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다관절 이동 로봇을 이용한 철 밴드 결속시스템

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다관절 이동 로봇을 이용한 철 밴드 결속시스템

A System for Steel Band Strap Using Mobile Manipulators

2017년 2月 24日

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ABSTRACT

A System for Steel Band Strap Using Mobile Manipulators

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This paper describes a development of a spot welding system. The welding system binds two ends of a steel band to wrap an object. Usual industrial spot welding machine is bulky in volume and heavy in weight. Since they are heavy, high powered motors and cylinders are needed for motion, while their bandage is not robust. Also, most of them welds only one spot at a time, and spends long time to weld multiple spots for robust binding. The developed welding system welds four spots at a time. It has transformer module to decrease welding voltage. The welding voltage is upper tips of the welding module. The steel bands between the upper tip and lower tip are binded by the welding voltage. Two bus bars which connects high current electricity from the transformer to welding tip is equipped with bracket. The upper tip control unit controls the vertical motion of the tip to press two steel bands. Pneumatic cylinder is used to control horizontal motion of the four pairs of welding tips. The press unit grasps steel band and the feeding unit moves the steel band to the desired location. The pneumatic cylinder of the press unit presses steel band together with a rotating wheel. In the feeding module, a pneumatic motor is connected to a flange to reduce the rotation speed and increase the force.

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Since it reduces the welding time and increas binding force, it can be used in practice with letter performance. The proposed design improves the bandage force with reduced volume of system. So, it is expect that the proposed system can be used widely in the wrapping system.

Keywords : Strapping Machine, Press unit, Feeding Module, Reducer Module, Spot Welding, Binding, Steel Band, Tip

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제1장. 서 론

제1절. 연구 배경과 목적

산업의 발전이 계속해서 빠르게 진행되는 가운데 로봇 시장의 규모는 급속한 속도로 커지고 있고 우리나라를 비롯한 많은 선진국에서는 가정용로봇, 산업용로봇, 의료용로봇, 군사용로봇 등의 개발에 많은 연구를 하고 있다. 한국의 로봇시장은 대기업의 자동화 라인을 중심으로 성장해왔으며 로봇과 자동화는 그 관계가 매우 밀접하게 연관되어 있다. 최근 이러한 로봇시장이 중소기업으로 확대되어 가고 있으며 그 형태는 로봇이 가이드를 따라 이동하며 물건을 운반해주는 운송로봇과 인간의 작업을 보조해주는 작업보조로봇이 대표적이다. 특히 작업보조로봇은 유럽에서는 SME로봇 이라는 이름으로 많은 연구가 진행되고 있으며 우리나라에서도 기계연구원에서 이러한 컨셉의 로봇을 제안한 바 있다.

작업보조로봇이 할 수 있는 일들은 어떤 문서를 어떤 위치에서 다른 위치로 전달해주는 배달기능, 건물의 쾌적한 실내 환경을 위한 청소기능, 저녁에 경비원의 일을 보조하여 무인경비 업무를 담당하는 경비기능, 현장에서 로봇이 기술자로부터 로봇에 달려있는 툴이 움직이는 궤적을 익힌 후 용접이나 디버링을 수행하는 작업자보조기능 등으로 크게 나뉠 수 있다. 이러한 기능들을 위한 기본이 되는 로봇의 자율주행을 구현하기 위해서 기본적으로 필요한 기술들은 이동 가능한 이동체 하드웨어 구현 및 속도명령 제어기술, 시스템 상태 및 외부환경인식 기술, 현재 위치를 파악하는 Localization기술, 주체가 목표하는 위치로 이동시키기 위한 Path Planning 기술, 작업환경과의 충돌을 방지하기위한 Obstacle Avoidance 기술, 현재 작업하고 있는 환경에서의 변화된 환경정보를 갱신하기위한 Map Update기술 등이 있다. 위의 제시한 기술들이 모두 구현이 되어 있다고 하더라도 실제적으로 로봇을 현장에 구동시키기 위해서는 모든 제반기술들이 통합되어 유기적으로 동작하여야 하며, 확장성에 있어서 용이 하여야 하므로 전체적인 기술들을 운영하기 위한 잘 짜여진 Task Operating System이 필요하게 된다.

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사람이 직접 제품을 생산하고 상표를 붙이고 포장해야만 하는 작업 환경에서 현재는 각각의 공정을 자동화하여 상용화하고 있는 실정이다. 이로 인하여 제품을 생산하는 인력보다는 생산하는 기계를 관리하는 인력이 늘어나고 있으며 많은 산업현장에 제품을 생산하는 기계와 그것을 운반하는 물류기계 등이 많이 도입되고 있고 자동차 시장으로 시작해서 의류, 제지, 철강, 식품, 화학 등 대부분의 생산 산업분야가 이제는 기계로 인한 자동화가 되어 가고 있다. 이러한 제품을 생산해 내는 것만큼 중요한 것이 제품의 가치를 높이는 것이며 이미 만들어진 똑같은 제품이라 할지라도 포장을 어떻게 하느냐에 따라서 제품의 가치가 평가 된다. 현재 산업은 포장설비에 관한 많은 관심을 보이고 있다. 소비자는 같은 가격, 같은 품질의 제품을 구매하더라도 제품의 포장이 소비자가 원하는 외형과 운반과정시 제품의 손상을 막아주고 또한, 그 제품을 사용함에 있어서의 편리함을 추구하게 된다. 본 연구에서는 압연공정을 거쳐 회전하는 복수 개의 롤(Roll) 사이를 통과한 얇은 강판을 코일형태로 감겨져 제공되는 코일이나 그 외에 어떠한 모양을 포장할 때 Steel Band로 자동으로 결속하는 시스템에 관한 연구이다. 철강제품의 포장특성은 특히 생산품 자체가 중량물이면서 방수, 방습과 함께 주문자의 다양한 포장방법에 의한 난이도에 따라 생산라인에서 자동포장이 적용되지 못하였고, 작업자가 해당 규격의 포장용 판재를 수동으로 운반하여 포장하는 매우 어려운 실정이다. 최근에는 자동포장 방식이 검토되어져 왔으며 일부 외국의 기계설비가 도입되었으나 높은 설비가격과 설치환경이 적합하지 못한 현실이다. 이에 따라, 국내의 실정에 맞는 낮은 설비가격과, 설비의 크기를 대폭 축소하여 국내의 설치환경에 적합하도록 개발하는 것이 목표이다. 이번 연구의 목표로 하고 있는 개발대상기술은 포장용 자재를 Steel Band로 고정하기 위해 다관절로봇을 활용한 코일포장용 결속장치에 관한 것으로서 다관절 로봇의 Jig를 이용하여 철 밴드를 결속하고 접착하는 방식이다. 철 밴드의 결속 방법을 다관절로봇을 활용하여 하는 것으로 기존 설비보다 투자비용 절감 및 설치장소 축소를 할 수 있고 설비운용 인원 및 유지보수 비용 절감을 볼 수 있다. 기존 설비는 21m의 공정 길이를 가지고 있는 것을 다관절 로봇을 통하여 7m로 단축하여 설비비용도 약 35% 절감 할 수 있는 기술이다. 다관절 로봇을 이용한 코일 포장용 기술은 자동 코일 포장기를 개발하는 것으로서 현재 현장에서 사용되는 다관절 로봇을 활용 할 수 있게 Jig을 통합하는 과

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정까지의 기술 확보를 목적으로 하고 있다. 어떠한 제품이든 운송중에 포장이 풀리게 되면 주위 인명 피해뿐 아니라 시간, 경제적으로도 막대한 손실이 있게 된다. 이런 경우를 방지하기 위해서 제품을 포장할 때에는 철 밴드를 사용해서 강하게 결속을 해야 하고, 기본적으로 포장할 때에는 3~9번 정도의 결속을 하도록 되어 있으며 수동포장Tool을 사용하고 있지만 기계가 아닌 인력이 들어가야 하는 작업이고 이로 인한 적지 않은 인명피해가 발생하고 경제적 손실이 크기 때문에 이를 해결하기위한 인력이 동원되지 않는 기술개발이 필요하다.

제2절. 연구 방향

산업현장에서 많이 사용되는 6축으로 구성된 다관절로봇 2대를 응용하여 전체적인 시스템을 구성하였다. 로봇전체가 주행할 수 있도록 구성하였고, 로봇 끝에 공압시스템을 이용한 실린더와 모터가 적용된 Tool을 연구하였다. 여기에 여러 가지 종류의 센서를 장착하고 이를 DeviceNet 통신을 적용하여 Controller와 연결하여 제어하였다.

전체적인 시스템이 안정적으로 운영될 수 있도록 하기 위해서 기계 정밀부품들과 제어와 관련된 많은 Unit가 적용된 결속시스템을 제안한다.

제3절. 논문의 구성

본 논문의 구성은 다음과 같다. 제2장에서는 기존에 개발된 결속장치의 구조와 방식 등을 알아보고 그 단점을 설명한다. 제3장에서는 결속시스템의 기계적 구조에 대해서 각 파트별로 나누어서 설명한다. 제4장에서는 결속시스템의 제어부분에 관한 전반적인 구성과 적용된 통신시스템 및 Manipulator의 제어와 관련된 설명과 관련 Simulation에 대한 부분을 설명한다. 제5장에서는 이러한 시스템을 이용하여 실험한 과정 및 결과를 설명하고 마지막으로 제6장에서는 전체 논문에 대한 요약과 적용 범위, 향후 연구 분야 및 보완 사항에 대해 설명하고자 한다.

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제2장. 기존 결속시스템

현재 산업에서 생산되는 여러 가지의 제품은 다양하고 대량 생산함에 따라 이를 결속하기 위한 장치들은 많아졌다. 철밴드 결속기에 대한 연구는 국외에 비해 매우 미비한 수준이며, 철밴드 결속기에 대한 툴도 대다수 수입에 의존 하고 있으며, 이러한 툴은 가격도 비싸고 구하기도 쉽지가 않다. 또한 하나의 제품을 여러 가지 방향에서 결속해야 하는 경우가 발생하기 때문에 이에 대한 기술의 연구가 더욱 필요하다. 본 논문에서는 철밴드를 이용하여 자동으로 결속하는 설비를 중심으로 구성한다. 그러므로 본 장에서는 현재까지 개발된 결속기를 중심으로 설명하고자 한다.

제1절 수동 결속시스템

현재 여러 가지의 제품을 생산하고 포장을 위해서 결속할 때 Fig 2-1-1과 같은 수동결속Tool을 이용하여 사람이 직접 결속하고 있다. 사람이 직접 결속을 하다 보니 시간이 많이 소요되며 안전상의 문재가 있어 산업재해의 원인이 되기도 하며 포장이 일률적으로 되지 않아서 손해가 발생하고 이를 해결하기 위해서 많은 노력과 연구가 이루어지고 있는 실정이다.

Fig 2-1-1. Manual Strapping Tool

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제1절 자동 결속시스템

산업현장의 국내시장은 철밴드 결속기에 대한 연구는 매우 미비한 수준이고 또한 외국시장에서도 자동포장설비의 기술은 매우 부족한 상황이다. 또한 국내에서는 외국의 기술력을 이용하여 자동결속장치를 개발하였지만 크기가 너무 크고 구조가 매우 복잡하여 고장이 많고 설비운용 인원 및 비용이 많이 소요되고 있다. 많은 연구를 통한 기술을 개발하여 기존의 문제점을 해결하여 자동포장 설비의 국내 기술력 확보 및 해외장비의 대체에 따른 매출 증대와 고급 기술력 보유로 기술 종속 탈피가 필요한 실정이다.

Fig 2-1-2. Automatic Strapping Machine

신성장분야인 로봇에 대한 기술은 국가적인 투자로 많은 발전을 이루고 있지만 실질적으로 해당하는 로봇의 Tool 부분에 대한 기술 투자는 미비한 수준이기 때문에 현재 많이 사용하고 있는 다관절 로봇을 이용하여 결속을 할 수 있는 Jig를 개발하고 다관절 로봇활용 Jig통합 기술력 확보가 필요하다. 봉 연구를 통한 다관절 로봇을 활용한 코일 포장기술은 최종 설비의 크기를 단축하는 것으로 기존설비 투자비용과 라인길이 축소와 설비운용 인원 및 유지보수 비용까지 절감 할 수 있다.

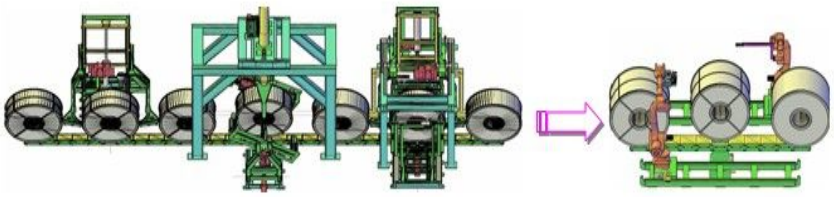

Fig 2-1-3. 결속시스템 공간 축소 개선

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제3장. 자동결속시스템의 기계적 구조

본 장에서는 자동결속시스템를 구성하는 기계적인 특징과 구조에 대해 설명하고자 한다. 자동결속시스템은 Steel Band Feeding Device, Steel Band Welding Device, Steel Band Cutting Device, Steel Band Grip Unit 등의 총 4가지의 유니트로 구성되어 있다.

Steel Band Feeding Device는 밴드에 대한 공급을 위해서 회전장치를 이용하여 Steel Band를 이송하여 주는 파트이며, Steel Band Welding Unit는 결속이 완료되고 풀리지 않게 접합하기 위해서 2개의 Steel Band를 용접하여 주는 파트이다. Steel Band Cutting Unit는 용접까지 마무리된 Steel Band를 절단하기 위한 파트이여 Steel Band Grip Unit는 제품에 Steel Band를 결속하기 위해서 잡고 이송하여 주는 파트이다.

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제1절. Steel Band Feeding Device

1. 개요

결속을 하기 위해서는 Steel Band를 설정된 데이터만큼 제어할 수 있는 시스템을 구성하는 것이 중요하다. 이러한 시스템을 구성하기 위한 방법으로 공압을 이용하여 회전하는 Actuator를 큰 힘으로 회전시키기 위해서 감속기를 장착하고 실린더를 이용하여 밴드를 압연하는 방식을 적용하여 연구해 보았다. 이러한 시스템을 구성하기 위해서는 많은 부품들을 필요로 하는데 정확하게 조립되기 위해서는 정밀한 가공이 필요로하고 내구성을 위해서 많은 부품들의 열처리가 필요하다. 공압의 압력을 조절하여 주는 Regulator를 이용하여 다양한 힘으로 가압 시켜주어 밴드가 변형하기 않도록 하였고 또한 이송에 대한 제어를 위해서 DC 24V 전압의근접센서를 적용하였으며 센서신호를 받는 모듈은 Devicenet 통신방식을 적용하여 간단하게 구성될 수 있도록 연구하였다. Fig 3-1-1은 Band Feeding Device를 3D로 표현된 구조를 나타낸다.

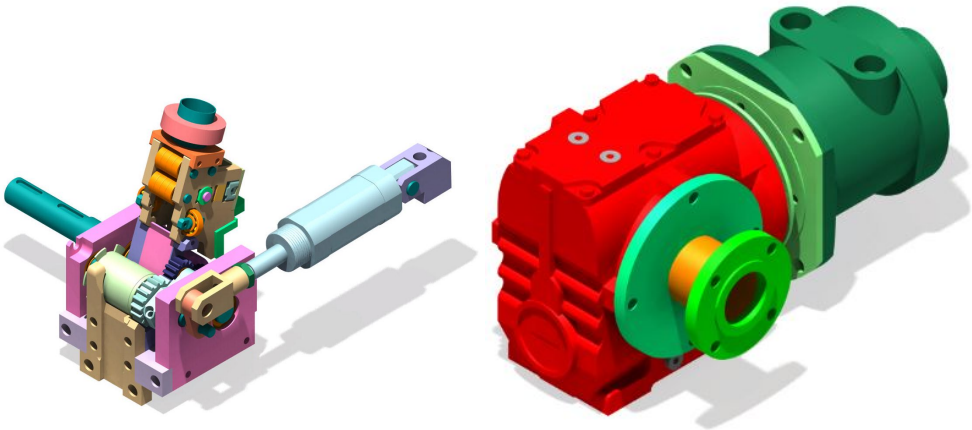

Fig 3-1-1. Band Feeding Device 3D Modeling

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2. Steel Band Press Unit의 구조

Steel Band가 진행하는 과정에서 많은 힘이 가해지면 변형이 생길 수가 있으며 이러한 현상에 의해서 아무리 제어를 정밀하게 한다고 하더라도 원하지 않는 결과가 나올 수 있다. 밴드의 진행을 위해서 감압시켜주는 장치내부에 Rail을 형성시킬 때 휘어지지 않고 직선으로 되어지는 것이 중요하다. 그리고 직접적으로 감압시켜주는 부분에서 절곡되지 않도록 구성하는 것이 가장 중요하다. 그리고 진행을 위해서 필요한 롤러의 직진도가 나올 수 있도록 구성하여야 하며 베어링의 선정 및 끼워맞춤을 위한 정밀가공이 중요하다. Fig 3-1-1은 Steel Band Press Unit를 구성하기 위한 상세한 조립도이다.

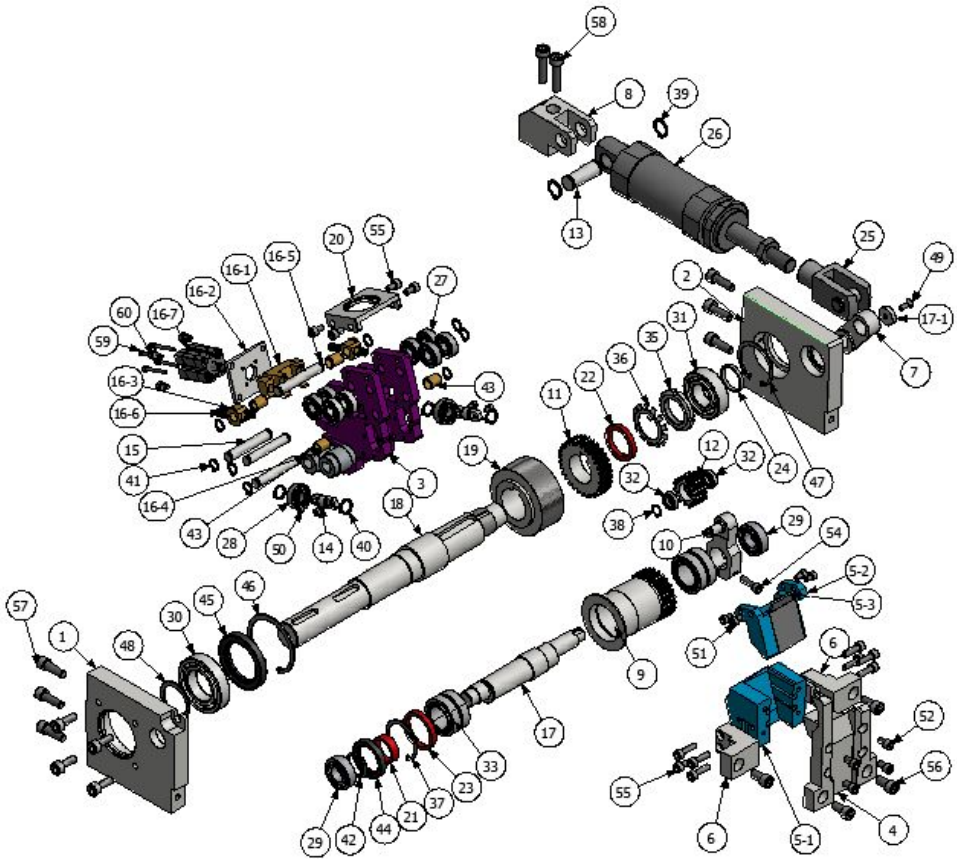

Fig 3-1-2. Steel Band Press Unit Assembly Drawing

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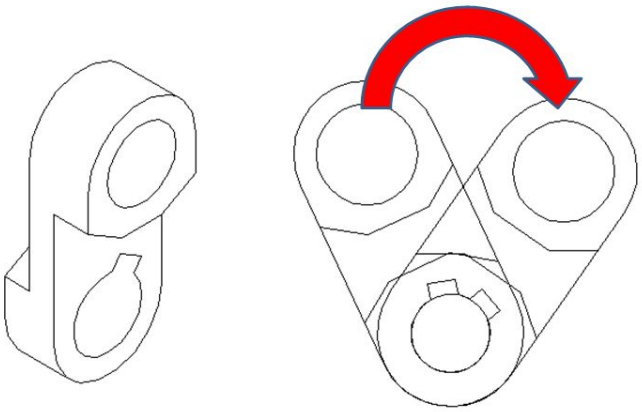

Fig 3-1-3. Hinge Bracket Drawing

처음에 Steel Band를 장착하기 위해서 두개의 Wheel 사이에 통과시키는데, 이러한 시스템이 되기 위해서는 하나의 휠은 고정시키고 다른 휠은 동작될 수 있도록 구성하여야 한다. 이러한 동작을 위해 공압실린더에 휠을 연결하는데 Hinge Bracket을 통해 회전될 수 있도록 구성시켜 주고 40mm의 행정거리를 가진 공압실린더와 Hinge Bracket을 연결하여 60°정도 회전될 수 있도록 하였다.

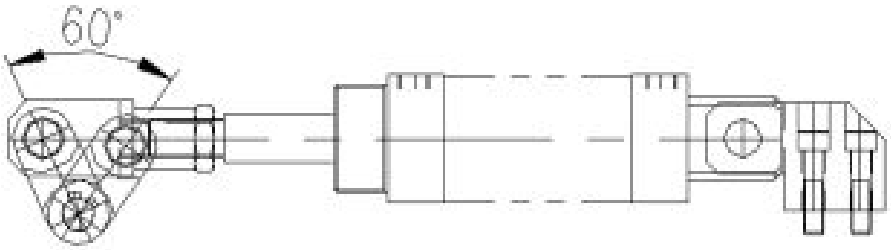

Fig 3-1-4. Connect Pneumatic Cylinder

Hinge Bracket에 연결되는 Wheel의 shaft에는 모듈이 2이고 잇수가 25개인 스퍼기어와 모듈이 2이고 잇수가 15개인 Spur Gear를 Idle Bracket의 양쪽에 연결하여 축이 실린더를 따라서 동작하켜 동시에 회전될 수 있도록 구성하였다.적용된 Spur Gear는 쇼어 경도(Hs)가 50~60°정도 되는 기계구조용 탄소강 재질을 사용하였으며 모듈은 전체적으로 M2인 것을 사용하였다.[10]

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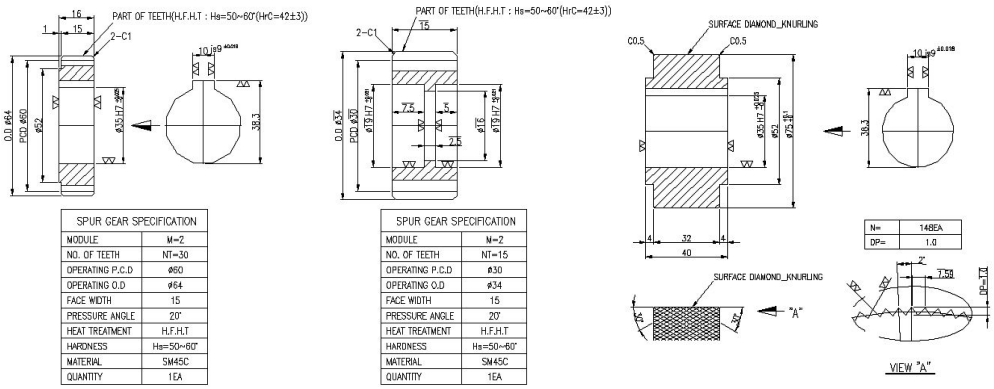

Fig 3-1-5. Gear & Wheel Detail Design Drawing

Steel Band와 Wheel이 미끄럼이 발생하지 않아야만 원하는 위치에 철밴드를 제어할 수 있기 때문에 Wheel의 표면이 최대한 마찰이 없도록 구성하였다. 보통 산업에서는 이러한 구성을 위해서 널링(knurling)작업을 하는데 기계 가공 분야에서는 주로 원통 형상의 공작물의 외면에 미끄럼을 방지하기 위한 목적으로 만들어지는 깔쭉깔쭉한 모양을 가리킨다. 일반적인 널링은 깔쭉깔쭉한 롤러가 달려 있는, 널링 툴이라고 불리는 전용의 공구를 공작물 위로 굴려서 그 깔쭉깔쭉한 무늬를 베끼는 방법을 쓴다. 널링은 직선널링, 사선널링, 다이아몬드형 널링등이 있는데 다이아몬드형 널링을 깊이를 1mm정도로 가공하여 적용하였다.

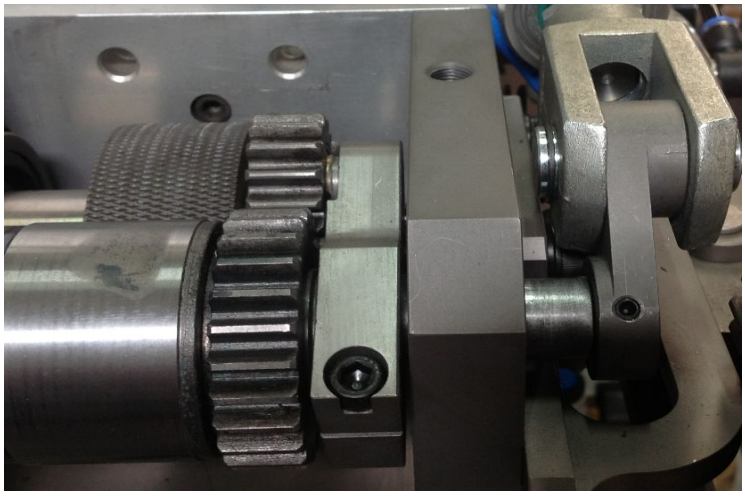

Fig 3-1-6. Steel Band Press Unit Manufacture Photograph

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3. Steel Band Supply Drive 의 구조

별도로 고압의 전기를 공급하지 않고 공압시스템먼 사용하여 물체를 결속할 때 마지막에 일정한 힘으로 계속해서 Steel Band를 당길 수가 있어야 한다. 일반적인 모터를 사용하면 토크를 제어하기 위해서는 별도의 드라이브와 센서장치 등이 저적용되어야 하며 서보모터(servo motor)를 사용하여도 속도,토크제어를 적용하면 되지만 별도로 전기를 공급하여야 하며 서보드라이브(servo drive)도 설치되어야 한다. 이러한 문제점들을 해결하고 시스템을 간결하게 하기 위해서 압축된 공기를 사용하여 회전운동을 하는 에어모터를 적용하였다. 전기사용이 어려운 구역이나 토크제어가 어려워 모터의 방폭을 필요한 곳에 에어모터를 많이 사용한다.

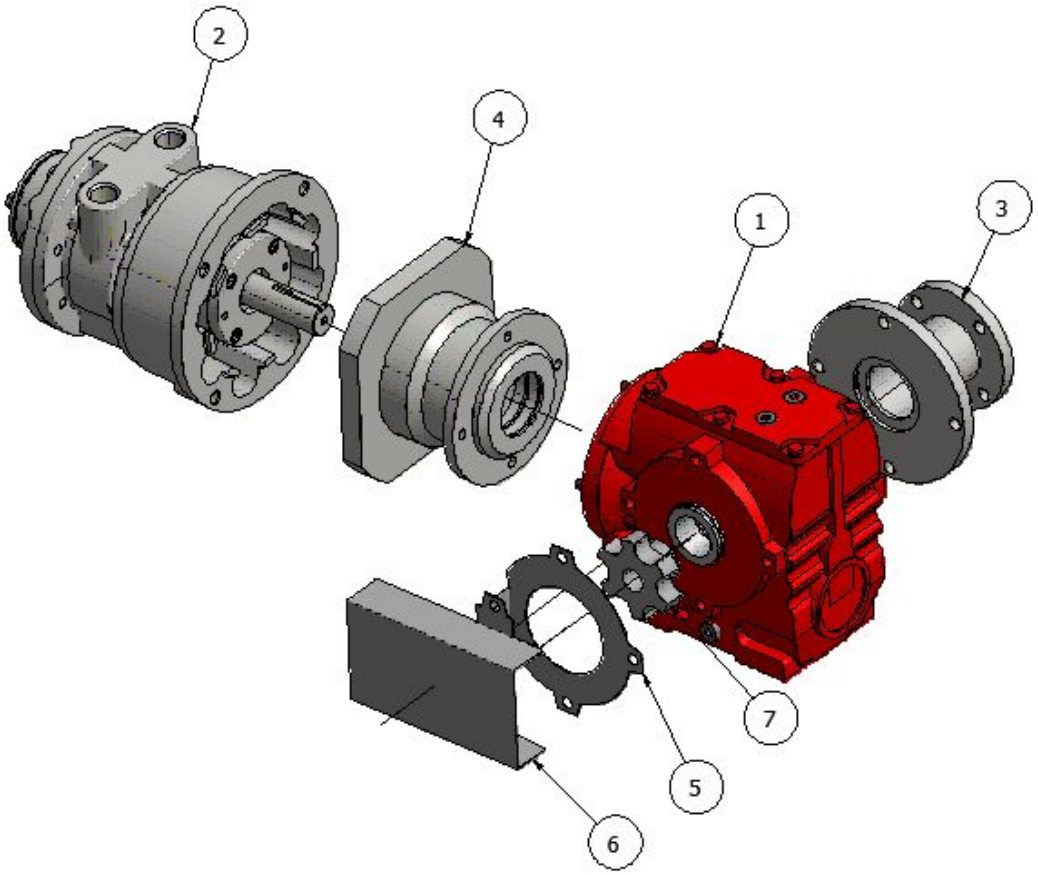

Fig 3-1-7. Steel Band Supply Unit Assembly Drawing

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산업현장에서 사용되는 대부분의 공기압축기(compressor)에서는 5~6(bar)의 압력의 공압을 공급해 주는데 부스터(booster)를 사용하면 7(bar)이상까지도 공급해 줄 수가 있다. 먼저 6AM 규격의 에어모터를 검토한 결과 그래프와 같이 6바(bar)를 기준으로 하였을 때 분당회전수 3,000RPM에서 토크를 약 9(N·m)까지 올릴 수 있었다.[11]

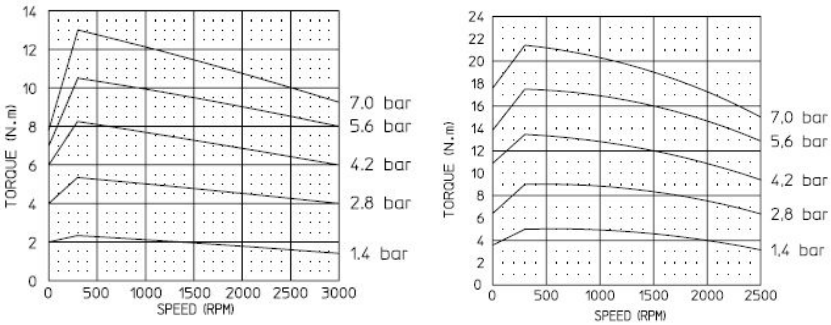

Fig 3-1-8. Pneumatic Motor Performance Graph

물체가 풀리지 않도록 강력한 결속력을 필요로 하기 때문에 10(N·m) 이상의 토크가 필요하다. 그리고 회전 속도로 감속기를 이용하여 줄여야 하기 때문에 빠른 회전속도가 필요하지는 않을 것으로 판단되어 2,500RPM정도 속도밖에 나오지 않지만 더 큰 토크를 얻을 수 있는 8AM 에어모터를 검토하여 적용하였다. 8AM 에어모터는 그래프와 같이 압력이 6바(bar)를 기준으로 하였을 때 분당회전수 2500(RPM)에서 토크를 약 14(N·m)까지 올릴 수 있으며 압력을 8바(bar)를 공급하여 주면 16(N·m)까지 올릴 수 있다.[11]

모델	작동데이터						최대토크	
	작동범위	최대출력		토크	최대공기소모량			
	rpm	마력(hp)	KW	Nm	cfm	㎥/h	rpm	Nm
4AM	300~3000	1.70	1.30	4.10	78	132.5	300	6.3
6AM	300~3000	4.00	3.00	10.00	128	228	300	13.00
8AM	300~2500	5.25	3.90	14.40	175	293	300	21.00

Table 3-1-1. 6AM Pneumatic Motor 성능 표

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공압시스템이 적용된 모터는 보편적으로 1800rpm으로 회전하는 일반적인 전기 모터보다 높은 속도로 회전하며 속도조절밸브(speed control valve)를 통해서 속도 조절을 가능하다. Steel Band를 공급할 때 2,500rpm정도 이상이 되는 높은 회전 속도는 필요하지 않기 때문에 감속기를 적용하였다.

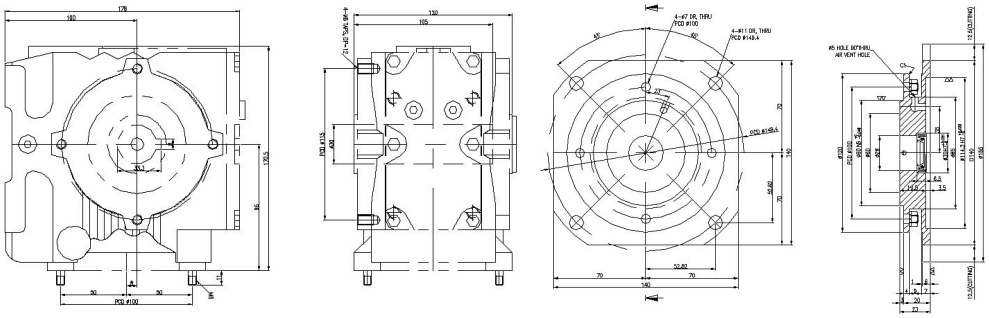

Fig 3-1-9. Drive Reducer Module

보다 높은 결속력을 얻기 위해서 모터에 기어 비율이 1/45정도 되는 감속기를 적용하였다. 회전수는 55rpm으로 대략 1초에 1회전정도 가능하도록 구성하였으며 그만큼 토크를 약 720N·m높여 큰힘으로 작동될 수 있도록 구성하였다. 그리고 Motor와 Reducer의 중간에 호환을 시키기 위한 별도의 Flange와 Adapter 가공하여 연결시켜 구성하였다.

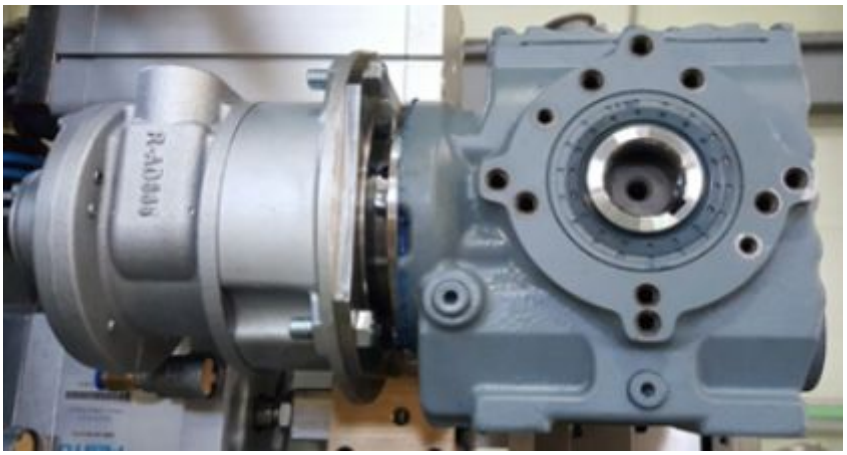

Fig 3-1-10. Steel Band Supply Drive Manufacture Photograph

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제2절. Steel Band Welding Device

1. 개요

제품에 원하는 부분에 감싸고 나면 풀리지 않게 마무리하기 위해서는 접합하는 공정이 필수로 필요한데 접합은 결속하는 재료에 따라서 여러 가지 방식이 적용된다. 종이나 천의 경우에는 본드를 이용하고 플라스틱의 경우에는 열을 이용하여 재료를 녹여서 붙이고 건조시키는 방식을 많이 사용된다. 본 연구에서는 Steel Band를 사용하기 때문에 고압전기를 이용한 Spot Welding 방식을 사용하여 접합하였다. 이 방식에서는 크게 2개의 Part로 나누어지는데 Steel Band에 직접적으로 접촉하는 Tip을 공압시스템을 이용한 실린더를 이용하여 이송시켜주는 Part와 강압된 전력을 공급하는 Part로 나누어진다. Steel Band에 적당한 전력을 공급하여 주는 것도 중요하지만 전체가 하나의 모듈로 이루어져 있기 때문에 용접할 때의 절연에 대한 처리로 매우 중요하다.

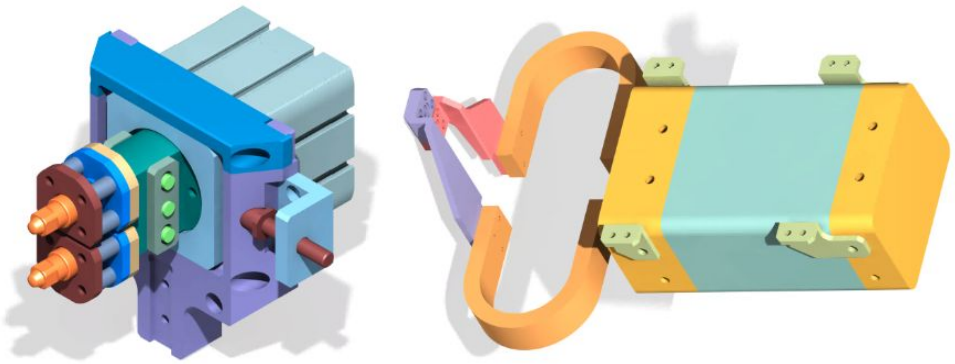

Fig 3-2-1. Band Feeding Device 3D Modeling

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2. Spot Weld Tip Moving Unit의 구조

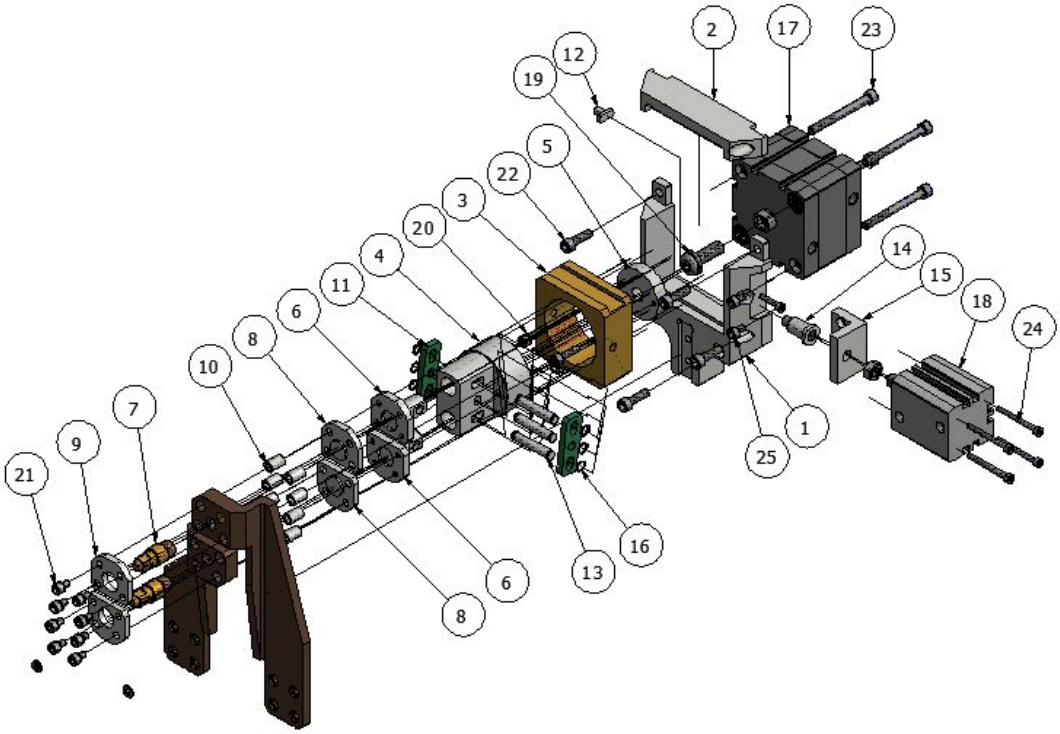

Fig 3-2-2. Spot Weld Tip Moving Unit Assembly Drawing

공압실린더를 이용하여 용접Tip을 상하작동을 하면서 Steel Band에 접촉시키는 역할을 하는 Part인데 접합을 위해 용접을 위해 전기가 통하는 시간은 0.5초이내인데 이 짧은 시간 안에 높은 전류의 전력을 전달하기 위해서 Steel Band에 접촉하는 용접Tip의 재질 선정이 중요하다. 본 연구에서는 용접Tip을 베릴코 합금(berylco alloy) 재질을 적용하였는데 이 재질은 구리가 첨가되어 있으며 탄성과 내피로성이 인청동을 능가한다. 철 밴드에 연속적으로 접촉하여 용접하기 때문에 용접팁은 소모성이다. 보통 3,000회정도를 용접하면 끝이 변형되어 제대로 용접되지가 않는다. 교체를 쉽게 할 수 있도록 하기 위해서 고정되는 부분에는 M12의 나사작업을 하였다.

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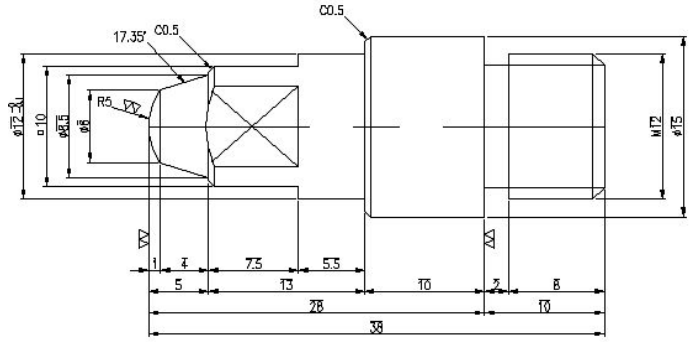

Fig 3-2-3. Spot Tip Detail Design Drawing

용접팁에 공급되는 전력은 차단이 잘 되어야 철밴드가 원하는 접합력으로 용접될 수가 있으며 다른 부품들에 손상을 주지 않는다. Steel Band에는 전기가 잘 통하고 이동시켜주는 실린더나 연결시켜주는 부품들에는 전기가 차단되어야 한다. 그래서 중간과 끝부분에 스페이서를 설치하였다. 스페이서는 나란히 조립되는 물품과 물품 사이의 간격을 고르게 유지하기 위해서 그 틈에 끼우는 라이너이다. 스페이서는 전기가 통하지 않는 베이클라이트(bakelite)를 사용하였다. 베이클라이트는 합성수지의 일종으로 경화되기 전의 제1차 반응에서 생긴 것이 천연의 로진을 닮았다. 전기절연성, 기계적강도, 내열성이 우수하고. 제1차의 반응 때 산성으로 하면 노볼락수지가 되고, 알칼리성으로 하면 레졸계가 된다. 목분이나 안료를 섞거나 종이에 침투시켜서 형틀에 넣고 가압 및 가열해서 성형시킨다. 베이클라이트 재질의 스페이서를 용접팁과 용접팁을 이송시키는 실린더 사이에 삽입하여 트랜스포머 모듈에서 공급되는 전력이 용접팁이외에는 전달되지 않도록 하였다.

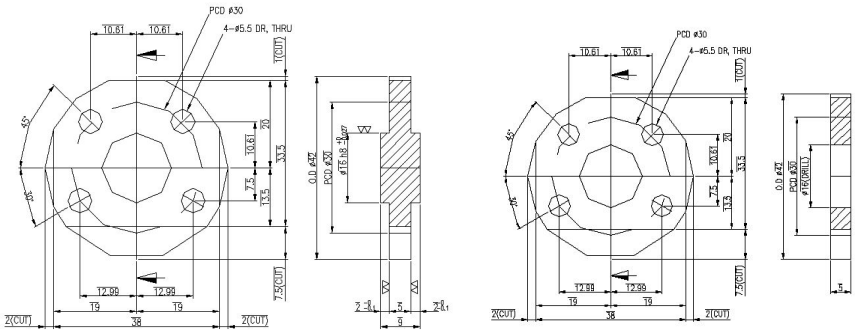

Fig 3-2-4. Bakelite Spacer Detail Design Drawing

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2. Welding Transformer의 구조

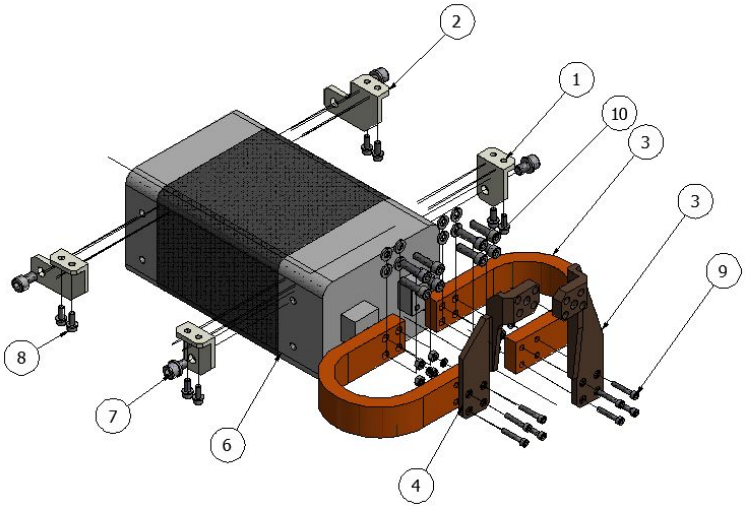

Fig 3-2-5. Welding Transformer Unit Assembly Drawing

보편적으로 산업현장이나 공장들에서 가장 많이 쓰이는 대부분 산업전기는 교류380(V)이나 교류440(V)이 공급된다. 이러한 상황에 맞추기 위해서 전압을 강압시켜주는 Transformer가 적용되어야 한다. 본연구에서는 정격용량이 50KVA에 1차 전압은 380V,60Hz을 공급받는 것으로 적용하였다. 그리고 2차전압을 8.26V로 내보내서 직접적으로 용접할 수 있도록 하였으며 이때 대략적인 2차전류 15,000A 정도가 된다. 그리고 2차전류 이하의 전류로 용접을 하게 되는데 이 때 허용되는 허용사용률은 7.3%가 되도록 구성하였다.

