CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

5.1 CONCLUSIONS

This study is aimed at the formability of three kinds of low-carbon steel sheets. The uniaxial tensile properties, the strain-hardening characters under the uniaxial and plane-strain tensile tests, the forming limit diagram (left hand) and the limit drawing ratio are measured in this work. For strain analysis, the pattern of circles is used to make grids on the surfaces of steel sheets to illustrate how the metal moved during the tests. The conclusions from the results of this study are as follows:

1. The specimen A which are double-reduced following annealing have the higher yield strength and tensile strength, and the lower ductility than those of the specimen B and C due to strain hardening.

2. The specimen B have a higher strain-aging rate than that of the specimen C.

3. The forming limit diagram (left hand) of three kinds of steel sheets have the similar shape but the intercepts of the FLD's on the major strain axis and the end point of the FLD's are variable with the strain hardening exponent, n, the thickness of steel sheets, and the limit strain under the condition of the uniaxial tension.

4. The limit drawing ratios of three kinds of steel sheets increase with the increase of the value of anisotropy, R, and the increase of thickness of steel sheets. The LDRs increase with the decrease of yield strength and hardness, and the increase of elongation.

For these three kinds of low-carbon steel sheets, the sheet C has the highest formability, and the sheet A has a highest strength and lowest formability. The sheet B has another type of defect, stretcher strains Luders bands are formed in steel sheet during forming. These are particularly apparent in regions where the strain is low. The usual solution to this problem is to give the steel sheet a small cold reduction, such a temper-rolling or skin-rolling treatment cold-works the steel sheets sufficiently to eliminate the yield point. However, if the steel sheets strain-aged during storage, the yield

point will return and difficulties with stretcher strains will reappear.

5.2 RECOMMENDATIONS FOR FUTURE RESEARCH

1. The formability of these steel sheets under the stretching and balanced biaxial stretching, in which the strain conditions are the tension strain in two directions and the compression strain in one direction, should be studied.

2. The forming limit diagram (right hand) should be determined to complete the forming limit diagram of these steel sheets (In this study only the left hand of the forming limit diagram is shown.).

3. The effect of the percentage of carbon on the appearance of yield point should be investigated for controlling the steel making process to prevent the defect of stretcher strains.

4. Expand the study to similar types of work so that more conclusive results can be drawn.