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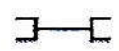
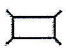
 **Duplex Outlet**	 **Weatherproof Duplex Outlet**	 **Ground Fault Circuit Interrupt Duplex Outlet**	 **Duplex Outlet - One Receptacle Controlled by Switch**
 **Duplex Outlet on Emergency Branch**	 **Quad Outlet - 4 Gang Box**	S **Switch**	S_3 **3-Way Switch**
S_{DIM} **Switch with Built-In Dimmer**	 **Power Panel**	**Lighting Panel**	 **Through-Wall Sleeve**
 **Junction Box**	 **Recessed Floor Box**		

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▼ **Telephone Jack**	▼W **Telephone Jack - Wall Mounted**	▽ **Data Jack**
▼ **Combination Telephone and Data Jack**	Ⓢ **Speaker**	

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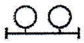
 **2x2 Recessed Light**	 **2x2 Recessed Light on Emergency Branch**	 **2x4 Recessed Light**
 **2x4 Recessed Light on Emergency Branch**	 **Recessed Linear Light**	 **Recessed Linear Light on Emergency Branch**
 **Surface Mounted Fluorescent Light**	 **Track Lighting**	 **Recessed Can Light**
 **Wall Mounted Light**	 **Recessed Wall Wash Light**	

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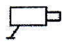
PB DB **Panic Button or Distress Button**	ML **Magnetic Door Lock**	EL **Electric Door Latch**
CR **Card Reader**	ES **Electric Door Strike**	 **Security Camera**

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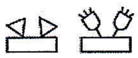
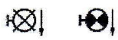
 **Fire Alarm Pull Box**	 **Fire Alarm Strobe and Horn Combination**	 **Smoke Detector**	 **Knox Box - Fire Department Keys**
 **Battery Powered Emergency Light**	 **Ceiling Mounted Exit Sign - Arrow Indicates Direction**	 **Wall Mounted Exit Sign - Arrow Indicates Direction**	

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Supply and Return Airflow Symbols

Standard 4-Way Blow Diffuser	**3-Way Blow Diffuser**	**2-Way Blow Diffuser**
1-Way Blow Diffuser	**Return Grille**	**Direction of Supply Air**
Direction of Return Air	UC 1/2" **Door Undercut Size**	LVDR 3.5 SF **Door Louver with Clear Area**

HVAC Damper Symbols

VD **Volume Damper**	FD **Fire Damper**	SD **Smoke Damper**
SFD **Combination Smoke and Fire Damper**	BDD **Back-draft Damper**	

HVAC Piping Symbols

CHWS **Chilled Water Supply**	CHWR **Chilled Water Return**	
HWS **Hot Water Supply**	HWR **Hot Water Return**	
V **Vent Pipe**	D **Drain Pipe**	MU **Make-Up Water Pipe**

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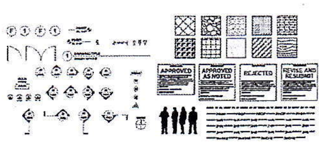

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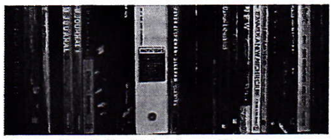

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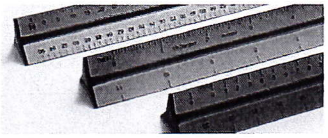

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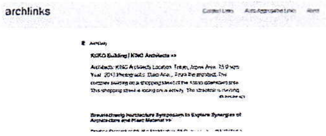

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Electrical Conduit Types

Electrical conduit is a raceway or piping system that protects wires and cables from impact, moisture, and vapors. It is a path for either power or communication (low voltage) electrical wiring. It is usually tubular and made of metal (galvanized steel, stainless steel, aluminum) or non-metallic materials (plastics) and is either rigid or flexible. Special types of conduit are required for wet areas and hazardous areas.

In the United States, conduit installation falls under the tasks performed by licensed. NFPA 70, also known as the National Electric Code (NEC), provides information on the safe and proper way to install conduit and associated cabling.

The advantages of all types of conduit are that they:

- Protect electrical wires from damage due to abuse or accident
- Can allow for cables to be easily pulled to inaccessible areas in the future (i.e. inside finished walls)
- Allow wiring changes to be made simpler and safer
- Can be made waterproof or submersible
- Can be sealed to provide protection from fire and explosion hazards

The cost of conduit installation is higher than other wiring methods due to the cost of materials and labor. In residential, construction a high degree of physical damage protection may not be not required so the expense is not justified.

Two main categories of conduit body are considered here: metal conduits and non-metal conduit. Conduit systems can be differentiated by their wall thickness, mechanical stiffness, and tubing material. Conduit materials are often chosen for their mechanical protection, corrosion resistance, and the overall installation cost.

Types of Metal Conduit

Metal conduit comes in many forms and can be made from galvanized steel, stainless steel, or aluminum. Other types of metals are generally not used for conduit.

While metal conduit may sometimes be used as a grounding conductor, conduit circuit length is limited and it is safer to use cables that include a ground wire.

Rigid Metal Conduit (RMC)

RMC is a thick-walled, threaded tubing. It is generally made of coated steel, stainless steel, or aluminum. The conduit is connected together by screwing connectors to the main tubes. Rigid metal conduit provides significant protection from impacts and other damage. It can be used as a grounding conductor for short runs, but it is best practice to use wiring that has a grounding wire. The thicker walls of RMC protects the cables inside from electromagnetic interference (EMI), which can be harmful to sensitive equipment.

The following image shows rigid metal conduit with threaded screw fittings. The conduits are hung from metal channel framing.