Fig 3-2-6. Transformer (R87-450D6)

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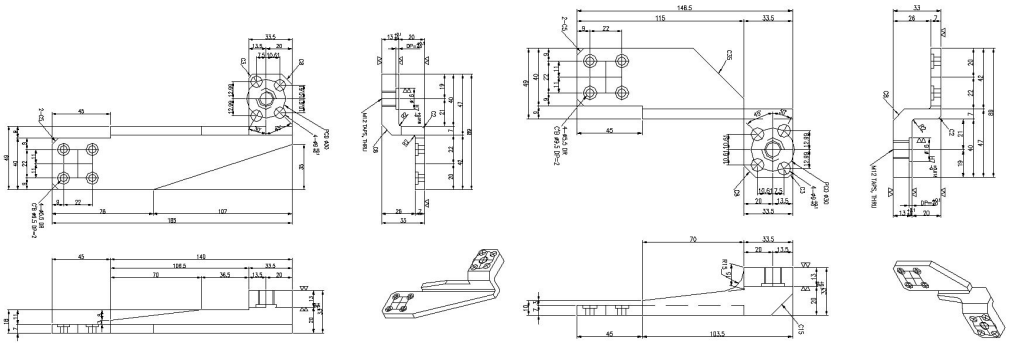

Fig 3-2-7. Fixture Bracket Detail Design Drawing

용접팁으로 전력을 전달하기 위해 양극에 별도의 Fixture Bracket을 제작하였는데 전도율을 높이기 위해서 재질을 구리(copper)로 적용하였다. 구리는 특유한 적색 광택을 가진 금속으로 전성 ,연성가공성이 뛰어날 뿐만 아니라 강도도 높은 편이다. 열 및 전기의 전도율은 은에 이어 2번째로 크고 결정은 등축정계이다. 용접팁의 위치가 다르기 때문에 Fixture Bracket 한개는 185(mm)의 길이로 가공하고 다른 하나는 148.5(mm)로 가공하였다. 용접팁이 움직이기 때문에 Transformer에서 용접Tip으로 전력을 전달할 때 두께가 17(mm)이고 부드럽게 움직이는 Bus Bar를 M8 Bolt를 이용하여 연결하였고 Bus Bar 끝에 2개의 Fixture Bracket을 M5 Bolt를 이용하여 연결하였다.

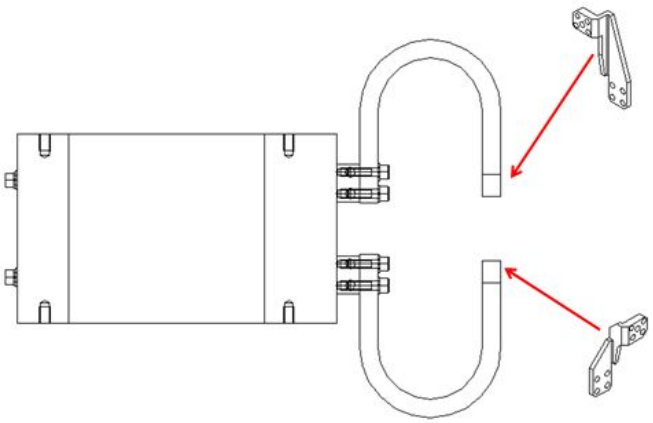

Fig 3-2-8. Welding Transformer Unit Assembly Construction

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제3절. Steel Band Cutting Device

1. 개요

밴드를 용접한 후 끝부분을 절단시켜 공정을 마무리 하여야 하는데 절단 방법 중 Shearing Cutting, Gas Cutting, Plasma Cutting, Laser Cutting, Wire Cutting 등이 있다. 본 연구에서는 다른 복잡한 장치가 없이 공압실린더만 적용하여 절단하여야 하기 때문에 Shearing Cutting 방식을 적용하였는데 기본적으로 산업현장에서 가장 많이 쓰이는 절단방법인 Shearing은 금속재료의 가공에 널리 사용되고, 한 쌍의 전단날이 서로 닫혀짐으로써 재료를 절단하는 것을 보통 전단기 또는 Shear라 한다. 0.1초도 안되는 아주 짧은 순간에 주어진 공압실린더의 힘만을 이용하여 Steel Band를 절단하여야 하기 때문에 공차관리가 매우 중요하기 때문에 정밀하게 가공하고 연마처리 또한 잘 되어야 한다.

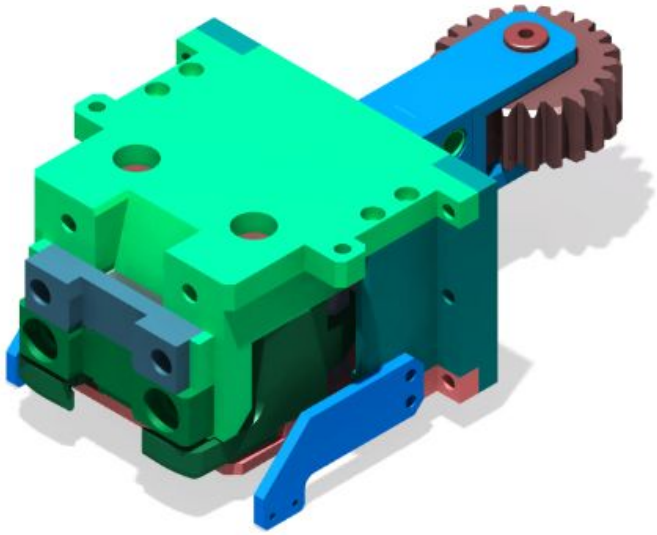

Fig 3-3-1. Steel Band Cutting Device 3D Modeling

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2. Jaw & Cutter Unit의 구조

이렇게 여러 절단방법이 있는데 개발할 절단장치는 JAW라는 부품이 밴드를 잡아주면서 CUTTING하는 원리로 Shearing Cutting법을 사용할 계획이다. 특히 위아래 PLATE와 각각 들어가는 PIN의 공차가 매우 중요하다. 공차가 미세하게 틀려서 조립을 하게 되면 밴드가 빠지거나 컷팅이 안 될수도 있고, 또한 밴드를 잡아줘야 되는데 공차가 틀릴 경우 작동이 안될 수 있어 공차에 대해 매우 신경을 써야 된다. 아래의 조립도와 같이 정밀한 Pin이 많이 사용되기 때문에 공차에 대한 부분을 잘 확인하고 설계 및 가공하여 제작되어야 한다.

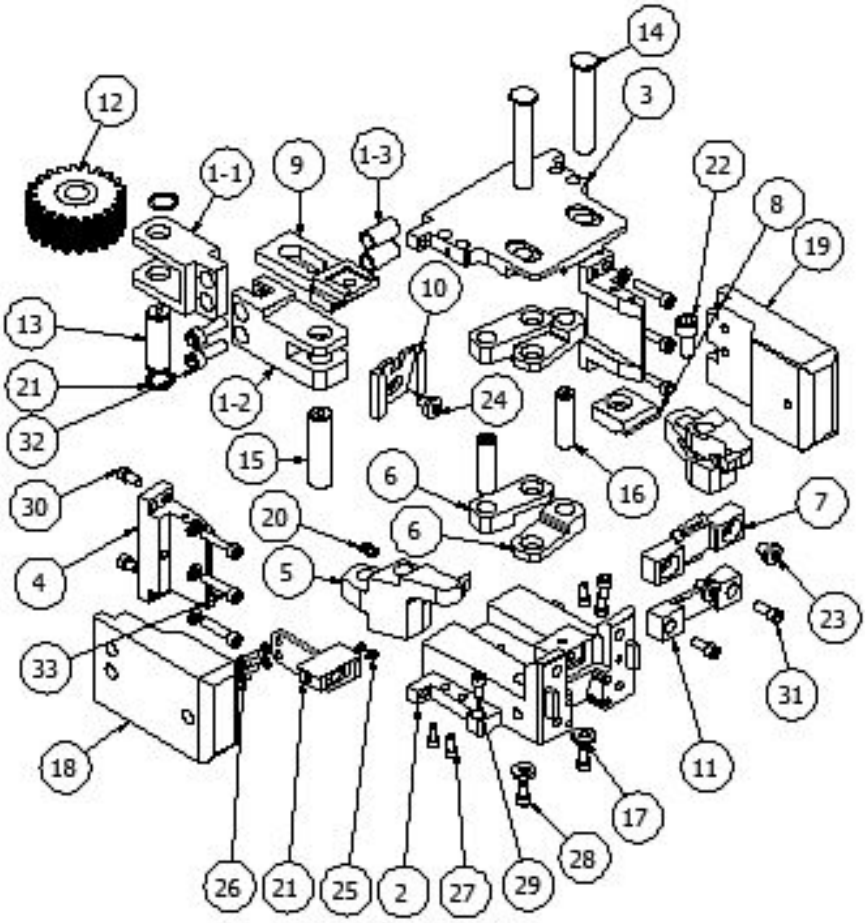

Fig 3-3-2. Jaw & Cutter Unit Assembly Drawing

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정확하게 원하는 지점의 Steel Band를 절단하기 위해서는 바로 이전 단계에서 잡아주는 행정이 같이 병행되어야 한다. Steel Band를 잡아주고 원하는 인장력으로 결속되면 바로 절단이 이루어져야 하는데 본 연구에서 아래의 그림과 같이 기구적으로 하나의 링크로 통합하여 동작하게 된다. 첫 번째 그림과 같이 대기된 상태에서 2개의 Steel Band가 원하는 위치도 겹치게 되면 두 번째 그림과 같이 가운데 있는 링크가 22.5mm가 상승하여 2개의 Jaw 사이의 공간이 4.63mm로 줄어들면서 고정시켜주게 된다. 그리고 이러한 상태에서 제품에 강한 인장력으로 결속하게 되면 세 번째 그림과 같이 이전에 동작했던 같은 링크가 7.5mm 상승하게 되면 Jaw는 그래로 고정되어 있으면서 Cutter만 상승하여 Steel Band가 절단된다. 공동으로 사용되는 링크의 중심에는 Pinion Gear가 설치되어 Rack Gear의 동작에 따라서 작동되는 원리이다. 두께가 0.8mm이상이 되는 철판을 절단하기 위해서는 Cutter가 정밀하게 가공되고 연마작업도 공차에 맞게 진행되어야 한다. Cutter는 Knife에 많이 사용되는 냉간금형용 합금공구강인 SKD11재질을 사용하였고 진공속에서 담금질을 하여 경도를 높여주었다.

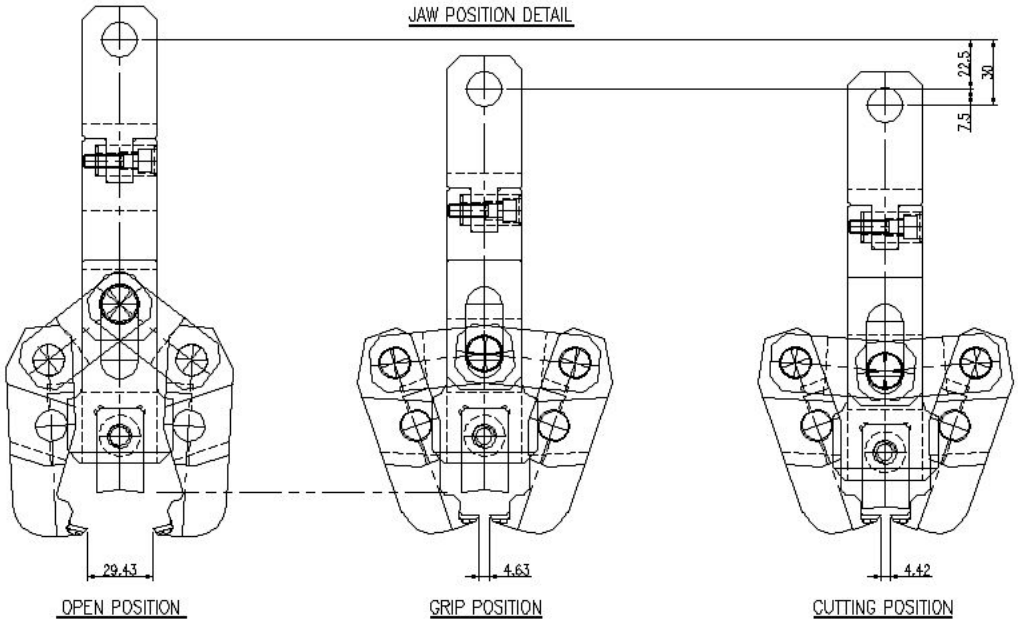

Fig 3-3-3. Jaw & Cutter Operation

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3. Lifting Actuator Unit의 구조

앞에서 설명했던 것과 같이 Jaw와 Cutter는 하나의 Pinion Gear를 통해서 Ready, Grip, Cutting의 동작을 진행하게 된다. 이러한 동작은 2개의 공압 실린더를 적용하여 진행하였다. 아래 Fig의 4번부품에 해당하는 ADN-100-45규격의 일반 실린더에 3번 부품인 Rack Gear를 장착하여 1차 상승하여 Band를 Grip 시켜준다. 철판을 절단할 때는 큰 힘이 필요하기 때문에 아래 Fig의 7번부품에 해당하는 ADNH-100-15-2N규격의 승압타입의 실린더를 반대쪽에 또 하나의 Rack Gear를 사용하여 강한 힘과 빠른 속도로 Steel Band를 절단하도록 구성하였다. 그리고 SM45C 재질의 Rack Gear가 반복적으로 상하작동할 때 원활하게 동작시키기 위해서 서로 다른 재질인 PBC3로 제작된 2번부품을 사용하였다.

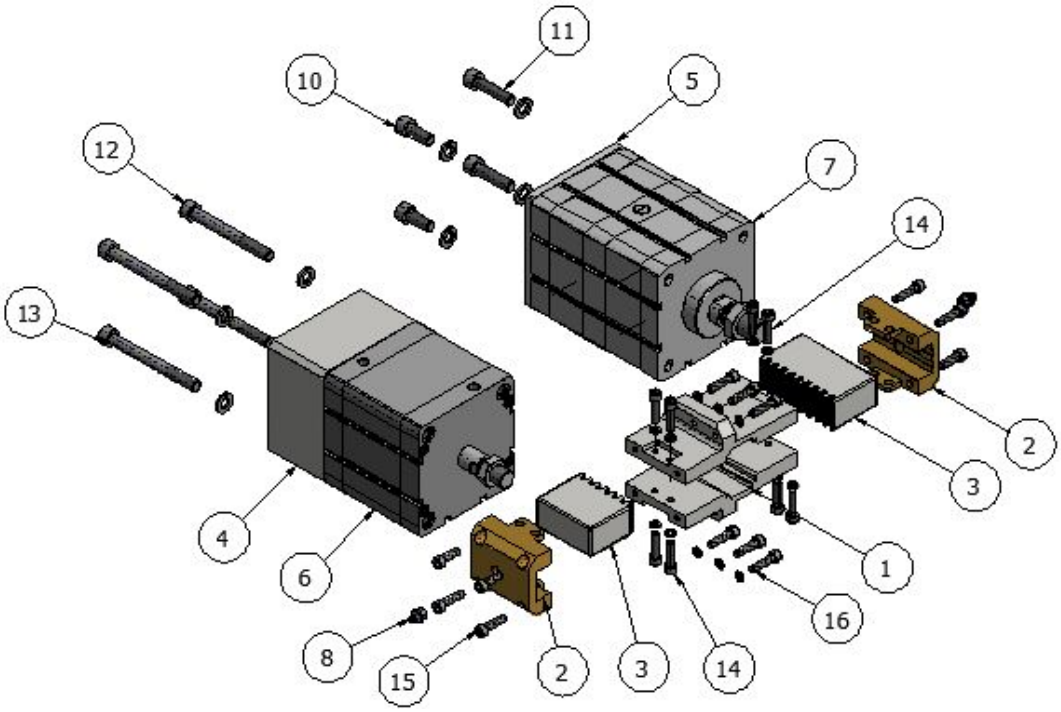

Fig 3-3-4. Lifting Actuator Unit Assembly Drawing

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제4절. Steel Band Grip Unit

1. GRIP UNIT의 개요

어떠한 특정 제품을 결속하기 위해서 Steel Band를 Head Unit에서 전달받아서 이송하고 다시 Head Unit로 전달하여야 하는데 이러한 공정을 진행하기 위해서 Manipulator Robot을 적용하였고 끝부분에 Grip Unit를 장착하였다. Grip Unit의 가장 큰 역할은 Steel Band를 강하게 잡아주는 것이고 여러 가지 모양의 특정 제품을 결속하기 위해서 전체를 이송시킨다. Grip Unit는 아래와 같이 4개의 구조로 이루어져 있다. Main Frame이라고 할 수 있는 Outer Pipe안에 Grip Head가 포함된 Inner Pipe가 연결되고 Cableveyor를 통해 전기와 공압을 공급시켜 준다.

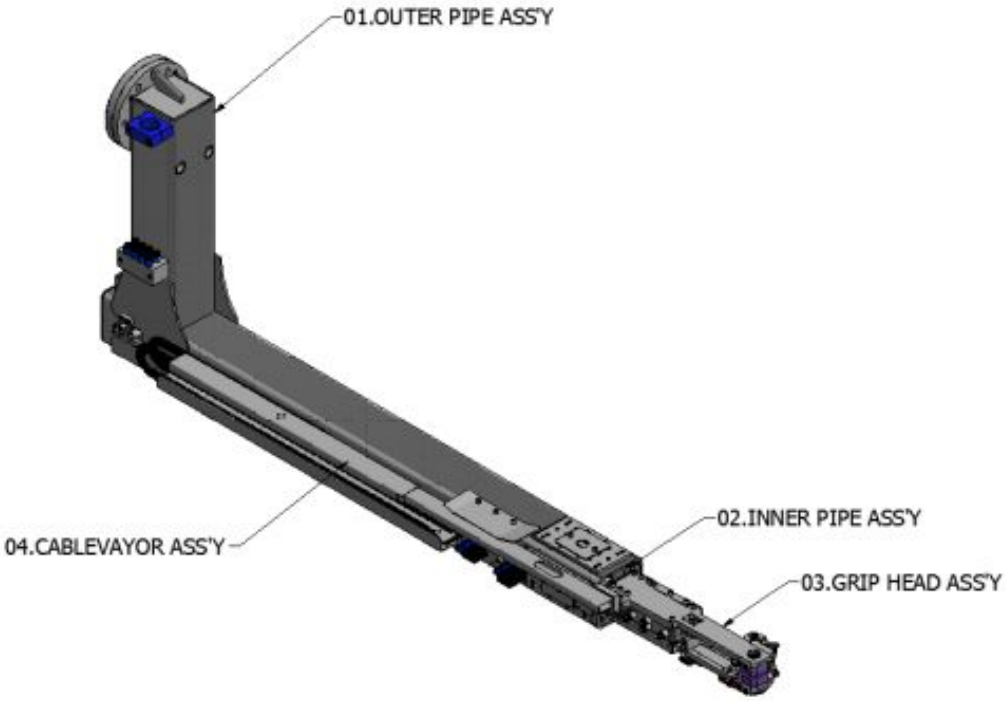

Fig 3-4-1. Steel Band Grip Unit 3D Modeling

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2. OUTER PIPE의 구조

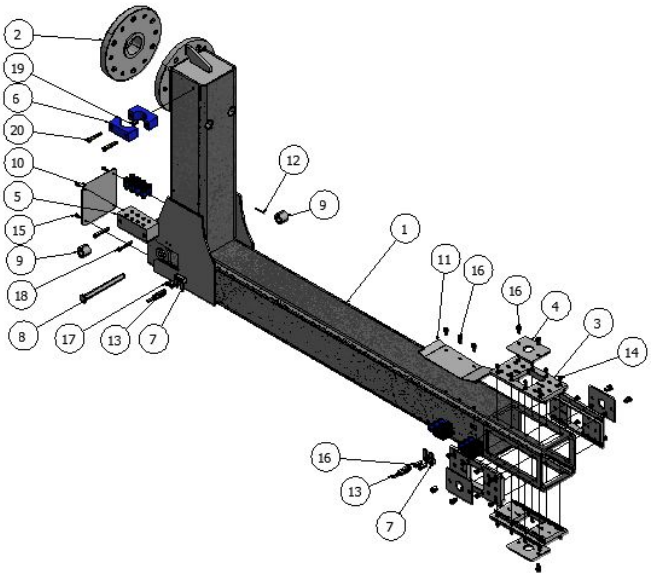

Fig 3-4-2. Outer Pipe Assembly Drawing

Outer Pipe는 Square Pipe, Flange, LM Block Fix Plate, Cover Plate, Manifold, Hose Holder, Sensor Bracket, Pin, Collar, End Cover, Cableveyor Guide 등으로 구성된다.

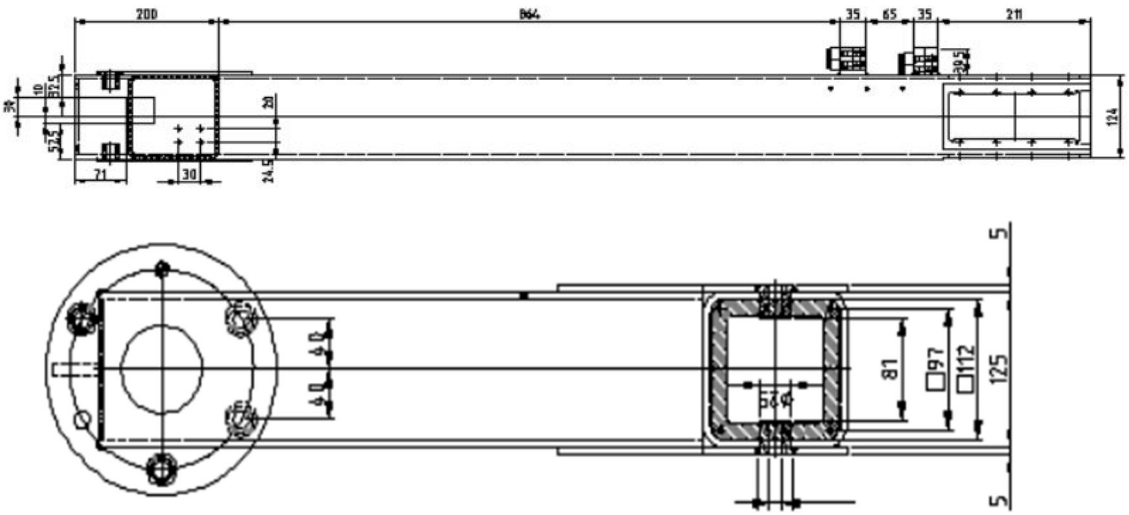

Fig 3-4-3. Outer Square Pipe Detail Design Drawing

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125*125*6T 규격의 Square Pipe를 이용하여 위와 같이 가공하여 가공한 모양이며 크기는 125*125*6T-525.5L, 125*125*6T-1410L이다 이 부품이 하는 역할은 Outer Pipe Ass'y의 기본 틀이 되는 역할을 하는 부품이다. 이 부품은 뼈대 역할을 하기 때문에 파이프의 직진도 및 표면상태 가 좋아야 된다. 그리고 파이프에 M5와 M4 나사작업을 하여야 하기 때문에 틀어지지 않도록 주의를 가져야 된다. 파이프 가공이 끝난 후에는 상도 및 하도 페인트 작업을 하여 부식이 일어나지 않도록 작업을 한다.

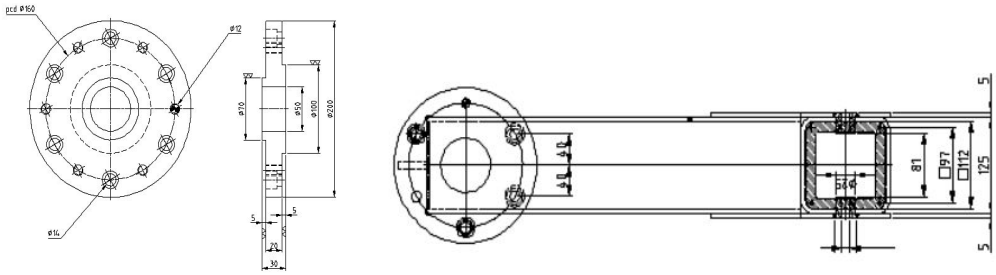

Fig 3-4-4. Flange Detail Design Drawing

SS400으로 만들어진 Flange 부품이며 크기는 Ø200*30T이다 이 부품의 역할은 Grip Unit의 전체를 Robot에 고정시켜주는 역할을 하는 부품이다. 이 부품을 가공하기 위해서는 SS400를 이용하여 밀링에서 가공한다. 홀 작업 시 공차 도면을 확인 후 작업을 진행하여야 한다. Bolt를 이용하여 조립되기 때문에 공차가 많이 발생 할 경우 조립 시 제대로 고정이 되지 않을 수 있기 때문이다. 이 부품도 마찬가지로 가공 완료 후 상도 및 하도 작업을 진행한다

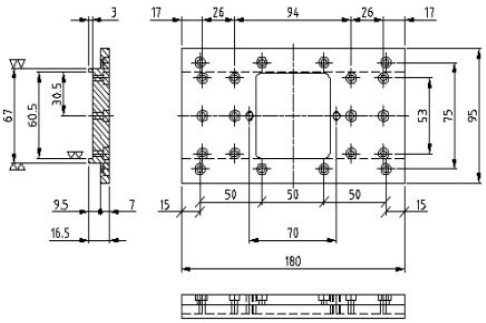

Fig 3-4-5. LM Block Fix Plate Detail Design Drawing

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Grip Head가 부드럽게 직선운동 할 수 있도록 하기 위한 LM Bearing을 고정시켜 주는 역할을 하는 LM Block Fix Plate이며 SS400으로 이루어져 있으며 크기는 180*95*16.5T이다. SS400의 사각 Plate를 180*90*17T로 절단하여 밀링에서 가공을 하고 그 다음 Ø8로 홀 작업을 하는데 깊이를 4.5만큼 작업을 한다. 정밀한 직선운동을 위해 공차를 정밀하게 작업하였다.

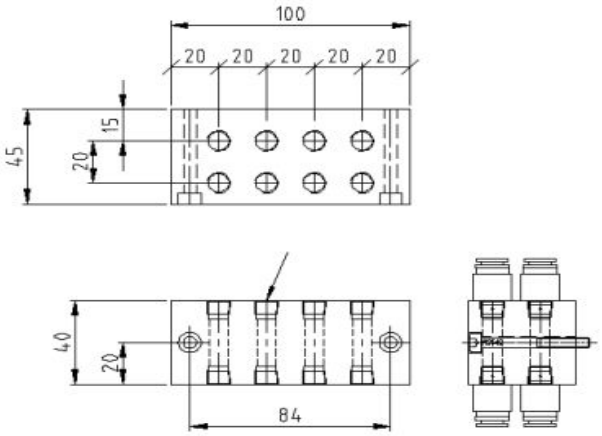

Fig 3-4-6. Manifold Detail Design Drawing

Grip Unit는 총 여러 개의 실린더가 장착되고 동작을 시키기 위해서 외부에서 솔레노이드 밸브가 설치된다. 두 개를 연결시켜 주는 호스의 분해 조립이 편하게 하기 위해서 Block형태의 Manifold가 가공하여 설치된다. 공압용 피팅과 연결되기 때문에 나사 작업에 신경을 써야 한다. 녹과 부식을 발생하지 않게 하기 위해서 아연도금처리를 하였다.

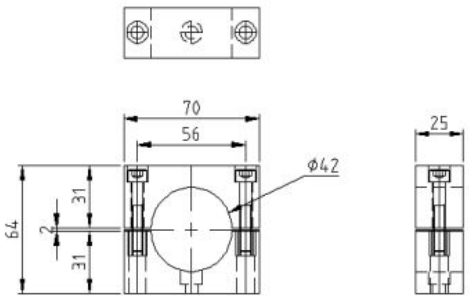

Fig 3-4-7. Flexible Hose Holder Detail Design Design

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자유자재로 움직이는 6축 다관절 로봇의 특성 때문에 Grip Unit에 공압이나 전력을 공급할 때 관련 공압호스나 전기케이블을 보호하기 위해서 Flexible Hose를 통해 공급하게 된다. 이러한 호스를 잡아주기 위해서 Holder가 설치된다. MC Nylon으로 이루어져 있으며 크기는 70*64정도에 두께는 25mm정도 절단하여 밀링과 선반으로 가공하여 2개로 분리시켜 Bolt를 이용하여 잡아줄 수 있도록 구성된다. 호스의 크기에 맞추어 가운데 홀을 42mm로 가공하여 작업하였다.

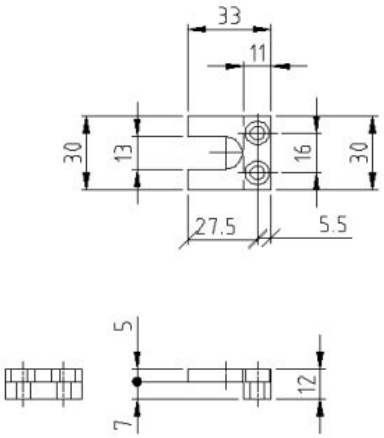

Fig 3-4-8. Proximity Sensor Bracket Detail Design Drawing

Steel Band를 잡는 Grip Part 전체를 이동시키기 위해서 공압실린더를 적용하였는데 각 위치에 대한 정보를 받기 위해서 Proximity S두낵가 사용된다. 이러한 센서를 설치하기 위한 Bracket으로써 12mm 규격의 센서를 사용할 수 있도록 밀링으로 가공하여 설치하였다.

Fig 3-4-9. Outer Pipe Manufacture Photograph

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3. INNER PIPE의 구조

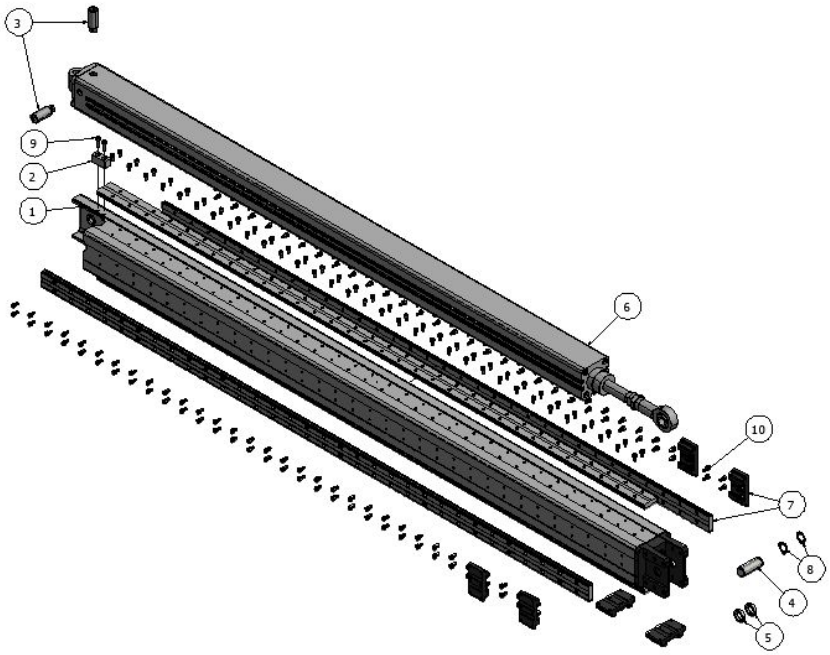

Fig 3-4-10. Inner Pipe Assembly Drawing

Inner Pipe는 Square Pipe, Grip Head Connector, Safety Pin Guide, S두낵 Dog, Fitting Connector, Pin, Collar, Pneumatic Cylinder, LM Guide 등으로 구성된다.

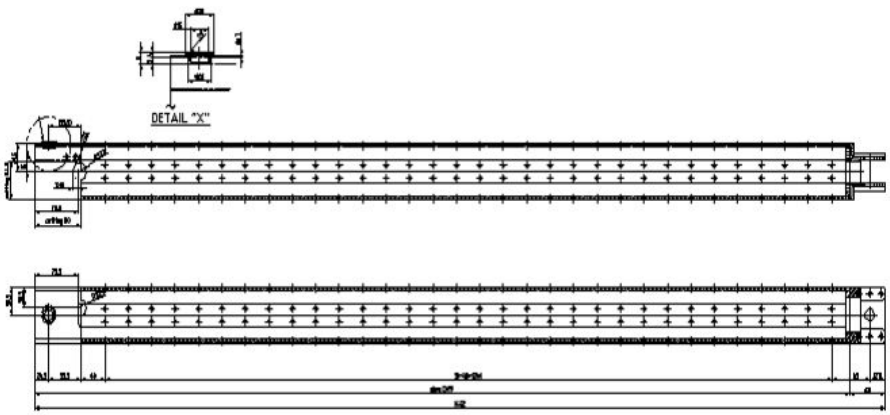

Fig 3-4-11. Inner Square Pipe Detail Design Drawing

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Outer Pipe의 안에 설치되는 Inner Pipe의 Main Frame으로써 80*80크기에 5.7mm의 Square Pipe를 1,390L의 길이로 구성하였다. Pipe전체가 직선운동 하기 위해 직진도가 나오게 공차를 관리하면서 밀링으로 정밀하게 가공한 후 LM Rail을 적용한다. 4면 전체에 M4 규격의 나사작업을 하여 고정하였다.

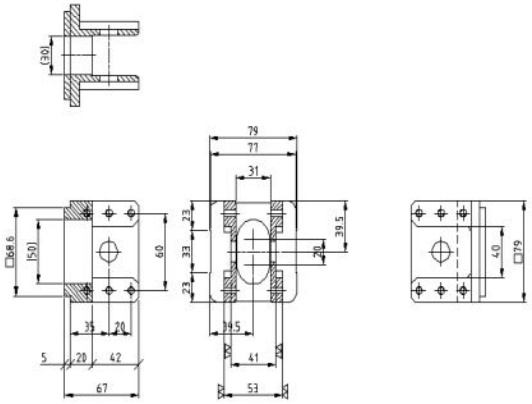

Fig 3-4-12. Connector Detail Design Drawing

SS400으로 이루어져 있으며 크기는 80mm*80mm에 두께는 67T이다. 이 부품은 Grip Head와 Inner Pipe Ass'y를 연결시켜주는 역할을 하는 부품이다. 이 부품 가공은 SS400 각재를 절단하여 밀링과 선반 작업을 실시한다. 그리고 M6 홀 작업을 진행하여 작업한다. 이 부품 가공 완료 후에는 아연 도금을 통해 부식 및 녹이 발생하지 않도록 작업한다.

Fig 3-4-13. Inner Pipe Manufacture Photograph

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4. STEEL BAND GRIPPER의 구조

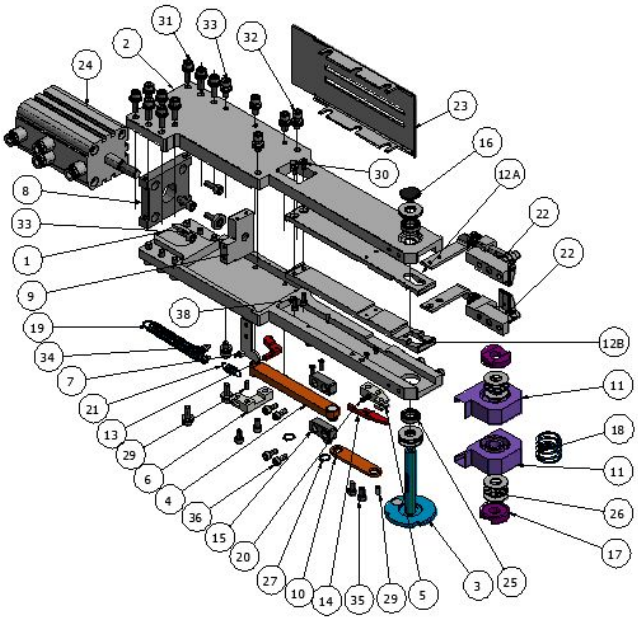

Fig 3-4-14. Steel Band Gripper Assembly Drawing

Steeel Band Gripper는 Side Plate, Crank Shaft, Link Bracket, Ratchet Fixture, Lock Fixture, Contact Bracket, Cylinder Fixture, Rod Fixture, Crank Arm, Grip Bracket, Contact Slide, Lock Bracket, Ratchet, Dicking Guide, End Bolt, Contact Cam, Coil Spring, Band Guide Assembly 등으로 구성되어 있다.

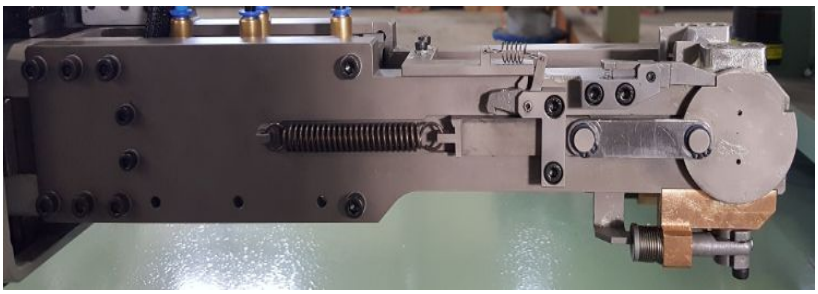

Fig 3-4-15. Steel Band Gripper Manufacture Photograph

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제5절. Manipulator Carrier

1. Manipulator Carrier 개요

다관절 로봇의 기본적인 작업반경으로는 다양한 모양과 크기의 제품을 결속하는 것에 대해서 한계가 있다. 6축의 다관절을 가진 로봇은 대부분의 공간을 자유롭게 작업할 수가 있지만 전체를 이동시킬 수만 있다면 더 많은 공간을 작업할 수가 있어서 더 다양한 제품에 대해서 결속이 가능해 질 것이다. 현재 다관절로봇은 6축의 Servo Motor가 하나의 시스템으로 이루어져 동작되고 있는 여기에 전체를 이동시킬 수 있는 1축을 추가시키고 설치된 감속기와 Gear에 대한 값은 연산하여 연동시켜 제어할 수 있도록 연구하였다.

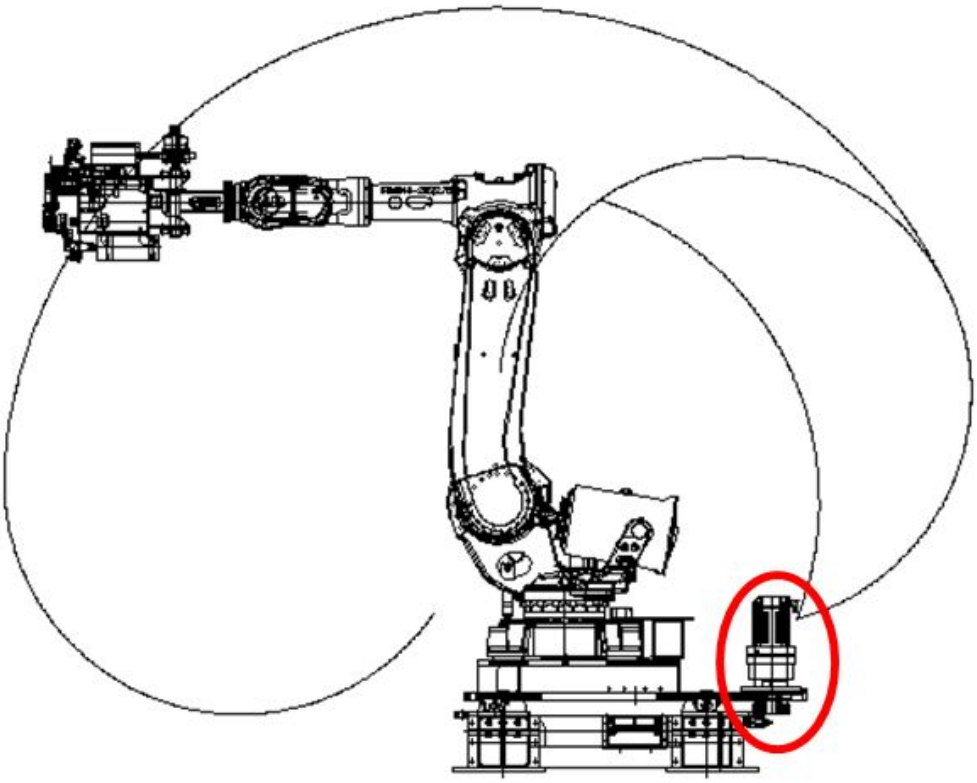

Fig 3-5-1. Robot Carrier Basic Drawing

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2. Moving Drive Module

부가로 추가되는 1축에서 다관절 로봇 전체를 이동하기 때문에 약간의 오차가 생기게 된다면 작업이 되는 끝부분에서는 많은 오차가 발생할 수 있으므로 정밀하게 동작될 수 있도록 구성하였다. 무거운 하중을 받는 상태에서 움직여야 하고 어떠한 외력에 의해서 축이 흔들리지 않게 하기 위해서 Ac Brake Type의 타입의 Servo Motor에 1/30비율의 감속기를 연결하였다. 그리고 중량물을 운송할 때에는 가동시작이나 중지할 때 원하는 위치에 정확게 멈추지 않고 Backlash가 발생한다. 물론 한 쌍의 기어를 매우 매끄럽게 회전시키기 위해서는 적절한 Backlash가 필요하긴 하지만 Backlash가 너무 적으면 윤활이 불충분하게 되기 쉬워져서 치면끼리의 마찰이 커진다. 또, 백래시가 너무 크면 기어의 맞물림이 나빠져 기어가 파손되기 쉽다. 이러한 부분의 방지하기 위해서 감속기의 Shaft에 Key를 연결하여 Spur Gear와 연결하였는데 Power Lock도 같이 적용하여 설치하였다.

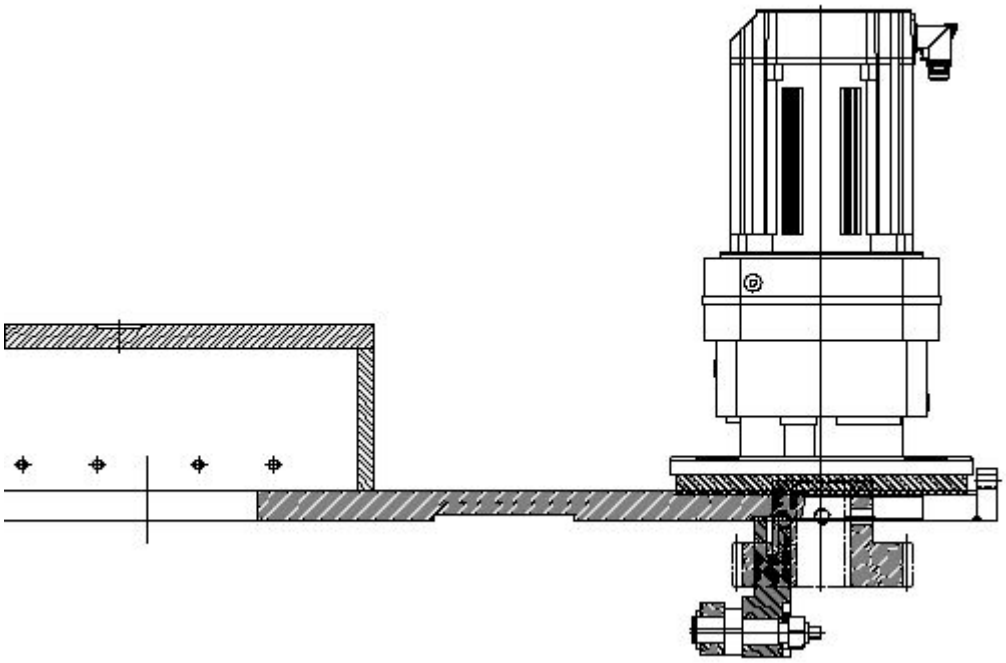

Fig 3-5-2. Moving Drive Module Basic Drawing

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3. Track Rail Device

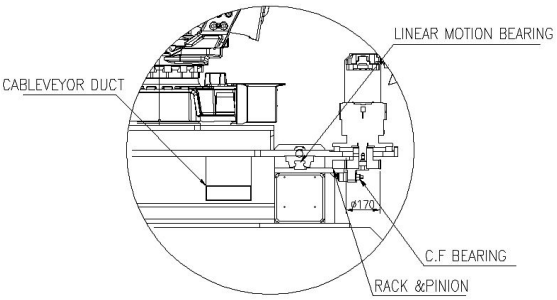

Fig 3-5-3. Track Rail Device Basic Drawing

적용된 부가축 Servo Motor의 회전으로 인해 다관절 로봇을 이송시키기 위해서 맞물림에 의하여 회전운동을 직선운동으로 또는 그 반대운동으로 바꾸는데 사용하는 장치이며 시설하우스의 천측창 개폐장치 등에 많이 사용되는 Rack Pinion Gear 방식을 적용하였다. 기어는 모듈 M5를 사용하였으며 큰 토크를 받기 때문에 파손되지 안게 하기 위해서 기어부분에 열처리를 하여 Hs경도가 50이상이 될 수 있도록 하였다. 그리고 Gear의 P.C.D가 170mm 정도로 맞추어 주행거리에 대한 연산처리를 하였다. 이송되는 다관절로봇의 전력 및 공압을 공급하기 위해서 Cableveyor를 설치하였고 오차없이 부드러게 직선 운동을 할 수 있도록 하기 위해서 HSR45규격의 Linear Motion Bearing System을 적용하였다. 그리고 Track Rail의 양쪽 끝부분에 탈선을 방지하고 작업 반경을 넘어가더라도 갑작스런 정지를 방지하기 위해서 유압방식의 Absorber를 설치하였다.

