HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

WARNING

THE INSTALLATION SHALL BE MADE BY QUALIFIED INSTALLATION PERSONNEL AND SHOULD CONFORM TO ALL NATIONAL AND LOCAL CODES

Hyundai Robot

Hi5HD121101FMEN1

Hi5 Controller Function Manual

HRLoad

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Contents

List of Figures

List of Tables

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1 About HRLoad

1. About HRLoad

For designing a working process that use robots, they should be selected by taking into consideration the loads of tools of robots, the loads from works, and the working range. If loads are too big for selected robots, their lifetime will be adversely influenced. In this case, the error due to overloading will be generated to prevent such situation from taking place.

As the specifications of individual robots show the payload, which users need to refer to. However, even when the weight is same, the force to be applied on individual robots will vary significantly depending on the center of mass of the load and the robot's moving pattern. It would be hard to determine about the optimal condition only based on the payload.

Using HRSpace, a HHI's OLP simulator, will help select a robot and conduct teaching and reproducing in a virtual environment, which will make it possible to carry out a test in advance to see if overloading will occur. Just like manipulating the Hi5's controller actually, users enter the additive load and the conditions of it, and playback it. Then, the internal dynamics algorithm will detect the overloading, and will notify the situation to the users by generating an error. Even in a virtual environment, it would take long time to conduct the teaching. So, it would be impossible to select a robot quickly while dong such tests for multiple robots.

#	Code	Message	Date	Time	Prog	Step	Func
1	W0148	Accelerating and decelerating torques are insuffic	2012/08/23	13:45:04	P0001	S001	F000
2	E0249	V axis) Excessive Torque detection in reduction s	2012/08/23	13:45:04	P0001	S001	F000

Figure 1.1 Load-related err displayed on the virtual teach pendant of HRSpace

HRLoad is a utility that operates in a way that when the weight of the additive load, the position of the center of mass, the moment of inertia are entered, the utility will indicate whether overweight will be applied on various types HHI' robots. It has some limitation in terms of accuracy of its calculation as it comes up with the calculation only based on the conditions of the load, without taking into consideration the patterns of the robot's activities of the work program. However, it is still advantageous in that it will help select a robot quickly before the off-line teaching for the robot can be conducted.

Table 1-1 List of the robot models that are supported by the HRLoad.

HA006	HH100SL	HS180-ISO	HX200L
HA010L	HH130L	HS180-ST	HX200L-2000
HA020	HS150L	HS200	HX300
HH030L	HS165	HS200S	HX300L
HH050	HS165D	HS220-ISO	HX400
	HS165S	HS220-ST	HX400S
			YS080

2

HRLoad Installation and Start

Run the setup file of HRLoad. Follow the instructions while clicking the [Next >] button. Select all the languages you want to install from the 『Language Selection』 menu.

