PLAST-CONTROL Inc.
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PLAST CONTROL Gravimetric Hopper Fill Level Setup

The purpose of this document is to instruct the user on the proper setup for the fill levels of the gravimetric hoppers. Depending on the age of the system there are two possible ways for the system to be setup which determine when the slide gate above the gravimetric hopper will open and close to put resin in the hopper.

In all systems it is possible to put a preset hopper weight in the setup page such that when the load cell calculates the combined hopper and resin weight and the level reaches this actual lower weight the slide gate will open. When it reaches the upper set weight the slide gate closes. The issue with this type of setup is since there are many different resin densities that can be put into the hopper these weights will need to be adjusted to get the best usage of the hopper volume when a resin density change is made.

Technical explanation of weight and volume:
PLAST-CONTROL delivers three standard sizes of hoppers [300mm (12”), 400mm (16”), 500mm (20”)] which has different throughput capabilities. For a gravimetric system to work properly the computer needs to be in the measurement & calculation mode at least 95% of the time versus the moments when the slide gate is open and refilling the hopper. When in the refill mode the system is in volumetric mode meaning the current speeds will be maintained because no calculation of throughput is possible. For that reason the correct size of the hopper is determined during the purchase of the system to give a high rate of measurement & calculation time. The following table gives an overview of the hopper rates.

Size- diameter	Max. rate	Empty hopper weight*	Full hopper weight **	Volume
300mm (12”)	300 lb/hr	5.5 – 6.5 lb	36 lb, typical 27 lb	0.873 ft^3
400mm (16”)	700 lb/hr	9 – 11 lb	56 lb, typical 47 lb	1.322 ft3
500mm (20”)	1325 lb/hr	13 – 15.5 lb	84 lb, typical 70 lb	1.976 ft3

* Weights are approximate, can vary based upon how they hang on the load cell and how the rubber seal is mounted. Exact weights are not important to the system.

** Full weight depends on the resin density, values based on 35$lbft^3$ (.92gccm) and completely full which is not possible. 2nd weight is typical full weight with resin to about 2” from the top of the hopper.

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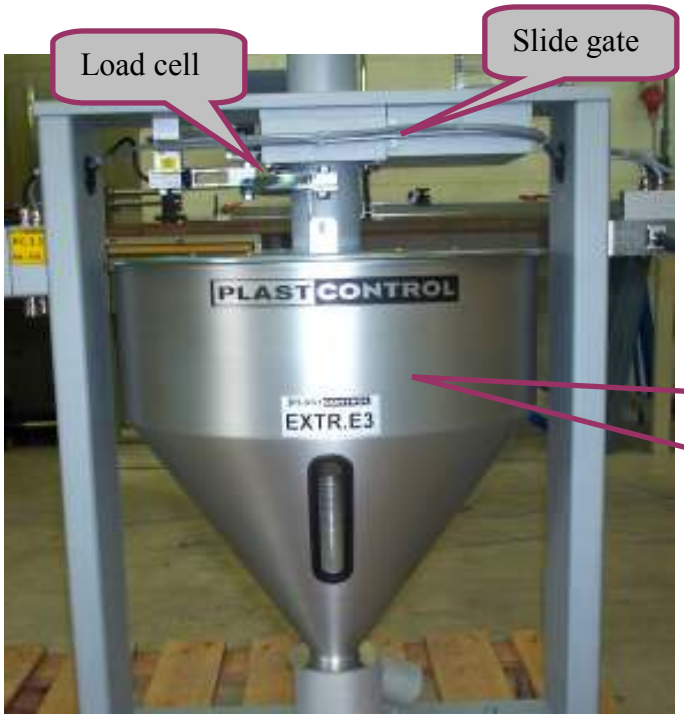
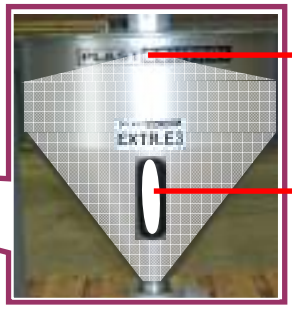


Typical 500mm main hopper, no Dosing



Full Hopper Example

Example fill cycle

Once a component has a target and the vacuum loading is turned on the system will look at the current actual hopper weight and compare it to the lower level trigger weight and if the actual is smaller than this trigger value the slide gate will open. If there is material available the resin will start to flow and fill the hopper. Once the load cell reads the upper fill trigger value the slide gate will close. Because the material is flowing very fast and the reaction time to close the slide gate is determined by the air pressure going to the slide gate and the setting of the throttle valve on the cylinder there will be more material in the hopper than this upper level trigger set point. This is no issue at all other than the hopper must not be allowed to over fill with material going back up into the fill tube. Once the material is filling back up into the fill tube (over filling) the actual load cell weight will no longer read an increasing weight. This may cause the slide gate to not fully close if the air pressure is set too low.

If the filling is completed correctly and the slide gate closes properly then after a short wait time to allow the hopper to settle out the computer begins the process of reading the load cell weight and every minute or so a new lb/hr rate is displayed. This is compared to the target rate and the extruder (Dosing unit) will be adjusted to match the actual to the required target. Once the lower level trigger weight is reached again the slide gate will open again. The time between the closing and opening of the slide gate should be 3 or 4 rate calculation cycles as a minimum for proper control. One rate calculation cycle is 15 seconds. When the slide gate opens the current rate cycle is cancelled and will wait until the slide gate closes and the hopper settles before beginning the next 15 second rate cycle. This is why a maximum rate limit for each size hopper is determined for good performance.

