Comparison Instructions

Chapter 5

Table of Content

Comparison instruction overview.

Timer and Counter Instructions Review

If you want to:	Use this instruction:
time how long a timer is enabled	TON
time how long a timer is disabled	TOF
accumulate time	RTO
reset a timer or counter	RES
count up	CTU
count down	CTD

Comparison Instructions Overview

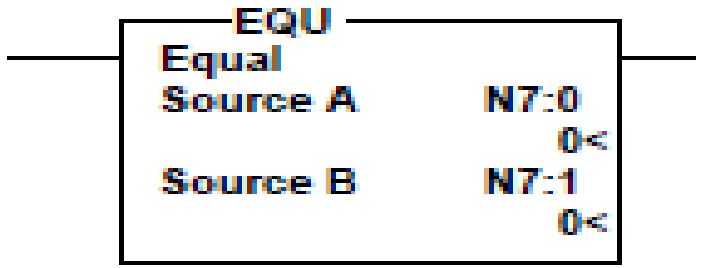
Comparison instructions are used to test pairs of values to condition the logical continuity of a rung. As an example, suppose a LES instruction is presented with two values. If the first value is less than the second, then the comparison instruction is true.

The following is a list of comparison instructions in SLC 500:

- **EQU -Equal**
- **NEQ -Not Equal**
- **LES -Less Than**
- **LEQ -Less Than or Equal**
- **GRT -Greater Than**
- **GEQ -Greater Than or Equal**
- **MEQ -Masked Comparison for Equal**
- **LIM -Limit Test**

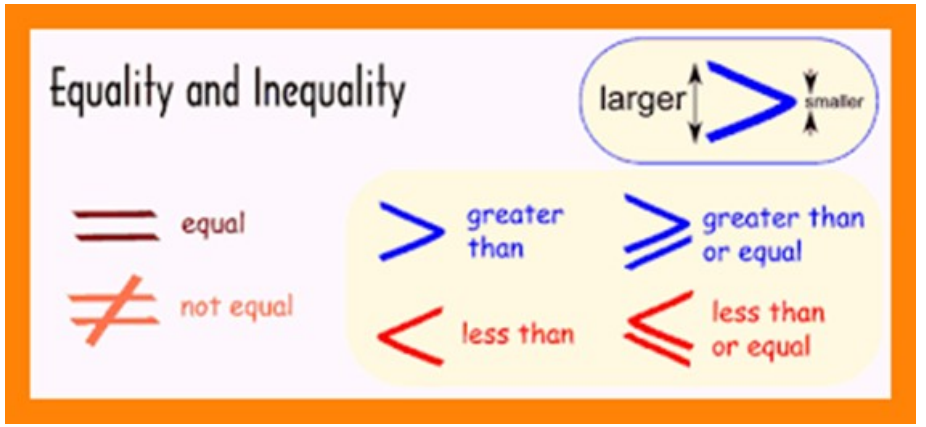
Equal (EQU) and Not Equal (NEQ) Instructions

- Use the EQU instruction to test whether two values are equal.
- Use the NEQ instruction to test whether two values are not equal.



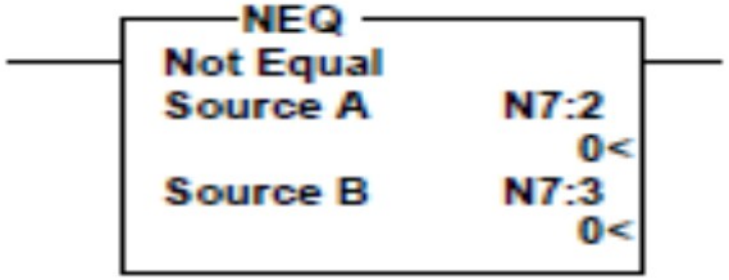
Equal (EQU)

- If source A and source B are equal, the instruction is logically true.
- If these values are not equal, the instruction is logically false.



Not Equal (NEQ)

- If source A and source B are not equal, the instruction is logically true.
- If the two values are equal, the instruction is logically false.



- Source A must be an address.
- Source B can either be a program constant or a address.
- Negative integers are stored in two's complement form.

