Asprova's "Pocket manual" series No.12

Setup times

Explanation of the available functions used for creating setup tasks.

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Important elements in any planning proposal are setup time prior to the start of equipment operation, such as installing intermediate items for cutters and planers, installing tools into a press, heating up of furnace resources, cleaning tanks and teardown time, the cleaning up of machines and equipment after operation. Asprova is equipped with a wide variety of functions for both setup times and we will examine the entire range from basic assignment method to function type.

Setup time and teardown time

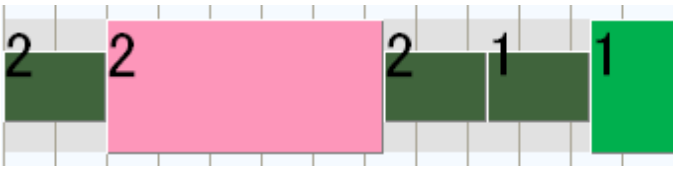
Setup time and teardown time are basically, assigned with the integrated master table. Assignments with the integrated master table are assignments of each item and each resource (See Fig. 1).

	Item	Process number	Instruction type	Instruction code	Resource /Item	Setup	Productior	Teardown
1	A	10	Use instr	M	X	10	15.1mp	10
2		20	Use instr	M	Y	120	10.8mp	120

▲ Fig. 1 Integrated master table
Setup and teardown time can be assigned by expression.

Integrated master table's "Setup" and "Teardown" time properties have an expression format that is the same as that of the "Production" property. Assignments are made in seconds (s), minutes (m), hours (h), days (d) and weeks (w). If the unit is omitted, it is interpreted as minute. If mp is specified in the same way as with production, set up time/teardown time are proportionate to production quantity.

Rescheduling in this status allocates setup time and teardown time and is displayed in the Resource Gantt chart is as shown in Fig. 2.



▲ Fig. 2 Gantt resource chart showing setup and teardown times
The character string in the instruction bar is the order code. From left to right, the setup, production, and teardown of order 2 followed by the setup and production of order 1.

Help
"Introduction Manual" (Introduction Manual 1.pdf)
"Resource capacity expression"(Help No.746200)
"Setup time"(Help No. 781000)
"Changing setup time in proportion to production quantity"(Help No. 331000)
"Expression Handbook"(ExpressionHandbook.pdf)

Efficiencies can be assigned to setup time in the same way that they are assigned to production time.

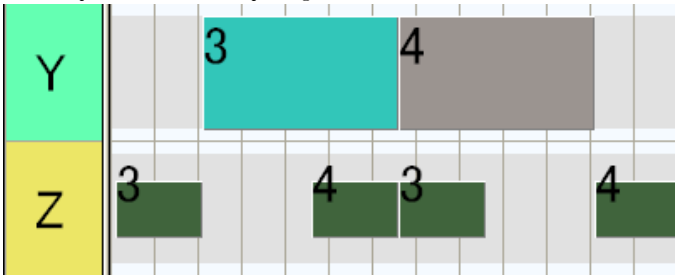
Help
"Specifying a setup time factor"(Help No. 277000)

Internal and external setup

The setup time in Fig. 2 is for a setup performed with a stop in resource operations, and is called an internal setup. Conversely, a setup performed externally to resources without stopping resource operations is called an external setup. An external setup uses sub-resources. The assignments or rescheduling shown in Fig. 3 give the allocation shown in Fig. 4.

	Item	Process code	Instruction type	Instruction code	Resource /Item	Setup	Production	Teardown
1	B	20	Use instr	M	Y		10.8mp	
2			Use instr	S0	Z	120		120

▲ Fig. 3 Integrated master table
An example of External setup assignment.



▲ Fig. 4 External setup time shown in a Gantt resource chart. The setup sub-resource Z finishes order 4's setup before the order 3 teardown.

Please take a look at the practical training text where you will find a more detailed explanation of external setup time.