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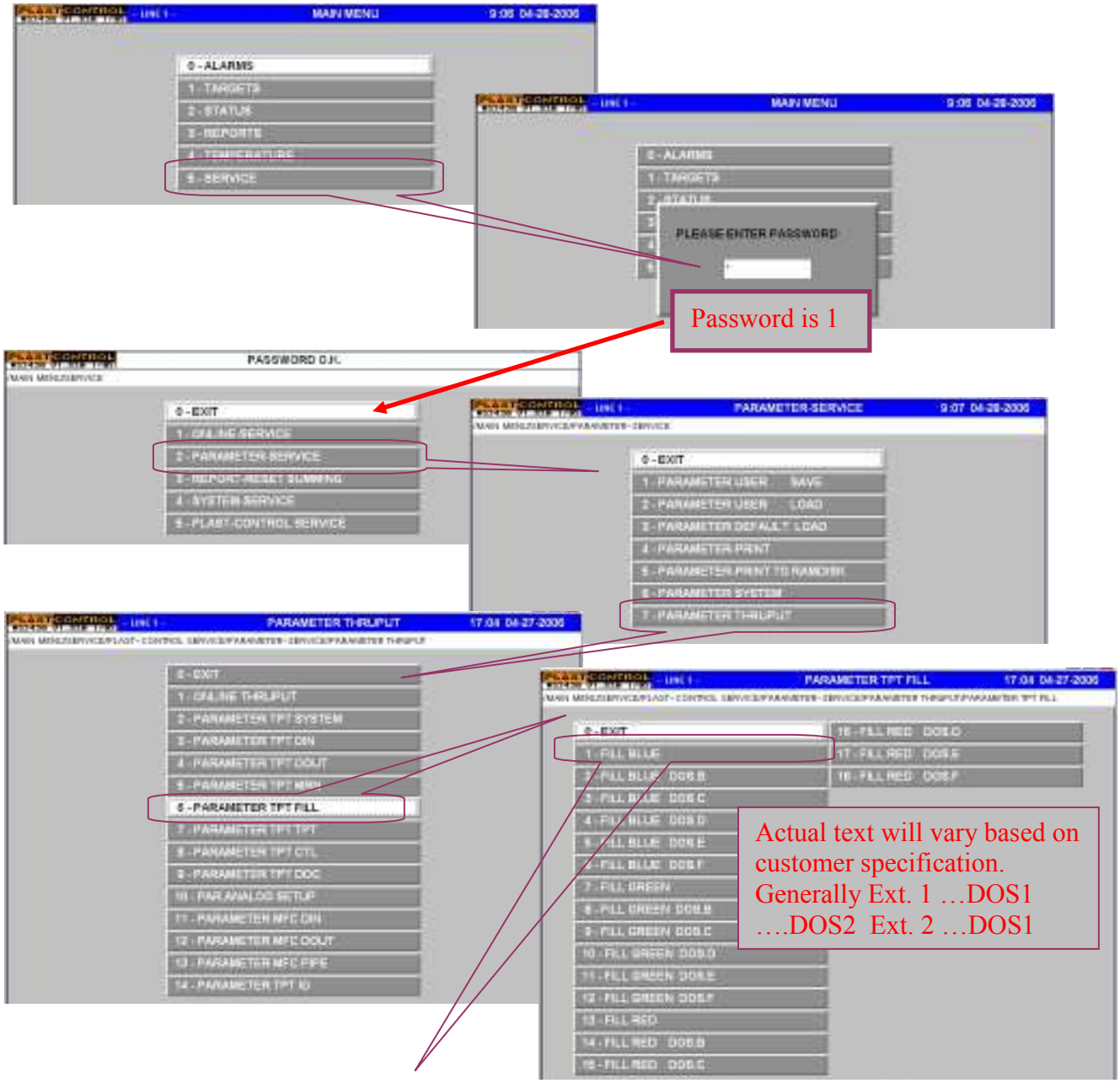
Manual setup of the upper and lower fill levels

For older systems or for customers who want to manually set these trigger levels to control the slide gate then follow this procedure.

For this example the screens of an ACS system will be used, for GT3 and GDC similar screens can be followed but you may have to access the 2nd page of a screen since there is limited amount of lines that can be displayed compared to the ACS monitor.



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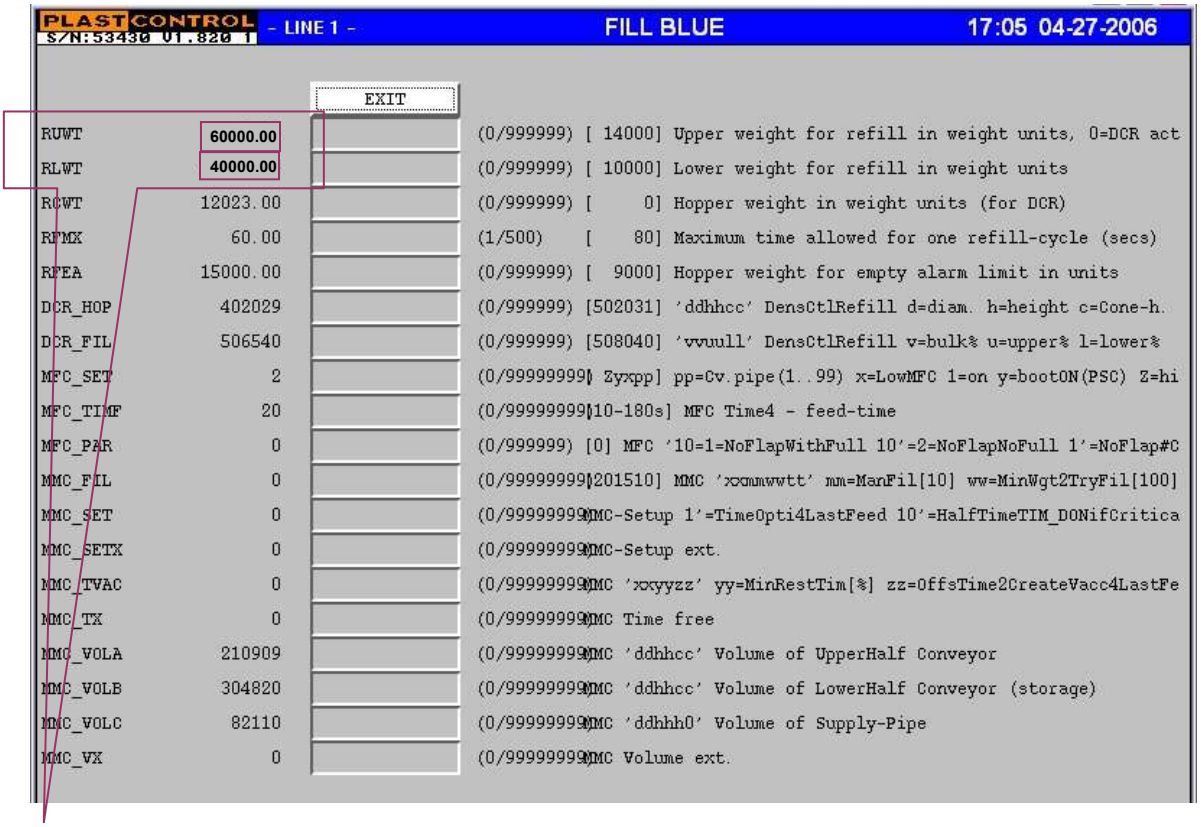