Example 1

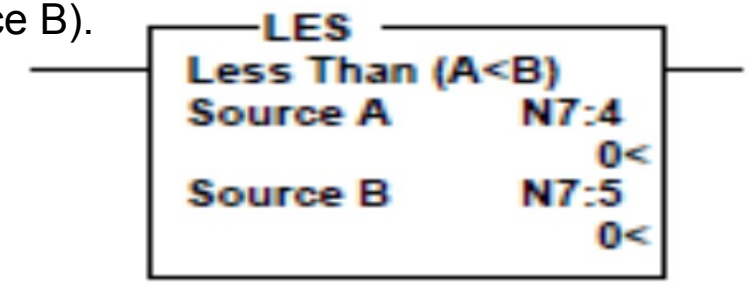
A gas-heated, two-zone belt conveyor oven is used to stress heavy-duty steel springs. This unit has a maximum operating temperature of 850°F.

A counter C5:1 has a value in its preset register equals 20, it is required to stop the conveyor motor and start the heating coils in first oven zone when the value of the C5:1 accumulator is equals half of its preset register.

- **Input / Output table**
  - conveyor Motor O:2.0/3
  - Heating coil in first zone O:2.0/4
- **Ladder Logic Solution**

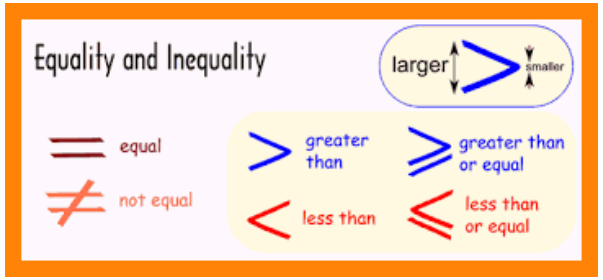
Less Than (LES) and Greater Than (GRT) Instructions

- Use the LES instruction to test whether one value (source A) is less than another (source B).
- Use the GRT instruction to test whether one value (source A) is greater than another (source B).



Less Than (LES)

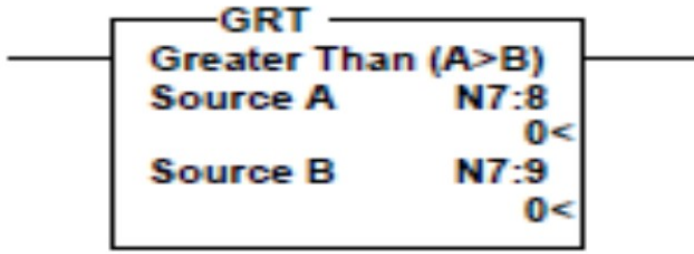
- If source A is less than the value at source B, the instruction is logically true.
- If the value at source A is greater than or equal to the value at source B, the instruction is logically false.



Greater Than (GRT)

- If the value at source A is greater than the value at source B, the instruction is logically true.
- If the value at source A is less than or equal to the value at source B, the instruction is logically false.

- Source A must be an address.
- Source B can either be a program constant or a address.
- Negative integers are stored in two's complement form.



Example 2

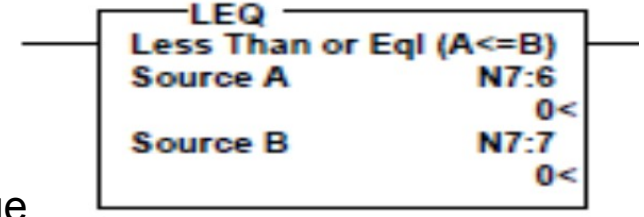
A steel sheet cutting machine must have the following two conditions to start the cutting laser:

1) The steel roll weight must be more than 1 KG.
2) The length of the cutting sheet must be above 2 m.