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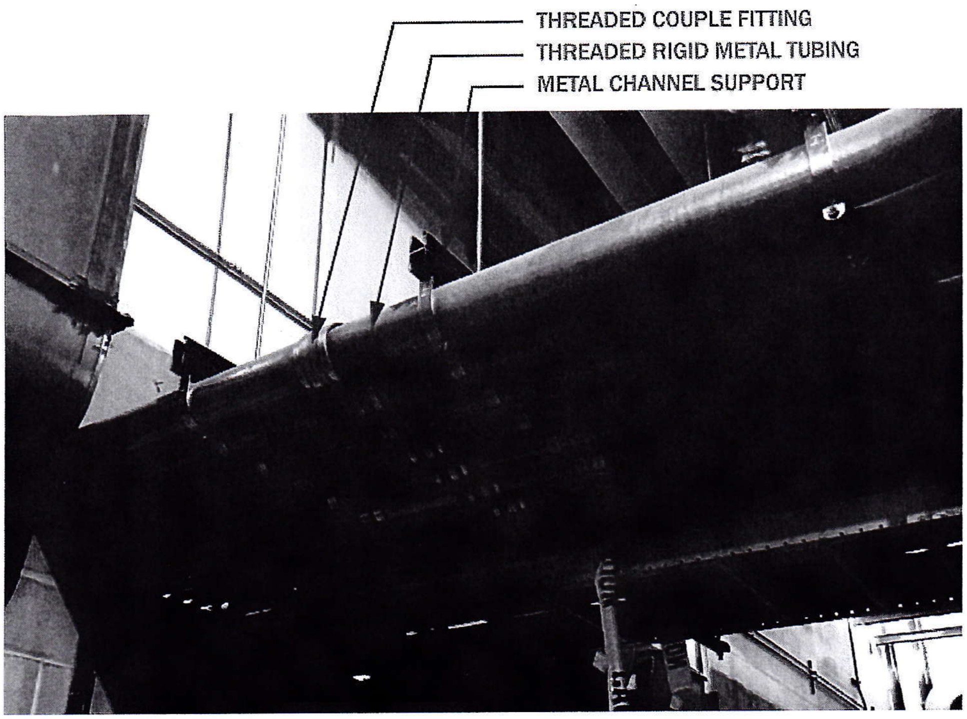


RMC can be made corrosion-resistant by applying a coating such as PVC or by galvanizing the metal. The corrosion protection resists damage from water or other chemicals that can degrade metal. There are three common types of corrosion treatment:

- Galvanized Rigid Conduit (GRC), which is the most popular form of RMC, is used in commercial and industrial buildings.
- PVC-coated aluminum, which is suitable where chemical fumes that are corrosive to steel are present.
- Bronze alloy, which is suitable for coastal areas, chemical plants, oil refineries and underwater situations.
- PVC-coated rigid steel, which is resistant to oils, grease, acids, alkalis, and moisture and is flame-retardant.

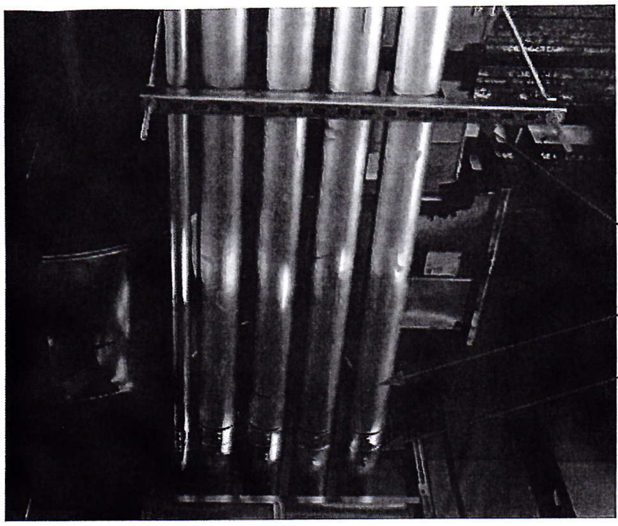
When cut, the ends of rigid metal conduit should be reamed (remove burrs and rough edges) to protect the wire insulation from abrasion. In addition, any fittings should match the type of metal used for the conduit tubing to prevent problems from galvanic action.

There are two main disadvantages to using rigid metal conduit. First, since all connections are threaded, there is much more labor required when installing the system – this makes RMC much more expensive. Second, the thick walls of the tubing make the conduit much heavier, which also makes installation more labor intensive and expensive.

Electrical Metallic Tubing (EMT)

EMT is an unthreaded, thin-wall metal tubing generally made of coated steel, though it may be made of aluminum. It is a popular choice for electrical conduit in commercial buildings, but is generally not used in residential buildings. EMT is connected together using clamp-type fittings that slide onto the tubing and then are secured with a set-screw. Electrical Metal Tubing is less expensive and 40% lighter than GRC.

The following image shows electrical metal tubing with clamp fittings. The conduits are supported from metal channel framing.



While EMT provides a good amount of protection for the cables inside, it should not be used in hazardous areas where it is exposed to sever damage (like power plants or around vehicular traffic.) EMT is not suitable for wet areas or where corrosive fumes and vapors exist – special corrosive-resistant tubing and gasketed clamps are required in these areas.

Like RMC, the cut ends of the tubing must be reamed to remove all sharp edges.

Some electricians are skeptical of using EMT in critical areas because the set-screws in the clamps can loosen over time. In order to prevent this, a torque wrench or driver can be used to be sure the screws are set to the correct tension as required by the manufacturer.

