determine eligibility for the FRT, OFR, and SFQ measurements.

Rules for Zero Denominator Data

It is possible under TL 9000 for the denominator to be zero when calculating the output data points. There are two different cases

- Both numerator and denominator are 0 – that is 0/0
- Numerator is not zero but denominator is 0 – that is n/0

For example, if a registration had no problem reports to fix in a given month then 0 is reported as the number of problems fixed and also 0 for the number of problems to fix. This leads to the 0/0 condition.

The correct interpretation of these conditions is different depending on the measurement – the result could be interpreted as a '0', '100%', 'Not Valid', or 'No Data' as shown in Table 1.

Table 1 – Interpreting Zero Denominators

Measurement	Defined value		Comments
	0/0	n/0	
NPR1,2,3	Not valid	Not valid	Correct data entry is "EXEMPT" for cases where there is no field population
NPR4	No data	n/1	Product Category 7 & 8
FRT2,3,4	100%	Not valid	
OFR2,3,4	100%	Not valid	
OTI	No data	Not valid	
OTS	No data	Not valid	
SO (SO1-4)	No data	Not valid	Correct data entry for 0/0 is "EXEMPT"
SONE (NEO1-4)	No data	Not valid	Correct data entry for 0/0 is "EXEMPT"
SSO	No data	n/1	
ERI,YRR, LTR	No data	Not valid	There should be data for at least 1 of the three return rates or all three data entries should be "EXEMPT"
NYR	No data	n/1	n/1 is an unlikely event and should trigger question
SFQ	No data	n/n	
SPR1,2,3	Not valid	Not valid	Correct data entry is "EXEMPT" for cases where there is no field population
SQ	No data	n/n	This equates to 100% defective transactions

These interpretations are based on

- TL 9000 Measurements Handbook 4.5
- Rewarding desired behavior, e.g. no problem reports were overdue
- Not rewarding undesired behavior, e.g. defective patch or service transaction found in later months

Application of the rules is as follows:

No data	Ignore the data in monthly and summary data calculations
Not valid	Fail the data submission
n/1	Treat as if the monthly data submission denominator had been 1. In summary calculations across months, use actual denominator(s) as soon as they are non-zero
n/n	Treat as if the monthly data submission denominator had been n. In summary calculations across months, use actual denominator(s) as soon as they are equal to or greater than n

Ramp-up Rules for Smoothed Data

The following is an example of the application of the ramp-up rules. It is shown for the OTS measurement but applies for any measurement that has a 12-month time window.

For the example, assume that at time = 0, no certified registrations reported data for the specific product category. In Month 1, 5 new certified registrations reported data and continued through Month 12. Furthermore, the five certified registrations are from three or more companies. A 6th certified submission submitted data starting in Month 4 and a 7th certified submission submitted data starting in Month 6. Assume that the data submitted for the DVa and DVd measurements by the registrations are as shown in Table 2.

Table 2 – OTS Data Inputs

DVa = Number of Service Orders Accepted on the Customer Requested Date During the Month Reported							
Month	Registration 1	Registration 2	Registration 3	Registration 4	Registration 5	Registration 6	Registration 7
1	34	40	36	36	50	Not Certified	Not Certified
2	35	40	38	36	40	Not Certified	Not Certified
3	36	40	40	36	45	Not Certified	Not Certified
4	37	41	38	36	50	28	Not Certified
5	38	41	36	37	45	27	Not Certified
6	39	41	34	37	40	26	38
7	40	32	32	37	30	25	39
8	41	32	30	37	20	26	40
9	42	32	30	38	26	27	42
10	43	30	36	38	35	28	42
11	44	30	38	38	33	29	44
12	45	30	40	38	32	30	44

DVd = Number of Service Orders with a Customer Requested Date During the Month Reported							
Month	Registration 1	Registration 2	Registration 3	Registration 4	Registration 5	Registration 6	Registration 7
1	36	43	38	39	52	Not Certified	Not Certified
2	37	43	40	39	42	Not Certified	Not Certified
3	38	43	42	39	47	Not Certified	Not Certified
4	39	44	40	39	52	31	Not Certified
5	40	44	38	40	47	30	Not Certified
6	41	44	36	40	42	29	40
7	42	35	34	40	32	27	41
8	43	35	32	40	22	28	42
9	44	35	32	41	28	29	44
10	45	33	38	41	37	29	44
11	46	33	40	41	35	30	46
12	47	33	42	41	34	31	46

Since there are more than 3 data submissions from 3 companies, the [Monthly Average](#) for OTS can be reported starting in Month 1. It is calculated from the data submitted by registrations 1 through 5. In Month 4, it also includes the data submitted by registration 6 and in Month 6 it includes the data submitted by registration 7.