The upper fill (RUWT) weight is entered into this parameter. The value entered is in 1000th of a pound so the number 60,000.00 = 60.000 pounds. The slide gate will be triggered at this weight but by the time the gate closes the final weight will be somewhere around 70 – 75 pounds. In older PLAST-CONTROL systems this delay took longer which resulted in more material being dumped before the flow stopped. In newer system a fast fill mode can be used which allows for a much faster reaction. In this case the RUWT value can be set to a higher number such as 65000. Only by watching the actual fill cycle can this value really be set properly based upon the actual resin being used. Once the flow has stopped you can look inside the hopper lid and there should be around 2" of space above the top mound of the resin and the top of the hopper. Watch several cycles to determine the correct setting.

The lower fill (RLWT) weight is entered in this parameter. Again the weight is in 1000th of a pound so the number 40,000.00 = 40.000 pounds. The slide gate will open once this weight is reached. Whether the system is the older or newer software this number will be the same value. The ideal location of the resin level in the hopper is about in the middle of the sight glass on a 500mm hopper. On the 400mm & 300mm hoppers the sight glass is in the upper area on the hopper so for these size hoppers the height in the hopper is about in the middle of the angled cone part of the hopper.

Once these values are set for each hopper the parameters need to be saved by pressing escape or exit until the screen titled "Parameter Service" shows and select "Parameter User Save" #1.

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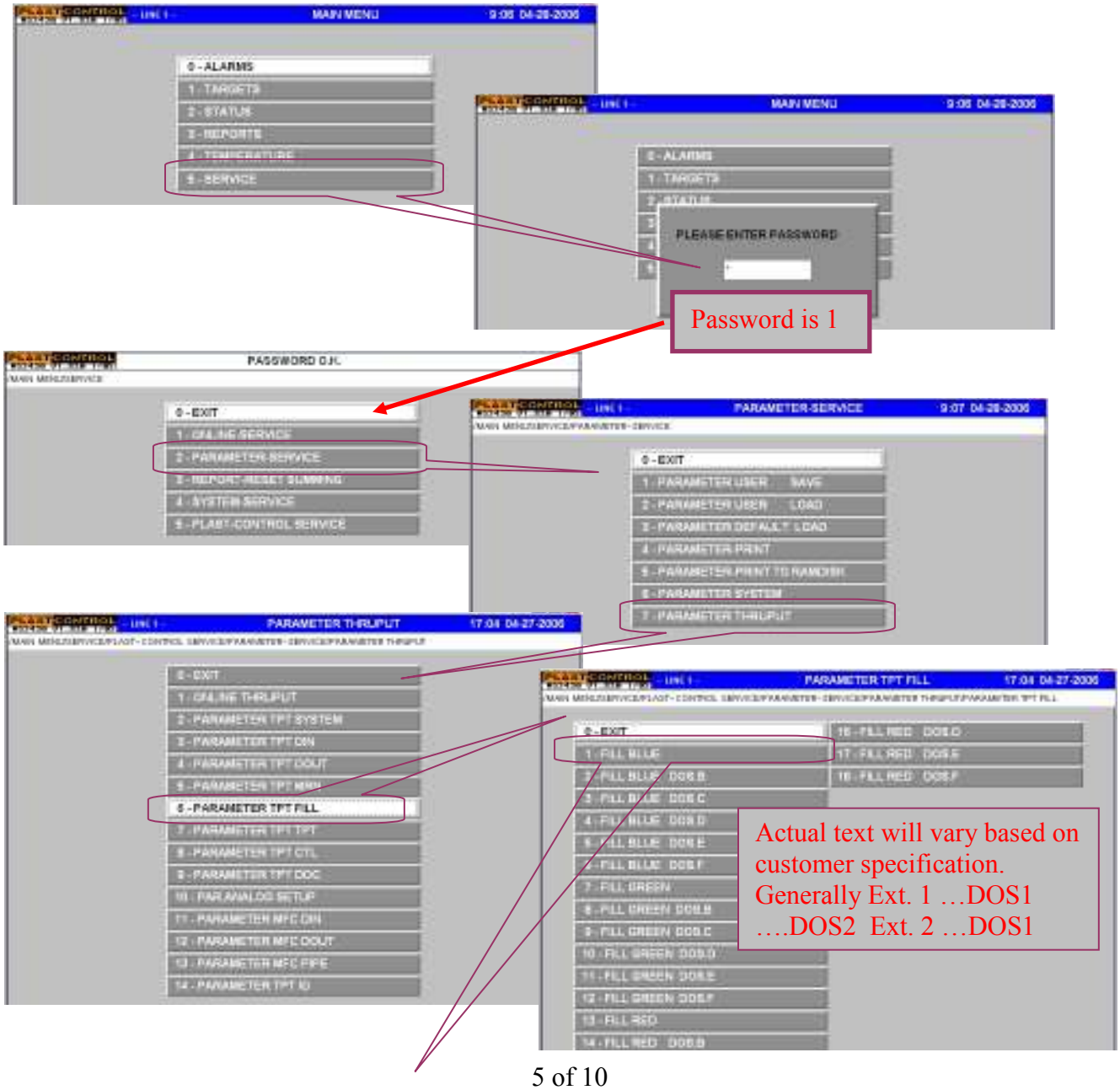
Automatic setup of the upper and lower fill levels
On newer systems these values will be calculated by the computer automatically based upon the entered density on the target screen. Each hopper must be defined which the computer needs to calculate the volume of resin and then the actual weight that can be dumped.