Help
"Practical training text"
"Specifying a setup time factor"(Help No. 320000)
"Setting a sub resource"(Help No. 16280)

Item setup、Spec setup、Resource setup

The setups for switching items, switching specifications and switching resources are assigned, respectively, in the Item setup table (Fig. 5), the Spec setup table (Fig. 6) and the Resource setup table (Fig. 7). These setups generated when the items, specs and resources are switched in consecutive operations. They are the setup times that let us know whether an event is occurring for the first time and when they are assigned they are known as changeover time.

	Resource	Item L	Item R	Setup time	Sort order	Never flag
1	X	A	B	120M		Allowed

▲ Fig. 5 Item setup table here assigns 120 minutes to be required in the switch from item A to item B for resource X.

	Resource	Previous spec	Next spec	Setup time	Sort order	Never flag
1	Y	M	N	120M		Allowed

▲ Fig. 6 Spec setup table here assigns 120 minutes to be required in the switch from spec M to spec N for resource Y.

	Resource	Resource L	Resource R	Setup time	Sort order	Never flag
1	X	Y	Z	120M		Allowed

▲ Fig. 7 Resource setup table here assigns 120 minutes to be required in the switch from sub-resource Y to sub-resource Z for resource X. There is no need to have the pre-resource and the post-resource be sub-resources, for example with sub-resource X, the setup can also be assigned when switching from main resource X to main resource Z. Generally this is called the resource setup table without any reference to main or sub-resource.

If there is originally, no fixed set up time in the operating instruction that causes a setup to occur, a 0 is assigned to "setup" when changeover time is assigned with the integrated master table (see Fig. 8). If Fig. 6's and Fig. 8's assignments are made in this way, the switching setup of specifications shown in Fig. 9 occurs.

	Item	Process number	Instruction type	Instruction code	Resource /Item	Setup	Production
1	C	10	Use instr	M	X		4mp
2		20	Use instr	M	Y	0	5mp

▲ Fig. 8 If the Master use instruction that generation Changeover time has no fixed setup time initially, a zero will be assigned to indicate marking the point as 'will be generated here."

▲ Fig. 9 The Gantt resource chart allocated by assignments in Fig. 6 and 8. That generates spec setup time because specs will be switched between orders 5 and 6.

Help

"Specifying a setup time for changing items"(Help No. 307000)
"Specifying a setup time for changing specs"(Help No. 308000)
"Specifying a setup time for changing sub resources"(Help No. 309000)
"Sample A"(Help No. 906000)
"Sample C"(Help No. 908000)
"Sample E"(Help No. 910000)

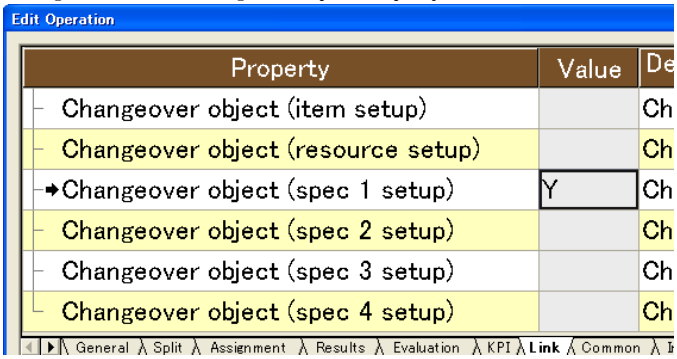
A "sort order" property is prepared for each setup table, and each setup table contains such things as asterisks (*) to indicate all objects, including Item groups and Resource groups, that allow assignments as applicable, the same as with Calendar tables.

In such situations, we may want to know what setup object generated that setup. For such instances, the operation that applied the post- or pre-dependent setup object can be referred to from the operation. Using that, we can assign comments to the Changeover object and display those comments in the Changeover time object for the setup generated by each operation in the Resource Gantt chart.