A summary of the OTS value for each of the different Registrations and the OTS Monthly Average are shown in Table 3. The Monthly Average is just the sum of the individual DVa measurements each eligible registration divided by the sum of the individual DVd measurements. For example, in month 4 there are six eligible registrations. The sum of DVa is $37 + 41 + 38 + 36 + 50 + 28 = 230$. The sum of DVd is $39 + 44 + 40 + 39 + 52 + 31 = 245$ and this gives us a Monthly Average for month 4 of $100 * 230 / 245 = 93.88\%$.

Table 3 – OTS Monthly Data Outputs

Monthly OTS = 100* (DVa/DVd)								
Month	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6	Reg 7	Monthly Average
1	94.44%	93.02%	94.74%	92.31%	96.15%	Not Certified	Not Certified	94.23%
2	94.59%	93.02%	95.00%	92.31%	95.24%	Not Certified	Not Certified	94.03%
3	94.74%	93.02%	95.24%	92.31%	95.74%	Not Certified	Not Certified	94.26%
4	94.87%	93.18%	95.00%	92.31%	96.15%	90.32%	Not Certified	93.88%
5	95.00%	93.18%	94.74%	92.50%	95.74%	90.00%	Not Certified	93.72%
6	95.12%	93.18%	94.44%	92.50%	95.24%	89.66%	95.00%	93.75%
7	95.24%	91.43%	94.12%	92.50%	93.75%	92.59%	95.12%	93.63%
8	95.35%	91.43%	93.75%	92.50%	90.91%	92.86%	95.24%	93.39%
9	95.45%	91.43%	93.75%	92.68%	92.86%	93.10%	95.45%	93.68%
10	95.56%	90.91%	94.74%	92.68%	94.59%	96.55%	95.45%	94.38%
11	95.65%	90.91%	95.00%	92.68%	94.29%	96.67%	95.65%	94.46%
12	95.74%	90.91%	95.24%	92.68%	94.12%	96.77%	95.65%	94.53%

Next we will examine when the smoothed measurements can be calculated and reported. As noted above, even though OTS is identified as a 12-month window for smoothing, reporting starts after 6 consecutive months of data. Since the rules for minimum data points necessary for reporting are met in Month 6, [Best In Class](#), [Worst In Class](#), and [Industry Average](#) can also be reported. Based on the data submitted, the Best In Class Registration is the one highlighted in green below (Reg 5 in Month 6). The Worst In Class is the one highlighted in red (Reg 4 in Month 6). The companies from Registrations 1 through 5 could also calculate their smoothed OTS to support their quality system in Month 6. Registration 6's company could start reporting internally a smoothed OTS in Month 9 and Registration 7's company could start in Month 11. Of course, as time continues, the smoothed OTS calculation uses all certified data until a full consecutive 12-month window is filled (that is Months 1-12 for Registrations 1 through 5 in our example). Going forward to Month 13, Registrations 1 through 5 will use only Months 2-13 in their calculation. A summary of the OTS smoothed output values for the different submissions is shown in Table 4.