- **Input / Output table**
  - Weight sensor I:3.0/0
  - Length sensor I:3.0/1
  - Cutting laser O:2.0/0
- **Ladder Logic Solution**

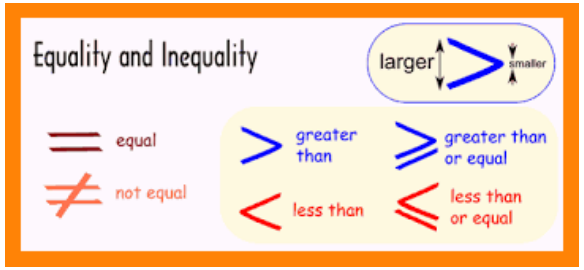
Less Than or Equal (LEQ) and Greater Than or Equal (GEQ) Instructions

- Use the LEQ instruction to test whether one value (source A) is less than or equal to another (source B).
- Use the GEQ instruction to test whether one value (source A) is greater than or equal to another (source B).



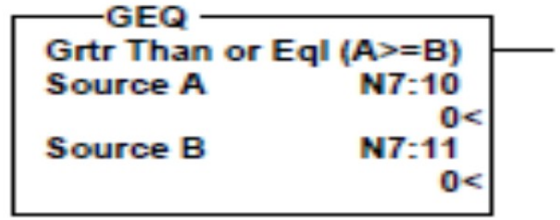
Less Than or Equal (LEQ)

- If the value at source A is less than or equal to the value at source B, the instruction is logically true.
- If the value at source A is greater than the value at source B, the instruction is logically false.



Greater Than or Equal (GEQ)

- If the value at source A is greater than or equal to the value at source B, the instruction is logically true.
- If the value at source A is less than the value at source B, the instruction is logically false.