For this example the screens of an ACS system will be used, for GT3 and GDC similar screens can be followed but you may have to access the 2nd page of a screen since there is limited amount of lines that can be displayed compared to the ACS monitor.



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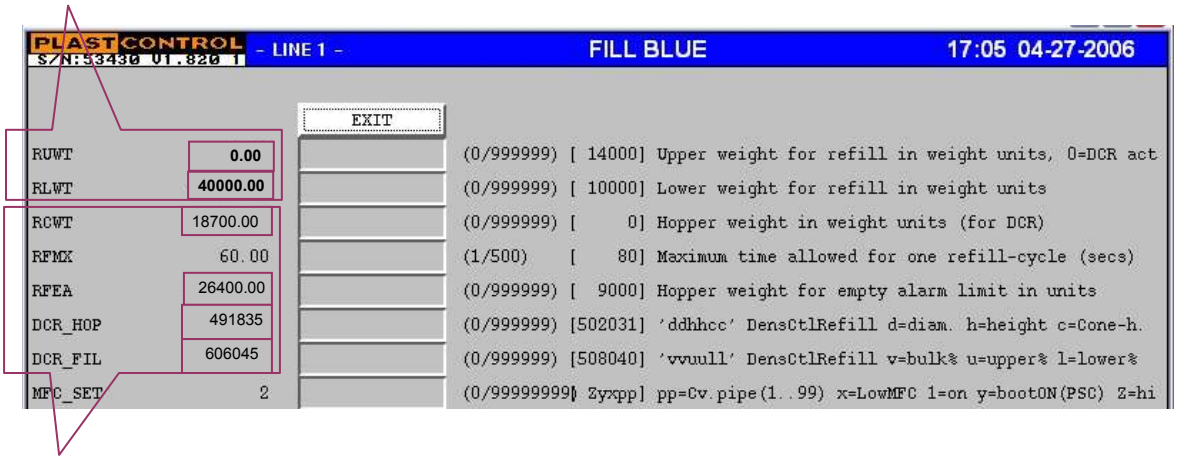
The upper fill (RUWT) weight is entered into this parameter. When a value of 0.0 is entered into the RUWT parameter it indicates to the computer to automatically calculate the RUWT & RLWT values.

The lower fill (RLWT) weight is entered in this parameter. The value in this parameter is not looked at when the RUWT value is 0.0. It does not mater what number is in this parameter.



The RCWT parameter for a 500mm hopper need to be set to 18,700.00 for a 500mm hopper, 13,000.00 for a 400mm hopper and 7,200.00 for a 300mm Dosing hopper.

The RFEA parameter for a 500mm hopper needs to be set to RCWT value plus 7,700, for a 400mm hopper the RCWT plus 3,300 and for a 300mm hopper RCWT plus 2,650. This triggers the empty hopper alarm.

The DCR_HOP parameter for a 500mm hopper needs to be set to 491835, for a 400mm hopper set to 392228 and for a 300mm hopper set to 292821. These are the dimensions in mm to describe the shape of the hoppers – 49 = 500mm diameter, 18 = length of top and 35 is the length of the cone section.

The DCR_FIL parameter is used for describing the bulk density and fill levels in % for triggering the slide gate operation. 1st 2 digits are the bulk density (60 means 60% of the actual volume in the hopper will be resin), 2nd 2 digits is the fill level to close the slide gate (60 = 60%) and the last 2 digits is the opening level for the slide gate (45 = 45%). If the hopper does not perform properly with automatic fill level then this parameter can be changed to correct the problem. This is only for automatic level correction, not used when RUWT has a value other than 0.
For a 500mm hopper the value should be 606045, for the 400mm hopper the value should be 606545 and for the 300mm hopper the value should be 605030.

Once these values are set for each hopper the parameters need to be saved by pressing escape or exit until the screen titled “Parameter Service” shows and select “Parameter User Save” #1.

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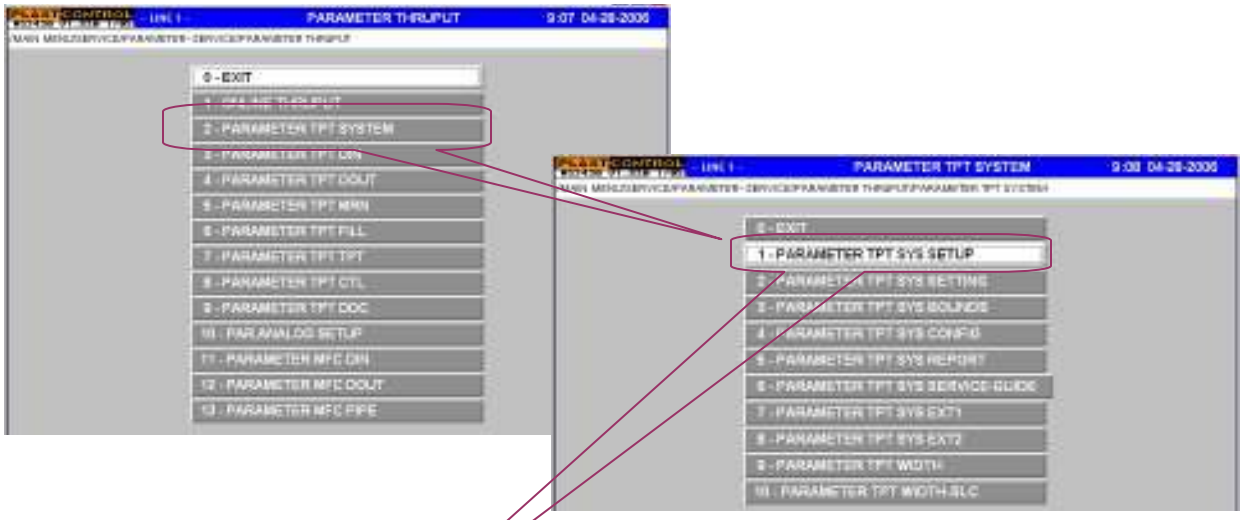
The control setup is entered by following this procedure.