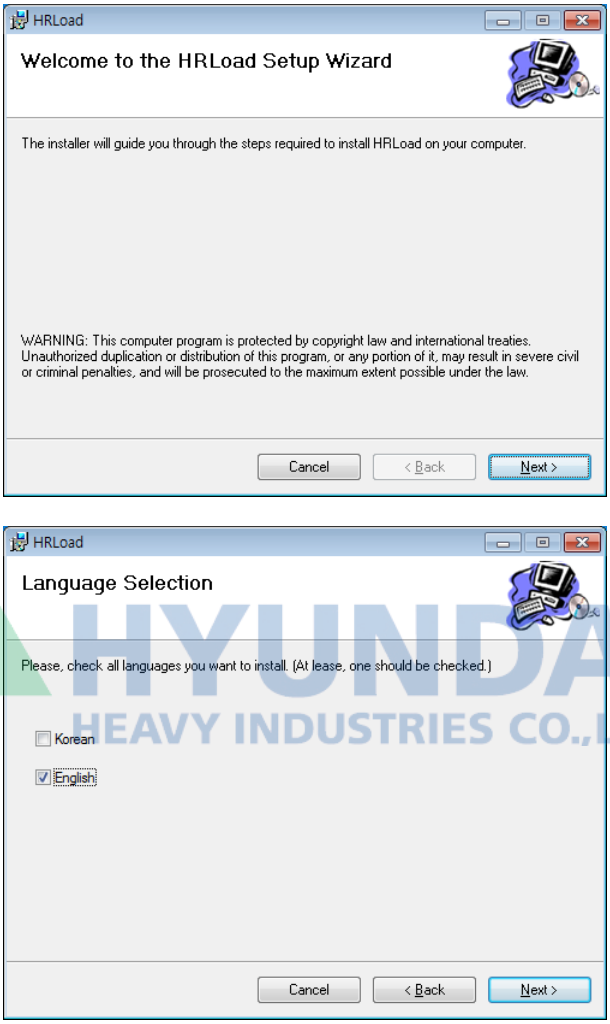

Figure 2.1 HRLoad setup wizard

When the setup is completed, the icon of HRLoad will be created on the wallpaper and the start button. Double-click to start HRLoad.

Figure 2.2 HRLoad icon

3 Use of HRLoad

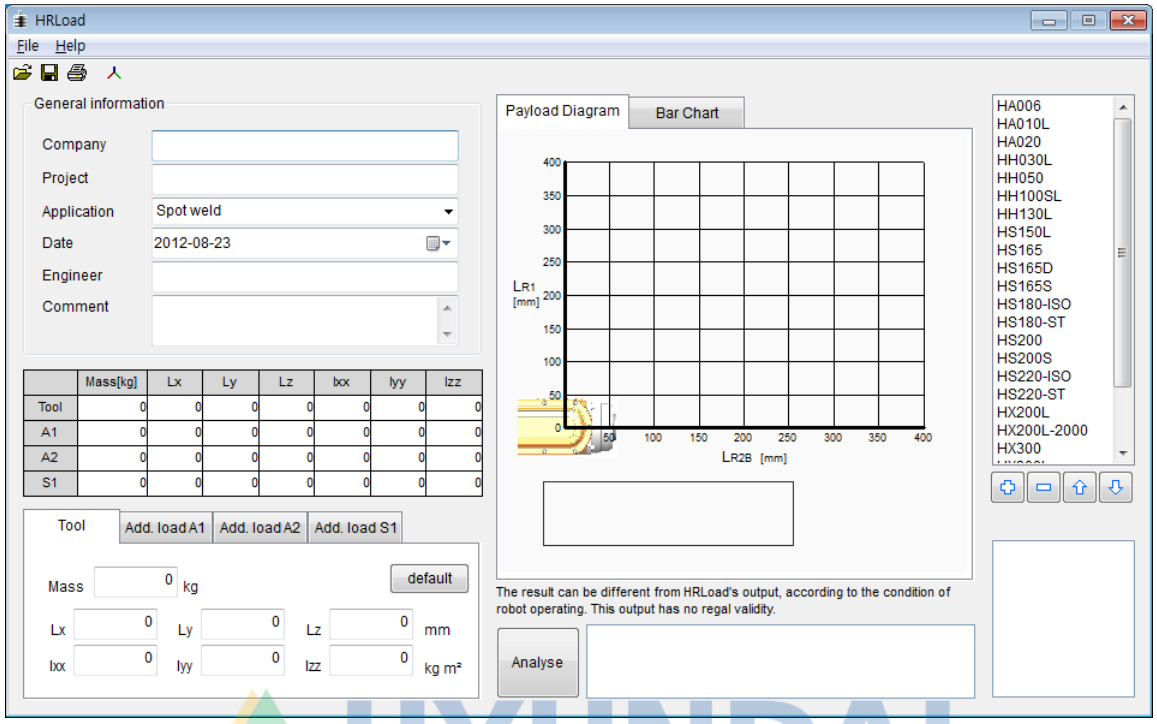

Figure 3.1 HRLoad execution screen

When HRLoad is started, the screen will be displayed as shown in Figure 3.1. First of all, you need to enter 『General Information』 on the upper left. The entered values will be recorded together with the report that will be printed out later, while the values will not make any influence on the results of the analysis.

