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WiM-mode DSP Version 3.119 - Weight Correction Factors

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The following description of the
"Weight Correction Factors" feature
is quoted from "LCIC-WIM-WIM-MODE.PDF".

6. Weight Correction Factors (V3.119 and up)

6.1 Background

As you may know, the accuracy of WIM depends also on the **speed** of the trucks. So, usually our customers use to have some Correction Factors (CF) in their **applications** in order to improve the accuracy. For example, if the truck static weight is 20 ton and at 5 km/h you read 19.85 ton, the CF will be 1.0076 (20/19.85). Now, the same truck at 10 km/h shows 19.35 ton, so the CF will be 1.0336. Supplying the program with these Speed/CF pairs (such as 5/1.0076 in the example) will enable the program to improve the accuracy. Obviously, the more Speed/CF pairs are supplied, the accuracy will be better.

In order to save our customers to put those correction factors in their applications, we have decided to add this feature to the embedded software on the LCIC-WIM board as new parameters that allow you to enter up to 10 CF's. (Of course you can enter any other number smaller than 10, or not use this feature at all, which is equivalent to CF = 1.0000).

The new feature allows storing a table of up to 10 correction factors. For example:

Correction Factor (CF)	**Speed (km/h)**
1.0000	5
1.0120	8
1.0190	12
1.0210	17
1.0280	20

Now, when an axle passes over the scale, the board will look for the speed of this axle and the closest CF for this speed, and correct the reported weight accordingly. In other words, the weight takes into consideration the truck speed – no need to do it in your application any more. For example, if the speed is 7 km/h and the raw weight is 10 ton, the reported weight would be 10*1.0120 = 10.12 ton. Note that the CF used is according to the closest speed in the table (8 km/h) – no interpolation is carried out.

6.2 Introduction

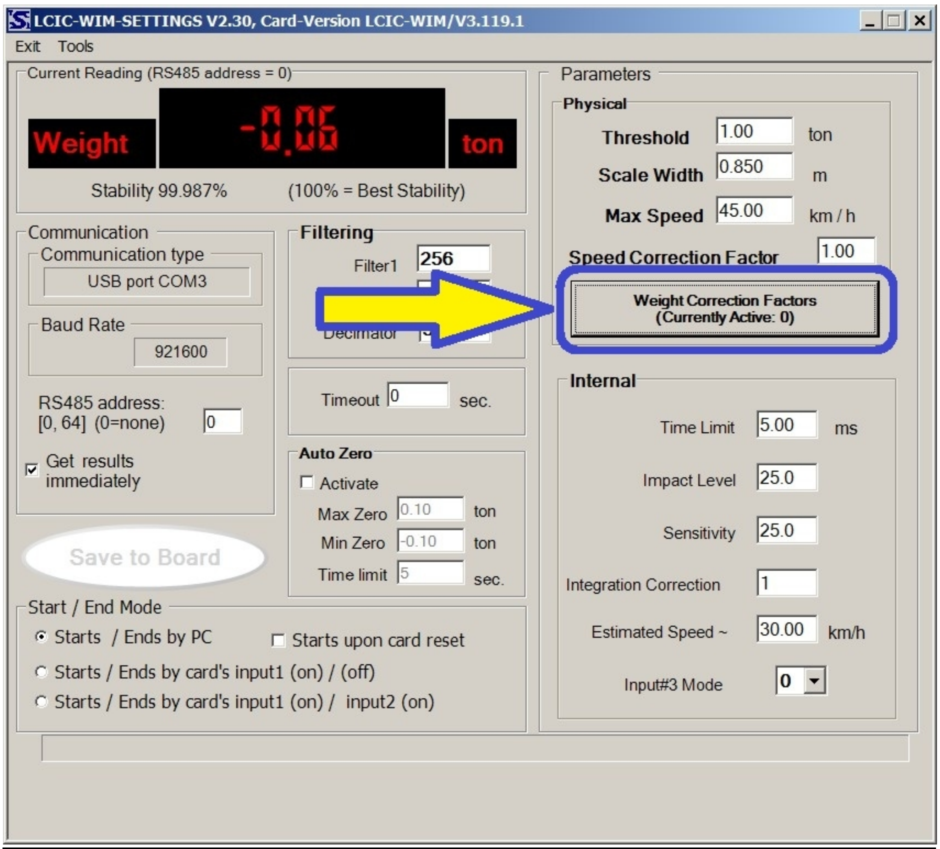
The new "Weight Correction Factors" feature is supported by **board** version 3.119 and up, and by the **Settings** application version 2.28 and up.