If we assign, for example, a character string to the comments in the Changeover time object as shown in Fig. 10, then we can assign IF(ME.Work.Type=='P',ME.Order+'¥n'+ME.Order.Spec1,ME.Operation.Change1.Comments) to the "Use instruction bar text expression" (Resource Gantt tab) in the Resource Gantt chart's Display settings. Reference can then be made to the changeover time object that is applied in Fig. 11. The comments for setup instruction object in Fig. 12 can then be displayed.

	Resource	Previous spec	Next spec	Setup time	Sort order	Comments
1	Y	M	N	120M	10	Worker required

▲ Fig. 10 Comments assigned to Spec setup object



▲ Fig. 11 Reference can be made to the Changeover object applied to the Operation class

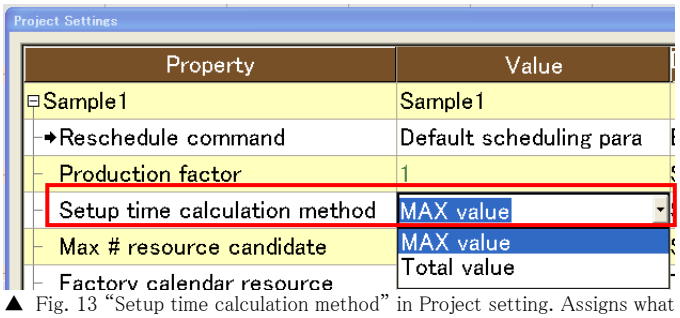
▲ Fig. 12 Comments for the generated Changeover object appear in the Instruction bar

Setup time calculation method

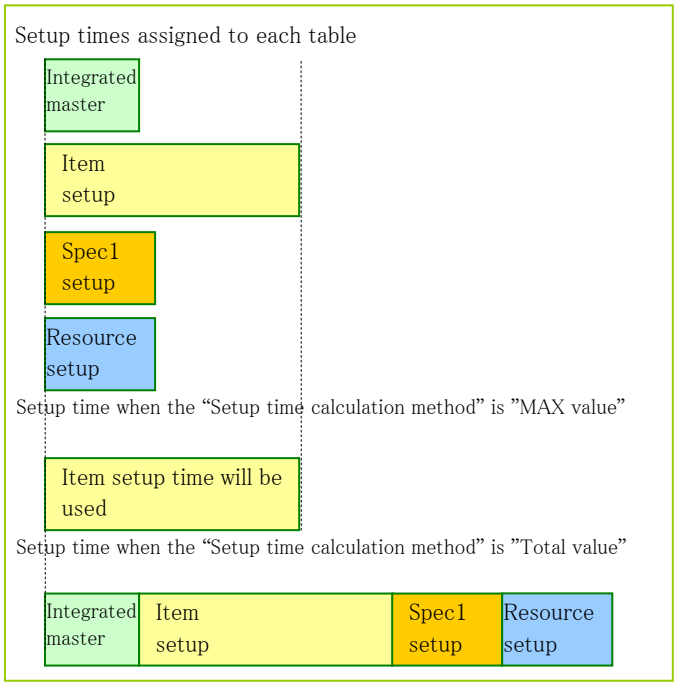
When setup times and multiple changeover times are assigned to the Integrated master table, we can use the setup time calculation method property that is in Project settings to determine whether the maximum values or total values will be the setup times (see Figs. 13 and 14). When creating a master, decide in advance whether this "setup time calculation method" will be "Max value" or "Total value" and then create each table.

Help

"Specifying a method of calculating multiple setups"(Help No. 324000)



▲ Fig. 13 "Setup time calculation method" in Project setting. Assigns what method is to be used in applying the assigned setup time to each table.