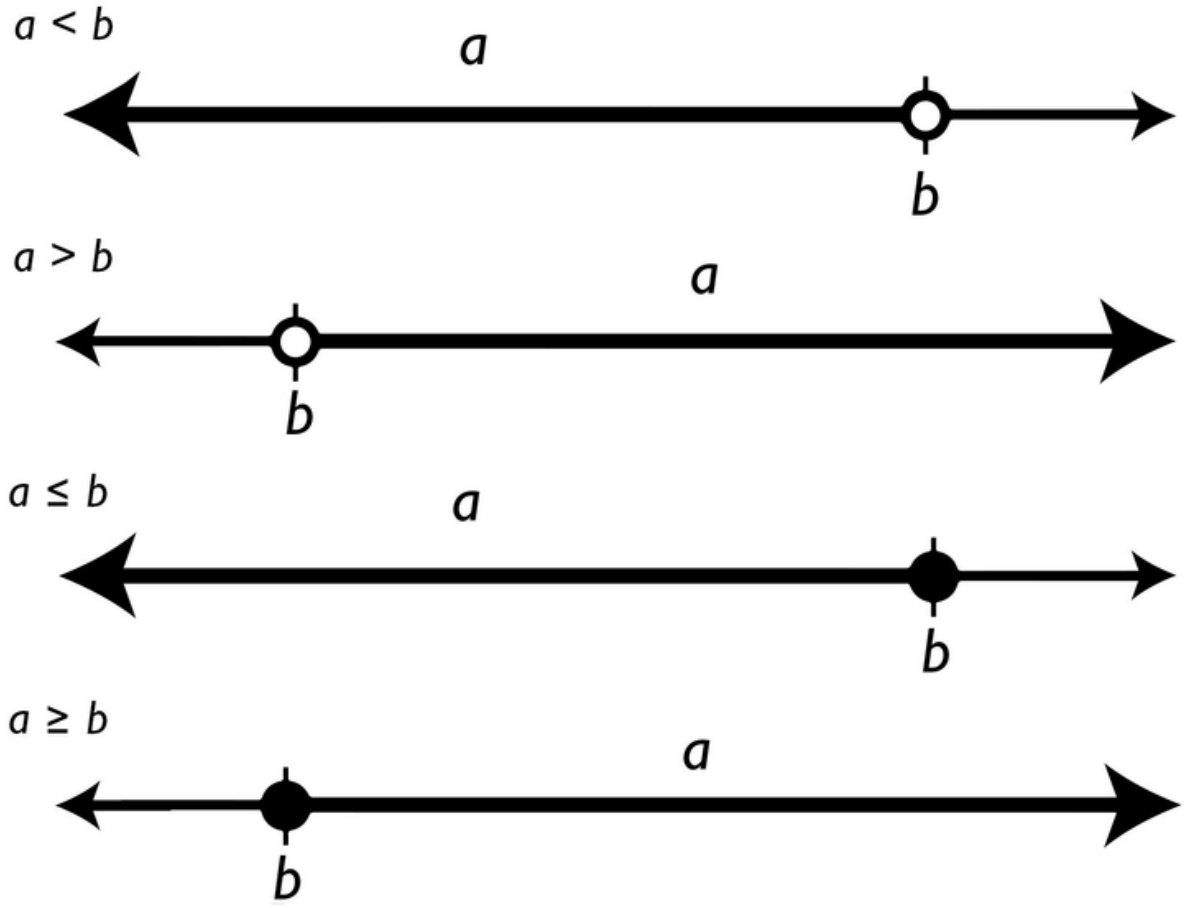


- Source A must be an address.
- Source B can either be a program constant or a address.
- Negative integers are stored in two's complement form.

Example 3

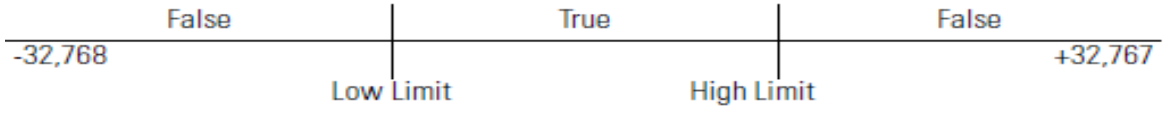
Write Less Than or Equal (LEQ) instruction using Less Than (LES) and Equal (EQU) instructions.

Write Greater Than (GRT) instruction using Greater Than or Equal (GEQ) and Not Equal (NEQ) instructions.



Limit Test (LIM)

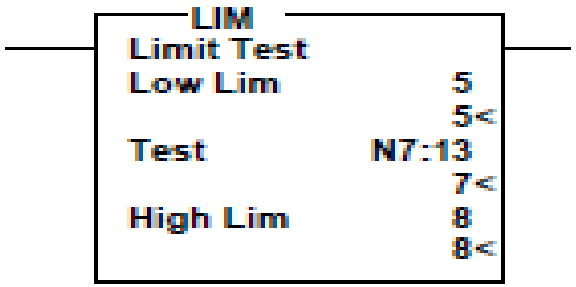
- The Low Limit, Test, and High Limit values can be word addresses or constants, restricted to the following combinations.
  - **If the Test parameter is a program constant, both the Low Limit and High Limit parameters must be word addresses.**
  - **If the Test parameter is a word address, the Low Limit and High Limit parameters can be either a program constant or a word address.**



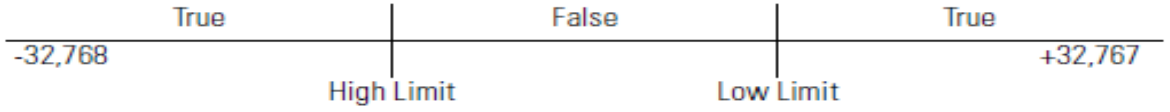
Example, low limit less than high limit:

Low Limit	High Limit	Instruction is True when Test value is	Instruction is False when Test value is
5	8	5 through 8	-32,768 through 4 and 9 through 32,767

- Use the LIM instruction to test for values within or outside a specified range, depending on how you set the limits (Normal).
  - **If the Low Limit has a value equal to or less than the High Limit, the instruction is true when the Test value is between the limits or is equal to either limit.**
  - **If the Test value is outside the limits, the instruction is false.**



- Use the LIM instruction to test for values within or outside a specified range, depending on how you set the limits (Inverted).
  - **If the Low Limit has a value greater than the High Limit, the instruction is false when the Test value is between the limits.**
  - **If the Test value is equal to either limit or outside the limits, the instruction is true.**