The "Weight Correction Factors" option enables the user define correction factor(s) for the weight based on his experience with dynamic vs. static weighing.

The user has 3 main options:

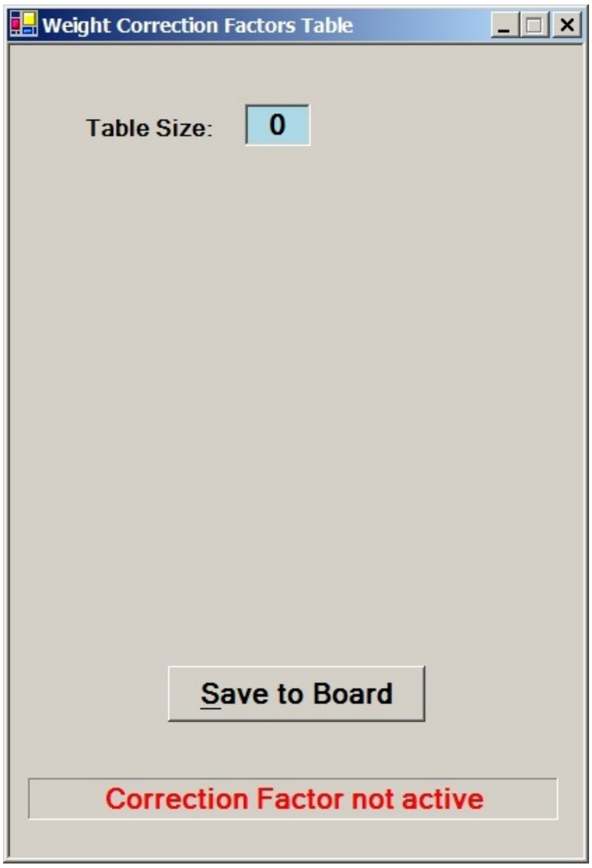
1. Using the dynamic weighing "**as is**" without correction factor (the default).
2. Use **one** correction factor, common for all speeds.
3. Use **some** correction factors (up to 10) for various speeds.

In order to select one of these options, use the Settings program and click the "Weight Correction Factors" button in the 'Parameters' / 'Physical' frame:



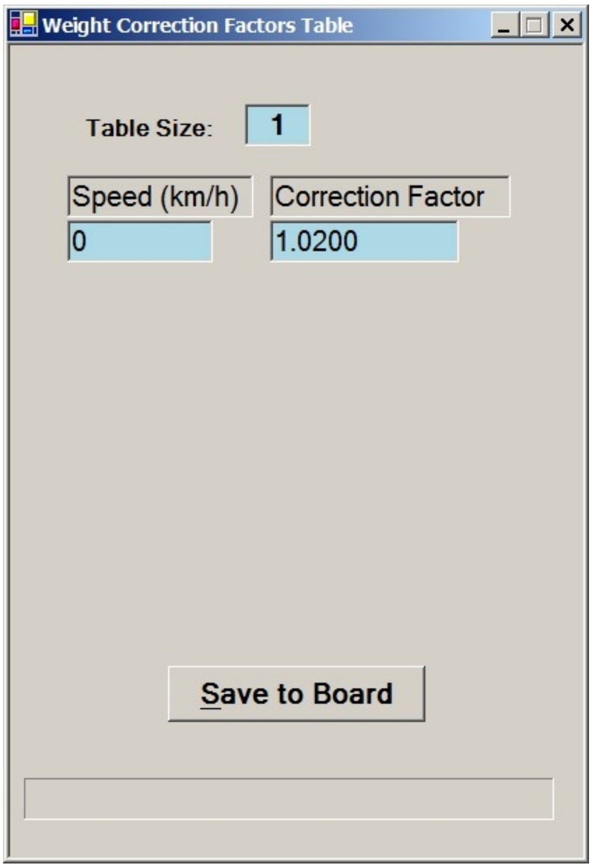
For option #1 (no correction factor, the default):

Make sure that "Table Size" is 0. If it is not 0, specify 0 in "Table Size", then click "Save to Board":



For option #2 (**one** correction factor, common for all speeds):