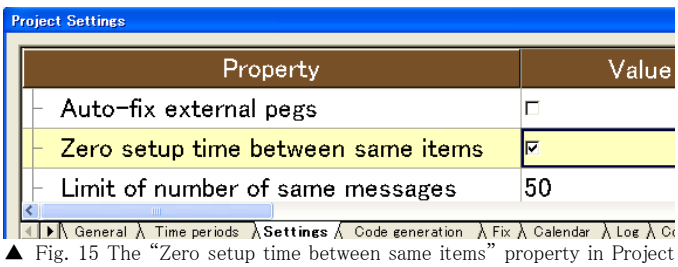
▲ Fig. 14 An example of setup time application by means of the "Setup time calculation method." Spec setup makes reference not to just one setup but to all Spec N setups that exist.

Zero setup time between same items

Assignments for these setups can be forcibly ignored if the same items are positioned consecutively when the assignment is made, so to make setup time zero seconds, place a checkmark on the "Zero setup time between same items" property in Project settings. (See Fig. 10)。

Help

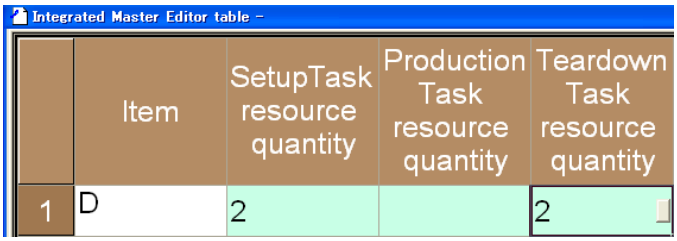
"Forcibly setting a setup time to 0 between same items"(Help No. 323000)



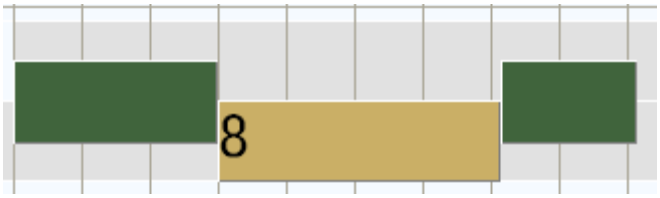
▲ Fig. 15 The "Zero setup time between same items" property in Project settings. Assign in order to forcibly ignore all setup assignments when the same items are placed consecutively.

Resource quantity in setup time

If resource quantity is not specified in setup time, resource quantity will be regarded as 1. However, resource quantity can be specified in the Integrated master table's "Setup Task resource quantity" or its "Teardown Task resource quantity" (see Fig. 16). The property format is expression format.



▲ Fig. 16 With the Integrated master table, each resource assigned to Setup time and Teardown time is 2.



▲ Fig. 17 Resource Gantt chart when allocation is done according to the assignments in Fig. 16

(The "Piled operation display method" is set to "Accurate resource quantity". The display of use instructions in Setup task is not strictly faithful to resource quantity but height is proportional to resource quantity.)

Help

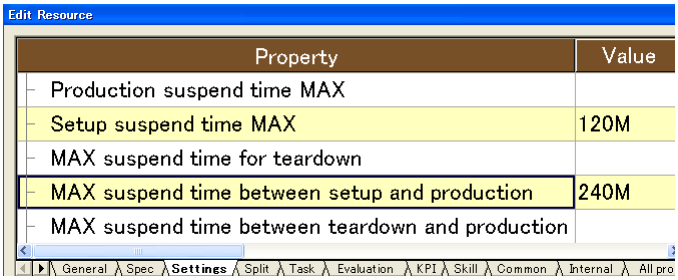
"Required resource quantity in master use instruction"(Help No. 753500)

Limits on suspend time during setup time

It is possible to assign an upper limit to the range of time in which a setup can be suspended, and this can be used for drafting plans within that range. In the example in Fig. 18, the time in which setup for resources can be interrupted is set to 120 minutes.

An upper limit on suspend time can also be assigned from the end of setup to the beginning of production. Fig. 18 shows an assignment so that the maximum time allowed between the end of setup and the beginning of production is 240 minutes for the resource.

These assignments can also be made in the Integrated master table for other than Resource class and can be made dependent on item (see Fig. 19)



▲ Fig. 18 The Resource class's "Setup suspend time MAX" property displayed in the property window.