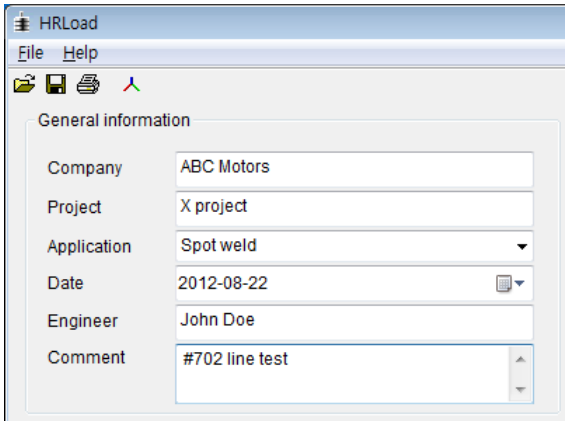

Figure 3.2 Entering of Generation Information

As next, you need to enter the 『Tool』 and the 『Additive load values』 on the lower left. The analysis results will be influenced by these entered values. There are 4 different tabs, one for the tool that will be mounted on the robot's flange, and three for the 『Additive loads (V, H, and S)』 that will be mounted on the 3 links.

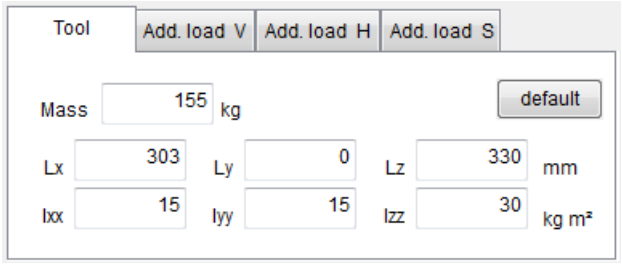

Figure 3.3 A dialogue box for entering the load data

An additive load is the load that will be mounted on the link, not on the robot's tool flange. A servogun dress pack or a cable guide is one of the examples.

In each tab, there are items that need to be entered as shown in Table 3-1. They include weight, center of mass and moment of inertia. Users should enter the values for all tabs (If there is not additive load, "0' just needs to be set all for the relevant tabs).

Table 3-1 Items to be entered for the load

Items	Description	Unit
Weight	Weight of the load mounted on the robot	kg
Lx, Ly, Lz	Position of the center of mass of the load	mm
Ixx, Iyy, Izz	Moment of inertia of the load	kg m^2

Selecting the coordinate system from the help menu or clicking the tool button in the shape of the coordinate system on it, users can get the information about the positions of the coordinate system and additive load.

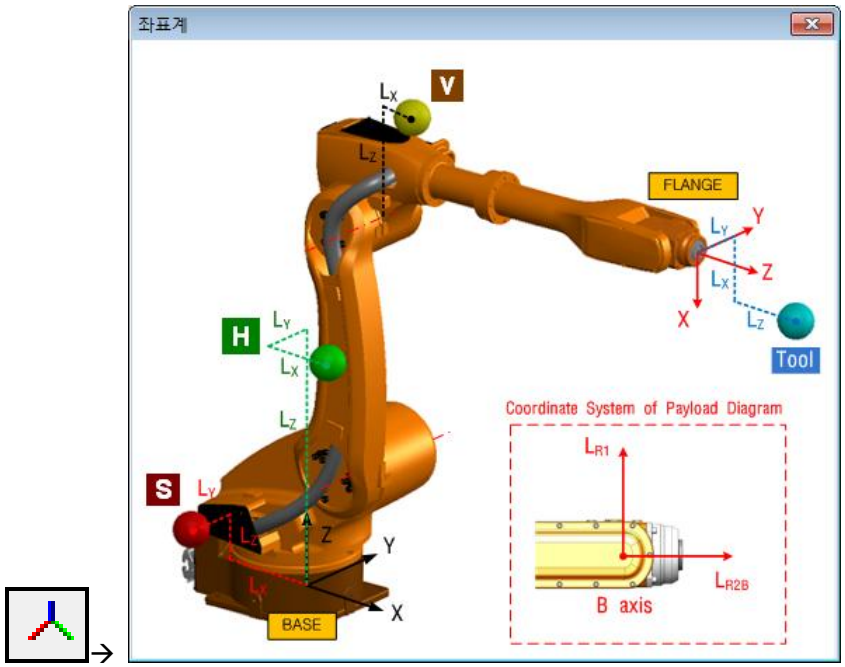

Figure 3.4 The coordinate system and the positions of additive load

It is time to select a robot. Select a robot from the list on the left, and then click the “+” button at the bottom of the list. A name of a robot will be added to the legend linked to a graph (Max. 3 names can be added). In order to delete a name, select the robot in the legend and then click “-” button.