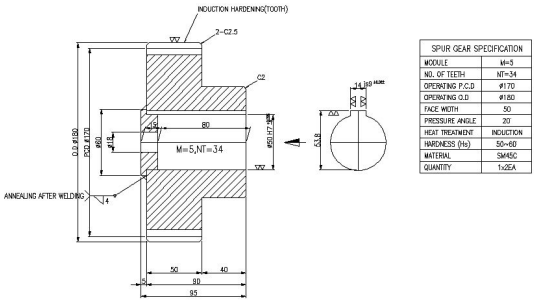

Fig 3-5-4. Track Rail Spur Gear

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제4장. 결속시스템의 제어

제1절. Manipulator Control

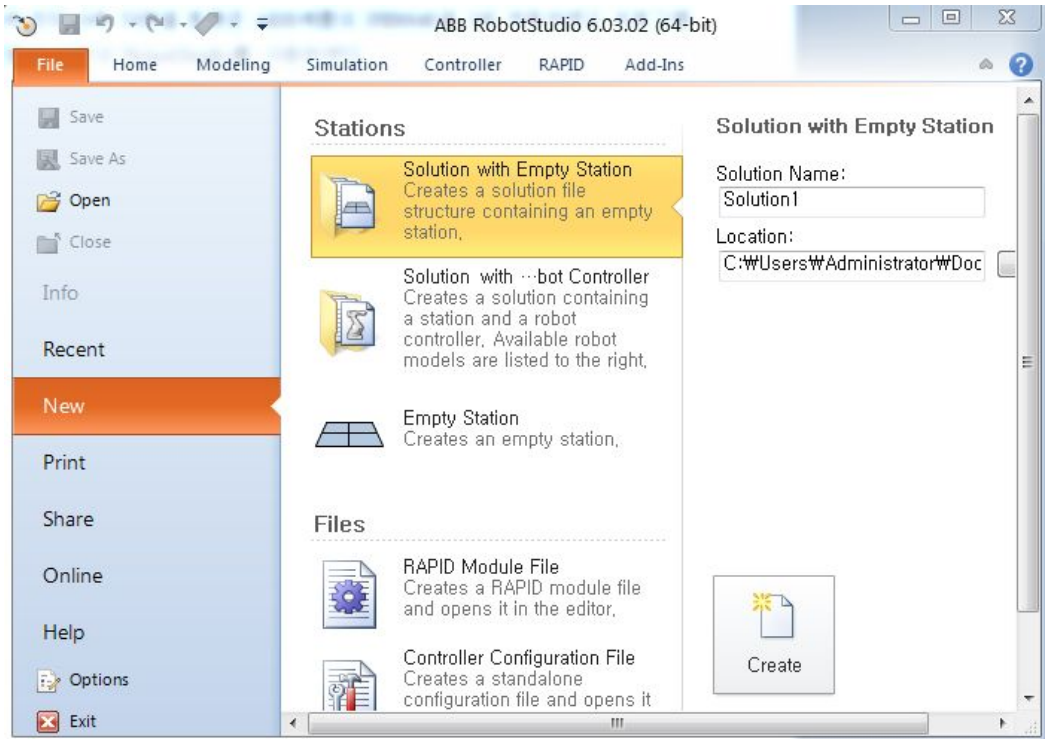

Fig 4-1-1. Robotstudio Program

결속시스템을 구성하기 위해서 2대의 로봇을 운영하였는데 Steel Band를 공급 및 접합, 용접하는 Head Robot Part와 Grip하여 제품에 감싸는 Grip Robot Part로 나누어 진다. 6축 다관절 로봇은 ABB제품의 IRB6640을 2대 적용하였고 프로그램은 RAPID(Robotics Application Programming Interactive Dialogue)의 기반인 RobotStudio를 사용하였다.

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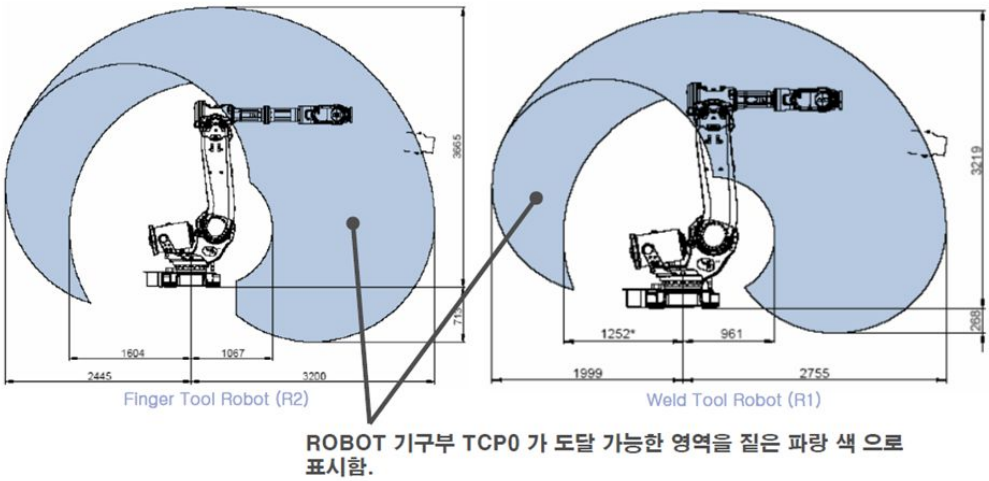

Fig 4-1-2. Application of Two Robots

- ▶ 프로그래밍 언어: RAPID(Robotics Application Programming Interactive Dialogue)
- ▶ 프로그램 = 프로그램 데이터 + 명령어(루틴 단위로 취급)
- ▶ 작업 프로그램은 시스템 모듈과 연동하여 동작한다.
- ▶ 작업 프로그램은 프로그램 메모리에 하나만 존재할 수 있다.(확장자: *.PRG)

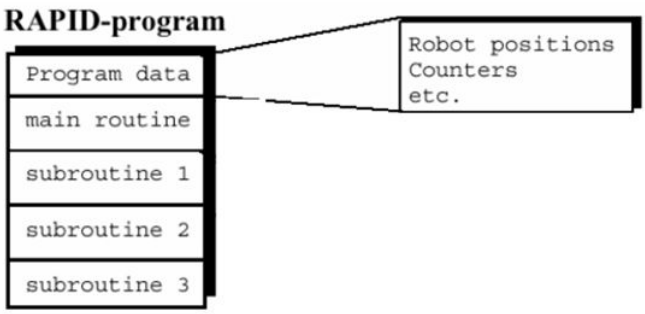

Fig 4-1-3. Robotics Application Programming Interactive Dialogue

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1. Main Module Program

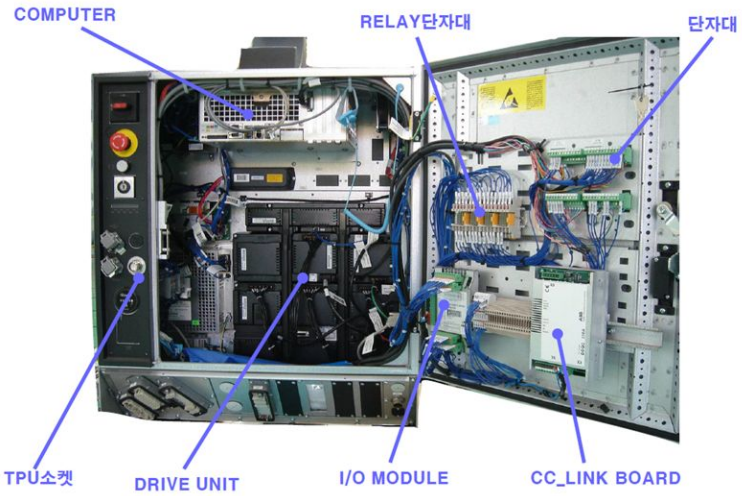

Fig 4-1-4. Robot Main Drive Controller

Head Part 프로그램의 기본적인 셋팅 값이나 파라메터등의 데이터를 설정하기 위해 프로그래밍 하였다. 또한 로봇의 기본적이 좌표와 기본 자세 등에 대한 프로그래밍하였고 기본적으로 현재 결속할 제품에 대한 정보를 측정하는 프로그램도 포함되어 있다.

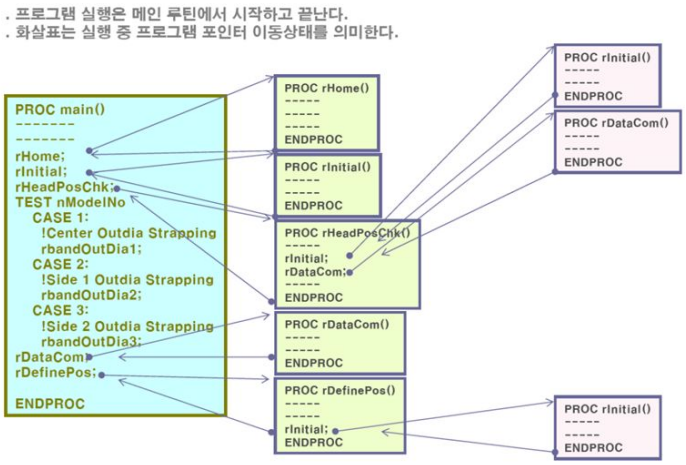

Fig 4-1-5. Structure of Programs

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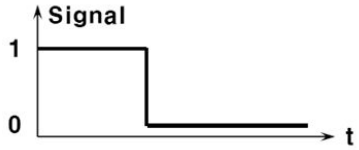
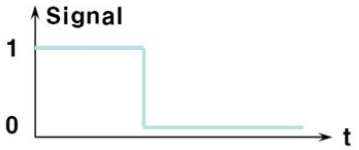
2. Posotion Calculate Program

```
Set do03_Clamp;
Reset do03_Clamp;
```




```
SetDO \SDelay:=1.5, do04, 1;
SetDO do04, low;
```




```
PulseDO do12;
PulseDO \PLength:=1, do12;
```

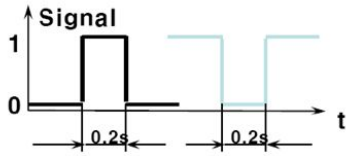


Fig 4-1-6. Control of Digital Device

다관절로봇이 제품을 결속하기 위해서는 작업반경내에서 로봇의 자세 맞는 움직임으로 동작하기 위해서는 연산처리를 하여야 한다. 그러한 연산처리는 우선 계산 관련된 함수에 모든 값을 셋팅하고 나중에 Call을 하여 사용될 수 있도록 프로그램을 구성하였다.

산술 연산(+, -, *, /, DIV, MOD)

Clear nCounter; nCounter := 초기값;	nCounter 를 초기화 시킨다.
Incr nCounter; nCounter := nCounter + 1;	nCounter 에 1 을 더한다.
Decr nCounter; nCounter := nCounter - 1;	nCounter 에서 1 을 뺀다.
Add nCounter, 5; nCounter := nCounter + 5;	nCounter 에 5 를 더한다.

Fig 4-1-7. Calculate Program

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3. Strapping Process Program

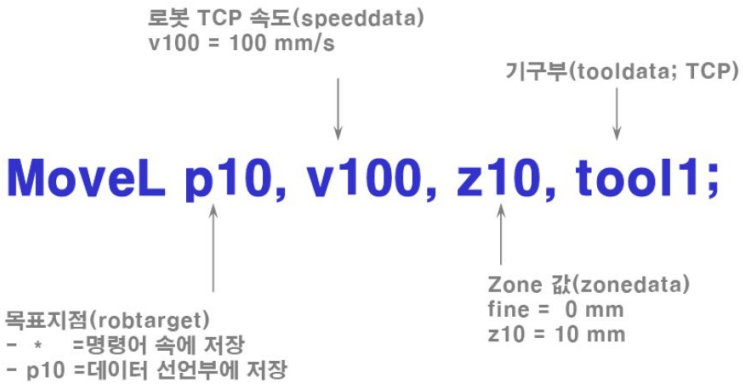

Fig 4-1-8. Teaching Instruction basic Structure

Head Part에서 직접적으로 Steel Band를 공급하여 잡고 용접 및 절단 등의 전체적인 동작에 대한 프로그래밍을 하였다. 다관절로봇이 제품을 결속하기 위해서는 작업반경내에서 로봇의 자세 맞는 움직임으로 동작하기 위해서는 연산처리를 하여야 한다. 그러한 연산처리는 우선 계산 관련된 함수에 모든 값을 셋팅하고 나중에 Call을 하여 사용될 수 있도록 프로그램을 구성하였다.

- AccSet : 모터의 가감속 특성을 조절. 모션이 부드러워 진다.
- VelSet: 특정 구간의 프로그램 속도를 조절. 백분율로 증감 가능.
- GripLoad: 로봇의 부하량 지정. 제품을 집고, 놓을 때 사용.

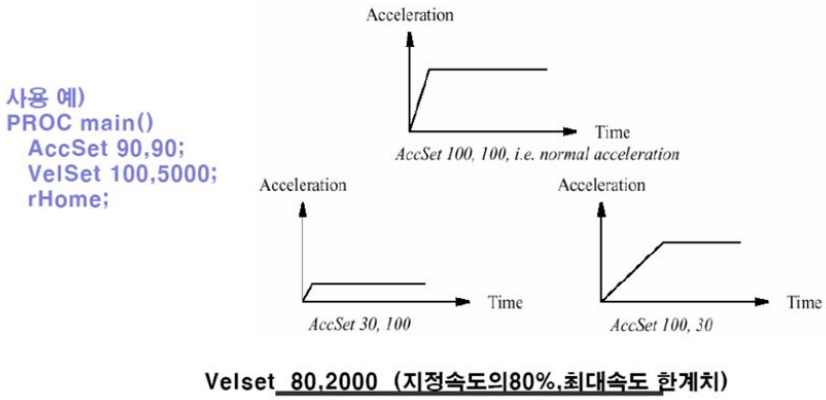

Fig 4-1-9. Robot Speed Related Settings

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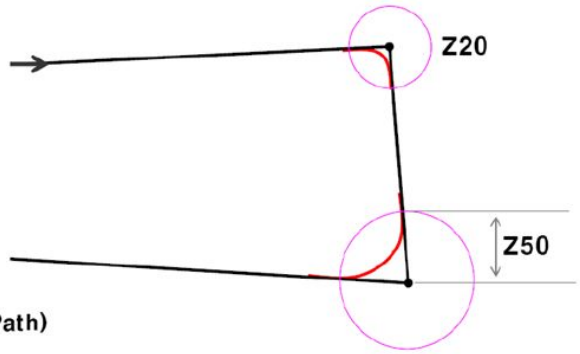


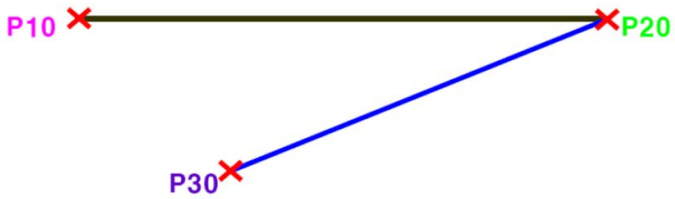
이동 경로(Path)

경로란 모션 명령어를 실행했을 때 로봇의 TCP가 지나간 흔적을 말한다.
위치데이터가 똑같다 하더라도 모션명령어 종류나 데이터에 따라서 실제 그 지점을 지나가는 방법은 다를 수 있다.

존(Zone, zonedata)

모션명령어의 한 요소로서 2가지 기능이 있다.
경로가 바뀔 때 코너부의 형태를 결정 한다. 존 값이 클수록 곡면의 반지름도 커진다.
신호처리 명령어를 만났을 때 해당 신호의 처리 시점을 존 값 만큼 앞당긴다.
Zone Data 미사용 : fine(z0 을 의미)
Zone Data 설정범위 : z1 ~ z200

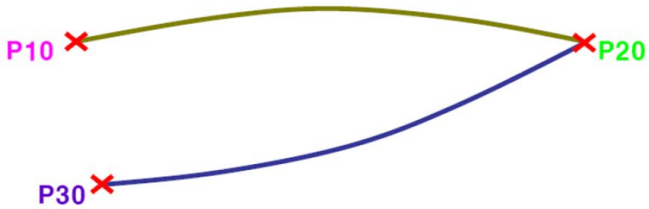
좌표 지점간 이동시 해당 point로 직선 이동하는 명령



Program 예)

MoveL p10, v200, fine, tool1;

좌표 지점간 이동시 해당 point로 약간의 곡선 이동하는 명령



Program 예)

MoveJ p10, v200, fine, tool1;

Fig 4-1-10. Robot Teaching Program-1

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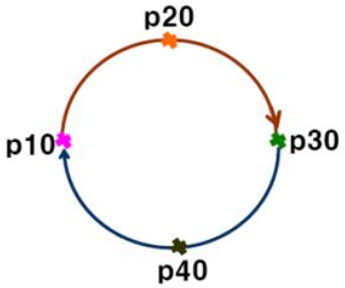
- MoveC(Circular): 반원(부채꼴) 형태의 곡선경로로 이동.
- 완전한 원(동그라미)을 그리려면 MoveC를 2번 실행.

중간지점(robtarget)
- * = 명령어 속에 저장
- p20 = 데이터 선언부에 저장

MoveC p20, p30, v100, z10, tool1;

목표지점(robtarget)
- * = 명령어 속에 저장
- p30 = 데이터 선언부에 저장



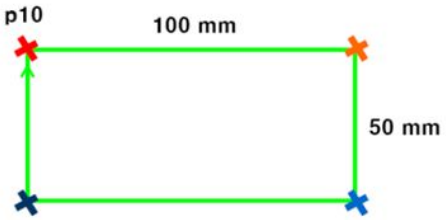
프로그램 (ex.동그라미, Circle)

```
MoveL p10, v200, fine, tool1;
MoveC p20, p30, v200, z5, tool1;
MoveC p40, p10, v200, fine, tool1;
```

- 위치데이터를 조깅(절대좌표)이 아닌 함수(상대좌표) 를 이용하여 지정.
- 좌표해석은 World 좌표계를 기준으로 한다.

기준점 변위 X, Y, Z

MoveL Offs(p10, 50, 100, 0), v100,fine,tool1;



프로그램 (ex).직사각형, Square)

```
MoveL p10, v200, fine, tool1;
MoveL Offs (p10,50,0,0), v100,...
MoveL Offs (p10,50,100,0), v100,...
MoveL Offs (p10,0,100,0), v100,...
MoveL p10, v200, fine, tool1;
```

Fig 4-1-11. Robot Teaching Program-2

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4. Program Simulation

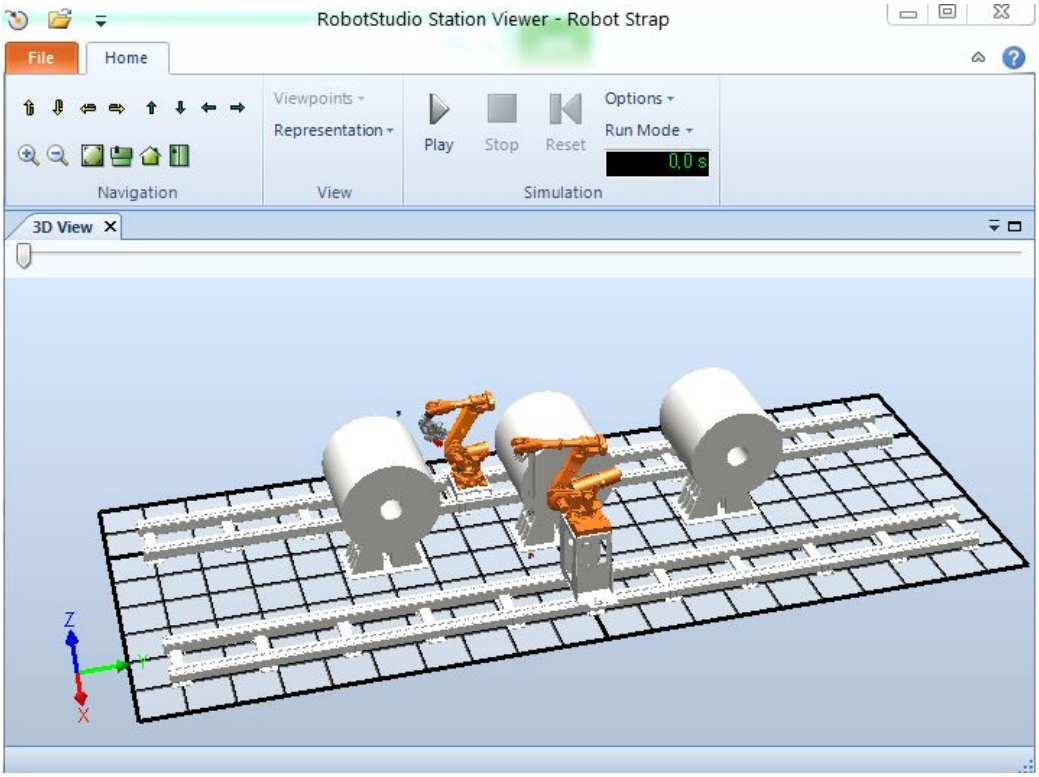

Fig 4-1-12. Robot Simulation(Ready Position)

3D Modeling이 완료된 Head Part와 Grip Part를 Robotstudio 프로그램에 대입시켜 2대의 Robot에 각각 적용시켰다. 그리고 위에 Programming된 프로그램을 코딩하고 가상으로 Simulation하여 충돌이나 간섭등의 문제가 있을지에 대해 연구하였다. Head Part에서 Steel Band를 Grip Part로 정밀하게 전달하기 위해서 1차 Docking후에 원하는 결속방식으로 제품의 형태에 맞추어 Grip Part가 작동하여 용접 및 절단등의 마무리 작업을 위해서 Grip Part에서 Head Part로 Steel Band를 전달하기 위해서 2차 Docking하는 것에 대한 가상 Simulation을 진행하였다. 제품의 대상을 코일로 하여 Core, Center, Edge에 결속할 수 있도록 전체적으로 Programming 작업을 하였고 관련된 Simulation을 진행하였다.

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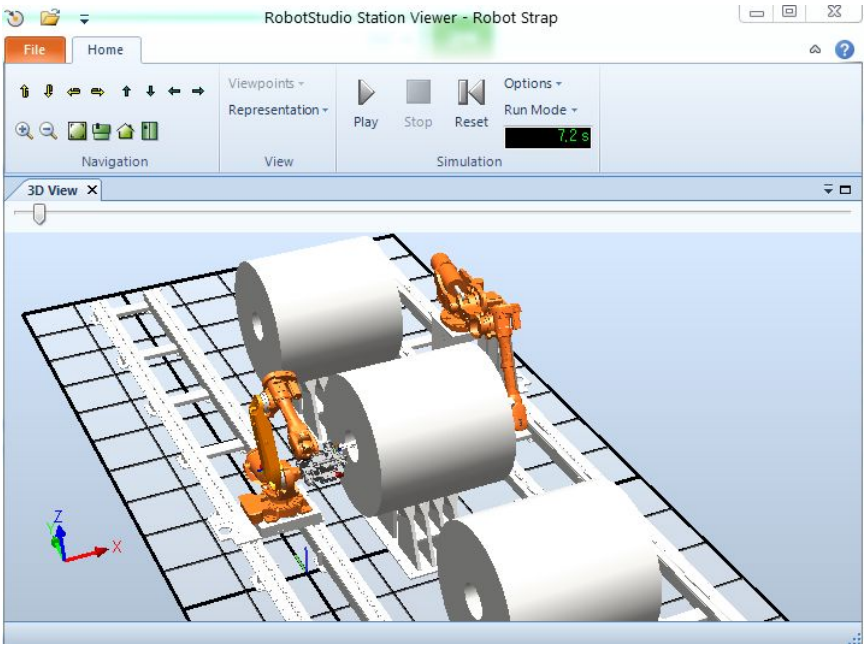

Fig 4-1-13. Robot Simulation(Core Docking-1)

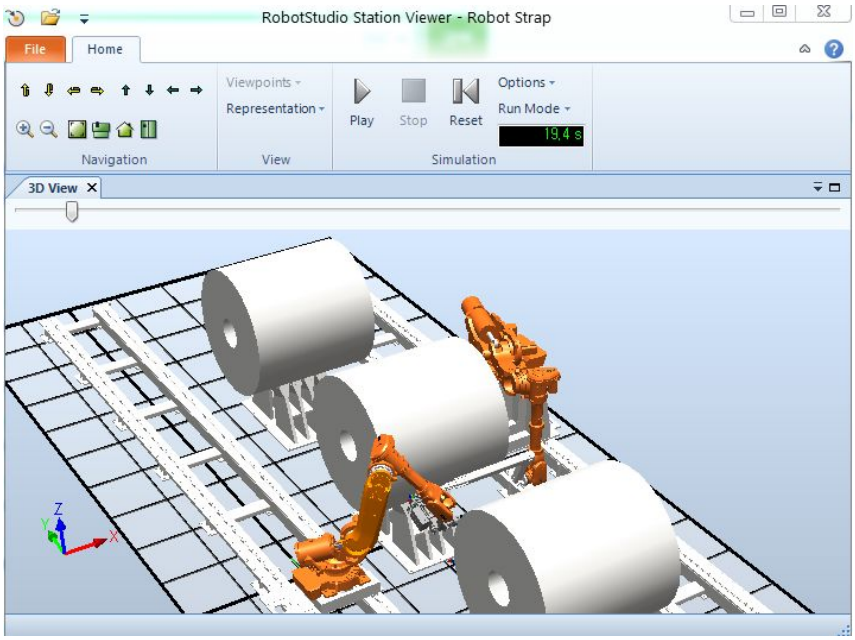

Fig 4-1-14. Robot Simulation(Core Docking-2)

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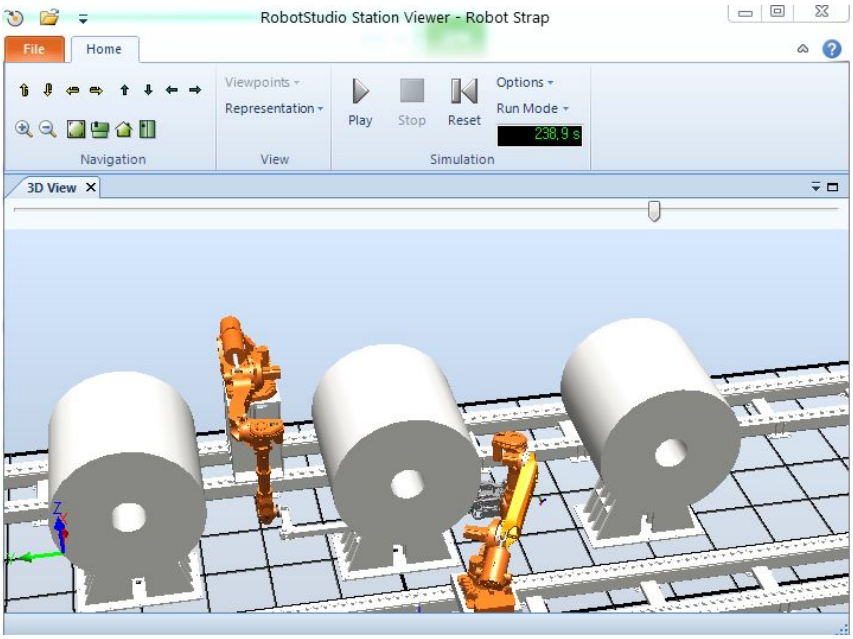

Fig 4-1-15. Robot Simulation(Center Docking-1)

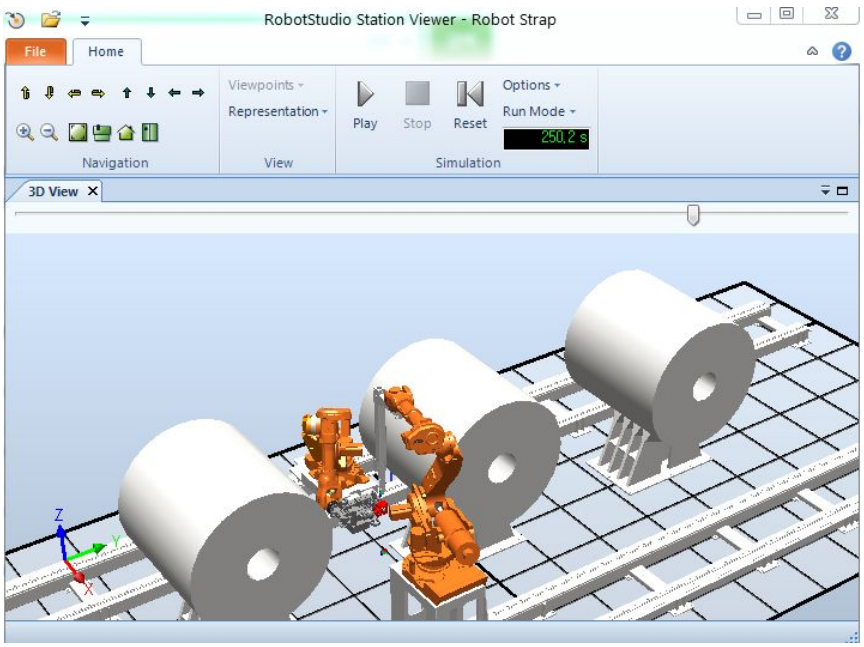

Fig 4-1-16. Robot Simulation(Center Docking-2)

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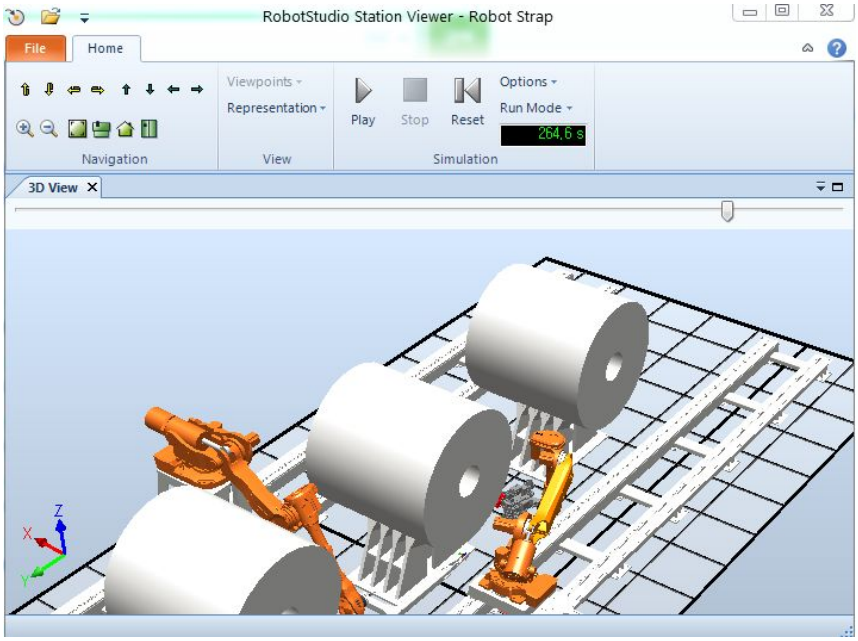

Fig 4-1-17. Robot Simulation(Edge Docking-1)

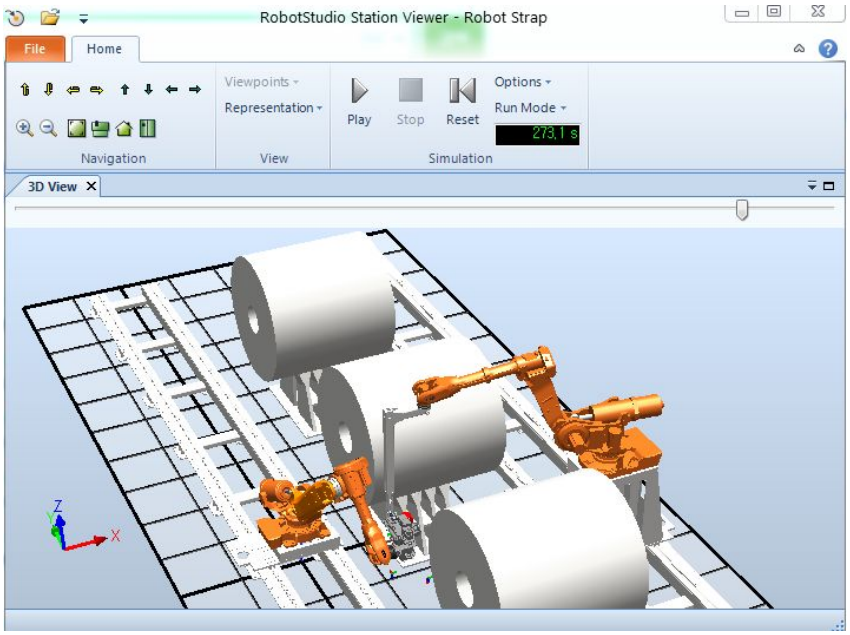

Fig 4-1-18. Robot Simulation(Edge Docking-2)

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제2절. DeviceNet Communication

1. DeviceNet의 개요

DeviceNet Communicaion은 세계적인 제어기기 회사이면서 미사일 개발로 많은 기술력을 보유하고 있는 미국의 Rockwell/Allen-Bradley 에서 개발된 응용 통신으로써, 현재 산업 현장에서 안정적인 통신으로 폭넓게 이용되고 있다. 이러한 통신은 CAN 통신 프로토콜을 사용하기 때문에 값이 싼 저가의 CAN 마이크로 칩을 사용하고 있으므로 적은 비용으로 구성할 수 있어서 적용하였다. 그리고 마스터 및 각 기기가 디바이스 레벨의 네트워크에 직접 접속하는 것이 가능하여 종전의 I/O 인터페이스를 경유하는 접근과 이용이 불가능했던 디바이스 레벨의 중요한 진단 정보의 접근이 가능하여 고장 상태에 대하여 유연하게 대처할 수 있다. 한대의 마스터 모듈이 다수의 슬레이브 모듈을 제어할 수 있어서 다중으로 많은 유니트를 통신으로 제어하기 위해서 많이 사용되고 멀리 드롭 및 분기 접속이 가능하여 시스템의 확장 및 변형이 용이하여 시스템을 유연하게 운영할 수 있다. 특히 서로 다른 제품들의 각종 슬레이브 모듈과 접속이 가능한 오픈 네트워크라서 로봇의 Controller에서 공압모듈을 제어하였다.

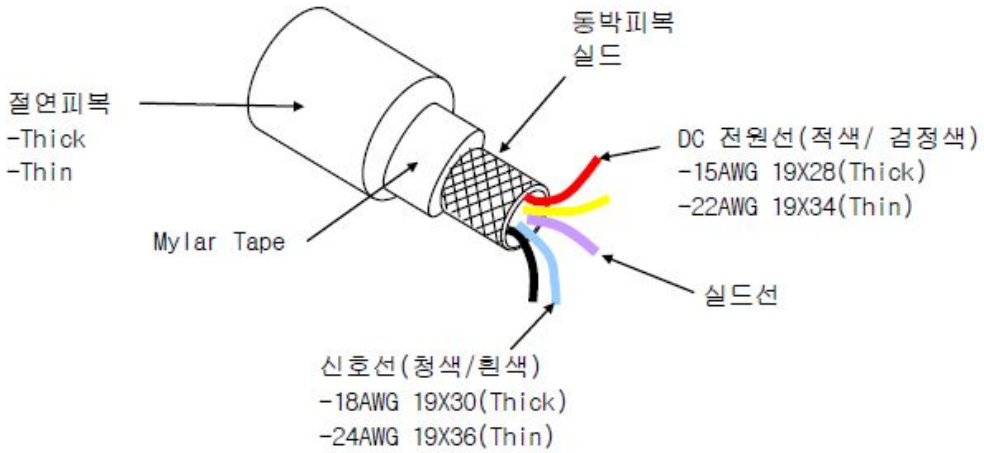

Fig 4-2-1. DeviceNet Cable Structure

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산업용 컨트롤러 및 센서장치들 간의 Digital Multi-Drop네트워트로서 각 디바이스 / 제어기는 네트워크강의 Node가 된다. 또한 Producer-cConsumer네트워크로써 Multiple Communication Hieeaechy과 메시지 우선순위 기능 및 Master-Slave, Peer-to-peer 통신 구조가 모두 가능하다. 그리고 네트워크상에 Power를 공급한기 때문에 간결한 구조로 구성될 수 있다.

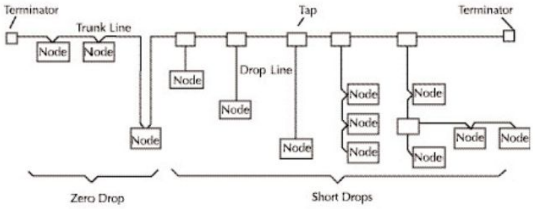

Fig 4-2-2. Device Line Block Diagram

어떤 Device와 정보를 교환하기 위해서는 먼저 그 Device와의 Connection이 확립되야 되기 때문에 각 DeviceNet 제품들은 Unconnected Message Manager 혹은 Group 2 Unconnected Port기능을 지원해야 한다. 이 기능을 사용하여 Explicit Messaging Connection을 확립하게 되면, 이 Explicit Connection은 Node간에 정보를 이동하거나, I/O Connection ID의 유일성은 Producer-Consumer기능을 충분히 발휘하기 위해 엄격하게 관리된다. DeviceNet은 11Bit CAN identifier를 네 그룹으로 나누는데 처음의 3개의 그룹은 두 개의 필드를 조합하는데 바로 이 조합된 필드가 Connection ID가 된다.

10비트											16진수 범위	ID의 사용방법
10	9	8	7	6	5	4	3	2	1	0		
0	Group1 메시지 ID				송신측 MAC ID						000-3ff	메시지 Group1
1	0	MAC ID						Group2 메시지 ID			400-5ff	메시지 Group2
1	1	Group3 메시지 ID			송신측 MAC ID						600-7bf	메시지 Group3
1	1	1	1	1	Group4 메시지 ID						7c0-7ef	메시지 Group4
1	1	1	1	1	1	1	1	X	X	X	7f0-7ff	invalid
10	9	8	7	6	5	4	3	2	1	0		

Table 4-2-1. Connection ID

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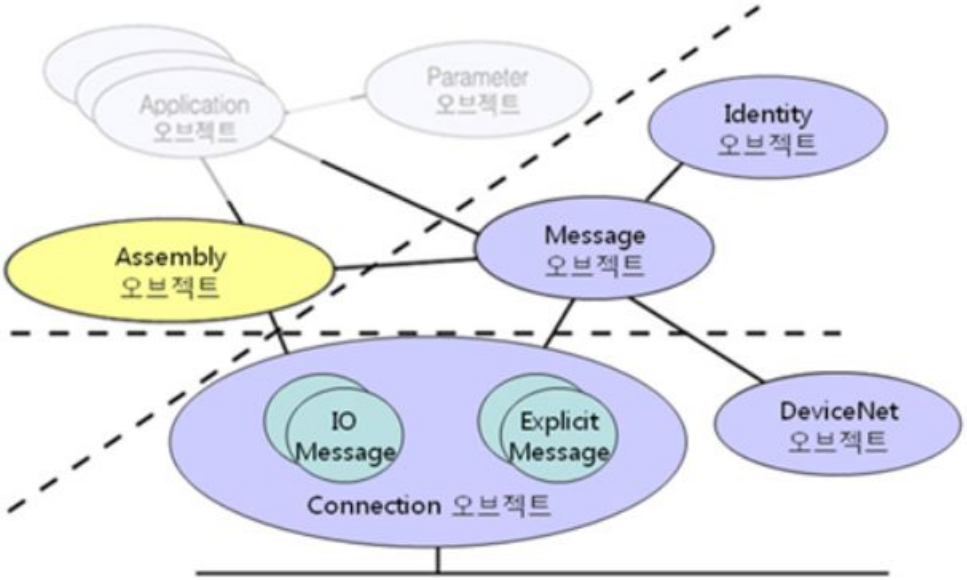

Fig 4-2-3. DeviceNet Connection

DeviceNet은 Upper 레이어로 Common Industrial Protocol (CIP) 을 사용한다. CIP는 철저한 Object oriented 특성을 지니고 있는데 각 Object는 Attributes (data), Services (commands), Behavior (reaction to events) 를 가지고 있다.

CIP 사양에는 두 가지의 다른 Type의 Object (즉, Communication Object / Application-specific Object)가 정의 되어 있는데. Vendor-specific Object도 정의 될 수 있는데. 이는 CIP 사양에 존재하지 않는 제품을 정의할 때 사용된다. 모든 Device상에는 최소한의 Common Object가 실행 되는데, 이를 통하여 Device간에 그 Device의 제조사에 관계없이 호환성이 가능하게 된다. CIP 기반 네트워크는 공통의 Application 계층을 기반으로 하고 있기 때문에, 애플리케이션 Data는 네트워크 Type에 관계없이 동일하게 유지된다. 따라서, 응용 프로그래머는 Device가 어떤 네트워크에 연결 되어 있는지 알 필요가 없다. CIP는 Device Profile도 정의하고 있습니다. 이 Device Profile은 Minimum Object Set, Configuration option, I/O data format 을 정의하고, 표준 Profile 중에 한 Type을 따르는 Device는 동일한 Profile을 가진 다른 Device와 동일한 I/O Data와 동일한 Configuration option을 가지며, 동일한 명령에 반응하며, 동일한 행동을 하게 된다.

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Device Profile	Device Type NO.
AC Drives	02hex
Communication Adapter	0chex
Contactor	15hex
DC Drives	13hex
DC Power Generator	1Fhex
General Purpose Discrete I/O	07hex

Table 4-2-2. Device Profile

Vendor 자신의 제품에 Minimum Object Set외에도 Vendor 고유의 특성을 추가하도록 하는 표준 메커니즘을 가지고 있으나, 이러한 추가 기능은 DeviceNet 규격에 규정 된 방식을 엄격히 준수하여 구현되야 한다.

근본적으로 DeviceNet은 Peer-to-Peer Messaging model을 채용해야 하지만, Master/Slave 관계를 기반으로 한 단순화 된 통신 방식도 제공하고 있다. 이 사전 정의 된 연결 방식이 Predefined Master/Slave Connection Set. 알려져 있다. 이러한 Connection 방법은 I/O 메세지의 교환을 간소화시키게 되고, 다수의 센서 및 액츄에이터는 통상적으로 Power-up 시에 그 Device가 Produce/Consume하는 Data의 유형과 양을 알 수 있는 Predetermined function (Connection object)를 제공을 수행하도록 설계되어 있다. 따라서, 네트워크에 전원을 공급 한 후, 마스터가 Slave안에 있는 이 Predefined Connection Set에 대한 Ownership을 요구하면 Data 교환이 즉시 가능하게 되고, Slave Device는 자신이 Configure된 결과와 Application의 요구에 따라, 오른쪽 표에 나타난 메세지 Type중 몇 개를 사용하여 Data를 Produce하게 된다.