	Item	Setup suspend time MAX	MAX suspend time between setup and production	Production suspend time MAX	MAX suspend time between teardown and production	Teardown suspend time MAX
1	A					

▲ Fig. 19 Integrated master table
The same properties as the Resource class

Help
Practical training textbook
"Suspend time"(Help No. 747300)
"Preventing setup from extending into the next day"(Help No. 353000)
"Sample Q"(Help No. 922000)

Customizing setup times

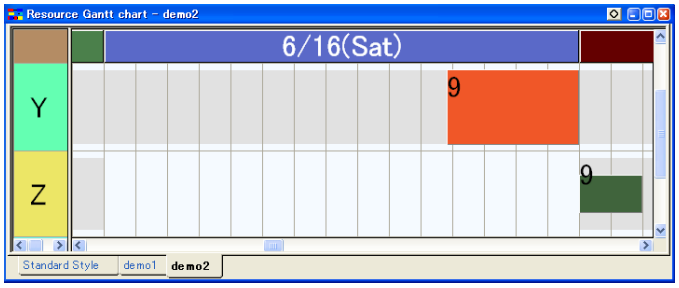
If, when using the functions available for the above setup time, you have a setup time that assignments cannot provide, use the COM interface (EIIFilterCalcCombinationSetupDuration) and specify setup time from the plug-in. This interface allows detailed specification by being called every time a tentative assignment is executed and every time an operation is allocated, at which point it is able to refer to the allocation date, resource, adjacent operation and planning parameter and overwrite the setup time. The COM interface is also called when there is a transition in the Gantt resource chart.

Development of this plug-in will cover almost any situation in which setup time is generated.

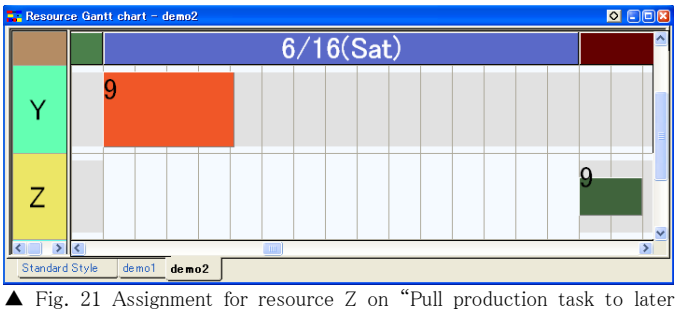
Help
"Plugin Manual (EIIVB)"(PlugIn Training EII VB.pdf)
"Plugin Manual (EIIVC++)"(PlugIn Training VC.pdf)

Separating setup and production tasks

Setup tasks are, normally, allocated right next to production tasks. For example in Fig. 20, main resource Y and sub-resource Z are different during operating time, but when they are allocated forward, the production task pulls on and is allocated to the teardown task after the teardown task is allocated. To prevent pulling, specify "No" to the Resource class's "Pull production task to later assign task" (see Fig. 21).



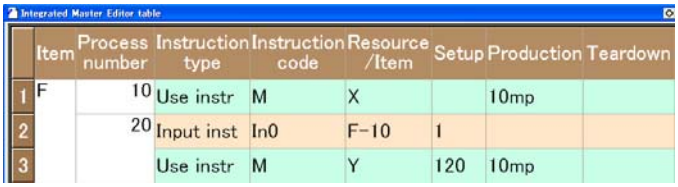
▲ Fig. 20 A Gantt resource chart that is forward allocated and has for Resource Z "Yes" specified for "Pull production task to later assigned task". The initial production task for Order "9" is allocated to the morning of 6/16. the teardown task is allocated after that to 6/17, and that pulls the production task to the evening of 6/16.



▲ Fig. 21 Assignment for resource Z on "Pull production task to later assigned task" is "No". The teardown task for order 9 is allocated to 6/17, and the production task is not then pulled to the teardown task. The allocation position remains as is.