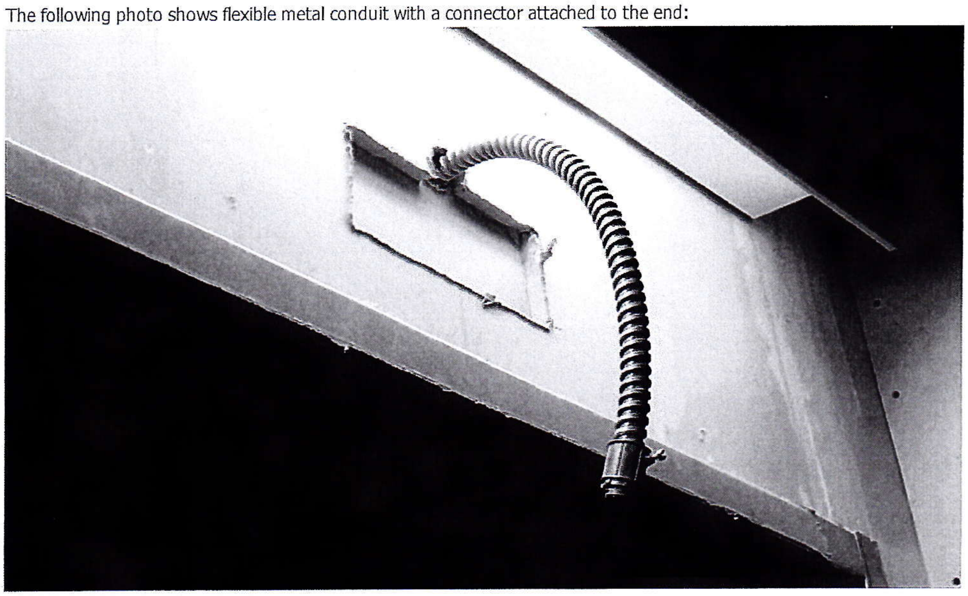
Intermediate Metal Conduit (IMC)

As its name suggests, Intermediate Metal Conduit (IMC) has walls that are thinner than RMC, but thicker than EMT. Thus the weight of IMC also falls between RMC and EMT. Intermediate Metal Conduit is threadable, but it can also be un-threaded and used with clamp-type fittings. IMC is generally made from steel and can be coated.

Flexible Metal Conduit (FMC)

Flexible metal conduit (FMC) is typically available in diameters between 3/8" and 3", but larger sizes can sometimes be found. It is made by coiling self-interlocked aluminum or steel strips, which forms a hollow tube that wires can be pulled through. FMC comes in a standard wall (sometimes called full wall) thickness or a reduced wall thickness. Most manufacturers also produce an extra-flexible FMC for tighter bend radiuses, but this is generally not UL approved.

The following photo shows flexible metal conduit with a connector attached to the end:



Standard FMC is recommended in dry areas where it would be impractical to install EMT or other non-flexible conduit, yet where metallic strength to protect conductors is still required. Because of its flexibility, the FMC can help reduce vibrations from passing from motor to structure through the conduit.

Liquid-Tight Flexible Metal Conduit (LFMC) is FMC covered by a plastic waterproof coating. Its interior is similar to FMC, but it is suitable for wiring in wet or damp locations. It can also be buried in the ground or embedded in concrete. There are many types of LFMC on the market depending on the type of resistance needed, including extreme temperatures, oil resistant, anti-bacteria, flame resistant, and reinforced. It also comes in various jacket colors for easy identification. LFMC used for computer wires is usually blue.

It is important to note that Flexible Metal Conduit is **NOT** the same as metal clad (MC) cable or armored cable (AC). MC cable and armored cable include permanently integrated conductors in the flexible metal armor. However, flexible metal conduit is a raceway that the conductors are pulled through **AFTER** installation.

Types of Non-Metal Conduit

Non-metal conduit is made of plastic, also called PVC. It is used in areas where metals can cause problems, such as in hospital MRI rooms. It is also used where it will be in contact with water, such as below ground or encased in concrete. PVC conduit will not rust or corrode when exposed to water.

Rigid Nonmetallic Conduit (RNC)

RNC is the lightest conduit available and is generally the least expensive. Fittings slipped onto the tubing and welded with a solvent, which is faster than the fittings used in metal conduits. In addition, the welded joints are water-tight. Plastic conduit can be heated with special tools so that it can be bent in the field.

RNC Pipe is most commonly available as schedule 40 or schedule 80 pipe, but can also be manufactured in other sizes and wall thicknesses. It is also available in extra-heavy wall thicknesses for areas where extra protection is needed; however, thicker walls make the conduit harder to bend.

The main disadvantages are that plastic conduit will not stand up to impacts as well as metal conduits. In addition, plastic conduits cannot be used for grounding, so a grounding conductor will need to be pulled along with the other conductors. Finally, plastic conduit expands and contracts more than metal conduit when exposed to heat, which needs to be taken into account when designing long runs.

Electrical Nonmetallic Tubing (ENT)

ENT is a thin-walled corrugated tubing that is flexible so it can be bent without special tools, however it will not permanently hold the bend. It is easier to install than RNC because it can be routed around obstructions without cutting and welding the pipe. Special ENT connectors are used – these are generally snap-in connections and are not watertight.

Liquid-Tight Flexible Nonmetallic Conduit (LFNC) is also available for use where the conduit will be subjected to moisture.

Recommended Lighting Levels in Buildings

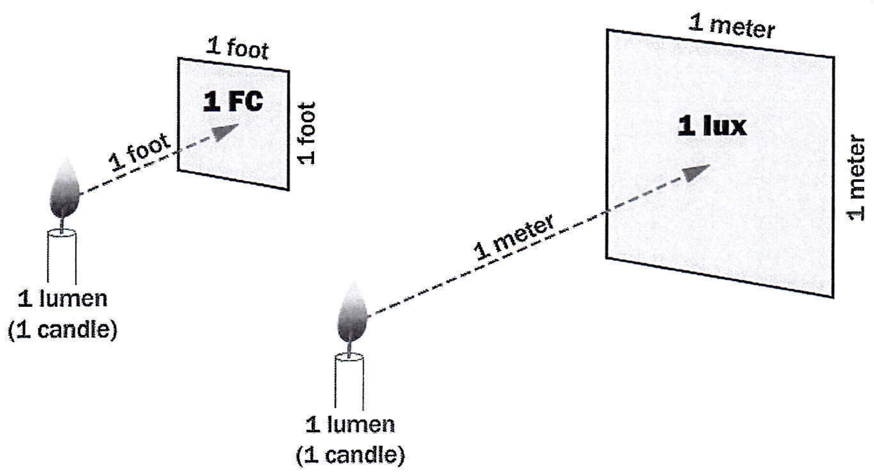
Lighting in our living and workplaces is critically important for our ability to accomplish tasks efficiently and safely. In addition, proper light levels prevent eye strain, which allows us to work comfortably for longer periods of time. This article covers proper lighting levels and will include various lighting concepts during the conversation. If you need to brush up on the basics of lighting, check out our Properties of Light article.