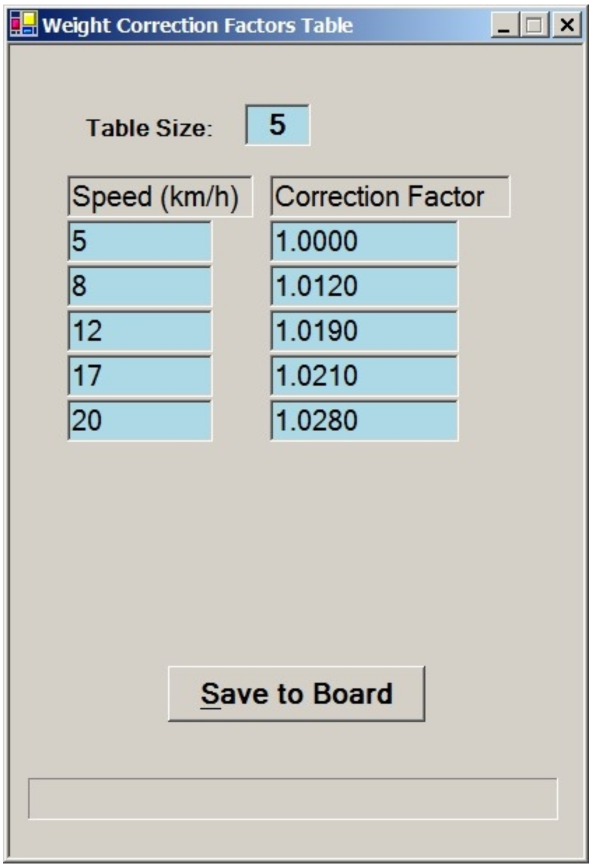
* Specify 1 in "Table Size".
* Specify 0 in the "Speed" square.
* Specify the desired weight correction factor in the "Correction Factor" square.
  In the example below the correction factor is 1.0200 which means "plus 2%". That is, if the raw dynamic weight gave 1000 kg, the result will be set to 1000*1.0200 = 1020 kg.
* Click "Save to Board".



For option #3 (**some** correction factors for various speeds):

* In the "Table Size" square specify for how many speeds (max. 10) you have a corresponding correction factor. In the example below there are 5 such speeds.
* In the "Speed" column specify the speeds. Make sure that the minimum difference between speeds is 1 km/h.
* In the "Correction Factor" column specify the corresponding correction factor for each speed.
* Click "Save to Board".

For a specific speed, the actual correction factor will be that one whose speed is **closest** to the actual speed.
There is **no interpolation!** In the example below, for speed = 6 km/h the actual correction factor would be 1.0000, as 5 km/h is the closest speed to the actual 6 km/h. It would **not** be 1.0040 as interpolation for the correction factors of 5 km/h and 8 km/h would give.



The Two Aspects of the Actual Speed

The (theoretical) calculated Actual Speed participates in two places:
a. When selecting the Actual CF, the program looks in the table for the speed which is closest to the Actual Speed, making its corresponding CF the Actual CF.
b. The Actual Speed is reported to the communication port –
* each axle (if Get Results Immediately is on);
* when responding to the '**r**', '**#*nnnn***' or 'L' command.

However, there is a slight difference between the Actual Speed of 'a' and that of 'b':

The Actual Speed used in 'a' is the exact value that was calculated, for example, 6.784 km/h. But the Actual Speed in 'b' is rounded to the closest integer, so 6.784 would be represented as '7'.

The difference between 'a' and 'b' becomes meaningful in the borderline cases. For example, with the table on the previous page both 9.9 km/h and 10.1 km/h will be represented in 'b' as 10 km/h. But note that the closest speed in the table is:
* For 9.9 km/h: 8 km/h.
* For 10.1 km/h: 12 km/h.
So, the mechanism of 'a' will give Actual CF=1.0120 for 9.9 km/h and 1.0190 for 10.1 km/h.
That means that **identical reported speeds do not have necessarily the same Actual CF**. Actually this is not a problem, but in case you need to take the report for analysis and you wish to reproduce the Actual CF for each axle according to the speed, it will be ambiguous if the speed falls on a borderline case. If such analysis is really essential for you, there are two option for a solution:
1. You may program your application to send the 't' command after each axle in order to get the last Actual CF (refer to section 6.5).
2. You may evade these borderline cases: Make sure that the difference between two adjacent speeds in the table will always be an **odd** value (1, 3, 5 etc.). That way, the borderline will never fall on an integer speed and the matching between speed and its Actual CF will always be unambiguous. For example, watch the two last lines in the table on the previous page: The speeds are 17 and 20 km/h. The borderline is 18.5 km/h, so there is no ambiguity:

* If the reported speed is 18 km/h:
  The exact speed is more than 17.5 km/h and less than 18.5 km/h.
  So, the corresponding CF is 1.0210.
* If the reported speed is 19 km/h:
  The exact speed is more than 18.5 km/h and less than 19.5 km/h.
  So, the corresponding CF is 1.0280.