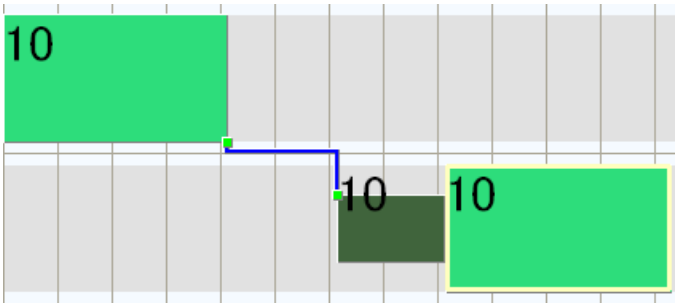
Time constraints

Time constraints are normally assigned as constraints between pre-and post-production tasks and one or two of them can be made into setup tasks. The relationship between which time constraint and which task, is determined by the assignment to each "Setup," "Production and "Teardown" of the volume input-output ratio assigned to the Master output instruction and Master input instruction.


Integrated Master Editor table

	Item	Process number	Instruction type	Instruction code	Resource /Item	Setup	Production	Teardown
1	F	10	Use instr	M	X		10mp	
2		20	Input inst	In0	F-10	1		
3			Use instr	M	Y	120	10mp	

▲ Fig. 22 An example of the relationship for Time constraint that is made between the pre-production Production task and the post-production setup task in the Integrated master table. The input-output ratio (the value of 1 in the second row) is assigned to "Setup" not to "Production," and the Input instruction is placed below the setup task.



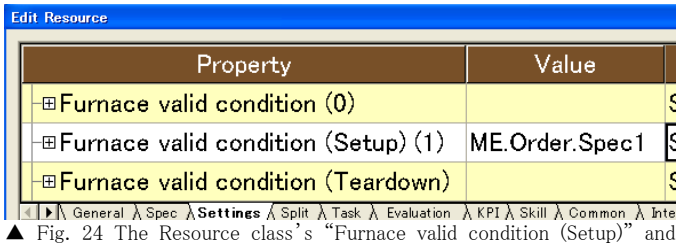
▲ Fig. 23 The assignment in Fig. 22 places the Input instruction below the setup task and the constraint time applies a restriction between the ending time for pre-production and the start time for post-production setup.

Help
"Starting point in the time relationship between current and previous processes"(Help No. 16270)
"Time constraint method"(Help No. 753000)

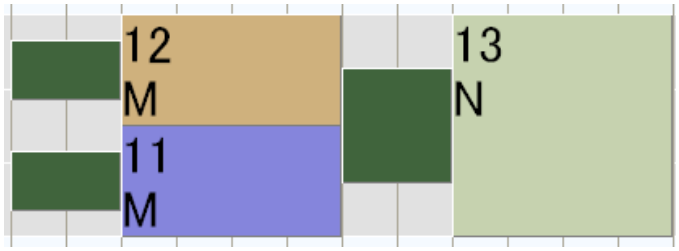
Furnace prep

When a furnace is prepped, the conditions for inclusion in a batch are specified in the Resource class's "Furnace valid conditions" . However, in this case, if the setup time generated is one of the conditions of inclusion, those conditions should be set in the Resource class's "Furnace valid condition (Setup)" and "Furnace

valid condition (Teardown)" (see Fig 18). Fig. 25 shows an example of specifications M and N assigned to an order allocation.