There are two main concepts that architects need to understand as they plan lighting in their buildings: Light Levels and Lighting Power Density.

Light Levels in Buildings

Since we are concerned mainly with accomplishing tasks in our buildings, we need to understand the Illuminance, or the amount of light that is hitting a surface. In an office, we might want to understand the amount of light that is hitting our desk; however, in a gymnasium or corridor we may be more interested in the amount of light hitting the floor.

Illuminance is measured in foot candles (FC) or lux. 1 FC is the amount of light that hits a 1 square foot surface when 1 lumen is shined from 1 foot away – this equates to 1 lumen per square foot. 1 lux is the amount of light that hits a 1 square meter surface when 1 lumen is shined from 1 meter away – this equates to 1 lumen per square meter. 10 lux is roughly 1 FC.



We need to provide enough light to allow people to accomplish see their tasks, but not so much light that it is hard to see the tasks – over lighting is just as bad as under lighting. Detailed tasks like drafting require more light, while general tasks like walking can be accomplished with less light.

The most cited reference for lighting levels is the IESNA Lighting Handbook, which is published by the Illuminating Engineering Society. The lighting levels listed below come from the Handbook as well as various other lighting references.

Lighting Power Density (LPD)

Lighting power density is the amount of power used by lighting per unit of building area. In the United States, LPD is measured in watts per square foot. Included in the watt measurement is all power consumed by light fixtures, ballasts, controls, transformers, etc. – essentially, if the component or device is involved in lighting, it must be included in the calculation.

Lighting power density is established by local and international codes. The values listed below for LPD come from the 2015 version of the International Energy Conservation Code (IECC 2015). Please keep in mind that certain cities or states may

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have codes that require LPDs to be a certain percentage BELOW the IECC. Always make sure to check your local codes before establishing LPD criteria for your project.

There are two ways to calculate the lighting power density. The first way is to use an LPD that applies to the full building based on the type of building (school, museum, office, etc.) -- this method is very basic and is called the Building Area Method. The second way is to calculate the LPD based on each specific room and is called the Space-by-Space method -- this method is much more accurate and may result in a lower LPD number, which is helpful when applying for utility incentives.

Many utility incentive programs require the design team to improve upon the lighting power density baseline required by local codes. For instance, a utility incentive program may require a 15% (or more) improvement over the baseline LPD in order to receive a lower electricity rate.

Recommended Light Levels by Space

The table below provides recommended light levels from the IESNA Lighting Handbook and LPD levels from the IECC 2015. Check your local jurisdiction for other or more stringent requirements. The US General Services Administration provides lighting levels and LPDs for US Government buildings, which can be used as a guide for other types of buildings.

The required light levels are indicated in a range because different tasks, even in the same space, require different amounts of light. In general, low contrast and detailed tasks require more light while high contrast and less detailed tasks require less light.

Please keep in mind that this chart is not comprehensive. The IESNA Lighting Handbook has pages and pages of various categories. If you have a very specific need, we recommend further research.

ROOM TYPE	LIGHT LEVEL (FOOT CANDLES)	LIGHT LEVEL (LUX)	IECC 2015 LIGHTING POWER DENSITY (WATTS PER SF)
Bedroom - Dormitory	20-30 FC	200-300 lux	0.38
Cafeteria - Eating	20-30 FC	200-300 lux	0.65
Classroom - General	30-50 FC	300-500 lux	1.24
Conference Room	30-50 FC	300-500 lux	1.23
Corridor	5-10 FC	50-100 lux	0.66
Exhibit Space	30-50 FC	300-500 lux	1.45
Gymnasium - Exercise / Workout	20-30 FC	200-300 lux	0.72
Gymnasium - Sports / Games	30-50 FC	300-500 lux	1.20
Kitchen / Food Prep	30-75 FC	300-750 lux	1.21
Laboratory (Classroom)	50-75 FC	500-750 lux	1.43
Laboratory (Professional)	75-120 FC	750-1200 lux	1.81
Library - Stacks	20-50 FC	200-500 lux	1.71
Library - Reading / Studying	30-50 FC	300-500 lux	1.06
Loading Dock	10-30 FC	100-300 lux	0.47
Lobby - Office/General	20-30 FC	200-300 lux	0.90
Locker Room	10-30 FC	100-300 lux	0.75
Lounge / Breakroom	10-30 FC	100-300 lux	0.73

ROOM TYPE	LIGHT LEVEL (FOOT CANDLES)	LIGHT LEVEL (LUX)	IECC 2015 LIGHTING POWER DENSITY (WATTS PER SF)
Mechanical / Electrical Room	20-50 FC	200-500 lux	0.95
Office - Open	30-50 FC	300-500 lux	0.98
Office - Private / Closed	30-50 FC	300-500 lux	1.11
Parking - Interior	5-10 FC	50-100 lux	0.19
Restroom / Toilet	10-30 FC	100-300 lux	0.98
Retail Sales	20-50 FC	200-500 lux	1.59
Stairway	5-10 FC	50-100 lux	0.69
Storage Room - General	5-20 FC	50-200 lux	0.63
Workshop	30-75 FC	300-750 lux	1.59

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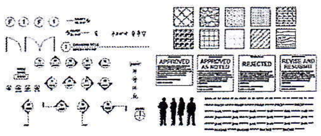

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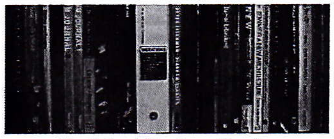

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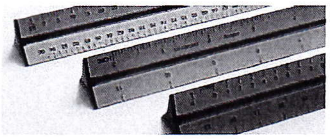

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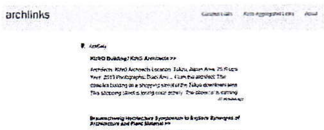

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Architectural Floor Plan Symbols

The symbols below are used in architectural floor plans. Every office has their own standard, but most symbols should be similar to those shown on this page.