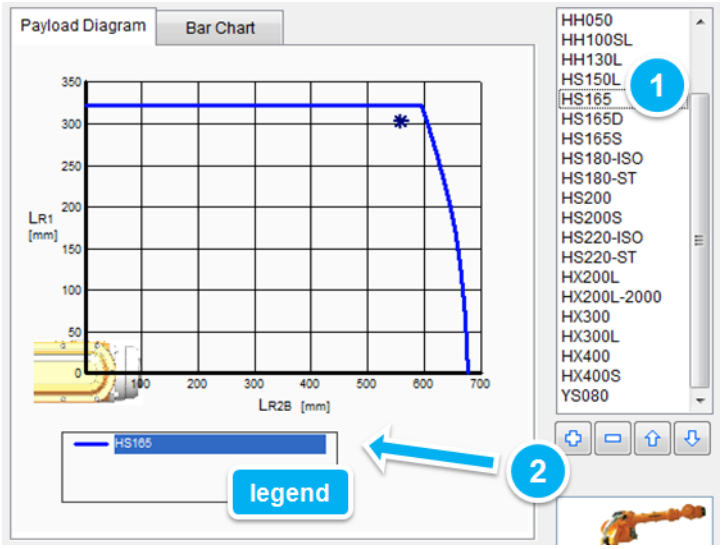

Figure 3.5 Adding a robot to the legend

(Can change the color by changing the order of the robots in the legend by using the Up/Down arrow buttons).

As a last step, when the analysis button at the bottom is clicked, the calculation will be completed. Let's take a look at the 『Payload Diagram』 first. We now know that the star mark stays inside the graph. This means that, statistically, overweight will not be caused.

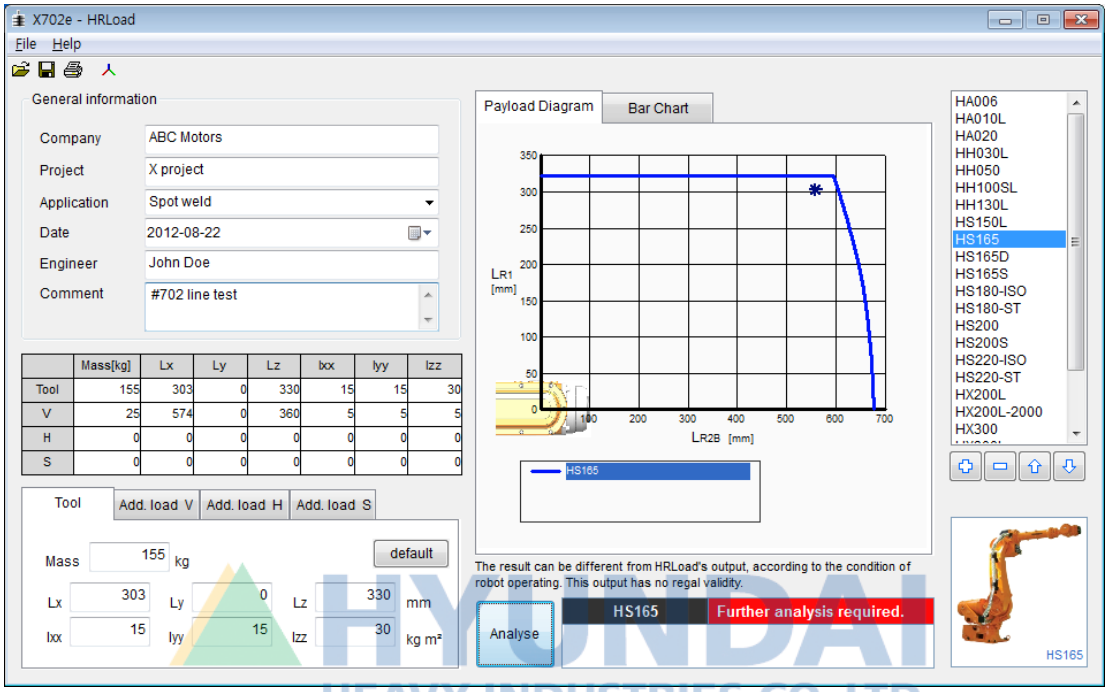

Figure 3.6 Analysis results - Payload Diagram

As next, click the 『Bar Chart』 tab. We now know that the load for the J6 axis (The sixth axis, in other words, the R1 axis) exceeds the max. allowable value of 100%.