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2. DeviceNet의 적용

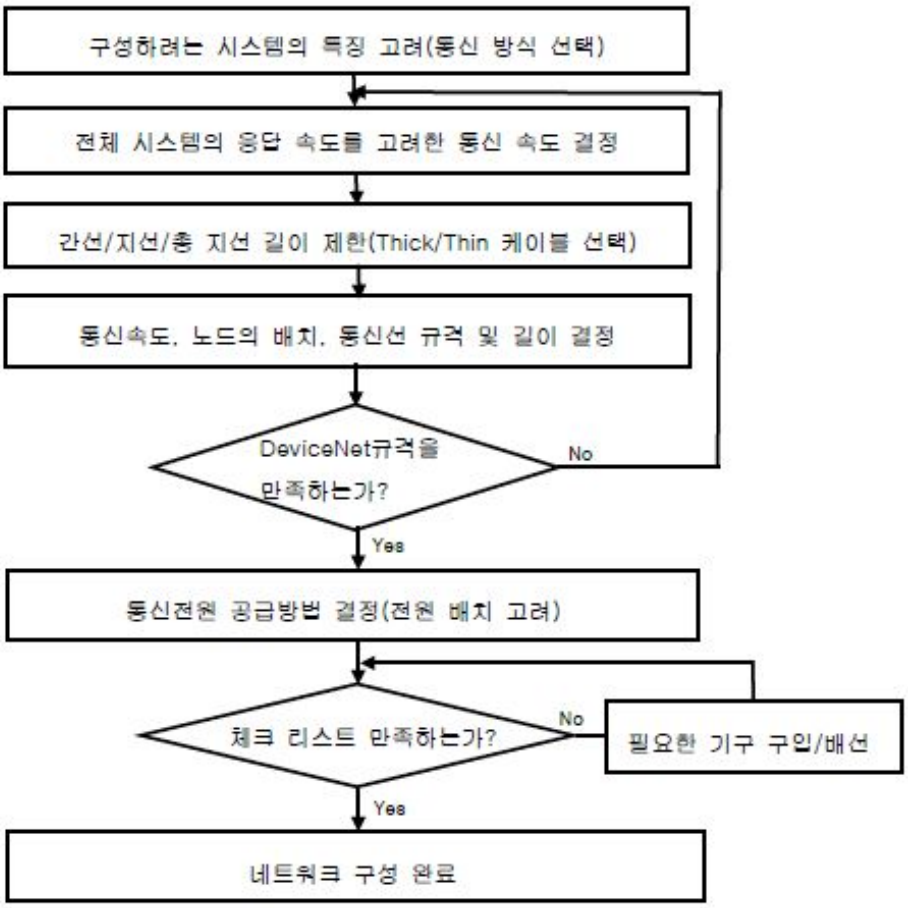

Fig 4-2-4. DeviceNet Network Check List

시스템의 구성을 위해서는 Fig 4-2-1와 같은 부분을 고려하여야 하는데 그중에서 가장 중요한 요소는 케이블의 선정이다. 로봇에 적용된 Tool은 많은 실린더와 센서등이 적용되었다. 본 연구에서는다관절 로봇을 적용하여 케이블이 많은 움직임이 있기 때문에 통신방식을 적용하므로써 배선을 감소시켰다.

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Fig 4-2-5. DeviceNet Cable Cross Sectional Diagram

구분	Thick	Thick	Thin	비고
형명	7897A	3082A	3084A	
케이블 종류	Round			
임피던스	120			
동작 온도 범위	-20 ~ 75			
최대 허용 전류	8		2.4	
최소 굴곡 반경	4.4	4.6	2.75	
심선 수	5선			

Table 4-2-3. DeviceNet Cable 규격

전송속도	최대거리	
	Thick 케이블	Thin 케이블
125kbps	500m	100m
250kbps	250m	100m
500kbps	100m	100m

Table 4-2-4. Single Trunk Line DeviceNet Cable 전송거리

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전송속도	Thin과 Thick케이블을 혼합하여 사용할 경우 최대 거리
125kbps	Thick 케이블 길이 + 5 x Thin 케이블 길이 < 500m
250kbps	Thick 케이블 길이 + 2.5 x Thin 케이블 길이 < 250m
500kbps	Thick 케이블 길이 + Thin 케이블 길이 < 100m

Table 4-2-5. Complex Trunk Line DeviceNet Cable 전송거리

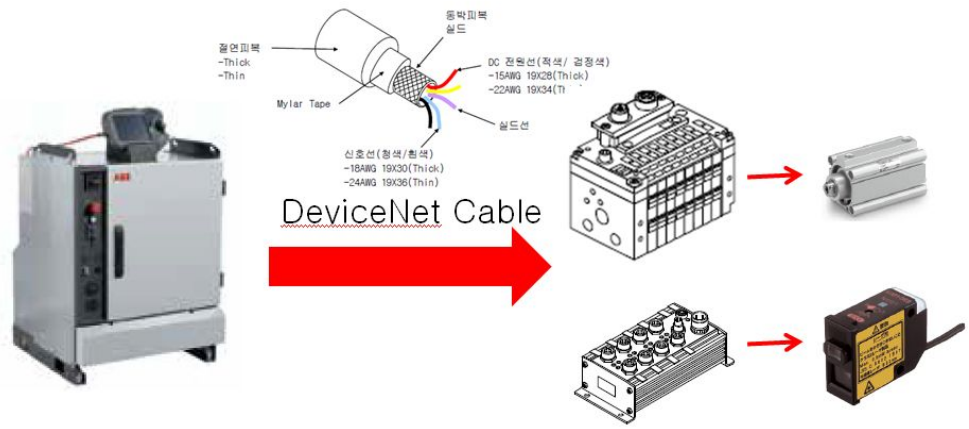

Fig 4-2-6. Application of DeviceNet Communication

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제5장. 실험 및 고찰

제1절. Steel Band Feeding Tension

결속시스템의 최종적인 연구목적은 결속력을 강하게 하여 물체를 큰 힘으로 결속하는 것이다. 가압장치와 공급장치가 결합된 Feeding Device에 구조용각형강으로 제작된 구조물에 설치하였다. 그리고 현재 제품의 결속에 가장 많이 사용되는 32미리(mm)폭에 0.8미리(mm)두께의 철밴드를 적용하여 실험하였다. 결속력측정은 AND TB-5T 장비를 사용하였고 최대 5톤(ton)의 하중을 측정할 수 있고 1눈의 값은 1(Kg)이며 분해능이 1/5,000의 성능을 가진 로드셀(load cell)을 이용하여 실험하였다.[13]

Fig 5-1-1. Load Cell (AND KOREA)

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Fig 5-1-2. Tension Test (6kgf/cm^2)

국내 많은 공장의 산업현장에서는 6 kgf/cm^2을 가장 많이 사용되어 기본적으로 공압시스템을 설계할 때도 기준으로 적용된다. 이러한 실험을 위해서 정확한 압력을 위해서 레귤레이터(regulator)를 통해 조절하여 에어모터에 공급하여 실험하였으며 결과는 그래프와 같이 최대하중이 1,366(kg)까지 측정되었다.

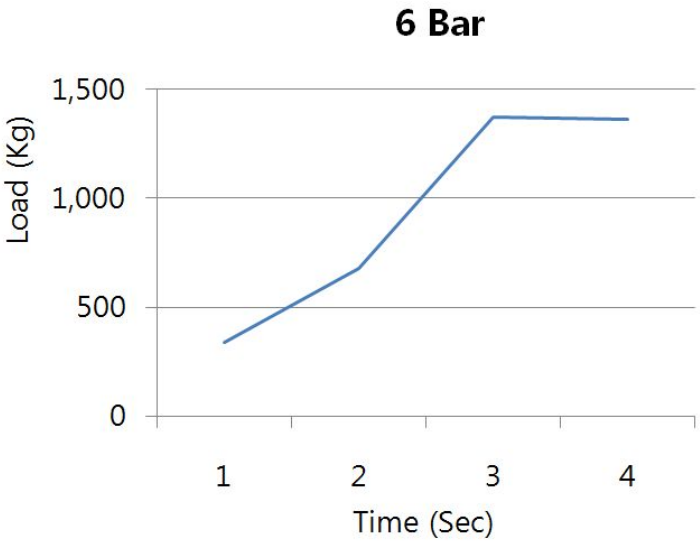

Fig 5-1-3. Tension Test Graph (6kgf/cm^2)

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Fig 5-1-4. Tension Test (7kgf/cm^2)

공압시스템에 사용되는 모터와 실린더는 보편적으로 최대 10kgf/cm^2까지 사용할 수 있도록 되어있다. 그러나 거의 대부분의 산업현장에서는 안전의 문제로 인하여 8kgf/cm^2이상의 압력은 사용하지 않고 있다. 제품의 손상되지 않고 산업현장의 보편적인 적용에 대응하기 위해서 레귤레이터(regulator)를 통해 7kgf/cm^2의 압력과 8kgf/cm^2의 압력을 셋팅하여 에어모터에 공급하여 실험하였다.

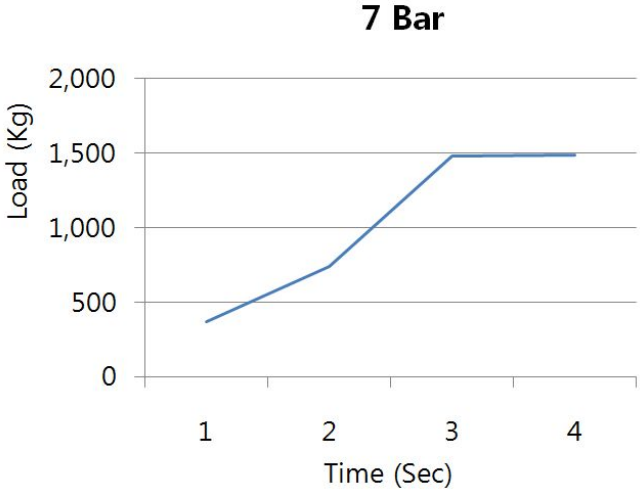

Fig 5-1-5. Tension Test Graph (7kgf/cm^2)

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Fig 5-1-6. Tension Test (8kgf/cm^2)

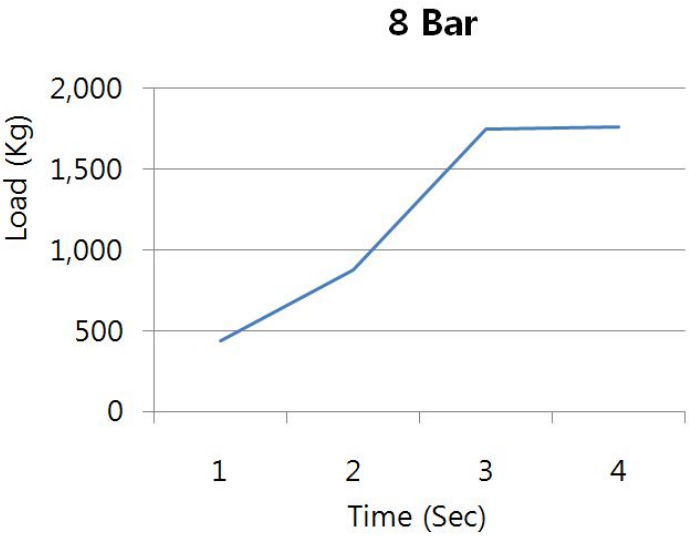

Fig 5-1-7. Tension Test Graph (8kgf/cm^2)

철밴드의 인장력 테스트의 결과는 7kgf/cm^2의 경우에는 최대하중이 1,480(kg)까지 측정되었으며 8kgf/cm^2에서는 1,752(kg)이 측정되었다. 산업현장에서 결속력을 1,200(kg)정도를 선호한다는 것에 기준할 때 6kgf/cm^2의 압력을 사용하더라도 충분히 적용가능할 것으로 판단된다.

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제2절. Steel Band Spot Welding Tension

물체를 결속하기 위해 두 개의 철 밴드를 용접하였을 때 용접점수에 따른 접합력에 얼마만큼 강한지가 매우 중요한 조건이 된다. 이러한 결과를 얻기 위해서 트랜스포머 모듈에 상부팁 제어장치와 하부팁 제어장치를 연결하여 32미리(mm)폭에 0.8미리(mm)두께 규격의 철 밴드에 2점과 4점을 용접하고 그에 대한 인장력을 테스트를 하였다. 우선은 기준이 될 수 있는 용접되지 않는 철밴드와 용접된 철밴드를 대상으로 인장실험기로 접합력에 대한 실험을 하였다. 철 밴드의 접합력에 대한 인장 측정은 MTS사의 LandMark 인장실험기을 사용하였다. 이 실험기는 인장거리는 0~1,000(mm)이며 최대인장속도는 500(mm/min)이며 금속시험편을 최대 50(KN)의 힘으로 당길 수 있다.[24]

Fig 5-2-1. Tensile Tester (MTS Landmark)

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앞서 말했던 것과 같이 모든 실험에는 기준이라는 것이 필요하다. 용접된 철 밴드의 접합력에 대해 기준을 가지고 실험을 하기 위해서는 비교할 대상물이 있어야 한다. 그래서 용접되지 않는 철 밴드를 인장시험기에 장착하여 실험하였다.

Fig 5-2-2. 용접되지 않는 시험편 인장 실험 결과

실험결과 용접되지 않는 시험편은 최대22.55(kN)의 힘으로 인장력이 가해지면 밴드가 절단되었다. 연속적으로 10회를 실험한 결과 평균 22.35(kN)의 인장력이 가해지면 밴드가 절단되었다.

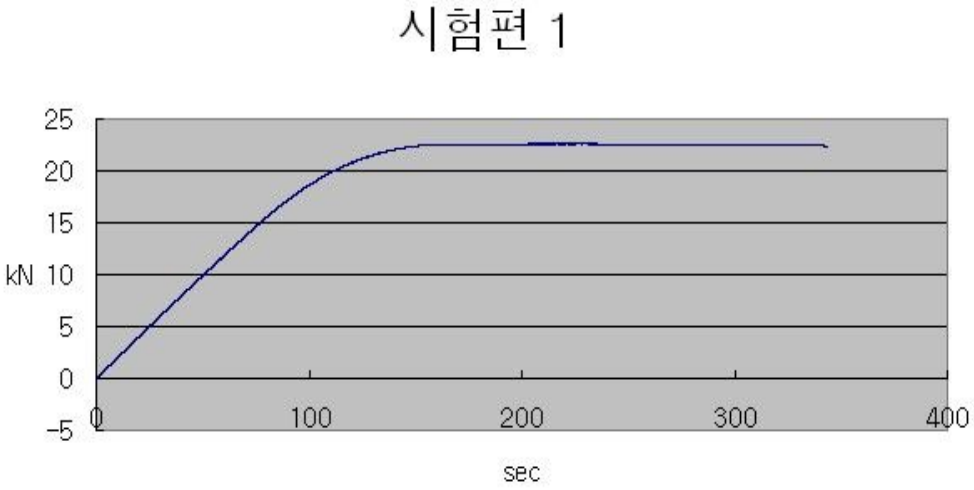

Fig 5-2-3. 용접되지 않는 시험편 인장 실험 그래프

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Wedling Unit는 빠른 시간에 원하는 작업을 진행하기 위해서 동시에 2점을 용접할 수 있도록 양쪽Tip에 각각 다른 극성의 전력을 투입되어 접합한다. 이로 인해 2점이 용접된 시험편을 인장 시험기에 장착하여 실험하였다.

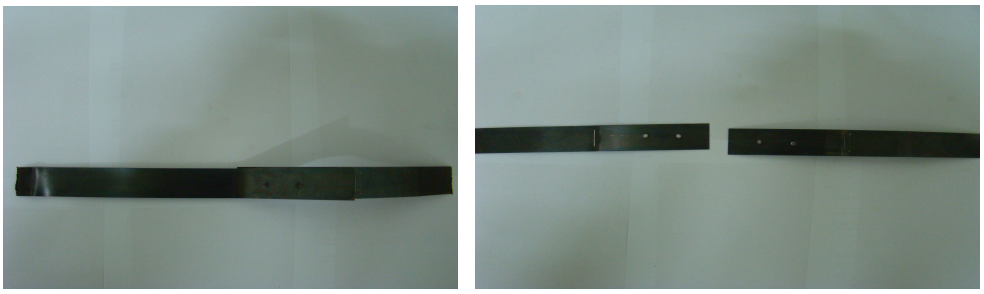

Fig 5-2-4. 2점 용접 시험편 인장 실험 결과

실험결과 2점이 용접된 시험편은 최대17.25(kN)의 힘으로 인장력이 가해지면 용접된 부위에서 분리가 되었다. 연속적으로 10회를 실험한 결과 평균 17.13(kN)의 인장력이 가해지면 용접된 부위에서 분리되었다. 용접되지 않는 시험편을 기준으로 하였을 때 용접효율은 평균 76.6(%)정도 된다.

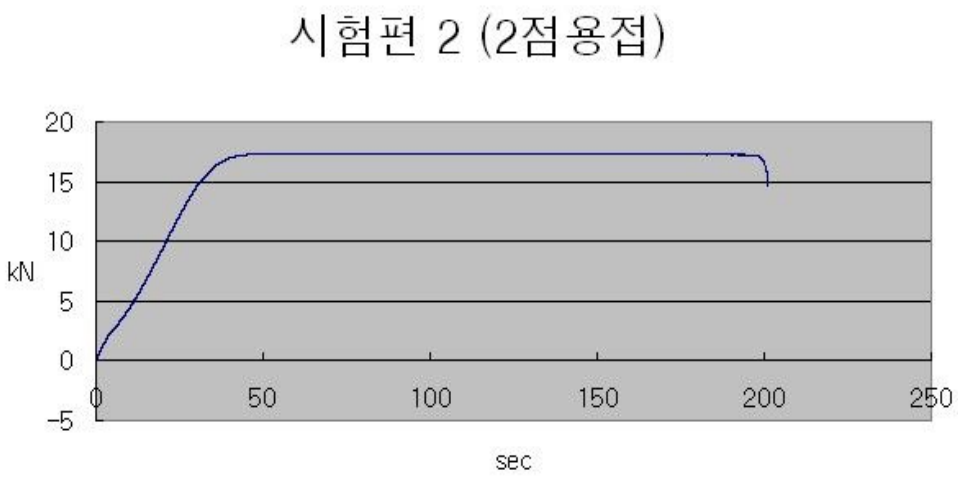

Fig 5-2-5. 2점 용접 시험편 인장 실험 그래프

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3장에서 설명했듯이 공압시스템을 기반으로 되어 있는 2개의 실린더를 이용하여 1회에 2점을 용접하며 최대2회를 걸쳐 4점을 용접할 수 있도록 구성되어 있다. 4점이 용접된 시험편을 인장 시험기에 장착하여 실험하였다.

Fig 5-2-6. 4점 용접 시험편 인장 실험 결과

실험결과 4점이 용접된 시험편은 최대22..52(kN)의 힘으로 인장력이 가해지면 밴드의 용접된 부위가 아닌 Cutting하는 과정에서 Jaw에 Grip되어 취약해진 지점에서 철 밴드가 절단되었다. 연속적으로 10회를 실험한 결과 평균 22.45(kN)의 인장력이 가해지면 용접된 부위가 아닌 곳에서 철 밴드가 절단되었다.

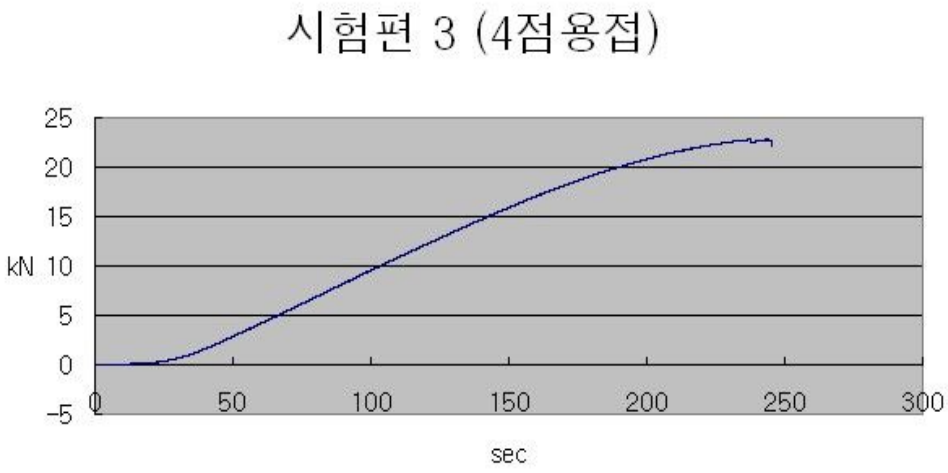

Fig 5-2-7. 4점 용접 시험편 인장 실험 그래프

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결속을 하는 최종적인 목적은 어떠한 제품이 포장되었을 때 외부에 어떠한 힘이 가하더라도 풀리지 않게 하기 위해서이다. 접합된 지점에서 강한 인장력에 의해서 풀리지 않은 것이 중요한데 실험 결과 4점을 용접하였을 때 용접되지 않는 원재와 거의 같은 인장력이 가해야만 절단되었다. 또한 2점을 용접할 경우에도 용접되지 않는 원재의 70%이상의 인장력을 가해야만 절단되는 것으로 나타났다. 4점을 용접할 경우에는 실린더의 동작이 추가되어 2점보다 시간이 3초정도 더 소요되어 큰 인장력이 필요할 경우에는 4점을 용접하고 그러지 않는 경우에는 2점을 용접하여 적용하면 될 것으로 판단된다.

검사항목	절단시 인장력 (KN)			비 고
	평균	최대	최소	
1. 원재 (용접되지 않은 시험편)	22.35 KN	22.55 KN	22.15 KN	-
2. 2점 용접된 시험편	17.13 KN	17.25 KN	17.01 KN	-
3. 4점 용접된 시험편	22.45 KN	22.52 KN	22.08 KN	용접 부위 외에서 절단됨

Table 5-2-1. Spot Welding 인장 실험 결과

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6장. 결 론

본 논문에서는 어떠한 제품을 포장하기 위해 Steel Band를 이용하여 결속을 하는데 2대의 다관절 산업로봇을 적용하여 그 끝에 연구한 Tool을 복합하여 구성하였으며 여러 가지 센서를 DeviceNet Communication 방식을 적용하여 현재 정보를 획득하고, 이정보를 이용하여 안정적이고 우수한 인장력을 가진 결속하는 방법을 제안하여 만족할 만한 결과를 획득할 수 있었다. 그리고 전체적인 시스템 제어와 관련하여 프로그래밍을 통해 사용하여 인간이 직접 작업 및 조작하는 방식과 비교하여 지능적으로 설비를 운용하는 조작성이 뛰어나고, 제품의 관리나 작업 이력등의 정보관리 체제 또한 단순하고 획일적으로 구성되어 사용자의 편의성이 강화되었다.

또한 본 논문에서는 물체가 풀어지지 않도록 Steel Band를 이용하여 큰 힘으로 결속할 때 필요한 Feeding Device와 Spot 용접시스템,Cutting Unit를 하나의 장치에 통합시켜 구성하였고 공정 중에 발생되는 동작상황이나 오류 등을 자동으로 감지하여 진행 및 정지 등의 알람시스템을 작동시켜 줄 수 있도록 많은 센서와 콘트롤러를 사용하여 Feed Back 될 수 있도록 Programming하여 새로운 제어 시스템의 구축을 실현하였다.

향후 연구 과제로는 본 논문에서 제안한 결속시스템으로 많은 부품들과 센서들이 통신을 통한 하나의 시스템으로 통합하는 개발이 활발하게 이뤄지고 있는 현실에서 인간과 기계가 소통하는 HMI시스템의 많은 발전이 필요하다. 손안에 디지털이라는 말이 나올 정도로 생활 속에서 접하는 모든 기기와 프로그래밍이 호환되어야 하기 때문이다. 또한 대부분의 설비나 기기는 365일 동안 거의 모든 시간에 가동되기 때문에 내구성이 뛰어나고 인간의 두뇌만큼 판단력이 뛰어난 고부가가치의 결과물이 계속해서 연구되기를 기대해 본다.

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부 록

실제 코딩하여 사용된 ROBOT 프로그램(ROBOT-1)

- 기본 시스템 셋팅

```
MODULE user (SYSMODULE)

! Predefined user data
!*********************

! Declaration of numeric registers reg1...reg5
VAR num reg1 := 0;
VAR num reg2 := 0;
VAR num reg3 := 0;
VAR num reg4 := 0;
VAR num reg5 := 0;

! Declaration of stopwatch clock1
VAR clock clock1;

! Template for declaration of workobject wobj1
!TASK PERS wobjdata wobj1 := [FALSE, TRUE, "", [[0, 0, 0],[1, 0, 0, 0]],[[0,
0, 0],[1, 0, 0, 0]]];

! Declaration of Home Signal
TASK PERS pos pHomepos:=[-113.21,-990.88,1379.29];
VAR shapedata HomeZoneShape;
VAR wzstationary HomeData;
TASK PERS pos poHomepos:=[-113.256,-990.81,1379.34];
VAR shapedata oHomeZoneShape;
VAR wzstationary oHomeData;
```


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```
PROC rRob1HomeZones()
pHomepos:=pHome.trans;
WZSphDef\Inside,HomeZoneShape,pHomepos,100;
WZDOSet\Stat, HomeData\Inside, HomeZoneShape, so12_Rob1_HomeSig, 1;
poHomepos:=pHome.trans;
WZSphDef\Inside,oHomeZoneShape,poHomepos,100;
WZDOSet\Stat, oHomeData\Inside, oHomeZoneShape, so14_Rob1_oHomeSig, 1;
ENDPROC

ENDMODULE
```

- Main Program

```
MODULE MainModule_R1
!+++++          SYSTEM DESCRIPTION          +++++
!-------------------------------------------
!Application      :
!Customer         :
!Robot Serial No :
!Project No       : RS
!Author           :
!Installation Date :
!---------------- Program Teach Target data ----------------
!  IF nCoilDia>1200 AND nCoilWidth>1220 THEN
! Program Target point
TASK PERS robtarget
pOdOut{3}:=[[[246.7,-1231.37,-1111.37],[0.717255,-0.00149852,0.696797,-0.00402763],[0
,0,-1,1],[-1559.96,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-219.32,-1232.05,-1130.2],[0.708
407,-6.56083E-05,0.705792,-0.00405027],[-1,-1,0,1],[-201.126,9E+09,9E+09,9E+09,9E+0
9,9E+09]],[[734.25,-1232.03,-1126.65],[0.709836,-0.00379001,0.704345,-0.00403216],[0,0,
-1,1],[-1559.97,9E+09,9E+09,9E+09,9E+09,9E+09]]];
```


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```
TASK PERS robtarget
pOdBdOut1{3}:=[[[245,-1382.53,-745.37],[0.692634,0.152246,0.68914,0.148882],[-1,-1,0,
1],[-1560,9E+09,9E+09,9E+09,9E+09,9E+09]],[[1064.99,-1382.52,-745.32],[0.690347,0.16
2343,0.691236,0.138774],[-1,-1,0,1],[-101.135,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-540
.01,-1382.53,-745.35],[0.693734,0.14717,0.688027,0.153926],[-1,-1,0,1],[-1450,9E+09,9E+
09,9E+09,9E+09,9E+09]]];
TASK PERS robtarget
pOdBdOut2{3}:=[[[2017.49,-958.17,452.23],[0.711542,0.0295138,0.69966,0.0575537],[-1,-
1,0,1],[-1263.33,9E+09,9E+09,9E+09,9E+09,9E+09]],[[9.92271E+06,-928.62,447.06],[0.70
0085,0.0291009,0.71129,0.0556777],[-1,-1,0,1],[225.557,9E+09,9E+09,9E+09,9E+09,9E+09
]],[[-9.91867E+06,-911.68,524.57],[0.699479,0.0365453,0.71093,0.06302],[-1,-1,0,1],[-137
4.36,9E+09,9E+09,9E+09,9E+09,9E+09]]];
TASK PERS robtarget
pOdIn{3}:=[[[234.68,-1325.12,-753.114],[0.693761,0.134549,0.69533,0.130797],[-1,-1,0,1],
[-1438.12,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-260.46,-1323.42,-746.694],[0.699143,0.1
33022,0.692462,0.118324],[-1,-1,0,1],[-450.119,9E+09,9E+09,9E+09,9E+09,9E+09]],[[759.
18,-1320.99,-754.754],[0.693679,0.141243,0.692714,0.137867],[-1,-1,0,1],[-1300.67,9E+09
,9E+09,9E+09,9E+09,9E+09]]];
TASK PERS robtarget
pOdWeld{3}:=[[[233.02,-1104.64,-611.214],[0.695341,0.143022,0.687654,0.152244],[0,0,0,
1],[-1438.12,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-254.5,-1104.01,-605.854],[0.695159,0
.126109,0.696601,0.124893],[-1,-1,0,1],[-450.119,9E+09,9E+09,9E+09,9E+09,9E+09]],[[76
9.5,-1107.53,-617.194],[0.694366,0.139933,0.690594,0.146132],[0,0,0,1],[-1420.13,9E+09,9
E+09,9E+09,9E+09,9E+09]]];
!-----------------------------------------------------------------
-----------------------------------------------------------------
---

TASK PERS robtarget
pIdBdOut1{6}:=[[[803.99,-565.28,-337.465],[0.123315,-0.881294,-0.448249,-0.0847807],[
-1,0,0,0],[862.791,9E+09,9E+09,9E+09,9E+09,9E+09]],[[809.14,-382.55,-173.745],[0.8063
61,0.368542,0.19224,-0.420716],[-1,0,0,1],[2377,9E+09,9E+09,9E+09,9E+09,9E+09]],[[778
.03,-339.94,-317.005],[0.121518,0.885363,-0.444062,0.0646109],[0,-1,-1,0],[-1146.75,9E+
```


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09,9E+09,9E+09,9E+09,9E+09]],[[784.59,-565.68,-156.895],[0.791715,-0.383348,0.201323,0.43093],[0,-1,-1,1],[-2185.74,9E+09,9E+09,9E+09,9E+09,9E+09]],[[781.93,-615.18,-272.835],[0.0167378,-0.89409,-0.447547,0.00502875],[-1,-1,0,0],[1000,9E+09,9E+09,9E+09,9E+09,9E+09]],[[794.32,-357.63,-264.815],[0.0329141,-0.894798,0.445057,0.0133225],[0,0,-1,0],[-1146.76,9E+09,9E+09,9E+09,9E+09,9E+09]]];

TASK PERS robtarget

pIdBdOut2{6}:=[[[891.16,-712.9,-385.155],[0.111043,-0.814338,-0.560766,-0.10032],[-1,0,0,0],[862.785,9E+09,9E+09,9E+09,9E+09,9E+09]],[[839.71,-310.09,-89.9888],[0.735203,0.336023,0.244669,-0.535447],[-1,0,0,1],[2377,9E+09,9E+09,9E+09,9E+09,9E+09]],[[794.62,-235.49,-345.485],[0.110111,0.806294,-0.575279,0.0825776],[0,-1,-1,0],[-1146.75,9E+09,9E+09,9E+09,9E+09,9E+09]],[[789.7,-640.14,-64.2589],[0.720361,-0.349869,0.255106,0.541842],[0,-1,-1,1],[-1950,9E+09,9E+09,9E+09,9E+09,9E+09]],[[817.94,-753.1,-272.919],[0.0173644,-0.800254,-0.599406,0.0019713],[-1,-1,0,0],[1000,9E+09,9E+09,9E+09,9E+09,9E+09]],[[845.49,-246.59,-264.63],[0.0300607,-0.802761,0.595244,0.0188925],[0,0,-1,0],[-1146.76,9E+09,9E+09,9E+09,9E+09,9E+09]]];

TASK PERS robtarget

pIdIn{6}:=[[[-115.64,-1201.39,-760.581],[0.0040297,0.00879146,0.97148,0.236925],[-1,0,-1,0],[-759.686,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-262.02,79.3665,283.79],[0.00155315,-0.00167985,-0.415707,0.909495],[-1,0,-2,1],[1843.31,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-183.87,307.525,-776.681],[0.00172714,0.0206671,-0.968711,0.247325],[0,-1,0,0],[1332.69,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-260.6,-966.326,293.22],[0.00415344,-0.00842296,0.432922,0.901382],[0,-1,1,1],[-1338.56,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-252.4,-1503.09,-175.08],[0.00146873,-0.0183664,0.999743,0.0131724],[-1,0,-1,0],[-820.062,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-248.06,565.95,-165.73],[0.00320619,-0.0135922,0.999277,0.0353619],[0,0,0,0],[954.123,9E+09,9E+09,9E+09,9E+09,9E+09]]];

TASK PERS robtarget

pIdOut{6}:=[[[-397.47,-553.16,-404.907],[0.180092,-0.68576,-0.687888,-0.155277],[-1,0,0,0],[862.794,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-374.59,-410.33,-270.247],[0.644239,0.294459,0.293381,-0.64201],[-1,0,-1,1],[1959.84,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-393.81,-379.87,-398.667],[0.172622,0.685873,-0.684392,0.177166],[0,-1,-1,0],[-1146.75,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-403.55,-532.9,-262.857],[0.634052,-0.309132,0.303219,0.640682],[0,-1,0,1],[-1979.98,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-389.72,-577.88,-335.937],[0.0174559,-0.694852,-0.71894,-0.000809557],[-1,-1,0,0],[1000.01,9E+09,9E+09,9

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```
E+09,9E+09,9E+09]],[[-397.83,-380.47,-329.367],[0.0270066,-0.708007,0.705312,0.02304
94],[0,0,-1,0],[-1146.76,9E+09,9E+09,9E+09,9E+09,9E+09]]];
TASK PERS robtarget
pIdViaP1{6}:=[[[-465.74,-989.535,-635.921],[0.181619,-0.692495,-0.681103,-0.15351],[-
1,0,0,0],[674.141,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-466.29,-54.5435,160.7],[0.634516,
0.29001,0.297769,-0.651628],[-1,0,-1,1],[1767.8,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-4
09.88,7.33528,-616.951],[0.174147,0.691784,-0.678415,0.175671],[0,-1,-1,0],[-631.122,9E
+09,9E+09,9E+09,9E+09,9E+09]],[[-422.76,-901.276,208.83],[0.643389,-0.313537,0.29863
3,0.631319],[0,-1,0,1],[-1914.59,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-573.31,-1267.02,-
172.36],[0.0174586,-0.697561,-0.716313,-0.000746659],[-1,-1,0,0],[379.232,9E+09,9E+09,
9E+09,9E+09,9E+09]],[[-542.9,412.27,-163.18],[0.0266811,-0.69778,0.715432,0.0234382],[
0,0,-1,0],[-210.92,9E+09,9E+09,9E+09,9E+09,9E+09]]];
TASK PERS robtarget
pIdViaP2{6}:=[[[-334.69,-1216.77,-757.341],[0.117215,-0.413779,-0.878771,-0.206905],[
-1,0,-1,0],[-20.6393,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-327.86,104.256,344.09],[0.469
217,0.214468,0.356068,-0.779137],[-1,0,-1,1],[1767.8,9E+09,9E+09,9E+09,9E+09,9E+09]],
[[-332.06,280.125,-765.961],[0.11135,0.448332,-0.85896,0.220881],[0,-1,0,0],[-11.3477,9E
+09,9E+09,9E+09,9E+09,9E+09]],[[-291.21,-1017.75,356.73],[0.475619,-0.233914,0.36437
,0.765706],[0,-1,0,1],[-1914.59,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-573.31,-1267.02,-1
72.36],[0.0174586,-0.697561,-0.716313,-0.000746659],[-1,-1,0,0],[379.232,9E+09,9E+09,9
E+09,9E+09,9E+09]],[[-542.9,412.27,-163.18],[0.0266811,-0.69778,0.715432,0.0234382],[0
,0,-1,0],[-210.92,9E+09,9E+09,9E+09,9E+09,9E+09]]];
TASK PERS robtarget
pIdWeld{6}:=[[[-310.82,-868.605,-805.511],[0.277145,-0.646776,-0.657616,-0.269095],[-
1,0,0,0],[736.054,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-312.08,-13.7735,88.8],[0.649531,0
.280318,0.255323,-0.659046],[-1,0,-1,1],[1766.56,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-
311.93,-19.6947,-824.951],[0.26879,0.65058,-0.654046,0.276986],[0,-1,-1,0],[-692.994,9E
+09,9E+09,9E+09,9E+09,9E+09]],[[-309.9,-888.737,72.52],[0.642591,-0.282729,0.258507,
0.663563],[0,-1,0,1],[-1908.07,9E+09,9E+09,9E+09,9E+09,9E+09]],[[-382.15,-951.8,-475.
454],[0.0107472,0.695153,0.718773,-0.00341103],[-1,-1,0,0],[802.872,9E+09,9E+09,9E+09,
9E+09,9E+09]],[[-381.94,75.13,-482.274],[0.000323983,0.700231,-0.713901,0.00452052],[0
,-1,-1,0],[-495.917,9E+09,9E+09,9E+09,9E+09,9E+09]]];
```


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```
!---------------- Program Soft Act Target data ----------------
TASK PERS robtarget
pSoftAct:=[[-287.521,61.3333,239.369],[0.00155117,-0.0016836,-0.415706,0.909496],[-1,
0,-2,1],[1825.28,9E+09,9E+09,9E+09,9E+09,9E+09]];
!---------------- Program Tool data ----------------
TASK PERS tooldata
toolPeader1:=[TRUE,[[95,612,253],[1,0,0,0]],[206.1,[7.8,249.6,208.1],[1,0,0,0],19.713,12.68
9,16.527]];
TASK PERS tooldata
toolPeader2:=[TRUE,[[95,-612,253],[1,0,0,0]],[206.1,[7.8,-247.1,183],[1,0,0,0],18.382,11.4
57,17.193]];
TASK PERS tooldata
toolPeader:=[TRUE,[[95,-612,253],[1,0,0,0]],[206.1,[7.8,-247.1,183],[1,0,0,0],18.382,11.45
7,17.193]];
!---------------- Program Num data ----------------
TASK PERS num nOdJabNo:=3;
TASK PERS num nX:=-100;
TASK PERS num nTheta:=-15;
TASK PERS num nY:=50;
TASK PERS num nZ:=10;
TASK PERS num nFreeFdTime:=0;
TASK PERS num nIdJabNo:=4;
PERS num nDamping:=80;
PERS num nStiffness:=100;
PERS num nLHSideOdVer:=0;
PERS num nRHSideOdVer:=0;
PERS num nCoilDiaMax:=2300;
PERS num nCoilDiaMin:=800;
PERS num nCoilWidthMax:=1860;
PERS num nCoilWidthMin:=800;
PERS num nOffsetLimit:=30;
PERS num nRob1_X := -61;
PERS num nOffsetM := -40;
```


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```
PERS num nRobStartPos:=1;
!---------------- Program Bool data ----------------
TASK PERS bool bOdWork:=FALSE
PERS bool b9BandWork:=FALSE
PERS bool bIdSideJob:=FALSE
PERS bool bPadIn:=FALSE
PERS bool IdSide2PointUse:=FALSE
!---------------- Program Wobj data ----------------
TASK PERS wobjdata
wobjHead:=[FALSE,TRUE,"",[[1777.29,440.578,1587.98],[1,0,0,0]],[[0,0,0],[1,0,0,0]]];
!---------------- Program Pose data ----------------
PERS pose Rob1Offset := [[-61,0,0],[1,0,0,0]];
VAR syncident syncStart;
VAR syncident syncHome;
VAR syncident sync1;
VAR syncident sync2;
VAR syncident sync3;
VAR syncident sync4;
VAR syncident sync5;
VAR syncident sync6;
VAR syncident sync7;
VAR syncident sync8;
VAR syncident sync9;
PERS tasks Alltask{2}:=[["T_ROB1"],["T_ROB2"]];
CONST robtarget
pHome10:=[[-113.21,562.19,1379.27],[0.01148,0.0375477,0.946181,-0.321247],[-2,0,-1,0],
[1642.91,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pHome20:=[[42.82,2650.00,1599.19],[0.475414,-0.879375,0.00197304,0.0260332],[1,0,-1,0]
,[1806.14,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pHome30:=[[-647.75,4035.34,902.42],[0.458865,-0.529705,0.538423,0.467927],[1,0,0,1],[18
06.14,9E+09,9E+09,9E+09,9E+09,9E+09]];
```


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```
CONST robtarget
poHome10:=[[-113.20,-218.09,1379.28],[0.0114804,0.0375429,0.946174,-0.321269],[-2,0,-
2,0],[533.728,9E+09,9E+09,9E+09,9E+09,9E+09]];
VAR bool bDataError:=FALSE
CONST identno idSideId:=10;
CONST robtarget
pId1hHome30:=[[-667.97,-1657.42,1083.95],[0.644465,-0.275218,0.253832,0.666701],[0,-
1,1,1],[-1744.28,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pToolTurnMove20:=[[-1181.60,834.10,976.43],[0.487805,0.497467,0.500129,-0.514241],[
-2,-1,-1,0],[2018.35,9E+09,9E+09,9E+09,9E+09,9E+09]];



PROC rMoveToId1hRdy()
MoveJ pHome,v2500,fine,toolPeader1;
rPrtDownChk;
!MoveJ pId79Move10, v5000, z100, toolPeader1\WObj:=wobjHead;
MoveJ pToolTurnMove20, v5000, fine, toolPeader1\WObj:=wobjHead;
MoveJ pToolTurnMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
Set po22_DfLeft;
rHeadPosTurn;
MoveJ pId1hMove20, v2500, z100, toolPeader1\WObj:=wobjHead;
MoveJ pId1hMove10,v1000,z50,toolPeader2\WObj:=wobjHead;
RETURN
ENDPROC

PROC rbandInDia1h()
WaitSyncTask syncHome, Alltask;
nIdJabNo:=4;
rMoveToId1hRdy;
rIdStrap;
rMoveHomeFromId1h;
```


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```
RETURN
ENDPROC


PROC rMoveHomeFromId1h()
MoveL pIdViaP2{nIdJabNo}, v2500, z50, toolPeader\WObj:=wobjHead;
PDispOff;
MoveJ pId1hHome10, v5000, z100, toolPeader2\WObj:=wobjHead;
MoveJ pId1hHome20, v5000, z100, toolPeader2\WObj:=wobjHead;
MoveJ pToolHomeMove10,v5000,fine,toolPeader1\WObj:=wobjHead;
rHeadPosHome;
MoveJ pHome,v1000,fine,toolPeader1;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
RETURN
ENDPROC

PROC rMoveToId35hRdy()
MoveJ pHome,v2500,fine,toolPeader1;
rPrtDownChk;
RETURN
ENDPROC

PROC rbandInDia5h()
WaitSyncTask syncHome, Alltask;
nIdJabNo:=1;
rMoveToId35hRdy;
rIdStrap;
rMoveHomeFromId35h;
RETURN
ENDPROC

PROC rbandInDia3h()
```


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```
WaitSyncTask syncHome, Alltask;
nIdJabNo:=5;
rMoveToId35hRdy;
rIdStrap;
rMoveHomeFromId35h;
RETURN
ENDPROC


PROC rMoveHomeFromId35h()
PDispOff;
MoveJ pHome,v1000,z150,toolPeader1;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
ENDPROC


PROC rMoveToId79hRdy()
MoveJ pHome,v2500,fine,toolPeader1;
rPrtDownChk;
!MoveJ pId79Move10, v5000, z100, toolPeader1\WObj:=wobjHead;
MoveJ pToolTurnMove20, v5000, fine, toolPeader1\WObj:=wobjHead;
MoveJ pToolTurnMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
Set po22_DfLeft;
rHeadPosTurn;
MoveJ pId1hMove20, v2500, z100, toolPeader1\WObj:=wobjHead;
RETURN
ENDPROC

PROC rbandInDia7h()
WaitSyncTask syncHome, Alltask;
nIdJabNo:=3;
rMoveToId79hRdy;
```


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```
rIdStrap;
rMoveHomeFromId79h;
RETURN
ENDPROC

PROC rbandInDia9h()
WaitSyncTask syncHome, Alltask;
nIdJabNo:=6;
rMoveToId79hRdy;
rIdStrap;
rMoveHomeFromId79h;
RETURN
ENDPROC


PROC rMoveHomeFromId79h()
MoveL pIdViaP2{nIdJabNo}, v5000, fine, toolPeader\WObj:=wobjHead;
PDispOff;
MoveJ pId1hMove20, v5000, z100, toolPeader1\WObj:=wobjHead;
MoveJ pId1hMove30, v5000, z100, toolPeader1\WObj:=wobjHead;
MoveJ pId1hMove40, v5000, z100, toolPeader1\WObj:=wobjHead;
MoveJ pToolHomeMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
rHeadPosHome;
MoveJ pHome,v1000,fine,toolPeader1;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
RETURN
ENDPROC

PROC rMoveToId11hRdy()
MoveJ pHome,v2500,fine,toolPeader1;
rPrtDownChk;
MoveJ Offs(pIdOut{2},-200,0,0), v500, z10, toolPeader1\WObj:=wobjHead;
```


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```
RETURN
ENDPROC

PROC rbandInDia11h()
WaitSyncTask syncHome, Alltask;
nIdJabNo:=2;
rMoveToId11hRdy;
rIdStrap;
rMoveHomeFromId11h;
RETURN
ENDPROC

PROC rMoveHomeFromId11h()
MoveL pIdViaP2{2},v5000,z100,toolPeader1\WObj:=wobjHead;
MoveL pIdViaP1{2},v5000,z100,toolPeader1\WObj:=wobjHead;
PDispOff;
MoveJ pId11hHome10, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveJ pHome,v1000,fine,toolPeader1;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
RETURN
ENDPROC


PROC rMoveToOdRdy()
MoveJ pHome,v2500,fine,toolPeader1;
Reset po13_SaftPosAll;
IF nOdJabNo=1 THEN
rPrtDownChk;
ELSEIF nOdJabNo=2 THEN
WaitDI pi16_PrtDownChkF,1;
WaitDI pi17_PrtUpChkH, 1;
```


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```
ELSEIF nOdJabNo=3 THEN
Set po18_PrtUpRqF;
WaitDI pi15_PrtDownChkH,1;
WaitDI pi18_PrtUpChkF,1;
!Reset po18_PrtUpRqF;
ENDIF
MoveJ pOdMove10,v5000,z20,toolPeader1\WObj:=wobjHead;
MoveJ pOdMove20,v5000,z20,toolPeader1\WObj:=wobjHead;
MoveJ pOdMove30,v5000,z20,toolPeader1\WObj:=wobjHead;
ENDPROC

PROC rbandOutDiaFg()
WaitSyncTask syncHome, Alltask;
nOdJabNo:=3;
rMoveToOdRdy;
rOdStrap;
rMoveHomeFromOd;
RETURN
ENDPROC