Building Section

Top Line = Drawing Number

Bottom Line = Sheet Number

Wall Section

Top Line = Drawing Number

Bottom Line = Sheet Number

Detail Section

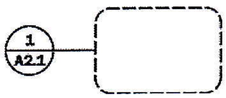
Top Line = Drawing Number

Bottom Line = Sheet Number

Exterior or Building Elevation

Top Line = Drawing Number

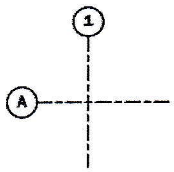
Bottom Line = Sheet Number



Plan Detail Call Out

Top Line = Drawing Number

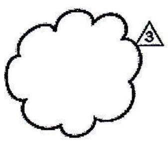
Bottom Line = Sheet Number



Column Grid Call Out

Horizontal Lines = Letters

Vertical Lines = Numbers

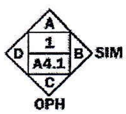


Revision Cloud

Number = Revision on this sheet

Wall or Partition Tag

Number = Partition type



Interior Elevations

North Arrow

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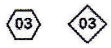
SIM = Similar & OPH = Opposite Hand

Door Tag

The number is relative to the room that the door leads to.



Window or Glazing Tag

The number identifies the window type or the glass type

Room ID

Top Lines = Room Name

Inside Box = Room Number

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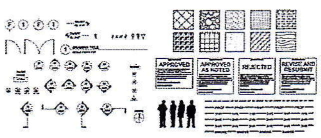

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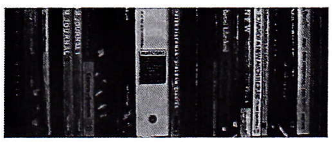

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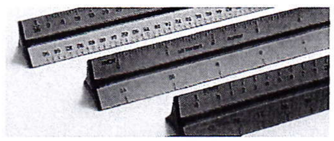

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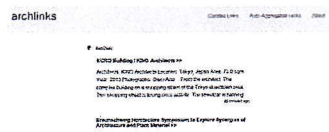

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Architectural Acoustics - Acceptable Room Sound Levels

It is important for architects to understand what sound levels are acceptable in different types of spaces. In addition, they need to understand which sound level measurements are relevant to what is trying to be achieved. We will cover the different sound measurements and end with a chart addressing the various levels of acceptability.

There are Many Ways to Measure Sound Levels

Before you can determine the appropriate sound level for your space, we need to discuss the various ways of measuring sound. Unfortunately, it isn't as simple as saying the sound in a bedroom should be 30 dB or lower. There are different measurements for different conditions, so let's take a look at them.

Decibels [dB]: The decibel is used in acoustics as the standard unit of sound pressure level, or the loudness of a sound. Keep in mind that sound pressure increases on a logarithmic scale. As a general rule of thumb, an increase of 10 dB means the sound is perceived to be twice as loud – however this can vary based on the type of sound and the listening conditions. Humans can just barely detect a 3 dB sound level difference. They can easily detect a 5 dB change in sound level under most conditions.

Decibel A [dB(A)]: dB(A) is simply a filter that adjusts decibels for the frequency range that the human ear is capable of hearing, which is in the range of 1 kHz to 4 kHz. Outside of that general range, we aren't concerned about whether the sound levels are very high or low (for architecture, at least).

Before you can begin to understand the various rating criteria, it is important to understand that humans detect varying frequencies differently because the human ear is less sensitive to very high and very low frequencies. For instance, a 40 dB sound at 1000 Hz frequency would seem louder than a 50 dB sound at 80 Hz frequency – even though the sound pressure is higher in the 80Hz sound, our ears are not as sensitive to it as they are to the 1000 Hz frequency. Since humans detect frequencies differently, sound criteria are measured with curves across a range of frequencies.

Sound Rating Criteria for Buildings

The main goal for acoustic design in a space is to keep the background noise levels low enough that normal speech (or other special sound, like music) is easily understood. A classroom will need to be quieter than a residential living room since the speech needs to reach people further away. Concert halls tend to need the quietest levels to allow people to hear the intricacies of the different instruments.

Keep in mind that we need to provide acceptable dB levels across a range of frequencies to account for all the different kinds of sounds in our environment. In addition, acceptable dB levels vary with the frequency of the sound due to the varying sensitivity of the human ear across frequencies.

The criteria and ratings below take help identify acceptable background noise levels caused by HVAC equipment, refrigerators, computer fans, etc. Background noise can be thought of as the general hum of the room or building.

Noise Rating [NR]: Noise Rating curves have been the international standard for indicating acceptable sound levels within a space. NR curves were developed by the International Organization for Standardization (ISO.) Each curve depicts the acceptable dB levels across a range of frequencies between 31.5 Hz and 8,000 Hz (8 kHz).

NR Curves are depicted in the graphic below.