PLAST CONTROL S/N:53430 V1.820 1 - LINE 1 - PARAMETER TPT SYS SETUP 17:02 04-27-2006

EXIT

SOPCTL	110.00	(0/1111)	[111] 100'=FastTpt 10'=UltaFastCtl 1'=Auto-Restart Dos.
DOSSET	0.00	(0/99)	[0] 1'=PIB start with RPM not KG/H
FFILL	1	(0/9999)	[0] 1'=FastFill, RebootOnChg (Speeds are Invalid if MIOINT)!
OVLCHK	0	(0/99999999)	[0|2510] xxyy Dos.Ovl-Chk xx=OvlDivider[10] yy=MinRPM->Stop
SHR_ON	2.00	(0/5)	[0] Setup Shrink-Mode 0=off 1=on 2=Auto-Shrink
SCR_SET	0	(0/999)	[0] Scrap setup 1'=GrossDosCtl
CTLTYP	4.00	(1/6)	[4] Control-Type 0=default 1=A 2=S 3=SS 4=AS 5=A+S
MXO	1	(0/99999999)	[1] ThruputObsMode 1'=on 10'=EnObsAlarm 100'=ForeverInObs
MXO_SET	5080200	(0/99999999)	[3080200] xxyyzzz xx=FstCtlIf<x% yy=%ofMXE zzz=Tim2Observe
SIMUL	0.00	(0/100)	[0] Simulation 1'=(b0-simEX b1-simHO) 10'=free
CLEAR	0.00	(0/999999)	[0] Clear SRAM-parts ... (n.u.)
DSB	50205003	(0/99999999)	[50105003] DosLowIfMNoTpt w=>rpm x=MnDosTpt y=%Back z=#clc
CV_CCMV	453.59	(0/99999)	[0] DCR&MMC: g/ccm & l => [kg] (0|1000) or [lb] (453.59)
MFILL	16600	(0/99999999)	[16300] Detect Refill [xyzzz] +z g=Wait y sec, x=enableSTPT
CHECK	0	(0/99999)	[0] Checkups: 1'=enableLioCfgLoop

Check to see if fast fill is turned on (1). This allows for faster closing of the slide gate once the RUWT weight is reached.

Check to see if 453.59 is entered in CV_CCMV. This is used to calculate the hopper volume in cu^3 as opposed to metric liters.

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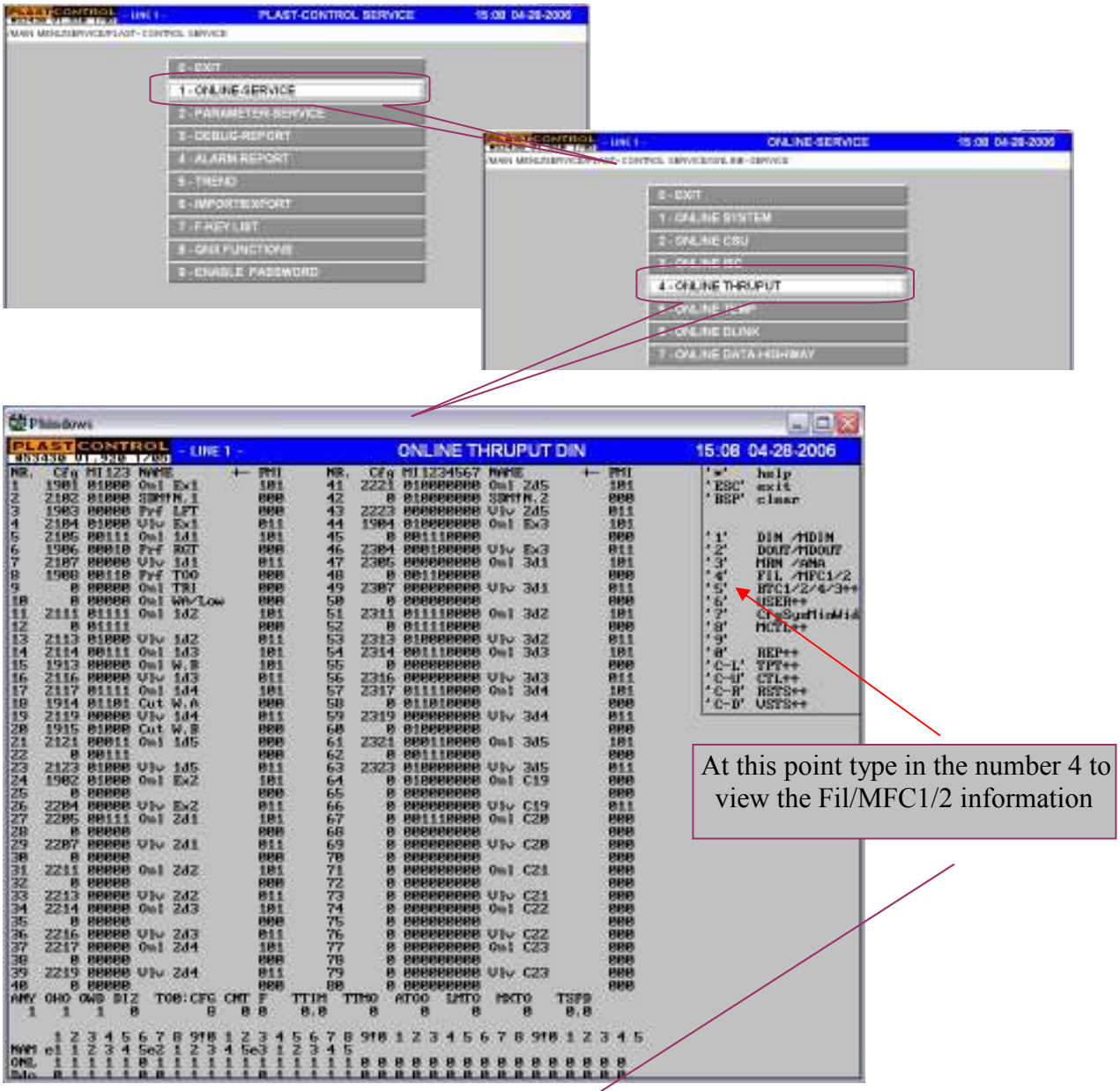
Checking the results using Online Service screens. Press escape or exit until the screen appears to select on-line service #1. Follow these steps to see the actual values being used by the system for filling the hopper.