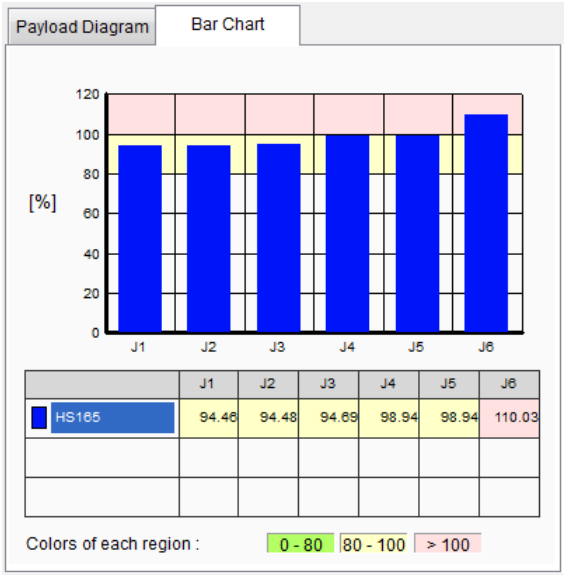

Figure 3.7 Analysis results - Bar Chart

The final results will be produced on the right side of the analysis button. In terms of statistics, the robot has no problem. However, considering that the robot is in the dynamical overweight state, if the robot needs to be used despite the fact, it may be required to slow down the speed of it due to the overweight error, following the installation. The meaning of the final conclusion, see Table 3-2.

Figure 3.8 Analysis results - Final conclusion

Table 3-2 Meaning of the final conclusion

Massage	Ground color	Payload Diagram	Bar Chart	Conclusion
PASSED	Green	Within the allowed area ☺	All the axes below 100%, the max. allowed level ☺	Can be operated at normal speeds
Further analysis required	Red	Within the allowed area ☺	Some axes above 100%, the max. allowed level ☹	Limited operation through the adjustment of the max. speed.
UNPASSED	Red	Exceeding the allowed area ☹	Don't care	Not allowed to use

In the above example, it is found that the HS165 model has the possibility of overweight. Now, it time to make comparison with other robots with higher payloads. Add the HS180-ST and HS200 to the legend by using the "+" button. Push the button to run the calculation for the 3 models. While the 『Payload Diagram』 and the 『Bar Chart』 will show the results of multiple models together, the final results will show the information only about the robot that is currently selected from the legend.