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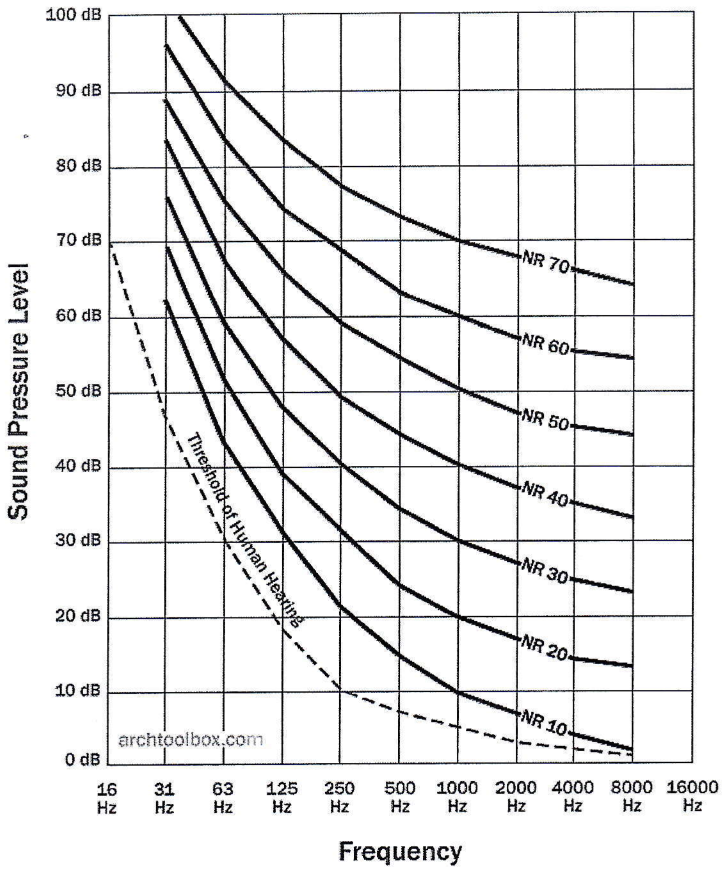
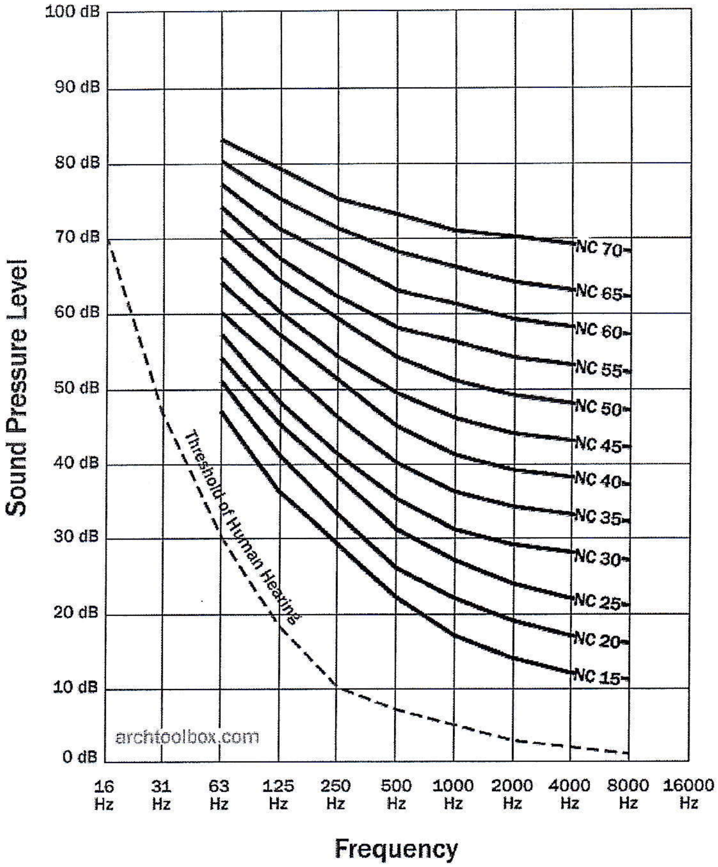
Noise Rating (NR) Curves



Noise Criterion [NC]: Noise Criterion was developed in the 1950s and was most often used in the United States to depict the acceptable range of background noise in a space. It is measured in the range of 63 Hz to 8000 Hz (8 kHz).

NC Curves are depicted in the graphic below.

Noise Criteria (NC) Curves

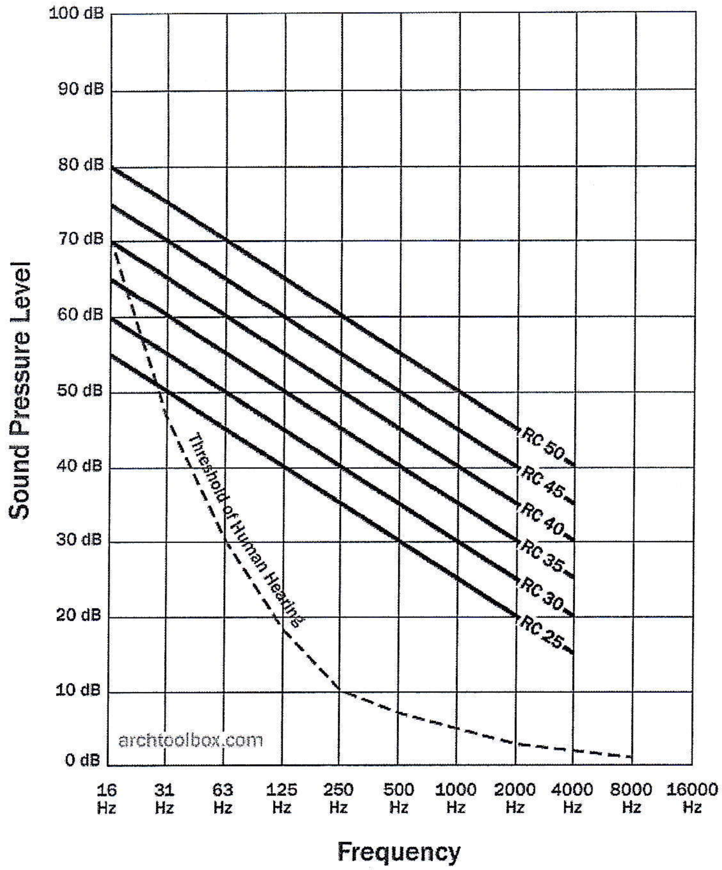


Unfortunately, NR and NC aren't perfect. Recent studies indicate that the NR and NC curves allow for dB levels that are uncomfortable at very low or very high frequencies, such as the rumble or hiss of HVAC equipment. A couple of new standards have been developed and are gaining popularity around the world.

Room Criteria [RC]: Room Criteria is an alternative range of allowable background noise in a building or room that was developed in the 1980s. It is measured in the range of 16 Hz to 4000 Hz (4 kHz). Like NC, RC takes into account the general "hum" of the building. However, RC looks at sounds at much lower frequency levels to account for rumbling HVAC equipment. RC are depicted with straight lines of constant slope, which were observed to be the average spectrum seen in office buildings in the 1980s.

RC Curves are depicted in the graphic below.