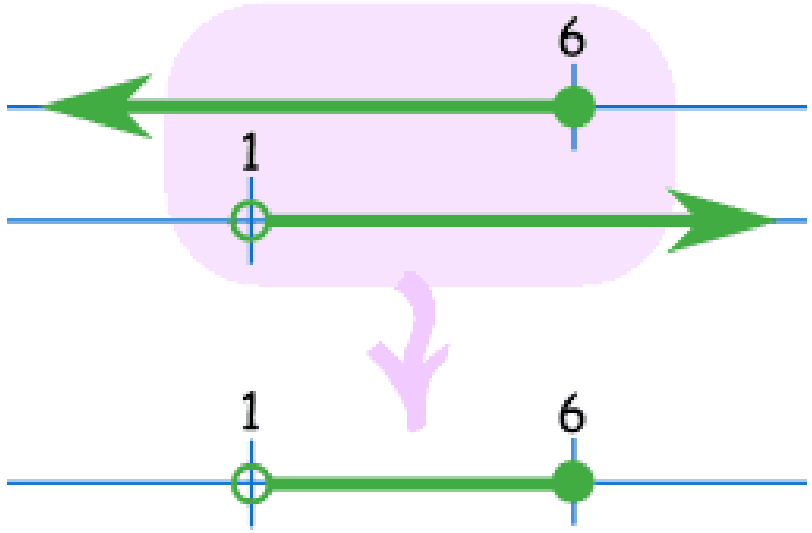
Example, low limit greater than high limit:

Low Limit	High Limit	Instruction is True when Test value is	Instruction is False when Test value is
8	5	-32,768 through 5 and 8 through 32,767	6 and 7

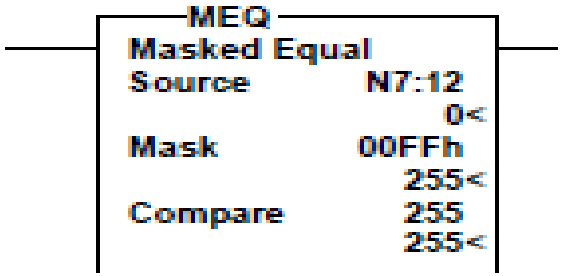
Example 4

Write Limit Test (LIM) instruction using other comparison instructions.

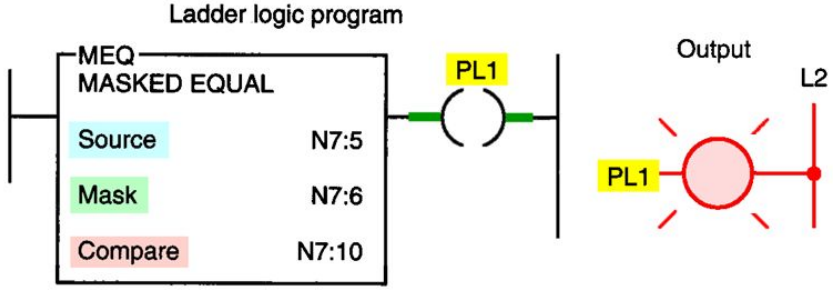
Write Equal (EQU) instruction using Limit Test (LIM) instruction.



Masked Comparison for Equal (MEQ)



- Use the MEQ instruction to compare data at a source address with data at a compare addre
- Use of this instruction allows portions of the data to be masked by a separate word.
- Source is the address of the value you want to compare.
- Mask is the address of the mask through which the instruction moves data.
- The mask can also be a hexadecimal value (constant).
- Compare is an integer value or the address of the reference.



Source	N7:5	01010101 01011111
Mask	N7:6	11111111 11110000
Compare	N7:10	01010101 0101xxxx

- If the 16 bits of data at the source address are equal to the 16 bits of data at the compare address (less masked bits), the instruction is true.
- The instruction becomes false as soon as it detects a mismatch. Bits in the mask word mask data when reset; they pass data when set.

Example 5

- Lets say we have four counters. Each counter goes from 0 to 9. Since 0 to 9 can be represented in 4 bits then we can combine the four counters in one word of 16 bits. This is to reduce the amount of memory counters will need.

- Counter 1 = N7:0 bit 0,1,2,3
- Counter 2 = N7:0 bit 4,5,6,7
- Counter 3 = N7:0 bit 8,19,10,11
- Counter 4 = N7:0 bit 12,13,14,15