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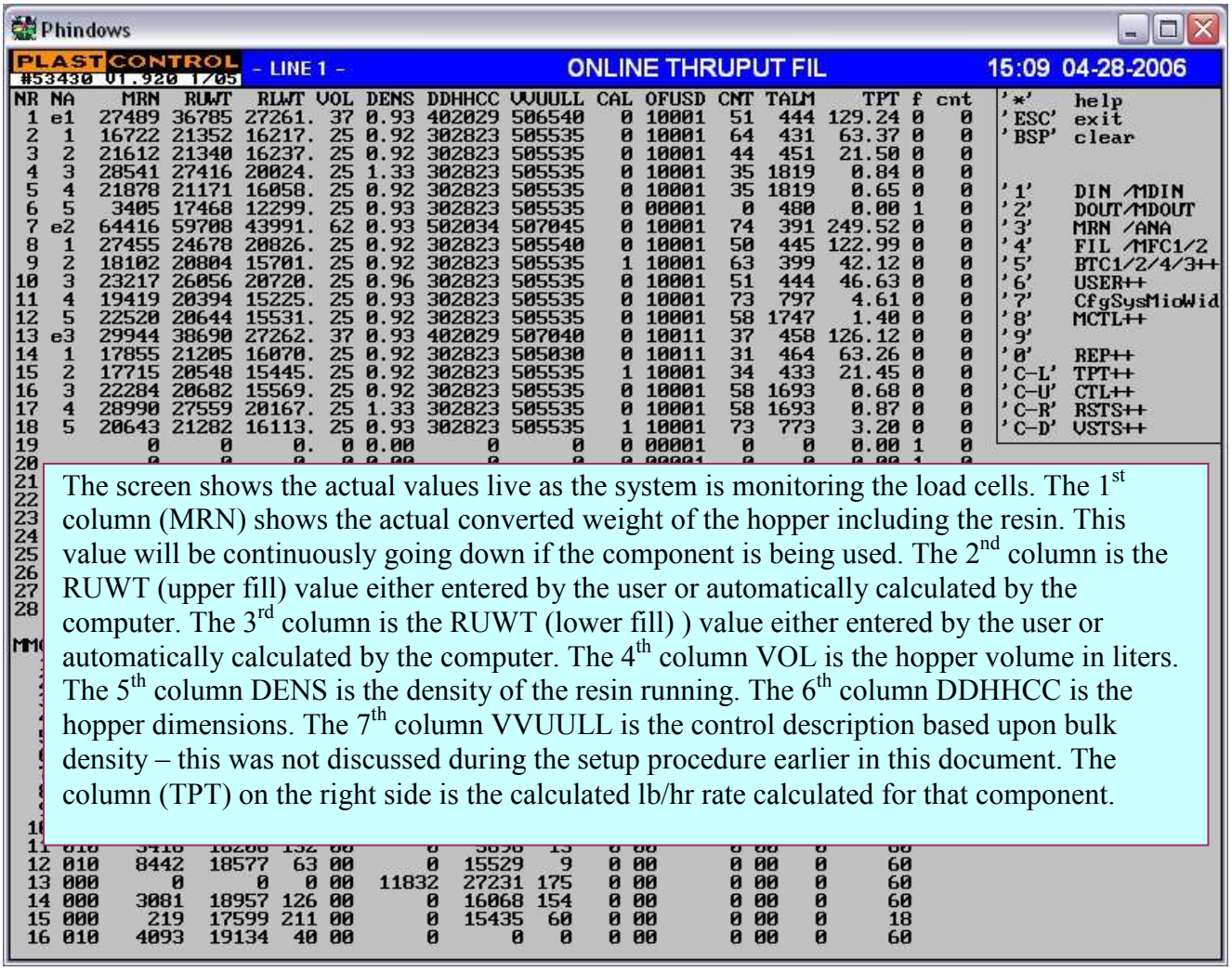

The screen shows the actual values live as the system is monitoring the load cells. The 1st column (MRN) shows the actual converted weight of the hopper including the resin. This value will be continuously going down if the component is being used. The 2nd column is the RUWT (upper fill) value either entered by the user or automatically calculated by the computer. The 3rd column is the RUWT (lower fill)) value either entered by the user or automatically calculated by the computer. The 4th column VOL is the hopper volume in liters. The 5th column DENS is the density of the resin running. The 6th column DDHHCC is the hopper dimensions. The 7th column VVUULL is the control description based upon bulk density – this was not discussed during the setup procedure earlier in this document. The column (TPT) on the right side is the calculated lb/hr rate calculated for that component.