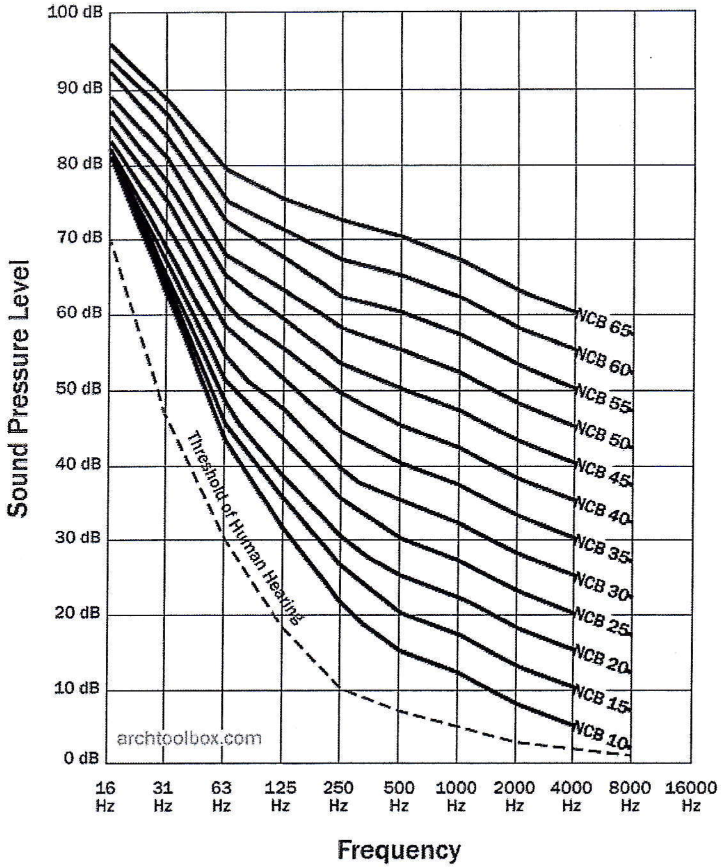
Room Criteria (RC) Curves



Balanced Noise Criterion [NCB]: The new Balanced Noise Criterion curves, updated in ANSI S12.2-2008, accounts for sound frequencies down to 16 Hz, which will address issues from the low-frequency hum of energy efficient HVAC equipment. NCB also reduces the higher frequency levels to eliminate hiss.

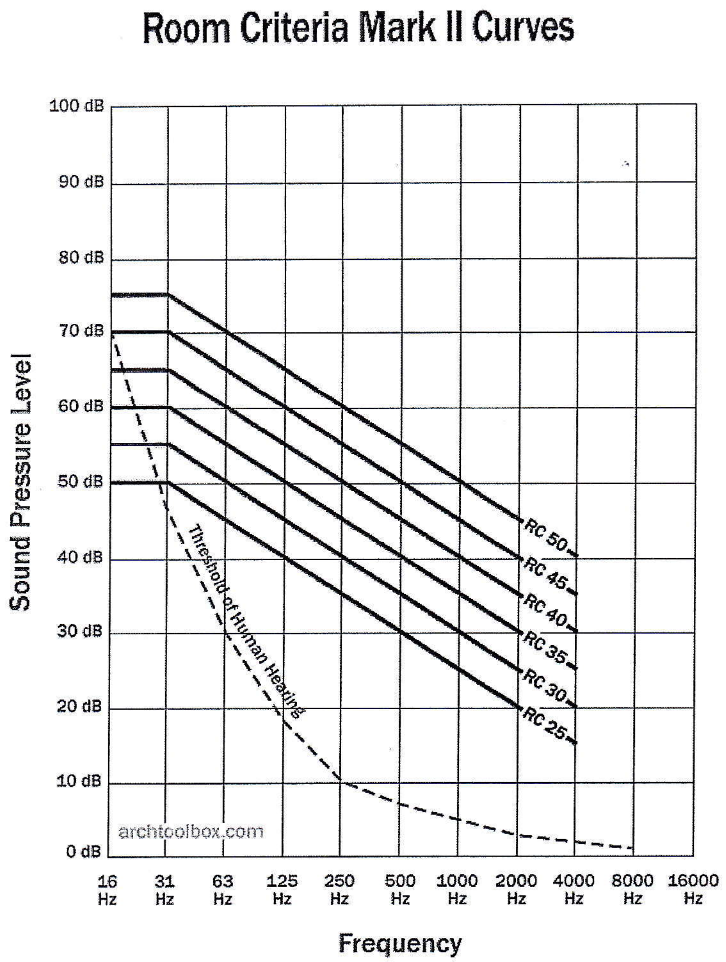
The NCB curves are depicted below.

Balanced Noise Criteria (NCB) Curves



RC Mark II: This criteria is an improvement to the original Room Criteria. It is almost the same as RC, except that it takes into account the subjective response of room occupants to vibrations of very low frequencies, which are often caused by HVAC equipment. It was developed in the late 1990s.

The RC Mark II curves are depicted below.



Of course, there are other noise criteria that have been developed, however they haven't caught on like those mentioned above. Some of the other criteria include eNC and PNC.

So Which Noise Criteria Should be Used?

In general, architects will not be selecting whether to use one criteria or another. However, they may be part of a discussion about whether a certain piece of HVAC equipment can be placed in the ceiling of a space or in an adjacent room. Our experience is that most HVAC equipment manufacturers are using the standard Noise Criteria (NC).

We expect that many acoustic experts will be pushing manufacturers toward the Blanaced Noise Criterion (NCB) and RC Mark II since these two criteria take into account the high frequencies that create a hiss and the low frequencies that can create uncomfortable vibrations.

Table of Acceptable Room / Space Sound Levels

The table below provides acceptable sound levels for various room types. This table covers a majority of the space types that an architect may be interested in.