Table 4 – OTS Smoothed Data Outputs

Smoothed OTS								
Month	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6	Reg 7	Industry Average
1	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Certified	Not Certified	Not Calculated
2	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Certified	Not Certified	Not Calculated
3	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Certified	Not Certified	Not Calculated
4	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Certified	Not Certified	Not Calculated
5	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Certified	Not Certified	Not Calculated
6	94.81%	93.10%	94.87%	92.37%	95.74%	Not Calculated	Not Calculated	94.21%
7	94.87%	92.91%	94.78%	92.37%	95.74%	Not Calculated	Not Calculated	94.11%
8	94.94%	92.75%	94.67%	92.41%	95.24%	Not Calculated	Not Calculated	93.76%
9	95.00%	92.62%	94.58%	92.44%	95.05%	91.38%	Not Calculated	93.68%
10	95.06%	92.48%	94.59%	92.46%	95.01%	92.12%	Not Calculated	93.77%
11	95.12%	92.36%	94.63%	92.48%	94.95%	92.70%	95.33%	93.89%
12	95.18%	92.26%	94.69%	92.50%	94.89%	93.18%	95.38%	94.03%

Best-in-Class Registration for month n
Worst-in-Class Registration for month n

The Industry Average includes only the data from registrations that have submitted six or more consecutive months of data. Therefore for month 10 the Industry Average is calculated using the data from registrations 1 through 6. Data from registration 7 is not used in month 10 even though registration 7 submitted data in months 6 through 10 because they had not submitted six months of data by month 10. They became eligible in month 11 and their data was included starting in month 11.

Table 5 – Measurement Smoothing Windows and Optimum Values

Measurement	Time Window in Months	Optimum Value
NPR – Number of Problem Reports	6	0
FRT – Fix Response Time	6	100 %
OFR – Overdue Fix Response Time	6	100 %
OTI – On-Time Delivery for Line Items	6	100 %
OTS – On-Time Delivery for Service	12	100 %
SO – Service Impact System Outage	12	0
SONE – Network Element System Outage	12	0
SSO – Engineering/Installation System Outage	12	0
FR – Field Returns	12	0
SFQ – Software Fix Quality	6	0
SPR – Software Problem Reports	6	0
SQ – Service Quality	12	0 %

Table 6 – Inclusion Rule Threshold Values (Alternative to 2%)

Product Category	Name	NPR	FRT	OFR	OTI	SO	SONE	FR
1.1	Circuit Switch	100	120	120	600	0	100	25000
1.2.2	Access Multi-Service	100	120	120	600	0	100	25000
3.1.1.1.1	Metallic Conductor Cable	0	120	120	600	NA	NA	NA
3.1.1.2.1	Fiber Optic Cable	0	120	120	600	NA	NA	NA
3.1.1.2.2	Optical Connectors	0	120	120	600	NA	NA	NA
3.1.2.1	Enclosures	0	120	120	600	NA	NA	10000
3.2.2.1.2.1	SONET/SDH Transport Systems	250	120	120	600	0	250	40000
3.2.2.1.2.2	WDM/DWDM Optical Amplification	250	120	120	600	0	250	40000
3.2.2.2	Loop Carrier	1000	120	120	600	0	1000	10000
3.2.4.1	Legacy (DSL)	500	120	120	600	0	500	50000
3.2.4.2	Symmetric (DSL)	500	120	120	600	0	500	50000
3.2.4.3	Asymmetric (DSL)	500	120	120	600	0	500	50000
3.3.2.1	Basic (BTS)	250	120	120	600	250	250	5000
3.3.2.2	Advanced (BTS)	250	120	120	600	250	250	5000
3.3.2.3	4G (BTS)	250	120	120	600	250	250	5000
6.2.1.2.1	Simple (Wireless Subscriber- Terminals)	100000	120	120	600	NA	NA	10000
6.2.1.2.2	Complex (Wireless Subscriber Terminals)	100000	120	120	600	NA	NA	10000
6.2.3.1	Wired Modems	50000	120	120	600	NA	NA	10000
6.2.3.2	Wireless Modems	50000	120	120	600	NA	NA	10000
7.1.1	Installation Service	0	120	120	600	NA	NA	NA
7.4	Repair Service	0	120	120	600	NA	NA	NA
7.7.2	Printed Circuit Board Assembly	250000	120	120	600	NA	NA	0
8.1.x	Components	250000	120	120	600	NA	NA	NA

A zero (0) entry in the table means to use the 2% rule only.

NA means the measurement is not applicable to the product category.

Data from the registration is included if the denominator is greater than 2% of the total population or is greater than the number in the table.