This screen is used to watch the actual calculated data as the material flows through the hopper. Watch the MRN value as it goes lower and when it reaches the RLWT value the slide gate will open. Once the RUWT value is reached the slide gate closes but the MRN value will go higher than the RUWT because of the delay in time.

If the slide gate stays open during a refill look at this page and see if the MRN is lower than the RUWT. If the resin is totally above the hopper inlet but the weight is still too low to trigger closing the slide gate then the density value entered in the target screen could be wrong, the hopper is not hanging properly on the load cell, the rubber boot could be causing a problem or the setup is not correct (automatic calculation). If manual setup was performed then the RUWT value could be too low.

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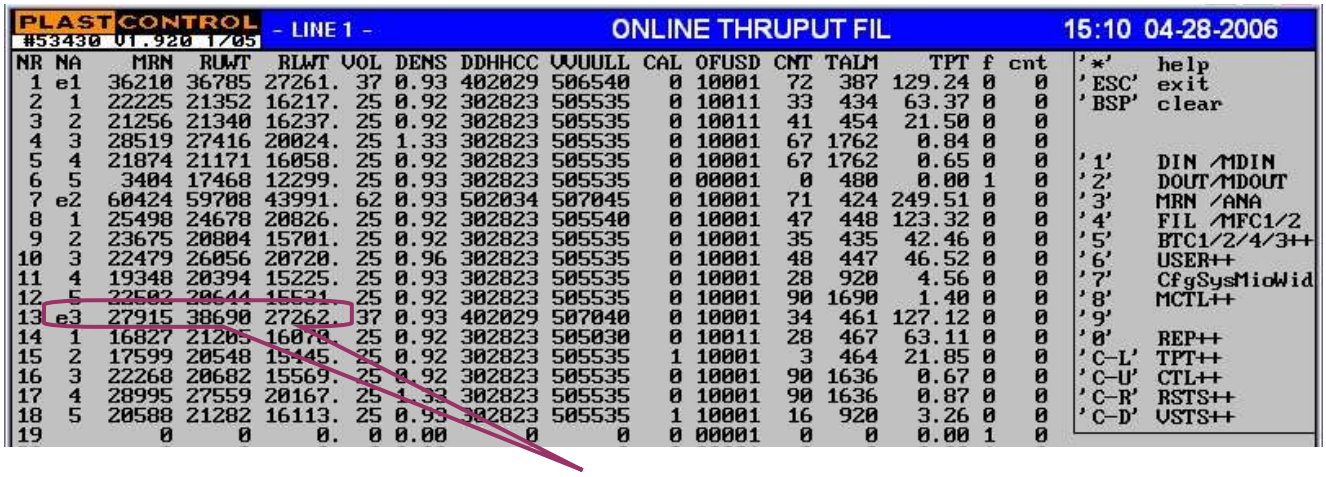
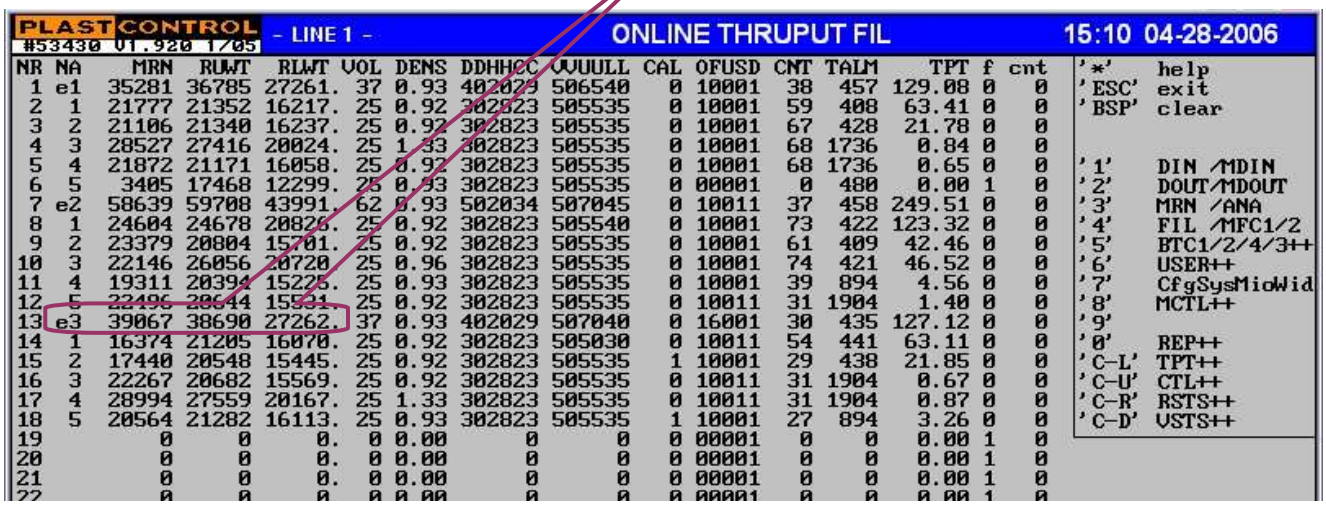
If the MRN is higher than the RUWT then check the air pressure on the slide gate, should be 80-90psi. It could be the throttle valves on the solenoid are dirty not allowing the air to bleed out. You can temporarily remove the throttle valves but the gate will open/close at full speed. The gate should close slower than it opens. It the hopper is over filled and the resin is up in the fill tube then it is possible the gate will not close fully because it can not push the resin out of the way since there may not be room for it to go to. This will allow resin to continuously flow into the gravimetric hopper.