PROC rbandOutDiaHd()
WaitSyncTask syncHome, Alltask;
nOdJabNo:=2;
rMoveToOdRdy;
rOdStrap;
Set po15_PrtDownRqH;
rMoveHomeFromOd;
RETURN
ENDPROC

PROC rbandOutDiaCt()
WaitSyncTask syncHome, Alltask;
nOdJabNo:=1;
```


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```
rMoveToOdRdy;
rOdStrap;
rMoveHomeFromOd;
RETURN
ENDPROC


PROC rMoveHomeFromOd()
MoveJ pOdMove30, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove20,v5000,z20,toolPeader1\WObj:=wobjHead;
MoveJ pOdMove10,v5000,z20,toolPeader1\WObj:=wobjHead;
MoveJ pHome, v2500, fine, toolPeader1;
!Set po16_PrtDownRqF;
!Set po15_PrtDownRqH;
!WaitDI pi15_PrtDownChkH, 1;
!WaitDI pi16_PrtDownChkF, 1;
!Reset po15_PrtDownRqH;
!Reset po16_PrtDownRqF;
!Set po13_SaftPosAll;
!Set po12_SaftPosPrt;
RETURN
ENDPROC


PROC rErrIdRwd()
rErrorHeadReset;
pSoftAct:=CRobT();
CSSDeactMoveL pSoftAct,v200,toolPeader\WObj:=wobjHead;
MoveL pSoftAct,v500,z0,toolPeader\WObj:=wobjHead;
MoveL RelTool(pSoftAct,0,nY,0),v500,z20,toolPeader\WObj:=wobjHead;
IF bIdSideJob=TRUE THEN
MoveL RelTool(pIdIn{nIdJabNo},0,nY,0), v2500, fine, toolPeader\WObj:=wobjHead;
MoveL pIdViaP2{nIdJabNo}, v500, z0, toolPeader\WObj:=wobjHead;
```


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```
MoveL pIdViaP1{nIdJabNo}, v500, z0, toolPeader\WObj:=wobjHead;
ENDIF
IF nIdJabNo=1 OR nIdJabNo=5 THEN
rMoveHomeFromId35h;
ELSEIF nIdJabNo=2 THEN
rMoveHomeFromId11h;
ELSEIF nIdJabNo=3 OR nIdJabNo=6 THEN
rMoveHomeFromId79h;
ELSEIF nIdJabNo=4 THEN
rMoveHomeFromId1h;
ENDIF
PDispOff;
MoveJ pHome,v500,fine,toolPeader1;
rHome;
rErrorSigReset;
WaitSyncTask syncHome, Alltask;
ExitCycle;
ENDPROC

PROC rErrIdIn()
rErrorHeadReset;
pSoftAct:=CRobT();
CSSDeactMoveL pSoftAct,v200,toolPeader\WObj:=wobjHead;
MoveL pSoftAct,v500,z0,toolPeader\WObj:=wobjHead;
rBandUnclp;
IF nIdJabNo=1 OR nIdJabNo=5 THEN
rMoveHomeFromId35h;
ELSEIF nIdJabNo=2 THEN
rMoveHomeFromId11h;
ELSEIF nIdJabNo=3 OR nIdJabNo=6 THEN
rMoveHomeFromId79h;
ELSEIF nIdJabNo=4 THEN
rMoveHomeFromId1h;
```


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```
ENDIF
PDispOff;
MoveJ pHome,v2500,fine,toolPeader1;
rHome;
rErrorSigReset;
WaitSyncTask syncHome, Alltask;
ExitCycle;
ENDPROC


PROC rErrIdOut()
rErrorHeadReset;
pSoftAct:=CRobT();
CSSDeactMoveL pSoftAct,v200,toolPeader\WObj:=wobjHead;
MoveL pSoftAct,v500,z0,toolPeader\WObj:=wobjHead;
MoveL Offs(pSoftAct,-150,0,0), v500, z10, toolPeader\WObj:=wobjHead;
IF nIdJabNo=1 OR nIdJabNo=2 OR nIdJabNo=5 THEN
MoveL Offs(pIdOut{nIdJabNo},-100,0,0),v500,z10,toolPeader1\WObj:=wobjHead;
ELSEIF nIdJabNo=3 OR nIdJabNo=4 OR nIdJabNo=6THEN
PDispOff;
IF nIdJabNo=3 THEN
MoveJ pId1hMove10,v500,z50,toolPeader2\WObj:=wobjHead;
ENDIF
MoveJ pId1hMove20,v500,z100,toolPeader1\WObj:=wobjHead;
MoveJ pId1hMove30,v500,z100,toolPeader1\WObj:=wobjHead;
MoveJ pId1hMove40,v500,z100,toolPeader1\WObj:=wobjHead;
MoveJ pToolHomeMove10,v500,fine,toolPeader1\WObj:=wobjHead;
rHeadPosHome;
ENDIF
PDispOff;
MoveJ pHome,v500,fine,toolPeader1;
rHome;
```


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```
rErrorSigReset;
WaitSyncTask syncHome, Alltask;
ExitCycle;
ENDPROC

PROC rErrOdOut()
PDispOff;
rErrorHeadReset;
pSoftAct:=CRobT();
CSSDeactMoveL pSoftAct,v200,toolPeader\WObj:=wobjHead;
MoveL pSoftAct,v500,z0,toolPeader\WObj:=wobjHead;
rMoveHomeFromOd;
MoveJ pHome,v500,fine,toolPeader1;
rHome;
rErrorSigReset;
WaitSyncTask syncHome, Alltask;
ExitCycle;
ENDPROC


PROC rErrOdIn()
PDispOff;
rErrorHeadReset;
pSoftAct:=CRobT();
CSSDeactMoveL pSoftAct,v200,toolPeader\WObj:=wobjHead;
MoveL pSoftAct,v500,z0,toolPeader\WObj:=wobjHead;
WaitSyncTask sync1, Alltask;
VelSet 50, 5000;
rMoveHomeFromOd;
MoveJ pHome,v500,fine,toolPeader1;
rHome;
rErrorSigReset;
```


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```
WaitSyncTask syncHome, Alltask;
ExitCycle;
ENDPROC


PROC rIdSideOutStrap()
Reset po13_SaftPosAll;
MoveJ pHome,v2500,fine,toolPeader1;
MoveJ pOdMove10,v5000,z20,toolPeader1\WObj:=wobjHead;
MoveJ pOdMove20, v5000, z20, toolPeader1\WObj:=wobjHead;
WaitDI pi09_StnRdy,1;
WaitDI pi16_PrtDownChkF, 1;
MoveJ pOdMove30, v5000, z20, toolPeader1\WObj:=wobjHead;
!=================Rob1 OUT DIA Side2
Job==========================================
nOdJabNo:=2;
rOdStrap;
!=================Rob1 OUT DIA Side3
Job==========================================
goSideOd3:
Set po18_PrtUpRqF;
Set po15_PrtDownRqH;
nOdJabNo:=3;
rOdStrap;
MoveL pOdMove30, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove20, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove10,v5000,z20,toolPeader1\WObj:=wobjHead;
MoveJ pId5hMove10,v5000,z200,toolPeader1\WObj:=wobjHead;
rPrtDownChk;
!===============Rob1 IN DIA 3Hour
direction===================================
IF IdSide2PointUse = FALSE THEN
```


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```
nIdJabNo:=5;
rIdStrap;
ENDIF
MoveJ pId11hMove10,v5000,z50,toolPeader1\WObj:=wobjHead;
!===============Rob1 IN DIA 11Hour
direction=====================================
goId11Hour:
nIdJabNo:=2;
rIdStrap;
!MoveL pIdViaP2{nIdJabNo}, v2500, z50, toolPeader\WObj:=wobjHead;
MoveJ pToolTurnMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
Set po22_DfLeft;
rHeadPosTurn;
MoveJ pId1hMove20, v2500, z100, toolPeader1\WObj:=wobjHead;
!===============Rob1 IN DIA 9Hour
direction=====================================
IF IdSide2PointUse = FALSE THEN
nIdJabNo:=6;
rIdStrap;
ENDIF
MoveJ pId1hMove10,v5000,z50,toolPeader2\WObj:=wobjHead;
!===============Rob1 IN DIA 1Hour
direction=====================================
goId1Hour:
IF bIdSideJob = TRUE THEN
MoveJ pId1hMove10,v5000,z50,toolPeader2\WObj:=wobjHead;
ENDIF
nIdJabNo:=4;
rIdStrap;
!MoveL pIdViaP2{nIdJabNo}, v2500, z50, toolPeader2\WObj:=wobjHead;
MoveJ pId1hHome10,v5000,z100,toolPeader2\WObj:=wobjHead;
MoveJ pId1hHome20,v5000,z100,toolPeader2\WObj:=wobjHead;
MoveJ pToolHomeMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
```


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```
rHeadPosHome;
MoveJ pHome, v1500, z200, toolPeader1;
WaitSyncTask syncHome, Alltask;
IF pi33_SenterOd=1 THEN
nOdJabNo:=1;
rMoveToOdRdy;
rOdStrap;
rMoveHomeFromOd;
ENDIF
RETURN
ENDPROC

PROC rAllPointStrap()
IF nRobStartPos > 8 THEN
ExitCycle;
ENDIF
!=================Rob1 Start Position
Check==========================================
IF nRobStartPos = 1 THEN
GOTO goSideOd2;
ELSEIF nRobStartPos = 2 THEN
rMoveToOdRdy;
GOTO goSideOd3;
ELSEIF nRobStartPos = 3 THEN
nOdJabNo := 3;
rMoveToId35hRdy;
GOTO goId5Hour;
ELSEIF nRobStartPos = 4 THEN
rMoveToId35hRdy;
GOTO goId3Hour;
ELSEIF nRobStartPos = 5 THEN
rMoveToId11hRdy;
GOTO goId11Hour;
```


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```
ELSEIF nRobStartPos = 6 THEN
rMoveToId79hRdy;
GOTO goId7Hour;
ELSEIF nRobStartPos = 7 THEN
rMoveToId79hRdy;
GOTO goId9Hour;
ELSEIF nRobStartPos = 8 THEN
rMoveToId1hRdy;
GOTO goId1Hour;
ENDIF
!=================================================================
==============
goSideOd2:
Reset po13_SaftPosAll;
MoveJ pHome,v2500,fine,toolPeader1;
MoveJ pOdMove10,v5000,z20,toolPeader1\WObj:=wobjHead;
MoveJ pOdMove20, v5000, z20, toolPeader1\WObj:=wobjHead;
WaitDI pi09_StnRdy,1;
WaitDI pi16_PrtDownChkF, 1;
MoveJ pOdMove30, v5000, z20, toolPeader1\WObj:=wobjHead;
!=================Rob1 OUT DIA Side2
Job==========================================
nOdJabNo:=2;
rOdStrap;
!=================Rob1 OUT DIA Side3
Job==========================================
IF nCoilDia > 2000 THEN
MoveL pOdMove30, v5000, z20, toolPeader1\WObj:=wobjHead;
ENDIF
goSideOd3:
Set po18_PrtUpRqF;
Set po15_PrtDownRqH;
nOdJabNo:=3;
```


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```
rOdStrap;
MoveL pOdMove30, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove20, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove10,v5000,z20,toolPeader1\WObj:=wobjHead;
MoveJ pId5hMove10,v5000,z200,toolPeader1\WObj:=wobjHead;
rPrtDownChk;
!===============Rob1 IN DIA 5Hour
direction====================================
goId5Hour:
nIdJabNo:=1;
rIdStrap;
IF b9BandWork = TRUE THEN
MoveJ pId5hMove10,v5000,z200,toolPeader1\WObj:=wobjHead;
!===============Rob1 IN DIA 3Hour
direction====================================
ENDIF
goId3Hour:
IF b9BandWork = TRUE AND pi41_Id3Hr=1 THEN
nIdJabNo:=5;
rIdStrap;
ENDIF
MoveJ pId11hMove10,v5000,z50,toolPeader1\WObj:=wobjHead;
!===============Rob1 IN DIA 11Hour
direction====================================
goId11Hour:
IF pi45_Id11Hr=1 OR pi39_Id10Hr=1 THEN
nIdJabNo:=2;
rIdStrap;
MoveL pIdViaP2{nIdJabNo}, v2500, z50, toolPeader\WObj:=wobjHead;
ELSE
MoveJ pToolTurnMove20, v5000, fine, toolPeader1\WObj:=wobjHead;
ENDIF
MoveJ pToolTurnMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
```


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```
Set po22_DfLeft;
!Reset po22_DfLeft;
rHeadPosTurn;
MoveJ pId1hMove20, v2500, z100, toolPeader1\WObj:=wobjHead;
!===============Rob1 IN DIA 7Hour
direction=====================================
goId7Hour:
IF pi43_Id7Hr=1 OR pi38_Id8Hr=1 THEN
nIdJabNo:=3;
rIdStrap;
ENDIF
goId9Hour:
IF b9BandWork = TRUE AND pi44_Id9Hr=1 THEN
MoveJ pId1hMove20,v5000,z50,toolPeader1\WObj:=wobjHead;
!===============Rob1 IN DIA 9Hour
direction=====================================
nIdJabNo:=6;
rIdStrap;
ENDIF
MoveJ pId1hMove10,v5000,z50,toolPeader2\WObj:=wobjHead;
!===============Rob1 IN DIA 1Hour
direction=====================================
goId1Hour:
IF bIdSideJob = TRUE THEN
MoveJ pId1hMove10,v5000,z50,toolPeader2\WObj:=wobjHead;
ENDIF
Set po22_DfLeft;
nIdJabNo:=4;
rIdStrap;
MoveL pIdViaP2{nIdJabNo}, v2500, z50, toolPeader2\WObj:=wobjHead;
MoveJ pId1hHome10,v5000,z100,toolPeader2\WObj:=wobjHead;
MoveJ pId1hHome20,v5000,z100,toolPeader2\WObj:=wobjHead;
MoveJ pToolHomeMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
```


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```
rHeadPosHome;
MoveJ pHome, v1500, z200, toolPeader1;
WaitSyncTask syncHome, Alltask;
IF pi33_SenterOd=1 THEN
nOdJabNo:=1;
rMoveToOdRdy;
rOdStrap;
rMoveHomeFromOd;
ENDIF
RETURN
ENDPROC


PROC rOdStrap()
bOdWork:=TRUE
Set so08_DpFdOn;
Set po23_DfRight;
rPDispXoffset;
rToolDataChg;
MoveL Offs(pOdOut{nOdJabNo},0,-50,20),v5000,z10,toolPeader\WObj:=wobjHead;
rBandOutRdy;
WaitSyncTask sync1, Alltask;
WaitDI di17_FgFwd, 1;
MoveL pOdOut{nOdJabNo}, v2500, fine, toolPeader\WObj:=wobjHead;
rBandOutSig;
MoveL RelTool(pOdOut{nOdJabNo},-150,-50,nZ\Rz:=15), v200, z20,
toolPeader\WObj:=wobjHead;
WaitDI di18_FgBwd,1;
WaitSyncTask sync2, Alltask;
MoveL Offs(pOdIn{nOdJabNo},0,-50,0),v1500,fine,toolPeader\WObj:=wobjHead;
WaitSyncTask sync3, Alltask;
MoveL pOdIn{nOdJabNo}, v5000, fine, toolPeader\WObj:=wobjHead;
```


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```
WaitSyncTask sync4, Alltask;
rBandInSig;
WaitSyncTask sync5, Alltask;
MoveL RelTool(pOdWeld{nOdJabNo},0,-50,0), v5000, z10,
toolPeader\WObj:=wobjHead;
rPrtUpChk;
rStiffnessSet;
CSSAct CSS_Y\Damping:=nDamping\Stiffness:=nStiffness\AllowMove;
MoveL pOdWeld{nOdJabNo},v500,fine,toolPeader\WObj:=wobjHead;
Set so07_BandRwd;
rWeldProcess;
CSSDeactMoveL RelTool(pOdWeld{nOdJabNo},0,-50,0), v500,
toolPeader\WObj:=wobjHead;
MoveL Offs(pOdOut{nOdJabNo},0,-50,20),v5000,z10,toolPeader\WObj:=wobjHead;
rOdJobClearNo;
PDispOff;
RETURN
ENDPROC

PROC rIdSideStrap()
SyncMoveOn sync1, Alltask;
MoveL RelTool(pIdWeld{nIdJabNo},0,nY,0)\ID:=idSideId, v5000, fine,
toolPeader\WObj:=wobjHead;
SyncMoveOff sync1;
rStiffnessSet;
CSSAct CSS_Y\Damping:=nDamping\Stiffness:=nStiffness\AllowMove;
MoveL pIdWeld{nIdJabNo}, v500, fine, toolPeader\WObj:=wobjHead;
Set so07_BandRwd;
rWeldProcess;
CSSDeactMoveL RelTool(pIdWeld{nIdJabNo},0,nY,0), v500,
toolPeader\WObj:=wobjHead;
rIdJobClearNo;
MoveL RelTool(pIdIn{nIdJabNo},0,nY,0),v5000,z20,toolPeader\WObj:=wobjHead;
```


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```
IF nIdJabNo=5 OR nIdJabNo =6 THEN
MoveL pIdViaP2{nIdJabNo}, v5000, z50, toolPeader\WObj:=wobjHead;
MoveL pIdViaP1{nIdJabNo}, v2500, z50, toolPeader\WObj:=wobjHead;
ENDIF
PDispOff;
RETURN
ENDPROC

PROC rIdStrap()
bOdWork:=FALSE
rPDispXoffset;
rToolDataChg;
rBandOutRdy;
MoveJ Offs(pIdOut{nIdJabNo},-100,0,0),v5000,z10,toolPeader\WObj:=wobjHead;
WaitSyncTask sync1, Alltask;
Set so08_DpFdOn;
WaitDI di17_FgFwd, 1;
MoveL pIdOut{nIdJabNo}, v800, fine, toolPeader\WObj:=wobjHead;
rBandOutSig;
MoveL RelTool(pIdOut{nIdJabNo},nX,nY,0\Rz:=nTheta), v200, z20,
toolPeader\WObj:=wobjHead;
WaitDI di17_FgFwd, 0;
WaitDI di18_FgBwd,1;
WaitSyncTask sync2, Alltask;
MoveL pIdViaP1{nIdJabNo}, v2500, z50, toolPeader\WObj:=wobjHead;
!WaitSyncTask sync2, Alltask;
MoveL pIdViaP2{nIdJabNo}, v2500, z50, toolPeader\WObj:=wobjHead;
MoveL RelTool(pIdIn{nIdJabNo},0,nY,0), v2500, fine, toolPeader\WObj:=wobjHead;
Reset so08_DpFdOn;
WaitSyncTask sync3, Alltask;
MoveL pIdIn{nIdJabNo},v2500,fine,toolPeader\WObj:=wobjHead;
WaitSyncTask sync4, Alltask;
rBandInSig;
```


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```
IF bIdSideJob = TRUE THEN
rIdSideStrap;
RETURN
ENDIF
MoveL RelTool(pIdIn{nIdJabNo},0,nY,0),v5000,z20,toolPeader\WObj:=wobjHead;
MoveL pIdViaP2{nIdJabNo}, v5000, z50, toolPeader\WObj:=wobjHead;
MoveL pIdViaP1{nIdJabNo}, v5000, fine, toolPeader\WObj:=wobjHead;
WaitSyncTask sync5, Alltask;
SyncMoveOn sync6, Alltask;
MoveL
RelTool(pIdWeld{nIdJabNo},0,nY,0)\ID:=50,v5000,fine,toolPeader\WObj:=wobjHead;
IF nIdJabNo=1 OR nIdJabNo=2 OR nIdJabNo=5 THEN
MoveL RelTool(pIdWeld{nIdJabNo},0,-0,0)\ID:=60, v5000, fine,
toolPeader\WObj:=wobjHead;
ELSEIF nIdJabNo=4 OR nIdJabNo=3 OR nIdJabNo=6 THEN
MoveL RelTool(pIdWeld{nIdJabNo},0,0,0)\ID:=60, v5000, fine,
toolPeader\WObj:=wobjHead;
ENDIF
SyncMoveOff sync7;
rStiffnessSet;
CSSAct\RefFrame:=CSS_REFFRAME_WOBJ,
CSS_X\Damping:=nDamping\Stiffness:=nStiffness\AllowMove;
MoveL pIdWeld{nIdJabNo}, v500, fine, toolPeader\WObj:=wobjHead;
Set so07_BandRwd;
rWeldProcess;
CSSDeactMoveL RelTool(pIdWeld{nIdJabNo},0,nY,0), v500,
toolPeader\WObj:=wobjHead;
rIdJobClearNo;
MoveL pIdViaP1{nIdJabNo}, v2500, z50, toolPeader\WObj:=wobjHead;
PDispOff;
RETURN
ENDPROC
```


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```
PROC rInitial()
PDispOff;
nTechDia:=1555;
nTechWidth:=1220;
nCoilDia:=0;
nCoilWidth:=0;
SetGO go02_CoillWidth, 0;
SetGO go01_CoillDia, 0;
rHeadInitial;
rIdClNoInitial;
Reset so01_HdFeedEnd;
Reset so02_BandFixOk;
Reset so03_DataComOk;
Set so05_BdRwdEnd;
Reset so06_LowFeed;
Reset so07_BandRwd;
Reset so08_DpFdOn;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
Reset po07_FeedOn;
Reset po08_WeldOn;
Reset po09_WorkEnd;
Reset po15_PrtDownRqH;
Reset po16_PrtDownRqF;
Reset po18_PrtUpRqF;
Reset po19_OutFeedErr;
Reset po20_InFeedErr;
Reset po21_RwdErr;
Reset po22_DfLeft;
Reset po23_DfRight;
!Set po23_DfRight;
Reset po24_Nvector;
```


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```
Set so05_BdRwdEnd;
IdSide2PointUse:=FALSE
IF di13_HeadPosHome = 0 OR di14_HeadPosTurn = 1 THEN
MoveJ pToolHomeMove10,v5000,fine,toolPeader1\WObj:=wobjHead;
rHeadPosHome;
MoveJ pHome,v2500,fine,toolPeader1;
ENDIF
ENDPROC

PROC rDataCom()
WaitDI pi10_DataRecRdy,1;
bIdSideJob := FALSE
Retry01:
nCoilWidth:=gi02_CoillWidth;
nCoilDia:=gi01_CoillDia;
nRob1_X:=gi03_Xoffset;
SetGO go02_CoillWidth,nCoilWidth;
SetGO go01_CoillDia,nCoilDia;
IF pi24_Nvector = 1 Set po24_Nvector;
SetGO go03_Xoffset, nRob1_X;
rJobNoReturn;
IF  nRob1_X>nOffsetLimit THEN
TPErase;
TPWrite " * OffsetData is out of the limit "
Stop;
GOTO Retry01;
ENDIF
IF nCoilDia<nCoilDiaMin THEN
TPErase;
TPWrite " * nCoilDia is out of the limit "
TPWrite " * nCoilDiaMin is = "\Num:=nCoilDiaMin;
TPWrite " * Input of CoilDia is  = "\Num:=nCoilDia;
Stop;
```


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```
GOTO Retry01;
ENDIF
IF nCoilWidth<nCoilWidthMin THEN
TPErase;
TPWrite " * nCoilWidth is out of the limit "
TPWrite " * nCoilWidthMin is = "\Num:=nCoilWidthMin;
TPWrite " * Input of CoilWidth is  = "\Num:=nCoilWidth;
Stop;
GOTO Retry01;
ENDIF
IF nCoilWidth>nCoilWidthMax THEN
TPErase;
TPWrite " * nCoilWidth is out of the limit "
TPWrite " * nCoilWidthMax is = "\Num:=nCoilWidthMax;
TPWrite " * Input of CoilWidth is  = "\Num:=nCoilWidth;
Stop;
GOTO Retry01;
ENDIF
IF nCoilDia>nCoilDiaMax  THEN
TPErase;
TPWrite " * nCoilDia is out of the limit "
TPWrite " * nCoilDiaMax is = "\Num:=nCoilDiaMax;
TPWrite " * Input of CoilDia is  = "\Num:=nCoilDia;
Stop;
GOTO Retry01;
ENDIF
IF nCoilWidth < 900 AND nRob1_X > (nOffsetLimit-30) THEN
TPWrite " *The robot expect collision by the OffsetData"
Stop;
GOTO Retry01;
ENDIF
TPErase;
TPWrite "==================================="
```


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```
TPWrite " * Coilwith = "\Num:=nCoilWidth;
TPWrite " * CoilDia  = "\Num:=nCoilDia;
IF pi24_Nvector = 1 THEN
TPWrite " * CoilOffset=  -"\Num:=nRob1_X;
ELSE
TPWrite " * CoilOffset=   "\Num:=nRob1_X;
ENDIF
rIdBandType;
IF nCoilDia < nSideJobIdDia bIdSideJob := TRUE
!IF  bIdSideJob = TRUE AND pi35_Id2Hr = 1 THEN
!TPErase;
!TPWrite " * IdJobNomber Errer! Can't strap InDiaJob 2H ";
!Stop;
!GOTO Retry01;
!ENDIF
WaitDI pi11_DataCheckOk, 5\MaxTime:=3\TimeFlag:=bDataError;
IF bDataError = TRUE THEN
TPWrite " * pi11_DataCheckOk=0 , Data Error--! "
!Stop;
WaitDI pi11_DataCheckOk, 1;
bDataError := FALSE
GOTO Retry01;
ENDIF
Set so03_DataComOk;
RETURN
ENDPROC



PROC rWorkModel()
IF nRobStartPos <> 0 THEN
rAllPointStrap;
ELSEIF nRobStartPos = 0 THEN
```


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```
IF bIdSideJob = TRUE AND pi34_SideOdFg = 1 AND pi35_SideOdHd = 1 AND
(( pi40_Id1Hr = 1 AND pi41_Id3Hr = 1 AND pi44_Id9Hr = 1 AND pi45_Id11Hr
=1 ) OR
( pi40_Id1Hr = 1 AND pi45_Id11Hr =1 AND pi41_Id3Hr = 0 AND pi44_Id9Hr =
0 )) THEN
IdSide2PointUse:=FALSE
IF (pi40_Id1Hr = 1 AND pi45_Id11Hr =1) AND (pi41_Id3Hr = 0 AND pi44_Id9Hr
= 0)  THEN
IdSide2PointUse:=TRUE
ENDIF
rIdSideOutStrap;
IdSide2PointUse:=FALSE
ELSEIF b9BandWork = TRUE THEN
IF pi35_SideOdHd = 1 rbandOutDiaHd;
IF pi34_SideOdFg = 1 rbandOutDiaFg;
IF pi42_Id5Hr=1 rbandInDia5h;
IF pi41_Id3Hr=1 rbandInDia3h;
IF pi45_Id11Hr=1 rbandInDia11h;
IF pi43_Id7Hr=1 rbandInDia7h;
IF pi44_Id9Hr=1 rbandInDia9h;
IF pi40_Id1Hr=1 rbandInDia1h;
IF pi33_SenterOd=1 rbandOutDiaCt;
ELSE
IF pi35_SideOdHd = 1 rbandOutDiaHd;
IF pi34_SideOdFg = 1 rbandOutDiaFg;
IF pi37_Id4Hr=1 rbandInDia5h;
IF pi39_Id10Hr=1 rbandInDia11h;
IF pi38_Id8Hr=1 rbandInDia7h;
IF pi36_Id2Hr = 1 AND bIdSideJob = FALSE rbandInDia1h;
IF pi33_SenterOd=1 rbandOutDiaCt;
ENDIF
ENDIF
MoveJ pHome,v2500,fine,toolPeader1;
```


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```
ENDPROC

PROC rHome()
!MoveJ poHome, v2500, fine, toolPeader1;
MoveJ pHome, v2500, fine, toolPeader1;
poHomepos := CPos();
!pHomepos := CPos();
RETURN
ENDPROC

PROC main()
AccSet 60,80;
VelSet 90,5000;
rInitial;
rHome;
WaitDI pi14_CurCoil, 1;
IF pi14_CurCoil=1 THEN
rDataCom;
rDefinePos;
!Stop;
rStrartPosSet;
WaitSyncTask syncStart, Alltask;
rWorkModel;
rWorkFinish;
ENDIF
rInitial;
rHome;
ExitCycle;
ENDPROC
PROC rMaintrance()
```


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```
MoveJ
[[-459.67,-2377.92,1026.96],[0.513395,0.485949,0.505841,-0.494372],[-2,-1,0,1],[-223.305
,9E+09,9E+09,9E+09,9E+09,9E+09]], v1000, z50, toolPeader1;
ENDPROC


ENDMODULE
```

- 위치연산프로그램

```
MODULE PosCalculate
!Teach Data
PERS num nTechDia:=1550;
PERS num nTechWidth:=1220;
PERS num nSmallJobSeletDia:=1200;
PERS num nSmallTechDia:=1160;
PERS num nSmallTechWidth:=1250;
PERS num nLargeTechDia:=1730;
PERS num nLargeTechWidth:=1250;
PERS num nSideJobIdDia:=840;
PERS num nSideIdLow:=1000;
!InPut Data
PERS num nCoilDia:=0;
PERS num nCoilWidth:=0;
PERS num nTanAngle:=135;
!Calculate Data
PERS num nXoffset:=70.5;
PERS num nZoffset:=-165.127;
PERS num nYoffset:=0;
PERS num nDz:=200;
PERS num nDy:=178.57;
PERS num nDx:=200;
VAR num nRetryNo:=0;
```


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```
PROC rDefinePos()
rRobTargetSelect;
DefineOdStrap;
DefineOdOut;
DefineIdInsert;
DefineIdOut;
!Stop;
RETURN
ENDPROC

PROC rRobTargetSelect()
IF nCoilDia>nSmallJobSeletDia THEN
nTechDia:=nLargeTechDia;
nTechWidth:=nLargeTechWidth;
pIdOut{1}:=poIdOut1;
pIdOut{2}:=poIdOut2;
pIdOut{3}:=poIdOut3;
pIdOut{4}:=poIdOut4;
pIdOut{5}:=poIdOut5;
pIdOut{6}:=poIdOut6;
pOdOut{1}:=poOdOut1;
pOdOut{2}:=poOdOut2;
pOdOut{3}:=poOdOut3;
pOdWeld{1}:=poOdWeld1;
pOdWeld{2}:=poOdWeld2;
pOdWeld{3}:=poOdWeld3;
pOdIn{1}:=poOdIn1;
pOdIn{2}:=poOdIn2;
pOdIn{3}:=poOdIn3;
pIdIn{1}:=poIdIn1;
pIdIn{2}:=poIdIn2;
pIdIn{3}:=poIdIn3;
```


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```
pIdIn{4}:=poIdIn4;
pIdIn{5}:=poIdIn5;
pIdIn{6}:=poIdIn6;
pIdViaP1{1}:=poIdViaP1_1;
pIdViaP1{2}:=poIdViaP2_1;
pIdViaP1{3}:=poIdViaP3_1;
pIdViaP1{4}:=poIdViaP4_1;
pIdViaP1{5}:=poIdViaP5_1;
pIdViaP1{6}:=poIdViaP6_1;
pIdViaP2{1}:=poIdViaP1_2;
pIdViaP2{2}:=poIdViaP2_2;
pIdViaP2{3}:=poIdViaP3_2;
pIdViaP2{4}:=poIdViaP4_2;
pIdViaP2{5}:=poIdViaP5_1;
pIdViaP2{6}:=poIdViaP6_1;
IF b9BandWork = TRUE THEN
pIdWeld{1}:=poIdWeld5h;
pIdWeld{2}:=poIdWeld11h;
pIdWeld{3}:=poIdWeld7h;
pIdWeld{4}:=poIdWeld1h;
pIdWeld{5}:=poIdWeld3h;
pIdWeld{6}:=poIdWeld9h;
ELSE
pIdWeld{1}:=poIdWeld4h;
pIdWeld{2}:=poIdWeld10h;
pIdWeld{3}:=poIdWeld8h;
pIdWeld{4}:=poIdWeld2h;
ENDIF
ELSE
nTechDia:=nSmallTechDia;
nTechWidth:=nSmallTechWidth;
pIdOut{1}:=pSIdOut1;
pIdOut{2}:=pSIdOut2;
```


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```
pIdOut{3}:=pSIdOut3;
pIdOut{4}:=pSIdOut4;
pIdOut{5}:=pSIdOut5;
pIdOut{6}:=pSIdOut6;
pOdOut{1}:=pSOdOut1;
pOdOut{2}:=pSOdOut2;
pOdOut{3}:=pSOdOut3;
pOdWeld{1}:=pSOdWeld1;
pOdWeld{2}:=pSOdWeld2;
pOdWeld{3}:=pSOdWeld3;
pOdIn{1}:=pSOdIn1;
pOdIn{2}:=pSOdIn2;
pOdIn{3}:=pSOdIn3;
pIdIn{1}:=pSIdIn1;
pIdIn{2}:=pSIdIn2;
pIdIn{3}:=pSIdIn3;
pIdIn{4}:=pSIdIn4;
pIdIn{5}:=pSIdIn5;
pIdIn{6}:=pSIdIn6;
pIdViaP1{1}:=pSIdViaP1_1;
pIdViaP1{2}:=pSIdViaP2_1;
pIdViaP1{3}:=pSIdViaP3_1;
pIdViaP1{4}:=pSIdViaP4_1;
pIdViaP1{5}:=pSIdViaP5_1;
pIdViaP1{6}:=pSIdViaP6_1;
pIdViaP2{1}:=pSIdViaP1_2;
pIdViaP2{2}:=pSIdViaP2_2;
pIdViaP2{3}:=pSIdViaP3_2;
pIdViaP2{4}:=pSIdViaP4_2;
pIdViaP2{5}:=pSIdViaP5_1;
pIdViaP2{6}:=pSIdViaP6_1;
IF bIdSideJob =TRUE THEN
pIdWeld{1}:=pSIdWeld3hS;
```


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```
pIdWeld{2}:=pSIdWeld10hS;
pIdWeld{3}:=pSIdWeld9hS;
pIdWeld{4}:=pSIdWeld2hS;
pIdWeld{5}:=pSIdWeld3hS;
pIdWeld{6}:=pSIdWeld9hS;
pIdIn{1}:=pSIdIn5;
pIdViaP1{1}:=pSIdViaP5_1;
pIdViaP2{1}:=pSIdViaP5_2;
pIdOut{1}:=pSIdOut5;
pIdIn{3}:=pSIdIn6;
pIdViaP1{3}:=pSIdViaP6_1;
pIdViaP2{3}:=pSIdViaP6_2;
pIdOut{3}:=pSIdOut6;
ELSE
pIdWeld{5}:=pSIdWeld3h;
pIdWeld{6}:=pSIdWeld9h;
IF nCoilDia < nSideIdLow THEN
pIdWeld{1}:=pSIdWeld4hS_Small;
pIdWeld{2}:=pSIdWeld10h;
pIdWeld{3}:=pSIdWeld8hS_Small;
pIdWeld{4}:=pSIdWeld2h;
ELSE
pIdWeld{1}:=pSIdWeld4h;
pIdWeld{2}:=pSIdWeld10h;
pIdWeld{3}:=pSIdWeld8h;
pIdWeld{4}:=pSIdWeld2h;
ENDIF
ENDIF
ENDIF
ENDPROC

PROC DefineIdOut()
nIdJabNo:=1;
```


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```
WHILE nIdJabNo<=6 DO
nXoffset:=(nTechWidth-nCoilWidth)/2;
nYoffset:=0;
nZoffset:=-(((nTechDia/2)/Cos(15))-((nCoilDia/2)/Cos(15)));
IF nCoilDia < 700 THEN
nZoffset:=-(((nTechDia/2)/Cos(15))-((700/2)/Cos(15)));
ENDIF
pIdOut{nIdJabNo}.trans.x:=pIdOut{nIdJabNo}.trans.x+nXoffset;
pIdOut{nIdJabNo}.trans.y:=pIdOut{nIdJabNo}.trans.y+nYoffset;
pIdOut{nIdJabNo}.trans.z:=pIdOut{nIdJabNo}.trans.z+nZoffset;
Incr nIdJabNo;
ENDWHILE
Clear nIdJabNo;
RETURN
ENDPROC

PROC DefineOdOut()
nOdJabNo:=1;
WHILE nOdJabNo<=3 DO
IF nOdJabNo=1 THEN
nXoffset:=0;
ELSEIF nOdJabNo=2 THEN
nXoffset:=(nTechWidth-nCoilWidth)/2;
ELSEIF nOdJabNo=3 THEN
nXoffset:=-(nTechWidth-nCoilWidth)/2;
ENDIF
nYoffset:=0;
nZoffset:=0;
pOdOut{nOdJabNo}.trans.x:=pOdOut{nOdJabNo}.trans.x+nXoffset;
pOdOut{nOdJabNo}.trans.y:=pOdOut{nOdJabNo}.trans.y+nYoffset;
pOdOut{nOdJabNo}.trans.z:=pOdOut{nOdJabNo}.trans.z+nZoffset;
Incr nOdJabNo;
ENDWHILE
```


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```
Clear nOdJabNo;
RETURN
ENDPROC

PROC DefineOdStrap()
nTanAngle:=70;
nOdJabNo:=1;
WHILE nOdJabNo<=3 DO
IF nOdJabNo=1 THEN
nXoffset:=0;
ELSEIF nOdJabNo=2 THEN
nXoffset:=(nTechWidth-nCoilWidth)/2;
ELSEIF nOdJabNo=3 THEN
nXoffset:=-(nTechWidth-nCoilWidth)/2;
ENDIF
nYoffset:=(((nTechDia/2)*Sin(nTanAngle))-((nCoilDia/2)*Sin(nTanAngle)));
nZoffset:=-(((nTechDia/2)/Cos(15)-(nTechDia/2)*Cos(nTanAngle))-((nCoilDia/2)/
Cos(15)-(nCoilDia/2)*Cos(nTanAngle)));
pOdWeld{nOdJabNo}.trans.x:=pOdWeld{nOdJabNo}.trans.x+nXoffset;
pOdWeld{nOdJabNo}.trans.y:=pOdWeld{nOdJabNo}.trans.y+nYoffset;
pOdWeld{nOdJabNo}.trans.z:=pOdWeld{nOdJabNo}.trans.z+nZoffset;
pOdWeld{nOdJabNo}.extax.eax_a:=pOdWeld{nOdJabNo}.extax.eax_a+nYoffset;
IF bIdSideJob = TRUE OR nSmallTechDia > nCoilDia THEN
!nZoffset:=-(((nTechDia/2)/Cos(15)-(nTechDia/2)*Cos(nTanAngle))-((1000/2)/Cos(
15)-(1000/2)*Cos(nTanAngle)));
!nYoffset:=0;
nZoffset:=0;
ENDIF
pOdIn{nOdJabNo}.trans.x:=pOdIn{nOdJabNo}.trans.x+nXoffset;
pOdIn{nOdJabNo}.trans.y:=pOdIn{nOdJabNo}.trans.y+nYoffset;
pOdIn{nOdJabNo}.trans.z:=pOdIn{nOdJabNo}.trans.z+nZoffset;
pOdIn{nOdJabNo}.extax.eax_a:=pOdIn{nOdJabNo}.extax.eax_a+nYoffset;
Incr nOdJabNo;
```


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```
ENDWHILE
Clear nOdJabNo;
RETURN
ENDPROC


PROC DefineIdInsert()
nIdJabNo:=1;
WHILE (nIdJabNo<=6 AND b9BandWork = TRUE)OR(nIdJabNo<=4 AND
b9BandWork = FALSE) DO
IF b9BandWork = TRUE  THEN
IF nIdJabNo=1 THEN
nTanAngle:=55;
ELSEIF nIdJabNo=2 THEN
nTanAngle:=-140;
ELSEIF nIdJabNo=3 THEN
nTanAngle:=-55;
ELSEIF nIdJabNo=4 THEN
nTanAngle:=140;
ELSEIF nIdJabNo=5 THEN
nTanAngle:=90;
ELSEIF nIdJabNo=6 THEN
nTanAngle:=-90;
ENDIF
ELSE
IF nIdJabNo=1 THEN
nTanAngle:=55;
ELSEIF nIdJabNo=2 THEN
nTanAngle:=-135;
ELSEIF nIdJabNo=3 THEN
nTanAngle:=-55;
ELSEIF nIdJabNo=4 THEN
```


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```
nTanAngle:=135;
!ELSEIF nIdJabNo=5 THEN
!nTanAngle:=90;
!ELSEIF nIdJabNo=6 THEN
!nTanAngle:=-90;
ENDIF
ENDIF
nXoffset:=(nTechWidth-nCoilWidth)/2;
nYoffset:=((nTechDia/2)*Sin(nTanAngle))-((nCoilDia/2)*Sin(nTanAngle));
nZoffset:=-(((nTechDia/2)/Cos(15)-(nTechDia/2)*Cos(nTanAngle))-((nCoilDia/2)/
Cos(15)-(nCoilDia/2)*Cos(nTanAngle)));
pIdIn{nIdJabNo}.trans.x:=pIdIn{nIdJabNo}.trans.x+nXoffset;
pIdIn{nIdJabNo}.trans.y:=pIdIn{nIdJabNo}.trans.y+nYoffset;
pIdIn{nIdJabNo}.trans.z:=pIdIn{nIdJabNo}.trans.z+nZoffset;
pIdViaP1{nIdJabNo}.trans.x:=pIdViaP1{nIdJabNo}.trans.x+nXoffset;
pIdViaP1{nIdJabNo}.trans.y:=pIdViaP1{nIdJabNo}.trans.y+nYoffset;
pIdViaP1{nIdJabNo}.trans.z:=pIdViaP1{nIdJabNo}.trans.z+nZoffset;
pIdViaP2{nIdJabNo}.trans.x:=pIdViaP2{nIdJabNo}.trans.x+nXoffset;
pIdViaP2{nIdJabNo}.trans.y:=pIdViaP2{nIdJabNo}.trans.y+nYoffset;
pIdViaP2{nIdJabNo}.trans.z:=pIdViaP2{nIdJabNo}.trans.z+nZoffset;
pIdWeld{nIdJabNo}.trans.x:=pIdWeld{nIdJabNo}.trans.x+nXoffset;
pIdWeld{nIdJabNo}.trans.y:=pIdWeld{nIdJabNo}.trans.y+nYoffset;
pIdWeld{nIdJabNo}.trans.z:=pIdWeld{nIdJabNo}.trans.z+nZoffset;
pIdIn{nIdJabNo}.extax.eax_a:=pIdIn{nIdJabNo}.extax.eax_a+nYoffset;
IF nIdJabNo=2 OR nIdJabNo=4 THEN
nYoffset:= nYoffset-(nTechWidth-nCoilWidth)/2;
ENDIF
pIdViaP1{nIdJabNo}.extax.eax_a:=pIdViaP1{nIdJabNo}.extax.eax_a+nYoffset;
pIdViaP2{nIdJabNo}.extax.eax_a:=pIdViaP2{nIdJabNo}.extax.eax_a+nYoffset;
pIdWeld{nIdJabNo}.extax.eax_a:=pIdWeld{nIdJabNo}.extax.eax_a+nYoffset;
IF pIdViaP1{nIdJabNo}.extax.eax_a<-2500 THEN
pIdViaP1{nIdJabNo}.extax.eax_a:=-2500;
ENDIF
```


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```
IF pIdViaP1{nIdJabNo}.extax.eax_a>2500 THEN
pIdViaP1{nIdJabNo}.extax.eax_a:=2500;
ENDIF
IF pIdViaP2{nIdJabNo}.extax.eax_a>2500 THEN
pIdViaP2{nIdJabNo}.extax.eax_a:=2500;
ENDIF
IF pIdViaP2{nIdJabNo}.extax.eax_a<-2500 THEN
pIdViaP2{nIdJabNo}.extax.eax_a:=-2500;
ENDIF
IF pIdWeld{nIdJabNo}.extax.eax_a<-2500 THEN
pIdWeld{nIdJabNo}.extax.eax_a:=-2500;
ENDIF
IF pIdWeld{nIdJabNo}.extax.eax_a>2500 THEN
pIdWeld{nIdJabNo}.extax.eax_a:=2500;
ENDIF
Incr nIdJabNo;
ENDWHILE
Clear nIdJabNo;
RETURN
ENDPROC
ENDMODULE
```

- 결속 관련 프로그램

```
MODULE StrapProcess
PERS num nInDiaFeedTime:=0.8;
PERS num nOutDiaFeedTime:=0.8;
PROC rBandOutRdy()
rBandGdBwd;
rUpperRollBwd;
rWeldPltFwd;
RETURN
ENDPROC
```


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```
PROC rToolDataChg()
IF bOdWork=TRUE THEN
toolPeader:=toolPeader1;
nDamping := 30;
IF nOdJabNo = 1  THEN
nZ:=0;
ELSEIF  nOdJabNo = 2 THEN
nZ:=-10;
ELSEIF  nOdJabNo = 3 THEN
nZ:=10;
ENDIF
ELSE
nDamping := 50;
IF nIdJabNo=1 OR nIdJabNo=2 OR nIdJabNo=5 THEN
toolPeader:=toolPeader1;
nY:=-50;
nX:=-100;
nTheta:=15;
ELSEIF nIdJabNo=4 OR nIdJabNo=3 OR nIdJabNo=6 THEN
toolPeader:=toolPeader2;
nY:=50;
nX:=-100;
nTheta:=-15;
ENDIF
ENDIF
ENDPROC

PROC rStrartPosSet()
nRobStartPos :=0;
WaitUntil  pi33_SenterOd = 1 OR pi34_SideOdFg = 1 OR pi35_SideOdHd = 1
OR pi36_Id2Hr = 1 OR pi37_Id4Hr = 1 OR pi38_Id8Hr = 1 OR pi39_Id10Hr = 1
OR pi40_Id1Hr = 1 OR pi41_Id3Hr = 1 OR pi42_Id5Hr = 1 OR pi43_Id7Hr = 1
OR pi44_Id9Hr = 1 OR pi45_Id11Hr = 1;
```