6.3 Adjusting the "Weight Correction Factors" table

As the correction factor depends on the mechanics of the scale, scale alignment, type of load cells etc., the technician has to do the required tests and calculate the correction factor for each particular speed. The speed in the table should be the speed that the **board** reports, which will be the **average** speed of all axles.

* Make some experiments with a truck whose static weight is known.
* Within each experiment, as far as possible, keep truck's speed steady. That is, avoid accelerating/decelerating.
* When you have the result:
  As 'speed' specify the **average** of all axles, rounded to the closest integer. For example, if there are 4 axles with speeds 8, 9, 8 and 8 km/h, specify 8 km/h.
  As 'correction factor' specify truck static weight divided by the sum of all axles' weights. For example, if the static weight is 1000 kg and the sum of all axles' weights is only 980 kg, specify 1000/980 = 1.0204.
* Note that the actual speed considers the **speed** correction factor as specified above the "Weight Correction Factors" button in the Setting application.

Example

Following is an example how to do the required tests and calculate the correction factor for **one** particular speed.
Suppose that static weighing of the truck gave 32.5 ton.

During the tests we need that the reported weights will be the raw weights (without any correction). Therefore, we set the "Weight Correction Factors" to "Table Size = 0", that is, "Correction Factor not active".

In this example we pass the truck only twice, in order to explain the principle. In reality, it is recommended to pass the truck more times in order to improve the accuracy.

First Pass

Axle	Weight	Speed
1	10.15	10
2	5.83	11
3	8.77	11
4	7.54	10

Second Pass

Axle	Weight	Speed
1	10.05	11
2	5.89	10
3	8.84	10
4	7.45	10

Conclusions:

Average Truck **Weight**:
(10.15 + 5.83 + 8.77 + 7.54 + 10.05 + 5.89 + 8.84 + 7.45) / 2 = 64.52 / 2 = 32.26 ton

Recall that the static weight was 32.5 ton.
Correction Factor = 32.5 / 32.26 = 1.0074
→ Specify **1.0074** in the "Correction Factor" square in the table.

Average Truck **Speed**:
(10 + 11 + 11 + 10 + 11 + 10 + 10 + 10) / 8 = 83 / 8 = 10.375 km/h
Round to closest integer, that is, 10 km/h.
→ Specify **10** in the "Speed" square in the table.

Note:
Weight sum was divided by the number of **passes** (2).
Speed sum was divided by the **total** number of **axles** (8).

6.4 How to Update the Correction Factors Table

To update the correction factors table:

1. In the Setting application:
Click the 'Weight Correction Factors' button in the 'Parameters' / 'Physical' frame (see screenshot in the beginning of section 6.2).

2. Define 'Table Size':
If no correction factor is needed: 0 (the default).
If correction factor is needed: How many 'Speed' / 'Weight Correction Factor' pairs are about to be defined (1-10).

3. If Table Size > 0: Define table entries:
Update all table's entries ('Speed' & 'Weight Correction Factor' in each line).

4. Click 'Save to Board'.

6.5 New Commands (through Communication)

There are two new commands:
't': Print the last actual 'Weight Correction Factor'.
'T': Print the 'Weight Correction Factor' Table.

Examples:

(The **blue** text is **to** the board, the **green** text is **from** the board)

With CF table as in the example of option 1 in section 2

```
T
Table size =  0
Correction Factor not active
```

With CF table as in the example of option 2 in section 2

```
T
Table size =  1
 #   Speed (km/h)    CF
 1      0           1.0200
```

With CF table as in the example of option 3 in section 2

```
T
Table size =  5
 #   Speed (km/h)    CF
 1      5           1.0000
 2      8           1.0120
 3     12           1.0190
 4     17           1.0210
 5     20           1.0280
```

Example using this table when an axle passed the scale:

```
#1        10.17     11       0
t
Last CF =     1.0190
```

Explanation:
The **raw** weight of the axle was 9.98 ton (not seen in the report). The speed was 11 km/h. The closest speed in the CF table is in line #3: 12 km/h. The corresponding CF is 1.0190, therefore the **reported** weight was 9.98*1.0190 = 10.17 ton.