ROOM/SPACE	DBA	NR	NC/NCB	RC/RCM2
Theaters, Concert Halls, Recording Studios	25-30	20	10-20	20
Bedrooms, Libraries, Religious Prayer Rooms	25-30	25	20-25	25
Living Rooms, Classrooms, Lecture Halls, Conference Rooms	30-35	30	30-40	30

ROOM/SPACE	DBA	NR	NC/NCB	RC/RCM2
Offices, Courtrooms, Private Work Rooms	40-45	35	30-40	35
Corridors, Open Offices, Bathrooms, Toilet Rooms, Reception, Lobbies, Shopping	45-55	40	30-40	40
Kitchens, Shopping, Common Spaces, Dining Halls, Computer Rooms, Workshops	45-55	45	40-50	45

References

In case you are interested in going more in-depth with room acoustics, we recommend the following articles, which were used to develop this article.

Fundamentals of Acoustics by Colin H. Hansen.
Room Noise Criteria — The State of the Art in the Year 2000 by Gregory C. Tocci.

Acoustic Treatment Manufacturers

The links below will take you to Archimat, our building product directory, which hosts a list of manufacturers.

Acoustic Treatment
Acoustic Drapery
Acoustic Stretched-Fabric Wall Systems
Fixed Sound-Reflective Panels
Fixed Sound-Absorptive Panels

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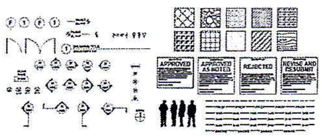

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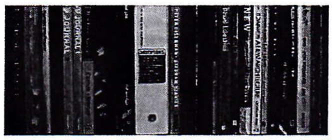

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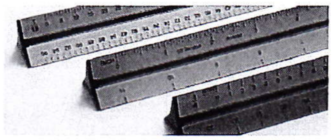

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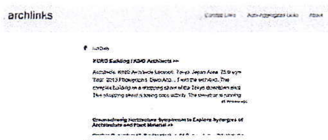

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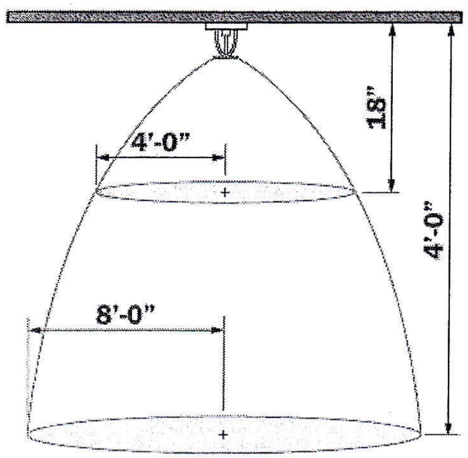
Sprinkler Head Spacing and Location

******WARNING: Fire suppression systems, including sprinklers, MUST be designed by a Professional Engineer. The information contained in this article is general in nature and is to be used as a GUIDELINE for architects. You must have a Professional Engineer design a sprinkler system to address your specific situation and to meet the codes applicable in your jurisdiction. The information in the article is based on NFPA 13.***

Sprinkler Head Location

There are two main criteria for the location of sprinkler heads. First, sprinklers must be located so they are within the hot-gas layer that develops near the ceiling during a fire because activation occurs when the sprinkler head reaches a certain temperature. Second, they must be located so that the water that is discharged from the sprinkler is not disrupted or affected by construction elements such as beams, trusses, or soffits.



The diagram at left shows the water distribution for standard pendant and upright sprinkler fixtures. It is useful to understand how objects within this distribution area can alter the throw and disrupt the ability of the sprinkler to extinguish a fire.

This is a general depiction of sprinkler throw and should not be used to determine sprinkler spacing. Refer to the manufacturer data for specific throw data. Please note, that the throw of a sprinkler should not be used for sprinkler spacing - local codes determine spacing requirements.

Sprinkler Head Spacing

The table below shows sprinkler spacing requirements based on NFPA 13. This table shall be used only as a tool for architects. Actual design of a sprinkler system **MUST** be done by a Professional Engineer for each project.

OCCUPANCY HAZARD	SQUARE FOOT PER HEAD	MAXIMUM SPACING BETWEEN SPRINKLERS
Light Hazard (Office, Educational, Religious, Institutional, Hospitals, Restaurants, Clubs, Theaters, etc.)	130-200 SF per head (based on obstructions and flow calcs)	15 ft
Ordinary Hazard (Mills, Manufacturing, Processing, Machine Shops, Repair Garages, Post Offices, Bakeries, Wood Machining and Assembly, Auto Parking, etc.)	130 SF per head	15 ft

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OCCUPANCY HAZARD	SQUARE FOOT PER HEAD	MAXIMUM SPACING BETWEEN SPRINKLERS
Extra Hazard (Plastic Processing, Chemical Spraying, Metal Extruding, Printing, Varnishing, Painting, etc.)	90-130 SF per head (based on obstructions and flow calcs)	12 ft

Maximum Distance from Wall: half (1/2) of the maximum distance between sprinkler heads.

Minimum Distance Between Sprinklers: typically 6'-0".

Distance from Ceiling: minimum 1", maximum 12" for unobstructed construction. The minimum 1" is typical; however, concealed, recessed, and flush sprinklers may be mounted less than 1" from the ceiling and shall be installed based on their listing.

Extended Coverage Sprinkler Heads

In some circumstances, standard distribution sprinkler heads will not provide enough coverage. In these cases, extended coverage sprinkler heads can be installed to increase the spacing between heads. Extended coverage sprinklers have a water distribution radius of a little over 10 feet, so they can be spaced approximately 20 feet apart.

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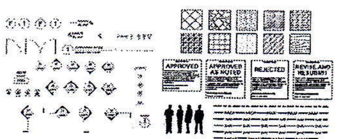

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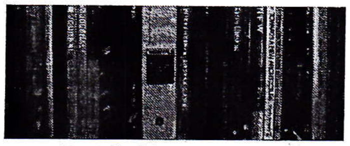

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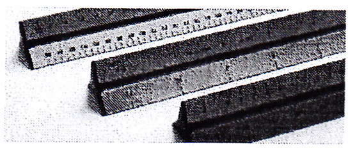

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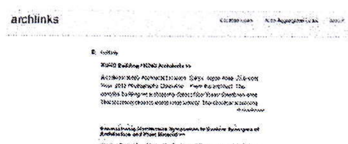

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