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```
rIdBandType;
IF b9BandWork =TRUE THEN
IF  pi34_SideOdFg=1 AND  pi35_SideOdHd=1 AND  pi40_Id1Hr=1 AND
pi41_Id3Hr=1 AND  pi42_Id5Hr=1 AND  pi43_Id7Hr=1 AND  pi44_Id9Hr=1
AND  pi45_Id11Hr=1 THEN
nRobStartPos :=1;
ELSEIF pi34_SideOdFg=1 AND  pi35_SideOdHd=0 AND  pi40_Id1Hr=1 AND
pi41_Id3Hr=1 AND  pi42_Id5Hr=1 AND  pi43_Id7Hr=1 AND  pi44_Id9Hr=1
AND  pi45_Id11Hr=1 THEN
nRobStartPos :=2;
ELSEIF pi34_SideOdFg=0 AND  pi35_SideOdHd=0 AND  pi40_Id1Hr=1 AND
pi41_Id3Hr=1 AND  pi42_Id5Hr=1 AND  pi43_Id7Hr=1 AND  pi44_Id9Hr=1
AND  pi45_Id11Hr=1 THEN
nRobStartPos :=3;
ELSEIF pi34_SideOdFg=0 AND  pi35_SideOdHd=0 AND  pi40_Id1Hr=1 AND
pi41_Id3Hr=1 AND  pi42_Id5Hr=0 AND  pi43_Id7Hr=1 AND  pi44_Id9Hr=1
AND  pi45_Id11Hr=1 THEN
nRobStartPos :=4;
ELSEIF pi34_SideOdFg=0 AND  pi35_SideOdHd=0 AND  pi40_Id1Hr=1 AND
pi41_Id3Hr=0 AND  pi42_Id5Hr=0 AND  pi43_Id7Hr=1 AND  pi44_Id9Hr=1
AND  pi45_Id11Hr=1 THEN
nRobStartPos :=5;
ELSEIF pi34_SideOdFg=0 AND  pi35_SideOdHd=0 AND  pi40_Id1Hr=1 AND
pi41_Id3Hr=0 AND  pi42_Id5Hr=0 AND  pi43_Id7Hr=1 AND  pi44_Id9Hr=1
AND  pi45_Id11Hr=0 THEN
nRobStartPos :=6;
ELSEIF pi34_SideOdFg=0 AND  pi35_SideOdHd=0 AND  pi40_Id1Hr=1 AND
pi41_Id3Hr=0 AND  pi42_Id5Hr=0 AND  pi43_Id7Hr=0 AND  pi44_Id9Hr=1
AND  pi45_Id11Hr=0 THEN
nRobStartPos :=7;
ELSEIF pi34_SideOdFg=0 AND  pi35_SideOdHd=0 AND  pi40_Id1Hr=1 AND
pi41_Id3Hr=0 AND  pi42_Id5Hr=0 AND  pi43_Id7Hr=0 AND  pi44_Id9Hr=0
AND  pi45_Id11Hr=0 THEN
```


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```
nRobStartPos :=8;
ENDIF
IF pi34_SideOdFg=1 AND pi35_SideOdHd=1 AND pi40_Id1Hr=1 AND
pi41_Id3Hr=0 AND pi42_Id5Hr=1 AND pi43_Id7Hr=0 AND pi44_Id9Hr=1
AND pi45_Id11Hr=0 THEN
nRobStartPos :=1;
ELSEIF pi34_SideOdFg=1 AND pi35_SideOdHd=0 AND pi40_Id1Hr=1 AND
pi41_Id3Hr=0 AND pi42_Id5Hr=1 AND pi43_Id7Hr=0 AND pi44_Id9Hr=1
AND pi45_Id11Hr=0 THEN
nRobStartPos :=2;
ELSEIF pi34_SideOdFg=0 AND pi35_SideOdHd=0 AND pi40_Id1Hr=1 AND
pi41_Id3Hr=0 AND pi42_Id5Hr=1 AND pi43_Id7Hr=0 AND pi44_Id9Hr=1
AND pi45_Id11Hr=0 THEN
nRobStartPos :=3;
ELSEIF pi34_SideOdFg=0 AND pi35_SideOdHd=0 AND pi40_Id1Hr=1 AND
pi41_Id3Hr=0 AND pi42_Id5Hr=0 AND pi43_Id7Hr=0 AND pi44_Id9Hr=1
AND pi45_Id11Hr=0 THEN
nRobStartPos :=7;
ENDIF
ELSEIF b9BandWork =FALSE THEN
IF pi34_SideOdFg=1 AND pi35_SideOdHd=1 AND pi36_Id2Hr=1 AND
pi37_Id4Hr=1 AND pi38_Id8Hr=1 AND pi39_Id10Hr=1 THEN
nRobStartPos :=1;
ELSEIF pi34_SideOdFg=1 AND pi35_SideOdHd=0 AND pi36_Id2Hr=1 AND
pi37_Id4Hr=1 AND pi38_Id8Hr=1 AND pi39_Id10Hr=1 THEN
nRobStartPos :=2;
ELSEIF pi34_SideOdFg=0 AND pi35_SideOdHd=0 AND pi36_Id2Hr=1 AND
pi37_Id4Hr=1 AND pi38_Id8Hr=1 AND pi39_Id10Hr=1 THEN
nRobStartPos :=3;
ELSEIF pi34_SideOdFg=0 AND pi35_SideOdHd=0 AND pi36_Id2Hr=1 AND
pi37_Id4Hr=0 AND pi38_Id8Hr=1 AND pi39_Id10Hr=1 THEN
nRobStartPos :=5;
ELSEIF pi34_SideOdFg=0 AND pi35_SideOdHd=0 AND pi36_Id2Hr=1 AND
```


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```
pi37_Id4Hr=0 AND  pi38_Id8Hr=1 AND  pi39_Id10Hr=0  THEN
nRobStartPos :=6;
ELSEIF pi34_SideOdFg=0 AND  pi35_SideOdHd=0 AND  pi36_Id2Hr=1 AND
pi37_Id4Hr=0 AND  pi38_Id8Hr=0 AND  pi39_Id10Hr=0  THEN
nRobStartPos :=8;
ENDIF
IF (pi34_SideOdFg=1 AND  pi35_SideOdHd=1 AND pi37_Id4Hr=1 AND
pi38_Id8Hr=1 AND  pi39_Id10Hr=1) AND bIdSideJob =TRUE THEN
nRobStartPos :=1;
ELSEIF (pi34_SideOdFg=1 AND  pi35_SideOdHd=0 AND  pi37_Id4Hr=1 AND
pi38_Id8Hr=1 AND  pi39_Id10Hr=1) AND bIdSideJob =TRUE THEN
nRobStartPos :=2;
ELSEIF (pi34_SideOdFg=0 AND  pi35_SideOdHd=0 AND  pi37_Id4Hr=1 AND
pi38_Id8Hr=1 AND  pi39_Id10Hr=1) AND bIdSideJob =TRUE THEN
nRobStartPos :=3;
ELSEIF (pi34_SideOdFg=0 AND  pi35_SideOdHd=0 AND  pi37_Id4Hr=0 AND
pi38_Id8Hr=1 AND  pi39_Id10Hr=1) AND bIdSideJob =TRUE THEN
nRobStartPos :=5;
ELSEIF (pi34_SideOdFg=0 AND  pi35_SideOdHd=0 AND  pi37_Id4Hr=0 AND
pi38_Id8Hr=1 AND  pi39_Id10Hr=0) AND bIdSideJob =TRUE THEN
nRobStartPos :=6;
ELSEIF (pi34_SideOdFg=0 AND  pi35_SideOdHd=0 AND  pi37_Id4Hr=0 AND
pi38_Id8Hr=0 AND  pi39_Id10Hr=0) AND bIdSideJob =TRUE THEN
nRobStartPos :=0;
ENDIF
ENDIF
TPWrite " *** Robot Start Position *** = "\Num:=nRobStartPos;
RETURN
ENDPROC


PROC rWorkFinish()
PDispOff;
```


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```
MoveJ pHome,v5000,fine,toolPeader1;
WaitSyncTask syncHome, Alltask;
rIdClNoInitial;
Set po12_SaftPosPrt;
Set po13_SaftPosAll;
Set po09_WorkEnd;
RETURN
ENDPROC


PROC rPDispXoffset()
nRob1_X := 0;
nRHSideOdVer := 0;
IF pi24_Nvector=1 THEN
IF nOdJabNo = 2 AND bOdWork = TRUE THEN
nRob1_X := gi03_Xoffset+nOffsetM  ;
Rob1Offset.trans.x := nRob1_X - nRHSideOdVer;
ELSE
nRob1_X:=gi03_Xoffset+nOffsetM  ;
Rob1Offset.trans.x := nRob1_X;
ENDIF
ELSE
IF nOdJabNo = 2 AND bOdWork = TRUE THEN
nRob1_X := -gi03_Xoffset+nOffsetM  ;
Rob1Offset.trans.x := nRob1_X - nRHSideOdVer;
ELSE
nRob1_X:=-gi03_Xoffset+nOffsetM  ;
Rob1Offset.trans.x := nRob1_X ;
ENDIF
ENDIF
Rob1Offset.trans.y := 0;
!Rob1Offset.trans.y := -20;
IF bOdWork = TRUE AND nOdJabNo = 1 THEN
```


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```
PDispOff;
ELSE
PDispSet Rob1Offset;
ENDIF
ENDPROC

PROC rIdBandType()
IF pi40_Id1Hr = 1 OR pi41_Id3Hr = 1 OR pi42_Id5Hr = 1 OR pi43_Id7Hr = 1
OR pi44_Id9Hr = 1 OR pi45_Id11Hr = 1 THEN
b9BandWork := TRUE
ELSE
b9BandWork := FALSE
ENDIF
TPWrite " * b9BandWork = "\Bool:=b9BandWork;
RETURN
ENDPROC

PROC rIdJobClearNo()
Reset po22_DfLeft;
Reset po23_DfRight;
IF b9BandWork = TRUE THEN
IF nIdJabNo = 1 THEN
Reset po42_Id5Hr;
ELSEIF nIdJabNo =2 THEN
Reset po45_Id11Hr;
ELSEIF nIdJabNo = 3 THEN
Reset po43_Id7Hr;
ELSEIF nIdJabNo = 4 THEN
Reset po40_Id1Hr;
ELSEIF nIdJabNo = 5 THEN
Reset po41_Id3Hr;
ELSEIF nIdJabNo = 6 THEN
Reset po44_Id9Hr;
```


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```
ENDIF
ELSE
IF nIdJabNo = 1 THEN
Reset po37_Id4Hr;
ELSEIF nIdJabNo =2 THEN
Reset po39_Id10Hr;
ELSEIF nIdJabNo = 3 THEN
Reset po38_Id8Hr;
ELSEIF nIdJabNo = 4 THEN
Reset po36_Id2Hr;
ENDIF
ENDIF
ENDPROC

PROC rOdJobClearNo()
IF nOdJabNo = 1 THEN
Reset po33_CenterOd;
ELSEIF nOdJabNo = 2 THEN
Reset po35_SideOdHd;
ELSEIF nOdJabNo = 3 THEN
Reset po34_SideOdFg;
ENDIF
Reset po22_DfLeft;
Reset po23_DfRight;
ENDPROC

PROC rIdClNoInitial()
Reset po33_CenterOd;
Reset po34_SideOdFg;
Reset po35_SideOdHd;
Reset po36_Id2Hr;
Reset po37_Id4Hr;
Reset po38_Id8Hr;
```


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```
Reset po39_Id10Hr;
Reset po40_Id1Hr;
Reset po41_Id3Hr;
Reset po42_Id5Hr;
Reset po43_Id7Hr;
Reset po44_Id9Hr;
Reset po45_Id11Hr;
ENDPROC

PROC rJobNoReturn()
IF pi33_SenterOd = 1 THEN
Set po33_CenterOd;
ENDIF
IF pi34_SideOdFg = 1 THEN
Set po34_SideOdFg;
ENDIF
IF pi35_SideOdHd = 1 THEN
Set po35_SideOdHd;
ENDIF
IF pi36_Id2Hr = 1 THEN
Set po36_Id2Hr;
ENDIF
IF pi37_Id4Hr = 1 THEN
Set po37_Id4Hr;
ENDIF
IF pi38_Id8Hr = 1 THEN
Set po38_Id8Hr;
ENDIF
IF pi39_Id10Hr = 1 THEN
Set po39_Id10Hr;
ENDIF
IF pi40_Id1Hr = 1 THEN
Set po40_Id1Hr;
```


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```
ENDIF
IF pi41_Id3Hr = 1 THEN
Set po41_Id3Hr;
ENDIF
IF pi42_Id5Hr = 1 THEN
Set po42_Id5Hr;
ENDIF
IF pi43_Id7Hr = 1 THEN
Set po43_Id7Hr;
ENDIF
IF pi44_Id9Hr = 1 THEN
Set po44_Id9Hr;
ENDIF
IF pi45_Id11Hr = 1 THEN
Set po45_Id11Hr;
ENDIF
RETURN
ENDPROC

PROC rStiffnessSet()
IF bOdWork = TRUE THEN
nStiffness := 5;
nDamping := 30;
ELSE
IF nIdJabNo = 1 OR nIdJabNo = 3 OR nIdJabNo = 5 OR nIdJabNo = 6 THEN
nStiffness := 100;
nDamping := 80;
ELSEIF nIdJabNo = 2 OR nIdJabNo = 4 THEN
nStiffness := 100;
nDamping := 80;
ENDIF
ENDIF
ENDPROC
```


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```
PROC rPrtDownChk()
Set po12_SaftPosPrt;
Reset po18_PrtUpRqF;
Set po16_PrtDownRqF;
Set po15_PrtDownRqH;
WaitDI pi15_PrtDownChkH,1;
WaitDI pi16_PrtDownChkF,1;
Reset po15_PrtDownRqH;
Reset po16_PrtDownRqF;
Reset po12_SaftPosPrt;
Reset po13_SaftPosAll;
ENDPROC

PROC rPrtUpChk()
IF nOdJabNo = 2  THEN
WaitDI pi17_PrtUpChkH, 1;
ELSEIF nOdJabNo = 3 THEN
Set po18_PrtUpRqF;
WaitDI pi18_PrtUpChkF, 1;
Reset po18_PrtUpRqF;
ENDIF
RETURN
ENDPROC



PROC rErrorHeadReset()
Reset so07_BandRwd;
Reset so06_LowFeed;
Reset so08_DpFdOn;
```


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```
Reset po22_DfLeft;
Reset po23_DfRight;
Reset do05_BandGdIn;
rUpperRollBwd;
rBandClp;
rBandGdBwd;
WaitTime 1;
rBandCutting;
WaitTime 1;
rWeldPltBwd;
rBandUnclp;
WaitTime 1;
RETURN
ENDPROC

PROC rErrorSigReset()
Reset po19_OutFeedErr;
Reset po20_InFeedErr;
Reset po21_RwdErr;
Reset so08_DpFdOn;
Set po13_SaftPosAll;
rPrtDownChk;
RETURN
ENDPROC

PROC rBandOutSig()
Set so08_DpFdOn;
IF bOdWork=TRUE THEN
Reset po22_DfLeft;
Set po23_DfRight;
ELSE
IF nIdJabNo = 1 OR nIdJabNo = 2 OR nIdJabNo = 5 THEN
Reset po22_DfLeft;
```


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```
Set po23_DfRight;
ELSEIF nIdJabNo = 4 OR nIdJabNo = 3 OR nIdJabNo = 6 THEN
Reset po23_DfRight;
Set po22_DfLeft;
ENDIF
ENDIF
IF pi13_HomeReturn = 1 THEN
IF bOdWork=TRUE THEN
rErrOdOut;
ELSEIF bOdWork=FALSE THEN
rErrIdOut;
ENDIF
ENDIF
WaitDI di17_FgFwd, 1;
rBandFeedOut;
rUpperRollFwd;
Reset do25_FgFwd;
!Set do20_FgBwd;
IF bOdWork = TRUE THEN
!WaitDI di17_FgFwd, 0;
ENDIF
RETURN
ENDPROC

PROC rFeedingTime()
IF nCoilDia > 1800 OR nCoilWidth > 1500 THEN
IF bOdWork=TRUE THEN
WaitTime nOutDiaFeedTime;
ELSE
WaitTime nInDiaFeedTime;
ENDIF

ELSEIF nCoilDia <= 1800 AND nCoilDia > 1300 THEN
```


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```
IF bOdWork=TRUE THEN
WaitTime nOutDiaFeedTime;
ELSE
WaitTime nInDiaFeedTime;
ENDIF
ELSE
IF nCoilDia <= 950 THEN
IF bOdWork=TRUE THEN
WaitTime 0;
ELSE
WaitTime nInDiaFeedTime;
ENDIF
ELSE
IF bOdWork=TRUE THEN
WaitTime nOutDiaFeedTime;
ELSE
WaitTime nInDiaFeedTime;
ENDIF
ENDIF
ENDIF
IF nIdJabNo = 1 OR nIdJabNo = 3 THEN
WaitTime 1;
ENDIF
RETURN
ENDPROC

PROC rBandInSig()
IF pi13_HomeReturn = 1 THEN
IF bOdWork=TRUE THEN
rErrOdIn;
ELSEIF bOdWork=FALSE THEN
rErrIdIn;
ENDIF
```


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```
ENDIF
Reset so08_DpFdOn;
Reset po22_DfLeft;
Reset po23_DfRight;
Set so06_LowFeed;
rUpperRollBwd;
rFeedingTime;
Reset so06_LowFeed;
PulseDO\PLength:=0.2, so06_LowFeed;
rBandGdFwd;
rWeldPltBwd;
rUpperRollFwd;
Reset do27_FgClp_2;
Reset do26_FgClp_1;
WaitUntil di19_Unclp1=1 AND di20_Unclp2=1;
rBandFeedIn;
rBandRwdRdy;
RETURN
ERROR
Set po20_InFeedErr;
IF bOdWork=TRUE THEN
rErrOdIn;
ELSEIF bOdWork=FALSE THEN
rErrIdIn;
ENDIF
Reset po20_InFeedErr;
Reset so08_DpFdOn;
ENDPROC

PROC rWeldProcess()
rBandRewOn;
rBandWeld;
rBandUnclp;
```


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```
Reset do03_WeldPltIn;
WaitDI di09_WeldPltOut, 1;
Reset do01_BdRwdPos;
Reset po22_DfLeft;
Reset po23_DfRight;
RETURN
ENDPROC

PROC rBandRewOn()
Set so07_BandRwd;
Reset po16_PrtDownRqF;
WaitTime 0.5;
WaitDI si09_RwdStop, 1\MaxTime:=10;
IF nOdJabNo = 3 THEN
Set po12_SaftPosPrt;
Set po16_PrtDownRqF;
ENDIF
Set so05_BdRwdEnd;
RETURN
ERROR
Set po21_RwdErr;
IF bOdWork=TRUE THEN
rErrOdIn;
ELSEIF bOdWork=FALSE THEN
rErrIdRwd;
ENDIF
Reset po21_RwdErr;
ENDPROC

PROC rBandCutting()
Set do22_BandCut;
WaitDI di12_BandCut,1;
Reset do22_BandCut;
```


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```
WaitDI di12_BandCut,0;
RETURN
ENDPROC

PROC rBandUnclp()
Reset do21_BandGrip;
WaitDI di07_BandGrip,0;
WaitTime 0.1;
ENDPROC

PROC rBandFeedOut()
Set so06_LowFeed;
WaitDI di01_BdFdOutSen,1\MaxTime:=5;
Reset so06_LowFeed;
WaitTime 0.2;
Set so01_HdFeedEnd;
Set do27_FgClp_2;
WaitDI di20_Unclp2, 0;
RETURN
ERROR
Set po19_OutFeedErr;
IF bOdWork=TRUE THEN
rErrOdOut;
ELSEIF bOdWork=FALSE THEN
rErrIdOut;
ENDIF
Reset po19_OutFeedErr;
ENDPROC

PROC rPadPshBwd()
!Reset do09_PadPshFwd;
!WaitDI di11_PadPshBwd,1;
RETURN
```


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```
ENDPROC

PROC rPadPshFwd()
!Set do09_PadPshFwd;
!WaitDI di11_PadPshBwd,0;
!WaitTime 1;
RETURN
ENDPROC

PROC rBandGdBwd()
Reset do05_BandGdIn;
WaitDI di06_BdGdOut, 1;
RETURN
ENDPROC

PROC rBandGdFwd()
Set do05_BandGdIn;
WaitDI di06_BdGdOut, 0;
WaitTime 1;
RETURN
ENDPROC

PROC rWeldPltFwd()
Set do03_WeldPltIn;
WaitDI di09_WeldPltOut, 0;
RETURN
ENDPROC

PROC rWeldPltBwd()
Reset do03_WeldPltIn;
WaitDI di09_WeldPltOut, 1;
RETURN
ENDPROC
```


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```
PROC rUpperRollBwd()
Reset do01_BdRwdPos;
WaitDI di04_BdRwdPos, 1;
RETURN
ENDPROC

PROC rUpperRollFwd()
Set do01_BdRwdPos;
WaitDI di04_BdRwdPos, 0;
RETURN
ENDPROC

PROC rBandFeedIn()
Set so06_LowFeed;
WaitDI di02_BdFdInSen,1\MaxTime:=5;
Set so04_BdInFdEnd;
Reset so06_LowFeed;
rBandClp;
RETURN
ERROR
Set po20_InFeedErr;
IF bOdWork=TRUE THEN
rErrOdIn;
ELSEIF bOdWork=FALSE THEN
rErrIdIn;
ENDIF
Reset po20_InFeedErr;
ENDPROC

PROC rBandRwdRdy()
WaitTime 0.5;
rWeldPltFwd;
```


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```
rBandGdBwd;
rUpperRollBwd;
RETURN
ENDPROC

PROC rHeadInitial()
Reset do21_BandGrip;
Reset do22_BandCut;
Reset do01_BdRwdPos;
!Reset do09_PadPshFwd;
Reset do05_BandGdIn;
Reset do03_WeldPltIn;
Reset do07_GunClose;
Reset do11_HeadUnlock;
WaitDI di10_GunOpen, 1;
WaitDI di01_BdFdOutSen,0;
WaitDI di02_BdFdInSen,0;
WaitDI di06_BdGdOut, 1;
WaitDI di15_HeadLock, 1;
WaitDI di09_WeldPltOut,1;
WaitDI di07_BandGrip,0;
WaitDI di04_BdRwdPos,1;
!WaitDI di11_PadPshBwd,1;
WaitDI di12_BandCut,0;
RETURN
ENDPROC


PROC rHeadPosTurn()
Reset do20_HeadPosTurn;
Set do19_HeadPosHome;
Set do11_HeadUnlock;
```


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```
WaitDI di15_HeadLock, 0;
Reset do19_HeadPosHome;
Set do20_HeadPosTurn;
WaitTime 0.5;
WaitDI di14_HeadPosTurn, 1;
Reset do11_HeadUnlock;
WaitDI di15_HeadLock, 1;
!WaitTime 0.5;
RETURN
ENDPROC

PROC rHeadPosHome()
Reset do19_HeadPosHome;
Set do20_HeadPosTurn;
Set do11_HeadUnlock;
WaitDI di15_HeadLock,0;
Reset do20_HeadPosTurn;
Set do19_HeadPosHome;
!WaitTime 1;
WaitDI di13_HeadPosHome, 1;
Reset do11_HeadUnlock;
WaitDI di15_HeadLock,1;
WaitTime 0.5;
RETURN
ENDPROC

PROC rBandWeld()
Set do09_Gun_LR_Ok;
WaitTime 1;
Set do07_GunClose;
!WaitTime 0.3;
Set po08_WeldOn;
WaitDI pi08_WeldOk, 1;
```


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```
Reset do09_Gun_LR_Ok;
Reset so07_BandRwd;
Reset po08_WeldOn;
Reset do07_GunClose;
WaitDI di10_GunOpen, 1;
!!!!!--------------------
IF pi19_DoubleWeld=1 THEN
Set do09_Gun_LR_Ok;
WaitDI di11_WeldGun_LR, 1;
WaitTime 1;
Set do07_GunClose;
WaitTime 0.5;
Set po08_WeldOn;
WaitDI pi08_WeldOk, 1;
Reset po08_WeldOn;
WaitTime 0.2;
Reset do07_GunClose;
WaitDI di10_GunOpen, 1;
Reset do09_Gun_LR_Ok;
WaitDI di11_WeldGun_LR, 0;
ENDIF
!!!!!--------------------
Set do22_BandCut;
WaitDI di12_BandCut,1;
Reset do03_WeldPltIn;
WaitDI di09_WeldPltOut, 1;
Reset do22_BandCut;
Reset do21_BandGrip;
WaitDI di12_BandCut,0;
RETURN
ERROR
weldRetry:
!WaitTime 3;
```


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```
!WaitTime 0.2;
PulseDO\PLength:=0.5, po08_WeldOn;
WaitTime 0.2;
IF pi08_WeldOk = 1 THEN
RETRY
ELSE
GOTO weldRetry;
ENDIF
ENDPROC

PROC rBandClp()
!WaitTime 0.2;
Set do21_BandGrip;
WaitDI di07_BandGrip,1;
RETURN
ENDPROC

ENDMODULE
```

- 위치 티칭 프로그램

```
MODULE Teaching_R1
!---------------- Program Wobj data ----------------
!---------------- Program Teach Target data ----------------
!  IF nCoilDia>1200 AND nCoilWidth>1220 THEN
!---------------- Program Teach Out Dia Target data ----------------
CONST robtarget
poOdOut1:=[[246.70,-1231.37,-1111.37],[0.717255,-0.00149852,0.696797,-0.00402763],[0,
0,-1,1],[-1559.96,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdOut2:=[[-289.82,-1232.05,-1130.2],[0.708407,-6.56083E-05,0.705792,-0.00405027],
[-1,-1,0,1],[-201.126,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
```


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```
poOdOut3:=[[804.75,-1232.03,-1126.65],[0.709836,-0.00379001,0.704345,-0.00403216],[0,
0,-1,1],[-1559.97,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdIn1:=[[234.68,-1475.00,-642.54],[0.693761,0.134549,0.69533,0.130797],[-1,-1,0,1],[-
1588,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdIn2:=[[-330.96,-1473.3,-636.12],[0.699143,0.133022,0.692462,0.118324],[-1,-1,0,1],[
-600,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdIn3:=[[829.68,-1470.87,-644.18],[0.693679,0.141243,0.692714,0.137867],[-1,-1,0,1],[
-1450.55,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdWeld1:=[[233.02,-1254.52,-500.64],[0.695341,0.143022,0.687654,0.152244],[0,0,0,1],[
-1588,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdWeld2:=[[-325,-1253.89,-495.28],[0.695159,0.126109,0.696601,0.124893],[-1,-1,0,1]
,[-600,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdWeld3:=[[840,-1257.41,-506.62],[0.694366,0.139933,0.690594,0.146132],[0,0,0,1],[-1
570.01,9E+09,9E+09,9E+09,9E+09,9E+09]];

!---------------- Program Teach In Dia Target data ----------------
CONST robtarget
poIdOut1:=[[-467.97,-553.16,-239.78],[0.180092,-0.68576,-0.687888,-0.155277],[-1,0,0,0
],[862.794,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdOut2:=[[-445.09,-410.33,-105.12],[0.644239,0.294459,0.293381,-0.64201],[-1,0,-1,1],
[1959.84,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdOut3:=[[-464.31,-379.87,-233.54],[0.172622,0.685873,-0.684392,0.177166],[0,-1,-1,0
],[-1146.75,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdOut4:=[[-474.05,-532.90,-97.73],[0.634052,-0.309132,0.303219,0.640682],[0,-1,0,1],[
```


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```
-1979.98,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdOut5:=[[-460.22,-577.88,-170.81],[0.0174559,-0.694852,-0.71894,-0.000809557],[-1,
-1,0,0],[1000.01,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdOut6:=[[-468.33,-380.47,-164.24],[0.0270066,-0.708007,0.705312,0.0230494],[0,0,-1,
0],[-1146.76,9E+09,9E+09,9E+09,9E+09,9E+09]];
!!!!!!!!!!!!!!!!!!!!!!!!!!
!-----------------------------------------------------------------
-----------------------------------------------------------------
---
!-----------------------------------------------------------------
-----------------------------------------------------------------
---
CONST robtarget
poIdIn1:=[[-186.14,-1332.04,-686.94],[0.0040297,0.00879146,0.97148,0.236925],[-1,0,-1,0
],[-890.341,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdIn2:=[[-332.52,192.15,561.70],[0.00155315,-0.00167985,-0.415707,0.909495],[-1,0,-2,
1],[1956.09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdIn3:=[[-254.37,438.18,-703.04],[0.00172714,0.0206671,-0.968711,0.247325],[0,-1,0,0],
[1463.34,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdIn4:=[[-331.10,-1079.11,571.13],[0.00415344,-0.00842296,0.432922,0.901382],[0,-1,1,
1],[-1451.34,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdIn5:=[[-252.40,-1503.09,-175.08],[0.00146873,-0.0183664,0.999743,0.0131724],[-1,0,
-1,0],[-820.062,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdIn6:=[[-248.06,565.95,-165.73],[0.00320619,-0.0135922,0.999277,0.0353619],[0,0,0,0],
[954.123,9E+09,9E+09,9E+09,9E+09,9E+09]];
```


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```
CONST robtarget
poIdViaP1_1:=[[-536.24,-1120.19,-562.28],[0.181619,-0.692495,-0.681103,-0.15351],[-1,
0,0,0],[543.486,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdViaP2_1:=[[-536.79,58.24,438.61],[0.634516,0.29001,0.297769,-0.651628],[-1,0,-1,1],
[1951.08,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdViaP3_1:=[[-480.38,137.99,-543.31],[0.174147,0.691784,-0.678415,0.175671],[0,-1,-1
,0],[-500.467,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdViaP4_1:=[[-493.26,-1014.06,486.74],[0.643389,-0.313537,0.298633,0.631319],[0,-1,0
,1],[-1956.87,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdViaP5_1:=[[-573.31,-1267.02,-172.36],[0.0174586,-0.697561,-0.716313,-0.00074665
9],[-1,-1,0,0],[379.232,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdViaP6_1:=[[-542.9,412.27,-163.18],[0.0266811,-0.69778,0.715432,0.0234382],[0,0,-1,
0],[-210.92,9E+09,9E+09,9E+09,9E+09,9E+09]];

CONST robtarget
poIdViaP1_2:=[[-405.19,-1347.42,-683.7],[0.117215,-0.413779,-0.878771,-0.206905],[-1,
0,-1,0],[-151.294,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdViaP2_2:=[[-398.36,217.04,622],[0.469217,0.214468,0.356068,-0.779137],[-1,0,-1,1],[
1951.08,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdViaP3_2:=[[-402.56,410.78,-692.32],[0.11135,0.448332,-0.85896,0.220881],[0,-1,0,0],
[119.307,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdViaP4_2:=[[-361.71,-1130.53,634.64],[0.475619,-0.233914,0.36437,0.765706],[0,-1,0,
1],[-1956.87,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdViaP5_2:=[[-380.49,-1399.7,-174.46],[0.0165824,-0.471925,-0.881465,-0.00555755],
```


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```
[-1,-1,-1,0],[379.232,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdViaP6_2:=[[-407.34,571.73,-160.21],[0.0165169,-0.395459,0.917798,0.0314292],[0,0,-
1,0],[377.935,9E+09,9E+09,9E+09,9E+09,9E+09]];


CONST robtarget
poIdWeld1h:=[[-380.43,-925.23,435.03],[0.627119,-0.320557,0.315762,0.635814],[0,-1,0,1
],[-1957.22,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld2h:=[[-380.40,-1001.52,350.43],[0.642591,-0.282729,0.258507,0.663563],[0,-1,0,
1],[-1950.35,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld3h:=[[-382.15,-1236.80,-180.40],[0.0107472,0.695153,0.718773,-0.00341103],[-
1,-1,0,0],[517.872,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld4h:=[[-381.32,-999.26,-731.87],[0.277145,-0.646776,-0.657616,-0.269095],[-1,
0,0,0],[605.399,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld5h:=[[-387.89,-918.84,-798.03],[0.322318,-0.621859,-0.643188,-0.309373],[-1,
0,0,0],[543.509,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld7h:=[[-381.59,16.04,-831.08],[0.310011,0.6281,-0.63332,0.329072],[0,-1,-1,0],[-
500.451,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld8h:=[[-382.43,110.96,-751.31],[0.26879,0.65058,-0.654046,0.276986],[0,-1,-1,0],
[-562.339,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld9h:=[[-381.94,360.13,-187.22],[0.000323983,0.700231,-0.713901,0.00452052],[0,
-1,-1,0],[-210.917,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld10h:=[[-382.58,99.01,366.71],[0.649531,0.280318,0.255323,-0.659046],[-1,0,-1,1
],[1949.84,9E+09,9E+09,9E+09,9E+09,9E+09]];
```


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```
CONST robtarget
poIdWeld11h:=[[-380.48,24.99,452.74],[0.632651,0.319767,0.304637,-0.636159],[-1,0,-1,1
],[1921.08,9E+09,9E+09,9E+09,9E+09,9E+09]];
!
!---------------- Program Teach Tool Change Target data
----------------
CONST robtarget
pToolHomeMove10:=[[-1193.56,-1318.98,381.03],[0.496334,0.50382,0.48312,-0.516153],[
-2,0,-1,0],[179.014,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pToolTurnMove10:=[[-1088.20,2196.96,1009.62],[0.713658,-0.0199282,0.699565,0.03007
94],[0,0,-1,0],[2018.35,9E+09,9E+09,9E+09,9E+09,9E+09]];
!
!---------------- Program Teach Home Target data ----------------
CONST robtarget
pHome:=[[-113.21,-990.88,1379.29],[0.0114781,0.0375443,0.94617,-0.32128],[-2,0,-2,0],[
-225,9E+09,9E+09,9E+09,9E+09,9E+09]];

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!---------------- Program Teach Move to OutDiaJob Position Target data
----------------
CONST robtarget
pOdMove30:=[[-534.89,-1444.45,-975.45],[0.261048,0.00859471,0.963421,-0.0599926],[-
1,-1,0,1],[-1104.68,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pOdMove20:=[[-739.88,-1487.84,-779.08],[0.0234111,0.0368323,0.990197,-0.132686],[-1,
-1,-1,0],[-1026.23,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pOdMove10:=[[-1126.89,-1731.73,-706.77],[0.0193054,0.0344946,0.998635,-0.0341541],[
-1,0,-1,0],[-207.243,9E+09,9E+09,9E+09,9E+09,9E+09]];
!---------------- Program Teach Move to IdJob from Home Position Target
data ----------------
CONST robtarget
```


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```
pId1hMove10:=[[-1267.71,-517.54,-308.61],[0.625711,-0.318435,0.344507,0.623218],[1,0,
-1,1],[-1955.75,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pId1hMove20:=[[-2389.02,-87.24,91.37],[0.0190778,0.725964,-0.687351,0.0127133],[1,-1,
-1,0],[-183.216,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pId1hMove30:=[[-1404.62,-173.67,426.46],[0.201475,0.056461,0.977771,-0.0136141],[-1,
-1,-1,0],[-284.986,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pId1hMove40:=[[-1118.37,-665.26,206.13],[0.00765217,-0.685654,-0.727888,-0.00022588
9],[-1,-1,-1,0],[179.011,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pId5hMove10:=[[-1354.70,-1312.03,-539.58],[0.0127773,-0.322394,-0.946429,0.0131316],
[-1,-1,-1,0],[137.546,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pId79Move10:=[[-831.23,1132.43,979.90],[0.768813,0.197348,0.313318,-0.521356],[-1,0,-
1,1],[2127.78,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pId11hMove10:=[[-1207.27,-1221.45,152.53],[0.6415,0.287145,0.296744,-0.646506],[-2,-
1,0,1],[1306.44,9E+09,9E+09,9E+09,9E+09,9E+09]];
!---------------- Program Teach Move to InDiaJob Position Target data
----------------
CONST robtarget
pId1hHome10:=[[-1355.44,-1310.18,711.45],[0.00555401,-0.0237013,0.37365,0.927251],[0
,-1,2,1],[-1744.28,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pId1hHome20:=[[-667.94,-1657.41,1083.93],[0.644462,-0.275215,0.253844,0.6667],[0,-1,1
,1],[-1744.28,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pId11hHome10:=[[-1065.02,-434.46,960.12],[0.62401,0.290952,0.343816,-0.638553],[-1,-
1,-1,1],[1679.91,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pCalib_X1:=[[1752.38,470.58,1557.97],[0.507386,0.497781,0.485999,-0.508507],[-1,0,-1,1]
```


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```
,[1530.6,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pCalib_X2:=[[2252.36,471.77,1560.33],[0.507386,0.497784,0.486003,-0.5085],[-1,0,-1,1],[1
530.61,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pCalib_Y1:=[[1752.11,970.52,1555.39],[0.507392,0.497779,0.485998,-0.508503],[-1,0,-1,1]
,[1530.6,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pCalib_X210:=[[-113.21,-990.86,1379.28],[0.0114794,0.0375431,0.946172,-0.321273],[-2,
0,-2,0],[-224.986,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pCalibRdy:=[[1804.04,563.35,1813.88],[0.570426,0.391701,0.36506,-0.622829],[-1,0,-1,1],[
2041.64,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pCalibChk:=[[568.01,-16.88,-156.66],[0.504358,0.498472,0.487921,-0.509001],[-1,0,-1,1],
[1530.6,9E+09,9E+09,9E+09,9E+09,9E+09]];
TASK PERS tooldata
tool1:=[TRUE,[[-65.3007,43.8778,249.025],[1,0,0,0]],[5,[0,0,50],[1,0,0,0],0,0,0]];
CONST robtarget
p10:=[[-289.83,-1226.97,-1100.29],[0.708389,-6.24644E-05,0.70581,-0.00402372],[-1,-1,
0,1],[-101.127,9E+09,9E+09,9E+09,9E+09,9E+09]];

PROC rTeachLgOd1()
PDispOff;
!------------Large OutDia 1 Teaching---------------!
MoveJ pHome,v2500,fine,toolPeader1;
MoveJ pOdMove10, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove20, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove30, v5000, z200, toolPeader1\WObj:=wobjHead;
nOdJabNo:=1;
MoveL Offs(poOdOut1,0,-100,0),v5000,z10,toolPeader1\WObj:=wobjHead;
MoveL poOdOut1, v2000, fine, toolPeader1\WObj:=wobjHead;
MoveL poOdIn1, v2500, fine, toolPeader1\WObj:=wobjHead;
```


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```
MoveL poOdWeld1, v2500, fine, toolPeader1\WObj:=wobjHead;
MoveL poOdOut1, v5000, z100, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove30, v5000, z200, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove20, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove10, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pHome,v2500,fine,toolPeader1;
ENDPROC

PROC rTeachLgOd2()
PDispOff;
!------------Large OutDia 2 Teaching---------------!
MoveJ pHome,v2500,fine,toolPeader1;
MoveJ pOdMove10, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove20, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove30, v5000, z200, toolPeader1\WObj:=wobjHead;
nOdJabNo:=2;
MoveL Offs(poOdOut2,0,-100,0),v5000,z10,toolPeader1\WObj:=wobjHead;
MoveL poOdOut2, v2000, fine, toolPeader1\WObj:=wobjHead;
MoveL poOdIn2, v2500, fine, toolPeader1\WObj:=wobjHead;
MoveL poOdWeld2, v2500, fine, toolPeader1\WObj:=wobjHead;
MoveL poOdOut2, v5000, z100, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove30, v5000, z200, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove20, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove10, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pHome,v2500,fine,toolPeader1;
ENDPROC

PROC rTeachLgOd3()
PDispOff;
!------------Large OutDia 3 Teaching---------------!
MoveJ pHome,v2500,fine,toolPeader1;
MoveJ pOdMove10, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove20, v5000, z20, toolPeader1\WObj:=wobjHead;
```


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```
MoveJ pOdMove30, v5000, z200, toolPeader1\WObj:=wobjHead;
nOdJabNo:=3;
MoveL Offs(poOdOut3,0,-100,0),v5000,z10,toolPeader1\WObj:=wobjHead;
MoveL poOdOut3, v2000, fine, toolPeader1\WObj:=wobjHead;
MoveL poOdIn3, v2500, fine, toolPeader1\WObj:=wobjHead;
MoveL poOdWeld3, v2500, fine, toolPeader1\WObj:=wobjHead;
MoveL poOdOut3, v5000, z100, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove30, v5000, z200, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove20, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove10, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pHome,v2500,fine,toolPeader1;
ENDPROC

PROC rTeachLgId1()
!------------Large In Dia 1 Teaching---------------!
nIdJabNo:=1;
MoveJ Offs(poIdOut1,-100,0,0), v5000, z10, toolPeader1\WObj:=wobjHead;
MoveL poIdOut1, v2000, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP1_1, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP1_2, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveJ poIdIn1, v2500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP1_2, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP1_1, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveJ poIdWeld4h, v500, fine, toolPeader1\WObj:=wobjHead;
MoveJ poIdWeld5h, v500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP1_1, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP1_2, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveJ pHome,v5000,fine,toolPeader1;
ENDPROC

PROC rTeachLgId2()
!------------Large In Dia 2 Teaching---------------!
nIdJabNo:=2;
```


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```
MoveJ Offs(poIdOut2,-100,0,0), v5000, z10, toolPeader1\WObj:=wobjHead;
MoveL poIdOut2, v2000, fine, toolPeader1\WObj:=wobjHead;

MoveL poIdViaP2_1, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP2_2, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveJ poIdIn2, v2500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP2_2, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP2_1, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveJ poIdWeld10h, v500, fine, toolPeader1\WObj:=wobjHead;
MoveJ poIdWeld11h, v500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP2_1,v5000,z50,toolPeader1\WObj:=wobjHead;
MoveL poIdViaP2_2,v5000,z50,toolPeader1\WObj:=wobjHead;
MoveJ pHome,v5000,fine,toolPeader1;
ENDPROC

PROC rTeachLgId3()
!------------Large In Dia 3 Teaching---------------!
nIdJabNo:=3;
MoveJ pId79Move10, v5000, z100, toolPeader1\WObj:=wobjHead;
MoveJ pToolTurnMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
rHeadPosTurn;
MoveL Offs(poIdOut3,-100,0,0),v5000,z10,toolPeader2\WObj:=wobjHead;
MoveL poIdOut3, v2000, fine, toolPeader2\WObj:=wobjHead;

MoveL poIdViaP3_1, v5000, z50, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP3_2, v5000, z50, toolPeader2\WObj:=wobjHead;
MoveJ poIdIn3, v2500, fine, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP3_2, v5000, z50, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP3_1, v5000, z50, toolPeader2\WObj:=wobjHead;
MoveJ poIdWeld7h, v500, fine, toolPeader2\WObj:=wobjHead;
MoveJ poIdWeld8h, v500, fine, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP3_1,v5000,z50,toolPeader2\WObj:=wobjHead;
MoveL poIdViaP3_2,v5000,z50,toolPeader2\WObj:=wobjHead;
```


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```
MoveJ pToolHomeMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
rHeadPosHome;
MoveJ pHome,v5000,fine,toolPeader1;
ENDPROC

PROC rTeachLgId4()
!------------Large In Dia 4 Teaching---------------!
nIdJabNo:=4;
MoveJ pId79Move10, v5000, z100, toolPeader1\WObj:=wobjHead;
MoveJ pToolTurnMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
rHeadPosTurn;
MoveJ Offs(poIdOut4,-100,0,0),v5000,z10,toolPeader2\WObj:=wobjHead;
MoveL poIdOut4, v2000, fine, toolPeader2\WObj:=wobjHead;

MoveL poIdViaP4_1, v5000, z50, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP4_2, v5000, z50, toolPeader2\WObj:=wobjHead;
MoveJ poIdIn4, v2500, fine, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP4_2, v5000, z50, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP4_1, v5000, z50, toolPeader2\WObj:=wobjHead;
MoveJ poIdWeld1h, v500, fine, toolPeader2\WObj:=wobjHead;
MoveL poIdWeld2h, v500, fine, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP4_1,v5000,z50,toolPeader2\WObj:=wobjHead;
MoveL poIdViaP4_2,v5000,z50,toolPeader2\WObj:=wobjHead;
MoveJ pToolHomeMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
rHeadPosHome;
MoveJ pHome,v5000,fine,toolPeader1;
ENDPROC
PROC rTeachLgId5()
!------------Large In Dia 5 Teaching---------------!
nIdJabNo:=5;
MoveJ Offs(poIdOut5,-100,0,0), v5000, z10, toolPeader1\WObj:=wobjHead;
MoveL poIdOut5, v2000, fine, toolPeader1\WObj:=wobjHead;
```