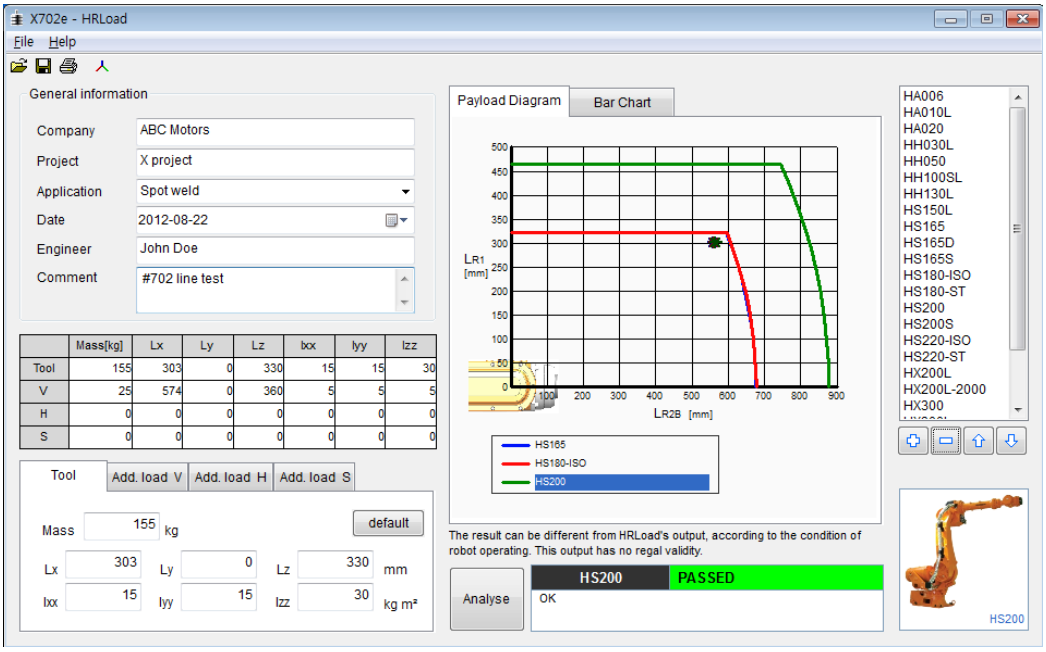

Figure 3.9 Comparison of robot models

In this example, as there is almost no difference between HS165 and HS180-ST, whose graphs are almost overlapped, while the graph for HS200 shows a wider scope. According to the 『Payload Diagram』, all the 3 robot models are not in the overweight state.

The 『Bar Chart』 shows that HS165 and HS180-ISO exceed 100% at the J6 bar, meaning that overweight is expected. In case of HS200, all the six bars are below 80% as we can see. When HS200 is selected from the legend, the final result will be indicated as PASSED.

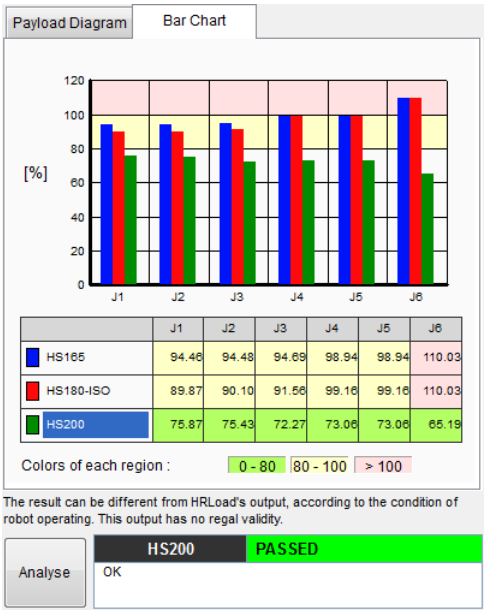

Figure 3.10 Comparison of robot models - Bar chart and final conclusion

Selecting the “file – save” menu will allow the entered data to be saved as a file with the extension of ‘.hrload’. It can be retrieved by using the “file – open” menu later (It is also possible to drag and drop a ‘.hrload’ file onto HRLoad).

Selecting the “file – print” menu or clicking the print tool button will bring up a dialogue box. Select a printer at the upper part and click the print button to print out a report.
In case of a color printer, the Gray-scaled check button needs to be turned off to print the report in colors.

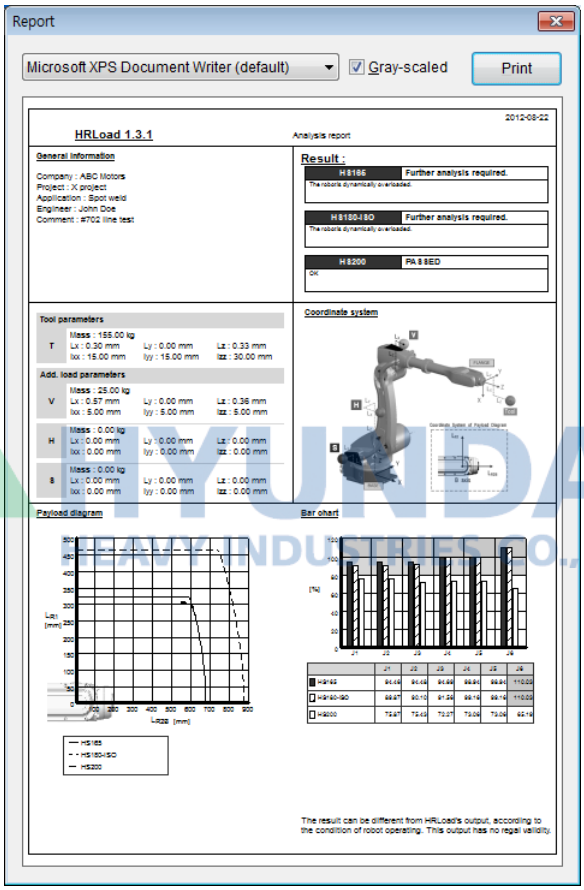

Figure 3.11 Report printing-out function

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