NR	NA	MRN	RUWT	RLWT	VOL	DENS	DDHHCC	VVUULL	CAL	OFUSD	CNT	TALM	TPT	f	cnt
1	e1	36210	36785	27261.	37	0.93	402029	506540	0	10001	72	387	129.24	0	0
2	1	22225	21352	16217.	25	0.92	302823	505535	0	10011	33	434	63.37	0	0
3	2	21256	21340	16237.	25	0.92	302823	505535	0	10011	41	454	21.50	0	0
4	3	28519	27416	20024.	25	1.33	302823	505535	0	10001	67	1762	0.84	0	0
5	4	21874	21171	16058.	25	0.92	302823	505535	0	10001	67	1762	0.65	0	0
6	5	3404	17468	12299.	25	0.93	302823	505535	0	00001	0	480	0.00	1	0
7	e2	60424	59708	43991.	62	0.93	502034	507045	0	10001	71	424	249.51	0	0
8	1	25498	24678	20826.	25	0.92	302823	505540	0	10001	47	448	123.32	0	0
9	2	23675	20804	15701.	25	0.92	302823	505535	0	10001	35	435	42.46	0	0
10	3	22479	26056	20720.	25	0.96	302823	505535	0	10001	48	447	46.52	0	0
11	4	19348	20394	15225.	25	0.93	302823	505535	0	10001	28	920	4.56	0	0
12	5	22582	20644	15531.	25	0.92	302823	505535	0	10001	90	1690	1.40	0	0
13	e3	27915	38690	27262.	37	0.93	402029	507040	0	10001	34	461	127.12	0	0
14	1	16827	21205	16070.	25	0.92	302823	505030	0	10011	28	467	63.11	0	0
15	2	17599	20548	15445.	25	0.92	302823	505535	1	10001	3	464	21.85	0	0
16	3	22268	20682	15569.	25	0.92	302823	505535	0	10001	90	1636	0.67	0	0
17	4	28995	27559	20167.	25	1.33	302823	505535	0	10001	90	1636	0.87	0	0
18	5	20588	21282	16113.	25	0.93	302823	505535	1	10001	16	920	3.26	0	0
19		0	0	0.	0	0.00	0	0	0	00001	0	0	0.00	1	0

'*'	help
'ESC'	exit
'BSP'	clear
'1'	DIN /MDIN
'2'	DOUT/MDOUT
'3'	MRN /ANA
'4'	FIL /MFC1/2
'5'	BTC1/2/4/3++
'6'	USER++
'7'	CfgSysMioWid
'8'	MCTL++
'9'	
'0'	REP++
'C-L'	TPT++
'C-U'	CTL++
'C-R'	RSTS++
'C-D'	VSTS++

Main hopper E3 just before the refill, MRN = 27915 (27.915 lb) and RLWT = 27262 (27.262 lb). Once the 27262 is reached the slide gate opens and the resin flows in. The next screen shows the values just after the slide gate closes several seconds later. The new MRN is now 39067 (39.067 lb). The RUWT is 38690 (38.690) so the extra weight (about 0.37 lb) is the delay in closing.



NR	NA	MRN	RUWT	RLWT	VOL	DENS	DDHHCC	VVUULL	CAL	OFUSD	CNT	TALM	TPT	f	cnt
1	e1	35281	36785	27261.	37	0.93	402029	506540	0	10001	38	457	129.08	0	0
2	1	21777	21352	16217.	25	0.92	302823	505535	0	10001	59	408	63.41	0	0
3	2	21106	21340	16237.	25	0.92	302823	505535	0	10001	67	428	21.78	0	0
4	3	28527	27416	20024.	25	1.33	302823	505535	0	10001	68	1736	0.84	0	0
5	4	21872	21171	16058.	25	0.92	302823	505535	0	10001	68	1736	0.65	0	0
6	5	3405	17468	12299.	25	0.93	302823	505535	0	00001	0	480	0.00	1	0
7	e2	58639	59708	43991.	62	0.93	502034	507045	0	10011	37	458	249.51	0	0
8	1	24604	24678	20826.	25	0.92	302823	505540	0	10001	73	422	123.32	0	0
9	2	23379	20804	15701.	25	0.92	302823	505535	0	10001	61	409	42.46	0	0
10	3	22146	26056	20720.	25	0.96	302823	505535	0	10001	74	421	46.52	0	0
11	4	19311	20394	15225.	25	0.93	302823	505535	0	10001	39	894	4.56	0	0
12	5	22496	20644	15531.	25	0.92	302823	505535	0	10011	31	1904	1.40	0	0
13	e3	39067	38690	27262.	37	0.93	402029	507040	0	16001	30	435	127.12	0	0
14	1	16374	21205	16070.	25	0.92	302823	505030	0	10011	54	441	63.11	0	0
15	2	17440	20548	15445.	25	0.92	302823	505535	1	10001	29	438	21.85	0	0
16	3	22267	20682	15569.	25	0.92	302823	505535	0	10011	31	1904	0.67	0	0
17	4	28994	27559	20167.	25	1.33	302823	505535	0	10011	31	1904	0.87	0	0
18	5	20564	21282	16113.	25	0.93	302823	505535	1	10001	27	894	3.26	0	0
19		0	0	0.	0	0.00	0	0	0	00001	0	0	0.00	1	0
20		0	0	0.	0	0.00	0	0	0	00001	0	0	0.00	1	0
21		0	0	0.	0	0.00	0	0	0	00001	0	0	0.00	1	0
22		0	0	0.	0	0.00	0	0	0	00001	0	0	0.00	1	0

'*'	help
'ESC'	exit
'BSP'	clear
'1'	DIN /MDIN
'2'	DOUT/MDOUT
'3'	MRN /ANA
'4'	FIL /MFC1/2
'5'	BTC1/2/4/3++
'6'	USER++
'7'	CfgSysMioWid
'8'	MCTL++
'9'	
'0'	REP++
'C-L'	TPT++
'C-U'	CTL++
'C-R'	RSTS++
'C-D'	VSTS++

As an example, if it takes 5 minutes (300 seconds) between refills and takes 3 seconds to refill then the system will be in automatic gravimetric mode for 98.99% of the time (3/297). This is very acceptable, even at every 2 minutes with a 3 second refill (3/117) the percent is 97.44% and that is good.