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```
MoveL poIdViaP5_1, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP5_2, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveJ poIdIn5, v2500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP5_2, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP5_1, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveL poIdWeld3h, v500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP5_1,v5000,z50,toolPeader1\WObj:=wobjHead;
MoveL poIdViaP5_2,v5000,z50,toolPeader1\WObj:=wobjHead;
MoveJ pHome,v5000,fine,toolPeader1;
ENDPROC
PROC rTeachLgId6()
!------------Large In Dia 6 Teaching---------------!
nIdJabNo:=6;
MoveJ pId79Move10, v5000, z100, toolPeader1\WObj:=wobjHead;
MoveJ pToolTurnMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
rHeadPosTurn;
MoveL Offs(poIdOut6,-100,0,0),v5000,z10,toolPeader2\WObj:=wobjHead;
MoveL poIdOut6, v2000, fine, toolPeader2\WObj:=wobjHead;

MoveL poIdViaP6_1, v5000, z50, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP6_2, v5000, z50, toolPeader2\WObj:=wobjHead;
MoveJ poIdIn6, v2500, fine, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP6_2, v5000, z50, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP6_1, v5000, z50, toolPeader2\WObj:=wobjHead;
MoveL poIdWeld9h, v500, fine, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP6_1,v5000,z50,toolPeader2\WObj:=wobjHead;
MoveL poIdViaP6_2,v5000,z50,toolPeader2\WObj:=wobjHead;
MoveJ pToolHomeMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
rHeadPosHome;
MoveJ pHome,v5000,fine,toolPeader1;
ENDPROC

PROC rTeachLgRoll()
```


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```
!  IF nCoilDia=1200 AND nCoilWidth=1220 THEN
PDispOff;
!------------OutDia Teaching---------------!
MoveJ pHome,v2500,fine,toolPeader1;
MoveJ pOdMove10, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove20, v5000, z20, toolPeader1\WObj:=wobjHead;
MoveJ pOdMove30, v5000, z200, toolPeader1\WObj:=wobjHead;
nOdJabNo:=2;
!!!
```

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```
MoveL poOdIn3, v2500, fine, toolPeader1\WObj:=wobjHead;
Stop;
MoveL poOdWeld3, v2500, fine, toolPeader1\WObj:=wobjHead;
Stop;
MoveL poOdOut3, v5000, z100, toolPeader1\WObj:=wobjHead;
Stop;
MoveL Offs(poOdOut1,0,-100,0),v5000,z10,toolPeader1\WObj:=wobjHead;
MoveL poOdOut1, v2000, fine, toolPeader1\WObj:=wobjHead;
!rBandFeedOut;
Stop;
MoveL RelTool(poOdOut1,-100,-50,0\Rz:=15), v2000, z20,
toolPeader1\WObj:=wobjHead;
Stop;
MoveL poOdIn1, v2500, fine, toolPeader1\WObj:=wobjHead;
Stop;
MoveL poOdWeld1, v2500, fine, toolPeader1\WObj:=wobjHead;
Stop;
MoveL poOdOut1, v5000, z100, toolPeader1\WObj:=wobjHead;
!!!
```

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```
RelTool(poIdOut1,-100,-50,0\Rz:=15),v200,z20,toolPeader1\WObj:=wobjHead;
Stop;
MoveL poIdViaP1_1, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP1_2, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveJ poIdIn1, v2500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP1_2, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP1_1,v5000,z50,toolPeader1\WObj:=wobjHead;
Stop;
MoveJ poIdWeld5h, v500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdWeld4h, v500, fine, toolPeader1\WObj:=wobjHead;
Stop;
MoveL poIdOut5, v500, fine, toolPeader1\WObj:=wobjHead;
MoveL
RelTool(poIdOut5,-100,-50,0\Rz:=15),v500,fine,toolPeader1\WObj:=wobjHead;
MoveL poIdViaP5_1, v500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP5_2, v500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdIn5, v500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP5_2, v500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP5_1, v500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdWeld3h, v500, fine, toolPeader1\WObj:=wobjHead;
Stop;
MoveL RelTool(poIdWeld3h,100,-50,0),v5000,z100,toolPeader1\WObj:=wobjHead;
!!!
```

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```
Stop;
MoveL poIdViaP2_1, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP2_2, v5000, z50, toolPeader1\WObj:=wobjHead;
MoveJ poIdIn2, v2500, fine, toolPeader1\WObj:=wobjHead;
MoveL poIdViaP2_2,v5000,z50,toolPeader1\WObj:=wobjHead;
MoveL poIdViaP2_1,v5000,z50,toolPeader1\WObj:=wobjHead;
Stop;
MoveJ poIdWeld10h, v500, fine, toolPeader1\WObj:=wobjHead;
Stop;
MoveL poIdWeld11h, v500, fine, toolPeader1\WObj:=wobjHead;
MoveL RelTool(poIdWeld11h,100,-50,0),v5000,z100,toolPeader1\WObj:=wobjHead;
!!!
```

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```
MoveL poIdWeld8h, v500, fine, toolPeader2\WObj:=wobjHead;
Stop;
MoveL poIdViaP3_1,v5000,z50,toolPeader2\WObj:=wobjHead;
Stop;
MoveL poIdOut6, v500, fine, toolPeader2\WObj:=wobjHead;
MoveL
RelTool(poIdOut6,-100,50,0\Rz:=-15),v200,z20,toolPeader2\WObj:=wobjHead;
MoveL poIdViaP6_1, v500, fine, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP6_2, v500, fine, toolPeader2\WObj:=wobjHead;
MoveJ poIdIn6, v500, fine, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP6_2,v500,fine,toolPeader2\WObj:=wobjHead;
MoveL poIdViaP6_1,v500,fine,toolPeader2\WObj:=wobjHead;
MoveL poIdWeld9h, v500, fine, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP6_1,v500,fine,toolPeader2\WObj:=wobjHead;
Stop;
!!!
```

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```
MoveL poIdWeld2h, v500, fine, toolPeader2\WObj:=wobjHead;
MoveL poIdViaP4_1,v5000,z50,toolPeader2\WObj:=wobjHead;
MoveL poIdViaP4_2,v5000,z50,toolPeader2\WObj:=wobjHead;
Stop;
MoveJ pToolHomeMove10, v5000, fine, toolPeader1\WObj:=wobjHead;
rHeadPosHome;
MoveJ pHome,v5000,fine,toolPeader1;
ENDPROC

PROC rCalibration()
MoveJ pHome, v1000, z50, toolPeader1;
MoveJ pCalibRdy, v1000, z50, toolPeader1;
MoveL Offs(pCalib_X2,0,0,-500), v1000, z50, toolPeader1;
MoveL pCalib_X2, v1000, fine, toolPeader1;
MoveL pCalib_X1, v1000, fine, toolPeader1;
MoveL pCalib_Y1, v1000, fine, toolPeader1;
MoveL Offs(pCalib_X1,00,500,-500), v1000, z50, toolPeader1;
MoveL Offs(pCalib_Y1,-50,0,0), v1000, z50, toolPeader1;
!-------------------------------------
MoveL pCalibChk, v1000, fine, toolPeader1\WObj:=wobjHead;
MoveL Offs(pCalibChk,0,0,-500), v1000, fine, toolPeader1\WObj:=wobjHead;
MoveL Offs(pCalibChk,0,500,-500), v1000, fine, toolPeader1\WObj:=wobjHead;
MoveL Offs(pCalibChk,500,500,-500), v1000, fine, toolPeader1\WObj:=wobjHead;
MoveL Offs(pCalibChk,-502,502.8,-502.5), v1000, z50,
toolPeader1\WObj:=wobjHead;
MoveL pCalibRdy, v1000, z50, toolPeader1;
MoveJ pHome, v1000, z50, toolPeader1;
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!nDx:=500/2;
!nDy:=500/2.8;
!nDz:=500/2.5;
ENDPROC
ENDMODULE
```


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실제 코딩하여 사용된 ROBOT 프로그램(ROBOT-2)

- 기본 시스템 셋팅

```
MODULE MainModule_R2
PERS pose Rob2Offset := [[61,0,0],[1,0,0,0]];
PERS num nRob2_X := 61;
PERS num nOffsetM := -40;
TASK PERS num nXin:=-1050;
TASK PERS num nXout:=-750;

!---------------- Out Dia Target data ----------------
!
!  IF nCoilDia=1900 AND nCoilWidth=1100 THEN
!
TASK PERS robtarget
pOdOut{3}:=[[[2001.11,-18.94,-201.26],[0.496712,-0.494928,0.503359,0.504929],[-1,0,-3,
0],[-1479.98,9E+09,9E+09,9E+09,9E+09,9E+09]],[[2463.12,-18.8,-213.04],[0.5088,-0.509
386,0.494061,0.487394],[-1,0,-3,0],[-1480.38,9E+09,9E+09,9E+09,9E+09,9E+09]],[[1515.3
3,-18.19,-209.47],[0.505217,-0.503495,0.496576,0.494633],[-1,0,-3,0],[0.0131882,9E+09,9
E+09,9E+09,9E+09,9E+09]]];
TASK PERS robtarget
pOdAprch1{3}:=[[[2002,-607.216,-130.04],[0.200019,-0.698031,0.660174,0.192138],[-1,0,
-2,0],[-1480.53,9E+09,9E+09,9E+09,9E+09,9E+09]],[[2447.49,-607.756,-170.68],[0.21458
6,-0.688097,0.66119,0.208095],[-1,0,-2,0],[-1392.1,9E+09,9E+09,9E+09,9E+09,9E+09]],[[
1490.5,-607.237,-170.01],[0.257941,-0.674219,0.642299,0.25758],[-1,0,-3,0],[-337.001,9E
+09,9E+09,9E+09,9E+09,9E+09]]];
!
TASK PERS robtarget
pIdIn{6}:=[[[2038.68,804.045,170.559],[0.365477,-0.600944,0.370021,-0.606941],[-1,1,0,0],
[2141.93,9E+09,9E+09,9E+09,9E+09,9E+09]],[[2184.81,-595.357,1306.94],[0.657895,0.233
687,0.674078,0.241214],[-1,1,-2,0],[1415.8,9E+09,9E+09,9E+09,9E+09,9E+09]],[[2102.05,
```


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```
-853.765,144.199],[0.355032,0.592625,0.382834,0.613341],[-1,1,-1,0],[882.811,9E+09,9E+0
9,9E+09,9E+09,9E+09]],[[2172.96,543.927,1322.72],[0.668438,-0.242981,0.660408,-0.2408
59],[-1,1,-3,0],[2160.33,9E+09,9E+09,9E+09,9E+09,9E+09]],[[2173.31,1097.3,785.49],[0.4
9588,-0.509082,0.485131,-0.509498],[-1,1,0,0],[2219.39,9E+09,9E+09,9E+09,9E+09,9E+0
9]],[[2162.4,-1120.01,803.9],[0.519054,0.475776,0.52883,0.473877],[-1,1,-1,0],[563.492,9E
+09,9E+09,9E+09,9E+09,9E+09]]];
TASK PERS robtarget
pIdOut{6}:=[[[1855.48,46.92,575.513],[0.365321,-0.598232,0.36207,-0.614463],[-1,1,0,0],[
1246.7,9E+09,9E+09,9E+09,9E+09,9E+09]],[[1835.69,-33.79,655.773],[0.664082,0.237984,
0.665533,0.243771],[-1,1,-2,0],[1999.98,9E+09,9E+09,9E+09,9E+09,9E+09]],[[1854.55,-53
.32,574.383],[0.368506,0.597434,0.368332,0.609596],[-1,1,-1,0],[1369.03,9E+09,9E+09,9E+
09,9E+09,9E+09]],[[1861.49,37.74,679.633],[0.662198,-0.23928,0.667392,-0.242543],[-1,1,
-3,0],[1911.22,9E+09,9E+09,9E+09,9E+09,9E+09]],[[1851.48,70.01,625.533],[0.490051,-0.
503082,0.48948,-0.516883],[-1,1,0,0],[1844.91,9E+09,9E+09,9E+09,9E+09,9E+09]],[[1858.
5,-52.82,627.713],[0.519209,0.474024,0.523676,0.48113],[-1,1,-1,0],[1369.01,9E+09,9E+09,
9E+09,9E+09,9E+09]]];
TASK PERS robtarget
pIdWeld{6}:=[[[1471.57,577.885,-12.1611],[0.268472,-0.664706,0.27552,-0.640451],[-2,0,
0,0],[1961.77,9E+09,9E+09,9E+09,9E+09,9E+09]],[[1480.96,-630.376,1212.57],[0.657858,0
.2559,0.659777,0.257747],[-2,0,-1,0],[1472.01,9E+09,9E+09,9E+09,9E+09,9E+09]],[[1479.
69,-606.915,-28.8611],[0.278104,0.647446,0.287768,0.648585],[-2,0,-1,0],[944.722,9E+09,
9E+09,9E+09,9E+09,9E+09]],[[1470.5,597.857,1240.96],[0.656439,-0.27467,0.651277,-0.26
3596],[-1,1,-3,0],[2098.48,9E+09,9E+09,9E+09,9E+09,9E+09]],[[1399.83,728.67,468.826],[
0.493517,-0.51649,0.481048,-0.508205],[-2,0,0,0],[1735,9E+09,9E+09,9E+09,9E+09,9E+0
9]],[[1405.22,-755.48,467.506],[0.505951,0.500109,0.506039,0.487678],[-2,0,-1,0],[848.592,
9E+09,9E+09,9E+09,9E+09,9E+09]]];
!
!----------------Tool data ----------------
PERS tooldata
toolFinger:=[TRUE,[[242.606,-460.543,1330],[0.970296,0,0,0.241922]],[68.7,[255.3,-331.7
,428.6],[1,0,0,0],18,13.808,3.585]];
!
!************ Work-Object data ***********************************
```


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```
TASK PERS wobjdata
wobjFinger:=[FALSE,TRUE,"",[[-25,22,-76],[1,0,0,0]],[[0,0,0],[1,0,0,0]]];
!----------------Num data ----------------

TASK PERS num nOdJabNo:=3;
TASK PERS bool bOdWork:=FALSE
TASK PERS num nIdJabNo:=4;
TASK PERS robtarget
pOdIn{3,7}:=[[[[2000,-789.876,3.60692],[0.223535,-0.68331,0.660066,0.217791],[-1,0,-2,0
],[-1279.32,9E+09,9E+09,9E+09,9E+09,9E+09]],[[2001.99,-911.73,659.753],[0.0607807,-0.
707809,0.700376,0.0691842],[-1,0,-2,0],[-890.5,9E+09,9E+09,9E+09,9E+09,9E+09]],[[200
2,-646.586,1256.82],[0.352329,0.623682,-0.605454,0.346858],[-1,-1,-2,0],[812.784,9E+09,
9E+09,9E+09,9E+09,9E+09]],[[2002.03,-26.88,1445.02],[0.499426,0.518273,-0.500937,0.48
0656],[-1,-1,-2,0],[1627,9E+09,9E+09,9E+09,9E+09,9E+09]],[[2000,687.227,1322.09],[0.2
45998,0.666198,-0.659299,0.246963],[0,-1,-2,0],[1687.22,9E+09,9E+09,9E+09,9E+09,9E+
09]],[[2009,1020.25,536.193],[0.0785567,0.716335,-0.688843,0.0786702],[0,-1,-2,0],[1139.7
,9E+09,9E+09,9E+09,9E+09,9E+09]],[[2018.55,1042.34,484.966],[0.117723,0.690594,-0.70
178,0.129333],[0,-1,-2,0],[1174.55,9E+09,9E+09,9E+09,9E+09,9E+09]]],[[[2482.5,-789.87
6,3.59692],[0.122577,-0.707262,0.686319,0.117142],[0,0,-2,0],[-1341.19,9E+09,9E+09,9E+
09,9E+09,9E+09]],[[2482.5,-911.7,659.623],[0.0343539,0.705704,-0.70681,0.0349523],[-1,
-1,-2,0],[-691.339,9E+09,9E+09,9E+09,9E+09,9E+09]],[[2482.5,-647.196,1256.09],[0.348
752,0.625954,-0.604783,0.347551],[-1,-1,-2,0],[827.055,9E+09,9E+09,9E+09,9E+09,9E+0
9]],[[2502.5,-26.86,1445.37],[0.401298,0.593133,-0.573638,0.39761],[-1,-1,-2,0],[1539.05,
9E+09,9E+09,9E+09,9E+09,9E+09]],[[2502.49,687.196,1322.14],[0.412198,0.589676,-0.568
78,0.398577],[0,-1,-2,0],[1689.6,9E+09,9E+09,9E+09,9E+09,9E+09]],[[2515.2,1020.2,536.0
73],[0.109965,0.702525,-0.694457,0.109984],[0,-1,-2,0],[1139.7,9E+09,9E+09,9E+09,9E+0
9,9E+09]],[[2515.2,1037.04,493.026],[0.142819,0.696244,-0.688755,0.143054],[0,-1,-2,0],[1
149.32,9E+09,9E+09,9E+09,9E+09,9E+09]]],[[[1490.5,-789.846,3.61692],[0.226216,-0.683
404,0.659914,0.215172],[-1,0,-3,0],[-258.421,9E+09,9E+09,9E+09,9E+09,9E+09]],[[1490.5
,-911.75,659.693],[0.0105477,-0.721027,0.692794,0.00680168],[-1,0,-3,0],[577.883,9E+09,
9E+09,9E+09,9E+09,9E+09]],[[1490.5,-687.206,1472.08],[0.24676,0.680263,-0.647066,0.24
0119],[-1,-1,-2,0],[942.747,9E+09,9E+09,9E+09,9E+09,9E+09]],[[1490.5,-26.93,1445.16],[
0.380702,0.60945,-0.587844,0.371586],[-1,-1,-2,0],[1784.7,9E+09,9E+09,9E+09,9E+09,9E
```


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```
+09]],[[1490.49,737.247,1522.09],[0.405688,0.579203,-0.579348,0.405337],[0,-1,-2,0],[2169
.22,9E+09,9E+09,9E+09,9E+09,9E+09]],[[1490.46,1020.28,536.153],[0.109922,0.705691,-0.
691278,0.109785],[-1,-1,-2,0],[2122.5,9E+09,9E+09,9E+09,9E+09,9E+09]],[[1493.24,1041.
71,473.156],[0.131476,0.702117,-0.68623,0.137242],[-1,-1,-2,0],[2132.13,9E+09,9E+09,9E
+09,9E+09,9E+09]]]];
PERS num nFk:=5;
VAR num nPosOff_X:=0;
PERS num nLHSideOdVer:=0;
PERS num nRHSideOdVer:=0;
PERS bool b9BandWork:=FALSE
VAR syncident syncStart;
VAR syncident syncHome;
VAR syncident sync1;
VAR syncident sync2;
VAR syncident sync3;
VAR syncident sync4;
VAR syncident sync5;
VAR syncident sync6;
VAR syncident sync7;
VAR syncident sync8;
VAR syncident sync9;
PERS tasks Alltask{2}:=[["T_ROB1"],["T_ROB2"]];
PERS bool bIdSideJob:=FALSE
PERS bool IdSide2PointUse:=FALSE
CONST identno idSideId:=10;
!Interrupt data
VAR intnum intGripChk:=0;

TRAP iGripChkTRAP
TPErase;
TPWrite "di18_FgBwd Signal is 0"
TPWrite "Check Signal di18_FgBwd!!!!!!!!"
StopMove;
```


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```
StorePath;
WaitDI di18_FgBwd,1;
RestoPath;
StartMove;
!Stop;
RETURN
ENDTRAP

PROC rCallTRAP()
IDelete intGripChk;
CONNECT intGripChk WITH iGripChkTRAP;
ISignalDI di18_FgBwd,0,intGripChk;
ISleep intGripChk;
RETURN
ENDPROC


PROC rMoveToId1hRdy()
MoveJ pHome,v2500,fine,toolFinger;
rPrtDownChk;
MoveJ pIdMove10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove20,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_10,v2500,z50,toolFinger\WObj:=wobjFinger;
RETURN
ENDPROC

PROC rbandInDia1h()
WaitSyncTask syncHome, Alltask;
nIdJabNo:=4;
rMoveToId1hRdy;
rIdStrap;
rMoveHomeFromId1h;
```


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```
RETURN
ENDPROC

PROC rMoveHomeFromId1h()
MoveJ poIdVia4_20,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_30,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_40,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,fine,toolFinger;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
RETURN
ENDPROC

PROC rMoveToId35hRdy()
MoveJ pHome,v2500,fine,toolFinger;
rPrtDownChk;
MoveJ pIdMove10,v2500,z50,toolFinger\WObj:=wobjFinger;
!MoveJ poIdVia1_20,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia1_30,v2500,z100,toolFinger\WObj:=wobjFinger;
RETURN
ENDPROC

PROC rbandInDia3h()
WaitSyncTask syncHome, Alltask;
nIdJabNo:=5;
rMoveToId35hRdy;
rIdStrap;
rMoveHomeFromId35h;
RETURN
ENDPROC

PROC rbandInDia5h()
WaitSyncTask syncHome, Alltask;
```


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```
nIdJabNo:=1;
rMoveToId35hRdy;
rIdStrap;
rMoveHomeFromId35h;
RETURN
ENDPROC

PROC rMoveHomeFromId35h()
MoveJ pIdMove30,v2000,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove40,v2000,z50,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,fine,toolFinger;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
RETURN
ENDPROC

PROC rMoveToId79hRdy()
MoveJ pHome,v2500,fine,toolFinger;
rPrtDownChk;
MoveJ pIdMove10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove20,v2500,z50,toolFinger\WObj:=wobjFinger;
RETURN
ENDPROC

PROC rbandInDia7h()
WaitSyncTask syncHome, Alltask;
nIdJabNo:=3;
rMoveToId79hRdy;
rIdStrap;
rMoveHomeFromId79h;
RETURN
ENDPROC
```


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```
PROC rbandInDia9h()
WaitSyncTask syncHome, Alltask;
nIdJabNo:=6;
rMoveToId79hRdy;
rIdStrap;
rMoveHomeFromId79h;
RETURN
ENDPROC

PROC rMoveHomeFromId79h()
MoveJ pIdMove40,v2000,z50,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,fine,toolFinger;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
RETURN
ENDPROC

PROC rMoveToId11hRdy()
MoveJ pHome,v2500,fine,toolFinger;
rPrtDownChk;
MoveJ pIdMove10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove20,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia2_10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia2_20,v2500,z50,toolFinger\WObj:=wobjFinger;
RETURN
ENDPROC

PROC rbandInDia11h()
WaitSyncTask syncHome, Alltask;
nIdJabNo:=2;
rMoveToId11hRdy;
rIdStrap;
rMoveHomeFromId11h;
```


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```
RETURN
ENDPROC

PROC rMoveHomeFromId11h()
MoveJ pIdMove40,v2000,z50,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,fine,toolFinger;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
RETURN
ENDPROC

PROC rMoveToOdRdy()
MoveJ pHome,v2500,fine,toolFinger;
Reset po13_SaftPosAll;
IF nOdJabNo=1 THEN
rPrtDownChk;
ELSEIF nOdJabNo=2 THEN
WaitDI pi16_PrtDownChkF,1;
WaitDI pi17_PrtUpChkH, 1;
ELSEIF nOdJabNo=3 THEN
Set po18_PrtUpRqF;
WaitDI pi15_PrtDownChkH,1;
WaitDI pi18_PrtUpChkF,1;
!Reset po18_PrtUpRqF;
ENDIF
MoveJ pOdAprch1{nOdJabNo},v2500,z100,toolFinger\WObj:=wobjFinger;
RETURN
ENDPROC

PROC rbandOutDiaFg()
WaitSyncTask syncHome, Alltask;
nOdJabNo:=3;
rMoveToOdRdy;
```


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```
rOdStrap;
rMoveHomeFromOd;
RETURN
ENDPROC

PROC rbandOutDiaHd()
WaitSyncTask syncHome, Alltask;
nOdJabNo:=2;
rMoveToOdRdy;
rOdStrap;
rMoveHomeFromOd;
RETURN
ENDPROC

PROC rbandOutDiaCt()
WaitSyncTask syncHome, Alltask;
nOdJabNo:=1;
rMoveToOdRdy;
rOdStrap;
rMoveHomeFromOd;
RETURN
ENDPROC

PROC rMoveHomeFromOd()
MoveL pOdIn{nOdJabNo,4},v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{nOdJabNo,3},v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{nOdJabNo,2},v2000,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,fine,toolFinger;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
RETURN
ENDPROC
```


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```
PROC rWorkModel()
IF nRobStartPos <> 0 THEN
rAllPointStrap;
ELSEIF nRobStartPos = 0 THEN
IF bIdSideJob = TRUE AND pi34_SideOdFg = 1 AND pi35_SideOdHd = 1 AND
(( pi40_Id1Hr = 1 AND pi41_Id3Hr = 1 AND pi44_Id9Hr = 1 AND pi45_Id11Hr
=1 ) OR
( pi40_Id1Hr = 1 AND pi45_Id11Hr =1 AND pi41_Id3Hr = 0 AND pi44_Id9Hr =
0 )) THEN
IdSide2PointUse:=FALSE
IF (pi40_Id1Hr = 1 AND pi45_Id11Hr =1) AND (pi41_Id3Hr = 0 AND pi44_Id9Hr
= 0)  THEN
IdSide2PointUse:=TRUE
ENDIF
rIdSideOutStrap;
IdSide2PointUse:=FALSE
ELSEIF b9BandWork = TRUE THEN
IF pi35_SideOdHd = 1 rbandOutDiaHd;
IF pi34_SideOdFg=1 rbandOutDiaFg;
IF pi42_Id5Hr=1 rbandInDia5h;
IF pi41_Id3Hr=1 rbandInDia3h;
IF pi45_Id11Hr=1 rbandInDia11h;
IF pi43_Id7Hr=1 rbandInDia7h;
IF pi44_Id9Hr=1 rbandInDia9h;
IF pi40_Id1Hr=1 rbandInDia1h;
IF pi33_SenterOd=1 rbandOutDiaCt;
ELSE
IF pi35_SideOdHd=1 rbandOutDiaHd;
IF pi34_SideOdFg=1 rbandOutDiaFg;
IF pi37_Id4Hr=1 rbandInDia5h;
IF pi39_Id10Hr=1 rbandInDia11h;
IF pi38_Id8Hr=1 rbandInDia7h;
IF pi36_Id2Hr = 1 AND bIdSideJob = FALSE rbandInDia1h;
```


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```
IF pi33_SenterOd=1 rbandOutDiaCt;
ENDIF
ENDIF
MoveJ pHome, v2500, fine, toolFinger\WObj:=wobj0;
ENDPROC

PROC rPrtDownChk()
WaitDI pi15_PrtDownChkH,1;
WaitDI pi16_PrtDownChkF,1;
!Reset po15_PrtDownRqH;
!Reset po16_PrtDownRqF;
Reset po12_SaftPosPrt;
Reset po13_SaftPosAll;
ENDPROC


PROC rAllPointStrap()
IF nRobStartPos > 8 THEN
ExitCycle;
ENDIF
!=================Rob1 Start Position
Check==========================================
IF nRobStartPos = 1 THEN
GOTO goSideOd2;
ELSEIF nRobStartPos = 2 THEN
nOdJabNo := 3;
rMoveToOdRdy;
GOTO goSideOd3;
ELSEIF nRobStartPos = 3 THEN
rMoveToId35hRdy;
GOTO goId5Hour;
ELSEIF nRobStartPos = 4 THEN
rMoveToId35hRdy;
```


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```
GOTO goId3Hour;
ELSEIF nRobStartPos = 5 THEN
rMoveToId11hRdy;
GOTO goId11Hour;
ELSEIF nRobStartPos = 6 THEN
rMoveToId79hRdy;
GOTO goId7Hour;
ELSEIF nRobStartPos = 7 THEN
rMoveToId79hRdy;
GOTO goId9Hour;
ELSEIF nRobStartPos = 8 THEN
rMoveToId1hRdy;
GOTO goId1Hour;
ENDIF
!==================================================================
==============
goSideOd2:
WaitDI pi09_StnRdy,1;
Reset po13_SaftPosAll;
MoveJ pOdAprch1{1},v2500,z100,toolFinger\WObj:=wobjFinger;
WaitDI pi16_PrtDownChkF, 1;
!=================Rob2 OUT DIA Side2
Job==========================================
nOdJabNo:=2;
rOdStrap;
MoveL pOdIn{1,5},v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{1,4},v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{1,3},v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{1,2},v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{3,1},v2000,z100,toolFinger\WObj:=wobjFinger;
!=================Rob2 OUT DIA Side3
Job==========================================
goSideOd3:
```


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```
nOdJabNo:=3;
rOdStrap;
MoveL pOdIn{3,5},v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poIdVia1_10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia1_20,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia1_30,v2500,z100,toolFinger\WObj:=wobjFinger;
!===============Rob2 IN DIA 5Hour
direction=====================================
Reset po12_SaftPosPrt;
goId5Hour:
nIdJabNo:=1;
rIdStrap;
MoveJ poIdVia2_10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia2_20,v2500,z50,toolFinger\WObj:=wobjFinger;
!-------------------------------------------------------------------
--
IF b9BandWork = TRUE AND pi41_Id3Hr=1 THEN
MoveJ poIdVia1_30,v2500,z100,toolFinger\WObj:=wobjFinger;
ENDIF
goId3Hour:
IF b9BandWork = TRUE AND pi41_Id3Hr=1 THEN
!===============Rob2 IN DIA  3Hour
direction=====================================
nIdJabNo:=5;
rIdStrap;
MoveJ poIdVia2_10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia2_20,v2500,z50,toolFinger\WObj:=wobjFinger;
ELSE
MoveJ poIdVia2_20,v2500,z50,toolFinger\WObj:=wobjFinger;
ENDIF
!===============Rob2 IN DIA  11Hour
direction=====================================
goId11Hour:
```


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```
IF pi45_Id11Hr=1 OR pi39_Id10Hr=1 THEN
nIdJabNo:=2;
rIdStrap;
ELSE
MoveJ poIdVia2_20,v2500,z50,toolFinger\WObj:=wobjFinger;
ENDIF
!===============Rob2 IN DIA  7Hour
direction=====================================
goId7Hour:
IF pi43_Id7Hr=1 OR pi38_Id8Hr=1 THEN
nIdJabNo:=3;
rIdStrap;
ENDIF
MoveJ poIdVia4_10,v2500,z50,toolFinger\WObj:=wobjFinger;
!===============Rob2 IN DIA  9Hour
direction=====================================
goId9Hour:
IF b9BandWork = TRUE AND pi44_Id9Hr=1 THEN
nIdJabNo:=6;
rIdStrap;
MoveJ poIdVia4_10,v2500,z50,toolFinger\WObj:=wobjFinger;
ENDIF
!===============Rob2 IN DIA  1Hour
direction=====================================
goId1Hour:

nIdJabNo:=4;
rIdStrap;
MoveJ poIdVia4_20,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_30,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_40,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,z200,toolFinger;
WaitSyncTask syncHome, Alltask;
```


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```
IF pi33_SenterOd=1 THEN
nOdJabNo:=1;
MoveJ pOdAprch1{1},v2500,z100,toolFinger\WObj:=wobjFinger;
rOdStrap;
MoveL pOdIn{1,5},v5000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{1,4},v5000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{1,3},v5000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{1,2},v5000,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,z50,toolFinger;
ENDIF
RETURN
ENDPROC

PROC rIdSideOutStrap()
WaitDI pi09_StnRdy,1;
Reset po13_SaftPosAll;
MoveJ pOdAprch1{1},v2500,z100,toolFinger\WObj:=wobjFinger;
WaitDI pi16_PrtDownChkF, 1;
!=================Rob2 OUT DIA Side2
Job=========================================
nOdJabNo:=2;
rOdStrap;
MoveL pOdIn{1,5},v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{1,4},v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{1,3},v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{1,2},v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{3,1},v2000,z100,toolFinger\WObj:=wobjFinger;
!=================Rob2 OUT DIA Side3
Job=========================================
goSideOd3:
nOdJabNo:=3;
rOdStrap;
MoveL pOdIn{3,5},v2000,z100,toolFinger\WObj:=wobjFinger;
```


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```
MoveL poIdVia1_10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia1_20,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia1_30,v2500,z100,toolFinger\WObj:=wobjFinger;
!===============Rob2 IN DIA  3Hour
direction=====================================
IF IdSide2PointUse = FALSE THEN
nIdJabNo:=5;
rIdStrap;
ENDIF
MoveJ poIdVia2_10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia2_20,v2500,z50,toolFinger\WObj:=wobjFinger;
!===============Rob2 IN DIA  11Hour
direction=====================================
goId11Hour:
nIdJabNo:=2;
rIdStrap;
MoveJ poIdVia4_10,v2500,z50,toolFinger\WObj:=wobjFinger;
!===============Rob2 IN DIA  9Hour
direction=====================================
IF IdSide2PointUse = FALSE THEN
nIdJabNo:=6;
rIdStrap;
ENDIF
MoveJ poIdVia4_10,v2500,z50,toolFinger\WObj:=wobjFinger;
!===============Rob2 IN DIA  1Hour
direction=====================================
goId1Hour:
nIdJabNo:=4;
rIdStrap;
MoveJ poIdVia4_20,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_30,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_40,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,z200,toolFinger;
```


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```
WaitSyncTask syncHome, Alltask;
IF pi33_SenterOd=1 THEN
nOdJabNo:=1;
MoveJ pOdAprch1{1},v2500,z100,toolFinger\WObj:=wobjFinger;
rOdStrap;
MoveL pOdIn{1,5},v5000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{1,4},v5000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{1,3},v5000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{1,2},v5000,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,z50,toolFinger;
ENDIF
RETURN
ENDPROC

PROC rErrOdRwd()
Reset so08_DpFdOn;
rBandUnclp;
rFgBwd;
MoveL pOdAprch1{nOdJabNo},v500,z100,toolFinger\WObj:=wobjFinger;
PDispOff;
MoveL poOdAprch1_10,v500,z100,toolFinger\WObj:=wobjFinger;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
MoveJ pHome,v2500,fine,toolFinger;
rHome;
WaitSyncTask syncHome, Alltask;
ExitCycle;
ENDPROC

PROC rErrOdOut()
Reset so08_DpFdOn;
rBandUnclp;
rFgBwd;
```


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```
MoveL pOdAprch1{nOdJabNo},v500,z100,toolFinger\WObj:=wobjFinger;
PDispOff;
MoveL poOdAprch1_10,v500,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v500,fine,toolFinger;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
rHome;
WaitSyncTask syncHome, Alltask;
ExitCycle;
ENDPROC

PROC rErrOdIn()
Reset so08_DpFdOn;
rBandUnclp;
rFgBwd;
MoveL pOdIn{nOdJabNo,5},v500,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{nOdJabNo,4},v500,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{nOdJabNo,3},v500,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{nOdJabNo,2},v500,z100,toolFinger\WObj:=wobjFinger;
WaitSyncTask sync1, Alltask;
MoveL pOdAprch1{nOdJabNo},v500,z100,toolFinger\WObj:=wobjFinger;
PDispOff;
MoveL poOdAprch1_10,v500,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v500,fine,toolFinger;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
rHome;
WaitSyncTask syncHome, Alltask;
ExitCycle;
ENDPROC
```


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```
PROC rErrIdOut()
Reset so08_DpFdOn;
rBandUnclp;
rFgBwd;
MoveL
Offs(pIdOut{nIdJabNo},(-100+nXout+(nTechWidth-nCoilWidth)),0,0),v500,z50,toolFi
nger\WObj:=wobjFinger;
PDispOff;
IF nIdJabNo=1 OR nIdJabNo=5  THEN
MoveJ poIdVia1_30,v500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia1_20,v500,z100,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove10,v500,z50,toolFinger\WObj:=wobjFinger;
ELSEIF nIdJabNo=2 THEN
MoveJ pIdMove20,v500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove10,v500,z50,toolFinger\WObj:=wobjFinger;
ELSEIF nIdJabNo=3 OR nIdJabNo=6 THEN
MoveJ pIdMove20,v500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove10,v500,z50,toolFinger\WObj:=wobjFinger;
ELSEIF nIdJabNo=4 THEN
MoveJ poIdVia4_10,v500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove20,v500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove10,v500,z50,toolFinger\WObj:=wobjFinger;
ENDIF
MoveJ pHome,v500,fine,toolFinger;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
rHome;
WaitSyncTask syncHome, Alltask;
ExitCycle;
ENDPROC

PROC rErrIdIn()
Reset so08_DpFdOn;
```


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```
rBandUnclp;
rFgBwd;
MoveL
Offs(pIdIn{nIdJabNo},(-100+nXin+(nTechWidth-nCoilWidth)/2),0,0),v500,z50,toolFin
ger\WObj:=wobjFinger;
PDispOff;
IF nIdJabNo=1 OR nIdJabNo=5 THEN
MoveJ pIdMove30,v500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove40, v500,z50,toolFinger\WObj:=wobjFinger;
ELSEIF nIdJabNo=2 THEN
MoveJ pIdMove40, v500,z50,toolFinger\WObj:=wobjFinger;
ELSEIF nIdJabNo=3  OR nIdJabNo=6 THEN
MoveJ pIdMove40, v500,z50,toolFinger\WObj:=wobjFinger;
ELSEIF nIdJabNo=4THEN
MoveJ poIdVia4_20,v500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_30,v500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_40,v500,z100,toolFinger\WObj:=wobjFinger;
ENDIF
MoveJ pHome,v500,fine,toolFinger;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
rHome;
WaitSyncTask syncHome, Alltask;
ExitCycle;
ENDPROC

PROC rRwdErrorChk()
WaitUntil si05_BdRwdEnd = 1 OR si08_RwdErr = 1 OR pi13_HomeReturn = 1
OR si07_InFeedErr = 1;
IF si08_RwdErr = 1 OR pi13_HomeReturn = 1 OR si07_InFeedErr = 1 THEN
IF bOdWork=TRUE THEN
rErrOdRwd;
ELSEIF bOdWork=FALSE THEN
```


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```
rErrIdIn;
ENDIF
ENDIF
WaitDI di18_FgBwd,1;
RETURN
ENDPROC

PROC rFeedOutErrorChk()
WaitUntil si03_HdFeedEnd = 1 OR si06_OutFeedErr = 1 OR pi13_HomeReturn =
1;
WaitTime 0.1;
IF si06_OutFeedErr = 1 OR pi13_HomeReturn = 1 THEN
IF bOdWork=TRUE THEN
rErrOdOut;
ELSEIF bOdWork=FALSE THEN
rErrIdOut;
ENDIF
ENDIF
Reset so01_HdFeedEnd;
WaitDI di18_FgBwd,1;
WaitTime 0.5;
IWatch intGripChk;
RETURN
ENDPROC


PROC rFeedInErrorChk()
WaitUntil si04_BdInFdEnd=1 OR si07_InFeedErr=1 OR pi13_HomeReturn=1;
WaitTime 0.1;
IF bOdWork=FALSE AND (si07_InFeedErr=1 OR pi13_HomeReturn=1) THEN
rErrIdIn;
ELSEIF bOdWork=TRUE AND (si07_InFeedErr=1 OR pi13_HomeReturn=1)
THEN
```


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```
rErrOdIn;
ENDIF
Reset so04_BdInFdEnd;
WaitDI di18_FgBwd,1;
ISleep intGripChk;
RETURN
ENDPROC

PROC rFingerRdy()
rBandClp;
rBandUnclp;
r1stBandClp;
RETURN
ENDPROC

PROC rPrtUpChk()
IF nOdJabNo = 2  THEN
WaitDI pi17_PrtUpChkH, 1;
ELSEIF nOdJabNo = 3 THEN
WaitDI pi18_PrtUpChkF,1;
!Reset po18_PrtUpRqF;
ENDIF
RETURN
ENDPROC

PROC rOdStrap()
bOdWork:=TRUE
rPDispXoffset;
MoveL pOdAprch1{nOdJabNo},v5000,z100,toolFinger\WObj:=wobjFinger;
rFingerRdy;
rRwdErrorChk;
Reset so05_BdRwdEnd;
MoveL pOdOut{nOdJabNo},v1000,fine,toolFinger\WObj:=wobjFinger;
```


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```
rFgFwd;
WaitSyncTask sync1, Alltask;
rFeedOutErrorChk;
Set so08_DpFdOn;
MoveL pOdAprch1{nOdJabNo}, v5000, z100, toolFinger\WObj:=wobjFinger;
rPrtUpChk;
MoveL pOdIn{nOdJabNo,1},v5000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{nOdJabNo,2},v5000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{nOdJabNo,3},v5000,z100,toolFinger\WObj:=wobjFinger;
MoveL pOdIn{nOdJabNo,4}, v1500, z100, toolFinger\WObj:=wobjFinger;
MoveL pOdIn{nOdJabNo,5}, v1500, z100, toolFinger\WObj:=wobjFinger;
MoveL pOdIn{nOdJabNo,6}, v1500, fine, toolFinger\WObj:=wobjFinger;
WaitSyncTask sync2, Alltask;
!MoveL
RelTool(pOdIn{nOdJabNo,7},100,0,-100),v5000,z10,toolFinger\WObj:=wobjFinger;
MoveL RelTool(pOdIn{nOdJabNo,7},100,0,0), v5000, fine,
toolFinger\WObj:=wobjFinger;
WaitSyncTask sync3, Alltask;
MoveL pOdIn{nOdJabNo,7}, v2500, fine, toolFinger\WObj:=wobjFinger;
WaitSyncTask sync4, Alltask;
rFeedInErrorChk;
rBandClp;
MoveL
RelTool(pOdIn{nOdJabNo,7},-10,0,-100),v5000,z10,toolFinger\WObj:=wobjFinger;
IF nCoilDia > 1200 THEN
MoveL pOdIn{nOdJabNo,6}, v2500, fine, toolFinger\WObj:=wobjFinger;
ELSE
MoveL RelTool(pOdIn{nOdJabNo,7},-10,0,-100), v5000, fine,
toolFinger\WObj:=wobjFinger;
ENDIF
!rBandClp;
!rBandClp;
MoveL pOdIn{nOdJabNo,5}, v5000, fine, toolFinger\WObj:=wobjFinger;
```


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```
!rBandUnclp;
WaitSyncTask sync5, Alltask;
rBandUnclp;
PDispOff;
RETURN
ENDPROC

PROC rIdSideStrap()
SyncMoveOn sync1, Alltask;
MoveL RelTool(pIdWeld{nIdJabNo},-15,0,0)\ID:=idSideId, v5000, fine,
toolFinger\WObj:=wobjFinger;
SyncMoveOff sync1;
rRwdErrorChk;
rBandClp;
MoveL
Offs(pIdIn{nIdJabNo},(nXin+(nTechWidth-nCoilWidth)),0,0),v5000,fine,toolFinger\
WObj:=wobjFinger;
PDispOff;
RETURN
ENDPROC

PROC rIdStrap()
bOdWork:=FALSE
rPrtDownChk;
IF nIdJabNo = 1 THEN
WaitUntil si05_BdRwdEnd = 1 OR si08_RwdErr = 1 OR pi13_HomeReturn = 1 ;
IF si08_RwdErr = 1 OR pi13_HomeReturn = 1 OR si07_InFeedErr = 1 THEN
rErrIdOut;
ENDIF
ENDIF
Reset so05_BdRwdEnd;
rPDispXoffset;
nXin:=-1050;
```


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```
nXout:=-750;
rFingerRdy;
MoveJ
Offs(pIdOut{nIdJabNo},nXout+(nTechWidth-nCoilWidth),0,0),v5000,z50,toolFinger\
WObj:=wobjFinger;
MoveL Offs(pIdOut{nIdJabNo},-100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL pIdOut{nIdJabNo},v1000,fine,toolFinger\WObj:=wobjFinger;
WaitSyncTask sync1, Alltask;
rFgFwd;
rFeedOutErrorChk;
Set so08_DpFdOn;
WaitDI di18_FgBwd,1;
MoveL Offs(pIdOut{nIdJabNo},-100,0,0), v2500, z20,
toolFinger\WObj:=wobjFinger;
MoveL Offs(pIdOut{nIdJabNo},nXout+(nTechWidth-nCoilWidth),0,0), v2500, z50,
toolFinger\WObj:=wobjFinger;
MoveL Offs(pIdIn{nIdJabNo},nXin+(nTechWidth-nCoilWidth),0,0), v2500, z50,
toolFinger\WObj:=wobjFinger;
MoveL RelTool(pIdIn{nIdJabNo},20,0,0), v2500, z20, toolFinger\WObj:=wobjFinger;
WaitSyncTask sync2, Alltask;
WaitSyncTask sync3, Alltask;
MoveL pIdIn{nIdJabNo},v2500,fine,toolFinger\WObj:=wobjFinger;
WaitSyncTask sync4, Alltask;
rFeedInErrorChk;
MoveL RelTool(pIdIn{nIdJabNo},-10,0,-100), v2500, z10,
toolFinger\WObj:=wobjFinger;
MoveL RelTool(pIdIn{nIdJabNo},0,0,-300), v2500, z50,
toolFinger\WObj:=wobjFinger;
IF bIdSideJob = TRUE THEN
rIdSideStrap;
RETURN
ENDIF
WaitSyncTask sync5, Alltask;
```