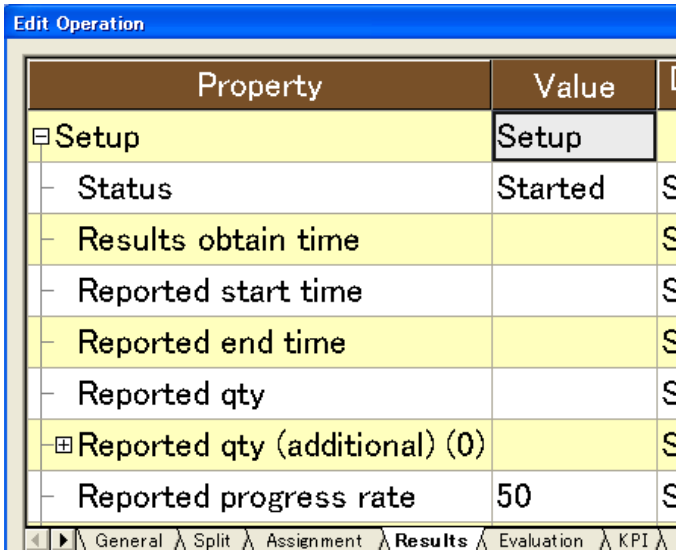
▲ Fig. 24 The Resource class's "Furnace valid condition (Setup)" and "Furnace valid condition (Teardown)" displayed in the property window. This means operations can only be included and allocated when the order's "Spec1" is the same as that of other operations and the Setup task is at the same time.



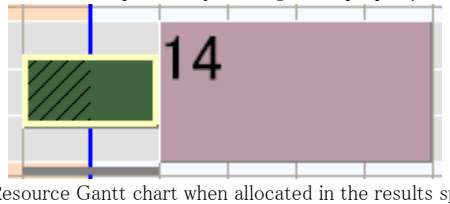
▲ Fig. 25 Resource Gantt chart. Only items with the same specs can be setup together.

Performance results

Results are normally specifiable for each operation, and can be assigned in task units. For example, results for setup can be assigned in a format such as 50 percent completed. Properties such as status Reported start time, Reported end time, Results obtain time and Reported progress rate can be used. Results of a setup task can be obtained by importing. In such instances, use the "Task index" property with the Result table.



▲ Fig. 26 Results of Setup task object assigned in property window



▲ Fig. 27 Resource Gantt chart when allocated in the results specified from Fig. 26. Only the setup task is 50% complete.

Help

"Results data reflection rule"(Help No. 783200)
"Assignment of results operations"(Help No. 783100)

Setup time and event control

A setup not incorporated in the master, for example:

- Insert setup of fixed time when 1000 units are produced.
- Clean up once for every three operations

is possible using the event option and is able to provide Event orders by generating and allocating them. The Event order is an independent order and has completely different setup times.

Help

"Event option user manual"(Event Object User Manual.pdf)
Event Object Reference Manual.pdf
"Event option"(Help No. 777600)

Q&A

1 Can you change Teardown time into Changeover time?

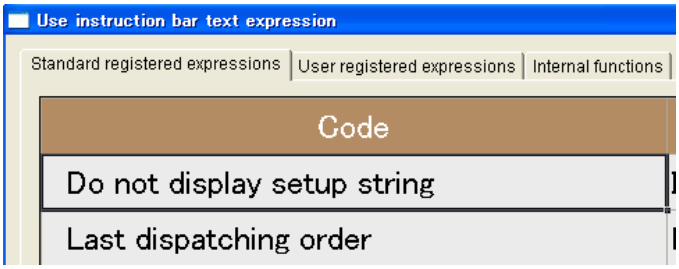
No, you can't. Assign it so that it will be incorporated into setup time.

2 How do you go about preventing the display of setup character strings in the Setup task/Teardown task's Use instruction bar of the Resource Gantt chart?

In the Display settings' "Use instruction bar text expression" in the Resource Gantt chart specify

IF(ME.Work.Type=='P',ME.Order+'¥n'+ME.Order.Spec1,ME.Operation.Change1.Comments)

This uses the 'if' statement to check whether the task is a production task. If it is not a production task no characters will be displayed. Fig. 27 shows an actual display.



▲ Fig. 28 Standard registered expressions in the Expression dialog. Use this sample for non-display of Setup task (Teardown task) character strings.

For more information

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