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```
SyncMoveOn sync6, Alltask;
MoveL RelTool(pIdWeld{nIdJabNo},-50,0,0)\ID:=50, v5000, fine,
toolFinger\WObj:=wobjFinger;
MoveL RelTool(pIdWeld{nIdJabNo},-15,0,0)\ID:=60, v5000, fine,
toolFinger\WObj:=wobjFinger;
SyncMoveOff sync7;
rRwdErrorChk;
MoveL RelTool(pIdWeld{nIdJabNo},-15,0,-100), v5000, z10,
toolFinger\WObj:=wobjFinger;
rBandClp;
MoveL
Offs(pIdIn{nIdJabNo},nXin+(nTechWidth-nCoilWidth),0,0),v5000,z50,toolFinger\WO
bj:=wobjFinger;
PDispOff;
RETURN
ENDPROC

PROC rBandClp()
Set do26_FgClp_1;
WaitDI di19_Unclp1, 0\MaxTime:=2;
Set do27_FgClp_2;
WaitDI di20_Unclp2, 0\MaxTime:=2;
WaitTime 0.5;
!WaitDO co97_UnClp,0;
RETURN
ERROR
Reset do27_FgClp_2;
Reset do26_FgClp_1;
WaitTime 2;
Set do26_FgClp_1;
Set do27_FgClp_2;
WaitTime 1;
RETURN
```


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```
ENDPROC

PROC r1stBandClp()
Set do26_FgClp_1;
WaitDI di19_Unclp1, 0;
WaitTime 0.3;
RETURN
ENDPROC

PROC r2ndBandClp()
Set do27_FgClp_2;
WaitDI di20_Unclp2, 0;
WaitTime 0.3;
RETURN
ENDPROC

PROC rFgFwd()
!Reset do20_FgBwd;
Set do25_FgFwd;
WaitUntil di17_FgFwd=1 AND di18_FgBwd=0;
RETURN
ENDPROC
PROC rFgBwd()
Reset do25_FgFwd;
!Set do20_FgBwd;
WaitUntil di17_FgFwd=0 AND di18_FgBwd=1;
RETURN
ENDPROC
PROC rBandUnclp()
Reset do27_FgClp_2;
Reset do26_FgClp_1;
WaitUntil di19_Unclp1=1 AND di20_Unclp2=1;
RETURN
```


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```
ENDPROC

PROC rDataCom()
Retry02:
WaitDI pi11_DataCheckOk,1;
WaitTime 0.5;
WaitDO so03_DataComOk,1;
!IF nCoilDia<690 OR nCoilWidth<800 OR nCoilWidth>1600 OR nCoilDia>2200
THEN
!WaitTime 0.5;
!GOTO Retry02;
!ENDIF
Reset so03_DataComOk;
ENDPROC
PROC rWorkFinish()
PDispOff;
rHome;
WaitSyncTask syncHome, Alltask;
WaitDO po09_WorkEnd, 1;
WaitTime 1;
Reset po09_WorkEnd;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
Reset po16_PrtDownRqF;
Reset po15_PrtDownRqH;
Reset po18_PrtUpRqF;
RETURN
ENDPROC
PROC rPDispXoffset()
nRob2_X := 0;
nRHSideOdVer := 0;
IF pi24_Nvector=1 THEN
IF nOdJabNo = 2 AND bOdWork = TRUE THEN
```


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```
nRob2_X := -gi03_Xoffset-nOffsetM ;
Rob2Offset.trans.x := nRob2_X + nRHSideOdVer;
ELSE
nRob2_X:=-gi03_Xoffset-nOffsetM ;
Rob2Offset.trans.x := nRob2_X ;
ENDIF
ELSE
IF nOdJabNo = 2 AND bOdWork = TRUE THEN
nRob2_X := gi03_Xoffset-nOffsetM ;
Rob2Offset.trans.x := nRob2_X + nRHSideOdVer;
ELSE
nRob2_X:=gi03_Xoffset-nOffsetM ;
Rob2Offset.trans.x := nRob2_X ;
ENDIF
ENDIF
Rob2Offset.trans.y := 0;
!Rob2Offset.trans.y := 20;
IF bOdWork = TRUE AND nOdJabNo = 1 THEN
PDispOff;
ELSE
PDispSet Rob2Offset;
ENDIF
ENDPROC
PROC rHome()
MoveJ pHome,v2500,fine,toolFinger;
pHomepos := CPos();
RETURN
ENDPROC

PROC rInitial()
nTechDia:=1550;
nTechWidth:=1220;
rCallTRAP;
```


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```
PDispOff;
rFgBwd;
rBandUnclp;
Set po13_SaftPosAll;
Set po12_SaftPosPrt;
IdSide2PointUse:=FALSE
RETURN
ENDPROC
PROC main()
AccSet 80,80;
VelSet 100,5000;
rInitial;
rHome;
WaitDI pi14_CurCoil, 1;
IF pi14_CurCoil=1 THEN
rDataCom;
rDefinePos;
!Stop;
WaitSyncTask syncStart, Alltask;
rWorkModel;
rWorkFinish;
ENDIF
rHome;
rInitial;
ExitCycle;
ENDPROC
PROC rMaintrance()
MoveJ
[[-12.61,2636.35,-252.47],[0.50072,-0.516521,0.486921,0.495373],[1,0,-1,1],[-1481.1,9E+0
9,9E+09,9E+09,9E+09,9E+09]], v1000, z50, toolFinger\WObj:=wobjFinger;
ENDPROC
ENDMODULE
```


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- 위치 연산 프로그램

```
MODULE PosCalculateF
!Teach Data
PERS num nTechDia:=1550;
PERS num nTechWidth:=1220;
!InPut Data
PERS num nCoilDia:=0;
PERS num nCoilWidth:=0;
PERS num nSmallTechDia:=1160;
PERS num nSmallTechWidth:=1250;
PERS num nSmallJobSeletDia:=1200;
PERS num nLargeTechDia:=1730;
PERS num nLargeTechWidth:=1250;
PERS num nSideJobIdDia:=840;
TASK PERS num nTanAngle:=-135;
!Calculate Data
TASK PERS num nXoffset:=70.5;
TASK PERS num nZoffset:=-277.91;
TASK PERS num nYoffset:=-112.784;
TASK PERS num nStrapPoint:=1;
PERS num nRobStartPos:=1;
TASK PERS tooldata
tool1:=[TRUE,[[-75.7884,35.3916,250.271],[1,0,0,0]],[5,[0,0,50],[1,0,0,0],0,0,0]];
PERS num nSideIdLow:=1000;

PROC rRobTargetSelect()
IF nCoilDia>nSmallJobSeletDia THEN
nTechDia:=nLargeTechDia;
nTechWidth:=nLargeTechWidth;
pOdOut{1}:=poOdOut1;
pOdOut{2}:=poOdOut2;
pOdOut{3}:=poOdOut3;
pOdIn{1,1}:=poOdVia1_45;
```


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```
pOdIn{2,1}:=poOdVia2_45;
pOdIn{3,1}:=poOdVia3_45;
pOdIn{1,2}:=poOdVia1_90;
pOdIn{2,2}:=poOdVia2_90;
pOdIn{3,2}:=poOdVia3_90;
pOdIn{1,3}:=poOdVia1_135;
pOdIn{2,3}:=poOdVia2_135;
pOdIn{3,3}:=poOdVia3_135;
pOdIn{1,4}:=poOdVia1_180;
pOdIn{2,4}:=poOdVia2_180;
pOdIn{3,4}:=poOdVia3_180;
pOdIn{1,5}:=poOdVia1_225;
pOdIn{2,5}:=poOdVia2_225;
pOdIn{3,5}:=poOdVia3_225;
pOdIn{1,6}:=poOdVia1_270;
pOdIn{2,6}:=poOdVia2_270;
pOdIn{3,6}:=poOdVia3_270;
pOdIn{1,7}:=poOdIn1;
pOdIn{2,7}:=poOdIn2;
pOdIn{3,7}:=poOdIn3;
pOdAprch1{1}:=poOdAprch1_10;
pOdAprch1{2}:=poOdAprch2_10;
pOdAprch1{3}:=poOdAprch3_10;
pIdOut{1}:=poIdOut1;
pIdOut{2}:=poIdOut2;
pIdOut{3}:=poIdOut3;
pIdOut{4}:=poIdOut4;
pIdOut{5}:=poIdOut5;
pIdOut{6}:=poIdOut6;
pIdIn{1}:=poIdIn1;
pIdIn{2}:=poIdIn2;
pIdIn{3}:=poIdIn3;
pIdIn{4}:=poIdIn4;
```


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```
pIdIn{5}:=poIdIn5;
pIdIn{6}:=poIdIn6;
IF b9BandWork = TRUE THEN
pIdWeld{1}:=poIdWeld5h;
pIdWeld{2}:=poIdWeld11h;
pIdWeld{3}:=poIdWeld7h;
pIdWeld{4}:=poIdWeld1h;
pIdWeld{5}:=poIdWeld3h;
pIdWeld{6}:=poIdWeld9h;
ELSE
pIdWeld{1}:=poIdWeld4h;
pIdWeld{2}:=poIdWeld10h;
pIdWeld{3}:=poIdWeld8h;
pIdWeld{4}:=poIdWeld2h;
ENDIF
ELSE
nTechDia:=nSmallTechDia;
nTechWidth:=nSmallTechWidth;
pOdOut{1}:=pSOdOut1;
pOdOut{2}:=pSOdOut2;
pOdOut{3}:=pSOdOut3;
pOdIn{1,1}:=pSOdVia1_45;
pOdIn{2,1}:=pSOdVia2_45;
pOdIn{3,1}:=pSOdVia3_45;
pOdIn{1,2}:=pSOdVia1_90;
pOdIn{2,2}:=pSOdVia2_90;
pOdIn{3,2}:=pSOdVia3_90;
pOdIn{1,3}:=pSOdVia1_135;
pOdIn{2,3}:=pSOdVia2_135;
pOdIn{3,3}:=pSOdVia3_135;
pOdIn{1,4}:=pSOdVia1_180;
pOdIn{2,4}:=pSOdVia2_180;
pOdIn{3,4}:=pSOdVia3_180;
```


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```
pOdIn{1,5}:=pSOdVia1_225;
pOdIn{2,5}:=pSOdVia2_225;
pOdIn{3,5}:=pSOdVia3_225;
pOdIn{1,6}:=pSOdVia1_270;
pOdIn{2,6}:=pSOdVia2_270;
pOdIn{3,6}:=pSOdVia3_270;
pOdIn{1,7}:=pSOdIn1;
pOdIn{2,7}:=pSOdIn2;
pOdIn{3,7}:=pSOdIn3;
pOdAprch1{1}:=pSOdAprch1_10;
pOdAprch1{2}:=pSOdAprch2_10;
pOdAprch1{3}:=pSOdAprch3_10;
pIdOut{1}:=pSIdOut1;
pIdOut{2}:=pSIdOut2;
pIdOut{3}:=pSIdOut3;
pIdOut{4}:=pSIdOut4;
pIdOut{5}:=pSIdOut5;
pIdOut{6}:=pSIdOut6;
pIdIn{1}:=pSIdIn1;
pIdIn{2}:=pSIdIn2;
pIdIn{3}:=pSIdIn3;
pIdIn{4}:=pSIdIn4;
pIdIn{5}:=pSIdIn5;
pIdIn{6}:=pSIdIn6;
pIdWeld{5}:=pSIdWeld3h;
pIdWeld{6}:=pSIdWeld9h;
IF bIdSideJob =TRUE THEN
pIdIn{1}:=pSIdIn5;
pIdOut{1}:=pSIdOut5;
pIdIn{3}:=pSIdIn6;
pIdOut{3}:=pSIdOut6;
pIdWeld{1}:=pSIdWeld3h;
pIdWeld{2}:=pSIdWeld10h;
```


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```
pIdWeld{3}:=pSIdWeld9h;
pIdWeld{4}:=pSIdWeld2h;
ELSE
IF nCoilDia < nSideIdLow THEN
pIdWeld{1}:=pSIdWeld4hS_Small;
pIdWeld{2}:=pSIdWeld10h;
pIdWeld{3}:=pSIdWeld8hS_Small;
pIdWeld{4}:=pSIdWeld2h;
ELSE
pIdWeld{1}:=pSIdWeld4h;
pIdWeld{2}:=pSIdWeld10h;
pIdWeld{3}:=pSIdWeld8h;
pIdWeld{4}:=pSIdWeld2h;
ENDIF
ENDIF
ENDIF
RETURN
ENDPROC

PROC rDefineOdOut()
nOdJabNo:=1;
WHILE nOdJabNo<=3 DO
IF nOdJabNo=1 THEN
nXoffset:=0;
ELSEIF nOdJabNo=2 THEN
nXoffset:=-(nTechWidth-nCoilWidth)/2;
ELSEIF nOdJabNo=3 THEN
nXoffset:=(nTechWidth-nCoilWidth)/2;
ENDIF
nYoffset:=0;
nZoffset:=0;
pOdOut{nOdJabNo}.trans.x:=pOdOut{nOdJabNo}.trans.x+nXoffset;
pOdOut{nOdJabNo}.trans.y:=pOdOut{nOdJabNo}.trans.y+nYoffset;
```


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```
pOdOut{nOdJabNo}.trans.z:=pOdOut{nOdJabNo}.trans.z+nZoffset;
Incr nOdJabNo;
ENDWHILE
Clear nOdJabNo;
RETURN
ENDPROC

PROC rDefineOdStrap()
nTanAngle:=45;
nOdJabNo:=1;
nStrapPoint:=1;
WHILE nOdJabNo<=3 DO
WHILE nStrapPoint<=7 DO
nYoffset:=((nTechDia/2)*Sin(nTanAngle))-((nCoilDia/2)*Sin(nTanAngle));
nZoffset:=-(((nTechDia/2)/Cos(15)-(nTechDia/2)*Cos(nTanAngle))-((nCoilDia/2)/
Cos(15)-(nCoilDia/2)*Cos(nTanAngle)));
IF nOdJabNo=1 THEN
nXoffset:=0;
ELSEIF nOdJabNo=2 THEN
nXoffset:=-(nTechWidth-nCoilWidth)/2;
ELSEIF nOdJabNo=3 THEN
nXoffset:=(nTechWidth-nCoilWidth)/2;
ENDIF
IF (bIdSideJob = TRUE OR nSmallTechDia > nCoilDia) AND (nStrapPoint = 7
OR nStrapPoint = 5) THEN
nZoffset:=0;
ENDIF
pOdIn{nOdJabNo,nStrapPoint}.trans.x:=pOdIn{nOdJabNo,nStrapPoint}.trans.x+nXoff
set;
pOdIn{nOdJabNo,nStrapPoint}.trans.z:=pOdIn{nOdJabNo,nStrapPoint}.trans.z+nZoff
set;
pOdIn{nOdJabNo,nStrapPoint}.trans.y:=pOdIn{nOdJabNo,nStrapPoint}.trans.y+nYoff
set;
```


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```
pOdIn{nOdJabNo,nStrapPoint}.extax.eax_a:=pOdIn{nOdJabNo,nStrapPoint}.extax.ea
x_a+nYoffset;
IF pOdIn{nOdJabNo,nStrapPoint}.extax.eax_a>2700 THEN
pOdIn{nOdJabNo,nStrapPoint}.extax.eax_a:=2700;
ENDIF
Incr nStrapPoint;
IF nStrapPoint=7 THEN
nTanAngle:=-70;
ELSE
nTanAngle:=nTanAngle+45;
ENDIF
ENDWHILE
nTanAngle:=45;
IF nOdJabNo=1 THEN
nXoffset:=0;
ELSEIF nOdJabNo=2 THEN
nXoffset:=-(nTechWidth-nCoilWidth)/2;
ELSEIF nOdJabNo=3 THEN
nXoffset:=(nTechWidth-nCoilWidth)/2;
ENDIF
IF nCoilDia < nSmallTechDia THEN
nYoffset:=0;
ELSE
nYoffset:=((nTechDia/2)*Sin(nTanAngle))-((nCoilDia/2)*Sin(nTanAngle));
ENDIF
nZoffset:=0;
pOdAprch1{nOdJabNo}.trans.x:=pOdAprch1{nOdJabNo}.trans.x+nXoffset;
pOdAprch1{nOdJabNo}.trans.y:=pOdAprch1{nOdJabNo}.trans.y+nYoffset;
pOdAprch1{nOdJabNo}.trans.z:=pOdAprch1{nOdJabNo}.trans.z+nZoffset;
nStrapPoint:=1;
nTanAngle:=45;
Incr nOdJabNo;
ENDWHILE
```


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```
Clear nOdJabNo;
RETURN
ENDPROC

PROC rDefinePos()
rRobTargetSelect;
rDefineOdOut;
rDefineOdStrap;
rDefineIdOut;
rDefineIdInsert;
!Stop;
RETURN
ENDPROC

PROC rDefineIdOut()
nIdJabNo:=1;
WHILE nIdJabNo<=6 DO
nYoffset:=0;
nZoffset:=-(((nTechDia/2)/Cos(15))-((nCoilDia/2)/Cos(15)));
nXoffset:=-(nTechWidth-nCoilWidth)/2;
IF nCoilDia < 700 THEN
nZoffset:=-(((nTechDia/2)/Cos(15))-((700/2)/Cos(15)));
ENDIF
pIdOut{nIdJabNo}.trans.x:=pIdOut{nIdJabNo}.trans.x+nXoffset;
pIdOut{nIdJabNo}.trans.y:=pIdOut{nIdJabNo}.trans.y+nYoffset;
pIdOut{nIdJabNo}.trans.z:=pIdOut{nIdJabNo}.trans.z+nZoffset;
Incr nIdJabNo;
ENDWHILE
Clear nIdJabNo;
RETURN
ENDPROC

PROC rDefineIdInsert()
```


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```
nIdJabNo:=1;
WHILE (nIdJabNo<=6 AND b9BandWork = TRUE)OR(nIdJabNo<=4 AND
b9BandWork = FALSE) DO
IF b9BandWork = TRUE  THEN
IF nIdJabNo=1 THEN
nTanAngle:=-55;
ELSEIF nIdJabNo=2 THEN
nTanAngle:=140;
ELSEIF nIdJabNo=3 THEN
nTanAngle:=55;
ELSEIF nIdJabNo=4 THEN
nTanAngle:=-140;
ELSEIF nIdJabNo=5 THEN
nTanAngle:=-90;
ELSEIF nIdJabNo=6 THEN
nTanAngle:=90;
ENDIF
ELSE
IF nIdJabNo=1 THEN
nTanAngle:=-55;
ELSEIF nIdJabNo=2 THEN
nTanAngle:=135;
ELSEIF nIdJabNo=3 THEN
nTanAngle:=55;
ELSEIF nIdJabNo=4 THEN
nTanAngle:=-135;
!ELSEIF nIdJabNo=5 THEN
!nTanAngle:=-90;
!ELSEIF nIdJabNo=6 THEN
!nTanAngle:=90;
ENDIF
ENDIF
nXoffset:=-(nTechWidth-nCoilWidth)/2;
```


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```
nYoffset:=((nTechDia/2)*Sin(nTanAngle))-((nCoilDia/2)*Sin(nTanAngle));
nZoffset:=-(((nTechDia/2)/Cos(15)-(nTechDia/2)*Cos(nTanAngle))-((nCoilDia/2)/
Cos(15)-(nCoilDia/2)*Cos(nTanAngle)));
pIdIn{nIdJabNo}.trans.x:=pIdIn{nIdJabNo}.trans.x+nXoffset;
pIdIn{nIdJabNo}.trans.y:=pIdIn{nIdJabNo}.trans.y+nYoffset;
pIdIn{nIdJabNo}.trans.z:=pIdIn{nIdJabNo}.trans.z+nZoffset;
pIdIn{nIdJabNo}.extax.eax_a:=pIdIn{nIdJabNo}.extax.eax_a+nYoffset;
IF pIdIn{nIdJabNo}.extax.eax_a>2700 THEN
pIdIn{nIdJabNo}.extax.eax_a:=2700;
ENDIF
nXoffset:=(nTechWidth-nCoilWidth)/2;
pIdWeld{nIdJabNo}.trans.x:=pIdWeld{nIdJabNo}.trans.x+nXoffset;
pIdWeld{nIdJabNo}.trans.y:=pIdWeld{nIdJabNo}.trans.y+nYoffset;
pIdWeld{nIdJabNo}.trans.z:=pIdWeld{nIdJabNo}.trans.z+nZoffset;
pIdWeld{nIdJabNo}.extax.eax_a:=pIdWeld{nIdJabNo}.extax.eax_a+nYoffset;
IF pIdWeld{nIdJabNo}.extax.eax_a>2700 THEN
pIdWeld{nIdJabNo}.extax.eax_a:=2700;
ENDIF
Incr nIdJabNo;
ENDWHILE
Clear nIdJabNo;
RETURN
ENDPROC

ENDMODULE
```


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- 위치 티칭 프로그램

```
MODULE Teaching_R2
!---------------- Out Dia Target data ----------------

CONST robtarget
poOdOut1:=[[2001.11,-18.94,-201.26],[0.496712,-0.494928,0.503359,0.504929],[-1,0,-3,0]
,[-1479.98,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdOut2:=[[2533.62,-18.80,-213.04],[0.5088,-0.509386,0.494061,0.487394],[-1,0,-3,0],[
-1480.38,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdOut3:=[[1444.83,-18.19,-209.47],[0.505217,-0.503495,0.496576,0.494633],[-1,0,-3,0]
,[0.0131882,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdIn1:=[[2018.55,1192.22,595.54],[0.117723,0.690594,-0.70178,0.129333],[0,-1,-2,0],[1
324.43,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdIn2:=[[2585.7,1186.92,603.6],[0.142819,0.696244,-0.688755,0.143054],[0,-1,-2,0],[12
99.2,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdIn3:=[[1422.74,1191.59,583.73],[0.131476,0.702117,-0.68623,0.137242],[-1,-1,-2,0],[
2282.01,9E+09,9E+09,9E+09,9E+09,9E+09]];
!
CONST robtarget
poOdAprch1_10:=[[2002,-720,-130.04],[0.200019,-0.698031,0.660174,0.192138],[-1,0,-2,
0],[-1480.53,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdAprch2_10:=[[2517.99,-720.54,-170.68],[0.214586,-0.688097,0.66119,0.208095],[-1,
0,-2,0],[-1392.1,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdAprch3_10:=[[1420,-720.02,-170.01],[0.257941,-0.674219,0.642299,0.25758],[-1,0,-
3,0],[-337.001,9E+09,9E+09,9E+09,9E+09,9E+09]];
```


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```
!
CONST robtarget
poOdVia1_45:=[[2000.00,-902.66,55.95],[0.223535,-0.68331,0.660066,0.217791],[-1,0,-2,0
],[-1392.1,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdVia2_45:=[[2553,-902.66,55.94],[0.122577,-0.707262,0.686319,0.117142],[0,0,-2,0],[
-1453.97,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdVia3_45:=[[1420,-902.63,55.96],[0.226216,-0.683404,0.659914,0.215172],[-1,0,-3,0],
[-371.205,9E+09,9E+09,9E+09,9E+09,9E+09]];

CONST robtarget
poOdVia1_90:=[[2001.99,-1071.23,824.88],[0.0607807,-0.707809,0.700376,0.0691842],[-1,
0,-2,0],[-1050,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdVia2_90:=[[2553,-1071.2,824.75],[0.0343539,0.705704,-0.70681,0.0349523],[-1,-1,-2
,0],[-850.839,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdVia3_90:=[[1420,-1071.25,824.82],[0.0105477,-0.721027,0.692794,0.00680168],[-1,0,
-3,0],[418.383,9E+09,9E+09,9E+09,9E+09,9E+09]];

CONST robtarget
poOdVia1_135:=[[2002,-759.37,1534.73],[0.352329,0.623682,-0.605454,0.346858],[-1,-1,-
2,0],[700,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdVia2_135:=[[2553,-759.98,1534],[0.348752,0.625954,-0.604783,0.347551],[-1,-1,-2,0
],[714.272,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdVia3_135:=[[1420,-799.99,1749.99],[0.24676,0.680263,-0.647066,0.240119],[-1,-1,-2
,0],[829.963,9E+09,9E+09,9E+09,9E+09,9E+09]];

CONST robtarget
poOdVia1_180:=[[2002.03,-26.88,1769.65],[0.499426,0.518273,-0.500937,0.480656],[-1,-1
```


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```
,-2,0],[1627,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdVia2_180:=[[2573,-26.86,1770],[0.401298,0.593133,-0.573638,0.39761],[-1,-1,-2,0],[
1539.05,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdVia3_180:=[[1420,-26.93,1769.79],[0.380702,0.60945,-0.587844,0.371586],[-1,-1,-2,
0],[1784.7,9E+09,9E+09,9E+09,9E+09,9E+09]];

CONST robtarget
poOdVia1_225:=[[2000,800.01,1600],[0.245998,0.666198,-0.659299,0.246963],[0,-1,-2,0],[
1800,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdVia2_225:=[[2572.99,799.98,1600.05],[0.412198,0.589676,-0.56878,0.398577],[0,-1,-
2,0],[1802.38,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdVia3_225:=[[1419.99,850.03,1800.00],[0.405688,0.579203,-0.579348,0.405337],[0,-1,
-2,0],[2282,9E+09,9E+09,9E+09,9E+09,9E+09]];

CONST robtarget
poOdVia1_270:=[[2009,1179.75,701.32],[0.0785567,0.716335,-0.688843,0.0786702],[0,-1,-
2,0],[1299.2,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdVia2_270:=[[2585.7,1179.7,701.2],[0.109965,0.702525,-0.694457,0.109984],[0,-1,-2,0
],[1299.2,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdVia3_270:=[[1419.96,1179.78,701.28],[0.109922,0.705691,-0.691278,0.109785],[-1,-1
,-2,0],[2282,9E+09,9E+09,9E+09,9E+09,9E+09]];

CONST robtarget
poOdVia20_135:=[[2690,-960.2,1586.41],[0.305104,0.647959,-0.624424,0.311698],[0,-1,-2
,0],[-331.122,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poOdVia20_180:=[[2699.95,-46.12,1978.47],[0.371244,0.602671,-0.593234,0.383457],[0,-1
```


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```
,-2,0],[1160,9E+09,9E+09,9E+09,9E+09,9E+09]];
!
!----------------In Dia Target data ----------------
CONST robtarget
poIdIn1:=[[2109.18,934.70,244.20],[0.365477,-0.600944,0.370021,-0.606941],[-1,1,0,0],[22
72.58,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdIn2:=[[2255.31,-708.14,1584.85],[0.657895,0.233687,0.674078,0.241214],[-1,1,-2,0],[1
303.02,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdIn3:=[[2172.55,-984.42,217.84],[0.355032,0.592625,0.382834,0.613341],[-1,1,-1,0],[75
2.156,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdIn4:=[[2243.46,656.71,1600.63],[0.668438,-0.242981,0.660408,-0.240859],[-1,1,-3,0],[
2273.11,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdIn5:=[[2173.31,1097.30,785.49],[0.49588,-0.509082,0.485131,-0.509498],[-1,1,0,0],[22
19.39,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdIn6:=[[2162.40,-1120.01,803.90],[0.519054,0.475776,0.52883,0.473877],[-1,1,-1,0],[56
3.492,9E+09,9E+09,9E+09,9E+09,9E+09]];

CONST robtarget
poIdOut1:=[[1925.98,46.92,740.64],[0.365321,-0.598232,0.36207,-0.614463],[-1,1,0,0],[124
6.7,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdOut2:=[[1906.19,-33.79,820.90],[0.664082,0.237984,0.665533,0.243771],[-1,1,-2,0],[19
99.98,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdOut3:=[[1925.05,-53.32,739.51],[0.368506,0.597434,0.368332,0.609596],[-1,1,-1,0],[13
69.03,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdOut4:=[[1931.99,37.74,844.76],[0.662198,-0.23928,0.667392,-0.242543],[-1,1,-3,0],[19
```


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```
11.22,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdOut5:=[[1921.98,70.01,790.66],[0.490051,-0.503082,0.48948,-0.516883],[-1,1,0,0],[184
4.91,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdOut6:=[[1929.00,-52.82,792.84],[0.519209,0.474024,0.523676,0.48113],[-1,1,-1,0],[136
9.01,9E+09,9E+09,9E+09,9E+09,9E+09]];

CONST robtarget
poIdVia1_10:=[[1157.77,901.05,1804.13],[0.232976,0.654245,-0.653297,0.301479],[-1,-1,-
2,0],[2194.74,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdVia1_20:=[[-30.39,18.44,2137.86],[0.25056,0.382276,0.81606,-0.353739],[-1,-1,-1,0],[
2194.74,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdVia1_30:=[[350.7,134.95,892.47],[0.318416,0.801632,0.250476,0.439613],[-2,0,-1,0],[2
194.74,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdVia1_40:=[[81.16,-1645.33,719.24],[0.240928,0.870086,0.310681,0.29729],[-2,0,-1,0],[
-185.174,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdVia2_10:=[[967.43,910.23,84.05],[0.255828,-0.661383,0.248402,-0.659864],[-2,0,0,0],[
2180.73,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdVia2_20:=[[557.17,131.96,734.38],[0.663355,0.240737,0.664274,0.246467],[-2,0,-2,0],[
2000,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdVia4_10:=[[538.66,51.12,928.29],[0.68539,-0.222531,0.662317,-0.205078],[-2,0,-3,0],[
2211.26,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdVia4_20:=[[1177.21,331.53,2655.08],[0.683671,-0.229169,0.644622,-0.254046],[-2,1,-
2,0],[2055.02,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
```


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```
poIdVia4_30:=[[1456.04,-1671.34,2219.98],[0.56389,-0.0978475,0.81983,-0.0182671],[-2,0
,-2,0],[-281.778,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdVia4_40:=[[1226.65,-1537.35,960.54],[0.261524,0.118985,0.937534,0.196159],[-1,0,-1,
0],[-835.864,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pHome:=[[720.02,-1750.34,439.00],[0.00376526,-0.00689878,0.999964,0.00326797],[0,0,-1
,0],[-1481.12,9E+09,9E+09,9E+09,9E+09,9E+09]];

!!---------------- Program Original-Teach Welding Target data
(Large)----------------
CONST robtarget
poIdWeld1h:=[[1398.93,584.07,1617.81],[0.675556,-0.221222,0.671334,-0.209752],[-2,0,-
3,0],[2273.13,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld2h:=[[1400,710.64,1518.87],[0.656439,-0.27467,0.651277,-0.263596],[-1,1,-3,0],[
2211.26,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld3h:=[[1399.83,1013.67,763.88],[0.493517,-0.51649,0.481048,-0.508205],[-2,0,0,0
],[2020,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld4h:=[[1401.07,708.54,61.48],[0.268472,-0.664706,0.27552,-0.640451],[-2,0,0,0],[
2092.42,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld5h:=[[1400.18,595.82,-26.86],[0.226431,-0.684786,0.240546,-0.649565],[-2,0,0,0
],[2154.31,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld7h:=[[1410.34,-620.71,-60.55],[0.222205,0.66949,0.231891,0.669803],[-2,0,-1,0],
[752.179,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld8h:=[[1409.19,-737.57,44.78],[0.278104,0.647446,0.287768,0.648585],[-2,0,-1,0],
[814.067,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
```


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```
poIdWeld9h:=[[1405.22,-1040.48,762.56],[0.505951,0.500109,0.506039,0.487678],[-2,0,-1,
0],[563.592,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld10h:=[[1410.46,-743.16,1490.48],[0.657858,0.2559,0.659777,0.257747],[-2,0,-1,0
],[1359.23,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
poIdWeld11h:=[[1407.17,-631.74,1589.80],[0.675438,0.205382,0.677206,0.207349],[-2,0,-2
,0],[1303,9E+09,9E+09,9E+09,9E+09,9E+09]];
!
!----------------Tool data ----------------
!
!----------------Num data ----------------

CONST robtarget
pIdMove40:=[[82.74,-1144.83,468.65],[0.136982,0.813525,0.56013,0.0752862],[-1,0,-1,0],[
-129.862,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pIdMove10:=[[-226.79,-2216.21,439.54],[0.0248046,0.702057,0.711544,-0.0143809],[-1,-1
,-1,0],[-1481.12,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pIdMove30:=[[879.29,835.61,675.33],[0.255832,-0.661391,0.248404,-0.659855],[-2,0,0,0],[
2092.33,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pIdMove20:=[[327.96,-990.45,462.15],[0.0423603,-0.805485,-0.533848,-0.253785],[-1,0,0,
0],[-184.531,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pCalib_X1:=[[2260.72,-474.99,930.13],[0.707067,-0.00877354,0.707038,-0.00872312],[-1,
1,-2,0],[1416.69,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
pCalibRdy:=[[1323.81,-1445.53,1143.30],[0.706845,-0.0142195,0.707085,-0.0140718],[-2,
0,-2,0],[399.901,9E+09,9E+09,9E+09,9E+09,9E+09]];
```


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```
PROC rTeachLgOd1()
!------------Large OutDia 1 Teaching---------------!
MoveJ poOdAprch1_10,v2000,z100,toolFinger\WObj:=wobjFinger;
PDispOff;
MoveL poOdOut1,v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL poOdAprch1_10,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_45,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_90,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_135,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_180,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_225,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_270,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveJ RelTool(poOdIn1,30,0,0),v500,z20,toolFinger\WObj:=wobjFinger;
MoveL poOdIn1,v300,fine,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_270,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_225,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_180,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_135,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_90,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveJ poOdAprch1_10,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v1500,z0,toolFinger;
ENDPROC

PROC rTeachLgOd2()
!------------Large OutDia 2 Teaching---------------!
MoveJ poOdAprch2_10,v2000,z100,toolFinger\WObj:=wobjFinger;
PDispOff;
MoveL poOdOut2,v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL poOdAprch2_10,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_45,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_90,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_135,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_180,v2000,z100,toolFinger\WObj:=wobjFinger;
```


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```
MoveL poOdVia2_225,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_270,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveJ RelTool(poOdIn2,30,0,0),v500,z20,toolFinger\WObj:=wobjFinger;
MoveL poOdIn2,v300,fine,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_270,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_225,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_180,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_135,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_90,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveJ poOdAprch2_10,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v1500,z0,toolFinger;
ENDPROC

PROC rTeachLgOd3()
!------------Large OutDia 3 Teaching---------------!
MoveJ poOdAprch3_10,v2000,z100,toolFinger\WObj:=wobjFinger;
PDispOff;
MoveL poOdOut3,v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL poOdAprch3_10,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_45,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_90,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_135,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_180,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_225,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_270,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveJ RelTool(poOdIn3,30,0,0),v500,z20,toolFinger\WObj:=wobjFinger;
MoveL poOdIn3,v300,fine,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_270,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_225,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_180,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_135,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_90,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveJ poOdAprch3_10,v2000,z100,toolFinger\WObj:=wobjFinger;
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```
MoveJ pHome,v1500,z0,toolFinger;
ENDPROC

PROC rTeachLgId1()
!------------Large In Dia 1 Teaching---------------!
nIdJabNo:=1;
MoveJ pIdMove10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove20,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut1,-900,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut1,-100,0,0),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveJ poIdOut1,v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut1,-100,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut1,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn1,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ RelTool(poIdIn1,50,0,-100),v2000,z30,toolFinger\WObj:=wobjFinger;
MoveJ poIdIn1,v300,fine,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poIdIn1,50,0,-100),v500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn1,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL poIdWeld5h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL poIdWeld4h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn1,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_20,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_30,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_40,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,fine,toolFinger;
ENDPROC

PROC rTeachLgId2()
!------------Large In Dia 2 Teaching---------------!
nIdJabNo:=2;
MoveJ pIdMove10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove20,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut2,-900,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
```


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```
MoveL Offs(poIdOut2,-100,0,0),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveJ poIdOut2,v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut2,-100,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut2,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn2,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ RelTool(poIdIn2,50,0,-100),v2000,z30,toolFinger\WObj:=wobjFinger;
MoveJ poIdIn2,v300,fine,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poIdIn2,50,0,-100),v500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn2,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdWeld11h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL poIdWeld10h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn2,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_20,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_30,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_40,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,fine,toolFinger;
ENDPROC

PROC rTeachLgId3()
!------------Large In Dia 3 Teaching---------------!
nIdJabNo:=3;
MoveJ pIdMove10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove20,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut3,-900,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut3,-100,0,0),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveJ poIdOut3,v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut3,-100,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut3,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn3,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ RelTool(poIdIn3,50,0,-100),v2000,z30,toolFinger\WObj:=wobjFinger;
MoveJ poIdIn3,v300,fine,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poIdIn3,50,0,-100),v500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn3,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
```


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```
MoveL poIdWeld7h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL poIdWeld8h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn3,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_20,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_30,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_40,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,fine,toolFinger;
ENDPROC

PROC rTeachLgId4()
!------------Large In Dia 4 Teaching---------------!
nIdJabNo:=4;
MoveJ pIdMove10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove20,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut4,-900,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut4,-100,0,0),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveJ poIdOut4,v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut4,-100,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut4,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn4,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ RelTool(poIdIn4,50,0,-100),v2000,z30,toolFinger\WObj:=wobjFinger;
MoveJ poIdIn4,v300,fine,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poIdIn4,50,0,-100),v500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn4,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdWeld1h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL poIdWeld2h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn4,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_20,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_30,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_40,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,fine,toolFinger;
ENDPROC
```


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```
PROC rTeachLgId5()
!------------Large In Dia 5 Teaching---------------!
nIdJabNo:=5;
MoveJ pIdMove10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove20,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut5,-900,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut5,-100,0,0),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveJ poIdOut5,v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut5,-100,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut5,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn5,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ RelTool(poIdIn5,50,0,-100),v2000,z30,toolFinger\WObj:=wobjFinger;
MoveJ poIdIn5,v300,fine,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poIdIn5,50,0,-100),v500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn5,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdWeld3h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn5,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_20,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_30,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_40,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,fine,toolFinger;
ENDPROC

PROC rTeachLgId6()
!------------Large In Dia 5 Teaching---------------!
nIdJabNo:=6;
MoveJ pIdMove10,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveJ pIdMove20,v2500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut6,-900,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut6,-100,0,0),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveJ poIdOut6,v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut6,-100,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut6,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
```


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```
MoveL Offs(poIdIn6,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ RelTool(poIdIn6,50,0,-100),v2000,z30,toolFinger\WObj:=wobjFinger;
MoveJ poIdIn6,v300,fine,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poIdIn6,50,0,-100),v500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn6,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdWeld9h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn6,-1100,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_20,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_30,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_40,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,fine,toolFinger;
ENDPROC


PROC rTeachLgRoll()
!  IF nCoilDia=1170 AND nCoilWidth=920 THEN
PDispOff;
MoveJ pHome,v1500,z0,toolFinger;
!
!OUT_DIA_IN_OUT_SPOT_Position
MoveJ poOdAprch2_10,v2000,z100,toolFinger\WObj:=wobjFinger;
PDispOff;
MoveL Offs(poOdOut2,0,-100,0), v2000, fine, toolFinger\WObj:=wobjFinger;
MoveL poOdOut2,v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL poOdAprch2_10,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_45,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_90,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_135,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_180,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_225,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_270,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poOdIn2,30,0,0),v500,z20,toolFinger\WObj:=wobjFinger;
```


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```
!MoveL RelTool(poOdIn2,0,0,-20),v500,z20,toolFinger\WObj:=wobjFinger;
MoveL poOdIn2,v300,fine,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poOdIn2,30,0,0),v500,z20,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_270,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_225,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_180,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_135,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia2_90,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_45,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdAprch3_10,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL Offs(poOdOut3,0,-100,0), v2000, fine, toolFinger\WObj:=wobjFinger;
MoveL poOdOut3,v2000,fine,toolFinger\WObj:=wobjFinger;
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
MoveL poOdAprch3_10,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_45,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_90,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_135,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_180,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_225,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_270,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poOdIn3,50,0,0),v500,z20,toolFinger\WObj:=wobjFinger;
!MoveL RelTool(poOdIn3,0,0,-20),v500,z20,toolFinger\WObj:=wobjFinger;
MoveL poOdIn3,v300,fine,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poOdIn3,0,0,-100),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_270,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia3_225,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_180,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_135,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_90,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_45,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdAprch1_10,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL Offs(poOdOut1,0,-100,0), v2000, fine, toolFinger\WObj:=wobjFinger;
MoveL poOdOut1,v2000,fine,toolFinger\WObj:=wobjFinger;
```


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```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
MoveL poOdAprch1_10,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_45,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_90,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_135,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_180,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_225,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_270,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poOdIn1,50,0,0),v500,z20,toolFinger\WObj:=wobjFinger;
!MoveL RelTool(poOdIn1,0,0,-20),v500,z20,toolFinger\WObj:=wobjFinger;
MoveL poOdIn1,v300,fine,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poOdIn1,0,0,-100),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_270,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_225,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_180,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_135,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdVia1_90,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveL poOdAprch3_10,v2000,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v1500,z0,toolFinger;
!!!!!!!!!!!!!!!!!!!
```

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```
MoveJ poIdIn1,v300,fine,toolFinger\WObj:=wobjFinger;
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
MoveL RelTool(poIdIn1,50,0,-100),v500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn1,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
!!!!!!!!!!!!!!!!!!!
```

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```
MoveJ RelTool(poIdIn2,100,0,-1000),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveJ RelTool(poIdIn2,100,0,-250),v2000,fine,toolFinger\WObj:=wobjFinger;
!MoveL RelTool(poIdIn2,0,0,-20),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL poIdIn2,v300,fine,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poIdIn2,100,0,-250),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poIdIn2,100,0,-900),v2000,fine,toolFinger\WObj:=wobjFinger;
!===============9?????¿oA???o?????cCa Rob2=========================
!MoveL poIdIn5,v300,fine,toolFinger;
!=====================================================
!MoveL RelTool(poIdIn2,-30,0,-100),v500,z50,toolFinger;
MoveL Offs(poIdIn2,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
MoveJ poIdWeld11h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL poIdWeld10h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn2,-1000,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
MoveJ poIdVia2_20,v2500,z50,toolFinger\WObj:=wobjFinger;
nIdJabNo:=3;
MoveJ Offs(poIdOut3,-900,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut3,-100,0,0),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL poIdOut3,v2000,fine,toolFinger\WObj:=wobjFinger;
!!!!!!!!!!!!!!!!!!!!!!
MoveL Offs(poIdOut3,-100,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut3,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ Offs(poIdIn3,-1000,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poIdIn3,60,0,-100),v2000,fine,toolFinger\WObj:=wobjFinger;
!MoveL RelTool(poIdIn3,0,0,-20),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL poIdIn3,v300,fine,toolFinger\WObj:=wobjFinger;
!!!!!!!!!!!!!!!!!!!!!!!!!
MoveL RelTool(poIdIn3,60,0,-100),v500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn3,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL poIdWeld8h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL poIdWeld7h, v5000, fine, toolFinger\WObj:=wobjFinger;
```


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```
MoveL Offs(poIdIn3,-1000,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
Stop;
PDispOff;
MoveL Offs(poIdOut6,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL poIdOut6,v5000,fine,toolFinger\WObj:=wobjFinger;
MoveJ Offs(poIdOut6,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ Offs(poIdIn6,-1000,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poIdIn6,100,0,-100),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poIdIn6,0,0,-20),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveJ poIdIn6,v5000,fine,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn6,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL poIdWeld9h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn6,-1000,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
Stop;
MoveJ poIdVia4_10,v2500,z50,toolFinger\WObj:=wobjFinger;
nIdJabNo:=4;
MoveJ Offs(poIdOut4,-900,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut4,-100,0,0),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL poIdOut4,v2000,fine,toolFinger\WObj:=wobjFinger;
!==================================================
MoveL Offs(poIdOut4,-100,0,0),v2000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdOut4,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn4,-1000,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveL RelTool(poIdIn4,60,0,-100),v2000,fine,toolFinger\WObj:=wobjFinger;
!MoveL RelTool(poIdIn4,0,0,-20),v2000,fine,toolFinger\WObj:=wobjFinger;
MoveL poIdIn4,v300,fine,toolFinger\WObj:=wobjFinger;
!!!!!!!!!!!!!!!!!!!!!!!!!
MoveL RelTool(poIdIn4,60,0,-100),v500,z50,toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn4,-900,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdWeld1h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL poIdWeld2h, v5000, fine, toolFinger\WObj:=wobjFinger;
MoveL Offs(poIdIn4,-1000,0,0),v5000,z50,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_20,v2500,z100,toolFinger\WObj:=wobjFinger;
```


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```
MoveJ poIdVia4_30,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ poIdVia4_40,v2500,z100,toolFinger\WObj:=wobjFinger;
MoveJ pHome,v2500,fine,toolFinger;
Stop;
ENDPROC

PROC rCalibration()
MoveJ pHome, v1000, fine, toolFinger;
MoveJ pCalibRdy, v1000, fine, toolFinger;
MoveL Offs(pCalib_X1,-500,0,0), v1000, fine, toolFinger;
MoveL pCalib_X1, v1000, fine, toolFinger;
MoveL Offs(pCalib_X1,0,-500,0), v1000, fine, toolFinger;
MoveL Offs(pCalib_X1,100,300,-500), v1000, fine, toolFinger;
Stop;
MoveL pCalib_X1, v1000, fine, toolFinger;
MoveL Offs(pCalib_X1,-500,-500,-500), v1000, fine, toolFinger;
MoveL pCalibRdy, v1000, fine, toolFinger;
MoveJ pHome, v1000, fine, toolFinger;
ENDPROC

ENDMODULE
```


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